



# FAST CMOS 16-BIT BIDIRECTIONAL TRANSCEIVER

## IDT54/74FCT16245T/AT/CT/ET

### FEATURES:

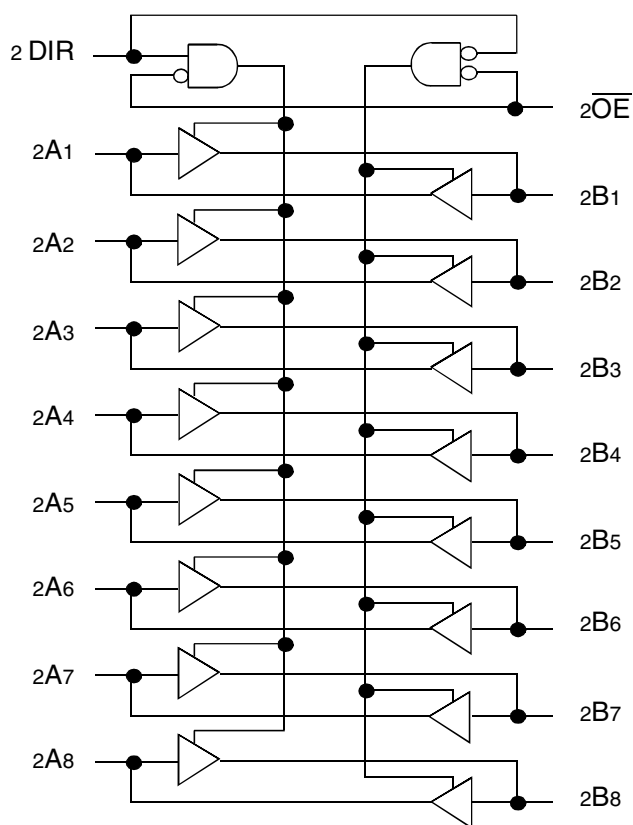
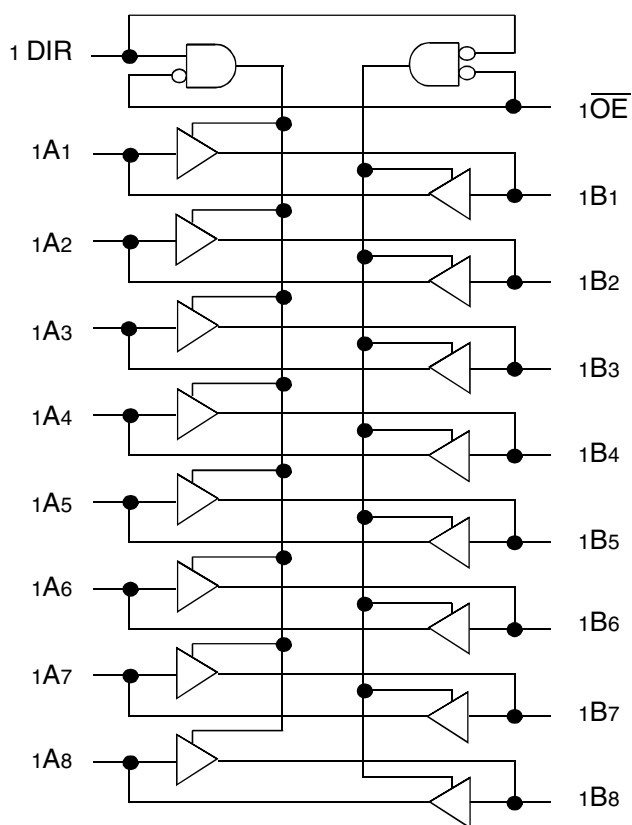
- 0.5 MICRON CMOS Technology
- High-speed, low-power CMOS replacement for ABT functions
- Typical  $t_{sk(o)}$  (Output Skew) < 250ps
- Low input and output leakage  $\leq 1\mu A$  (max.)
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- High drive outputs (-32mA IOH, 64mA IOL)
- Power off disable outputs permit "live insertion"
- Typical VOLP (Output Ground Bounce) < 1.0V at Vcc = 5V, TA = 25°C
- Available in the following packages:
  - Industrial: SSOP, TSSOP, TVSOP
  - Military: CERPACK

### DESCRIPTION:

The FCT16245T 16-bit transceiver is built using advanced dual metal CMOS technology. These high-speed, low-power transceivers are ideal for synchronous communication between two busses (A and B). The Direction and Output Enable controls operate these devices as either two independent 8-bit transceivers or one 16-bit transceiver. The direction control pin (xDIR) controls the direction of data flow. The output enable pin (xOE) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

The FCT16245T is ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability to allow "live insertion" of boards when used as backplane drivers.

### FUNCTIONAL BLOCK DIAGRAM

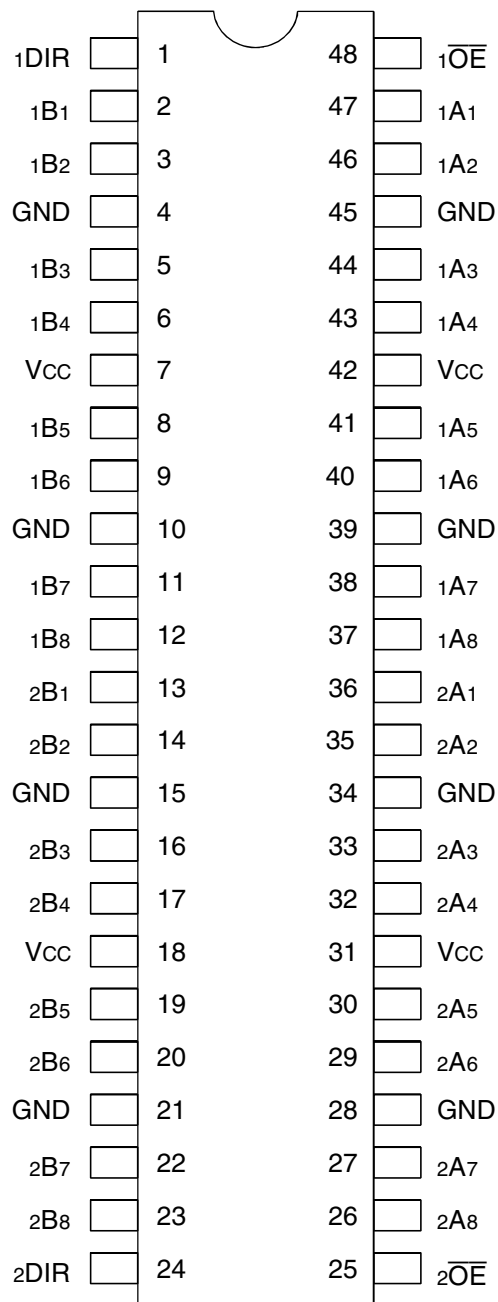


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MILITARY AND INDUSTRIAL TEMPERATURE RANGES

OCTOBER 2003

### PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP/ CERPACK  
TOP VIEW

### ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
VTERM <sup>(2)</sup>	Terminal Voltage with Respect to GND	-0.5 to +7	V
VTERM <sup>(3)</sup>	Terminal Voltage with Respect to GND	-0.5 to VCC+0.5	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-60 to +120	mA

**NOTES:**

1. 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.
2. All device terminals except FCT162XXX and FCT166XXX (A-Port) Output and I/O terminals.
3. Output and I/O terminals for FCT162XXX and FCT166XXX (A-Port).

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

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance	VIN = 0V	3.5	6	pF
COU	Output Capacitance	VOUT = 0V	3.5	8	pF

**NOTE:**

1. This parameter is measured at characterization but not tested.

### PIN DESCRIPTION

Pin Names	Description
xOE	Output Enable Inputs (Active LOW)
xDIR	Direction Control Inputs
xAx	Side A Inputs or 3-State Outputs
xBx	Side B Inputs or 3-State Outputs

### FUNCTION TABLE(1)

Inputs		Outputs
xOE	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

**NOTE:**

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$ ; 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 <sub>IH</sub>	Input HIGH Level	Guaranteed Logic HIGH Level		2	—	—	V
V <sub>IL</sub>	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I <sub>IH</sub>	Input HIGH Current (Input pins) <sup>(5)</sup>	V <sub>CC</sub> = Max.	V <sub>I</sub> = V <sub>CC</sub>	—	—	±1	μA
	Input HIGH Current (I/O pins) <sup>(5)</sup>			—	—	±1	
I <sub>IL</sub>	Input LOW Current (Input pins) <sup>(5)</sup>		V <sub>I</sub> = GND	—	—	±1	
	Input LOW Current (I/O pins) <sup>(5)</sup>			—	—	±1	
I <sub>OZH</sub>	High Impedance Output Current (3-State Output pins) <sup>(5)</sup>	V <sub>CC</sub> = Max.	V <sub>O</sub> = 2.7V	—	—	±1	μA
I <sub>OZL</sub>			V <sub>O</sub> = 0.5V	—	—	±1	
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>CC</sub> = Min., I <sub>IN</sub> = -18mA		—	-0.7	-1.2	V
I <sub>OS</sub>	Short Circuit Current	V <sub>CC</sub> = Max., V <sub>O</sub> = GND <sup>(3)</sup>		-80	-140	-250	mA
V <sub>H</sub>	Input Hysteresis	—		—	100	—	mV
I <sub>CCL</sub> I <sub>CCH</sub> I <sub>CCZ</sub>	Quiescent Power Supply Current	V <sub>CC</sub> = Max. V <sub>IN</sub> = GND or V <sub>CC</sub>		—	5	500	μA

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
I <sub>O</sub>	Output Drive Current	V <sub>CC</sub> = Max., V <sub>O</sub> = 2.5V <sup>(3)</sup>		-50	—	-180	mA
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min. V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -3mA,	-2.5	3.5	—	V
			I <sub>OH</sub> = -12mA MIL	2.4	3.5	—	V
			I <sub>OH</sub> = -15mA IND	—	—	—	—
			I <sub>OH</sub> = -24mA MIL I <sub>OH</sub> = -32mA IND <sup>(4)</sup>	2	3	—	V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min. V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 48mA MIL I <sub>OL</sub> = 64mA IND	—	0.2	0.55	V
I <sub>OFF</sub>	Input/Output Power Off Leakage <sup>(5)</sup>	V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 4.5V		—	—	±1	μA

### 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<sub>CC</sub> = 5.0V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. Duration of the condition can not exceed one second.
5. The test limit for this parameter is ±5μA at T<sub>A</sub> = -55°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 TTL Inputs HIGH	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4V^{(3)}$		—	0.5	1.5	mA
$I_{CCD}$	Dynamic Power Supply Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $\overline{xOE} = xDIR = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	60	100	$\mu\text{A}/\text{MHz}$
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{xOE} = xDIR = \text{GND}$ One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.6	1.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	0.9	2.3	
		$V_{CC} = \text{Max.}$ Outputs Open $f_i = 2.5\text{MHz}$ 50% Duty Cycle $\overline{xOE} = xDIR = \text{GND}$ Sixteen Bits Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	2.4	4.5 <sup>(5)</sup>	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	6.4	16.5 <sup>(5)</sup>	

### 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  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  ambient.

3. Per TTL driven input ( $V_{IN} = 3.4V$ ). All other inputs at  $V_{CC}$  or GND.

4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.

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

6.  $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

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

$I_{CC}$  = Quiescent Current ( $I_{CCL}$ ,  $I_{CCH}$  and  $I_{CCZ}$ )

$\Delta I_{CC}$  = 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)

$N_{CP}$  = Number of Clock Inputs at  $f_{CP}$

$f_i$  = Input Frequency

$N_i$  = Number of Inputs at  $f_i$

SWITCHING CHARACTERISTICS OVER OPERATING RANGE - INDUSTRIAL

Symbol	Parameter	Condition <sup>(1)</sup>	74FCT16245AT		74FCT16245CT		74FCT16245ET		Unit
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay A to B, B to A	C <sub>L</sub> = 50pF R <sub>L</sub> = 500Ω	1.5	4.6	1.5	4.1	1.5	3.2	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time x $\overline{OE}$ to A or B		1.5	6.2	1.5	5.8	1.5	4.4	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time x $\overline{OE}$ to A or B		1.5	5	1.5	4.8	1.5	4	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time xDIR to A or B <sup>(4)</sup>		1.5	6.2	1.5	5.8	1.5	4.8	ns
t <sub>PHZ</sub> t <sub>PZL</sub>	Output Disable Time xDIR to A or B <sup>(4)</sup>		1.5	5	1.5	4.8	1.5	4	ns
t <sub>SK(o)</sub>	Output Skew <sup>(3)</sup>		—	0.5	—	0.5	—	0.5	ns

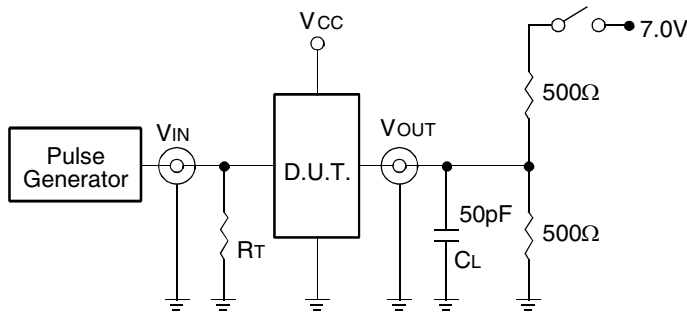
SWITCHING CHARACTERISTICS OVER OPERATING RANGE - MILITARY

Symbol	Parameter	Condition <sup>(1)</sup>	54FCT16245T		54FCT16245AT		54FCT16245CT		Unit
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay A to B, B to A	C <sub>L</sub> = 50pF R <sub>L</sub> = 500Ω	1.5	7.5	1.5	4.9	1.5	4.5	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time x $\overline{OE}$ to A or B		1.5	10	1.5	6.5	1.5	6.2	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time x $\overline{OE}$ to A or B		1.5	10	1.5	6	1.5	5.2	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time xDIR to A or B <sup>(4)</sup>		1.5	10	1.5	6.5	1.5	6.2	ns
t <sub>PHZ</sub> t <sub>PZL</sub>	Output Disable Time xDIR to A or B <sup>(4)</sup>		1.5	10	1.5	6	1.5	5.2	ns
t <sub>SK(o)</sub>	Output Skew <sup>(3)</sup>		—	0.5	—	0.5	—	0.5	ns

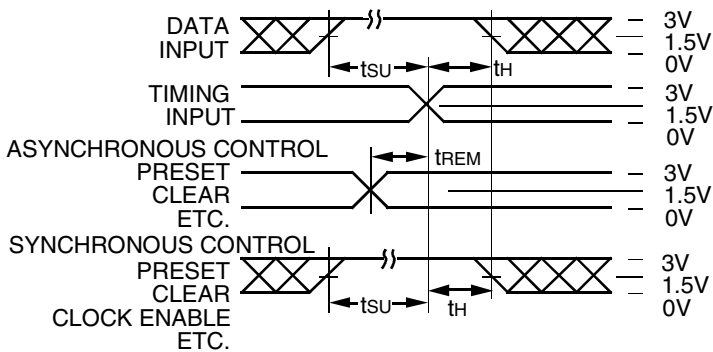
NOTES:

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
4. This limit is guaranteed but not tested.

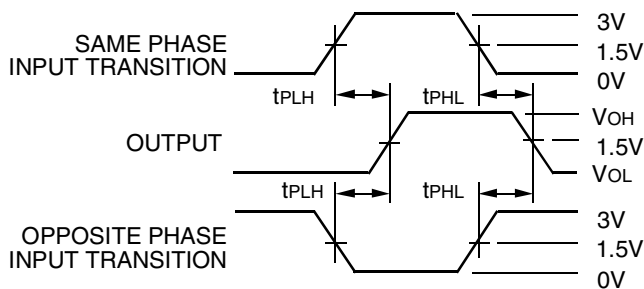
### TEST CIRCUITS AND WAVEFORMS



Test Circuits for All Outputs



Set-up, Hold, and Release Times



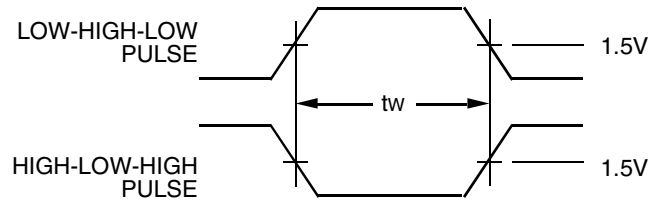
Propagation Delay

### SWITCH POSITION

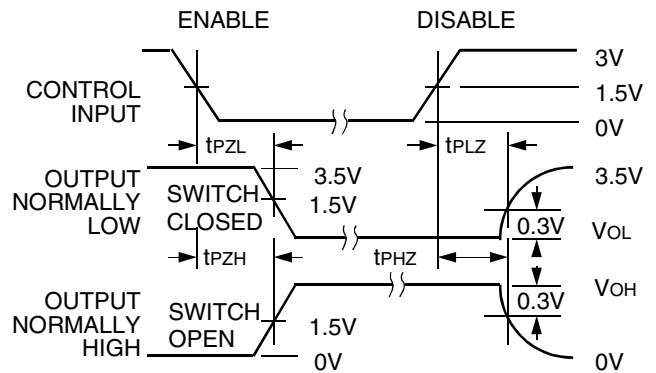
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

**DEFINITIONS:**

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



Pulse Width

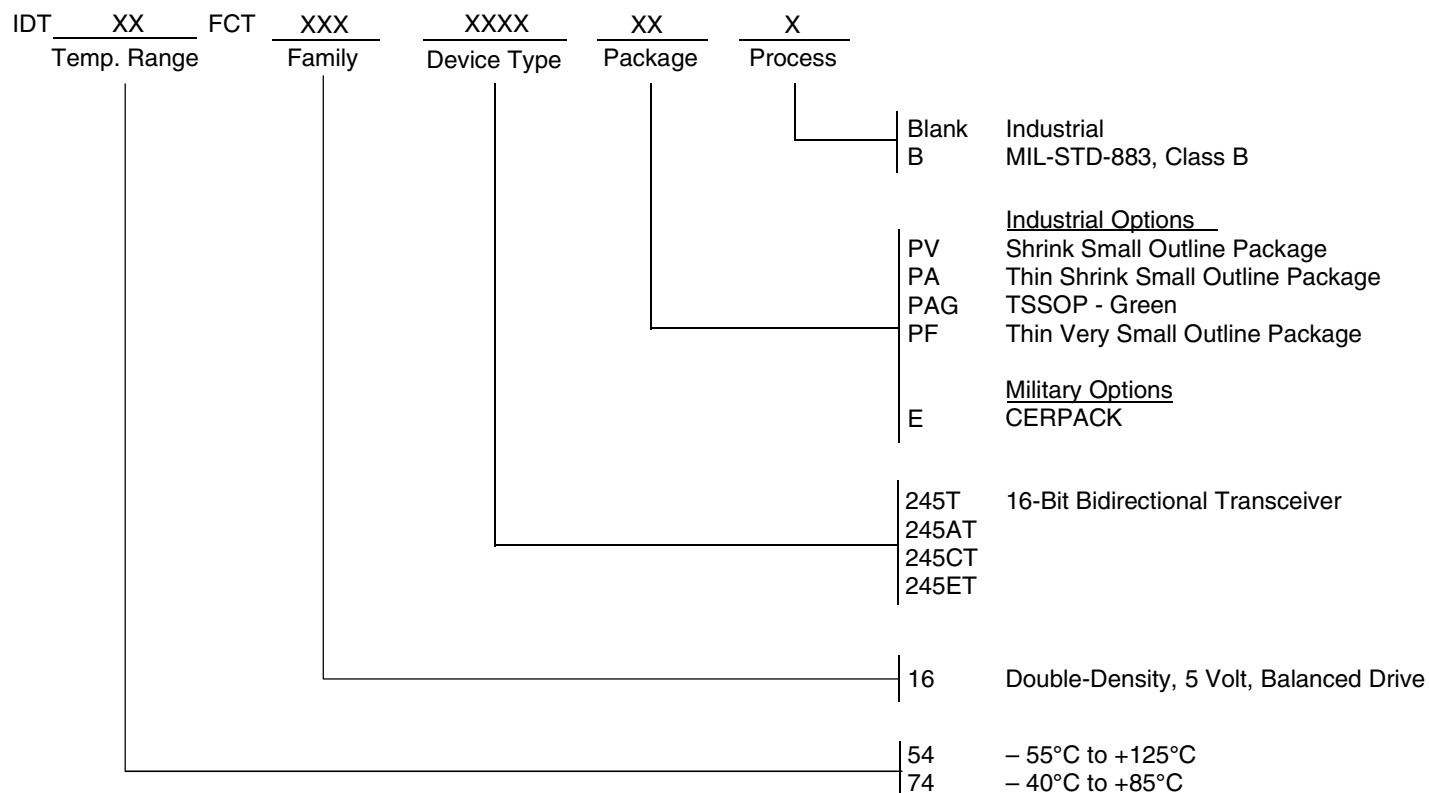


Enable and Disable Times

**NOTES:**

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; tr ≤ 2.5ns; tr ≤ 2.5ns.

## ORDERING INFORMATION



## DATA SHEET DOCUMENT HISTORY

3/26/2002 Removed standard speed grade

6/26/2002 Updated as per PDNs Logic-00-07 and Logic-01-04

6/5/2003 Removed blank Industrial speed grade as per PDNs Logic-00-07 and Logic-01-04



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