3.3V CMOS OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O, AND BUS-HOLD

IDT74LVCH2245A

FEATURES:

– 0.5 MICRON CMOS Technology
– ESD > 2000V per MIL-STD-883, Method 3015;
  > 200V using machine model (C = 200pF, R = 0)
– 1.27mm pitch SOIC, 0.65mm pitch SSOP,
  0.635mm pitch QSOP, 0.65mm pitch TSSOP packages
– Extended commercial range of – 40°C to +85°C
– Vcc = 3.3V ±0.3V, Normal Range
– Vcc = 2.3V to 3.6V, Extended Range
– CMOS power levels (0.4μW typ. static)
– Rail-to-Rail output swing for increased noise margin
– All inputs, outputs and I/O are 5 Volt tolerant
– Supports hot insertion

Drive Features for LVCH2245A:

– Balanced Output Drivers: ±12mA (B port)
– High Output Drivers : ±24mA (A port)

APPLICATIONS:

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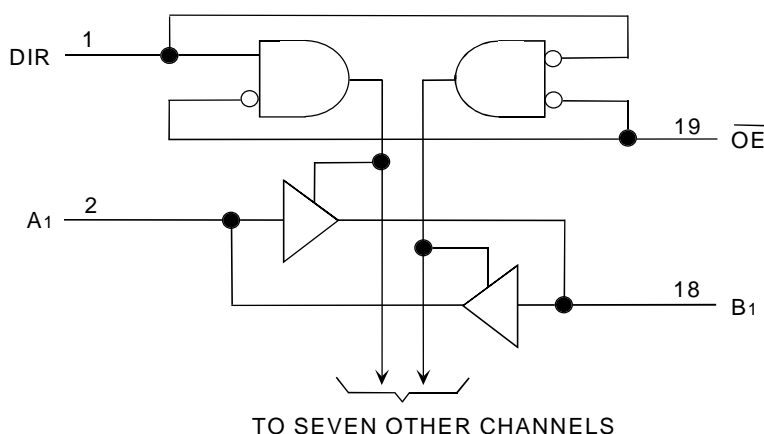• Data communication and telecommunication systems

DESCRIPTION:

This bus transceiver is built using advanced dual metal CMOS technology. The LVCH2245A device is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the device so the buses are effectively isolated.

Inputs 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 environment.
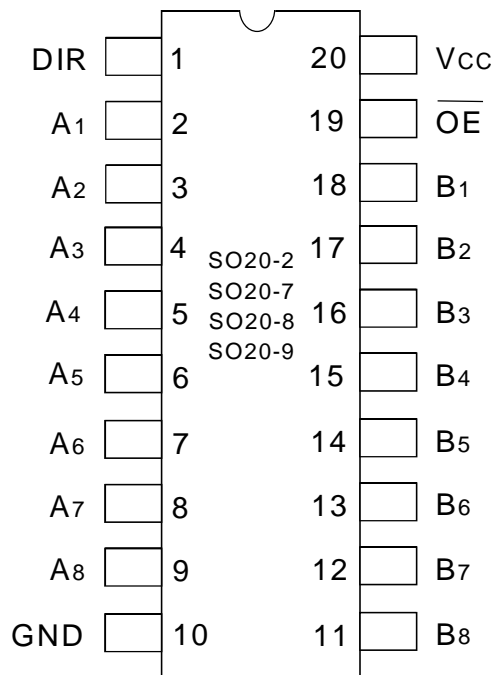
The LVCH2245A has series resistors in the output structure of the "B" port, which will significantly reduce line noise when used with light loads. The driver has been designed to drive ±12mA at the designated threshold levels. The "A" port has a ±24mA driver.

The LVCH2245A 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

TO SEVEN OTHER CHANNELS

DSC-4937/-

PIN CONFIGURATION

```
            ┌────────┐
    DIR ──┤ 1    20 ├── VCC
     A1 ──┤ 2    19 ├── OE
     A2 ──┤ 3    18 ├── B1
     A3 ──┤ 4    17 ├── B2
          │ SO20-2 │
     A4 ──┤ SO20-7 │
          │ SO20-8 5  16 ├── B3
          │ SO20-9 │
     A5 ──┤ 6    15 ├── B4
     A6 ──┤ 7    14 ├── B5
     A7 ──┤ 8    13 ├── B6
     A8 ──┤ 9    12 ├── B7
    GND ──┤ 10   11 ├── B8
            └────────┘
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SOIC/ SSOP/ QSOP/ TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS [1]

Symbol	Description	Max.	Unit
V_{TERM}	Terminal Voltage with Respect to GND	– 0.5 to +6.5	V
T_{STG}	Storage Temperature	– 65 to +150	°C
I_{OUT}	DC Output Current	– 50 to +50	mA
I_{IK} I_{OK}	Continuous Clamp Current, $V_I < 0$ or $V_O < 0$	– 50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

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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 $(T_A = +25°C, f = 1.0MHz)$

Symbol	Parameter[1]	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	$V_{IN} = 0V$	4.5	6	pF
C_{OUT}	Output Capacitance	$V_{OUT} = 0V$	5.5	8	pF
$C_{I/O}$	I/O Port Capacitance	$V_{IN} = 0V$	6.5	8	pF

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NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
$\overline{OE}$	Output-enable Input (Active LOW)
xAx	Side A Inputs or 3-State Outputs [1]
xBx	Side B Inputs or 3-State Outputs [1]
DIR	Direction-control Input

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

FUNCTION TABLE [1]

Inputs		Outputs
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

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

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.

BUS-HOLD CHARACTERISTICS

Symbol	Parameter[1]	Test Conditions		Min.	Typ.[2]	Max.	Unit
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 3.0V	V_I = 2.0V	– 75	—	—	µA
I_{BHL}			V_I = 0.8V	75	—	—	
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 2.3V	V_I = 1.7V	—	—	—	µA
I_{BHL}			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

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NOTES:
1. Pins with Bus-hold are identified in the pin description.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS FOR PORT A

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	—	
		VCC = 2.3V	IOH = – 12mA	1.7	—	
		VCC = 2.7V		2.2	—	
		VCC = 3.0V		2.4	—	
		VCC = 3.0V	IOH = – 24mA	2.2	—	
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	
		VCC = 3.0V	IOL = 24mA	—	0.55	

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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 FOR PORT B

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 = 3.0V	IOH = – 6mA	2.4	—	
			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 = 3.0V	IOL = 6mA	—	0.55	
			IOL = 12mA	—	0.8	

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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°C

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power dissipation capacitance per tranceiver Outputs enabled	CL = 0pF, f = 10Mhz	48	pF
CPD	Power dissipation capacitance per tranceiver Outputs disabled		4	pF

SWITCHING CHARACTERISTICS (A PORT) [(1)]

Symbol	Parameter	Vcc = 2.7V		Vcc = 3.3V±0.3V		Unit
		Min.	Max.	Min.	Max.	
tPLH tPHL	Propagation Delay xBx to xAx	—	7.3	1.5	6.3	ns
tPZH tPZL	Output Enable Time x$\overline{OE}$ to xAx	—	9.5	1.5	8.5	ns
tPHZ tPLZ	Output Disable Time x$\overline{OE}$ to xAx	—	8.5	1.7	7.5	ns
tSK(o)	Output Skew[(2)]	—	—	—	500	ps

SWITCHING CHARACTERISTICS (B PORT)[(1)]

Symbol	Parameter	Vcc = 2.7V		Vcc = 3.3V±0.3V		Unit
		Min.	Max.	Min.	Max.	
tPLH tPHL	Propagation Delay xAx to xBx	—	8.1	1.5	7.1	ns
tPZH tPZL	Output Enable Time x$\overline{OE}$ to xBx	—	10	1.5	9	ns
tPHZ tPLZ	Output Disable Time x$\overline{OE}$ to xBx	—	9.2	1.7	8.2	ns
tSK(o)	Output Skew[(2)]	—	—	—	500	ps

NOTES:

1. See test circuits and waveforms. TA = − 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
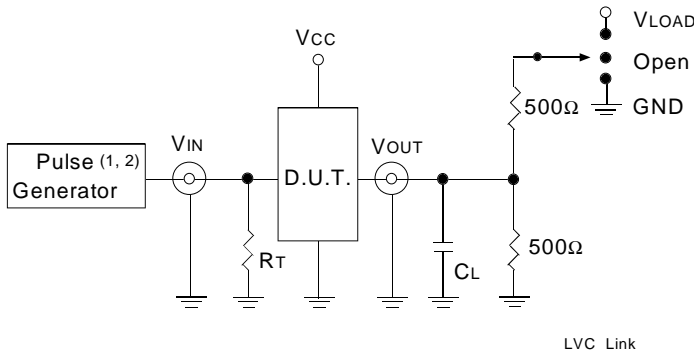
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DEFINITIONS:
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

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)
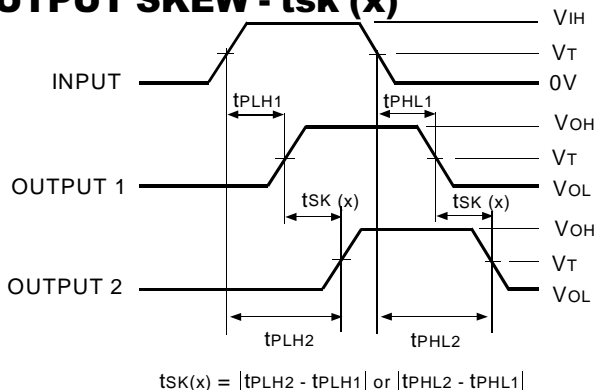
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

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NOTES:
1. For $t_{SK}(o)$ OUTPUT1 and OUTPUT2 are any two outputs.
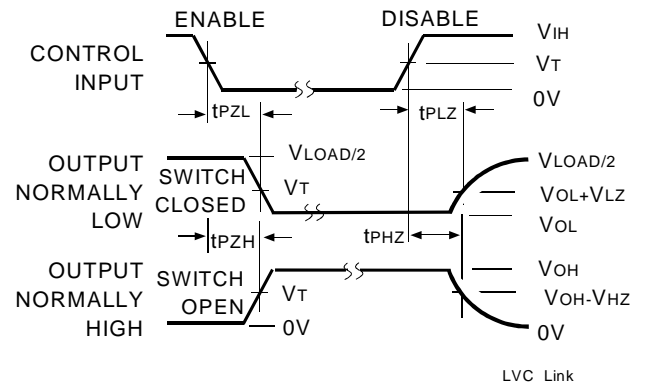2. For $t_{SK}(b)$ OUTPUT1 and OUTPUT2 are in the same bank.

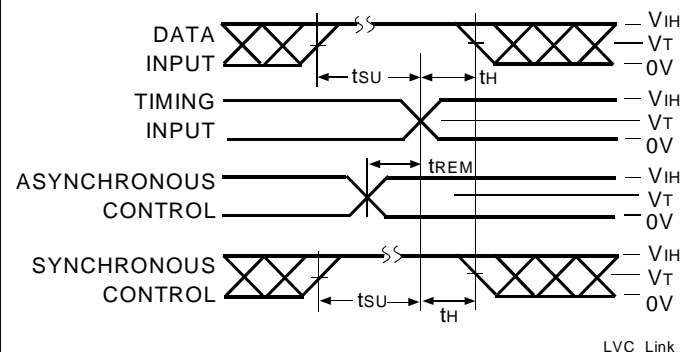## PROPAGATION DELAY
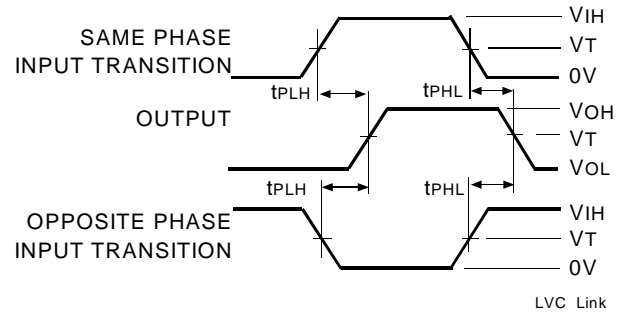
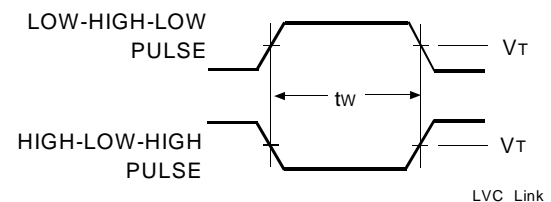
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ENABLE AND DISABLE TIMES

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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

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IDT____XX____LVC___X___ __XXXX__ __XX__
    Temp. Range   Bus-Hold  Device Type  Package
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SO   Small Outline IC (gull wing) (SO20-2)
PY   Shrink Small Outline Package (SO20-7)
Q   Quarter Size Small Outline Package (SO20-8)
PG   Thin Shrink Small Outline Package (SO20-9)

2245A   Octal Bus Transceiver with 3-State Outputs, ±12mA (B port)
±24mA (A port)

H   Bus-hold

74   −40°C to +85°C