# DATA SHEET

## 74ALVT16244

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

Product specification
Supersedes data of 1998 Feb 13
IC23 Data Handbook

1998 Oct 07

Philips
Semiconductors

PHILIPS

# 2.5V/3.3V 16-bit buffer/driver (3-State) 74ALVT16244

## FEATURES

- 16-bit bus interface
- 5V I/O compatibile
- 3-State buffers
- Output capability: +64mA/-32mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- Power-up 3-State
- No bus current loading when output is tied to 5V bus
- Latch-up protection exceeds 500mA per JEDEC Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model

## DESCRIPTION

The 74ALVT16244 is a high-performance BiCMOS product designed for $V_{CC}$ operation at 2.5V or 3.3V with I/O compatibility up to 5V.

This device is a 16-bit buffer and line driver featuring non-inverting 3-State bus outputs. The device can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer.

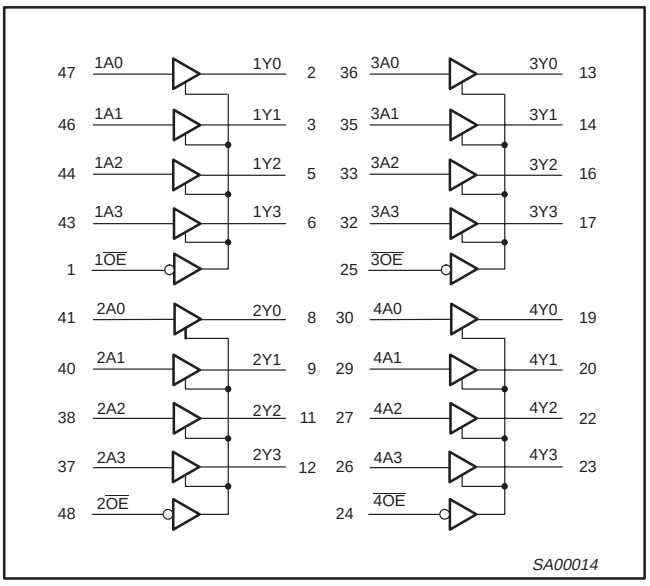
## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS $T_{amb}$ = 25°C | TYPICAL | | UNIT |
|---|---|---|---|---|---|
| | | | 2.5V | 3.3V | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nYx | $C_L$ = 50pF | 1.8<br>1.9 | 1.5<br>1.5 | ns |
| $C_{IN}$ | Input capacitance DIR, $\overline{OE}$ | $V_I$ = 0V or $V_{CC}$ | 3 | 3 | pF |
| $C_{Out}$ | Output capacitance | $V_{I/O}$ = 0V or $V_{CC}$ | 9 | 9 | pF |
| $I_{CCZ}$ | Total supply current | Outputs disabled | 40 | 70 | µA |

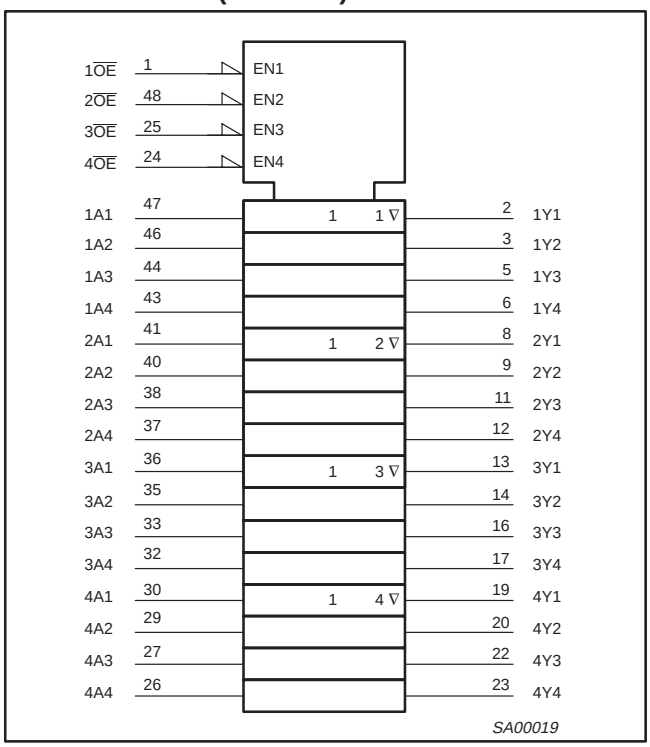
## ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|---|---|---|---|---|
| 48-Pin Plastic SSOP Type III | –40°C to +85°C | 74ALVT16244 DL | AV16244 DL | SOT370-1 |
| 48-Pin Plastic TSSOP Type II | –40°C to +85°C | 74ALVT16244 DGG | AV16244 DGG | SOT362-1 |

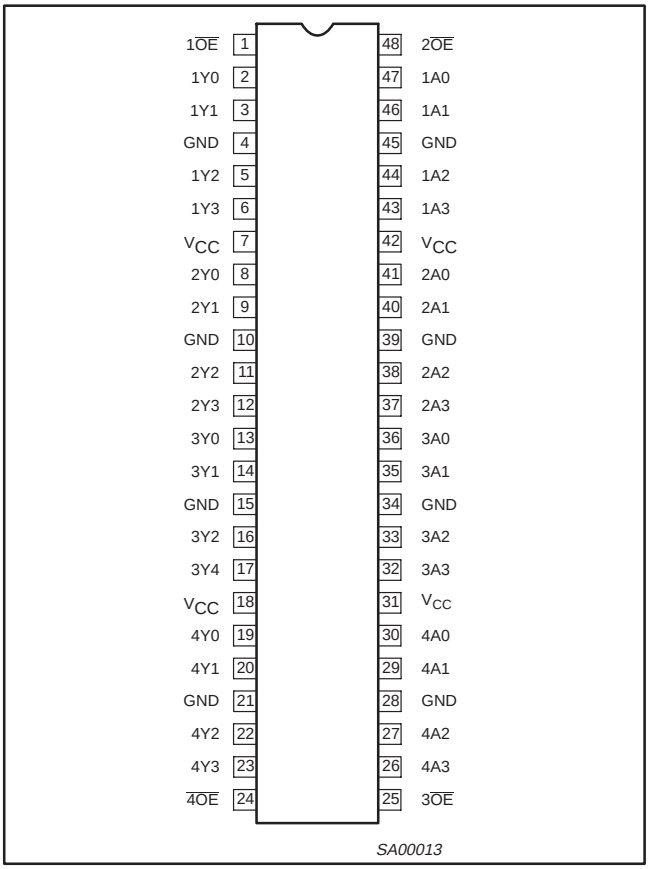
## LOGIC SYMBOL




## LOGIC SYMBOL (IEEE/IEC)



## PIN CONFIGURATION




SA00013

## PIN DESCRIPTION

| PIN NUMBER | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 47, 46, 44, 43<br>41, 40, 38, 37<br>36, 35, 33, 32<br>30, 29, 27, 26 | 1A0 - 1A3,<br>2A0 - 2A3,<br>3A0 - 3A3,<br>4A0 - 4A3 | Data inputs |
| 2, 3, 5, 6<br>8, 9, 11, 12<br>13, 14, 16, 17<br>19, 20, 22, 23 | 1Y0 - 1Y3,<br>2Y0 - 2Y3,<br>3Y0 - 3Y3,<br>4Y0 - 4Y3 | Data outputs |
| 1, 48<br>25, 24 | 1$\overline{OE}$, 2$\overline{OE}$,<br>3$\overline{OE}$, 4$\overline{OE}$ | Output enables |
| 4, 10, 15, 21<br>28, 34, 39, 45 | GND | Ground (0V) |
| 7, 18, 31, 42 | $V_{CC}$ | Positive supply voltage |

## FUNCTION TABLE

| INPUTS | | OUTPUTS |
|---|---|---|
| n$\overline{OE}$ | nAx | nYx |
| L | L | L |
| L | H | H |
| H | X | Z |

H = High voltage level
L = Low voltage level
X = Don't care
Z = High Impedance "off" state

## ABSOLUTE MAXIMUM RATINGS[1, 2]

| SYMBOL | PARAMETER | CONDITIONS | RATING | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | DC supply voltage | | -0.5 to +4.6 | V |
| $I_{IK}$ | DC input diode current | $V_I < 0$ | -50 | mA |
| $V_I$ | DC input voltage[3] | | -0.5 to +7.0 | V |
| $I_{OK}$ | DC output diode current | $V_O < 0$ | -50 | mA |
| $V_{OUT}$ | DC output voltage[3] | Output in Off or High state | -0.5 to +7.0 | V |
| $I_{OUT}$ | DC output current | Output in Low state | 128 | mA |
| | | Output in High state | -64 | |
| $T_{stg}$ | Storage temperature range | | -65 to +150 | °C |

**NOTES:**
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 those indicated under "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. The maximum junction temperature of this integrated circuit should not exceed 150°C.
3. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | 2.5V RANGE LIMITS | | 3.3V RANGE LIMITS | | UNIT |
|---|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX | |
| $V_{CC}$ | DC supply voltage | 2.3 | 2.7 | 3.0 | 3.6 | V |
| $V_I$ | Input voltage | 0 | 5.5 | 0 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | 1.7 | | 2.0 | | V |
| $V_{IL}$ | Input voltage | | 0.7 | | 0.8 | V |
| $I_{OH}$ | High-level output current | | –8 | | –32 | mA |
| $I_{OL}$ | Low-level output current | | 8 | | 32 | mA |
| | Low-level output current; current duty cycle ≤ 50%; f ≥ 1kHz | | 24 | | 64 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate; Outputs enabled | | 10 | | 10 | ns/V |
| $T_{amb}$ | Operating free-air temperature range | –40 | +85 | –40 | +85 | °C |

## DC ELECTRICAL CHARACTERISTICS (3.3V ±0.3V RANGE)

| SYMBOL | PARAMETER | TEST CONDITIONS | | LIMITS Temp = -40°C to +85°C | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP[1] | MAX | |
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = 3.0V; $I_{IK}$ = –18mA | | | –0.85 | –1.2 | V |
| $V_{OH}$ | High-level output voltage | $V_{CC}$ = 3.0 to 3.6V; $I_{OH}$ = –100µA | | $V_{CC}$–0.2 | $V_{CC}$ | | V |
| | | $V_{CC}$ = 3.0V; $I_{OH}$ = –32mA | | 2.0 | 2.3 | | |
| $V_{OL}$ | Low–level output voltage | $V_{CC}$ = 3.0V; $I_{OL}$ = 100µA | | | 0.07 | 0.2 | V |
| | | $V_{CC}$ = 3.0V; $I_{OL}$ = 16mA | | | 0.25 | 0.4 | |
| | | $V_{CC}$ = 3.0V; $I_{OL}$ = 32mA | | | 0.3 | 0.5 | |
| | | $V_{CC}$ = 3.0V; $I_{OL}$ = 64mA | | | 0.4 | 0.55 | |
| $I_I$ | Input leakage current | $V_{CC}$ = 3.6V; $V_I$ = $V_{CC}$ or GND | Control pins | | 0.1 | ±1 | µA |
| | | $V_{CC}$ = 0 or 3.6V; $V_I$ = 5.5V | | | 01. | 10 | |
| | | $V_{CC}$ = 3.6V; $V_I$ = $V_{CC}$ | Data pins[4] | | 0.5 | 1 | |
| | | $V_{CC}$ = 3.6V; $V_I$ = 0V | | | 0.1 | -5 | |
| $I_{OFF}$ | Off current | $V_{CC}$ = 0V; $V_I$ or $V_O$ = 0 to 4.5V | | | 0.1 | ±100 | µA |
| $I_{HOLD}$ | Bus Hold current Data inputs[6] | $V_{CC}$ = 3V; $V_I$ = 0.8V | | 75 | 130 | | µA |
| | | $V_{CC}$ = 3V; $V_I$ = 2.0V | | –75 | –140 | | |
| | | $V_{CC}$ = 0V to 3.6V; $V_{CC}$ = 3.6V | | ±500 | | | |
| $I_{EX}$ | Current into an output in the High state when $V_O$ > $V_{CC}$ | $V_O$ = 5.5V; $V_{CC}$ = 3.0V | | | 10 | 125 | µA |
| $I_{PU/PD}$ | Power up/down 3-State output current[3] | $V_{CC}$ ≤ 1.2V; $V_O$ = 0.5V to $V_{CC}$; $V_I$ = GND or $V_{CC}$ $\overline{OE}$ = Don't care | | | 1 | ±100 | µA |
| $I_{OZH}$ | 3-State output High current | $V_{CC}$ = 3.6V; $V_O$ = 3.0V; $V_I$ = $V_{IL}$ or $V_{IH}$ | | | 0.5 | 5 | µA |
| $I_{OZL}$ | 3-State output Low current | $V_{CC}$ = 3.6V; $V_O$ = 0.5V; $V_I$ = $V_{IL}$ or $V_{IH}$ | | | 0.5 | –5 | µA |
| $I_{CCH}$ | Quiescent supply current | $V_{CC}$ = 3.6V; Outputs High, $V_I$ = GND or $V_{CC}$, $I_O$ = 0 | | | 0.05 | 0.1 | mA |
| $I_{CCL}$ | | $V_{CC}$ = 3.6V; Outputs Low, $V_I$ = GND or $V_{CC}$, $I_O$ = 0 | | | 3.6 | 5 | |
| $I_{CCZ}$ | | $V_{CC}$ = 3.6V; Outputs Disabled; $V_I$ = GND or $V_{CC}$, $I_O$ = 0[5] | | | 0.06 | 0.1 | |
| $\Delta I_{CC}$ | Additional supply current per input pin[2] | $V_{CC}$ = 3V to 3.6V; One input at $V_{CC}$–0.6V, Other inputs at $V_{CC}$ or GND | | | 0.04 | 0.4 | mA |

**NOTES:**
1. All typical values are at $V_{CC}$ = 3.3V and $T_{amb}$ = 25°C.
2. This is the increase in supply current for each input at the specified voltage level other than $V_{CC}$ or GND
3. This parameter is valid for any $V_{CC}$ between 0V and 1.2V with a transition time of up to 10msec. From $V_{CC}$ = 1.2V to $V_{CC}$ = 3.3V ± 0.3V a transition time of 100µsec is permitted. This parameter is valid for $T_{amb}$ = 25°C only.
4. Unused pins at $V_{CC}$ or GND.
5. $I_{CCZ}$ is measured with outputs pulled up to $V_{CC}$ or pulled down to ground.
6. This is the bus hold overdrive current required to force the input to the opposite logic state.

## AC CHARACTERISTICS (3.3V ±0.3V RANGE)

GND = 0V; $t_R = t_F$ = 2.5ns; $C_L$ = 50pF; $R_L$ = 500Ω; $T_{amb}$ = –40°C to +85°C.

| SYMBOL | PARAMETER | WAVEFORM | LIMITS | | | UNIT |
|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = 3.3V ±0.3V | | | |
| | | | MIN | TYP[1] | MAX | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nYx | 1 | 0.8<br>0.8 | 1.5<br>1.5 | 2.4<br>2.5 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>to High and Low level | 2 | 1.0<br>0.5 | 2.3<br>1.8 | 3.8<br>2.9 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>from High and Low Level | 2 | 1.5<br>1.5 | 2.7<br>2.3 | 4.2<br>3.6 | ns |

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

## DC ELECTRICAL CHARACTERISTICS (2.5V ±0.2V RANGE)

| SYMBOL | PARAMETER | TEST CONDITIONS | | LIMITS | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | Temp = -40°C to +85°C | | | |
| | | | | MIN | TYP[1] | MAX | |
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = 2.3V; $I_{IK}$ = –18mA | | | –0.85 | –1.2 | V |
| $V_{OH}$ | High-level output voltage | $V_{CC}$ = 2.3 to 2.7V; $I_{OH}$ = –100µA | | $V_{CC}$–0.2 | $V_{CC}$ | | V |
| | | $V_{CC}$ = 2.3V; $I_{OH}$ = –8mA | | 1.8 | 2.5 | | |
| $V_{OL}$ | Low-level output voltage | $V_{CC}$ = 2.3V; $I_{OL}$ = 100µA | | | 0.07 | 0.2 | |
| | | $V_{CC}$ = 2.3V; $I_{OL}$ = 24mA | | | 0.3 | 0.5 | |
| $I_I$ | Input leakage current | $V_{CC}$ = 2.7V; $V_I$ = $V_{CC}$ or GND | Control pins | | 0.1 | ±1 | µA |
| | | $V_{CC}$ = 0 or 2.7V; $V_I$ = 5.5V | | | 0.1 | 10 | |
| | | $V_{CC}$ = 2.7V; $V_I$ = $V_{CC}$ | Data pins[4] | | 0.1 | 1 | |
| | | $V_{CC}$ = 2.7V; $V_I$ = 0 | | | 0.1 | -5 | |
| $I_{OFF}$ | Off current | $V_{CC}$ = 0V; $V_I$ or $V_O$ = 0 to 4.5V | | | 0.1 | ±100 | µA |
| $I_{HOLD}$ | Bus Hold current<br>Data inputs[6] | $V_{CC}$ = 2.3V; $V_I$ = 0.7V | | | 115 | | µA |
| | | $V_{CC}$ = 2.3V; $V_I$ = 1.7V | | | –10 | | |
| $I_{EX}$ | Current into an output in the High state when $V_O > V_{CC}$ | $V_O$ = 5.5V; $V_{CC}$ = 2.3V | | | 10 | 125 | µA |
| $I_{PU/PD}$ | Power up/down 3-State output current[3] | $V_{CC} \leq$ 1.2V; $V_O$ = 0.5V to $V_{CC}$; $V_I$ = GND or $V_{CC}$; OE/$\overline{OE}$ = Don't care | | | 1 | ±100 | µA |
| $I_{OZH}$ | 3-State output High current | $V_{CC}$ = 2.7V; $V_O$ = 2.3V; $V_I$ = $V_{IL}$ or $V_{IH}$ | | | 0.5 | 5 | µA |
| $I_{OZL}$ | 3-State output Low current | $V_{CC}$ = 2.7V; $V_O$ = 0.5V; $V_I$ = $V_{IL}$ or $V_{IH}$ | | | 0.5 | –5 | µA |
| $I_{CCH}$ | Quiescent supply current | $V_{CC}$ = 2.7V; Outputs High, $V_I$ = GND or $V_{CC}$, $I_O$ = 0 | | | 0.04 | 0.1 | mA |
| $I_{CCL}$ | | $V_{CC}$ = 2.7V; Outputs Low, $V_I$ = GND or $V_{CC}$, $I_O$ = 0 | | | 2.5 | 4.5 | |
| $I_{CCZ}$ | | $V_{CC}$ = 2.7V; Outputs Disabled; $V_I$ = GND or $V_{CC}$, $I_O$ = 0[5] | | | 0.04 | 0.1 | |
| $\Delta I_{CC}$ | Additional supply current per input pin[2] | $V_{CC}$ = 2.3V to 2.7V; One input at $V_{CC}$–0.6V, Other inputs at $V_{CC}$ or GND | | | 0.04 | 0.4 | mA |

**NOTES:**
1. All typical values are at $V_{CC}$ = 2.5V and $T_{amb}$ = 25°C.
2. This is the increase in supply current for each input at the specified voltage level other than $V_{CC}$ or GND
3. This parameter is valid for any $V_{CC}$ between 0V and 1.2V with a transition time of up to 10msec. From $V_{CC}$ = 1.2V to $V_{CC}$ = 2.5V ± 0.2V a transition time of 100µsec is permitted. This parameter is valid for $T_{amb}$ = 25°C only.
4. Unused pins at $V_{CC}$ or GND.
5. $I_{CCZ}$ is measured with outputs pulled up to $V_{CC}$ or pulled down to ground.
6. Not guaranteed.

## AC CHARACTERISTICS (2.5V ±0.2V RANGE)

GND = 0V; $t_R = t_F$ = 2.5ns; $C_L$ = 50pF; $R_L$ = 500Ω; $T_{amb}$ = –40°C to +85°C.

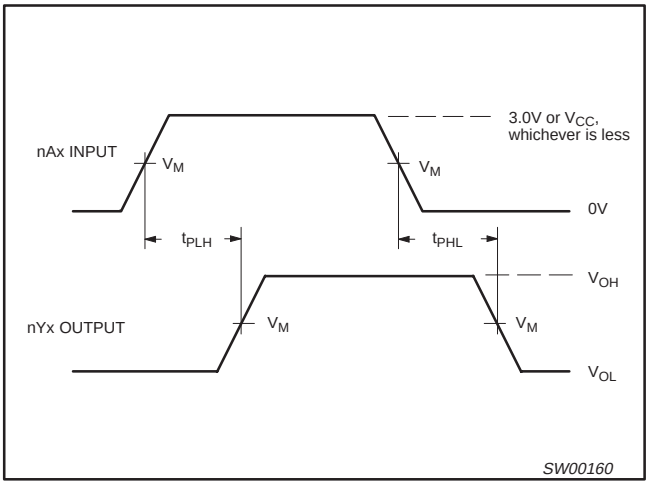
| SYMBOL | PARAMETER | WAVEFORM | LIMITS | | | UNIT |
|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = 2.5V ±0.2V | | | |
| | | | MIN | TYP[1] | MAX | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nYx | 1 | 1.0<br>1.0 | 1.8<br>1.9 | 3.0<br>3.5 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>to High and Low level | 2 | 2.0<br>1.5 | 3.1<br>2.5 | 5.9<br>4.7 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>from High and Low Level | 2 | 1.5<br>1.0 | 2.7<br>2.0 | 4.4<br>3.4 | ns |

**NOTE:**

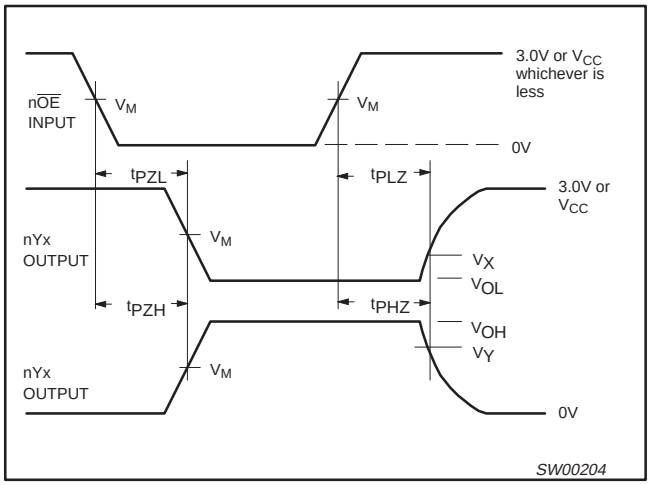
1. All typical values are at $V_{CC}$ = 2.5V and $T_{amb}$ = 25°C.

## AC WAVEFORMS

$V_M$ = 1.5V at $V_{CC} \geq$ 3.0V; $V_M = V_{CC}/2$ at $V_{CC} \leq$ 2.7V
$V_X = V_{OL}$ + 0.3V at $V_{CC} \geq$ 3.0V; $V_X = V_{OL}$ + 0.15V at $V_{CC} \leq$ 2.7V
$V_Y = V_{OH}$ – 0.3V at $V_{CC} \geq$ 3.0V; $V_Y = V_{OH}$ – 0.15V at $V_{CC} \leq$ 2.7V

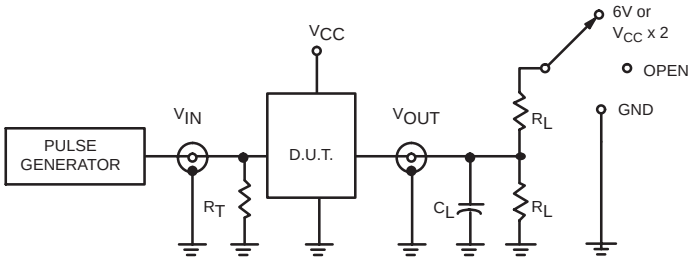



**Waveform 1. Input (nAx) to Output (nYx) Propagation Delays**

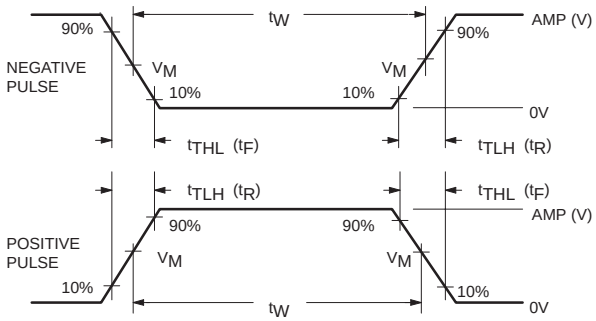



**Waveform 2. 3-State Output Enable and Disable Times**

## TEST CIRCUIT AND WAVEFORMS




**Test Circuit for 3-State Outputs**




**$V_M$ = 1.5V or $V_{CC}$ / 2, whichever is less**
**Input Pulse Definition**

### SWITCH POSITION

| TEST | SWITCH |
|---|---|
| $t_{PHZ}/t_{PZH}$ | GND |
| $t_{PLZ}/t_{PZL}$ | 6V or $V_{CC}$ x 2 |
| $t_{PLH}/t_{PHL}$ | open |

### DEFINITIONS

$R_L$ = Load resistor; see AC CHARACTERISTICS for value.

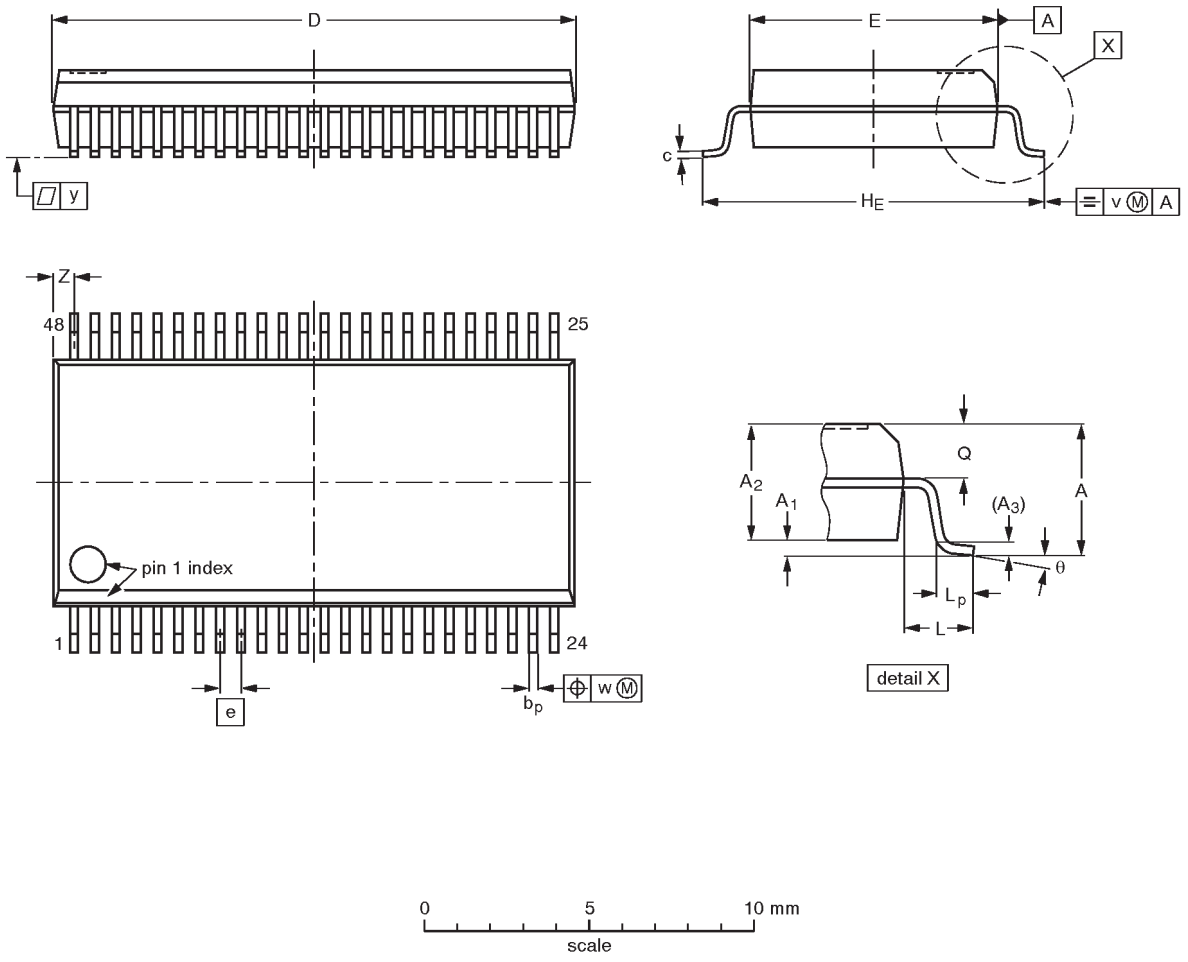
$C_L$ = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

$R_T$ = Termination resistance should be equal to $Z_{OUT}$ of pulse generators.

| FAMILY | INPUT PULSE REQUIREMENTS | | | | |
|---|---|---|---|---|---|
| | Amplitude | Rep. Rate | $t_W$ | $t_R$ | $t_F$ |
| 74ALVT16 | 3.0V or $V_{CC}$ whichever is less | ≤10MHz | 500ns | ≤2.5ns | ≤2.5ns |

*SW00162*

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




**DIMENSIONS (mm are the original dimensions)**

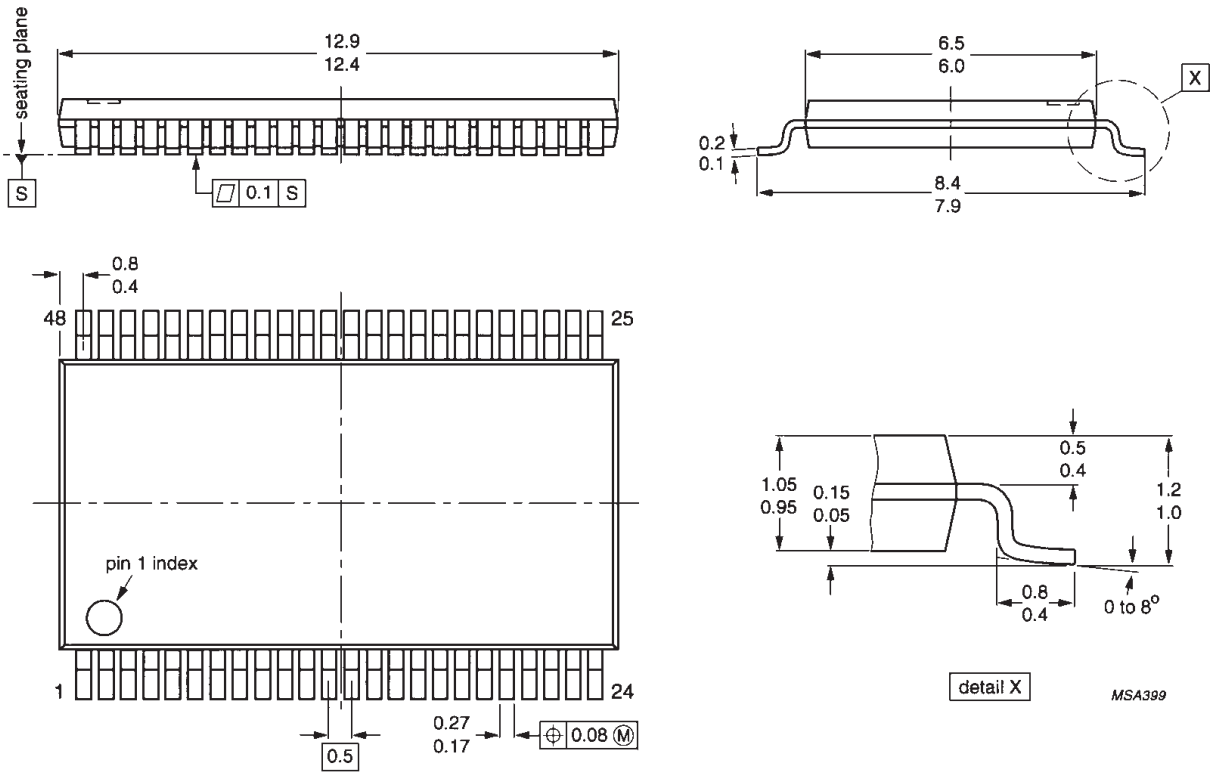
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (1) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.8 | 0.4<br>0.2 | 2.35<br>2.20 | 0.25 | 0.3<br>0.2 | 0.22<br>0.13 | 16.00<br>15.75 | 7.6<br>7.4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

**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 | EIAJ | | | |
| SOT370-1 | | MO-118AA | | | | ~~93-11-02~~<br>95-02-04 |

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




Dimensions in mm.

## Data sheet status

| Data sheet status | Product status | Definition [1] |
|---|---|---|
| Objective specification | Development | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice. |
| Preliminary specification | Qualification | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make chages at any time without notice in order to improve design and supply the best possible product. |
| Product specification | Production | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

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

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