

## FEATURES

- Lowest auto-zero amplifier noise
- Low offset voltage: 1  $\mu\text{V}$  typical
- Input offset drift: 0.002  $\mu\text{V}/^\circ\text{C}$  typical
- Rail-to-rail input and output swing
- 5 V single-supply operation
- High gain, CMRR, and PSRR: 130 dB
- Very low input bias current: 100 pA maximum
- Low supply current: 1.0 mA
- Overload recovery time: 50  $\mu\text{s}$
- No external components required

## ENHANCED PRODUCT FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Extended temperature range:  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$
- Controlled manufacturing baseline
- One assembly/test site
- One fabrication site
- Enhanced product change notification
- Qualification data available on request

## APPLICATIONS

- Pressure and position sensors
- Strain gage amplifiers
- Medical instrumentation
- Thermocouple amplifiers
- Precision current sensing
- Photodiode amplifiers

## PIN CONFIGURATION

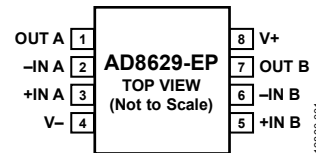


Figure 1. 8-Lead SOIC\_N (R-8)

## GENERAL DESCRIPTION

The **AD8629-EP** amplifier has ultralow offset, drift, and bias current. The device is a wide bandwidth auto-zero amplifier featuring rail-to-rail input and output swing and low noise. Operation is fully specified from 2.7 V to 5 V single supply ( $\pm 1.35$  V to  $\pm 2.5$  V dual supply).

The **AD8629-EP** provides benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. Using Analog Devices, Inc., topology, this zero-drift amplifier combines low cost with high accuracy and low noise. No external capacitor is required. In addition, the **AD8629-EP** greatly reduces the digital switching noise found in most chopper-stabilized amplifiers.

With an offset voltage of only 1  $\mu\text{V}$ , drift of less than 0.05  $\mu\text{V}/^\circ\text{C}$ , and noise of only 0.5  $\mu\text{V}$  p-p (0 Hz to 10 Hz), the **AD8629-EP** is suited for applications where error sources cannot be tolerated. Position and pressure sensors, medical equipment, and strain gage amplifiers benefit greatly from nearly zero drift over the operating temperature range. Many systems can take advantage of the rail-to-rail input and output swings provided by the **AD8629-EP** to reduce input biasing complexity and maximize SNR.

The **AD8629-EP** is specified for the extended industrial temperature range ( $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ ). The **AD8629-EP** is available in a standard 8-lead narrow SOIC plastic package.

## TABLE OF CONTENTS

|                                                        |   |                                                        |   |
|--------------------------------------------------------|---|--------------------------------------------------------|---|
| Features .....                                         | 1 | Electrical Characteristics— $V_S = 2.7\text{ V}$ ..... | 4 |
| Enhanced Product Features .....                        | 1 | Absolute Maximum Ratings .....                         | 5 |
| Applications .....                                     | 1 | Thermal Characteristics .....                          | 5 |
| Pin Configuration .....                                | 1 | ESD Caution .....                                      | 5 |
| General Description .....                              | 1 | Typical Performance Characteristics .....              | 6 |
| Revision History .....                                 | 2 | Outline Dimensions .....                               | 8 |
| Specifications .....                                   | 3 | Ordering Guide .....                                   | 8 |
| Electrical Characteristics— $V_S = 5.0\text{ V}$ ..... | 3 |                                                        |   |

## REVISION HISTORY

|                                 |   |
|---------------------------------|---|
| 8/15—Rev. 0 to Rev. A           |   |
| Changes to Ordering Guide ..... | 8 |

6/15—Revision 0: Initial Version

## SPECIFICATIONS

ELECTRICAL CHARACTERISTICS— $V_S = 5.0\text{ V}$ 

$V_S = 5.0\text{ V}$ ,  $V_{CM} = 2.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 1.

| Parameter                    | Symbol                   | Test Conditions/Comments                                                                                                  | Min      | Typ      | Max | Unit                         |
|------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------|----------|----------|-----|------------------------------|
| INPUT CHARACTERISTICS        |                          |                                                                                                                           |          |          |     |                              |
| Offset Voltage               | $V_{OS}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 1        | 5   | $\mu\text{V}$                |
| Input Bias Current           | $I_B$                    | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 30       | 15  | $\mu\text{V}$                |
| Input Offset Current         | $I_{OS}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 50       | 100 | $\text{pA}$                  |
| Input Voltage Range          |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          |          | 1.5 | $\text{nA}$                  |
| Common-Mode Rejection Ratio  | CMRR                     | $V_{CM} = 0\text{ V to } 5\text{ V}$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                              | 0        | 120      | 200 | $\text{pA}$                  |
| Large Signal Voltage Gain    | $A_{VO}$                 | $R_L = 10\text{ k}\Omega$ , $V_O = 0.3\text{ V to } 4.7\text{ V}$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ | 115      | 140      | 250 | $\text{pA}$                  |
| Offset Voltage Drift         | $\Delta V_{OS}/\Delta T$ | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      | 120      | 135      | 5   | $\text{V}$                   |
| OUTPUT CHARACTERISTICS       |                          |                                                                                                                           |          |          |     |                              |
| Output Voltage High          | $V_{OH}$                 | $R_L = 100\text{ k}\Omega$ to ground<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                              | 4.99     | 4.996    |     | $\text{V}$                   |
|                              |                          | $R_L = 10\text{ k}\Omega$ to ground<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                               | 4.99     | 4.995    |     | $\text{V}$                   |
| Output Voltage Low           | $V_{OL}$                 | $R_L = 100\text{ k}\Omega$ to $V_+$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                               | 4.95     | 4.98     |     | $\text{V}$                   |
|                              |                          | $R_L = 10\text{ k}\Omega$ to $V_+$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                | 4.95     | 4.97     |     | $\text{V}$                   |
| Short-Circuit Limit          | $I_{SC}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 1        | 5   | $\text{mV}$                  |
| Output Current               | $I_O$                    | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 2        | 5   | $\text{mV}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 10       | 20  | $\text{mV}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 15       | 20  | $\text{mV}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      | $\pm 25$ | $\pm 50$ |     | $\text{mA}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | $\pm 40$ |     | $\text{mA}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | $\pm 30$ |     | $\text{mA}$                  |
|                              |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | $\pm 15$ |     | $\text{mA}$                  |
| POWER SUPPLY                 |                          |                                                                                                                           |          |          |     |                              |
| Power Supply Rejection Ratio | PSRR                     | $V_S = 2.7\text{ V to } 5.5\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                              | 115      | 130      |     | $\text{dB}$                  |
| Supply Current per Amplifier | $I_{SY}$                 | $V_O = V_S/2$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                     |          | 0.85     | 1.1 | $\text{mA}$                  |
|                              |                          |                                                                                                                           |          | 1.0      | 1.2 | $\text{mA}$                  |
| INPUT CAPACITANCE            |                          |                                                                                                                           |          |          |     |                              |
| Differential                 | $C_{IN}$                 |                                                                                                                           |          | 1.5      |     | $\text{pF}$                  |
| Common Mode                  |                          |                                                                                                                           |          | 8.0      |     | $\text{pF}$                  |
| DYNAMIC PERFORMANCE          |                          |                                                                                                                           |          |          |     |                              |
| Slew Rate                    | SR                       | $R_L = 10\text{ k}\Omega$                                                                                                 |          | 1.0      |     | $\text{V}/\mu\text{s}$       |
| Overload Recovery Time       |                          |                                                                                                                           |          | 0.05     |     | $\text{ms}$                  |
| Gain Bandwidth Product       | GBP                      |                                                                                                                           |          | 2.5      |     | $\text{MHz}$                 |
| NOISE PERFORMANCE            |                          |                                                                                                                           |          |          |     |                              |
| Voltage Noise                | $e_n$ p-p                | 0.1 Hz to 10 Hz                                                                                                           |          | 0.5      |     | $\mu\text{V p-p}$            |
|                              |                          | 0.1 Hz to 1.0 Hz                                                                                                          |          | 0.16     |     | $\mu\text{V p-p}$            |
| Voltage Noise Density        | $e_n$                    | $f = 1\text{ kHz}$                                                                                                        |          | 22       |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| Current Noise Density        | $i_n$                    | $f = 10\text{ Hz}$                                                                                                        |          | 5        |     | $\text{fA}/\sqrt{\text{Hz}}$ |

**ELECTRICAL CHARACTERISTICS— $V_S = 2.7\text{ V}$** 

$V_S = 2.7\text{ V}$ ,  $V_{CM} = 1.35\text{ V}$ ,  $V_O = 1.4\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 2.**

| Parameter                     | Symbol                   | Test Conditions/Comments                                                                                                  | Min      | Typ      | Max  | Unit                                        |
|-------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------|----------|----------|------|---------------------------------------------|
| <b>INPUT CHARACTERISTICS</b>  |                          |                                                                                                                           |          |          |      |                                             |
| Offset Voltage                | $V_{OS}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 1        | 5    | $\mu\text{V}$                               |
| Input Bias Current            | $I_B$                    | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 30       | 100  | $\mu\text{V}$<br>$\text{pA}$                |
| Input Offset Current          | $I_{OS}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 1.0      | 1.5  | $\text{nA}$<br>$\text{pA}$                  |
| Input Voltage Range           |                          |                                                                                                                           | 0        |          | 2.7  | $\text{V}$                                  |
| Common-Mode Rejection Ratio   | CMRR                     | $V_{CM} = 0\text{ V to } 2.7\text{ V}$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                            | 115      | 130      |      | $\text{dB}$                                 |
| Large Signal Voltage Gain     | $A_{VO}$                 | $R_L = 10\text{ k}\Omega$ , $V_O = 0.3\text{ V to } 2.4\text{ V}$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ | 110      | 120      |      | $\text{dB}$                                 |
| Offset Voltage Drift          | $\Delta V_{OS}/\Delta T$ | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | 110      | 140  | $\text{dB}$<br>$\mu\text{V}/^\circ\text{C}$ |
|                               |                          |                                                                                                                           |          | 105      | 130  | $\text{dB}$                                 |
|                               |                          |                                                                                                                           |          | 0.002    | 0.05 | $\mu\text{V}/^\circ\text{C}$                |
| <b>OUTPUT CHARACTERISTICS</b> |                          |                                                                                                                           |          |          |      |                                             |
| Output Voltage High           | $V_{OH}$                 | $R_L = 100\text{ k}\Omega$ to ground<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                              | 2.68     | 2.695    |      | $\text{V}$                                  |
|                               |                          | $R_L = 10\text{ k}\Omega$ to ground<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                               | 2.67     | 2.68     |      | $\text{V}$                                  |
| Output Voltage Low            | $V_{OL}$                 | $R_L = 100\text{ k}\Omega$ to $V+$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                | 2.67     | 2.675    |      | $\text{V}$                                  |
|                               |                          | $R_L = 10\text{ k}\Omega$ to $V+$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                 |          | 1        | 5    | $\text{mV}$                                 |
| Short-Circuit Limit           | $I_{SC}$                 | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      | $\pm 10$ | $\pm 15$ |      | $\text{mA}$                                 |
| Output Current                | $I_O$                    | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | $\pm 10$ |      | $\text{mA}$                                 |
|                               |                          | $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                                      |          | $\pm 5$  |      | $\text{mA}$                                 |
| <b>POWER SUPPLY</b>           |                          |                                                                                                                           |          |          |      |                                             |
| Power Supply Rejection Ratio  | PSRR                     | $V_S = 2.7\text{ V to } 5.5\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                              | 115      | 130      |      | $\text{dB}$                                 |
| Supply Current per Amplifier  | $I_{SY}$                 | $V_O = V_S/2$<br>$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$                                                     |          | 0.75     | 1.0  | $\text{mA}$                                 |
|                               |                          |                                                                                                                           |          | 0.9      | 1.2  | $\text{mA}$                                 |
| <b>INPUT CAPACITANCE</b>      |                          |                                                                                                                           |          |          |      |                                             |
| Differential                  | $C_{IN}$                 |                                                                                                                           |          | 1.5      |      | $\text{pF}$                                 |
| Common Mode                   |                          |                                                                                                                           |          | 8.0      |      | $\text{pF}$                                 |
| <b>DYNAMIC PERFORMANCE</b>    |                          |                                                                                                                           |          |          |      |                                             |
| Slew Rate                     | SR                       | $R_L = 10\text{ k}\Omega$                                                                                                 |          | 1        |      | $\text{V}/\mu\text{s}$                      |
| Overload Recovery Time        |                          |                                                                                                                           |          | 0.05     |      | $\text{ms}$                                 |
| Gain Bandwidth Product        | GBP                      |                                                                                                                           |          | 2        |      | $\text{MHz}$                                |
| <b>NOISE PERFORMANCE</b>      |                          |                                                                                                                           |          |          |      |                                             |
| Voltage Noise                 | $e_n$ p-p                | 0.1 Hz to 10 Hz                                                                                                           |          | 0.5      |      | $\mu\text{V p-p}$                           |
| Voltage Noise Density         | $e_n$                    | $f = 1\text{ kHz}$                                                                                                        |          | 22       |      | $\text{nV}/\sqrt{\text{Hz}}$                |
| Current Noise Density         | $i_n$                    | $f = 10\text{ Hz}$                                                                                                        |          | 5        |      | $\text{fA}/\sqrt{\text{Hz}}$                |

## ABSOLUTE MAXIMUM RATINGS

Table 3.

| Parameter                               | Rating                       |
|-----------------------------------------|------------------------------|
| Supply Voltage                          | 6 V                          |
| Input Voltage                           | GND – 0.3 V to $V_S + 0.3$ V |
| Differential Input Voltage <sup>1</sup> | ±5.0 V                       |
| Output Short-Circuit Duration to GND    | Indefinite                   |
| Storage Temperature Range               | –65°C to +150°C              |
| Operating Temperature Range             | –55°C to +125°C              |
| Junction Temperature Range              | –65°C to +150°C              |
| Lead Temperature (Soldering, 60 sec)    | 300°C                        |
| ESD                                     |                              |
| HBM 8-Lead SOIC_N                       | ±4000 V                      |
| FICDM 8-Lead SOIC_N                     | ±1250 V                      |

<sup>1</sup> The differential input voltage is limited to ±5 V or the supply voltage, whichever is less.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## THERMAL CHARACTERISTICS

$\theta_{JA}$  is specified for worst-case conditions, that is,  $\theta_{JA}$  is specified for the device soldered in a circuit board for surface-mount packages. This was measured using a standard two-layer board.

Table 4.

| Package Type        | $\theta_{JA}$ | $\theta_{JC}$ | Unit |
|---------------------|---------------|---------------|------|
| 8-Lead SOIC_N (R-8) | 158           | 43            | °C/W |

## ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

TYPICAL PERFORMANCE CHARACTERISTICS

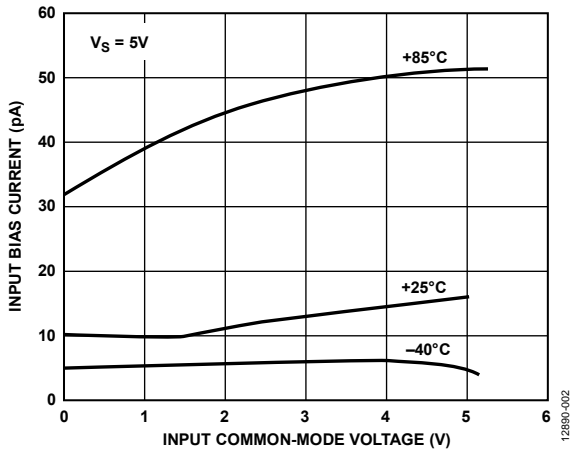


Figure 2. Input Bias Current vs. Input Common-Mode Voltage

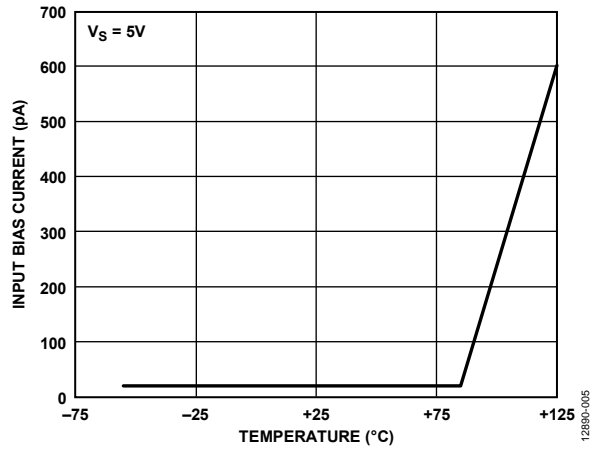


Figure 5. Input Bias Current vs. Temperature

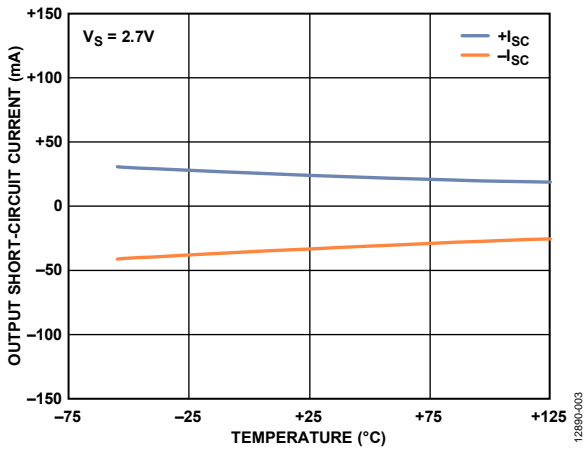


Figure 3. Output Short-Circuit Current vs. Temperature (2.7 V)

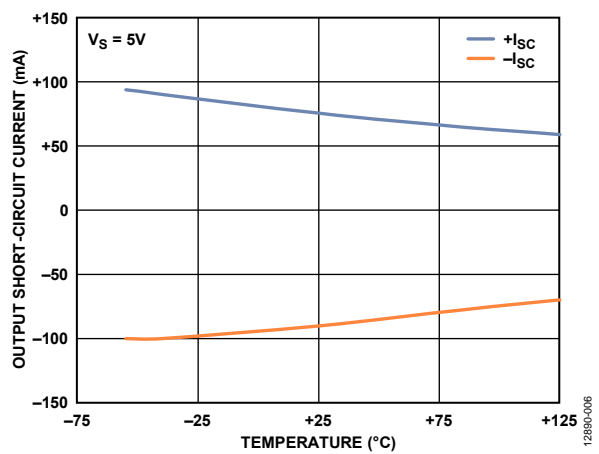


Figure 6. Output Short-Circuit Current vs. Temperature (5 V)

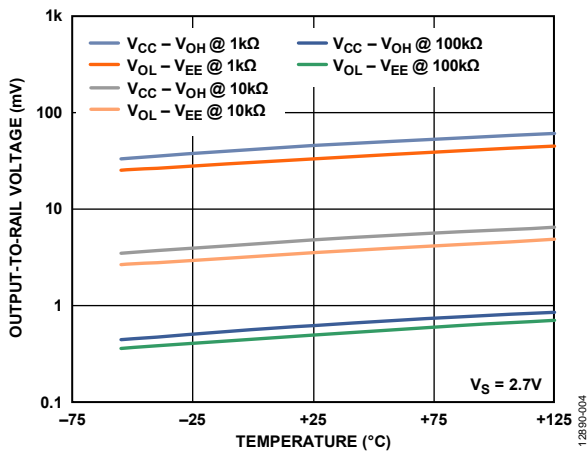


Figure 4. Output-to-Rail Voltage vs. Temperature (2.7 V)

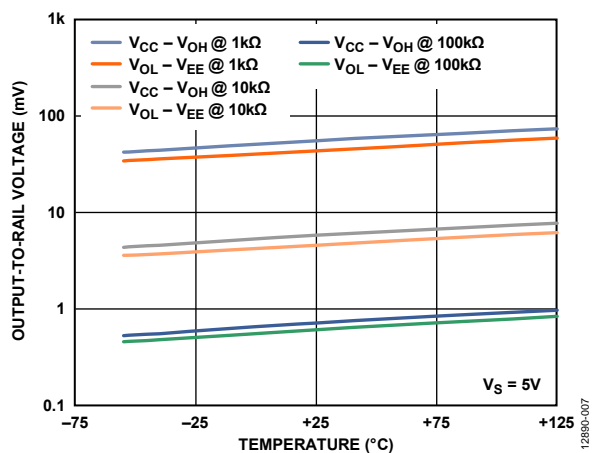


Figure 7. Output-to-Rail Voltage vs. Temperature (5 V)

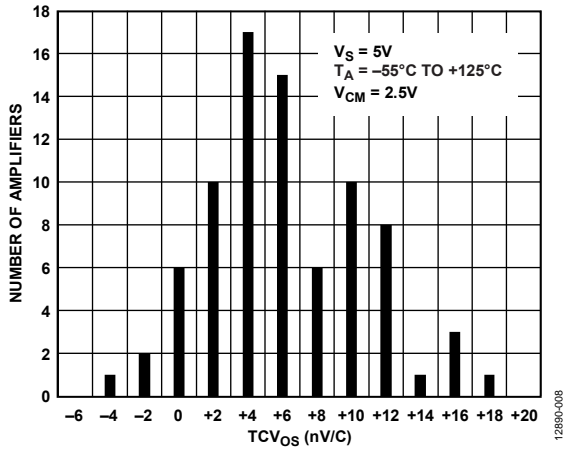


Figure 8. Input Offset Voltage Drift Distribution

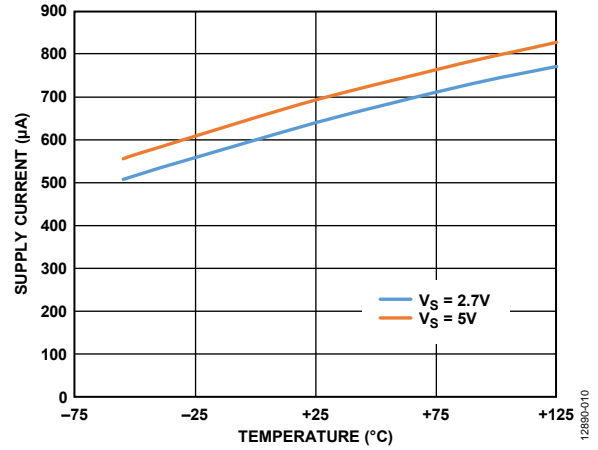


Figure 10. Supply Current vs. Temperature

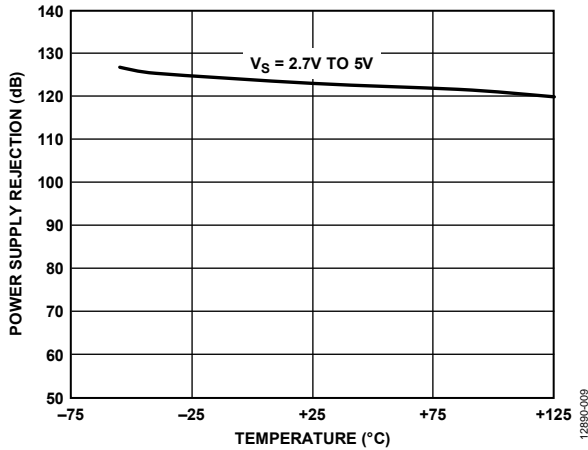
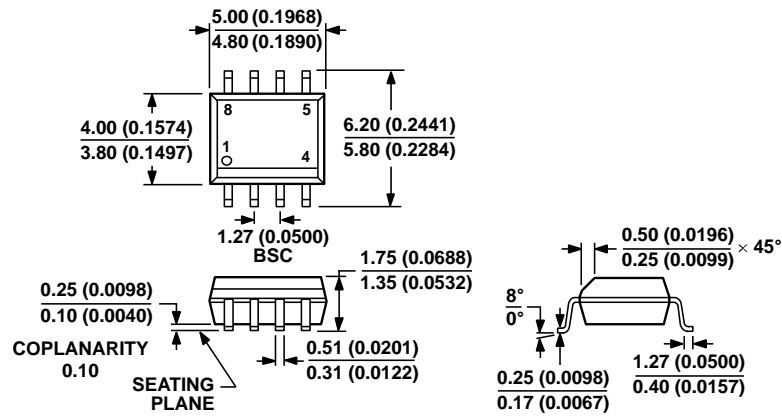


Figure 9. Power Supply Rejection vs. Temperature

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

012407-A

Figure 11. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-8)

Dimensions shown in millimeters and (inches)

ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                            | Package Option |
|--------------------|-------------------|------------------------------------------------|----------------|
| AD8629TRZ-EP       | -55°C to +125°C   | 8-Lead Standard Small Outline Package [SOIC_N] | R-8            |
| AD8629TRZ-EP-R7    | -55°C to +125°C   | 8-Lead Standard Small Outline Package [SOIC_N] | R-8            |

<sup>1</sup> Z = RoHS Compliant Part.



# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

## [Analog Devices Inc.:](#)

[AD8629ARMZ](#) [AD8629ARZ](#) [AD8629ARMZ-REEL](#) [AD8629ARZ-REEL](#) [AD8629ARZ-REEL7](#) [AD8629WARZ-R7](#)  
[AD8629WARZ-RL](#) [AD8629TRZ-EP](#) [AD8629TRZ-EP-R7](#)