

December 1996

## Fast CMOS Octal Bidirectional Transceivers

### Features

- Advanced 0.8 micron CMOS Technology
- These Devices are Pin Compatible With Bipolar FAST™ Series at a Higher Speed and Lower Power Consumption
- 25Ω Series Resistor on All Outputs (CD74FCT2245T)
- 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 buffer bidirectional transceivers designed for asynchronous two-way communication between data buses. The transmit/receive (T/R) input determines the direction of data flow through the bidirectional transceiver. Transmit (active HIGH) enables data from A ports to B ports, and receive (active LOW) from B ports to A ports. The output enable ( $\overline{OE}$ ) input, when HIGH, disables both A and B ports by placing them in HIGH Z condition

All CD74FCT2245T 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. |
|-----------------|------------------|------------|----------|
| CD74FCT245ATM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT245ATQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT245CTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT245CTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT245DTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT245DTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT245TM    | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT245TQM   | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT640ATM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT640ATQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT640CTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT640CTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT640DTM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT640DTQM  | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT640TM    | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT640TQM   | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2245ATM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2245ATQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2245CTM  | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2245CTQM | -40 to 85        | 20 Ld QSOP | M20.15-P |
| CD74FCT2245TM   | -40 to 85        | 20 Ld SOIC | M20.3-P  |
| CD74FCT2245TQM  | -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.

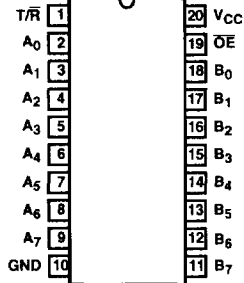
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 OCTAL 5V FCT  
 5V FCT 25Ω

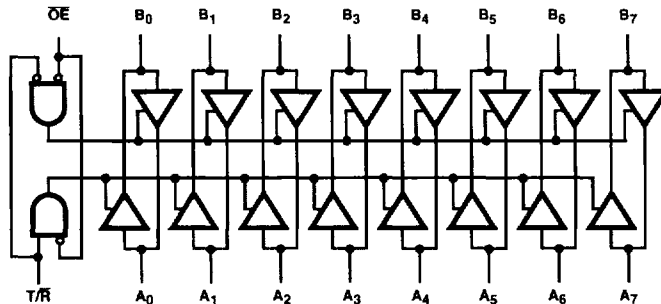
# CD74FCT245T, CD74FCT640T, CD74FCT2245T

## Pinout

CD74FCT245T, CD74FCT640T, CD74FCT2245T  
(QSOP, SOIC)  
TOP VIEW



## Functional Block Diagram



NOTE: CD74FCT245T, CD74FCT2245T are non-inverting options. CD74FCT640T is the inverting option.

TRUTH TABLE (NOTE 1)

| INPUTS |     | OUTPUTS                      |
|--------|-----|------------------------------|
| OE     | T/R |                              |
| L      | L   | Bus B Data to Bus A (NOTE 2) |
| L      | H   | Bus A Data to Bus B (NOTE 2) |
| H      | X   | High Z State                 |

NOTES:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High Impedance
- CD74FCT640T is inverting from input to output.

## Pin Descriptions

| PIN NAME                       | DESCRIPTION                                   |
|--------------------------------|---|
| OE                             | Three-State Output Enable Inputs (Active LOW) |
| T/R                            | Transmit/Receive Input                        |
| A <sub>0</sub> -A <sub>7</sub> | Side A Inputs or Three-State Outputs          |
| B <sub>0</sub> -B <sub>7</sub> | Side B Inputs or Three-State Outputs          |
| GND                            | Ground  |
| V <sub>CC</sub>                | Power   |



**CD74FCT245T, CD74FCT640T, CD74FCT2245T**

**Electrical Specifications (Continued)**

| PARAMETER                                 | SYMBOL          | (NOTE 4)<br>TEST CONDITIONS  |   | MIN | (NOTE 5) | MAX               | UNITS           |
|---|-----------------|--|---|-----|----------|-------------------|-----------------|
|   |                 |  |   |     | TYP      |                   |                 |
| <b>POWER SUPPLY SPECIFICATIONS</b>        |                 |  |   |     |          |                   |                 |
| Quiescent Power Supply Current            | $I_{CC}$        | $V_{CC} = \text{Max}$  | $V_{IN} = \text{GND or } V_{CC}$                | -   | 0.1      | 500               | $\mu\text{A}$   |
| Supply Current per Input at TTL HIGH      | $\Delta I_{CC}$ | $V_{CC} = \text{Max}$  | $V_{IN} = 3.4\text{V}$<br>(Note 8)              | -   | 0.5      | 2.0               | $\text{mA}$     |
| Supply Current per Input per MHz (Note 9) | $I_{CCD}$       | $V_{CC} = \text{Max}$ , Outputs Open<br>$\overline{OE} = \text{GND}$<br>$T/\overline{R} = \text{GND or } V_{CC}$<br>One Input Toggling<br>50% Duty Cycle | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$      | -   | 0.15     | 0.25              | $\text{mA/MHz}$ |
| Total Power Supply Current (Note 11)      | $I_C$           | $V_{CC} = \text{Max}$ , Outputs Open<br>$f_T = 10\text{MHz}$ , 50% Duty Cycle<br>$T/\overline{R} = \overline{OE} = \text{GND}$<br>One Bit Toggling       | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$      | -   | 1.5      | 3.5<br>(Note 10)  | $\text{mA}$     |
|   |                 |  | $V_{IN} = 3.4\text{V}$<br>$V_{IN} = \text{GND}$ | -   | 1.8      | 4.5<br>(Note 10)  | $\text{mA}$     |
|   |                 | $V_{CC} = \text{Max}$ , Outputs Open<br>$f_T = 2.5\text{MHz}$ , 50% Duty Cycle<br>$T/\overline{R} = \overline{OE} = \text{GND}$<br>Eight Bits Toggling   | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$      | -   | 3.0      | 6.0<br>(Note 10)  | $\text{mA}$     |
|   |                 |  | $V_{IN} = 3.4\text{V}$<br>$V_{IN} = \text{GND}$ | -   | 5.0      | 14.0<br>(Note 10) | $\text{mA}$     |

**Switching Specifications Over Operating Range**

| PARAMETER   | SYMBOL                   | (NOTE 12)<br>TEST<br>CONDITIONS          | T                                |      | AT               |     | CT               |     | DT               |     | UNITS |
|---|--------------------------|--|----------------------------------|------|------------------|-----|------------------|-----|------------------|-----|-------|
|   |                          |  | (NOTE 13)<br>MIN                 | MAX  | (NOTE 13)<br>MIN | MAX | (NOTE 13)<br>MIN | MAX | (NOTE 13)<br>MIN | MAX |       |
|   |                          |  | <b>CD74FCT245T, CD74FCT2245T</b> |      |                  |     |                  |     |                  |     |       |
| Propagation Delay<br>A to B, B to A                         | $t_{PLH}$ ,<br>$t_{PHL}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 1.5                              | 7.0  | 1.5              | 4.6 | 1.5              | 4.1 | 1.5              | 3.8 | ns    |
| Output Enable Time<br>$\overline{OE}$ to A or B             | $t_{PZH}$ ,<br>$t_{PZL}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 1.5                              | 9.0  | 1.5              | 6.2 | 1.5              | 5.8 | 1.5              | 5.0 | ns    |
| Output Disable Time<br>$\overline{OE}$ to A or B (Note 14)  | $t_{PHZ}$ ,<br>$t_{PLZ}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 1.5                              | 7.5  | 1.5              | 5.0 | 1.5              | 4.8 | 1.5              | 4.3 | ns    |
| Output Enable Time<br>$T/\overline{R}$ to A or B            | $t_{PZH}$ ,<br>$t_{PZL}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 1.5                              | 9.0  | 1.5              | 6.2 | 1.5              | 5.8 | 1.5              | 5.0 | ns    |
| Output Disable Time<br>$T/\overline{R}$ to A or B (Note 14) | $t_{PHZ}$ ,<br>$t_{PLZ}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 1.5                              | 7.5  | 1.5              | 5.0 | 1.5              | 4.8 | 1.5              | 4.3 | ns    |
| <b>CD74FCT640T</b>  |                          |  |                                  |      |                  |     |                  |     |                  |     |       |
| Propagation Delay<br>A to B, B to A                         | $t_{PLH}$ ,<br>$t_{PHL}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 2                                | 7.0  | 1.5              | 5.0 | 1.5              | 4.4 | 1.5              | 3.7 | ns    |
| Output Enable Time<br>$\overline{OE}$ to A or B             | $t_{PZH}$ ,<br>$t_{PZL}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 2                                | 13.0 | 1.5              | 6.2 | 1.5              | 5.8 | 1.5              | 5.0 | ns    |
| Output Disable Time<br>$\overline{OE}$ to A or B (Note 14)  | $t_{PHZ}$ ,<br>$t_{PLZ}$ | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | 2                                | 10.0 | 1.5              | 5.0 | 1.5              | 4.8 | 1.5              | 4.3 | ns    |

Switching Specifications Over Operating Range (Continued)

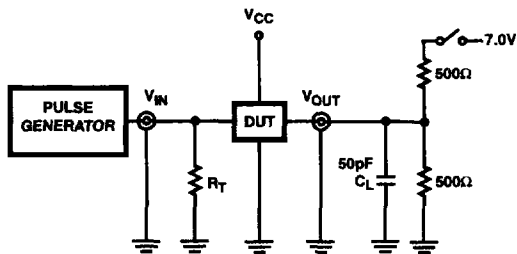
| PARAMETER                                      | SYMBOL                                 | (NOTE 12)<br>TEST<br>CONDITIONS                | T                |      | AT               |     | CT               |     | DT               |     | UNITS |
|--|--|--|------------------|------|------------------|-----|------------------|-----|------------------|-----|-------|
|  |  |  | (NOTE 13)<br>MIN | MAX  | (NOTE 13)<br>MIN | MAX | (NOTE 13)<br>MIN | MAX | (NOTE 13)<br>MIN | MAX |       |
| Output Enable Time<br>T/R to A or B            | t <sub>pZH</sub> ,<br>t <sub>pZL</sub> | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 2                | 13.0 | 1.5              | 6.2 | 1.5              | 5.8 | 1.5              | 5.0 | ns    |
| Output Disable Time<br>T/R to A or B (Note 14) | t <sub>pHZ</sub> ,<br>t <sub>pLZ</sub> | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 2                | 10.0 | 1.5              | 5.0 | 1.5              | 4.8 | 1.5              | 4.3 | ns    |

NOTES:

4. For conditions shown as Max or Min, use appropriate value specified under Electrical Specifications for the applicable device type.
5. Typical values are at V<sub>CC</sub> = 5.0V, 25°C ambient and maximum loading.
6. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
7. This parameter is determined by device characterization but is not production tested.
8. Per TTL driven input (V<sub>IN</sub> = 3.4V); all other inputs at V<sub>CC</sub> or GND.
9. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
10. Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are guaranteed but not tested.
11. I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$   
 I<sub>CC</sub> = Quiescent Current  
 ΔI<sub>CC</sub> = Power Supply Current for a TTL High Input (V<sub>IN</sub> = 3.4V)  
 D<sub>H</sub> = Duty Cycle for TTL Inputs High  
 N<sub>T</sub> = Number of TTL Inputs at D<sub>H</sub>  
 I<sub>CCD</sub> = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 f<sub>CP</sub> = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 f<sub>I</sub> = Input Frequency  
 N<sub>I</sub> = Number of Inputs at f<sub>I</sub>  
 All currents are in milliamps and all frequencies are in megahertz.
12. See test circuit and wave forms.
13. Minimum limits are guaranteed but not tested on Propagation Delays.
14. This parameter is guaranteed but not production tested.

4  
OCTAL 5V FCT  
5V FCT 25Ω

Test Circuits and Waveforms



| 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.

NOTE:

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

FIGURE 1. TEST CIRCUIT

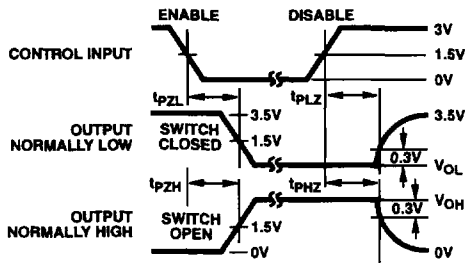


FIGURE 2. ENABLE AND DISABLE TIMING

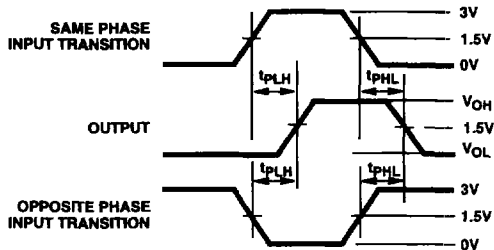


FIGURE 3. PROPAGATION DELAY