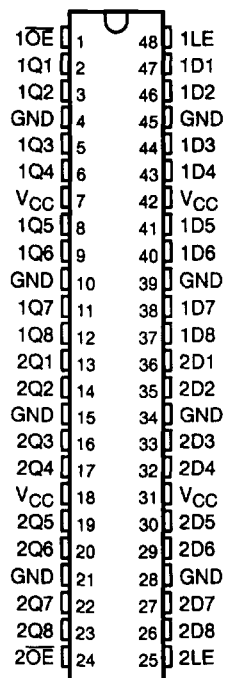


SN54LVT16373, SN74LVT16373 3.3-V ABT 16-BIT TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

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- State-of-the-Art Advanced BICMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation
- Members of the Texas Instruments *Widebus™* Family
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Support Unregulated Battery Operation Down to 2.7 V
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Bus-Hold Data Inputs Eliminate the Need for External Pullup Resistors
- Support Live Insertion
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings

SN54LVT16373 ... WD PACKAGE
SN74LVT16373 ... DGG OR DL PACKAGE
(TOP VIEW)



description

The 'LVT16373 are 16-bit transparent D-type latches with 3-state outputs designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment. These devices are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

These devices can be used as two 8-bit latches or one 16-bit latch. When the latch-enable (LE) input is high, the Q outputs follow the data (D) inputs. When LE is taken low, the Q outputs are latched at the levels set up at the D inputs.

A buffered output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without interface or pullup components.

\overline{OE} does not affect internal operations of the latch. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

Widebus is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA Information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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description (continued)

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

To ensure the high-impedance state during power up or power down, \overline{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.

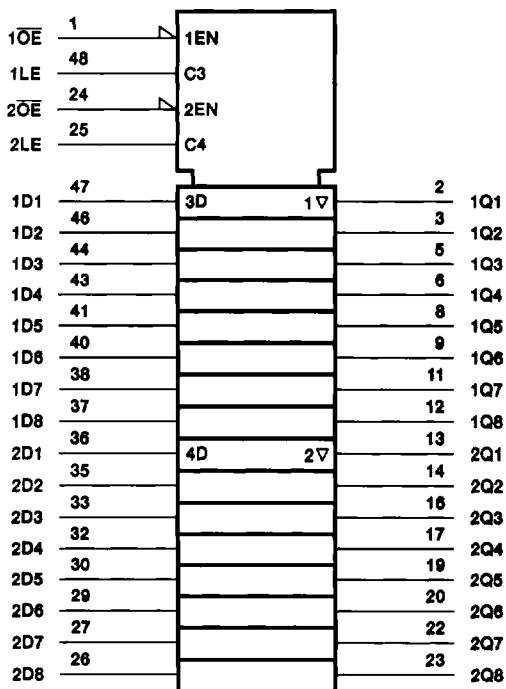
The SN74LVT16373 is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN54LVT16373 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LVT16373 is characterized for operation from -40°C to 85°C .

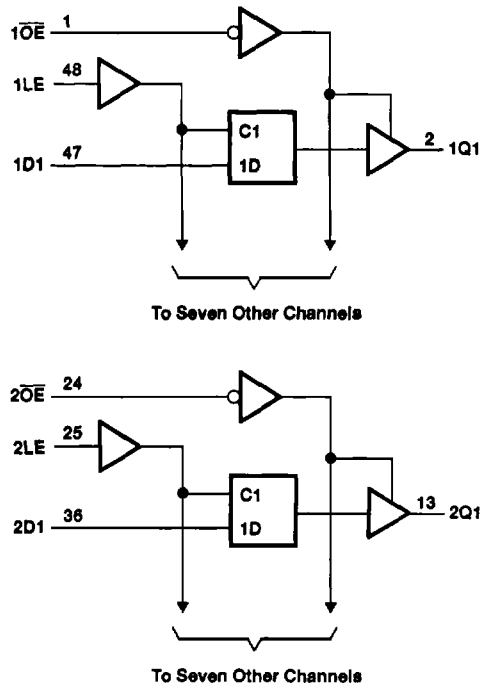
FUNCTION TABLE
(each 8-bit section)

INPUTS			OUTPUT
\overline{OE}	LE	D	Q
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

logic symbol†



logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC}	-0.5 V to 4.6 V
Input voltage range, V_I (see Note 1)	-0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, V_O (see Note 1)	-0.5 V to 7 V
Current into any output in the low state, I_O : SN54LVT16373	96 mA
SN74LVT16373	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVT16373	48 mA
SN74LVT16373	64 mA
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Output clamp current, I_{OK} ($V_O < 0$)	-50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package	0.85 W
DL package	1.2 W
Storage temperature range, T_{stg}	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. This current flows only when the output is in the high state and $V_O > V_{CC}$.
 3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 4)

		SN54LVT16373		SN74LVT16373		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	2.7	3.6	2.7	3.6	V
V_{IH}	High-level input voltage	2		2		V
V_{IL}	Low-level input voltage	0.8		0.8		V
V_I	Input voltage	5.5		5.5		V
I_{OH}	High-level output current	-24		-32		mA
I_{OL}	Low-level output current	48		64		mA
$\Delta t/\Delta v$	Input transition rise or fall rate	10		10		ns/V
T_A	Operating free-air temperature	-55	125	-40	85	°C

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	SN54LVT16373			SN74LVT16373			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}	$V_{CC} = 2.7\text{ V}$, $I_I = -18\text{ mA}$			-1.2			-1.2	V
V_{OH}	$V_{CC} = \text{MIN to MAX}^\ddagger$, $I_{OH} = -100\ \mu\text{A}$	$V_{CC} - 0.2$			$V_{CC} - 0.2$			V
	$V_{CC} = 2.7\text{ V}$, $I_{OH} = -8\text{ mA}$	2.4			2.4			
	$V_{CC} = 3\text{ V}$	2			2			
V_{OL}	$V_{CC} = 2.7\text{ V}$	$I_{OL} = 100\ \mu\text{A}$		0.2		0.2		V
		$I_{OL} = 24\text{ mA}$		0.5		0.5		
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$		0.4		0.4		
		$I_{OL} = 32\text{ mA}$		0.5		0.5		
		$I_{OL} = 48\text{ mA}$		0.55		0.55		
		$I_{OL} = 64\text{ mA}$				0.55		
I_I	$V_{CC} = 0\text{ or MAX}^\ddagger$, $V_I = 5.5\text{ V}$	40			10			μA
	Control inputs $V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}\text{ or GND}$	± 1			± 1			
	Data inputs $V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$		1		1		
		$V_I = 0$		-5		-5		
I_{off}	$V_{CC} = 0$, $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$	± 100			± 100			μA
$I_I(\text{hold})$	Data inputs $V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$		75		75		μA
		$V_I = 2\text{ V}$		-75		-75		
I_{OZH}	$V_{CC} = 3.6\text{ V}$, $V_O = 3\text{ V}$	5			5			μA
I_{OZL}	$V_{CC} = 3.6\text{ V}$, $V_O = 0.5\text{ V}$	-5			-5			μA
I_{CC}	Outputs high	$V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}\text{ or GND}$, $I_O = 0$		0.09		0.09		mA
	Outputs low			5		5		
	Outputs disabled			0.09		0.09		
ΔI_{CC}^\S	$V_{CC} = 3\text{ V to }3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at $V_{CC}\text{ or GND}$	0.2			0.2			mA
C_i	$V_I = 3\text{ V or }0$	5			5			pF
C_o	$V_O = 3\text{ V or }0$	9.5			9.5			pF

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

		SN54LVT16373				SN74LVT16373				UNIT
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, LE high	3.3		3.3		3.3		3.3		ns
t_{su}	Setup time, data before LE↓	1		1		0.5		0.5		ns
t_h	Hold time, data after LE↓	2.6		2.9		1.8		2		ns



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switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

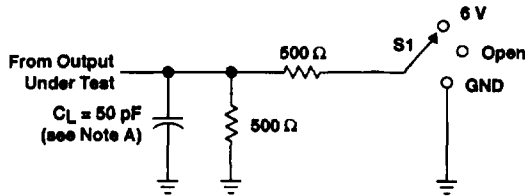
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT16373				SN74LVT16373				UNIT	
			$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$			$V_{CC} = 2.7\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
t_{PLH}	D	Q	0.5	5.1	5.8		1.3	2.7	5	5.7		ns
t_{PHL}			0.5	5	5.8		1.4	2.9	4.9	5.7		
t_{PLH}	LE	Q	1	6.8	7.3		2.1	3.6	6	6.8		ns
t_{PHL}			1	7.8	8.9		3	4.7	6.9	8.8		
t_{PZH}	\overline{OE}	Q	0.5	5.6	6.4		1	2.9	5.3	6.3		ns
t_{PZL}			0.5	5.5	6		1.3	3	5.1	5.9		
t_{PHZ}	\overline{OE}	Q	1	7.2	8		2.7	4.3	6.8	7.6		ns
t_{PLZ}			1	6.1	6.2		2.6	4	5.8	5.9		

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.



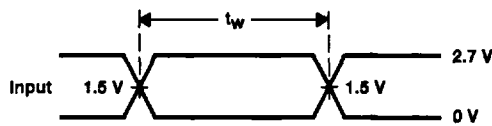
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PARAMETER MEASUREMENT INFORMATION

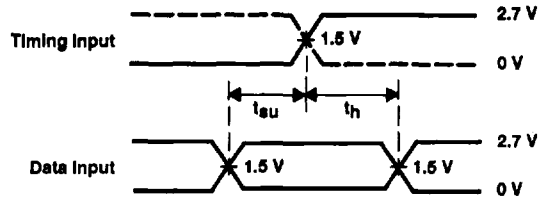


LOAD CIRCUIT FOR OUTPUTS

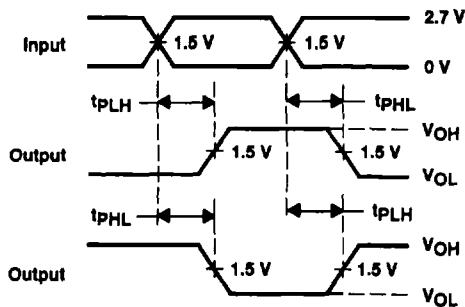
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



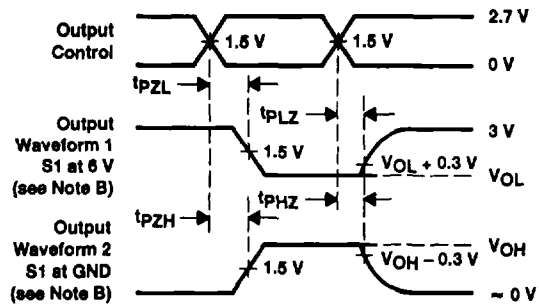
VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES INVERTING AND 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 MHz, $Z_O = 50 \Omega$, $t_r \leq 2.5$ ns, $t_f \leq 2.5$ ns.
 D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

