



Integrated Device Technology, Inc.

# FAST CMOS QUAD 2-INPUT MULTIPLEXER

**IDT54/74FCT157T/AT/CT/DT**  
**IDT54/74FCT257T/AT/CT/DT**  
**IDT54/74FCT2257T/AT/CT**

## FEATURES:

### • Common features:

- Low input and output leakage  $\leq 1\mu\text{A}$  (max.)
- CMOS power levels
- True TTL input and output compatibility
  - $V_{OH} = 3.3\text{V}$  (typ.)
  - $V_{OL} = 0.3\text{V}$  (typ.)
- Meets or exceeds JEDEC standard 18 specifications
- Product available in Radiation Tolerant and Radiation Enhanced versions
- Military product compliant to MIL-STD-883, Class B and DESC listed (dual marked)
- Available in DIP, SOIC, SSOP, QSOP, CERPACK and LCC packages

### • Features for FCT157T/257T:

- Std., A, C and D speed grades
- High drive outputs (-15mA IOH, 48mA IOL)

### • Features for FCT2257T:

- Std., A, and C speed grades
- Resistor outputs (-15mA IOH, 12mA IOL Com.) (-12mA IOH, 12mA IOL Mil.)
- Reduced system switching noise

## DESCRIPTION:

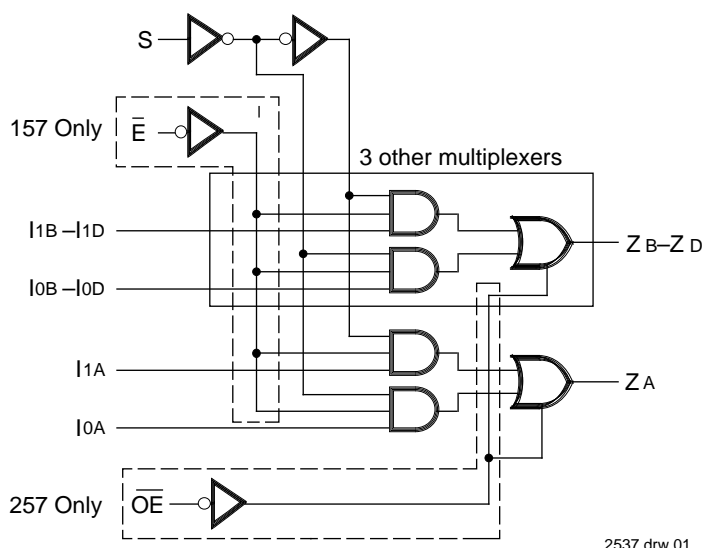
The FCT157T, FCT257T/FCT2257T are high-speed quad 2-input multiplexers built using an advanced dual metal CMOS technology. Four bits of data from two sources can be selected using the common select input. The four buffered outputs present the selected data in the true (non-inverting) form.

The FCT157T has a common, active-LOW, enable input. When the enable input is not active, all four outputs are held LOW. A common application of 'FCT157T is to move data from two different groups of registers to a common bus. Another application is as a function generator. The 'FCT157T can generate any four of the 16 different functions of two variables with one variable common.

The FCT257T/FCT2257T have a common Output Enable ( $\overline{OE}$ ) input. When  $\overline{OE}$  is HIGH, all outputs are switched to a high-impedance state allowing the outputs to interface directly with bus-oriented systems.

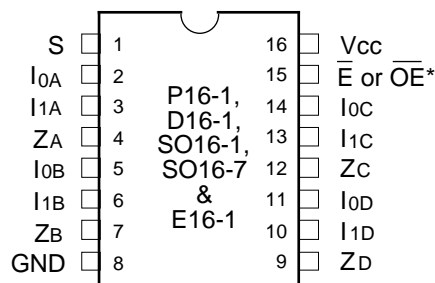
The FCT2257T has balanced output drive with current limiting resistors. This offers low ground bounce, minimal undershoot and controlled output fall times-reducing the need for external series terminating resistors. FCTxxxT parts are plug-in replacements for FCTxxxT parts.

## FUNCTIONAL BLOCK DIAGRAM



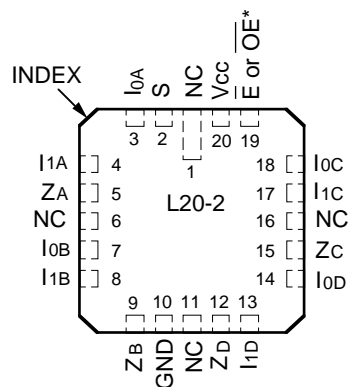
2537 drw 01

## PIN CONFIGURATIONS



DIP/SOIC/QSOP/CERPACK  
TOP VIEW

2537 drw 02



LCC  
TOP VIEW

2537 drw 03

The IDT logo is a registered trademark of Integrated Device Technology, Inc.

\*  $\overline{E}$  for FCT157,  $\overline{OE}$  for FCT257/FCT2257.

**MILITARY AND COMMERCIAL TEMPERATURE RANGES**

**JUNE 1996**

## PIN DESCRIPTION

| Pin Names  | Description                              |
|------------|--|
| I0A–I0D    | Source 0 Data Inputs                     |
| I1A–I1D    | Source 1 Data Inputs                     |
| $\bar{E}$  | Enable Input (Active LOW)–FCT157T        |
| $\bar{OE}$ | Output Enable (Active LOW)–FCT257T/2257T |
| S          | Select Input                             |
| ZA–ZD      | Outputs                                  |

2537 tbl 01

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

| Inputs             |   |    |    | Output Zn |     |
|--------------------|---|----|----|-----------|-----|
| $\bar{E}/\bar{OE}$ | S | I0 | I1 | 157       | 257 |
| H                  | X | X  | X  | L         | Z   |
| L                  | H | X  | L  | L         | L   |
| L                  | H | X  | H  | H         | H   |
| L                  | L | L  | X  | L         | L   |
| L                  | L | H  | X  | H         | H   |

2537 tbl 02

**NOTE:**

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

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

| Symbol               | Rating                               | Commercial       | Military         | Unit |
|----------------------|--------------------------------------|------------------|------------------|------|
| VTERM <sup>(2)</sup> | Terminal Voltage with Respect to GND | –0.5 to +7.0     | –0.5 to +7.0     | V    |
| VTERM <sup>(3)</sup> | Terminal Voltage with Respect to GND | –0.5 to VCC +0.5 | –0.5 to VCC +0.5 | V    |
| TA                   | Operating Temperature                | 0 to +70         | –55 to +125      | °C   |
| TBIAS                | Temperature Under Bias               | –55 to +125      | –65 to +135      | °C   |
| TSTG                 | Storage Temperature                  | –55 to +125      | –65 to +150      | °C   |
| PT                   | Power Dissipation                    | 0.5              | 0.5              | W    |
| IOUT                 | DC Output Current                    | –60 to +120      | –60 to +120      | mA   |

2537 lmk 03

**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 VCC by +0.5V unless otherwise noted.
- Input and VCC terminals only.
- Outputs and I/O terminals only.

## CAPACITANCE (TA = +25°C, f = 1.0MHz)

| Symbol | Parameter <sup>(1)</sup> | Conditions | Typ. | Max. | Unit |
|--------|--------------------------|------------|------|------|------|
| CIN    | Input Capacitance        | VIN = 0V   | 6    | 10   | pF   |
| COU    | Output Capacitance       | VOUT = 0V  | 8    | 12   | pF   |

2537 lmk 04

**NOTE:**

- This parameter is measured at characterization but not tested.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial:  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 5\%$ ; Military:  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$

| Symbol    | Parameter   | Test Conditions <sup>(1)</sup>                         |                     | Min. | Typ. <sup>(2)</sup> | Max.    | Unit          |
|-----------|---|--|---------------------|------|---------------------|---------|---------------|
| $V_{IH}$  | Input HIGH Level  | Guaranteed Logic HIGH Level                            |                     | 2.0  | —                   | —       | 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>                                      |  | $V_I = 0.5\text{V}$ | —    | —                   | $\pm 1$ |               |
| $I_{OZH}$ | High Impedance Output Current<br>(3-State Output pins) <sup>(4)</sup> | $V_{CC} = \text{Max.}$                                 | $V_O = 2.7\text{V}$ | —    | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{OZL}$ |   |  | $V_O = 0.5\text{V}$ | —    | —                   | $\pm 1$ |               |
| $I_I$     | 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  | $V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$ |                     | —    | 0.01                | 1       | mA            |

2537 Ink 05

## OUTPUT DRIVE CHARACTERISTICS FOR FCT157/257T

| Symbol    | Parameter                                     | Test Conditions <sup>(1)</sup>                                 |  | Min. | Typ. <sup>(2)</sup> | Max.    | Unit          |
|-----------|---|--|--|------|---------------------|---------|---------------|
| $V_{OH}$  | Output HIGH Voltage                           | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OH} = -6\text{mA MIL.}$                                    | 2.4  | 3.3                 | —       | V             |
|           |   |  | $I_{OH} = -8\text{mA COM'L.}$                                  | —    | —                   | —       | —             |
|           |   |  | $I_{OH} = -12\text{mA MIL.}$<br>$I_{OH} = -15\text{mA COM'L.}$ | 2.0  | 3.0                 | —       | V             |
| $V_{OL}$  | Output LOW Voltage                            | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OL} = 32\text{mA MIL.}$<br>$I_{OL} = 48\text{mA COM'L.}$   | —    | 0.3                 | 0.50    | V             |
| $I_{OS}$  | Short Circuit Current                         | $V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$                 |  | -60  | -120                | -225    | mA            |
| $I_{OFF}$ | Input/Output Power Off Leakage <sup>(5)</sup> | $V_{CC} = 0\text{V}, V_{IN} \text{ or } V_O \leq 4.5\text{V}$  |  | —    | —                   | $\pm 1$ | $\mu\text{A}$ |

2537 tbl 06

## OUTPUT DRIVE CHARACTERISTICS FOR FCT2257T

| 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>$V_{IN} = V_{IH} \text{ or } V_{IL}$                        | $I_{OH} = -12\text{mA MIL.}$<br>$I_{OH} = -15\text{mA COM'L.}$ | 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                 | 0.50 | V    |

2537 Ink 07

### NOTES:

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

## 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>$V_{IN} = 3.4^{(3)}$  |  |          | —    | 0.5                 | 2.0                | mA         |
| $I_{CCD}$       | Dynamic Power Supply Current <sup>(4)</sup>       | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$\bar{E}$ or $\bar{OE} = \text{GND}$<br>One Bit Toggling<br>50% Duty Cycle                            | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | FCTxxxT  | —    | 0.15                | 0.25               | mA/<br>MHz |
|                 |   |   |  | FCT2xxxT | —    | 0.06                | 0.12               |            |
| $I_C$           | Total Power Supply Current <sup>(6)</sup>         | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_o = 10\text{MHz}$<br>50% Duty Cycle<br>$\bar{E}$ or $\bar{OE} = \text{GND}$<br>One Bit Toggling    | $V_{IN} = V_{CC}$                          | FCTxxxT  | —    | 1.5                 | 3.5                | mA         |
|                 |   |   | $V_{IN} = \text{GND}$                      | FCT2xxxT | —    | 0.6                 | 2.2                |            |
|                 |   |   | $V_{IN} = 3.4$                             | FCTxxxT  | —    | 1.8                 | 4.5                |            |
|                 |   |   | $V_{IN} = \text{GND}$                      | FCT2xxxT |      | 0.9                 | 3.2                |            |
|                 |   | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_o = 2.5\text{MHz}$<br>50% Duty Cycle<br>$\bar{E}$ or $\bar{OE} = \text{GND}$<br>Four Bits Toggling | $V_{IN} = V_{CC}$                          | FCTxxxT  | —    | 1.5                 | 3.5 <sup>(5)</sup> |            |
|                 |   |   | $V_{IN} = \text{GND}$                      | FCT2xxxT |      | 0.6                 | 2.2 <sup>(5)</sup> |            |
|                 |   |   | $V_{IN} = 3.4$                             | FCTxxxT  |      | 2.5                 | 7.5 <sup>(5)</sup> |            |
|                 |   |   | $V_{IN} = \text{GND}$                      | FCT2xxxT |      | 1.6                 | 6.2 <sup>(5)</sup> |            |

2537 tbl 06

### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0\text{V}$ ,  $+25^\circ\text{C}$  ambient.
- Per TTL driven input ( $V_{IN} = 3.4\text{V}$ ); 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 the  $I_{CC}$  formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_o N_o)$   
 $I_{CC} = \text{Quiescent Current}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4\text{V})$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current Caused by an Output Transition Pair (HLH or LHL)}$   
 $f_o = \text{Output Frequency}$   
 $N_o = \text{Number of Outputs at } f_o$   
 All currents are in milliamps and all frequencies are in megahertz.

**SWITCHING CHARACTERISTICS OVER OPERATING RANGE - FCT157T**

| Symbol       | Parameter  | Condition <sup>(1)</sup> | FCT157T             |      |                     |      | FCT157AT            |      |                     |      | Unit |
|--------------|--|--------------------------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|------|
|              |  |                          | Com'l.              |      | Mil.                |      | Com'l.              |      | Mil.                |      |      |
|              |  |                          | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| tPLH<br>tPHL | Propagation Delay I <sub>N</sub> to Z <sub>N</sub> | CL = 50pF<br>RL = 500Ω   | 1.5                 | 6.0  | 1.5                 | 7.0  | 1.5                 | 5.0  | 1.5                 | 5.8  | ns   |
| tPLH<br>tPHL | Propagation Delay $\bar{E}$ to Z <sub>N</sub>      |                          | 1.5                 | 10.5 | 1.5                 | 12.0 | 1.5                 | 6.0  | 1.5                 | 7.4  | ns   |
| tPLH<br>tPHL | Propagation Delay S to Z <sub>N</sub>              |                          | 1.5                 | 10.5 | 1.5                 | 12.0 | 1.5                 | 7.0  | 1.5                 | 8.1  | ns   |

2537 tbl 07

| Symbol       | Parameter  | Condition <sup>(1)</sup> | FCT157CT            |      |                     |      | FCT157DT            |      |                     |      | Unit |
|--------------|--|--------------------------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|------|
|              |  |                          | Com'l.              |      | Mil.                |      | Com'l.              |      | Mil.                |      |      |
|              |  |                          | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| tPLH<br>tPHL | Propagation Delay I <sub>N</sub> to Z <sub>N</sub> | CL = 50pF<br>RL = 500Ω   | 1.5                 | 4.3  | 1.5                 | 5.0  | 1.5                 | 3.9  | —                   | —    | ns   |
| tPLH<br>tPHL | Propagation Delay $\bar{E}$ to Z <sub>N</sub>      |                          | 1.5                 | 4.8  | 1.5                 | 5.9  | 1.5                 | 4.4  | —                   | —    | ns   |
| tPLH<br>tPHL | Propagation Delay S to Z <sub>N</sub>              |                          | 1.5                 | 5.2  | 1.5                 | 6.0  | 1.5                 | 4.6  | —                   | —    | ns   |

2537 tbl 08

**SWITCHING CHARACTERISTICS OVER OPERATING RANGE – FCT257/2257T**

| Symbol       | Parameter  | Condition <sup>(1)</sup> | FCT257/2257T        |      |                     |      | FCT257/2257AT       |      |                     |      | Unit |
|--------------|--|--------------------------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|------|
|              |  |                          | Com'l.              |      | Mil.                |      | Com'l.              |      | Mil.                |      |      |
|              |  |                          | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| tPLH<br>tPHL | Propagation Delay I <sub>N</sub> to Z <sub>N</sub> | CL = 50pF<br>RL = 500Ω   | 1.5                 | 6.0  | 1.5                 | 7.0  | 1.5                 | 5.0  | 1.5                 | 5.8  | ns   |
| tPLH<br>tPHL | Propagation Delay S to Z <sub>N</sub>              |                          | 1.5                 | 10.5 | 1.5                 | 12.0 | 1.5                 | 7.0  | 1.5                 | 8.1  | ns   |
| tPZH<br>tPZL | Output Enable Time                                 |                          | 1.5                 | 8.5  | 1.5                 | 10.0 | 1.5                 | 7.0  | 1.5                 | 8.0  | ns   |
| tPHZ<br>tPLZ | Output Disable Time                                |                          | 1.5                 | 6.0  | 1.5                 | 8.0  | 1.5                 | 5.5  | 1.5                 | 5.8  | ns   |

2537 tbl 09

| Symbol       | Parameter  | Condition <sup>(1)</sup> | FCT257/2257CT       |      |                     |      | FCT257DT            |      |                     |      | Unit |
|--------------|--|--------------------------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|------|
|              |  |                          | Com'l.              |      | Mil.                |      | Com'l.              |      | Mil.                |      |      |
|              |  |                          | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| tPLH<br>tPHL | Propagation Delay I <sub>N</sub> to Z <sub>N</sub> | CL = 50pF<br>RL = 500Ω   | 1.5                 | 4.3  | 1.5                 | 5.0  | 1.5                 | 3.9  | —                   | —    | ns   |
| tPLH<br>tPHL | Propagation Delay S to Z <sub>N</sub>              |                          | 1.5                 | 5.2  | 1.5                 | 6.0  | 1.5                 | 4.4  | —                   | —    | ns   |
| tPZH<br>tPZL | Output Enable Time                                 |                          | 1.5                 | 6.0  | 1.5                 | 6.8  | 1.5                 | 4.4  | —                   | —    | ns   |
| tPHZ<br>tPLZ | Output Disable Time                                |                          | 1.5                 | 5.0  | 1.5                 | 5.3  | 1.5                 | 4.4  | —                   | —    | ns   |

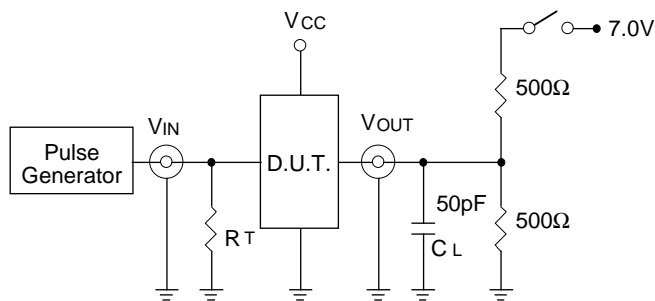
2537 tbl 10

**NOTES:**

1. See test circuits and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delay.

## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



2537 drw 04

### SWITCH POSITION

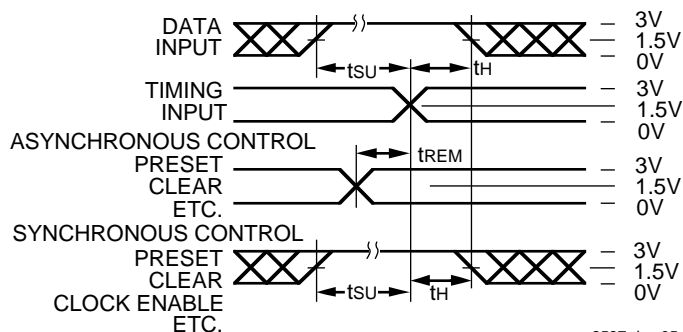
| Test                                    | Switch |
|---|--------|
| Open Drain<br>Disable Low<br>Enable Low | Closed |
| All Other Tests                         | Open   |

#### DEFINITIONS:

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

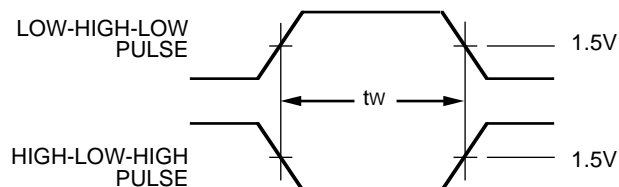
2537 Ink 11

### SET-UP, HOLD AND RELEASE TIMES



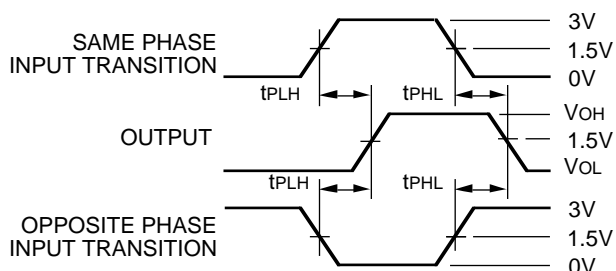
2537 drw 05

### PULSE WIDTH



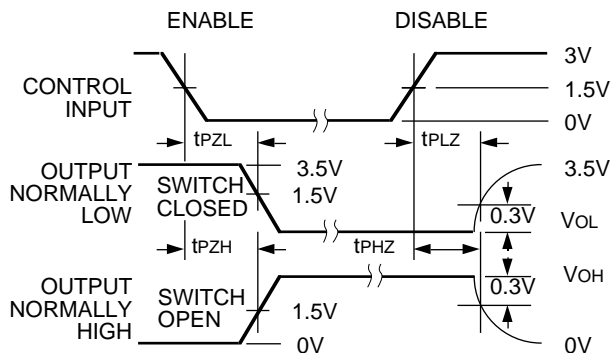
2537 drw 06

### PROPAGATION DELAY



2537 drw 07

### ENABLE AND DISABLE TIMES

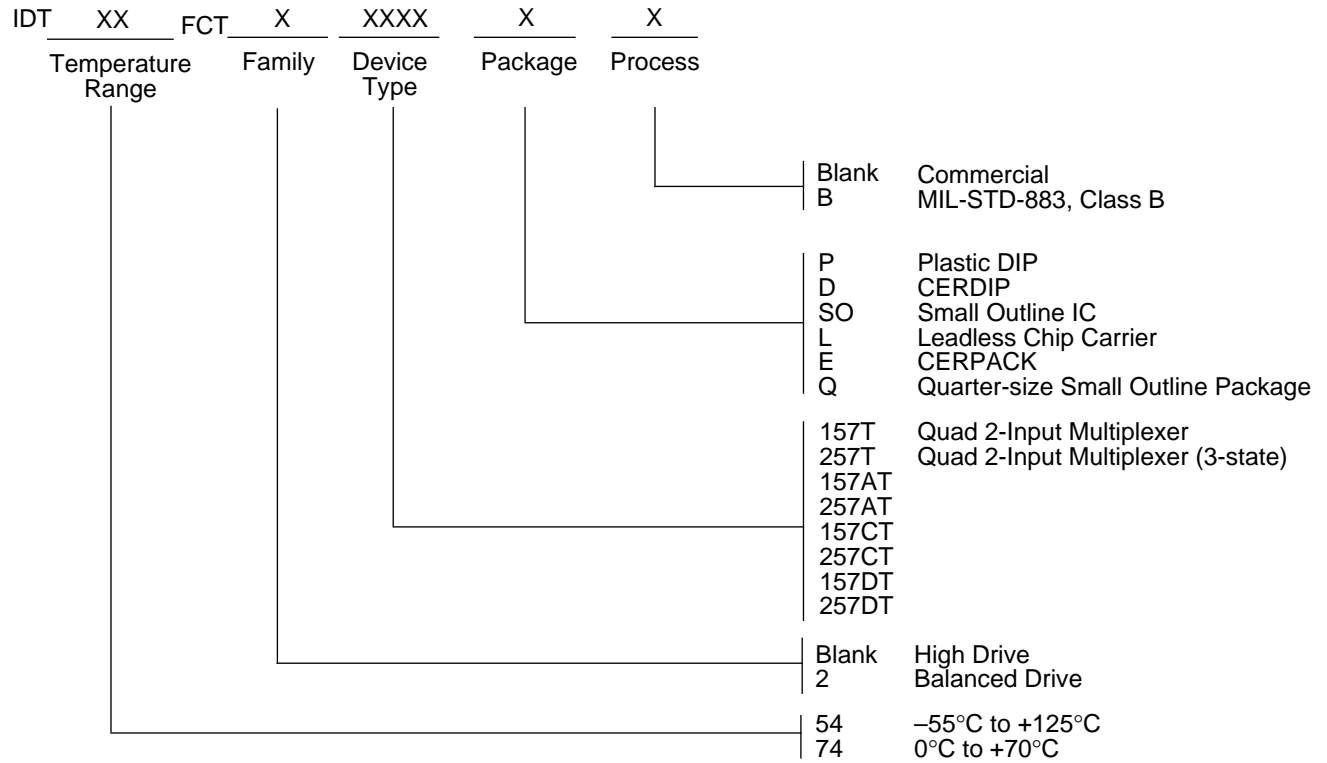


2537 drw 08

#### NOTES:

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

**ORDERING INFORMATION**



2537 drw 09