

# Ultra-Low-Voltage $\mu$ P Reset Circuits and Voltage Detectors

## General Description

The MAX6841–MAX6845 microprocessor ( $\mu$ P) supervisory circuits monitor ultra-low-voltage power supplies in  $\mu$ P and digital systems. They provide excellent circuit reliability at low cost by eliminating external components and adjustments when used with +0.9V to +1.5V systems. Factory-trimmed reset thresholds are available for the MAX6841/MAX6842. The MAX6843/MAX6844/MAX6845 provide a RESET IN input, allowing the user to externally adjust the reset threshold. The MAX6841–MAX6845 family features a debounced manual reset input ( $\overline{MR}$ ). The reset comparator is designed to ignore fast transients on V<sub>CC</sub>.

The MAX6841–MAX6845 assert a reset signal whenever the V<sub>CC</sub> supply voltage declines below a preset or adjustable threshold or whenever manual reset ( $\overline{MR}$ ) is asserted. Reset remains asserted for a fixed timeout delay after V<sub>CC</sub> has risen above the reset threshold and when manual reset is deasserted. Five timeout periods are available for each part: 150 $\mu$ s (voltage detector version), 1.5ms, 30ms, 210ms, and 1.68s (typ).

The MAX6841/MAX6843 have an active-low push-pull reset output. The MAX6841/MAX6842/MAX6844 have an active-high push-pull reset output, and the MAX6842/MAX6845 have an active-low open-drain reset output. The active-low open-drain reset output requires a pullup resistor that can be connected to a voltage from 0 to V<sub>CC</sub>.

The low supply current (5.7 $\mu$ A) and small package (SOT23-5) make the MAX6841–MAX6845 ideal for use in portable equipment.

## Applications

- Computers
- Controllers
- Intelligent Instruments
- Critical  $\mu$ P and  $\mu$ C Power Monitoring
- Portable/Battery-Powered Equipment
- Telecom/Networking Equipment
- Basestations
- Servers/Workstations

**Selector Guide and Typical Operating Circuit appear at end of data sheet.**

## Features

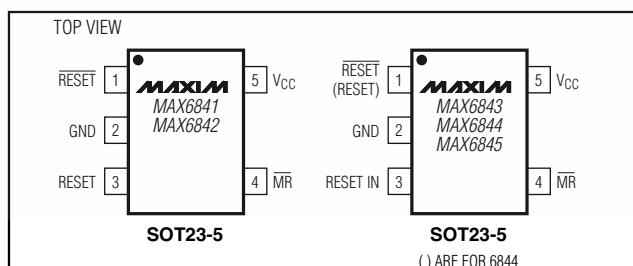
- ◆ Factory-Set Reset Threshold Voltages for Monitoring Supplies from 0.9V to 1.5V (MAX6841/MAX6842)
- ◆ Adjustable Threshold RESET IN (MAX6843/MAX6844/MAX6845)
- ◆ Low Power Consumption: 5.7 $\mu$ A (typ)
- ◆  $\pm 2.5\%$  Reset Threshold Accuracy Over Temperature
- ◆ Five Timeout Periods: 150 $\mu$ s (Voltage Detector Version), 1.5ms, 30ms, 210ms, and 1.68s
- ◆ Available in Three Output Configurations
  - Push-Pull RESET
  - Push-Pull RESET
  - Open-Drain RESET
- ◆ Guaranteed Reset Valid to V<sub>CC</sub> = 0.55V (Active Low)
- ◆ Manual Reset Input
- ◆ Immune to Short V<sub>CC</sub> Transients
- ◆ Space-Saving 5-Pin SOT23 Package

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
<b>MAX6841_UKD_T</b>	-40°C to +85°C	5 SOT23-5
<b>MAX6842_UKD_T</b>	-40°C to +85°C	5 SOT23-5
<b>MAX6843UKD_T</b>	-40°C to +85°C	5 SOT23-5
<b>MAX6844UKD_T</b>	-40°C to +85°C	5 SOT23-5
<b>MAX6845UKD_T</b>	-40°C to +85°C	5 SOT23-5

**Note:** Insert desired suffix letter (from the Threshold Suffix Guide and the Active Timeout Period tables) into the blanks to complete the part number. For example, the MAX6842GUKD1 has a reset threshold of 1.11V and a typical reset timeout period of 1.5ms. Sample stock is generally available on standard versions only (see the Standard Versions table). Standard versions require a minimum order increment of 2.5k units. Nonstandard versions must be ordered in 10k-unit increments. Contact factory for availability. All parts are offered in tape-and-reel only.

## Pin Configurations



MAX6841–MAX6845

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## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)	
$V_{CC}$	-0.3V to +6V
MR, RESET IN, RESET (open-drain)	-0.3V to +6V
Push-Pull RESET and RESET	-0.3V to ( $V_{CC}$ + 0.3V)
Input Current (all pins)	20mA
Output Current (RESET, RESET)	20mA

Continuous Power Dissipation ( $T_A = +70^\circ C$ )	
5-Pin SOT23 (derate 7.1mW/ $^\circ C$ above $+70^\circ C$ ).....571mW	
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

( $V_{CC} = +0.55V$  to  $+1.8V$ ,  $T_A = -40^\circ C$  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
Supply Voltage Range	$V_{CC}$	MAX6843/MAX6845	0.55	1.80		V
		MAX6841/MAX6842/MAX6844 (Note 2)	0.75	1.80		
Supply Current	$I_{CC}$	$V_{CC} = 0.9V$ , no load, reset not asserted		5.7	20	$\mu A$
		$V_{CC} = 1.5V$ , no load, reset not asserted		7.3	20	
		$V_{CC} = 1.8V$ , no load, reset not asserted		8.1	20	
Reset Threshold ( $V_{CC}$ Falling)	$V_{TH}$	I	1.350	1.388	1.425	V
		H	1.275	1.313	1.350	
		G	1.080	1.110	1.140	
		F	1.020	1.050	1.080	
		E	0.810	0.833	0.855	
		D, $T_A = 0^\circ C$ to $+85^\circ C$	0.765	0.788	0.810	
RESET IN Threshold	$V_{RSTIN}$	MAX6843/MAX6844/MAX6845 (Note 3)	181.2	187.4	191.5	mV
RESET IN Leakage Current	$I_{RSTIN}$		-25		+25	nA
Reset Threshold Hysteresis	$V_{HYS}$			0.75		% $V_{TH}$
$V_{CC}$ or RESET IN to Reset Delay		$V_{CC}$ falling, step signal from ( $V_{TH} + 10\%$ ) to ( $V_{TH} - 10\%$ ) within 1 $\mu s$		150		$\mu s$
Reset Active Timeout Period	$t_{RP}$	D0 (voltage detector)		0.15		ms
		D1	1	1.5	2	
		D2	20	30	40	
		D3	140	210	280	
		D4	1120	1680	2240	
MR Input Voltage (Note 3)	$V_{IL}$			0.3 $\times V_{CC}$		V
	$V_{IH}$			0.7 $\times V_{CC}$		
MR Minimum Input Pulse Width		MR driven from $V_{CC}$ to 0 (Note 3)	1			$\mu s$
MR Glitch Rejection		MR driven from $V_{CC}$ to 0 (Note 3)		150		ns
MR to Reset Delay		MR driven from $V_{CC}$ to 0 (Note 3)		500		ns
MR Pullup Resistance to $V_{CC}$			10	20	26	k $\Omega$

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## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = +0.55V$  to  $+1.8V$ ,  $T_A = -40^\circ C$  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
Open-Drain RESET Output Voltage	$V_{OL}$	$V_{CC} \geq 0.55V$ , $I_{SINK} = 10\mu A$ , reset asserted			$0.2 \times V_{CC}$	V
		$V_{CC} \geq 0.83V$ , $I_{SINK} = 80\mu A$ , reset asserted			$0.2 \times V_{CC}$	
Open-Drain RESET Output Leakage Current	$I_{LKG}$	$V_{CC} > V_{TH}$ , reset not asserted			1	$\mu A$
		$V_{CC} \geq 0.55V$ , $I_{SINK} = 10\mu A$ , reset asserted			$0.2 \times V_{CC}$	
Push-Pull RESET Output Voltage	$V_{OL}$	$V_{CC} \geq 0.83V$ , $I_{SINK} = 80\mu A$ , reset asserted			$0.2 \times V_{CC}$	V
		$V_{CC} \geq 0.83V$ , $I_{SOURCE} = 40\mu A$ , reset not asserted			$0.8 \times V_{CC}$	
Push-Pull RESET Output Voltage	$V_{OH}$	$V_{CC} \geq 0.75V$ , $I_{SOURCE} = 10\mu A$ , reset asserted			$0.8 \times V_{CC}$	V
		$V_{CC} \geq 0.83V$ , $I_{SOURCE} = 40\mu A$ , reset asserted			$0.8 \times V_{CC}$	
	$V_{OL}$	$V_{CC} \geq 0.83V$ , $I_{SINK} = 80\mu A$ , reset not asserted			$0.2 \times V_{CC}$	

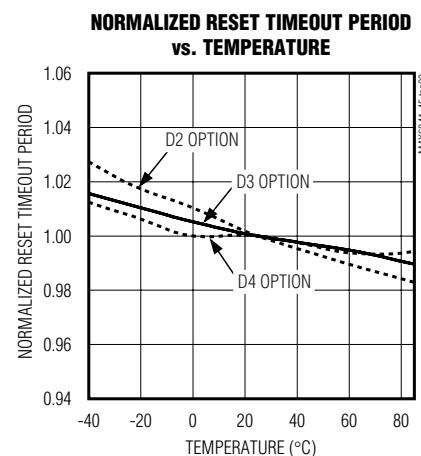
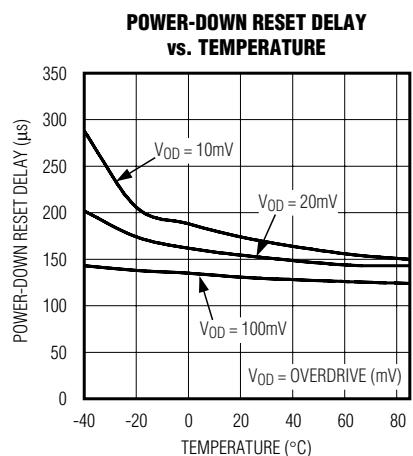
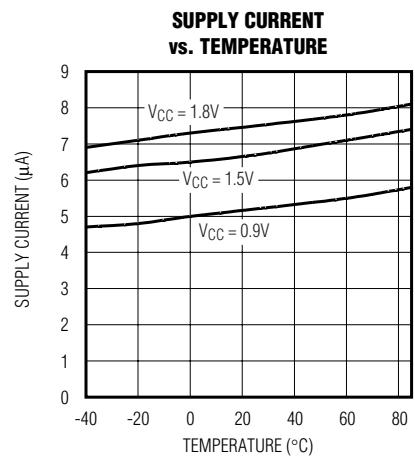
**Note 1:** 100% production tested at  $+25^\circ C$ . Overtemperature limits are guaranteed by design.

**Note 2:** The active-low output RESET has  $V_{CC(MIN)} = 0.55V$  (MAX6841/MAX6842).

**Note 3:** For  $V_{CC} > 0.788V$ ,  $T_A = 0^\circ C$  to  $+85^\circ C$ , and for  $V_{CC} > 0.833V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ .

## Typical Operating Characteristics

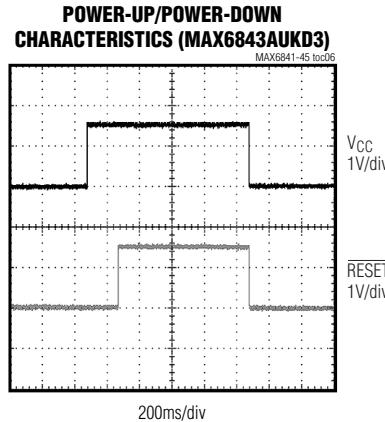
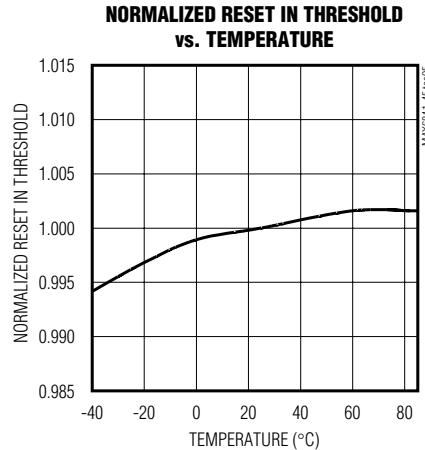
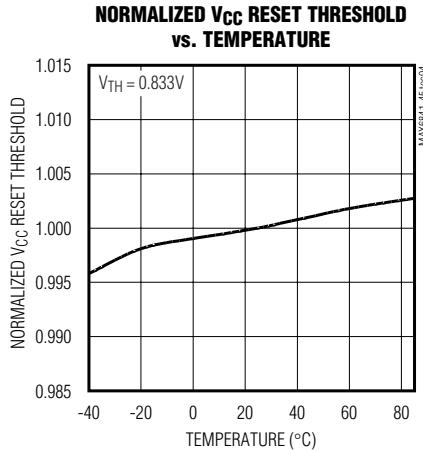
( $V_{CC} = 1.5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



# Ultra-Low-Voltage $\mu$ P Reset Circuits and Voltage Detectors

## Typical Operating Characteristics (continued)

( $V_{CC} = 1.5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

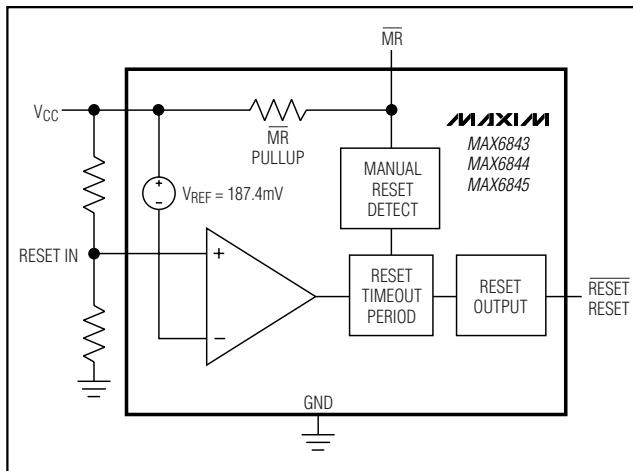
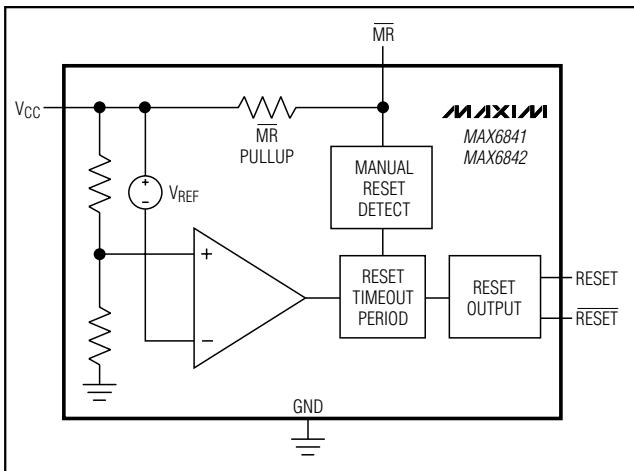


## Pin Description

PIN			NAME	FUNCTION
MAX6841 MAX6842	MAX6843 MAX6845	MAX6844		
1	—	—	RESET	Push-Pull (MAX6841) or Open-Drain (MAX6842) Active-Low Reset Output. RESET changes from high to low when $V_{CC}$ drops below the selected reset threshold or $\overline{MR}$ is pulled low. RESET remains low for the reset timeout period after $V_{CC}$ exceeds the device reset threshold and $\overline{MR}$ is released high.
—	1	—		Push-Pull (MAX6843) or Open-Drain (MAX6845) Active-Low Reset Output. RESET changes from high to low when RESET IN drops below the 187.4mV reset threshold (referenced to $V_{CC}$ ) or $\overline{MR}$ is pulled low. RESET remains low for the reset timeout period after RESET IN exceeds the reset threshold and $\overline{MR}$ is released high.
2	2	2	GND	Ground
3	—	—	RESET	Push-Pull Active-High Reset Output. RESET changes from low to high when $V_{CC}$ input drops below the selected reset threshold or $\overline{MR}$ is pulled low. RESET remains high for the reset timeout period after $V_{CC}$ exceeds the device reset threshold and $\overline{MR}$ is released high.
—	—	1		Push-Pull Active-High Reset Output. RESET changes from low to high when the RESET IN input drops below the 187.4mV reset threshold (referenced to $V_{CC}$ ). RESET remains high for the reset timeout period after RESET IN exceeds the reset threshold.
—	3	3	RESET IN	Adjustable Reset Input. High-impedance input for reset comparator. Connect this pin to an external resistive-divider network to set the reset threshold voltage; the typical threshold is 187.4mV (referenced to $V_{CC}$ ). The MAX6843/MAX6844/MAX6845 assert a reset signal when the $V_{CC}$ to RESET IN differential falls below its threshold voltage.
4	4	4	$\overline{MR}$	Active-Low Manual Reset Input. Internal 20k $\Omega$ pullup to $V_{CC}$ . Pull low to force a reset. Reset remains active as long as $\overline{MR}$ is low and for the reset timeout period after $\overline{MR}$ goes high. Leave unconnected or connect to $V_{CC}$ if unused.
5	5	5	$V_{CC}$	Supply Voltage. Monitored supply for the MAX6841/MAX6842.

# Ultra-Low-Voltage µP Reset Circuits and Voltage Detectors

## Functional Diagrams



## Detailed Description

### Reset Output

A microprocessor's (µP's) reset input starts the µP in a known state. The MAX6841-MAX6845 assert a reset during power-up, power-down, and brownout conditions. When the V<sub>CC</sub> supply voltage falls below a preset threshold (MAX6841/MAX6842) or RESET IN falls below the adjustable threshold (MAX6843/MAX6844/MAX6845), reset asserts and stays asserted for a fixed timeout delay (Table 2) after V<sub>CC</sub> or RESET IN has risen above the reset threshold. The MAX6841-MAX6845 are available with five typical timeout options for each part: 150µs (voltage detector), 1.5ms, 30ms, 210ms, and 1.68s.

The MAX6841/MAX6842 have two reset outputs (RESET and RESET̄); one is the inverse of the other. The MAX6841 has one active-high push-pull output and one active-low push-pull output. The MAX6842 has one active-high push-pull output and one active-low open-drain output. The MAX6843 features an active-low push-pull output. The MAX6844 features an active-high push-pull output, and the MAX6845 has an active-low open-drain output stage. Connect a pullup resistor from the open-drain RESET̄ output to any voltage between 0 and 6V.

### Manual Reset Input

Many µP-based systems require a manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. Reset remains asserted while MR is low, and for a fixed timeout delay after MR returns high. This input has an internal 20kΩ pullup resistor, so it can be left open if it is not used. MR can be driven with CMOS logic level or with open-drain/collector outputs. To create a manual reset func-

tion, connect a normally open momentary switch from MR to ground; external debounce circuitry is not required. If MR is driven from long cables or the device is used in a noisy environment, connect a 0.1µF capacitor from MR to ground to provide additional noise immunity.

### RESET IN

The MAX6843/MAX6844/MAX6845 feature a RESET IN input, which allows users to adjust the reset threshold voltage. The internal reference voltage is 187.4mV with respect to V<sub>CC</sub>. An external resistive-divider network can be used to set voltage monitoring thresholds, as shown in Figure 1. The resistive-divider network must be referenced to V<sub>CC</sub>. As V<sub>CC</sub> falls, the voltage at

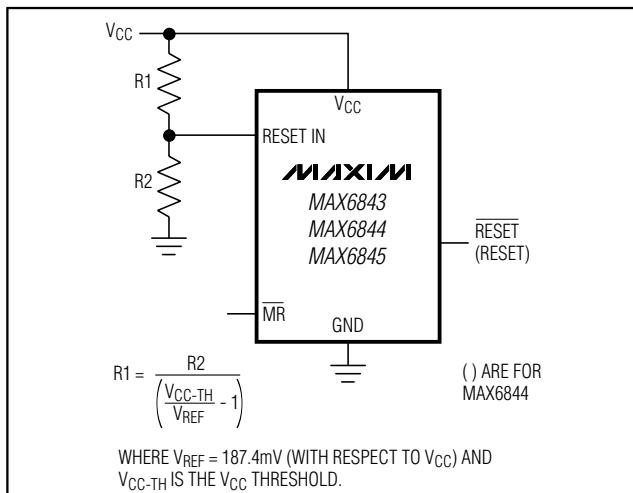


Figure 1. Setting the Adjustable Threshold Externally

## Ultra-Low-Voltage $\mu$ P Reset Circuits and Voltage Detectors

RESET IN decreases. The MAX6843/MAX6844/MAX6845 assert a reset when the voltage at RESET IN falls below the RESET IN threshold ( $V_{RSTIN}$ ). The low-leakage current at RESET IN allows for relatively large-value resistors to be used, which reduces power consumption. For example, for  $V_{CC-TH} = 0.9V$ , if  $R2 = 100k\Omega$ , then  $R1 = 26.3k\Omega$ .

### Applications Information

#### VCC Falling Transients

The MAX6841–MAX6845 are relatively immune to short-duration falling  $V_{CC}$  transients (glitches). Figure 2 shows typical transient duration vs. reset comparator overdrive, for which the MAX6841–MAX6845 do not generate a reset pulse. The graph was generated using a falling pulse applied to  $V_{CC}$ , starting 0.1V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width that a falling  $V_{CC}$  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. A 0.1 $\mu$ F bypass capacitor mounted as close as possible to the  $V_{CC}$  pin provides additional transient immunity.

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

When  $V_{CC}$  falls below 0.55V, the MAX6841/MAX6843 push-pull RESET output no longer sinks current; it becomes an open circuit. Therefore, high-impedance CMOS-logic inputs connected to RESET can drift to undetermined voltages. This presents no problem in

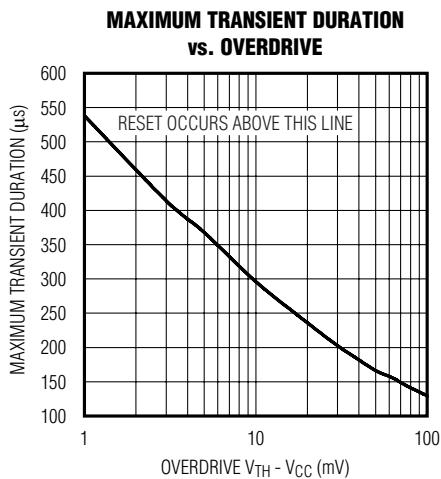


Figure 2. Maximum Transient Duration vs. Overdrive

most applications, because most  $\mu$ P and other circuitry are inoperative with  $V_{CC}$  lower than 0.55V. However, in applications in which RESET must be valid down to 0, adding a pulldown resistor to RESET causes any stray leakage currents to flow to ground, holding RESET low (Figure 3).  $R3$ 's value is not critical; 200 $k\Omega$  is large enough not to load RESET and small enough to pull RESET to ground.

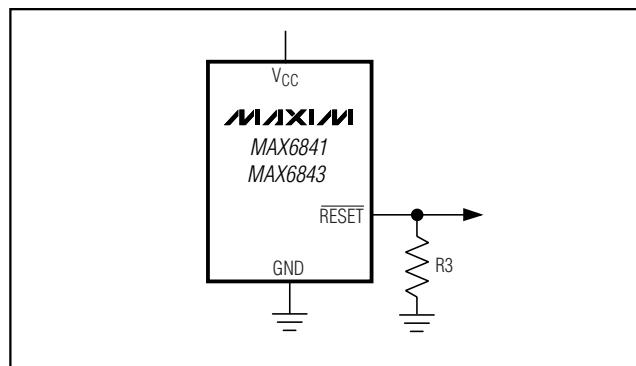


Figure 3. RESET Valid to  $V_{CC} = 0$

A 200 $k\Omega$  pullup resistor to  $V_{CC}$  is also recommended for the MAX6841/MAX6842/MAX6844 if push-pull RESET is required to remain valid for  $V_{CC} \leq 0.75V$ .

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

Because the RESET output on the MAX6842/MAX6845 is open drain, these devices interface easily with  $\mu$ Ps that have bidirectional reset pins. Connecting the  $\mu$ P supervisor's RESET output directly to the  $\mu$ P's RESET pin with a single pullup resistor allows either device to assert reset (Figure 4).

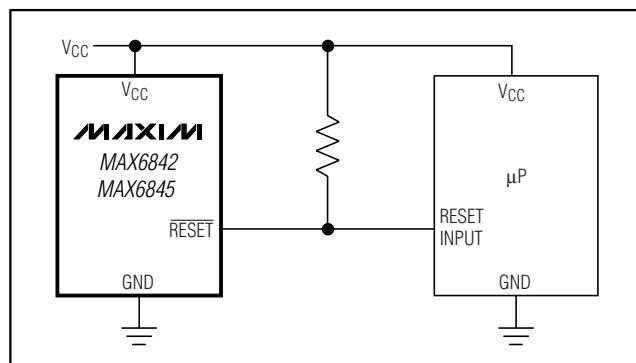


Figure 4. Interfacing to Microprocessors with Bidirectional Reset I/O

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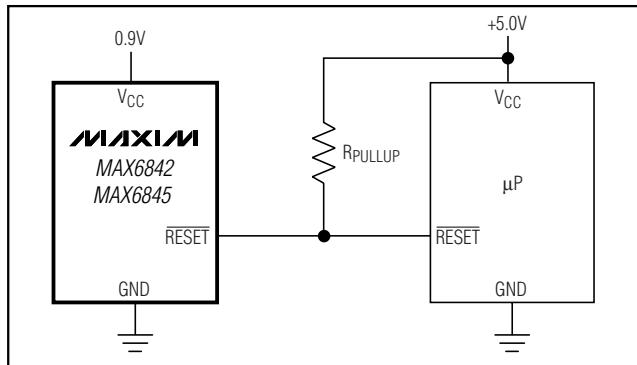


Figure 5. Using the MAX6842/MAX6845 Open-Drain  $\overline{\text{RESET}}$  Output with Multiple Supplies

## Using the MAX6842/MAX6845 Open-Drain $\overline{\text{RESET}}$ Output with Multiple Supplies

Generally, the pullup connected to the MAX6842/MAX6845 connects to the supply voltage being monitored at the IC's V<sub>CC</sub> pin. However, some systems use the open-drain output to level-shift from the monitored supply to reset circuitry powered by some other supply (Figure 5). Note that as the MAX6842/MAX6845's V<sub>CC</sub> decreases, so does the IC's ability to sink current at  $\overline{\text{RESET}}$ . Also, with any pullup,  $\overline{\text{RESET}}$  is pulled high as V<sub>CC</sub> decays toward 0. The voltage where this occurs depends on the pullup resistor value and the voltage to which it is connected.

## Chip Information

TRANSISTOR COUNT: 788

PROCESS: BiCMOS

Table 1. Threshold Suffix Guide

SUFFIX	RESET THRESHOLD (V)
I	1.388
H	1.313
G	1.110
F	1.050
E	0.833
D	0.788

Table 2. Active Timeout Period Guide

SUFFIX	RESET ACTIVE TIMEOUT PERIOD (ms)		
	MIN	TYP	MAX
D0	—	0.15	—
D1	1	1.5	2
D2	20	30	40
D3	140	210	280
D4	1120	1680	2240

Table 3. Standard Versions

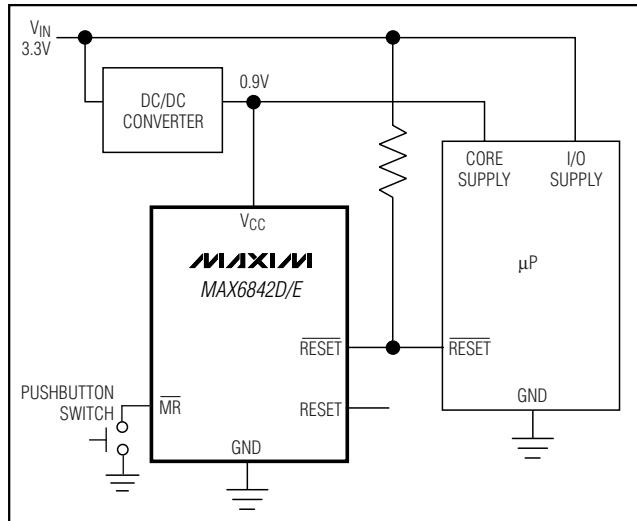
DEVICE	TOP MARK
MAX6841HUKD0	AEDR
MAX6841HUKD3	AEDS
MAX6841FUKD0	AEDP
MAX6841FUKD3	AEDQ
MAX6841DUKD0	AEDN
MAX6841DUKD3	AEDO
MAX6842HUKD0	AEDX
MAX6842HUKD3	AEDY
MAX6842FUKD0	AEDV
MAX6842FUKD3	AEDW
MAX6842DUKD0	AEDT
MAX6842DUKD3	AEDU
MAX6843UKD0	AEDZ
MAX6843UKD3	AEAV
MAX6844UKD0	AEEB
MAX6844UKD3	AEEC
MAX6845UKD0	AEAX
MAX6845UKD3	AEAY

## Ultra-Low-Voltage $\mu$ P Reset Circuits and Voltage Detectors

### Selector Guide

PART	MANUAL RESET	ADJUSTABLE RESET INPUT	PUSH-PULL RESET	PUSH-PULL RESET	OPEN-DRAIN RESET
MAX6841	✓	—	✓	✓	—
MAX6842	✓	—	—	✓	✓
MAX6843	✓	✓	✓	—	—
MAX6844	✓	✓	—	✓	—
MAX6845	✓	✓	—	—	✓

### Typical Operating Circuit

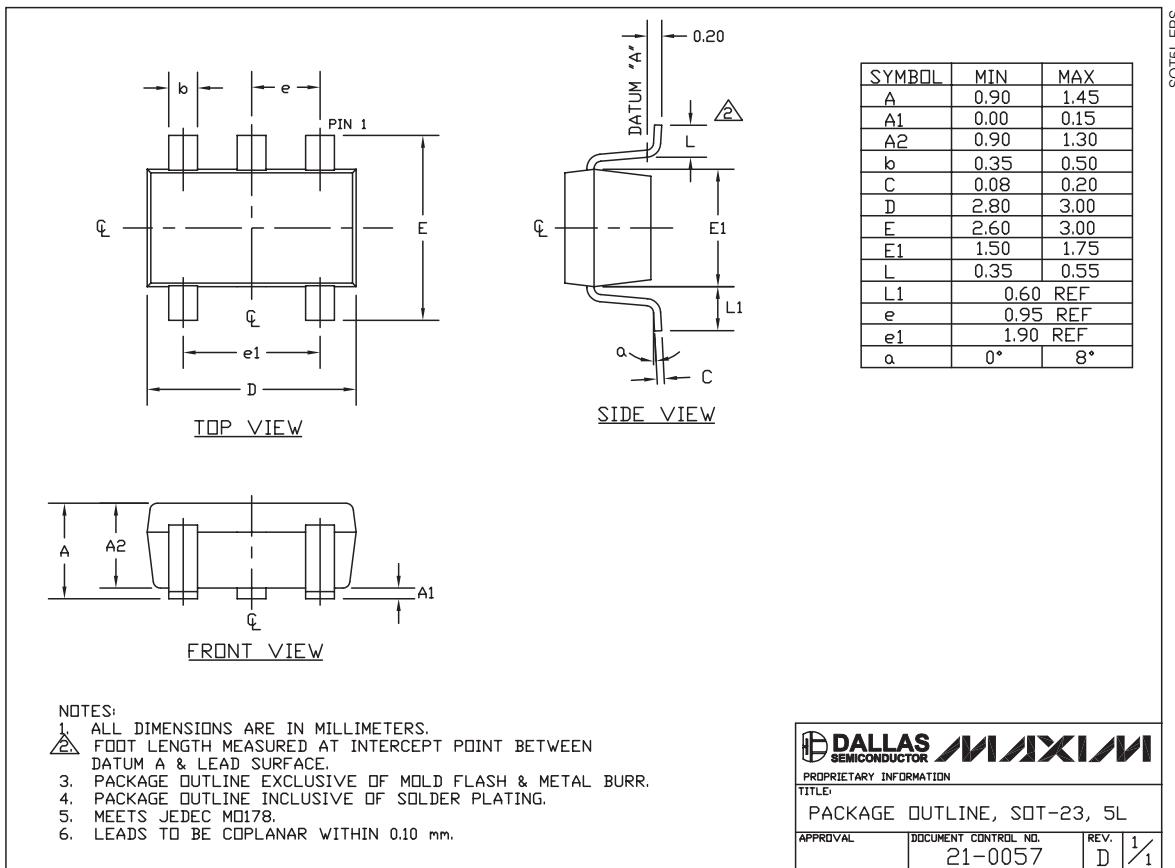


# Ultra-Low-Voltage µP Reset Circuits and Voltage Detectors

## 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).)

**MAX6841-MAX6845**



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