INTEGRATED CIRCUITS

DATA SHEET

74AVC16244; 74AVCH16244

16-bit buffer/line driver; 3-state

Objective specification

1998 Dec 11

File under Integrated Circuits, IC24

Philips Semiconductors

PHILIPS

FEATURES

- **Wide supply voltage range of 1.2 V to 3.6 V**
- **Complies with JEDEC standard no. 8-1A/5/7**
- **CMOS low power consumption**
- **Input/Output tolerant up to 3.6 V**
- **DCO (Dynamic Controlled Output) Circuit dynamically changes output impedance, resulting in noise reduction without speed degradation**
- **Low inductance multiple V_{CC} and GND pins for minimize noise and ground bounce.**
- **All data inputs have bushold. (only 74AVCH16244)**
- **Power off disables 74AVC16244; 74AVCH16244 outputs, permitting Live Insertion.**

DESCRIPTION

The 74AVC(H)16244 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 input $1\overline{OE}$ and $2\overline{OE}$. A HIGH on $n\overline{OE}$ causes the outputs to assume a high impedance OFF-state.

This product is designed to have an extremely fast propagation delay and a minimum amount of power consumption.

To ensure the high-impedance output state during power up or power down, $\overline{OE}_n$ should be tied to V_{CC} through a pull up resistor (Live insertion).

A Dynamic Controlled Output (DCO) circuitry is implemented to support termination line drive during transient. See graphs at this page for typical curves.

The 74AVCH16244 has active bushold 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.

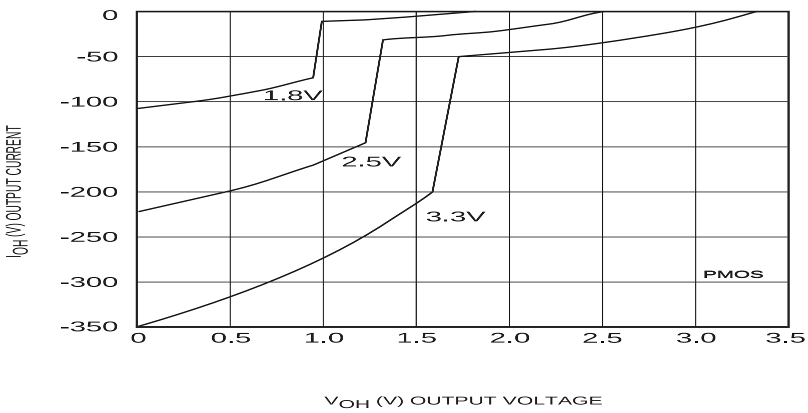
QUICK REFERENCE DATA

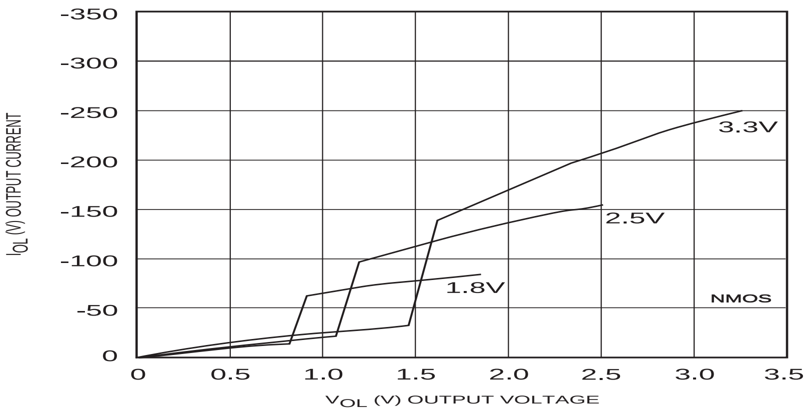
GND = 0 V; T_{amb} = 25 °C; $t_r = t_f \leq 2.0$ ns; C_L = 30 pF.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/ t_{PLH}	propagation delay A_n to Y_n	V_{CC} = 1.8 V	1.5	ns
		V_{CC} = 2.5 V	1.1	ns
		V_{CC} = 3.3 V	1.0	ns
t_{PHL}/ t_{PLH}	propagation delay A_n to Y_n	V_{CC} = 1.8 V(3)	1.5	ns
		V_{CC} = 2.5 V(3)	1.1	ns
		V_{CC} = 3.3 V(3)	1.0	ns
C_I	input capacitance		5.0	pF
C_{PD}	power dissipation capacitance per buffer	notes 1 and 2		
		outputs enabled	20	pF
		output disabled	4	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ 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 V;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.
2. The condition is V_I = GND to V_{CC}.
3. For type with bushold.





FUNCTION TABLE

See Note 1.

INPUTS		OUTPUTS
n$\overline{OE}$	nA_n	nY_n
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 AND PACKAGE INFORMATION

OUTSIDE NORTH AMERICA	NORTH AMERICA	PACKAGES				
		TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74AVC16244DGG		–40 to +85 °C	48	TSSOP	plastic	SOT362-1
74AVCH16244DGG		–40 to +85 °C	48	TSSOP	plastic	SOT362-1

PINNING

PIN	SYMBOL	DESCRIPTION
1	1$\overline{OE}$	Output enable input (active LOW)
2, 3, 5 and 6	$1Y_0$ to $1Y_3$	Data outputs
4, 10, 15, 21, 28, 34, 39 and 45	GND	Ground (0 V)
7,18, 31 and 42	V_{CC}	Positive supply voltage
8, 9, 11 and 12	$2Y_0$ to $2Y_3$	Data outputs
13, 14, 16 and 17	$3Y_0$ to $3Y_3$	Data outputs
19, 20, 22 and 23	$4Y_0$ to $4Y_3$	Data outputs
24	4$\overline{OE}$	Output enable input (active LOW)
25	3$\overline{OE}$	Output enable input (active LOW)
30, 29, 27 and 26	$4A_0$ to $4A_3$	Data inputs
36, 35, 33 and 32	$3A_0$ to $3A_3$	Data inputs
41, 40, 38 and 37	$2A_0$ to $2A_3$	Data inputs
47, 46, 44 and 43	$1A_0$ to $1A_3$	Data inputs
48	2$\overline{OE}$	Output enable input (active LOW)

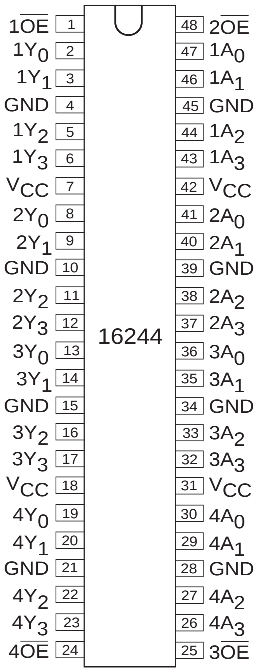


Fig.1 Pin configuration.

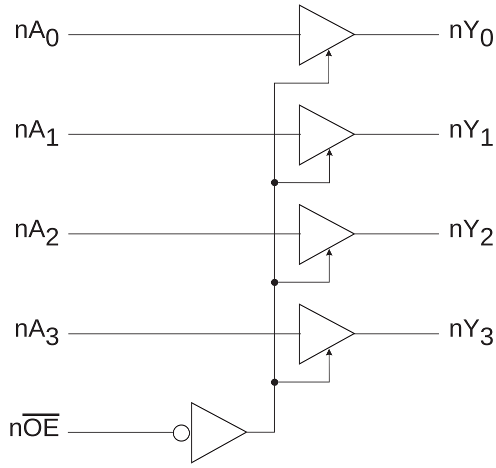


Fig.2 Logic symbol.

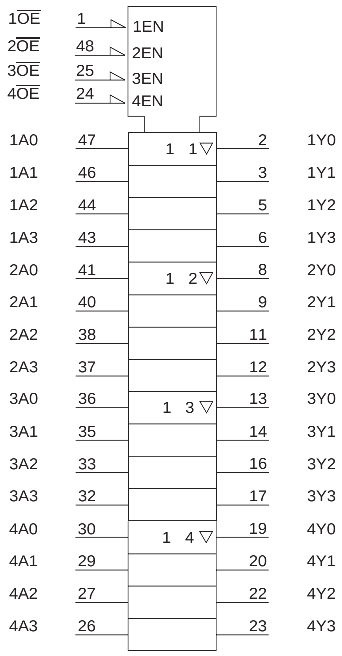


Fig.3 IEEE/IEC logic symbol.

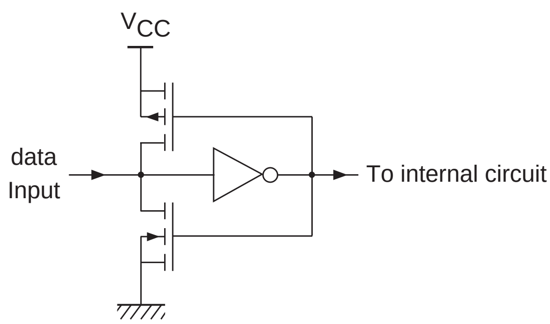


Fig.4 Bushold circuit.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	DC supply voltage				
	According JEDEC Low Voltage Standards		1.65	1.95	V
			2.3	2.7	V
			3.0	3.6	V
V_{CC}	DC supply voltage (for low-voltage applications)		1.2	3.6	V
V_I	DC input voltage range		0	3.6	V
V_O	DC output voltage range; output 3-state		0	3.6	V
V_O	DC output voltage range; output High or Low state		0	V_{CC}	V
T_{amb}	operating ambient temperature range	in free air	–40	+85	°C
t_r, t_f	input rise and fall times	V_{CC} = 1.65 to 2.3 V	0	30	ns/V
		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 134). Voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	DC supply voltage		–0.5	+4.6	V
I_{IK}	DC input diode current	$V_I < 0$	–	–50	mA
V_I	DC input voltage	for inputs; note 1	–0.5	4.6	V
I_{OK}	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	–	±50	mA
V_O	DC output voltage; output High or Low state	note 1	–0.5	V_{CC} + 0.5	V
V_O	DC output voltage; output 3-state	note 1	–0.5	4.6	V
I_O	DC output source or sink current	V_O = 0 to V_{CC}	–	±50	mA
I_{GND}, I_{CC}	DC V_{CC} or GND current		–	±100	mA
T_{stg}	storage temperature range		–65	+150	°C
P_{tot}	power dissipation per package	for temperature range: –40 to +125 °C			
	plastic thin-medium-shrink (TSSOP)	above +55 °C derate linearly with 8 mW/K	–	600	mW

Notes

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

DC CHARACTERISTICS

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

SYMBOL	PARAMETER	T_{amb} = –40 TO +85 °C			UNIT	TEST CONDITIONS		
		MIN.	TYP.[1]	MAX.		V_{CC} (V)	V_I (V)	OTHER
V_{IH}	HIGH level input voltage	V_{CC}	–	–	V	1.2		
		0.65V_{CC}	0.9	–	V	1.65 to 1.95		
		1.7	1.2	–	V	2.3 to 2.7		
		2.0	1.5	–	V	3.0 to 3.6		
V_{IL}	LOW level input voltage	–	–	GND	V	1.2		
		–	0.9	0.35V_{CC}	V	1.65 to 1.95		
		–	1.2	0.7	V	2.3 to 2.7		
		–	1.5	0.8	V	3.0 to 3.6		
V_{OH}	HIGH level output voltage	V_{CC}–0.20	V_{CC}	–	V	1.65 to 3.6	V_{IH} or V_{IL}	I_O = –100 μA
		V_{CC}–0.45	V_{CC}–0.10	–	V	1.65		I_O = –4 mA
		V_{CC}–0.55	V_{CC}–0.28	–	V	2.3		I_O = –8 mA
		V_{CC}–0.70	V_{CC}–0.32	–	V	3.0		I_O = –12 mA
V_{OL}	LOW level output voltage	–	GND	0.20	V	1.65 to 3.6	V_{IH} or V_{IL}	I_O = 100 μA
		–	0.10	0.45	V	1.65		I_O = 4 mA
		–	0.26	0.55	V	2.3		I_O = 8 mA
		–	0.36	0.70	V	3.0		I_O = 12 mA
I_I	input leakage current per pin	–	0.1	2.5	μA	1.65 to 3.6	V_{CC} or GND	
I_{OFF}	power off leakage current	–	0.1	±10	μA	0		V_I or V_O = 3.6
I_{IHZ}/I_{ILZ}	input current for common I/O pins	–	0.1	12.5	μA	1.65 to 3.6	V_{CC} or GND	
I_{OZ}	3-state output OFF–state current	–	0.1	5	μA	1.65 to 2.7	V_{IH} or V_{IL}	V_O = V_{CC} or GND
		–	0.1	10	μA	3.0 to 3.6		
I_{CC}	quiescent supply current	–	0.1	20	μA	1.65 to 2.7	V_{CC} or GND	I_O = 0
		–	0.2	40	μA	3.0 to 3.6		

Note

1. All typical values are measured at T_{amb} = 25 °C.

OPTIONAL: BUSHOLD SPECIFICATION FOR 74AVCH16244 ONLY

DC CHARACTERISTICS

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

SYMBOL	PARAMETER	T_{amb} = –40 TO +85 °C			UNIT	TEST CONDITIONS		
		MIN.	TYP.[1]	MAX.		V_{CC} (V)	V_I (V)	OTHER
I_{BHL}	bushold LOW sustaining current	25	–	–	μA	1.65	0.35V_{CC}	see note 2.
		45	–	–	μA	2.3	0.7 V	
		75	–	–	μA	3.0	0.8 V	

SYMBOL	PARAMETER	T_{amb} = –40 TO +85 °C			UNIT	TEST CONDITIONS		
		MIN.	TYP.[1]	MAX.		V_{CC} (V)	V_I (V)	OTHER
I_{BHH}	bushold HIGH sustaining current	–25	–	–	μA	1.65	$0.65V_{CC}$	see note 2.
		–45	–	–	μA	2.3	1.7 V	
		–75	–	–	μA	3.0	2.0 V	
I_{BHLO}	bushold LOW overdrive current	200	–	–	μA	1.95		see note 2.
		300	–	–	μA	2.7		
		450	–	–	μA	3.6		
I_{BHHO}	bushold HIGH overdrive current	–200	–	–	μA	1.95		see note 2.
		–300	–	–	μA	2.7		
		–450	–	–	μA	3.6		

Note

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

AC CHARACTERISTICS 74AVC16244

GND = 0 V; $t_r = t_f \leq 2.0$ ns; $C_L = 30$ pF.

SYMBOL	PARAMETER	$T_{amb} = -40$ to $+85$ °C			UNIT	TEST CONDITIONS	
		MIN.	TYP.[1]	MAX.		V_{CC} (V)	WAVEFORMS
t_{PHL}/t_{PLH}	propagation delay nA_n to nY_n	1.6	2.6	4.0	ns	1.2	see Fig.5, Fig.7
		0.9	1.5[2]	3.2	ns	1.65 to 1.95	
		0.8	1.1[2]	1.9	ns	2.3 to 2.7	
		0.7	1.0[2]	1.7	ns	3.0 to 3.6	
t_{PZH}/t_{PZL}	3-state output enable time $n\overline{OE}_n$ to nY_n	–	5.0	–	ns	1.2	see Fig.6, Fig.7
		1.6	2.1[2]	5.5	ns	1.65 to 1.95	
		1.3	1.6[2]	4.5	ns	2.3 to 2.7	
		1.2	1.4[2]	4.0	ns	3.0 to 3.6	
t_{PHZ}/t_{PLZ}	3-state output disable time $n\overline{OE}_n$ to nY_n	–	5.0	–	ns	1.2	see Fig.6, Fig.7
		2.4	3.0[2]	5.0	ns	1.65 to 1.95	
		1.3	1.6[2]	4.0	ns	2.3 to 2.7	
		1.3	1.7[2]	3.5	ns	3.0 to 3.6	

Note

1. All typical values are measured at $T_{amb} = 25$ °C.
2. Typical value is measured at $V_{CC} = 1.8$ V, $V_{CC} = 2.5$ V, $V_{CC} = 3.3$ V.

AC CHARACTERISTICS 74AVCH16244

GND = 0 V; $t_r = t_f \leq 2.0$ ns; $C_L = 30$ pF.

SYMBOL	PARAMETER	$T_{amb} = -40$ to $+85$ °C			UNIT	TEST CONDITIONS	
		MIN.	TYP.[1]	MAX.		V_{CC} (V)	WAVEFORMS
t_{PHL}/t_{PLH}	propagation delay nA_n to nY_n	1.6	2.6	4.1	ns	1.2	see Fig.5, Fig.7
		0.9	1.5[2]	3.3	ns	1.65 to 1.95	
		0.8	1.1[2]	2.0	ns	2.3 to 2.7	
		0.7	1.0[2]	1.8	ns	3.0 to 3.6	
t_{PZH}/t_{PZL}	3-state output enable time $n\overline{OE}_n$ to nY_n	–	5.0	–	ns	1.2	see Fig.6, Fig.7
		1.6	2.1[2]	5.5	ns	1.65 to 1.95	
		1.3	1.6[2]	4.5	ns	2.3 to 2.7	
		1.2	1.4[2]	4.0	ns	3.0 to 3.6	
t_{PHZ}/t_{PLZ}	3-state output disable time $n\overline{OE}_n$ to nY_n	–	5.0	–	ns	1.2	see Fig.6, Fig.7
		2.4	3.0[2]	5.0	ns	1.65 to 1.95	
		1.3	1.6[2]	4.0	ns	2.3 to 2.7	
		1.3	1.7[2]	3.5	ns	3.0 to 3.6	

Note

1. All typical values are measured at $T_{amb} = 25$ °C.
2. Typical value is measured at $V_{CC} = 1.8$ V, $V_{CC} = 2.5$ V, $V_{CC} = 3.3$ V.

AC WAVEFORMS

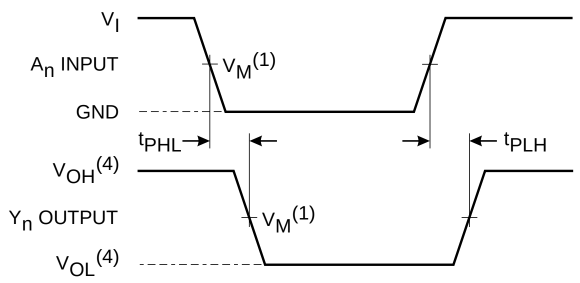


Fig.5 The input (A_n) to output (Y_n) propagation delay.

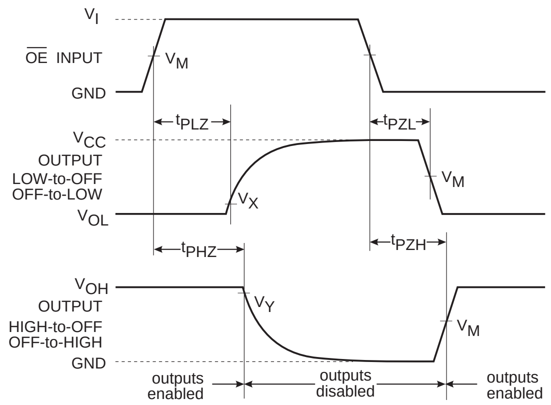
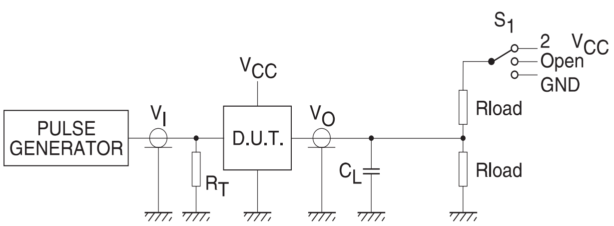


Fig.6 The 3-state enable and disable times.



TEST	SWITCH
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2V_{CC}$
t_{PHZ}/t_{PZH}	GND

V_{CC}	V_I	R_{LOAD}
< 2.3 V	V_{CC}	1000Ω
2.3 - 2.7 V	V_{CC}	500Ω
3.0 - 3.6 V	2.7 V	500Ω

Fig.7 Load circuitry for switching times.

NOTES: V_{CC} = 2.3 TO 2.7 V RANGE AND V_{CC} < 2.3 V

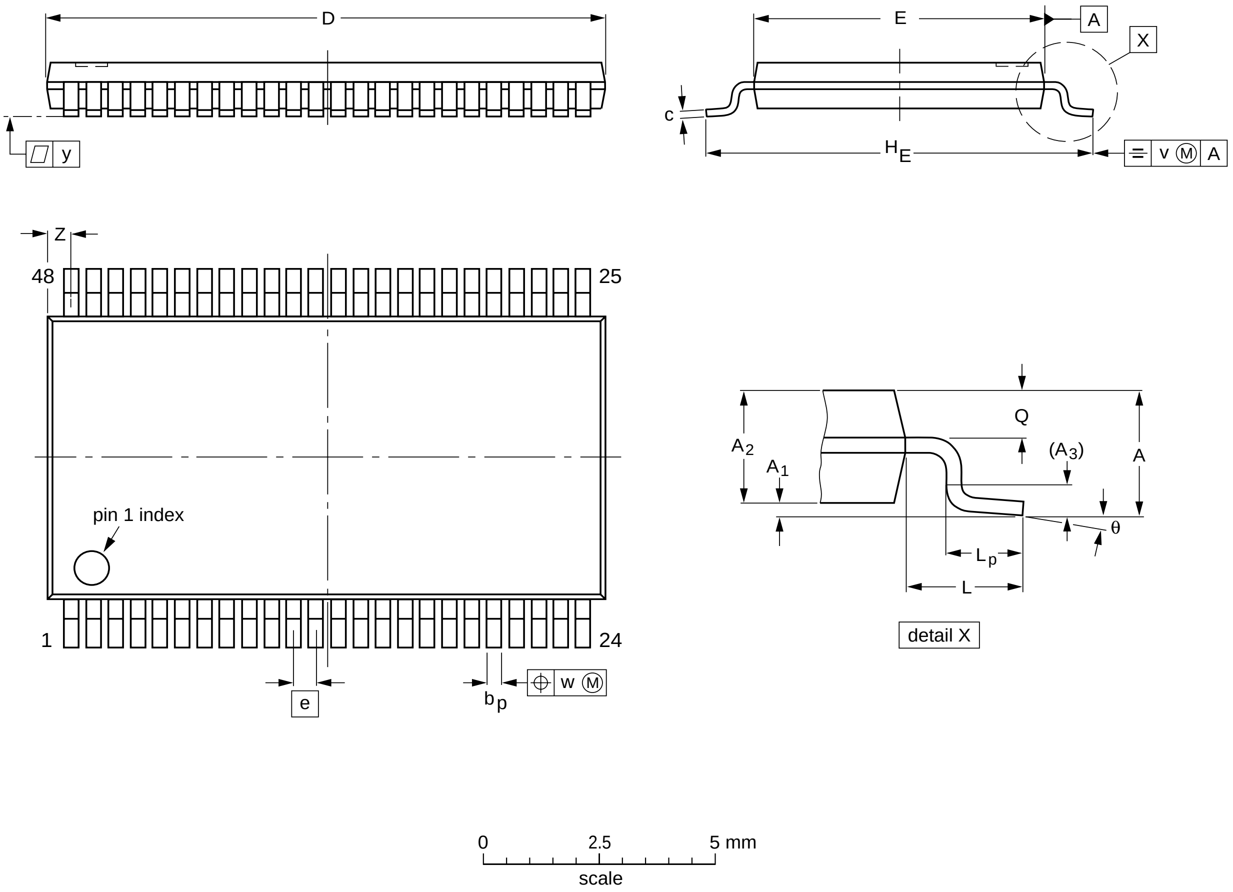
1. $V_M = 0.5V_{CC}$
2. $V_X = V_{OL} + 150$ mV
3. $V_Y = V_{OH} - 150$ mV
4. $V_I = V_{CC}$
5. V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

NOTES: V_{CC} = 3.0 TO 3.6 V RANGE

1. $V_M = 0.5V_{CC}$
2. $V_X = V_{OL} + 300$ mV
3. $V_Y = V_{OH} - 300$ mV
4. $V_I = 2.7$ V
5. V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

PACKAGE OUTLINE

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	EIAJ				
SOT362-1		MO-153ED					~~93-02-03~~ 95-02-10

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 is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

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.

Several methods exist for reflowing; for example, infrared/convection 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 250 °C. The top-surface temperature of the packages should preferable be kept below 230 °C.

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 is 4 seconds at 250 °C.
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	SOLDERING METHOD	
	WAVE	REFLOW[1]
BGA, SQFP	not suitable	suitable
HLQFP, HSQFP, HSOP, SMS	not suitable[2]	suitable
PLCC[3], SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended[3][4]	suitable
SSOP, TSSOP, VSO	not recommended[5]	suitable

Notes

1. 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"*.
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. 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.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP 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.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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