



Integrated Device Technology, Inc.

## FAST CMOS 16-BIT TRANSPARENT LATCHES

IDT54/74FCT16373T/AT/CT/ET  
IDT54/74FCT162373T/AT/CT/ET

### FEATURES:

- **Common features:**

- 0.5 MICRON CMOS Technology
- **High-speed, low-power CMOS replacement for ABT functions**
- **Typical tsk(o) (Output Skew) < 250ps**
- **Low input and output leakage  $\leq 1\mu\text{A}$  (max.)**
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- Packages include 25 mil pitch SSOP, 19.6 mil pitch TSSOP, 15.7 mil pitch TVSOP and 25 mil pitch Cerpack
- Extended commercial range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- $V_{CC} = 5\text{V} \pm 10\%$

- **Features for FCT16373T/AT/CT/ET:**

- High drive outputs ( $-32\text{mA}$  IOH,  $64\text{mA}$  IOL)
- Power off disable outputs permit "live insertion"
- Typical VOLP (Output Ground Bounce) < 1.0V at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^{\circ}\text{C}$

- **Features for FCT162373T/AT/CT/ET:**

- Balanced Output Drivers:  $\pm 24\text{mA}$  (commercial),  $\pm 16\text{mA}$  (military)
- Reduced system switching noise
- Typical VOLP (Output Ground Bounce) < 0.6V at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^{\circ}\text{C}$

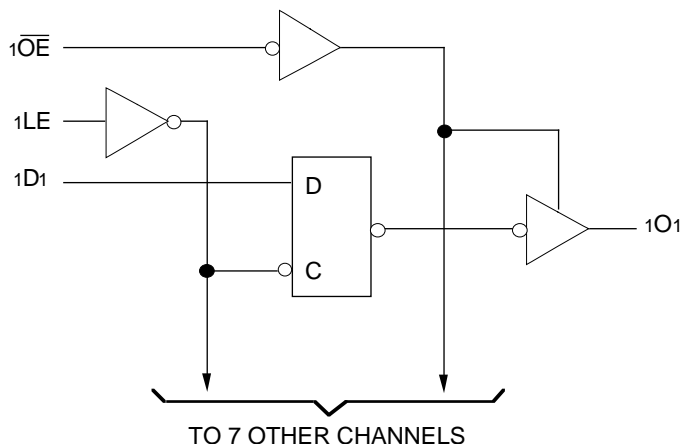
### DESCRIPTION:

The FCT16373T/AT/CT/ET and FCT162373T/AT/CT/ET 16-bit transparent D-type latches are built using advanced dual metal CMOS technology. These high-speed, low-power latches are ideal for temporary storage of data. They can be used for implementing memory address latches, I/O ports, and bus drivers. The Output Enable and Latch Enable controls are organized to operate each device as two 8-bit latches, or one 16-bit latch. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

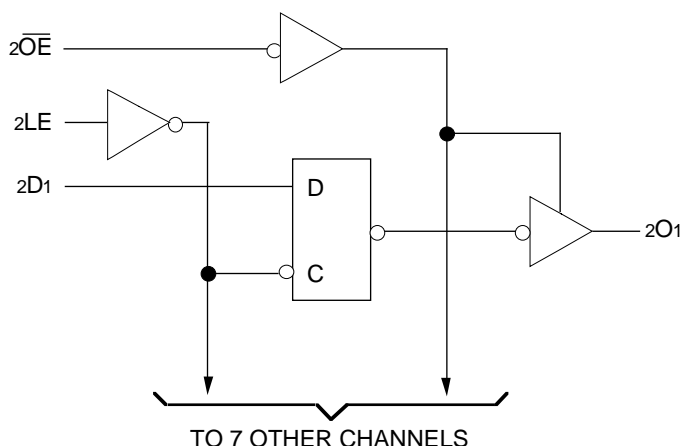
The FCT16373T/AT/CT/ET are ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability to allow "live insertion" of boards when used as backplane drivers.

The FCT162373T/AT/CT/ET have 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. The FCT162373T/AT/CT/ET are plug-in replacements for the FCT16373T/AT/CT/ET and ABT16373 for on-board interface applications.

### FUNCTIONAL BLOCK DIAGRAM



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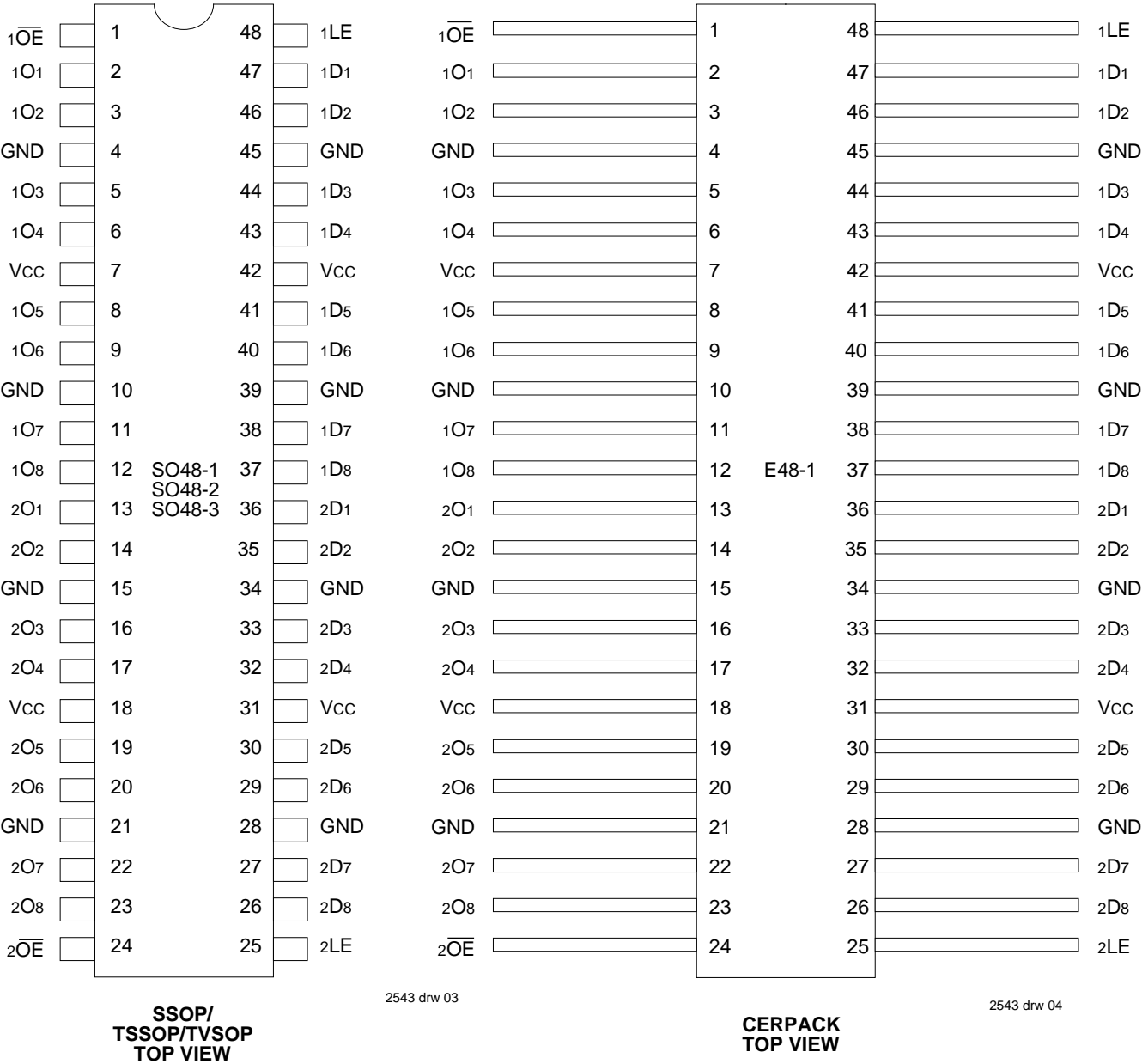
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**MILITARY AND COMMERCIAL TEMPERATURE RANGES**

**AUGUST 1996**

PIN CONFIGURATIONS



## PIN DESCRIPTION

Pin Names	Description
xDx	Data Inputs
xLE	Latch Enable Input (Active HIGH)
x $\overline{OE}$	Output Enable Input (Active LOW)
xOx	3-State Outputs

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

Inputs			Outputs
xDx	xLE	x $\overline{OE}$	xOx
H	H	L	H
L	H	L	L
X	X	H	Z

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### NOTE:

1. H = HIGH voltage level  
L = LOW voltage level  
X = Don't care  
Z = High-impedance

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

Symbol	Description	Max.	Unit
V <sub>TERM</sub> (2)	Terminal Voltage with Respect to GND	−0.5 to +7.0	V
V <sub>TERM</sub> (3)	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

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### 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 FCT162XXXT Output and I/O terminals.
3. Output and I/O terminals for FCT162XXXT.

## 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	3.5	6.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	3.5	8.0	pF

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### NOTE:

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial:  $T_A = -40^{\circ}\text{C}$  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
$V_{IH}$	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) <sup>(5)</sup>	$V_{CC} = \text{Max.}$	$V_I = V_{CC}$	—	—	$\pm 1$	$\mu\text{A}$
	Input HIGH Current (I/O pins) <sup>(5)</sup>			—	—	$\pm 1$	
$I_{IL}$	Input LOW Current (Input pins) <sup>(5)</sup>		$V_I = \text{GND}$	—	—	$\pm 1$	
	Input LOW Current (I/O pins) <sup>(5)</sup>			—	—	$\pm 1$	
$I_{OZH}$	High Impedance Output Current (3-State Output pins) <sup>(5)</sup>	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{OZL}$			$V_O = 0.5\text{V}$	—	—	$\pm 1$	
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = \text{Min.}$ , $I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
$I_{OS}$	Short Circuit Current	$V_{CC} = \text{Max.}$ , $V_O = \text{GND}$ <sup>(3)</sup>		-80	-140	-225	mA
$V_H$	Input Hysteresis	—		—	100	—	mV
$I_{CCL}$ $I_{CCH}$ $I_{CCZ}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$ , $V_{IN} = \text{GND}$ or $V_{CC}$		—	5	500	$\mu\text{A}$

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## OUTPUT DRIVE CHARACTERISTICS FOR FCT16373T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$I_O$	Output Drive Current	$V_{CC} = \text{Max.}$ , $V_O = 2.5\text{V}$ <sup>(3)</sup>		-50	—	-180	mA
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -3\text{mA}$	2.5	3.5	—	V
			$I_{OH} = -12\text{mA MIL.}$ $I_{OH} = -15\text{mA COM'L.}$	2.4	3.5	—	V
			$I_{OH} = -24\text{mA MIL.}$ $I_{OH} = -32\text{mA COM'L.}$ <sup>(4)</sup>	2.0	3.0	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 48\text{mA MIL.}$ $I_{OL} = 64\text{mA COM'L.}$	—	0.2	0.55	V
$I_{OFF}$	Input/Output Power Off Leakage <sup>(5)</sup>	$V_{CC} = 0\text{V}$ , $V_{IN}$ or $V_O \leq 4.5\text{V}$		—	—	$\pm 1$	$\mu\text{A}$

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## OUTPUT DRIVE CHARACTERISTICS FOR FCT162373T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$I_{ODL}$	Output LOW Current	$V_{CC} = 5\text{V}$ , $V_{IN} = V_{IH}$ or $V_{IL}$ , $V_{OUT} = 1.5\text{V}$ <sup>(3)</sup>		60	115	200	mA
$I_{ODH}$	Output HIGH Current	$V_{CC} = 5\text{V}$ , $V_{IN} = V_{IH}$ or $V_{IL}$ , $V_{OUT} = 1.5\text{V}$ <sup>(3)</sup>		-60	-115	-200	mA
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -16\text{mA MIL.}$ $I_{OH} = -24\text{mA COM'L.}$	2.4	3.3	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 16\text{mA MIL.}$ $I_{OL} = 24\text{mA COM'L.}$	—	0.3	0.55	V

### NOTES:

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- 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 tested at one time. Duration of the test should not exceed one second.
- Duration of the condition can not exceed one second.
- 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 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 $\overline{xOE} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	60	100	$\mu A/\text{MHz}$
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{xOE} = \text{GND}$ $xLE = V_{CC}$ 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 $\overline{xOE} = \text{GND}$ $xLE = V_{CC}$ 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:

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- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  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 the  $I_{CC}$  formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP} / 2 + f_i N_i)$   
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ} \text{)}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (} V_{IN} = 3.4V \text{)}$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$   
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$   
 $N_{CP} = \text{Number of Clock Inputs at } f_{CP}$   
 $f_i = \text{Input Frequency}$   
 $N_i = \text{Number of Inputs at } f_i$

# SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition <sup>(1)</sup>	FCT16373T/162373T				FCT16373AT/162373AT				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 tPHL	Propagation Delay xDx to xOx	CL = 50pF RL = 500Ω	1.5	8.0	1.5	8.5	1.5	5.2	1.5	5.6	ns
tPLH tPHL	Propagation Delay xLE to xOx		2.0	13.0	2.0	15.0	2.0	8.5	2.0	9.8	ns
tPZH tPZL	Output Enable Time		1.5	12.0	1.5	13.5	1.5	6.5	1.5	7.5	ns
tPHZ tPLZ	Output Disable Time		1.5	7.5	1.5	10.0	1.5	5.5	1.5	6.5	ns
tsu	Set-up Time HIGH or LOW, xDx to xLE		2.0	—	2.0	—	2.0	—	2.0	—	ns
th	Hold Time HIGH or LOW, xDx to xLE		1.5	—	1.5	—	1.5	—	1.5	—	ns
tw	xLE Pulse Width HIGH		6.0	—	6.0	—	5.0	—	6.0	—	ns
tsk(o)	Output Skew <sup>(3)</sup>		—	0.5	—	0.5	—	0.5	—	0.5	ns

Symbol	Parameter	Condition <sup>(1)</sup>	FCT16373CT/162373CT				FCT16373ET/162373ET				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 tPHL	Propagation Delay xDx to xOx	CL = 50pF RL = 500Ω	1.5	4.2	1.5	5.1	1.5	3.4	—	—	ns
tPLH tPHL	Propagation Delay xLE to xOx		2.0	5.5	2.0	8.0	1.5	3.7	—	—	ns
tPZH tPZL	Output Enable Time		1.5	5.5	1.5	6.3	1.5	4.4	—	—	ns
tPHZ tPLZ	Output Disable Time		1.5	5.0	1.5	5.9	1.5	3.6	—	—	ns
tsu	Set-up Time HIGH or LOW, xDx to xLE		2.0	—	2.0	—	1.0	—	—	—	ns
th	Hold Time HIGH or LOW, xDx to xLE		1.5	—	1.5	—	1.0	—	—	—	ns
tw	xLE Pulse Width HIGH		5.0	—	6.0	—	3.0 <sup>(4)</sup>	—	—	—	ns
tsk(o)	Output Skew <sup>(3)</sup>		—	0.5	—	0.5	—	0.5	—	—	ns

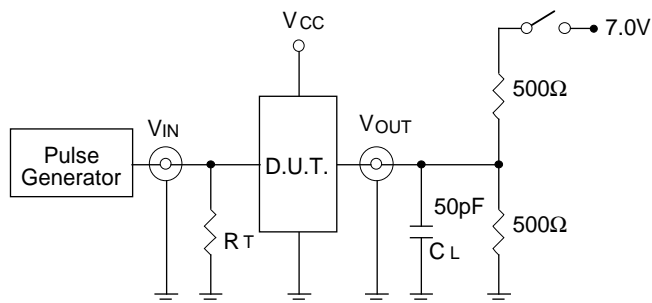
## NOTES:

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.

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## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



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### SWITCH POSITION

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

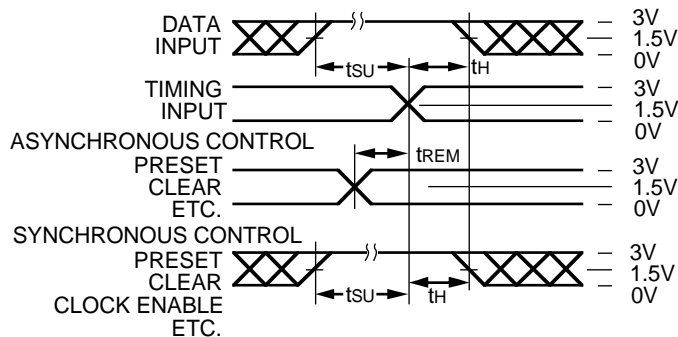
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#### DEFINITIONS:

$C_L$  = Load capacitance: includes jig and probe capacitance.

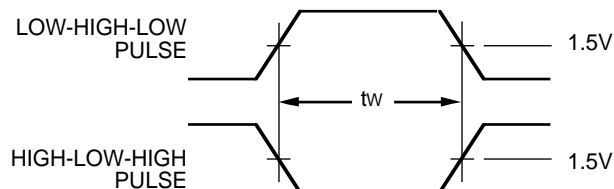
$R_T$  = Termination resistance: should be equal to  $Z_{OUT}$  of the Pulse Generator.

### SET-UP, HOLD AND RELEASE TIMES



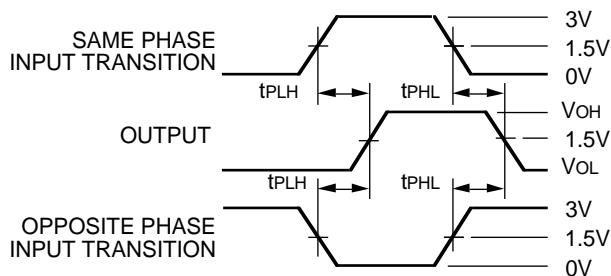
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### PULSE WIDTH



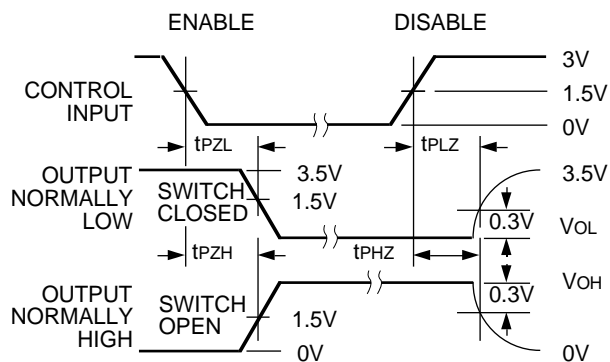
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### PROPAGATION DELAY



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### ENABLE AND DISABLE TIMES



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#### NOTES:

- 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

IDT	XX	FCT	XXXX	X	X	
Temp. Range		Device Type		Package	Process	
					Blank B	Commercial MIL-STD-883, Class B
					PV	Shrink Small Outline Package (SO48-1)
					PA	Thin Shrink Small Outline Package (SO48-2)
					PF	Thin Very Small Outline Package (SO48-3)
					E	CERPACK (E48-1)
				16373T 16373AT 16373CT 16373ET 162373T 162373AT 162373CT 162373ET		Non-Inverting 16-Bit Transparent Latch
				54		−55°C to +125°C
				74		−40°C to +85°C

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