HARRIS

HA-5154/883

Quad, Low Power Operational Amplifier

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 (All 4 Amplifiers) .... 1mA (Max)**
- **Wide Supply Voltage Range .... Single 3V to 30V or Dual ±1.5 to ±15V**
- **High Slew Rate .... +S.R. 4V/µs (Min) 6V/µs (Typ)**
- **Low V_{OS} Drift (Over Full Temp) .... 3µV/°C (Typ)**
- **Low Noise (1kHz) .... 15nV/$\sqrt{Hz}$ (Typ)**
- **100% Tested at ±15V and +5V Power Supplies**
- **Dielectric Isolation**

Applications

- **Portable Instruments**
- **Meter Amplifiers**
- **Telephone Headsets**
- **Microphone Amplifiers**
- **Remote Sensor/Transmitter**
- **Battery Powered Equipment**
- **For Further Design Ideas See App. Note 544**

Description

The HA-5154/883 quad operational amplifier completes the family of dielectrically isolated bipolar amplifiers designed to provide excellent AC performance while drawing less than 250µA of supply current per amplifier at +25°C. This series consists of single (5151), dual (5152) or quad (5154), unity gain stable amplifiers which are especially well suited for portable and lightweight equipment where available power is limited.

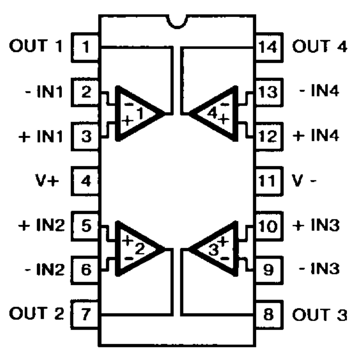
The HA-5154/883 combines superior low power AC performance with DC precision not usually found in general purpose amplifiers. The DC performance is centered around low input offset voltage (3mV), low offset voltage drift (3µV/°C), and low input bias current (250nA). This is combined with a very low input noise voltage of 15nV/$\sqrt{Hz}$ at 1kHz.

The AC performance of the HA-5154/883 surpasses that of typical low power amplifiers with 4V/µs slew rate and a full power bandwidth of 64kHz. This makes the HA-5154/883 an excellent choice for virtually all audio processing applications as well as remote sensor/transmitter designs requiring both low power and high speed. The suitability of the HA-5154/883 for remote and low power operation is further enhanced by the wide range of supply voltages (±1.5V to ±15V) as well as single supply operation (3V to 30V).

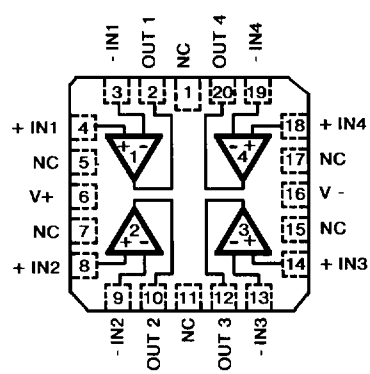
The HA-5154/883 is available in 14 pin Ceramic DIP or 20 pad Ceramic LCC, and is interchangeable with most other operational amplifiers in their class.

Pinouts

HA1-5154/883 (CERAMIC DIP)
TOP VIEW



HA4-5154/883 (CERAMIC LCC)
TOP VIEW



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OP AMPs & COMPARATORS

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 $T_J \leq$ +175°C
Ceramic DIP Package 1.33mW
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
Operating Supply Voltage .... ±1.5V to ±15V or 3V to 30V
$V_{INcm} \leq$ 1/2 (V+ - V-)
$R_L \geq$ 10kΩ

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 MIN	LIMITS MAX	UNITS
Input Offset Voltage	V_{IO1}	V_{CM} = 0V	1	+25°C	-3	3	mV
			2, 3	+125°C, -55°C	-4	4	mV
	V_{IO2}	V_{CM} = 0V V_{OUT} = 1.4V	1	+25°C	-3	3	mV
			2, 3	+125°C, -55°C	-4	4	mV
Input Bias Current	$+I_{B1}$	V_{CM} = 0V $+R_S$ = 10kΩ $-R_S$ = 100Ω	1	+25°C	-250	250	nA
			2, 3	+125°C, -55°C	-400	400	nA
	$-I_{B1}$	V_{CM} = 0V $+R_S$ = 100Ω $-R_S$ = 10kΩ	1	+25°C	-250	250	nA
			2, 3	+125°C, -55°C	-400	400	nA
	$+I_{B2}$	V_{CM} = 0V, V_{OUT} = 1.4V $+R_S$ = 10kΩ $-R_S$ = 100Ω	1	+25°C	-250	250	nA
			2, 3	+125°C, -55°C	-400	400	nA
	$-I_{B2}$	V_{CM} = 0V, V_{OUT} = 1.4V $+R_S$ = 100Ω $-R_S$ = 10kΩ	1	+25°C	-250	250	nA
			2, 3	+125°C, -55°C	-400	400	nA
Input Offset Current	I_{IO1}	V_{CM} = 0V $+R_S$ = 10kΩ $-R_S$ = 10kΩ	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-80	80	nA
	I_{IO2}	V_{CM} = 0V, V_{OUT} = 1.4V $+R_S$ = 10kΩ $-R_S$ = 10kΩ	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-80	80	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.

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

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

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS MIN	MAX	UNITS
Large Signal Voltae Gain	$+A_{VOL1}$	V_{OUT} = 0V and 10V, R_L = 10kΩ	4	+25°C	50	-	kV/V
			5, 6	+125°C, -55°C	25	-	kV/V
	$-A_{VOL1}$	V_{OUT} = 0V and -10V, R_L = 10kΩ	4	+25°C	50	-	kV/V
			5, 6	+125°C, -55°C	25	-	kV/V
	$+A_{VOL2}$	V_{OUT} = 1.4V and 2.5V, R_L = 10kΩ	4	+25°C	50	-	kV/V
			5, 6	+125°C, -55°C	25	-	kV/V
Common Mode Rejection Ratio	$+CMRR_1$	ΔV_{CM} = 10V, +V = 5V, -V = -25V, V_{OUT} = -10V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
	$-CMRR_1$	ΔV_{CM} = 10V, +V = 25V, -V = -5V, V_{OUT} = 10V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
	$+CMRR_2$	ΔV_{CM} = 0V to 3V, +V = 2V, -V = -3V, V_{OUT} = -3V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
Output Voltage Swing	$+V_{OUT1}$	R_L = 10kΩ	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	$-V_{OUT1}$	R_L = 10kΩ	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
	$+V_{OUT2}$	R_L = 10kΩ, Terminated at 2.5V	1	+25°C	3.2	-	V
			2, 3	+125°C, -55°C	2.9	-	V
	$-V_{OUT2}$	R_L = 10kΩ, 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)	$+I_{CC1}$	V_{OUT} = 0V, I_{OUT} = 0mA	1	+25°C	-	1	mA
			2, 3	+125°C, -55°C	-	1.1	mA
	$-I_{CC1}$	V_{OUT} = 0V, I_{OUT} = 0mA	1	+25°C	-1	-	mA
			2, 3	+125°C, -55°C	-1.1	-	mA
	$+I_{CC2}$	V_{OUT} = 1.4V, I_{OUT} = 0mA	1	+25°C	-	1	mA
			2, 3	+125°C, -55°C	-	1.1	mA
Power Supply Rejection Ratio	$+PSRR_1$	ΔV_{SUP} = 10V, +V = 10V, -V = -15V, +V = 20V, -V = -15V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
	$-PSRR_1$	ΔV_{SUP} = 10V, +V = 15V, -V = -10V, +V = 15V, -V = -20V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
	$+PSRR_2$	ΔV_{SUP} = 10V, +V = 5V, -V = 0V, +V = 15V, -V = 0V	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
Channel Separation	±CS	R_L = 10kΩ	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} = 50Ω, R_{LOAD} = 10kΩ, C_{LOAD} = 100pF, 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.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	$+SR_1$	V_{OUT} = -3V to 3V V_{IN} S.R. ≤ 25V/μs	4	+25°C	4	-	V/μs
	$-SR_1$	V_{OUT} = 3V to -3V V_{IN} S.R. ≤ 25V/μs	4	+25°C	4	-	V/μs
	$+SR_2$	V_{OUT} = 0V to 3V V_{IN} S.R. ≤ 25V/μs	4	+25°C	2	-	V/μs
	$-SR_2$	V_{OUT} = 3V to 0V V_{IN} S.R. ≤ 25V/μs	4	+25°C	2	-	V/μs

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: R_{SOURCE} = 50Ω, R_{LOAD} = 10kΩ, C_{LOAD} = 100pF, A_V = 1V/V, Unless Otherwise Specified.
Subscript 1 Refers to Supply Voltages (±V_S) = ±15V; Subscript 2 Refers to +V_S = 5.0V, -V_S = 0.0V.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Gain Bandwidth Product	GBWP	V_O = 200mV, f_o = 10kHz	1	+25°C	0.7	-	MHz
Full Power Bandwidth	$FPBW_1$	V_{PEAK} = 10V	1, 2	+25°C	64	-	kHz
	$FPBW_2$	V_{PEAK} = 1.1V V_{Ref} = 2.5V	1, 2	+25°C	290	-	kHz
Minimum Closed Loop Stable Gain	CLSG	R_L = 10kΩ, C_L = 100pF	1	-55°C to +125°C	1	-	V/V
Quiecent Power Consumption	PC_1	V_{OUT} = 0V, I_{OUT} = 0mA	1, 3	-55°C to +125°C	-	33	mW
	PC_2	V_{OUT} = 1.4V, I_{OUT} = 0mA	1, 3	-55°C to +125°C	-	5.5	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 = Slew Rate/($2\pi V_{PEAK}$).

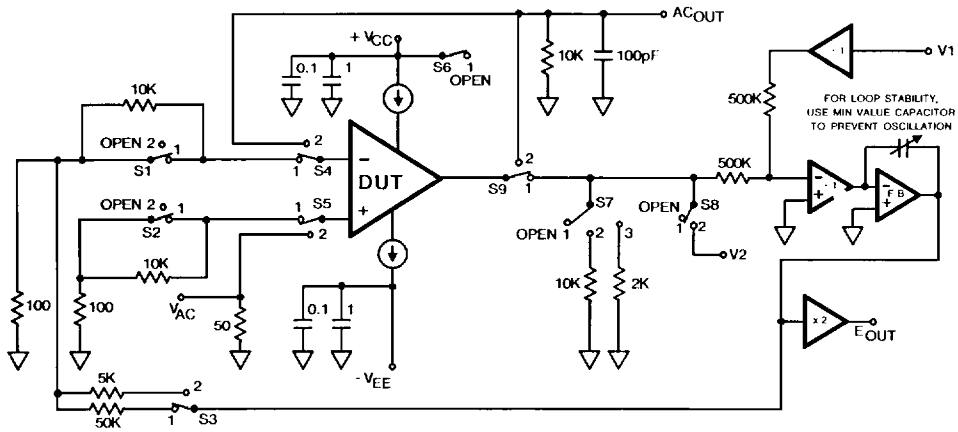
3. Quiescent Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.)

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)



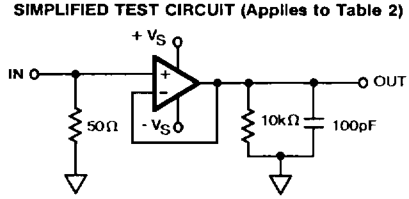
ONE OF FOUR TEST LOOPS FOR THE HA - 5154/883

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

For Detailed Information, Refer to HA-5154/883 Test Tech Brief

Test Waveforms

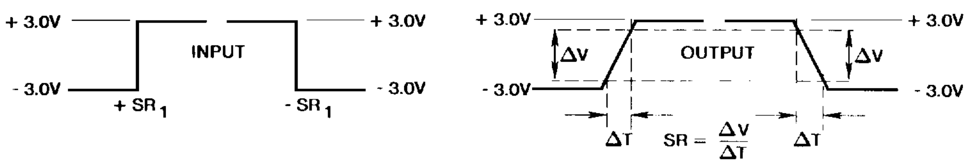
SIMPLIFIED TEST CIRCUIT (Applies to Table 2)



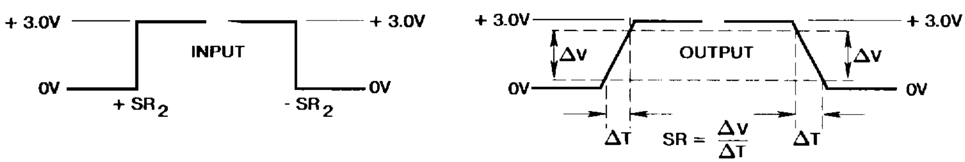
NOTE: $\pm V_{SUPPLY}$ ($\pm V_S$) Tested with ±15V and 0V, +5V. V_{IN} Slew Rate Maintained with Less Than 10V/μs Input for Voltage Follower Configuration.

SLEW RATE WAVEFORMS, A_V = 1V/V

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

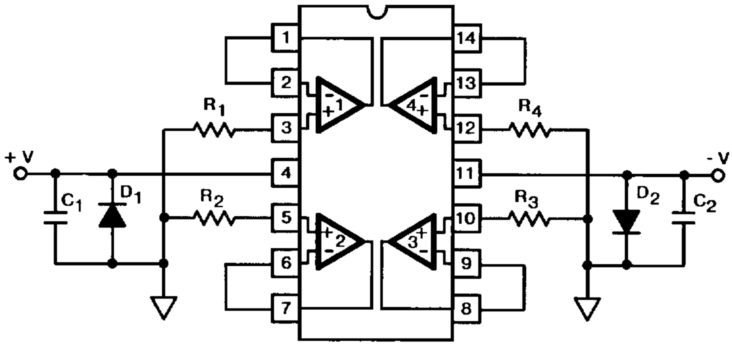


$+V_{SUPPLY} = 5V,\ -V_{SUPPLY} = 0V$

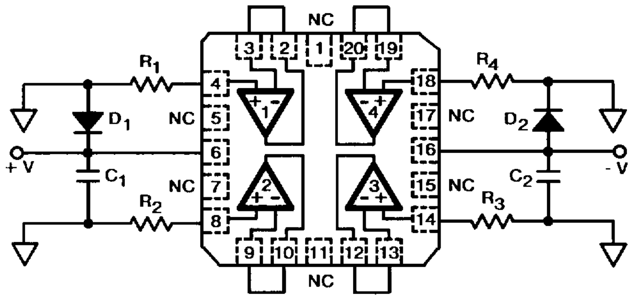


Burn-In Circuits

HA1-5154/883 CERAMIC DIP



HA4-5154/883 CERAMIC LCC



NOTES:

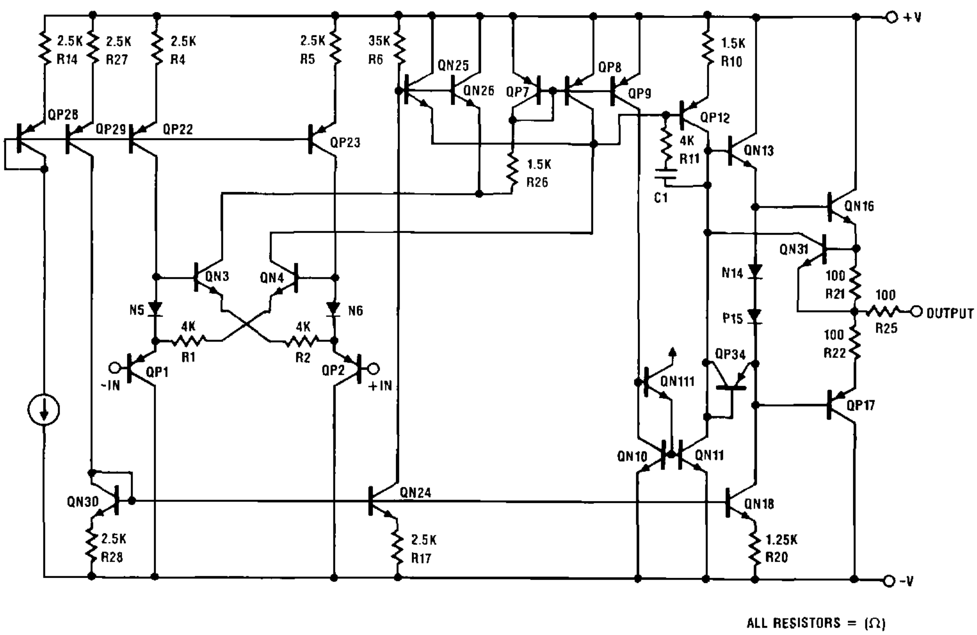
$R_1 = R_2 = R_3 = R_4 = 1M\Omega$, ±5%, 1/4W (Min)

$C_1 = C_2 = 0.01\mu F$/Socket (Min) or $0.1\mu F$/Row, (Min)

$D_1 = D_2$ = IN4002 or Equivalent/Board

$|(V+) - (V-)| = 30V$

Schematic Diagram (1/4 Of HA-5154/883)



Die Characteristics

DIE DIMENSIONS:
95.7 x 101.6 x 19 mils
(2430 x 2580 x 483 μm)

METALLIZATION:
Type: Aluminum
Thickness: 16kÅ ± 2kÅ

WORST CASE CURRENT DENSITY:
0.45 x 10^5A/cm^2 @ 2.5mA

SUBSTRATE POTENTIAL (Powered Up): V-

GLASSIVATION:
Type: Nitride
Thickness: 7kÅ ± 0.7kÅ

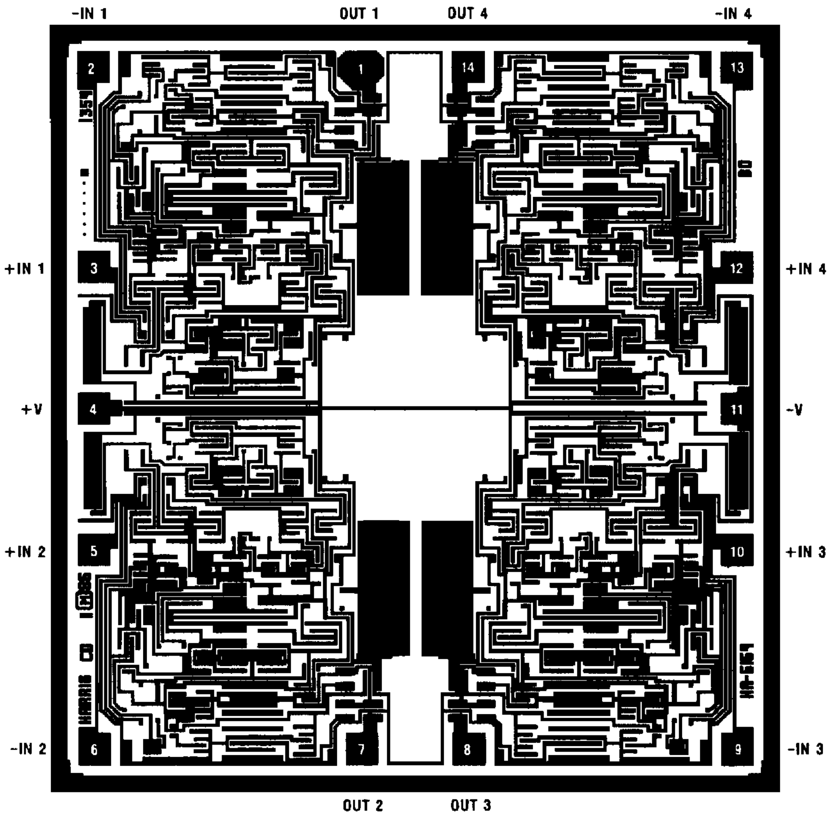
TRANSISTOR COUNT: 144

PROCESS: HFSB 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

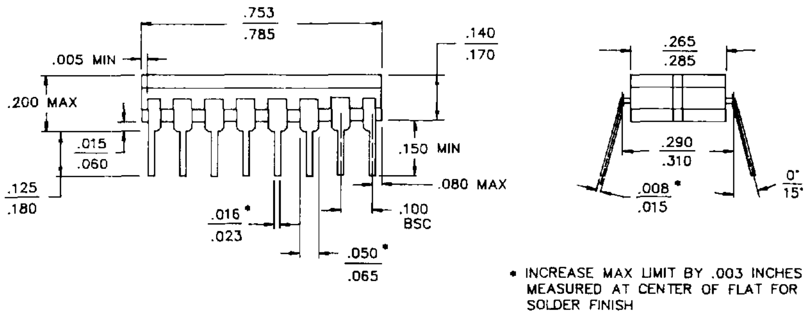
HA-5154/883



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

Packaging†

14 PIN CERAMIC DIP



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

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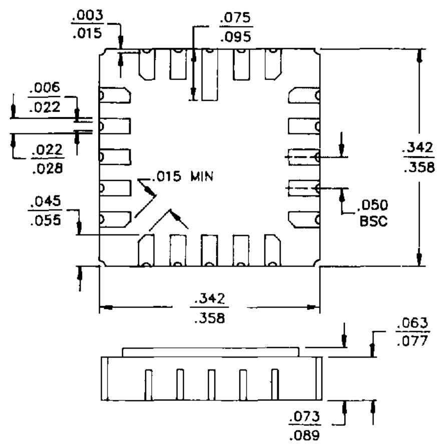
20 PAD CERAMIC LCC



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 Min/Max, Dimensions are in inches.

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

HA-5154

DESIGN INFORMATION

Quad, Low Power Operational Amplifier

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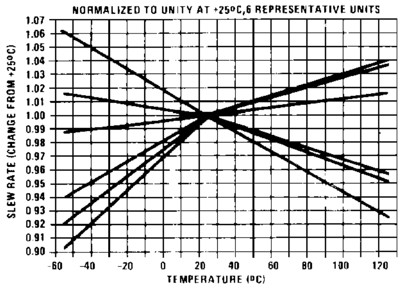
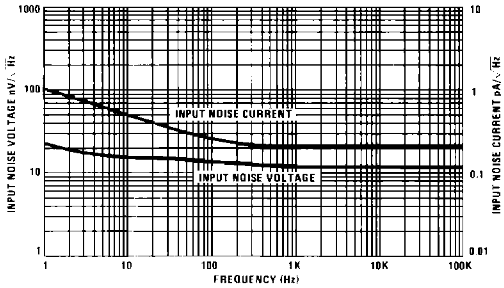
Typical Performance Curves Unless Otherwise Specified: $T_A = +25^oC$, $V_{SUPPLY} = \pm15V$

SLEW RATE vs. TEMPERATURE

Normalized to Unity at +25°C, 6 Representative Units

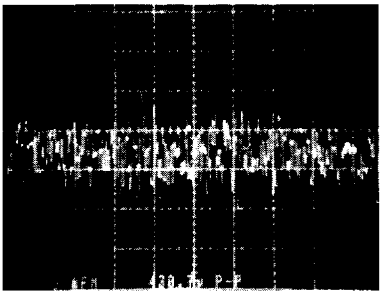


NOISE SPECTRAL DENSITY



PEAK-TO-PEAK NOISE 0.1Hz TO 10Hz

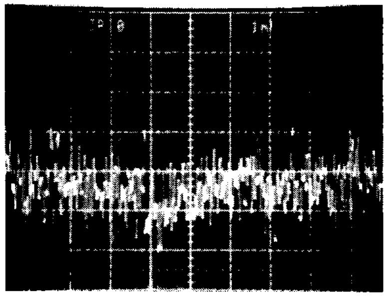
$T_A = +25^oC$, $A_V = 1000V/V$



Vertical Scale: (Volts: 100µs/Div.)
Horizontal Scale: (Time: 1sec/Div.)
$430nV_{p-p}$ RTI

PEAK-TO-PEAK 0.1Hz TO 1MHz

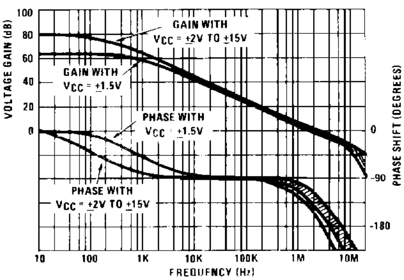
$T_A = +25^oC$, $A_V = 1000V/V$



Vertical Scale: (Volts: 1mV/Div.)
Horizontal Scale: (Time: 1sec/Div.)
$3.70\mu V_{p-p}$ RTI

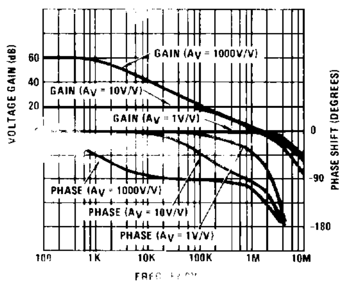
FREQUENCY RESPONSE vs. SUPPLY VOLTAGE

$T_A = +25^oC$, $R_L = 10K$, $C_L = 100pF$



FREQUENCY RESPONSE AT VARIOUS GAINS

$T_A = +25^oC$, $V_{CC} = \pm15V$, $R_L = 10K$, $C_L = 100pF$



DESIGN INFORMATION (Continued)

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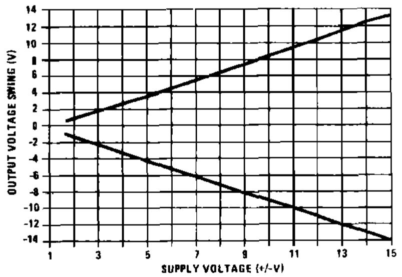
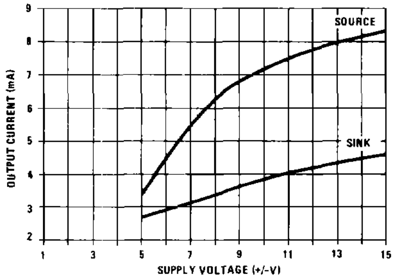
Typical Performance Curves Unless Otherwise Specified: $T_A = +25^oC$, $V_{SUPPLY} = \pm15V$

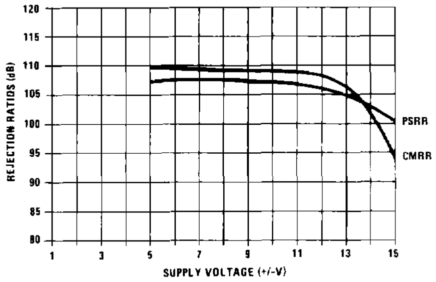
OUTPUT VOLTAGE SWING vs. SUPPLY VOLTAGE
(+25°C)



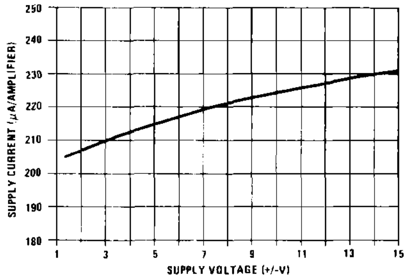
OUTPUT CURRENT vs. SUPPLY VOLTAGE
(+25°C)



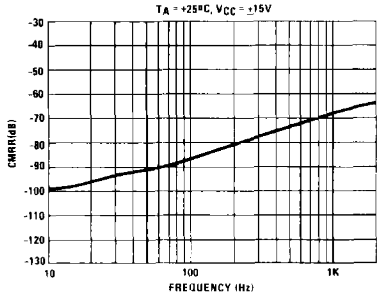
CMRR AND PSRR vs. SUPPLY VOLTAGE
(+25°C)



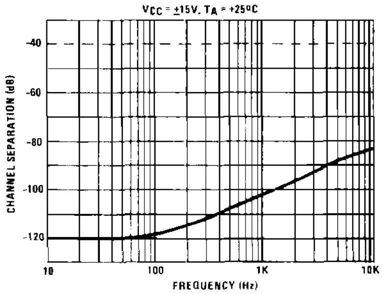
SUPPLY CURRENT vs. SUPPLY VOLTAGE
Per Amplifier (+25°C)



CHANNEL SEPARATION vs. FREQUENCY
$V_{CC} = \pm15V$, $T_A = +25^oC$



CMRR vs. FREQUENCY
$T_A = +25^oC$, $V_{CC} = \pm15V$



DESIGN INFORMATION (Continued)

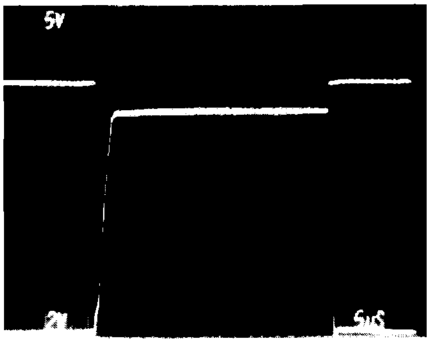
The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design aid only. These characteristics are not 100% tested and no product guarantee is implied.

Typical Performance Curves Unless Otherwise Specified: $T_A = +25^oC$, $V_{SUPPLY} = \pm15V$

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

INPUT

OUTPUT

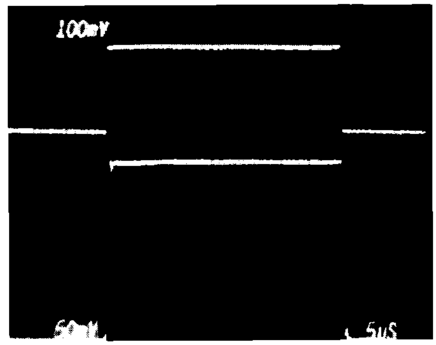


$+V_{SUPPLY} = +15V$, $-V_{SUPPLY} = -15V$

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

INPUT

OUTPUT

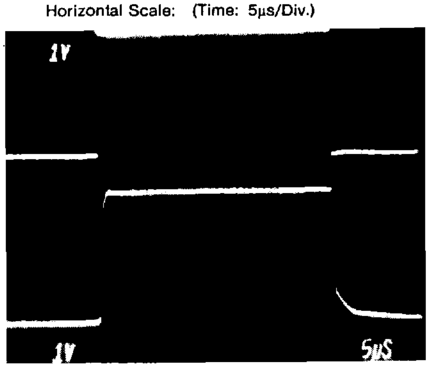


$+V_{SUPPLY} = +15V$, $-V_{SUPPLY} = -15V$

MEASURED LARGE SIGNAL RESPONSE
Vertical Scale: (Volts: Input = 1V/Div.; Output = 1V/Div.)
Horizontal Scale: (Time: 5μs/Div.)

INPUT

OUTPUT

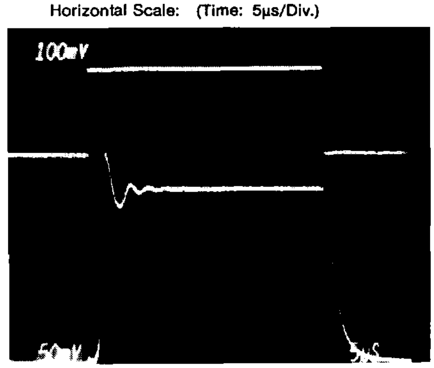


$+V_{SUPPLY} = +5V$, $-V_{SUPPLY} = 0V$

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

INPUT

OUTPUT



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

DESIGN INFORMATION (Continued)

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Typical Applications Unless Otherwise Specified: $T_A = +25^oC$, $V_{SUPPLY} = \pm15V$

Independent Amplifier

The HA-5154 quad op amp consist of completely separate amplifier circuits. Unlike most quads, this device does not share a common bias network. Thus, one amplifier passing large, or noisy signals will have minimal effect on another channel carrying small, sensitive signals.

Loading

Although the standard load is 10kΩ, the HA-5154 is capable of driving resistive loads down to 2kΩ and capacitive loads beyond 300pF.

Input Stage

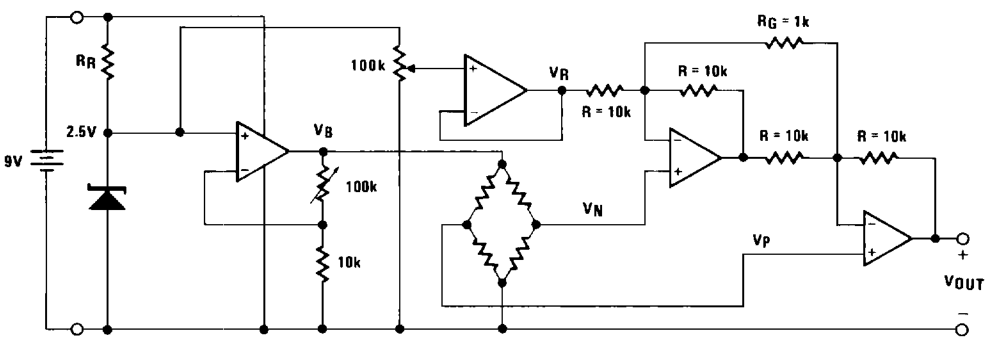
This amplifier uses a current amplifying input stage (see Application Note 544) and is not recommended for use in applications which involve large differential input voltages such as open-loop comparators. Most op amp applications use feedback and keep the input terminals at approximately the same voltage. The HA-5154 will perform well in these circuits as long as the input terminals see less than 7 volts differential.

Typical Applications

The low power consumption of the HA-5154 makes it ideal for applications like battery-powered instrumentation where the bridge amplifier circuit below would be used.

Choose a low-current zener voltage reference such as LM285Z-2.5 and select R_R accordingly. This circuit was evaluated using the resistor values shown and a laboratory voltage source for the 2.5V reference. With unmatched, off-the-shelf, 1% resistors, a gain accuracy of 1% to 2% can be expected. Temperature testing indicated a voltage offset tempco of less then 100μV/oC referred to output.

$$V_{OUT} = (V_P - V_N)\left[2\left(1 + \frac{R}{R_G}\right)\right] + V_R$$



DESIGN INFORMATION (Continued)

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TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: Supply Voltage = 0V, 5 to ±15V, R_L = 10kΩ, C_L = 100pF, 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	μV/°C
Bias Current	V_{CM} = 0V	+25°C, +125°C	130	Table 1	nA
		-55°C	150	Table 1	nA
Offset Current	V_{CM} = 0V	Full	5	Table 1	nA
Differential Input Resistance		+25°C	1.5	1	MΩ
Input Noise Voltage	f_O = 10Hz	+25°C	18	25	nV/√Hz
	f_O = 100Hz	+25°C	15	20	nV/√Hz
	f_O = 1kHz	+25°C	14.8	18	nV/√Hz
Input Noise Current	f_O = 10Hz	+25°C	0.5	0.7	pA/√Hz
	f_O = 100Hz	+25°C	0.3	0.6	pA/√Hz
	f_O = 1kHz	+25°C	0.25	0.4	pA/√Hz
Large Signal Voltage Gain	R_L = 10kΩ	+25°C, +125°C	150K	Table 1	V/V
		-55°C	100K	Table 1	V/V
CMRR		Full	105	Table 1	dB
PSRR		Full	105	Table 1	dB
Unity Gain Bandwidth	f @ -3dB	+25°C	1.3	0.7	MHz
+ Slew Rate	V_S = 0V, 5V	-55°C	4	2	V/μs
	V_S = 0V, 5V to ±15V	+25°C, +125°C	6.5	4	V/μs
- Slew Rate	V_S = 0V, 5V	Full	12	2	V/μs
	V_S = ±15V	Full	25	4	V/μs
$+I_{OUT}$		+25°C, +125°C	3	1.5	mA
		-55°C	0.8	0.4	mA
$-I_{OUT}$		-55°C, +25°C	-7.5	-6	mA
		+125°C	-4.5	-3.5	mA
Rise Time	V_S = ±15V, V_O = 200mV	Full	250	500	ns
Fall Time	V_S = ±15V, V_O = -200mV	-55°C, +25°C	110	300	ns
		+125°C	200	400	ns
Overshoot	V_S = ±15V, V_O = ±200mV	Full	2	10	%
Supply Current (All Four Amplifiers)	V_S = 0V, 5V	+25°C	700	Table 1	μA
	V_S = ±15V	+25°C	880	Table 1	μA