High Speed, Low Power Monolithic Op Amp

AD848/AD849

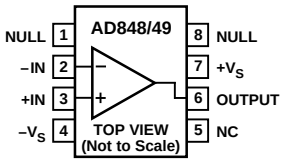
FEATURES
725 MHz Gain Bandwidth – AD849
175 MHz Gain Bandwidth – AD848
4.8 mA Supply Current
300 V/μs Slew Rate
80 ns Settling Time to 0.1% for a 10 V Step – AD849
Differential Gain: AD848 = 0.07%, AD849 = 0.08%
Differential Phase: AD848 = 0.08°, AD849 = 0.04°
Drives Capacitive Loads

DC PERFORMANCE
3 nV/√Hz Input Voltage Noise – AD849
85 V/mV Open Loop Gain into a 1 kΩ Load – AD849
1 mV max Input Offset Voltage
Performance Specified for ±5 V and ±15 V Operation
Available in Plastic, Hermetic Cerdip and Small Outline Packages. Chips and MIL-STD-883B Parts Available.
Available in Tape and Reel in Accordance with EIA-481A Standard

APPLICATIONS
Cable Drivers
8- and 10-Bit Data Acquisition Systems
Video and R_F Amplification
Signal Generators

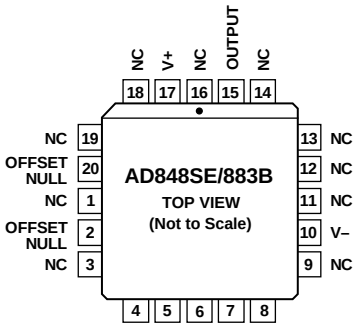
CONNECTION DIAGRAMS

Plastic (N), Small Outline (R) and Cerdip (Q) Packages



NC = NO CONNECT

20-Terminal LCC Pinout



NC = NO CONNECT

PRODUCT DESCRIPTION

The AD848 and AD849 are high speed, low power monolithic operational amplifiers. The AD848 is internally compensated so that it is stable for closed loop gains of 5 or greater. The AD849 is fully decompensated and is stable at gains greater than 24. The AD848 and AD849 achieve their combination of fast ac and good dc performance by utilizing Analog Devices' junction isolated complementary bipolar (CB) process. This process enables these op amps to achieve their high speed while only requiring 4.8 mA of current from the power supplies.

The AD848 and AD849 are members of Analog Devices' family of high speed op amps. This family includes, among others, the AD847 which is unity gain stable, with a gain bandwidth of 50 MHz. For more demanding applications, the AD840, AD841 and AD842 offer even greater precision and greater output current drive.

The AD848 and AD849 have good dc performance. When operating with ±5 V supplies, they offer open loop gains of 13 V/mV (AD848 with a 500 Ω load) and low input offset voltage of 1 mV maximum. Common-mode rejection is a minimum of 92 dB. Output voltage swing is ±3 V even into loads as low as 150 Ω.

APPLICATIONS HIGHLIGHTS

1. The high slew rate and fast settling time of the AD848 and AD849 make them ideal for video instrumentation circuitry, low noise pre-amps and line drivers.
2. In order to meet the needs of both video and data acquisition applications, the AD848 and AD849 are optimized and tested for ±5 V and ±15 V power supply operation.
3. Both amplifiers offer full power bandwidth greater than 20 MHz (for 2 V p-p with ±5 V supplies).
4. The AD848 and AD849 remain stable when driving any capacitive load.
5. Laser wafer trimming reduces the input offset voltage to 1 mV maximum on all grades, thus eliminating the need for external offset nulling in many applications.
6. The AD848 is an enhanced replacement for the LM6164 series and can function as a pin-for-pin replacement for many high speed amplifiers such as the HA2520/2/5 and EL2020 in applications where the gain is 5 or greater.

REV. B

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Tel: 617/329-4700 **Fax: 617/326-8703**

AD848/AD849–SPECIFICATIONS (@ T_A = +25°C, unless otherwise noted)

Model	Conditions	V_S	AD848J Min	AD848J Typ	AD848J Max	AD848A/S Min	AD848A/S Typ	AD848A/S Max	Units
INPUT OFFSET VOLTAGE[1]		±5 V		0.2	**1**		0.2	**1**	mV
		±15 V		0.5	**2.3**		0.5	**2.3**	mV
	T_{MIN} to T_{MAX}	±5 V			1.5			**2**	mV
		±15 V			3.0			**3.5**	mV
Offset Drift		±5 V, ±15 V		7			7		µV/°C
INPUT BIAS CURRENT		±5 V, ±15 V		3.3	**6.6**		3.3	**6.6/5**	µA
	T_{MIN} to T_{MAX}	±5 V, ±15 V			7.2			7.5	µA
INPUT OFFSET CURRENT		±5 V, ±15 V		50	**300**		50	**300**	nA
	T_{MIN} to T_{MAX}	±5 V, ±15 V			400			**400**	nA
Offset Current Drift		±5 V, ±15 V		0.3			0.3		nA/°C
OPEN LOOP GAIN	V_O = ±2.5 V	±5 V							
	R_{LOAD} = 500 Ω		**9**	13		**9**	13		V/mV
	T_{MIN} to T_{MAX}		7			**7/5**			V/mV
	R_{LOAD} = 150 Ω			8			8		V/mV
	V_{OUT} = ±10 V	±15 V							
	R_{LOAD} = 1 kΩ		**12**	20		**12**	20		V/mV
	T_{MIN} to T_{MAX}		8			**8/6**			V/mV
DYNAMIC PERFORMANCE									
Gain Bandwidth	A_{VCL} ≥ 5	±5 V		125			125		MHz
		±15 V		175			175		MHz
Full Power Bandwidth[2]	V_O = 2 V p-p,								
	R_L = 500 Ω	±5 V		24			24		MHz
	V_O = 20 V p-p,								
	R_L = 1 kΩ	±15 V		4.7			4.7		MHz
Slew Rate		±5 V		200			200		V/µs
	R_{LOAD} = 1 kΩ	±15 V	225	300		225	300		V/µs
Settling Time to 0.1%	–2.5 V to +2.5 V	±5 V		65			65		ns
	10 V Step, A_V = –4	±15 V		100			100		ns
Phase Margin	C_{LOAD} = 10 pF	±15 V							
	R_{LOAD} = 1 kΩ			60			60		Degrees
DIFFERENTIAL GAIN	f = 4.4 MHz	±15 V		0.07			0.07		%
DIFFERENTIAL PHASE	f = 4.4 MHz	±15 V		0.08			0.08		Degree
COMMON-MODE REJECTION	V_{CM} = ±2.5 V	±5 V	**92**	105		**92**	105		dB
	V_{CM} = ±12 V	±15 V	**92**	105		**92**	105		dB
	T_{MIN} to T_{MAX}		88			**88**			dB
POWER SUPPLY REJECTION	V_S = ±4.5 V to ±18 V		**85**	98		**85**	98		dB
	T_{MIN} to T_{MAX}		80			**80**			dB
INPUT VOLTAGE NOISE	f = 10 kHz	±15 V		5			5		nV/√Hz
INPUT CURRENT NOISE	f = 10 kHz	±15 V		1.5			1.5		pA/√Hz
INPUT COMMON-MODE VOLTAGE RANGE		±5 V		+4.3			+4.3		V
				–3.4			–3.4		V
		±15 V		+14.3			+14.3		V
				–13.4			–13.4		V
OUTPUT VOLTAGE SWING	R_{LOAD} = 500 Ω	±5 V	**3.0**	3.6		**3.0**	3.6		±V
	R_{LOAD} = 150 Ω	±5 V	**2.5**	3		**2.5**	3		±V
	R_{LOAD} = 50 Ω	±5 V		1.4			1.4		±V
	R_{LOAD} = 1 kΩ	±15 V	**12**			**12**			±V
	R_{LOAD} = 500 Ω	±15 V	**10**			**10**			±V
SHORT CIRCUIT CURRENT		±15 V		32			32		mA
INPUT RESISTANCE				70			70		kΩ
INPUT CAPACITANCE				1.5			1.5		pF
OUTPUT RESISTANCE	Open Loop			15			15		Ω
POWER SUPPLY									
Operating Range			**±4.5**		**±18**	**±4.5**		**±18**	V
Quiescent Current		±5 V		4.8	**6.0**		4.8	**6.0**	mA
	T_{MIN} to T_{MAX}				7.4			**7.4/8.3**	mA
		±15 V		5.1	**6.8**		5.1	**6.8**	mA
	T_{MIN} to T_{MAX}				8.0			**8.0/9.0**	mA

NOTES

[1]Input offset voltage specifications are guaranteed after 5 minutes at T_A = +25°C.

[2]Full power bandwidth = slew rate/2 π V_{PEAK}. Refer to Figure 1.

All min and max specifications are guaranteed. Specifications in **boldface** are tested on all production units at final electrical test. All others are guaranteed but not necessarily tested. Specifications subject to change without notice.

Model	Conditions	V_S	AD849J Min	AD849J Typ	AD849J Max	AD849A/S Min	AD849A/S Typ	AD849A/S Max	Units
INPUT OFFSET VOLTAGE[1]		±5 V		0.3	**1**		0.1	**0.75**	mV
		±15 V		0.3	**1**		0.1	**0.75**	mV
	T_{MIN} to T_{MAX}	±5 V			1.3			**1.0**	mV
		±15 V			1.3			**1.0**	mV
Offset Drift		±5 V, ±15 V		2			2		µV/°C
INPUT BIAS CURRENT		±5 V, ±15 V		3.3	**6.6**		3.3	**6.6/5**	µA
	T_{MIN} to T_{MAX}	±5 V, ±15 V			7.2			7.5	µA
INPUT OFFSET CURRENT		±5 V, ±15 V		50	**300**		50	**300**	nA
	T_{MIN} to T_{MAX}	±5 V, ±15 V			400			**400**	nA
Offset Current Drift		±5 V, ±15 V		0.3			0.3		nA/°C
OPEN LOOP GAIN	V_O = ±2.5 V	±5 V							
	R_{LOAD} = 500 Ω		**30**	50		**30**	50		V/mV
	T_{MIN} to T_{MAX}		20			**20/15**			V/mV
	R_{LOAD} = 150 Ω			32			32		V/mV
	V_{OUT} = ±10 V	±15 V							
	R_{LOAD} = 1 kΩ		**45**	85		**45**	85		V/mV
	T_{MIN} to T_{MAX}		30			**30/25**			V/mV
DYNAMIC PERFORMANCE									
Gain Bandwidth	A_{VCL} ≥ 25	±5 V		520			520		MHz
		±15 V		725			725		MHz
Full Power Bandwidth[2]	V_O = 2 V p-p,								
	R_L = 500 Ω	±5 V		20			20		MHz
	V_O = 20 V p-p,								
	R_L = 1 kΩ	±15 V		4.7			4.7		MHz
Slew Rate		±5 V		200			200		V/µs
	R_{LOAD} = 1 kΩ	±15 V	225	300		225	300		V/µs
Settling Time to 0.1%	–2.5 V to +2.5 V	±5 V		65			65		ns
	10 V Step, A_V = –24	±15 V		80			80		ns
Phase Margin	C_{LOAD} = 10 pF	±15 V							
	R_{LOAD} = 1 kΩ			60			60		Degrees
DIFFERENTIAL GAIN	f = 4.4 MHz	±15 V		0.08			0.08		%
DIFFERENTIAL PHASE	f = 4.4 MHz	±15 V		0.04			0.04		Degrees
COMMON-MODE REJECTION	V_{CM} = ±2.5 V	±5 V	**100**	115		**100**	115		dB
	V_{CM} = ±12 V	±15 V	**100**	115		**100**	115		dB
	T_{MIN} to T_{MAX}		96			**96**			dB
POWER SUPPLY REJECTION	V_S = ±4.5 V to ±18 V		**98**	120		**98**	120		dB
	T_{MIN} to T_{MAX}		94			**94**			dB
INPUT VOLTAGE NOISE	f = 10 kHz	±15 V		3			3		nV/√Hz
INPUT CURRENT NOISE	f = 10 kHz	±15 V		1.5			1.5		pA/√Hz
INPUT COMMON-MODE VOLTAGE RANGE		±5 V		+4.3			+4.3		V
				–3.4			–3.4		V
		±15 V		+14.3			+14.3		V
				–13.4			–13.4		V
OUTPUT VOLTAGE SWING	R_{LOAD} = 500 Ω	±5 V	**3.0**	3.6		**3.0**	3.6		±V
	R_{LOAD} = 150 Ω	±5 V	**2.5**	3		**2.5**	3		±V
	R_{LOAD} = 50 Ω	±5 V		1.4			1.4		±V
	R_{LOAD} = 1 kΩ	±15 V	**12**			**12**			±V
	R_{LOAD} = 500 Ω	±15 V	**10**			**10**			±V
SHORT CIRCUIT CURRENT		±15 V		32			32		mA
INPUT RESISTANCE				25			25		kΩ
INPUT CAPACITANCE				1.5			1.5		pF
OUTPUT RESISTANCE	Open Loop			15			15		Ω
POWER SUPPLY									
Operating Range			**±4.5**		**±18**	**±4.5**		**±18**	V
Quiescent Current		±5 V		4.8	**6.0**		4.8	**6.0**	mA
	T_{MIN} to T_{MAX}				7.4			**7.4/8.3**	mA
		±15 V		5.1	**6.8**		5.1	**6.8**	mA
	T_{MIN} to T_{MAX}				8.0			**8.0/9.0**	mA

NOTES

[1]Input offset voltage specifications are guaranteed after 5 minutes at T_A = +25°C.

[2]Full power bandwidth = slew rate/2 π V_{PEAK}. Refer to Figure 1.

All min and max specifications are guaranteed. Specifications in **boldface** are tested on all production units at final electrical test. All others are guaranteed but not necessarily tested. Specifications subject to change without notice.

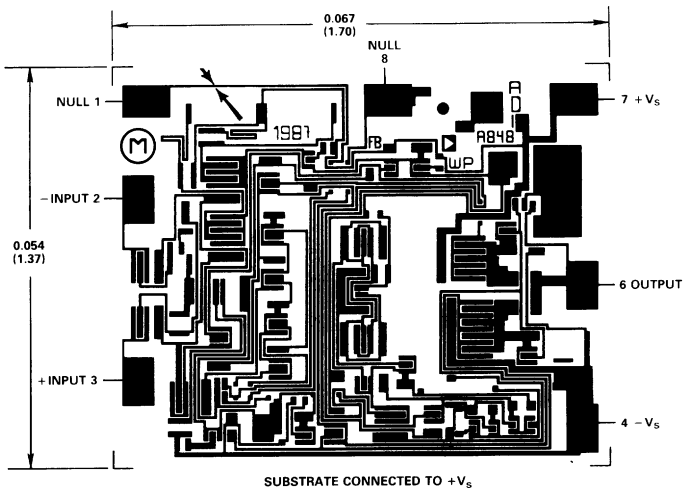
ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage ..... ±18 V
Internal Power Dissipation[2]
Plastic (N) ..... 1.1 Watts
Small Outline (R) ..... 0.9 Watts
Cerdip (Q) ..... 1.1 Watts
LCC (E) ..... 0.8 Watts
Input Voltage ..... $\pm V_S$
Differential Input Voltage ..... ±6 V
Storage Temperature Range (Q) ..... –65°C to +150°C
(N, R) ..... –65°C to +125°C
Junction Temperature ..... +175°C
Lead Temperature Range (Soldering 60 sec) ..... +300°C

NOTES
[1]Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only, and 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.
[2]LCC: θ_{JA} = 150°C/Watt
Mini-DIP Package: θ_{JA} = 110°C/Watt
Cerdip Package: θ_{JA} = 110°C/Watt
Small Outline Package: θ_{JA} = 155°C/Watt.

METALIZATION PHOTOGRAPH

Contact factory for latest dimensions. (AD848 and AD849 are identical except for the part number in the upper right.)
Dimensions shown in inches and (mm).



ORDERING GUIDE

Model	Gain Bandwidth MHz	Min Stable Gain	Max Offset Voltage mV	Temperature Range – °C	Package Option[1]
AD848JN	175	5	1	0 to +70	N-8
AD848JR[2]	175	5	1	0 to +70	R-8
AD848JCHIPS	175	5	1	0 to +70	Die Form
AD848AQ	175	5	1	–40 to +85	Q-8
AD848SQ	175	5	1	–55 to +125	Q-8
AD848SQ/883B	175	5	1	–55 to +125	Q-8
AD848SE/883B	175	5	1	–55 to +125	E-20A
AD849JN	725	25	1	0 to +70	N-8
AD849JR[2]	725	25	1	0 to +70	R-8
AD849AQ	725	25	0.75	–40 to +85	Q-8
AD849SQ	725	25	0.75	–55 to +125	Q-8
AD849SQ/883B	725	25	0.75	–55 to +125	Q-8
AD847J/A/S	50	1	1	See AD847 Data Sheet	

NOTES
[1]E = LCC; N = Plastic DIP; Q = Cerdip; R = Small Outline IC (SOIC).
[2]Plastic SOIC (R) available in tape and reel. AD848 available in S grade chips. AD849 available in J and S grade chips.

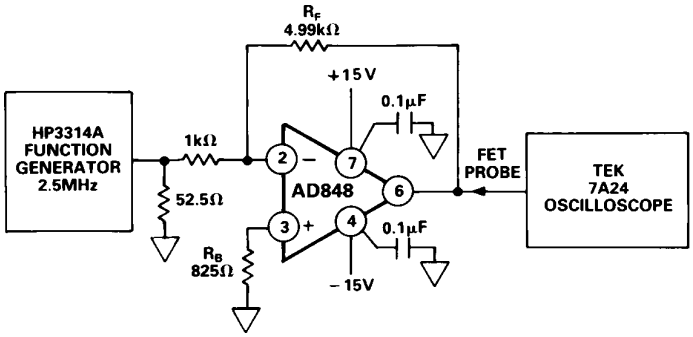


Figure 1. AD848 Inverting Amplifier Configuration

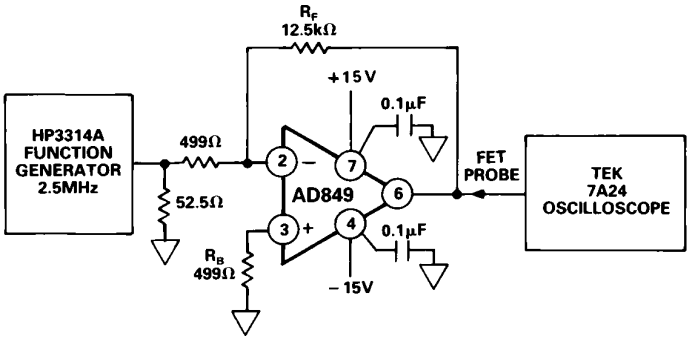


Figure 2. AD849 Inverting Amplifier Configuration

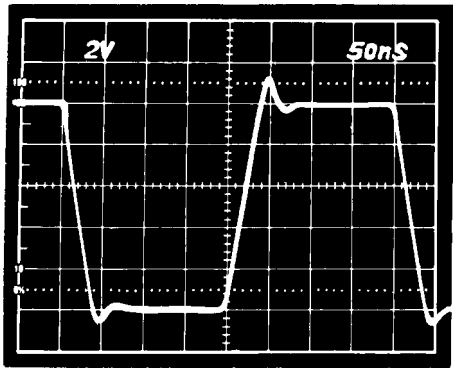


Figure 1a. AD848 Large Signal Pulse Response

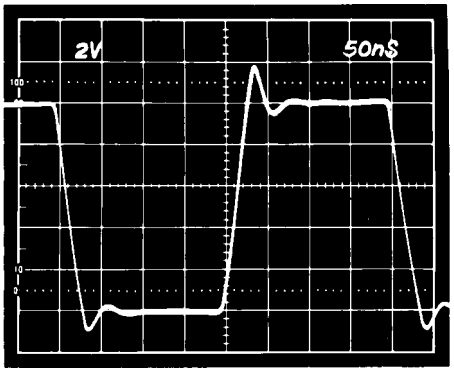


Figure 2a. AD849 Large Signal Pulse Response

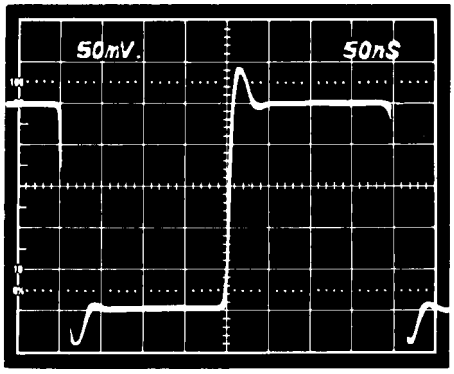


Figure 1b. AD848 Small Signal Pulse Response

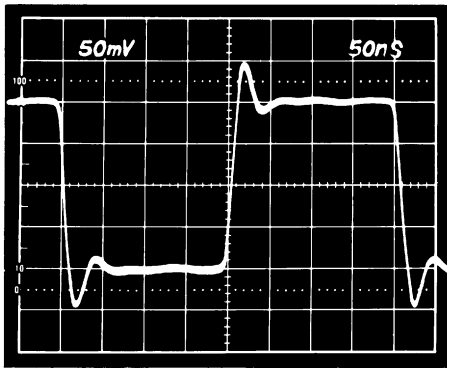


Figure 2b. AD849 Small Signal Pulse Response

OFFSET NULLING

The input voltage of the AD848 and AD849 are very low for high speed op amps, but if additional nulling is required, the circuit shown in Figure 3 can be used.

For high performance circuits it is recommended that a resistor (R_B in Figures 1 and 2) be used to reduce bias current errors by matching the impedance at each input. The offset voltage error caused by the input currents is decreased by more than an order of magnitude.

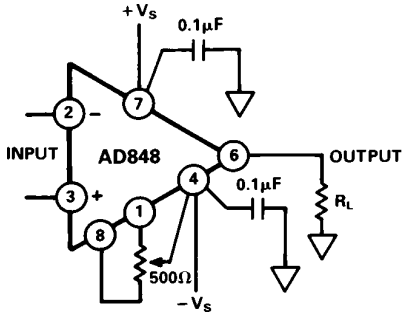


Figure 3. Offset Nulling

AD848/AD849–Typical Characteristics (@ T_A = +25°C and V_S = ±15 V, unless otherwise noted)

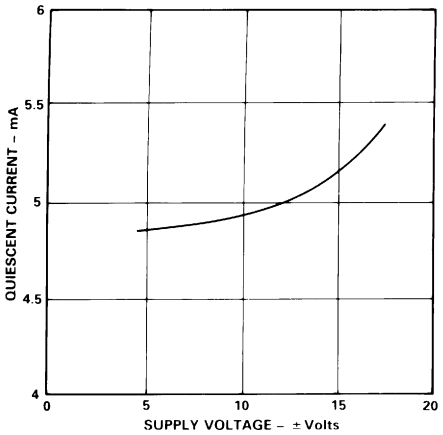


Figure 4. Quiescent Current vs. Supply Voltage (AD848 and AD849)

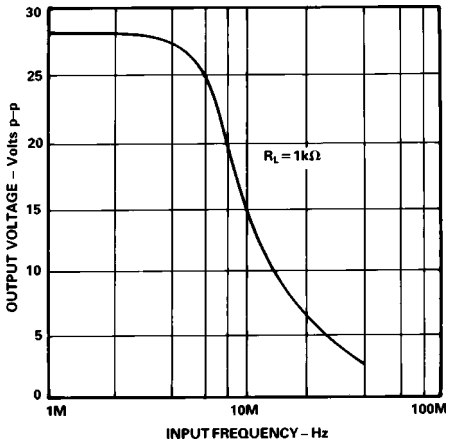


Figure 5. Large Signal Frequency Response (AD848 and AD849)

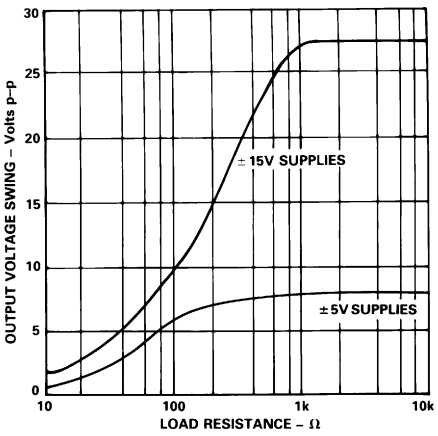


Figure 6. Output Voltage Swing vs. Load Resistance (AD848 and AD849)

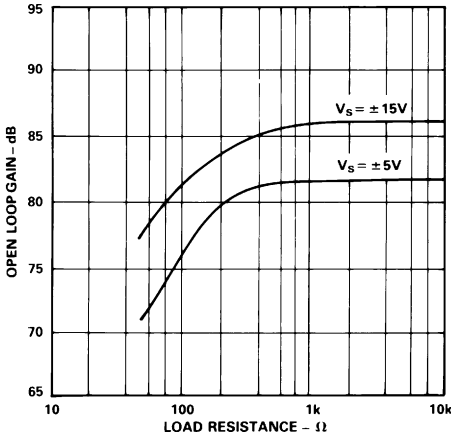


Figure 7. Open Loop Gain vs. Load Resistance (AD848)

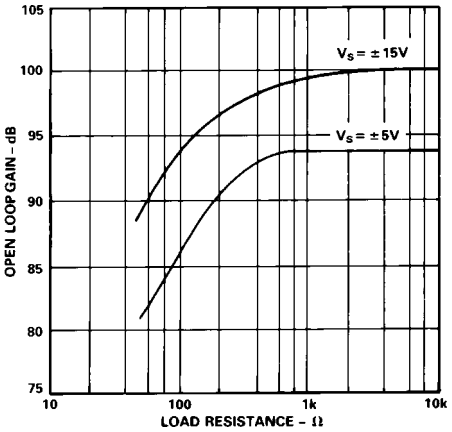


Figure 8. Open Loop Gain vs. Load Resistance (AD849)

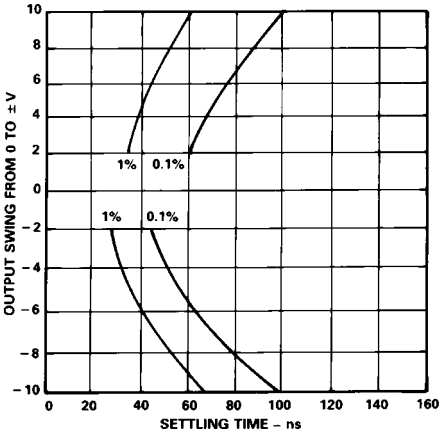


Figure 9. Output Swing and Error vs. Settling Time (AD848)

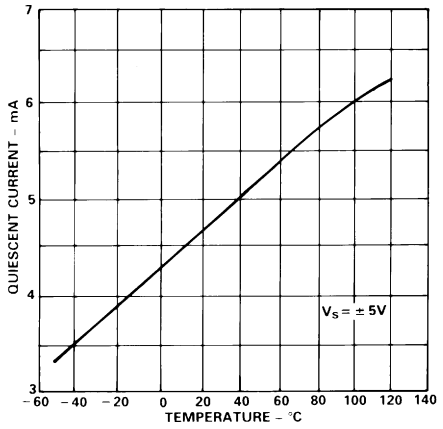


Figure 10. Quiescent Current vs. Temperature (AD848 and AD849)

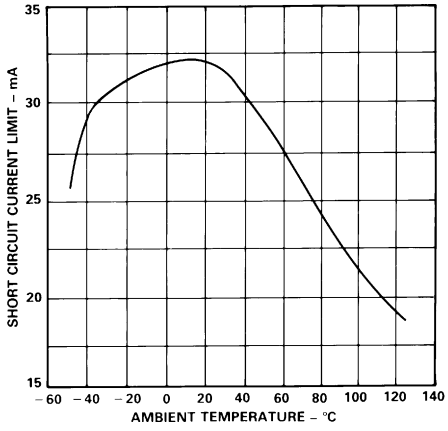


Figure 11. Short Circuit Current Limit vs. Temperature (AD848 and AD849)

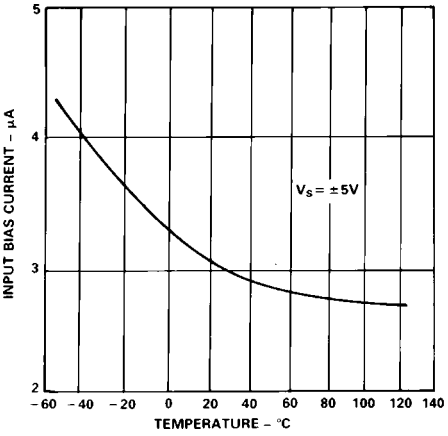


Figure 12. Input Bias Current vs. Temperature (AD848 and AD849)

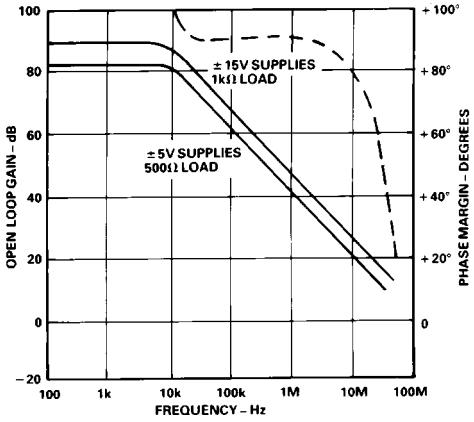


Figure 13. Open Loop Gain and Phase Margin vs. Frequency (AD848)

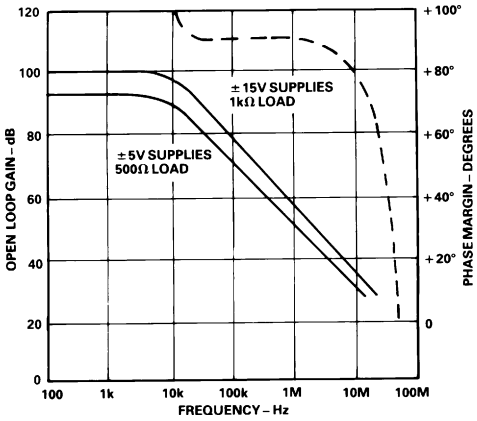


Figure 14. Open Loop Gain and Phase Margin vs. Frequency (AD849)

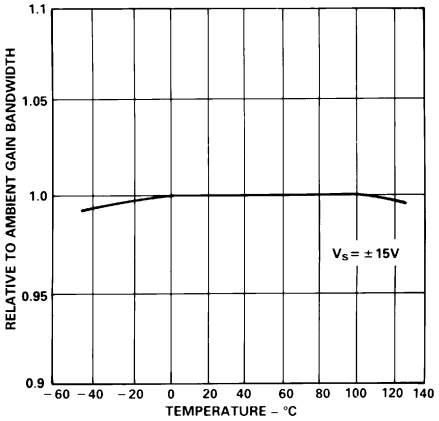


Figure 15. Normalized Gain Bandwidth Product vs. Temperature (AD848 and AD849)

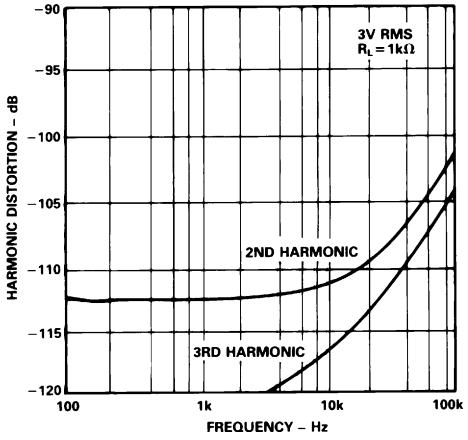


Figure 16. Harmonic Distortion vs. Frequency (AD848)

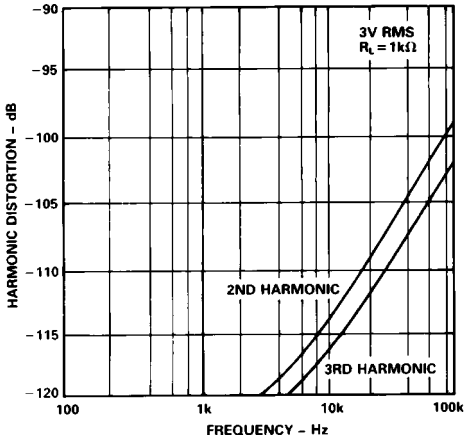


Figure 17. Harmonic Distortion vs. Frequency (AD849)

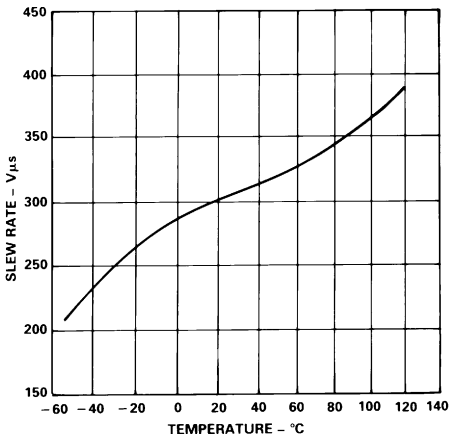


Figure 18. Slew Rate vs. Temperature (AD848 and AD849)

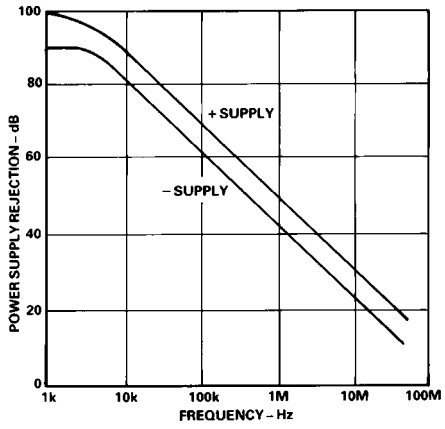


Figure 19. Power Supply Rejection vs. Frequency (AD848)

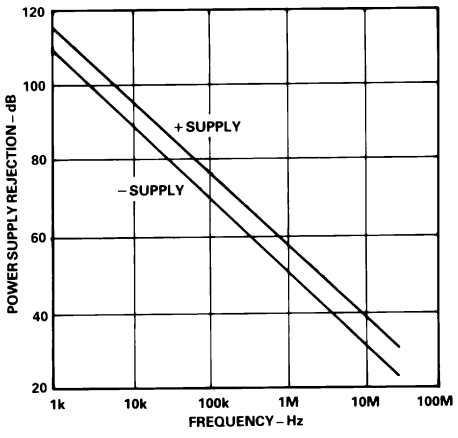


Figure 20. Power Supply Rejection vs. Frequency (AD849)

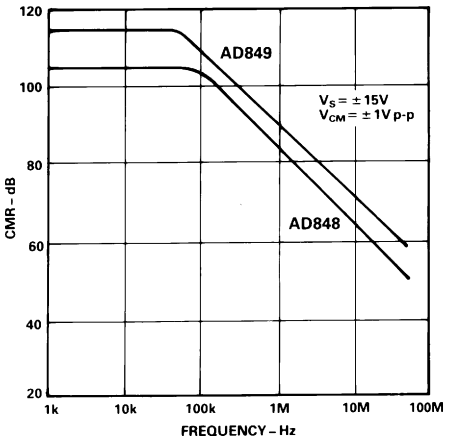


Figure 21. Common-Mode Rejection vs. Frequency