



## CMOS OCTAL BUS TRANSCEIVER WITH ADJUSTABLE OUTPUT VOLTAGE, 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O

IDT74LVCC3245A

### FEATURES:

- 0.5 MICRON CMOS Technology
- $V_{CCA} = 2.3V$  to  $3.6V$
- $V_{CCB} = 3V$  to  $5.5V$
- 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 5 Volt tolerant
- Supports hot insertion
- Available in SOIC, SSOP, QSOP, and TSSOP packages

#### Drive Features for LVCC3245A:

- High Output Drivers:  $\pm 24mA$
- Reduced system switching noise

### DESCRIPTION:

The LVCC3245A is manufactured using advanced dual metal CMOS technology. This 8-bit (octal) noninverting bus transceiver contains two separate supply rails. The B port is designed to track  $V_{CCB}$ , which accepts voltages from  $3V$  to  $5.5V$ , and the A port is designed to track  $V_{CCA}$ , which operates at  $2.3V$  to  $3.6V$ . This allows for translation from a  $3.3V$  to a  $5V$  system environment and vice-versa, or from a  $2.5V$  to a  $3.3V$  system environment, and vice-versa.

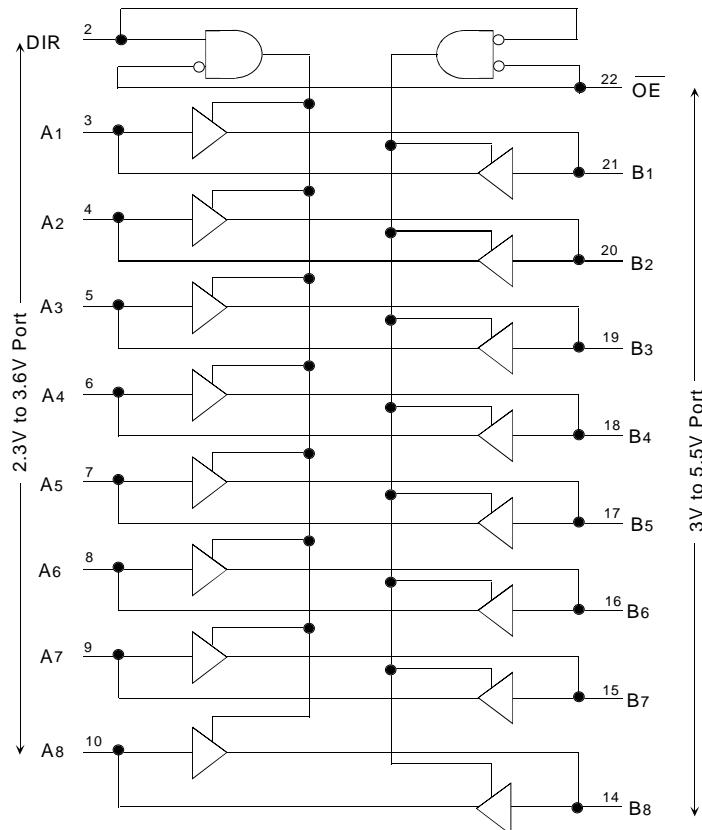
This LVCC3245A is ideal for asynchronous communication between two data buses (A and B). The device transmits data from A to B or from B to A, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so the buses are effectively isolated.

The LVCC3245A has been designed with a  $\pm 24mA$  output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

### APPLICATIONS:

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

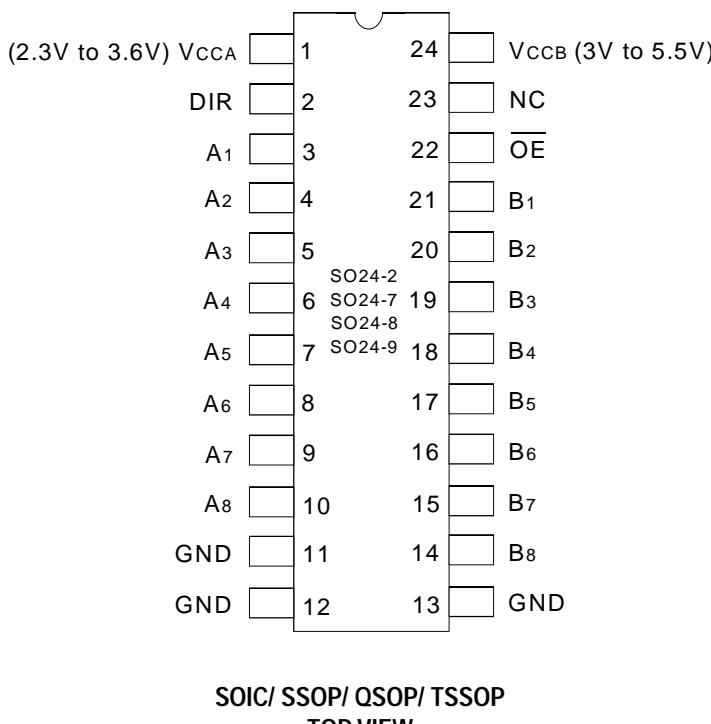
### FUNCTIONAL BLOCK DIAGRAM



INDUSTRIAL TEMPERATURE RANGE

JULY 2000

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin Names	Description
OE	Output Enable Input (Active LOW)
DIR	Direction Control Input
Ax	Port A Inputs or 3-State Outputs
Bx	Port B Inputs or 3-State Outputs
NC	No Internal Connection

## FUNCTION TABLE (1)

Inputs		Outputs
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

## ABSOLUTE MAXIMUM RATINGS

### FOR VCCB (1)

Symbol	Description	Max.	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +6	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-50 to +50	mA
I <sub>IK</sub>	Continuous Clamp Current, $V_I < 0$ or $V_O < 0$	-50	mA
I <sub>OK</sub>			
I <sub>CC</sub>	Continuous Current through each Vcc or GND	±100	mA
I <sub>SS</sub>			

## ABSOLUTE MAXIMUM RATINGS

### FOR VCCA (1)

Symbol	Description	Max.	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +6	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-50 to +50	mA
I <sub>IK</sub>	Continuous Clamp Current, $V_I < 0$ or $V_O < 0$	-50	mA
I <sub>OK</sub>			
I <sub>CC</sub>	Continuous Current through each Vcc or GND	±100	mA
I <sub>SS</sub>			

### 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 ( $T_A = +25^\circ C$ , $f = 1.0\text{MHz}$ )

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Unit
C <sub>IN</sub>	Input Capacitance	$V_{IN} = 0V$	4.5	pF
C <sub>I/O</sub>	I/O Port Capacitance	$V_{IN} = 0V$	11	pF

### NOTE:

1. As applicable to the device type.

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

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^\circ\text{C}$  To  $+85^\circ\text{C}$ ;  $V_{CCA} = 2.3\text{V}$  to  $3.6\text{V}$ <sup>(1)</sup>

Symbol	Parameter	Test Conditions		Min.	Typ. <sup>(2)</sup>	Max.	Unit	
V <sub>IH</sub>	Input HIGH Voltage Level	V <sub>OB</sub> $\leq 0.1\text{V}$	V <sub>CCA</sub> = 2.3V, V <sub>CCB</sub> = 3V	1.7	—	—	V	
			V <sub>OB</sub> $\geq V_{CCB} - 0.1\text{V}$	2	—	—		
V <sub>IL</sub>	Input LOW Voltage Level		V <sub>CCA</sub> = 2.7V to 3.6V	—	—	0.7	V	
			V <sub>CCA</sub> = 2.3V, V <sub>CCB</sub> = 3V	—	—	0.8		
I <sub>IIH</sub> I <sub>IL</sub>	Input Leakage Current Control Inputs	V <sub>CCA</sub> = 3.6V	V <sub>I</sub> = 0 to 5.5V	—	—	$\pm 1$	$\mu\text{A}$	
I <sub>OZH</sub> I <sub>OZL</sub>	High Impedance Output Current (3-State Output pins)	V <sub>CCA</sub> = 3.6V	V <sub>O</sub> = V <sub>CCA</sub> or GND	—	—	$\pm 5$	$\mu\text{A}$	
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>CCA</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> $\leq 5.5\text{V}$		—	—	$\pm 50$	$\mu\text{A}$	
V <sub>H</sub>	Input Hysteresis	V <sub>CCA</sub> = 3.3V		—	100	—	mV	
I <sub>CCL</sub> I <sub>CCH</sub> I <sub>CCZ</sub>	Quiescent Power Supply Current	V <sub>CCA</sub> = 3.6V	V <sub>IN</sub> = GND or V <sub>CC</sub>	—	—	50	$\mu\text{A}$	
$\Delta I_{CC}$	Quiescent Power Supply Current Variation	One input at V <sub>CCA</sub> - 0.6V, other inputs at V <sub>CCA</sub> or GND			—	—	500	$\mu\text{A}$

**NOTES:**

1. V<sub>CCB</sub> = 3V to 5.5V
2. Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.
3. This applies in the disabled state only.

## 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<sub>CCB</sub> = 3V to 5.5V<sup>(1)</sup>

Symbol	Parameter	Test Conditions		Min.	Typ. <sup>(2)</sup>	Max.	Unit	
V <sub>IH</sub>	Input HIGH Voltage Level	V <sub>OA</sub> $\leq 0.1\text{V}$	V <sub>CCB</sub> = 3V to 3.6V	2	—	—	V	
			V <sub>CCB</sub> = 5.5V	3.85	—	—		
V <sub>IL</sub>	Input LOW Voltage Level	V <sub>OA</sub> $\geq V_{CCA} - 0.1\text{V}$	V <sub>CCB</sub> = 3V to 3.6V	—	—	0.8	V	
			V <sub>CCB</sub> = 5.5V	—	—	1.65		
I <sub>IIH</sub> I <sub>IL</sub>	Input Leakage Current	V <sub>CCB</sub> = 3.6V	V <sub>I</sub> = 0 to 5.5V	—	—	$\pm 1$	$\mu\text{A}$	
I <sub>OZH</sub> I <sub>OZL</sub>	High Impedance Output Current (3-State Output pins)	V <sub>CCB</sub> = 3.6V	V <sub>O</sub> = V <sub>CCB</sub> or GND	—	—	$\pm 5$	$\mu\text{A}$	
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>CCB</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> $\leq 5.5\text{V}$		—	—	$\pm 50$	$\mu\text{A}$	
V <sub>H</sub>	Input Hysteresis	V <sub>CCB</sub> = 3.3V		—	100	—	mV	
I <sub>CCL</sub> I <sub>CCH</sub> I <sub>CCZ</sub>	Quiescent Power Supply Current	V <sub>CCB</sub> = 3.6V	V <sub>IN</sub> = GND or V <sub>CC</sub>	—	—	50	$\mu\text{A}$	
		V <sub>CCB</sub> = 5.5V		—	—	80		
$\Delta I_{CC}$	Quiescent Power Supply Current Variation	One input at V <sub>CCB</sub> - 2.1V, other inputs at V <sub>CCB</sub> or GND			—	—	1.5	mA

**NOTES:**

1. V<sub>CCA</sub> = 2.3V to 3.6V
2. Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.
3. This applies in the disabled state only.

## OUTPUT DRIVE CHARACTERISTICS, V<sub>CCA</sub> = 2.3V to 3.6V (A PORT)

Symbol	Parameter	Test Conditions <sup>(1)</sup>			Min.	Max.	Unit
V <sub>OHA</sub>	Output HIGH Voltage (B port to A port)	V <sub>CCA</sub> = 3V	V <sub>CCB</sub> = 3V	I <sub>OH</sub> = - 0.1mA	2.9	—	V
		V <sub>CCA</sub> = 2.3V	V <sub>CCB</sub> = 3V	I <sub>OH</sub> = - 8mA	2	—	
		V <sub>CCA</sub> = 2.7V	V <sub>CCB</sub> = 3V	I <sub>OH</sub> = - 12mA	2.2	—	
		V <sub>CCA</sub> = 3V	V <sub>CCB</sub> = 3V		2.4	—	
		V <sub>CCA</sub> = 3V	V <sub>CCB</sub> = 3V	I <sub>OH</sub> = - 24mA	2.2	—	
		V <sub>CCA</sub> = 2.7V	V <sub>CCB</sub> = 4.5V		2	—	
V <sub>OLO</sub>	Output LOW Voltage (B port to A port)	V <sub>CCA</sub> = 3V	V <sub>CCB</sub> = 3V	I <sub>OL</sub> = 0.1mA	—	0.1	V
		V <sub>CCA</sub> = 2.3V	V <sub>CCB</sub> = 3V	I <sub>OL</sub> = 8mA	—	0.6	
		V <sub>CCA</sub> = 2.7V	V <sub>CCB</sub> = 3V	I <sub>OL</sub> = 12mA	—	0.5	
		V <sub>CCA</sub> = 3V	V <sub>CCB</sub> = 3V	I <sub>OL</sub> = 24mA	—	0.5	
		V <sub>CCA</sub> = 2.7V	V <sub>CCB</sub> = 4.5V		—	0.5	

**NOTE:**

1. V<sub>IH</sub> and V<sub>IL</sub> must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V<sub>cc</sub> range. T<sub>A</sub> = -40°C to +85°C, V<sub>CCB</sub> = 3V ± 5.5V.

## OUTPUT DRIVE CHARACTERISTICS, V<sub>CCB</sub> = 3V to 5.5V (B PORT)

Symbol	Parameter	Test Conditions <sup>(1)</sup>			Min.	Max.	Unit
V <sub>OHB</sub>	Output HIGH Voltage (A port to B port)	V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 3V	I <sub>OH</sub> = - 0.1mA	2.9	—	V
		V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 2.3V	I <sub>OH</sub> = - 12mA	2.4	—	
		V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 2.7V		2.4	—	
		V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 3V	I <sub>OH</sub> = - 24mA	2.2	—	
		V <sub>CCB</sub> = 4.5V	V <sub>CCA</sub> = 2.7V		3.2	—	
V <sub>OLO</sub>	Output LOW Voltage (A port to B port)	V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 3V	I <sub>OL</sub> = 0.1mA	—	0.1	V
		V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 2.3V	I <sub>OL</sub> = 12mA	—	0.4	
		V <sub>CCB</sub> = 3V	V <sub>CCA</sub> = 3V	I <sub>OL</sub> = 24mA	—	0.5	
		V <sub>CCB</sub> = 4.5V	V <sub>CCA</sub> = 3V		—	0.5	

**NOTE:**

1. V<sub>IH</sub> and V<sub>IL</sub> must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V<sub>cc</sub> range. T<sub>A</sub> = -40°C to +85°C, V<sub>CCA</sub> = 2.3V to 3.6V.

## OPERATING CHARACTERISTICS, T<sub>A</sub> = 25°C

Symbol	Parameter	Test Conditions	Typical		Unit
			V <sub>CCB</sub> = 5V	V <sub>CCA</sub> = 3.3V	
CPD	Power Dissipation Capacitance per Transceiver Outputs enabled A to B	C <sub>L</sub> = 0, f = 10Mhz	38	—	pF
	Power Dissipation Capacitance per Transceiver Outputs enabled B to A		—	36.5	

## SWITCHING CHARACTERISTICS (1)

		V <sub>CCA</sub> = 2.5V±0.2V		V <sub>CCA</sub> = 2.7V to 3.6V				Unit	
Symbol	Parameter	V <sub>CCB</sub> = 3.3V±0.3V		V <sub>CCB</sub> = 5V±0.5V		V <sub>CCB</sub> = 3.3V to 0.3V			
		Min.	Max.	Min.	Max.	Min.	Max.		
t <sub>PHL</sub>	Propagation Delay Ax to Bx	1	9.4	1	6	1	7.1	ns	
t <sub>PLH</sub>		1	9.1	1	5.3	1	7.2		
t <sub>PHL</sub>	Propagation Delay Bx to Ax	1	11.2	1	5.8	1	6.4	ns	
t <sub>PLH</sub>		1	9.9	1	7	1	7.6		
t <sub>PZL</sub>	Output Enable Time OE to Bx	1	13	1	8.1	1	9.2	ns	
t <sub>PZH</sub>		1	12.8	1	8.4	1	9.9		
t <sub>PZL</sub>	Output Enable Time OE to Ax	1	14.5	1	9.2	1	9.7	ns	
t <sub>PZH</sub>		1	12.9	1	9.5	1	9.5		
t <sub>PLZ</sub>	Output Disable Time OE to Ax	1	7.1	1	5.5	1	6.6	ns	
t <sub>PHZ</sub>		1	6.9	1	7.8	1	6.9		
t <sub>PLZ</sub>	Output Disable Time OE to Bx	1	8.8	1	7.3	1	7.5	ns	
t <sub>PHZ</sub>		1	8.9	1	7	1	7.9		

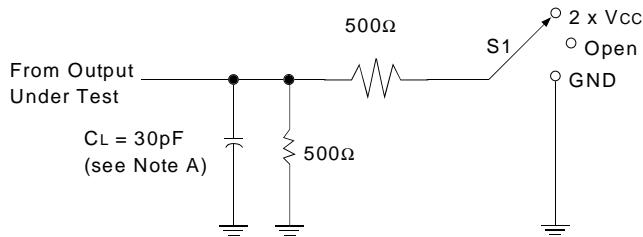
**NOTE:**

1. See test circuits and waveforms. TA = -40°C to +85°C.

## PARAMETER MEASUREMENT INFORMATION FOR A PORT

**$V_{CCA} = 2.5V \pm 0.2V$  AND  $V_{CCB} = 3.3V \pm 0.3V$**

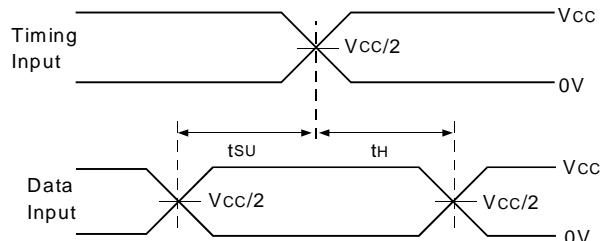
### LOAD CIRCUIT



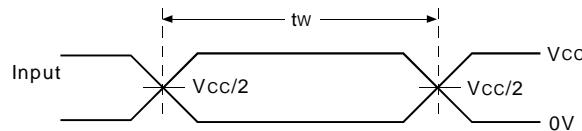
### TEST CONDITIONS

TEST	S1
t <sub>PD</sub>	Open
t <sub>PLZ</sub> / t <sub>PZL</sub>	2 X Vcc
t <sub>PHZ</sub> / t <sub>PZH</sub>	GND

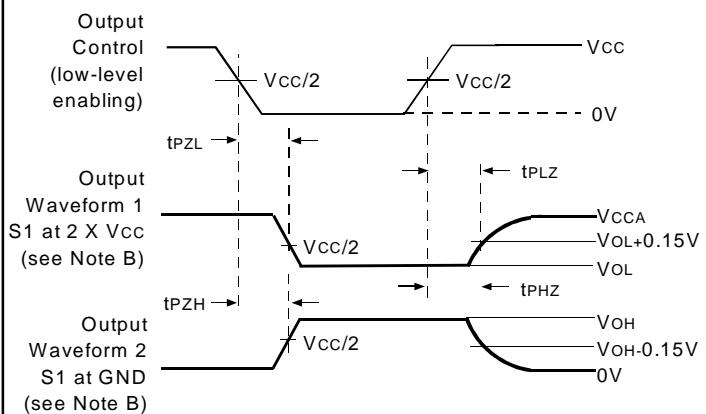
### VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



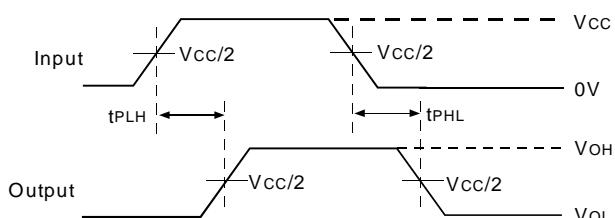
### VOLTAGE WAVEFORMS PULSE DURATION



### VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES



### VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



#### NOTES:

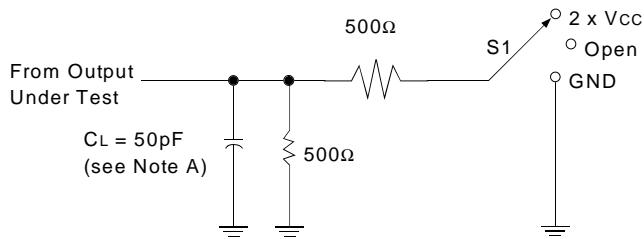
- CL includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10MHz;  $Z_o = 50\Omega$ ;  $t_f \leq 2\text{ns}$ ;  $t_r \leq 2\text{ns}$ .
- The outputs are measured one at a time with one transition per measurement.

### LOAD CIRCUIT AND VOLTAGE WAVEFORMS

## PARAMETER MEASUREMENT INFORMATION FOR B PORT

**V<sub>CCA</sub> = 2.5V ± 0.2V AND V<sub>CCB</sub> = 3.3V ± 0.3V**

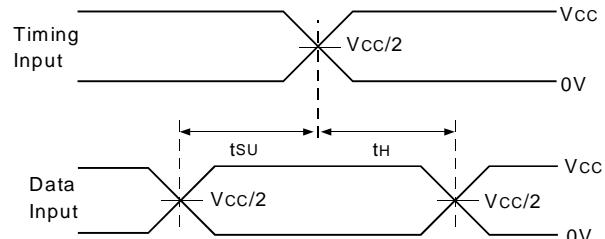
### LOAD CIRCUIT



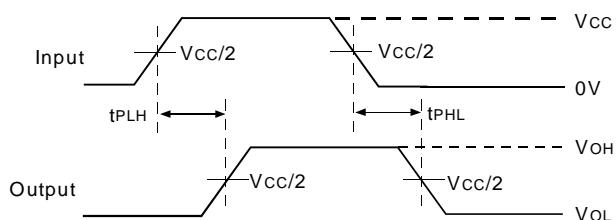
### TEST CONDITIONS

TEST	S1
t <sub>PD</sub>	Open
t <sub>PZL</sub> / t <sub>PZL</sub>	2 X Vcc
t <sub>PHZ</sub> / t <sub>PHZ</sub>	GND

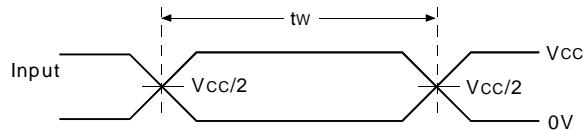
### VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



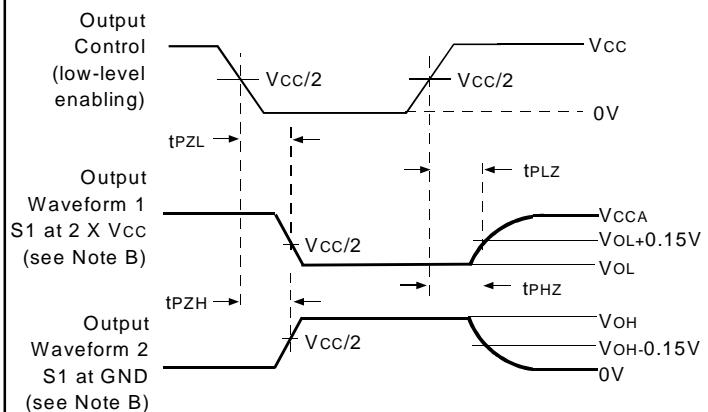
### VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



### VOLTAGE WAVEFORMS PULSE DURATION



### VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES



### NOTES:

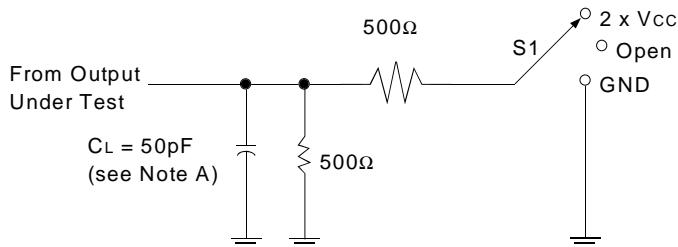
- CL includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz; Z<sub>0</sub> = 50Ω; t<sub>f</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.
- The outputs are measured one at a time with one transition per measurement.

### LOAD CIRCUIT AND VOLTAGE WAVEFORMS

## PARAMETER MEASUREMENT INFORMATION FOR B PORT

**V<sub>CCA</sub> = 3.6 V AND V<sub>CCB</sub> = 5.5V**

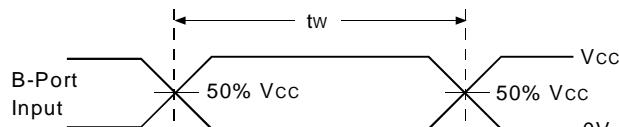
### LOAD CIRCUIT



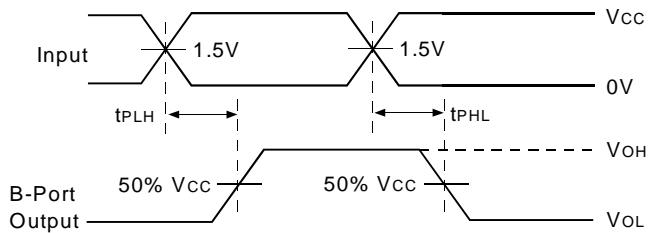
### TEST CONDITIONS

TEST	S1
t <sub>PLH</sub> / t <sub>PHL</sub>	Open
t <sub>PZL</sub> / t <sub>PZL</sub>	2 X Vcc
t <sub>PHZ</sub> / t <sub>PZH</sub>	Open

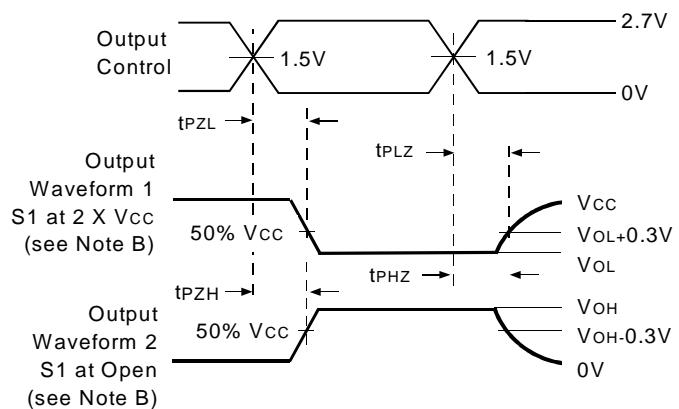
### VOLTAGE WAVEFORMS PULSE DURATION



### VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES NONINVERTING OUTPUTS



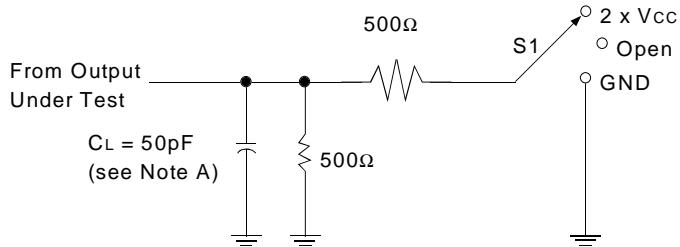
### VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES LOW- AND HIGH-LEVEL ENABLING



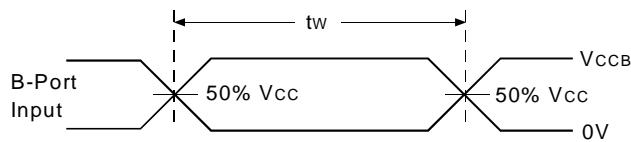
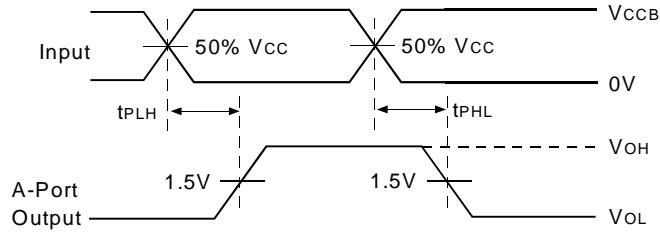
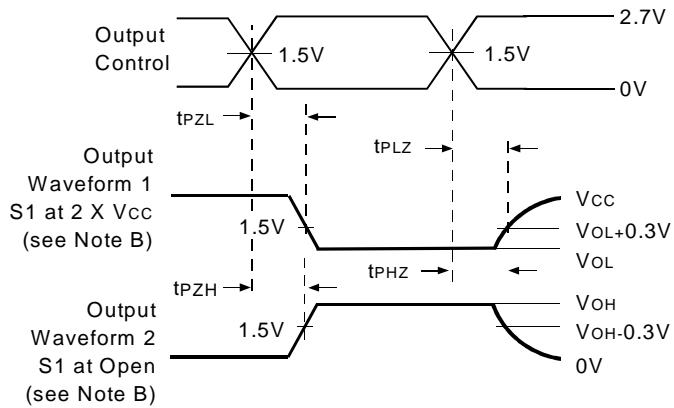
#### NOTES:

- A. CL 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;  $Z_o = 50\Omega$ ;  $t_f \leq 2.5\text{ns}$ ;  $t_r \leq 2.5\text{ns}$ .
- D. The outputs are measured one at a time with one transition per measurement.

### LOAD CIRCUIT AND VOLTAGE WAVEFORMS

**PARAMETER MEASUREMENT INFORMATION FOR A PORT****V<sub>CCA</sub> = 3.6 V AND V<sub>CCB</sub> = 5.5V****LOAD CIRCUIT****TEST CONDITIONS**

TEST	S1
t <sub>PLH</sub> / t <sub>PHL</sub>	Open
t <sub>PZL</sub> / t <sub>PZL</sub>	2 X Vcc
t <sub>PHZ</sub> / t <sub>PZH</sub>	Open

**VOLTAGE WAVEFORMS  
PULSE DURATION****VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
NONINVERTING OUTPUTS****VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING****NOTES:**

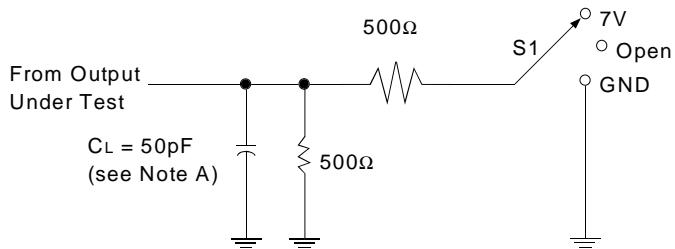
- CL includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10MHz;  $Z_o = 50\Omega$ ;  $t_f \leq 2.5\text{ns}$ ;  $t_r \leq 2.5\text{ns}$ .
- The outputs are measured one at a time with one transition per measurement.

**LOAD CIRCUIT AND VOLTAGE WAVEFORMS**

## PARAMETER MEASUREMENT INFORMATION FOR A AND B PORT

**V<sub>CCA</sub> AND V<sub>CCB</sub> = 3.6V**

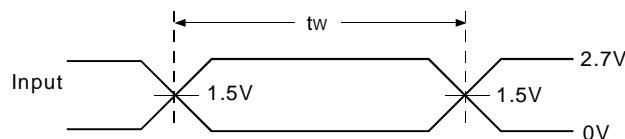
### LOAD CIRCUIT



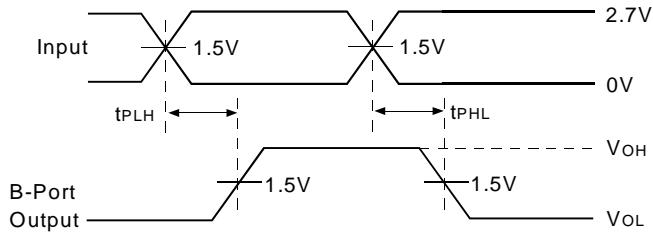
### TEST CONDITIONS

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

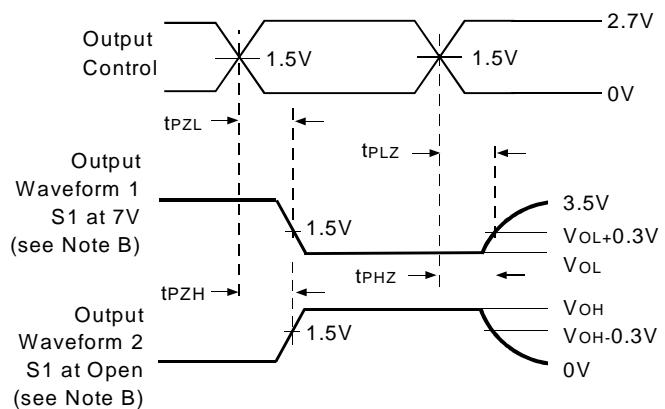
### VOLTAGE WAVEFORMS PULSE DURATION



### 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  $\leq 10\text{MHz}$ ;  $Z_o = 50\Omega$ ;  $t_f \leq 2.5\text{ns}$ ;  $t_r \leq 2.5\text{ns}$ .
- D. The outputs are measured one at a time with one transition per measurement.

### LOAD CIRCUIT AND VOLTAGE WAVEFORMS

## ORDERING INFORMATION

IDT	XX	LVC	X	XXXX	XX	
Temp. Range		Bus-Hold		Device Type	Package	
					SO	Small Outline IC (gull wing) (SO24-2)
					PY	Shrink Small Outline Package (SO24-7)
					Q	Quarter Size Small Outline Package (SO24-8)
					PG	Thin Shrink Small Outline Package (SO24-9)
				C3245A		Octal Bus Transceiver with Adjustable Output Voltage, 3-State Outputs, $\pm 24\text{mA}$
					Blank	No Bus-Hold
					74	$-40^\circ\text{C}$ to $+85^\circ\text{C}$



### CORPORATE HEADQUARTERS

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[www.idt.com](http://www.idt.com)\*

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