

HI-518

8-Channel/Differential 4-Channel, CMOS High Speed Analog Multiplexer

FN3147  
Rev 4.00  
January 23, 2006

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 Intersil Dielectric Isolation process to achieve optimum performance in both high and low level signal applications. The low output leakage current ( $I_{D(OFF)} < 100pA$  at  $25^{\circ}C$ ) and fast settling ( $t_{SETTLE} = 800ns$  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	PART MARKING	TEMP. RANGE (°C)	PACKAGE	PKG. DWG. #
HI3-0518-5	HI3-518-5	0 to 75	18 Ld PDIP	E18.3
HI3-0518-5Z (See Note)	HI3-518-5Z	0 to 75	18 Ld PDIP* (Pb-free)	E18.3
HI1-0518-8		-55 to 125	18 Ld CERDIP	F18.3

\*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

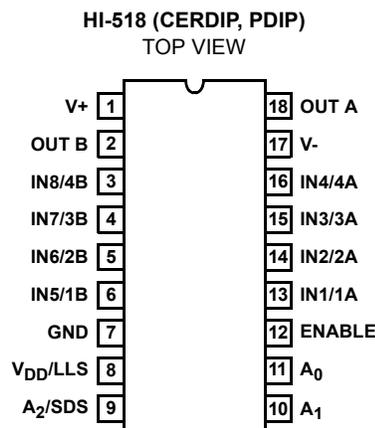
**Features**

- 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)
- Pb-Free Plus Anneal Available (RoHS Compliant)

**Applications**

- Data Acquisition Systems
- Precision Instrumentation
- Industrial Control

**Pinout**



**Truth Tables**

**TABLE 1. HI-518 USED AS AN 8-CHANNEL MULTIPLEXER OR DUAL 4-CHANNEL MULTIPLEXER (NOTE 1)**

USE A <sub>2</sub> AS DIGITAL ADDRESS INPUT				ON CHANNEL TO	
ENABLE	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	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

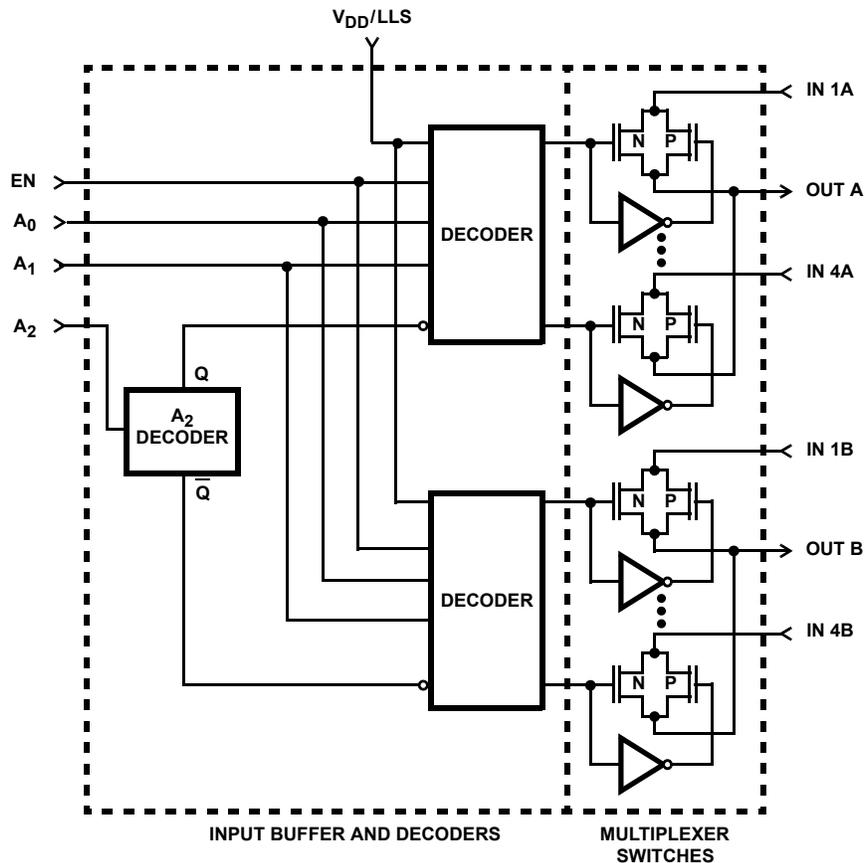
**TABLE 2. HI-518 USED AS A DIFFERENTIAL 4-CHANNEL MULTIPLEXER**

A <sub>2</sub> CONNECTED TO V- SUPPLY			ON CHANNEL TO	
ENABLE	A <sub>1</sub>	A <sub>0</sub>	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

NOTE:

- For 8-Channel single ended function, tie "Out A" to "Out B"; for dual 4-Channel function, use the A<sub>2</sub> address pin to select between Mux A and Mux B, where Mux A is selected with A<sub>2</sub> low.

**Functional Block Diagram**



A <sub>2</sub> DECODE		
A <sub>2</sub>	Q	Q
H	H	mL
L	L	H
V-	L	L

**Absolute Maximum Ratings**

V+ to V- ..... 33V  
 Analog (VIN, VOUT) ..... (V-) -2V to (V+) +2V  
 Digital Input Voltage:  
 TTL Levels Selected (VDD/LLS Pin = GND or Open)  
     VA0-1 ..... -6V to +6V  
     VA2/SDS ..... (V-) -2V to (V+) +2V  
 CMOS Levels Selected (VDD/LLS Pin = VDD)  
     VA0-2 ..... -2V to (V+) +2V

**Operating Conditions**

Temperature Ranges  
 HI-518-8 ..... -55°C to 125°C  
 HI-518-5 ..... 0°C to 75°C

**Thermal Information**

Thermal Resistance (Typical, Note 2).....  $\theta_{JA}$  (°C/W)     $\theta_{JC}$  (°C/W)  
 PDIP Package\* ..... 90    N/A  
 CERDIP Package ..... 70    18  
 Maximum Junction Temperature  
     Ceramic Package ..... 175°C  
     Plastic Package ..... 150°C  
 Maximum Storage Temperature ..... -65°C to 150°C  
 Maximum Lead Temperature (Soldering 10s) ..... 300°C  
 \*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

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:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

**Electrical Specifications** Supplies = +15V, -15V; VAH (Logic Level High) = 2.4V, VAL (Logic Level Low) = 0.8V; VDD/LLS = GND (Note 3), Unless Otherwise Specified

PARAMETER	TEST CONDITIONS	TEMP (°C)	-8			-5			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
<b>DYNAMIC CHARACTERISTICS</b>									
Access Time, tA		25	-	130	175	-	130	175	ns
		Full	-	-	225	-	-	225	ns
Break-Before-Make Delay, tOPEN		25	10	20	-	10	20	-	ns
Enable Delay (ON), tON(EN)		25	-	120	175		120	175	ns
Enable Delay (OFF), tOFF(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	-	-	25	-	-	25	mV
Off Isolation	Note 7	25	45	-	-	45	-	-	dB
Channel Input Capacitance, CS(OFF)		25	-	-	5	-	-	5	pF
Channel Output Capacitance, CD(OFF)		25	-	-	10	-	-	10	pF
Digital Input Capacitance, CA		25	-	-	5	-	-	5	pF
Input to Output Capacitance, CDS(OFF)		25	-	0.02	-	-	0.02	-	pF
<b>DIGITAL INPUT CHARACTERISTICS</b>									
Input Low Threshold, VAL (TTL)	Note 3	Full	-	-	0.8	-	-	0.8	V
Input High Threshold, VAH (TTL)	Note 3	Full	2.4	-	-	2.4	-	-	V
Input Low Threshold, VAL (CMOS)	Note 3	Full	-	-	0.3VDD	-	-	0.3VDD	V
Input High Threshold, VAH (CMOS)	Note 3	Full	0.7VDD	-	-	0.7VDD	-	-	V
Input Leakage Current, IAH (High)		Full	-	-	1	-	-	1	µA
Input Leakage Current, IAL (Low)		Full	-	-	20	-	-	20	µA
<b>ANALOG CHANNEL CHARACTERISTICS</b>									
Analog Signal Range, VIN	Note 4	Full	-14	-	+14	-15	-	+15	V
On Resistance, rON	Note 5	25	-	480	750	-	480	750	Ω
		Full	-	-	1,000	-	-	1,000	Ω
Off Input Leakage Current, IS(OFF)		25	-	0.01	-	-	0.01	-	nA
		Full	-	-	50	-	-	50	nA
Off Output Leakage Current, ID(OFF)		25	-	0.015	-	-	0.015	-	nA
		Full	-	-	50	-	-	50	nA
On Channel Leakage Current, ID(ON)		25	-	0.015	-	-	0.015	-	nA
		Full	-	-	50	-	-	50	nA
<b>POWER SUPPLY CHARACTERISTICS</b>									
Power Dissipation, PD		Full	-	-	450	-	-	540	mW

**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)	-8			-5			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
I+, Current	$V_{EN} = 2.4V$	Full	-	-	15	-	-	18	mA
I-, Current		Full	-	-	15	-	-	18	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 1.0V 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,  $f = 500kHz$ .
- $C_L = 40pF$ ,  $R_L = 1K$ ,  $V_{EN} = 0.8V$ ,  $V_{IN} = 3V_{RMS}$ ,  $f = 500kHz$ . 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.

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

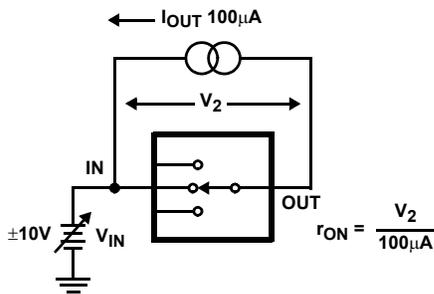


FIGURE 1. ON RESISTANCE TEST CIRCUIT

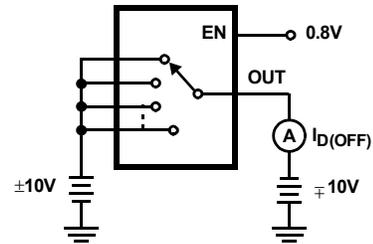


FIGURE 2.  $I_{D(OFF)}$  TEST CIRCUIT (NOTE 8)

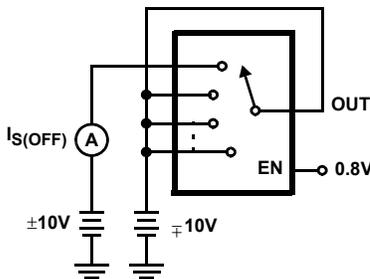


FIGURE 3.  $I_{S(OFF)}$  TEST CIRCUIT (NOTE 8)

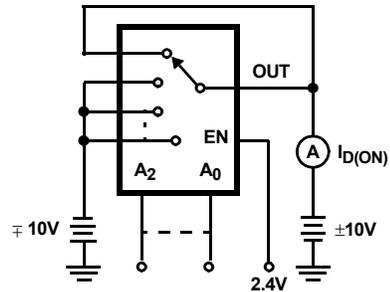


FIGURE 4.  $I_{D(ON)}$  TEST CIRCUIT (NOTE 8)

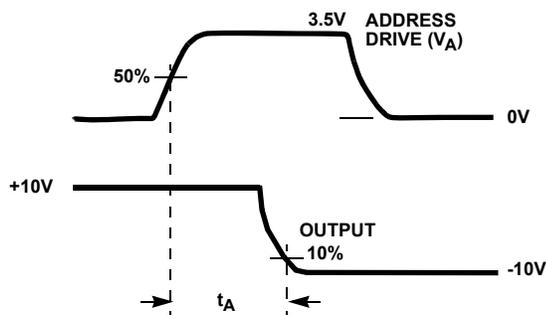


FIGURE 5A. MEASUREMENT POINTS

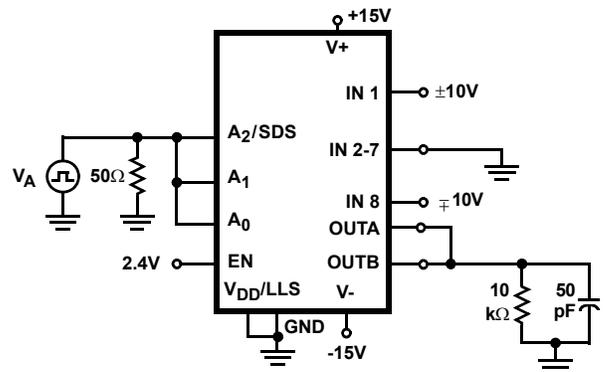


FIGURE 5B. TEST CIRCUIT

FIGURE 5. ACCESS TIME

NOTE:

- 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)

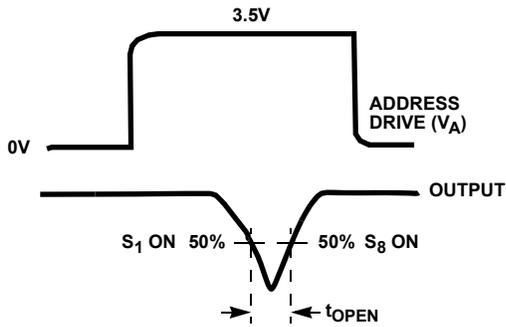


FIGURE 6A. MEASUREMENT POINTS

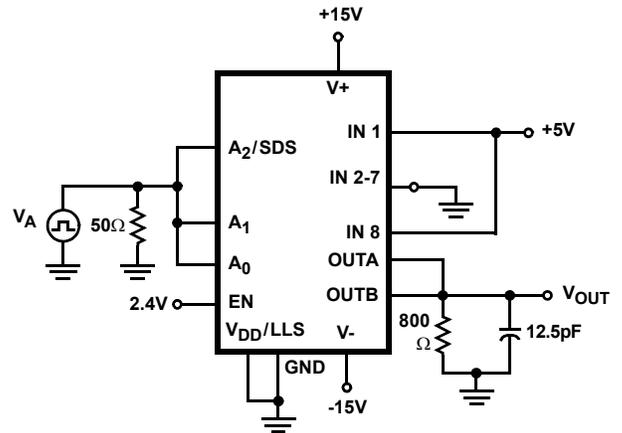


FIGURE 6B. TEST CIRCUIT

FIGURE 6. BREAK-BEFORE-MAKE DELAY

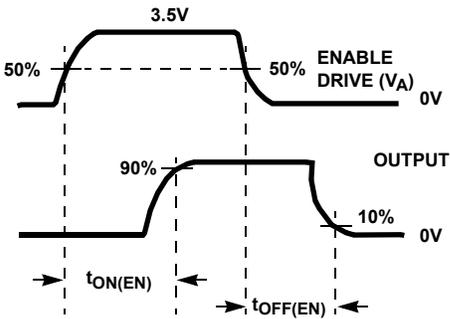


FIGURE 7A. MEASUREMENT POINTS

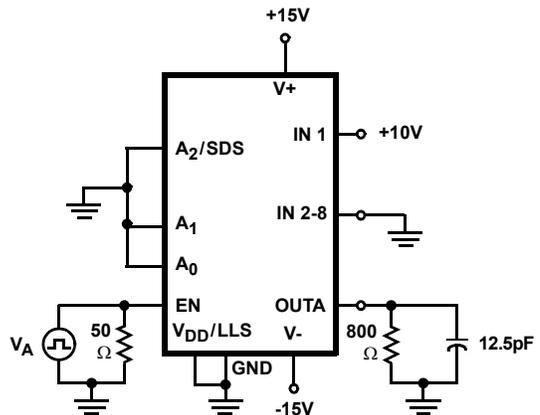


FIGURE 7B. TEST CIRCUIT

FIGURE 7. ENABLE DELAY

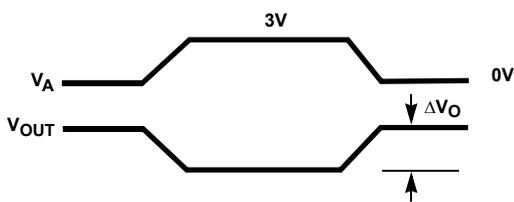


FIGURE 8A. MEASUREMENT POINTS

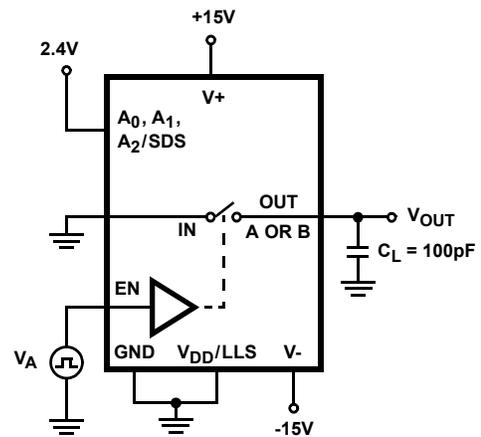


FIGURE 8B. TEST CIRCUIT

$\Delta V_O$  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

**Die Characteristics**

**DIE DIMENSIONS:**

89 mils x 93 mils

**METALLIZATION:**

Type: AlCu

Thickness: 16kÅ ±2kÅ

**SUBSTRATE POTENTIAL (NOTE):**

-V<sub>SUPPLY</sub>

**PASSIVATION:**

Type: Nitride Over Silox

Nitride Thickness: 3.5kÅ ±1.0kÅ

Silox Thickness: 12kÅ ±2.0kÅ

**WORST CASE CURRENT DENSITY:**

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

**TRANSISTOR COUNT:**

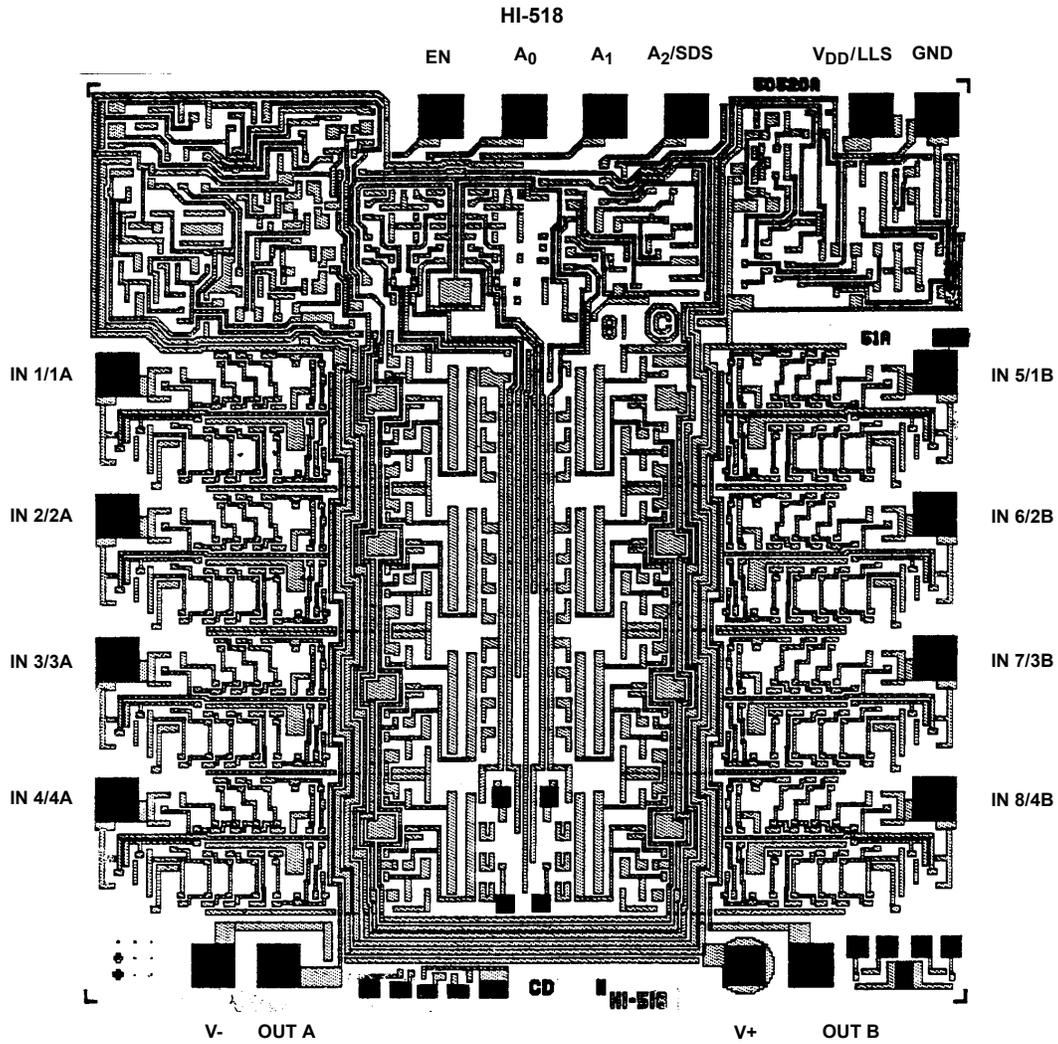
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**PROCESS:**

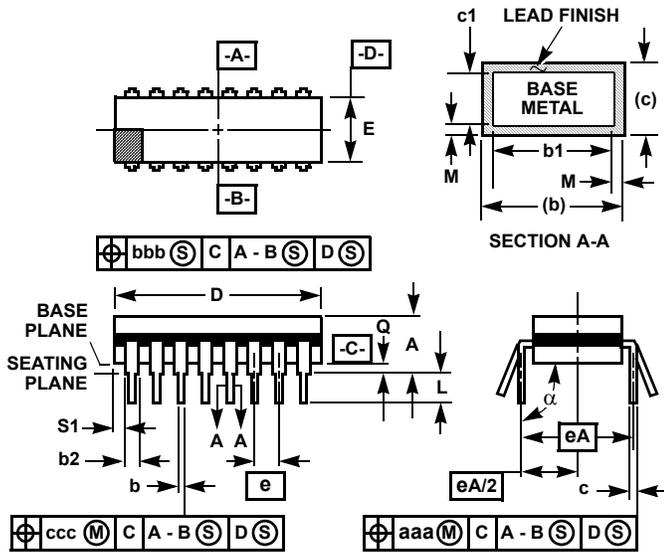
CMOS-DI

NOTE: The substrate appears resistive to the -V<sub>SUPPLY</sub> terminal, therefore it may be left floating (Insulating Die Mount) or it may be mounted on a conductor at -V<sub>SUPPLY</sub> potential.

**Metallization Mask Layout**



**Ceramic Dual-In-Line Frit Seal Packages (CERDIP)**



**NOTES:**

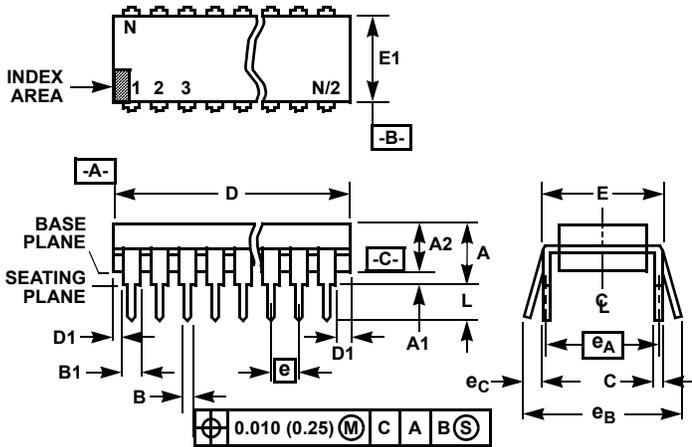
1. Index area: A notch or a pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark.
2. The maximum limits of lead dimensions b and c or M shall be measured at the centroid of the finished lead surfaces, when solder dip or tin plate lead finish is applied.
3. Dimensions b1 and c1 apply to lead base metal only. Dimension M applies to lead plating and finish thickness.
4. Corner leads (1, N, N/2, and N/2+1) may be configured with a partial lead paddle. For this configuration dimension b3 replaces dimension b2.
5. This dimension allows for off-center lid, meniscus, and glass overrun.
6. Dimension Q shall be measured from the seating plane to the base plane.
7. Measure dimension S1 at all four corners.
8. N is the maximum number of terminal positions.
9. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
10. Controlling dimension: INCH.

**F18.3 MIL-STD-1835 GDIP1-T18 (D-6, CONFIGURATION A)  
18 LEAD CERAMIC DUAL-IN-LINE FRIT SEAL PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.200	-	5.08	-
b	0.014	0.026	0.36	0.66	2
b1	0.014	0.023	0.36	0.58	3
b2	0.045	0.065	1.14	1.65	-
b3	0.023	0.045	0.58	1.14	4
c	0.008	0.018	0.20	0.46	2
c1	0.008	0.015	0.20	0.38	3
D	-	0.960	-	24.38	5
E	0.220	0.310	5.59	7.87	5
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		-
eA/2	0.150 BSC		3.81 BSC		-
L	0.125	0.200	3.18	5.08	-
Q	0.015	0.070	0.38	1.78	6
S1	0.005	-	0.13	-	7
$\alpha$	90°	105°	90°	105°	-
aaa	-	0.015	-	0.38	-
bbb	-	0.030	-	0.76	-
ccc	-	0.010	-	0.25	-
M	-	0.0015	-	0.038	2, 3
N	18		18		8

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**Dual-In-Line Plastic Packages (PDIP)**



**NOTES:**

- Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
- Dimensioning and tolerancing per ANSI Y14.5M-1982.
- Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication No. 95.
- Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
- D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
- E and  $e_A$  are measured with the leads constrained to be perpendicular to datum [-C-].
- $e_B$  and  $e_C$  are measured at the lead tips with the leads unconstrained.  $e_C$  must be zero or greater.
- B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
- N is the maximum number of terminal positions.
- Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3 may have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

**E18.3 (JEDEC MS-001-BC ISSUE D)  
18 LEAD DUAL-IN-LINE PLASTIC PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.845	0.880	21.47	22.35	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
$e_A$	0.300 BSC		7.62 BSC		6
$e_B$	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	18		18		9

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