![intersil]

HA-2841/883

Wideband, Fast Settling, Unity Gain Stable, 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**
- **Low Supply Current. . . . . 11mA (Max)**
- **Unity Gain Bandwidth . . . . 50MHz (Typ)**
- **High Slew Rate. . . . . 290V/µs (Typ)**
- **Low Offset Voltage. 1mV (Typ)**
- **Full Power Bandwidth . . . . 4.6MHz (Typ)**
- **Low Differential Gain/Phase . . . . 0.03%/0.03^o (Typ)**

Applications

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

Description

The HA-2841/883 is a wideband, unity gain stable, operational amplifier featuring a 50MHz unity gain bandwidth, and excellent DC specifications. This amplifier's performance is further enhanced through stable operation down to closed loop gains of +1, the inclusion of offset null controls, and by its excellent video performance.

The capabilities of the HA-2841/883 are ideally suited for high speed pulse and video amplifier circuits, where high slew rates and wide bandwidth are required. Gain flatness of 0.05dB, combined with differential gain and phase specifications of 0.03%, and 0.03 degrees, respectively, make the HA-2841/883 ideal for component and composite video applications.

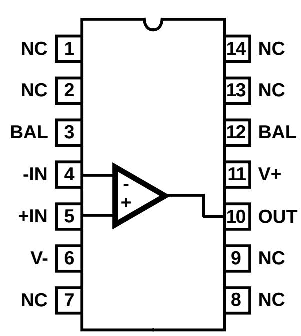
A zener/nichrome based reference circuit, coupled with advanced laser trimming techniques, yields a supply current with a low temperature coefficient and low lot-to-lot variability. Tighter I_{CC} control translates to more consistent AC parameters ensuring that units from each lot perform the same way, and easing the task of designing systems for wide temperature ranges.

Ordering Information

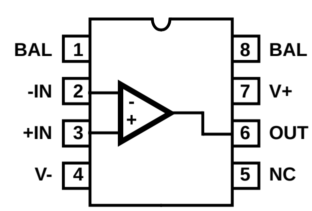
PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2841/883	-55^{o}C to +125^{o}C	14 Lead CerDIP
HA7-2841/883	-55^{o}C to +125^{o}C	8 Lead CerDIP

Pinouts

HA-2841/883
(CERDIP)
TOP VIEW



HA-2841/883
(CERDIP)
TOP VIEW



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

Spec Number **511087-883**
File Number **3621.1**

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 (≤10% Duty Cycle) 50mA
Junction Temperature (T_J) . . . . +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 Pin CerDIP Package	73^{o}C/W	18^{o}C/W
8 Pin 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 Pin CerDIP Package 1.05W
8 Pin CerDIP Package 0.9W
Package Power Dissipation Derating Factor Above +75^{o}C
14 Pin CerDIP Package . . . . 10.5mW/^{o}C
8 Pin 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-)
$R_L \geq 1k\Omega$

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		UNITS
					MIN	MAX	
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	10	-	kV/V
			5, 6	+125^{o}C, -55^{o}C	5	-	kV/V
	$-A_{VOL}$	V_{OUT} = 0V and -10V R_L = 1kΩ	4	+25^{o}C	10	-	kV/V
			5, 6	+125^{o}C, -55^{o}C	5	-	kV/V
Common Mode Rejection Ratio	+CMRR	ΔV_{CM} = 10V, V_{OUT} = -10V V+ = 5V, V- = -25V	1	+25^{o}C	86	-	dB
			2, 3	+125^{o}C, -55^{o}C	80	-	dB
	-CMRR	ΔV_{CM} = -10V, V_{OUT} = 10V V+ = 25V, V- = -5V	1	+25^{o}C	86	-	dB
			2, 3	+125^{o}C, -55^{o}C	80	-	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 MIN	LIMITS MAX	UNITS
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	25	-	mA
			2, 3	+125°C, -55°C	15	-	mA
	$-I_{OUT}$	V_{OUT} = 5V, (Note 1)	1	+25°C	-	-25	mA
			2, 3	+125°C, -55°C	-	-15	mA
Quiescent Power Supply Current	$+I_{CC}$	V_{OUT} = 0V I_{OUT} = 0mA	1	+25°C	-	11	mA
			2, 3	+125°C, -55°C	-	11	mA
	$-I_{CC}$	V_{OUT} = 0V I_{OUT} = 0mA	1	+25°C	-11	-	mA
			2, 3	+125°C, -55°C	-11	-	mA
Power Supply Rejection Ratio	+PSRR	ΔV_{SUPPLY} = 10V V+ = 10V, V- = -15V V+ = 20V, V- = -15V	1	+25°C	70	-	dB
			2, 3	+125°C, -55°C	70	-	dB
	-PSRR	ΔV_{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	$+V_{IO}Adj$	(Note 2)	1	+25°C	V_{IO}-1	-	mV
	$-V_{IO}Adj$	(Note 2)	1	+25°C	V_{IO}+1	-	mV

NOTES:

1. The output metal is sized to handle I_{OUT} = 10mA at a 50% duty cycle, for T_J = +175°C. For I_{OUT} = 15mA and T_J = +175°C, a duty cycle ≤33% 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 = +1V/V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Gain Bandwidth Product	GBWP	V_O = 200mV, f_O = 0.1MHz	1	+25°C	42	-	MHz
		V_O = 200mV, f_O = 10MHz	1	+25°C	44	-	MHz
Slew Rate	SR	V_O = -3V to +3V	1, 3	+25°C	200	-	V/µs
	SR	V_O = -3V to +3V	1, 3	-55°C to +125°C	187	-	V/µs
Rise Time	T_R	V_O = 0V to +200mV C_L < 10pF	1, 3	+25°C	-	6	ns
			1, 3	-55°C to +125°C	-	6	ns
Fall Time	T_F	V_O = 0V to -200mV C_L < 10pF	1, 3	+25°C	-	5	ns
			1, 3	-55°C to +125°C	-	6	ns
Full Power Bandwidth	FPBW	V_{PEAK} = +10V	1, 2	+25°C	3.1	-	MHz
			1, 2	-55°C to +125°C	3.0	-	MHz
Overshoot	+OS	V_O = 0V to +200mV	1	+25°C	-	60	%
			1	-55°C to +125°C	-	65	%
	-OS	V_O = 0V to -200mV	1	+25°C	-	60	%
			1	-55°C to +125°C	-	70	%
Closed Loop Output Resistance	R_{OUT}	A_V > +1 V_M = 10V, ΔI = 9mA	1	+25°C	-	1	Ω

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 ± 1kÅ

WORST CASE CURRENT DENSITY:
1.2×10^5 A/cm^2 at 9.7mA

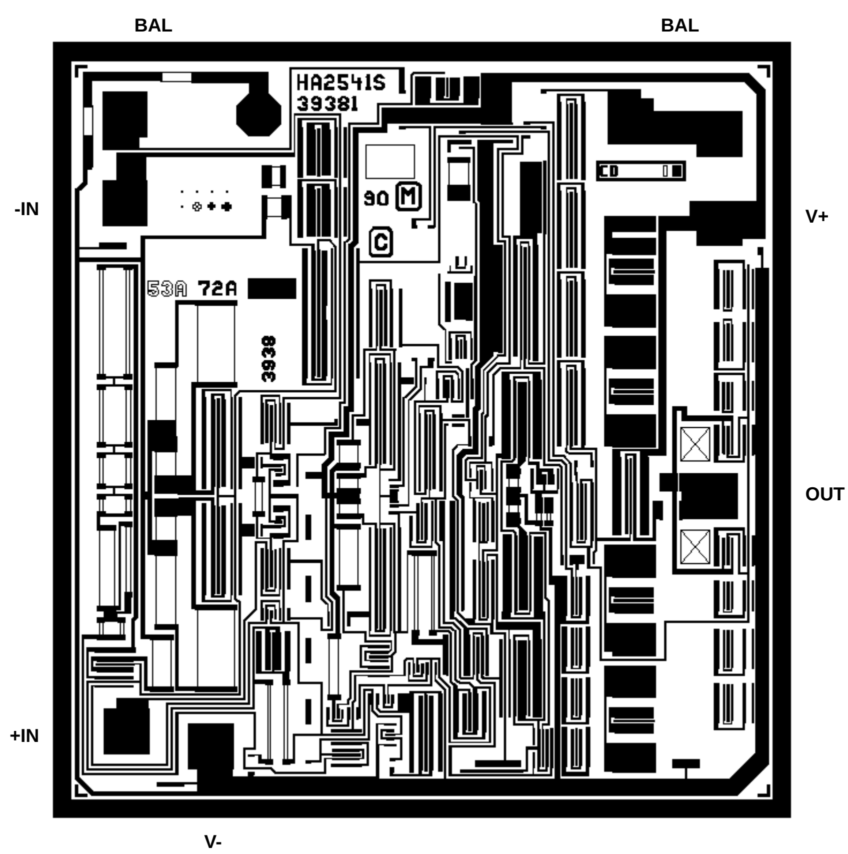
SUBSTRATE POTENTIAL (Powered Up): V-

TRANSISTOR COUNT: 43

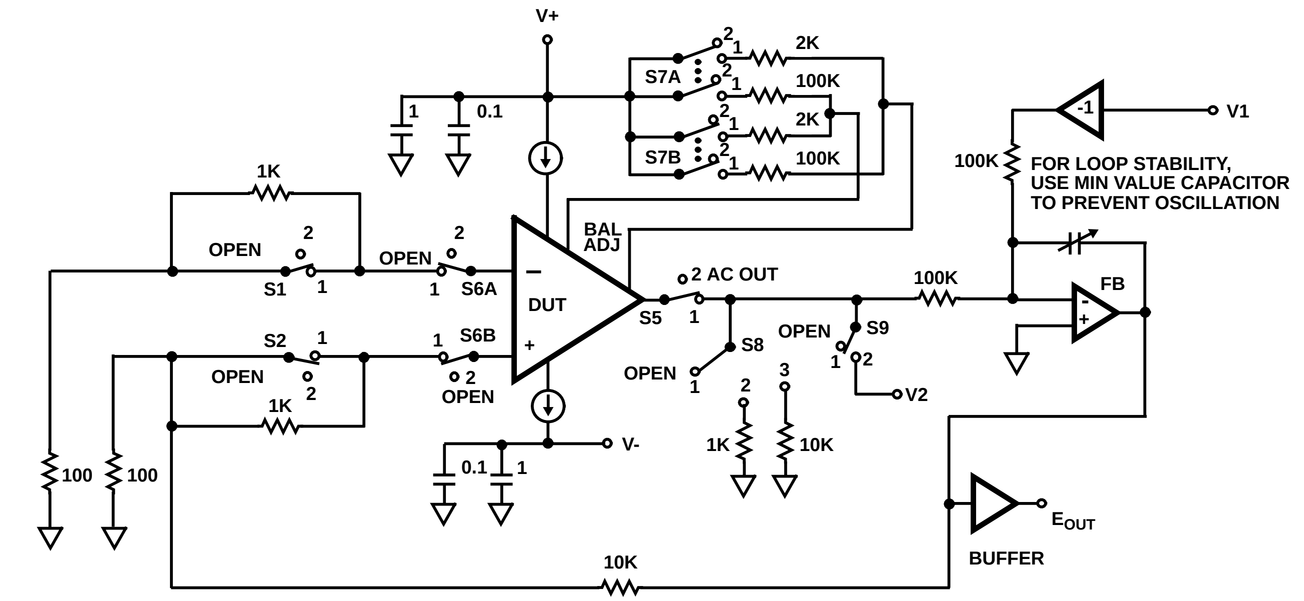
PROCESS: Bipolar Dielectric Isolation

Metallization Mask Layout

HA-2841/883



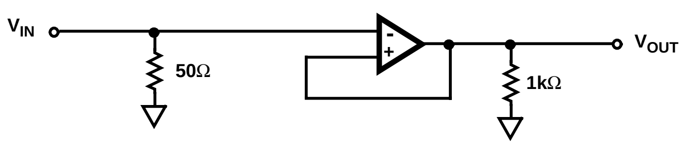
Test Circuit (Applies to Table 1)



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

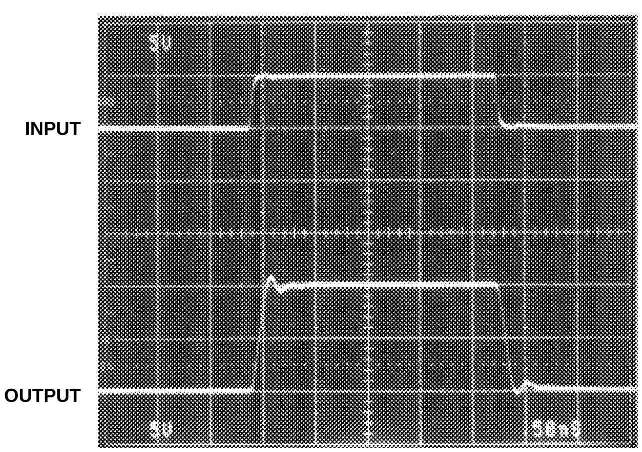
Test Waveforms

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

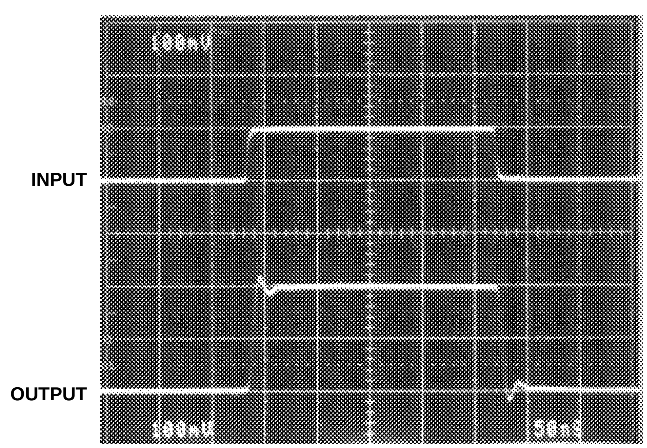


V_S = ±15V
A_V = +1
C_L ≤ 10pF
NOTE: No Capacitive Load, Maintain Parasitics Less Than 10pF.

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

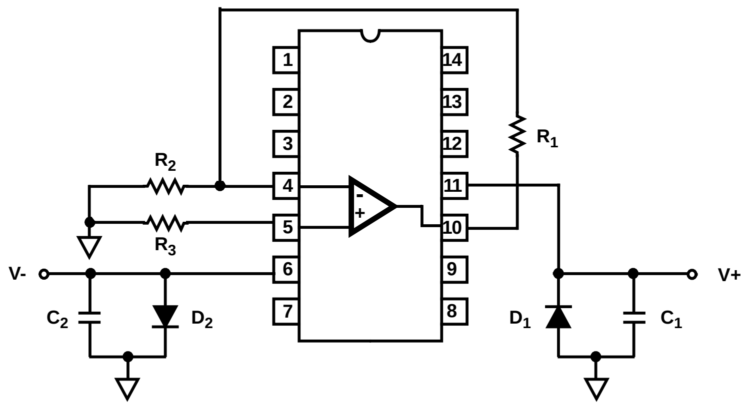


MEASURED SMALL SIGNAL RESPONSE
Vertical Scale: Input = 100mV/Div., Output = 100mV/Div.
Horizontal Scale: 50ns/Div.

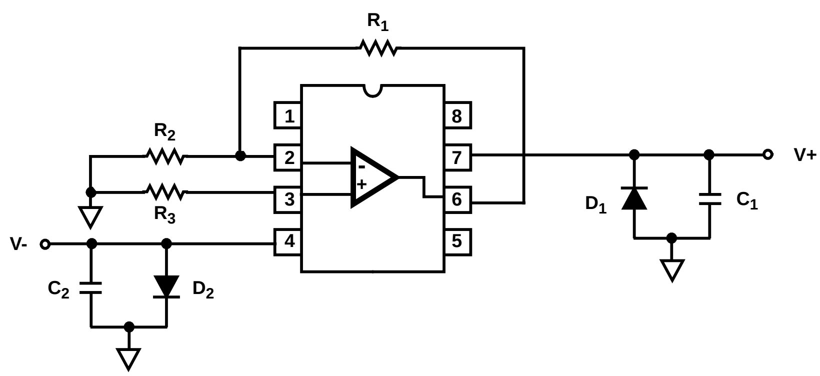


Burn-In Circuits

HA1-2841/883 CERAMIC DIP



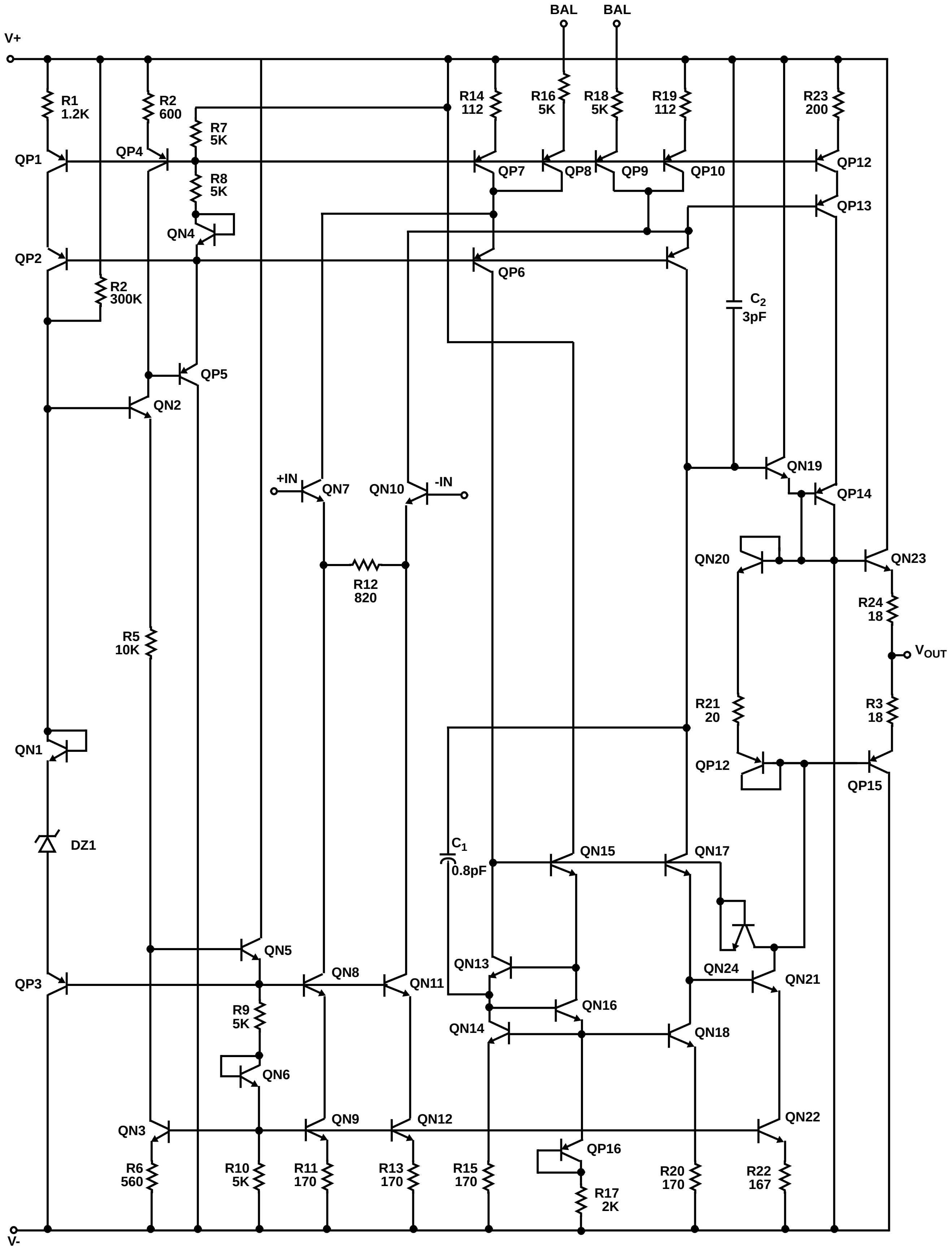
HA7-2841/883 CERAMIC DIP



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



DESIGN INFORMATION

Wideband, Fast Settling, Unity Gain Stable, Video Operational Amplifier

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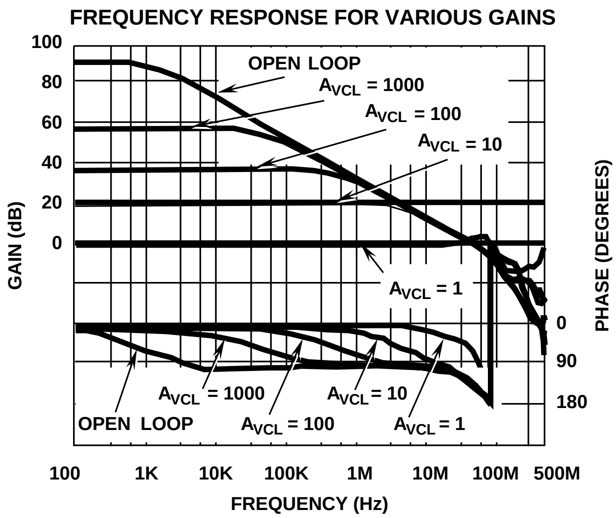
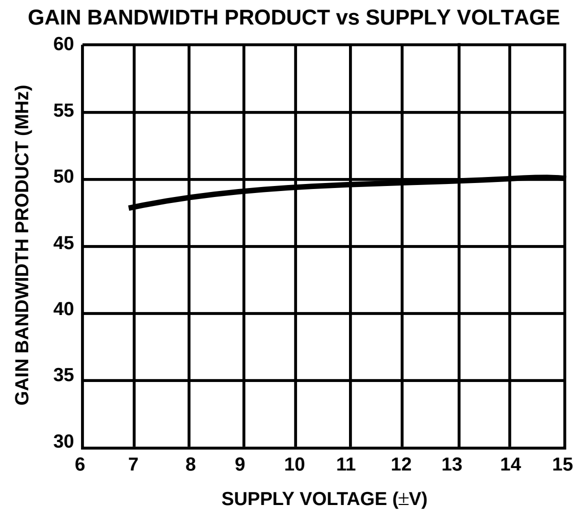
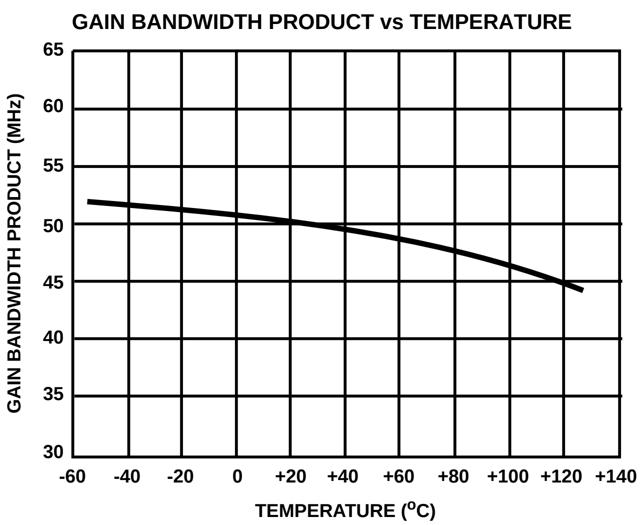
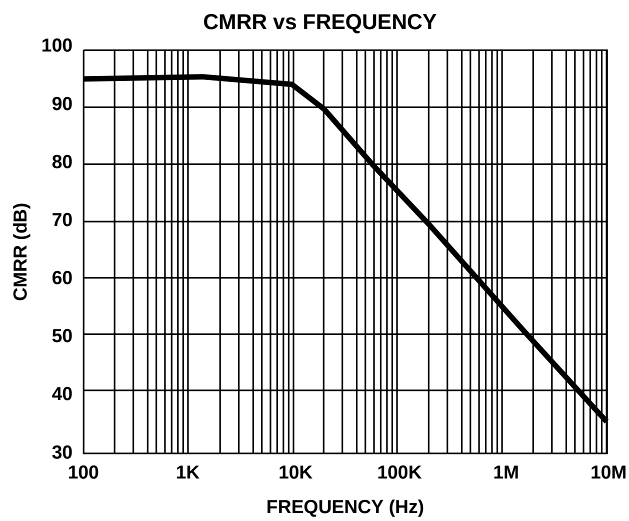
Typical Performance Curves V_{SUPPLY} = ±15V, A_V = +1, R_L = 1kΩ, C_L ≤ 10pF, T_A = +25°C, Unless Otherwise Specified.









DESIGN INFORMATION (Continued)

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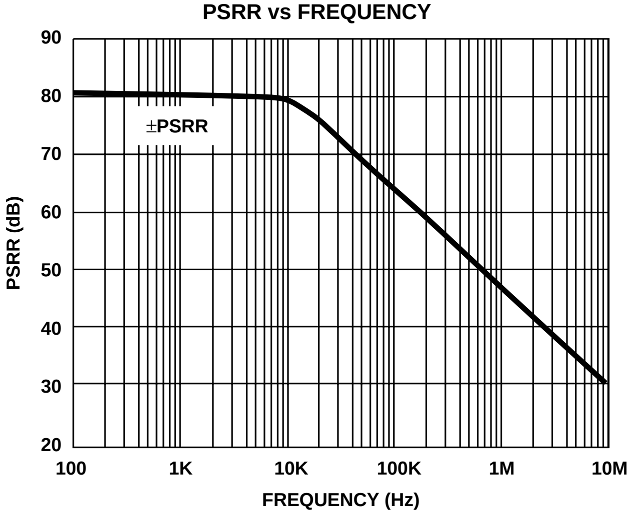
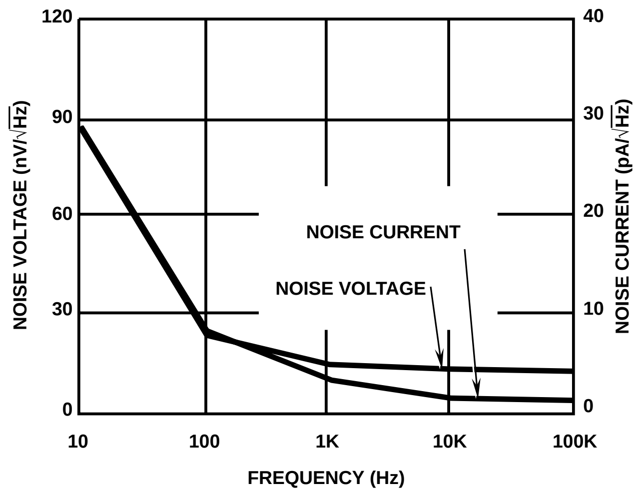
Typical Performance Curves
V_{SUPPLY} = ±15V, A_V = +1, R_L = 1kΩ, C_L ≤ 10pF, T_A = +25°C, Unless Otherwise Specified.

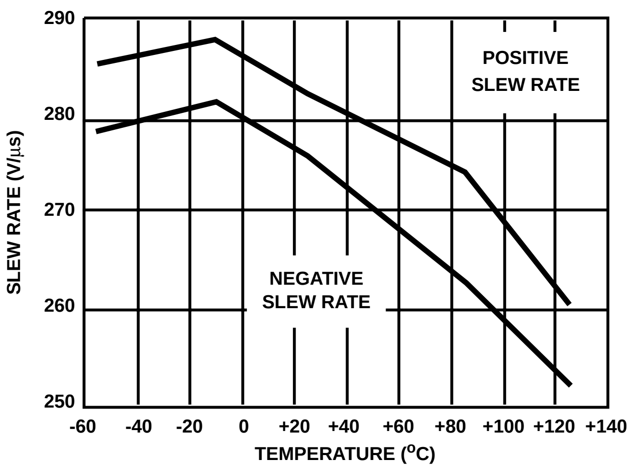
PSRR vs FREQUENCY



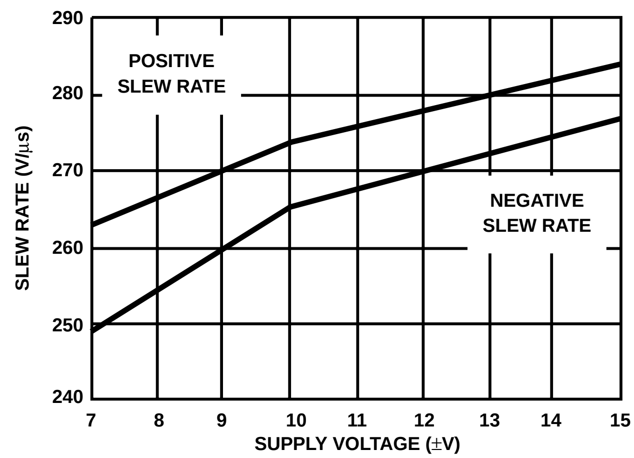
INPUT NOISE vs FREQUENCY



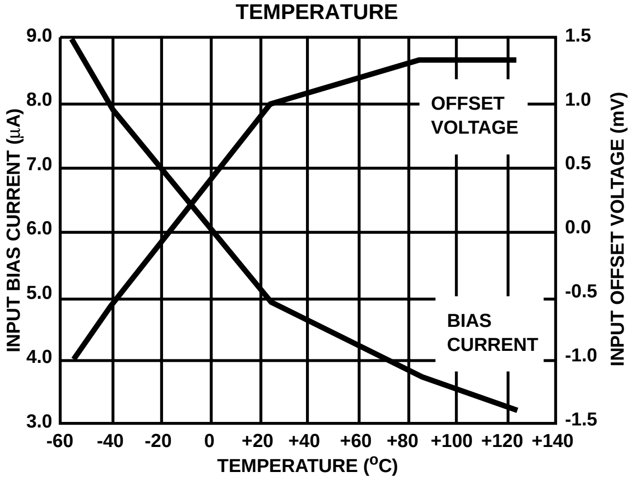
SLEW RATE vs TEMPERATURE



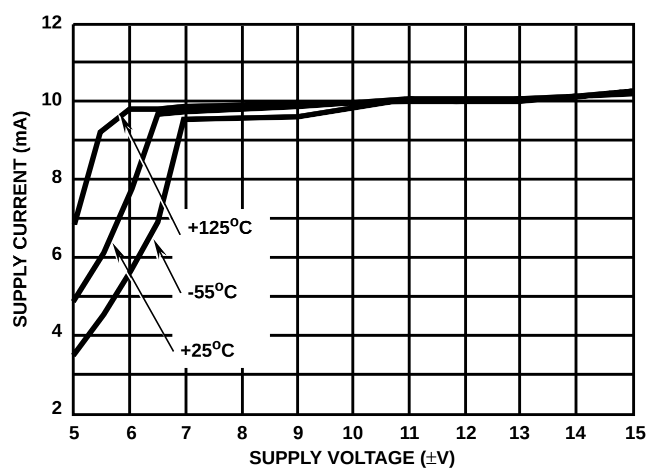
SLEW RATE vs SUPPLY VOLTAGE



INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE



SUPPLY CURRENT vs SUPPLY VOLTAGE



DESIGN INFORMATION (Continued)

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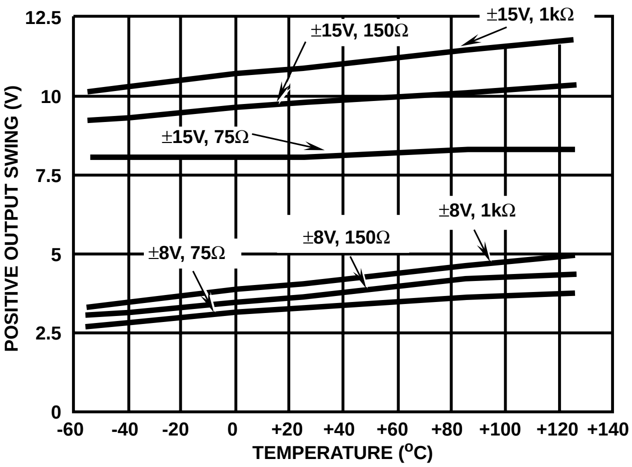
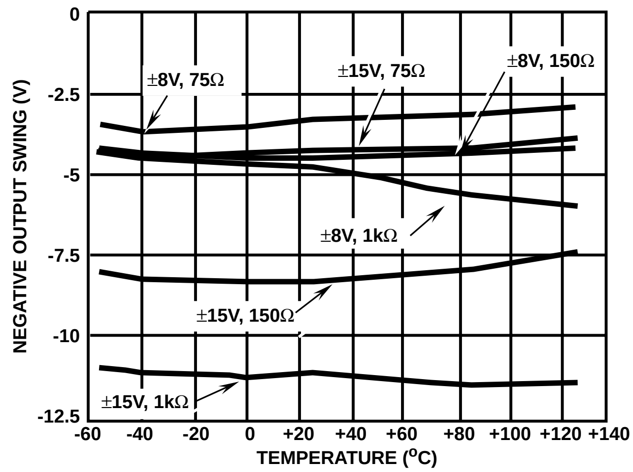
Typical Performance Curves V_{SUPPLY} = ±15V, A_V = +1, R_L = 1kΩ, C_L ≤ 10pF, T_A = +25°C, Unless Otherwise Specified.

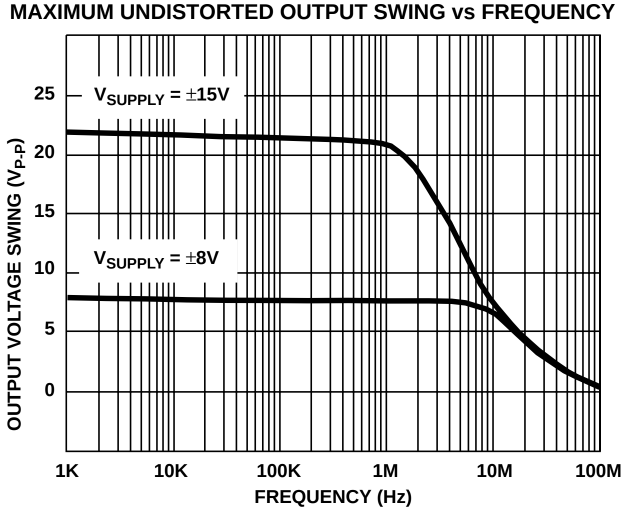
POSITIVE OUTPUT SWING vs TEMPERATURE



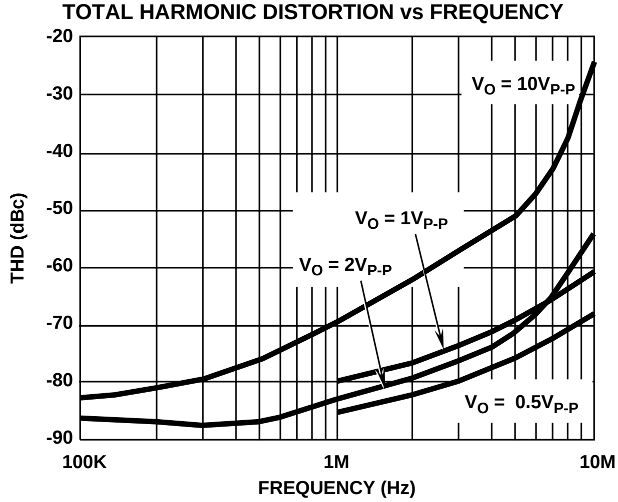
NEGATIVE OUTPUT SWING vs TEMPERATURE



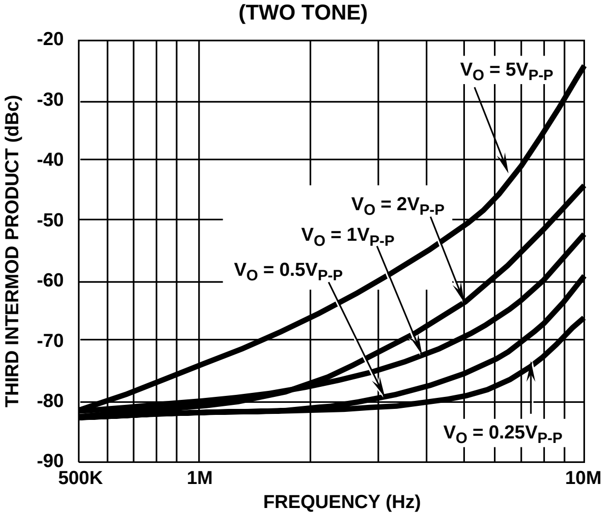
MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY



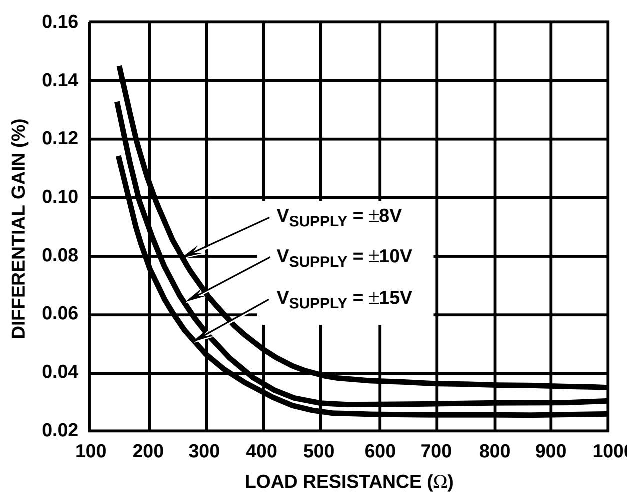
TOTAL HARMONIC DISTORTION vs FREQUENCY



INTERMODULATION DISTORTION vs FREQUENCY (TWO TONE)



DIFFERENTIAL GAIN vs LOAD RESISTANCE



DESIGN INFORMATION (Continued)

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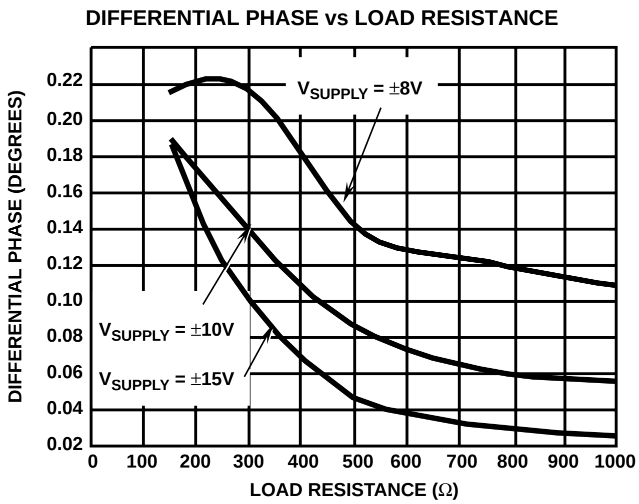
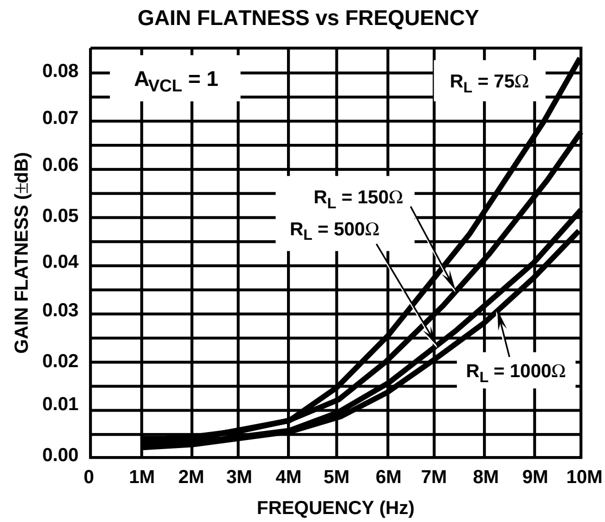
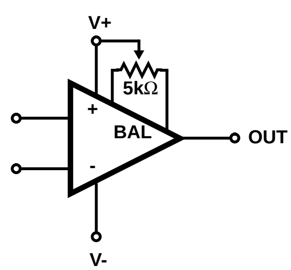
Typical Performance Curves V_{SUPPLY} = ±15V, A_V = +1, R_L = 1kΩ, C_L ≤ 10pF, T_A = +25°C, Unless Otherwise Specified.





Suggested Offset Voltage Adjustment



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	14	μV/°C
Input Bias Current	V_{CM} = 0V	+25°C	5.0	μA
		Full	8.0	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	50	kV/V
		Full	30	kV/V
CMRR	V_{CM} = ±2V	Full	95	dB
Gain Bandwidth Product	f = 10MHz	+25°C	50	MHz
Output Voltage Swing		Full	±10.5	V
Output Current	V_{OUT} > 10V	Full	30	mA
Output Resistance	Open Loop	+25°C	8.5	Ω
Full Power Bandwidth	FPBW = SR/2πV_P, V_P = 10V	+25°C	4.6	MHz
Slew Rate	V_{OUT} = ±5V, A_V = +2	+25°C	290	V/μs
Rise Time	V_{OUT} = ±100mV, A_V = +2	+25°C	3.5	ns
Overshoot	V_{OUT} = ±100mV, A_V = +2	+25°C	47	%
Settling Time	0.1%, 10V Step, A_V = +2	+25°C	145	ns
PSRR	Delta V_S = ±10V to ±20V	Full	80	dB
Supply Current	No Load	Full	10	mA
Differential Gain	R_L = 700Ω	+25°C	0.03	%
Differential Phase	R_L = 700Ω	+25°C	0.03	Degrees
Gain Flatnes to 5MHz	R_L = 75Ω	+25°C	±0.015	dB
Gain Flatness to 10MHz	R_L = 75Ω	+25°C	±0.05	dB