



Precision, Micropower, 3V Series Voltage Reference in SOT23

MAX6010

General Description

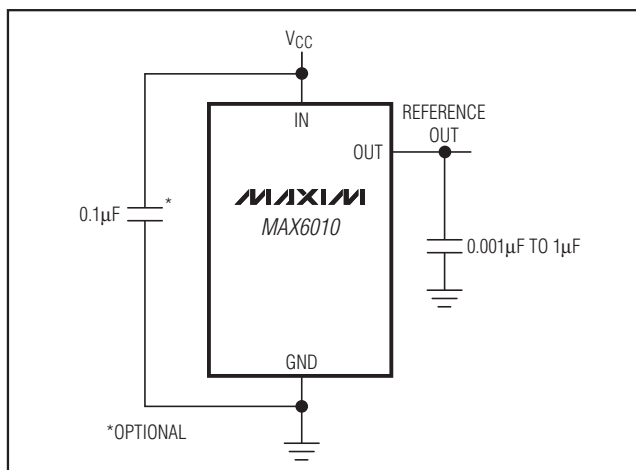
The MAX6010 is a precision, low-noise, low-dropout, micropower voltage reference in a SOT23 package. This three-terminal voltage reference operates with an input voltage from 3.2V to 5.5V, and outputs 3V.

The MAX6010 voltage reference consumes less than 5µA (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 0.05µA/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/°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: 5µA (max)
- ◆ 3V Output from 3.2V Input
- ◆ Small, 3-Pin SOT23 Package
- ◆ Initial Accuracy: ±0.2% (max)
- ◆ Low Temperature Drift: 50ppm/°C (max)
- ◆ 200mV Dropout Voltage
- ◆ Load Regulation (7mA Source): 200µV/mA (max)
- ◆ Line Regulation 3.2V to 5.5V: 350µV/V (max)

Ordering Information

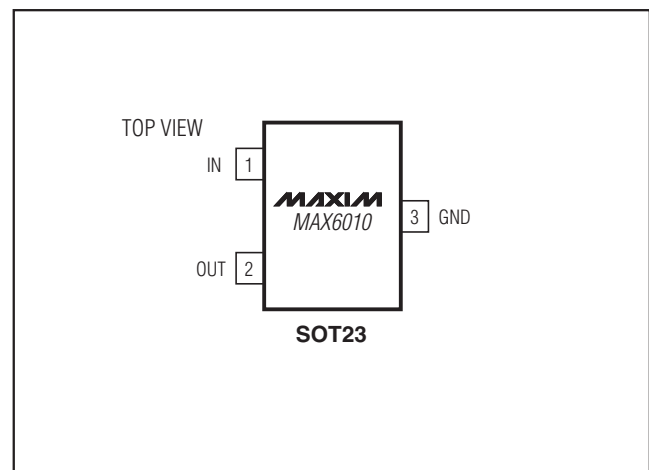
| PART | TEMP RANGE | PIN-PACKAGE | TOP MARK |
|---------------|----------------|-------------|----------|
| MAX6010AEUR+T | -40°C to +85°C | 3 SOT23 | FZUS |
| MAX6010BEUR+T | -40°C to +85°C | 3 SOT23 | FZUU |

+Denotes a lead(Pb)-free/RoHS-compliant package.
T = Tape and reel.

Selector Guide

| PART | OUTPUT VOLTAGE (V) | INITIAL ACCURACY (%) | TEMP COEFFICIENT (ppm/°C) |
|-------------|--------------------|----------------------|---------------------------|
| MAX6010AEUR | 3 | ±0.2 | 50 |
| MAX6010BEUR | 3 | ±0.4 | 50 |

Pin Configuration



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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/°C above +70°C) 320mW

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

($V_{IN} = 5\text{V}$; $C_{OUT} = 47\text{nF}$, $C_{IN} = 0.1\mu\text{F}$, $I_{OUT} = 0$; $T_A = T_{MIN}$ 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/°C |
| Line Regulation | $\Delta V_{OUT}/\Delta V_{IN}$ | $3.2\text{V} \leq V_{IN} \leq 5.5\text{V}$ | | 50 | 350 | $\mu\text{V}/\text{V}$ |
| Load Regulation | $\Delta V_{OUT}/\Delta I_{OUT}$ | $0 \leq I_{OUT} \leq 7\text{mA}$ | | 60 | 200 | $\mu\text{V}/\text{mA}$ |
| | | $-1\text{mA} \leq I_{OUT} \leq 0$ | | 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 | $\mu\text{A}/\text{V}$ |

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.

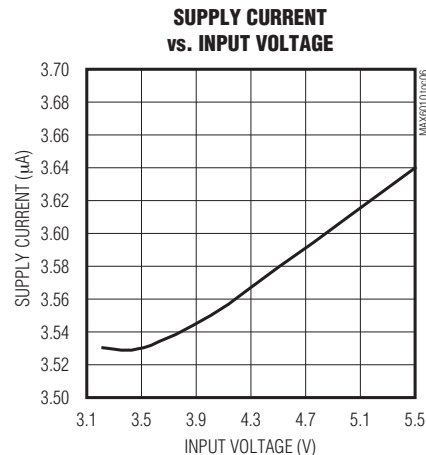
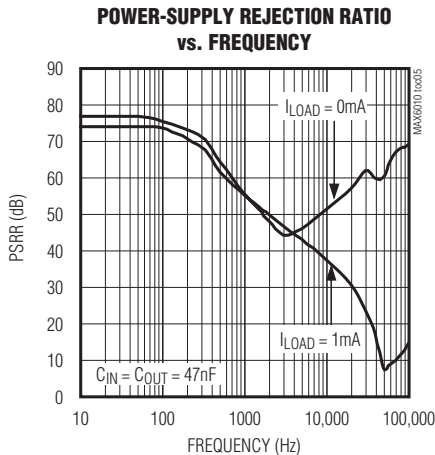
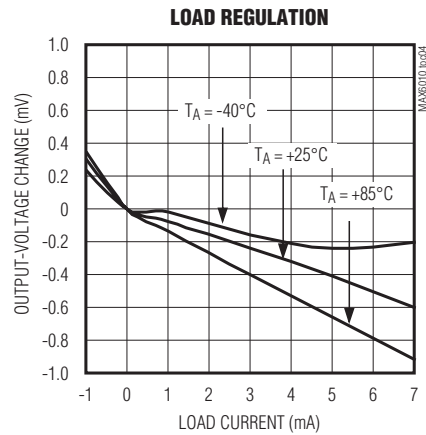
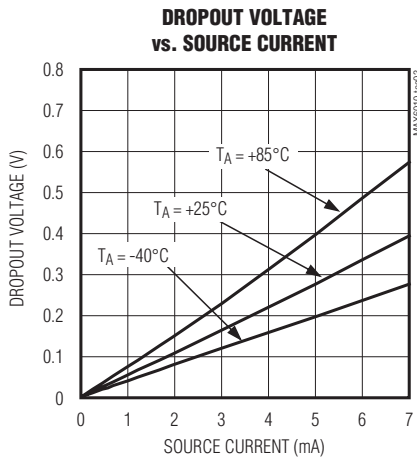
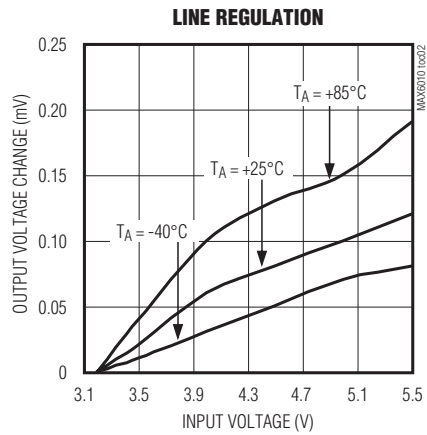
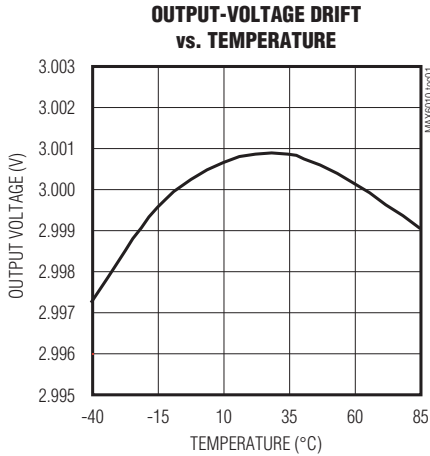
Note 4: Thermal hysteresis is defined as the change in $T_A = +25^\circ\text{C}$ output voltage before and after temperature cycling of the device (from $T_A = T_{MIN}$ to T_{MAX}). Initial measurement at $T_A = +25^\circ\text{C}$ is followed by temperature cycling the device to $T_A = +85^\circ\text{C}$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

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Typical Operating Characteristics

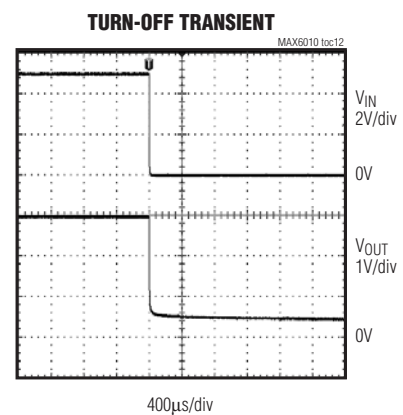
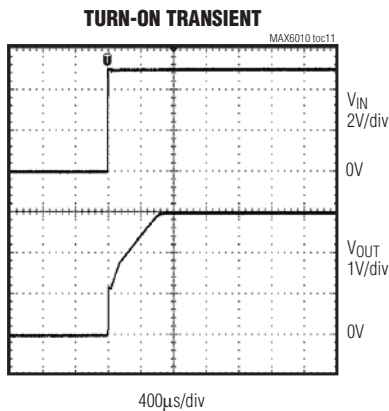
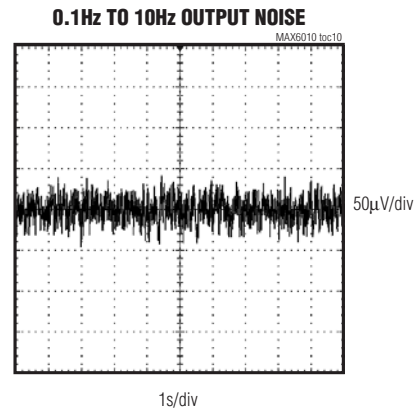
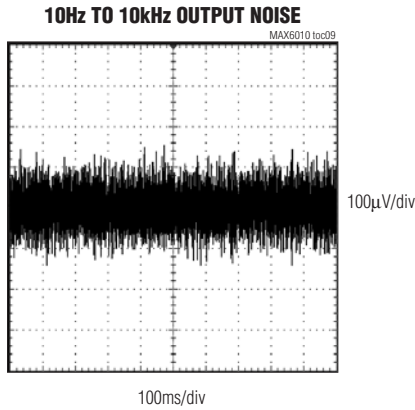
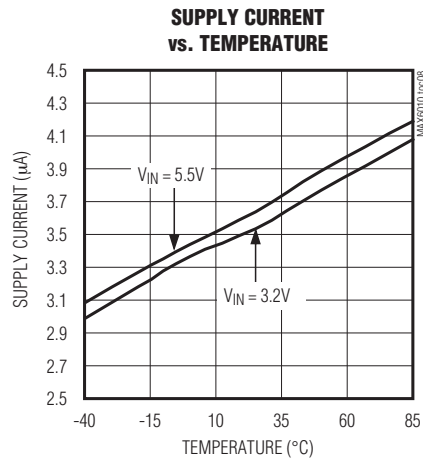
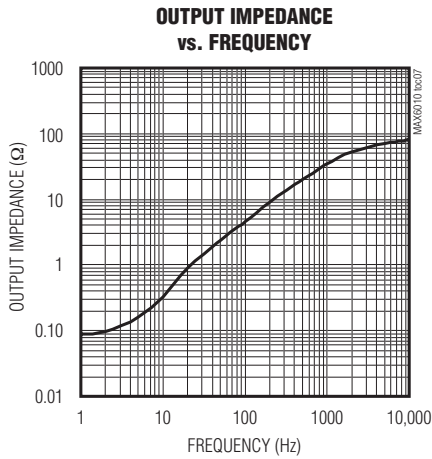
($V_{IN} = 5V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 0.1\mu F$, $T_A = +25^\circ C$, unless otherwise noted.)



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Typical Operating Characteristics (continued)

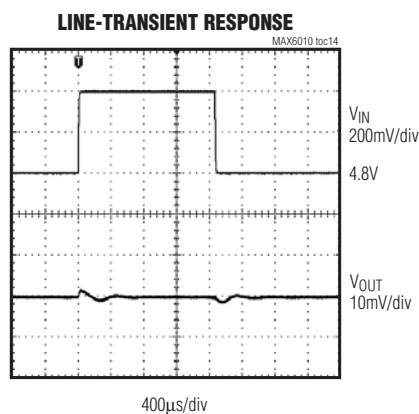
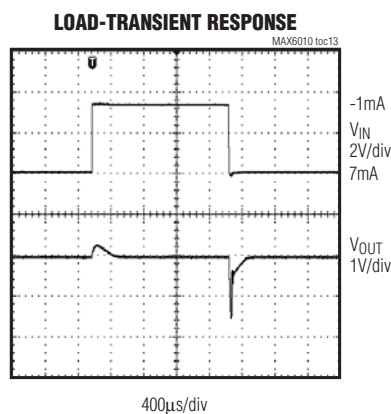
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Typical Operating Characteristics (continued)

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

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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 |

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