

February 1991

## Selectable, Four Channel Video Operational Amplifier

### Features

- Digital Selection of Input Channel
- Unity Gain Stability
- Gain Flatness @ 10MHz..... 0.12dB (Typ.)
- Differential Gain..... 0.03% (Typ.)
- Differential Phase..... 0.03 Degrees (Typ.)
- Fast Channel Selection..... 60ns (Typ.)
- Crosstalk Rejection..... 60dB (Typ.)

### Description

The HA-2444 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 also includes a high impedance output state allowing the outputs of multiple HA-2444s to be wire-OR'd. Functionally, the HA-2444 is equivalent to four wideband video op amps and a wideband multiplexer.

Unlike similar competitor devices, the HA-2444 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 have been optimized without compromising dc performance. Gain Flatness, at 10MHz, is only 0.12dB. Differential gain and

### Applications

- Video Multiplexer
- Programmable Gain Amplifier
- Special Effects Processors
- Video Distribution Systems
- Heads-up/Night Vision Displays
- Medical Imaging Systems
- Radar Video

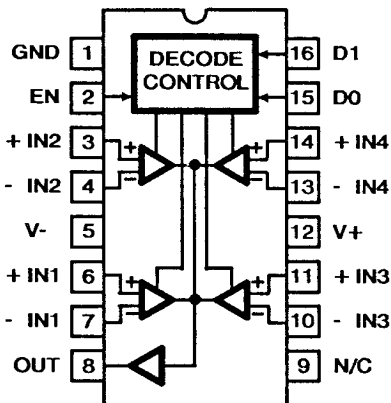
phase are typically 0.03% and 0.03 degrees, respectively. Laser trimming allows offset voltages in the 4.0mV range and a unique common current source design assures minimal channel-to-channel mismatch, while maintaining 60dB of crosstalk rejection at 5MHz. Open loop gain of 76dB and low input offset and bias currents enhance the performance of this versatile device.

For HA-2444 ordering information, refer to page 4 of this data sheet.

For information about military grade devices, please refer to the HA-2444/883 data sheet. The HA-2444/883 devices are offered in Ceramic DIP and Ceramic Flatpack packages.

### Pinout

HA3-2444 (PLASTIC DIP)  
HA9P-2444 (SOIC)  
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

# Specifications HA-2444

## Absolute Maximum Ratings (Note 1)

Voltage Between V+ and V- Terminals .....	35V ( $\pm 17.5V$ )
Differential Input Voltage .....	$\pm 6V$
Peak (Short Duration) Output Current .....	$\pm 40mA$
Maximum Junction Temperature .....	+175°C
Maximum Junction Temperature (Plastic Packages) .....	+150°C

## Operating Temperature Range

HA-2444-5 .....	0°C < T <sub>A</sub> < +75°C	
HA-2444-9 .....	-40°C < T <sub>A</sub> < +85°C	
Storage Temperature Range .....	-65°C < T <sub>A</sub> < +150°C	
Thermal Package Characteristics	$\theta_{jc}$	$\theta_{ja}$
16 Pin Plastic DIP	27	88
16 Pin SOIC	26	96

**Electrical Specifications** V+ = +15V, V- = -15V, R<sub>L</sub> = 1K, C<sub>L</sub> = 10pF, V<sub>IL</sub> = 0.8V, V<sub>IH</sub> = 2.4V. Unless Otherwise Specified.  
Specifications Apply to All Channels.

PARAMETER	TEMP	HA-2444-5, -9			UNITS
		MIN	TYP	MAX	
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage	+25°C	-	4	7	mV
	Full	-	-	15	mV
Average Input Offset Voltage Drift	Full	-	10	-	$\mu V/^\circ C$
Channel to Channel Offset Voltage Mismatch	+25°C	-	-	5	mV
	Full	-	-	8	mV
Input Bias Current	+25°C	-	9	15	$\mu A$
	Full	-	-	20	$\mu A$
Average Input Bias Current Drift	Full	-	0.04	-	$\mu A/^\circ C$
Input Offset Current	+25°C	-	2	4	$\mu A$
	Full	-	-	6	$\mu A$
Average Input Offset Current Drift	Full	-	10	-	nA/°C
Common Mode Range	Full	-	$\pm 11.5$	-	V
Differential Input Resistance (Note 16)	+25°C	50	90	-	K $\Omega$
Differential Input Capacitance	+25°C	-	3	-	pF
Input Noise Voltage Density fo = 1000Hz	+25°C	-	26	-	nV/ $\sqrt{Hz}$
Input Noise Current Density fo = 1000Hz	+25°C	-	4	-	pA/ $\sqrt{Hz}$
<b>TRANSFER CHARACTERISTICS</b>					
Large Signal Voltage Gain (Note 3)	+25°C	71	76	-	dB
	Full	68	-	-	dB
Common Mode Rejection Ratio (Note 4)	Full	70	80	-	dB
Minimum Stable Gain	+25°C	+1	-	-	V/V
Unity Gain Bandwidth (Notes 2, 5)	+25°C	-	45	-	MHz
Gain Bandwidth Product (Note 5)	+25°C	-	50	-	MHz
Phase Margin (Note 2)	+25°C	-	65	-	Degrees
Gain Margin (Note 2)	+25°C	-	8.0	-	dB
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Swing (R <sub>L</sub> = 1K $\Omega$ )	Full	$\pm 10$	$\pm 11$	-	V
Output Voltage Swing (R <sub>L</sub> = 75 $\Omega$ ) (Note 16)	+25°C	$\pm 2$	-	-	V
Full Power Bandwidth (Note 6)	Full	3.8	5.1	-	MHz
Output Current (Note 17)	Full	$\pm 25$	-	-	mA
Disabled Output Current (Note 18)	Full	-	-	860	$\mu A$
Output Resistance	+25°C	-	20	-	$\Omega$
<b>TRANSIENT RESPONSE</b>					
Rise Time (Notes 2, 7)	+25°C	-	7	-	ns
Overshoot (Notes 2, 7)	+25°C	-	10	-	%
Slew Rate (Notes 2, 9)	Full	120	160	-	V/ $\mu s$
Settling Time to 0.1% of $\pm 10V$ Output (Note 8)	+25°C	-	120	-	ns

## Specifications HA-2444

**Electrical Specifications**  $V_+ = +15V$ ,  $V_- = -15V$ ,  $R_L = 1K$ ,  $C_L = 10pF$ ,  $V_{IL} = 0.8V$ ,  $V_{IH} = 2.4V$ . Unless Otherwise Specified. Specifications Apply to All Channels.

PARAMETER	TEMP	HA-2444-5, -9			UNITS
		MIN	TYP	MAX	
<b>SWITCHING CHARACTERISTICS</b>					
Channel Select Time (Note 10)	Full	-	60	100	ns
Output Enable Time (Note 11)	Full	-	40	100	ns
Digital Input Voltages					
$V_{IH}$	Full	2.4	-	-	V
$V_{IL}$	Full	-	-	0.8	V
D0/D1 Input Current					
$(V_{IL} = 0.0V)$	Full	-	0.7	1	mA
$(V_{IH} = 5.0V)$	Full	-	-	1.2	$\mu A$
EN Input Current					
$(V_{IL} = 0.0V)$	Full	-	-	50	$\mu A$
$(V_{IH} = 5.0V)$	Full	-	-	1.2	$\mu A$
Crosstalk Rejection (Note 12)	+25°C	-	60	-	dB
<b>VIDEO PARAMETERS</b>					
Differential Phase (Note 14)	+25°C	-	0.03	-	Degrees
Differential Gain (Note 14)	+25°C	-	0.03	-	%
Gain Flatness (Notes 2, 13) (10MHz)	+25°C	-	0.12	-	dB
Chrominance to Luminance Gain (Note 14)	+25°C	-	0.1	-	dB
Chrominance to Luminance Delay (Note 14)	+25°C	-	7	-	ns
<b>POWER SUPPLY</b>					
$I_{CC}$	Full	-	20	25	mA
$I_{EE}$	Full	-	20	25	mA
Supply Current (Output Disabled) (Note 19)	Full	-	-	10	mA
PSRR (Note 15)	Full	65	80	-	dB

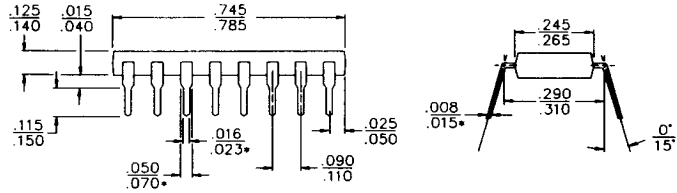
**NOTES:**

1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operation under any of these conditions is not necessarily implied.
2.  $A_V = +1$ .
3.  $V_{OUT} = \pm 5V$ .
4.  $V_{CM} = \pm 5V$ .
5.  $V_{OUT} = \pm 100mV$ .
6. Full Power Bandwidth is calculated by:  

$$FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$$
 $V_{PEAK} = 5V$
7.  $V_{OUT} = 0$  to  $\pm 200mV$ .
8. Settling time to 0.1% with a 10V step. Specified with the channel pre-selected and the output stage enabled.  $A_V = -1$ .
9.  $V_{OUT} = -5V$  to  $+5V$  or  $+5V$  to  $-5V$ .
10. The time required for an enabled HA-2444 to switch from one input channel to another. Measured from the 50% point of the digital input to 4V on the output.  $A_V = +1$  for all channels.  $V_{OUT}$  switches from 0V to 5V.
11. The time required to enable the output with a channel preselected. Measured from the 50% point of the Enable input to 4V on the output.  $A_V = +1$  for all channels.  $V_{IN} = 5V$  for the selected channel.
12.  $V_{IN} = 5V_{p-p}$ ,  $f_o = 5MHz$ , for one of the 3 unselected channels.  $V_{IN} = 0$  for the selected channel.  $A_V = +1$  for all channels.
13.  $V_{IN} = 200mV_{RMS}$ .
14. Tested with a VM700A video tester using a NTC-7 Composite input signal.
15.  $V_S = \pm 15V$  to  $\pm 20V$ .
16. These parameters are not tested. The limits are guaranteed based on lab characterization and reflect lot to lot variation.
17.  $V_{OUT} = \pm 10V$ ,  $V_{EN} = 2.4V$ , 50% Duty Cycle max.
18.  $V_{OUT} = \pm 5V$ ,  $V_{EN} = 0.8V$ .
19. Applies to  $I_{CC}$  and  $I_{EE}$ .  $V_{OUT} = 0V$ ,  $V_{EN} = 0.8V$ .

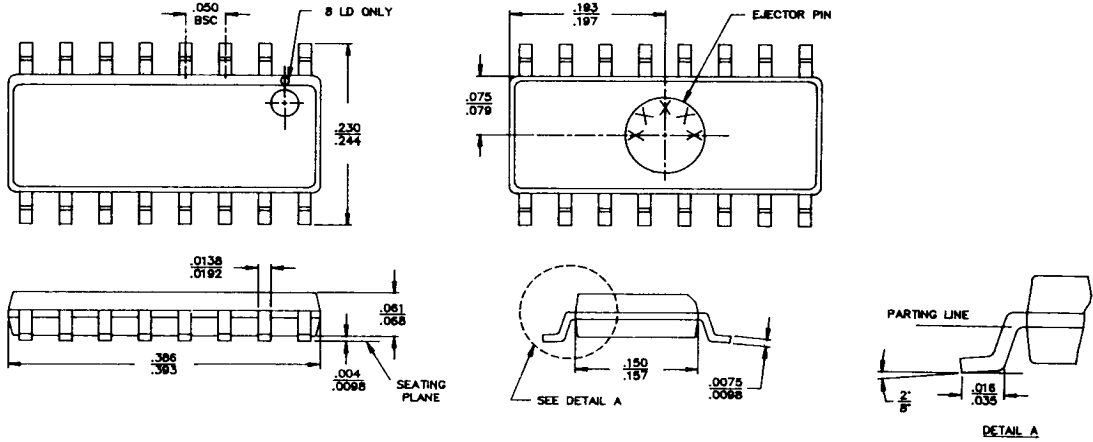
**Packaging**

**16 PIN PLASTIC DIP**



\* ADD .003 INCHES TO DIM FOR SOLDER DIPPED LEADS.

**16 PIN SOIC**



**Ordering Information**

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA3-2444-5	0°C to +75°C	16 Pin Plastic DIP
HA9P-2444-5	0°C to +75°C	16 Pin SOIC
HA3-2444-9	-40°C to +85°C	16 Pin Plastic DIP
HA9P-2444-9	-40°C to +85°C	16 Pin SOIC

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