

74LVC623A

Octal transceiver with dual enable; 3-state

Rev. 03 — 6 May 2004

Production data sheet

1. General description

The 74LVC623A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

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 as translators in a mixed 3.3 V or 5 V environment.

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 A bus to the B bus or from the B bus to the A bus, depending upon the logic levels at the enable inputs (pins OEAB and $\overline{\text{OEBA}}$). 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 $\overline{\text{OEBA}}$. 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.

2. Features

- 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
- Inputs accept voltages up to 5.5 V
- High-impedance when $V_{CC} = 0$ V
- 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 °C to $+85$ °C and from -40 °C to $+125$ °C.

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3. Quick reference data

Table 1: Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
t_{PHL} , t_{PLH}	propagation delay An to Bn; Bn to An	$C_L = 50\text{ pF}$; $V_{CC} = 3.3\text{ V}$	-	2.9	-	ns	
C_I	input capacitance		-	4.0	-	pF	
$C_{I/O}$	input/output capacitance		-	10.0	-	pF	
C_{PD}	power dissipation capacitance per gate	$V_{CC} = 3.3\text{ V}$					
		outputs enabled	[1][2]	-	19	-	pF
		outputs disabled		-	4	-	pF

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ 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 = total load switching outputs;

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

[2] The condition is $V_I = GND$ to V_{CC} .

4. Ordering information

Table 2: Ordering information

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

5. Functional diagram

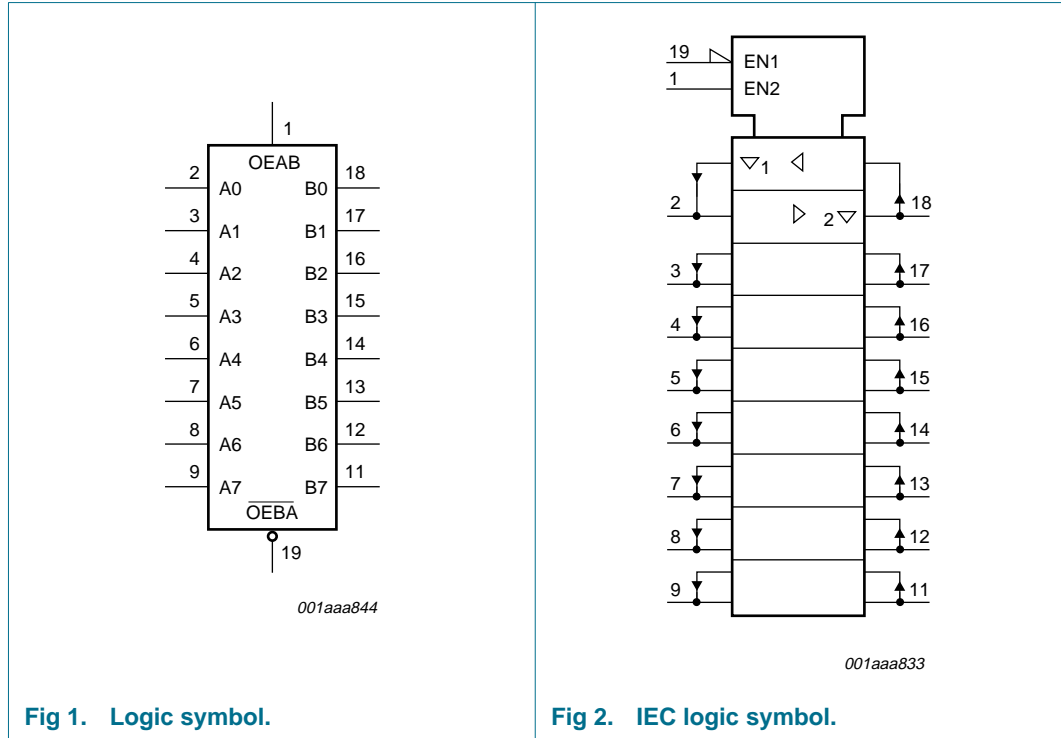


Fig 1. Logic symbol.

Fig 2. IEC logic symbol.

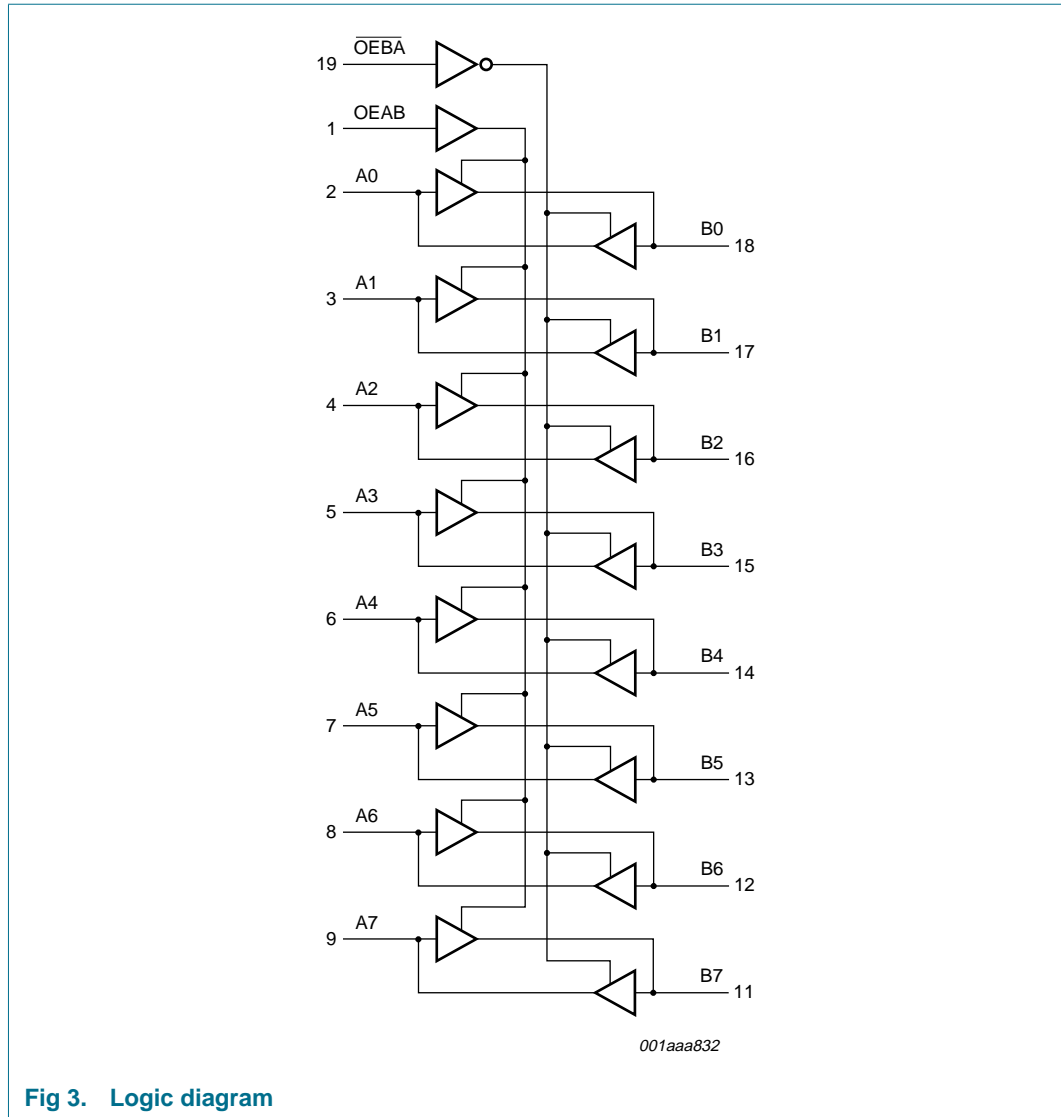


Fig 3. Logic diagram

6. Pinning information

6.1 Pinning

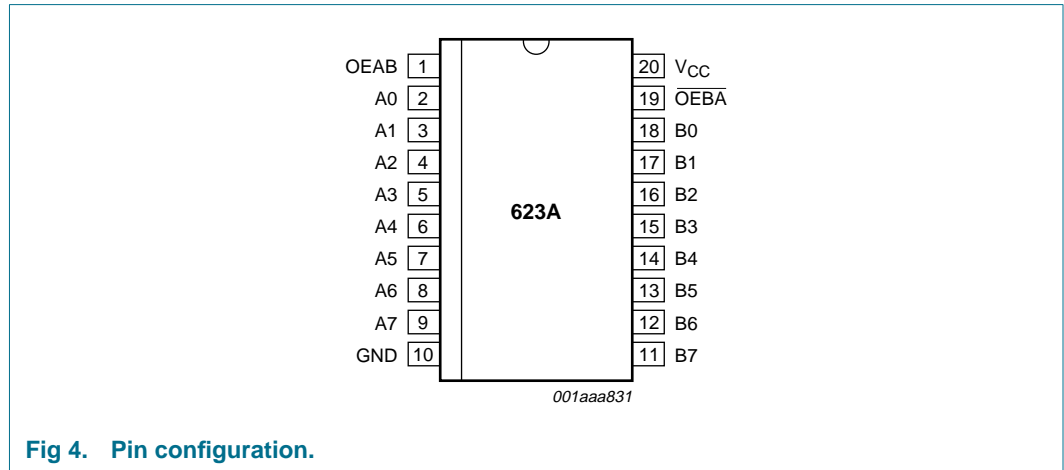


Fig 4. Pin configuration.

6.2 Pin description

Table 3: Pin description

Pin	Symbol	Description
1	OEAB	output enable input
2	A0	data input or output
3	A1	data input or output
4	A2	data input or output
5	A3	data input or output
6	A4	data input or output
7	A5	data input or output
8	A6	data input or output
9	A7	data input or output
10	GND	ground (0 V)
11	B7	data output or input
12	B6	data output or input
13	B5	data output or input
14	B4	data output or input
15	B3	data output or input
16	B2	data output or input
17	B1	data output or input
18	B0	data output or input
19	$\overline{\text{OEBA}}$	output enable input (active LOW)
20	V _{CC}	supply voltage

7. Functional description

7.1 Function table

Table 4: Function table ^[1]

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

- [1] H = HIGH voltage level;
L = LOW voltage level;
Z = high-impedance OFF-state;

8. Limiting values

Table 5: 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		^[1] -0.5	+6.5	V
V_O	output voltage	HIGH or LOW state	^[1] -0.5	$V_{CC} + 0.5$	V
		3-state	^[1] -0.5	+6.5	V
I_{IK}	input diode current	$V_I < 0$ V	-	-50	mA
I_{OK}	output diode current	$V_O > V_{CC}$ or $V_O < 0$ V	-	± 50	mA
I_O	output source or sink current	$V_O = 0$ V to V_{CC}	-	± 50	mA
I_{CC}, I_{GND}	V_{CC} or GND current		-	± 100	mA
T_{stg}	storage temperature		-65	± 150	°C
P_{tot}	power dissipation	$T_{amb} = -40$ °C to $+125$ °C	^[2] -	500	mW

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For SO20 packages: 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.

9. Recommended operating conditions

Table 6: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	for maximum speed performance	2.7	-	3.6	V
		for low-voltage applications	1.2	-	3.6	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage	HIGH or LOW state	0	-	V_{CC}	V
		3-state or $V_{CC} = 0$ V	0	-	5.5	V
T_{amb}	operating ambient temperature	in free air	-40	-	+125	°C
t_r, t_f	input rise and fall times	$V_{CC} = 1.2$ V to 2.7 V	0	-	20	ns/V
		$V_{CC} = 2.7$ V to 3.6 V	0	-	10	ns/V

10. Static characteristics

Table 7: Static characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = -40$ °C to $+85$ °C [1]						
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.2$ V	V_{CC}	-	-	V
		$V_{CC} = 2.7$ V to 3.6 V	2.0	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.2$ V	-	-	GND	V
		$V_{CC} = 2.7$ V to 3.6 V	-	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = -100$ μ A; $V_{CC} = 2.7$ V to 3.6 V	[2] $V_{CC} - 0.2$	V_{CC}	-	V
		$I_O = -12$ mA; $V_{CC} = 2.7$ V	$V_{CC} - 0.2$	-	-	V
		$I_O = -18$ mA; $V_{CC} = 3.0$ V	$V_{CC} - 0.2$	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = 100$ μ A; $V_{CC} = 2.7$ V to 3.6 V	[2] -	GND	0.2	V
		$I_O = 12$ mA; $V_{CC} = 2.7$ V	-	-	0.4	V
		$I_O = 24$ mA; $V_{CC} = 3.0$ V	-	-	0.55	V
I_{LI}	input leakage current	$V_I = 5.5$ V or GND; $V_{CC} = 3.6$ V	-	± 0.1	± 5	μ A
I_{OZ}	3-state output OFF-state current	$V_I = V_{IH}$ or V_{IL} ; $V_O = 5.5$ V or GND; $V_{CC} = 3.6$ V	[3] -	0.1	± 10	μ A
I_{off}	power-off leakage supply	V_I or $V_O = 5.5$ V; $V_{CC} = 0$ V	-	0.1	± 10	μ A
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 3.6$ V	-	0.1	10	μ A
ΔI_{CC}	additional quiescent supply current per pin	$V_I = V_{CC} - 0.6$ V; $I_O = 0$ A; $V_{CC} = 2.7$ V to 3.6 V	[2] -	5	500	μ A
C_I	input capacitance		-	4.0	-	pF
$C_{I/O}$	input/output capacitance		-	10.0	-	pF

Table 7: Static characteristics ...continued

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +125 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 1.2 V	V _{CC}	-	-	V
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	GND	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = -100 μA; V _{CC} = 2.7 V to 3.6 V	V _{CC} - 0.3	-	-	V
		I _O = -12 mA; V _{CC} = 2.7 V	V _{CC} - 0.65	-	-	V
		I _O = -18 mA; V _{CC} = 3.0 V	V _{CC} - 0.75	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = 100 μA; V _{CC} = 2.7 V to 3.6 V	-	-	0.3	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.3	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.8	V
I _{LI}	input leakage current	V _I = 5.5 V or GND; V _{CC} = 3.6 V	-	-	±20	μA
I _{OZ}	3-state output OFF-state current	V _I = V _{IH} or V _{IL} ; V _O = 5.5 V or GND; V _{CC} = 3.6 V	[3] -	-	±20	μA
I _{off}	power-off leakage supply	V _I or V _O = 5.5 V; V _{CC} = 0 V	-	-	±20	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V	-	-	40	μA
ΔI _{CC}	additional quiescent supply current per pin	V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 3.6 V	-	-	5000	μA

[1] All typical values are measured T_{amb} = 25 °C.[2] These typical values are measured at V_{CC} = 3.3 V.[3] For transceivers, the parameter I_{OZ} includes the input leakage current.

11. Dynamic characteristics

Table 8: Dynamic characteristics
GND = 0 V; for test circuit see Figure 8.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$T_{amb} = -40\text{ °C to }+85\text{ °C}$ [1]							
t_{PHL}, t_{PLH}	propagation delay An to Bn; Bn to An	see Figure 5					
		$V_{CC} = 1.2\text{ V}$	-	19	-	ns	
		$V_{CC} = 2.7\text{ V}$	1.5	-	5.7	ns	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.0	2.9	5.2	ns	
t_{PZH}, t_{PZL}	3-state output enable time OEAB to Bn	see Figure 6					
		$V_{CC} = 1.2\text{ V}$	-	26	-	ns	
		$V_{CC} = 2.7\text{ V}$	1.5	-	6.9	ns	
			$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.0	3.8	6.6	ns
	3-state output enable time OEBA to An	see Figure 7					
		$V_{CC} = 1.2\text{ V}$	-	26	-	ns	
$V_{CC} = 2.7\text{ V}$		1.5	-	7.5	ns		
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.0	3.6	6.6	ns	
t_{PHZ}, t_{PLZ}	3-state output disable time OEAB to Bn	see Figure 6	-	-	-		
		$V_{CC} = 1.2\text{ V}$	-	12	-	ns	
		$V_{CC} = 2.7\text{ V}$	1.5	-	6.2	ns	
			$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.0	3.2	5.5	ns
	3-state output disable time OEBA to An	see Figure 7					
		$V_{CC} = 1.2\text{ V}$	-	11	-	ns	
$V_{CC} = 2.7\text{ V}$		1.5	-	5.5	ns		
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.0	3.4	5.3	ns	
$t_{sk(0)}$	skew		[3] -	-	1.0	ns	
C_{PD}	power dissipation capacitance per gate	$V_{CC} = 3.3\text{ V}$	[4] [5]				
		outputs enabled	-	19	-	pF	
		outputs disabled	-	4	-	pF	
$T_{amb} = -40\text{ °C to }+125\text{ °C}$ [1]							
t_{PHL}, t_{PLH}	propagation delay An to Bn; Bn to An	see Figure 5					
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns	
		$V_{CC} = 2.7\text{ V}$	1.5	-	7.5	ns	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	6.5	ns	
t_{PZH}, t_{PZL}	3-state output enable time OEAB to Bn	see Figure 6					
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns	
		$V_{CC} = 2.7\text{ V}$	1.5	-	9.0	ns	
			$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	8.5	ns
	3-state output enable time OEBA to An	see Figure 7					
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns	
$V_{CC} = 2.7\text{ V}$		1.5	-	9.5	ns		
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	8.5	ns	

Table 8: Dynamic characteristics ...continued
 GND = 0 V; for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{PHZ}, t_{PLZ}	3-state output disable time OEAB to Bn	see Figure 6	-	-	-	
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.5	-	8.0	ns
	3-state output disable time OEBA to An	see Figure 7	-	-	-	ns
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.5	-	7.0	ns
$t_{sk(0)}$	skew	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	7.0	ns
		[3]	-	-	1.5	ns

- [1] All typical values are measured $T_{amb} = 25\text{ }^{\circ}\text{C}$.
- [2] These typical values are measured at $V_{CC} = 3.3\text{ V}$.
- [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_D 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_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 = total load switching outputs;
 $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
- [5] The condition is $V_i = \text{GND to } V_{CC}$.

12. Waveforms

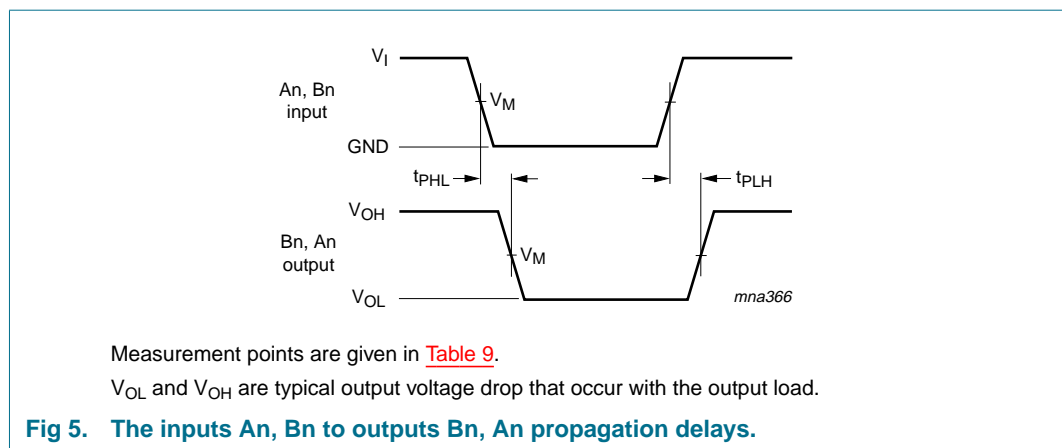


Table 9: Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
$< 2.7\text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
$\geq 2.7\text{ V}$	1.5 V	1.5 V

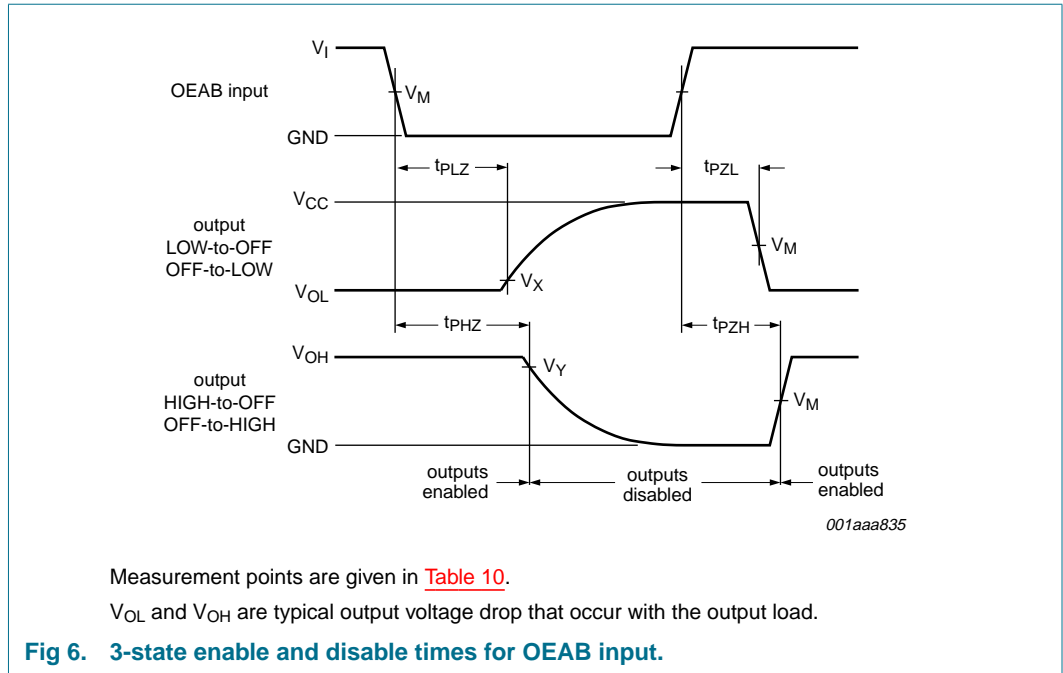


Table 10: Measurement points

Supply voltage	Input	Output		
V_{CC}	V_M	V_M	V_X	V_Y
$< 2.7\text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.1 \times V_{CC}$	$V_{OH} - 0.1 \times V_{CC}$
$\geq 2.7\text{ V}$	1.5 V	1.5 V	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$

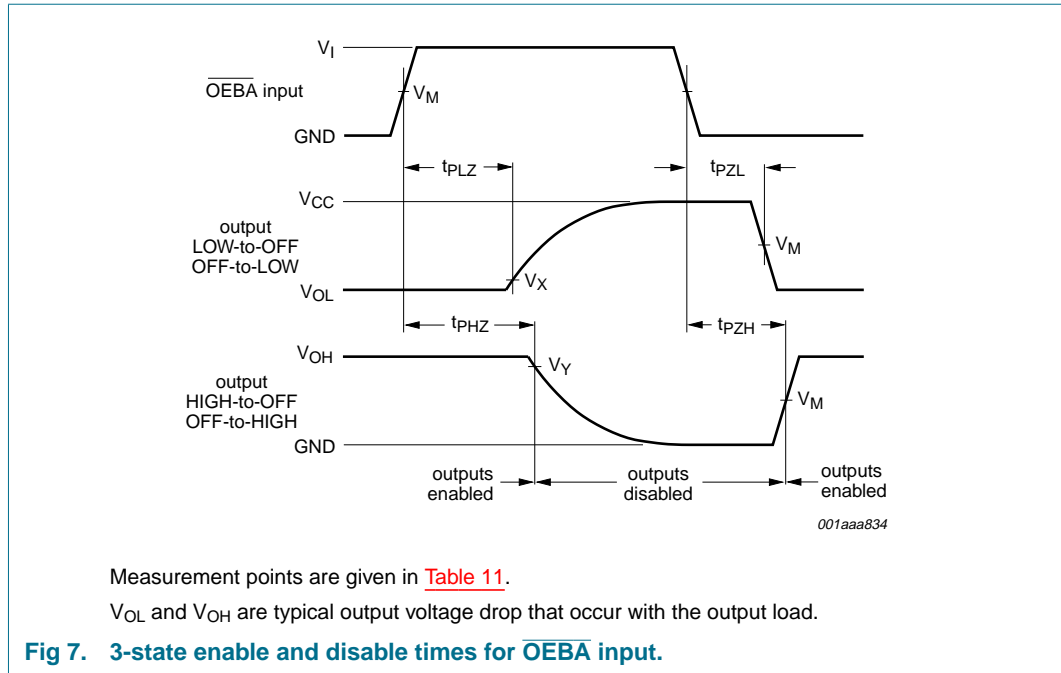


Table 11: Measurement points

Supply voltage	Input	Output		
V_{CC}	V_M	V_M	V_X	V_Y
$< 2.7\text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.1 \times V_{CC}$	$V_{OH} - 0.1 \times V_{CC}$
$\geq 2.7\text{ V}$	1.5 V	1.5 V	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$

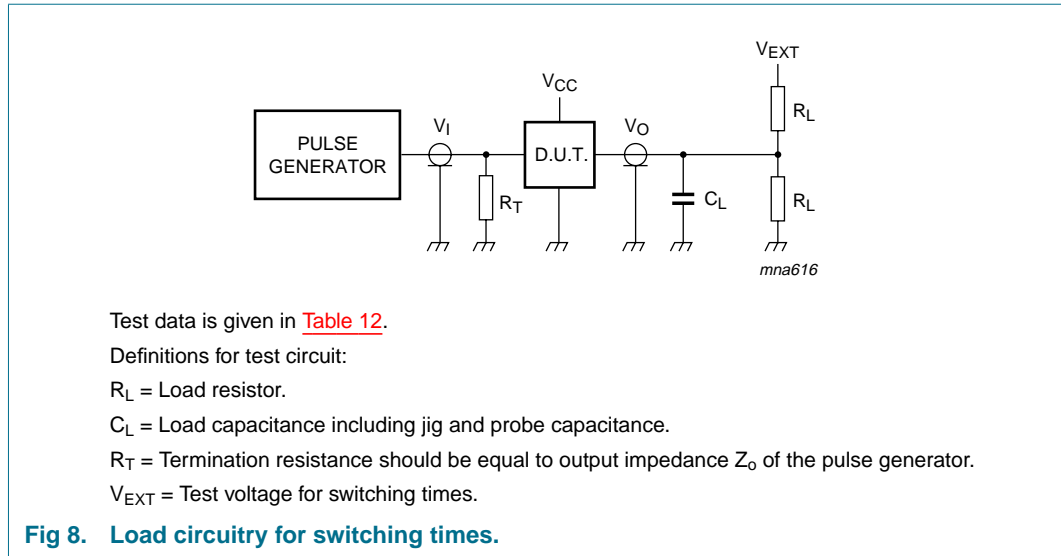


Table 12: Test data

Supply voltage	Input		Load		V_{EXT}		
	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
1.2 V	V_{CC}	≤ 2.5 ns	50 pF	500 Ω [1]	open	GND	$2 \times V_{CC}$
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	GND	$2 \times V_{CC}$
3.0 to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	GND	$2 \times V_{CC}$

[1] The circuit performs better when $R_L = 1000 \Omega$.

13. Package outline

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

SOT163-1

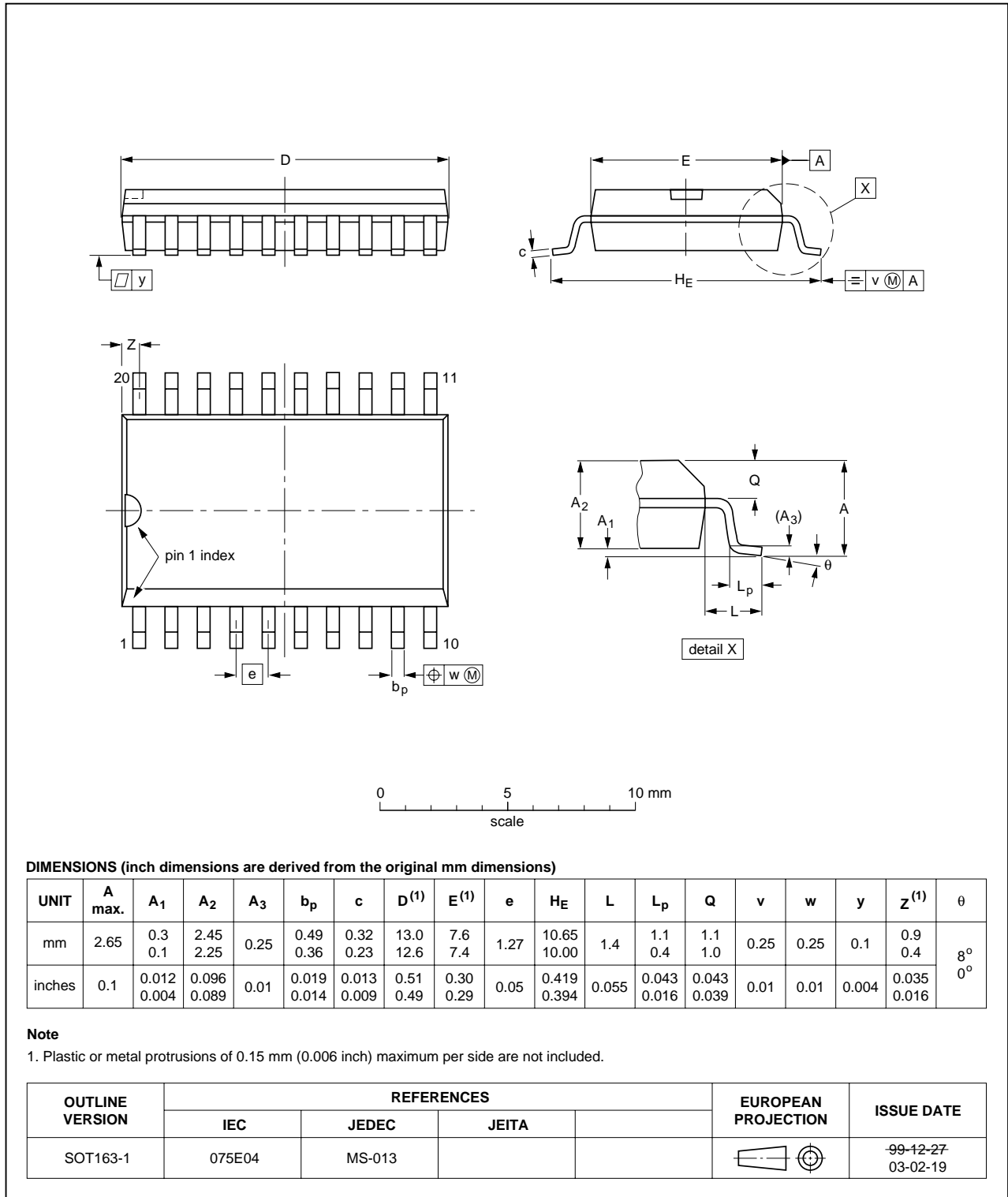


Fig 9. Package outline SOT163-1.

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

SOT339-1

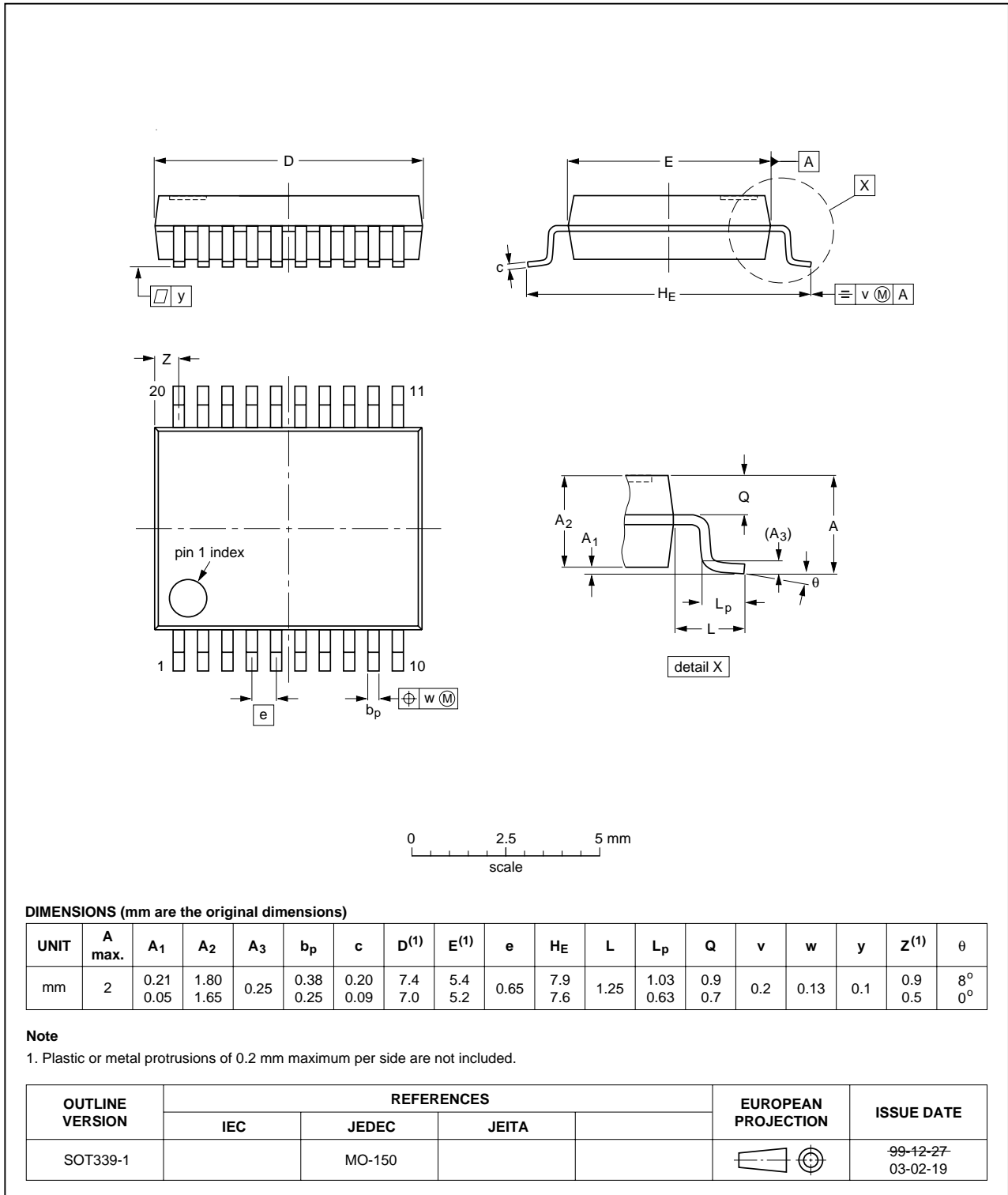


Fig 10. Package outline SOT339-1.

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

SOT360-1

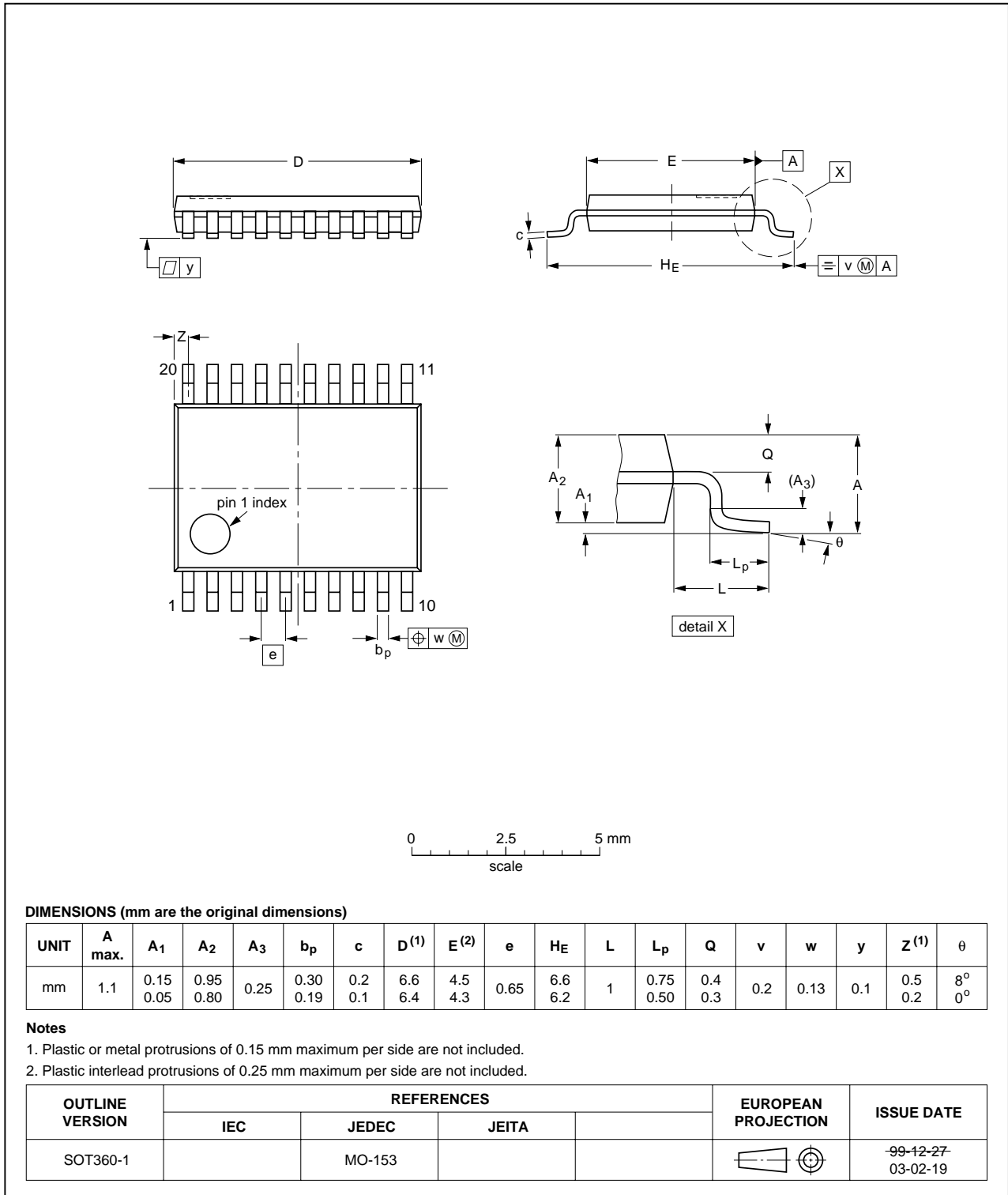


Fig 11. Package outline SOT 360-1.

14. Revision history

Table 13: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74LVC623A_3	20040506	Product data	-	9397 750 13155	74LVC623A_2
Modifications:					
					<ul style="list-style-type: none">• The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors.• Table 7: added values for $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$.• Table 8: added values for $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$.
74LVC623A_2	19980729	Product specification	-	9397 750 04515	-

15. Data sheet status

Level	Data sheet status ^[1]	Product status ^[2] ^[3]	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.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

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

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

16. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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