



# 3.3V CMOS 16-BIT TRANSPARENT D-TYPE LATCH WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O, BUS-HOLD

**IDT74LVCH162373A**

## 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
- Available in SSOP and TSSOP packages

## DRIVE FEATURES:

- Balanced Output Drivers:  $\pm 12mA$
- Low switching noise

## APPLICATIONS:

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

## DESCRIPTION:

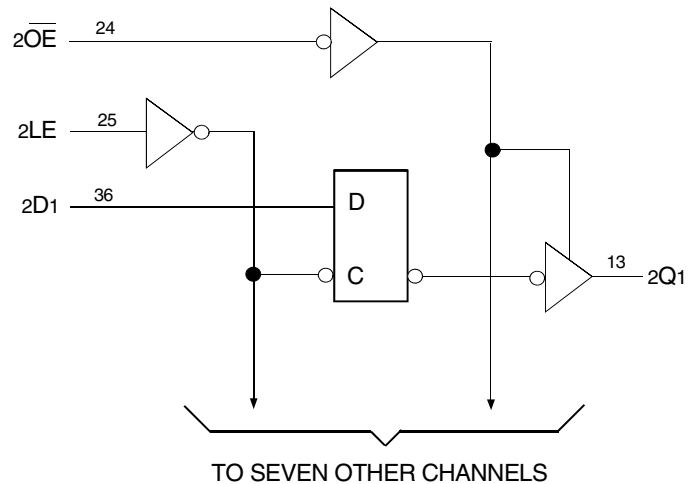
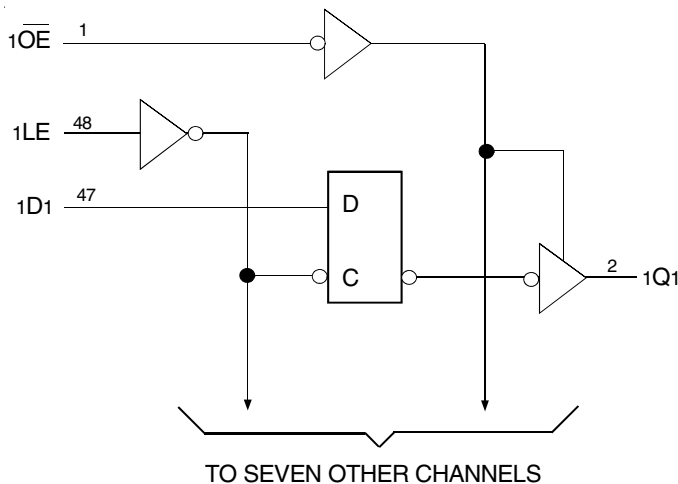
The LVCH162373A 16-bit transparent D-type latch is built using advanced dual metal CMOS technology. This high-speed, low-power latch is ideal for temporary storage of data. The LVCH162373A can be used for implementing memory address latches, I/O ports, and bus drivers. The output enable and latch enable controls are organized to operate each device as two 8-bit latches or one 16-bit latch. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

All pins of the LVCH162373A 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.

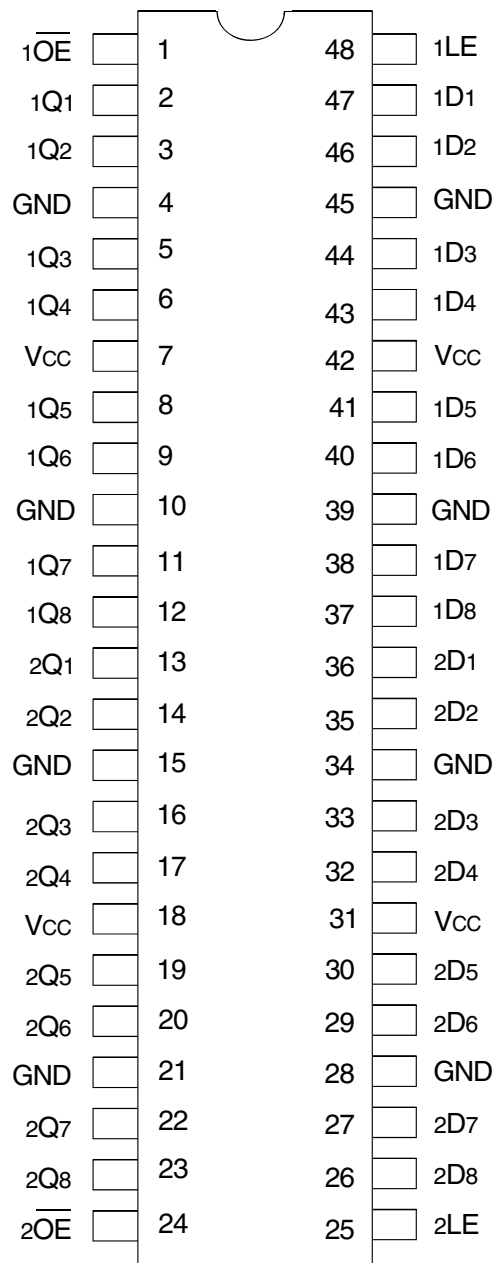
The LVCH162373A has series resistors in the device output structure which will significantly reduce line noise when used with light loads. The driver has been developed to drive  $\pm 12mA$  at the designated threshold levels.

The LVCH162373A 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  
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	6.5	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
xDx	Data Inputs <sup>(1)</sup>
xLE	Latch Enable Inputs (Active HIGH)
xQx	3-State Outputs
xOE	Output Enable Inputs (Active LOW)

### NOTE:

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

## FUNCTION TABLE (EACH 8-BIT SECTION)<sup>(1)</sup>

Inputs			Outputs
xOE	xLE	xDx	xQx
L	H	H	H
L	H	L	L
L	L	X	Q <sup>(2)</sup>
H	X	X	Z

### NOTES:

- H = HIGH Voltage Level  
X = Don't Care  
L = LOW Voltage Level  
Z = High-Impedance
- Output level before the indicated steady-state input conditions were established.

## 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	—	—	±5	μA
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	—	—	±10	μA
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 5.5V		—	—	±50	μA
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>CC</sub> = 2.3V, I <sub>IN</sub> = -18mA		—	-0.7	-1.2	V
V <sub>H</sub>	Input Hysteresis	V <sub>CC</sub> = 3.3V		—	100	—	mV
I <sub>CC1</sub> I <sub>CC2</sub> I <sub>CC3</sub>	Quiescent Power Supply Current	V <sub>CC</sub> = 3.6V	V <sub>IN</sub> = GND or V <sub>CC</sub>	—	—	10	μA
			3.6 ≤ V <sub>IN</sub> ≤ 5.5V <sup>(2)</sup>	—	—	10	
ΔI <sub>CC</sub>	Quiescent Power Supply Current Variation	One input at V <sub>CC</sub> - 0.6V, other inputs at V <sub>CC</sub> or GND		—	—	500	μA

### NOTES:

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

## BUS-HOLD CHARACTERISTICS

Symbol	Parameter <sup>(1)</sup>	Test Conditions		Min.	Typ. <sup>(2)</sup>	Max.	Unit
I <sub>BHH</sub> I <sub>BHL</sub>	Bus-Hold Input Sustain Current	V <sub>CC</sub> = 3V	V <sub>I</sub> = 2V	-75	—	—	μA
			V <sub>I</sub> = 0.8V	75	—	—	
I <sub>BHH</sub> I <sub>BHL</sub>	Bus-Hold Input Sustain Current	V <sub>CC</sub> = 2.3V	V <sub>I</sub> = 1.7V	—	—	—	μA
			V <sub>I</sub> = 0.7V	—	—	—	
I <sub>BHHO</sub> I <sub>BHLO</sub>	Bus-Hold Input Overdrive Current	V <sub>CC</sub> = 3.6V	V <sub>I</sub> = 0 to 3.6V	—	—	±500	μA

### NOTES:

1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Max.	Unit
VOH	Output HIGH Voltage	V <sub>CC</sub> = 2.3V to 3.6V	I <sub>OH</sub> = - 0.1mA	V <sub>CC</sub> - 0.2	—	V
		V <sub>CC</sub> = 2.3V	I <sub>OH</sub> = - 4mA	1.9	—	
			I <sub>OH</sub> = - 6mA	1.7	—	
		V <sub>CC</sub> = 2.7V	I <sub>OH</sub> = - 4mA	2.2	—	
			I <sub>OH</sub> = - 8mA	2	—	
		V <sub>CC</sub> = 3V	I <sub>OH</sub> = - 6mA	2.4	—	
I <sub>OH</sub> = - 12mA	2		—			
VOL	Output LOW Voltage	V <sub>CC</sub> = 2.3V to 3.6V	I <sub>OL</sub> = 0.1mA	—	0.2	V
		V <sub>CC</sub> = 2.3V	I <sub>OL</sub> = 4mA	—	0.4	
			I <sub>OL</sub> = 6mA	—	0.55	
		V <sub>CC</sub> = 2.7V	I <sub>OL</sub> = 4mA	—	0.4	
			I <sub>OL</sub> = 8mA	—	0.6	
		V <sub>CC</sub> = 3V	I <sub>OL</sub> = 6mA	—	0.55	
I <sub>OL</sub> = 12mA	—		0.8			

**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.

## OPERATING CHARACTERISTICS, V<sub>CC</sub> = 3.3V ± 0.3V, T<sub>A</sub> = 25°C

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power Dissipation Capacitance per Latch Outputs enabled	C <sub>L</sub> = 0pF, f = 10MHz	—	pF
CPD	Power Dissipation Capacitance per Latch Outputs disabled		—	

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

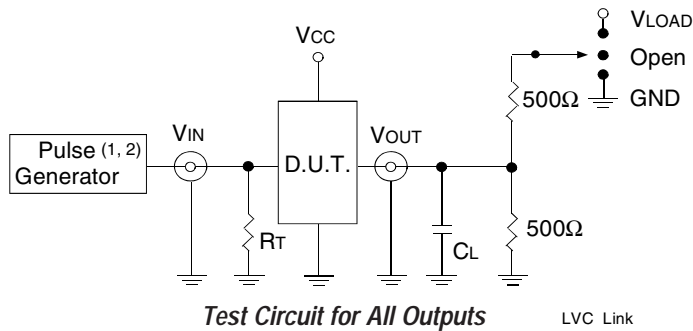
Symbol	Parameter	V <sub>CC</sub> = 2.7V		V <sub>CC</sub> = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay xDx to xQx	—	6	1.6	5.3	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay xLE to xQx	—	6.4	2.1	5.7	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time xOE to xQx	—	7.1	1.3	6.1	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time xOE to xQx	—	7.7	2.5	7.3	ns
t <sub>SU</sub>	Set-up Time HIGH or LOW, xDx to xLE	2.3	—	2.3	—	ns
t <sub>H</sub>	Hold Time HIGH or LOW, xDx after xLE	1.6	—	1.6	—	ns
t <sub>w</sub>	xLE Pulse Width HIGH	3.3	—	3.3	—	ns
t <sub>sk(o)</sub>	Output Skew <sup>(2)</sup>	—	—	—	500	ps

**NOTES:**  
1. See TEST CIRCUITS AND WAVEFORMS. T<sub>A</sub> = - 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 <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



#### DEFINITIONS:

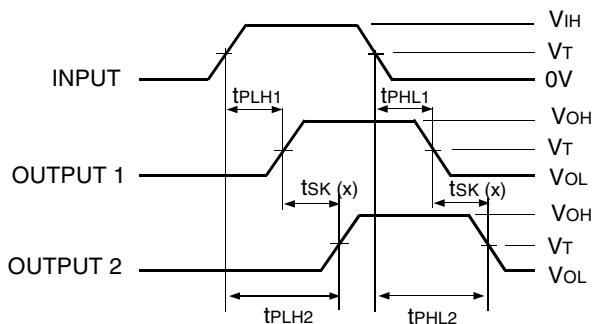
C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.  
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

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

### SWITCH POSITION

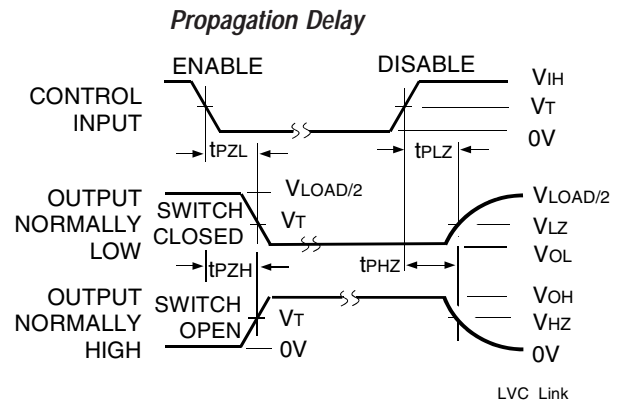
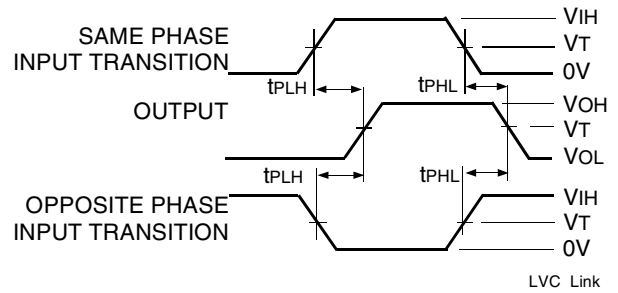
Test	Switch
Open Drain Disable Low Enable Low	V <sub>LOAD</sub>
Disable High Enable High	GND
All Other Tests	Open



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

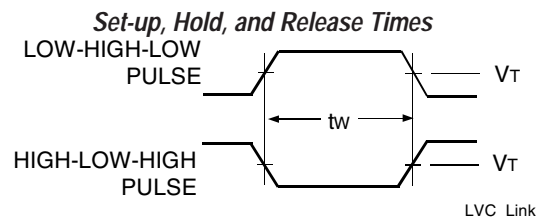
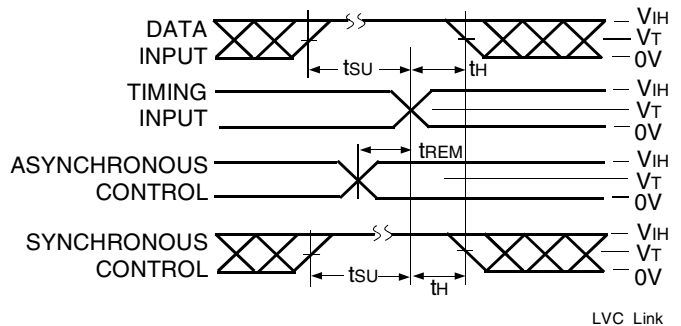
#### NOTES:

1. For t<sub>SK</sub>(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t<sub>SK</sub>(b) OUTPUT1 and OUTPUT2 are in the same bank.



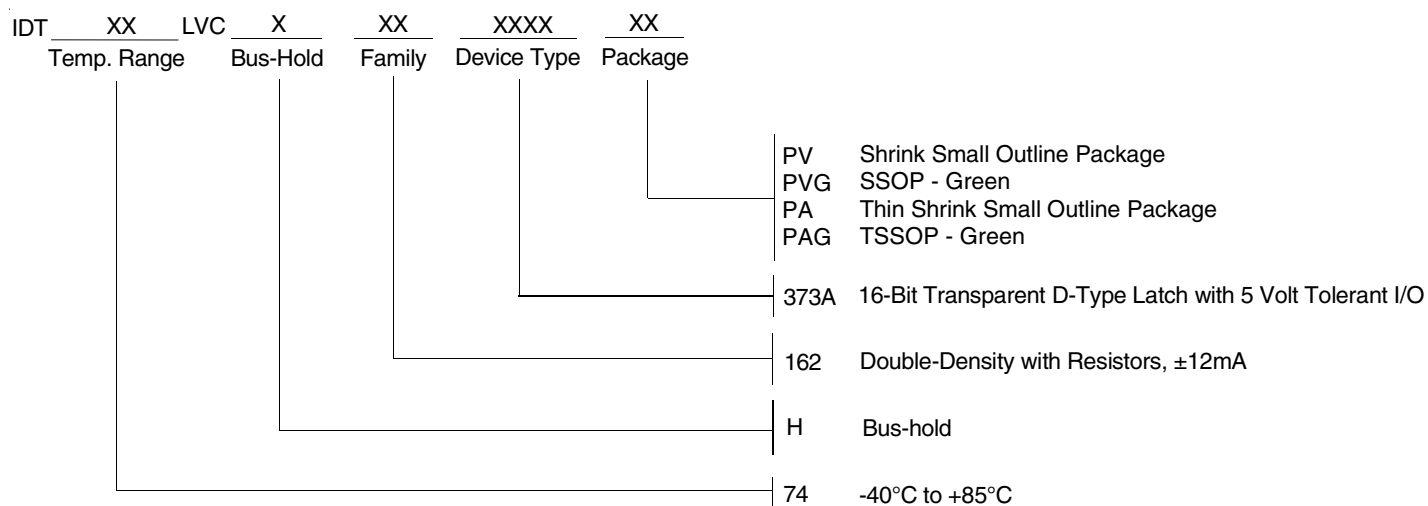
#### NOTE:

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



#### Pulse Width

## ORDERING INFORMATION



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