Integrated Device Technology, Inc.

FAST CMOS 16-BIT BUFFER/LINE DRIVER

IDT54/74FCT16244T/AT/CT/ET
IDT54/74FCT162244T/AT/CT/ET
IDT54/74FCT166244T/AT//CT
IDT54/74FCT16XH244T/AT/CT/ET
ADVANCE INFORMATION

FEATURES:

- **Common 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 ≤ 1μA (max.)**
  - ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
  - 25 mil pitch SSOP and Cerpack packages and 19.6 mil pitch TSSOP package
  - Extended commercial range of -40°C to +85°C
- **Features for FCT16244T/AT/CT/ET:**
  - High drive outputs (-32mA I_{OH}, 64mA I_{OL})
  - Power off disable outputs permit "live insertion"
  - Typical V_{OLP} (Output Ground Bounce) < 1.0V at V_{CC} = 5V, T_A = 25°C
- **Features for FCT162244T/AT/CT/ET:**
  - Balanced Output Drivers: ±24mA (commercial), ±16mA (military)
  - Reduced system switching noise
  - Typical V_{OLP} (Output Ground Bounce) < 0.6V at V_{CC} = 5V, T_A = 25°C
- **Features for FCT166244T/AT/CT:**
  - Light Drive Balanced Output: ±8mA (commercial), ±6mA (military)
  - Minimal system switching noise
  - Typical V_{OLP} (Output Ground Bounce) < 0.4V at V_{CC} = 5V, T_A = 25°C
- **Features for FCT16XH244AT/CT/ET:**
  - Bus Hold retains last active bus state during 3-state
  - Eliminates the need for external pull up resistors.

DESCRIPTION:

The 16-Bit Buffer/Line Driver is for bus interface or signal buffering applications requiring high speed and low power dissipation. These devices have a flow through pin organization, and shrink packaging to simplify board layout. All inputs are designed with hysteresis for improved noise margin. The three-state controls allow independent 4-bit, 8-bit or combined 16-bit operation. These parts are plug in replacements for 54/74ABT16244 where higher speed, lower noise or lower power dissipation levels are desired.

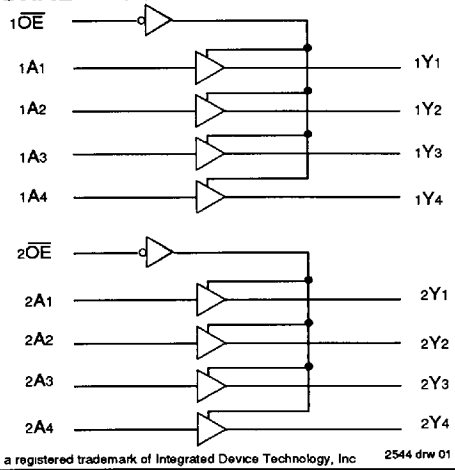
The IDT54/74FCT16244T/AT/CT/ET are ideally suited for driving high capacitance loads (>200pF) and low impedance backplanes. These "high drive" buffers are designed with power off disable capability to allow "live insertion" of boards when used in a backplane interface.

The IDT54/74FCT162244T/AT/CT/ET have balanced output current levels and current limiting resistors. These offer low ground bounce, minimal undershoot, and controlled output fall times, reducing the need for external series terminating resistors while still providing very high speed operation for loads of less than 200pF.

The IDT54/74FCT166244T/AT/CT are suited for very low noise, point-to-point driving where there is a single receiver, or a very light lumped load (<50pF). The buffers are designed to limit the output current to levels which will avoid noise and ringing on the signal lines without using external series terminating resistors.

The IDT54/74FCT16XH244T/AT/CT/ET have "Bus Hold" which retains the input's last state whenever the input goes to high impedance. This prevents "floating" inputs and eliminates the need for pull up resistors.

FUNCTIONAL BLOCK DIAGRAM



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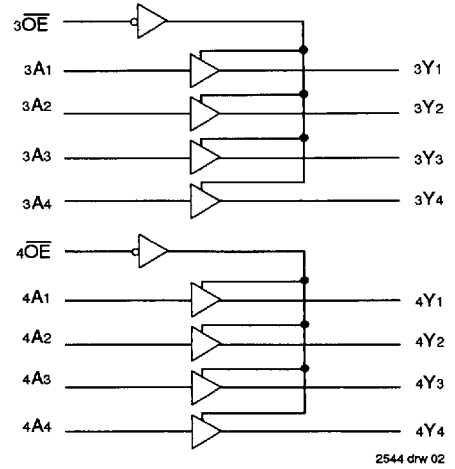

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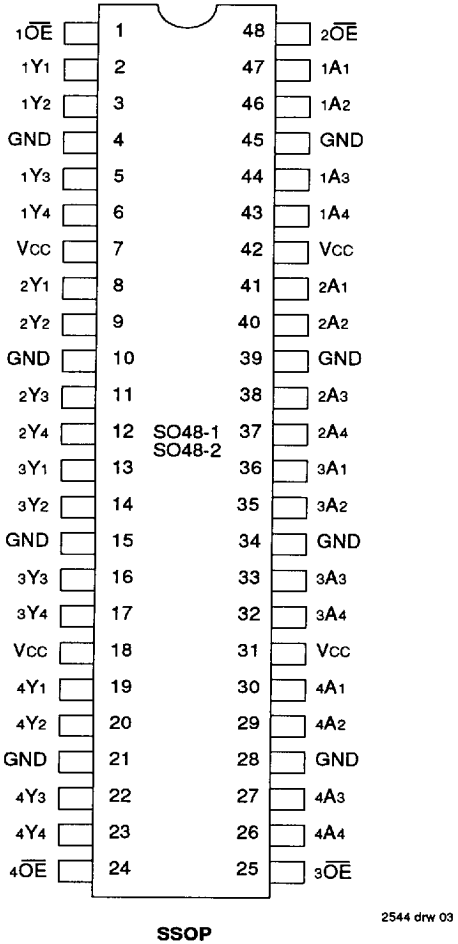
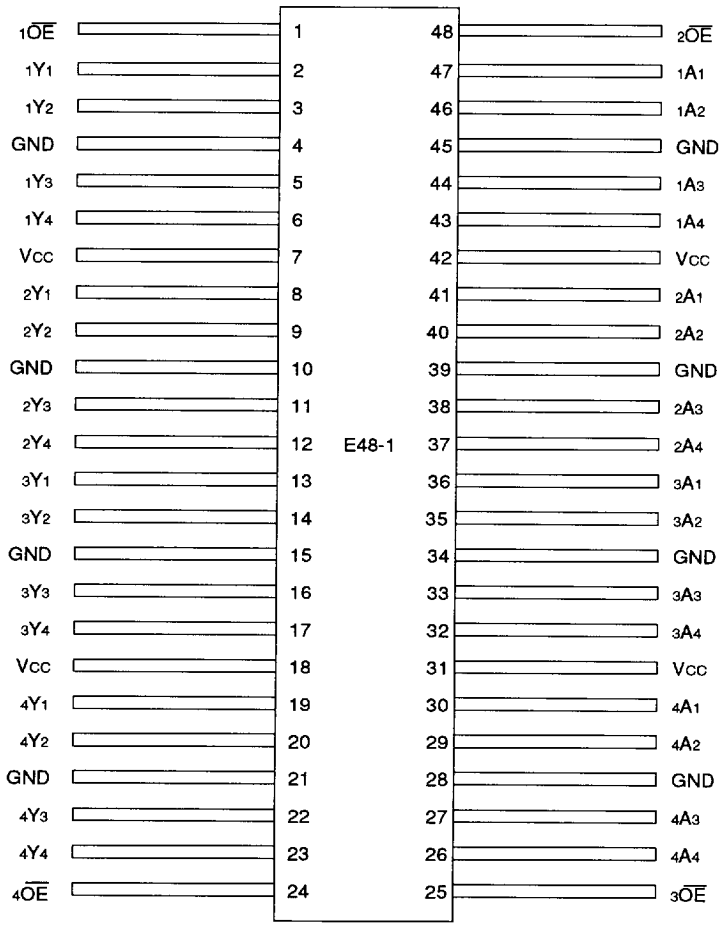
PIN CONFIGURATIONS



SSOP
TSSOP
TOP VIEW



CERPACK
TOP VIEW

PIN DESCRIPTION

Pin Names	Description
$x\overline{OE}$	3–State Output Enable Inputs (Active LOW)
xAx	Data Inputs(1)
xYx	3-State Outputs

NOTE: 2544 tbl 01

1. On FCT16XH244T these pins have "Bus Hold". All other pins are standard inputs, outputs or I/Os.

FUNCTION TABLE(1)

Inputs		Outputs
$x\overline{OE}$	xAx	xYx
L	L	L
L	H	H
H	X	Z

NOTE: 2544 tbl 02

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

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Rating	Commercial	Military	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0 5 to +7.0	–0.5 to +7.0	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to V_{CC}	–0.5 to V_{CC}	V
T_A	Operating Temperature	–40 to +85	–55 to +125	°C
T_{BIAS}	Temperature Under Bias	–55 to +125	–65 to +135	°C
T_{STG}	Storage Temperature	–55 to +125	–65 to +150	°C
P_T	Power Dissipation	1 0	1.0	W
I_{OUT}	DC Output Current	–60 to +120	–60 to +120	mA

NOTES: 2544 lnk 03

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 FCT162XXXT and FCT166XXXT output and I/O terminals.
3. Output and I/O terminals for FCT162XXXT and FCT166XXXT.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	4.5	6.0	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	5.5	8.0	pF

NOTE: 2544 lnk 04

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

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (STANDARD PARTS)

Following Conditions Apply Unless Otherwise Specified:
Commercial: $T_A = -40°C$ to $+85°C$, $V_{CC} = 5.0V \pm 10\%$; Military: $T_A = -55°C$ to $+125°C$, $V_{CC} = 5.0V \pm 10\%$

Symbol	Parameter	Test Conditions (1)		Min.	Typ.(2)	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 (Input pins)(5)	V_{CC} = Max.	$V_I = V_{CC}$	—	—	±1	µA
	Input HIGH Current (I/O pins)(5)			—	—	±1	
I_{IL}	Input LOW Current (Input pins)(5)		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)(5)			—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = 2.7V	—	—	±1	µA
I_{OZL}	(3-State Output pins)(5)		V_O = 0.5V	—	—	±1	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = −18mA		—	−0.7	−1.2	V
I_{OS}	Short Circuit Current	V_{CC} = Max., V_O = GND(3)		−80	−140	−200	mA
I_O	Output Drive Current	V_{CC} = Max., V_O = 2.5V(3)		−50	—	−180	mA
V_H	Input Hysteresis	—		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		—	5	500	µA

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DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (BUS HOLD)

Symbol	Parameter		Test Conditions(1)		Min.	Typ.(2)	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(6)	Standard Input(5)	V_{CC} = Max.	$V_I = V_{CC}$	—	—	±1	µA
		Standard I/O(5)			—	—	±1	
		Bus Hold Input			±100	—	—	
		Bus Hold I/O			±100	—	—	
I_{IL}	Input LOW Current(6)	Standard Input(5)		V_I = GND	—	—	±1	
		Standard I/O(5)			—	—	±1	
		Bus Hold Input			±100	—	—	
		Bus Hold I/O			±100	—	—	
$I_{I(HOLD)}$	Input Current(6)	Bus Hold Input	V_{CC} = Min.	V_I = 2.4V	−50	—	—	µA
				V_I = 0.4V	+50	—	—	
I_{OZH}	High Impedance Output Current		V_{CC} = Max.	V_O = 2.7V	—	—	±1	µA
I_{OZL}	(3-State Output pins)(5)			V_O = 0.5V	—	—	±1	
V_{IK}	Clamp Diode Voltage		V_{CC} = Min., I_{IN} = −18mA		—	−0.7	−1.2	V
I_{OS}	Short Circuit Current		V_{CC} = Max., V_O = GND(3)		−80	−140	−200	mA
I_O	Output Drive Current		V_{CC} = Max., V_O = 2.5V(3)		−50	—	−180	mA
V_H	Input Hysteresis		—		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current		V_{CC} = Max., V_{IN} = GND or V_{CC}		—	5	500	µA

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NOTES:

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°C ambient.
3. Not more than one output should be tested 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 $T_A = -55°C$.
6. Pins with Bus Hold are identified in the pin description.

OUTPUT DRIVE CHARACTERISTICS FOR FCT16244T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –3mA	2.5	3.5	—	V
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –12mA MIL. I_{OH} = –15mA COM'L.	2.4	3.5	—	V
			I_{OH} = –24mA MIL. I_{OH} = –32mA COM'L.[4]	2 0	3.0	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 48mA MIL. I_{OL} = 64mA COM'L.	—	0.2	0.55	V
I_{OFF}	Input/Output Power Off Leakage[5]	V_{CC} = 0V, V_{IN} or $V_O \leq$ 4.5V		—	—	±1	µA

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OUTPUT DRIVE CHARACTERISTICS FOR FCT162244T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
I_{ODL}	Output LOW Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1 5V[3]		60	115	150	mA
I_{ODH}	Output HIGH Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		–60	–115	–150	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –16mA MIL I_{OH} = –24mA COM'L.	2.4	3.3	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 16mA MIL. I_{OL} = 24mA COM'L.	—	0.3	0.55	V

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OUPUT DRIVE CHARACTERISTICS FOR FCT166244T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
I_{ODL}	Output LOW Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		24	48	72	mA
I_{ODH}	Output HIGH Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		–24	–48	–72	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –6mA MIL. I_{OH} = –8mA COM'L.	2 4	3.3	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 6mA MIL. I_{OL} = 8mA COM'L.	—	0.3	0.55	V

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NOTES:

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at Vcc = 5.0V, +25°C ambient.
3. Not more than one output should be tested 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_A = –55°C.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	V_{CC} = Max. V_{IN} = 3.4V[3]		—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open $x\overline{OE}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	60	100	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max. Outputs Open fi = 10MHz 50% Duty Cycle $x\overline{OE}$ = GND One Bit Toggling	V_{IN} = V_{CC} V_{IN} = GND	—	0.6	1.5	mA
			V_{IN} = 3.4V V_{IN} = GND	—	0.9	2.3	
		V_{CC} = Max. Outputs Open fi = 2.5MHz 50% Duty Cycle $x\overline{OE}$ = GND Sixteen Bits Toggling	V_{IN} = V_{CC} V_{IN} = GND	—	2.4	4.5[5]	
			V_{IN} = 3.4V V_{IN} = GND	—	6.4	16.5[5]	

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NOTES:

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°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})
   ΔI_{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 FOR FCT16244T/FCT162244T

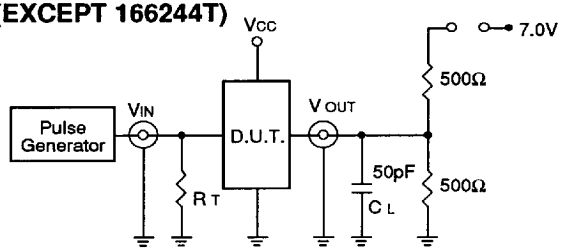
Symbol	Parameter	Condition[1]	FCT16244T/162244T/166244T[4] Com'l. Min.[2]	Com'l. Max.	Mil. Min.[2]	Mil. Max.	FCT16244AT/162244AT/166244AT[4] Com'l. Min.[2]	Com'l. Max.	Mil. Min.[2]	Mil. Max.	Unit
tPLH tPHL	Propagation Delay xAx to xYx	CL = 50pF RL = 500Ω	1.5	6.5	1.5	7.0	1.5	4.8	1.5	5.1	ns
tPZH tPZL	Output Enable Time		1.5	8.0	1.5	8.5	1 5	6.2	1.5	6.5	ns
tPHZ tPLZ	Output Disable Time		1.5	7.0	1.5	7.5	1.5	5.6	1.5	5 9	ns
tSK(o)	Output Skew[3]		—	0.5	—	0.5	—	0.5	—	0.5	ns

Symbol	Parameter	Condition[1]	FCT16244CT/162244CT/166244CT[4] Com'l. Min.[2]	Com'l. Max.	Mil. Min.[2]	Mil. Max.	FCT16244ET/162244ET Com'l. Min.[2]	Com'l. Max.	Mil. Min.[2]	Mil. Max.	Unit
tPLH tPHL	Propagation Delay xAx to xYx	CL = 50pF RL = 500Ω	1.5	4 1	1.5	4.6	1.5	3.2	—	—	ns
tPZH tPZL	Output Enable Time		1.5	5.8	1.5	6.5	1.5	4.4	—	—	ns
tPHZ tPLZ	Output Disable Time		1.5	5.2	1.5	5.7	1.5	3.6	—	—	ns
tSK(o)	Output Skew[3]		—	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. CL = 20pF for FCT166244T/AT/CT.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS (EXCEPT 166244T)



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SWITCH POSITION

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

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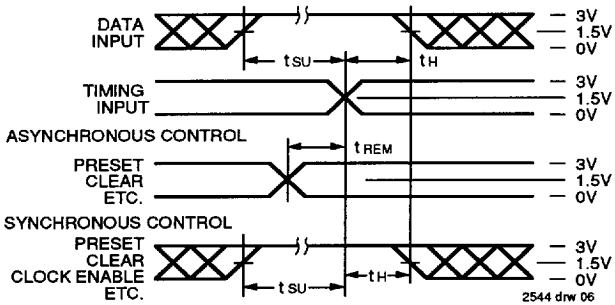
DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

SET-UP, HOLD AND RELEASE TIMES



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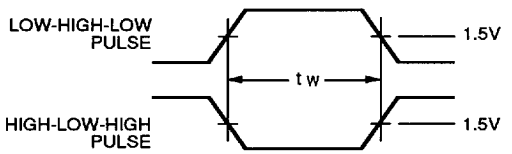
PULSE WIDTH



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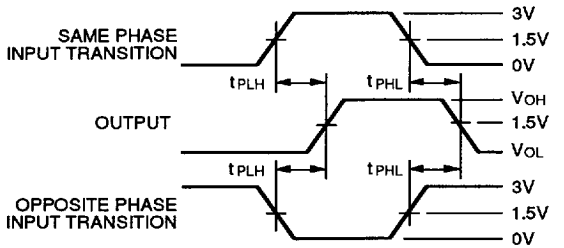
PROPAGATION DELAY



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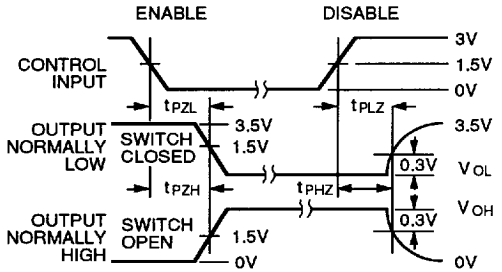
ENABLE AND DISABLE TIMES



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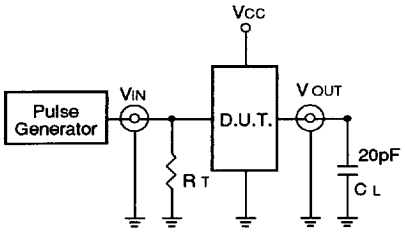
NOTES:

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

TEST CIRCUITS FOR 166244T OUTPUTS



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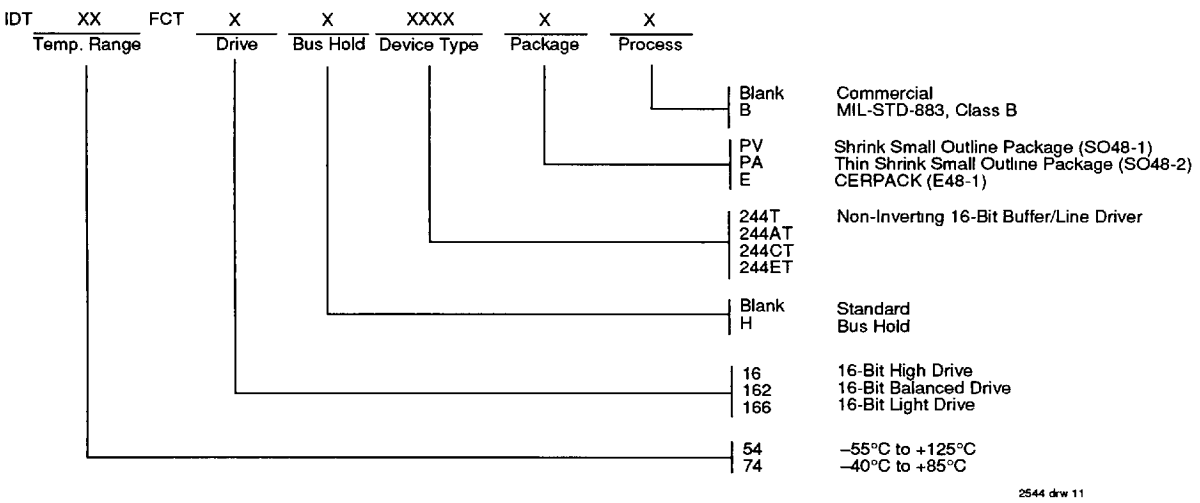
ORDERING INFORMATION



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