

Features

- Voltage noise of only $4.9\text{nV}/\sqrt{\text{Hz}}$
- Current noise of only $1.2\text{pA}/\sqrt{\text{Hz}}$
- Bandwidth (-3dB) of 80MHz
@ $A_V = +1$
- Gain-of-1 stable
- Just 4.5mA per amplifier
- 8-pin MSOP package
- $\pm 2.5\text{V}$ to $\pm 12\text{V}$ 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

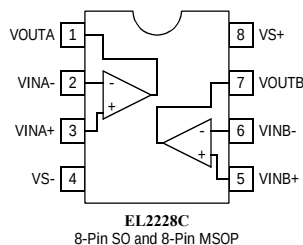
General Description

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 $4.9\text{nV}/\sqrt{\text{Hz}}$ and $1.2\text{pA}/\sqrt{\text{Hz}}$, 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 $\pm 2.5\text{V}$ to $\pm 12\text{V}$.

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 $+85^\circ\text{C}$ temperature range.

Connection Diagram



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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

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

Parameter	Description	Condition	Min	Typ	Max	Unit
Input Characteristics						
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	μA
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		$\text{pA}/\sqrt{\text{Hz}}$
Output Characteristics						
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
Power Supply Performance						
$PSRR$	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
Dynamic Performance						
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

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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.

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		$\mu V/^\circ C$
I_B	Input Bias Current	$V_{CM} = 0V$	-9	-4.5	-1	μA
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		$pA/\sqrt{Hz}$
Output Characteristics						
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
Power Supply Performance						
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
Dynamic Performance						
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

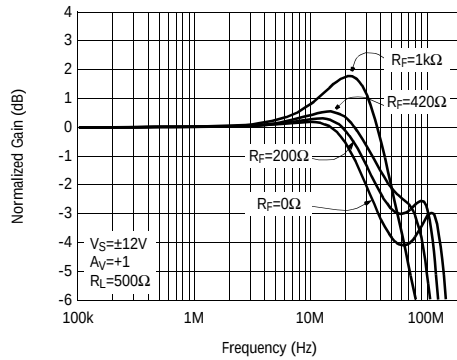
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2. Slew rate is measured on rising and falling edges

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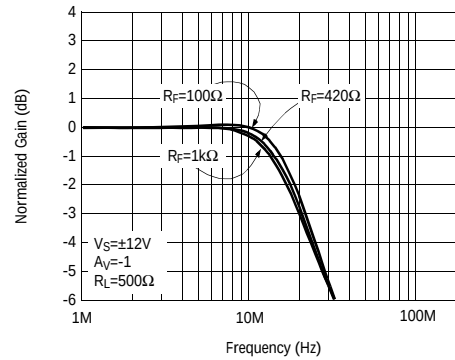
Dual Low Noise Amplifier

Typical Performance Curves

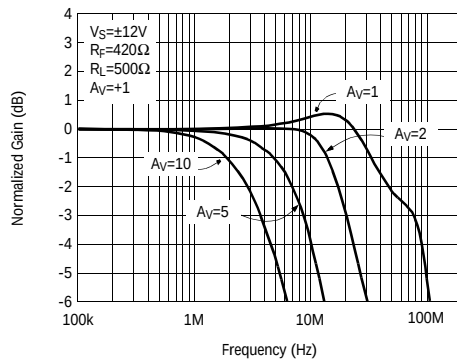
Non-inverting Frequency Response for Various R_F



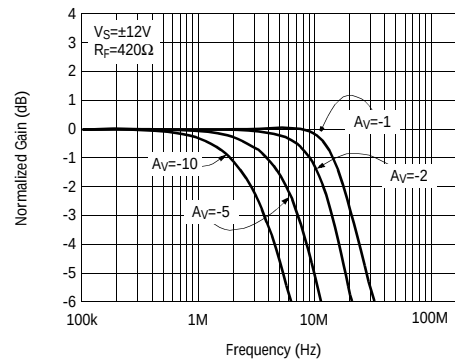
Inverting Frequency Response for Various R_F



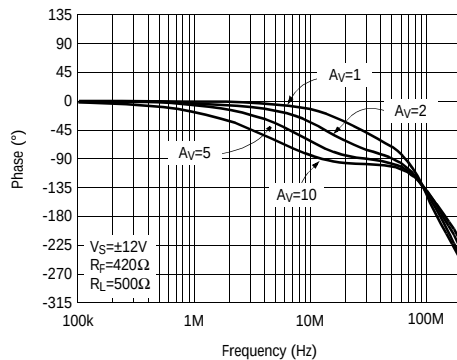
Non-inverting Frequency Response (Gain)



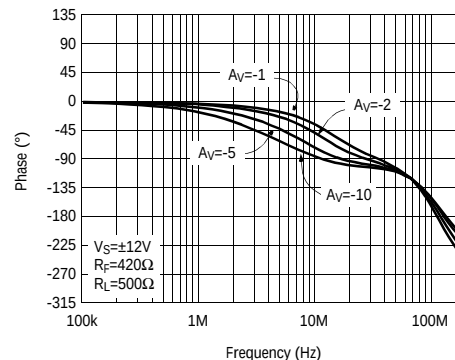
Inverting Frequency Response (Gain)



Non-inverting Frequency Response (Phase)



Inverting Frequency Response (Phase)

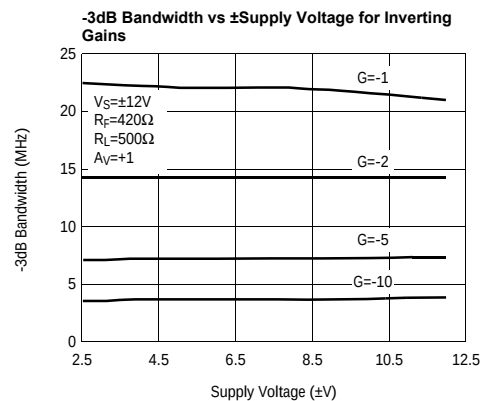
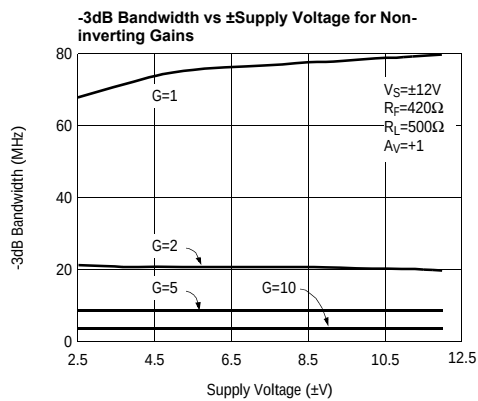
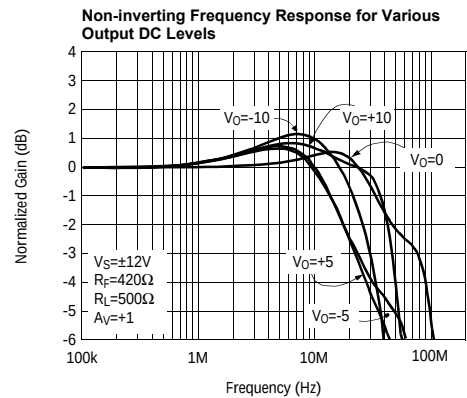
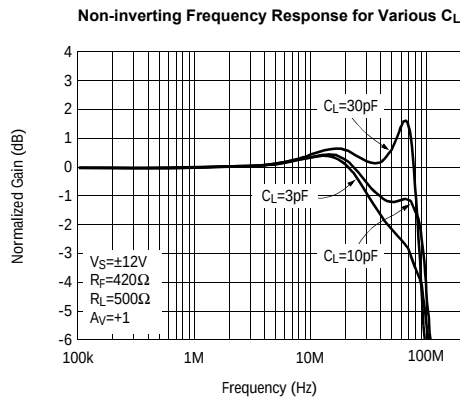
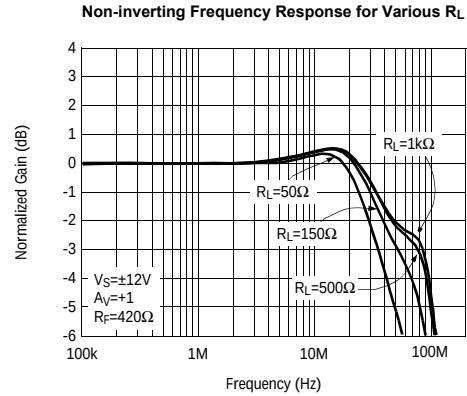
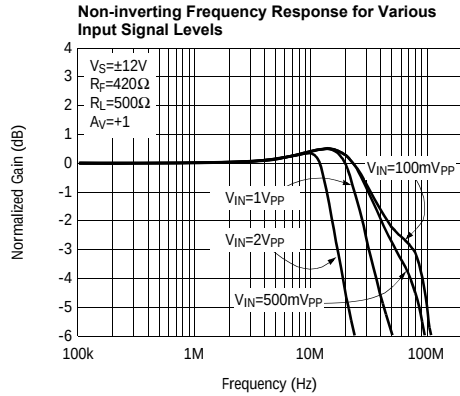


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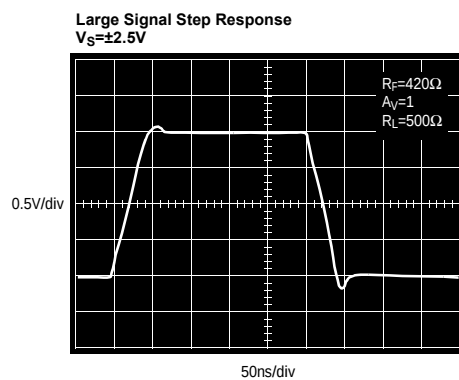
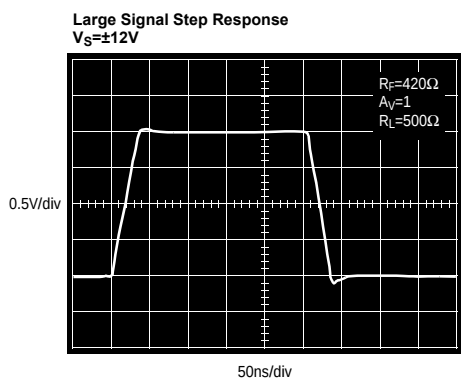
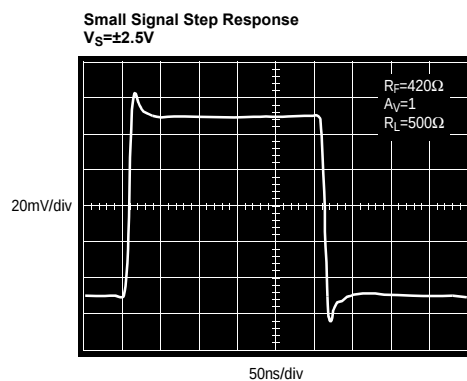
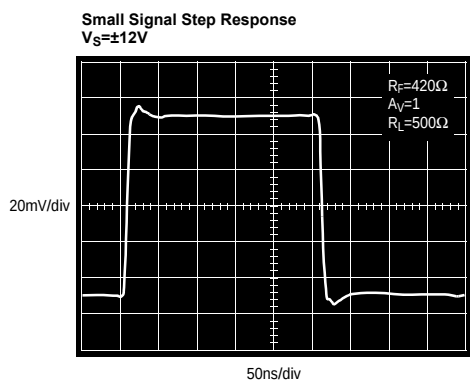
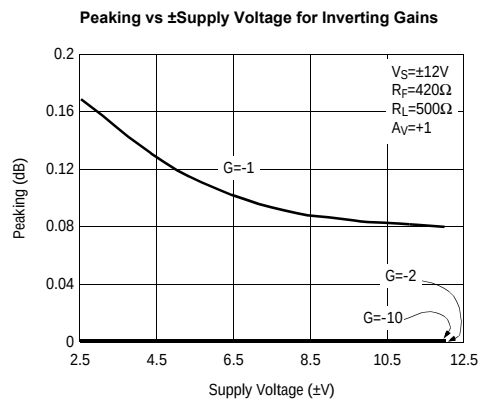
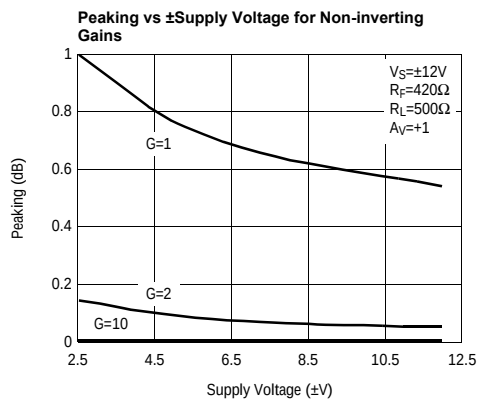
Typical Performance Curves



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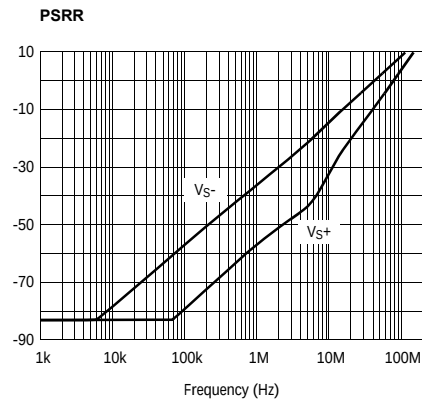
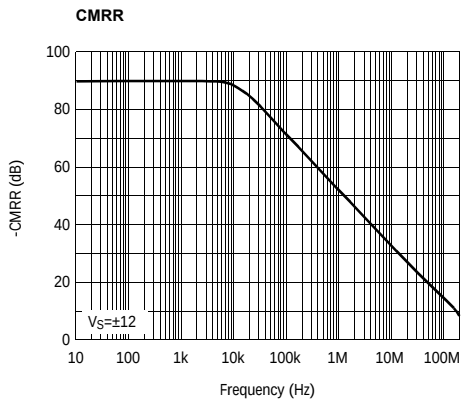
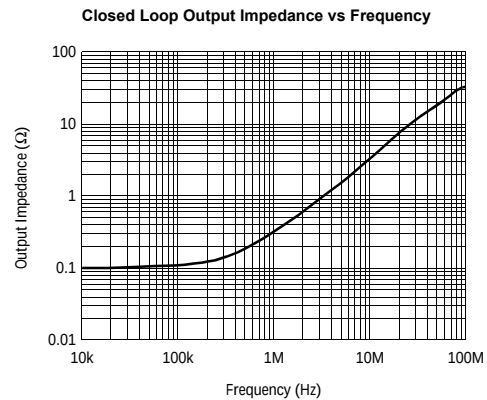
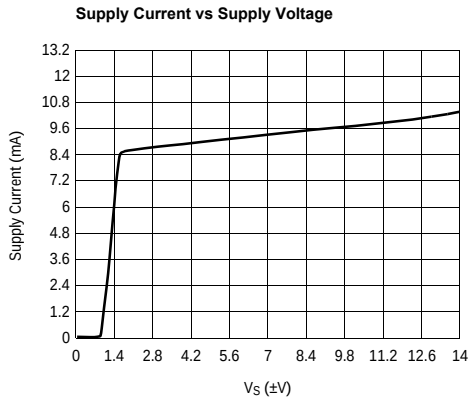
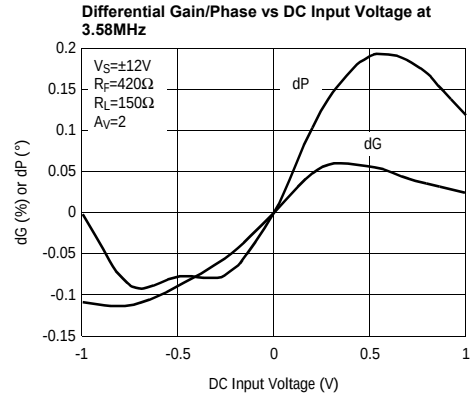
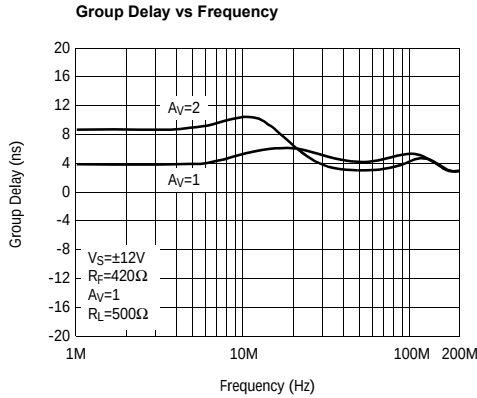


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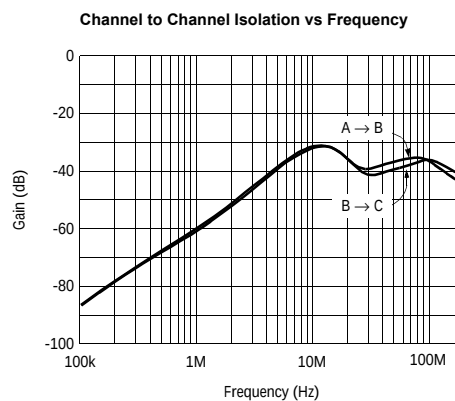
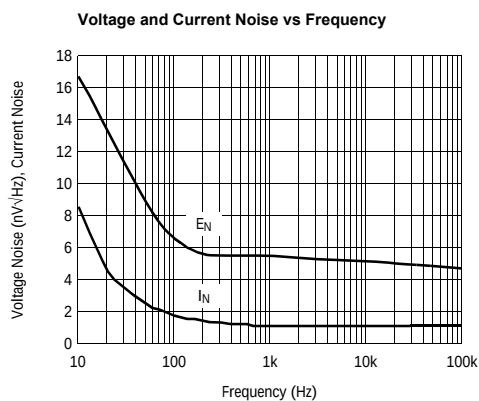
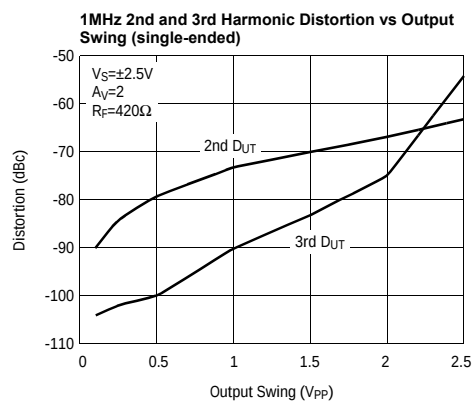
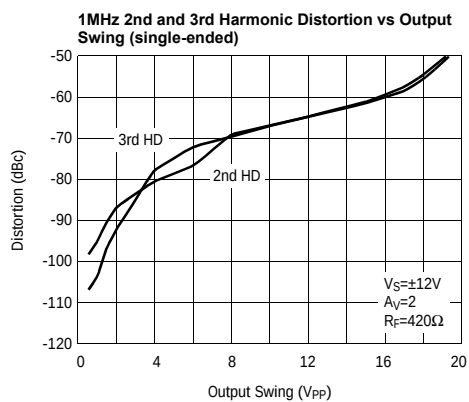
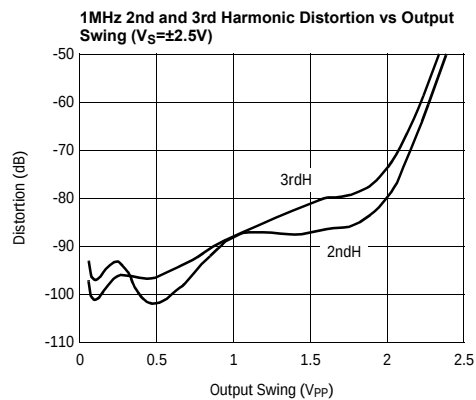
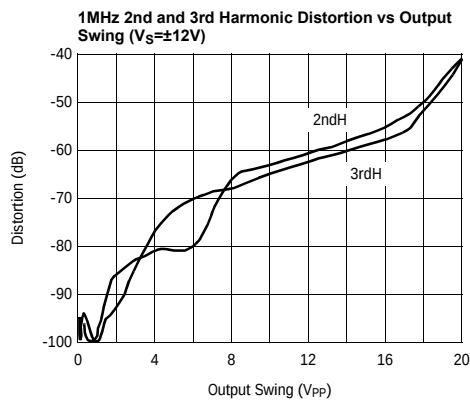
Typical Performance Curves



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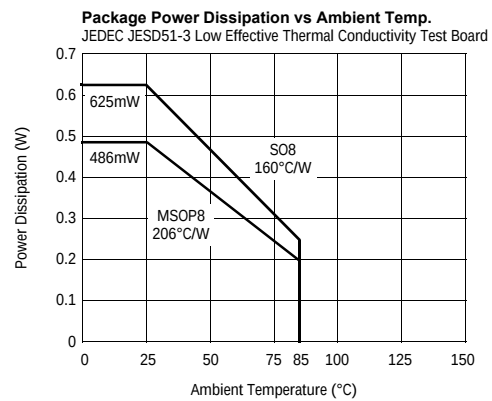
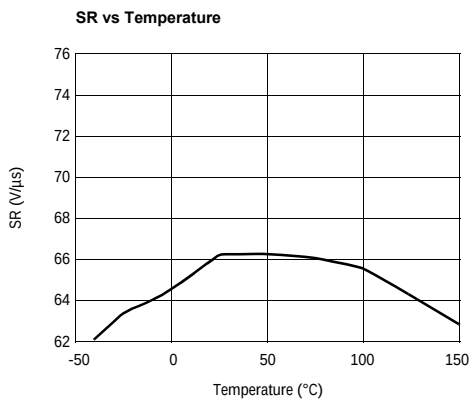
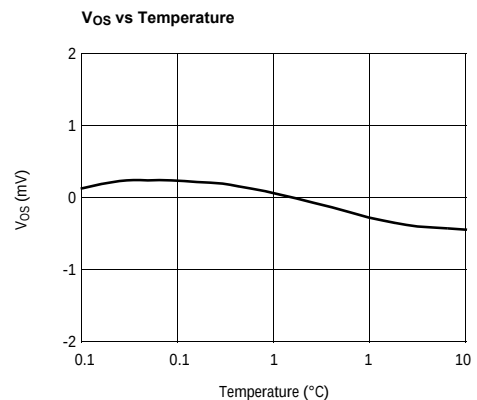
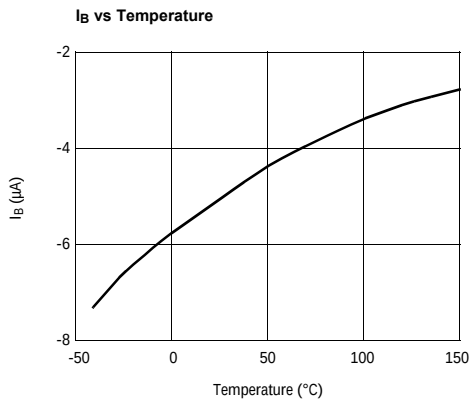
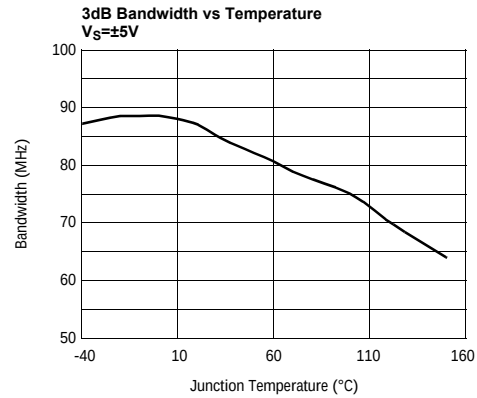
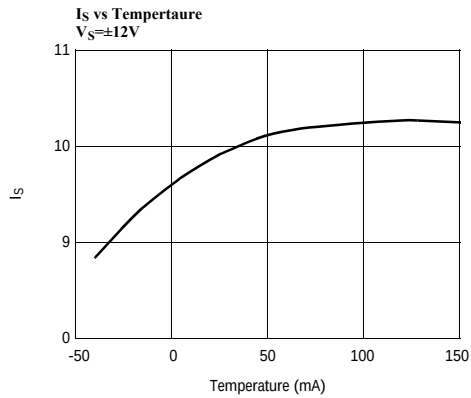


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Typical Performance Curves



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Applications Information

Product Description

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Dual Low Noise Amplifier

General Disclaimer

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HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

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