HA-2444/883

Selectable, Four Channel Video Operational Amplifier

August 1998

Features

- **This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.**
- **Digital Selection of Input Channel**
- **Unity Gain Stable**
- **Gain Flatness (to 10MHz) . . . . . 0.12dB (Typ)**
- **Differential Gain . . . . . 0.03% (Typ)**
- **Differential Phase. . . . . 0.03 Degrees (Typ)**
- **Fast Channel Selection . . . . . 100ns (Max)**
- **Crosstalk Rejection . . . . . 60dB (Typ)**

Applications

- **Programmable Gain Amplifier**
- **Special Effects Processors**
- **Video Distribution Systems/Multiplexers**
- **Heads-up/Night Vision Displays**
- **Radar Video**
- **Flight Simulators**
- **IR Imaging**

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA1-2444/883	-55°C to +125°C	16 Lead CerDIP

Description

The HA-2444/883 is a channel-selectable video op amp consisting of four differential inputs, a single-ended output, and digital control circuitry allowing two digital inputs to activate one of the four differential inputs. The HA-2444/883 also includes a high impedance output state allowing the outputs of multiple HA-2444/883s to be wire-OR'd. Functionally, the HA-2444/883 is equivalent to four wideband video op amps and a wideband multiplexer.

Unlike similar competitor devices, the HA-2444/883 is not restricted to multiplexing. Any op amp configuration can be used with any of the inputs. Signal amplification, addition, integration, and more can be put under digital control with broadcast quality performance.

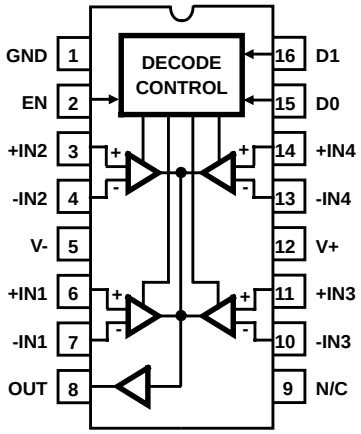
The key video parameters of the HA-2444/883 have been optimized without compromising DC performance. Gain Flatness, to 10MHz, is only 0.12dB. Differential gain and phase are typically 0.03% and 0.03 degrees, respectively.

Laser trimming allows offset voltages in the 4.0mV range and a unique common current source design assures minimal channel-to-channel mismatch, while maintaining 60dB of crosstalk rejection at 5MHz. Open loop gain of 76dB and low input offset and bias currents enhance the performance of this versatile device.

Uses for the HA-2444/883 include video test equipment, guidance systems, radar displays, and other precise imaging systems where stringent gain and phase requirements have previously required costly hybrids and discrete circuitry. It will also be used for systems requiring high speed signal conditioning, such as data acquisition systems, specialized instrumentation, and communications systems.

Pinout

HA-2444/883
(CERDIP)
TOP VIEW



Logic Operation

TRUTH TABLE

EN	D1	D0	SELECTED CHANNEL
H	L	L	1
H	L	H	2
H	H	L	3
H	H	H	4
L	X	X	NONE-OUT is set to a high impedance state.

L = Low State (0.8V Max.)
H = High State (2.4V Min.)
X = Don't Care

Spec Number **511091-883**
File Number **3608.1**

Absolute Maximum Ratings

Voltage between V+ and V- Terminals 35V
Differential Input Voltage 6V
Voltage at Either Input Terminal . . . . . V+ to V-
Voltage on Digital Inputs. . . . . GND +7.5V to GND -0.5V
Peak Output Current (≤10% Duty Cycle) 40mA
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 Resistance	θ_{JA}	θ_{JC}
CerDIP Package	82°C/W	27°C/W

Package Power Dissipation Limit at +75°C for $T_J \leq +175°C$
CerDIP Package 1.22W
Package Power Dissipation Derating Factor Above +75°C
CerDIP Package . . . . . 12.2mW/°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
Operating Supply Voltage . . . . . ±12V to ±15V

$V_{INCM} \leq 1/2(V+ - V-)$
$R_L \geq 1k\Omega$

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 1k\Omega$, $C_{LOAD} \leq 10pF$, $V_{OUT} = 0V$, $V_{IL} = 0.8V$, $V_{IH} = 2.4V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Input Offset Voltage	V_{IO}	V_{CM} = 0V	1	+25°C	-7	7	mV
			2, 3	+125°C, -55°C	-20	20	mV
Channel to Channel Offset Voltage Mismatch	V_{IODEV}	V_{CM} = 0V	1	+25°C	-	5	mV
			2, 3	+125°C, -55°C	-	12	mV
Input Bias Current	$+I_B$	V_{CM} = 0V, $+R_S$ = 250Ω $-R_S$ = 50Ω	1	+25°C	-15	15	µA
			2, 3	+125°C, -55°C	-25	25	µA
	$-I_B$	V_{CM} = 0V, $+R_S$ = 50Ω $-R_S$ = 250Ω	1	+25°C	-15	15	µA
			2, 3	+125°C, -55°C	-25	25	µA
Input Offset Current	I_{IO}	V_{CM} = 0V, $+R_S$ = 250Ω $-R_S$ = 250Ω	1	+25°C	-4	4	µA
			2, 3	+125°C, -55°C	-8	8	µA
Large Signal Voltage Gain	$+A_{VOL}$	V_{OUT} = 0V and +5V	4	+25°C	71	-	dB
			5, 6	+125°C, -55°C	65	-	dB
	$-A_{VOL}$	V_{OUT} = 0V and -5V	4	+25°C	71	-	dB
			5, 6	+125°C, -55°C	65	-	dB
Common Mode Rejection Ratio	+CMRR	ΔV_{CM} = +5V, V_{OUT} = -5V, V+ = 10V, V- = -20V	1	+25°C	68	-	dB
			2, 3	+125°C, -55°C	68	-	dB
	-CMRR	ΔV_{CM} = -5V, V_{OUT} = +5V, V+ = 20V, V- = -10V	1	+25°C	68	-	dB
			2, 3	+125°C, -55°C	68	-	dB
Output Voltage Swing	$+V_{OUT}$		1	+25°C	10	-	V
			2, 3	+125°C, -55°C	10	-	V
	$-V_{OUT}$		1	+25°C	-	-10	V
			2, 3	+125°C, -55°C	-	-10	V
Output Current	$+I_{OUT}$	V_{OUT} = -10V R_{LOAD} = OPEN	1	+25°C	25	-	mA
			2, 3	+125°C, -55°C	25	-	mA
	$-I_{OUT}$	V_{OUT} = 10V R_{LOAD} = OPEN	1	+25°C	-	-25	mA
			2, 3	+125°C, -55°C	-	-25	mA
Output Current (Device Disabled)	+DISAB	V_{OUT} = 5V, V_{EN} = 0.8V R_{LOAD} = OPEN	1	+25°C	-	860	µA
			2, 3	+125°C, -55°C	-	860	µA
	-DISAB	V_{OUT} = -5V, V_{EN} = 0.8V R_{LOAD} = OPEN	1	+25°C	-	860	µA
			2, 3	+125°C, -55°C	-	860	µA

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: V_{SUPPLY} = ±15V, R_{SOURCE} = 50Ω, R_{LOAD} = 1kΩ, C_{LOAD} ≤10pF, V_{OUT} = 0V, V_{IL} = 0.8V, V_{IH} = 2.4V, Unless Otherwise Specified. **(Continued)**

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Quiescent Power Supply Current	$+I_{CC}$	V_{OUT} = 0V, I_{OUT} = 0mA	1	+25°C	-	25	mA
			2, 3	+125°C, -55°C	-	25	mA
	$-I_{CC}$	V_{OUT} = 0V, I_{OUT} = 0mA	1	+25°C	-25	-	mA
			2, 3	+125°C, -55°C	-25	-	mA
Supply Current (Device Disabled)	$+I_{CCDIS}$	V_{OUT} = 0V, V_{EN} = 0.8V	1	+25°C	-	10	mA
			2, 3	+125°C, -55°C	-	10	mA
	$-I_{CCDIS}$	V_{OUT} = 0V, V_{EN} = 0.8V	1	+25°C	-10	-	mA
			2, 3	+125°C, -55°C	-10	-	mA
Power Supply Rejection Ratio	+PSRR	ΔV_{SUPPLY} = 5V, V+ = 15V, V- = -15V, V+ = 20V, V- = -15V	1	+25°C	65	-	dB
			2, 3	+125°C, -55°C	65	-	dB
	-PSRR	ΔV_{SUPPLY} = 5V, V+ = 15V, V- = -15V, V+ = 15V, V- = -20V	1	+25°C	65	-	dB
			2, 3	+125°C, -55°C	65	-	dB
Digital Input Voltages (D0, D1, EN)	V_{IL}		1	+25°C	-	0.8	V
			2, 3	+125°C, -55°C	-	0.8	V
	V_{IH}		1	+25°C	2.4	-	V
			2, 3	+125°C, -55°C	2.4	-	V
Input Current (D0, D1)	DX_{IIL}	V_{IL} = 0V	1	+25°C	-	1	mA
			2, 3	+125°C, -55°C	-	1	mA
	DX_{IIH}	V_{IH} = 5V	1	+25°C	-	1.2	µA
			2, 3	+125°C, -55°C	-	1.2	µA
Input Current (EN)	EN_{IIL}	V_{IL} = 0V	1	+25°C	-	50	µA
			2, 3	+125°C, -55°C	-	50	µA
	EN_{IIH}	V_{IH} = 5V	1	+25°C	-	1.2	µA
			2, 3	+125°C, -55°C	-	1.2	µA

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: V_{SUPPLY} = ±15V, R_{SOURCE} = 50Ω, R_{LOAD} = 1kΩ, C_{LOAD} ≤10pF, A_{VCL} = +1V/V, V_{IL} = 0.8V, V_{IH} = 2.4V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS MIN	LIMITS MAX	UNITS
Slew Rate	+SR	V_{OUT} = -5V to +5V	7	+25°C	120	-	V/µs
			8	+125°C, -55°C	120	-	V/µs
	-SR	V_{OUT} = +5V to -5V	7	+25°C	120	-	V/µs
			8	+125°C, -55°C	120	-	V/µs
Channel Select Time	CHSE	Note 1, V_{EN} = 2.4V	9, 10	+25°C, +125°C	-	100	ns
			11	-55°C	-	125	ns
Output Enable Time	CHEN	Note 2	9	+25°C	-	100	ns
			10, 11	+125°C, -55°C	-	100	ns

NOTES:

1. Measured for all channel combinations. Channel Select time is the delay in switching from channel X to channel Y. Channel Y input set to +5V, all other channels set to 0V. Select time is measured from the 50% point of the critical digital select input to the 50% point on the output.
2. Channel 1 selected with the input at 5V. All other channels set to 0V. Enable input switched from 0.8V to 2.4V. Enable time is measured from the 50% point of the EN input to the 50% point on the output.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: V_{SUPPLY} = ±15V, R_{SOURCE} = 50Ω, R_{LOAD} = 1kΩ, C_L ≤10pF, A_{VCL} = 1V/V, V_{IL} = 0.8V, V_{IH} = 2.4V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Rise Time	T_R	V_{OUT} = 0V to +200mV	1, 4	+25°C	-	11	ns
			1, 4	-55°C, +125°C	-	12	ns
Fall Time	T_F	V_{OUT} = 0V to -200mV	1, 4	+25°C	-	11	ns
			1, 4	-55°C, +125°C	-	12	ns
Overshoot	+OS	V_{OUT} = 0V to +200mV	1	+25°C	-	15	%
			1	-55°C, +125°C	-	30	%
	-OS	V_{OUT} = 0V to -200mV	1	+25°C	-	15	%
			1	-55°C, +125°C	-	30	%
Full Power Bandwidth	FPBW	V_{PEAK} = 5V	1, 2	+25°C	3.8	-	MHz
			1, 2	-55°C, +125°C	3.8	-	MHz
Minimum Closed Loop Stable Gain	CLSG		1	+25°C	1	-	V/V
			1	-55°C, +125°C	1	-	V/V
Quiescent Power Consumption	PC	V_{OUT} = 0V, I_{OUT} = 0mA	1, 3	+25°C	-	750	mW
			1, 3	-55°C, +125°C	-	750	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. Full Power Bandwidth guarantee based on Slew Rate measurement using FPBW = Slew Rate/($2\pi V_{PEAK}$).
3. 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 TABLES 1 AND 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1 (Note 1), 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Groups C and D Endpoints	1

NOTE:

1. PDA applies to Subgroup 1 only.

Die Characteristics

DIE DIMENSIONS:
74mils x 103mils x 19mils ± 1mil
1880µm x 2620µm x 483µm ± 25.4µm

METALLIZATION:
Type: Al, 1% Cu
Thickness: 16kÅ ± 2kÅ

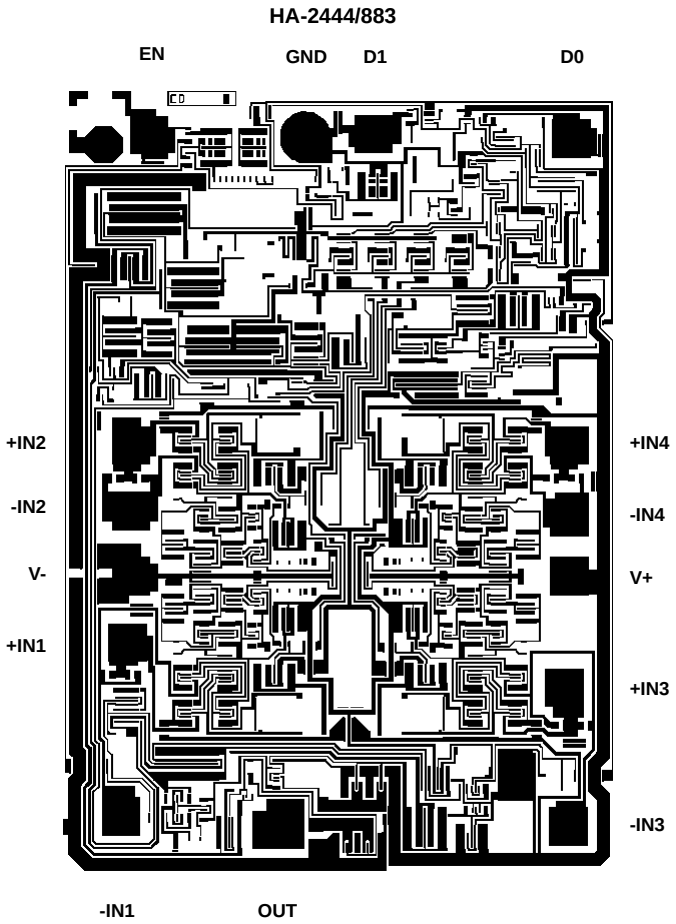
SUBSTRATE POTENTIAL (Powered Up): V-

GLASSIVATION:
Type: Nitride over Silox
Silox Thickness: 12kÅ ± 2kÅ
Nitride Thickness: 3.5kÅ ± 1.5kÅ

TRANSISTOR COUNT: 129

PROCESS: Bipolar Dielectric Isolation

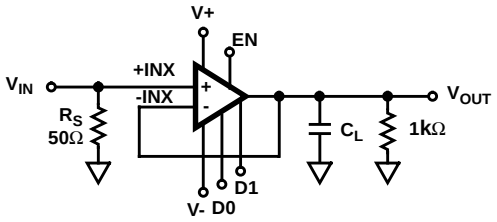
Metallization Mask Layout



Test Waveforms

SIMPLIFIED TEST CIRCUIT FOR LARGE AND SMALL SIGNAL PULSE RESPONSE (Applies to Tables 2 and 3)

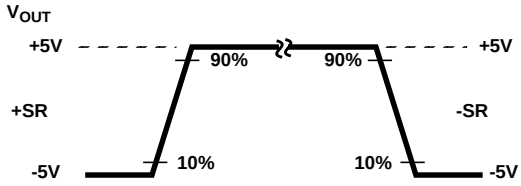
A_V = +1 TEST CIRCUIT



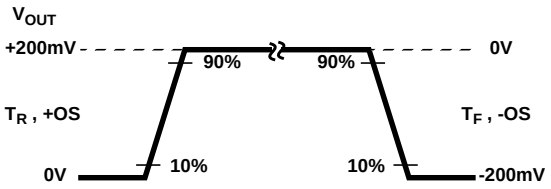
NOTE:

1. V_S = ±15V, A_V = +1, C_L ≤10pF
2. All 4 Channels Tested
3. D0 and D1 = 2.4V or 0.8V to Select Proper Channel
4. EN = 2.4V

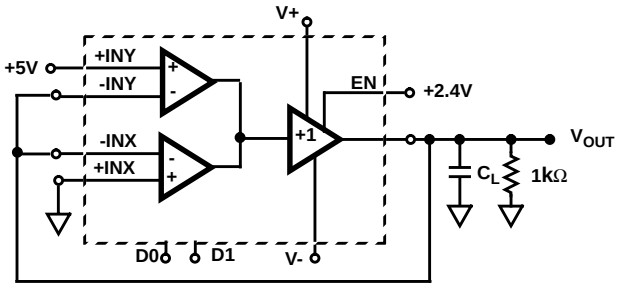
LARGE SIGNAL WAVEFORM



SMALL SIGNAL WAVEFORM



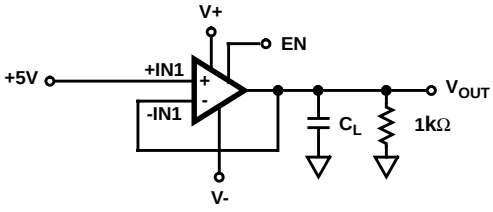
SIMPLIFIED TEST CIRCUIT FOR CHANNEL SELECT TIMES



NOTE:

1. V_S = ±15V, A_V = +1 (all channels), C_L ≤10pF
2. All Channel Combinations Tested

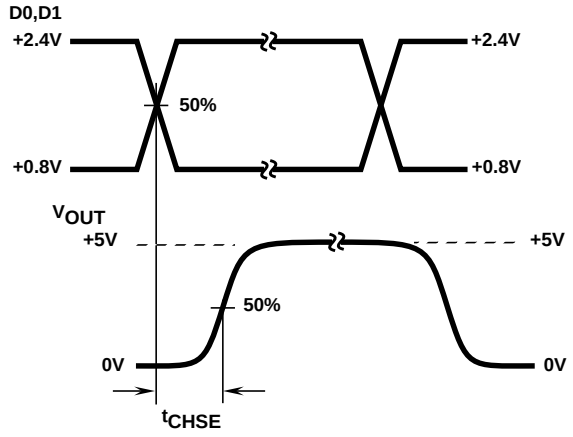
SIMPLIFIED TEST CIRCUIT FOR OUTPUT ENABLE TIMES



NOTE:

1. V_S = ±15V, A_V = +1, C_L ≤10pF
2. D0 = D1 = 0.8V, +IN2 = +IN3 = +IN4 = 0V

CHANNEL SELECT TIME SWITCHING WAVEFORMS



OUTPUT ENABLE TIME SWITCHING WAVEFORMS