HA-5104/883

Low Noise, High Performance, Quad Operational Amplifier

FN3710
Rev 1.00
April 2002

Features

- **This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.**
- **Low Input Noise Voltage Density at 1kHz . . 6nV/√Hz (Max) 4.3nV/√Hz (Typ)**
- **Slew Rate. . . . . 1V/μs (Min) 3V/μs (Typ)**
- **Unity Gain Bandwidth . . . . 8MHz (Typ)**
- **High Open Loop Gain (Full Temp). . . . . . 100kV/V (Min) 250kV/V (Typ)**
- **High CMRR, PSRR (Full Temp) . . . . 86dB (Min) 100dB (Typ)**
- **Low Offset Voltage Drift . . . . 3μV/°C (Typ)**
- **No Crossover Distortion**
- **Standard Quad Pinout**

Applications

- **High Q Active Filters**
- **Audio Amplifiers**
- **Integrators**
- **Signal Generators**
- **Instrumentation Amplifiers**

Description

Low noise and high performance are key words describing the unity gain stable HA-5104/883. This general purpose quad amplifier offers an array of dynamic specifications including 1V/μs slew rate (min), and 8MHz bandwidth (typ). Complementing these outstanding parameters are very low noise specifications of 4.3nV/√Hz at 1kHz (typ) or 6nV/√Hz (max).

Fabricated using the Intersil standard high frequency D.I. process, these operational amplifiers also offer excellent input specifications such as 2.5mV (max) offset voltage and 75nA (max) offset current. Complementing these specifications are 100dB (min) open loop gain and 55dB channel separation (min). Economically, the HA-5104/883 also consumes a very moderate amount of power (225mW per package) while also saving board space and cost.

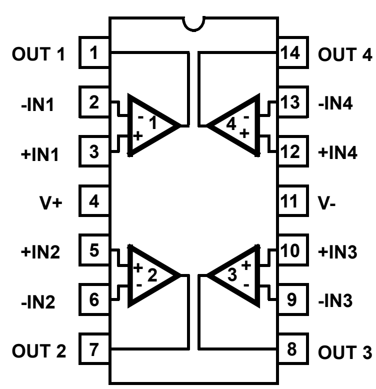
This impressive combination of features make this amplifier ideally suited for designs ranging from audio amplifiers and active filters to the most demanding signal conditioning and instrumentation circuits.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-5104/883	-55°C to +125°C	14 Lead CerDIP

Pinout

HA-5104/883
(CERDIP)
TOP VIEW



Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 40V
Differential Input Voltage 7V
Voltage at Either Input Terminal . . . . V+ to V-
Peak Output Current . . . . 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 10s) . . . . +300°C

Thermal Information

Thermal Resistance	θ_{JA}	θ_{JC}
CerDIP Package	75°C/W	20°C/W

Package Power Dissipation Limit at +75°C for $T_J \leq$ +175°C
CerDIP Package 1.33W
Package Power Dissipation Derating Factor Above +75°C
CerDIP Package . . . . 13.3mW/°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.

NOTE:

1. θ_{JA} is measured with the component mounted on a low effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

Operating Conditions

Operating Temperature Range. . . . . -55°C to +125°C
Operating Supply Voltage . . . . ±5V to ±15V
$V_{INCM} \leq$ 1/2 (V+ - V-)
$R_L \geq$ 2kΩ

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: V_{SUPPLY} = ±15V, R_{SOURCE} = 100Ω, R_{LOAD} = 500kΩ, 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	-2.5	2.5	mV
			2, 3	+125°C, -55°C	-3.0	3.0	mV
Input Bias Current	$+I_B$	V_{CM} = 0V, $+R_S$ = 10kΩ, $-R_S$ = 100Ω	1	+25°C	-200	200	nA
			2, 3	+125°C, -55°C	-325	325	nA
	$-I_B$	V_{CM} = 0V, $+R_S$ = 100Ω, $-R_S$ = 10kΩ	1	+25°C	-200	200	nA
			2, 3	+125°C, -55°C	-325	325	nA
Input Offset Current	I_{IO}	V_{CM} = 0V, $+R_S$ = 10kΩ, $-R_S$ = 10kΩ	1	+25°C	-75	75	nA
			2, 3	+125°C, -55°C	-125	125	nA
Common Mode Range	+CMR	V+ = +3V, V- = -27V	1	+25°C	+12	-	V
			2, 3	+125°C, -55°C	+12	-	V
	-CMR	V+ = +27V, V- = -3V	1	+25°C	-	-12	V
			2, 3	+125°C, -55°C	-	-12	V
Large Signal Voltage Gain	$+A_{VOL}$	V_{OUT} = 0V and +10V, R_L = 2kΩ	4	+25°C	100	-	kV/V
			5, 6	+125°C, -55°C	100	-	kV/V
	$-A_{VOL}$	V_{OUT} = 0V and -10V, R_L = 2kΩ	4	+25°C	100	-	kV/V
			5, 6	+125°C, -55°C	100	-	kV/V
Common Mode Rejection Ratio	+CMRR	ΔV_{CM} = +5V, V+ = +10V, V- = -20V, V_{OUT} = -5V	1	+25°C	86	-	dB
			2, 3	+125°C, -55°C	86	-	dB
	-CMRR	ΔV_{CM} = -5V, V+ = +20V, V- = -10V, V_{OUT} = +5V	1	+25°C	86	-	dB
			2, 3	+125°C, -55°C	86	-	dB

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $V_{SUPPLY} = \pm15V$, $R_{SOURCE} = 100\Omega$, $R_{LOAD} = 500k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Output Voltage Swing	$+V_{OUT1}$	$R_L = 2k\Omega$	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	$-V_{OUT1}$	$R_L = 2k\Omega$	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
	$+V_{OUT2}$	$R_L = 10k\Omega$	1	+25°C	12	-	V
			2, 3	+125°C, -55°C	12	-	V
	$-V_{OUT2}$	$R_L = 10k\Omega$	1	+25°C	-	-12	V
			2, 3	+125°C, -55°C	-	-12	V
Output Current	$+I_{OUT}$	$V_{OUT} = -5V$	1	+25°C	10	-	mA
			2, 3	+125°C, -55°C	10	-	mA
	$-I_{OUT}$	$V_{OUT} = +5V$	1	+25°C	-	-10	mA
			2, 3	+125°C, -55°C	-	-10	mA
Quiescent Power Supply Current	$+I_{CC}$	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	1	+25°C	-	6.5	mA
			2, 3	+125°C, -55°C	-	7.5	mA
	$-I_{CC}$	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	1	+25°C	-6.5	-	mA
			2, 3	+125°C, -55°C	-7.5	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUP} = 10V$, V+ = +10V, V- = -15V V+ = +20V, V- = -15V	1	+25°C	86	-	dB
			2, 3	+125°C, -55°C	86	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$, V+ = +15V, V- = -10V V+ = +15V, V- = -20V	1	+25°C	86	-	dB
			2, 3	+125°C, -55°C	86	-	dB

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 2k\Omega$, $C_{LOAD} = 50pF$, $A_{VCL} = +1V/V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Slew Rate	+SR	$V_{OUT} = -3V$ to $+3V$	4	+25°C	1	-	V/µs
	-SR	$V_{OUT} = +3V$ to $-3V$	4	+25°C	1	-	V/µs
Rise and Fall Time	T_R	$V_{OUT} = 0$ to $+200mV$ $10\% \le T_R \le 90\%$	4	+25°C	-	200	ns
	T_F	$V_{OUT} = 0$ to $-200mV$ $10\% \le T_F \le 90\%$	4	+25°C	-	200	ns
Overshoot	+OS	$V_{OUT} = 0$ to $+200mV$	4	+25°C	-	35	%
	-OS	$V_{OUT} = 0$ to $-200mV$	4	+25°C	-	35	%

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: V_{SUPPLY} = ±15V, R_{LOAD} = 2kΩ, C_{LOAD} = 50pF, A_{VCL} = 1V/V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Differential Input Resistance	R_{IN}	V_{CM} = 0V	1	+25°C	250	-	kΩ
Input Noise Voltage Density	E_N	R_S = 20Ω, f_O = 1000Hz	1	+25°C	-	6	nV/√Hz
Input Noise Current Density	I_N	R_S = 2MΩ, f_O = 1000Hz	1	+25°C	-	3	pA/√Hz
Full Power Bandwidth	FPBW	V_{PEAK} = 10V	1, 2	+25°C	32	-	kHz
Minimum Closed Loop Stable Gain	CLSG	R_L = 2kΩ, C_L = 50pF	1	-55°C to +125°C	+1	-	V/V
Output Resistance	R_{OUT}	Open Loop	1	+25°C	-	270	Ω
Quiescent Power Consumption	PC	V_{OUT} = 0V, I_{OUT} = 0mA	1, 3	-55°C to +125°C	-	225	mW
Channel Separation	CS	R_S = 1kΩ, A_{VCL} = 100V/V, V_{IN} = 100mV_{PEAK} at 10kHz Referred to Input	1	+25°C	55	-	dB

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 AND 2)
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 and D Endpoints	1

NOTE:

1. PDA applies to Subgroup 1 only.

Die Characteristics

DIE DIMENSIONS:
95 x 99 x 19 mils ± 1 mils
2420 x 2530 x 483µm ± 25.4µm

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

GLASSIVATION:
Type: Nitride (Si3N4) over Silox (SIO2, 5% Phos.)
Silox Thickness: 12kÅ ± 2kÅ
Nitride Thickness: 3.5kÅ ± 1.5kÅ

WORST CASE CURRENT DENSITY:
1.43×10^5 A/cm^2

SUBSTRATE POTENTIAL (Powered Up):
Unbiased

TRANSISTOR COUNT: 175

PROCESS: Bipolar Dielectric Isolation

Metallization Mask Layout

HA5104/883