

FEATURES:

- Typical $t_{SK(o)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{CC} = 3.3V \pm 0.3V$, Normal Range
- $V_{CC} = 2.7V$ to $3.6V$, Extended Range
- CMOS power levels (0.4 μ W typ. static)
- All inputs, outputs, and I/O are 5V tolerant
- Available in TSSOP package

DRIVE FEATURES:

- Balanced Output Drivers: $\pm 12mA$ (A port)
- High Output Drivers: $\pm 24mA$ (B port)

APPLICATIONS:

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

DESCRIPTION:

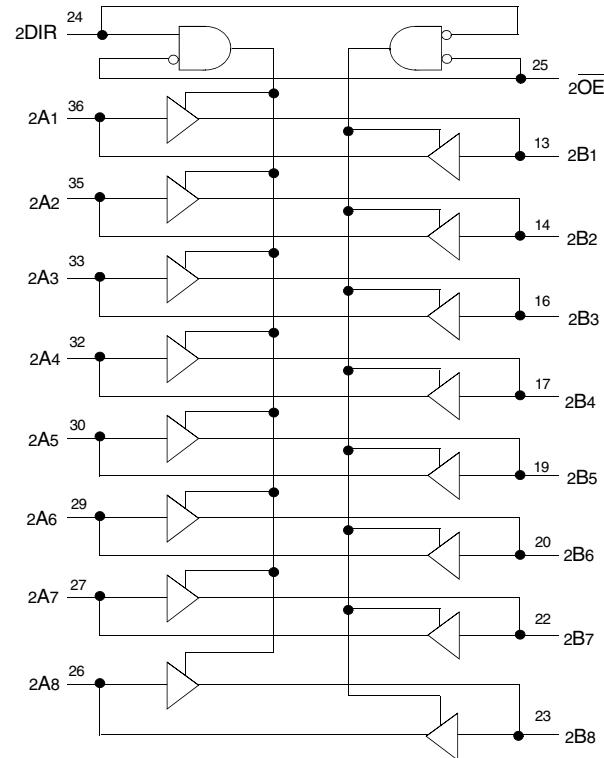
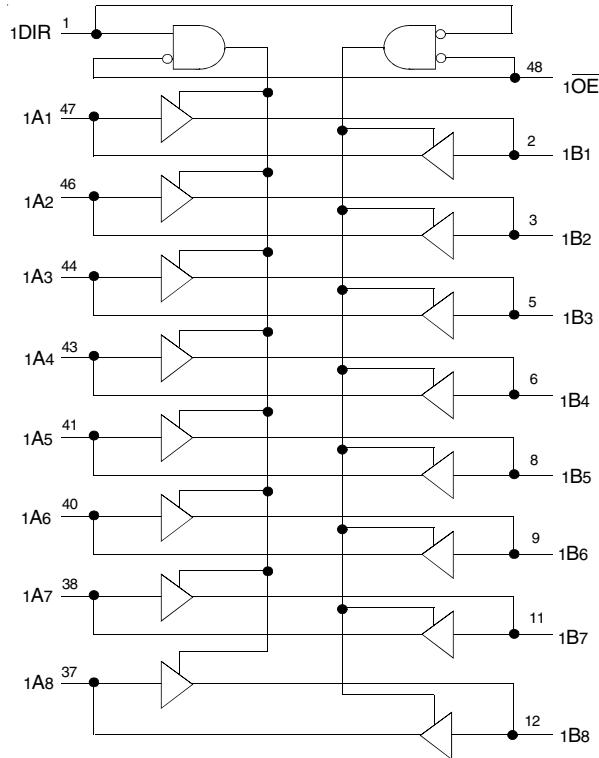
This 16-bit bus transceiver is built using advanced dual metal CMOS technology. This high-speed, low power transceiver is ideal for asynchronous communication between two busses (A and B). The Direction and Output Enable controls are designed to operate this device as either two independent 8-bit transceivers or one 16-bit transceiver. The direction control pin (DIR) controls the direction of data flow. The output enable pin (\bar{OE}) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

All pins can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVCH162245A (B port) has been designed with a $\pm 24mA$ output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

The LVCH162245 (A port) has "bus-hold" which retains the inputs' last state whenever the input goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

FUNCTIONAL BLOCK DIAGRAM



The IDT logo is a registered trademark of Integrated Device Technology, Inc.

INDUSTRIAL TEMPERATURE RANGE

PIN CONFIGURATION

1DIR	1	48	1OE
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	2OE

TSSOP
TOP VIEW**ABSOLUTE MAXIMUM RATINGS⁽¹⁾**

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +6.5	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-50 to +50	mA
I _{IK}	Continuous Clamp Current, V _I < 0 or V _O < 0	-50	mA
I _{CC}	Continuous Current through each V _{CC} or GND	±100	mA
I _{SS}			

NOTE:

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.

CAPACITANCE (TA = +25°C, F = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	4.5	6	pF
C _{OUT}	Output Capacitance	V _{OUT} = 0V	6.5	8	pF
C _{I/O}	I/O Port Capacitance	V _{IN} = 0V	6.5	8	pF

NOTE:

1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
x _{OE}	Output Enable Input (Active LOW)
xDIR	Direction Control Output
xAx	Side A Inputs or 3-State Outputs ⁽¹⁾
xBx	Side B Inputs or 3-State Outputs ⁽¹⁾

NOTE:

1. These pins have "Bus-Hold". All other pins are standard inputs, outputs, or I/Os.

FUNCTION TABLE (EACH 8-BIT SECTION)⁽¹⁾

Inputs		Outputs
x _{OE}	xDIR	
L	L	B Data to A Bus
L	H	A Data to B Bus
H	X	High Z State

NOTE:

1. H = HIGH Voltage Level

X = Don't Care

L = LOW Voltage Level

Z = High-Impedance

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$

Symbol	Parameter	Test Conditions		Min.	Typ. ⁽¹⁾	Max.	Unit
VIH	Input HIGH Voltage Level	V _{CC} = 2.3V to 2.7V		1.7	—	—	V
		V _{CC} = 2.7V to 3.6V		2	—	—	
VIL	Input LOW Voltage Level	V _{CC} = 2.3V to 2.7V		—	—	0.7	V
		V _{CC} = 2.7V to 3.6V		—	—	0.8	
I _{IH} I _{IL}	Input Leakage Current	V _{CC} = 3.6V	V _I = 0 to 5.5V	—	—	± 5	μA
I _{OZH} I _{OZL}	High Impedance Output Current (3-State Output pins)	V _{CC} = 3.6V	V _O = 0 to 5.5V	—	—	± 10	μA
I _{OFF}	Input/Output Power Off Leakage	V _{CC} = 0V, V _{IN} or V _O \leq 5.5V		—	—	± 50	μA
V _{IK}	Clamp Diode Voltage	V _{CC} = 2.3V, I _{IN} = -18mA		—	-0.7	-1.2	V
V _H	Input Hysteresis	V _{CC} = 3.3V		—	100	—	mV
I _{CCL} I _{CCH} I _{CCZ}	Quiescent Power Supply Current	V _{CC} = 3.6V	V _{IN} = GND or V _{CC}	—	—	10	μA
			3.6 \leq V _{IN} \leq 5.5V ⁽²⁾	—	—	10	
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V _{CC} - 0.6V, other inputs at V _{CC} or GND		—	—	500	μA

NOTES:

1. Typical values are at V_{CC} = 3.3V, $+25^\circ\text{C}$ ambient.
2. This applies in the disabled state only.

BUS-HOLD CHARACTERISTICS

Symbol	Parameter ⁽¹⁾	Test Conditions		Min.	Typ. ⁽²⁾	Max.	Unit
I _{BHH} I _{BHL}	Bus-Hold Input Sustain Current	V _{CC} = 3V	V _I = 2V	-75	—	—	μA
			V _I = 0.8V	75	—	—	
I _{BHH} I _{BHL}	Bus-Hold Input Sustain Current	V _{CC} = 2.3V	V _I = 1.7V	—	—	—	μA
			V _I = 0.7V	—	—	—	
I _{BHHO} I _{BHLO}	Bus-Hold Input Overdrive Current	V _{CC} = 3.6V	V _I = 0 to 3.6V	—	—	± 500	μA

NOTES:

1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V_{CC} = 3.3V, $+25^\circ\text{C}$ ambient.

OUTPUT DRIVE CHARACTERISTICS (A PORT)

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	Output HIGH Voltage	Vcc = 2.3V to 3.6V	IOH = - 0.1mA	Vcc - 0.2	—	V
		Vcc = 2.3V	IOH = - 4mA	1.9	—	
			IOH = - 6mA	1.7	—	
		Vcc = 2.7V	IOH = - 4mA	2.2	—	
			IOH = - 8mA	2	—	
		Vcc = 3V	IOH = - 6mA	2.4	—	
			IOH = - 12mA	2	—	
			IOH = - 12mA	2	—	
		IOH = - 12mA	IOH = - 12mA	2	—	
VOL	Output LOW Voltage	Vcc = 2.3V to 3.6V	IOL = 0.1mA	—	0.2	V
		Vcc = 2.3V	IOL = 4mA	—	0.4	
			IOL = 6mA	—	0.55	
		Vcc = 2.7V	IOL = 4mA	—	0.4	
			IOL = 8mA	—	0.6	
		Vcc = 3V	IOL = 6mA	—	0.55	
			IOL = 12mA	—	0.8	
			IOL = 12mA	—	0.8	
		IOL = 12mA	IOL = 12mA	—	0.8	

NOTE:

1. VIH and Vil must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate Vcc range. TA = - 40°C to + 85°C.

OUTPUT DRIVE CHARACTERISTICS (B PORT)

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	Output HIGH Voltage	Vcc = 2.3V to 3.6V	IOH = - 0.1mA	Vcc - 0.2	—	V
		Vcc = 2.3V	IOH = - 6mA	2	—	
			IOH = - 12mA	1.7	—	
		Vcc = 2.7V	IOH = - 12mA	2.2	—	
			IOH = - 24mA	2.4	—	
		Vcc = 3V	IOH = - 24mA	2	—	
			IOH = - 24mA	—	0.2	V
			IOH = - 24mA	—	0.4	
			IOH = - 24mA	—	0.7	
VOL	Output LOW Voltage	Vcc = 2.3V to 3.6V	IOL = 0.1mA	—	0.2	V
		Vcc = 2.3V	IOL = 6mA	—	0.4	
			IOL = 12mA	—	0.7	
		Vcc = 2.7V	IOL = 12mA	—	0.4	
			IOL = 24mA	—	0.55	

NOTE:

1. VIH and Vil must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate Vcc range. TA = - 40°C to + 85°C.

OPERATING CHARACTERISTICS, $V_{CC} = 3.3V \pm 0.3V$, $T_A = 25^\circ C$

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power Dissipation Capacitance per Transceiver Outputs enabled	$CL = 0\text{pF}$, $f = 10\text{MHz}$	39	pF
CPD	Power Dissipation Capacitance per Transceiver Outputs disabled		4	

SWITCHING CHARACTERISTICS (A PORT)⁽¹⁾

Symbol	Parameter	$V_{CC} = 2.7V$		$V_{CC} = 3.3V \pm 0.3V$		Unit
		Min.	Max.	Min.	Max.	
t_{PLH}	Propagation Delay x_{Bx} to x_{Ax}	1.5	5.7	1.5	4.8	ns
t_{PHL}	Output Enable Time $x_{\overline{OE}}$ to x_{Ax}	1.5	7.9	1.5	6.3	ns
t_{PZH}	Output Disable Time $x_{\overline{OE}}$ to x_{Ax}	1.5	8.3	2.2	7.4	ns
t_{PLZ}		—	—	—	500	ps
$t_{SK(o)}$	Output Skew ⁽²⁾	—	—	—	500	ps

NOTES:

1. See TEST CIRCUITS AND WAVEFORMS. $T_A = -40^\circ C$ to $+85^\circ C$.
2. Skew between any two outputs of the same package and switching in the same direction.

SWITCHING CHARACTERISTICS (B PORT)⁽¹⁾

Symbol	Parameter	$V_{CC} = 2.7V$		$V_{CC} = 3.3V \pm 0.3V$		Unit
		Min.	Max.	Min.	Max.	
t_{PLH}	Propagation Delay x_{Ax} to x_{Bx}	1.5	4.7	1	4	ns
t_{PHL}	Output Enable Time $x_{\overline{OE}}$ to x_{Bx}	1.5	6.7	1.5	5.5	ns
t_{PZH}	Output Disable Time $x_{\overline{OE}}$ to x_{Bx}	1.5	7.1	1.5	6.6	ns
t_{PLZ}		—	—	—	500	ps
$t_{SK(o)}$	Output Skew ⁽²⁾	—	—	—	500	ps

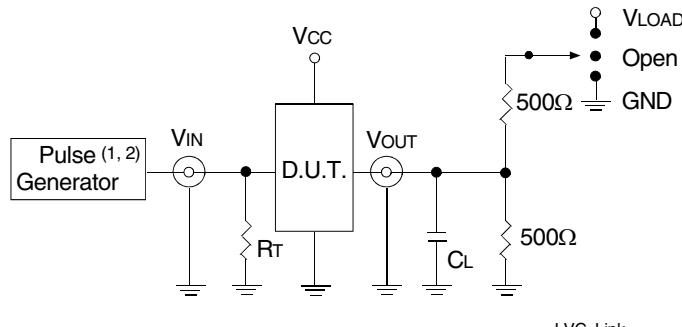
NOTES:

1. See TEST CIRCUITS AND WAVEFORMS. $T_A = -40^\circ C$ to $+85^\circ C$.
2. Skew between any two outputs of the same package and switching in the same direction.

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

Symbol	$V_{CC}^{(1)} = 3.3V \pm 0.3V$	$V_{CC}^{(1)} = 2.7V$	$V_{CC}^{(2)} = 2.5V \pm 0.2V$	Unit
V_{LOAD}	6	6	$2 \times V_{CC}$	V
V_{IH}	2.7	2.7	V_{CC}	V
V_T	1.5	1.5	$V_{CC} / 2$	V
V_{LZ}	300	300	150	mV
V_{HZ}	300	300	150	mV
C_L	50	50	30	pF



Test Circuit for All Outputs

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

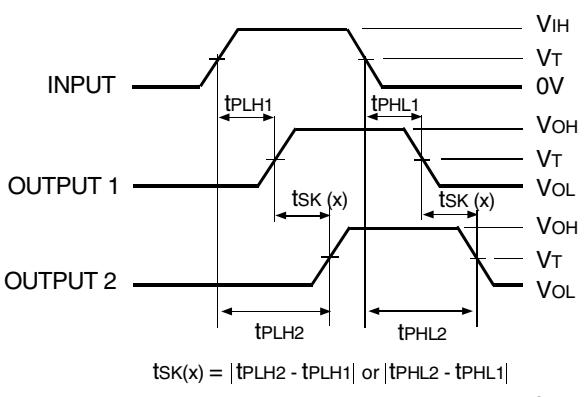
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

1. Pulse Generator for All Pulses: Rate $\leq 10\text{MHz}$; $t_f \leq 2.5\text{ns}$; $t_r \leq 2.5\text{ns}$.
2. Pulse Generator for All Pulses: Rate $\leq 10\text{MHz}$; $t_f \leq 2\text{ns}$; $t_r \leq 2\text{ns}$.

SWITCH POSITION

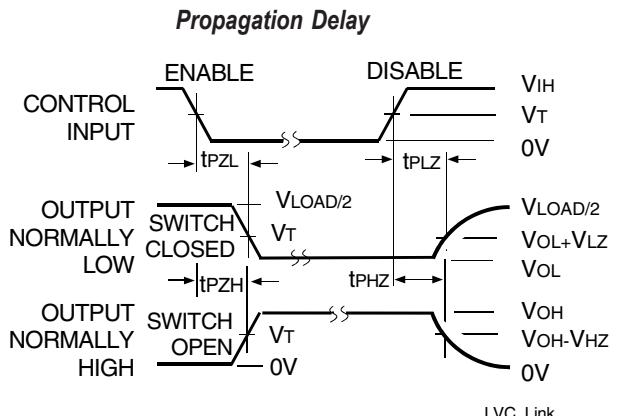
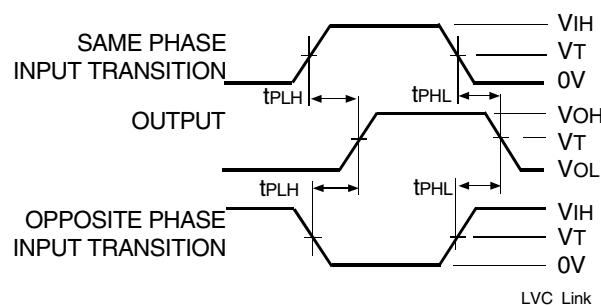
Test	Switch
Open Drain	
Disable Low	V_{LOAD}
Enable Low	
Disable High	GND
Enable High	
All Other Tests	Open



Output Skew - $tsk(x)$

NOTES:

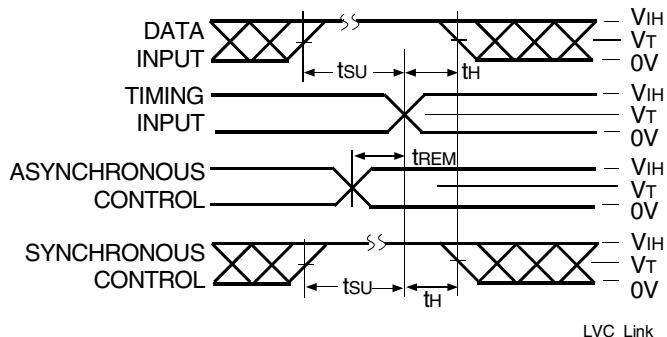
1. For $tsk(o)$ OUTPUT1 and OUTPUT2 are any two outputs.
2. For $tsk(b)$ OUTPUT1 and OUTPUT2 are in the same bank.



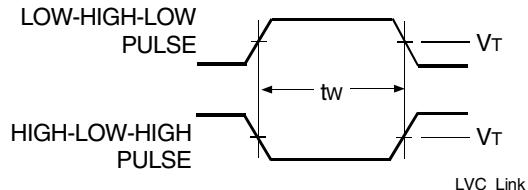
Enable and Disable Times

NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.



Set-up, Hold, and Release Times



Pulse Width

ORDERING INFORMATION

XX	LVC	X	XX	XXXX	XX	X	
Temp. Range	Bus-Hold		Family	Device Type	Package		
						Blank	Tube or Tray
						8	Tape and Reel
						PAG	Thin Shrink Small Outline Package - Green
						PFG	Thin Very Small Outline Package - Green
					245A		16-Bit Bus Transceiver
					162		Double-Density with Resistors, $\pm 24\text{mA}$ (B Port) $\pm 12\text{mA}$ (A Port)
					H		Bus-hold
					74		-40°C to +85°C

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit www.renesas.com/contact-us/.