

Click [here](#) for production status of specific part numbers.

## MAX44244/MAX44245/ MAX44248

## 36V, Precision, Low-Power, 90 $\mu$ A, Single/Quad/Dual Op Amps

### General Description

The MAX44244/MAX44245/MAX44248 family of parts provide ultra-precision, low-noise, zero-drift single/quad/dual operational amplifiers featuring very low-power operation with a wide supply range. The devices incorporate a patented auto-zero circuit that constantly measures and compensates the input offset to eliminate drift over time and temperature as well as the effect of 1/f noise. These devices also feature integrated EMI filters to reduce high-frequency signal demodulation on the output. The op amps operate from either a single 2.7V to 36V supply or dual  $\pm 1.35$ V to  $\pm 18$ V supply. The devices are unity-gain stable with a 1MHz gain-bandwidth product and a low 90 $\mu$ A supply current per amplifier.

The low offset and noise specifications and high supply range make the devices ideal for sensor interfaces and transmitters.

The devices are available in  $\mu$ MAX®, SO, SOT23, and TSSOP packages and are specified over the -40°C to +125°C automotive operating temperature range.

### Applications

- Sensors Interfaces
- 4mA to 20mA and 0 to 10V Transmitters
- PLC Analog I/O Modules
- Weight Scales
- Portable Medical Devices

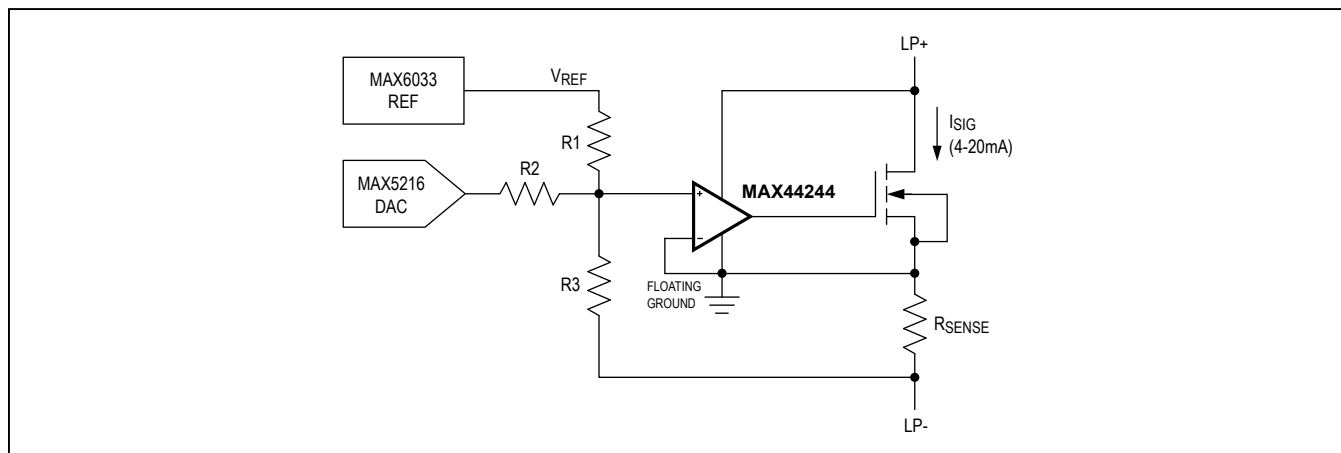
### Benefits and Features

- Reduces Power for Sensitive Precision Applications
  - Low 90 $\mu$ A Quiescent Current per Amplifier
- Eliminates the Cost of Calibration with Increased Accuracy with Maxim's Patented Autozero Circuitry
  - Very Low Input Voltage Offset 7.5 $\mu$ V (max)
  - Low 30nV/°C Offset Drift (max)
- Low Noise Ideal for Sensor Interfaces and Transmitters
  - 50nV/ $\sqrt{\text{Hz}}$  at 1kHz
  - 0.5 $\mu$ V<sub>P-P</sub> from 0.1Hz to 10Hz
- 1MHz Gain-Bandwidth Product
  - EMI Suppression Circuitry
- Rail-to-Rail Output
- Wide Supply for High-Voltage Front Ends
  - 2.7V to 36V Supply Range
- $\mu$ MAX, SO, SOT23, TSSOP Packages

**Ordering Information** appears at end of data sheet.

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### Typical Operating Circuit



# MAX44244/MAX44245/ MAX44248

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## Absolute Maximum Ratings

V<sub>DD</sub> to V<sub>SS</sub>.....-0.3V to +40V  
Common-Mode Input Voltage.....(V<sub>SS</sub> - 0.3V) to (V<sub>DD</sub> + 0.3V)  
Differential Input Voltage IN<sub>+</sub>, IN<sub>-</sub> .....6V  
Continuous Input Current Into Any Pin.....±20mA  
Output Voltage to V<sub>SS</sub> (OUT<sub>-</sub>)..... - 0.3V to (V<sub>DD</sub> + 0.3V)  
Output Short-Circuit Duration (OUT<sub>-</sub>)..... 1s

Operating Temperature Range..... -40°C to +125°C  
Storage Temperature..... -65°C to +150°C  
Junction Temperature..... +150°C  
Lead Temperature (soldering, 10s) .....+300°C  
Soldering Temperature (reflow).....+260°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.

## Package Thermal Characteristics (Note 1)

### SO-8

Junction-to-Ambient Thermal Resistance (θ<sub>JA</sub>) .....132°C/W  
Junction-to-Case Thermal Resistance (θ<sub>JC</sub>) .....38°C/W

### SO-14

Junction-to-Ambient Thermal Resistance (θ<sub>JA</sub>) .....120°C/W  
Junction-to-Case Thermal Resistance (θ<sub>JC</sub>) .....37°C/W

### SOT23

Junction-to-Ambient Thermal Resistance (θ<sub>JA</sub>) .....324.3°C/W  
Junction-to-Case Thermal Resistance (θ<sub>JC</sub>) .....82°C/W

### TSSOP

Junction-to-Ambient Thermal Resistance (θ<sub>JA</sub>) .....110°C/W  
Junction-to-Case Thermal Resistance (θ<sub>JC</sub>) .....30°C/W

### μMAX

Junction-to-Ambient Thermal Resistance (θ<sub>JA</sub>) .....206.3°C/W  
Junction-to-Case Thermal Resistance (θ<sub>JC</sub>) .....42°C/W

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

## Electrical Characteristics

(V<sub>DD</sub> = 10V, V<sub>SS</sub> = 0V, V<sub>IN+</sub> = V<sub>IN-</sub> = V<sub>DD</sub>/2, R<sub>L</sub> = 5kΩ to V<sub>DD</sub>/2, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at +25°C.) (Note 2)

| PARAMETER                                                | SYMBOL          | CONDITIONS                                                                            | MIN                    | TYP | MAX                   | UNITS |
|----------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------|------------------------|-----|-----------------------|-------|
| POWER SUPPLY                                             |                 |                                                                                       |                        |     |                       |       |
| Supply Voltage Range                                     | V <sub>DD</sub> | Guaranteed by PSRR                                                                    | 2.7                    |     | 36                    | V     |
| Power-Supply Rejection Ratio (Note 3)                    | PSRR            | T <sub>A</sub> = +25°C, V <sub>IN+</sub> = V <sub>IN-</sub> = V <sub>DD</sub> /2 - 1V | 140                    | 148 |                       | dB    |
|                                                          |                 | -40°C < T <sub>A</sub> < +125°C                                                       | 133                    |     |                       |       |
| Quiescent Current Per Amplifier (MAX4244 Only)           | I <sub>DD</sub> | T <sub>A</sub> = +25°C                                                                |                        | 100 | 160                   | μA    |
|                                                          |                 | -40°C < T <sub>A</sub> < +125°C                                                       |                        |     | 190                   |       |
| Quiescent Current Per Amplifier (MAX44245/MAX44248 Only) | I <sub>DD</sub> | T <sub>A</sub> = +25°C                                                                |                        | 90  | 130                   | μA    |
|                                                          |                 | -40°C < T <sub>A</sub> < +125°C                                                       |                        |     | 145                   |       |
| DC SPECIFICATIONS                                        |                 |                                                                                       |                        |     |                       |       |
| Input Common-Mode Range                                  | V <sub>CM</sub> | Guaranteed by CMRR test                                                               | V <sub>SS</sub> - 0.05 |     | V <sub>DD</sub> - 1.5 | V     |

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## Electrical Characteristics (continued)

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ ,  $T_A = -40^\circ C$  to  $+125^\circ C$ , unless otherwise noted. Typical values are at  $+25^\circ C$ .) (Note 2)

| PARAMETER                            | SYMBOL                             | CONDITIONS                                                                                           |                                 | MIN | TYP  | MAX | UNITS             |
|--------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------|-----|------|-----|-------------------|
| Common-Mode Rejection Ratio (Note 3) | CMRR                               | T <sub>A</sub> = +25°C, V <sub>CM</sub> = V <sub>SS</sub> - 0.05V to V <sub>DD</sub> - 1.5V          |                                 | 126 | 130  |     | dB                |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C, V <sub>CM</sub> = V <sub>SS</sub> - 0.05V to V <sub>DD</sub> - 1.5V |                                 | 120 |      |     |                   |
| Input Offset Voltage (Note 3)        | V <sub>OS</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |     | 2    | 7.5 | μV                |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |     | 10   |     |                   |
| Input Offset Voltage Drift (Note 3)  | TC V <sub>OS</sub>                 |                                                                                                      |                                 |     | 10   | 30  | nV/°C             |
| Input Bias Current (Note 3)          | I <sub>B</sub>                     | T <sub>A</sub> = +25°C                                                                               |                                 |     | 150  | 300 | pA                |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |     | 700  |     |                   |
| Input Offset Current (Note 3)        | I <sub>OS</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |     | 300  | 600 | pA                |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |     | 1400 |     |                   |
| Open-Loop Gain (Note 3)              | A <sub>VOL</sub>                   | V <sub>SS</sub> + 0.5V ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> - 0.5V                                   | T <sub>A</sub> = +25°C          | 140 | 150  |     | dB                |
|                                      |                                    |                                                                                                      | -40°C < T <sub>A</sub> < +125°C | 135 |      |     |                   |
| Output Short-Circuit Current         |                                    | To V <sub>DD</sub> or V <sub>SS</sub> , noncontinuous                                                |                                 |     | 40   |     | mA                |
| Output Voltage Swing                 | V <sub>DD</sub> - V <sub>OUT</sub> | T <sub>A</sub> = +25°C                                                                               |                                 |     |      | 80  | mV                |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |     |      | 110 |                   |
|                                      | V <sub>OUT</sub> - V <sub>SS</sub> | T <sub>A</sub> = +25°C                                                                               |                                 |     |      | 50  |                   |
|                                      |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |     |      | 75  |                   |
| AC SPECIFICATIONS                    |                                    |                                                                                                      |                                 |     |      |     |                   |
| Input Voltage-Noise Density          | e <sub>N</sub>                     | f = 1kHz                                                                                             |                                 |     | 50   |     | nV/√Hz            |
| Input Voltage Noise                  |                                    | 0.1Hz < f < 10Hz                                                                                     |                                 |     | 500  |     | nV <sub>P-P</sub> |
| Input Current-Noise Density          | i <sub>N</sub>                     | f = 1kHz                                                                                             |                                 |     | 0.1  |     | pA/√Hz            |
| Gain-Bandwidth Product               | GBW                                |                                                                                                      |                                 |     | 1    |     | MHz               |
| Slew Rate                            | SR                                 | A <sub>V</sub> = 1V/V, V <sub>OUT</sub> = 2V <sub>P-P</sub>                                          |                                 |     | 0.7  |     | V/μs              |
| Capacitive Loading                   | C <sub>L</sub>                     | No sustained oscillation, A <sub>V</sub> = 1V/V                                                      |                                 |     | 400  |     | pF                |
| Total Harmonic Distortion Plus Noise | THD+N                              | V <sub>OUT</sub> = 2V <sub>P-P</sub> , A <sub>V</sub> = +1V/V, f = 1kHz                              |                                 |     | -100 |     | dB                |
| EMI Rejection Ratio                  | EMIRR                              | V <sub>RF_PEAK</sub> = 100mV                                                                         | f = 400MHz                      |     | 75   |     | dB                |
|                                      |                                    |                                                                                                      | f = 900MHz                      |     | 78   |     |                   |
|                                      |                                    |                                                                                                      | f = 1800MHz                     |     | 80   |     |                   |
|                                      |                                    |                                                                                                      | f = 2400MHz                     |     | 90   |     |                   |

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## Electrical Characteristics (continued)

( $V_{DD} = 30V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ ,  $T_A = -40^\circ C$  to  $+125^\circ C$ , unless otherwise noted. Typical values are at  $+25^\circ C$ .) (Note 2)

| PARAMETER                                                | SYMBOL                             | CONDITIONS                                                                                           |                                 | MIN                    | TYP | MAX                   | UNITS             |
|----------------------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------|------------------------|-----|-----------------------|-------------------|
| POWER SUPPLY                                             |                                    |                                                                                                      |                                 |                        |     |                       |                   |
| Quiescent Current Per Amplifier (MAX44244 Only)          | I <sub>DD</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |                        | 100 | 160                   | μA                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 190                   |                   |
| Quiescent Current Per Amplifier (MAX44245/MAX44248 Only) | I <sub>DD</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |                        | 90  | 130                   | μA                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 145                   |                   |
| DC SPECIFICATIONS                                        |                                    |                                                                                                      |                                 |                        |     |                       |                   |
| Input Common-Mode Range                                  | V <sub>CM</sub>                    | Guaranteed by CMRR test                                                                              |                                 | V <sub>SS</sub> - 0.05 |     | V <sub>DD</sub> - 1.5 | V                 |
| Common-Mode Rejection Ratio (Note 3)                     | CMRR                               | T <sub>A</sub> = +25°C, V <sub>CM</sub> = V <sub>SS</sub> - 0.05V to V <sub>DD</sub> - 1.5V          |                                 | 130                    | 140 |                       | dB                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C, V <sub>CM</sub> = V <sub>SS</sub> - 0.05V to V <sub>DD</sub> - 1.5V |                                 | 126                    |     |                       |                   |
| Input Offset Voltage (Note 3)                            | V <sub>OS</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |                        | 2   | 7.5                   | μV                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 10                    |                   |
| Input Offset Voltage Drift (Note 3)                      | TC V <sub>OS</sub>                 |                                                                                                      |                                 |                        | 10  | 30                    | nV/°C             |
| Input Bias Current (Note 3)                              | I <sub>B</sub>                     | T <sub>A</sub> = +25°C                                                                               |                                 |                        | 150 | 300                   | pA                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 700                   |                   |
| Input Offset Current (Note 3)                            | I <sub>OS</sub>                    | T <sub>A</sub> = +25°C                                                                               |                                 |                        | 300 | 600                   | pA                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 1400                  |                   |
| Open-Loop Gain (Note 3)                                  | A <sub>VOL</sub>                   | V <sub>SS</sub> + 0.5V ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> - 0.5V                                   | T <sub>A</sub> = +25°C          | 146                    | 150 |                       | dB                |
|                                                          |                                    |                                                                                                      | -40°C < T <sub>A</sub> < +125°C | 140                    |     |                       |                   |
| Output Short-Circuit Current                             |                                    | To V <sub>DD</sub> or V <sub>SS</sub> , noncontinuous                                                |                                 |                        | 40  |                       | mA                |
| Output Voltage Swing                                     | V <sub>DD</sub> - V <sub>OUT</sub> | T <sub>A</sub> = +25°C                                                                               |                                 |                        |     | 200                   | mV                |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 270                   |                   |
|                                                          | V <sub>OUT</sub> - V <sub>SS</sub> | T <sub>A</sub> = +25°C                                                                               |                                 |                        |     | 140                   |                   |
|                                                          |                                    | -40°C < T <sub>A</sub> < +125°C                                                                      |                                 |                        |     | 220                   |                   |
| AC SPECIFICATIONS                                        |                                    |                                                                                                      |                                 |                        |     |                       |                   |
| Input Voltage-Noise Density                              | e <sub>N</sub>                     | f = 1kHz                                                                                             |                                 |                        | 50  |                       | nV/√Hz            |
| Input Voltage Noise                                      |                                    | 0.1Hz < f < 10Hz                                                                                     |                                 |                        | 500 |                       | nV <sub>p-p</sub> |
| Input Current-Noise Density                              | i <sub>N</sub>                     | f = 1kHz                                                                                             |                                 |                        | 0.1 |                       | pA/√Hz            |
| Gain-Bandwidth Product                                   | GBW                                |                                                                                                      |                                 |                        | 1   |                       | MHz               |

## Electrical Characteristics (continued)

( $V_{DD} = 30V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ ,  $T_A = -40^\circ C$  to  $+125^\circ C$ , unless otherwise noted. Typical values are at  $+25^\circ C$ .) (Note 2)

| PARAMETER                            | SYMBOL | CONDITIONS                                        | MIN | TYP         | MAX | UNITS |
|--------------------------------------|--------|---------------------------------------------------|-----|-------------|-----|-------|
| Slew Rate                            | SR     | $A_V = 1V/V$ , $V_{OUT} = 2V_{P-P}$               |     | 0.7         |     | V/μs  |
| Capacitive Loading                   | $C_L$  | No sustained oscillation, $A_V = 1V/V$            |     | 400         |     | pF    |
| Total Harmonic Distortion Plus Noise | THD+N  | $V_{OUT} = 2V_{P-P}$ , $A_V = +1V/V$ , $f = 1kHz$ |     | -100        |     | dB    |
| EMI Rejection Ratio                  | EMIRR  | $V_{RF\_PEAK} = 100mV$                            |     | f = 400MHz  | 75  | dB    |
|                                      |        |                                                   |     | f = 900MHz  | 78  |       |
|                                      |        |                                                   |     | f = 1800MHz | 80  |       |
|                                      |        |                                                   |     | f = 2400MHz | 90  |       |

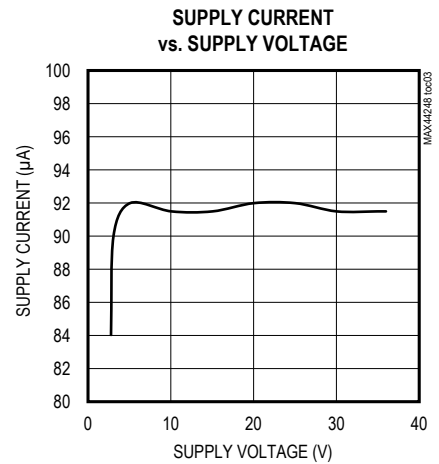
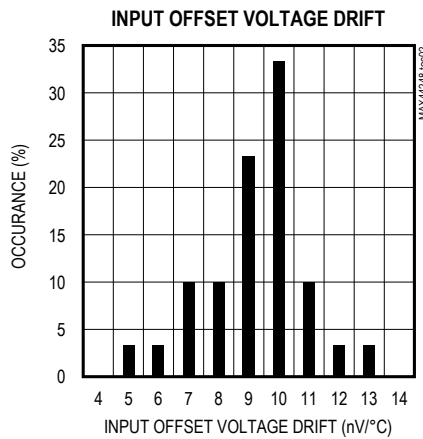
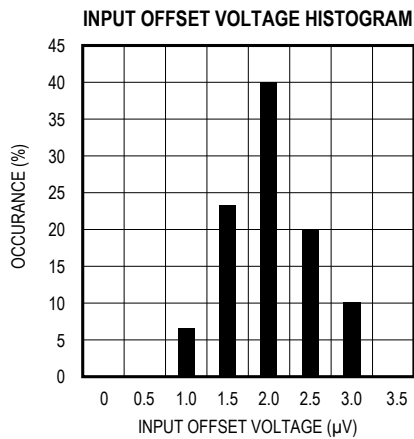
**Note 2:** All devices are 100% production tested at  $T_A = +25^\circ C$ . Temperature limits are guaranteed by design.

**Note 3:** Guaranteed by design.

**Note 4:** At  $IN+$  and  $IN-$ . Defined as  $20\log(V_{RF\_PEAK}/\Delta V_{OS})$ .

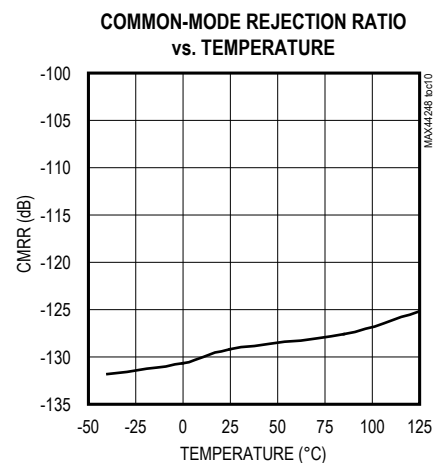
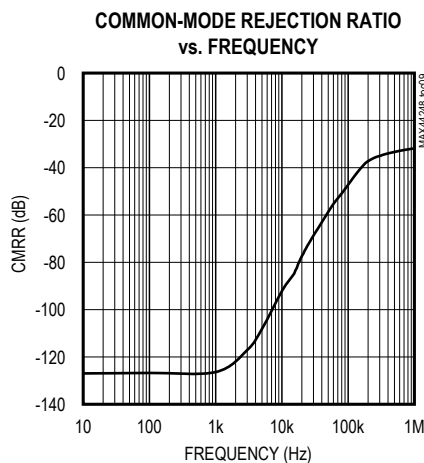
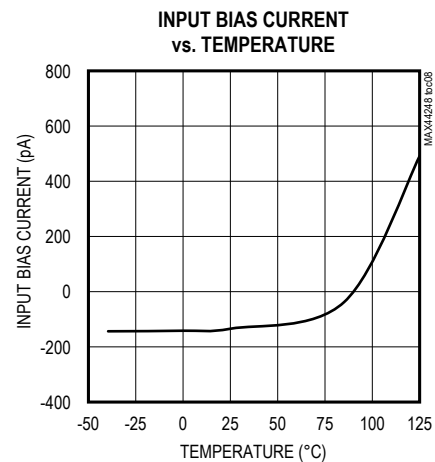
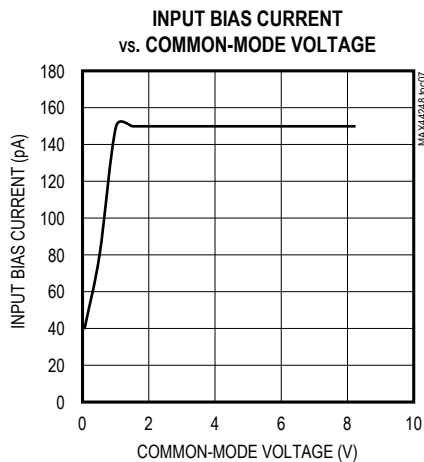
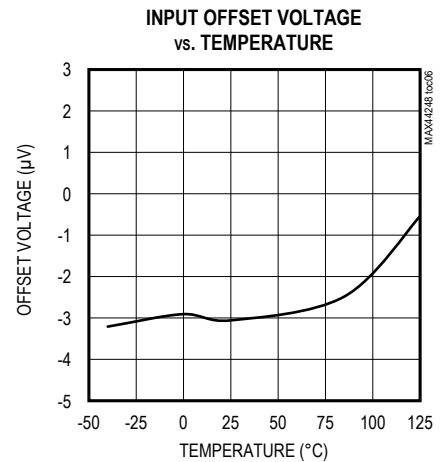
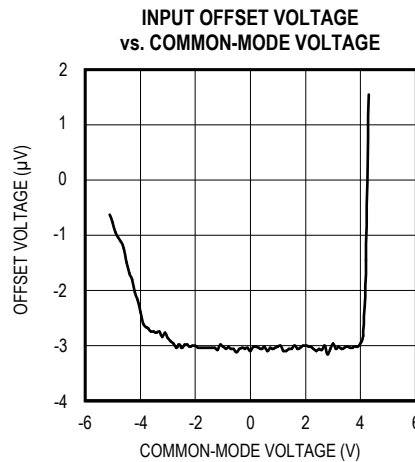
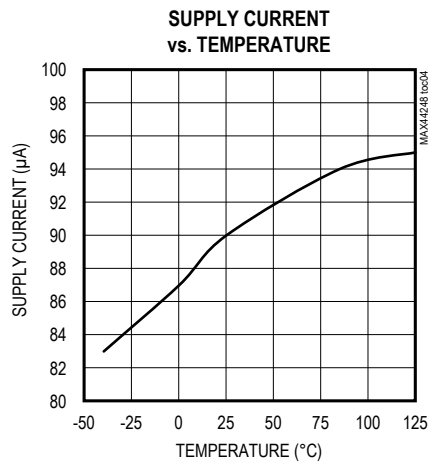
## Typical Operating Characteristics

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ . Typical values are at  $T_A = +25^\circ C$ .)



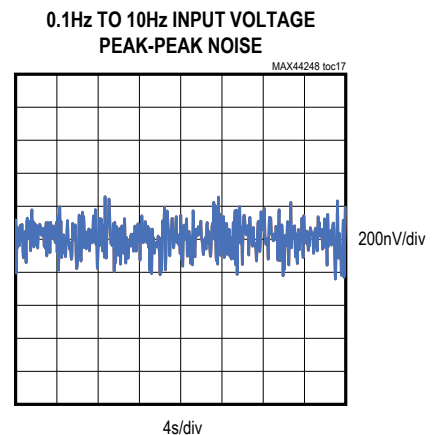
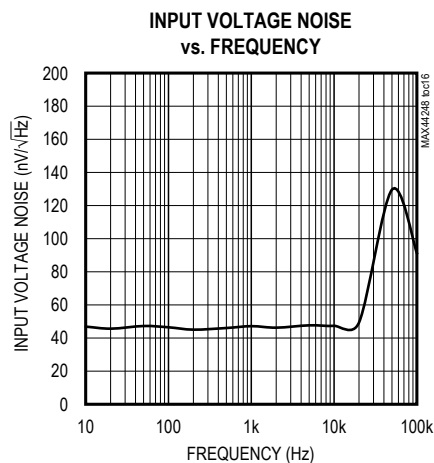
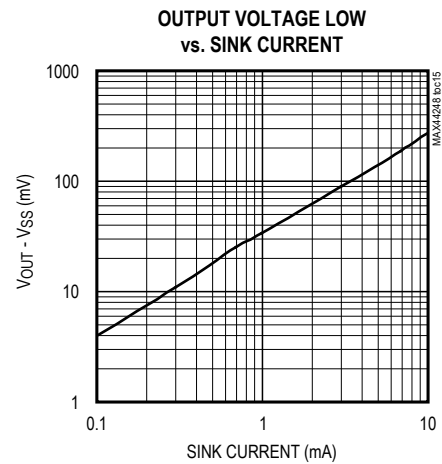
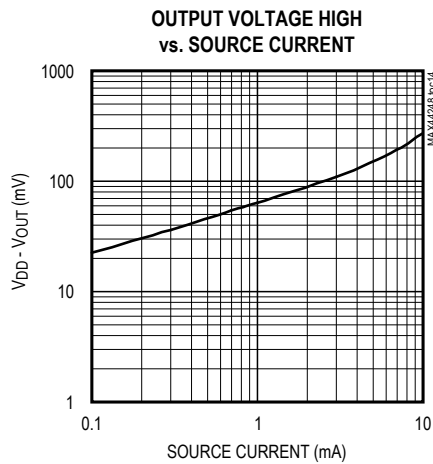
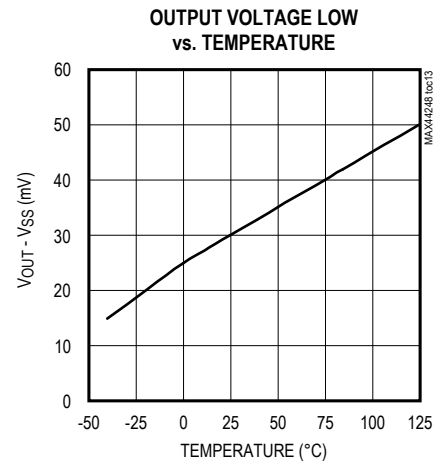
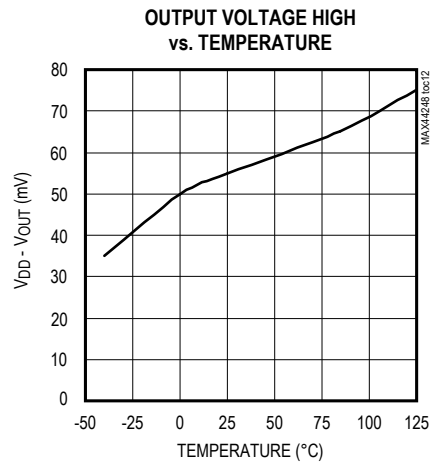
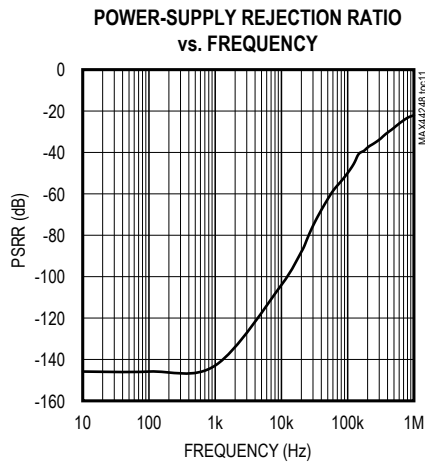
## Typical Operating Characteristics (continued)

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ . Typical values are at  $T_A = +25^\circ C$ .)



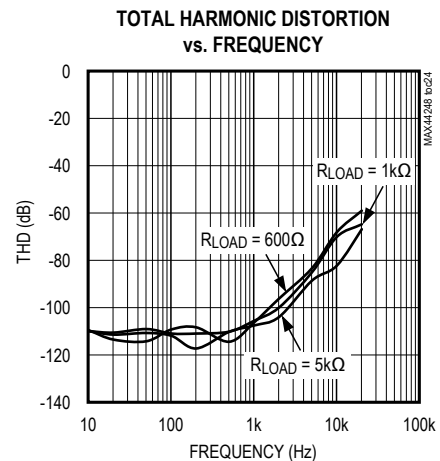
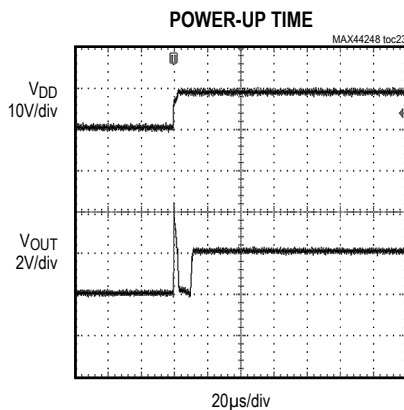
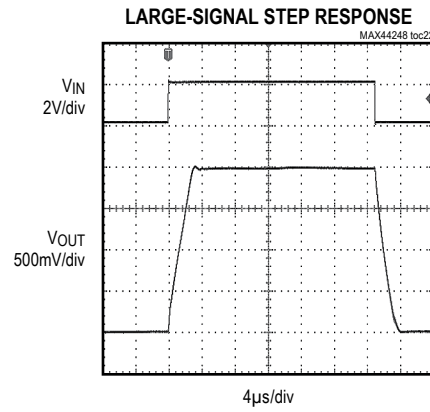
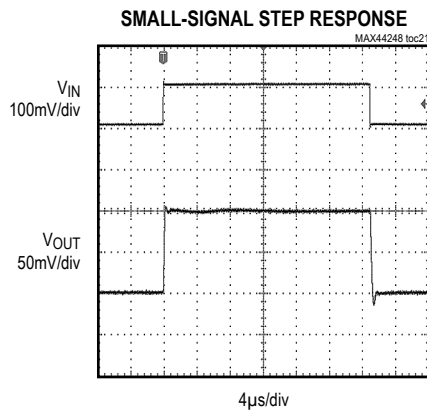
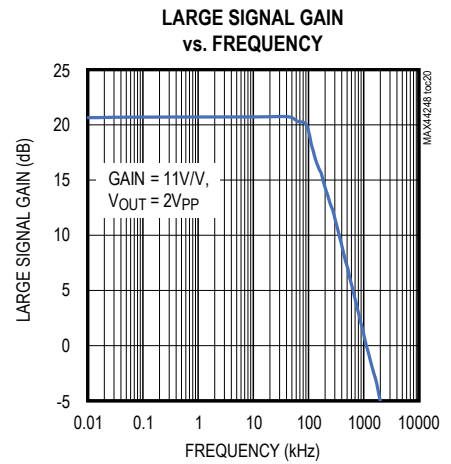
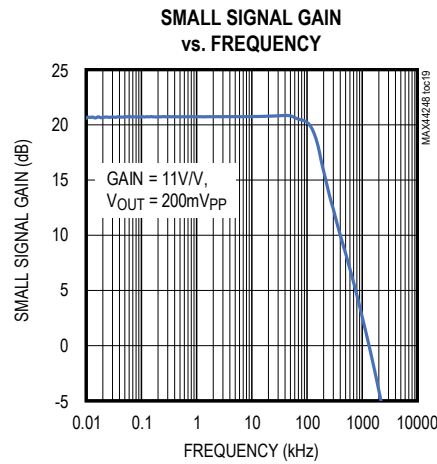
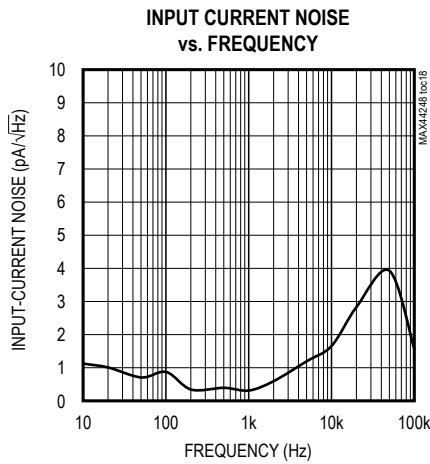
## Typical Operating Characteristics (continued)

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ . Typical values are at  $T_A = +25^\circ C$ .)



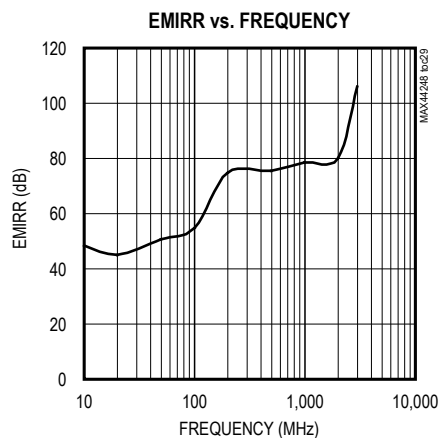
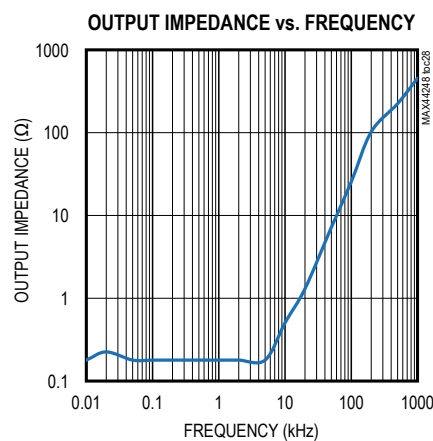
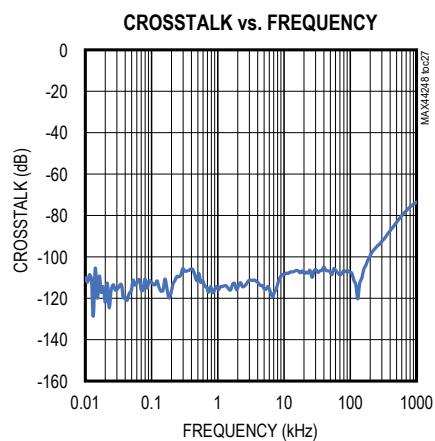
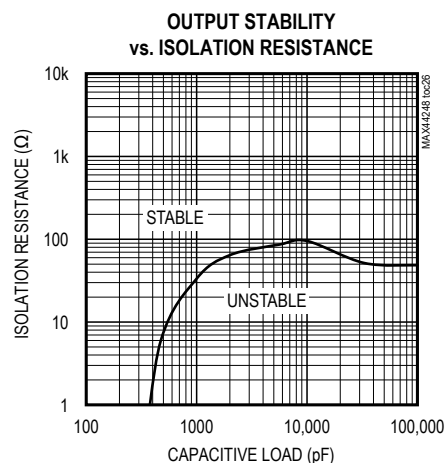
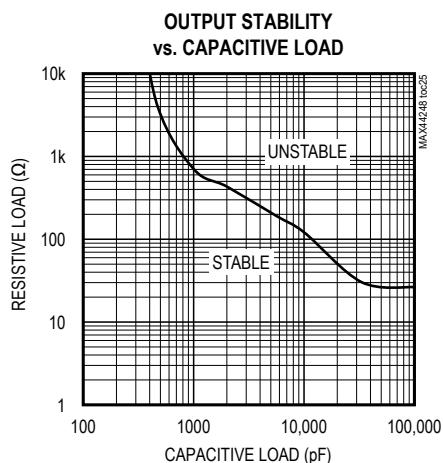
## Typical Operating Characteristics (continued)

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ . Typical values are at  $T_A = +25^\circ C$ .)

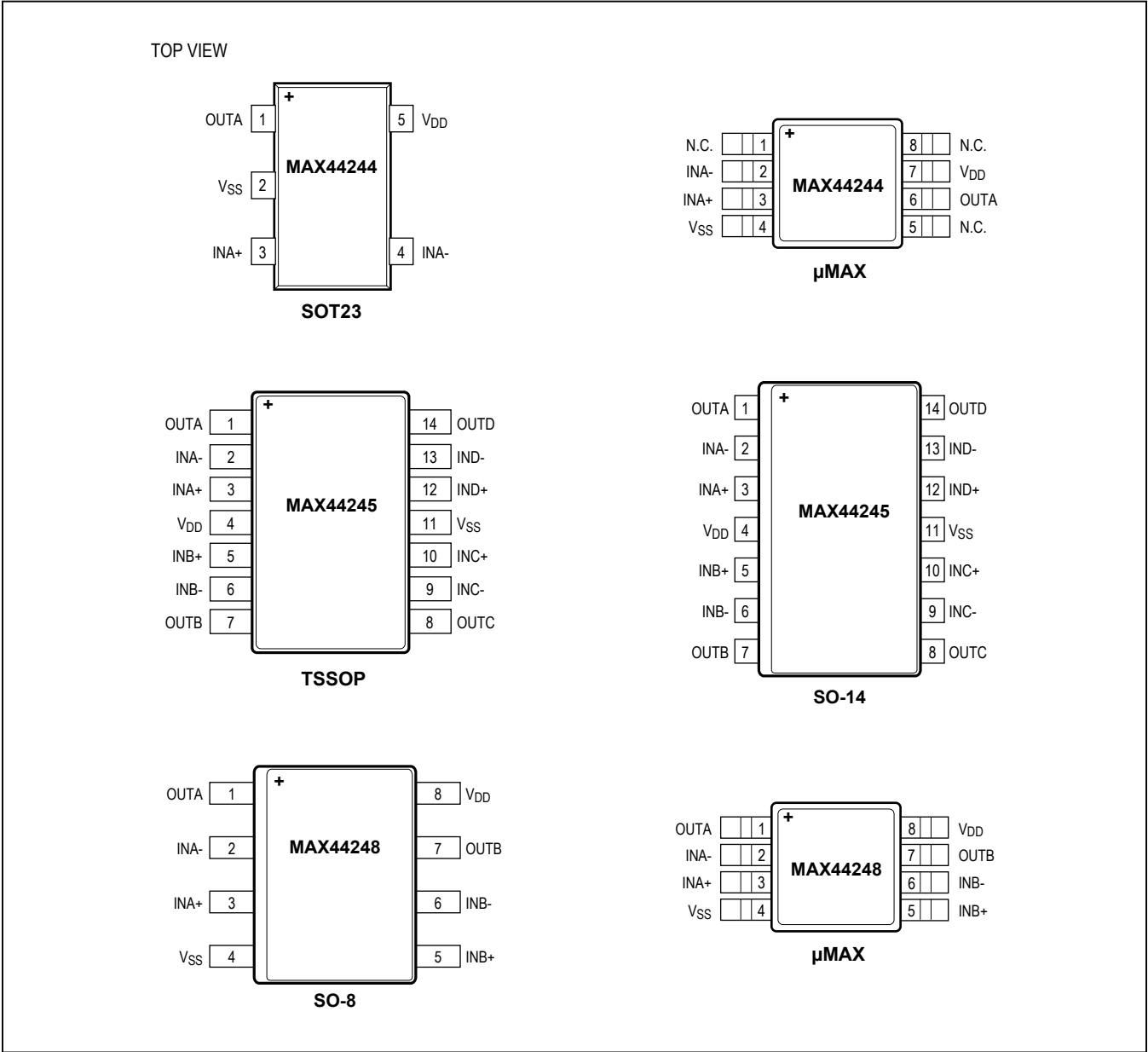


## Typical Operating Characteristics (continued)

( $V_{DD} = 10V$ ,  $V_{SS} = 0V$ ,  $V_{IN+} = V_{IN-} = V_{DD}/2$ ,  $R_L = 5k\Omega$  to  $V_{DD}/2$ . Typical values are at  $T_A = +25^\circ C$ .)



Pin Configurations



## Pin Description

| PIN      |         |          |       |          |      | NAME            | FUNCTION                                 |
|----------|---------|----------|-------|----------|------|-----------------|------------------------------------------|
| MAX44244 |         | MAX44245 |       | MAX44248 |      |                 |                                          |
| SOT23    | μMAX    | SO-14    | TSSOP | SO-8     | μMAX |                 |                                          |
| 1        | 6       | 1        | 1     | 1        | 1    | OUTA            | Channel A Output                         |
| 2        | 4       | 11       | 11    | 4        | 4    | V <sub>SS</sub> | Negative Supply Voltage                  |
| 3        | 3       | 3        | 3     | 3        | 3    | INA+            | Channel A Positive Input                 |
| 4        | 2       | 2        | 2     | 2        | 2    | INA-            | Channel A Negative Input                 |
| 5        | 7       | 4        | 4     | 8        | 8    | V <sub>DD</sub> | Positive Supply Voltage                  |
| —        | —       | 5        | 5     | 5        | 5    | INB+            | Channel B Positive Input                 |
| —        | —       | 6        | 6     | 6        | 6    | INB-            | Channel B Negative Input                 |
| —        | —       | 7        | 7     | 7        | 7    | OUTB            | Channel B Output                         |
| —        | —       | 8        | 8     | —        | —    | OUTC            | Channel C Output                         |
| —        | —       | 9        | 9     | —        | —    | INC-            | Channel C Negative Input                 |
| —        | —       | 10       | 10    | —        | —    | INC+            | Channel C Positive Input                 |
| —        | —       | 12       | 12    | —        | —    | IND+            | Channel D Positive Input                 |
| —        | —       | 13       | 13    | —        | —    | IND-            | Channel D Negative Input                 |
| —        | —       | 14       | 14    | —        | —    | OUTD            | Channel D Output                         |
| —        | 1, 5, 8 | —        | —     | —        | —    | N.C.            | No Connection. Not internally connected. |

## Detailed Description

The MAX44244/MAX44245/MAX44248 are high-precision amplifiers with less than 2 $\mu$ V (typ) input-referred offset and low input voltage-noise density at 10Hz. 1/f noise, in fact, is eliminated to improve the performance in low-frequency applications. These characteristics are achieved through an auto-zeroing technique that cancels the input offset voltage and 1/f noise of the amplifier.

### External Noise Suppression in EMI Form

These devices have input EMI filters to prevent effects of radio frequency interference on the output. The EMI filters comprise passive devices that present significant higher impedance to higher frequency signals. See the EMIRR vs. Frequency graph in the [Typical Operating Characteristics](#) section for details.

### High Supply Voltage Range

The devices feature 90 $\mu$ A current consumption per channel and a voltage supply range from either 2.7V to 36V single supply or  $\pm$ 1.35V to  $\pm$ 18V split supply.

## Applications Information

The devices feature ultra-high precision operational amplifiers with a high supply voltage range designed for load cell, medical instrumentation, and precision instrument applications.

### 4–20mA Current-Loop Communication

Industrial environments typically have a large amount of broadcast electromagnetic interference (EMI) from high-voltage transients and switching motors. This combined with long cables for sensor communication leads to high-voltage noise on communication lines. Current-Loop communication is resistant to this noise because the EMI induced current is low. This configuration also allows for low-power sensor applications to be powered from the communication lines.

The [Typical Operating Circuit](#) shows how the device can be used to make a current loop driver.

## 36V, Precision, Low-Power, 90 $\mu$ A, Single/Quad/Dual Op Amps

high dynamic range with low power such as sensors on a 4–20mA industrial control loop. The devices provide a high-accuracy internal oscillator that requires no external components.

The MAX44244/MAX44245/MAX44248 feature ultra-low input offset voltage and noise. Therefore, to get optimum performance follow the layout guidelines.

## Driving High-Performance ADCs

The MAX11205 is an ultra-low-power (< 300μA, max active current), high-resolution, serial output ADC. It provides the highest resolution per unit power in the industry and is optimized for applications that require very



MAX44244/MAX44245/  
MAX44248

36V, Precision, Low-Power, 90µA,  
Single/Quad/Dual Op Amps

## Chip Information

PROCESS: BiCMOS

## Ordering Information

| PART                 | TEMP RANGE      | PIN-<br>PACKAGE | TOP<br>MARK |
|----------------------|-----------------|-----------------|-------------|
| <b>MAX44244</b> AUK+ | -40°C to +125°C | 5 SOT23         | AFMR        |
| MAX44244AUA+         | -40°C to +125°C | 8 µMAX          | —           |
| <b>MAX44245</b> ASD+ | -40°C to +125°C | 14 SO           | —           |
| MAX44245AUD+         | -40°C to +125°C | 14 TSSOP        | —           |
| <b>MAX44248</b> AUA+ | -40°C to +125°C | 8 µMAX          | —           |
| MAX44248ASA+         | -40°C to +125°C | 8 SO            | —           |

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

## Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE<br>TYPE | PACKAGE<br>CODE | OUTLINE<br>NO.          | LAND<br>PATTERN NO.     |
|-----------------|-----------------|-------------------------|-------------------------|
| 5 SOT23         | U5+1            | <a href="#">21-0057</a> | <a href="#">90-0174</a> |
| 8 SO            | S8+4            | <a href="#">21-0041</a> | <a href="#">90-0096</a> |
| 8 µMAX          | U8+1            | <a href="#">21-0036</a> | <a href="#">90-0092</a> |
| 14 SO           | S14M+4          | <a href="#">21-0041</a> | <a href="#">90-0112</a> |
| 14 TSSOP        | U14M+1          | <a href="#">21-0066</a> | <a href="#">90-0113</a> |

MAX44244/MAX44245/  
MAX44248

36V, Precision, Low-Power, 90 $\mu$ A,  
Single/Quad/Dual Op Amps

## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                                                                                                                                                           | PAGES<br>CHANGED |
|--------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 0                  | 7/12             | Initial release                                                                                                                                                                       | —                |
| 1                  | 6/13             | Added the MAX44244/MAX44245 to data sheet. Updated the <i>Electrical Characteristics</i> , <i>Absolute Maximum Ratings</i> , <i>Pin Description</i> , and <i>Pin Configurations</i> . | 1–13             |
| 2                  | 9/13             | Released the MAX44244 for introduction. Revised the <i>Electrical Characteristics</i>                                                                                                 | 2–5, 13          |
| 3                  | 6/14             | Corrected Figure 1 and <i>Package Information</i>                                                                                                                                     | 12, 13           |
| 4                  | 12/14            | Updated <i>Benefits and Features</i> section                                                                                                                                          | 1                |
| 5                  | 9/15             | Updated <i>Typical Operating Circuit</i>                                                                                                                                              | 1                |
| 6                  | 11/18            | Updated <i>Typical Operating Characteristics</i>                                                                                                                                      | 7–9              |

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at <https://www.maximintegrated.com/en/storefront/storefront.html>.

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