



Integrated Device Technology, Inc.

# FAST CMOS OCTAL BUFFER/LINE DRIVERS

IDT54/74FCT240T/AT/CT/DT - 2240T/AT/CT  
 IDT54/74FCT244T/AT/CT/DT - 2244T/AT/CT  
 IDT54/74FCT540T/AT/CT  
 IDT54/74FCT541/2541T/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 FCT240T/FCT244T/FCT540T/FCT541T:**
  - Std., A, C and D speed grades
  - High drive outputs (-15mA IOH, 64mA IOL)
- **Features for FCT2240T/FCT2244T/FCT2541T:**
  - Std., A and C speed grades
  - Resistor outputs (-15mA IOH, 12mA IOL Com.) (-12mA IOH, 12mA IOL Mil.)
  - Reduced system switching noise

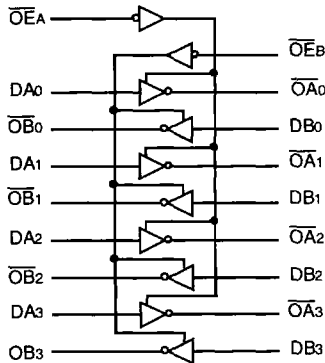
## DESCRIPTION:

The IDT octal buffer/line drivers are built using an advanced dual metal CMOS technology. The FCT240T/FCT2240T and FCT244T/FCT2244T are designed to be employed as memory and address drivers, clock drivers and bus-oriented transmitter/receivers which provide improved board density.

The FCT540T and FCT541T/FCT2541T are similar in function to the FCT240T/FCT2240T and FCT244T/FCT2244T, respectively, except that the inputs and outputs are on opposite sides of the package. This pinout arrangement makes these devices especially useful as output ports for microprocessors and as backplane drivers, allowing ease of layout and greater board density.

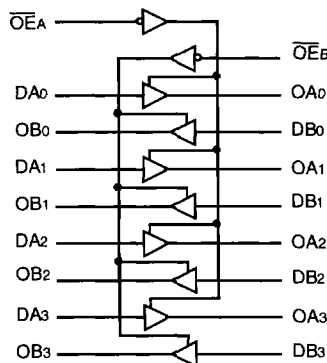
The FCT2240T, FCT2244T and FCT2541T have balanced output drive with current limiting resistors. This offers low ground bounce, minimal undershoot and controlled output fall times-reducing the need for external series terminating resistors. FCT2xxxT parts are plug-in replacements for FCTxxxT parts.

## FUNCTIONAL BLOCK DIAGRAMS



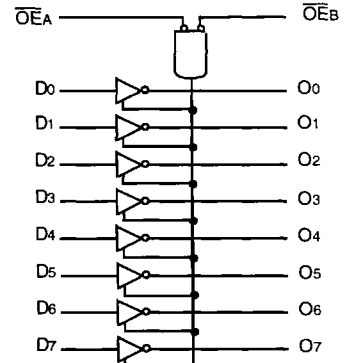
FCT240/2240T

2585 drw 01



FCT244/2244T

2565 drw 02



FCT540/541/2541T

2565 drw 03

\*Logic diagram shown for FCT540.  
 \*FCT541/2541T is the non-inverting option.

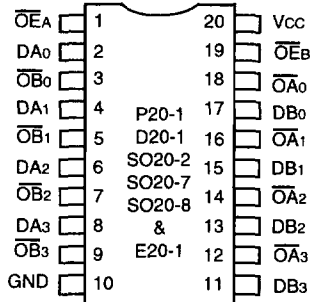
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MILITARY AND COMMERCIAL TEMPERATURE RANGES

JUNE 1996

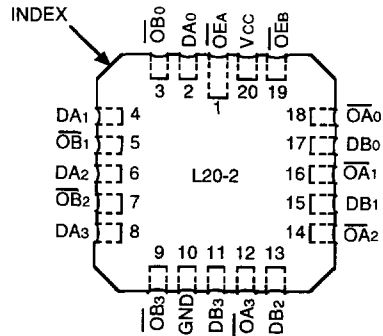
**PIN CONFIGURATIONS**

**FCT240/2240T**



**DIP/SOIC/SSOP/QSOP/CERPACK  
 TOP VIEW**

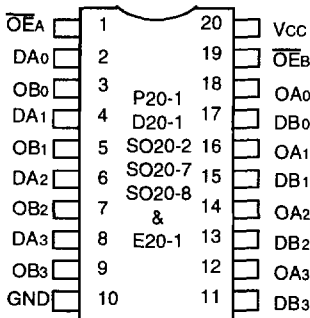
2565 drw 04



**LCC  
 TOP VIEW**

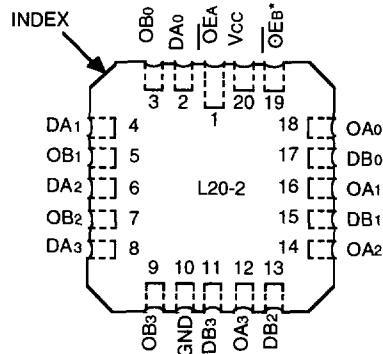
2565 drw 07

**FCT244/2244T**



**DIP/SOIC/SSOP/QSOP/CERPACK  
 TOP VIEW**

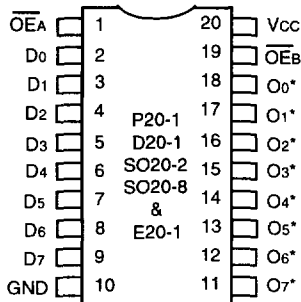
2565 drw 05



**LCC  
 TOP VIEW**

2565 drw 08

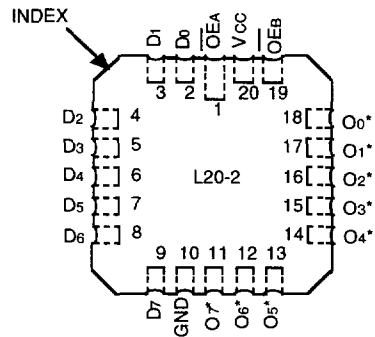
**FCT540/541/2541T**



**DIP/SOIC/QSOP/CERPACK  
 TOP VIEW**

\*O<sub>x</sub> for 540, O<sub>x</sub> for 541/2541T

2565 drw 06



**LCC  
 TOP VIEW**

2565 drw 09



**PIN DESCRIPTION**

Pin Names	Description
$\overline{OE}A$ , $\overline{OE}B$	3-State Output Enable Inputs (Active LOW)
Dxx	Inputs
Oxx	Outputs

2565 tbl 01

**FUNCTION TABLE**

Inputs <sup>(1)</sup>			Outputs <sup>(1)</sup>			
$\overline{OE}A$	$\overline{OE}B$	D	240	244	540	541
L	L	L	H	L	H	L
L	L	H	L	H	L	H
H	H	X	Z	Z	Z	Z

**NOTES:**

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

2565 tbl 02

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

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 $V_{CC} + 0.5$	-0.5 to $V_{CC} + 0.5$	V
$T_A$	Operating Temperature	0 to +70	-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	0.5	0.5	W
$I_{OUT}$	DC Output Current	-60 to +120	-60 to +120	mA

2565 Ink 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  $V_{CC}$  by +0.5V unless otherwise noted.
- Input and  $V_{CC}$  terminals only.
- Outputs and I/O terminals only.

**CAPACITANCE ( $T_A = +25^\circ\text{C}$ ,  $f = 1.0\text{MHz}$ )**

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
$C_{IN}$	Input Capacitance	$V_{IN} = 0V$	6	10	pF
$C_{OUT}$	Output Capacitance	$V_{OUT} = 0V$	8	12	pF

**NOTE:**

- This parameter is measured at characterization but not tested.

2565 Ink 04

### DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial: TA = 0°C to +70°C, VCC = 5.0V ± 5%; Military: TA = -55°C to +125°C, VCC = 5.0V ± 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		2.0	—	—	V
V <sub>IL</sub>	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I <sub>IH</sub>	Input HIGH Current <sup>(4)</sup>	VCC = Max.	V <sub>I</sub> = 2.7V	—	—	±1	μA
I <sub>IL</sub>	Input LOW Current <sup>(4)</sup>		V <sub>I</sub> = 0.5V	—	—	±1	
I <sub>OZH</sub>	High Impedance Output Current (3-State Output pins) <sup>(4)</sup>	VCC = Max.	V <sub>O</sub> = 2.7V	—	—	±1	μA
I <sub>OZL</sub>			V <sub>O</sub> = 0.5V	—	—	±1	
I <sub>I</sub>	Input HIGH Current <sup>(4)</sup>	VCC = Max., V <sub>I</sub> = VCC (Max.)		—	—	±1	μA
V <sub>IK</sub>	Clamp Diode Voltage	VCC = Min., I <sub>IN</sub> = -18mA		—	-0.7	-1.2	V
V <sub>H</sub>	Input Hysteresis	—		—	200	—	mV
I <sub>CC</sub>	Quiescent Power Supply Current	VCC = Max., V <sub>IN</sub> = GND or VCC		—	0.01	1	mA

2565 Ink 05

### OUTPUT DRIVE CHARACTERISTICS FOR FCT240/244/540/541T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	VCC = Min. V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -6mA MIL. I <sub>OH</sub> = -8mA COM'L.	2.4	3.3	—	V
			I <sub>OH</sub> = -12mA MIL. I <sub>OH</sub> = -15mA COM'L.	2.0	3.0	—	V
V <sub>OL</sub>	Output LOW Voltage	VCC = 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 COM'L.	—	0.3	0.55	V
I <sub>OS</sub>	Short Circuit Current	VCC = Max., V <sub>O</sub> = GND <sup>(3)</sup>		-60	-120	-225	mA

2565 Ink 06

### OUTPUT DRIVE CHARACTERISTICS FOR FCT2240/2244/2541T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
I <sub>ODL</sub>	Output LOW Current	VCC = 5V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> = 1.5V <sup>(3)</sup>		16	48	—	mA
I <sub>ODH</sub>	Output HIGH Current	VCC = 5V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> = 1.5V <sup>(3)</sup>		-16	-48	—	mA
V <sub>OH</sub>	Output HIGH Voltage	VCC = Min. V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -12mA MIL. I <sub>OH</sub> = -15mA COM'L.	2.4	3.3	—	V
			I <sub>OL</sub> = 12mA	—	0.3	0.50	V

2565 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 VCC = 5.0V, +25°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 ±5μA at TA = -55°C.

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### 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 <sub>CC</sub> = Max. V <sub>IN</sub> = 3.4V <sup>(3)</sup>		—	0.5	2.0	mA	
I <sub>CCD</sub>	Dynamic Power Supply Current <sup>(4)</sup>	V <sub>CC</sub> = Max. Outputs Open $\overline{OE}_A = \overline{OE}_B = GND$ One Input Toggling 50% Duty Cycle	V <sub>IN</sub> = V <sub>CC</sub> V <sub>IN</sub> = GND	FCTxxxT	—	0.15	0.25	mA/ MHz
				FCT2xxxT	—	0.06	0.12	
I <sub>C</sub>	Total Power Supply Current <sup>(6)</sup>	V <sub>CC</sub> = Max. Outputs Open f <sub>i</sub> = 10MHz 50% Duty Cycle $\overline{OE}_A = \overline{OE}_B = GND$ One Bit Toggling	V <sub>IN</sub> = V <sub>CC</sub> V <sub>IN</sub> = GND	FCTxxxT	—	1.5	3.5	mA
			V <sub>IN</sub> = GND	FCT2xxxT	—	0.6	2.2	
			V <sub>IN</sub> = 3.4	FCTxxxT	—	1.8	4.5	
			V <sub>IN</sub> = GND	FCT2xxxT	—	0.9	3.2	
	V <sub>CC</sub> = Max. Outputs Open f <sub>i</sub> = 2.5MHz 50% Duty Cycle $\overline{OE}_A = \overline{OE}_B = GND$	V <sub>IN</sub> = V <sub>CC</sub>	V <sub>IN</sub> = GND	FCTxxxT	—	3.0	6.0 <sup>(5)</sup>	
		V <sub>IN</sub> = 3.4	V <sub>IN</sub> = GND	FCT2xxxT	—	1.2	3.4 <sup>(5)</sup>	
	Eight Bits Toggling	V <sub>IN</sub> = 3.4	V <sub>IN</sub> = GND	FCTxxxT	—	5.0	14.0 <sup>(5)</sup>	
			V <sub>IN</sub> = GND	FCT2xxxT	—	3.2	11.4 <sup>(5)</sup>	

**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<sub>CC</sub> = 5.0V, +25°C ambient.
- Per TTL driven input (V<sub>IN</sub> = 3.4V). All other inputs at V<sub>CC</sub> 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<sub>CC</sub> formula. These limits are guaranteed but not tested.
- I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 I<sub>CC</sub> = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input (V<sub>IN</sub> = 3.4V)  
 D<sub>H</sub> = Duty Cycle for TTL Inputs High  
 N<sub>T</sub> = Number of TTL Inputs at D<sub>H</sub>  
 I<sub>CCD</sub> = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 f<sub>CP</sub> = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 f<sub>i</sub> = Input Frequency  
 N<sub>i</sub> = Number of Inputs at f<sub>i</sub>  
 All currents are in milliamps and all frequencies are in megahertz.

2565 tbl 08

**SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT240/2240T**

Symbol	Parameter	Condition <sup>(1)</sup>	FCT240T FCT2240T				FCT240AT FCT2240AT				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 DN to $\bar{O}N$	CL = 50pF RL = 500Ω	1.5	8.0	1.5	9.0	1.5	4.8	1.5	5.1	ns
tPZH tPZL	Output Enable Time		1.5	10.0	1.5	10.5	1.5	6.2	1.5	6.5	ns
tPHZ tPLZ	Output Disable Time		1.5	9.5	1.5	10.0	1.5	5.6	1.5	5.9	ns

2565 tbl 09

Symbol	Parameter	Condition <sup>(1)</sup>	FCT240CT FCT2240CT				FCT240DT				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 DN to $\bar{O}N$	CL = 50pF RL = 500Ω	1.5	4.3	1.5	4.7	1.5	3.6	—	—	ns
tPZH tPZL	Output Enable Time		1.5	5.8	1.5	6.5	1.5	4.8	—	—	ns
tPHZ tPLZ	Output Disable Time		1.5	5.2	1.5	5.7	1.5	4.0	—	—	ns

2565 tbl 10

**SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT244/2244T**

Symbol	Parameter	Condition <sup>(1)</sup>	FCT244T FCT2244T				FCT244AT FCT2244AT				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 DN to ON	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

2565 tbl 11

Symbol	Parameter	Condition <sup>(1)</sup>	FCT244CT FCT2244CT				FCT244DT				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 DN to ON	CL = 50pF RL = 500Ω	1.5	4.1	1.5	4.6	1.5	3.6	—	—	ns
tPZH tPZL	Output Enable Time		1.5	5.8	1.5	6.5	1.5	4.8	—	—	ns
tPHZ tPLZ	Output Disable Time		1.5	5.2	1.5	5.7	1.5	4.0	—	—	ns

2565 tbl 12

**NOTES:**

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



**SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT540/541/2541T**

Symbol	Parameter	Condition <sup>(1)</sup>	FCT540T/541T FCT2541T				FCT540AT/541AT FCT2541AT				FCT540CT/541CT FCT2541CT				Unit
			Com'l.		Mil.		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.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
tPLH tPHL	Propagation Delay DN to ON FCT540	CL = 50pF RL = 500Ω	1.5	8.5	1.5	9.5	1.5	4.8	1.5	5.1	1.5	4.3	1.5	4.7	ns
tPLH tPHL	Propagation Delay DN to ON FCT541/2541T		1.5	8.0	1.5	9.0	1.5	4.8	1.5	5.1	1.5	4.1	1.5	4.6	ns
tPZH tPZL	Output Enable Time		1.5	10.0	1.5	10.5	1.5	6.2	1.5	6.5	1.5	5.8	1.5	6.5	ns
tPHZ tPLZ	Output Disable Time		1.5	9.5	1.5	10.0	1.5	5.6	1.5	5.9	1.5	5.2	1.5	5.7	ns

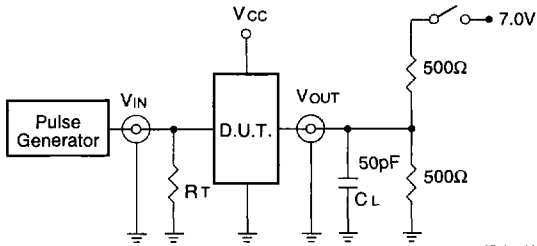
2565 tbl 13

**NOTES:**

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

## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



2565 drw 10

### SWITCH POSITION

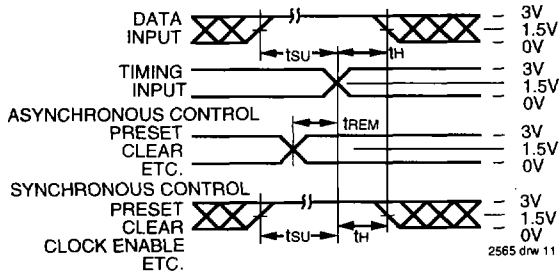
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

#### DEFINITIONS:

CL = Load capacitance; includes jig and probe capacitance.  
 RT = Termination resistance; should be equal to Z<sub>out</sub> of the Pulse Generator.

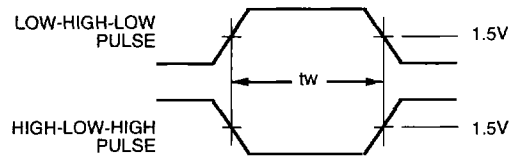
2565 drw 14

### SET-UP, HOLD AND RELEASE TIMES



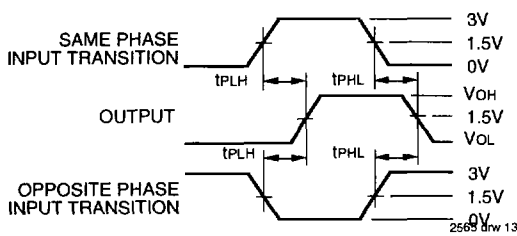
2565 drw 11

### PULSE WIDTH



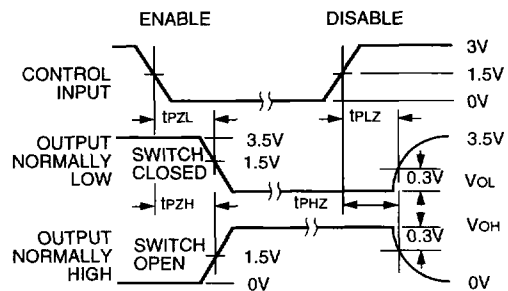
2565 drw 12

### PROPAGATION DELAY



2565 drw 13

### ENABLE AND DISABLE TIMES



2565 drw 14

#### NOTES:

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

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**ORDERING INFORMATION**

IDT	XX	FCT	X	XXXX	X	X		
Temp. Range	Family	Device Type	Package	Process				
						Blank	Commercial	
						B	MIL-STD-883, Class B	
						P	Plastic DIP	
						D	CERDIP	
						SO	Small Outline IC	
						L	Leadless Chip Carrier	
						E	CERPACK	
						PY	Shrink Small Outline Package	
						Q	Quarter-size Small Outline Package	
						240T	Inverting Octal Buffer/Line Driver	
						244T	Non-Inverting Octal Buffer/Line Driver	
						540T	Non-Inverting Octal Buffer/Line Driver	
						541T	Inverting Octal Buffer/Line Driver	
						240AT	Non-Inverting Octal Buffer/Line Driver	
						244AT		
						540AT		
						541AT		
						240CT		
						244CT		
						540CT		
						541CT		
						240DT		
						244DT		
						Blank	High Drive	
						2	Balanced Drive	
						54	-55°C to +125°C	
						74	0°C to +70°C	

2565 drw 15

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[NLU3G16AMX1TCG](#) [NLV27WZ125USG](#) [MC74HCT365ADTR2G](#) [BCM6306KMLG](#) [54FCT240CTDB](#) [Le87401NQC](#) [Le87402MQC](#)  
[028192B](#) [042140C](#) [051117G](#) [070519XB](#) [065312DB](#) [091056E](#) [098456D](#) [NL17SG07DFT2G](#) [NL17SG17DFT2G](#) [NL17SG34DFT2G](#)  
[NL17SZ07P5T5G](#) [NL17SZ125P5T5G](#) [NLU1GT126AMUTCG](#) [NLV27WZ16DFT2G](#) [5962-8982101PA](#) [5962-9052201PA](#) [74LVC07ADR2G](#)  
[MC74VHC1G125DFT1G](#) [NL17SH17P5T5G](#) [NL17SZ125CMUTCG](#) [NLV17SZ07DFT2G](#) [NLV37WZ17USG](#) [NLVHCT244ADTR2G](#)  
[NC7WZ17FHX](#) [74HCT126T14-13](#) [NL17SH125P5T5G](#) [NLV14049UBDTR2G](#) [NLV37WZ07USG](#) [74VHC541FT\(BE\)](#) [RHFAC244K1](#)  
[74LVC1G17FW4-7](#) [74LVC1G126FZ4-7](#) [BCM6302KMLG](#) [74LVC1G07FZ4-7](#) [74LVC1G125FW4-7](#)