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

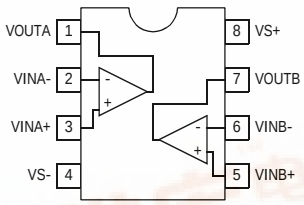
General Description

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

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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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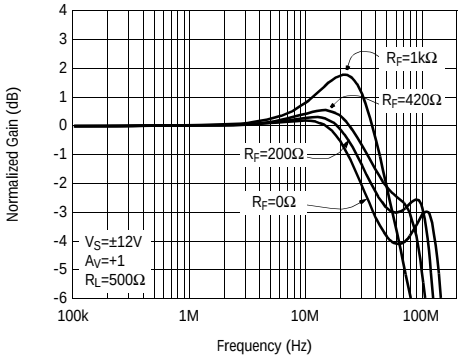
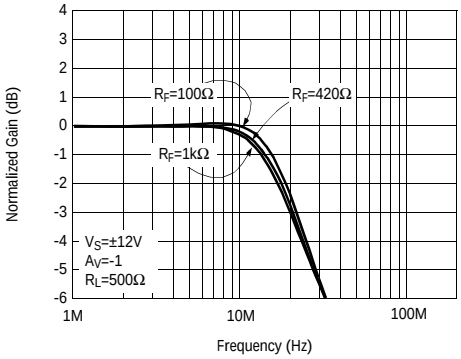
Typical Performance Curves

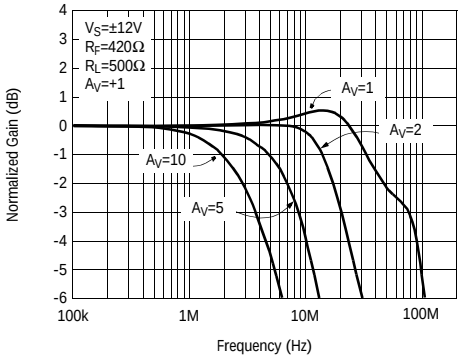
Non-inverting Frequency Response for Various R_F



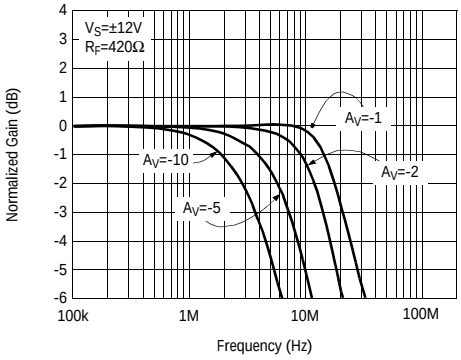
Inverting Frequency Response for Various R_F



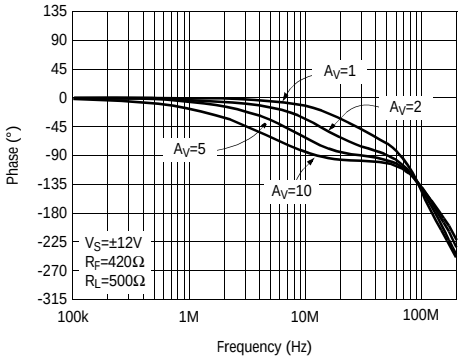
Non-inverting Frequency Response (Gain)



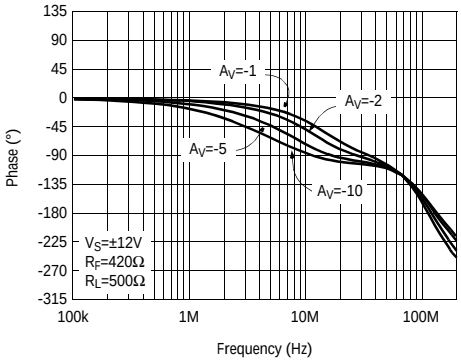
Inverting Frequency Response (Gain)



Non-inverting Frequency Response (Phase)

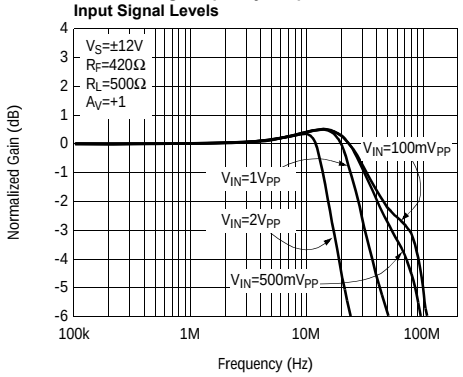


Inverting Frequency Response (Phase)

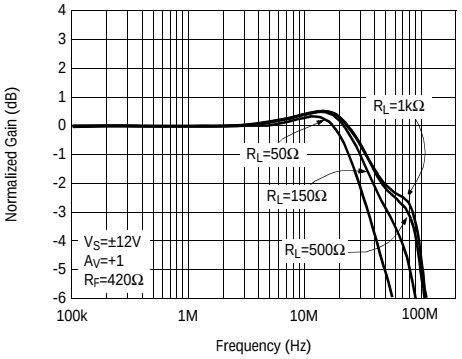


Typical Performance Curves

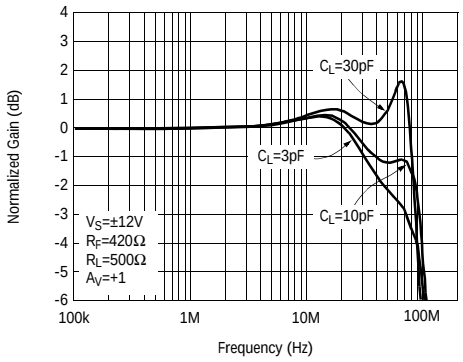
Non-inverting Frequency Response for Various Input Signal Levels



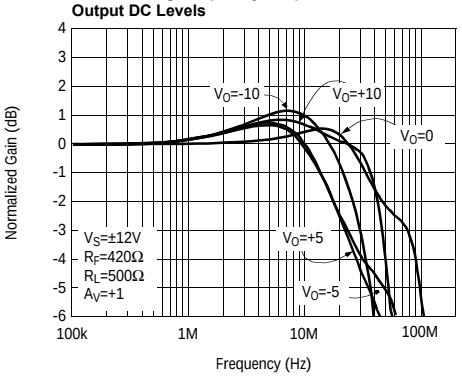
Non-inverting Frequency Response for Various R_L



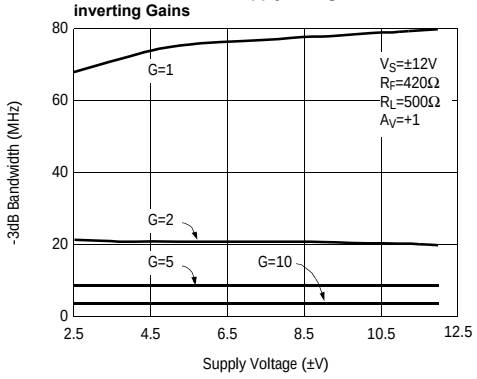
Non-inverting Frequency Response for Various C_L



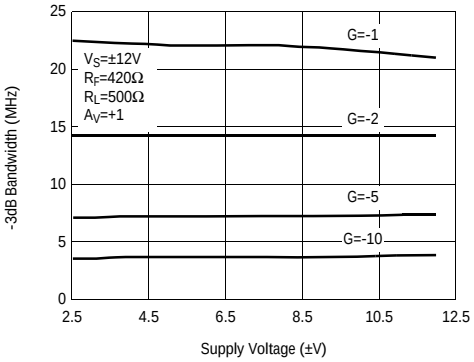
Non-inverting Frequency Response for Various Output DC Levels



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



-3dB Bandwidth vs ±Supply Voltage for Inverting Gains



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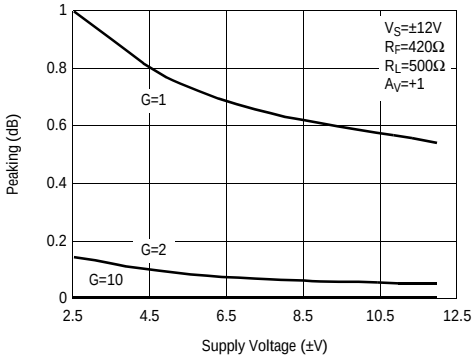
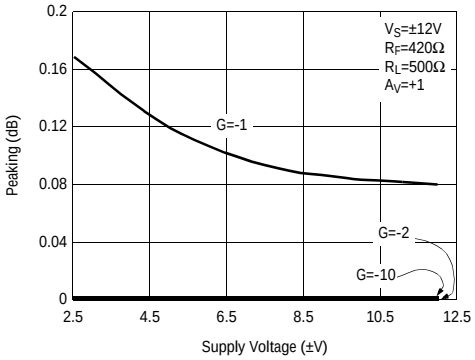
Typical Performance Curves

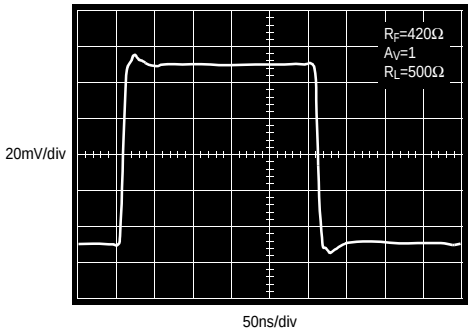
Peaking vs ±Supply Voltage for Non-inverting Gains



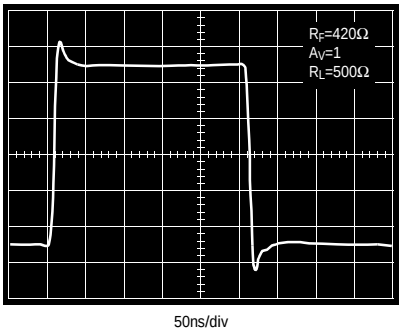
Peaking vs ±Supply Voltage for Inverting Gains



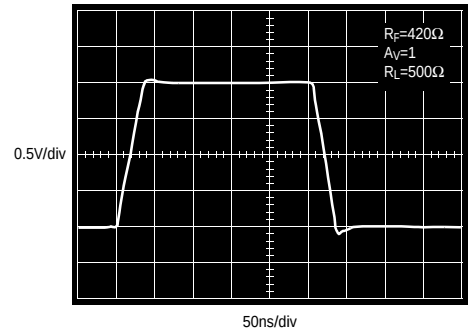
Small Signal Step Response
V_S=±12V



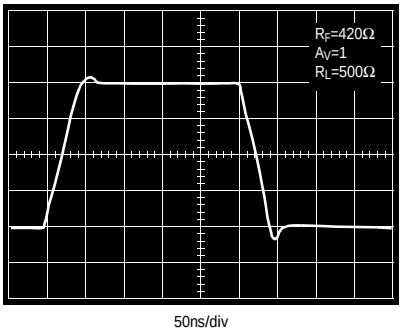
Small Signal Step Response
V_S=±2.5V



Large Signal Step Response
V_S=±12V

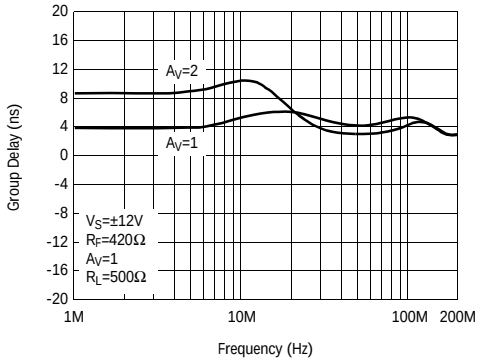


Large Signal Step Response
V_S=±2.5V

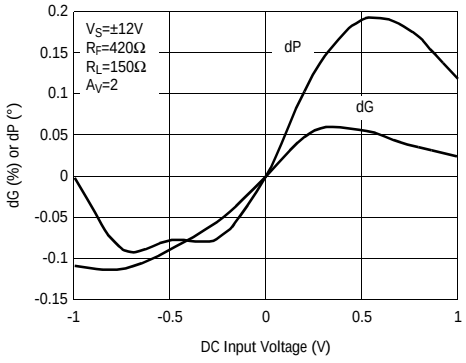


Typical Performance Curves

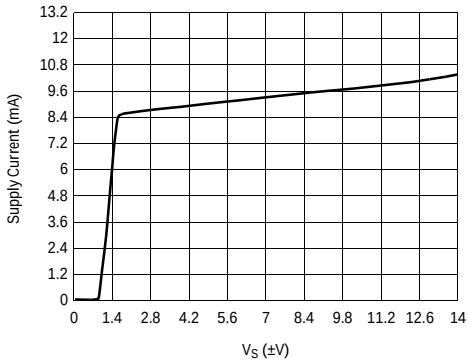
Group Delay vs Frequency



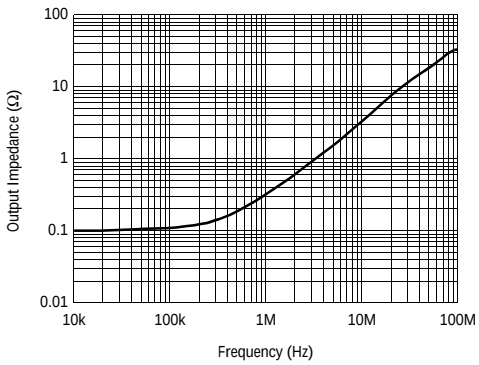
Differential Gain/Phase vs DC Input Voltage at 3.58MHz



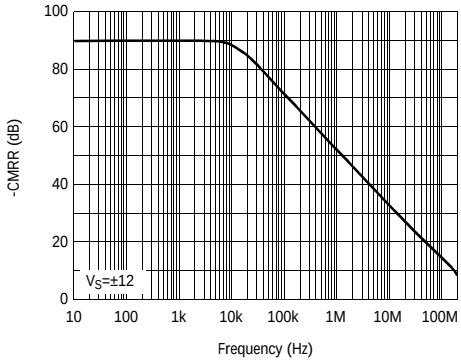
Supply Current vs Supply Voltage



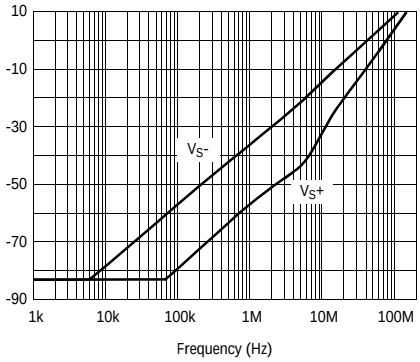
Closed Loop Output Impedance vs Frequency



CMRR



PSRR



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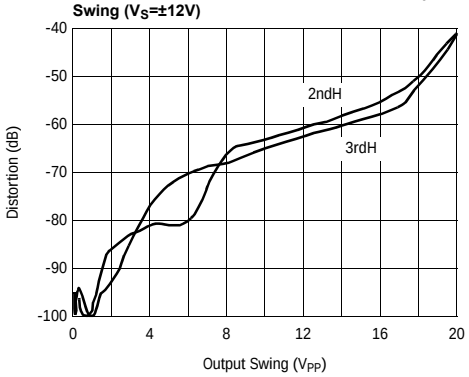
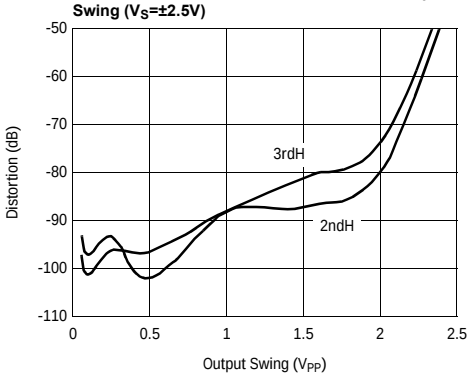
Typical Performance Curves

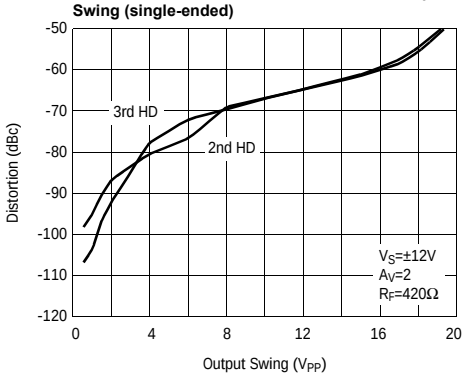
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (V_S=±12V)



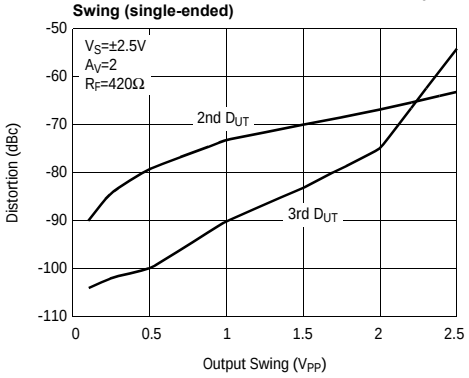
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (V_S=±2.5V)



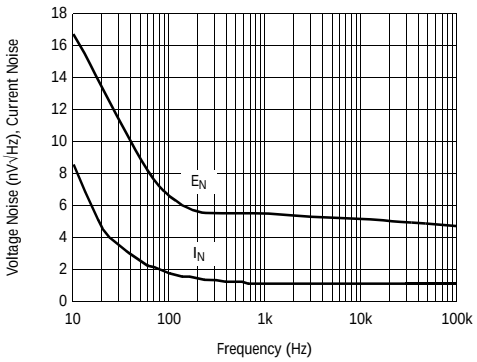
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (single-ended)



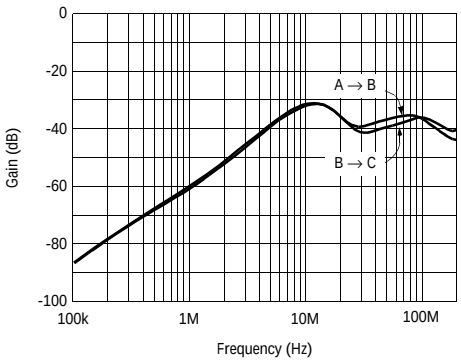
1MHz 2nd and 3rd Harmonic Distortion vs Output Swing (single-ended)



Voltage and Current Noise vs Frequency



Channel to Channel Isolation vs Frequency



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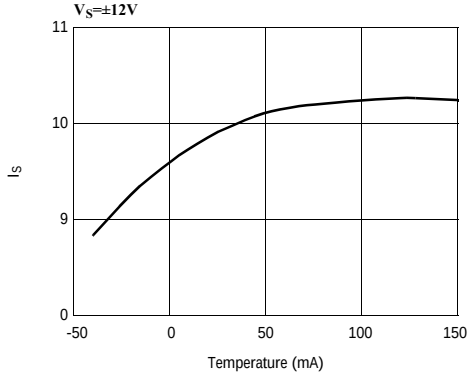
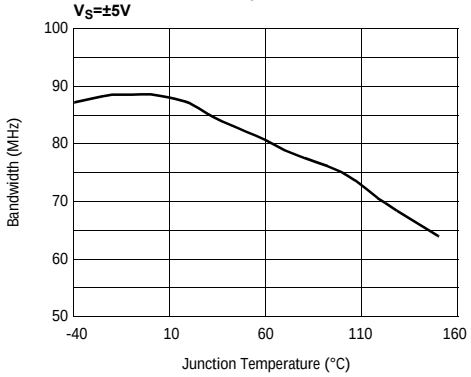
Typical Performance Curves

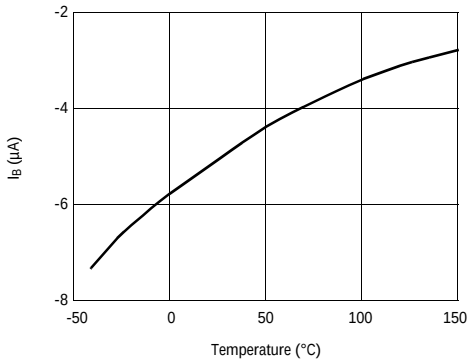
I_S vs Tempertaure
V_S=±12V



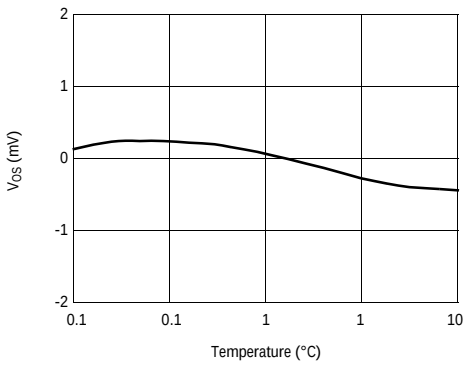
3dB Bandwidth vs Temperature
V_S=±5V



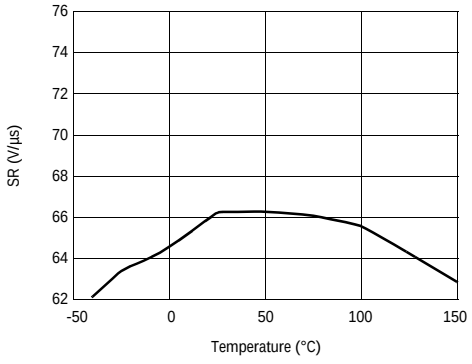
I_B vs Temperature



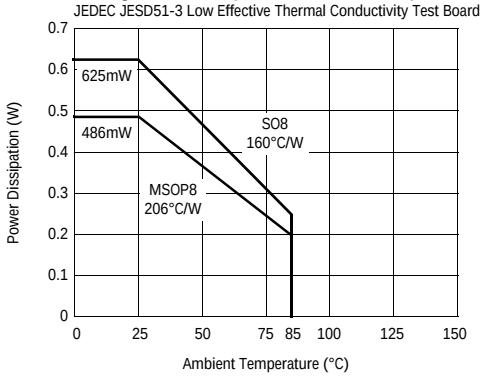
V_{OS} vs Temperature



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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HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

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