HA-2842/883

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^o (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.

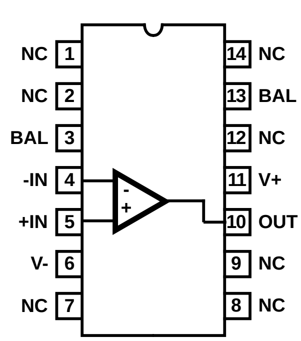
A zener/nichrome based reference circuit, coupled with advanced laser trimming techniques, yields a supply current with a low temperature coefficient and low lot-to-lot variability. For example, the average I_{CC} variation from +85^{o}C to -40^{o}C is <600µA (±2%),while the standard deviation of the I_{CC} distribution is <0.1mA (0.8%) at +25^{o}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

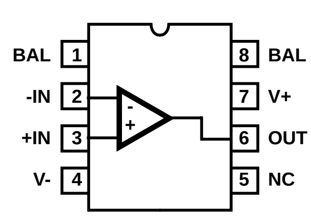
PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2842/883	-55^{o}C to +125^{o}C	14 Lead CerDIP
HA7-2842/883	-55^{o}C to +125^{o}C	8 Lead CerDIP

Pinouts

HA-2842/883
(CERDIP)
TOP VIEW



HA-2842/883
(CERDIP)
TOP VIEW



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

CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.

Spec Number **511088-883**
File Number **3622.1**

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 (≤40% Duty Cycle) 125mA
Junction Temperature (T_J) (Note 1) . . . . . +175^{o}C
Storage Temperature Range . . . . . -65^{o}C to +150^{o}C
ESD Rating . . . . . <2000V
Lead Temperature (Soldering 10s) . . . . . +300^{o}C

Thermal Information

Thermal Resistance	θ_{JA}	θ_{JC}
14 Lead CerDIP Package	73^{o}C/W	18^{o}C/W
8 Lead CerDIP Package	110^{o}C/W	27^{o}C/W

Package Power Dissipation Limit at +75^{o}C for $T_J \leq$ +175^{o}C
14 Lead CerDIP Package 1.1W
8 Lead CerDIP Package 0.9W
Package Power Dissipation Derating Factor Above +75^{o}C
14 Lead CerDIP Package . . . . . 11mW/^{o}C
8 Lead CerDIP Package . . . . . 9mW/^{o}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^{o}C to +125^{o}C
Operating Supply Voltage . . . . . ±12V to ±15V
$V_{INCM} \leq$ 1/2(V+ - V-)
$R_L \geq$ 1kΩ

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: V_{SUPPLY} = ±15V, R_{SOURCE} = 100Ω, R_{LOAD} = 100kΩ, V_{OUT} = 0V, Unless Otherwise Specified.

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

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: V_{SUPPLY} = ±15V, R_{SOURCE} = 100Ω, R_{LOAD} = 100kΩ, 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^{o}C	10	-	V
			2, 3	+125^{o}C, -55^{o}C	10	-	V
	$-V_{OUT}$	R_L = 1kΩ	1	+25^{o}C	-	-10	V
			2, 3	+125^{o}C, -55^{o}C	-	-10	V
Output Current	$+I_{OUT}$	V_{OUT} = -5V Note 1	1	+25^{o}C	100	-	mA
			2, 3	+125^{o}C, -55^{o}C	100	-	mA
	$-I_{OUT}$	V_{OUT} = +5V Note 1	1	+25^{o}C	-	-100	mA
			2, 3	+125^{o}C, -55^{o}C	-	-100	mA
Quiescent Power Supply Current	$+I_{CC}$	V_{OUT} = 0V I_{OUT} = 0mA	1	+25^{o}C	-	15	mA
			2, 3	+125^{o}C, -55^{o}C	-	15	mA
	$-I_{CC}$	V_{OUT} = 0V I_{OUT} = 0mA	1	+25^{o}C	-15	-	mA
			2, 3	+125^{o}C, -55^{o}C	-15	-	mA
Power Supply Rejection Ratio	+PSRR	ΔV_{SUPPLY} = 10V V+ = 10V, V- = -15V V+ = 20V, V- = -15V	1	+25^{o}C	70	-	dB
			2, 3	+125^{o}C, -55^{o}C	70	-	dB
	-PSRR	ΔV_{SUPPLY} = 10V V+ = 15V, V- = -10V V+ = 15V, V- = -20V	1	+25^{o}C	70	-	dB
			2, 3	+125^{o}C, -55^{o}C	70	-	dB
Offset Voltage Adjustment	$+V_{IO}Adj$	Note 2	1	+25^{o}C	V_{IO}-1	-	mV
	$+V_{IO}Adj$	Note 2	1	+25^{o}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^{o}C. For a 100mA load and a +125^{o}C ambient, heat sinking is required.
2. Offset Adjustment range is $|V_{IO}$ (measured) ±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.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: V_{SUPPLY} = ±15V, R_{SOURCE} = 50Ω, R_{LOAD} = 1kΩ, V_{OUT} = 0V, A_V = +2V/V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
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:

1. 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.
2. Full Power Bandwidth guarantee based on Slew Rate measurement using FPBW = Slew Rate/($2\pi V_{PEAK}$).
3. 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:

1. PDA applies to Subgroup 1 only.

Die Characteristics

DIE DIMENSIONS:
77 x 81 x 19 mils ± 1 mils
1960 x 2060 x 483µm ± 25.4µm

METALLIZATION:
Type: Al, 1% Cu
Thickness: 16kÅ ± 2kÅ

GLASSIVATION:
Type: Nitride over Silox
Silox Thickness: 12kÅ ± 2kÅ
Nitride Thickness: 3.5kÅ ± 1.5kÅ

WORST CASE CURRENT DENSITY:
1.83×10^5 A/cm^2 at 56mA

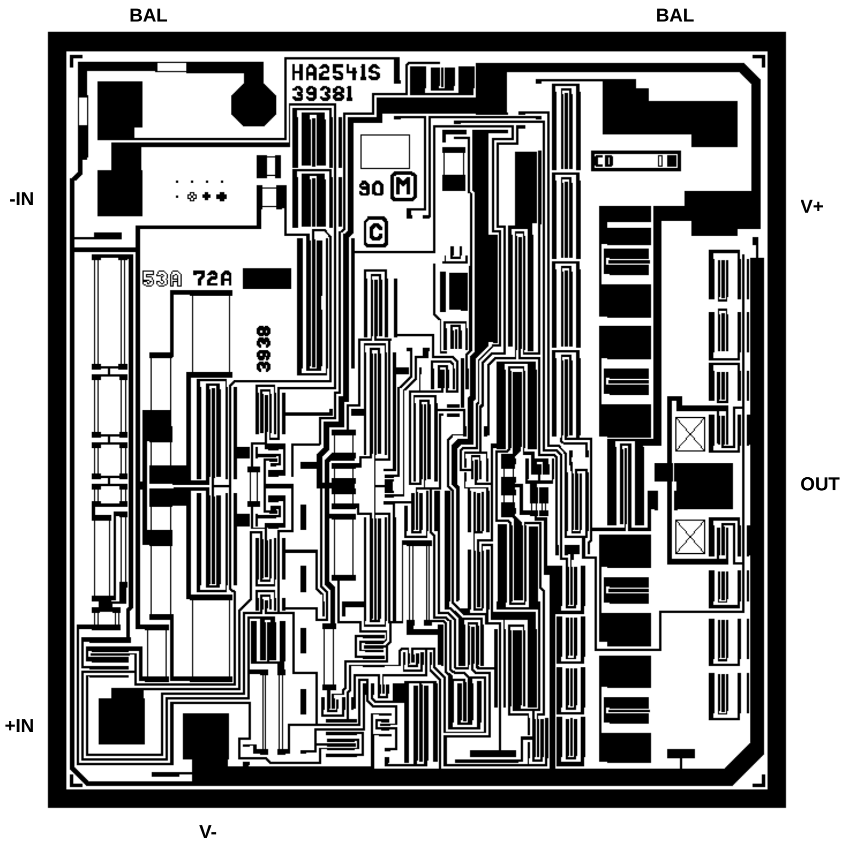
SUBSTRATE POTENTIAL (Powered Up): V-

TRANSISTOR COUNT: 58

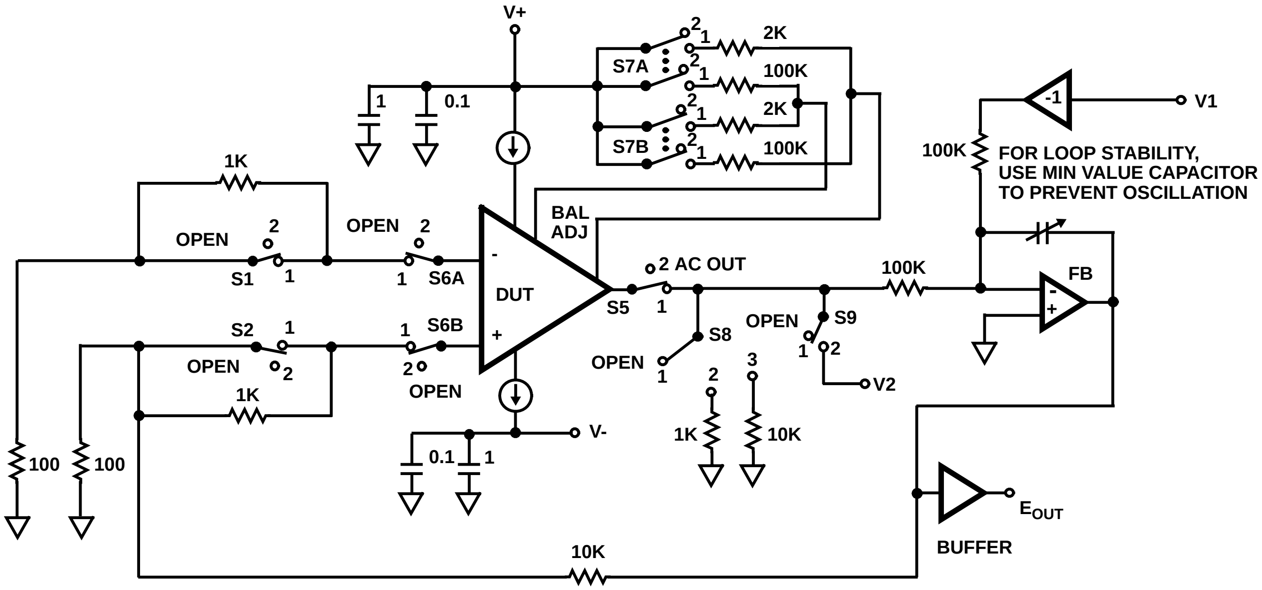
PROCESS: Bipolar Dielectric Isolation

Metallization Mask Layout

HA-2842/883



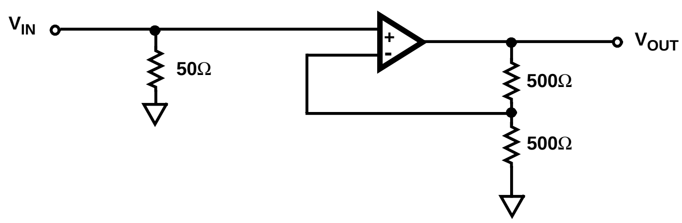
Test Circuit (Applies to Table 1)



ALL RESISTORS = ±1% (Ω)
ALL CAPACITORS = ±10% (μF)

Test Waveforms

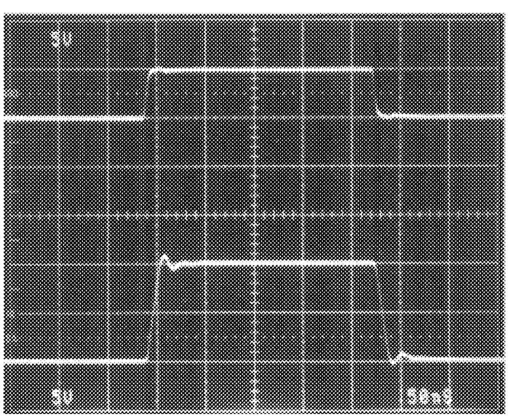
SIMPLIFIED TEST CIRCUIT FOR LARGE AND SMALL SIGNAL RESPONSE (Applies to Table 3)



$V_S = \pm15V$
$A_V = +2$
$C_L \leq 10pF$

MEASURED LARGE SIGNAL RESPONSE
Vertical Scale: Input = 5V/Div., Output = 5V/Div.
Horizontal Scale: 50ns/Div.

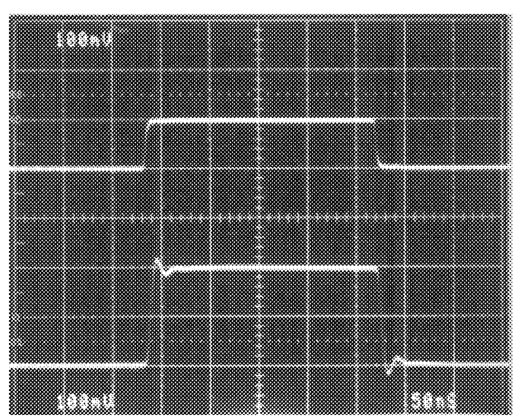
INPUT



OUTPUT

MEASURED SMALL SIGNAL RESPONSE
Vertical Scale: Input = 100mV/Div., Output = 100mV/Div.
Horizontal Scale: 50ns/Div.

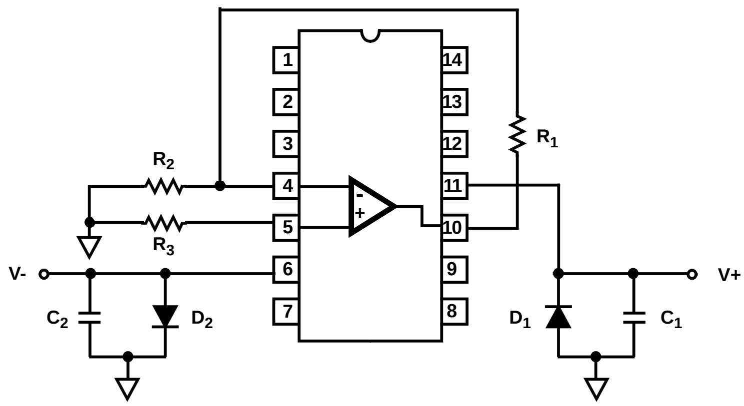
INPUT



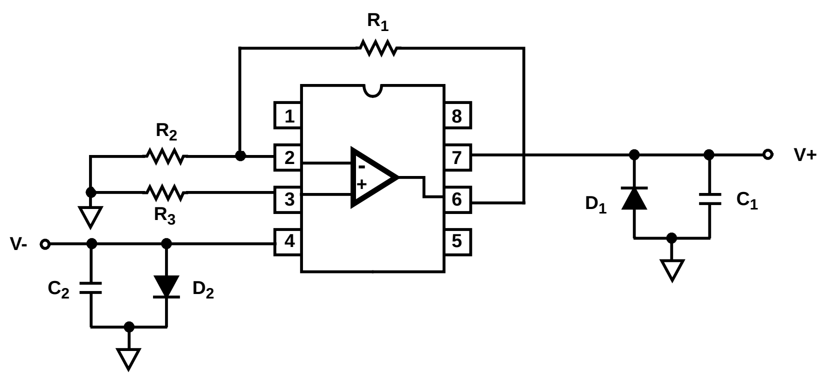
OUTPUT

Burn-In Circuits

HA1-2842/883 CERAMIC DIP



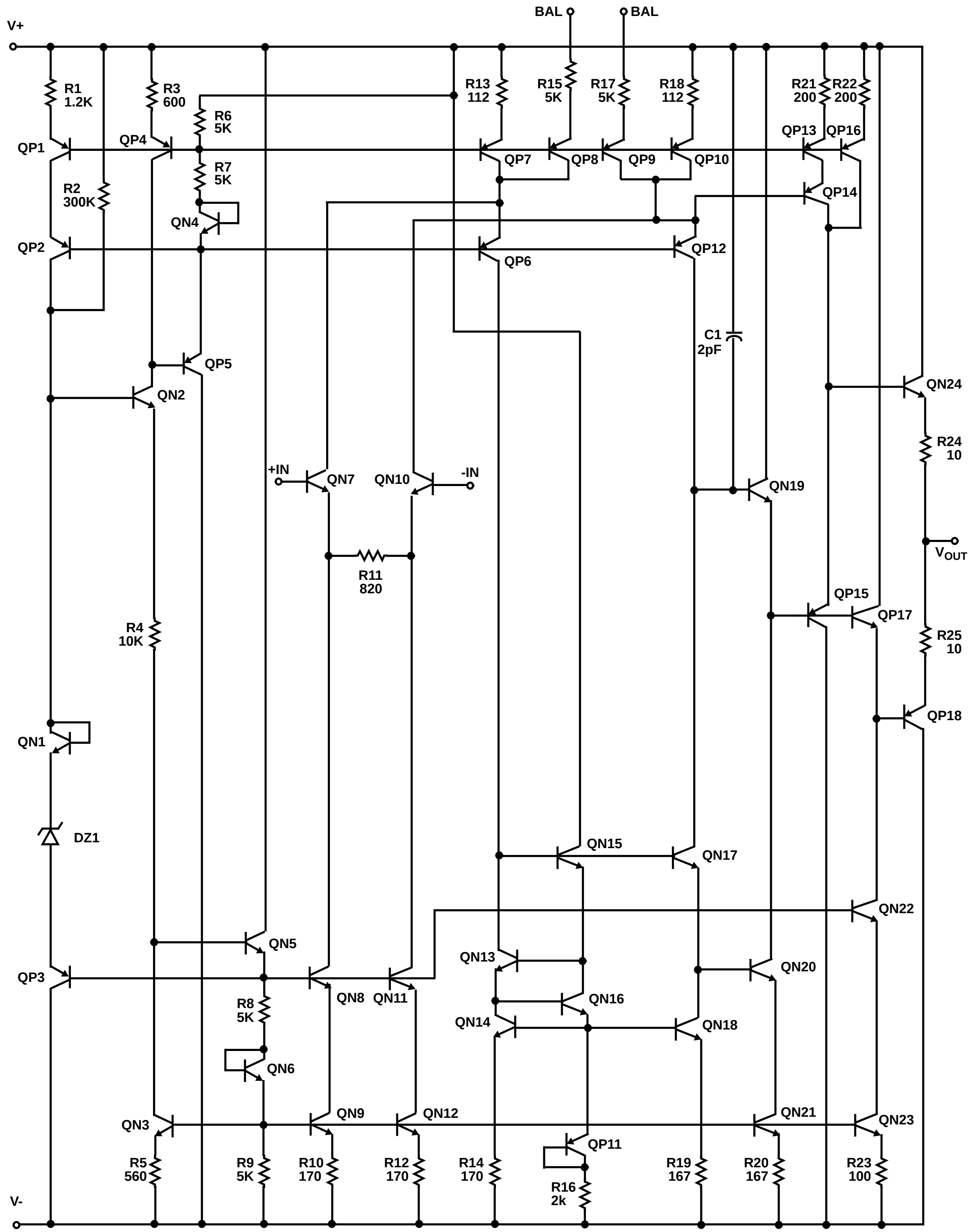
HA7-2842/883 CERAMIC DIP



NOTES:

1. R_1 = 1MΩ, ±5%, 1/4W (Min)
2. R_2 = 100kΩ, ±5%, 1/4W (Min) = R_3
3. C_1 = C_2 = 0.01µF/Socket (Min) or 0.1µF/Row, (Min)
4. D_1 = D_2 = 1N4002 or Equivalent/Board
5. $|(V+) - (V-)|$ = 31V ±1V

Schematic Diagram



Spec Number **511088-883**

HA-2842

DESIGN INFORMATION

Wideband, High Slew Rate High Output Current, Operational Amplifier

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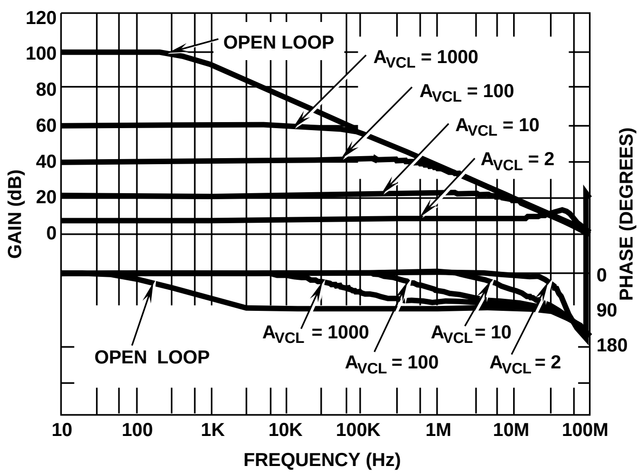
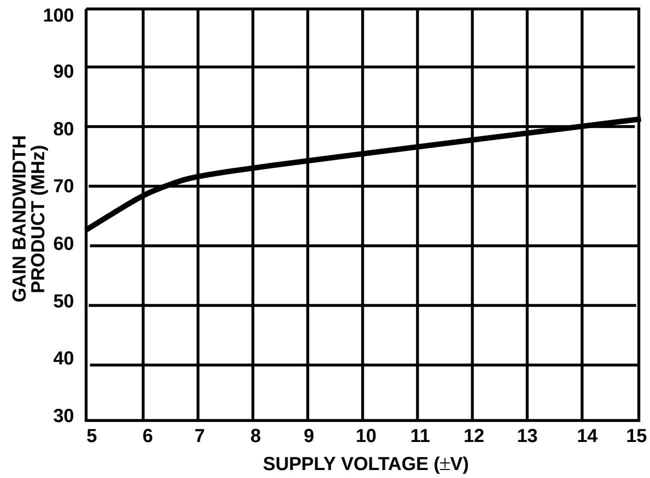
Typical Performance Curves $V_{SUPPLY} = \pm15V$, $A_V = +2$, $R_L = 1k\Omega$, $C_L < 10pF$, $T_A = +25^oC$, Unless Otherwise Specified.

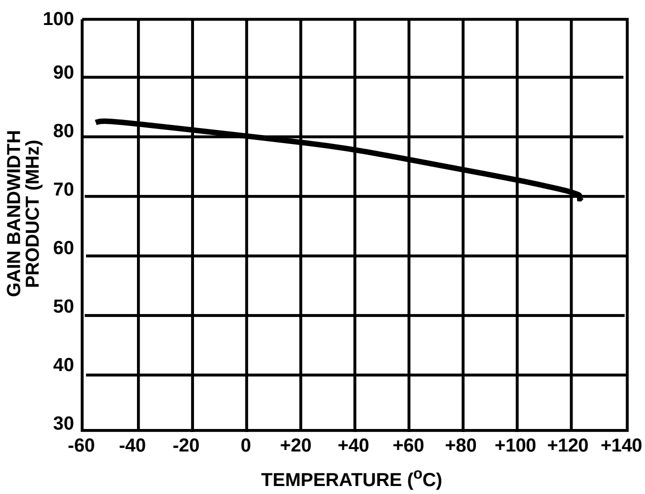
FREQUENCY RESPONSE FOR VARIOUS GAINS



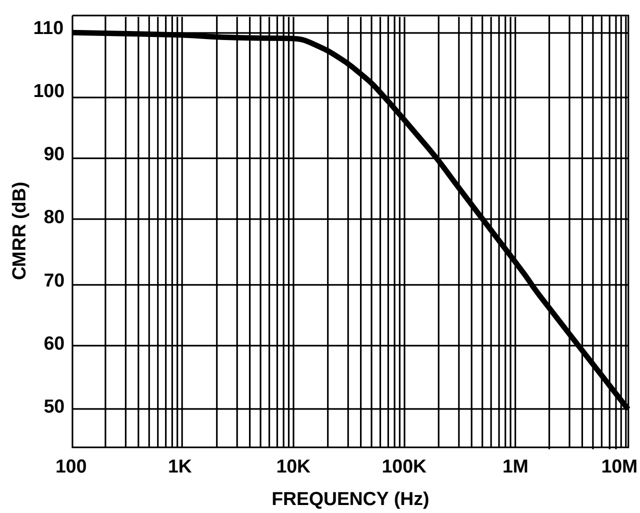
GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE



GAIN BANDWIDTH PRODUCT vs TEMPERATURE



CMRR vs FREQUENCY



DESIGN INFORMATION (Continued)

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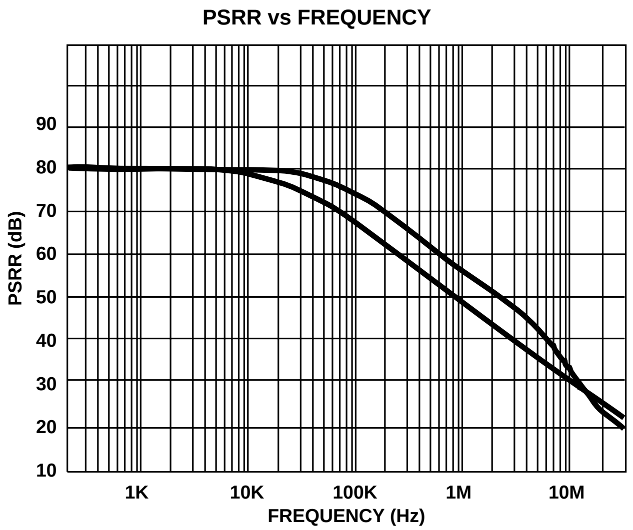

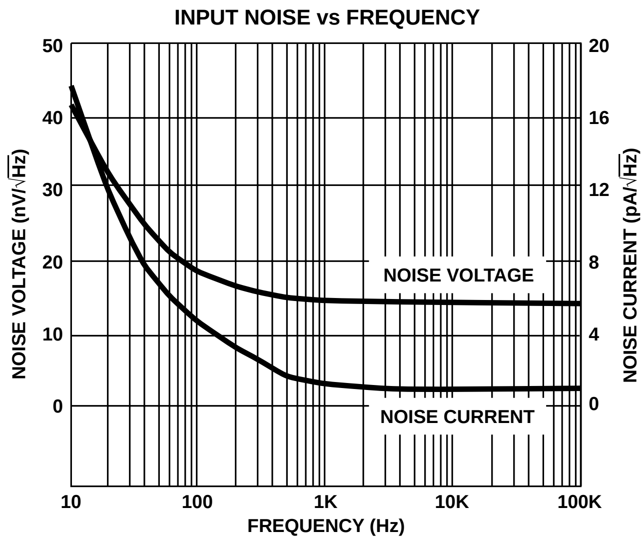

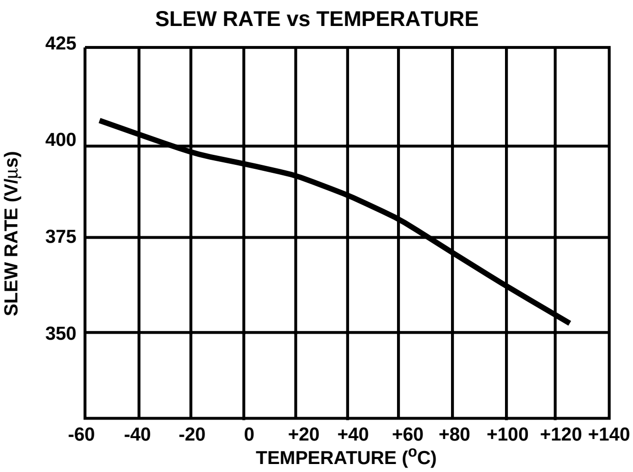

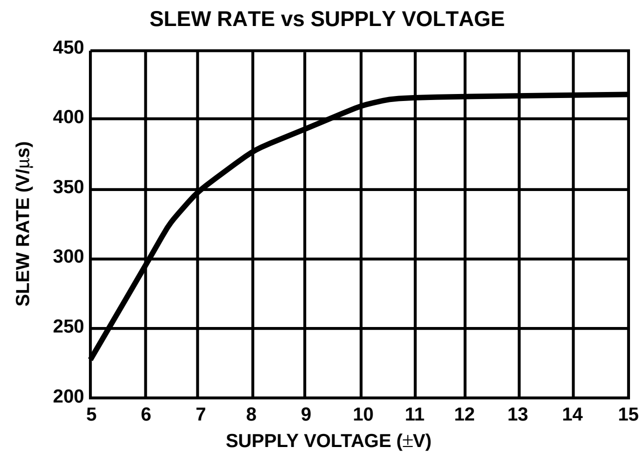

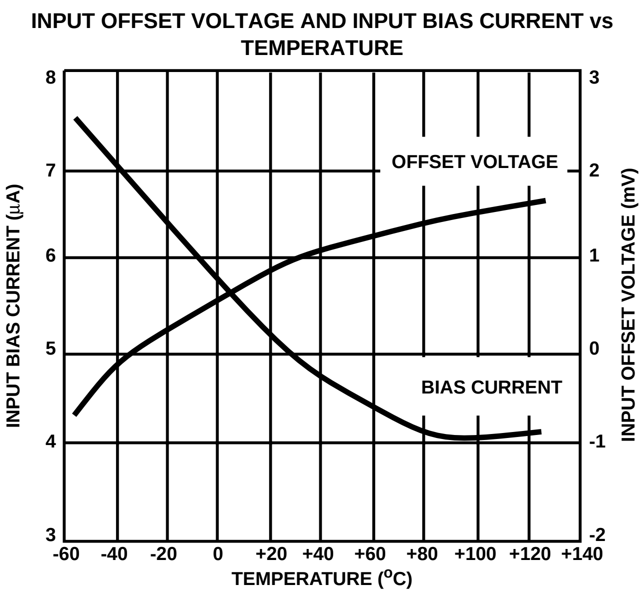

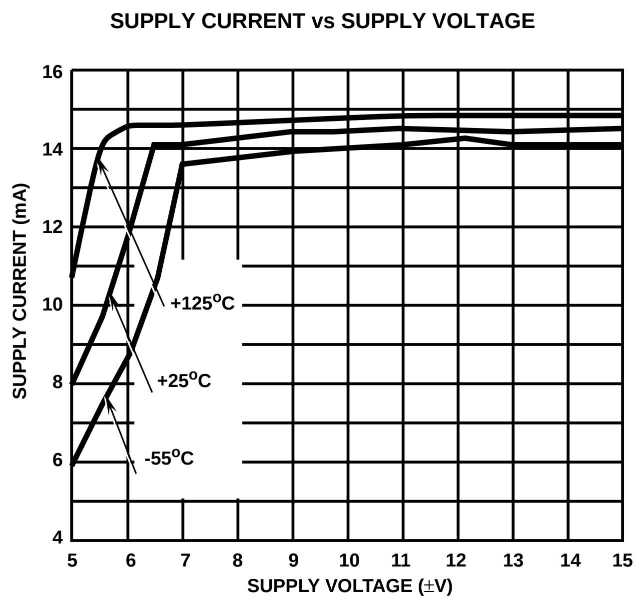

DESIGN INFORMATION (Continued)

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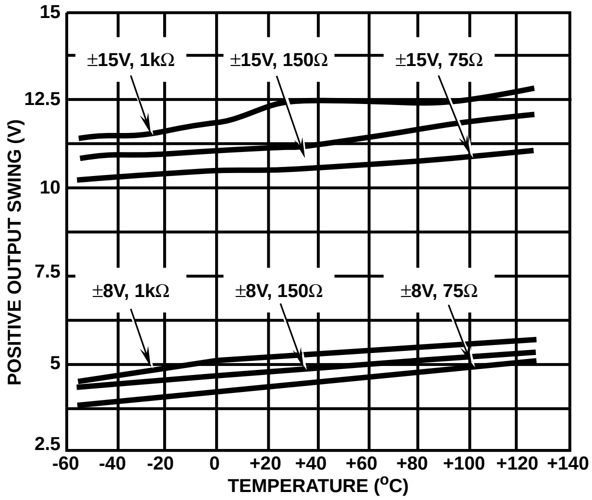
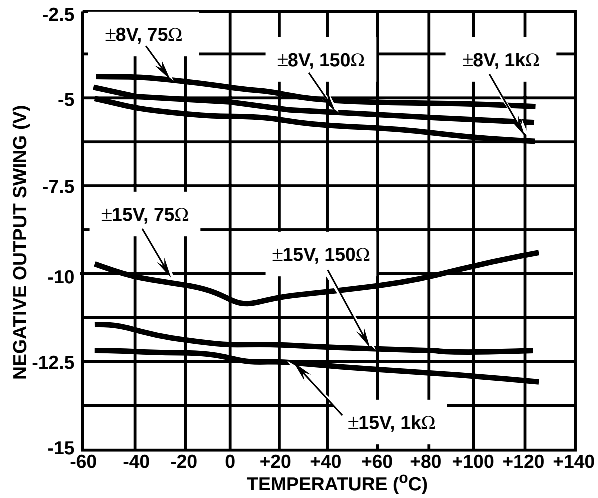
Typical Performance Curves V_{SUPPLY} = ±15V, A_V = +2, R_L = 1kΩ, C_L < 10pF, T_A = +25°C, Unless Otherwise Specified.

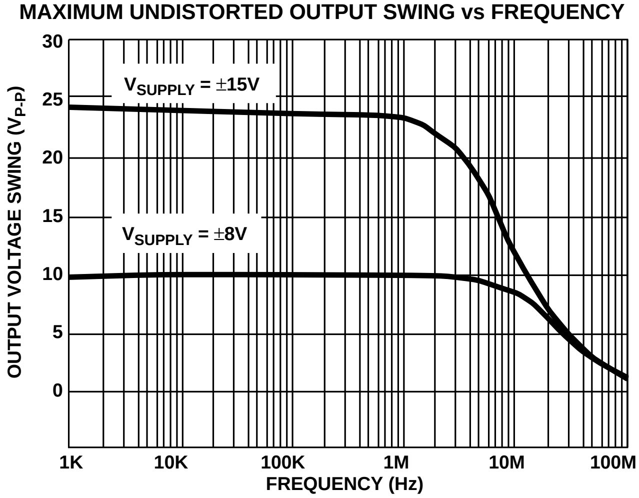
POSITIVE OUTPUT SWING vs TEMPERATURE



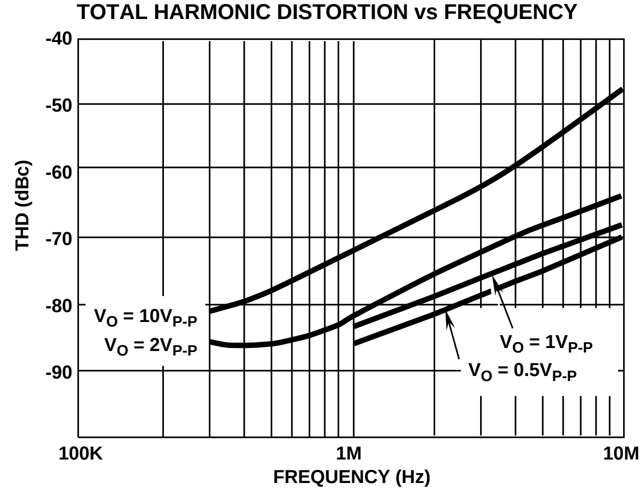
NEGATIVE OUTPUT SWING vs TEMPERATURE



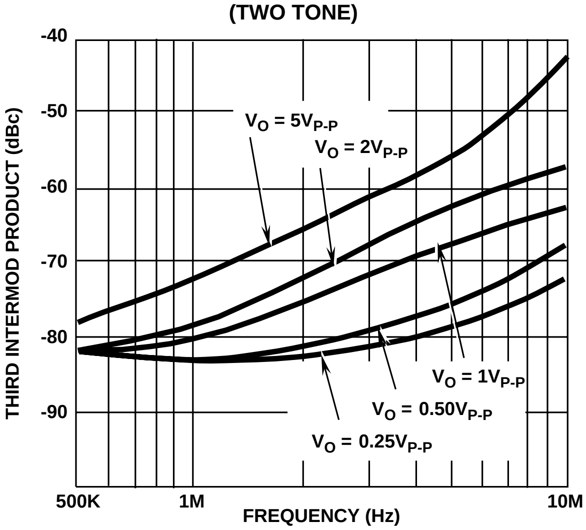
MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY



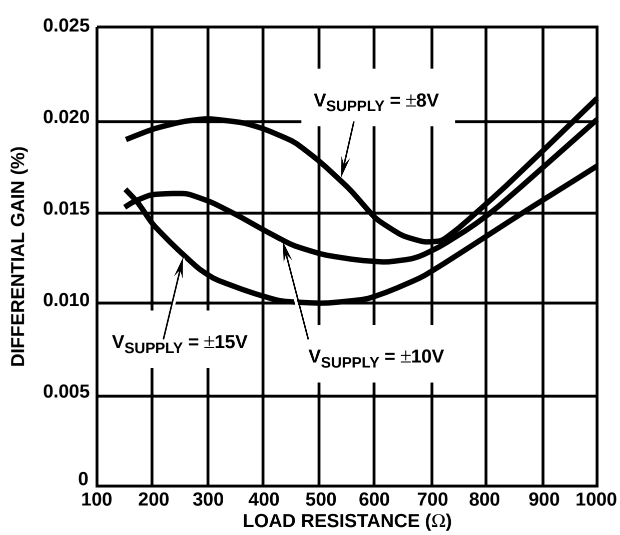
TOTAL HARMONIC DISTORTION vs FREQUENCY



INTERMODULATION DISTORTION vs FREQUENCY (TWO TONE)



DIFFERENTIAL GAIN vs LOAD RESISTANCE



DESIGN INFORMATION (Continued)

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Typical Performance Curves

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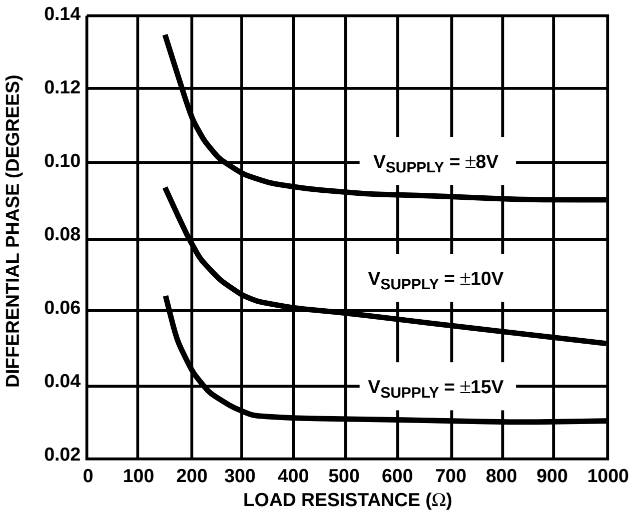
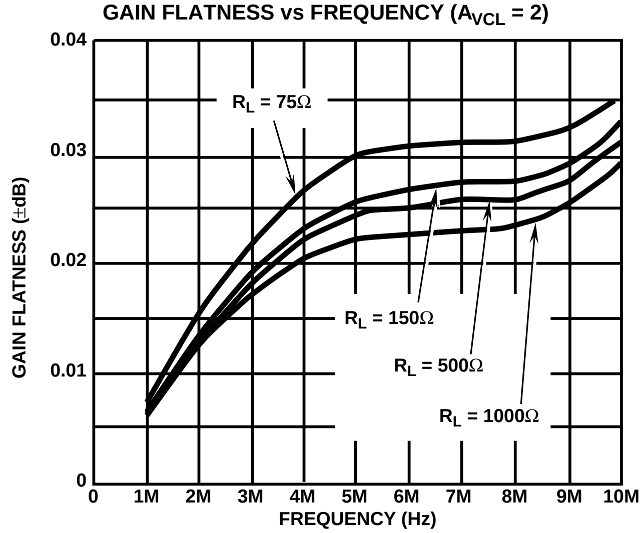
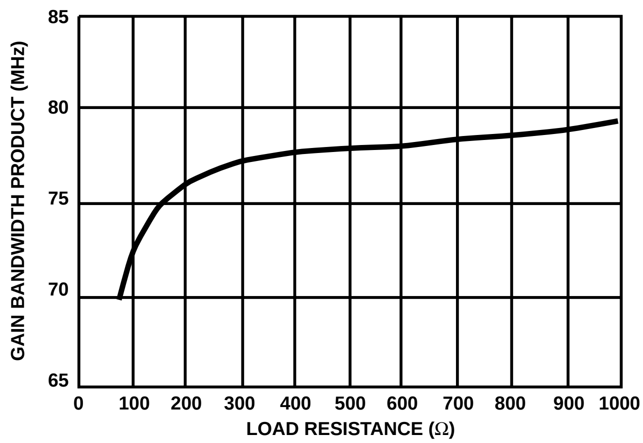
DIFFERENTIAL PHASE vs LOAD RESISTANCE



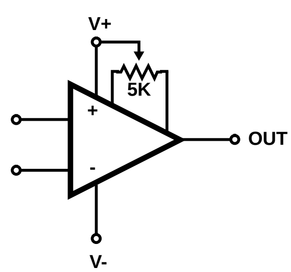
GAIN FLATNESS vs FREQUENCY (A_{VCL} = 2)



GAIN BANDWIDTH PRODUCT vs LOAD RESISTANCE



SUGGESTED OFFSET VOLTAGE ADJUSTMENT



Spec Number **511088-883**

TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: V_{SUPPLY} = ±15V, R_L = 1kΩ, C_L ≤ 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	μV/°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	kΩ
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} = ±10V	+25°C	100	kV/V
		Full	60	kV/V
CMRR	V_{CM} = ±10V	Full	110	dB
Gain Bandwidth Product	f = 10MHz	+25°C	80	MHz
Output Voltage Swing	R_L = 1kΩ	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/2πV_P, V_P = 10V	+25°C	6.0	MHz
Slew Rate	V_{OUT} = ±5V, A_V = +2	+25°C	375	V/μs
Rise and Fall Time	V_{OUT} = ±100mV, A_V = +2	+25°C	3.5	ns
Overshoot	V_{OUT} = ±100mV, A_V = +2	+25°C	20	%
PSRR	Delta V_S = ±10V to ±20V	Full	80	dB
Supply Current	No Load	Full	14.2	mA
Differential Gain	R_L = 700Ω	+25°C	0.02	%
Differential Phase	R_L = 700Ω	+25°C	0.03	Degrees
Gain Flatness to 10MHz	R_L = 75Ω	+25°C	±0.035	dB