élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

EL2228C - Preliminary

Dual Low Noise Amplifier

Features

- Voltage noise of only 4.9nV/√Hz
- Current noise of only 1.2pA/√Hz
- Bandwidth (-3dB) of 80MHz @A_V = +1
- Gain-of-1 stable
- Just 4.5mA per amplifier
- 8-pin MSOP package
- ±2.5V to ±12V operation

Applications

- ADSL Filters
- HDSLII Filters
- Ultrasound input amplifiers
- Wideband Instrumentation
- Communications equipment
- Wideband sensors

Ordering Information

Part No.	Temp. Range	Package	Outline #
EL2228CY	8-Pin MSOP	-	MDP0043
EL2228CY-T13	8-Pin MSOP	13”	MDP0043
EL2228CY-T7	8-Pin MSOP	7”	MDP0043
EL2228CS	8-Pin SO	-	MDP0027
EL2228CS-T13	8-Pin SO	13”	MDP0027
EL2228CS-T7	8-Pin SO	7”	MDP0027

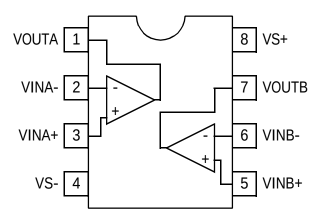
General Description

The EL2228C is a dual, low-noise amplifier, ideally suited to filtering applications in ADSL and HDSLII designs. It feature low noise specification of just 4.9nV/√Hz and 1.2pA/√Hz, making it ideal for processing low voltage waveforms.

The EL2228C has a -3dB bandwidth of 80MHz and is gain-of-1 stable. It also affords minimal power dissipation with a supply current of just 4.5mA per amplifier. The amplifier can be powered from supplies ranging from ±2.5V to ±12V.

The EL2228C is available in a space saving 8-Pin MSOP package as well as the industry standard 8-Pin SO. It can operate over the -40°C to +85°C temperature range.

Connection Diagram



EL2228C
8-Pin SO and 8-Pin MSOP

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Absolute Maximum Ratings (T_A = 25°C)

Values beyond absolute maximum ratings can cause the device to be prematurely damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Supply Voltage between V_S+ and V_S-	+28V
Input Voltage	V_S- - 0.3V, V_S +0.3V
Maximum Continuous Output Current	40mA
Maximum Die Temperature	+125°C
Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Lead Temperature	260°C
Power Dissipation	See Curves
ESD Voltage	2kV

Important Note:

All parameters having Min/Max specifications are guaranteed. Typ values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

Electrical Characteristics

V_S+= +12V, V_S - = -12V, R_L = 500Ω and C_L = 3pF to 0V, R_F = 420Ω & T_A = 25°C unless otherwise specified.

Parameter	Description	Condition	Min	Typ	Max	Unit
Input Characteristics						
V_{OS}	Input Offset Voltage	V_{CM} = 0V		0.2	3	mV
TCV_{OS}	Average Offset Voltage Drift	[1]		-4		µV/°C
I_B	Input Bias Current	V_{CM} = 0V	-9	-4.5	-1	µA
R_{IN}	Input Impedance			8		MΩ
C_{IN}	Input Capacitance			1		pF
CMIR	Common-Mode Input Range		-11.8		+10.4	V
CMRR	Common-Mode Rejection Ratio	for V_{IN} from -11.8V to +10.4V	60	90		dB
		for V_{IN} from -10V to +10V	60	75		dB
A_{VOL}	Open-Loop Gain	-5V ≤ V_{OUT} ≤ 5V	60	75		dB
e_n	Voltage Noise	f = 100kHz		4.9		nV/√Hz
i_n	Current Noise	f = 100kHz		1.2		pA/√Hz
Output Characteristics						
V_{OL}	Output Swing Low	R_L = 500Ω		-10.3	-10	V
		R_L = 250Ω		-9.5	-9	V
V_{OH}	Output Swing High	R_L = 500Ω	10	10.3		V
		R_L = 250Ω	9.5	10		V
I_{SC}	Short Circuit Current	R_L = 10Ω	140	180		mA
Power Supply Performance						
PSRR	Power Supply Rejection Ratio	V_S is moved from ±10.8V to ±13.2V	65	83		dB
I_S	Supply Current (Per Amplifier)	No load	4	5	6	mA
Dynamic Performance						
SR	Slew Rate [2]	±2.5V square wave, measured 25%-75%	44	65		V/µs
t_S	Settling to +0.1% (A_V = +1)	(A_V = +1), V_O = 2V step		50		ns
BW	-3dB Bandwidth			80		MHz
HD2	2nd Harmonic Distortion	f = 1MHz, V_O = $2V_{P-P}$, R_L = 500Ω, A_V = 2		-86		dBc
		f = 1MHz, V_O = $2V_{P-P}$, R_L = 150Ω, A_V = 2		-79		dBc
HD3	3rd Harmonic Distortion	f = 1MHz, V_O = $2V_{P-P}$, R_L = 500Ω, A_V = 2		-93		dBc
		f = 1MHz, V_O = $2V_{P-P}$, R_L = 150Ω, A_V = 2		-70		dBc

1. Measured over operating temperature range
2. Slew rate is measured on rising and falling edges

Electrical Characteristics

V_S+= +5V, V_S - = -5V, R_L = 500Ω and C_L = 3pF to 0V, R_F = 420Ω & T_A = 25°C unless otherwise specified.

Parameter	Description	Condition	Min	Typ	Max	Unit
Input Characteristics						
V_{OS}	Input Offset Voltage	V_{CM} = 0V		0.6	3	mV
TCV_{OS}	Average Offset Voltage Drift	[1]		4.9		µV/°C
I_B	Input Bias Current	V_{CM} = 0V	-9	-4.5	-1	µA
R_{IN}	Input Impedance			6		MΩ
C_{IN}	Input Capacitance			1.2		pF
CMIR	Common-Mode Input Range		-4.7		+3.4	V
CMRR	Common-Mode Rejection Ratio	for V_{IN} from -4.7V to +3.4V	60	90		dB
		for V_{IN} from -2V to +2V				dB
A_{VOL}	Open-Loop Gain	-2.5V ≤ V_{OUT} ≤ 2.5V	60	72		dB
e_n	Voltage Noise	f = 100kHz		4.7		nV/√Hz
i_n	Current Noise	f = 100kHz		1.2		pA/√Hz
Output Characteristics						
V_{OL}	Output Swing Low	R_L = 500Ω		-3.8	-3.5	V
		R_L = 250Ω		-3.7	-3.5	V
V_{OH}	Output Swing High	R_L = 500Ω	3.5	3.7		V
		R_L = 250Ω	3.5	3.6		V
I_{SC}	Short Circuit Current	R_L = 10Ω	60	100		mA
Power Supply Performance						
PSRR	Power Supply Rejection Ratio	V_S is moved from ±4.5V to ±5.5V	65	83		dB
I_S	Supply Current (Per Amplifier)	No load	3.5	4.5	5.5	mA
Dynamic Performance						
SR	Slew Rate [2]	±2.5V square wave, measured 25%-75%	35	50		V/µs
t_S	Settling to +0.1% (A_V = +1)	(A_V = +1), V_O = 2V step		50		ns
BW	-3dB Bandwidth			75		MHz
HD2	2nd Harmonic Distortion	f = 1MHz, V_O = $2V_{P-P}$, R_L = 500Ω, A_V = 2		-90		dBc
		f = 1MHz, V_O = $2V_{P-P}$, R_L = 150Ω, A_V = 2		-71		dBc
HD3	3rd Harmonic Distortion	f = 1MHz, V_O = $2V_{P-P}$, R_L = 500Ω, A_V = 2		-99		dBc
		f = 1MHz, V_O = $2V_{P-P}$, R_L = 150Ω, A_V = 2		-69		dBc

1. Measured over operating temperature range
2. Slew rate is measured on rising and falling edges

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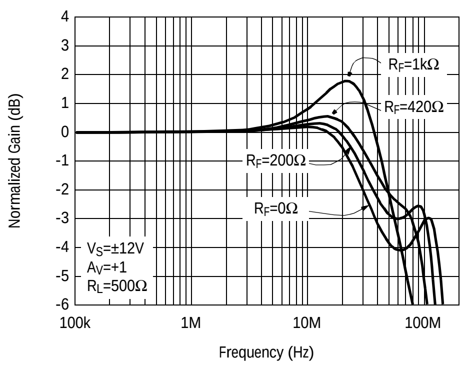
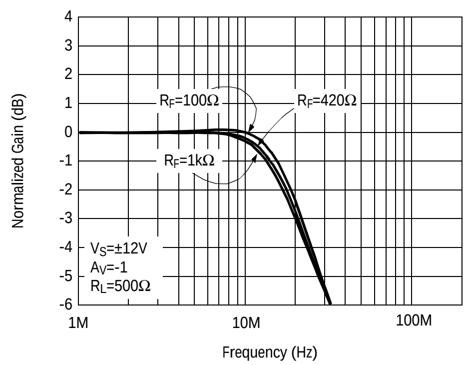
Typical Performance Curves

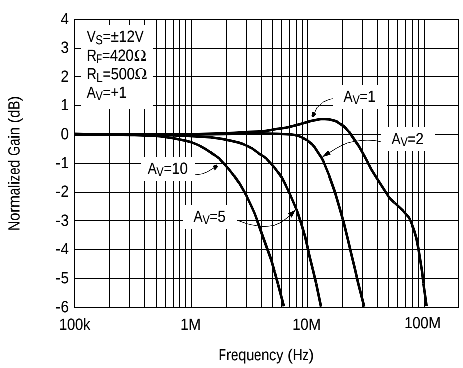
Non-inverting Frequency Response for Various R_F



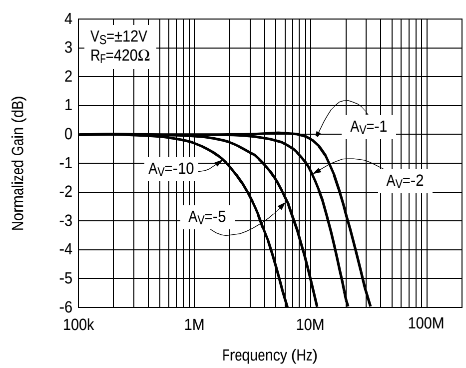
Inverting Frequency Response for Various R_F



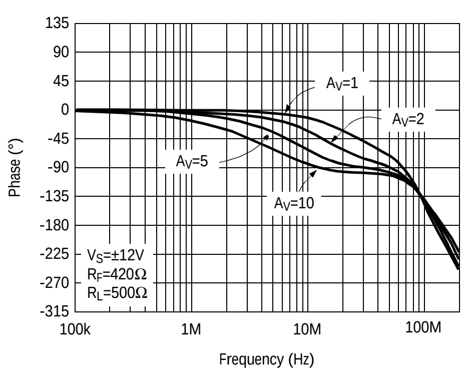
Non-inverting Frequency Response (Gain)



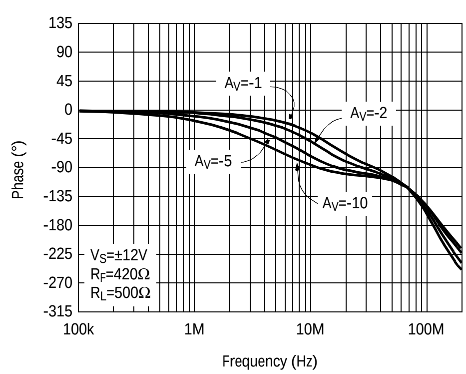
Inverting Frequency Response (Gain)



Non-inverting Frequency Response (Phase)

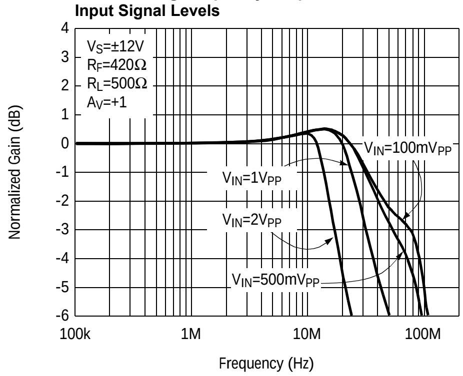


Inverting Frequency Response (Phase)

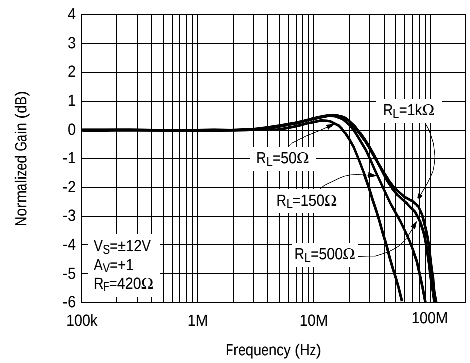


Typical Performance Curves

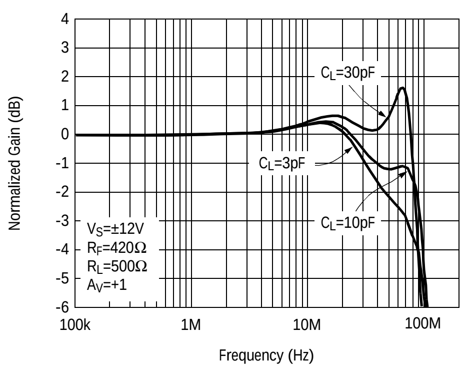
Non-inverting Frequency Response for Various Input Signal Levels



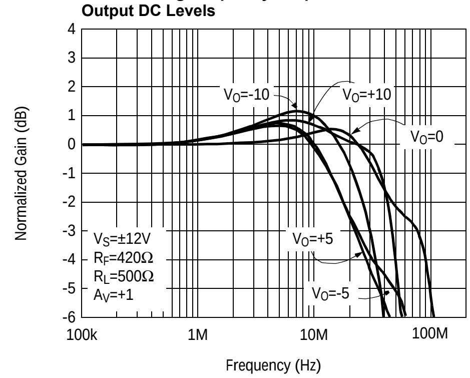
Non-inverting Frequency Response for Various R_L



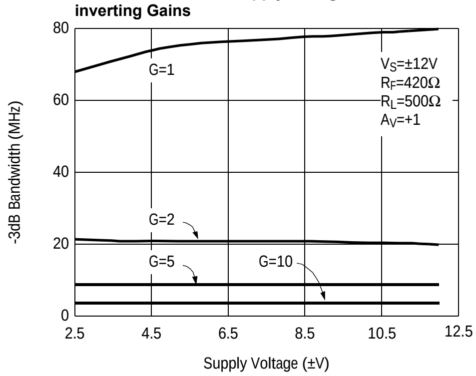
Non-inverting Frequency Response for Various C_L



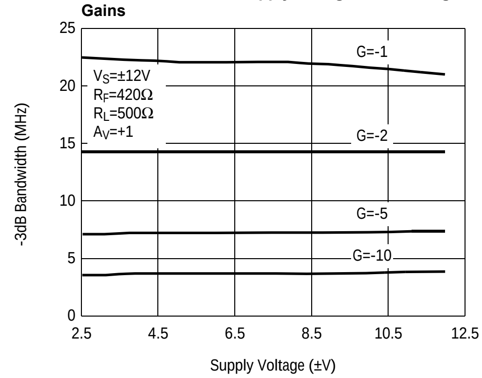
Non-inverting Frequency Response for Various Output DC Levels



-3dB Bandwidth vs ±Supply Voltage for Non-inverting Gains

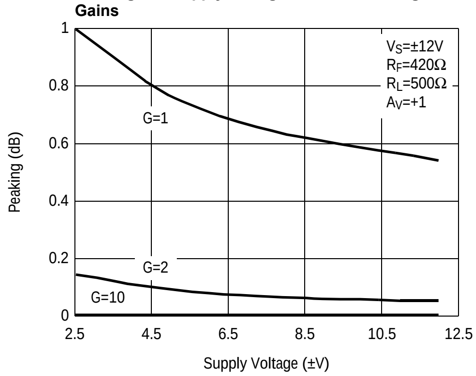


-3dB Bandwidth vs ±Supply Voltage for Inverting Gains

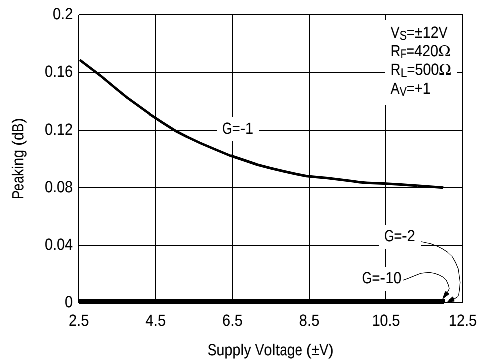


Typical Performance Curves

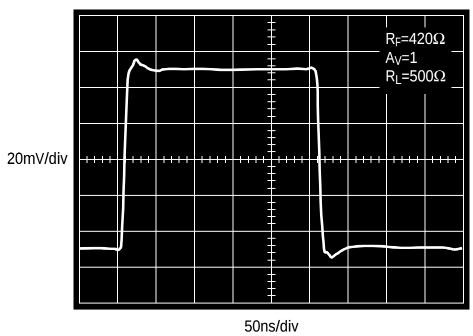
Peaking vs ±Supply Voltage for Non-inverting Gains



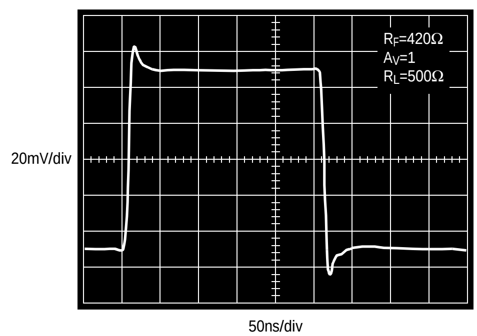
Peaking vs ±Supply Voltage for Inverting Gains



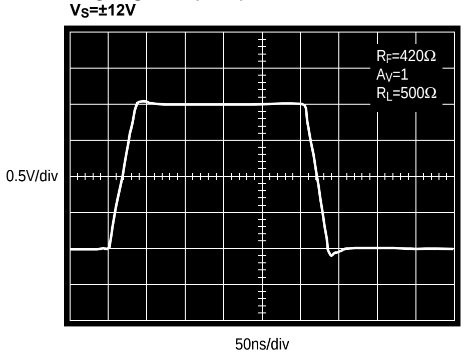
Small Signal Step Response
V_S=±12V



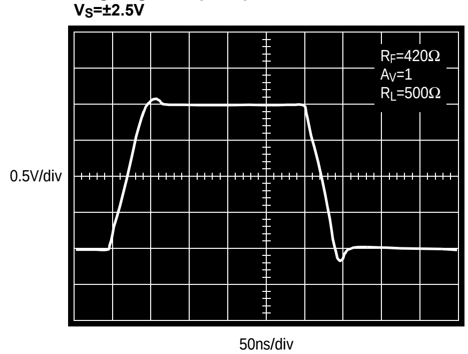
Small Signal Step Response
V_S=±2.5V



Large Signal Step Response
V_S=±12V



Large Signal Step Response
V_S=±2.5V



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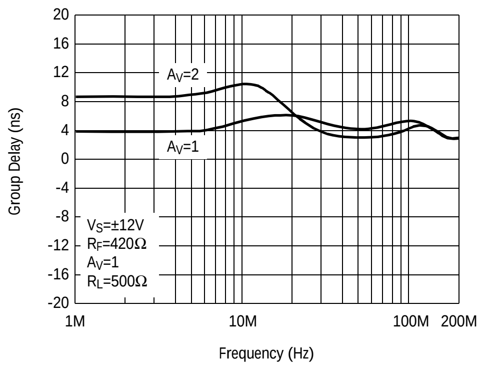
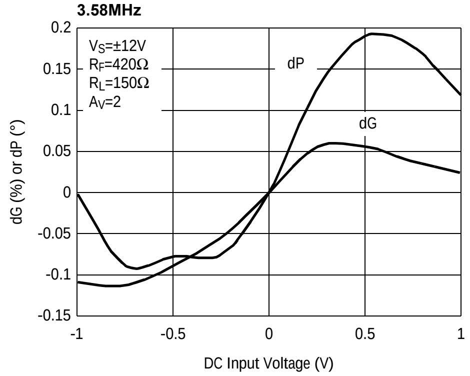
Typical Performance Curves

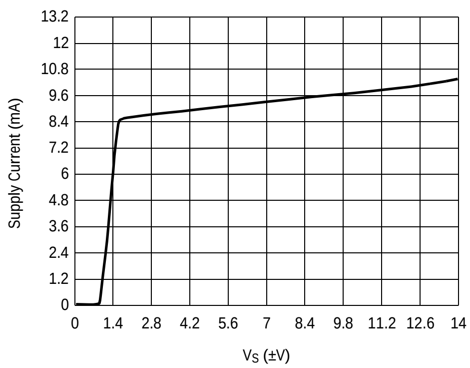
Group Delay vs Frequency



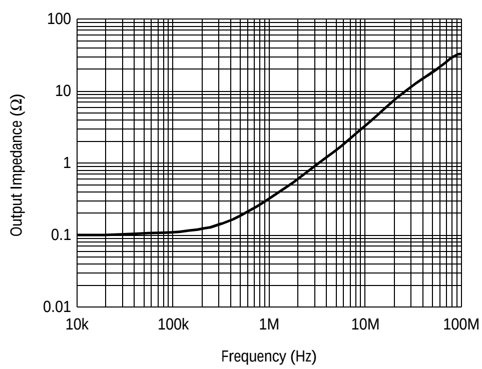
Differential Gain/Phase vs DC Input Voltage at 3.58MHz



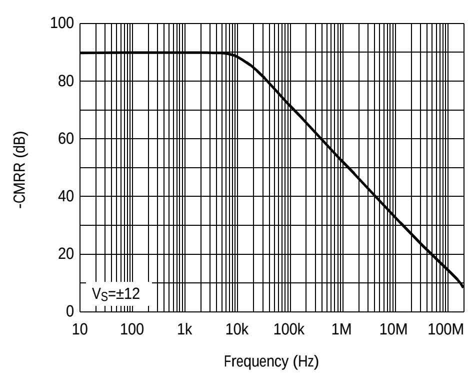
Supply Current vs Supply Voltage



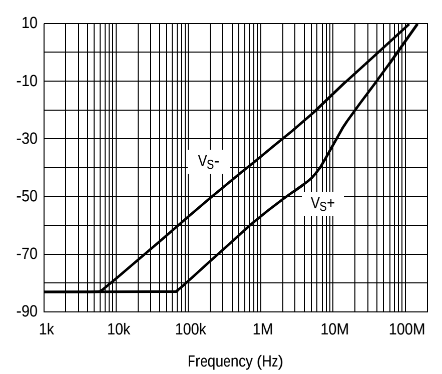
Closed Loop Output Impedance vs Frequency



CMRR



PSRR



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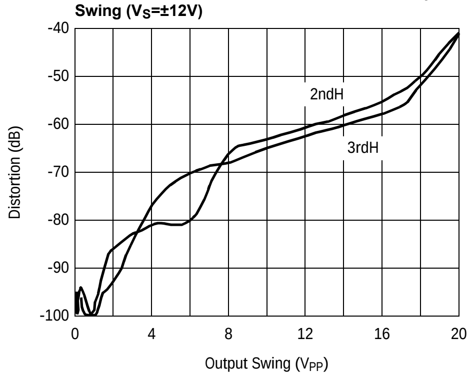
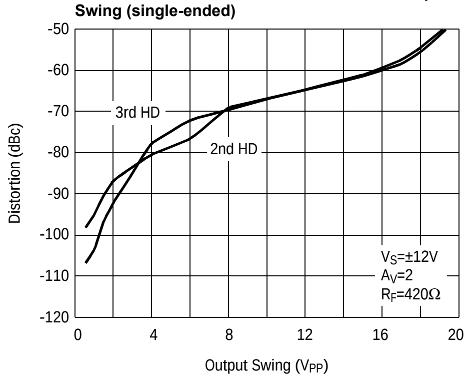
Typical Performance Curves

1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (V_S=±12V)

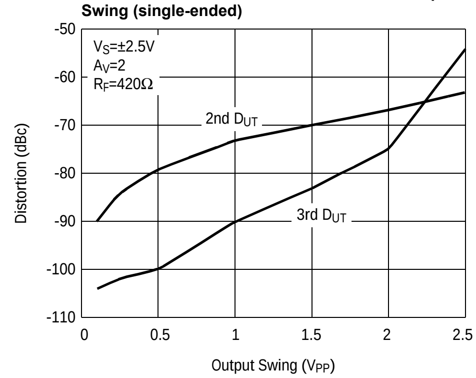


1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (V_S=±2.5V)

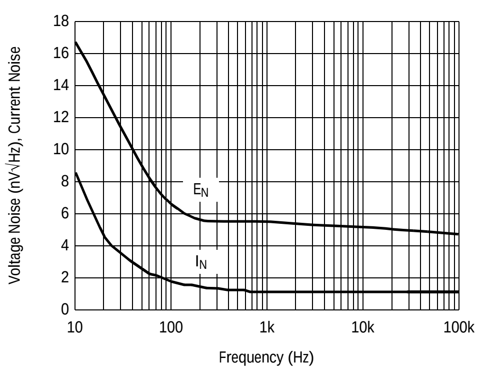
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (single-ended)



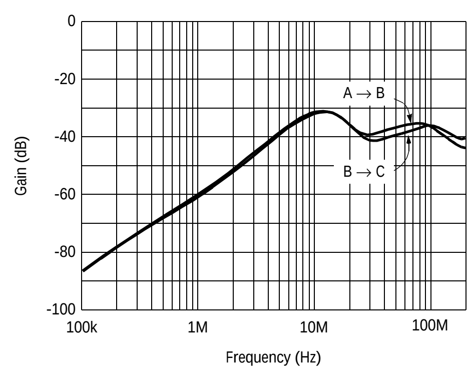
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (single-ended)



Voltage and Current Noise vs Frequency

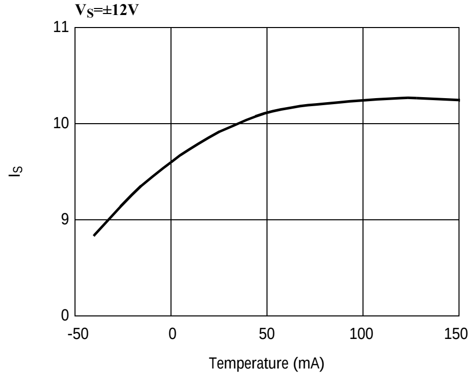


Channel to Channel Isolation vs Frequency

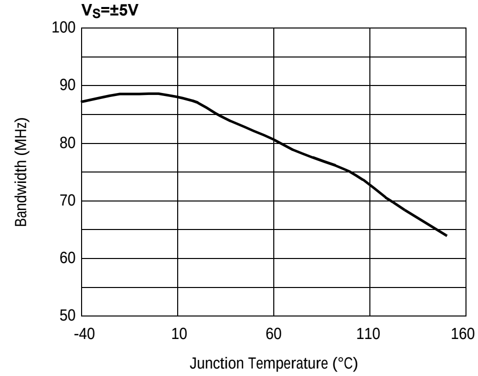


Typical Performance Curves

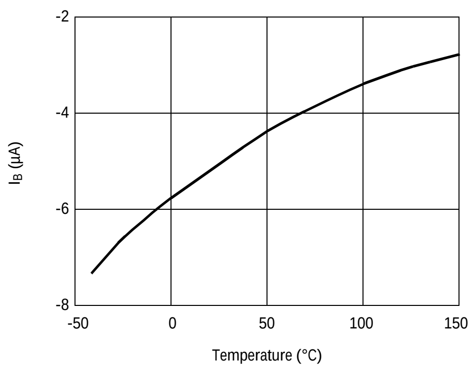
I_S vs Tempertaure
V_S=±12V



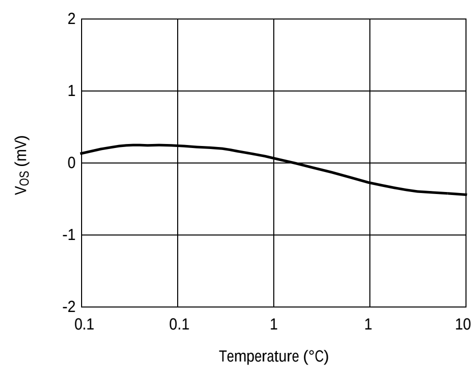
3dB Bandwidth vs Temperature
V_S=±5V



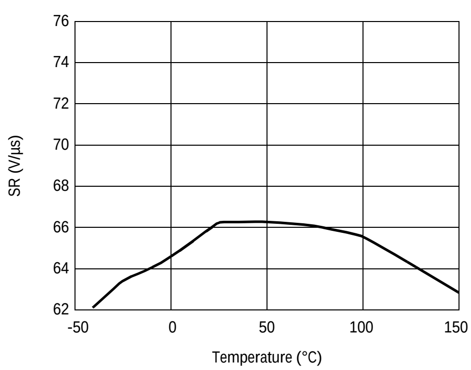
I_B vs Temperature



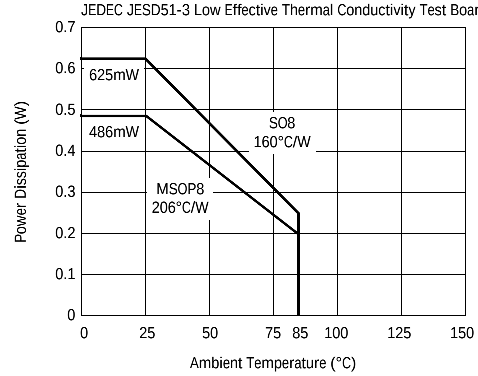
V_{OS} vs Temperature



SR vs Temperature



Package Power Dissipation vs Ambient Temp.
JEDEC JESD51-3 Low Effective Thermal Conductivity Test Board



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Pin Descriptions

EL2228CY 8-Pin MSOP	EL2228CS 8-Pin SO	Pin Name	Pin Function	Equivalent Circuit

Applications Information

Product Description

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Dual Low Noise Amplifier

General Disclaimer

Specifications contained in this data sheet are in effect as of the publication date shown. Elantec, Inc. reserves the right to make changes in the circuitry or specifications contained herein at any time without notice. Elantec, Inc. assumes no responsibility for the use of any circuits described herein and makes no representations that they are free from patent infringement.

élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

Elantec Semiconductor, Inc.
675 Trade Zone Blvd.
Milpitas, CA 95035
Telephone: (408) 945-1323
(888) ELANTEC
Fax: (408) 945-9305
European Office: +44-118-977-6020
Japan Technical Center: +81-45-682-5820

WARNING - Life Support Policy

Elantec, Inc. products are not authorized for and should not be used within Life Support Systems without the specific written consent of Elantec, Inc. Life Support systems are equipment intended to support or sustain life and whose failure to perform when properly used in accordance with instructions provided can be reasonably expected to result in significant personal injury or death. Users contemplating application of Elantec, Inc. Products in Life Support Systems are requested to contact Elantec, Inc. factory headquarters to establish suitable terms & conditions for these applications. Elantec, Inc.'s warranty is limited to replacement of defective components and does not cover injury to persons or property or other consequential damages.