

16-Channel/Differential 8-Channel, CMOS High Speed Analog Multiplexer

The HI-516 is a monolithic, dielectrically isolated, high-speed, high-performance CMOS analog multiplexer. It offers unique built-in channel selection decoding plus an inhibit input for disabling all channels. The dual function of address input A_3 enables the HI-516 to be user programmed either as a single ended 16-Channel multiplexer by connecting 'out A' to 'out B' and using A_3 as a digital address input, or as an 8-Channel differential multiplexer by connecting A_3 to the V_- supply. The substrate leakages and parasitic capacitances are reduced substantially by using the Harris Dielectric Isolation process to achieve optimum performance in both high and low level signal applications. The low output leakage current ($I_{D(OFF)} < 100\text{pA}$ at 25°C) and fast settling ($t_{SETTLE} = 800\text{ns}$ to 0.01%) characteristics of the device make it an ideal choice for high speed data acquisition systems, precision instrumentation, and industrial process control.

For MIL-STD-883 compliant parts, request the HI-516/883 data sheet.

Ordering Information

PART NUMBER	TEMP. RANGE ($^\circ\text{C}$)	PACKAGE	PKG. NO.
HI3-0516-5	0 to 75	28 Ld PDIP	E28.6
HI1-0516-2	-55 to 125	28 Ld Cerdip	F28.6

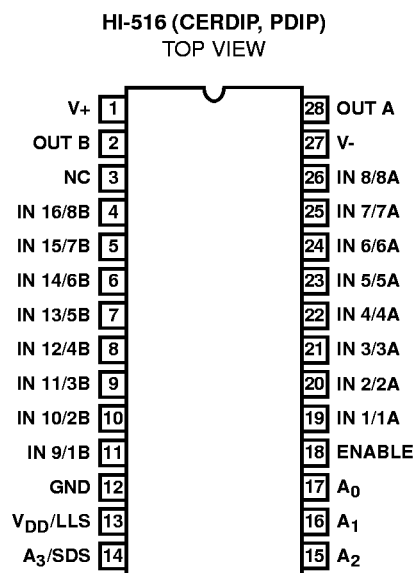
Features

- Access Time (Typical) 130ns
- Settling Time 250ns (0.1%)
- Low Leakage (Typical)
 - $I_{S(OFF)}$ 10pA
 - $I_{D(OFF)}$ 30pA
- Low Capacitance (Max)
 - $C_{S(OFF)}$ 10pF
 - $C_{D(OFF)}$ 25pF
- Off Isolation at 500kHz 55dB (Min)
- Low Charge Injection Error 20mV
- Single Ended to Differential Selectable (SDS)
- Logic Level Selectable (LLS)

Applications

- Data Acquisition Systems
- Precision Instrumentation
- Industrial Control

Pinout



Truth Tables

HI-516 USED AS A 16-CHANNEL MULTIPLEXER OR
DUAL 8-CHANNEL MULTIPLEXER (NOTE 1)

USE A ₃ AS DIGITAL ADDRESS INPUT					ON CHANNEL TO	
ENABLE	A ₃	A ₂	A ₁	A ₀	OUT A	OUT B
L	X	X	X	X	None	None
H	L	L	L	L	1A	None
H	L	L	L	H	2A	None
H	L	L	H	L	3A	None
H	L	L	H	H	4A	None
H	L	L	L	L	5A	None
H	L	L	L	H	6A	None
H	L	L	H	L	7A	None
H	L	L	H	H	8A	None
H	H	L	L	L	None	1B
H	H	L	L	H	None	2B
H	H	L	H	L	None	3B
H	H	L	H	H	None	4B
H	H	H	L	L	None	5B
H	H	H	L	H	None	6B
H	H	H	H	L	None	7B
H	H	H	H	H	None	8B

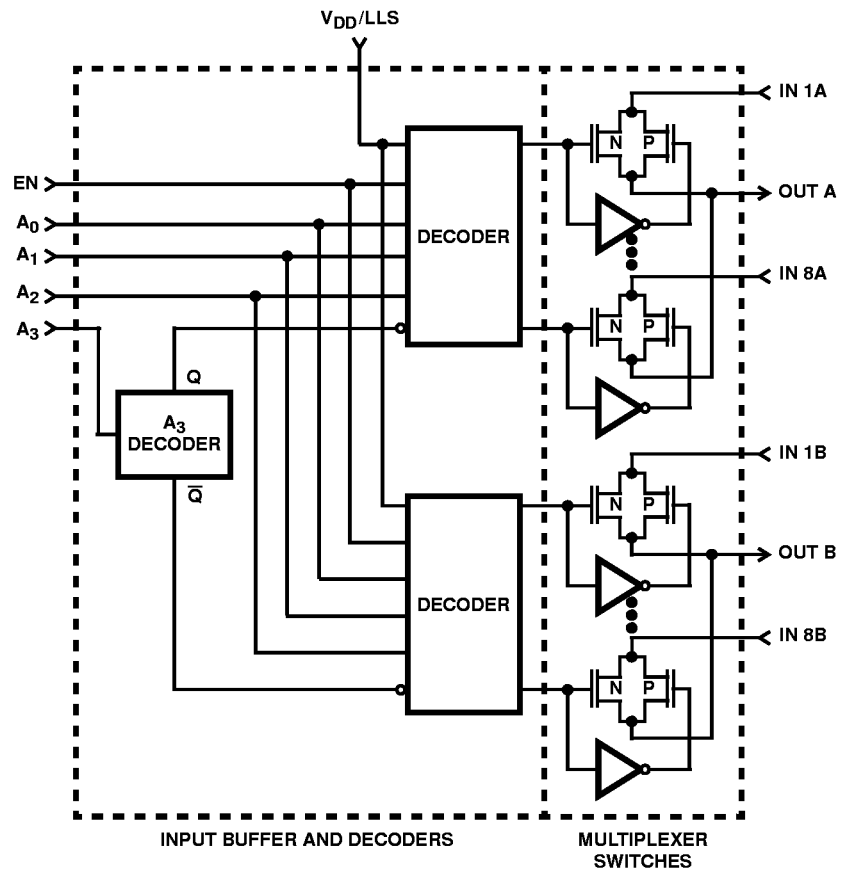
NOTE:

1. For 16-channel single-ended function, tie 'out A' to 'out B'; for dual 8-channel function use the A₃ address pin to select between MUX A and MUX B, where MUX A is selected with A₃ low.

HI-516 USED AS A DIFFERENTIAL 8-CHANNEL MULTIPLEXER

A ₃ CONNECTED TO V- SUPPLY				ON CHANNEL TO	
ENABLE	A ₂	A ₁	A ₀	OUT A	OUT B
L	X	X	X	None	None
H	L	L	L	1A	1B
H	L	L	H	2A	2B
H	L	H	L	3A	3B
H	L	H	H	4A	4B
H	H	L	L	5A	5B
H	H	L	H	6A	6B
H	H	H	L	7A	7B
H	H	H	H	8A	8B

Functional Block Diagram



A ₃ DECODE		
A ₃	Q	$\bar{Q}$
H	H	L
L	L	H
V-	L	L

Absolute Maximum Ratings

V+ to V- 33V
 Analog Signal (V_{IN}, V_{OUT})
 (V-) -2V to (V+) +2V
 Digital Input Voltage:
 TTL Levels Selected (V_{DD}/LLS Pin = GND or Open)
 V_{A0-2} -6V to +6V
 V_{A3}/SDS (V-) -2V to (V+) +2V
 CMOS Levels Selected (V_{DD}/LLS Pin = V_{DD})
 V_{A0-3} -2V to (V+) +2V

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
PDIP Package	60	N/A
CERDIP Package	55	18
Maximum Junction Temperature		
Ceramic Package	175°C	
Plastic Package	150°C	
Maximum Storage Temperature Range	-65°C to 150°C	
Maximum Lead Temperature (Soldering 10s)	300°C	

Operating Conditions

Temperature Ranges
 HI-516-2 -55°C to 125°C
 HI-516-5 0°C to 75°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.

NOTE:

2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications Supplies = +15V, -15V; V_{AH} (Logic Level High) = 2.4V, V_{AL} (Logic Level Low) = 0.8V;
 V_{DD}/LLS = GND. (Note 3) Unless Otherwise Specified

PARAMETER	TEST CONDITIONS	TEMP (°C)	-2			-5			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
DYNAMIC CHARACTERISTICS									
Access Time, t _A		25	-	130	175	-	130	175	ns
		Full	-	-	225	-	-	225	ns
Break-Before-Make Delay, t _{OPEN}		25	10	20	-	10	20	-	ns
Enable Delay (ON), t _{ON(EN)}		25	-	120	175	-	120	175	ns
Enable Delay (OFF), t _{OFF(EN)}		25	-	140	175	-	140	175	ns
Settling Time	To 0.1%	25	-	250	-	-	250	-	ns
	To 0.01%	25	-	800	-	-	800	-	ns
Charge Injection Error	Note 6	25	-	-	20	-	-	20	mV
Off Isolation	Note 7	25	55	-	-	55	-	-	dB
Channel Input Capacitance, C _{S(OFF)}		25	-	-	10	-	-	10	pF
Channel Output Capacitance, C _{D(OFF)}		25	-	-	25	-	-	25	pF
Digital Input Capacitance, C _A		25	-	-	10	-	-	10	pF
Input to Output Capacitance, C _{DS(OFF)}		25	-	0.02	-	-	0.02	-	pF
DIGITAL INPUT CHARACTERISTICS									
Input Low Threshold, V _{AL} (TTL)	Note 3	Full	-	-	0.8	-	-	0.8	V
Input High Threshold, V _{AH} (TTL)	Note 3	Full	2.4	-	-	2.4	-	-	V
Input Low Threshold, V _{AL} (CMOS)	Note 3	Full		-	0.3V _{DD}	-	-	0.3V _{DD}	V
Input High Threshold, V _{AH} (CMOS)	Note 3	Full	0.7V _{DD}	-	-	0.7V _{DD}	-	-	V

Electrical Specifications Supplies = +15V, -15V; V_{AH} (Logic Level High) = 2.4V, V_{AL} (Logic Level Low) = 0.8V; V_{DD}/LLS = GND. (Note 3) Unless Otherwise Specified **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP (°C)	-2			-5			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Input Leakage Current, I_{AH} (High)		Full	-	-	1	-	-	1	μA
Input Leakage Current, I_{AL} (Low)		Full	-	-	25	-	-	25	μA
ANALOG CHANNEL CHARACTERISTICS									
Analog Signal Range, V_{IN}	Note 4	Full	-14	-	+14	-15	-	+15	V
On Resistance, r_{ON}	Note 5	25	-	620	750	-	620	750	Ω
		Full	-	-	1,000	-	-	1,000	Ω
Off Input Leakage Current, $I_{S(OFF)}$		25	-	0.01	-	-	0.01	-	nA
		Full	-	-	50	-	-	50	nA
Off Output Leakage Current, $I_{D(OFF)}$		25	-	0.03	-	-	0.03	-	nA
		Full	-	-	100	-	-	100	nA
On Channel Leakage Current, $I_{D(ON)}$		25	-	0.04	-	-	0.04	-	nA
POWER SUPPLY CHARACTERISTICS									
Power Dissipation, P_D		Full	-	-	750	-	-	900	mW
I_+ , Current	$V_{EN} = 2.4V$	Full	-	-	25	-	-	30	mA
I_- , Current		Full	-	-	25	-	-	30	mA

NOTES:

- V_{DD}/LLS pin = open or grounded for TTL compatibility. V_{DD}/LLS pin = V_{DD} for CMOS compatibility.
- At temperatures above 90°C, care must be taken to assure V_{IN} remains at least 1V below the V_{SUPPLY} for proper operation.
- $V_{IN} = \pm 10V$, $I_{OUT} = -100\mu A$.
- $V_{IN} = 0V$, $C_L = 100pF$, enable input pulse = 3V, $f = 500kHz$.
- $V_{EN} = 0.8V$, $V_{IN} = 3V_{RMS}$, $f = 500kHz$, $C_L = 40pF$, $R_L = 1K$, Pin 3 grounded.

Test Circuits and Waveforms $V_{DD}/LLS = GND$, Unless Otherwise Specified.

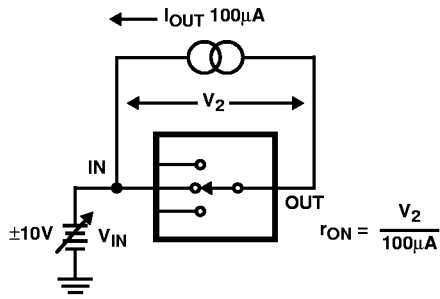


FIGURE 1. ON RESISTANCE TEST CIRCUIT

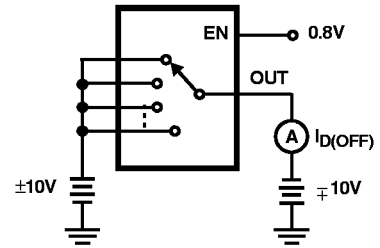


FIGURE 2. $I_{D(OFF)}$ TEST CIRCUIT (NOTE 8)

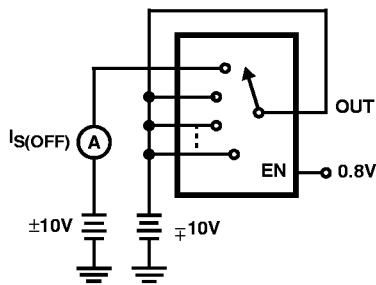


FIGURE 3. $I_{S(OFF)}$ TEST CIRCUIT (NOTE 8)

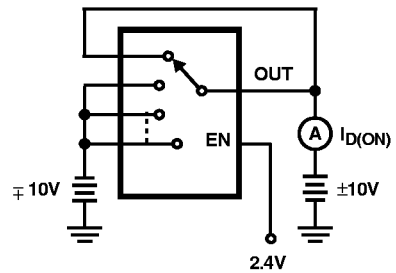


FIGURE 4. $I_{D(ON)}$ TEST CIRCUIT (NOTE 8)

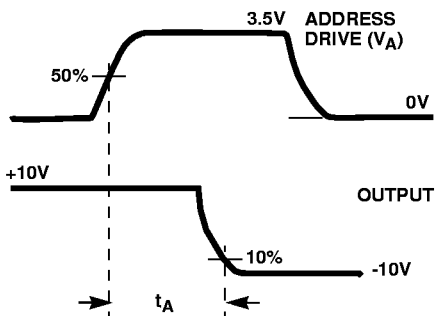


FIGURE 5A. MEASUREMENT POINTS

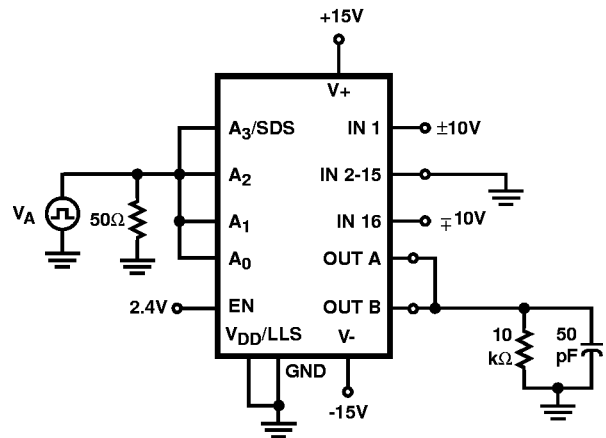


FIGURE 5B. TEST CIRCUIT

FIGURE 5. ACCESS TIME

NOTE:

8. Two measurements per channel: $\pm 10V$ and $\mp 10V$. (Two measurements per device for $I_{D(OFF)}$ $\pm 10V$ and $\mp 10V$).

Test Circuits and Waveforms $V_{DD}/LLS = GND$, Unless Otherwise Specified. (Continued)

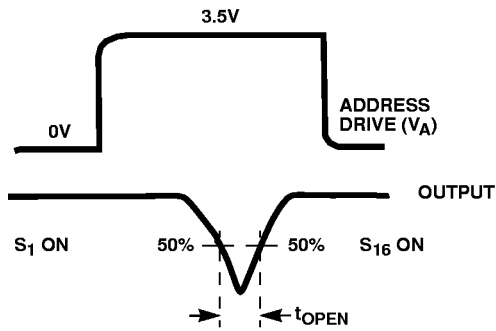


FIGURE 6A. MEASUREMENT POINTS

FIGURE 6. BREAK-BEFORE-MAKE DELAY

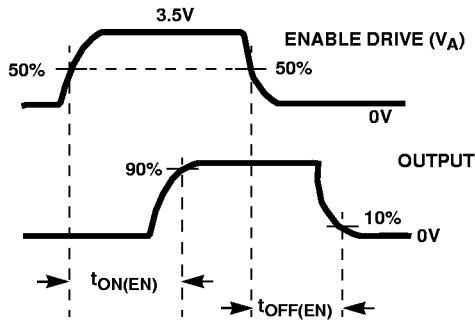


FIGURE 7A. MEASUREMENT POINTS

FIGURE 7. ENABLE DELAYS

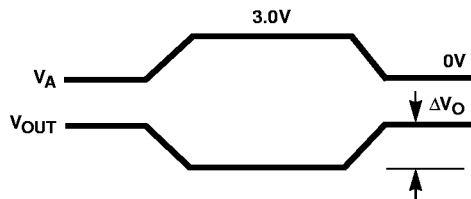


FIGURE 8A. MEASUREMENT POINTS

ΔV_O is the measured voltage error due to charge injection. The error in coulombs is $Q = C_L \times \Delta V_O$.

FIGURE 8. CHARGE INJECTION

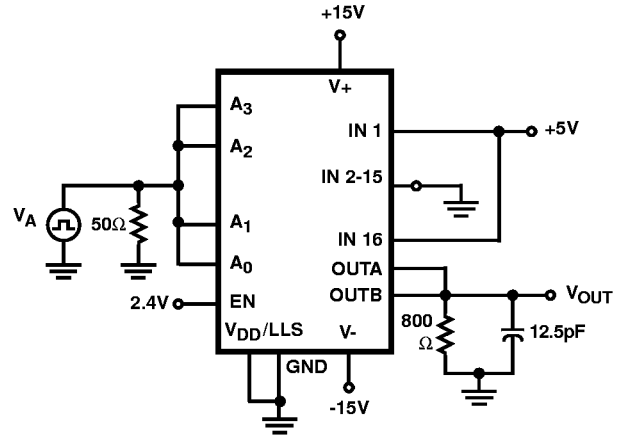


FIGURE 6B. TEST CIRCUIT

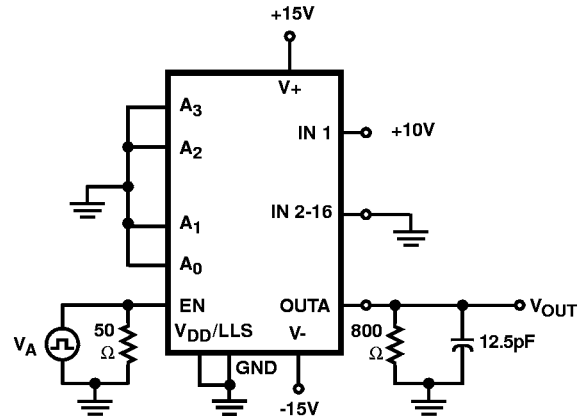


FIGURE 7B. TEST CIRCUIT

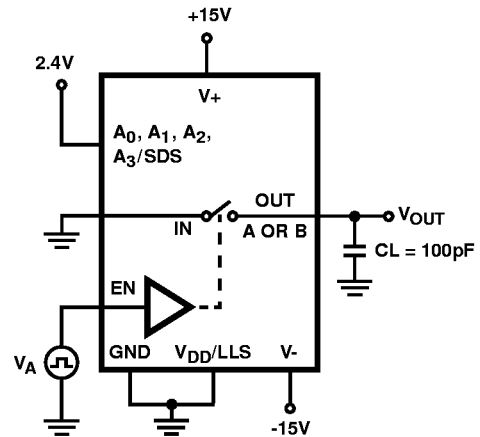


FIGURE 8B. TEST CIRCUIT

Die Characteristics

DIE DIMENSIONS:

2250 μ m x 3720 μ m x 485 μ m

METALLIZATION:

Type: CuAl

Thickness: 16k $\text{\AA}$ $\pm$ 2k $\text{\AA}$

PASSIVATION:

Type: Nitride Over Silox

Nitride Thickness: 3.5k $\text{\AA}$ $\pm$ 1k $\text{\AA}$

Silox Thickness: 12k $\text{\AA}$ $\pm$ 2k $\text{\AA}$

WORST CASE CURRENT DENSITY:

1.64 x 10⁵ A/cm²

Metallization Mask Layout

HI-516

