IDT

3.3V CMOS 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O

IDT74LVC16245A

FEATURES:

– Typical $t_{SK(0)}$ (Output Skew) < 250ps
– ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
– 0.635mm pitch SSOP, 0.50mm pitch TSSOP and 0.40mm pitch TVSOP packages
– Extended commercial range of -40°C to +85°C
– V_{CC} = 3.3V ±0.3V, Normal Range
– V_{CC} = 2.7V to 3.6V, Extended Range
– CMOS power levels (0.4µW typ. static)
– All inputs, outputs and I/O are 5 Volt tolerant
– Supports hot insertion

Drive Features for LVC16245A:
– High Output Drivers: ±24 mA
– Reduced system switching noise

APPLICATIONS:

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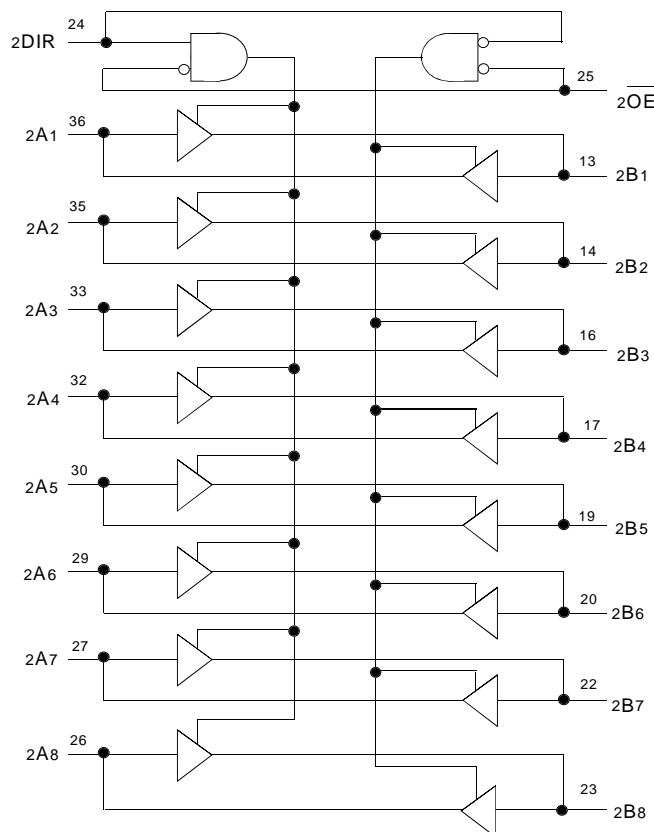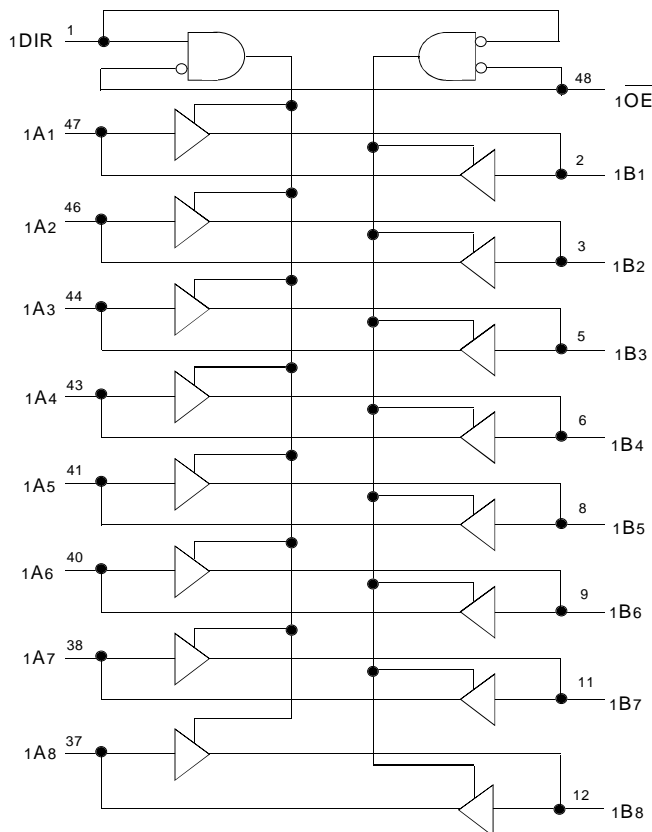• Data communication and telecommunication systems

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 ($\overline{OE}$) 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 LVC16245A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.
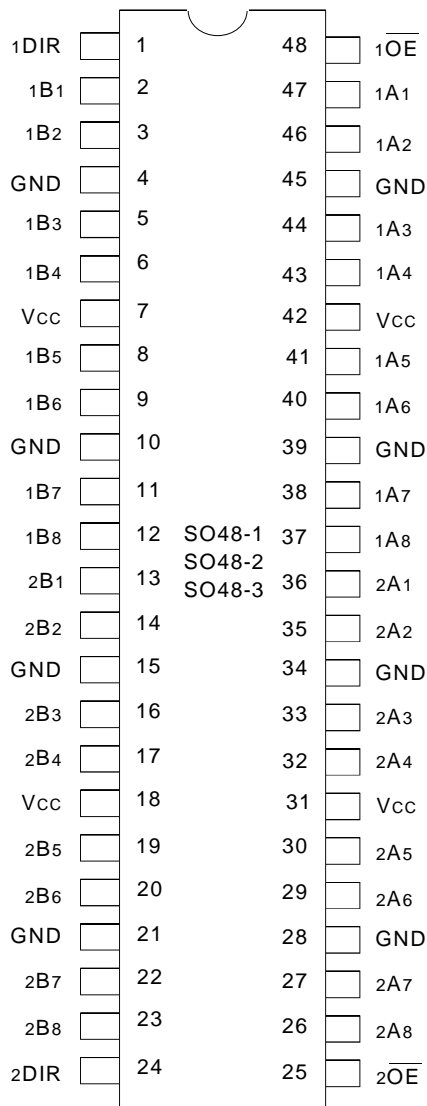
Functional Block Diagram

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	SO48-1	37	1A8
2B1	13	SO48-2 SO48-3	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
VTERM[2]	Terminal Voltage with Respect to GND	– 0.5 to +6.5	V
VTERM[3]	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
IIK IOK	Continuous Clamp Current, VI < 0 or VO < 0	– 50	mA
ICC ISS	Continuous Current through each VCC or GND	±100	mA

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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. All terminals except VCC.

CAPACITANCE (TA = +25°C, f = 1.0MHz)

Symbol	Parameter[1]	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance	VIN = 0V	4.5	6	pF
COUT	Output Capacitance	VOUT = 0V	6.5	8	pF
CI/O	I/O Port Capacitance	VIN = 0V	6.5	8	pF

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NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
x$\overline{OE}$	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

FUNCTION TABLE (each 8-bit section) [1]

Inputs		Outputs
x$\overline{OE}$	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:
Operating Condition: T_A = –40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ.[1]	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CC} = 2.3V to 2.7V		1.7	—	—	V
		V_{CC} = 2.7V to 3.6V		2	—	—	
V_{IL}	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 ≤ 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}	Quiescent Power Supply Current	V_{CC} = 3.6V	V_{IN} = GND or V_{CC}	—	—	10	µA
I_{CCZ}			3.6 ≤ V_{IN} ≤ 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

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NOTES:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.
2. This applies in the disabled state only.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = 2.3V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CC} = 2.3V	I_{OH} = – 6mA	2	—	
		V_{CC} = 2.3V	I_{OH} = – 12mA	1.7	—	
		V_{CC} = 2.7V		2.2	—	
		V_{CC} = 3.0V		2.4	—	
		V_{CC} = 3.0V	I_{OH} = – 24mA	2.2	—	
V_{OL}	Output LOW Voltage	V_{CC} = 2.3V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CC} = 2.3V	I_{OL} = 6mA	—	0.4	
			I_{OL} = 12mA	—	0.7	
		V_{CC} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CC} = 3.0V	I_{OL} = 24mA	—	0.55	

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NOTE:
1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to +85°C.

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

Symbol	Parameter	Test Conditions	Typical	Unit
C_{PD}	Power Dissipation Capacitance per Transceiver Outputs enabled	C_L = 0pF, f = 10Mhz	38	pF
C_{PD}	Power Dissipation Capacitance per Transceiver Outputs disabled		4	pF

SWITCHING CHARACTERISTICS [1]

Symbol	Parameter	V_{CC} = 2.7V		V_{CC} = 3.3V $\pm$ 0.3V		Unit
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xAx to xBx, xBx to xAx	—	4.7	1	4	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OE}$ to xAx or xBx	—	6.7	1.5	5.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OE}$ to xAx or xBx	—	7.1	1.5	6.6	ns
t_{SK}(o)	Output Skew[2]	—	—	—	1	ns

NOTES:
1. See test circuits and waveforms. T_A = $-$ 40°C to + 85°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 ±0.3V	$V_{CC}^{(1)}$ = 2.7V	$V_{CC}^{(2)}$= 2.5V ±0.2V	Unit
V_{LOAD}	6	6	2 x 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

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TEST CIRCUITS FOR ALL OUTPUTS
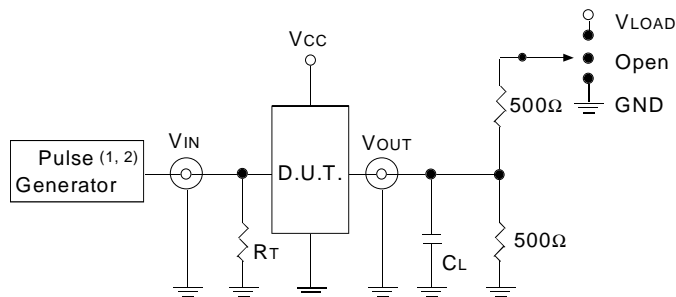
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DEFINITIONS:

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 ≤ 10MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2ns; t_R ≤ 2ns.

SWITCH POSITION

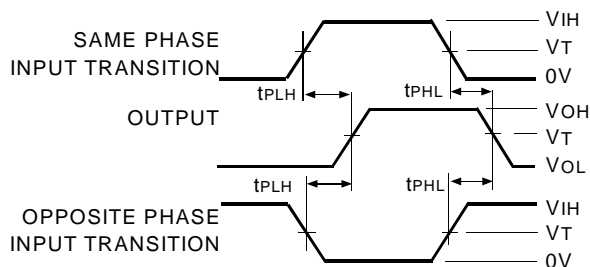| Test	Switch
Open Drain Disable Low Enable Low	V_{LOAD}
Disable High Enable High	GND
All Other tests	Open

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OUTPUT SKEW - tsk (x)
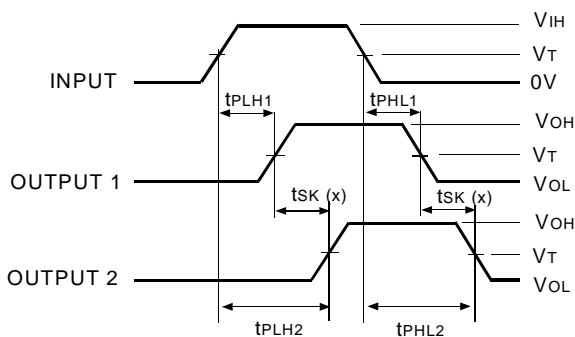
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$
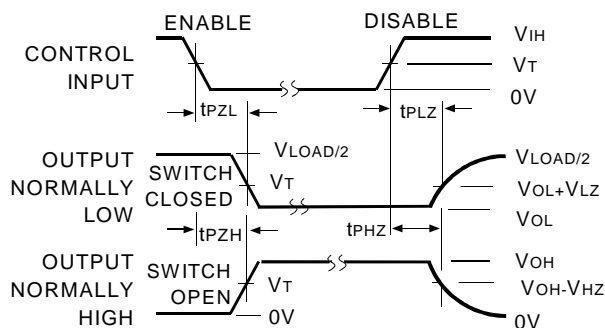
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NOTES:
1. For $t_{SK}(o)$ OUTPUT1 and OUTPUT2 are any two outputs.
2. For $t_{SK}(b)$ OUTPUT1 and OUTPUT2 are in the same bank.

PROPAGATION DELAY
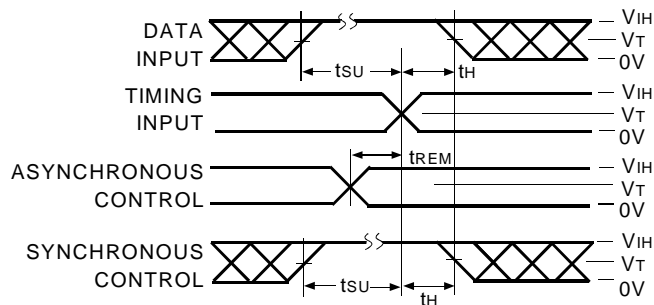

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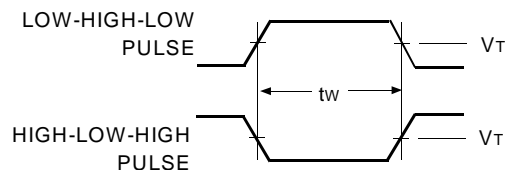## ENABLE AND DISABLE TIMES

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

SET-UP, HOLD, AND RELEASE TIMES

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PULSE WIDTH

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ORDERING INFORMATION

IDT <u>XX</u> LVC <u>X</u> <u>XX</u> <u>XXXX</u> <u>XX</u>
Temp. Range Bus-Hold Family Device Type Package

PV   Shrink Small Outline Package (SO48-1)
PA   Thin Shrink Small Outline Package (SO48-2)
PF   Thin Very Small Outline Package (SO48-3)

245A   16-Bit Bus Transceiver with 3-State Outputs

16   Double-Density with Resistors, ±24mA

Blank   No Bus-hold

74   -40°C to +85°C