

July 2001

## Precision Quad Operational Amplifier

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Low Offset Voltage (+25°C) . . . . . 200µV (Max)  
(Full Temp.) . . . . . 350µV (Max)
- Low Offset Voltage Drift at Temp. . . . . 2µV/°C (Max)
- Offset Voltage Match . . . . . 350µV (Max)
- High Channel Separation . . . . . 120dB (Min)
- Low Noise ( $f \geq 100\text{Hz}$ ) . . . . . 10nV/√Hz (Max)
- Wide Bandwidth . . . . . 4MHz (Typ)
- High CMRR/PSRR . . . . . 100dB (Min)
- High Voltage Gain . . . . . 800kV/V (Min)
- Dielectric Isolation

### Applications

- Instrumentation Amplifiers
- State-Variable Filters
- Precision Integrators
- Threshold Detectors
- Precision Data Acquisition Systems
- Low-Level Transducer Amplifiers

### Description

The HA-5134/883 is a precision quad operational amplifier that is pin compatible with the OP-400, LT1014, OP11, RM4156, and LM148 as well as the HA-4741/883. Each amplifier features guaranteed maximum values for offset voltage of 350µV, offset voltage drift of 2µV/°C (max), and offset current of 75nA over the full military temperature range while CMRR/PSRR is guaranteed greater than 94dB and open loop gain is guaranteed above 500kV/V from -55°C to +125°C. Room temperature specifications exceed these values such as an offset voltage matching specification between channels of 200µV (max) at +25°C.

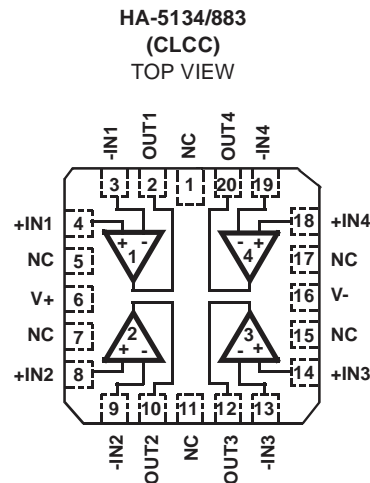
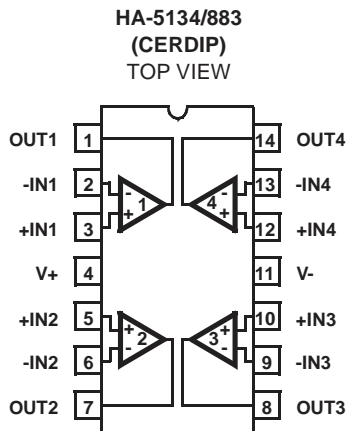
Precision performance of the HA-5134/883 is enhanced by a noise voltage density of 7nV/√Hz at 1kHz (typ), noise current density of 2pA/√Hz at 1kHz and channel separation of 120dB (min). Each of the four unity gain stable amps on the quad are electrically isolated, having only supply lines in common and are fabricated using Dielectric Isolation to insure quality performance in the most demanding applications.

The HA-5134/883 is ideal for compact circuits such as instrumentation amplifiers, state-variable filters, and low level transducer amplifiers. Other applications include precision data acquisition systems, precision integrators, and accurate threshold detectors in designs where board space is a limitation.

### Part Number Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-5134/883	-55°C to +125°C	14 Lead CerDIP
HA4-5134/883	-55°C to +125°C	20 Lead Ceramic LCC

### Pinouts



# Specifications HA-5134/883

## Absolute Maximum Ratings

Voltage Between V+ and V- Terminals . . . . .	40V
Differential Input Voltage . . . . .	6V
Voltage at Either Input Terminal . . . . .	V+ to V-
Input Current . . . . .	±25mA
Output Current . . . . .	Full Short Circuit Protection
Output Current Duration . . . . .	Indefinite
(One Amplifier Shorted to Ground)	
Junction Temperature . . . . .	+175°C
Storage Temperature Range . . . . .	-65°C to +150°C
ESD Rating . . . . .	<2000V
Lead Temperature (Soldering 10s) . . . . .	+300°C

## Thermal Information

Thermal Resistance	$\theta_{JA}$	$\theta_{JC}$
CerDIP Package . . . . .	75°C/W	20°C/W
Ceramic LCC Package . . . . .	65°C/W	15°C/W
Package Power Dissipation Limit at +75°C for $T_J \leq +175^\circ\text{C}$		
CerDIP Package . . . . .		1.33W
Ceramic LCC Package . . . . .		1.54W
Package Power Dissipation Derating Factor Above +75°C		
CerDIP Package . . . . .		13.3mW/°C
Ceramic LCC Package . . . . .		15.4mW/°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 . . . . .	±15V	$R_L \geq 2k\Omega$

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{SOURCE} = 50\Omega$ ,  $R_{LOAD} = 100k\Omega$ ,  $V_{OUT} = 0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	$V_{IO}$	$V_{CM} = 0V$	1	+25°C	-200	200	$\mu V$
			2, 3	+125°C, -55°C	-350	350	$\mu V$
Offset Voltage Match	$\Delta V_{IO}$	$ V_{IO}(\text{Max}) - V_{IO}(\text{Min}) $	1	+25°C	-	200	$\mu V$
			2, 3	+125°C, -55°C	-	350	$\mu V$
Input Bias Current	+ $I_B$	$V_{CM} = 0V$ , $+R_S = 10k\Omega$ , $-R_S = 50\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-75	75	nA
	- $I_B$	$V_{CM} = 0V$ , $+R_S = 50\Omega$ , $-R_S = 10k\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-75	75	nA
Input Offset Current	$I_{IO}$	$V_{CM} = 0V$ , $+R_S = 10k\Omega$ , $-R_S = 10k\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-75	75	nA
Common Mode Range	+CMR	$V+ = +5V$ , $V- = -25V$	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-CMR	$V+ = +25V$ , $V- = -5V$	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
Large Signal Voltage Gain	+ $A_{VOL}$	$V_{OUT} = 0V$ and +10V, $R_L = 2k\Omega$	4	+25°C	800	-	kV/V
			5, 6	+125°C, -55°C	500	-	kV/V
	- $A_{VOL}$	$V_{OUT} = 0V$ and -10V, $R_L = 2k\Omega$	4	+25°C	800	-	kV/V
			5, 6	+125°C, -55°C	500	-	kV/V
Common Mode Rejection Ratio	+CMRR	$\Delta V_{CM} = 10V$ , $V+ = +5V$ , $V- = -25V$ , $V_{OUT} = -10V$	1	+25°C	100	-	dB
			2, 3	+125°C, -55°C	94	-	dB
	-CMRR	$\Delta V_{CM} = 10V$ , $V+ = +25V$ , $V- = -5V$ , $V_{OUT} = +10V$	1	+25°C	100	-	dB
			2, 3	+125°C, -55°C	94	-	dB
Output Voltage Swing	+ $V_{OUT1}$	$R_L = 2k\Omega$	4	+25°C	12	-	V
			5, 6	+125°C, -55°C	12	-	V
	- $V_{OUT1}$	$R_L = 2k\Omega$	4	+25°C	-	-12	V
			5, 6	+125°C, -55°C	-	-12	V

# Specifications HA-5134/883

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Tested at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{SOURCE} = 50\Omega$ ,  $R_{LOAD} = 100k\Omega$ ,  $V_{OUT} = 0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Current	+I <sub>OUT</sub>	V <sub>OUT</sub> = -10V	4	+25°C	15	-	mA
			5, 6	+125°C, -55°C	8	-	mA
	-I <sub>OUT</sub>	V <sub>OUT</sub> = +10V	4	+25°C	-	-15	mA
			5, 6	+125°C, -55°C	-	-8	mA
Quiescent Power Supply Current	+I <sub>CC</sub>	V <sub>OUT</sub> = 0V, I <sub>OUT</sub> = 0mA	1	+25°C	-	6.8	mA
			2, 3	+125°C, -55°C	-	8	mA
	-I <sub>CC</sub>	V <sub>OUT</sub> = 0V, I <sub>OUT</sub> = 0mA	1	+25°C	-	6.8	mA
			2, 3	+125°C, -55°C	-	8	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUP} = 10V$ , V <sub>+</sub> = +20V, V <sub>-</sub> = -15V V <sub>+</sub> = +10V, V <sub>-</sub> = -15V	1	+25°C	100	-	dB
			2, 3	+125°C, -55°C	94	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$ , V <sub>+</sub> = +15V, V <sub>-</sub> = -20V V <sub>+</sub> = +15V, V <sub>-</sub> = -10V	1	+25°C	100	-	dB
			2, 3	+125°C, -55°C	94	-	dB

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{SOURCE} = 50\Omega$ ,  $R_{LOAD} = 2k\Omega$ ,  $C_{LOAD} = 50pF$ ,  $A_{VCL} = +1V/V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	+SR	V <sub>OUT</sub> = -3V to +3V	7	+25°C	0.75	-	V/μs
	-SR	V <sub>OUT</sub> = +3V to -3V	7	+25°C	0.75	-	V/μs
Rise and Fall Time	t <sub>R</sub>	V <sub>OUT</sub> = 0 to +200mV 10% ≤ T <sub>R</sub> ≤ 90%	7	+25°C	-	400	ns
	t <sub>F</sub>	V <sub>OUT</sub> = 0 to -200mV 10% ≤ T <sub>F</sub> ≤ 90%	7	+25°C	-	400	ns
Overshoot	+OS	V <sub>OUT</sub> = 0 to +200mV	7	+25°C	-	40	%
	-OS	V <sub>OUT</sub> = 0 to -200mV	7	+25°C	-	40	%

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Characterized at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{LOAD} = 2k\Omega$ ,  $C_{LOAD} = 50pF$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Average Offset Voltage Drift	V <sub>IO TC</sub>	V <sub>CM</sub> = 0V	1	-55°C to +125°C	-	2	μV/°C
Differential Input Resistance	R <sub>IN</sub>	V <sub>CM</sub> = 0V	1	+25°C	20	-	MΩ
Low Frequency Peak-to-Peak Noise	E <sub>NP-P</sub>	0.1Hz to 10Hz	1	+25°C	-	0.25	μV <sub>P-P</sub>
Input Noise Voltage Density	E <sub>N</sub>	R <sub>S</sub> = 20Ω, f <sub>O</sub> = 1kHz	1	+25°C	-	10	nV/√Hz
Input Noise Current Density	I <sub>N</sub>	R <sub>S</sub> = 2MΩ, f <sub>O</sub> = 1kHz	1	+25°C	-	2	pA/√Hz

# Specifications HA-5134/883

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Characterized at:  $V_{SUPPLY} = \pm 15V$ ,  $R_{LOAD} = 2k\Omega$ ,  $C_{LOAD} = 50pF$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Gain Bandwidth Product	GBWP	$V_O = 200mV$ , $f_O \geq 100kHz$	1	+25°C	3	-	MHz
Unity Bandwidth Product	UBWP	$V_O = 200mV$	1	+25°C	3	-	MHz
Slew Rate	+SR	$V_{OUT} = -3V$ to +3V	1	+25°C to +125°C	0.75	-	V/ $\mu$ s
	-SR	$V_{OUT} = +3V$ to -3V	1	-55°C	0.6	-	V/ $\mu$ s
Full Power Bandwidth	FPBW	$V_{PEAK} = 10V$	1, 2	+25°C	12	-	kHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 2k\Omega$ , $C_L = 50pF$	1	-55°C to +125°C	+1	-	V/V
Rise and Fall Time	$t_R$	$V_{OUT} = 0V$ to +200mV	1, 4	-55°C to +125°C	-	400	ns
	$t_F$	$V_{OUT} = 0V$ to -200mV	1, 4	-55°C to +125°C	-	400	ns
Overshoot	+OS	$V_{OUT} = 0V$ to +200mV	1	-55°C to +125°C	-	40	%
	-OS	$V_{OUT} = 0V$ to -200mV	1	-55°C to +125°C	-	40	%
Output Resistance	$R_{OUT}$	Open Loop	1	+25°C	-	86	$\Omega$
Power Consumption	PC	$V_{OUT} = 0V$ , $I_{OUT} = 0mA$	1, 3	-55°C to +125°C	-	240	mW
Channel Separation (AC)	CS (AC)	$V_{IN} = 1V_{P-P}$ , $f_O = 100Hz$	1	+25°C	120	-	dB
		$V_{IN} = 1V_{P-P}$ , $f_O = 10kHz$	1	+25°C	120	-	dB
Channel Separation (DC)	CS (DC)	$V_O = \pm 10V$ (20V <sub>P-P</sub> ), $\Delta V_{IO} \leq 20\mu V$	1	+25°C	120	-	dB

**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 variation.
- Full Power Bandwidth guarantee based on Slew Rate measurement using  $FPBW = \text{Slew Rate} / (2\pi V_{PEAK})$ .
- Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.).
- Measured between 10% and 90% points.

**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLES 1 AND 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1 (Note 1), 2, 3, 4, 5, 6, 7
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7
Groups C and D Endpoints	1

**NOTE:**

- PDA applies to Subgroup 1 only.

## Die Characteristics

### DIE DIMENSIONS:

91 x 114 x 19 mils  $\pm$  1 mils  
 2300 x 2900 x 483 $\mu$ m  $\pm$  25.4 $\mu$ m

### METALLIZATION:

Type: Al, 1% Cu  
 Thickness: 16k $\text{\AA}$   $\pm$  2k $\text{\AA}$

### GLASSIVATION:

Type: Nitride (Si<sub>3</sub>N<sub>4</sub>) over Si<sub>3</sub>lox (SiO<sub>2</sub>, 5% Phos.)  
 Si<sub>3</sub>lox Thickness: 12k $\text{\AA}$   $\pm$  2k $\text{\AA}$   
 Nitride Thickness: 3.5k $\text{\AA}$   $\pm$  1.5k $\text{\AA}$

### WORST CASE CURRENT DENSITY:

2.5 x 10<sup>5</sup>A/cm<sup>2</sup>  
 This device meets Glassivation Integrity Test Requirement  
 per MIL-STD-883 Method 2021 and MIL-I-38535 Paragraph 30.5.5.4.

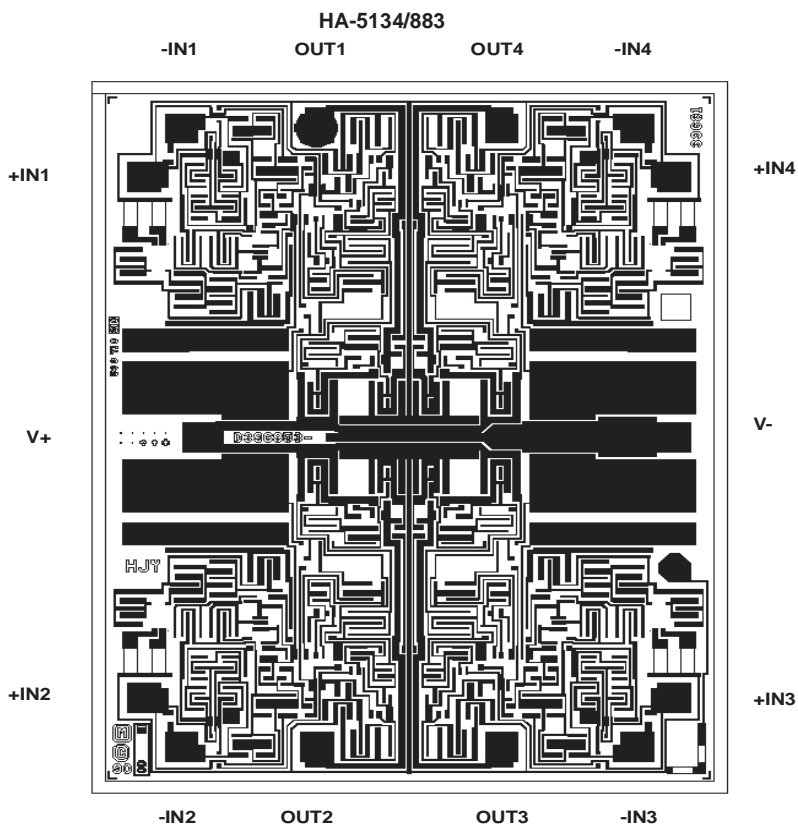
### SUBSTRATE POTENTIAL (Powered Up):

Unbiased

### TRANSISTOR COUNT: 160

### PROCESS: Bipolar Dielectric Isolation

## Metallization Mask Layout



All Intersil products are manufactured, assembled and tested utilizing ISO9000 quality systems.

Intersil Corporation's quality certifications can be viewed at website [www.intersil.com/design/quality/iso.asp](http://www.intersil.com/design/quality/iso.asp).

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