



# FAST CMOS OCTAL BIDIRECTIONAL TRANSCEIVER

*IDT74FCT645T/AT/CT/DT*

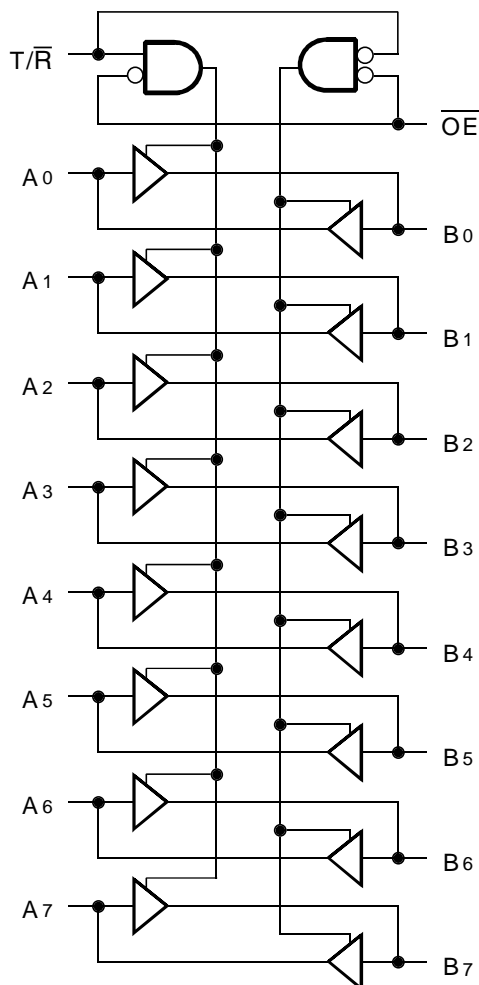
## FEATURES:

- 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
- Available in SOIC, and SSOP packages
- Std., A, C and D speed grades
- High drive outputs (-15mA  $I_{OH}$ , 64mA  $I_{OL}$ )

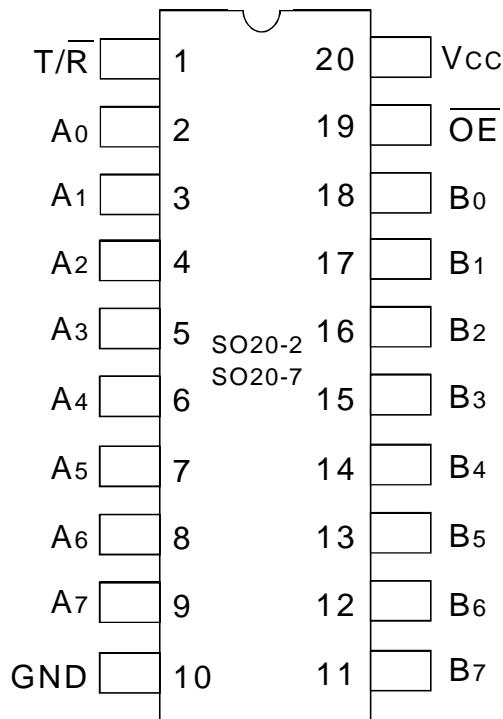
## DESCRIPTION:

The IDT octal bidirectional transceivers are built using an advanced dual metal CMOS technology. The FCT645T is designed for asynchronous two-way communication between data buses. The transmit/receive (T/R) input determines the direction of data flow through the bidirectional transceiver. Transmit (active high) enables data from A ports to B ports, and receive (active low) from B ports to A ports. The output enable ( $\overline{OE}$ ) input, when high, disables both A and B ports by placing them in high Z condition.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



SOIC/ SSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Rating	Max.	Unit
V <sub>TERM</sub> <sup>(2)</sup>	Terminal Voltage with Respect to GND	-0.5 to +7	V
V <sub>TERM</sub> <sup>(3)</sup>	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:

- 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<sub>CC</sub> by +0.5V unless otherwise noted.
- Inputs and V<sub>CC</sub> terminals only.
- Outputs and I/O terminals only.

## 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	6	10	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	8	12	pF

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### NOTE:

- This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

Pin Names	Description
$\overline{OE}$	Output Enable Input (Active LOW)
$\overline{T/R}$	Transmit/Receive Input
A0-A7	Side A Inputs or 3-State Outputs
B0-B7	Side B Inputs or 3-State Outputs

## FUNCTION TABLE (1)

Inputs		Outputs
$\overline{OE}$	$\overline{T/R}$	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

### NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 5\%$

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$V_{IH}$	Input HIGH Level	Guaranteed Logic HIGH Level		2	—	—	V
$V_{IL}$	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
$I_{IH}$	Input HIGH Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$	$V_I = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{IL}$	Input LOW Current <sup>(4)</sup>		$V_I = 0.5\text{V}$	—	—	$\pm 1$	
$I_{OZH}$	High Impedance Output Current (3-State output pins) <sup>(4)</sup>	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{OZL}$			$V_O = 0.5\text{V}$	—	—	$\pm 1$	
$I_I$	Input HIGH Current	$V_{CC} = \text{Max.}, V_I = V_{CC} (\text{Max.})$		—	—	$\pm 1$	$\mu\text{A}$
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
$V_H$	Input Hysteresis	—		—	200	—	mV
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$		—	0.01	1	$\mu\text{A}$

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -8\text{mA}$	2.4	3.3	—	V
			$I_{OH} = -15\text{mA}$	2	3	—	
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 64\text{mA}$	—	0.3	0.55	V
$I_{OS}$	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-120	-225	mA

### 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  $V_{CC} = 5.0\text{V}$ ,  $+25^{\circ}\text{C}$  ambient and maximum loading.
3. Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed one second.
4. 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	2	mA
$I_{CCD}$	Dynamic Power Supply Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $\overline{OE} = T/\overline{R} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.15	0.25	mA/ MHz
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{OE} = T/\overline{R} = \text{GND}$ One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.5	3.5	mA
			$V_{IN} = 3.4$ $V_{IN} = \text{GND}$	—	1.8	4.5	
		$V_{CC} = \text{Max.}$ Outputs Open $f_i = 2.5\text{MHz}$ 50% Duty Cycle $\overline{OE} = T/\overline{R} = \text{GND}$ Eight Bits Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3	6 <sup>(5)</sup>	
			$V_{IN} = 3.4$ $V_{IN} = \text{GND}$	—	5	14 <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  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  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.
- $I_C = I_{\text{QUIESCENT}} + I_{\text{INPUTS}} + I_{\text{DYNAMIC}}$   
 $I_C = I_{CC} + \Delta I_{CC} D_{HNT} + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 $I_{CC} = \text{Quiescent Current}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4V)$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$   
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$   
 $f_i = \text{Input Frequency}$   
 $N_i = \text{Number of Inputs at } f_i$   
 All currents are in milliamps and all frequencies are in megahertz.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE

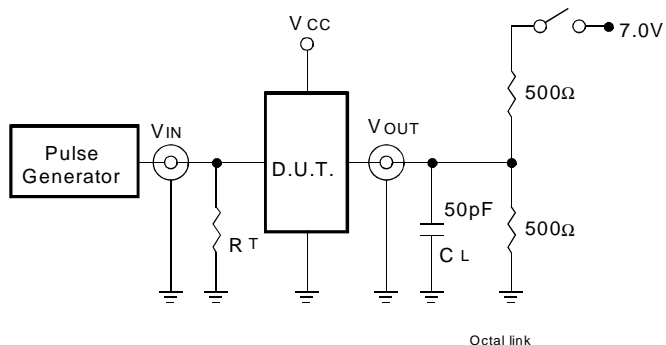
Symbol	Parameter	Conditions <sup>(1)</sup>	FCT645T		FCT645AT		FCT645CT		FCT645DT		Unit
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
$t_{PLH}$ $t_{PHL}$	Propagation Delay A to B, B to A	$C_L = 50\text{ pF}$ $R_L = 500\Omega$	1.5	9.5	1.5	4.6	1.5	4.1	1.5	3.8	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time $\overline{OE}$ to A or B		1.5	11	1.5	6.2	1.5	5.8	1.5	5	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time $\overline{OE}$ to A or B		1.5	12	1.5	5	1.5	4.8	1.5	4.3	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time $T/\overline{R}$ to A or B <sup>(3)</sup>		1.5	11	1.5	6.2	1.5	5.8	1.5	5	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time $T/\overline{R}$ to A or B <sup>(3)</sup>		1.5	12	1.5	5	1.5	4.8	1.5	4.3	ns

### NOTES:

- See test circuit and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- This parameter is guaranteed but not tested.

## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



### SWITCH POSITION

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

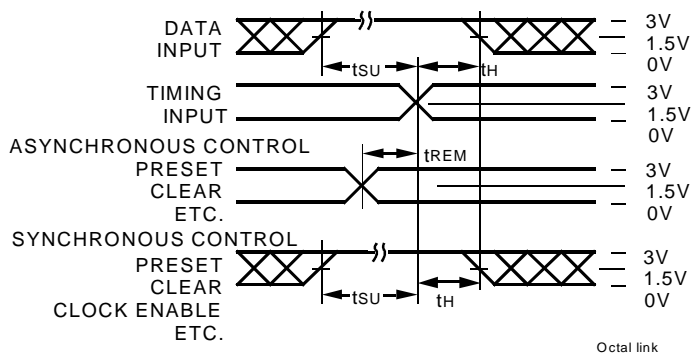
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#### DEFINITIONS:

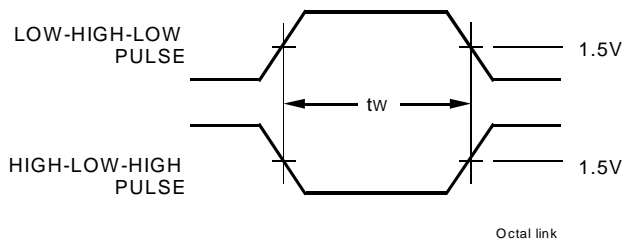
CL = Load capacitance: includes jig and probe capacitance.

RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.

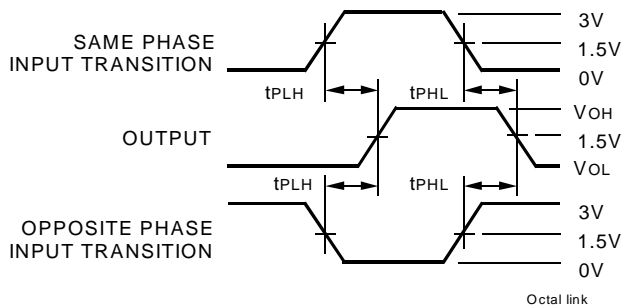
### SET-UP, HOLD, AND RELEASE TIMES



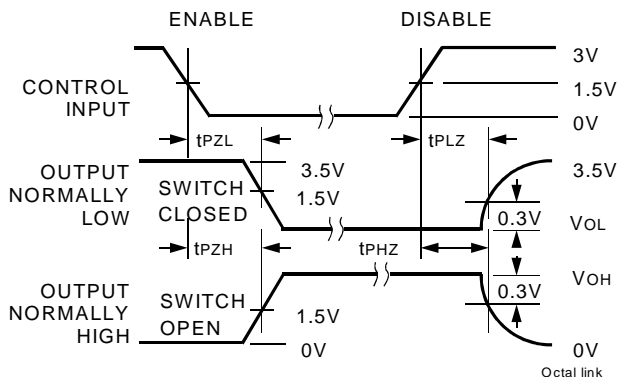
### PULSE WIDTH



### PROPAGATION DELAY



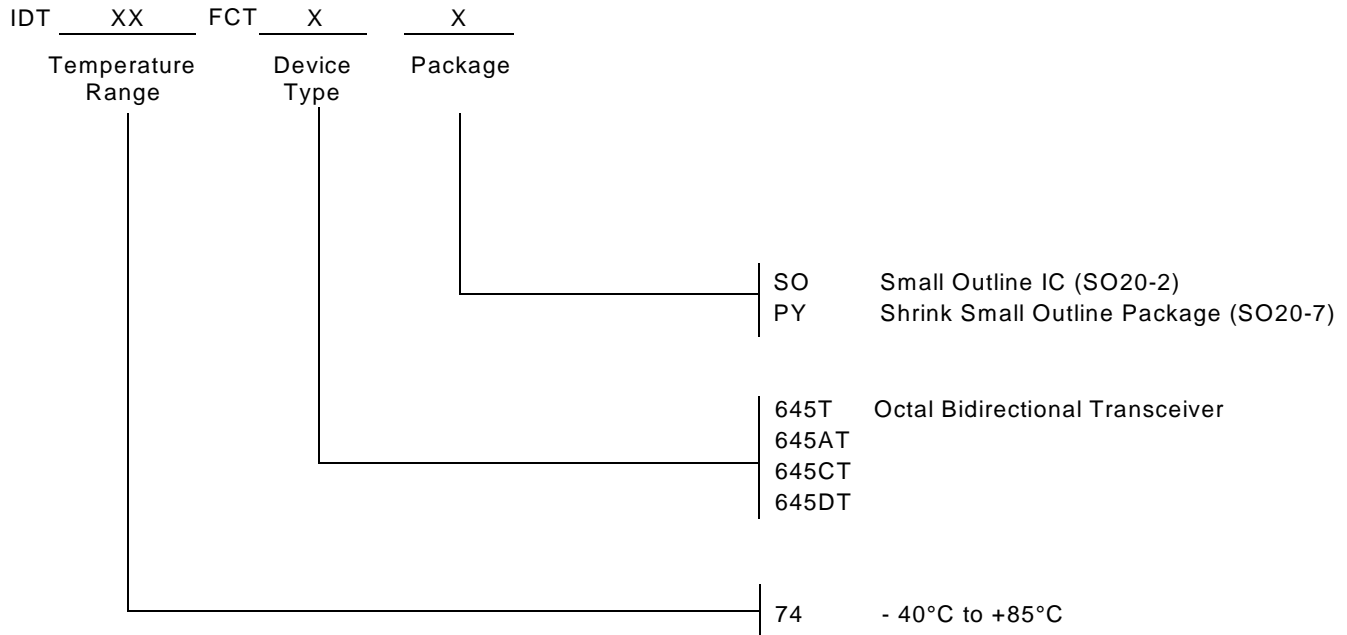
### ENABLE AND DISABLE TIMES



#### NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
- Pulse Generator for All Pulses: Rate  $\leq$  1.0MHz;  $t_f \leq$  2.5ns;  $t_r \leq$  2.5ns

**ORDERING INFORMATION**



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