



# CMOS OCTAL BUS TRANSCEIVER AND 3.3V TO 5V SHIFTER WITH 3-STATE OUT- PUTS 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 ( $0.4\mu W$  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:  $\pm 24mA$
- Reduced system switching noise

### APPLICATIONS:

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

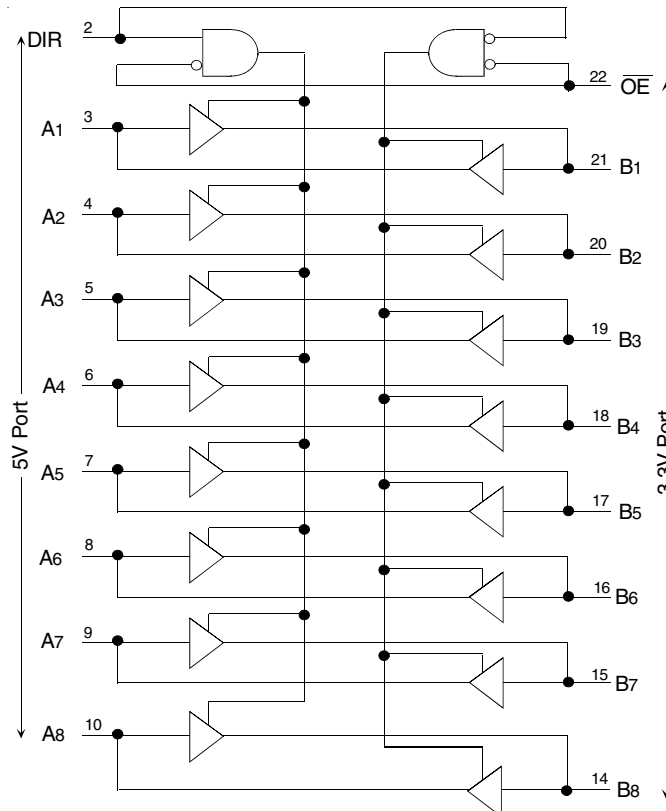
### DESCRIPTION:

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  $\pm 24mA$  output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

## FUNCTIONAL BLOCK DIAGRAM

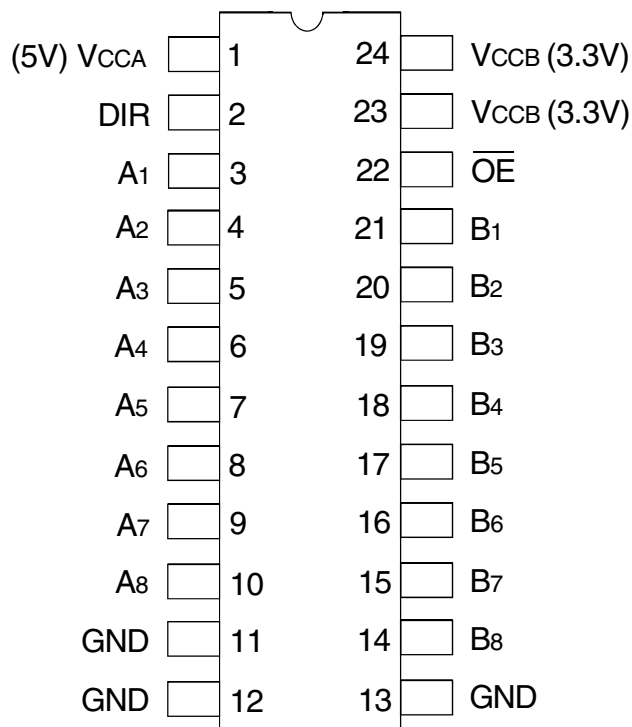


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**INDUSTRIAL TEMPERATURE RANGE**

February 20, 2009

## PIN CONFIGURATION



SOIC/ SSOP/ QSOP/ TSSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS FOR V<sub>CCB</sub> OR V<sub>CCB</sub>(<sup>1</sup>)

Symbol	Description	Max	Unit
V <sub>TERM</sub>	Terminal Voltage with Respect to GND	-0.5 to +6.5	V
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C
I <sub>OUT</sub>	DC Output Current	-50 to +50	mA
I <sub>IK</sub> I <sub>OK</sub>	Continuous Clamp Current, V <sub>I</sub> < 0 or V <sub>O</sub> < 0	-50	mA
I <sub>CC</sub> I <sub>SS</sub>	Continuous Current through each V <sub>CC</sub> or GND	±100	mA

### NOTE:

- 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<sub>A</sub> = +25°C, F = 1.0MHz)

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V or V <sub>CCA</sub> V <sub>CCA</sub> = Open	5	—	pF
C <sub>I/O</sub>	I/O Port Capacitance <sup>(2)</sup>	V <sub>OUT</sub> = V <sub>CCA</sub> or GND V <sub>CCA</sub> = 5V	11	—	pF
C <sub>I/O</sub>	I/O Port Capacitance <sup>(3)</sup>	V <sub>IN</sub> = V <sub>CCB</sub> or GND V <sub>CCB</sub> = 3.3V	11	—	pF

### NOTES:

- As applicable to the device type.
- For A port only.
- For B port only.

## PIN DESCRIPTION

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

## FUNCTION TABLE<sup>(1)</sup>

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:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (A PORT)

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CCA} = 5\text{V} \pm 0.5\text{V}^{(1)}$

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

**NOTES:**

- $V_{CCB} = 2.7\text{V}$  to  $3.6\text{V}$ .
- Typical values are at  $V_{CCA} = 5\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (B PORT)

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CCB} = 2.7\text{V}$  to  $3.6\text{V}^{(1)}$

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

**NOTES:**

- $V_{CCA} = 5\text{V} \pm 0.5\text{V}$ .
- Typical values are at  $V_{CCB} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.

### OUTPUT DRIVE CHARACTERISTICS, $V_{CCA} = 5V \pm 0.5V$ (A PORT)

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Max.	Unit
VOH	Output HIGH Voltage (B Port to A Port)	VCCA = 4.5V	IOH = -0.1mA	4.3	—	V
		VCCA = 5.5V		5.3	—	
		VCCA = 4.5V	IOH = -24mA	3.7	—	
		VCCA = 5.5V		4.7	—	
VOL	Output LOW Voltage (B Port to A Port)	VCCA = 4.5V	IOL = 0.1mA	—	0.2	V
		VCCA = 5.5V		—	0.2	
		VCCA = 4.5V	IOL = 24mA	—	0.55	
		VCCA = 5.5V		—	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, VCCB = 2.7V to 3.6V.

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

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Max.	Unit
VOH	Output HIGH Voltage (A Port to B Port)	VCCB = 2.7V to 3.6V	IOH = -0.1mA	VCC - 0.2	—	V
		VCCB = 2.7V	IOH = -12mA	2.2	—	
		VCCB = 3V		2.4	—	
		VCCB = 3V	IOH = -24mA	2	—	
VOL	Output LOW Voltage (A Port to B Port)	VCCB = 2.7V to 3.6V	IOL = 0.1mA	—	0.2	V
		VCCB = 2.7V	IOL = 12mA	—	0.4	
		VCCB = 3V	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, VCCA = 5V ± 0.5V.

### OPERATING CHARACTERISTICS, TA = 25°C

Symbol	Parameter	Test Conditions	VCCA = 5V, VCCB = 3.3V	Unit
			Typical	
CPD	Power Dissipation Capacitance per Transceiver Outputs enabled	CL = 0pF, f = 10Mhz	39.5	pF
CPD	Power Dissipation Capacitance per Transceiver Outputs disabled		5	

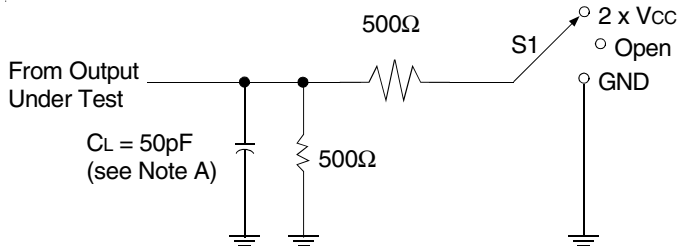
SWITCHING CHARACTERISTICS<sup>(1)</sup>

Symbol	Parameter	V <sub>CCA</sub> = 5V ± 0.5V V <sub>CCB</sub> = 2.7V to 3.6V		Unit
		Min.	Max.	
t <sub>PLH</sub>	Propagation Delay	1	6.3	ns
t <sub>PHL</sub>	Ax to Bx	1	6.7	
t <sub>PLH</sub>	Propagation Delay	1	6.1	ns
t <sub>PHL</sub>	Bx to Ax	1	5	
t <sub>PZL</sub>	Output Enable Time	1	8.8	ns
t <sub>PLZ</sub>	$\overline{OE}$ to Bx	1	9.8	
t <sub>PZL</sub>	Output Enable Time	1	9	ns
t <sub>PLZ</sub>	$\overline{OE}$ to Ax	1	8.1	
t <sub>PLZ</sub>	Output Disable Time	1	7.7	ns
t <sub>PHZ</sub>	$\overline{OE}$ to Bx	1	7.8	
t <sub>PLZ</sub>	Output Disable Time	1	7	ns
t <sub>PHZ</sub>	$\overline{OE}$ to Ax	1	5.8	

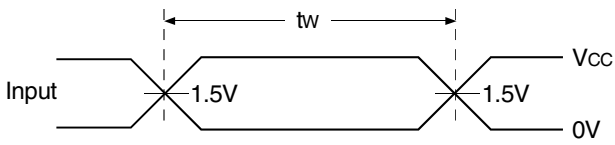
NOTE:

1. See TEST CIRCUITS AND WAVEFORMS. T<sub>A</sub> = - 40°C to + 85°C.

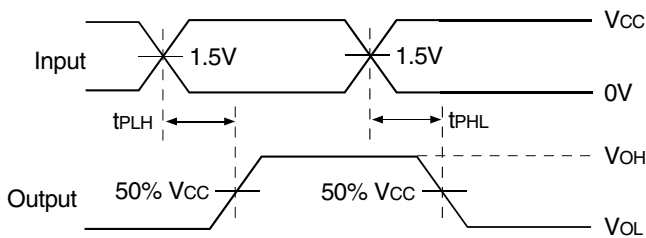
LOAD CIRCUIT AND VOLTAGE WAVEFORMS  
PARAMETER MEASUREMENT INFORMATION (A PORT)



Load Circuit



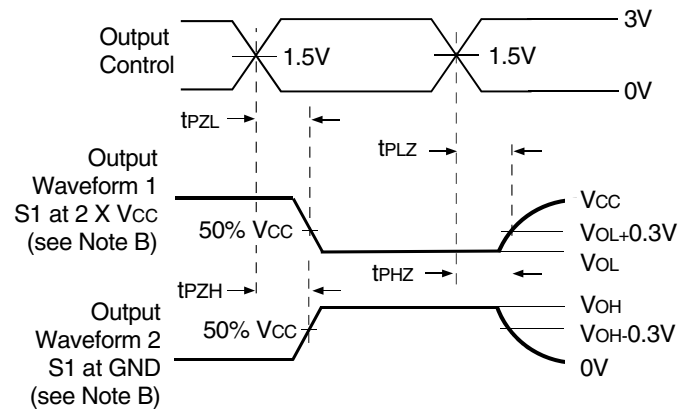
Voltage Waveforms Pulse Duration



Voltage Waveforms Propagation Delay Times  
Noninverting Outputs

TEST CONDITIONS

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND

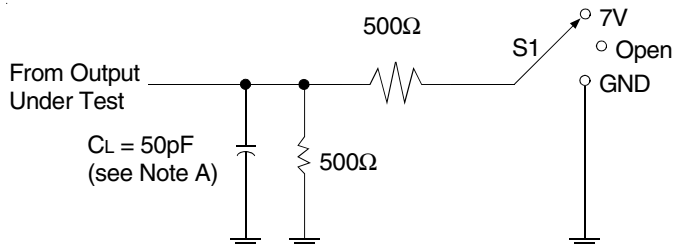


Voltage Waveforms Enable and Disable Times  
Low- and High-Level Enabling

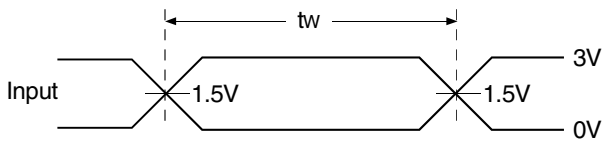
NOTES:

- $C_L$  includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{MHz}$ ;  $Z_o = 50\Omega$ ;  $t_r \leq 2.5\text{ns}$ ;  $t_f \leq 2.5\text{ns}$ .
- The outputs are measured one at a time with one transition per measurement.

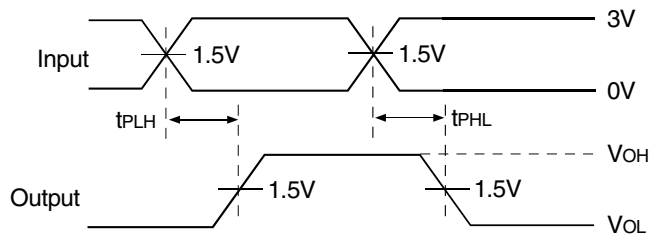
## LOAD CIRCUIT AND VOLTAGE WAVEFORMS PARAMETER MEASUREMENT INFORMATION (B PORT)



**Load Circuit**



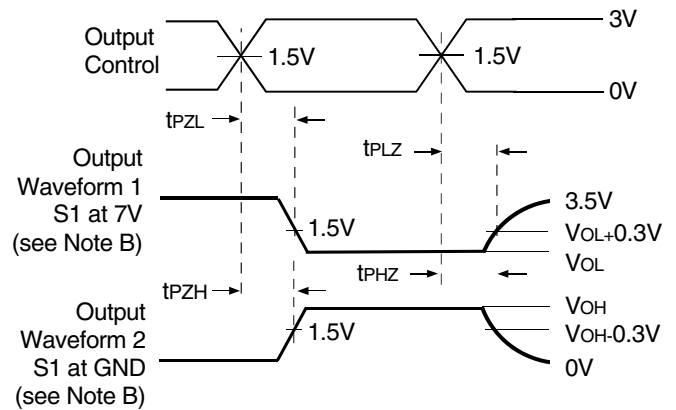
**Voltage Waveforms Pulse Duration**



**Voltage Waveforms Propagation Delay Times  
Noninverting Outputs**

## TEST CONDITIONS

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



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

### NOTES:

- CL includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{MHz}$ ;  $Z_o = 50\Omega$ ;  $t_r \leq 2.5\text{ns}$ ;  $t_f \leq 2.5\text{ns}$ .
- The outputs are measured one at a time with one transition per measurement.

## ORDERING INFORMATION

<u>XX</u> Temp. Range	<u>LVC X</u> Bus-Hold	<u>XXXX</u> Device Type	<u>XX</u> Package	
			SO	Small Outline IC (gull wing)
			SOG	SOIC - Green
			PY	Shrink Small Outline Package
			PYG	SSOP - Green
			Q	Quarter Size Small Outline Package
			QG	QSOP - Green
			PG	Thin Shrink Small Outline Package
			PGG	TSSOP - Green
		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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