

# 74LVTH32245

3.3 V 32-bit bus transceiver; 3-state

Rev. 01 — 23 January 2008

Product data sheet

## 1. General description

The 74LVTH32245 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V. The 74LVTH32245 is a 32-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The device features four output enable ( $n\overline{OE}$ ) inputs for easy cascading and four send/receive ( $n\overline{DIR}$ ) inputs for direction control. Pin  $n\overline{OE}$  controls the outputs so that the buses are effectively isolated. Bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

## 2. Features

- 32-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:
  - ◆ JESD78 Class II level A 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			Version
	Temperature range	Name	Description	
74LVTH32245EC	-40 °C to +85 °C	LFPGA96	plastic low profile fine-pitch ball grid array package; 96 balls; body 13.5 × 5.5 × 1.05 mm	SOT536-1

4. Functional diagram

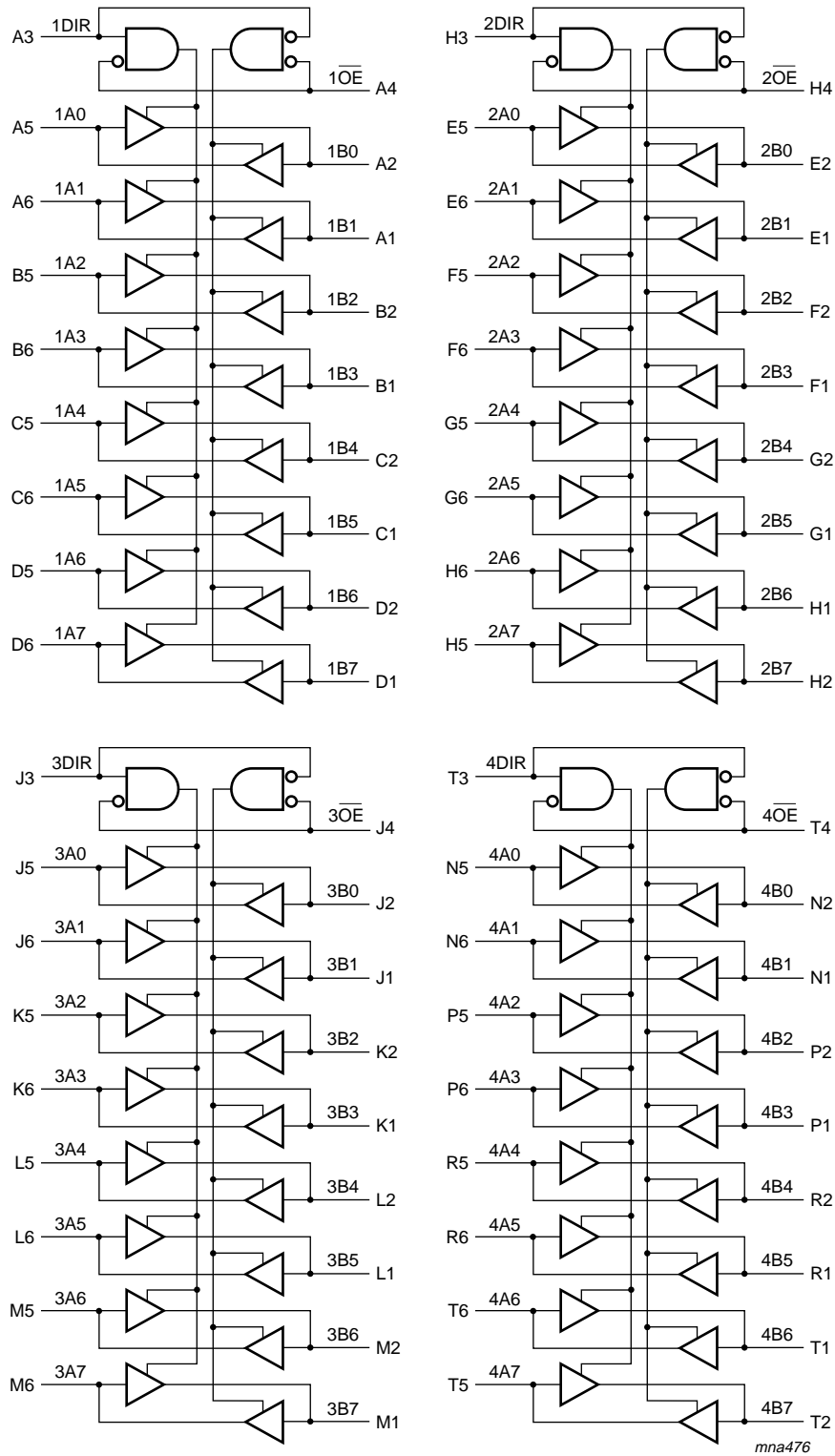


Fig 1. Logic symbol

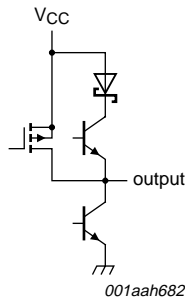


Fig 2. Schematic of each output

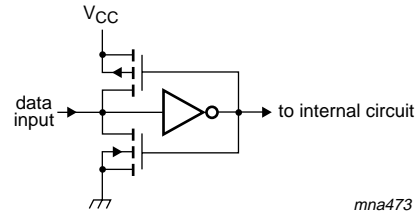


Fig 3. Bus hold circuit

## 5. Pinning information

### 5.1 Pinning

mna475

6	1A1	1A3	1A5	1A7	2A1	2A3	2A5	2A6	3A1	3A3	3A5	3A7	4A1	4A3	4A5	4A6
5	1A0	1A2	1A4	1A6	2A0	2A2	2A4	2A7	3A0	3A2	3A4	3A6	4A0	4A2	4A4	4A7
4	1OE	GND	VCC	GND	GND	VCC	GND	2OE	3OE	GND	VCC	GND	GND	VCC	GND	4OE
3	1DIR	GND	VCC	GND	GND	VCC	GND	2DIR	3DIR	GND	VCC	GND	GND	VCC	GND	4DIR
2	1B0	1B2	1B4	1B6	2B0	2B2	2B4	2B7	3B0	3B2	3B4	3B6	4B0	4B2	4B4	4B7
1	1B1	1B3	1B5	1B7	2B1	2B3	2B5	2B6	3B1	3B3	3B5	3B7	4B1	4B3	4B5	4B6
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	T

Fig 4. Pin configuration

### 5.2 Pin description

Table 2. Pin description

Symbol	Ball	Description
nDIR (n = 1 to 4)	A3, H3, J3, T3	direction control
nOE (n = 1 to 4)	A4, H4, J4, T4	output enable input (active LOW)
1A[0:7]	A5, A6, B5, B6, C5, C6, D5, D6	input or output
1B[0:7]	A2, A1, B2, B1, C2, C1, D2, D1	input or output
2A[0:7]	E5, E6, F5, F6, G5, G6, H6, H5	input or output
2B[0:7]	E2, E1, F2, F1, G2, G1, H1, H2	input or output
3A[0:7]	J5, J6, K5, K6, L5, L6, M5, M6	input or output
3B[0:7]	J2, J1, K2, K1, L2, L1, M2, M1	input or output
4A[0:7]	N5, N6, P5, P6, R5, R6, T6, T5	input or output

Table 2. Pin description ...continued

Symbol	Ball	Description
4B[0:7]	N2, N1, P2, P1, R2, R1, T1, T2	input or output
GND	B3, B4, D3, D4, E3, E4, G3, G4, K3, K4, M3, M4, N3, N4, R3, R4	ground (0 V)
V <sub>CC</sub>	C3, C4, F3, F4, L3, L4, P3, P4	supply voltage

## 6. Functional description

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

Input		Input/output	
nOE	nDIR	nAn	nBn
L	L	nAn = nBn	inputs
L	H	inputs	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)<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	+7.0	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		-	150	°C

- [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 indicated under [Section 8 "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.
- [3] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

## 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
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 ≥ 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
P <sub>tot</sub>	total power dissipation		[1]	-	1000	mW

[1] Above 70 °C the value of P<sub>tot</sub> derates linearly with 1.8 mW/K.

## 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 [1]</b>							
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>IH</sub>	HIGH-level input voltage		2.0	-	-	V	
V <sub>IL</sub>	LOW-level input voltage		-	-	0.8	V	
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>	-	V	
		V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -8 mA	2.4	2.5	-	V	
		V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -32 mA	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	
		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	
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	
	V <sub>I</sub> = 0 V	-5	-0.1	-	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	-	0.1	±100	μA	
I <sub>LO</sub>	output leakage current	output HIGH; 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> ; nOE = don't care	[4]	-	40	±100	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>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	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	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = 3.6 V	[3] 500	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = 3.6 V	[3] -	-	-500	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	-	0.14	0.24	mA
		outputs LOW	-	8.4	12	mA
		outputs disabled	[5] -	0.14	0.24	mA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 3 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	control pins; V <sub>O</sub> = 0 V or 3.0 V	-	3	-	pF
C <sub>I/O</sub>	input/output capacitance	input/output data pins; outputs disabled; V <sub>CC</sub> = 3.6 V; I <sub>O</sub> = 0 A; V <sub>I</sub> = GND or V <sub>CC</sub>	-	9	-	pF

- [1] All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C unless otherwise specified.
- [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 load circuit see [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
t <sub>PLH</sub>	LOW to HIGH propagation delay	nAn to nBn or nBn to nAn; see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 2.7 V	-	-	3.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	1.9	3.3	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	nAn to nBn or nBn to nAn; see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 2.7 V	-	-	3.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	1.7	3.3	ns
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	n $\overline{OE}$ to nAn or nBn; see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 2.7 V	-	-	5.3	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.8	4.5	ns

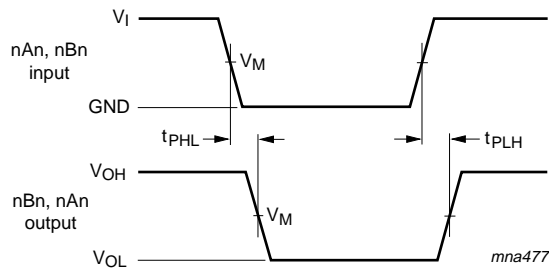
**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V); for load circuit see [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
t <sub>PZL</sub>	OFF-state to LOW propagation delay	n $\overline{\text{OE}}$ to nAn or nBn; see <a href="#">Figure 6</a> V <sub>CC</sub> = 2.7 V	-	-	5.1	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.8	4.1	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	n $\overline{\text{OE}}$ to nAn or nBn; see <a href="#">Figure 6</a> V <sub>CC</sub> = 2.7 V	-	-	5.7	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.2	5.1	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	n $\overline{\text{OE}}$ to nAn or nBn; see <a href="#">Figure 6</a> V <sub>CC</sub> = 2.7 V	-	-	4.6	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.0	4.6	ns

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

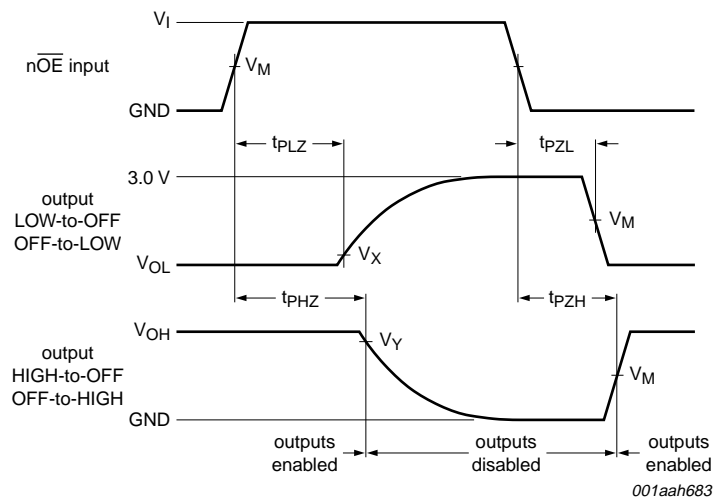
## 11. Waveforms



Measurement points are given in [Table 8](#).

V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

**Fig 5. Input to output propagation delays**



Measurement points are given in [Table 8](#).

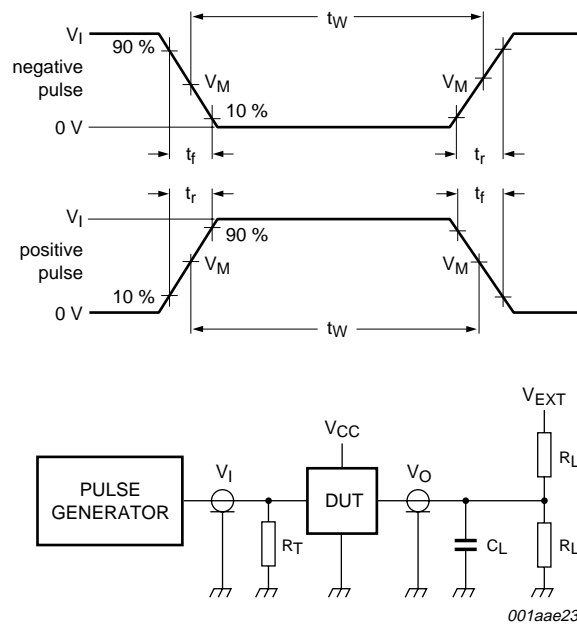
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 6. enable and disable times**

**Table 8. Measurement points**

Supply voltage	Input	Output		
$V_{CC}$	$V_M$	$V_M$	$V_X$	$V_Y$
2.7 V to 3.6 V	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 7. Load circuitry for switching times**

**Table 9. 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

LFBGA96: plastic low profile fine-pitch ball grid array package; 96 balls; body 13.5 x 5.5 x 1.05 mm SOT536-1

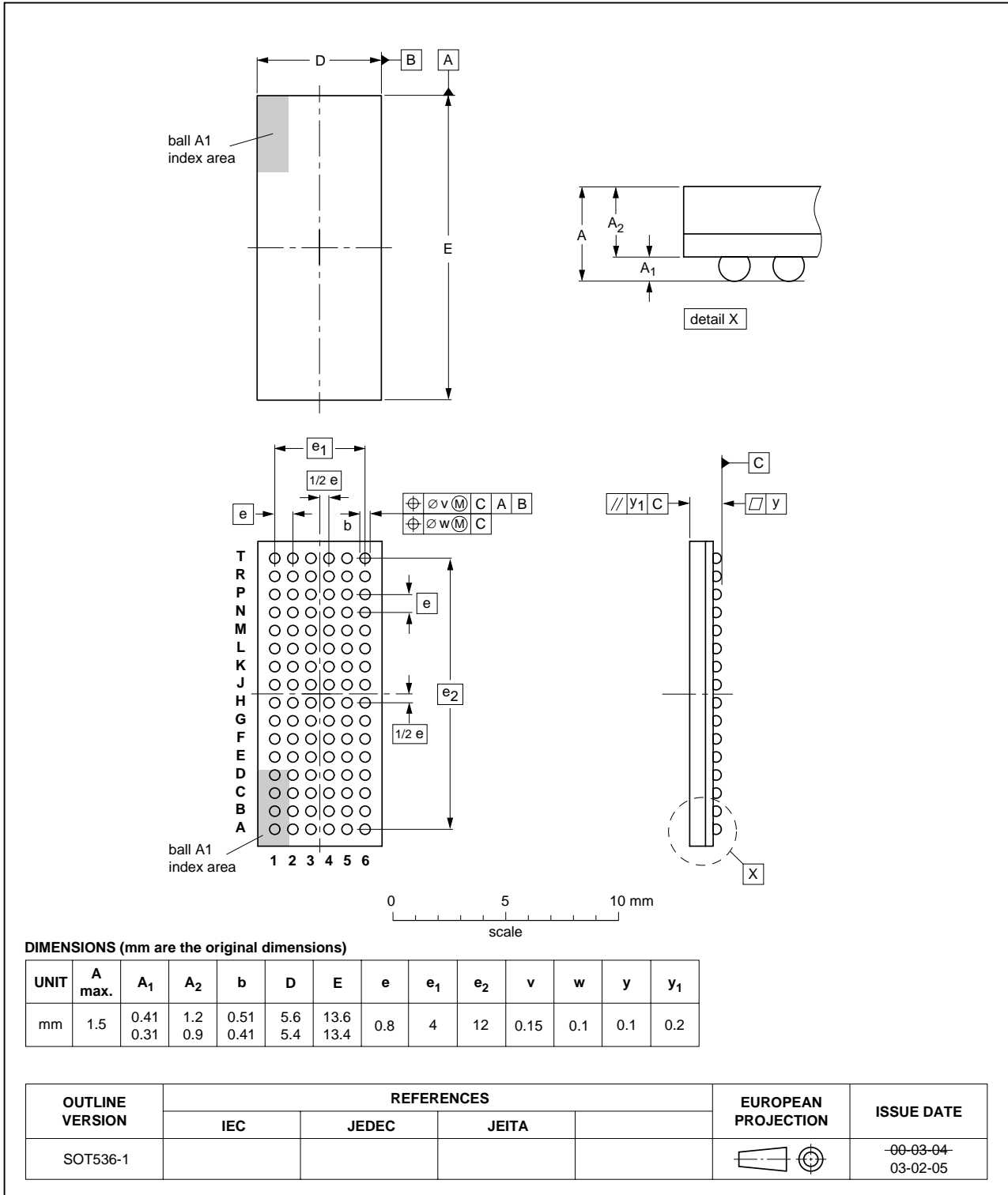


Fig 8. Package outline SOT536-1 (LFBGA96)

## 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
74LVTH32245_1	20080123	Product data sheet	-	-

## 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.
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**17. Contents**

**1 General description . . . . . 1**

**2 Features . . . . . 1**

**3 Ordering information . . . . . 1**

**4 Functional diagram . . . . . 2**

**5 Pinning information . . . . . 3**

5.1 Pinning . . . . . 3

5.2 Pin description . . . . . 3

**6 Functional description . . . . . 4**

**7 Limiting values . . . . . 4**

**8 Recommended operating conditions . . . . . 5**

**9 Static characteristics . . . . . 5**

**10 Dynamic characteristics . . . . . 6**

**11 Waveforms . . . . . 7**

**12 Package outline . . . . . 10**

**13 Abbreviations . . . . . 11**

**14 Revision history . . . . . 11**

**15 Legal information . . . . . 12**

15.1 Data sheet status . . . . . 12

15.2 Definitions . . . . . 12

15.3 Disclaimers . . . . . 12

15.4 Trademarks . . . . . 12

**16 Contact information . . . . . 12**

**17 Contents . . . . . 13**

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