DATA SHEET

74LVCH32244A
32-bit buffer/line driver; 5 V input/output tolerant; 3-state

Product specification
2004 May 13
Supersedes data of 1999 Aug 31

Philips Semiconductors

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32-bit buffer/line driver; 5 V input/output tolerant; 3-state

74LVCH32244A

FEATURES

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range of 1.2 V to 3.6 V
- CMOS low power consumption
- MULTIBYTE flow-trough standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- All data inputs have bushold
- Complies with JEDEC standard JESD8-B/JESD36
- ESD protection:
  HBM EIA/JESD22-A114-B exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from –40 °C to +85 °C
- Packaged in plastic fine-pitch ball grid array package.

DESCRIPTION

The 74LVCH32244A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families. Inputs can be driven from either 3.3 V or 5 V devices. In 3-state operation, outputs can handle 5 V. These features allow the use of these devices in a mixed 3.3 V and 5 V environment.

The 74LVCH32244A is a 32-bit non-inverting buffer/line driver with 3-state outputs. The 3-state outputs are controlled by eight output enable inputs ($1\overline{OE}$ to $8\overline{OE}$). A HIGH on pin $n\overline{OE}$ causes the outputs to assume a high-impedance OFF-state.

To ensure the high-impedance state during power up or power down, pin $n\overline{OE}$ should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The 74LVCH32244A bushold data inputs eliminates the need for external pull-up resistors to hold unused or floating data inputs at a valid logic level.

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 nAn to nYn	C_L = 50 pF; V_{CC} = 3.3 V	3.0	ns
t_{PZH}/t_{PZL}	3-state output enable time $n\overline{OE}$ to nYn	C_L = 50 pF; V_{CC} = 3.3 V	3.5	ns
t_{PHZ}/t_{PLZ}	3-state output disable time $n\overline{OE}$ to nYn	C_L = 50 pF; V_{CC} = 3.3 V	3.7	ns
C_I	input capacitance		5.0	pF
C_{PD}	power dissipation capacitance per gate	V_{CC} = 3.3 V; notes 1 and 2		
		outputs enabled	12	pF
		outputs disabled	4.0	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz;
   f_o = output frequency in MHz;
   C_L = output load capacitance in pF;
   V_{CC} = supply voltage in Volts;
   N = total load switching outputs;
   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. The condition is V_I = GND to V_{CC}.

FUNCTION TABLE

See note 1.

INPUT		OUTPUT
$n\overline{OE}$	nAn	nYn
L	L	L
L	H	H
H	X	Z

Note

1. H = HIGH voltage level
   L = LOW voltage level
   X = don't care
   Z = high-impedance OFF-state

ORDERING INFORMATION

TYPE NUMBER	PACKAGES				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74LVCH32244AEC	–40 °C to +85 °C	96	LFBGA96	plastic	SOT536-1

PINNING

BALL	SYMBOL	DESCRIPTION
A1	1Y1	data output
A2	1Y0	data output
A3	$1\overline{OE}$	3-state output enable input (active LOW)
A4	$2\overline{OE}$	3-state output enable input (active LOW)
A5	1A0	data input
A6	1A1	data input
B1	1Y3	data output
B2	1Y2	data output
B3	GND	ground (0 V)
B4	GND	ground (0 V)
B5	1A2	data input
B6	1A3	data input
C1	2Y1	data output
C2	2Y0	data output
C3	V_{CC}	supply voltage
C4	V_{CC}	supply voltage
C5	2A0	data input
C6	2A1	data input
D1	2Y3	data output
D2	2Y2	data output
D3	GND	ground (0 V)
D4	GND	ground (0 V)
D5	2A2	data input
D6	2A3	data input
E1	3Y1	data output
E2	3Y0	data output
E3	GND	ground (0 V)
E4	GND	ground (0 V)
E5	3A0	data input
E6	3A1	data input
F1	3Y3	data output
F2	3Y2	data output
F3	V_{CC}	supply voltage
F4	V_{CC}	supply voltage
F5	3A2	data input
F6	3A3	data input
G1	4Y1	data output
G2	4Y0	data output

BALL	SYMBOL	DESCRIPTION
G3	GND	ground (0 V)
G4	GND	ground (0 V)
G5	4A0	data input
G6	4A1	data input
H1	4Y2	data output
H2	4Y3	data output
H3	$4\overline{OE}$	output enable input (active LOW)
H4	$3\overline{OE}$	output enable input (active LOW)
H5	4A3	data input
H6	4A2	data input
J1	5Y1	data output
J2	5Y0	data output
J3	$5\overline{OE}$	3-state output enable input (active LOW)
J4	$6\overline{OE}$	3-state output enable input (active LOW)
J5	5A0	data input
J6	5A1	data input
K1	5Y3	data output
K2	5Y2	data output
K3	GND	ground (0 V)
K4	GND	ground (0 V)
K5	5A2	data input
K6	5A3	data input
L1	6Y1	data output
L2	6Y0	data output
L3	V_{CC}	supply voltage
L4	V_{CC}	supply voltage
L5	6A0	data input
L6	6A1	data input
M1	6Y3	data output

BALL	SYMBOL	DESCRIPTION
M2	6Y2	data output
M3	GND	ground (0 V)
M4	GND	ground (0 V)
M5	6A2	data input
M6	6A3	data input
N1	7Y1	data output
N2	7Y0	data output
N3	GND	ground (0 V)
N4	GND	ground (0 V)
N5	7A0	data input
N6	7A1	data input
P1	7Y3	data output
P2	7Y2	data output
P3	V_{CC}	supply voltage
P4	V_{CC}	supply voltage
P5	7A2	data input
P6	7A3	data input
R1	8Y1	data output
R2	8Y0	data output
R3	GND	ground (0 V)
R4	GND	ground (0 V)
R5	8A0	data input
R6	8A1	data input
T1	8Y2	data output
T2	8Y3	data output
T3	$8\overline{OE}$	3-state output enable input (active LOW)
T4	$7\overline{OE}$	3-state output enable input (active LOW)
T5	8A3	data input
T6	8A2	data input

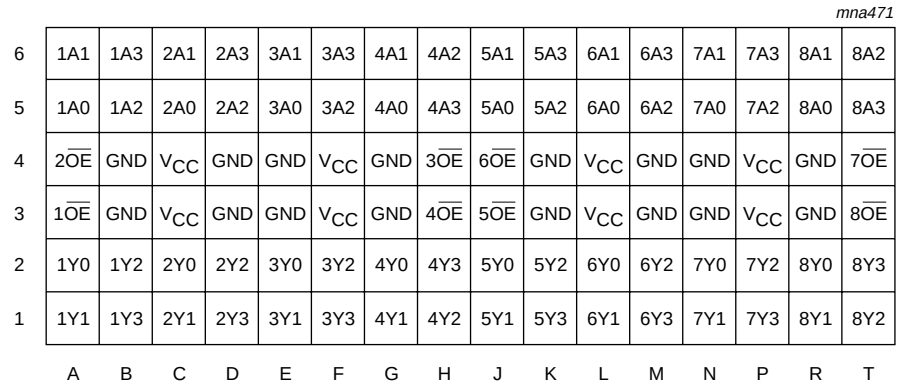


Fig.1 Pin configuration.

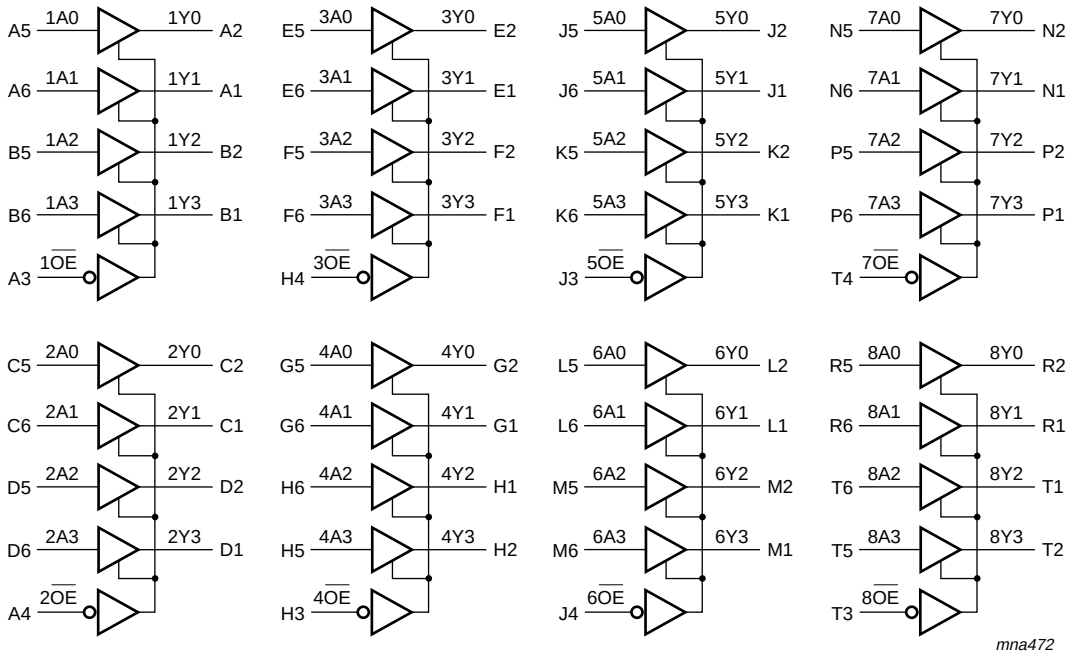


Fig.2 Logic symbol.

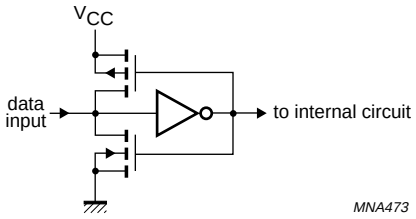


Fig.3 Bushold circuit.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage	for maximum speed performance	2.7	3.6	V
		for low-voltage applications	1.2	3.6	V
V_I	input voltage		0	5.5	V
V_O	output voltage	output HIGH or LOW state	0	V_{CC}	V
		output 3-state	0	5.5	V
T_{amb}	operating ambient temperature	in free air	–40	+85	°C
t_r, t_f	input rise and fall times	V_{CC} = 1.2 V to 2.7 V	0	20	ns/V
		V_{CC} = 2.7 V to 3.6 V	0	10	ns/V

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_{CC}	supply voltage		–0.5	+6.5	V
I_{IK}	input diode current	V_I < 0 V	–	–50	mA
V_I	input voltage	note 1	–0.5	+6.5	V
I_{OK}	output diode current	V_O > V_{CC} or V_O < 0 V	–	±50	mA
V_O	output voltage	output HIGH or LOW state; note 1	–0.5	V_{CC} + 0.5	V
		output 3-state; note 1	–0.5	+6.5	V
I_O	output source or sink current	V_O = 0 V to V_{CC}	–	±50	mA
I_{CC}, I_{GND}	V_{CC} or GND current	note 2	–	±200	mA
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	power dissipation	T_{amb} = –40 °C to +85 °C; note 3	–	1000	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. All supply and ground pins connected externally to one voltage source.
3. Above 70 °C the value of P_{tot} derates linearly with 1.8 mW/K.

DC CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = −40 °C to +85 °C; note 1							
V_{IH}	HIGH-level input voltage		1.2	V_{CC}	–	–	V
			2.7 to 3.6	2.0	–	–	V
V_{IL}	LOW-level input voltage		1.2	–	–	GND	V
			2.7 to 3.6	–	–	0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = –100 µA	2.7 to 3.6	V_{CC} – 0.2	V_{CC}	–	V
		I_O = –12 mA	2.7	V_{CC} – 0.5	–	–	V
		I_O = –18 mA	3.0	V_{CC} – 0.6	–	–	V
		I_O = –24 mA	3.0	V_{CC} – 0.8	–	–	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 µA	2.7 to 3.6	–	GND	0.20	V
		I_O = 12 mA	2.7	–	–	0.40	V
		I_O = 24 mA	3.0	–	–	0.55	V
I_{LI}	input leakage current	V_I = 5.5 V or GND; note 2	3.6	–	±0.1	±5	µA
I_{OZ}	3-state output OFF-state current	V_I = V_{IH} or V_{IL}; V_O = 5.5 V or GND; note 2	3.6	–	0.1	±5	µA
I_{off}	power-off leakage supply current	V_I or V_O = 5.5 V	0.0	–	0.1	±10	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0 A	3.6	–	0.1	40	µA
ΔI_{CC}	additional quiescent supply current per input pin	V_I = V_{CC} – 0.6 V; I_O = 0 A	2.7 to 3.6	–	5	500	µA
I_{BH}	bushold LOW sustaining current	V_I = 0.8 V; notes 3 and 4	3.0	75	–	–	µA
I_{BHH}	bushold HIGH sustaining current	V_I = 2.0 V; notes 3 and 4	3.0	–75	–	–	µA
I_{BHLO}	bushold LOW overdrive current	notes 3 and 5	3.6	500	–	–	µA
I_{BHHO}	bushold HIGH overdrive current	notes 3 and 5	3.6	–500	–	–	µA

Notes

1. All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.
2. For bushold parts, the bushold circuit is switched off when V_I > V_{CC} allowing 5.5 V on the input pin.
3. For data inputs only, control inputs do not have a bushold circuit.
4. The specified sustaining current at the data inputs holds the input below the specified V_I level.
5. The specified overdrive current at the data input forces the data input to the opposite logic input state.

AC CHARACTERISTICS

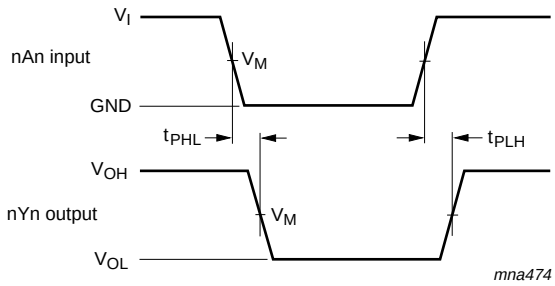
GND = 0 V; $t_r = t_f \leq 2.5$ ns; $C_L = 50$ pF; $R_L = 500\ \Omega$.

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = −40 °C to +85 °C; note 1							
t_{PHL}/t_{PLH}	propagation delay nAn to nYn	see Figs 4 and 6	1.2	–	11.0	–	ns
			2.7	1.0	–	4.7	ns
			3.0 to 3.6	1.1	3.0[2]	4.1	ns
t_{PZH}/t_{PZL}	3-state output enable time n$\overline{OE}$ to nYn	see Figs 5 and 6	1.2	–	15.0	–	ns
			2.7	1.0	–	5.8	ns
			3.0 to 3.6	1.0	3.5[2]	4.6	ns
t_{PHZ}/t_{PLZ}	3-state output disable time n$\overline{OE}$ to nYn	see Figs 5 and 6	1.2	–	10.0	–	ns
			2.7	1.0	–	6.2	ns
			3.0 to 3.6	1.8	3.7[2]	5.2	ns
$t_{sk(0)}$	skew		3.0 to 3.6	–	–	1.0	ns

Notes

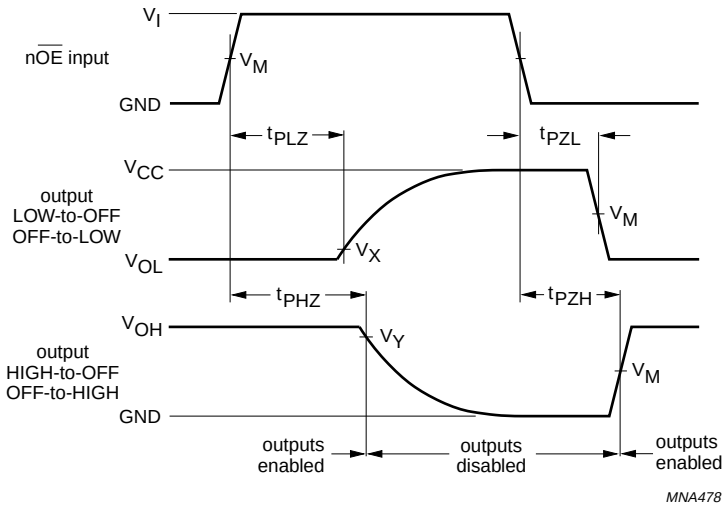
1. All typical values are measured at $T_{amb} = 25$ °C.
2. These typical values are measured at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C.

AC WAVEFORMS



V_M = 1.5 V at $V_{CC} \geq$ 2.7 V;
$V_M = 0.5 \times V_{CC}$ at V_{CC} < 2.7 V;
V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

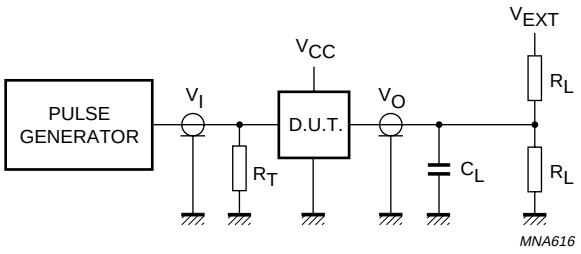
Fig.4 Input nAn to output nYn propagation delay times.



V_M = 1.5 V at $V_{CC} \geq$ 2.7 V;
$V_M = 0.5 \times V_{CC}$ at V_{CC} < 2.7 V;
$V_X = V_{OL}$ + 0.3 V at $V_{CC} \geq$ 2.7 V;
$V_X = V_{OL}$ + 0.1 V at V_{CC} < 2.7 V;
$V_Y = V_{OH} - 0.3$ V at $V_{CC} \geq$ 2.7 V;
$V_Y = V_{OH} - 0.1$ V at V_{CC} < 2.7 V

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

Fig.5 3-state enable and disable times.



V_{CC}	V_I	C_L	R_L	V_{EXT}		
				t_{PLH}/t_{PHL}	t_{PZH}/t_{PHZ}	t_{PZL}/t_{PLZ}
1.2 V	V_{CC}	50 pF	500 Ω(1)	open	GND	$2 \times V_{CC}$
2.7 V	2.7 V	50 pF	500 Ω	open	GND	$2 \times V_{CC}$
3.0 to 3.6 V	2.7 V	50 pF	500 Ω	open	GND	$2 \times V_{CC}$

Note

1. The circuit performs better when R_L = 1000 Ω.

Definitions for test circuits:

R_L = Load resistor.

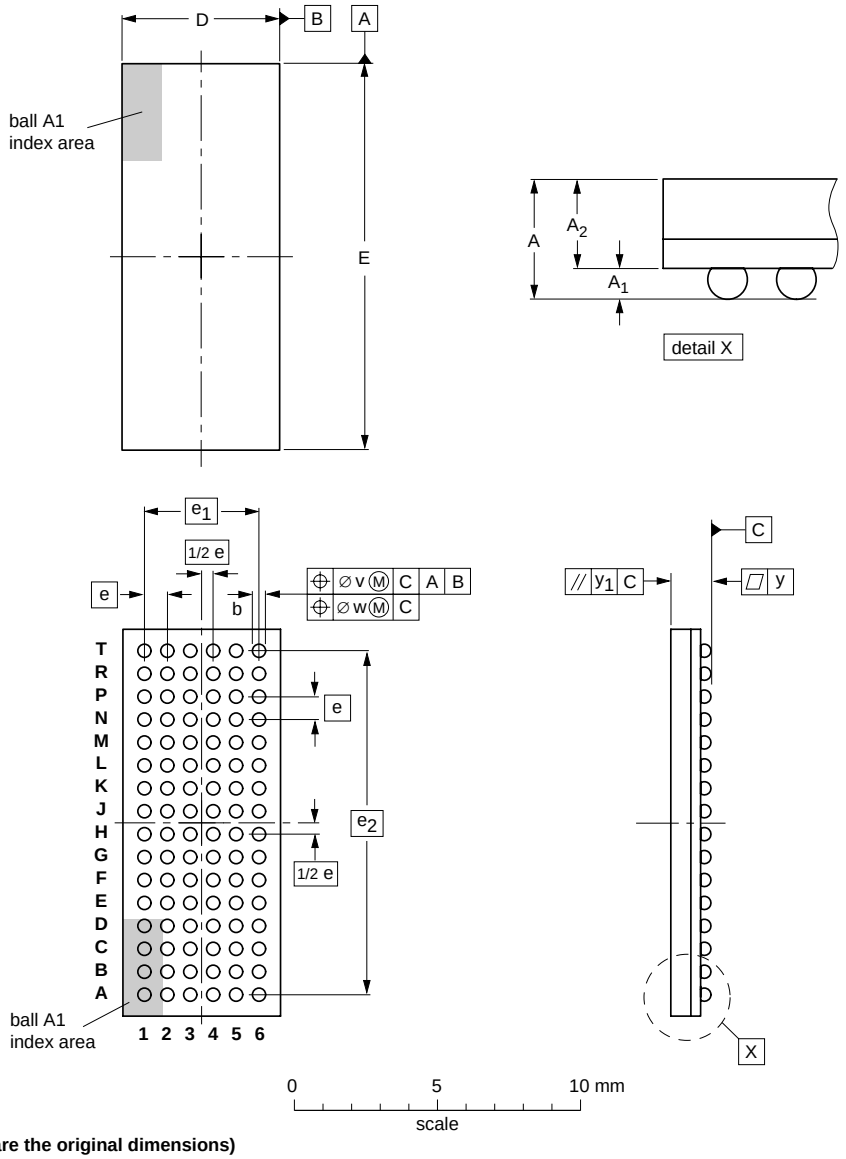
C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig.6 Load circuitry for switching times.

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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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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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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