

# 74LVC373A

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

Rev. 3 — 22 November 2012

Product data sheet

## 1. General description

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The 74LVC373A consists of eight D-type transparent latches, featuring separate D-type inputs for each latch and 3-state true outputs for bus-oriented applications. A latch enable input (pin LE) and an output enable input (pin  $\overline{OE}$ ) are common to all internal latches.

When pin LE is HIGH, data at the D-inputs (pins D0 to D7) enters the latches. In this condition, the latches are transparent, that is, a latch output will change each time its corresponding D-input changes. When pin LE 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 pin LE.

When pin  $\overline{OE}$  is LOW, the contents of the eight latches are available at the Q-outputs (pins Q0 to Q7). When pin  $\overline{OE}$  is HIGH, the outputs go to the high-impedance OFF-state. Operation of input pin  $\overline{OE}$  does not affect the state of the latches.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices as translators in mixed 3.3 V and 5 V applications.

The 74LVC373A is functionally identical to the 74LVC573A, but has a different pin arrangement.

## 2. Features and benefits

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- 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
- Direct interface with TTL levels
- High-impedance outputs when  $V_{CC} = 0$  V
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)
  - ◆ JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from  $-40$  °C to  $+85$  °C and  $-40$  °C to  $+125$  °C

### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVC373AD	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC373ADB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC373APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC373ABQ	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1

### 4. Functional diagram



Fig 1. Logic symbol

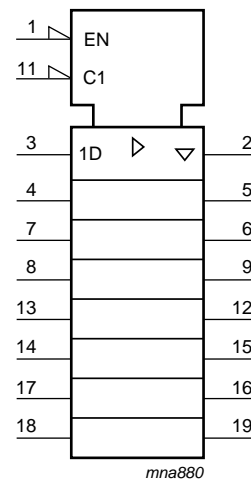


Fig 2. IEC logic symbol



Fig 3. Functional diagram

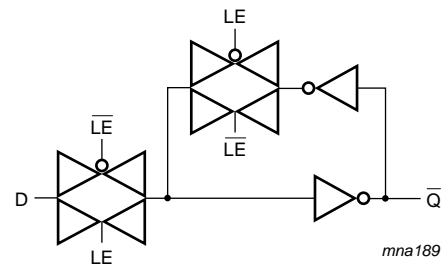


Fig 4. Logic diagram for one latch

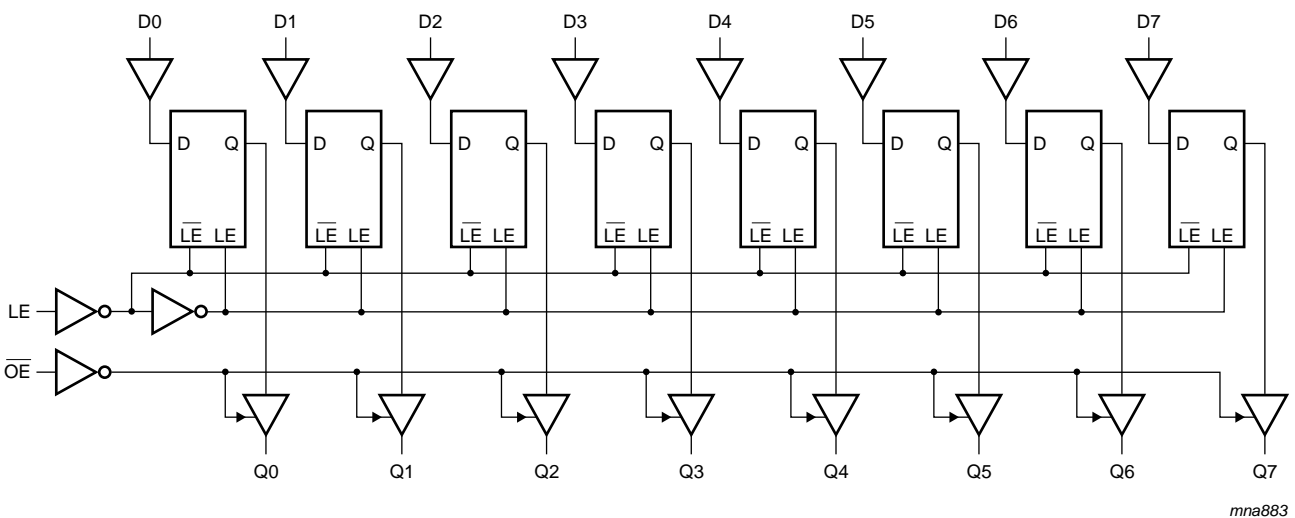


Fig 5. Logic diagram

## 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
OE	1	output enable input (active LOW)
LE	11	latch enable input (active HIGH)
D[0:7]	3, 4, 7, 8, 13, 14, 17, 18	data input
Q[0:7]	2, 5, 6, 9, 12, 15, 16, 19	latch output
GND	10	ground (0 V)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

Table 3. Functional table<sup>[1]</sup>

Operating modes	Input			Internal latch	Output Qn
	$\overline{\text{OE}}$	LE	Dn		
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

- [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

## 7. Limiting values

Table 4. 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
$V_{CC}$	supply voltage		-0.5	+6.5	V
$I_{IK}$	input clamping current	$V_I < 0$	-50	-	mA
$V_I$	input voltage		<sup>[1]</sup> -0.5	+6.5	V
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$	-	±50	mA
$V_O$	output voltage	HIGH or LOW-state	<sup>[2]</sup> -0.5	$V_{CC} + 0.5$	V
		3-state	<sup>[2]</sup> -0.5	+6.5	V
$I_O$	output current	$V_O = 0 \text{ V to } V_{CC}$	-	±50	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40 \text{ °C to } +125 \text{ °C}$	<sup>[3]</sup> -	500	mW

- [1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.  
 [2] The output voltage ratings may be exceeded if the output current ratings are observed.  
 [3] For SO20 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.  
 For (T)SSOP20 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.  
 For DHVQFN20 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	HIGH or LOW-state	0	-	V <sub>CC</sub>	V
		3-state	0	-	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 V	0	-	10	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	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; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	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; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND	-	±0.1	±5	-	±20	μA

**Table 6. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; V <sub>O</sub> = 5.5 V or GND;	-	±0.1	±5	-	±20	μA
I <sub>OFF</sub>	power-off leakage supply	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 5.5 V	-	±0.1	±10	-	±20	μA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	5	500	-	5000	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	5.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 12](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	Dn to Qn; see <a href="#">Figure 8</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	14	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	6.5	15.8	1.5	18.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.4	8.2	1.0	9.4	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.4	7.8	1.5	10.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	2.9	6.8	1.5	8.5	ns
		LE to Qn; see <a href="#">Figure 9</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	16	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.2	7.3	16.8	2.2	19.3	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	3.9	8.6	1.5	10.0	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.5	8.2	1.5	10.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.3	7.2	1.5	9.0	ns
t <sub>en</sub>	enable time	OE to Qn; see <a href="#">Figure 10</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	17	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	6.8	17.6	1.5	20.3	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	3.8	9.7	1.5	11.2	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.8	8.7	1.5	11.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.1	7.7	1.5	10.0	ns

**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 12](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>dis</sub>	disable time	OE to Qn; see <a href="#">Figure 10</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	8.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.3	4.3	10.3	2.3	11.9	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.4	5.8	1.0	6.8	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.2	7.1	1.5	9.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.0	6.1	1.5	8.0	ns
t <sub>w</sub>	pulse width	LE HIGH; see <a href="#">Figure 9</a>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V <sub>CC</sub> = 2.7 V	3.0	-	-	3.0	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	3.0	1.5	-	3.0	-	ns
t <sub>su</sub>	set-up time	Dn to LE; see <a href="#">Figure 11</a>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	4.0	-	-	4.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	3.0	-	-	3.0	-	ns
		V <sub>CC</sub> = 2.7 V	2.0	-	-	2.0	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.0	0.0	-	2.0	-	ns
t <sub>h</sub>	hold time	Dn to LE; see <a href="#">Figure 11</a>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	-	1.5	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	0.3	-	1.5	-	ns
t <sub>sk(0)</sub>	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>	-	-	1.0	-	1.5	ns
C <sub>PD</sub>	power dissipation capacitance	per latch; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	16.6	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	19.2	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	21.6	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.

t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:

f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz

C<sub>L</sub> = output load capacitance in pF

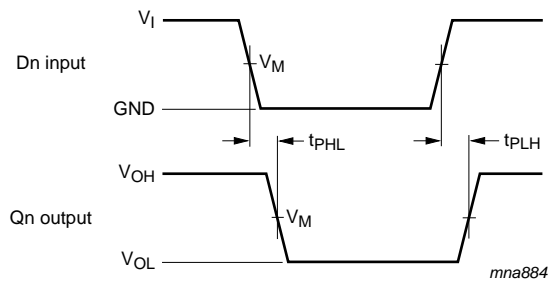
V<sub>CC</sub> = supply voltage in Volts

N = number of inputs switching

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

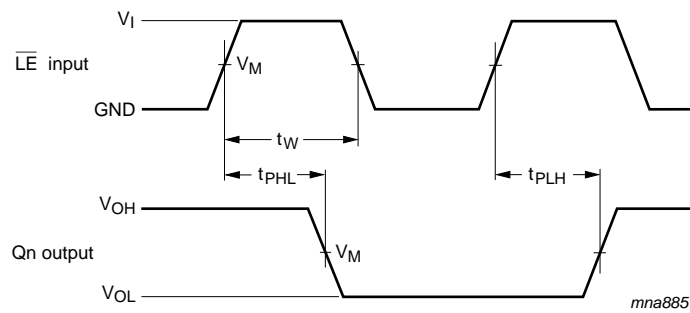


11. AC waveforms



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 8. Input (Dn) to output (Qn) propagation delays**



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 9. Latch Enable input (LE) pulse width, the latch enable input to output (Qn) propagation delays**



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 10. 3-state enable and disable times**

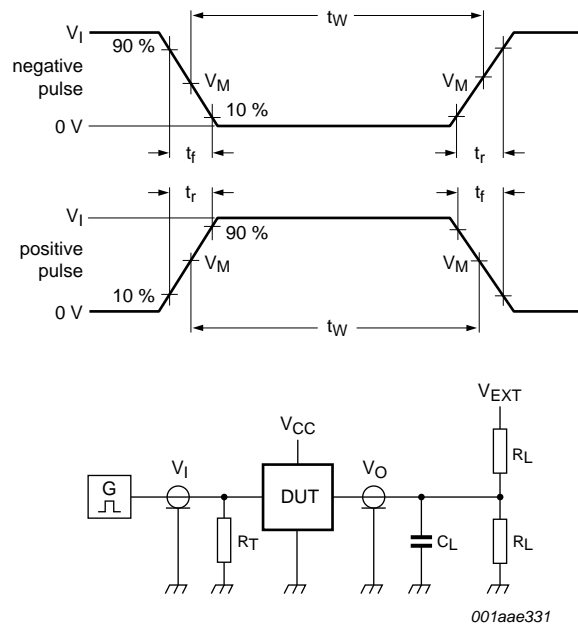


Measurement points are given in [Table 8](#).  
 The shaded areas indicate when the input is permitted to change for predictable output performance.

**Fig 11. Data set-up and hold times for the Dn input to the LE input**

**Table 8. Measurement points**

Supply voltage	Input		Output		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.2 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



Test data is given in [Table 9](#).

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 12. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

12. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1

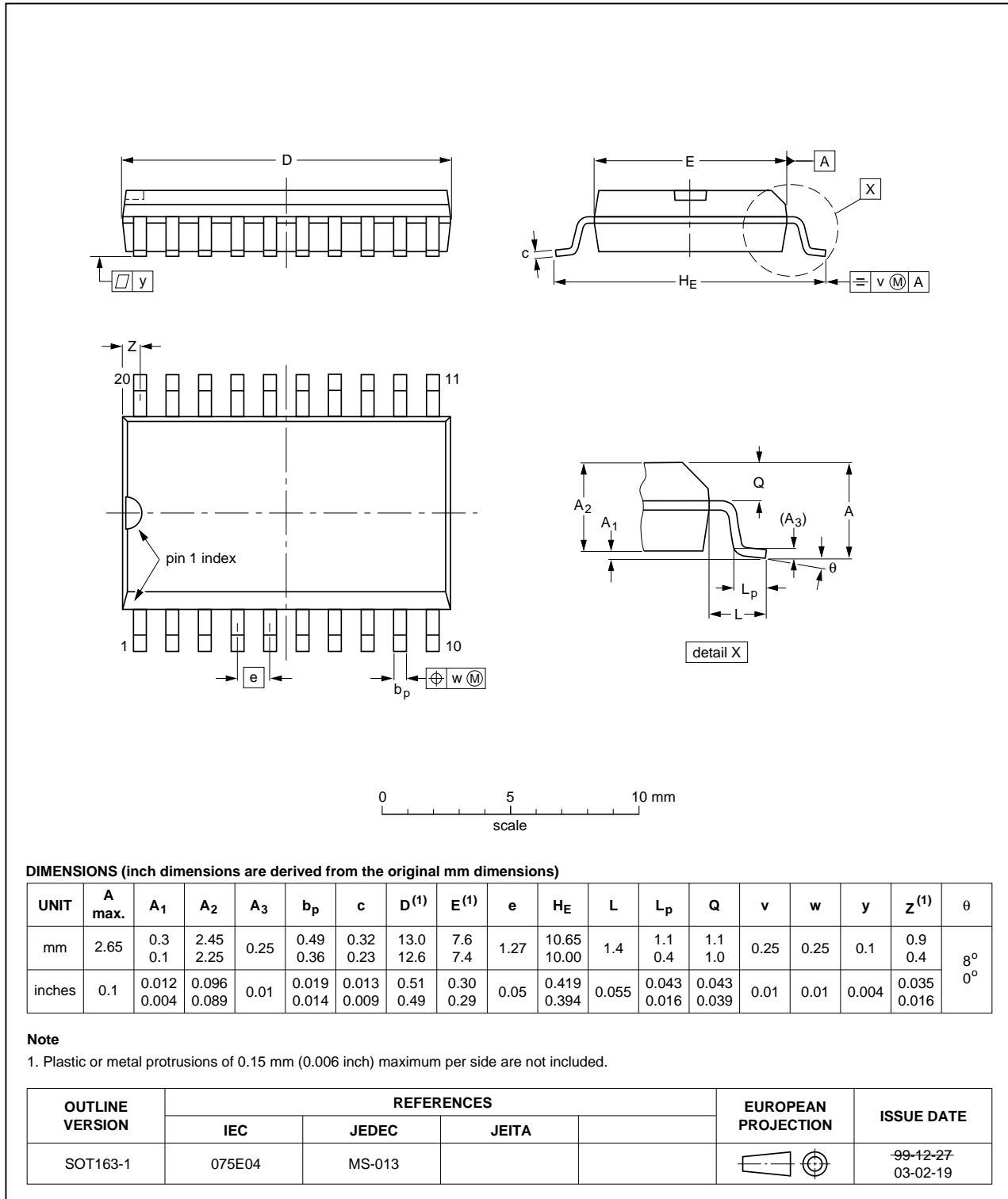


Fig 13. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

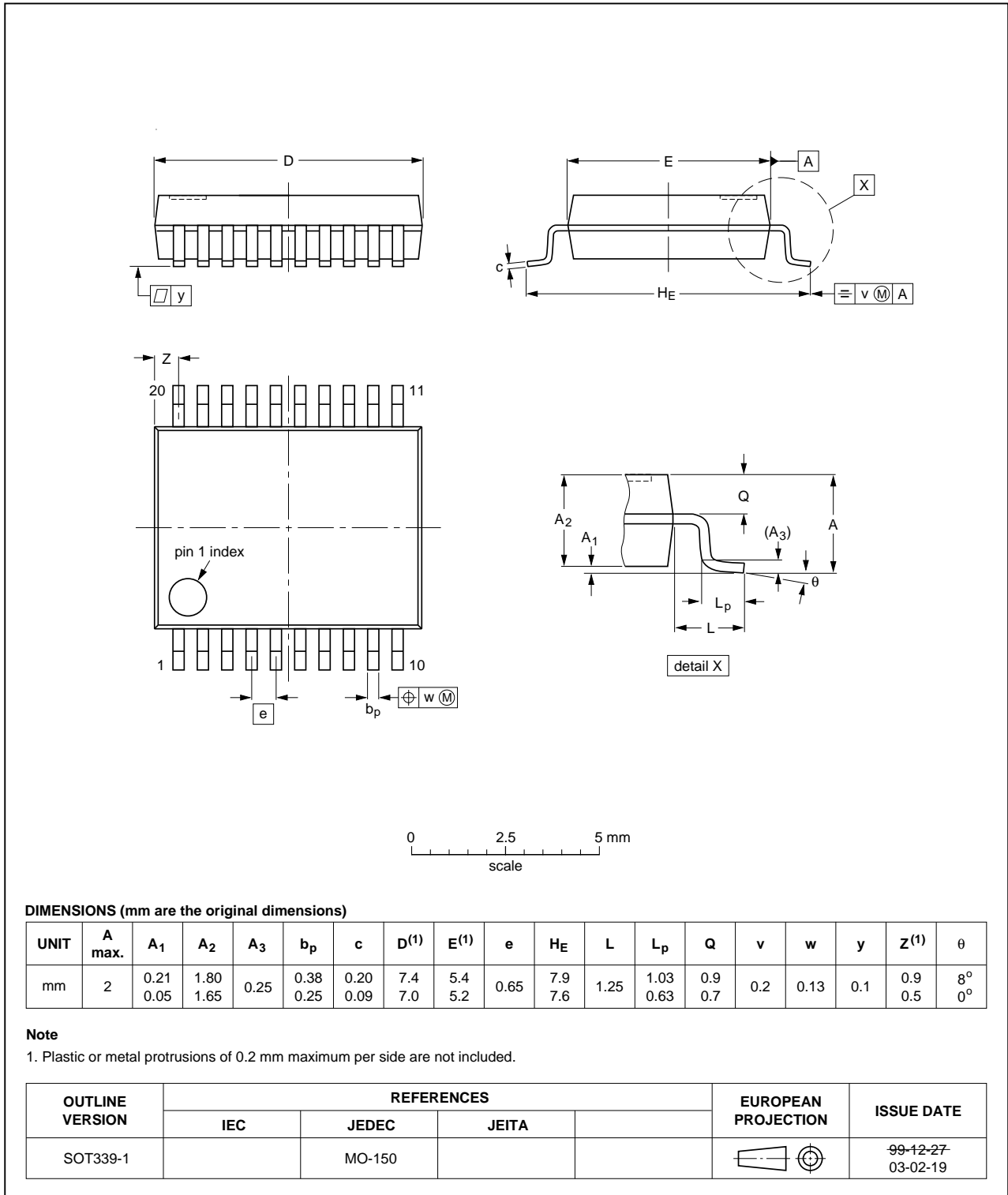


Fig 14. Package outline SOT339-1 (SSOP20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



Fig 15. Package outline SOT360-1 (TSSOP20)

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1



Fig 16. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC373A v.3	20121122	Product data sheet	-	74LVC373A v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a>, <a href="#">Table 8</a> and <a href="#">Table 9</a>: values added for lower voltage ranges.</li> </ul>			
74LVC373A v.2	20030519	Product specification	-	74LVC373A v.1
74LVC373A v.1	19980729	Product specification	-	-



## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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

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