



HARRIS

HI-506L/HI-507L

Single 16/Differential 8 Channel CMOS Analog Multiplexers With Latches And Overvoltage Protection

FEATURES

- Analog Overvoltage protection
- Resettable Latches (\overline{RS})
- TTL/DTL and CMOS Compatible
- Failsafe for conditions of Overvoltage & Loss of Power
- No SCR Latch-up
- Break-before-make switching
- Microprocessor Bus compatible
- Very low leakage - $I_D(\text{off}) \leq 8\text{nA}$ (typ) over full temp range
- Access time - $t_A = 500\text{nS}$ (typ)
- Minimum write pulse width (\overline{WR}) = 300 nS
- OFF Isolation = -100dB, typ @ 10kHz

DESCRIPTION

These monolithic CMOS multiplexers feature on-board address latches, plus overvoltage protection for the analog inputs and the output as well. Each model includes digital inputs for channel selection and an Enable input for device selection under program control. In addition, Write (\overline{WR}) and Reset (\overline{RS}) inputs allow the program to store or clear the channel address.

The overvoltage performance of these multiplexers is particularly useful in redundant systems, where the inputs and output must present a high impedance when power is off. This is achieved by a switch cell with three MOSFET's in series, rather than the conventional transmission gate design.

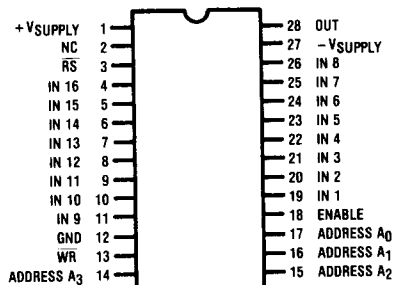
Each channel can withstand overvoltage to $\pm 25\text{VDC}$ with respect to ground with power ON or OFF. An OFF channel remains OFF in the presence of overvoltage. If the channel is ON, output voltage is clamped below the supply rail, which protects the load circuit.

The HI-506L offers 16 single-ended channels, and the HI-507L is an 8 channel differential version. The recommended supply voltages are $\pm 15\text{V}$, though operation at reduced levels or with a single supply may also be implemented. The package is a 28 pin ceramic or plastic DIP.

Each product is specified for the commercial temperature range (0°C to $+75^\circ\text{C}$, -5 suffix) and the military range (-55°C to $+125^\circ\text{C}$, -2 suffix). Military high reliability burned-in product is available as a "-8" suffix.

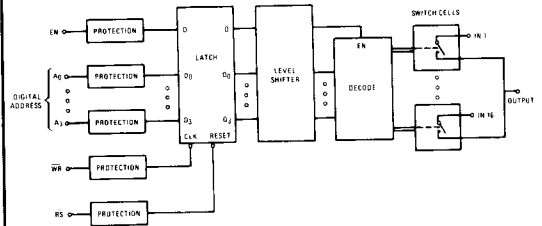
PINOUT

HI-506L

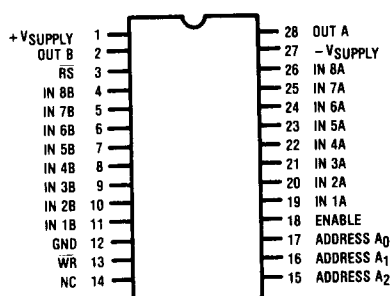


FUNCTIONAL DIAGRAM

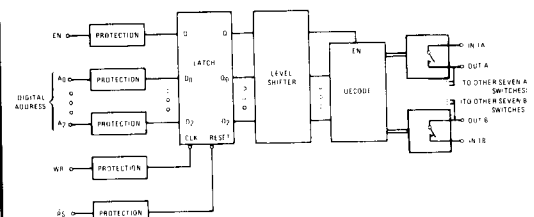
HI-506L



HI-507L



HI-507L



CAUTION: Electronic devices are sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

SPECIFICATIONS

HI-506L/507L

ABSOLUTE MAXIMUM RATINGS (Note 1)

| | | | |
|---|--------|------------------------------------|-----------------|
| Supply Voltage Between Pins 1 and 27 | 44V | Operating Temperature | |
| Digital Input Overvoltage, V_A , V_{EN} , V_{RS} , V_{WR} | | | |
| V supply (+) | +4V | HI-506L/507L-2 | -55°C to 125°C |
| V supply (-) | -4V | HI-506L/507L-5 | 0°C to 75°C |
| Analog Overvoltage | | Storage Temperature | -65°C to +150°C |
| Input to Ground | ±25VDC | | |
| Total Power Dissipation* (Package) | 1200mW | *Derate-8mW/°C above $T_A = +75°C$ | |

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified)

+V supply = 15V, -V supply = -15V, V_{AH} (Logic High) = 2.0V, V_{AL} (Logic Low) = 0.8V

| PARAMETER | HI-506L/507L-2 -55°C to +125°C | | | HI-506L/507L-5 0°C to +75°C | | | UNITS |
|--|-----------------------------------|------|------|--------------------------------|------|------|-------|
| | TEMP | MIN | TYP | MAX | MIN | TYP | |
| ANALOG CHANNEL CHARACTERISTICS | | | | | | | |
| V_S Analog Signal Range | Full | | ±10 | | | ±10 | V |
| R_{ON} , ON Resistance (Note 2) | +25°C | | | 1.2 | | | KΩ |
| | Full | | | 1.8 | | 1.5 | KΩ |
| ΔR_{ON} , Change in R_{ON} (Note 3) between channels | +25°C | | 5 | | | 5 | % |
| $I_{S(off)}$, OFF input leakage current | +25°C | | | 10 | | | nA |
| | Full | | 5 | 50 | | 5 | nA |
| $I_{D(off)}$, OFF output leakage current | +25°C | | | 10 | | | nA |
| | HI-506L | | 8 | 200 | | 8 | nA |
| | HI-507L | | 4 | 100 | | 4 | nA |
| $I_{D(on)}$, ON Channel leakage current | +25°C | | | 5 | | 5 | nA |
| | HI-506L | | 10 | 200 | | 10 | nA |
| | HI-507L | | 5 | 100 | | 5 | nA |
| FAULT CHARACTERISTICS | | | | | | | |
| $I_{S(off)}$, with Power OFF | Full | | 10 | 1000 | | 10 | nA |
| $I_{S(off)}$, overvoltage (Note 4) | Full | | 10 | 750 | | 10 | nA |
| $I_{D(off)}$, with input overvoltage applied (Note 4) | +25°C | | 5 | | | 5 | nA |
| | Full | | 10 | 750 | | 10 | nA |
| DIGITAL INPUT CHARACTERISTICS | | | | | | | |
| V_{AL} , Input Low Threshold | Full | | 1.4 | 0.8 | | 1.4 | V |
| V_{AH} , Input High Threshold | Full | 2.0 | 1.4 | | 2.0 | 1.4 | V |
| I_{AH} , Input High Current (Note 5) | Full | | 10 | 40 | | 10 | μA |
| I_{AL} , Input Low Current (Note 5) | Full | | 10 | 200 | | 40 | μA |
| DYNAMIC SWITCHING CHARACTERISTICS (Note 6) | | | | | | | |
| t_a , Access Time | +25°C | | 0.5 | 1.0 | | 0.5 | μS |
| t_{OPEN} , Break-Before-Make | +25°C | .025 | 0.1 | | .025 | 0.1 | μS |
| t_{ON} , (EN), Enable Delay (ON) | +25°C | | 0.5 | 1.0 | | 0.5 | μS |
| t_{OFF} , (EN), Enable Delay (OFF) | +25°C | | 0.5 | 1.0 | | 0.5 | μS |
| Settling Time (±0.1%) | +25°C | | 1.0 | | | 1.0 | μS |
| | +25°C | | 1.75 | | | 1.75 | μS |
| OFF Isolation (Note 7) | +25°C | 50 | 68 | | 50 | 68 | dB |
| OFF Isolation POWER OFF (Note 8) | +25°C | | 56 | | | 56 | dB |
| $C_S(off)$, Channel Input Cap. | +25°C | | 5 | | | 5 | pF |
| $C_D(off)$, Channel Output Cap. | | | | | | | |
| | +25°C | | 50 | | | 50 | pF |
| | +25°C | | 25 | | | 25 | pF |
| C_A , Digital Input Capacitance | +25°C | | 5 | | | 5 | pF |
| $C_{DS(off)}$, Input to Output capacitance | +25°C | | 0.1 | | | 0.1 | pF |
| POWER REQUIREMENTS | | | | | | | |
| P_D , Power Dissipation (Note 9) | Full | | 60 | 100 | | 60 | mW |
| I_+ , Current Pin 1 (Note 9) | Full | | 3.7 | 6.0 | | 3.7 | mA |
| I_- , Current Pin 27 (Note 9) | Full | | 0.3 | 0.6 | | 0.3 | mA |

NOTES: 1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operation under any of these conditions is not necessarily implied.

2. $V_{OUI} = \pm 10V$, $I_{out} = -100\mu A$
 3. $\Delta R_{ON} = R_{ON}(Max) - R_{ON}(Min)$, $V_{IN} = \pm 10V$
 $R_{ON}(Avg)$

4. Analog Overvoltage = ±25V
 5. I_{AH} and I_{AL} tested at 2.4V and 0.4 V respectively

6. For measurements in this section, input logic levels are 3.0V (High) and 0V (Low).

7. $V_{EN} = 0.6V$, $R_L = 1K\Omega$, $C_L = 15pF$,
 $V_S = 7Vrms$, $f = 500kHz$,
 Off isolation = 20 log $\frac{|V_O|}{|V_S|}$

8. $V_+ = V_- = 0V$, $R_L = 1K\Omega$,
 $C_L = 50pF$, $V_S = 8Vrms$, $f = 500kHz$.

9. See Test Circuit #8 for high toggle frequency applications.

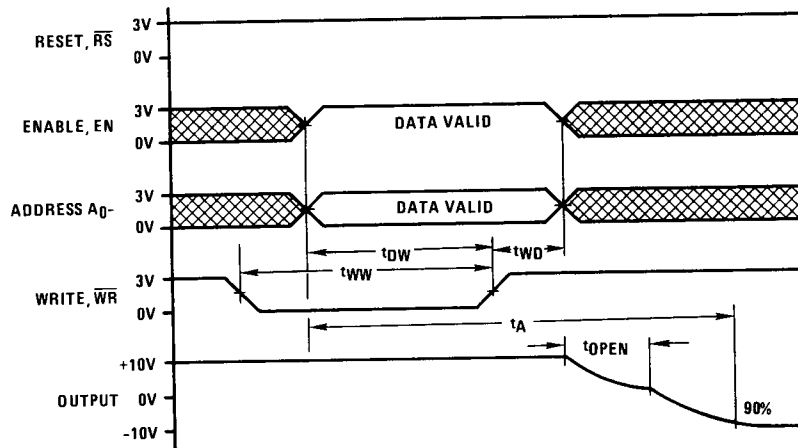
4

MULTIPLEXERS

MINIMUM TIMING REQUIREMENTS

| PARAMETER | MIN LIMITS FULL TEMP RANGE | UNITS |
|--|-------------------------------|-------|
| t_{WW} : Write Pulse Width | 300 | nS |
| t_{DW} : A. EN Data Valid To WRITE (Stabilization Time) | 225 | nS |
| t_{WD} : A. EN Data Valid After Write (hold Time) | 100 | nS |
| t_{RS} : RESET pulse width | 400 | nS |
| $t_{OFF}(\overline{RS})$: Reset Delay | 1000 | nS |
| $t_{ON}(\overline{WR})$: Write Turn-on Time | 1000 | nS |

TIMING REQUIREMENTS



1. $+V_{SUPPLY} = +15V$; $-V_{SUPPLY} = -15V$.
2. Logic Levels: $V_{AL} = 0V$; $V_{AH} = +3.0V$.
3. Time intervals are measured between 50% levels unless otherwise noted.
4. Minimum values for t_{RS} , t_{DW} , t_{WW} and t_{WD} are guaranteed separately but not simultaneously.

Figure 1

SCHEMATIC DIAGRAM

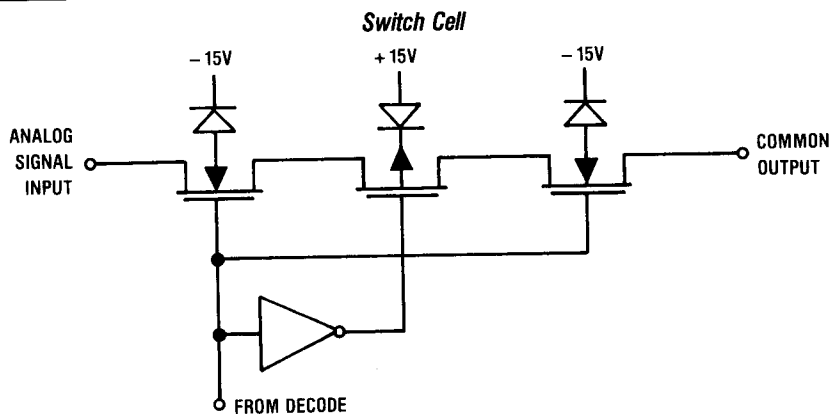


Figure 2

506L

| A3 | A2 | A1 | A0 | EN | WR | RS | OUTPUT - ON CHANNEL |
|----|----|----|----|----|----|----|------------------------|
| X | X | X | X | L | L | H | None |
| X | X | X | X | X | H | H | Previous ON Channel. |
| X | X | X | X | X | X | L | None (latches cleared) |
| L | L | L | L | H | L | H | Channel 1 |
| L | L | L | H | H | L | H | Channel 2 |
| L | L | H | L | H | L | H | Channel 3 |
| L | L | H | H | H | L | H | Channel 4 |
| L | H | L | L | H | L | H | Channel 5 |
| L | H | L | H | H | L | H | Channel 6 |
| L | H | H | L | H | L | H | Channel 7 |
| L | H | H | H | H | L | H | Channel 8 |
| H | L | L | L | H | L | H | Channel 9 |
| H | L | L | H | H | L | H | Channel 10 |
| H | L | H | L | H | L | H | Channel 11 |
| H | L | H | H | H | L | H | Channel 12 |
| H | H | L | L | H | L | H | Channel 13 |
| H | H | L | H | H | L | H | Channel 14 |
| H | H | H | L | H | L | H | Channel 15 |
| H | H | H | H | H | L | H | Channel 16 |

4

MULTIPLEXERS

507L

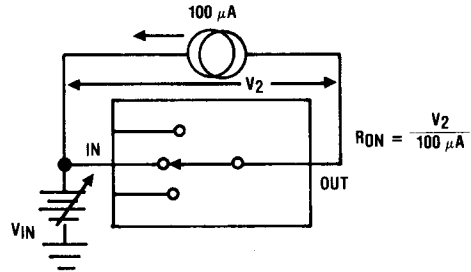
| A2 | A1 | A0 | EN | WR | RS | OUTPUT - ON CHANNEL PAIR |
|----|----|----|----|----|----|--------------------------|
| X | X | X | L | L | H | None |
| X | X | X | X | H | H | Previous ON Channel. |
| X | X | X | X | X | L | None (latches cleared) |
| L | L | L | H | L | H | Channel 1A and 1B |
| L | L | H | H | L | H | Channel 2A and 2B |
| L | H | L | H | L | H | Channel 3A and 3B |
| L | H | H | H | L | H | Channel 4A and 4B |
| H | L | L | H | L | H | Channel 5A and 5B |
| H | L | H | H | L | H | Channel 6A and 6B |
| H | H | L | H | L | H | Channel 7A and 7B |
| H | H | H | H | L | H | Channel 8A and 8B |

DESCRIPTION AND APPLICATION

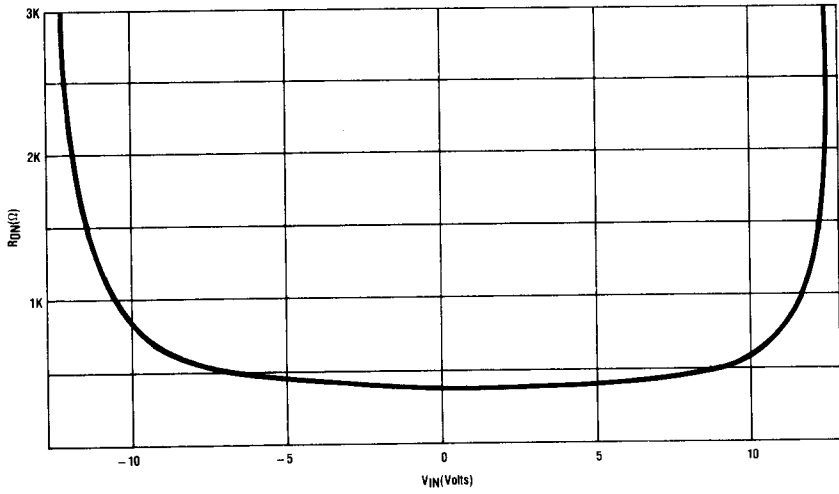
The switch cell of the HI-506L/507L has a different structure than earlier Harris designs (HI-506, HI506A). The new switch (Figure 2) consists of an N-channel, P-channel and N-channel MOSFET in series, as opposed to the transmission gate configuration with an N and P-channel device in parallel. The series N-P-N switch offers higher Off Isolation with power off, and better fault performance. Channel overvoltage protection is inherent since one of the three MOSFETs turn off in the presence of overvoltage. This turn-off process begins well below the supply rail so the V_{IN} range is less than the power supply range. Electrical performance is guaranteed to $\pm 10V$ for each channel, and the usable range extends above ± 11 Volts.

The address inputs A_0 , A_1 , A_2 , A_3 , and ENABLE are latched into an internal buffer when WR goes high. Each latch output is level shifted into the decode section, which activates the appropriate channel. The device may be reset (all channels OFF) by taking RS low. Usually, RS is tied to the system RESET line, to assure that all channels are OFF following a turn-on of power. The reset function overrides all others, just as WR overrides the address inputs (A_0 - A_3 and EN are ignored when WR is high). With WR low and RS high, the switches respond immediately to a change in channel address; i.e. the latches are "transparent". Refer to Figure 1.

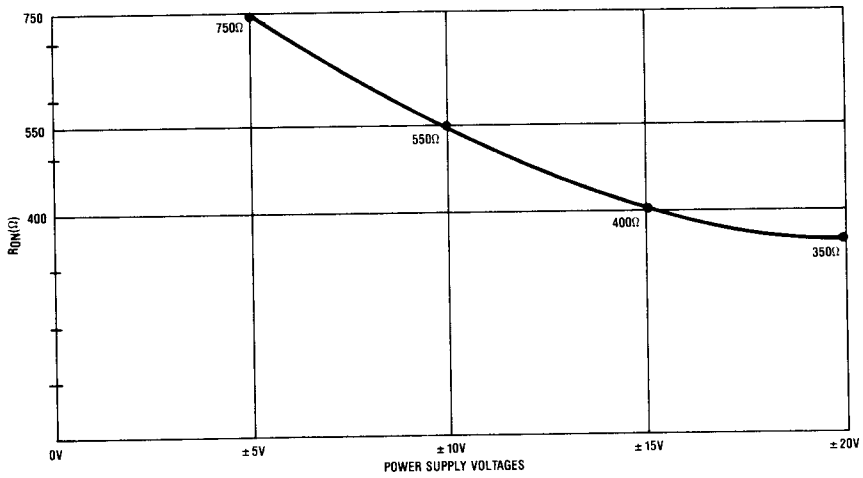
TEST CIRCUIT NO. 1
ON RESISTANCE vs.
INPUT SIGNAL LEVEL



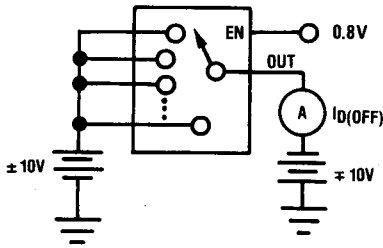
V_{IN} vs. R_{ON}



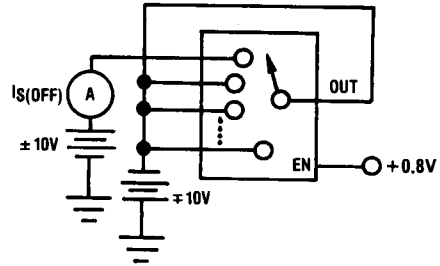
R_{ON} vs. POWER SUPPLY VOLTAGES
INPUT = 0V



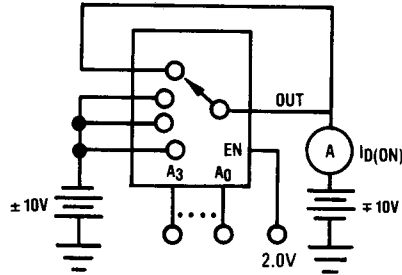
TEST CIRCUIT NO. 2*



TEST CIRCUIT NO. 3*



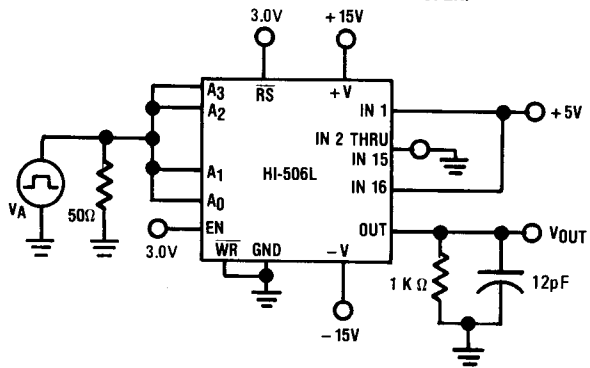
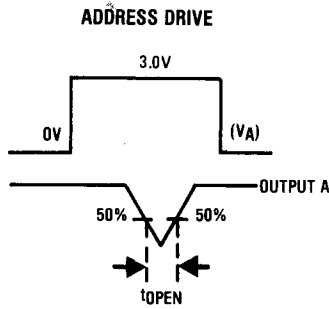
TEST CIRCUIT NO. 4*



*Two measurements per channel:
+10V/-10V and -10V/+10V.
(Two measurements per device for I_{D(OFF)}:
+10V/-10V and -10V/+10V.)

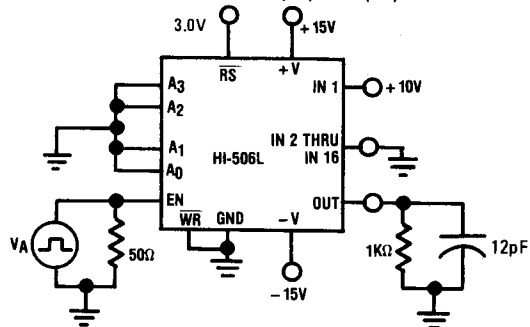
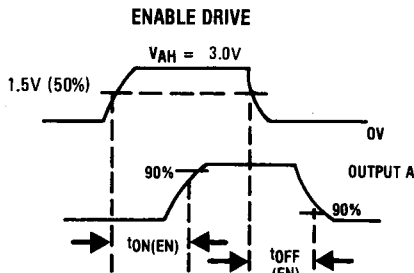
TEST CIRCUIT NO. 5

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



TEST CIRCUIT NO. 6

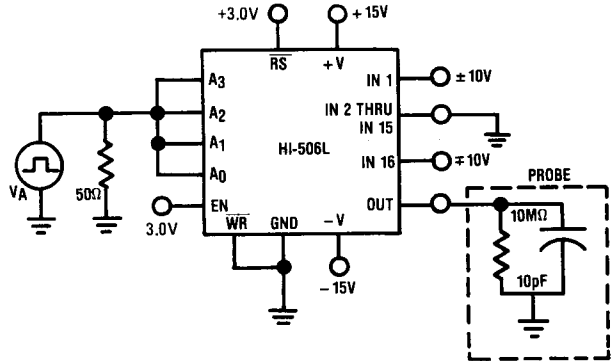
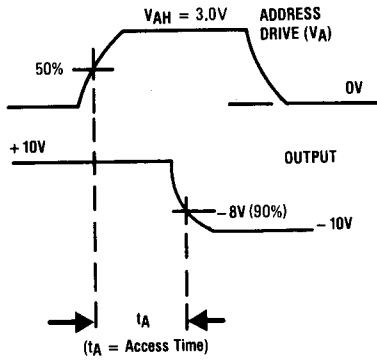
ENABLE DELAY (t_{ON(EN)}, t_{OFF(EN)})



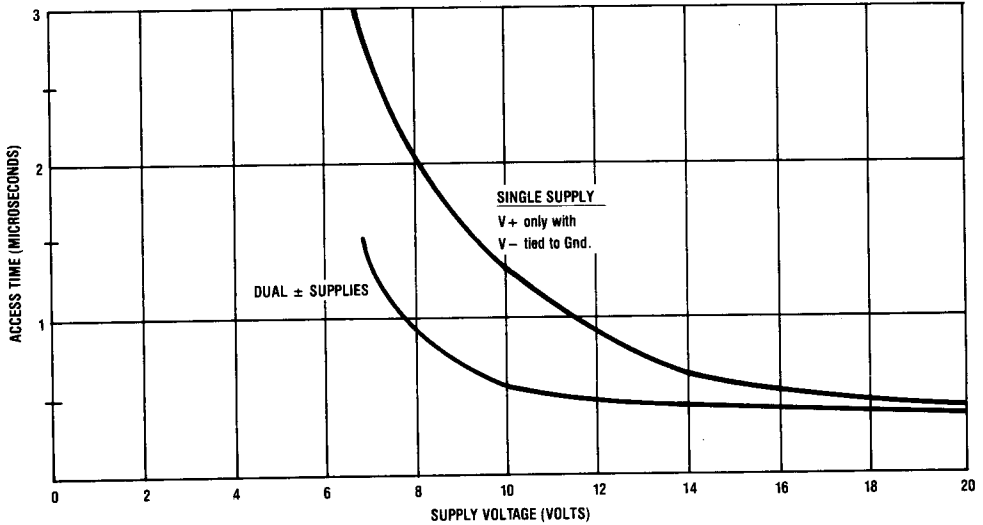
HI-506L TEST CIRCUITS

TEST CIRCUIT NO. 7

ACCESS TIME

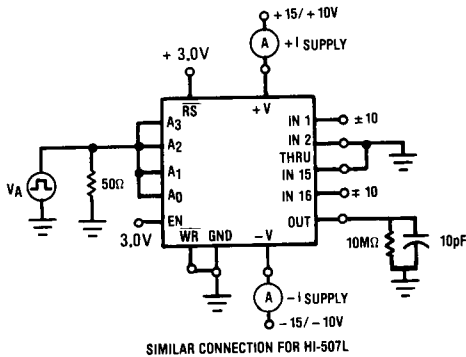


ACCESS TIME vs. SUPPLY VOLTAGE

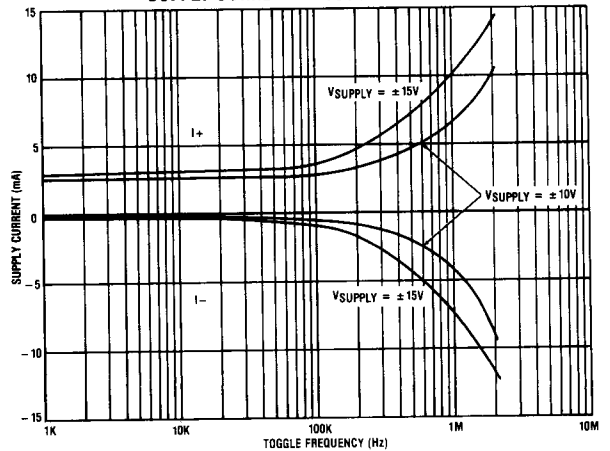


TEST CIRCUIT NO. 8

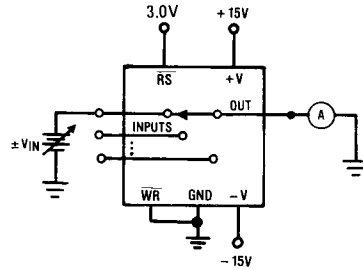
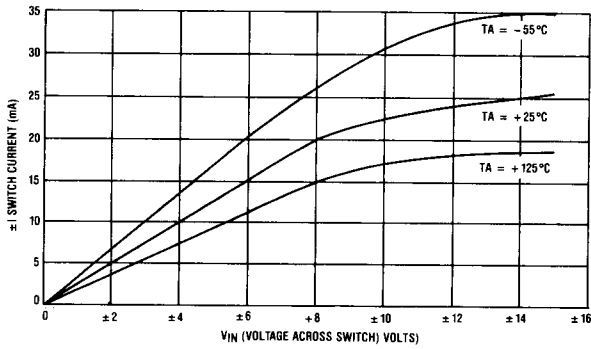
SUPPLY CURRENTS vs. TOGGLE FREQUENCY



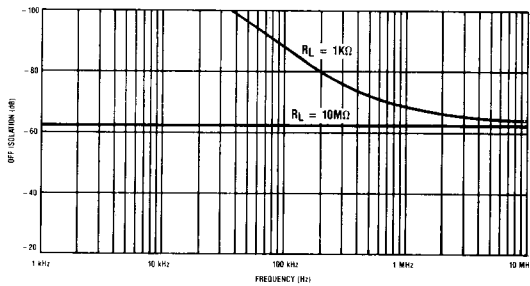
SUPPLY CURRENT vs. TOGGLE FREQUENCY



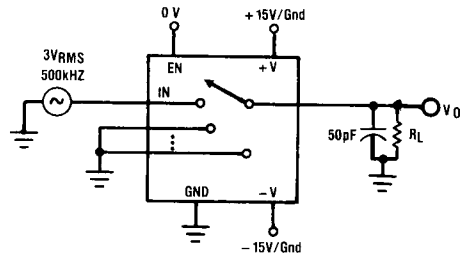
TEST CIRCUIT NO. 9
ON CHANNEL CURRENT vs. INPUT VOLTAGE



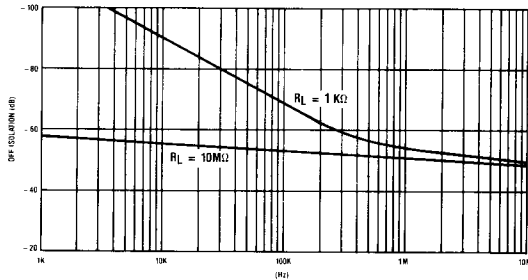
OFF ISOLATION vs. FREQUENCY POWER ON



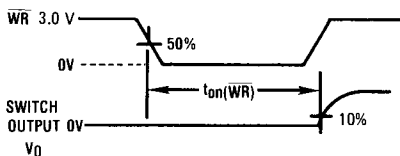
TEST CIRCUIT NO. 10
OFF ISOLATION



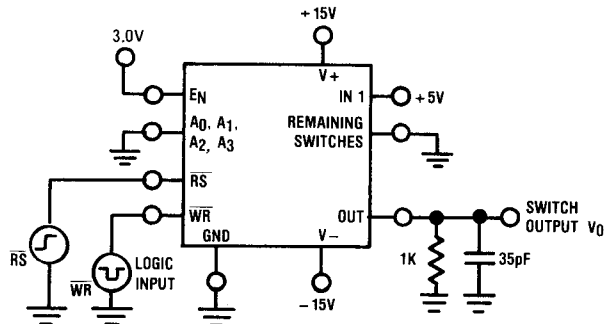
OFF ISOLATION vs. FREQUENCY (POWER OFF)



TEST CIRCUIT 11
WRITE TURN-ON TIME $t_{ON}(WR)$

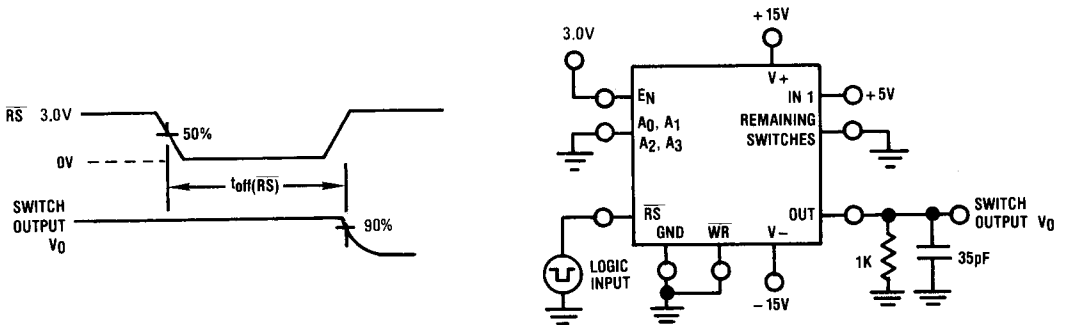


DEVICE MUST BE RESET PRIOR TO APPLYING WR PULSE

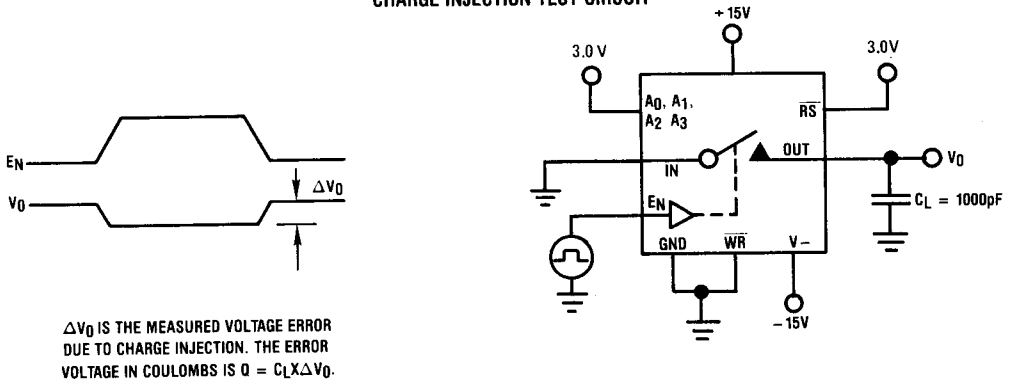


HI-506L TEST CIRCUITS

TEST CIRCUIT 12
RESET TURN-OFF TIME $t_{off}(\overline{RS})$



TEST CIRCUIT 13
CHARGE INJECTION TEST CIRCUIT



DIE CHARACTERISTICS

| | |
|-------------------|--------------|
| Transistor Count | 672 |
| Die Size | 168x124mils. |
| Thermal Impedance | |
| θ_{JA} | 48°C/W |
| θ_{JC} | 15°C/W |
| Tie Substrate to: | -VSupply |
| Process | CMOS-D1 |