DATA SHEET

74ALVC16244; 74ALVCH16244
2.5 V/3.3 V 16-bit buffer/line driver (3-state)

Product specification
Supersedes data of 1998 Jun 29

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Philips
Semiconductors



PHILIPS

2.5 V/3.3 V 16-bit buffer/line driver (3-state)

74ALVC16244; 74ALVCH16244

FEATURES

- Wide supply voltage range from 1.2 to 3.6 V
- CMOS low power consumption
- MultiByte flow-through standard pin-out architecture
- Low inductance multiple V_{CC} and GND pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Bus hold on data inputs (74ALVCH16244 only)
- Output drive capability 50 Ω transmission lines at 85 °C
- Current drive ±24 mA at 3.0 V
- Complies with JEDEC standard no. 8-1 A
- ESD protection:
  HBM EIA/JESD22-A114-A exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V.

DESCRIPTION

The 74ALVC16244; 74ALVCH16244 is a 16-bit non-inverting buffer/line driver with 3-state outputs. The device can be used as four 4-bit buffers, two 8-bit buffers or one 16-bit buffer. The 3-state outputs are controlled by the output enable inputs $1\overline{OE}$, $2\overline{OE}$, $3\overline{OE}$ and $4\overline{OE}$. A HIGH on $n\overline{OE}$ causes the outputs to assume a high-impedance OFF-state.

The 74ALVCH16244 has active bus hold circuitry which is provided to hold unused or floating data inputs at a valid logic level. This feature eliminates the need for external pull-up or pull-down resistors.

The 74ALVC16244 has 5 V tolerant inputs.

QUICK REFERENCE DATA

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

SYMBOL	PARAMETERS	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	propagation delay nAn to nYn	V_{CC} = 2.5 V; C_L = 30 pF	1.9	ns
		V_{CC} = 3.3 V; C_L = 50 pF	1.9	ns
C_I	input capacitance		5.0	pF
C_{PD}	power dissipation capacitance per buffer	notes 1 and 2		
		outputs enabled	25	pF
		outputs disabled	4	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	TEMPERATURE RANGE	PACKAGE			
		PINS	PACKAGE	MATERIAL	CODE
74ALVC16244DL	–40 °C to +85 °C	48	SSOP48	plastic	SOT370-1
74ALVCH16244DL	–40 °C to +85 °C	48	SSOP48	plastic	SOT370-1
74ALVC16244DGG	–40 °C to +85 °C	48	TSSOP48	plastic	SOT362-1
74ALVCH16244DGG	–40 °C to +85 °C	48	TSSOP48	plastic	SOT362-1

PINNING

PIN	SYMBOL	DESCRIPTION
1	$1\overline{OE}$	output enable input (active LOW)
2	1Y0	data output
3	1Y1	data output
4	GND	ground (0 V)
5	1Y2	data output
6	1Y3	data output
7	V_{CC}	supply voltage
8	2Y0	data output
9	2Y1	data output
10	GND	ground (0 V)
11	2Y2	data output
12	2Y3	data output
13	3Y0	data output
14	3Y1	data output
15	GND	ground (0 V)
16	3Y2	data output
17	3Y3	data output
18	V_{CC}	supply voltage
19	4Y0	data output
20	4Y1	data output
21	GND	ground (0 V)
22	4Y2	data output
23	4Y3	data output
24	$4\overline{OE}$	output enable input (active LOW)
25	$3\overline{OE}$	output enable input (active LOW)
26	4A3	data input
27	4A2	data input
28	GND	ground (0 V)
29	4A1	data input
30	4A0	data input
31	V_{CC}	supply voltage
32	3A3	data input
33	3A2	data input
34	GND	ground (0 V)
35	3A1	data input
36	3A0	data input
37	2A3	data input
38	2A2	data input
39	GND	ground (0 V)
40	2A1	data input
41	2A0	data input
42	V_{CC}	supply voltage
43	1A3	data input
44	1A2	data input
45	GND	ground (0 V)
46	1A1	data input
47	1A0	data input
48	$2\overline{OE}$	output enable input (active LOW)

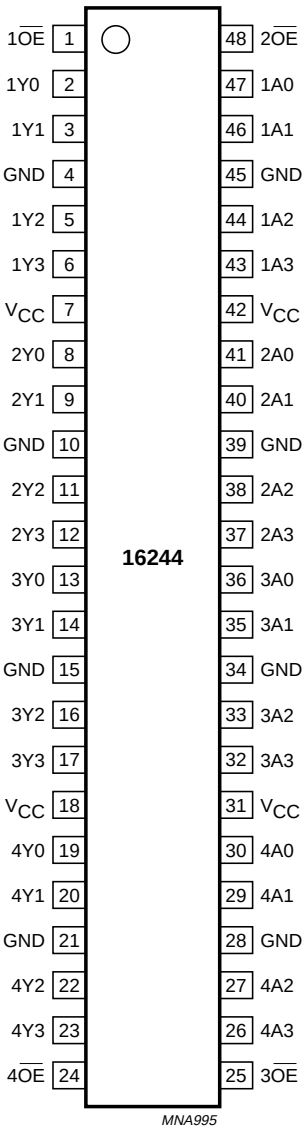


Fig.1 Pin configuration.

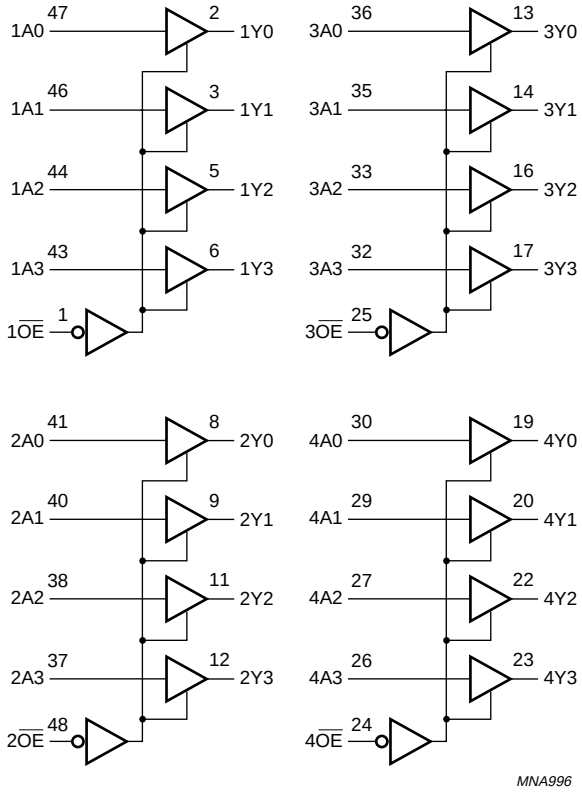


Fig.2 Logic symbol.

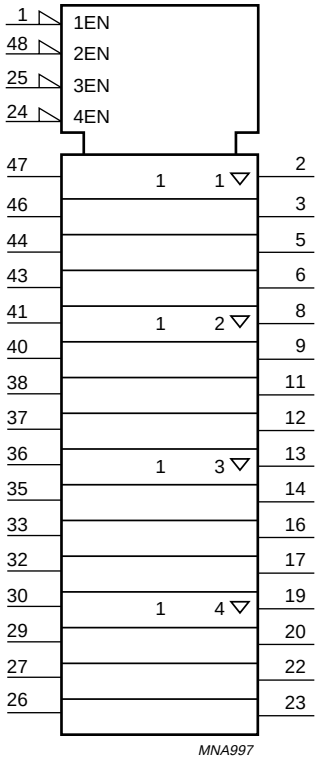


Fig.3 Logic symbol (IEEC/IEC).

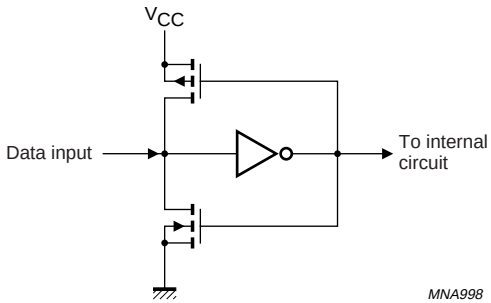


Fig.4 Bus hold circuit.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage	maximum speed performance			
		V_{CC} = 2.5 V; C_L = 30 pF	2.3	2.7	V
		V_{CC} = 3.3 V; C_L = 50 pF	3.0	3.6	V
		low-voltage applications	1.2	3.6	V
V_I	input voltage	for pins nAn with bus hold	0	V_{CC}	V
		for pins nAn without bus hold	0	5.5	V
		for pins $n\overline{OE}$	0	5.5	V
V_O	output voltage		0	V_{CC}	V
T_{amb}	operating temperature	in free air	−40	+85	°C
t_r, t_f	input rise and fall times	V_{CC} = 2.3 to 3.0 V	0	20	ns/V
		V_{CC} = 3.0 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	+4.6	V
I_{IK}	input diode current	$V_I < 0$	–	–50	mA
V_I	input voltage	for data inputs with bus hold; note 1	–0.5	V_{CC} + 0.5	V
		for data inputs without bus hold; note 1	–0.5	+5.5	V
		for control pins; note 1	–0.5	+5.5	V
I_{OK}	output diode current	$V_O > V_{CC}$ or $V_O < 0$	–	±50	mA
V_O	output voltage	note 1	–0.5	V_{CC} + 0.5	V
I_O	output source or sink current	V_O = 0 to V_{CC}	–	±50	mA
I_{CC}, I_{GND}	V_{CC} or GND current		–	±100	mA
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	power dissipation	T_{amb} = –40 to +85 °C; note 2			
		SSOP48 package	–	850	mW
		TSSOP48 package	–	600	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. For SSOP48 packages: above 55 °C the value of P_{tot} derates linearly with 11.3 mW/K.
   For TSSOP48 packages: above 55 °C the value of P_{tot} derates linearly with 8 mW/K.

DC CHARACTERISTICS

At 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 to +85 °C							
V_{IH}	HIGH-level input voltage		1.2	V_{CC}	–	–	V
			1.8	$0.7 \times V_{CC}$	0.9	–	V
			2.3 to 2.7	1.7	1.2	–	V
			2.7 to 3.6	2.0	1.5	–	V
V_{IL}	LOW-level input voltage		1.2	–	–	GND	V
			1.8	–	0.9	$0.2 \times V_{CC}$	V
			2.3 to 2.7	–	1.2	0.7	V
			2.7 to 3.6	–	1.5	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = −100 μA	1.8 to 3.6	$V_{CC} - 0.2$	V_{CC}	–	V
		I_O = −6 mA	1.8	$V_{CC} - 0.4$	$V_{CC} - 0.10$	–	V
		I_O = −6 mA	2.3	$V_{CC} - 0.3$	$V_{CC} - 0.08$	–	V
		I_O = −12 mA	2.3	$V_{CC} - 0.5$	$V_{CC} - 0.17$	–	V
		I_O = −18 mA	2.3	$V_{CC} - 0.6$	$V_{CC} - 0.26$	–	V
		I_O = −12 mA	2.7	$V_{CC} - 0.5$	$V_{CC} - 0.14$	–	V
		I_O = −24 mA	3.0	$V_{CC} - 1.0$	$V_{CC} - 0.28$	–	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = 100 μA	1.8 to 3.6	–	GND	0.20	V
		I_O = 6 mA	1.8	–	0.09	0.30	V
		I_O = 6 mA	2.3	–	0.07	0.20	V
		I_O = 12 mA	2.3	–	0.15	0.40	V
		I_O = 18 mA	2.3	–	0.23	0.60	V
		I_O = 12 mA	2.7	–	0.14	0.40	V
		I_O = 24 mA	3.0	–	0.27	0.55	V
I_{LI}	input leakage current	data pin with bus hold; $V_I = V_{CC}$ or GND	1.8 to 3.6	–	0.1	5	μA
		data pin without bus hold; V_I = 5.5 V or GND	1.8 to 3.6	–	0.1	5	μA
		control pin; V_I = 5.5 V or GND	1.8 to 3.6	–	0.1	5	μA
I_{IHZ}, I_{ILZ}	3-state input current for common I/O pins	$V_I = V_{CC}$ or GND	1.8 to 2.7	–	0.1	10	μA
			3.6	–	0.1	15	μA
I_{OZ}	3-state output OFF-state current	$V_I = V_{CC}$ or GND; $V_I = V_{IH}$ or V_{IL}	1.8 to 2.7	–	0.1	5	μA
			3.6	–	0.1	10	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0	1.8 to 2.7	–	0.1	20	μA
			2.3 to 3.6	–	0.2	40	μA

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
ΔI_{CC}	additional quiescent supply current per pin	$V_I = V_{CC} - 0.6$ V; $I_O = 0$					
		data pin with bus hold	2.7 to 3.6	–	150	750	μA
		data pin without bus hold	2.7 to 3.6	–	5	500	μA
		control pin	2.7 to 3.6	–	5	500	μA
I_{BHL}	bus hold LOW sustaining current	V_I = 0.7 V; note 2	2.3	45	–	–	μA
		V_I = 0.8 V; note 2	3.0	75	150	–	μA
I_{BHH}	bus hold HIGH sustaining current	V_I = 1.7 V; note 2	2.3	–45	–	–	μA
		V_I = 2.0 V; note 2	3.0	–75	–175	–	μA
I_{BHLO}	bus hold LOW overdrive current	note 2	2.7	300	–	–	μA
			3.6	450	–	–	μA
I_{BHHO}	bus hold HIGH overdrive current	note 2	2.7	–300	–	–	μA
			3.6	–450	–	–	μA

Notes

1. All typical values are measured at T_{amb} = 25 °C.
2. Valid for data inputs of bus hold parts.

AC CHARACTERISTICS

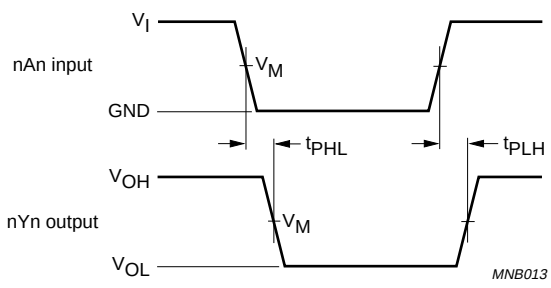
GND = 0 V; $t_r = t_f \leq 2.0$ ns and $C_L = 30$ pF for $V_{CC} < 2.7$ V; $t_r = t_f \leq 2.5$ ns and $C_L = 50$ pF for $V_{CC} \geq 2.7$ V.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = −40 to +85 °C; note 1							
t_{PHL}/t_{PLH}	propagation delay nAn to nYn	see Figs 5 and 7	1.2	–	5.8	–	ns
			1.8	1.5	2.8	5.1	ns
			2.3 to 2.7	1.0	1.9	3.7	ns
			2.7	1.0	2.1	3.6	ns
			3.0 to 3.6	1.0	1.9	3.0	ns
t_{PZH}/t_{PZL}	3-state output enable time $n\overline{OE}$ to nYn	see Figs 6 and 7	1.2	–	8.4	–	ns
			1.8	1.5	3.8	7.1	ns
			2.3 to 2.7	1.0	2.5	4.9	ns
			2.7	1.0	2.9	4.9	ns
			3.0 to 3.6	1.0	2.3	4.0	ns
t_{PHZ}/t_{PLZ}	3-state output disable time $n\overline{OE}$ to nYn	see Figs 6 and 7	1.2	–	5.9	–	ns
			1.8	1.5	3.1	5.4	ns
			2.3 to 2.7	1.0	2.1	4.1	ns
			2.7	1.0	3.0	4.5	ns
			3.0 to 3.6	1.0	2.7	4.1	ns

Note

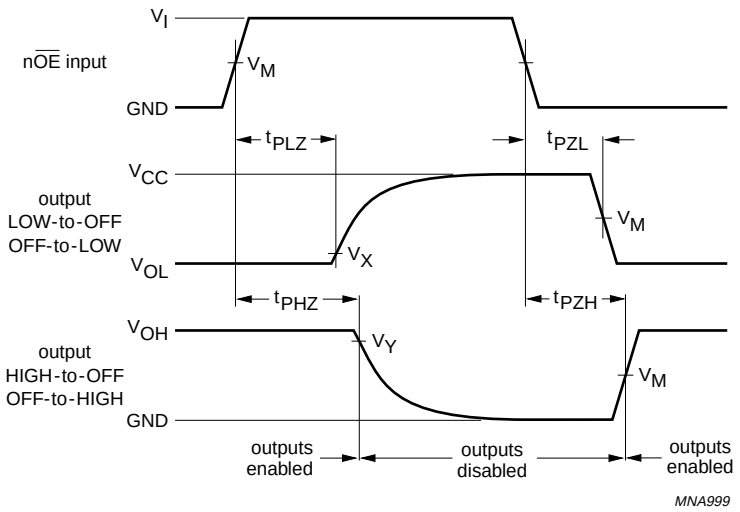
1. All typical values are measured at $T_{amb} = 25$ °C.
   Typical values for $V_{CC} = 2.3$ to 2.7 V are measured at $V_{CC} = 2.5$ V.
   Typical values for $V_{CC} = 3.3$ to 3.6 V are measured at $V_{CC} = 3.3$ V.

AC WAVEFORMS



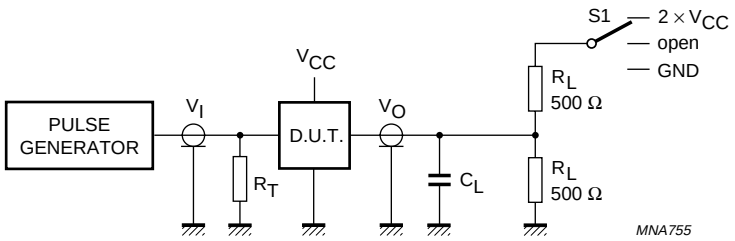
$V_M = 0.5V_{CC}$ at $V_{CC} < 2.7$ V and $V_M = 1.5$ V at $V_{CC} \geq 2.7$ V.
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

Fig.5 Input (nAn) to output (nYn) propagation delays.



$V_M = 0.5V_{CC}$ at $V_{CC} < 2.7$ V and $V_M = 1.5$ V at $V_{CC} \geq 2.7$ V.
$V_X = V_{OL} + 0.15$ V at $V_{CC} < 2.7$ V and $V_X = V_{OL} + 0.3$ V at $V_{CC} \geq 2.7$ V.
$V_Y = V_{OH} - 0.15$ V at $V_{CC} < 2.7$ V and $V_Y = V_{OH} - 0.3$ V at $V_{CC} \geq 2.7$ V.
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

Fig.6 3-state enable and disable times.



TEST	S1
t_{PLH}/t_{PHL}	open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

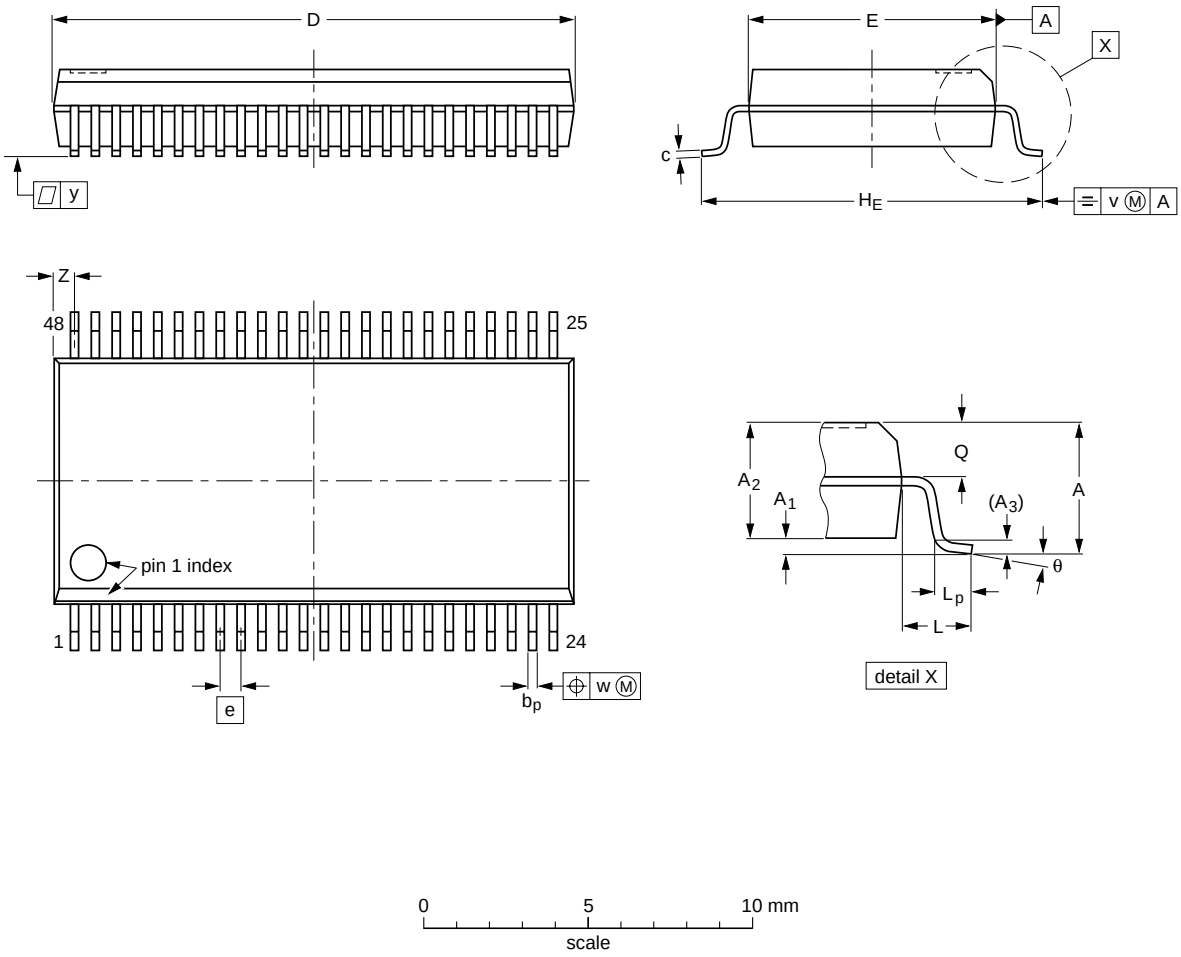
V_{CC}	V_I
<2.7 V	V_{CC}
2.7 to 3.6 V	2.7 V

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 Z_o of the pulse generator.

Fig.7 Load circuitry for switching times.

PACKAGE OUTLINES

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm **SOT370-1**



DIMENSIONS (mm are the original dimensions)

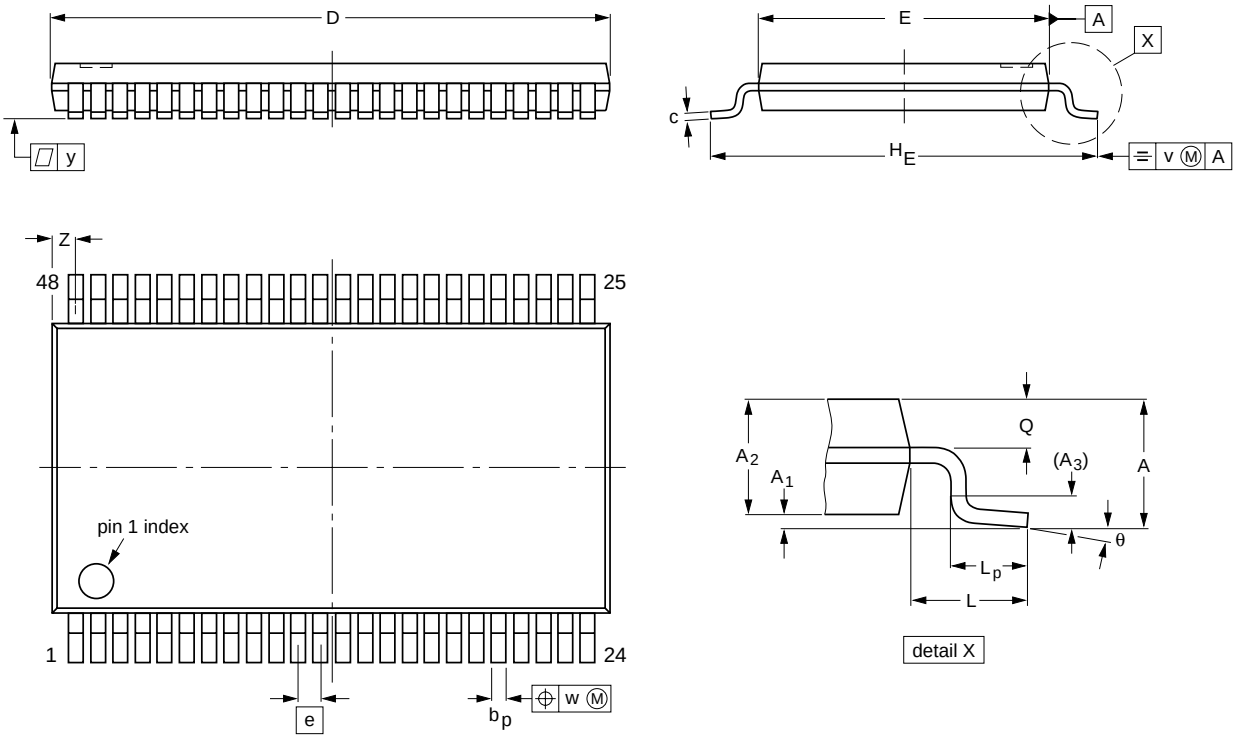
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8^o 0^o

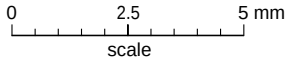
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT370-1		MO-118				~~99-12-27~~ 03-02-19

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm **SOT362-1**





DIMENSIONS (mm are the original dimensions).

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	Z	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	**0.2** **0.1**	12.6 12.4	6.2 6.0	0.5	8.3 7.9	1	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.8 0.4	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT362-1		MO-153				~~99-12-27~~ 03-02-19

SOLDERING

Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 220 °C (SnPb process) or below 245 °C (Pb-free process)
  - for all the BGA packages
  - for packages with a thickness ≥ 2.5 mm
  - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm^3 so called thick/large packages.
- below 235 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm^3 so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

  The footprint must incorporate solder thieves at the downstream end.
- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

Suitability of surface mount IC packages for wave and reflow soldering methods

PACKAGE[1]	SOLDERING METHOD	
	WAVE	REFLOW[2]
BGA, LBGA, LFBGA, SQFP, TFBGA, VFBGA	not suitable	suitable
DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS	not suitable[3]	suitable
PLCC[4], SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended[4][5]	suitable
SSOP, TSSOP, VSO, VSSOP	not recommended[6]	suitable

Notes

1. For more detailed information on the BGA packages refer to the *"(LF)BGA Application Note*" (AN01026); order a copy from your Philips Semiconductors sales office.
2. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
3. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
4. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
5. Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
6. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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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Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

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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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