



# 3.3V CMOS OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O

**IDT74LVC244A**

## FEATURES:

- 0.5 MICRON CMOS Technology
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- Vcc = 3.3V ± 0.3V, Normal Range
- Vcc = 2.7V to 3.6V, Extended Range
- 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:

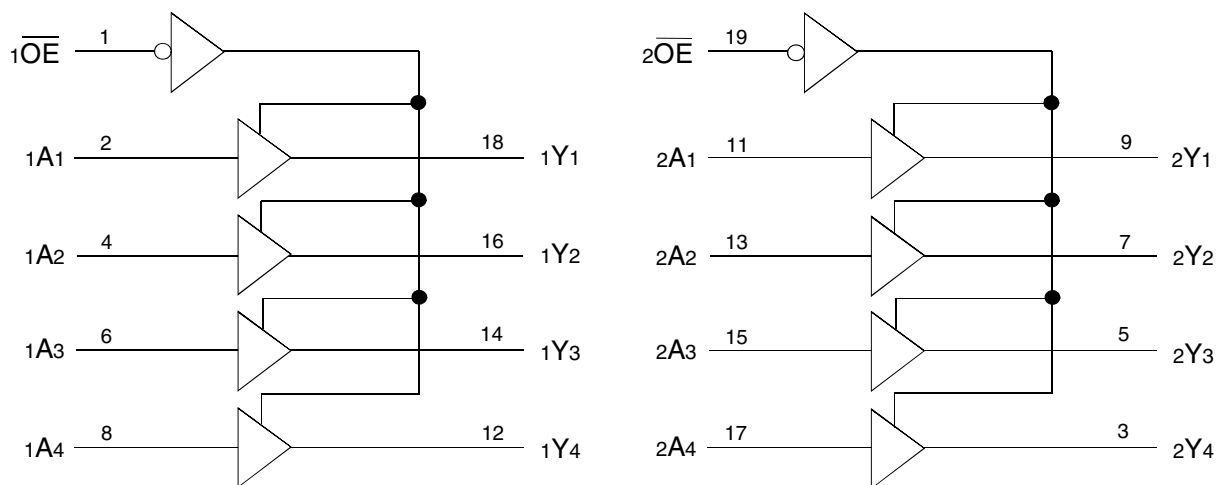
The LVC244A device is organized as two 4-bit line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the device passes data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

The LVC244A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

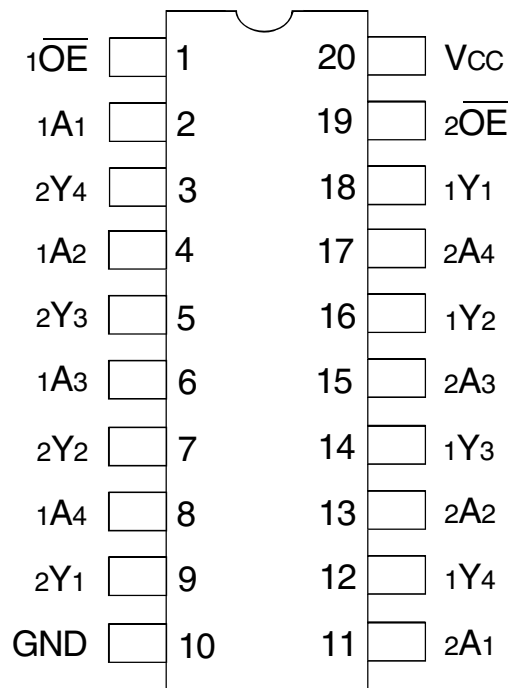
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to Vcc through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

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 system environment.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



SOIC/ SSOP/ QSOP/ TSSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +6.5	V
TSTG	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	4.5	6	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	5.5	8	pF
C <sub>I/O</sub>	I/O Port Capacitance	V <sub>IN</sub> = 0V	6.5	8	pF

### NOTE:

- As applicable to the device type.

## PIN DESCRIPTION

Pin Names	Description
xAx	Data Inputs
xYx	3-State Outputs
xOE	Output Enable Inputs (Active LOW)

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

Inputs		Outputs
xOE	xAx	xYx
L	H	H
L	L	L
H	X	Z

### NOTES:

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

Symbol	Parameter	Test Conditions		Min.	Typ. <sup>(1)</sup>	Max.	Unit
$V_{IH}$	Input HIGH Voltage Level	$V_{CC} = 2.3\text{V}$ to $2.7\text{V}$		1.7	—	—	V
		$V_{CC} = 2.7\text{V}$ to $3.6\text{V}$		2	—	—	
$V_{IL}$	Input LOW Voltage Level	$V_{CC} = 2.3\text{V}$ to $2.7\text{V}$		—	—	0.7	V
		$V_{CC} = 2.7\text{V}$ to $3.6\text{V}$		—	—	0.8	
$I_{IH}$ $I_{IL}$	Input Leakage Current	$V_{CC} = 3.6\text{V}$	$V_I = 0$ to $5.5\text{V}$	—	—	$\pm 5$	$\mu\text{A}$
$I_{OZH}$ $I_{OZL}$	High Impedance Output Current (3-State Output pins)	$V_{CC} = 3.6\text{V}$	$V_O = 0$ to $5.5\text{V}$	—	—	$\pm 10$	$\mu\text{A}$
$I_{OFF}$	Input/Output Power Off Leakage	$V_{CC} = 0\text{V}$ , $V_{IN}$ or $V_O \leq 5.5\text{V}$		—	—	$\pm 50$	$\mu\text{A}$
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
$V_H$	Input Hysteresis	$V_{CC} = 3.3\text{V}$		—	100	—	mV
$I_{CCL}$ $I_{CCH}$ $I_{CCZ}$	Quiescent Power Supply Current	$V_{CC} = 3.6\text{V}$	$V_{IN} = \text{GND}$ or $V_{CC}$	—	—	10	$\mu\text{A}$
			$3.6 \leq V_{IN} \leq 5.5\text{V}^{(2)}$	—	—	10	
$\Delta I_{CC}$	Quiescent Power Supply Current Variation	One input at $V_{CC} - 0.6\text{V}$ , other inputs at $V_{CC}$ or GND		—	—	500	$\mu\text{A}$

### NOTES:

1. Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
2. This applies in the disabled state only.

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Max.	Unit
$V_{OH}$	Output HIGH Voltage	$V_{CC} = 2.3\text{V}$ to $3.6\text{V}$	$I_{OH} = -0.1\text{mA}$	$V_{CC} - 0.2$	—	V
		$V_{CC} = 2.3\text{V}$	$I_{OH} = -6\text{mA}$	2	—	
		$V_{CC} = 2.3\text{V}$	$I_{OH} = -12\text{mA}$	1.7	—	
		$V_{CC} = 2.7\text{V}$		2.2	—	
		$V_{CC} = 3\text{V}$		2.4	—	
		$V_{CC} = 3\text{V}$	$I_{OH} = -24\text{mA}$	2.2	—	
$V_{OL}$	Output LOW Voltage	$V_{CC} = 2.3\text{V}$ to $3.6\text{V}$	$I_{OL} = 0.1\text{mA}$	—	0.2	V
		$V_{CC} = 2.3\text{V}$	$I_{OL} = 6\text{mA}$	—	0.4	
			$I_{OL} = 12\text{mA}$	—	0.7	
		$V_{CC} = 2.7\text{V}$	$I_{OL} = 12\text{mA}$	—	0.4	
		$V_{CC} = 3\text{V}$	$I_{OL} = 24\text{mA}$	—	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.  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

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

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power Dissipation Capacitance per Buffer/Driver Outputs enabled	$C_L = 0pF$ , $f = 10MHz$	44	pF
CPD	Power Dissipation Capacitance per Buffer/Driver Outputs disabled		2	

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

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 xYx	—	6.9	1.5	5.9	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time x $\overline{OE}$ to xYx	—	8.6	1.5	7.6	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time x $\overline{OE}$ to xYx	—	6.8	1.5	6.5	ns
$t_{SK(0)}$	Output Skew <sup>(2)</sup>	—	—	—	500	ps

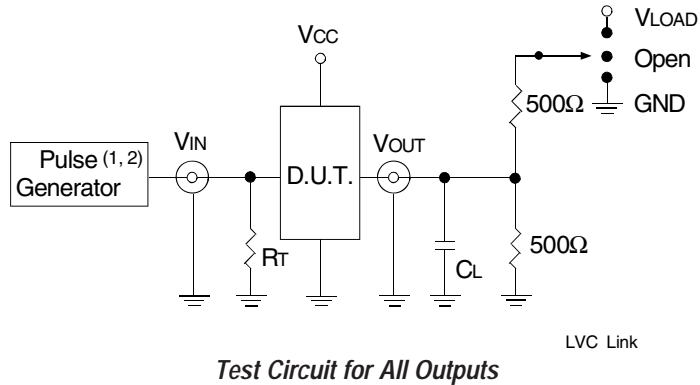
NOTES:

1. See TEST CIRCUITS AND WAVEFORMS.  $T_A = -40^\circ C$  to  $+85^\circ C$ .
2. Skew between any two outputs of the same package and switching in the same direction.

## TEST CIRCUITS AND WAVEFORMS

### TEST CONDITIONS

Symbol	V <sub>CC</sub> <sup>(1)</sup> = 3.3V ± 0.3V	V <sub>CC</sub> <sup>(1)</sup> = 2.7V	V <sub>CC</sub> <sup>(2)</sup> = 2.5V ± 0.2V	Unit
V <sub>LOAD</sub>	6	6	2 x V <sub>CC</sub>	V
V <sub>IH</sub>	2.7	2.7	V <sub>CC</sub>	V
V <sub>T</sub>	1.5	1.5	V <sub>CC</sub> / 2	V
V <sub>LZ</sub>	300	300	150	mV
V <sub>HZ</sub>	300	300	150	mV
C <sub>L</sub>	50	50	30	pF



Test Circuit for All Outputs

#### DEFINITIONS:

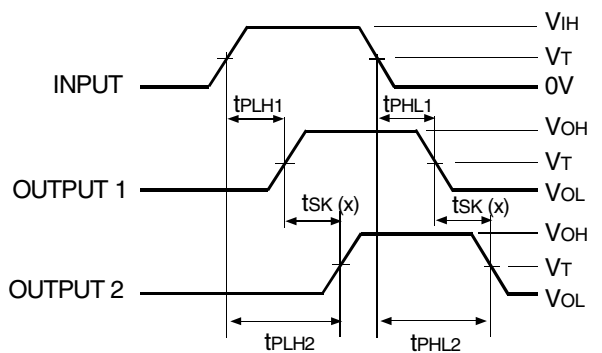
C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.  
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>r</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>r</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.

### SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V <sub>LOAD</sub>
Disable High Enable High	GND
All Other Tests	Open

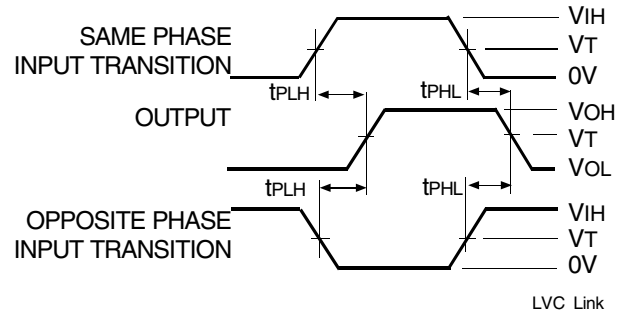


$$tsk(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

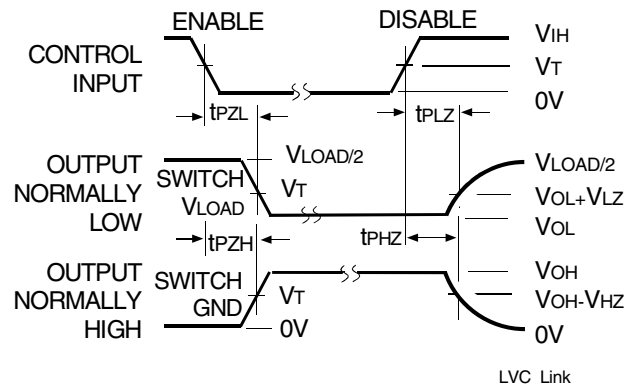
Output Skew - tsk(x)

#### NOTES:

1. For tsk(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For tsk(b) OUTPUT1 and OUTPUT2 are in the same bank.



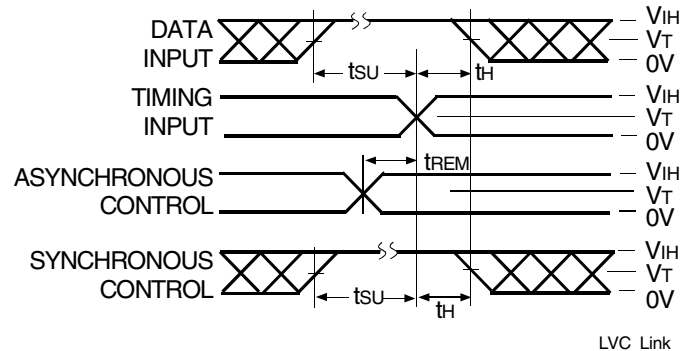
#### Propagation Delay



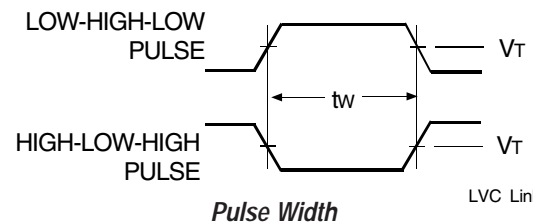
#### Enable and Disable Times

#### NOTE:

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



#### Set-up, Hold, and Release Times



Pulse Width

**ORDERING INFORMATION**

<u>XX</u>	<u>LVC</u>	<u>X</u>	<u>XXXX</u>	<u>XX</u>	
Temp. Range	Bus-Hold		Device Type	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
					244A Octal Buffer/Driver with 3-State Outputs, ±24mA
					Blank No Bus-hold
					74 -40°C to +85°C



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