



Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6061-MAX6068

General Description

The MAX6061–MAX6068 are precision, low-dropout, micropower voltage references. These three-terminal devices are available with output voltage options of 1.25V, 1.8V, 2.048V, 2.5V, 3V, 4.096V, 4.5V, and 5V. They feature a proprietary curvature-correction circuit and laser-trimmed thin-film resistors that result in a very low temperature coefficient of 20ppm/°C (max) and an initial accuracy of $\pm 0.2\%$ (max). Specifications apply to the extended temperature range (-40°C to $+85^{\circ}\text{C}$).

The MAX6061–MAX6068 typically draw only 90 μA of supply current and can source 5mA or sink 2mA of load current. Unlike conventional shunt-mode (two-terminal) references that waste supply current and require an external resistor, these devices offer a supply current that is virtually independent of the supply voltage (8 $\mu\text{A}/\text{V}$ variation) and do not require an external resistor. Additionally, the internally compensated devices do not require an external compensation capacitor. Eliminating the external compensation capacitor saves valuable board area in space-critical applications. Low dropout voltage and supply independent, ultra-low supply current make these devices ideal for battery-operated, high-performance, low-voltage systems.

The MAX6061–MAX6068 are available in a 3-pin SOT23 package.

Applications

- Analog-to-Digital Converters (ADCs)
- Portable Battery-Powered Systems
- Notebook Computers
- PDA's, GPS's, DMM's
- Cellular Phones
- Precision 3V/5V Systems

Typical Operating Circuit appears at end of data sheet.

Selector Guide

| PART | OUTPUT VOLTAGE (V) | INPUT VOLTAGE (V) |
|---------|--------------------|---|
| MAX6061 | 1.248 | 2.5 to 12.6 |
| MAX6068 | 1.800 | 2.5 to 12.6 |
| MAX6062 | 2.048 | 2.5 to 12.6 |
| MAX6066 | 2.500 | ($V_{\text{OUT}} + 200\text{mV}$) to 12.6 |
| MAX6063 | 3.000 | ($V_{\text{OUT}} + 200\text{mV}$) to 12.6 |
| MAX6064 | 4.096 | ($V_{\text{OUT}} + 200\text{mV}$) to 12.6 |
| MAX6067 | 4.500 | ($V_{\text{OUT}} + 200\text{mV}$) to 12.6 |
| MAX6065 | 5.000 | ($V_{\text{OUT}} + 200\text{mV}$) to 12.6 |

Features

- ◆ Ultra-Small 3-Pin SOT23 Package
- ◆ $\pm 0.2\%$ (max) Initial Accuracy
- ◆ 20ppm/°C (max) Temperature Coefficient
- ◆ 5mA Source Current
- ◆ 2mA Sink Current
- ◆ No Output Capacitor Required
- ◆ Stable with Capacitive Loads
- ◆ 90 μA (typ) Quiescent Supply Current
- ◆ 200mV (max) Dropout at 1mA Load Current
- ◆ Output Voltage Options: 1.25V, 1.8V, 2.048V, 2.5V, 3V, 4.096V, 4.5V, 5V
- ◆ 13 $\mu\text{Vp-p}$ Noise 0.1Hz to 10Hz (MAX6061)

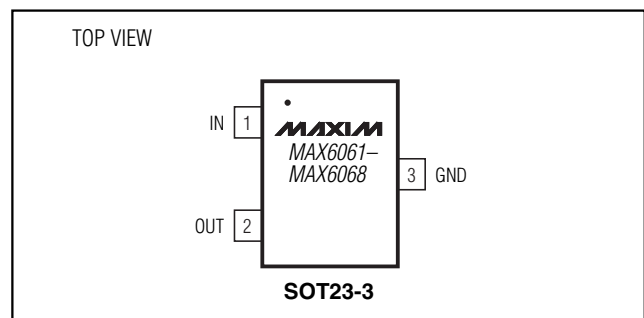
Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE | TOP MARK |
|---------------|--|-------------|----------|
| MAX6061AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFP |
| MAX6061BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFQ |
| MAX6062AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFY |
| MAX6062BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZfZ |
| MAX6063AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFV |
| MAX6063BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZfW |
| MAX6064AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZGB |
| MAX6064BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZGC |
| MAX6065AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZGE |
| MAX6065BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZGF |
| MAX6066AEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFM |
| MAX6066BEUR-T | -40°C to $+85^{\circ}\text{C}$ | 3 SOT23-3 | FZFN |

Note: There is a minimum order increment of 2500 pieces for SOT23 packages.

Ordering Information continued at end of data sheet.

Pin Configuration



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ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)

IN-0.3V to +13.5V
 OUT-0.3V to ($V_{IN} + 0.3V$)
 Output Short-Circuit Duration to GND or IN ($V_{IN} < 6V$)...Continuous
 Output Short-Circuit Duration to GND or IN ($V_{IN} \geq 6V$).....60s

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 $^\circ\text{C}$ to +85 $^\circ\text{C}$
 Storage Temperature Range-65 $^\circ\text{C}$ 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—MAX6061, $V_{OUT} = 1.25V$

($V_{IN} = +5V$, $I_{OUT} = 0$, $T_A = T_{MIN}$ 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 Voltage | V_{OUT} | $T_A = +25^\circ\text{C}$ | MAX6061A (0.32%) | 1.244 | 1.248 | 1.252 | V |
| | | | MAX6061B (0.48%) | 1.242 | 1.248 | 1.254 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV_{OUT} | MAX6061A | | 6 | 20 | ppm/ $^\circ\text{C}$ | |
| | | MAX6061B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $2.5V \leq V_{IN} \leq 12.6V$ | | 10 | 90 | $\mu\text{V/V}$ | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5\text{mA}$ | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: $-2\text{mA} \leq I_{OUT} \leq 0$ | | 1.3 | 3.0 | | |
| OUT Short-Circuit Current | I_{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at $+25^\circ\text{C}$ | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e_{OUT} | $f = 0.1\text{Hz to }10\text{Hz}$ | | 13 | | $\mu\text{Vp-p}$ | |
| | | $f = 10\text{Hz to }10\text{kHz}$ | | 15 | | μVRMS | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $V_{IN} = 5V \pm 100\text{mV}$, $f = 120\text{Hz}$ | | 86 | | dB | |
| Turn-On Settling Time | t_R | To $V_{OUT} = 0.1\%$ of final value, $C_{OUT} = 50\text{pF}$ | | 50 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V_{IN} | Guaranteed by line regulation test | 2.5 | | 12.6 | V | |
| Quiescent Supply Current | I_{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | $\frac{\Delta I_{IN}}{\Delta V_{IN}}$ | $2.5V \leq V_{IN} \leq 12.6V$ | | 3.4 | 8.0 | $\mu\text{A/V}$ | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6061-MAX6068

ELECTRICAL CHARACTERISTICS—MAX6068, $V_{OUT} = 1.80V$

($V_{IN} = +5V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ C$.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|---|------------------|-------|-------|-----------------|---|
| Output Voltage | V_{OUT} | $T_A = +25^\circ C$ | MAX6068A (0.17%) | 1.797 | 1.800 | 1.803 | V |
| | | | MAX6068B (0.39%) | 1.793 | 1.800 | 1.807 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV_{OUT} | MAX6068A | | 6 | 20 | ppm/ $^\circ C$ | |
| | | MAX6068B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $2.5V \leq V_{IN} \leq 12.6V$ | | 33 | 200 | $\mu V/V$ | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5mA$ | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: $-2mA \leq I_{OUT} \leq 0$ | | 1.5 | 4 | | |
| OUT Short-Circuit Current | I_{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at $+25^\circ C$ | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e_{OUT} | $f = 0.1Hz$ to $10Hz$ | | 22 | | μV_{p-p} | |
| | | $f = 10Hz$ to $10kHz$ | | 25 | | μV_{RMS} | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $V_{IN} = 5V \pm 100mV$, $f = 120Hz$ | | 86 | | dB | |
| Turn-On Settling Time | t_R | To $V_{OUT} = 0.1\%$ of final value, $C_{OUT} = 50pF$ | | 115 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V_{IN} | Guaranteed by line regulation test | 2.5 | | 12.6 | V | |
| Quiescent Supply Current | I_{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | $\frac{\Delta I_{IN}}{\Delta V_{IN}}$ | $2.5V \leq V_{IN} \leq 12.6V$ | | 3.3 | 8.0 | $\mu A/V$ | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

ELECTRICAL CHARACTERISTICS—MAX6062, $V_{OUT} = 2.048V$

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

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|---|------------------|-------|-------|-----------------|---|
| Output Voltage | V_{OUT} | $T_A = +25^\circ C$ | MAX6062A (0.24%) | 2.043 | 2.048 | 2.053 | V |
| | | | MAX6062B (0.39%) | 2.040 | 2.048 | 2.056 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV_{OUT} | MAX6062A | | 6 | 20 | ppm/ $^\circ C$ | |
| | | MAX6062B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $2.5V \leq V_{IN} \leq 12.6V$ | | 33 | 200 | $\mu V/V$ | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5mA$ | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: $-2mA \leq I_{OUT} \leq 0$ | | 1.5 | 4 | | |
| OUT Short-Circuit Current | I_{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at $+25^\circ C$ | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e_{OUT} | $f = 0.1Hz$ to $10Hz$ | | 22 | | μV_{p-p} | |
| | | $f = 10Hz$ to $10kHz$ | | 25 | | μV_{RMS} | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $V_{IN} = 5V \pm 100mV$, $f = 120Hz$ | | 86 | | dB | |
| Turn-On Settling Time | t_R | To $V_{OUT} = 0.1\%$ of final value, $C_{OUT} = 50pF$ | | 115 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V_{IN} | Guaranteed by line-regulation test | 2.5 | | 12.6 | V | |
| Quiescent Supply Current | I_{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | I_{IN}/V_{IN} | $2.5V \leq V_{IN} \leq 12.6V$ | | 3.3 | 8.0 | $\mu A/V$ | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

ELECTRICAL CHARACTERISTICS—MAX6066, V_{OUT} = 2.500V

(V_{IN} = +5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|--|-----------------|------------------------|-------|-------|-------------------|
| Output Voltage | V _{OUT} | T _A = +25°C | MAX6066A (0.2%) | 2.495 | 2.500 | 2.505 | V |
| | | | MAX6066B (0.4%) | 2.490 | 2.500 | 2.510 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV _{OUT} | MAX6066A | | 6 | | 20 | ppm/°C |
| | | MAX6066B | | 6 | | 30 | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 60 | | 300 | μV/V |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I _{OUT} ≤ 5mA | | 0.5 | | 0.9 | mV/mA |
| | | Sinking: -2mA ≤ I _{OUT} ≤ 0 | | 1.6 | | 5 | |
| Dropout Voltage (Note 4) | $\frac{V_{IN} - V_{OUT}}$ | I _{OUT} = 1mA | | 50 | | 200 | mV |
| OUT Short-Circuit Current | I _{SC} | Short to GND | | 25 | | | mA |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at +25°C | | 62 | | | ppm/1000hr |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | | ppm |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e _{OUT} | f = 0.1Hz to 10Hz | | 27 | | | μVp-p |
| | | f = 10Hz to 10kHz | | 30 | | | μV _{RMS} |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | V _{IN} = 5V ± 100mV, f = 120Hz | | 86 | | | dB |
| Turn-On Settling Time | t _R | To V _{OUT} = 0.1% of final value, C _{OUT} = 50pF | | 115 | | | μs |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V _{IN} | Guaranteed by line-regulation test | | V _{OUT} + 0.2 | | 12.6 | V |
| Quiescent Supply Current | I _{IN} | | | 90 | | 125 | μA |
| Change in Supply Current | I _{IN} /V _{IN} | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 3.3 | | 8.0 | μA/V |

MAX60661-MAX60668

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

ELECTRICAL CHARACTERISTICS—MAX6063, $V_{OUT} = 3.0V$

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

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|---|-----------------|-----------------|-------|-----------------|---|
| Output Voltage | V_{OUT} | $T_A = +25^\circ C$ | MAX6063A (0.2%) | 2.994 | 3.000 | 3.006 | V |
| | | | MAX6063B (0.4%) | 2.988 | 3.000 | 3.012 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV_{OUT} | MAX6063A | | 6 | 20 | ppm/ $^\circ C$ | |
| | | MAX6063B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $(V_{OUT} + 0.2V) \leq V_{IN} \leq 12.6V$ | | 90 | 400 | $\mu V/V$ | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5mA$ | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: $-2mA \leq I_{OUT} \leq 0$ | | 2.0 | 6.0 | | |
| Dropout Voltage (Note 4) | $V_{IN} - V_{OUT}$ | $I_{OUT} = 1mA$ | | 50 | 200 | mV | |
| OUT Short-Circuit Current | I_{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at $+25^\circ C$ | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e_{OUT} | $f = 0.1Hz$ to $10Hz$ | | 35 | | μV_{p-p} | |
| | | $f = 10Hz$ to $10kHz$ | | 40 | | μV_{RMS} | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | $V_{IN} = 5V \pm 100mV$, $f = 120Hz$ | | 76 | | dB | |
| Turn-On Settling Time | t_R | To $V_{OUT} = 0.1\%$ of final value, $C_{OUT} = 50pF$ | | 115 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V_{IN} | Guaranteed by line-regulation test | | $V_{OUT} + 0.2$ | 12.6 | V | |
| Quiescent Supply Current | I_{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | I_{IN}/V_{IN} | $(V_{OUT} + 0.2V) \leq V_{IN} \leq 12.6V$ | | 3.4 | 8.0 | $\mu A/V$ | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6061-MAX6068

ELECTRICAL CHARACTERISTICS—MAX6064, V_{OUT} = 4.096V

(V_{IN} = +5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|--|------------------------|-------|-------|-------------------|---|
| Output Voltage | V _{OUT} | T _A = +25°C | MAX6064A (0.2%) | 4.088 | 4.096 | 4.104 | V |
| | | | MAX6064B (0.4%) | 4.080 | 4.096 | 4.112 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV _{OUT} | MAX6064A | | 6 | 20 | ppm/°C | |
| | | MAX6064B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 130 | 430 | μV/V | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I _{OUT} ≤ 5mA | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: -2mA ≤ I _{OUT} ≤ 0 | | 2.2 | 8 | | |
| Dropout Voltage (Note 4) | $\frac{V_{IN} - V_{OUT}}$ | I _{OUT} = 1mA | | 50 | 200 | mV | |
| OUT Short-Circuit Current | I _{SC} | Short to GND | | 25 | | mA | |
| | | Short to I _N | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at +25°C | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e _{OUT} | f = 0.1Hz to 10Hz | | 50 | | μVp-p | |
| | | f = 10Hz to 10kHz | | 50 | | μV _{RMS} | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | V _{IN} = 5V ±100mV, f = 120Hz | | 72 | | dB | |
| Turn-On Settling Time | t _R | To V _{OUT} = 0.1% of final value, C _{OUT} = 50pF | | 190 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V _{IN} | Guaranteed by line-regulation test | V _{OUT} + 0.2 | | 12.6 | V | |
| Quiescent Supply Current | I _{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | I _{IN} /V _{IN} | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 3.2 | 8.0 | μA/V | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

ELECTRICAL CHARACTERISTICS—MAX6067, V_{OUT} = 4.500V

(V_{IN} = +5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|--|-----------------|------------------------|-------|-------------------|---|
| Output Voltage | V _{OUT} | T _A = +25°C | MAX6067A (0.2%) | 4.491 | 4.500 | 4.509 | V |
| | | | MAX6067B (0.4%) | 4.482 | 4.500 | 4.518 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV _{OUT} | MAX6067A | | 6 | 20 | ppm/°C | |
| | | MAX6067B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 170 | 550 | μV/V | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I _{OUT} ≤ 5mA | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: -2mA ≤ I _{OUT} ≤ 0 | | 2.4 | 8 | | |
| Dropout Voltage (Note 4) | $\frac{V_{IN} - V_{OUT}}$ | I _{OUT} = 1mA | | 50 | 200 | mV | |
| OUT Short-Circuit Current | I _{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at +25°C | | 62 | | ppm/ 1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e _{OUT} | f = 0.1Hz to 10Hz | | 55 | | μVp-p | |
| | | f = 10Hz to 10kHz | | 55 | | μV _{RMS} | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | V _{IN} = 5V ± 100mV, f = 120Hz | | 70 | | dB | |
| Turn-On Settling Time | t _R | To V _{OUT} = 0.1% of final value, C _{OUT} = 50pF | | 230 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V _{IN} | Guaranteed by line-regulation test | | V _{OUT} + 0.2 | 12.6 | V | |
| Quiescent Supply Current | I _{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | I _{IN} /V _{IN} | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 3.2 | 8.0 | μA/V | |

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6061-MAX6068

ELECTRICAL CHARACTERISTICS—MAX6065, V_{OUT} = 5.000V

(V_{IN} = +5.2V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|---|--|-----------------|------------------------|-------|------------|---|
| Output Voltage | V _{OUT} | T _A = +25°C | MAX6065A (0.2%) | 4.990 | 5.000 | 5.010 | V |
| | | | MAX6065B (0.4%) | 4.980 | 5.000 | 5.020 | |
| Output Voltage Temperature Coefficient (Note 2) | TCV _{OUT} | MAX6065A | | 6 | 20 | ppm/°C | |
| | | MAX6065B | | 6 | 30 | | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 180 | 550 | μV/V | |
| Load Regulation | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I _{OUT} ≤ 5mA | | 0.5 | 0.9 | mV/mA | |
| | | Sinking: -2mA ≤ I _{OUT} ≤ 0 | | 2.4 | 8.0 | | |
| Dropout Voltage (Note 4) | $\frac{V_{IN} - V_{OUT}}$ | I _{OUT} = 1mA | | 50 | 200 | mV | |
| OUT Short-Circuit Current | I _{SC} | Short to GND | | 25 | | mA | |
| | | Short to IN | | 25 | | | |
| Long-Term Stability | $\frac{\Delta V_{OUT}}{\text{time}}$ | 1000hr at +25°C | | 62 | | ppm/1000hr | |
| Output Voltage Hysteresis (Note 3) | $\frac{\Delta V_{OUT}}{\text{cycle}}$ | | | 130 | | ppm | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Noise Voltage | e _{OUT} | f = 0.1Hz to 10Hz | | 60 | | μVp-p | |
| | | f = 10Hz to 10kHz | | 60 | | μVRMS | |
| Ripple Rejection | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | V _{IN} = 5V ±100mV, f = 120Hz | | 65 | | dB | |
| Turn-On Settling Time | t _R | To V _{OUT} = 0.1% of final value, C _{OUT} = 50pF | | 300 | | μs | |
| INPUT CHARACTERISTICS | | | | | | | |
| Supply Voltage Range | V _{IN} | Guaranteed by line-regulation test | | V _{OUT} + 0.2 | 12.6 | V | |
| Quiescent Supply Current | I _{IN} | | | 90 | 125 | μA | |
| Change in Supply Current | I _{IN} /V _{IN} | (V _{OUT} + 0.2V) ≤ V _{IN} ≤ 12.6V | | 3.2 | 8.0 | μA/V | |

Note 1: All devices are 100% production tested at T_A = +25°C and are guaranteed by design for T_A = T_{MIN} to T_{MAX}, as specified.

Note 2: Temperature Coefficient is measured by the “box” method, i.e., the maximum ΔV_{OUT} is divided by the maximum ΔT.

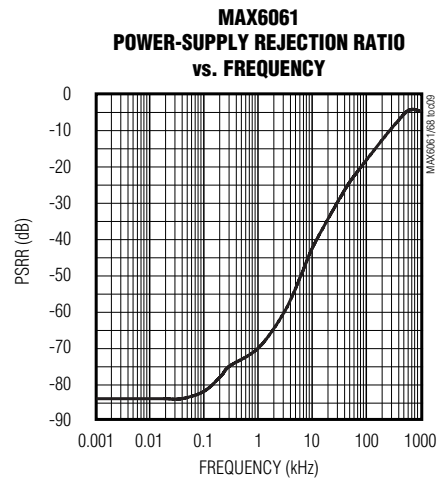
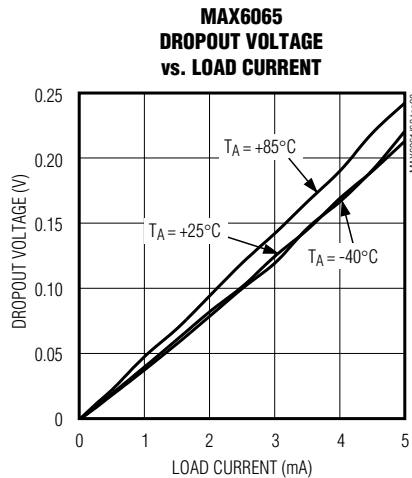
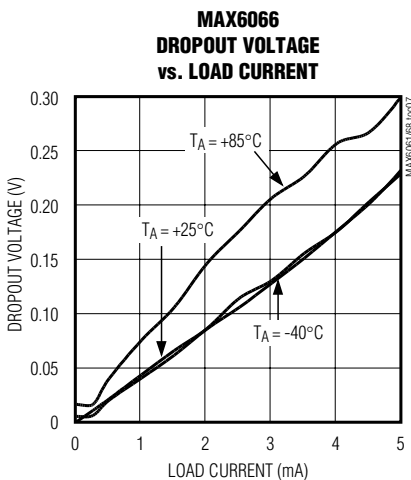
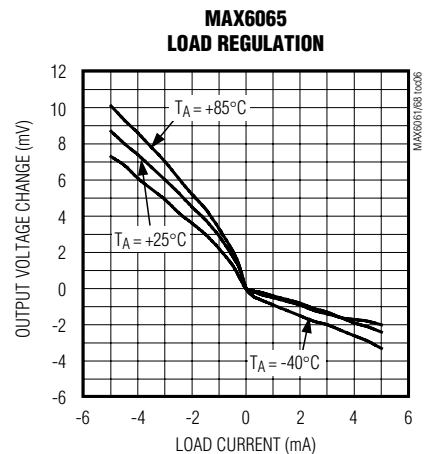
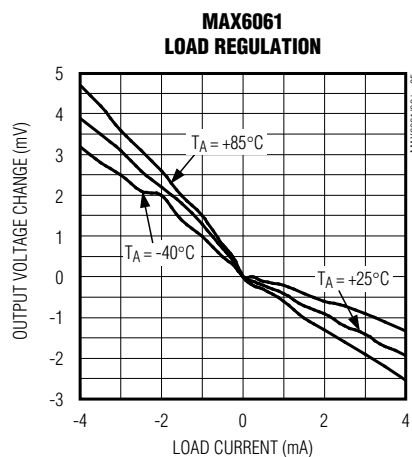
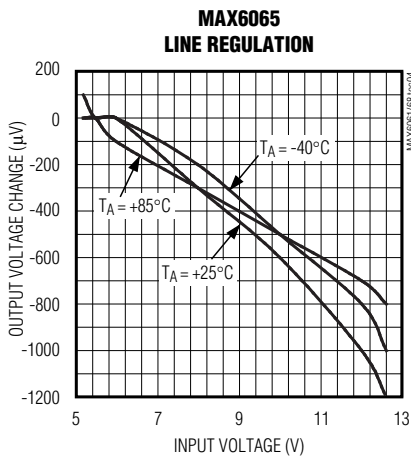
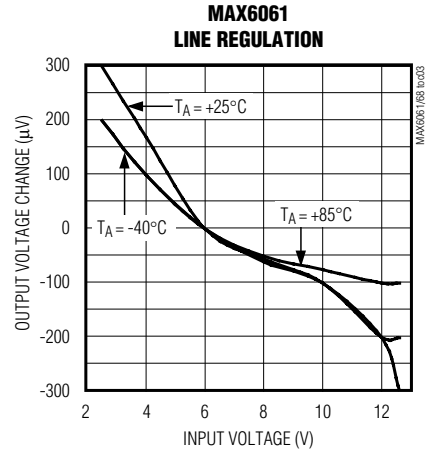
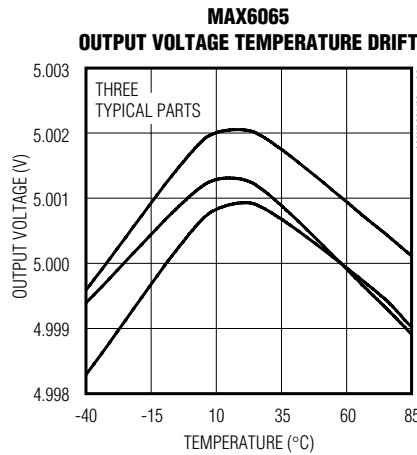
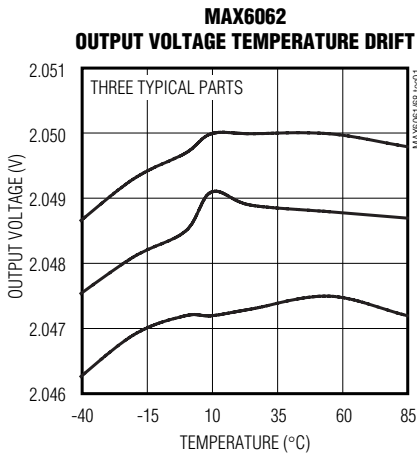
Note 3: Temperature Hysteresis is defined as the change in +25°C output voltage before and after cycling the device from T_{MIN} to T_{MAX}.

Note 4: Dropout voltage is the minimum input voltage at which V_{OUT} changes ≤ 0.2% from V_{OUT} at V_{IN} = 5.0V (V_{IN} = 5.5V for MAX6065).

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

Typical Operating Characteristics

($V_{IN} = +5V$ for MAX6061-MAX6068, $V_{IN} = +5.5V$ for MAX6065, $I_{OUT} = 0$, $T_A = +25^\circ C$, unless otherwise noted.) (Note 5)

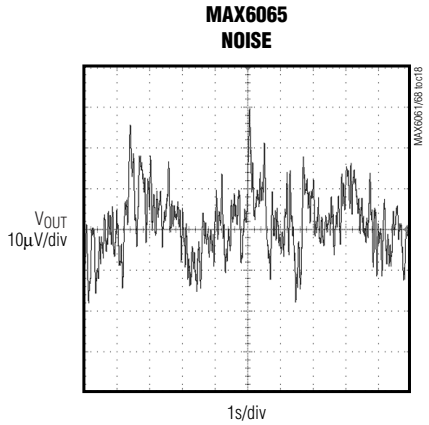
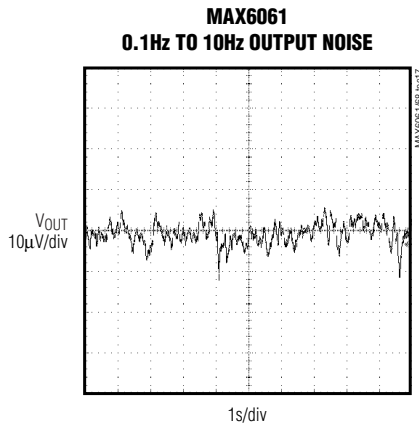
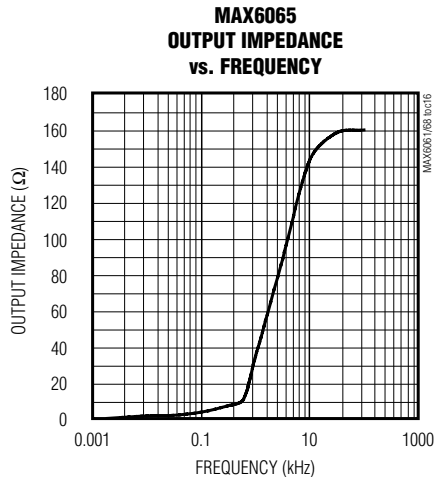
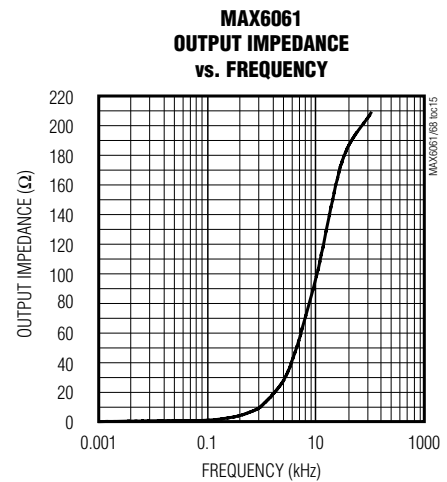
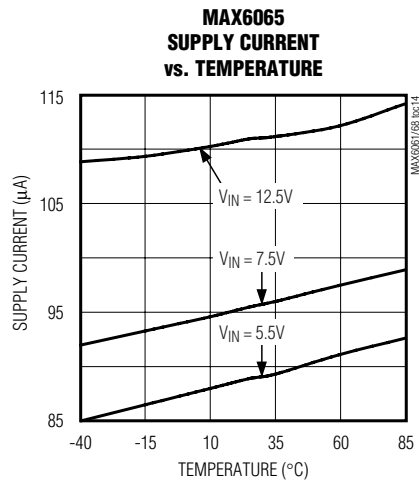
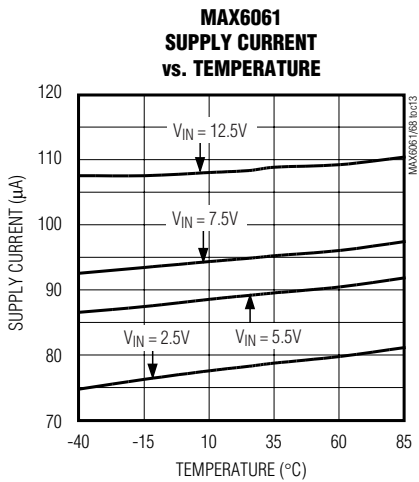
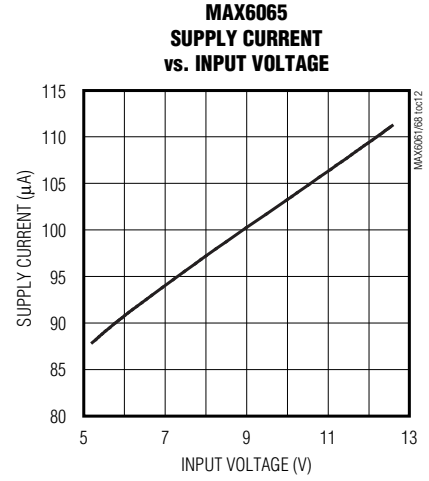
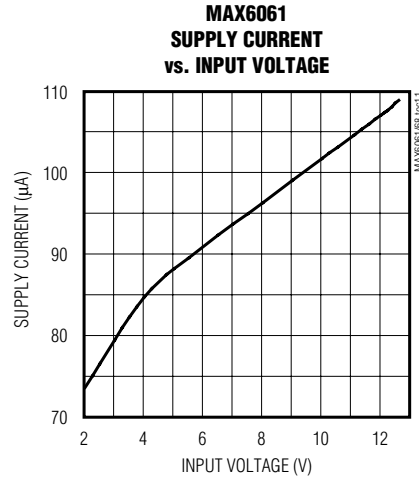
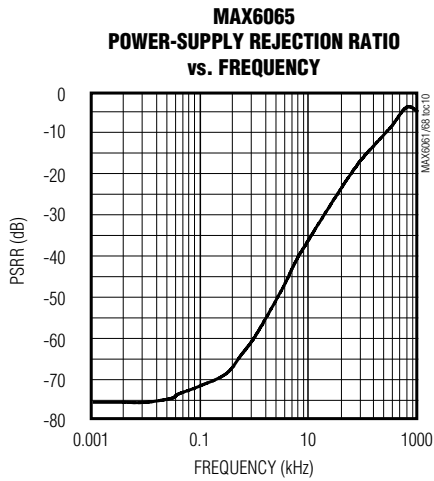


Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

Typical Operating Characteristics (continued)

($V_{IN} = +5V$ for MAX6061–MAX6068, $V_{IN} = +5.5V$ for MAX6065, $I_{OUT} = 0$, $T_A = +25^\circ C$, unless otherwise noted.) (Note 5)

MAX6061–MAX6068

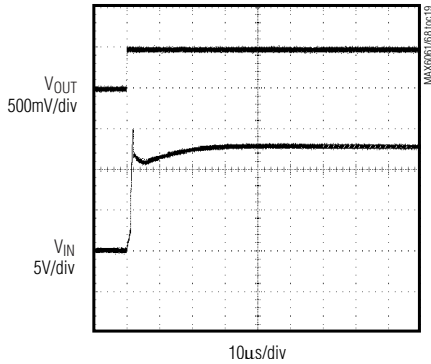


Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

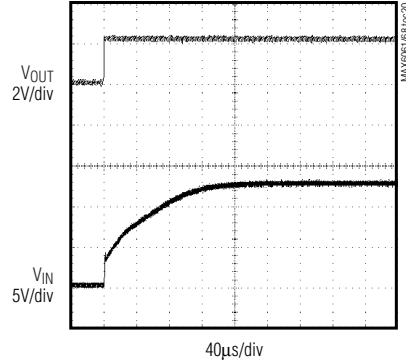
Typical Operating Characteristics (continued)

($V_{IN} = +5V$ for MAX6061-MAX6068, $V_{IN} = +5.5V$ for MAX6065, $I_{OUT} = 0$, $T_A = +25^\circ C$, unless otherwise noted.) (Note 5)

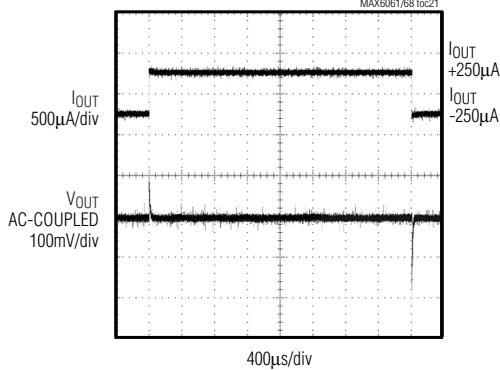
MAX6061
TURN-ON TRANSIENT
($C_L = 50pF$)



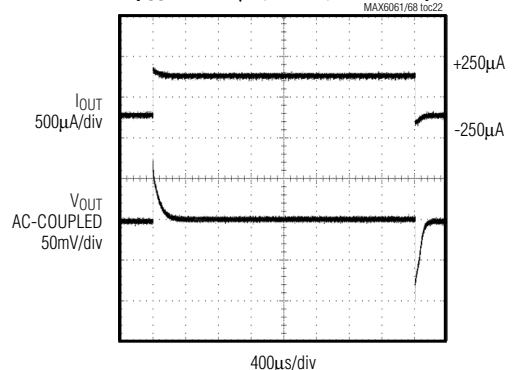
MAX6065
TURN-ON TRANSIENT
($C_L = 50pF$)



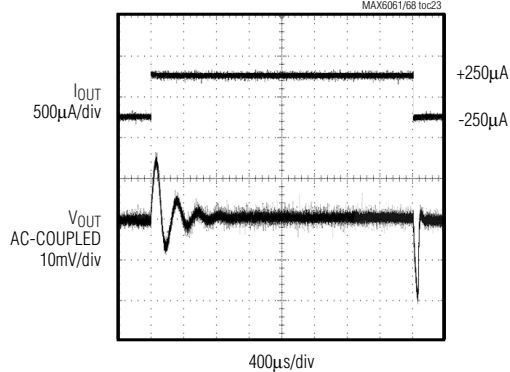
MAX6061
LOAD TRANSIENT
($I_{OUT} = \pm 250\mu A$, $V_{IN} = 5.0$, $C_L = 0$)



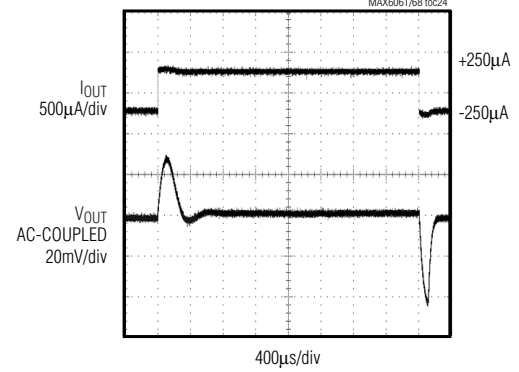
MAX6065
LOAD TRANSIENT
($I_{OUT} = \pm 250\mu A$, $C_L = 0$, $V_{IN} = 5.5V$)



MAX6061
LOAD TRANSIENT
($I_{OUT} = \pm 250\mu A$, $V_{IN} = 5.0V$, $C_L = 1\mu F$)



MAX6065
LOAD TRANSIENT
($I_{OUT} = \pm 250\mu A$, $C_L = 1\mu F$, $V_{IN} = 5.5V$)

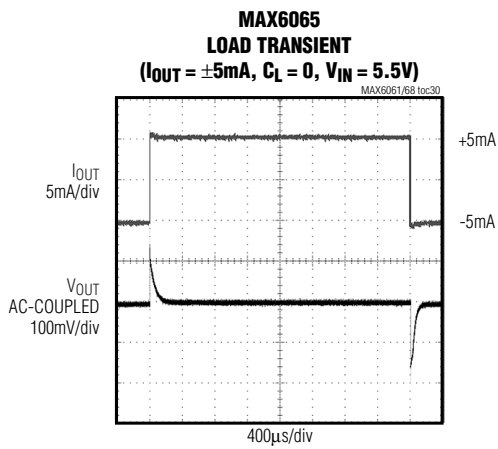
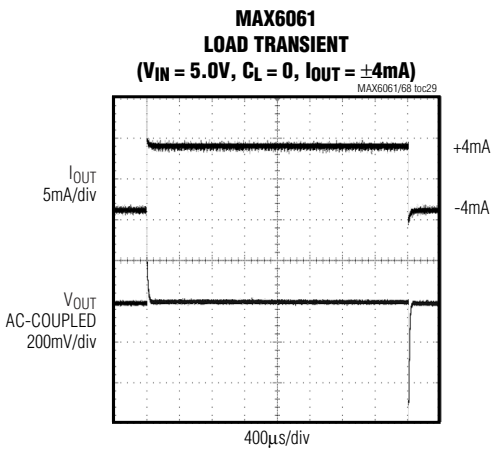
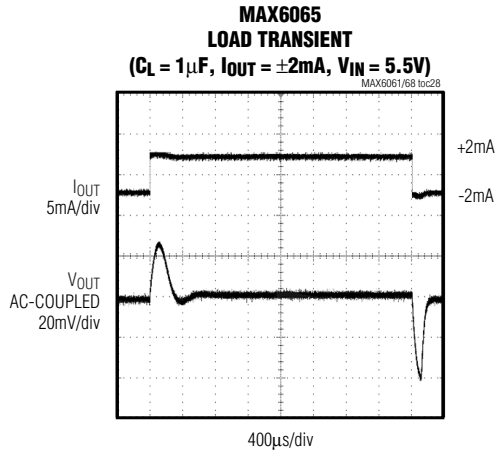
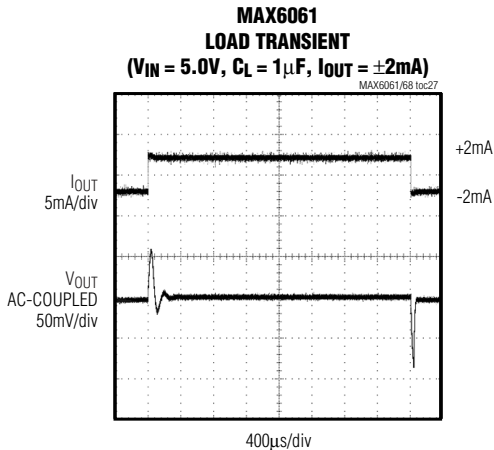
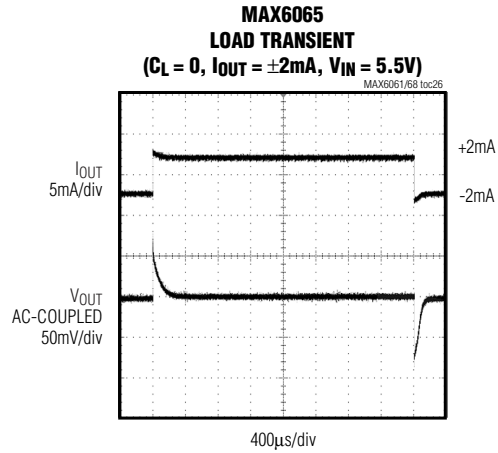
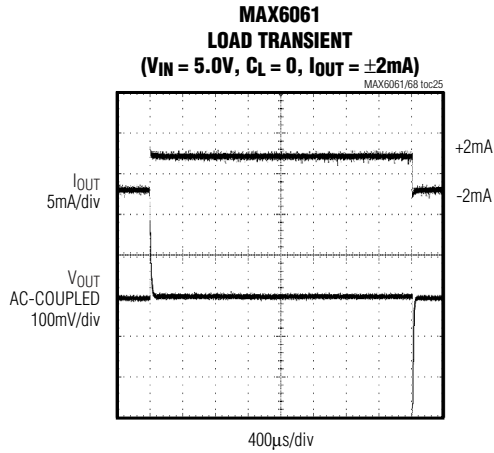


Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

Typical Operating Characteristics (continued)

($V_{IN} = +5V$ for MAX6061–MAX6068, $V_{IN} = +5.5V$ for MAX6065, $I_{OUT} = 0$, $T_A = +25^\circ C$, unless otherwise noted.) (Note 5)

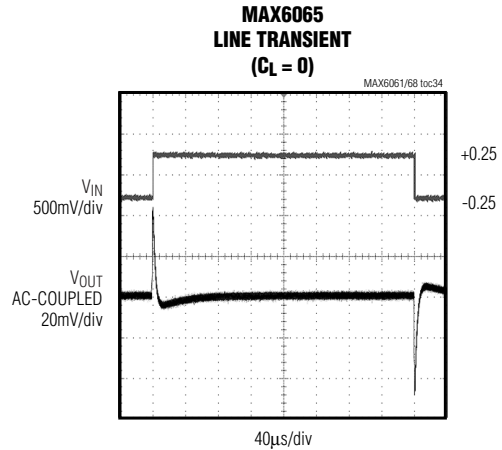
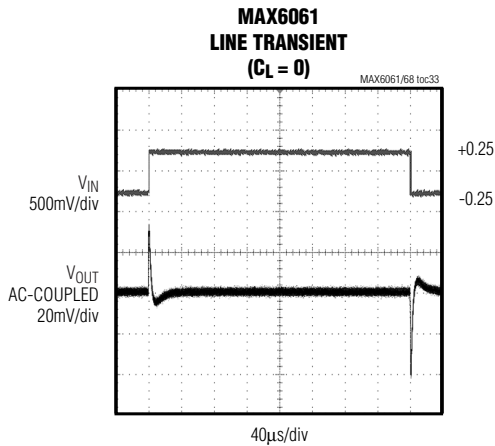
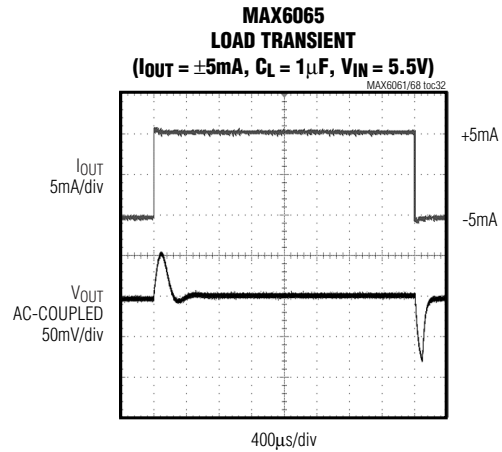
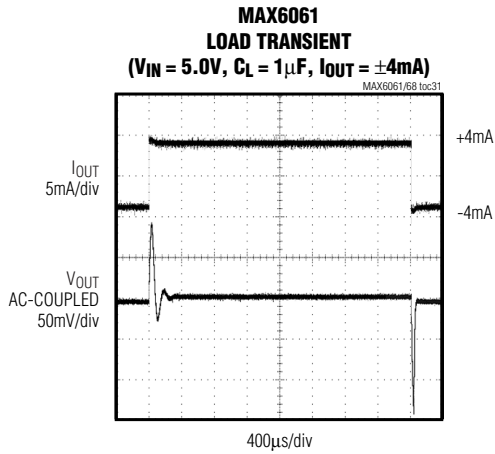
MAX6061–MAX6068



Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

Typical Operating Characteristics (continued)

($V_{IN} = +5V$ for MAX6061-MAX6068, $V_{IN} = +5.5V$ for MAX6065, $I_{OUT} = 0$, $T_A = +25^\circ C$, unless otherwise noted.) (Note 5)



Note 5: Many of the MAX6061 family *Typical Operating Characteristics* are extremely similar. The extremes of these characteristics are found in the MAX6061 (1.25V output) and the MAX6065 (5.0V output). The *Typical Operating Characteristics* of the remainder of the MAX6061 family, typically lie between these two extremes and can be estimated based on their output voltages.

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6061-MAX6068

Pin Description

| PIN | NAME | FUNCTION |
|-----|------|------------------|
| 1 | IN | Input Voltage |
| 2 | OUT | Reference Output |
| 3 | GND | Ground |

Applications Information

Input Bypassing

For the best line-transient performance, decouple the input with a 0.1 μ F ceramic capacitor as shown in the *Typical Operating Circuit*. Locate the capacitor as close to IN as possible. Where transient performance is less important, no capacitor is necessary.

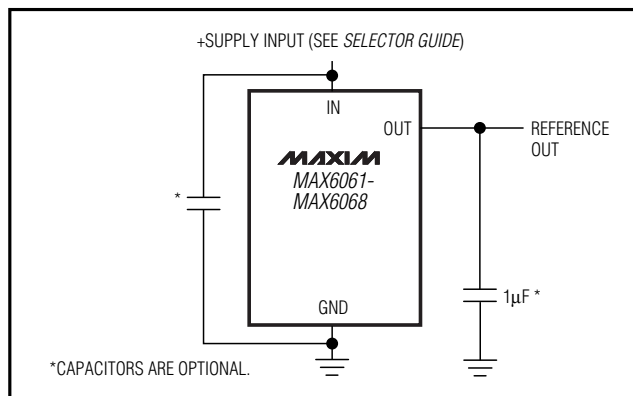
Output/Load Capacitance

Devices in the MAX6061 family do not require an output capacitance for frequency stability. In applications where the load or the supply can experience step changes, an output capacitor of at least 0.1 μ F will reduce the amount of overshoot (undershoot) and improve the circuit's transient response. Many applications do not require an external capacitor, and the MAX6061 family can offer a significant advantage in these applications when board space is critical.

Supply Current

The quiescent supply current of the series-mode MAX6061 family is typically 90 μ A and is virtually independent of the supply voltage, with only an 8 μ A/V (max) variation with supply voltage. Unlike series references, shunt-mode references operate with a series resistor connected to the power supply. The quiescent current of a shunt-mode reference is thus a function of the input voltage. Additionally, shunt-mode references have to be biased at the maximum expected load current, even if the load current is not present at the time. In the MAX6061 family, the load current is drawn from the input voltage only when required, so supply current is not wasted and efficiency is maximized at all input voltages. This improved efficiency reduces power dissipation and extends battery life. When the supply voltage is below the minimum specified input voltage (as during turn-on), the devices can draw up to 400 μ A beyond the nominal supply current. The input voltage source must be capable of providing this current to ensure reliable turn-on.

Typical Operating Circuit



Ordering Information (continued)

| PART | TEMP. RANGE | PIN-PACKAGE | TOP MARK |
|---------------|----------------|-------------|----------|
| MAX6067AEUR-T | -40°C to +85°C | 3 SOT23-3 | FZFS |
| MAX6067BEUR-T | -40°C to +85°C | 3 SOT23-3 | FZFT |
| MAX6068AEUR-T | -40°C to +85°C | 3 SOT23-3 | FZIB |
| MAX6068BEUR-T | -40°C to +85°C | 3 SOT23-3 | FZIC |

Output Voltage Hysteresis

Output voltage hysteresis is the change of output voltage at $T_A = +25^\circ\text{C}$ before and after the device is cycled over its entire operating temperature range. Hysteresis is caused by differential package stress appearing across the bandgap core transistors. The typical temperature hysteresis value is 130ppm.

Turn-On Time

These devices typically turn on and settle to within 0.1% of their final value in 50 μ s to 300 μ s, depending on the device. The turn-on time can increase up to 1.5ms with the device operating at the minimum dropout voltage and the maximum load.

Chip Information

TRANSISTOR COUNT: 117

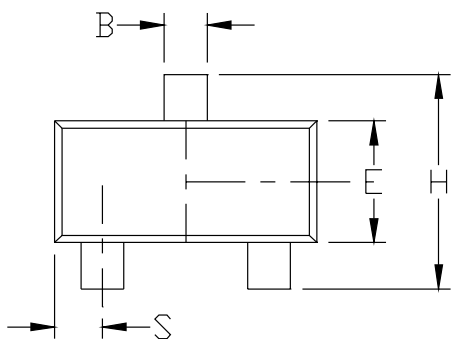
PROCESS: BiCMOS

Precision, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

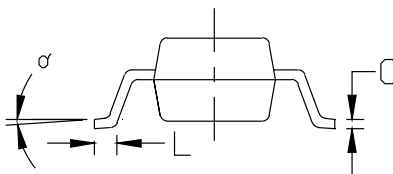
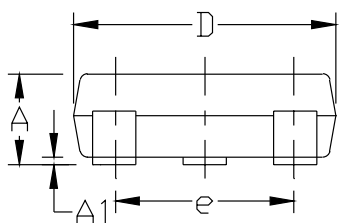
Package Information

NOTES:

1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER



| DIM | INCHES | | MILLIMETERS | |
|----------|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.031 | 0.047 | 0.787 | 1.194 |
| A1 | 0.001 | 0.005 | 0.025 | 0.127 |
| B | 0.014 | 0.022 | 0.356 | 0.559 |
| C | 0.0034 | 0.006 | 0.086 | 0.152 |
| D | 0.105 | 0.120 | 2.667 | 3.048 |
| E | 0.047 | 0.055 | 1.194 | 1.397 |
| e | 0.070 | 0.080 | 1.778 | 2.032 |
| H | 0.082 | 0.098 | 2.083 | 2.489 |
| L | 0.004 | 0.012 | 0.102 | 0.305 |
| S | 0.017 | 0.022 | 0.432 | 0.559 |
| α | 0° | 8° | 0° | 8° |



| | | | |
|--|-------------------------------------|--------------------|--------------------|
| MAXIM | | | |
| <small>PROPRIETARY INFORMATION</small> | | | |
| <small>TITLE:</small> | | | |
| PACKAGE OUTLINE, SOT-23, 3L | | | |
| <small>APPROVAL</small> | <small>DOCUMENT CONTROL NO.</small> | <small>REV</small> | <small>1/1</small> |
| | 21-0051 | C | |

SOT23LEFS

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