

# HA-5004/883

July 1998

## 100MHz Current Feedback Amplifier

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Slew Rate ..... 1000V/ $\mu$ s (Min)  
1200V/ $\mu$ s (Typ)
- Output Current .....  $\pm$ 80mA (Min)  
 $\pm$ 100mA (Typ)
- Drives .....  $\pm$ 8.0V into 100 $\Omega$  (Min)  
 $\pm$ 9.5V into 100 $\Omega$  (Typ)
- V<sub>SUPPLY</sub> .....  $\pm$ 5V to  $\pm$ 18V
- Thermal Overload Protection and Output Flag
- Bandwidth Nearly Independent of Gain
- Output Enable/Disable

### Applications

- Unity Gain Video/Wideband Buffer
- Video Gain Block
- High Speed Peak Detector
- Fiber Optic Transmitters
- Zero Insertion Loss Transmission Line Drivers
- Current to Voltage Converter
- Radar Systems

### Description

The HA-5004/883 current feedback amplifier is a video/wideband amplifier optimized for low gain applications. The design is based on current-mode feedback which allows the amplifier to achieve higher closed loop bandwidth than voltage-mode feedback operational amplifiers. Since feedback is employed, the HA-5004/883 can offer better gain accuracy and lower distortion than open loop buffers. Unlike conventional op amps, the bandwidth and rise time of the HA-5004/883 are nearly independent of closed loop gain. The 100MHz bandwidth at unity gain reduces to only 65MHz at a gain of 10. The HA-5004/883 may be used in place of a conventional op amp with a significant improvement in speed power product.

Several features have been designed in for added value. A thermal overload feature protects the part against excessive junction temperature by shutting down the output. If this feature is not needed, it can be inhibited via a TTL input (TOI). A TTL chip enable/disable ( $\overline{OE}$ ) input is also provided; when the chip is disabled its output is high impedance. Finally, an open collector output flag ( $\overline{TOL}$ ) is provided to indicate the status of the chip. The status flag goes low to indicate when the chip is disabled due to either the internal Thermal Overload shutdown or the external disable.

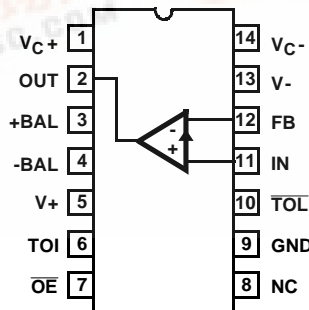
In order to maximize bandwidth and output drive capacity, internal current limiting is not provided. However, current limiting may be applied via the V<sub>C+</sub> and V<sub>C-</sub> pins which provide power separately to the output stage.

### Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
HA1-5004/883	-55 to +125	14 Lead CerDIP

### Pinout

HA-5004/883  
(CERDIP)  
TOP VIEW



## HA-5004/883

### 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 Pulsed at 1ms ≤ 10% Duty Cycle	±300mA
Continuous Output Current	±120mA rms
Junction Temperature (T <sub>J</sub> )	+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	73°C/W	18°C/W
Package Power Dissipation Limit at +75°C		
CerDIP Package	1.37W	
Package Power Dissipation Derating Factor Above +75°C		
CerDIP Package	13.7mW/°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	$R_L \geq 100\Omega$
Operating Supply Voltage	±12V to ±15V	

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at: V+ = □V<sub>C+</sub> = +15V, V- = □V<sub>C-</sub> = -15V, R<sub>L</sub> = 100Ω, A<sub>V</sub> = +1, R<sub>F</sub> = 250Ω,  $\overline{OE}$  = 0.8V, TOI = 0.8V or 2.0V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	V <sub>IO</sub>	V <sub>IN</sub> = 0V	1	+25°C	-2.5	2.5	mV
			2, 3	+125°C, -55°C	-20	20	mV
Input Bias Current	+I <sub>B</sub>	V <sub>IN</sub> = 0V (Note 1)	1	+25°C	-5	5	μA
			2, 3	+125°C, -55°C	-20	20	μA
DC Gain Error (Small Signal)	SSGE	V <sub>IN</sub> = ±100mV, R <sub>L</sub> = 100Ω	1	+25°C	-	0.43	%
			2, 3	+125°C, -55°C	-	0.75	%
DC Gain Error (Large Signal)	LSGE <sub>1</sub>	V <sub>IN</sub> = ±5.0V, R <sub>L</sub> = 1kΩ	1	+25°C	-	0.43	%
			2, 3	+125°C, -55°C	-	0.75	%
	LSGE <sub>2</sub>	V <sub>IN</sub> = ±10V, R <sub>L</sub> = 1kΩ	1	+25°C	-	0.43	%
			2, 3	+125°C, -55°C	-	0.75	%
DC Voltage Gain	A <sub>V</sub>	For All Gain Error Conditions (Note 2)	1	+25°C	233	-	V/V
			2, 3	+125°C, -55°C	133	-	V/V
DC Transimpedance	A <sub>R</sub>	For All Gain Error Conditions (Note 3)	1	+25°C	58	-	V/mA
			2, 3	+125°C, -55°C	33	-	V/mA
Output Voltage Swing	±V <sub>OUT1</sub>	V <sub>IN</sub> = ±15V, R <sub>L</sub> = 1kΩ	1	+25°C	11.5	-11.5	V
			2, 3	+125°C, -55°C	10.5	-10.5	V
	±V <sub>OUT2</sub>	V <sub>IN</sub> = ±10V, R <sub>L</sub> = 100Ω	1	+25°C	9.0	-9.0	V
			2, 3	+125°C, -55°C	8.0	-8.0	V
Output Current	±I <sub>OUT</sub>	V <sub>IN</sub> = ±10V, R <sub>L</sub> = 100Ω	1	+25°C	90	-90	mA
			2, 3	+125°C, -55°C	80	-80	mA

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

Device Tested at:  $V_+ = \square V_{C+} = +15V$ ,  $V_- = \square V_{C-} = -15V$ ,  $R_L = 100\Omega$ ,  $A_V = +1$ ,  $R_F = 250\Omega$ ,  $\overline{OE} = 0.8V$ ,  $TOI = 0.8V$  or  $2.0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Logic Input Voltage	$V_{IH}$	Pins $\overline{OE}$ , TOI (Note 4)	1	+25°C	2.0	-	V
			2, 3	+125°C, -55°C	2.0	-	V
	$V_{IL}$	Pins $\overline{OE}$ , TOI	1	+25°C	-	0.8	V
			2, 3	+125°C, -55°C	-	0.8	V
Power Supply Rejection Ratio	PSRR <sub>1</sub>	$V_+ = +10V, +20V$ $V_- = -15V$	1	+25°C	50	-	dB
			2, 3	+125°C, -55°C	50	-	dB
	PSRR <sub>2</sub>	$V_- = -10V, -20V$ $V_+ = +15V$	1	+25°C	50	-	dB
			2, 3	+125°C, -55°C	50	-	dB
Power Supply Current	+I <sub>CC</sub>	$V_{IN} = 0V, R_L = 1k\Omega$	1	+25°C	-	16	mA
			2, 3	+125°C, -55°C	-	22	mA
	-I <sub>CC</sub>	$V_{IN} = 0V, R_L = 1k\Omega$	1	+25°C	-16	-	mA
			2, 3	+125°C, -55°C	-22	-	mA

**NOTES:**

- Inverting (FB) input is a low impedance point; Bias Current and Offset Current are not specified for this terminal.
- DC Voltage Gain =  $\frac{1}{\text{Gain Error}}$ , for all Gain Error conditions.
- DC Transimpedance =  $\frac{R_F}{\text{Gain Error}}$ ,  $R_F = 250\Omega$ , for all Gain Error conditions.
- Please refer to the Truth Table in the Applications Information section.

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

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

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Characterized at:  $V_+ = \square V_{C+} = +15V$ ,  $V_- = \square V_{C-} = -15V$ ,  $R_L = 1k\Omega$ ,  $A_V = +1$ ,  $R_F = 250\Omega$ ,  $C_L \leq 10pF$ ,  $\overline{OE} = 0.8V$ ,  $TOI = 0.8V$  or  $2.0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	+SR	$V_{OUT} = 0V$ to $+10V$	1, 2	+25°C	1000	-	V/ $\mu$ s
	-SR	$V_{OUT} = 0V$ to $-10V$	1, 2	+25°C	1000	-	V/ $\mu$ s
Rise and Fall Time	T <sub>R</sub>	$V_{OUT} = 0V$ to $+200mV$ ,	1, 2	+25°C	-	7.0	ns
	T <sub>F</sub>	$V_{OUT} = 0V$ to $-200mV$	1, 2	+25°C	-	7.0	ns
Full Power Bandwidth	FPBW	$V_{PEAK} = 2V$	1, 3	+25°C	79.5	-	MHz

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

Device Characterized at:  $V_+ = \square V_{C+} = +15V$ ,  $V_- = \square V_{C-} = -15V$ ,  $R_L = 1k\Omega$ ,  $A_V = +1$ ,  $R_F = 250\Omega$ ,  $C_L \leq 10pF$ ,  $\overline{OE} = 0.8V$ ,  $TOI = 0.8V$  or  $2.0V$ , Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Quiescent Power Consumption	PC	$V_{IN} = 0V$	1, 4	-55°C to +125°C	-	660	mW

**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. Measured between 10% and 90% points.
3. Full Power Bandwidth guarantee based on Slew Rate measurement using  $FPBW = \text{Slew Rate}/(2\pi V_{PEAK})$ .
4. Power Consumption based upon Quiescent Supply Current test maximum.

**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
Group A Test Requirements	1, 2, 3
Groups C & D Endpoints	1

**NOTE:**

1. PDA applies to Subgroup 1 only.

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## Die Characteristics

### DIE DIMENSIONS:

63 x 93 x 19 mils  $\pm$  1 mils  
1600 x 2370 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 (Silox, 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:

6.6 x 10<sup>4</sup>A/cm<sup>2</sup>

### SUBSTRATE POTENTIAL (Powered Up): V<sub>EE</sub>

### TRANSISTOR COUNT: 64

### PROCESS: Bipolar Dielectric Isolation

## Metallization Mask Layout

HA-5004/883

