RENESAS

3.3V CMOS 16-BIT BIDIRECTIONAL TRANSCEIVER

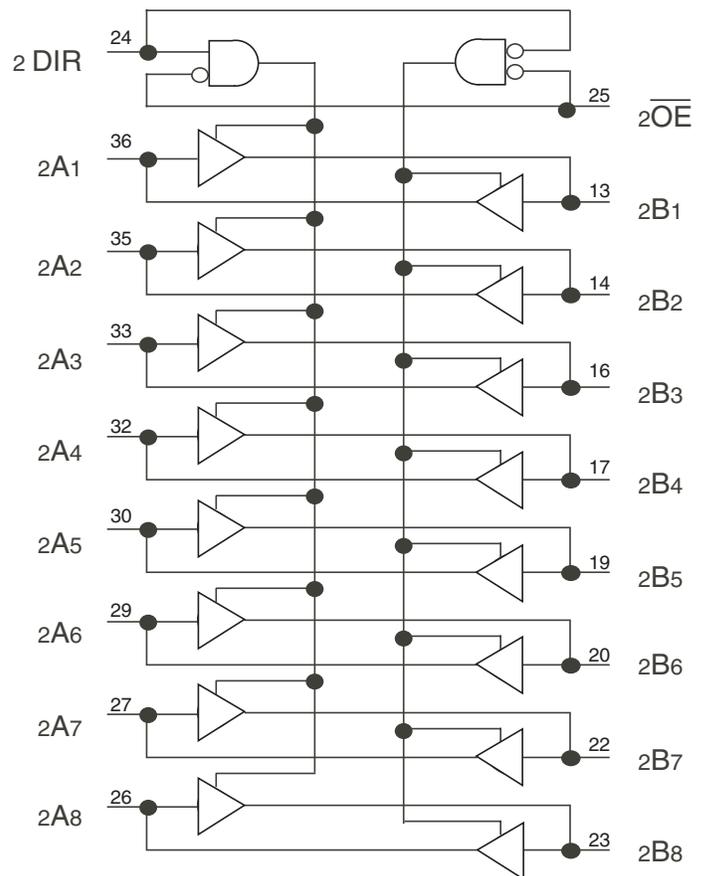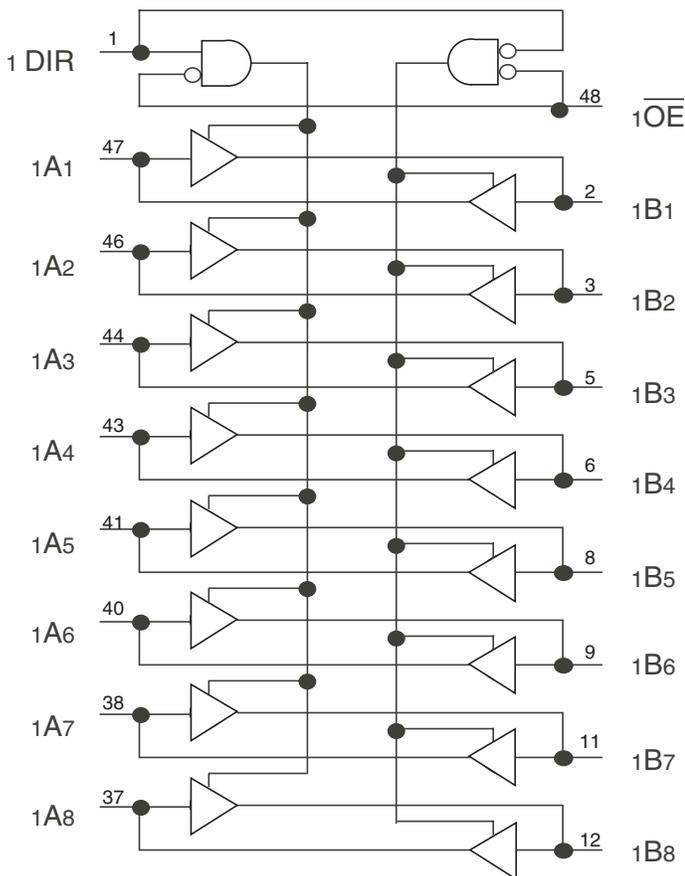## IDT74FCT163245A/C

FEATURES:
- 0.5 MICRON CMOS Technology
- Typical $t_{SK(o)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- V_{CC} = 3.3V ± 0.3V, Normal Range, or V_{CC} = 2.7V to 3.6V, Extended Range
- CMOS power levels (0.4µ W 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
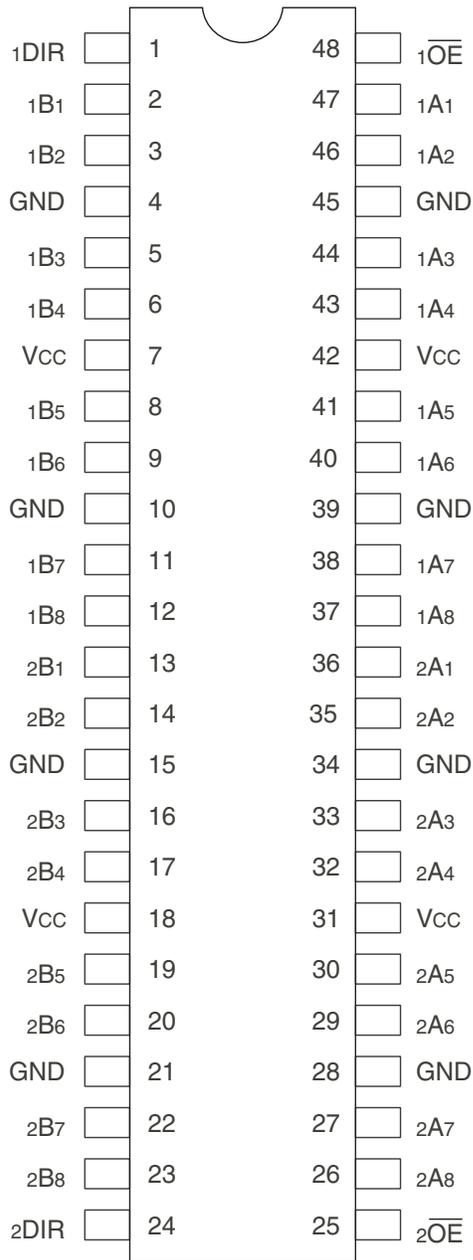- Available in SSOP, TSSOP, and TVSOP packages

DESCRIPTION:
The FCT163245 16-bit transceivers are built using advanced dual metal CMOS technology. These high-speed, low-power transceivers are ideal for asynchronous communication between two buses (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 (x$\overline{OE}$) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

FUNCTIONAL BLOCK DIAGRAM

INDUSTRIAL TEMPERATURE RANGE

SEPTEMBER 2009

DSC-2554/13

PIN CONFIGURATION

1DIR	1 ⌒ 48	1$\overline{OE}$
1B1	2	47	1A1
1B2	3	46	1A2
GND	4	45	GND
1B3	5	44	1A3
1B4	6	43	1A4
VCC	7	42	VCC
1B5	8	41	1A5
1B6	9	40	1A6
GND	10	39	GND
1B7	11	38	1A7
1B8	12	37	1A8
2B1	13	36	2A1
2B2	14	35	2A2
GND	15	34	GND
2B3	16	33	2A3
2B4	17	32	2A4
VCC	18	31	VCC
2B5	19	30	2A5
2B6	20	29	2A6
GND	21	28	GND
2B7	22	27	2A7
2B8	23	26	2A8
2DIR	24	25	2$\overline{OE}$

SSOP/ TSSOP/ TVSOP
TOP VIEW

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	V
V_{TERM}[4]	Terminal Voltage with Respect to GND	−0.5 to V_{CC}+0.5	V
T_{STG}	Storage Temperature	−65 to +150	°C
I_{OUT}	DC Output Current	−60 to +60	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.
2. Vcc terminals.
3. Input terminals.
4. Outputs and I/O terminals.

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	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	3.5	8	pF

NOTE:
1. This parameter is measured at characterization but not tested.

PIN DESCRIPTION

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

FUNCTION TABLE[1]

Inputs		Outputs
x$\overline{OE}$1	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

NOTE:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High-impedance

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Industrial: T_A = –40°C to +85°C, V_{CC} = 2.7V 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	—	5.5	V
	Input HIGH Level (I/O pins)			2	—	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} = Max.	V_I = 5.5V	—	—	±1	
	Input HIGH Current (I/O pins)		V_I = V_{CC}	—	—	±1	μA
I_{IL}	Input LOW Current (Input pins)		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)		V_I = GND	—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = V_{CC}	—	—	±1	μA
I_{OZL}	(3-State Output pins)		V_O = GND	—	—	±1	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
I_{ODH}	Output HIGH Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		–36	–60	–110	mA
I_{ODL}	Output LOW Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		50	90	200	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –0.1mA	V_{CC}-0.2	—	—	
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –3mA	2.4	3	—	V
		V_{CC} = 3V V_{IN} = V_{IH} or V_{IL}	I_{OH} = –8mA	2.4[5]	3	—	
V_{OL}	Output LOW Voltage	V_{CC} = Min.	I_{OL} = 0.1mA	—	—	0.2	
		V_{IN} = V_{IH} or V_{IL}	I_{OL} = 16mA	—	0.2	0.4	
			I_{OL} = 24mA	—	0.3	0.55	V
		V_{CC} = 3V V_{IN} = V_{IH} or V_{IL}	I_{OL} = 24mA	—	0.3	0.5	
I_{OS}	Short Circuit Current[4]	V_{CC} = Max., V_O = GND[3]		–60	–135	–240	mA
V_H	Input Hysteresis	—		—	150	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max. V_{IN} = GND or V_{CC}		—	0.1	10	μA

NOTES:
1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. This parameter is guaranteed but not tested.
5. V_{OH} = V_{CC}–0.6V 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} = Max. V_{IN} = V_{CC} - 0.6V[3]		—	2	30	µA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open x$\overline{OE}$ = xDIR = GND One Input Togging 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	50	75	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max., Outputs Open f_I = 10MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	0.5	0.8	mA
		x$\overline{OE}$ = xDIR = GND One Bit Toggling	V_{IN} = V_{CC} - 0.6V V_{IN} = GND	—	0.5	0.8	
		V_{CC} = Max., Outputs Open f_I = 2.5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	2	3[5]	
		x$\overline{OE}$ = xDIR = GND Sixteen Bits Toggling	V_{IN} = V_{CC} - 0.6V V_{IN} = GND	—	2	3.3[5]	

NOTES:
1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.
3. Per TTL driven input. All other inputs at V_{CC} or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$
   I_{CC} = Quiescent Current (I_{CCL}, I_{CCH} and I_{CCZ})
   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

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE[1]

| Symbol	Parameter	Condition[2]	FCT163245A		FCT163245C		Unit
			Min.[3]	Max.	Min.[3]	Max.	
t_{PLH} t_{PHL}	Propagation Delay A to B, B to A	C_L = 50pF R_L = 500Ω	1.5	4.6	1.5	4.1	ns
t_{PZH} t_{PZL}	Output Enable Time xOE to A or B		1.5	6.2	1.5	5.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time xOE to A or B		1.5	5	1.5	4.8	ns
t_{PZH} t_{PZL}	Output Enable Time xDIR to A or B[4]		1.5	6.2	1.5	5.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time xDIR to A or B[4]		1.5	5	1.5	4.8	ns
$t_{SK(o)}$	Output Skew[5]		—	0.5	—	0.5	ns

NOTES:

1. Propagation Delays and Enable/Disable times are with V_{CC} = 3.3V ±0.3V, Normal Range. For V_{CC} = 2.7V to 3.6V, Extended Range, all Propagation Delays and Enable/Disable times should be degraded by 20%.
2. See test circuit and waveforms.
3. Minimum limits are guaranteed but not tested on Propagation Delays.
4. This parameter is guaranteed but not tested.
5. Skew between any two outputs, of the same package, switching in the same direction. This parameter is guaranteed by design.
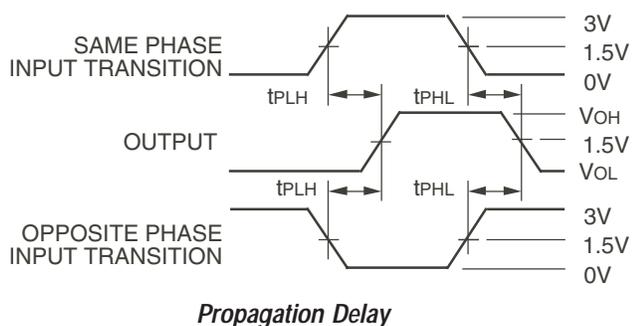
TEST CIRCUITS AND WAVEFORMS
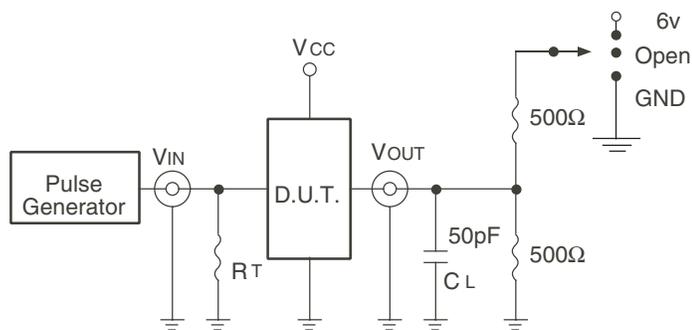
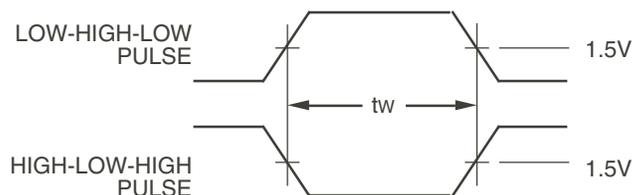*Test Circuits for All Outputs*
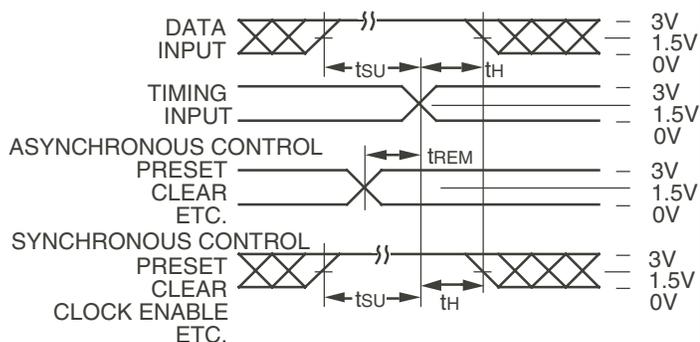
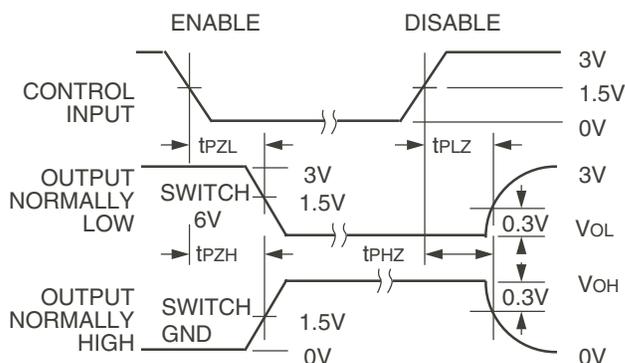*Set-up, Hold, and Release Times*

Propagation Delay

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.
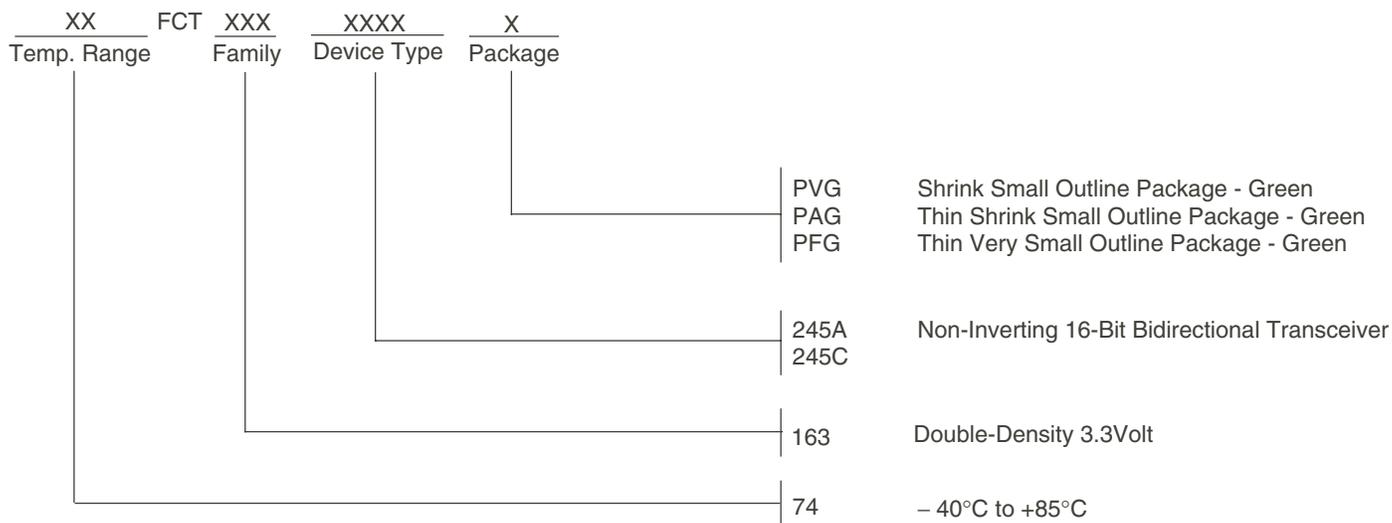

Pulse Width

Enable and Disable Times

NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
3. if V_{CC} is below 3V, input voltage swings should be adjusted not to exceed V_{CC}.

ORDERING INFORMATION

XX	FCT	XXX	XXXX	X
Temp. Range		Family	Device Type	Package

PVG — Shrink Small Outline Package - Green
PAG — Thin Shrink Small Outline Package - Green
PFG — Thin Very Small Outline Package - Green

245A — Non-Inverting 16-Bit Bidirectional Transceiver
245C

163 — Double-Density 3.3Volt

74 — − 40°C to +85°C

Datasheet Document History

09/10/09 Pg.7   Updated the ordering information by removing the "IDT" notation and non RoHS part.

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