

January 1989

Features

- This Circuit is Processed in Accordance to Mil-Std-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Low Supply Current @ $V_S = +5V \dots (+25^\circ C)$ 320 μA (Max)
(Full) 400 μA (Max)
- Wide Supply Voltage Range Single 3V to 30V
or Dual ± 1.5 to $\pm 15V$
- High Slew Rate +S.R. 0.8V/ μs (Min)
1.5V/ μs (Typ)
- High Gain 20kV/V (Min)
75kV/V (Typ)
- Low Noise (1kHz) 20nV/ \sqrt{Hz} (Typ)
- 100% Tested at $\pm 15V$ and 0V, +5V Power Supplies
- Unity Gain Stable
- Dielectric Isolation

Applications

- Portable Instruments
- Meter Amplifiers
- Telephone Headsets
- Microphone Amplifiers
- Instrumentation
- For Further Design Ideas See App. Note 544

Description

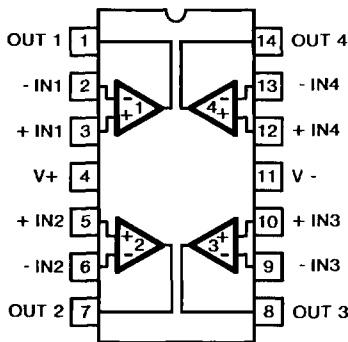
The HA-5144/883 quad, ultra-low power operational amplifier provide AC and DC performance characteristics similar to, or better than most general purpose amplifiers while only drawing 1/30 of the supply current of most general purpose amplifiers. This amplifier is well suited to applications which require low power dissipation and good electrical characteristics.

The HA-5144/883 provides accurate signal processing by virtue of their low input offset voltage (6mV), low input bias current (100nA), high open loop gain (20kV/V) and low noise (20nV/ \sqrt{Hz}). These characteristics coupled with a 1.5V/ μs slew rate and a 24kHz bandwidth make the HA-5144/883 ideal for use in low power instrumentation, audio amplifier and active filter designs. The wide range of supply voltages (3V to 30V) also allow these amplifier and active filter designs. The wide range of supply voltages (3V to 30V) also allow these amplifiers to be very useful in low voltage battery powered equipment.

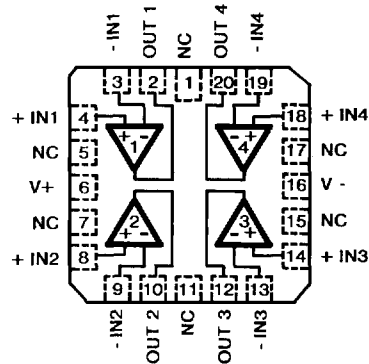
The HA-5144/883 offers tested specifications at both single ended levels (0V, +5V) and dual supplies ($\pm 15V$). Packaging is offered in the 14 pin Ceramic DIP or 20 pad Ceramic LCC, and operation is specified at the full military $-55^\circ C$ to $+125^\circ C$ temperature range.

Pinouts

HA1-5144/883 (CERAMIC DIP)
TOP VIEW



HA4-5144/883 (CERAMIC LCC)
TOP VIEW



Specifications HA-5144/883

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals	35V
Differential Input Voltage	7V
Voltage at Either Input Terminal	V+ to V-
Output Current	Full Short Circuit Protection
Output Current Duration	Indefinite, One Amplifier Shorted to Ground
Junction Temperature (T _J)	+175°C
Storage Temperature Range	-65°C to +150°C
ESD Rating	<2000V
Lead Temperature (Soldering 10 sec)	+275°C

CAUTION: 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.

Thermal Information

Thermal Resistance	θ_{ja}	θ_{jc}
Ceramic DIP Package	75°C/W	17°C/W
Ceramic LCC Package	76°C/W	19°C/W
Package Power Dissipation Limit at +75°C For T _J ≤ +175°C		
Ceramic DIP Package	1.33W	
Ceramic LCC Package	1.32W	
Package Power Dissipation Derating Factor Above +75°C		
Ceramic DIP Package	13.3mW/°C	
Ceramic LCC Package	13.2mW/°C	

Recommended Operating Conditions

Operating Temperature Range	-55°C to +125°C	V _{INcm} ≤ 1/2 (V+ - V-)
Operating Supply Voltage	±1.5V to ±15V or 3V to 30V	R _L ≥ 50kΩ

TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: R_{SOURCE} = 100Ω, R_{LOAD} = 500kΩ, V_{OUT} = 0V, Unless Otherwise Specified.
 Subscript 1 Refers to Supply Voltages (±V_S) = ±15V, Subscript 2 Refers to +V_S = 5.0V, -V_S = 0.0V.

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	V _{IO1}	V _{CM} = 0V	1	+25°C	-6	6	mV
			2,3	+125°C, -55°C	-8	8	mV
	V _{IO2}	V _{CM} = 0V V _{OUT} = 1.4V	1	+25°C	-6	6	mV
			2,3	+125°C, -55°C	-8	8	mV
Input Bias Current	+I _{B1}	V _{CM} = 0V +R _S = 10kΩ -R _S = 100Ω	1	+25°C	-100	100	nA
			2,3	+125°C, -55°C	-125	125	nA
	-I _{B1}	V _{CM} = 0V +R _S = 100Ω -R _S = 10kΩ	1	+25°C	-100	100	nA
			2,3	+125°C, -55°C	-125	125	nA
	+I _{B2}	V _{CM} = 0V, V _{OUT} = 1.4V +R _S = 10kΩ -R _S = 100Ω	1	+25°C	-100	100	nA
			2,3	+125°C, -55°C	-125	125	nA
	-I _{B2}	V _{CM} = 0V, V _{OUT} = 1.4V +R _S = 100Ω -R _S = 10kΩ	1	+25°C	-100	100	nA
			2,3	+125°C, -55°C	-125	125	nA
Input Offset Current	I _{IO1}	V _{CM} = 0V +R _S = 10kΩ -R _S = 10kΩ	1	+25°C	-10	10	nA
			2,3	+125°C, -55°C	-20	20	nA
	I _{IO2}	V _{CM} = 0V, V _{OUT} = 1.4V +R _S = 10kΩ -R _S = 10kΩ	1	+25°C	-10	10	nA
			2,3	+125°C, -55°C	-20	20	nA
Common Mode Range	+CMR ₁	V+ = 5V V- = -25V	1	+25°C	10	-	V
			2,3	+125°C, -55°C	10	-	V
	-CMR ₁	V+ = 25V V- = -5V	1	+25°C	-	-10	V
			2,3	+125°C, -55°C	-	-10	V
	+CMR ₂	V+ = 5V to 2V V- = 0V to -3V V _{OUT} = 1.4V to -1.6V	1	+25°C	0 to 3	-	V
			2,3	+125°C, -55°C	0 to 3	-	V

CAUTION: This device is sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

Specifications HA-5144/883

TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $R_{SOURCE} = 100\Omega$, $R_{LOAD} = 500k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

Subscript 1 Refers to Supply Voltages ($\pm V_S$) = $\pm 15V$; Subscript 2 Refers to $+V_S = 5.0V$, $-V_S = 0.0V$.

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Large Signal Voltage Gain	+AVOL1	$V_{OUT} = 0V$ and $10V$ $R_L = 50k\Omega$	4	+25°C	20	-	kV/V
			5, 6	+125°C, -55°C	15	-	kV/V
	-AVOL1	$V_{OUT} = 0V$ and $-10V$ $R_L = 50k\Omega$	4	+25°C	20	-	kV/V
			5, 6	+125°C, -55°C	15	-	kV/V
	+AVOL2	$V_{OUT} = 1.4V$ and $2.5V$ $R_L = 50k\Omega$	4	+25°C	20	-	kV/V
			5, 6	+125°C, -55°C	15	-	kV/V
Common Mode Rejection Ratio	+CMRR1	$\Delta V_{CM} = 10V$ $+V = 5V$ $-V = -25V$ $V_{OUT} = -10V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
	-CMRR1	$\Delta V_{CM} = 10V$ $+V = 25V$ $-V = -5V$ $V_{OUT} = 10V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
	+CMRR2	$\Delta V_{CM} = 0V$ to $3V$ $+V = 2V$ $-V = -3V$ $V_{OUT} = -3V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
Output Voltage Swing	+VOUT1	$R_L = 50k\Omega$	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-VOUT1	$R_L = 50k\Omega$	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
	+VOUT2	$R_L = 50k\Omega$ Terminated at 2.5V	1	+25°C	3.8	-	V
			2, 3	+125°C, -55°C	3.5	-	V
-VOUT2	$R_L = 50k\Omega$ Terminated at 2.5V	1	+25°C	-	1	V	
		2, 3	+125°C, -55°C	-	1.2	V	
Quiescent Power Supply Current (All Four Amplifiers)	+ICC1	$V_{OUT} = 0V$ $I_{OUT} = 0mA$	1	+25°C	-	600	μA
			2, 3	+125°C, -55°C	-	800	μA
	-ICC1	$V_{OUT} = 0V$ $I_{OUT} = 0mA$	1	+25°C	-600	-	μA
			2, 3	+125°C, -55°C	-800	-	μA
	+ICC2	$V_{OUT} = 1.4V$ $I_{OUT} = 0mA$	1	+25°C	-	320	μA
			2, 3	+125°C, -55°C	-	400	μA
Power Supply Rejection Ratio	+PSRR1	$\Delta V_{SUP} = 10V$ $+V = 10V, -V = -15V$ $+V = 20V, -V = -15V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
	-PSRR1	$\Delta V_{SUP} = 10V$ $+V = 15V, -V = -10V$ $+V = 15V, -V = -20V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
	+PSRR2	$\Delta V_{SUP} = 10V$ $+V = 5V, -V = 0V$ $+V = 15V, -V = 0V$	1	+25°C	77	-	dB
			2, 3	+125°C, -55°C	77	-	dB
Channel Separation	$\pm CS$	$R_L = 50k\Omega$	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB

TABLE 2. A.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 50k\Omega$, $C_{LOAD} = 50pF$, $V_{OUT} = 0V$, Unless Otherwise Specified.
 Subscript 1 Refers to Supply Voltages ($\pm V_S$) = $\pm 15V$; Subscript 2 Refers to $+V_S = 5.0V$, $-V_S = 0.0V$.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	+SR ₁	$V_{OUT} = -3V$ to $3V$ V_{IN} S.R. $\leq 10V/\mu s$ @ $A_V = 1$	4	+25°C	0.8	-	V/ μs
	-SR ₁	$V_{OUT} = 3V$ to $-3V$ V_{IN} S.R. $\leq 10V/\mu s$ @ $A_V = 1$	4	+25°C	0.8	-	V/ μs
	+SR ₂	$V_{OUT} = 0V$ to $3V$ V_{IN} S.R. $\leq 10V/\mu s$ @ $A_V = 1$	4	+25°C	0.8	-	V/ μs
	-SR ₂	$V_{OUT} = 3V$ to $0V$ V_{IN} S.R. $\leq 10V/\mu s$ @ $A_V = 1$	4	+25°C	0.8	-	V/ μs

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 50k\Omega$, $C_{LOAD} = 50pF$, $A_V = 1V/V$, Unless Otherwise Specified.
 Subscript 1 Refers to Supply Voltages ($\pm V_S$) = $\pm 15V$; Subscript 2 Refers to $+V_S = 5.0V$, $-V_S = 0.0V$.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Full Power Bandwidth	FPBW ₁	$V_{PEAK} = 10V$	1, 2	+25°C	12.7	-	kHz
	FPBW ₂	$V_{PEAK} = 1.1V$ $V_{Ref} = 2.5V$	1, 2	+25°C	115.8	-	kHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 50k\Omega$, $C_L = 50pF$	1	-55°C to +125°C	1	-	V/V
Quiescent Power Consumption	PC ₁	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	1, 3	-55°C to +125°C	-	24	mW
	PC ₂	$V_{OUT} = 1.4V$, $I_{OUT} = 0mA$	1, 3	-55°C to +125°C	-	2	mW

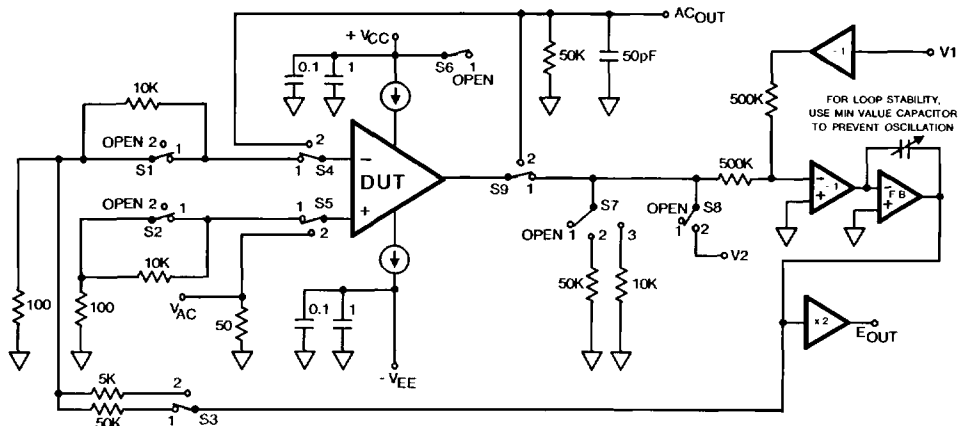
- NOTES: 1. Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested at final production. These parameters are lab characterized upon initial design release, or upon design changes. These parameters are guaranteed by characterization based upon data from multiple production runs which reflect lot to lot and within lot variation.
2. Full Power Bandwidth guarantee based on Slew Rate measurement using $FPBW = \text{Slew Rate}/(2\pi V_{PEAK})$.
3. Quiescent Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.)

TABLE 4. ELECTRICAL TEST REQUIREMENTS

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

* PDA applies to Subgroup 1 only.

Test Circuit (Applies to Tables 1 and 2)



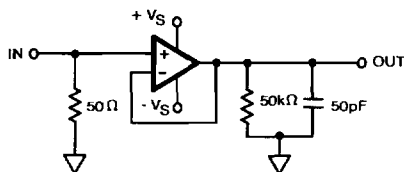
ONE OF FOUR TEST LOOPS FOR THE HA - 5144/883

ALL RESISTORS = $\pm 1\%$ (Ω)
ALL CAPACITORS = $\pm 10\%$ (μF)

For Detailed Information, Refer to HA-5144/883 Test Tech Brief

Test Waveforms

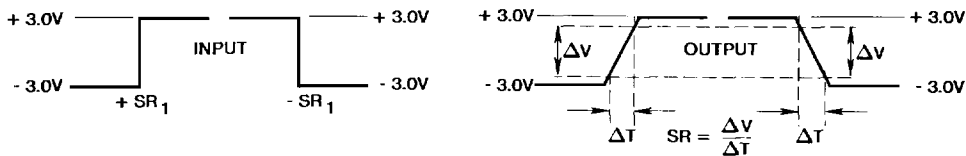
SIMPLIFIED TEST CIRCUIT (Applies to Table 2)



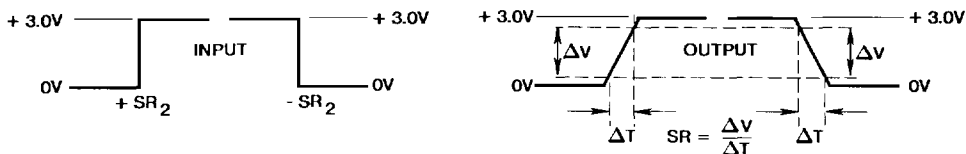
NOTE: $\pm V_{\text{SUPPLY}}$ ($\pm V_S$) Tested with $\pm 15\text{V}$ and 0V , $+5\text{V}$. V_{IN} Slew Rate Maintained with Less Than $10\text{V}/\mu\text{s}$ Input for Voltage Follower Configuration.

SLEW RATE WAVEFORMS, $A_V = 1\text{V/V}$

$\pm V_{\text{SUPPLY}} = \pm 15\text{V}$

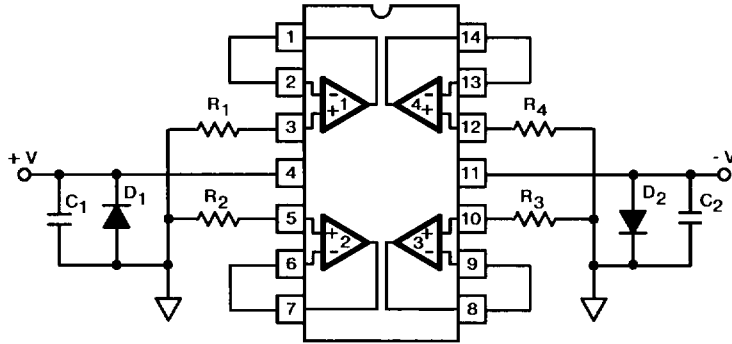


$+V_{\text{SUPPLY}} = 5\text{V}, -V_{\text{SUPPLY}} = 0\text{V}$

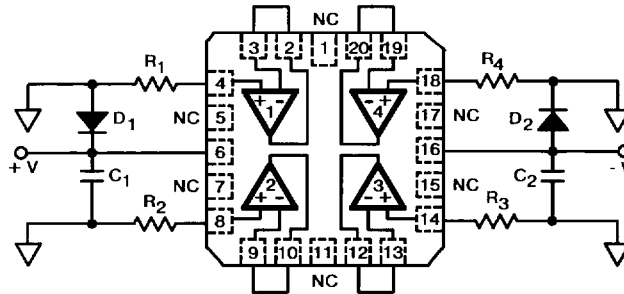


Burn-In Circuits

HA1-5144/883 CERAMIC DIP



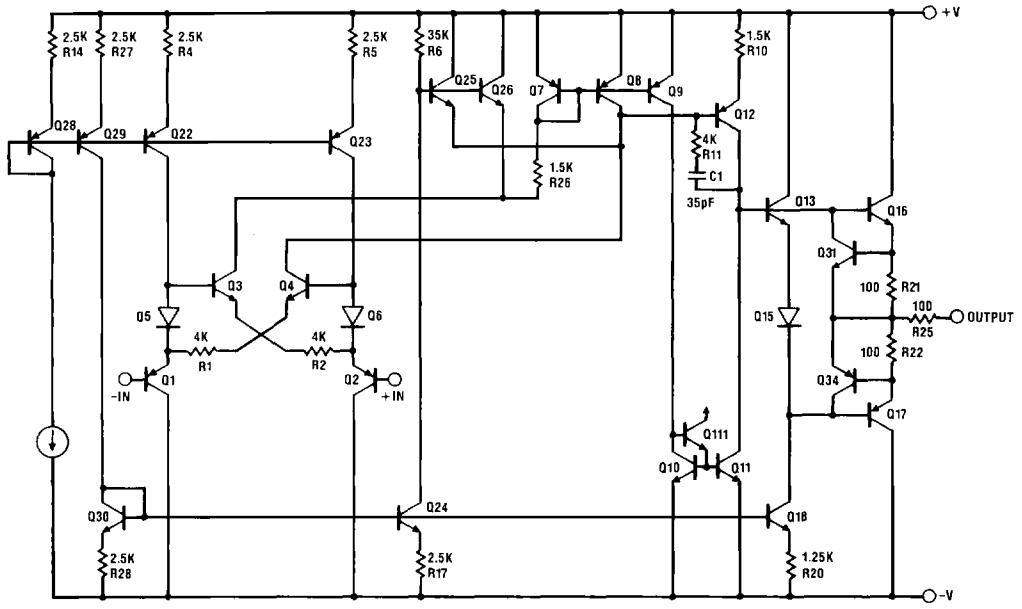
HA4-5144/883 CERAMIC LCC



NOTES:

- $R_1 = R_2 = R_3 = R_4 = 1\text{M}\Omega, \pm 5\%, 1/4\text{W (Min)}$
- $C_1 = C_2 = 0.01\mu\text{F/Socket (Min)}$ or $0.1\mu\text{F/Row, (Min)}$
- $D_1 = D_2 = \text{IN4002 or Equivalent/Board}$
- $|V(+)-V(-)| = 30\text{V}$

Schematic Diagram (1/4 Of HA-5144/883)



ALL RESISTORS = (Ω)

Die Characteristics

DIE DIMENSIONS:

95.7 x 101.6 x 19 mils
(2430 x 2580 x 483 μm)

METALLIZATION:

Type: Aluminum
Thickness: $16\text{k}\text{\AA} \pm 2\text{k}\text{\AA}$

WORST CASE CURRENT DENSITY:

$0.45 \times 10^5 \text{A/cm}^2$ @ 2.5mA

SUBSTRATE POTENTIAL (Powered Up): V-

GLASSIVATION:

Type: Nitride
Thickness: $7\text{k}\text{\AA} \pm 0.7\text{k}\text{\AA}$

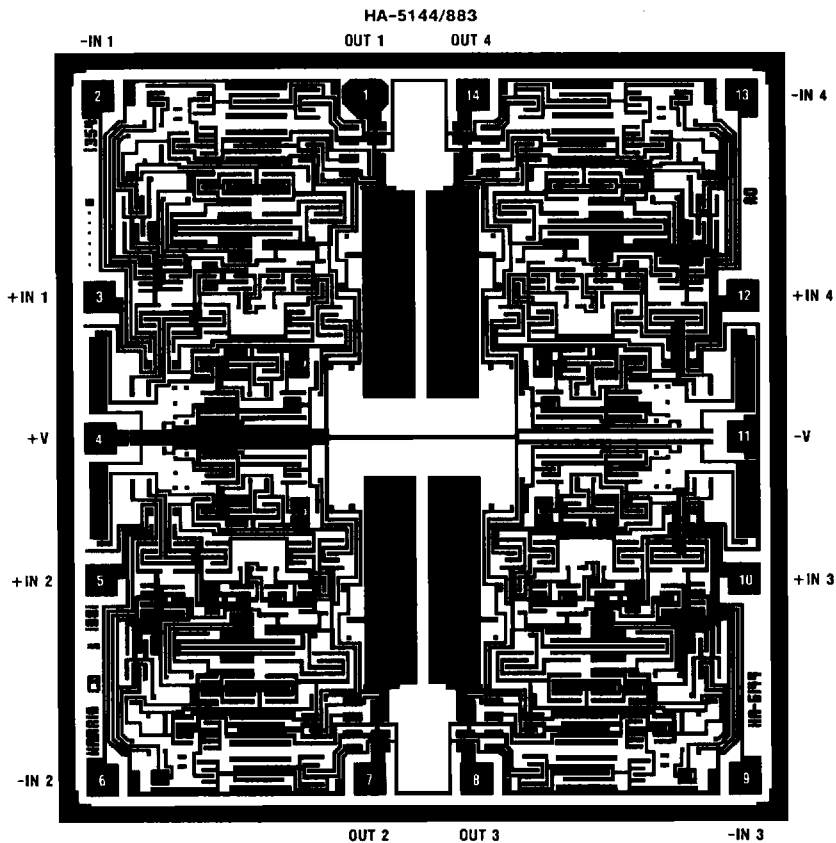
TRANSISTOR COUNT: 144

PROCESS: HFBS Bipolar/JFET Dielectric Isolation

DIE ATTACH:

Material: Gold/Silicon Eutectic Alloy
Temperature: Ceramic DIP — 460°C (Max)
Ceramic LCC — 420°C (Max)

Metallization Mask Layout

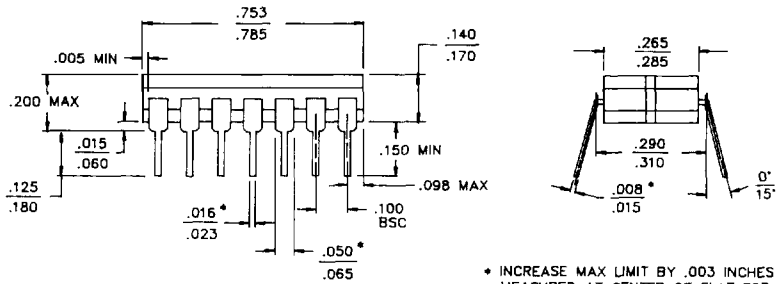


NOTE: Pad Numbers Refer to 14 Pin Ceramic DIP Package Pinout Only.

3
OP AMPs &
COMPARATORS

Packaging†

14 PIN CERAMIC DIP

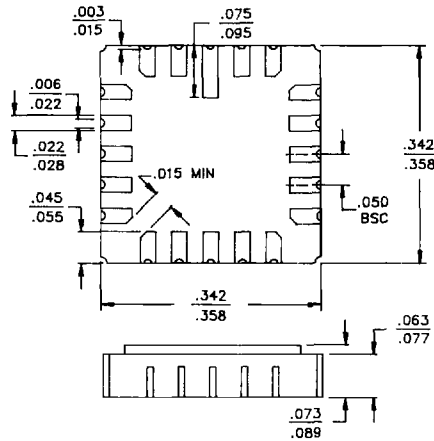


* INCREASE MAX LIMIT BY .003 INCHES MEASURED AT CENTER OF FLAT FOR SOLDER FINISH

LEAD MATERIAL: Type B
LEAD FINISH: Type A
PACKAGE MATERIAL: Ceramic, 90% Alumina
PACKAGE SEAL:
 Material: Glass Frit
 Temperature: 450°C ± 10°C
 Method: Furnace Seal

INTERNAL LEAD WIRE:
 Material: Aluminum
 Diameter: 1.25 Mil
 Bonding Method: Ultrasonic
COMPLIANT OUTLINE: 38510 D-1

20 PAD CERAMIC LCC



PAD MATERIAL: Type C
PAD FINISH: Type A
FINISH DIMENSION: Type A
PACKAGE MATERIAL: Multilayer Ceramic, 90% Alumina
PACKAGE SEAL:
 Material: Gold/Tin (80/20)
 Temperature: 320°C ± 10°C
 Method: Furnace Braze

INTERNAL LEAD WIRE:
 Material: Aluminum
 Diameter: 1.25 Mil
 Bonding Method: Ultrasonic
COMPLIANT OUTLINE: 38510 C-2

NOTE: All Dimensions are $\frac{\text{Min}}{\text{Max}}$, Dimensions are in inches.

† Mil-M-38510 Compliant Materials, Finishes, and Dimensions.

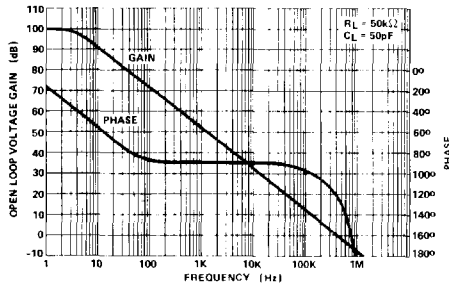
DESIGN INFORMATION

Quad, Ultra-Low Power Operational Amplifier

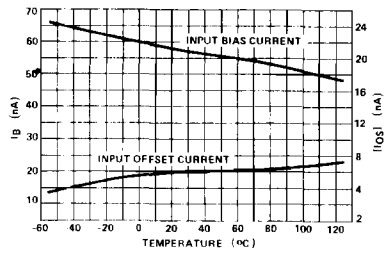
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Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

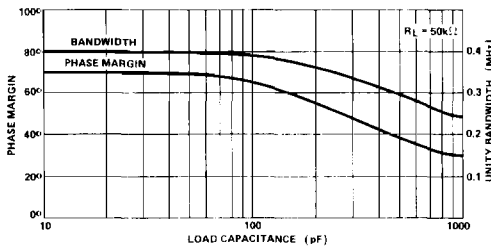
OPEN LOOP FREQUENCY RESPONSE



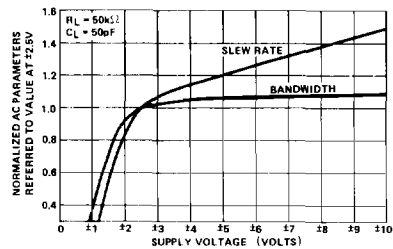
INPUT OFFSET CURRENT AND BIAS CURRENT vs. TEMPERATURE



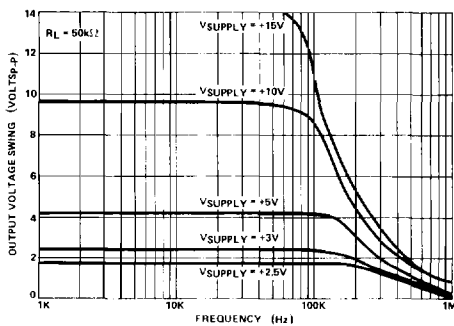
BANDWIDTH AND PHASE MARGIN vs. LOAD CAPACITANCE



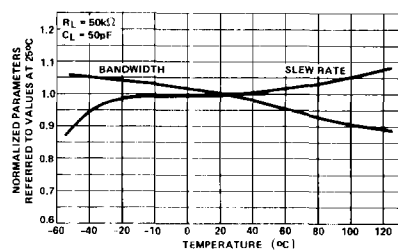
NORMALIZED AC PARAMETERS vs. SUPPLY VOLTAGE



OUTPUT VOLTAGE SWING vs. FREQUENCY AND SINGLE SUPPLY VOLTAGE



NORMALIZED AC PARAMETERS vs. TEMPERATURE



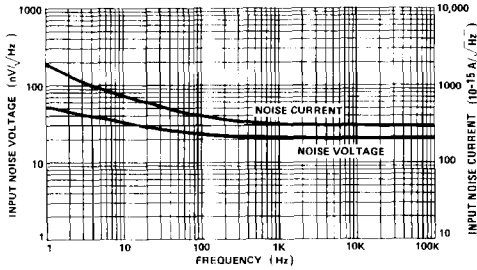
3
 OP AMPS &
 COMPARATORS

DESIGN INFORMATION (Continued)

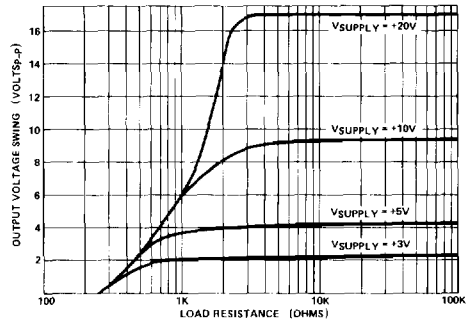
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Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

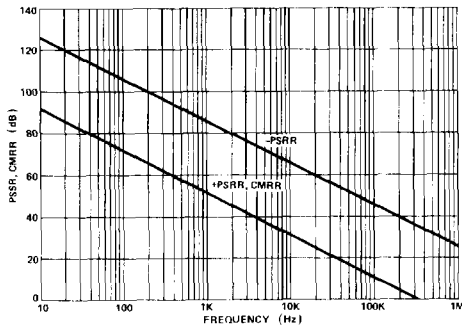
INPUT NOISE vs. FREQUENCY



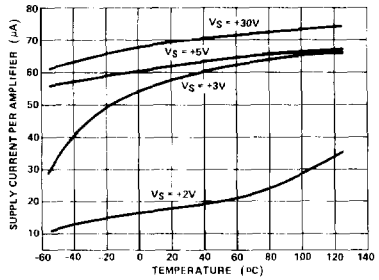
MAXIMUM OUTPUT VOLTAGE SWING vs. LOAD RESISTANCE AND SINGLE SUPPLY VOLTAGE



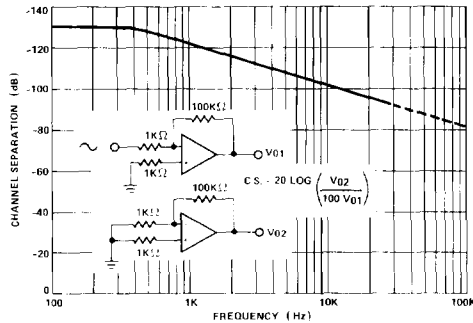
PSRR AND CMRR vs. FREQUENCY



POWER SUPPLY CURRENT vs. TEMPERATURE AND SINGLE SUPPLY VOLTAGE



CHANNEL SEPARATION vs. FREQUENCY



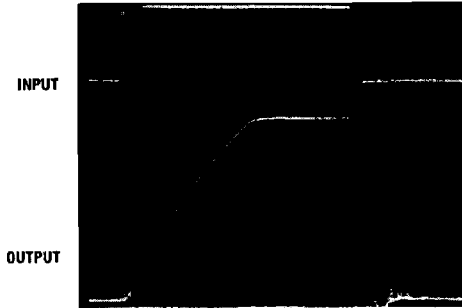
DESIGN INFORMATION (Continued)

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Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

MEASURED LARGE SIGNAL RESPONSE

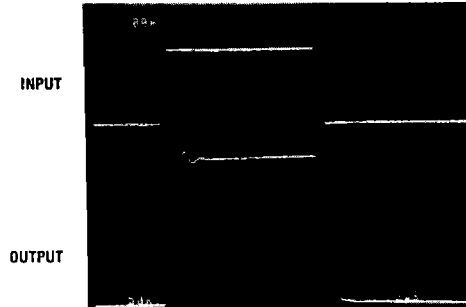
Vertical Scale: (Volts: Input = 5V/Div.; Output = 2V/Div.)
Horizontal Scale: (Time: 2 μs /Div.)



$+V_{\text{SUPPLY}} = +15\text{V}$, $-V_{\text{SUPPLY}} = -15\text{V}$

MEASURED SMALL SIGNAL RESPONSE

Vertical Scale: (Volts: Input = 100mV/Div.; Output = 50mV/Div.)
Horizontal Scale: (Time: 2 μs /Div.)



$+V_{\text{SUPPLY}} = +15\text{V}$, $-V_{\text{SUPPLY}} = -15\text{V}$

MEASURED LARGE SIGNAL RESPONSE

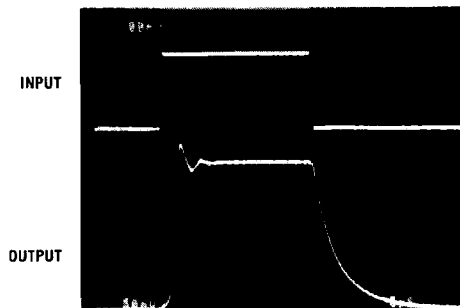
Vertical Scale: (Volts: Input = 2V/Div.; Output = 1V/Div.)
Horizontal Scale: (Time: 5 μs /Div.)



$+V_{\text{SUPPLY}} = +5\text{V}$, $-V_{\text{SUPPLY}} = 0\text{V}$

MEASURED SMALL SIGNAL RESPONSE

Vertical Scale: (Volts: Input = 100mV/Div.; Output = 50mV/Div.)
Horizontal Scale: (Time: 5 μs /Div.)



$+V_{\text{SUPPLY}} = +5\text{V}$, $-V_{\text{SUPPLY}} = 0\text{V}$

DESIGN INFORMATION (Continued)

The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design aid only. These characteristics are not 100% tested and no product guarantee is implied.

TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: Supply Voltage = 0V, 5 to ± 15 V, $R_L = 50k\Omega$, $C_L = 50pF$, Unless Otherwise Specified.

PARAMETERS	CONDITIONS	TEMP	TYPICAL	DESIGN LIMIT	UNITS
Offset Voltage	$V_{CM} = 0V$	Full	0.5	Table 1	mV
Offset Voltage Drift	Versus Temperature	Full	3	6	$\mu V/^\circ C$
Bias Current	$V_{CM} = 0V$	+25 $^\circ C$, +125 $^\circ C$	50	Table 1	nA
		-55 $^\circ C$	75	Table 1	nA
Offset Current	$V_{CM} = 0V$	Full	5	Table 1	nA
Differential Input Resistance		+25 $^\circ C$	0.6	0.4	M Ω
Input Noise Voltage	$f_o = 10Hz$	+25 $^\circ C$	40	80	nV/\sqrt{Hz}
	$f_o = 100Hz$	+25 $^\circ C$	30	60	nV/\sqrt{Hz}
	$f_o = 1kHz$	+25 $^\circ C$	20	40	nV/\sqrt{Hz}
Input Noise Current	$f_o = 10Hz$	+25 $^\circ C$	0.7	1	pA/\sqrt{Hz}
	$f_o = 100Hz$	+25 $^\circ C$	0.25	0.8	pA/\sqrt{Hz}
	$f_o = 1kHz$	+25 $^\circ C$	0.2	0.5	pA/\sqrt{Hz}
Large Signal Voltage Gain	$R_L = 50k\Omega$	+25 $^\circ C$, +125 $^\circ C$	75K	Table 1	V/V
		-55 $^\circ C$	30K	Table 1	V/V
CMRR		Full	105	Table 1	dB
PSRR		Full	100	Table 1	dB
Unity Gain Bandwidth	$f @ -3dB$	+25 $^\circ C$	400	300	kHz
+ Slew Rate	$V_S = 0V, 5V$	-55 $^\circ C$	1	0.6	V/ μs
	$V_S = 0V, 5V$ to $\pm 15V$	+25 $^\circ C$, +125 $^\circ C$	1.5	0.8	V/ μs
- Slew Rate	$V_S = 0V, 5V$ to $\pm 15V$	Full	15	0.8	V/ μs
+ I _{OUT}		+25 $^\circ C$, +125 $^\circ C$	2	0.4	mA
		-55 $^\circ C$	0.8	0.4	mA
- I _{OUT}		-55 $^\circ C$, +25 $^\circ C$	-7.5	-6	mA
		+125 $^\circ C$	-4.5	-3.5	mA
Rise Time	$V_S = \pm 15V, V_O = 200mV$	Full	0.8	1.5	μs
Fall Time	$V_S = \pm 15V, V_O = -200mV$	Full	0.9	1.5	μs
Overshoot	$V_S = \pm 15V, V_O = \pm 200mV$	Full	5	10	%
Supply Current (All Four Amplifiers)	$V_S = 0V, 5V$	+25 $^\circ C$	250	Table 1	μA
	$V_S = \pm 15V$	+25 $^\circ C$	300	Table 1	μA