

Dual/Triple-Voltage μP Supervisory Circuits

General Description

The MAX6351–MAX6360 microprocessor (μ P) supervisors with multiple reset voltages significantly improve system reliability and accuracy compared to separate ICs or discrete components. If any input supply voltage drops below its associated preset threshold, all reset outputs are asserted. In addition, the output(s) is valid as long as either input supply voltage remains greater than +1.0V.

All devices in this series have an active-low debounced manual reset input. In addition, the MAX6358/MAX6359/MAX6360 offer a watchdog timer input with a 46.4sec start-up timeout period and a 2.9sec timeout period. The MAX6355/MAX6356/MAX6357 offer an additional voltage monitor input to monitor a third voltage.

The MAX6351 features both 3V and 5V active-low push-pull reset outputs. The MAX6353/MAX6356/MAX6359 offer a 5V active-low push-pull reset. The MAX6354/MAX6357/MAX6360 offer a 3V active-low push-pull reset. The MAX6352/MAX6355/MAX6358's reset is active-low open-drain.

All of these devices are offered with a wide variety of voltage threshold levels, as shown in the *Voltage Threshold Levels* table below. They are available in 5-and 6-pin SOT23 packages and operate over the extended (-40°C to +85°C) temperature range.

Applications

Computers	Intelligent Instruments
Controllers	Multivoltage Systems
Portable/Battery-Powered	
Equipment	

Voltage Threshold Levels

PART NO. SUFFIX ()	V _{CC} 5 NOMINAL VOLTAGE THRESHOLD (V)	V _{CC} 3 NOMINAL VOLTAGE THRESHOLD (V)
LT	4.63	3.08
LS	4.63	2.93
LR	4.63	2.63
MT	4.38	3.08
MS	4.38	2.93
MR	4.38	2.63
TY	3.08	2.19
SY	2.93	2.19

Note: Standard versions are shown in bold and have a required order increment of 2500 pieces. Sample stock is generally held on the standard versions only. The required order increment for non-standard versions is 10,000 pieces. Contact factory for availability.

Features

- Precision Monitoring of Multiple +2.5V, +3.0V, +3.3V, and +5V Power-Supply Voltages
- Precision Factory-Set Power-Supply Reset Thresholds
- ♦ 20µA Supply Current
- ♦ 100ms min Power-On Reset Pulse Width
- **♦** Fully Guaranteed Over Temperature
- ◆ Guaranteed RESET Valid to V_{CC}5 = 1V or V_{CC}3 = 1V
- **♦ Power-Supply Transient Immunity**
- No External Components for Dual-Voltage Systems
- ♦ Small 5- and 6-Pin SOT23 Packages
- ◆ Debounced TTL/CMOS-Compatible Manual-Reset Input
- Watchdog Timer
 46.4sec Start-Up Timeout
 2.9sec Normal Timeout
- **♦ Low Cost**

Ordering Information

PART*	TEMP. RANGE	PIN-PACKAGE
MAX6351UT-T	-40°C to +85°C	6 SOT23-6
MAX6352 UK-T	-40°C to +85°C	5 SOT23-5
MAX6353 UK-T	-40°C to +85°C	5 SOT23-5
MAX6354UK-T	-40°C to +85°C	5 SOT23-5
MAX6355UT-T	-40°C to +85°C	6 SOT23-6
MAX6356UT-T	-40°C to +85°C	6 SOT23-6
MAX6357UT-T	-40°C to +85°C	6 SOT23-6
MAX6358UT-T	-40°C to +85°C	6 SOT23-6
MAX6359UT-T	-40°C to +85°C	6 SOT23-6
MAX6360UT-T	-40°C to +85°C	6 SOT23-6

*The _ _ are placeholders for the threshold voltage levels of the devices. Substitute the part number suffix in the Voltage Threshold Levels table for the desired voltage level. There are two standard versions for each of the above part numbers. All devices are available in tape-and-reel only.

Pin Configurations appear at end of data sheet. Selector Guide appears at end of data sheet.

MIXIM

Maxim Integrated Products 1

For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800. For small orders, phone 1-800-835-8769.

Dual/Triple-Voltage µP Supervisory Circuits

ABSOLUTE MAXIMUM RATINGS

Vcc5, Vcc3 to GND	-0.3V to +6V
RST (MAX6352/55/58)	
RST, MR, WDI, RST5, RSTIN	
(MAX6351/53/56/59)	0.3V to $(V_{CC}5 + 0.3V)$
RST, RST3 (MAX6351/54/57/60)	3V to (V _{CC} 3 + 0.3V)
Input/Output Current, All Pins	20mA

Continuous Power Dissipation ($T_A = +70^{\circ}C$)
5-Pin SOT23-5 (derate 7.1mW/°C above +70°C)571mW
6-Pin SOT23-6 (derate 7.1mW/°C above +70°C)571mW
Operating Temperature Range40°C to +85°C
Storage Temperature Range65°C to +150°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

 $(V_{CC}3 = V_{CC}5 = +1.2V \text{ to } +5.5V, T_A = -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}, \text{ unless otherwise noted.}$ Typical values are at $T_A = +25^{\circ}\text{C}.)$ (Note 1)

PARAMETER	SYMBOL	CONDITIONS			TYP	MAX	UNITS	
Cumply Valtage Denge (Nata 2)	\/.	$T_A = 0$ °C to +70°C		1.0		5.5	V	
Supply Voltage Range (Note 2)	V _{CC}	$T_A = -40$ °C to $+85$ °C		1.2		5.5	V	
Supply Current	ICC5 + ICC3	V _C C5 = 5.5V, V _C C3 =	V _{CC} 5 = 5.5V, V _{CC} 3 = 3.6V, all I/O pins open		20	50	μA	
		MAYCO	T _A = +25°C	4.54	4.63	4.72		
		MAX63L_	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	4.5		4.75	1	
		141/00 14	T _A = +25°C	4.3	4.38	4.46		
VacE Throphold (Note 2)	\/E	MAX63M_	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	4.25		4.50	V	
V _{CC} 5 Threshold (Note 3)	V _{TH} 5	MAX63 T	T _A = +25°C	3.03	3.08	3.14	V	
		IVIAA03I_	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	3.00		3.15		
		NAAVOO O	T _A = +25°C	2.88	2.93	2.98	-	
		MAX63S_	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	2.85		3.00		
	V _{TH} 3	MAX63T	T _A = +25°C	3.03	3.08	3.14	V	
			$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	3.00		3.15		
		MAX63S	T _A = +25°C	2.88	2.93	2.98		
V _{CC} 3 Threshold (Note 3)			$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	2.85		3.00		
VCC3 Threshold (Note 3)		MAX63R	$T_A = +25^{\circ}C$	2.58	2.63	2.68		
			$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	2.55		2.70		
		MANGO	T _A = +25°C	2.16	2.19	2.22		
		$\begin{array}{c} \text{MAX63}__Y \\ \hline \text{T}_A = -40^{\circ}\text{C to } +85^{\circ}\text{C} \end{array}$		2.13		2.25		
Reset Threshold Tempco	ΔV _{TH} /°C				20		ppm/°C	
Reset Threshold Hysteresis					V _{TH} /500		V	
V _{CC} to Reset Delay		100mV overdrive		20		μs		
Reset Timeout Period	t _{RP}	VCC5 > VTH5(MAX), VC	100	180	280	ms		
RESET Output Voltage Low	VoL	V _{CC} 5 or V _{CC} 3 ≥ 2.7V, I _{SINK} = 1.2mA				0.3	V	
		V _{CC} 5 or V _{CC} 3 ≥ 4.5V, I _{SINK} = 3.2mA				0.4		
		$V_{CC}5$ or $V_{CC}3 < 1V$, $I_{SINK} = 50\mu A$, $T_A = 0^{\circ}C$ to $+70^{\circ}C$				0.3	V	
		V _{CC} 5 or V _{CC} 3 < 1.2V,			0.3	V		

Dual/Triple-Voltage μP Supervisory Circuits

ELECTRICAL CHARACTERISTICS (continued)

 $(V_{CC}3 = V_{CC}5 = +1.2V \text{ to } +5.5V, T_A = -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}, \text{ unless otherwise noted.}$ Typical values are at $T_A = +25^{\circ}\text{C}.)$ (Note 1)

PARAMETER	SYMBOL	COND	ITIONS	MIN	TYP	MAX	UNITS
DECET Outside Valleure High	V	MAX6351/MAX6353/ MAX6354/MAX6356/ MAX6357/MAX6359/ MAX6360 (_Y versions only), VCC5 > VTH5(MAX), VCC3 > VTH3(MAX)	ISOURCE = 500μA	0.8V _{CC}			V
RESET Output Voltage High	Vон	MAX6351/MAX6353/ MAX6354/MAX6356/ MAX6357/MAX6359/ MAX6360 (L_, M_ versions only), V _{CC} 5 > V _{TH} 5(MAX), V _{CC} 3 > V _{TH} 3(MAX)					v
WATCHDOG INPUT (MAX6358	/MAX6359/M	AX6360)					
Watchdog Timeout Period	twp	First timeout period after	25.6	46.4	72.0	sec	
	· · · · · · · · · · · · · · · · · · ·	After first WDI falling ed	<u> </u>	1.6	2.9	4.5	
WDI Pulse Width (Note 4)	twDI	$V_{IL} = 0.4V, V_{IH} = 0.8V_{C}$	50			ns	
WDI Input Threshold (Note 5)	V _{IL} V _{IH}	V _{CC} 3 = 5V	0.3V _{CC}		0.7V _{CC}	V	
MDI Inc. of Occurrent (Nata C)		V _{WDI} = V _{CC}		120	160	^	
WDI Input Current (Note 6)		V _{WDI} = 0		-20	-15		μΑ
MANUAL RESET INPUT							
	VIL	MAX63L_, MAX63_	$_{M_{,}}$ $V_{CC5} > V_{TH5(MAX)}$	0.8			
MR Input	VIH	MAX63L_, MAX63			2.3	V	
MA IIIput	VIL	MAX63Y, V _{CC} 5 >	0.3V _{CC}			V	
	VIH	MAX63Y, V _{CC} 5 >			0.7V _{CC}		
MR Pull-Up Resistance			32	63.5	100	kΩ	
MR Minimum Pulse Width	t _{RP}			10			μs
MR Glitch Rejection					100		ns
MR to Reset Delay	t _{MD}			0.1		μs	
ADJUSTABLE RESET COMPA	RATOR INP	UT (MAX6355/MAX6356	/MAX6357)			'	
DOTINI Issault Thursday	\/pa=:::	$V_{CC5} > V_{TH5(MAX)}$, $T_A = +25^{\circ}C$		1.20	1.22	1.24	V
RSTIN Input Threshold	VRSTIN	$V_{CC}3 > V_{TH}3_{(MAX)}$	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	1.19		1.25	V
RSTIN Input Current	I _{RSTIN}	0 < VRISTIN < VCC5 - 0	.3V	-25		25	nA
RSTIN Hysteresis				2.5		mV	

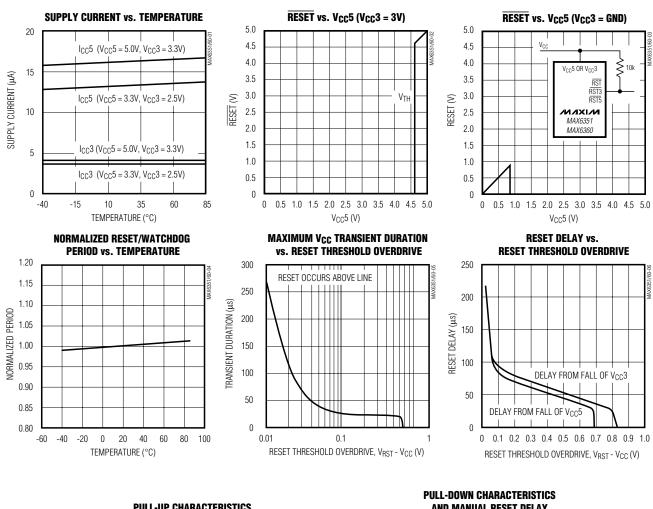
- Note 1: Overtemperature limits are guaranteed by design and not production tested.
- Note 2: The reset output is guaranteed to be in the correct state if either V_{CC}3 or V_{CC}5 is within its specified region of operation.
- Note 3: The reset output(s) is asserted if either V_{CC}5 or V_{CC}3 drops below its associated trip point.
- Note 4: Guaranteed by design. Not production tested.
- Note 5: WDI is internally serviced within the watchdog timeout period if WDI is left unconnected.
- Note 6: The WDI input current is specified as the average input current when the WDI input is driven high or low.

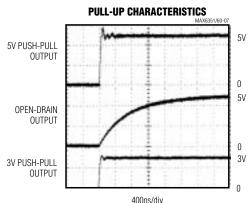


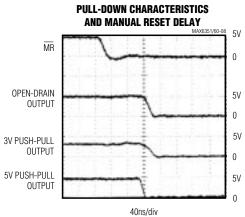
Dual/Triple-Voltage µP Supervisory Circuits

Typical Operating Characteristics

 $(V_{CC} = +5V, T_A = +25^{\circ}C, unless otherwise noted.)$







Dual/Triple-Voltage μP Supervisory Circuits

Pin Description

	Р	IN						
MAX6351	MAX6352 MAX6353 MAX6354	MAX6355 MAX6356 MAX6357	MAX6358 MAX6359 MAX6360	NAME	FUNCTION			
1	_	_	_	RST5	Active-Low, 5V CMOS Reset Output			
_	1	1	1	RST	Active-Low Reset Output. Open-drain for the MAX6352/MAX6355/MAX6358, 5V push-pull for MAX6353/MAX6356/MAX6359, and 3V push-puthe MAX6354/MAX6357/MAX6360.			
2	2	2	2	GND	Ground			
3	3	3	3	MR	Manual-Reset Input. Pull low to force a reset. RST RST5, and RST3 remain active as long as MR is I and for the timeout period after MR goes high. Leave unconnected or connect to V _{CC} 5 if unused V _{MR} must be below V _{CC} 5.			
4	4	4	4	V _{CC} 3	+3.3V/+3.0V Supply Input. Powers the device when it is above V _{CC} 5 and monitors its own voltage.			
5	_	_	_	RST3	Active-Low, 3V CMOS Reset Output			
_	_	5	_	RSTIN	Undervoltage Reset Comparator Input. Asserts reset when the monitored voltage falls below 1.23V. Set the reset threshold with an external resistor-divider. Connect to V _{CC} 5 if unused. V _{RSTIN} must be below V _{CC} 5.			
_	_	_	5	WDI	Watchdog Input. If WDI remains either high or low longer than the timeout period, then reset is triggered. The timer clears when reset is asserted or whenever WDI sees a rising or falling edge. Leave floating to disable it if unused.			
6	5	6	6	V _{CC} 5	+5V Supply Input. Powers the device when it is above V _{CC} 3 and monitors its own voltage.			

Dual/Triple-Voltage µP Supervisory Circuits

Detailed Description

Supply Voltages

The MAX6351–MAX6360 microprocessor (μP) supervisory circuits maintain system integrity by alerting the μP to fault conditions. These ICs monitor multiple-supply systems and derive their internal power from the highest voltage source present at V_{CC5} and V_{CC3}. In addition, the output reset state is guaranteed to remain viable while either V_{CC5} or V_{CC3} is above +1V.

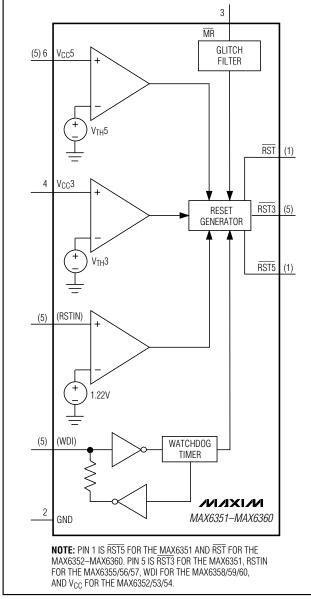


Figure 1. Functional Diagram

Threshold Levels

All the possible input voltage threshold level combinations are indicated by a two-letter code in *Voltage Threshold Levels*. The two standard combinations are LS and SY. LS parts monitor one $+5V \pm 5\%$ supply and one $+3.3V \pm 10\%$ supply. SY parts monitor one $+3.3V \pm 10\%$ supply and one $+2.5V \pm 10\%$ supply. The other combinations also monitor $+5V \pm 10\%$ supplies, $+3.3V \pm 5\%$ supplies, and $+3V \pm 5\%$ supplies.

Reset Outputs

The MAX6351 provides a 5V active-low reset and a 3V active-low reset. The MAX6353/MAX6356/MAX6359 provide a 5V active-low push-pull reset and the MAX6354/MAX6357/MAX6360 provide a 3V active-low push-pull reset. The MAX6353/MAX6355/MAX6358 provide an active-low open-drain reset. The higher input voltages of VCC5 and VCC3 maintain the sinking capability of the low reset-output state. The reset outputs are maintained as long as either supply is above +1V.

Negative-Going Vcc Transients

The MAX6351–MAX6360 are designed to ignore short negative-going V_{CC}5 and V_{CC}3 transients. See *Typical Operating Characteristics* for a glitch immunity graph.

Third Input Voltage (MAX6355/MAX6356/MAX6357)

The MAX6355/MAX6356/MAX6357 provide an additional input to monitor a third voltage. The threshold voltage at RSTIN is typically 1.22V. To monitor a voltage higher than 1.22V, connect a resistor-divider to the circuit as shown in Figure 2. The threshold at V₃ is:

$$V_{3TH} = 1.22 \left(\frac{R1 + R2}{R2} \right)$$

Note that RSTIN is powered by V_{CC}5, and its voltage must therefore remain lower than V_{CC}5.

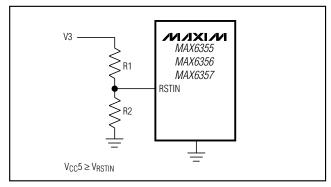


Figure 2. Monitoring a Third Voltage

Dual/Triple-Voltage μP Supervisory Circuits

Microprocessors with bidirectional reset pins will con-

tend with the push-pull outputs of these devices. To

prevent this, connect a $4.7k\Omega$ resistor between RESET

and the µP's reset I/O port, as shown in Figure 5. Buffer

Interfacing to µPs with

Bidirectional Reset Pins

Watchdog Input (MAX6358/MAX6359/MAX6360)

The MAX6358/MAX6359/MAX6360 include a WDI to provide a reset if the µP goes into an infinite loop. After a reset, the start-up timeout period and the initial timeout period is nominally 46.4sec to allow the µP time to initialize. After the first transition on the WDI and after any toggle of the watchdog thereafter, the timeout period is nominally 2.9sec.

Applications Information

Ensuring a Valid RESET Output Down to VCC = 0

In some systems, it is necessary to ensure a valid reset even if VCC falls to 0. In these applications, use the circuit shown in Figure 3. Note that this configuration does not work for the open-drain outputs of the MAX6352/ MAX6355/MAX6358.

Monitoring a Negative Voltage

To monitor a negative supply rail using RSTIN or the MAX6355/MAX6356/MAX6357, use the circuit shown in Figure 4. In this configuration, a reset is issued when the negative supply falls below VINTH.

RESET as shown in the figure if this reset is used by other components in the system. V_{CC}5

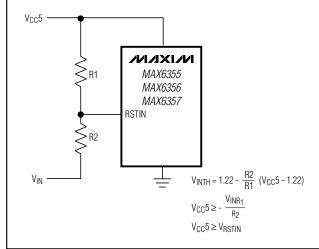


Figure 4. Monitoring a Negative Voltage

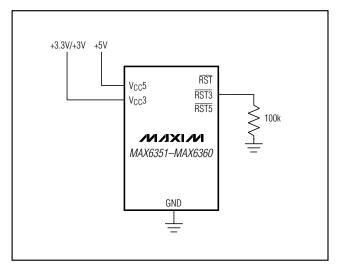


Figure 3. Ensuring a Valid Reset Low to V_{CC}5 and V_{CC}3 = 0

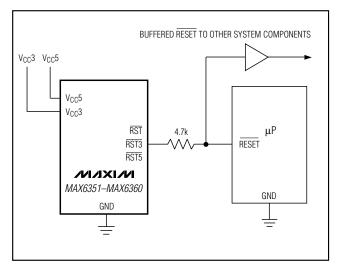


Figure 5. Interfacing to µPs with Bidirectional Reset I/O

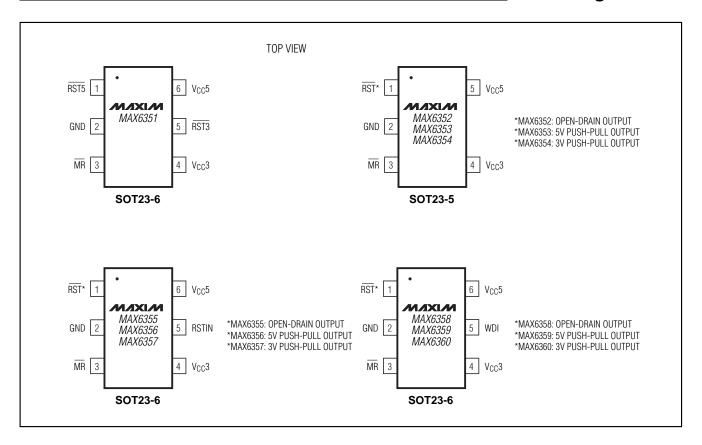
Chip Information

TRANSISTOR COUNT: 855



Dual/Triple-VoltageµP Supervisory Circuits

Pin Configurations



Selector Guide

PART	PIN COUNT	NUMBER OF SUPPLIES MONITORED	5V RESET	3V RESET	OPEN-DRAIN RESET	WATCHDOG TIMER	MANUAL RESET
MAX6351	6	2	~	~	_	_	~
MAX6352	5	2	_	_	~	_	~
MAX6353	5	2	~	_	_	_	~
MAX6354	5	2	_	~	_	_	~
MAX6355	6	3	_	_	~	_	~
MAX6356	6	3	~	_	_	_	~
MAX6357	6	3	_	~	_	_	~
MAX6358	6	2	_	_	~	~	~
MAX6359	6	2	~	_	_	~	~
MAX6360	6	2	_	~	_	~	~

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

© 1999 Maxim Integrated Products

Printed USA

is a registered trademark of Maxim Integrated Products.