



Integrated Device Technology, Inc.

FAST CMOS 20-BIT TRANSPARENT LATCHES

IDT54/74FCT16841AT/BT/CT/ET
IDT54/74FCT162841AT/BT/CT/ET

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 $\leq 1\mu A$ (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°C to +85°C
 - $V_{CC} = 5V \pm 10\%$
- **Features for FCT16841AT/BT/CT/ET:**
 - High drive outputs (-32mA I_{OH} , 64mA I_{OL})
 - Power off disable outputs permit "live insertion"
 - Typical VOLP (Output Ground Bounce) < 1.0V at $V_{CC} = 5V$, $T_A = 25^\circ C$
- **Features for FCT162841AT/BT/CT/ET:**
 - Balanced Output Drivers: $\pm 24mA$ (commercial), $\pm 16mA$ (military)
 - Reduced system switching noise
 - Typical VOLP (Output Ground Bounce) < 0.6V at $V_{CC} = 5V$, $T_A = 25^\circ C$

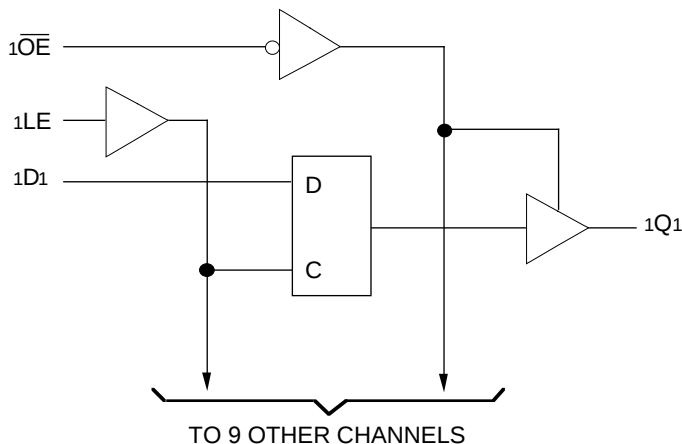
DESCRIPTION:

The FCT16841AT/BT/CT/ET and FCT162841AT/BT/CT/ET 20-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 10-bit latches or one 20-bit latch. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

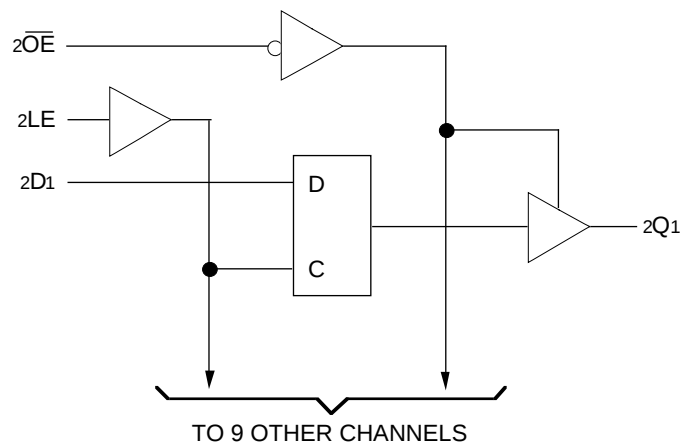
The FCT16841AT/BT/CT/ET are ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability to allow "live insertion" of boards when used as backplane drivers.

The FCT162841AT/BT/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 FCT162841AT/BT/CT/ET are plug-in replacements for the FCT16841AT/BT/CT/ET and ABT16841 for on-board interface applications.

FUNCTIONAL BLOCK DIAGRAM



2556 drw 01



2556 drw 02

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MILITARY AND COMMERCIAL TEMPERATURE RANGES

JULY 1996

1OE	1	56	1LE
1Q1	2	55	1D1
1Q2	3	54	1D2
GND	4	53	GND
1Q3	5	52	1D3
1Q4	6	51	1D4
VCC	7	50	VCC
1Q5	8	49	1D5
1Q6	9	48	1D6
1Q7	10	47	1D7
GND	11	46	GND
1Q8	12	45	1D8
1Q9	13	44	1D9
1Q10	14	43	1D10
2Q1	15	42	2D1
2Q2	16	41	2D2
2Q3	17	40	2D3
GND	18	39	GND
2Q4	19	38	2D4
2Q5	20	37	2D5
2Q6	21	36	2D6
VCC	22	35	VCC
2Q7	23	34	2D7
2Q8	24	33	2D8
GND	25	32	GND
2Q9	26	31	2D9
2Q10	27	30	2D10
2OE	28	29	2LE

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PIN DESCRIPTION

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

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FUNCTION TABLE⁽¹⁾

Inputs			Outputs
xDx	xLE	x $\overline{\text{OE}}$	xQx
H	H	L	H
L	H	L	L
X	L	L	Q ⁽²⁾
X	X	H	Z

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NOTES:

1. H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
Z = High Impedance
2. Output level before xLE HIGH-to-LOW Transition.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Description	Max.	Unit
V _{TERM} ⁽²⁾	Terminal Voltage with Respect to GND	−0.5 to +7.0	V
V _{TERM} ⁽³⁾	Terminal Voltage with Respect to GND	−0.5 to V _{CC} +0.5	V
T _{STG}	Storage Temperature	−65 to +150	°C
I _{OUT}	DC Output Current	−60 to +120	mA

2556 lmk 03

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_A = +25°C, f = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	3.5	6.0	pF
C _{OUT}	Output Capacitance	V _{OUT} = 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 ⁽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⁾	$V_{CC} = \text{Max.}$	$V_I = V_{CC}$	—	—	± 1	μA
	Input HIGH Current (I/O pins) ⁽⁵⁾			—	—	± 1	
I_{IL}	Input LOW Current (Input pins) ⁽⁵⁾		$V_I = \text{GND}$	—	—	± 1	
	Input LOW Current (I/O pins) ⁽⁵⁾			—	—	± 1	
I_{OZH}	High Impedance Output Current (3-State Output pins) ⁽⁵⁾	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	± 1	μA
I_{OZL}			$V_O = 0.5\text{V}$	—	—	± 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	$V_{CC} = \text{Max.}$, $V_O = \text{GND}$ ⁽³⁾		-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	μA

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OUTPUT DRIVE CHARACTERISTICS FOR FCT16841T

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
I_O	Output Drive Current	$V_{CC} = \text{Max.}$, $V_O = 2.5\text{V}$ ⁽³⁾		-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
			$I_{OH} = -24\text{mA MIL.}$ $I_{OH} = -32\text{mA COM'L.}$ ⁽⁴⁾	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 ⁽⁵⁾	$V_{CC} = 0\text{V}$, V_{IN} or $V_O \leq 4.5\text{V}$		—	—	± 1	μA

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OUTPUT DRIVE CHARACTERISTICS FOR FCT162841T

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
I_{ODL}	Output LOW Current	$V_{CC} = 5\text{V}$, $V_{IN} = V_{IH}$ or V_{IL} , $V_{OUT} = 1.5\text{V}$ ⁽³⁾		60	115	200	mA
I_{ODH}	Output HIGH Current	$V_{CC} = 5\text{V}$, $V_{IN} = V_{IH}$ or V_{IL} , $V_{OUT} = 1.5\text{V}$ ⁽³⁾		-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

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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 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 ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
ΔI_{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 ⁽⁴⁾	$V_{CC} = \text{Max.}$ Outputs Open $\overline{xOE} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	60	100	μA / MHz
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$ 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 $\overline{xOE} = \text{GND}$ $xLE = V_{CC}$ Twenty Bits Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.0	5.5 ⁽⁵⁾	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	8.0	20.5 ⁽⁵⁾	

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 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_C 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 ⁽¹⁾	FCT16841AT/162841AT				FCT16841BT/162841BT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay xDx to xQx (LE = HIGH)	CL = 50pF RL = 500Ω	1.5	9.0	1.5	10.0	1.5	6.5	1.5	7.5	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	13.0	1.5	15.0	1.5	13.0	1.5	15.0	
tPLH tPHL	Propagation Delay xLE to xQx	CL = 50pF RL = 500Ω	1.5	12.0	1.5	13.0	1.5	8.0	1.5	10.5	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	16.0	1.5	20.0	1.5	15.5	1.5	18.0	
tPZH tPZL	Output Enable Time xOE to xQx	CL = 50pF RL = 500Ω	1.5	11.5	1.5	13.0	1.5	8.0	1.5	8.5	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	23.0	1.5	25.0	1.5	14.0	1.5	15.0	
tPHZ tPLZ	Output Disable Time xOE to xQx	CL = 5pF ⁽⁵⁾ RL = 500Ω	1.5	7.0	1.5	9.0	1.5	6.0	1.5	6.5	ns
		CL = 50pF RL = 500Ω	1.5	8.0	1.5	10.0	1.5	7.0	1.5	7.5	
tsu	Set-Up Time HIGH or LOW, xDx to xLE	CL = 50pF RL = 500Ω	2.5	—	2.5	—	2.5	—	2.5	—	ns
th	Hold Time HIGH or LOW, xDx to xLE		2.5	—	3.0	—	2.5	—	2.5	—	ns
tw	xLE Pulse Width HIGH		4.0 ⁽⁴⁾	—	5.0	—	4.0 ⁽⁴⁾	—	4.0 ⁽⁴⁾	—	ns
tsk(0)	Output skew ⁽³⁾		—	0.5	—	0.5	—	0.5	—	0.5	ns

NOTES:

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

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SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition ⁽¹⁾	FCT16841CT/162841CT				FCT16841ET/162841ET				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay xDx to xQx (LE = HIGH)	CL = 50pF RL = 500Ω	1.5	5.5	1.5	6.3	1.5	3.4	—	—	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	13.0	1.5	15.0	1.5	7.5	—	—	
tPLH tPHL	Propagation Delay xLE to xQx	CL = 50pF RL = 500Ω	1.5	6.4	1.5	6.8	1.5	3.7	—	—	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	15.0	1.5	16.0	1.5	7.5	—	—	
tpZH tpZL	Output Enable Time xOE to xQx	CL = 50pF RL = 500Ω	1.5	6.5	1.5	7.3	1.5	4.4	—	—	ns
		CL = 300pF ⁽⁵⁾ RL = 500Ω	1.5	12.0	1.5	13.0	1.5	9.0	—	—	
tpHZ tPLZ	Output Disable Time xOE to xQx	CL = 5pF ⁽⁵⁾ RL = 500Ω	1.5	5.7	1.5	6.0	1.5	3.6	—	—	ns
		CL = 50pF RL = 500Ω	1.5	6.0	1.5	6.3	1.5	3.6	—	—	
tsu	Set-Up Time HIGH or LOW, xDx to xLE	CL = 50pF RL = 500Ω	2.5	—	2.5	—	1.0	—	—	—	ns
th	Hold Time HIGH or LOW, xDx to xLE		2.5	—	2.5	—	1.0	—	—	—	ns
tw	xLE Pulse Width HIGH		4.0 ⁽⁴⁾	—	4.0 ⁽⁴⁾	—	3.0 ⁽⁴⁾	—	—	—	ns
tsk(0)	Output skew ⁽³⁾		—	0.5	—	0.5	—	0.5	—	—	ns

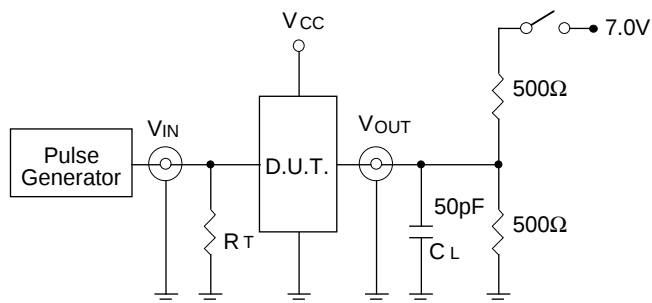
NOTES:

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

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TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



2556 drw 05

SWITCH POSITION

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

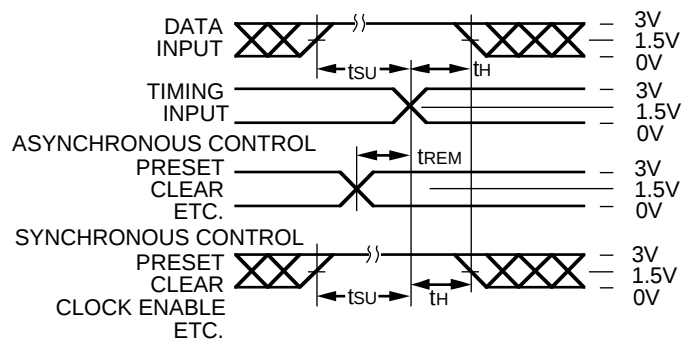
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DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

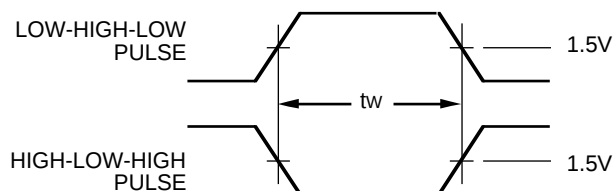
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

SET-UP, HOLD AND RELEASE TIMES



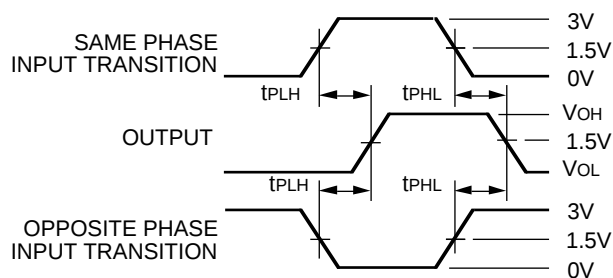
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PULSE WIDTH



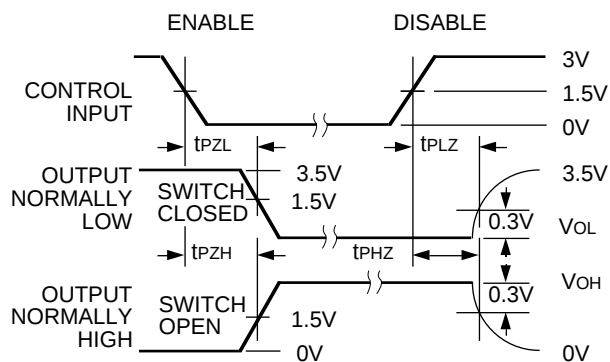
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PROPAGATION DELAY



2556 drw 08

ENABLE AND DISABLE TIMES



2556 drw 09

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 (SO56-1)	
					PA	Thin Shrink Small Outline Package (SO56-2)	
					PF	Thin Very Small Outline Package (SO56-3)	
					E	CERPACK (E56-1)	
					16841AT	Non-Inverting 20-Bit Transparent Latch	
					16841BT		
					16841CT		
					16841ET		
					162841AT		
					162841BT		
					162841CT		
					162841ET		
					54	-55°C to +125°C	
					74	-40°C to +85°C	

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