HFA1110

750MHz Low Distortion Unity Gain, Closed Loop Buffer

March 1993

Features

- **Wide -3dB Bandwidth 750MHz**
- **Very Fast Slew Rate 1300V/μs**
- **Fast Settling Time (0.2%) 7ns**
- **High Output Current 60mA**
- **Fixed Gain of +1**
- **Gain Flatness (100MHz)..................... 0.03dB**
- **Differential Phase....................... 0.025 deg.**
- **Differential Gain 0.04%**
- **3rd Harmonic Distortion (50MHz)............ -80dBc**
- **3rd Order Intercept (100MHz) 30dBm**

Applications

- **Video Switching and Routing**
- **RF/IF Processors**
- **Driving Flash A/D Converters**
- **High-Speed Communications**
- **Impedance Transformation**
- **Line Driving**
- **Radar Systems**

Description

The HFA1110 is a unity gain closed loop buffer that achieves -3dB bandwidth of 750MHz, while offering excellent video performance and low distortion. Manufactured on Harris' proprietary complementary bipolar UHF-1 process, the HFA1110 also offers very fast slew rate, and high output current. It is one more example of Harris' intent to enhance its leadership position in products for high speed signal processing applications.

The HFA1110's settling time of 11ns to 0.1%, low distortion and ability to drive capacitive loads make it an ideal flash A/D driver.

The HFA1110 is an enhanced, pin compatible upgrade for the AD9620, AD9630, CLC110, EL2072, BUF600 and BUF601.

For buffer applications requiring a standard op amp pinout, or selectable gain (-1, +1, +2), see the HFA1112 datasheet, for output clamping see the HFA1113 datasheet.

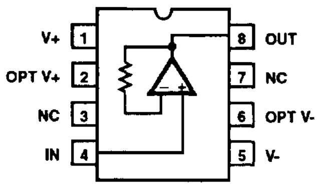
For military grade product please refer to the HFA1110/883 datasheet.

Ordering Information

PART NUMBER	OPERATING TEMP. RANGE	PRODUCT DESCRIPTION
HFA1110MJ/883	-55°C to +125°C	8 Lead Ceramic DIP
HFA1110IJ	-40°C to +85°C	8 Lead Ceramic DIP
HFA1110IP	-40°C to +85°C	8 Lead Plastic DIP
HFA1110IB	-40°C to +85°C	8 Lead SOIC
HFA1110Y	-40°C to +85°C	DIE

Pinout

HFA1110
(PDIP, CDIP, SOIC)
TOP VIEW



Pin Descriptions

NAME	PIN NUMBER	DESCRIPTION
V+	1	Positive Supply
Opt V+	2	Optional Positive Supply
NC	3	No Connection
IN	4	Input
V-	5	Negative Supply
Opt V-	6	Optional Negative Supply
NC	7	No Connection
OUT	8	Output

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.

File Number **2944.4**

Absolute Maximum Ratings

Voltage Between V+ and V- 12V
DC Input Voltage .... V_{SUPPLY}
Differential Input Voltage................................ 5V
Output Current 60mA
Lead Temperature (Soldering 10 Sec.)................. +300°C
Junction Temperature.............................. +175°C
Junction Temperature (Plastic Package) .... +150°C

Operating Conditions

Operating Temperature Range
HFA1110I............................ $-40^oC \le T_A \le +85^oC$
Storage Temperature.................... $-65^oC \le T_A \le +150^oC$

Thermal Resistance (°C/W)	θ_{ja}	θ_{jc}
Ceramic DIP Package	116	36
Plastic DIP Package	98	36
SOIC Package	158	43

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Characteristics

$V_{SUPPLY} = \pm5V$, $R_L = 100\Omega$, Unless Otherwise Specified

PARAMETER	TEMP.	HFA1110I MIN	HFA1110I TYP	HFA1110I MAX	UNITS
INPUT CHARACTERISTICS					
Output Offset Voltage*	+25°C	-	8	25	mV
	Full	-	-	35	mV
Output Offset Voltage Drift	Full	-	10	-	µV/°C
PSRR	+25°C	39	45	-	dB
	Full	35	-	-	dB
Input Voltage Noise (100kHz)*	+25°C	-	14	-	$nV/\sqrt{Hz}$
Input Current Noise (100kHz)*	+25°C	-	51	-	$pA/\sqrt{Hz}$
Input Bias Current*	+25°C	-	10	40	µA
	Full	-	-	65	µA
Non-Inv. Input Resistance	+25°C	25	50	-	kΩ
Input Capacitance	+25°C	-	2	-	pF
TRANSFER CHARACTERISTICS					
Gain ($V_{OUT} = 2V_{P-P}$)	+25°C	0.980	0.990	-	V/V
	Full	0.975	-	-	V/V
DC Non-Linearity (±2V Full Scale)*	+25°C	-	0.003	-	%
OUTPUT CHARACTERISTICS					
Output Voltage*	+25°C	3.0	3.3	-	±V
	Full	2.5	3.0	-	±V
Output Current ($R_L = 50\Omega$)*	+25°C, +85°C	50	60	-	mA
	-40°C	35	50	-	mA
POWER SUPPLY CHARACTERISTICS					
Supply Voltage Range	Full	4.5	-	5.5	±V
Supply Current*	+25°C	-	21	26	mA
	Full	-	-	33	mA

Electrical Characteristics $V_{SUPPLY} = \pm5V$, $R_L = 100\Omega$, Unless Otherwise Specified **(Continued)**

PARAMETER	TEMP.	HFA1110I MIN	HFA1110I TYP	HFA1110I MAX	UNITS
AC CHARACTERISTICS					
-3dB Bandwidth ($V_{OUT} = 0.2V_{P-P}$)*	+25°C	-	750	-	MHz
Slew Rate ($V_{OUT} = 5V_{P-P}$)	+25°C	-	1300	-	V/µs
Full Power Bandwidth ($4V_{P-P}$)*	+25°C	-	100	-	MHz
Gain Flatness (to 100MHz)*	+25°C	-	±0.03	-	dB
Gain Flatness (to 30MHz)	+25°C	-	±0.01	-	dB
Linear Phase Deviation (DC to 100MHz)*	+25°C	-	0.6	-	Degrees
2nd Harmonic Distortion (50MHz, $V_{OUT} = 2V_{P-P}$)*	+25°C	-	-60	-	dBc
3rd Harmonic Distortion (50MHz, $V_{OUT} = 2V_{P-P}$)*	+25°C	-	-80	-	dBc
3rd Order Intercept (100MHz)*	+25°C	-	30	-	dBm
-1dB Gain Compression (100MHz)	+25°C	-	14	-	dBm
Reverse Gain (S12 at 100MHz, $V_{OUT} = 1V_{P-P}$)*	+25°C	-	-60	-	dB
Rise Time (V_{OUT} = 0.5V Step)	+25°C	-	0.5	-	ns
Overshoot (V_{OUT} = 1.0V Step)* Input Signal Rise/Fall = 1ns	+25°C	-	2.5	-	%
0.2% Settling (V_{OUT} = 1V to 0V)*	+25°C	-	7	-	ns
0.1% Settling (V_{OUT} = 1V to 0V)*	+25°C	-	11	-	ns
Overdrive Recovery Time	+25°C	-	15	-	ns
Differential Gain (3.58MHz, $R_L = 75\Omega$)	+25°C	-	0.04	-	%
Differential Phase (3.58MHz, $R_L = 75\Omega$)	+25°C		0.025		Degrees

* See Typical Performance Curves for more information.

2

OPERATIONAL AMPLIFIERS

Application Information

PC Board Layout

The frequency performance of this amplifier depends a great deal on the amount of care taken in designing the PC board. **The use of low inductance components such as chip resistors and chip capacitors is strongly recommended, while a solid ground plane is a must!**

Attention should be given to decoupling the power supplies. A large value (10µF) tantalum in parallel with a small value chip (0.1µF) capacitor works well in most cases.

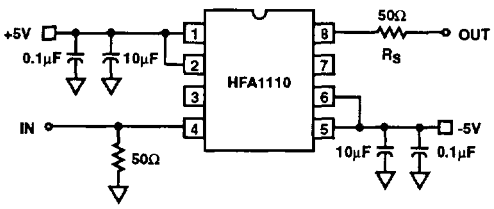
Terminated microstrip signal lines are recommended at the input and output of the device. Output capacitance, such as that resulting from an improperly terminated transmission line will degrade the frequency response of the amplifier and may cause oscillations. In most cases, the oscillation can be avoided by placing a resistor (R_S) in series with the output. See the "Recommended R_S vs Load Capacitance" graph for specific recommendations.

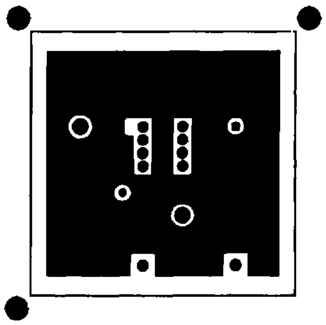
An example of a good high frequency layout is the Evaluation Board shown below.

Evaluation Board

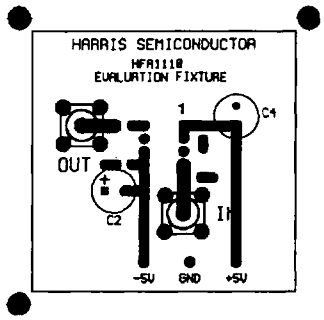
An evaluation board is available for the HFA1110. Please contact your local sales office for information.

The layout and schematic of the board are shown here:





BOTTOM LAYOUT



TOP LAYOUT

Die Characteristics

DIE DIMENSIONS:
63 x 44 x 19 ± 1mils
1600μm x 1130μm ±25.4μm

METALLIZATION:
Type: Metal 1: AlCu(2%)/TiW
Thickness: Metal 1: 8kÅ ± 0.4kÅ
Type: Metal 2: AlCu(2%)
Thickness: Metal 2: 16kÅ ± 0.8kÅ

GLASSIVATION:
Type: Nitride
Thickness: 4kÅ ± 0.5kÅ

DIE ATTACH:
Material: Epoxy - Plastic DIP and SOIC
Gold Eutectic - Ceramic DIP

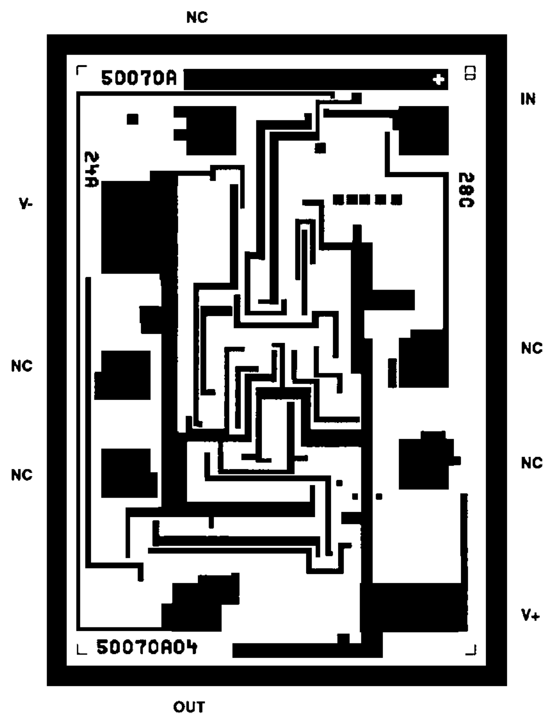
WORST CASE CURRENT DENSITY:
0.909×10^5 A/cm^2

TRANSISTOR COUNT: 52

SUBSTRATE POTENTIAL (Powered Up): Floating (Recommend Connection to V-)

Metallization Mask Layout

HFA1110



Typical Performance Curves $V_{SUPPLY} = \pm 5V$, $T_A = +25^oC$, $R_L = 100\Omega$ Unless Otherwise Specified.

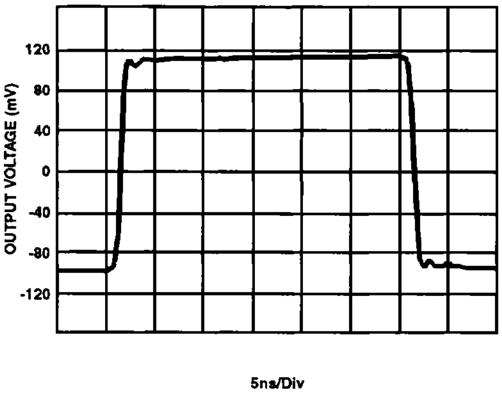


FIGURE 1. SMALL SIGNAL PULSE RESPONSE

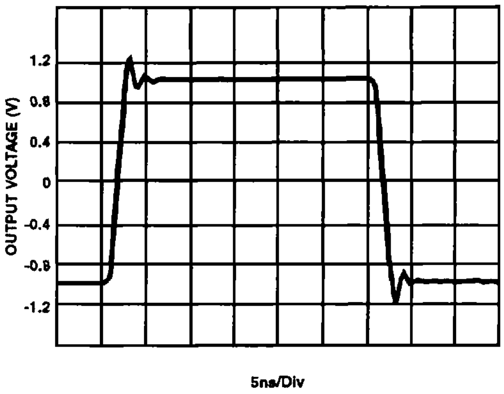


FIGURE 2. LARGE SIGNAL PULSE RESPONSE

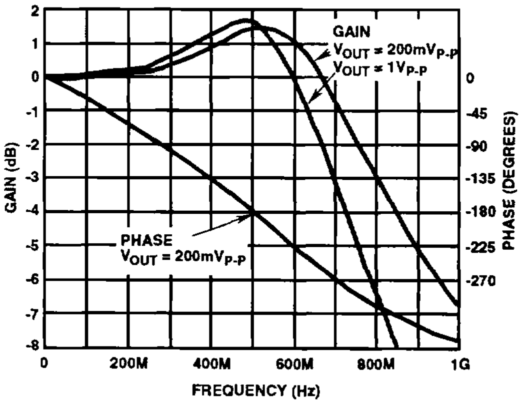


FIGURE 3. FORWARD GAIN AND PHASE

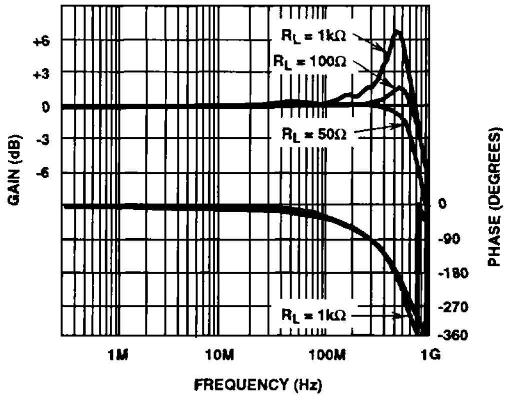


FIGURE 4. FREQUENCY RESPONSE FOR VARIOUS LOAD RESISTORS

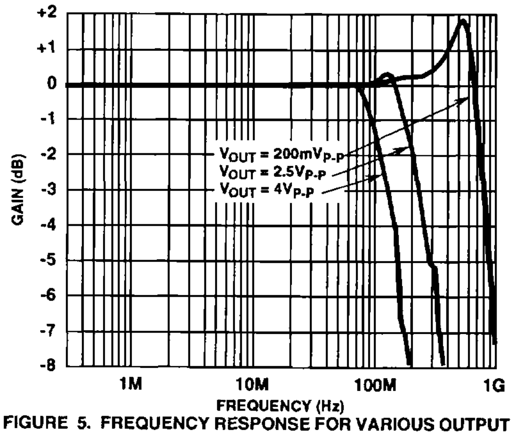


FIGURE 5. FREQUENCY RESPONSE FOR VARIOUS OUTPUT VOLTAGES

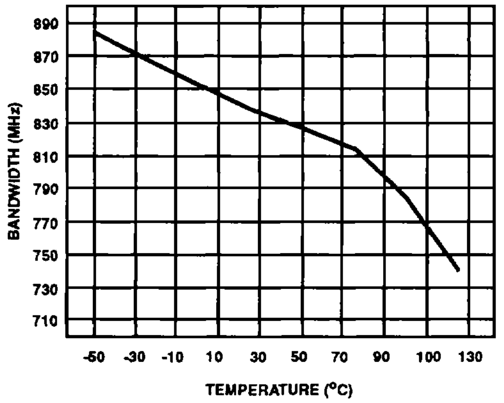


FIGURE 6. -3dB BANDWIDTH vs TEMPERATURE

Typical Performance Curves V_{SUPPLY} = ±5V, T_A = +25°C, R_L = 100Ω Unless Otherwise Specified. **(Continued)**

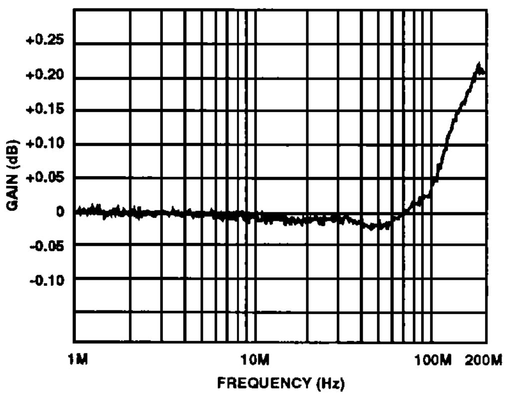


FIGURE 7. GAIN FLATNESS

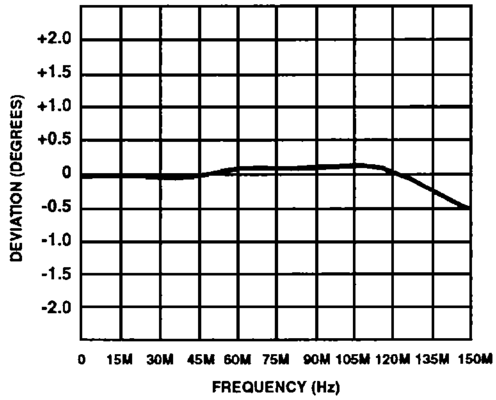


FIGURE 8. DEVIATION FROM LINEAR PHASE

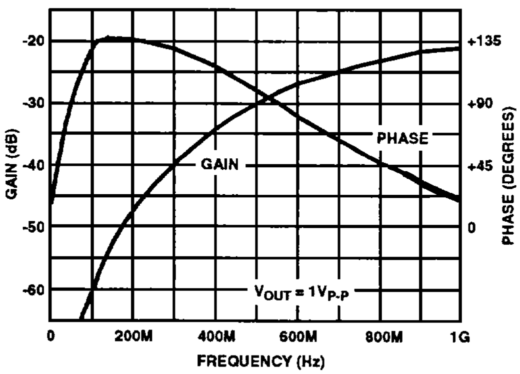


FIGURE 9. REVERSE GAIN AND PHASE

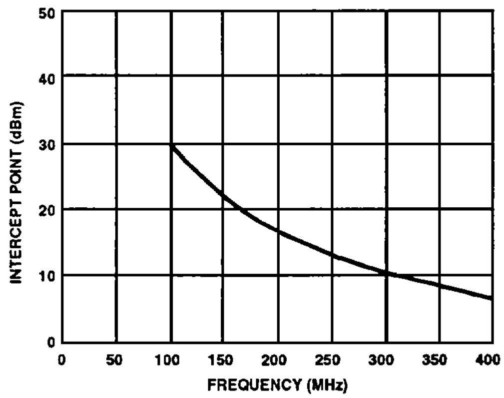


FIGURE 10. 2-TONE, 3RD ORDER INTERMODULATION INTERCEPT

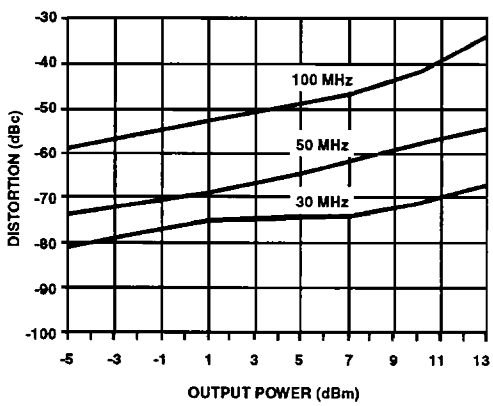


FIGURE 11. 2nd HARMONIC DISTORTION vs P_{OUT}

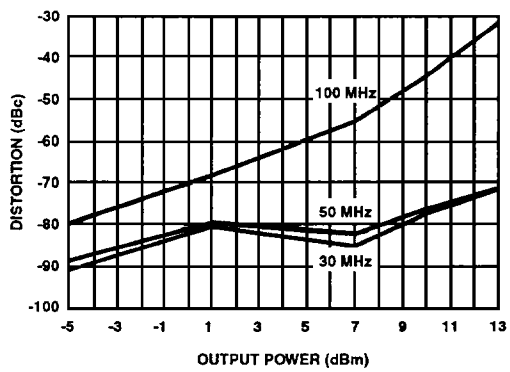


FIGURE 12. 3rd HARMONIC DISTORTION vs P_{OUT}

Typical Performance Curves V_{SUPPLY} = ±5V, T_A = +25°C, R_L = 100Ω Unless Otherwise Specified. **(Continued)**

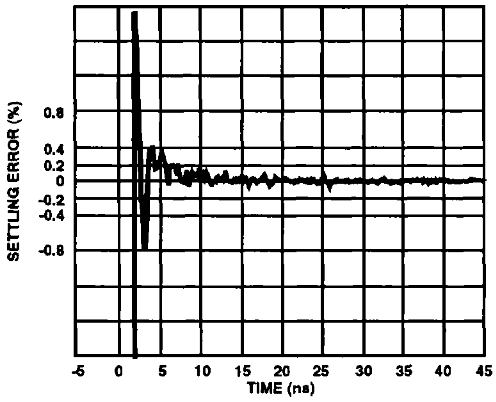


FIGURE 13. SETTLING RESPONSE (V_{OUT} = 1V)

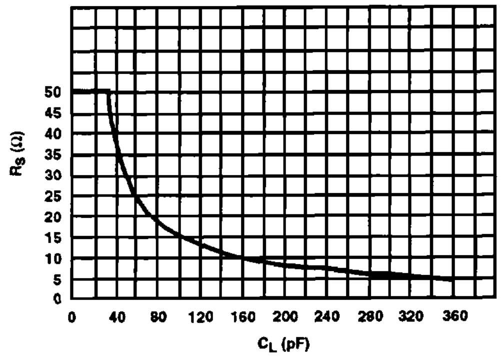


FIGURE 14. RECOMMENDED SERIES OUTPUT RESISTOR vs C_{LOAD}

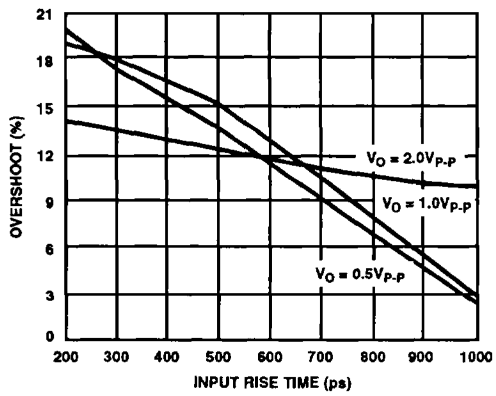


FIGURE 15. OVERSHOOT vs INPUT RISETIME

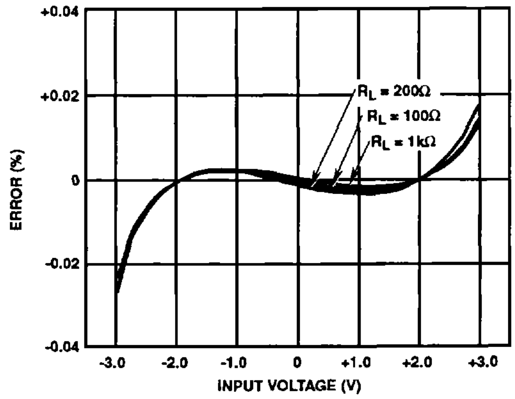


FIGURE 16. INTEGRAL LINEARITY ERROR

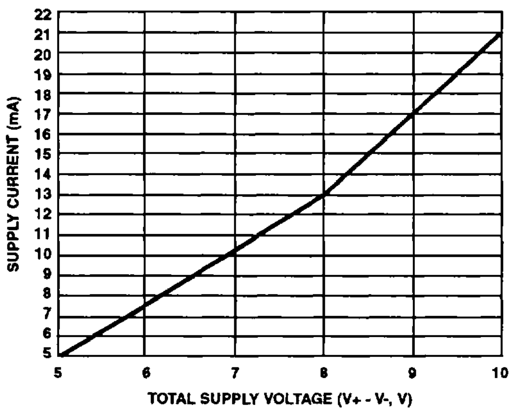


FIGURE 17. SUPPLY CURRENT vs SUPPLY VOLTAGE

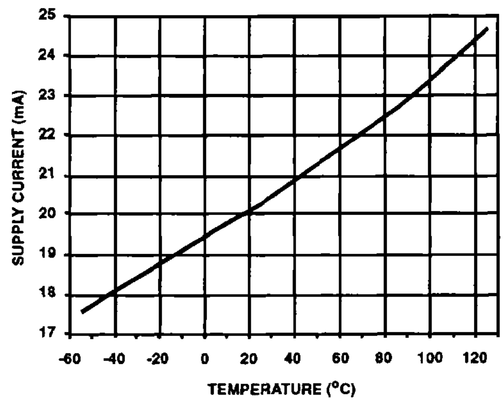


FIGURE 18. SUPPLY CURRENT vs TEMPERATURE

Typical Performance Curves V_{SUPPLY} = ±5V, T_A = +25°C, R_L = 100Ω Unless Otherwise Specified. **(Continued)**

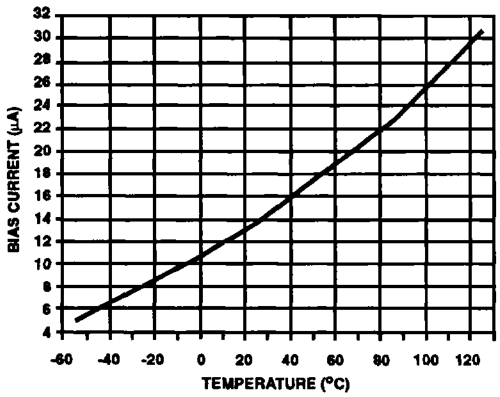


FIGURE 19. BIAS CURRENT vs TEMPERATURE

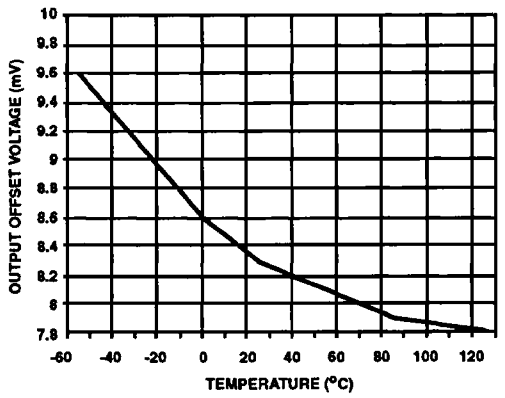


FIGURE 20. OFFSET VOLTAGE vs TEMPERATURE

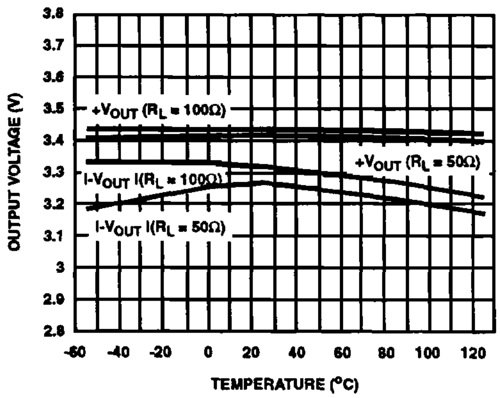


FIGURE 21. OUTPUT VOLTAGE vs TEMPERATURE

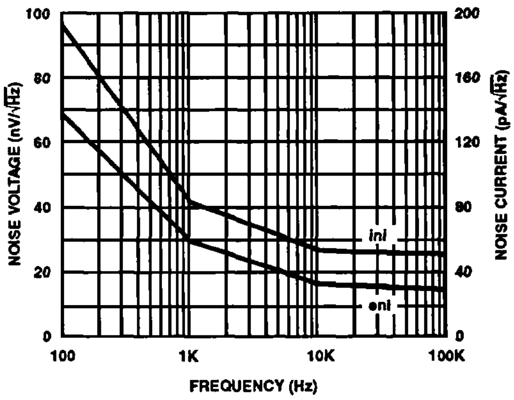


FIGURE 22. INPUT NOISE vs FREQUENCY

2

OPERATIONAL AMPLIFIERS