

# Single 8-Channel CMOS Analog Multiplexer

## HI-508/883

The HI-508/883 is an eight channel single-ended multiplexer. This monolithic CMOS multiplexer includes an array of eight analog switches, a digital decode circuit for channel selection, a voltage reference for logic thresholds, and an ENABLE input for device selection when several multiplexers are present.

The Dielectric Isolation (DI) process used in fabrication of this device eliminates the problem of latch-up. Also, DI offers much lower substrate leakage and parasitic capacitance than conventional junction-isolated CMOS. Switches are guaranteed to break-before-make, so that two channels are never shorted together. The switching threshold for each digital input is established by an internal +5V reference, providing a guaranteed minimum 2.4V for logic "1" and Maximum 0.8V for logic "0". This allows direct interface without pull-up resistors to signals from most logic families: CMOS, TTL, DTL and some PMOS. For protection against transient overvoltage, the digital inputs include a series 200Ω resistor and a diode clamp to each supply. If input overvoltage protection is needed, the HI-548/883 and HI-549/883 multiplexers are recommended. For further information see Application Note [AN520](#).

## Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Low On Resistance (Max)..... 400Ω
- Wide Analog Signal Range ..... ±15V
- TTL/CMOS Compatible ..... 2.4V (Logic "1")
- Access Time (Max)..... 1.0μs
- 44V Maximum Power Supply
- Break-Before-Make Switching
- No Latch-up

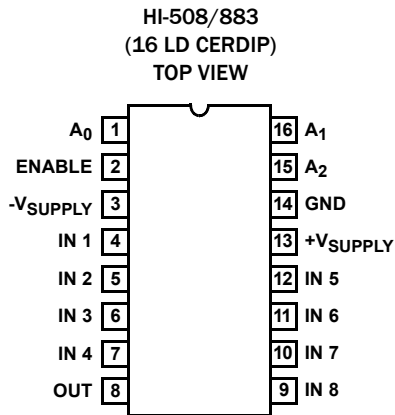
## Applications

- Data Acquisition Systems
- Precision Instrumentation
- Demultiplexing
- Selector Switch

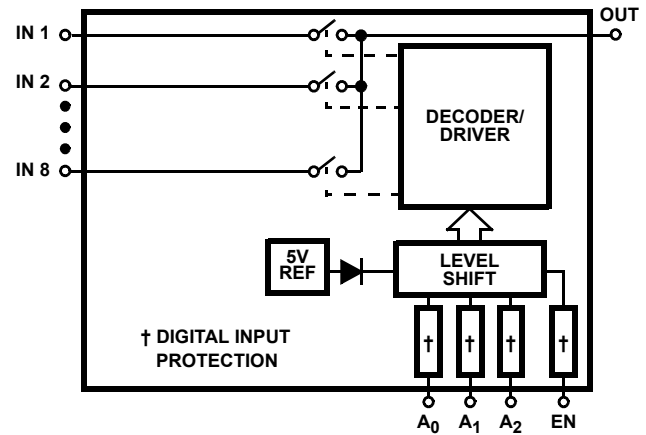
## Ordering Information

| PART #       | PART MARKING | TEMP. RANGE (°C) | PACKAGE      | PKG. DWG. # |
|--------------|--------------|------------------|--------------|-------------|
| HI1-0508/883 | HI1-508/883  | -55 to 125       | 16 Ld CerDIP | F16.3       |

## Pin Configuration



## Functional Diagram



TRUTH TABLE HI-508/883

| A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> | EN | "ON" CHANNEL |
|----------------|----------------|----------------|----|--------------|
| X              | X              | X              | L  | None         |
| L              | L              | L              | H  | 1            |
| L              | L              | H              | H  | 2            |
| L              | H              | L              | H  | 3            |
| L              | H              | H              | H  | 4            |
| H              | L              | L              | H  | 5            |
| H              | L              | H              | H  | 6            |
| H              | H              | L              | H  | 7            |
| H              | H              | H              | H  | 8            |

## Absolute Maximum Ratings

|   |                                 |
|---|---------------------------------|
| Voltage Between Supply Pins .....                               | 44V                             |
| +V <sub>SUPPLY</sub> to Ground .....                            | 22V                             |
| -V <sub>SUPPLY</sub> to Ground .....                            | 22V                             |
| Analog Input Voltage, +V <sub>S</sub> .....                     | +V <sub>SUPPLY</sub> +2V        |
| -V <sub>S</sub> .....   | -V <sub>SUPPLY</sub> -2V        |
| Digital Input Voltage, +V <sub>EN</sub> , +V <sub>A</sub> ..... | +V <sub>SUPPLY</sub> +4V        |
| -V <sub>EN</sub> , -V <sub>A</sub> .....                        | -V <sub>SUPPLY</sub> +4V        |
|   | or 20mA, whichever occurs first |
| Continuous Current, S or D .....                                | 20mA                            |
| Peak Current, S or D (Pulsed at 1ms, 10% Duty Cycle Max) .....  | 40mA                            |
| ESD Classification .....  | ≤2000V                          |

## Thermal Information

|   |                      |                      |
|---|----------------------|----------------------|
| Thermal Resistance                              | $\theta_{JA}$ (°C/W) | $\theta_{JC}$ (°C/W) |
| CerDIP Package .....                            | 83                   | 21                   |
| Power Dissipation (At +75°C)                    |                      |                      |
| CerDIP Package .....                            | 1.20W                |                      |
| Power Dissipation Derating Factor (Above +75°C) |                      |                      |
| CerDIP Package .....                            | 12.0mW/°C            |                      |
| Junction Temperature .....                      | +175°C               |                      |
| Storage Temperature Range .....                 | -65°C to +150°C      |                      |
| Lead Temperature (Soldering 10s) .....          | +275°C               |                      |

## Recommended Operating Conditions

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

**CAUTION:** Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

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

Device Tested at: +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, unless otherwise specified.

| D.C. PARAMETERS                 | SYMBOL               | CONDITIONS   | GROUP A SUBGROUPS | TEMPERATURE (°C) | MIN  | MAX | UNITS |
|---------------------------------|----------------------|--|-------------------|------------------|------|-----|-------|
| Input Leakage Current           | I <sub>IH</sub>      | Measure inputs sequentially, connect all unused inputs to GND                                  | 1, 2, 3           | +25, +125, -55   | -1.0 | 1.0 | μA    |
|                                 | I <sub>IL</sub>      |  | 1, 2, 3           | +25, +125, -55   | -1.0 | 1.0 | μA    |
| Source "OFF" Leakage Current    | +I <sub>S(OFF)</sub> | V <sub>S</sub> = +10V, V <sub>D</sub> = -10V, V <sub>EN</sub> = 0.8V, All unused inputs = -10V | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +125, -55        | -50  | 50  | nA    |
|                                 | -I <sub>S(OFF)</sub> | V <sub>S</sub> = -10V, V <sub>D</sub> = +10V, V <sub>EN</sub> = 0.8V, All unused inputs = +10V | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +125, -55        | -50  | 50  | nA    |
| Drain "OFF" Leakage Current     | +I <sub>D(OFF)</sub> | V <sub>D</sub> = +10V, V <sub>EN</sub> = 0.8V, All unused inputs = -10V                        | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +125, -55        | -200 | 200 | nA    |
|                                 | -I <sub>D(OFF)</sub> | V <sub>D</sub> = -10V, V <sub>EN</sub> = 0.8V, All unused inputs = +10V                        | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +25 to +125      | -200 | 200 | nA    |
| Channel "ON" Leakage Current    | +I <sub>D(ON)</sub>  | V <sub>S</sub> = V <sub>D</sub> = +10V, All unused inputs = -10V                               | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +125, -55        | -200 | 200 | nA    |
|                                 | -I <sub>D(ON)</sub>  | V <sub>S</sub> = V <sub>D</sub> = -10V, All unused inputs = +10V                               | 1                 | +25              | -10  | 10  | nA    |
|                                 |                      |  | 2, 3              | +125, -55        | -200 | 200 | nA    |
| Positive Supply Current         | +I                   | V <sub>A</sub> = 0V, V <sub>EN</sub> = 2.4V  | 1, 2, 3           | +25, +125, -55   | -    | 2.4 | mA    |
| Negative Supply Current         | -I                   | V <sub>A</sub> = 0V, V <sub>EN</sub> = 2.4V  | 1, 2, 3           | +25, +125, -55   | -1.0 | -   | mA    |
| Standby Positive Supply Current | +I <sub>SBY</sub>    | V <sub>A</sub> = 0V, V <sub>EN</sub> = 0V  | 1, 2, 3           | +25, +125, -55   |      | 2.4 | mA    |
| Standby Negative Supply Current | -I <sub>SBY</sub>    | V <sub>A</sub> = 0V, V <sub>EN</sub> = 0V  | 1, 2, 3           | +25, +125, -55   | -1.0 | -   | mA    |
| Switch "ON" Resistance          | +R <sub>DS1</sub>    | V <sub>S</sub> = 10V, I <sub>D</sub> = 1mA   | 1                 | +25              | -    | 300 | Ω     |
|                                 |                      |  | 2, 3              | +125, -55        | -    | 400 | Ω     |
|                                 | -R <sub>DS1</sub>    | V <sub>S</sub> = -10V, I <sub>D</sub> = -1mA   | 1                 | +25              | -    | 300 | Ω     |
|                                 |                      |  | 2, 3              | +125, -55        | -    | 400 | Ω     |

# HI-508/883

**TABLE 1. D.C. ELECTRICAL PERFORMANCE SPECIFICATIONS (Continued)**

Device Tested at: +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, unless otherwise specified.

| D.C. PARAMETERS     | SYMBOL          | CONDITIONS | GROUP A SUBGROUPS | TEMPERATURE (°C) | MIN | MAX | UNITS |
|---------------------|-----------------|------------|-------------------|------------------|-----|-----|-------|
| Logic Level Voltage | V <sub>AL</sub> | Note 1     | 1, 2, 3           | +25, +125        | -   | 0.8 | V     |
|                     | V <sub>AH</sub> | Note 1     | 1, 2, 3           | -55              | 2.4 | -   | V     |

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

Device Tested at: +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, unless otherwise specified.

| PARAMETERS   | SYMBOL               | CONDITIONS                                     | GROUP A SUBGROUPS | TEMPERATURE (°C) | MIN | MAX  | UNITS |
|--|----------------------|--|-------------------|------------------|-----|------|-------|
| Break-Before-Make Time Delay                                 | t <sub>D</sub>       | R <sub>L</sub> = 200Ω, C <sub>L</sub> = 12.5pF | 9                 | +25              | 25  |      | ns    |
| Propagation Delay Times: Address Inputs to I/O Channel Times | t <sub>A</sub>       | R <sub>L</sub> = 10MΩ, C <sub>L</sub> = 14pF   | 9                 | +25              |     | 500  | ns    |
|  |                      |  | 10, 11            | +125, -55        |     | 1000 | ns    |
| Enable to I/O  | t <sub>ON(EN)</sub>  | R <sub>L</sub> = 200Ω, C <sub>L</sub> = 12.5pF | 9                 | +25              |     | 500  | ns    |
|  |                      |  | 10, 11            | +125, -55        |     | 1000 | ns    |
|  | t <sub>OFF(EN)</sub> | R <sub>L</sub> = 200Ω, C <sub>L</sub> = 12.5pF | 9                 | +25              |     | 500  | ns    |
|  |                      |  | 10, 11            | +125, -55        |     | 1000 | ns    |

**TABLE 3. ELECTRICAL PERFORMANCE SPECIFICATIONS**

Device Tested at: +V<sub>SUPPLY</sub> = +15V, -V<sub>SUPPLY</sub> = -15V, V<sub>EN</sub> = 2.4V, unless otherwise specified.

| PARAMETERS                | SYMBOL           | CONDITIONS  | NOTE | TEMPERATURE (°C) | MIN | MAX | UNITS |
|---------------------------|------------------|---|------|------------------|-----|-----|-------|
| Capacitance Address Input | C <sub>A</sub>   | V+ = V- = 0V, f = 1MHz  | 2    | +25              |     | 10  | pF    |
| Capacitance Output Switch | C <sub>OS</sub>  | V+ = V- = 0V<br>f = 1MHz  | 2    | +25              |     | 45  | pF    |
| Capacitance Input Switch  | C <sub>IS</sub>  | V+ = V- = 0V, f = 1MHz  | 2    | +25              |     | 12  | pF    |
| Charge Transfer Error     | V <sub>CTE</sub> | V <sub>S</sub> = GND, V <sub>GEN</sub> = 0V to 5V   | 2    | +25              |     | 10  | mV    |
| Off Isolation             | V <sub>ISO</sub> | V <sub>EN</sub> = 0.8V, R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF,<br>V <sub>S</sub> = 7V <sub>RMS</sub> , f = 100kHz | 2, 3 | +25              | -50 |     | dB    |

**NOTES:**

- Used for forcing conditions for all DC Tests, unless otherwise specified.
- 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.
- Worst case isolation occurs on channel 4 due to proximity of the output pins.

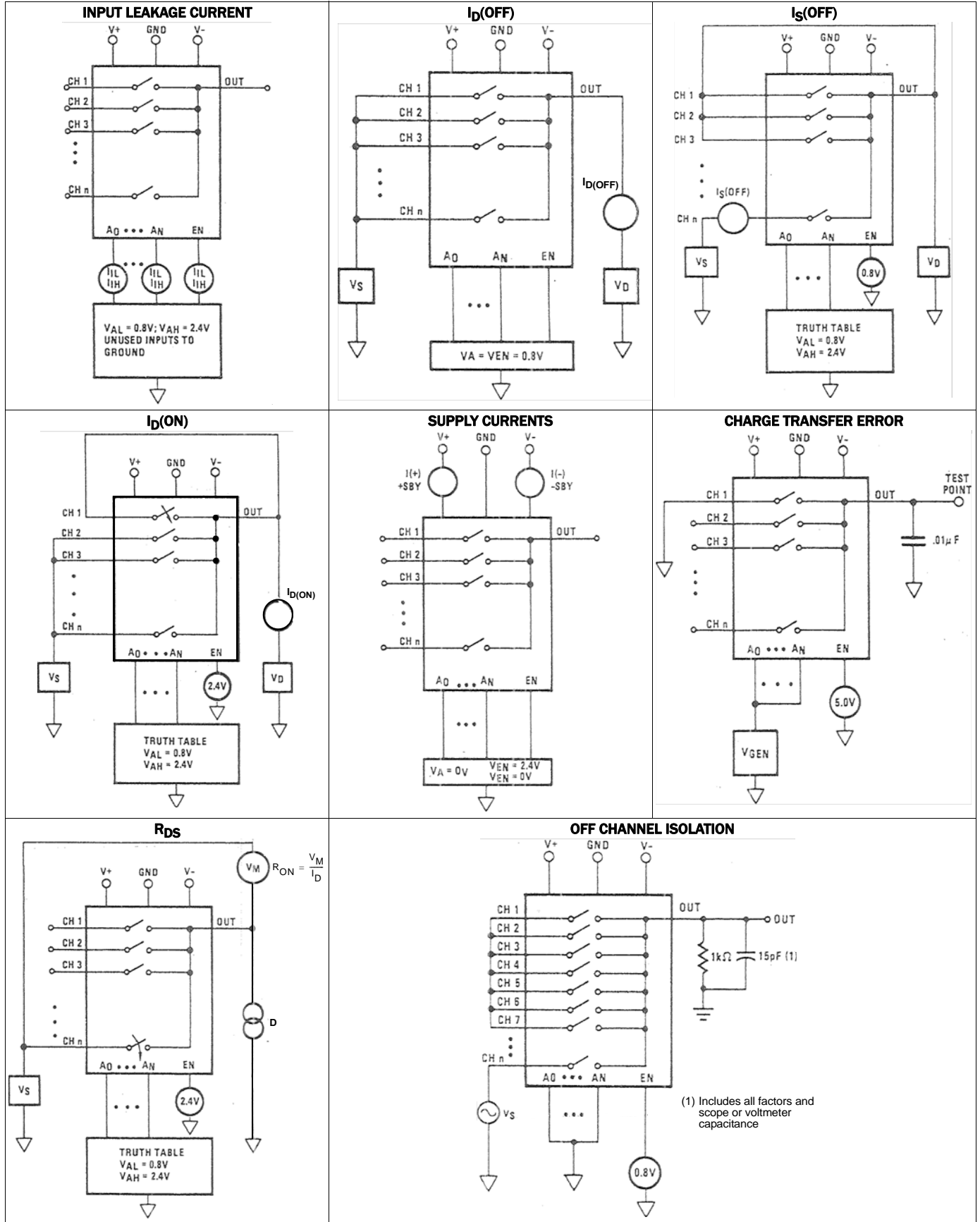
**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

| MIL-STD-883 TEST REQUIREMENTS               | SUBGROUPS (See Tables 1, 2, 3) |
|---|--------------------------------|
| Interim Electrical Parameters (Pre Burn-in) | 1                              |
| Final Electrical Test Parameters            | 1 (Note 4), 2, 3, 9, 10, 11    |
| Group A Test Requirements                   | 1, 2, 3, 9, 10, 11             |
| Groups C & D Endpoints                      | 1                              |

**NOTE:**

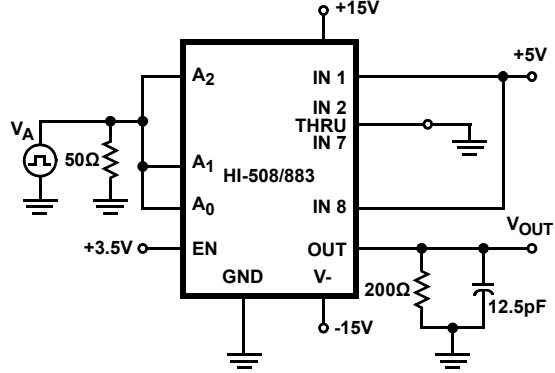
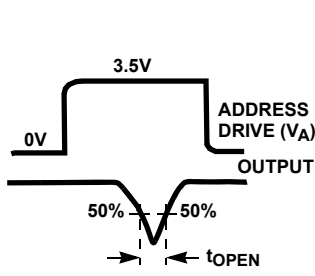
- PDA applies to Subgroup 1 only. No other subgroups are included in PDA.

## Test Circuits

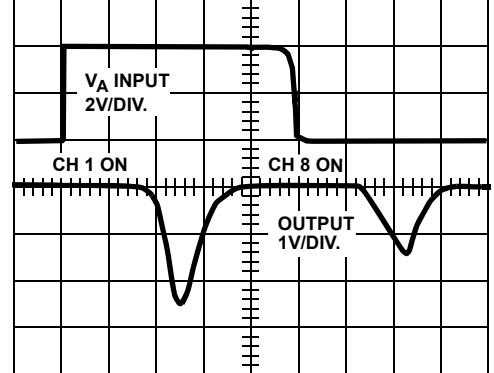


## Switching Waveforms

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

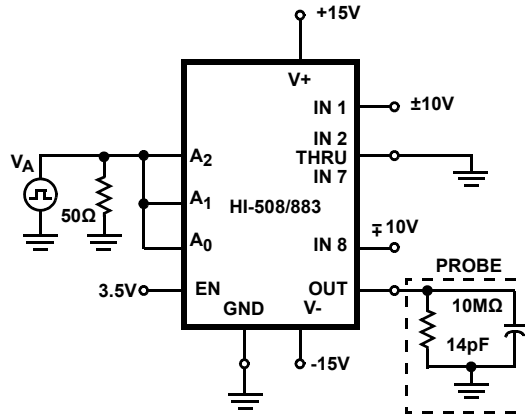
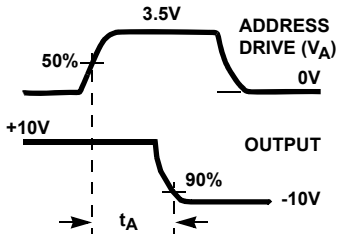


BREAK-BEFORE-MAKE DELAY ( $t_{OPEN}$ )

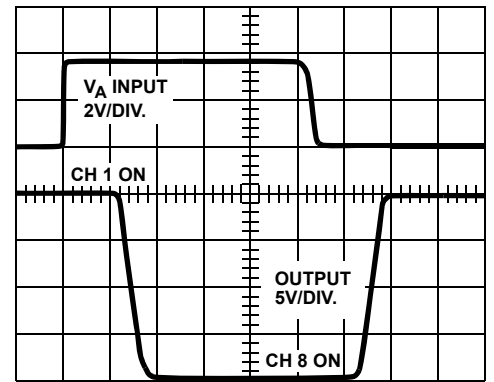


100ns/DIV.

ACCESS TIME vs LOGIC LEVEL (HIGH)

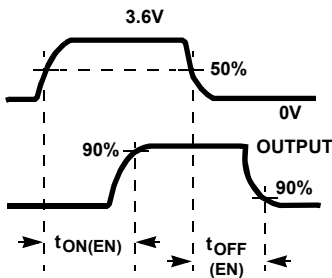


ACCESS TIME



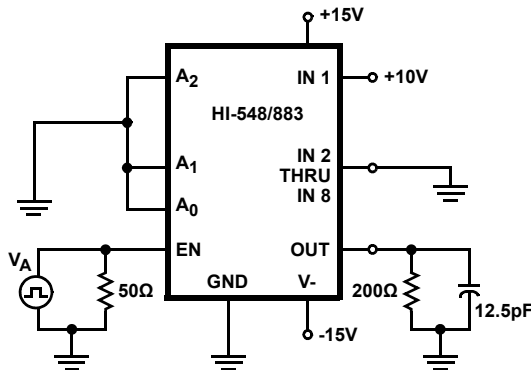
200ns/DIV.

ENABLE DRIVE



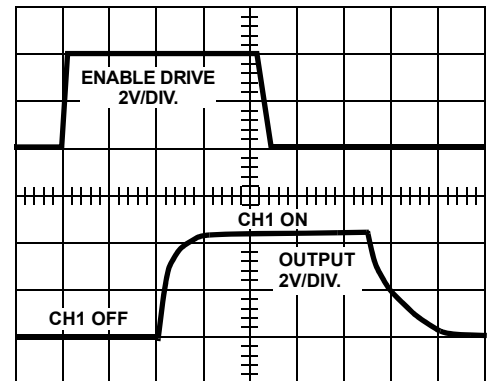
ENABLE DELAY

$t_{ON(EN)}$ ,  $t_{OFF(EN)}$



ENABLE DELAY

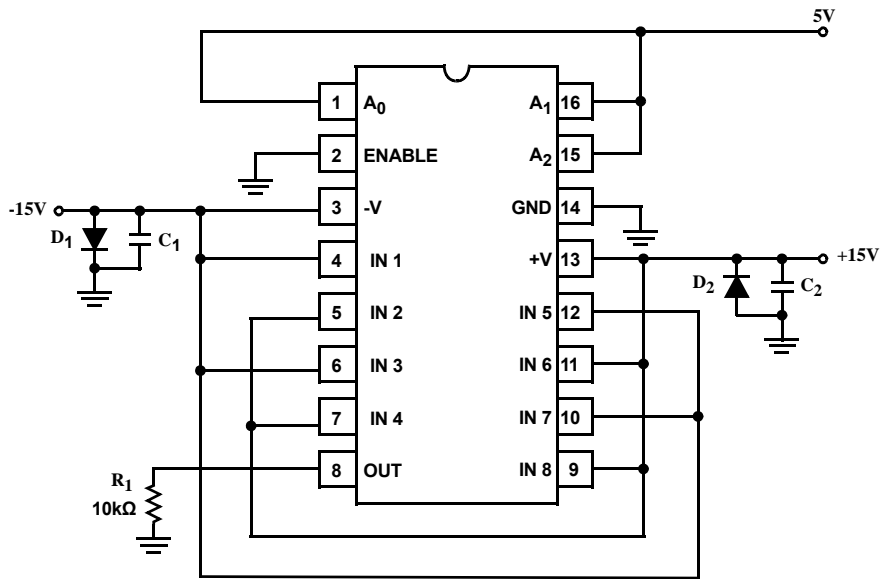
$t_{ON(EN)}$ ,  $t_{OFF(EN)}$



100ns/DIV.

## Burn-In Circuit

HI-508/883 CERDIP

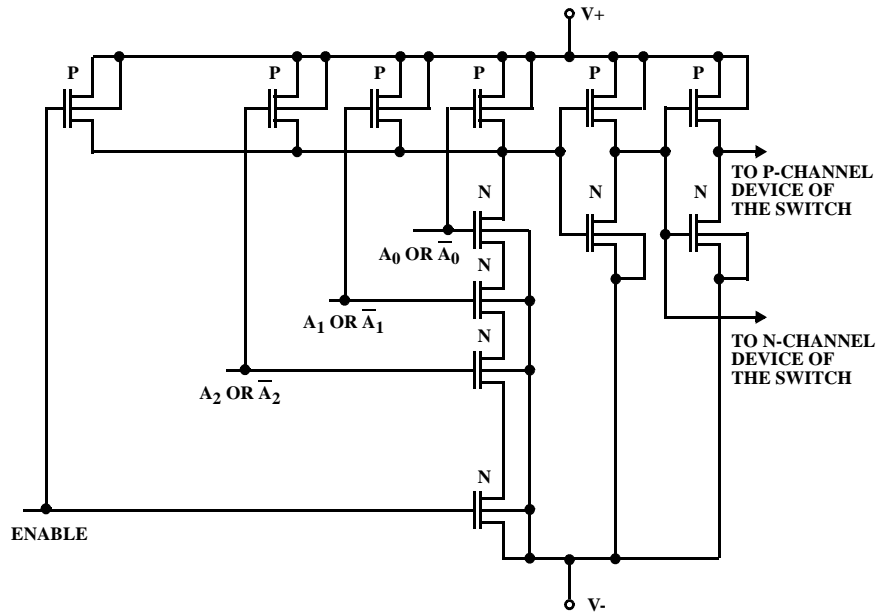


**NOTES:**

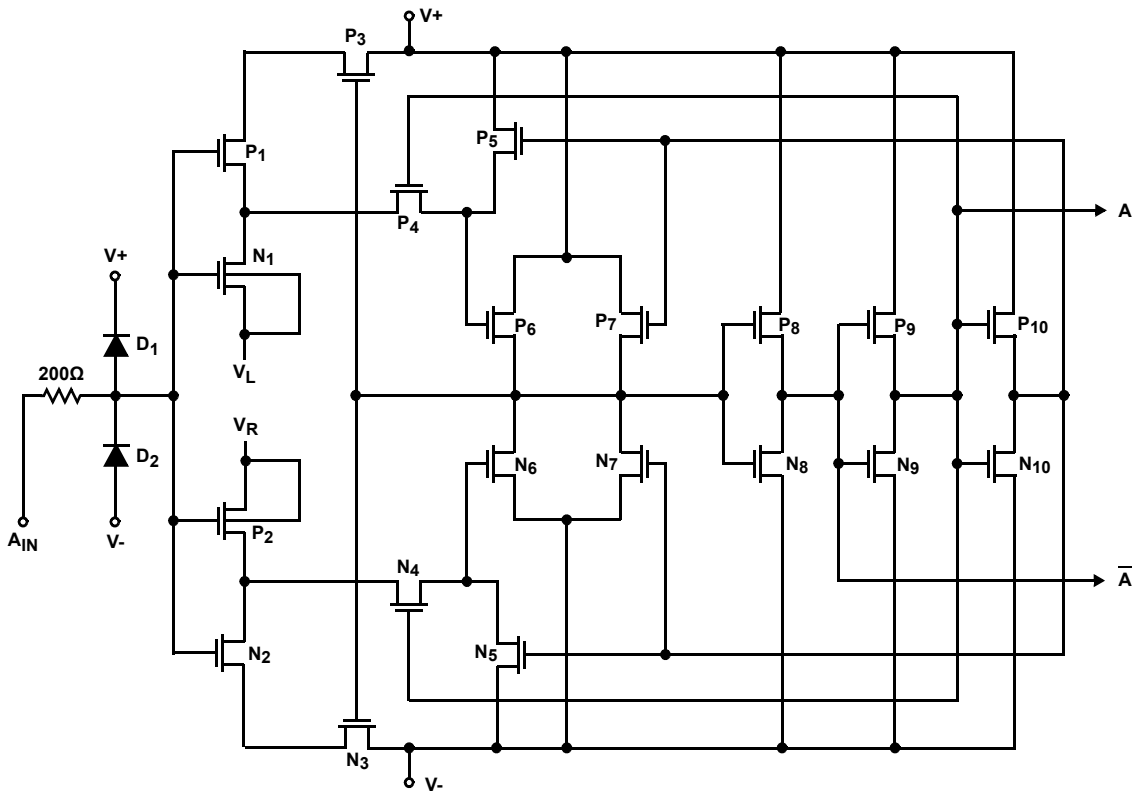
- R<sub>1</sub> = 10kΩ ± 5% 1/2W or 1/4W (per socket)
- C<sub>1</sub>, C<sub>2</sub> = 0.01μF (per socket) or 0.1μF (per row)
- D<sub>1</sub>, D<sub>2</sub> = 1N4002 (or equivalent) (per board)

Schematic Diagrams

ADDRESS DECODER

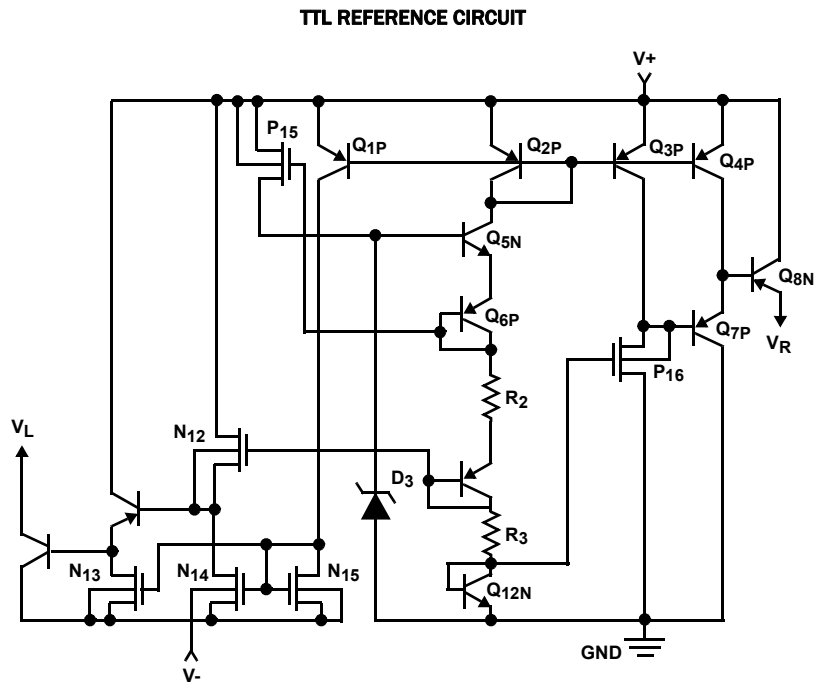
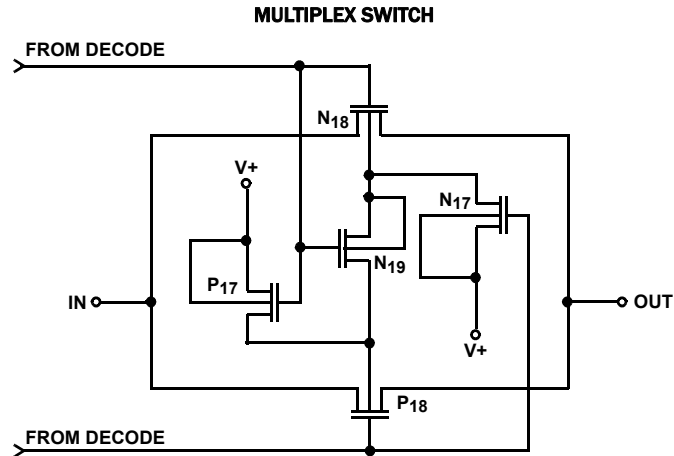


ADDRESS INPUT BUFFER AND LEVEL SHIFTER



All N-Channel bodies to V-, all P-Channel bodies to V+, unless otherwise indicated.

Schematic Diagrams (Continued)





# HI-508/883

## Die Characteristics

### DIE DIMENSIONS:

81.9mils x 90.2mils x 19mils

### METALLIZATION:

Type: Al

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

### GLASSIVATION:

Type: Nitride

Thickness:  $7\text{k}\text{\AA} \pm 0.7\text{k}\text{\AA}$

### WORST CASE CURRENT DENSITY:

$1.4 \times 10^5 \text{ A/cm}^2$

### TRANSISTOR COUNT:

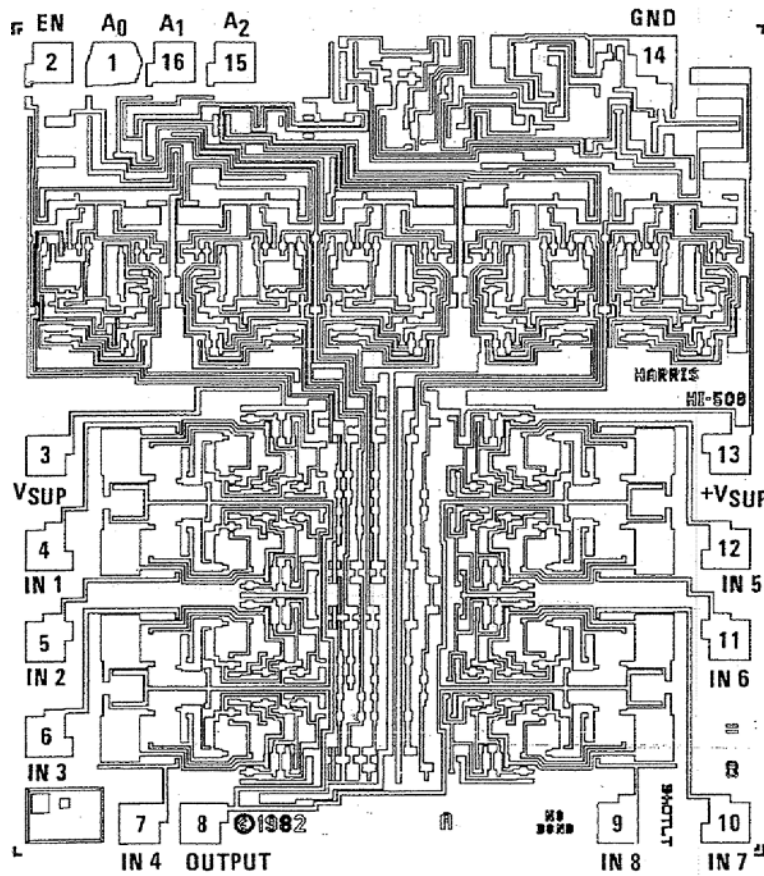
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### PROCESS:

CMOS-DI

## Metallization Mask Layout

HI-508/883



**Design Information** The information contained in this section has been developed through characterization and is for use as application and design information only. No guarantee is implied.

**Typical Performance Curves**

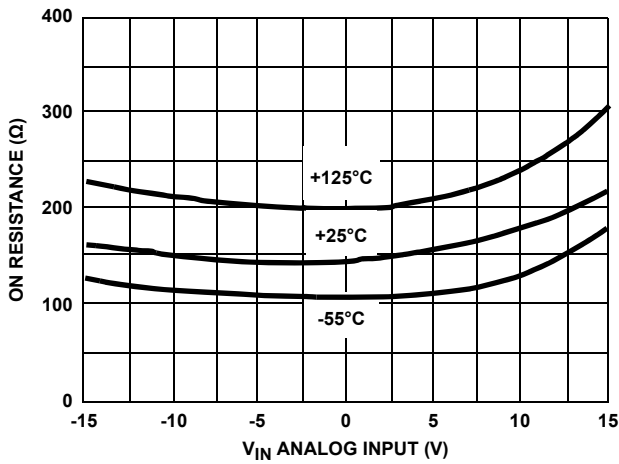


FIGURE 1. ON RESISTANCE vs ANALOG INPUT VOLTAGE, TEMPERATURE

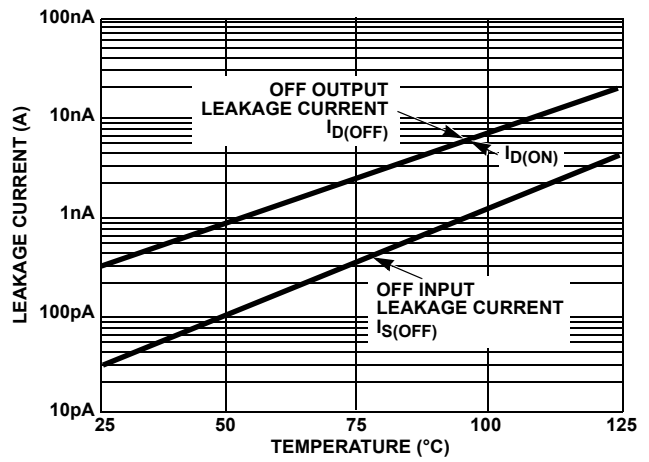


FIGURE 2. LEAKAGE CURRENT vs TEMPERATURE

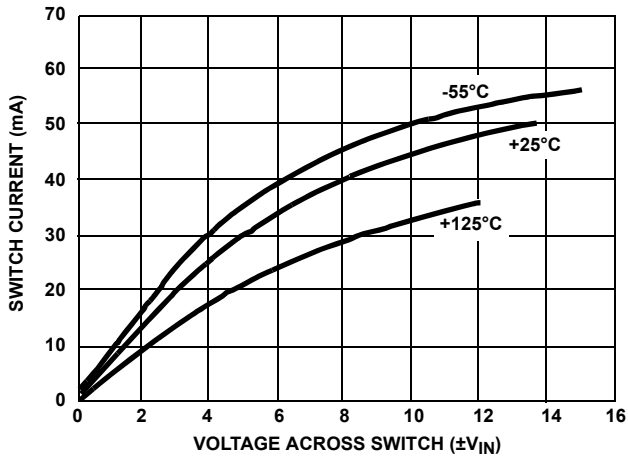


FIGURE 3. ON CHANNEL CURRENT vs VOLTAGE

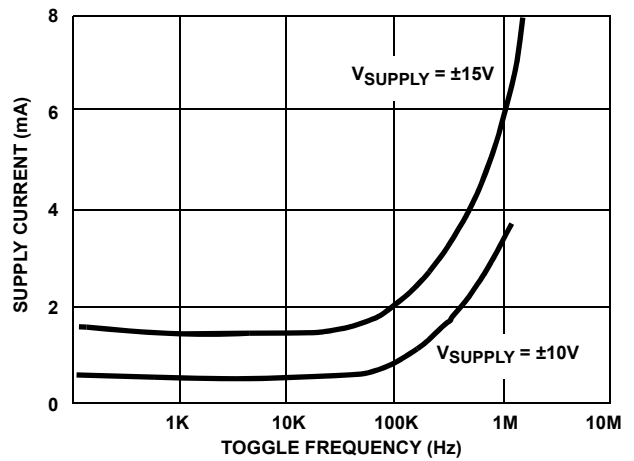
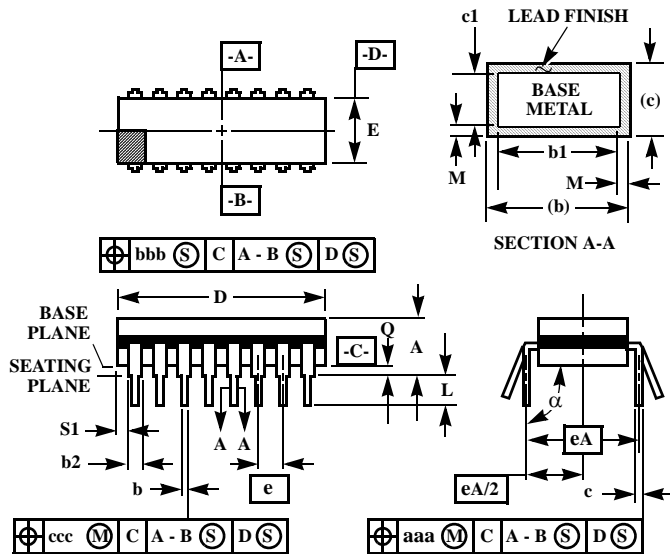


FIGURE 4A. SUPPLY CURRENT vs TOGGLE FREQUENCY

## 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.

**F16.3 MIL-STD-1835 GDIP1-T16 (D-2, CONFIGURATION A)  
16 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        | -         | 0.840  | -           | 21.34 | 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     | 0.060  | 0.38        | 1.52  | 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        | 16        |        | 16          |       | 8     |

Rev. 0 4/94

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