

# 74VCX16373

## Low-Voltage 1.8/2.5/3.3V 16-Bit Transparent Latch

### With 3.6 V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

The 74VCX16373 is an advanced performance, non-inverting 16-bit transparent latch. It is designed for very high-speed, very low-power operation in 1.8 V, 2.5 V or 3.3 V systems. The VCX16373 is byte controlled, with each byte functioning identically, but independently. Each byte has separate Output Enable and Latch Enable inputs. These control pins can be tied together for full 16-bit operation.

When operating at 2.5 V (or 1.8 V) the part is designed to tolerate voltages it may encounter on either inputs or outputs when interfacing to 3.3 V busses. It is guaranteed to be overvoltage tolerant to 3.6 V.

The 74VCX16373 contains 16 D-type latches with 3-state 3.6 V-tolerant outputs. When the Latch Enable (LEn) inputs are HIGH, data on the Dn inputs enters the latches. In this condition, the latches are transparent, (a latch output will change state each time its D input changes). When LE is LOW, the latch stores the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The 3-state outputs are controlled by the Output Enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is LOW, the outputs are enabled. When  $\overline{OE}$  is HIGH, the standard outputs are in the high impedance state, but this does not interfere with new data entering into the latches.

#### Features

- Designed for Low Voltage Operation:  $V_{CC} = 1.65\text{ V} - 3.6\text{ V}$
- 3.6 V Tolerant Inputs and Outputs
- High Speed Operation: 3.0 ns max for 3.0 V to 3.6 V  
3.9 ns max for 2.3 V to 2.7 V  
6.8 ns max for 1.65 V to 1.95 V
- Static Drive:  $\pm 24\text{ mA}$  Drive at 3.0 V  
 $\pm 18\text{ mA}$  Drive at 2.3 V  
 $\pm 6\text{ mA}$  Drive at 1.65 V
- Supports Live Insertion and Withdrawal
- $I_{OFF}$  Specification Guarantees High Impedance When  $V_{CC} = 0\text{ V}$
- Near Zero Static Supply Current in All Three Logic States (20  $\mu\text{A}$ )  
Substantially Reduces System Power Requirements
- Latchup Performance Exceeds  $\pm 250\text{ mA}$  @ 125°C
- ESD Performance: Human Body Model >2000 V;  
Machine Model >200 V
- All Devices in Package TSSOP are Inherently Pb-Free\*

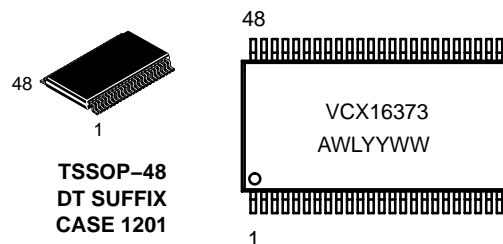
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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#### MARKING DIAGRAM



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week

#### PIN NAMES

Pins	Function
$\overline{OE}n$	Output Enable Inputs
LEn	Latch Enable Inputs
D0-D15	Inputs
O0-O15	Outputs

#### ORDERING INFORMATION

Device	Package	Shipping†
74VCX16373DT	TSSOP (Pb-Free)	39 / Rail
74VCX16373DTR	TSSOP (Pb-Free)	2500 / Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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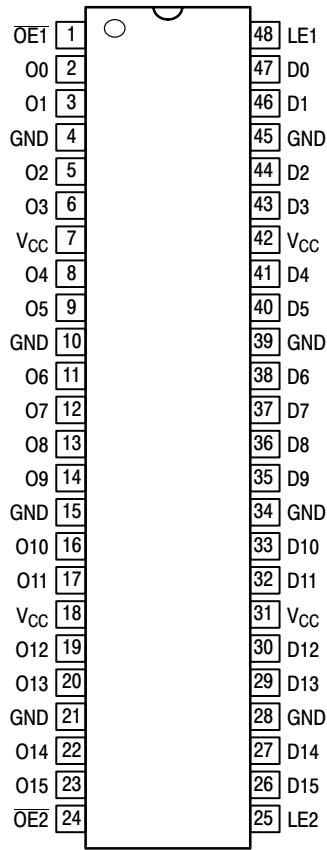


Figure 1. 48-Lead Pinout (Top View)

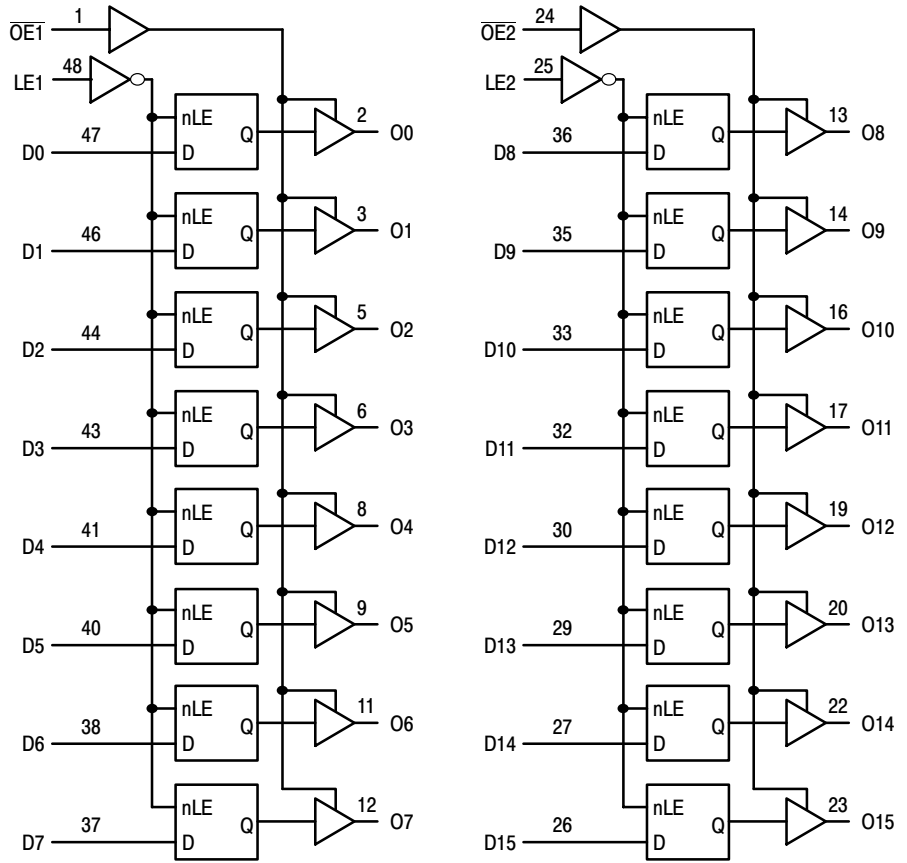


Figure 2. Logic Diagram

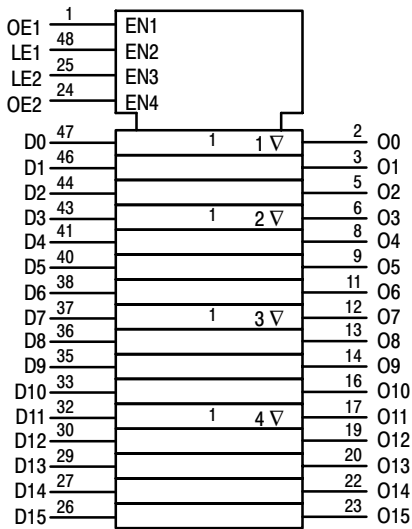


Figure 3. IEC Logic Diagram

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## TRUTH TABLE

Inputs			Outputs	Inputs			Outputs
LE1	OE1	D0:7	O0:7	LE2	OE2	D8:15	O8:15
X	H	X	Z	X	H	X	Z
H	L	L	L	H	L	L	L
H	L	H	H	H	L	H	H
L	L	X	O0	L	L	X	O0

H = High Voltage Level

L = Low Voltage Level

Z = High Impedance State

X = High or Low Voltage Level and Transitions Are Acceptable, for  $I_{CC}$  reasons, DO NOT FLOAT Inputs

O0 = No Change

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
$V_{CC}$	DC Supply Voltage	-0.5 to +4.6		V
$V_I$	DC Input Voltage	$-0.5 \leq V_I \leq +4.6$		V
$V_O$	DC Output Voltage	$-0.5 \leq V_O \leq +4.6$	Output in 3-State	V
		$-0.5 \leq V_O \leq V_{CC} + 0.5$	Note 1; Outputs Active	
$I_{IK}$	DC Input Diode Current	-50	$V_I < GND$	mA
$I_{OK}$	DC Output Diode Current	-50	$V_O < GND$	mA
		+50	$V_O > V_{CC}$	
$I_O$	DC Output Source/Sink Current	$\pm 50$		mA
$I_{CC}$	DC Supply Current Per Supply Pin	$\pm 100$		mA
$I_{GND}$	DC Ground Current Per Ground Pin	$\pm 100$		mA
$T_{STG}$	Storage Temperature Range	-65 to +150		$^{\circ}C$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1.  $I_O$  absolute maximum rating must be observed.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	
$V_{CC}$	Supply Voltage	Operating	1.65	3.3	3.6	V
		Data Retention Only	1.2	3.3	3.6	
$V_I$	Input Voltage	-0.3		3.6	V	
$V_O$	Output Voltage	(Active State)	0		$V_{CC}$	V
		(3-State)	0		3.6	
$I_{OH}$	HIGH Level Output Current, $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$			-24	mA	
$I_{OL}$	LOW Level Output Current, $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$			24	mA	
$I_{OH}$	HIGH Level Output Current, $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			-18	mA	
$I_{OL}$	LOW Level Output Current, $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			18	mA	
$I_{OH}$	HIGH Level Output Current, $V_{CC} = 1.65\text{ V} - 1.95\text{ V}$			-6	mA	
$I_{OL}$	LOW Level Output Current, $V_{CC} = 1.65\text{ V} - 1.95\text{ V}$			6	mA	
$T_A$	Operating Free-Air Temperature	-40		+85	$^{\circ}C$	
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC} = 3.0\text{ V}$	0		10	ns/V	

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## DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	$T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$		Unit
			Min	Max	
$V_{IH}$	HIGH Level Input Voltage (Note 2)	$1.65\text{ V} \leq V_{CC} < 2.3\text{ V}$	$0.65 \times V_{CC}$		V
		$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$	1.6		
		$2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$	2.0		
$V_{IL}$	LOW Level Input Voltage (Note 2)	$1.65\text{ V} \leq V_{CC} < 2.3\text{ V}$		$0.35 \times V_{CC}$	V
		$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$		0.7	
		$2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$		0.8	
$V_{OH}$	HIGH Level Output Voltage	$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; I_{OH} = -100\ \mu\text{A}$	$V_{CC} - 0.2$		V
		$V_{CC} = 1.65\text{ V}; I_{OH} = -6\text{ mA}$	1.25		
		$V_{CC} = 2.3\text{ V}; I_{OH} = -6\text{ mA}$	2.0		
		$V_{CC} = 2.3\text{ V}; I_{OH} = -12\text{ mA}$	1.8		
		$V_{CC} = 2.3\text{ V}; I_{OH} = -18\text{ mA}$	1.7		
		$V_{CC} = 2.7\text{ V}; I_{OH} = -12\text{ mA}$	2.2		
		$V_{CC} = 3.0\text{ V}; I_{OH} = -18\text{ mA}$	2.4		
		$V_{CC} = 3.0\text{ V}; I_{OH} = -24\text{ mA}$	2.2		
$V_{OL}$	LOW Level Output Voltage	$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; I_{OL} = 100\ \mu\text{A}$		0.2	V
		$V_{CC} = 1.65\text{ V}; I_{OL} = 6\text{ mA}$		0.3	
		$V_{CC} = 2.3\text{ V}; I_{OL} = 12\text{ mA}$		0.4	
		$V_{CC} = 2.3\text{ V}; I_{OL} = 18\text{ mA}$		0.6	
		$V_{CC} = 2.7\text{ V}; I_{OL} = 12\text{ mA}$		0.4	
		$V_{CC} = 3.0\text{ V}; I_{OL} = 18\text{ mA}$		0.4	
		$V_{CC} = 3.0\text{ V}; I_{OL} = 24\text{ mA}$		0.55	
$I_I$	Input Leakage Current	$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; 0\text{ V} \leq V_I \leq 3.6\text{ V}$		$\pm 5.0$	$\mu\text{A}$
$I_{OZ}$	3-State Output Current	$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; 0\text{ V} \leq V_O \leq 3.6\text{ V}; V_I = V_{IH}\text{ or } V_{IL}$		$\pm 10$	$\mu\text{A}$
$I_{OFF}$	Power-Off Leakage Current	$V_{CC} = 0\text{ V}; V_I\text{ or } V_O = 3.6\text{ V}$		10	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current (Note 3)	$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; V_I = \text{GND or } V_{CC}$		20	$\mu\text{A}$
		$1.65\text{ V} \leq V_{CC} \leq 3.6\text{ V}; 3.6\text{ V} \leq V_I, V_O \leq 3.6\text{ V}$		$\pm 20$	$\mu\text{A}$
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$2.7\text{ V} < V_{CC} \leq 3.6\text{ V}; V_{IH} = V_{CC} - 0.6\text{ V}$		750	$\mu\text{A}$

2. These values of  $V_I$  are used to test DC electrical characteristics only.

3. Outputs disabled or 3-state only.

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## AC CHARACTERISTICS (Note 4; $t_R = t_F = 2.0$ ns; $C_L = 30$ pF; $R_L = 500$ $\Omega$ )

Symbol	Parameter	Waveform	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$						Unit
			$V_{CC} = 3.0$ V to 3.6 V		$V_{CC} = 2.3$ V to 2.7 V		$V_{CC} = 1.65$ V to 1.95 V		
			Min	Max	Min	Max	Min	Max	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Dn-to-On	1	0.8 0.8	3.0 3.0	1.0 1.0	3.4 3.4	1.5 1.5	6.8 6.8	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay LE-to-On	1	0.8 0.8	3.0 3.0	1.0 1.0	3.9 3.9	1.5 1.5	7.8 7.8	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time to High and Low Level	2	0.8 0.8	3.5 3.5	1.0 1.0	4.6 4.6	1.5 1.5	9.2 9.2	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time From High and Low Level	2	0.8 0.8	3.5 3.5	1.0 1.0	3.8 3.8	1.5 1.5	6.8 6.8	ns
$t_s$	Setup Time, High or Low Dn-to-LE	3	1.5		1.5		2.5		ns
$t_h$	Hold Time, High or Low Dn-to-LE	3	1.0		1.0		1.0		ns
$t_w$	LE Pulse Width, High	3	1.5		1.5		4.0		ns
$t_{OSHL}$ $t_{OSLH}$	Output-to-Output Skew (Note 5)			0.5 0.5		0.5 0.5		0.75 0.75	ns

- For  $C_L = 50$  pF, add approximately 300 ps to the AC maximum specification.
- Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ); parameter guaranteed by design.

## AC CHARACTERISTICS ( $t_R = t_F = 2.0$ ns; $C_L = 50$ pF; $R_L = 500$ $\Omega$ )

Symbol	Parameter	Waveform	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$				Unit
			$V_{CC} = 3.0$ V to 3.6 V		$V_{CC} = 2.7$ V		
			Min	Max	Min	Max	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Dn-to-On	4	1.0 1.0	3.6 3.6		4.3 4.3	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay LE-to-On	4	1.0 1.0	3.9 3.9		4.6 4.6	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time to High and Low Level	5	1.0 1.0	4.7 4.7		5.7 5.7	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time From High and Low Level	5	1.0 1.0	4.1 4.1		4.5 4.5	ns
$t_{OSHL}$ $t_{OSLH}$	Output-to-Output Skew (Note 6)			0.5 0.5		0.5 0.5	ns

- Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ); parameter guaranteed by design.

**DYNAMIC SWITCHING CHARACTERISTICS**

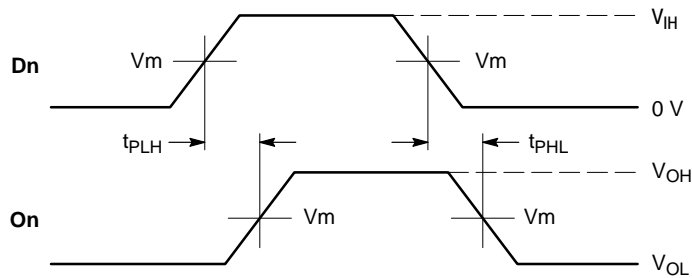
Symbol	Characteristic	Condition	T <sub>A</sub> = +25°C	
			Typ	Unit
V <sub>OLP</sub>	Dynamic LOW Peak Voltage (Note 7)	V <sub>CC</sub> = 1.8 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	0.25	V
		V <sub>CC</sub> = 2.5 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	0.6	
		V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	0.8	
V <sub>OLV</sub>	Dynamic LOW Valley Voltage (Note 7)	V <sub>CC</sub> = 1.8 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	-0.25	V
		V <sub>CC</sub> = 2.5 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	-0.6	
		V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	-0.8	
V <sub>OHV</sub>	Dynamic HIGH Valley Voltage (Note 8)	V <sub>CC</sub> = 1.8 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	1.5	V
		V <sub>CC</sub> = 2.5 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	1.9	
		V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	2.2	

- 7. Number of outputs defined as “n”. Measured with “n-1” outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.
- 8. Number of outputs defined as “n”. Measured with “n-1” outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the HIGH state.

**CAPACITIVE CHARACTERISTICS**

Symbol	Parameter	Condition	Typical	Unit
C <sub>IN</sub>	Input Capacitance	Note 9	6	pF
C <sub>OUT</sub>	Output Capacitance	Note 9	7	pF
C <sub>PD</sub>	Power Dissipation Capacitance	Note 9, 10 MHz	20	pF

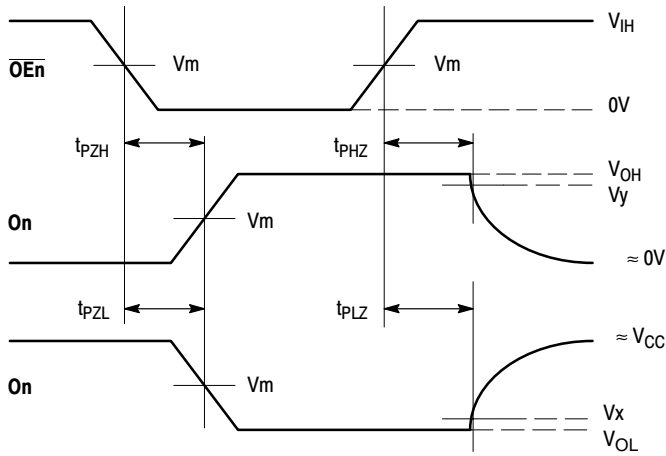
9. V<sub>CC</sub> = 1.8 V, 2.5 V or 3.3 V; V<sub>I</sub> = 0 V or V<sub>CC</sub>.



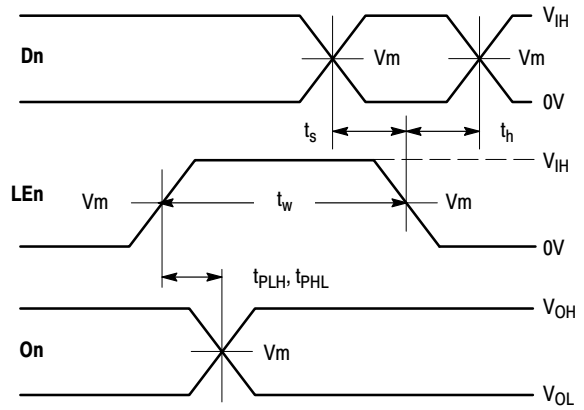
**WAVEFORM 1 – PROPAGATION DELAYS**  
 t<sub>R</sub> = t<sub>F</sub> = 2.0 ns, 10% to 90%; f = 1 MHz; t<sub>W</sub> = 500 ns

**Figure 4. AC Waveforms**

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**WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES**  
 $t_R = t_F = 2.0$  ns, 10% to 90%;  $f = 1$  MHz;  $t_W = 500$  ns

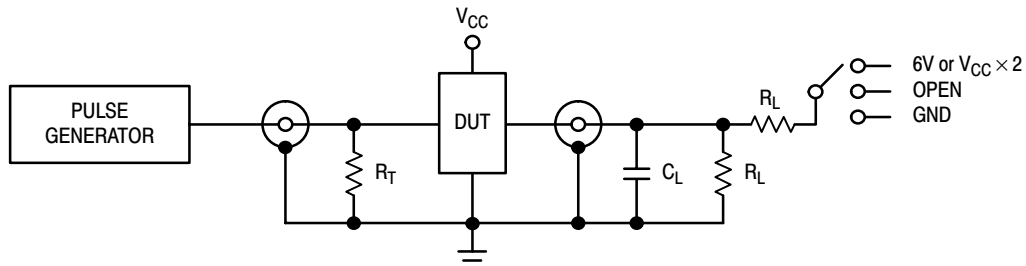


**WAVEFORM 3 - LE to On PROPAGATION DELAYS, LE MINIMUM PULSE WIDTH, Dn to LE SETUP AND HOLD TIMES**  
 $t_R = t_F = 2.0$  ns, 10% to 90%;  $f = 1$  MHz;  $t_W = 500$  ns except when noted

**Figure 5. AC Waveforms**

**Table 1. AC WAVEFORMS**

Symbol	V <sub>CC</sub>		
	3.3 V ± 0.3 V	2.5 V ± 0.2 V	1.8 V ± 0.15 V
V <sub>IH</sub>	2.7 V	V <sub>CC</sub>	V <sub>CC</sub>
V <sub>m</sub>	1.5 V	V <sub>CC</sub> /2	V <sub>CC</sub> /2
V <sub>x</sub>	V <sub>OL</sub> + 0.3 V	V <sub>OL</sub> + 0.15 V	V <sub>OL</sub> + 0.15 V
V <sub>y</sub>	V <sub>OH</sub> - 0.3 V	V <sub>OH</sub> - 0.15 V	V <sub>OH</sub> - 0.15 V



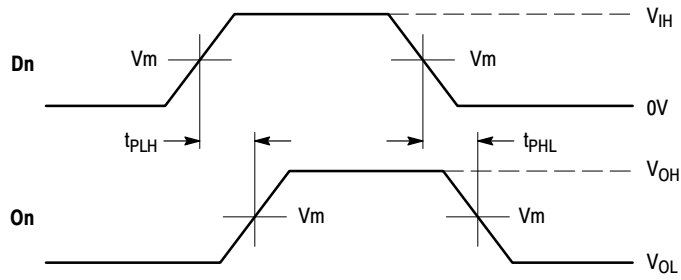
**Figure 6. Test Circuit**

**Table 2. TEST CIRCUIT**

TEST	SWITCH
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
t <sub>PZL</sub> , t <sub>PLZ</sub>	6 V at V <sub>CC</sub> = 3.3 ± 0.3 V; V <sub>CC</sub> × 2 at V <sub>CC</sub> = 2.5 ± 0.2 V; 1.8 ± 0.15 V
t <sub>PZH</sub> , t <sub>PHZ</sub>	GND

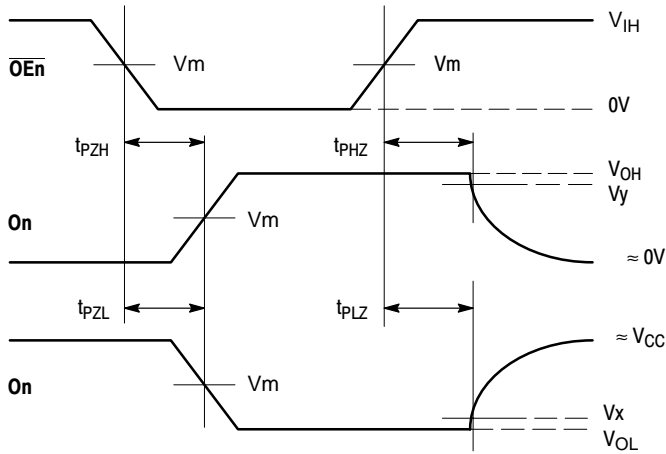
C<sub>L</sub> = 30 pF or equivalent (Includes jig and probe capacitance)  
R<sub>L</sub> = 500 Ω or equivalent  
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50 Ω)

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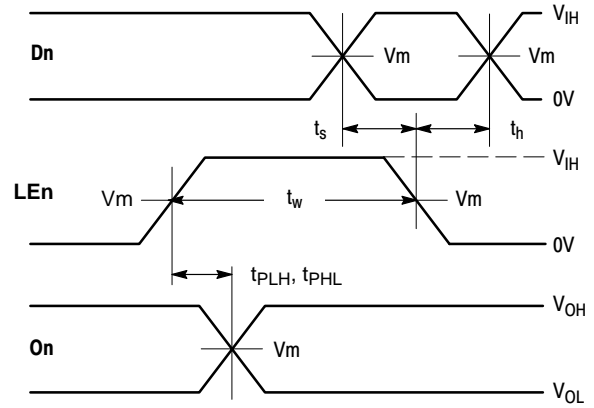


**WAVEFORM 4 – PROPAGATION DELAYS**  
 $t_R = t_F = 2.0 \text{ ns}$ , 10% to 90%;  $f = 1 \text{ MHz}$ ;  $t_W = 500 \text{ ns}$

**Figure 7. AC Waveforms**



**WAVEFORM 5 – OUTPUT ENABLE AND DISABLE TIMES**  
 $t_R = t_F = 2.0 \text{ ns}$ , 10% to 90%;  $f = 1 \text{ MHz}$ ;  $t_W = 500 \text{ ns}$



**WAVEFORM 6 – LE to On PROPAGATION DELAYS, LE MINIMUM PULSE WIDTH, Dn to LE SETUP AND HOLD TIMES**  
 $t_R = t_F = 2.0 \text{ ns}$ , 10% to 90%;  $f = 1 \text{ MHz}$ ;  $t_W = 500 \text{ ns}$  except when noted

**Figure 8. AC Waveforms**

**Table 3. AC WAVEFORMS**

Symbol	$V_{CC}$	
	3.3 V $\pm$ 0.3 V	2.7 V
$V_{IH}$	2.7 V	2.7 V
$V_m$	1.5 V	1.5 V
$V_x$	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.3 \text{ V}$
$V_y$	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



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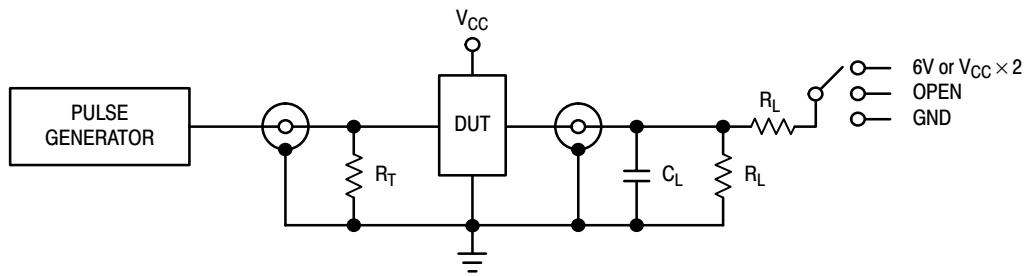


Figure 9. Test Circuit

Table 4. TEST CIRCUIT

TEST	SWITCH
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	6 V at $V_{CC} = 3.3 \pm 0.3$ V; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2$ V; $1.8 \pm 0.15$ V
$t_{PZH}$ , $t_{PHZ}$	GND

$C_L = 50$  pF or equivalent (Includes jig and probe capacitance)

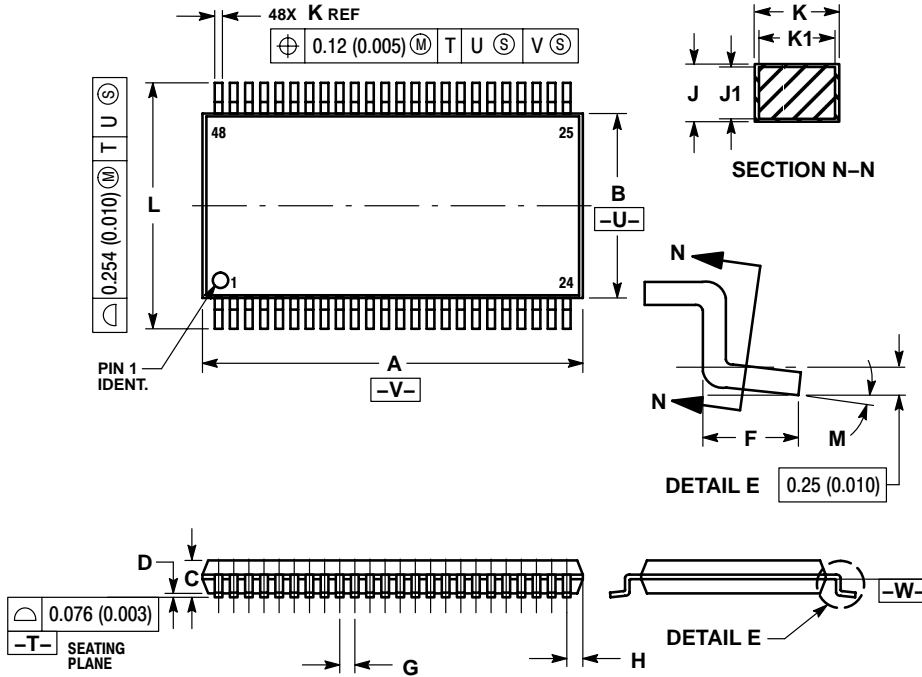
$R_L = 500 \Omega$  or equivalent

$R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

# 74VCX16373

## PACKAGE DIMENSIONS


TSSOP  
DT SUFFIX  
CASE 1201-01  
ISSUE A



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	12.40	12.60	0.488	0.496
B	6.00	6.20	0.236	0.244
C	---	1.10	---	0.043
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.50 BSC		0.0197 BSC	
H	0.37	---	0.015	---
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.17	0.27	0.007	0.011
K1	0.17	0.23	0.007	0.009
L	7.95	8.25	0.313	0.325
M	0°	8°	0°	8°

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