

August 1988

### Features

- This Circuit is Processed in Accordance to Mil-Std-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Crosstalk (7.0MHz) ..... <-56dB
- Fast access Time (Max. Over Temp.) ..... 500ns
- TTL Compatible

### Applications

- Wideband Switching
- Radar
- TV Video
- ECM

### Description

The HI-524/883 is a four channel CMOS analog multiplexer designed to process single-ended signals with bandwidths up to 6.8MHz. The chip includes a 1 of 4 decoder for channel selection and an Enable input to inhibit all channels (chip select).

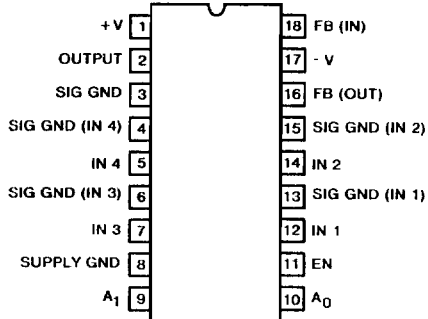
Three CMOS transmission gates are used in each channel, as compared to the single gate in more conventional CMOS multiplexers. This provides a double barrier to the unwanted coupling of signals from each input to the output. In addition, Dielectric Isolation (DI) processing helps to insure that Crosstalk is less than -56dB at 7MHz.

The HI-524/883 is designed to operate into a wideband buffer amplifier such as the Harris HA-2541/883. The multiplexer chip includes two "on" switches in series, for use as a feedback element with the amplifier. This feedback resistance matches and tracks the channel  $R_{ON}$  resistance, to minimize the amplifier  $V_{OS}$  and its variation with temperature.

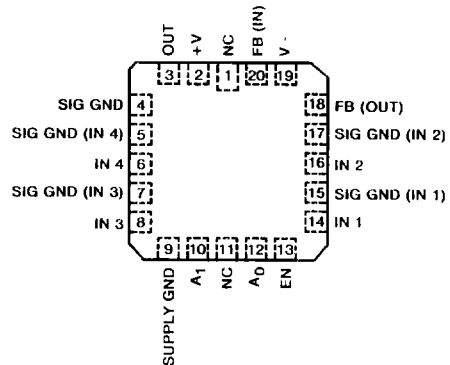
The HI-524/883 is well suited to the rapid switching of video and other wideband signals in telemetry, instrumentation, radar and video systems. It is packaged in an 18 pin Ceramic DIP or 20 pad LCC and operates on  $\pm 15V$  supplies.

### Pinouts

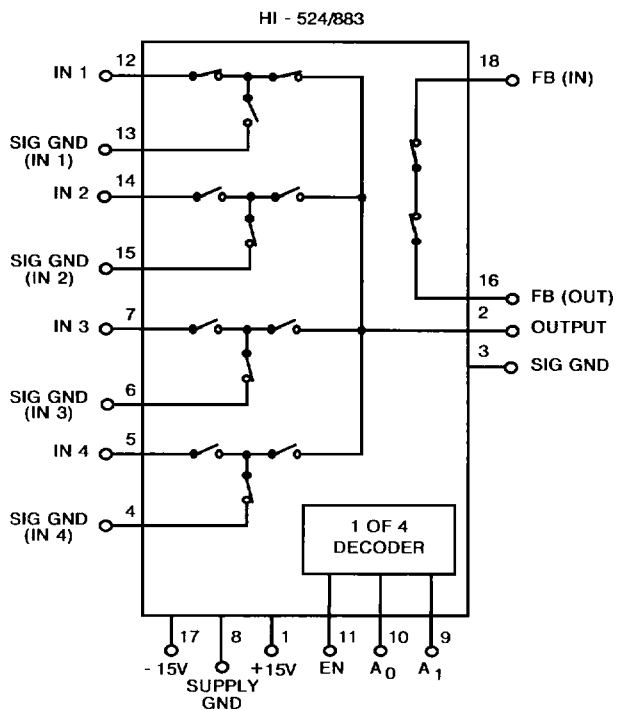
HI1-524/883 (CERAMIC DIP)  
TOP VIEW



HI4-524/883 (CERAMIC LCC)  
TOP VIEW



Functional Diagram



TRUTH TABLE

A1	A0	EN	ON CHANNEL
X	X	L	NONE
L	L	H	1*
L	H	H	2
H	L	H	3
H	H	H	4

\*CHANNEL 1 IS SHOWN  
SELECTED IN THE DIAGRAM

NOTE: Pin Numbers Refer to DIP Package Only.

# Specifications HI-524/883

## Absolute Maximum Ratings

Voltage Between Supply Pins .....	33V
+VSUPPLY to Ground .....	+16.5V
-VSUPPLY to Ground .....	-16.5V
<b>Analog Input Voltage</b>	
+VS .....	+VSUPPLY +2V
-VS .....	-VSUPPLY -2V
<b>Digital Input Voltage</b>	
+VEN, +VA .....	+6V
-VEN, -VA .....	-6V
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (Soldering 10 Seconds) .....	+275°C
Junction Temperature .....	+175°C

## Thermal Information

<b>Thermal Resistance, Junction-to-Case (<math>\theta_{jc}</math>)</b>	
Ceramic DIP Package .....	22°C/W
Ceramic LCC Package .....	19°C/W
<b>Thermal Resistance, Junction-to-Ambient (<math>\theta_{ja}</math>)</b>	
Ceramic DIP Package .....	81°C/W
Ceramic LCC Package .....	76°C/W
<b>Power Dissipation (at +75°C)</b>	
Ceramic DIP Package .....	1.23W
Ceramic LCC Package .....	1.32W
<b>Power Dissipation Derating Factor (Above +75°C)</b>	
Ceramic DIP Package .....	12.3mW/°C
Ceramic LCC Package .....	13.2mW/°C
ESD Classification .....	<2000V

## Recommended Operating Conditions

Operating Temperature Range .....	-55°C to +125°C	Logic Level Low ( $V_{AL}$ ) .....	0V to 0.8V
Operating Supply Voltage ( $\pm V_{SUPPLY}$ ) .....	$\pm 15V$	Logic Level High ( $V_{AH}$ ) .....	2.4V to +VSUPPLY
Analog Input Voltage ( $V_S$ ) .....	$\pm 10V$	Max RMS Current, S or D .....	8mA

**TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Devices Tested at +VSUPPLY = +15V, -VSUPPLY = -15V, VEN = 2.4V, VAH = 2.4V, VAL = +0.8V, Unless Otherwise Specified

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Leakage Current	$I_{IH}$	Measure Inputs Sequentially, Connect all Unused Inputs to GND	1, 2, 3	+25°C, +125°C, -55°C	-1.0	1.0	$\mu A$
	$I_{IL}$	Measure Inputs Sequentially, Connect All Unused Inputs to +5V	1, 2, 3	+25°C, +125°C, -55°C	-20	20	$\mu A$
Leakage Current Into the Source Terminal of an "OFF" Switch	+IS(OFF)	VS = 10V, VD = -10V, VEN = 0.8V All Unused Inputs = -10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
	-IS(OFF)	VS = -10V, VD = 10V, VEN = 0.8V All Unused Inputs = +10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
Leakage Current Into the Drain Terminal of an "OFF" Switch	+ID(OFF)	VS = -10V, VD = +10V, VEN = 0.8V All Unused Inputs = -10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
	-ID(OFF)	VS = +10V, VD = -10V, VEN = 0.8V All Unused Inputs = +10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
Leakage Current From an "ON" Driver Into the Switch (Drain)	+DI(ON)	VS = VD = 10V All Unused Inputs = -10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
	-DI(ON)	VS = VD = -10V All Unused Inputs = +10V	1, 2, 3	+25°C, +125°C, -55°C	-50	+50	nA
Positive Supply Current	I(+)	VS = 0V, VD = Open, VEN = 2.4V Sequence All Address Combinations, Record Highest I (+)	1, 2, 3	+25°C, +125°C, -55°C	-	25	mA
Negative Supply Current	I(-)	VS = 0V, VD = Open, VEN = 2.4V Sequence All Address Combinations, Record Highest I (-)	1, 2, 3	+25°C, +125°C, -55°C	-23	-	mA
Standby Positive Supply Current	+ISBV	VA = 0.8V, VEN = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	-	25	mA
Standby Negative Supply Current	-ISBY	VA = 0.8V, VEN = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	-23	-	mA
Switch "ON" Resistance	RDS	VS = 0V ID = $\pm 100\mu A$	1, 2, 3	+25°C, +125°C, -55°C	-	1500	$\Omega$
Digital Input Threshold Characteristics	VAL		1, 2, 3	+25°C, +125°C, -55°C	-	0.8	V
	VAH		1, 2, 3	+25°C, +125°C, -55°C	2.4	-	V

CAUTION: This device is sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

**TABLE 2. A.C. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Devices Tested at +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, V<sub>AH</sub> = 2.4, V<sub>AL</sub> = 0.8V, Unless Otherwise Specified.

A.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMP	LIMITS		UNITS
					MIN	MAX	
Break-Before-Make Time Delay	t <sub>D</sub>	R <sub>L</sub> = 500Ω, C <sub>L</sub> = 12.5pF	9	+25°C	10	-	ns
			10	+125°C	2	-	ns
Propagation Delay Times: Address Inputs to I/O Channel Times	t <sub>A</sub>	R <sub>L</sub> = 10MΩ, C <sub>L</sub> = 12.5pF	9	+25°C	-	300	ns
			10,11	+125°C, -55°C	-	500	ns
Enable to I/O	t <sub>ON(EN)</sub>	R <sub>L</sub> = 500Ω, C <sub>L</sub> = 12.5pF	9	+25°C	-	300	ns
			10, 11	+125°C, -55°C	-	500	ns
	t <sub>OFF(EN)</sub>	R <sub>L</sub> = 500Ω, C <sub>L</sub> = 12.5pF	9	+25°C	-	250	ns
			10, 11	+125°C, -55°C	-	500	ns

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Characterized at +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, V<sub>AH</sub> = 2.4, V<sub>AL</sub> = 0.8V, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	NOTE	TEMP	LIMITS		UNITS
					MIN	MAX	
Capacitance: Address Input	C <sub>A</sub>	V+ = V- = 0V, f = 1MHz	1	+25°C	-	7	pF
Capacitance: Output Switch	C <sub>OS</sub>	V+ = V- = 0V, f = 1MHz	1	+25°C	-	10	pF
Capacitance: Input Switch	C <sub>IS</sub>	V+ = V- = 0V, f = 1MHz	1	+25°C	-	6	pF
Bandwidth (-3dB)	BW	V <sub>S</sub> = 3Vp-p	1	+25°C	6.8	-	MHz
Crosstalk	C <sub>t</sub>	V <sub>S</sub> = 7MHz, 3Vp-p	1	+25°C	-56	-	dB
Break-Before-Make Time Delay	t <sub>D</sub>	R <sub>L</sub> = 500Ω, C <sub>L</sub> = 12.5pF	1	-55°C	2	-	ns

**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLES 1, 2, & 3)
Interim Electrical Parameters (Pre-Burn-In)	1
Final Electrical Test Parameters	1*, 2, 3, 9, 10, 11
Group A Test Requirements	1, 2, 3, 9, 10, 11
Groups C & D Endpoints	1

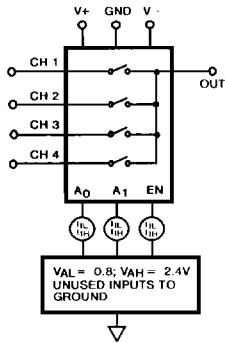
\*PDA applies to Subgroup 1 only. No other subgroups are included in PDA.

NOTE: 1. The parameters listed in this table are controlled via design or process parameters and are not directly tested. These parameters are characterized upon initial design release and upon design changes which would affect these characteristics.

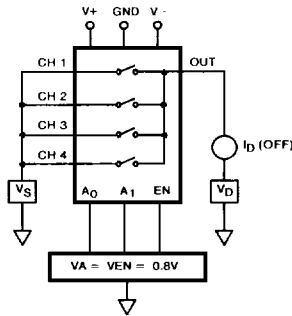
CAUTION: This device is sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

Test Circuits

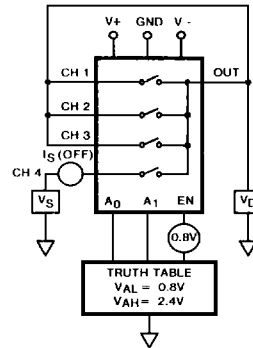
INPUT LEAKAGE CURRENT



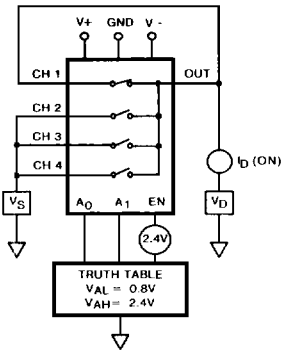
$I_D(OFF)$



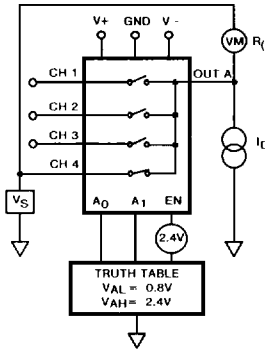
$I_S(OFF)$



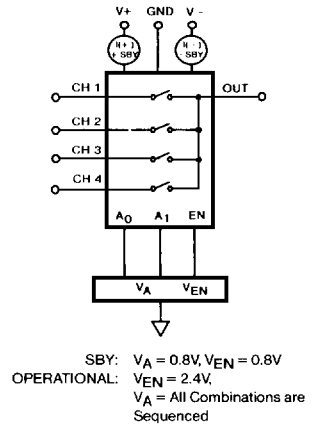
$I_D(ON)$



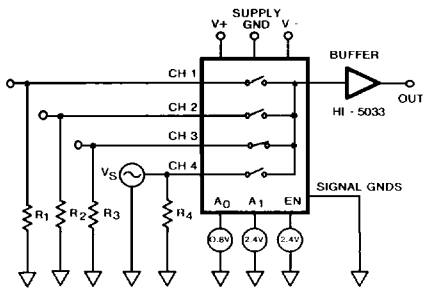
$R_{DS}$



SUPPLY CURRENTS

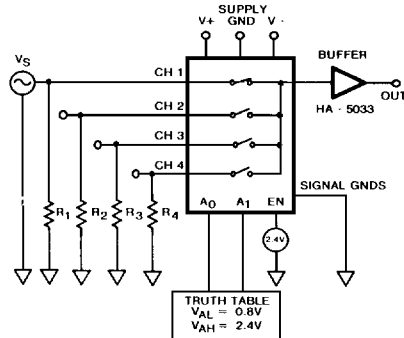


CROSSTALK



NOTE:  $R_1$  thru  $R_4 = 75\Omega$   
Worst Case is Channel Selected with Input On Channel 4

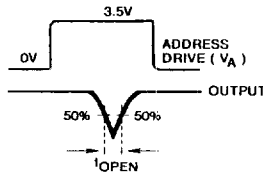
BANDWIDTH



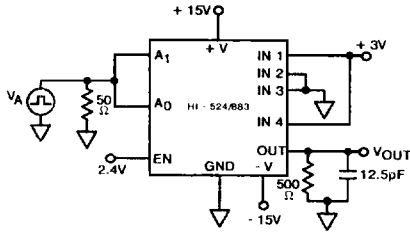
NOTES:  $R_1$  thru  $R_4 = 75\Omega$   
 $V_S$  Applied to Each Channel Separately, Worst Case is Recorded

**Switching Waveforms**

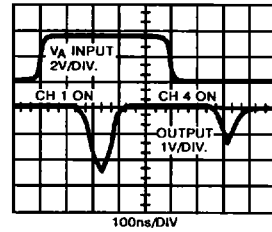
**ADDRESS DRIVE**



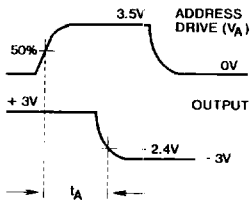
**BREAK-BEFORE-MAKE DELAY ( $t_{OPEN}$ )**



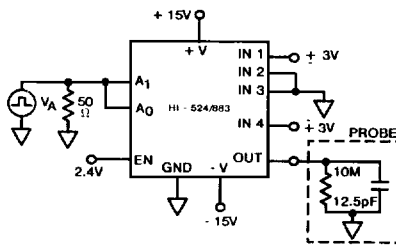
**BREAK-BEFORE-MAKE DELAY ( $t_{OPEN}$ )**



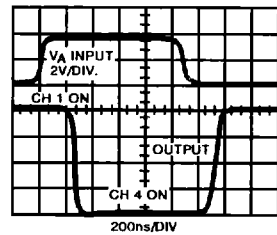
**ADDRESS DRIVE**



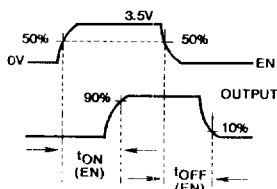
**ACCESS TIME**



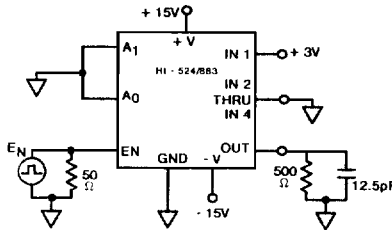
**ACCESS TIME**



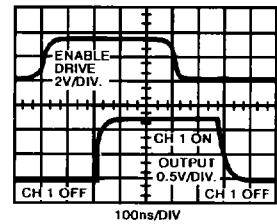
**ENABLE DRIVE**



**ENABLE DELAY  
 $t_{ON(EN)}$ ;  $t_{OFF(EN)}$**

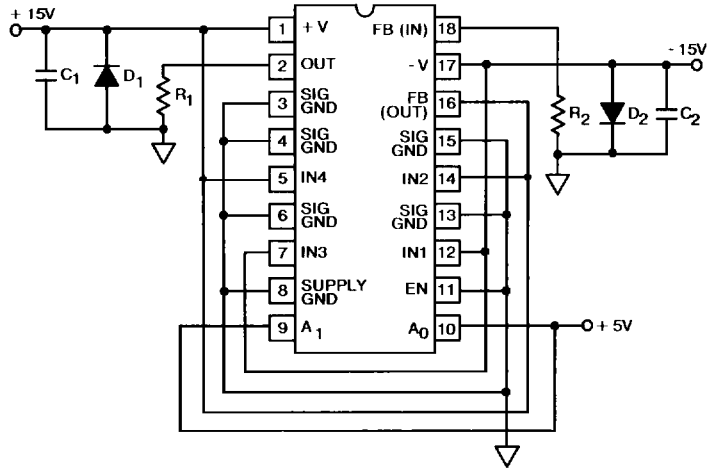


**ENABLE DELAY  
 $t_{ON(EN)}$ ;  $t_{OFF(EN)}$**

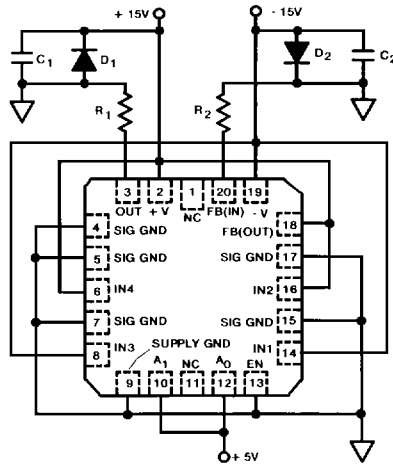


**Burn-In Circuits**

HA-524/883 CERAMIC DIP



HA-524/883 CERAMIC LCC

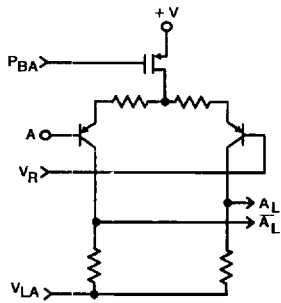


NOTES:

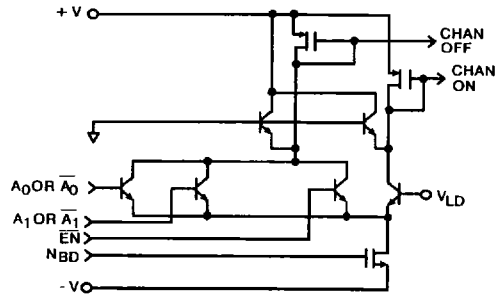
- R<sub>1</sub> = 10kΩ, ±5%, 1/4 or 1/2W (Per Socket)
- R<sub>2</sub> = 10kΩ, ±5%, 1/4 or 1/2W (Per Socket)
- C<sub>1</sub> = 0.01μF/Socket or 0.1μF/Row, (min.)
- C<sub>2</sub> = 0.01μF/Socket or 0.1μF/Row, (min.)
- D<sub>1</sub> = D<sub>2</sub> = 1N4002 or Equivalent/Board

**Schematic Diagrams**

**ADDRESS/ENABLE INPUT BUFFER**

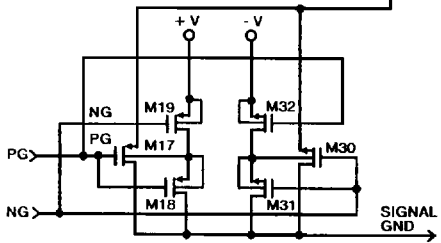
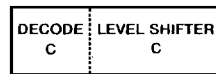
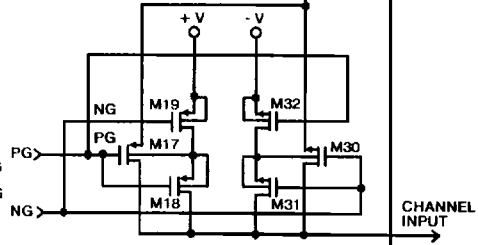
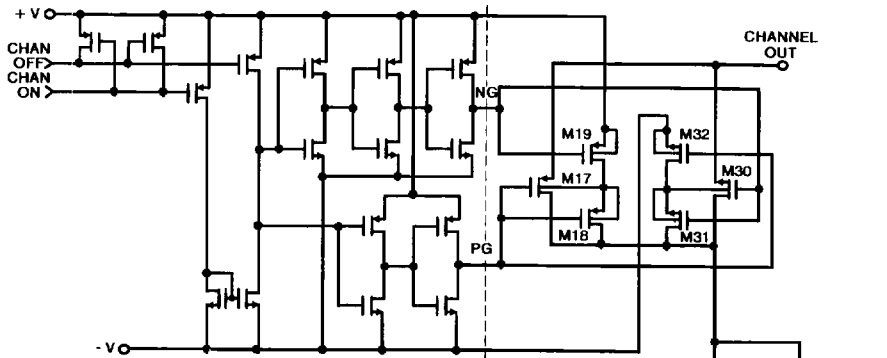


**A-DECODE**



**A-LEVEL SHIFTER**

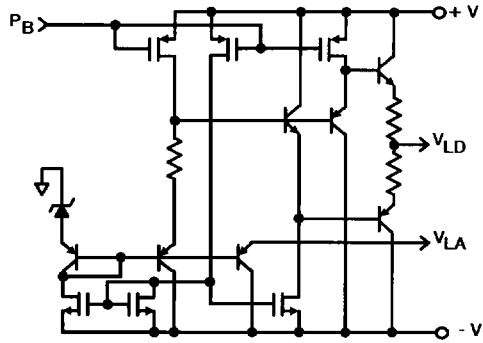
**A-SWITCH CELL**



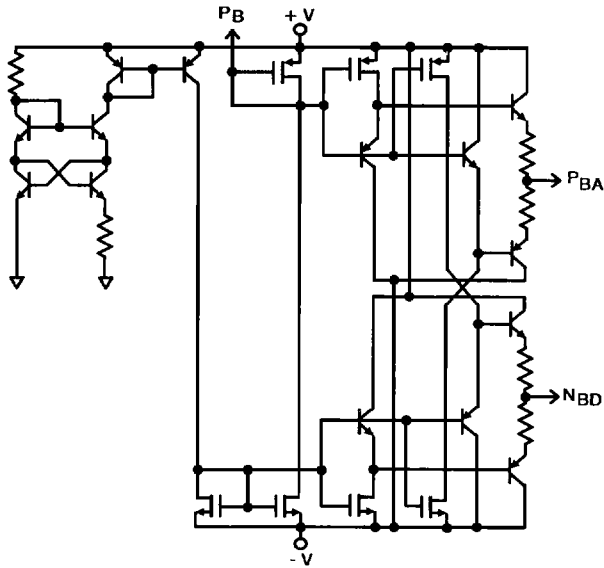


Schematic Diagrams (Continued)

REFERENCE VOLTAGES



BIAS



**Die Characteristics**

**DIE DIMENSIONS:**

146 x 89 x 19 mils  
(3710 x 2260 x 483 μm)

**METALLIZATION:**

Type: Aluminum  
Thickness: 16kÅ ± 2kÅ

**WORST CASE CURRENT DENSITY:**

2 x 10<sup>5</sup>A/cm<sup>2</sup>

**GLASSIVATION:**

Type: Nitride  
Thickness: 7kÅ ± 0.7kÅ

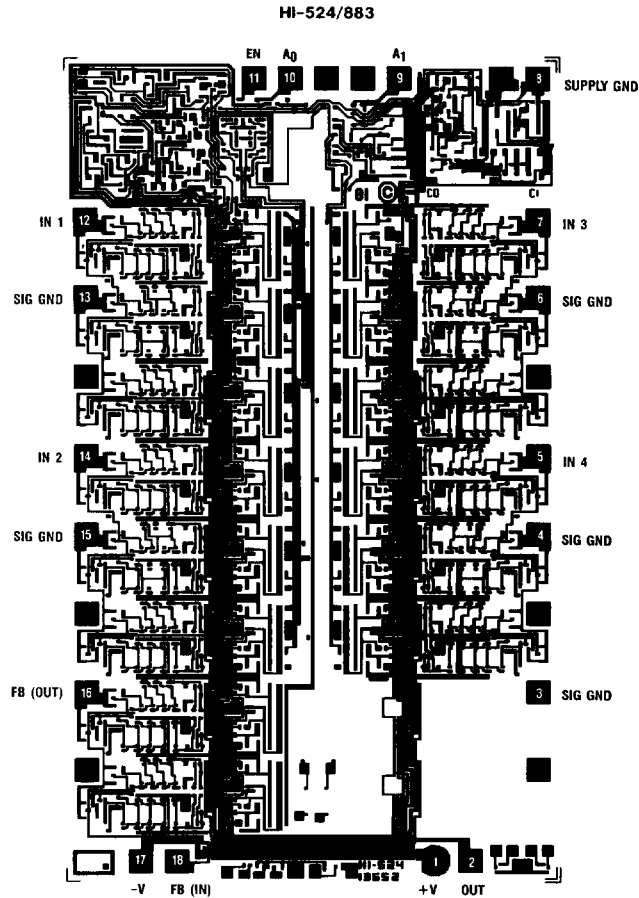
**TRANSISTOR COUNT: 599**

**PROCESS: CMOS-DI**

**DIE ATTACH:**

Material: Gold/Silicon Eutectic Alloy  
Temperature: Ceramic DIP — 460°C (Max)  
Ceramic LCC — 420°C (Max)

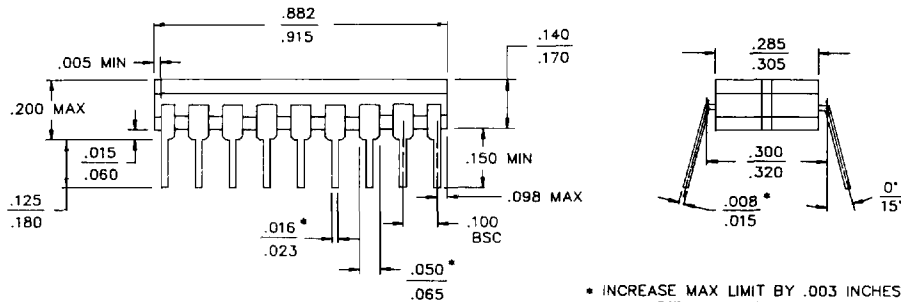
**Metallization Mask Layout**



NOTE: Pin Numbers Correspond to DIP Package Only.

**Packaging†**

**18 PIN CERAMIC DIP**

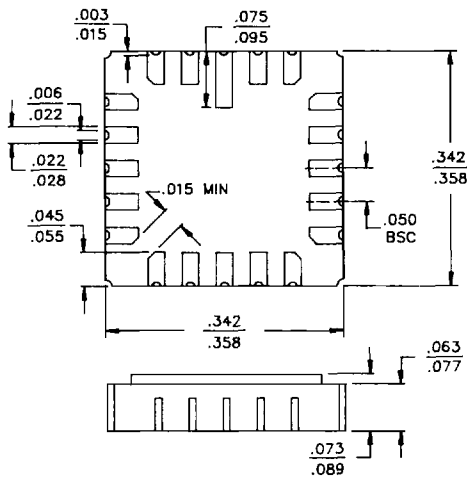


\* INCREASE MAX LIMIT BY .003 INCHES MEASURED AT CENTER OF FLAT FOR SOLDER FINISH

**LEAD MATERIAL:** Type B  
**LEAD FINISH:** Type A  
**PACKAGE MATERIAL:** Ceramic, 90% Alumina  
**PACKAGE SEAL:**  
 Material: Glass Frit  
 Temperature: 450°C ± 10°C  
 Method: Furnace Seal

**INTERNAL LEAD WIRE:**  
 Material: Aluminum  
 Diameter: 1.25 Mil  
 Bonding Method: Ultrasonic  
**COMPLIANT OUTLINE:** 38510 D-6

**20 PAD CERAMIC LCC**



**PAD MATERIAL:** Type C  
**PAD FINISH:** Type A  
**FINISH DIMENSION:** Type A  
**PACKAGE MATERIAL:** Multilayer Ceramic, 90% Alumina  
**PACKAGE SEAL:**  
 Material: Gold/Tin (80/20)  
 Temperature: 320°C ± 10°C  
 Method: Furnace Braze

**INTERNAL LEAD WIRE:**  
 Material: Aluminum  
 Diameter: 1.25 Mil  
 Bonding Method: Ultrasonic  
**COMPLIANT OUTLINE:** 38510 C-2

NOTE: All Dimensions are  $\frac{\text{Min}}{\text{Max}}$ , Dimensions are in inches.

† Mil-M-38510 Compliant Materials, Finishes, and Dimensions.

## DESIGN INFORMATION

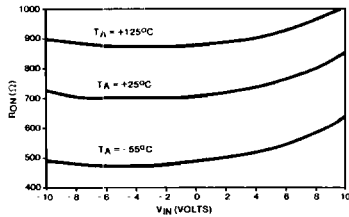
## 4 Channel Wideband Multiplexer

The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design data only. No guarantee is implied.

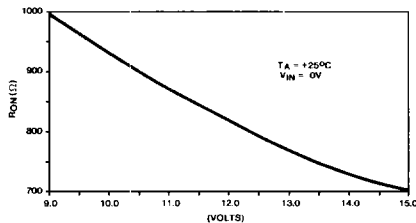
### Typical Performance Characteristics

Unless Otherwise Specified:  $T_A = +25^\circ\text{C}$ ,  $V_{\text{SUPPLY}} = \pm 15\text{V}$ ,  $V_{\text{AH}} = +2.4\text{V}$ ,  $V_{\text{AL}} = 0.8\text{V}$ , Pin Numbers Refer to DIP.

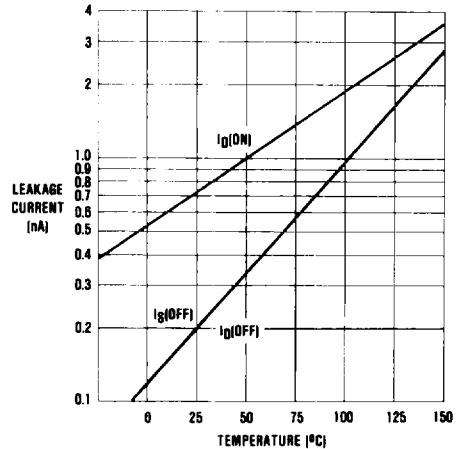
**ON RESISTANCE vs. ANALOG INPUT VOLTAGE, TEMPERATURE**



**ON RESISTANCE vs. SUPPLY VOLTAGE**

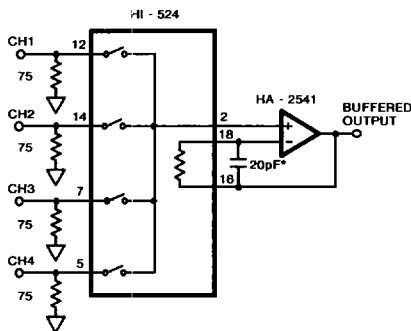


**LEAKAGE CURRENT vs. TEMPERATURE**



### Applications

Often it is desirable to buffer the HI-524 output, to avoid loading errors due to the channel "ON" resistance:



\*Capacitor value may be selected to optimize AC performance.

The buffer amplifier should offer sufficient bandwidth and slew rate to avoid degradation of the anticipated signals. For video switching, the HA-5033 and HA-2542 offer good performance plus  $\pm 100\text{mA}$  output current for driving coaxial cables. For general wideband applications, the HA-2541 offers the convenience of unity gain

stability plus 90ns settling (to  $\pm 0.1\%$ ) and  $\pm 10\text{V}$  output swing. Also, the HI-524 includes a feedback resistance for use with the HA-2541. This resistance matches and tracks the channel "ON" resistance, to minimize offset voltage due to the buffer's bias currents.

Note that the on-chip feedback element between pins 16 and 18 includes two switches in series, to simulate a channel resistance. These switches open for  $V_{\text{EN}} = \text{Low}$ . This allows two or more HI-524's to operate into one HA-2541, with their feedback elements connected in parallel. Thus, only the selected multiplexer provides feedback and the amplifier remains stable.

All HI-524 package pins labeled 'SIG GND' (pins 3, 4, 6, 13, 15) should be externally connected to signal ground for best crosstalk performance.

Bypass capacitors (0.1 to  $1.0\mu\text{F}$ ) are recommended from each HI-524 supply pin to power ground (pins 1 and 17 to pin 8). Locate the buffer amplifier near the HI-524 so the two capacitors may bypass both devices.

If an analog input 1V or greater is present when supplies are off, a low resistance is seen from that input to a supply line. (For example, the resistance is approximately  $160\Omega$  for an input of  $-3\text{V}$ .) Current flow may be blocked by a diode in each supply line, or limited by a resistor in series with each channel. The best solution, of course, is to arrange that no digital or analog inputs are present when the power supplies are off.