

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/ μ s (Typ)
- High Output Current 100mA (Min)
- Full Power Bandwidth 6MHz (Typ)
- Low Differential Gain/Phase 0.02%/0.03 $^{\circ}$ (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.

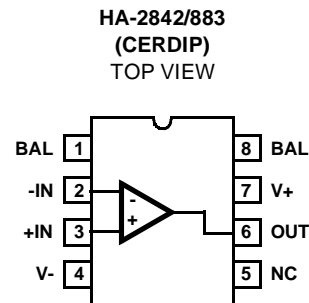
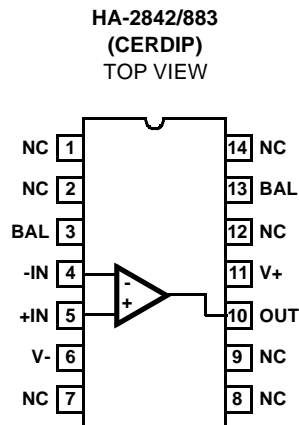
The capabilities of the HA-2842/883 are ideally suited for high speed cable driver circuits, where low closed loop gains and high output drive are required. With a 6MHz full power bandwidth, this amplifier is well suited for high frequency signal conditioning circuits and video amplifiers. Gain flatness 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_{CC} variation from +85 $^{\circ}$ C to -40 $^{\circ}$ C is <600 μ A (\pm 2%), while the standard deviation of the I_{CC} distribution is <0.1mA (0.8%) at +25 $^{\circ}$ C. Tighter I_{CC} 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 $^{\circ}$ C to +125 $^{\circ}$ C	14 Lead CerDIP
HA7-2842/883	-55 $^{\circ}$ C to +125 $^{\circ}$ 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	θ_{JA}	θ_{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	μA
			2, 3	+125°C, -55°C	-20	20	μA
	- I_B	$V_{CM} = 0\text{V}$, $+R_S = 100\Omega$ $-R_S = 1.1\text{k}\Omega$	1	+25°C	-10	10	μA
			2, 3	+125°C, -55°C	-20	20	μA
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	μA
			2, 3	+125°C, -55°C	-2	2	μA
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 _{OUT}	R _L = 1kΩ	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-V _{OUT}	R _L = 1kΩ	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
Output Current	+I _{OUT}	V _{OUT} = -5V Note 1	1	+25°C	100	-	mA
			2, 3	+125°C, -55°C	100	-	mA
	-I _{OUT}	V _{OUT} = +5V Note 1	1	+25°C	-	-100	mA
			2, 3	+125°C, -55°C	-	-100	mA
Quiescent Power Supply Current	+I _{CC}	V _{OUT} = 0V I _{OUT} = 0mA	1	+25°C	-	15	mA
			2, 3	+125°C, -55°C	-	15	mA
	-I _{CC}	V _{OUT} = 0V I _{OUT} = 0mA	1	+25°C	-15	-	mA
			2, 3	+125°C, -55°C	-15	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUPPLY} = 10V$ V+ = 10V, V- = -15V V+ = 20V, V- = -15V	1	+25°C	70	-	dB
			2, 3	+125°C, -55°C	70	-	dB
	-PSRR	$\Delta V_{SUPPLY} = 10V$ V+ = 15V, V- = -10V V+ = 15V, V- = -20V	1	+25°C	70	-	dB
			2, 3	+125°C, -55°C	70	-	dB
Offset Voltage Adjustment	+V _{IOAdj}	Note 2	1	+25°C	V _{IO-1}	-	mV
	+V _{IOAdj}	Note 2	1	+25°C	V _{IO+1}	-	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/μs
			1, 3	+125°C	300	-	V/μs
	-SR	$V_O = +5V$ to -5V	1, 3	+25°C, -55°C	350	-	V/μs
			1, 3	+125°C	300	-	V/μs
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 μ m \pm 25.4 μ m

METALLIZATION:

Type: Al, 1% Cu
 Thickness: 16k \AA \pm 2k \AA

GLASSIVATION:

Type: Nitride over Silox
 Silox Thickness: 12k \AA \pm 2k \AA
 Nitride Thickness: 3.5k \AA \pm 1.5k \AA

WORST CASE CURRENT DENSITY:

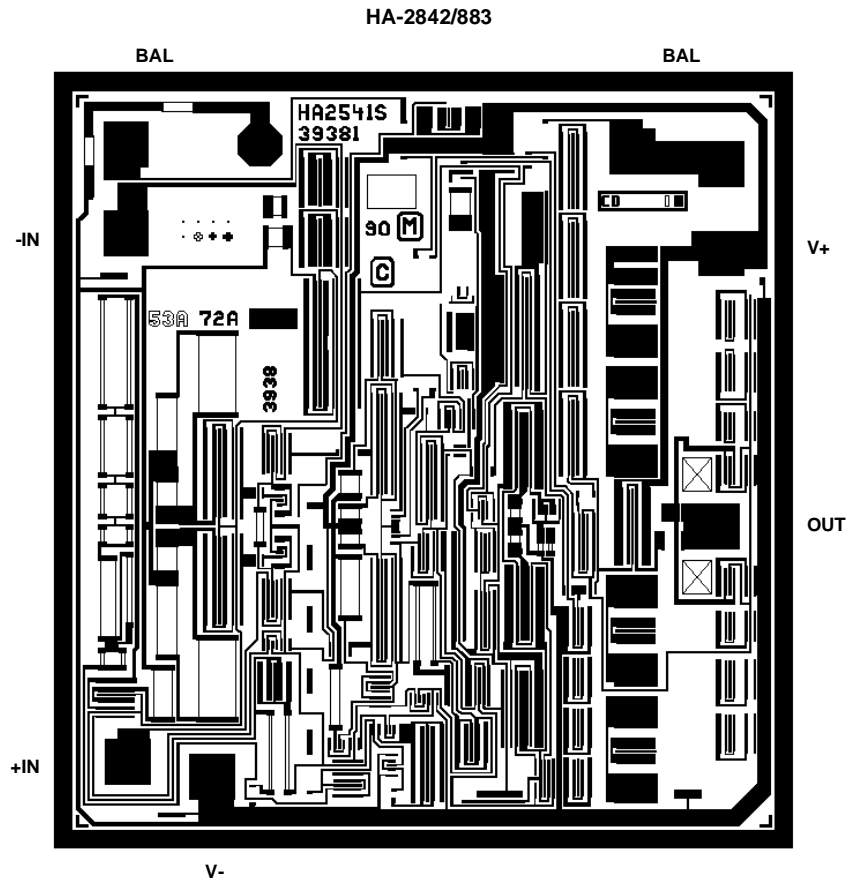
1.83 x 10⁵ A/cm² at 56mA

SUBSTRATE POTENTIAL (Powered Up): V-

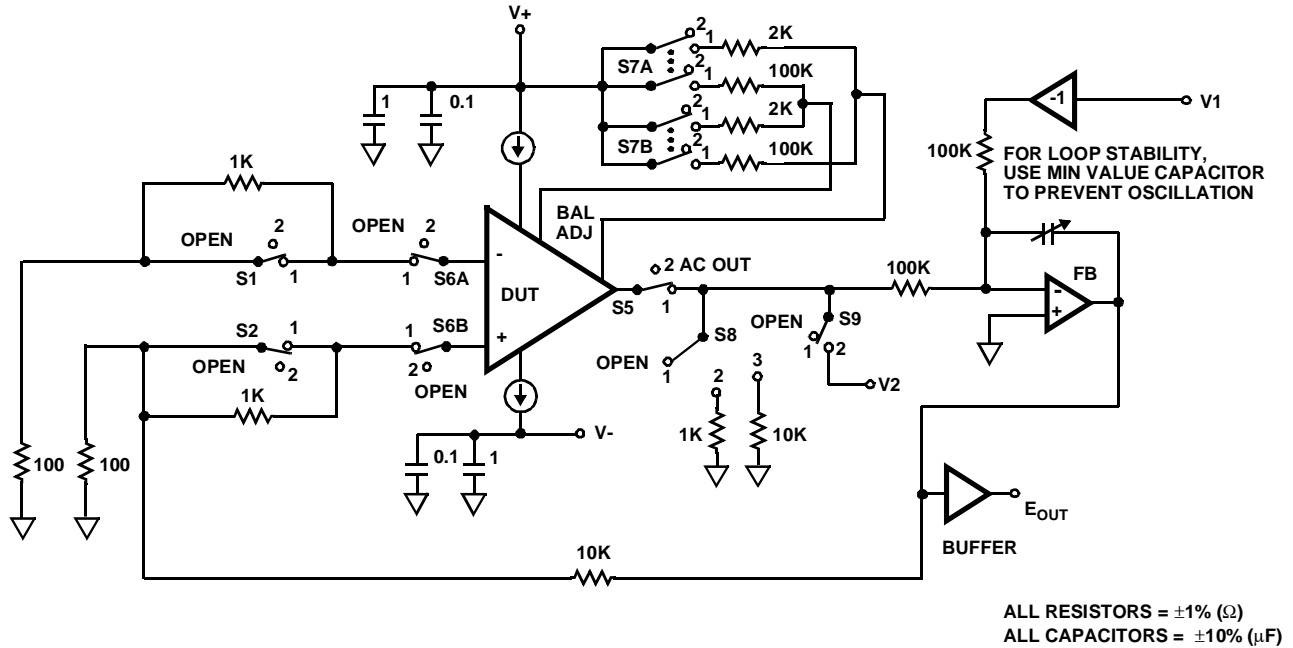
TRANSISTOR COUNT: 58

PROCESS: Bipolar Dielectric Isolation

Metallization Mask Layout

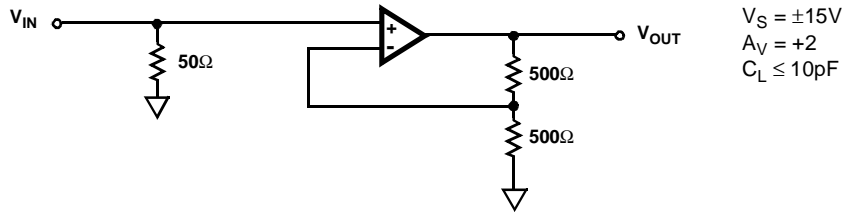


Test Circuit (Applies to Table 1)



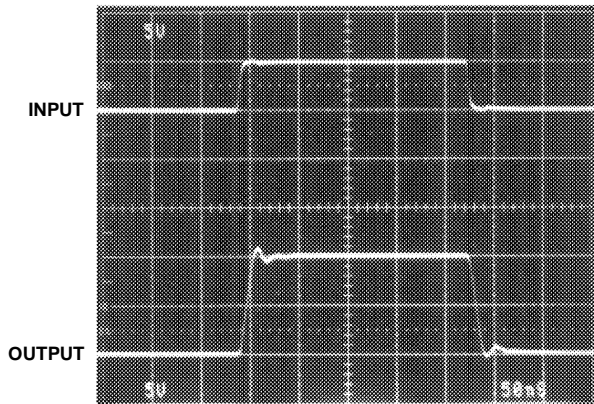
Test Waveforms

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



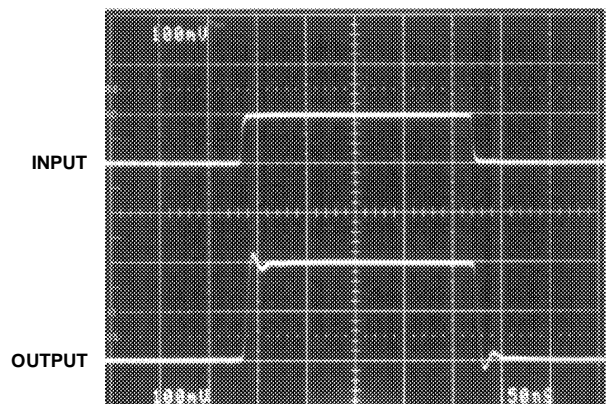
MEASURED LARGE SIGNAL RESPONSE

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



MEASURED SMALL SIGNAL RESPONSE

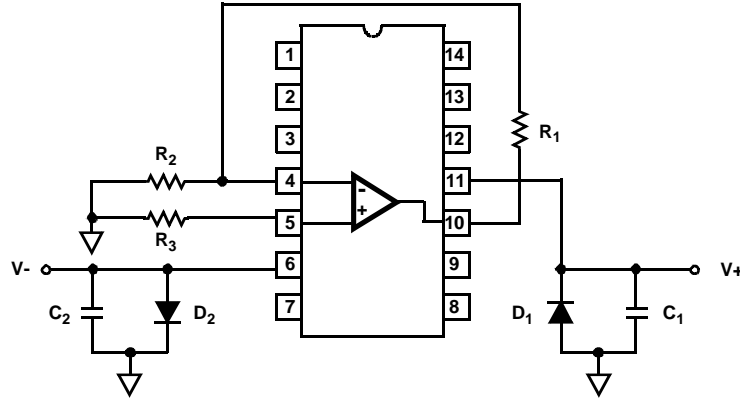
Vertical Scale: Input = 100mV/Div., Output = 100mV/Div.
Horizontal Scale: 50ns/Div.



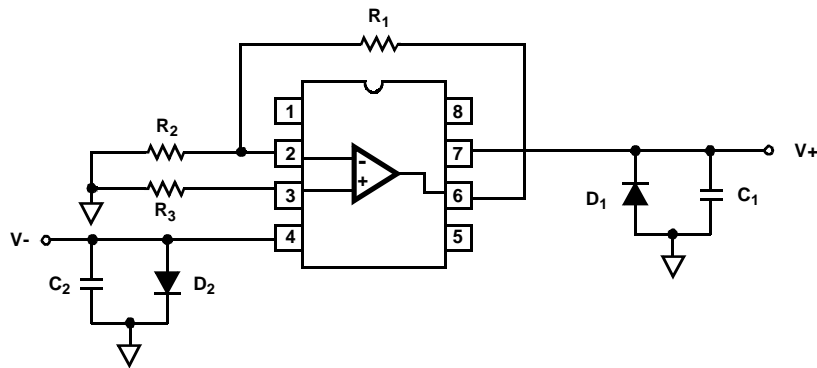
HA-2842/883

Burn-In Circuits

HA1-2842/883 CERAMIC DIP



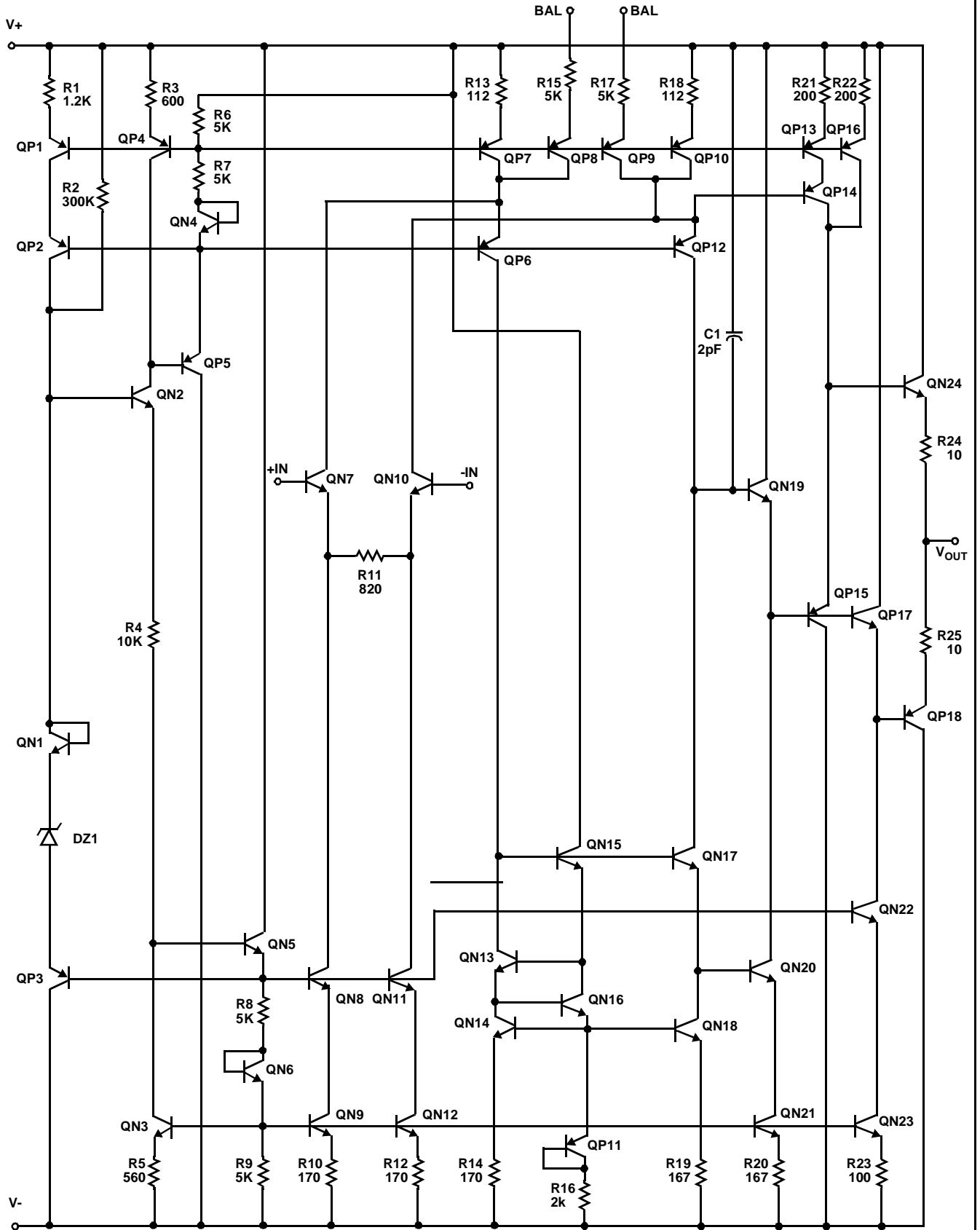
HA7-2842/883 CERAMIC DIP



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

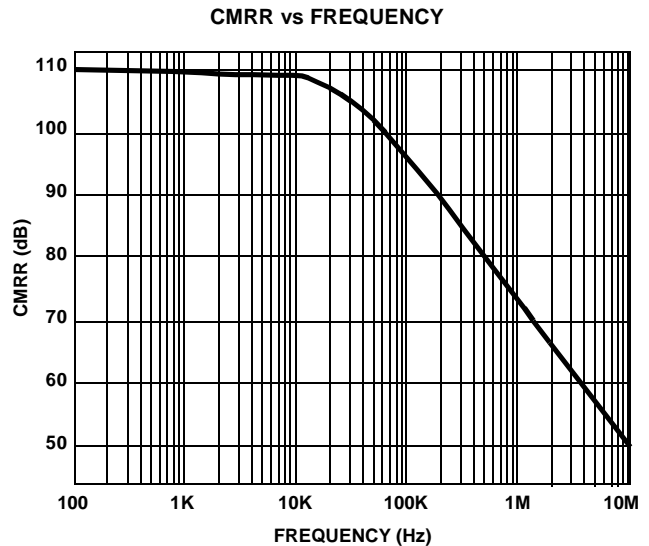
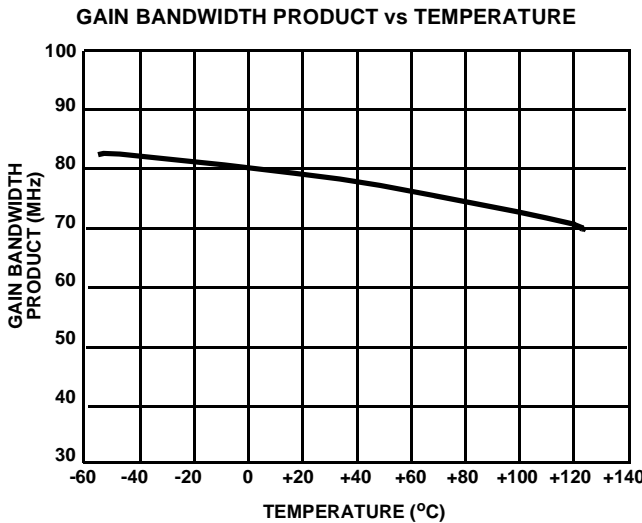
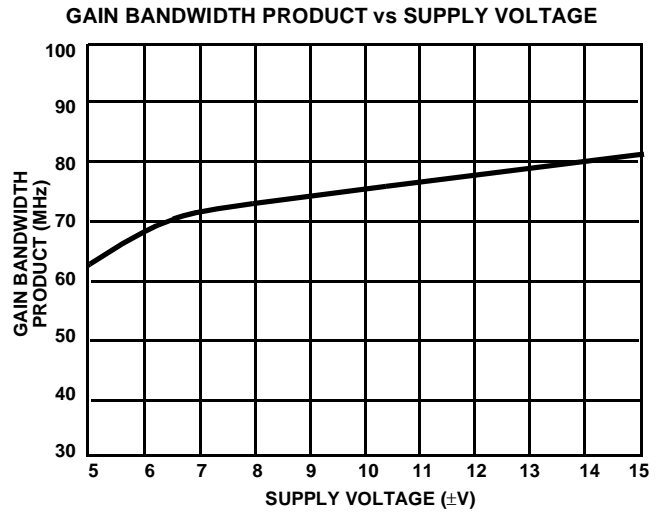
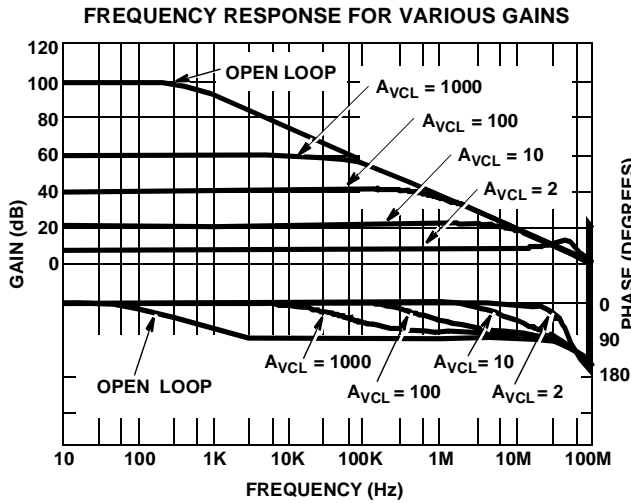


DESIGN INFORMATION

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.

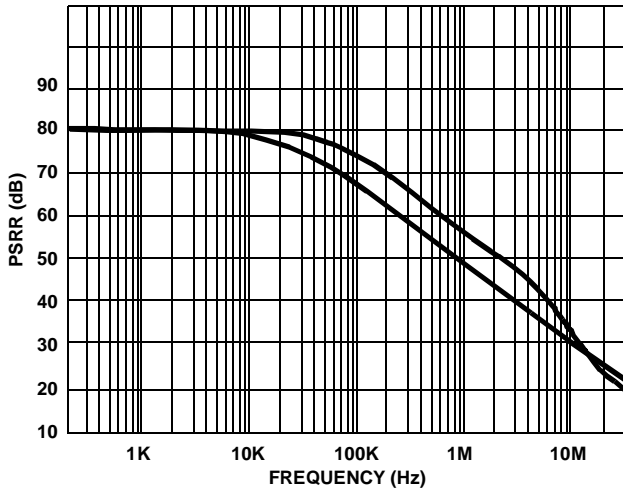


DESIGN INFORMATION (Continued)

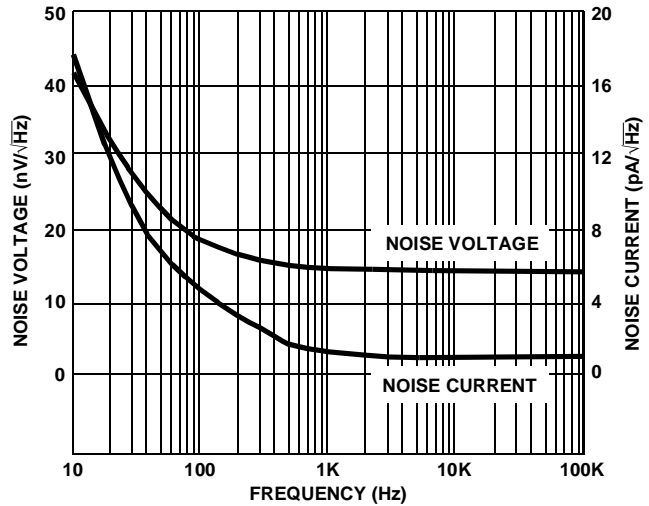
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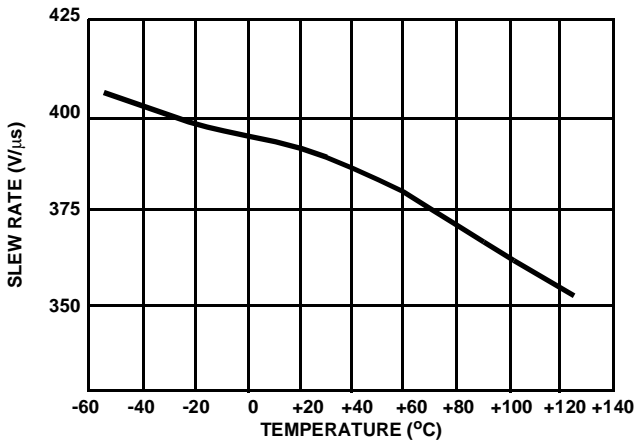
PSRR vs FREQUENCY



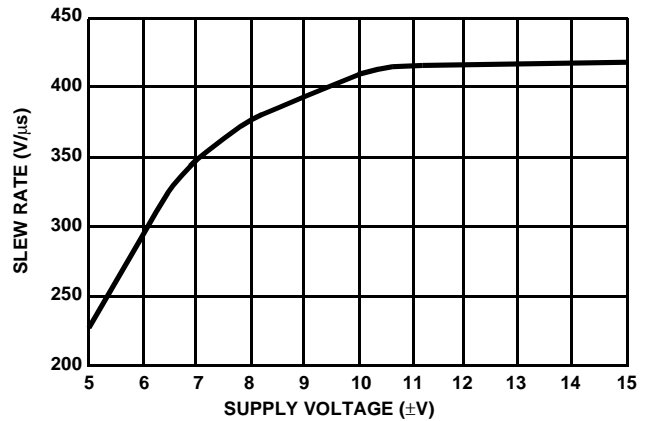
INPUT NOISE vs FREQUENCY



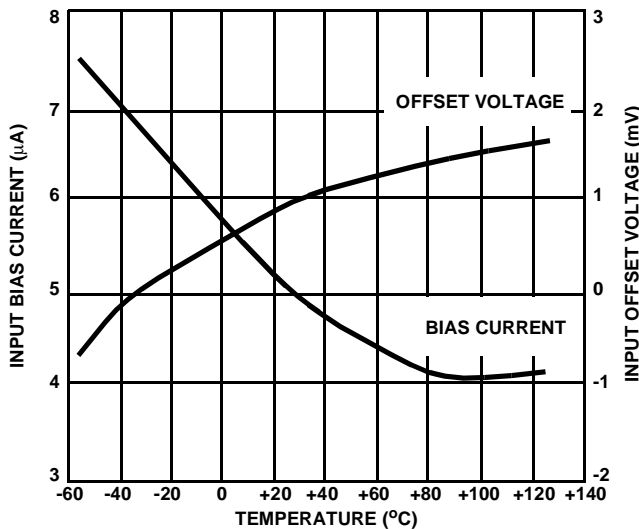
SLEW RATE vs TEMPERATURE



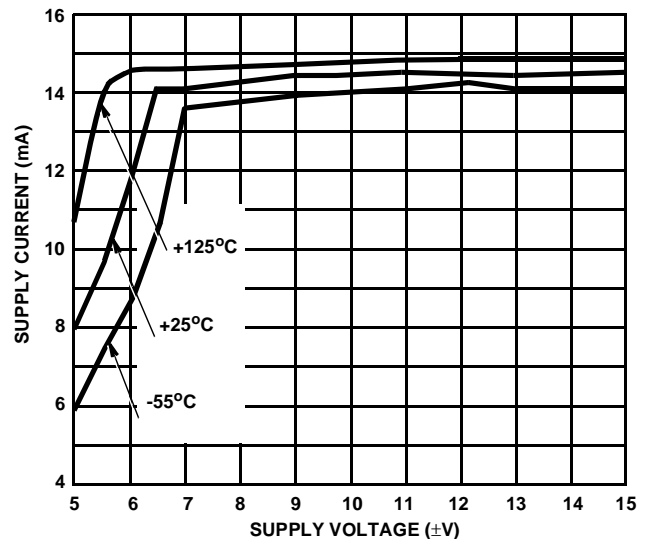
SLEW RATE vs SUPPLY VOLTAGE



INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE



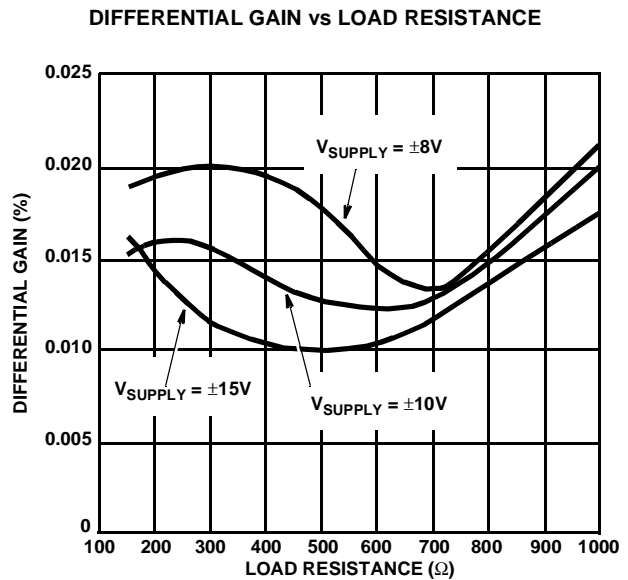
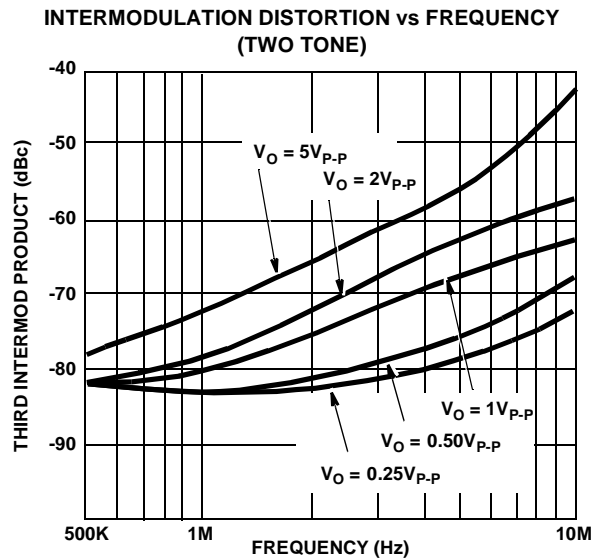
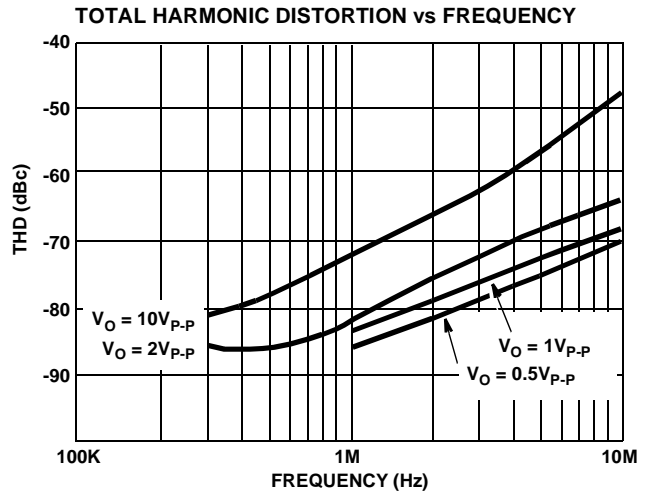
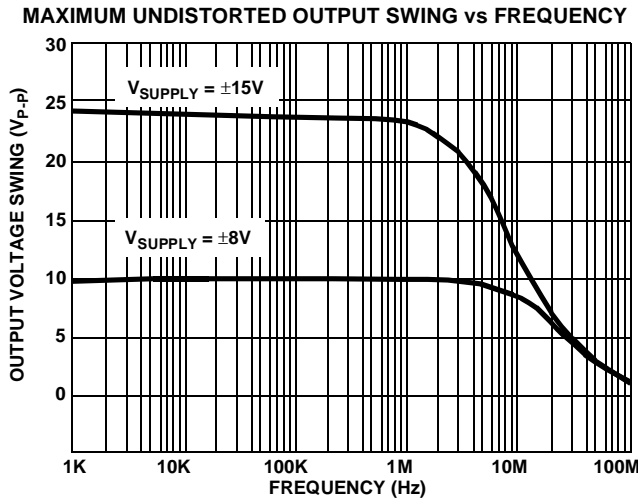
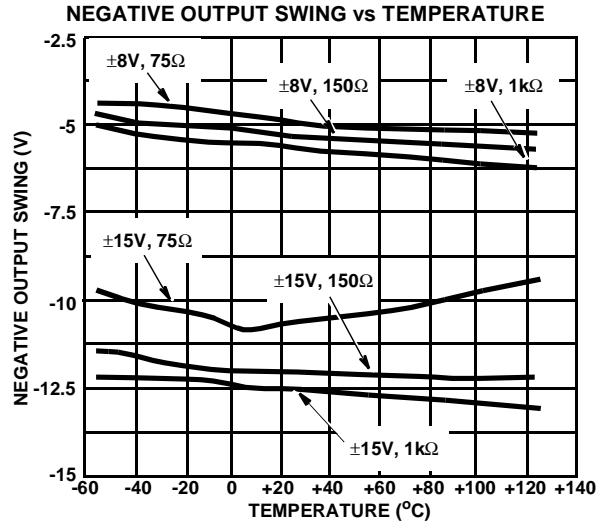
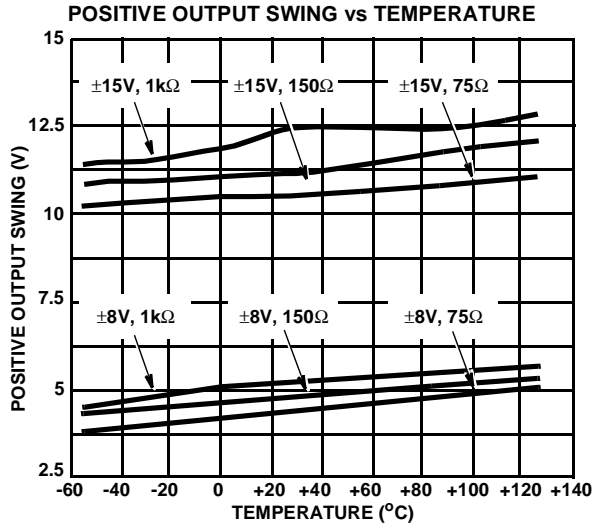
SUPPLY CURRENT vs SUPPLY VOLTAGE



DESIGN INFORMATION (Continued)

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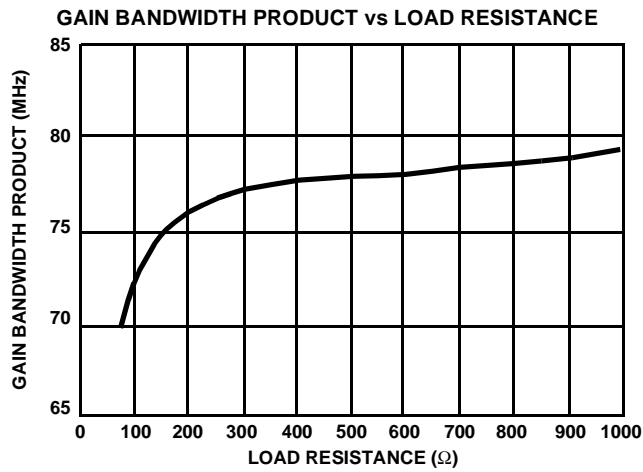
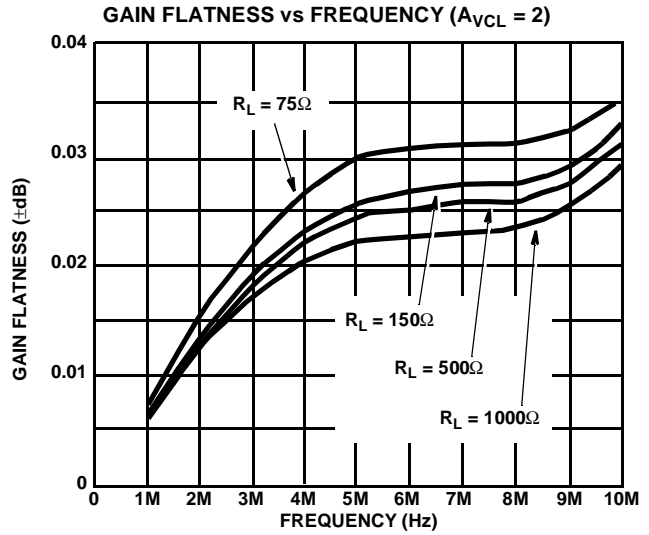
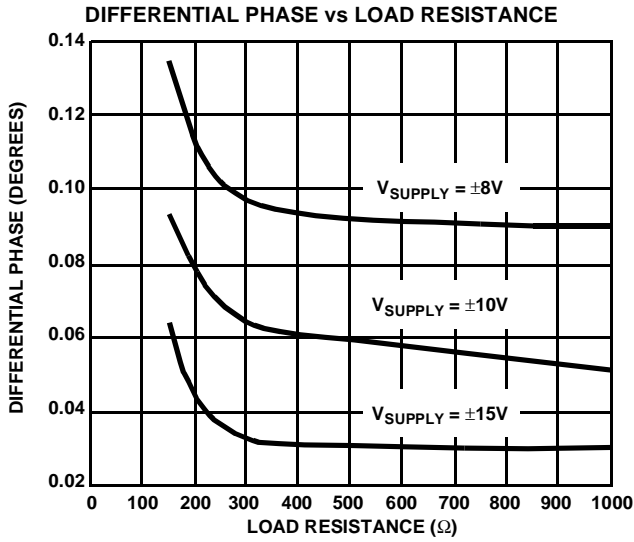
Typical Performance Curves $V_{SUPPLY} = \pm 15V$, $A_V = +2$, $R_L = 1k\Omega$, $C_L < 10pF$, $T_A = +25^\circ C$, Unless Otherwise Specified.



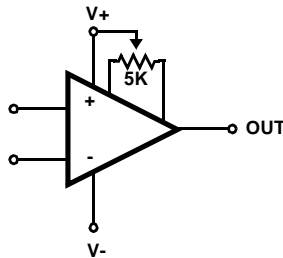
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SUGGESTED OFFSET VOLTAGE ADJUSTMENT



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	μA
Input Offset Current	$V_{CM} = 0V$	+25°C	0.5	μA
Differential Input Resistance		+25°C	170	k Ω
Input Noise Voltage	$f_O = 10Hz$ to 1MHz	+25°C	16	μV_{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	± 11	V
Output Current	$V_{OUT} > 10V$	Full	120	mA
Output Resistance	Open Loop	+25°C	8.5	Ω
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/ μs
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	± 0.035	dB

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