

# HA-2541/883

# Wideband, Fast Settling, Unity Gain Stable, 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.
- Low Offset Voltage......2mV (Max)
- Fast Settling Time (0.1%) ............ 90ns (Typ)

- Unity Gain Stability
- Monolithic Bipolar Dielectric Isolation Construction

# **Applications**

- Pulse and Video Amplifiers
- · Wideband Amplifiers
- · High Speed Sample and Hold Circuits
- Fast, Precise D/A Converters
- · High Speed A/D Input Buffer

# Description

The HA-2541/883 is the first unity gain stable monolithic operational amplifier to achieve 40MHz unity gain bandwidth. A major addition to the Intersil series of high speed, wideband op amps, the HA-2541/883 is designed for video and pulse applications requiring stable amplifier response at low closed loop gains.

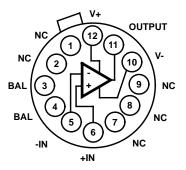
The uniqueness of the HA-2541/883 is that its slew rate and bandwidth characteristics are specified at unity gain. Historically, high slew rate, wide bandwidth and unity gain stability have been incompatible features for a monolithic operational amplifier. But features such as  $250V/\mu s$  slew rate and 40MHz unity gain bandwidth clearly show that this is not the case for the HA-2541/883. These features, along with 90ns settling time to 0.1%, make this product an excellent choice for high speed data acquisition systems.

# Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA2-2541/883	-55°C to +125°C	12 Pin Can

#### **Pinout**

HA-2541/883 (METAL CAN) TOP VIEW



CASE TIED TO V-

File Number 3698

# Specifications HA-2541/883

#### **Absolute Maximum Ratings**

# Voltage Between V+ and V- Terminals 35V Differential Input Voltage 6V Voltage at Either Input Terminal V+ to V Peak Output Current (< 10% Duty Cycle)</td> .50mA Junction Temperature (T<sub>J</sub>) +175°C Storage Temperature Range -65°C to +150°C ESD Rating <2000V</td>

Lead Temperature (Soldering 10s).....+300°C

#### **Thermal Information**

Thermal Resistance	$\theta_{JA}$	$\theta_{JC}$
Metal Can Package	65°C/W	34°C/W
Package Power Dissipation Limit at +75°C fo	or $T_J \le +175^\circ$	°C
Metal Can Package		1.54W
Package Power Dissipation Derating Factor	Above +75°	C
Metal Can 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**

### TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

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

			GROUP A		LIMITS		
PARAMETERS	SYMBOL	CONDITIONS	SUBGROUPS	TEMPERATURE	MIN	MAX	UNITS
Input Offset Voltage	V <sub>IO</sub>	V <sub>CM</sub> = 0V	1	+25°C	-2	2	mV
			2, 3	+125°C, -55°C	-6	6	mV
Input Bias Current	+l <sub>B</sub>	V <sub>CM</sub> = 0V,	1	+25°C	-35	35	μΑ
		$+R_S = 1.1k\Omega$ , $-R_S = 100\Omega$	2, 3	+125°C, -55°C	-50	50	μΑ
	-I <sub>B</sub>	V <sub>CM</sub> = 0V,	1	+25°C	-35	35	μА
		$+R_S = 100\Omega$ , $-R_S = 1.1k\Omega$	2, 3	+125°C, -55°C	-50	50	μА
Input Offset Current	I <sub>IO</sub>	$V_{CM} = 0V$ ,	1	+25°C	-7	7	μА
		$+R_S = 1.1kΩ$ , $-R_S = 1.1kΩ$	2, 3	+125°C, -55°C	-9	9	μΑ
Common Mode Range +CMR -CMR	+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 +A <sub>VOL</sub> Gain -A <sub>VOL</sub>	+A <sub>VOL</sub>	$V_{OUT} = 0V \text{ and } +10V,$ $R_L = 1k\Omega$	4	+25°C	10	-	kV/V
			5, 6	+125°C, -55°C	5	-	kV/V
	$V_{OUT} = 0V$ and -10V, $R_L = 1k\Omega$	4	+25°C	10	-	kV/V	
		5, 6	+125°C, -55°C	5	-	kV/V	
Common Mode		$\Delta V_{CM} = +10V,$ V+ = +5V, V- = -25V, V <sub>OUT</sub> = -10V	1	+25°C	70	-	dB
Rejection Ratio			2, 3	+125°C, -55°C	70	-	dB
-CI	-CMRR	L CIVI	1	+25°C	70	-	dB
		V+ = +25V, V- = -5V, $V_{OUT} = +10V$	2, 3	+125°C, -55°C	70	-	dB
Output Voltage Swing	+V <sub>OUT</sub>	$R_L = 1k\Omega$	1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	-V <sub>OUT</sub>	$R_L = 1k\Omega$	1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V

# Specifications HA-2541/883

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

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

			GROUP A		LIMITS		
PARAMETERS	SYMBOL	CONDITIONS	SUBGROUPS	TEMPERATURE	MIN	MAX	UNITS
Output Current	+I <sub>OUT</sub>	V <sub>OUT</sub> = -10V	1	+25°C	10	-	mA
			1, 3	+125°C, -55°C	10	-	mA
	-I <sub>OUT</sub>	V <sub>OUT</sub> = +10V	1	+25°C	-	-10	mA
			1, 3	+125°C, -55°C	-	-10	mA
Quiescent Power	+I <sub>CC</sub>	$V_{OUT} = 0V, I_{OUT} = 0mA$	1	+25°C	-	39	mA
Supply Current		2, 3	+125°C, -55°C	-	39	mA	
	-I <sub>CC</sub>	$V_{OUT} = 0V, I_{OUT} = 0mA$	1	+25°C	-39	-	mA
			2, 3	+125°C, -55°C	-39	-	mA
Power Supply	+PSRR	$\Delta V_{SUP} = 10V$ ,	1	+25°C	70	-	dB
Rejection Ratio		V+ = +5V, V- = -15V, V+ = +15V, V- = -15V	2, 3	+125°C, -55°C	70	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$	1	+25°C	70	-	dB
	V+ = +15V, V- = -5V, V+ = +15V, V- = -15V	2, 3	+125°C, -55°C	70	-	dB	
Offset Voltage	+V <sub>IO</sub> Adj	Note 1	1	+25°C	V <sub>IO</sub> -1	-	mV
Adjustment	-V <sub>IO</sub> Adj	Note 1	1	+25°C	V <sub>IO</sub> +1	-	mV

#### NOTE:

#### TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Table 2 Intentionally Left Blank. See A.C. Specifications in Table 3

### TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

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

					LIMITS		
PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	MIN	MAX	UNITS
Differential Input Resistance	R <sub>IN</sub>	V <sub>CM</sub> = 0V	1	+25°C	40	-	kΩ
Unity Gain Bandwidth	UGBW	V <sub>O</sub> = 90mV	1	+25°C	40	-	MHz
Slew Rate	+SR	V <sub>OUT</sub> = -3V to +3V	1	+25°C	200	-	V/μs
	-SR	V <sub>OUT</sub> = +3V to -3V	1	+25°C	200	-	V/μs
Full Power Bandwidth	FPBW	V <sub>PEAK</sub> = 10V	1, 2	+25°C	3	-	MHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 1k\Omega$ , $C_L = 10pF$	1	-55°C to +125°C	1	-	V/V
Rise and Fall Time	T <sub>R</sub>	V <sub>OUT</sub> = 0V to +200mV	1, 4	+25°C	-	20	ns
	T <sub>F</sub>	V <sub>OUT</sub> = 0V to -200mV	1, 4	+25°C	-	20	ns

<sup>1.</sup> Offset adjustment range is [V<sub>IO</sub> (Measured) ±1mV] minimum referred to output. This test is for functionality only to assure adjustment through 0V.

# Specifications HA-2541/883

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

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

					LIMITS		
PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	MIN	MAX	UNITS
Overshoot	+OS	V <sub>OUT</sub> = 0V to +200mV	1	+25°C	-	50	%
	-OS	V <sub>OUT</sub> = 0V to -200mV	1	+25°C	-	50	%
Output Resistance	R <sub>OUT</sub>	Open Loop	1	+25°C	-	25	Ω
Quiescent Power Consumption	PC	V <sub>OUT</sub> = 0V, I <sub>OUT</sub> = 0mA	1, 3	-55°C to +125°C	-	1.17	W

#### 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.)
- 4. Measured between 10% and 90% points.

#### **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:

1. PDA applies to Subgroup 1 only.

#### Die Characteristics

#### **DIE DIMENSIONS:**

 $80 \times 90 \times 19 \text{ mils} \pm 1 \text{ mils}$  $2020 \ x \ 2280 \ x \ 483 \mu m \pm 25.4 \mu m$ 

#### **METALLIZATION:**

Type: Al, 1% Cu Thickness: 16kÅ ± 2kÅ

#### **GLASSIVATION:**

Type: Nitride(Si3N4) over Silox (SiO2, 5% Phos.) Silox Thickness: 12kÅ  $\frac{\pm}{2}$  2kÅ  $_{_2}$ 

Nitride Thickness: 3.5kA ± 1.5kA

#### **WORST CASE CURRENT DENSITY:**

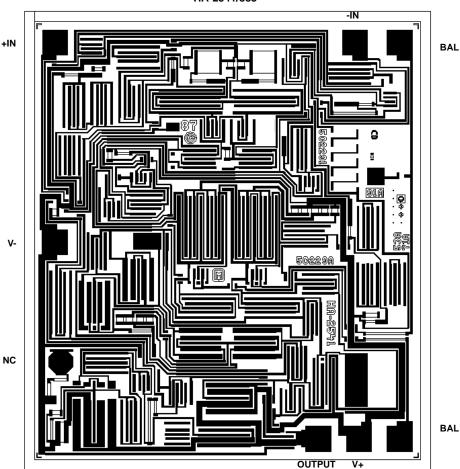
 $5.3 \times 10^4 \text{ A/cm}^2$ 

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

**TRANSISTOR COUNT: 41** 

PROCESS: Bipolar Dielectric Isolation Metallization Mask Layout

#### HA-2541/883



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