National Semiconductor

# 54FCT/74FCT245
# Octal Bidirectional Transceiver with TRI-STATE® Inputs/Outputs

## General Description

The 'FCT245 contains eight non-inverting bidirectional buffers with TRI-STATE outputs and is intended for bus-oriented applications. The Transmit/Receive ($T/\overline{R}$) input determines the direction of data flow through the bidirectional transceiver. Transmit (active-HIGH) enables data from A ports to B ports; Receive (active-LOW) enables data from B ports to A ports. The Output Enable input, when HIGH, disables both A and B ports by placing them in a HIGH Z condition.

FACT™ FCT utilizes NSC quiet series technology to provide improved quiet output switching and dynamic threshold performance.

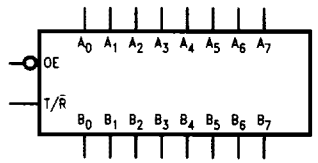
FACT FCT features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

## Features

- NSC54FCT/74FCT245 is pin and functionally equivalent to IDT54FCT/74FCT245
- Controlled output edge rates and undershoot for improved noise immunity. Internal split ground for improved noise immunity.
- Input clamp diodes to limit bus reflections
- TTL/CMOS input and output level compatible
- $I_{OL}$ = 64 mA (commercial) and 48 mA (military)
- CMOS power levels
- ESD immunity ≥ 4 kV typ
- Military product compliant to MIL-STD 883 and Standard Military Drawing #5962-87629

## Ordering Code: See Section 8

## Logic Symbols

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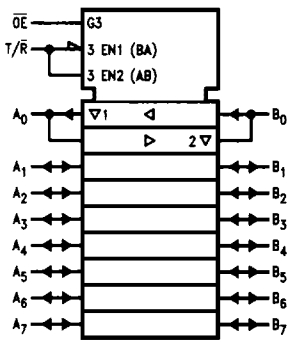
| Pin Names | Description |
|---|---|
| $\overline{OE}$ | Output Enable Input |
| $T/\overline{R}$ | Transmit/Receive Input |
| $A_0$–$A_7$ | Side A TRI-STATE Inputs or TRI-STATE Outputs |
| $B_0$–$B_7$ | Side B TRI-STATE Inputs or TRI-STATE Outputs |

IEEE/IEC

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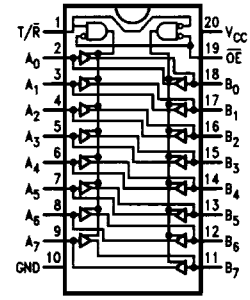
## Truth Table

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

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

## Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC

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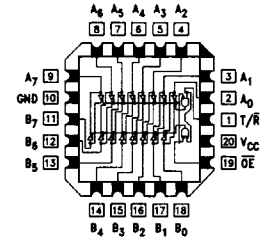
Pin Assignment for LCC

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## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.**

Terminal Voltage with Respect to GND ($V_{TERM}$)

| | |
|---|---|
| 54FCT | −0.5V to +7.0V |
| 74FCT | −0.5V to +7.0V |

Temperature under Bias ($T_{BIAS}$)

| | |
|---|---|
| 74FCT | −55°C to +125°C |
| 54FCT | −65°C to +135°C |

Storage Temperature ($T_{STG}$)

| | |
|---|---|
| 74FCT | −55°C to +125°C |
| 54FCT | −65°C to +150°C |

DC Output Current ($I_{OUT}$) 120 mA

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. Exposure to absolute maximum rating conditions for extended periods may affect reliability. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables.

## Recommended Operating Conditions

Supply Voltage ($V_{CC}$)

| | |
|---|---|
| 54FCT | 4.5V to 5.5V |
| 74FCT | 4.75V to 5.25V |

Input Voltage 0V to $V_{CC}$

Output Voltage 0V to $V_{CC}$

Operating Temperature ($T_A$)

| | |
|---|---|
| 54FCT | −55°C to +125°C |
| 74FCT | 0°C to +70°C |

Junction Temperature ($T_J$)

| | |
|---|---|
| CDIP | 175°C |
| PDIP | 140°C |

**Note:** All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from −40°C to +125°C.

## DC Characteristics for 'FCT Family Devices

Typical values are at $V_{CC}$ = 5.0V, 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com: $V_{CC}$ = 5.0V ±5%, $T_A$ = 0°C to +70°C; Mil: $V_{CC}$ = 5.0V ±10%, $T_A$ = −55°C to +125°C, $V_{HC}$ = $V_{CC}$ − 0.2V.

| Symbol | Parameter | 54FCT/74FCT Min | 54FCT/74FCT Typ | 54FCT/74FCT Max | Units | Conditions | |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Minimum High Level Input Voltage | 2.0 | | | V | | |
| $V_{IL}$ | Maximum Low Level Input Voltage | | | 0.8 | V | | |
| $I_{IH}$ | Input High Current (except I/O Pins) | | | 5.0<br>5.0 | μA | $V_{CC}$ = Max | $V_I$ = $V_{CC}$<br>$V_I$ = 2.7V (Note 2) |
| $I_{IH}$ | Input High Current (I/O Pins Only) | | | 15<br>15 | μA | $V_{CC}$ = Max | $V_I$ = $V_{CC}$<br>$V_I$ = 2.7V (Note 2) |
| $I_{IL}$ | Input Low Current (except I/O Pins) | | | −5.0<br>−5.0 | μA | $V_{CC}$ = Max | $V_I$ = 0.5V (Note 2)<br>$V_I$ = GND |
| $I_{IL}$ | Input Low Current (I/O Pins Only) | | | −15<br>−15 | μA | $V_{CC}$ = Max | $V_I$ = 0.5V (Note 2)<br>$V_I$ = GND |
| $V_{IK}$ | Clamp Diode Voltage | | −0.7 | −1.2 | V | $V_{CC}$ = Min; $I_N$ = −18 mA | |
| $I_{OS}$ | Short Circuit Current | −60 | −120 | | mA | $V_{CC}$ = Max (Note 1); $V_O$ = GND | |
| $V_{OH}$ | Minimum High Level Output Voltage | 2.8 | 3.0 | | V | $V_{CC}$ = 3V; $V_{IN}$ = 0.2V or $V_{HC}$; $I_{OH}$ = −32 μA | |
| | | $V_{HC}$<br>2.4<br>2.4 | $V_{CC}$<br>4.3<br>4.3 | | | $V_{CC}$ = Min<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = −300 μA<br>$I_{OH}$ = −12 mA (Mil)<br>$I_{OH}$ = −15 mA (Com) |
| $V_{OL}$ | Maximum Low Level Output Voltage | | GND | 0.2 | V | $V_{CC}$ = 3V; $V_{IN}$ = 0.2V or $V_{HC}$; $I_{OL}$ = 300 μA | |
| | | | GND<br>0.3<br>0.3 | 0.2<br>0.55<br>0.55 | | $V_{CC}$ = Min<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 300 μA<br>$I_{OL}$ = 48 mA (Mil)<br>$I_{OL}$ = 64 mA (Com) |

## DC Characteristics for 'FCT Family Devices (Continued)

Typical values are at $V_{CC}$ = 5.0V, 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com: $V_{CC}$ = 5.0V ±5%, $T_A$ = 0°C to +70°C; Mil: $V_{CC}$ = 5.0V ±10%, $T_A$ = −55°C to +125°C, $V_{HC} = V_{CC} - 0.2V$.

| Symbol | Parameter | 74FCT | | | Units | Conditions | |
|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | | |
| $I_{CC}$ | Maximum Quiescent Supply Current | | 0.001 | 1.5 | mA | $V_{CC}$ = Max<br>$V_{IN} \geq V_{HC}$, $V_{IN} \leq 0.2V$<br>$f_i = 0$ | |
| $\Delta I_{CC}$ | Quiescent Supply Current; TTL Inputs HIGH | | 0.5 | 2.0 | mA | $V_{CC}$ = Max<br>$V_{IN}$ = 3.4V (Note 3) | |
| $I_{CCD}$ | Dynamic Power Supply Current (Note 4) | | 0.25 | 0.40 | mA/MHz | $V_{CC}$ = Max<br>Outputs Open<br>$T/\overline{R} = \overline{OE}$ = GND<br>One Input Toggling<br>50% Duty Cycle | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq 0.2V$ |
| $I_C$ | Total Power Supply Current (Note 6) | | 1.5 | 4.5 | mA | $V_{CC}$ = Max<br>Outputs Open<br>$T/\overline{R} = \overline{OE}$ = GND | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq 0.2V$ |
| | | | 1.8 | 5.0 | | $f_i$ = 10 MHz<br>One Bit Toggling<br>50% Duty Cycle | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND |
| | | | 3.0 | 10.0 | | (Note 5)<br>$V_{CC}$ = Max<br>Outputs Open<br>$T/\overline{R} = \overline{OE}$ = GND | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq 0.2V$ |
| | | | 5.0 | 14.5 | | $f_i$ = 2.5 MHz<br>Eight Bits Toggling<br>50% Duty Cycle | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND |

**Note 1:** Maximum test duration not to exceed one second, not more than one output shorted at one time.

**Note 2:** This parameter guaranteed but not tested.

**Note 3:** Per TTL driven input ($V_{IN}$ = 3.4V); all other inputs at $V_{CC}$ or GND.

**Note 4:** This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

**Note 5:** Values for these conditions are examples of the $I_{CC}$ formula. These limits are guaranteed but not tested.

**Note 6:** $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

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

$I_{CC}$ = 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 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)

$f_i$ = Input Frequency

$N_i$ = Number of Inputs at $f_i$

All currents are milliamps and all frequencies are in megahertz.

**Note 7:** For 54FCT, $I_{CCD}$ = 0.40 mA/MHz.

Refer to applicable standard military drawing or NSC Table I for test conditions and $I_C/I_{CC}$ limits.

## AC Electrical Characteristics: See Section 2 for Waveforms

| Symbol | Parameter | 54FCT/74FCT | 74FCT | | 54FCT | | Units | No. Fig. |
|---|---|---|---|---|---|---|---|---|
| | | $T_A$ = +25°C, $V_{CC}$ = 5.0V | $T_A$, $V_{CC}$ = Com, $R_L$ = 500Ω, $C_L$ = 50 pF | | $T_A$, $V_{CC}$ = Mil, $R_L$ = 500Ω, $C_L$ = 50 pF | | | |
| | | Typ | Min (Note) | Max | Min | Max | | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay A to B, B to A | 5.0 | 1.5 | 7.0 | 1.5 | 7.5 | ns | 2-8 |
| $t_{PZH}$ $t_{PZL}$ | Output Enable Time $\overline{OE}$ to A or B | 6.0 | 1.5 | 9.5 | 1.5 | 10.0 | ns | 2-8 |
| $t_{PHZ}$ $t_{PHL}$ | Output Disable Time $\overline{OE}$ to A or B | 6.0 | 1.5 | 7.5 | 1.5 | 10.0 | ns | 2-11 |
| $t_{PZH}$ $t_{PZL}$ | Output Enable Time T/$\overline{R}$ to A or B | 6.0 | 1.5 | 9.5 | 1.5 | 10.0 | ns | 2-11 |
| $t_{PHZ}$ $t_{PLZ}$ | Output Enable Time T/$\overline{R}$ to A or B | 6.0 | 1.5 | 7.5 | 1.5 | 10.0 | ns | 2-11 |

**Note:** Minimum limits guaranteed but not tested on propagation delays.

## Capacitance $T_A$ = +25°C, f = 1.0 MHz

| Symbol | Parameter (Note) | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | 6 | 10 | pF | $V_{IN}$ = 0V |
| $C_{OUT}$ | Output Capacitance | 8 | 12 | pF | $V_{OUT}$ = 0V |

**Note:** This parameter is measured at characterization but not tested.
$C_{OUT}$ for 74FCT245 only.