

# 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 ( $\overline{nOE}$ ) inputs for easy cascading and four send/receive ( $nDIR$ ) inputs for direction control. Pin  $\overline{nOE}$  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			
	Temperature range	Name	Description	Version
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

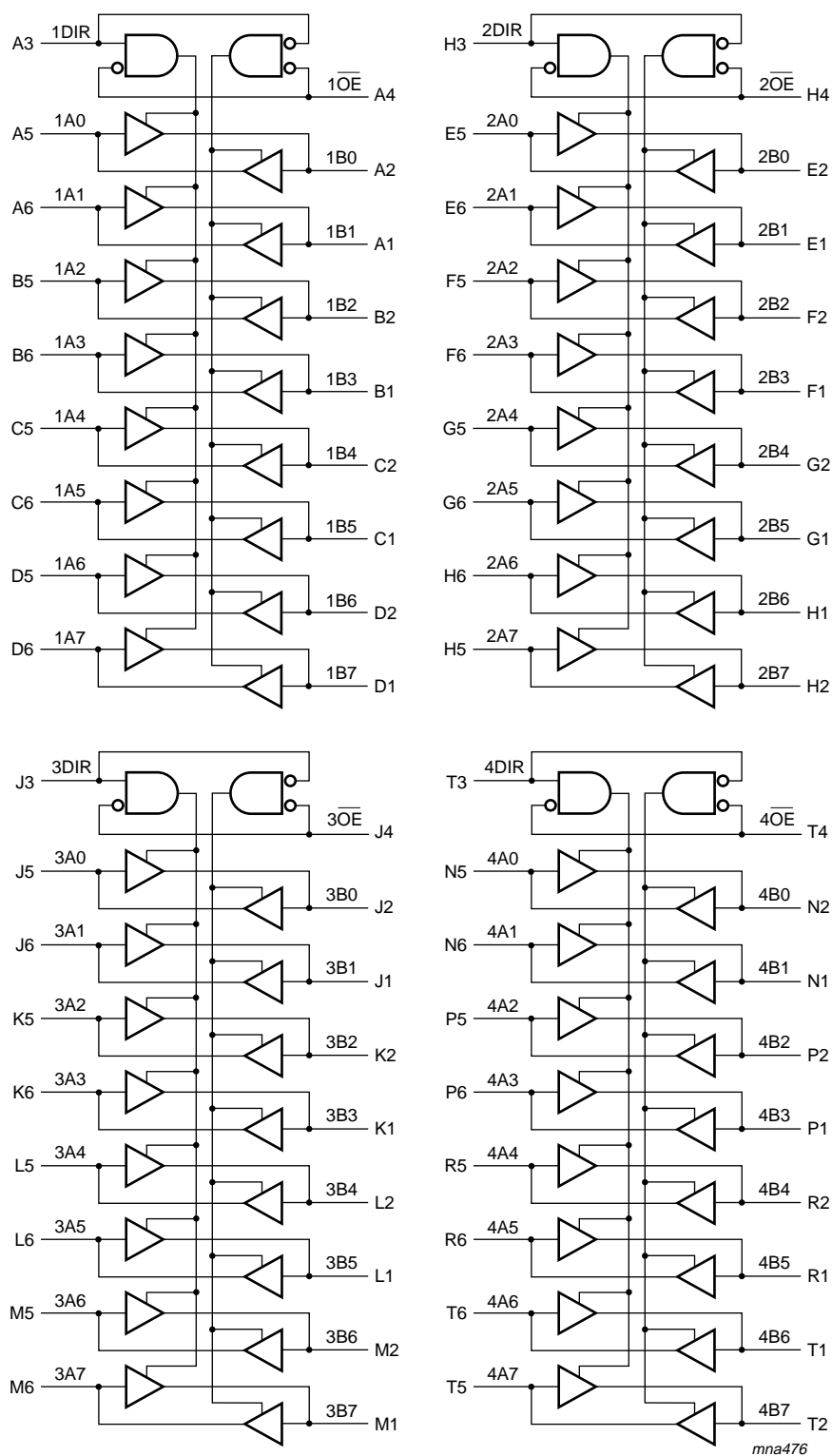
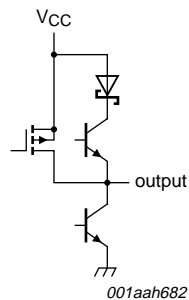
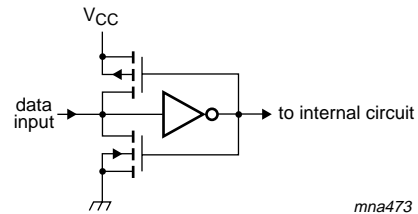


Fig 1. Logic symbol



**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	1 $\overline{\text{OE}}$	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	2 $\overline{\text{OE}}$	3 $\overline{\text{OE}}$	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	4 $\overline{\text{OE}}$
3	1DIR	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	GND	2DIR	3DIR	GND	V <sub>CC</sub>	GND	GND	V <sub>CC</sub>	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
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> = 0 V	-5	-0.1	-	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
		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
$I_{BHL}$	bus hold LOW current	$V_{CC} = 3\text{ V}$ ; $V_I = 0.8\text{ V}$	75	135	-	$\mu\text{A}$
$I_{BHH}$	bus hold HIGH current	$V_{CC} = 3\text{ V}$ ; $V_I = 2.0\text{ V}$	-	-135	-75	$\mu\text{A}$
$I_{BHLO}$	bus hold LOW overdrive current	$V_{CC} = 0\text{ V}$ to $3.6\text{ V}$ ; $V_I = 3.6\text{ V}$	[3] 500	-	-	$\mu\text{A}$
$I_{BHHO}$	bus hold HIGH overdrive current	$V_{CC} = 0\text{ V}$ to $3.6\text{ V}$ ; $V_I = 3.6\text{ V}$	[3] -	-	-500	$\mu\text{A}$
$I_{CC}$	supply current	$V_{CC} = 3.6\text{ V}$ ; $V_I = \text{GND}$ or $V_{CC}$ ; $I_O = 0\text{ A}$				
		outputs HIGH	-	0.14	0.24	$\text{mA}$
		outputs LOW	-	8.4	12	$\text{mA}$
		outputs disabled	[5] -	0.14	0.24	$\text{mA}$
$\Delta I_{CC}$	additional supply current	per input pin; $V_{CC} = 3\text{ V}$ to $3.6\text{ V}$ ; one input at $V_{CC} - 0.6\text{ V}$ ; other inputs at $V_{CC}$ or GND	[6] -	0.1	0.2	$\text{mA}$
$C_I$	input capacitance	control pins; $V_O = 0\text{ V}$ or $3.0\text{ V}$	-	3	-	$\text{pF}$
$C_{I/O}$	input/output capacitance	input/output data pins; outputs disabled; $V_{CC} = 3.6\text{ V}$ ; $I_O = 0\text{ A}$ ; $V_I = \text{GND}$ or $V_{CC}$	-	9	-	$\text{pF}$

[1] All typical values are at  $V_{CC} = 3.3\text{ V}$  and  $T_{\text{amb}} = 25\text{ }^\circ\text{C}$  unless otherwise specified.[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  $0\text{ V}$  and  $1.2\text{ V}$  with a transition time of up to  $10\text{ ms}$ . From  $V_{CC} = 1.2\text{ V}$  to  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  a transition time of  $100\text{ }\mu\text{s}$  is permitted. This parameter is valid for  $T_{\text{amb}} = 25\text{ }^\circ\text{C}$  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 characteristicsVoltages are referenced to GND (ground = 0 V); for load circuit see [Figure 7](#).

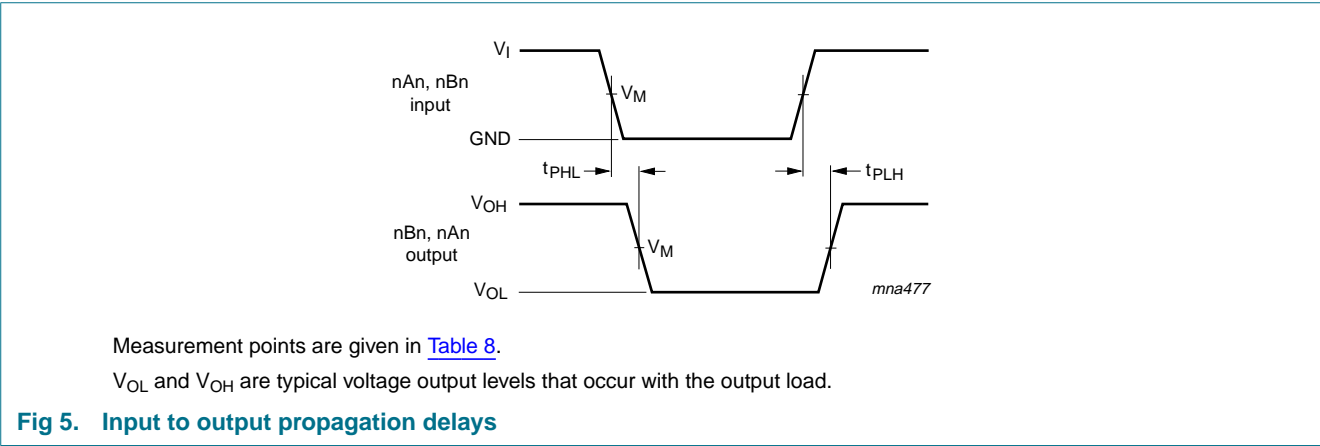
Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
<b><math>T_{\text{amb}} = -40\text{ }^\circ\text{C}</math> to <math>+85\text{ }^\circ\text{C}</math></b>						
$t_{PLH}$	LOW to HIGH propagation delay	nAn to nBn or nBn to nAn; see <a href="#">Figure 5</a>				
		$V_{CC} = 2.7\text{ V}$	-	-	3.5	ns
		$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$	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 5</a>				
		$V_{CC} = 2.7\text{ V}$	-	-	3.5	ns
		$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$	1.0	1.7	3.3	ns
$t_{PZH}$	OFF-state to HIGH propagation delay	$\overline{\text{nOE}}$ to nAn or nBn; see <a href="#">Figure 6</a>				
		$V_{CC} = 2.7\text{ V}$	-	-	5.3	ns
		$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$	1.0	2.8	4.5	ns

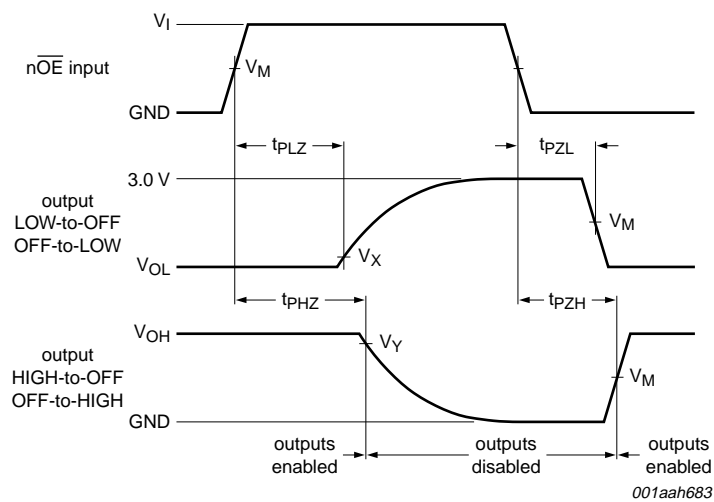
**Table 7. Dynamic characteristics ...continued**  
Voltages are referenced to GND (ground = 0 V); for load circuit see [Figure 7](#).

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





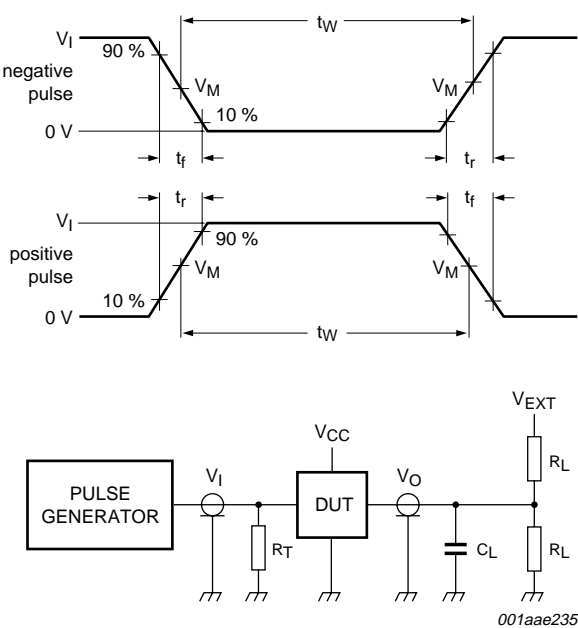
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

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	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$





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

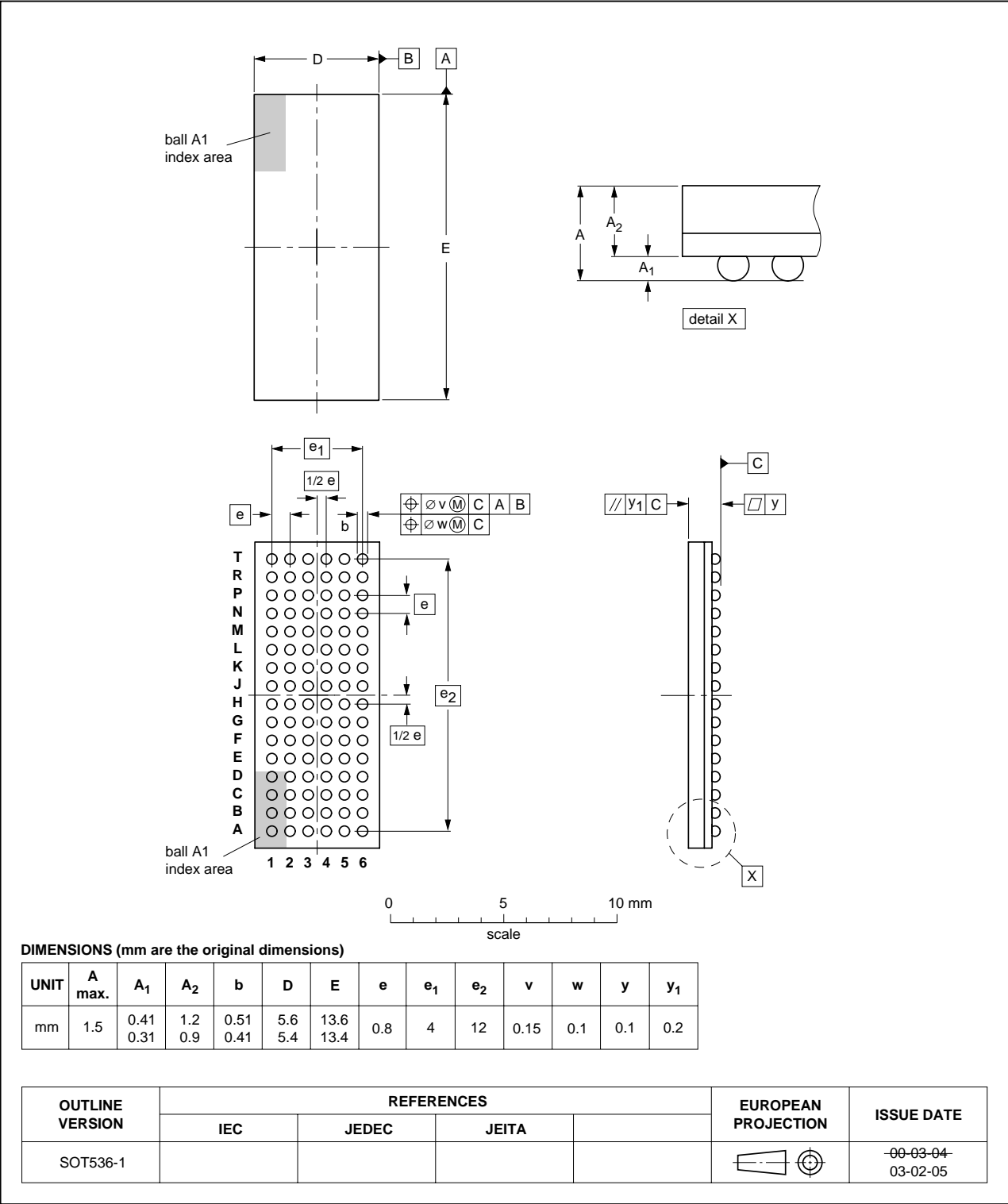


Fig 8. Package outline SOT536-1 (LFBGA96)

## 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.
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>.

### 15.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

### 15.3 Disclaimers

**General** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental

damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

**Terms and conditions of sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Quick reference data** — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

### 15.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 16. Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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



Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.