

100MHz Current Feedback Video Amplifier with Disable

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.
- Wide Unity Gain Bandwidth 105MHz (Min)
- Slew Rate 800V/ μ s
- Output Current \pm 30mA (Min)
- Drives 3.5V into 75 Ω
- Differential Gain 0.025%
- Differential Phase 0.025 Deg
- Low Input Noise Voltage 4.5nV/ $\sqrt{\text{Hz}}$
- Low Supply Current 10mA (Max)
- Wide Supply Range \pm 5V to \pm 15V
- Output Enable/Disable
- High Performance Replacement for EL2020/883

Applications

- Unity Gain Video/Wideband Buffer
- Video Gain Block
- Video Distribution Amp/Coax Cable Driver
- Flash A/D Driver
- Waveform Generator Output Driver
- Current to Voltage Converter; D/A Output Buffer
- Radar Systems
- Imaging Systems

Description

The HA-5020/883 is a wide bandwidth, high slew rate amplifier optimized for video applications and gains between 1 and 10. Manufactured on Harris' Reduced Feature Complementary Bipolar DI process, this amplifier uses current mode feedback to maintain higher bandwidth at a given gain than conventional voltage feedback amplifiers. Since it is a closed loop device, the HA-5020/883 offers better gain accuracy and lower distortion than open loop buffers.

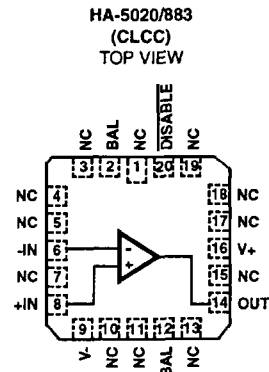
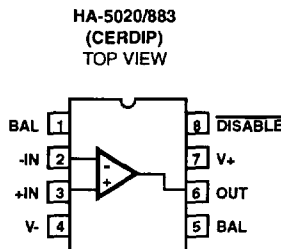
The HA-5020/883 features low differential gain and phase and will drive two double terminated 75 Ω coax cables to video levels with low distortion. Adding a gain flatness performance of 0.1dB makes this amplifier ideal for demanding video applications. The bandwidth and slew rate of the HA-5020/883 are relatively independent of closed loop gain. The 105MHz unity gain bandwidth only decreases to 77MHz at a gain of 10. The HA-5020/883 used in place of a conventional op amp will yield a significant improvement in the speed power product. To further reduce power, the HA-5020/883 has a disable function which significantly reduces supply current, while forcing the output to a true high impedance state. This allows the outputs of multiple amplifiers to be wire-OR'd into multiplexer configurations. The device also includes output short circuit protection and output offset voltage adjustment.

The HA-5020/883 offers significant enhancements over competing amplifiers, such as the EL2020. Improvements include unity gain bandwidth, slew rate, video performance, lower supply current, and superior DC specifications.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA7-5020/883	-55°C to +125°C	8 Lead CerDIP
HA4-5020/883	-55°C to +125°C	20 Lead Ceramic LCC

Pinouts



Specifications HA-5020/883

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals	36V
Differential Input Voltage	8V
Voltage at Either Input Terminal	V+ to V-
Peak Output Current	Full Short Circuit Protected
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 Package Characteristics	θ_{JA}	θ_{JC}
CerDIP Package	115°C/W	30°C/W
Ceramic LCC Package	75°C/W	23°C/W
Package Power Dissipation Limit at +75°C for T _J ≤ +175°C		
CerDIP Package	0.87W	
Ceramic LCC Package	1.33W	
Package Power Dissipation Derating Factor Above +75°C		
CerDIP Package	8.7mW/°C	
Ceramic LCC 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.

Operating Conditions

Operating Temperature Range	-55°C to +125°C	$V_{INCM} \leq 1/2(V+ - V-)$	$R_F = 1k\Omega$
Operating Supply Voltage	±5V to ±15V	$R_L \geq 400\Omega$	$V_{DISABLE} = V+ \text{ or } 0V$

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: Supply Voltage = ±15V, R_{SOURCE} = 0Ω, A_{VCL} = +1, R_F = 1kΩ, R_{LOAD} = 400Ω, V_{OUT} = 0V, V_{DISABLE} = V+, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	V _{IO}	V _{CM} = 0V	1	+25°C	-8	8	mV
			2, 3	+125°C, -55°C	-10	10	mV
Common Mode Rejection Ratio	+CMRR	ΔV _{CM} = +10V, V+ = 5V, V- = -25V	1	+25°C	60	-	dB
			2, 3	+125°C, -55°C	50	-	dB
	-CMRR	ΔV _{CM} = -10V, V+ = 25V, V- = -5V	1	+25°C	60	-	dB
			2, 3	+125°C, -55°C	50	-	dB
Power Supply Rejection Ratio	+PSRR	ΔV _{SUP} = 13.5V, V+ = 4.5V, V- = -15V; V+ = 18V, V- = -15V	1	+25°C	64	-	dB
			2, 3	+125°C, -55°C	60	-	dB
	-PSRR	ΔV _{SUP} = 13.5V, V+ = 15V, V- = -4.5V; V+ = 15V, V- = -18V	1	+25°C	64	-	dB
			2, 3	+125°C, -55°C	60	-	dB
Non-Inverting (+IN) Current	I _{BP}	V _{CM} = 0V	1	+25°C	-8	8	μA
			2, 3	+125°C, -55°C	-20	20	μA
+IN Common Mode Rejection	IBPCMP	ΔV _{CM} = +10V, V+ = 5V, V- = -25V	1	+25°C	-	0.1	μA/V
			2, 3	+125°C, -55°C	-	0.5	μA/V
	IBPCMN	ΔV _{CM} = -10V, V+ = 25V, V- = -5V	1	+25°C	-	0.1	μA/V
			2, 3	+125°C, -55°C	-	0.5	μA/V
Non-Inverting (+IN) Input Impedance	+R _{IN}	Calculated 1/IBPCMP	1	+25°C	10	-	MΩ
			2, 3	+125°C, -55°C	2	-	MΩ
+IN Power Supply Rejection	IBPPSP	ΔV _{SUP} = 13.5V, V+ = 4.5V, V- = -15V; V+ = 18V, V- = -15V	1	+25°C	-	0.06	μA/V
			2, 3	+125°C, -55°C	-	0.2	μA/V
	IBPPSN	ΔV _{SUP} = 13.5V, V+ = 15V, V- = -4.5V; V+ = 15V, V- = -18V	1	+25°C	-	0.06	μA/V
			2, 3	+125°C, -55°C	-	0.2	μA/V
Inverting Input (-IN) Current	I _{BN}	V _{CM} = 0V	1	+25°C	-20	20	μA
			2, 3	+125°C, -55°C	-50	50	μA

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OPERATIONAL AMPLIFIERS

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TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: Supply Voltage = $\pm 15V$, $R_{SOURCE} = 0\Omega$, $A_{VCL} = +1$, $R_F = 1k\Omega$, $R_{LOAD} = 400\Omega$, $V_{OUT} = 0V$, $V_{DISABLE} = V+$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
-IN Common Mode Rejection	IBNCMP	$\Delta V_{CM} = +10V$, $V+ = 5V$, $V- = -25V$	1	+25°C	-	0.4	$\mu A/V$
			2, 3	+125°C, -55°C	-	0.5	$\mu A/V$
	IBNCMN	$\Delta V_{CM} = -10V$, $V+ = 25V$, $V- = -5V$	1	+25°C	-	0.4	$\mu A/V$
			2, 3	+125°C, -55°C	-	0.5	$\mu A/V$
-IN Power Supply Rejection	IBNPSP	$\Delta V_{SUP} = 13.5V$, $V+ = 4.5V$, $V- = -15V$; $V+ = 18V$, $V- = -15V$	1	+25°C	-	0.2	$\mu A/V$
			2, 3	+125°C, -55°C	-	0.5	$\mu A/V$
	IBNPSN	$\Delta V_{SUP} = 13.5V$, $V+ = 15V$, $V- = -4.5V$; $V+ = 15V$, $V- = -18V$	1	+25°C	-	0.2	$\mu A/V$
			2, 3	+125°C, -55°C	-	0.5	$\mu A/V$
Common Mode Range	+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
Transimpedance	+A _{ZOL1}	$R_L = 400\Omega$, $V_{OUT} = 0$ to 10V	1	+25°C	1	-	M Ω
			2, 3	+125°C, -55°C	1	-	M Ω
	-A _{ZOL1}	$R_L = 400\Omega$, $V_{OUT} = 0$ to -10V	1	+25°C	1	-	M Ω
			2, 3	+125°C, -55°C	1	-	M Ω
Output Voltage Swing	+V _{OUT}	$V_{IN} = 12.8V$	1, 2	+25°C, +125°C	12	-	V
			3	-55°C	11	-	V
	-V _{OUT}	$V_{IN} = -12.8V$	1, 2	+25°C, +125°C	-	-12	V
			3	-55°C	-	-11	V
	+V _{OUT5}	$V+ = 5V$, $V- = -5V$, $V_{IN} = 3V$	1	+25°C	2	-	V
			2, 3	+125°C, -55°C	2	-	V
	-V _{OUT5}	$V+ = 5V$, $V- = -5V$, $V_{IN} = -3V$	1	+25°C	-	-2	V
			2, 3	+125°C, -55°C	-	-2	V
Output Current	+I _{OUT}	Note 1	1, 2	+25°C, +125°C	30	-	mA
			3	-55°C	27.5	-	mA
	-I _{OUT}	Note 1	1, 2	+25°C, +125°C	-	-30	mA
			3	-55°C	-	-27.5	mA
Short Circuit Output Current	+I _{SC}	$R_L = \text{Open}$, $V_{IN} = 10V$	1	+25°C	50	-	mA
			2, 3	+125°C, -55°C	50	-	mA
	-I _{SC}	$R_L = \text{Open}$, $V_{IN} = -10V$	1	+25°C	-	-50	mA
			2, 3	+125°C, -55°C	-	-50	mA
Disabled Output Current	+I _{LEAK}	$V_{IN} = 0V$, $V_{OUT} = +10V$, $R_L = \text{Open}$, $V_{DIS} = 0V$	1	+25°C	-1	1	μA
			3	-55°C	-1	1	μA
			2	+125°C	-1	1	μA
	-I _{LEAK}	$V_{IN} = 0V$, $V_{OUT} = -10V$, $R_L = \text{Open}$, $V_{DIS} = 0V$	1	+25°C	-1	1	μA
			3	-55°C	-1	1	μA
			2	+125°C	-1	1	μA

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TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: Supply Voltage = $\pm 15V$, $R_{SOURCE} = 0\Omega$, $A_{VCL} = +1$, $R_F = 1k\Omega$, $R_{LOAD} = 400\Omega$, $V_{OUT} = 0V$, $V_{DISABLE} = V+$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Disable Pin Input Current	I_{LOGIC}	$V_{DIS} = 0V$	1, 2	+25°C, +125°C	-1	0	mA
			3	-55°C	-1.5	0	mA
Minimum DISABLE Pin Current to Disable	I_{DIS}	Note 2	1	+25°C	-	350	μA
			2, 3	+125°C, -55°C	-	350	μA
Maximum DISABLE Pin Current to Enable	I_{EN}	Note 3	1	+25°C	20	-	μA
			2, 3	+125°C, -55°C	20	-	μA
Quiescent Power Supply Current	I_{CC}	$R_L = \text{Open}$	1	+25°C	-	10	mA
			2, 3	+125°C, -55°C	-	10	mA
	I_{EE}	$R_L = \text{Open}$	1	+25°C	-10	-	mA
			2, 3	+125°C, -55°C	-10	-	mA
Disabled Power Supply Current	I_{CCDIS}	$R_L = 400\Omega$, $V_{DIS} = 0V$	1	+25°C	-	5.6	mA
			2, 3	+125°C, -55°C	-	7.5	mA
	I_{EEDIS}	$R_L = 400\Omega$, $V_{DIS} = 0V$	1	+25°C	-5.6	-	mA
			2, 3	+125°C, -55°C	-7.5	-	mA
Offset Voltage Adjustment	+ V_{ADJ}	Note 4	1	+25°C	30	-	mV
			2, 3	+125°C, -55°C	25	-	mV
	- V_{ADJ}	Note 4	1	+25°C	-	-30	mV
			2, 3	+125°C, -55°C	-	-25	mV

NOTES:

- Guaranteed from V_{OUT} test by $I_{OUT} = V_{OUT}/400\Omega$.
- This is the minimum current which must be sourced from the DISABLE pin, to disable the output. The output is considered disabled when $V_{OUT} \leq 10mV$. Conditions are: $V_{IN} = 10V$, $R_L = 100\Omega$. The test is performed by sourcing $350\mu A$ from the DISABLE pin, and testing that the output decreases below the test limit (10mV).
- This is the maximum current that can be sourced from the DISABLE pin with the device remaining enabled. The device is considered disabled when the supply current decreases by at least 0.5mA. Conditions are: $R_L = 400\Omega$. Test is performed by sourcing $20\mu A$ from the DISABLE pin, and testing that the supply current decreases by no more than the test limit (0.5mA).
- The offset adjustment range is referred to the output. The inverting input current ($-I_{BIAS}$) can be adjusted with an external pot between pins 1 and 5, wiper connected to $V+$. Since $-I_{BIAS}$ flows through R_F , an adjustment of offset voltage results. The amount of offset adjustment is proportional to the value of R_F . Test conditions are: $R_L = \text{Open}$, $10k\Omega$ from pin 5 to $V+$, $1k\Omega$ from pin 1 to $V+$, for $+V_{ADJ}$; $R_L = \text{Open}$, $1k\Omega$ from pin 5 to $V+$, $10k\Omega$ from pin 1 to $V+$, for $-V_{ADJ}$.

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: Supply Voltage = $\pm 15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 400\Omega$, $C_{LOAD} \leq 10pF$, $A_{VCL} = +1V/V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Slew Rate	+SR	$V_{IN} = -10V$ to $+10V$	4	+25°C	600	-	V/ μs
			5, 6	+125°C, -55°C	400	-	V/ μs
	-SR	$V_{IN} = +10V$ to $-10V$	4	+25°C	600	-	V/ μs
			5, 6	+125°C, -55°C	400	-	V/ μs

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TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: Supply Voltage = $\pm 15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 400\Omega$, $R_F = 1k\Omega$, $V_{DISABLE} = V+$, $C_{LOAD} \leq 10pF$, $A_{VCL} = +1V/V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
-3dB Bandwidth	BW_1	$V_O = 100mV_{RMS}$, $A_V = +1$	1	+25°C	105	-	MHz
	BW_{10}	$V_O = 100mV_{RMS}$, $A_V = +10$, $R_F = 360\Omega$, $R_L = Open$	1	+25°C	77	-	MHz
Gain Flatness	GF_5	$V_O = 100mV_{RMS}$, $f = 5MHz$	1	+25°C	-0.075	+0.075	dB
	GF_{10}	$V_O = 100mV_{RMS}$, $f = 10MHz$	1	+25°C	-0.2	+0.2	dB
Rise Time	t_R	$V_O = 0V$ to $1V$, $R_L = 100\Omega$	1, 2	+25°C	-	3.7	ns
Fall Time	t_F	$V_O = 1V$ to $0V$, $R_L = 100\Omega$	1, 3	+25°C	-	4.0	ns
Overshoot	+OVS	$V_O = 0V$ to $1V$, $R_L = 100\Omega$	1	+25°C	-	18.0	%
	-OVS	$V_O = 1V$ to $0V$, $R_L = 100\Omega$	1	+25°C	-	16.6	%
Slew Rate	+SR ₁₀	$V_O = -10V$ to $10V$, $A_V = +10$, $R_F = 360\Omega$, $R_L = Open$	1, 4	+25°C	1070	-	V/ μ s
	-SR ₁₀	$V_O = 10V$ to $-10V$, $A_V = +10$, $R_F = 360\Omega$, $R_L = Open$	1, 5	+25°C	860	-	V/ μ s
Disable Time	+t _{DIS}	$V_O = 2V$ to $0V$, 50% of V_{DIS} to 90% V_O	1, 6	+25°C	-	3.13	μ s
	-t _{DIS}	$V_O = -2V$ to $0V$, 50% of V_{DIS} to 90% V_O	1, 6	+25°C	-	2.44	μ s
Enable Time	+t _{EN}	$V_O = 0V$ to $2V$, 50% to 90%	1, 7	+25°C	-	1.45	μ s
	-t _{EN}	$V_O = 0V$ to $-2V$, 50% to 90%	1, 7	+25°C	-	1.49	μ s

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 from 10% to 90% of the output waveform.
3. Measured from 90% to 10% of the output waveform.
4. Measured from 25% to 75% of the output waveform.
5. Measured from 75% to 25% of the output waveform.
6. $\overline{DISABLE} = +15V$ to $0V$. Measured from the 50% of $\overline{DISABLE}$ to $V_{OUT} = \pm 200mV$.
7. $\overline{DISABLE} = 0V$ to $+15V$. Measured from the 50% of $\overline{DISABLE}$ to $V_{OUT} = \pm 1.8V$.

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:

65 x 60 x 19 mils \pm 1 mils
 1640 μ m x 1520 μ m x 483 μ m \pm 25.4 μ m

METALLIZATION:

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

WORST CASE CURRENT DENSITY:

5.77 x 10⁴ A/cm² at 30mA

SUBSTRATE POTENTIAL (Powered Up): V-

GLASSIVATION:

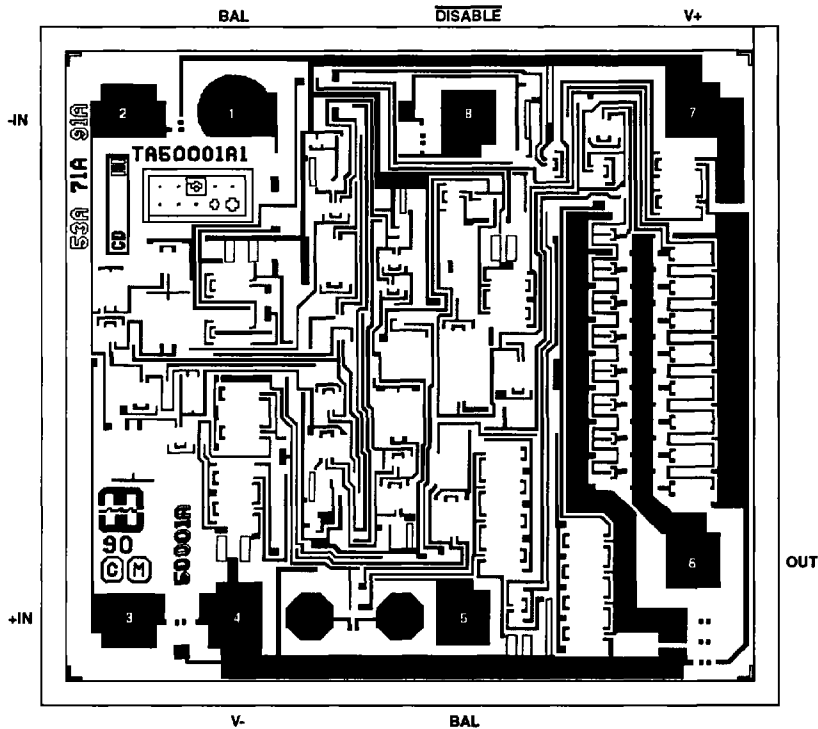
Type: Nitride over Silox
 Silox Thickness: 12k \AA \pm 2k \AA
 Nitride Thickness: 3.5k \AA \pm 1k \AA

TRANSISTOR COUNT: 62

PROCESS: Bipolar Dielectric Isolation

Metallization Mask Layout

HA-5020/883



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 OPERATIONAL
 AMPLIFIERS