

FEATURES

With no external resistors

Difference amplifier, gains of $\frac{1}{2}$, 1, or 2

Single-ended amplifier: over 40 different gains

Set reference voltage at midsupply

Excellent ac specifications

15 MHz bandwidth

30 V/ μ s slew rate

High accuracy dc performance

0.08% maximum gain error

10 ppm/ $^{\circ}$ C maximum gain drift

80 dB minimum CMRR (gain of 2)

10-lead MSOP package

Supply current: 2.6 mA

Supply range: ± 2.5 V to ± 18 V

APPLICATIONS

ADC driver

Instrumentation amplifier building blocks

Level translators

Automatic test equipment

High performance audio

Sine/cosine encoders

GENERAL DESCRIPTION

The AD8271 is a low distortion, precision difference amplifier with internal gain setting resistors. With no external components, it can be configured as a high performance difference amplifier with gains of $\frac{1}{2}$, 1, or 2. It can also be configured in over 40 single-ended configurations, with gains ranging from -2 to $+3$.

The AD8271 comes in a 10-lead MSOP package. The AD8271 operates on both single and dual supplies and requires only a 2.6 mA maximum supply current. It is specified over the industrial temperature range of -40° C to $+85^{\circ}$ C and is fully RoHS compliant.

For a dual channel version of the AD8271, see the [AD8270](#) data sheet.

FUNCTIONAL BLOCK DIAGRAM

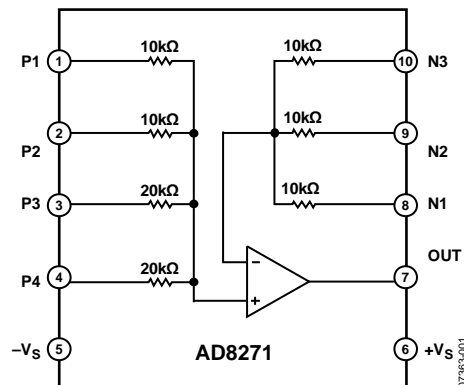


Figure 1.

Table 1. Difference Amplifiers by Category

| High Speed | High Voltage | Single-Supply Unidirectional | Single-Supply Bidirectional |
|------------------------|-----------------------|------------------------------|-----------------------------|
| AD8270 | AD628 | AD8202 | AD8205 |
| AD8273 | AD629 | AD8203 | AD8206 |
| AD8274 | | | AD8216 |
| AMP03 | | | |

Rev. 0

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REVISION HISTORY

1/09—Revision 0: Initial Version

SPECIFICATIONS

DIFFERENCE AMPLIFIER CONFIGURATIONS

$V_S = \pm 5$ to ± 15 V, $V_{REF} = 0$ V, $G = 1$, $R_{LOAD} = 2$ k Ω , $T_A = 25^\circ\text{C}$, specifications referred to input (RTI), unless otherwise noted.

Table 2.

| Parameter | Conditions | B Grade | | | A Grade | | | Unit |
|-------------------------------------|--|-----------------------|-----|-----------------------|-----------------------|-----|-----------------------|--------|
| | | Min | Typ | Max | Min | Typ | Max | |
| DYNAMIC PERFORMANCE | | | | | | | | |
| Bandwidth | | | 15 | | | 15 | | MHz |
| Slew Rate | | | 30 | | | 30 | | V/μs |
| Settling Time to 0.01% | V _S = ±15, 10 V step on output | | 700 | 800 | | 700 | 800 | ns |
| | V _S = ±5, 5 V step on output | | 550 | 650 | | 550 | 650 | ns |
| Settling Time to 0.001% | V _S = ±15, 10 V step on output | | 750 | 900 | | 750 | 900 | ns |
| | V _S = ±5, 5 V step on output | | 600 | 750 | | 600 | 750 | ns |
| NOISE/DISTORTION | | | | | | | | |
| Harmonic Distortion + Noise | V _S = ±15, f = 1 kHz, V _{OUT} = 10 V p-p, R _{LOAD} = 600 Ω | | 110 | | | 110 | | dB |
| | V _S = ±5, f = 1 kHz, V _{OUT} = 10 V p-p, R _{LOAD} = 600 Ω | | 141 | | | 141 | | dB |
| Voltage Noise ¹ | f = 0.1 Hz to 10 Hz | | 1.5 | | | 1.5 | | μV p-p |
| | f = 1 kHz | | 38 | | | 38 | | nV/√Hz |
| GAIN | | | | | | | | |
| Gain Error | V _{OUT} = 10 V p-p | | | 0.02 | | | 0.05 | % |
| Gain Drift | T _A = −40°C to +85°C | | 1 | 2 | | 1 | 10 | ppm/°C |
| Gain Nonlinearity | V _{OUT} = 10 V p-p, R _{LOAD} = 10 kΩ, 2 kΩ, 600 Ω | | 1 | | | 1 | | ppm |
| INPUT CHARACTERISTICS | | | | | | | | |
| Offset ² | | | 300 | 600 | | 300 | 1000 | μV |
| Average Temperature Drift | T _A = −40°C to +85°C | | 2 | | | 2 | | μV/°C |
| Common-Mode Rejection Ratio | DC to 1 kHz | 80 | 92 | | 74 | 92 | | dB |
| Power Supply Rejection Ratio | | | 2 | 10 | | 2 | 10 | μV/V |
| Input Voltage Range ³ | | −V _S − 0.4 | | +V _S + 0.4 | −V _S − 0.4 | | +V _S + 0.4 | V |
| Common-Mode Resistance ⁴ | | | 10 | | | 10 | | kΩ |
| Bias Current | Inputs grounded | | | 500 | | | 500 | nA |
| OUTPUT CHARACTERISTICS | | | | | | | | |
| Output Swing | V _S = ±15 | −13.8 | | +13.8 | −13.8 | | +13.8 | V |
| | V _S = ±15, T _A = −40°C to +85°C | −13.7 | | +13.7 | −13.7 | | +13.7 | V |
| | V _S = ±5 | −4 | | +4 | −4 | | +4 | V |
| | V _S = ±5, T _A = −40°C to +85°C | −3.9 | | +3.9 | −3.9 | | +3.9 | V |
| Short-Circuit Current Limit | Sourcing | | 100 | | | 100 | | mA |
| | Sinking | | 60 | | | 60 | | mA |
| POWER SUPPLY | | | | | | | | |
| Supply Current | | | 2.3 | 2.6 | | 2.3 | 2.6 | mA |
| | T _A = −40°C to +85°C | | | 3.2 | | | 3.2 | mA |

¹ Includes amplifier voltage and current noise, as well as noise of internal resistors.

² Includes input bias and offset errors.

³ At voltages beyond the rails, internal ESD diodes begin to turn on. In some configurations, the input voltage range may be limited by the internal op amp (see the Input Voltage Range section for details).

⁴ Internal resistors, trimmed to be ratio matched, have $\pm 20\%$ absolute accuracy. Common-mode resistance was calculated with both inputs in parallel. The common-mode impedance at only one input is $2\times$ the resistance listed.

AD8271

$V_S = \pm 5$ to ± 15 V, $V_{REF} = 0$ V, $G = \frac{1}{2}$, $R_{LOAD} = 2$ k Ω , $T_A = 25^\circ\text{C}$, specifications referred to input (RTI), unless otherwise noted.

Table 3.

| Parameter | Conditions | B Grade | | | A Grade | | | Unit |
|-------------------------------------|--|--------------|-----|--------------|--------------|-----|--------------|------------------------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| DYNAMIC PERFORMANCE | | | | | | | | |
| Bandwidth | | | 20 | | | 20 | | MHz |
| Slew Rate | | | 30 | | | 30 | | V/ μ s |
| Settling Time to 0.01% | $V_S = \pm 15$, 10 V step on output | | 700 | 800 | | 700 | 800 | ns |
| | $V_S = \pm 5$, 5 V step on output | | 550 | 650 | | 550 | 650 | ns |
| Settling Time to 0.001% | $V_S = \pm 15$, 10 V step on output | | 750 | 900 | | 750 | 900 | ns |
| | $V_S = \pm 5$, 5 V step on output | | 600 | 750 | | 600 | 750 | ns |
| NOISE/DISTORTION | | | | | | | | |
| Harmonic Distortion + Noise | $V_S = \pm 15$, $f = 1$ kHz, $V_{OUT} = 10$ V p-p, $R_{LOAD} = 600\ \Omega$ | | 74 | | | 74 | | dB |
| | $V_S = \pm 5$, $f = 1$ kHz, $V_{OUT} = 10$ V p-p, $R_{LOAD} = 600\ \Omega$ | | 101 | | | 101 | | dB |
| Voltage Noise ¹ | $f = 0.1$ Hz to 10 Hz | | 2 | | | 2 | | μ V p-p |
| | $f = 1$ kHz | | 52 | | | 52 | | nV/ $\sqrt{\text{Hz}}$ |
| GAIN | | | | | | | | |
| Gain Error | $V_{OUT} = 10$ V p-p | | | 0.04 | | | 0.08 | % |
| Gain Drift | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | 0.5 | 2 | | 1 | 10 | ppm/ $^\circ\text{C}$ |
| Gain Nonlinearity | $V_{OUT} = 10$ V p-p, $R_{LOAD} = 10\ \text{k}\Omega$, $2\ \text{k}\Omega$, $600\ \Omega$ | | 200 | | | 200 | | ppm |
| INPUT CHARACTERISTICS | | | | | | | | |
| Offset ² | | | 450 | 1000 | | 450 | 1500 | μ V |
| Average Temperature Drift | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | 3 | | | 3 | | $\mu\text{V}/^\circ\text{C}$ |
| Common-Mode Rejection Ratio | DC to 1 kHz | 74 | 86 | | 70 | 86 | | dB |
| Power Supply Rejection Ratio | | | 2 | 10 | | 2 | 10 | $\mu\text{V}/\text{V}$ |
| Input Voltage Range ³ | | $-V_S - 0.4$ | | $+V_S + 0.4$ | $-V_S - 0.4$ | | $+V_S + 0.4$ | V |
| Common-Mode Resistance ⁴ | | | 7.5 | | | 7.5 | | k Ω |
| Bias Current | Inputs grounded | | | 500 | | | 500 | nA |
| OUTPUT CHARACTERISTICS | | | | | | | | |
| Output Swing | $V_S = \pm 15$ | -13.8 | | +13.8 | -13.8 | | +13.8 | V |
| | $V_S = \pm 15$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | -13.7 | | +13.7 | -13.7 | | +13.7 | V |
| | $V_S = \pm 5$ | -4 | | +4 | -4 | | +4 | V |
| | $V_S = \pm 5$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | -3.9 | | +3.9 | -3.9 | | +3.9 | V |
| Short-Circuit Current Limit | Sourcing | | 100 | | | 100 | | mA |
| | Sinking | | 60 | | | 60 | | mA |
| POWER SUPPLY | | | | | | | | |
| Supply Current | | | 2.3 | 2.6 | | 2.3 | 2.6 | mA |
| | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | | | 3.2 | | | 3.2 | mA |

¹ Includes amplifier voltage and current noise, as well as noise of internal resistors.

² Includes input bias and offset errors.

³ At voltages beyond the rails, internal ESD diodes begin to turn on. In some configurations, the input voltage range may be limited by the internal op amp (see the Input Voltage Range section for details).

⁴ Internal resistors, trimmed to be ratio matched, have $\pm 20\%$ absolute accuracy. Common-mode resistance was calculated with both inputs in parallel. The common-mode impedance at only one input is $2\times$ the resistance listed.

$V_S = \pm 5$ to ± 15 V, $V_{REF} = 0$ V, $G = 2$, $R_{LOAD} = 2$ k Ω , $T_A = 25^\circ\text{C}$, specifications referred to input (RTI), unless otherwise noted.

Table 4.

| Parameter | Conditions | B Grade | | | A Grade | | | Unit |
|-------------------------------------|--|-----------------------|-----|-----------------------|-----------------------|-----|-----------------------|--------|
| | | Min | Typ | Max | Min | Typ | Max | |
| DYNAMIC PERFORMANCE | | | | | | | | |
| Bandwidth | | | 10 | | | 10 | | MHz |
| Slew Rate | | | 30 | | | 30 | | V/μs |
| Settling Time to 0.01% | V _S = ±15, 10 V step on output | | 700 | 800 | | 700 | 800 | ns |
| | V _S = ±5, 5 V step on output | | 550 | 650 | | 550 | 650 | ns |
| Settling Time to 0.001% | V _S = ±15, 10 V step on output | | 750 | 900 | | 750 | 900 | ns |
| | V _S = ±5, 5 V step on output | | 600 | 750 | | 600 | 750 | ns |
| NOISE/DISTORTION | | | | | | | | |
| Harmonic Distortion + Noise | V _S = ±15, f = 1 kHz, V _{OUT} = 10 V p-p, R _{LOAD} = 600 Ω | | 86 | | | 86 | | dB |
| | V _S = ±5, f = 1 kHz, V _{OUT} = 10 V p-p, R _{LOAD} = 600 Ω | | 112 | | | 112 | | dB |
| Voltage Noise ¹ | f = 0.1 Hz to 10 Hz | | 1 | | | 1 | | μV p-p |
| | f = 1 kHz | | 26 | | | 26 | | nV/√Hz |
| GAIN | | | | | | | | |
| Gain Error | V _{OUT} = 10 V p-p | | | 0.04 | | | 0.08 | % |
| Gain Drift | T _A = −40°C to +85°C | | 0.5 | 2 | | 1 | 10 | ppm/°C |
| Gain Nonlinearity | V _{OUT} = 10 V p-p, R _{LOAD} = 10 kΩ, 2 kΩ, 600 Ω | | 50 | | | 50 | | ppm |
| INPUT CHARACTERISTICS | | | | | | | | |
| Offset ² | | | 225 | 500 | | 225 | 750 | μV |
| Average Temperature Drift | T _A = −40°C to +85°C | | 1.5 | | | 1.5 | | μV/°C |
| Common-Mode Rejection Ratio | DC to 1 kHz | 84 | 98 | | 78 | 98 | | dB |
| Power Supply Rejection Ratio | | | 2 | 10 | | 2 | 10 | μV/V |
| Input Voltage Range ³ | | −V _S − 0.4 | | +V _S + 0.4 | −V _S − 0.4 | | +V _S + 0.4 | V |
| Common-Mode Resistance ⁴ | | | 7.5 | | | 7.5 | | kΩ |
| Bias Current | Inputs grounded | | | 500 | | | 500 | nA |
| OUTPUT CHARACTERISTICS | | | | | | | | |
| Output Swing | V _S = ±15 | −13.8 | | +13.8 | −13.8 | | +13.8 | V |
| | V _S = ±15, T _A = −40°C to +85°C | −13.7 | | +13.7 | −13.7 | | +13.7 | V |
| | V _S = ±5 | −4 | | +4 | −4 | | +4 | V |
| | V _S = ±5, T _A = −40°C to +85°C | −3.9 | | +3.9 | −3.9 | | +3.9 | V |
| Short-Circuit Current Limit | Sourcing | | 100 | | | 100 | | mA |
| | Sinking | | 60 | | | 60 | | mA |
| POWER SUPPLY | | | | | | | | |
| Supply Current | | | 2.3 | 2.6 | | 2.3 | 2.6 | mA |
| | T _A = −40°C to +85°C | | | 3.2 | | | 3.2 | mA |

¹ Includes amplifier voltage and current noise, as well as noise of internal resistors.

² Includes input bias and offset errors.

³ At voltages beyond the rails, internal ESD diodes begin to turn on. In some configurations, the input voltage range may be limited by the internal op amp (see the Input Voltage Range section for details).

⁴ Internal resistors, trimmed to be ratio matched, have $\pm 20\%$ absolute accuracy. Common-mode resistance was calculated with both inputs in parallel. The common-mode impedance at only one input is $2\times$ the resistance listed.

ABSOLUTE MAXIMUM RATINGS

Table 5.

| Parameter | Rating |
|--|--|
| Supply Voltage | $\pm 18\text{ V}$ |
| Output Short-Circuit Current | See derating curve in Figure 2 |
| Input Voltage Range | $+V_S + 0.4\text{ V}$ to $-V_S - 0.4\text{ V}$ |
| Storage Temperature Range | -65°C to $+130^\circ\text{C}$ |
| Specified Temperature Range | -40°C to $+85^\circ\text{C}$ |
| Package Glass Transition Temperature (T_G) | 150°C |
| ESD | |
| Human Body Model | 1 kV |
| Charge Device Model | 1 kV |
| Machine Model | 0.1 kV |

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

THERMAL RESISTANCE

Table 6. Thermal Resistance

| Package Type | θ_{JA} | θ_{JC} | Unit |
|--------------|---------------|---------------|---------------------------|
| 10-Lead MSOP | 141.9 | 43.7 | $^\circ\text{C}/\text{W}$ |

The θ_{JA} values in Table 6 assume a 4-layer JEDEC standard board with zero airflow.

MAXIMUM POWER DISSIPATION

The maximum safe power dissipation for the AD8271 is limited by the associated rise in junction temperature (T_J) on the die. At approximately 150°C , which is the glass transition temperature, the properties of the plastic change. Even temporarily exceeding this temperature limit may change the stresses that the package exerts on the die, permanently shifting the parametric performance of the amplifiers. Exceeding a temperature of 150°C for an extended period of time can cause changes in silicon devices, potentially resulting in a loss of functionality.

The AD8271 has built-in short-circuit protection that limits the output current to approximately 100 mA (see Figure 22 for more information). Although the short-circuit condition itself does not damage the part, the heat generated by the condition can cause the part to exceed its maximum junction temperature, with corresponding negative effects on reliability.

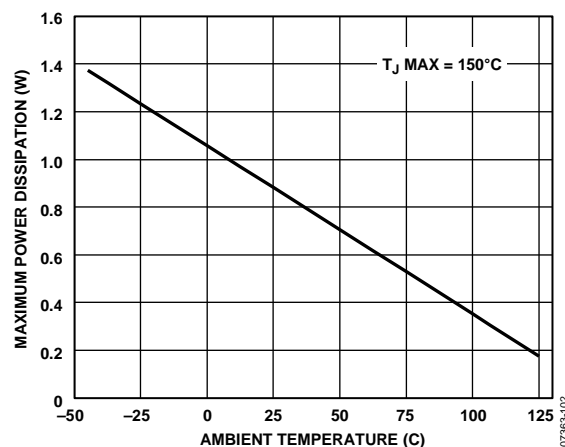


Figure 2. Maximum Power Dissipation vs. Ambient Temperature

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.

PIN CONFIGURATION AND FUNCTION DESCRIPTION

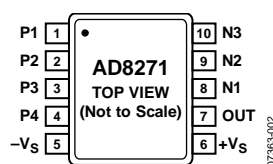


Figure 3.

Table 7. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|----------|---|
| 1 | P1 | Noninverting Input. A 10 k Ω resistor is connected to the noninverting (+) terminal of the op amp. |
| 2 | P2 | Noninverting Input. A 10 k Ω resistor is connected to the noninverting (+) terminal of the op amp. |
| 3 | P3 | Noninverting Input. A 20 k Ω resistor is connected to the noninverting (+) terminal of the op amp. This pin is used as a reference voltage input in many configurations. |
| 4 | P4 | Noninverting Input. A 20 k Ω resistor is connected to the noninverting (+) terminal of the op amp. This pin is used as a reference voltage input in many configurations. |
| 5 | -VS | Negative Supply. |
| 6 | +VS | Positive Supply. |
| 7 | OUT | Output. |
| 8 | N1 | Inverting Input. A 10 k Ω resistor is connected to the inverting (-) terminal of the op amp. |
| 9 | N2 | Inverting Input. A 10 k Ω resistor is connected to the inverting (-) terminal of the op amp. |
| 10 | N3 | Inverting Input. A 10 k Ω resistor is connected to the inverting (-) terminal of the op amp. |

TYPICAL PERFORMANCE CHARACTERISTICS

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

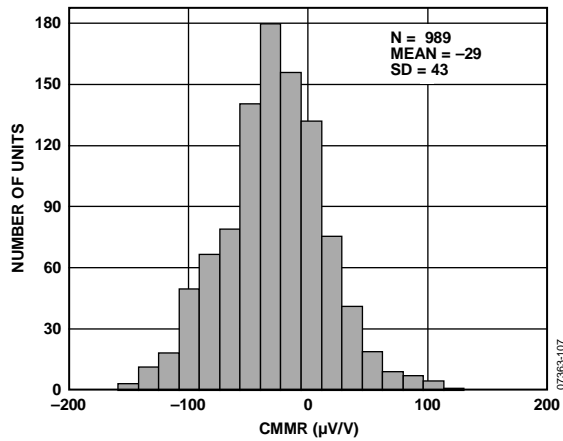


Figure 4. Typical Distribution of CMRR, Gain = 1

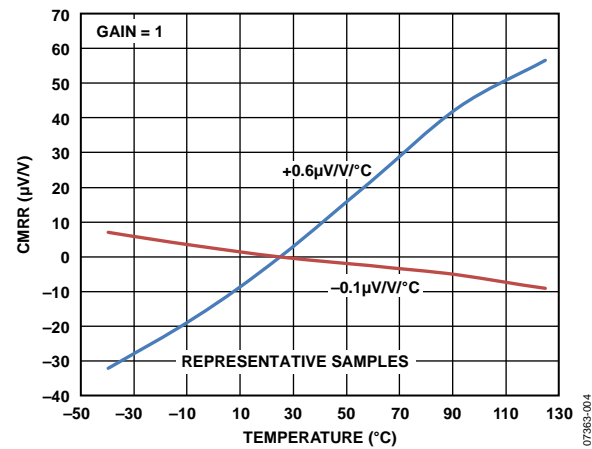


Figure 7. CMRR vs. Temperature, Normalized at 25°C , Gain = 1

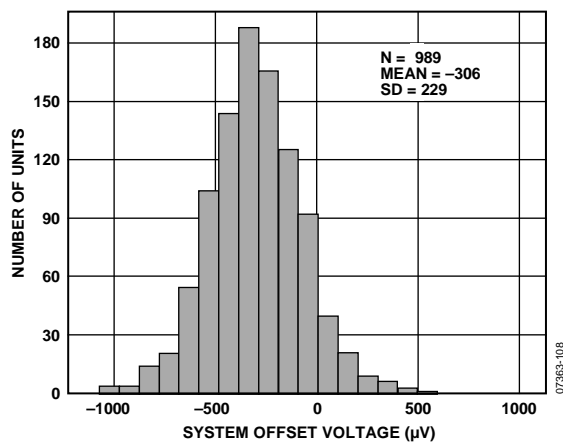


Figure 5. Typical Distribution of System Offset, Gain = 1

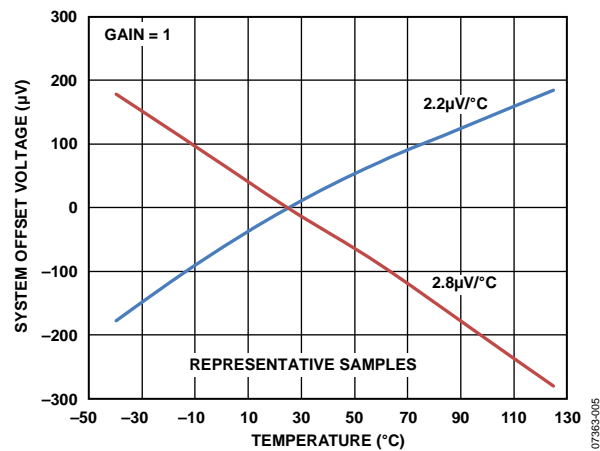


Figure 8. System Offset vs. Temperature, Normalized at 25°C , Referred to Output, Gain = 1

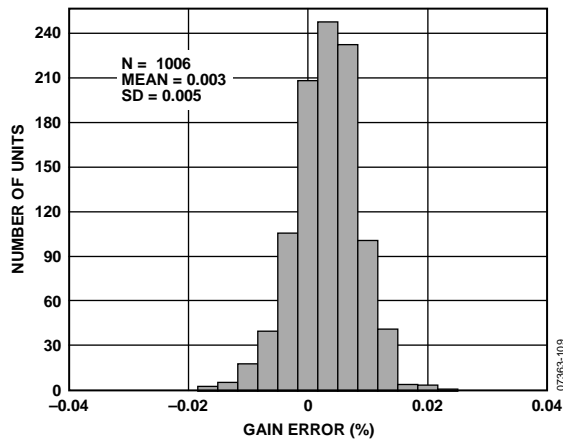


Figure 6. Typical Distribution of Gain Error, Gain = 1

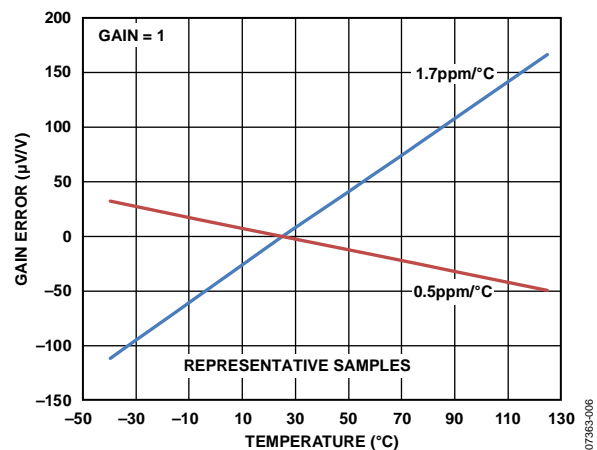


Figure 9. Gain Error vs. Temperature, Normalized at 25°C , Gain = 1

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

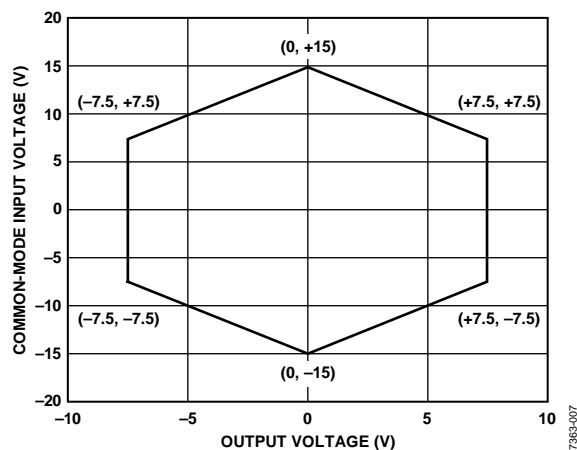


Figure 10. Common-Mode Input Voltage vs. Output Voltage, Gain = $\frac{1}{2}$, $\pm 15\text{ V}$ Supplies

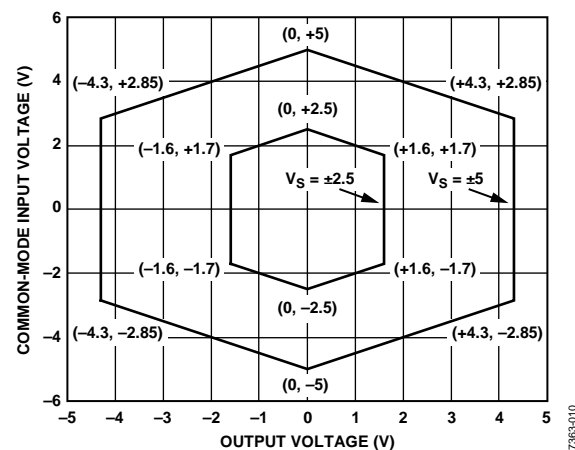


Figure 13. Common-Mode Input Voltage vs. Output Voltage, Gain = 1, $\pm 5\text{ V}$ and $\pm 2.5\text{ V}$ Supplies

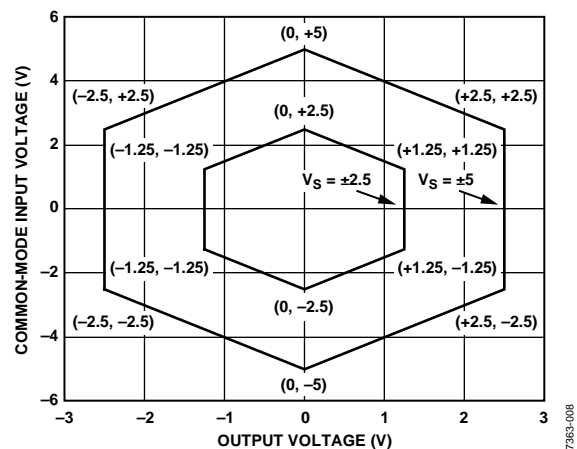


Figure 11. Common-Mode Input Voltage vs. Output Voltage, Gain = $\frac{1}{2}$, $\pm 5\text{ V}$ and $\pm 2.5\text{ V}$ Supplies

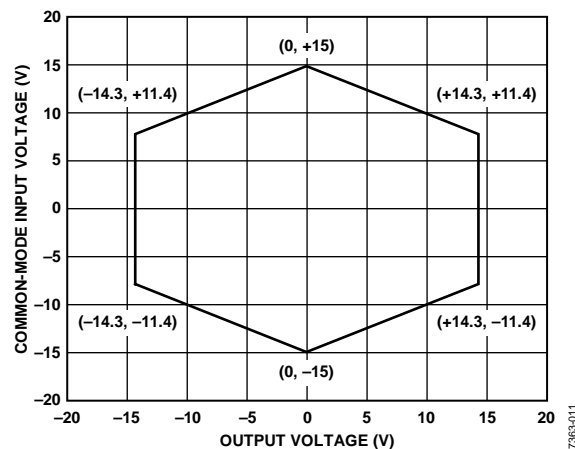


Figure 14. Common-Mode Input Voltage vs. Output Voltage, Gain = 2, $\pm 15\text{ V}$ Supplies

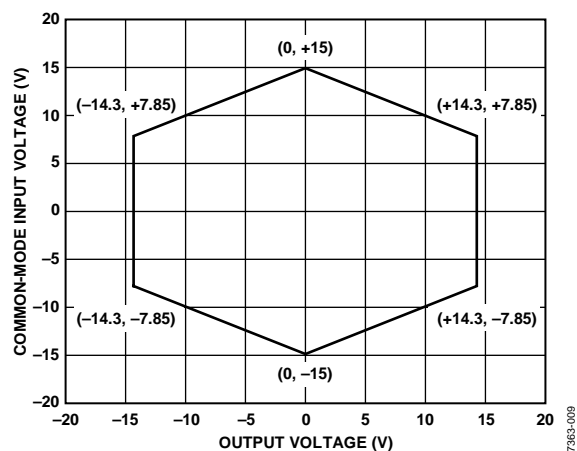


Figure 12. Common-Mode Input Voltage vs. Output Voltage, Gain = 1, $\pm 15\text{ V}$ Supplies

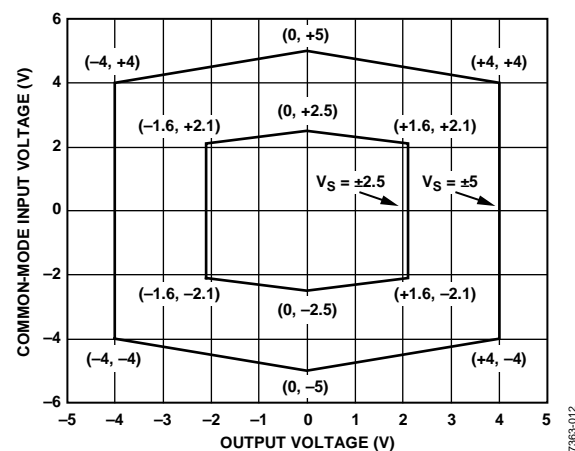


Figure 15. Common-Mode Input Voltage vs. Output Voltage, Gain = 2, $\pm 5\text{ V}$ and $\pm 2.5\text{ V}$ Supplies

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

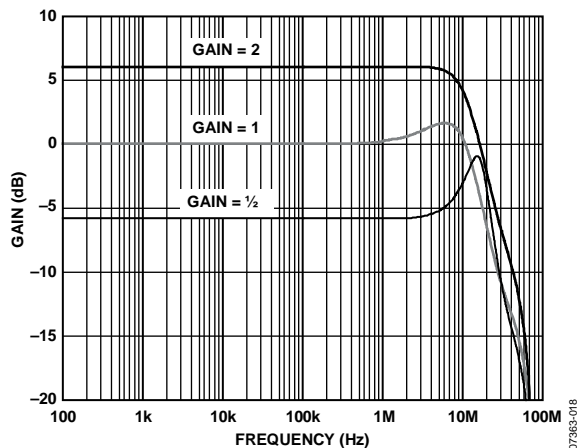


Figure 16. Gain vs. Frequency

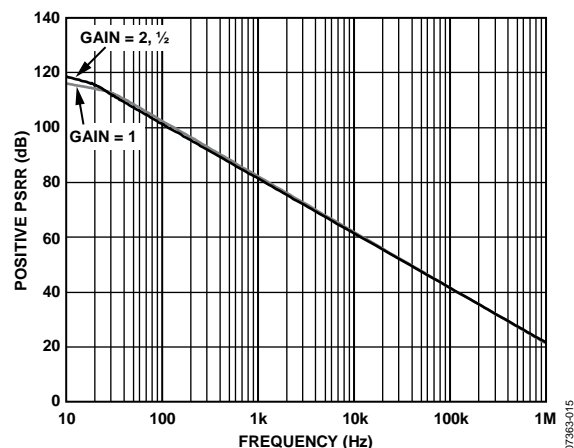


Figure 19. Positive PSRR vs. Frequency

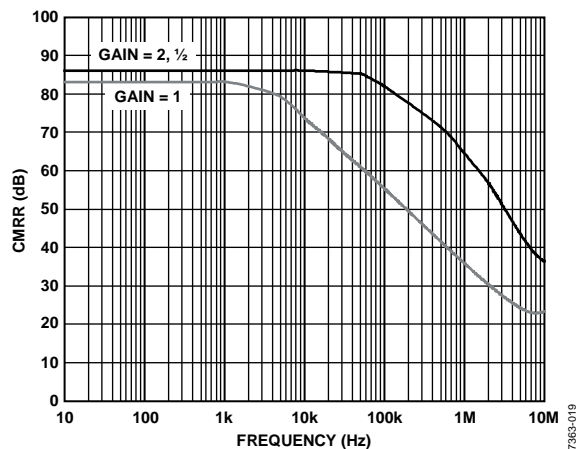


Figure 17. CMRR vs. Frequency

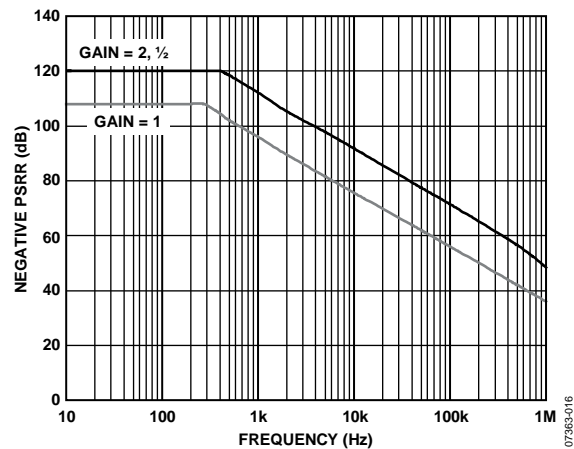


Figure 20. Negative PSRR vs. Frequency

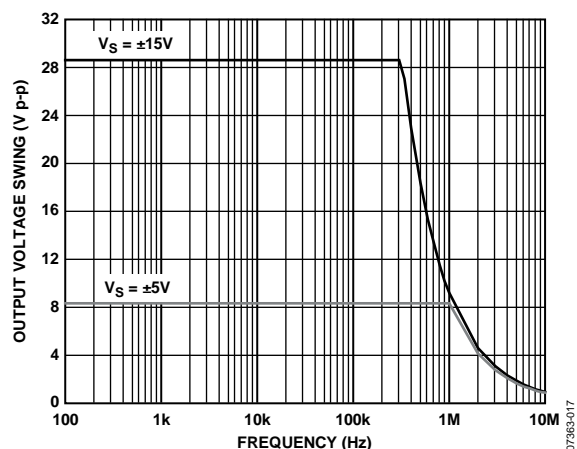


Figure 18. Output Voltage Swing vs. Large-Signal Frequency Response

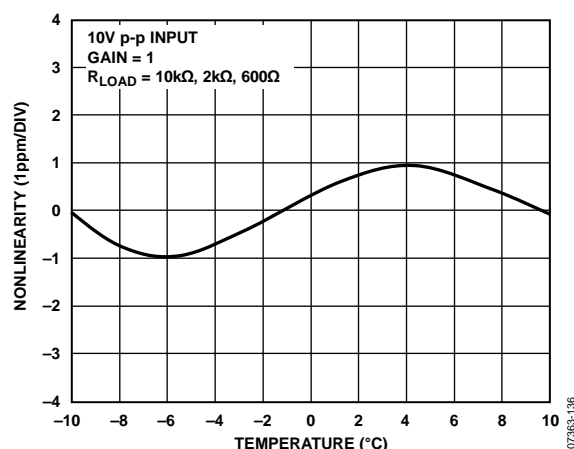


Figure 21. Gain Nonlinearity, Gain = 1

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

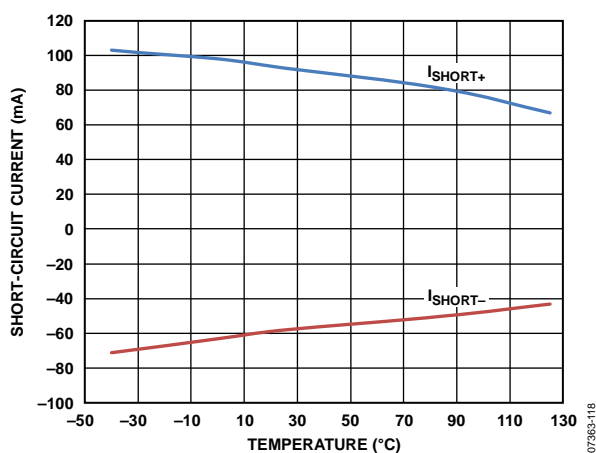


Figure 22. Short-Circuit Current vs. Temperature

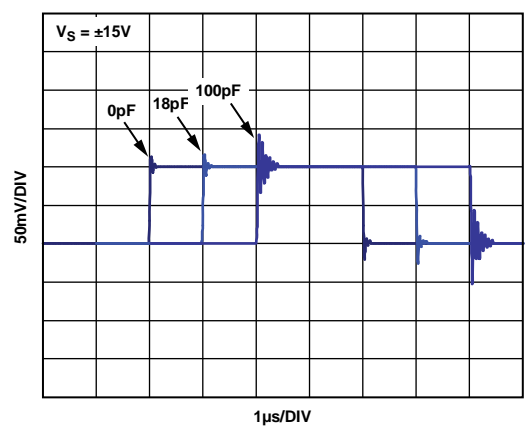


Figure 25. Small-Signal Step Response, Gain = $\frac{1}{2}$

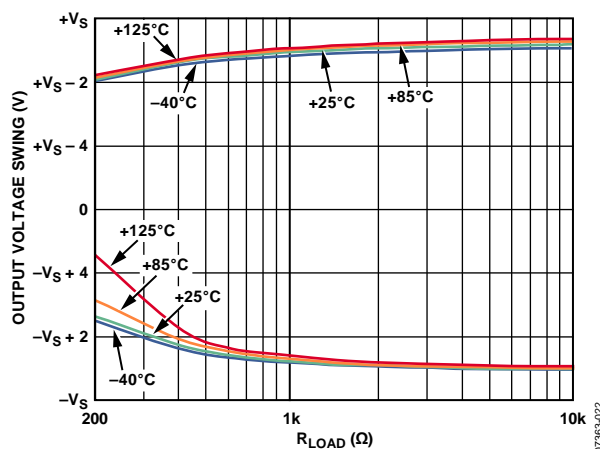


Figure 23. Output Voltage Swing vs. R_{LOAD}

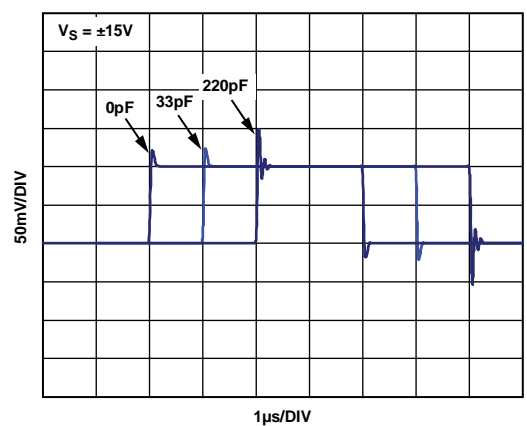


Figure 26. Small-Signal Step Response, Gain = 1

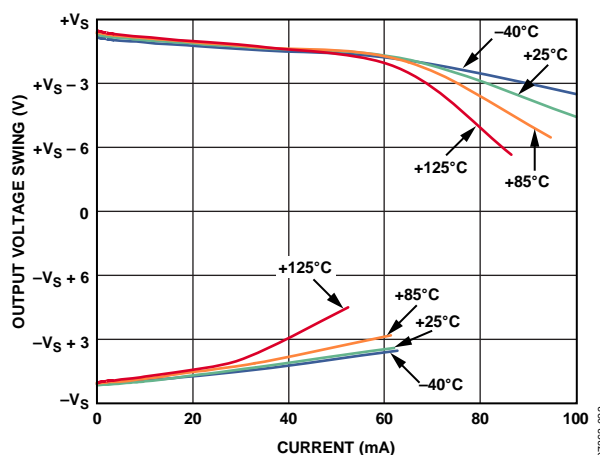


Figure 24. Output Voltage Swing vs. Current (I_{OUT})

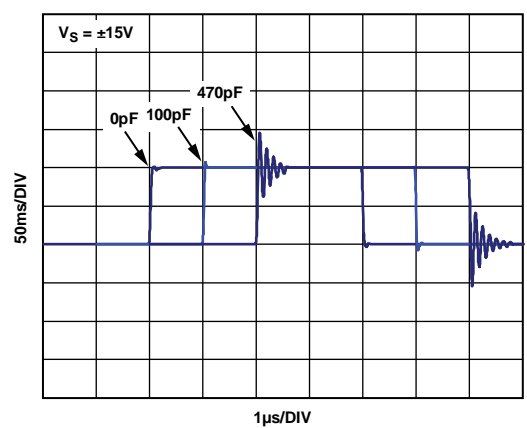


Figure 27. Small-Signal Step Response, Gain = 2

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

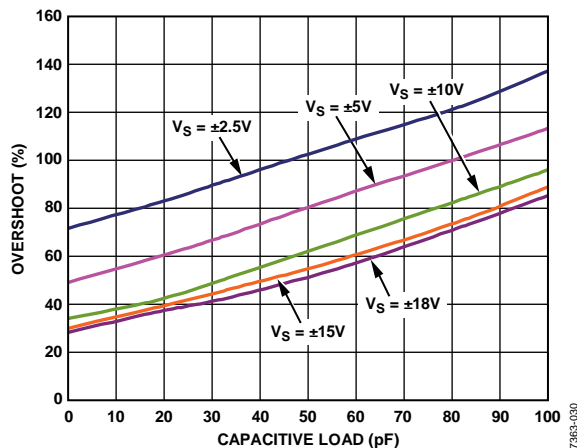


Figure 28. Small-Signal Overshoot vs. Capacitive Load, Gain = $\frac{1}{2}$

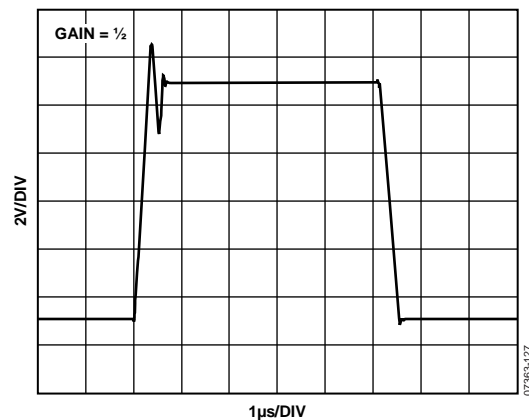


Figure 31. Large-Signal Pulse Response, Gain = $\frac{1}{2}$

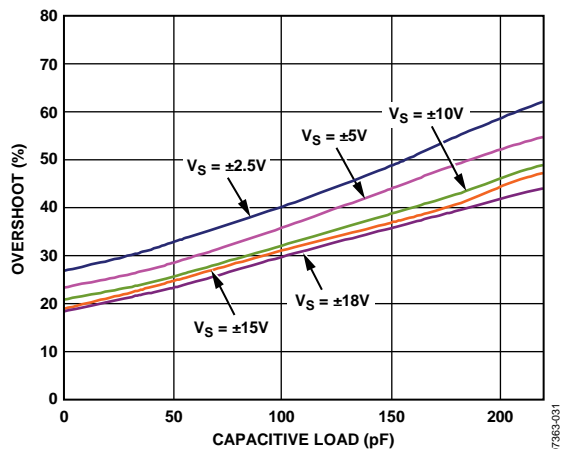


Figure 29. Small-Signal Overshoot vs. Capacitive Load, Gain = 1

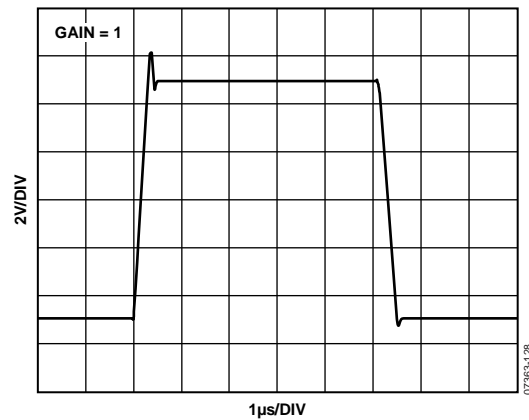


Figure 32. Large-Signal Pulse Response, Gain = 1

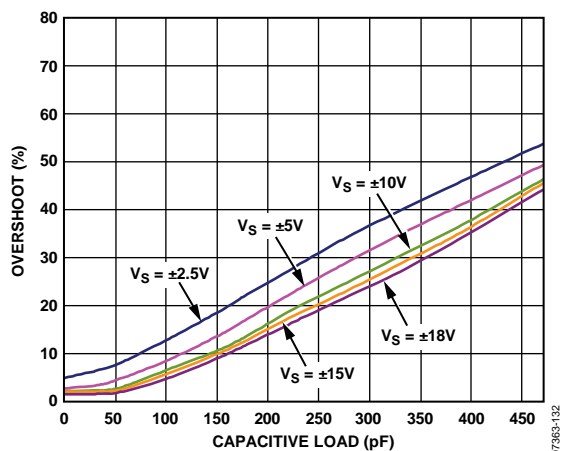


Figure 30. Small-Signal Overshoot vs. Capacitive Load, Gain = 2

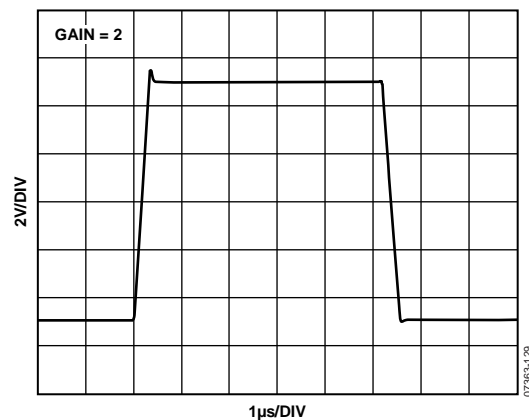


Figure 33. Large-Signal Pulse Response, Gain = 2

$V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, difference amplifier configuration, unless otherwise noted.

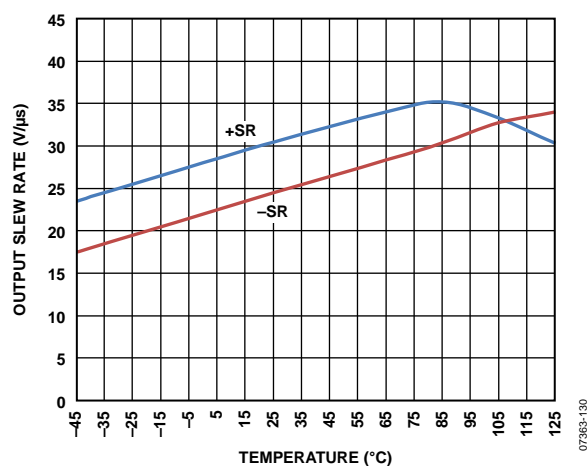


Figure 34. Output Slew Rate vs. Temperature

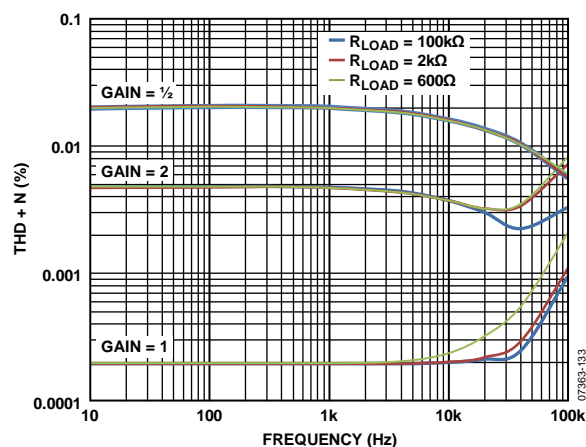


Figure 37. THD + N vs. Frequency

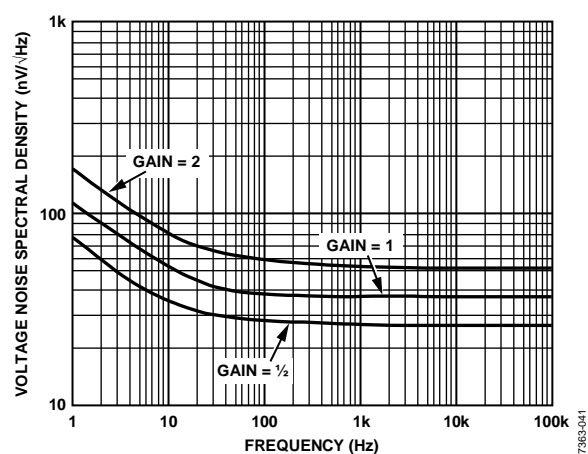


Figure 35. Voltage Noise Spectral Density vs. Frequency, Referred to Output

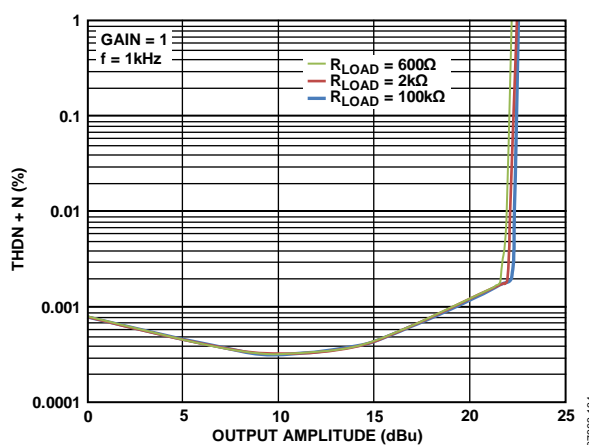


Figure 38. THD + N vs. Output Amplitude, Gain = 1

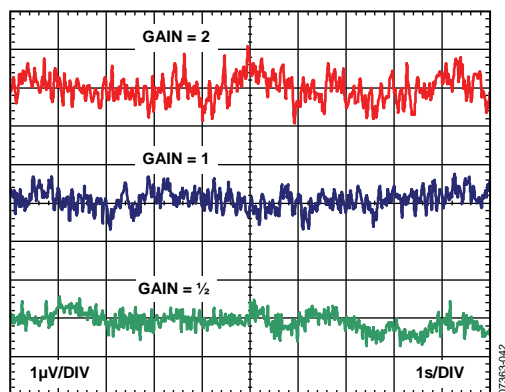


Figure 36. 0.1 Hz to 10 Hz Voltage Noise, Referred to Output

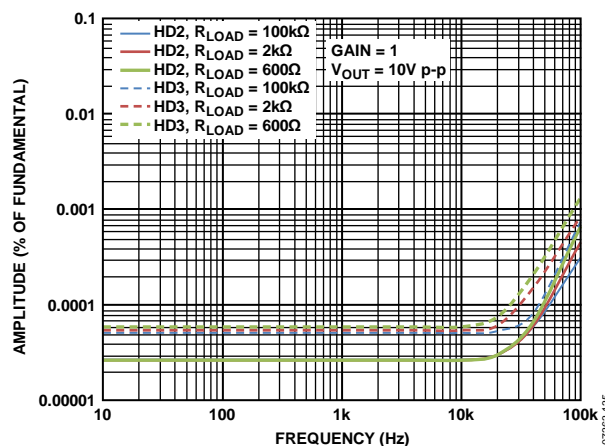


Figure 39. Harmonic Distortion Products vs. Frequency, Gain = 1

OPERATIONAL AMPLIFIER PLOTS

$V_s = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

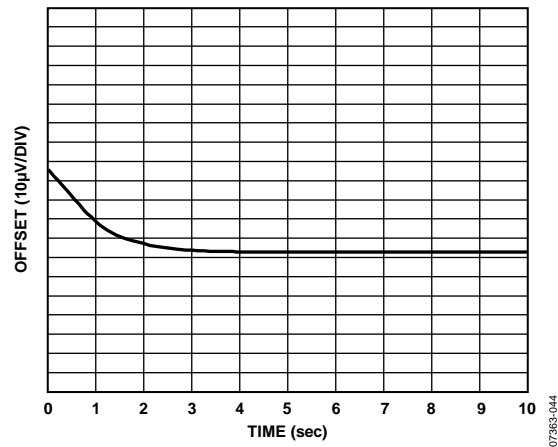


Figure 40. Change in Op Amp Offset Voltage vs. Warm-Up Time

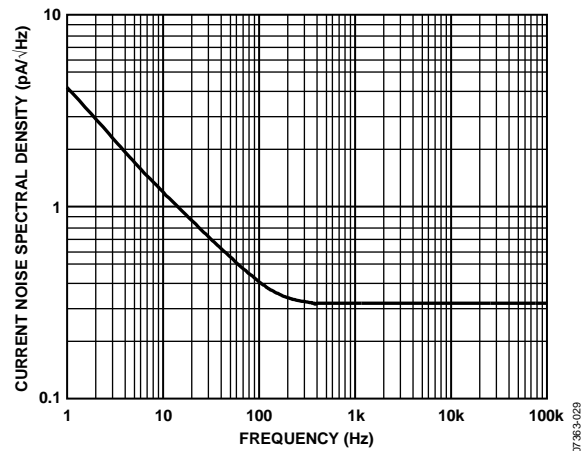


Figure 42. Current Noise Spectral Density vs. Frequency

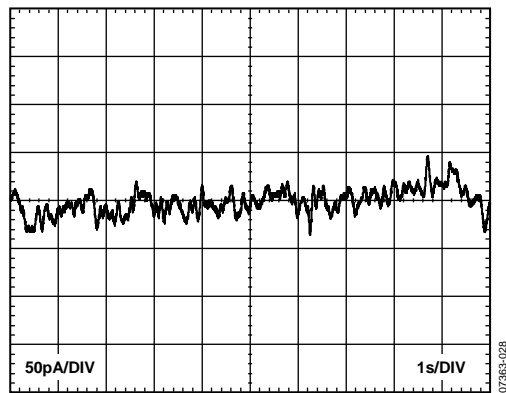


Figure 41. 0.1 Hz to 10 Hz Current Noise

THEORY OF OPERATION

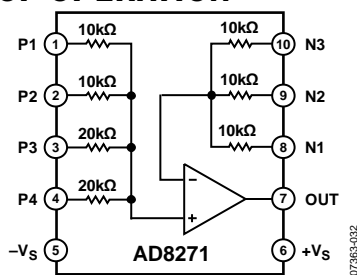


Figure 43. Functional Block Diagram

CIRCUIT INFORMATION

The AD8271 consists of a high precision, low distortion op amp and seven trimmed resistors. These resistors can be connected to create a wide variety of amplifier configurations, including difference, noninverting, and inverting configurations. The resistors on the chip can be connected in parallel for a wider range of options. Using the on-chip resistors of the AD8271 provides the designer with several advantages over a discrete design.

DC Performance

Much of the dc performance of op amp circuits depends on the accuracy of the surrounding resistors. The resistors on the AD8271 are laid out to be tightly matched. The resistors of each part are laser trimmed and tested for their matching accuracy. Because of this trimming and testing, the AD8271 can guarantee high accuracy for specifications, such as gain drift, common-mode rejection, and gain error.

AC Performance

Because feature size is much smaller in an integrated circuit than on a printed circuit board (PCB), the corresponding parasitics are also smaller. The smaller feature size helps the ac performance of the AD8271. For example, the positive and negative input terminals of the AD8271 op amp are not pinned out intentionally. By not connecting these nodes to the traces on the PCB, the capacitance remains low, resulting in both improved loop stability and common-mode rejection over frequency.

Production Costs

Because one part, rather than several discrete components, is placed on the PCB, the board can be built more quickly and efficiently.

Size

The AD8271 fits an op amp and seven resistors in one MSOP package.

DRIVING THE AD8271

The AD8271 is easy to drive, with all configurations presenting at least several kilohms (kΩ) of input resistance. The AD8271 should be driven with a low impedance source: for example, another amplifier. The gain accuracy and common-mode rejection

of the AD8271 depend on the matching of its resistors. Even source resistance of a few ohms can have a substantial effect on these specifications.

POWER SUPPLIES

A stable dc voltage should be used to power the AD8271. Noise on the supply pins can adversely affect performance. A bypass capacitor of 0.1 μF should be placed between each supply pin and ground, as close as possible to each supply pin. A tantalum capacitor of 10 μF should also be used between each supply and ground. It can be farther away from the supply pins and, typically, it can be shared by other precision integrated circuits.

The AD8271 is specified at ±15 V and ±5 V, but it can be used with unbalanced supplies, as well. For example, $-V_s = 0$ V, $+V_s = 20$ V. The difference between the two supplies must be kept below 36 V.

INPUT VOLTAGE RANGE

The AD8271 has a true rail-to-rail input range for the majority of applications. Because most AD8271 configurations divide down the voltage before they reach the internal op amp, the op amp sees only a fraction of the input voltage. Figure 44 shows an example of how the voltage division works in the difference amplifier configuration.

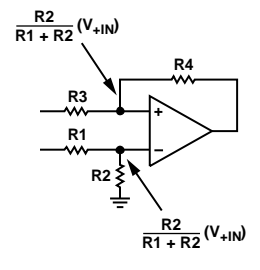


Figure 44. Voltage Division in the Difference Amplifier Configuration

The internal op amp voltage range may be relevant in the following applications, and calculating the voltage at the internal op amp is advised.

- Difference amplifier configurations using supply voltages of less than ±4.5 V
- Difference amplifier configurations with a reference voltage near the rail
- Single-ended amplifier configurations

For correct operation, the input voltages at the internal op amp must stay within 1.5 V of either supply rail.

Voltages beyond the supply rails should not be applied to the part. The part contains ESD diodes at the input pins, which conduct if voltages beyond the rails are applied. Currents greater than 5 mA may damage these diodes and the part. For a similar part that can operate with voltages beyond the rails, see the [AD8274](#) data sheet.

APPLICATIONS INFORMATION

The resistors and connections provided on the AD8271 offer abundant versatility through the variety of configurations that are possible.

DIFFERENCE AMPLIFIER CONFIGURATIONS

The AD8271 can be placed in difference amplifier configurations with gains of $\frac{1}{2}$, 1, and 2. Figure 45 through Figure 47 show sample difference amplifier configurations referenced to ground.

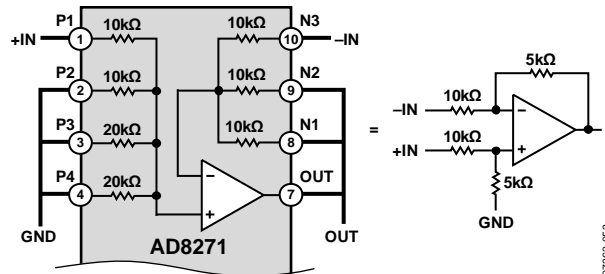


Figure 45. Gain = $\frac{1}{2}$ Difference Amplifier, Referenced to Ground

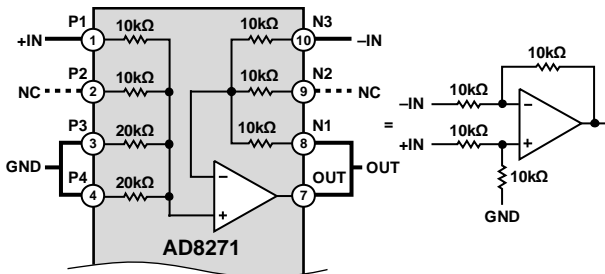


Figure 46. Gain = 1 Difference Amplifier, Referenced to Ground

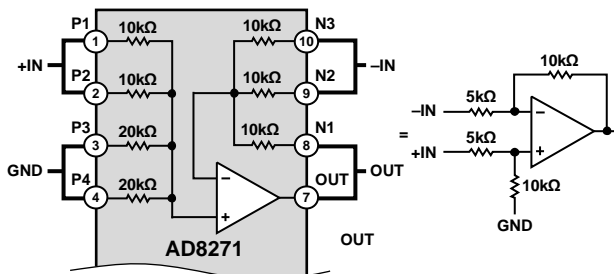


Figure 47. Gain = 2 Difference Amplifier, Referenced to Ground

The AD8271 can also be referred to a combination of reference voltages. For example, the reference can be set at 2.5 V, using just 5 V and GND. Some of the possible configurations are shown in Figure 48 through Figure 50. Note that the output is not internally tied to a feedback path, so any of the 10 kΩ resistors on the inverting input can be used in the feedback network. This flexibility allows for more efficient board layout options.

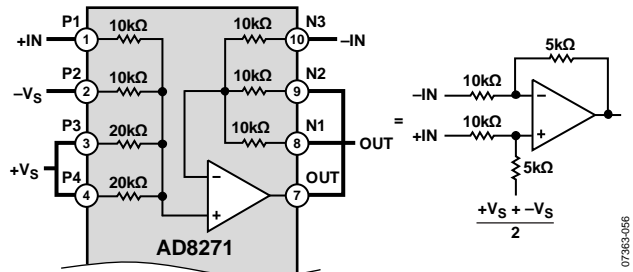


Figure 48. Gain = $\frac{1}{2}$ Difference Amplifier, Referenced to Midsupply

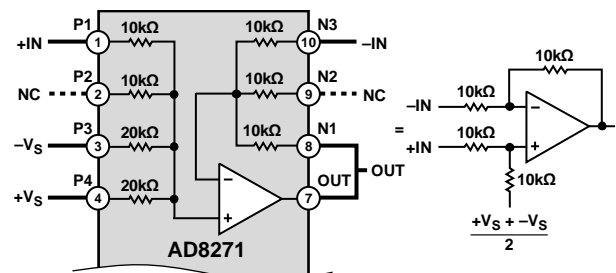


Figure 49. Gain = 1 Difference Amplifier, Referenced to Midsupply

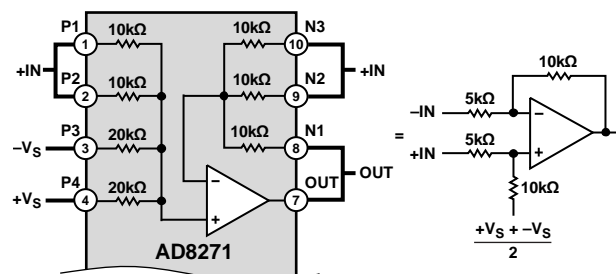


Figure 50. Gain = 2 Difference Amplifier, Referenced to Midsupply

Table 8. Pin Connections for Difference Amplifier Configurations

| Gain and Reference | Configuration | | | | | | |
|---|---------------|-----------------|-----------------|-----------------|------------|------------|-------------|
| | Pin 1 (P1) | Pin 2 (P2) | Pin 3 (P3) | Pin 4 (P4) | Pin 8 (N1) | Pin 9 (N2) | Pin 10 (N3) |
| Gain of $\frac{1}{2}$, Referenced to Ground | +IN | GND | GND | GND | OUT | OUT | -IN |
| Gain of $\frac{1}{2}$, Referenced to Midsupply | +IN | -V _S | +V _S | +V _S | OUT | OUT | -IN |
| Gain of 1, Referenced to Ground | +IN | NC | GND | GND | OUT | NC | -IN |
| Gain of 1, Referenced to Midsupply | +IN | NC | -V _S | +V _S | OUT | NC | -IN |
| Gain of 2, Referenced to Ground | +IN | +IN | GND | GND | OUT | -IN | -IN |
| Gain of 2, Referenced to Midsupply | +IN | +IN | -V _S | +V _S | OUT | -IN | -IN |

SINGLE-ENDED CONFIGURATIONS

The AD8271 can be configured for a wide variety of single-ended configurations with gains ranging from –2 to +3 (see Table 9).

Table 9. Selected Single-Ended Configurations

| Electrical Performance | | | Configuration | | | | | | |
|------------------------|-------------------------|------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Signal Gain | Op Amp Closed-Loop Gain | Input Resistance | Pin 10 ¹ | Pin 9 ¹ | Pin 8 ¹ | Pin 1 ² | Pin 2 ² | Pin 3 ³ | Pin 4 ³ |
| –2 | 3 | 5 kΩ | IN | IN | OUT | GND | GND | GND | GND |
| –1.5 | 3 | 4.8 kΩ | IN | IN | OUT | GND | GND | GND | IN |
| –1.4 | 3 | 5 kΩ | IN | IN | OUT | GND | GND | NC | IN |
| –1.25 | 3 | 5.333 kΩ | IN | IN | OUT | GND | NC | GND | IN |
| –1 | 3 | 5 kΩ | IN | IN | OUT | GND | GND | IN | IN |
| –0.8 | 3 | 5.556 kΩ | IN | IN | OUT | IN | GND | NC | GND |
| –0.667 | 2 | 8 kΩ | IN | NC | OUT | GND | GND | GND | IN |
| –0.6 | 2 | 8.333 kΩ | IN | NC | OUT | GND | GND | NC | IN |
| –0.5 | 2 | 8.889 kΩ | IN | NC | OUT | GND | NC | GND | IN |
| –0.333 | 2 | 7.5 kΩ | IN | NC | OUT | GND | GND | IN | IN |
| –0.25 | 1.5 | 8 kΩ | OUT | IN | OUT | GND | GND | GND | IN |
| –0.2 | 1.5 | 8.333 kΩ | OUT | IN | OUT | GND | GND | NC | IN |
| –0.125 | 1.5 | 8.889 kΩ | OUT | IN | OUT | GND | NC | GND | IN |
| +0.1 | 1.5 | 8.333 kΩ | OUT | IN | OUT | IN | GND | NC | GND |
| +0.2 | 2 | 10 kΩ | IN | NC | OUT | GND | IN | NC | IN |
| +0.25 | 1.5 | 24 kΩ | OUT | GND | OUT | GND | GND | GND | IN |
| +0.3 | 1.5 | 25 kΩ | OUT | GND | OUT | GND | GND | NC | IN |
| +0.333 | 2 | 24 kΩ | GND | NC | OUT | GND | GND | GND | IN |
| +0.375 | 1.5 | 26.67 kΩ | OUT | GND | OUT | GND | NC | GND | IN |
| +0.4 | 2 | 25 kΩ | GND | NC | OUT | GND | GND | NC | IN |
| +0.5 | 3 | 24 kΩ | GND | GND | OUT | GND | GND | GND | IN |
| +0.5 | 1.5 | 15 kΩ | OUT | GND | OUT | GND | GND | IN | IN |
| +0.6 | 3 | 25 kΩ | GND | GND | OUT | GND | GND | NC | IN |
| +0.6 | 1.5 | 16.67 kΩ | OUT | GND | OUT | IN | GND | NC | GND |
| +0.625 | 1.5 | 16 kΩ | OUT | IN | OUT | NC | IN | IN | GND |
| +0.667 | 2 | 15 kΩ | GND | NC | OUT | GND | GND | IN | IN |
| +0.7 | 1.5 | 16.67 kΩ | OUT | IN | OUT | IN | IN | NC | GND |
| +0.75 | 3 | 26.67 kΩ | GND | GND | OUT | GND | NC | GND | IN |
| +0.75 | 1.5 | 13.33 kΩ | OUT | GND | OUT | GND | IN | GND | IN |
| +0.8 | 2 | 16.67 kΩ | GND | NC | OUT | IN | GND | NC | GND |
| +0.9 | 1.5 | 16.67 kΩ | OUT | GND | OUT | GND | IN | NC | IN |
| +1 | 1.5 | 15 kΩ | OUT | GND | OUT | IN | IN | GND | GND |
| +1 | 1.5 | >1 GΩ | OUT | IN | OUT | IN | IN | IN | IN |
| +1 | 3 | >1 GΩ | IN | IN | OUT | IN | IN | IN | IN |
| +1.125 | 1.5 | 26.67 kΩ | OUT | GND | OUT | NC | IN | IN | GND |
| +1.2 | 3 | 16.67 kΩ | GND | GND | OUT | IN | GND | NC | GND |
| +1.2 | 1.5 | 25 kΩ | OUT | GND | OUT | IN | IN | NC | GND |
| +1.25 | 1.5 | 24 kΩ | OUT | GND | OUT | IN | IN | IN | GND |
| +1.333 | 2 | 15 kΩ | GND | NC | OUT | IN | IN | GND | GND |
| +1.5 | 3 | 13.33 kΩ | GND | GND | OUT | GND | IN | GND | IN |
| +1.5 | 1.5 | >1 GΩ | OUT | GND | OUT | IN | IN | IN | IN |
| +1.6 | 2 | 25 kΩ | GND | NC | OUT | IN | IN | NC | GND |
| +1.667 | 2 | 24 kΩ | GND | NC | OUT | IN | IN | IN | GND |
| +1.8 | 3 | 16.67 kΩ | GND | GND | OUT | GND | IN | NC | IN |
| +2 | 2 | >1 GΩ | GND | NC | OUT | IN | IN | IN | IN |
| +2.25 | 3 | 26.67 kΩ | GND | GND | OUT | NC | IN | IN | GND |
| +2.4 | 3 | 25 kΩ | GND | GND | OUT | IN | IN | NC | GND |
| +2.5 | 3 | 24 kΩ | GND | GND | OUT | IN | IN | IN | GND |
| +3 | 3 | >1 GΩ | GND | GND | OUT | IN | IN | IN | IN |

¹ A 10 kΩ resistor is connected to the inverting (–) terminal of the op amp.

² A 10 kΩ resistor is connected to the noninverting (+) terminal of the op amp.

³ A 20 kΩ resistor is connected to the noninverting (+) terminal of the op amp.

DRIVING CABLING

Because the AD8271 can drive large voltages at high output currents and slew rates, it makes an excellent cable driver. It is good practice to put a small value resistor between the AD8271 output and cable, since capacitance in the cable can cause peaking or instability in the output response. A resistance of 20 Ω or higher is recommended.

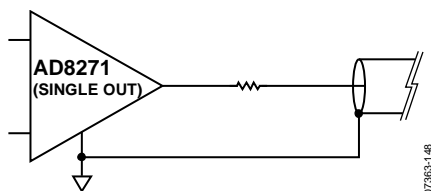
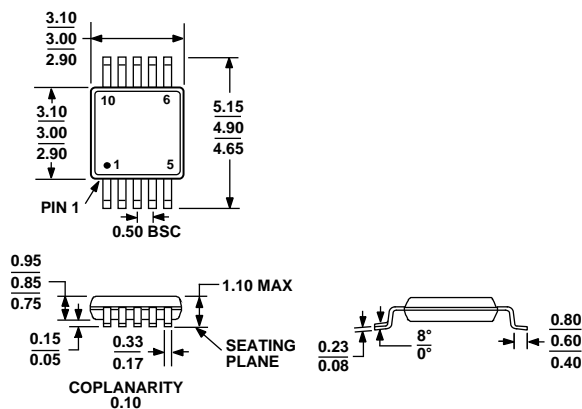


Figure 55. Driving Cabling

DRIVING AN ADC

The AD8271 high slew rate and drive capability, combined with its dc accuracy, make it a good ADC driver. The AD8271 can drive single-ended input ADCs. Many converters require the output to be buffered with a small value resistor combined with a high quality ceramic capacitor. See the relevant converter data sheet for more details.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187-BA
 Figure 56. 10-Lead Mini Small Outline Package [MSOP]
 (RM-10)
 Dimensions are shown in millimeters

ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option | Branding |
|----------------------------|-------------------|---------------------------------|----------------|----------|
| AD8271ARMZ ¹ | –40°C to +85°C | 10-Lead MSOP | RM-10 | Y1E |
| AD8271ARMZ-R7 ¹ | –40°C to +85°C | 10-Lead MSOP, 7" Tape and Reel | RM-10 | Y1E |
| AD8271ARMZ-RL ¹ | –40°C to +85°C | 10-Lead MSOP, 13" Tape and Reel | RM-10 | Y1E |
| AD8271BRMZ ¹ | –40°C to +85°C | 10-Lead MSOP | RM-10 | Y1G |
| AD8271BRMZ-R7 ¹ | –40°C to +85°C | 10-Lead MSOP, 7" Tape and Reel | RM-10 | Y1G |
| AD8271BRMZ-RL ¹ | –40°C to +85°C | 10-Lead MSOP, 13" Tape and Reel | RM-10 | Y1G |

¹ Z = RoHS Compliant Part.



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- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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