

8 Channel/Differential 4 Channel CMOS High Speed Analog Multiplexer

December 1993

Features

- Access Time (Typical) 130ns
- Settling Time 250ns (0.1%)
- Low Leakage (Typical)
 - $I_{S(OFF)}$ 10pA
 - $I_{D(OFF)}$ 15pA
- Low Capacitance (Max)
 - $C_{S(OFF)}$ 5pF
 - $C_{D(OFF)}$ 10pF
- Off Isolation at 500kHz 45dB (Min)
- Low Charge Injection Error 25mV
- Single Ended to Differential Selectable (SDS)
- Logic Level Selectable (LLS)

Applications

- Data Acquisition Systems
- Precision Instrumentation
- Industrial Control

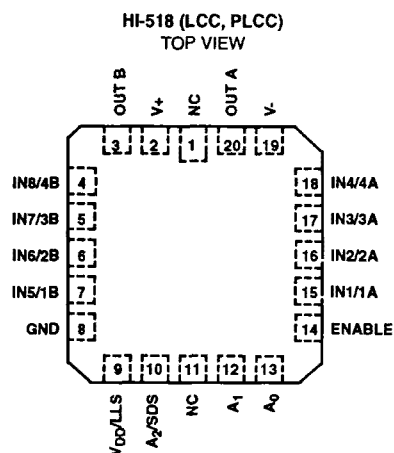
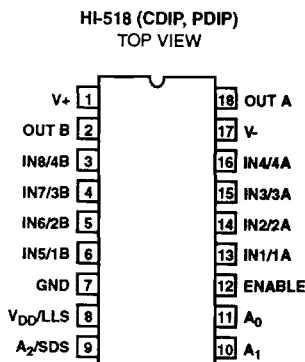
Description

The HI-518 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_2 enables the HI-518 to be user programmed either as a single ended 8-channel multiplexer by connecting 'out A' to 'out B' and using A_2 as a digital address input, or as a 4-channel differential multiplexer by connecting A_2 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 ($I_{DOFF} < 100\text{pA}$ at $+25^\circ\text{C}$) 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.

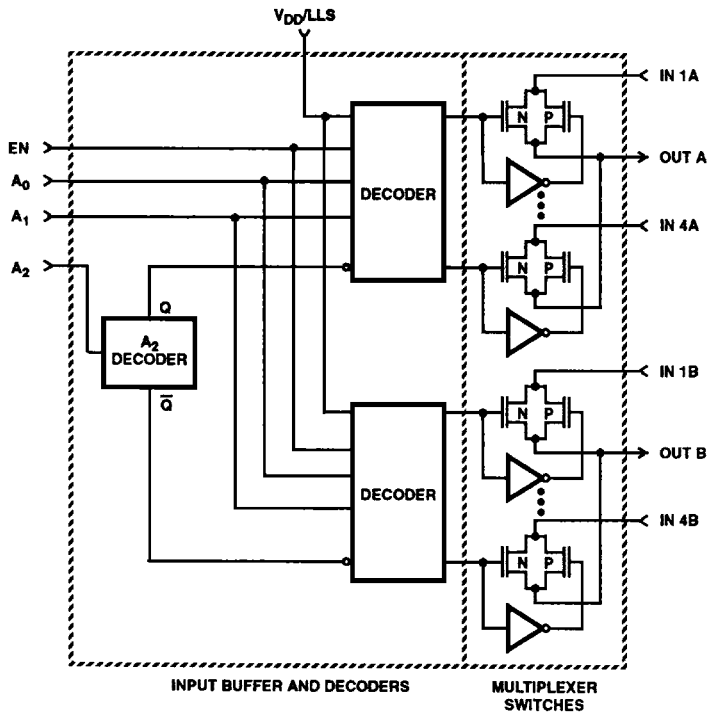
Ordering Information

PART NUMBER	TEMP. RANGE	PACKAGE
HI3-0518-5	0°C to +75°C	18 Lead Plastic DIP
HI1-0518-5	0°C to +75°C	18 Lead Ceramic DIP
HI1-0518-2	-55°C to +125°C	18 Lead Ceramic DIP
HI1-0518-8	-55°C to +125°C	18 Lead Ceramic DIP
HI4P0518-5	0°C to +75°C	20 Lead Plastic PLCC
HI4-0518-8	-55°C to +125°C	20 Lead Ceramic LCC
HI1-0518-9	-40°C to +85°C	18 Lead Ceramic DIP
HI3-0518-9	-40°C to +85°C	18 Lead Plastic DIP
HI4P-0518-9	-40°C to +85°C	20 Lead Plastic LCC
HI9P-0518-5	0°C to +75°C	18 Lead SOIC
HI9P-0518-9	-40°C to +85°C	18 Lead SOIC

Pinouts



Functional Block Diagram



A ₂ DECODE		
A ₂	Q	\bar{Q}
H	H	L
L	L	H
V-	L	L

Specifications HI-518

Absolute Maximum Ratings (Note 1)

V+ to V-	33V
Analog Input Voltage	
+V _{IN}	(V+) +2V
-V _{IN}	(V-) -2V
Digital Input Voltage	
TTL Levels Selected (V _{DD} /LLS Pin = GND or Open)	
+V _A	+6V
-V _A	-6V
+A ₂ /SDS	(V+) +2V
-A ₂ /SDS	(V-) -2V
CMOS Levels Selected (V _{DD} /LLS Pin = V _{DD})	
+V _A	(V+) +2V
-V _A	-2V
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering 10s)	+300°C

Thermal Information

Thermal Resistance	θ_{JA}	θ_{JC}
Plastic DIP Package	90°C/W	-
Plastic PLCC Package	80°C/W	-
Ceramic DIP Package	77°C/W	23°C/W
Ceramic LCC Package	65°C/W	12°C/W
SOIC Package	100°C/W	-
Junction Temperature		
Ceramic DIP, Ceramic LCC	+175°C	
Plastic DIP, Plastic PLCC, SOIC	+150°C	
Operating Temperature Ranges		
HI-518-2,-8	-55°C to +125°C	
HI-518-5	0°C to +75°C	
HI-518-9	-40°C to +85°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.

Electrical Specifications Supplies = +15V, -15V; V_{AH} (Logic Level High) = +2.4V, V_{AL} (Logic Level Low) = +0.8V; V_{DD}/LLS = GND. (Note 1), Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	TEMP	HI-518-2, -8			HI-518-5, -9			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
SWITCHING CHARACTERISTICS									
Access Time, t _A		+25°C	-	130	175	-	130	175	ns
		Full	-	-	225	-	-	225	ns
Break-Before-Make Delay, t _{OPEN}		+25°C	10	20	-	10	20	-	ns
Enable Delay (ON), t _{ON(EN)}		+25°C	-	120	175	-	120	175	ns
Enable Delay (OFF), t _{OFF(EN)}		+25°C	-	140	175	-	140	175	ns
Settling Time									
	0.1%	+25°C	-	250	-	-	250	-	ns
0.01%	+25°C	-	800	-	-	800	-	ns	
Charge Injection Error	Note 4	+25°C	-	-	25	-	-	25	mV
Off Isolation	Note 5	+25°C	45	-	-	45	-	-	dB
Channel Input Capacitance, C _{S(OFF)}		+25°C	-	-	5	-	-	5	pF
Channel Output Capacitance, C _{D(OFF)}		+25°C	-	-	10	-	-	10	pF
Digital Input Capacitance, C _A		+25°C	-	-	5	-	-	5	pF
Input to Output Capacitance, C _{DS(OFF)}		+25°C	-	0.02	-	-	0.02	-	pF
DIGITAL INPUT CHARACTERISTICS									
Input Low Threshold, V _{AL} (TTL)		Full	-	-	0.8	-	-	0.8	V
Input High Threshold, V _{AH} (TTL)		Full	2.4	-	-	2.4	-	-	V
Input Low Threshold, V _{AL} (CMOS)		Full	-	-	0.3V _{DD}	-	-	0.3V _{DD}	V
Input High Threshold, V _{AH} (CMOS)		Full	0.7V _{DD}	-	-	0.7V _{DD}	-	-	V
Input Leakage Current, I _{AH} (High)		Full	-	-	1	-	-	1	μA
Input Leakage Current, I _{AL} (Low)		Full	-	-	20	-	-	20	μA

Specifications HI-518

Electrical Specifications Supplies = +15V, -15V; V_{AH} (Logic Level High) = +2.4V, V_{AL} (Logic Level Low) = +0.8V; $V_{DD}/LLS = GND$. (Note 1), Unless Otherwise Specified. **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP	HI-518-2, -8			HI-518-5, -9			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
ANALOG CHANNEL CHARACTERISTICS									
Analog Signal Range, V_{IN}	Note 2	Full	-14		+14	-15	-	+15	V
On Resistance, R_{ON}	Note 3	+25°C	-	480	750	-	480	750	Ω
		Full	-	-	1,000	-	-	1,000	Ω
Off Input Leakage Current, $I_{S(OFF)}$		+25°C	-	0.01	-	-	0.01	-	nA
		Full	-	-	50	-	-	50	nA
Off Output Leakage Current, $I_{D(OFF)}$		+25°C	-	0.015	-	-	0.015	-	nA
		Full	-	-	50	-	-	50	nA
On Channel Leakage Current, $I_{D(ON)}$		+25°C	-	0.015	-	-	0.015	-	nA
		Full	-	-	50	-	-	50	nA
POWER SUPPLY CHARACTERISTICS									
Power Dissipation, P_D		Full	-	-	450	-	-	540	mW
I_+ , Current	Note 6	Full	-	-	15	-	-	18	mA
I_- , Current	Note 6	Full	-	-	15	-	-	18	mA

NOTES:

1. V_{DD}/LLS pin = open or grounded for TTL compatibility. V_{DD}/LLS pin = V_{DD} for CMOS compatibility.
2. At temperatures above +90°C, care must be taken to assure V_{IN} remains at least 1.0V below the V_{SUPPLY} for proper operation.
3. $V_{IN} = \pm 10V$, $I_{OUT} = -100\mu A$.
4. $V_{IN} = 0V$, $C_L = 100pF$, enable input pulse = 3V, $f = 500kHz$.
5. $C_L = 40pF$, $R_L = 1k$. Due to the pin to pin capacitance between IN 8/4B and OUT B, channel 8/4B exhibits 60dB of OFF isolation under the above test conditions.
6. $V_{EN} = +2.4V$.

TRUTH TABLE HI-518 Used as an 8-Channel Multiplexer or 4-Channel Differential Multiplexer

USE A_2 AS DIGITAL ADDRESS INPUT				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	None
H	L	L	H	2A	None
H	L	H	L	3A	None
H	L	H	H	4A	None
H	H	L	L	None	1B
H	H	L	H	None	2B
H	H	H	L	None	3B
H	H	H	H	None	4B

TRUTH TABLE HI-518 Used as a Differential 4-Channel Multiplexer

A_2 CONNECT TO V- SUPPLY			ON CHANNEL TO	
ENABLE	A_1	A_0	OUT A	OUT B
L	X	X	None	None
H	L	L	1A	1B
H	L	H	2A	2B
H	H	L	3A	3B
H	H	H	4A	4B

Test Circuits

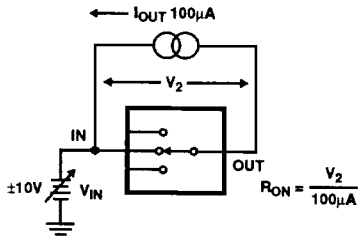


FIGURE 1. ON RESISTANCE vs INPUT SIGNAL LEVEL

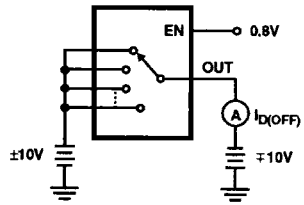


FIGURE 2. $I_{D(OFF)}$ (NOTE 1)

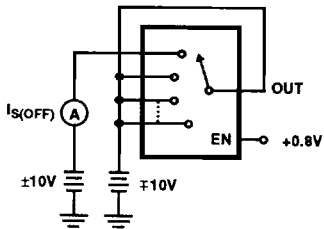


FIGURE 3. $I_{S(OFF)}$ (NOTE 1)

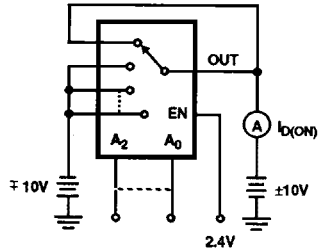


FIGURE 4. $I_{D(ON)}$ (NOTE 1)

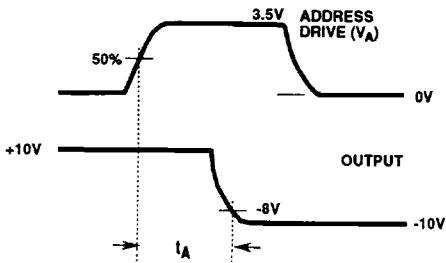


FIGURE 5A.

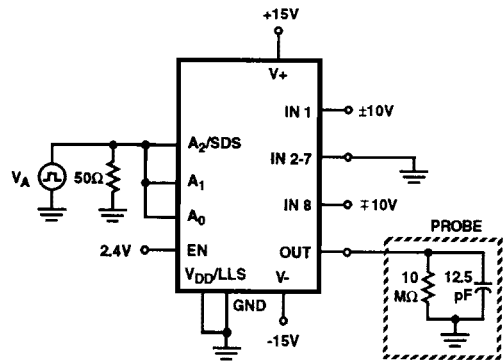


FIGURE 5B.

NOTE:

- Two measurements per channel: ±10V and ∓10V. (Two measurements per device for $I_{D(OFF)}$ ±10V and ∓10V)

Test Circuits (Continued)

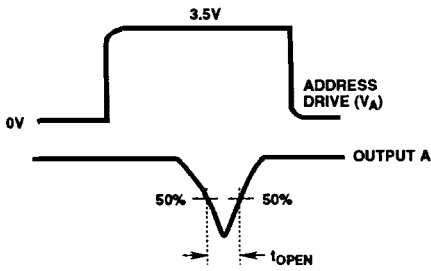


FIGURE 6A.

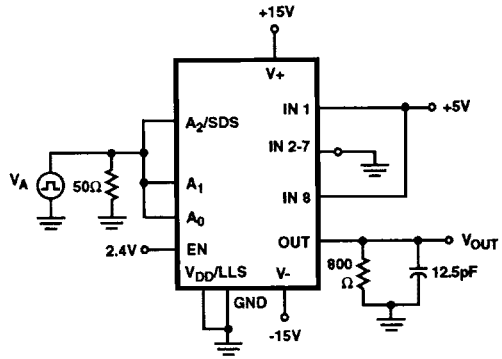


FIGURE 6B.

FIGURE 6. BREAK-BEFORE-MAKE DELAY (t_{OPEN})

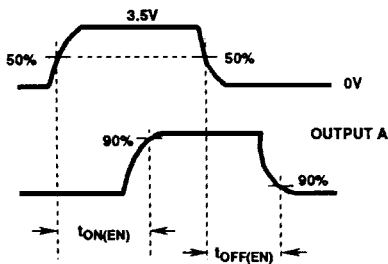


FIGURE 7A.

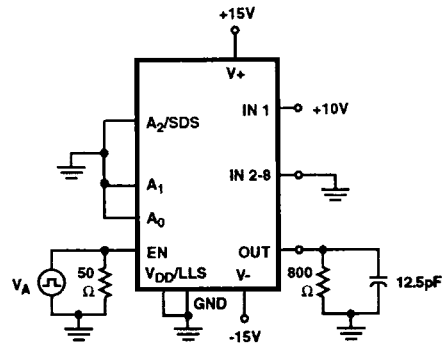


FIGURE 7B.

FIGURE 7. ENABLE DELAY $t_{ON(EN)}$, $t_{OFF(EN)}$

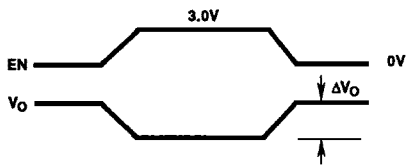


FIGURE 8A.

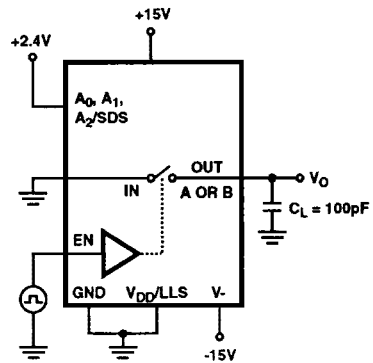


FIGURE 8B.

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

FIGURE 8. CHARGE INJECTION TEST CIRCUIT

HI-518

Die Characteristics

DIE DIMENSIONS:

89 x 93 mils

METALLIZATION:

Type: Al Cu

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

GLASSIVATION:

Type: Nitride Over Silox

Nitride Thickness: $3.5\text{k}\text{\AA} \pm 1.0\text{k}\text{\AA}$

Silox Thickness: $12\text{k}\text{\AA} \pm 2.0\text{k}\text{\AA}$

WORST CASE CURRENT DENSITY: $1.43 \times 10^5 \text{A/cm}^2$

TRANSISTOR COUNT: 356

PROCESS: CMOS-DI

SUBSTRATE POTENTIAL*: $-V_{\text{SUPPLY}}$

* The substrate appears resistive to the $-V_{\text{SUPPLY}}$ terminal, therefore it may be left floating (Insulating Die Mount) or it may be mounted on a conductor at $-V_{\text{SUPPLY}}$ potential

Metallization Mask Layout

HI-518

