19-1090; Rev 2; 12/05

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_{CC} 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_{CC} 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

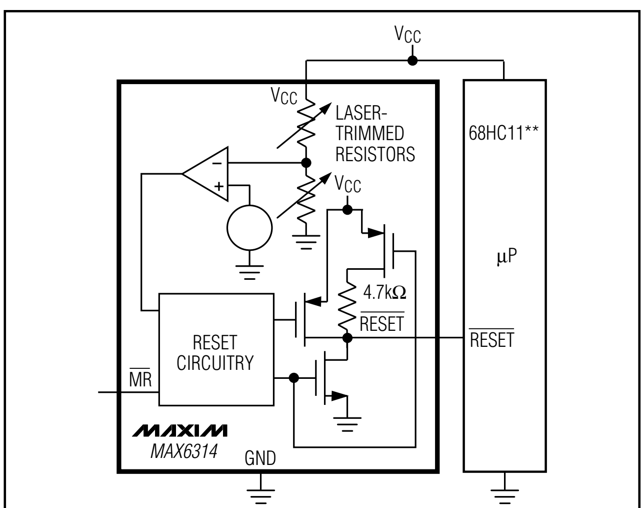
Controllers

Intelligent Instruments

Critical μP and μC Power Monitoring

Portable/Battery-Powered Equipment

Typical Operating Circuit



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

Features

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

Ordering Information

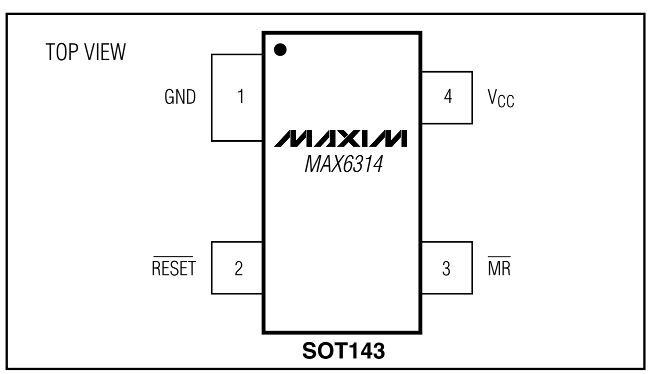
PART†	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)	TOP MARK††
MAX6314US50D1-T	5.00	1	AA_ _
MAX6314US49D1-T	4.90	1	AB_ _
MAX6314US48D1-T	4.80	1	AC_ _
MAX6314US47D1-T	4.70	1	AD_ _
MAX6314US46D1-T	4.63	1	AE_ _
MAX6314US45D1-T	4.50	1	AF_ _

†The MAX6314 is available in a SOT143 package, -40°C to +85°C temperature range.
††The first two letters in the package top mark identify the part, while the remaining two letters are the lot tracking code.

Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

Ordering Information continued at end of data sheet.

Pin Configuration



68HC11/Bidirectional-Compatible µP Reset Circuit

ABSOLUTE MAXIMUM RATINGS

V_{CC} ....-0.3V to +6.0V
All Other Pins...-0.3V to (V_{CC} + 0.3V)
Input Current (V_{CC}) 20mA
Output Current ($\overline{RESET}$)...20mA
Rate of Rise (V_{CC}) 100V/µs
Continuous Power Dissipation (T_A = +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_{CC} = +2.5V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage Range	V_{CC}	T_A = 0°C to +70°C	1.0		5.5	V
V_{CC} Supply Current	I_{CC}	V_{CC} = 5.5V, no load		5	12	µA
		V_{CC} = 3.6V, no load		4	10	
Reset Threshold (Note 1)	V_{TH}	T_A = +25°C	V_{TH} - 1.8%	V_{TH}	V_{TH} + 1.8%	V
		T_A = -40°C to +85°C	V_{TH} - 2.5%		V_{TH} + 2.5%	
Reset Threshold Tempco	ΔV_{TH}/°C			60		ppm/°C
V_{CC} to Reset Delay		V_{CC} = falling at 1mV/µs		35		µs
Reset Timeout Period	t_{RP}	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						
$\overline{MR}$ Input Threshold	V_{IL}	V_{TH} > 4.0V	0.8			V
	V_{IH}				2.4	
	V_{IL}	V_{TH} < 4.0V	0.3 x V_{CC}			
	V_{IH}				0.7 x V_{CC}	
$\overline{MR}$ Minimum Input Pulse			1			µs
$\overline{MR}$ Glitch Rejection				100		ns
$\overline{MR}$ to Reset Delay				500		ns
$\overline{MR}$ Pullup Resistance			32	63	100	kΩ
$\overline{RESET}$ Output Voltage	V_{OL}	V_{CC} > 4.25V, I_{SINK} = 3.2mA			0.4	V
		V_{CC} > 2.5V, I_{SINK} = 1.2mA			0.3	
		V_{CC} > 1.2V, I_{SINK} = 0.5mA			0.3	
		V_{CC} > 1.0V, I_{SINK} = 80µA			0.3	
$\overline{RESET}$ INTERNAL PULLUP						
Transition Flip-Flop Setup Time (Note 2)	t_S			400		ns
Active Pullup Enable Threshold		V_{CC} = 5V	0.4		0.9	V
$\overline{RESET}$ Active Pullup Current		V_{CC} = 5V		20		mA
$\overline{RESET}$ Pullup Resistance			4.2	4.7	5.2	kΩ
$\overline{RESET}$ Output Rise Time (Note 3)	t_R	V_{CC} = 3V, C_{LOAD} = 120pF			333	ns
		V_{CC} = 3V, C_{LOAD} = 250pF			666	
		V_{CC} = 5V, C_{LOAD} = 200pF			333	
		V_{CC} = 5V, C_{LOAD} = 400pF			666	

Note 1: The MAX6314 monitors V_{CC} 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*).

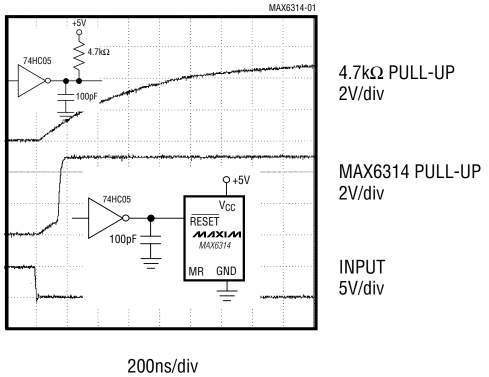
Note 2: This is the minimum time $\overline{RESET}$ must be held low by an external pull-down source to set the active pull-up flip-flop.

Note 3: Measured from $\overline{RESET}$ V_{OL} to (0.8 x V_{CC}), R_{LOAD} = ∞.

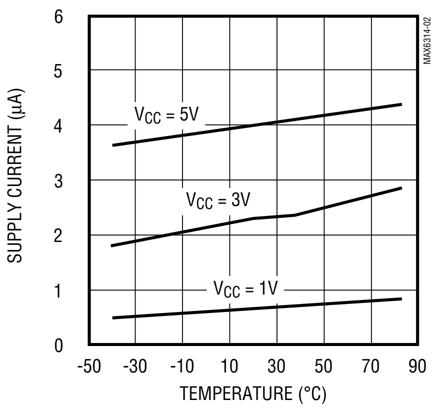
Typical Operating Characteristics

(T_A = +25°C, unless otherwise noted.)

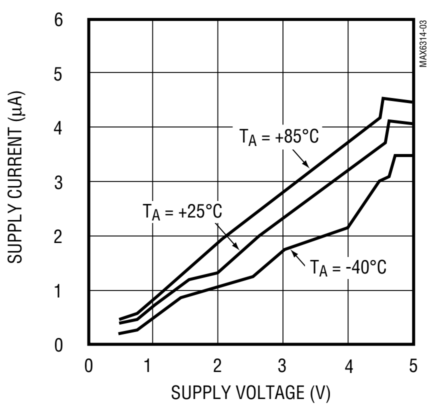
PULLUP CHARACTERISTICS



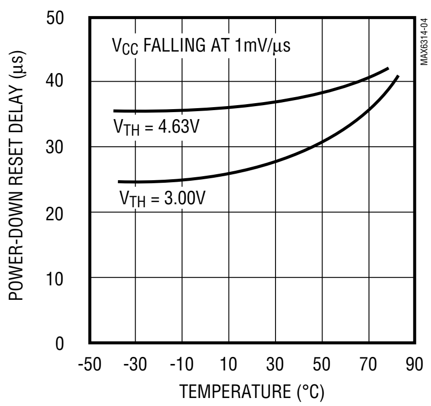
SUPPLY CURRENT vs. TEMPERATURE



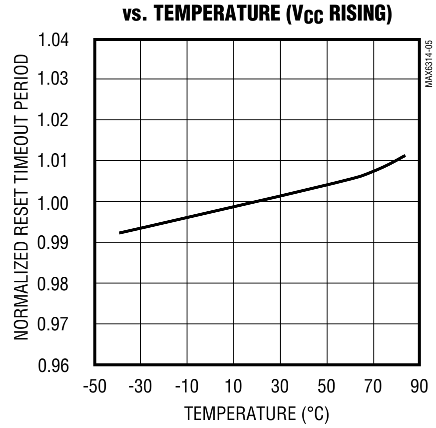
SUPPLY CURRENT vs. SUPPLY VOLTAGE



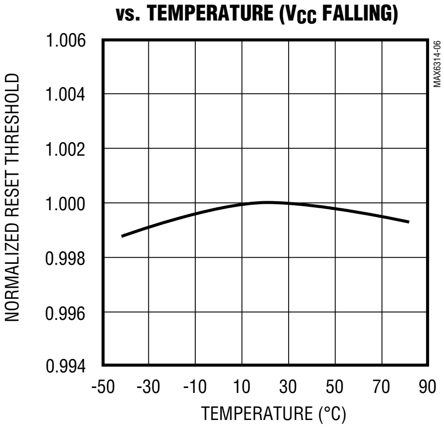
POWER-DOWN RESET DELAY vs. TEMPERATURE



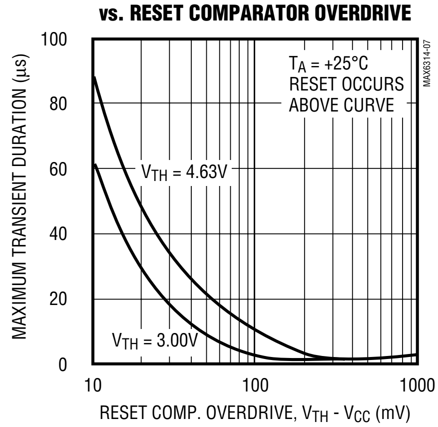
NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE (V_{CC} RISING)



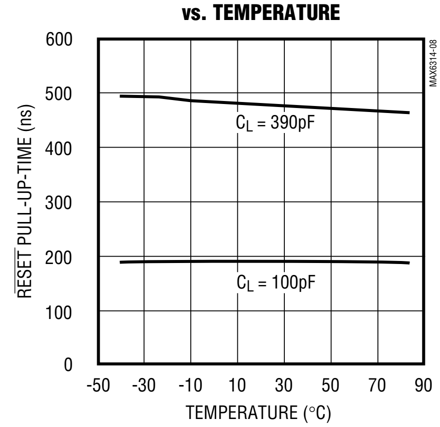
NORMALIZED RESET THRESHOLD vs. TEMPERATURE (V_{CC} FALLING)



MAXIMUM TRANSIENT DURATION vs. RESET COMPARATOR OVERDRIVE



$\overline{\text{RESET}}$ PULLUP TIME vs. TEMPERATURE



68HC11/Bidirectional-Compatible µP Reset Circuit

Pin Description

PIN	NAME	FUNCTION
1	GND	Ground
2	$\overline{RESET}$	Active-Low Complementary Output. In addition to the normal n-channel pulldown, $\overline{RESET}$ has a p-channel pullup transistor in parallel with a 4.7kΩ resistor to facilitate connection to µPs with bidirectional resets. See the *Reset Output* section.
3	$\overline{MR}$	Manual Reset Input. A logic low on $\overline{MR}$ asserts reset. Reset remains asserted as long as $\overline{MR}$ 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

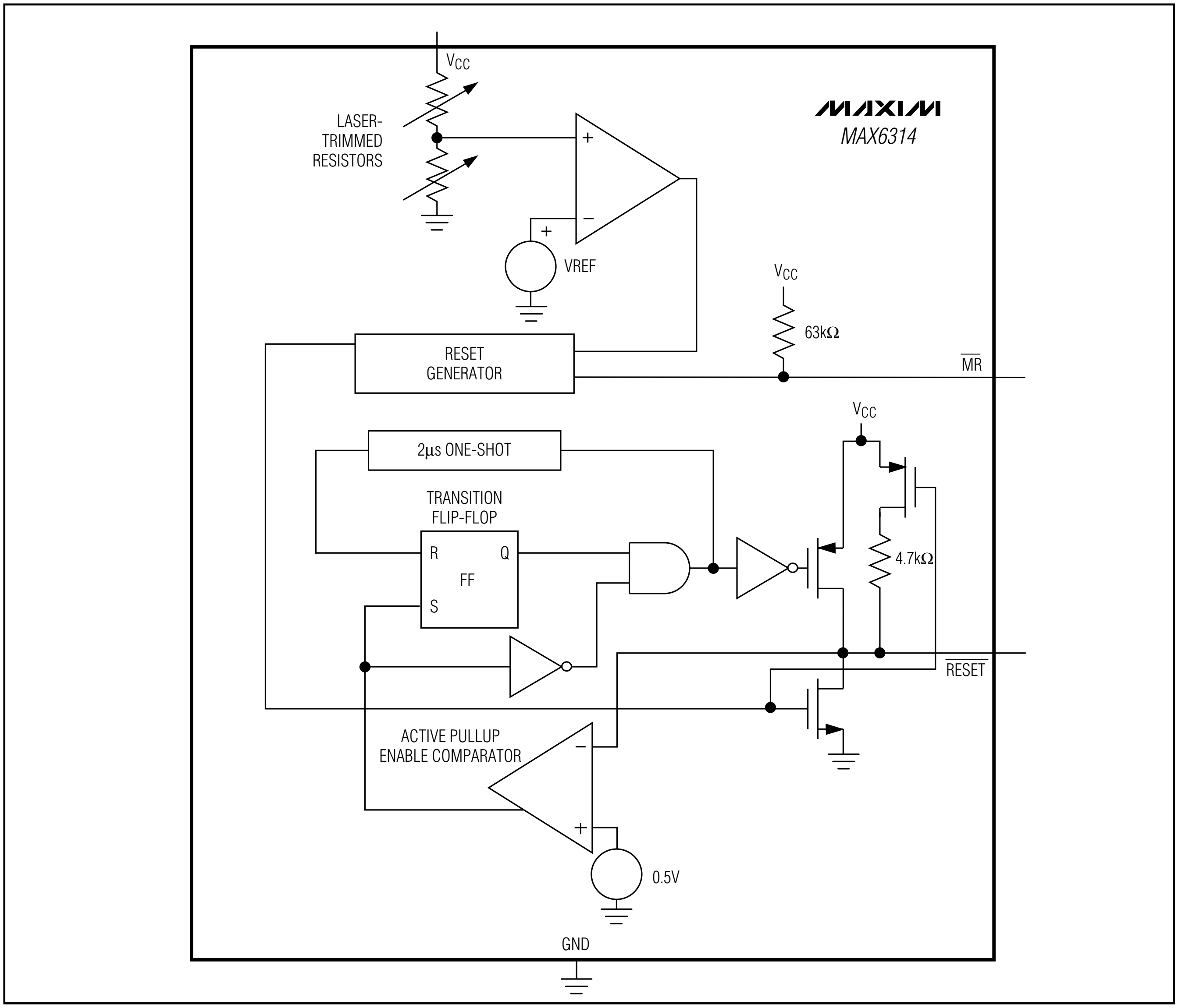


Figure 1. Functional Diagram

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. $\overline{RESET}$ is guaranteed to be a logic low for V_{CC} > 1V (see the *Electrical Characteristics* table). Once V_{CC} exceeds the reset threshold, the internal timer keeps reset asserted for the reset timeout period (t_{RP}); after this interval $\overline{RESET}$ goes high. If a brownout condition occurs (monitored voltage dips below its programmed reset threshold), $\overline{RESET}$ goes low. Any time V_{CC} dips below the reset threshold, the internal timer resets to zero and $\overline{RESET}$ goes low. The internal timer starts when V_{CC} returns above the reset threshold, and $\overline{RESET}$ remains low for the reset timeout period.

The MAX6314's $\overline{RESET}$ 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 $\overline{RESET}$ low and assert a reset condition. However, unlike a standard open-drain output, it includes the commonly specified 4.7kΩ pullup resistor with a P-channel active pullup 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 $\overline{RESET}$. 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 $\overline{RESET}$ low for about four E-clock cycles. It then releases $\overline{RESET}$, waits for two E-clock cycles, then checks $\overline{RESET}$'s state. If $\overline{RESET}$ is still low, the µP concludes that the source of the reset was external and, when $\overline{RESET}$ 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, $\overline{RESET}$ 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 $\overline{RESET}$ from reaching the logic-high state (0.8 x V_{CC}) in the allowed time if only a passive pullup 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 pullup resistance.

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

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 $\overline{MR}$ asserts reset. Reset remains asserted while $\overline{MR}$ is low, and for the reset active timeout period after $\overline{MR}$ returns high. To minimize current consumption, the internal 4.7kΩ pullup resistor on $\overline{RESET}$ is disconnected whenever $\overline{RESET}$ is asserted.

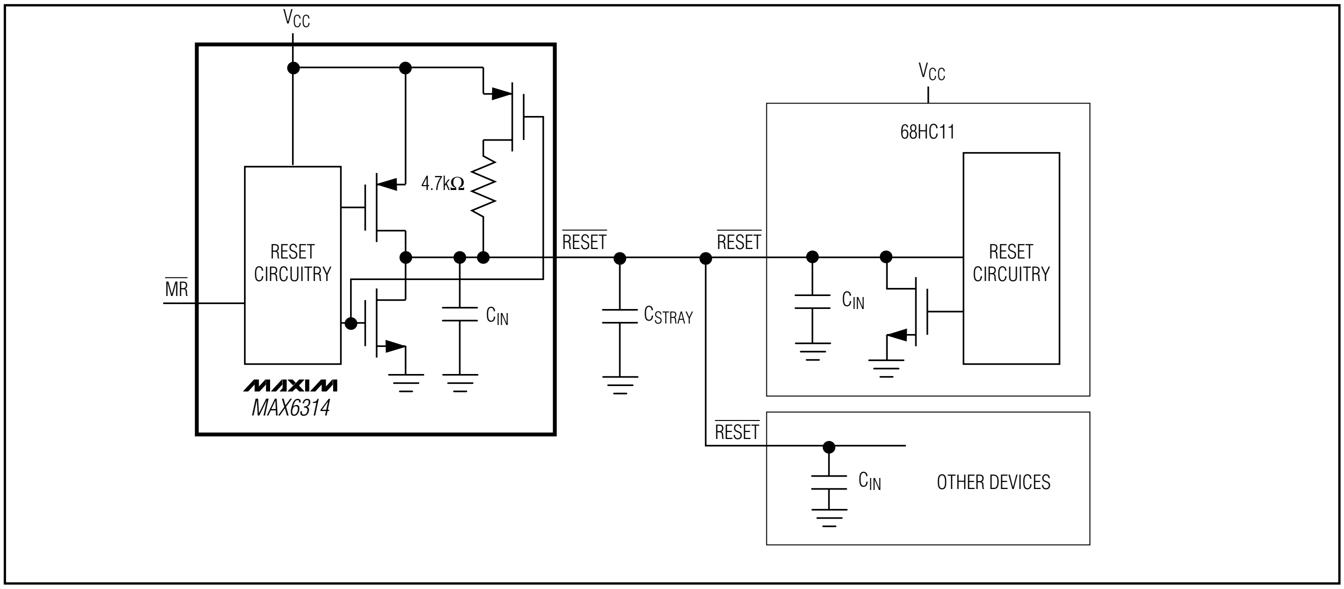


Figure 2. MAX6314 Supports Additional Devices on the Reset Bus

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

Applications Information

Negative-Going V_{CC} 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_{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 V_{CC} 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 V_{CC} provides additional transient immunity.

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

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

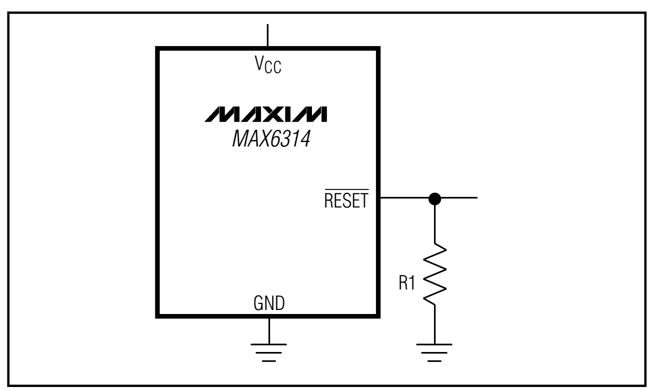


Figure 3. $\overline{RESET}$ Valid to V_{CC} = Ground Circuit

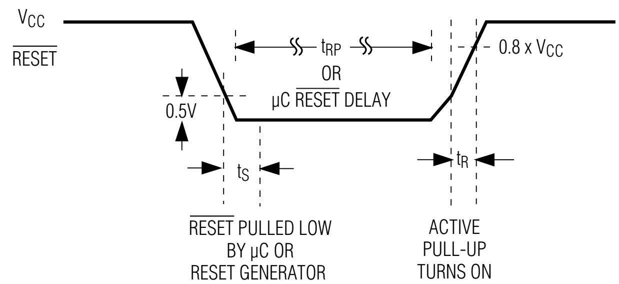


Figure 4. RESET Timing Diagram

Ordering Information (continued)

PART†	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)	TOP MARK††
MAX6314US44D1-T†††	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_ _
MAX6314US28D1-T	2.80	1	CK_ _
MAX6314US27D1-T	2.70	1	CL_ _
MAX6314US26D1-T†††	2.63	1	CM_ _

PART†	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)	TOP MARK††
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_ _
MAX6314US44D2-T†††	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_ _

†The MAX6314 is available in a SOT143 package, -40°C to +85°C temperature range.
††The first two letters in the package top mark identify the part, while the remaining two letters are the lot tracking code.
†††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.

Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

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†	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)	TOP MARK††
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_ _
MAX6314US26D2-T†††	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_ _
MAX6314US46D3-T†††	4.63	140	DW_ _
MAX6314US45D3-T	4.50	140	DX_ _
MAX6314US44D3-T†††	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_ _
MAX6314US31D3-T†††	3.08	140	EO_ _
MAX6314US30D3-T	3.00	140	EP_ _
MAX6314US29D3-T†††	2.93	140	ES_ _

PART†	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)	TOP MARK††
MAX6314US28D3-T	2.80	140	ET_ _
MAX6314US27D3-T	2.70	140	EU_ _
MAX6314US26D3-T†††	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_ _
MAX6314US44D4-T†††	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_ _
MAX6314US26D4-T†††	2.63	1120	FV_ _
MAX6314US25D4-T	2.50	1120	FW_ _

†The MAX6314 is available in a SOT143 package, -40°C to +85°C temperature range.
††The first two letters in the package top mark identify the part, while the remaining two letters are the lot tracking code.
†††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.
Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

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

Chip Information

TRANSISTOR COUNT: 519

Package Information

For the latest package outline information, go to **www.maxim-ic.com/packages**.