

## Very High Slew Rate Wideband Operational Amplifier

March 1993

### Features

- Low Supply Current..... 13mA
- Very High Slew Rate ..... 625V/ $\mu$ s
- Open Loop Gain..... 25kV/V
- Wide Gain-Bandwidth ( $A_v \geq 10$ ) ..... 600MHz
- Full Power Bandwidth ..... 10MHz
- Low Offset Voltage..... 0.6mV
- Differential Gain/Phase ..... 0.03%/0.03°
- Enhanced Replacement for EL2039

### Applications

- Pulse and Video Amplifiers
- Wideband Amplifiers
- High Speed Sample-Hold Circuits
- RF Oscillators

### Description

The HA-2840 is a wideband, very 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.

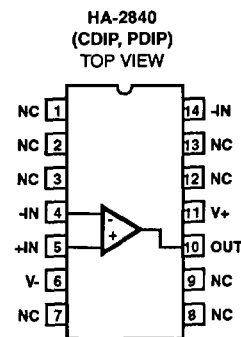
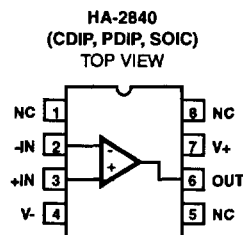
A 625V/ $\mu$ s slew rate and a 600MHz gain bandwidth product ensure high performance in video and RF amplifier designs. Differential gain and phase are a low 0.03% and 0.03° respectively, making the HA-2840 ideal for video applications. A full  $\pm 10V$  output swing, high open loop gain, and outstanding AC parameters, make the HA-2840 an excellent choice for high speed Data Acquisition Systems.

The HA-2840 is available in commercial and industrial temperature ranges, and a choice of packages. See the "Ordering Information" below for more information. For military grade product, refer to the HA-2840/883 data sheet.

### Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2840-5	0°C to +75°C	14 Lead Ceramic DIP
HA3B2840-5	0°C to +75°C	14 Lead Plastic DIP
HA7-2840-5	0°C to +75°C	8 Lead Ceramic DIP
HA3-2840-5	0°C to +75°C	8 Lead Plastic DIP
HA9P2840-5	0°C to +75°C	8 Lead SOIC
HA1-2840-9	-40°C to +85°C	14 Lead Ceramic DIP
HA3B2840-9	-40°C to +85°C	14 Lead Plastic DIP
HA7-2840-9	-40°C to +85°C	8 Lead Ceramic DIP
HA3-2840-9	-40°C to +85°C	8 Lead Plastic DIP

### Pinouts



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

## Specifications HA-2840

### Absolute Maximum Ratings (Note 1)

Voltage Between V+ and V- Terminals	35V
Differential Input Voltage	6V
Output Current	50mA
Internal Quiescent Power Dissipation (Note 2)	
Junction Temperature	+175°C
Junction Temperature (Plastic Package)	+150°C
Lead Temperature (Soldering 10 Sec.)	+300°C

### Operating Conditions

Operating Temperature Range	0°C ≤ T <sub>A</sub> ≤ +75°C	
HA-2840-5	-40°C ≤ T <sub>A</sub> ≤ +85°C	
HA-2840-9		
Recommended Supply Voltage Range	±7V to ±15V	
Storage Temperature Range	-65°C ≤ T <sub>A</sub> ≤ +150°C	
Thermal Package Characteristics (°C/W)	θ <sub>JA</sub>	θ <sub>JC</sub>
14 Lead Ceramic DIP Package	71	14
14 Lead Plastic DIP Package	107	38
8 Lead Ceramic DIP Package	115	36
8 Lead Plastic DIP Package	96	34
8 Lead SOIC	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<sub>SUPPLY</sub> = ±15V, R<sub>L</sub> = 1kΩ, C<sub>L</sub> ≤ 10pF, Unless Otherwise Specified.

PARAMETER	TEMPERATURE	HA-2840-5, -9			UNITS
		MIN	TYP	MAX	
<b>INPUT CHARACTERISTICS</b>					
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 <sub>SOURCE</sub> = 0Ω, Note 13)	+25°C	-	6	-	nV/√Hz
Input Noise Current (f = 1kHz, R <sub>SOURCE</sub> = 10kΩ, Note 13)	+25°C	-	6	-	pA/√Hz
<b>TRANSFER CHARACTERISTICS</b>					
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, 12, 13)	+25°C	-	600	-	MHz
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Swing (Notes 3, 13)	Full	±10	-	-	V
Output Current (Notes 3, 13)	Full	±10	±20	-	mA
Output Resistance	+25°C	-	30	-	Ω
Full Power Bandwidth (Notes 3, 7)	+25°C	8.7	10	-	MHz
Differential Gain (Notes 6, 11)	+25°C	-	0.03	-	%
Differential Phase (Notes 6, 11)	+25°C	-	0.03	-	Degrees
Harmonic Distortion (Notes 6, 13, 14)	+25°C	-	-79	-	dBc

## Specifications HA-2840

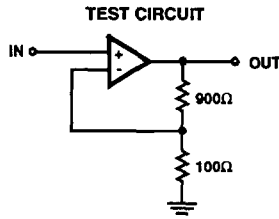
### Electrical Specifications $V_{SUPPLY} = \pm 15V$ , $R_L = 1k\Omega$ , $C_L \leq 10pF$ , Unless Otherwise Specified. (Continued)

PARAMETER	TEMPERATURE	HA-2840-5, -9			UNITS
		MIN	TYP	MAX	
<b>TRANSIENT RESPONSE (Note 8)</b>					
Rise Time	+25°C	-	4	-	ns
Overshoot	+25°C	-	20	-	%
Slew Rate (Notes 3, 10, 13)	+25°C	550	625	-	V/ $\mu$ s
Settling Time: 10V Step to 0.1%	+25°C	-	180	-	ns
<b>POWER REQUIREMENTS</b>					
Supply Current (Note 13)	Full	-	13	15	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. Maximum power dissipation with load conditions must be designed to maintain the maximum junction temperature below +175°C for ceramic packages and below +150°C for plastic packages.
3.  $R_L = 1k\Omega$ ,  $V_O = \pm 10V$ , 0V to  $\pm 10V$  for slew rate.
4.  $V_{CM} = \pm 10V$ .
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.  $V_{SUPPLY} = \pm 10VDC$  to  $\pm 20VDC$ .
10. This parameter is not tested. The limits are guaranteed based on lab characterization, and reflect lot-to-lot variation.
11. Differential gain and phase are measured with a VM700A video tester, using a NTC-7 composite VITS.
12.  $A_V = +100$ .
13. See "Typical Performance Curves" for more information.
14.  $V_O = 2V_{p-p}$ ,  $f = 1MHz$ .

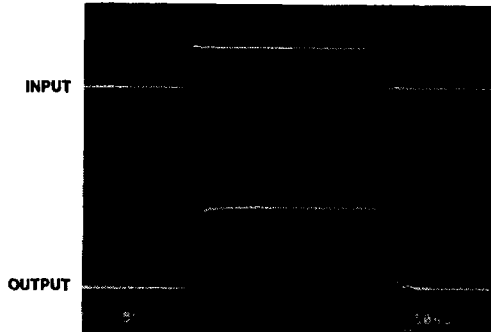
Test Circuit



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

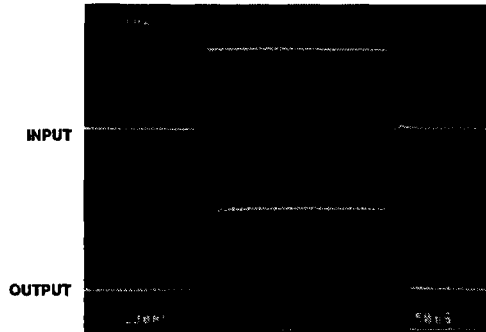
LARGE SIGNAL RESPONSE

Input = 1V/Div.  
 Output = 5V/Div.  
 50ns/Div.

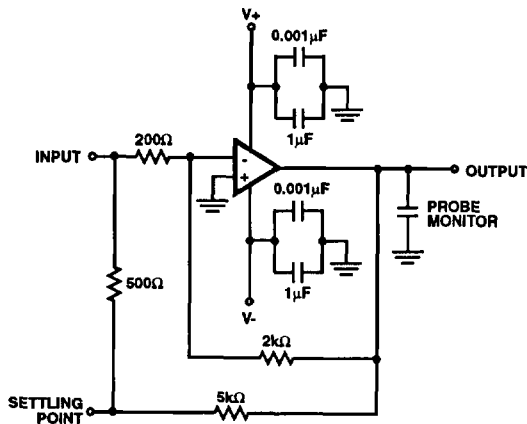


SMALL SIGNAL RESPONSE

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.

HA-2840

**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  
Gold Eutectic-Ceramic DIP

**WORST CASE CURRENT DENSITY:**

$1.3 \times 10^5$  A/cm<sup>2</sup> at 3.4mA

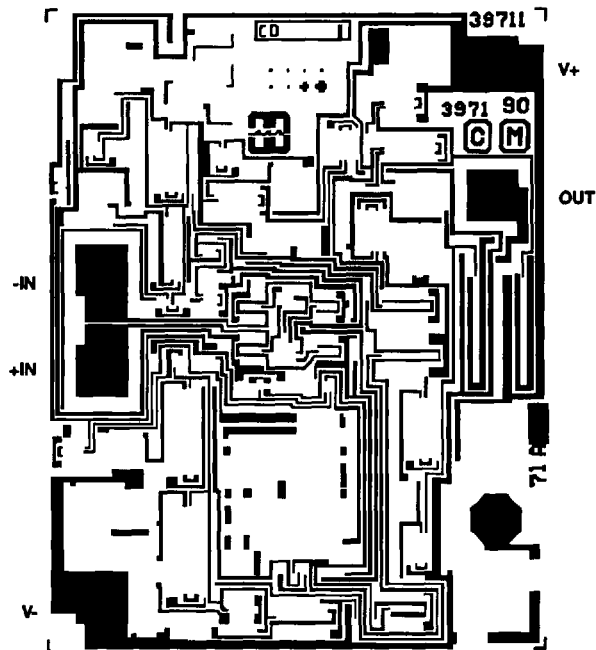
**SUBSTRATE POTENTIAL (POWERED UP):** V-

**TRANSISTOR COUNT:** 34

**PROCESS:** High Frequency Bipolar Dielectric Isolation

**Metallization Mask Layout**

HA-2840



**Typical Performance Curves**  $T_A = +25^\circ\text{C}$ ,  $V_{\text{SUPPLY}} = \pm 15\text{V}$ ,  $R_L = 1\text{k}\Omega$ ,  $C_L < 10\text{pF}$ , Unless Otherwise Specified

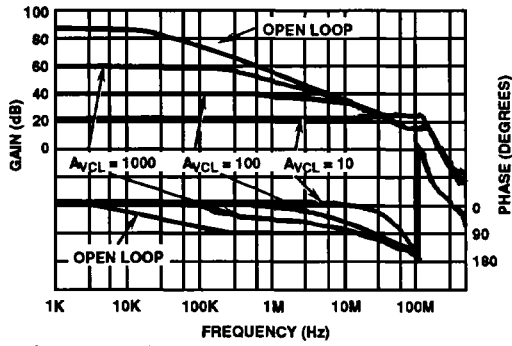


FIGURE 1. FREQUENCY RESPONSE FOR VARIOUS GAINS

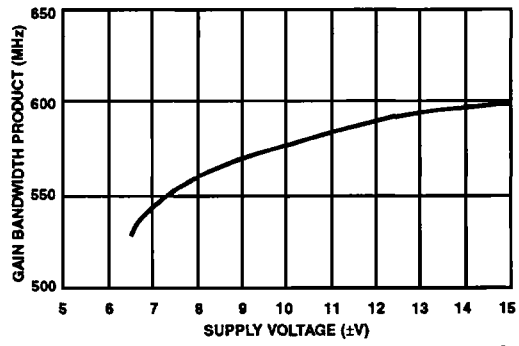


FIGURE 2. GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

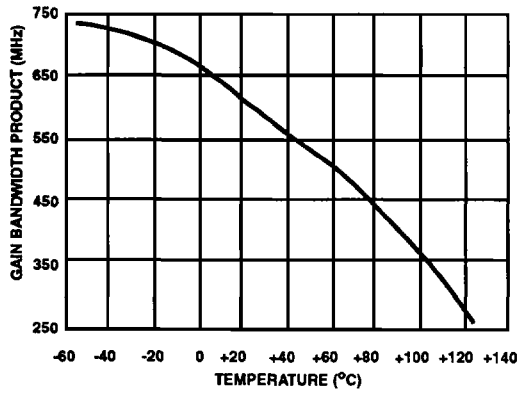


FIGURE 3. GAIN BANDWIDTH PRODUCT vs TEMPERATURE

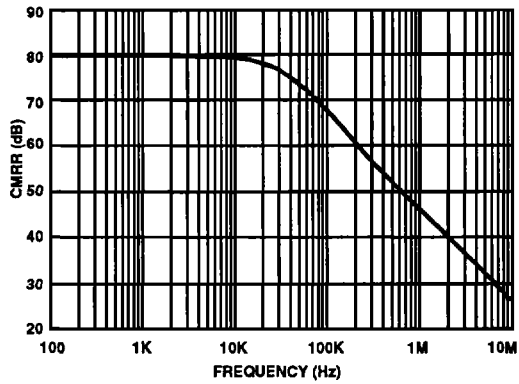


FIGURE 4. CMRR vs FREQUENCY

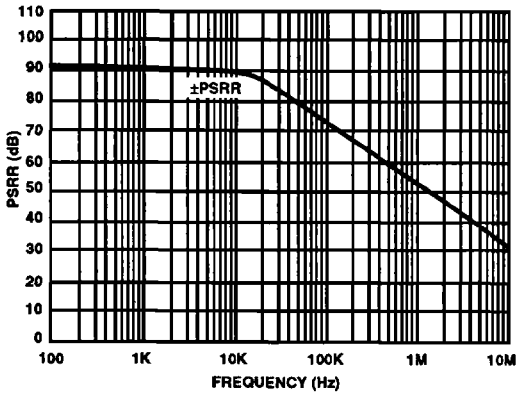


FIGURE 5. PSRR vs FREQUENCY

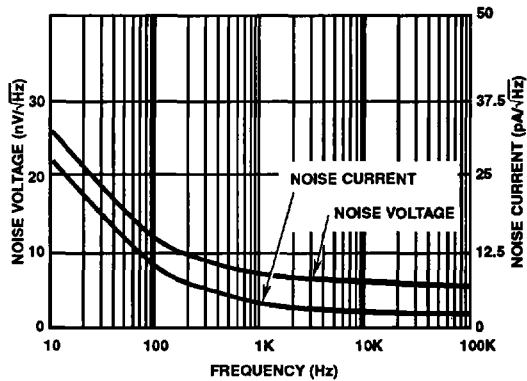


FIGURE 6. INPUT NOISE vs FREQUENCY

2  
OPERATIONAL  
AMPLIFIERS

**Typical Performance Curves**  $T_A = +25^\circ\text{C}$ ,  $V_{\text{SUPPLY}} = \pm 15\text{V}$ ,  $R_L = 1\text{k}\Omega$ ,  $C_L < 10\text{pF}$ , Unless Otherwise Specified (Continued)

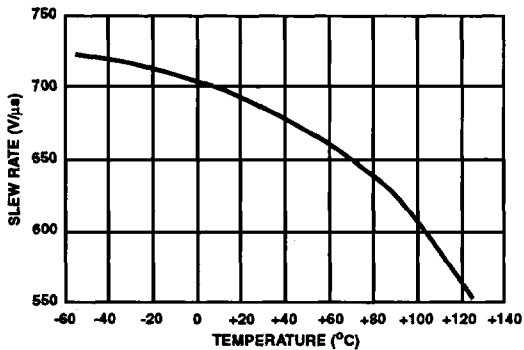


FIGURE 7. SLEW RATE vs TEMPERATURE

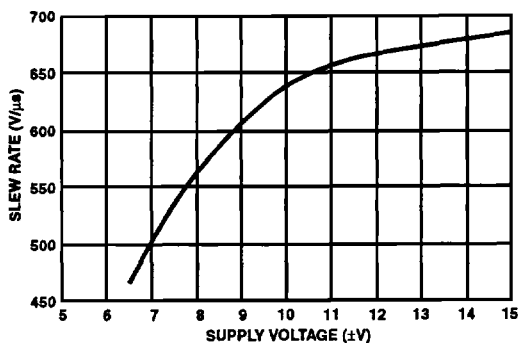


FIGURE 8. SLEW RATE vs SUPPLY VOLTAGE

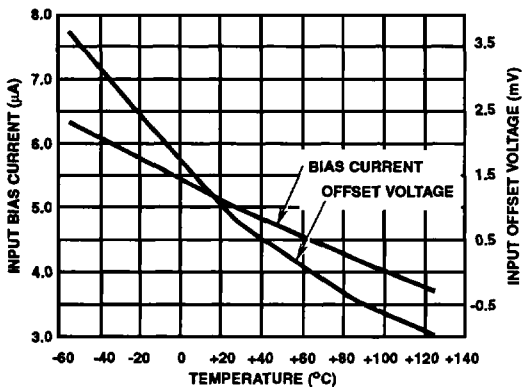


FIGURE 9. INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE

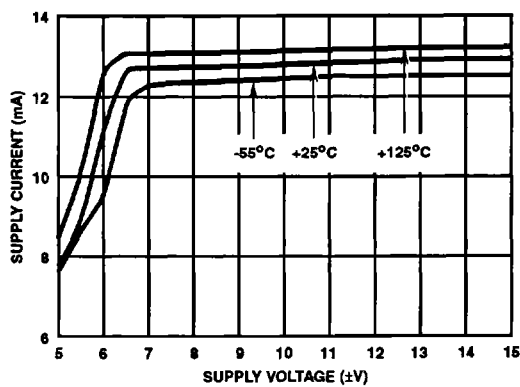


FIGURE 10. SUPPLY CURRENT vs SUPPLY VOLTAGE

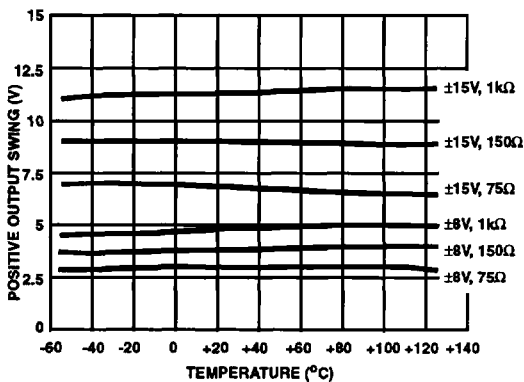


FIGURE 11. POSITIVE OUTPUT SWING vs TEMPERATURE

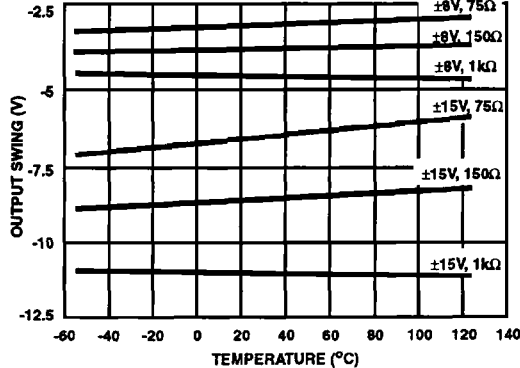


FIGURE 12. NEGATIVE OUTPUT SWING vs TEMPERATURE

**Typical Performance Curves**  $T_A = +25^\circ\text{C}$ ,  $V_{\text{SUPPLY}} = \pm 15\text{V}$ ,  $R_L = 1\text{k}\Omega$ ,  $C_L < 10\text{pF}$ , Unless Otherwise Specified (Continued)

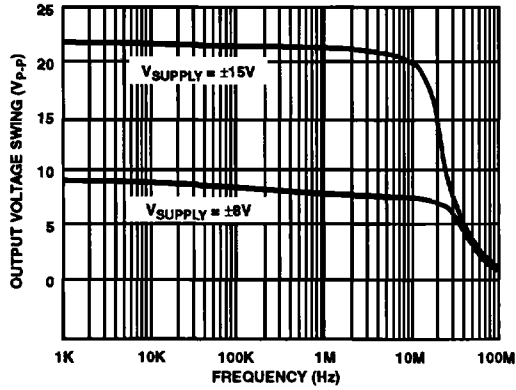


FIGURE 13. MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY

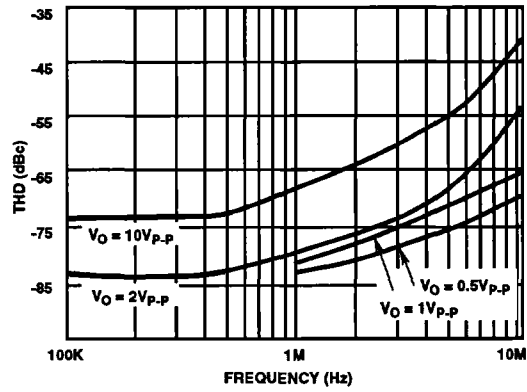


FIGURE 14. TOTAL HARMONIC DISTORTION vs FREQUENCY

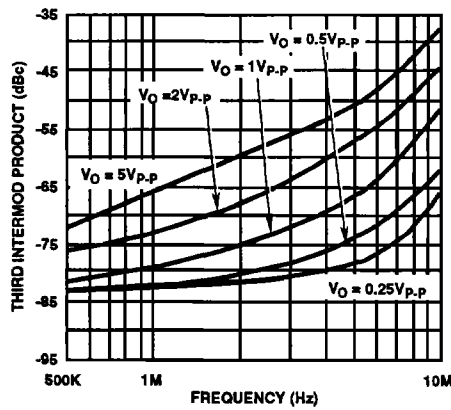


FIGURE 15. INTERMODULATION DISTORTION vs FREQUENCY TWO TONE