



# FAST CMOS OCTAL BIDIRECTIONAL TRANSCEIVER

**IDT74FCT2245AT/CT**

## FEATURES:

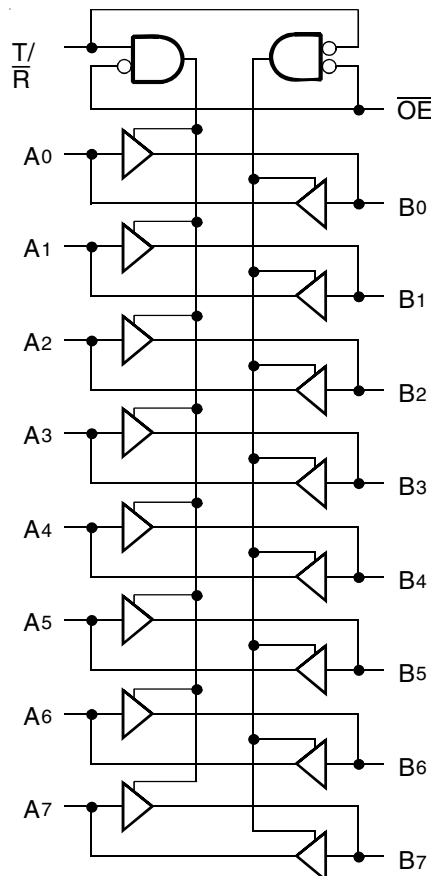
- A and C grades
- Low input and output leakage  $\leq 1\mu\text{A}$  (max.)
- CMOS power levels
- True TTL input and output compatibility:
  - $V_{OH} = 3.3V$  (typ.)
  - $V_{OL} = 0.3V$  (typ.)
- Meets or exceeds JEDEC standard 18 specifications
- Resistor outputs -15mA  $I_{OH}$ , 12mA  $I_{OL}$
- Reduced system switching noise
- Available in SOIC and QSOP packages

## DESCRIPTION:

The IDT octal bidirectional transceivers are built using an advanced dual metal CMOS technology. The FCT2245T is designed for asynchronous two-way communication between data buses. The transmit/receive ( $T/\bar{R}$ ) 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.

The FCT2245T has balanced drive outputs with current limiting resistors. This offers low ground bounce, minimal undershoot and controlled output fall times- reducing the need for external series terminating resistors. The FCT2245T parts are plug-in replacements for FCT245T parts.

## FUNCTIONAL BLOCK DIAGRAM

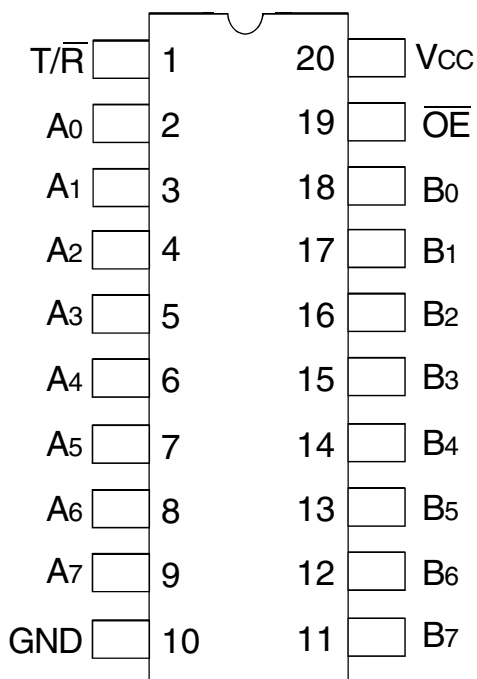


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INDUSTRIAL TEMPERATURE RANGE

JUNE 2006

## PIN CONFIGURATION



SOIC/ QSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                           | Description                          | Max                          | Unit |
|----------------------------------|--------------------------------------|------------------------------|------|
| V <sub>TERM</sub> <sup>(2)</sup> | Terminal Voltage with Respect to GND | -0.5 to +7                   | V    |
| V <sub>TERM</sub> <sup>(3)</sup> | Terminal Voltage with Respect to GND | -0.5 to V <sub>CC</sub> +0.5 | V    |
| T <sub>STG</sub>                 | Storage Temperature                  | -65 to +150                  | °C   |
| I <sub>OUT</sub>                 | DC Output Current                    | -60 to +120                  | mA   |

### NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability. No terminal voltage may exceed V<sub>CC</sub> by +0.5V unless otherwise noted.
- Inputs and V<sub>CC</sub> terminals only.
- Output and I/O terminals only.

## CAPACITANCE (T<sub>A</sub> = +25°C, F = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 6    | 10   | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | 8    | 12   | pF   |

### NOTE:

- This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

| Pin Names                       | Description                      |
|---------------------------------|----------------------------------|
| $\overline{OE}$                 | Output Enable Input (Active LOW) |
| $\overline{T/R}$                | Transmit/Receive Input           |
| A <sub>0</sub> - A <sub>7</sub> | Side A Inputs or 3-State Outputs |
| B <sub>0</sub> - B <sub>7</sub> | Side B Inputs or 3-State Outputs |

## FUNCTION TABLE<sup>(1)</sup>

| Inputs          |                  | Outputs             |
|-----------------|------------------|---------------------|
| $\overline{OE}$ | $\overline{T/R}$ |                     |
| L               | L                | Bus B Data to Bus A |
| L               | H                | Bus A Data to Bus B |
| H               | X                | High Z State        |

### NOTE:

- H = HIGH Voltage Level  
X = Don't Care  
L = LOW Voltage Level

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 5\%$

| Symbol    | Parameter   | Test Conditions <sup>(1)</sup>                             |                     | Min. | Typ. <sup>(2)</sup> | Max.    | Unit          |
|-----------|---|--|---------------------|------|---------------------|---------|---------------|
| $V_{IH}$  | Input HIGH Level  | Guaranteed Logic HIGH Level                                |                     | 2    | —                   | —       | V             |
| $V_{IL}$  | Input LOW Level   | Guaranteed Logic LOW Level                                 |                     | —    | —                   | 0.8     | V             |
| $I_{IH}$  | Input HIGH Current <sup>(4)</sup>                                     | $V_{CC} = \text{Max.}$                                     | $V_I = 2.7\text{V}$ | —    | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{IL}$  | Input LOW Current <sup>(4)</sup>                                      | $V_{CC} = \text{Max.}$                                     | $V_I = 0.5\text{V}$ | —    | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{OZH}$ | High Impedance Output Current<br>(3-State Output Pins) <sup>(4)</sup> | $V_{CC} = \text{Max.}$                                     | $V_I = 2.7\text{V}$ | —    | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{OZL}$ |   |  | $V_I = 0.5\text{V}$ | —    | —                   | $\pm 1$ |               |
| $I_I$     | Input HIGH Current <sup>(4)</sup>                                     | $V_{CC} = \text{Max.}, V_I = V_{CC} (\text{Max.})$         |                     | —    | —                   | $\pm 1$ | $\mu\text{A}$ |
| $V_{IK}$  | Clamp Diode Voltage   | $V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$              |                     | —    | -0.7                | -1.2    | V             |
| $V_H$     | Input Hysteresis  | —  |                     | —    | 200                 | —       | mV            |
| $I_{CC}$  | Quiescent Power Supply Current  | $V_{CC} = \text{Max.}$<br>$V_{IN} = \text{GND or } V_{CC}$ |                     | —    | 0.01                | 1       | mA            |

## OUTPUT DRIVE CHARACTERISTICS

| Symbol    | Parameter           | Test Conditions <sup>(1)</sup>  |                         | Min. | Typ. <sup>(2)</sup> | Max. | Unit |
|-----------|---------------------|---|-------------------------|------|---------------------|------|------|
| $I_{ODL}$ | Output LOW Current  | $V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$ |                         | 16   | 48                  | —    | mA   |
| $I_{ODH}$ | Output HIGH Current | $V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$ |                         | -16  | -48                 | —    | mA   |
| $V_{OH}$  | Output HIGH Voltage | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH} \text{ or } V_{IL}$                        | $I_{OH} = -15\text{mA}$ | 2.4  | 3.3                 | —    | V    |
| $V_{OL}$  | Output LOW Voltage  | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH} \text{ or } V_{IL}$                        | $I_{OL} = 12\text{mA}$  | —    | 0.3                 | 0.5  | V    |

### NOTES:

1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at  $V_{CC} = 5.0\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
3. Not more than one output should be tested at one time. Duration of the test should not exceed one second.
4. The test limit for this parameter is  $\pm 5\mu\text{A}$  at  $T_A = -55^{\circ}\text{C}$ .

## POWER SUPPLY CHARACTERISTICS

| Symbol          | Parameter   | Test Conditions <sup>(1)</sup>  |  | Min. | Typ. <sup>(2)</sup> | Max.                | Unit       |
|-----------------|---|---|--|------|---------------------|---------------------|------------|
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC} = \text{Max.}$<br>$V_{IN} = 3.4V^{(3)}$   |  | —    | 0.5                 | 2                   | mA         |
| $I_{CCD}$       | Dynamic Power Supply<br>Current <sup>(4)</sup>    | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$\overline{OE} = T/\overline{R} = \text{GND}$<br>One Input Toggling<br>50% Duty Cycle                           | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 0.06                | 0.12                | mA/<br>MHz |
| $I_C$           | Total Power Supply Current <sup>(6)</sup>         | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_i = 10\text{MHz}$<br>50% Duty Cycle<br>$\overline{OE} = T/\overline{R} = \text{GND}$<br>One Bit Toggling     | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 0.6                 | 2.2                 | mA         |
|                 |   |   | $V_{IN} = 3.4V$<br>$V_{IN} = \text{GND}$   | —    | 0.9                 | 3.2                 |            |
|                 |   | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_i = 2.5\text{MHz}$<br>50% Duty Cycle<br>$\overline{OE} = T/\overline{R} = \text{GND}$<br>Eight Bits Toggling | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 1.2                 | 3.4 <sup>(5)</sup>  |            |
|                 |   |   | $V_{IN} = 3.4V$<br>$V_{IN} = \text{GND}$   | —    | 3.2                 | 11.4 <sup>(5)</sup> |            |

### NOTES:

- For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
  - Typical values are at  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  ambient.
  - Per TTL driven input; ( $V_{IN} = 3.4V$ ). All other inputs at  $V_{CC}$  or  $\text{GND}$ .
  - This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
  - Values for these conditions are examples of  $\Delta I_{CC}$  formula. These limits are guaranteed but not tested.
  - $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 $I_{CC}$  = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input ( $V_{IN} = 3.4V$ )  
 $D_H$  = Duty Cycle for TTL Inputs High  
 $N_T$  = Number of TTL Inputs at  $D_H$   
 $I_{CCD}$  = Dynamic Current caused by an Input Transition Pair (HLH or LHL)  
 $f_{CP}$  = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 $f_i$  = Output Frequency  
 $N_i$  = Number of Outputs at  $f_i$
- All currents are in milliamps and all frequencies are in megahertz.

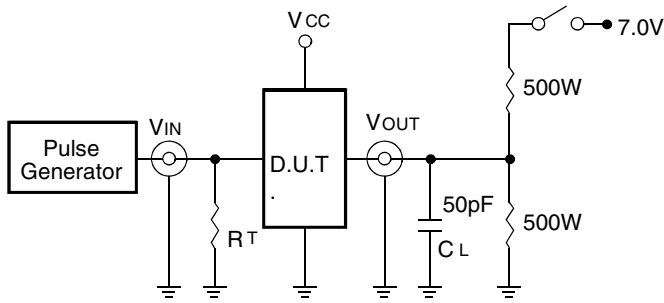
SWITCHING CHARACTERISTICS OVER OPERATING RANGE<sup>(1)</sup>

| Symbol                               | Parameter   | Condition <sup>(1)</sup> | 74FCT2245AT         |      | 74FCT2245CT         |      | Unit |
|--------------------------------------|---|--------------------------|---------------------|------|---------------------|------|------|
|                                      |   |                          | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>A to B, B to A                               | CL = 50 pF<br>RL = 500Ω  | 1.5                 | 4.6  | 1.5                 | 4.1  | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output Enable Time<br>$\overline{OE}$ to A or B                   |                          | 1.5                 | 6.2  | 1.5                 | 5.8  | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output Disable Time<br>$\overline{OE}$ to A or B                  |                          | 1.5                 | 5    | 1.5                 | 4.8  | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output Enable Time<br>T/ $\overline{R}$ to A or B <sup>(3)</sup>  |                          | 1.5                 | 6.2  | 1.5                 | 5.8  | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output Disable Time<br>T/ $\overline{R}$ to A or B <sup>(3)</sup> |                          | 1.5                 | 5    | 1.5                 | 4.8  | ns   |

NOTES:

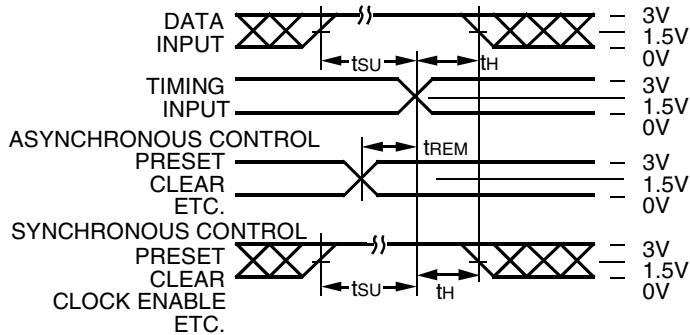
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS



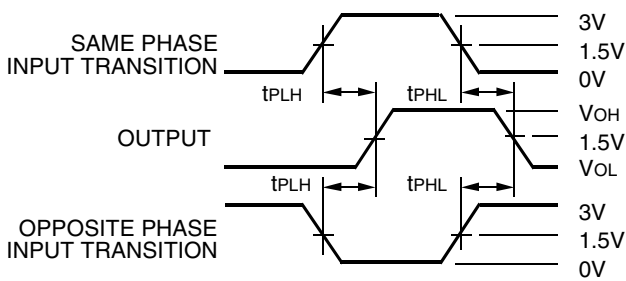
Octal Link

Test Circuits for All Outputs



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Set-Up, Hold, and Release Times



Octal Link

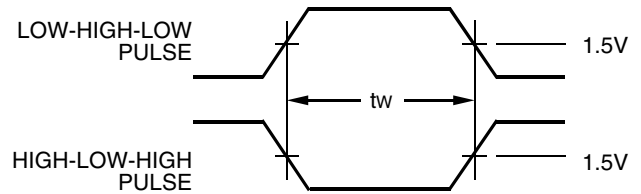
Propagation Delay

SWITCH POSITION

| Test                                    | Switch |
|---|--------|
| Open Drain<br>Disable Low<br>Enable Low | Closed |
| All Other Tests                         | Open   |

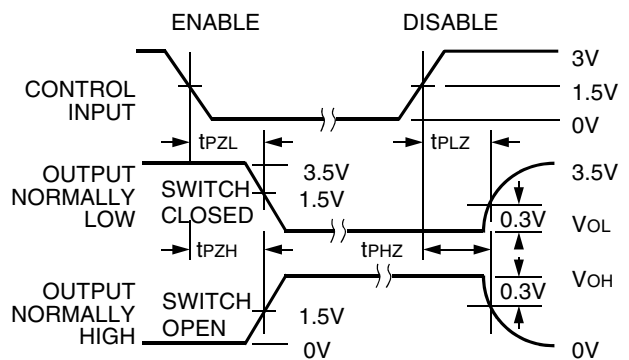
DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.  
RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.



Pulse Width

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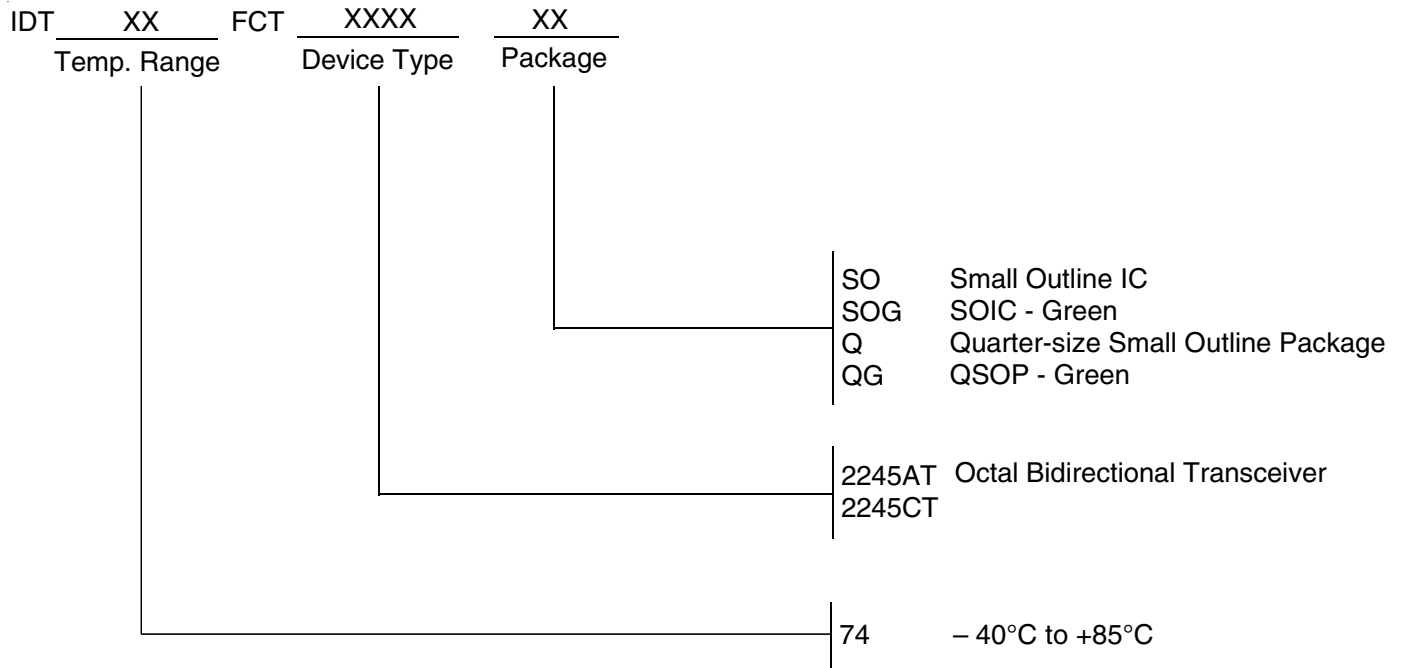
Octal Link

Enable and Disable Times

NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
- Pulse Generator for All Pulses: Rate  $\leq 1.0\text{MHz}$ ;  $t_r \leq 2.5\text{ns}$ ;  $t_f \leq 2.5\text{ns}$ .

## ORDERING INFORMATION



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