

# 74LVT2952

3.3 V Octal registered transceiver; 3-State

Rev. 4 — 11 September 2013

Product data sheet

## 1. General description

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The 74LVT2952 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

This device combines low static and dynamic power dissipation with high speed and high output drive.

The 74LVT2952 device is an 8-bit registered transceiver. Two 8-bit back-to-back registers store data flowing in both directions between two bidirectional buses.

Data applied to the inputs is entered and stored on the rising edge of the clock (CPxx) if the clock enable (CExx) is LOW. The data is then present at the 3-state output buffers, but is only accessible when the output enable ( $\overline{OE}xx$ ) is LOW. Data flow from An inputs to Bn outputs is the same as for Bn inputs to An outputs.

## 2. Features and benefits

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- 8-bit registered transceiver
- Independent registers for A and B buses
- Input and output interface capability to systems at 5 V supply
- TTL input and output switching levels
- Output capability: +64 mA/−32 mA
- Latch-up protection exceeds 500 mA per JESD78 class II level A
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Bus-hold data inputs eliminate the need for external pull-up resistors for unused inputs
- Live insertion/extraction permitted
- Power-up reset
- Power-up 3-state
- No bus current loading when output is tied to 5 V bus



### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVT2952D	-40 °C to +85 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
74LVT2952DB	-40 °C to +85 °C	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	SOT340-1
74LVT2952PW	-40 °C to +85 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1

### 4. Functional diagram

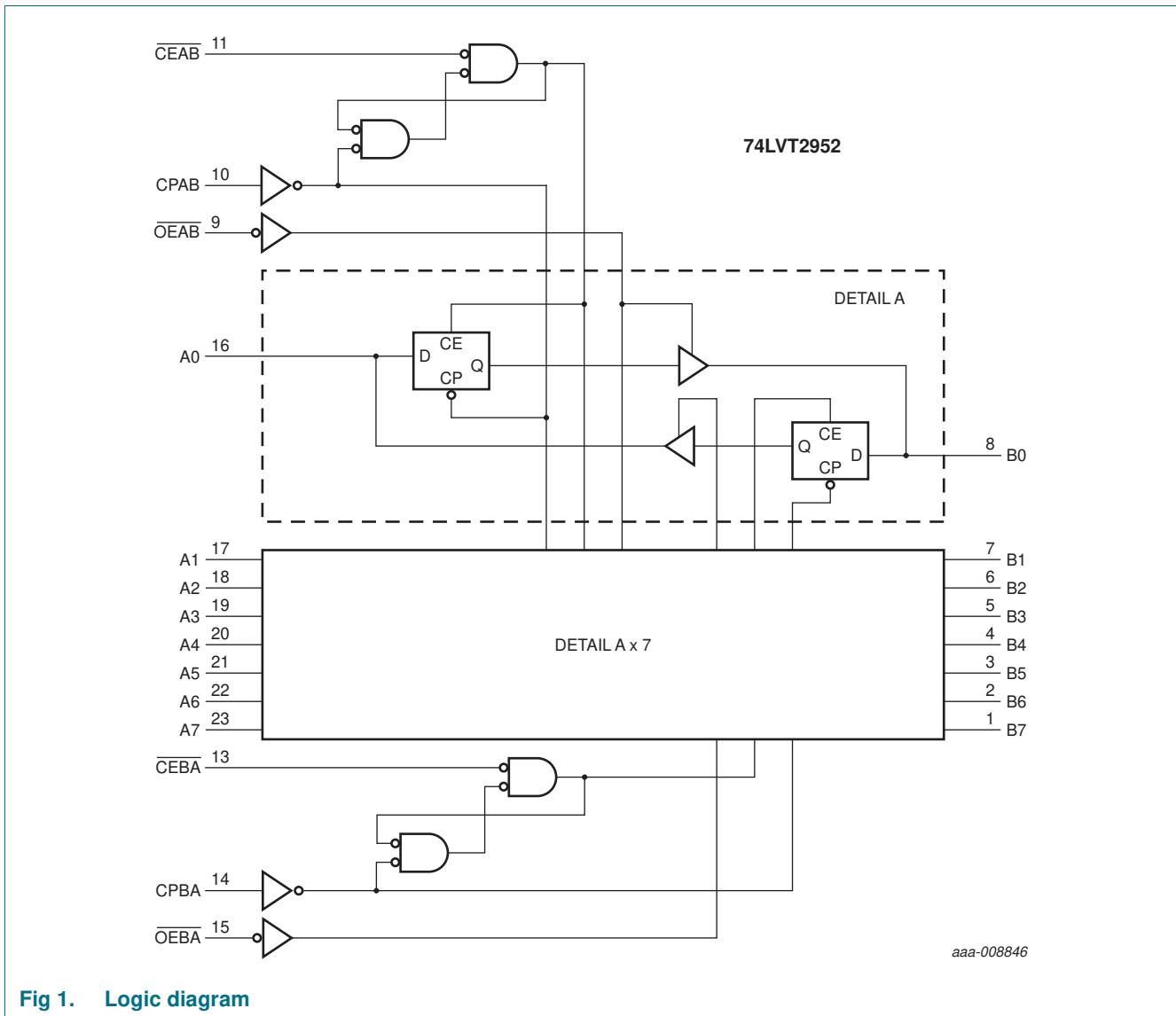
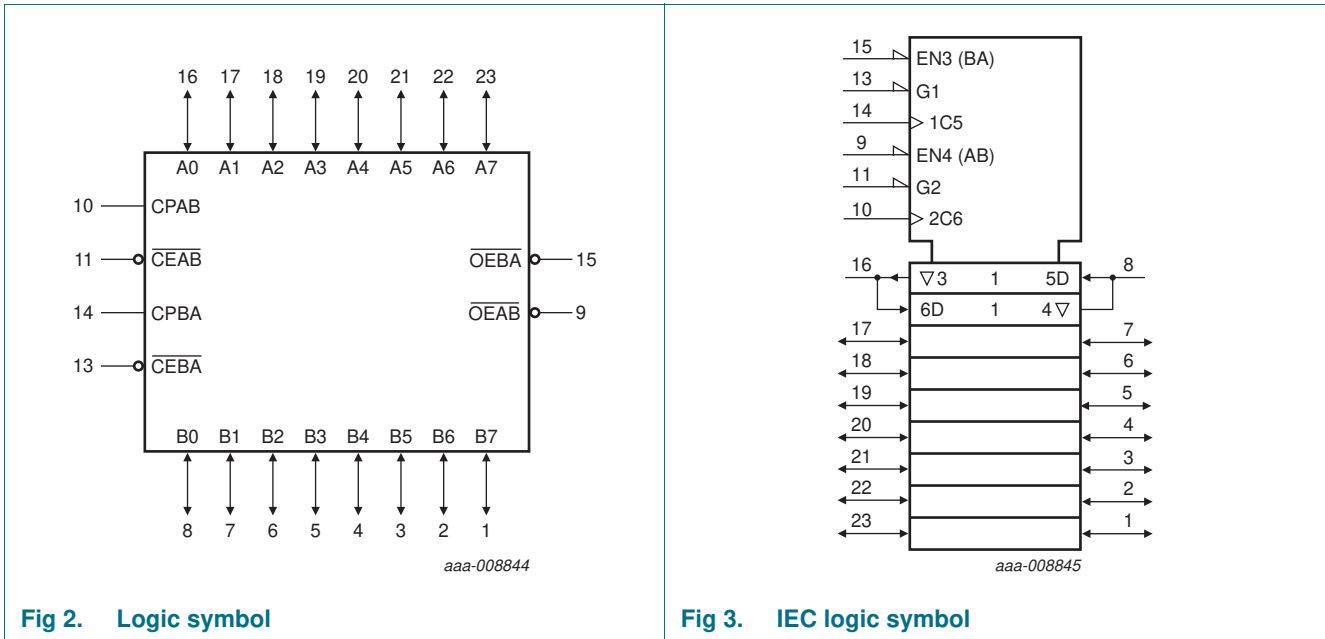
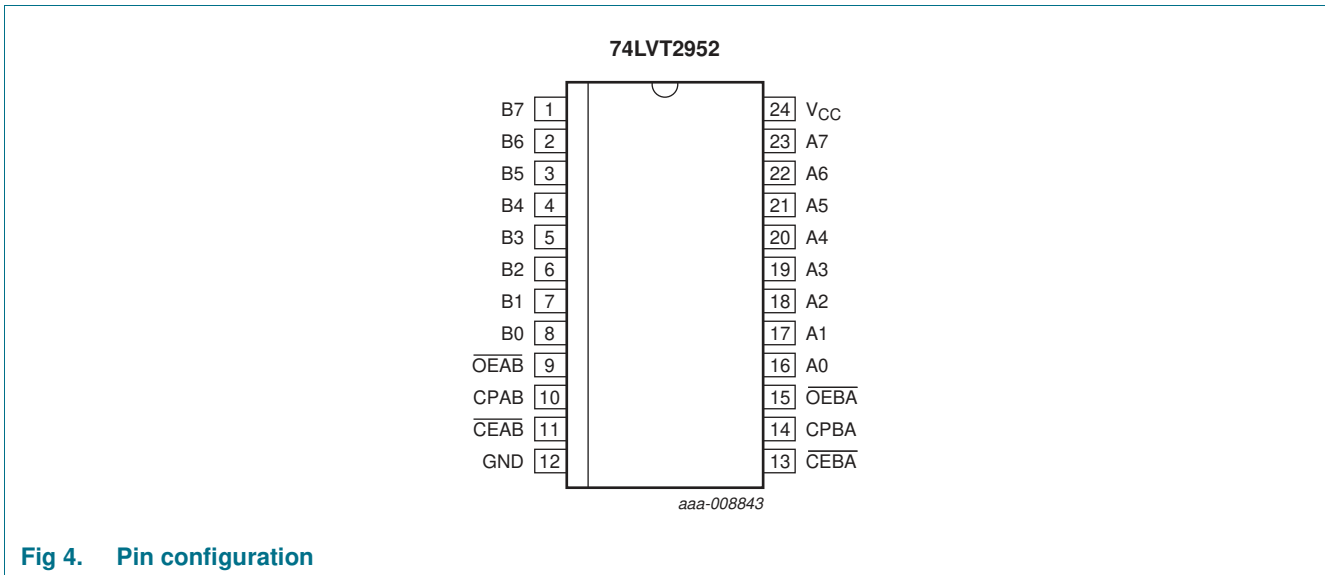


Fig 1. Logic diagram



## 5. Pinning information

### 5.1 Pinning



## 5.2 Pin description

**Table 2.** Pin description

Symbol	Pin	Description
B7 to B0	1, 2, 3, 4, 5, 6, 7, 8	data input/output (B side)
$\overline{\text{OEAB}}$ , $\overline{\text{OEBA}}$	9, 15	output enable input (active LOW)
CPAB, CPBA	10, 14	clock input
$\overline{\text{CEAB}}$ , $\overline{\text{CEBA}}$	11, 13	clock enable input
GND	12	ground (0 V)
A0 to A7	16, 17, 18, 19, 20, 21, 22, 23	data input/output (A side)
V <sub>CC</sub>	24	supply voltage

## 6. Functional description

**Table 3.** Function selection<sup>[1]</sup>

Inputs			Internal	Operating mode
An, Bn	CPxx <sup>[2]</sup>	$\overline{\text{CE}}_{xx}$ <sup>[2]</sup>		
X	X	H	nc	hold data
L	↑	L	L	load data
H	↑	L	H	load data

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 X = don't care;  
 ↑ = LOW-to-HIGH clock transition;  
 nc = no change.

- [2] xx = AB or BA.

**Table 4.** Function selection<sup>[1]</sup>

Inputs	Internal Q	An, Bn outputs	Operating mode
$\overline{\text{O}}_{E}xx$ <sup>[2]</sup>			
H	X	Z	outputs disabled
L	L	L	outputs enabled
L	H	H	outputs enabled

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 X = don't care;  
 Z = high impedance OFF-state.

- [2] xx = AB or BA.

## 7. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).<sup>[1][2]</sup>

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		-0.5	+4.6	V
V <sub>I</sub>	input voltage		<sup>[3]</sup> -0.5	7.0	V
V <sub>O</sub>	output voltage	output in OFF or HIGH state	<sup>[3]</sup> -0.5	+7	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < 0 V	-50	-	mA
I <sub>O</sub>	output current	output in LOW state	-	128	mA
		output in HIGH state	-64	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +85 °C	<sup>[4]</sup> -	500	mW

- [1] Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- [2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.
- [3] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
- [4] For SO20 packages: above 70 °C derate linearly with 8 mW/K.  
For SSOP20 and TSSOP20 packages: above 60 °C derate linearly with 5.5 mW/K.

## 8. Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		2.7	3.6	V
V <sub>I</sub>	input voltage		0	5.5	V
I <sub>OH</sub>	HIGH-level output current		-	-32	mA
I <sub>OL</sub>	LOW-level output current		-	32	mA
		current duty cycle ≤ 50 %; f <sub>i</sub> ≥ 1 kHz	-	64	mA
T <sub>amb</sub>	ambient temperature	in free air	-40	+85	°C
Δt/ΔV	input transition rise and fall rate	output enabled	-	10	ns/V

## 9. Static characteristics

**Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
V <sub>IK</sub>	input clamping voltage	V <sub>CC</sub> = 2.7 V; I <sub>IK</sub> = -18 mA	-1.2	-0.9	-	V
V <sub>IH</sub>	HIGH-level input voltage		2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage		-	-	0.8	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>CC</sub> = 2.7 V to 3.6 V; I <sub>OH</sub> = -100 μA	V <sub>CC</sub> - 0.2	V <sub>CC</sub> - 0.1	-	V
		V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -8 mA	2.4	2.5	-	
		V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -32 mA	2.0	2.2	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 100 μA	-	0.1	0.2	V
		V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 24 mA	-	0.3	0.5	V
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA	-	0.25	0.4	V
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 32 mA	-	0.3	0.5	V
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 64 mA	-	0.4	0.55	V
V <sub>OL(pu)</sub>	power-up LOW-level output voltage	V <sub>CC</sub> = 3.6 V; I <sub>O</sub> = 1 mA; V <sub>I</sub> = GND or V <sub>CC</sub> <sup>[2]</sup>	-	0.13	0.55	V
I <sub>I</sub>	input leakage current	control pins				
		V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V	-	1	10	μA
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	±0.1	±1	μA
		I/O data pins <sup>[3]</sup>				
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V	-	1	20	μA
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub>	-	0.1	1	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V	-	1	±100	μA
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V; output HIGH	-	60	125	μA
I <sub>LO</sub>	output leakage current	V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.6 V; output HIGH	-	60	125	μA
I <sub>O(pu/pd)</sub>	power-up/power-down output current	V <sub>CC</sub> ≤ 1.2 V V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; OE <sub>xx</sub> = don't care <sup>[4]</sup>	-	1	±100	μA
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V	75	150	-	μA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 2.0 V	-	-150	-75	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 0 V to 3.0 V; V <sub>I</sub> = 3.6 V <sup>[5]</sup>	500	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 0 V to 3.0 V; V <sub>I</sub> = 3.6 V <sup>[5]</sup>	-	-	-500	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				
		outputs HIGH	-	0.13	0.19	mA
		outputs LOW	-	3	12	mA
ΔI <sub>CC</sub>	additional supply current	outputs disabled	-	0.13	0.19	mA
		per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V; one input = V <sub>CC</sub> - 0.6 V; other inputs at V <sub>CC</sub> or GND <sup>[6]</sup>	-	0.1	0.2	mA
C <sub>I</sub>	input capacitance	control inputs; outputs disabled; V <sub>I</sub> = 0 V or 3.0 V	-	4	-	pF

**Table 7. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
C <sub>I/O</sub>	input/output capacitance	at I/O data pins, outputs disabled; V <sub>I/O</sub> = 0 V or 3.0 V	-	8	-	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.
- [2] For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.
- [3] Unused pins at V<sub>CC</sub> or GND.
- [4] This parameter is valid for any V<sub>CC</sub> between 0 V and 1.2 V with a transition time of up to 10 ms. From V<sub>CC</sub> = 1.2 V to V<sub>CC</sub> = 3.3 V ± 0.3 V a transition time of 100 ms is permitted. This parameter is valid for T<sub>amb</sub> = +25 °C only.
- [5] This parameter is the bus hold overdrive current required to force the input to the opposite logic state.
- [6] This parameter is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit, see [Figure 8](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
t <sub>PLH</sub>	LOW to HIGH propagation delay	CPBA to An or CPAB to Bn; see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 2.7 V	-	-	7.1	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.3	3.1	6.1	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	CPBA to An or CPAB to Bn; see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 2.7 V	-	-	6.9	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.8	3.8	6.0	ns
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	OEBA to An; OEAB to Bn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	6.7	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.0	3.4	5.6	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay	OEBA to An; OEAB to Bn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	8.0	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.2	3.6	6.5	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	OEBA to An; OEAB to Bn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	6.9	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.0	3.7	6.3	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	OEBA to An; OEAB to Bn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	5.3	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.6	3.4	5.1	ns
t <sub>su(H)</sub>	set-up time HIGH	An to CPAB or Bn to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	2.8	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	2.5	1.0	-	ns
		CEAB to CPAB or CEBA to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	0.8	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	0.9	0.3	-	ns

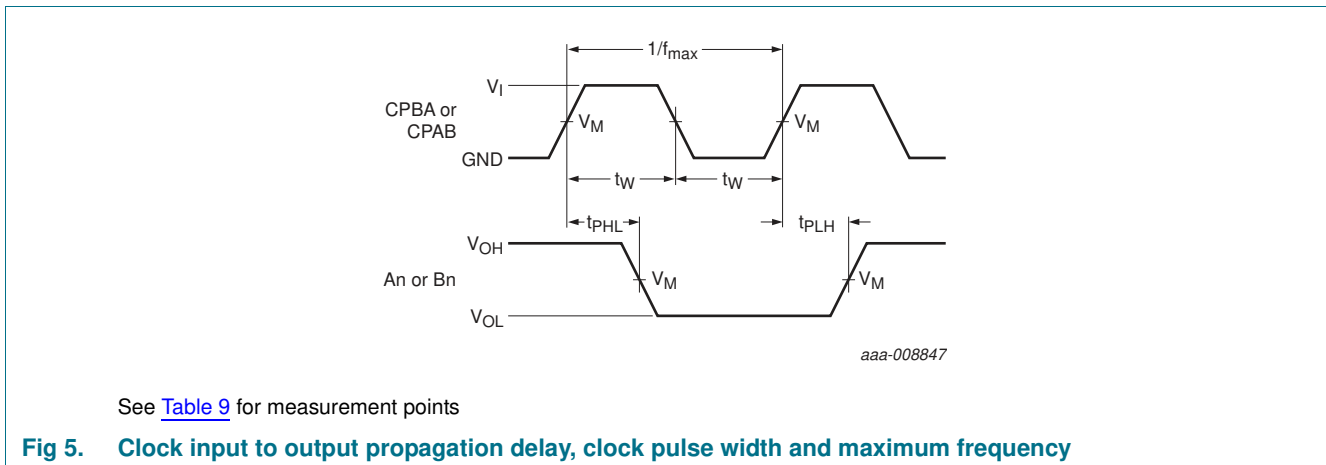
**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V). For test circuit, see [Figure 8](#).

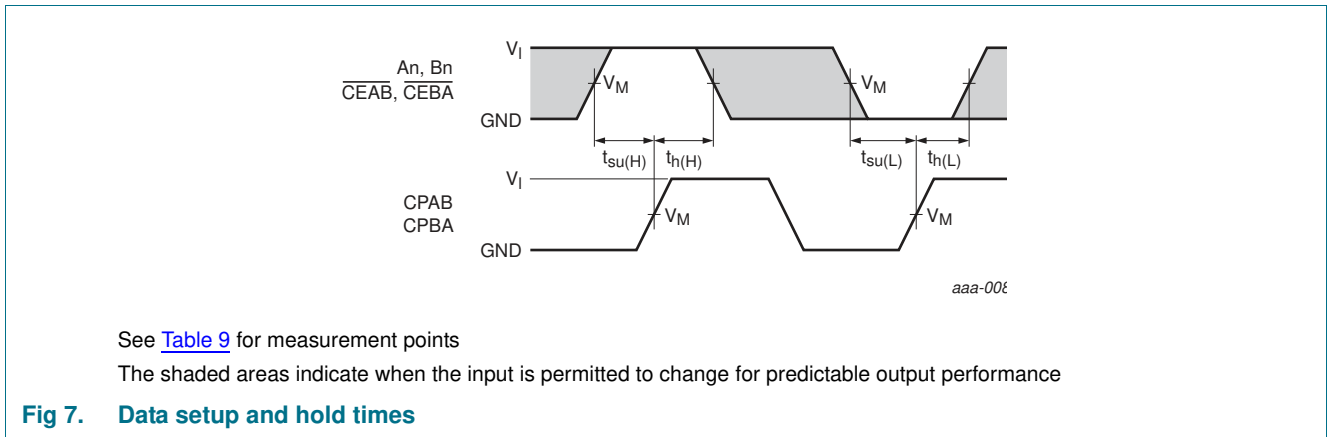
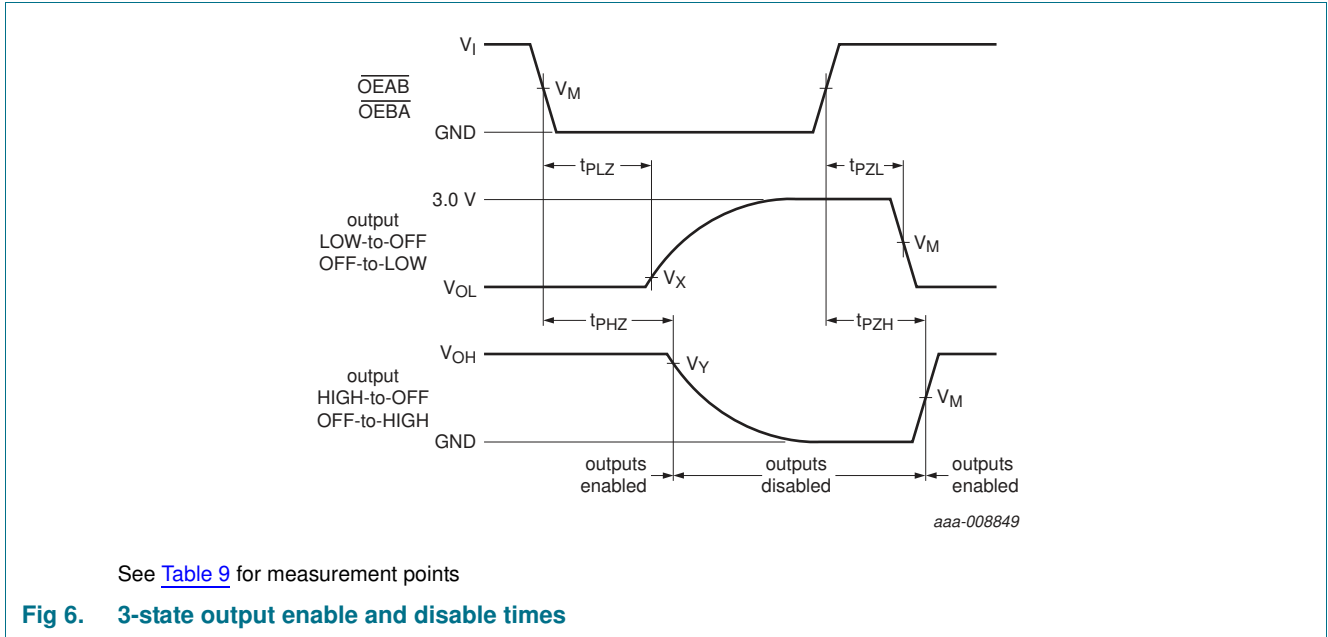
Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
t <sub>su(L)</sub>	set-up time LOW	An to CPAB or Bn to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	3.0	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	2.5	1.0	-	ns
		$\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	2.7	-	-	ns
t <sub>h(H)</sub>	hold time HIGH	An to CPAB or Bn to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	0.7	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.5	-0.5	-	ns
		$\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	0.7	-	-	ns
t <sub>h(L)</sub>	hold time LOW	An to CPAB or Bn to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	2.6	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.5	-0.5	-	ns
		$\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	2.6	-	-	ns
t <sub>w</sub>	pulse width	CPAB or CPBA; HIGH or LOW; see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 2.7 V	3.3	-	-	ns
		V <sub>CC</sub> = 3.3 V ± 0.3 V	3.3	1.0	-	ns
		$\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	2.5	0	-	ns
f <sub>max</sub>	maximum frequency	CPBA, CPAB; V <sub>CC</sub> = 3.3 V ± 0.3 V; see <a href="#">Figure 5</a>	150	200	-	MHz

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 3.3 V.

## 11. Waveforms

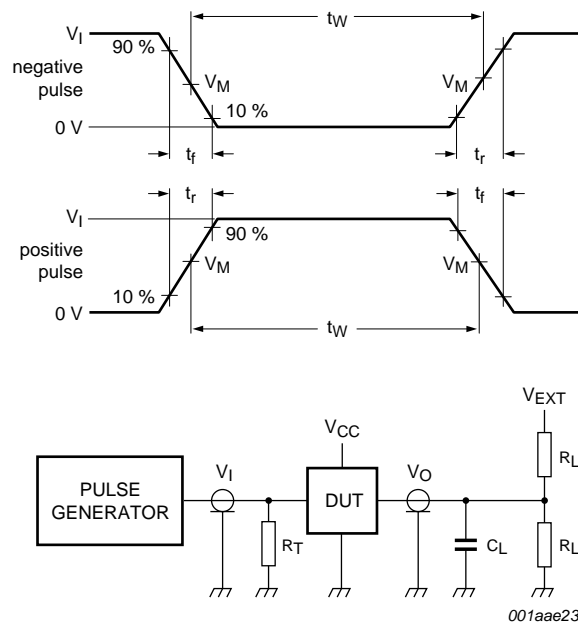






**Table 9. Measurement points**

V <sub>CC</sub>	Input		Output		
	V <sub>I</sub>	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>
2.7 V to 3.6 V	GND to 2.7 V	1.5 V	1.5 V	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V



Test data is given in [Table 10](#).

Definitions 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 switching times**

**Table 10. Test data**

Input				Load		$V_{EXT}$		
$V_I$	$f_i$	$t_W$	$t_r, t_f$	$R_L$	$C_L$	$t_{PHZ}, t_{PZH}$	$t_{PLZ}, t_{PZL}$	$t_{PLH}, t_{PHL}$
2.7 V	$\leq 10$ MHz	500 ns	$\leq 2.5$ ns	500 $\Omega$	50 pF	GND	6 V	open

12. Package outline

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

SOT137-1

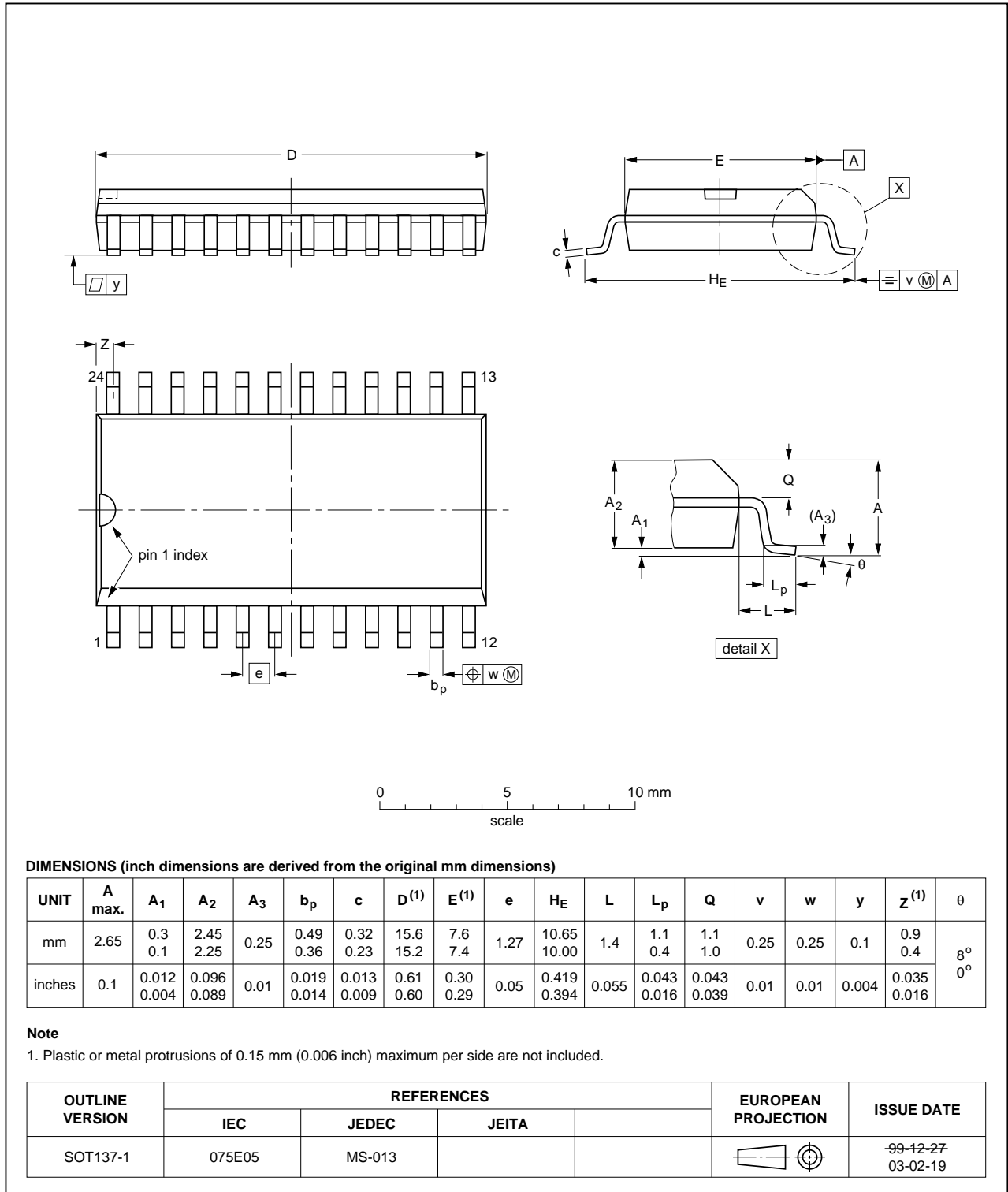


Fig 9. Package outline SOT137-1 (SO24)

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

SOT340-1

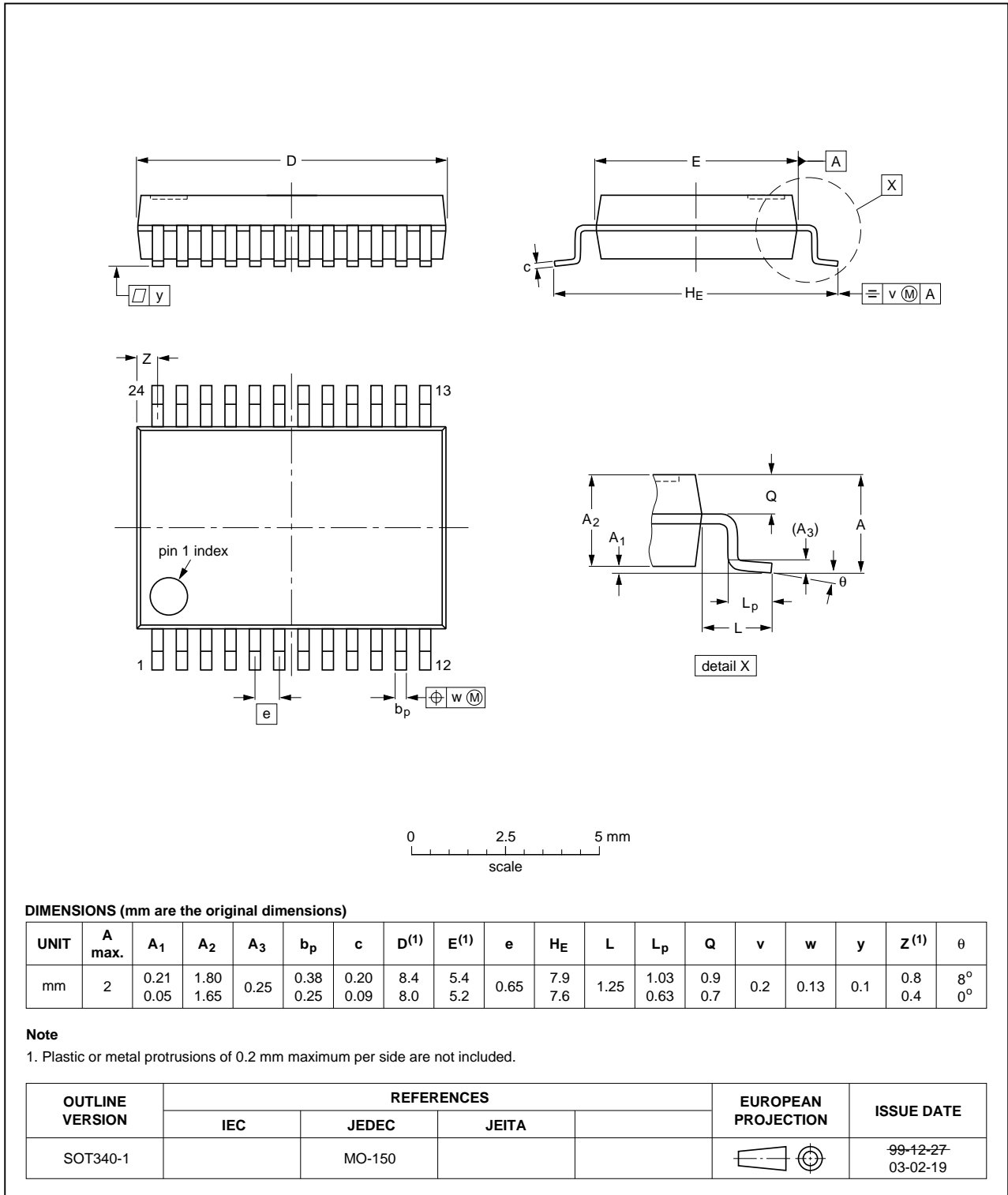


Fig 10. Package outline SOT340-1 (SSOP24)

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

SOT355-1

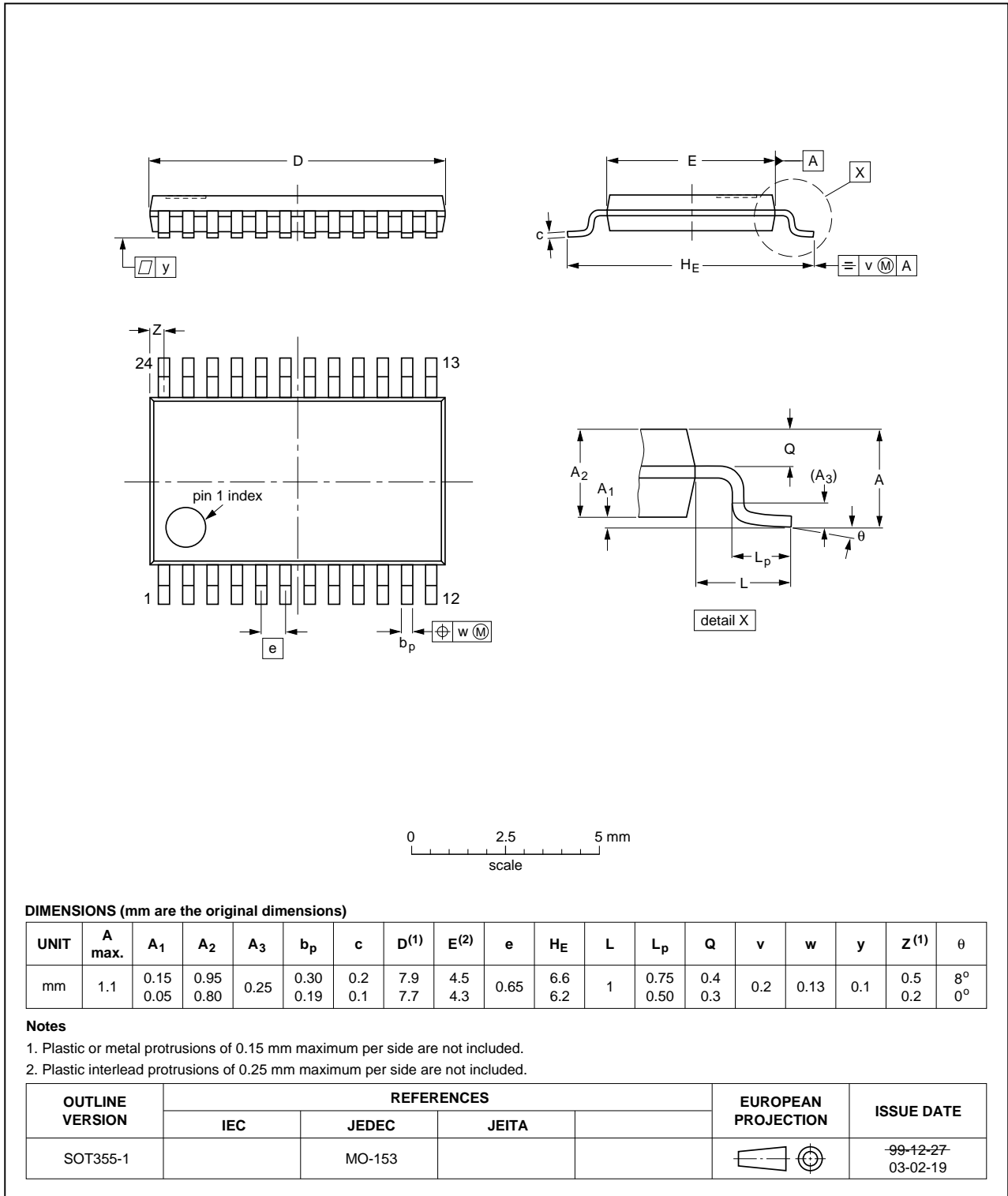


Fig 11. Package outline SOT355-1 (TSSOP24)

## 13. Abbreviations

Table 11. Abbreviations

Acronym	Description
BICMOS	Bipolar Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVT2952 v.4	20130911	Product data sheet	-	74LVT2952 v.3
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></ul>			
74LVT2952 v.3	20040907	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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## 17. Contents

<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>2</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>3</b>
5.1	Pinning .....	3
5.2	Pin description .....	4
<b>6</b>	<b>Functional description</b> .....	<b>4</b>
<b>7</b>	<b>Limiting values</b> .....	<b>5</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>5</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>6</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>7</b>
<b>11</b>	<b>Waveforms</b> .....	<b>8</b>
<b>12</b>	<b>Package outline</b> .....	<b>11</b>
<b>13</b>	<b>Abbreviations</b> .....	<b>14</b>
<b>14</b>	<b>Revision history</b> .....	<b>14</b>
<b>15</b>	<b>Legal information</b> .....	<b>15</b>
15.1	Data sheet status .....	15
15.2	Definitions .....	15
15.3	Disclaimers .....	15
15.4	Trademarks .....	16
<b>16</b>	<b>Contact information</b> .....	<b>16</b>
<b>17</b>	<b>Contents</b> .....	<b>17</b>

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