

**MAXIM**

# 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 V<sub>CC</sub> 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 V<sub>CC</sub> has risen above the reset threshold or manual reset is deasserted.

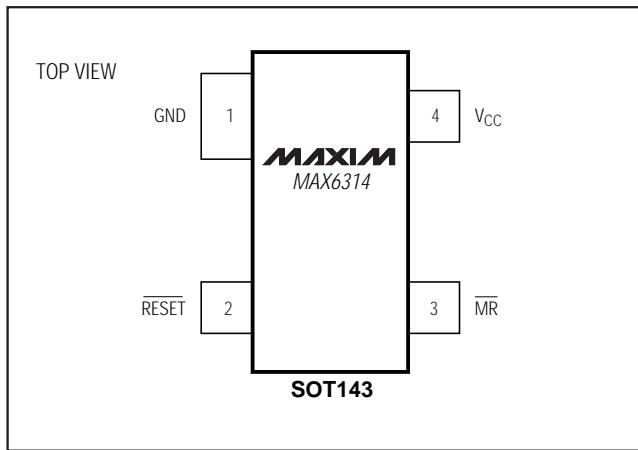
The MAX6314 comes with factory-trimmed reset threshold voltages in 100mV increments from 2.5V to 5V. Preset timeout periods of 1ms, 20ms, 140ms, and 1120ms (minimum) are also available. The device comes in a SOT143 package.

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



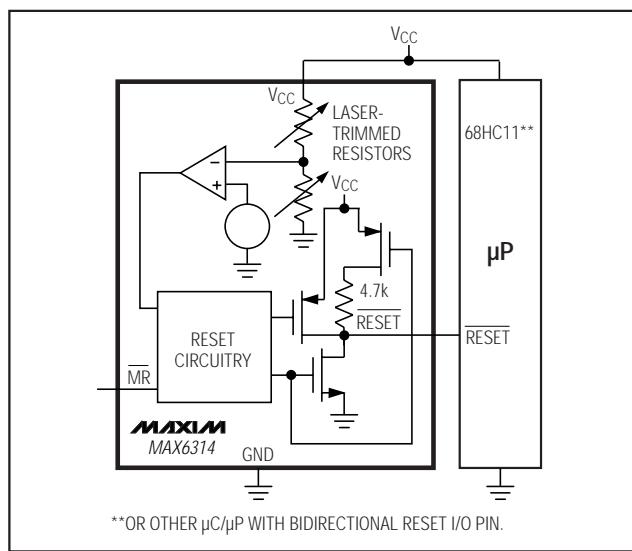
\* Patents Pending

## Features

- ♦ Small SOT143 Package
- ♦ RESET Output Simplifies Interface to Bidirectional Reset I/Os
- ♦ Precision Factory-Set V<sub>CC</sub> 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 V<sub>CC</sub> Transients
- ♦ 5μA Supply Current
- ♦ Pin-Compatible with MAX811

**Ordering and Marking Information appears at end of data sheet.**

## Typical Operating Circuit



# 68HC11/Bidirectional-Compatible μP Reset Circuit

## ABSOLUTE MAXIMUM RATINGS

V <sub>CC</sub> .....	-0.3V to +6.0V	Continuous Power Dissipation (T <sub>A</sub> = +70°C)
All Other Pins.....	-0.3V to (V <sub>CC</sub> + 0.3V)	SOT143 (derate 4mW/°C above +70°C).....320mW
Input Current (V <sub>CC</sub> ).....	20mA	Operating Temperature Range .....-40°C to +85°C
Output Current (RESET).....	20mA	Storage Temperature Range .....-65°C to +160°C
Rate of Rise (V <sub>CC</sub> ).....	100V/μs	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						
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 x V <sub>CC</sub>			
	V <sub>IH</sub>			0.7 x V <sub>CC</sub>		
MR Minimum Input Pulse			1			μs
MR Glitch Rejection				100		ns
MR to Reset Delay				500		ns
MR Pull-Up Resistance			32	63	100	kΩ
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		
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
RESET Active Pull-Up Current		V <sub>CC</sub> = 5V		20		mA
RESET Pull-Up Resistance			4.2	4.7	5.2	kΩ
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 VOL to (0.8 x V<sub>CC</sub>), R<sub>LOAD</sub> = ∞.

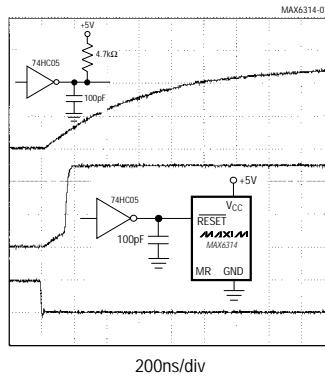
# 68HC11/Bidirectional-Compatible $\mu$ P Reset Circuit

MAX6314

## Typical Operating Characteristics

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

### PULL-UP CHARACTERISTICS

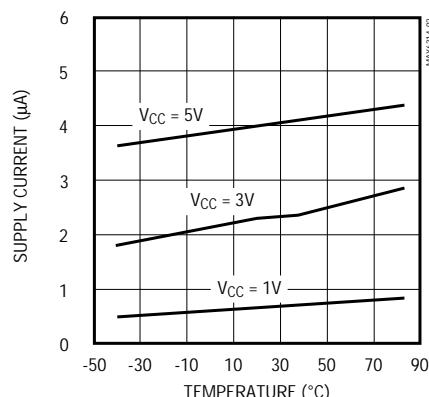


4.7k $\Omega$  PULL-UP  
2V/div

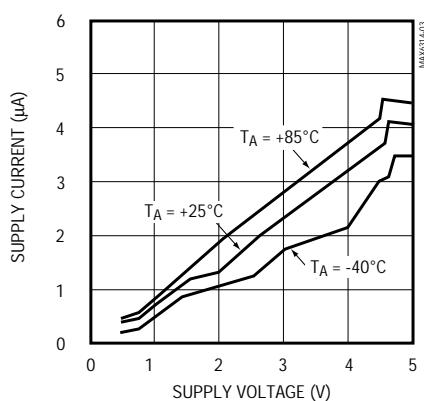
MAX6314 PULL-UP  
2V/div  
INPUT  
5V/div

200ns/div

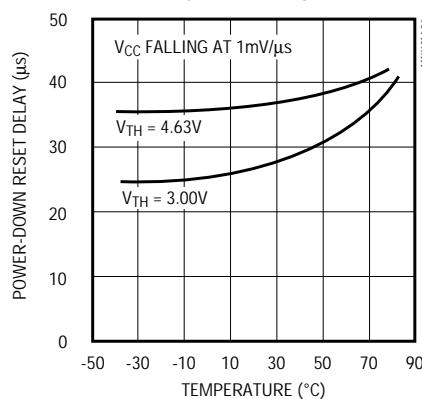
### SUPPLY CURRENT vs. TEMPERATURE



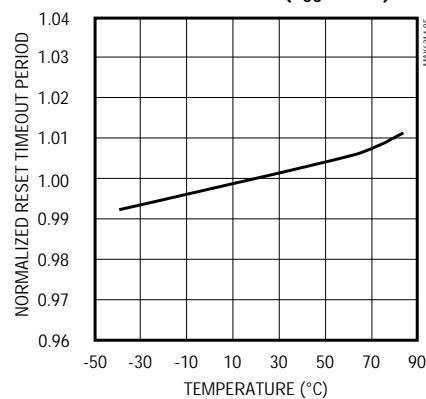
### SUPPLY CURRENT vs. SUPPLY VOLTAGE



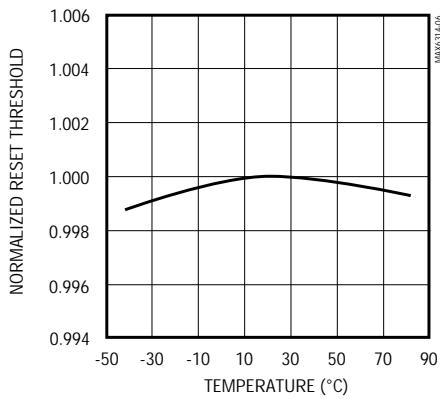
### POWER-DOWN RESET DELAY vs. TEMPERATURE



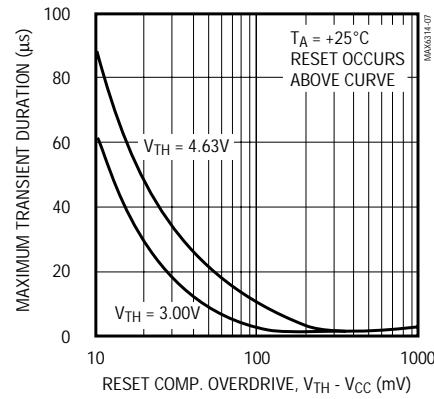
### NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE (V<sub>CC</sub> RISING)



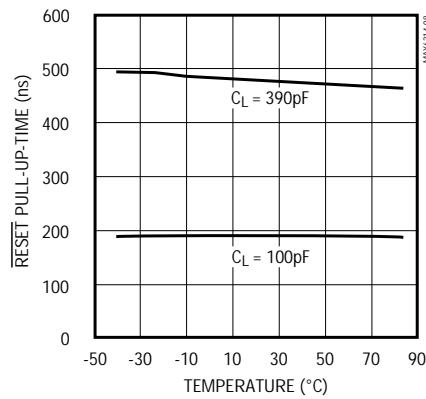
### NORMALIZED RESET THRESHOLD vs. TEMPERATURE (V<sub>CC</sub> FALLING)



### 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	RESET	Active-Low Complementary Output. In addition to the normal N-channel pull-down, <u>RESET</u> has a P-channel pull-up transistor in parallel with a $4.7\text{k}\Omega$ resistor to facilitate connection to μPs with bidirectional resets. See the <i>Reset Output</i> section.
3	MR	Manual Reset Input. A logic low on <u>MR</u> asserts reset. Reset remains asserted as long as <u>MR</u> 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

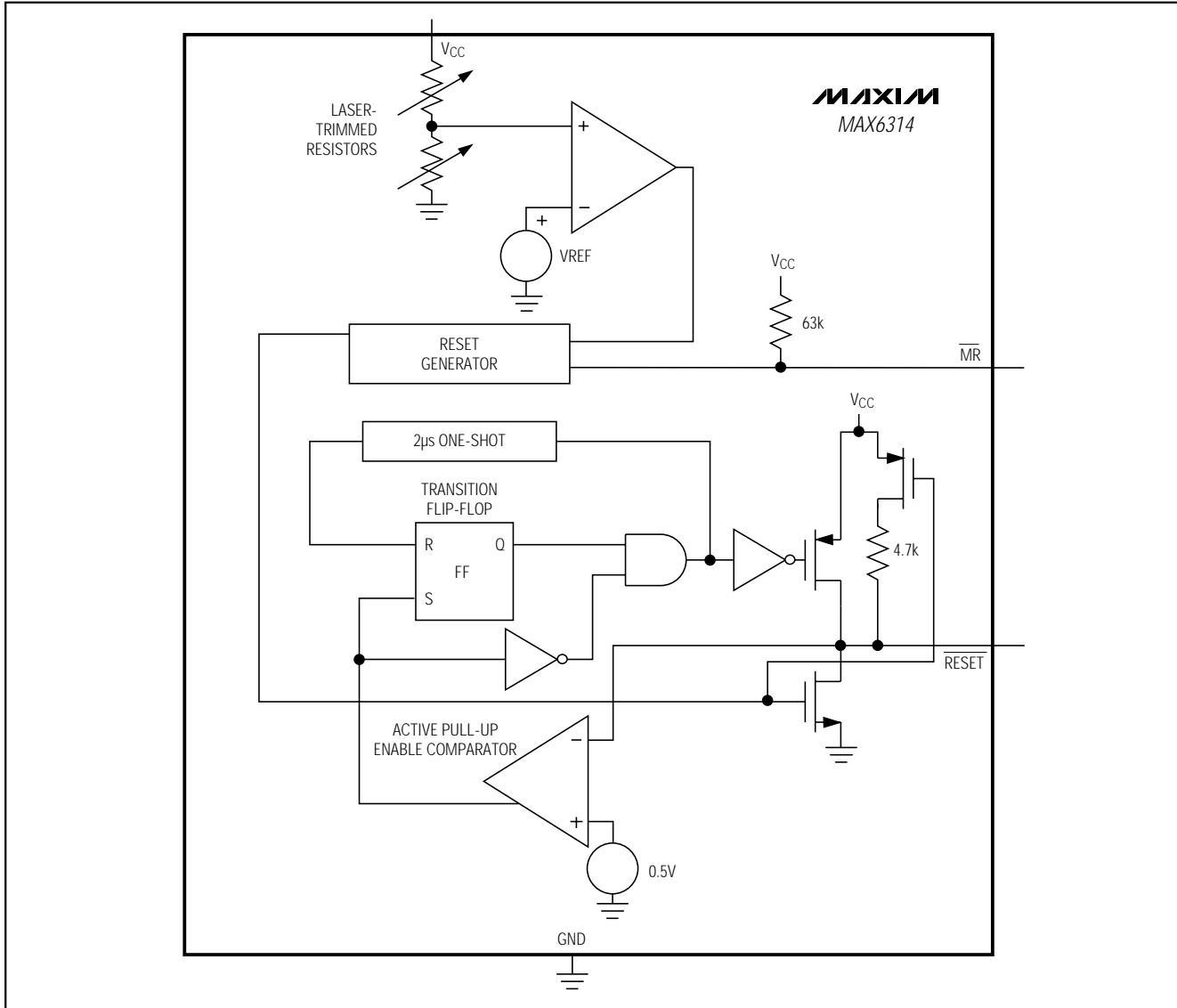


Figure 1. Functional Diagram

# 68HC11/Bidirectional-Compatible μP Reset Circuit

MAX6314

## Detailed Description

The MAX6314 has a reset output consisting of a  $4.7\text{k}\Omega$  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  $V_{CC} > 1\text{V}$  (see the *Electrical Characteristics*). Once  $V_{CC}$  exceeds the reset threshold, the internal timer keeps reset asserted for the reset timeout period ( $t_{RP}$ ); 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  $4.7\text{k}\Omega$  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  $4.7\text{k}\Omega$  pull-up resistance.

The MAX6314 solves this problem by including a pull-up transistor in parallel with the recommended  $4.7\text{k}\Omega$  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  $4.7\text{k}\Omega$  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  $4.7\text{k}\Omega$  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  $4.7\text{k}\Omega$  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  $4.7\text{k}\Omega$  pull-up resistor on RESET is disconnected whenever RESET is asserted.

## 68HC11/Bidirectional-Compatible $\mu$ P Reset Circuit

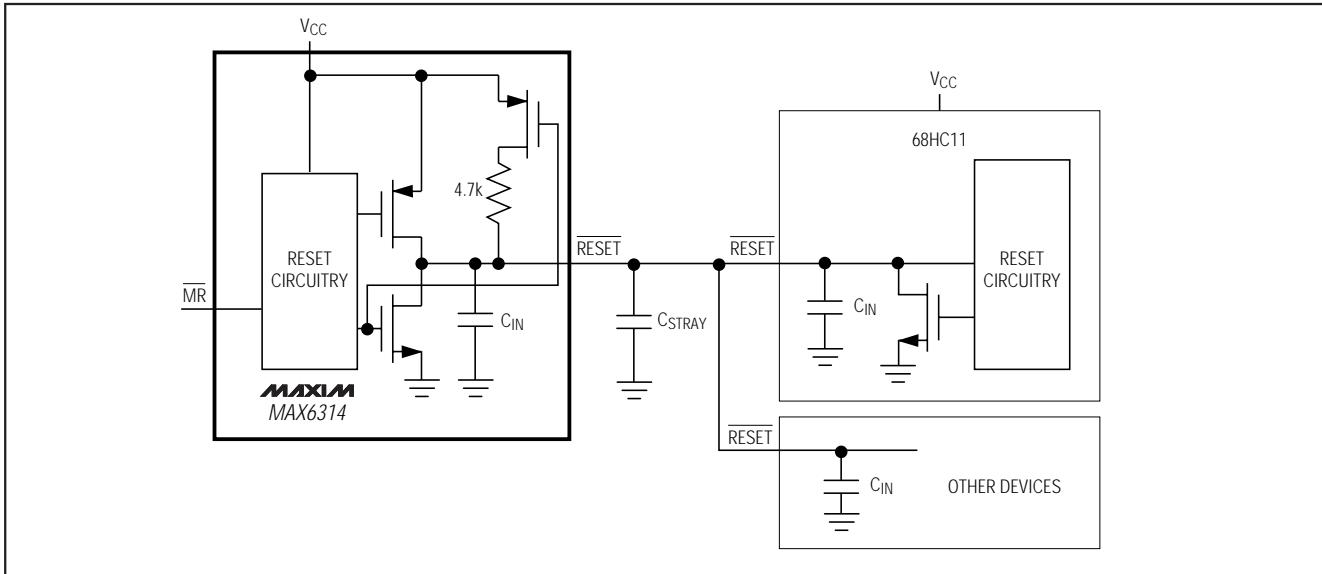


Figure 2. MAX6314 Supports Additional Devices on the Reset Bus

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

### Applications Information

#### Negative-Going VCC Transients

In addition to issuing a reset to the  $\mu$ P 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 VRST 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  $0.1\mu\text{F}$  bypass capacitor mounted close to VCC provides additional transient immunity.

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

When  $V_{\text{CC}}$  falls below  $1\text{V}$ ,  $\overline{\text{RESET}}$  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  $\mu$ P and other circuitry is inoperative with  $V_{\text{CC}}$  below  $1\text{V}$ . However, in applications where  $\overline{\text{RESET}}$  must be valid down to  $V_{\text{CC}} = 0\text{V}$ , 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;  $100\text{k}\Omega$  is large enough not to load  $\overline{\text{RESET}}$  and small enough to pull  $\overline{\text{RESET}}$  to ground.

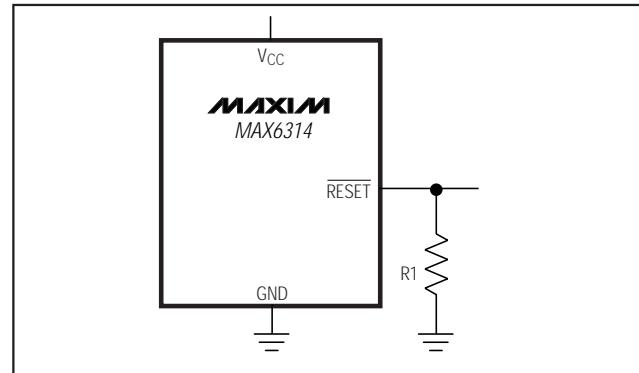


Figure 3.  $\overline{\text{RESET}}$  Valid to  $V_{\text{CC}} = \text{Ground}$  Circuit

# 68HC11/Bidirectional-Compatible μP Reset Circuit

MAX6314

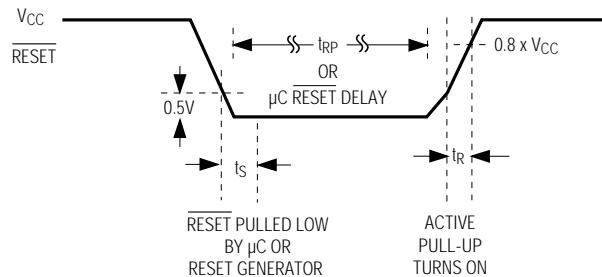


Figure 4. *RESET* Timing Diagram

## Ordering and Marking Information

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_

<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.

# 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_ _

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

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

## Chip Information

TRANSISTOR COUNT: 519

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

**8** Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600