

**OBSOLETE PRODUCT  
NO RECOMMENDED REPLACEMENT**  
Call Central Applications 1-800-442-7747  
or email: centapp@harris.com

# CD22100

February 1999

## CMOS 4 x 4 Crosspoint Switch with Control Memory High-Voltage Type (20V Rating)

### Features

- Low ON Resistance . . . . .  $75\Omega$  (Typ) at  $V_{DD} = 12V$
- “Built-In” Control Latches
- Large Analog Signal Capability . . . . .  $\pm V_{DD}/2$
- 10MHz Switch Bandwidth
- Matched Switch Characteristics  $\Delta R_{ON} = 18\Omega$  (Typ) at  $V_{DD} = 12V$
- High Linearity - 0.5% Distortion (Typ) at  $f = 1kHz$ ,  $V_{IN} = 5V_{P-P}$ ,  $V_{DD} = 10V$ , and  $R_L = 1k\Omega$
- Standard CMOS Noise Immunity
- 100% Tested for Maximum Quiescent Current at 20V

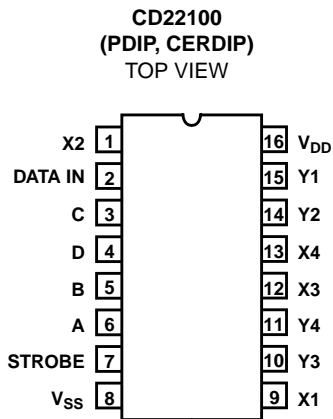
### Description

CD22100 combines a 4 x 4 array of crosspoints (transmission gates) with a 4-line to 16-line decoder and 16 latch circuits. Any one of the sixteen transmission gates (crosspoints) can be selected by applying the appropriate four line address. The selected transmission gate can be turned on or off by applying a logic one or zero, respectively, to the data input and strobing the strobe input to a logic one. Any number of the transmission gates can be ON simultaneously. When the required operating power is applied to the CD22100, the states of the 16 switches are indeterminate. Therefore, all switches must be turned off by putting the strobe high and data in low, and then addressing all switches in succession.

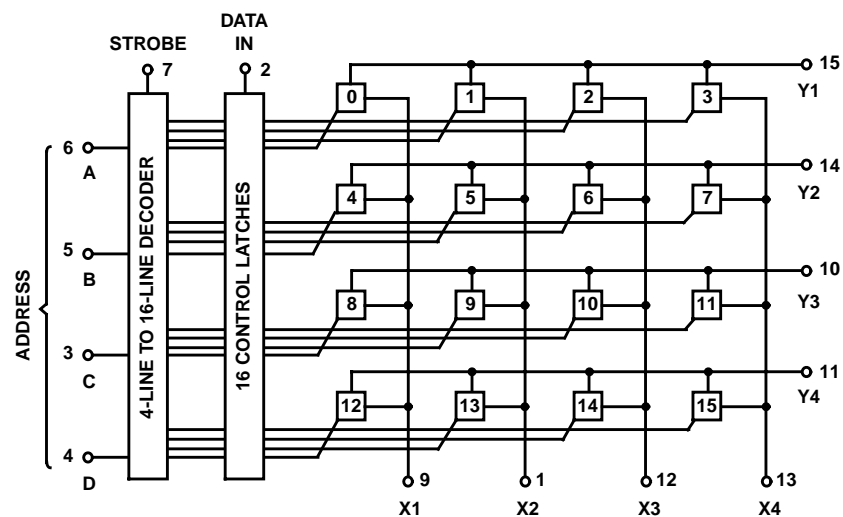
### Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE      | PKG. NO. |
|-------------|------------------|--------------|----------|
| CD22100E    | -40 to 85        | 16 Ld PDIP   | E16.3    |
| CD22100F    | -55 to 125       | 16 Ld CERDIP | F16.3    |

### Pinout



### Functional Diagram



# CD22100

## Absolute Maximum Ratings

Supply Voltage (Referenced to VSS Terminal) . . . . . -0.5 to 20V  
 Input Voltage (All Inputs) . . . . . -0.5 to  $V_{DD}$  0.5V  
 Input Current (Any one input (Note 1)) . . . . .  $\pm 10$ mA  
 Power Dissipation  
 For  $T_A = -40^\circ\text{C}$  to  $60^\circ\text{C}$  (Package Type E) . . . . . 500mW  
 For  $T_A = 60^\circ\text{C}$  to  $85^\circ\text{C}$   
 (Package Type E) . . . . . Derate Linearly  $12\text{mW}/^\circ\text{C}$  to 200mW  
 For  $T_A = -55^\circ\text{C}$  to  $100^\circ\text{C}$  (Package Type F) . . . . . 500mW  
 For  $T_A = 100^\circ\text{C}$  to  $125^\circ\text{C}$   
 (Package Type F) . . . . . Derate Linearly  $12\text{mW}/^\circ\text{C}$  to 200mW  
 Device Dissipation per Transmission Gate  
 For  $T_A = \text{Full Package Temperature Range (All Types)}$  . . . . . 100mW

## Thermal Information

Maximum Junction Temperature . . . . .  $175^\circ\text{C}$   
 Maximum Junction Temperature (Plastic Package) . . . . .  $150^\circ\text{C}$   
 Storage Temperature Range . . . . .  $-65^\circ\text{C} \leq T_A \leq 150^\circ\text{C}$   
 Maximum Lead Temperature (Soldering 10s) . . . . .  $300^\circ\text{C}$

## Operating Conditions

Temperature Range  
 Package Type F . . . . .  $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$   
 Package Type E . . . . .  $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$   
 Supply Voltage Range  
 For  $T_A = \text{Full Package Temperature Range}$  . . . . . 3V to 18V

*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

Values at  $-55^\circ\text{C}$ ,  $25^\circ\text{C}$ ,  $125^\circ\text{C}$  Apply to F Package  
 Values at  $-40^\circ\text{C}$ ,  $25^\circ\text{C}$ ,  $85^\circ\text{C}$  Apply to E Package

| PARAMETER                  | SYMBOL          | TEST CONDITIONS                             | TEST CONDITIONS |              | -55°C     | -40°C     | 85°C       | 125°C   | 25°C |               |                    | UNITS         |
|----------------------------|-----------------|---|-----------------|--------------|-----------|-----------|------------|---------|------|---------------|--------------------|---------------|
|                            |                 |   | FIG.            | $V_{DD}$ (V) | MAX       | MAX       | MAX        | MAX     | MIN  | TYP           | MAX                |               |
| <b>STATIC CROSSPOINTS</b>  |                 |   |                 |              |           |           |            |         |      |               |                    |               |
| Quiescent Device Current   | $I_{DD}$ (Max)  |   | 1               | 5            | 5         | 5         | 150        | 150     | -    | 0.04          | 5                  | $\mu\text{A}$ |
|                            |                 |   | 1               | 10           | 10        | 10        | 300        | 300     | -    | 0.04          | 10                 | $\mu\text{A}$ |
|                            |                 |   | 1               | 15           | 20        | 20        | 600        | 600     | -    | 0.04          | 20                 | $\mu\text{A}$ |
|                            |                 |   | 1               | 20           | 100       | 100       | 3000       | 3000    | -    | 0.08          | 100                | $\mu\text{A}$ |
| On Resistance              | $R_{ON}$ (Max)  | Any Switch<br>$V_{IS} = 0$ to $V_{DD}$      | 11              | 5            | 475       | 500       | 725        | 800     | -    | 225           | 600                | $\Omega$      |
|                            |                 |   | 12              | 10           | 135       | 145       | 205        | 230     | -    | 85            | 180                | $\Omega$      |
|                            |                 |   | -               | 12           | 100       | 110       | 155        | 175     | -    | 75            | 135                | $\Omega$      |
|                            |                 |   | 13              | 15           | 70        | 75        | 110        | 125     | -    | 65            | 95                 | $\Omega$      |
| $\Delta R_{ON}$ Resistance | $\Delta R_{ON}$ | Between any two switches                    | -               | 5            | -         | -         | -          | -       | -    | 25            | -                  | $\Omega$      |
|                            |                 |   | -               | 10           | -         | -         | -          | -       | -    | 10            | -                  | $\Omega$      |
|                            |                 |   | -               | 12           | -         | -         | -          | -       | -    | 8             | -                  | $\Omega$      |
|                            |                 |   | -               | 15           | -         | -         | -          | -       | -    | 5             | -                  | $\Omega$      |
| OFF Switch Leakage Current | $I_L$ (Max)     | All switches OFF, $V_{IS} = 18\text{V}$     | 3               | 18           | $\pm 100$ |           | $\pm 1000$ |         | -    | $\pm 1$       | $\pm 100$ (Note 2) | nA            |
| <b>STATIC CONTROLS</b>     |                 |   |                 |              |           |           |            |         |      |               |                    |               |
| Input Low Voltage          | $V_L$ (Max)     | OFF switch<br>$I_L < 0.2\mu\text{A}$        | -               | 5            | 1.5       |           |            | -       | -    | 1.5           | V                  |               |
|                            |                 |   | -               | 10           | 3         |           |            | -       | -    | 3             | V                  |               |
|                            |                 |   | -               | 15           | 4         |           |            | -       | -    | 4             | V                  |               |
| Input High Voltage         | $V_{IH}$ (Min)  | ON switch<br>see $R_{ON}$<br>characteristic | -               | 5            | 3.5       |           |            | 3.5     | -    | -             | V                  |               |
|                            |                 |   | -               | 10           | 7         |           |            | 7       | -    | -             | V                  |               |
|                            |                 |   | -               | 15           | 11        |           |            | 11      | -    | -             | V                  |               |
| Input Current              | $I_N$ (Max)     | Any control<br>$V_{IN} = 0, 18\text{V}$     | 2               | 18           | $\pm 0.1$ | $\pm 0.1$ | $\pm 1$    | $\pm 1$ | -    | $\pm 10^{-5}$ | $\pm 0.1$          | $\mu\text{A}$ |

**NOTES:**

1. Maximum current through transmission gates (switches) = 25mA.
2. Determined by minimum feasible leakage measurement for automatic testing.

# CD22100

## Electrical Specifications $T_A = 25^\circ\text{C}$

| PARAMETER  | SYMBOL             | TEST CONDITIONS                             |  |                        |                          |                 | MIN | TYP | MAX | UNITS |  |
|--|--------------------|---|--|------------------------|--------------------------|-----------------|-----|-----|-----|-------|--|
|  |                    | FIGURE                                      | $f_{IS}$<br>(kHz)  | $R_L$<br>(k $\Omega$ ) | $V_{IS}$ (V)<br>(Note 3) | $V_{DD}$<br>(V) |     |     |     |       |  |
| <b>DYNAMIC CROSSPOINTS</b>   |                    |   |  |                        |                          |                 |     |     |     |       |  |
| Propagation Delay Time,<br>(Switch ON) Signal Input to<br>Output                 | $t_{PHL}, t_{PLH}$ | 5   | -  | 10                     | 5                        | 5               | -   | 30  | 60  | ns    |  |
|  |                    |   |  |                        | 10                       | 10              | -   | 15  | 30  | ns    |  |
|  |                    |   |  |                        | 15                       | 15              | -   | 10  | 20  | ns    |  |
|  |                    | $C_L = 50\text{pF}; t_R, t_F = 20\text{ns}$ |  |                        |                          |                 |     |     |     |       |  |
| Frequency Response (Any<br>Switch ON)  | $f_{3dB}$          | 16  | 1  | 1                      | 5                        | 10              | -   | 40  | -   | MHz   |  |
|  |                    |   | Sine Wave Input, $20 \log \frac{V_{OS}}{V_{IS}} = -3\text{dB}$               |                        |                          |                 |     |     |     |       |  |
| Sine Wave Response<br>(Distortion)   | THD                |   | 1  | 1                      | 5                        | 10              | -   | 0.5 | -   | %     |  |
| Feedthrough (All switches OFF)   | $F_{DT}$           |   | 1.6  | 1                      | 5                        | 10              | -   | -80 | -   | dB    |  |
|  |                    |   | Sine Wave Input  |                        |                          |                 |     |     |     |       |  |
| Frequency for Signal Crosstalk<br>Attenuation of 40dB<br>Attenuation of 110dB    | $F_{CT}$           | 7   | -  | 1                      | 10                       | 10              | -   | 1.5 | -   | MHz   |  |
|  |                    |   | Sine Wave Input  |                        |                          |                 |     |     |     |       |  |
|  |                    |   | -  | -                      | -                        | -               | -   | 0.1 | -   | kHz   |  |
| Capacitance:<br>Xn to Ground   | $C_{IS}$           |   | -  | -                      | -                        | 5 - 15          | -   | 18  | -   | pF    |  |
| Yn to Ground   |                    |   | -  | -                      | -                        | 5 - 15          | -   | 30  | -   | pF    |  |
| Feedthrough  | $C_{IOS}$          |   | -  | -                      | -                        | -               | -   | 0.4 | -   | pF    |  |
| <b>DYNAMIC CONTROLS</b>  |                    |   |  |                        |                          |                 |     |     |     |       |  |
| Propagation Delay Time:<br>Strobe to Output<br>(Switch Turn-ON to High<br>Level) | $t_{PZH}$          | 8   | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 300             | 600 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 125             | 250 | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 80              | 160 | ns  |     |       |  |
| Propagation Delay Time:<br>Data-In to Output<br>(Turn-ON to High Level)          | $t_{PZH}$          | 9   | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 110             | 220 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 40              | 80  | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 25              | 50  | ns  |     |       |  |
| Propagation Delay Time:<br>Address to Output<br>(Turn-ON to High Level)          | $t_{PZH}$          | 10  | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 350             | 700 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 135             | 270 | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 90              | 180 | ns  |     |       |  |
| Propagation Delay Time:<br>Strobe to Output<br>(Switch Turn-OFF)                 | $t_{PHZ}$          | 8   | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 165             | 330 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 85              | 170 | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 70              | 140 | ns  |     |       |  |
| Propagation Delay Time:<br>Data-In to Output<br>(Turn-ON to Low Level)           | $t_{PZL}$          | 9   | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 210             | 420 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 110             | 220 | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 100             | 200 | ns  |     |       |  |
| Propagation Delay Time:<br>Address to Output<br>(Turn-OFF)                       | $t_{PHZ}$          | 10  | $R_L = 1\text{k}\Omega,$<br>$C_L = 50\text{pF},$<br>$t_R, t_F = 20\text{ns}$ | 5                      | -                        | 435             | 870 | ns  |     |       |  |
|  |                    |   |  | 10                     | -                        | 210             | 420 | ns  |     |       |  |
|  |                    |   |  | 15                     | -                        | 160             | 320 | ns  |     |       |  |

## CD22100

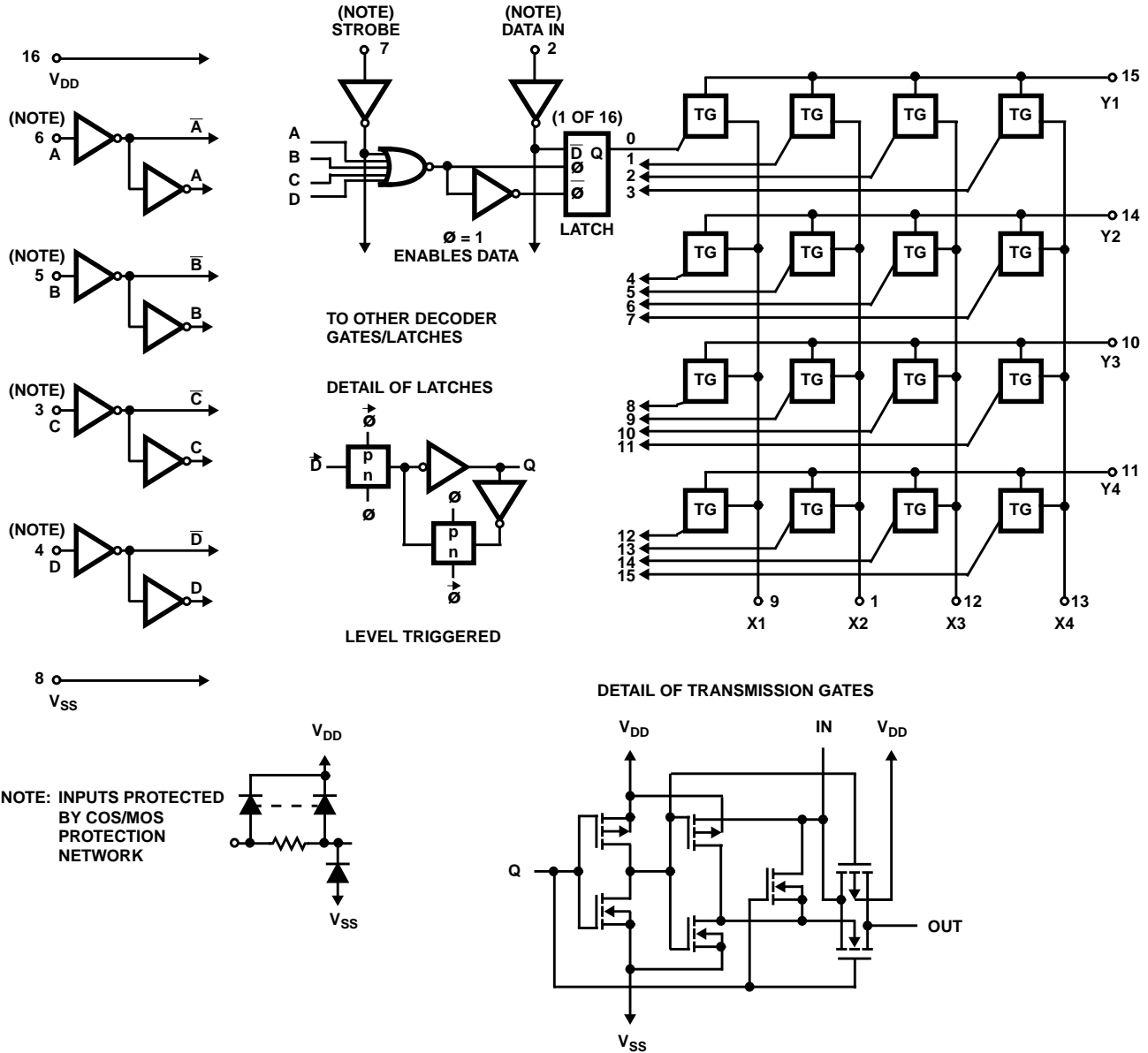
### Electrical Specifications $T_A = 25^\circ\text{C}$ (Continued)

| PARAMETER  | SYMBOL          | TEST CONDITIONS |  |                        |                          | MIN | TYP | MAX | UNITS              |
|--|-----------------|-----------------|--|------------------------|--------------------------|-----|-----|-----|--------------------|
|  |                 | FIGURE          | $f_{IS}$<br>(kHz)  | $R_L$<br>(k $\Omega$ ) | $V_{IS}$ (V)<br>(Note 3) |     |     |     |                    |
| Minimum Setup Time<br>Data-In to Strobe, Address           | $t_S$           | 8, 10           | $R_L = 1\text{k}\Omega$ ,<br>$C_L = 50\text{pF}$ ,<br>$t_R, t_F = 20\text{ns}$ |                        | 5                        | -   | 95  | 190 | ns                 |
|  |                 |                 |  |                        | 10                       | -   | 25  | 50  | ns                 |
|  |                 |                 |  |                        | 15                       | -   | 15  | 30  | ns                 |
| Minimum Hold Time<br>Data-In to Strobe, Address            | $t_H$           | 8, 10           | $R_L = 1\text{k}\Omega$ ,<br>$C_L = 50\text{pF}$ ,<br>$t_R, t_F = 20\text{ns}$ |                        | 5                        | -   | 180 | 360 | ns                 |
|  |                 |                 |  |                        | 10                       | -   | 110 | 220 | ns                 |
|  |                 |                 |  |                        | 15                       | -   | 35  | 70  | ns                 |
| Maximum Switching Frequency                                | $f_{\emptyset}$ |                 | $R_L = 1\text{k}\Omega$ ,<br>$C_L = 50\text{pF}$ ,<br>$t_R, t_F = 20\text{ns}$ |                        | 5                        | 0.6 | 1.2 | -   | MHz                |
|  |                 |                 |  |                        | 10                       | 1.6 | 3.2 | -   | MHz                |
|  |                 |                 |  |                        | 15                       | 2.5 | 5   | -   | MHz                |
| Minimum Strobe Pulse Width                                 | $t_W$           | 8               |  |                        | 5                        | -   | 300 | 600 | ns                 |
|  |                 |                 |  |                        | 10                       | -   | 120 | 240 | ns                 |
|  |                 |                 |  |                        | 15                       | -   | 90  | 180 | ns                 |
| Control Crosstalk, Data-In,<br>Address or Strobe to Output |                 | 6               | Square Wave Input;<br>$t_R, t_F = 20\text{ns}$                                 |                        | 10                       | -   | 75  | -   | mV <sub>PEAK</sub> |
|  |                 |                 | -  | 10                     |                          |     |     |     |                    |
| Input Capacitance  | $C_{IN}$        |                 | Any Control Input  |                        | -                        | -   | 5   | 7.5 | pF                 |

NOTE:

- Peak-to-peak voltage symmetrical about  $\frac{V_{DD}}{2}$ .

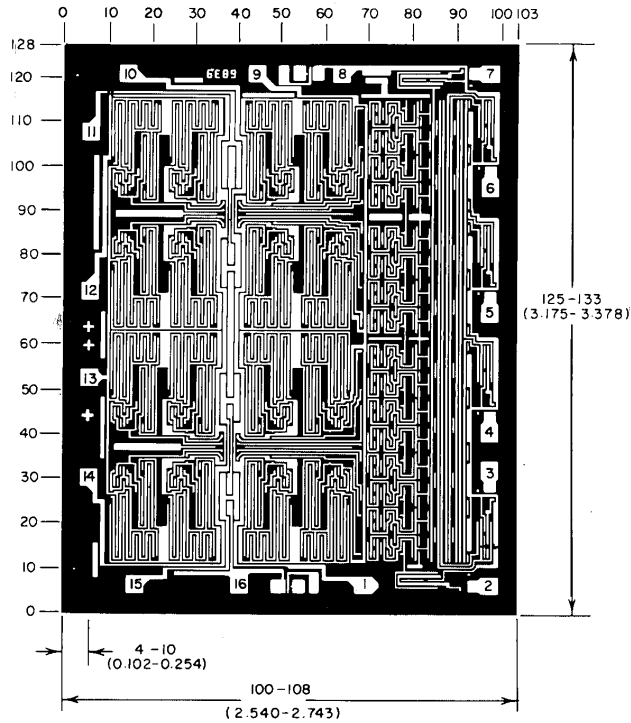
Schematic Diagram



TRUTH TABLE

| ADDRESS |   |   |   | SELECT | ADDRESS |   |   |   | SELECT |
|---------|---|---|---|--------|---------|---|---|---|--------|
| A       | B | C | D |        | A       | B | C | D |        |
| 0       | 0 | 0 | 0 | X1Y1   | 0       | 0 | 0 | 1 | X1Y3   |
| 1       | 0 | 0 | 0 | X2Y1   | 1       | 0 | 0 | 1 | X2Y3   |
| 0       | 1 | 0 | 0 | X3Y1   | 0       | 1 | 0 | 1 | X3Y3   |
| 1       | 1 | 0 | 0 | X4Y1   | 1       | 1 | 0 | 1 | X4Y3   |
| 0       | 0 | 1 | 0 | X1Y2   | 0       | 0 | 1 | 1 | X1Y4   |
| 1       | 0 | 1 | 0 | X2Y2   | 1       | 0 | 1 | 1 | X2Y4   |
| 0       | 1 | 1 | 0 | X3Y2   | 0       | 1 | 1 | 1 | X3Y4   |
| 1       | 1 | 1 | 0 | X4Y2   | 1       | 1 | 1 | 1 | X4Y4   |

**Metallization Mask Layout**



Dimensions in parenthesis are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

**Test Circuits and Waveforms**

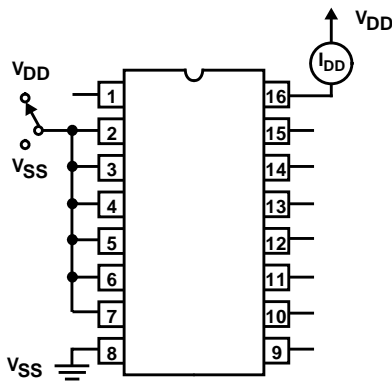
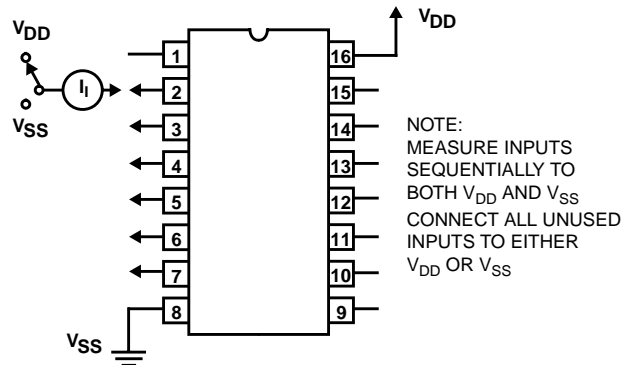


FIGURE 1. QUIESCENT CURRENT TEST CIRCUIT



NOTE:  
MEASURE INPUTS  
SEQUENTIALLY TO  
BOTH  $V_{DD}$  AND  $V_{SS}$   
CONNECT ALL UNUSED  
INPUTS TO EITHER  
 $V_{DD}$  OR  $V_{SS}$

FIGURE 2. INPUT CURRENT TEST CIRCUIT

Test Circuits and Waveforms (Continued)

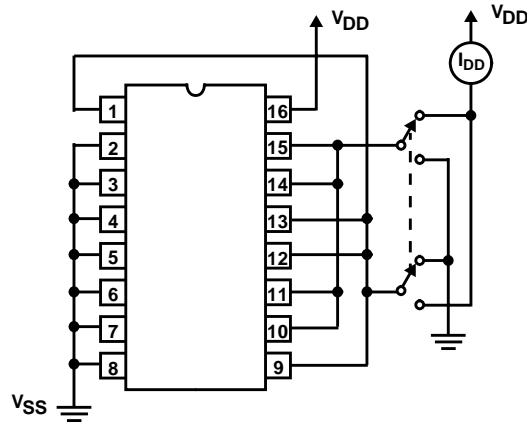
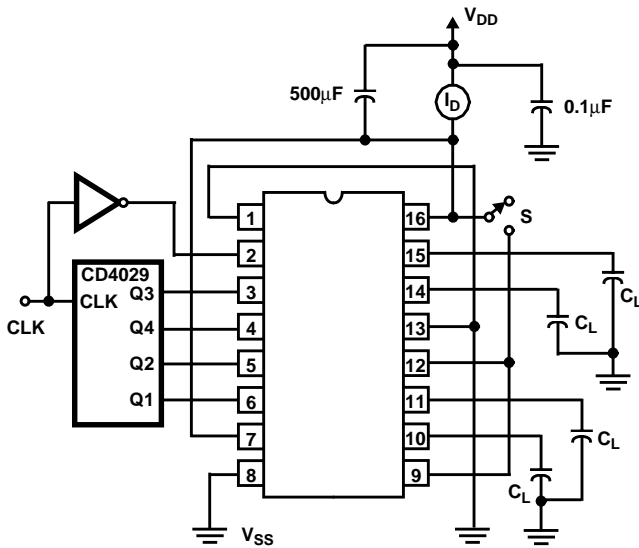


FIGURE 3. OFF SWITCH INPUT OR OUTPUT LEAKAGE CURRENT TEST CIRCUIT



NOTE:  
CLOSE SWITCH S AFTER APPLYING  $V_{DD}$

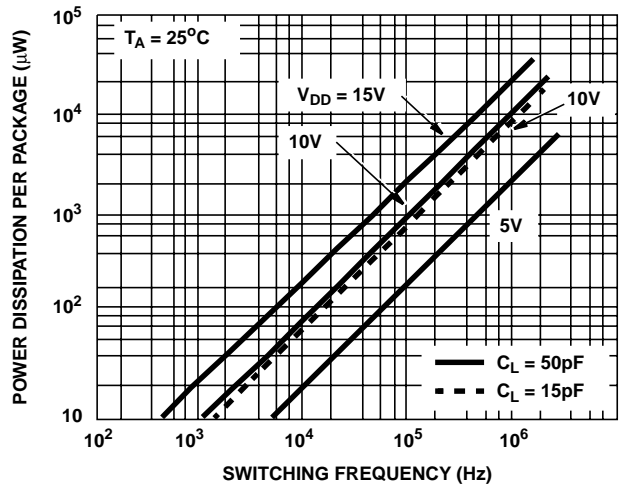


FIGURE 4. DYNAMIC POWER DISSIPATION TEST CIRCUIT AND TYPICAL DYNAMIC POWER DISSIPATION AS A FUNCTION OF SWITCHING FREQUENCY

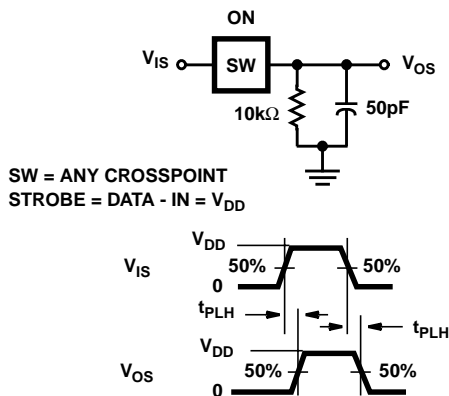


FIGURE 5. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS (SIGNAL INPUT TO SIGNAL OUTPUT, SWITCH ON)

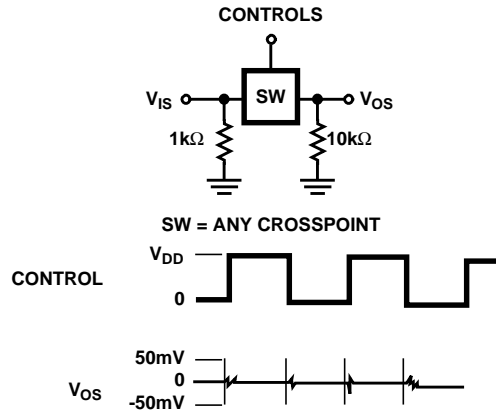


FIGURE 6. TEST CIRCUIT AND WAVEFORMS FOR CROSSTALK (CONTROL INPUT TO SIGNAL OUTPUT)

Test Circuits and Waveforms (Continued)

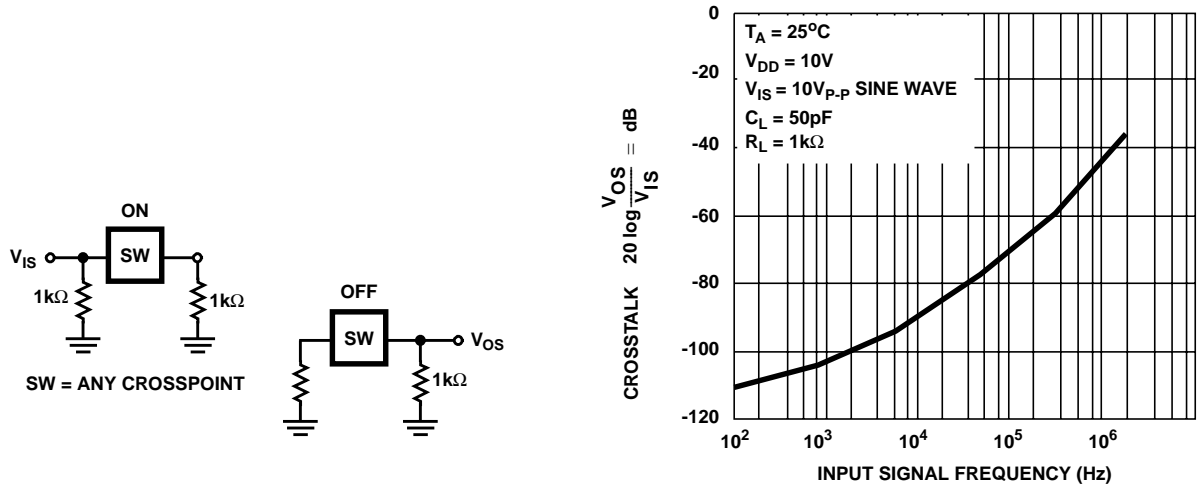


FIGURE 7. TEST CIRCUIT AND TYPICAL CROSSTALK BETWEEN SWITCH CIRCUITS IN THE SAME PACKAGE AS A FUNCTION OF SIGNAL FREQUENCY

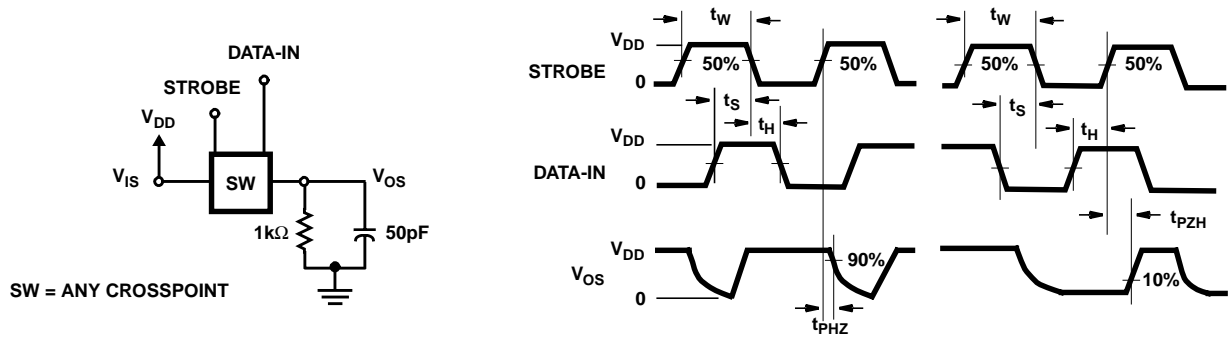


FIGURE 8. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS (STROBE TO SIGNAL OUTPUT, SWITCH TURN-ON OR TURN-OFF)

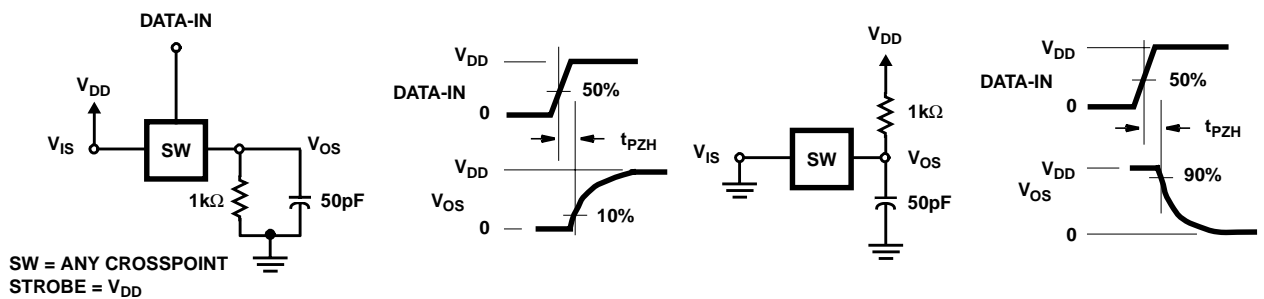
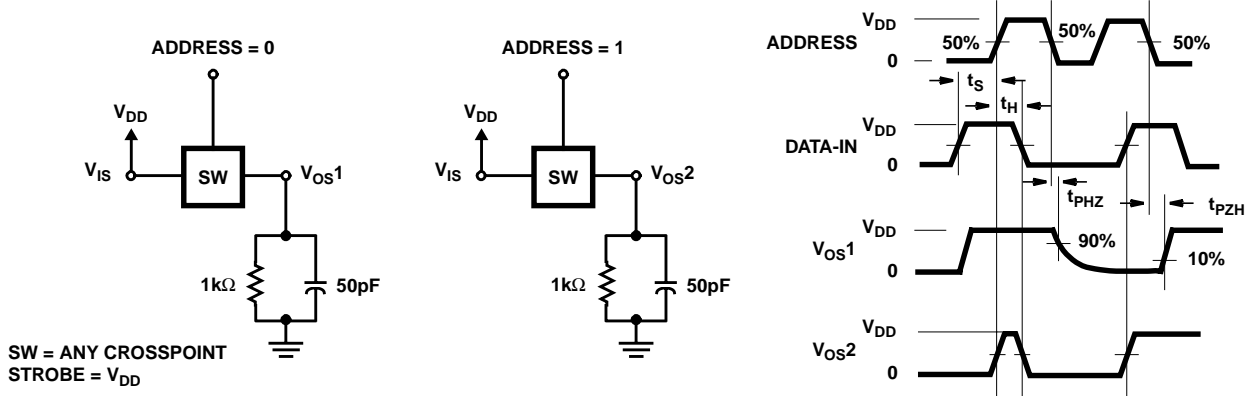


FIGURE 9. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS (DATA-IN TO SIGNAL OUTPUT, SWITCH TURN-ON TO HIGH OR LOW LEVEL)

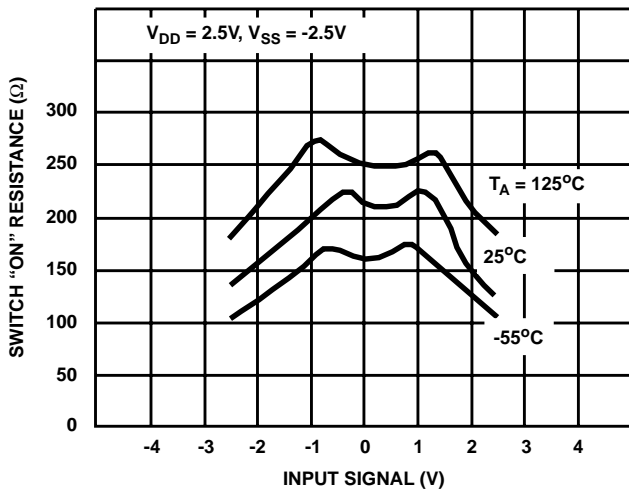


**Test Circuits and Waveforms** (Continued)

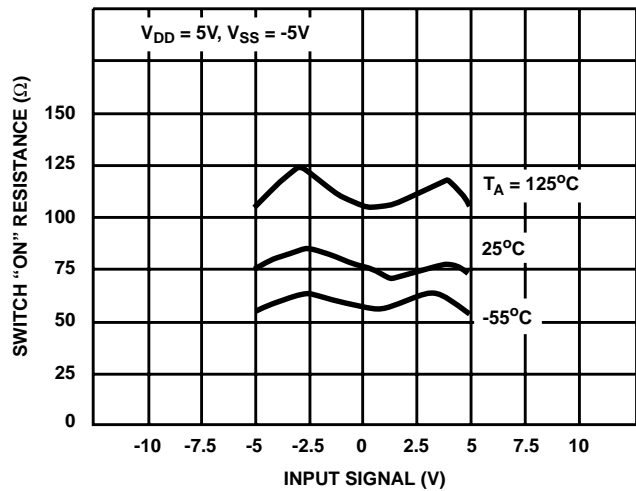


**FIGURE 10. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS  
(ADDRESS TO SIGNAL OUTPUT, SWITCH TURN-ON OR TURN-OFF)**

**Typical Performance Curves**



**FIGURE 11. TYPICAL ON RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE AT  $V_{DD} = -V_{SS} = 2.5V$**



**FIGURE 12. TYPICAL ON RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE AT  $V_{DD} = -V_{SS} = 5V$**

Typical Performance Curves (Continued)

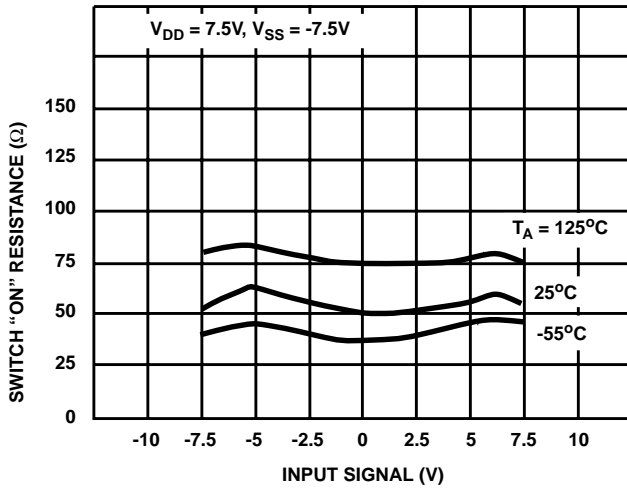


FIGURE 13. TYPICAL ON RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE AT  $V_{DD} = -V_{SS} = 7.5V$

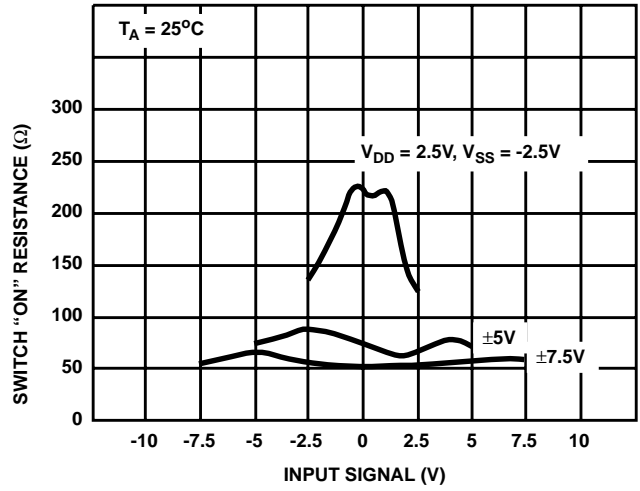


FIGURE 14. TYPICAL ON RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE AT  $T_A = 25^\circ C$

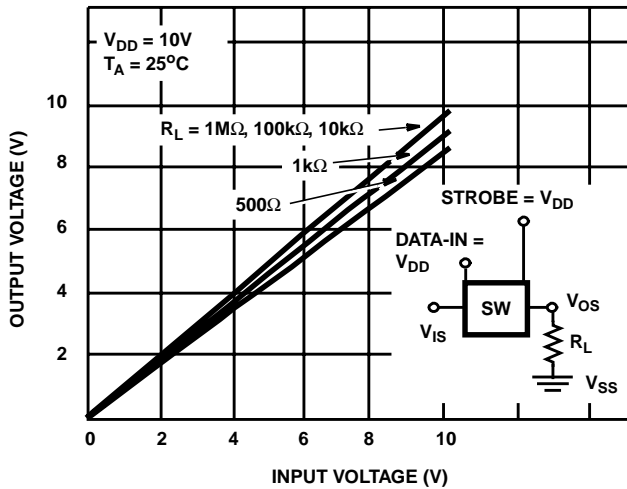


FIGURE 15. TYPICAL SWITCH ON TRANSFER CHARACTERISTICS (1 OF 16 SWITCHES)

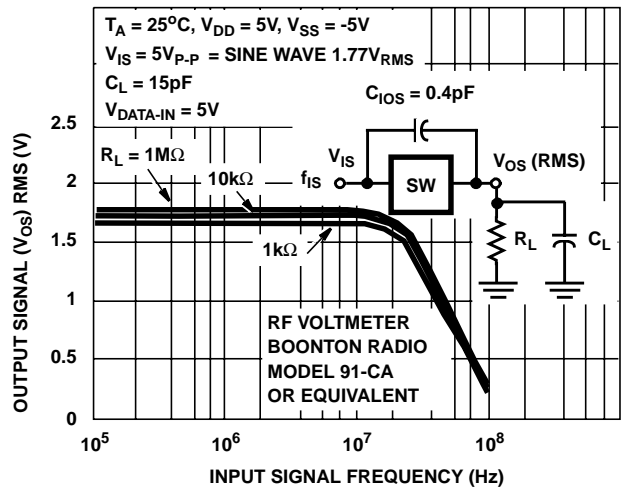


FIGURE 16. TYPICAL SWITCH ON FREQUENCY RESPONSE CHARACTERISTICS