

April 2003

### Features

- 280MHz small signal bandwidth
- 1100V/ $\mu$ s slew rate
- 3.3mA/channel static supply current
- 60Mhz gain flatness to +/- 0.1dB
- 14 pin SOIC

### Applications

- Video switchers/routers
- Video line drivers
- Twisted pair driver/receiver
- Active filters
- Cable drivers

### Description

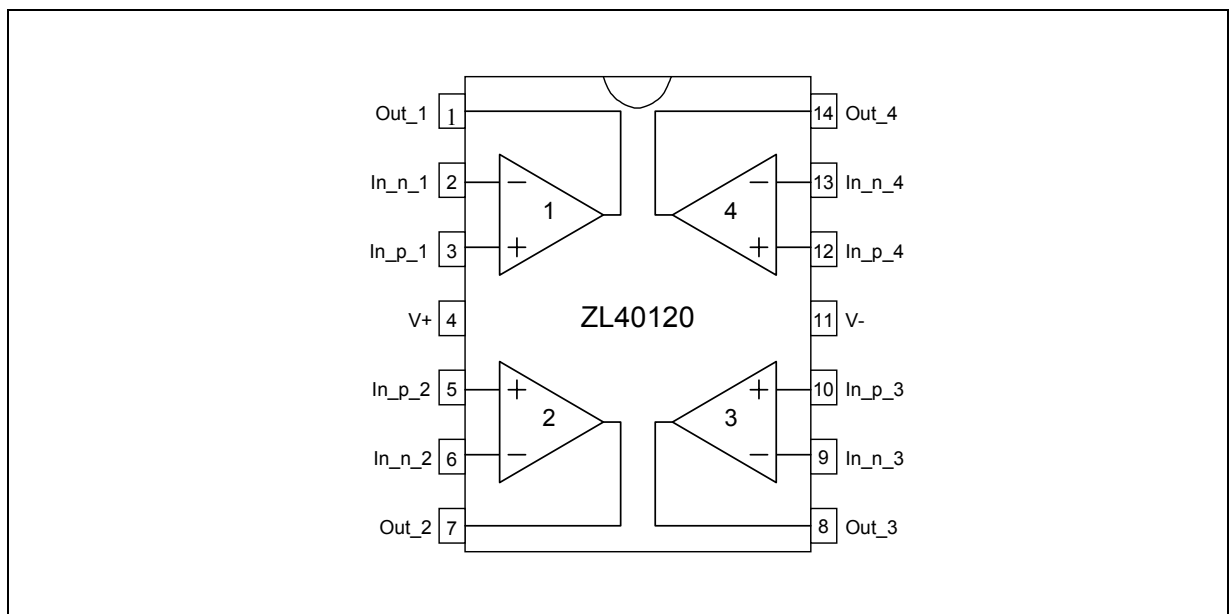
The ZL40120 is a low power, quad, current feedback operational amplifier offering high performance at a low cost. The device provides a very high output current drive capability of 65mA while requiring only 3.3mA of static supply current per channel. This feature makes the ZL40120 the ideal choice where a high density of high speed devices is required.

### Ordering Information

ZL40120/DCA (tubes) 14 lead SOIC  
 ZL40120/DCB (tape and reel) 14 lead SOIC  
**-40°C to +85°C**

The 280MHz  $A_v=+1V/V$  small signal bandwidth and 1100V/ $\mu$ s slew rate make the device an excellent solution for component video applications such as driving RGB signals down significant cable lengths.

Other applications which may take advantage of the ZL40120 dynamic performance features and matched amplifiers include low cost high order active filters and twisted pair driver/receivers.



**Figure 1 - Functional Block Diagram and Pin Connection**

## Application Notes

### Current Feedback Op Amps

Current feedback op amps offer several advantages over voltage feedback amplifiers:

- AC bandwidth not dependent on closed loop gain
- High Slew Rate
- Fast settling time

The architecture of the current feedback opamp consists of a high impedance non-inverting input and a low impedance inverting input which is always feedback connected. The error current is amplified by a transimpedance amplifier which can be considered to have gain

$$Z(f) = \frac{Z_o}{1 + j\left(\frac{f}{f_o}\right)}$$

where  $Z_o$  is the DC gain.

It can be shown that the closed loop non-inverting gain is given by

$$\frac{V_{out}}{V_{in}} = \frac{A_v}{1 + j\left(\frac{fR_f}{f_oZ_o}\right)}$$

where  $A_v$  is the DC closed loop gain,  $R_f$  is the feedback resistor. The closed loop bandwidth is therefore given by

$$BW_{CL} = \frac{f_oZ_o}{R_f} = \frac{GB_{OL}}{R_f}$$

and for low values of closed loop gain  $A_v$  depends only on the feedback resistor  $R_f$  and not the closed loop gain. This can readily be seen from the performance characteristic frequency response graph with varying  $R_f$

It can be shown that increasing the value of  $R_f$

- Increases closed loop stability
- Decreases loop gain
- Decreases bandwidth
- Reduces gain peaking
- Reduces overshoot

Using a resistor value of  $R_f=510\Omega$  for  $A_v=+2$  V/V gives good stability and bandwidth. However since requirements for stability and bandwidth vary it may be worth some experimentation to find the optimal  $R_f$  for a given application.

### Layout Considerations

Correct high frequency operation requires a considered PCB layout as stray capacitances have a strong influence over high frequency operation for this device. This is particularly important for high performance current feedback opamps. The Zarlink evaluation board serves as a good example layout that should be copied. The following guidelines should be followed:

- Include 6.8uF tantalum and 0.1uF ceramic capacitors on both positive and negative supplies
- Remove the ground plane under and around the part, especially near the input and output pins to reduce parasitic capacitances
- Minimize all trace lengths to reduce series inductance

Application Diagrams

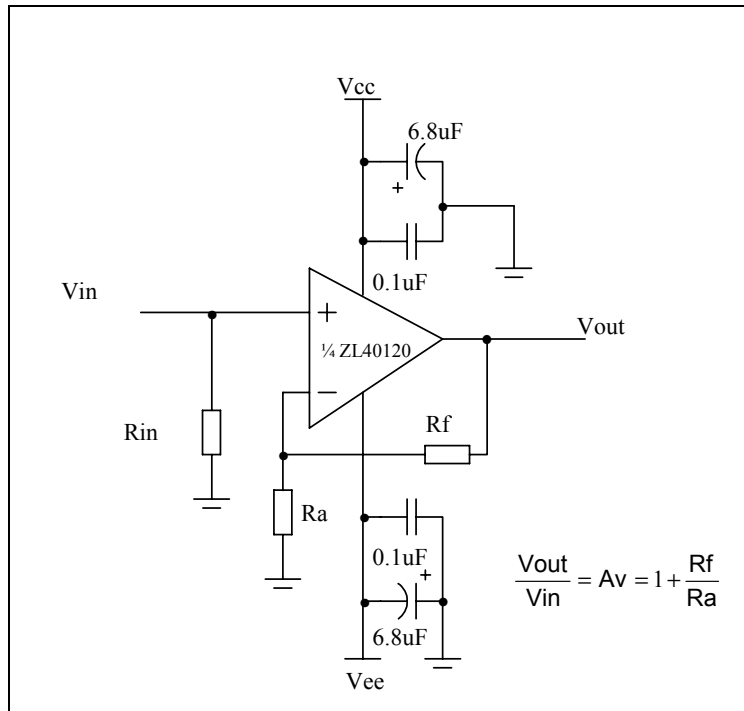


Figure 2 - Non-inverting Gain

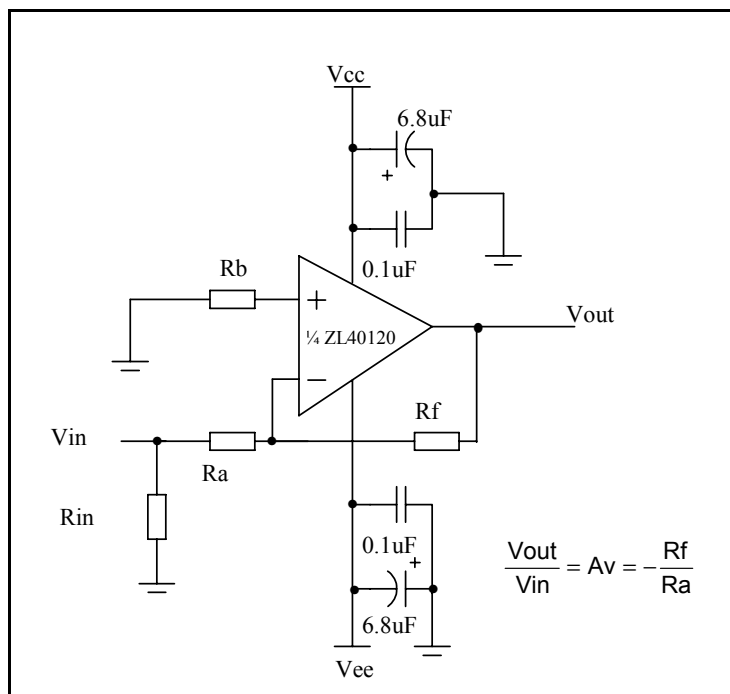


Figure 3 - Inverting Gain

## Absolute Maximum Ratings

	Parameter	Symbol	Min	Max	Units
1	Vin Differential	$V_{IN}$		$\pm 1.2$	V
2	Output Short Circuit Protection	$V_{OS/C}$		See Apps Note in this data sheet	
3	Supply voltage	V+, V-		$\pm 6.5$	V
4	Voltage at Input Pins	$V_{(+IN)}, V_{(-IN)}$	V-	V+	V
5	Voltage at Output Pins	$V_O$	V-	V+	V
6	EDS Protection (HBM Human Body Model) (see Note 2)		2	(see Note 3)	kV
7	Storage Temperature		-55	+150	°C
8	Latch-up test		$\pm 100$ mA for 100ms	(see Note 4)	
9	Supply transient test		20% pulse for 100ms	(see Note 5)	

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5k $\Omega$  in series with 100pF. Machine model, 20 $\Omega$  in series with 100pF.

Note 3: 0.8kV between the pairs of +INA, -INA and +INB pins only. 2kV between supply pins, OUTA or OUTB pins and any input pin.

Note 4:  $\pm 100$ mA applied to input and output pins to force the device to go into "latch-up". The device passes this test to JEDEC spec 17.

Note 5: Positive and Negative supply transient testing increases the supplies by 20% for 100ms.

## Operating Range

Characteristic	Min	Typ	Max	Units	Comments
Supply Voltage (Vcc)	$\pm 4.0$		$\pm 6.0$	V	
Operating Temperature (Ambient)	-40		+85	°C	
Junction to Ambient resistance	Rth(j-a)	150		°C 4 layer FR4 board	
Junction to Case resistance	Rth(j-c)	60		°C 4 layer FR4 board	

**Electrical Characteristics** -  $V_{CC}=\pm 5V$ ,  $T_{amb}=25C$ (typ.),  $T_{amb}=-40C$  to  $+85C$ (min-max),  $A_v=+2V/V$ ,  $R_f=510\Omega$ ,  $R_{load}=100\Omega$  unless specified.

Characteristic	Conditions	Typ 25C	Min/ Max 25C	Min/ Max -40 to +85C	Units	Test Type <sup>1</sup>
<b>Frequency Domain Response</b>						
-3dB Bandwidth	$A_v=+1$ ; $V_o < 0.5V_{p-p}$ ; $R_f=1.1k\Omega$	280	-	-	MHz	C
	$A_v=+2$ ; $V_o < 0.5V_{p-p}$ ; $R_f=510\Omega$	230	-	-	MHz	C
	$A_v=+2$ ; $V_o < 5V_{p-p}$ ; $R_f=510\Omega$	130	-	-	MHz	C
+/- 0.1dB Flatness	$A_v=+2$ ; $V_o < 0.5V_{p-p}$ ; $R_f=510\Omega$	60	-	-	MHz	C
Differential Gain (NTSC)	$R_{load}=150\Omega$	0.02	-	-	%	C
Differential Phase (NTSC)	$R_{load}=150\Omega$	0.06	-	-	deg.	C
<b>Time Domain Response</b>						
Rise and Fall Time	$V_{out}=0.5V$ Step	1.4	-	-	ns	C
	$V_{out}=5V$ Step	3.6	-	-	ns	C
Settling Time to 0.1%	$V_{out}=2V$ Step	6	-	-	ns	C
Overshoot	$V_{out}=0.5V$ Step	6	-	-	%	C
Slew Rate	$V_{out}=5V$ Step	1100	-	-	V/ $\mu$ s	C
<b>Noise and Distortion</b>						
2 <sup>nd</sup> Harmonic Distortion	$V_{out}=2V_{p-p}$ , 1MHz	-78	-	-	dBc	C
3 <sup>rd</sup> Harmonic Distortion	$V_{out}=2V_{p-p}$ , 1MHz	-88	-	-	dBc	C
Equivalent Input Noise						
Voltage	>1MHz	6.4	-	-	nV $\sqrt{Hz}$	C
Non-Inverting Current	>1MHz	1.0	-	-	pV $\sqrt{Hz}$	C
Inverting Current	>1MHz	9.3	-	-	pA $\sqrt{Hz}$	C
<b>Static, DC Performance</b>						
Input Offset Voltage		1.4	$\pm 6.0$	$\pm 7.5$	mV	A
Average Drift		-	-	15	$\mu$ V/deg. C	C
Input Bias Current – Non-inverting		1.3	$\pm 2.6$	$\pm 2.8$	$\mu$ A	A
Average Drift		-	-	2.6	nA/deg. C	C

Characteristic	Conditions	Typ 25C	Min/ Max 25C	Min/ Max -40 to +85C	Units	Test Type <sup>1</sup>
Input Bias Current – Inverting		4.4	±14	±15	uA	A
Average Drift		-	-	15	nA/deg. C	C
Power Supply Rejection Ratio (+ve)	DC	65	63	62	dB	A
Power Supply Rejection Ratio (-ve)	DC	62	58	56	dB	A
Common Mode Rejection Ratio	DC	57	54	53	dB	A
Supply Current (per Channel)	Quiescent	3.3	4.5	4.7	mA	A
<b>Miscellaneous Performance</b>						
Input Resistance (Non-inverting)		19.0	-	-	MΩ	C
Input Capacitance (Non-inverting)		1	-	-	pF	C
Common Mode Input Range		±2.3	±2.2	±1.9	V	A
Output Voltage Range	Rload=100Ω	±2.8	±2.7	±2.6	V	A
Output Current (max)		65	-	-	mA	C
Output Resistance, Closed Loop	DC	110	-	-	mΩ	C

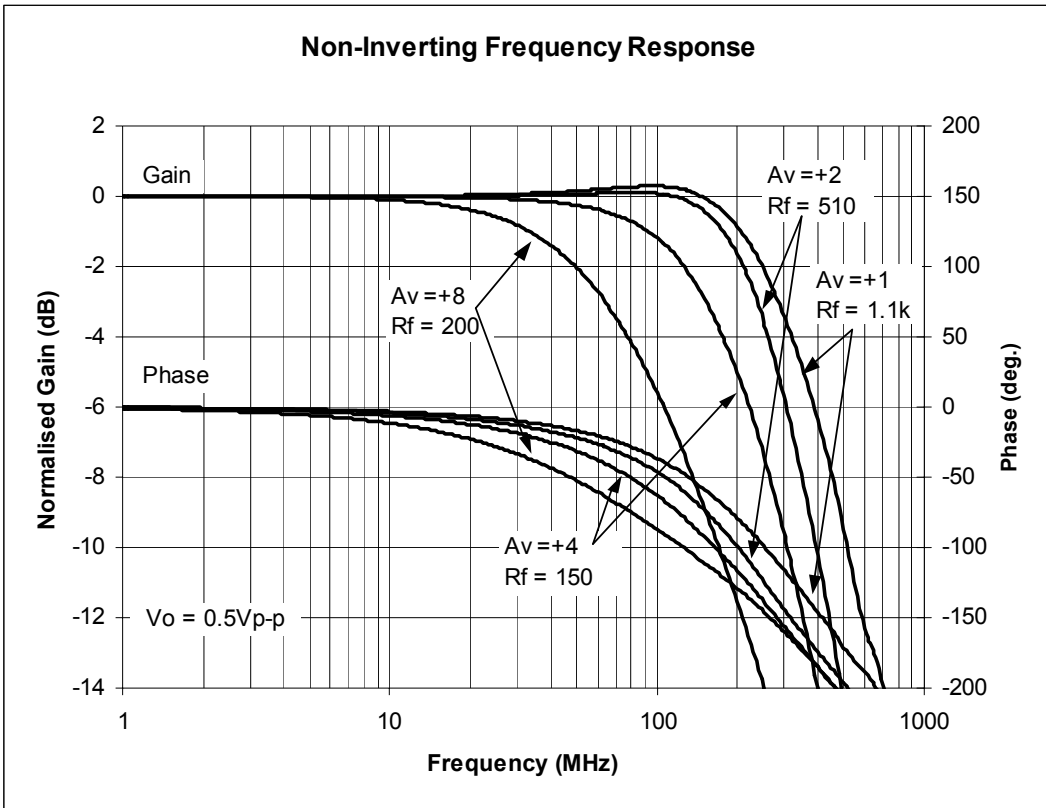
NOTE 1: Test Types:

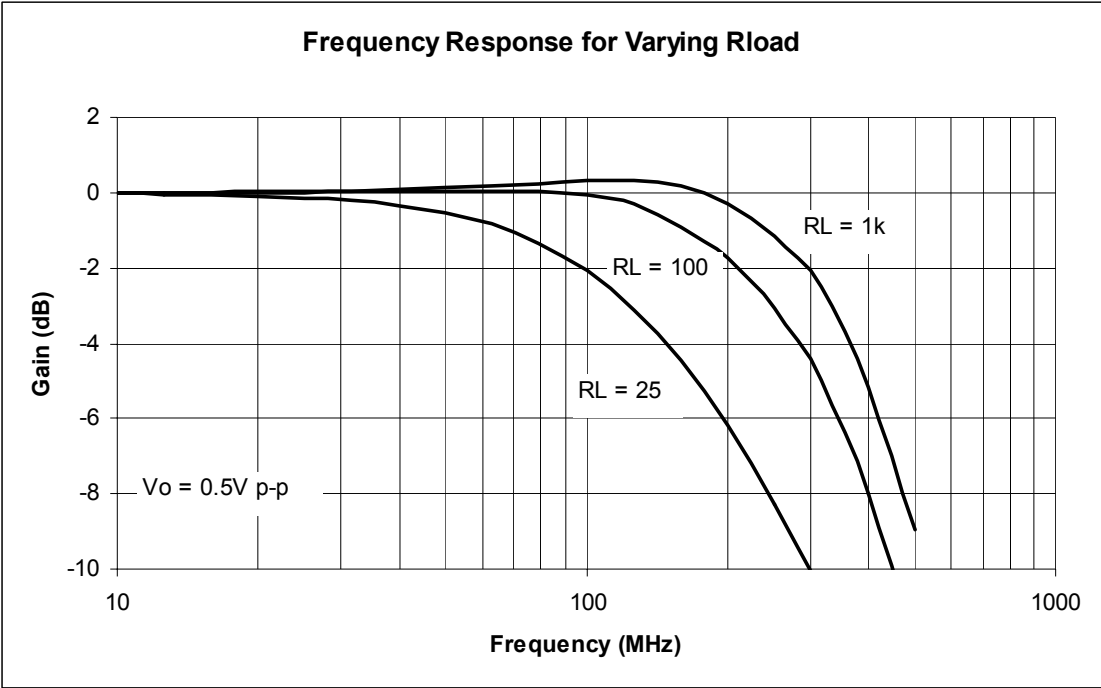
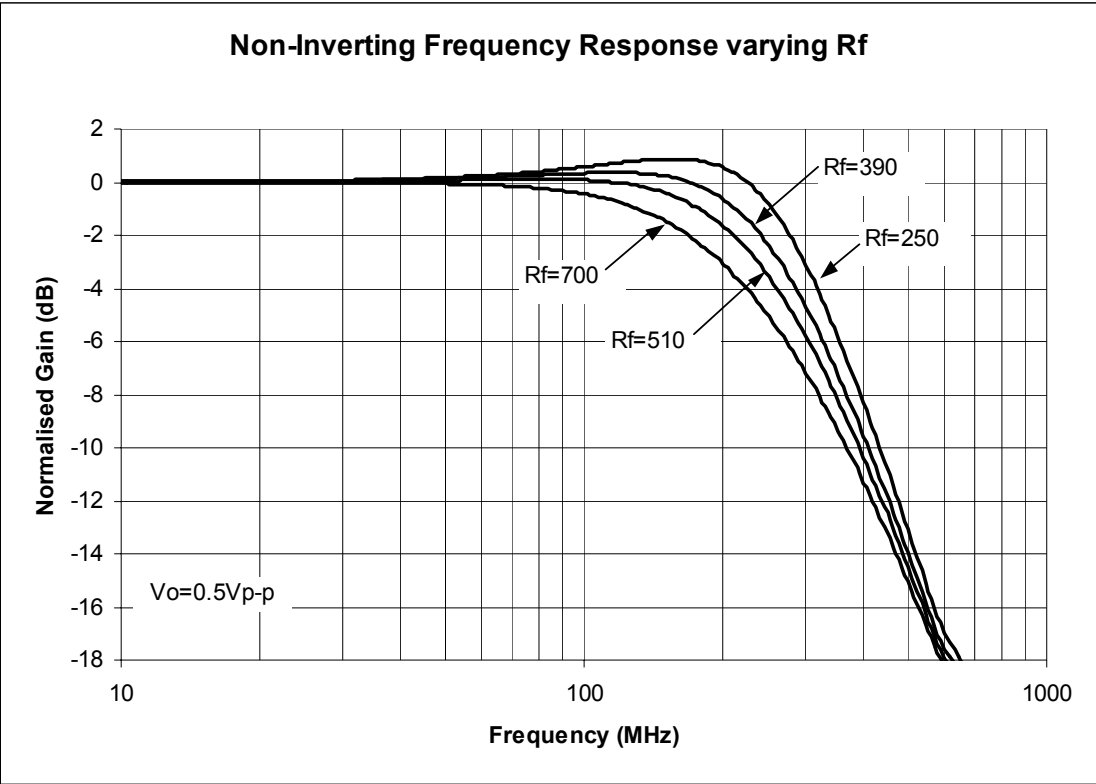
(A) 100% tested at 25°C. Over temperature limits are set by characterization and simulation.

(B) Limits set by characterization or simulation.

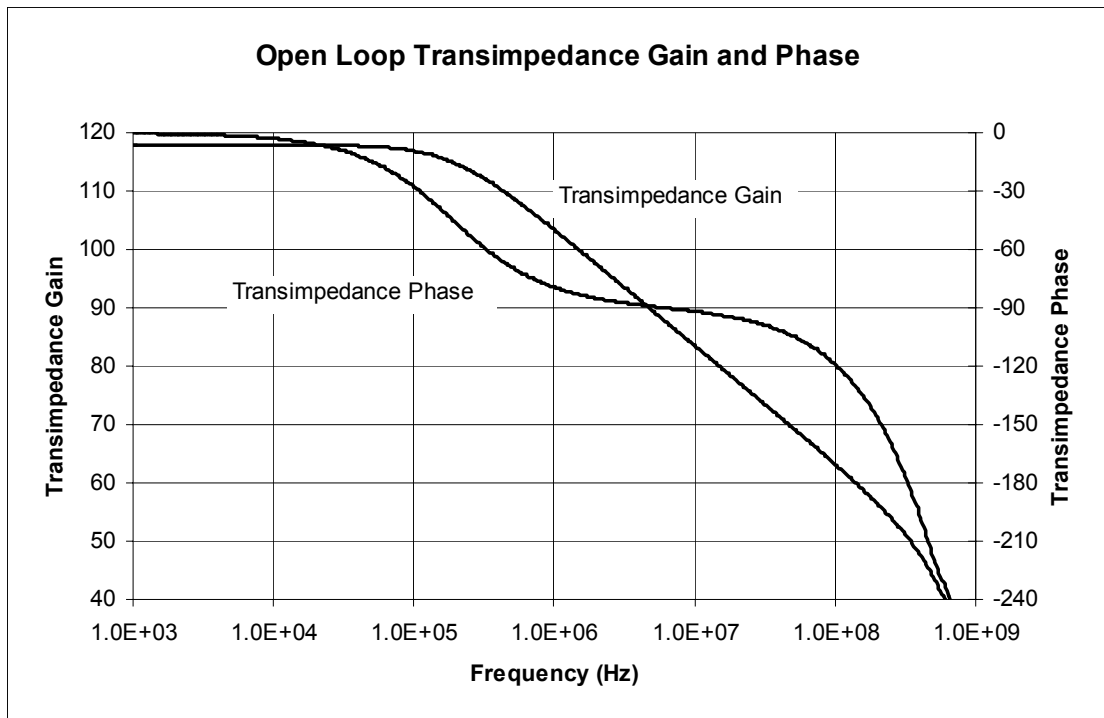
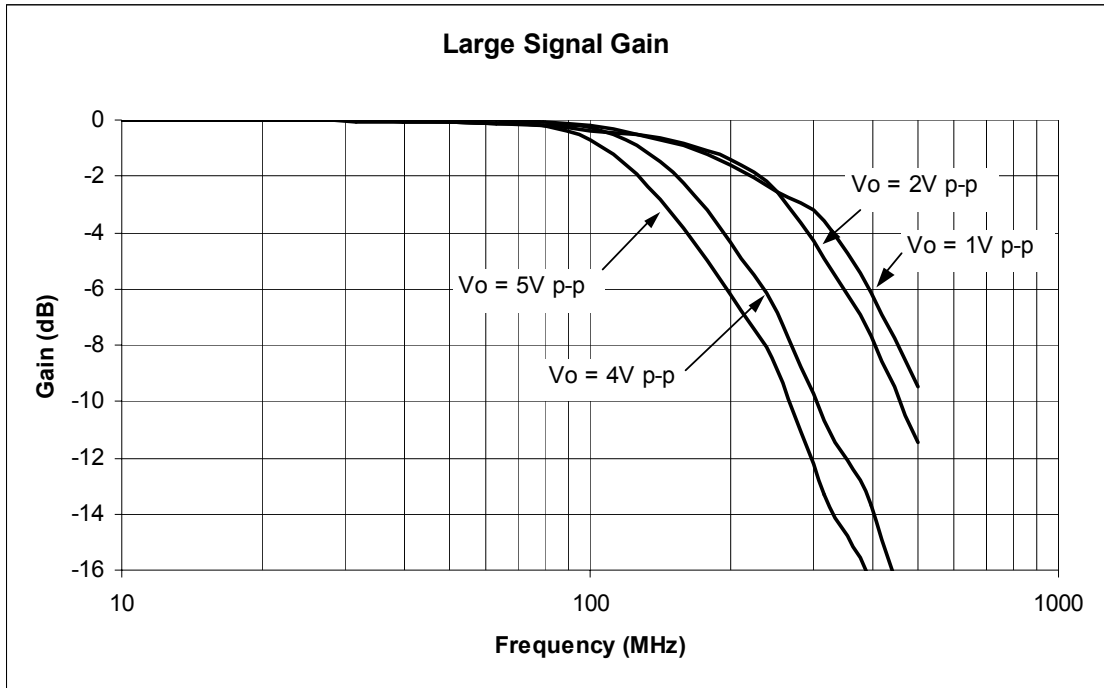
(C) Typical value only for information.

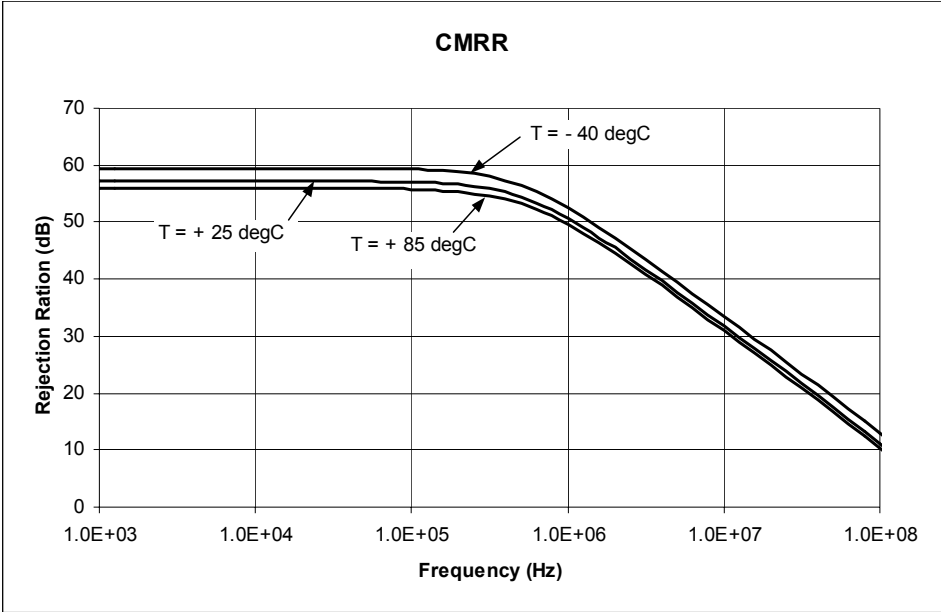
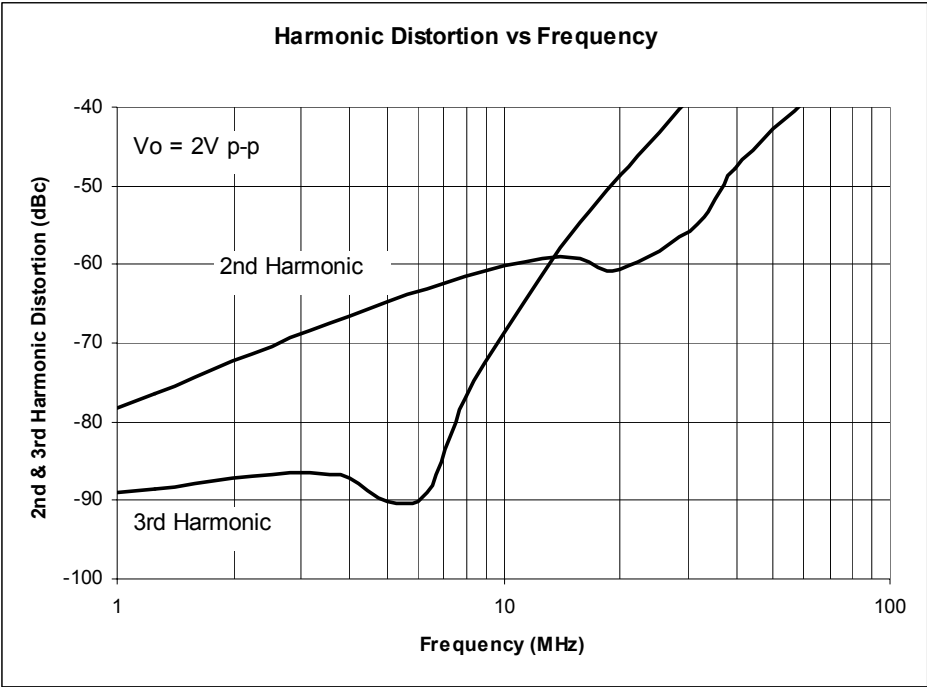
**Typical Performance Characteristics** -  $T_{amb}=25\text{degC}$ ,  $V_{supply}=\pm 5\text{V}$ ,  $R_{load}=100\Omega$ ,  $A_v=+2\text{V/V}$ ,  $R_f=510\Omega$ , unless otherwise specified.

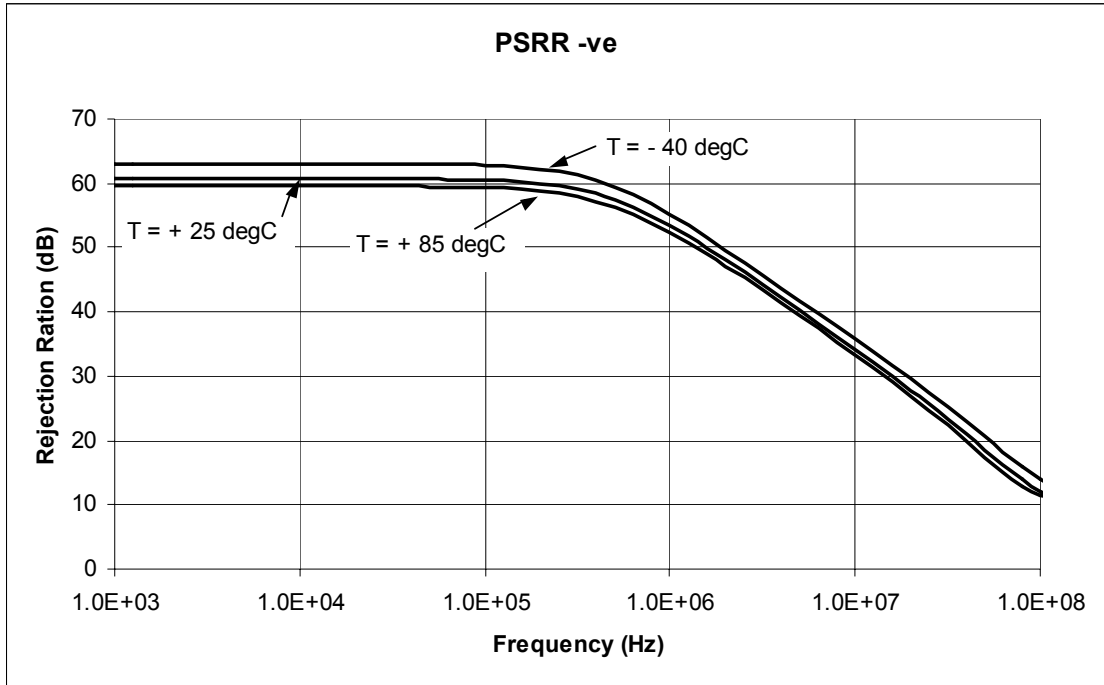
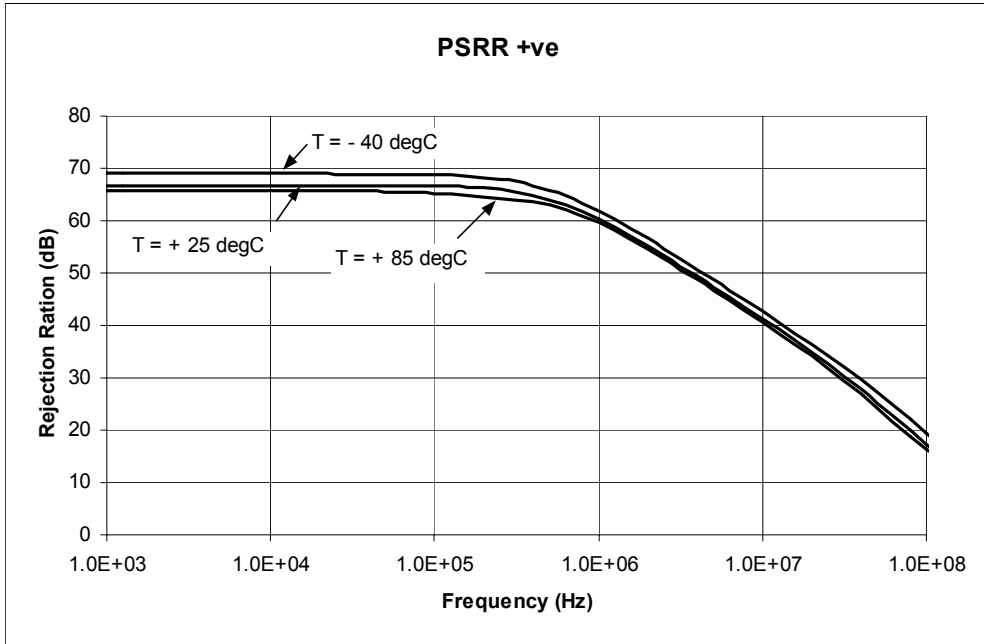


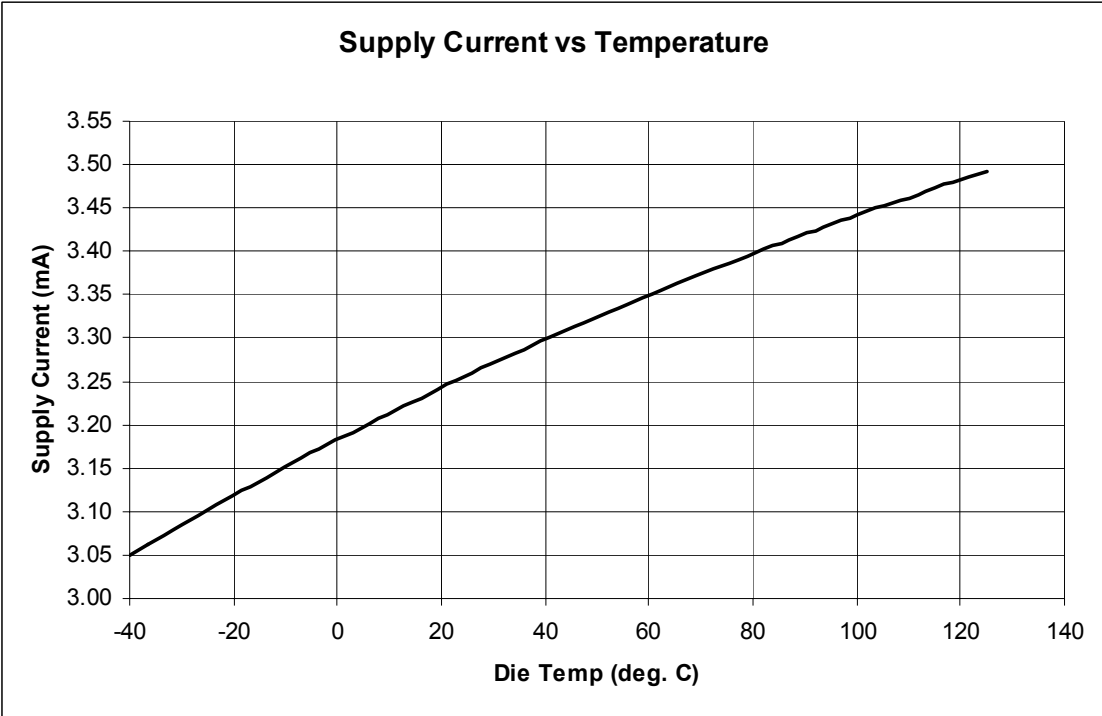
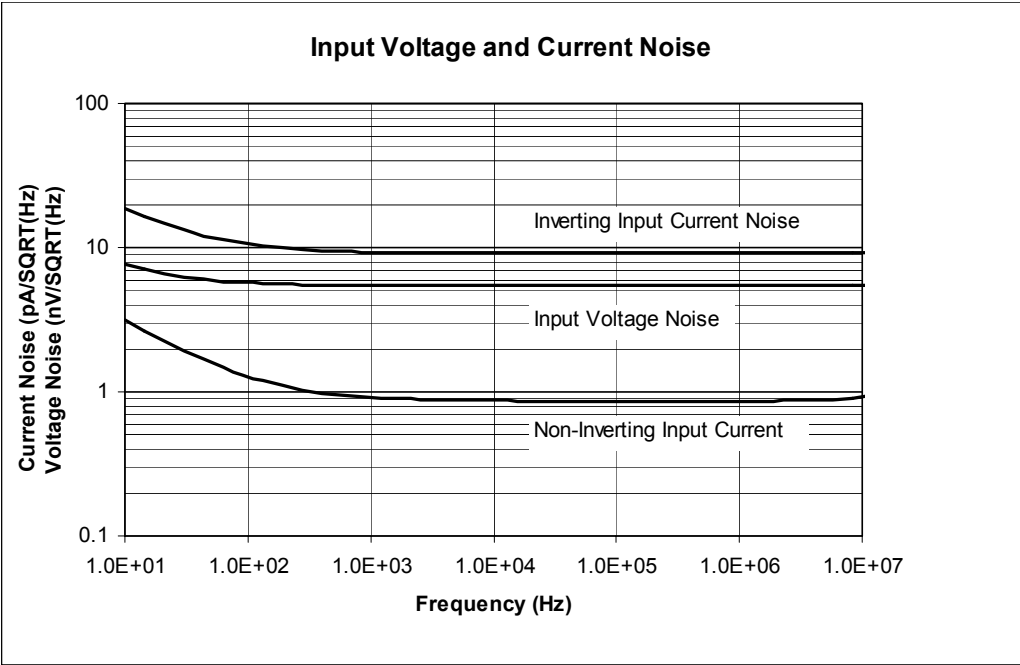


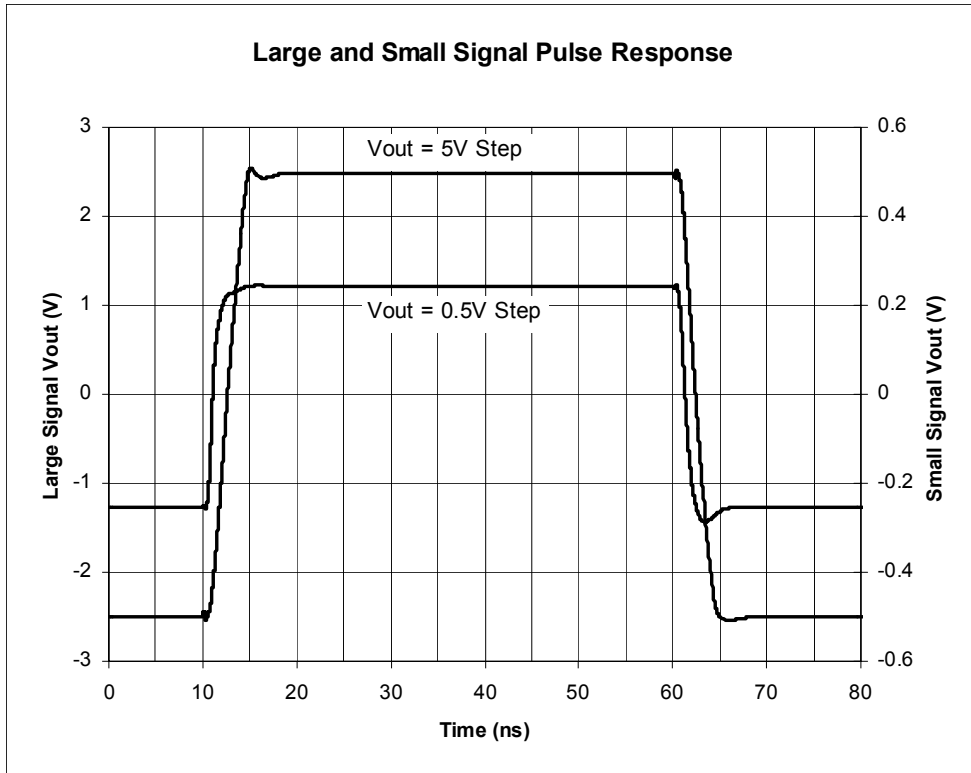
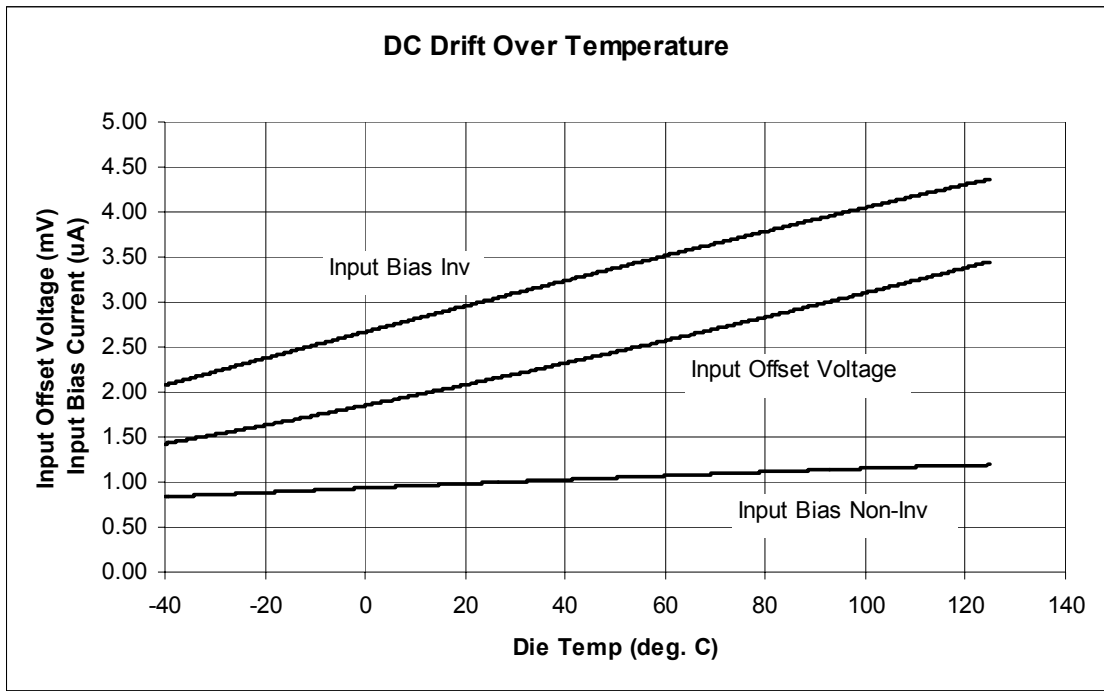


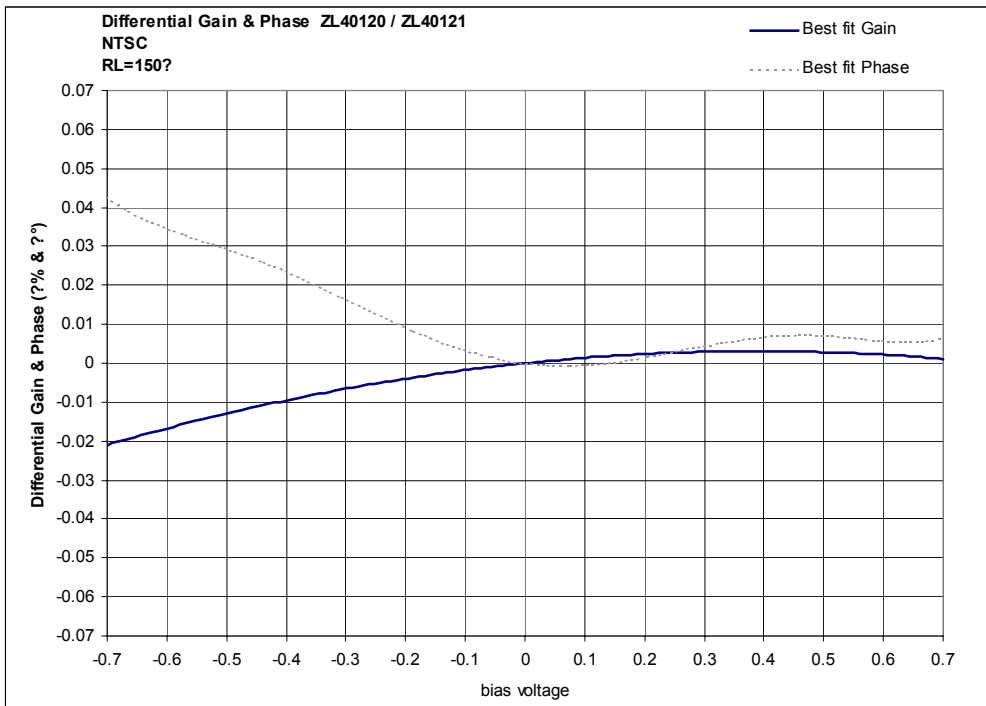
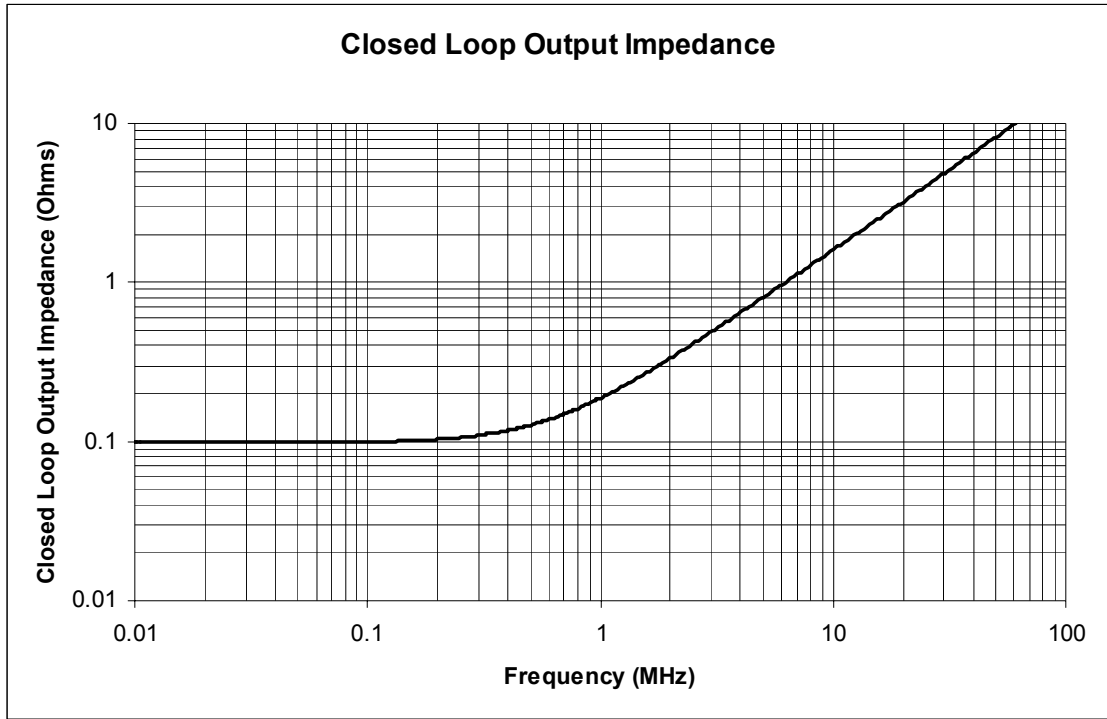


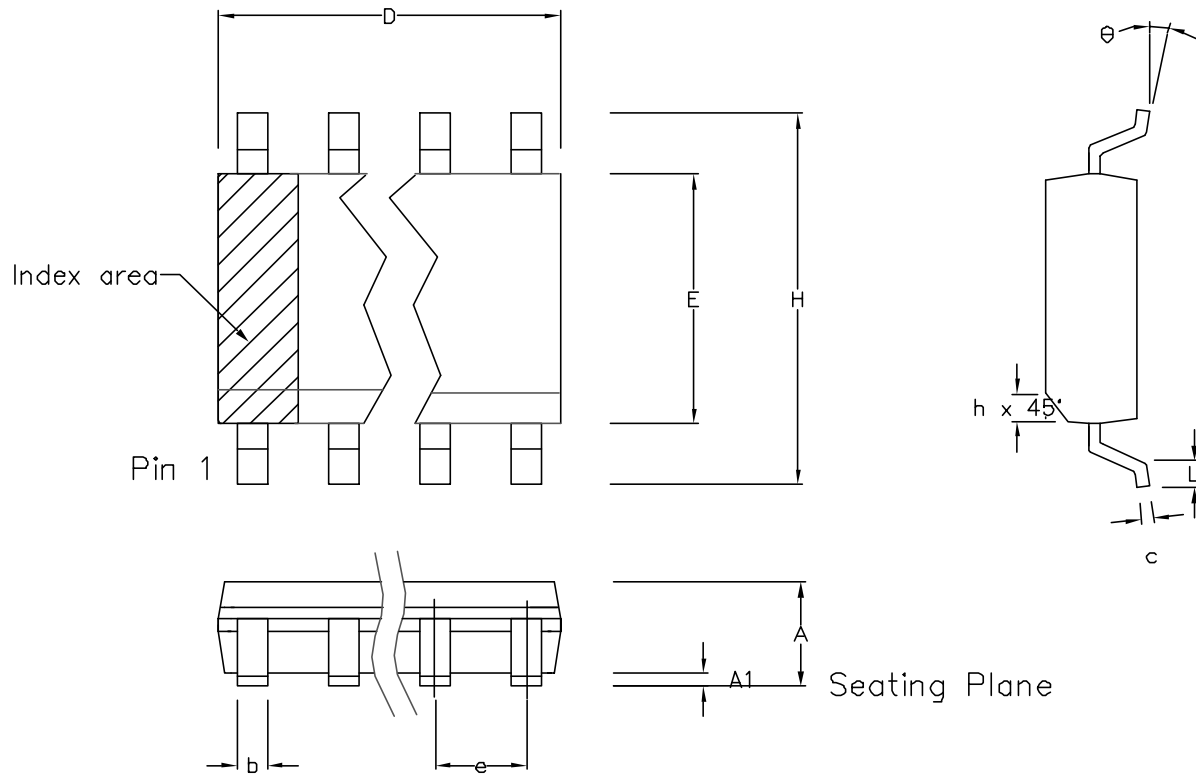












	Min mm	Max mm	Min inch	Max inch
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	8.55	8.75	0.337	0.344
H	5.80	6.20	0.228	0.244
E	3.80	4.00	0.150	0.157
L	0.40	1.27	0.016	0.050
e	1.27 BSC		0.050 BSC	
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.008	0.010
$\theta$	$0^\circ$	$8^\circ$	$0^\circ$	$8^\circ$
h	0.25	0.50	0.010	0.020
Pin Features				
N	14		14	
Conforms to JEDEC MS-012AB Iss. C				

Notes:

1. The chamfer on the body is optional. If not present, a visual index feature, e.g. a dot, must be located within the cross-hatched area.
2. Controlling dimensions are in inches.
3. Dimension D do not include mould flash, protusion or gate burrs. These shall not exceed 0.006" per side.
4. Dimension E1 do not include inter-lead flash or protusion. These shall not exceed 0.010" per side.
5. Dimension b does not include dambar protusion / intrusion. Allowable dambar protusion shall be 0.004" total in excess of b dimension.

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ISSUE	6	2	3	4	5
ACN	214220	201937	202596	203707	212430
DATE	7Apr03	27Feb97	12Jun97	9Dec97	25Mar02
APPRD.					



Previous package codes

MP / S

Package Code DC

Package Outline for  
14 lead SOIC  
(0.150" Body Width)

GPD00011



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