



# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

**MAX6736–MAX6745**

## General Description

The MAX6736–MAX6745 are low-power dual-/triple-voltage microprocessor ( $\mu$ P) supervisors. These devices assert a reset if any monitored supply falls below its factory-trimmed or adjustable threshold and maintain reset for a minimum timeout period after all supplies rise above their thresholds. The integrated dual/triple supervisory circuits significantly reduce size and power compared to separate ICs or discrete components. The low supply current of 6 $\mu$ A makes these devices ideal for portable equipment.

The MAX6736/MAX6737 are dual fixed-voltage  $\mu$ P supervisors with a manual reset input. The MAX6738/MAX6739 have one fixed and one adjustable reset threshold and a manual reset input. The MAX6740/MAX6743 are triple-voltage  $\mu$ P supervisors with two fixed and one user-adjustable reset threshold inputs. The MAX6741/MAX6744 are dual-voltage  $\mu$ P supervisors with a power-OK (POK) output ideal for power-supply sequencing. The MAX6742/MAX6745 monitor the primary VCC supply and have an independent power-fail comparator.

The MAX6736–MAX6745 monitor I/O supply voltages (VCC1) from 1.8V to 5.0V and core supply voltages (VCC2) from 0.9V to 3.3V with factory-trimmed reset threshold voltage options (Table 1). An external adjustable RSTIN input option allows monitoring voltages down to 0.5V.

A variety of push-pull or open-drain reset outputs along with manual reset input and power-fail input/output features are available (see the *Selector Guide*). The MAX6736–MAX6745 are offered in a space-saving 5-pin SC70 package and operate over the -40°C to +85°C temperature range.

## Applications

|                                    |               |
|------------------------------------|---------------|
| Portable/Battery-Powered Equipment | Controllers   |
| Multivoltage Systems               | PDA's         |
| Notebook Computers                 | GPS Equipment |
|                                    | POS Equipment |

## Features

- ◆ Dual-/Triple-Supply Reset Voltage Monitors
- ◆ Precision Factory-Set Reset Thresholds for Monitoring from 0.9V to 5.0V
- ◆ Adjustable Reset Input Down to 0.488V
- ◆ 150ms and 1200ms (min) Reset Timeout Period Options
- ◆ VCC1 Power-OK Output for Power-Supply Sequencing Applications (MAX6741/MAX6744)
- ◆ Power-Fail Input/Power-Fail Output (MAX6742/MAX6745)
- ◆ 6 $\mu$ A Supply Current
- ◆ Tiny SC70 Package

## Ordering Information

| PART             | TEMP RANGE     | PIN-PACKAGE |
|------------------|----------------|-------------|
| MAX6736XK_ _D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6737XK_ _D_-T | -40°C to +85°C | 5 SC70-5    |

**Note:** The first “\_ \_” or “\_” are placeholders for the threshold voltage levels of the devices. Desired threshold levels are set by the part number suffix found in Tables 1 and 2. The “\_” after the D is a placeholder for the reset timeout period suffix found in Table 3. For example, the MAX6736XKLTD3-T is a dual-voltage supervisor  $V_{TH1} = 4.625V$ ,  $V_{TH2} = 3.075V$ , and a 150ms minimum reset timeout period. All devices are available in tape-and-reel only. There is a 2500-piece minimum order increment for standard versions (see Table 1). Sample stock is typically held on standard versions only. Nonstandard versions require a minimum order increment 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.

**Ordering Information and Selector Guide continued at end of data sheet.**

**Pin Configurations, Typical Application Circuits, and Functional Diagram appear at end of data sheet.**

## Selector Guide

| PART    | VOLTAGE MONITORS | OPEN-DRAIN RESET | PUSH-PULL RESET | MANUAL RESET | POWER-FAIL INPUT/OUTPUT | POK OUTPUT | RSTIN INPUT |
|---------|------------------|------------------|-----------------|--------------|-------------------------|------------|-------------|
| MAX6736 | 2 fixed          | X                | —               | X            | —                       | —          | —           |
| MAX6737 | 2 fixed          | —                | X               | X            | —                       | —          | —           |
| MAX6738 | 1 fixed, 1 adj   | X                | —               | X            | —                       | —          | X           |

\*Manual reset detect on  $\overline{RESET}$  output.



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## ABSOLUTE MAXIMUM RATINGS

V<sub>CC1</sub>, V<sub>CC2</sub>, POK1 to GND ..... -0.3V to +6V  
 Open-Drain RESET, PFO to GND ..... -0.3V to +6V  
 Push-Pull RESET to GND ..... -0.3V to (V<sub>CC1</sub> + 0.3V)  
 MR, RSTIN, PFI to GND ..... -0.3V to (V<sub>CC1</sub> + 0.3V)  
 Input/Output Current, All Pins ..... 20mA  
 Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
   5-Pin SC70 (derate 3.1mW/°C above +70°C) ..... 247mW

Operating Temperature Range ..... -40°C to +85°C  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +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 +85°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>CC1</sub> ,<br>V <sub>CC2</sub> | T <sub>A</sub> = -40°C to 0°C                                                              |                                 | 1.2   |       | 5.5   | V     |
|                                      |                                        | T <sub>A</sub> = 0°C to +85°C                                                              |                                 | 1.0   |       | 5.5   |       |
| V <sub>CC1</sub> Supply Current      | I <sub>CC1</sub>                       | V <sub>CC1</sub> = 3.3V, V <sub>CC1</sub> > V <sub>CC2</sub> , no load, reset not asserted |                                 |       | 5     | 10    | μA    |
|                                      |                                        | V <sub>CC1</sub> = 1.8V, V <sub>CC1</sub> < V <sub>CC2</sub> , no load, reset not asserted |                                 |       | 5     | 10    |       |
| V <sub>CC2</sub> Supply Current      | I <sub>CC2</sub>                       | V <sub>CC2</sub> = 1.8V, V <sub>CC2</sub> < V <sub>CC1</sub> , no load, reset not asserted |                                 |       | 1     | 2     | μA    |
|                                      |                                        | V <sub>CC2</sub> = 3.3V, V <sub>CC2</sub> > V <sub>CC1</sub> , no load, reset not asserted |                                 |       | 10    | 20    |       |
| Reset Threshold for V <sub>CC1</sub> | V <sub>TH1</sub>                       | MAX67_ _L                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 4.500 | 4.625 | 4.750 | V     |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 4.425 |       | 4.825 |       |
|                                      |                                        | MAX67_ _M                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 4.250 | 4.375 | 4.500 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 4.175 |       | 4.575 |       |
|                                      |                                        | MAX67_ _T                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 3.000 | 3.075 | 3.150 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 2.950 |       | 3.200 |       |
|                                      |                                        | MAX67_ _S                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 2.850 | 2.925 | 3.000 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 2.800 |       | 3.050 |       |
|                                      |                                        | MAX67_ _R                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 2.550 | 2.625 | 2.700 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 2.505 |       | 2.745 |       |
|                                      |                                        | MAX67_ _Z                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 2.250 | 2.313 | 2.375 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 2.213 |       | 2.413 |       |
|                                      |                                        | MAX67_ _Y                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 2.125 | 2.188 | 2.250 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 2.088 |       | 2.288 |       |
|                                      |                                        | MAX67_ _W                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 1.620 | 1.665 | 1.710 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 1.593 |       | 1.737 |       |
|                                      |                                        | MAX67_ _V                                                                                  | T <sub>A</sub> = 0°C to +85°C   | 1.530 | 1.575 | 1.620 |       |
|                                      |                                        |                                                                                            | T <sub>A</sub> = -40°C to +85°C | 1.503 |       | 1.647 |       |

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = 1.2V$  to  $5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 1)

| PARAMETER                                             | SYMBOL                | CONDITIONS                                                                       |                                 | MIN   | TYP   | MAX   | UNITS |  |
|-------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------|---------------------------------|-------|-------|-------|-------|--|
| Reset Threshold for V <sub>CC2</sub>                  | V <sub>TH2</sub>      | MAX67__T                                                                         | T <sub>A</sub> = 0°C to +85°C   | 3.000 | 3.075 | 3.150 | V     |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 2.905 |       | 3.050 |       |  |
|                                                       |                       | MAX67__S                                                                         | T <sub>A</sub> = 0°C to +85°C   | 2.850 | 2.925 | 3.000 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 2.800 |       | 3.050 |       |  |
|                                                       |                       | MAX67__R                                                                         | T <sub>A</sub> = 0°C to +85°C   | 2.550 | 2.625 | 2.700 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 2.505 |       | 2.745 |       |  |
|                                                       |                       | MAX67__Z                                                                         | T <sub>A</sub> = 0°C to +85°C   | 2.250 | 2.313 | 2.375 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 2.213 |       | 2.413 |       |  |
|                                                       |                       | MAX67__Y                                                                         | T <sub>A</sub> = 0°C to +85°C   | 2.125 | 2.188 | 2.250 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 2.088 |       | 2.288 |       |  |
|                                                       |                       | MAX67__W                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.620 | 1.665 | 1.710 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.593 |       | 1.737 |       |  |
|                                                       |                       | MAX67__V                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.530 | 1.575 | 1.620 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.503 |       | 1.647 |       |  |
|                                                       |                       | MAX67__I                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.350 | 1.388 | 1.425 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.328 |       | 1.448 |       |  |
|                                                       |                       | MAX67__H                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.275 | 1.313 | 1.350 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.253 |       | 1.373 |       |  |
|                                                       |                       | MAX67__G                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.080 | 1.110 | 1.140 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.062 |       | 1.158 |       |  |
|                                                       |                       | MAX67__F                                                                         | T <sub>A</sub> = 0°C to +85°C   | 1.020 | 1.050 | 1.080 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 1.002 |       | 1.098 |       |  |
|                                                       |                       | MAX67__E                                                                         | T <sub>A</sub> = 0°C to +85°C   | 0.810 | 0.833 | 0.855 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 0.797 |       | 0.869 |       |  |
|                                                       |                       | MAX67__D                                                                         | T <sub>A</sub> = 0°C to + 85°C  | 0.765 | 0.788 | 0.810 |       |  |
|                                                       |                       |                                                                                  | T <sub>A</sub> = -40°C to +85°C | 0.752 |       | 0.824 |       |  |
| RSTIN Threshold (MAX6738/<br>MAX6739/MAX6740/MAX6743) | V <sub>TH-RSTIN</sub> | T <sub>A</sub> = 0°C to +85°C                                                    | 0.476                           | 0.488 | 0.500 | V     |       |  |
|                                                       |                       | T <sub>A</sub> = -40°C to +85°C                                                  | 0.468                           |       | 0.507 |       |       |  |
| RSTIN Input Current                                   |                       | V <sub>RSTIN</sub> ≥ 0.1V (Note 2)                                               | -10                             |       | +10   | nA    |       |  |
| Reset Threshold Hysteresis                            |                       | V <sub>TH1</sub> , V <sub>TH2</sub> , RSTIN, PFI                                 |                                 | 0.5   |       | %     |       |  |
| $\overline{\text{RESET}}$ , POK1 Output Low           | V <sub>OL</sub>       | V <sub>CC1</sub> ≥ 1.0V, I <sub>SINK</sub> = 50μA, T <sub>A</sub> = 0°C to +85°C |                                 |       | 0.3   | V     |       |  |
|                                                       |                       | V <sub>CC1</sub> ≥ 1.2V, I <sub>SINK</sub> = 100μA                               |                                 |       | 0.3   |       |       |  |
|                                                       |                       | V <sub>CC1</sub> ≥ 2.13V, I <sub>SINK</sub> = 1.2mA                              |                                 |       | 0.3   |       |       |  |
|                                                       |                       | V <sub>CC1</sub> ≥ 4.25V, I <sub>SINK</sub> = 3.2mA,                             |                                 |       | 0.4   |       |       |  |
| $\overline{\text{RESET}}$ Output High (Push-Pull)     | V <sub>OH</sub>       | V <sub>CC1</sub> ≥ 2.38V, I <sub>SOURCE</sub> = 500μA, output deasserted         | 0.8 × V <sub>CC</sub>           |       |       | V     |       |  |
|                                                       |                       | V <sub>CC1</sub> ≥ 4.75V, I <sub>SOURCE</sub> = 800μA, output deasserted         | 0.8 × V <sub>CC</sub>           |       |       |       |       |  |

MAX6736-MAX6745

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = 1.2V$  to  $5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 1)

| PARAMETER                                                 | SYMBOL            | CONDITIONS                                                                                                                | MIN                     | TYP                     | MAX                     | UNITS |
|-----------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------|
| RESET Output Open-Drain Leakage Current (MAX6736/MAX6738) | I <sub>LKG</sub>  | Output not asserted low (Note 2)                                                                                          |                         |                         | 500                     | nA    |
| POK1 Output Open-Drain Leakage                            |                   | Output not asserted low (Note 2)                                                                                          |                         |                         | 500                     | nA    |
| V <sub>CC</sub> Reset Delay                               | t <sub>RD</sub>   | V <sub>CC</sub> 1, V <sub>CC</sub> 2, or RSTIN 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 (Note 3)             | t <sub>RP</sub>   | MAX67_ _ _ _ XK_ _ D3                                                                                                     | 150                     | 225                     | 300                     | ms    |
|                                                           |                   | MAX67_ _ _ _ XK_ _ D7                                                                                                     | 1200                    | 1800                    | 2400                    |       |
| MANUAL RESET (MAX6736–MAX6739 only)                       |                   |                                                                                                                           |                         |                         |                         |       |
| MR to V <sub>CC</sub> 1 Internal Pullup Impedance         |                   |                                                                                                                           | 0.75                    | 1.5                     | 3.00                    | kΩ    |
| MR Timeout Period                                         | t <sub>MRP</sub>  | Both D3 and D7 timing options                                                                                             | 150                     | 225                     | 300                     | ms    |
| MR Minimum Input Pulse Width                              | t <sub>MPW</sub>  |                                                                                                                           | 1                       |                         |                         | μs    |
| MR Glitch Rejection                                       |                   |                                                                                                                           |                         | 100                     |                         | ns    |
| MR Input Voltage                                          | V <sub>IL</sub>   |                                                                                                                           |                         |                         | 0.3 × V <sub>CC</sub> 1 | V     |
|                                                           | V <sub>IH</sub>   |                                                                                                                           | 0.8 × V <sub>CC</sub> 1 |                         |                         |       |
| MR to RESET Delay                                         |                   |                                                                                                                           |                         | 300                     |                         | ns    |
| V <sub>CC</sub> 1 POWER-OK OUTPUT (MAX6741/MAX6744 only)  |                   |                                                                                                                           |                         |                         |                         |       |
| POK1 Timeout Period                                       | t <sub>POKP</sub> |                                                                                                                           | 37.5                    | 56.25                   | 75.0                    | ms    |
| PUSHBUTTON RESET (MAX6740/MAX6741/MAX6742 only)           |                   |                                                                                                                           |                         |                         |                         |       |
| RESET to V <sub>CC</sub> 1 Internal Pullup Impedance      |                   |                                                                                                                           | 25                      | 50                      | 100                     | kΩ    |
| Manual Reset Detect Debounce Period                       | t <sub>DEB</sub>  | (Note 4)                                                                                                                  | 37.5                    | 56.25                   | 75.0                    | ms    |
| Manual Reset Timeout Period (Note 3)                      | t <sub>MRP</sub>  | MAX67_ _ _ _ XK_ _ D3                                                                                                     | 150                     | 225                     | 300                     | ms    |
|                                                           |                   | MAX67_ _ _ _ XK_ _ D7                                                                                                     | 1200                    | 1800                    | 2400                    |       |
| Manual Reset Minimum Input Pulse Width                    | t <sub>MPW</sub>  | (Note 4)                                                                                                                  | 1                       |                         |                         | μs    |
| Manual Reset Release Detect Threshold                     |                   | (Note 4)                                                                                                                  |                         | 0.5 × V <sub>CC</sub> 1 |                         | V     |
| Manual Reset Glitch Rejection                             |                   | (Note 4)                                                                                                                  |                         | 100                     |                         | ns    |
| Manual Reset to RESET Delay                               |                   |                                                                                                                           |                         | 300                     |                         | ns    |

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

MAX6736-MAX6745

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = 1.2V$  to  $5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 1)

| PARAMETER                                           | SYMBOL       | CONDITIONS                                                                                                                                                         | MIN   | TYP   | MAX   | UNITS   |
|-----------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|---------|
| <b>POWER-FAIL COMPARATOR (MAX6742/MAX6745 only)</b> |              |                                                                                                                                                                    |       |       |       |         |
| Power Fail In Threshold (Note 5)                    | $V_{TH-PFI}$ | $T_A = 0^{\circ}C$ to $+85^{\circ}C$                                                                                                                               | 0.476 | 0.488 | 0.500 | V       |
|                                                     |              | $T_A = -40^{\circ}C$ to $+85^{\circ}C$                                                                                                                             | 0.468 |       | 0.507 |         |
| Power Fail In Current                               | $I_{PFI}$    | $V_{PFI} \geq 0.1V$ (Note 2)                                                                                                                                       | -10   |       | +10   | nA      |
| $\overline{PFO}$ Output Low                         | $V_{OL}$     | $V_{CC1} \geq 1.53V$ , $I_{SINK} = 500\mu A$                                                                                                                       |       |       | 0.3   | V       |
|                                                     |              | $V_{CC1} \geq 2.03V$ , $I_{SINK} = 1.2mA$                                                                                                                          |       |       | 0.3   |         |
|                                                     |              | $V_{CC1} \geq 4.25V$ , $I_{SINK} = 3.2mA$                                                                                                                          |       |       | 0.4   |         |
| PFI to $\overline{PFO}$ Propagation Delay           | $t_P$        | PFI falling at $10mV/\mu s$ from $V_{TH-PFI} + 100mV$ to $V_{TH-PFI} - 100mV$ or rising at $10mV/\mu s$ from $V_{TH-PFI} - 100mV$ to $V_{TH-PFI} + 100mV$ (Note 5) |       | 35    |       | $\mu s$ |
| $\overline{PFO}$ Startup Delay                      |              | To output valid (Note 5)                                                                                                                                           |       | 5     |       | ms      |

**Note 1:** All devices are 100% tested at  $T_A = +25^{\circ}C$ . All temperature limits are guaranteed by design.

**Note 2:** Guaranteed by design.

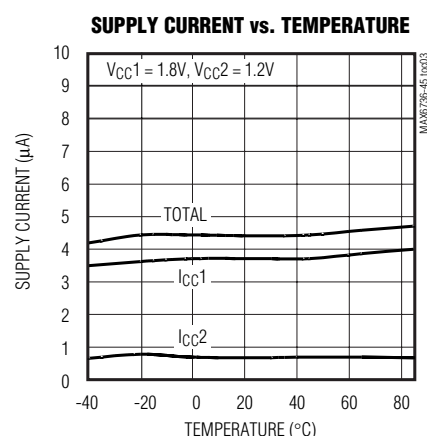
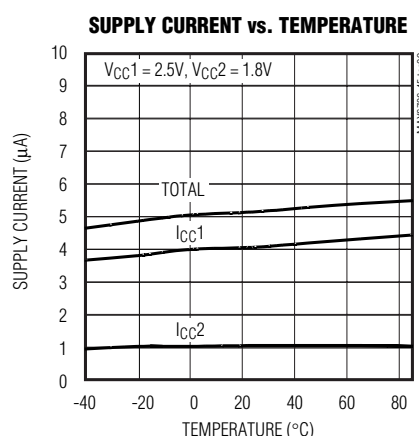
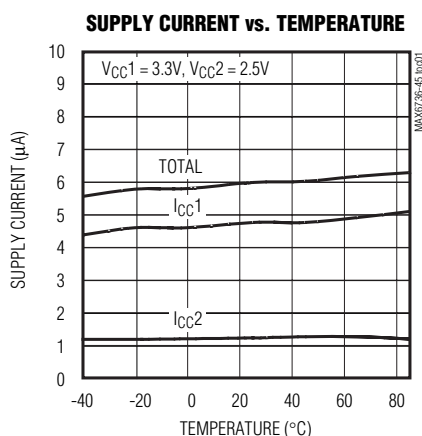
**Note 3:**  $t_{PD}$  timeout period begins after POK1 timeout period ( $t_{POKP}$ ) and  $V_{CC2} \geq V_{TH2}$  (max) (MAX6741/MAX6744).

**Note 4:** Refers to the manual reset function obtained by forcing the RESET output low.

**Note 5:**  $V_{CC1} \geq 1.6V$ .

## Typical Operating Characteristics

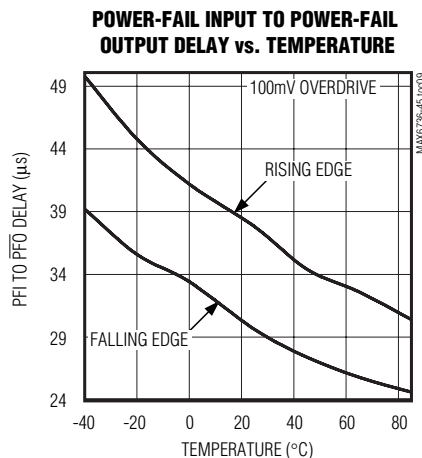
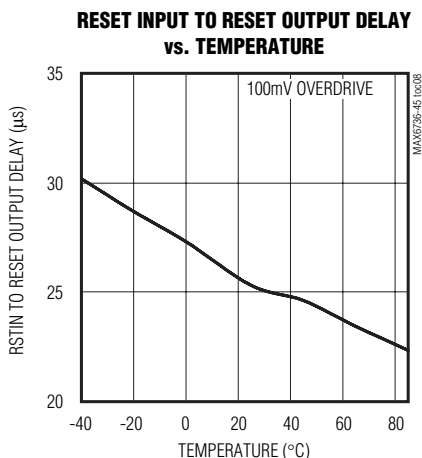
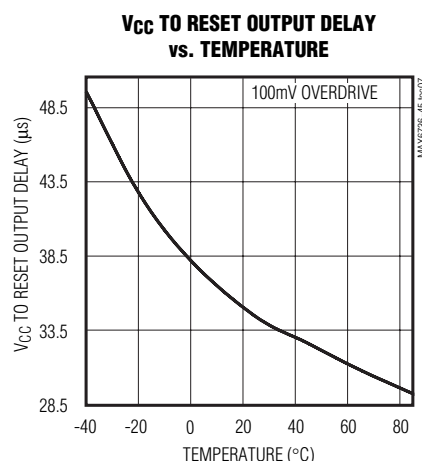
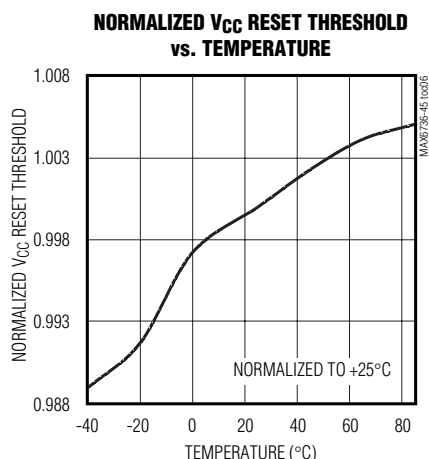
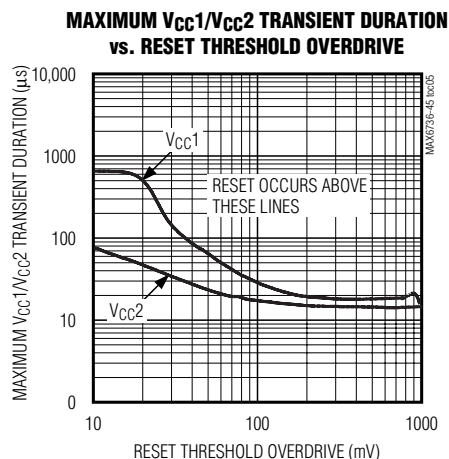
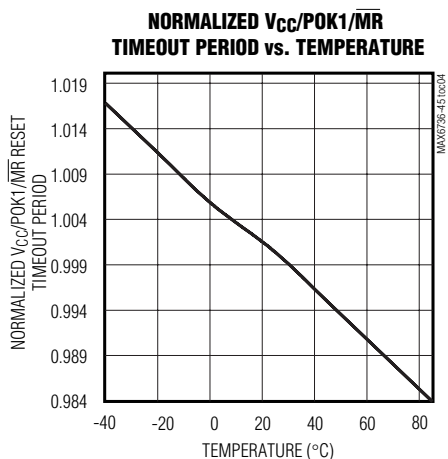
( $T_A = +25^{\circ}C$ , unless otherwise noted.)



# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

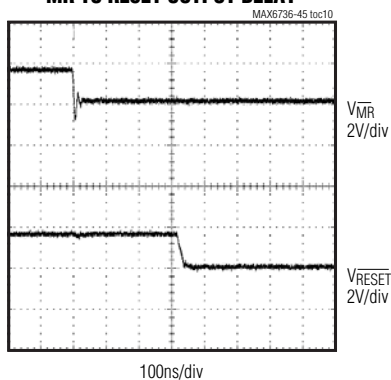


# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

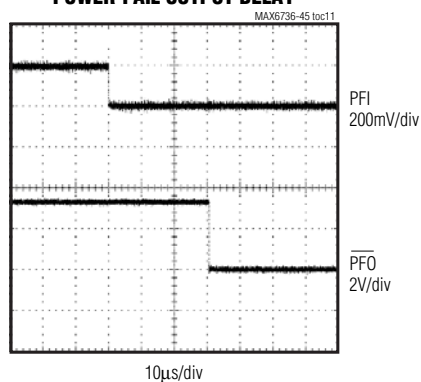
## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

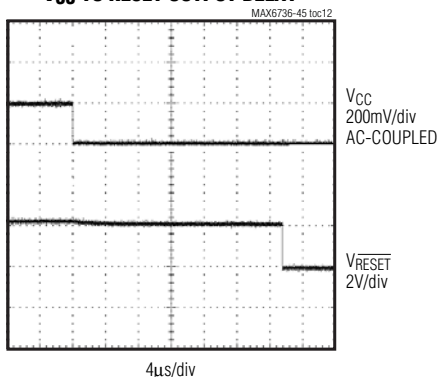
**MR TO RESET OUTPUT DELAY**



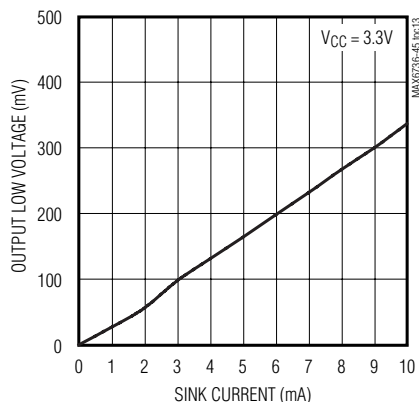
**POWER-FAIL INPUT TO POWER-FAIL OUTPUT DELAY**



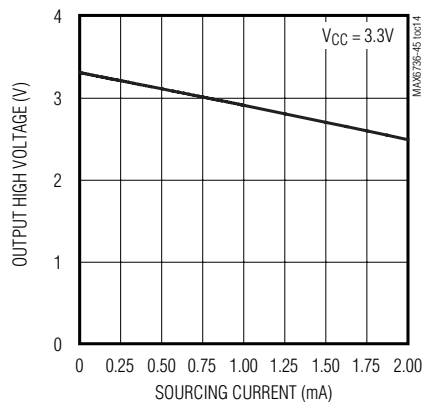
**V<sub>CC</sub> TO RESET OUTPUT DELAY**



**OUTPUT LOW VOLTAGE vs. SINK CURRENT**



**OUTPUT HIGH VOLTAGE vs. SOURCE CURRENT**



# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## Pin Description

| PIN                |                    |                    |                    |                    | NAME                      | FUNCTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MAX6736<br>MAX6737 | MAX6738<br>MAX6739 | MAX6740<br>MAX6743 | MAX6741<br>MAX6744 | MAX6742<br>MAX6745 |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1                  | 1                  | 1                  | 1                  | 1                  | $\overline{\text{RESET}}$ | Reset Output, Push-Pull or Open Drain Active Low. $\overline{\text{RESET}}$ changes from high to low when any monitored power-supply input ( $V_{CC1}$ , $V_{CC2}$ , RSTIN) drops below its selected reset threshold. It remains low until all monitored power-supply inputs exceed their selected reset thresholds for the $V_{CC}$ reset timeout period. $\overline{\text{RESET}}$ is forced low if $\overline{\text{MR}}$ is low for at least the $\overline{\text{MR}}$ minimum input pulse width. It remains low for the $\overline{\text{MR}}$ reset timeout period after $\overline{\text{MR}}$ goes high. The push-pull output is referenced to $V_{CC1}$ . The MAX6736/MAX6738 open-drain outputs require an external pullup resistor. The MAX6740/MAX6741/MAX6742 open-drain outputs have an internal 50k $\Omega$ pullup resistor to $V_{CC1}$ and provide a manual reset function. |
| 2                  | 2                  | 2                  | 2                  | 2                  | GND                       | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3                  | 3                  | —                  | —                  | —                  | $\overline{\text{MR}}$    | Manual Reset, Active Low. Pull low for at least $\overline{\text{MR}}$ minimum input pulse width to force $\overline{\text{RESET}}$ low. Reset remains active as long as $\overline{\text{MR}}$ is low and for the $\overline{\text{MR}}$ reset timeout period after $\overline{\text{MR}}$ goes high. There is an internal 1.5k $\Omega$ pullup resistor to $V_{CC1}$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4                  | —                  | 4                  | 4                  | —                  | $V_{CC2}$                 | Voltage Input 1. Power supply and input for the secondary $\mu$ P voltage reset monitor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| —                  | 4                  | 3                  | —                  | —                  | RSTIN                     | Adjustable Reset Threshold Input. $\overline{\text{RESET}}$ is asserted when RSTIN is below the internal 0.488V reference level. Set the adjustable reset threshold with an external resistor-divider network. Connect RSTIN to $V_{CC1}$ if unused.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 5                  | 5                  | 5                  | 5                  | 5                  | $V_{CC1}$                 | Voltage Input 2. Power supply and input for the primary $\mu$ P voltage reset monitor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| —                  | —                  | —                  | —                  | 4                  | PFI                       | Power-Fail Comparator Input. $\overline{\text{PFO}}$ is asserted when PFI is below 0.488V. $\overline{\text{PFO}}$ is deasserted without any reset timeout period when PFI goes above 0.488V. Connect PFI to an external resistor network to set the desired monitor threshold.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| —                  | —                  | —                  | —                  | 3                  | $\overline{\text{PFO}}$   | Power-Fail Comparator Output, Open Drain Active Low. $\overline{\text{PFO}}$ is asserted when PFI is below 0.488V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| —                  | —                  | —                  | 3                  | —                  | POK1                      | $V_{CC1}$ Power-OK Output, Open Drain Active High. POK1 remains low as long as $V_{CC1}$ is below $V_{TH1}$ . POK1 output goes high after $V_{CC1}$ exceeds $V_{TH1}$ for the POK1 timeout period. POK1 logic is independent of the $\overline{\text{MR}}$ or $V_{CC2}$ inputs. The output can be used to control $V_{CC1}$ -to- $V_{CC2}$ supply sequencing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

MAX6736-MAX6745

**Table 1. Reset Voltage Threshold Suffix Guide for MAX6736/MAX6737/MAX6740/MAX6741/MAX6743/MAX6744**

| PART NO. SUFFIX ( _ ) | V <sub>CC1</sub> NOMINAL VOLTAGE THRESHOLD (V) | V <sub>CC2</sub> NOMINAL VOLTAGE THRESHOLD (V) |
|-----------------------|------------------------------------------------|------------------------------------------------|
| LT                    | <b>4.625</b>                                   | <b>3.075</b>                                   |
| MS                    | 4.375                                          | 2.925                                          |
| MR                    | 4.375                                          | 2.625                                          |
| TZ                    | 3.075                                          | 2.313                                          |
| TW                    | 3.075                                          | 1.665                                          |
| TI                    | 3.075                                          | 1.388                                          |
| TG                    | <b>3.075</b>                                   | <b>1.110</b>                                   |
| TE                    | 3.075                                          | 0.833                                          |
| SY                    | <b>2.925</b>                                   | <b>2.188</b>                                   |
| SV                    | <b>2.925</b>                                   | <b>1.575</b>                                   |
| SH                    | <b>2.925</b>                                   | <b>1.313</b>                                   |
| SF                    | 2.925                                          | 1.050                                          |
| SD                    | <b>2.925</b>                                   | <b>0.788</b>                                   |
| RY                    | 2.625                                          | 2.188                                          |
| RV                    | <b>2.625</b>                                   | <b>1.575</b>                                   |
| RH                    | 2.625                                          | 1.313                                          |
| RF                    | 2.625                                          | 1.050                                          |

| PART NO. SUFFIX ( _ ) | V <sub>CC1</sub> NOMINAL VOLTAGE THRESHOLD (V) | V <sub>CC2</sub> NOMINAL VOLTAGE THRESHOLD (V) |
|-----------------------|------------------------------------------------|------------------------------------------------|
| RD                    | 2.625                                          | 0.788                                          |
| ZW                    | <b>2.313</b>                                   | <b>1.665</b>                                   |
| ZI                    | 2.313                                          | 1.388                                          |
| ZG                    | <b>2.313</b>                                   | <b>1.110</b>                                   |
| ZE                    | 2.313                                          | 0.833                                          |
| YV                    | 2.188                                          | 1.575                                          |
| YH                    | <b>2.188</b>                                   | <b>1.313</b>                                   |
| YF                    | 2.188                                          | 1.050                                          |
| YD                    | <b>2.188</b>                                   | <b>0.788</b>                                   |
| WT                    | <b>1.665</b>                                   | <b>3.075</b>                                   |
| WI                    | 1.665                                          | 1.388                                          |
| WG                    | <b>1.665</b>                                   | <b>1.110</b>                                   |
| WE                    | 1.665                                          | 0.833                                          |
| VR                    | <b>1.575</b>                                   | <b>2.625</b>                                   |
| VH                    | <b>1.575</b>                                   | <b>1.313</b>                                   |
| VF                    | 1.575                                          | 1.050                                          |
| VD                    | <b>1.575</b>                                   | <b>0.788</b>                                   |

**Note:** Standard versions, shown in bold, are available in the D3 timeout option only. Samples are typically held on standard versions only. There is a 10,000-piece order increment on nonstandard versions. **Other threshold voltage combinations may be available; contact factory for availability.**

**Table 2. Reset Voltage Threshold Suffix Guide for MAX6738/MAX6739/MAX6742/MAX6745**

| PART NO. SUFFIX ( _ ) | V <sub>CC1</sub> NOMINAL VOLTAGE THRESHOLD (V) |
|-----------------------|------------------------------------------------|
| L                     | <b>4.625</b>                                   |
| M                     | 4.375                                          |
| T                     | 3.075                                          |
| S                     | <b>2.925</b>                                   |
| R                     | <b>2.625</b>                                   |
| Z                     | <b>2.313</b>                                   |
| Y                     | 2.188                                          |
| W                     | 1.665                                          |
| V                     | <b>1.575</b>                                   |

**Note:** Standard versions, shown in bold, are available in the D3 timeout option only. Samples are typically held on standard versions only. There is a 10,000-piece order increment on non-standard versions. **Other threshold voltages may be available; contact factory for availability.**

**Table 3. V<sub>CC</sub> Timeout Period Suffix Guide**

| TIMEOUT PERIOD SUFFIX | ACTIVE TIMEOUT PERIOD |          |
|-----------------------|-----------------------|----------|
|                       | MIN (ms)              | MAX (ms) |
| D3                    | 150                   | 300      |
| D7                    | 1200                  | 2400     |

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

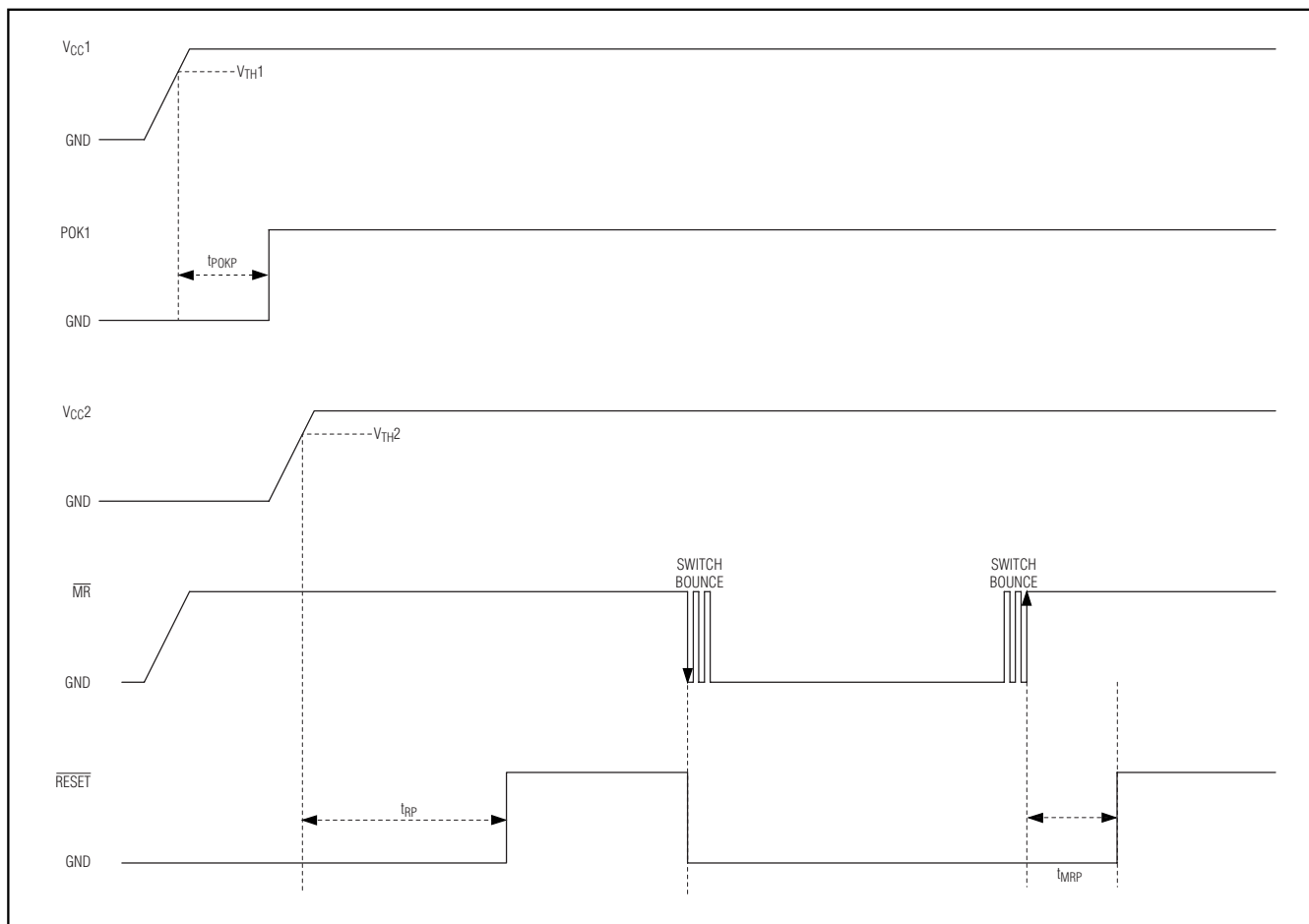


Figure 1. Timing Diagram

## Detailed Description

### Supply Voltages

The MAX6736–MAX6745  $\mu$ P supervisory circuits maintain system integrity by alerting the  $\mu$ P to fault conditions. These devices are optimized for systems that monitor two or three supply voltages. The reset output state is guaranteed to remain valid while either VCC1 or VCC2 is above 1.2V.

### Threshold Levels

The MAX6736/MAX6737/MAX6740/MAX6741/MAX6743/MAX6744 input voltage threshold combinations are indicated by a two-letter code in Table 1. The MAX6738/MAX6739/MAX6742/MAX6745 input voltage thresholds are indicated by a one-letter code in Table 2. Contact the factory for the availability of other voltage thresholds.

### Reset Output

The MAX6736–MAX6745 provide an active-low reset output (RESET). RESET is asserted when the voltage at either VCC1 or VCC2 falls below the voltage threshold level, RSTIN drops below the threshold, or MR is pulled low. Once reset is asserted, it stays low for the reset timeout period. If VCC1, VCC2, or RSTIN goes below the reset threshold before the reset timeout period is completed, the internal timer restarts. The MAX6736/MAX6738/MAX6740/MAX6741/MAX6742 have open-drain reset outputs, while the MAX6737/MAX6739/MAX6743/MAX6744/MAX6745 have push-pull reset outputs (Figure 1).

The MAX6740/MAX6741/MAX6742 include a  $\overline{\text{RESET}}$  output with a manual reset detect function. The open-drain  $\overline{\text{RESET}}$  output has an internal 50k $\Omega$  pullup to VCC1. The RESET output is low while the output is pulled to GND and remains low for at least the manual reset timeout period after the external GND pulldown is

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

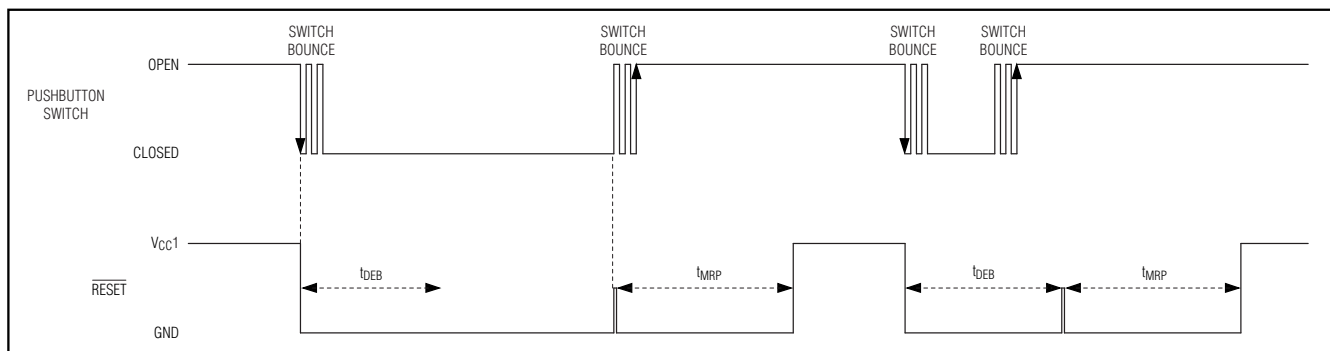


Figure 2. MAX6740/MAX6741/MAX6742 Manual Reset Timing Diagram

released. The manual reset detect function is internally debounced for the  $t_{DEB}$  timeout period, so the output can be connected directly to a momentary pushbutton switch, if desired (Figure 2).

## Manual Reset Input

Many microprocessor-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset while the monitored supplies remain above their reset thresholds. The MAX6736–MAX6739 have a dedicated active-low  $\overline{MR}$  input. The  $\overline{RESET}$  is asserted low while  $\overline{MR}$  is held low and remains asserted for the manual reset timeout period after  $\overline{MR}$  returns high. The  $\overline{MR}$  input has an internal  $1.5k\Omega$  pullup resistor to  $V_{CC1}$  and can be left unconnected if not used.  $\overline{MR}$  can be driven with CMOS logic levels, open-drain/open-collector outputs, or a momentary pushbutton switch to GND to create a manual reset function.

## Adjustable Input Voltage

The MAX6738/MAX6739 and MAX6740/MAX6743 provide an additional input to monitor a second or third system voltage. The threshold voltage at  $RSTIN$  is typi-

cally 488mV. Connect a resistor-divider network to the circuit as shown in Figure 3 to establish an externally controlled threshold voltage,  $V_{EXT\_TH}$ .

$$V_{EXT\_TH} = 0.488V((R1 + R2) / R2)$$

Low leakage current at  $RSTIN$  allows the use of large-valued resistors, resulting in reduced power consumption of the system.

## Power-Fail Comparator

PFI is the noninverting input to an auxiliary comparator. A 488mV internal reference ( $V_{TH-PFI}$ ) is connected to the inverting input of the comparator. If PFI is less than 488mV, PFO is asserted low. PFO deasserts without a timeout period when PFI rises above the externally set threshold. Common uses for the power-fail comparator include monitoring for low battery conditions or a failing DC-DC converter input voltage (see the *Typical Application Circuits*). The asserted PFO output can place a system in a low-power suspend mode or support an orderly system shutdown before monitored  $V_{CC}$  voltages drop below the reset thresholds. Connect PFI to an external resistor-divider network as shown in Figure 4 to set the desired trip threshold. Connect PFI to  $V_{CC1}$  if unused.

## Applications Information

### Interfacing to the $\mu$ P with Bidirectional Reset Pins

Most microprocessors with bidirectional reset pins can interface directly to open-drain  $\overline{RESET}$  output options. Systems simultaneously requiring a push-pull  $\overline{RESET}$  output and a bidirectional reset interface can be in logic contention. To prevent contention, connect a  $4.7k\Omega$  resistor between  $\overline{RESET}$  and the  $\mu$ P's reset I/O port as shown in Figure 5.

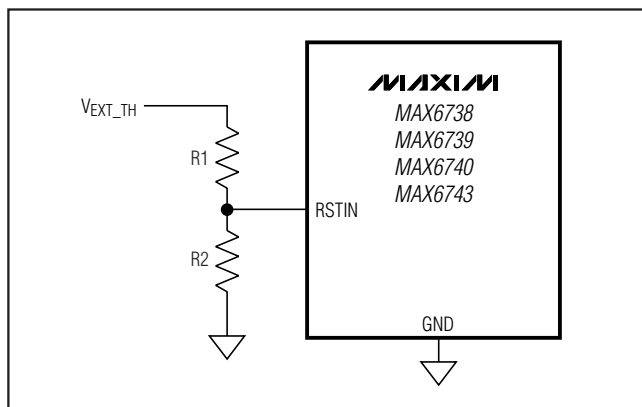


Figure 3. Monitoring an Additional Voltage

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

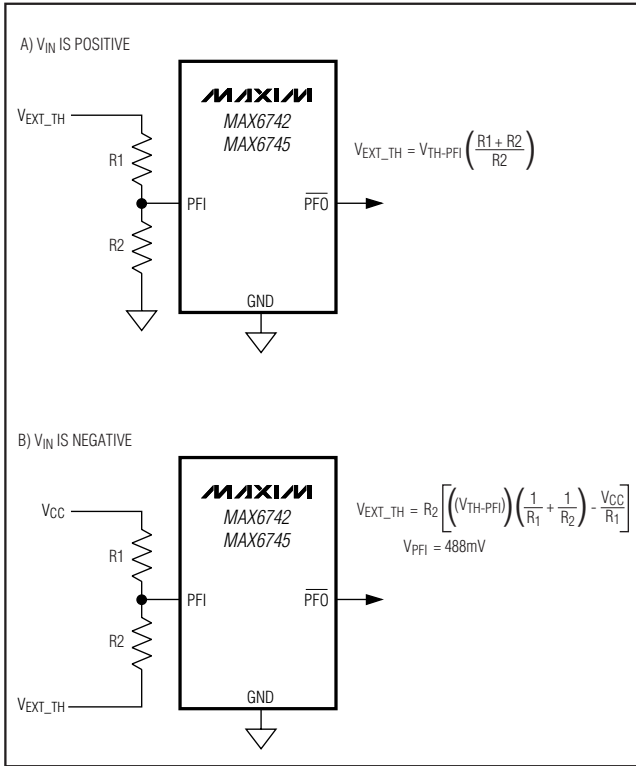


Figure 4. Using Power-Fail Input to Monitor an Additional Power Supply

## Adding Hysteresis to the Power-Fail Comparator

The power-fail comparator has a typical input hysteresis of 2.5mV. This is sufficient for most applications in which a power-supply line is being monitored through an external voltage-divider. If additional noise margin is desired, connect a resistor between  $\overline{\text{PFO}}$  and PFI, as

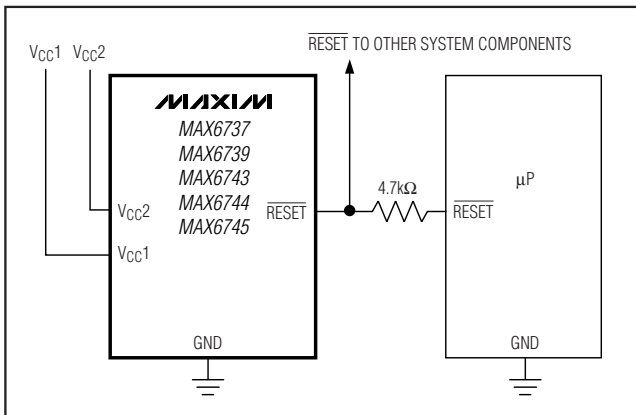


Figure 5. Interfacing to  $\mu$ Ps with Bidirectional Reset I/O

shown in Figure 6. Select the values of R1, R2, and R3 such that PFI sees  $V_{\text{TH-PFI}}$  (488mV) when  $V_{\text{EXT}}$  falls to its power-fail trip point ( $V_{\text{FAIL}}$ ) and when  $V_{\text{EXT}}$  rises to its power-good trip point ( $V_{\text{GOOD}}$ ). The hysteresis window extends between the specified  $V_{\text{FAIL}}$  and  $V_{\text{GOOD}}$  thresholds. R3 adds the additional hysteresis by sinking current from the R1/R2 divider network when the  $\overline{\text{PFO}}$  output is logic low and sourcing current into the network when  $\overline{\text{PFO}}$  is logic high. R3 is typically an order of magnitude greater than R1 or R2.

The current through R2 should be at least 1 $\mu$ A to ensure that the 10nA (max) PFI input current does not significantly shift the trip points. Therefore, for most applications:

$$R2 < V_{\text{TH-PFI}} / 1\text{mA} < 0.488\text{V} / 1\text{mA} < 488\text{k}\Omega$$

$\overline{\text{PFO}}$  is an open-drain output requiring an external pullup resistor, R4. Select R4 to be less than 1% of R3.

$V_{\text{GOOD}}$  = DESIRED  $V_{\text{EXT}}$  GOOD VOLTAGE THRESHOLD

$V_{\text{FAIL}}$  = DESIRED  $V_{\text{EXT}}$  FAIL VOLTAGE THRESHOLD

$V_{\text{PU}} = V_{\text{PULLUP}}$  (FOR OPEN-DRAIN  $\overline{\text{PFO}}$ )

$R2 = 488\text{k}\Omega$  (FOR  $>1\mu\text{A}$  R2 CURRENT)

$$R1 = R2 \frac{(V_{\text{GOOD}} - V_{\text{TH-PFI}}) - \frac{(V_{\text{TH-PFI}}(V_{\text{GOOD}} - V_{\text{FAIL}}))}{V_{\text{PU}}}}{V_{\text{TH}} - \text{PFI}}$$

$$R3 = (R1 \times V_{\text{PU}}) / (V_{\text{GOOD}} - V_{\text{FAIL}})$$

$$R4 \leq 0.01 \times R3$$

## Power Sequencing Applications

Many dual-voltage processors/ASICs require specific power-up/power-down sequences for the I/O and core supplies.

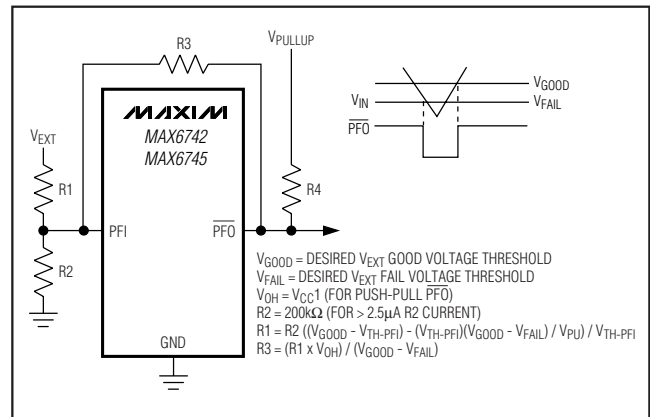


Figure 6. Adding Hysteresis to Power Fail for Push-Pull  $\overline{\text{PFO}}$

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

The MAX6741/MAX6744 offer a  $V_{CC1}$  POK (POK1) ideal for  $V_{CC1}$ -to- $V_{CC2}$  sequencing. POK1 remains low as long as  $V_{CC1}$  is below its  $V_{TH1}$  threshold. When  $V_{CC1}$  exceeds  $V_{TH1}$  for the POK1 timeout period ( $t_{POKP}$ ), the open-drain POK1 output is deasserted. The POK1 output can then enable the  $V_{CC2}$  power supply (use an external POK1 pullup resistor).  $\overline{RESET}$  is deasserted when both  $V_{CC1}$  and  $V_{CC2}$  remain above their selected thresholds for the reset timeout period ( $t_{RP}$ ). The POK1 output can be used for I/O before core or core before I/O sequencing, depending on the selected  $V_{CC1}/V_{CC2}$  thresholds. See the *Typical Application Circuit* and Figure 1.

## Monitoring a Negative Voltage

The power-fail comparator can be used to monitor a negative supply voltage using the circuit shown in Figure 4. When the negative supply is valid,  $\overline{PFO}$  is low. When the negative supply voltage drops,  $\overline{PFO}$  goes high. The circuit's accuracy is affected by the PFI threshold tolerance,  $V_{CC}$ , R1, and R2.

## Transient Immunity

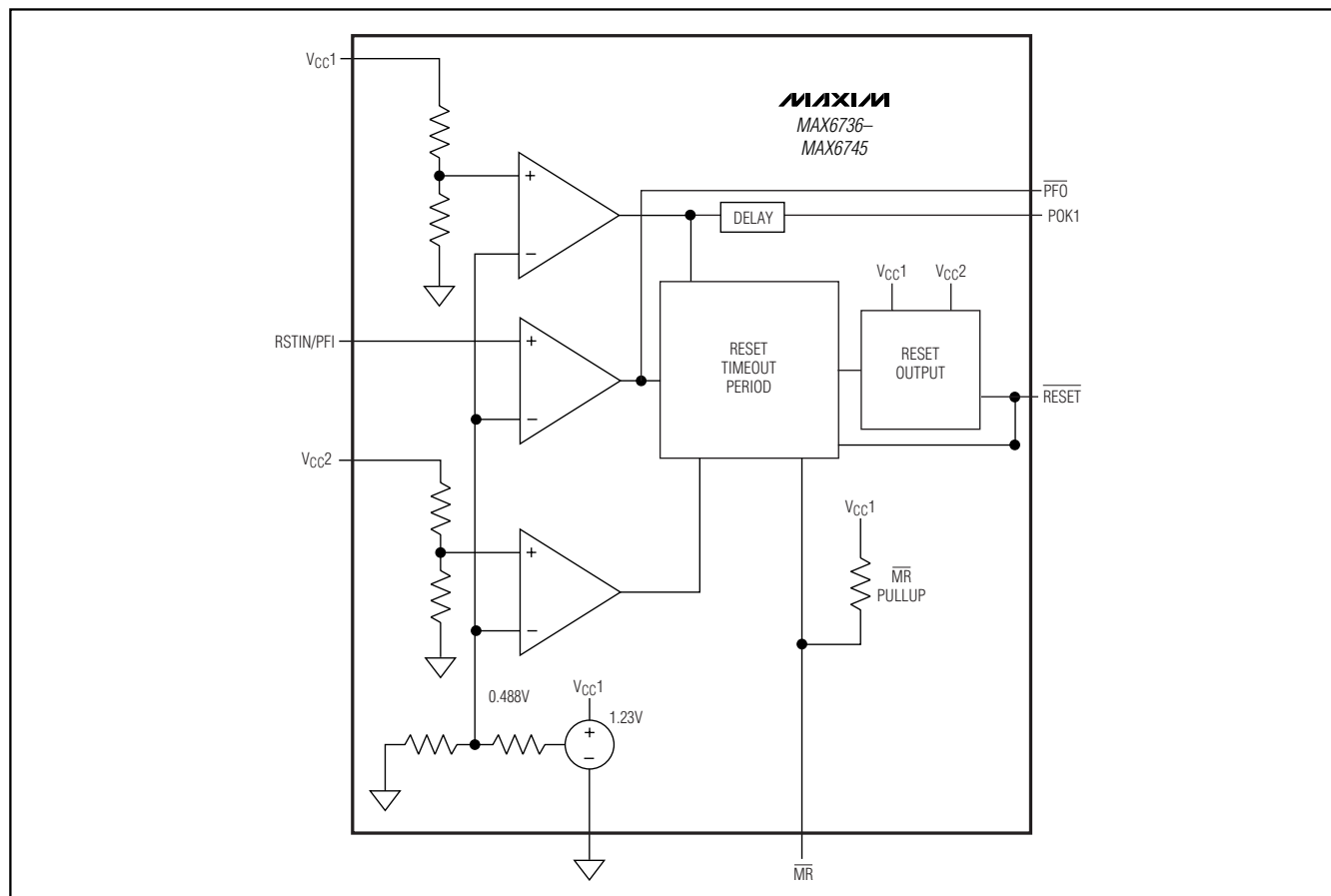
The MAX6736–MAX6745 supervisors are relatively immune to short-duration falling  $V_{CC}$  transients (glitches). It is usually undesirable to reset the  $\mu$ P when  $V_{CC}$  experiences only small glitches. The *Typical Operating Characteristics* show Maximum  $V_{CC1}/V_{CC2}$  Transient Duration vs. Reset Threshold Overdrive, for which reset pulses are not generated. The graph shows the maximum pulse width that a falling  $V_{CC}$  transient might typically have without causing a reset pulse to be issued. As the amplitude of the transient increases, the maximum allowable pulse width decreases. A 0.1 $\mu$ F bypass capacitor mounted close to the  $V_{CC}$  pin provides additional transient immunity.

## Chip Information

TRANSISTOR COUNT: 249

PROCESS: BiCMOS

## Functional Diagram



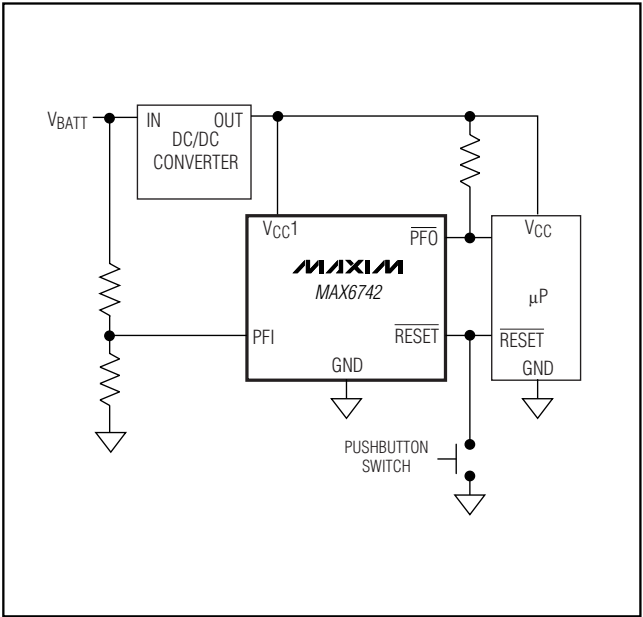
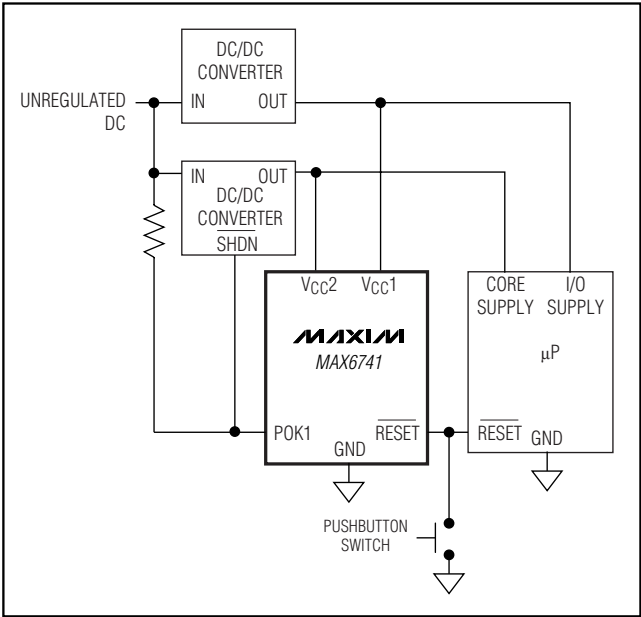
# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## Selector Guide (continued)

| PART    | VOLTAGE MONITORS | OPEN-DRAIN RESET | PUSH-PULL RESET | MANUAL RESET | POWER-FAIL INPUT/OUTPUT | POK OUTPUT | RSTIN INPUT |
|---------|------------------|------------------|-----------------|--------------|-------------------------|------------|-------------|
| MAX6739 | 1 fixed, 1 adj   | —                | X               | X            | —                       | —          | X           |
| MAX6740 | 2 fixed, 1 adj   | X*               | —               | X*           | —                       | —          | X           |
| MAX6741 | 2 fixed          | X*               | —               | X*           | —                       | X          | —           |
| MAX6742 | 1 fixed          | X*               | —               | X*           | X                       | —          | —           |
| MAX6743 | 2 fixed, 1adj    | —                | X               | —            | —                       | —          | X           |
| MAX6744 | 2 fixed          | —                | X               | —            | —                       | X          | —           |
| MAX6745 | 1 fixed          | —                | X               | —            | X                       | —          | —           |

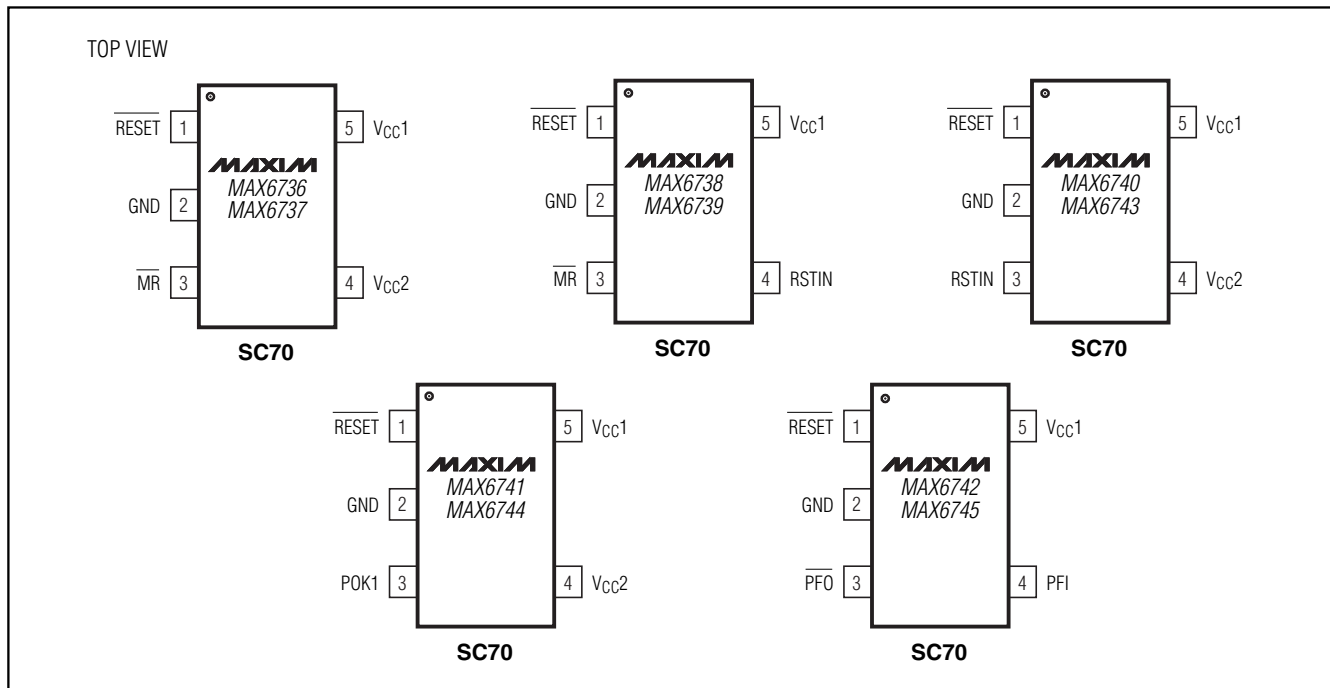
\*Manual reset detect on  $\overline{\text{RESET}}$  output.

## Typical Application Circuits



# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## Pin Configurations



MAX6736-MAX6745

## Ordering Information (continued)

| PART           | TEMP RANGE     | PIN-PACKAGE |
|----------------|----------------|-------------|
| MAX6738XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6739XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6740XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6741XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6742XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6743XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6744XK_D_-T | -40°C to +85°C | 5 SC70-5    |
| MAX6745XK_D_-T | -40°C to +85°C | 5 SC70-5    |

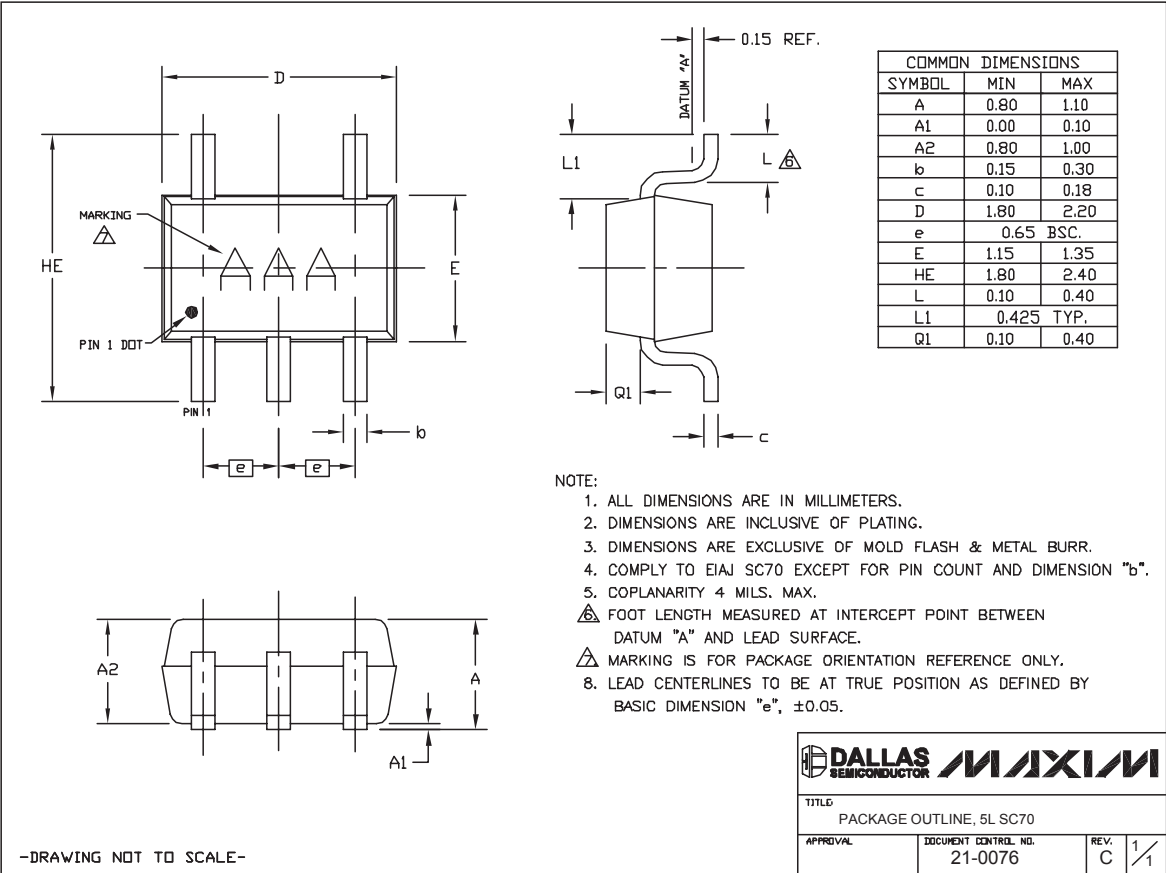
**Note:** The first “\_” or “\_” are placeholders for the threshold voltage levels of the devices. Desired threshold levels are set by the part number suffix found in Tables 1 and 2. The “\_” after the D is a placeholder for the reset timeout period suffix found in Table 3. For example, the MAX6736XKLT D3-T is a dual-voltage supervisor  $V_{TH1} = 4.625V$ ,  $V_{TH2} = 3.075V$ , and a 150ms minimum reset timeout period. All devices are available in tape-and-reel only. There is a 2500-piece minimum order increment for standard versions (see Table 1). Sample stock is typically held on standard versions only. Nonstandard versions require a minimum order increment 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.

# Low-Power Dual-/Triple-Voltage SC70 $\mu$ P Supervisory Circuits

## 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).)



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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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