

MAXIM

# Low-Voltage, High-Accuracy, Quad-Voltage μP Supervisory Circuit in SOT Package

## General Description

The MAX6710 precision quad-voltage monitor with microprocessor (μP) 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 (10μA) 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 35μA Supply Current
- ♦ Open-Drain RESET Output with 10μA Internal Pullup
- ♦ 140ms (min) Reset Timeout Period
- ♦ 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

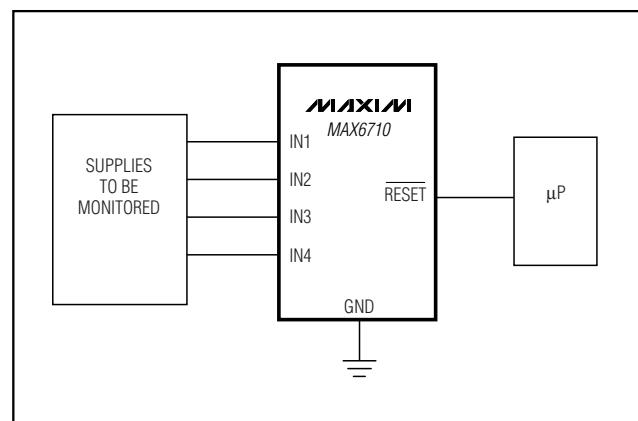
MAX6710

## 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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For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).

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

## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)	
Input Voltages (IN <sub>—</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

(VIN2 = 1V to 5.5V, T<sub>A</sub> = -40°C to +85°C, unless otherwise noted. Typical values are at VIN2 = 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
	VIN2	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>—</sub> = nominal input voltage (for 1.8V, 2.5V, and 5.0V supplies)	25	40		μA
		IN2 = nominal input voltage (for 3.0V and 3.3V supplies) (Note 4)	55	115		
		VIN1 = 0 to 0.85V (for adjustable thresholds)		0.4		
		VIN3, VIN4 = 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>—</sub> decreasing	5V (-5%)	4.50	4.63	4.75
			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>—</sub> decreasing	0.611	0.620	0.624	V
Reset Threshold Hysteresis	V <sub>HYST</sub>	IN <sub>—</sub> increasing relative to IN <sub>—</sub> decreasing		0.3		%V <sub>TH</sub>
Reset Threshold Temperature Coefficient	TCV <sub>TH</sub>			60		ppm/°C
IN <sub>—</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°C to +85°C, unless otherwise noted. Typical values are at  $V_{IN2}$  = 3.0V to 3.3V,  $T_A$  = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
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°C to +85°C		0.3		
RESET Output High	$V_{OH}$	$V_{CC} \geq 2.0V$ , $I_{SOURCE}$ = 6 $\mu$ A, RESET deasserted (MAX6710Q)		0.8 $\times V_{CC}$		V
		$V_{IN2} \geq 2.0V$ , $I_{SOURCE}$ = 6 $\mu$ A, RESET deasserted		0.8 $\times V_{IN2}$		
RESET Output High Source Current	$I_{OH}$	$V_{IN2} \geq 2.0V$ , RESET deasserted		10		$\mu$ A

**Note 1:** 100% production tested at  $T_A$  = +25°C. Limits over temperature guaranteed by design.

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

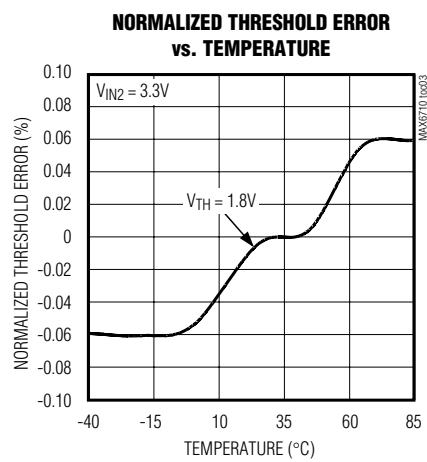
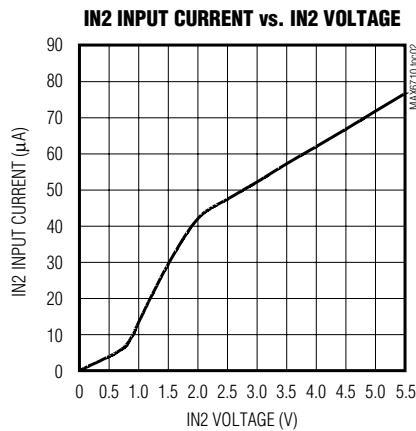
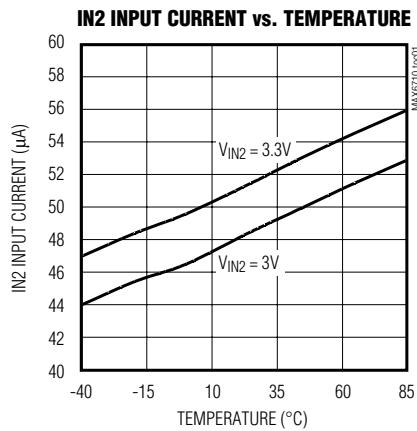
**Note 3:** The RESET output is guaranteed to be in the correct state for IN1 or IN2 down to 1V.

**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.

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## Typical Operating Characteristics

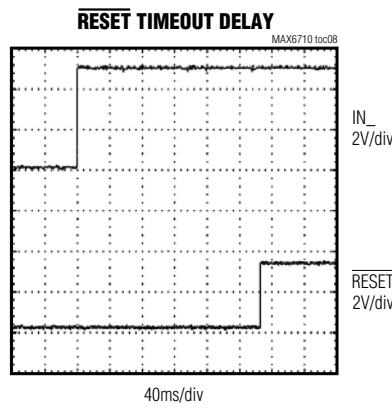
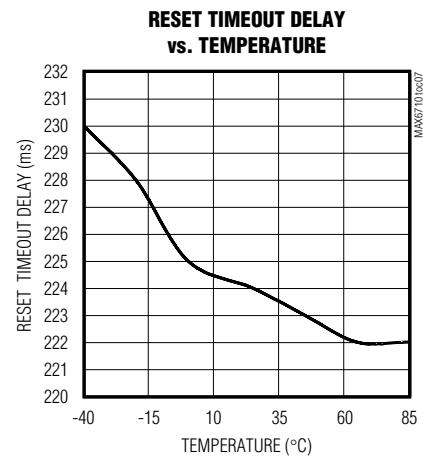
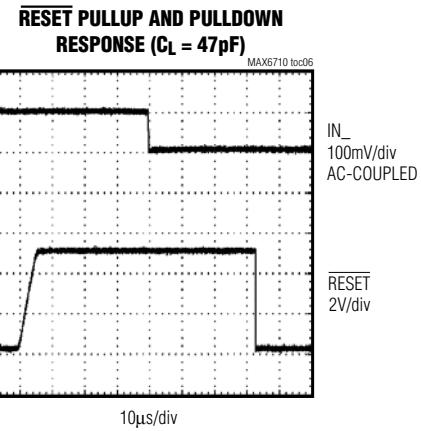
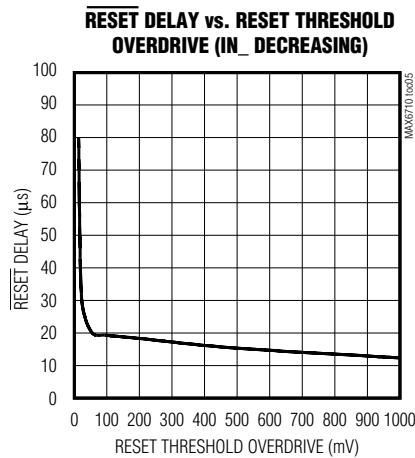
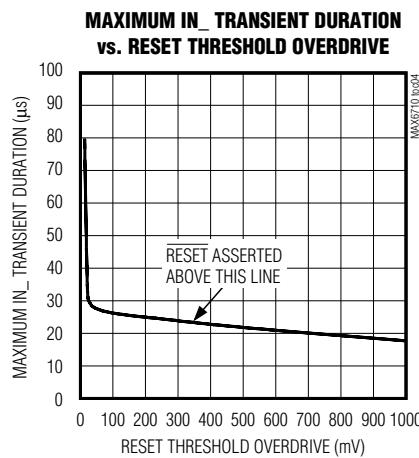
( $V_{IN2}$  = 3.0V,  $T_A$  = +25°C)



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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. V <sub>CC</sub> is the power-supply input for the device and is not a monitored voltage (MAX6710Q only).
	V <sub>CC</sub>	
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. $\overline{\text{RESET}}$ goes low when any input goes below its specified threshold. After all inputs are above their threshold voltage, $\overline{\text{RESET}}$ remains low for at least 140ms (minimum) before going high. $\overline{\text{RESET}}$ output is open-drain with a weak internal pullup to IN2, V <sub>CC</sub> .

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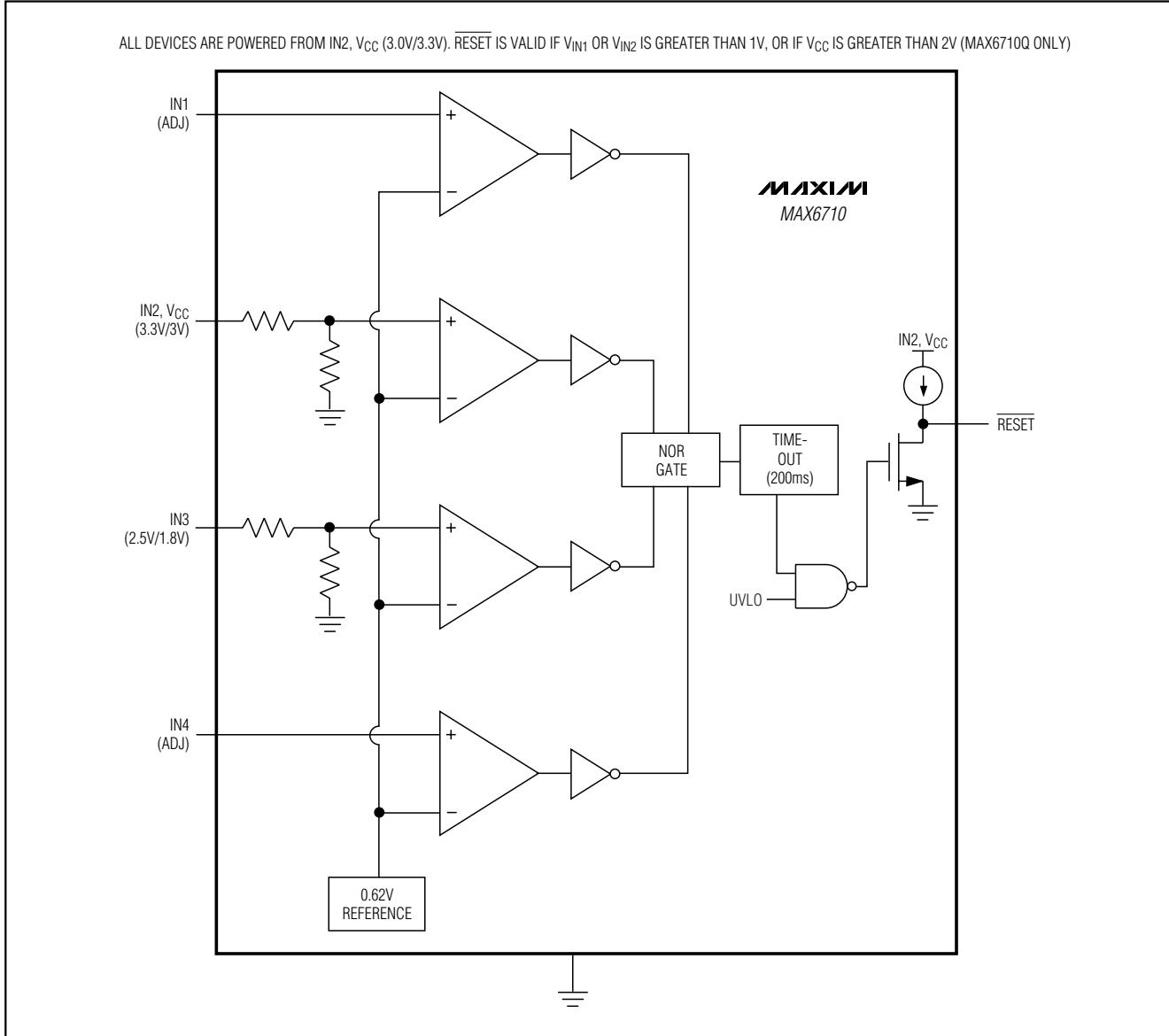


Figure 1. MAX6710 Functional Diagram

## 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>1</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<sub>CC</sub>) 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<sub>\_</sub> transients. See *Typical Operating Characteristics* for a glitch immunity graph.

## Applications Information

### Reset Output

The MAX6710  $\overline{\text{RESET}}$  output asserts low when any monitored IN<sub>\_</sub> 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<sub>CC</sub> 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<sub>\_</sub> input is typically 0.62V. To monitor a voltage >0.62V, connect a resistor-divider network to the circuit as shown in Figure 4.

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

or, solved in terms of R1:

$$R1 = R2 ((V_{\text{INTH}} / 0.62V) - 1)$$

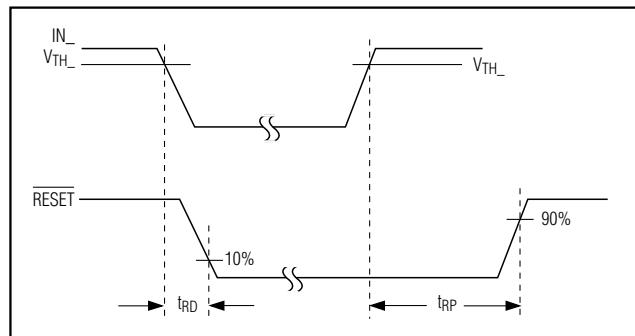


Figure 2.  $\overline{\text{RESET}}$  Output Timing Diagram

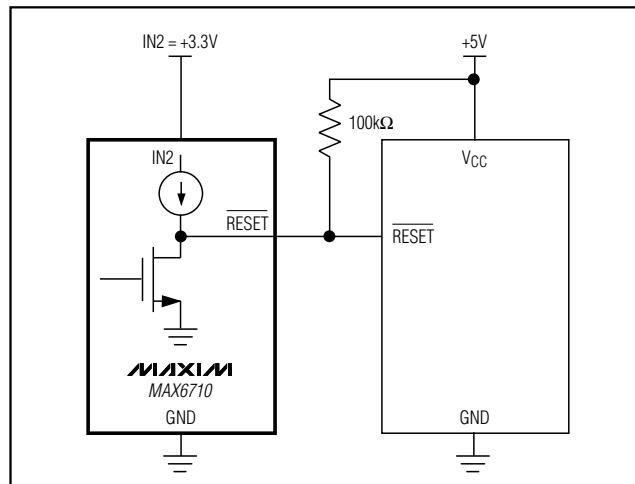


Figure 3. Interfacing to Different Logic-Supply Voltage

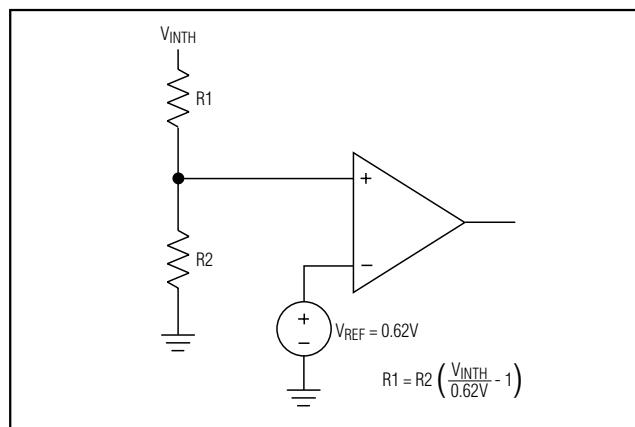


Figure 4. Setting the Auxiliary Monitor

# Low-Voltage, High-Accuracy, Quad-Voltage μP Supervisory Circuit in SOT Package

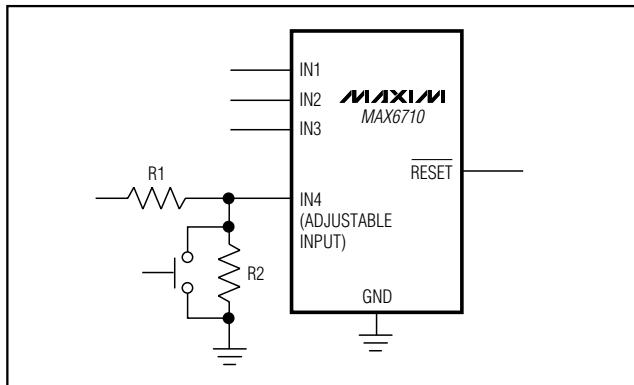


Figure 5. Adding Manual Reset Capability

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<sub>1</sub>–IN<sub>3</sub> 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 RESET pulse. The switch must be open for 200ms (typ) in order to deassert the 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

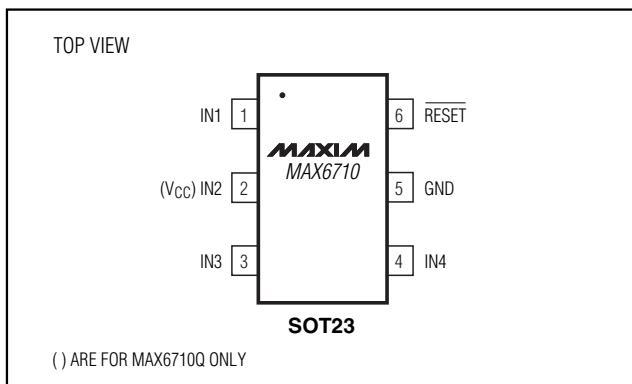
The MAX6710 is normally powered from the monitored IN2 or from the VCC supply input. All monitored inputs are immune to short supply transients. If higher immunity is desired in noisy applications, connect a  $0.1\mu\text{F}$  bypass capacitor from the IN2 input to ground. Additionally, capacitance can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

## Chip Information

TRANSISTOR COUNT: 699

PROCESS: BiCMOS

## Pin Configuration



**MAX6710**

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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)		
MAX6710AUT	5	3.3	2.5	Adj*	10	AAZA
MAX6710BUT	5	3.3	2.5	Adj*	5	AAZB
MAX6710CUT	5	3.3	1.8	Adj*	10	AAZC
MAX6710DUT	5	3.3	1.8	Adj*	5	AAZD
MAX6710EUT	Adj*	3.3	2.5	1.8	10	AAZE
MAX6710FUT	Adj*	3.3	2.5	1.8	5	AAZF
MAX6710GUT	5	3.3	Adj*	Adj*	10	AAZG
MAX6710HUT	5	3.3	Adj*	Adj*	5	AAZH
MAX6710IUT	Adj*	3.3	2.5	Adj*	10	AAZI
MAX6710JUT	Adj*	3.3	2.5	Adj*	5	AAZJ
MAX6710KUT	Adj*	3.3	1.8	Adj*	10	AAZK
MAX6710LUT	Adj*	3.3	1.8	Adj*	5	AAZL
MAX6710MUT	Adj*	3	2.5	Adj*	10	AAZM
MAX6710NUT	Adj*	3	2.5	Adj*	5	AAZN
MAX6710OUT	Adj*	3	1.8	Adj*	10	AAZO
MAX6710PUT	Adj*	3	1.8	Adj*	5	AAZP
MAX6710QUT	Adj*	V <sub>CC</sub>	Adj*	Adj*	N/A	AAZQ

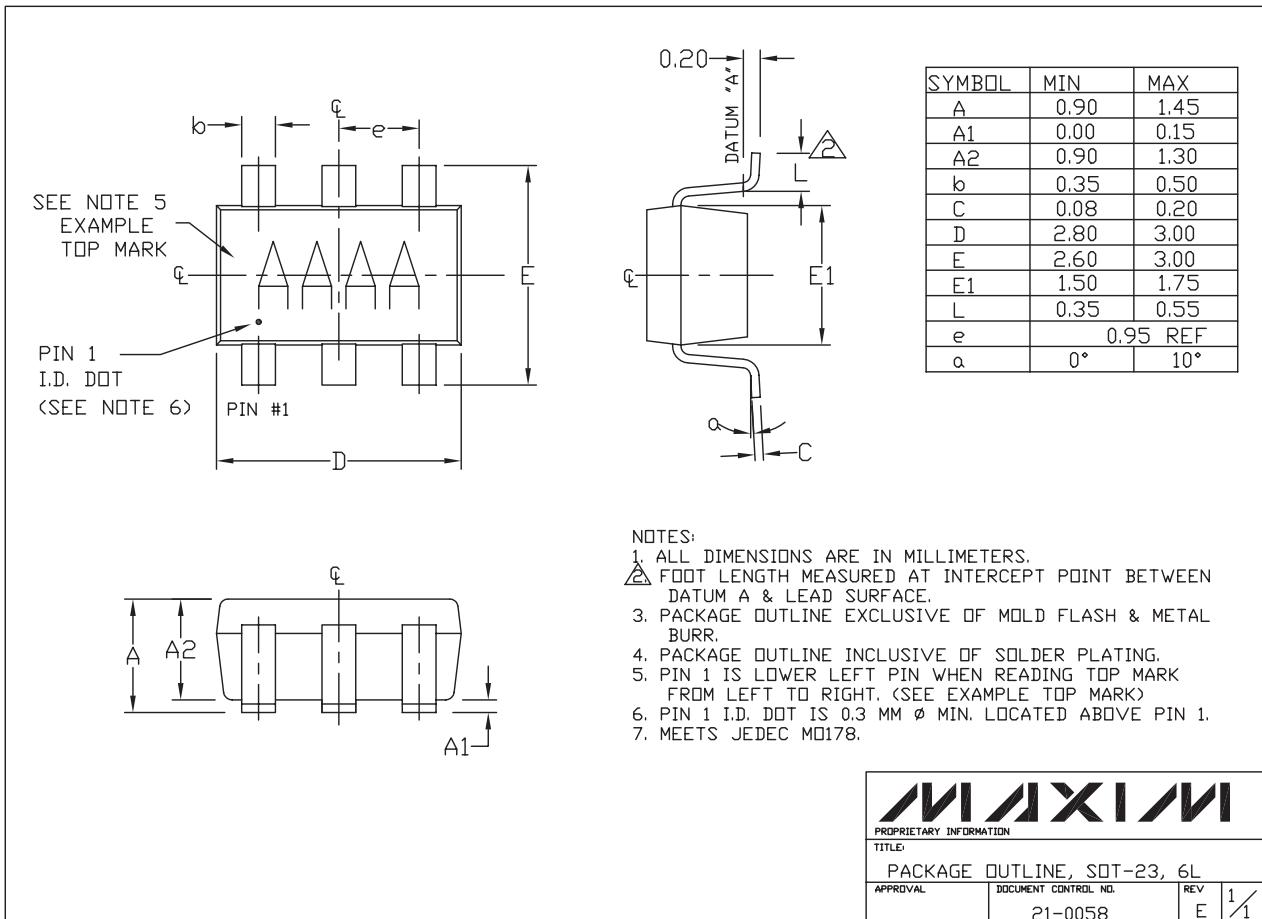
\*Adjustable voltage based on 0.62V internal threshold. External threshold voltage can be set using an external resistor-divider.

# Low-Voltage, High-Accuracy, Quad-Voltage μP Supervisory Circuit in SOT Package

## Package Information

MAX6710

6LSOT-6FS



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