



Precision, Micropower, 3V Series Voltage Reference in SOT23

MAX6010

General Description

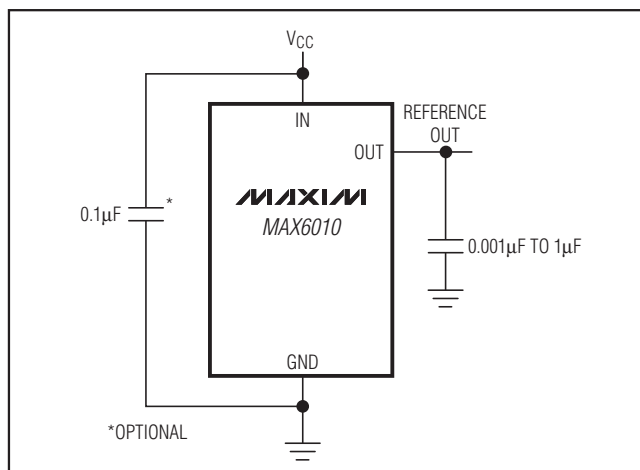
The MAX6010 is a precision, low-noise, low-dropout, micropower voltage reference in a SOT23 package. This three-terminal voltage reference operates with an input voltage from 3.2V to 5.5V, and outputs 3V.

The MAX6010 voltage reference consumes less than 5 μ A (max) of supply current and can source up to 7mA and sink up to 1mA of load current when the input is 5V. Unlike conventional shunt-mode (two-terminal) references that waste supply current and require an external resistor, the MAX6010 offers a supply current that is virtually independent of supply voltage (with only 0.05 μ A/V variation with supply voltage) and does not require an external resistor. The MAX6010 has initial accuracies of 0.2% (A grade) and 0.4% (B grade) and a temperature drift of 50ppm/ $^{\circ}$ C (max). The low-dropout voltage and the ultra-low supply current over the full voltage range make this device ideal for portable and battery-operated applications. The MAX6010 is available in a small, 3-pin SOT23 package.

Applications

Battery-Operated Equipment
Portable Equipment
Lens Image Stabilization
Data-Acquisition Systems
Industrial and Process-Control Systems

Typical Application Circuit



Features

- ♦ Ultra-Low Supply Current: 5 μ A (max)
- ♦ 3V Output from 3.2V Input
- ♦ Small, 3-Pin SOT23 Package
- ♦ Initial Accuracy: $\pm 0.2\%$ (max)
- ♦ Low Temperature Drift: 50ppm/ $^{\circ}$ C (max)
- ♦ 200mV Dropout Voltage
- ♦ Load Regulation (7mA Source): 200 μ V/mA (max)
- ♦ Line Regulation 3.2V to 5.5V: 350 μ V/V (max)

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX6010AEUR+T	-40 $^{\circ}$ C to +85 $^{\circ}$ C	3 SOT23	FZUS
MAX6010BEUR+T	-40 $^{\circ}$ C to +85 $^{\circ}$ C	3 SOT23	FZUU

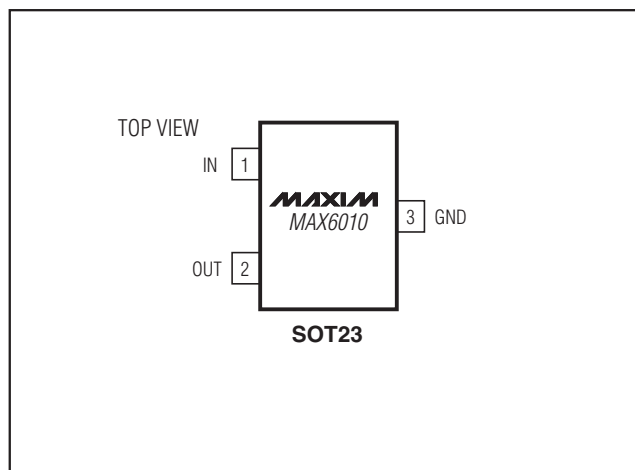
+Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

Selector Guide

PART	OUTPUT VOLTAGE (V)	INITIAL ACCURACY (%)	TEMP COEFFICIENT (ppm/ $^{\circ}$ C)
MAX6010AEUR	3	± 0.2	50
MAX6010BEUR	3	± 0.4	50

Pin Configuration



Precision, Micropower, 3V Series Voltage Reference in SOT23

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)

V_{IN} , V_{OUT} -0.3V to +6V
Output Short-Circuit Duration to GND or V_{IN} Continuous
Continuous Power Dissipation ($T_A = +70^\circ\text{C}$)
3-Pin SOT23 (derate 4.0mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$) 320mW

Operating Temperature Range -40°C to $+85^\circ\text{C}$
Junction Temperature $+150^\circ\text{C}$
Storage Temperature Range -65°C to $+150^\circ\text{C}$
Lead Temperature (soldering, 10s) $+300^\circ\text{C}$

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

($V_{IN} = 5\text{V}$; $C_{OUT} = 47\text{nF}$, $C_{IN} = 0.1\mu\text{F}$, $I_{OUT} = 0$; $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
OUTPUT						
Output Voltage	V_{OUT}	MAX6010A (0.2%), $T_A = +25^\circ\text{C}$	2.994	3.000	3.006	V
		MAX6010B (0.4%), $T_A = +25^\circ\text{C}$	2.988	3.000	3.012	
Output-Voltage Temperature Drift	TCV_{OUT}	(Note 2)		16	50	ppm/ $^\circ\text{C}$
Line Regulation	$\Delta V_{OUT} / \Delta V_{IN}$	$3.2\text{V} \leq V_{IN} \leq 5.5\text{V}$		50	350	$\mu\text{V/V}$
Load Regulation	$\Delta V_{OUT} / \Delta I_{OUT}$	$0 \leq I_{OUT} \leq 7\text{mA}$		60	200	$\mu\text{V/mA}$
		$-1\text{mA} \leq I_{OUT} \leq 0$		0.25	10	$\mu\text{V}/\mu\text{A}$
Short-Circuit Current	I_{SC}	Sourcing to GND		20		mA
		Sinking from V_{IN}		15		
Dropout Voltage	$V_{IN} - V_{OUT}$	$I_{OUT} = 1\text{mA}$ (Note 3)		55	200	mV
Thermal Hysteresis		(Note 4)		210		ppm
DYNAMIC CHARACTERISTICS						
Noise Voltage	e_{OUT}	0.1Hz to 10Hz		100		μV_{P-P}
		10Hz to 10kHz		200		μV_{RMS}
Ripple Rejection	PSRR	$V_{IN} = 5\text{V} \pm 100\text{mV}$ ($f \leq 2\text{kHz}$), $I_{OUT} = 1\text{mA}$		50		dB
Turn-On Settling Time	t_R	Settling to 0.1%, $C_{OUT} = 0.1\mu\text{F}$		700		μs
Capacitive-Load Stability Range	C_{OUT}	(Note 2)	1		1000	nF
INPUT						
Supply Voltage Range	V_{IN}	Guaranteed by line regulation test	3.2		5.5	V
Quiescent Supply Current	I_{IN}	$T_A = +25^\circ\text{C}$		3.6	5	μA
		$T_A = T_{MIN}$ to T_{MAX}		3.6	6	
Change in Quiescent Supply Current vs. Input Voltage	$\Delta I_{IN} / \Delta V_{IN}$	$3.2\text{V} \leq V_{IN} \leq 5.5\text{V}$		0.5	0.25	$\mu\text{A/V}$

Note 1: Devices are 100% production tested at $T_A = +25^\circ\text{C}$ and are guaranteed by design from $T_A = T_{MIN}$ to T_{MAX} .

Note 2: Not production tested. Guaranteed by design.

Note 3: Dropout voltage is the minimum input voltage at which V_{OUT} changes $\leq 0.2\%$ from V_{OUT} at rated V_{IN} and is guaranteed by load regulation test.

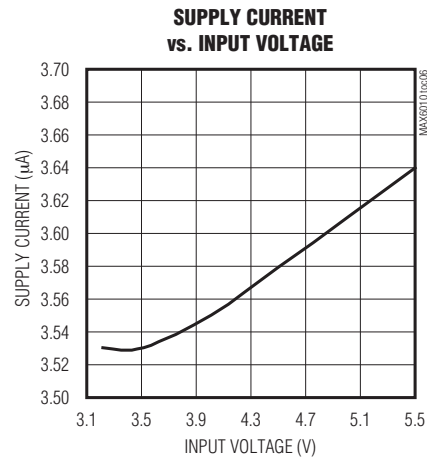
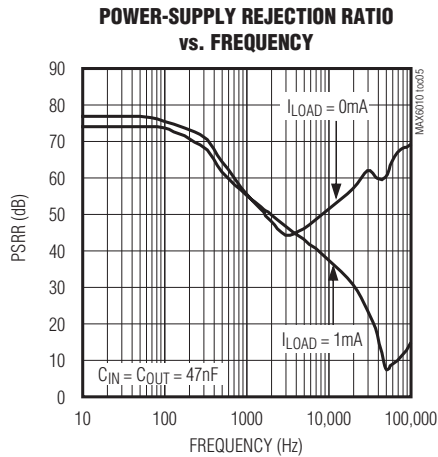
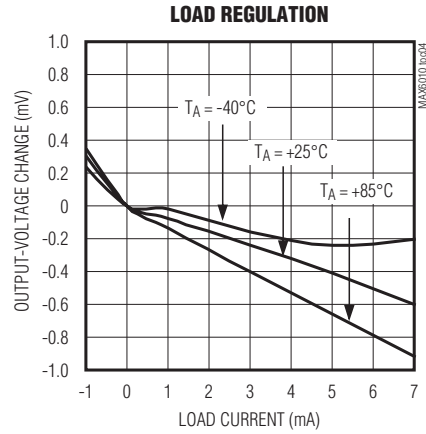
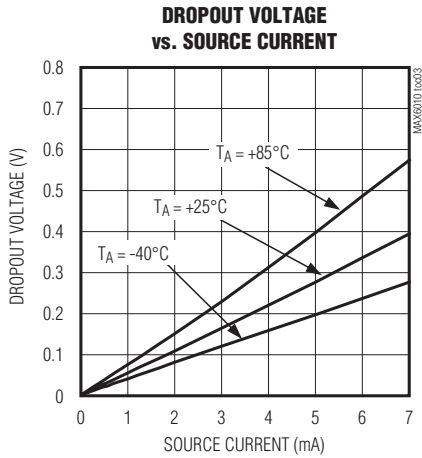
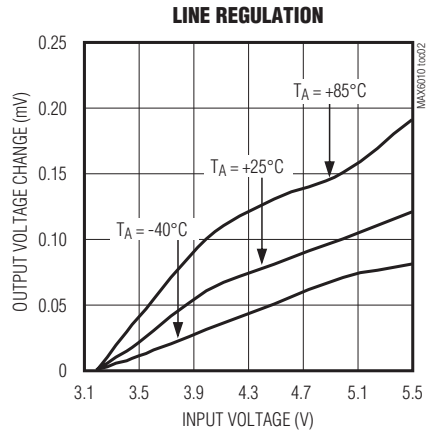
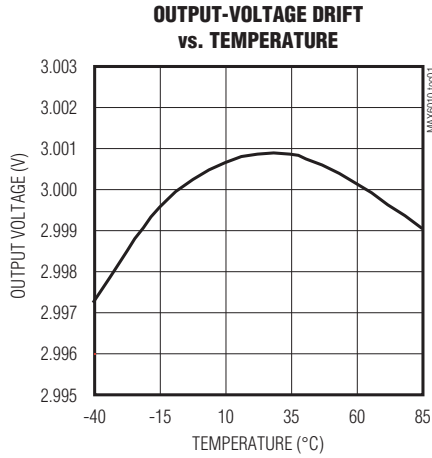
Note 4: Thermal hysteresis is defined as the change in $T_A = +25^\circ\text{C}$ output voltage before and after temperature cycling of the device (from $T_A = T_{MIN}$ to T_{MAX}). Initial measurement at $T_A = +25^\circ\text{C}$ is followed by temperature cycling the device to $T_A = +85^\circ\text{C}$ then to $T_A = -40^\circ\text{C}$ and another measurement at $T_A = +25^\circ\text{C}$ is compared to the original measurement at $T_A = +25^\circ\text{C}$.

Precision, Micropower, 3V Series Voltage Reference in SOT23

Typical Operating Characteristics

($V_{IN} = 5V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 0.1\mu F$, $T_A = +25^\circ C$, unless otherwise noted.)

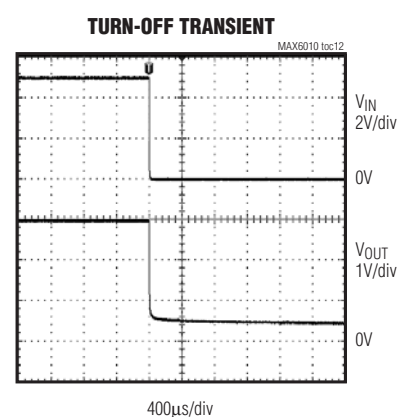
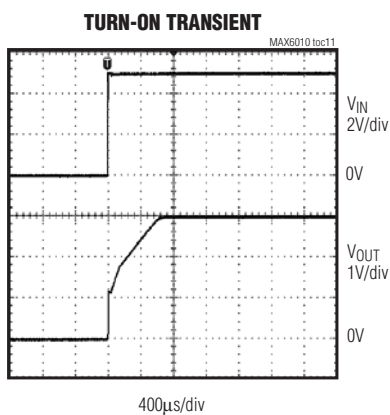
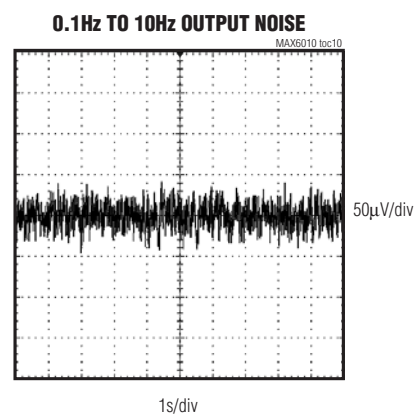
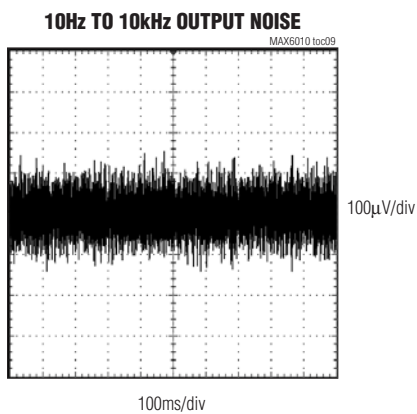
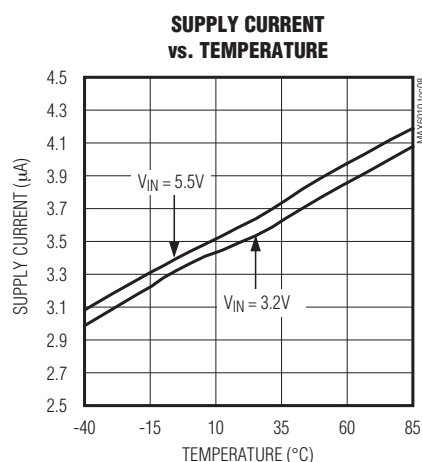
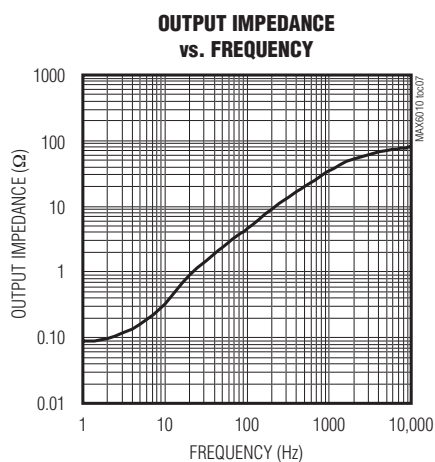
MAX6010



Precision, Micropower, 3V Series Voltage Reference in SOT23

Typical Operating Characteristics (continued)

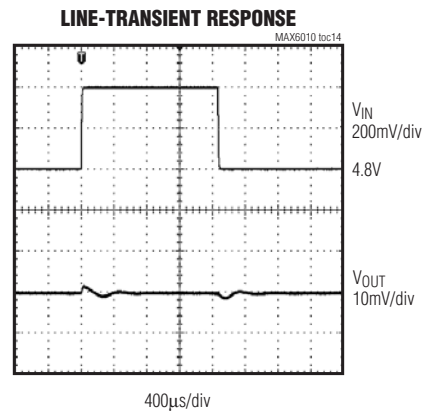
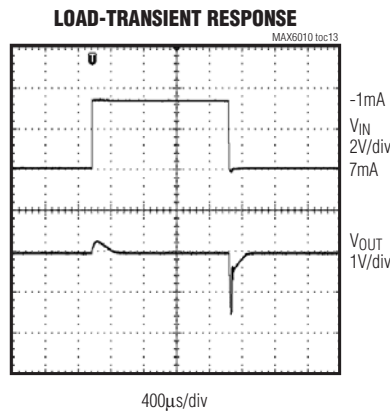
($V_{IN} = 5V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 0.1\mu F$, $T_A = +25^\circ C$, unless otherwise noted.)



Precision, Micropower, 3V Series Voltage Reference in SOT23

Typical Operating Characteristics (continued)

($V_{IN} = 5V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 0.1\mu F$, $T_A = +25^\circ C$, unless otherwise noted.)



Detailed Description

The MAX6010 is a precision, low-noise, low-dropout, micropower, bandgap voltage reference in a SOT23 package. This three-terminal reference operates with an input voltage from 3.2V to 5.5V, and outputs 3V. The device sources up to 7mA with < 200mV of dropout voltage and requires only 5µA (max) supply current.

Applications Information

Output/Load Capacitance

The MAX6010 requires a minimum of 1nF load to maintain output stability.

The device remains stable for capacitive loads as high as 1µF. In applications where the load or the supply can experience step changes, a larger output capacitor reduces the amount of overshoot (or undershoot) and assists the circuit's transient response.

Supply Current

The 5µA maximum supply current varies only 0.05µA/V with the supply voltage.

When the supply voltage is below the minimum-specified input voltage (as during turn-on), the device can draw up to 20µA beyond the nominal supply current.

Pin Description

PIN	NAME	FUNCTION
1	IN	Supply Voltage Input
2	OUT	Reference Voltage Output. Bypass with at least 1nF to ground. (See the <i>Output/Load Capacitance</i> section.)
3	GND	Ground

The input voltage source must be capable of providing this current to ensure reliable turn-on.

Turn-On Time

The MAX6010 typically turns on and settles to within 0.1% of the final value in 700µs. The turn-on time can increase with the device operating at the minimum dropout voltage and the maximum load.

Precision, Micropower, 3V Series Voltage Reference in SOT23

Chip Information

PROCESS: BiCMOS

Package Information

For the latest package outline information and land patterns, go to www.maxim-ic.com/packages.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
3 SOT23	U3-1	21-0051

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.

6 **Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600**