

July 1997

Uncompensated, High Slew Rate High Output Current, 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.
- High Slew Rate 135V/ μ s (Min)
150V/ μ s (Typ)
- High Output Current $\pm$ 30mA (Min)
- High Gain-Bandwidth Product 15MHz (Min)
20MHz(Typ)
- Wide Power Bandwidth 2.1MHz (Min)
- High Input Impedance 50M Ω (Min)
130M Ω (Typ)
- Low Offset Current 25nA (Max)
5nA (Typ)
- Fast Settling (10V Step to 0.1%) 200ns (Typ)
- Low Quiescent Supply Current 6mA (Max)

Applications

- Data Acquisition Systems
- RF Amplifiers
- Video Amplifiers
- Signal Generators
- Pulse Amplification

Description

The HA-2529/883 is a monolithic operational amplifier which typifies excellence of design. With a design based on years of experience coupled with the reliable dielectric isolation process, these amplifiers provide an outstanding combination of DC and AC parameters at closed loop gains of 3 or greater without external compensation.

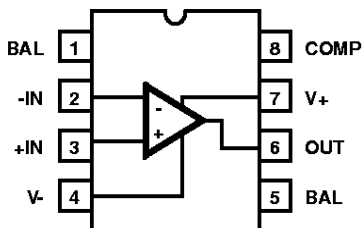
The HA-2529/883 offers 135V/ μ s (min) slew rate and fast settling time (200ns typ), while consuming a mere 6mA (max) quiescent supply current, making these amplifiers ideal components for video circuitry and data acquisition designs. With 15MHz minimum gain-bandwidth product combined with 7.5kV/V minimum open loop gain, the HA-2529/883 is an ideal component for demanding signal conditioning designs. These devices provide $\pm$ 30mA (min) output current drive with an output voltage swing of $\pm$ 10V (min), making them suited for pulse amplifier and RF amplifier components. HA-2529/883 will upgrade a system presently using the HA-2520/22/883 or EHA-2520/22/883 in regards to output current, slew rate, offset voltage drift, and offset current drift. To insure compliance with slew rate and transient response specifications, all devices are 100% tested for AC performance characteristics over full temperature.

Ordering Information

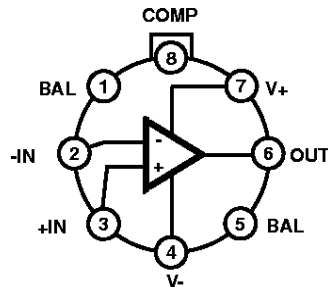
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HA2-2529/883	-55 to 125	8 Pin Metal Can	T8.C
HA7-2529/883	-55 to 125	8 Ld CERDIP	F8.3A

Pinouts

HA-2529/883
(CERDIP)
TOP VIEW



HA-2529/883
(METAL CAN)
TOP VIEW



Absolute Maximum Ratings $T_A = 25^\circ\text{C}$

Voltage Between V_+ and V_- Terminals 40V
 Differential Input Voltage 15V
 Voltage at Either Input Terminal V_+ to V_-
 Peak Output Current 50mA
 ESD Rating <2000V

Operating Conditions

Temperature Range -55°C to 125°C
 Supply Voltage $\pm 15\text{V}$
 $V_{\text{INCM}} \leq 1/2 (V_+ - V_-)$
 $R_L \geq 500\Omega$

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} θ_{JC}
 CERDIP Package 115°C/W 28°C/W
 Metal Can Package 160°C/W 75°C/W
 Package Power Dissipation Limit at 75°C for $T_J \leq 175^\circ\text{C}$
 CERDIP Package 870mW
 Metal Can Package 625mW
 Package Power Dissipation Derating Factor Above 75°C
 CERDIP Package $8.7\text{mW}/^\circ\text{C}$
 Metal Can Package $6.3\text{mW}/^\circ\text{C}$
 Maximum Junction Temperature 175°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°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 an evaluation PC board in free air.

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_{\text{SOURCE}} = 100\Omega$, $R_{\text{LOAD}} = 500\text{k}\Omega$, $V_{\text{OUT}} = 0\text{V}$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP. ($^\circ\text{C}$)	MIN	MAX	UNITS
Input Offset Voltage	V_{IO}	$V_{\text{CM}} = 0\text{V}$	1	25	-5	5	mV
			2, 3	125, -55	-8	8	mV
Input Bias Current	$+I_{\text{B}}$	$V_{\text{CM}} = 0\text{V}$, $+R_{\text{S}} = 100\text{k}\Omega$, $-R_{\text{S}} = 100\Omega$	1	25	-200	200	nA
			2, 3	125, -55	-400	400	nA
	$-I_{\text{B}}$	$V_{\text{CM}} = 0\text{V}$, $+R_{\text{S}} = 100\Omega$, $-R_{\text{S}} = 100\text{k}\Omega$	1	25	-200	200	nA
			2, 3	125, -55	-400	400	nA
Input Offset Current	I_{IO}	$V_{\text{CM}} = 0\text{V}$, $+R_{\text{S}} = 100\text{k}\Omega$, $-R_{\text{S}} = 100\text{k}\Omega$	1	25	-25	25	nA
			2, 3	125, -55	-50	50	nA
Common Mode Range	+CMR	$V_+ = 5\text{V}$, $V_- = -25\text{V}$	1	25	+10	-	V
			2, 3	125, -55	+10	-	V
	-CMR	$V_+ = 25\text{V}$, $V_- = -5\text{V}$	1	25	-	-10	V
			2, 3	125, -55	-	-10	V
Large Signal Voltage Gain	$+A_{\text{VOL}}$	$V_{\text{OUT}} = 0\text{V}$ and $+10\text{V}$, $R_{\text{L}} = 2\text{k}\Omega$	4	25	10	-	kV/V
			5, 6	125, -55	7.5	-	kV/V
	$-A_{\text{VOL}}$	$V_{\text{OUT}} = 0\text{V}$ and -10V , $R_{\text{L}} = 2\text{k}\Omega$	4	25	10	-	kV/V
			5, 6	125, -55	7.5	-	kV/V
Common Mode Rejection Ratio	+CMRR	$\Delta V_{\text{CM}} = +10\text{V}$, $V_+ = +5\text{V}$, $V_- = -25\text{V}$, $V_{\text{OUT}} = -10\text{V}$	1	25	83	-	dB
			2, 3	125, -55	80	-	dB
	-CMRR	$\Delta V_{\text{CM}} = -10\text{V}$, $V_+ = +25\text{V}$, $V_- = -5\text{V}$, $V_{\text{OUT}} = +10\text{V}$	1	25	83	-	dB
			2, 3	125, -55	80	-	dB
Output Voltage Swing	$+V_{\text{OUT}}$	$R_{\text{L}} = 2\text{k}\Omega$	4	25	10	-	V
			5, 6	125, -55	10	-	V
	$-V_{\text{OUT}}$	$R_{\text{L}} = 2\text{k}\Omega$	4	25	-	-10	V
			5, 6	125, -55	-	-10	V

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 100\Omega$, $R_{LOAD} = 500k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP. (°C)	MIN	MAX	UNITS
Output Current	+I _{OUT}	V _{OUT} = -10V	4	25	30	-	mA
			5, 6	125, -55	20	-	mA
	-I _{OUT}	V _{OUT} = +10V	4	25	-	-30	mA
			5, 6	125, -55	-	-20	mA
Quiescent Power Supply Current	+I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	25	-	6	mA
			2, 3	125, -55	-	7	mA
	-I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	25	-6	-	mA
			2, 3	125, -55	-7	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +20V, V ₋ = -15V, V ₊ = +10V, V ₋ = -15V	1	25	80	-	dB
			2, 3	125, -55	80	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +15V, V ₋ = -20V, V ₊ = +15V, V ₋ = -10V	1	25	80	-	dB
			2, 3	125, -55	80	-	dB
Offset Voltage Adjustment	+V _{IOAdj}	Note 2	1	25	V _{IO} -1	-	mV
			2, 3	125, -55	V _{IO} -1	-	mV
	-V _{IOAdj}	Note 2	1	25	V _{IO} +1	-	mV
			2, 3	125, -55	V _{IO} +1	-	mV

NOTE:

2. 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 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICSDevice Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 2k\Omega$, $C_{LOAD} = 50pF$, $A_{VCL} = +3V/V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP. (°C)	MIN	MAX	UNITS
Slew Rate	+SR	V _{OUT} = -5V to +5V 25% $\leq$ +SR $\leq$ 75%	7	25	135	-	V/ μ s
			8A, 8B	125, -55	125	-	V/ μ s
	-SR	V _{OUT} = +5V to -5V 75% $\geq$ -SR $\geq$ 25%	7	25	135	-	V/ μ s
			8A, 8B	125, -55	125	-	V/ μ s
Rise and Fall Time	t _r	V _{OUT} = 0 to +200mV 10% $\leq$ t _r $\leq$ 90%	7	25	-	45	ns
			8A, 8B	125, -55	-	50	ns
	t _f	V _{OUT} = 0 to -200mV 10% $\leq$ t _f $\leq$ 90%	7	25	-	45	ns
			8A, 8B	125, -55	-	50	ns
Overshoot	+OS	V _{OUT} = 0 to +200mV	7	25	-	40	%
			8A, 8B	125, -55	-	40	%
	-OS	V _{OUT} = 0 to -200mV	7	25	-	40	%
			8A, 8B	125, -55	-	40	%

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICSDevice Characterized at: $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_{\text{LOAD}} = 2\text{k}\Omega$, $C_{\text{LOAD}} = 50\text{pF}$, $C_{\text{COMP}} = 0\text{pF}$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMP. ($^{\circ}\text{C}$)	MIN	MAX	UNITS
Differential Input Resistance	R_{IN}	$V_{\text{CM}} = 0\text{V}$	3	25	50	-	$\text{M}\Omega$
Gain Power Bandwidth	GBWP	$V_{\text{O}} = 200\text{mV}$, $f_{\text{O}} \geq 10\text{kHz}$	3	25	15	-	MHz
Full Power Bandwidth	FPBW	$V_{\text{PEAK}} = 10\text{V}$	3, 4	25	2.1	-	MHz
Minimum Closed Loop Stable Gain	CLSG	$R_{\text{L}} = 2\text{k}\Omega$, $C_{\text{L}} = 50\text{pF}$	3	-55 to 125	± 3	-	V/V
Output Resistance	R_{OUT}	Open Loop	3	25	-	60	Ω
Power Consumption	PC	$V_{\text{OUT}} = 0\text{V}$, $I_{\text{OUT}} = 0\text{mA}$	3, 5	-55 to 125	-	210	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 $\text{FPBW} = \text{Slew Rate} / (2\pi V_{\text{PEAK}})$.
- 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 6), 2, 3, 4, 5, 6, 7, 8A, 8B
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7, 8A, 8B
Groups C and D Endpoints	1

NOTE:

- PDA applies to Subgroup 1 only.

Die Characteristics**DIE DIMENSIONS:**

67 mils x 57 mils x 19 mils
 1700 μ m x 1440 μ m x 483 μ m

METALLIZATION:

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

GLASSIVATION:

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

WORST CASE CURRENT DENSITY:

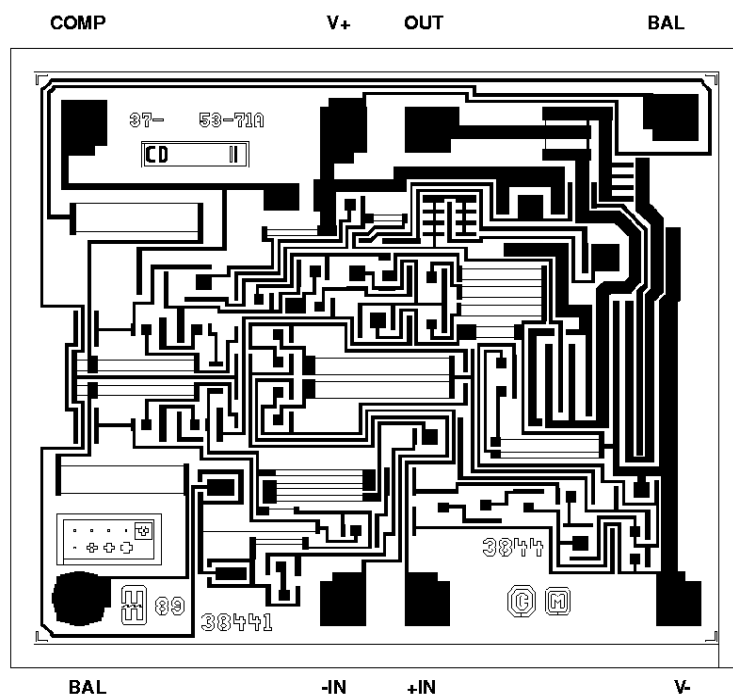
$0.78 \times 10^5 \text{ A/cm}^2$

SUBSTRATE POTENTIAL (Powered Up):

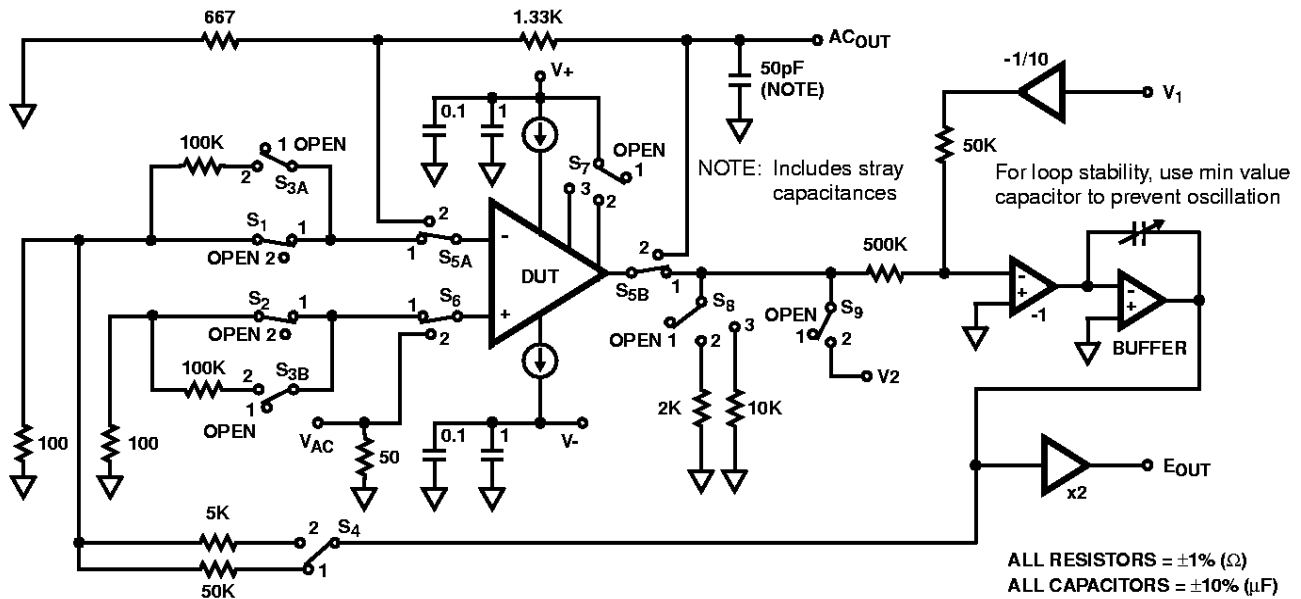
Unbiased

TRANSISTOR COUNT: 40**PROCESS: Bipolar Dielectric Isolation****Metallization Mask Layout**

HA-2529/883



Test Circuit (Applies to Tables 1 and 2)



Test Circuits and Waveforms

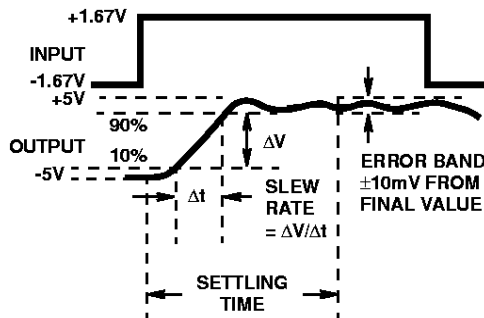
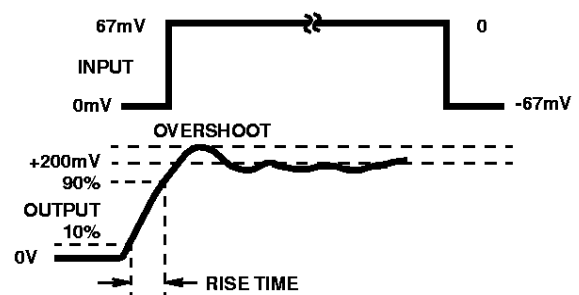


FIGURE 1. SLEW RATE AND SETTLING TIME



NOTE: Measured on both positive and negative transitions from 0V to +200mV and 0V to -200mV at the output.

FIGURE 2. TRANSIENT RESPONSE

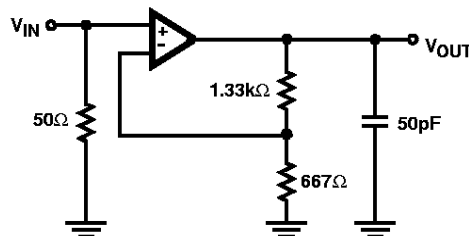
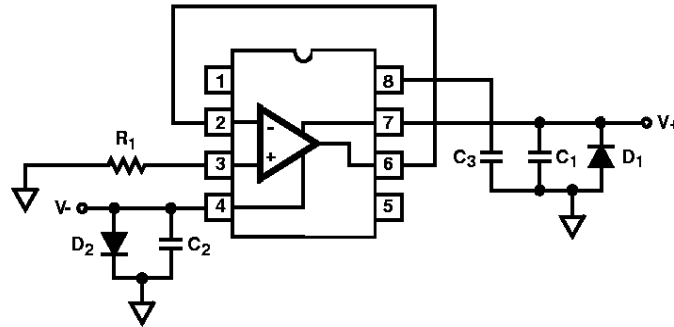


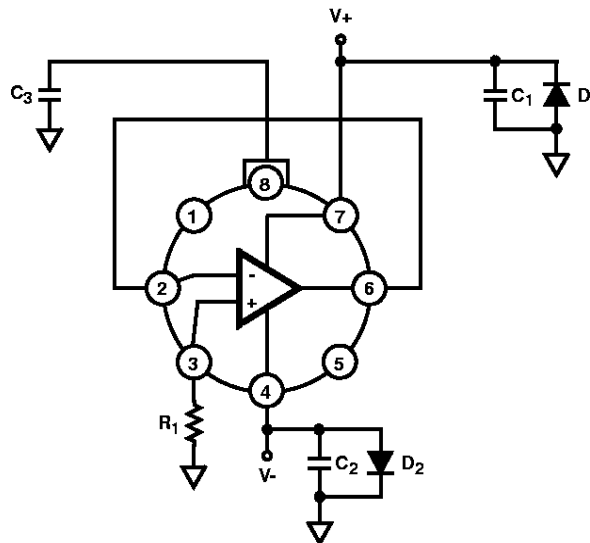
FIGURE 3. SIMPLIFIED TEST CIRCUIT (APPLIES TO TABLE 2)

Burn-In Circuits

HA7-2529/883 CERDIP



HA2-2529/883 METAL CAN



NOTES:

$R_1 = 1M\Omega, \pm 5\%, 1/4W$ (Min)

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

$C_3 = 0.01\mu F/\text{Socket}$ (10%)

$D_1 = D_2 = 1N4002$ or Equivalent/Board

$|V_+ - V_-| = 30V$