

July 1995

Features

- Low Power Dissipation 105mW
- Symmetrical Slew Rates 1400V/ μ s
- 0.1dB Gain Flatness..... 100MHz
- -3dB Bandwidth 400MHz
- Off Isolation (100MHz)..... 70dB
- Crosstalk Rejection (30MHz)..... 80dB
- Differential Gain and Phase 0.01%/0.01 Degrees
- High ESD Rating >2000V
- TTL Compatible Control Inputs
- Improved Replacement for GX4314 and GX4314L

Applications

- Professional Video Switching and Routing
- HDTV
- Computer Graphics
- RF Switching and Routing
- PCM Data Routing

Description

The HA4314 is a very wide bandwidth 4 x 1 crosspoint switch ideal for professional video switching, HDTV, computer monitor routing, and other high performance applications. The circuit features very low power dissipation (105mW Enabled, 4mW Disabled), excellent differential gain and phase, and very high off isolation. When disabled, the output is switched to a high impedance state, making the HA4314 ideal for routing matrix equipment.

The HA4314 requires no external current source, and features fast switching and symmetric slew rates.

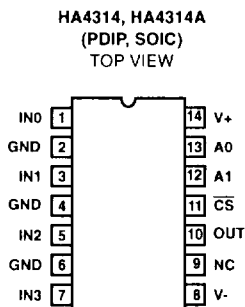
The only difference between the HA4314 and HA4314A is that the A grade part has lower disabled output capacitance.

For a 4 x 1 crosspoint with Tally outputs (channel indicators) or with synchronous control signals, please refer to the HA4404A and HA4344A data sheets, respectively.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HA4314CB	0°C to +70°C	14 Lead Plastic SOIC (N)
HA4314ACP	0°C to +70°C	14 Lead Plastic DIP
HA4314ACB	0°C to +70°C	14 Lead Plastic SOIC (N)

Pinout



Truth Table

$\overline{\text{CS}}$	A1	A0	OUT
0	0	0	IN0
0	0	1	IN1
0	1	0	IN2
0	1	1	IN3
1	X	X	HIGH - Z

Specifications HA4314, HA4314A

Absolute Maximum Ratings

Voltage Between V+ and V-	12V
Input Voltage	V_{SUPPLY}
Digital Input Current (Note 2)	$\pm 25\text{mA}$
Analog Input Current (Note 2)	$\pm 5\text{mA}$
Output Current	20mA
Junction Temperature (Die Only)	+175°C
Junction Temperature (Plastic Package)	+150°C
Lead Temperature (Soldering 10s)	+300°C
(SOIC - Lead Tips Only)	

Operating Conditions

Operating Temperature Range	HA4314C, HA4314AC	0°C \leq T _A \leq +70°C
Storage Temperature		-65°C \leq T _A \leq +150°C
Thermal Package Characteristics (°C/W)		θ_{JA}
Plastic DIP Package		100
SOIC Package		120

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.

Electrical Specifications $V_{SUPPLY} = \pm 5\text{V}$, $R_L = 10\text{k}\Omega$, $V_{DS} = 0.8\text{V}$. Unless Otherwise Specified

PARAMETER	(NOTE 3) TEMPERATURE	HA4314C, HA4314AC			UNITS	
		MIN	TYP	MAX		
DC SUPPLY CHARACTERISTICS						
Supply Voltage	Full	± 4.5	± 5.0	± 5.5	V	
Supply Current ($V_{OUT} = 0\text{V}$)	$V_{DS} = 0.8\text{V}$	+25°C, +70°C	-	10.5	13	mA
	$V_{DS} = 0.8\text{V}$	0°C	-	-	15.5	mA
	$V_{DS} = 2.0\text{V}$	+25°C, +70°C	-	400	450	μA
	$V_{DS} = 2.0\text{V}$	0°C	-	400	580	μA
ANALOG DC CHARACTERISTICS						
Output Voltage Swing without Clipping ($V_{OUT} = V_{IN} \pm V_{IC} \pm 20\text{mV}$)	+25°C, +70°C	± 2.7	± 2.8	-	V	
	0°C	± 2.4	± 2.5	-	V	
Output Current	Full	15	20	-	mA	
Input Bias Current	Full	-	30	50	μA	
Output Offset Voltage	Full	-10	-	10	mV	
Output Offset Voltage Drift (Note 1)	Full	-	25	50	$\mu\text{V}/^\circ\text{C}$	
SWITCHING CHARACTERISTICS						
Turn-On Time	+25°C	-	160	-	ns	
Turn-Off Time	+25°C	-	320	-	ns	
Output Glitch During Switching	+25°C	-	± 10	-	mV	
DIGITAL DC CHARACTERISTICS						
Input Logic High Voltage	Full	2	-	-	V	
Input Logic Low Voltage	Full	-	-	0.8	V	
Input Current (0V to 4V)	Full	-2	-	2	μA	
AC CHARACTERISTICS						
Insertion Loss ($\pm 1\text{V}$)	+25°C	-	0.055	0.063	dB	
	Full	-	0.07	0.08	dB	
Channel-to-Channel Insertion Loss Match	Full	-	± 0.004	± 0.006	dB	
-3dB Bandwidth	$R_S = 50\Omega$, $C_L = 10\text{pF}$	+25°C	-	400	-	MHz
	$R_S = 20\Omega$, $C_L = 20\text{pF}$	+25°C	-	280	-	MHz
	$R_S = 16\Omega$, $C_L = 36\text{pF}$	+25°C	-	140	-	MHz
	$R_S = 13\Omega$, $C_L = 49\text{pF}$	+25°C	-	110	-	MHz

Specifications HA4314, HA4314A

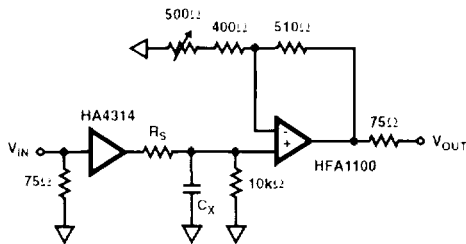
Electrical Specifications $V_{DD} = V_{SS} = +5V$, $R_L = 10k\Omega$, $V_{DS} = 0.8V$, Unless Otherwise Specified (Continued)

PARAMETER	(NOTE 3) TEMPERATURE	HA4314C, HA4314AC			UNITS	
		MIN	TYP	MAX		
+0 dB Flat Bandwidth	$R_S = 50\Omega$, $C_L = 10pF$	+25°C	-	100	-	MHz
	$R_S = 20\Omega$, $C_L = 20pF$	+25°C	-	100	-	MHz
	$R_S = 16\Omega$, $C_L = 36pF$	+25°C	-	85	-	MHz
	$R_S = 13\Omega$, $C_L = 49pF$	+25°C	-	75	-	MHz
Input Resistance	Full	200	400	-	k Ω	
Input Capacitance	Full	-	1.5	-	pF	
Enabled Output Resistance	Full	-	15	-	Ω	
Disabled Output Capacitance ($V_{DS} = 2.0V$)	HA4314	Full	-	6.5	-	pF
	HA4314A	Full	-	2.5	-	pF
Differential Gain (4.43MHz, Note 1)	+25°C	-	0.01	0.02	%	
Differential Phase (4.43MHz, Note 1)	+25°C	-	0.01	0.02	Degrees	
Off Isolation (1V _{rms} , 100MHz, $V_{DS} = 2.0V$, $R_L = 10k\Omega$)	Full	-	70	-	dB	
Crosstalk Rejection (1V _{rms} , 30MHz)	Full	-	80	-	dB	
Slew Rate (1.5V _{rms} , +SR/-SR)	$R_S = 50\Omega$, $C_L = 10pF$	+25°C	-	1425/1450	-	V/ μ s
	$R_S = 20\Omega$, $C_L = 20pF$	+25°C	-	1010/1010	-	V/ μ s
	$R_S = 16\Omega$, $C_L = 36pF$	+25°C	-	725/750	-	V/ μ s
	$R_S = 13\Omega$, $C_L = 49pF$	+25°C	-	600/650	-	V/ μ s
Total Harmonic Distortion (10MHz, $R_L = 1k\Omega$, Note 1)	Full	-	0.01	0.1	%	
Disabled Output Resistance ($V_{DS} = 2.0V$)	Full	-	12	-	M Ω	

NOTES

1. This parameter is not tested. The limits are guaranteed based on lab characterization, and reflect lot-to-lot variation.
2. If an input signal is applied before the supplies are powered up, the input current must be limited to these maximum values.
3. Units are 100% tested at +25°C. Sample tested at +70°C. Guaranteed but not tested at 0°C.

AC Test Circuit



NOTE

1. $C_L = C_X +$ Test Fixture Capacitance.

PC Board Layout

The frequency response of this circuit depends greatly on the care taken in designing the PC board. **The use of low inductance components such as chip resistors and chip capacitors is strongly recommended, while a solid ground plane is a must!**

Attention should be given to decoupling the power supplies. A large value (10 μ F) tantalum in parallel with a small value (0.1 μ F) chip capacitor works well in most cases.

Keep input and output traces as short as possible, because trace inductance and capacitance can easily become the performance limiting items.

Application Information

General

The HA4314 is a 4 x 1 crosspoint switch that is ideal for the matrix element of high performance switchers and routers. This crosspoint's low input capacitance and high input resistance provide excellent video terminations when used with an external 75 Ω resistor. Nevertheless, if several HA4314 inputs are connected together, the use of an input buffer should be considered (see Figure 1). This crosspoint contains no feedback or gain setting resistors, so the output is a true high impedance load when the IC is disabled ($\overline{CS} = 1$).

Ground Connections

All GND pins are connected to a common point on the die, so any one of them will suffice as the functional GND connection. For the best isolation and crosstalk rejection, however, all GND pins must connect to the GND plane.

Frequency Response

Most applications utilizing the HA4314 require a series output resistor, R_S , to tune the response for the specific load capacitance, C_L , driven. Bandwidth and slew rate degrade as C_L increases (as shown in the Electrical Specification table), so give careful consideration to component placement to minimize trace length. In big matrix configurations where C_L is large, better frequency response is obtained by cascading two levels of crosspoints in the case of multiplexed outputs (see Figure 2), or distributing the load between two drivers if C_L is due to bussing and subsequent stage input capacitance.

Control Signals

\overline{CS} - This is a TTL/CMOS compatible, active low Chip Select input. When driven high, \overline{CS} forces the output to a true high impedance state and reduces the power dissipation by a factor of 25. The \overline{CS} input has no on-chip pull-down resistor, so it must be connected to a logic low (recommend GND) if the enable function isn't utilized.

A0, A1 - These are binary coded, TTL/CMOS compatible address inputs that select which one of the four inputs connect to the crosspoint output.

Switcher/Router Applications

Figure 1 illustrates one possible implementation of a wide-band, low power, 4 x 4 switcher/router utilizing the HA4314 for the switch matrix. A 4 x 4 switcher/router allows any of the four outputs to be driven by any one of the four inputs (e.g. each of the four inputs may connect to a different output, or an input may connect to multiple outputs). This application utilizes the HA4600 (video buffer with output disable) for the input buffer, the HA4314 as the switch matrix, and the HFA1112 (programmable gain buffer) as the gain of two output driver. Figure 2 details a 16 x 1 switcher (basically a 16:1 mux) which uses the HA4201 (1 x 1 crosspoint) and the HA4314 in a cascaded stage configuration to minimize capacitive loading at each output node, thus increasing system bandwidth.

Power Up Considerations

No signals should be applied to the analog or digital inputs before the power supplies are activated. Latch-up may occur if the inputs are driven at the time of power up. To prevent latch-up, the input currents during power up must not exceed the values listed in the Absolute Maximum Ratings.

Harris' Crosspoint Family

Harris offers a variety of 4 x 1 and 1 x 1 crosspoint switches. In addition to the HA4314, the 4 x 1 family includes the HA4404 and HA4344. The HA4404 is a 16 lead device with Tally outputs to indicate the selected channel. The HA4344 is a 16 lead crosspoint with synchronized control lines (A0,

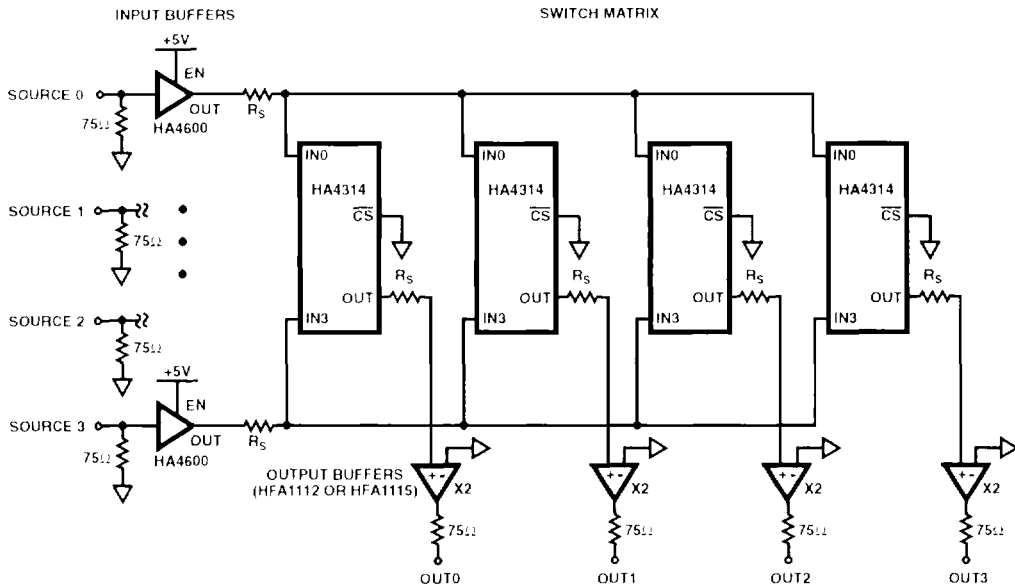


FIGURE 1. 4 x 4 SWITCHER/ROUTER APPLICATION

HA4314, HA4314A

A1, \overline{CS}). With synchronization, the control information for the next channel switch can be loaded into the crosspoint without affecting the current state. On a subsequent clock edge the stored control state effects the desired channel switch.

The 1 x 1 family is comprised of the HA4201 and HA4600. They are essentially similar devices, but the HA4201 includes a Tally output (enable indicator). The 1 x 1s are useful as high performance video input buffers, or in a switch matrix requiring very high off isolation.

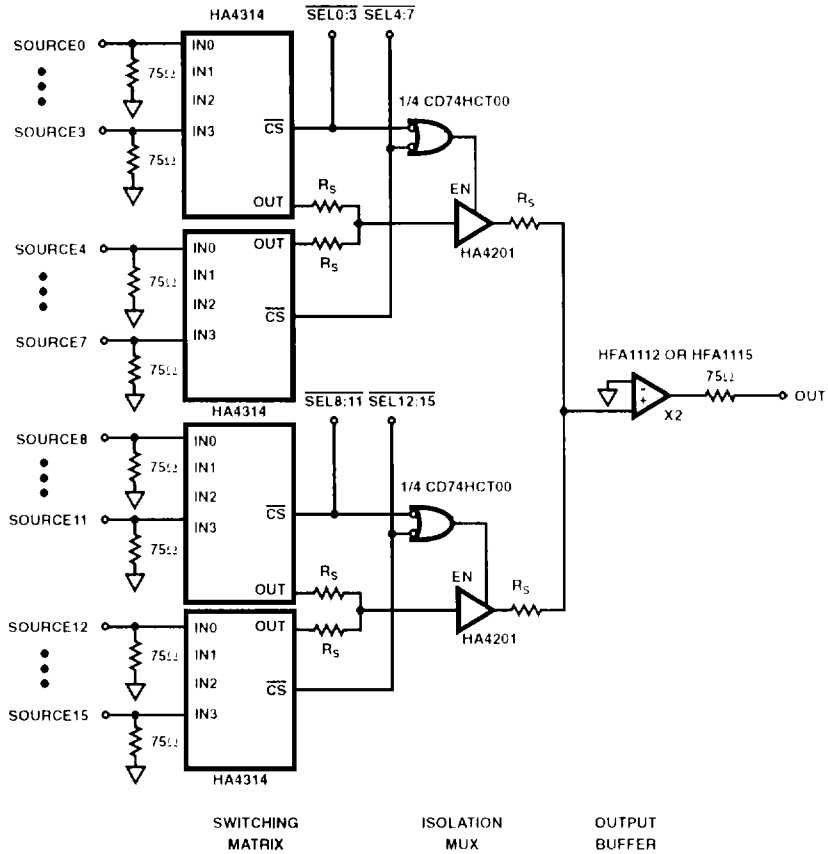


FIGURE 2. 16 x 1 SWITCHER APPLICATION

HA4314, HA4314A

Die Characteristics

DIE DIMENSIONS:

65 x 118 x 19 ±1mil
1640µm x 3000µm x 483µm ±25.4µm

METALLIZATION:

Type: Metal 1: AlCu (1%)/TiW Type: Metal 2: AlCu (1%)
Thickness: Metal 1: 6kÅ ±0.8kÅ Thickness: Metal 2: 16kÅ ±1.1kÅ

GLASSIVATION:

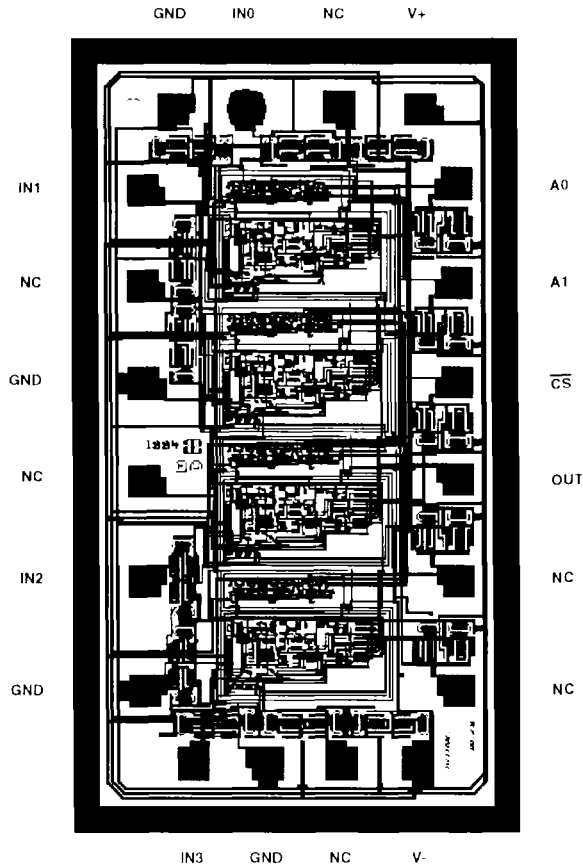
Type: Nitride
Thickness: 4kÅ ±0.5kÅ

TRANSISTOR COUNT: 200

SUBSTRATE POTENTIAL (Powered Up): V-

Metallization Mask Layout

HA4314, HA4314A



HA4314, HA4314A

Typical Performance Curves $V_{SUPPLY} = +5V$, $T_A = +25^{\circ}C$, $R_L = 10k\Omega$, Unless Otherwise Specified

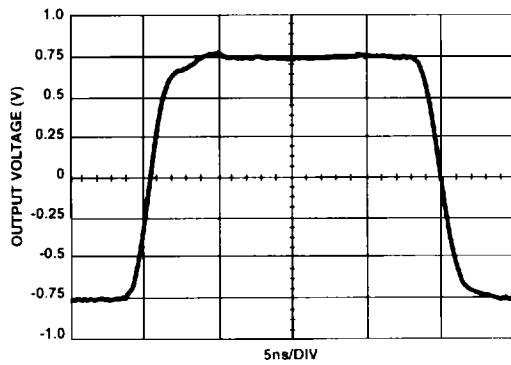


FIGURE 3. LARGE SIGNAL PULSE RESPONSE

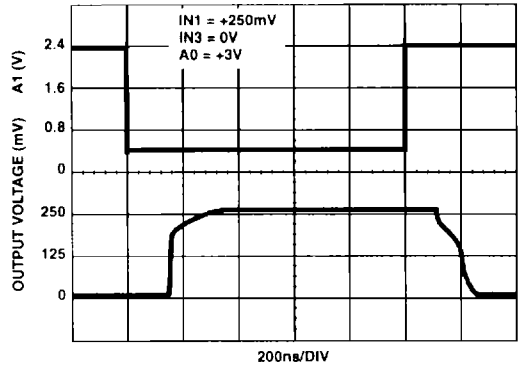


FIGURE 4. CHANNEL-TO-CANNEL SWITCHING RESPONSE

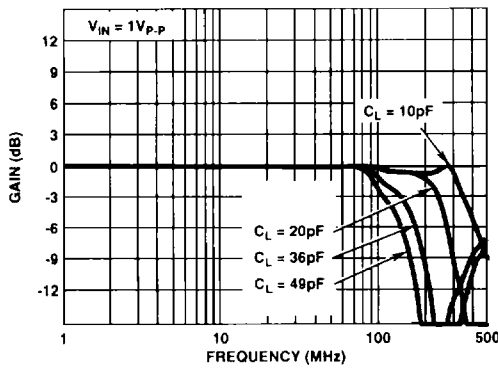


FIGURE 5. FREQUENCY RESPONSE

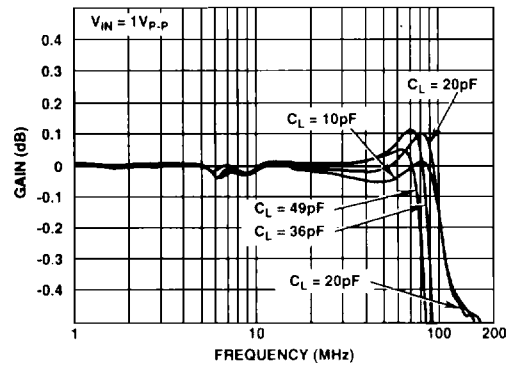


FIGURE 6. GAIN FLATNESS

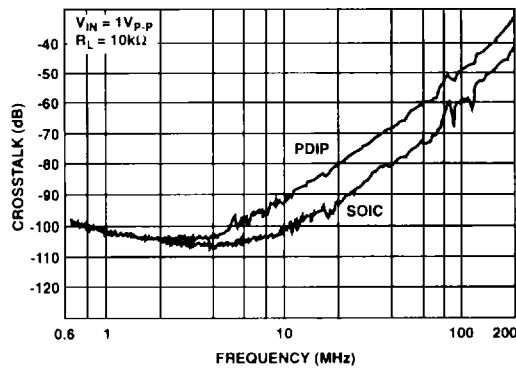


FIGURE 7. ALL HOSTILE CROSSTALK REJECTION

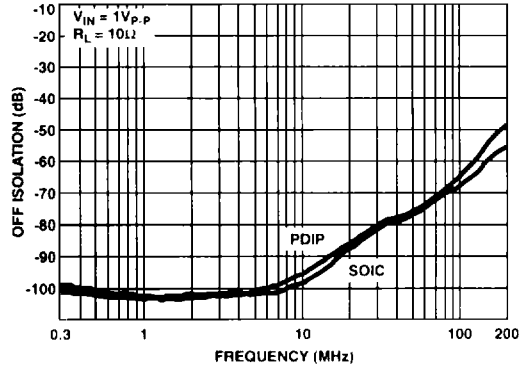


FIGURE 8. ALL HOSTILE OFF ISOLATION

Typical Performance Curves $V_{CC(EP)} = +5V$, $T_A = +25^\circ C$, $R_L = 10k\Omega$, Unless Otherwise Specified (Continued)

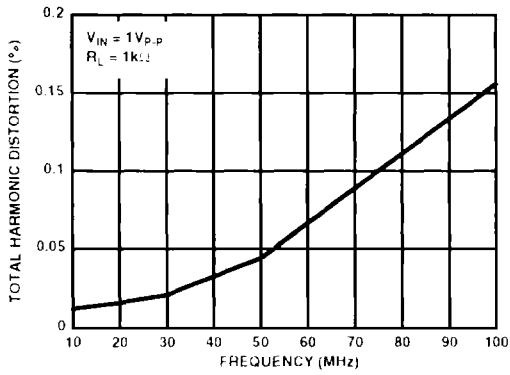


FIGURE 9. TOTAL HARMONIC DISTORTION vs FREQUENCY

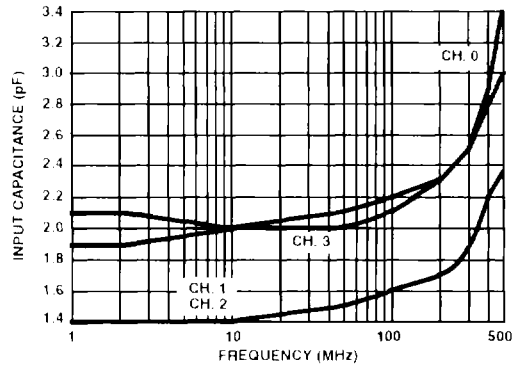


FIGURE 10. INPUT CAPACITANCE vs FREQUENCY