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Open-Drain SOT µP Reset Circuit

MAX6315

General Description

The MAX6315 low-power CMOS microprocessor (µP) supervisory circuit is designed to monitor power supplies in µP and digital systems. It provides excellent circuit reliability and low cost by eliminating external components and adjustments. The MAX6315 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 MAX6315's open-drain $\overline{RESET}$ output can be pulled up to a voltage higher than V_{CC}.

The MAX6315 comes with factory-trimmed reset threshold voltages in 100mV increments from 2.5V to 5V. Preset timeout periods of 1ms, 20ms, 140ms, and 1120ms (min) are also available. The device comes in a SOT23 package.

For microcontrollers (µCs) and µPs with bidirectional reset pins, see the MAX6314 data sheet.

Benefits and Features

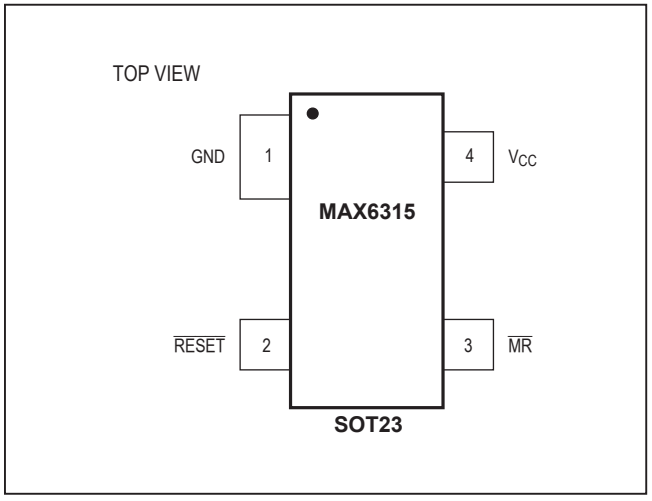
- Supervisory Circuit Ensures Reliable System Operation with Minimal Power Consumption
  - Precision, Factory-Set V_{CC} Reset Thresholds: 100mV Increments from 2.5V to 5V
  - Four Reset Timeout Periods Available: 1ms, 20ms, 140ms, or 1120ms (min)
  - Immune to Short V_{CC} Transients
  - Open-Drain $\overline{RESET}$ Output Can Exceed V_{CC}
  - Guaranteed Over Temperature
  - 5µA Supply Current
- Pin Compatible with MAX811
- Saves Space
  - 4-Pin SOT23 Package

Applications

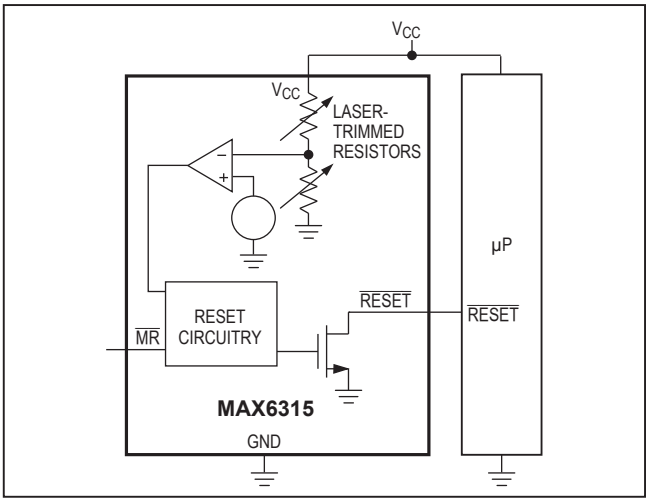
- Computers
- Controllers
- Intelligent Instruments
- Critical µP and µC Power Monitoring
- Portable/Battery-Powered Equipment

***Ordering Information* continued at end of data sheet.**

Pin Configuration



Typical Operating Circuit



19-2000; Rev 7; 2/25

Absolute Maximum Ratings

V_{CC} ..... -0.3V to +6.0V
$\overline{RESET}$ ..... -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)
SOT23 (derate 4mW/°C above +70°C) 320mW
Operating Temperature Range ..... -40°C to +125°C
Storage Temperature Range ..... -65°C to +160°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} = +2.5V to +5.5V, T_A = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.)

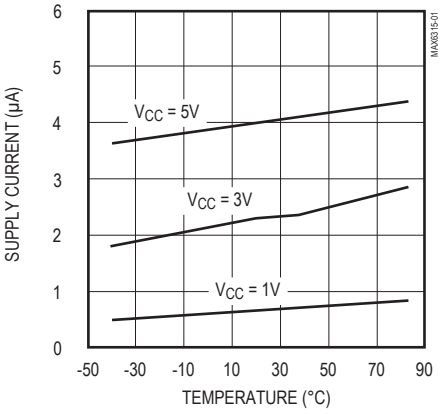
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage Range	V_{CC}	T_A = -40°C to +85°C	1.0		5.5	V
V_{CC} Supply Current	I_{CC}	V_{CC} = 5.5V, no load (-40°C to +85°C)		5	12	µA
		V_{CC} = 5.5V, no load (-40°C to +125°C)			15	
		V_{CC} = 3.6V, no load (-40°C to +85°C)		4	10	
		V_{CC} = 3.6V, no load (-40°C to +125°C)			12	
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%	
		T_A = -40°C to +125°C	V_{TH} - 3.5%		V_{TH} + 3.5%	
Reset Threshold Tempco	$\Delta V_{TH}/°C$			60		ppm/°C
V_{CC} to Reset Delay		V_{CC} = falling at 1mV/µs		35		µs
Reset Timeout Period	t_{RP}	MAX6315US_ _D1-T (-40°C to +85°C)	1	1.4	2	ms
		MAX6315US_ _D1-T (-40°C to +125°C)	0.8		2.4	
		MAX6315US_ _D2-T (-40°C to +85°C)	20	28	40	
		MAX6315US_ _D2-T (-40°C to +125°C)	16		48	
		MAX6315US_ _D3-T (-40°C to +85°C)	140	200	280	
		MAX6315US_ _D3-T (-40°C to +125°C)	112		336	
		MAX6315US_ _D4-T (-40°C to +85°C)	1120	1570	2240	
		MAX6315US_ _D4-T (-40°C to +125°C)	896		2688	
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	
$\overline{RESET}$ Output Leakage Current		V_{CC} > V_{TH}, $\overline{RESET}$ deasserted			1	µA

Note 1: The MAX6315 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 the *Ordering Information*).

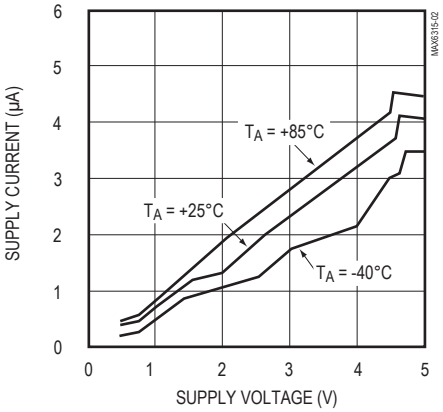
Typical Operating Characteristics

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

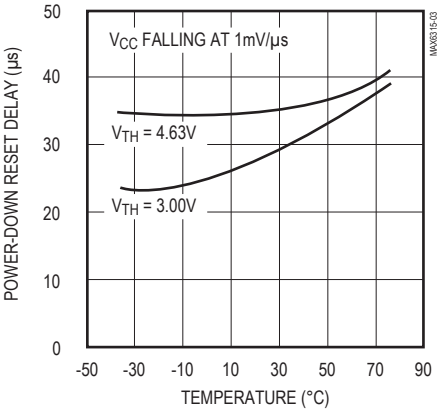
SUPPLY CURRENT vs. TEMPERATURE



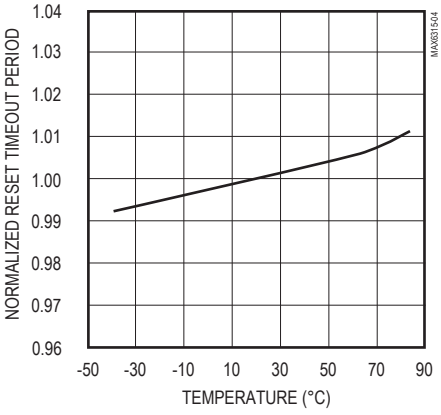
SUPPLY CURRENT vs. SUPPLY VOLTAGE



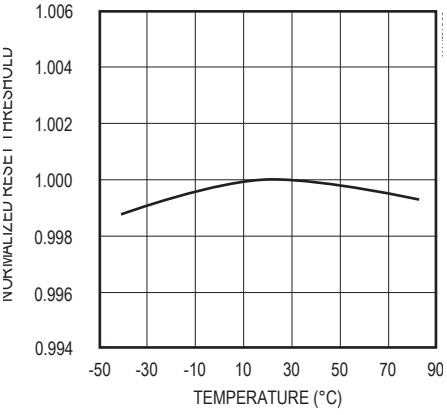
POWER-DOWN RESET DELAY vs. TEMPERATURE



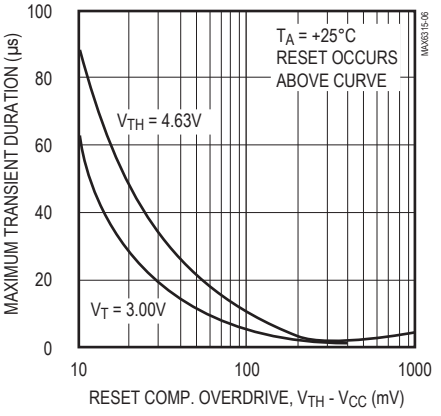
NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE (V_{CC} RISING)



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



MAXIMUM TRANSIENT DURATION vs. RESET COMPARATOR OVERDRIVE



Pin Description

PIN	NAME	FUNCTION
1	GND	Ground
2	$\overline{RESET}$	Active-Low Open-Drain Output. Connect to an external pullup resistor. Can be pulled up to a voltage higher than V_{CC}, but less than 6V.
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

Detailed Description

Reset Output

A microprocessor's (µP's) reset input starts the µP in a known state. The MAX6315 asserts reset to prevent code-execution errors during power-up, power-down, or brownout conditions. $\overline{\text{RESET}}$ 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 $\overline{\text{RESET}}$ asserted for the reset timeout period (t_{RP}); after this interval $\overline{\text{RESET}}$ goes high. If a brownout condition occurs (monitored voltage dips below its programmed reset threshold), $\overline{\text{RESET}}$ goes low. Any time V_{CC} dips below the reset threshold, the internal timer resets to zero and $\overline{\text{RESET}}$ goes low. The internal timer starts when V_{CC} returns above the reset threshold, and $\overline{\text{RESET}}$ remains low for the reset timeout period.

The MAX6315's $\overline{\text{RESET}}$ output structure is a simple open-drain n-channel MOSFET switch. Connect a pullup resistor to any supply in the 0V to +6V range. Select a resistor value large enough to register a logic low when $\overline{\text{RESET}}$ is asserted (see the *Electrical Characteristics* table), and small enough to register a logic high while supplying all input current and leakage paths connected to the $\overline{\text{RESET}}$ line. A 10kΩ pullup is sufficient in most applications.

Often, the pullup connected to the MAX6315's $\overline{\text{RESET}}$ output will connect to the supply voltage monitored at the IC's V_{CC} pin. However, some systems may use the open-drain output to level-shift from the monitored supply to reset circuitry powered by some other supply (Figure 1). This is one useful feature of an open-drain output. Keep in mind that as the MAX6315's V_{CC} decreases below 1V, so does the IC's ability to sink current at $\overline{\text{RESET}}$. Finally, with any pullup, $\overline{\text{RESET}}$ will be pulled high as V_{CC} decays toward 0V. The voltage where this occurs depends on the pullup resistor value and the voltage to which it connects (see the *Electrical Characteristics* table).

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 $\overline{\text{MR}}$ asserts reset. Reset remains asserted while $\overline{\text{MR}}$ is low, and for the reset active timeout period after $\overline{\text{MR}}$ returns high.

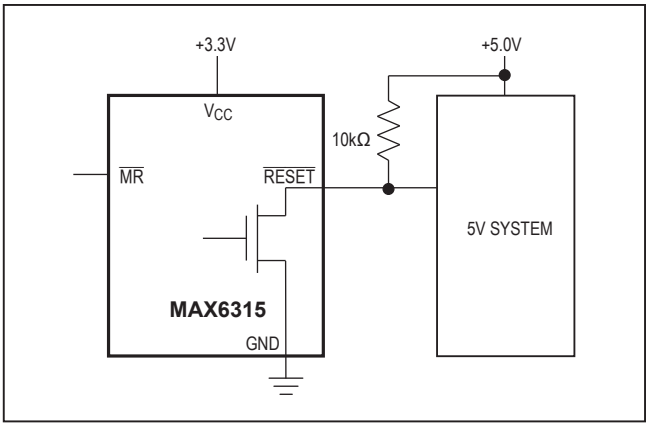


Figure 1. MAX6315 Open-Drain $\overline{\text{RESET}}$ Output Allows Use with Multiple Supplies

$\overline{\text{MR}}$ has an internal 63kΩ pullup 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 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 Comparator 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 transient amplitude 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.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PIN-PACKAGE	TOP MARK
MAX6315US26D1+T	-40°C to +125°C	4 SOT23	GVAA
MAX6315US29D1+T	-40°C to +125°C	4 SOT23	GSAA
MAX6315US30D1+T	-40°C to +125°C	4 SOT23	KAGZ
MAX6315US31D1+T	-40°C to +125°C	4 SOT23	GQAA
MAX6315US44D1+T	-40°C to +125°C	4 SOT23	GDAA
MAX6315US26D2+T	-40°C to +125°C	4 SOT23	HVAA
MAX6315US29D2+T	-40°C to +125°C	4 SOT23	HSAA
MAX6315US30D2+T	-40°C to +125°C	4 SOT23	HRAA
MAX6315US31D2+T	-40°C to +125°C	4 SOT23	HQAA
MAX6315US44D2+T	-40°C to +125°C	4 SOT23	HDAA
MAX6315US46D2+T	-40°C to +125°C	4 SOT23	HBAA
MAX6315US26D3+T	-40°C to +125°C	4 SOT23	IVAA
MAX6315US29D3+T	-40°C to +125°C	4 SOT23	ISAA
MAX6315US30D3+T	-40°C to +125°C	4 SOT23	IRAA
MAX6315US31D3+T	-40°C to +125°C	4 SOT23	IQAA
MAX6315US44D3+T	-40°C to +125°C	4 SOT23	IDAA
MAX6315US46D3+T	-40°C to +125°C	4 SOT23	IBAA
MAX6315US26D4+T	-40°C to +125°C	4 SOT23	JVAA
MAX6315US29D4+T	-40°C to +125°C	4 SOT23	KAGY
MAX6315US30D4+T	-40°C to +125°C	4 SOT23	JRAA
MAX6315US31D4+T	-40°C to +125°C	4 SOT23	JQAA

+Denotes a lead(Pb)-free/RoHS-compliant package.
T = Tape and reel.

Reset Threshold Voltage, and Minimum Reset Timeout Options

PART NUMBER	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)
MAX6315US26D1+T	2.63	1
MAX6315US29D1+T	2.93	1
MAX6315US30D1+T	3.00	1
MAX6315US31D1+T	3.08	1
MAX6315US44D1+T	4.39	1
MAX6315US26D2+T	2.63	20
MAX6315US29D2+T	2.93	20
MAX6315US30D2+T	3.00	20
MAX6315US31D2+T	3.08	20
MAX6315US44D2+T	4.39	20
MAX6315US46D2+T	4.63	20

PART NUMBER	NOMINAL V_{TH} (V)	MIN t_{RP} (ms)
MAX6315US26D3+T	2.63	140
MAX6315US29D3+T	2.93	140
MAX6315US30D3+T	3.00	140
MAX6315US31D3+T	3.08	140
MAX6315US44D3+T	4.39	140
MAX6315US46D3+T	4.63	140
MAX6315US26D4+T	2.63	1120
MAX6315US29D4+T	2.93	1120
MAX6315US30D4+T	3.00	1120
MAX6315US31D4+T	3.08	1120

Chip Information

TRANSISTOR COUNT: 519

Package Information

For the latest package outline information and land patterns (footprints), go to **www.analog.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
4 SOT23	U4+1, U4-1	21-0052	90-0183

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
4	4/15	Updated *Benefits and Features* and *Package Information*, added *Revision History*	1, 7
5	12/15	Added lead-free package numbers and package codes, removed top mark information, instead referring to Analog Devices site	1, 5, 6, 13
6	1/16	Updated out-of-date package type description	1, 2, 5, 6
7	2/25	Updated *Ordering Information* table, added *Reset Threshold Voltage, and Minimum Reset Timeout Options* table.	5