

## FEATURES:

- Typical  $t_{sk(0)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 0.635mm pitch SSOP, 0.50mm pitch TSSOP and 0.40mm pitch TVSOP packages
- Extended commercial range of -40°C to +85°C
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to 3.6V, Extended Range
- CMOS power levels (0.4 $\mu$ W typ. static)
- All inputs, outputs and I/O are 5 Volt tolerant
- Supports hot insertion

### Drive Features for LVC16541A:

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

## APPLICATIONS:

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

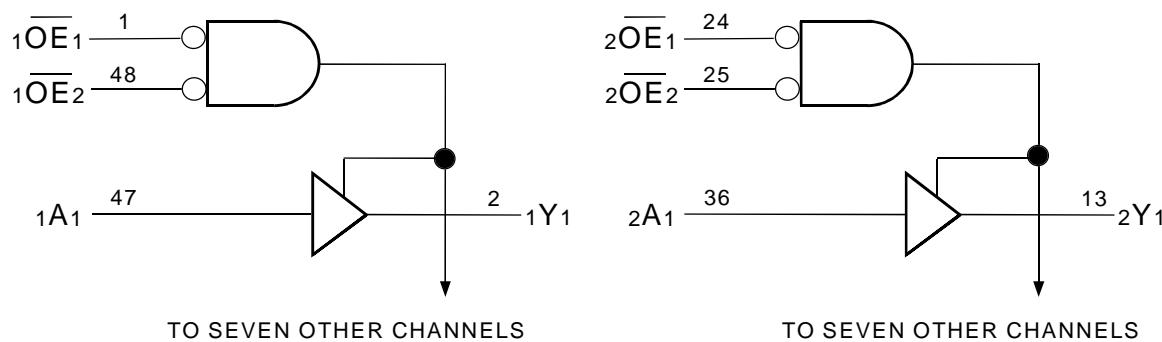
## DESCRIPTION:

This 16-bit buffer/driver is built using advanced dual metal CMOS technology. This device is composed of two 8-bit sections with separate output-enable signals. For either 8-bit buffer section, the two output-enable ( $1\bar{OE}_1$  and  $1\bar{OE}_2$  or  $2\bar{OE}_1$  and  $2\bar{OE}_2$ ) inputs must be low for the corresponding Y outputs to be active. If either output-enable input is high, the outputs of that 8-bit buffer section are in the high impedance state. To ensure the high-impedance state during power up or power down,  $OE$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current sinking capability of the driver.

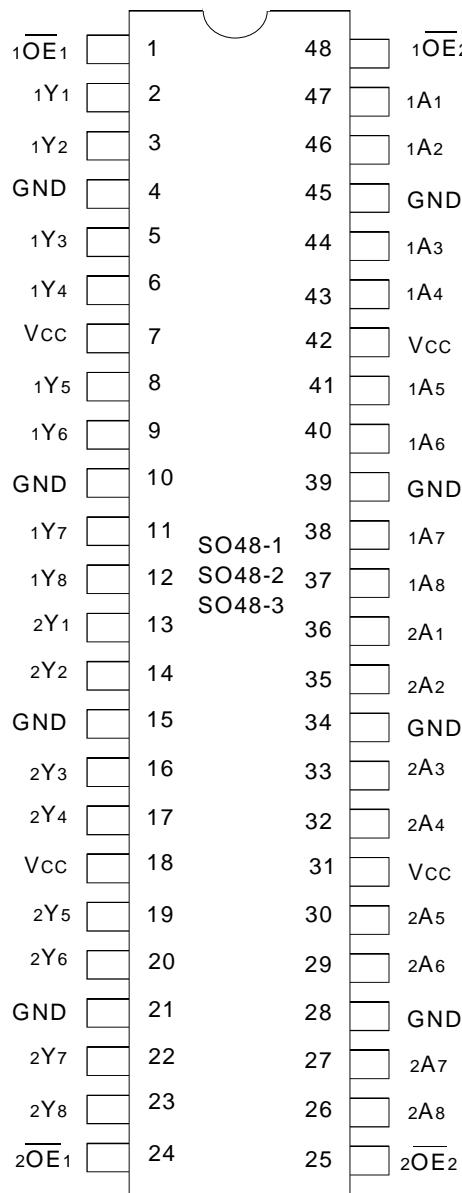
All pins of this 16-bit buffer/driver can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVC16541A has been designed with a  $\pm 24mA$  output driver. The driver is capable of driving a moderate to heavy load while maintaining speed performance.

## Functional Block Diagram



## PIN CONFIGURATION



SSOP/TSSOP/TVSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Description	Max.	Unit
VTERM(2)	Terminal Voltage with Respect to GND	- 0.5 to +6.5	V
VTERM(3)	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>	Continuous Clamp Current, V <sub>I</sub> < 0 or V <sub>O</sub> < 0	- 50	mA
I <sub>CC</sub>	Continuous Current through each V <sub>CC</sub> or GND	± 100	mA
I <sub>SS</sub>			

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### NOTES:

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.
2. V<sub>CC</sub> terminals.
3. All terminals except V<sub>CC</sub>.

## 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	6.5	8	pF
C <sub>I/O</sub>	I/O Port Capacitance	V <sub>IN</sub> = 0V	6.5	8	pF

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### NOTE:

1. As applicable to the device type.

## PIN DESCRIPTION

Pin Names	Description
x <sub>OE</sub> 1	3-State Output Enable Inputs (Active LOW)
x <sub>A</sub> x	Data Inputs
x <sub>Y</sub> x	3-State Outputs

## FUNCTION TABLE (each 8-bit buffer) (1)

Inputs			Outputs
x <sub>OE</sub> 1	x <sub>OE</sub> 2	x <sub>A</sub> x	x <sub>Y</sub> x
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

### NOTE:

1. H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
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 <sub>IH</sub>	Input HIGH Voltage Level	V <sub>CC</sub> = 2.3V to 2.7V		1.7	—	—	V
		V <sub>CC</sub> = 2.7V to 3.6V		2	—	—	
V <sub>IL</sub>	Input LOW Voltage Level	V <sub>CC</sub> = 2.3V to 2.7V		—	—	0.7	V
		V <sub>CC</sub> = 2.7V to 3.6V		—	—	0.8	
I <sub>IH</sub> I <sub>IL</sub>	Input Leakage Current	V <sub>CC</sub> = 3.6V	V <sub>I</sub> = 0 to 5.5V	—	—	$\pm 5$	$\mu\text{A}$
I <sub>OZH</sub> I <sub>OZL</sub>	High Impedance Output Current (3-State Output pins)	V <sub>CC</sub> = 3.6V	V <sub>O</sub> = 0 to 5.5V	—	—	$\pm 10$	$\mu\text{A}$
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> $\leq$ 5.5V		—	—	$\pm 50$	$\mu\text{A}$
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>CC</sub> = 2.3V, I <sub>IN</sub> = $-18\text{mA}$		—	-0.7	-1.2	V
V <sub>H</sub>	Input Hysteresis	V <sub>CC</sub> = 3.3V		—	100	—	mV
I <sub>CCL</sub> I <sub>CCH</sub> I <sub>CCZ</sub>	Quiescent Power Supply Current	V <sub>CC</sub> = 3.6V	V <sub>IN</sub> = GND or V <sub>CC</sub>	—	—	10	$\mu\text{A}$
		3.6 $\leq$ V <sub>IN</sub> $\leq$ 5.5V <sup>(2)</sup>		—	—	10	
$\Delta I_{CC}$	Quiescent Power Supply Current Variation	One input at V <sub>CC</sub> - 0.6V other inputs at V <sub>CC</sub> or GND		—	—	500	$\mu\text{A}$

**NOTES:**

1. Typical values are at V<sub>CC</sub> = 3.3V,  $+25^{\circ}\text{C}$  ambient.

2. This applies in the disabled state only.

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = 2.3V to 3.6V	I <sub>OH</sub> = $-0.1\text{mA}$	V <sub>CC</sub> - 0.2	—	V
		V <sub>CC</sub> = 2.3V	I <sub>OH</sub> = $-6\text{mA}$	2	—	
		V <sub>CC</sub> = 2.3V	I <sub>OH</sub> = $-12\text{mA}$	1.7	—	
		V <sub>CC</sub> = 2.7V		2.2	—	
		V <sub>CC</sub> = 3.0V		2.4	—	
		V <sub>CC</sub> = 3.0V	I <sub>OH</sub> = $-24\text{mA}$	2.2	—	
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = 2.3V to 3.6V	I <sub>OL</sub> = $0.1\text{mA}$	—	0.2	V
		V <sub>CC</sub> = 2.3V	I <sub>OL</sub> = $6\text{mA}$	—	0.4	
		I <sub>OL</sub> = $12\text{mA}$		—	0.7	
		V <sub>CC</sub> = 2.7V	I <sub>OL</sub> = $12\text{mA}$	—	0.4	
		V <sub>CC</sub> = 3.0V	I <sub>OL</sub> = $24\text{mA}$	—	0.55	

**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.  $T_A = -40^{\circ}\text{C}$  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	$C_L = 0pF, f = 10Mhz$	35	pF
CPD	Power Dissipation Capacitance per buffer/driver Outputs disabled		4	pF

**SWITCHING CHARACTERISTICS (1)**

Symbol	Parameter	$V_{CC} = 2.7V$		$V_{CC} = 3.3V \pm 0.3V$		Unit
		Min.	Max.	Min.	Max.	
$t_{PLH}$	Propagation Delay $xAx$ to $xYx$	—	5	1.1	4.2	ns
$t_{PHL}$	Output Enable Time $x\bar{O}Ex$ to $xYx$	—	6.9	1.5	5.6	ns
$t_{PZH}$	Output Disable Time $x\bar{O}Ex$ to $xYx$	—	7.4	1.9	6.8	ns
$t_{PLZ}$	Output Skew <sup>(2)</sup>	—	—	—	500	ps
$t_{SK(0)}$						

**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.

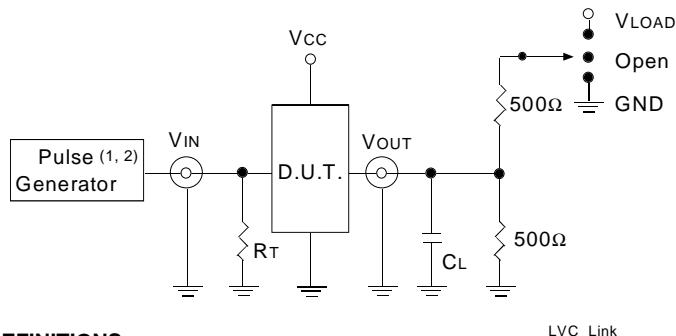
## TEST CIRCUITS AND WAVEFORMS:

### TEST CONDITIONS

Symbol	$V_{CC(1)} = 3.3V \pm 0.3V$	$V_{CC(1)} = 2.7V$	$V_{CC(2)} = 2.5V \pm 0.2V$	Unit
$V_{LOAD}$	6	6	$2 \times V_{CC}$	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



#### DEFINITIONS:

$CL$  = Load capacitance: includes jig and probe capacitance.

$RT$  = Termination resistance: should be equal to  $Z_{out}$  of the Pulse Generator.

#### NOTES:

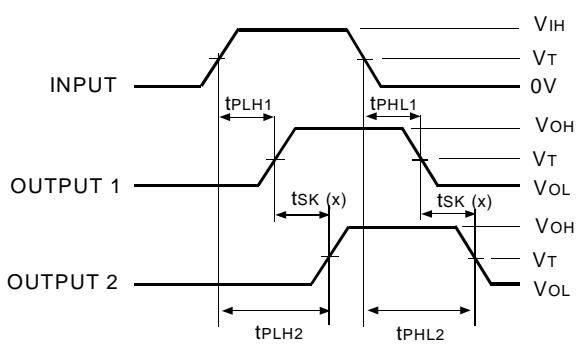
1. Pulse Generator for All Pulses: Rate  $\leq 10$ MHz;  $t_f \leq 2.5$ ns;  $t_r \leq 2.5$ ns.
2. Pulse Generator for All Pulses: Rate  $\leq 10$ MHz;  $t_f \leq 2$ ns;  $t_r \leq 2$ ns.

### SWITCH POSITION

Test	Switch
Open Drain	$V_{LOAD}$
Disable Low	
Enable Low	GND
Disable High	
Enable High	$V_T$
All Other tests	Open

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### OUTPUT SKEW - $t_{SK}(x)$



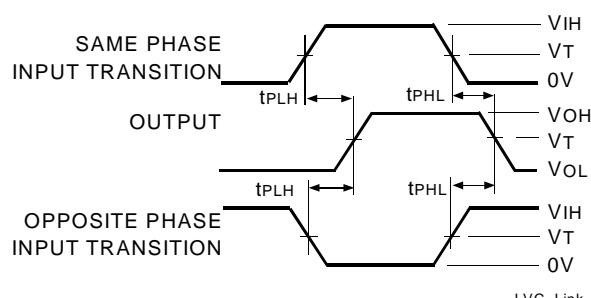
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

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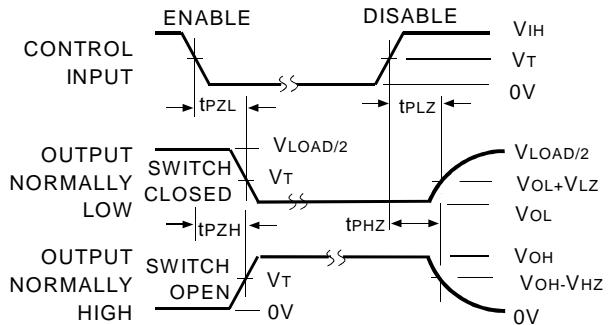
#### NOTES:

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



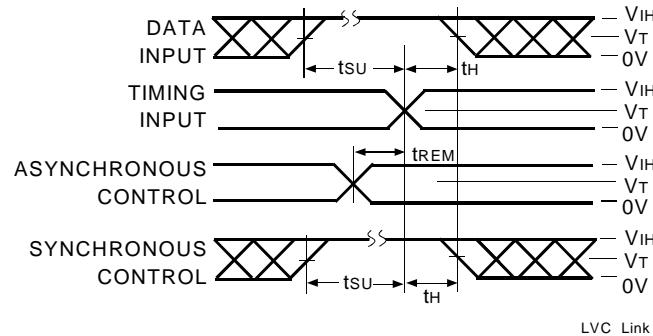
### ENABLE AND DISABLE TIMES



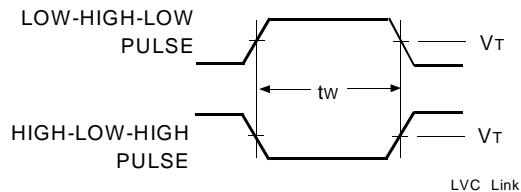
#### NOTE:

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

### SET-UP, HOLD, AND RELEASE TIMES



### PULSE WIDTH



## ORDERING INFORMATION

IDT	XX	LVC	X	XX	XXXX	XX
Temp. Range		Bus-Hold		Family	Device Type	Package
						PV      Shrink Small Outline Package (SO48-1)
						PA      Thin Shrink Small Outline Package (SO48-2)
						PF      Thin Very Small Outline Package (SO48-3)
					541A	16-Bit Buffer/Driver with 3-State Outputs
					16	Double-Density with Resistors, $\pm 24\text{mA}$
					Blank	No Bus-hold
					74	-40°C to +85°C



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