



# Low-Voltage, High-Accuracy, Quad-Voltage $\mu$ P Supervisory Circuit in SOT Package

MAX6710

## General Description

The MAX6710 precision quad-voltage monitor with micro-processor ( $\mu$ P) supervisory reset timing monitors up to four system-supply voltages and asserts a single reset if any supply voltage drops below its preset threshold. The device significantly reduces system size and component count while improving reliability compared to separate ICs or discrete components.

A variety of factory-trimmed threshold voltages are available to accommodate different supply voltages and tolerances with minimal external component requirements. The selection includes internally fixed options for monitoring 5.0V, 3.3V, 3.0V, 2.5V, and 1.8V supplies with -5% or -10% tolerances. The device is also available with one to three adjustable threshold options to monitor voltages down to 0.62V.

A single active-low reset output asserts when any monitored input is below its associated threshold. The output is open drain with a weak internal pullup (10 $\mu$ A) to IN2. Reset remains low for a reset timeout period (140ms min) after all voltages are above the selected thresholds. The output is valid as long as either the IN1 or IN2 input voltage remains >1V.

The MAX6710 is available in a small 6-pin SOT23 package and operates over the extended (-40°C to +85°C) temperature range.

## Applications

- Telecommunications
- High-End Printers
- Desktop and Network Computers
- Data Storage Equipment
- Networking Equipment
- Industrial Equipment
- Set-Top Boxes

*Selector Guide appears at end of data sheet.*

*Pin Configuration appears at end of data sheet.*

## Features

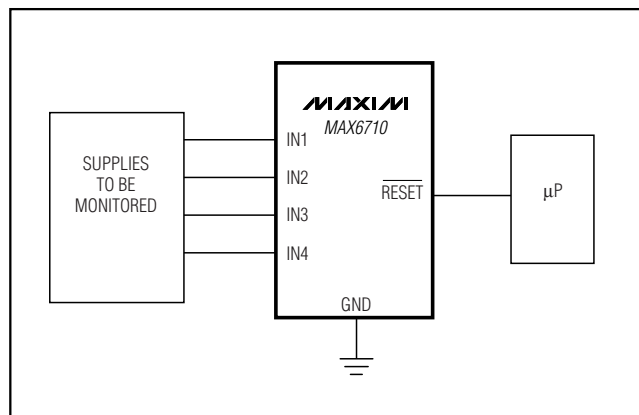
- ◆ Monitors Four Power-Supply Voltages
- ◆ Precision Factory-Set Reset Threshold Options for 5.0V, 3.3V, 3.0V, 2.5V, and 1.8V Supplies
- ◆ Adjustable Voltage Threshold Monitors Down to 0.62V with 1.5% Accuracy
- ◆ Low 35 $\mu$ A Supply Current
- ◆ Open-Drain  $\overline{\text{RESET}}$  Output with 10 $\mu$ A Internal Pullup
- ◆ 140ms (min) Reset Timeout Period
- ◆  $\overline{\text{RESET}}$  Valid to IN1 = 1V or IN2 = 1V
- ◆ Immune to Short Monitored Supply Transients
- ◆ Guaranteed from -40°C to +85°C
- ◆ Small 6-Pin SOT23 Package

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6710_UT-T*	-40°C to +85°C	6 SOT23-6

\*Insert the desired suffix letter from the Selector Guide into the blank to complete the part number. There is a 2500 piece minimum order increment requirement on the SOT package and these devices are available in tape-and-reel only.

## Typical Operating Circuit



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## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)  
 Input Voltages (IN<sub>n</sub>) .....-0.3V to +6V  
 RESET .....-0.3V to +6V  
 Continuous RESET Current .....20mA  
 Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 6-Pin SOT23 (derate 8.7mW/°C above +70°C).....695.7mW

Operating Temperature Range .....-40°C to +85°C  
 Storage Temperature Range .....-65°C to +150°C  
 Junction Temperature .....+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<sub>IN2</sub> = 1V to 5.5V, T<sub>A</sub> = -40°C to +85°C, unless otherwise noted. Typical values are at V<sub>IN2</sub> = 3.0V to 3.3V, T<sub>A</sub> = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Voltage Range (Notes 2, 3)	V <sub>CC</sub>	MAX6710Q		2.0		5.5	V
	V <sub>IN2</sub>	All others	T <sub>A</sub> = 0°C to +85°C	1.0		5.5	
			T <sub>A</sub> = -40°C to +85°C	1.2		5.5	
Input Current	I <sub>IN</sub>	IN <sub>n</sub> = nominal input voltage (for 1.8V, 2.5V, and 5.0V supplies)			25	40	μA
		IN <sub>2</sub> = nominal input voltage (for 3.0V and 3.3V supplies) (Note 4)			55	115	
		V <sub>IN1</sub> = 0 to 0.85V (for adjustable thresholds)				0.4	
		V <sub>IN3</sub> , V <sub>IN4</sub> = 0 to 0.85V (for adjustable thresholds)				0.2	
	I <sub>CC</sub>	MAX6710Q only, V <sub>CC</sub> = 5.5V			35	50	
Threshold Voltage	V <sub>TH</sub>	IN <sub>n</sub> decreasing	5V (-5%)	4.50	4.63	4.75	V
			5V (-10%)	4.25	4.38	4.50	
			3.3V (-5%)	3.00	3.08	3.15	
			3.3V (-10%)	2.85	2.93	3.00	
			3.0V (-5%)	2.70	2.78	2.85	
			3.0V (-10%)	2.55	2.63	2.70	
			2.5V (-5%)	2.25	2.32	2.38	
			2.5V (-10%)	2.13	2.19	2.25	
			1.8V (-5%)	1.62	1.67	1.71	
1.8V (-10%)	1.53	1.58	1.62				
Adjustable Threshold	V <sub>TH</sub>	IN <sub>n</sub> decreasing		0.611	0.620	0.624	V
Reset Threshold Hysteresis	V <sub>HYST</sub>	IN <sub>n</sub> increasing relative to IN <sub>n</sub> decreasing			0.3		%V <sub>TH</sub>
Reset Threshold Temperature Coefficient	TCV <sub>TH</sub>				60		ppm/°C
IN <sub>n</sub> to Reset Delay	t <sub>RD</sub>	V <sub>IN</sub> falling at 10mV/μs from V <sub>TH</sub> to (V <sub>TH</sub> - 50mV)			30		μs
Reset Timeout Period	t <sub>RP</sub>			140	200	280	ms

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## ELECTRICAL CHARACTERISTICS (continued)

( $V_{IN2} = 1V$  to  $5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted. Typical values are at  $V_{IN2} = 3.0V$  to  $3.3V$ ,  $T_A = +25^{\circ}C$ .) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
$\overline{RESET}$ Output Low	$V_{OL}$	$V_{IN2}, V_{CC} = 5V, I_{SINK} = 2mA$			0.3	V
		$V_{IN2}, V_{CC} = 2.5V, I_{SINK} = 1.2mA$			0.4	
		$V_{IN2} = 1.0V, I_{SINK} = 50\mu A, T_A = 0^{\circ}C$ to $+85^{\circ}C$			0.3	
$\overline{RESET}$ Output High	$V_{OH}$	$V_{CC} \geq 2.0V, I_{SOURCE} = 6\mu A, \overline{RESET}$ deasserted (MAX6710Q)	0.8 × $V_{CC}$		V	
		$V_{IN2} \geq 2.0V, I_{SOURCE} = 6\mu A, \overline{RESET}$ deasserted	0.8 × $V_{IN2}$			
$\overline{RESET}$ Output High Source Current	$I_{OH}$	$V_{IN2} \geq 2.0V, \overline{RESET}$ deasserted		10		$\mu A$

**Note 1:** 100% production tested at  $T_A = +25^{\circ}C$ . Limits over temperature guaranteed by design.

**Note 2:** The device is powered from input  $IN2$  or  $V_{CC}$  (for MAX6710Q).

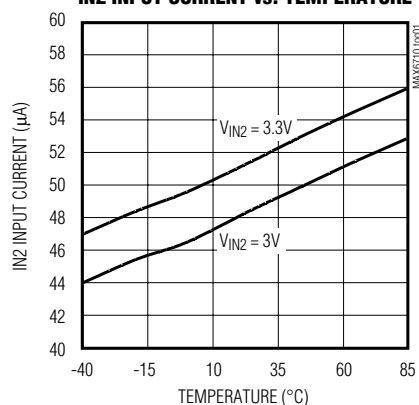
**Note 3:** The  $\overline{RESET}$  output is guaranteed to be in the correct state for  $IN1$  or  $IN2$  down to  $1V$ .

**Note 4:** Monitored  $IN2$  voltage ( $3.3V, 3.0V$ ) is also the device power supply. Supply current splits as follows:  $25\mu A$  for the resistor divider (for the monitored voltage) and  $30\mu A$  for other circuits.

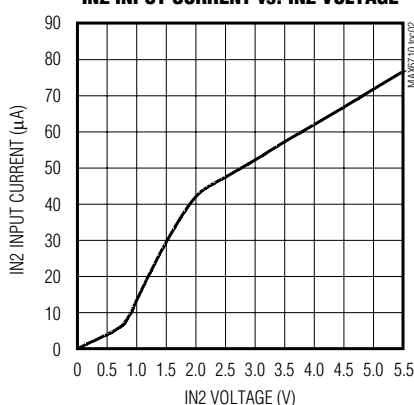
## Typical Operating Characteristics

( $V_{IN2} = 3.0V, T_A = +25^{\circ}C$ )

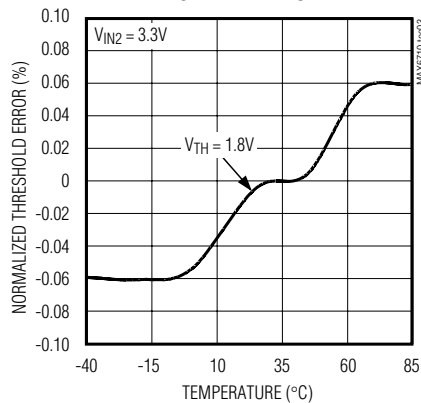
**IN2 INPUT CURRENT vs. TEMPERATURE**



**IN2 INPUT CURRENT vs. IN2 VOLTAGE**



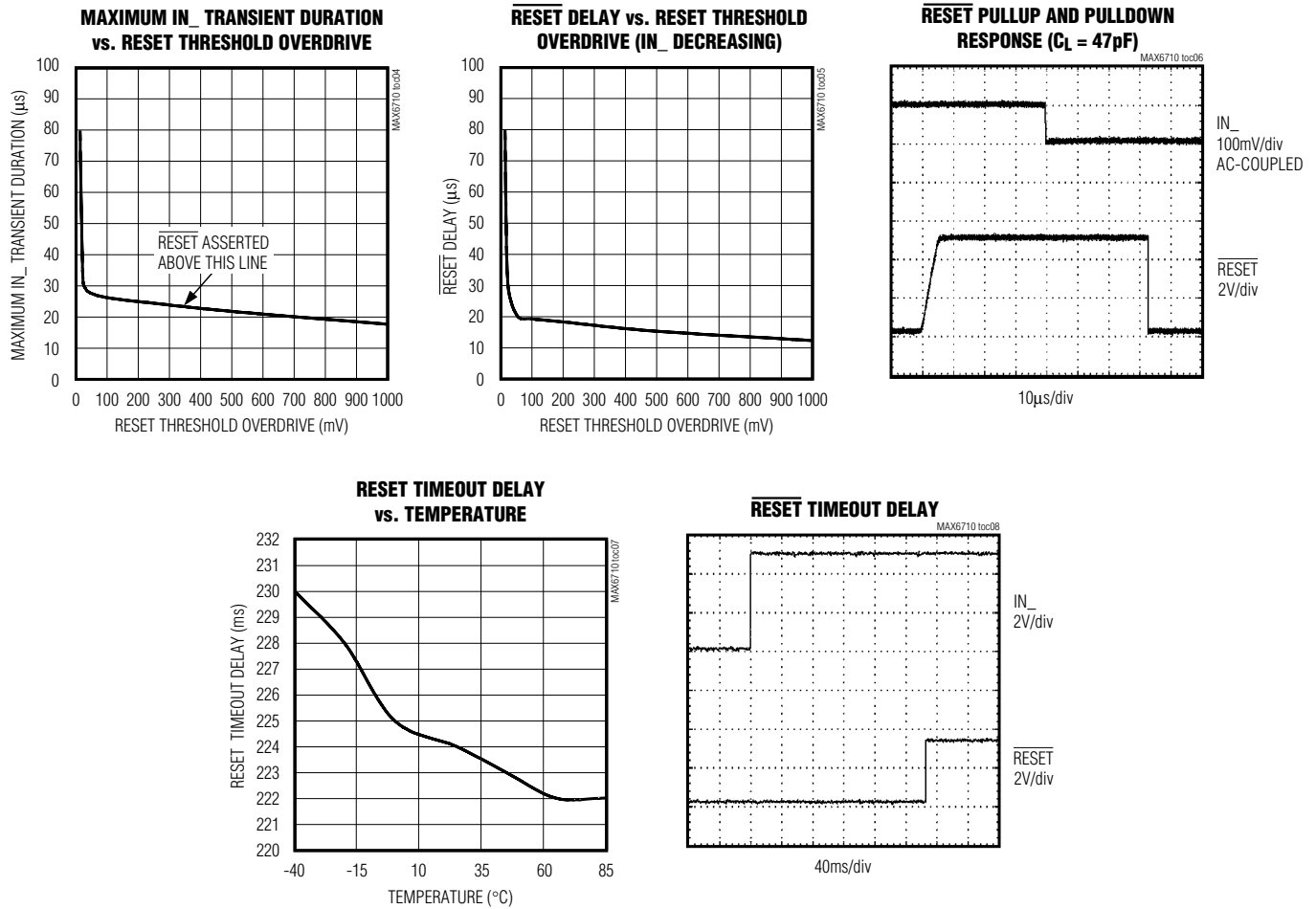
**NORMALIZED THRESHOLD ERROR vs. TEMPERATURE**



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## Typical Operating Characteristics (continued)

( $V_{IN2} = 3.0V$ ,  $T_A = +25^\circ C$ )



## Pin Description

PIN	NAME	FUNCTION
1	IN1	Input Voltage 1. See <i>Selector Guide</i> for monitored voltages.
2	IN2	Input Voltage 2. See <i>Selector Guide</i> for monitored voltages. IN2 is the power-supply input for the device. VCC is the power-supply input for the device and is not a monitored voltage (MAX6710Q only).
	VCC	
3	IN3	Input Voltage 3. See <i>Selector Guide</i> for monitored voltages.
4	IN4	Input Voltage 4. See <i>Selector Guide</i> for monitored voltages.
5	GND	Ground
6	RESET	Reset Output, Active Low. RESET goes low when any input goes below its specified threshold. After all inputs are above their threshold voltage, RESET remains low for at least 140ms (minimum) before going high. RESET output is open-drain with a weak internal pullup to IN2, VCC.

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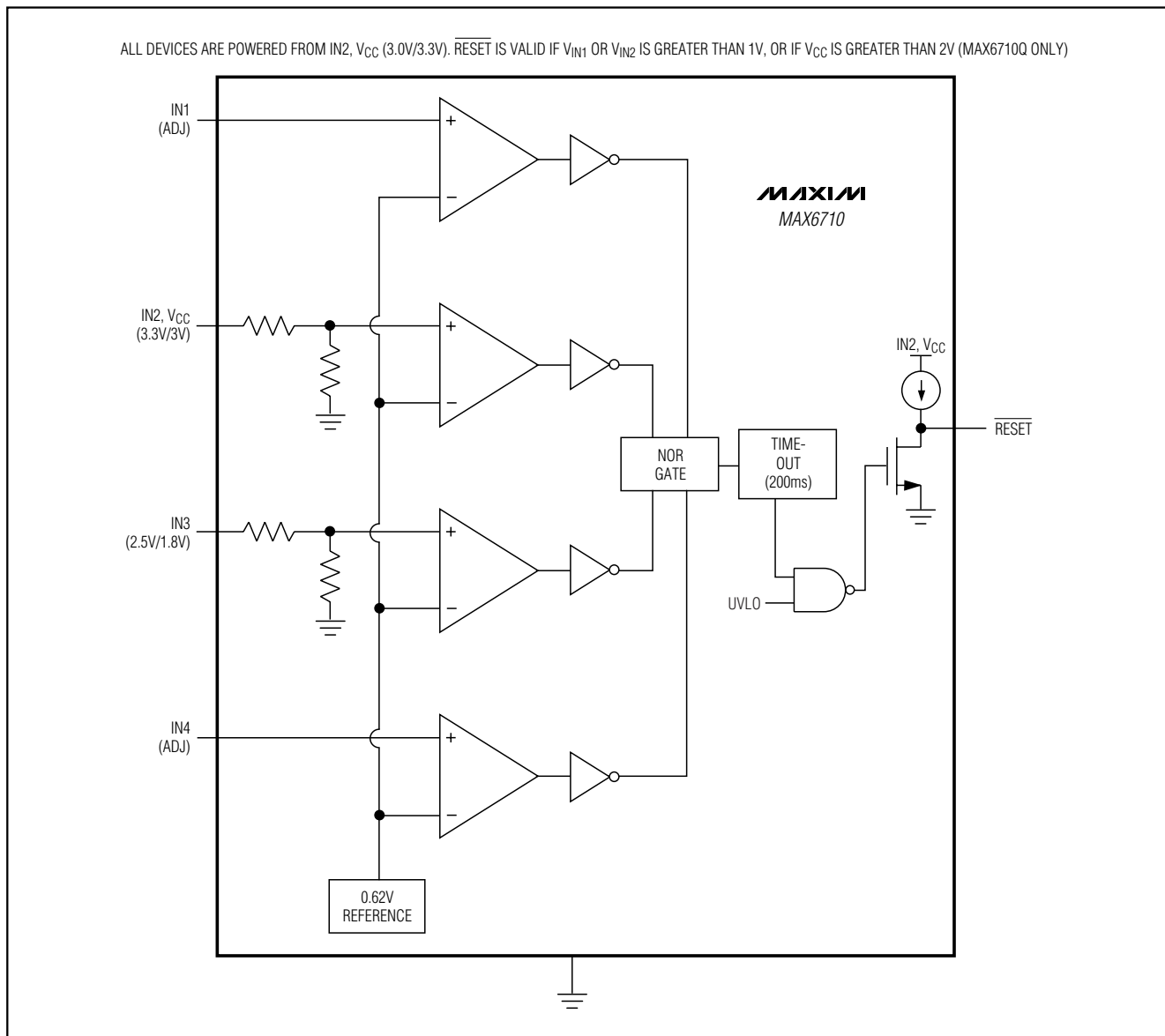


Figure 1. MAX6710 Functional Diagram

## Detailed Description

The MAX6710 is a very small, low-power, quad-voltage  $\mu$ P supervisory circuit designed to maintain system integrity in multisupply systems (Figure 1). The device offers several internally trimmed undervoltage threshold options that minimize the need for external components. Preset voltage monitoring options for 5.0V, 3.3V, 3.0V, 2.5V, and 1.8V make the device ideal for telecom-

munications, desktop and notebook computers, high-end printers, data storage equipment, and networking equipment applications.

The quad-voltage reset includes an accurate bandgap reference, four precision comparators, and a series of internally trimmed resistor-divider networks to set the factory-fixed reset threshold options. The resistor networks scale the specified IN<sub>n</sub> reset voltages to match the inter-

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nal bandgap reference/comparator voltage. Adjustable threshold options bypass the internal resistor networks and connect directly to one of the comparator inputs (an external resistor-divider network is required for threshold matching). The MAX6710Q provides a separate unmonitored power-supply input ( $V_{CC}$ ) and three adjustable voltage inputs.

Each of the internal comparators has a typical hysteresis of 0.3% with respect to its reset threshold. This built-in hysteresis improves the monitor's immunity to ambient noise without significantly reducing threshold accuracy when an input sits at its specified reset voltage. The MAX6710 is also designed to ignore short  $IN_{-}$  transients. See *Typical Operating Characteristics* for a glitch immunity graph.

## Applications Information

### Reset Output

The MAX6710  $\overline{RESET}$  output asserts low when any monitored  $IN_{-}$  voltage drops below its specified reset threshold and remains low for the reset timeout period (140ms minimum) after all inputs exceed their thresholds (Figure 2). The output is open drain with a weak internal pullup to the monitored  $IN2$  or  $V_{CC}$  supply (10 $\mu$ A typ). For many applications no external pullup resistor is required to interface with other logic devices. An external pullup resistor to any voltage from 0 to 5.5V can overdrive the internal pullup if interfacing to different logic-supply voltages (Figure 3). Internal circuitry prevents reverse current flow from the external pullup voltage to  $IN2$ .

The MAX6710 is normally powered from the monitored  $IN2$  supply when all input voltages are above their specified thresholds. When any supply drops below its threshold, the reset output is asserted and guaranteed to remain low while either  $IN1$  or  $IN2$  is above 1.0V.

### Adjustable Thresholds

The MAX6710 offers several monitor options with adjustable reset thresholds. The threshold voltage at each adjustable  $IN_{-}$  input is typically 0.62V. To monitor a voltage  $>0.62V$ , connect a resistor-divider network to the circuit as shown in Figure 4.

$$V_{INTH} = 0.62V \times (R1 + R2) / R2$$

or, solved in terms of  $R1$ :

$$R1 = R2 \left( \frac{V_{INTH}}{0.62V} - 1 \right)$$

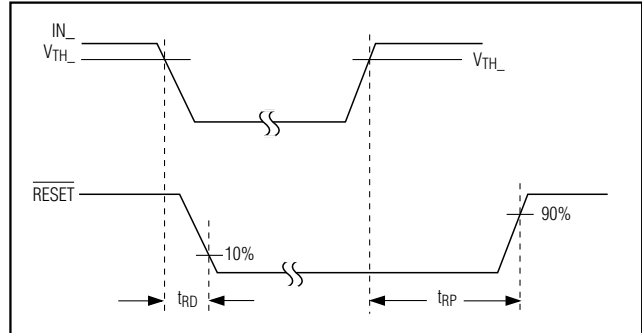


Figure 2.  $\overline{RESET}$  Output Timing Diagram

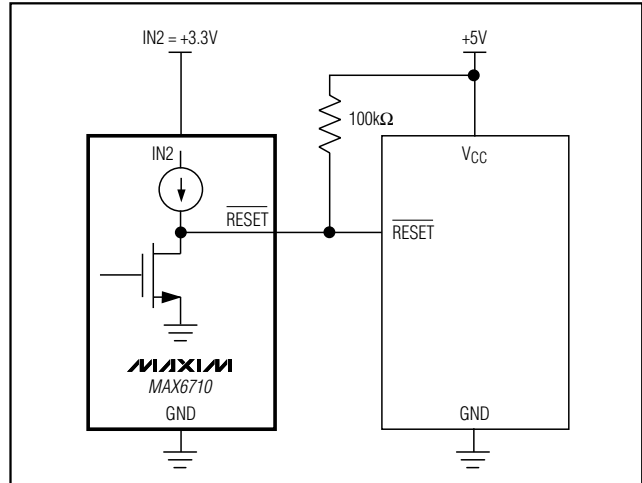


Figure 3. Interfacing to Different Logic-Supply Voltage

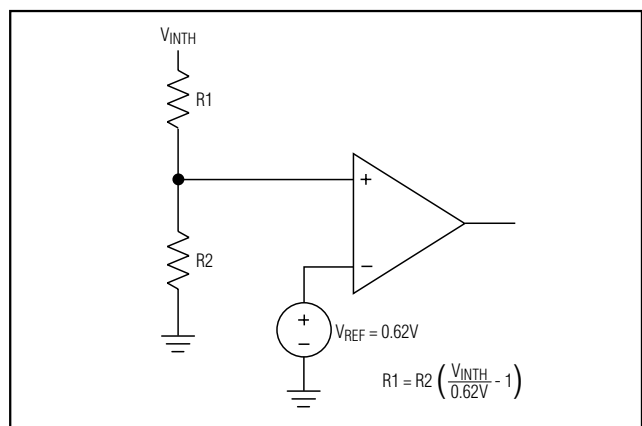


Figure 4. Setting the Auxiliary Monitor

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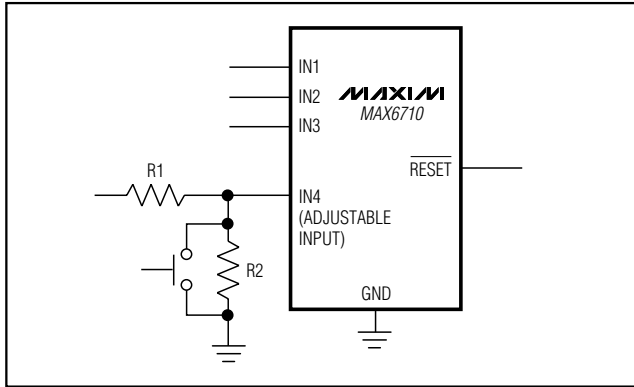


Figure 5. Adding Manual Reset Capability

Because the MAX6710 has a guaranteed input current of  $\pm 0.2\mu\text{A}$  ( $\pm 0.4\mu\text{A}$  for IN1) on its adjustable inputs, resistor values up to  $100\text{k}\Omega$  can be used for R2 with  $<1\%$  error. The MAX6710Q includes an internal voltage clamp (1.5V typ) at each of the adjustable voltage inputs. An input voltage higher than 1.5V induces a higher input current.

### Unused Inputs

Connect unused monitor inputs to a supply voltage greater in magnitude than their specified threshold voltages. For unused IN\_ adjustable inputs, connect a  $1\text{M}\Omega$  series resistor between the unused input and IN2 (or VCC) to limit the bias current. The IN2 input must

always be used for normal operation (device power-supply pin). Unused monitor inputs cannot be connected to ground or allowed to float.

### Adding Manual Reset Capability

Figure 5 shows an application circuit adding manual reset to the MAX6710 quad-voltage supervisor. Depressing the pushbutton switch short-circuits the analog input to ground and initiates a  $\overline{\text{RESET}}$  pulse. The switch must be open for 200ms (typ) in order to deassert the  $\overline{\text{RESET}}$  output. No external switch debounce is required. Use a small capacitor to improve noise immunity when using long leads from the pushbutton switch to the adjustable input.

### Power-Supply Bypassing and Grounding

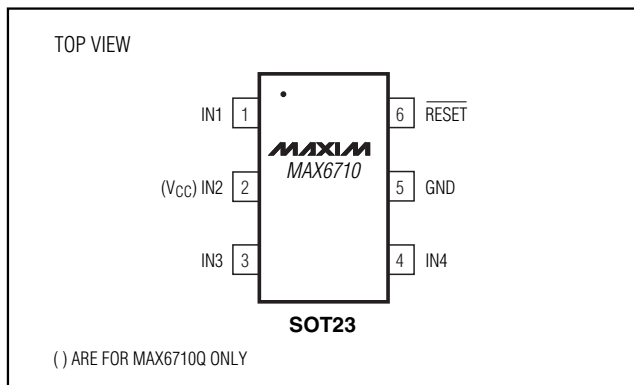
The MAX6710 is normally powered from the monitored IN2 or from the VCC supply input. All monitored inputs are immune to short supply transients. If higher immunity is desired in noisy applications, connect a  $0.1\mu\text{F}$  bypass capacitor from the IN2 input to ground. Additionally, capacitance can be added to IN1, IN3, and IN4 to increase their noise immunity.

### Chip Information

TRANSISTOR COUNT: 699

PROCESS: BiCMOS

### Pin Configuration



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## Selector Guide

PART (SUFFIX IN BOLD)	NOMINAL INPUT VOLTAGE				SUPPLY TOLERANCE (%)	TOP MARK
	IN1 (V)	IN2 (V)	IN3 (V)	IN4 (V)		
MAX6710 <b>A</b> UT	5	3.3	2.5	Adj*	10	AAZA
MAX6710 <b>B</b> UT	5	3.3	2.5	Adj*	5	AAZB
MAX6710 <b>C</b> UT	5	3.3	1.8	Adj*	10	AAZC
MAX6710 <b>D</b> UT	5	3.3	1.8	Adj*	5	AAZD
MAX6710 <b>E</b> UT	Adj*	3.3	2.5	1.8	10	AAZE
MAX6710 <b>F</b> UT	Adj*	3.3	2.5	1.8	5	AAZF
MAX6710 <b>G</b> UT	5	3.3	Adj*	Adj*	10	AAZG
MAX6710 <b>H</b> UT	5	3.3	Adj*	Adj*	5	AAZH
MAX6710 <b>I</b> UT	Adj*	3.3	2.5	Adj*	10	AAZI
MAX6710 <b>J</b> UT	Adj*	3.3	2.5	Adj*	5	AAZJ
MAX6710 <b>K</b> UT	Adj*	3.3	1.8	Adj*	10	AAZK
MAX6710 <b>L</b> UT	Adj*	3.3	1.8	Adj*	5	AAZL
MAX6710 <b>M</b> UT	Adj*	3	2.5	Adj*	10	AAZM
MAX6710 <b>N</b> UT	Adj*	3	2.5	Adj*	5	AAZN
MAX6710 <b>O</b> UT	Adj*	3	1.8	Adj*	10	AAZO
MAX6710 <b>P</b> UT	Adj*	3	1.8	Adj*	5	AAZP
MAX6710 <b>Q</b> UT	Adj*	V <sub>CC</sub>	Adj*	Adj*	N/A	AAZQ

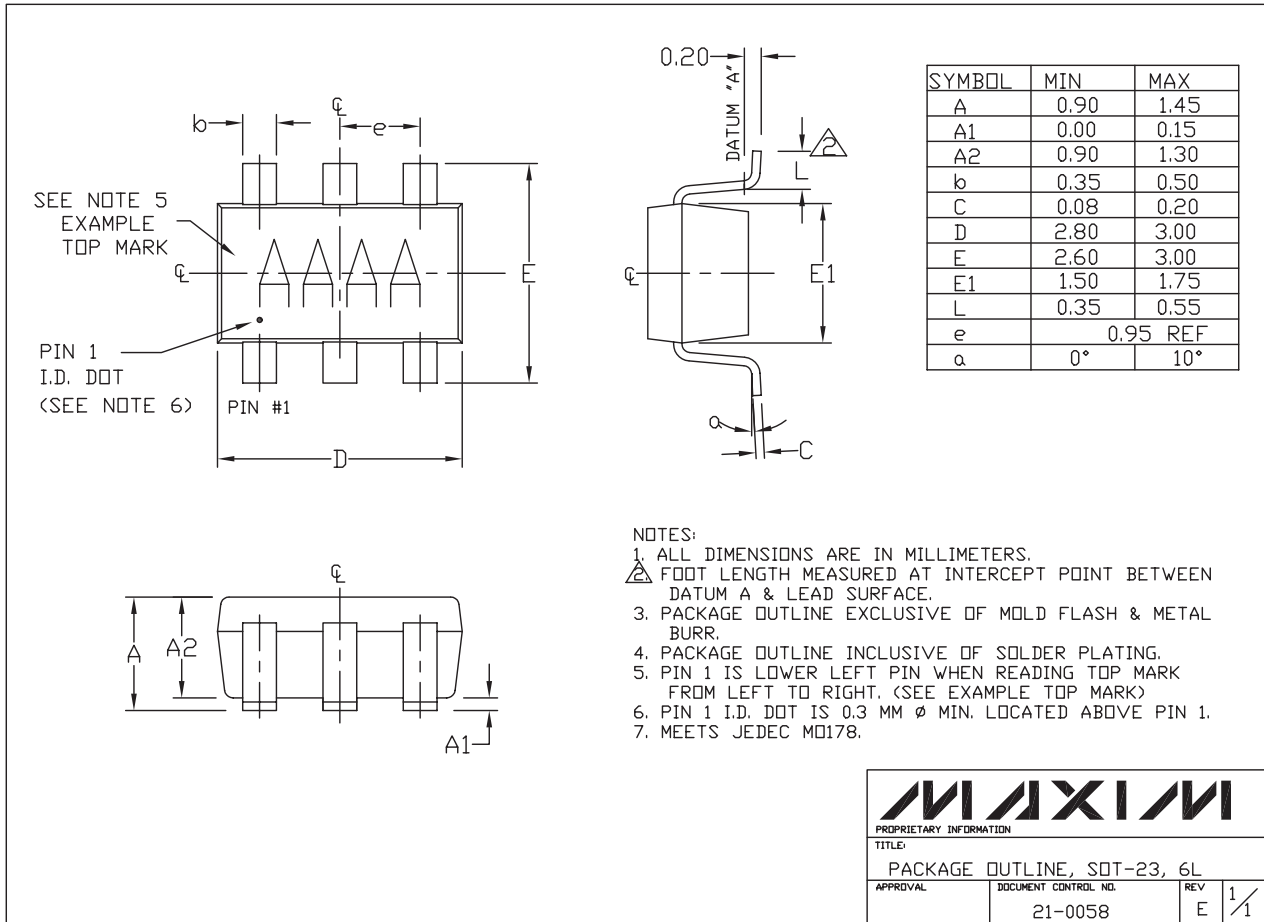
\*Adjustable voltage based on 0.62V internal threshold. External threshold voltage can be set using an external resistor-divider.



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## Package Information

**MAX6710**



6LSOT.EPS

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