SGM8429C-4
Quad Operational Amplifier

GENERAL DESCRIPTION

The SGM8429C-4 is a quad operational amplifier with internal frequency compensation. It is optimized for high voltage operation from 3V to 32V single supply or ±1.5V to ±16V dual supplies, and consumes only 860μA quiescent current.

The SGM8429C-4 features low power, low offset voltage and low bias current. The device can offer high open-loop voltage gain. It is well suited for various applications.

The SGM8429C-4 is available in a Green TQFN-3×3-16L package. It is specified over the -40℃ to +125℃ temperature range.

FEATURES

- **Support Single or Dual Power Supplies: 3V to 32V or ±1.5V to ±16V**
- **Low Quiescent Current: 860μA (TYP)**
- **Low Input Offset Voltage: 6mV (MAX)**
- **Low Input Offset Current: 10pA (TYP)**
- **Low Input Bias Current: 10pA (TYP)**
- **Minimum Input Common Mode Voltage: ($-V_S$) - 0.1V**
- **Maximum Differential Input Voltage: +32V/-32V**
- **Open-Loop Differential Voltage Gain: 111dB (TYP)**
- **Gain-Bandwidth Product: 1.1MHz**
- **Frequency-Compensated Amplifier**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green TQFN-3×3-16L Package**

APPLICATIONS

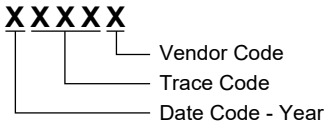
Wearable Products
Temperature Measurements
Battery-Powered Systems
Sensors
Audio
Active Filters
Communications
Test Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8429C-4	TQFN-3×3-16L	-40℃ to +125℃	SGM8429C-4XTQ16G/TR	CIFTQ XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage Range, V_S (1) ..... -0.3V to 32V
Differential Input Voltage Range, V_{ID} (2) ..... -32V to 32V
Input Voltage Range (Either Input) ..... -0.3V to 32V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 6000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Common Mode Voltage Range ..... -0.1V to ($+V_S$) - 1.5V
Operating Temperature Range ..... -40℃ to +125℃

NOTES:
1. The network GND is the reference point for all voltage values, except for differential voltages and V_S when measuring I_{SC}.
2. Differential voltage is between +IN and -IN.

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

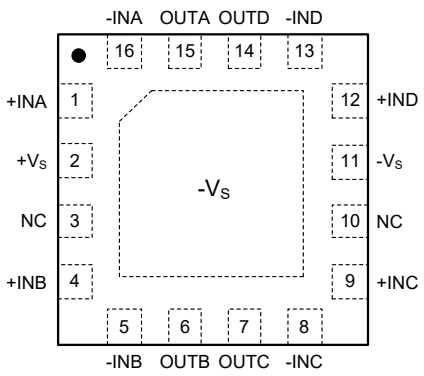
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION

(TOP VIEW)



TQFN-3×3-16L

NOTE: Exposed pad can be connected to $-V_S$ or left floating.

ELECTRICAL CHARACTERISTICS

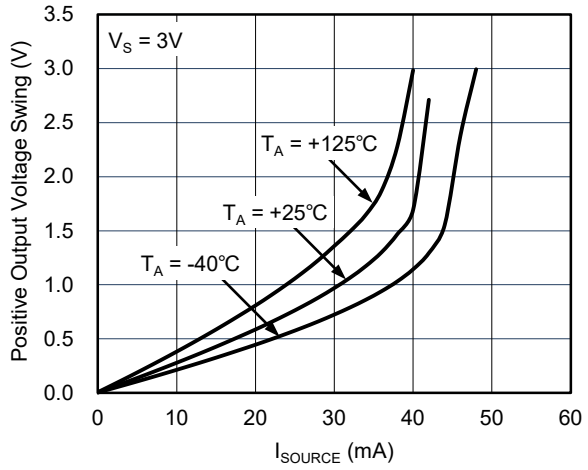
(V_S = 3V to 32V, -0.1V < V_{CM} < (+V_S) - 1.5V, R_L = 10kΩ connected to V_S/2, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage	V_{OS}		+25℃		1.2	6	mV
			Full			7	
Input Bias Current	I_B	V_{CM} = V_S/2	+25℃		10	200	pA
Input Offset Current	I_{OS}	V_{CM} = V_S/2	+25℃		10	200	pA
Input Common Mode Voltage Range	V_{CM}		Full	-0.1		(+V_S) - 1.5	V
Common Mode Rejection Ratio	CMRR	-0.1V < V_{CM} < (+V_S) - 1.5V	+25℃	82	100		dB
			Full	72			
Open-Loop Voltage Gain	A_{OL}	R_L = 10kΩ to V_S/2	+25℃	92	111		dB
			Full	83			
Output Characteristics							
Output Voltage Swing from Rail	V_{OH}	R_L = 10kΩ	+25℃		42	60	mV
			Full			80	
	V_{OL}	R_L = 10kΩ	+25℃		110	190	
			Full			240	
Output Short-Circuit Current	I_{SC}		+25℃	12	18		mA
Power Supply							
Operating Voltage Range	V_S		Full	3		32	V
Quiescent Current	I_Q	I_{OUT} = 0A	+25℃		860	1250	μA
			Full			1900	
Power Supply Rejection Ratio	PSRR		+25℃	102	122		dB
			Full	98			
Dynamic Performance (C_L = 100pF)							
Gain-Bandwidth Product	GBP		+25℃		1.1		MHz
Phase Margin	φ_O		+25℃		60		°
Slew Rate	SR	G = +1	+25℃		0.35		V/μs
Overload Recovery Time	ORT	V_{IN} × G > V_S	+25℃		2.3		μs
Turn-On Time		G = +1	+25℃		42		μs
NOISE							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25℃		9		μV_{P-P}
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		36		$nV/\sqrt{Hz}$

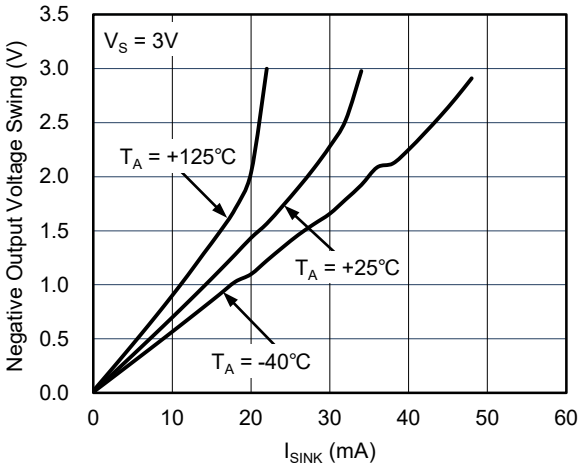
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

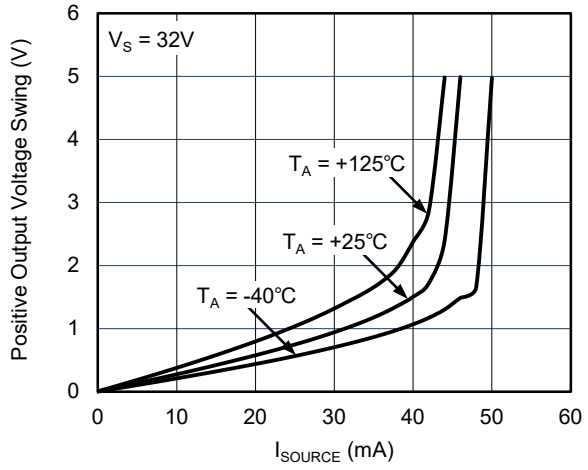
Positive Output Voltage Swing vs. Load Current



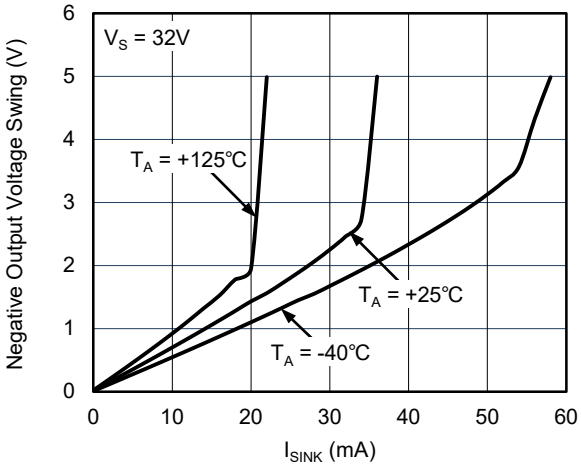
Negative Output Voltage Swing vs. Load Current



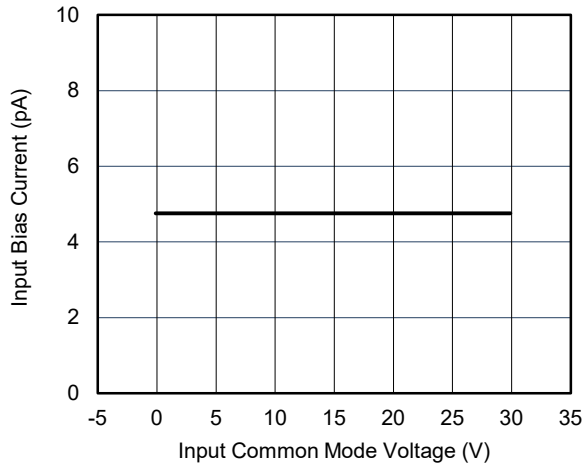
Positive Output Swing vs. Load Current



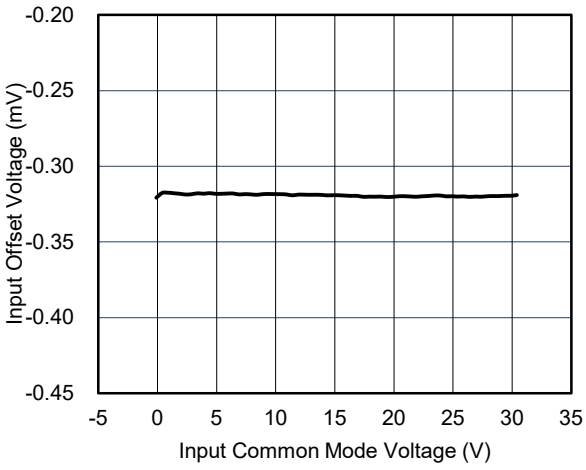
Negative Output Swing vs. Load Current



Input Bias Current vs. Input Common Mode Voltage



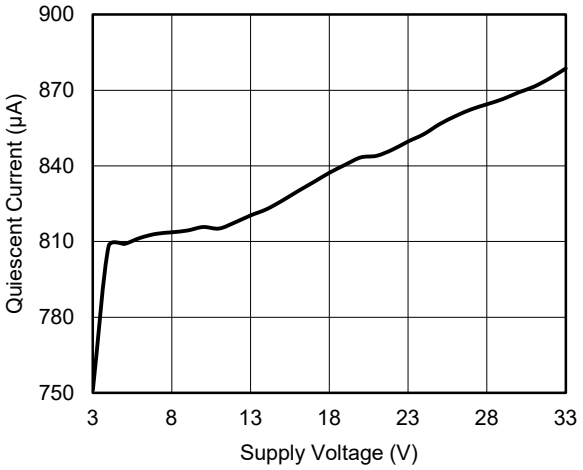
Input Offset Voltage vs. Input Common Mode Voltage



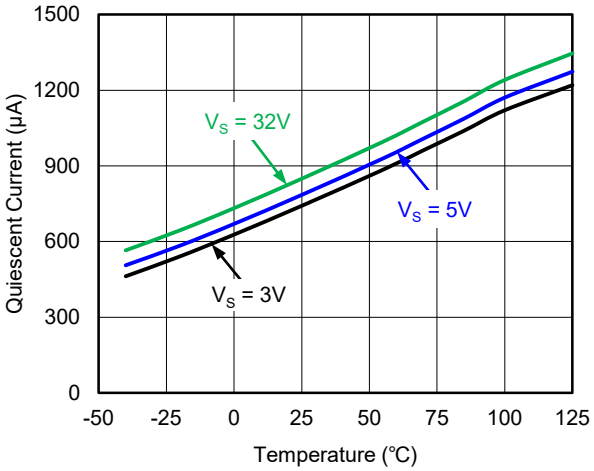
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

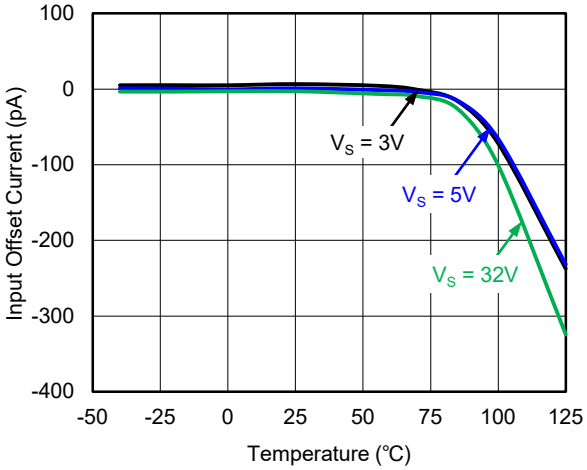
Quiescent Current vs. Supply Voltage



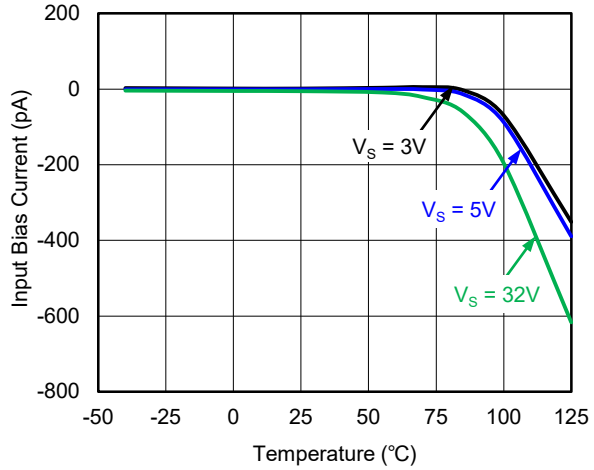
Quiescent Current vs. Temperature



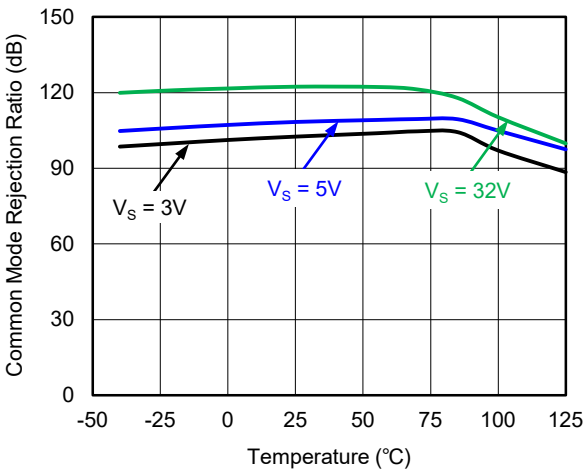
Input Offset Current vs. Temperature



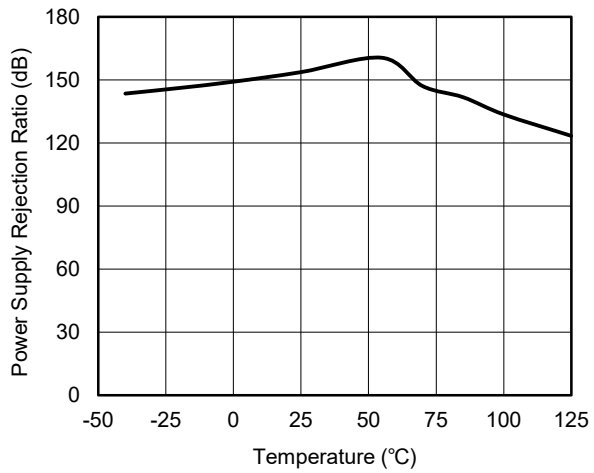
Input Bias Current vs. Temperature



CMRR vs. Temperature



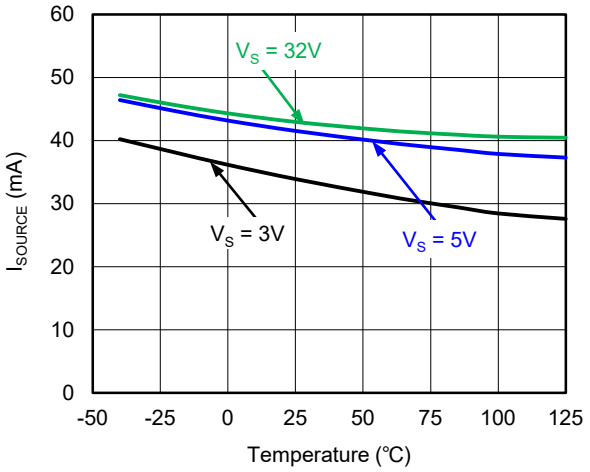
PSRR vs. Temperature



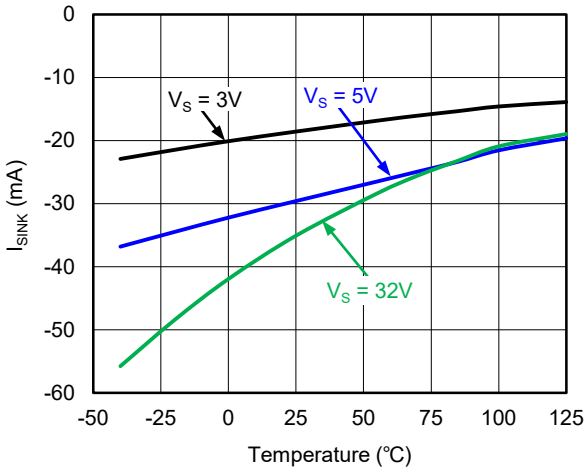
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

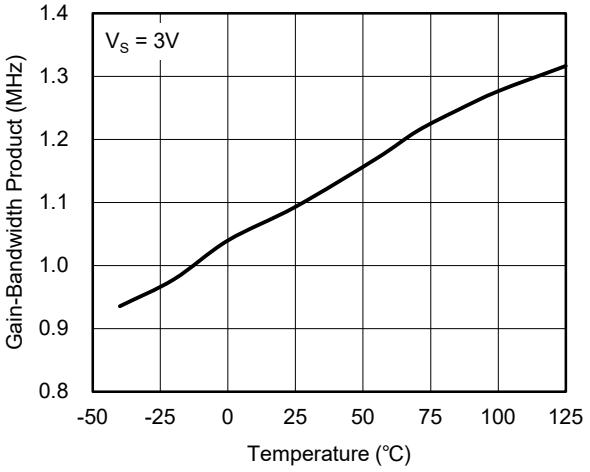
Output Short-Circuit Current (I_{SOURCE}) vs. Temperature



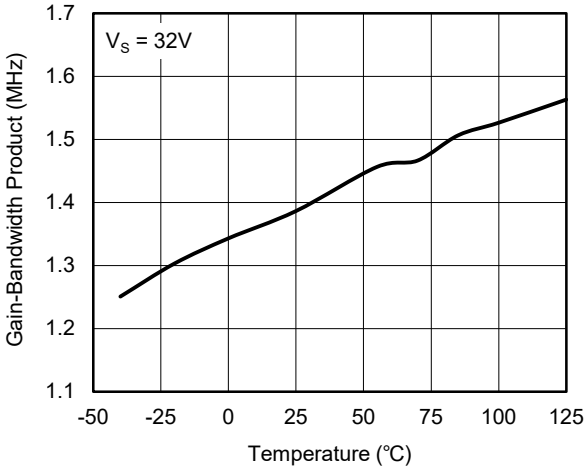
Output Short-Circuit Current (I_{SINK}) vs. Temperature



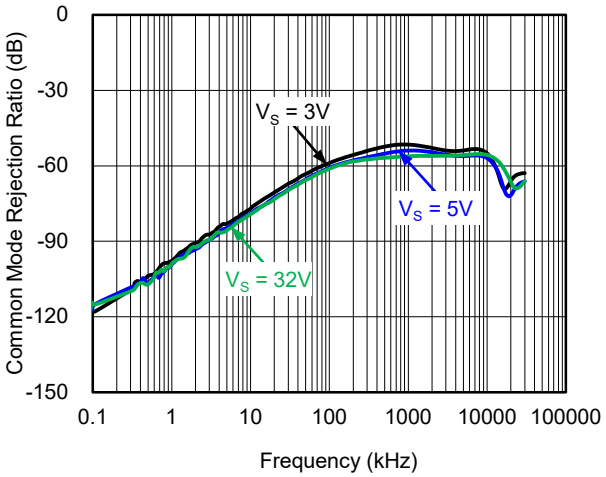
Gain-Bandwidth Product vs. Temperature



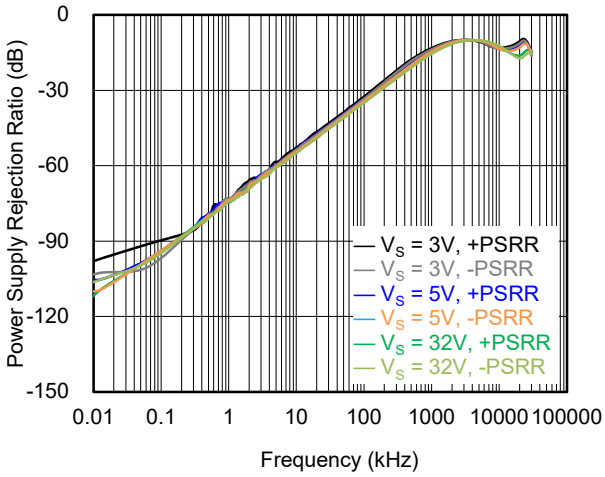
Gain-Bandwidth Product vs. Temperature



CMRR vs. Frequency



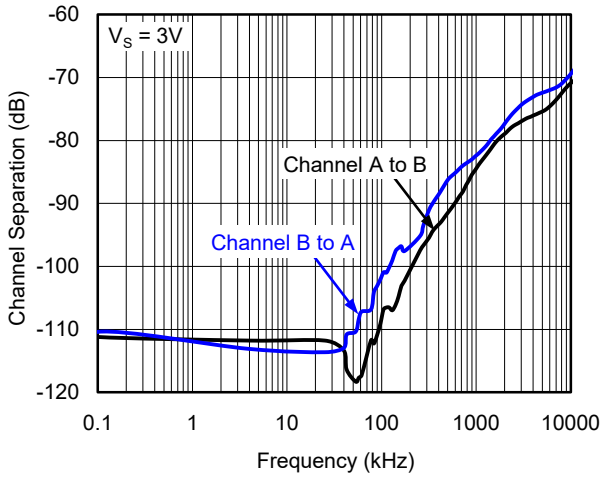
PSRR vs. Frequency



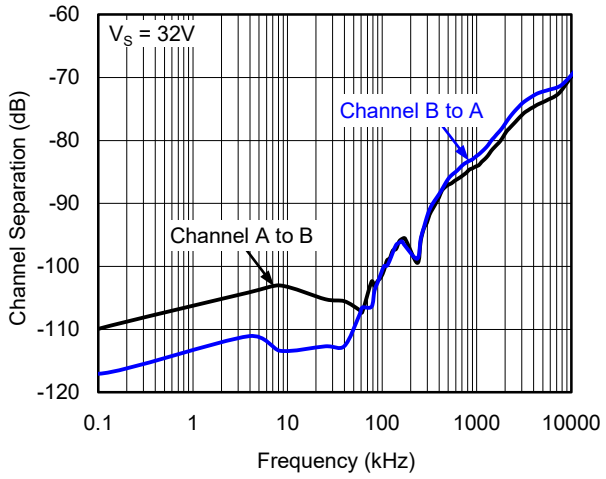
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

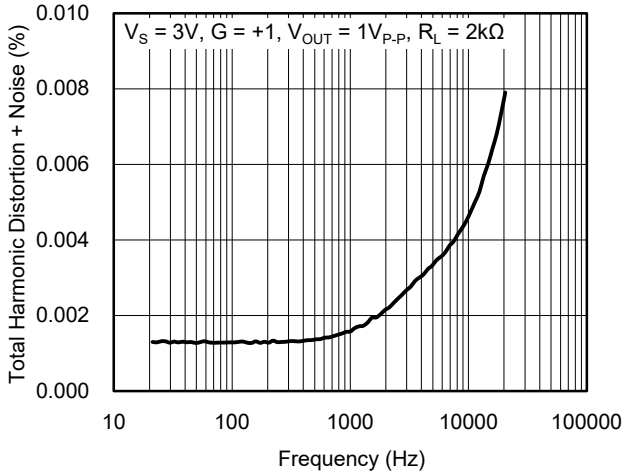
Channel Separation vs. Frequency



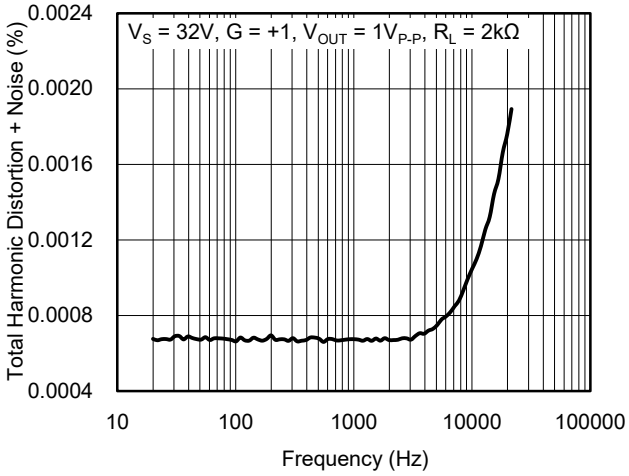
Channel Separation vs. Frequency



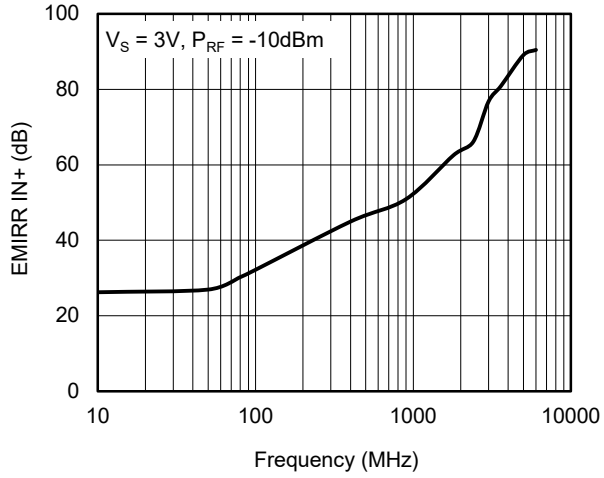
THD+N vs. Frequency



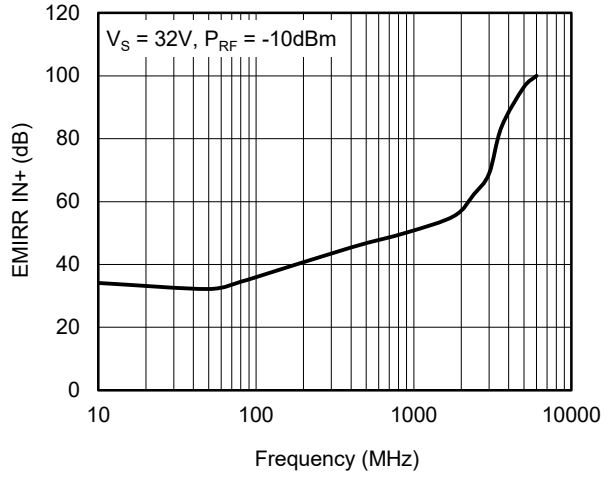
THD+N vs. Frequency



EMIRR IN+ vs. Frequency



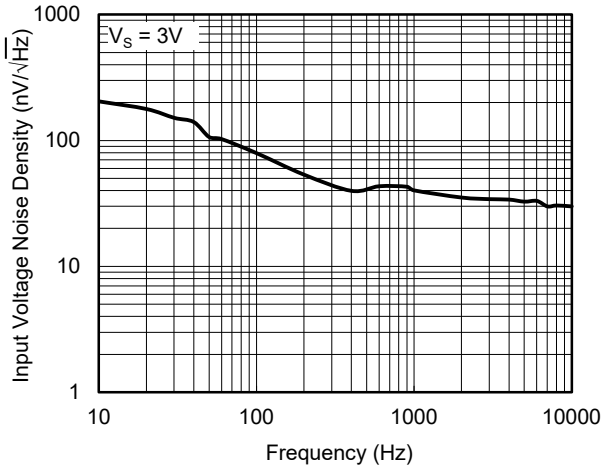
EMIRR IN+ vs. Frequency



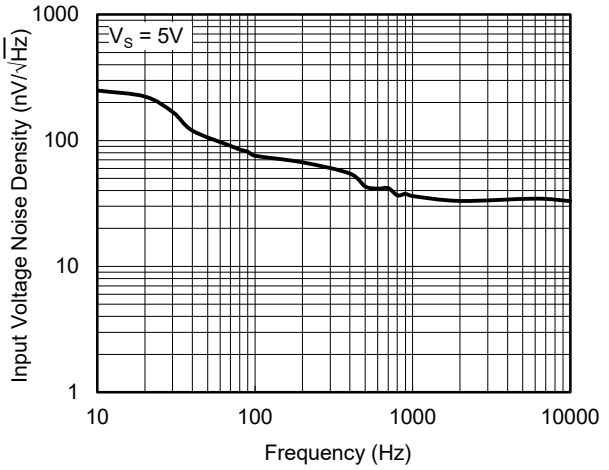
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

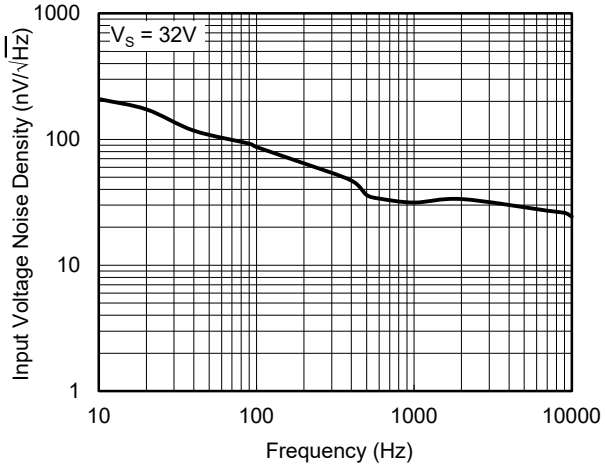
Input Voltage Noise Density vs. Frequency



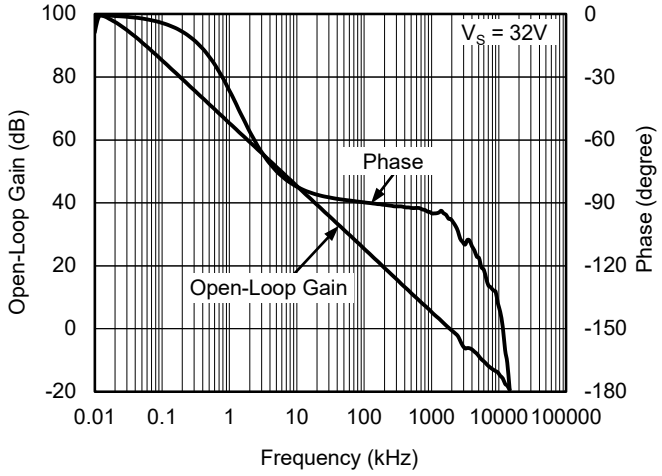
Input Voltage Noise Density vs. Frequency



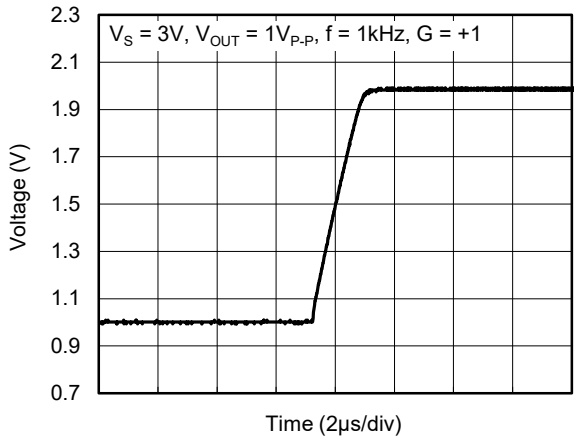
Input Voltage Noise Density vs. Frequency



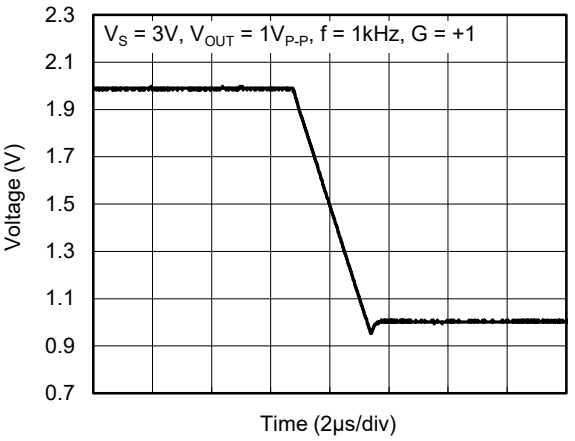
Open-Loop Gain and Phase vs. Frequency



Slew Rate (up)



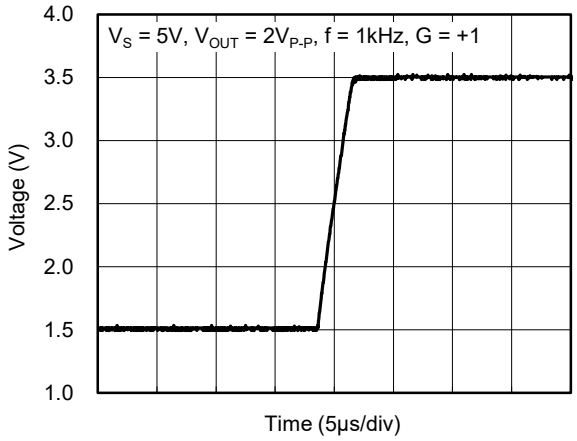
Slew Rate (down)



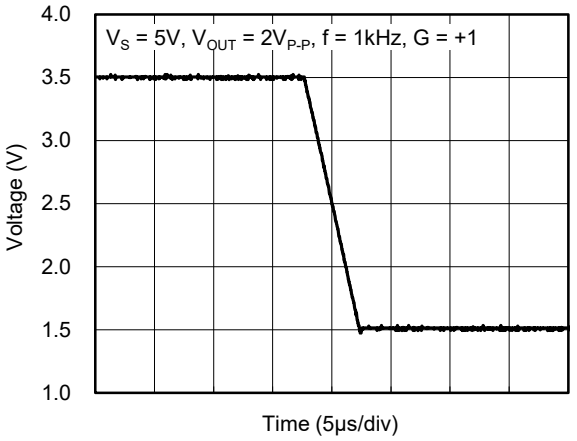
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

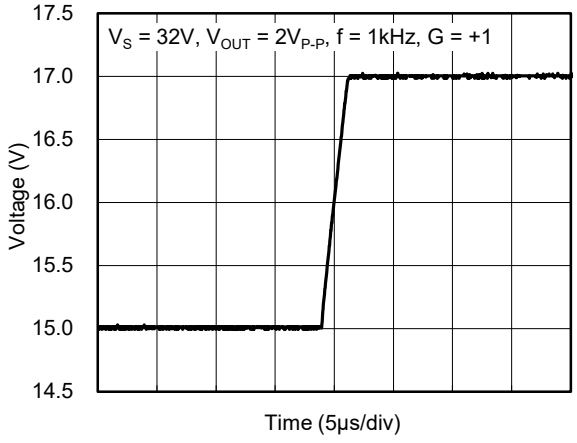
Slew Rate (up)



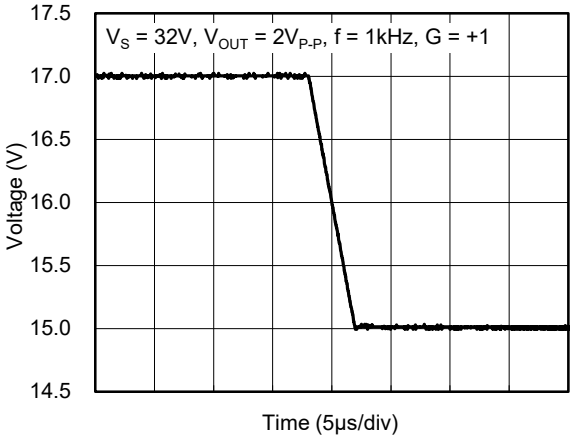
Slew Rate (down)



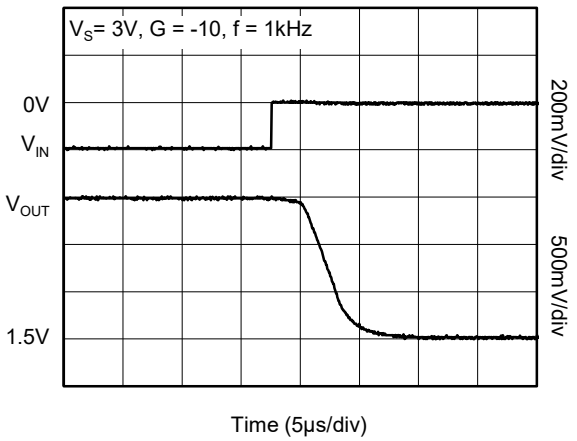
Slew Rate (up)



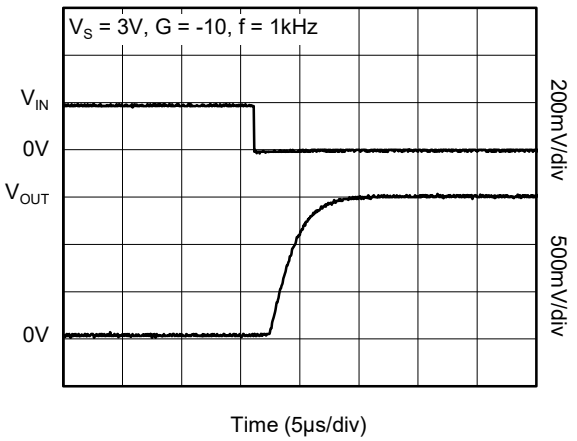
Slew Rate (down)



Positive Overload Recovery Time



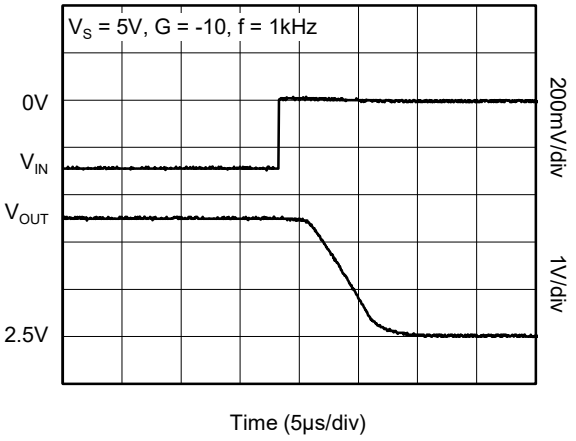
Negative Overload Recovery Time



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

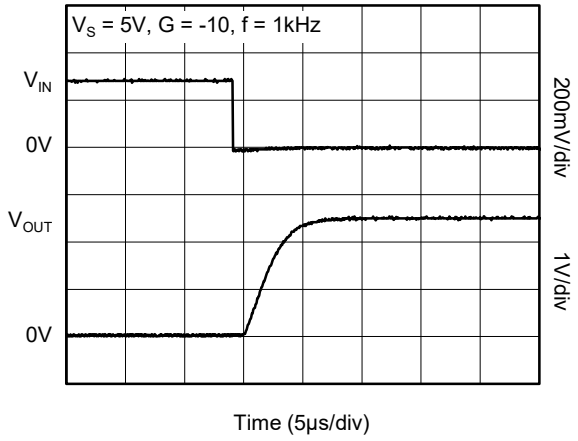
At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

Positive Overload Recovery Time



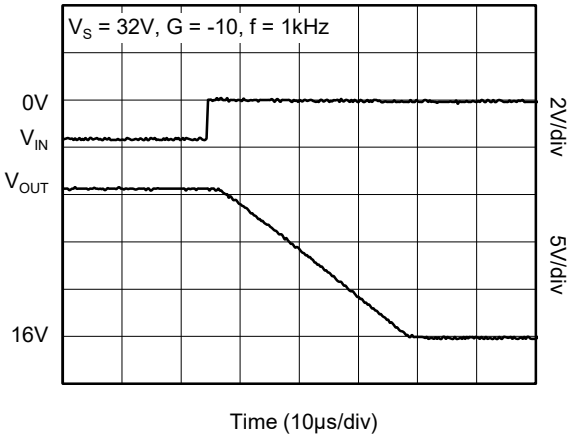
Time (5μs/div)

Negative Overload Recovery Time



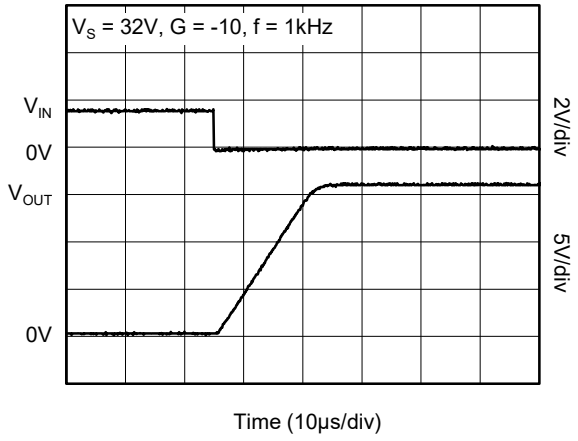
Time (5μs/div)

Positive Overload Recovery Time



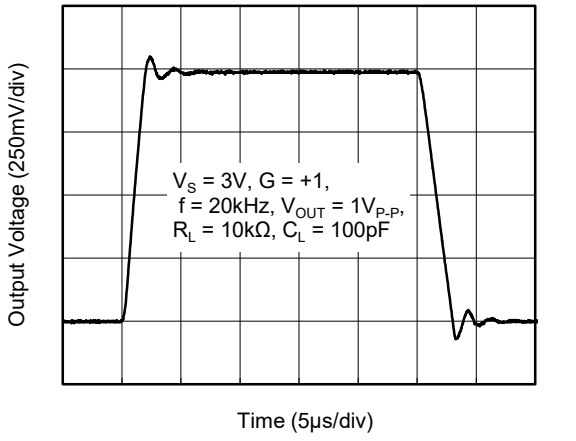
Time (10μs/div)

Negative Overload Recovery Time



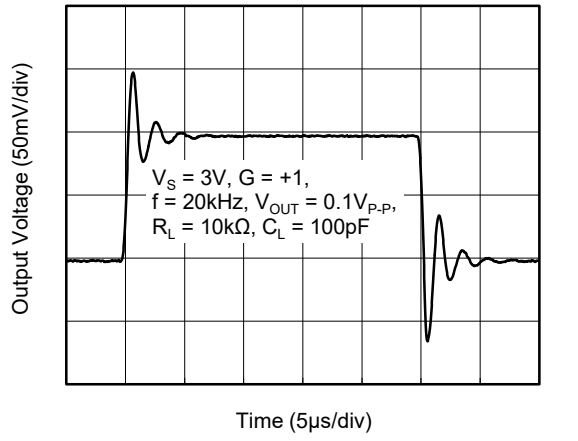
Time (10μs/div)

Large-Signal Step Response



Time (5μs/div)

Small-Signal Step Response

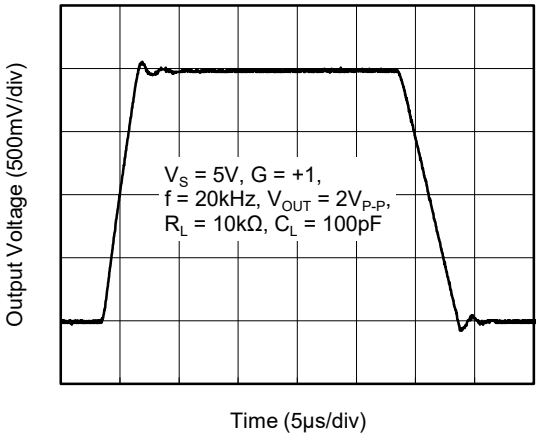


Time (5μs/div)

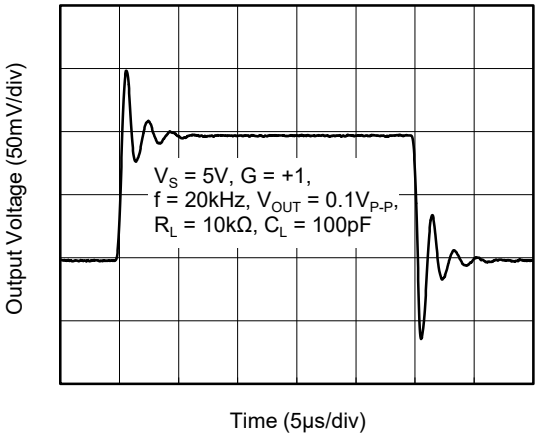
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

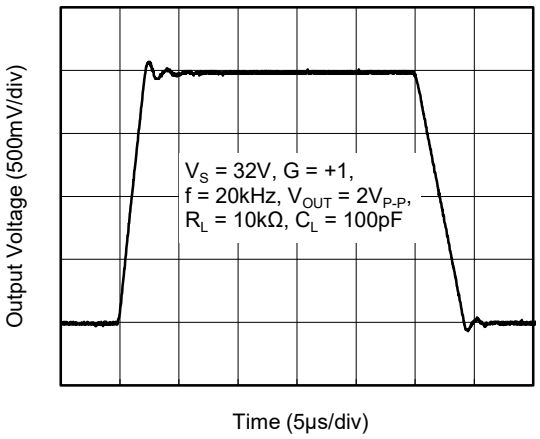
Large-Signal Step Response



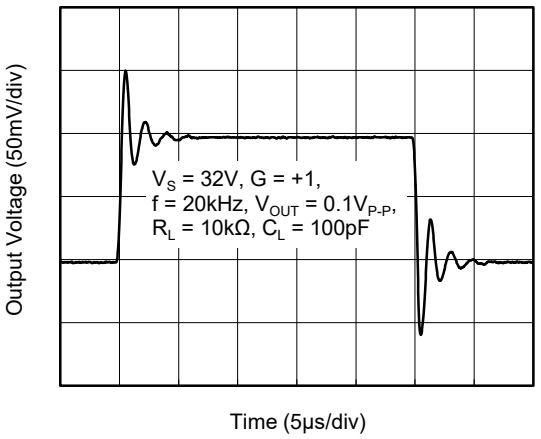
Small-Signal Step Response



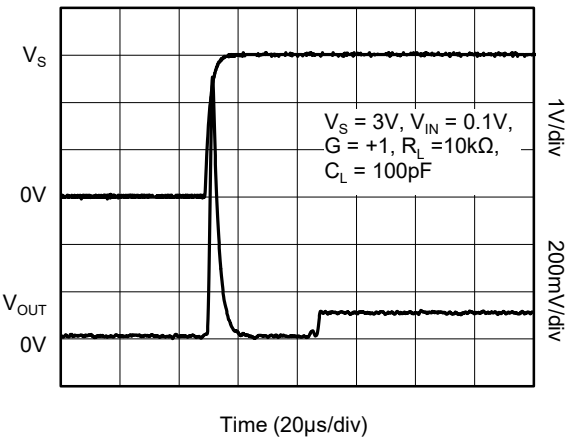
Large-Signal Step Response



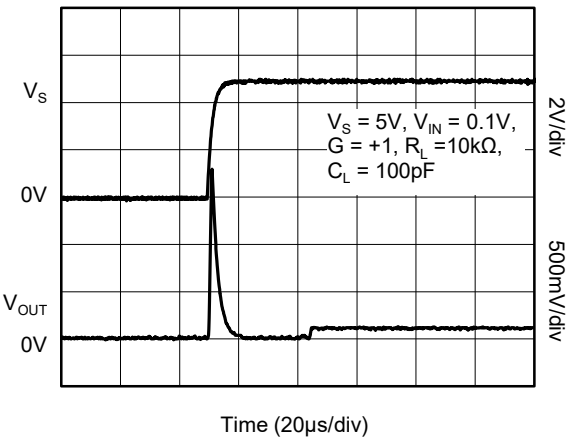
Small-Signal Step Response



Turn-On Time



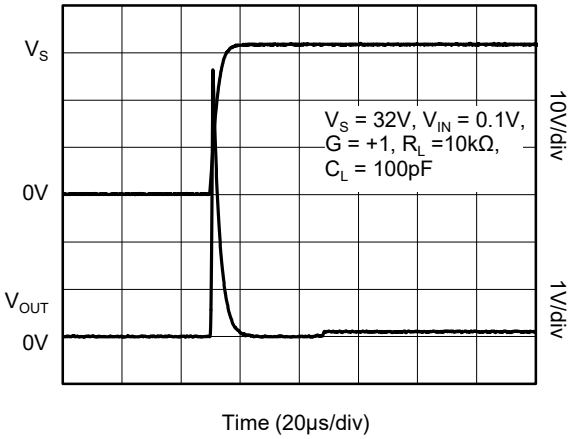
Turn-On Time



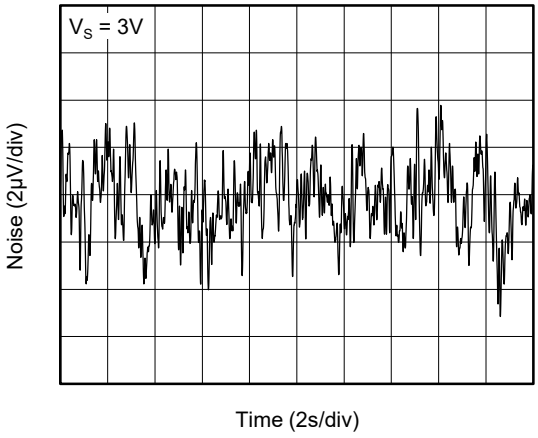
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

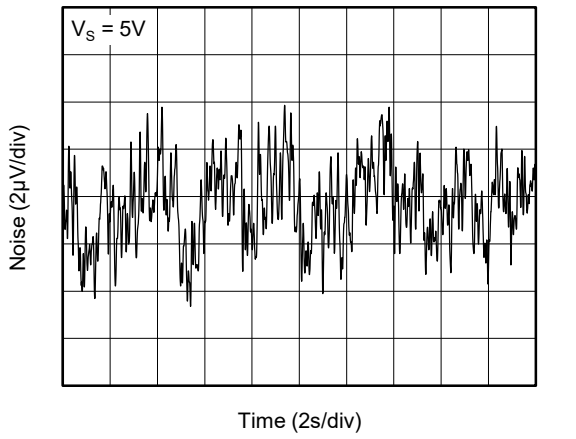
Turn-On Time



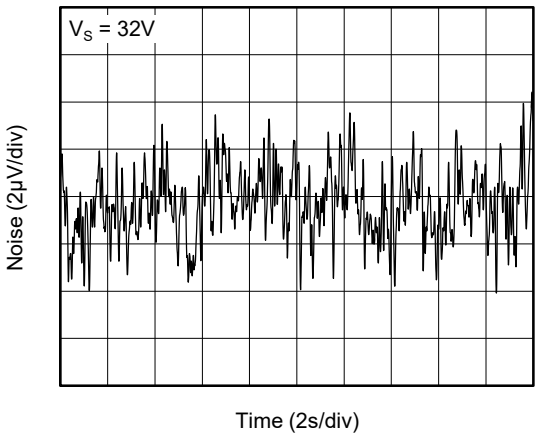
0.1Hz to 10Hz Input Voltage Noise



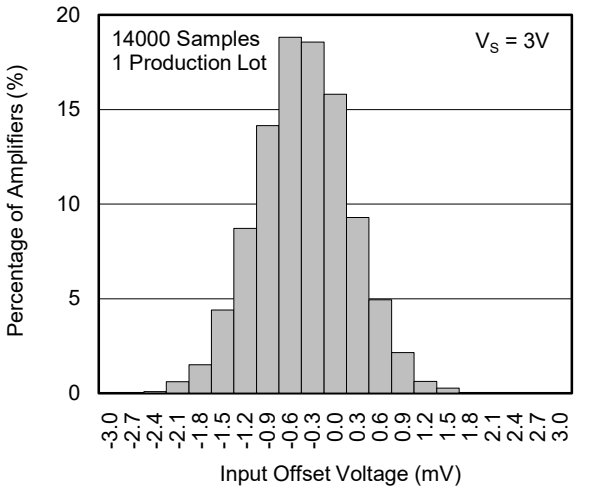
0.1Hz to 10Hz Input Voltage Noise



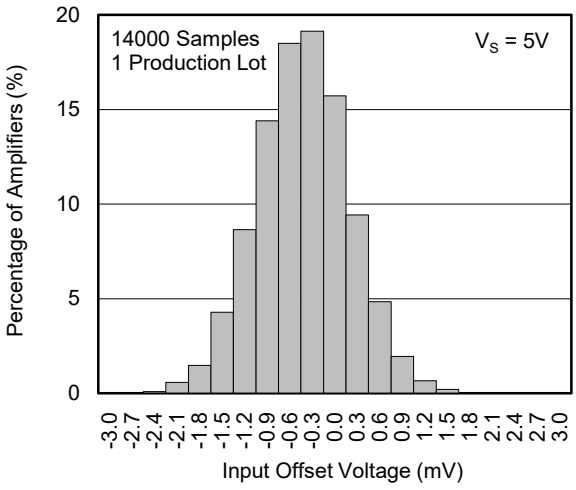
0.1Hz to 10Hz Input Voltage Noise



Input Offset Voltage Production Distribution



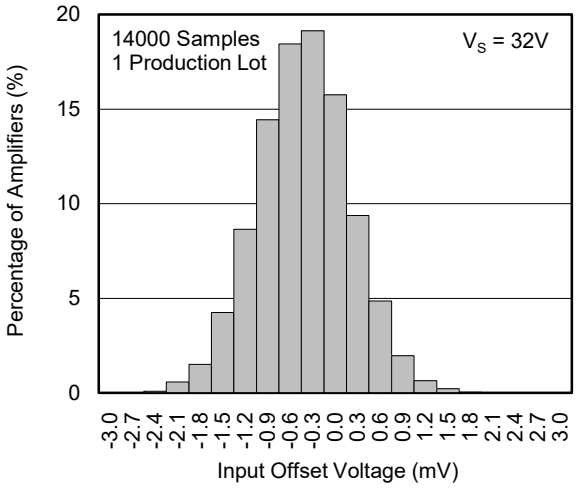
Input Offset Voltage Production Distribution



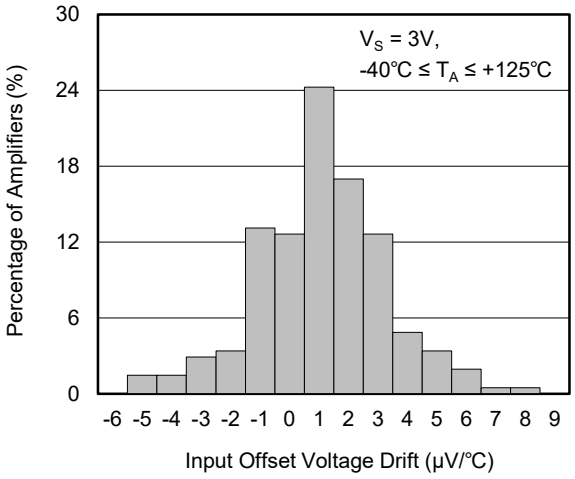
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, unless otherwise noted.

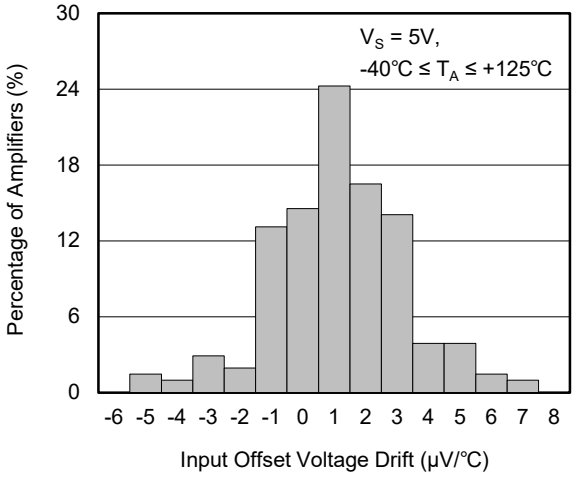
Input Offset Voltage Production Distribution



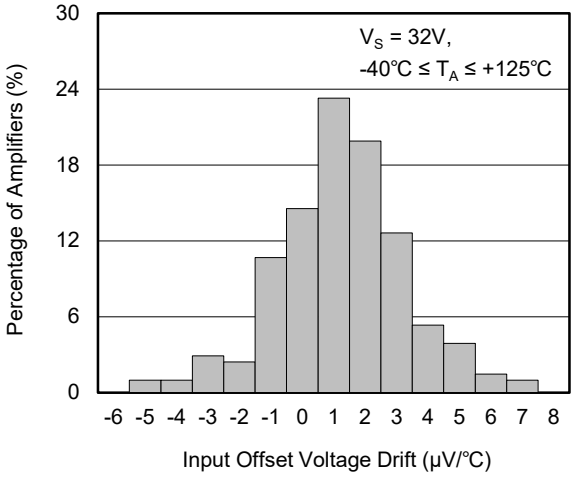
Input Offset Voltage Drift Distribution



Input Offset Voltage Drift Distribution



Input Offset Voltage Drift Distribution



DETAILED DESCRIPTION

The SGM8429C-4 is a quad, high open-loop gain operational amplifier with internal frequency compensation. It is optimized for high voltage operation from 3V to 32V single supply or ±1.5V to ±16V dual supplies. The input common mode voltage range is from -0.1V to ($+V_S$) - 1.5V.

This SGM8429C-4 makes it easier to implement all conventional operational amplifier circuits in a single-supply system, such as DC amplifier modules and transducer amplifiers. For instance, the device does not need extra ±5V supplies to work with the interface electronics, as it can be easily operated on the 5V source that is common for digital systems.

Unity-Gain Bandwidth

The unity-gain bandwidth is the maximum supported frequency which can be amplified by an amplifier without distortion. The unity-gain bandwidth of SGM8429C-4 is 1.1MHz.

Slew Rate

The slew rate is the time period for the output change when input signal is changed. The slew rate of SGM8429C-4 is 0.35V/μs.

Input Common Mode Voltage Range

The input common mode voltage range is from the device ground to ($+V_S$) - 1.5V. Also, the voltage level at the inputs can reach V_S without damaging the device. If the users desire the correct phase at the output of the operational amplifier, they need to make sure that at least one of the inputs is within the input common mode voltage range. If both of them are outside the input common mode voltage range, the state of the output will be undefined. However, if either input is below -0.3V, the input current should be limited and the output state will also be undefined.

Device Functional Modes

The SGM8429C-4 can be operated as it is powered by a DC power supply. The amplifier can be operated in single-supply or dual-supply mode.

APPLICATION INFORMATION

The SGM8429C-4 can be widely used for various signal processing purposes. The inputs have the option to get power before V_S, which allows for more versatility in circuits with multiple supplies.

Typical Application

The following circuit is an application of an inverting amplifier. To explain, the input is positive while the output is negative. However, if the input signal is negative, the output will be positive as well.

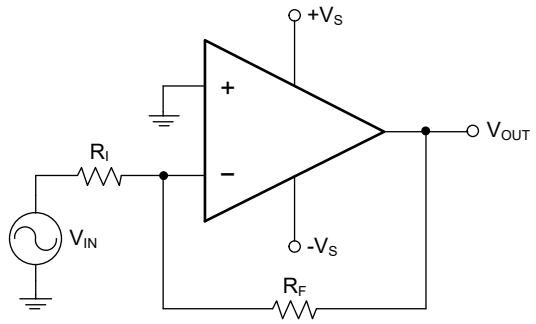


Figure 1. Application Schematic

The supply voltage range should always be larger than the input and the output range. The following example scales a signal with ±0.5V to ±1.8V, which means that the ±12V of the supply voltage is sufficient.

The following equations determine the voltage gain of the inverting amplifier circuit.

$$G = \frac{V_{OUT}}{V_{IN}} \quad (1)$$

$$G = \frac{1.8}{-0.5} = -3.6 \quad (2)$$

After setting the voltage gain, the value of the gain and feedback resistors should be determined as well. Since the operating current inside the circuit is in the mA range, the R_I and R_F should be at the level of kΩ. In this example, the R_I is 10kΩ and the R_F is 36kΩ.

$$G = -\frac{R_F}{R_I} \quad (3)$$

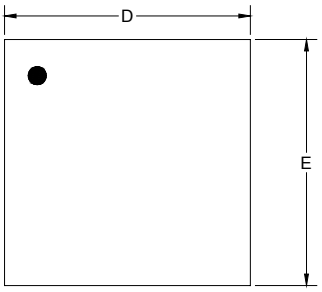
REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

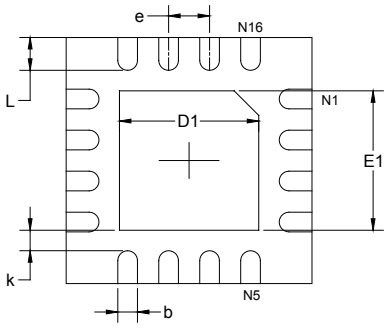
Changes from Original (AUGUST 2020) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

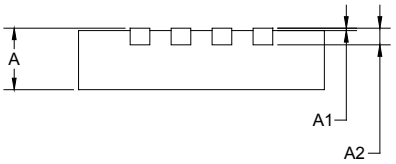
TQFN-3×3-16L



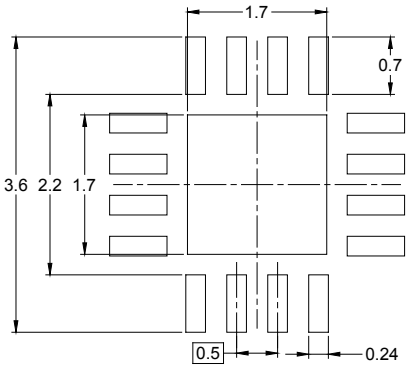
TOP VIEW



BOTTOM VIEW



SIDE VIEW

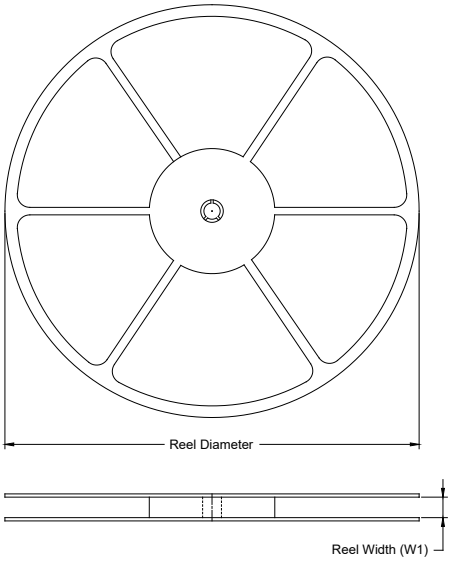


RECOMMENDED LAND PATTERN (Unit: mm)

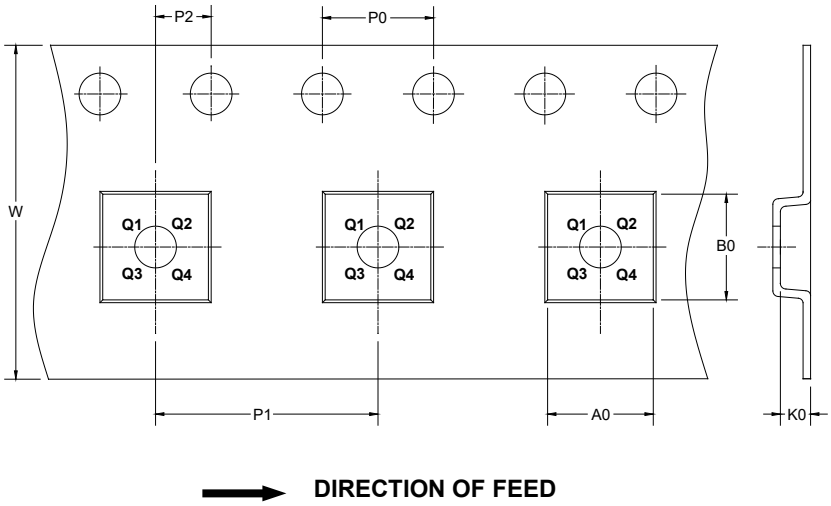
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



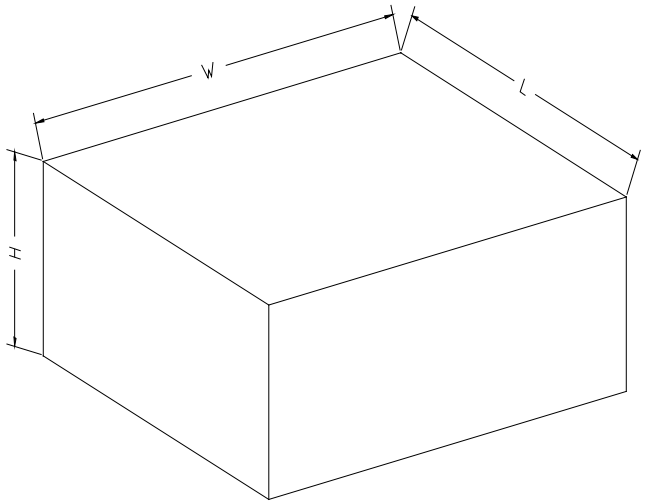
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-3×3-16L	13″	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q2

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5

DD0002