IDT

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

IDT74LVC4245A

FEATURES:
- 0.5 MICRON CMOS Technology
- $V_{CCA} = 5V \pm 0.5V$
- $V_{CCB} = 2.7V$ to $3.6V$
- CMOS power levels (0.4µ W typ. static)
- Rail-to-rail output swing for increased noise margin
- All inputs, outputs, and I/O are 5V tolerant
- Supports hot insertion
- Available in SOIC, SSOP, QSOP, and TSSOP packages

DRIVE FEATURES:
- High Output Drivers: ±24mA
- Reduced system switching noise

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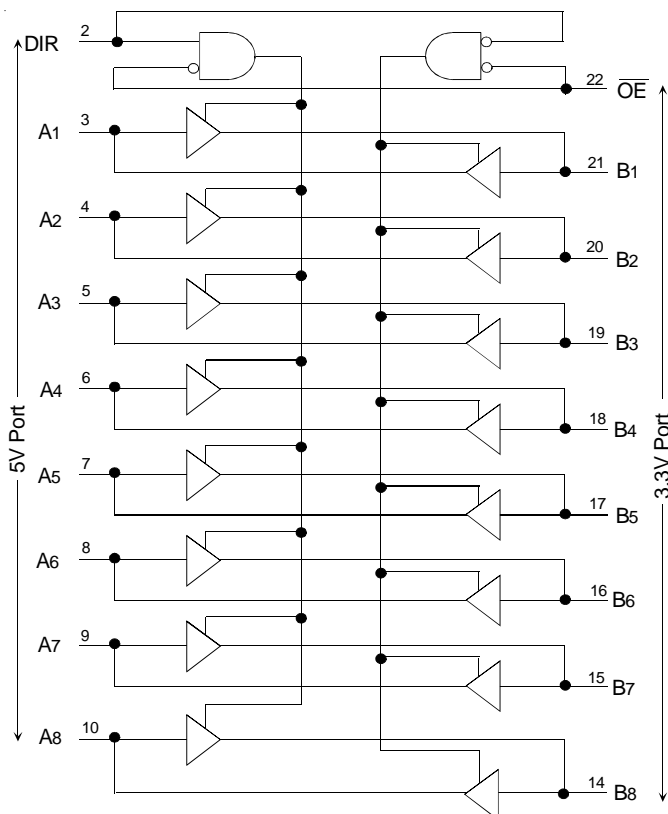- Data communication and telecommunication systems

DESCRIPTION:
The LVC4245A is manufactured using advanced dual metal CMOS technology. This octal noninverting bus transceiver contains two separate supply rails; B port has V_{CCB}, which is set at 3.3V, and A port has V_{CCA}, which is set at 5V. This allows for translation from a 3.3V to a 5V environment, and vice-versa.
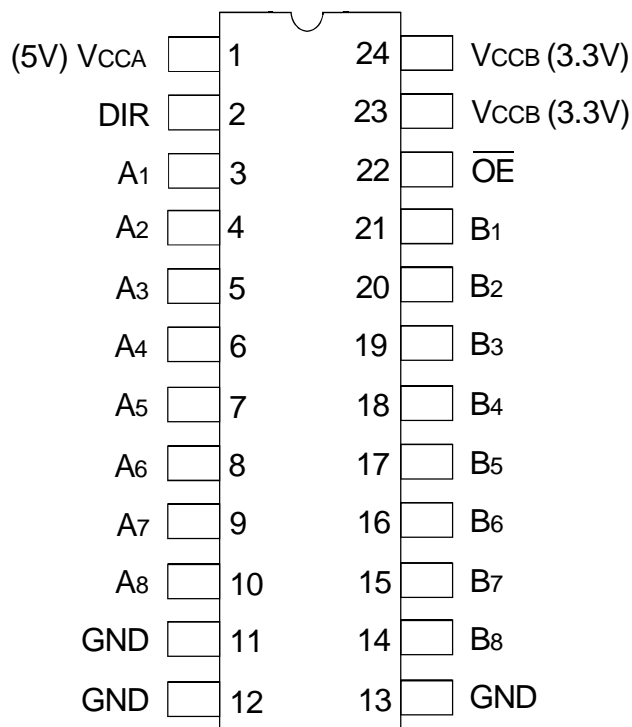
This device is ideal for asynchronous communication between two buses (A and B). The direction control pin (DIR) controls the direction of data flow. The output enable pin ($\overline{OE}$) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

The LVC4245A 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

INDUSTRIAL TEMPERATURE RANGE   JULY 2000

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IDT74LVC4245A
CMOS OCTAL BUS TRANSCEIVER AND 3.3V TO 5V SHIFTER

INDUSTRIAL TEMPERATURE RANGE

PIN CONFIGURATION

(5V) V_{CCA}	1		24	V_{CCB} (3.3V)
DIR	2		23	V_{CCB} (3.3V)
A_1	3		22	$\overline{OE}$
A_2	4		21	B_1
A_3	5		20	B_2
A_4	6		19	B_3
A_5	7		18	B_4
A_6	8		17	B_5
A_7	9		16	B_6
A_8	10		15	B_7
GND	11		14	B_8
GND	12		13	GND

SOIC/ SSOP/ QSOP/ TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS
FOR V_{CCB} OR V_{CCB}[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

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 or V_{CCA} V_{CCA} = Open	5	—	pF
$C_{I/O}$	I/O Port Capacitance[2]	V_{OUT} = V_{CCA} or GND V_{CCA} = 5V	11	—	pF
$C_{I/O}$	I/O Port Capacitance[3]	V_{IN} = V_{CCB} or GND V_{CCB} = 3.3V	11	—	pF

NOTES:
1. As applicable to the device type.
2. For A port only.
3. For B port only.

PIN DESCRIPTION

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

FUNCTION TABLE[1]

Inputs		Outputs
$\overline{OE}$	DIR	
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

IDT74LVC4245A
CMOS OCTAL BUS TRANSCEIVER AND 3.3V TO 5V SHIFTER   **INDUSTRIAL TEMPERATURE RANGE**

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (A PORT)

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: $T_A = -40°C$ to $+85°C$, $V_{CCA} = 5V \pm 0.5V^{(1)}$

Symbol	Parameter	Test Conditions		Min.	Typ.[2]	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CCA} = 4.5V to 5.5V		2	—	—	V
V_{IL}	Input LOW Voltage Level	V_{CCA} = 4.5V to 5.5V		—	—	0.8	V
I_{IH} I_{IL}	Input Leakage Current	V_{CCA} = 5.5V	V_I = 0 to 5.5V	—	—	±1	µA
I_{OZH} I_{OZL}	High Impedance Output Current (3-State Output pins)	V_{CCA} = 5.5V	V_O = 0 to 5.5V	—	—	±5	µA
V_H	Input Hysteresis	V_{CCA} = 5V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CCA} = 5.5V	V_{IN} = GND or V_{CCA}	—	—	80	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at 3.4V, other inputs at V_{CCA} or GND V_{CCA} = 4.5V to 5.5V		—	—	1.5	mA

NOTES:
1. V_{CCB} = 2.7V to 3.6V.
2. Typical values are at V_{CCA} = 5V, +25°C ambient.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (B PORT)

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: $T_A = -40°C$ to $+85°C$, $V_{CCB} = 2.7V$ to $3.6V^{(1)}$

Symbol	Parameter	Test Conditions		Min.	Typ.[2]	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CCB} = 2.7V to 3.6V		2	—	—	V
V_{IL}	Input LOW Voltage Level	V_{CCB} = 2.7V to 3.6V		—	—	0.8	V
I_{OZH} I_{OZL}	High Impedance Output Current (3-State Output pins)	V_{CCB} = 3.6V	V_O = 0 to V_{CCB}	—	—	±5	µA
V_H	Input Hysteresis	V_{CCB} = 3.3V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CCB} = 3.6V	V_{IN} = GND or V_{CCB}	—	—	50	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CCB} - 0.6V, other inputs at V_{CCB} or GND V_{CCB} = 2.7V to 3.6V		—	—	500	µA

NOTES:
1. V_{CCA} = 5V ± 0.5V.
2. Typical values are at V_{CCB} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS, V_{CCA} = 5V ± 0.5V (A PORT)

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage (B Port to A Port)	V_{CCA} = 4.5V	I_{OH} = – 0.1mA	4.3	—	V
		V_{CCA} = 5.5V		5.3	—	
		V_{CCA} = 4.5V	I_{OH} = – 24mA	3.7	—	
		V_{CCA} = 5.5V		4.7	—	
V_{OL}	Output LOW Voltage (B Port to A Port)	V_{CCA} = 4.5V	I_{OL} = 0.1mA	—	0.2	V
		V_{CCA} = 5.5V		—	0.2	
		V_{CCA} = 4.5V	I_{OL} = 24mA	—	0.55	
		V_{CCA} = 5.5V		—	0.55	

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, V_{CCB} = 2.7V to 3.6V.

OUTPUT DRIVE CHARACTERISTICS, V_{CCB} = 2.7V TO 3.6V (B PORT)

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage (A Port to B Port)	V_{CCB} = 2.7V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CCB} = 2.7V	I_{OH} = – 12mA	2.2	—	
		V_{CCB} = 3V		2.4	—	
		V_{CCB} = 3V	I_{OH} = – 24mA	2	—	
V_{OL}	Output LOW Voltage (A Port to B Port)	V_{CCB} = 2.7V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CCB} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CCB} = 3V	I_{OL} = 24mA	—	0.55	

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, V_{CCA} = 5V ± 0.5V.

OPERATING CHARACTERISTICS, T_A = 25°C

| Symbol	Parameter	Test Conditions	V_{CCA} = 5V, V_{CCB} = 3.3V Typical	Unit
C_{PD}	Power Dissipation Capacitance per Transceiver Outputs enabled	C_L = 0pF, f = 10Mhz	39.5	pF
C_{PD}	Power Dissipation Capacitance per Transceiver Outputs disabled		5	

SWITCHING CHARACTERISTICS[1]

Symbol	Parameter	VCCA = 5V ± 0.5V VCCB = 2.7V to 3.6V		Unit
		Min.	Max.	
tPLH	Propagation Delay	1	6.3	ns
tPHL	Ax to Bx	1	6.7	
tPLH	Propagation Delay	1	6.1	ns
tPHL	Bx to Ax	1	5	
tPZL	Output Enable Time	1	8.8	ns
tPLZ	$\overline{OE}$ to Bx	1	9.8	
tPZL	Output Enable Time	1	9	ns
tPLZ	$\overline{OE}$ to Ax	1	8.1	
tPLZ	Output Disable Time	1	7.7	ns
tPHZ	$\overline{OE}$ to Bx	1	7.8	
tPLZ	Output Disable Time	1	7	ns
tPHZ	$\overline{OE}$ to Ax	1	5.8	

NOTE:

1. See TEST CIRCUITS AND WAVEFORMS. T_A = – 40°C to + 85°C.

LOAD CIRCUIT AND VOLTAGE WAVEFORMS
PARAMETER MEASUREMENT INFORMATION (A PORT)
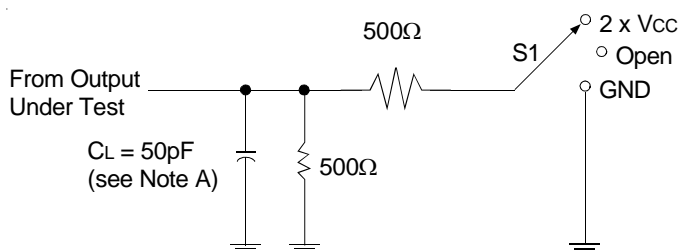
Load Circuit
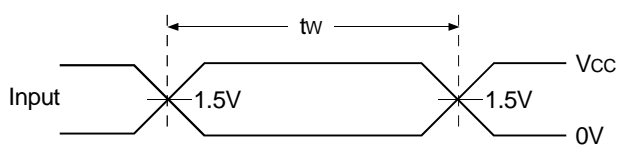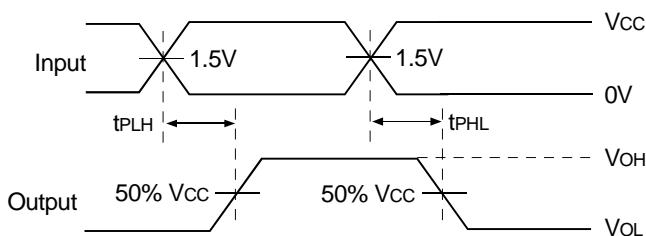
TEST CONDITIONS

TEST	S1
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	2 x V_{CC}
t_{PHZ} / t_{PZH}	GND
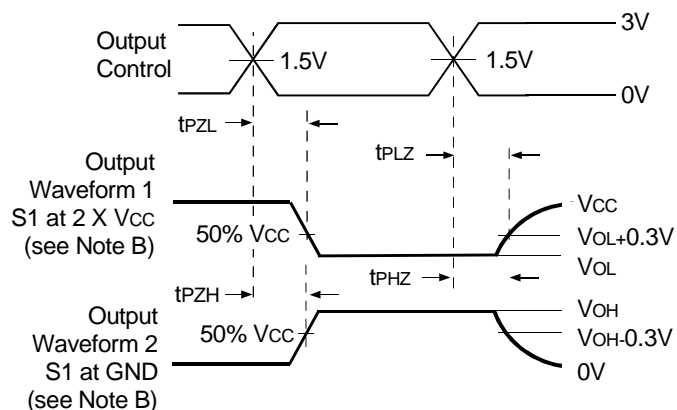
Voltage Waveforms Pulse Duration

Voltage Waveforms Enable and Disable Times
Low- and High-Level Enabling

Voltage Waveforms Propagation Delay Times
Noninverting Outputs

NOTES:

A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control.
   Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz; Zo = 50Ω; t_F ≤ 2.5ns; t_R ≤ 2.5ns.

D. The outputs are measured one at a time with one transition per measurement.
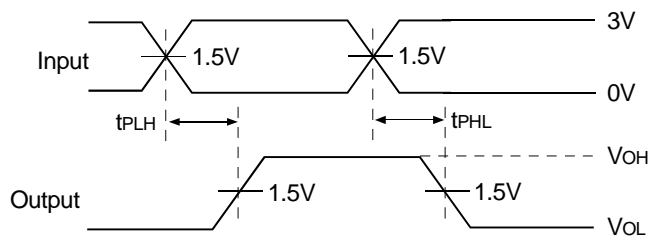
LOAD CIRCUIT AND VOLTAGE WAVEFORMS
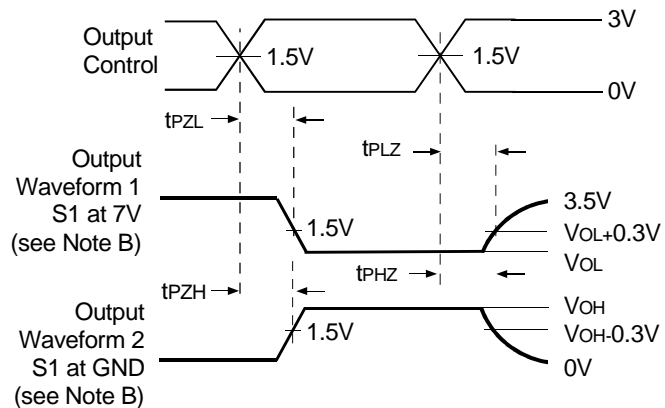## PARAMETER MEASUREMENT INFORMATION (B PORT)
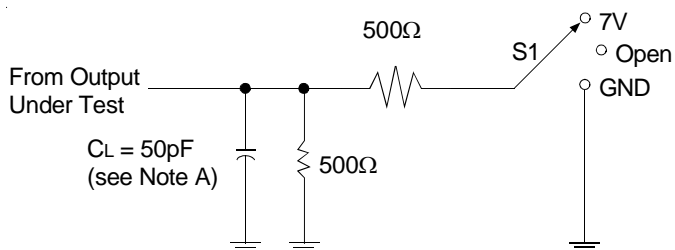
Load Circuit
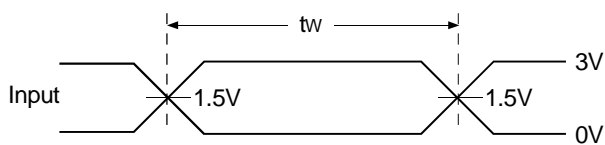
TEST CONDITIONS

TEST	S1
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	7V
t_{PHZ} / t_{PZH}	GND

Voltage Waveforms Pulse Duration

Voltage Waveforms Propagation Delay Times
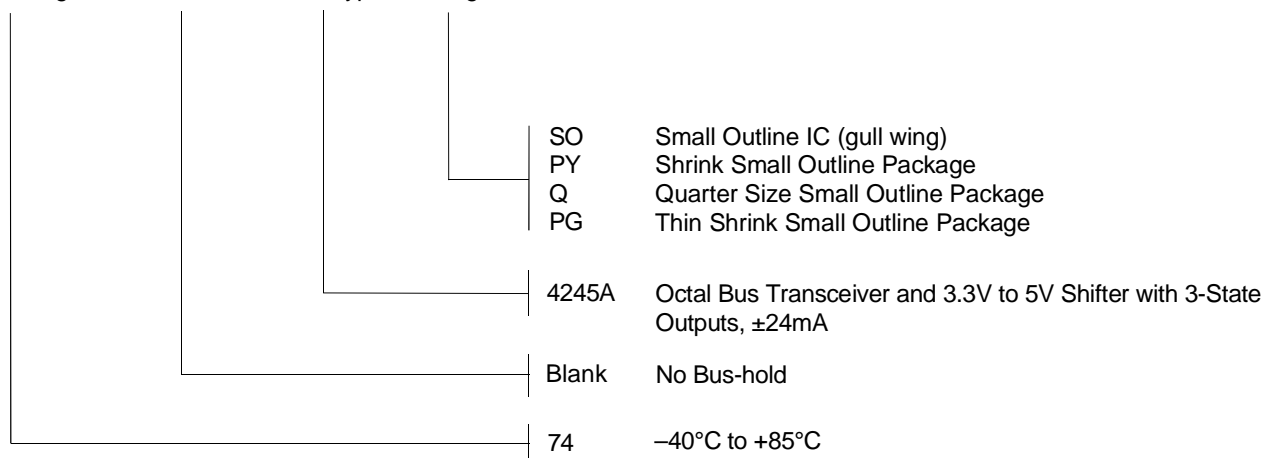*Noninverting Outputs*

Voltage Waveforms Enable and Disable Times
Low- and High-Level Enabling

NOTES:

A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control.
   Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR $\leq$ 10MHz; Z_o = 50Ω; $t_F \leq$ 2.5ns; $t_R \leq$ 2.5ns.

D. The outputs are measured one at a time with one transition per measurement.

ORDERING INFORMATION

IDT   XX   LVC   X   XXXX   XX
    Temp. Range   Bus-Hold   Device Type Package

SO	Small Outline IC (gull wing)
PY	Shrink Small Outline Package
Q	Quarter Size Small Outline Package
PG	Thin Shrink Small Outline Package
4245A	Octal Bus Transceiver and 3.3V to 5V Shifter with 3-State Outputs, ±24mA
Blank	No Bus-hold
74	−40°C to +85°C

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