Data Sheet

MAX74812

5V, Precision, Low Noise, Zero-Drift Operational Amplifier

FEATURES

- Low offset voltage: 5µV maximum
- Low offset voltage drift: 0.015µV/°C maximum
- Low noise
  - 5.9nV/√Hz at f = 1kHz, A_V = +100
  - 99nV p-p at f = 0.1Hz to 10Hz, A_V = +100
- Open-loop gain: 127dB minimum
- CMRR: 137dB minimum
- PSRR: 130dB minimum
- Unity-gain crossover: 4MHz
- Gain bandwidth product: 3.4MHz at A_V = +100
- −3dB closed-loop bandwidth: 6.5MHz
- Single-supply operation: 2.2V to 5.5V
- Dual-supply operation: ±1.1V to ±2.75V
- Rail-to-rail input and output
- Unity-gain stable

APPLICATIONS

- Thermocouple/Thermopile
- Load cell and bridge transducers
- Precision instrumentation
- Electronic scales
- Medical instrumentation
- Handheld test equipment

GENERAL DESCRIPTION

The MAX74812 is a low noise, zero-drift operational amplifier and provides rail-to-rail input and output swing. The MAX74812 suits applications that cannot tolerate error sources by providing a 5µV offset voltage, a 0.015µV/°C offset voltage drift, and a typical noise of 99nV p-p (0.1Hz to 10Hz, A_V = +100).

The MAX74812 provides a wide operating supply range of 2.2V to 5.5V, high gain, and excellent common-mode rejection ratio (CMRR) and power-supply rejection ratio (PSRR) specifications. These features make it ideal for applications that require precision amplification of low-level signals, such as position and pressure sensors, strain gauges, and medical instrumentation.

The MAX74812 operates over the extended industrial temperature range (−40°C to +125°C) and is available in **8-lead [MSOP] (RM-8)** package.

One Analog Way, Wilmington, MA 01887-2356, U.S.A.

| Tel: 781.935.5565 |

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REVISION HISTORY

8/2026—Revision 0: Initial Version

SPECIFICATIONS

Electrical Characteristics—5V Operation

V_{SY} = 5V, V_{CM} = $V_{SY}/2$, T_A = 25°C, unless otherwise specified.

Table 1. Electrical Characteristics—5V Operation

PARAMETER	SYMBOL	TEST CONDITIONS/COMMENTS	MIN	TYP	MAX	UNIT
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0V to 5V		0.3	5	µV
		−40°C ≤ T_A ≤ +125°C		6.5		µV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.0025	0.015	µV/°C
Input Bias Current	I_B			90	300	pA
		−40°C ≤ T_A ≤ +125°C		400		pA
Input Offset Current	I_{OS}			180	500	pA
		−40°C ≤ T_A ≤ +125°C		600		pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 5V	137	160		dB
		−40°C ≤ T_A ≤ +125°C		122		dB
Open-Loop Gain	A_{VO}	R_L = 10kΩ, V_O = 0.1V to 4.9V	127	139		dB
		−40°C ≤ T_A ≤ +125°C		125		dB
		R_L = 2kΩ, V_O = 0.1V to 4.9V	121	131		dB
		−40°C ≤ T_A ≤ +125°C		120		dB
Input Resistance	R_{INDM}	Differential mode		190		kΩ
	R_{INCM}	Common mode		1		GΩ
Input Capacitance	C_{INDM}	Differential mode		16.5		pF
	C_{INCM}	Common mode		33		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 10kΩ to V_{CM}	4.99	4.995		V
		−40°C ≤ T_A ≤ +125°C		4.98		V
		R_L = 2kΩ to V_{CM}	4.96	4.98		V
		−40°C ≤ T_A ≤ +125°C		4.94		V
Output Voltage Low	V_{OL}	R_L = 10kΩ to V_{CM}		5	10	mV
		−40°C ≤ T_A ≤ +125°C		20		mV
		R_L = 2kΩ to V_{CM}		20	40	mV
		−40°C ≤ T_A ≤ +125°C		60		mV
Short-Circuit Current	I_{SC}			±40		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1kHz, A_V = +10		0.1		Ω
POWER SUPPLY						
Power-Supply Rejection Ratio	PSRR	V_{SY} = 2.2V to 5.5V	130	150		dB
		−40°C ≤ T_A ≤ +125°C		127		dB
Supply Current Per Amplifier	I_{SY}	I_O = 0mA		1.5	1.8	mA
		−40°C ≤ T_A ≤ +125°C		2.2		mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10kΩ, C_L = 100pF, A_V = +1		0.5		V/µs
Settling Time To 0.1%	t_S	V_{IN} = 4V step, R_L = 10kΩ, C_L = 100pF, A_V = −1		10		µs

SPECIFICATIONS

Table 1. Electrical Characteristics—5V Operation (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS/COMMENTS	MIN	TYP	MAX	UNIT
Unity-Gain Crossover	UGC	V_{IN} = 10mV p-p, R_L = 10kΩ, C_L = 100pF, A_V = +1		4		MHz
Phase Margin	Φ_M	V_{IN} = 10mV p-p, R_L = 10kΩ, C_L = 100pF, A_V = +1		57		Degrees
Gain Bandwidth Product	GBP	V_{IN} = 10mV p-p, R_L = 10kΩ, C_L = 100pF, A_V = +100		3.4		MHz
−3dB Closed-Loop Bandwidth	f_{-3dB}	V_{IN} = 10mV p-p, R_L = 10kΩ, C_L = 100pF, A_V = +1		6.5		MHz
Overload Recovery Time		R_L = 10kΩ, C_L = 100pF, A_V = −10		50		µs
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1Hz to 10Hz, A_V = +100		99		nV p-p
Voltage Noise Density	e_n	f = 1kHz, A_V = +100		5.9		nV/√Hz
		f = 1kHz, A_V = +100, V_{CM} = 4.5V		5.3		nV/√Hz
Current Noise	i_n p-p	f = 0.1Hz to 10Hz, A_V = +100		10		pA p-p
Current Noise Density	i_n	f = 1kHz, A_V = +100		0.5		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute Maximum Ratings

PARAMETER	RATING
Supply Voltage	6V
Input Voltage	$\pm V_{SY} \pm 0.3V$
Input Current[1]	±10mA
Differential Input Voltage	$\pm V_{SY}$
Output Short-Circuit Duration to GND	Indefinite
Temperature	
Storage Range	−65°C to +150°C
Operating Range	−40°C to +125°C
Junction Range	−65°C to +150°C
Lead (Soldering, 60sec)	300°C

[1] The input pins have clamp diodes to the power supply pins. Limit the input current to 10mA or less whenever input signals exceed the power-supply rail by 0.3V.

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

Thermal Resistance

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

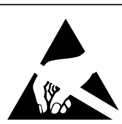
θ_{JA} is the natural convection junction-to-ambient thermal resistance measured in a one cubic foot sealed enclosure.

θ_{JC} is the junction-to-case thermal resistance.

Table 3. Thermal Resistance

PACKAGE TYPE	θ_{JA}	θ_{JC}	UNIT
8-Lead [MSOP] (RM-8)	142	45	°C/W

ESD Caution

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

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

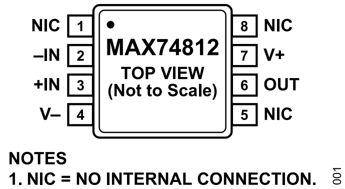


Figure 1. 8-Lead [MSOP] (RM Suffix)

Table 4. Pin Function Descriptions

PIN NUMBER	MNEMONIC	DESCRIPTION
1, 5, 8	NIC	No Internal Connection.
2	−IN	Inverting Input.
3	+IN	Noninverting Input.
4	V−	Negative Supply Voltage.
6	OUT	Output.
7	V+	Positive Supply Voltage.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

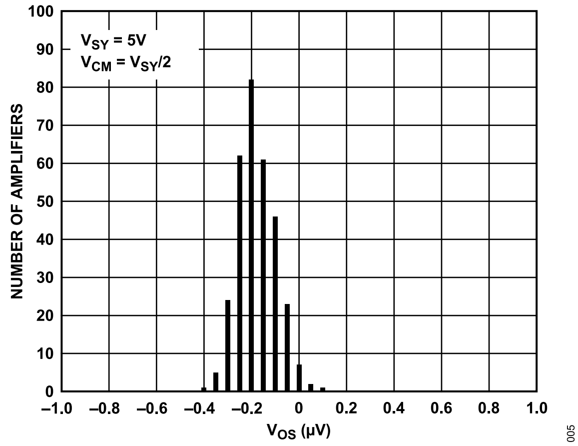


Figure 2. Input Offset Voltage Distribution

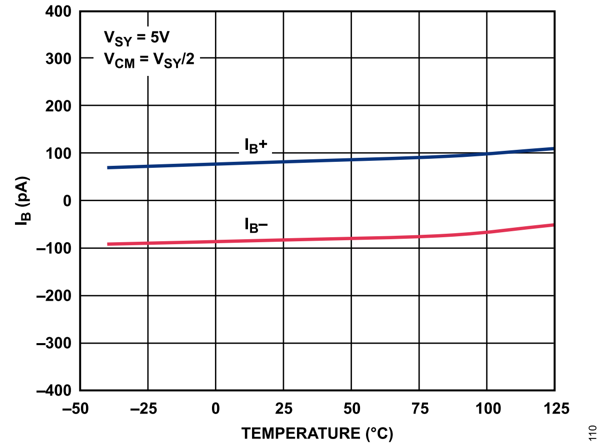


Figure 5. Input Bias Current vs. Temperature

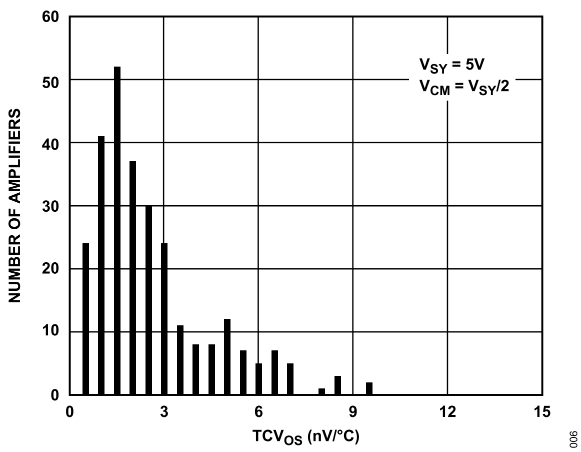


Figure 3. Input Offset Voltage Drift Distribution

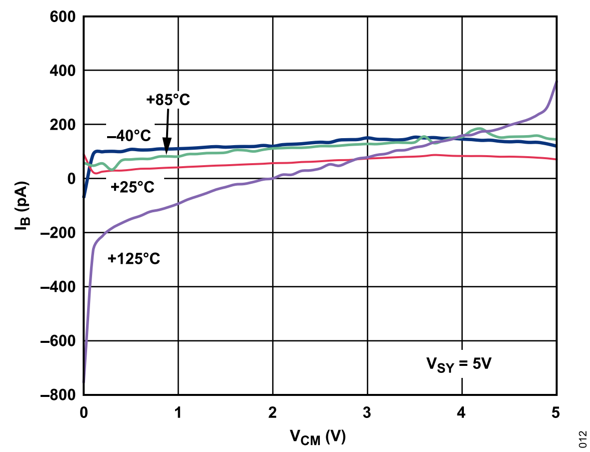


Figure 6. Input Bias Current vs. Common-Mode Voltage

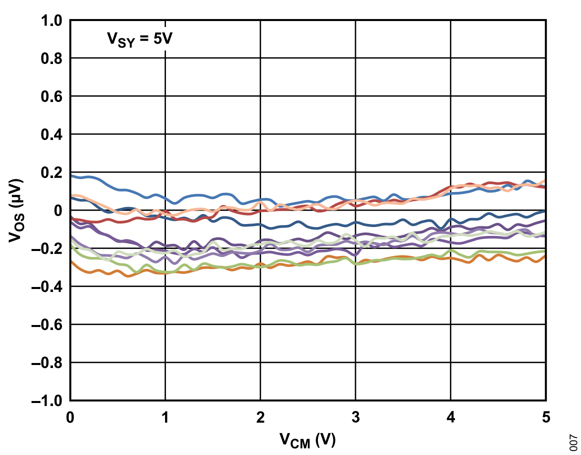


Figure 4. Input Offset Voltage vs. Common-Mode Voltage

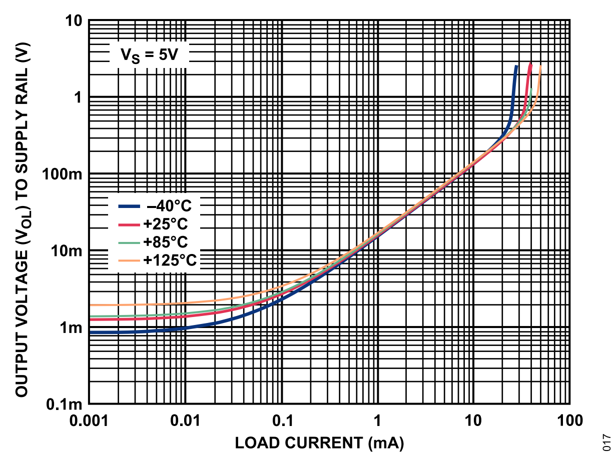


Figure 7. Output Voltage (V_{OL}) to Supply Rail vs. Load Current

TYPICAL PERFORMANCE CHARACTERISTICS

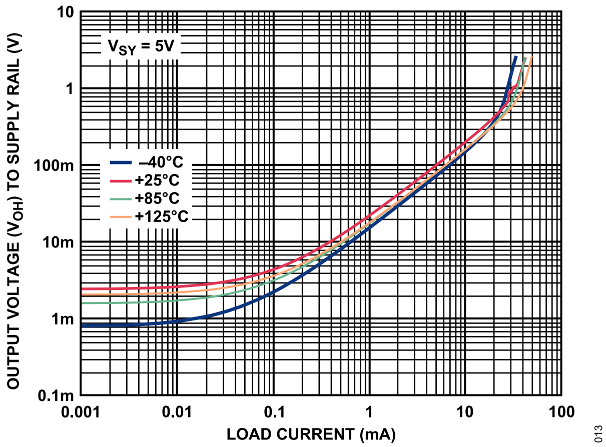


Figure 8. Output Voltage (V_{OH}) to Supply Rail vs. Load Current

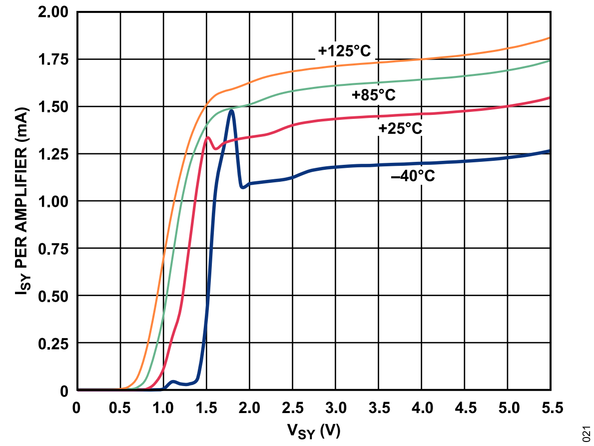


Figure 11. Supply Current vs. Supply Voltage

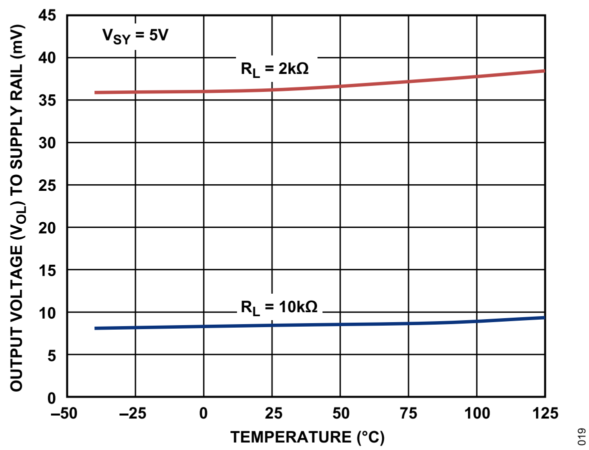


Figure 9. Output Voltage (V_{OL}) to Supply Rail vs. Temperature

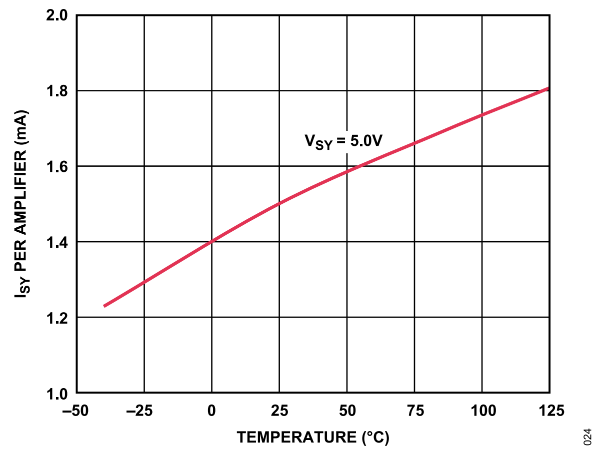


Figure 12. Supply Current vs. Temperature

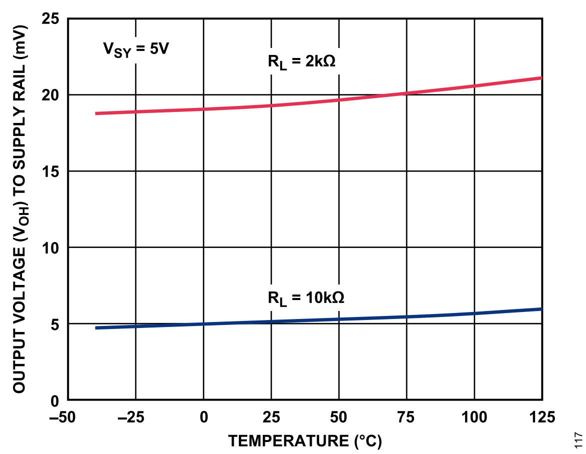


Figure 10. Output Voltage (V_{OH}) to Supply Rail vs. Temperature

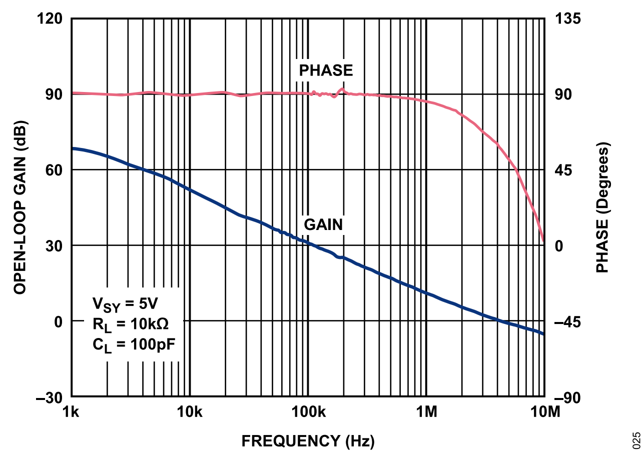


Figure 13. Open-Loop Gain and Phase vs. Frequency

TYPICAL PERFORMANCE CHARACTERISTICS

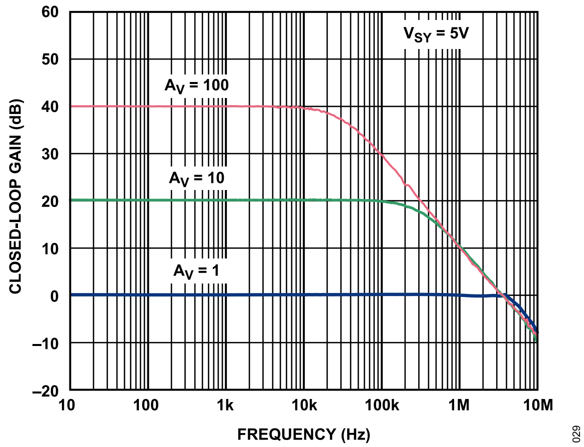


Figure 14. Closed-Loop Gain vs. Frequency

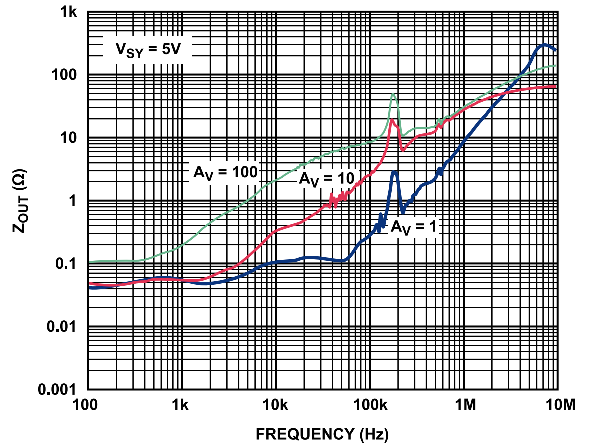


Figure 17. Closed-Loop Output Impedance vs. Frequency

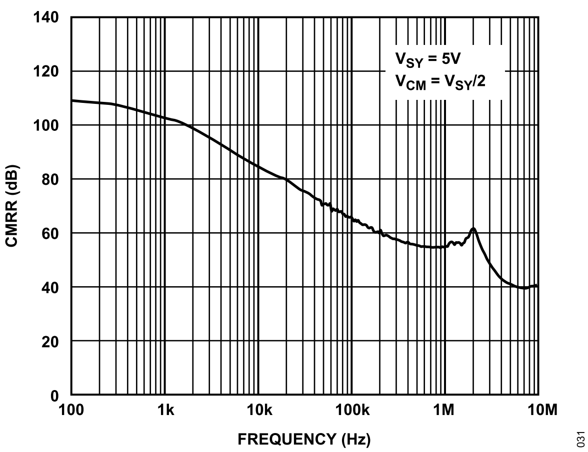


Figure 15. CMRR vs. Frequency

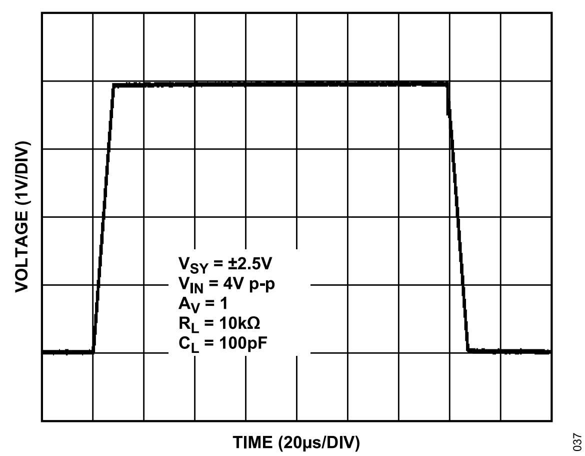


Figure 18. Large Signal Transient Response

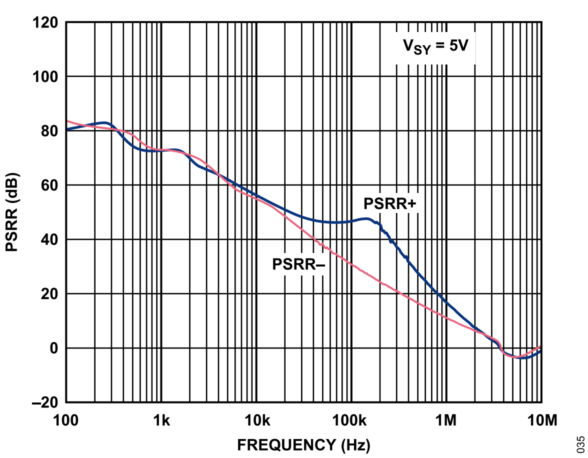


Figure 16. PSRR vs. Frequency

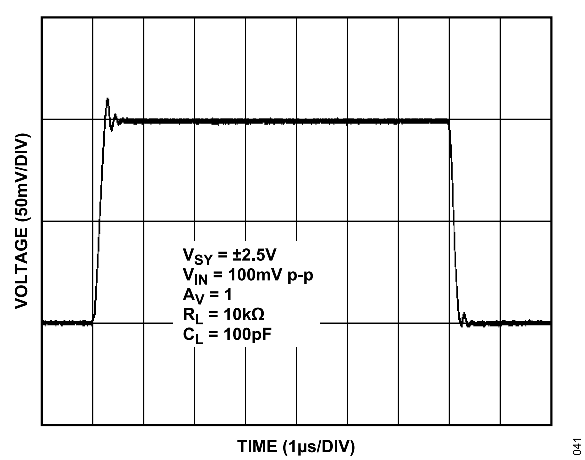


Figure 19. Small Signal Transient Response

TYPICAL PERFORMANCE CHARACTERISTICS

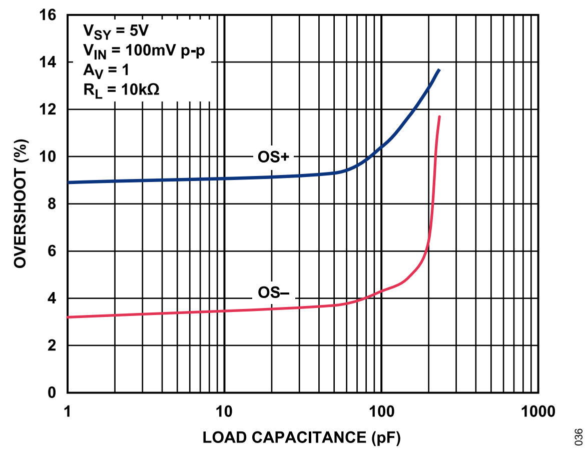


Figure 20. Small Signal Overshoot vs. Load Capacitance

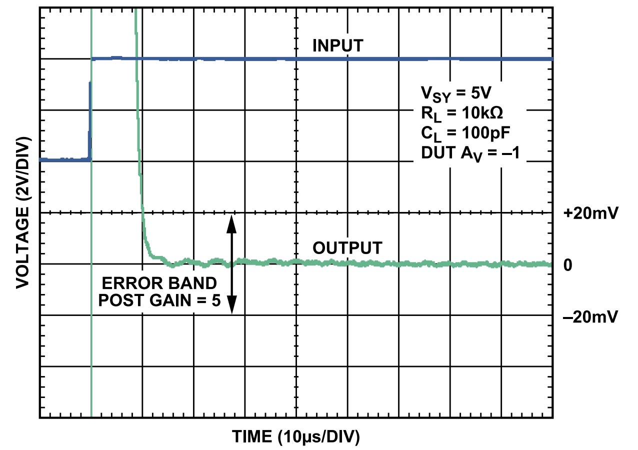


Figure 23. Positive Settling Time to 0.1%

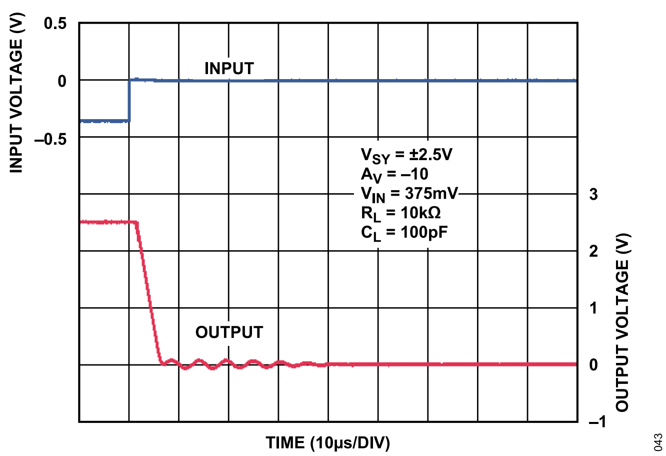


Figure 21. Positive Overload Recovery

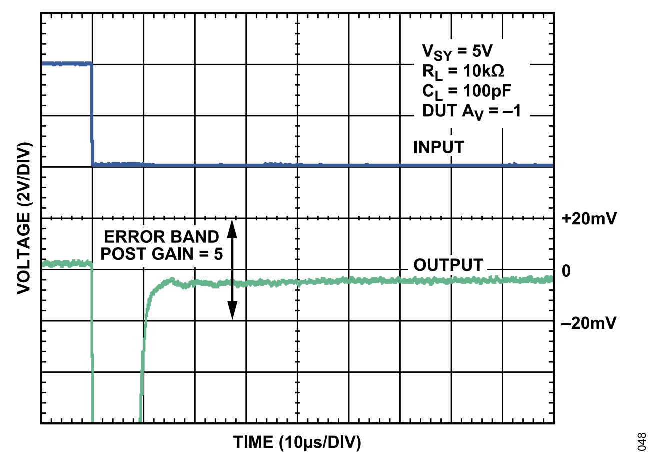


Figure 24. Negative Settling Time to 0.1%

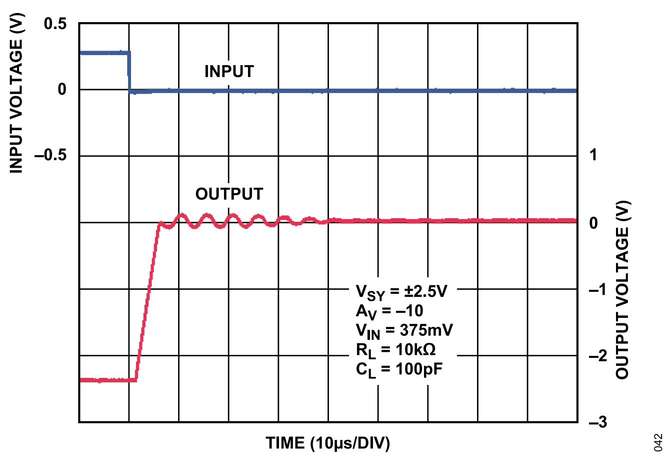


Figure 22. Negative Overload Recovery

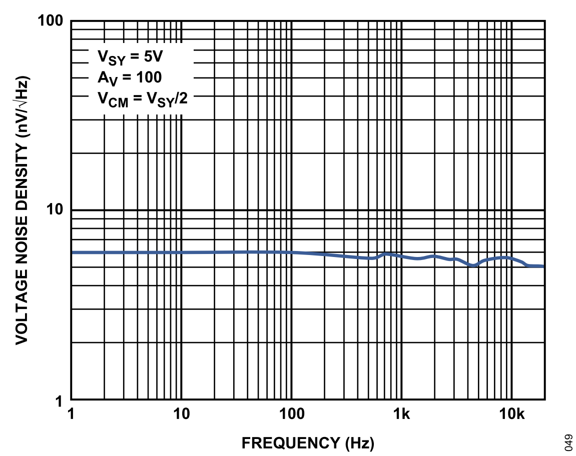


Figure 25. Voltage Noise Density vs. Frequency

TYPICAL PERFORMANCE CHARACTERISTICS

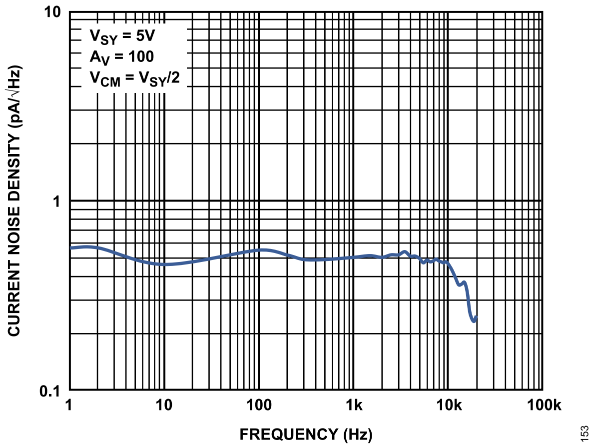


Figure 26. Current Noise Density vs. Frequency

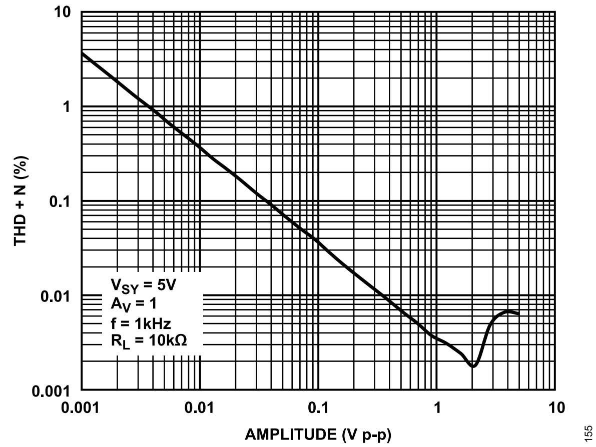


Figure 29. THD + N vs. Amplitude

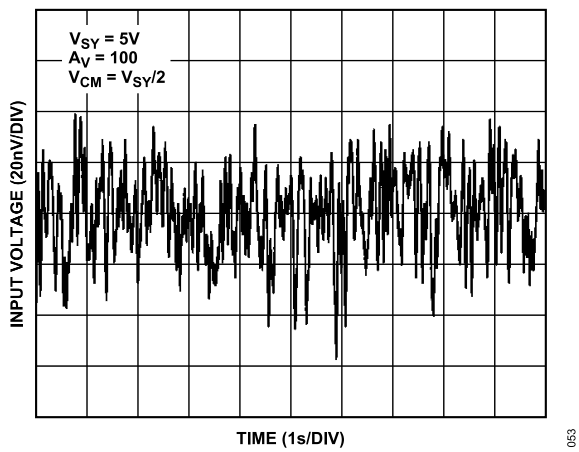


Figure 27. 0.1Hz to 10Hz Noise

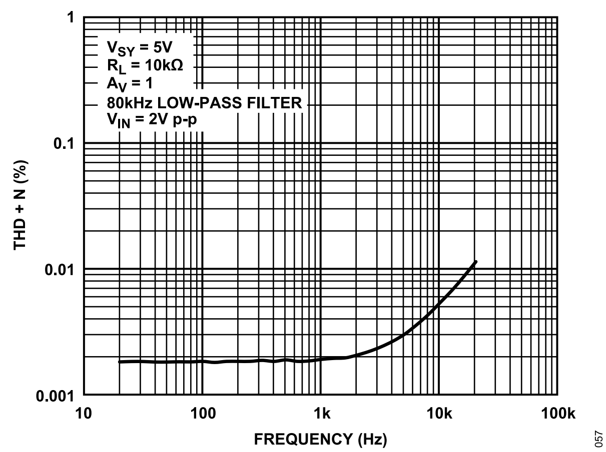


Figure 30. THD + N vs. Frequency

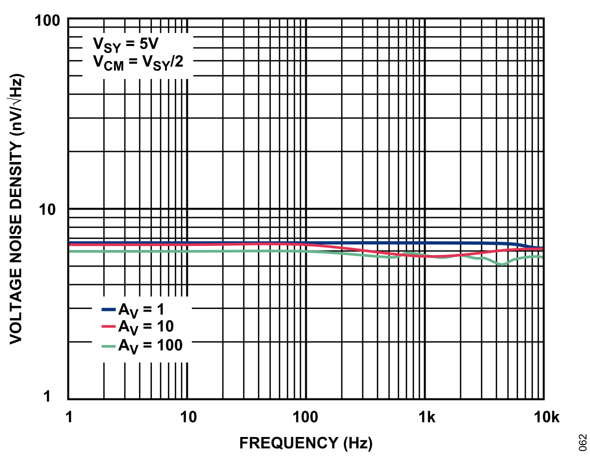


Figure 28. Voltage Noise Density vs. Frequency for Various Gains

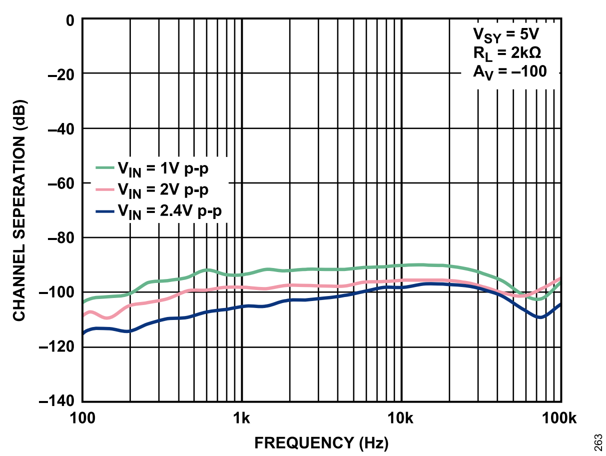


Figure 31. Channel Separation vs. Frequency

TYPICAL PERFORMANCE CHARACTERISTICS

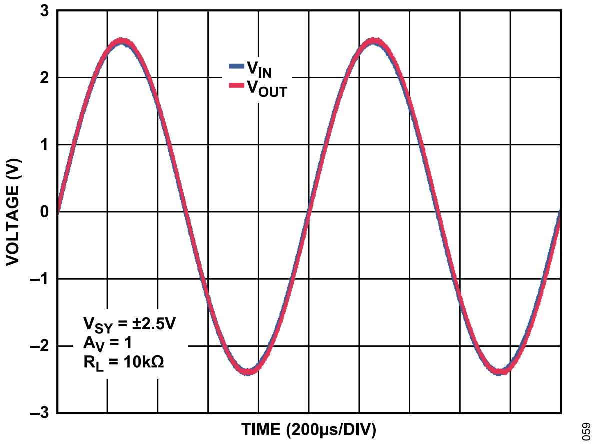


Figure 32. No Phase Reversal

THEORY OF OPERATION

The MAX74812 is a precision, low noise, zero-drift operational amplifier with a patented chopping technique. This chopping technique offers a typical low input offset voltage of 0.3µV and a typical input offset voltage drift of 0.0025µV/°C.

The chopping technique corrects offset voltage errors from common-mode voltage swings and power-supply variations and achieves a typical CMRR of 160dB and a typical PSRR of 150dB at 5V supply voltage. The MAX74812 delivers low broadband noise of 5.9nV/√Hz (at f = 1kHz, A_V = +100) without a 1/f noise component. These features make the MAX74812 ideal for amplifying low-level signals in DC or subhertz high-precision applications.

APPLICATIONS INFORMATION

Input Protection

The MAX74812 uses internal ESD protection diodes connected between the inputs and each supply rail. These diodes protect the input transistors from electrostatic discharge events and remain reverse biased during normal operation. This protection scheme allows either input terminal to withstand voltages up to approximately 300mV beyond the supply rails without sustaining permanent damage (see **Table 2**).

When either input exceeds one of the supply rails by more than 300mV, the ESD diodes become forward biased and large currents begin to flow through them. Without current limiting, this excessive fault current can permanently damage the device.

If overvoltage conditions occur at the inputs, insert a resistor in series with each input to limit the input current to 10mA maximum. However, consider the effect of resistor thermal noise on the overall circuit performance.

For example, at a 5V supply voltage, the broadband voltage noise of the MAX74812 is approximately 6nV/√Hz (at unity gain). A 1kΩ resistor generates 4nV/√Hz of thermal noise. Adding a 1kΩ resistor to the noninverting input pin increases the total noise by 30% root sum square (RSS).

Residual Voltage Ripple

Although auto-correction feedback (ACFB) suppresses the chopping-related voltage ripple, higher noise spectrum exists at the chopping frequency and its harmonics due to the remaining ripple. **Figure 33** shows the voltage noise density of the MAX74812 configured in unity gain. The noise energy spectrum reaches 50nV/√Hz at the 200kHz chopping frequency. This noise energy spectrum becomes significant when the operational amplifier (op amp) operates with a closed-loop frequency higher than the chopping frequency.

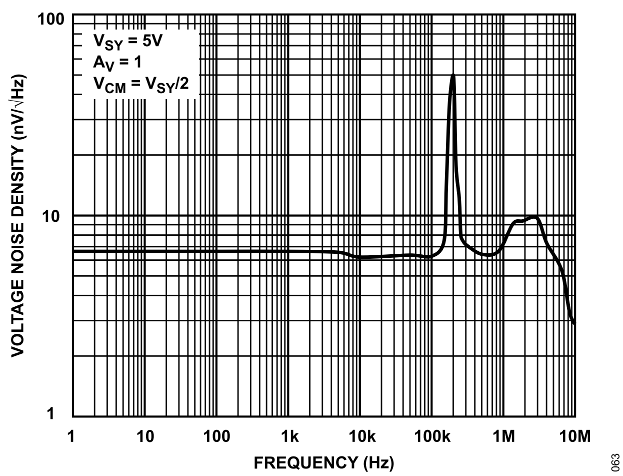


Figure 33. Voltage Noise Density vs. Frequency

OUTLINE DIMENSIONS

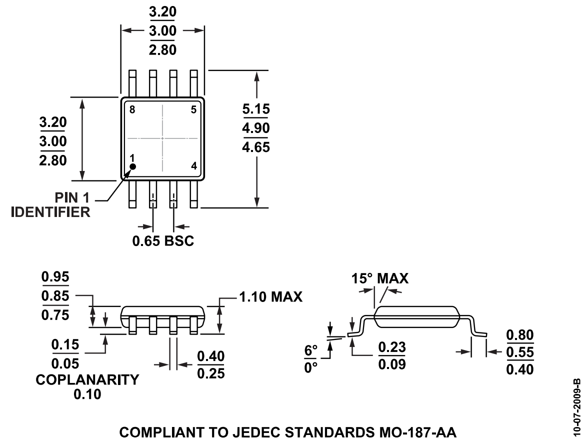


Figure 34. 8-Lead Mini Small Outline Package [MSOP] (RM-8)
Dimensions shown in millimeters

Updated: August 03, 2026

Ordering Guide

MODEL[1]	TEMPERATURE RANGE	PACKAGE DESCRIPTION	PACKING QUANTITY	PACKAGE OPTION	MARKING CODE
MAX74812ARMZ	−40°C to +125°C	8-Lead [MSOP]	Tube, 50	RM-8	A7R
MAX74812ARMZ-R7	−40°C to +125°C	8-Lead [MSOP]	Reel7, 1000	RM-8	A7R
MAX74812ARMZ-RL	−40°C to +125°C	8-Lead [MSOP]	Reel, 3000	RM-8	A7R

[1] Z = RoHS Compliant Part.