

December 1996

Fast CMOS 3.3V 16-Bit Bidirectional Transceiver

Features

- Advanced 0.6 micron CMOS Technology
- Advanced Low Power CMOS Operation
- Excellent Output Drive Capability:
 - Balanced Drives (24mA Sink and Source)
 - Compatible with LVC™ Class of Products.
- Pin Compatible with Industry Standard Double-Density Pinouts
- Low Ground Bounce Outputs
- Hysteresis on All Inputs
- Control Inputs Can Be Driven by 3.3V or 5V Devices
- Multiple Center Pin and Distributed V_{CC}/GND Pins Minimizing Switching Noise

Ordering Information

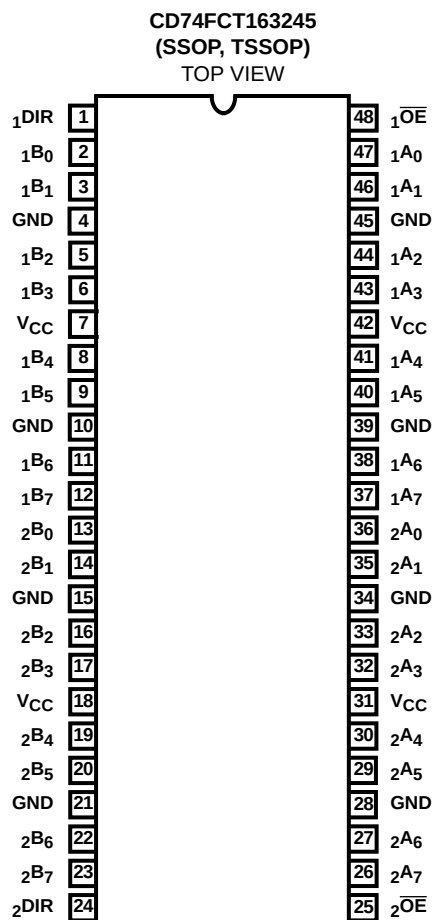
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT163245AMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT163245ASM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT163245CMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT163245CSM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT163245MT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT163245SM	-40 to 85	48 Ld SSOP	M48.300-P

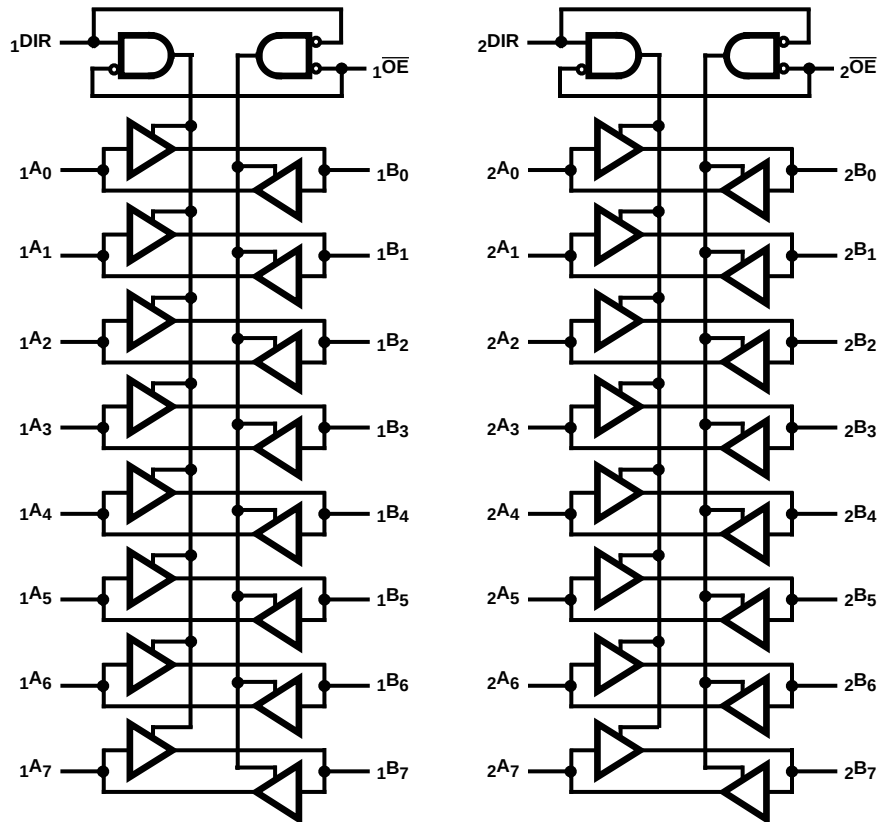
NOTE: When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

Description

The CD74FCT163245 is a 16-bit bidirectional transceiver designed for asynchronous two-way communication between data buses. The direction control input pin (χ DIR) determines the direction of data flow through the bidirectional transceiver. The Direction and Output Enable controls are designed to operate this device as either two independent 8-bit transceivers or one 16-bit transceiver. The output enable (χ OE) input, when HIGH, disables both A and B ports by placing them in HIGH Z condition.

Pinout



Functional Block Diagram

TRUTH TABLE (NOTE 1)

INPUTS		OUTPUTS
$\overline{xOE}$	$xDIR$	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	Z

NOTE:

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

Pin Descriptions

PIN NAME	DESCRIPTION
$\overline{xOE}$	Three-State Output Enable Inputs (Active LOW)
$xDIR$	Direction Control Input
xAX	Side A Inputs or Three-State Outputs
xBX	Side B Inputs or Three-State Outputs
GND	Ground
V_{CC}	Power

Absolute Maximum Ratings

DC Input Voltage -0.5V to 7.0V
 DC Output Current 120mA

Operating Conditions

Operating Temperature Range -40°C to 85°C
 Supply Voltage to Ground Potential
 Inputs and V_{CC} Only -0.5V to 7.0V
 Supply Voltage to Ground Potential
 Outputs and D/O Only -0.5V to 7.0V

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Thermal Information

Thermal Resistance (Typical, Note 2) θ_{JA} (°C/W)
 TSSOP Package 94
 SSOP Package 76
 Maximum Junction Temperature 150°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°C
 (Lead Tips Only)

Electrical Specifications

PARAMETERS	SYMBOL	(NOTE 3) TEST CONDITIONS		MIN	(NOTE 4) TYP	MAX	UNITS
DC ELECTRICAL SPECIFICATIONS Over the Operating Range TA = -40°C to 85°C, VCC = 2.7V to 3.6V							
Input HIGH Voltage (Input Pins)	VIH	Guaranteed Logic HIGH Level		2.2	-	5.5	V
Input HIGH Voltage (I/O Pins)	VIH	Guaranteed Logic HIGH Level		2.2	-	VCC + 0.5	V
Input LOW Voltage (Input and I/O Pins)	VIL	Guaranteed Logic LOW Level		-0.5	-	0.8	V
Input HIGH Current (Input Pins)	IIH	VCC = Max	VIN = 5.5V	-	-	±1	µA
Input HIGH Current (I/O Pins)	IIH	VCC = Max	VIN = VCC	-	-	±1	µA
Input LOW Current (Input Pins)	IIL	VCC = Max	VIN = GND	-	-	±1	µA
Input LOW Current (I/O Pins)	IIL	VCC = Max	VIN = GND	-	-	±1	µA
High Impedance Output Current (Three-State)	IOZH	VCC = Max	VOUT = VCC	-	-	±1	µA
	IOZL	VCC = Max	VOUT = GND	-	-	±1	µA
Clamp Diode Voltage	VIK	VCC = Min, IIN = -18mA		-	-0.7	-1.2	V
Output HIGH Current	IODH	VCC = 3.3V, VIN = VIH or VIL, VO = 1.5V (Note 5)		-36	-60	-110	mA
Output LOW Current	IODL	VCC = 3.3V, VIN = VIH or VIL, VO = 1.5V (Note 5)		50	90	200	mA
Output HIGH Voltage	VOH	VCC = Min, VIN = VIH or VIL	IOH = -0.1mA	VCC - 0.2	-	-	V
			IOH = -3mA	2.4	3.0	-	V
		VCC = 3.0V, VIN = VIH or VIL	IOH = -8mA	2.4 (Note 8)	3.0	-	V
			IOH = -24mA	2.0	-	-	V
Output LOW Voltage	VOL	VCC = Min, VIN = VIH or VIL	IOL = 0.1mA	-	-	0.2	V
			IOL = 16mA	-	0.2	0.4	V
			IOL = 24mA	-	0.3	0.5	V

Electrical Specifications (Continued)

PARAMETERS	SYMBOL	(NOTE 3) TEST CONDITIONS	MIN	(NOTE 4) TYP	MAX	UNITS	
Short Circuit Current (Note 6)	I _{OS}	V _{CC} = Max (Note 5), V _{OUT} = GND	-60	-85	-240	mA	
Input Hysteresis	V _H		-	150	-	mV	
CAPACITANCE T _A = 25 ⁰ C, f = 1MHz							
Input Capacitance (Note 7)	C _{IN}	V _{IN} = 0V	-	4.5	6	pF	
Output Capacitance (Note 7)	C _{OUT}	V _{OUT} = 0V	-	5.5	8	pF	
POWER SUPPLY SPECIFICATIONS							
Quiescent Power Supply Current	I _{CC}	V _{CC} = Max	V _{IN} = GND or V _{CC}	-	0.1	10	μA
Quiescent Power Supply Current TTL Inputs HIGH	ΔI _{CC}	V _{CC} = Max	V _{IN} = V _{CC} - 0.6V (Note 9)	-	2.0	30	μA
Dynamic Power Supply Current (Note 10)	I _{CCD}	V _{CC} = Max, Outputs Open X _{OE} = X _{DIR} = GND One Bit Toggling 50% Duty Cycle	V _{IN} = V _{CC} V _{IN} = GND	-	50	75	μA/ MHz
Total Power Supply Current (Note 12)	I _C	V _{CC} = Max, Outputs Open f _I = 10MHz, 50% Duty Cycle X _{OE} = X _{DIR} = GND One Bit Toggling	V _{IN} = V _{CC} - 0.6V V _{IN} = GND	-	0.5	0.8	mA
		V _{CC} = Max, Outputs Open f _I = 2.5MHz, 50% Duty Cycle X _{OE} = X _{DIR} = GND 16 Bits Toggling	V _{IN} = V _{CC} - 0.6V V _{IN} = GND	-	2.0	3.3 (Note 11)	mA

CD74FCT163245

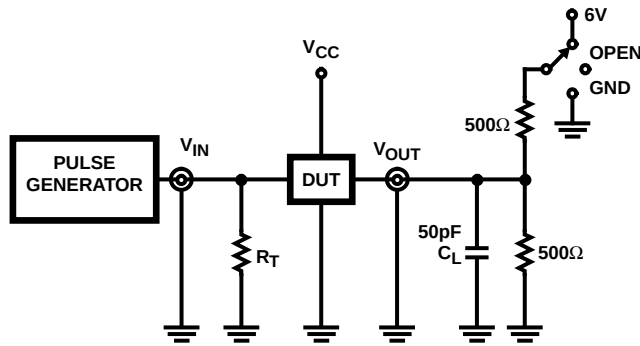
Switching Specifications Over Operating Range (Note 13)

PARAMETER	SYMBOL	(NOTE 14) TEST CONDITIONS	CD74FCT163245		CD74FCT163245A		CD74FCT163245C		UNITS
			(NOTE 15) MIN	MAX	(NOTE 15) MIN	MAX	(NOTE 15) MIN	MAX	
Propagation Delay A to B, B to A	t_{PLH} , t_{PHL}	$C_L = 50pF$ $R_L = 500\Omega$	1.5	7.0	1.5	4.6	1.5	4.1	ns
Output Enable Time $\overline{xOE}$ to A or B	t_{PZH} , t_{PZL}		1.5	9.5	1.5	6.2	1.5	5.8	ns
Output Disable Time (Note 16) $\overline{xOE}$ to A or B	t_{PHZ} , t_{PLZ}		1.5	7.5	1.5	5.0	1.5	4.8	ns
Output Enable Time $\overline{xDIR}$ to A or B	t_{PZH} , t_{PZL}		1.5	9.5	1.5	6.2	1.5	5.8	ns
Output Disable Time $\overline{xDIR}$ to A or B (Note 16)	t_{PHZ} , t_{PLZ}		1.5	7.5	1.5	5.0	1.5	4.8	ns
Output Skew(17)	$t_{SK(O)}$		-	0.5	-	0.5	-	0.5	ns

NOTES:

- For conditions shown as Max or Min, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 3.3V$, $25^{\circ}C$ ambient and maximum loading.
- Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
- This parameter is guaranteed but not tested.
- This parameter is determined by device characterization but is not production tested.
- $V_{OH} = V_{CC} - 0.6V$ at rated current.
- 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_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$
 I_{CC} = Quiescent Current
 ΔI_{CC} = Power Supply Current for a TTL High Input
 D_H = Duty Cycle for TTL Inputs High
 N_T = Number of TTL Inputs at D_H
 I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
 f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
 N_{CP} = Number of Clock Inputs at f_{CP}
 f_I = Input Frequency
 N_I = Number of Inputs at f_I
 All currents are in milliamps and all frequencies are in megahertz.
- Propagation Delays and Enable/Disable times are with $V_{CC} = 3.3V \pm 0.3V$, normal range. For $V_{CC} = 2.7V$, extended range, all Propagation Delays and Enable/Disable times should be degraded by 20%.
- See test circuit and wave forms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- This parameter is guaranteed but not production tested.
- Skew between any two outputs, of the same package, switching in the same direction. This parameter is guaranteed by design.

Test Circuits and Waveforms



NOTE:

18. Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $Z_{OUT} \leq 50\Omega$;
 $t_f, t_r \leq 2.5\text{ns}$.

FIGURE 1. TEST CIRCUIT

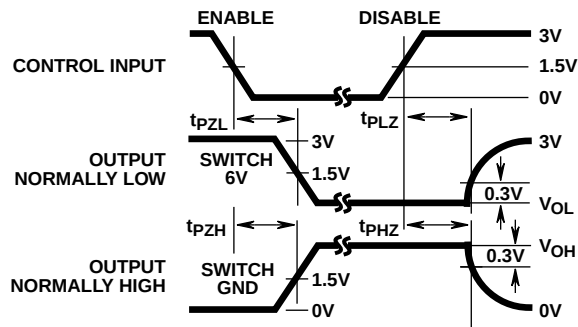


FIGURE 2. ENABLE AND DISABLE TIMING

SWITCH POSITION	
TEST	SWITCH
$t_{PLZ}, t_{PZL}, \text{Open Drain}$	6V
t_{PHZ}, t_{PZH}	GND
t_{PLH}, t_{PHL}	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.

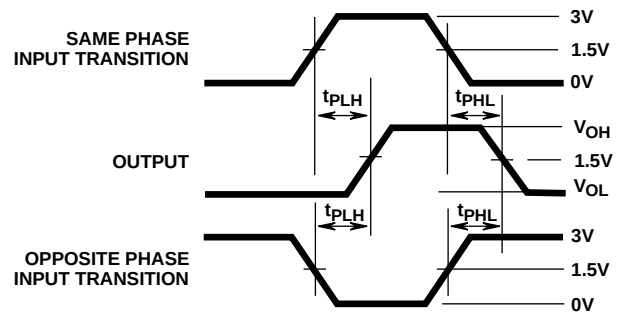
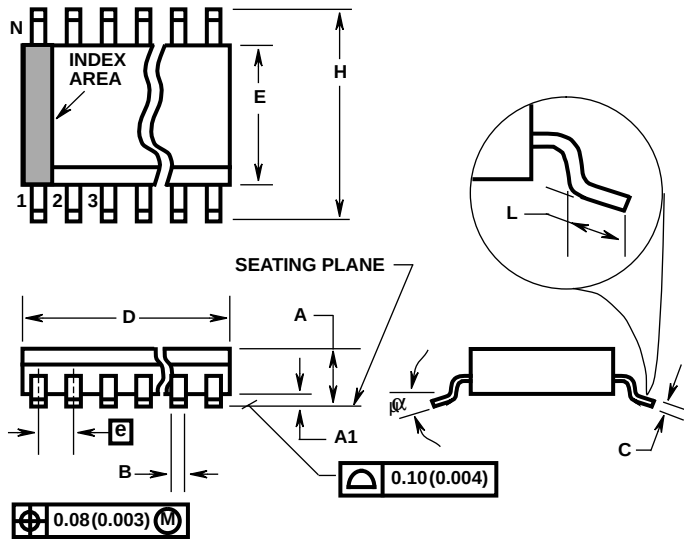


FIGURE 3. PROPAGATION DELAY

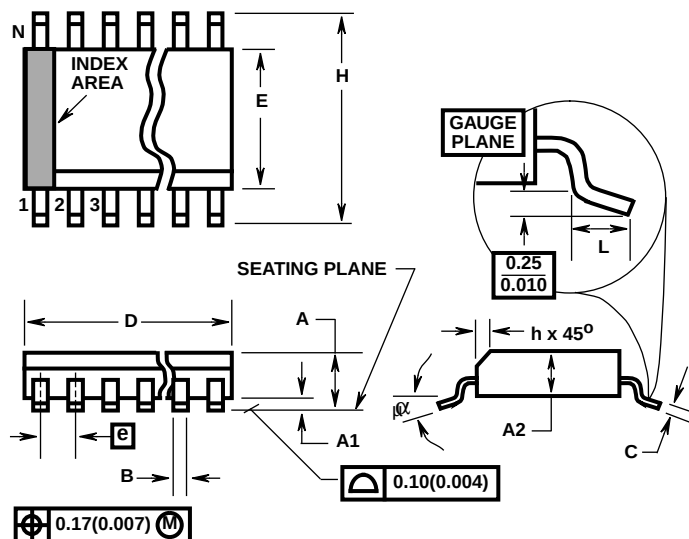
Thin Shrink Small Outline Plastic Packages (TSSOP)**M48.240-P****48 LEAD THIN SHRINK SMALL OUTLINE PLASTIC PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.041	0.047	1.05	1.20	-
A1	0.002	0.006	0.05	0.15	-
B	0.007	0.010	0.178	0.254	-
C	0.004	0.008	0.102	0.203	-
D	0.488	0.496	12.40	12.59	1
E	0.236	0.244	6.00	6.19	2
e	0.0197 BSC		0.50 BSC		-
H	0.307	0.330	7.80	8.38	-
L	0.020	0.030	0.51	0.76	3
N	48		48		4
α	0°	8°	0°	8°	-

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NOTES:

1. Dimension "D" does not include mold flash, protrusions or gate burrs.
2. Dimension "E" does not include interlead flash or protrusions.
3. "L" is the length of terminal for soldering to a substrate.
4. "N" is the number of terminal positions.
5. Terminal numbers are shown for reference only.
6. Controlling dimension: INCHES. Converted millimeter dimensions are not necessarily exact.

Shrink Small Outline Plastic Packages (SSOP)**NOTES:**

1. These package dimensions are within allowable dimensions of JECEC MO-118-AA, Issue B.
2. Dimension "D" does not include mold flash, protrusions or gate burrs.
3. Dimension "E" does not include interlead flash or protrusions.
4. "L" is the length of terminal for soldering to a substrate.
5. "N" is the number of terminal positions.
6. Terminal numbers are shown for reference only.
7. Controlling dimension: INCHES. Converted millimeter dimensions are not necessarily exact.

M48.300-P**48 LEAD SHRINK SMALL OUTLINE PLASTIC PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.096	0.108	2.44	2.74	-
A1	0.008	0.016	0.20	0.41	-
A2	0.088	0.092	2.24	2.34	-
B	0.008	0.0135	0.20	0.34	-
C	0.005	0.010	0.13	0.25	-
D	0.620	0.630	15.75	16.00	2
E	0.291	0.299	7.39	7.59	3
e	0.025 BSC		0.635 BSC		-
H	0.395	0.415	10.03	10.54	-
h	0.015	0.025	0.381	0.635	-
L	0.020	0.040	0.51	1.01	4
N	48		48		5
α	0°	8°	0°	8°	-

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