

## Wideband, High Slew Rate, High Output Current, Video Operational Amplifier

July 1994

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Low AC Variability Over Process and Temperature
- Stable at Gains of 2 or Greater
- Low Supply Current ..... 15mA (Max)
- Gain Bandwidth Product..... 80MHz (Typ)
- High Slew Rate..... 375V/μs (Typ)
- High Output Current ..... 100mA (Min)
- Full Power Bandwidth ..... 6MHz (Typ)
- Low Differential Gain/Phase ..... 0.02%/0.03° (Typ)

### Applications

- Coaxial Cable Drivers
- Pulse and Video Amplifiers
- Wideband Amplifiers
- Fast Sample and Hold Circuits
- High Frequency Signal Conditioning Circuits

### Description

The HA-2842/883 is a wideband, high slew rate, operational amplifier featuring an outstanding combination of speed, bandwidth, and output drive capability. This amplifier's performance is further enhanced through stable operation down to closed loop gains of +2, the inclusion of offset null controls, and by its excellent video performance.

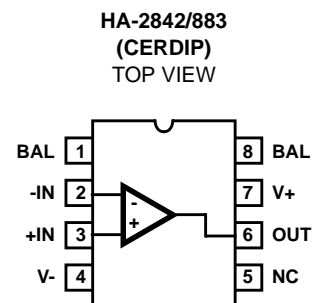
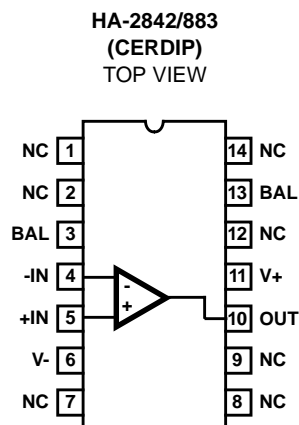
The capabilities of the HA-2842/883 are ideally suited for high speed cable driver circuits, where low closed loop gains and high output drive are required. With a 6MHz full power bandwidth, this amplifier is well suited for high frequency signal conditioning circuits and video amplifiers. Gain flatness of 0.035dB, combined with differential gain and phase specifications of 0.02%, and 0.03 degrees, respectively, make the HA-2842/883 ideal for component and composite video applications.

A zener/nichrome based reference circuit, coupled with advanced laser trimming techniques, yields a supply current with a low temperature coefficient and low lot-to-lot variability. For example, the average I<sub>CC</sub> variation from +85°C to -40°C is <600μA (±2%), while the standard deviation of the I<sub>CC</sub> distribution is <0.1mA (0.8%) at +25°C. Tighter I<sub>CC</sub> control translates to more consistent AC parameters ensuring that units from each lot perform the same way, and easing the task of designing systems for wide temperature ranges.

### Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2842/883	-55°C to +125°C	14 Lead CerDIP
HA7-2842/883	-55°C to +125°C	8 Lead CerDIP

### Pinouts



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

# Specifications HA-2842/883

## Absolute Maximum Ratings

Voltage between V+ and V- Terminals . . . . .	35V
Differential Input Voltage . . . . .	6V
Voltage at Either Input Terminal . . . . .	V+ to V-
Peak Output Current ( $\leq 40\%$ Duty Cycle) . . . . .	125mA
Junction Temperature ( $T_J$ ) (Note 1) . . . . .	+175°C
Storage Temperature Range . . . . .	-65°C to +150°C
ESD Rating . . . . .	<2000V
Lead Temperature (Soldering 10s) . . . . .	+300°C

## Thermal Information

Thermal Resistance	$\theta_{JA}$	$\theta_{JC}$
14 Lead CerDIP Package . . . . .	73°C/W	18°C/W
8 Lead CerDIP Package . . . . .	110°C/W	27°C/W
Package Power Dissipation Limit at +75°C for $T_J \leq +175^\circ\text{C}$		
14 Lead CerDIP Package . . . . .	1.1W	
8 Lead CerDIP Package . . . . .	0.9W	
Package Power Dissipation Derating Factor Above +75°C		
14 Lead CerDIP Package . . . . .	11mW/°C	
8 Lead CerDIP Package . . . . .	9mW/°C	

*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.*

## Operating Conditions

Operating Temperature Range . . . . .	-55°C to +125°C	$V_{INCM} \leq 1/2(V+ - V-)$
Operating Supply Voltage . . . . .	$\pm 12\text{V}$ to $\pm 15\text{V}$	$R_L \geq 1\text{k}\Omega$

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $V_{SUPPLY} = \pm 15\text{V}$ ,  $R_{SOURCE} = 100\Omega$ ,  $R_{LOAD} = 100\text{k}\Omega$ ,  $V_{OUT} = 0\text{V}$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	$V_{IO}$	$V_{CM} = 0\text{V}$	1	+25°C	-4	4	mV
			2, 3	+125°C, -55°C	-8	8	mV
Input Bias Current	+ $I_B$	$V_{CM} = 0\text{V}$ , $+R_S = 1.1\text{k}\Omega$ $-R_S = 100\Omega$	1	+25°C	-10	10	$\mu\text{A}$
			2, 3	+125°C, -55°C	-20	20	$\mu\text{A}$
	- $I_B$	$V_{CM} = 0\text{V}$ , $+R_S = 100\Omega$ $-R_S = 1.1\text{k}\Omega$	1	+25°C	-10	10	$\mu\text{A}$
			2, 3	+125°C, -55°C	-20	20	$\mu\text{A}$
Input Offset Current	$I_{IO}$	$V_{CM} = 0\text{V}$ , $+R_S = 1.1\text{k}\Omega$ $-R_S = 1.1\text{k}\Omega$	1	+25°C	-1	1	$\mu\text{A}$
			2, 3	+125°C, -55°C	-2	2	$\mu\text{A}$
Common Mode Range	+CMR	$V+ = 5\text{V}$ $V- = -25\text{V}$	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-CMR	$V+ = 25\text{V}$ $V- = -5\text{V}$	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
Large Signal Voltage Gain	+ $A_{VOL}$	$V_{OUT} = 0\text{V}$ and +10V $R_L = 1\text{k}\Omega$	4	+25°C	50	-	kV/V
			5, 6	+125°C, -55°C	30	-	kV/V
	- $A_{VOL}$	$V_{OUT} = 0\text{V}$ and -10V $R_L = 1\text{k}\Omega$	4	+25°C	50	-	kV/V
			5, 6	+125°C, -55°C	30	-	kV/V
Common Mode Rejection Ratio	+CMRR	$\Delta V_{CM} = 10\text{V}$ , $V_{OUT} = -10\text{V}$ $V+ = 5\text{V}$ , $V- = -25\text{V}$	1	+25°C	90	-	dB
			2, 3	+125°C, -55°C	85	-	dB
	-CMRR	$\Delta V_{CM} = -10\text{V}$ , $V_{OUT} = 10\text{V}$ $V+ = 25\text{V}$ , $V- = -5\text{V}$	1	+25°C	90	-	dB
			2, 3	+125°C, -55°C	85	-	dB

## Specifications HA-2842/883

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Tested at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{SOURCE} = 100\Omega$ ,  $R_{LOAD} = 100k\Omega$ ,  $V_{OUT} = 0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Voltage Swing	+V <sub>OUT</sub>	R <sub>L</sub> = 1kΩ	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-V <sub>OUT</sub>	R <sub>L</sub> = 1kΩ	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
Output Current	+I <sub>OUT</sub>	V <sub>OUT</sub> = -5V Note 1	1	+25°C	100	-	mA
			2, 3	+125°C, -55°C	100	-	mA
	-I <sub>OUT</sub>	V <sub>OUT</sub> = +5V Note 1	1	+25°C	-	-100	mA
			2, 3	+125°C, -55°C	-	-100	mA
Quiescent Power Supply Current	+I <sub>CC</sub>	V <sub>OUT</sub> = 0V I <sub>OUT</sub> = 0mA	1	+25°C	-	15	mA
			2, 3	+125°C, -55°C	-	15	mA
	-I <sub>CC</sub>	V <sub>OUT</sub> = 0V I <sub>OUT</sub> = 0mA	1	+25°C	-15	-	mA
			2, 3	+125°C, -55°C	-15	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUPPLY} = 10V$ V <sub>+</sub> = 10V, V <sub>-</sub> = -15V V <sub>+</sub> = 20V, V <sub>-</sub> = -15V	1	+25°C	70	-	dB
			2, 3	+125°C, -55°C	70	-	dB
	-PSRR	$\Delta V_{SUPPLY} = 10V$ V <sub>+</sub> = 15V, V <sub>-</sub> = -10V V <sub>+</sub> = 15V, V <sub>-</sub> = -20V	1	+25°C	70	-	dB
			2, 3	+125°C, -55°C	70	-	dB
Offset Voltage Adjustment	+V <sub>IOAdj</sub>	Note 2	1	+25°C	V <sub>IO-1</sub>	-	mV
	+V <sub>IOAdj</sub>	Note 2	1	+25°C	V <sub>IO+1</sub>	-	mV

**NOTES:**

1. Maximum power dissipation, including output load conditions, must be designed to maintain the maximum junction temperature below +175°C. For a 100mA load and a +125°C ambient, heat sinking is required.
2. Offset Adjustment range is  $|V_{IO} \text{ (measured)} \pm 1mV|$  minimum referred to output. This test is for functionality only, to assure adjustment through 0V.

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Table 2 Intentionally Left Blank. See A.C. Specifications in Table 3.

## Specifications HA-2842/883

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Characterized at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{SOURCE} = 50\Omega$ ,  $R_{LOAD} = 1k\Omega$ ,  $V_{OUT} = 0V$ ,  $A_V = +2V/V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Gain Bandwidth Product	GBWP	$V_O = 200mV$ , $f_O = 100kHz$	1	+25°C	60	-	MHz
		$V_O = 200mV$ , $f_O = 10MHz$	1	+25°C	70	-	MHz
Slew Rate	+SR	$V_O = -5V$ to +5V	1, 3	+25°C, -55°C	350	-	V/ $\mu$ s
			1, 3	+125°C	300	-	V/ $\mu$ s
	-SR	$V_O = +5V$ to -5V	1, 3	+25°C, -55°C	350	-	V/ $\mu$ s
			1, 3	+125°C	300	-	V/ $\mu$ s
Full Power Bandwidth	FPBW	$V_{PEAK} = +10V$	1, 2	+25°C, -55°C	5.5	-	MHz
			1, 2	+125°C	4.7	-	MHz
Rise Time	$T_R$	$V_O = 0V$ to +200mV $C_L \leq 10pF$	1, 3	+25°C	-	5	ns
			1, 3	-55°C to +125°C	-	7	ns
Fall Time	$T_F$	$V_O = 0V$ to -200mV $C_L \leq 10pF$	1, 3	+25°C	-	5	ns
			1, 3	-55°C to +125°C	-	5	ns
Overshoot	+OS	$V_O = 0V$ to +200mV	1	+25°C	-	50	%
			1	-55°C to +125°C	-	55	%
	-OS	$V_O = 0V$ to -200mV	1	+25°C	-	50	%
			1	-55°C to +125°C	-	55	%

**NOTES:**

- Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested at final production. These parameters are lab characterized upon initial design release, or upon design changes. These parameters are guaranteed by characterization based upon data from multiple production runs which reflect lot to lot and within lot variations.
- Full Power Bandwidth guarantee based on Slew Rate measurement using  $FPBW = \text{Slew Rate}/(2\pi V_{PEAK})$ .
- Measured between 10% and 90% points.

**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLE 1)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1 (Note 1), 2, 3, 4, 5, 6
Group A Test Requirements	1, 2, 3, 4, 5, 6
Groups C & D Endpoints	1

**NOTE:**

- PDA applies to Subgroup 1 only.

**Die Characteristics**

**DIE DIMENSIONS:**

77 x 81 x 19 mils  $\pm$  1 mils  
 1960 x 2060 x 483 $\mu$ m  $\pm$  25.4 $\mu$ m

**METALLIZATION:**

Type: Al, 1% Cu  
 Thickness: 16k $\text{\AA}$   $\pm$  2k $\text{\AA}$

**GLASSIVATION:**

Type: Nitride over Silox  
 Silox Thickness: 12k $\text{\AA}$   $\pm$  2k $\text{\AA}$   
 Nitride Thickness: 3.5k $\text{\AA}$   $\pm$  1.5k $\text{\AA}$

**WORST CASE CURRENT DENSITY:**

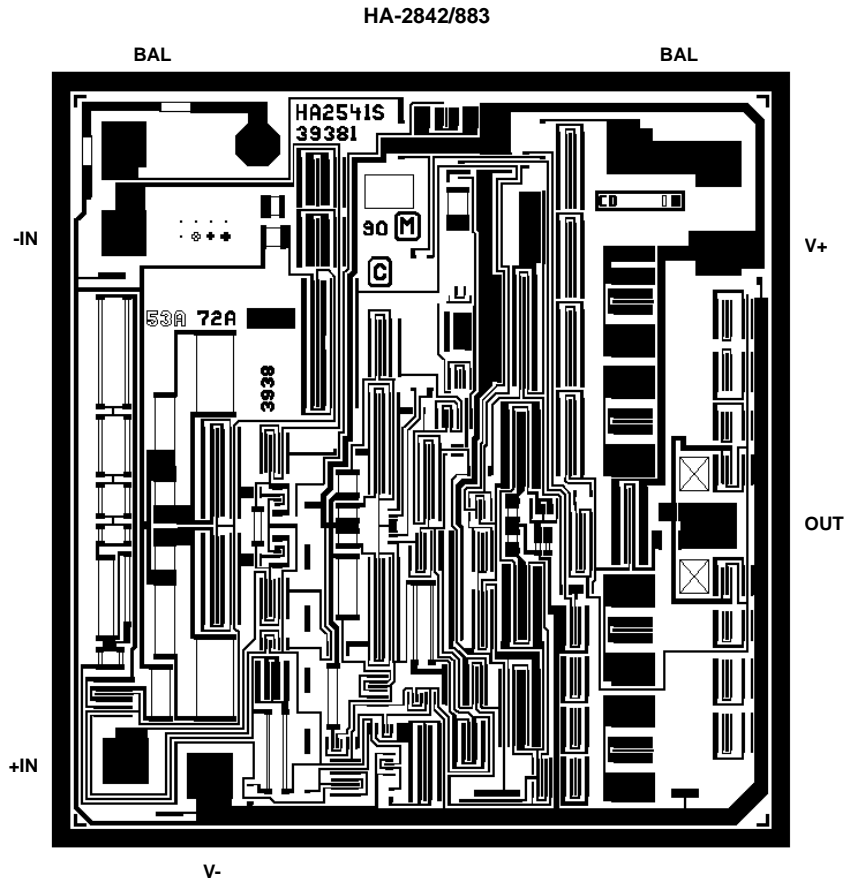
1.83 x 10<sup>5</sup> A/cm<sup>2</sup> at 56mA

**SUBSTRATE POTENTIAL (Powered Up): V-**

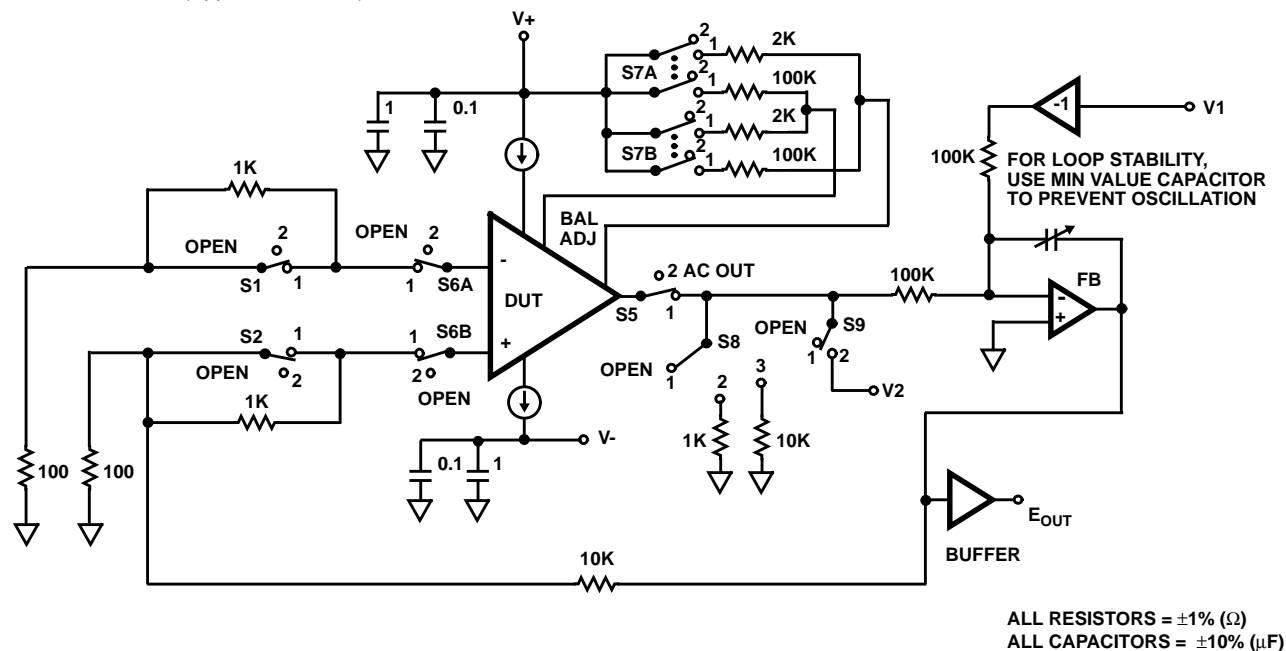
**TRANSISTOR COUNT: 58**

**PROCESS: Bipolar Dielectric Isolation**

**Metallization Mask Layout**

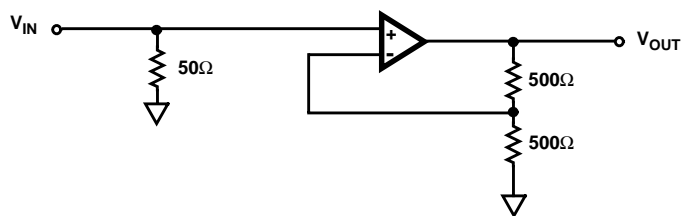


**Test Circuit** (Applies to Table 1)



**Test Waveforms**

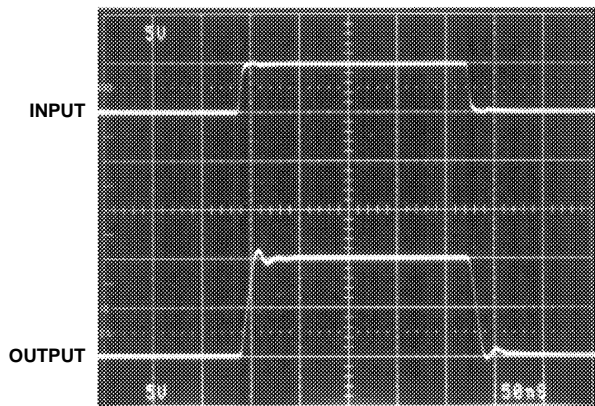
**SIMPLIFIED TEST CIRCUIT FOR LARGE AND SMALL SIGNAL RESPONSE** (Applies to Table 3)



$V_S = \pm 15V$   
 $A_V = +2$   
 $C_L \leq 10pF$

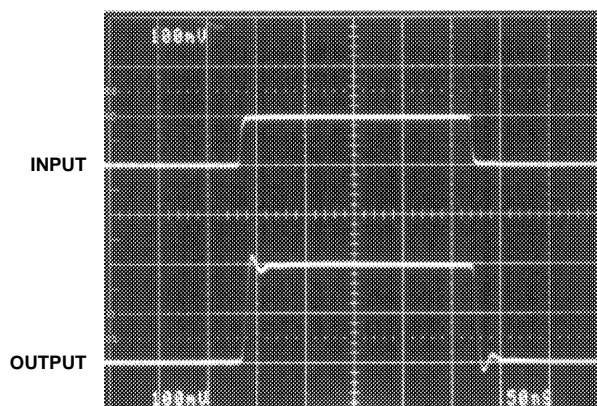
**MEASURED LARGE SIGNAL RESPONSE**

Vertical Scale: Input = 5V/Div., Output = 5V/Div.  
 Horizontal Scale: 50ns/Div.



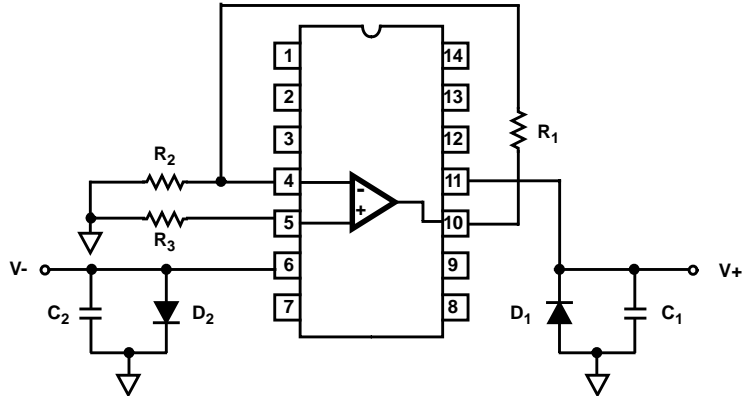
**MEASURED SMALL SIGNAL RESPONSE**

Vertical Scale: Input = 100mV/Div., Output = 100mV/Div.  
 Horizontal Scale: 50ns/Div.

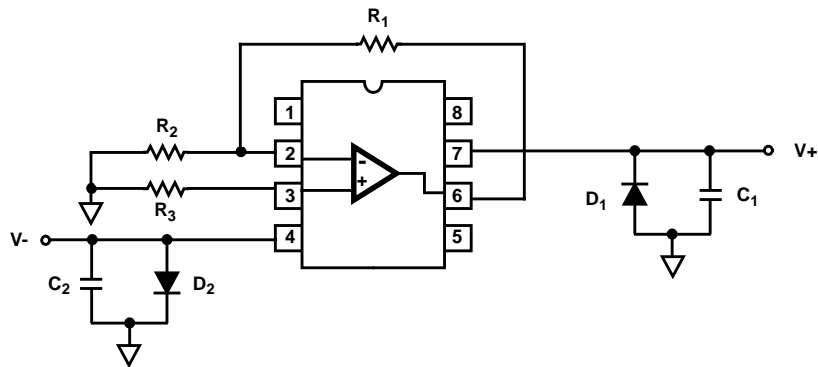


**Burn-In Circuits**

HA1-2842/883 CERAMIC DIP



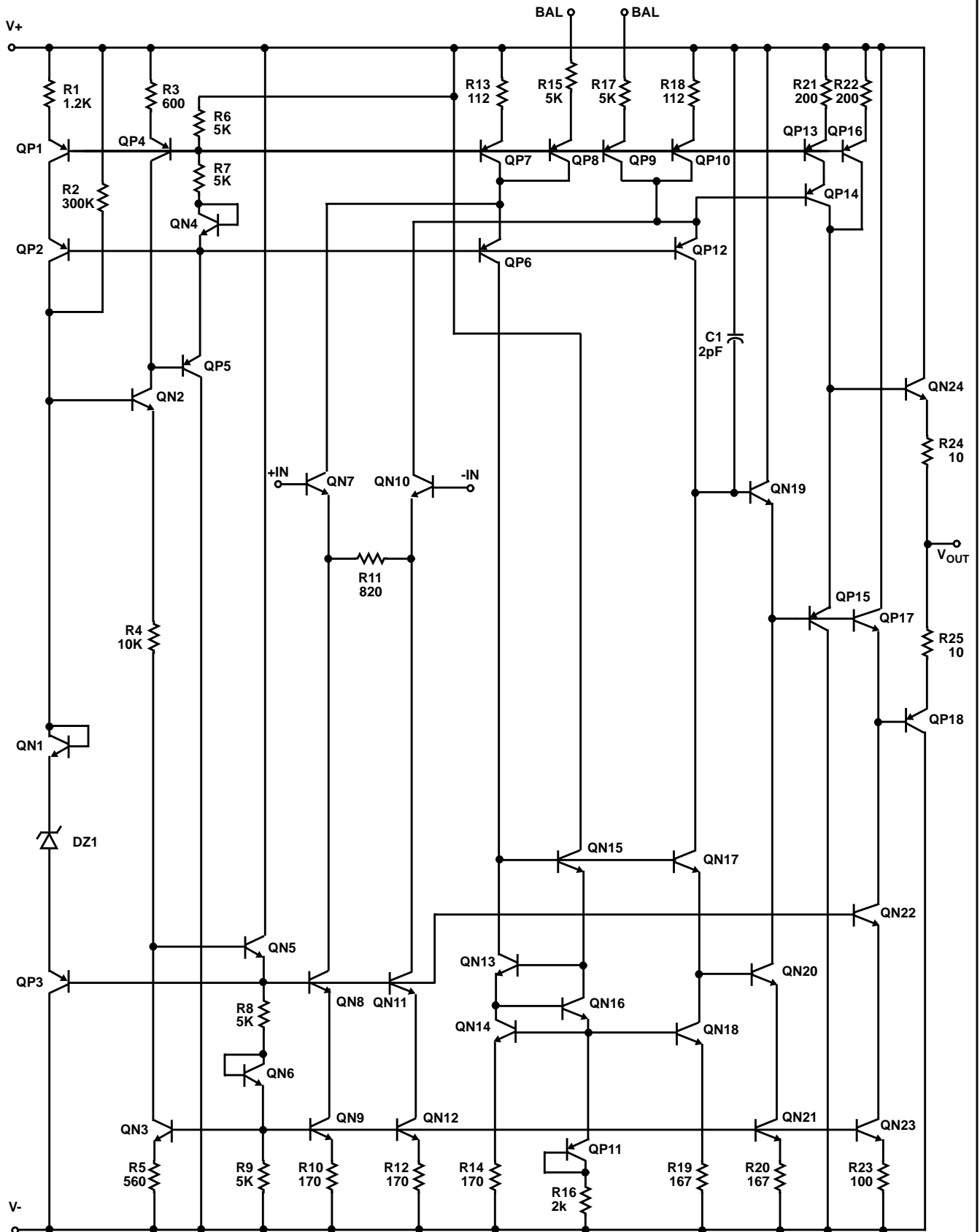
HA7-2842/883 CERAMIC DIP



NOTES:

1.  $R_1 = 1M\Omega, \pm 5\%, 1/4W$  (Min)
2.  $R_2 = 100k\Omega, \pm 5\%, 1/4W$  (Min) =  $R_3$
3.  $C_1 = C_2 = 0.01\mu F/\text{Socket}$  (Min) or  $0.1\mu F/\text{Row}$ , (Min)
4.  $D_1 = D_2 = 1N4002$  or Equivalent/Board
5.  $|V_+ - V_-| = 31V \pm 1V$

Schematic Diagram





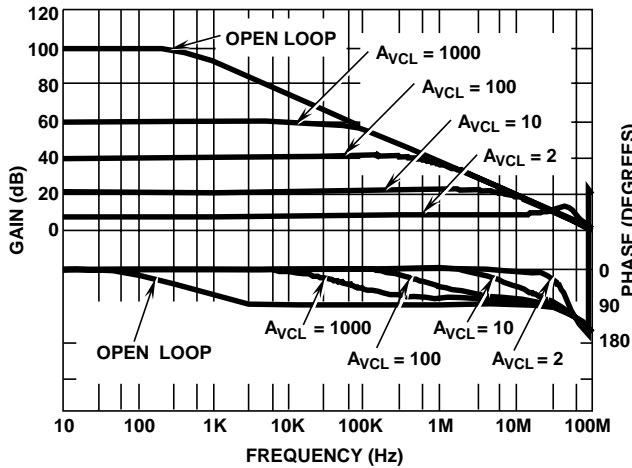
## DESIGN INFORMATION

## Wideband, High Slew Rate High Output Current, Operational Amplifier

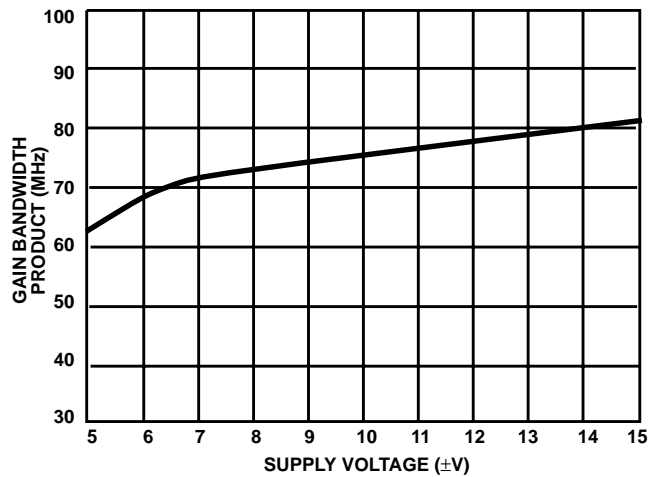
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**Typical Performance Curves**  $V_{SUPPLY} = \pm 15V$ ,  $A_V = +2$ ,  $R_L = 1k\Omega$ ,  $C_L < 10pF$ ,  $T_A = +25^\circ C$ , Unless Otherwise Specified.

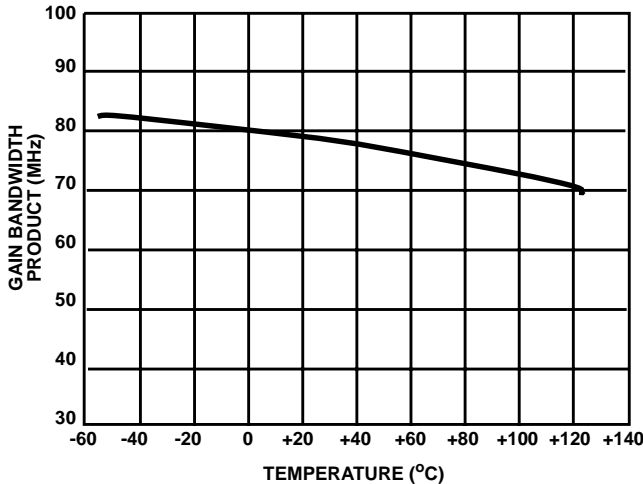
**FREQUENCY RESPONSE FOR VARIOUS GAINS**



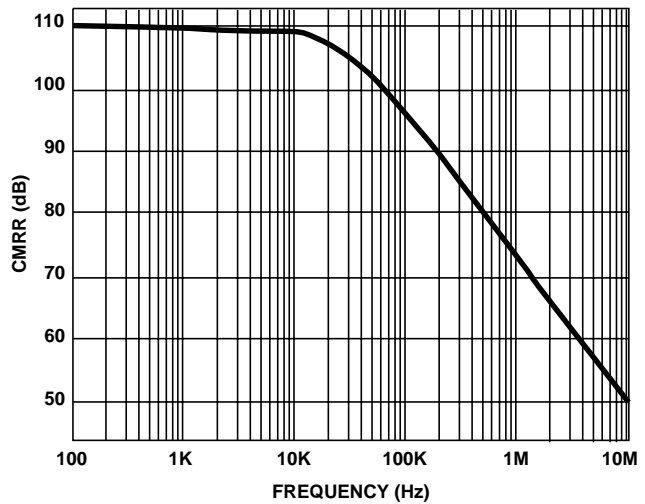
**GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE**



**GAIN BANDWIDTH PRODUCT vs TEMPERATURE**



**CMRR vs FREQUENCY**

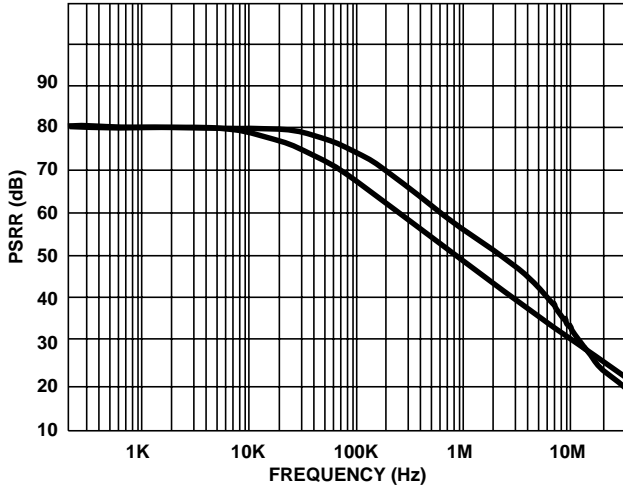


## DESIGN INFORMATION (Continued)

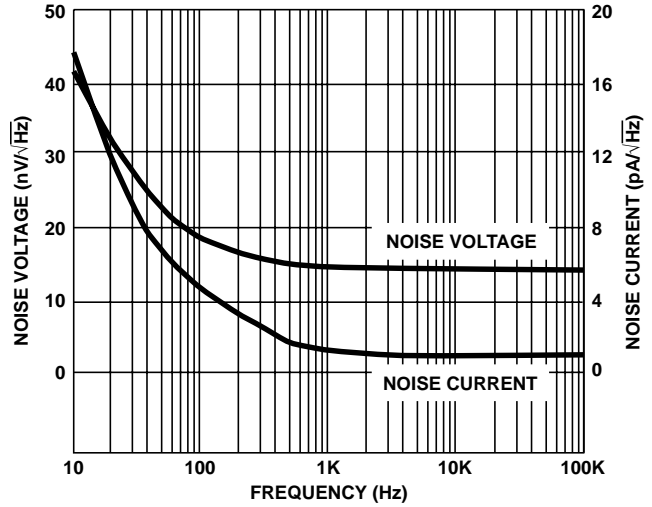
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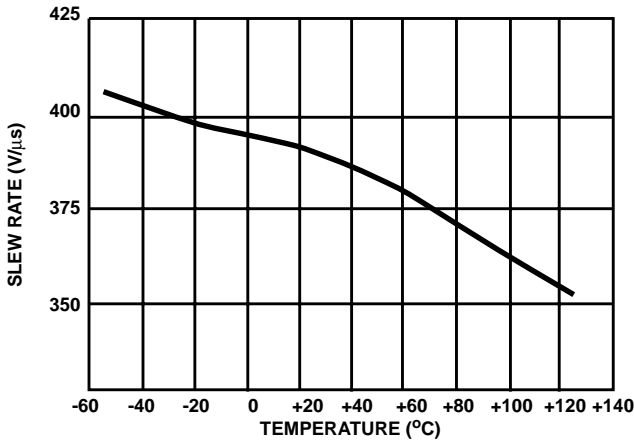
PSRR vs FREQUENCY



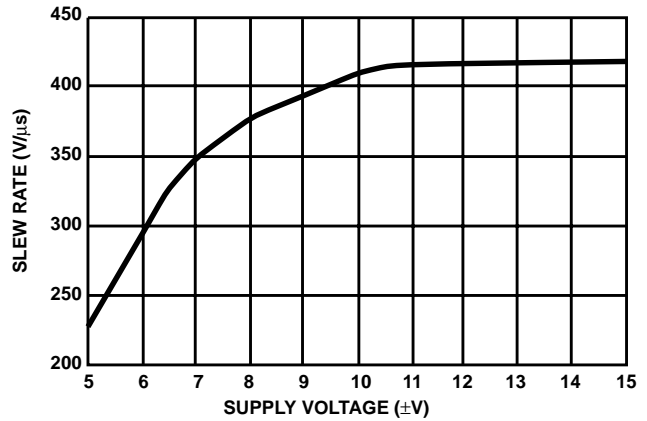
INPUT NOISE vs FREQUENCY



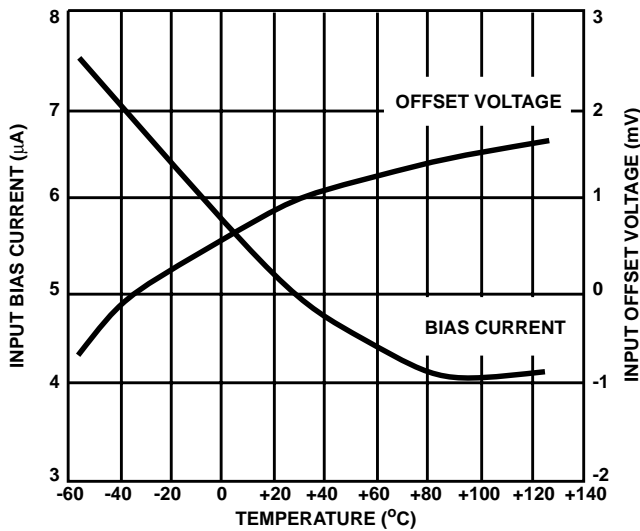
SLEW RATE vs TEMPERATURE



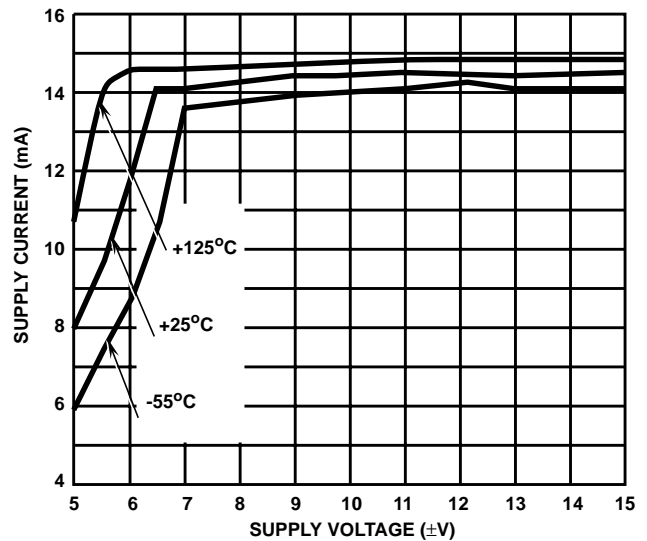
SLEW RATE vs SUPPLY VOLTAGE



INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE



SUPPLY CURRENT vs SUPPLY VOLTAGE

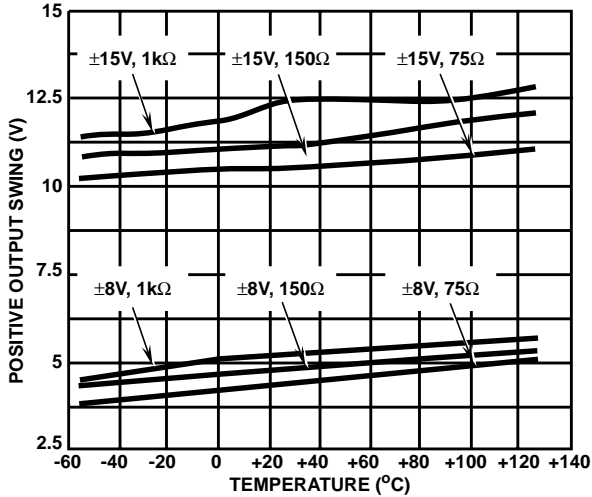


# DESIGN INFORMATION (Continued)

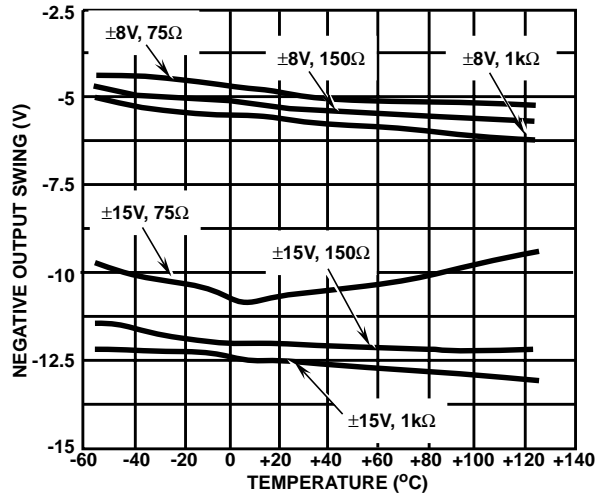
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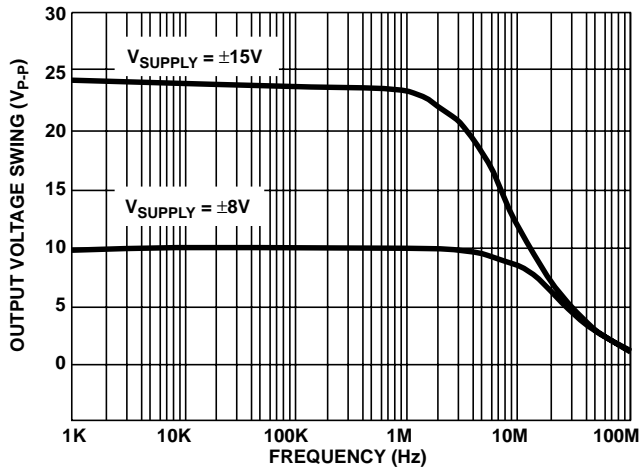
**POSITIVE OUTPUT SWING vs TEMPERATURE**



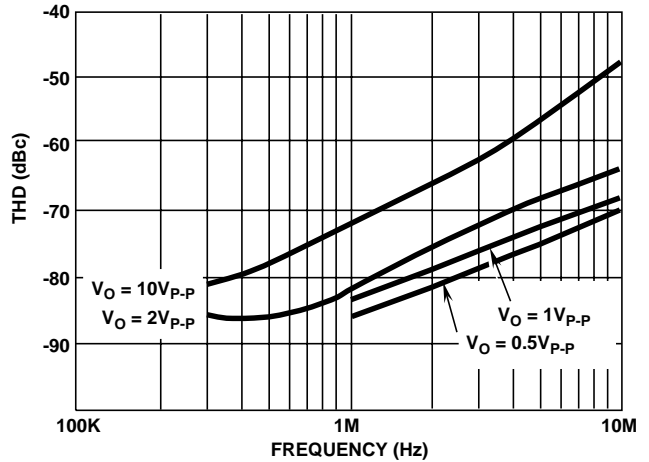
**NEGATIVE OUTPUT SWING vs TEMPERATURE**



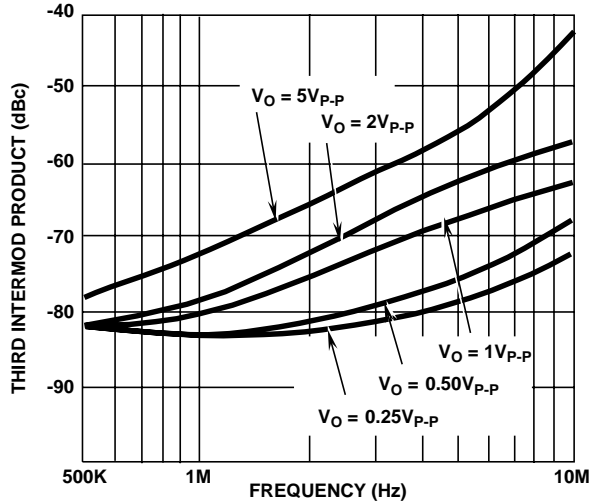
**MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY**



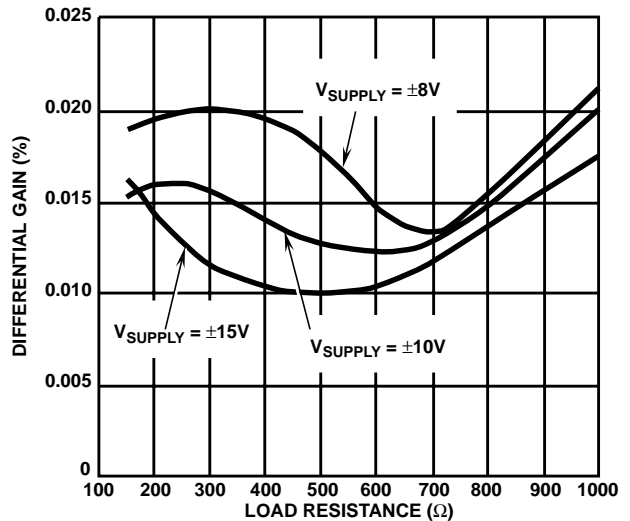
**TOTAL HARMONIC DISTORTION vs FREQUENCY**



**INTERMODULATION DISTORTION vs FREQUENCY (TWO TONE)**



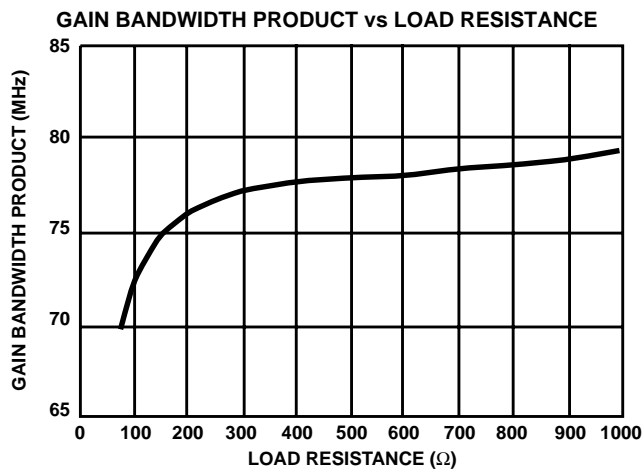
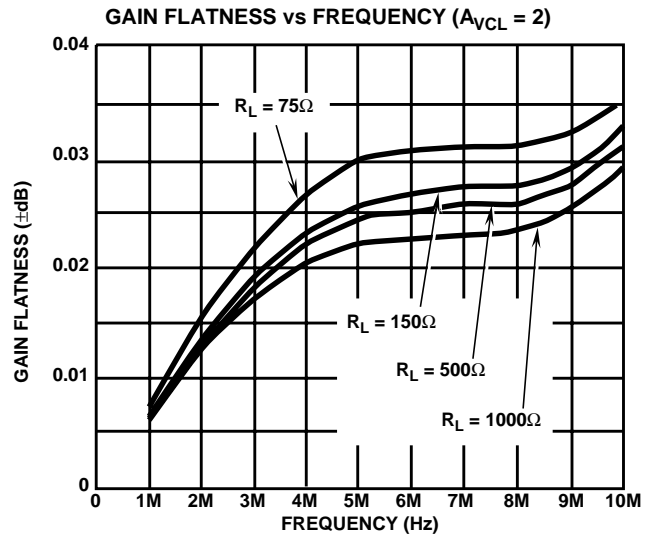
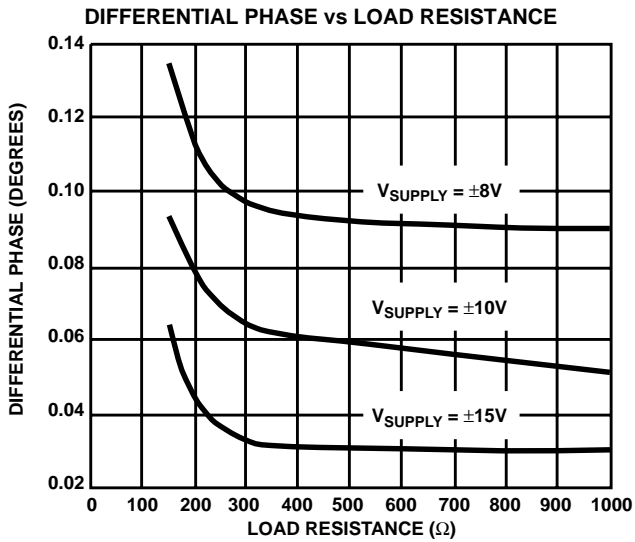
**DIFFERENTIAL GAIN vs LOAD RESISTANCE**



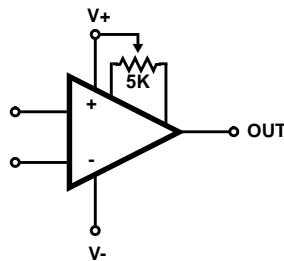
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### SUGGESTED OFFSET VOLTAGE ADJUSTMENT



## HA-2842

### TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at:  $V_{SUPPLY} = \pm 15V$ ,  $R_L = 1k\Omega$ ,  $C_L \leq 10pF$ , Unless Otherwise Specified.

PARAMETERS	CONDITIONS	TEMPERATURE	TYPICAL	UNITS
Input Offset Voltage	$V_{CM} = 0V$	+25°C	1	mV
Average Offset Voltage Drift	Versus Temperature	Full	13	$\mu V/^\circ C$
Input Bias Current	$V_{CM} = 0V$	+25°C	5.0	$\mu A$
Input Offset Current	$V_{CM} = 0V$	+25°C	0.5	$\mu A$
Differential Input Resistance		+25°C	170	k $\Omega$
Input Noise Voltage	$f_O = 10Hz$ to 1MHz	+25°C	16	$\mu V_{RMS}$
Input Noise Voltage Density	$f_O = 1000Hz$	+25°C	16	$nV/\sqrt{Hz}$
Input Noise Current Density	$f_O = 1000Hz$	+25°C	2	$pA/\sqrt{Hz}$
Large Signal Voltage Gain	$V_{OUT} = \pm 10V$	+25°C	100	kV/V
		Full	60	kV/V
CMRR	$V_{CM} = \pm 10V$	Full	110	dB
Gain Bandwidth Product	$f = 10MHz$	+25°C	80	MHz
Output Voltage Swing	$R_L = 1k\Omega$	Full	$\pm 11$	V
Output Current	$V_{OUT} > 10V$	Full	120	mA
Output Resistance	Open Loop	+25°C	8.5	$\Omega$
Full Power Bandwidth	$FPBW = SR/2\pi V_P$ , $V_P = 10V$	+25°C	6.0	MHz
Slew Rate	$V_{OUT} = \pm 5V$ , $A_V = +2$	+25°C	375	V/ $\mu s$
Rise and Fall Time	$V_{OUT} = \pm 100mV$ , $A_V = +2$	+25°C	3.5	ns
Overshoot	$V_{OUT} = \pm 100mV$ , $A_V = +2$	+25°C	20	%
PSRR	Delta $V_S = \pm 10V$ to $\pm 20V$	Full	80	dB
Supply Current	No Load	Full	14.2	mA
Differential Gain	$R_L = 700\Omega$	+25°C	0.02	%
Differential Phase	$R_L = 700\Omega$	+25°C	0.03	Degrees
Gain Flatness to 10MHz	$R_L = 75\Omega$	+25°C	$\pm 0.035$	dB

All Intersil semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

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