

December 1996

## Fast CMOS Octal D Registers (Three-State)

### Features

- Advanced 0.8 micron CMOS Technology
- Pin Compatible With Bipolar FAST™ Series at a Higher Speed and Lower Power Consumption
- 25Ω Series Resistor on All Outputs (CD74FCT2374T, CD74FCT2574T only)
- TTL Input and Output Levels
- Low Ground Bounce Outputs
- Extremely Low Static Power
- Hysteresis on All Inputs

### Description

These devices are 8-bit wide octal registers designed with eight D-type flip-flops with a buffered common clock and buffered three-state outputs. When output enable ( $\overline{OE}$ ) is LOW, the outputs are enabled. When  $\overline{OE}$  is HIGH, the outputs are in the high impedance state. Input data meeting the setup and hold time requirements of the D inputs is transferred to the O outputs on the LOW-to-HIGH transition of the clock input.

All CD74FCT2574T devices have a built-in 25Ω series resistor on all outputs to reduce noise due to reflections, thus eliminating the need for an external terminating resistor.

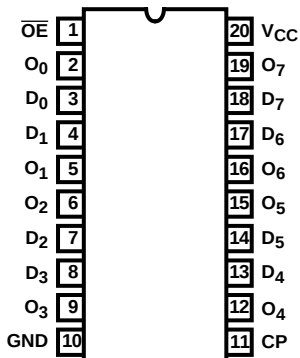
### Ordering Information

| PART NUMBER     | TEMP. RANGE (°C) | PACKAGE    | PKG. NO. |
|-----------------|------------------|------------|----------|
| CD74FCT374ATM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT374ATQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT374CTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT374CTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT374DTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT374DTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT374TM    | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT374TQM   | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT534ATM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT534ATQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT534CTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT534CTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT534DTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT534DTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT534TM    | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT534TQM   | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT574ATM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT574ATQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT574CTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT574CTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT574DTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT574DTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT574TM    | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT574TQM   | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2374ATM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2374ATQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2374CTM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2374CTQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2374TM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2374TQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2574ATM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2574ATQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2574CTM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2574CTQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2574TM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2574TQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |

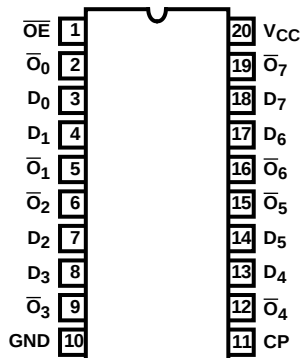
NOTE: When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

## Pinouts

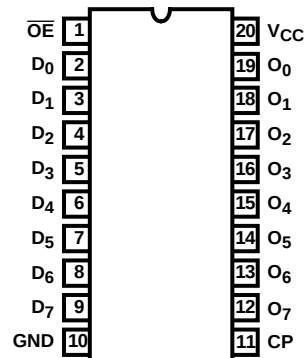
CD74FCT374T, CD74FCT2374T  
(QSOP, SOIC)  
TOP VIEW



CD74FCT534T  
(QSOP, SOIC)  
TOP VIEW

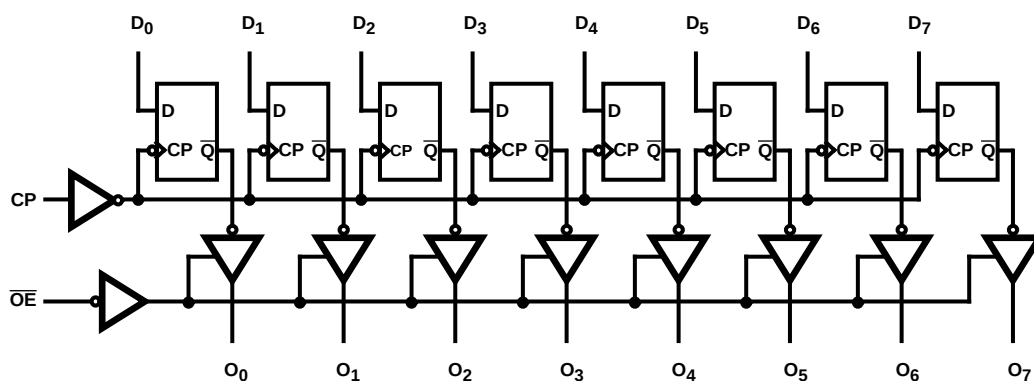


CD74FCT574T, CD74FCT2574T  
(QSOP, SOIC)  
TOP VIEW

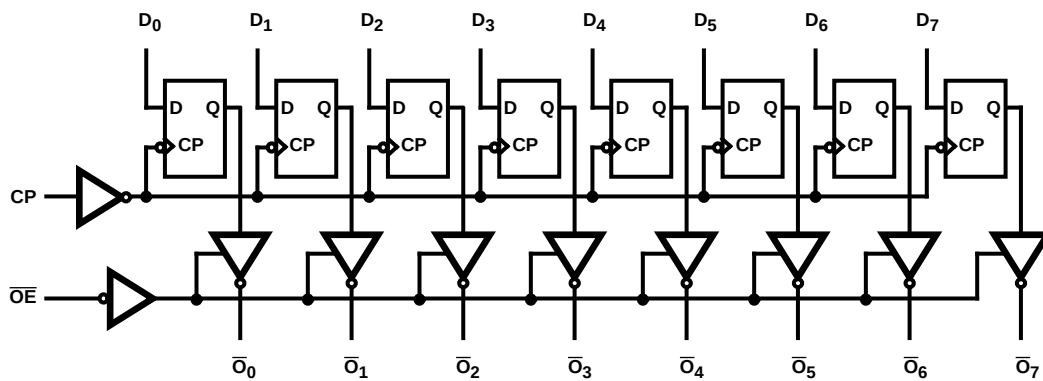


## Functional Block Diagrams

CD74FCT374T, CD74FCT2374T, CD74FCT574T, CD74FCT2574T



CD74FCT534T



**CD74FCT374T, CD74FCT534T, CD74FCT574T, CD74FCT2374T, CD74FCT2574T**

**TRUTH TABLE (NOTE 1)**

| FUNCTION                                                    | INPUTS          |    |       | OUTPUTS          | INTERNAL         |
|-------------------------------------------------------------|-----------------|----|-------|------------------|------------------|
|                                                             | $\overline{OE}$ | CP | $D_N$ | $\overline{O_N}$ | $Q_N$            |
| <b>CD74FCT534T</b>                                          |                 |    |       |                  |                  |
| High-Z                                                      | H               | L  | X     | Z                | NC               |
|                                                             | H               | H  | X     | Z                | NC               |
| Load Register                                               | L               | ↑  | L     | H                | L                |
|                                                             | L               | ↑  | H     | L                | H                |
|                                                             | H               | ↑  | L     | Z                | L                |
|                                                             | H               | ↑  | H     | Z                | H                |
| <b>CD74FCT374T, CD74FCT574T, CD74FCT2374T, CD74FCT2574T</b> |                 |    |       |                  |                  |
| FUNCTION                                                    | $\overline{OE}$ | CP | $D_N$ | $O_N$            | $\overline{Q_N}$ |
| High-Z                                                      | H               | L  | X     | Z                | NC               |
|                                                             | H               | H  | X     | Z                | NC               |
| Load Register                                               | L               | ↑  | L     | L                | H                |
|                                                             | L               | ↑  | H     | H                | L                |
|                                                             | H               | ↑  | L     | Z                | H                |
|                                                             | H               | ↑  | H     | Z                | L                |

NOTE:

1. H = High Voltage Level  
L = Low Voltage Level  
X = Don't Care  
Z = High Impedance  
NC = No Change  
↑ = LOW-to-HIGH Transition

**Pin Descriptions**

| PIN NAME                            | DESCRIPTION                                                         |
|-------------------------------------|---------------------------------------------------------------------|
| $\overline{OE}$                     | Output Enable Input (Active LOW)                                    |
| CP                                  | Clock Pulse for the register. Enters data on LOW-to-HIGH transition |
| $D_0$ - $D_7$                       | Data Inputs                                                         |
| $O_0$ - $O_7$                       | Three-State Outputs (True)                                          |
| $\overline{O_0}$ - $\overline{O_7}$ | Three-State Outputs (Inverted)                                      |
| GND                                 | Ground                                                              |
| $V_{CC}$                            | Power                                                               |

# CD74FCT374T, CD74FCT534T, CD74FCT574T, CD74FCT2374T, CD74FCT2574T

## Absolute Maximum Ratings

DC Input Voltage ..... -0.5V to 7.0V  
DC Output Current ..... 120mA

## Operating Conditions

Operating Temperature Range ..... -40°C to 85°C  
Supply Voltage to Ground Potential  
Inputs and V<sub>CC</sub> Only ..... -0.5V to 7.0V  
Supply Voltage to Ground Potential  
Outputs and D/O Only ..... -0.5V to 7.0V

## Thermal Information

Thermal Resistance (Typical, Note 2)  $\theta_{JA}$  (°C/W)  
SOIC Package ..... 87  
QSOP Package ..... 110  
Maximum Junction Temperature ..... 150°C  
Maximum Storage Temperature Range ..... -65°C to 150°C  
Maximum Lead Temperature (Soldering 10s) ..... 300°C  
(Lead Tips Only)

**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

| PARAMETER                                                                                                         | SYMBOL           | (NOTE 3)<br>TEST CONDITIONS                                                                                                                |                                                            | MIN | (NOTE 4)<br>TYP | MAX              | UNITS      |
|-------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----|-----------------|------------------|------------|
| DC ELECTRICAL SPECIFICATIONS Over the Operating Range, T <sub>A</sub> = -40°C to 85°C, V <sub>CC</sub> = 5.0V ±5% |                  |                                                                                                                                            |                                                            |     |                 |                  |            |
| Output HIGH Voltage                                                                                               | V <sub>OH</sub>  | V <sub>CC</sub> = Min, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                | I <sub>OH</sub> = -15.0mA                                  | 2.4 | 3.0             | -                | V          |
| Output LOW Voltage                                                                                                | V <sub>OL</sub>  | V <sub>CC</sub> = Min, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                | I <sub>OL</sub> = 64mA                                     | -   | 0.3             | 0.50             | V          |
| Output LOW Voltage                                                                                                | V <sub>OL</sub>  | V <sub>CC</sub> = Min, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                | I <sub>OL</sub> = 12mA<br>(25Ω Series)                     | -   | 0.3             | 0.50             | V          |
| Input HIGH Voltage                                                                                                | V <sub>IH</sub>  | Guaranteed Logic HIGH Level                                                                                                                |                                                            | 2.0 | -               | -                | V          |
| Input LOW Voltage                                                                                                 | V <sub>IL</sub>  | Guaranteed Logic LOW Level                                                                                                                 |                                                            | -   | -               | 0.8              | V          |
| Input HIGH Current                                                                                                | I <sub>IH</sub>  | V <sub>CC</sub> = Max                                                                                                                      | V <sub>IN</sub> = V <sub>CC</sub>                          | -   | -               | 1                | μA         |
| Input LOW Current                                                                                                 | I <sub>IL</sub>  | V <sub>CC</sub> = Max                                                                                                                      | V <sub>IN</sub> = GND                                      | -   | -               | -1               | μA         |
| High Impedance<br>Output Current                                                                                  | I <sub>OZH</sub> | V <sub>CC</sub> = Max                                                                                                                      | V <sub>OUT</sub> = 2.7V                                    | -   | -               | 1                | μA         |
|                                                                                                                   | I <sub>OZL</sub> |                                                                                                                                            | V <sub>OUT</sub> = 0.5V                                    | -   | -               | -1               | μA         |
| Clamp Diode Voltage                                                                                               | V <sub>IK</sub>  | V <sub>CC</sub> = Min, I <sub>IIN</sub> = -18mA                                                                                            |                                                            | -   | -0.7            | -1.2             | V          |
| Short Circuit Current                                                                                             | I <sub>OS</sub>  | V <sub>CC</sub> = Max (Note 5),<br>V <sub>OUT</sub> = GND                                                                                  |                                                            | -60 | -120            | -                | mA         |
| Power Down Disable                                                                                                | I <sub>OFF</sub> | V <sub>CC</sub> = GND, V <sub>OUT</sub> = 4.5V                                                                                             |                                                            | -   | -               | 100              | μA         |
| Input Hysteresis                                                                                                  | V <sub>H</sub>   |                                                                                                                                            |                                                            | -   | 200             | -                | mV         |
| CAPACITANCE T <sub>A</sub> = 25°C, f = 1MHz                                                                       |                  |                                                                                                                                            |                                                            |     |                 |                  |            |
| Input Capacitance<br>(Note 6)                                                                                     | C <sub>IN</sub>  | V <sub>IN</sub> = 0V                                                                                                                       |                                                            | -   | 6               | 10               | pF         |
| Output Capacitance<br>(Note 6)                                                                                    | C <sub>OUT</sub> | V <sub>OUT</sub> = 0V                                                                                                                      |                                                            | -   | 8               | 12               | pF         |
| POWER SUPPLY SPECIFICATIONS                                                                                       |                  |                                                                                                                                            |                                                            |     |                 |                  |            |
| Quiescent Power<br>Supply Current                                                                                 | I <sub>CC</sub>  | V <sub>CC</sub> = Max                                                                                                                      | V <sub>IN</sub> = GND or V <sub>CC</sub>                   | -   | 0.1             | 500              | μA         |
| Supply Current per<br>Input at TTL HIGH                                                                           | ΔI <sub>CC</sub> | V <sub>CC</sub> = Max                                                                                                                      | V <sub>IN</sub> = 3.4V<br>(Note 7)                         | -   | 0.5             | 2.0              | mA         |
| Supply Current per<br>Input per MHz<br>(Note 8)                                                                   | I <sub>CCD</sub> | V <sub>CC</sub> = Max, Outputs Open<br>OE = GND<br>One Input Toggling<br>50% Duty Cycle                                                    | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND | -   | 0.15            | 0.25             | mA/<br>MHz |
| Total Power Supply<br>Current (Note 10)                                                                           | I <sub>C</sub>   | V <sub>CC</sub> = Max, Outputs Open<br>f <sub>CP</sub> = 10MHz, 50% Duty Cycle<br>OE = GND<br>f <sub>I</sub> = 5MHz, One Bit toggling      | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND | -   | 1.5             | 3.5<br>(Note 9)  | mA         |
|                                                                                                                   |                  |                                                                                                                                            | V <sub>IN</sub> = 3.4V<br>V <sub>IN</sub> = GND            | -   | 2.0             | 5.5<br>(Note 9)  | mA         |
|                                                                                                                   |                  | V <sub>CC</sub> = Max, Outputs Open<br>f <sub>CP</sub> = 10MHz, 50% Duty Cycle<br>OE = GND<br>f <sub>I</sub> = 2.5MHz, Eight Bits toggling | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND | -   | 3.5             | 7.3<br>(Note 9)  | mA         |
|                                                                                                                   |                  |                                                                                                                                            | V <sub>IN</sub> = 3.4V<br>V <sub>IN</sub> = GND            | -   | 6.0             | 16.3<br>(Note 9) | mA         |

**Switching Specifications Over Operating Range**

| PARAMETER                                                | SYMBOL                                 | (NOTE 11)<br>TEST<br>CONDITIONS                | T                |      | AT               |     | CT               |     | DT               |     | UNITS |
|----------------------------------------------------------|----------------------------------------|------------------------------------------------|------------------|------|------------------|-----|------------------|-----|------------------|-----|-------|
|                                                          |                                        |                                                | (NOTE 12)<br>MIN | MAX  | (NOTE 12)<br>MIN | MAX | (NOTE 12)<br>MIN | MAX | (NOTE 12)<br>MIN | MAX |       |
| CD74FCT374T, CD74FCT534T, CD74FCT2374T                   |                                        |                                                |                  |      |                  |     |                  |     |                  |     |       |
| Propagation Delay<br>CP to O <sub>N</sub>                | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 2.0              | 10.0 | 2.0              | 6.5 | 2.0              | 5.2 | 2.0              | 4.5 | ns    |
| Output Enable Time<br>OE to O <sub>N</sub>               | t <sub>PZH</sub> ,<br>t <sub>PZL</sub> |                                                | 1.5              | 12.5 | 1.5              | 6.5 | 1.5              | 5.5 | 1.5              | 5.5 | ns    |
| Output Disable Time<br>(Note 13)<br>OE to O <sub>N</sub> | t <sub>PHZ</sub> ,<br>t <sub>PLZ</sub> |                                                | 1.5              | 8.0  | 1.5              | 5.5 | 1.5              | 5.0 | 1.5              | 5.0 | ns    |
| Setup Time HIGH or<br>LOW, D <sub>N</sub> to CP          | t <sub>SU</sub>                        |                                                | 2.0              | -    | 2.0              | -   | 2.0              | -   | 2.0              | -   | ns    |
| Hold Time HIGH or<br>LOW, D <sub>N</sub> to CP           | t <sub>H</sub>                         |                                                | 1.5              | -    | 1.5              | -   | 1.5              | -   | 1.0              | -   | ns    |
| CP Pulse Width<br>(Note 13)<br>HIGH or LOW               | t <sub>W</sub>                         |                                                | 7.0              | -    | 5.0              | -   | 5.0              | -   | 3.0              | -   | ns    |
| CD74FCT574T, CD74FCT2574T                                |                                        |                                                |                  |      |                  |     |                  |     |                  |     |       |
| Propagation Delay<br>CP to O <sub>N</sub>                | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 2.0              | 8.5  | 2.0              | 6.5 | 2.0              | 5.2 | 2.0              | 4.5 | ns    |
| Output Enable Time<br>OE to O <sub>N</sub>               | t <sub>PZH</sub> ,<br>t <sub>PZL</sub> |                                                | 1.5              | 10.0 | 1.5              | 6.5 | 1.5              | 5.5 | 1.5              | 5.5 | ns    |
| Output Disable Time<br>(Note 13)<br>OE to O <sub>N</sub> | t <sub>PHZ</sub> ,<br>t <sub>PLZ</sub> |                                                | 1.5              | 6.5  | 1.5              | 5.5 | 1.5              | 5.0 | 1.5              | 5.0 | ns    |
| Setup Time HIGH or<br>LOW, D <sub>N</sub> to CP          | t <sub>SU</sub>                        |                                                | 2.0              | -    | 2.0              | -   | 2.0              | -   | 2.0              | -   | ns    |
| Hold Time HIGH or<br>LOW, D <sub>N</sub> to CP           | t <sub>H</sub>                         |                                                | 1.5              | -    | 1.5              | -   | 1.5              | -   | 1.0              | -   | ns    |
| CP Pulse Width<br>(Note 13)<br>HIGH or LOW               | t <sub>W</sub>                         |                                                | 7.0              | -    | 5.0              | -   | 5.0              | -   | 3.0              | -   | ns    |

**NOTES:**

- For conditions shown as Max or Min, use appropriate value specified under Electrical Specifications for the applicable device type.
- Typical values are at V<sub>CC</sub> = 5.0V, 25°C ambient and maximum loading.
- Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
- This parameter is determined by device characterization but is not production tested.
- Per TTL driven input (V<sub>IN</sub> = 3.4V); all other inputs at V<sub>CC</sub> or GND.
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are guaranteed but not tested.
- $$I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$$

$$I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$$

$$I_{CC} = \text{Quiescent Current}$$

$$\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (V}_{IN} = 3.4V)$$

$$D_H = \text{Duty Cycle for TTL Inputs High}$$

$$N_T = \text{Number of TTL Inputs at } D_H$$

$$I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$$

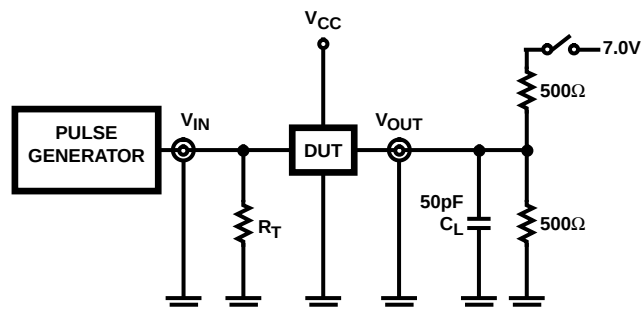
$$f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$$

$$f_I = \text{Input Frequency}$$

$$N_I = \text{Number of Inputs at } f_I$$

All currents are in milliamps and all frequencies are in megahertz.
- See test circuit and wave forms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- This parameter is guaranteed but not production tested.

## Test Circuits and Waveforms



NOTE:

14. Pulse Generator for All Pulses: Rate  $\leq 1.0\text{MHz}$ ;  $Z_{OUT} \leq 50\Omega$ ;  
 $t_f, t_r \leq 2.5\text{ns}$ .

FIGURE 1. TEST CIRCUIT

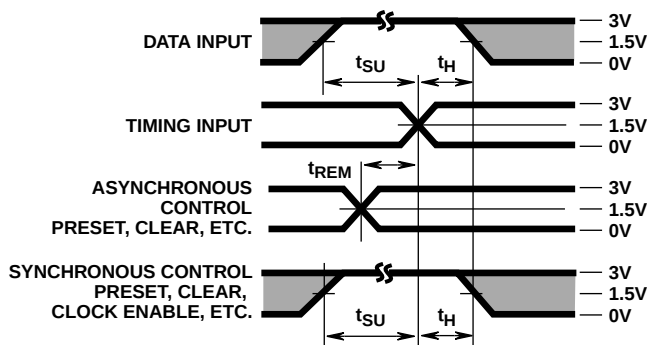


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

| SWITCH POSITION                      |        |
|--------------------------------------|--------|
| TEST                                 | SWITCH |
| $t_{PLZ}, t_{PZL}$                   | Closed |
| $t_{PHZ}, t_{PZH}, t_{PLH}, t_{PHL}$ | Open   |

DEFINITIONS:

$C_L$  = Load capacitance, includes jig and probe capacitance.

$R_T$  = Termination resistance, should be equal to  $Z_{OUT}$  of the Pulse Generator.

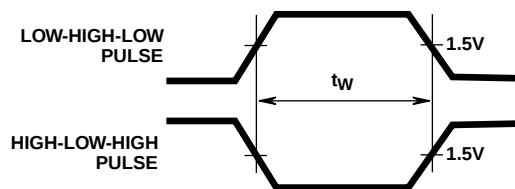


FIGURE 3. PULSE WIDTH

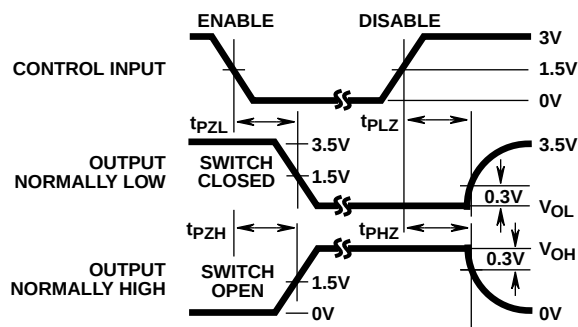


FIGURE 4. ENABLE AND DISABLE TIMING

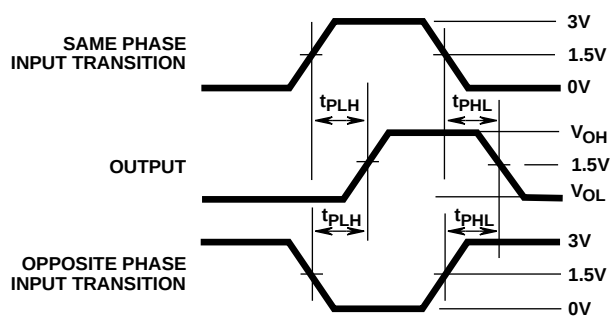


FIGURE 5. PROPAGATION DELAY