

# ADA4075-2\* Product Page Quick Links

Last Content Update: 08/30/2016

---

## Comparable Parts

View a parametric search of comparable parts

## Evaluation Kits

- EVAL-OPAMP-2 Evaluation Board

## Documentation

### Application Notes

- AN-1328: High Performance, Low Noise Studio Microphone with MEMS Microphones, Analog Beamforming, and Power Management
- AN-940: Low Noise Amplifier Selection Guide for Optimal Noise Performance

### Data Sheet

- ADA4075-2: Ultralow Noise Amplifier at Lower Power Data Sheet

## Tools and Simulations

- Analog Filter Wizard
- Analog Photodiode Wizard
- ADA4075-2 SPICE Macro Model

## Reference Designs

- CN0274

## Reference Materials

### Product Selection Guide

- SAR ADC & Driver Quick-Match Guide

### Tutorials

- MT-047: Op Amp Noise
- MT-052: Op Amp Noise Figure: Don't Be Misled

## Design Resources

- ADA4075-2 Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

## Discussions

View all ADA4075-2 EngineerZone Discussions

## Sample and Buy

Visit the product page to see pricing options

## Technical Support

Submit a technical question or find your regional support number

---

\* This page was dynamically generated by Analog Devices, Inc. and inserted into this data sheet. Note: Dynamic changes to the content on this page does not constitute a change to the revision number of the product data sheet. This content may be frequently modified.

## TABLE OF CONTENTS

Features .....	1	Applications Information .....	16
Applications .....	1	Input Protection .....	16
Pin Configurations .....	1	Total Harmonic Distortion .....	16
General Description .....	1	Phase Reversal .....	16
Revision History .....	2	DAC Output Filter.....	17
Specifications.....	3	Balanced Line Driver .....	18
Absolute Maximum Ratings.....	5	Balanced Line Receiver.....	19
Thermal Resistance .....	5	Low Noise Parametric Equalizer .....	20
Power Sequencing .....	5	Schematic.....	21
ESD Caution.....	5	Outline Dimensions .....	22
Typical Performance Characteristics .....	6	Ordering Guide .....	22

## REVISION HISTORY

### 11/13—Rev. B to Rev. C

Change to Balanced Line Receiver Section.....	19
---	----

### 12/11—Rev. A to Rev. B

Changes to Features Section.....	1
----------------------------------	---

### 8/09—Rev. 0 to Rev. A

Added 8-Lead LFCSP_WD .....	Universal
Changes to Table 1 .....	1
Changes to Table 2.....	3
Changes to Table 3.....	4
Changes to Table 4 and Table 5.....	5
Changes to Figure 3, Figure 5, Figure 6, and Figure 8 .....	6
Added Figure 4 and Figure 7; Renumbered Sequentially .....	6
Added Figure 9 and Figure 12.....	7
Changes to Figure 10, Figure 11, Figure 13, and Figure 14.....	7
Changes to Figure 16, Figure 17, Figure 19, and Figure 20.....	8
Changes to Figure 22 and Figure 25.....	9
Changes to Figure 36.....	11
Changes to Figure 54.....	14
Changes to and Moved Figure 57 and Figure 60 to .....	15
Changes to Figure 59 and Figure 62.....	15
Changes to Input Protection Section and Phase Reversal Section.....	16
Changes to DAC Output Filter Section .....	17
Changes to Figure 67 .....	18
Updated Outline Dimensions .....	22
Changes to Ordering Guide .....	22

### 10/08—Revision 0: Initial Version

## SPECIFICATIONS

$V_{SY} = \pm 15\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , SOIC package, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.2	1	mV
Input Bias Current	$I_B$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		30	100	nA
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		5	50	nA
Input Voltage Range		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	-12.5		75	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -12.5\text{ V to } +12.5\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	118	+12.5	dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $V_O = -11\text{ V to } +11\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	114	117		dB
		$R_L = 600\text{ }\Omega$ , $V_O = -10\text{ V to } +10\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	108	117		dB
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	112			dB
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	106			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.3		$\mu\text{V}/^\circ\text{C}$
Input Resistance, Differential Mode	$R_{INDM}$			1.5		M $\Omega$
Input Resistance, Common Mode	$R_{INCM}$			500		M $\Omega$
Input Capacitance, Differential Mode	$C_{INDM}$			2.4		pF
Input Capacitance, Common Mode	$C_{INCM}$			2.1		pF
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.8	13		V
		$R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.5			V
		$R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.4	12.8		V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12			V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	15	15.8		V
Output Voltage Low	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	14			V
		$R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-14	-13.6	V
		$R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			-13	V
		$R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-13.6	-13	V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\text{ }\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-16.6	-16	V
Short-Circuit Current	$I_{SC}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		40	-15	V
Closed-Loop Output Impedance	$Z_{OUT}$	$f = 1\text{ kHz}$ , $A_V = 1$		0.1		mA $\Omega$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_{SY} = \pm 4.5\text{ V to } \pm 18\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	106	110		dB
Supply Current per Amplifier	$I_{SY}$	$V_{SY} = \pm 4.5\text{ V to } \pm 18\text{ V}$ , $I_O = 0\text{ mA}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	100			dB
				1.8	2.25	mA
					3.35	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$ , $A_V = 1$		12		V/ $\mu\text{s}$
Settling Time	$t_S$	To 0.01%, $V_{IN} = 10\text{ V step}$ , $R_L = 1\text{ k}\Omega$		3		$\mu\text{s}$
Gain Bandwidth Product	GBP	$R_L = 1\text{ M}\Omega$ , $C_L = 35\text{ pF}$ , $A_V = 1$		6.5		MHz
Phase Margin	$\Phi_M$	$R_L = 1\text{ M}\Omega$ , $C_L = 35\text{ pF}$ , $A_V = 1$		60		Degrees
<b>THD + NOISE</b>						
Total Harmonic Distortion and Noise	THD + N	$R_L = 2\text{ k}\Omega$ , $A_V = 1$ , $V_{IN} = 3\text{ V rms}$ , $f = 1\text{ kHz}$		0.0002		%
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	$f = 0.1\text{ Hz to } 10\text{ Hz}$		60		nV p-p
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		2.8		nV/ $\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 1\text{ kHz}$		1.2		pA/ $\sqrt{\text{Hz}}$

$V_{SY} = \pm 15\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , LFCSP package, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	$V_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.3	1	mV
Input Bias Current	$I_B$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		30	100	nA
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		5	50	nA
Input Voltage Range		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	-12.5		+12.5	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -12.5\text{ V to }+12.5\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	116		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $V_O = -11\text{ V to }+11\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	117		dB
		$R_L = 600\ \Omega$ , $V_O = -10\text{ V to }+10\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	102	117		dB
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	108			dB
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	100			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		3		$\mu\text{V}/^\circ\text{C}$
Input Resistance, Differential Mode	$R_{INDM}$			1.5		M $\Omega$
Input Resistance, Common Mode	$R_{INCM}$			500		M $\Omega$
Input Capacitance, Differential Mode	$C_{INDM}$			2.4		pF
Input Capacitance, Common Mode	$C_{INCM}$			2.1		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.8	13		V
		$R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.5	12.8		V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12.4			V
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	12			V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	15	15.8		V
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	14			V
Output Voltage Low	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-14	-13.6	V
		$R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			-13	V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-13.6	-13	V
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			-12.5	V
		$V_{SY} = \pm 18\text{ V}$ , $R_L = 600\ \Omega$ to GND $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-16.6	-16	V
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			-15	V
Short-Circuit Current	$I_{SC}$		40			mA
Closed-Loop Output Impedance	$Z_{OUT}$	$f = 1\text{ kHz}$ , $A_V = 1$		0.1		$\Omega$
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_{SY} = \pm 4.5\text{ V to } \pm 18\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	100	104		dB
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	95			dB
Supply Current per Amplifier	$I_{SY}$	$V_{SY} = \pm 4.5\text{ V to } \pm 18\text{ V}$ , $I_O = 0\text{ mA}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1.8	2.25	mA
		$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			3.35	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$ , $A_V = 1$		12		V/ $\mu\text{s}$
Settling Time	$t_s$	To 0.01%, $V_{IN} = 10\text{ V step}$ , $R_L = 1\text{ k}\Omega$		3		$\mu\text{s}$
Gain Bandwidth Product	GBP	$R_L = 1\text{ M}\Omega$ , $C_L = 35\text{ pF}$ , $A_V = 1$		6.5		MHz
Phase Margin	$\Phi_M$	$R_L = 1\text{ M}\Omega$ , $C_L = 35\text{ pF}$ , $A_V = 1$		60		Degrees
THD + NOISE						
Total Harmonic Distortion and Noise	THD + N	$R_L = 2\text{ k}\Omega$ , $A_V = 1$ , $V_{IN} = 3\text{ V rms}$ , $f = 1\text{ kHz}$		0.0002		%
NOISE PERFORMANCE						
Voltage Noise	$e_n$ p-p	$f = 0.1\text{ Hz to }10\text{ Hz}$		60		nV p-p
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		2.8		nV/ $\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 1\text{ kHz}$		1.2		pA/ $\sqrt{\text{Hz}}$

## ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	$\pm 20$ V
Input Voltage	$\pm V_{SY}$
Input Current <sup>1</sup>	$\pm 10$ mA
Differential Input Voltage	$\pm 1.2$ V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	$-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$
Operating Temperature Range	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
Junction Temperature Range	$-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$
Lead Temperature (Soldering, 60 sec)	$300^{\circ}\text{C}$

<sup>1</sup>The input pins have clamp diodes to the power supply pins.

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

$\theta_{JA}$  is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages. This was measured using a standard 4-layer board.

Table 5. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead SOIC	158	43	$^{\circ}\text{C}/\text{W}$
8-Lead LFCSP	115	40	$^{\circ}\text{C}/\text{W}$

## POWER SEQUENCING

The op amp supplies must be established simultaneously with, or before, any input signals are applied. If this is not possible, limit the input current to 10 mA.

## 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

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

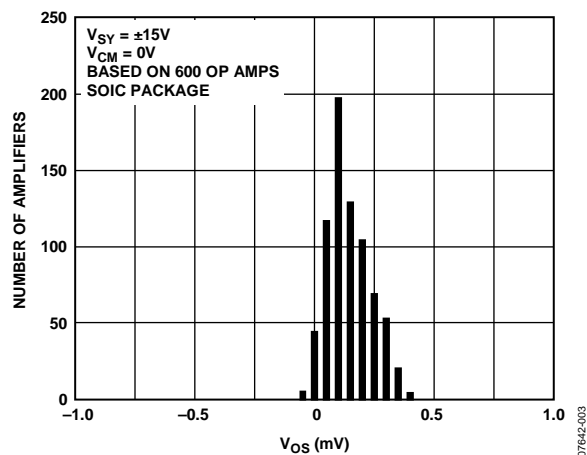


Figure 3. Input Offset Voltage Distribution

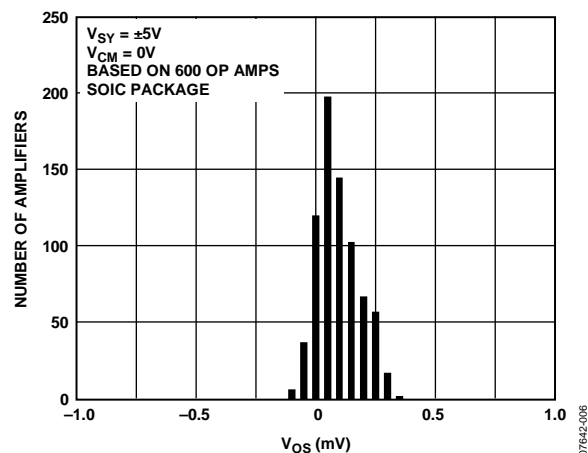


Figure 6. Input Offset Voltage Distribution

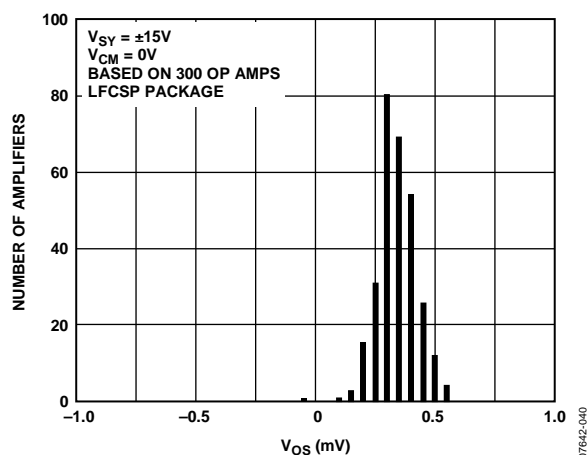


Figure 4. Input Offset Voltage Distribution

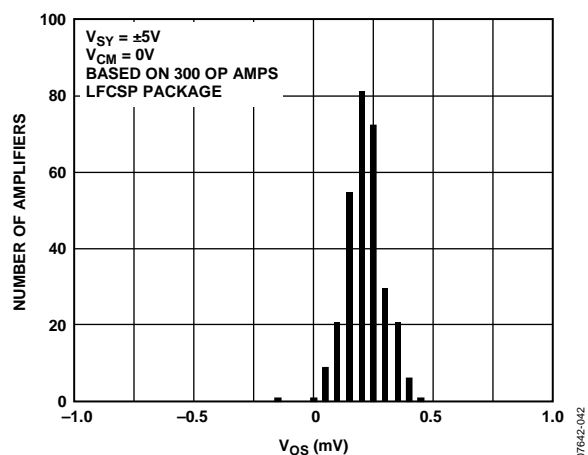


Figure 7. Input Offset Voltage Distribution

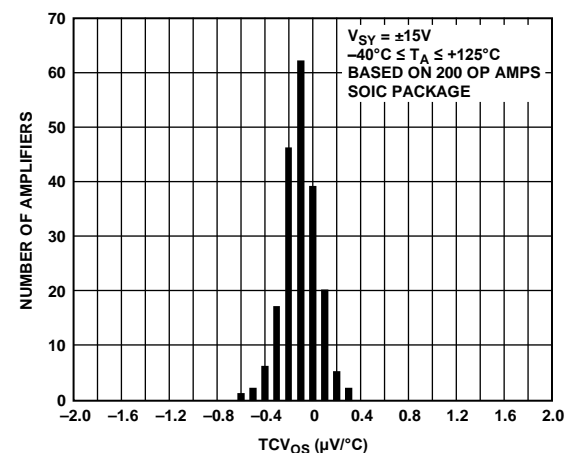


Figure 5. Input Offset Voltage Drift Distribution

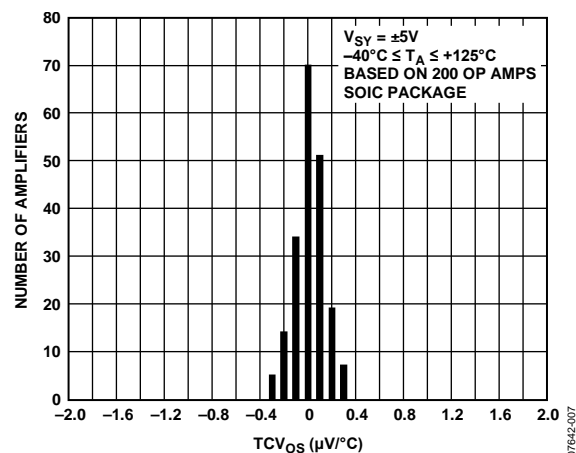


Figure 8. Input Offset Voltage Drift Distribution

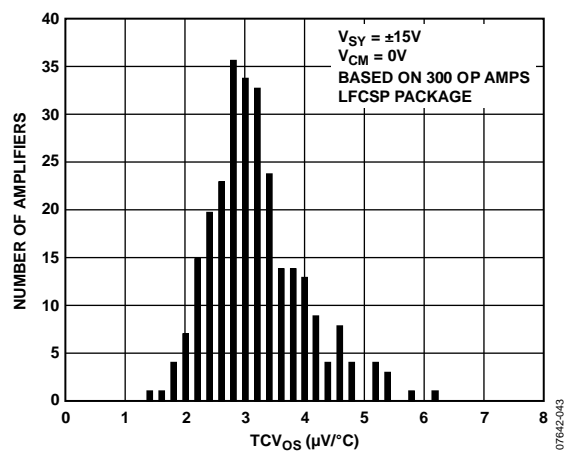


Figure 9. Input Offset Voltage Drift Distribution

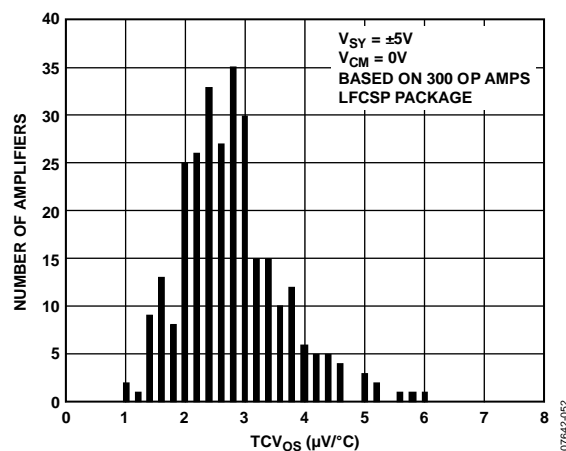


Figure 12. Input Offset Voltage Drift Distribution

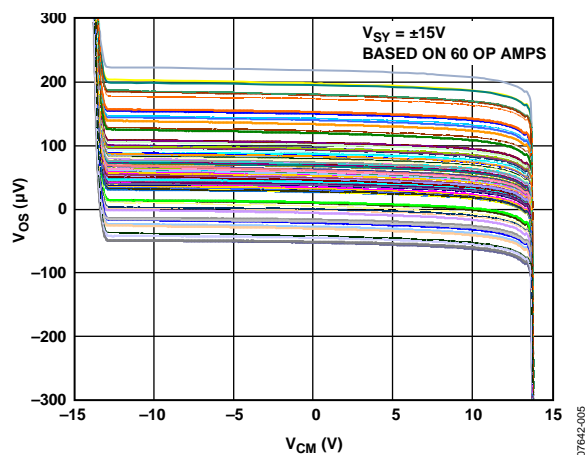


Figure 10. Input Offset Voltage vs. Common-Mode Voltage

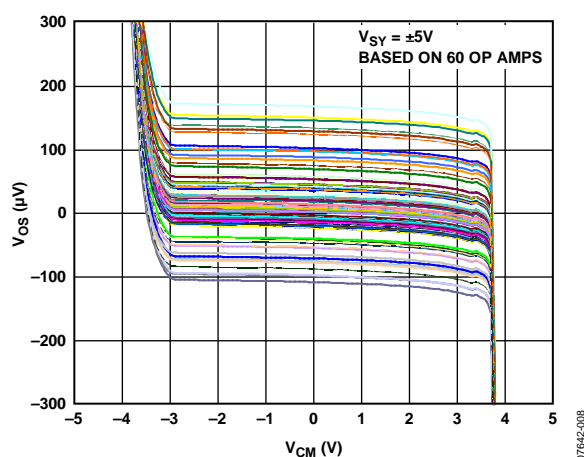


Figure 13. Input Offset Voltage vs. Common-Mode Voltage

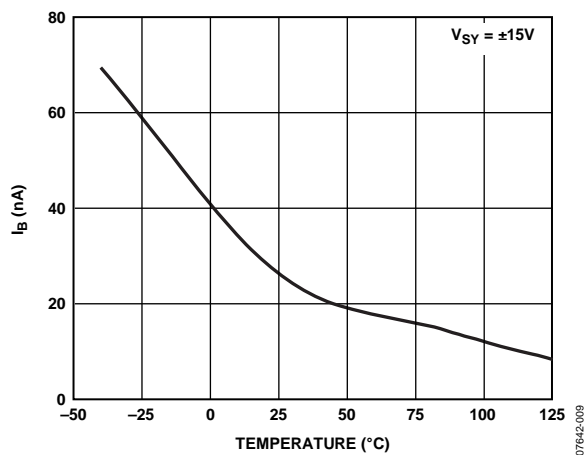


Figure 11. Input Bias Current vs. Temperature

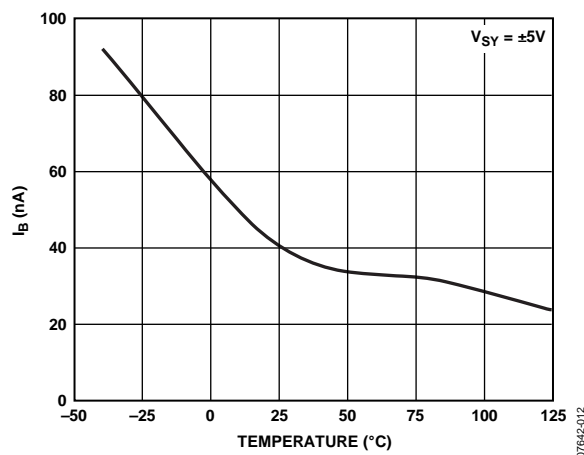


Figure 14. Input Bias Current vs. Temperature

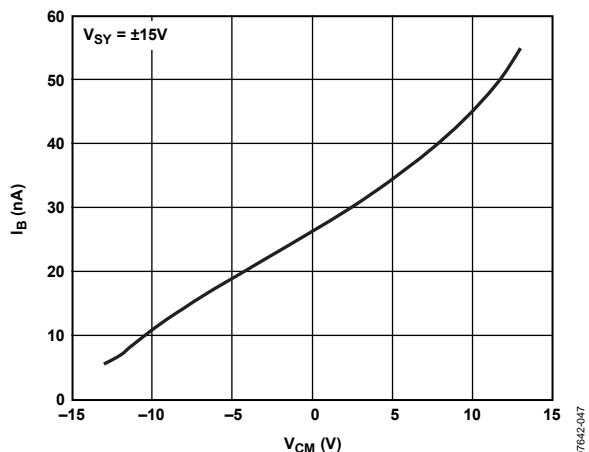


Figure 15. Input Bias Current vs. Input Common-Mode Voltage

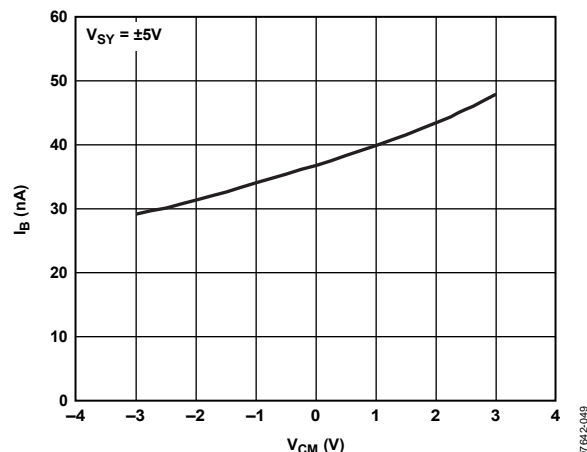


Figure 18. Input Bias Current vs. Input Common-Mode Voltage

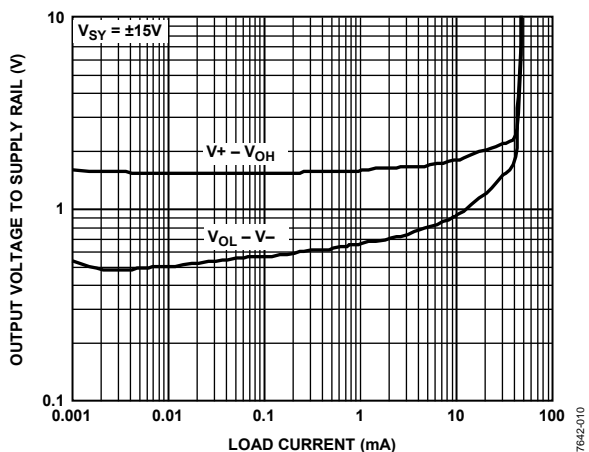


Figure 16. Output Voltage to Supply Rail vs. Load Current

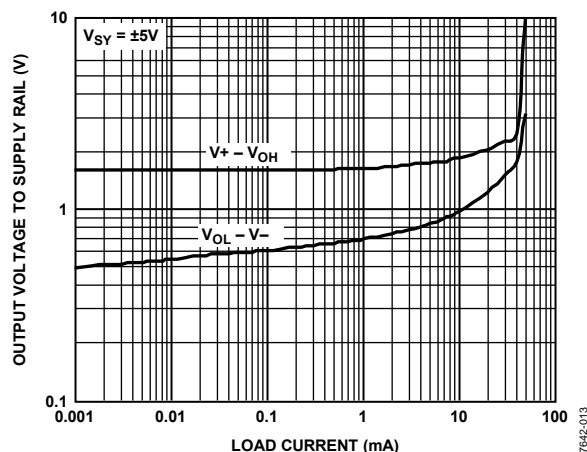


Figure 19. Output Voltage to Supply Rail vs. Load Current

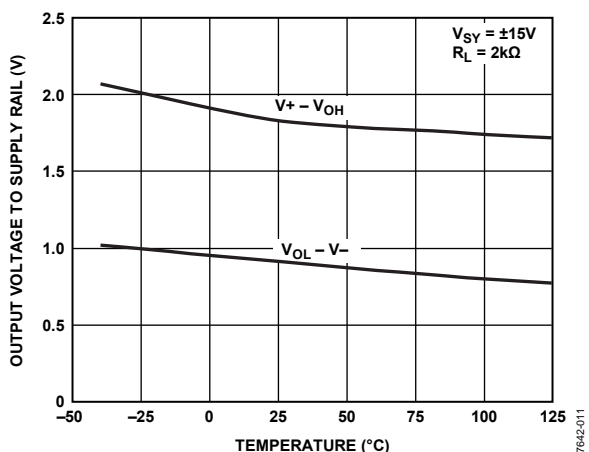


Figure 17. Output Voltage to Supply Rail vs. Temperature

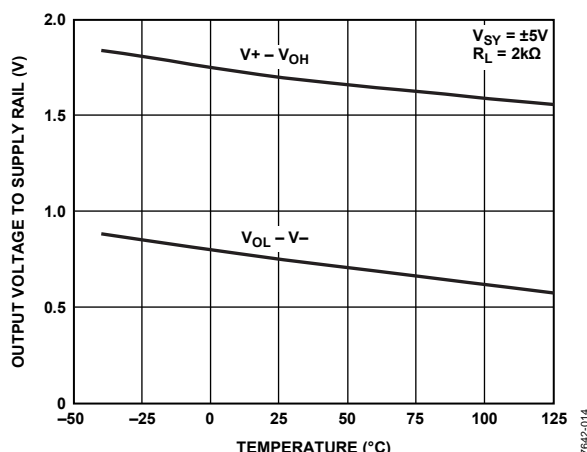


Figure 20. Output Voltage to Supply Rail vs. Temperature



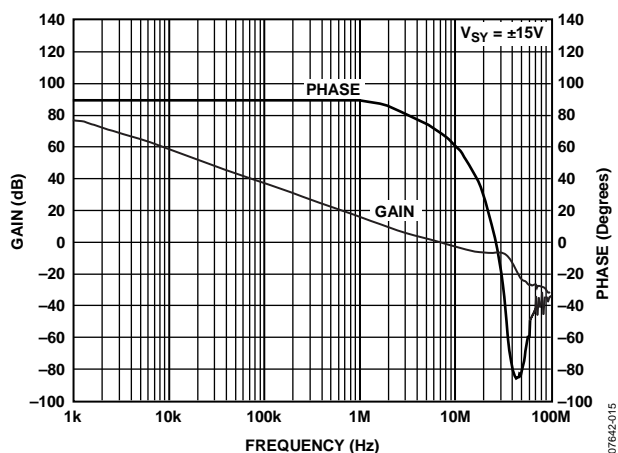


Figure 21. Open-Loop Gain and Phase vs. Frequency

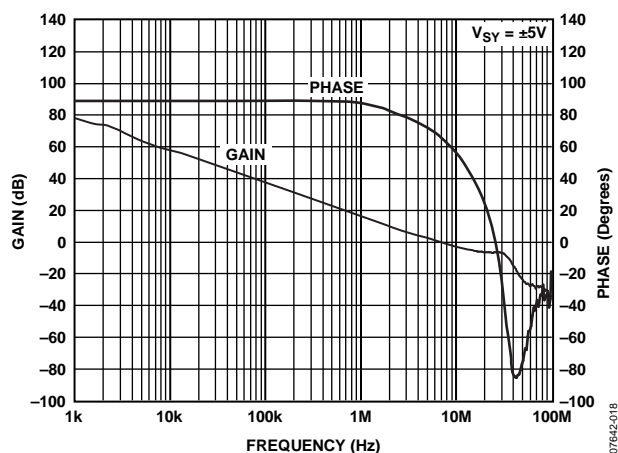


Figure 24. Open-Loop Gain and Phase vs. Frequency

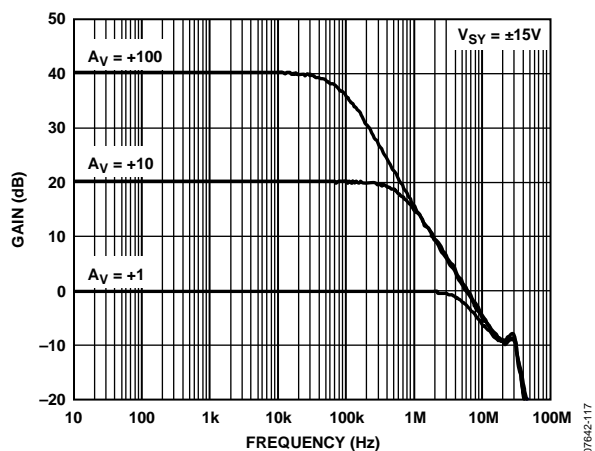


Figure 22. Closed-Loop Gain vs. Frequency

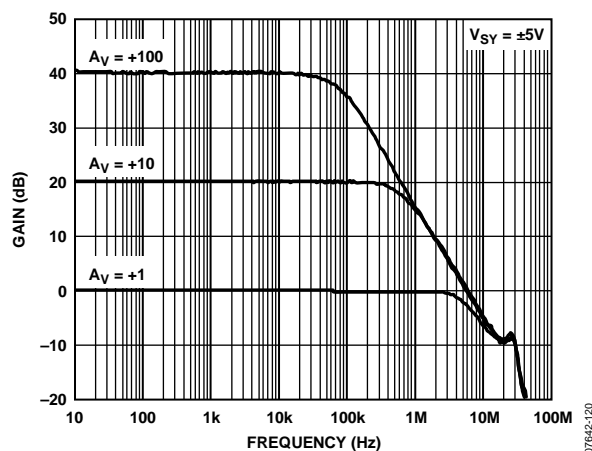


Figure 25. Closed-Loop Gain vs. Frequency

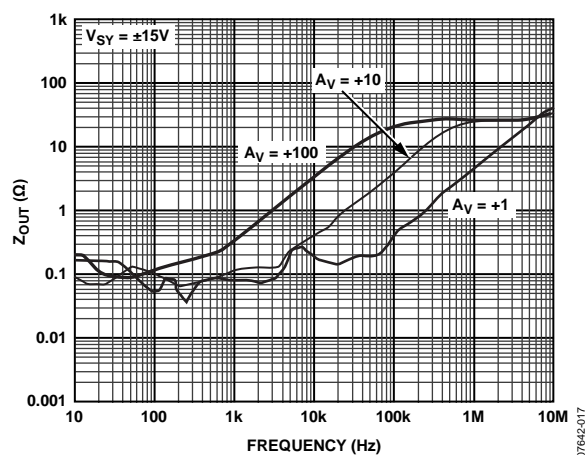


Figure 23. Output Impedance vs. Frequency

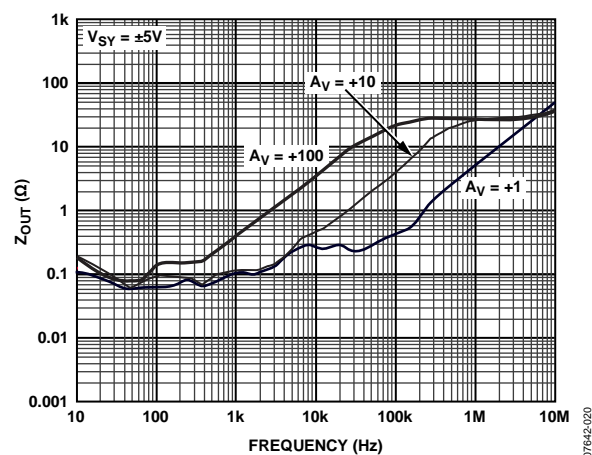


Figure 26. Output Impedance vs. Frequency

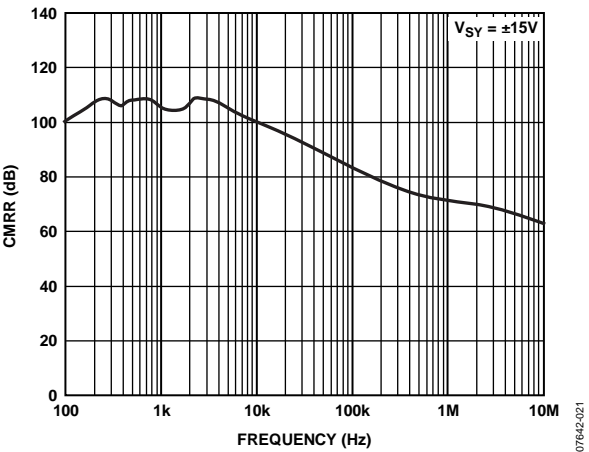


Figure 27. CMRR vs. Frequency

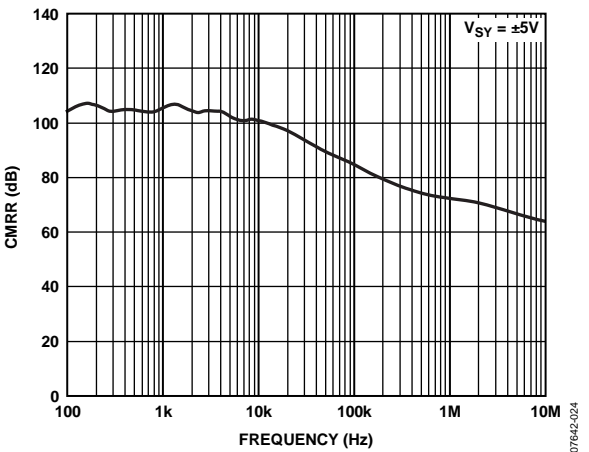


Figure 30. CMRR vs. Frequency

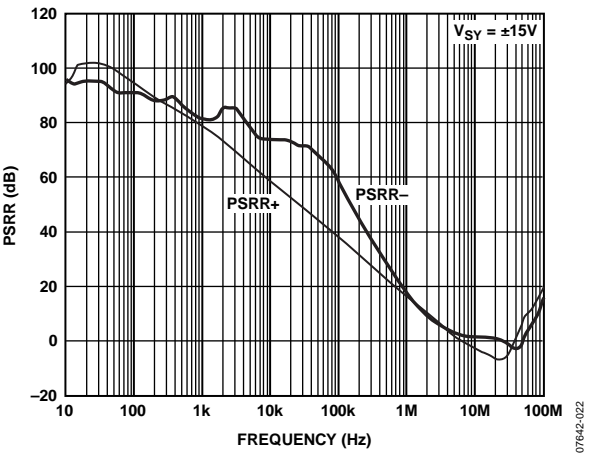


Figure 28. PSRR vs. Frequency

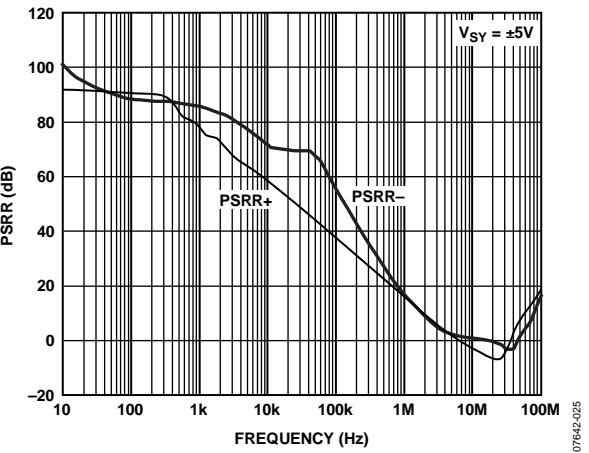


Figure 31. PSRR vs. Frequency

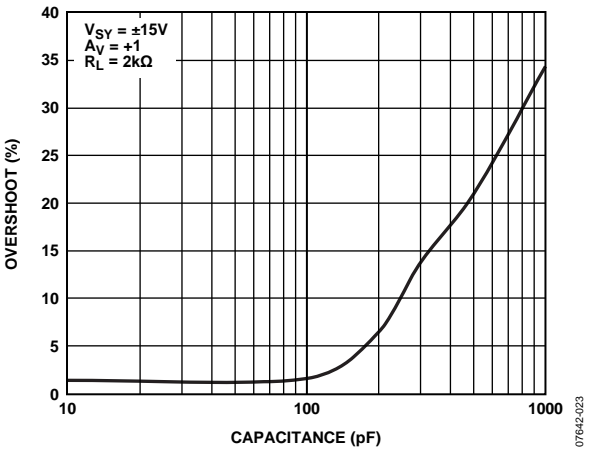


Figure 29. Small Signal Overshoot vs. Load Capacitance

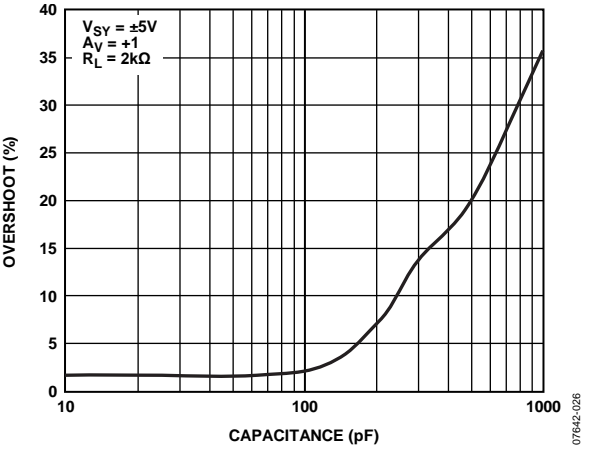


Figure 32. Small Signal Overshoot vs. Load Capacitance

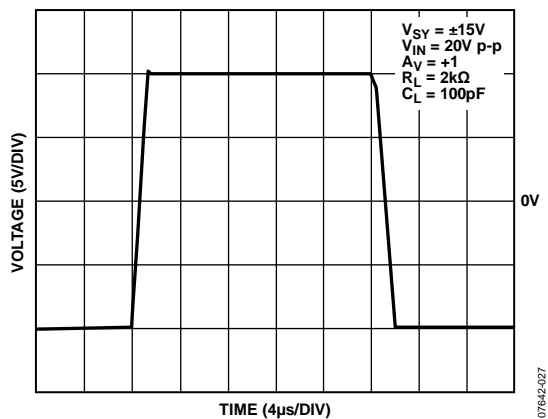


Figure 33. Large Signal Transient Response

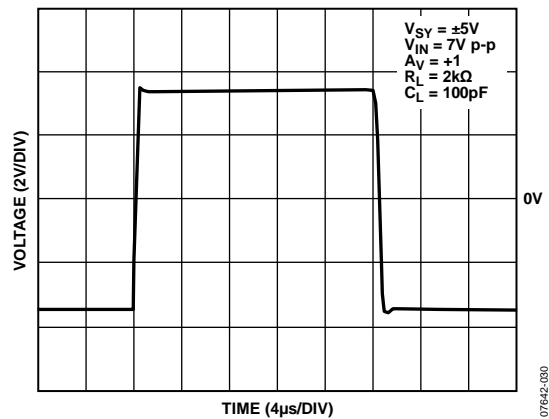


Figure 36. Large Signal Transient Response

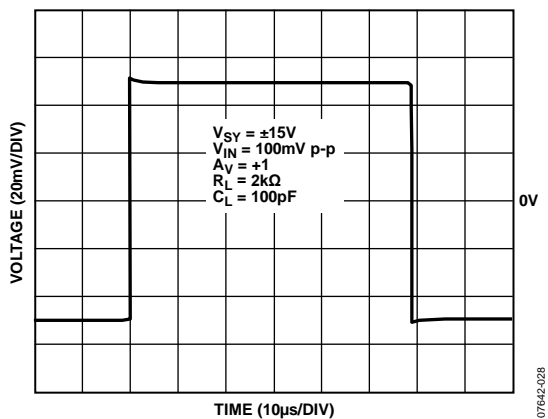


Figure 34. Small Signal Transient Response

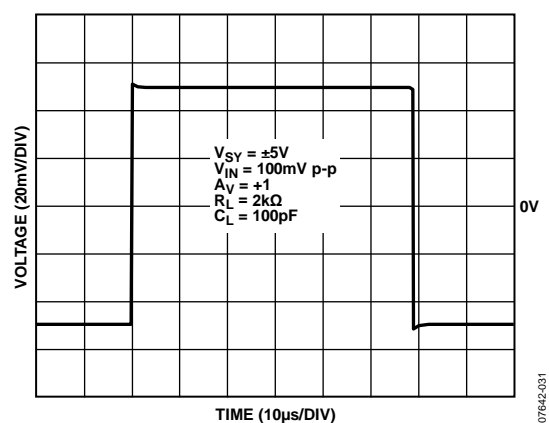


Figure 37. Small Signal Transient Response

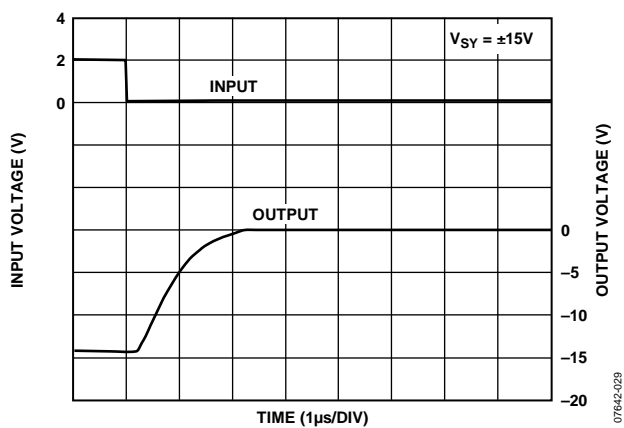


Figure 35. Negative Overload Recovery

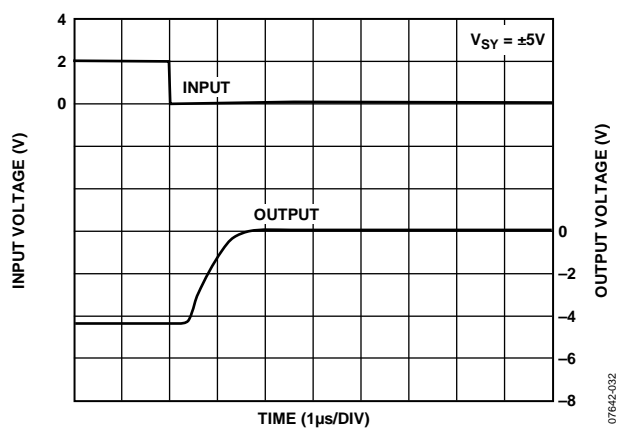


Figure 38. Negative Overload Recovery

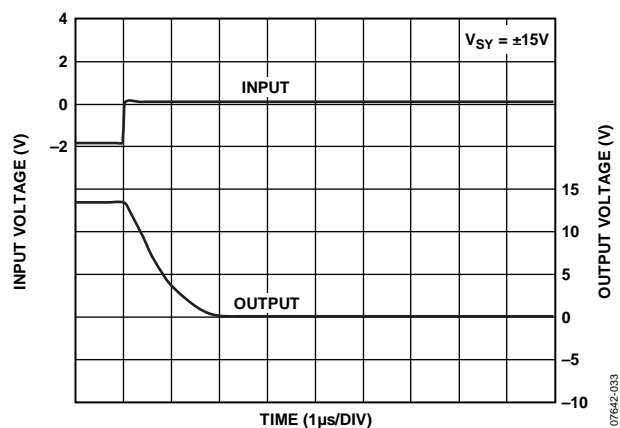


Figure 39. Positive Overload Recovery

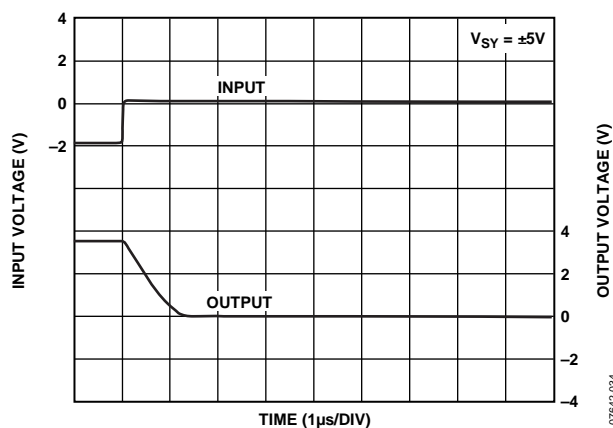


Figure 42. Positive Overload Recovery

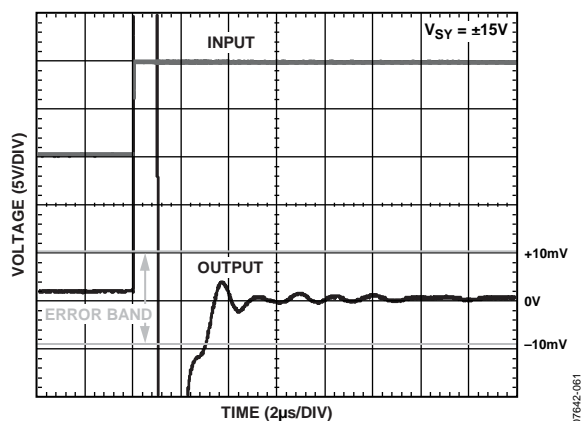


Figure 40. Positive Settling Time to 0.01%

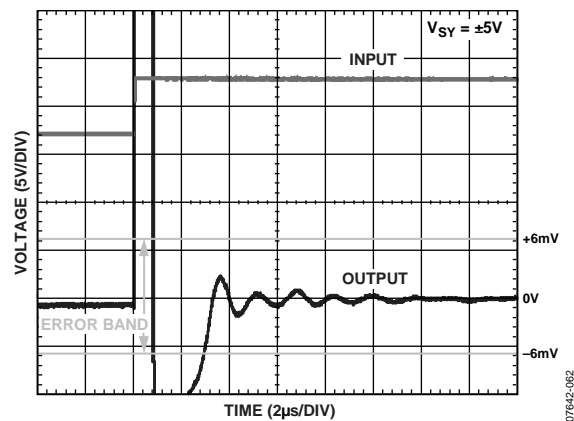


Figure 43. Positive Settling Time to 0.01%

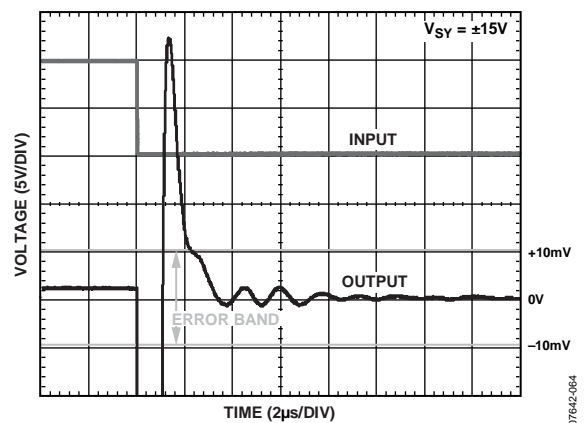


Figure 41. Negative Settling Time to 0.01%

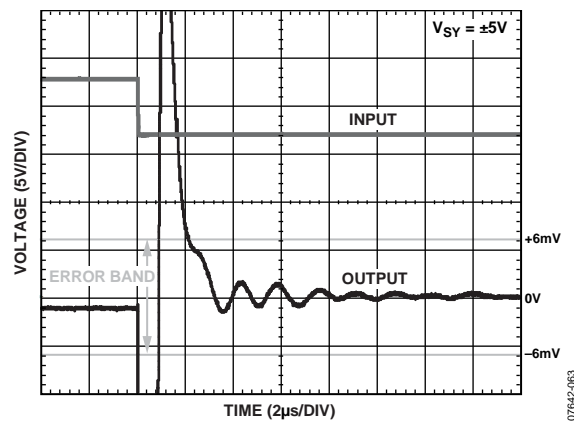


Figure 44. Negative Settling Time to 0.01%

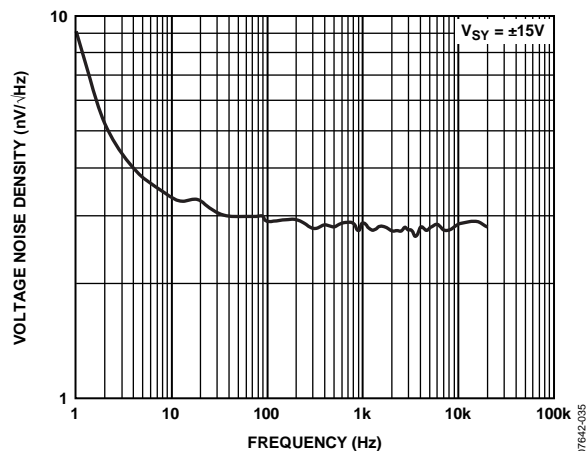


Figure 45. Voltage Noise Density

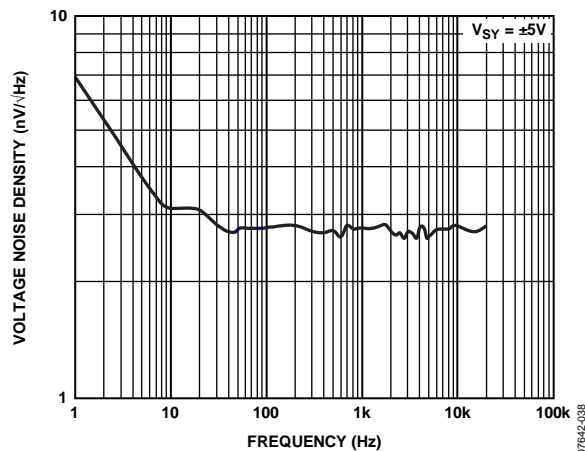


Figure 48. Voltage Noise Density

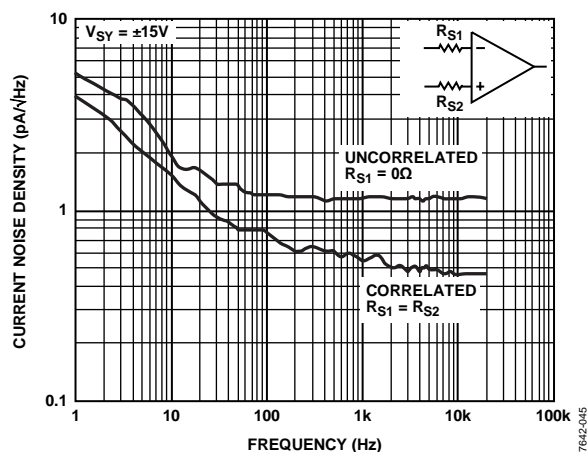


Figure 46. Current Noise Density

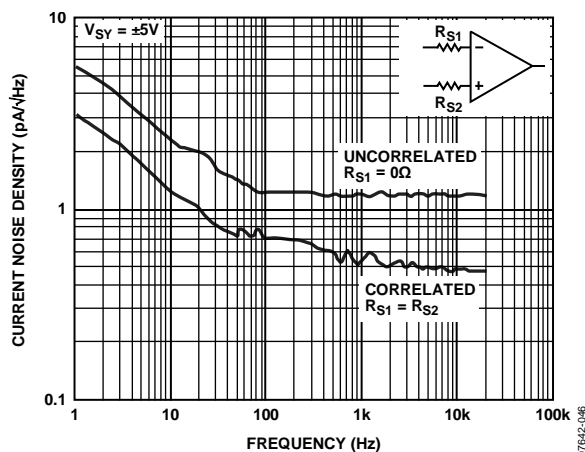


Figure 49. Current Noise Density

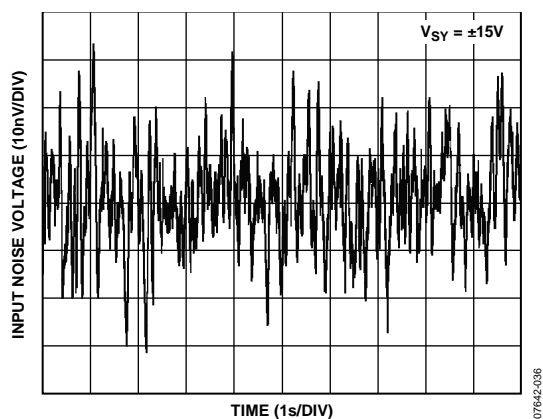


Figure 47. 0.1 Hz to 10 Hz Noise

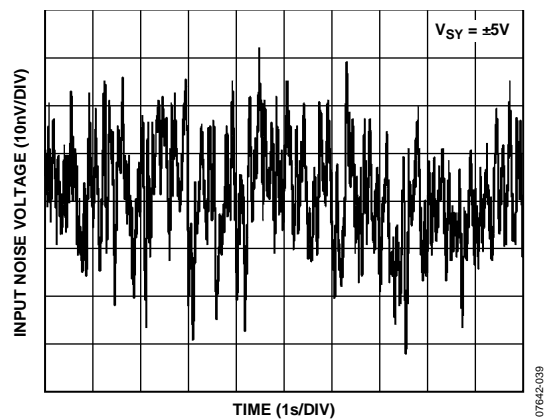


Figure 50. 0.1 Hz to 10 Hz Noise

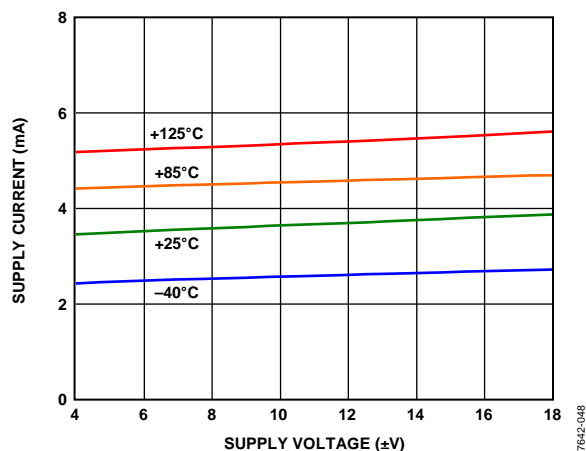


Figure 51. Supply Current vs. Supply Voltage

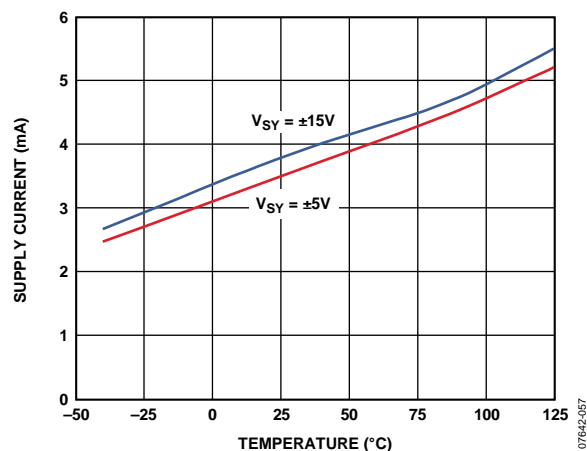


Figure 54. Supply Current vs. Temperature

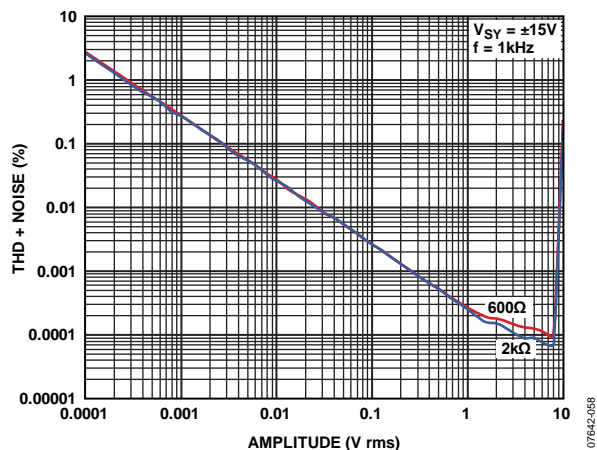


Figure 52. THD + Noise vs. Amplitude

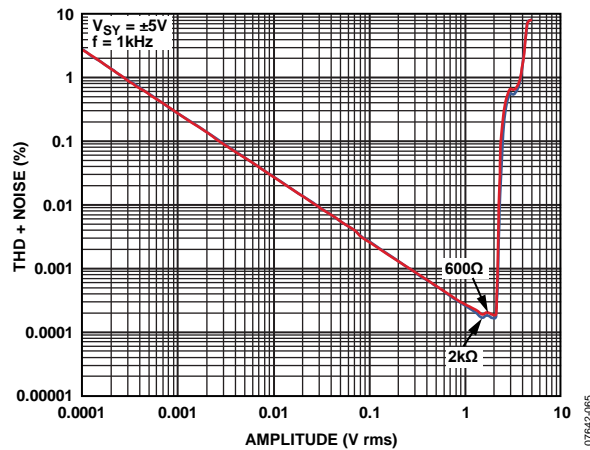


Figure 55. THD + Noise vs. Amplitude

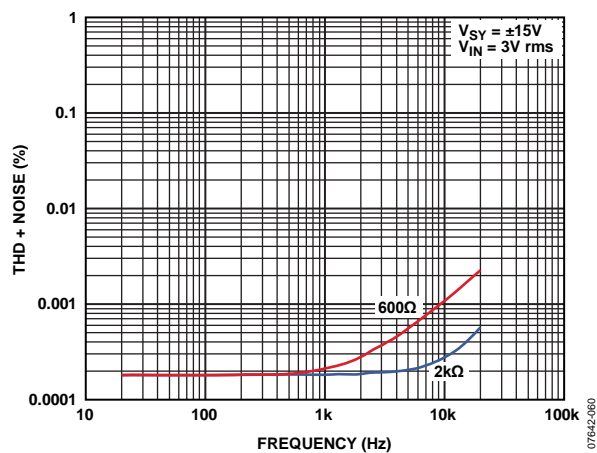


Figure 53. THD + Noise vs. Frequency

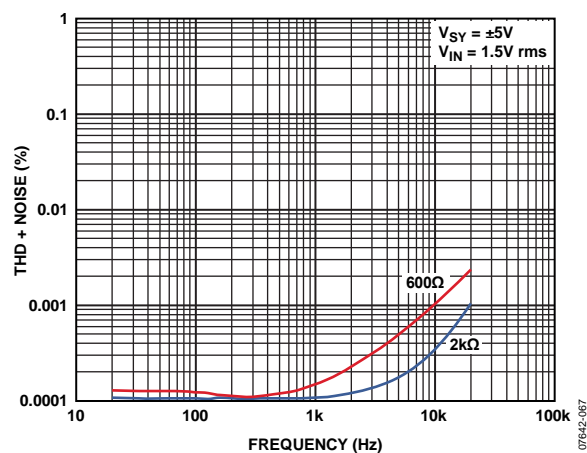


Figure 56. THD + Noise vs. Frequency

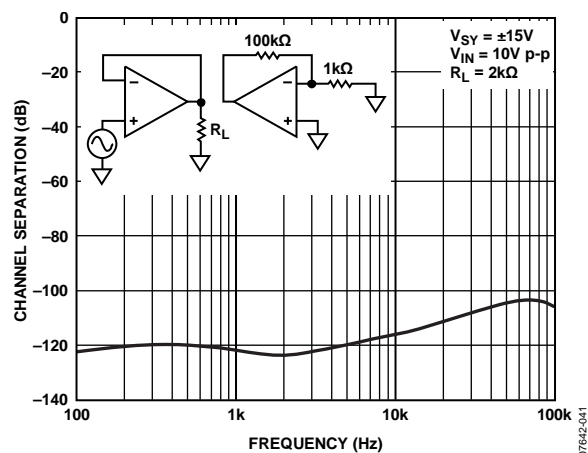


Figure 57. Channel Separation vs. Frequency

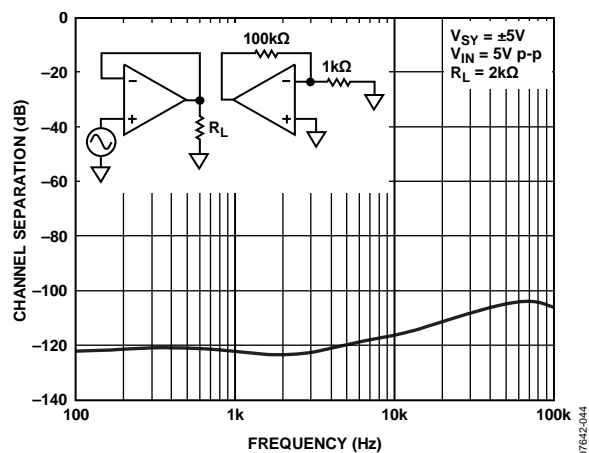


Figure 60. Channel Separation vs. Frequency

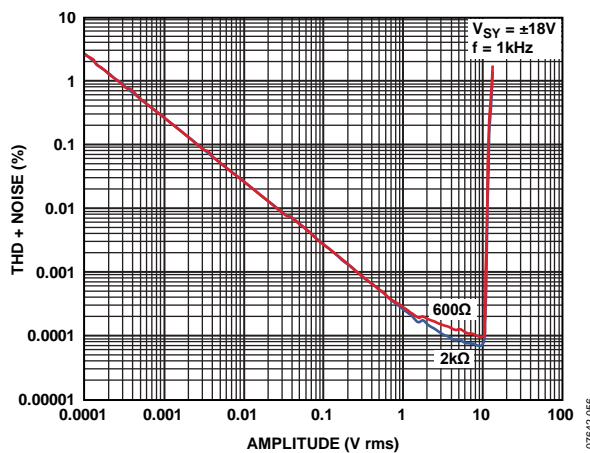


Figure 58. THD + Noise vs. Amplitude

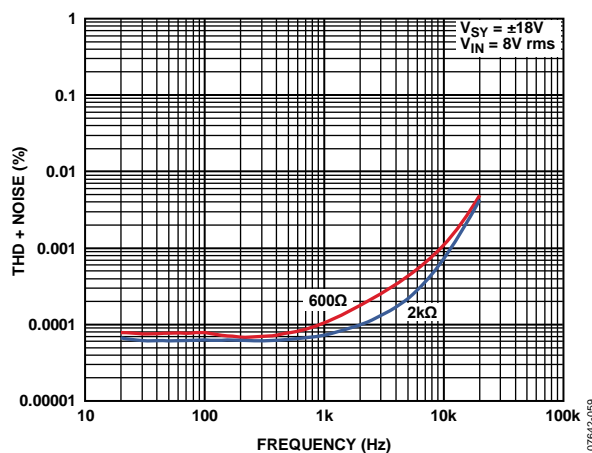


Figure 61. THD + Noise vs. Frequency

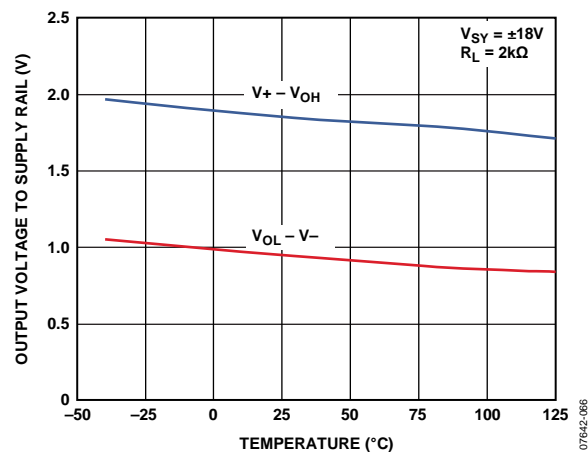


Figure 59. Output Voltage to Supply Rail vs. Temperature

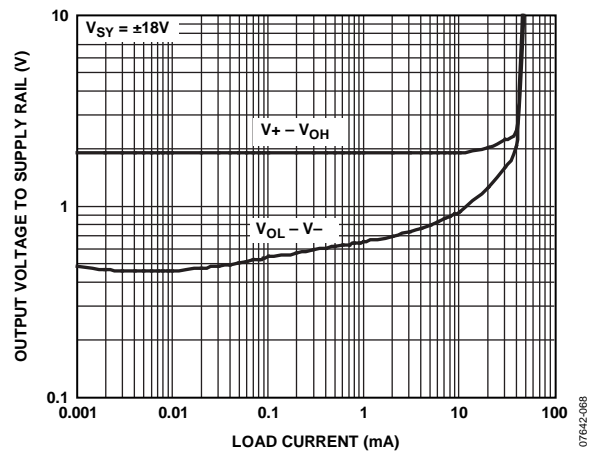


Figure 62. Output Voltage to Supply Rail vs. Load Current

## APPLICATIONS INFORMATION

### INPUT PROTECTION

To prevent base-emitter junction breakdown from occurring in the input stage of the ADA4075-2 when a very large differential voltage is applied, the inputs are clamped by the internal diodes to  $\pm 1.2$  V. To preserve the ultralow voltage noise feature of the ADA4075-2, the commonly used internal current-limiting resistors in series with the inputs are not used.

In small signal applications, current limiting is not required; however, in applications where the differential voltage of the ADA4075-2 exceeds  $\pm 1.2$  V, large currents may flow through these diodes. Employ external current-limiting resistors as shown in Figure 63 to reduce the input currents to less than  $\pm 10$  mA. Note that depending on the value of these resistors, the total voltage noise will most likely be degraded. For example, a 1 k $\Omega$  resistor at room temperature has a thermal noise of 4 nV/ $\sqrt{\text{Hz}}$ , whereas the ADA4075-2 has an ultralow voltage noise of only 2.8 nV/ $\sqrt{\text{Hz}}$  typical.

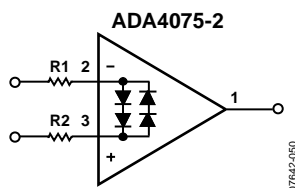


Figure 63. Input Protection

### TOTAL HARMONIC DISTORTION

The total harmonic distortion + noise (THD + N) of the ADA4075-2 is 0.0002% typical with a load resistance of 2 k $\Omega$ . Figure 64 shows the performance of the ADA4075-2 driving a 2 k $\Omega$  load with supply voltages of  $\pm 4$  V and  $\pm 15$  V. Notice that there is more distortion for the supply voltage of  $\pm 4$  V than for a supply voltage of  $\pm 15$  V. Therefore, it is important to operate the ADA4075-2 at a supply voltage greater than  $\pm 5$  V for optimum distortion. The THD + noise graphs for supply voltages of  $\pm 5$  V and  $\pm 18$  V are available in Figure 56 and Figure 61.

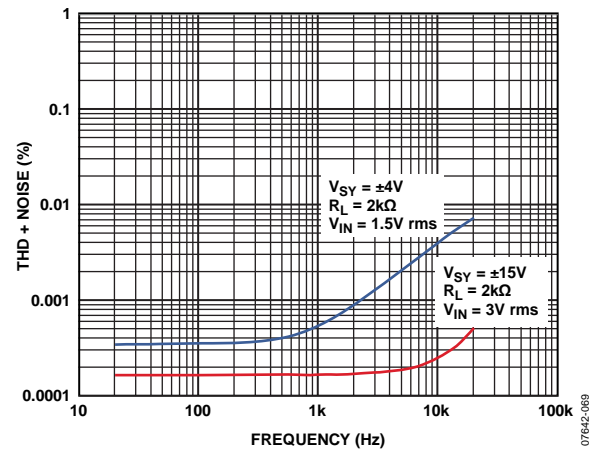


Figure 64. THD + Noise vs. Frequency

### PHASE REVERSAL

An undesired phenomenon, phase reversal (also known as phase inversion) occurs in many op amps when one or both of the inputs are driven beyond the specified input common-mode voltage ( $V_{ICM}$ ) range, in effect reversing the polarity of the output. In some cases, phase reversal can induce lockups and cause equipment damage as well as self destruction.

The ADA4075-2 incorporates phase reversal prevention circuitry that clamps the output to 2 V typical from the supply rails when one or both inputs exceed the  $V_{ICM}$  range. Figure 65 shows the input/output waveforms of the ADA4075-2 configured as a unity-gain buffer for a supply voltage of  $\pm 15$  V.

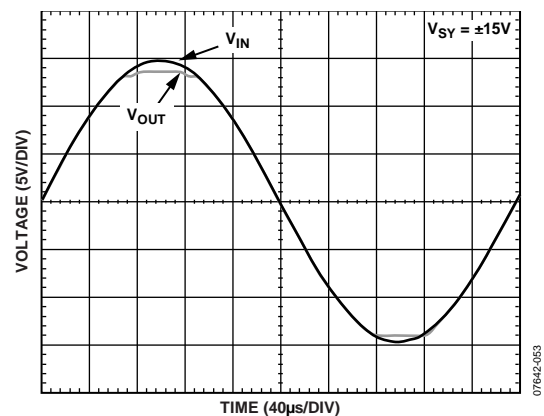


Figure 65. No Phase Reversal



## DAC OUTPUT FILTER

The ultralow voltage noise, low distortion, and high slew rate of the ADA4075-2 make it an ideal choice for professional audio signal processing. Figure 66 shows the ADA4075-2 used in a typical audio DAC output filter configuration. The differential outputs of the DAC are fed into the ADA4075-2. The ADA4075-2 is configured as a differential Sallen-Key filter. It operates as an external low-pass filter to remove high frequency noise present on the output pins of the DAC. It also provides differential-to-single-ended conversion from the differential outputs of the DAC.

For a DAC output filter, an op amp with reasonable slew rate and bandwidth is required. The ADA4075-2 has a high slew rate of the 12 V/ $\mu$ s and a relatively wide bandwidth of 6.5 MHz. The cutoff frequency of the low-pass filter is approximately 167 kHz. In addition, the 100 k $\Omega$  – 47  $\mu$ F RC network provides ac coupling to block out the dc components at the output.

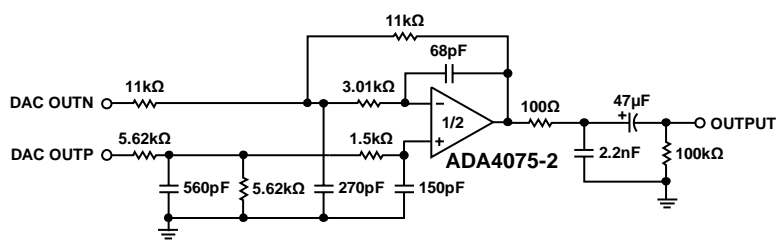


Figure 66. Typical DAC Output Filter Circuit (Differential)

076942-05-4

## BALANCED LINE DRIVER

The circuit of Figure 67 shows a balanced line driver designed for audio use. Such drivers are intended to mimic an output transformer in operation, whereby the common-mode voltage can be impressed by the load. Furthermore, either output can be shorted to ground in single-ended applications without affecting the overall operation.

Circuits of this type use positive and negative feedback to obtain a high common-mode output impedance, and they are somewhat notorious for component sensitivity and susceptibility to latch-up. This circuit uses several techniques to avoid spurious behavior.

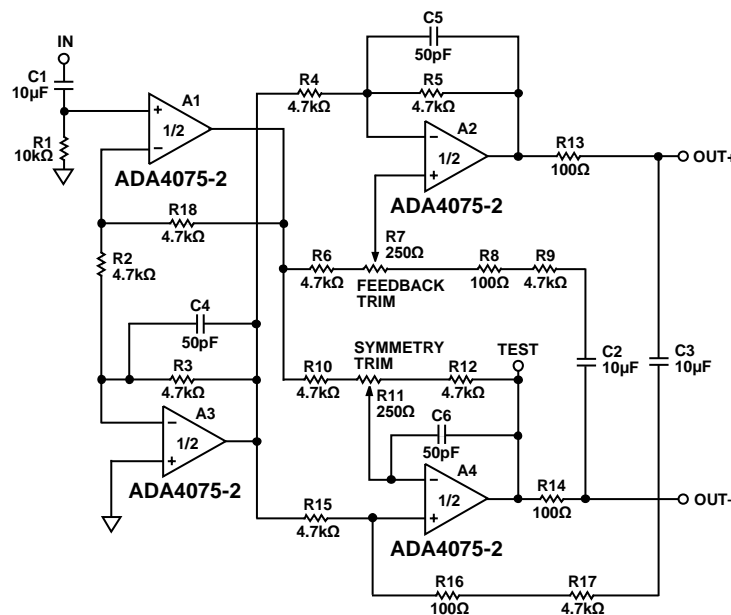
First, the 4-op-amp arrangement ensures that the input impedance is load independent (the input impedance can become negative with some configurations). Note that the output op amps are packaged with the input op amps to maximize drive capability.

Second, the positive feedback is ac-coupled by C2 and C3, which eliminates the need for offset trim. Because the circuit is ac-coupled at the input, these capacitors do not have significant dc voltage across them, thus tantalum types of capacitors can be used.

Finally, even with these precautions, it is vital that the positive feedback be accurately controlled. This is partly achieved by using 1% resistors. In addition, the following setup procedure ensures that the positive feedback does not become excessive:

1. Set R11 to its midposition (or short the ends together, whichever is easier) and temporarily short the negative output to ground.
2. Apply a 10 V p-p sine wave at approximately 1 kHz to the input and adjust R7 to provide 930 mV p-p at TEST (see Figure 67).
3. Remove the short from the negative output (and across R11, if used) and adjust R11 until the output waveforms are symmetric.

The overall gain of the driver is equal to 2, which provides an extra 6 dB of headroom in balanced differential mode. The output noise is about  $-109$  dBV in a 20 kHz bandwidth.



**NOTES**  
1. ALL RESISTORS SHOULD HAVE 1% TOLERANCE.  
2. A1/A2 IN SAME PACKAGE; A3/A4 IN SAME PACKAGE.

Figure 67. Balanced Line Driver

## BALANCED LINE RECEIVER

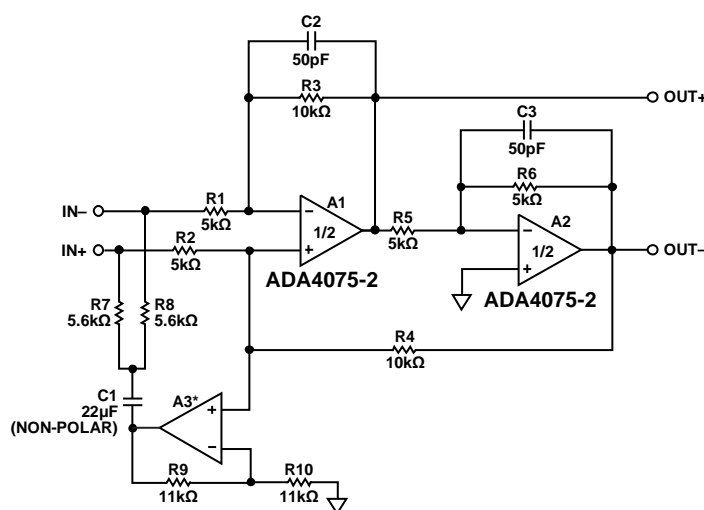
Figure 68 depicts a unity-gain balanced line receiver capable of a high degree of hum rejection. The CMRR is approximately given by

$$20 \log_{10} \left| \frac{R_1 R_4 + 2 R_3 R_4 + R_2 R_3}{2(R_1 R_4 - R_2 R_3)} \right|$$

Therefore, R1 to R4 should be close tolerance components to obtain the best possible CMRR without adjustment. The presence of A2 ensures that the impedances are symmetric at the two inputs (unlike many other designs), and, as a bonus, A2 also provides a complementary output. A3 raises the common-mode input impedance from approximately 7.5 kΩ to approximately 70 kΩ, reducing the degradation of CMRR due to mismatches in source impedance.

Note that A3 is not in the signal path, and almost any op amp works well here. Although it may seem as though the inverting output should be noisier than the noninverting one, they are in fact symmetric at about -111 dBV (20 kHz bandwidth).

Sometimes an overall gain of ½ is desired to provide an extra 6 dB of differential input headroom. This can be attained by reducing R3 and R4 to 5 kΩ and increasing R9 to 22 kΩ.



\*A3 REDUCES THE DEGRADATION OF CMRR  
(SEE THE BALANCED LINE RECEIVER SECTION FOR MORE DETAILS).

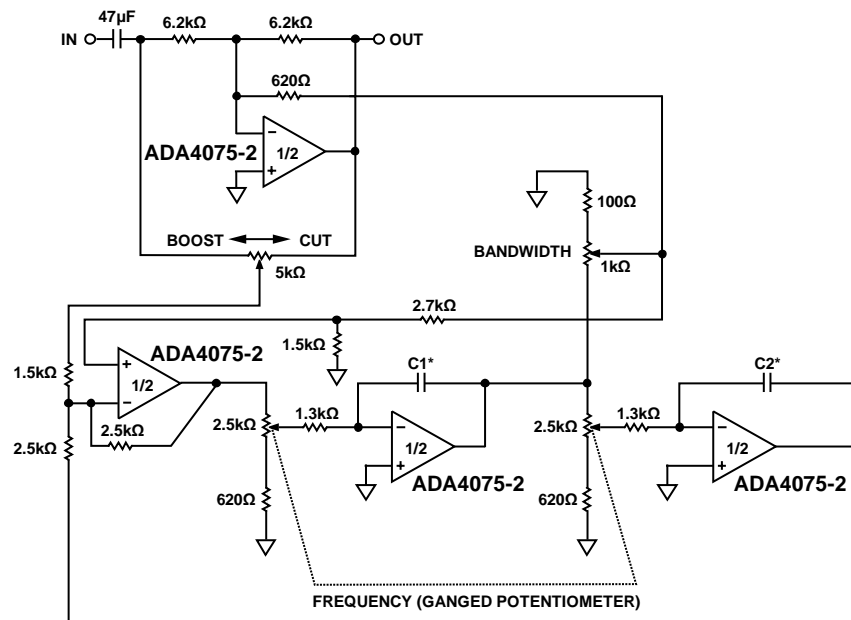
Figure 68. Balanced Line Receiver

07942-071

## LOW NOISE PARAMETRIC EQUALIZER

The circuit in Figure 69 is a reciprocal parametric equalizer yielding  $\pm 20$  dB of cut or boost with variable bandwidth and frequency. The frequency control range is 6.9:1, with the geometric mean center frequency conveniently occurring at the midpoint of the potentiometer setting. The center frequency is equal to 48 Hz/Ct, where Ct is the value of C1 and C2 in microfarads.

The bandwidth control adjusts the Q from 0.9 to about 11. The overall noise is setting dependent, but with all controls centered, it is about  $-104$  dBV in a 20 kHz bandwidth. Such a low noise level can obviate the need for a bypass switch in many applications.



\*THE CENTER FREQUENCY IS AFFECTED BY THE VALUE OF C1 AND C2  
(SEE THE LOW NOISE PARAMETRIC EQUALIZER SECTION FOR MORE DETAILS).

07010 071

Figure 69. Low Noise Parametric Equalizer

## SCHEMATIC

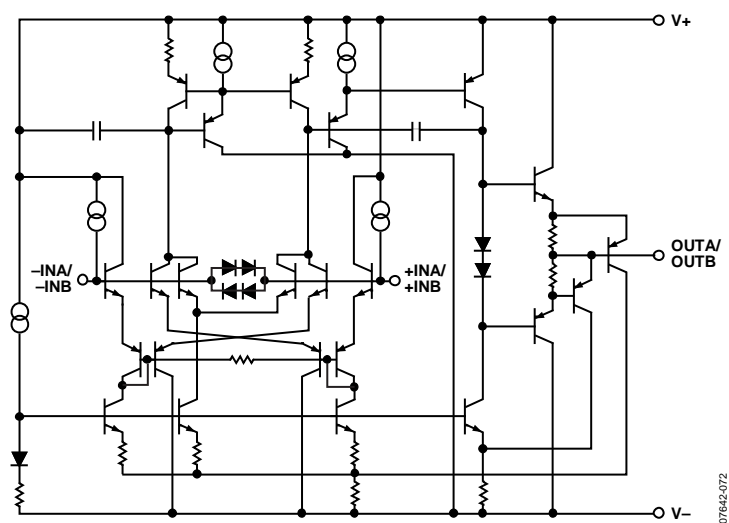


Figure 70. Simplified Schematic

OUTLINE DIMENSIONS

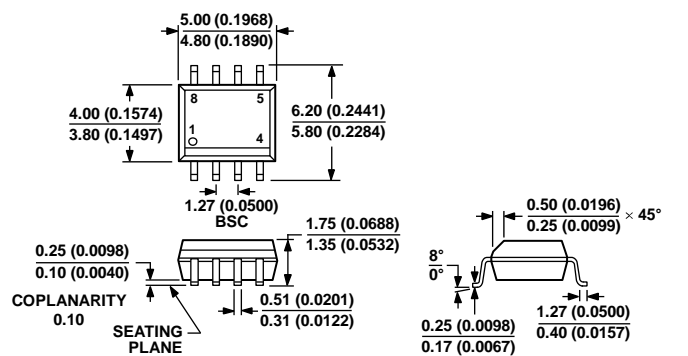


Figure 71. 8-Lead Standard Small Outline Package [SOIC\_N]  
Narrow Body (R-8)  
Dimensions shown in millimeters and (inches)

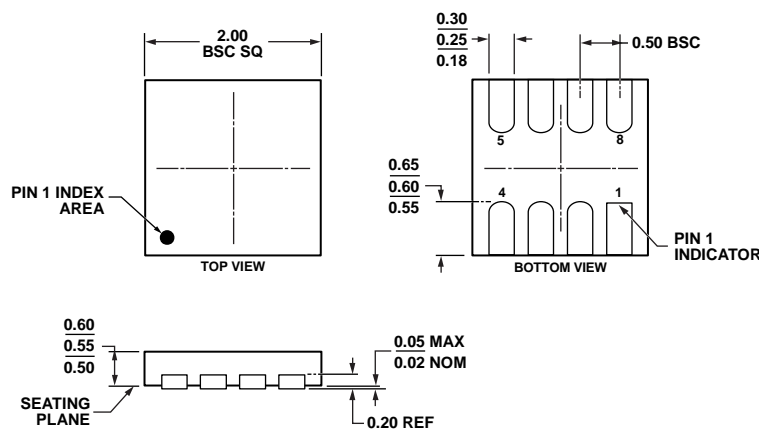


Figure 72. 8-Lead Lead Frame Chip Scale Package [LFCSF\_WD]  
2 mm × 2 mm Body, Very Very Thin, Dual Lead  
(CP-8-6)  
Dimensions shown in millimeters

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option	Branding
ADA4075-2ARZ	−40°C to +125°C	8-Lead SOIC_N	R-8	
ADA4075-2ARZ-R7	−40°C to +125°C	8-Lead SOIC_N	R-8	
ADA4075-2ARZ-RL	−40°C to +125°C	8-Lead SOIC_N	R-8	
ADA4075-2ACPZ-R7	−40°C to +125°C	8-Lead LFCSP_WD	CP-8-6	A0
ADA4075-2ACPZ-RL	−40°C to +125°C	8-Lead LFCSP_WD	CP-8-6	A0

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

## NOTES

**NOTES**