



3.3V CMOS 16-BIT BUFFER/ DRIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O AND BUS-HOLD

IDT74LVCH16541A

FEATURES:

- Typical $t_{sk(o)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{cc} = 3.3V \pm 0.3V$, 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 5V tolerant
- Supports hot insertion
- Available in SSOP, TSSOP, and TVSOP 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

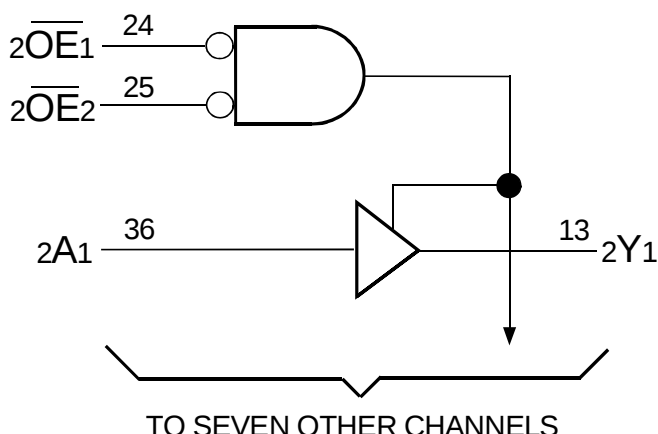
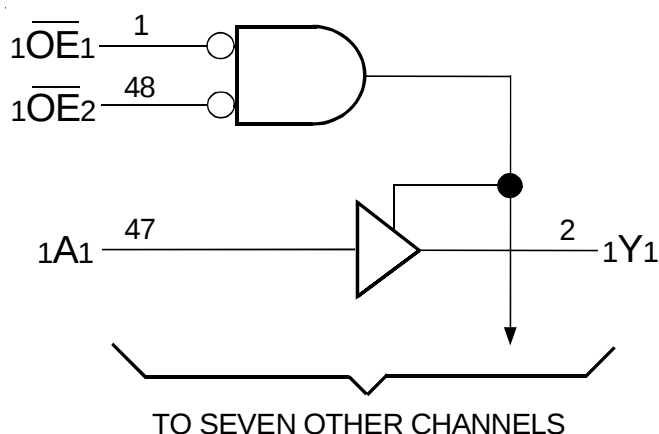
This 16-bit buffer/driver is built using advanced dual metal CMOS technology. This high-speed, low power device is a noninverting 16-bit buffer composed of two 8-bit sections with separate output-enable signals. For either 8-bit buffer section, the two output-enable ($1\overline{OE}1$ and $1\overline{OE}2$ or $2\overline{OE}1$ and $2\overline{OE}2$) 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.

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.

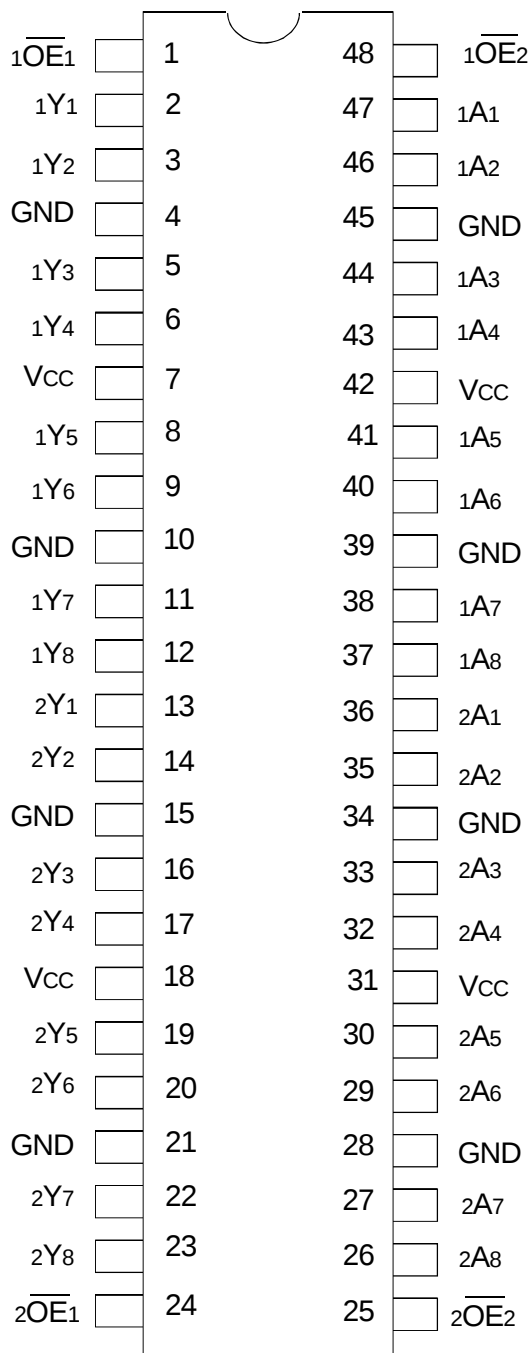
The LVCH16541A has been designed with a $\pm 24mA$ output driver. The driver is capable of driving a moderate to heavy load while maintaining speed performance.

The LVCH16541A has "bus-hold" which retains the inputs' last state whenever the input goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +6.5	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-50 to +50	mA
IIK IOLK	Continuous Clamp Current, Vi < 0 or Vo < 0	-50	mA
ICC Iss	Continuous Current through each Vcc 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 (TA = +25°C, F = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance	VIN = 0V	4.5	6	pF
COUT	Output Capacitance	VOU = 0V	6.5	8	pF
CII/O	I/O Port Capacitance	VIN = 0V	6.5	8	pF

NOTE:

- As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
xOE _x	3-State Output Enable Inputs (Active LOW)
xA _x	Data Inputs ⁽¹⁾
xy _x	3-State Outputs

NOTE:

- These pins have "Bus-Hold". All other pins are standard inputs, outputs, or I/Os.

FUNCTION TABLE (EACH 8-BIT SECTION)⁽¹⁾

Inputs			Outputs
xOE ₁	xOE ₂	xA _x	xy _x
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

NOTE:

- 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. ⁽¹⁾	Max.	Unit
V_{IH}	Input HIGH Voltage Level	$V_{CC} = 2.3\text{V}$ to 2.7V		1.7	—	—	V
		$V_{CC} = 2.7\text{V}$ to 3.6V		2	—	—	
V_{IL}	Input LOW Voltage Level	$V_{CC} = 2.3\text{V}$ to 2.7V		—	—	0.7	V
		$V_{CC} = 2.7\text{V}$ to 3.6V		—	—	0.8	
I_{IH} I_{IL}	Input Leakage Current	$V_{CC} = 3.6\text{V}$	$V_I = 0$ to 5.5V	—	—	± 5	μA
I_{OZH} I_{OZL}	High Impedance Output Current (3-State Output pins)	$V_{CC} = 3.6\text{V}$	$V_O = 0$ to 5.5V	—	—	± 10	μA
I_{OFF}	Input/Output Power Off Leakage	$V_{CC} = 0\text{V}$, V_{IN} or $V_O \leq 5.5\text{V}$		—	—	± 50	μA
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	μA
			$3.6 \leq V_{IN} \leq 5.5\text{V}^{(2)}$	—	—	10	
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at $V_{CC} - 0.6\text{V}$, other inputs at V_{CC} or GND		—	—	500	μA

NOTES:

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

BUS-HOLD CHARACTERISTICS

Symbol	Parameter ⁽¹⁾	Test Conditions		Min.	Typ. ⁽²⁾	Max.	Unit
I_{BHH} I_{BHL}	Bus-Hold Input Sustain Current	$V_{CC} = 3\text{V}$	$V_I = 2\text{V}$	-75	—	—	μA
			$V_I = 0.8\text{V}$	75	—	—	
I_{BHH} I_{BHL}	Bus-Hold Input Sustain Current	$V_{CC} = 2.3\text{V}$	$V_I = 1.7\text{V}$	—	—	—	μA
			$V_I = 0.7\text{V}$	—	—	—	
I_{BHNO} I_{BHLO}	Bus-Hold Input Overdrive Current	$V_{CC} = 3.6\text{V}$	$V_I = 0$ to 3.6V	—	—	± 500	μA

NOTES:

- Pins with Bus-Hold are identified in the pin description.
- Typical values are at $V_{CC} = 3.3\text{V}$, $+25^{\circ}\text{C}$ ambient.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	Output HIGH Voltage	VCC = 2.3V to 3.6V	IOH = – 0.1mA	VCC – 0.2	—	V
		VCC = 2.3V	IOH = – 6mA	2	—	
		VCC = 2.3V	IOH = – 12mA	1.7	—	
		VCC = 2.7V		2.2	—	
		VCC = 3V		2.4	—	
		VCC = 3V	IOH = – 24mA	2	—	
VOL	Output LOW Voltage	VCC = 2.3V to 3.6V	IOL = 0.1mA	—	0.2	V
		VCC = 2.3V	IOL = 6mA	—	0.4	
			IOL = 12mA	—	0.7	
		VCC = 2.7V	IOL = 12mA	—	0.4	
		VCC = 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.

OPERATING CHARACTERISTICS, VCC = 3.3V ± 0.3V, TA = 25°C

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power Dissipation Capacitance per Buffer/Driver Outputs enabled	CL = 0pF, f = 10Mhz	35	pF
CPD	Power Dissipation Capacitance per Buffer/Driver Outputs disabled		4	

SWITCHING CHARACTERISTICS⁽¹⁾

Symbol	Parameter	VCC = 2.7V		VCC = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
tPLH tPHL	Propagation Delay xAx to xYx	—	5	1.1	4.2	ns
tPZH tPZL	Output Enable Time xOEx to xYx	—	6.9	1.5	5.6	ns
tPHZ tPLZ	Output Disable Time xOEx to xYx	—	7.4	1.9	6.8	ns
tsk(0)	Output Skew ⁽²⁾	—	—	—	500	ps

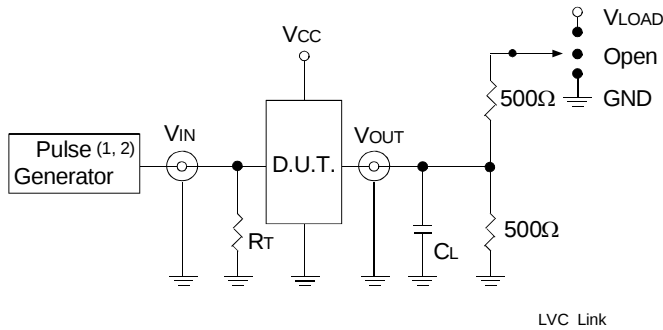
NOTES:

1. See TEST CIRCUITS AND WAVEFORMS. TA = – 40°C to + 85°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±0.3V	V _{CC} ⁽¹⁾ =2.7V	V _{CC} ⁽²⁾ =2.5V±0.2V	Unit
V _{LOAD}	6	6	2 x 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



Test Circuit for All Outputs

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

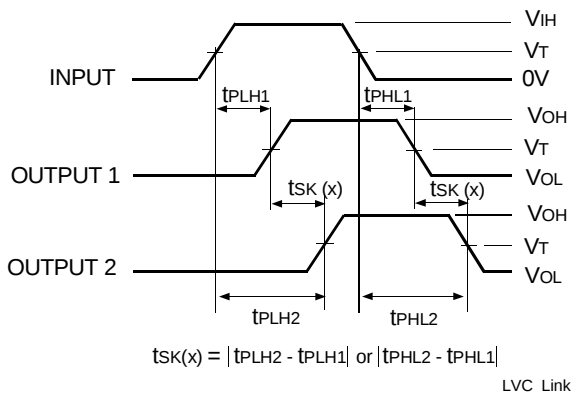
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

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

SWITCH POSITION

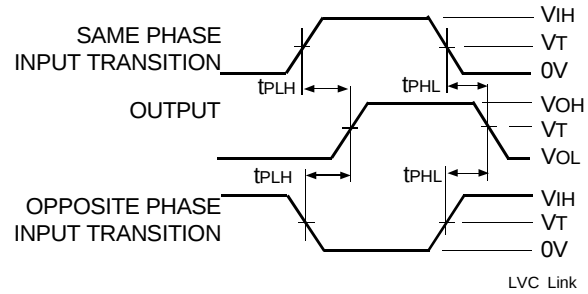
Test	Switch
Open Drain Disable Low Enable Low	V _{LOAD}
Disable High Enable High	GND
All Other Tests	Open



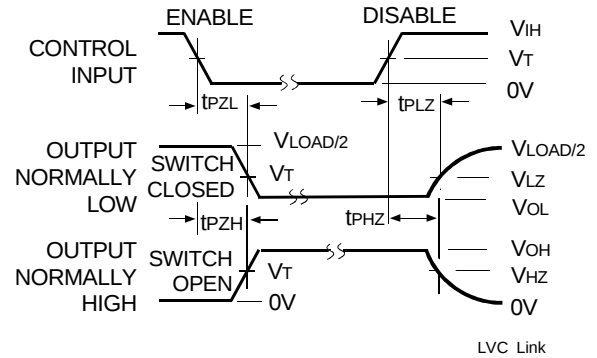
Output Skew - t_{SK}(x)

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.



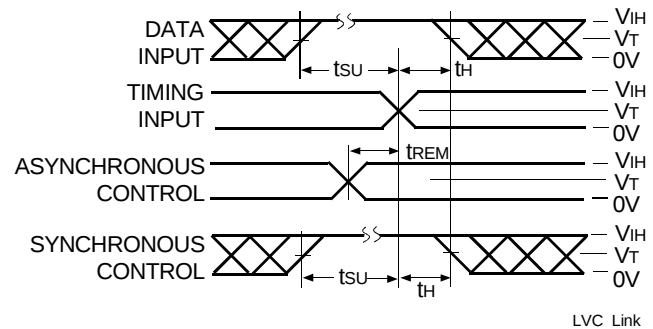
Propagation Delay



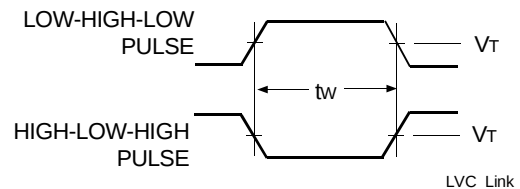
Enable and Disable Times

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
						PA	Thin Shrink Small Outline Package
						PF	Thin Very Small Outline Package
						541A	16-Bit Buffer/Driver with 3 State Outputs and 5 Volt Tolerant I/O
						16	Double-Density, $\pm 24\text{mA}$
						H	Bus-hold
						74	-40°C to +85°C



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