



Integrated Device Technology, Inc.

3.3V CMOS 16-BIT BIDIRECTIONAL TRANSCEIVERS

IDT74FCT163245/A/C

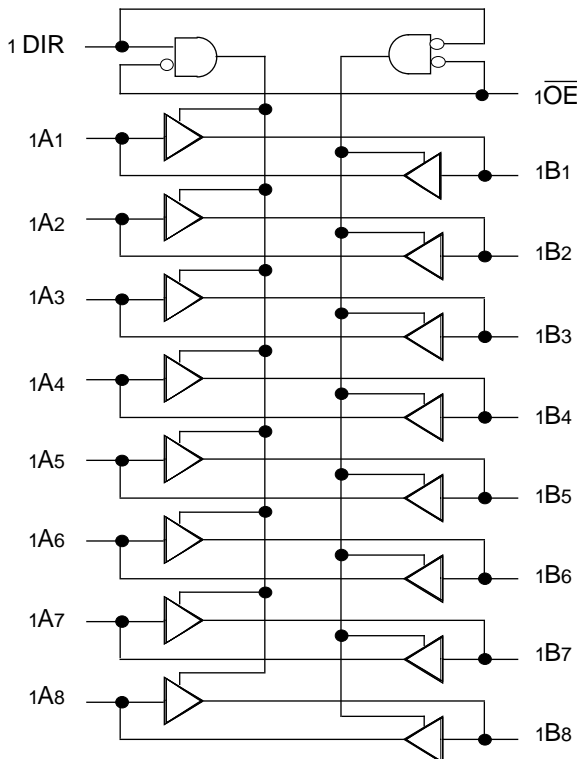
FEATURES:

- 0.5 MICRON CMOS Technology
- **Typical tsk(o) (Output Skew) < 250ps**
- 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 and 15.7 mil pitch TVSOP
- Extended commercial range of -40°C to +85°C
- VCC = 3.3V ±0.3V, Normal Range or VCC = 2.7 to 3.6V, Extended Range
- CMOS power levels (0.4µW typ. static)
- Rail-to-Rail output swing for increased noise margin
- Low Ground Bounce (0.3V typ.)
- Inputs (except I/O) can be driven by 3.3V or 5V components

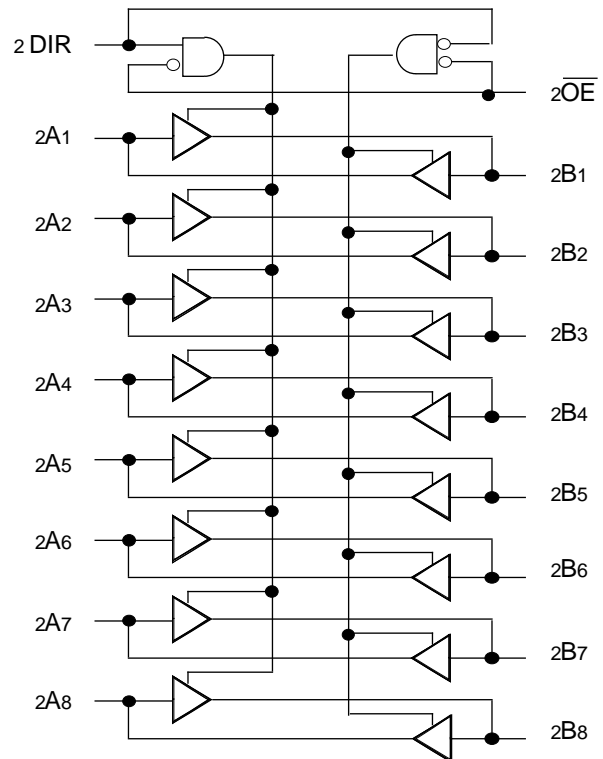
DESCRIPTION:

The FCT163245/A/C 16-bit transceivers are built using advanced dual metal CMOS technology. These high-speed, low-power transceivers are ideal for synchronous communication between two busses (A and B). The Direction and Output Enable controls are designed to operate these devices as either two independent 8-bit transceivers or one 16-bit transceiver. The direction control pin (xDIR) controls the direction of data flow. The output enable pin (xOE) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

FUNCTIONAL BLOCK DIAGRAM



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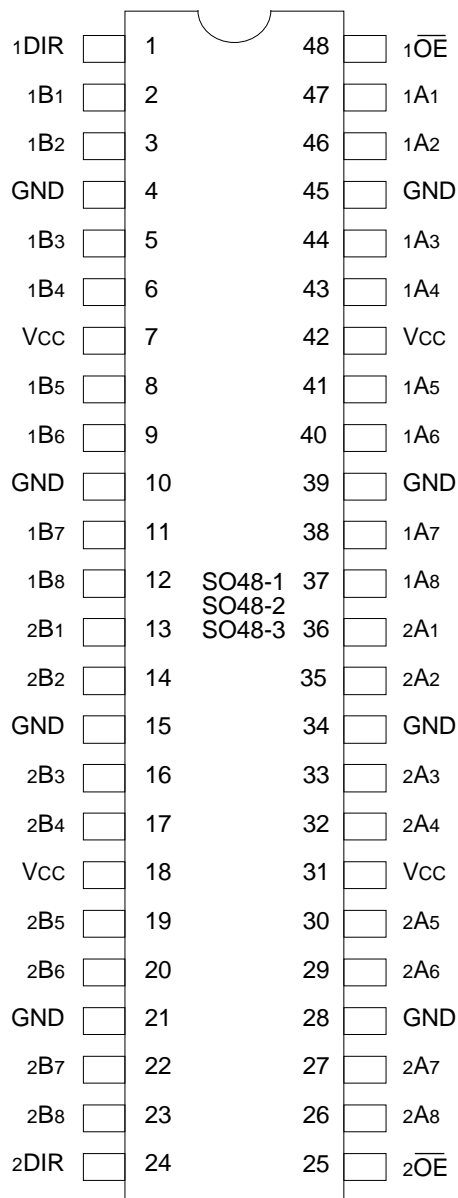
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COMMERCIAL TEMPERATURE RANGE

AUGUST 1996

PIN CONFIGURATIONS



SSOP/
TSSOP/TVSOP
TOP VIEW

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PIN DESCRIPTION

Pin Names	Description
\overline{xOE}	Output Enable Input (Active LOW)
xDIR	Direction Control Input
xAx	Side A Inputs or 3-State Outputs
xBx	Side B Inputs or 3-State Outputs

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ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Description	Max.	Unit
$V_{TERM}^{(2)}$	Terminal Voltage with Respect to GND	-0.5 to +4.6	V
$V_{TERM}^{(3)}$	Terminal Voltage with Respect to GND	-0.5 to +7.0	V
$V_{TERM}^{(4)}$	Terminal Voltage with Respect to GND	-0.5 to $V_{CC} + 0.5$	V
TSTG	Storage Temperature	-65 to +150	°C
I _{OUT}	DC Output Current	-60 to +60	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.
- V_{CC} terminals.
- Input terminals.
- Output and I/O terminals.

FUNCTION TABLE⁽¹⁾

Inputs		Outputs
\overline{xOE}	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

NOTE:

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

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 _{I/O}	I/O Capacitance	V _{OUT} = 0V	3.5	8.0	pF

NOTE:

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- 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 $+85^{\circ}\text{C}$, $V_{CC} = 2.7\text{V}$ to 3.6V

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
V_{IH}	Input HIGH Level (Input pins)	Guaranteed Logic HIGH Level		2.0	—	5.5	V
	Input HIGH Level (I/O pins)			2.0	—	$V_{CC}+0.5$	
V_{IL}	Input LOW Level (Input and I/O pins)	Guaranteed Logic LOW Level		-0.5	—	0.8	V
I_{IH}	Input HIGH Current (Input pins)	$V_{CC} = \text{Max.}$	$V_I = 5.5\text{V}$	—	—	± 1	μA
	Input HIGH Current (I/O pins)		$V_I = V_{CC}$	—	—	± 1	
I_{IL}	Input LOW Current (Input pins)		$V_I = \text{GND}$	—	—	± 1	
	Input LOW Current (I/O pins)		$V_I = \text{GND}$	—	—	± 1	
I_{OZH}	High Impedance Output Current (3-State Output pins)	$V_{CC} = \text{Max.}$	$V_O = V_{CC}$	—	—	± 1	μA
I_{OZL}			$V_O = \text{GND}$	—	—	± 1	
V_{IK}	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
I_{ODH}	Output HIGH Current	$V_{CC} = 3.3\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_O = 1.5\text{V}^{(3)}$		-36	-60	-110	mA
I_{ODL}	Output LOW Current	$V_{CC} = 3.3\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_O = 1.5\text{V}^{(3)}$		50	90	200	mA
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -0.1\text{mA}$	$V_{CC}-0.2$	—	—	V
			$I_{OH} = -3\text{mA}$	2.4	3.0	—	
		$V_{CC} = 3.0\text{V}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -8\text{mA}$	2.4 ⁽⁵⁾	3.0	—	
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 0.1\text{mA}$	—	—	0.2	V
			$I_{OL} = 16\text{mA}$	—	0.2	0.4	
			$I_{OL} = 24\text{mA}$	—	0.3	0.55	
		$V_{CC} = 3.0\text{V}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 24\text{mA}$	—	0.3	0.50	
I_{OS}	Short Circuit Current ⁽⁴⁾	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-135	-240	mA
V_H	Input Hysteresis	—		—	150	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	$V_{CC} = \text{Max.},$ $V_{IN} = \text{GND}$ or V_{CC}		—	0.1	10	μA

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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 $V_{CC} = 3.3\text{V}$, $+25^{\circ}\text{C}$ ambient.
- Not more than one output should be tested at one time. Duration of the test should not exceed one second.
- This parameter is guaranteed but not tested.
- $V_{OH} = V_{CC} - 0.6\text{V}$ at rated current.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	$V_{CC} = \text{Max.}$	$V_{IN} = V_{CC} - 0.6V^{(3)}$	—	2.0	30	μA
I_{CCD}	Dynamic Power Supply Current ⁽⁴⁾	$V_{CC} = \text{Max.}$ Outputs Open $\overline{xOE} = xDIR = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	50	75	$\mu A/$ MHz
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$ Outputs Open $f_i = 10\text{MHz}$ 50% Duty Cycle $\overline{xOE} = xDIR = \text{GND}$ One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.5	0.8	mA
			$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = \text{GND}$	—	0.5	0.8	
		$V_{CC} = \text{Max.}$ Outputs Open $f_i = 2.5\text{MHz}$ 50% Duty Cycle $\overline{xOE} = xDIR = \text{GND}$ Sixteen Bits Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	2.0	3.0 ⁽⁵⁾	
			$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = \text{GND}$	—	2.0	3.3 ⁽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 $V_{CC} = 3.3V$, $+25^\circ C$ ambient.
- Per TTL driven input; 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.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP} / 2 + f_i N_i)$
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ})$
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input}$
 $D_H = \text{Duty Cycle for TTL Inputs High}$
 $N_T = \text{Number of TTL Inputs at } D_H$
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$
 $N_{CP} = \text{Number of Clock Inputs at } f_{CP}$
 $f_i = \text{Input Frequency}$
 $N_i = \text{Number of Inputs at } f_i$

SWITCHING CHARACTERISTICS OVER OPERATING RANGE⁽⁴⁾

Symbol	Parameter	Condition ⁽¹⁾	FCT163245		FCT163245A		FCT163245C		Unit
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay A to B, B to A	CL = 50pF RL = 500Ω	1.5	7.0	1.5	4.6	1.5	4.1	ns
tpZH tpZL	Output Enable Time xOE to A or B		1.5	9.5	1.5	6.2	1.5	5.8	ns
tPHZ tPLZ	Output Disable Time xOE to A or B		1.5	7.5	1.5	5.0	1.5	4.8	ns
tpZH tpZL	Output Enable Time xDIR to A or B ⁽⁵⁾		1.5	9.5	1.5	6.2	1.5	5.8	ns
tPHZ tPLZ	Output Disable Time xDIR to A or B ⁽⁵⁾		1.5	7.5	1.5	5.0	1.5	4.8	ns
tsk(o)	Output Skew ⁽³⁾		—	0.5	—	0.5	—	0.5	ns

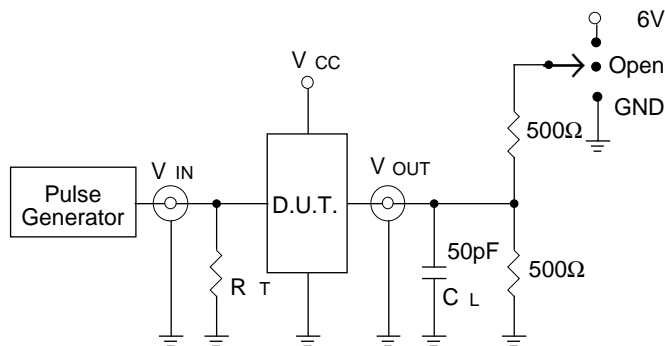
NOTES:

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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. Propagation Delays and Enable/Disable times are with Vcc = 3.3V ± 0.3V, Normal Range. For Vcc = 2.7V to 3.6V, Extended Range, all Propagation Delays and Enable/Disable times should be degraded by 20%.
5. This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



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SWITCH POSITION

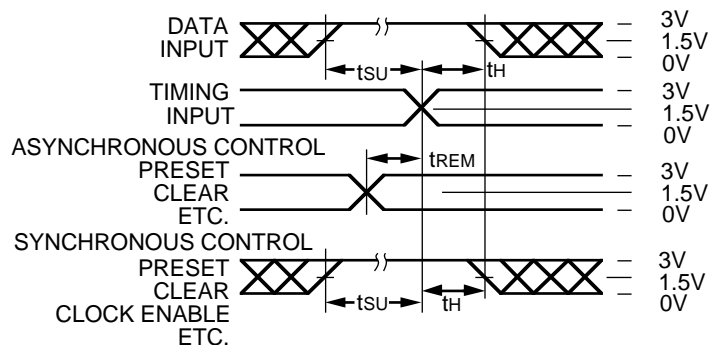
Test	Switch
Open Drain Disable Low Enable Low	6V
Disable High Enable High	GND
All Other tests	Open

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.
 R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

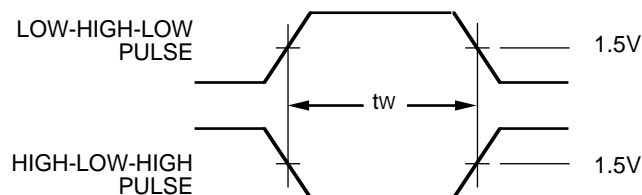
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SET-UP, HOLD AND RELEASE TIMES



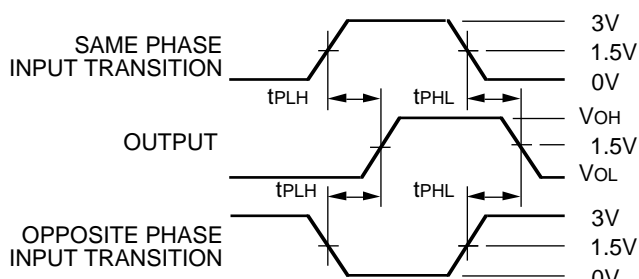
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PULSE WIDTH



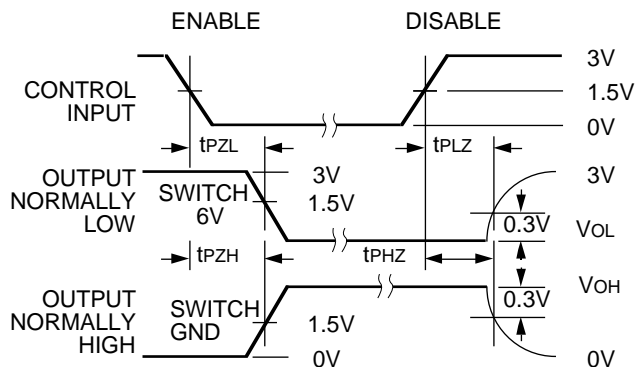
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PROPAGATION DELAY



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ENABLE AND DISABLE TIMES

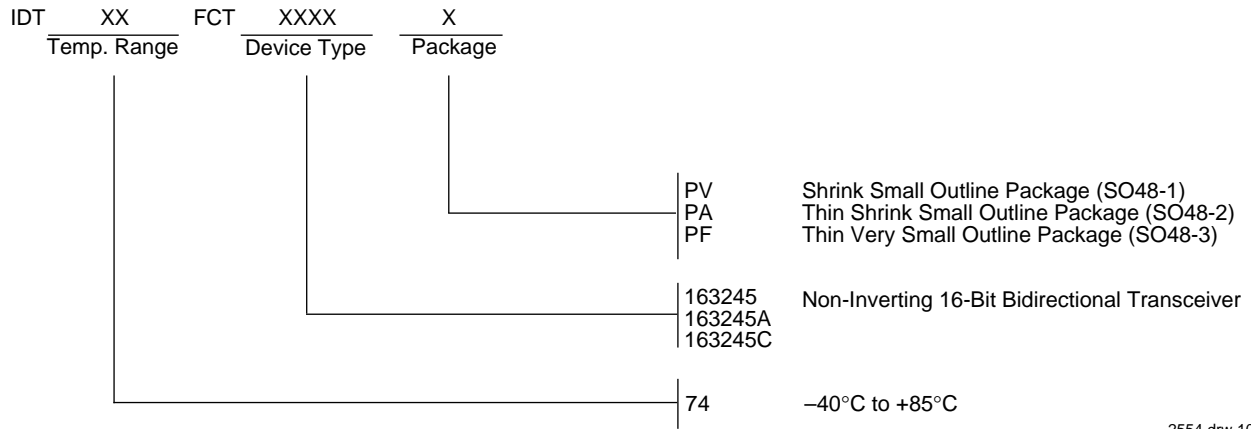


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NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $t_f \leq 2.5\text{ns}$; $t_r \leq 2.5\text{ns}$.
3. If V_{CC} is below 3V, input voltage swings should be adjusted not to exceed V_{CC} .

ORDERING INFORMATION



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