

# 74LVC623A

Octal transceiver with dual enable; 3-state

Rev. 5 — 25 November 2011

Product data sheet

## 1. General description

The 74LVC623A is an octal transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. This octal bus transceiver is designed for asynchronous two-way communication between data buses.

The control function implementation allows maximum flexibility in timing. This device allows data transmission from the An bus to the Bn bus or from the Bn bus to the An bus, depending upon the logic levels at the enable inputs (pins OEAB and  $\overline{OEBA}$ ). The enable inputs can be used to disable the device so that the buses are effectively isolated. The dual enable function configuration gives this transceiver the capability to store data by simultaneous enabling of pins OEAB and  $\overline{OEBA}$ . Each output reinforces its input in this transceiver configuration. Thus, when both control inputs are enabled and all other data sources to the two sets of the bus lines are at high-impedance OFF-state, both sets of the bus lines will remain at their last states. The 8-bit codes appearing on the two sets of buses will be identical.

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 or 5 V applications.

## 2. Features and benefits

- 5 V tolerant inputs and 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 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-A115B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C.



### 3. Ordering information

Table 1. Ordering information

Type number	Package	Temperature range	Name	Description	Version
74LVC623AD	SO20	−40 °C to +125 °C		plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC623ADB	SSOP20	−40 °C to +125 °C		plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC623APW	TSSOP20	−40 °C to +125 °C		plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1

### 4. Functional diagram

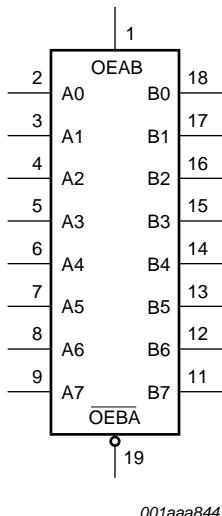


Fig 1. Logic symbol

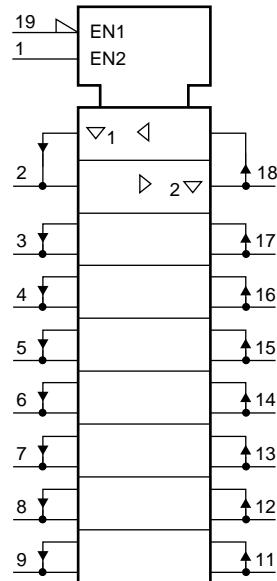


Fig 2. IEC logic symbol

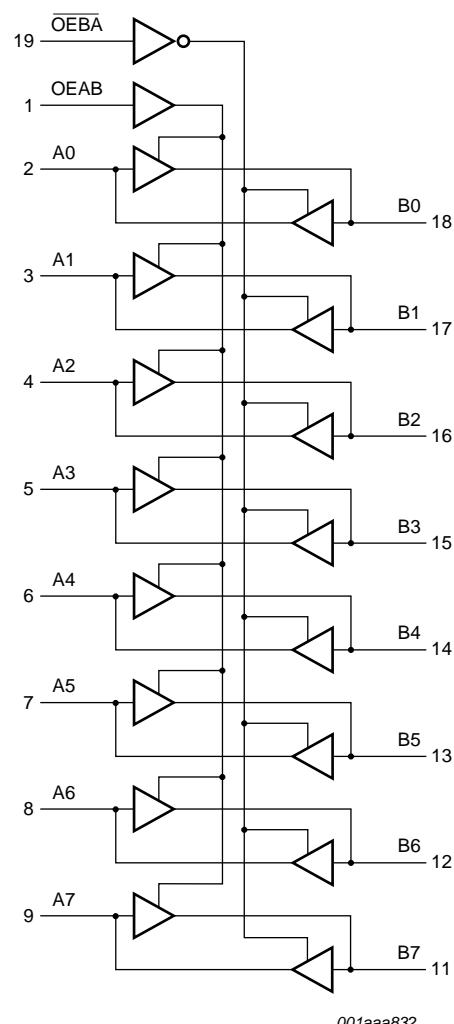


Fig 3. Logic diagram

## 5. Pinning information

### 5.1 Pinning

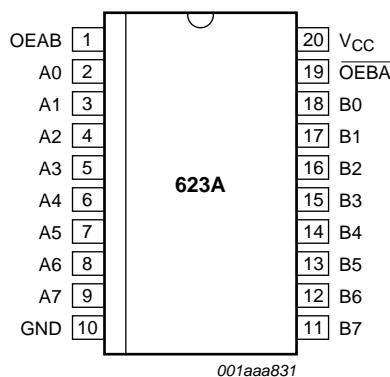


Fig 4. Pin configuration SO20 and (T)SSOP20

### 5.2 Pin description

Table 2. Pin description

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

## 6. Functional description

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

Input		Input or output	
OEAB	OEBA	An	Bn
L	L	An = Bn	input
H	H	input	Bn = An
L	H	Z	Z
H	L	An = Bn	input
		input	Bn = An

[1] H = HIGH voltage level; L = LOW voltage level; 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
$V_I$	input voltage		<sup>[1]</sup> -0.5	+6.5	V
$V_O$	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
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	$\pm 150$	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °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 package: above 70 °C  $P_{tot}$  derates linearly with 8 mW/K.

For (T)SSOP20 packages: above 60 °C  $P_{tot}$  derates linearly with 5.5 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 or V <sub>CC</sub> = 0 V	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
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	2.0	-	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	
$I_{OZ}$ <sup>[2]</sup>	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 3.6$ V; $V_O = 5.5$ V or GND;	-	0.1	$\pm 5$	-	$\pm 20$	$\mu A$
$I_{OFF}$	power-off leakage current	$V_{CC} = 0$ V; $V_I$ or $V_O = 5.5$ V	-	0.1	$\pm 10$	-	$\pm 20$	$\mu A$
$I_{CC}$	supply current	$V_{CC} = 3.6$ V; $V_I = V_{CC}$ or GND; $I_O = 0$ A	-	0.1	10	-	40	$\mu A$
$\Delta I_{CC}$	additional supply current	per input pin; $V_{CC} = 2.7$ V to 3.6 V; $V_I = V_{CC} - 0.6$ V; $I_O = 0$ A	-	5	500	-	5000	$\mu A$
$C_I$	input capacitance	$V_{CC} = 0$ V to 3.6 V; $V_I = GND$ to $V_{CC}$	-	4.0	-	-	-	$pF$
$C_{I/O}$	input/output capacitance	$V_{CC} = 0$ V to 3.6 V; $V_I = GND$ to $V_{CC}$	-	10.0	-	-	-	$pF$

[1] All typical values are measured at  $V_{CC} = 3.3$  V (unless stated otherwise) and  $T_{amb} = 25$  °C.[2] For transceivers, the parameter  $I_{OZ}$  includes the input leakage current.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{pd}$	propagation delay	An to Bn; Bn to An; see <a href="#">Figure 5</a> <sup>[2]</sup>	-	19	-	-	-	ns
		$V_{CC} = 1.2$ V	-	19	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	1.7	6.4	13.5	1.7	14.2	ns
		$V_{CC} = 2.3$ V to 2.7 V	1.5	3.4	6.7	1.5	7.4	ns
		$V_{CC} = 2.7$ V	1.5	3.4	5.7	1.5	7.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	2.9	5.2	1.0	6.5	ns
$t_{en}$	enable time	OEAB to Bn; see <a href="#">Figure 6</a> <sup>[2]</sup>	-	26	-	-	-	ns
		$V_{CC} = 1.2$ V	-	26	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	2.7	8.7	17.0	2.7	17.9	ns
		$V_{CC} = 2.3$ V to 2.7 V	2.2	4.8	8.9	2.2	9.8	ns
		$V_{CC} = 2.7$ V	1.5	4.2	6.9	1.5	9.0	ns
	OEBA to An; see <a href="#">Figure 7</a> <sup>[2]</sup>	$V_{CC} = 3.0$ V to 3.6 V	1.0	3.9	6.6	1.0	8.5	ns
		$V_{CC} = 1.2$ V	-	26	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	2.6	8.1	17.0	2.6	17.9	ns
		$V_{CC} = 2.3$ V to 2.7 V	2.2	4.5	8.9	2.2	9.8	ns
		$V_{CC} = 2.7$ V	1.5	4.6	7.5	1.5	9.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	3.6	6.6	1.0	8.5	ns

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{dis}$	disable time	OEAB to Bn; see <a href="#">Figure 6</a>	<sup>[2]</sup>					
				V <sub>CC</sub> = 1.2 V	-	12	-	- ns
				V <sub>CC</sub> = 1.65 V to 1.95 V	2.3	4.7	10.5	2.3 11.1 ns
				V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.6	5.7	1.0 6.4 ns
				V <sub>CC</sub> = 2.7 V	1.5	4.2	6.2	1.5 8.0 ns
		OEBA to An; see <a href="#">Figure 7</a>	<sup>[2]</sup>	V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.2	5.5	1.0 7.0 ns
				V <sub>CC</sub> = 1.2 V	-	11	-	- ns
				V <sub>CC</sub> = 1.65 V to 1.95 V	3.6	5.2	10.1	3.6 10.7 ns
				V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.9	5.5	1.0 6.1 ns
				V <sub>CC</sub> = 2.7 V	1.5	3.7	5.5	1.5 7.0 ns
$t_{sk(o)}$	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V	<sup>[3]</sup>	-	-	1.0	-	1.5 ns
$C_{PD}$	power dissipation capacitance	per input; $V_i$ = GND to V <sub>CC</sub>	<sup>[4]</sup>					
				V <sub>CC</sub> = 1.65 V to 1.95 V	-	11.9	-	- pF
				V <sub>CC</sub> = 2.3 V to 2.7 V	-	15.5	-	- pF
				V <sub>CC</sub> = 3.0 V to 3.6 V	-	18.8	-	- 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]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ . $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ . $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

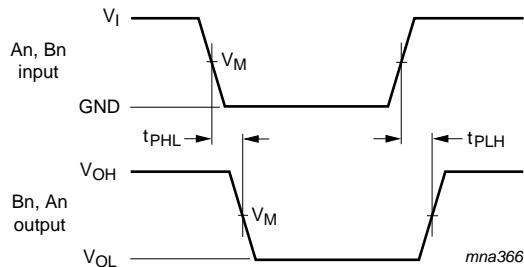
[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4]  $C_{PD}$  is used to determine the dynamic power dissipation (P<sub>D</sub> in  $\mu$ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where: $f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz $C_L$  = output load capacitance in pF $V_{CC}$  = supply voltage in Volts

N = number of inputs switching

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

## 11. Waveforms

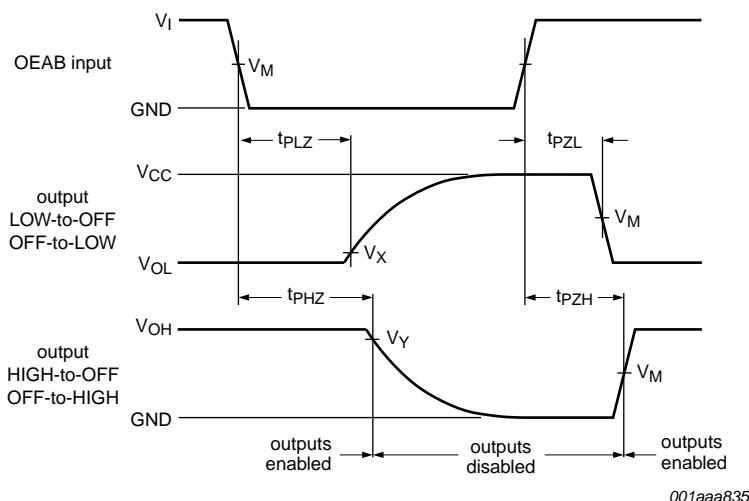


$V_M = 1.5 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$ ;

$V_M = 0.5 \times V_{CC}$  at  $V_{CC} < 2.7 \text{ V}$

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig 5. The inputs An, Bn to outputs Bn, An propagation delays



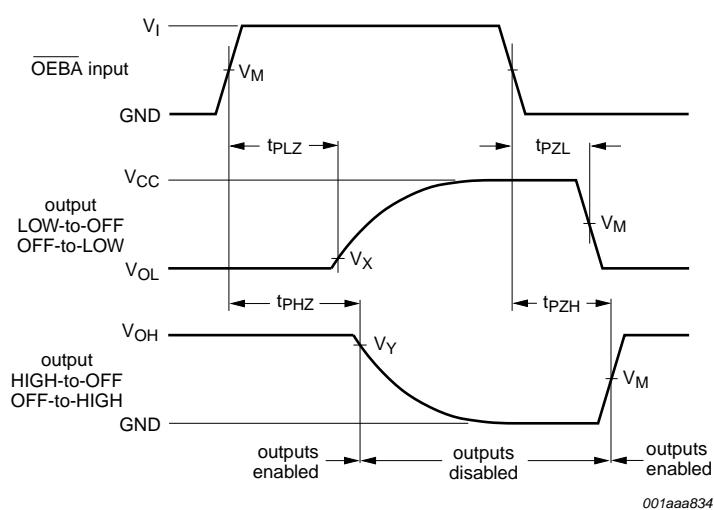
Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig 6. 3-state enable and disable times for OEAB input

Table 8. Measurement points

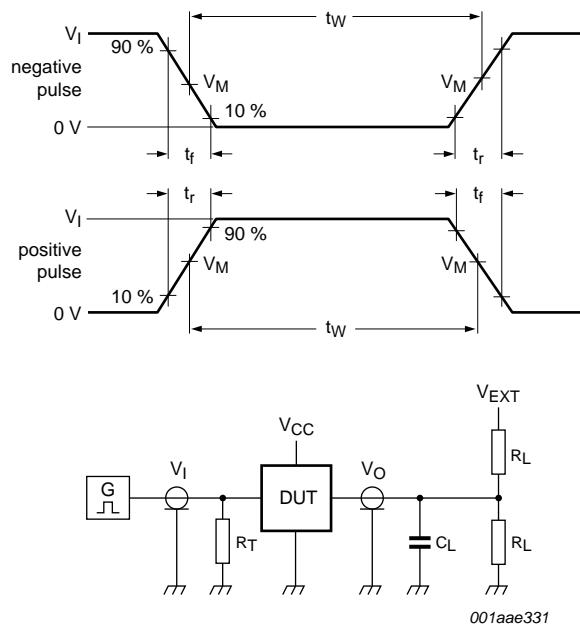
Supply voltage	Input	Output		
$V_{CC}$	$V_M$	$V_M$	$V_X$	$V_Y$
$< 2.7 \text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
$\geq 2.7 \text{ V}$	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 7. 3-state enable and disable times for OEBA input**



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 8. Test circuit for measuring switching times**

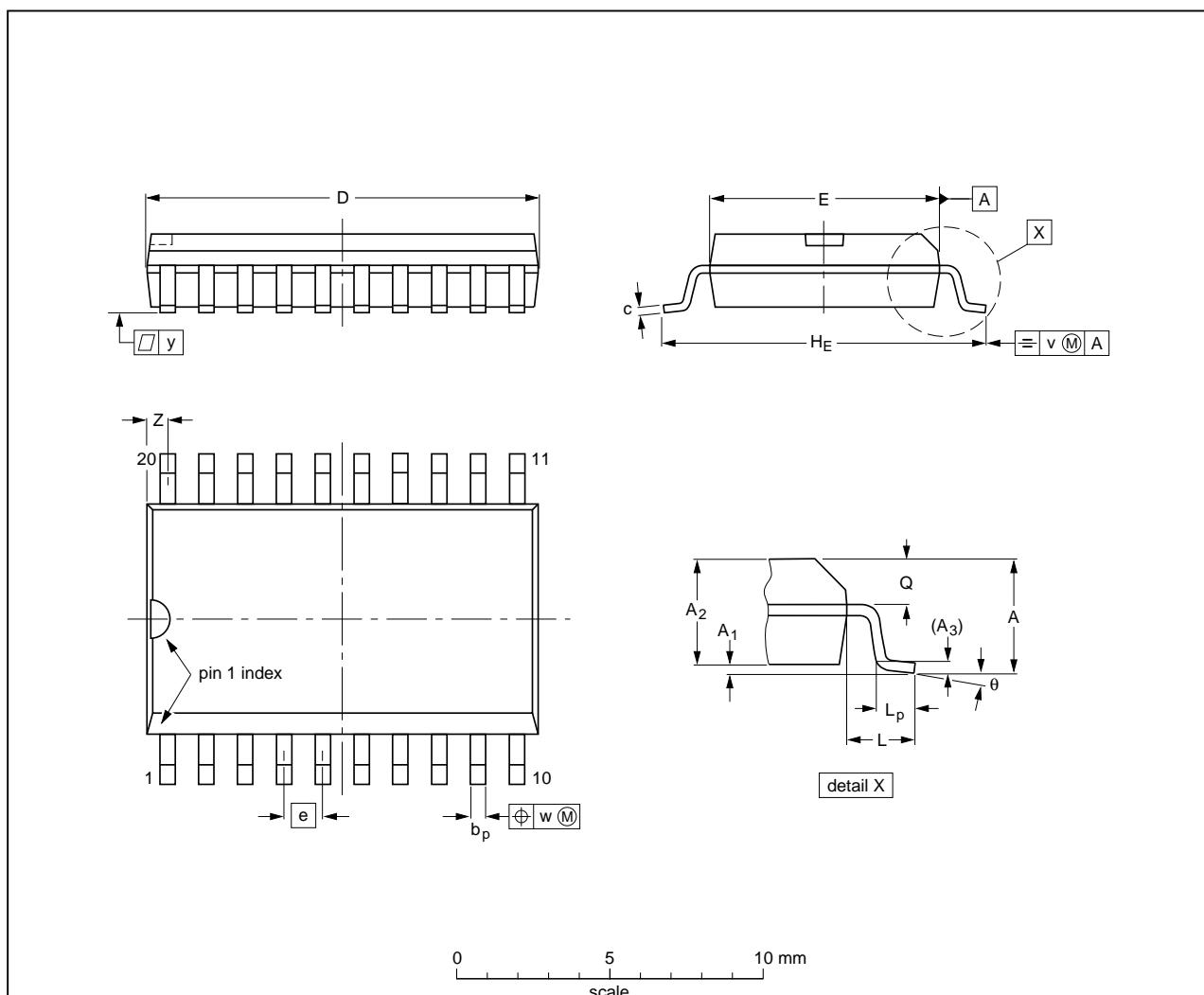
**Table 9. Test data**

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



### DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.65 0.1	0.3 2.25	2.45	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	8° 0°

### Note

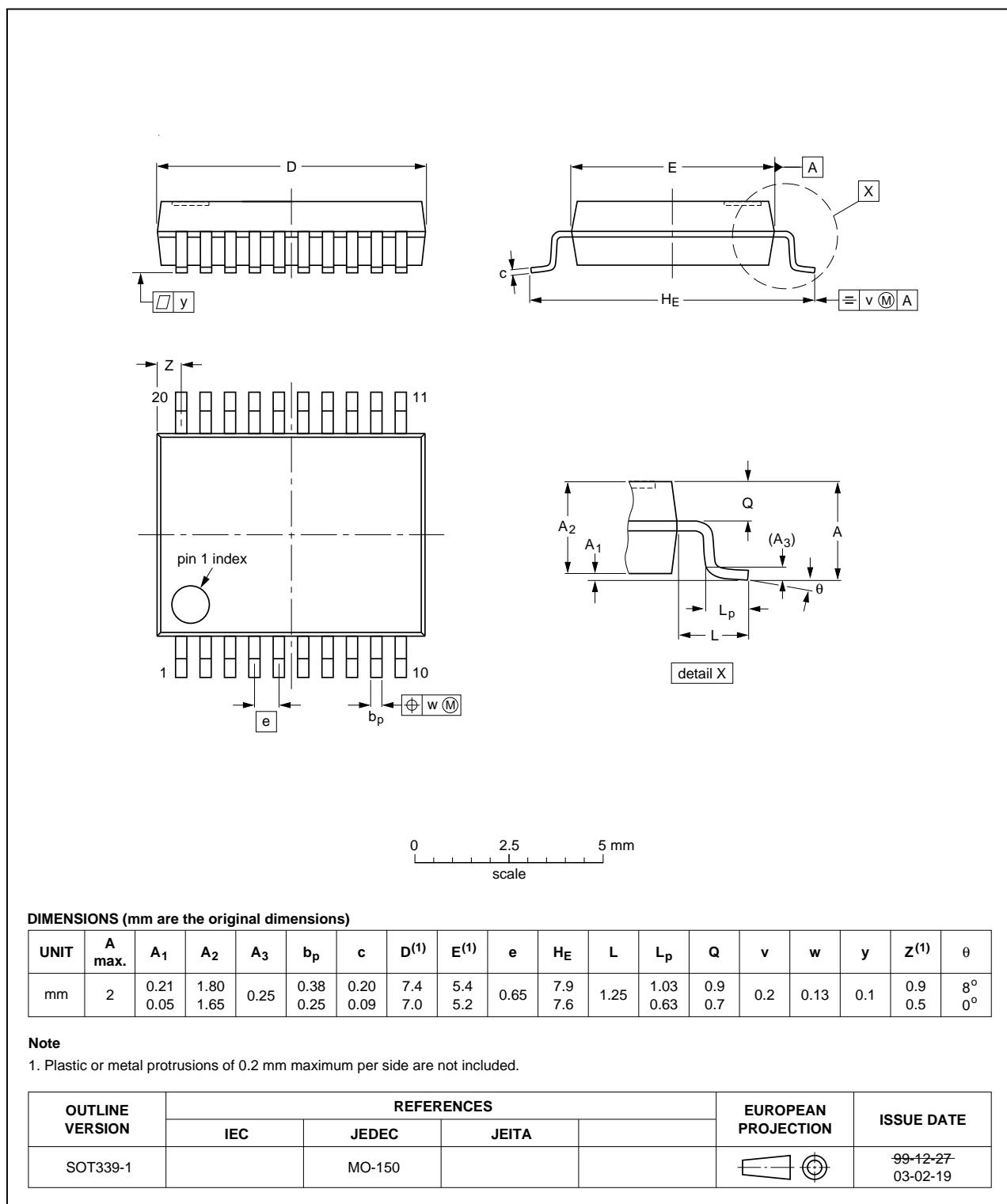
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT163-1	075E04	MS-013			-99-12-27 03-02-19

Fig 9. Package outline SOT163-1 (SO20)

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

SOT339-1



## DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>P</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>P</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2 0.05	0.21 1.65	1.80	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

## Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT339-1		MO-150				99-12-27 03-02-19

Fig 10. Package outline SOT339-1 (SSOP20)

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

SOT360-1

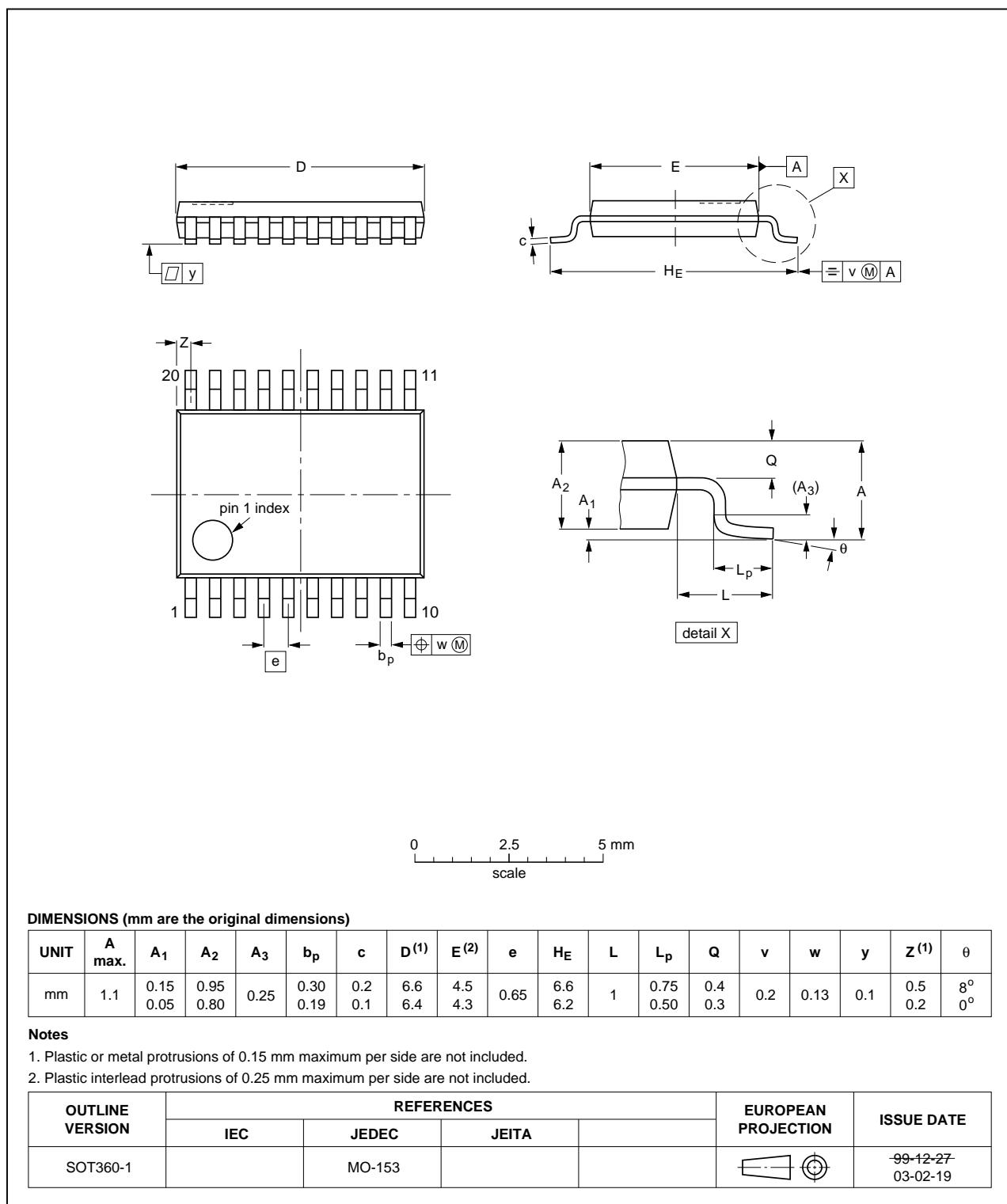


Fig 11. Package outline SOT 360-1 (TSSOP20)

## 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
74LVC623A v.5	20111125	Product data sheet	-	74LVC623A v.4
Modifications:			<ul style="list-style-type: none"> <li>Typographical errors corrected</li> </ul>	
74LVC623A v.4	20111107	Product data sheet	-	74LVC623A v.3
Modifications:			<ul style="list-style-type: none"> <li>The format of this document 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>, and <a href="#">Table 9</a>: values added for lower voltage ranges.</li> <li>DHVQFN package added to <a href="#">Section 3</a> and <a href="#">Section 12</a>.</li> </ul>	
74LVC623A v.3	20040506	Product specification	-	74LVC623A v.2
74LVC623A v.2	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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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