

**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
- $\pm 2.5V$  to  $\pm 12V$  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

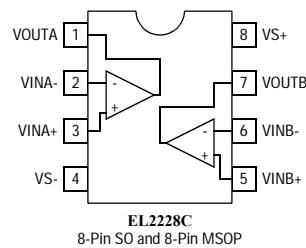
**General Description**

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  $\pm 2.5V$  to  $\pm 12V$ .

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  $-40^{\circ}C$  to  $+85^{\circ}C$  temperature range.

**Connection Diagram**



Note: All information contained in this data sheet has been carefully checked and is believed to be accurate as of the date of publication; however, this data sheet cannot be a "controlled document". Current revisions, if any, to these specifications are maintained at the factory and are available upon your request. We recommend checking the revision level before finalization of your design documentation.

# EL2228C - Preliminary

## Dual Low Noise Amplifier

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )

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	$V_{S-} - 0.3\text{V}, V_{S+} + 0.3\text{V}$
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

$V_{S+} = +12\text{V}, V_{S-} = -12\text{V}, R_L = 500\Omega$  and  $C_L = 3\text{pF}$  to  $0\text{V}, R_F = 420\Omega$  &  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Parameter	Description	Condition	Min	Typ	Max	Unit
<b>Input Characteristics</b>						
$V_{OS}$	Input Offset Voltage	$V_{CM} = 0\text{V}$		0.2	3	mV
$TCV_{OS}$	Average Offset Voltage Drift	[1]		-4		$\mu\text{V}/^\circ\text{C}$
$I_B$	Input Bias Current	$V_{CM} = 0\text{V}$	-9	-4.5	-1	$\mu\text{A}$
$R_{IN}$	Input Impedance			8		$\text{M}\Omega$
$C_{IN}$	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	$-5\text{V} \leq V_{OUT} \leq 5\text{V}$	60	75		dB
$e_n$	Voltage Noise	$f = 100\text{kHz}$		4.9		$\text{nV}/\sqrt{\text{Hz}}$
$i_n$	Current Noise	$f = 100\text{kHz}$		1.2		$\text{pA}/\sqrt{\text{Hz}}$
<b>Output Characteristics</b>						
$V_{OL}$	Output Swing Low	$R_L = 500\Omega$		-10.3	-10	V
		$R_L = 250\Omega$		-9.5	-9	V
$V_{OH}$	Output Swing High	$R_L = 500\Omega$	10	10.3		V
		$R_L = 250\Omega$	9.5	10		V
$I_{SC}$	Short Circuit Current	$R_L = 10\Omega$	140	180		mA
<b>Power Supply Performance</b>						
$PSRR$	Power Supply Rejection Ratio	$V_S$ is moved from $\pm 10.8\text{V}$ to $\pm 13.2\text{V}$	65	83		dB
$I_S$	Supply Current (Per Amplifier)	No load	4	5	6	mA
<b>Dynamic Performance</b>						
$SR$	Slew Rate [2]	$\pm 2.5\text{V}$ square wave, measured 25%-75%	44	65		$\text{V}/\mu\text{s}$
$t_S$	Settling to +0.1% ( $A_V = +1$ )	( $A_V = +1$ ), $V_O = 2\text{V}$ step		50		ns
$BW$	-3dB Bandwidth			80		MHz
$HD2$	2nd Harmonic Distortion	$f = 1\text{MHz}, V_O = 2V_{P-P}, R_L = 500\Omega, A_V = 2$		-86		dBc
		$f = 1\text{MHz}, V_O = 2V_{P-P}, R_L = 150\Omega, A_V = 2$		-79		dBc
$HD3$	3rd Harmonic Distortion	$f = 1\text{MHz}, V_O = 2V_{P-P}, R_L = 500\Omega, A_V = 2$		-93		dBc
		$f = 1\text{MHz}, V_O = 2V_{P-P}, R_L = 150\Omega, A_V = 2$		-70		dBc

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

# EL2228C - Preliminary

## Dual Low Noise Amplifier

EL2228C - Preliminary

### Electrical Characteristics

$V_{S+} = +5V$ ,  $V_{S-} = -5V$ ,  $R_L = 500\Omega$  and  $C_L = 3pF$  to  $0V$ ,  $R_F = 420\Omega$  &  $T_A = 25^\circ C$  unless otherwise specified.

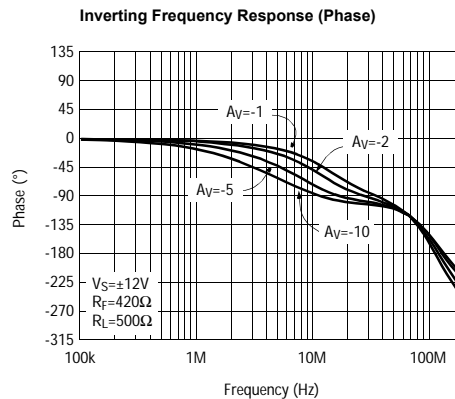
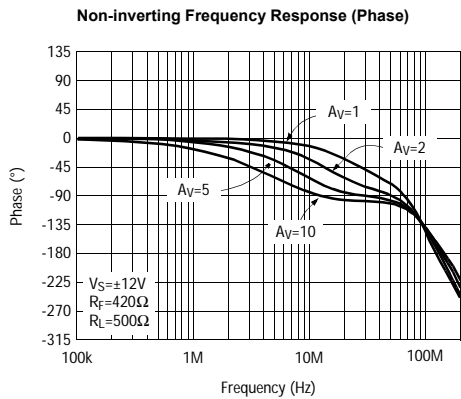
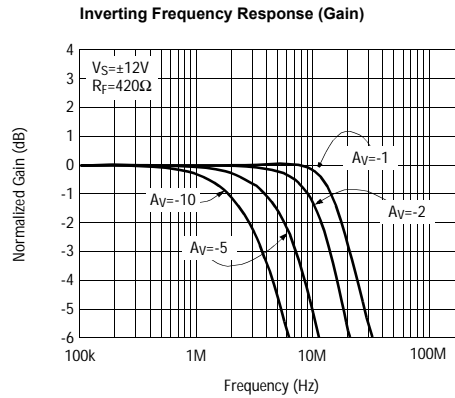
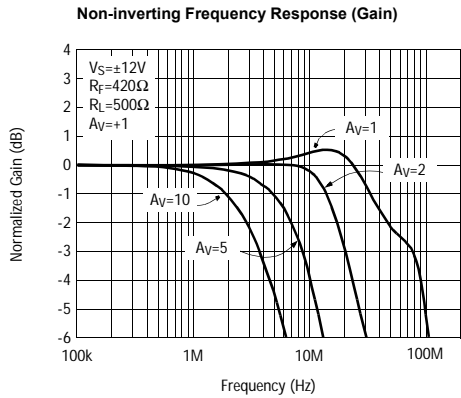
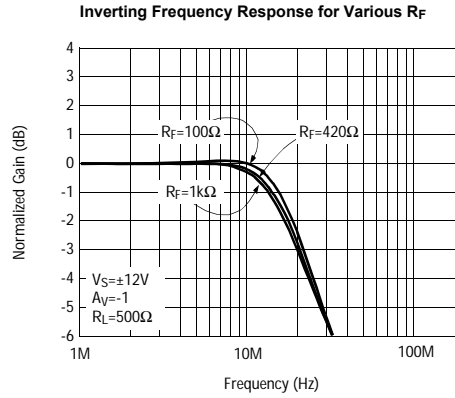
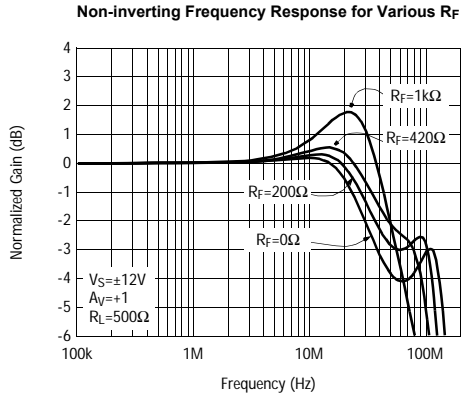
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<b>Input Characteristics</b>						
$V_{OS}$	Input Offset Voltage	$V_{CM} = 0V$		0.6	3	mV
$TCV_{OS}$	Average Offset Voltage Drift	[1]		4.9		$\mu V/^\circ C$
$I_B$	Input Bias Current	$V_{CM} = 0V$	-9	-4.5	-1	$\mu A$
$R_{IN}$	Input Impedance			6		$M\Omega$
$C_{IN}$	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	$-2.5V \leq V_{OUT} \leq 2.5V$	60	72		dB
$e_n$	Voltage Noise	$f = 100kHz$		4.7		$nV/\sqrt{Hz}$
$i_n$	Current Noise	$f = 100kHz$		1.2		$pA/\sqrt{Hz}$
<b>Output Characteristics</b>						
$V_{OL}$	Output Swing Low	$R_L = 500\Omega$		-3.8	-3.5	V
		$R_L = 250\Omega$		-3.7	-3.5	V
$V_{OH}$	Output Swing High	$R_L = 500\Omega$	3.5	3.7		V
		$R_L = 250\Omega$	3.5	3.6		V
$I_{SC}$	Short Circuit Current	$R_L = 10\Omega$	60	100		mA
<b>Power Supply Performance</b>						
PSRR	Power Supply Rejection Ratio	$V_S$ is moved from $\pm 4.5V$ to $\pm 5.5V$	65	83		dB
$I_S$	Supply Current (Per Amplifier)	No load	3.5	4.5	5.5	mA
<b>Dynamic Performance</b>						
SR	Slew Rate [2]	$\pm 2.5V$ square wave, measured 25%-75%	35	50		$V/\mu s$
$t_s$	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	$f = 1MHz$ , $V_O = 2V_{P-P}$ , $R_L = 500\Omega$ , $A_V = 2$		-90		dBc
		$f = 1MHz$ , $V_O = 2V_{P-P}$ , $R_L = 150\Omega$ , $A_V = 2$		-71		dBc
HD3	3rd Harmonic Distortion	$f = 1MHz$ , $V_O = 2V_{P-P}$ , $R_L = 500\Omega$ , $A_V = 2$		-99		dBc
		$f = 1MHz$ , $V_O = 2V_{P-P}$ , $R_L = 150\Omega$ , $A_V = 2$		-69		dBc

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

# EL2228C - Preliminary

## Dual Low Noise Amplifier

### Typical Performance Curves

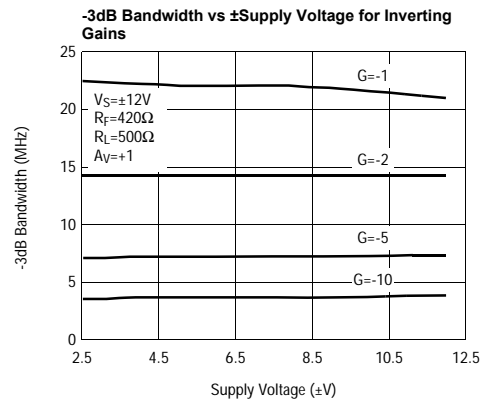
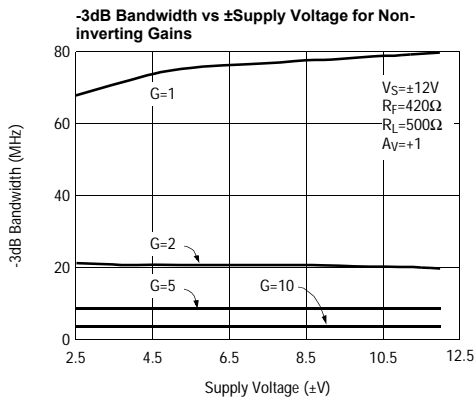
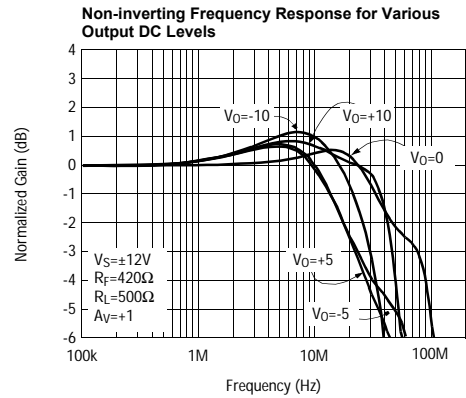
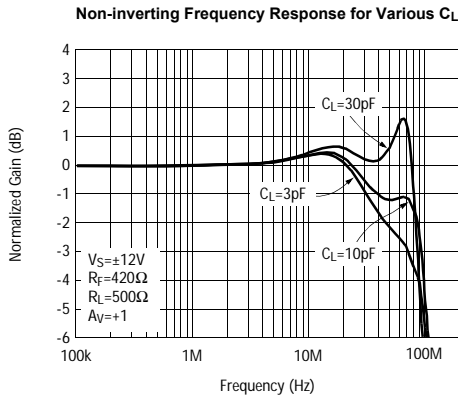
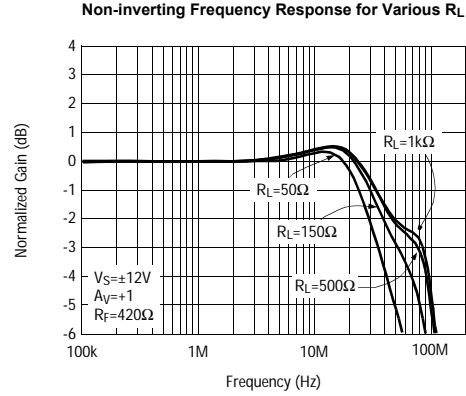
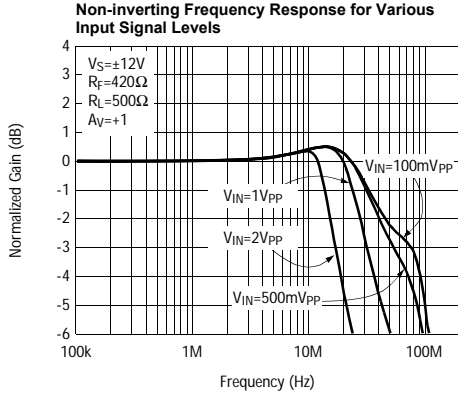


# EL2228C - Preliminary

## Dual Low Noise Amplifier

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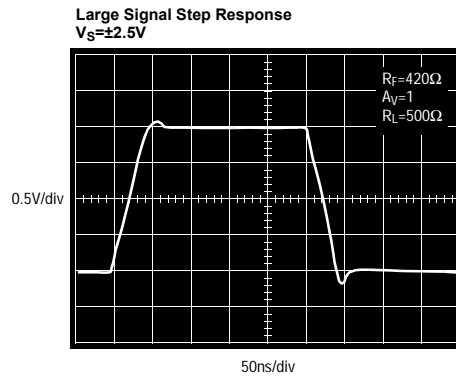
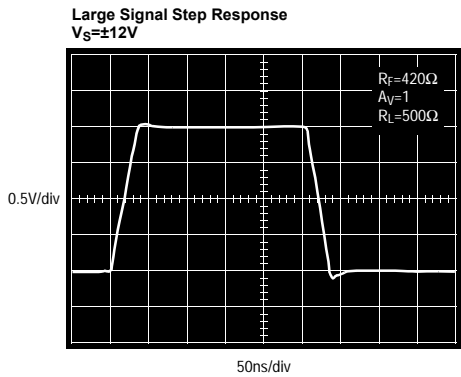
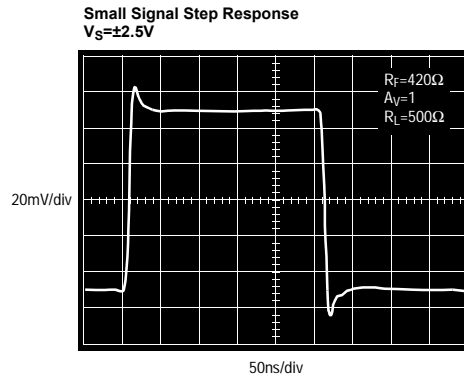
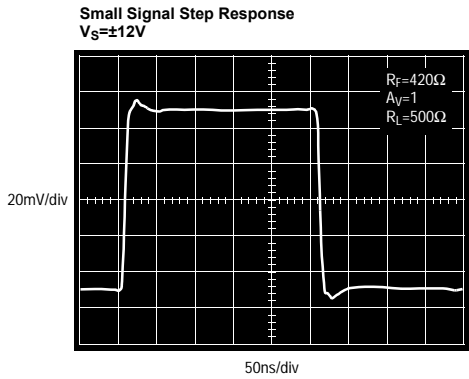
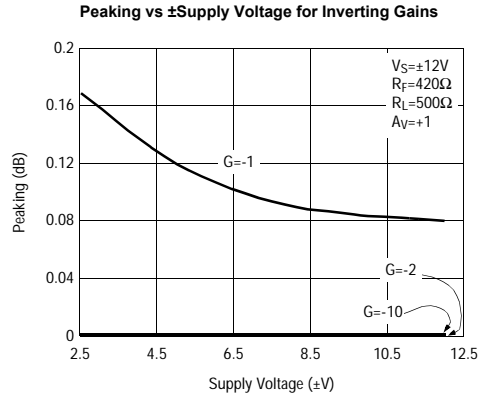
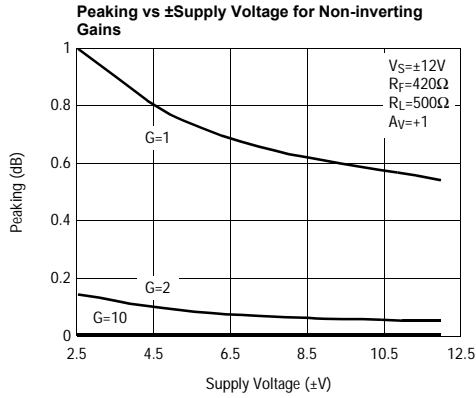
### Typical Performance Curves



# EL2228C - Preliminary

## Dual Low Noise Amplifier

### Typical Performance Curves

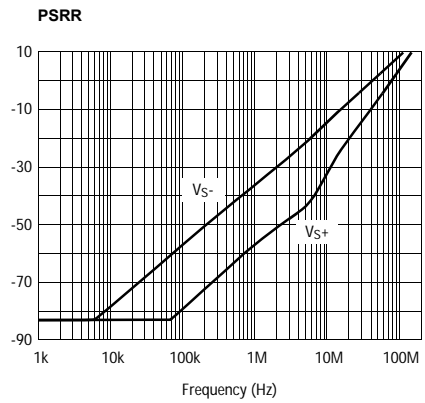
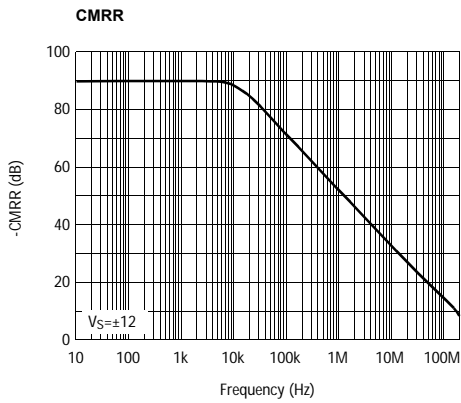
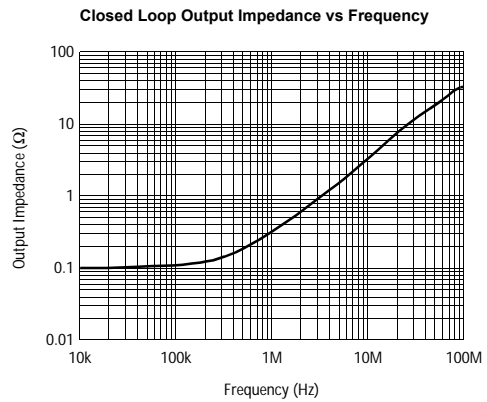
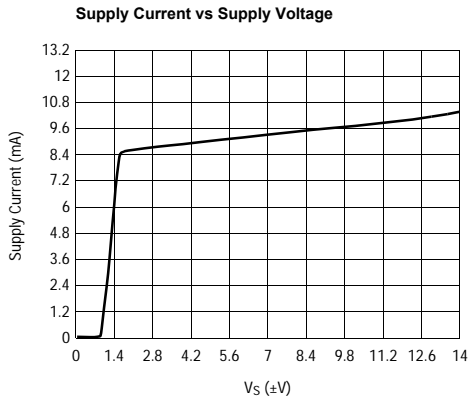
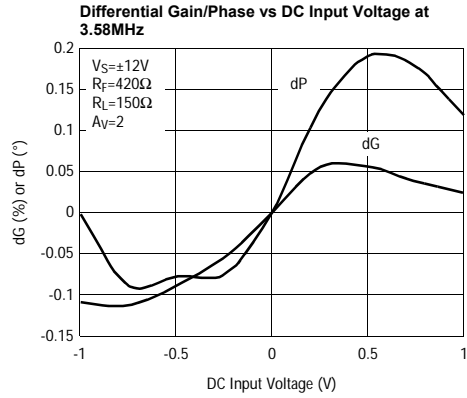
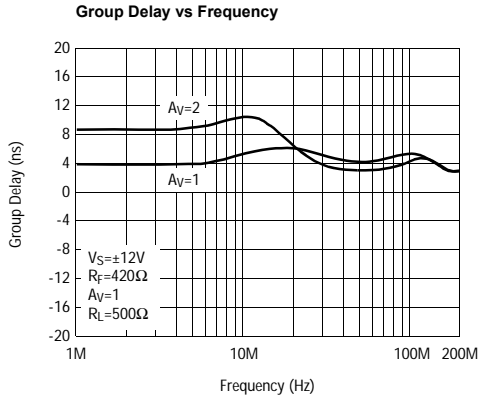


# EL2228C - Preliminary

## Dual Low Noise Amplifier

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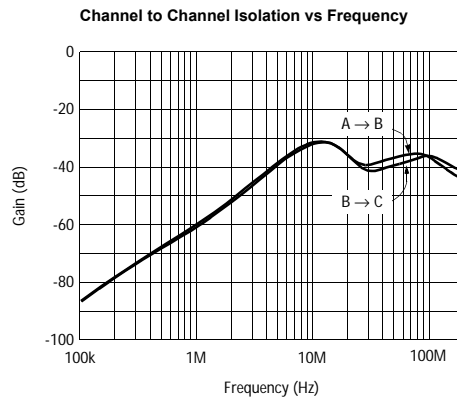
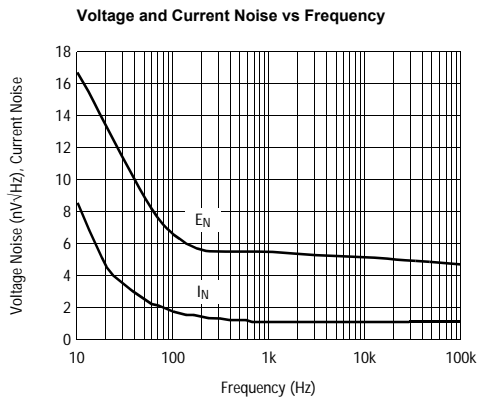
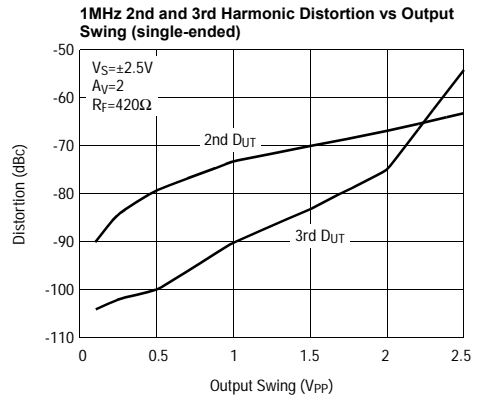
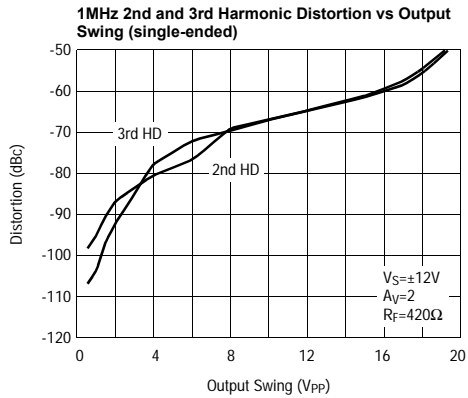
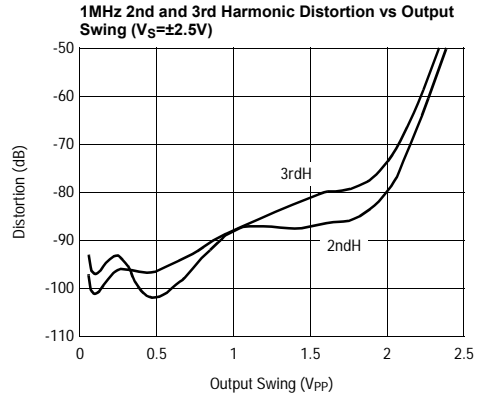
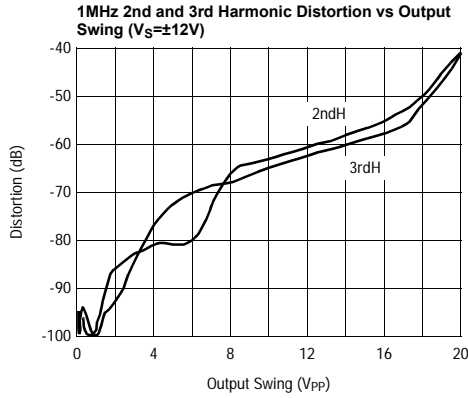
### Typical Performance Curves



# EL2228C - Preliminary

## Dual Low Noise Amplifier

### Typical Performance Curves



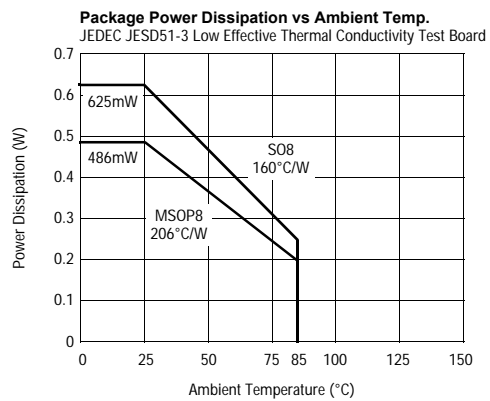
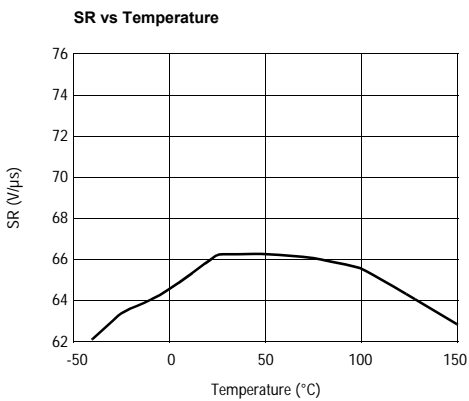
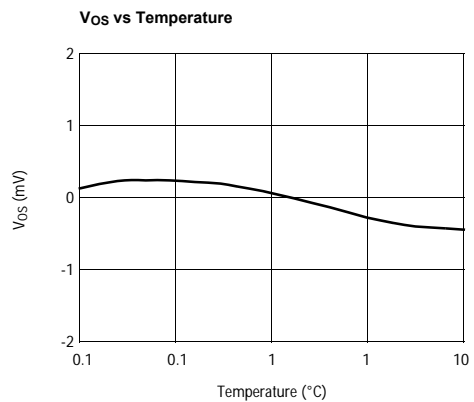
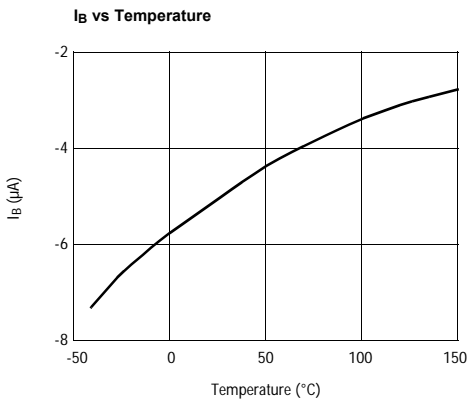
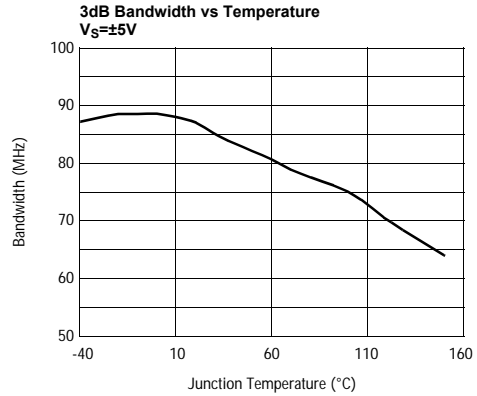
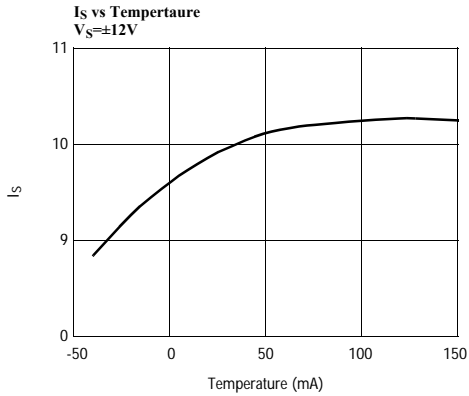


# EL2228C - Preliminary

## Dual Low Noise Amplifier

EL2228C - Preliminary

### Typical Performance Curves



**EL2228C - Preliminary**  
*Dual Low Noise Amplifier*

**Pin Descriptions**

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

***EL2228C - Preliminary***  
*Dual Low Noise Amplifier*

EL2228C - Preliminary

**Applications Information**

**Product Description**

# ***EL2228C - Preliminary***

*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

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