HARRIS SEMICONDUCTOR

HA-2850

Low Power, High Slew Rate Wideband Operational Amplifier

March 1993

Features

- Low Supply Current 7.5mA
- High Slew Rate 340V/µs
- Open Loop Gain 25kV/V
- Wide Gain-Bandwidth ($A_V \geq 10$) 470MHz
- Full Power Bandwidth 5.4MHz
- Low Offset Voltage 0.6mV
- Input Noise Voltage . . . . . $11nV/\sqrt{Hz}$
- Differential Gain/Phase . . . . . 0.04%/0.04°
- Lower Power Enhanced Replacement for AD840 and EL2040

Applications

- Pulse and Video Amplifiers
- Wideband Amplifiers
- High Speed Sample-Hold Circuits
- Fast, Precise D/A Converters

Description

The HA-2850 is a wideband, high slew rate, operational amplifier featuring superior speed and bandwidth characteristics. Bipolar construction, coupled with dielectric isolation, delivers outstanding performance in circuits with a closed loop gain of 10 or greater.

A 340V/µs slew rate and a 470MHz gain bandwidth product ensure high performance in video and wideband amplifier designs. Differential gain and phase are a low 0.04% and 0.04° respectively, making the HA-2850 ideal for video applications. A full ±10V output swing, high open loop gain, and outstanding AC parameters, make the HA-2850 an excellent choice for high speed Data Acquisition Systems.

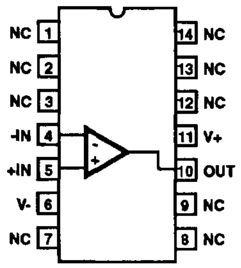
The HA-2850 is available in commercial and industrial temperature ranges, and a choice of packages. For military grade product, refer to the HA-2850/883 data sheet.

Ordering Information

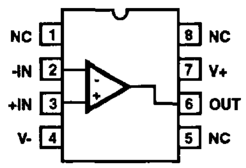
PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2850-5	0°C to +75°C	14 Lead Ceramic DIP
HA3B2850-5	0°C to +75°C	14 Lead Plastic DIP
HA7-2850-5	0°C to +75°C	8 Lead Ceramic DIP
HA3-2850-5	0°C to +75°C	8 Lead Plastic DIP
HA9P2850-5	0°C to +75°C	8 Lead SOIC
HA1-2850-9	-40°C to +85°C	14 Lead Ceramic DIP
HA3B2850-9	-40°C to +85°C	14 Lead Plastic DIP
HA7-2850-9	-40°C to +85°C	8 Lead Ceramic DIP
HA3-2850-9	-40°C to +85°C	8 Lead Plastic DIP

Pinouts

HA-2850
(CDIP, PDIP)
TOP VIEW



HA-2850
(CDIP, PDIP, SOIC)
TOP VIEW



NOTE: (NC) No Connection pins may be tied to a ground plane for better isolation and heat dissipation.

Absolute Maximum Ratings (Note 1)

Voltage Between V+ and V- Terminals 35V
Differential Input Voltage 6V
Junction Temperature .... +175°C
Junction Temperature (Plastic Package) .... +150°C
Lead Temperature (Soldering 10 Sec.) .... +300°C

Operating Conditions

Operating Temperature Range
HA-2850-5 .... $0^oC \le T_A \le +75^oC$
HA-2850-9 .... $-40^oC \le T_A \le +85^oC$
Recommended Supply Voltage Range .... ±6V To ±15V
Storage Temperature Range .... $-65^oC \le T_A \le +150^oC$

Thermal Package Characteristics (°C/W)	θ_{JA}	θ_{JC}
14 Lead Plastic DIP Package	107	38
14 Lead Ceramic DIP Package	71	14
8 Lead Plastic DIP Package	96	34
8 Lead Ceramic DIP Package	115	36
8 Lead SOIC Package	157	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 Specifications $V_{SUPPLY} = \pm15V$, $R_L = 1k\Omega$, $C_L \le 10pF$, Unless Otherwise Specified.

PARAMETER	TEMPERATURE	HA-2850-5, -9 MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Offset Voltage (Note 13)	+25°C	-	0.6	2	mV
	Full	-	2	6	mV
Average Offset Voltage Drift	Full	-	20	-	µV/°C
Bias Current (Note 13)	+25°C	-	5	14.5	µA
	Full	-	8	20	µA
Offset Current	+25°C	-	1	4	µA
	Full	-	-	8	µA
Input Resistance	+25°C	-	10	-	kΩ
Input Capacitance	+25°C	-	1	-	pF
Common Mode Range	Full	±10	-	-	V
Input Noise Voltage (f = 1kHz, R_{SOURCE} = 0Ω, Note 13)	+25°C	-	11	-	$nV/\sqrt{Hz}$
Input Noise Current (f = 1kHz, R_{SOURCE} = 10kΩ, Note 13)	+25°C	-	6	-	$pA/\sqrt{Hz}$
TRANSFER CHARACTERISTICS					
Large Signal Voltage Gain (Note 3)	+25°C	20	25	-	kV/V
	Full	15	20	-	kV/V
Common-Mode Rejection Ratio (Notes 4, 13)	Full	75	80	-	dB
Minimum Stable Gain	+25°C	10	-	-	V/V
Gain Bandwidth Product (Notes 5, 11, 13)	+25°C	-	470	-	MHz
OUTPUT CHARACTERISTICS					
Output Voltage Swing (Notes 3, 13)	Full	±10	±11	-	V
Output Current (Notes 3, 13)	Full	±10	±20	-	mA
Output Resistance	+25°C	-	30	-	Ω
Full Power Bandwidth (Notes 3, 7)	+25°C	4.8	5.4	-	MHz
Differential Gain (Notes 2, 6)	+25°C	-	0.04	-	%
Differential Phase (Notes 2, 6)	+25°C	-	0.04	-	Degrees
Harmonic Distortion (Notes 6, 12, 13)	+25°C	-	-74	-	dBc

Electrical Specifications V_{SUPPLY} = ±15V, R_L = 1kΩ, $C_L \leq$ 10pF, Unless Otherwise Specified. **(Continued)**

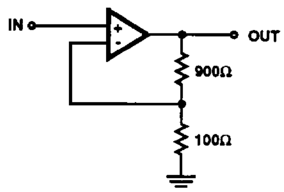
PARAMETER	TEMPERATURE	HA-2850-5, -9			UNITS
		MIN	TYP	MAX	
TRANSIENT RESPONSE (Note 8)					
Rise Time	+25°C	-	5	-	ns
Overshoot	+25°C	-	25	-	%
Slew Rate (Notes 3, 10, 13)	+25°C	300	340	-	V/µs
Settling Time: 10V Step to 0.1%	+25°C	-	200	-	ns
POWER REQUIREMENTS					
Supply Current (Note 13)	Full	-	7.5	8.0	mA
Power Supply Rejection Ratio (Notes 9, 13)	Full	75	90	-	dB

NOTES:

1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not necessarily implied.
2. Differential gain and phase are measured with a VM700A video tester, using a NTC-7 composite VITS.
3. R_L = 1kΩ, V_O = ±10V, 0V to ±10V for slew rate.
4. V_{CM} = ±10V.
5. V_O = 90mV.
6. A_V = +10.
7. Full Power Bandwidth guaranteed based on slew rate measurement using $FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$; (V_{PEAK} = 10V) .
8. Refer to Test Circuit section of data sheet.
9. V_{SUPPLY} = ±10VDC to ±20VDC.
10. This parameter is not tested. The limits are guaranteed based on lab characterization, and reflect lot-to-lot variation.
11. A_V = +100.
12. V_O = $2V_{P-P}$, f = 1MHz
13. See "Typical Performance Curves" for more information.

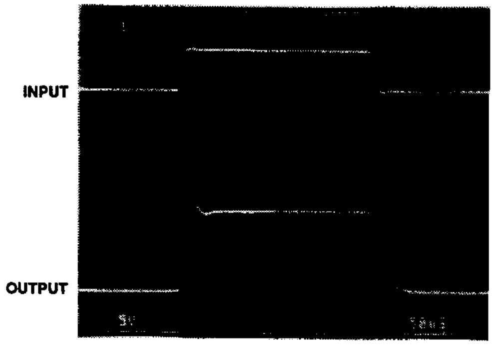
Test Circuit

TEST CIRCUIT

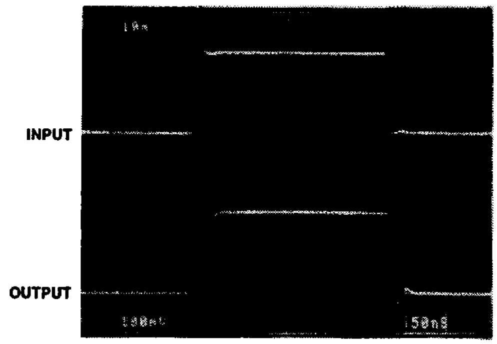


NOTE:
$V_S = \pm 15V$
$A_V = +10$
$C_L < 10pF$

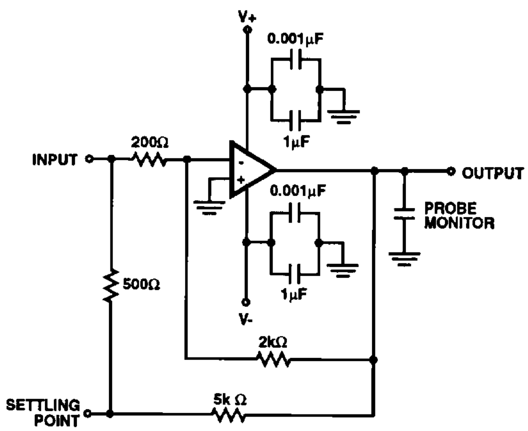
LARGE SIGNAL RESPONSE
Input = 1V/Div.
Output = 5V/Div.
50ns/Div.



SMALL SIGNAL RESPONSE
Input = 10mV/Div.
Output = 100mV/Div.
50ns/Div.



SETTLING TIME TEST CIRCUIT



- $A_V = -10$
- Load Capacitance should be less than 10pF.
- It is recommended that resistors be carbon composition and that feedback and summing network ratios be matched to 0.1%.
- SETTLING POINT (Summing Node) capacitance should be less than 10pF. For optimum settling time results, it is recommended that the test circuit be constructed directly onto the device pins. A Tektronix 568 Sampling Oscilloscope with S-3A sampling heads is recommended as a settle point monitor.

Die Characteristics

DIE DIMENSIONS:
65 x 52 x 19 ± 1mils
(1650 x 1310 x 483μm)

METALLIZATION:
Type: Aluminum, 1% Copper
Thickness: 16kÅ ± 2kÅ

GLASSIVATION:
Type: Nitride over Silox
Silox Thickness: 12kÅ ± 2kÅ
Nitride thickness: 3.5kÅ ± 1kÅ

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

WORST CASE CURRENT DENSITY:
0.7 x 10^5 A/cm^2 at 1.8mA

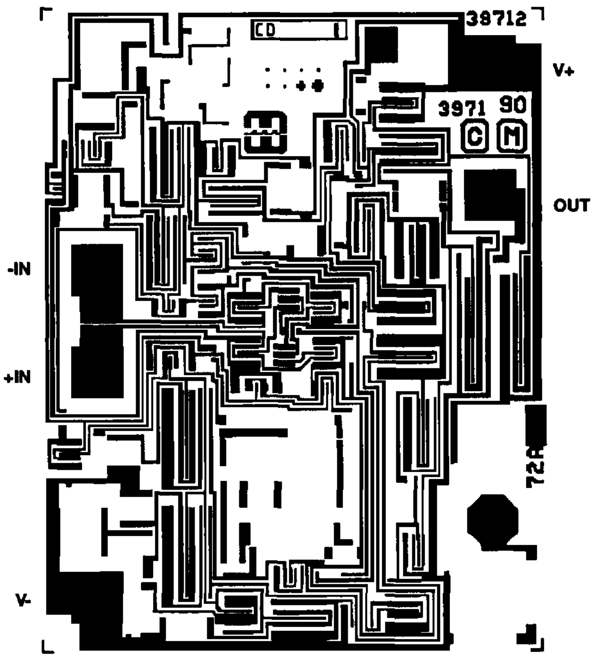
SUBSTRATE POTENTIAL (POWERED UP): V-

TRANSISTOR COUNT: 34

PROCESS: High Frequency Bipolar Dielectric Isolation

Metallization Mask Layout

HA-2850



Typical Performance Curves T_A = +25°C, V_{SUPPLY} = ±15V, R_L = 1kΩ, C_L < 10pF, Unless Otherwise Specified

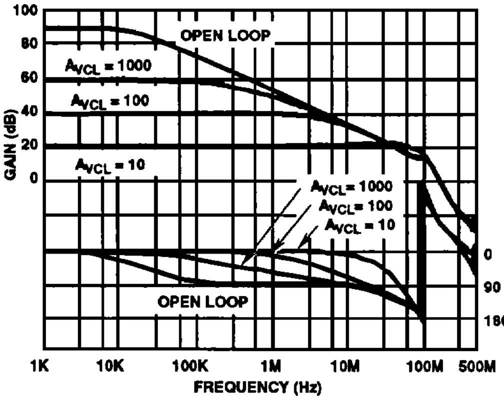


FIGURE 1. FREQUENCY RESPONSE FOR VARIOUS GAINS

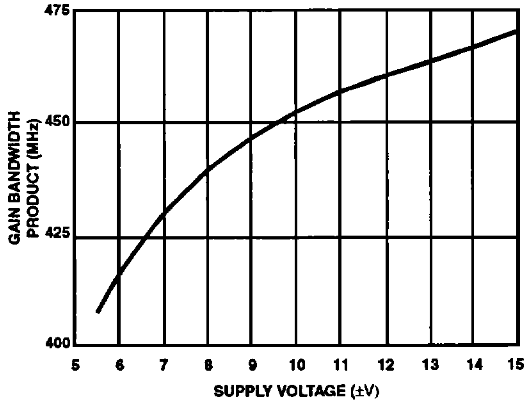


FIGURE 2. GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

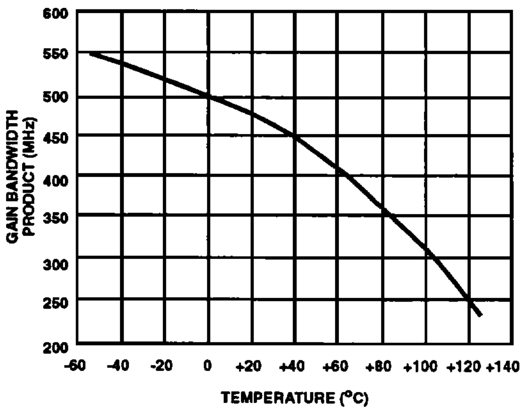


FIGURE 3. GAIN BANDWIDTH PRODUCT vs TEMPERATURE

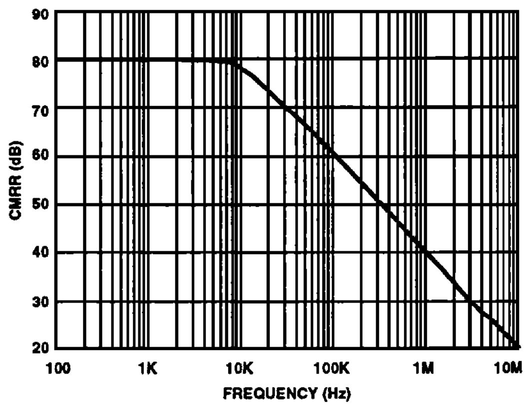


FIGURE 4. CMRR vs FREQUENCY

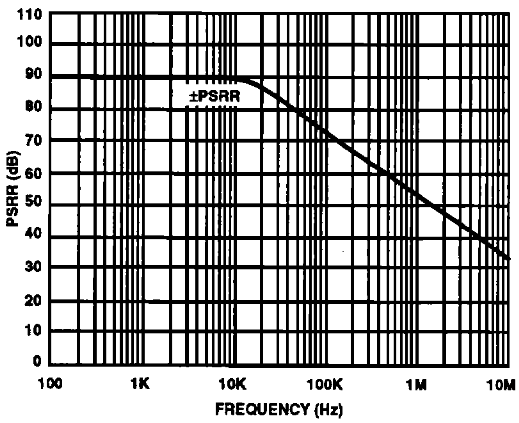


FIGURE 5. PSRR vs FREQUENCY

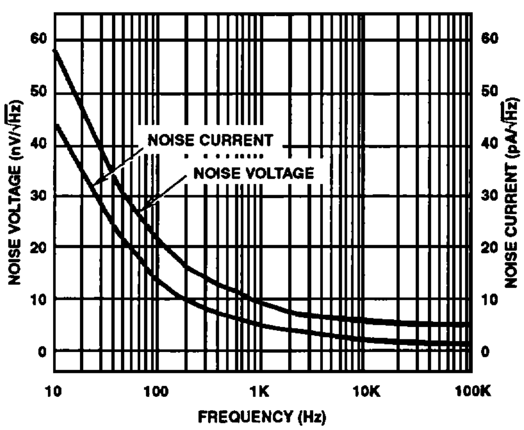


FIGURE 6. INPUT NOISE vs FREQUENCY

2
OPERATIONAL AMPLIFIERS

Typical Performance Curves T_A = +25°C, V_{SUPPLY} = ±15V, R_L = 1kΩ, C_L < 10pF, Unless Otherwise Specified **(Continued)**

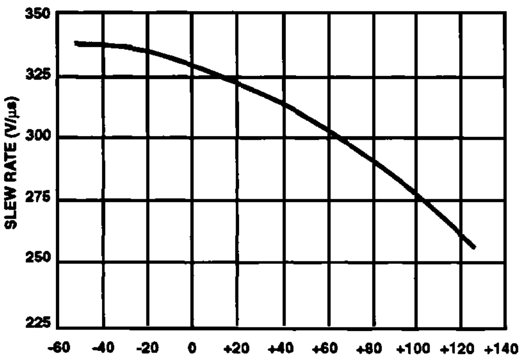


FIGURE 7. SLEW RATE vs TEMPERATURE

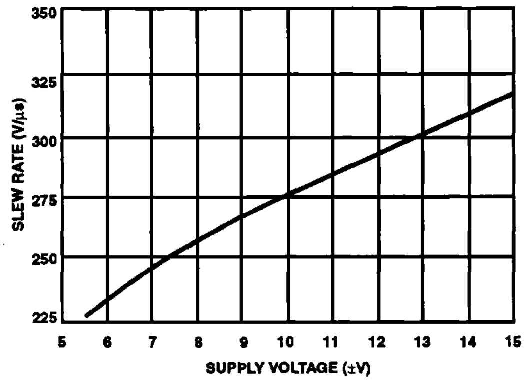


FIGURE 8. SLEW RATE vs SUPPLY VOLTAGE

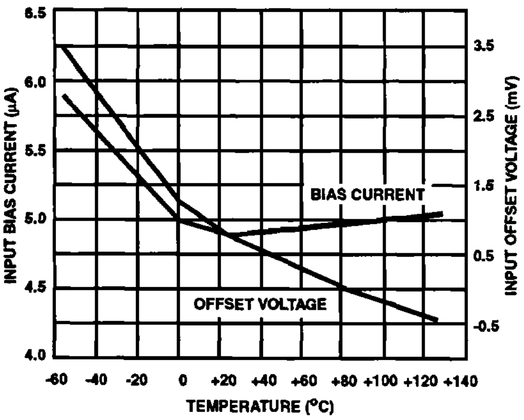


FIGURE 9. INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE

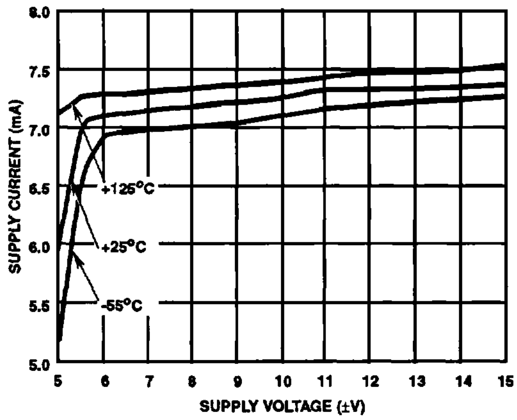


FIGURE 10. SUPPLY CURRENT vs SUPPLY VOLTAGE

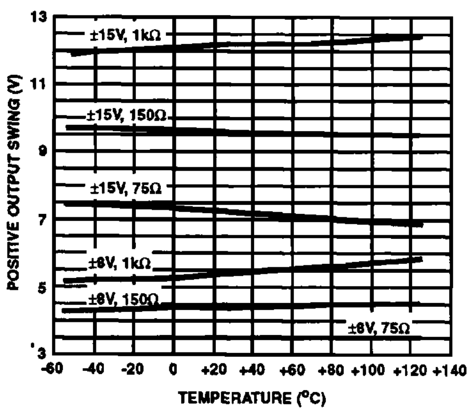


FIGURE 11. POSITIVE OUTPUT SWING vs TEMPERATURE

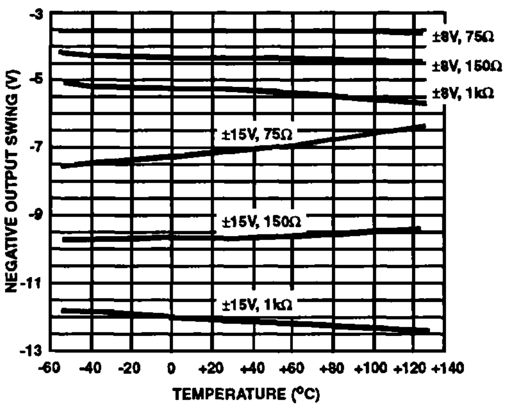


FIGURE 12. NEGATIVE OUTPUT SWING vs TEMPERATURE

Typical Performance Curves T_A = +25°C, V_{SUPPLY} = ±15V, R_L = 1kΩ, C_L < 10pF, Unless Otherwise Specified **(Continued)**

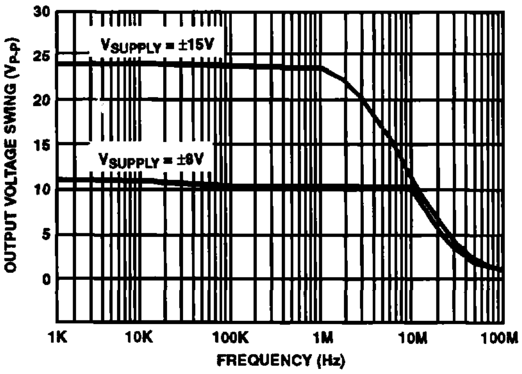


FIGURE 13. MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY

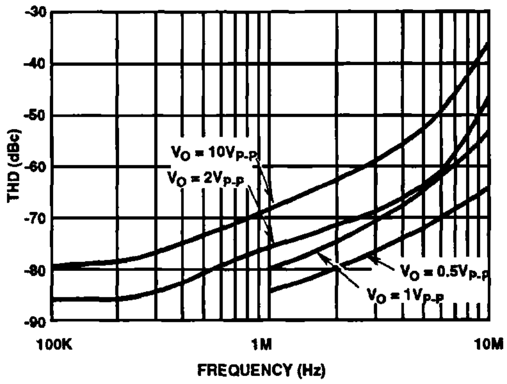


FIGURE 14. TOTAL HARMONIC DISTORTION vs FREQUENCY

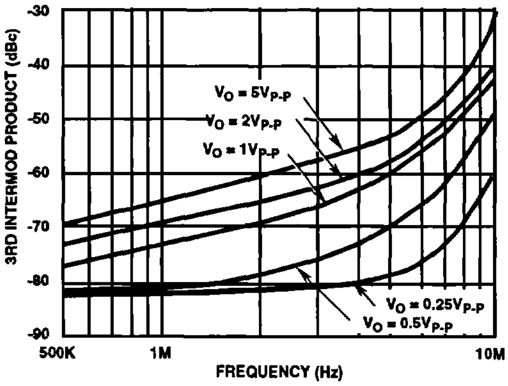


FIGURE 15. INTERMODULATION DISTORTION vs FREQUENCY (2 TONE)

2 OPERATIONAL AMPLIFIERS