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# DATA SHEET

## **74LVCH32373A**

**32-bit transparent D-type latch with  
5 V tolerant inputs/outputs; 3-state**

Product specification  
Supersedes data of 1999 Nov 24

2004 May 19

## 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

## 74LVCH32373A

### FEATURES

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- All data inputs have bushold
- Complies with JEDEC standard JESD8-B/JESD36
- ESD protection:  
HBM EIA/JESD22-A114-B exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$
- Packaged in plastic fine-pitch ball grid array package.

### DESCRIPTION

The 74LVCH32373A is a high-performance, low-power, low-voltage, Si-gate CMOS device superior to most advanced CMOS compatible TTL families.

The inputs can be driven from either 3.3 V or 5 V devices. In 3-state operation, outputs can handle 5 V. These features allow the use of these devices in a mixed 3.3 V and 5 V environment.

### QUICK REFERENCE DATA

GND = 0 V;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f \leq 2.5\text{ ns}$

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$t_{\text{PHL}}/t_{\text{PLH}}$	propagation delay nDn to nQn	$C_L = 50\text{ pF}$ ; $V_{\text{CC}} = 3.3\text{ V}$	3.0	ns
	propagation delay nLE to nQn	$C_L = 50\text{ pF}$ ; $V_{\text{CC}} = 3.3\text{ V}$	3.4	ns
$t_{\text{PZH}}/t_{\text{PZL}}$	3-state output enable time $n\overline{\text{OE}}$ to nQn	$C_L = 50\text{ pF}$ ; $V_{\text{CC}} = 3.3\text{ V}$	3.5	ns
$t_{\text{PHZ}}/t_{\text{PLZ}}$	3-state output disable time $n\overline{\text{OE}}$ to nQn	$C_L = 50\text{ pF}$ ; $V_{\text{CC}} = 3.3\text{ V}$	3.9	ns
$C_I$	input capacitance		5.0	pF
$C_{\text{PD}}$	power dissipation per latch	$V_{\text{CC}} = 3.3\text{ V}$ ; notes 1 and 2 outputs enabled	15	pF
		outputs disabled	11	pF

### Notes

1.  $C_{\text{PD}}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{\text{PD}} \times V_{\text{CC}}^2 \times f_i \times N + \Sigma(C_L \times V_{\text{CC}}^2 \times f_o)$  where:  
 $f_i$  = input frequency in MHz;  
 $f_o$  = output frequency in MHz;

The 74LVCH32373A is a 32-bit transparent D-type latch featuring separate D-type inputs for each latch and 3-state outputs for bus oriented applications. One latch enable input (nLE) and one output enable input ( $n\overline{\text{OE}}$ ) are provided for each octal. Inputs can be driven from either 3.3 V or 5 V devices.

The 74LVCH32373A consists of 4 sections of eight D-type transparent latches with 3-state true outputs. When input nLE is HIGH, data at the nDn inputs enter the latches. In this condition the latches are transparent, i.e. a latch output will change each time its corresponding D-input changes.

When input nLE is LOW, the latches store the information that was present at the D-inputs one set-up time preceding the HIGH-to-LOW transition of nLE. When input  $n\overline{\text{OE}}$  is LOW, the contents of the eight latches are available at the outputs. When input  $n\overline{\text{OE}}$  is HIGH, the outputs go to the high-impedance OFF-state. Operation of the  $n\overline{\text{OE}}$  input does not affect the state of the latches.

The 74LVCH32373A bushold data input circuits eliminate the need for external pull-up resistors to hold unused inputs.

## 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

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$C_L$  = output load capacity in pF;

$V_{CC}$  = supply voltage in Volts;

N = total load switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

2. The condition is  $V_I = \text{GND to } V_{CC}$ .

### FUNCTION TABLE

See note 1.

OPERATING MODE	INPUT			INTERNAL LATCH	OUTPUT
	nOE	nLE	nDn		nQn
Enable and read register (transparent mode)	L	H	L	L	L
	L	H	H	H	H
Latch and read register	L	L	l	L	L
	L	L	h	H	H
Latch register and disable outputs	H	L	l	L	Z
	H	L	h	H	Z

### Note

1. H = HIGH voltage level;

h = HIGH voltage level one set-up time prior to the HIGH-to-LOW LE transition;

L = LOW voltage level;

l = LOW voltage level one set-up time prior to the HIGH-to-LOW LE transition;

Z = high-impedance OFF-state.

### ORDERING INFORMATION

TYPE NUMBER	PACKAGE				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74LVCH32373AEC	-40 °C to +85 °C	96	LFBGA96	plastic	SOT536-1

### PINNING

BALL	SYMBOL	DESCRIPTION
A1	1Q1	data output
A2	1Q0	data output
A3	1OE	output enable input (active LOW)
A4	1LE	latch enable input (active HIGH)
A5	1D0	data input
A6	1D1	data input
B1	1Q3	data output
B2	1Q2	data output
B3	GND	ground (0 V)
B4	GND	ground (0 V)

BALL	SYMBOL	DESCRIPTION
B5	1D2	data input
B6	1D3	data input
C1	1Q5	data output
C2	1Q4	data output
C3	$V_{CC}$	supply voltage
C4	$V_{CC}$	supply voltage
C5	1D4	data input
C6	1D5	data input
D1	1Q7	data output
D2	1Q6	data output
D3	GND	ground (0 V)

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BALL	SYMBOL	DESCRIPTION
D4	GND	ground (0 V)
D5	1D6	data input
D6	1D7	data input
E1	2Q1	data output
E2	2Q0	data output
E3	GND	ground (0 V)
E4	GND	ground (0 V)
E5	2D0	data input
E6	2D1	data input
F1	2Q3	data output
F2	2Q2	data output
F3	V <sub>CC</sub>	supply voltage
F4	V <sub>CC</sub>	supply voltage
F5	2D2	data input
F6	2D3	data input
G1	2Q5	data output
G2	2Q4	data output
G3	GND	ground (0 V)
G4	GND	ground (0 V)
G5	2D4	data input
G6	2D5	data input
H1	2Q6	data output
H2	2Q7	data output
H3	2 $\overline{OE}$	output enable input (active LOW)
H4	2LE	latch enable input (active HIGH)
H5	2D7	data input
H6	2D6	data input
J1	3Q1	data output
J2	3Q0	data output
J3	3 $\overline{OE}$	output enable input (active LOW)
J4	3LE	latch enable input (active HIGH)
J5	3D0	data input
J6	3D1	data input
K1	3Q3	data output
K2	3Q2	data output
K3	GND	ground (0 V)
K4	GND	ground (0 V)
K5	3D2	data input
K6	3D3	data input
L1	3Q5	data output
L2	3Q4	data output

BALL	SYMBOL	DESCRIPTION
L3	V <sub>CC</sub>	supply voltage
L4	V <sub>CC</sub>	supply voltage
L5	3D4	data input
L6	3D5	data input
M1	3Q7	data output
M2	3Q6	data output
M3	GND	ground (0 V)
M4	GND	ground (0 V)
M5	3D6	data input
M6	3D7	data input
N1	4Q1	data output
N2	4Q0	data output
N3	GND	ground (0 V)
N4	GND	ground (0 V)
N5	4D0	data input
N6	4D1	data input
P1	4Q3	data output
P2	4Q2	data output
P3	V <sub>CC</sub>	supply voltage
P4	V <sub>CC</sub>	supply voltage
P5	4D2	data input
P6	4D3	data input
R1	4Q5	data output
R2	4Q4	data output
R3	GND	ground (0 V)
R4	GND	ground (0 V)
R5	4D4	data input
R6	4D5	data input
T1	4Q6	data output
T2	4Q7	data output
T3	4 $\overline{OE}$	output enable input (active LOW)
T4	4LE	latch enable input (active HIGH)
T5	4D7	data input
T6	4D6	data input

# 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

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6	1D1	1D3	1D5	1D7	2D1	2D3	2D5	2D6	3D1	3D3	3D5	3D7	4D1	4D3	4D5	4D6
5	1D0	1D2	1D4	1D6	2D0	2D2	2D4	2D7	3D0	3D2	3D4	3D6	4D0	4D2	4D4	4D7
4	1LE	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	2LE	3LE	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	4LE
3	1 $\overline{O}E$	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	2 $\overline{O}E$	3 $\overline{O}E$	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	4 $\overline{O}E$
2	1Q0	1Q2	1Q4	1Q6	2Q0	2Q2	2Q4	2Q7	3Q0	3Q2	3Q4	3Q6	4Q0	4Q2	4Q4	4Q7
1	1Q1	1Q3	1Q5	1Q7	2Q1	2Q3	2Q5	2Q6	3Q1	3Q3	3Q5	3Q7	4Q1	4Q3	4Q5	4Q6
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	T

Fig.1 Pin configuration.

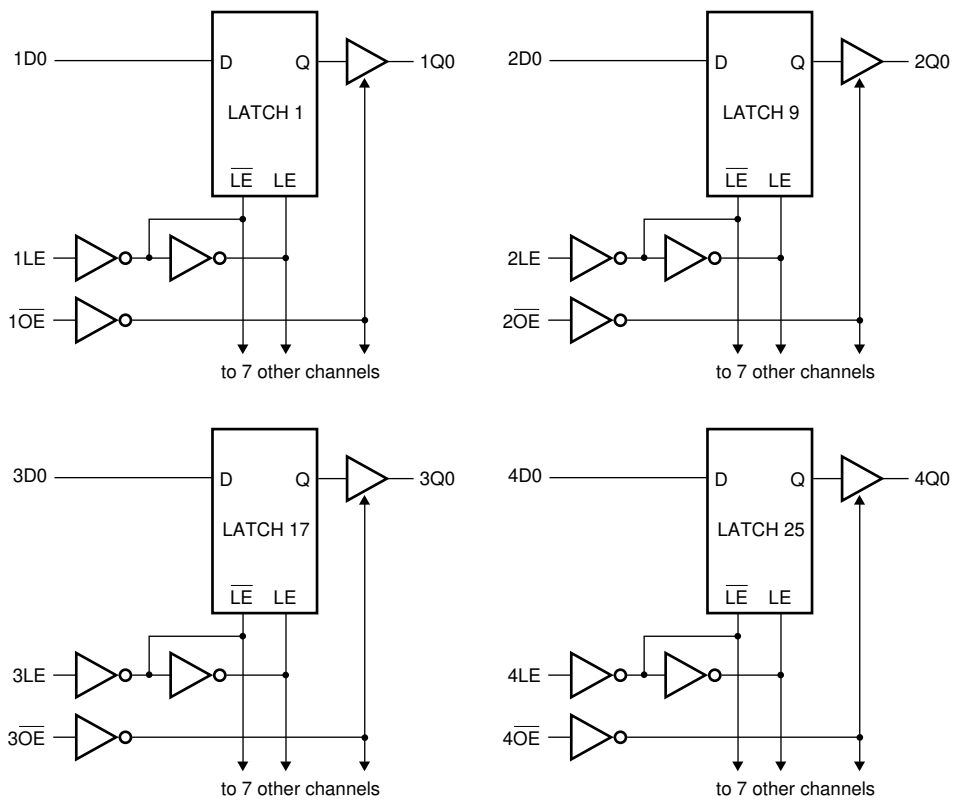


Fig.2 Logic symbol.

32-bit transparent D-type latch with  
5 V tolerant inputs/outputs; 3-state

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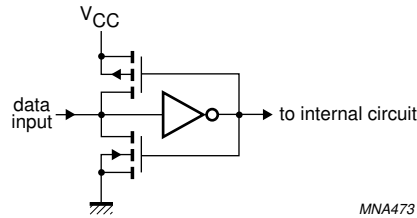


Fig.3 Bushold circuit.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>CC</sub>	supply voltage	for maximum speed performance	2.7	3.6	V
		for low-voltage applications	1.2	3.6	V
V <sub>I</sub>	input voltage		0	5.5	V
V <sub>O</sub>	output voltage	output HIGH or LOW state	0	V <sub>CC</sub>	V
		output 3-state	0	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	input rise and fall times	V <sub>CC</sub> = 1.2 V to 2.7 V	0	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 V	0	10	ns/V

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>CC</sub>	supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	input diode current	V <sub>I</sub> < 0 V	-	-50	mA
V <sub>I</sub>	input voltage	note 1	-0.5	+6.5	V
I <sub>OK</sub>	output diode current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA
V <sub>O</sub>	output voltage	output HIGH or LOW state; note 1	-0.5	V <sub>CC</sub> + 0.5	V
		output 3-state; note 1	-0.5	+6.5	V
I <sub>O</sub>	output source or sink current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub> , I <sub>GND</sub>	V <sub>CC</sub> or GND current	note 2	-	±200	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	power dissipation	T <sub>amb</sub> = -40 °C to +85 °C; note 3	-	1000	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. All supply and ground pins connected externally to one voltage source.
3. Above 70 °C the value of P<sub>tot</sub> derates linearly with 1.8 mW/K.

## 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

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### DC CHARACTERISTICS

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 °C to +85 °C; note 1</b>							
V <sub>IH</sub>	HIGH-level input voltage		1.2	V <sub>CC</sub>	–	–	V
			2.7 to 3.6	2.0	–	–	V
V <sub>IL</sub>	LOW-level input voltage		1.2	–	–	GND	V
			2.7 to 3.6	–	–	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = -100 µA	2.7 to 3.6	V <sub>CC</sub> - 0.2	V <sub>CC</sub>	–	V
		I <sub>O</sub> = -12 mA	2.7	V <sub>CC</sub> - 0.5	–	–	V
		I <sub>O</sub> = -18 mA	3.0	V <sub>CC</sub> - 0.6	–	–	V
		I <sub>O</sub> = -24 mA	3.0	V <sub>CC</sub> - 0.8	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 100 µA	2.7 to 3.6	–	GND	0.20	V
		I <sub>O</sub> = 12 mA	2.7	–	–	0.40	V
		I <sub>O</sub> = 24 mA	3.0	–	–	0.55	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; note 2	3.6	–	±0.1	±5	µA
I <sub>OZ</sub>	3-state output OFF-state current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5 V or GND; note 2	3.6	–	0.1	±5	µA
I <sub>off</sub>	power-off leakage supply current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V	0.0	–	0.1	±10	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	3.6	–	0.1	40	µA
ΔI <sub>CC</sub>	additional quiescent supply current per input pin	V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	2.7 to 3.6	–	5	500	µA
I <sub>BH</sub>	bushold LOW sustaining current	V <sub>I</sub> = 0.8 V; notes 3 and 4	3.0	75	–	–	µA
I <sub>BHH</sub>	bushold HIGH sustaining current	V <sub>I</sub> = 2.0 V; notes 3 and 4	3.0	-75	–	–	µA
I <sub>BHLO</sub>	bushold LOW overdrive current	notes 3 and 5	3.6	500	–	–	µA
I <sub>BHHO</sub>	bushold HIGH overdrive current	notes 3 and 5	3.6	-500	–	–	µA

### Notes

- All typical values are measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- For bushold parts, the bushold circuit is switched off when V<sub>I</sub> > V<sub>CC</sub> allowing 5.5 V on the input pin.
- For data inputs only, control inputs do not have a bushold circuit.
- The specified sustaining current at the data inputs holds the input below the specified V<sub>I</sub> level.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.



# 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

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**AC CHARACTERISTICS**GND = 0 V;  $t_r = t_f \leq 2.5$  ns;  $C_L = 50$  pF;  $R_L = 500$   $\Omega$ .

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 °C to +85 °C; note 1</b>							
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay nDn to nQn	see Fig 4 and 8	1.2	–	12	–	ns
			2.7	1.5	–	4.9	ns
			3.0 to 3.6	1.0	3.0 <sup>(2)</sup>	4.4	ns
	propagation delay nLE to nQn	see Fig 5 and 8	1.2	–	14	–	ns
			2.7	1.5	–	5.3	ns
			3.0 to 3.6	1.5	3.4 <sup>(2)</sup>	4.8	ns
t <sub>PZH</sub> /t <sub>PZL</sub>	3-state output enable time $\overline{nOE}$ to nQn	see Fig 7 and 8	1.2	–	18	–	ns
			2.7	1.5	–	5.7	ns
			3.0 to 3.6	1.0	3.5 <sup>(2)</sup>	4.9	ns
t <sub>PHZ</sub> /t <sub>PLZ</sub>	3-state output disable time $\overline{nOE}$ to nQn	see Fig 7 and 8	1.2	–	11	–	ns
			2.7	1.5	–	6.3	ns
			3.0 to 3.6	1.5	3.9 <sup>(2)</sup>	5.4	ns
t <sub>w</sub>	nLE pulse width HIGH	see Fig 5	1.2	–	–	–	ns
			2.7	3.0	–	–	ns
			3.0 to 3.6	3.0	2.0 <sup>(2)</sup>	–	ns
t <sub>su</sub>	set-up time nDn to nLE	see Fig 6	1.2	–	–	–	ns
			2.7	2.0	–	–	ns
			3.0 to 3.6	2.0	1.0 <sup>(2)</sup>	–	ns
t <sub>h</sub>	hold time nDn to nLE	see Fig 6	1.2	–	–	–	ns
			2.7	0.9	–	–	ns
			3.0 to 3.6	0.9	-1.0 <sup>(2)</sup>	–	ns
t <sub>sk(0)</sub>	skew		3.0 to 3.6	–	–	1.0	ns

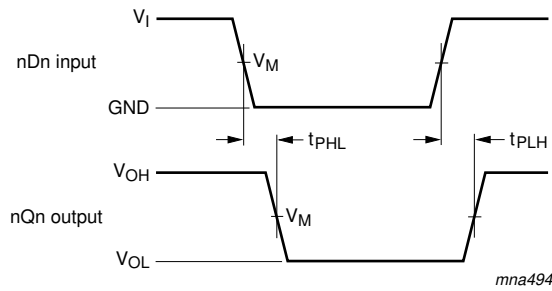
**Notes**

1. All typical values are measured at T<sub>amb</sub> = 25 °C.
2. Measured at V<sub>CC</sub> = 3.3 V.

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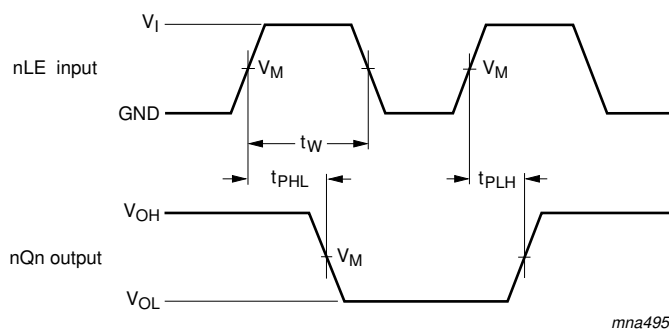
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AC WAVEFORMS



$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ ;  
 $V_M = 0.5 \times V_{CC}$  at  $V_{CC} < 2.7\text{ V}$ ;  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage drop that occur with the output load.

Fig.4 Input (nDn) to output (nQn) propagation delay times.

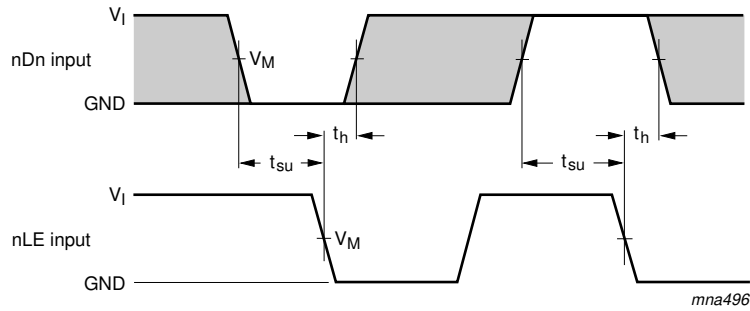


$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ ;  
 $V_M = 0.5 \times V_{CC}$  at  $V_{CC} < 2.7\text{ V}$ ;  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage drop that occur with the output load.

Fig.5 Latch enable inputs (nLE) pulse width and the latch enable input to outputs (nQn) propagation delay times.

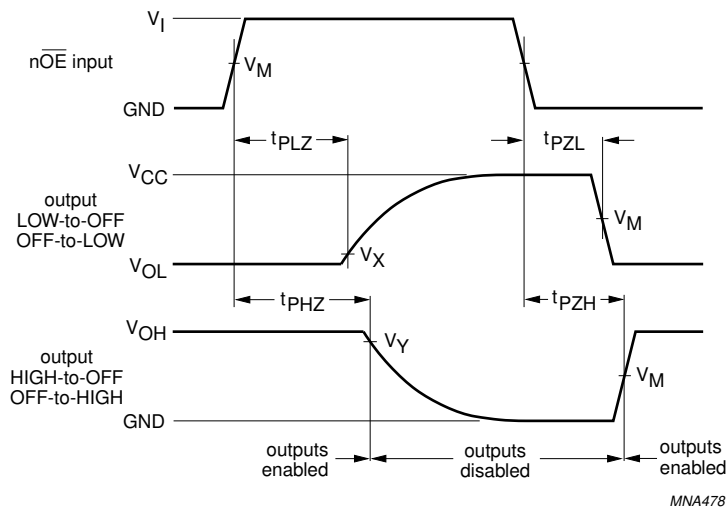
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V<sub>M</sub> = 1.5 V at V<sub>CC</sub> ≥ 2.7 V;  
V<sub>M</sub> = 0.5 × V<sub>CC</sub> at V<sub>CC</sub> < 2.7 V.

Fig.6 Set-up and hold times for inputs (nDn) to inputs (nLE).



V<sub>M</sub> = 1.5 V at V<sub>CC</sub> ≥ 2.7 V;  
V<sub>M</sub> = 0.5 × V<sub>CC</sub> at V<sub>CC</sub> < 2.7 V.

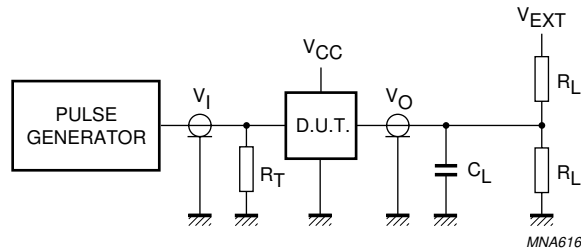
V<sub>X</sub> = V<sub>OL</sub> + 0.3 V at V<sub>CC</sub> ≥ 2.7 V;  
V<sub>X</sub> = V<sub>OL</sub> + 0.1 V at V<sub>CC</sub> < 2.7 V;  
V<sub>Y</sub> = V<sub>OH</sub> - 0.3 V at V<sub>CC</sub> ≥ 2.7 V;  
V<sub>Y</sub> = V<sub>OH</sub> - 0.1 V at V<sub>CC</sub> < 2.7 V.

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage drop that occur with the output load.

Fig.7 3-state output enable and disable times.

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V <sub>CC</sub>	V <sub>I</sub>	C <sub>L</sub>	R <sub>L</sub>	V <sub>EXT</sub>		
				t <sub>PLH</sub> /t <sub>PHL</sub>	t <sub>PZH</sub> /t <sub>PHZ</sub>	t <sub>PZL</sub> /t <sub>PLZ</sub>
1.2 V	V <sub>CC</sub>	50 pF	500 Ω <sup>(1)</sup>	open	GND	2 × V <sub>CC</sub>
2.7 V	2.7 V	50 pF	500 Ω	open	GND	2 × V <sub>CC</sub>
3.0 V to 3.6 V	2.7 V	50 pF	500 Ω	open	GND	2 × V <sub>CC</sub>

**Note**

1. The circuit performs better when R<sub>L</sub> = 1000 Ω.

Definitions for test circuits:

R<sub>L</sub> = Load resistor.

C<sub>L</sub> = Load capacitance including jig and probe capacitance.

R<sub>T</sub> = Termination resistance should be equal to the output impedance Z<sub>o</sub> of the pulse generator.

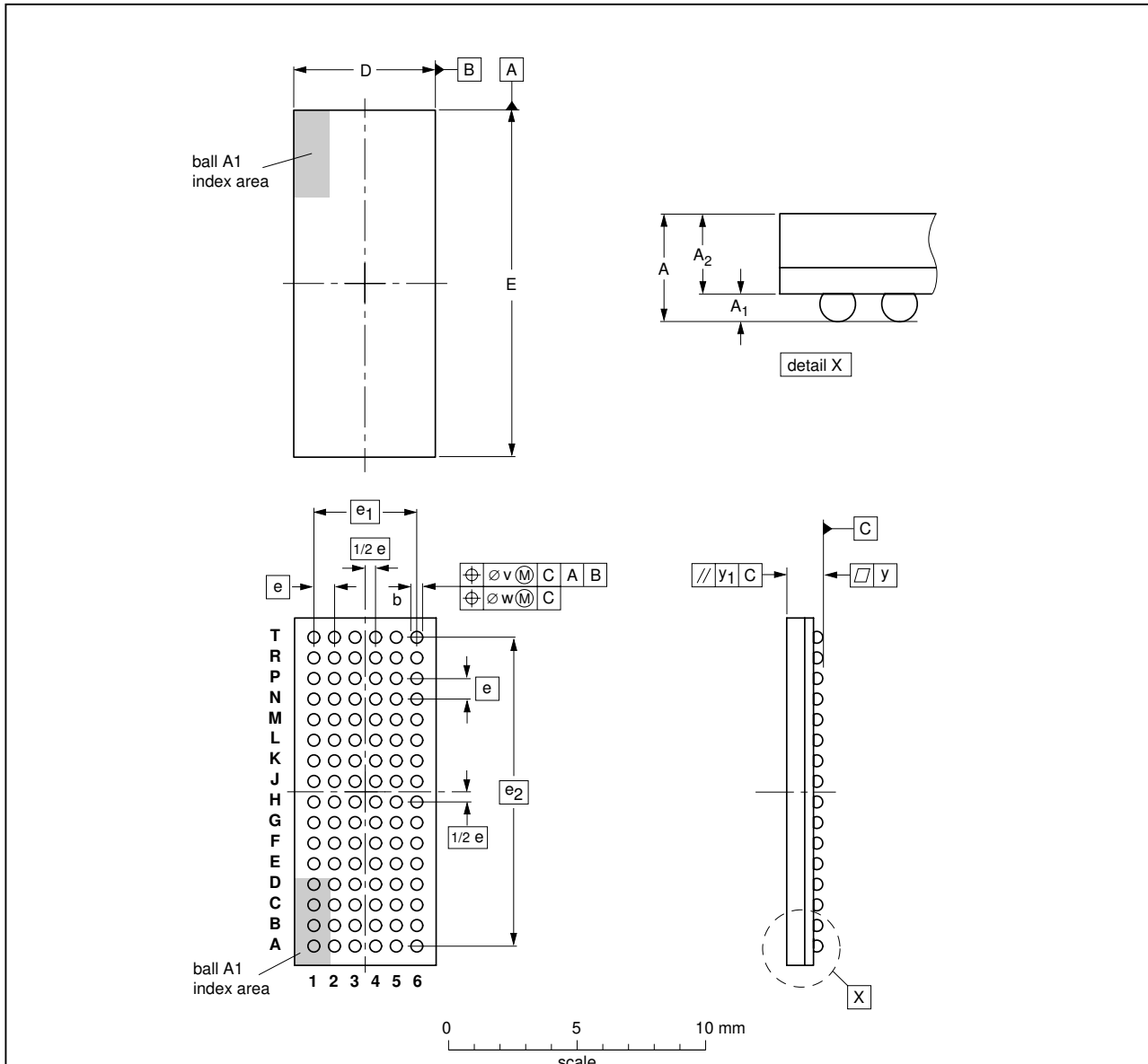
Fig.8 Load circuitry for switching times.

# 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

74LVCH32373A

## PACKAGE OUTLINE

**LFBGA96: plastic low profile fine-pitch ball grid array package; 96 balls; body 13.5 x 5.5 x 1.05 mm SOT536-1**



**DIMENSIONS (mm are the original dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	b	D	E	e	e <sub>1</sub>	e <sub>2</sub>	v	w	y	y <sub>1</sub>
mm	1.5	0.41 0.31	1.2 0.9	0.51 0.41	5.6 5.4	13.6 13.4	0.8	4	12	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT536-1						00-03-04 03-02-05

## 32-bit transparent D-type latch with 5 V tolerant inputs/outputs; 3-state

74LVCH32373A

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LEVEL	DATA SHEET STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)(3)</sup>	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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