DATA SHEET

74LVT32374
3.3 V 32-bit edge-triggered D-type flip-flop; 3-state

Product specification
Supersedes data of 2002 Mar 20

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3.3 V 32-bit edge-triggered D-type flip-flop; 3-state

74LVT32374

FEATURES

- 32-bit edge-triggered flip-flop
- 3-state buffers
- Output capability: +64 mA/–32 mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold 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
- Latch-up protection exceeds 500 mA in accordance with JEDEC std 17
- ESD protection exceeds 2000 V in accordance with MIL STD 883 method 3015 and 200 V in accordance with machine model.

DESCRIPTION

The 74LVT32374 is a high-performance BICMOS product designed for V_{CC} operation at 3.3 V.

The 74LVT32374 is a 32-bit edge-triggered D-type flip-flop featuring non-inverting 3-state outputs. The device can be used as four 8-bit flip-flops, or two 16-bit flip-flops or one 32-bit flip-flop. On the positive transition of the clock (CP), the Q outputs of the flip-flop take on the logic levels set-up at the D inputs.

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f \leq 2.5$ ns.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	propagation delay nCP to nQ_n	C_L = 50 pF; V_{CC} = 3.3 V	2.9	ns
C_I	input capacitance	V_I = 0 V or 3.0 V	3	pF
C_O	output capacitance	outputs disabled; V_O = 0 V or 3.0 V	9	pF
I_{CCZ}	total supply current	output disabled; V_{CC} = 3.6 V	140	µA

FUNCTION TABLE

See note 1.

OPERATING MODE	INPUT			INTERNAL REGISTER	OUTPUT
	$n\overline{OE}$	nCP	nD_n		nQ_n
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Hold	L	↕	X	NC	NC
Disable outputs	H	↕	X	NC	Z
	H	↑	nD_n	nD_n	Z

Note

1. H = HIGH voltage level;
   h = HIGH voltage level one set-up time prior to the HIGH-to-LOW OE transition;
   L = LOW voltage level;
   l = LOW voltage level one set-up time prior to the HIGH-to-LOW OE transition;
   NC = not connected;
   X = don't care;
   Z = high-impedance OFF-state;
   ↑ = LOW-to-HIGH CP transition;
   ↕ = not a LOW-to-HIGH CP transition.

ORDERING INFORMATION

TYPE NUMBER	TEMPERATURE RANGE	PACKAGE			
		PINS	PACKAGE	MATERIAL	CODE
74LVT32374EC	–40 °C to +85 °C	96	LFBGA96	plastic	SOT536-1

PINNING

SYMBOL	DESCRIPTION
nD_n	data input
nCP	clock input
nQ_n	flip-flop output
GND	ground (0 V)
$n\overline{OE}$	output enable input (active LOW)
V_{CC}	supply voltage

MNA497

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	T
6	$1D_1$	$1D_3$	$1D_5$	$1D_7$	$2D_1$	$2D_3$	$2D_5$	$2D_7$	$3D_1$	$3D_3$	$3D_5$	$3D_7$	$4D_1$	$4D_3$	$4D_5$	$4D_6$
5	$1D_0$	$1D_2$	$1D_4$	$1D_6$	$2D_0$	$2D_2$	$2D_4$	$2D_6$	$3D_0$	$3D_2$	$3D_4$	$3D_6$	$4D_0$	$4D_2$	$4D_4$	$4D_7$
4	1CP	GND	V_{CC}	GND	GND	V_{CC}	GND	2CP	3CP	GND	V_{CC}	GND	GND	V_{CC}	GND	4CP
3	$1\overline{OE}$	GND	V_{CC}	GND	GND	V_{CC}	GND	$2\overline{OE}$	$3\overline{OE}$	GND	V_{CC}	GND	GND	V_{CC}	GND	$4\overline{OE}$
2	$1Q_0$	$1Q_2$	$1Q_4$	$1Q_6$	$2Q_0$	$2Q_2$	$2Q_4$	$2Q_6$	$3Q_0$	$3Q_2$	$3Q_4$	$3Q_6$	$4Q_0$	$4Q_2$	$4Q_4$	$4Q_7$
1	$1Q_1$	$1Q_3$	$1Q_5$	$1Q_7$	$2Q_1$	$2Q_3$	$2Q_5$	$2Q_7$	$3Q_1$	$3Q_3$	$3Q_5$	$3Q_7$	$4Q_1$	$4Q_3$	$4Q_5$	$4Q_6$

Fig.1 Pin configuration.

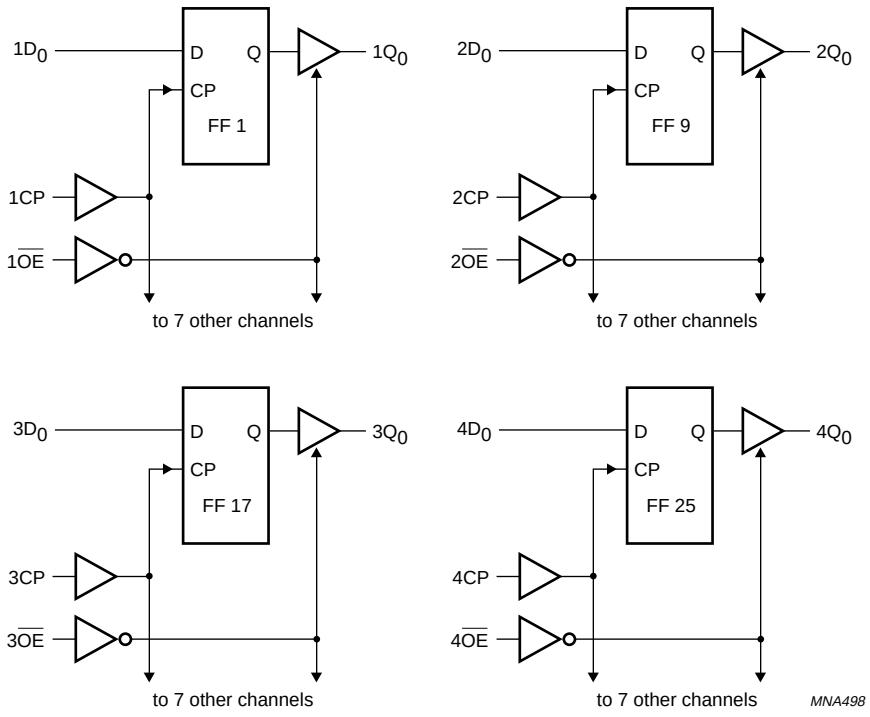


Fig.2 Logic symbol.

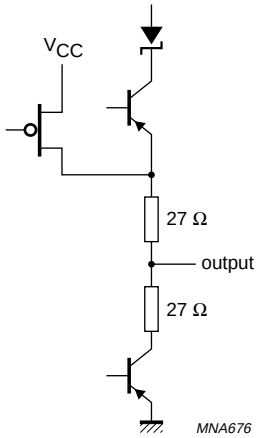


Fig.3 Schematic of each output.

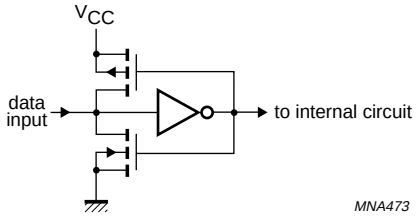


Fig.4 Bus hold circuit.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage		2.7	+3.6	V
V_I	input voltage	note 1	0	5.5	V
V_{IH}	HIGH-level input voltage		2.0	–	V
V_{IL}	LOW-level input voltage		–	0.8	V
I_{OH}	HIGH-level output current		–	–32	mA
I_{OL}	LOW-level output current		–	32	mA
		current duty cycle ≤ 50 %; f ≥ 1 kHz	–	64	mA
$\Delta t/\Delta V$	input transition rise or fall times	outputs enabled	–	10	ns/V
T_{amb}	ambient temperature		–40	+85	°C
P_{tot}	power dissipation per package	note 2	–	1000	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. Above 70 °C the value of P_{tot} derates linearly with 1.8 mW/K.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); note 1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	supply voltage		–0.5	–	+4.6	V
I_{IK}	input diode current	$V_I < 0$ V	–	–50	–	mA
V_I	input voltage	note 2	–0.5	–	+7.0	V
I_{OK}	output diode current		–	–50	–	mA
V_O	output voltage	output in OFF or HIGH state; note 2	–0.5	–	+7.0	V
I_O	output current	output in LOW state	–	128	–	mA
		output in HIGH state	–	–64	–	mA
T_{stg}	storage temperature		–65	–	+150	°C

Notes

1. 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.
2. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

DC CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = −40 °C to +85 °C							
V_{IK}	input clamp voltage	I_{IK} = −18 mA	2.7	–	−0.85	−1.2	V
V_{OH}	HIGH-level output voltage	I_{OH} = −32 mA	3.0	2.0	2.3	–	V
V_{OL}	LOW-level output voltage	I_{OL} = 64 mA	3.0	–	0.4	0.55	V
V_{RST}	power-up output LOW voltage	I_O = −1 mA; V_I = GND or V_{CC}; note 2	3.6	–	0.1	0.55	V
I_{LI}	input leakage current	V_I = V_{CC} or GND; control pins	3.6	–	0.1	±1	µA
		V_I = 5.5 V	0 or 3.6	–	0.4	10	µA
		V_I = V_{CC}; data pins; note 3	3.6	–	0.1	1	µA
		V_I = 0 V; data pins; note 3	3.6	–	−0.4	−5	µA
I_{off}	output OFF current	V_I or V_O = 0 V to 4.5 V	0	–	0.1	±100	µA
I_{hold}	bus hold current D inputs	V_I = 0.8 V; note 4	3.0	75	135	–	µA
		V_I = 2.0 V; note 4	3.0	−75	−135	–	µA
		V_{CC} = 3.6 V; note 4	0 to 3.6	±500	–	–	µA
I_{EX}	current into an output in the HIGH state when $V_O > V_{CC}$	V_O = 5.5 V	3.0	–	50	125	µA
$I_{pu/pd}$	power-up/down 3-state output current	V_O = 5.5 V to V_{CC}; V_I = GND or V_{CC}; V_{OE} = don't care; note 5	≤ 1.2 V	–	1	±100	µA
I_{OZH}	3-state output HIGH current	V_O = 3.0 V; V_I = V_{IH} or V_{IL}	3.6	–	0.5	5	µA
I_{OZL}	3-state output LOW current	V_O = 0.5 V; V_I = V_{IH} or V_{IL}	3.6	–	+0.5	−5	µA
I_{CCH}	quiescent supply current	outputs HIGH; I_O = 0 A; V_I = GND or V_{CC}	3.6	–	0.14	0.24	mA
I_{CCL}	quiescent supply current	outputs LOW; I_O = 0 A; V_I = GND or V_{CC}	3.6	–	8	12	mA
I_{CCZ}	quiescent supply current	outputs disabled; I_O = 0 A; V_I = GND or V_{CC}; note 6	3.6	–	0.14	0.24	mA
ΔI_{CC}	additional supply current per input pin	one input at V_{CC} − 0.6 V; other inputs at GND or V_{CC}; note 7	3.0 to 3.6	–	0.1	0.2	µA

Notes

1. All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 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_{CC} or GND.
4. This is the bus hold overdrive current required to force the input to the opposite logic state.
5. 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 ± 0.3 V a transition time of 100 µs is permitted. This parameter is valid for T_{amb} = 25 °C only.
6. I_{CCZ} is measured with outputs pulled to V_{CC} or GND.
7. This is the increase in supply current for each input at the specified voltage level other than V_{CC} or GND.

AC CHARACTERISTICS

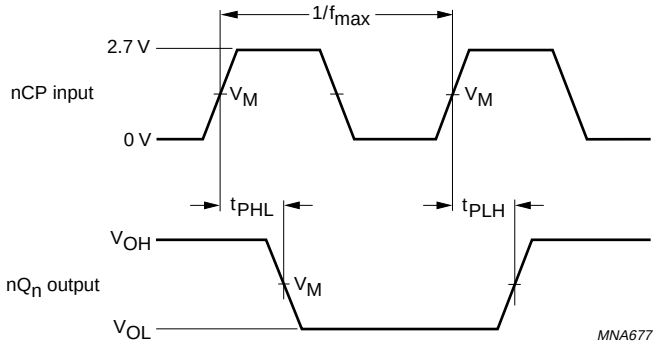
GND = 0 V; $t_r = t_f \leq 2.5$ ns; $C_L = 50$ pF; $R_L = 500\ \Omega$.

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = −40 °C to +85 °C							
t_{PLH}	propagation delay nCP to nQ_n	see Fig.5	2.7	–	–	6.2	ns
			3.0 to 3.6	1.5	3.0	5.3	ns
t_{PHL}	propagation delay nCP to nQ_n	see Fig.5	2.7	–	–	5.1	ns
			3.0 to 3.6	1.5	3.0	4.9	ns
t_{PZH}	output enable time to HIGH level	see Figs 7 and 8	2.7	–	–	6.9	ns
			3.0 to 3.6	1.5	3.5	5.6	ns
t_{PZL}	output enable time to LOW level	see Figs 7 and 8	2.7	–	–	6.0	ns
			3.0 to 3.6	1.5	3.2	4.9	ns
t_{PHZ}	output disable time from HIGH level	see Figs 7 and 8	2.7	–	–	5.7	ns
			3.0 to 3.6	1.5	3.5	5.4	ns
t_{PLZ}	output disable time from LOW level	see Figs 7 and 8	2.7	1.5	3.2	5.1	ns
			3.0 to 3.6	1.5	3.2	5.0	ns
t_{suH}	set-up time nD_n HIGH to nCP	see Fig.6	2.7	2.0	–	–	ns
			3.0 to 3.6	2.0	0.7	–	ns
t_{suL}	set-up time nD_n LOW to nCP	see Fig.6	2.7	2.0	–	–	ns
			3.0 to 3.6	2.0	0.7	–	ns
t_{hH}	hold time nD_n HIGH to nCP	see Fig.6	2.7	0.1	–	–	ns
			3.0 to 3.6	0.8	0	–	ns
t_{hL}	hold time nD_n LOW to nCP	see Fig.6	2.7	0.1	–	–	ns
			3.0 to 3.6	0.8	0	–	ns
t_{WH}	nCP HIGH pulse width	see Fig.6	2.7	1.5	–	–	ns
			3.0 to 3.6	1.5	0.6	–	ns
t_{WL}	nCP LOW pulse width	see Fig.6	2.7	3.0	–	–	ns
			3.0 to 3.6	3.0	1.6	–	ns
f_{max}	maximum clock pulse frequency	see Fig.5	3.0 to 3.6	150	–	–	MHz

Note

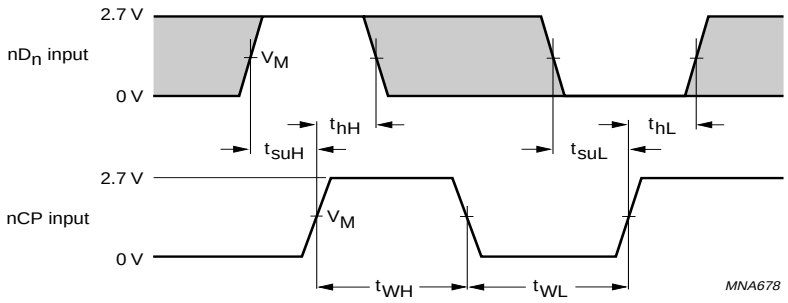
1. All typical values are measured at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C.

AC WAVEFORMS



V_M = 1.5 V;
V_M = GND to 3.0 V.

Fig.5 Clock (nCP) to output (nQ_n) propagation delays, the clock pulse width and the maximum clock pulse frequency.



The shaded areas indicate when the input is permitted to change for predicable output performance.

Fig.6 Set-up and hold times for inputs (nD_n) to inputs (nCP).

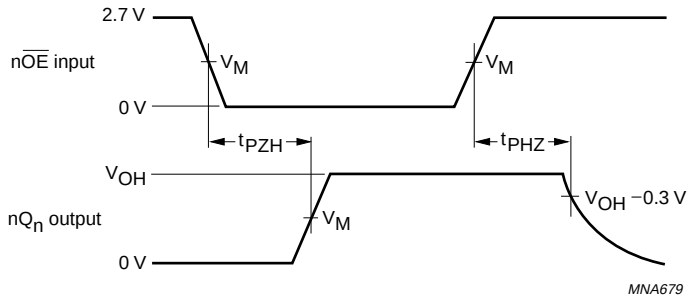


Fig.7 3-state output enable time to HIGH level and output disable time from HIGH level.

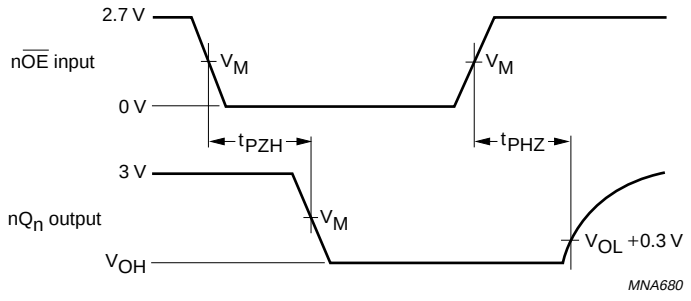
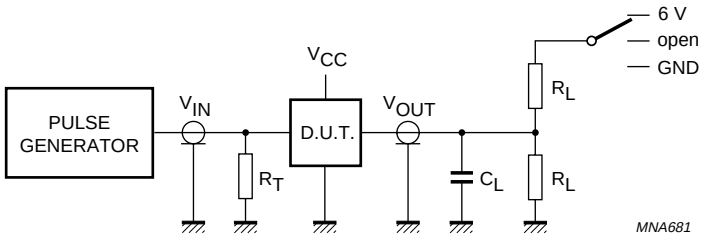


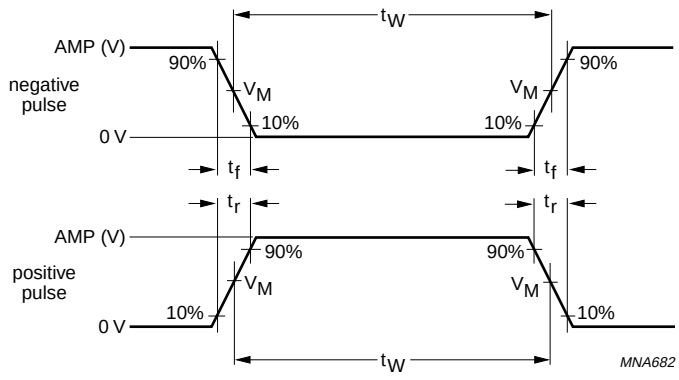
Fig.8 3-state output enable time to LOW level and output disable time from LOW level.



TEST	SWITCH
t_{PLH}/t_{PHL}	open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND

Definitions for test circuit:
R_L = Load resistor.
C_L = Load capacitance including jig and probe capacitance.
R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig.9 Load circuitry for switching times.

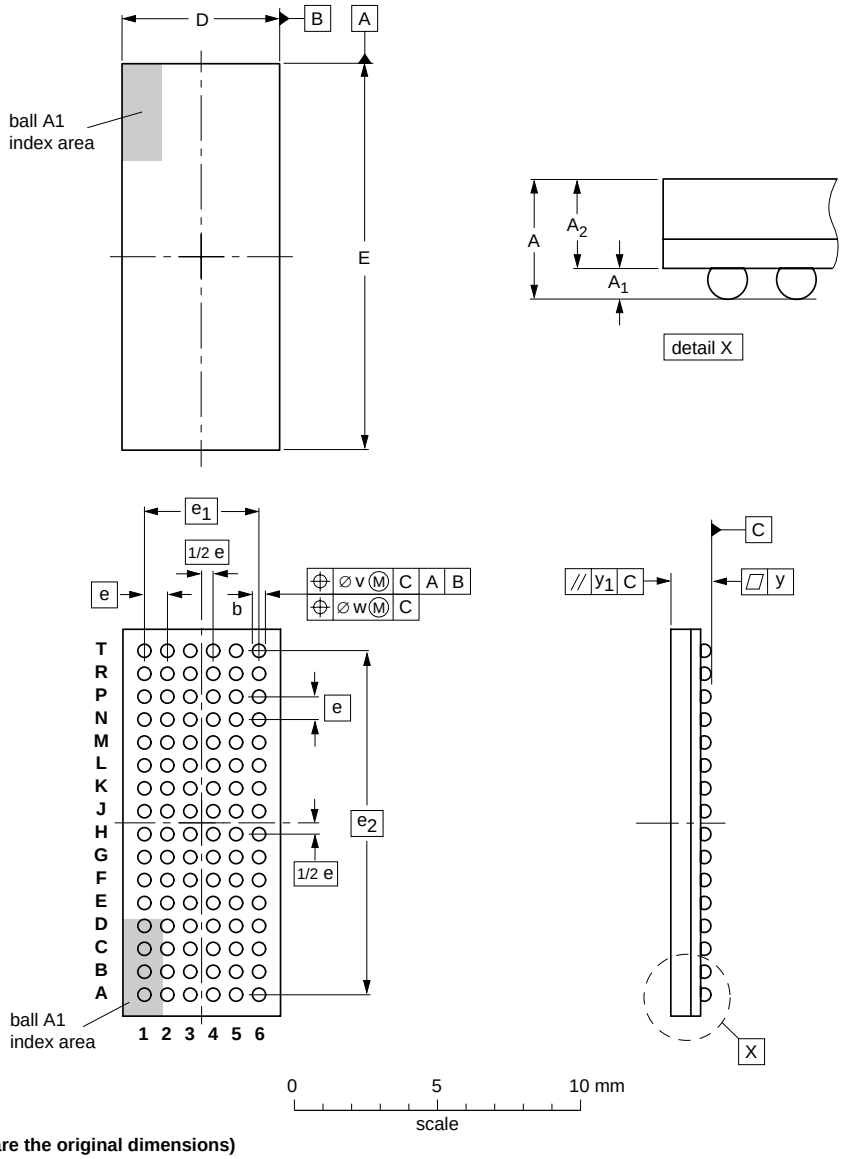


INPUT PULSE REQUIREMENTS				
AMPLITUDE	**PULSE RATE**	**t_W**	**t_r**	**t_f**
2.7 V	≤ 10 MHz	500 ns	≤ 2.5 ns	≤ 2.5 ns

Fig.10 Input pulse definition.

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



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	b	D	E	e	e_1	e_2	v	w	y	y_1
mm	1.5	0.41 0.31	1.2 0.9	0.51 0.41	5.6 5.4	13.6 13.4	0.8	4	12	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT536-1						~~00-03-04~~ 03-02-05

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS(1)	PRODUCT STATUS(2)(3)	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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

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Contact information

For additional information please visit **http://www.semiconductors.philips.com**. Fax: **+31 40 27 24825**
For sales offices addresses send e-mail to: **sales.addresses@www.semiconductors.philips.com**.

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