MAX6332/MAX6333/ MAX6334

3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

General Description

The MAX6332/MAX6333/MAX6334 microprocessor (µP) supervisory circuits monitor the power supplies in 1.8V to 3.3V µP and digital systems. They increase circuit reliability and reduce cost by eliminating external components and adjustments.

These devices perform a single function: they assert a reset signal whenever the V_{CC} supply voltage declines below a preset threshold, keeping it asserted for a preset timeout period after V_{CC} has risen above the reset threshold. The only difference among the three devices is their output. The MAX6333 (push/pull) and MAX6334 (open-drain) have an active-low $\overline{RESET}$ output, while the MAX6332 (push/pull) has an active-high RESET output. The MAX6332/MAX6333 are guaranteed to be in the correct state for V_{CC} down to 0.7V. The MAX6334 is guaranteed to be in the correct state for V_{CC} down to 1.0V.

The reset comparator in these ICs is designed to ignore fast transients on V_{CC}. Reset thresholds are factory-trimmable between 1.6V and 2.5V, in approximately 100mV increments. There are 15 standard versions available (2,500 piece minimum-order quantity); contact the factory for availability of nonstandard versions (10,000 piece minimum-order quantity). For space-critical applications, the MAX6332/MAX6333/MAX6334 come packaged in a 3-pin SOT23.

Applications

- Pentium® II Computers
- Computers
- Controllers
- Intelligent Instruments
- Critical µP/µC Power Monitoring
- Portable/Battery-Powered Equipment

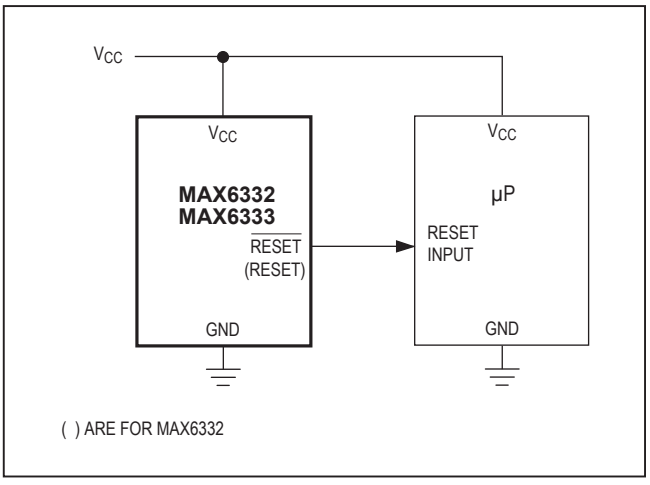
Pentium is a registered trademark of Intel Corp.

Benefits and Features

- Ultra-Low 0.7V Operating Supply Voltage
- Low 3.3µA Supply Current
- Precision Monitoring of 1.8V and 2.5V Power- Supply Voltages
- Reset Thresholds Available from 1.6V to 2.5V, in Approximately 100mV Increments
- Fully Specified Over Temperature
- Three Power-On Reset Pulse Widths Available (1ms min, 20ms min, 100ms min)
- Low Cost
- Three Available Output Structures: Push/Pull $\overline{RESET}$, Push/Pull RESET, Open-Drain $\overline{RESET}$
- Guaranteed RESET/$\overline{RESET}$ Valid to V_{CC} = 0.7V (MAX6332/MAX6333)
- Power-Supply Transient Immunity
- No External Components
- 3-Pin SOT23 Package
- Pin-Compatible with MAX809/MAX810 and MAX6326/MAX6327/MAX6328

Selector Guide (Standard Versions*) appears at end of data sheet.

Typical Operating Circuit



19-1411; Rev 4; 2/16

maxim integrated™

Absolute Maximum Ratings

Terminal Voltage (with respect to GND)
- V_{CC} ..... -0.3V to +6V
- Push/Pull RESET, $\overline{RESET}$ ..... -0.3V to (V_{CC} + 0.3V)
- Open-Drain $\overline{RESET}$ ..... -0.3V to +6V

Input Current (V_{CC}) 20mA
Output Current (RESET, $\overline{RESET}$) 20mA
Continuous Power Dissipation (T_A = +70°C)
- SOT23-3 (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
Soldering Temperature (reflow)
- Lead(Pb)-free packages ..... +260°C
- Packages containing lead (Pb) ..... +240°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

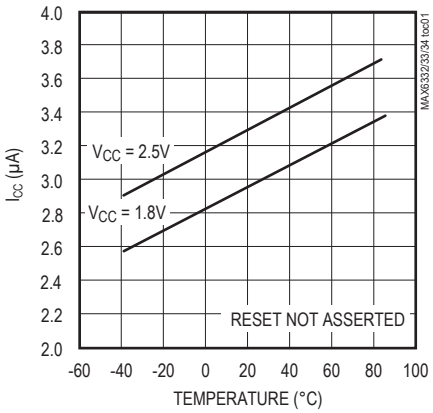
(V_{CC} = full range, T_A = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = 3V, reset not asserted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	T_A = 0°C to +85°C	MAX6332/MAX6333	0.7		5.5	V
			MAX6334	1.0		5.5	
		T_A = -40°C to +85°C	MAX6332/MAX6333	0.78		5.5	
			MAX6334	1.2		5.5	
		T_A = 0°C to +125°C	MAX6332/MAX6333 MAX6334	1.2		5.5	
Supply Current	I_{CC}	No load	V_{CC} = 1.8V		3.0	6.0	µA
			V_{CC} = 2.5V		3.3	7.0	
Reset Threshold	V_{TH}	MAX633_UR__D_-T, Table 1	T_A = +25°C	V_{TH} - 1.8%	V_{TH}	V_{TH} + 1.8%	V
			T_A = -40°C to +125°C	V_{TH} - 3%	V_{TH}	V_{TH} + 3%	
V_{CC} Falling Reset Delay		V_{CC} falling at 10V/ms			24		µs
Reset Active Timeout Period	t_{RP}	MAX633_UR__D1-T		1	1.5	2	ms
		MAX633_UR__D2-T		20	30	40	
		MAX633_UR__D3-T		100	150	200	
$\overline{RESET}$ Output Low Voltage (MAX6333/MAX6334)	V_{OL}	Reset asserted	I_{SINK} = 50µA, V_{CC} ≥ 1.0V			0.4	V
			I_{SINK} = 500µA, V_{CC} ≥ 1.8V			0.3	
$\overline{RESET}$ Output High Voltage (MAX6333)	V_{OH}	Reset not asserted	I_{SOURCE} = 200µA, V_{CC} ≥ 1.8V	0.8 x V_{CC}			V
			I_{SOURCE} = 500µA, V_{CC} ≥ 2.7V	0.8 x V_{CC}			
RESET Output Voltage (MAX6332)	V_{OH}	Reset asserted	I_{SOURCE} = 1µA, V_{CC} ≥ 1.0V	0.8 x V_{CC}			V
			I_{SOURCE} = 200µA, V_{CC} ≥ 1.8V	0.8 x V_{CC}			
	V_{OL}	Reset not asserted	I_{SINK} = 500µA, V_{CC} ≥ 1.8V			0.3	
			I_{SINK} = 1.2mA, V_{CC} ≥ 2.7V			0.3	
$\overline{RESET}$ Output Leakage Current (MAX6334)		V_{CC} > V_{TH}, $\overline{RESET}$ not asserted				0.5	µA

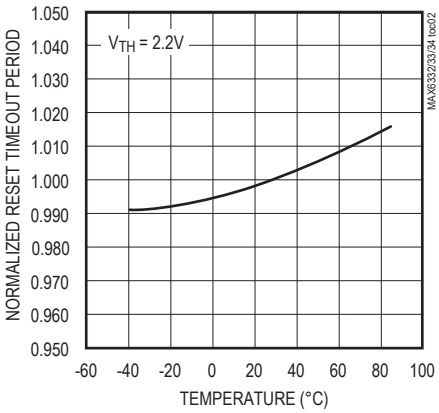
Typical Operating Characteristics

(Reset not asserted, T_A = +25°C, unless otherwise noted.)

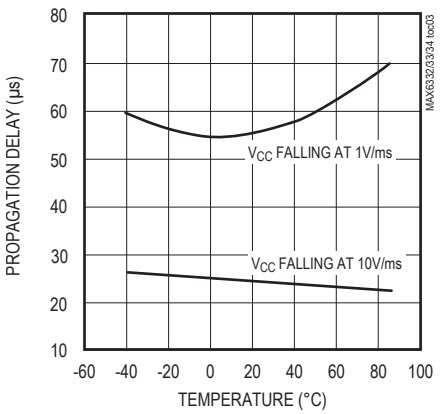
SUPPLY CURRENT vs. TEMPERATURE



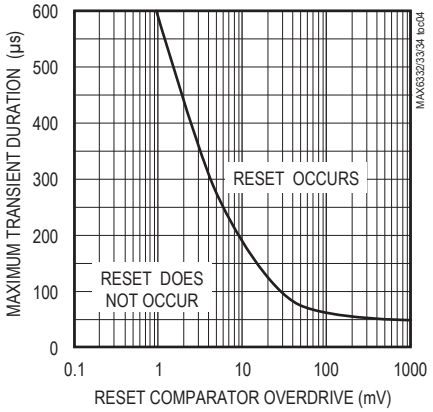
NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE



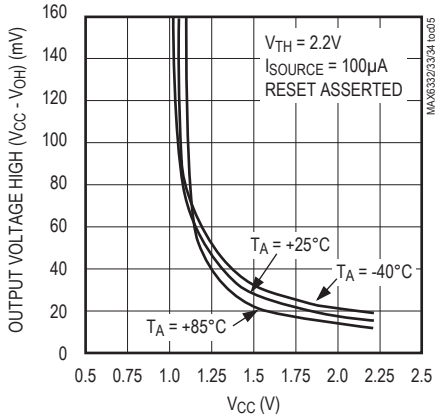
V_{CC} FALLING PROPAGATION DELAY vs. TEMPERATURE



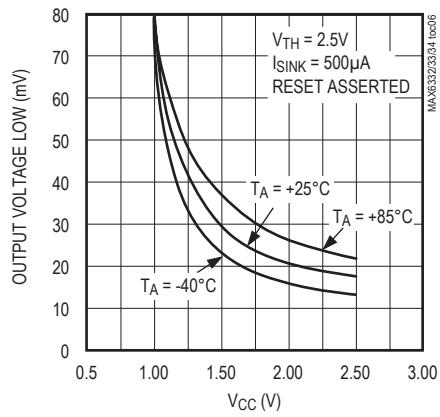
MAXIMUM TRANSIENT DURATION vs. RESET COMPARATOR OVERDRIVE



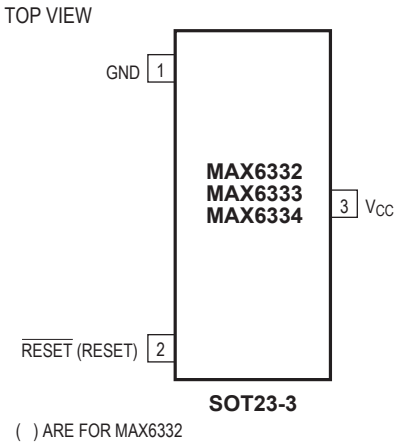
OUTPUT VOLTAGE HIGH vs. SUPPLY VOLTAGE



OUTPUT VOLTAGE LOW vs. SUPPLY VOLTAGE



Pin Configuration



Pin Description

PIN		NAME	FUNCTION
MAX6332	MAX6333 MAX6334		
1	1	GND	Ground
—	2	$\overline{\text{RESET}}$	Active-Low Reset Output. $\overline{\text{RESET}}$ remains low while V_{CC} is below the reset threshold and for a reset timeout period (t_{RP}) after V_{CC} rises above the reset threshold. $\overline{\text{RESET}}$ on the MAX6334 is open-drain.
2	—	RESET	Active-High Reset Output. RESET remains high while V_{CC} is below the reset threshold and for a reset timeout period (t_{RP}) after V_{CC} rises above the reset threshold.
3	3	V_{CC}	Supply Voltage (0.7V to 5.5V)

Applications Information

Interfacing to µPs with Bidirectional Reset Pins

Since the RESET output on the MAX6334 is open-drain, this device interfaces easily with µPs that have bidirectional reset pins, such as the Motorola 68HC11. Connecting the µP supervisor's RESET output directly to the microcontroller's (µC's) RESET pin with a single pullup resistor allows either device to assert reset (Figure 1).

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 V_{CC} transients (glitches). The *Typical Operating Characteristics* show the Maximum Transient Duration vs. Reset Comparator Overdrive graph. The graph shows the maximum pulse width that a negative-going V_{CC} transient may typically have without issuing a reset signal. As the amplitude of the transient increases, the maximum allowable pulse width decreases.

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

When V_{CC} falls below 1V and approaches the minimum operating voltage of 0.7V, push/pull-structured reset sinking (or sourcing) capabilities decrease drastically. High-impedance CMOS-logic inputs connected to the RESET pin can drift to indeterminate voltages. This does not present a problem in most cases, since most µPs and circuitry do not operate at V_{CC} below 1V. For the MAX6333, where RESET must be valid down to 0, adding a pull-down resistor between RESET and GND removes stray leakage currents, holding RESET low (Figure 2a). The pull-down resistor value is not critical; 100kΩ is large enough not to load RESET and small enough to pull it low. For the MAX6332, where RESET must be valid to V_{CC} = 0, a 100kΩ pull-up resistor between RESET and V_{CC} will hold RESET high when V_{CC} falls below 0.7V (Figure 2b).

Since the MAX6334 has an open-drain, active-low output, it typically uses a pull-up resistor. With this device, RESET will most likely not maintain an active condition, but will drift to a non-active level due to the pull-up resistor and the reduced sinking capability of the open-drain device. Therefore, this device is not recommended for applications where the RESET pin is required to be valid down to V_{CC} = 0.

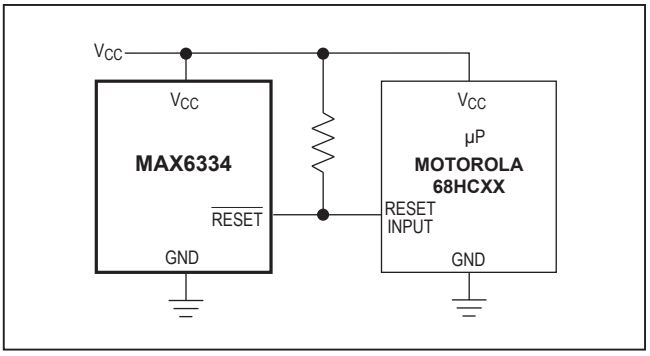


Figure 1. Interfacing to µPs with Bidirectional Reset Pins

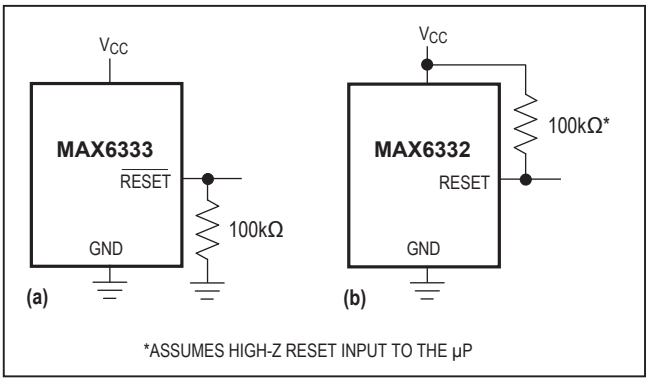


Figure 2. Ensuring Reset Valid Down to V_{CC} = 0

Table 1. Factory-Trimmed Reset Thresholds*

RESET-THRESHOLD SUFFIX	T_A = +25°C			T_A = -40°C to +125°C BIT 4	
	MIN	TYP	MAX	MIN	MAX
MAX633_UR25D_	2.46	2.50	2.55	2.43	2.58
MAX633_UR24D_	2.36	2.40	2.44	2.33	2.47
MAX633_UR23D_	2.26	2.30	2.34	2.23	2.37
MAX633_UR22D_	2.16	2.20	2.24	2.13	2.27
MAX633_UR21D_	2.06	2.10	2.14	2.04	2.16
MAX633_UR20D_	1.96	2.00	2.04	1.94	2.06
MAX633_UR19D_	1.87	1.90	1.93	1.84	1.96
MAX633_UR18D_	1.77	1.80	1.83	1.75	1.85
MAX633_UR17D_	1.67	1.70	1.73	1.65	1.75
MAX633_UR16D_	1.57	1.60	1.63	1.55	1.65

**Factory-trimmed reset thresholds are available in approximately 100mV increments, with a ±1.8% room-temperature variance.*

Selector Guide (Standard Versions*)

PART	OUTPUT STAGE	NOMINAL V_{TH} (V)	MINIMUM RESET TIMEOUT (ms)	SOT TOP MARK
MAX6332UR23D3-T	Push/Pull RESET	2.30	100	FZDM
MAX6332UR22D3-T	Push/Pull RESET	2.20	100	FZCN
MAX6332UR20D3-T	Push/Pull RESET	2.00	100	FZDL
MAX6332UR18D3-T	Push/Pull RESET	1.80	100	FZCM
MAX6332UR16D3-T	Push/Pull RESET	1.60	100	FZCL
MAX6333UR23D3-T	Push/Pull $\overline{\text{RESET}}$	2.30	100	FZCS
MAX6333UR22D3-T	Push/Pull $\overline{\text{RESET}}$	2.20	100	FZCR
MAX6333UR20D3-T	Push/Pull $\overline{\text{RESET}}$	2.00	100	FZCQ
MAX6333UR18D3-T	Push/Pull $\overline{\text{RESET}}$	1.80	100	FZCP
MAX6333UR16D3-T	Push/Pull $\overline{\text{RESET}}$	1.60	100	FZCO
MAX6334UR23D3-T	Open-Drain $\overline{\text{RESET}}$	2.30	100	FZDO
MAX6334UR22D3-T	Open-Drain $\overline{\text{RESET}}$	2.20	100	FZCV
MAX6334UR20D3-T	Open-Drain $\overline{\text{RESET}}$	2.00	100	FZDN
MAX6334UR18D3-T	Open-Drain $\overline{\text{RESET}}$	1.80	100	FZCU
MAX6334UR16D3-T	Open-Drain $\overline{\text{RESET}}$	1.60	100	FZCT

**Sample stock is generally held on all standard versions.*

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6332UR__D_-T	-40°C to +125°C	3 SOT23
MAX6333UR__D_-T	-40°C to +125°C	3 SOT23
MAX6334UR__D_-T	-40°C to +125°C	3 SOT23

**These devices are available in factory-set V_{CC} reset thresholds from 1.6V to 2.5V, in approximately 0.1V increments. Choose the desired reset threshold suffix from Table 1 and insert it in the blanks following "UR" in the part number. Factory-programmed reset timeout periods are also available. Insert the number corresponding to the desired nominal reset timeout period (1 = 1ms min, 2 = 20ms min, 3 = 100ms min) in the blank following "D" in the part number. There are 15 standard versions with a required order increment of 2500 pieces. Sample stock is generally held on the standard versions only (see Selector Guide). Contact the factory for availability of nonstandard versions (required order increment is 10,000 pieces). All devices available in tape-and-reel only.*

Devices are available in both leaded and lead-free packaging.

Specify lead-free by replacing "-T" with "+T" when ordering.

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.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.
3 SOT23	U3+1	21-0051	90-0179

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/98	Initial release	—
1	6/00	Revised *Ordering Information*, *Absolute Maximum Ratings*, *Electrical Characteristics*, and Table 1.	1, 2, 4
2	12/05	Revised *Ordering Information* to add lead-free information.	1
3	6/12	Update *Ordering Information* with automotive part.	1
4	2/16	Updated *Ordering Information* table and *Applications* section	1

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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