

# 74LVT16245B; 74LVTH16245B

3.3 V 16-bit transceiver; 3-state

Rev. 07 — 29 March 2010

Product data sheet

## 1. General description

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The 74LVT16245B; 74LVTH16245B is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

This device is a 16-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The control function implementation minimizes external timing requirements. The device features an output enable input ( $\overline{nOE}$ ) for easy cascading and a direction input ( $nDIR$ ) for direction control.

## 2. Features and benefits

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- 16-bit bidirectional 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
- Live insertion and extraction permitted
- Power-up 3-state
- No bus current loading when output is tied to 5 V bus
- Latch-up protection:
  - ◆ JESD78B Class II exceeds 500 mA
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

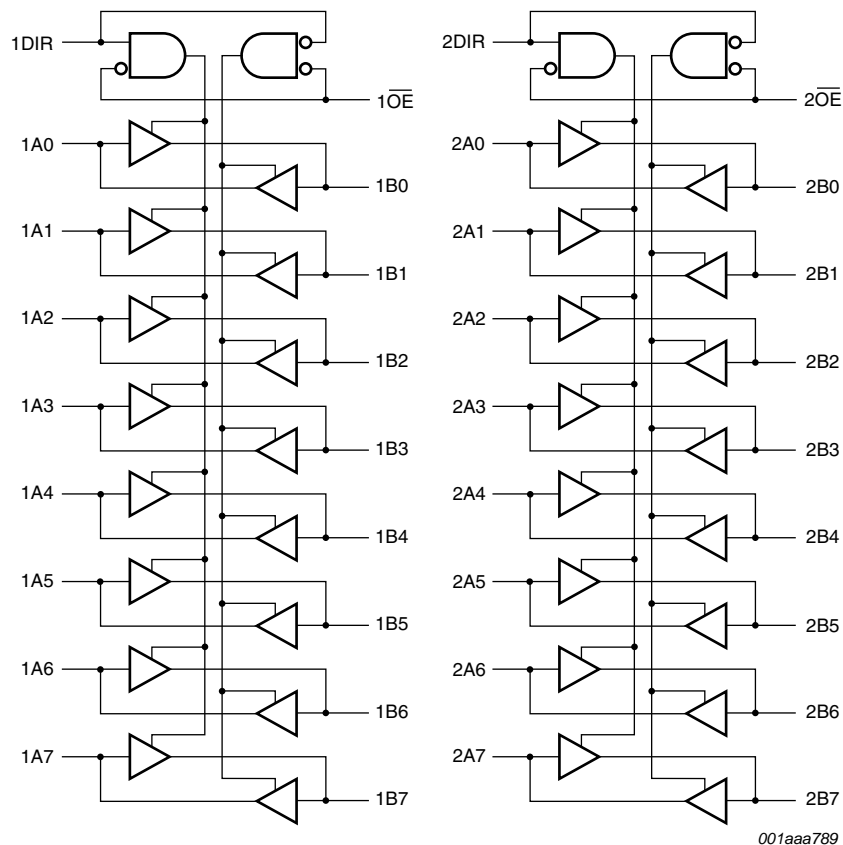


## 3. Ordering information

Table 1. Ordering information

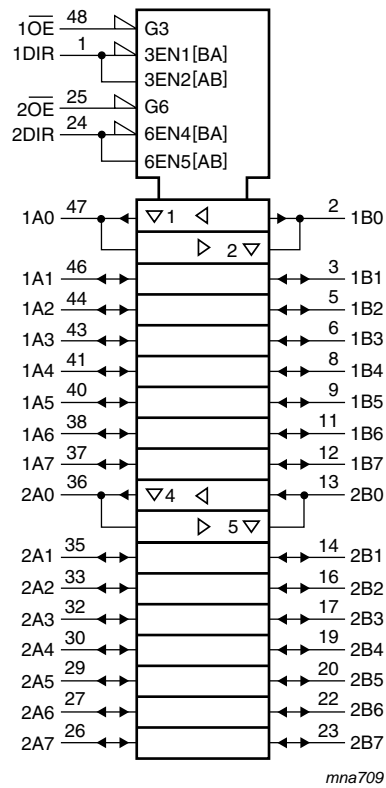
Type number	Package			Version
	Temperature range	Name	Description	
74LVT16245BDL 74LVTH16245BDL	-40 °C to +85 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74LVT16245BDGG 74LVTH16245BDGG	-40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVT16245BEV	-40 °C to +85 °C	VFPGA56	plastic very thin fine-pitch ball grid array package; 56 balls; body 4.5 × 7 × 0.65 mm	SOT702-1
74LVT16245BBQ 74LVTH16245BBQ	-40 °C to +85 °C	HXQFN60U	plastic thermal enhanced extremely thin quad flat package; no leads; 60 terminals; UTLP based; body 4 × 6 × 0.5 mm	SOT1134-1

## 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

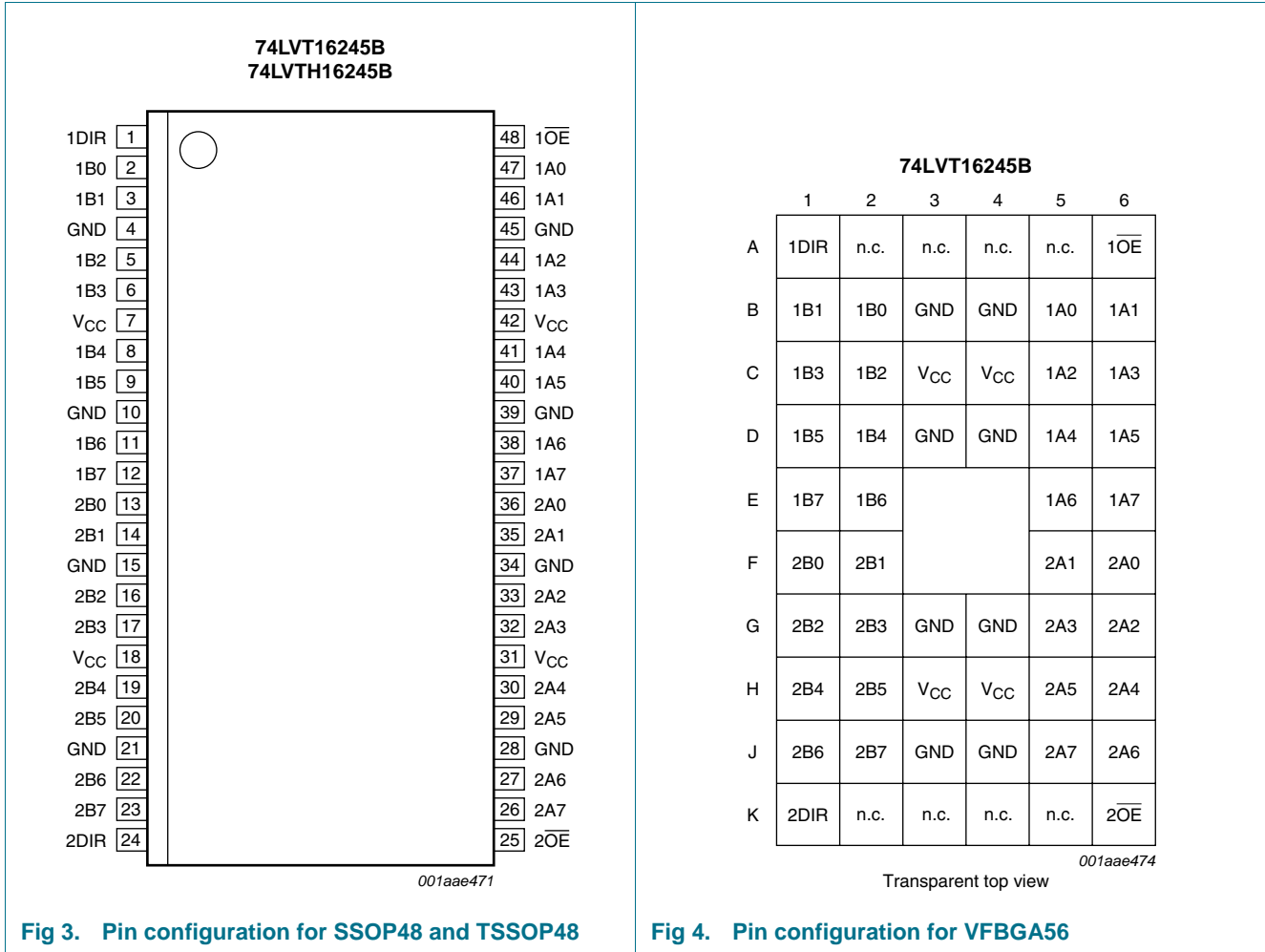
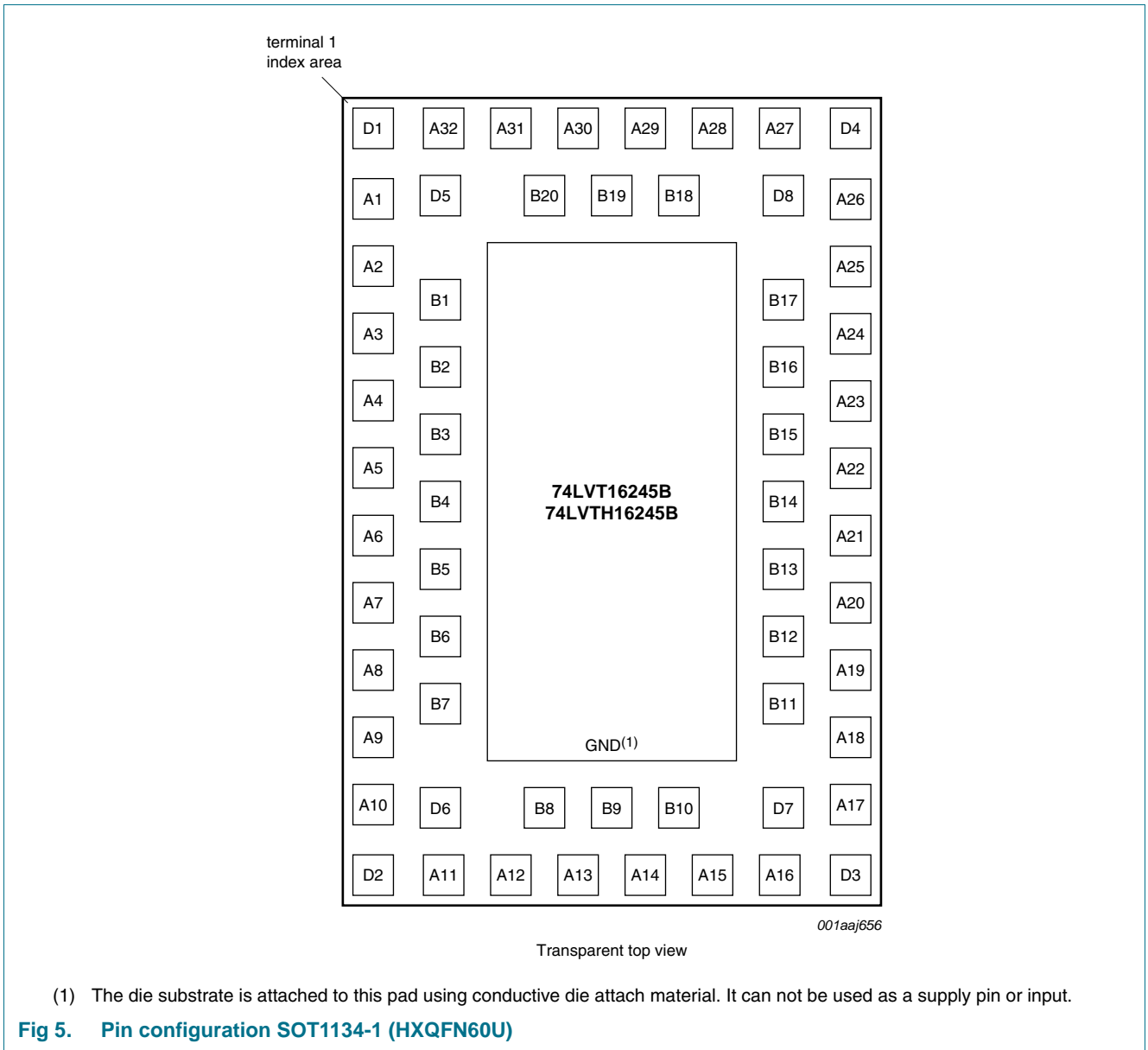


Fig 3. Pin configuration for SSOP48 and TSSOP48

Fig 4. Pin configuration for VFBGA56



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin			Description
	SOT370-1 and SOT362-1	SOT702-1	SOT1134-1	
1DIR, 2DIR	1, 24	A1, K1	A30, A13	direction control input
1B0 to 1B7	2, 3, 5, 6, 8, 9, 11, 12	B2, B1, C2, C1, D2, D1, E2, E1	B20, A31, D5, D1, A2, B2, B3, A5	data input/output
2B0 to 2B7	13, 14, 16, 17, 19, 20, 22, 23	F1, F2, G1, G2, H1, H2, J1, J2	A6, B5, B6, A9, D2, D6, A12, B8	data input/output
GND	4, 10, 15, 21, 28, 34, 39, 45	B3, D3, G3, J3, J4, G4, D4, B4	A32, A3, A8, A11, A16, A19, A24, A27	ground (0 V)
V <sub>CC</sub>	7, 18, 31, 42	C3, H3, H4, C4	A1, A10, A17, A26	supply voltage
1OE, 2OE	48, 25	A6, K6	A29, A14	output enable input (active LOW)
2A0 to 2A7	36, 35, 33, 32, 30, 29, 27, 26	F6, F5, G6, G5, H6, H5, J6, J5	A21, B13, B12, A18, D3, D7, A15, B10	data input/output
1A0 to 1A7	47, 46, 44, 43, 41, 40, 38, 37	B5, B6, C5, C6, D5, D6, E5, E6	B18, A28, D8, D4, A25, B16, B15, A22	data input/output
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

### 6.1 Function table

Table 3. Function table [1]

Control		Input/output	
nOE	nDIR	nAn	nBn
L	L	output nAn = nBn	input
L	H	input	output nBn = nAn
H	X	Z	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		[1] -0.5	+7.0	V
V <sub>O</sub>	output voltage	output in OFF-state or HIGH-state	[1] -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		[2] -	150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +85 °C;			
		(T)SSOP48 package	[3] -	500	mW
		VFBGA56 package	[4] -	1000	mW
		HXQFN60U 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> [1]						
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	control pins				
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	0.1	±1	μA
		V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V	-	0.1	10	μA
		input/output data pins; V <sub>CC</sub> = 3.6 V	[2]			
		V <sub>I</sub> = 5.5 V	-	0.1	20	μA
		V <sub>I</sub> = V <sub>CC</sub>	-	0.5	10	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	-	0.1	±100	μA
		V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	[3]	75	135	μA
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	[3]	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>I</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V	500	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	nAn input; V <sub>I</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V	-	-	-500	μA
I <sub>LO</sub>	output leakage current	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	-	75	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	[4]	-	40	±100 μA
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				
		outputs HIGH	-	0.07	0.12	mA
		outputs LOW	-	4.7	6.0	mA
		outputs disabled	[5]	-	0.07	0.12
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	pins nDIR and n $\overline{OE}$ , V <sub>O</sub> = 0 V or 3.0 V	-	3	-	pF



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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iO(off)}$	off-state input/output capacitance	pins nAn and nBn, outputs disabled; $V_O = GND$ or $V_{CC}$	-	9	-	pF

[1] Typical values are measured at  $V_{CC} = 3.3$  V and at  $T_{amb} = 25$  °C.[2] Unused pins at  $V_{CC}$  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  $V_{CC}$  between 0 V and 1.2 V with a transition time of up to 10 ms. From  $V_{CC} = 1.2$  V to  $V_{CC} = 3.3$  V  $\pm$  0.3 V a transition time of 100  $\mu$ s is permitted. This parameter is valid for  $T_{amb} = 25$  °C only.[5]  $I_{CC}$  is measured with outputs pulled to  $V_{CC}$  or GND.[6] This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND.

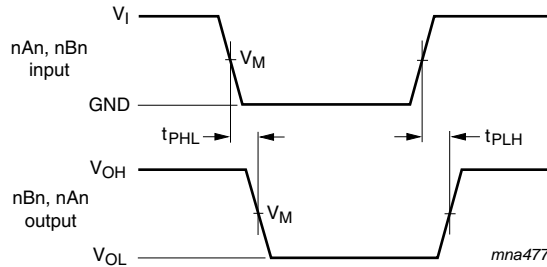
## 10. Dynamic characteristics

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

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b>						
$t_{PLH}$	LOW to HIGH propagation delay	nAn to nBn or nBn to nAn; see <a href="#">Figure 6</a>				
		$V_{CC} = 2.7$ V	-	-	3.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	1.9	3.3	ns
$t_{PHL}$	HIGH to LOW propagation delay	nAn to nBn or nBn to nAn; see <a href="#">Figure 6</a>				
		$V_{CC} = 2.7$ V	-	-	3.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	1.7	3.3	ns
$t_{PZH}$	OFF-state to HIGH propagation delay	$\overline{nOE}$ to nAn or nBn; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.7$ V	-	-	5.3	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	2.8	4.5	ns
$t_{PZL}$	OFF-state to LOW propagation delay	$\overline{nOE}$ to nAn or nBn; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.7$ V	-	-	5.1	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	2.8	4.1	ns
$t_{PHZ}$	HIGH to OFF-state propagation delay	$\overline{nOE}$ to nAn or nBn; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.7$ V	-	-	5.7	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.5	3.2	5.1	ns
$t_{PLZ}$	LOW to OFF-state propagation delay	$\overline{nOE}$ to nAn or nBn; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.7$ V	-	-	4.6	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.5	3.0	4.6	ns

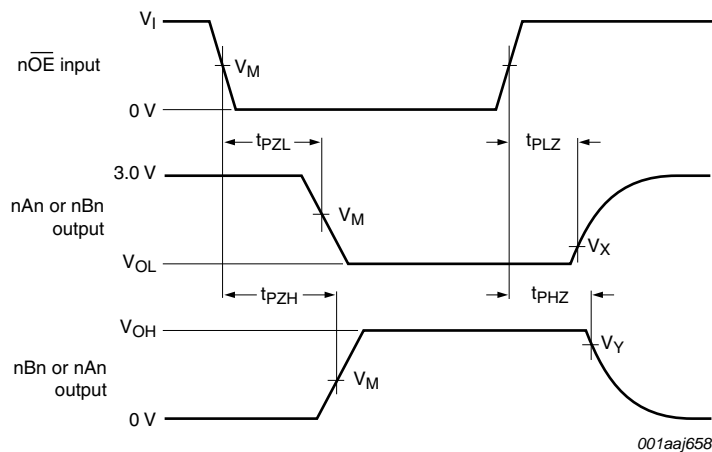
[1] All typical values are at  $V_{CC} = 3.3$  V and  $T_{amb} = 25$  °C.

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, nBn) to output (nBn, nAn)**

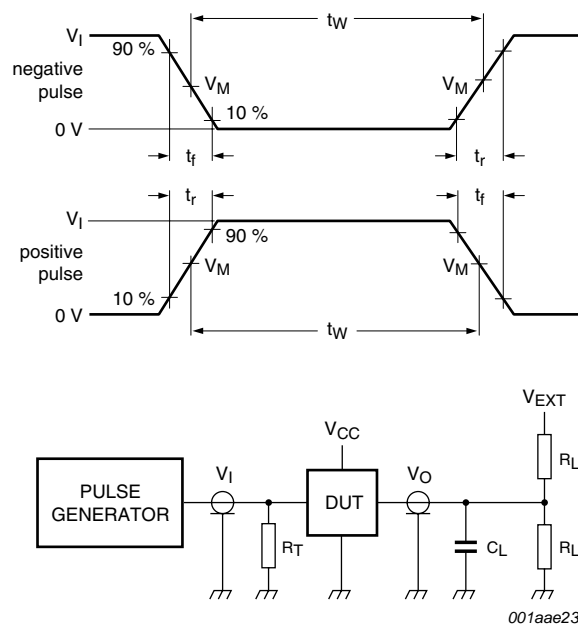


Measurements points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**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. Test 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

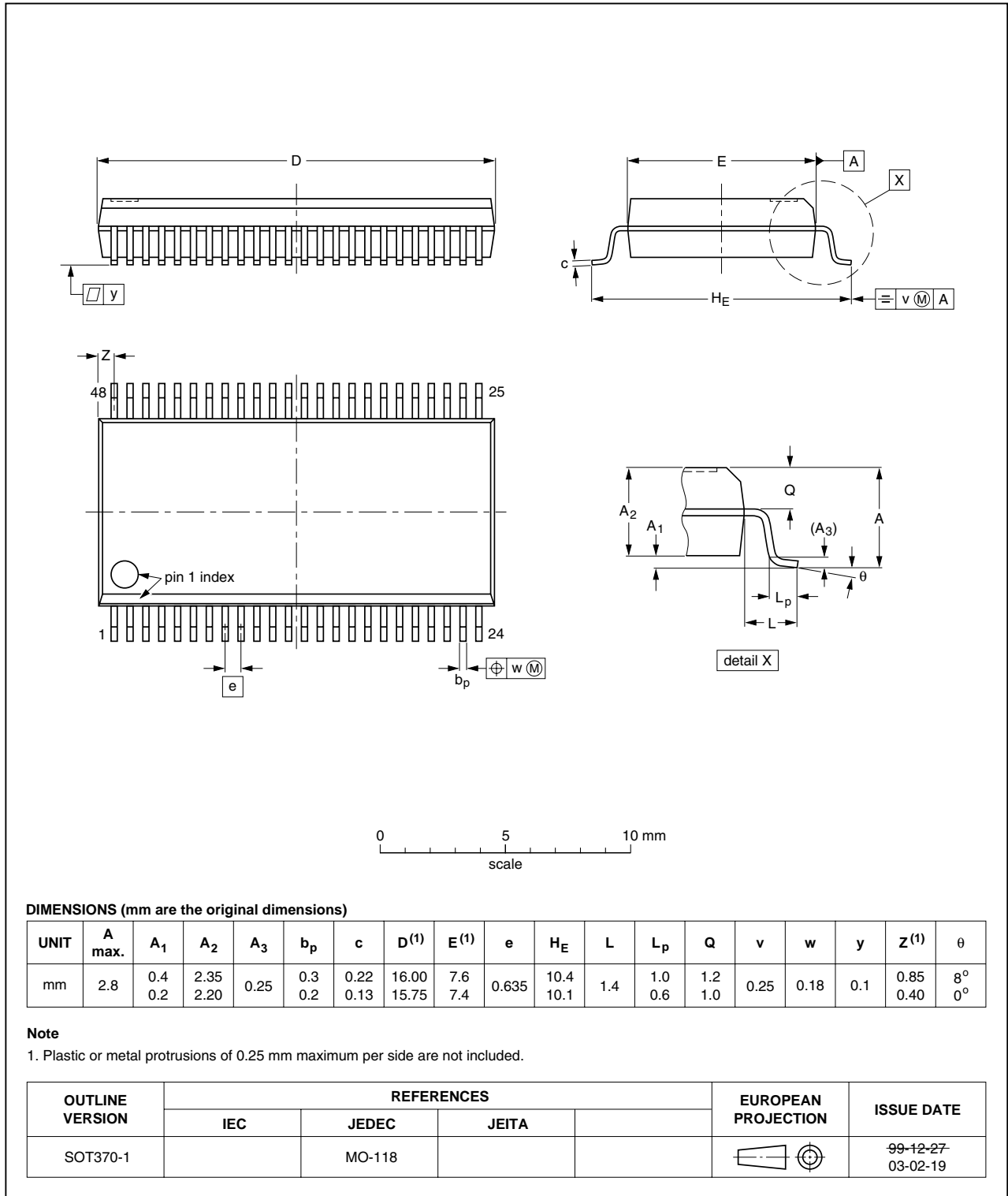


Fig 9. Package outline SOT370-1 (SSOP48)

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

SOT362-1

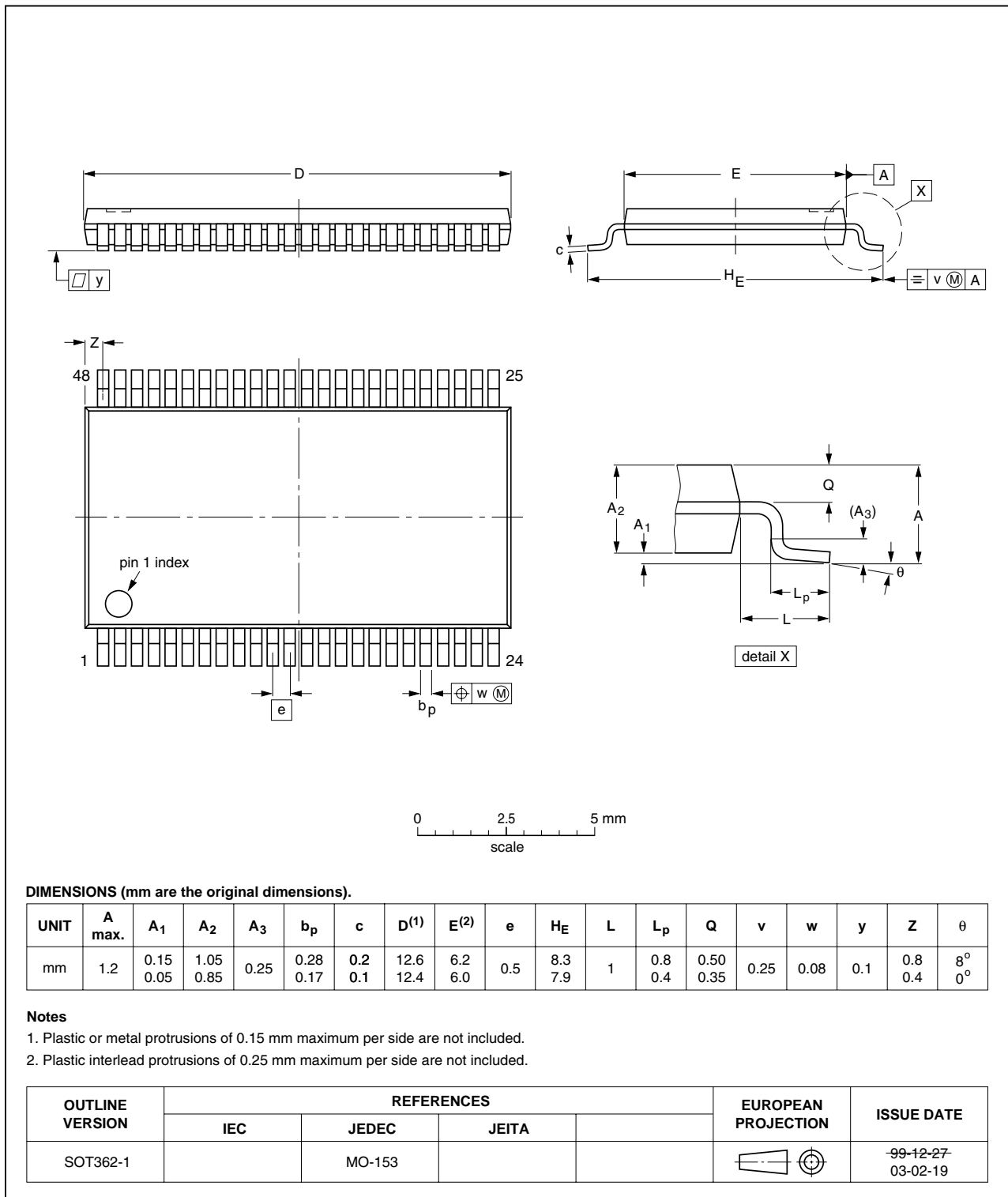
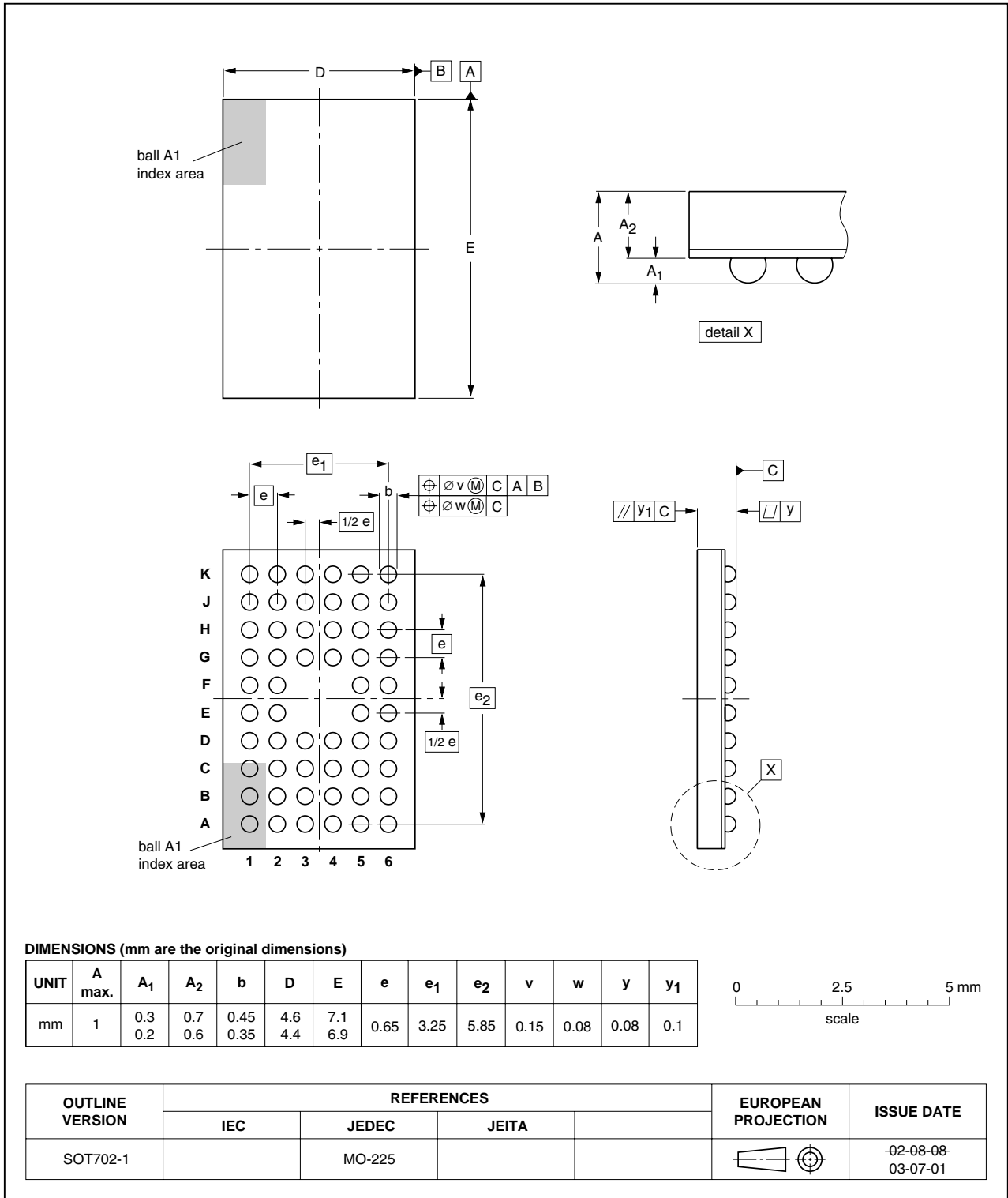


Fig 10. Package outline SOT362-1 (TSSOP48)

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

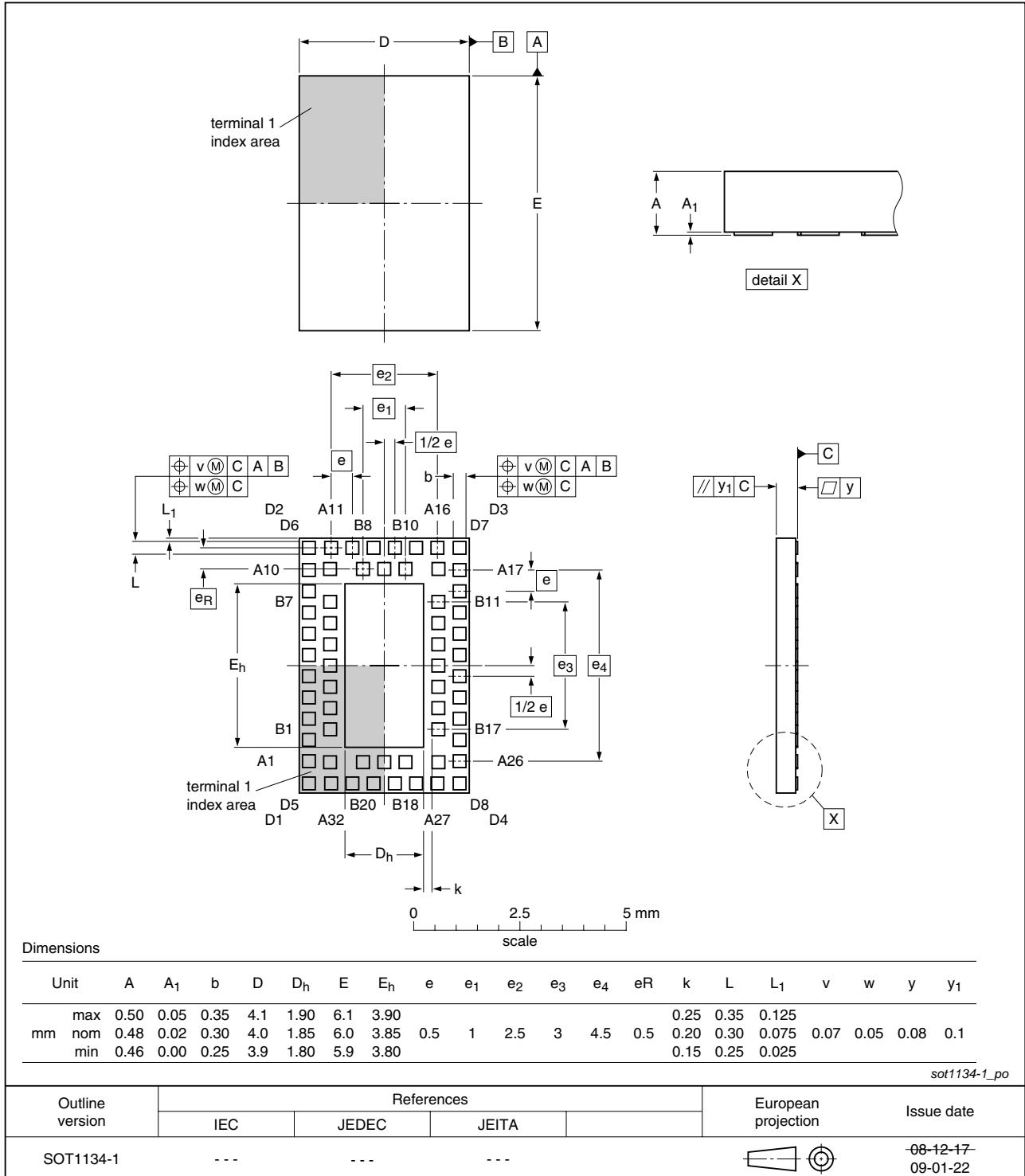
**SOT702-1**



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

**HXQFN60U: plastic thermal enhanced extremely thin quad flat package; no leads;**  
**60 terminals; UTLP based; body 4 x 6 x 0.5 mm**

**SOT1134-1**



**Fig 12. Package outline SOT1134-1 (HXQFN60U)**

## 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_LVTH16245B_7	20100329	Product data sheet	-	74LVT_LVTH16245B_6
Modifications:	<ul style="list-style-type: none"> <li>74LVT16245BBQ and 74LVTH16245BBQ changed from HUQFN60U (SOT1025-1) to HXQFN60U (SOT1134-1) package.</li> </ul>			
74LVT_LVTH16245B_6	20090409	Product data sheet	-	74LVT_LVTH16245B_5
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 2</a>: Class II added for latch-up protection.</li> <li><a href="#">Table 6</a>: Conditions for bus hold overdrive current have changed.</li> </ul>			
74LVT_LVTH16245B_5	20090312	Product data sheet	-	74LVT_LVTH16245B_4
74LVT_LVTH16245B_4	20060323	Product data sheet	-	74LVT16245B_3
74LVT16245B_3	20021031	Product data sheet	-	74LVT16245B_2
74LVT16245B_2	19980219	Product specification	-	74LVT16245B_1
74LVT16245B_1	19940523	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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**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

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