

Precision, High Slew Rate, Wideband 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.
- High Slew Rate 120V/ μ s (Typ)
- Low Offset Voltage 300 μ V (Typ)
900 μ V (Max)
- High Open Loop Gain 130dB (Typ)
114dB (Min)
- Gain Bandwidth Product 150MHz (Typ)
- Low Voltage Noise at 1kHz 8.3nV/ $\sqrt{\text{Hz}}$ (Typ)
- Minimum Gain Stability ≥ 5 (Typ)

Applications

- High Speed Instrumentation
- Data Acquisition Systems
- Analog Signal Conditioning
- Precision, Wideband Amplifiers
- Pulse/RF Amplifiers

Description

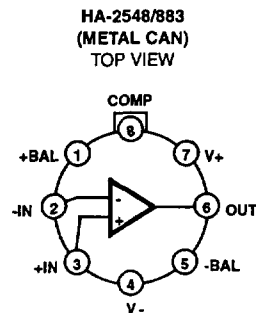
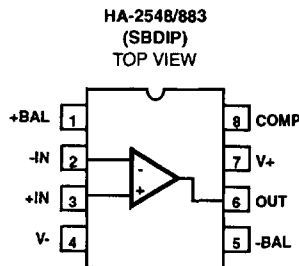
The HA-2548/883 is a monolithic op amp that offers a unique combination of bandwidth, slew rate, and precision specifications. These features can eliminate the need for composite op amp designs and external calibration circuitry.

Optimized for gains ≥ 5 , the HA-2548/883 has a gain bandwidth product of 150MHz (typ) and a slew rate of 120V/ μ s (typ) while maintaining an extremely high open loop gain of 130dB (typ) and a low offset voltage of 300 μ V (typ). These specifications are achieved through uniquely designed input circuitry and a single ultra-high gain stage that minimizes the AC signal path. Capable of delivering over 30mA (min) of output current, the HA-2548/883 is ideal for precision, high speed applications such as signal conditioning, instrumentation, video/pulse amplifiers and buffers.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA2-2548/883	-55°C to +125°C	8 Pin Can
HA7-2548/883	-55°C to +125°C	8 Lead Sidebrazed DIP

Pinouts



Specifications HA-2548/883

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals	40V
Differential Input Voltage	5V
Voltage at Either Input Terminal	V+ to V-
Peak Output Current (< 10% Duty Cycle)	60mA
Continuous Output Current	40mA
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	θ_{JA}	θ_{JC}
Ceramic Sidebrazed DIP Package	97°C/W	20°C/W
Metal Can Package	142°C/W	66°C/W
Package Power Dissipation Limit at +75°C		
Ceramic Sidebrazed DIP Package	1.03W	
Metal Can Package	0.70W	
Package Power Dissipation Derating Factor Above +75°C		
Ceramic Sidebrazed DIP Package	10.3mW/°C	
Metal Can Package	7.0mW/°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	$\pm 15V$	$R_L \geq 1k\Omega$

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 100k\Omega$, $V_{OUT} = 0V$, 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	-900	900	μV
			2, 3	+125°C, -55°C	-1200	1200	μV
Input Bias Current	+ I_B	$V_{CM} = 0V$, $+R_S = 100.1k\Omega$, $-R_S = 100\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-100	100	nA
	- I_B	$V_{CM} = 0V$, $+R_S = 100\Omega$, $-R_S = 100.1k\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-100	100	nA
Input Offset Current	I_{IO}	$V_{CM} = 0V$, $+R_S = 100.1k\Omega$, $-R_S = 100.1k\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-100	100	nA
Common Mode Range	+CMR	$V+ = +8V$, $V- = -22V$	1	+25°C	7	-	V
			2, 3	+125°C, -55°C	7	-	V
	-CMR	$V+ = +22V$, $V- = -8V$	1	+25°C	-	-7	V
			2, 3	+125°C, -55°C	-	-7	V
Large Signal Voltage Gain	+ A_{VOL}	$V_{OUT} = 0V$ and +10V, $R_L = 1k\Omega$	4	+25°C	114	-	dB
			5, 6	+125°C, -55°C	108	-	dB
	- A_{VOL}	$V_{OUT} = 0V$ and -10V, $R_L = 1k\Omega$	4	+25°C	114	-	dB
			5, 6	+125°C, -55°C	108	-	dB
Common Mode Rejection Ratio	+CMRR	$\Delta V_{CM} = +2V$, $V+ = +13V$, $V- = -17V$, $V_{OUT} = -2V$	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB
	-CMRR	$\Delta V_{CM} = -2V$, $V+ = +17V$, $V- = -13V$, $V_{OUT} = +2V$	1	+25°C	80	-	dB
			2, 3	+125°C, -55°C	80	-	dB

Specifications HA-2548/883

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

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

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Voltage Swing	+V _{OUT}	R _L = 1kΩ	4	+25°C	11	-	V
			5, 6	+125°C, -55°C	11	-	V
	-V _{OUT}	R _L = 1kΩ	4	+25°C	-	-11	V
			5, 6	+125°C, -55°C	-	-11	V
Output Current	+I _{OUT}	V _{OUT} = +10V	4	+25°C	30	-	mA
			5, 6	+125°C, -55°C	30	-	mA
	-I _{OUT}	V _{OUT} = -10V	4	+25°C	-	-30	mA
			5, 6	+125°C, -55°C	-	-30	mA
Quiescent Power Supply Current	+I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	+25°C	-	18	mA
			2, 3	+125°C, -55°C	-	18	mA
	-I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	+25°C	-18	-	mA
			2, 3	+125°C, -55°C	-18	-	mA
Power Supply Rejection Ratio	+PSRR	ΔV _{SUP} = 10V, V ₊ = +10V, V ₋ = -15V, V ₊ = +20V, V ₋ = -15V	1	+25°C	86	-	dB
			2, 3	+125°C, -55°C	86	-	dB
	-PSRR	ΔV _{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

Table 2 Intentionally Left Blank. See AC Characteristics in Table 3.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $C_{LOAD} \leq 10pF$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Average Offset Voltage Drift	V _{IO} TC	V _{CM} = 0V	1	-55°C to +125°C	-	7	μV/°C
Offset Voltage Adjust	V _{IO} Adj		1, 5	+25°C	1	-	mV
Input Noise Voltage Density	E _N	R _S = 10Ω, f _O = 1kHz	1	+25°C	-	13.0	nV/√Hz
Input Noise Current Density	I _N	R _S = 500Ω, f _O = 1kHz	1	+25°C	-	1.0	pA/√Hz
Gain Bandwidth Product	GBWP	V _O = 1.0V, f _O = 1MHz	1	+25°C	-	130	MHz
			1	-55°C to +125°C	-	110	MHz

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TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Characterized at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $C_{LOAD} \leq 10pF$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	+SR	$V_{OUT} = -5V$ to $+5V$	1	+25°C	80	-	V/ μ s
			1	-55°C to +125°C	70	-	V/ μ s
	-SR	$V_{OUT} = +5V$ to $-5V$	1	+25°C	80	-	V/ μ s
			1	-55°C to +125°C	70	-	V/ μ s
Full Power Bandwidth	FPBW	$V_{PEAK} = 10V$	1, 2	+25°C	1.11	-	MHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 1k\Omega$, $C_L = 10pF$	1	-55°C to +125°C	5	-	V/V
Rise and Fall Time	T_R	$V_{OUT} = -100mV$ to $+100mV$	1, 4	+25°C	-	15	ns
			1, 4	-55°C to +125°C	-	20	ns
	T_F	$V_{OUT} = +100mV$ to $-100mV$	1, 4	+25°C	-	15	ns
			1, 4	-55°C to +125°C	-	20	ns
Overshoot	+OS	$V_{OUT} = -100mV$ to $+100mV$	1	+25°C	-	30	%
			1	-55°C to +125°C	-	35	%
	-OS	$V_{OUT} = +100mV$ to $-100mV$	1	+25°C	-	30	%
			1	-55°C to +125°C	-	35	%
Settling Time	T_S	To 0.01% for a 10V Step	1	+25°C	-	260	ns
Power Consumption	PC	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	1, 3	-55°C to +125°C	-	540	mW

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 $FPBW = Slew\ Rate / (2\pi V_{PEAK})$.
- Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.)
- Measured between 10% and 90% points.
- Offset adjustment range is $[V_{IO}(Measured) \pm 1mV]$ minimum referred to output. This test is for functionality only to assure adjustment through 0V.

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 and D Endpoints	1

NOTE:

- PDA applies to Subgroup 1 only.

3
OPERATIONAL AMPLIFIERS

Die Characteristics

DIE DIMENSIONS:

85 x 91 x 19 mils \pm 1 mils
 2160 x 2320 x 483 μ m \pm 25.4 μ m

METALLIZATION:

Type: Al, 1% Cu
 Thickness: 16k \AA \pm 2k \AA

GLASSIVATION:

Type: Nitride (Si₃N₄) over Silox (SiO₂, 5% Phos.)
 Silox Thickness: 12k \AA \pm 2k \AA
 Nitride Thickness: 3.5k \AA \pm 1.5k \AA

WORST CASE CURRENT DENSITY:

3.6 x 10⁴ A/cm²

SUBSTRATE POTENTIAL (Powered Up): V- (Note)

TRANSISTOR COUNT: 60

PROCESS: Bipolar, Dielectric Isolation

NOTE: The Substrate may be left floating (Insulating Die Mount) or it may be mounted on a conductor at a V- potential.

Metallization Mask Layout

