



# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## General Description

The MAX6100–MAX6107 are low-cost, low-dropout (LDO), micropower voltage references. These three-terminal references 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 low temperature coefficient of 75ppm/°C (max) and an initial accuracy of  $\pm 0.4\%$  (max). These devices are specified over the extended temperature range ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

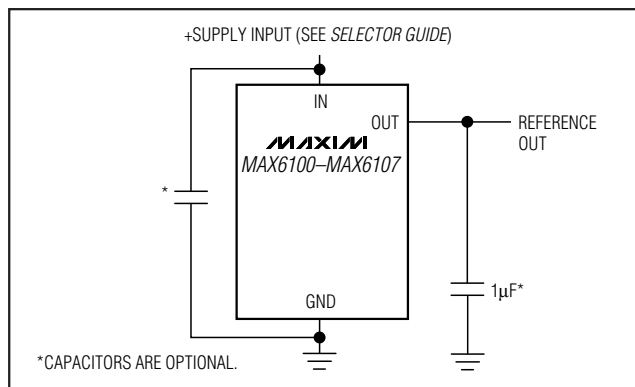
These series-mode voltage references draw only  $90\mu\text{A}$  of supply current and can source 5mA and sink 2mA of load current. Unlike conventional shunt-mode (two-terminal) references that waste supply current and require an external resistor, these devices offer a supply current that is virtually independent of the supply voltage (with only a  $4\mu\text{A/V}$  variation with supply voltage) and do not require an external resistor. Additionally, these internally compensated devices do not require an external compensation capacitor and are stable with load capacitance. 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 MAX6100–MAX6107 are available in tiny 3-pin SOT23 packages.

## Applications

Portable Battery-Powered Systems  
 Notebook Computers  
 PDAs, GPSs, DMMs  
 Cellular Phones  
 Hard-Disk Drives

## Typical Operating Circuit



## Features

- ◆ Ultra-Small 3-Pin SOT23 Package
- ◆ Low Cost
- ◆ No Output Capacitor Required
- ◆ Stable with Capacitive Loads
- ◆ Load Regulation (2mA Sink): 8mV/mA (max)  
Load Regulation (5mA Source): 0.9mV/mA (max)
- ◆  $\pm 0.4\%$  (max) Initial Accuracy
- ◆ Low 75ppm/°C Temperature Coefficient
- ◆ 125 $\mu\text{A}$  (max) Quiescent Supply Current
- ◆ 50mV Dropout at 1mA Load Current

## Ordering Information

| PART         | TEMP RANGE                                     | PIN-PACKAGE | TOP MARK |
|--------------|--|-------------|----------|
| MAX6100EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZID     |
| MAX6101EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZGT     |
| MAX6102EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZGU     |
| MAX6103EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZGV     |
| MAX6104EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZGW     |
| MAX6105EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZGX     |
| MAX6106EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZJR     |
| MAX6107EUR-T | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 3 SOT23-3   | FZMV     |

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

## Selector Guide

| PART    | OUTPUT VOLTAGE (V) | INPUT VOLTAGE RANGE (V)                     |
|---------|--------------------|---|
| MAX6100 | 1.800              | 2.5 to 12.6                                 |
| MAX6101 | 1.250              | 2.5 to 12.6                                 |
| MAX6102 | 2.500              | ( $V_{\text{OUT}} + 200\text{mV}$ ) to 12.6 |
| MAX6103 | 3.000              | ( $V_{\text{OUT}} + 200\text{mV}$ ) to 12.6 |
| MAX6104 | 4.096              | ( $V_{\text{OUT}} + 200\text{mV}$ ) to 12.6 |
| MAX6105 | 5.000              | ( $V_{\text{OUT}} + 200\text{mV}$ ) to 12.6 |
| MAX6106 | 2.048              | 2.5 to 12.6                                 |
| MAX6107 | 4.5                | ( $V_{\text{OUT}} + 200\text{mV}$ ) to 12.6 |

Pin Configuration appears at end of data sheet.



# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)

|  |                              |
|--|------------------------------|
| IN   | -0.3V to +13.5V              |
| OUT  | -0.3V to ( $V_{IN} + 0.3V$ ) |
| Output Short-Circuit to GND or IN ( $V_{IN} < 6V$ )    | Continuous                   |
| Output Short-Circuit 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—MAX6101, $V_{OUT} = 1.25V$

( $V_{IN} = 5V$ ,  $I_{OUT} = 0$ ,  $T_A = T_{MIN}$  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                                      | $V_{OUT}$                               | $T_A = +25^\circ\text{C}$                                    | 1.245 | 1.250 | 1.255 | V                     |
| Output Voltage Temperature Coefficient (Notes 2, 3) | $TCV_{OUT}$                             | $0^\circ\text{C}$ to $+70^\circ\text{C}$                     |       |       | 65    | ppm/ $^\circ\text{C}$ |
|   |   | $-40^\circ\text{C}$ to $+85^\circ\text{C}$                   |       |       | 75    |                       |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | $2.5V \leq V_{IN} \leq 12.6V$                                |       |       | 90    | $\mu\text{V/V}$       |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5\text{mA}$                   |       |       | 0.9   | mV/mA                 |
|   |   | Sinking: $-2\text{mA} \leq I_{OUT} \leq 0$                   |       |       | 3.0   |                       |
| OUT Short-Circuit Current                           | $I_{SC}$                                | Short to GND   |       | 110   |       | mA                    |
|   |   | Short to IN  |       | 12    |       |                       |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at $+25^\circ\text{C}$                                |       | 50    |       | ppm/1000hr            |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |       | 130   |       | ppm                   |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |       |       |       |                       |
| Noise Voltage                                       | $e_{OUT}$                               | $f = 0.1\text{Hz}$ to $10\text{Hz}$                          |       | 13    |       | $\mu\text{V}_{P-P}$   |
|   |   | $f = 10\text{Hz}$ to $10\text{kHz}$                          |       | 15    |       | $\mu\text{V}_{RMS}$   |
| 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    |       | $\mu\text{s}$         |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |       |       |       |                       |
| Supply Voltage Range                                | $V_{IN}$                                | Guaranteed by line-regulation test                           | 2.5   |       | 12.6  | V                     |
| Quiescent Supply Current                            | $I_{IN}$                                |  |       | 90    | 125   | $\mu\text{A}$         |
| Change in Supply Current                            | $I_{IN}/V_{IN}$                         | $2.5V \leq V_{IN} \leq 12.6V$                                |       | 4     | 8     | $\mu\text{A/V}$       |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

**MAX6100-MAX6107**

## ELECTRICAL CHARACTERISTICS—MAX6100, V<sub>OUT</sub> = 1.8V

(V<sub>IN</sub> = 5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C) (Note 1)

| PARAMETER   | SYMBOL                                  | CONDITIONS   | MIN   | TYP   | MAX   | UNITS             |
|---|---|--|-------|-------|-------|-------------------|
| Output Voltage                                      | V <sub>OUT</sub>                        | T <sub>A</sub> = +25°C   | 1.793 | 1.800 | 1.807 | V                 |
| Output Voltage Temperature Coefficient (Notes 2, 3) | TCV <sub>OUT</sub>                      | 0°C to +70°C   |       |       | 65    | ppm/°C            |
|   |   | -40°C to +85°C   |       |       | 75    |                   |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | 2.5V ≤ V <sub>IN</sub> ≤ 12.6V                                     |       |       | 200   | μV/V              |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I <sub>OUT</sub> ≤ 5mA                               |       |       | 0.9   | mV/mA             |
|   |   | Sinking: -2mA ≤ I <sub>OUT</sub> ≤ 0                               |       |       | 4.0   |                   |
| OUT Short-Circuit Current                           | I <sub>SC</sub>                         | Short to GND   |       | 110   |       | mA                |
|   |   | Short to IN  |       | 12    |       |                   |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at +25°C  |       | 50    |       | ppm/1000hr        |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |       | 130   |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |       |       |       |                   |
| Noise Voltage                                       | e <sub>OUT</sub>                        | f = 0.1Hz to 10Hz  |       | 22    |       | μV <sub>P-P</sub> |
|   |   | f = 10Hz to 10kHz  |       | 25    |       | μV <sub>RMS</sub> |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | V <sub>IN</sub> = 5V, ±100mV, f = 120Hz                            |       | 86    |       | dB                |
| Turn-On Settling Time                               | t <sub>R</sub>                          | To V <sub>OUT</sub> = 0.1% of final value, C <sub>OUT</sub> = 50pF |       | 100   |       | μs                |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |       |       |       |                   |
| Supply Voltage Range                                | V <sub>IN</sub>                         | Guaranteed by line-regulation test                                 | 2.5   |       | 12.6  | V                 |
| Quiescent Supply Current                            | I <sub>IN</sub>                         |  |       | 90    | 125   | μA                |
| Change in Supply Current                            | I <sub>IN</sub> /V <sub>IN</sub>        | 2.5V ≤ V <sub>IN</sub> ≤ 12.6V                                     |       | 4     | 8     | μA/V              |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## ELECTRICAL CHARACTERISTICS—MAX6106, $V_{OUT} = 2.048V$

( $V_{IN} = 5V$ ,  $I_{OUT} = 0$ ,  $T_A = T_{MIN}$  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                                      | $V_{OUT}$                               | $T_A = +25^\circ C$                                   | 2.040 | 2.048 | 2.056 | V               |
| Output Voltage Temperature Coefficient (Notes 2, 3) | $TCV_{OUT}$                             | $0^\circ C$ to $+70^\circ C$                          |       |       | 65    | ppm/ $^\circ C$ |
|   |   | $-40^\circ C$ to $+85^\circ C$                        |       |       | 75    |                 |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | $2.5V \leq V_{IN} \leq 12.6V$                         |       |       | 200   | $\mu V/V$       |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5mA$                   |       |       | 0.9   | mV/mA           |
|   |   | Sinking: $-2mA \leq I_{OUT} \leq 0$                   |       |       | 4.0   |                 |
| OUT Short-Circuit Current                           | $I_{SC}$                                | Short to GND  |       | 110   |       | mA              |
|   |   | Short to IN   |       | 12    |       |                 |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at $+25^\circ C$                               |       | 50    |       | ppm/<br>1000hr  |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |   |       | 130   |       | ppm             |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |   |       |       |       |                 |
| Noise Voltage                                       | $e_{OUT}$                               | $f = 0.1Hz$ to $10Hz$                                 |       | 22    |       | $\mu V_{P-P}$   |
|   |   | $f = 10Hz$ to $10kHz$                                 |       | 25    |       | $\mu V_{RMS}$   |
| 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, $C_{OUT} = 50pF$ |       | 100   |       | $\mu s$         |
| <b>INPUT CHARACTERISTICS</b>                        |   |   |       |       |       |                 |
| Supply Voltage Range                                | $V_{IN}$                                | Guaranteed by line-regulation test                    | 2.5   |       | 12.6  | V               |
| Quiescent Supply Current                            | $I_{IN}$                                |   |       | 90    | 125   | $\mu A$         |
| Change in Supply Current                            | $I_{IN} / V_{IN}$                       | $2.5 \leq V_{IN} \leq 12.6V$                          |       | 4     | 8     | $\mu A/V$       |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6100-MAX6107

## ELECTRICAL CHARACTERISTICS—MAX6102, V<sub>OUT</sub> = 2.50V

(V<sub>IN</sub> = 5V, I<sub>OUT</sub> = 0, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER   | SYMBOL                                  | CONDITIONS   | MIN                         | TYP  | MAX   | UNITS             |
|---|---|--|-----------------------------|------|-------|-------------------|
| Output Voltage                                      | V <sub>OUT</sub>                        | T <sub>A</sub> = +25°C   | 2.490                       | 2.50 | 2.510 | V                 |
| Output Voltage Temperature Coefficient (Notes 2, 3) | TCV <sub>OUT</sub>                      | 0°C to +70°C   |                             |      | 65    | ppm/°C            |
|   |   | -40°C to +85°C   |                             |      | 75    |                   |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             |      | 300   | μV/V              |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I <sub>OUT</sub> ≤ 5mA                               |                             |      | 0.9   | mV/mA             |
|   |   | Sinking: -2mA ≤ I <sub>OUT</sub> ≤ 0                               |                             |      | 5.0   |                   |
| Dropout Voltage (Note 5)                            | $\frac{V_{IN} - V_{OUT}}$               | I <sub>OUT</sub> = 1mA   |                             | 50   | 200   | mV                |
| OUT Short-Circuit Current                           | I <sub>SC</sub>                         | Short to GND   |                             | 110  |       | mA                |
|   |   | Short to IN  |                             | 12   |       |                   |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at +25°C  |                             | 50   |       | ppm/1000hr        |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |                             | 130  |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |                             |      |       |                   |
| Noise Voltage                                       | e <sub>OUT</sub>                        | f = 0.1Hz to 10Hz  |                             | 27   |       | μV <sub>P-P</sub> |
|   |   | f = 10Hz to 10kHz  |                             | 30   |       | μV <sub>RMS</sub> |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | V <sub>IN</sub> = 5V ± 100mV, f = 120Hz                            |                             | 86   |       | dB                |
| Turn-On Settling Time                               | t <sub>R</sub>                          | To V <sub>OUT</sub> = 0.1% of final value, C <sub>OUT</sub> = 50pF |                             | 115  |       | μs                |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |                             |      |       |                   |
| Supply Voltage Range                                | V <sub>IN</sub>                         | Guaranteed by line-regulation test                                 | $\frac{V_{OUT} + 0.2}{0.2}$ |      | 12.6  | V                 |
| Quiescent Supply Current                            | I <sub>IN</sub>                         |  |                             | 90   | 125   | μA                |
| Change in Supply Current                            | I <sub>IN</sub> /V <sub>IN</sub>        | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             | 4    | 8     | μA/V              |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## ELECTRICAL CHARACTERISTICS—MAX6103, V<sub>OUT</sub> = 3.0V

(V<sub>IN</sub> = 5V, I<sub>OUT</sub> = 0, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER   | SYMBOL                                  | CONDITIONS   | MIN                         | TYP   | MAX   | UNITS             |
|---|---|--|-----------------------------|-------|-------|-------------------|
| Output Voltage                                      | V <sub>OUT</sub>                        | T <sub>A</sub> = +25°C   | 2.988                       | 3.000 | 3.012 | V                 |
| Output Voltage Temperature Coefficient (Notes 2, 3) | TCV <sub>OUT</sub>                      | 0°C to +70°C   |                             |       | 65    | ppm/°C            |
|   |   | -40°C to +85°C   |                             |       | 75    |                   |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             |       | 400   | μV/V              |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I <sub>OUT</sub> ≤ 5mA                               |                             |       | 0.9   | mV/mA             |
|   |   | Sinking: -2mA ≤ I <sub>OUT</sub> ≤ 0                               |                             |       | 6.0   |                   |
| Dropout Voltage (Note 5)                            | $\frac{V_{IN} - V_{OUT}}{V_{OUT}}$      | I <sub>OUT</sub> = 1mA   |                             | 50    | 200   | mV                |
| OUT Short-Circuit Current                           | I <sub>SC</sub>                         | Short to GND   |                             | 110   |       | mA                |
|   |   | Short to IN  |                             | 12    |       |                   |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at +25°C  |                             | 50    |       | ppm/1000hr        |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |                             | 130   |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |                             |       |       |                   |
| Noise Voltage                                       | e <sub>OUT</sub>                        | f = 0.1Hz to 10Hz  |                             | 35    |       | μV <sub>P-P</sub> |
|   |   | f = 10Hz to 10kHz  |                             | 40    |       | μV <sub>RMS</sub> |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | V <sub>IN</sub> = 5V ± 100mV, f = 120Hz                            |                             | 76    |       | dB                |
| Turn-On Settling Time                               | t <sub>R</sub>                          | To V <sub>OUT</sub> = 0.1% of final value, C <sub>OUT</sub> = 50pF |                             | 115   |       | μs                |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |                             |       |       |                   |
| Supply Voltage Range                                | V <sub>IN</sub>                         | Guaranteed by line-regulation test                                 | $\frac{V_{OUT} + 0.2}{0.2}$ |       | 12.6  | V                 |
| Quiescent Supply Current                            | I <sub>IN</sub>                         |  |                             | 90    | 125   | μA                |
| Change in Supply Current                            | I <sub>IN</sub> /V <sub>IN</sub>        | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             | 4     | 8     | μA/V              |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6100-MAX6107

## ELECTRICAL CHARACTERISTICS—MAX6104, V<sub>OUT</sub> = 4.096V

(V<sub>IN</sub> = 5V, I<sub>OUT</sub> = 0, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER   | SYMBOL                                  | CONDITIONS   | MIN                         | TYP   | MAX   | UNITS             |
|---|---|--|-----------------------------|-------|-------|-------------------|
| Output Voltage                                      | V <sub>OUT</sub>                        | T <sub>A</sub> = +25°C   | 4.080                       | 4.096 | 4.112 | V                 |
| Output Voltage Temperature Coefficient (Notes 2, 3) | TCV <sub>OUT</sub>                      | 0°C to +70°C   |                             |       | 65    | ppm/°C            |
|   |   | -40°C to +85°C   |                             |       | 75    |                   |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             |       | 430   | μV/V              |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I <sub>OUT</sub> ≤ 5mA                               |                             |       | 0.9   | mV/mA             |
|   |   | Sinking: -2mA ≤ I <sub>OUT</sub> ≤ 0                               |                             |       | 8.0   |                   |
| Dropout Voltage (Note 5)                            | $\frac{V_{IN} - V_{OUT}}{V_{OUT}}$      | I <sub>OUT</sub> = 1mA   |                             | 50    | 200   | mV                |
| OUT Short-Circuit Current                           | I <sub>SC</sub>                         | Short to GND   |                             | 110   |       | mA                |
|   |   | Short to IN  |                             | 12    |       |                   |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at +25°C  |                             | 50    |       | ppm/1000hr        |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |                             | 130   |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |                             |       |       |                   |
| Noise Voltage                                       | e <sub>OUT</sub>                        | f = 0.1Hz to 10Hz  |                             | 50    |       | μV <sub>P-P</sub> |
|   |   | f = 10Hz to 10kHz  |                             | 50    |       | μV <sub>RMS</sub> |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | V <sub>IN</sub> = 5V ± 100mV, f = 120Hz                            |                             | 72    |       | dB                |
| Turn-On Settling Time                               | t <sub>R</sub>                          | To V <sub>OUT</sub> = 0.1% of final value, C <sub>OUT</sub> = 50pF |                             | 190   |       | μs                |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |                             |       |       |                   |
| Supply Voltage Range                                | V <sub>IN</sub>                         | Guaranteed by line-regulation test                                 | $\frac{V_{OUT} + 0.2}{0.2}$ |       | 12.6  | V                 |
| Quiescent Supply Current                            | I <sub>IN</sub>                         |  |                             | 90    | 125   | μA                |
| Change in Supply Current                            | I <sub>IN</sub> /V <sub>IN</sub>        | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             | 4     | 8     | μA/V              |

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## ELECTRICAL CHARACTERISTICS—MAX6107, $V_{OUT} = 4.5V$

( $V_{IN} = 5V$ ,  $I_{OUT} = 0$ ,  $T_A = T_{MIN}$  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                                      | $V_{OUT}$                               | $T_A = +25^\circ C$                                   | 4.482           | 4.500 | 4.518 | V               |
| Output Voltage Temperature Coefficient (Notes 2, 3) | $TCV_{OUT}$                             | $0^\circ C$ to $+70^\circ C$                          |                 |       | 65    | ppm/ $^\circ C$ |
|   |   | $-40^\circ C$ to $+85^\circ C$                        |                 |       | 75    |                 |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | $(V_{OUT} + 0.2V) \leq V_{IN} \leq 12.6V$             |                 |       | 550   | $\mu V/V$       |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: $0 \leq I_{OUT} \leq 5mA$                   |                 |       | 0.9   | mV/mA           |
|   |   | Sinking: $-2mA \leq I_{OUT} \leq 0$                   |                 |       | 8.0   |                 |
| Dropout Voltage (Note 5)                            | $V_{IN} - V_{OUT}$                      | $I_{OUT} = 1mA$                                       |                 | 50    | 200   | mV              |
| OUT Short-Circuit Current                           | $I_{SC}$                                | Short to GND  |                 | 110   |       | mA              |
|   |   | Short to IN   |                 | 12    |       |                 |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at $+25^\circ C$                               |                 | 50    |       | ppm/1000hr      |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |   |                 | 130   |       | ppm             |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |   |                 |       |       |                 |
| Noise Voltage                                       | $e_{OUT}$                               | $f = 0.1Hz$ to $10Hz$                                 |                 | 55    |       | $\mu V_{P-P}$   |
|   |   | $f = 10Hz$ to $10kHz$                                 |                 | 55    |       | $\mu V_{RMS}$   |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | $V_{IN} = 5V \pm 100mV$ , $f = 120Hz$                 |                 | 70    |       | dB              |
| Turn-On Settling Time                               | $t_R$                                   | To $V_{OUT} = 0.1\%$ of final value, $C_{OUT} = 50pF$ |                 | 230   |       | $\mu s$         |
| <b>INPUT CHARACTERISTICS</b>                        |   |   |                 |       |       |                 |
| Supply Voltage Range                                | $V_{IN}$                                | Guaranteed by line-regulation test                    | $V_{OUT} + 0.2$ |       | 12.6  | V               |
| Quiescent Supply Current                            | $I_{IN}$                                |   |                 | 90    | 125   | $\mu A$         |
| Change in Supply Current                            | $I_{IN}/V_{IN}$                         | $(V_{OUT} + 0.2V) \leq V_{IN} \leq 12.6V$             |                 | 4     | 8     | $\mu A/V$       |



# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

MAX6100-MAX6107

## ELECTRICAL CHARACTERISTICS—MAX6105, V<sub>OUT</sub> = 5.000V

(V<sub>IN</sub> = 5.5V, I<sub>OUT</sub> = 0, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER   | SYMBOL                                  | CONDITIONS   | MIN                         | TYP   | MAX   | UNITS             |
|---|---|--|-----------------------------|-------|-------|-------------------|
| Output Voltage                                      | V <sub>OUT</sub>                        | T <sub>A</sub> = +25°C   | 4.980                       | 5.000 | 5.020 | V                 |
| Output Voltage Temperature Coefficient (Notes 2, 3) | TCV <sub>OUT</sub>                      | 0°C to +70°C   |                             |       | 65    | ppm/°C            |
|   |   | -40°C to +85°C   |                             |       | 75    |                   |
| Line Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             |       | 550   | μV/V              |
| Load Regulation                                     | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Sourcing: 0 ≤ I <sub>OUT</sub> ≤ 5mA                               |                             |       | 0.9   | mV/mA             |
|   |   | Sinking: -2mA ≤ I <sub>OUT</sub> ≤ 0                               |                             |       | 10    |                   |
| Dropout Voltage (Note 5)                            | $\frac{V_{IN} - V_{OUT}}{V_{OUT}}$      | I <sub>OUT</sub> = 1mA   |                             | 50    | 200   | mV                |
| OUT Short-Circuit Current                           | I <sub>SC</sub>                         | Short to GND   |                             | 110   |       | mA                |
|   |   | Short to IN  |                             | 12    |       |                   |
| Long-Term Stability                                 | $\frac{\Delta V_{OUT}}{\text{time}}$    | 1000hr at +25°C  |                             | 50    |       | ppm/1000hr        |
| Output Voltage Hysteresis (Note 4)                  | $\frac{\Delta V_{OUT}}{\text{cycle}}$   |  |                             | 130   |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>                      |   |  |                             |       |       |                   |
| Noise Voltage                                       | e <sub>OUT</sub>                        | f = 0.1Hz to 10Hz  |                             | 60    |       | μV <sub>P-P</sub> |
|   |   | f = 10Hz to 10kHz  |                             | 60    |       | μV <sub>RMS</sub> |
| Ripple Rejection                                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | V <sub>IN</sub> = 6V ± 100mV, f = 120Hz                            |                             | 65    |       | dB                |
| Turn-On Settling Time                               | t <sub>R</sub>                          | To V <sub>OUT</sub> = 0.1% of final value, C <sub>OUT</sub> = 50pF |                             | 300   |       | μs                |
| <b>INPUT CHARACTERISTICS</b>                        |   |  |                             |       |       |                   |
| Supply Voltage Range                                | V <sub>IN</sub>                         | Guaranteed by line-regulation test                                 | $\frac{V_{OUT} + 0.2}{0.2}$ |       | 12.6  | V                 |
| Quiescent Supply Current                            | I <sub>IN</sub>                         |  |                             | 90    | 125   | μA                |
| Change in Supply Current                            | I <sub>IN</sub> /V <sub>IN</sub>        | (V <sub>OUT</sub> + 0.2V) ≤ V <sub>IN</sub> ≤ 12.6V                |                             | 4     | 8     | μA/V              |

**Note 1:** Devices are 100% production tested at T<sub>A</sub> = +25°C and are guaranteed by design from T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub> by correlation to sample units characterized over temperature.

**Note 2:** Temperature coefficient is specified by the “box” method, i.e., the maximum ΔV<sub>OUT</sub> is divided by the maximum Δt.

**Note 3:** Not production tested. Guaranteed by design.

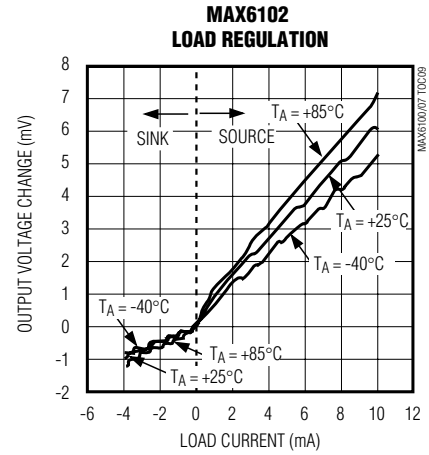
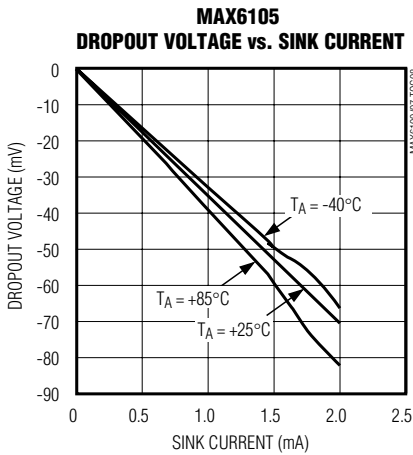
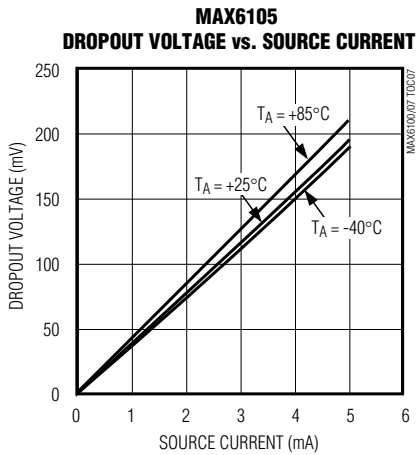
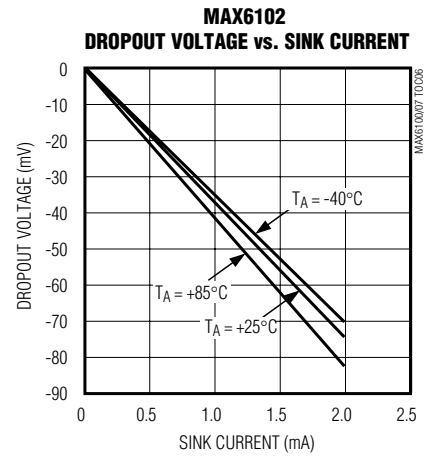
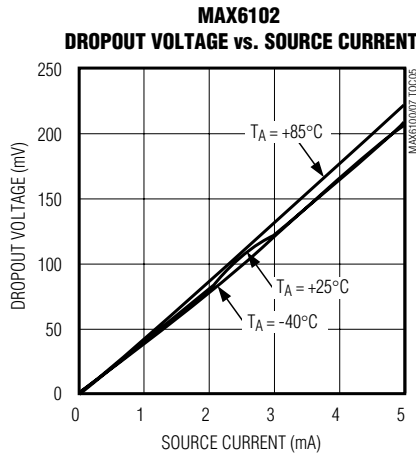
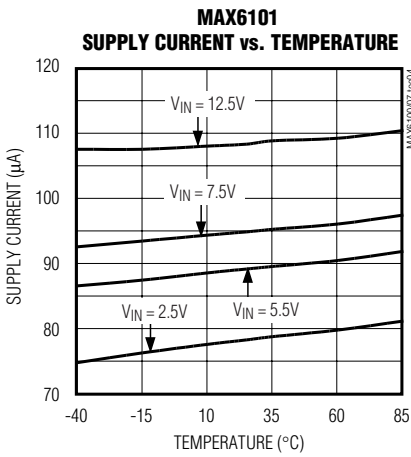
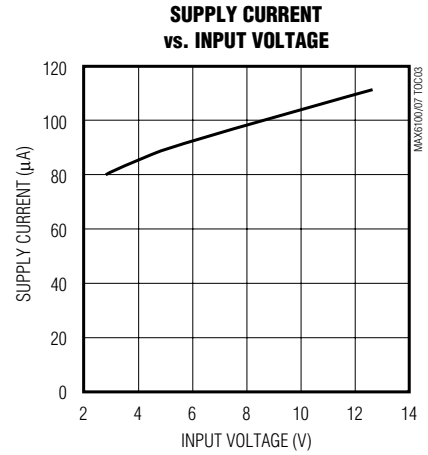
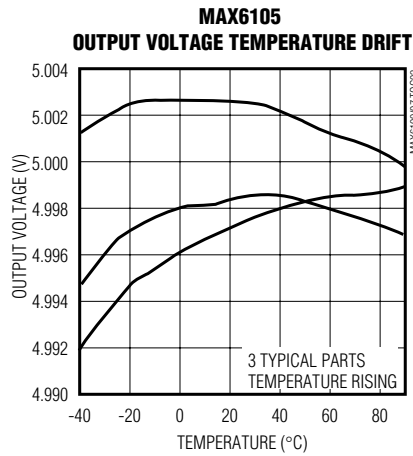
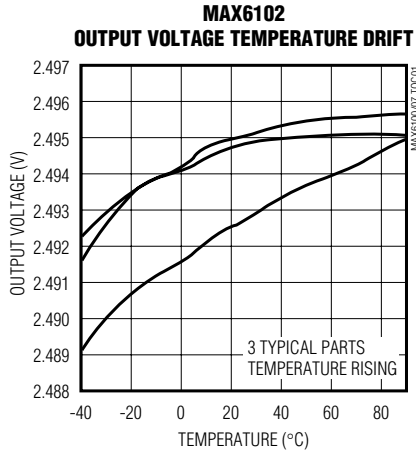
**Note 4:** Thermal hysteresis is defined as the change in +25°C output voltage before and after temperature cycling of the device from T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>.

**Note 5:** Dropout voltage is the minimum input voltage at which V<sub>OUT</sub> changes ≤ 0.2% from V<sub>OUT</sub> at V<sub>IN</sub> = 5.0V (V<sub>IN</sub> = 5.5V for MAX6105).

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## Typical Operating Characteristics

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

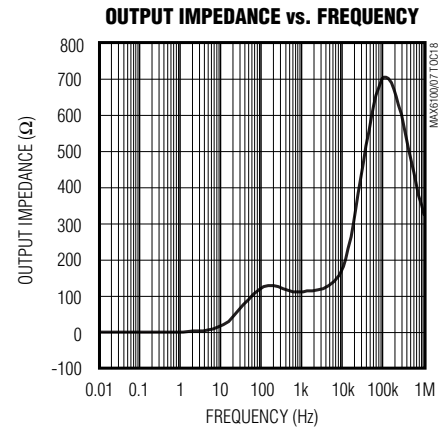
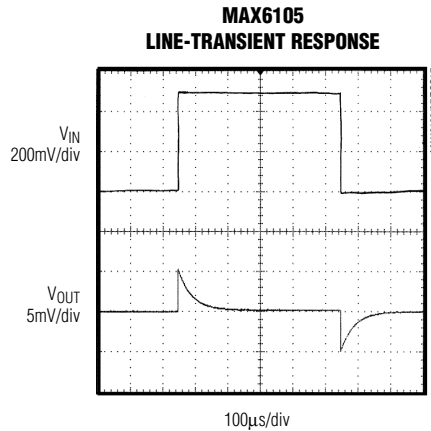
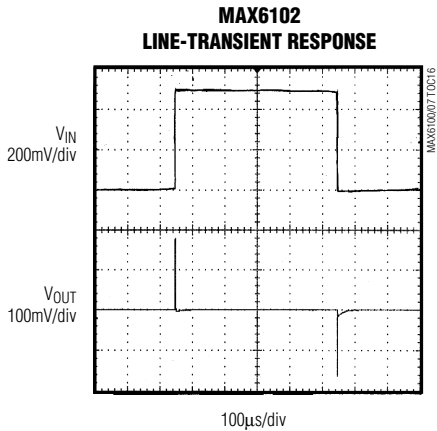
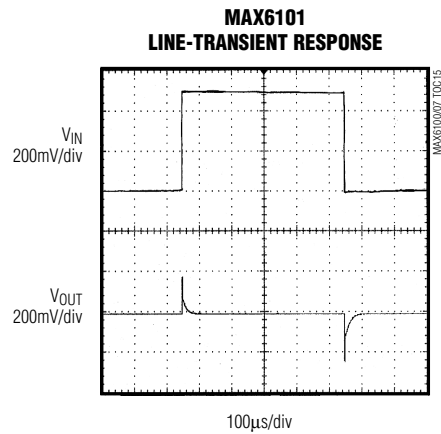
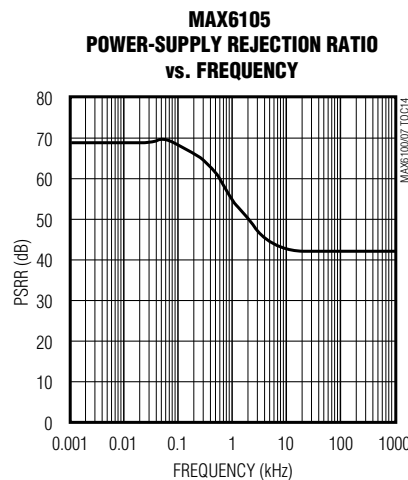
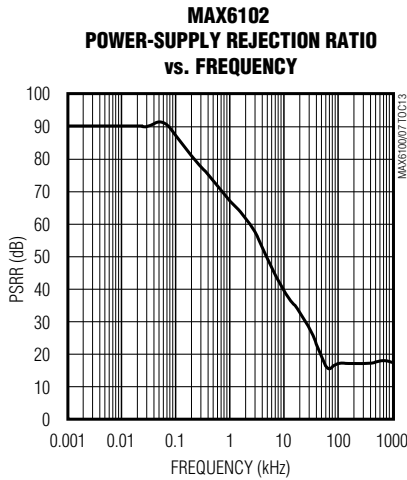
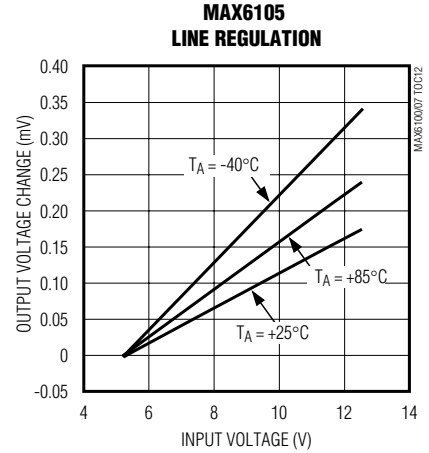
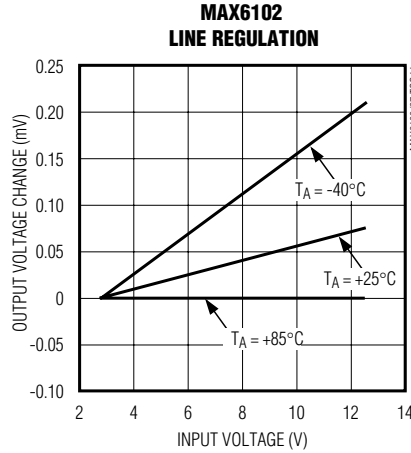
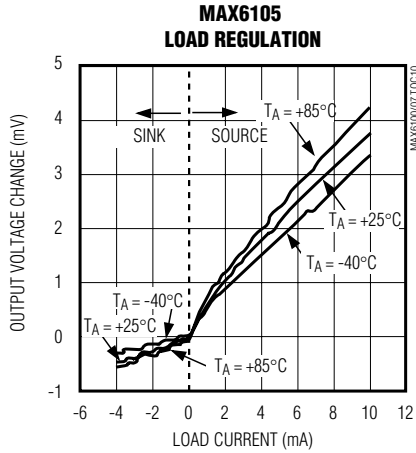


# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

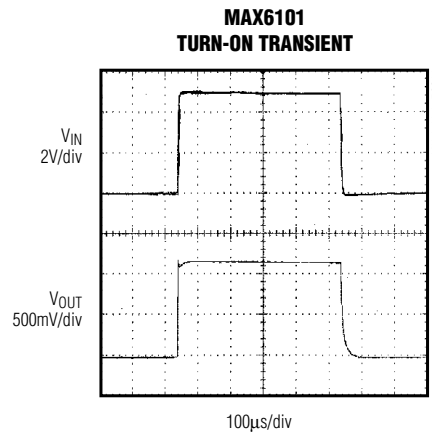
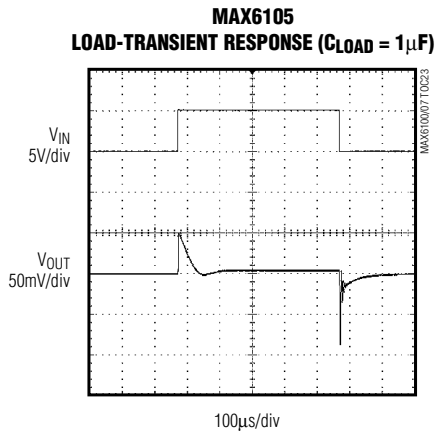
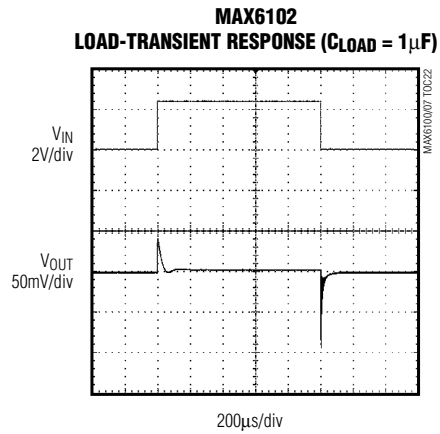
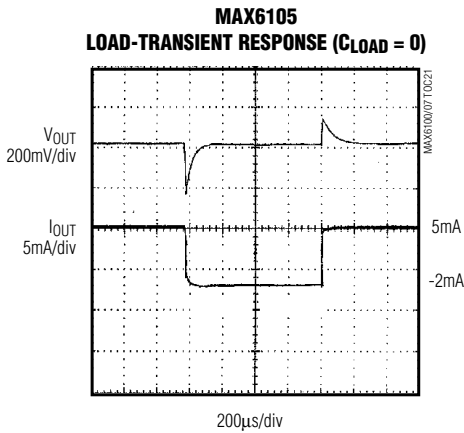
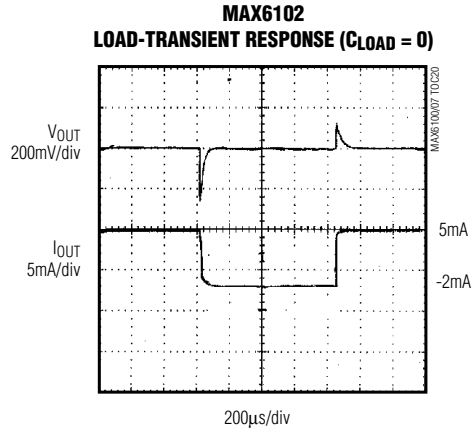
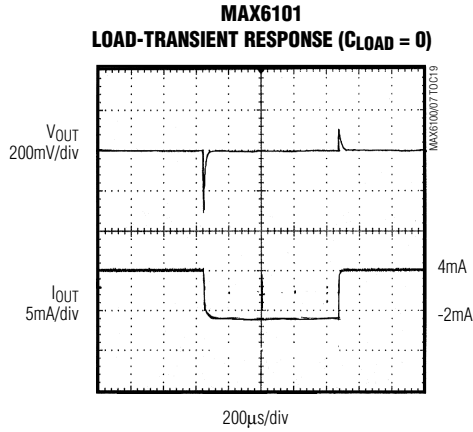
MAX6100-MAX6107



# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## Typical Operating Characteristics (continued)

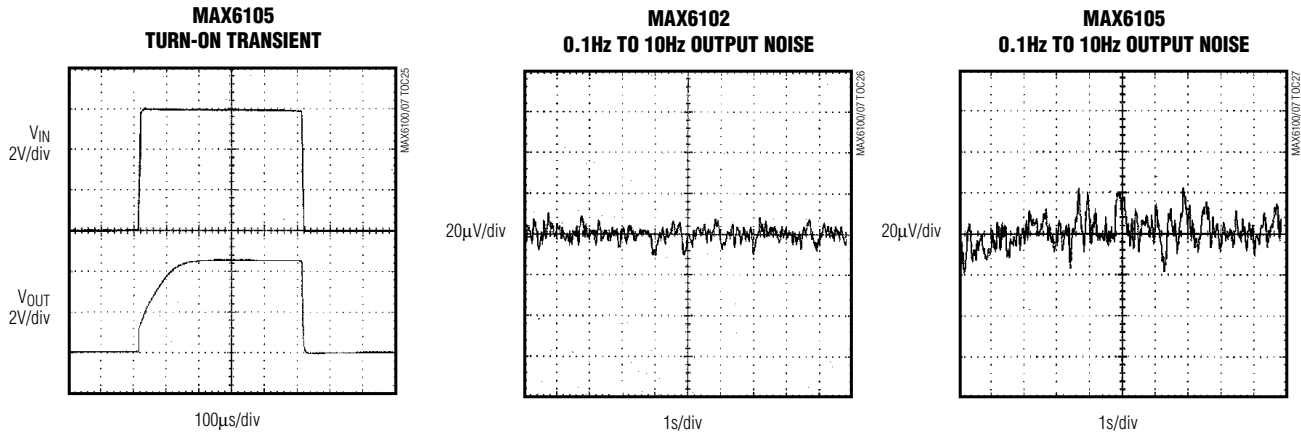
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



MAX6100-MAX6107

### 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 $\mu\text{F}$  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 MAX6100 family do not require an output capacitance for frequency stability. They are stable for any capacitive load when sourcing less than 200 $\mu\text{A}$ . When sourcing greater than 200 $\mu\text{A}$ , the output may become unstable with capacitive loads between 0.5nF and 50nF. In applications where the load or the supply can experience step changes, an output capacitor reduces the amount of overshoot (undershoot) and improves the circuit's transient response. Many applications do not require an external capacitor, and the MAX6100 family can offer a significant advantage in these applications when board space is critical.

#### Supply Current

The quiescent supply current of the series-mode MAX6100 family is typically 90 $\mu\text{A}$  and is virtually independent of the supply voltage, with only an 8 $\mu\text{A/V}$  (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 MAX6100 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 $\mu\text{A}$  beyond the nominal supply current. The input voltage source must be capable of providing this current to ensure reliable turn-on.

#### Output Voltage Hysteresis

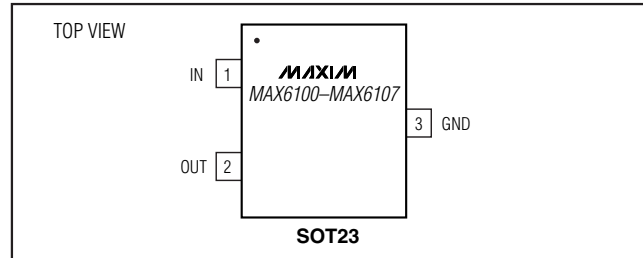
Output voltage hysteresis is the change of output voltage at  $T_A = +25^\circ\text{C}$  before and after the device is cycled over its entire operating temperature range. Hysteresis is caused by differential package stress appearing across the bandgap core transistors. The typical temperature hysteresis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

# Low-Cost, Micropower, Low-Dropout, High-Output-Current, SOT23 Voltage References

## Turn-On Time

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

## Pin Configuration



## Chip Information

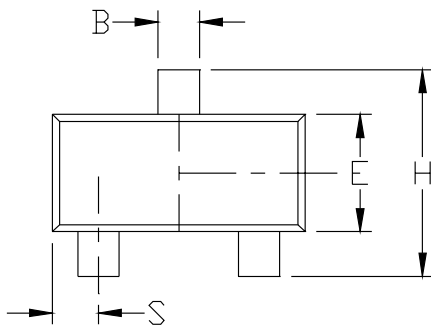
TRANSISTOR COUNT: 117

## Package Information

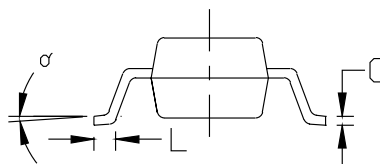
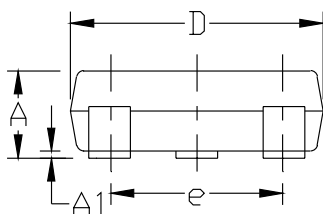
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

### 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 |
| $\alpha$ | 0°     | 8°    | 0°          | 8°    |



|  |                                     |                    |                    |
|--|-------------------------------------|--------------------|--------------------|
| <b>MAXIM</b>                           |                                     |                    |                    |
| <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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