



Integrated Device Technology, Inc.

FAST CMOS OCTAL BUFFER/LINE DRIVERS

IDT54/74FCT240/2240T/AT/CT/DT
IDT54/74FCT241/2241T/AT/CT/DT
IDT54/74FCT244/2244T/AT/CT/DT
IDT54/74FCT540T/AT/CT
IDT54/74FCT541/2541T/AT/CT

FEATURES:

- **Common features:**
 - Std., A, C and D speed grades
 - 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 FCT240/241/244/540/541T:**
 - High drive outputs (-15mA IOH, 64mA IOL)
- **Features for FCT2240/2241/2244/2541T:**
 - Balanced Output Drivers: $\pm 24\text{mA}$ (commercial), $\pm 16\text{mA}$ (military)
 - Reduced system switching noise

DESCRIPTION:

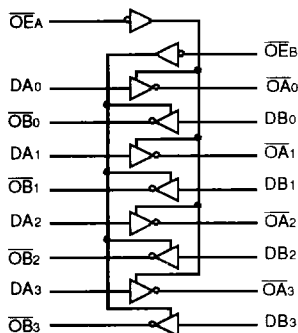
The IDT octal buffer/line drivers are built using an advanced dual metal CMOS technology. The IDT54/74FCT240/2240T/AT/CT/DT, IDT54/74FCT241/2241T/AT/CT/DT and IDT54/74FCT244/2244T/AT/CT/DT are designed to be employed as memory and address drivers, clock drivers and bus-oriented transmitter/receivers which provide improved board density.

The IDT54/74FCT540T/AT/CT and IDT54/74FCT541/2541T/AT/CT are similar in function to the IDT54/74FCT240/2240T/AT/CT/DT and IDT54/74FCT244/2244T/AT/CT/DT, 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 IDT54/74FCT2240T/AT/CT/DT, IDT54/74FCT2241T/AT/CT/DT, IDT54/74FCT2244T/AT/CT/DT and IDT54/74FCT2541T/AT/CT 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. IDT54/74FCTxxxT parts are plug-in replacements for IDT54/74FCTxxxT parts.

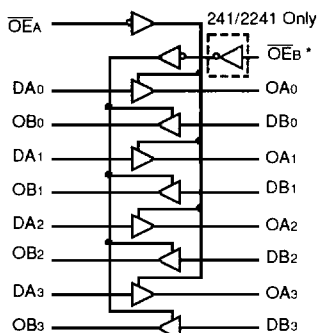
FUNCTIONAL BLOCK DIAGRAMS

6



FCT240/2240T

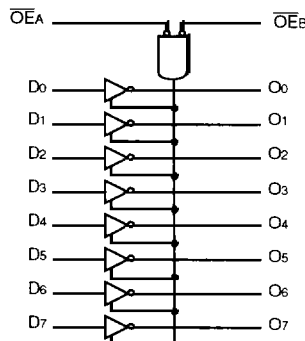
2565 drw 01



FCT241/2241T/244/2244T

2565 drw 02

*OEB for 241/2241T, OEB for 244/2244T



FCT540/541/2541T

2565 drw 03

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

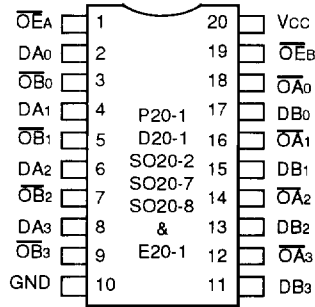
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MILITARY AND COMMERCIAL TEMPERATURE RANGES

APRIL 1994

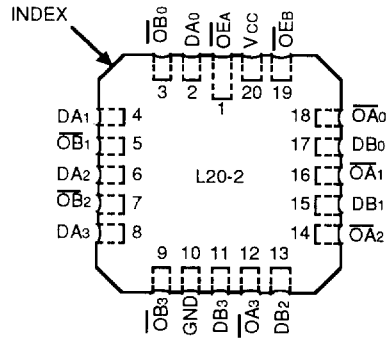
PIN CONFIGURATIONS

FCT240/2240T



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

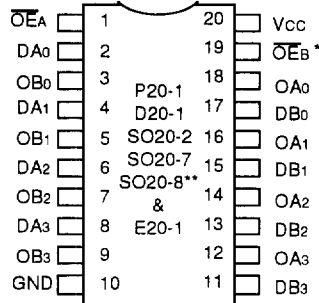
2565 drw 04



**LCC
TOP VIEW**

2565 drw 07

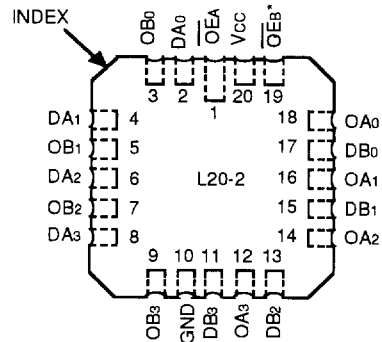
FCT241/2241T/244/2244T



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

*OE_A for FCT241/2241T, OE_B for FCT244/2244T
 **FCT244/2244T/AT/CT/DT only

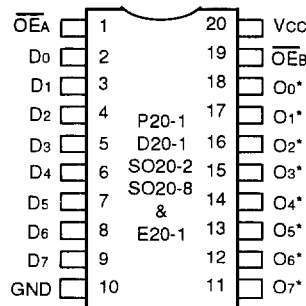
2565 drw 05



**LCC
TOP VIEW**

2565 drw 08

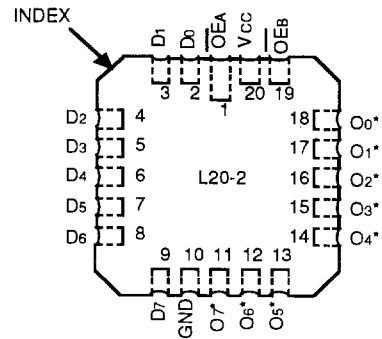
FCT540//541/2541T



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

*O_x for 540, O_x 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)
$OE_B^{(1)}$	3-State Output Enable Input (Active HIGH)
Dxx	Inputs
Oxx	Outputs

NOTE:

1. OE_B for FCT241/2241 only.

2565 tbl 01

FUNCTION TABLE

Inputs ⁽¹⁾				Outputs ⁽¹⁾				
$\overline{OE}A$	$\overline{OE}B$	$OE_B^{(2)}$	D	240	241	244	540	541
L	L	H	L	H	L	L	H	L
L	L	H	H	L	H	H	L	H
H	H	L	X	Z	Z	Z	Z	Z

NOTES:

- 1. H = High Voltage Level
 X = Don't Care
 L = Low Voltage Level
 Z = High Impedance
- 2. OE_B for FCT 241/2241 only.

2565 tbl 02

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 $V_{CC} + 0.5$	-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
PT	Power Dissipation	0.5	0.5	W
I_{OUT}	DC Output Current	-60 to +120	-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. No terminal voltage may exceed V_{CC} by +0.5V unless otherwise noted.
- 2. Input and V_{CC} terminals only.
- 3. Outputs and I/O terminals only.

2565 lmk 03

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

Symbol	Parameter ⁽¹⁾	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:

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

2565 lmk 04



DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial: $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$, $V_{CC} = 5.0\text{V} \pm 5\%$; 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 ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_i = 2.7\text{V}/V_{CC}$	—	—	± 1	μA
I_{IL}	Input LOW Current ⁽⁴⁾		$V_i = 0.5\text{V}/\text{GND}$	—	—	± 1	
I_{OZH}	High Impedance Output Current (3-State Output pins) ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	± 1	μA
I_{OZL}			$V_O = 0.5\text{V}$	—	—	± 1	
I_i	Input HIGH Current ⁽⁴⁾	$V_{CC} = \text{Max.}, V_i = V_{CC} (\text{Max.})$		—	—	± 1	μA
V_{IK}	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-120	-225	mA
V_H	Input Hysteresis	—		—	200	—	mV
I_{CC}	Quiescent Power Supply Current	$V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$		—	0.01	1	mA

2565 Ink 05

OUTPUT DRIVE CHARACTERISTICS FOR FCT240/241/244/540/541T

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -6\text{mA MIL.}$	2.4	3.3	—	V
			$I_{OH} = -8\text{mA COM'L.}$	—	—	—	—
			$I_{OH} = -12\text{mA MIL.}$ $I_{OH} = -15\text{mA COM'L.}$	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 32\text{mA MIL.}$	—	0.3	0.5	V
			$I_{OL} = 64\text{mA COM'L.}$	—	—	—	—

2565 Ink 06

OUTPUT DRIVE CHARACTERISTICS FOR FCT2240/2241/2244/2541T

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

NOTES:

2565 Ink 07

- 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 and maximum loading
- 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 $\pm 5\mu\text{A}$ 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	2.0	mA	
I_{CCD}	Dynamic Power Supply Current ⁽⁴⁾	$V_{CC} = \text{Max.}$ Outputs Open $\overline{OE}_A = \overline{OE}_B = \text{GND}$ or $\overline{OE}_A = \text{GND}, \overline{OE}_B = V_{CC}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	FCTxxxT	—	0.15	0.25	mA/ MHz
				FCT2xxxT	—	0.06	0.12	
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{OE}_A = \overline{OE}_B = \text{GND}$ or $\overline{OE}_A = \text{GND}, \overline{OE}_B = V_{CC}$ One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	FCTxxxT	—	1.5	3.5	mA
				FCT2xxxT	—	0.6	2.2	
			$V_{IN} = 3.4$ $V_{IN} = \text{GND}$	FCTxxxT	—	1.8	4.5	
				FCT2xxxT	—	0.9	3.2	
			$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	FCTxxxT	—	3.0	6.0 ⁽⁵⁾	
				FCT2xxxT	—	1.2	3.4 ⁽⁵⁾	
			$V_{IN} = 3.4$ $V_{IN} = \text{GND}$	FCTxxxT	—	5.0	14.0 ⁽⁵⁾	
				FCT2xxxT	—	3.2	11.4 ⁽⁵⁾	

NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ 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_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

2565 tbl 08

$I_C = I_{CC} + \Delta I_{CC} D_{HNT} + I_{CCD} (f_{CP}/2 + f_i N_i)$

$I_{CC} = \text{Quiescent Current}$

$\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4V)$

$D_{HNT} = \text{Duty Cycle for TTL Inputs High}$

$N_T = \text{Number of TTL Inputs at } D_H$

$I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$

$f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$

$f_i = \text{Input Frequency}$

$N_i = \text{Number of Inputs at } f_i$

All currents are in milliamps and all frequencies are in megahertz.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT240/2240T

Symbol	Parameter	Condition ⁽¹⁾	FCT240T FCT2240T				FCT240AT FCT2240AT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay DN to ON	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 tbi 09

Symbol	Parameter	Condition ⁽¹⁾	FCT240CT FCT2240CT				FCT240DT FCT2240DT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay DN to ON	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 tbi 10

SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT241/2241T/244/2244T

Symbol	Parameter	Condition ⁽¹⁾	FCT241T/244T FCT2241T/2244T				FCT241AT/244AT FCT2241AT/2244AT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	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 tbi 11

Symbol	Parameter	Condition ⁽¹⁾	FCT241CT/244CT FCT2241CT/2244CT				FCT241DT/244DT FCT2241DT/2244DT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	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 tbi 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 ⁽¹⁾	FCT540T/541T FCT2541T				FCT540AT/541AT FCT2541AT				FCT540CT/541CT FCT2541CT				Unit
			Com'l.		Mil.		Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	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

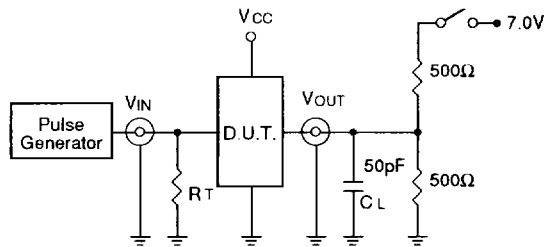
NOTES:

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

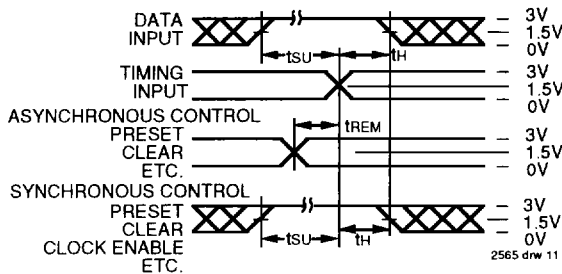
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

2565 drw 14

DEFINITIONS:

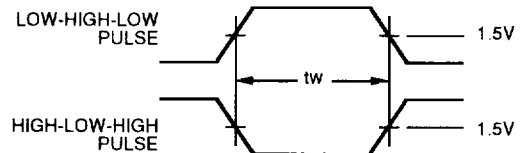
CL = Load capacitance: includes jig and probe capacitance.
 RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.

SET-UP, HOLD AND RELEASE TIMES



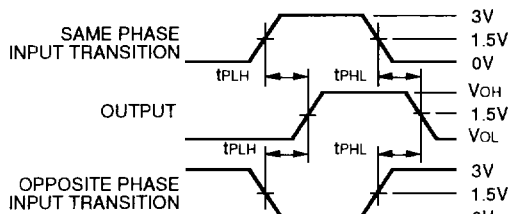
2565 drw 11

PULSE WIDTH



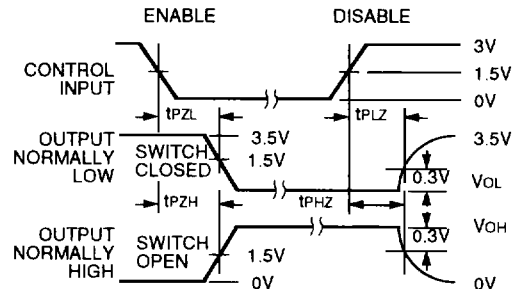
2565 drw 12

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 ≤ 1.0 MHz; $t_r \leq 2.5$ ns; $t_n \leq 2.5$ ns

ORDERING INFORMATION

IDT	XX	FCT	X	XXXX	X	X	
	Temp. Range		Family	Device Type	Package	Process	
							Blank
							B Commercial 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
							241T Non-Inverting Octal Buffer/Line Driver
							244T Non-Inverting Octal Buffer/Line Driver
							540T Inverting Octal Buffer/Line Driver
							541T Non-Inverting Octal Buffer/Line Driver
							240AT
							241AT
							244AT
							540AT
							541AT
							240CT
							241CT
							244CT
							540CT
							541CT
							240DT
							241DT
							244DT
							Blank
							2 High Drive Balanced Drive
							54 -55°C to +125°C
							74 0°C to +70°C

6

2565 drw 15