# MAXIM

# Monolithic CMOS Analog Multiplexers



## General Description

Maxim's DG506A and DG507A are monolithic CMOS analog multiplexers. The DG506A is a single 16 channel (1 of 16) multiplexer, and the DG507A is a differential 8 channel (2 of 16) multiplexer.

Both devices feature break-before-make switching. Maxim guarantees that these multiplexers will not latch-up if the power supplies are turned off with the input signals still present as long as absolute maximum ratings are not violated. The multiplexers operate over a wide range of power supplies from ±4.5V to ±18V.

Compared to the original manufacturer's devices, Maxim's DG506A and DG507A consume significantly less power, making them ideal for portable equipment.

Maxim's DG506A and DG507A meet or exceed the specifications of, and are drop-in replacements for, Intersil's IH6116 and IH6216, Siliconix's DG506A and DG507A, and Harris' HI506 and HI507.

## Applications

Control Systems

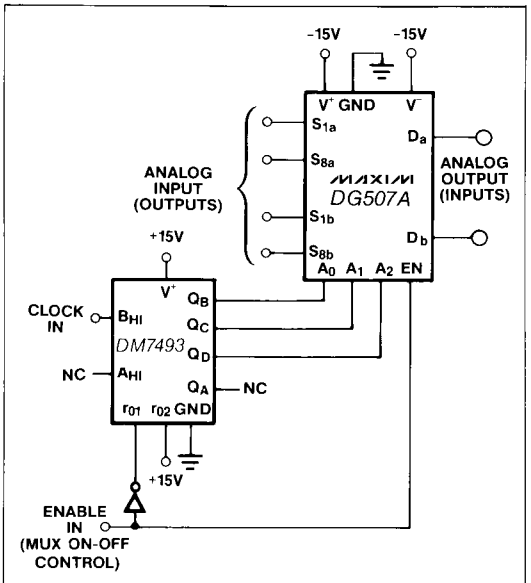
Data Logging Systems

Aircraft Heads Up Displays

Data Acquisition Systems

Signal Routing

## Typical Operating Circuit




8 Channel Sequential Differential MUX/DEMUX

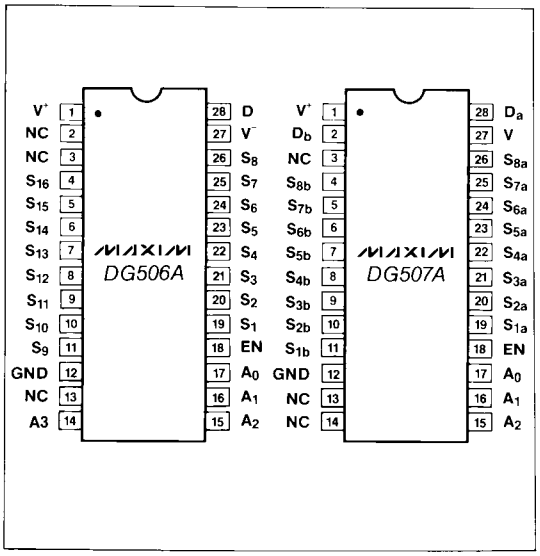
## Features

- ◆ **Improved 2nd Source!**
- ◆ **Pin compatible with Harris, Siliconix, Intersil**
- ◆ **Operable with ±4.5V to ±18V Supplies**
- ◆ **Symmetrical, Bi-Directional Operation**
- ◆ **Logic and Enable inputs, TTL and CMOS Compatible**
- ◆ **Latch-Up Proof Construction**
- ◆ **Monolithic, Low-Power CMOS Design**

## Ordering Information

| PART | TEMP. RANGE | PACKAGE |
|---|---|---|
| DG506AAK | -55°C to +125°C | 28 Lead CERDIP |
| DG506ABK | -20°C to +85°C | 28 Lead CERDIP |
| DG506AC/D | 0°C to +70°C | Dice |
| DG506ACJ | 0°C to +70°C | 28 Lead Plastic DIP |
| DG506ACK | 0°C to +70°C | 28 Lead CERDIP |
| DG506ACWI | 0°C to +70°C | 28 Lead Wide SO |
| DG507AAK | -55°C to +125°C | 28 Lead CERDIP |
| DG507ABK | -20°C to +85°C | 28 Lead CERDIP |
| DG507AC/D | 0°C to +70°C | Dice |
| DG507ACJ | 0°C to +70°C | 28 Lead Plastic DIP |
| DG507ACK | 0°C to +70°C | 28 Lead CERDIP |
| DG507ACWI | 0°C to +70°C | 28 Lead Wide SO |

## Pin Configurations



# Monolithic CMOS Analog Multiplexers

## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to $V^-$
$V^+$ ..... 44V
GND ..... 25V
Digital Inputs $V_S$, $V_D$ (Note 1) ..... -2V to ($V^+$ + 2V) or 20mA, whichever occurs first.
Current, Any Terminal Except S or D ..... 30mA
Continuous Current, S or D ..... 20mA
Peak Current, S or D
(Pulsed at 1msec, 10% duty cycle max) ..... 40mA
Storage Temperature (A & B Suffix) ..... -65°C to 150°C
(C Suffix) ..... -65°C to 125°C
Operating Temperature (A Suffix) ..... -55°C to 125°C
(B Suffix) ..... -25°C to 85°C
(C Suffix) ..... 0°C to 70°C
Power Dissipation (Package)*
28 Pin Ceramic DIP** ..... 1200mW
28 Pin Plastic DIP*** ..... 625mW

*All leads soldered or welded to PC board.
**Derate 16mW/°C above 75°C
***Derate 8.3mW/°C above 75°C

*Stresses listed under "Absolute Maximum Ratings" may be applied (one at a time) to devices without resulting in permanent damage. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS ($V^+$ = 15V, $V^-$ = -15V, GND = 0V, $T_A$ = 25°C, unless otherwise indicated.)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | DG506AA DG507AA MIN (Note 2) | DG506AA DG507AA TYP (Note 3) | DG506AA DG507AA MAX | DG506AB/C DG507AB/C MIN (Note 2) | DG506AB/C DG507AB/C TYP (Note 3) | DG506AB/C DG507AB/C MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SWITCH** | | | | | | | | | | | |
| Analog Signal Range | | $V_{ANALOG}$ | | | -15 | | 15 | -15 | | 15 | V |
| Drain-Source ON Resistance | | $r_{DS(on)}$ | Sequence Each Switch On $V_{AL}$ = 0.8V, $V_{AH}$ = 2.4V, $V_{EN}$ = 2.4V | $V_D$ = 10V, $I_S$ = -200μA | | 270 | 400 | | 270 | 450 | Ω |
| | | | | $V_D$ = -10V, $I_S$ = -200μA | | 230 | 400 | | 230 | 450 | |
| Greatest Change in Drain-Source ON Resistance Between Channels | | $\Delta r_{DS(on)}$ | $\Delta r_{DS(on)} = \left(\frac{r_{DS(on)}^{MAX} - r_{DS(on)}^{MIN}}{r_{DS(on)}^{AVE}}\right)$ $-10V \leq V_S \leq 10V$ | | | 6 | | | 6 | | % |
| Source OFF Leakage Current | | $I_{S(off)}$ | $V_{EN}$ = 0.8V $V_{AL}$ = 0.8V | $V_S$ = 10V, $V_D$ = -10V | -1 | 0.002 | 1 | -5 | 0.002 | 5 | nA |
| | | | | $V_S$ = -10V, $V_D$ = 10V | -1 | -0.005 | 1 | -5 | -0.005 | 5 | |
| Drain OFF Leakage Current | DG506A | $I_{D(off)}$ | | $V_D$ = 10V, $V_S$ = -10V | -10 | 0.02 | 10 | -20 | 0.02 | 20 | |
| | | | | $V_D$ = -10V, $V_S$ = 10V | -10 | -0.03 | 10 | -20 | -0.03 | 20 | |
| | DG507A | | | $V_D$ = 10V, $V_S$ = -10V | -5 | 0.007 | 5 | -10 | 0.007 | 10 | |
| | | | | $V_D$ = -10V, $V_S$ = 10V | -5 | -0.015 | 5 | -10 | -0.015 | 10 | |
| Channel ON Leakage Current | DG506A | $I_{D(on)}$[4] | Sequence Each Switch On $V_{AL}$ = 0.8V, $V_{AH}$ = 2.4V, $V_{EN}$ = 2.4V | $V_{S(all)}$ = $V_D$ = 10V | -10 | 0.03 | 10 | -20 | 0.03 | 20 | |
| | | | | $V_{S(all)}$ = $V_D$ = -10V | -10 | -0.06 | 10 | -20 | -0.06 | 20 | |
| | DG507A | | | $V_{S(all)}$ = $V_D$ = 10V | -5 | 0.015 | 5 | -10 | 0.015 | 10 | |
| | | | | $V_{S(all)}$ = $V_D$ = -10V | -5 | -0.03 | 5 | -10 | -0.03 | 10 | |
| **INPUT** | | | | | | | | | | | |
| Address Input Current, Input Voltage High | | $I_{AH}$ | $V_A$ = 2.4V | | -10 | -0.002 | | -10 | -0.002 | | μA |
| | | | $V_A$ = 15V | | | 0.006 | 10 | | 0.006 | 10 | |
| Address Input Current, Input Voltage Low | | $I_{AL}$ | All $V_A$ = 0 | $V_{EN}$ = 2.4V | -10 | -0.002 | | -10 | -0.002 | | |
| | | | | $V_{EN}$ = 0 | -10 | -0.002 | | -10 | -0.002 | | |

## ELECTRICAL CHARACTERISTICS (Continued)

($V^+$ = 15V, $V^-$ = -15V, GND = 0V, $T_A$ = 25°C, unless otherwise indicated.)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | DG506AA DG507AA | | | DG506AB/C DG507AB/C | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN (Note 2) | TYP (Note 3) | MAX | MIN (Note 2) | TYP (Note 3) | MAX | |
| **DYNAMIC** | | | | | | | | | | | |
| Switching Time Of Multiplexer | | $t_{transition}$ | See Figure 1 | | | 0.6 | 1 | | 0.6 | | μs |
| Break-Before-Make Interval | | $t_{open}$ | See Figure 3 | | | 0.2 | | | 0.2 | | μs |
| Enable Turn-ON Time | | $t_{on(EN)}$ | See Figure 2 | | | 1 | | | 1 | | μs |
| Enable Turn-OFF Time | | $t_{off(EN)}$ | See Figure 2 | | | 0.4 | | | 0.4 | | μs |
| OFF Isolation[2] | | OIRR | $V_{EN}$ = 0, $R_L$ = 1kΩ, $C_L$ = 15pF $V_S$ = 7Vrms, f = 500kHz | | | 68 | | | 68 | | dB |
| Source OFF Capacitance | | $C_{S(off)}$ | $V_{EN}$ = 0, f = 140kHz | $V_S$ = 0 | | 6 | | | 6 | | pF |
| Drain OFF Capacitance | DG506A | $C_{D(off)}$ | $V_{EN}$ = 0, f = 140kHz | $V_D$ = 0 | | 45 | | | 45 | | pF |
| | DG507A | $C_{D(off)}$ | $V_{EN}$ = 0, f = 140kHz | $V_D$ = 0 | | 23 | | | 23 | | pF |
| **SUPPLY** | | | | | | | | | | | |
| Positive Supply Current | | $I^+$ | $V_{EN}$ = 0V or 5V, All $V_A$ = 0 | | | .13 | .25 | | .13 | .3 | mA |
| Negative Supply Current | | $I^-$ | $V_{EN}$ = 0V or 5V, All $V_A$ = 0 | | -.15 | -.07 | | -.25 | -.07 | | mA |

**Note 1:** Signals on $S_X$, $D_X$, or $IN_X$ exceeding $V^+$ or $V^-$ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

**Note 2:** The algebraic convention whereby the most negative value is a minimum, and the most positive value is a maximum, is used in this data sheet.

**Note 3:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 4:** $I_{D(on)}$ is leakage from driver into "ON" switch.

**Note 5:** OFF isolation = $20 \log \frac{V_D}{V_S}$, $V_S$ = input to "OFF" switch, $V_D$ = output due to $V_S$.

# Monolithic CMOS Analog Multiplexers

## ELECTRICAL CHARACTERISTICS (Over Temperature)

($V^+$ = 15V, $V^-$ = -15V, GND = 0V, $T_A$ = Over Temperature Range, unless otherwise indicated.)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | DG506AA DG507AA MIN (Note 2) | DG506AA DG507AA TYP (Note 3) | DG506AA DG507AA MAX | DG506AB/C DG507AB/C MIN (Note 2) | DG506AB/C DG507AB/C TYP (Note 3) | DG506AB/C DG507AB/C MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SWITCH** | | | | | | | | | | | |
| Analog Signal Range | | $V_{ANALOG}$ | | | -15 | | 15 | -15 | | 15 | V |
| Drain-Source ON Resistance | | $r_{DS(on)}$ | Sequence Each Switch On $V_{AL}$ = 0.8V, $V_{AH}$ = 2.4V, $V_{EN}$ = 2.4V | $V_D$ = 10V, $I_S$ = -200μA | | 500 | | | 550 | | Ω |
| | | | | $V_D$ = -10V, $I_S$ = -200μA | | 500 | | | 550 | | |
| Source OFF Leakage Current | | $I_{S(off)}$ | $V_{EN}$ = 0.8V $V_{AL}$ = 0.8V | $V_S$ = 10V, $V_D$ = -10V | -50 | 50 | | -50 | 50 | | nA |
| | | | | $V_S$ = -10V, $V_D$ = 10V | -50 | 50 | | -50 | 50 | | |
| Drain OFF Leakage Current | DG506A | $I_{D(off)}$ | | $V_D$ = 10V, $V_S$ = -10V | -300 | 300 | | -300 | 300 | | |
| | | | | $V_D$ = -10V, $V_S$ = 10V | -300 | 300 | | -300 | 300 | | |
| | DG507A | | | $V_D$ = 10V, $V_S$ = -10V | -200 | 200 | | -200 | 200 | | |
| | | | | $V_D$ = -10V, $V_S$ = 10V | -200 | 200 | | -200 | 200 | | |
| Channel ON Leakage Current | DG506A | $I_{D(on)}$[4] | Sequence Each Switch On $V_{AL}$ = 0.8V, $V_{AH}$ = 2.4V, $V_{EN}$ = 2.4V | $V_{S(all)}$ = $V_D$ = 10V | -300 | 300 | | -300 | 300 | | |
| | | | | $V_{S(all)}$ = $V_D$ = -10V | -300 | 300 | | -300 | 300 | | |
| | DG507A | | | $V_{S(all)}$ = $V_D$ = 10V | -200 | 200 | | -200 | 200 | | |
| | | | | $V_{S(ALL)}$ = $V_D$ = -10V | -200 | 200 | | -200 | 200 | | |
| **INPUT** | | | | | | | | | | | |
| Address Input Current, Input Voltage High | | $I_{AH}$ | $V_A$ = 2.4V | | -30 | | | -30 | | | μA |
| | | | $V_A$ = 15V | | | | 30 | | | 30 | |
| Address Input Current, Input Voltage Low | | $I_{AL}$ | All $V_A$ = 0 | $V_{EN}$ = 2.4V | -30 | | | -30 | | | |
| | | | | $V_{EN}$ = 0 | | | 30 | | | 30 | |

**Note 1:** Signals on $S_X$, $D_X$, or $IN_X$ exceeding $V^+$ or $V^-$ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

**Note 2:** The algebraic convention whereby the most negative value is a minimum, and the most positive value is a maximum, is used in this data sheet.

**Note 3:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 4:** $I_{D(on)}$ is leakage from driver into "ON" switch.

**Note 5:** OFF isolation = $20 \log \frac{V_D}{V_S}$, $V_S$ = input to "OFF" switch, $V_D$ = output due to $V_S$.

## Truth Tables

**DG506A**

| $A_3$ | $A_2$ | $A_1$ | $A_0$ | EN | ON SWITCH |
|---|---|---|---|---|---|
| X | X | X | X | 0 | NONE |
| 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 2 |
| 0 | 0 | 1 | 0 | 1 | 3 |
| 0 | 0 | 1 | 1 | 1 | 4 |
| 0 | 1 | 0 | 0 | 1 | 5 |
| 0 | 1 | 0 | 1 | 1 | 6 |
| 0 | 1 | 1 | 0 | 1 | 7 |
| 0 | 1 | 1 | 1 | 1 | 8 |
| 1 | 0 | 0 | 0 | 1 | 9 |
| 1 | 0 | 0 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 1 | 11 |
| 1 | 0 | 1 | 1 | 1 | 12 |
| 1 | 1 | 0 | 0 | 1 | 13 |
| 1 | 1 | 0 | 1 | 1 | 14 |
| 1 | 1 | 1 | 0 | 1 | 15 |
| 1 | 1 | 1 | 1 | 1 | 16 |

**DG507A**

| $A_2$ | $A_1$ | $A_0$ | EN | ON SWITCH |
|---|---|---|---|---|
| X | X | X | 0 | NONE |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 1 | 0 | 1 | 3 |
| 0 | 1 | 1 | 1 | 4 |
| 1 | 0 | 0 | 1 | 5 |
| 1 | 0 | 1 | 1 | 6 |
| 1 | 1 | 0 | 1 | 7 |
| 1 | 1 | 1 | 1 | 8 |

**Logic "0" = $V_{AL} \leq 0.8V$, Logic "1" = $V_{AH} \geq 2.4V$**
**"0" = DON'T CARE**

## Switching Time Test Circuit

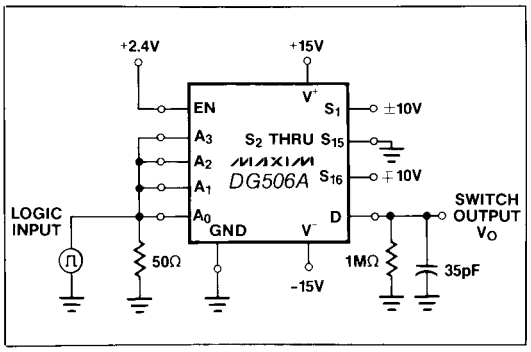



*Figure 1A. Transition Switching Time*

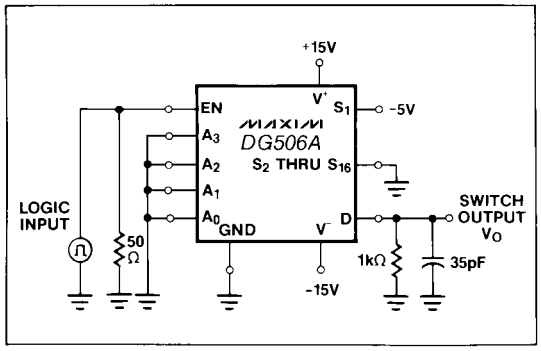



*Figure 2A. Enable Switching Time*

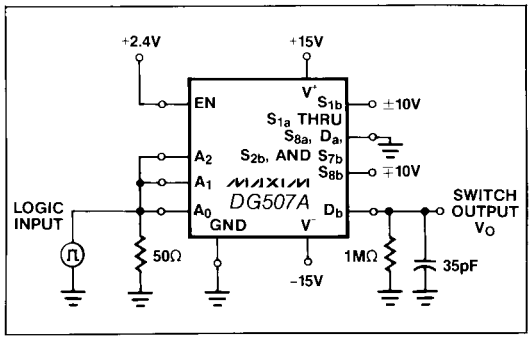



*Figure 1B. Transition Switching Time*

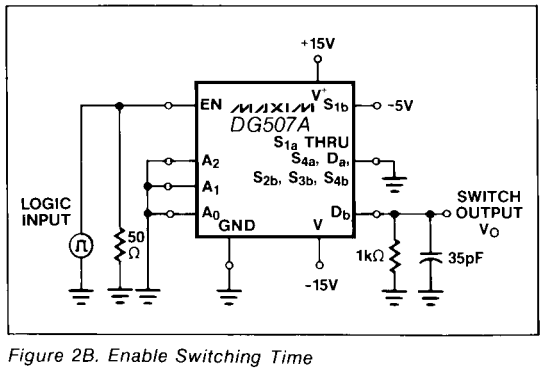



*Figure 2B. Enable Switching Time*

# Monolithic CMOS Analog Multiplexers

## Switching Time Test Circuit (continued)

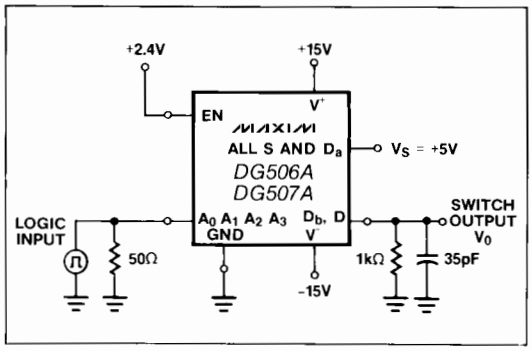



Figure 3. Break-Before-Make

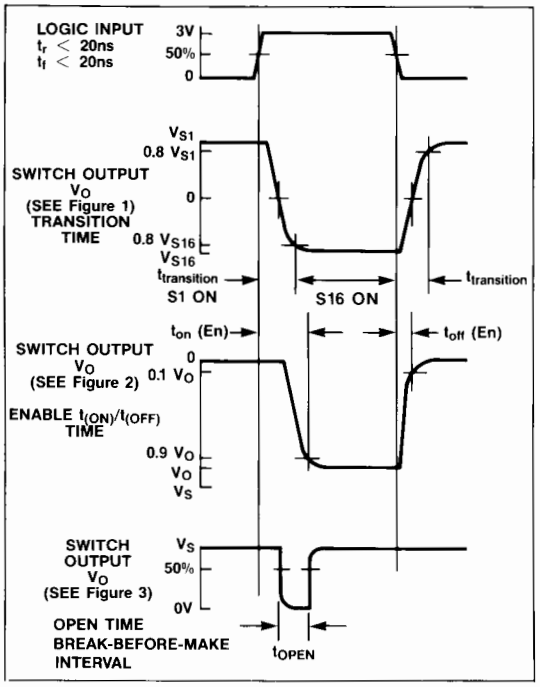
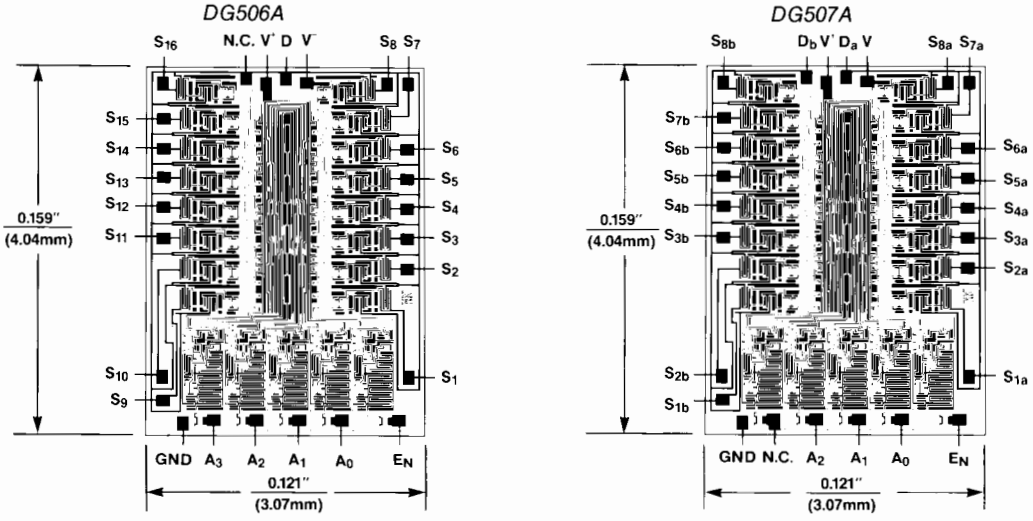



Figure 4. Timing Diagrams for Figures 1, 2, and 3

## Chip Topography







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