

# 74LVT16244B; 74LVTH16244B

3.3 V 16-bit buffer/driver; 3-state

Rev. 06 — 13 November 2008

Product data sheet

## 1. General description

The 74LVT16244B; 74LVTH16244B is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

This device is a 16-bit buffer and line driver featuring non-inverting 3-state bus outputs. The device can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer.

## 2. Features

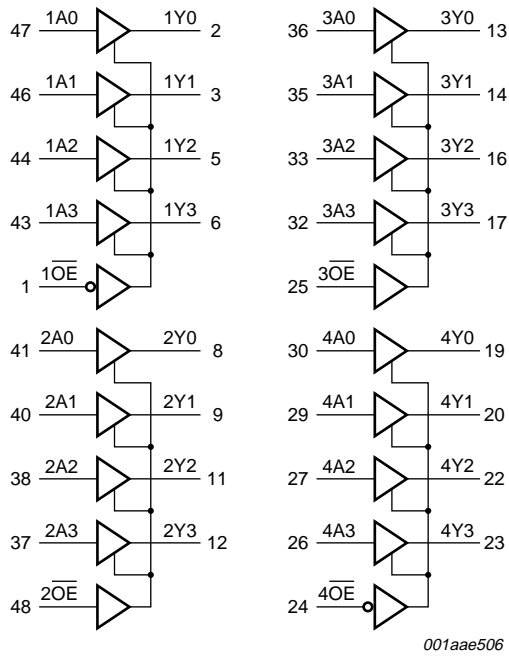
- 16-bit bus interface
- 3-state buffers
- Output capability: +64 mA and -32 mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus hold data inputs eliminate need for external pull-up resistors to hold unused inputs
- Power-up 3-state
- Live insertion and extraction permitted
- No bus current loading when output is tied to 5 V bus
- Latch-up protection
  - ◆ JESD78 Class II exceeds 500 mA
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

## 3. Ordering information

Table 1. Ordering information

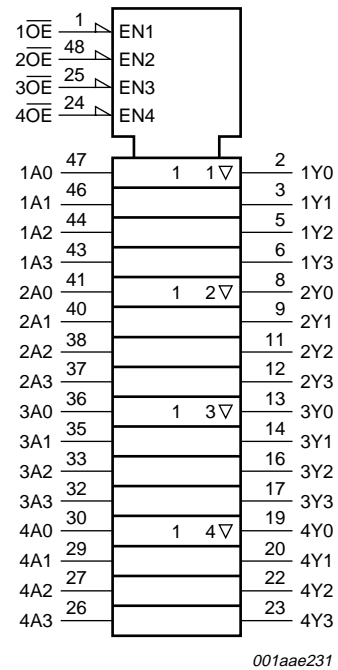
Type number	Package			
	Temperature range	Name	Description	Version
74LVT16244BDL 74LVTH16244BDL	-40 °C to +85 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74LVT16244BDGG 74LVTH16244BDGG	-40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVT16244BEV	-40 °C to +85 °C	VFBGA56	plastic very thin fine-pitch ball grid array package; 56 balls; body 4.5 × 7 × 0.65 mm	SOT702-1
74LVT16244BBQ 74LVTH16244BBQ	-40 °C to +125 °C	HUQFN60U	plastic thermal enhanced ultra thin quad flat package; no leads; 60 terminals; UTLF based; body 4 × 6 × 0.55 mm	SOT1025-1

## 4. Functional diagram



Pin numbers are shown for SSOP48 and TSSOP48 packages only.

**Fig 1. Logic symbol**

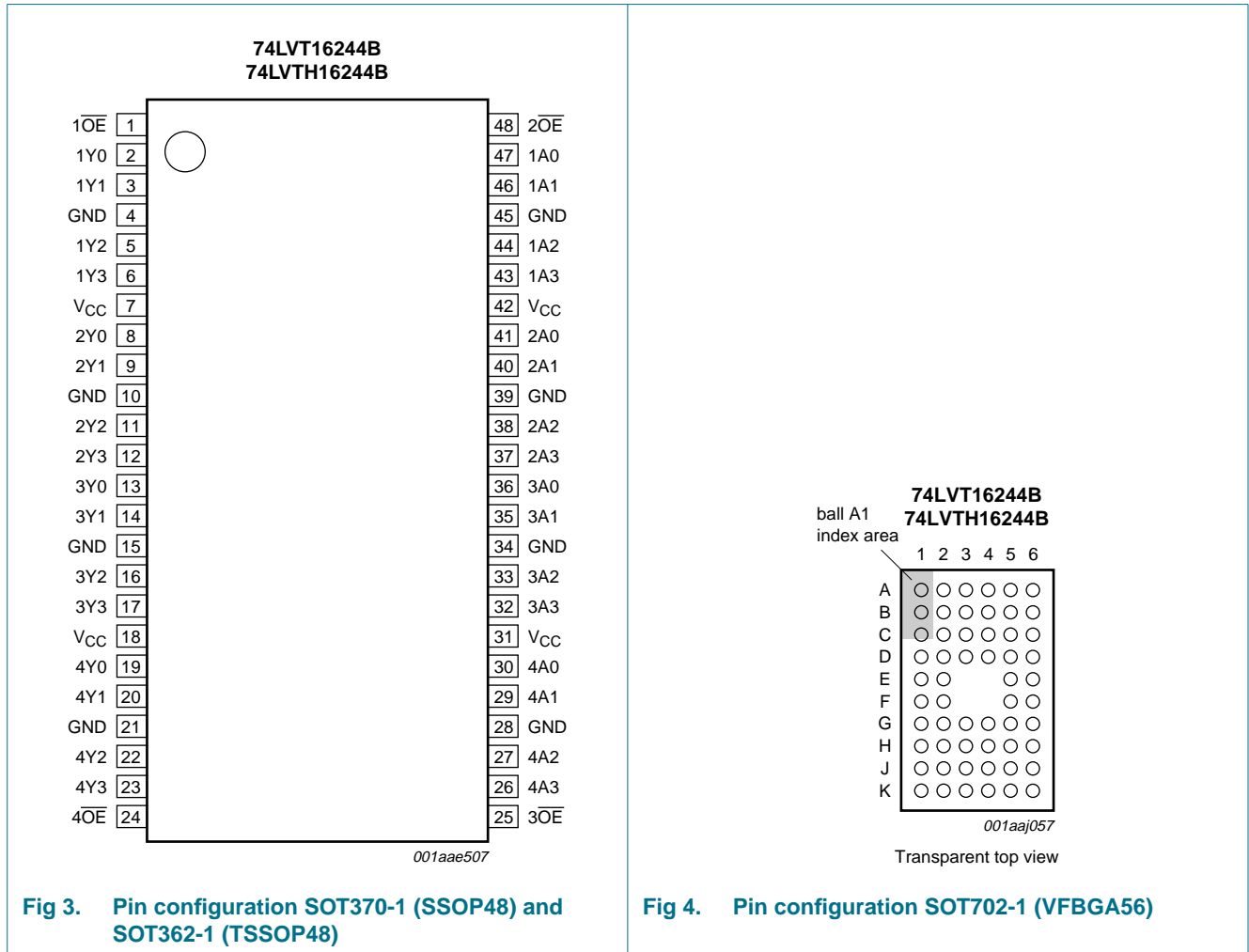


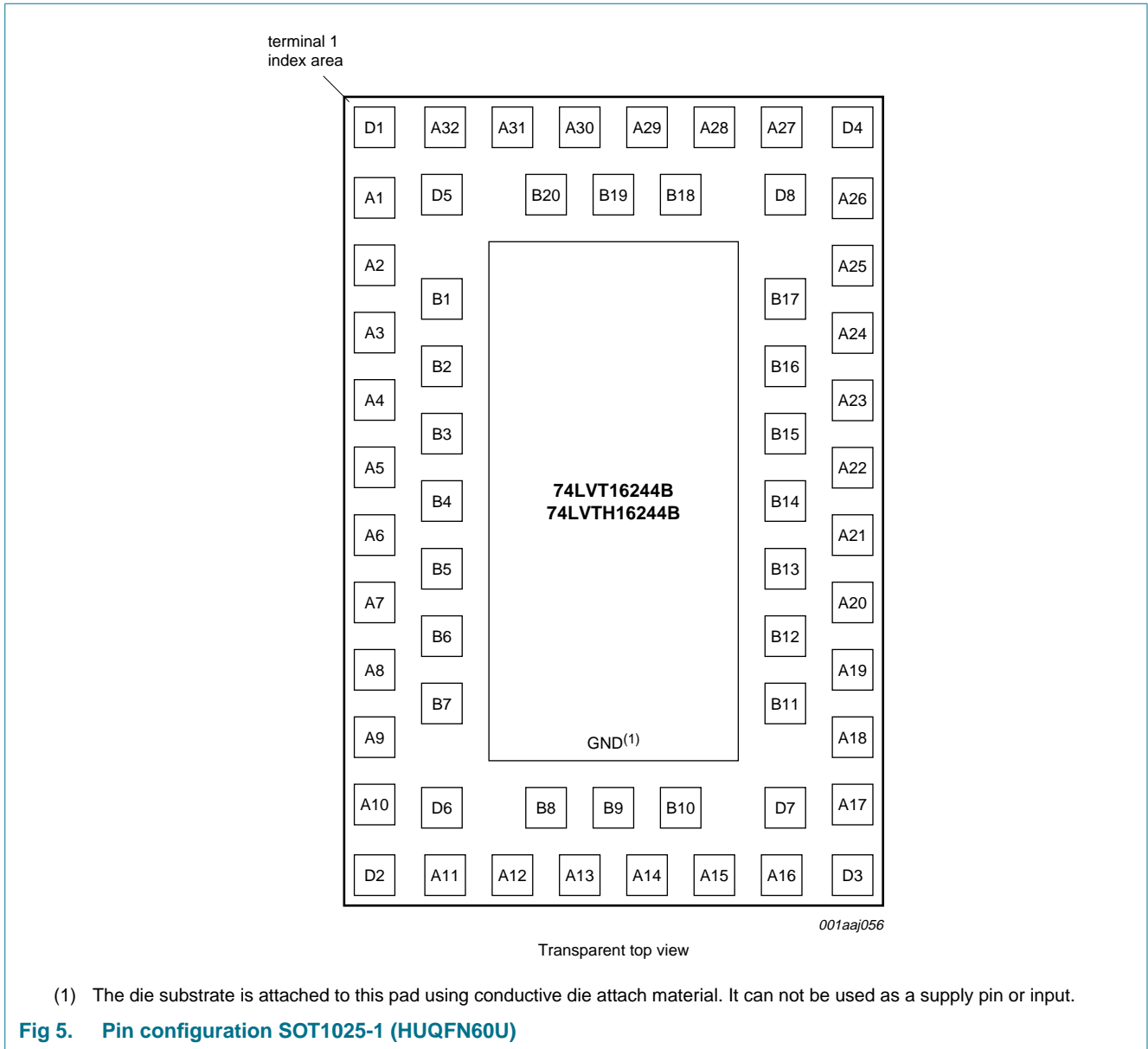
Pin numbers are shown for SSOP48 and TSSOP48 packages only.

**Fig 2. IEC logic symbol**

## 5. Pinning information

### 5.1 Pinning





## 5.2 Pin description

Table 2. Pin description

Symbol	Pin			Description
	SOT370-1 and SOT362-1	SOT702-1	SOT1025-1	
1OE, 2OE, 3OE, 4OE	1, 48, 25, 24	A1, A6, K6, K1	A30, A29, A14, A13	output enable input (active LOW)
1Y0 to 1Y3	2, 3, 5, 6	B2, B1, C2, C1	B20, A31, D5, D1	data output
2Y0 to 2Y3	8, 9, 11, 12	D2, D1, E2, E1	A2, B2, B3, A5	data output
3Y0 to 3Y3	13, 14, 16, 17	F1, F2, G1, G2	A6, B5, B6, A9	data output
4Y0 to 4Y3	19, 20, 22, 23	H1, H2, J1, J2	D2, D6, A12, B8	data output

Table 2. Pin description ...continued

Symbol	Pin			Description
	SOT370-1 and SOT362-1	SOT702-1	SOT1025-1	
GND	4, 10, 15, 21, 28, 34, 39, 45	B3, B4, D3, D4, G3, G4, J3, J4	A32, A3, A8, A11, A16, A19, A24, A27	ground (0 V)
V <sub>CC</sub>	7, 18, 31, 42	C3, C4, H3, H4	A1, A10, A17, A26	supply voltage
1A0 to 1A3	47, 46, 44, 43	B5, B6, C5, C6	B18, A28, D8, D4	data input
2A0 to 2A3	41, 40, 38, 37	D5, D6, E5, E6	A25, B16, B15, A22	data input
3A0 to 3A3	36, 35, 33, 32	F6, F5, G6, G5	A21, B13, B12, A18	data input
4A0 to 4A3	30, 29, 27, 26	H6, H5, J6, J5	D3, D7, A15, B10	data input
n.c.	-	A2, A3, A4, A5, K2, K3, K4, K5	A4, A7, A20, A23, B1, B4, B7, B9, B11, B14, B17, B19	not connected

## 6. Functional description

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

Control	Input	Output
$\overline{\text{nOE}}$	nAn	nYn
L	L	L
L	H	H
H	X	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; 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 <sub>CC</sub>	supply voltage		-0.5	+4.6	V
V <sub>I</sub>	input voltage		<sup>[1]</sup> -0.5	+7.0	V
V <sub>O</sub>	output voltage	output in OFF-state or HIGH-state	<sup>[1]</sup> -0.5	+7.0	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		<sup>[2]</sup> -	150	°C

**Table 4.** Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C;			
		(T)SSOP48 package	[3] -	500	mW
		VFBGA56 package	[4] -	1000	mW
		HUQFN60U package	[4] -	1000	mW

- [1] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
- [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.
- [3] Above 60 °C the value of P<sub>tot</sub> derates linearly with 5.5 mW/K.
- [4] Above 70 °C the value of P<sub>tot</sub> derates linearly with 1.8 mW/K.

## 8. Recommended operating conditions

**Table 5.** Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		2.7	-	3.6	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>IH</sub>	HIGH-level input voltage		2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage		-	-	0.8	V
I <sub>OH</sub>	HIGH-level output current		-32	-	-	mA
I <sub>OL</sub>	LOW-level output current	none	-	-	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	outputs enabled	-	-	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	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b> <sup>[1]</sup>						
V <sub>IK</sub>	input clamping voltage	V <sub>CC</sub> = 2.7 V; I <sub>IK</sub> = -18 mA	-1.2	-0.85	-	V
V <sub>OH</sub>	HIGH-level output voltage	I <sub>OH</sub> = -100 μA; V <sub>CC</sub> = 2.7 V to 3.6 V	V <sub>CC</sub> - 0.2	V <sub>CC</sub>	-	V
		I <sub>OH</sub> = -8 mA; V <sub>CC</sub> = 2.7 V	2.4	2.5	-	V
		I <sub>OH</sub> = -32 mA; V <sub>CC</sub> = 3.0 V	2.0	2.3	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>CC</sub> = 2.7 V				
		I <sub>OL</sub> = 100 μA	-	0.07	0.2	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
		I <sub>OL</sub> = 32 mA	-	0.3	0.5	V
I <sub>I</sub>	input leakage current	I <sub>OL</sub> = 64 mA	-	0.4	0.55	V
		all input pins; V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V	-	0.4	10	μA
		control pins; V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	0.1	±1.0	μA
		data pins; V <sub>CC</sub> = 3.6 V	<sup>[2]</sup>			
		V <sub>I</sub> = V <sub>CC</sub>	-	0.1	1	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> = 0 V	-	-0.4	-5	μA
		V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V	-	0.1	±100	μA
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	<sup>[3]</sup> 75	135	-	μA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 2.0 V	-	-135	-75	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	nAn input; V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = 3.6 V	500	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	nAn input; V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = 3.6 V	-	-	-500	μA
I <sub>HOLD</sub>	bus hold current data input	V <sub>CC</sub> = 3 V	<sup>[3]</sup>			
		V <sub>I</sub> = 0.8 V	75	135	-	μA
		V <sub>I</sub> = 2.0 V	-	-135	-75	μA
		V <sub>CC</sub> = 0 V to 3.6 V				
I <sub>LO</sub>	output leakage current	V <sub>I</sub> = 3.6 V	±500	-	-	μA
		output in HIGH-state when V <sub>O</sub> > V <sub>CC</sub> ; V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.0 V	-	50	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> ; n $\overline{OE}$ = don't care	<sup>[4]</sup> -	1	±100	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		output HIGH: V <sub>O</sub> = 3.0 V	-	0.5	5	μA
		output LOW: V <sub>O</sub> = 0.5 V	-	+0.5	-5	μA

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 A					
		output HIGH	-	0.07	0.12	mA	
		output LOW	-	4.0	6.0	mA	
		outputs disabled	[5]	-	0.07	0.12	mA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V; one input at V <sub>CC</sub> - 0.6 V other inputs at V <sub>CC</sub> or GND	[6]	-	0.1	0.2	mA
C <sub>I</sub>	input capacitance	V <sub>I</sub> = 0 V or 3.0 V	-	3	-	pF	
C <sub>O</sub>	output capacitance	outputs disabled; V <sub>O</sub> = 0 V or 3.0 V	-	9	-	pF	

- [1] Typical values are measured at V<sub>CC</sub> = 3.3 V and at T<sub>amb</sub> = 25 °C.
- [2] Unused pins at V<sub>CC</sub> or GND.
- [3] This is the bus hold overdrive current required to force the input to the opposite logic state.
- [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 μs is permitted. This parameter is valid for T<sub>amb</sub> = 25 °C only.
- [5] I<sub>CC</sub> is measured with outputs pulled to V<sub>CC</sub> or GND.
- [6] This 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 7. Dynamic characteristics**

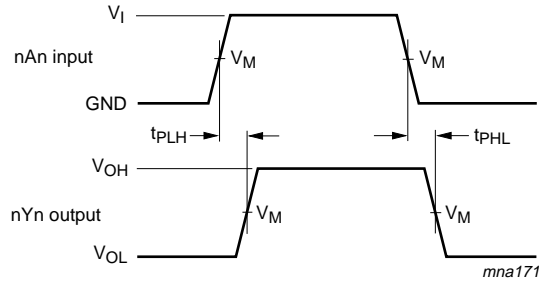
Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>						
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	nAn to nYn; see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 2.7 V	-	-	4.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	1.8	3.2	ns
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	nAn to nYn; see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 2.7 V	-	-	4.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	1.7	3.2	ns
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	n $\overline{O}E$ to nYn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	5.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.3	4.0	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay	n $\overline{O}E$ to nYn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	5.3	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.1	4.0	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	n $\overline{O}E$ to nYn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	5.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.2	4.5	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	n $\overline{O}E$ to nYn; see <a href="#">Figure 7</a>				
		V <sub>CC</sub> = 2.7 V	-	-	4.4	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.9	4.0	ns

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

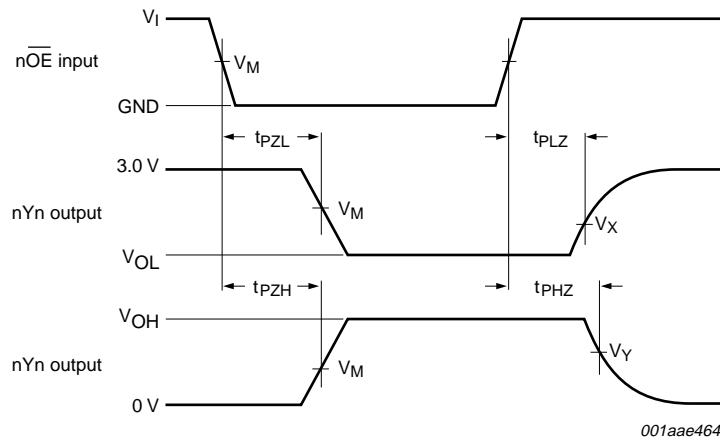


11. Waveforms



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

**Fig 6. Propagation delay input (nAn) to output (nYn)**

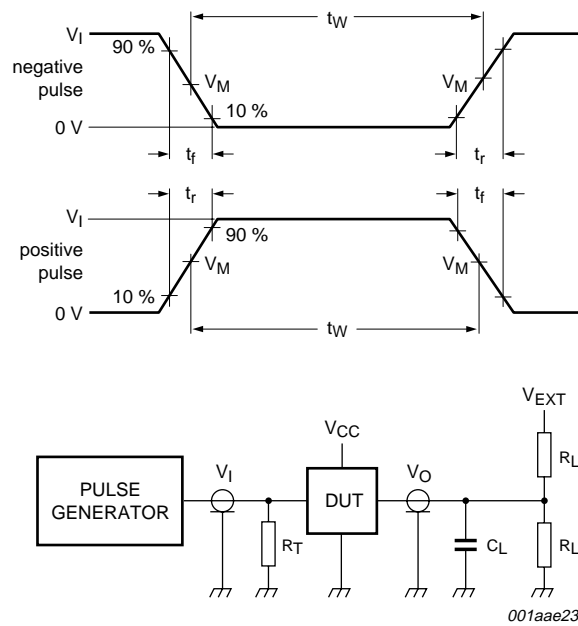


Measurements points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 7. 3-state output enable and disable times**

**Table 8. Measurement points**

Input	Output		
$V_M$	$V_M$	$V_X$	$V_Y$
1.5 V	1.5 V	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$



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

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. Load circuit for measuring switching times**

**Table 9. Test data**

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

12. Package outline

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1

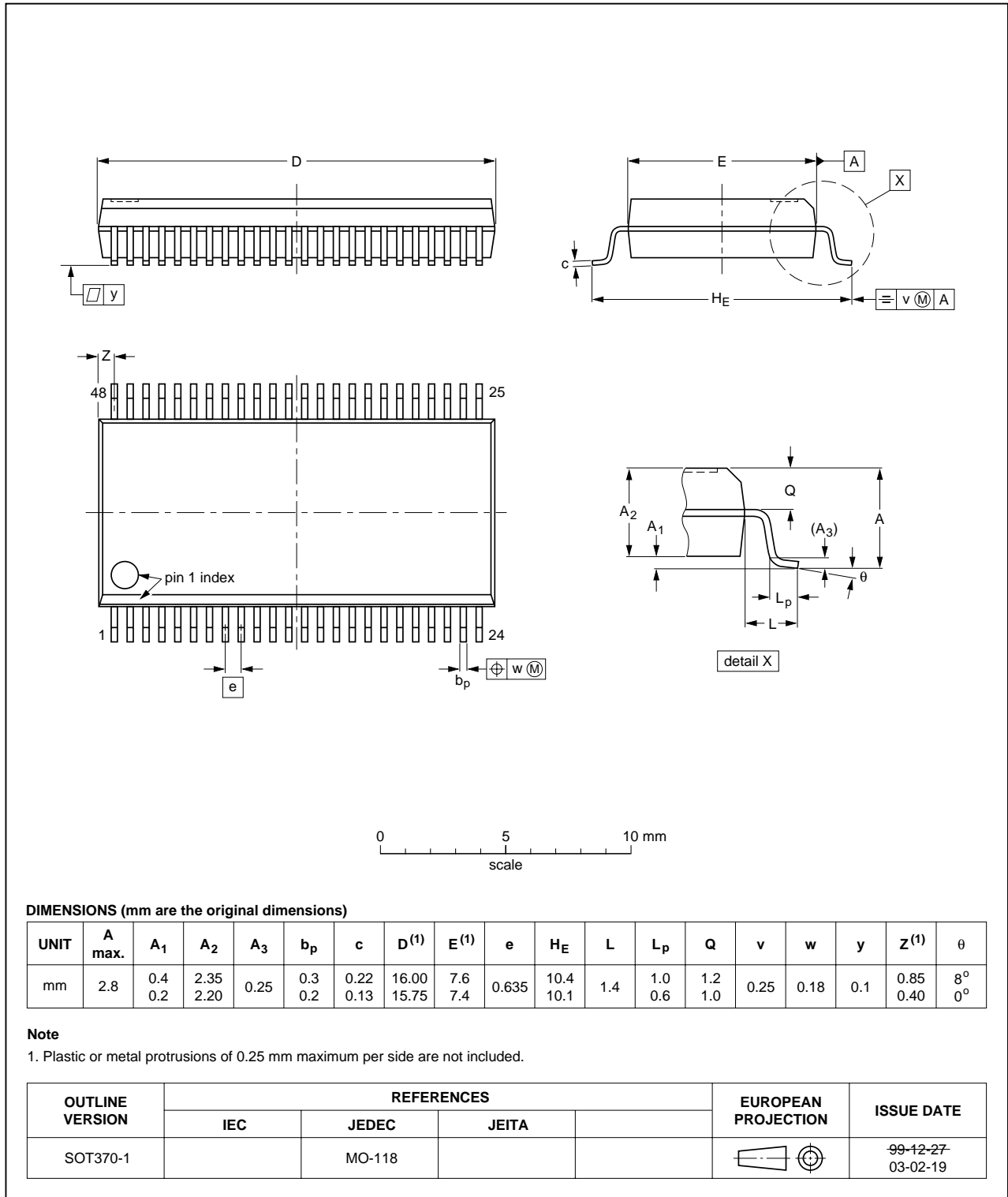


Fig 9. Package outline SOT370-1 (SSOP48)

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm

SOT362-1

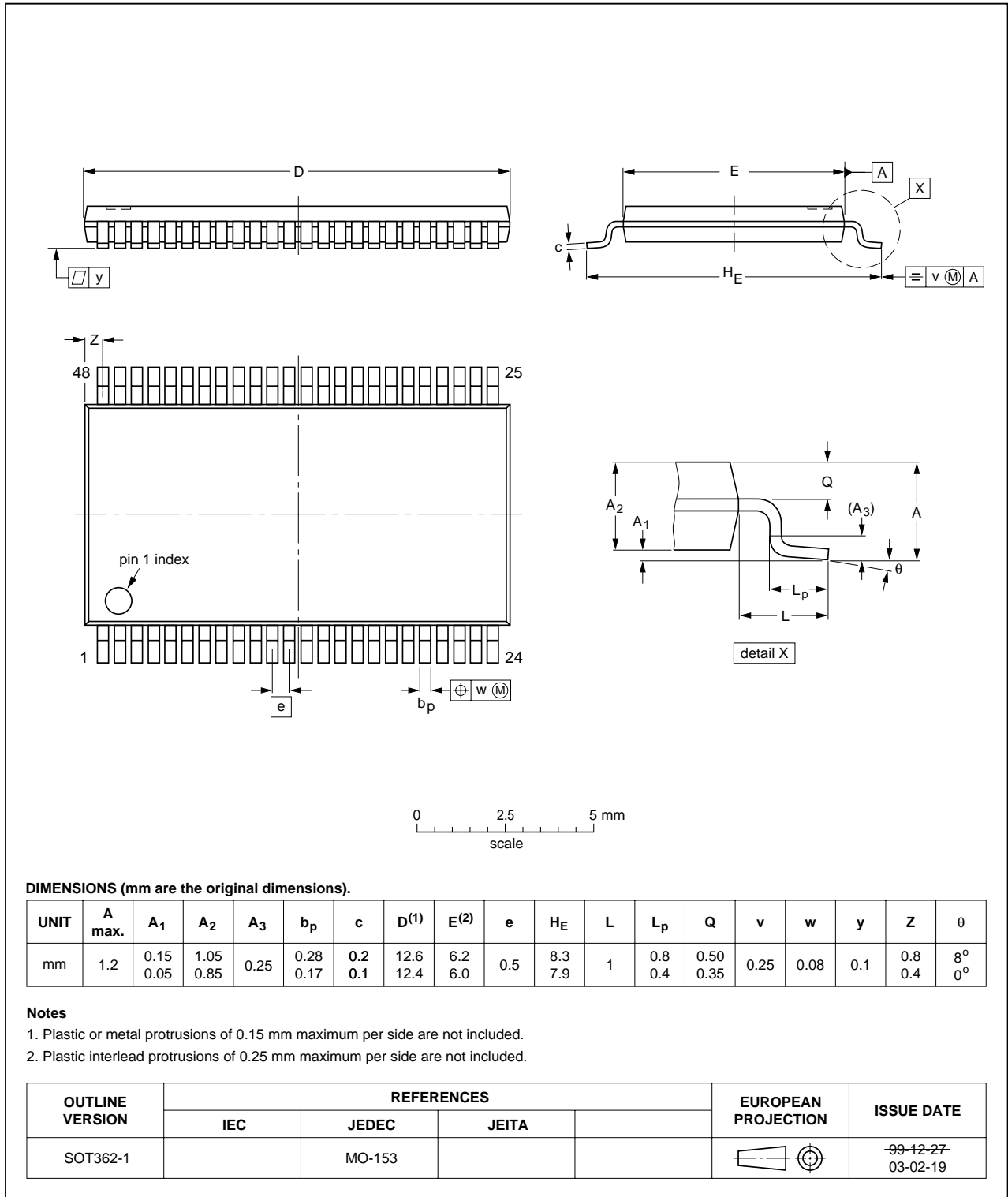
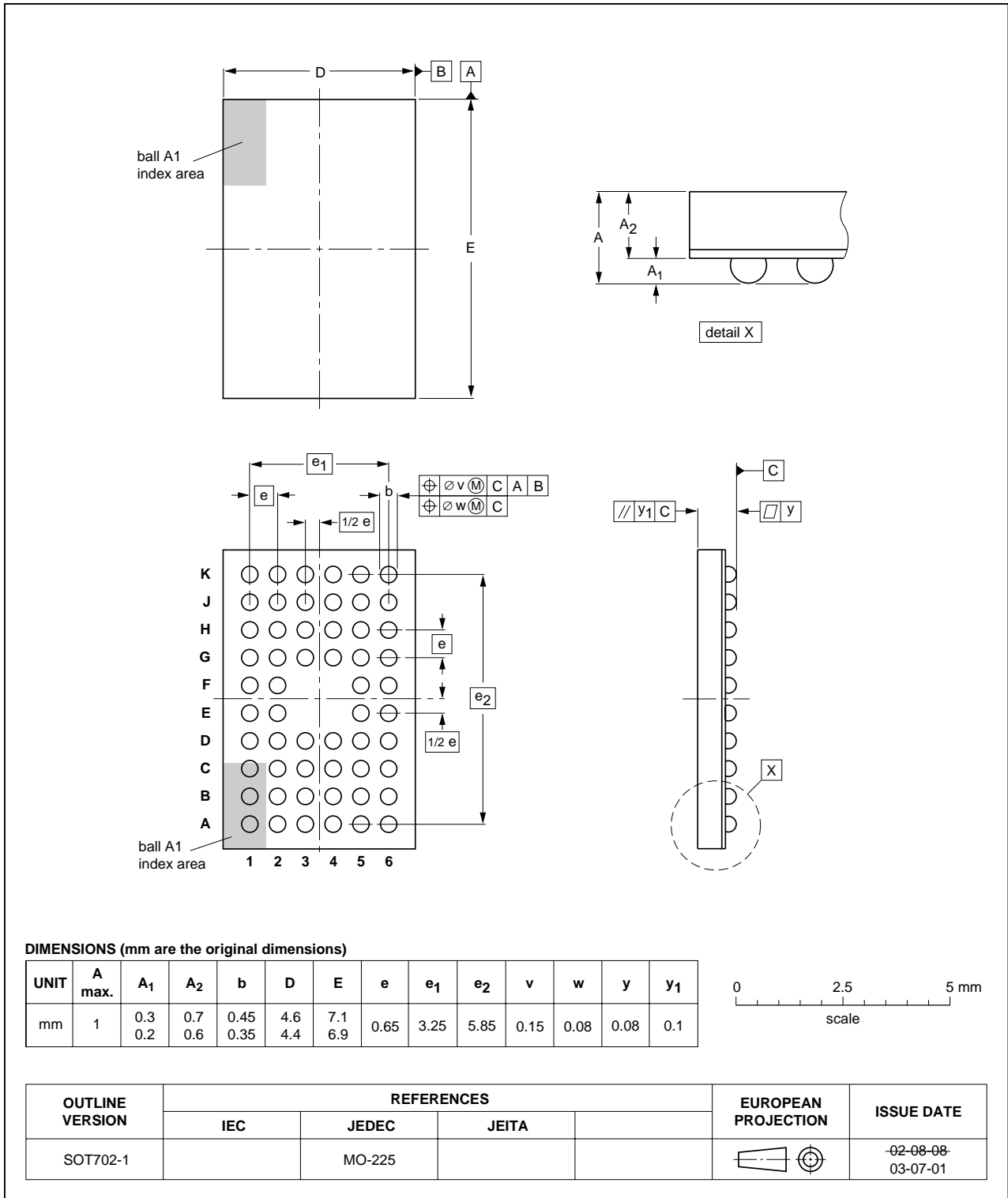


Fig 10. Package outline SOT362-1 (TSSOP48)

**VFPGA56: plastic very thin fine-pitch ball grid array package; 56 balls; body 4.5 x 7 x 0.65 mm**

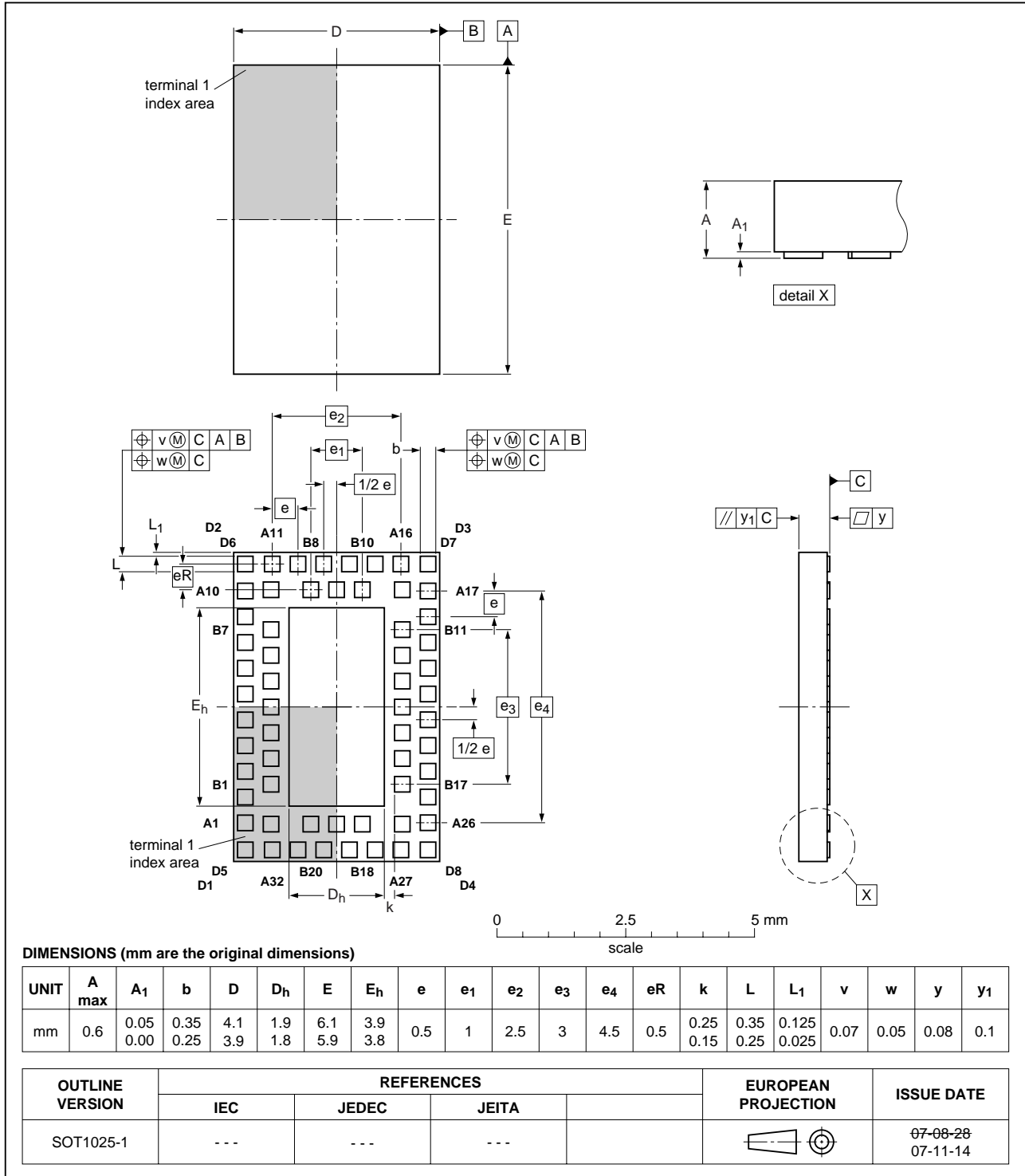
**SOT702-1**



**Fig 11. Package outline SOT702-1 (VFPGA56)**

**HUQFN60U: plastic thermal enhanced ultra thin quad flat package; no leads**  
**60 terminals; UTLP based; body 4 x 6 x 0.55 mm**

**SOT1025-1**



**Fig 12. Package outline SOT1025-1 (HUQFN60U)**

## 13. Abbreviations

Table 10. 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 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVT_LVTH16244B_6	20081113	Product data sheet	-	74LVT_LVTH16244B_5
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>Added type number 74LVT16244BBQ and 74LVTH16244BBQ (HUQFN60U package)</li> </ul>			
74LVT_LVTH16244B_5	20060321	Product data sheet	-	74LVT16244B_4
74LVT16244B_4	20021031	Product specification	-	74LVT16244B_3
74LVT16244B_3	19981007	Product specification	-	74LVT16244B_2
74LVT16244B_2	19980219	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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