

General Description

The MAX6391/MAX6392 microprocessor (μP) supervisory circuits provide sequenced logic reset outputs for multicomponent or dual-voltage systems. Each device can monitor two supply voltages and time-sequence two reset outputs to control the order in which system components are turned on and off. The MAX6391/MAX6392 increase system reliability and reduce circuit complexity and cost compared to separate ICs or discrete components.

The MAX6391/MAX6392 monitor VCC as the master reset supply. Both RESET1 and RESET2 are asserted whenever VCC drops below the selected factory-fixed reset threshold voltage. RESET1 remains asserted as long as VCC is below the threshold and deasserts 140ms (min) after VCC exceeds the thresholds.

RESET IN2 is monitored as the secondary reset supply and is adjustable with an external resistive-divider network. RESET2 is asserted whenever either VCC or RESET IN2 is below the selected thresholds. RESET2 remains asserted 140ms (min) or a capacitor-adjustable time period after VCC and RESET IN2 exceed their thresholds. RESET2 is always deasserted after RESET1 during system power-up and is always asserted before RESET1 during power-down.

The MAX6391 includes two internal pullup resistors for RESET1 and RESET2 (the open-drain outputs can be externally connected to the desired pullup voltages). The MAX6392 includes an active-low manual reset input (MR) that asserts both RESET1 (push-pull) and RESET2 (open drain).

The MAX6391/MAX6392 are available in small 8-pin SOT23 packages and are specified over the -40°C to +85°C extended temperature range.

Applications

Computers

Controllers

Critical µP Power Monitoring

Set-Top Boxes

Printers

Servers/Workstations

Industrial Equipment

Multivoltage Monitoring

Typical Operating Circuit appears at end of data sheet.

Features

- Preset VCC Reset Threshold Voltages from 1.58V to 4.63V (master supply)
- Customer-Adjustable RESET IN2 to Monitor Voltages Down to 625mV (secondary supply)
- ♦ Fixed (140ms min) RESET1 Timeout
- ♦ Fixed (140ms min) or Customer-Adjustable RESET2 Timeout Period
- ♦ Guaranteed Reset Valid to V_{CC} = 1V
- Active-Low Open-Drain Outputs or Push-Pull/Open-Drain Combination
- ♦ Internal Open-Drain Pullup Resistors (for external VoH voltage connections)
- ♦ Manual Reset Input (MAX6392 only)
- **♦ Immune to Short Negative Vcc Transients**
- ♦ 15µA Typical Supply Current
- **♦ Few External Components**
- ♦ Small 8-Pin SOT23 Package

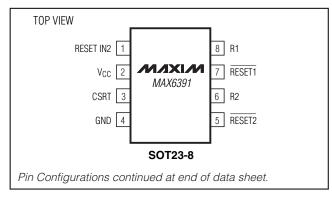
Ordering Information

PART*	TEMP RANGE	PIN-PACKAGE
MAX6391KAT	-40°C to +85°C	SOT23-8
MAX6392KAT	-40°C to +85°C	SOT23-8

*Insert the desired suffix (see Selector Guide) into the blanks to complete the part number. The MAX6391/MAX6392 require a 2.5k minimum order increment and are available in tape-and-reel only. Samples are typically available for standard versions (see Selector Guide for standard versions). Contact factory for availability.

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

Pin Configurations



Maxim Integrated Products 1

ABSOLUTE MAXIMUM RATINGS

V _{CC} to GND0.3V to +6.0V
RESET1 (MAX6392), RESET IN2, CSRT,
$\overline{\text{MR}}$ to GND0.3V to (V _{CC} + 0.3V)
RESET1 (MAX6391), RESET2, R1, R2 to GND0.3V to +6.0V
Input Current (V _{CC} , GND, CSRT, R1, R2, MR)±20mA
Output Current (RESET1, RESET2)±20mA
Continuous Power Dissipation (T _A = +70°C)
8-Pin SOT23 (derate 5.26mW/°C above +70°C)421mW

Operating Temperature Range	40°C to +85°C
Junction Temperature	+150°C
Storage Temperature Range	65°C to +150°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

 $(V_{CC} = 1.2V \text{ to } 5.5V, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise specified. Typical values are at } V_{CC} = +5V \text{ and } T_A = +25^{\circ}C.)$ (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
V Panga		$T_A = 0$ °C to +85°C	1.0		5.5	V
V _{CC} Range		$T_A = -40^{\circ}C$ to $+85^{\circ}C$	1.2		5.5]
Supply Current	Icc	No load		15	25	μΑ
		MAX639_UA46	4.50	4.63	4.75	
		MAX639_UA44	4.25	4.38	4.50	
		MAX639_UA31	3.00	3.08	3.15	
		MAX639_UA29	2.85	2.93	3.00	
V _{CC} Reset Threshold	V _{TH1}	MAX639_UA26	2.55	2.63	2.70	V
		MAX639_UA23	2.25	2.32	2.38	
		MAX639_UA22	2.12	2.19	2.25	
		MAX639_UA17	1.62	1.67	1.71	
		MAX639_UA16	1.54	1.58	1.61	
RESET IN2 Threshold	V _{TH2}	V _{CC} = 5V	610	625	640	mV
RESET IN2 Input Current					50	nA
V _{CC} to RESET1 Delay	t _{RD1}			20	•	
V _{CC} or RESET IN2 to RESET2 Delay	t _{RD2}	V _{CC} falling at 1mV/μs (Note 2)		10		μs

ELECTRICAL CHARACTERISTICS (continued)

 $(V_{CC} = 1.2V \text{ to } 5.5V, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise specified.}$ Typical values are at $V_{CC} = +5V$ and $T_A = +25^{\circ}C$.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
RESET1 Timeout Period	t _{RP1}			140	200	280	ms
RESET2 Timeout Period (Note 3)		C _{CSRT} = 1500pF		2.2	3.1	4.0	ma
RESETZ Timeout Period (Note 3)	t _{RP2}	C _C SRT = V _C C		140	200	280	ms
		I _{SINK} = 50µA,	$V_{CC} \ge 1.0V$, $T_A = 0^{\circ}C$ to $+85^{\circ}C$			0.3	
RESET_ Output Voltage Low	V _{OL}	reset asserted	$V_{CC} \ge 1.2V$, $T_{A} = -40^{\circ}C$ to $+85^{\circ}C$			0.3	V
		I _{SINK} = 1.2mA, reset asserted, V _{CC} ≥ 2.5V				0.3	
		I _{SINK} = 3.2mA, reset asserted, V _{CC} ≥ 4.25V				0.4	
Open-Drain RESET Output Leakage Current	ILKG	V _{CC} ≥ V _{TH1} , V _{RESET IN2} ≥ V _{TH2} , reset not asserted				1.0	μΑ
Push-Pull RESET1 Output Voltage High (MAX6392 only)	V _{ОН}	V _{CC} ≥ 2.25V, I _{SOURC} reset not asserted				0.8 x	V
		V _{CC} ≥ 4.5V, I _{SOURCE} asserted	E = 800μA, reset not			Vcc	Vcc
	VIL	Vcc > 4.0V				0.8	
	VIH	VCC > 4.0V		2.4			
MR Input	V _{IL}	V _{CC} < 4.0V				0.3 x V _C C	V
	V _{IH}	VCC < 4.0V		0.7 x V _C C			
MR Minimum Pulse Width				50			μs
MR Glitch Rejection					100		ns
MR to RESET1 Delay	t _{MR1}				10		μs
MR to RESET2 Delay	t _{MR2}				100		ns
t _{MR} Skew		t _{MR1} - t _{MR2}			10		μs
MR Pullup Resistance		Pullup to V _{CC}		35	47	60	kΩ
Reset Pullup Resistance		RESET1 to R1 or RESET2 to R2		35	47	60	kΩ

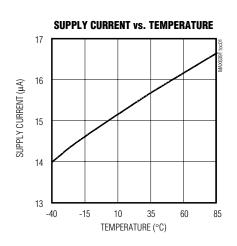
Note 1: Overtemperature limits are guaranteed by design and not production tested. Devices tested at +25°C only.

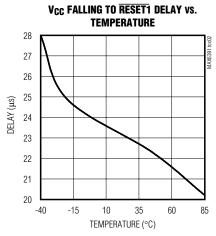
Note 2: RESET2 asserts before RESET1 when V_{CC} goes below the threshold for all supply voltage and temperature ranges.

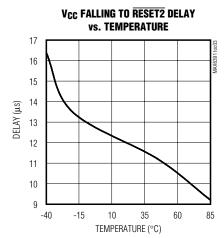
Note 3: CSRT must be connected to either V_{CC} (for fixed $\overline{RESET2}$ timeout period) or an external capacitor (for user-adjustable $\overline{RESET2}$ timeout period).

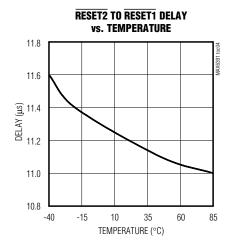
Typical Operating Characteristics

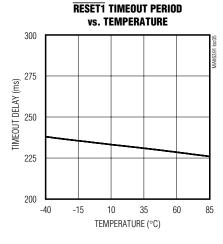
 $(V_{CC} = +5V, T_A = +25^{\circ}C, unless otherwise noted.)$

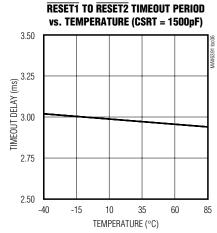


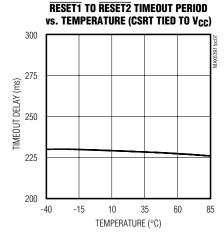


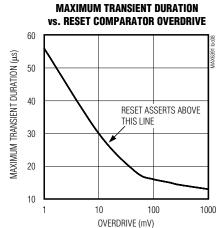












Pin Description

PIN			FUNCTION			
MAX6391	MAX6391 MAX6392 NAME		FUNCTION			
1	1	RESET IN2	Input Voltage for RESET2 Monitor. High-impedance input for internal reset comparator. Connect this pin to an external resistive-divider network to set the reset threshold voltage.			
2	2	Vcc	Supply Voltage and Input Voltage for Primary Supply Monitor			
3	3	CSRT	RESET2 Delay Set Capacitor. Connect to V _{CC} for a fixed 140ms (min) timeout period or to an external capacitor for a user-adjustable timeout period after V _{CC} exceeds its minimum threshold.			
4	4	GND	Ground			
5	5	RESET2	Secondary Reset Output, Open-Drain, Active-Low. $\overline{RESET2}$ changes from high to low when either V _{CC} or RESET IN2 drop below their thresholds. $\overline{RESET2}$ remains low for a user-adjustable timeout period (see CSRT) or a fixed 140ms (min) after V _{CC} and RESET IN2 meet their minimum thresholds.			
6	6	R2	47kΩ Internal Pullup Resistor for $\overline{\text{RESET2}}$. Connect to external voltage for $\overline{\text{RESE}}$ high pullup.			
7	7	RESET1	Primary Reset Output, Open-Drain (MAX6391) or Push-Pull (MAX6392), Active-Low. RESET1 changes from HIGH to LOW when the V _{CC} input drops below the selected reset threshold. RESET1 remains LOW for the reset timeout period after V _{CC} exceeds the minimum threshold.			
8		R1	47kΩ Internal Pullup Resistor for RESET1. Connect to external voltage for RESET1 high pullup.			
_	8	MR	Manual Reset, Active-Low, Internal 47k Ω Pullup to V _{CC} . Pull LOW to force a reset. RESET1 and RESET2 remain asserted as long as $\overline{\text{MR}}$ is LOW and for the RESET1 RESET2 timeout periods after $\overline{\text{MR}}$ goes HIGH. Leave unconnected or connect to V if unused.			

Detailed Description

Each device includes a pair of voltage monitors with sequenced reset outputs. The first block monitors V_{CC} only (RESET1 output is independent of the RESET IN2 monitor). It asserts a reset signal (LOW) whenever V_{CC} is below the preset voltage threshold. RESET1 remains asserted for at least 140ms after V_{CC} rises above the reset threshold. RESET1 timing is internally set in each device. V_{CC} voltage thresholds are available from 1.57V to 4.63V. In all cases V_{CC} acts as the master supply (all resets are asserted when V_{CC} goes below its selected threshold). The V_{CC} input also acts as the device power supply.

The second block monitors both RESET IN2 and V_{CC} . It asserts a reset signal (LOW) whenever RESET IN2 is below the <u>625mV</u> threshold or V_{CC} is below its reset threshold. <u>RESET2</u> remains asserted for a fixed 140ms

(min) or a user-adjustable time period after RESET IN2 rises above the 625mV reset threshold and $\overline{\text{RESET1}}$ is deasserted. Resets are guaranteed valid for VCC down to 1V.

The timing diagram in Figure 2 shows the reset timing characteristics of the MAX6391/MAX6392. As shown in Figure 2, RESET1 deasserts 140ms (min) (tRP1) after VCC exceeds the reset threshold. RESET2 deasserts tRP2 (140ms minimum or a user-adjustable timeout period) after RESET IN2 exceeds 625mV and RESET1 is deasserted. When RESET IN2 drops below 625mV while VCC is above the reset threshold, RESET2 asserts within 10µs typ. RESET1 is unaffected when this happens. When VCC falls below VTH1, RESET2 always asserts before RESET1 (tRD2 < tRD1).

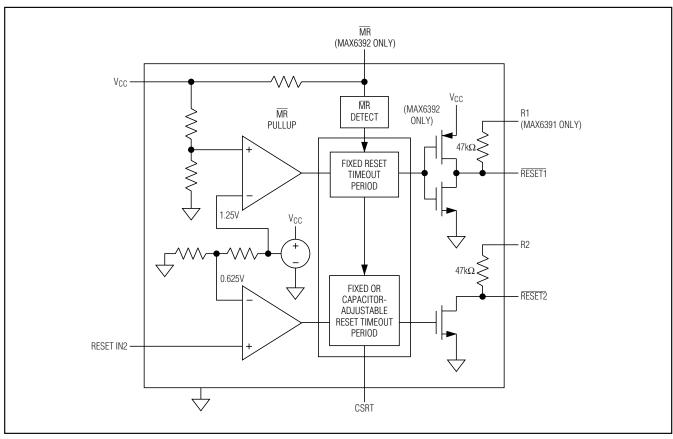


Figure 1. Functional Diagram

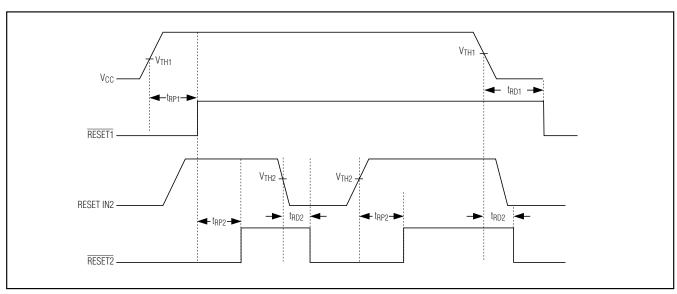


Figure 2. Timing Diagram

Selector Guide

PART NUMBER	NOMINAL THRESHOLD (V)	TOP MARK
MAX6391KA 46	4.63	AAHJ
MAX6391KA44	4.38	AAHK
MAX6391KA31	3.08	AAHL
MAX6391KA 29	2.93	AAHM
MAX6391KA26	2.63	AAHN
MAX6391KA 23	2.32	AAHO
MAX6391KA22	2.19	AAHP
MAX6391KA17	1.67	AAHQ
MAX6391KA 16	1.58	AAHR
MAX6392KA 46	4.63	AAHS
MAX6392KA44	4.38	AAHT
MAX6392KA31	3.08	AAHU
MAX6392KA 29	2.93	AAHV
MAX6392KA26	2.63	AAHW
MAX6392KA 23	2.32	AAHX
MAX6392KA22	2.19	AAHY
MAX6392KA17	1.67	AAHZ
MAX6392KA 16	1.58	AAIA

Standard versions in bold face. Samples are typically available for standard versions. Contact factory for availability.

Applications Information

Selecting the Reset Timeout Capacitor

The RESET2 delay may be adjusted by the user with an external capacitor connected from the CSRT pin to ground. The MAX6391 includes a 600nA current source that is switched to CCSRT to create a voltage ramp. The voltage ramp is compared to the internal 1.25V reference to set the RESET2 delay period. The period is calculated by:

$$\Delta t = C \times \Delta V/I$$

where ΔV = 1.25V, I = 600nA, and C is the external capacitor.

Simplifying,

$$t_{RP} = 2.08 \times 10^6 \text{ s} / F \times C_{CSRT}$$

For $C_{CSRT} = 1500 \text{pF}$, $t_{RP} = 3.1 \text{ms}$

 $\frac{A \text{ fixed}}{\text{RESET2}}$ internal 140ms (min) reset delay time for $\frac{A \text{ Fixed}}{\text{RESET2}}$ may be chosen by connecting the CSRT pin to VCC. The VCC to CSRT connection disables the voltage ramp and enables a separate fixed delay counter

chain. The MAX6391 internally determines the CSRT connection and provides the proper timing setup.

In all cases, RESET IN2 acts as the slave supply. VCC can assert the $\overline{\text{RESET2}}$ output but RESET IN2 will have no effect on the $\overline{\text{RESET1}}$ output.

Monitoring Voltages Other Than Vcc

An external resistive-divider network is required at RESET IN2 for most applications. The divider resistors, R3 and R4, may be calculated by the following formula:

$$V_{RST} = V_{TH2} \times (R3 + R4)/R4$$

where V_{TH2} = 625mV (internal reference voltage) and V_{RST} is the desired reset threshold voltage. R4 may be set to a conveniently high value (500k Ω for example, to minimize current consumption) and the equation may be solved for R3 by:

$$R3 = R4 \times (V_{RST}/V_{TH2} - 1)$$

For single-supply operations requiring two reset outputs (RESET1 before RESET2), connect RESET IN2 directly to V_{CC} and adjust RESET2 timeout delay with C_{CRST} as desired.

Pullup Resistors

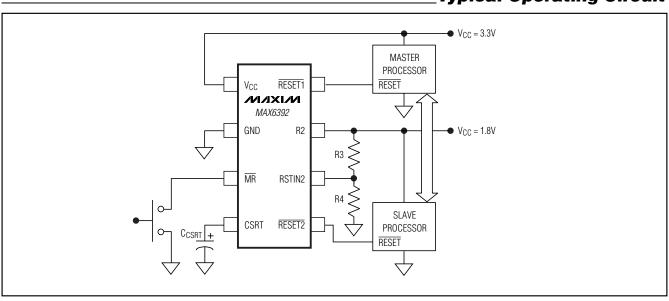
The MAX6391 includes open-drain outputs for both RESET1 and RESET2. Two internal resistors, R1 and R2, of $47 k\Omega$ each are provided with internal connections to RESET1 and RESET2. These resistors may be connected to the appropriate external voltage for independent VOH drive with no additional component requirements.

The MAX6392 includes a manual reset option, \overline{MR} , that replaces the R1 pullup resistor. The active-low manual reset input forces both $\overline{RESET1}$ and $\overline{RESET2}$ low. $\overline{RESET2}$ is driven active before $\overline{RESET1}$ in all cases (10µs typ). The resets follow standard reset timing specifications after the manual reset is released. The manual reset is internally pulled up to VCC through a $47k\Omega$ resistor.

Negative-Going Vcc 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 VCC or RESET IN2 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 VCC transient may typically have without issuing a reset signal. As the amplitude of the transient increases, the maximum allowable pulse width decreases.

Typical Operating Circuit



Pin Configurations (continued)

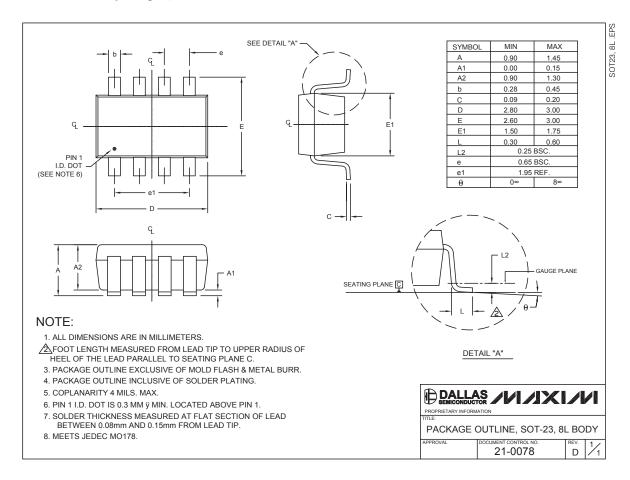
TOP VIEW RESET IN2 1 Vcc 2 CSRT 3 GND 4 8 MR 7 RESET1 6 R2 5 RESET2 SOT23-8

Chip Information

TRANSISTOR COUNT: 810 PROCESS: BICMOS

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)



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