

# 74LVC827A

10-bit buffer/line driver with 5 V tolerant inputs/outputs;  
3-state

Rev. 02 — 8 April 2004

Product data sheet

## 1. General description

The 74LVC827A 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 and 5 V environment.

The 74LVC827A is a 10-bit buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable pins  $\overline{OE}1$  and  $\overline{OE}2$ . A HIGH on pin  $\overline{OE}n$  causes the outputs to assume a high-impedance OFF-state.

## 2. 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
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- Complies with JESD8-B and EIA/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  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

## 3. Quick reference data

**Table 1: Quick reference data**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PHL}$ , $t_{PLH}$	propagation delay An to Yn	$C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$	-	2.8	-	ns
$t_{PZH}$ , $t_{PZL}$	3-state output enable times $\overline{OE}n$ to Yn	$C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$	-	3.5	-	ns
$t_{PHZ}$ , $t_{PLZ}$	3-state output disable times $\overline{OE}n$ to Yn	$C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$	-	2.9	-	ns
$C_I$	input capacitance		-	5.0	-	pF

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**Table 1: Quick reference data ...continued** $GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $t_r = t_f \leq 2.5\text{ ns}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{PD}$	power dissipation capacitance per buffer	$V_{CC} = 3.3\text{ V}$	[1] [2]			
		outputs enabled	-	12	-	pF
		outputs disabled	-	3	-	pF

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$N$  = total load switching outputs;

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

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

## 4. Ordering information

**Table 2: Ordering information**

Type number	Package			
	Temperature range	Name	Description	Version
74LVC827AD	-40 °C to +125 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
74LVC827ADB	-40 °C to +125 °C	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	SOT340-1
74LVC827APW	-40 °C to +125 °C	TSSOP24	plastic thin shrink small package outline package; 24 leads; body width 4.4 mm	SOT355-1

5. Functional diagram

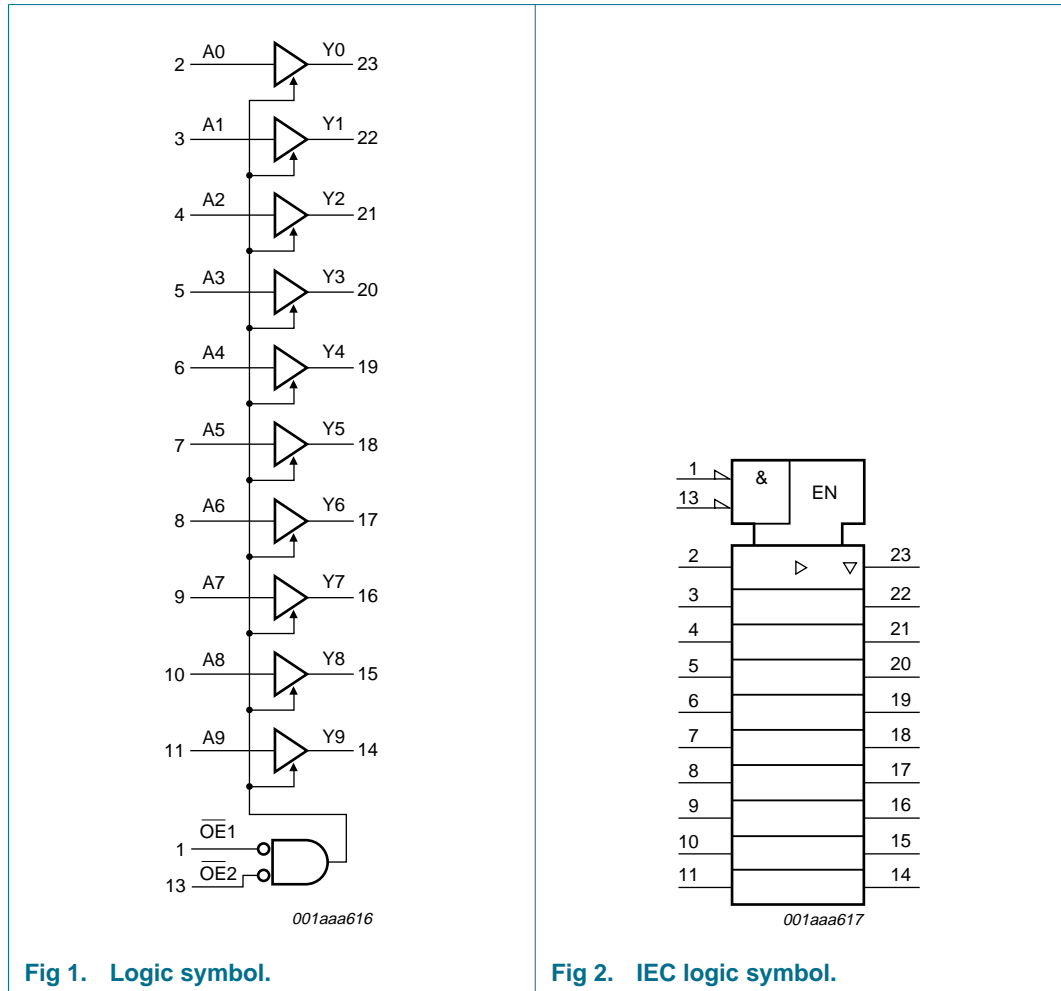


Fig 1. Logic symbol.

Fig 2. IEC logic symbol.

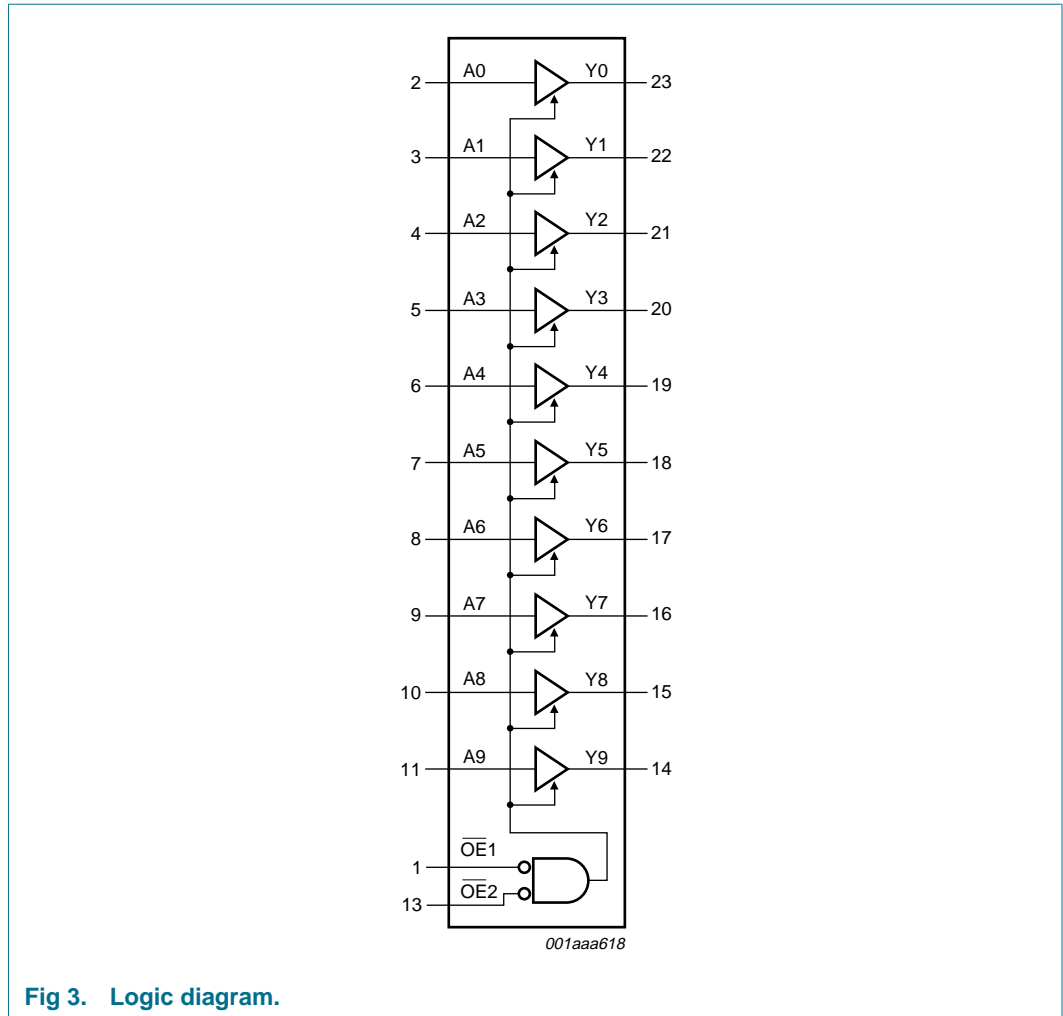
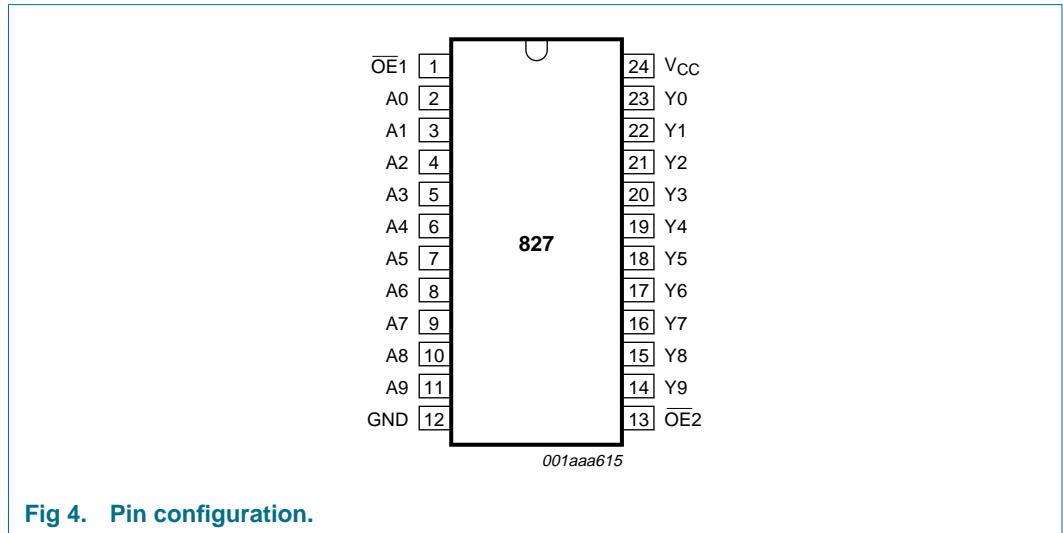


Fig 3. Logic diagram.

## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3: Pin description

Pin	Symbol	Description
1	$\overline{OE1}$	output enable input (active LOW)
2	A0	data input
3	A1	data input
4	A2	data input
5	A3	data input
6	A4	data input
7	A5	data input
8	A6	data input
9	A7	data input
10	A8	data input
11	A9	data input
12	GND	ground (0 V)
13	$\overline{OE2}$	output enable input (active LOW)
14	Y9	data output
15	Y8	data output
16	Y7	data output
17	Y6	data output
18	Y5	data output
19	Y4	data output
20	Y3	data output
21	Y2	data output

Table 3: Pin description ...continued

Pin	Symbol	Description
22	Y1	data output
23	Y0	data output
24	V <sub>CC</sub>	supply voltage

## 7. Functional description

### 7.1 Function table

Table 4: Function table [1]

Input			Output
OE1	OE2	An	Yn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 X = don't care;  
 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 <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		[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	[1] -0.5	V <sub>CC</sub> + 0.5	V
		output 3-state	[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		-	±100	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	power dissipation	T <sub>amb</sub> = -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 SO24 packages: above 70 °C derate linearly with 8 mW/K.

For SSOP24 and TSSOP24 packages: above 60 °C derate linearly with 5.5 mW/K.

## 9. Recommended operating conditions

**Table 6: Recommended operating conditions**

Symbol	Parameter	Conditions	Min	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	output HIGH or LOW state	0	$V_{CC}$	V
		output 3-state	0	5.5	V
$T_{amb}$	operating ambient temperature		-40	+125	°C
$t_r, t_f$	input rise and fall times	$V_{CC} = 1.2\text{ V to } 2.7\text{ V}$	0	20	ns/V
		$V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	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
<b><math>T_{amb} = -40\text{ °C to } +85\text{ °C}</math> [1]</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.2\text{ V}$	$V_{CC}$	-	-	V
		$V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$	-	-	GND	V
		$V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	-	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}\text{ or } V_{IL}$				
		$I_O = -100\text{ }\mu\text{A}; V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	[2] $V_{CC} - 0.2$	$V_{CC}$	-	V
		$I_O = -12\text{ mA}; V_{CC} = 2.7\text{ V}$	$V_{CC} - 0.5$	-	-	V
		$I_O = -18\text{ mA}; V_{CC} = 3.0\text{ V}$	$V_{CC} - 0.6$	-	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}\text{ or } V_{IL}$				
		$I_O = 100\text{ }\mu\text{A}; V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	[2] -	GND	0.2	V
		$I_O = 12\text{ mA}; V_{CC} = 2.7\text{ V}$	-	-	0.4	V
		$I_O = 24\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.55	V
$I_{LI}$	input leakage current	$V_I = 5.5\text{ V or GND}; V_{CC} = 3.6\text{ V}$	-	$\pm 0.1$	$\pm 5$	$\mu\text{A}$
$I_{OZ}$	3-state output OFF-state current	$V_I = V_{IH}\text{ or } V_{IL}; V_O = 5.5\text{ V or GND}; V_{CC} = 3.6\text{ V}$	-	0.1	$\pm 5$	$\mu\text{A}$
$I_{off}$	power-off leakage supply	$V_I\text{ or } V_O = 5.5\text{ V}; V_{CC} = 0\text{ V}$	-	0.1	$\pm 10$	$\mu\text{A}$
$I_{CC}$	quiescent supply current	$V_I = V_{CC}\text{ or GND}; I_O = 0\text{ A}; V_{CC} = 3.6\text{ V}$	-	0.1	10	$\mu\text{A}$
$\Delta I_{CC}$	additional quiescent supply current per pin	$V_I = V_{CC} - 0.6\text{ V}; I_O = 0\text{ A}; V_{CC} = 2.7\text{ V to } 3.6\text{ V}$	[2] -	5	500	$\mu\text{A}$
$C_I$	input capacitance		-	5.0	-	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
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	V <sub>CC</sub>	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	GND	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	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> = 2.7 V to 3.6 V	V <sub>CC</sub> - 0.3	-	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	V <sub>CC</sub> - 0.65	-	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	V <sub>CC</sub> - 0.75	-	-	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> = 2.7 V to 3.6 V	-	-	0.3	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.8	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	-	-	±20	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; V <sub>CC</sub> = 3.6 V	-	-	±20	μA
I <sub>off</sub>	power-off leakage supply	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V	-	-	±20	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V	-	-	40	μA
ΔI <sub>CC</sub>	additional quiescent supply current per pin	V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	5000	μA

[1] All typical values are measured T<sub>amb</sub> = 25 °C.

[2] These typical values are measured at V<sub>CC</sub> = 3.3 V.

## 11. Dynamic characteristics

**Table 8: Dynamic Characteristics**

GND = 0 V; see [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay An to Yn	see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 1.2 V	-	15	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	7.1	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	[2] 1.0	2.8	6.7	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	3-state output enable time OEn to Yn	see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 1.2 V	-	20	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	[2] 1.0	3.5	7.3	ns



**Table 8: Dynamic Characteristics ...continued**  
*GND = 0 V; see Figure 7.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PHZ}, t_{PLZ}$	3-state output disable time $\overline{OEn}$ to $Y_n$	see <a href="#">Figure 6</a>				
		$V_{CC} = 1.2\text{ V}$	-	10.0	-	ns
		$V_{CC} = 2.7\text{ V}$	1.5	-	7.3	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	[2] 1.5	2.9	6.7	ns
$t_{sk(0)}$	skew		[3] -	-	1.0	ns
$C_{PD}$	power dissipation capacitance per buffer	$V_{CC} = 3.3\text{ V}$	[4] [5]			
		outputs enabled	-	12	-	pF
		outputs disabled	-	3	-	pF
<b><math>T_{amb} = -40\text{ }^{\circ}\text{C to }+125\text{ }^{\circ}\text{C}</math></b>						
$t_{PHL}, t_{PLH}$	propagation delay $A_n$ to $Y_n$	see <a href="#">Figure 5</a>				
		$V_{CC} = 1.2\text{ V}$	-	-	-	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
$t_{PZH}, t_{PZL}$	3-state output enable time $\overline{OEn}$ to $Y_n$	see <a href="#">Figure 6</a>				
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.5	-	11.0	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	9.5	ns
$t_{PHZ}, t_{PLZ}$	3-state output disable time $\overline{OEn}$ to $Y_n$	see <a href="#">Figure 6</a>				
		$V_{CC} = 1.2\text{ V}$	-	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.5	-	9.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.5	-	8.5	ns
$t_{sk(0)}$	skew		[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  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

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

$N$  = 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

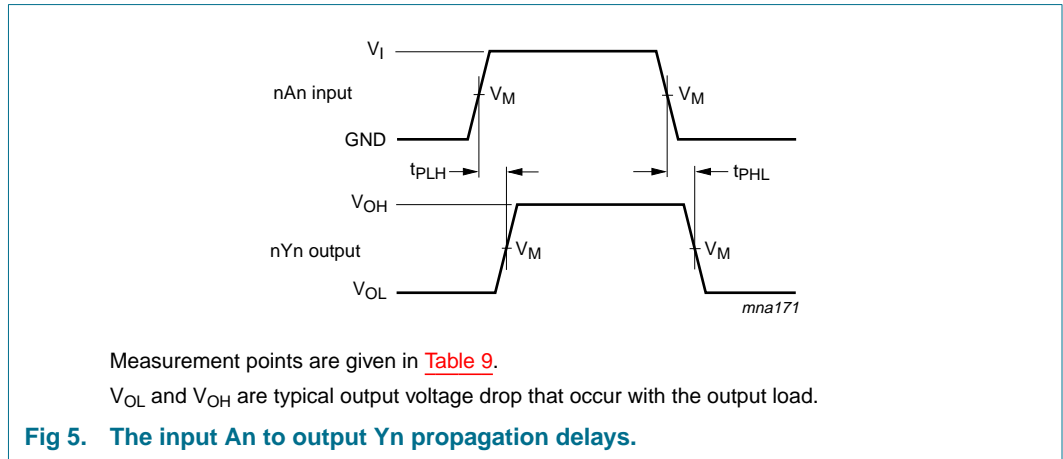


Table 9: Measurement points

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

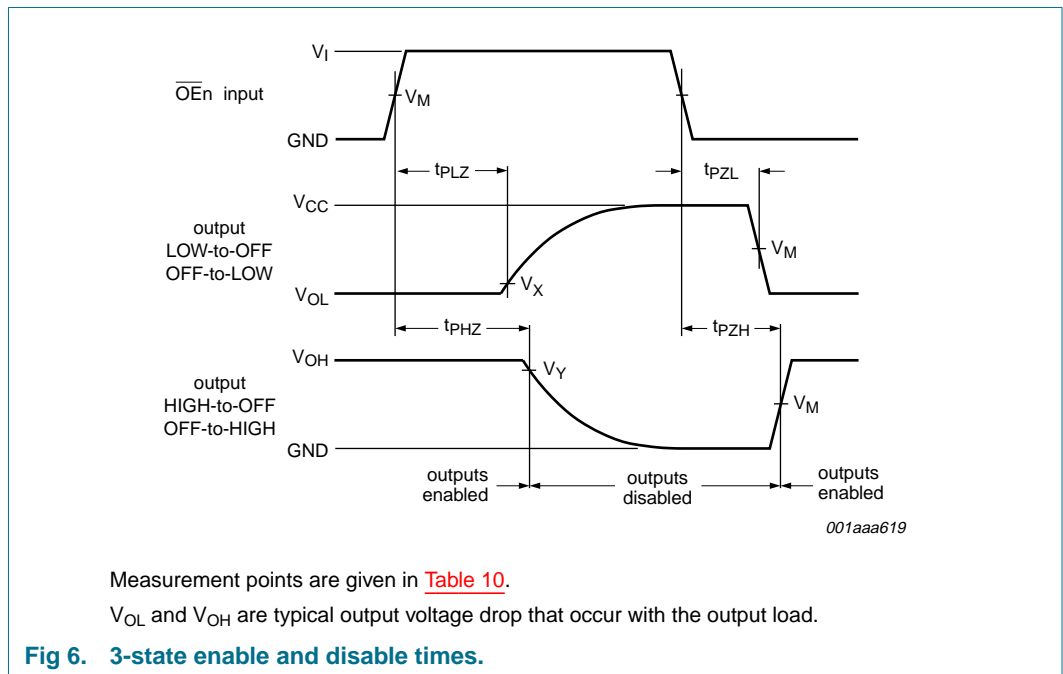
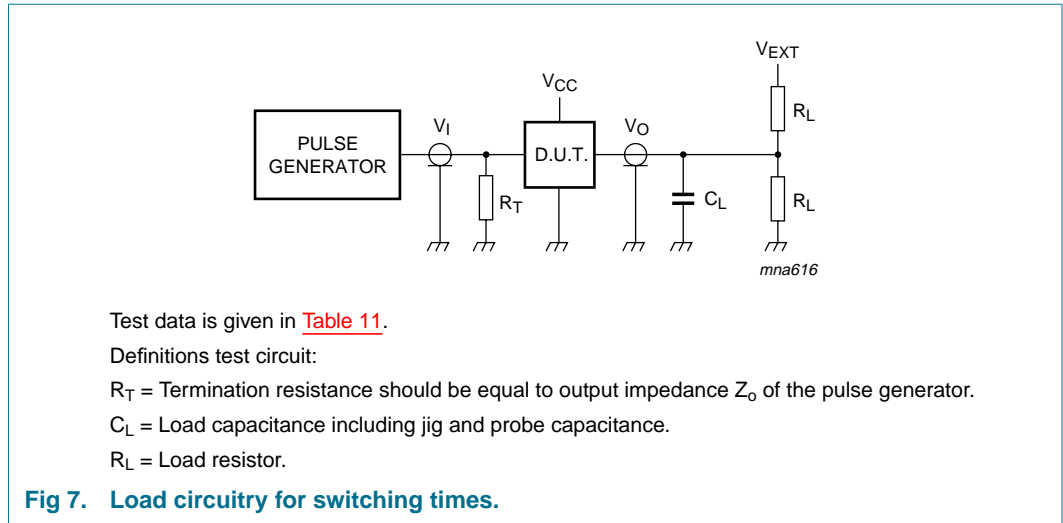


Table 10: Measurement points

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



**Table 11: Test data**

Supply voltage	Input		Load		V <sub>EXT</sub>		
V <sub>CC</sub>	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	C <sub>L</sub>	R <sub>L</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>	≤ 2.5 ns	50 pF	500 Ω [1]	open	GND	2 × V <sub>CC</sub>
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	GND	2 × V <sub>CC</sub>
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	GND	2 × V <sub>CC</sub>

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

13. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1

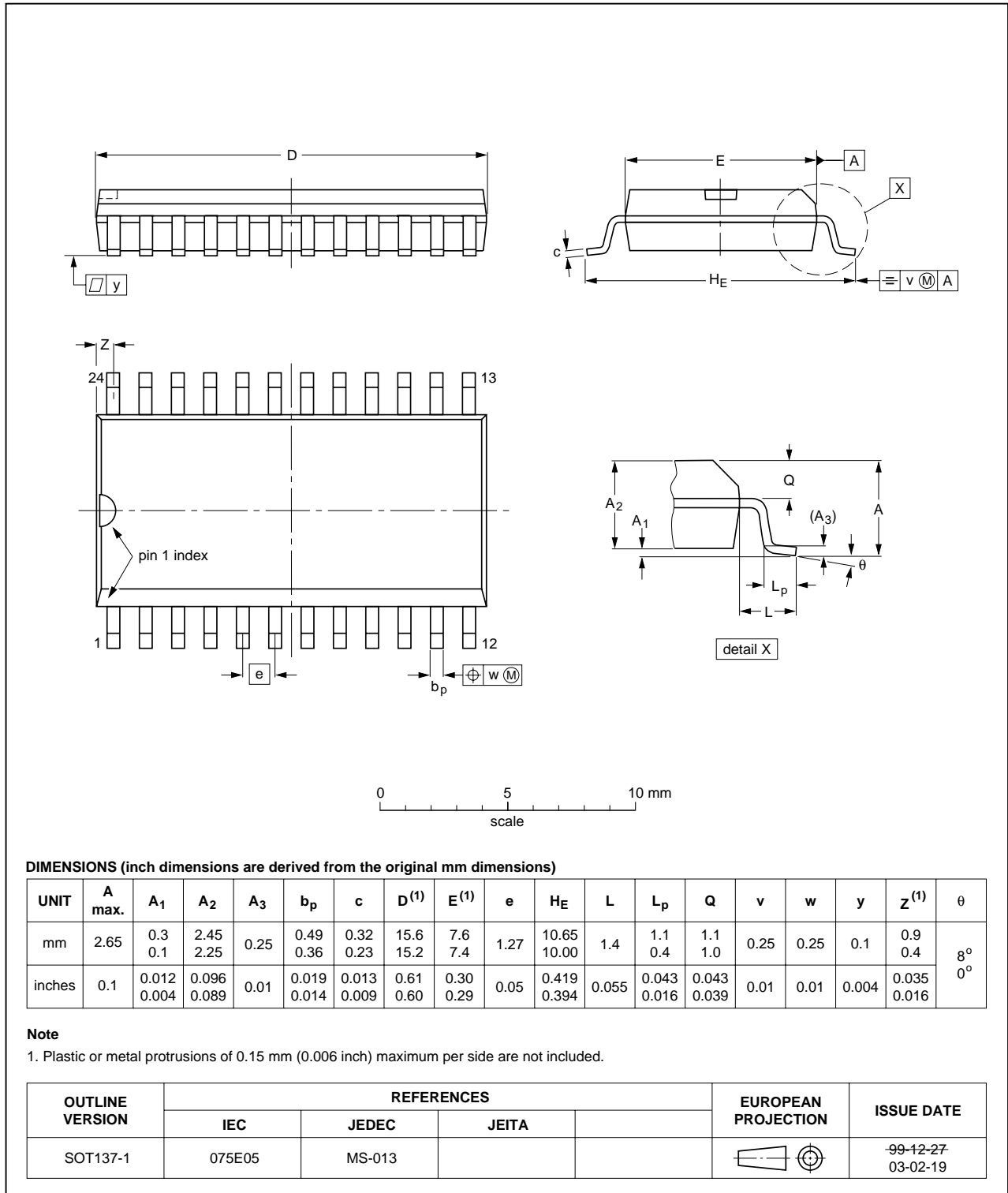


Fig 8. Package outline SO24.

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1

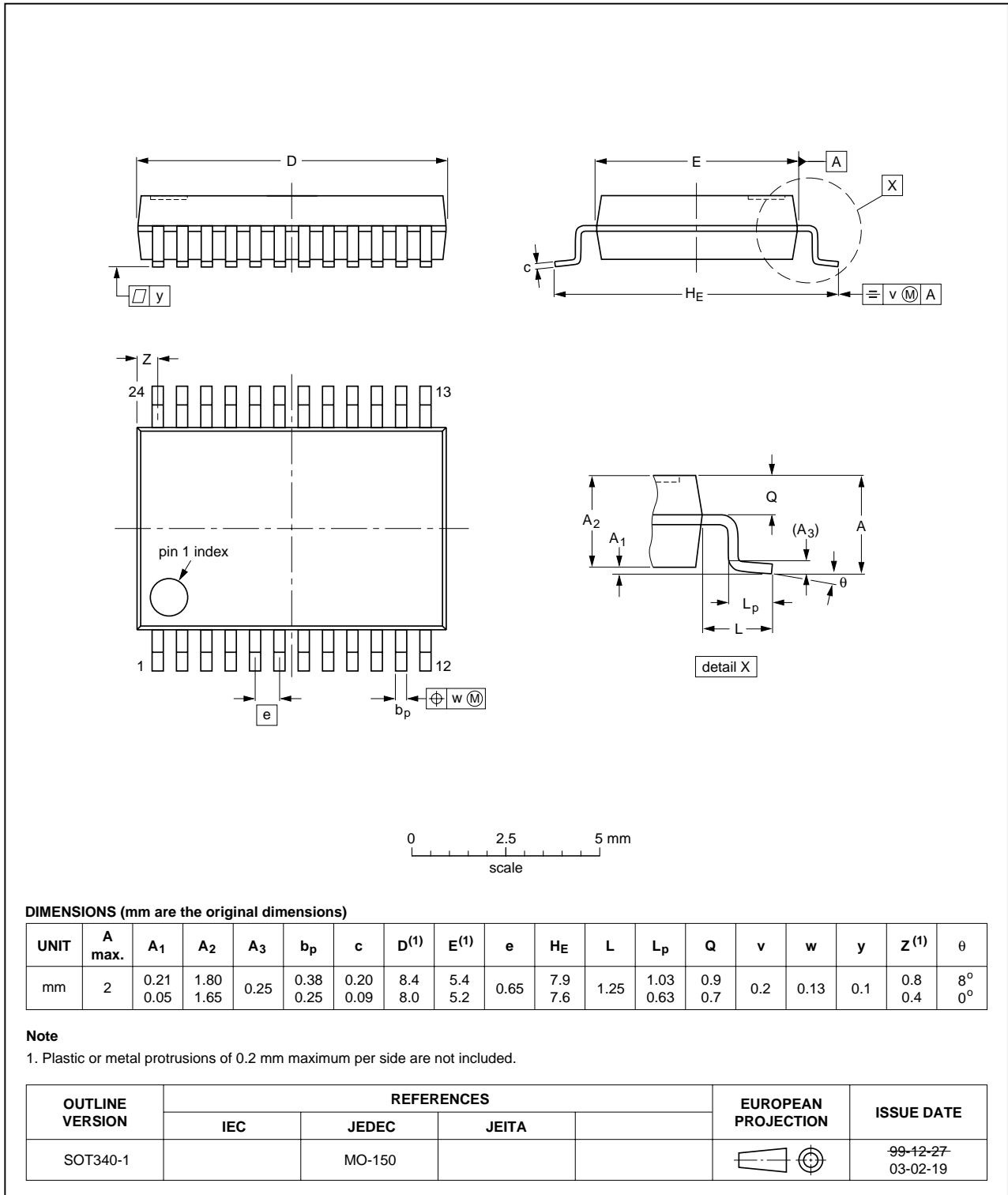


Fig 9. Package outline SSOP24.

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1

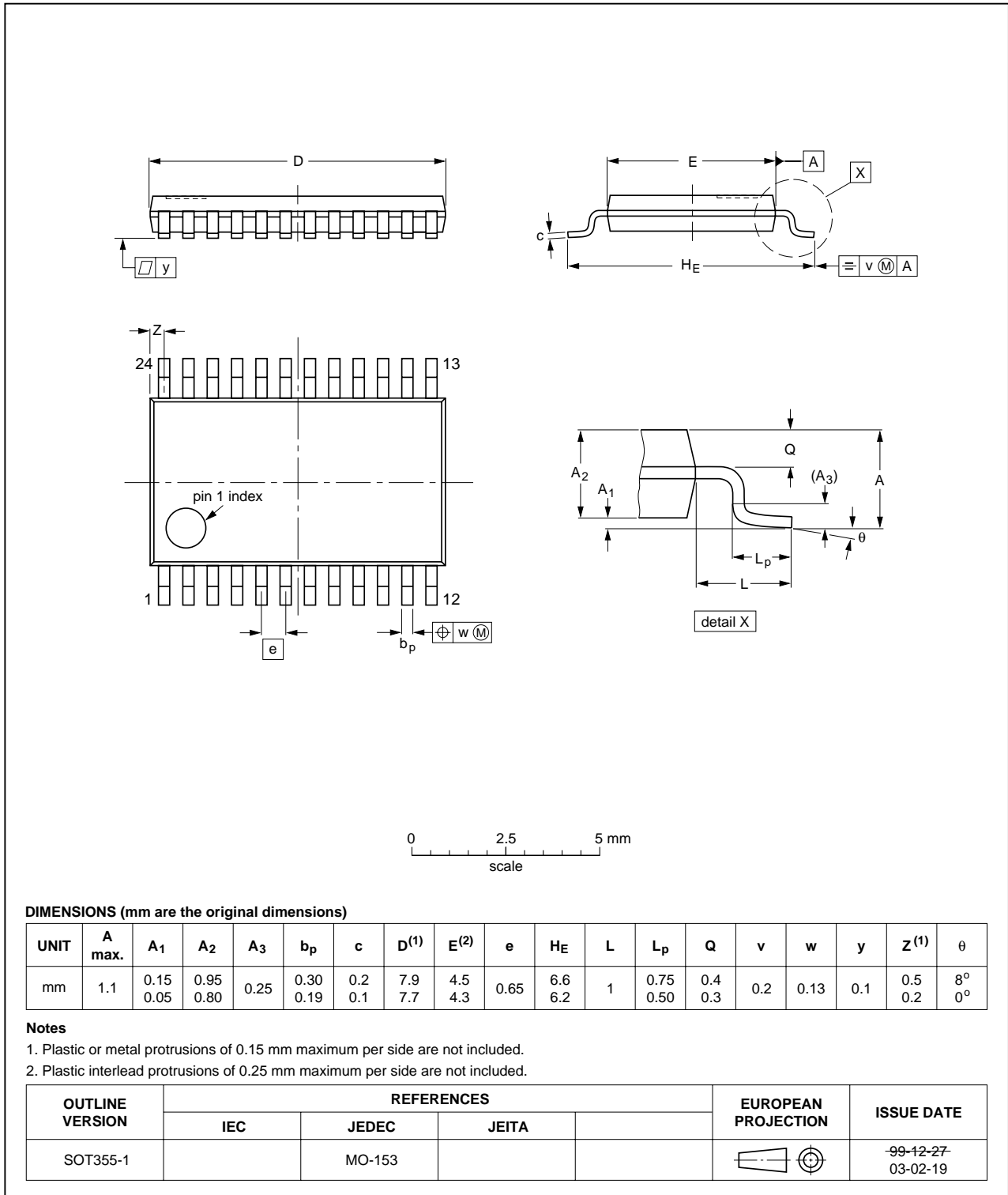


Fig 10. Package outline TSSOP24.

## 14. Revision history

**Table 12: Revision history**

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74LVC827A_2	20040408	Product data	-	9397 750 13037	74LVC827A_1
Modifications:	<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the presentation and information standard of Philips Semiconductors.</li><li>• <a href="#">Section 2 on page 1</a>: feature list is updated.</li><li>• <a href="#">Section 10 on page 7</a>: added values for <math>T_{amb} = -40\text{ °C}</math> to <math>+125\text{ °C}</math>.</li><li>• <a href="#">Section 11 on page 8</a>: added values for <math>T_{amb} = -40\text{ °C}</math> to <math>+125\text{ °C}</math>.</li></ul>				
74LVC827A_1	19980904	Product data sheet	-	9397 750 04521	-

## 15. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[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.
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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