



## 68HC11/Bidirectional-Compatible μP Reset Circuit

**MAX6314\***

### General Description

The MAX6314 low-power CMOS microprocessor (μP) supervisory circuit is designed to monitor power supplies in μP and digital systems. The MAX6314's RESET output is bidirectional, allowing it to be directly connected to μPs with bidirectional reset inputs, such as the 68HC11. It provides excellent circuit reliability and low cost by eliminating external components and adjustments. The MAX6314 also provides a debounced manual reset input.

This device performs a single function: it asserts a reset signal whenever the VCC supply voltage falls below a preset threshold or whenever manual reset is asserted. Reset remains asserted for an internally programmed interval (reset timeout period) after VCC has risen above the reset threshold or manual reset is deasserted.

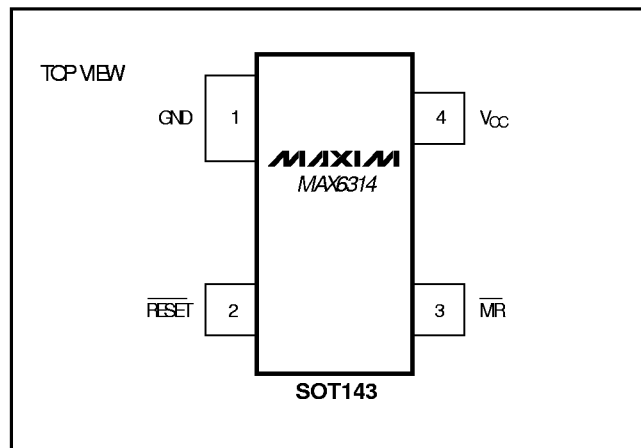
The MAX6314 comes with factory-trimmed reset threshold voltages in 100mV increments from 2.5V to 5V. Preset timeout periods of 1ms, 20ms, 140ms, and 1120ms (minimum) are also available. The device comes in a SOT143 package.

For a μP supervisor with an open-drain reset pin, see the MAX6315 data sheet.

### Applications

Computers  
Controllers  
Intelligent Instruments  
Critical μP and μC Power Monitoring  
Portable/Battery-Powered Equipment

### Pin Configuration



\* Patents Pending

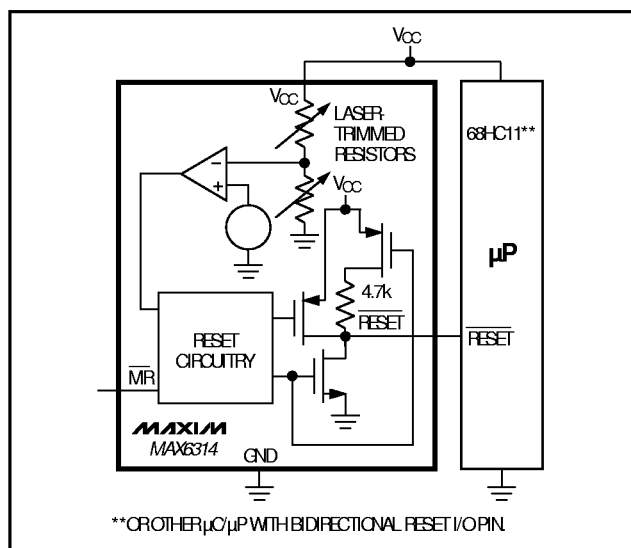


### Features

- ♦ Small SOT143 Package
- ♦ RESET Output Simplifies Interface to Bidirectional Reset I/Os
- ♦ Precision Factory-Set VCC Reset Thresholds: 100mV Increments from 2.5V to 5V
- ♦ ±1.8% Reset Threshold Accuracy at T<sub>A</sub> = +25°C
- ♦ ±2.5% Reset Threshold Accuracy Over Temp.
- ♦ Four Reset Timeout Periods Available: 1ms, 20ms, 140ms, or 1120ms (minimum)
- ♦ Immune to Short VCC Transients
- ♦ 5μA Supply Current
- ♦ Pin-Compatible with MAX811

Ordering and Marking Information appears at end of data sheet.

### Typical Operating Circuit



\*\*OTHER μC/μP WITH BIDIRECTIONAL RESET I/O PIN.

# 68HC11/Bidirectional-Compatible μP Reset Circuit

## ABSOLUTE MAXIMUM RATINGS

V<sub>CC</sub>.....-0.3V to +6.0V  
 All Other Pins.....-0.3V to (V<sub>CC</sub> + 0.3V)  
 Input Current (V<sub>CC</sub>).....20mA  
 Output Current (RESET).....20mA  
 Rate of Rise (V<sub>CC</sub>).....100V/μs

Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 SOT143 (derate 4mW/°C above +70°C).....320mW  
 Operating Temperature Range .....-40°C to +85°C  
 Storage Temperature Range.....-65°C to +160°C  
 Lead Temperature (soldering, 10sec).....+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> = +2.5V 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.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Voltage Range	V <sub>CC</sub>	T <sub>A</sub> = 0°C to +70°C		1.0		5.5	V
V <sub>CC</sub> Supply Current	I <sub>CC</sub>	V <sub>CC</sub> = 5.5V, no load			5	12	μA
		V <sub>CC</sub> = 3.6V, no load			4	10	
Reset Threshold (Note 1)	V <sub>TH</sub>	T <sub>A</sub> = +25°C		V <sub>TH</sub> - 1.8%	V <sub>TH</sub>	V <sub>TH</sub> + 1.8%	V
		T <sub>A</sub> = -40°C to +85°C		V <sub>TH</sub> - 2.5%		V <sub>TH</sub> + 2.5%	
Reset Threshold Tempco	ΔV <sub>TH</sub> /°C				60		ppm/°C
V <sub>CC</sub> to Reset Delay		V <sub>CC</sub> = falling at 1mV/μs			35		μs
Reset Timeout Period	t <sub>RP</sub>	MAX6314US_ _D1-T		1	1.4	2	ms
		MAX6314US_ _D2-T		20	28	40	
		MAX6314US_ _D3-T		140	200	280	
		MAX6314US_ _D4-T		1120	1570	2240	
MANUAL RESET INPUT							
$\overline{\text{MR}}$ Input Threshold	V <sub>IL</sub>	V <sub>TH</sub> > 4.0V		0.8		V	
	V <sub>IH</sub>			2.4			
	V <sub>IL</sub>	V <sub>TH</sub> < 4.0V		0.3 × V <sub>CC</sub>			
	V <sub>IH</sub>			0.7 × V <sub>CC</sub>			
$\overline{\text{MR}}$ Minimum Input Pulse				1		μs	
$\overline{\text{MR}}$ Glitch Rejection				100		ns	
$\overline{\text{MR}}$ to Reset Delay				500		ns	
$\overline{\text{MR}}$ Pull-Up Resistance				32	63	100	kΩ
$\overline{\text{RESET}}$ Output Voltage	V <sub>OL</sub>	V <sub>CC</sub> > 4.25V, I <sub>SINK</sub> = 3.2mA		0.4		V	
		V <sub>CC</sub> > 2.5V, I <sub>SINK</sub> = 1.2mA		0.3			
		V <sub>CC</sub> > 1.2V, I <sub>SINK</sub> = 0.5mA		0.3			
		V <sub>CC</sub> > 1.0V, I <sub>SINK</sub> = 80μA		0.3			
$\overline{\text{RESET}}$ INTERNAL PULL-UP							
Transition Flip-Flop Setup Time (Note 2)	t <sub>S</sub>			400		ns	
Active Pull-Up Enable Threshold		V <sub>CC</sub> = 5V		0.4		0.9	V
$\overline{\text{RESET}}$ Active Pull-Up Current		V <sub>CC</sub> = 5V		20		mA	
$\overline{\text{RESET}}$ Pull-Up Resistance				4.2	4.7	5.2	kΩ
$\overline{\text{RESET}}$ Output Rise Time (Note 3)	t <sub>R</sub>	V <sub>CC</sub> = 3V	C <sub>LOAD</sub> = 120pF	333		ns	
			C <sub>LOAD</sub> = 250pF	666			
		V <sub>CC</sub> = 5V	C <sub>LOAD</sub> = 200pF	333			
			C <sub>LOAD</sub> = 400pF	666			

**Note 1:** The MAX6314 monitors V<sub>CC</sub> through an internal, factory-trimmed voltage divider that programs the nominal reset threshold. Factory-trimmed reset thresholds are available in 100mV increments from 2.5V to 5V (see *Ordering and Marking Information*).

**Note 2:** This is the minimum time RESET must be held low by an external pull-down source to set the active pull-up flip-flop.

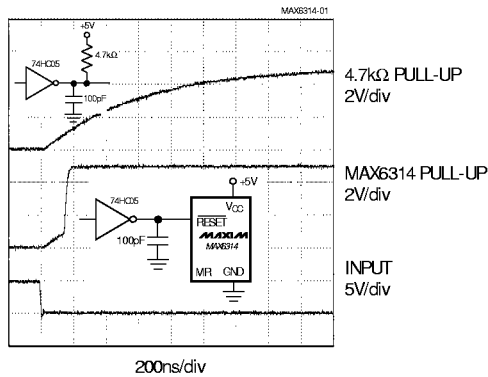
**Note 3:** Measured from RESET V<sub>OL</sub> to (0.8 x V<sub>CC</sub>), R<sub>LOAD</sub> = ∞.

# 68HC11/Bidirectional-Compatible μP Reset Circuit

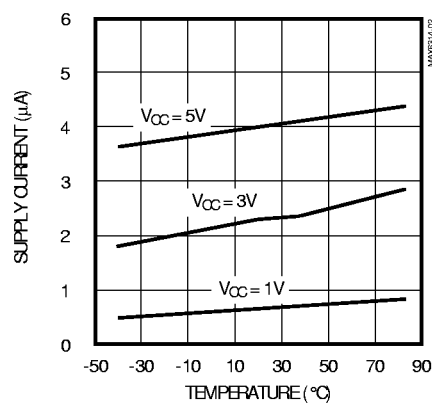
## Typical Operating Characteristics

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

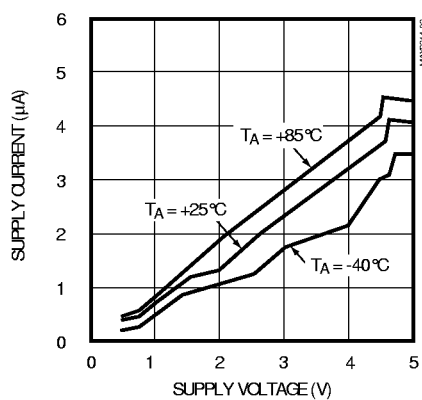
PULL-UP CHARACTERISTICS



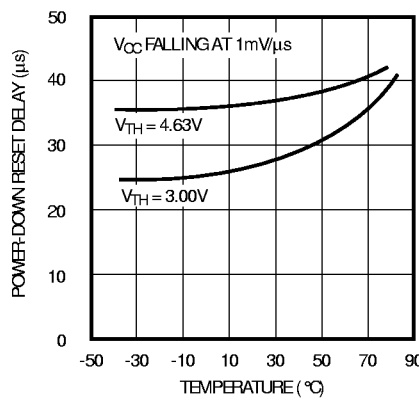
SUPPLY CURRENT vs. TEMPERATURE



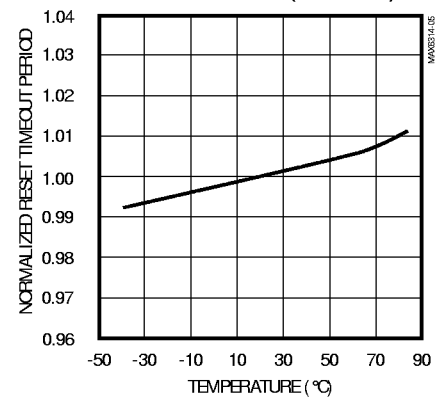
SUPPLY CURRENT  
vs. SUPPLY VOLTAGE



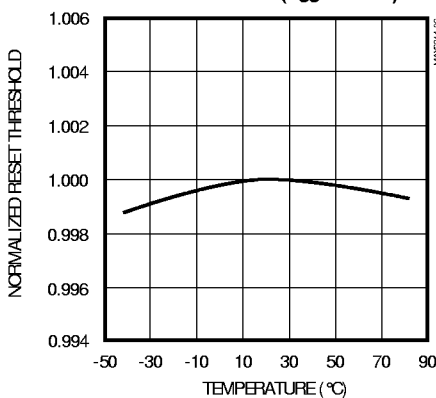
POWER-DOWN RESET DELAY  
vs. TEMPERATURE



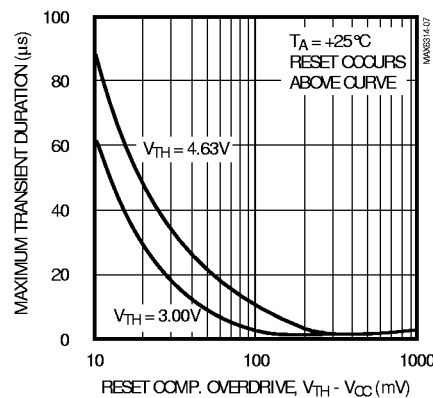
NORMALIZED RESET TIMEOUT PERIOD  
vs. TEMPERATURE ( $V_{CC}$  RISING)



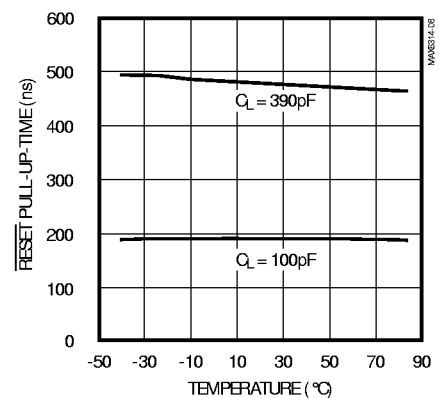
NORMALIZED RESET THRESHOLD  
vs. TEMPERATURE ( $V_{CC}$  FALLING)



MAXIMUM TRANSIENT DURATION  
vs. RESET COMP. OVERDRIVE



RESET PULL-UP TIME  
vs. TEMPERATURE



# 68HC11/Bidirectional-Compatible μP Reset Circuit

## Pin Description

PIN	NAME	FUNCTION
1	GND	Ground
2	$\overline{\text{RESET}}$	Active-Low Complementary Output. In addition to the normal N-channel pull-down, $\overline{\text{RESET}}$ has a P-channel pull-up transistor in parallel with a 4.7kΩ resistor to facilitate connection to μPs with bidirectional resets. See the <i>Reset Output</i> section.
3	$\overline{\text{MR}}$	Manual Reset Input. A logic low on $\overline{\text{MR}}$ asserts reset. Reset remains asserted as long as $\overline{\text{MR}}$ is low, and for the reset timeout period ( $t_{RP}$ ) after the reset conditions are terminated. Connect to $V_{CC}$ if not used.
4	$V_{CC}$	Supply Voltage and Reset Threshold Monitor Input

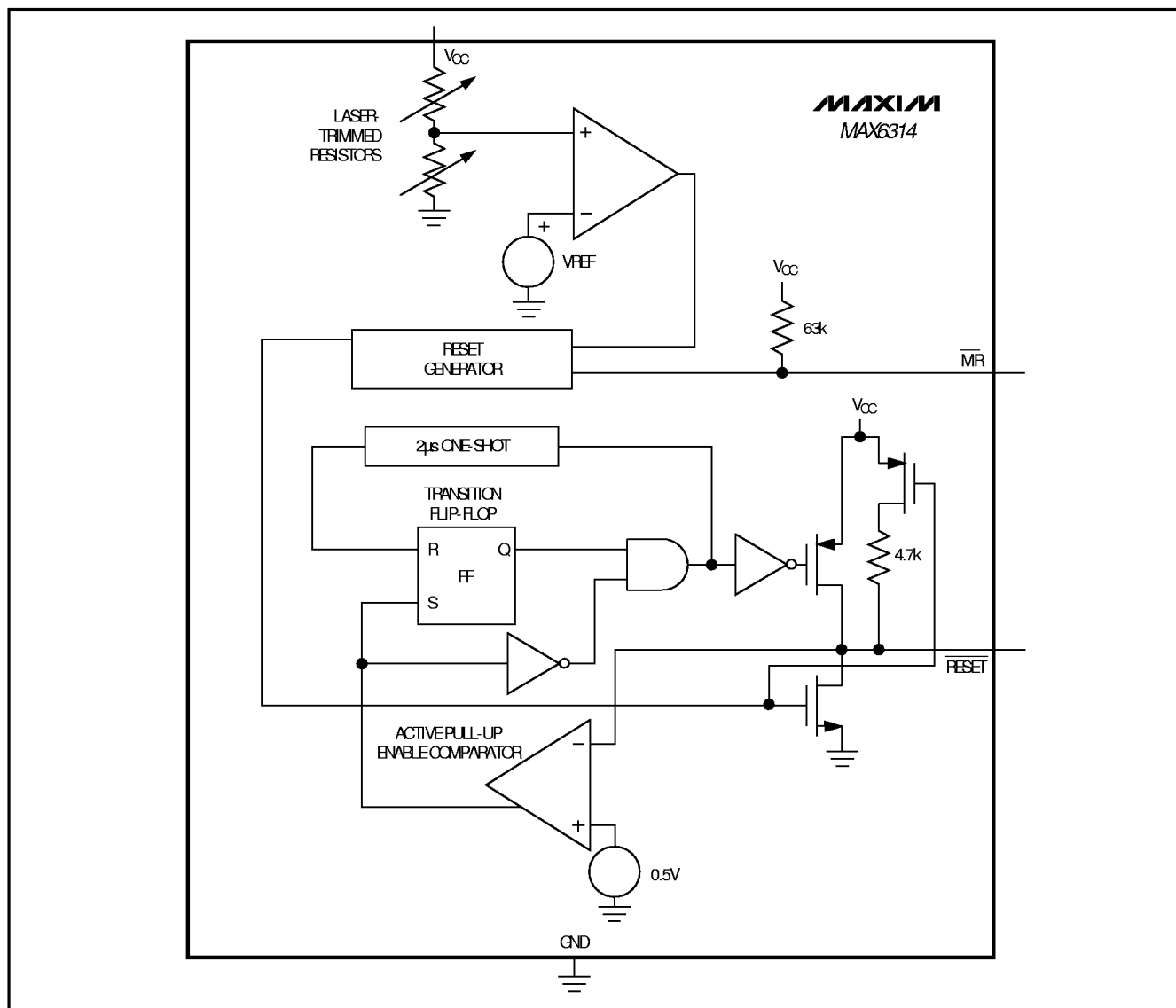


Figure 1. Functional Diagram

# 68HC11/Bidirectional-Compatible μP Reset Circuit

MAX6314

## Detailed Description

The MAX6314 has a reset output consisting of a 4.7kΩ pull-up resistor in parallel with a P-channel transistor and an N-channel pull down (Figure 1), allowing this IC to directly interface with microprocessors (μPs) that have bidirectional reset pins (see the *Reset Output* section).

### Reset Output

A μP's reset input starts the μP in a known state. The MAX6314 asserts reset to prevent code-execution errors during power-up, power-down, or brownout conditions. RESET is guaranteed to be a logic low for  $V_{CC} > 1V$  (see the *Electrical Characteristics*). Once  $V_{CC}$  exceeds the reset threshold, the internal timer keeps reset asserted for the reset timeout period (trp); after this interval RESET goes high. If a brownout condition occurs (monitored voltage dips below its programmed reset threshold), RESET goes low. Any time  $V_{CC}$  dips below the reset threshold, the internal timer resets to zero and RESET goes low. The internal timer starts when  $V_{CC}$  returns above the reset threshold, and RESET remains low for the reset timeout period.

The MAX6314's RESET output is designed to interface with μPs that have bidirectional reset pins, such as the Motorola 68HC11. Like an open-drain output, the MAX6314 allows the μP or other devices to pull RESET low and assert a reset condition. However, unlike a standard open-drain output, it includes the commonly specified 4.7kΩ pull-up resistor with a P-channel active pull-up in parallel.

This configuration allows the MAX6314 to solve a problem associated with μPs that have bidirectional reset pins in systems where several devices connect to RESET. These μPs can often determine if a reset was asserted by an external device (i.e., the supervisor IC) or by the μP itself (due to a watchdog fault, clock error, or other source), and then jump to a vector appropriate for the source of the reset. However, if the μP does assert reset, it does not retain the information, but must determine the cause after the reset has occurred.

The following procedure describes how this is done with the Motorola 68HC11. In all cases of reset, the μP pulls RESET low for about four E-clock cycles. It then releases RESET, waits for two E-clock cycles, then checks RESET's state. If RESET is still low, the μP concludes that the source of the reset was external and, when RESET eventually reaches the high state, jumps to the normal reset vector. In this case, stored state information is erased and processing begins from

scratch. If, on the other hand, RESET is high after the two E-clock cycle delay, the processor knows that it caused the reset itself and can jump to a different vector and use stored state information to determine what caused the reset.

The problem occurs with faster μPs; two E-clock cycles is only 500ns at 4MHz. When there are several devices on the reset line, the input capacitance and stray capacitance can prevent RESET from reaching the logic-high state ( $0.8 \times V_{CC}$ ) in the allowed time if only a passive pull-up resistor is used. In this case, all resets will be interpreted as external. The μP is guaranteed to sink only 1.6mA, so the rise time cannot be much reduced by decreasing the recommended 4.7kΩ pull-up resistance.

The MAX6314 solves this problem by including a pull-up transistor in parallel with the recommended 4.7kΩ resistor (Figure 1). The pull-up resistor holds the output high until RESET is forced low by the μP reset I/O, or by the MAX6314 itself. Once RESET goes below 0.5V, a comparator sets the transition edge flip-flop, indicating that the next transition for RESET will be low to high. As soon as RESET is released, the 4.7kΩ resistor pulls RESET up toward  $V_{CC}$ . When RESET rises above 0.5V, the active P-channel pull-up turns on for the 2μs duration of the one-shot. The parallel combination of the 4.7kΩ pull-up and the P-channel transistor on-resistance quickly charges stray capacitance on the reset line, allowing RESET to transition low to high within the required two E-clock period, even with several devices on the reset line (Figure 2). Once the one-shot times out, the P-channel transistor turns off. This process occurs regardless of whether the reset was caused by  $V_{CC}$  dipping below the reset threshold, MR being asserted, or the μP or other device asserting RESET. Because the MAX6314 includes the standard 4.7kΩ pull-up resistor, no external pull-up resistor is required. To minimize current consumption, the internal pull-up resistor is disconnected whenever the MAX6314 asserts RESET.

### Manual Reset Input

Many μP-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. A logic low on MR asserts reset. Reset remains asserted while MR is low, and for the reset active timeout period after MR returns high. To minimize current consumption, the internal 4.7kΩ pull-up resistor on RESET is disconnected whenever RESET is asserted.

# 68HC11/Bidirectional-Compatible μP Reset Circuit

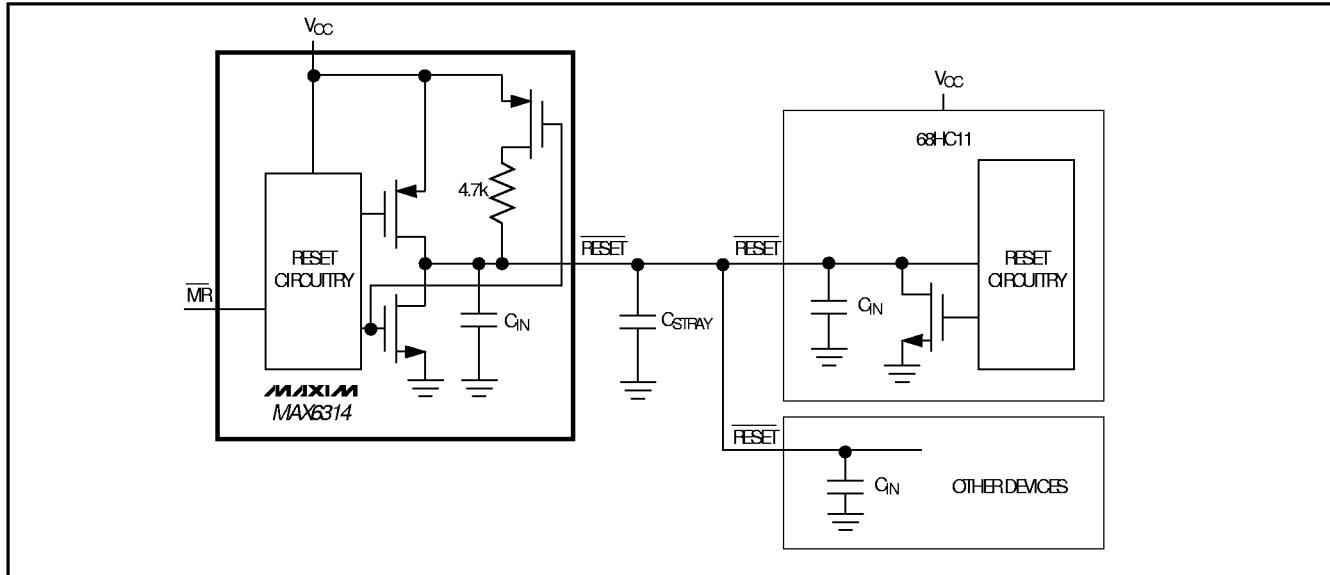


Figure 2. MAX6314 Supports Additional Devices on the Reset Bus

$\overline{\text{MR}}$  has an internal 63kΩ pull-up resistor, so it can be left open if not used. Connect a normally open momentary switch from  $\overline{\text{MR}}$  to GND to create a manual reset function; external debounce circuitry is not required. If  $\overline{\text{MR}}$  is driven from long cables or if the device is used in a noisy environment, connecting a 0.1μF capacitor from  $\overline{\text{MR}}$  to ground provides additional noise immunity.

## Applications Information

### Negative-Going VCC Transients

In addition to issuing a reset to the μP during power-up, power-down, and brownout conditions, these devices are relatively immune to short-duration negative-going transients (glitches). The Typical Operating Characteristics show the Maximum Transient Duration vs. Reset Threshold Overdrive, for which reset pulses are not generated. The graph was produced using negative-going pulses, starting at  $V_{\text{RST max}}$  and ending below the programmed reset threshold by the magnitude indicated (reset threshold overdrive). The graph shows the maximum pulse width that a negative-going VCC transient may typically have without causing a reset pulse to be issued. As the amplitude of the transient increases (i.e., goes farther below the reset threshold), the maximum allowable pulse width decreases. A 0.1μF bypass capacitor mounted close to VCC provides additional transient immunity.

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

When VCC falls below 1V,  $\overline{\text{RESET}}$  no longer sinks current—it becomes an open circuit. Therefore, high-impedance CMOS-logic inputs connected to  $\overline{\text{RESET}}$  can drift to undetermined voltages. This presents no problem in most applications, since most μP and other circuitry is inoperative with VCC below 1V. However, in applications where  $\overline{\text{RESET}}$  must be valid down to VCC = 0V, adding a pull-down resistor to  $\overline{\text{RESET}}$  will cause any stray leakage currents to flow to ground, holding  $\overline{\text{RESET}}$  low (Figure 3). R1's value is not critical; 100kΩ is large enough not to load  $\overline{\text{RESET}}$  and small enough to pull  $\overline{\text{RESET}}$  to ground.

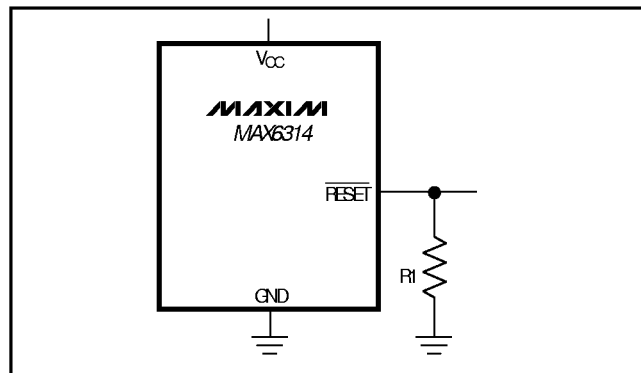


Figure 3.  $\overline{\text{RESET}}$  Valid to VCC = Ground Circuit

**MAX6314**



PART <sup>†</sup>	NOMINAL V <sub>TH</sub> (V)	MIN t <sub>RP</sub> (ms)	PKG. TOP MARK <sup>††</sup>
MAX6314US50D1-T	5.00	1	AA__
MAX6314US49D1-T	4.90	1	AB__
MAX6314US48D1-T	4.80	1	AC__
MAX6314US47D1-T	4.70	1	AD__
MAX6314US46D1-T	4.63	1	AE__
MAX6314US45D1-T	4.50	1	AF__
<b>MAX6314US44D1-T<sup>†††</sup></b>	4.39	1	AG__
MAX6314US43D1-T	4.30	1	AH__
MAX6314US42D1-T	4.20	1	AI__
MAX6314US41D1-T	4.10	1	AJ__
MAX6314US40D1-T	4.00	1	AK__
MAX6314US39D1-T	3.90	1	AL__
MAX6314US38D1-T	3.80	1	CA__
MAX6314US37D1-T	3.70	1	CB__
MAX6314US36D1-T	3.60	1	CC__
MAX6314US35D1-T	3.50	1	CD__
MAX6314US34D1-T	3.40	1	CE__
MAX6314US33D1-T	3.30	1	CF__
MAX6314US32D1-T	3.20	1	CG__
MAX6314US31D1-T	3.08	1	CH__
MAX6314US30D1-T	3.00	1	CI__
MAX6314US29D1-T	2.93	1	CJ__

PART <sup>†</sup>	NOMINAL V <sub>TH</sub> (V)	MIN t <sub>RP</sub> (ms)	PKG. TOP MARK <sup>††</sup>
MAX6314US28D1-T	2.80	1	CK__
MAX6314US27D1-T	2.70	1	CL__
<b>MAX6314US26D1-T<sup>†††</sup></b>	2.63	1	CM__
MAX6314US25D1-T	2.50	1	CN__
MAX6314US50D2-T	5.00	20	CO__
MAX6314US49D2-T	4.90	20	CP__
MAX6314US48D2-T	4.80	20	CQ__
MAX6314US47D2-T	4.70	20	CR__
MAX6314US46D2-T	4.63	20	CS__
MAX6314US45D2-T	4.50	20	CT__
<b>MAX6314US44D2-T<sup>†††</sup></b>	4.39	20	CU__
MAX6314US43D2-T	4.30	20	CV__
MAX6314US42D2-T	4.20	20	CW__
MAX6314US41D2-T	4.10	20	CX__
MAX6314US40D2-T	4.00	20	CY__
MAX6314US39D2-T	3.90	20	CZ__
MAX6314US38D2-T	3.80	20	DA__
MAX6314US37D2-T	3.70	20	DB__
MAX6314US36D2-T	3.60	20	DC__
MAX6314US35D2-T	3.50	20	DD__
MAX6314US34D2-T	3.40	20	DE__
MAX6314US33D2-T	3.30	20	DJ__

# 68HC11/Bidirectional-Compatible μP Reset Circuit

## Ordering and Marking Information (continued)

PART <sup>†</sup>	NOMINAL V <sub>TH</sub> (V)	MIN t <sub>RP</sub> (ms)	PKG. TOP MARK <sup>††</sup>
MAX6314US32D2-T	3.20	20	DK__
MAX6314US31D2-T	3.08	20	DL__
MAX6314US30D2-T	3.00	20	DM__
MAX6314US29D2-T	2.93	20	DN__
MAX6314US28D2-T	2.80	20	DO__
MAX6314US27D2-T	2.70	20	DP__
<b>MAX6314US26D2-T<sup>†††</sup></b>	2.63	20	DQ__
MAX6314US25D2-T	2.50	20	DR__
MAX6314US50D3-T	5.00	140	DS__
MAX6314US49D3-T	4.90	140	DT__
MAX6314US48D3-T	4.80	140	DU__
MAX6314US47D3-T	4.70	140	DV__
<b>MAX6314US46D3-T<sup>†††</sup></b>	4.63	140	DW__
MAX6314US45D3-T	4.50	140	DX__
<b>MAX6314US44D3-T<sup>†††</sup></b>	4.39	140	DY__
MAX6314US43D3-T	4.30	140	DZ__
MAX6314US42D3-T	4.20	140	EA__
MAX6314US41D3-T	4.10	140	EB__
MAX6314US40D3-T	4.00	140	EC__
MAX6314US39D3-T	3.90	140	EG__
MAX6314US38D3-T	3.80	140	EH__
MAX6314US37D3-T	3.70	140	EI__
MAX6314US36D3-T	3.60	140	EJ__
MAX6314US35D3-T	3.50	140	EK__
MAX6314US34D3-T	3.40	140	EL__
MAX6314US33D3-T	3.30	140	EM__
MAX6314US32D3-T	3.20	140	EN__
<b>MAX6314US31D3-T<sup>†††</sup></b>	3.08	140	EO__
MAX6314US30D3-T	3.00	140	EP__
<b>MAX6314US29D3-T<sup>†††</sup></b>	2.93	140	ES__

PART <sup>†</sup>	NOMINAL V <sub>TH</sub> (V)	MIN t <sub>RP</sub> (ms)	PKG. TOP MARK <sup>††</sup>
MAX6314US28D3-T	2.80	140	ET__
MAX6314US27D3-T	2.70	140	EU__
<b>MAX6314US26D3-T<sup>†††</sup></b>	2.63	140	EV__
MAX6314US25D3-T	2.50	140	EW__
MAX6314US50D4-T	5.00	1120	EX__
MAX6314US49D4-T	4.90	1120	EY__
MAX6314US48D4-T	4.80	1120	EZ__
MAX6314US47D4-T	4.70	1120	FA__
MAX6314US46D4-T	4.63	1120	FB__
MAX6314US45D4-T	4.50	1120	FC__
<b>MAX6314US44D4-T<sup>†††</sup></b>	4.39	1120	FD__
MAX6314US43D4-T	4.30	1120	FE__
MAX6314US42D4-T	4.20	1120	FF__
MAX6314US41D4-T	4.10	1120	FG__
MAX6314US40D4-T	4.00	1120	FH__
MAX6314US39D4-T	3.90	1120	FI__
MAX6314US38D4-T	3.80	1120	FJ__
MAX6314US37D4-T	3.70	1120	FK__
MAX6314US36D4-T	3.60	1120	FL__
MAX6314US35D4-T	3.50	1120	FM__
MAX6314US34D4-T	3.40	1120	FN__
MAX6314US33D4-T	3.30	1120	FO__
MAX6314US32D4-T	3.20	1120	FP__
MAX6314US31D4-T	3.08	1120	FQ__
MAX6314US30D4-T	3.00	1120	FR__
MAX6314US29D4-T	2.93	1120	FS__
MAX6314US28D4-T	2.80	1120	FT__
MAX6314US27D4-T	2.70	1120	FU__
<b>MAX6314US26D4-T<sup>†††</sup></b>	2.63	1120	FV__
MAX6314US25D4-T	2.50	1120	FW__

<sup>†</sup> The MAX6314 is available in a SOT143 package, -40°C to +85°C temperature range.

<sup>††</sup> The first two letters in the package top mark identify the part, while the remaining two letters are the lot tracking code.

<sup>†††</sup> Sample stocks generally held on the bolded products; also, the bolded products have 2,500 piece minimum-order quantities. Non-bolded products have 10,000 piece minimum-order quantities. Contact factory for details.

**Note:** All devices available in tape-and-reel only. Contact factory for availability.

## Chip Information

TRANSISTOR COUNT: 519

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