DATA SHEET

74ALVCH16540

2.5V/3.3V 16-bit buffer/line driver, inverting, 5V input tolerant (3-State)

Product specification
Supersedes data of 1996 Feb 07
IC24 Data Handbook

1997 Aug 11

Philips
Semiconductors

PHILIPS

16-bit buffer/line driver, inverting, 5V input tolerant (3-State)

74ALVCH16540

FEATURES

- Wide supply voltage range of 1.2 V to 3.6 V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- MULTIBYTE™ flow-through standard pin-out architecture
- Low inductance multiple V_{CC} and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Bus hold on all data inputs eliminates the need for external pull-up resistors to hold unused inputs
- Output drive capability 50Ω transmission lines @ 85°C

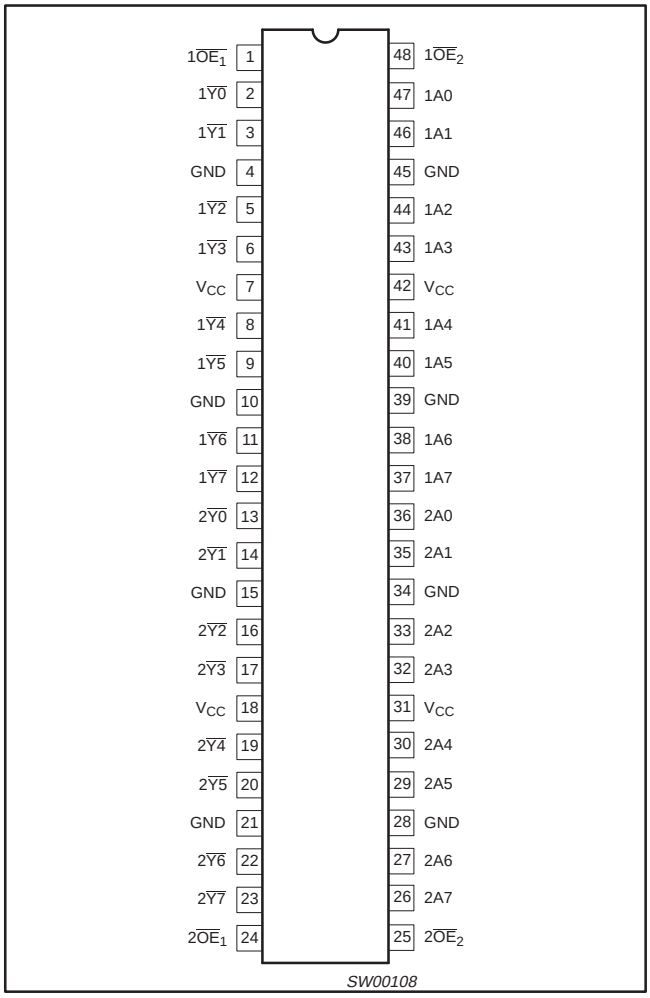
DESCRIPTION

The 74ALVCH16540 is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

The 74ALVCH16540 is a 16-bit inverting buffer/line driver with 3-State outputs. The 3-State outputs are controlled by the output enable inputs $1\overline{OE}_n$ and $2\overline{OE}_n$. A HIGH on $n\overline{OE}_n$ causes the outputs to assume a high impedance OFF-state.

Active bus hold circuitry 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 device can be used as four 4-bit buffers, two 8-bit buffers or one 16-bit buffer.

PIN CONFIGURATION



QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS		TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay 1An to 1Yn; 2An to 2Yn	C_L = 50pF, V_{CC} = 3.3V		1.8	ns
		C_L = 30pF, V_{CC} = 2.5V		1.8	ns
C_I	Input capacitance			5.0	pF
C_{PD}	Power dissipation capacitance per buffer	V_I = GND to V_{CC}[1]	Outputs enabled	26	pF
			Outputs disabled	5	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; C_L = output load capacitance in pF;
   f_o = output frequency in MHz; V_{CC} = supply voltage in V;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

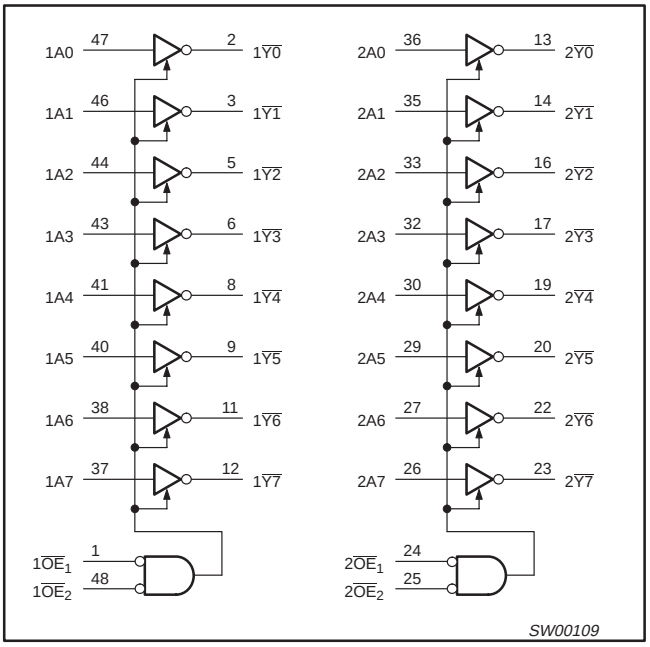
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	–40°C to +85°C	74ALVCH16540 DL	ACH16540 DL	SOT370-1
48-Pin Plastic TSSOP Type II	–40°C to +85°C	74ALVCH16540 DGG	ACH16540 DGG	SOT362-1

PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1, 24	$n\overline{OE}_1$	Output enable input (active LOW)
2, 3, 5, 6, 8, 9, 11, 12	1Y0 to 1Y7	Data outputs
13, 14, 16, 17, 19, 20, 22, 23	2Y0 to 2Y7	
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V_{CC}	Positive supply voltage
25, 48	$n\overline{OE}_2$	Output enable input (active LOW)
36, 35, 33, 32, 30, 29, 27, 26	2A0 to 2A7	Data inputs
47, 46, 44, 43, 41, 40, 38, 37	1A0 to 1A7	

LOGIC SYMBOL

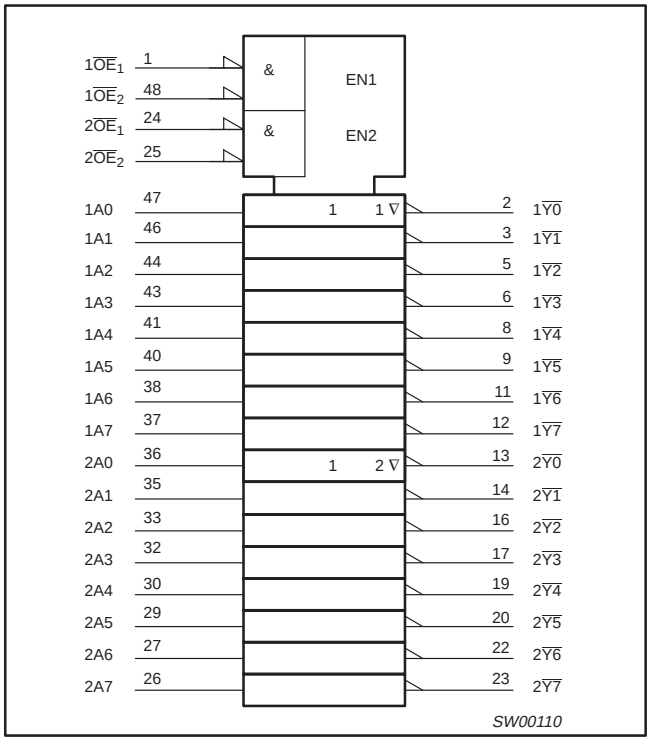


FUNCTION TABLE

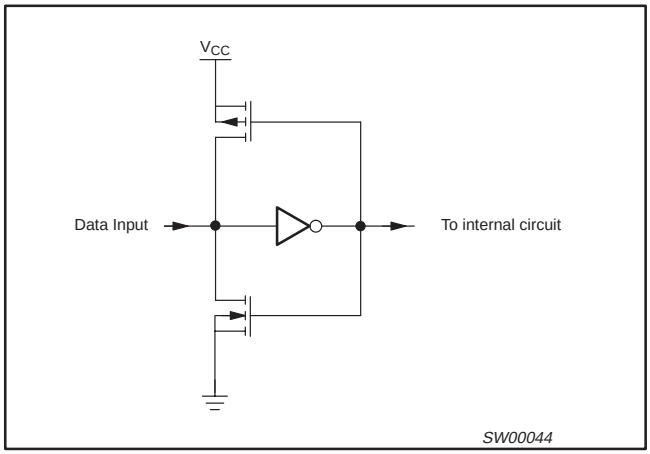
INPUTS			OUTPUT
$n\overline{OE}_1$	$n\overline{OE}_2$	nAn	nYn
L	L	L	H
L	L	H	L
X	H	X	Z
H	X	X	Z

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

LOGIC SYMBOL (IEEE/IEC)



BUS HOLD CIRCUIT



RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{CC}	DC supply voltage 2.5V range (for max. speed performance)		2.3	2.7	V
	DC supply voltage 3.3V range (for max. speed performance)		3.0	3.6	
	DC supply voltage (for low-voltage applications)		1.2	3.6	
V_I	DC Input voltage range	For data input pins	0	V_{CC}	V
	DC Input voltage range	For control pins	0	5.5	
V_O	DC output voltage range		0	V_{CC}	V
T_{amb}	Operating free-air temperature range		–40	+85	°C
t_r, t_f	Input rise and fall times	V_{CC} = 2.3 to 3.0V V_{CC} = 3.0 to 3.6V	0 0	20 10	ns/V

ABSOLUTE MAXIMUM RATINGS[1, 2]

In accordance with the Absolute Maximum Rating System (IEC 134)
Voltages are referenced to GND (ground = 0V)

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	For control pins and data inputs of ALVC parts[2]	–0.5 to +5.5	V
		For data inputs of ALVCH parts[2]	–0.5 to V_{CC} +0.5	
I_{OK}	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	±50	mA
V_O	DC output voltage	Note 2	–0.5 to V_{CC} +0.5	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 to +150	°C
P_{TOT}	Power dissipation per package –plastic medium-shrink SO (SSOP) –plastic mini-pack (TSSOP)	For temperature range: –40 to +125 °C above +55°C derate linearly with 11.3 mW/K above +55°C derate linearly with 8 mW/K	 850 600	mW

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

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS		LIMITS			UNIT
				Temp = -40°C to +85°C			
				MIN	TYP[1]	MAX	
V_{IH}	HIGH level Input voltage	V_{CC} = 1.2V		V_{CC}			V
		V_{CC} = 2.3 to 2.7V		1.7			
		V_{CC} = 2.7 to 3.6V		2.0			
V_{IL}	LOW level Input voltage	V_{CC} = 1.2V				GND	V
		V_{CC} = 2.3 to 2.7V				0.7	
		V_{CC} = 2.7 to 3.6V				0.8	
V_{OH}	HIGH level output voltage	V_{CC} = 2.3V; V_I = V_{IH} or V_{IL}; I_O = –1mA		V_{CC} – 0.3			V
		V_{CC} = 2.3V; V_I = V_{IH} or V_{IL}; I_O = –8mA		V_{CC} – 0.5			
		V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = –12mA		V_{CC} – 0.5			
		V_{CC} = 2.3/3.0V; V_I = V_{IH} or V_{IL}; I_O = –100µA		V_{CC} – 0.2	V_{CC}		
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = –24mA		V_{CC} – 1.0			
V_{OL}	LOW level output voltage	V_{CC} = 2.3V; V_I = V_{IH} or V_{IL}; I_O = 1mA				0.40	V
		V_{CC} = 2.3V; V_I = V_{IH} or V_{IL}; I_O = 8mA				0.60	
		V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = 12mA				0.40	
		V_{CC} = 2.3/3.0V; V_I = V_{IH} or V_{IL}; I_O = 100µA				0.20	
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 24mA				0.55	
I_I	Input leakage current	V_{CC} = 3.6V; V_I = 5.5V or GND	Control pins		±0.1	±5	µA
		V_{CC} = 3.6V; V_I = V_{CC} or GND	Data input pins		±0.1	±5	
I_{IHZ}/I_{ILZ}	Input current for common I/O pins	V_{CC} = 3.6V; V_I = V_{CC} or GND			±0.1	±15	µA
I_{OZ}	3-State output OFF-state current	V_{CC} = 3.6V; V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND			0.1	±10	µA
	3-State output OFF-state current	V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND			0.1	±5	
I_{CC}	Quiescent supply current	V_{CC} = 3.6V; V_I = V_{CC} or GND; I_O = 0			0.2	40	µA
	Quiescent supply current	V_{CC} = 2.7V; V_I = V_{CC} or GND; I_O = 0			0.2	20	
ΔI_{CC}	Additional quiescent supply current per control pin	V_{CC} = 2.7V to 3.6V; V_I = V_{CC} –0.6V; I_O = 0			5	500	µA
	Additional quiescent supply current per data I/O pin	V_{CC} = 2.7V to 3.6V; V_I = V_{CC} –0.6V; I_O = 0			150	750	
IBHL	Bus hold LOW sustaining current	V_{CC} = 2.3V; V_I = 0.7V		45			µA
		V_{CC} = 3.0V; V_I = 0.8V		75			
IBHH	Bus hold HIGH sustaining current	V_{CC} = 2.3V; V_I = 1.7V		–45			µA
		V_{CC} = 3.0V; V_I = 2.0V		–75			
IBHLO	Bus hold LOW overdrive current	V_{CC} = 2.7V		300			µA
		V_{CC} = 3.6V		450			
IBHHO	Bus hold HIGH overdrive current	V_{CC} = 2.7V		–300			µA
		V_{CC} = 3.6V		–450			

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

AC CHARACTERISTICS FOR V_{CC} = 3.0V TO 3.6V RANGE AND V_{CC} = 2.7V

GND = 0V; $t_r = t_f \leq 2.5$ns; C_L = 50pF

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			V_{CC} = 3.0 ± 0.3V			V_{CC} = 2.7V		
			MIN	TYP[1]	MAX	TYP	MAX	
t_{PHL}/t_{PLH}	Propagation delay 1An to 1Yn; 2An to 2Yn	4		1.8	3.0	2.1	3.6	ns
t_{PZH}/t_{PZL}	3-State output enable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	5, 6		2.1	3.8	2.9	4.7	ns
t_{PHZ}/t_{PLZ}	3-State output disable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	5, 6		2.7	4.1	3.2	4.5	ns

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

AC CHARACTERISTICS FOR V_{CC} = 2.3V TO 2.7V RANGE AND V_{CC} < 2.3V

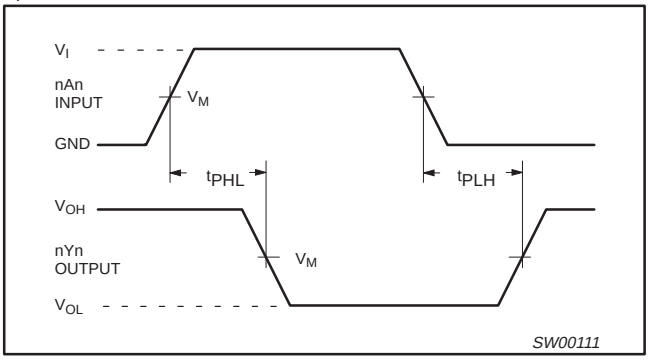
GND = 0V; $t_r = t_f \leq 2.0$ns; C_L = 30pF

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			V_{CC} = 2.3 to 2.7V			V_{CC} = 1.8V	V_{CC} = 1.2V	
			MIN	TYP[1]	MAX	TYP	MAX	
t_{PHL}/t_{PLH}	Propagation delay 1An to 1Yn; 2An to 2Yn	4		1.8	3.2	3.1	6.0	ns
t_{PZH}/t_{PZL}	3-State output enable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	5, 6		2.5	4.4	4.3	8.9	ns
t_{PHZ}/t_{PLZ}	3-State output disable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	5, 6		2.2	3.8	3.6	6.4	ns

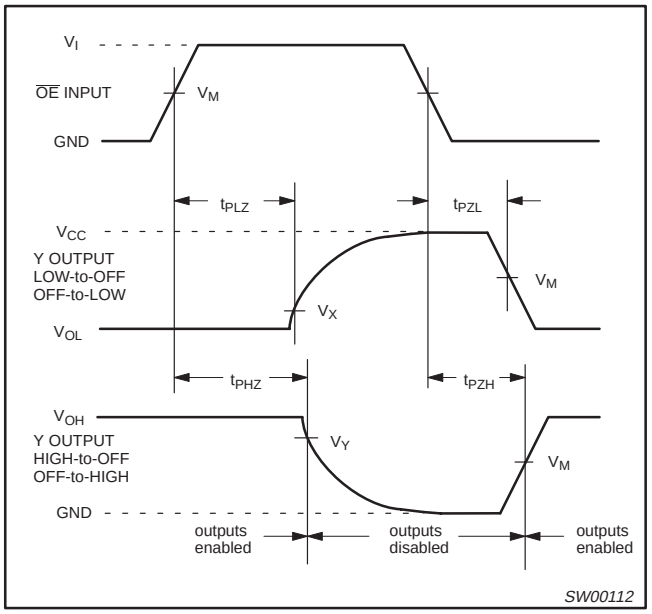
NOTE:
1. All typical values are at V_{CC} = 2.5V and T_{amb} = 25°C.

AC WAVEFORMS FOR V_{CC} = 3.0V TO 3.6V AND V_{CC} = 2.7V RANGE

V_M = 1.5 V
$V_X = V_{OL}$ + 0.3V
$V_Y = V_{OH}$ –0.3V
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
V_I = 2.7V

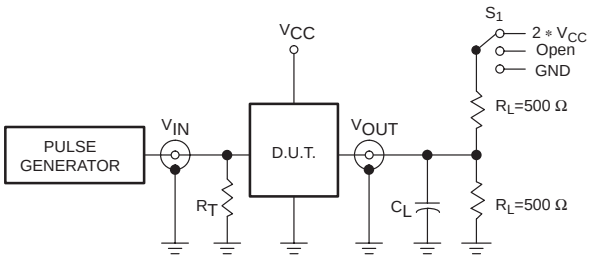


Waveform 1. Input (An) to output (Yn) propagation delay times



Waveform 2. 3-State enable and disable times

TEST CIRCUIT



Test Circuit for 3-State Outputs

SWITCH POSITION

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

V_{CC}	V_{IN}
< 2.7V	V_{CC}
2.7 – 3.6V	2.7V

DEFINITIONS

R_L = Load resistor

C_L = Load capacitance includes jig and probe capacitance

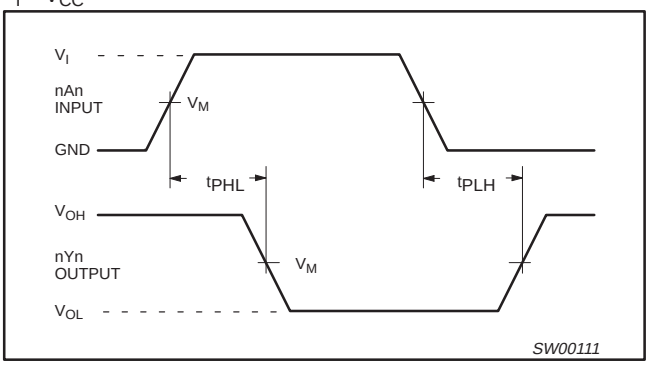
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

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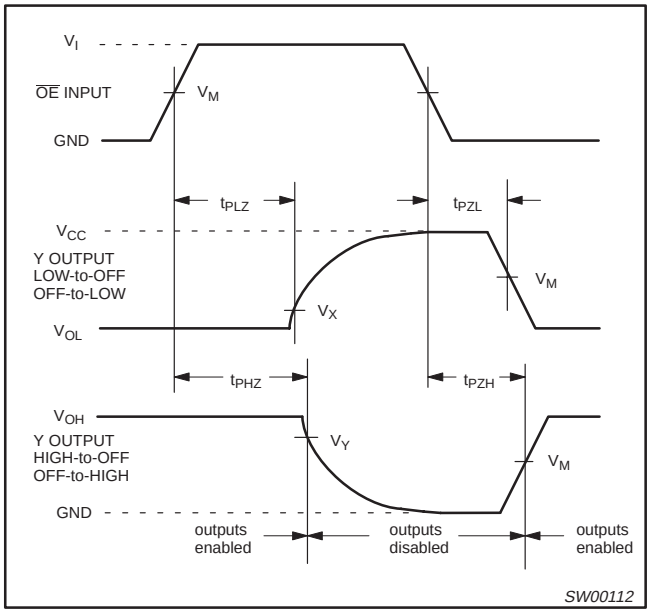
Waveform 3. Load circuitry for switching times

AC WAVEFORMS FOR V_{CC} = 2.3V TO 2.7V AND V_{CC} < 2.3V RANGE

$V_M = 0.5 * V_{CC}$
$V_X = V_{OL} + 0.15V$
$V_Y = V_{OH} – 0.15V$
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
$V_I = V_{CC}$

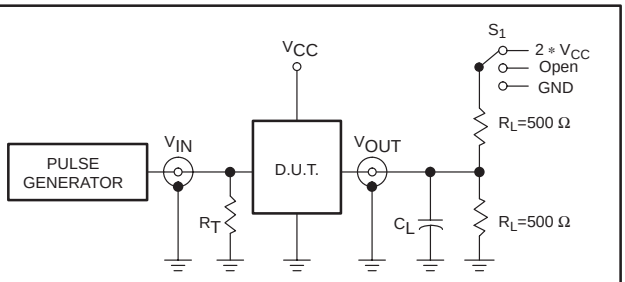


Waveform 4. Input (An) to output (Yn) propagation delay times



Waveform 5. 3-State enable and disable times

TEST CIRCUIT



Test Circuit for 3-State Outputs

SWITCH POSITION

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

V_{CC}	V_{IN}
< 2.7V	V_{CC}
2.7 – 3.6V	2.7V

DEFINITIONS

R_L = Load resistor

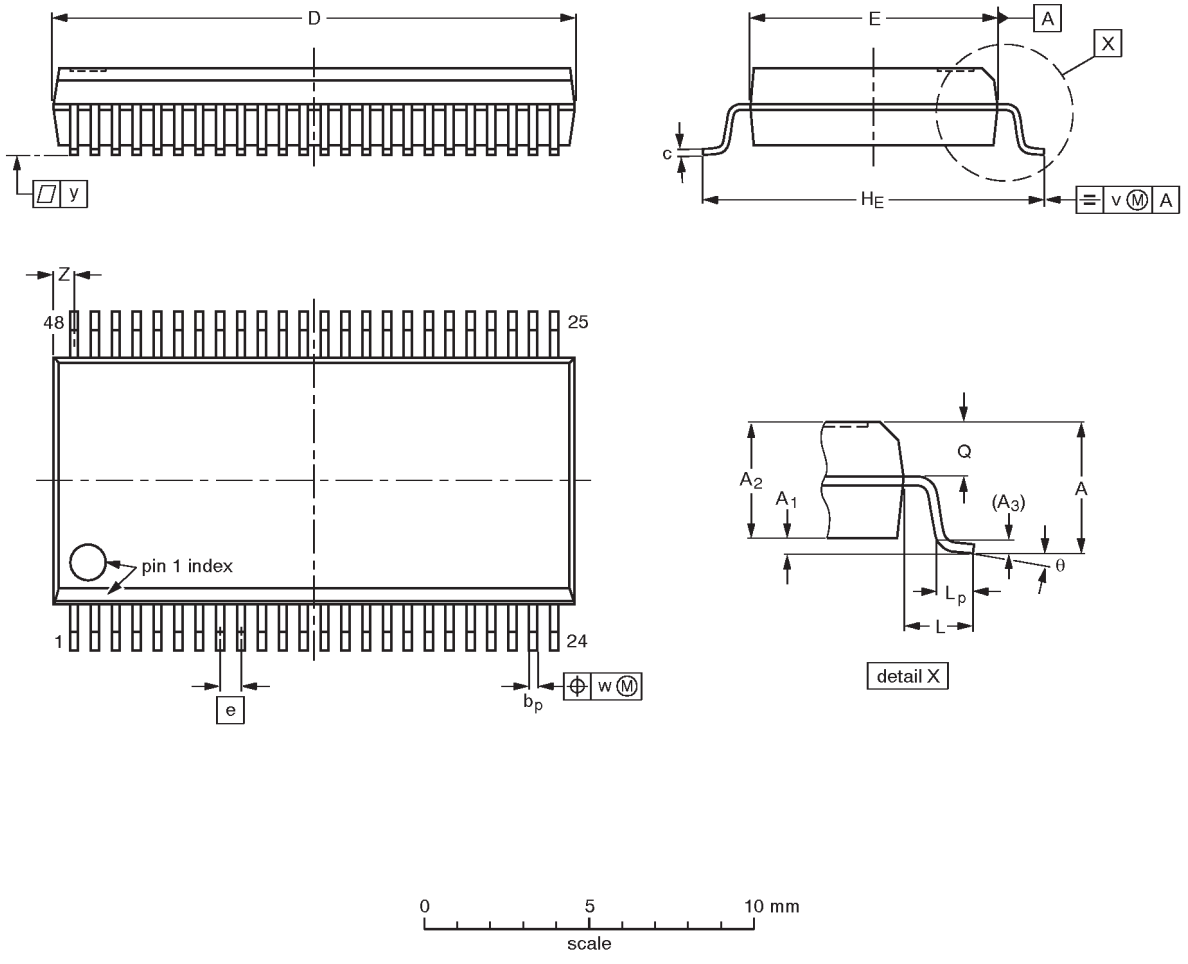
C_L = Load capacitance includes jig and probe capacitance

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

SW00047

Waveform 6. Load circuitry for switching times

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



DIMENSIONS (mm are the original dimensions)

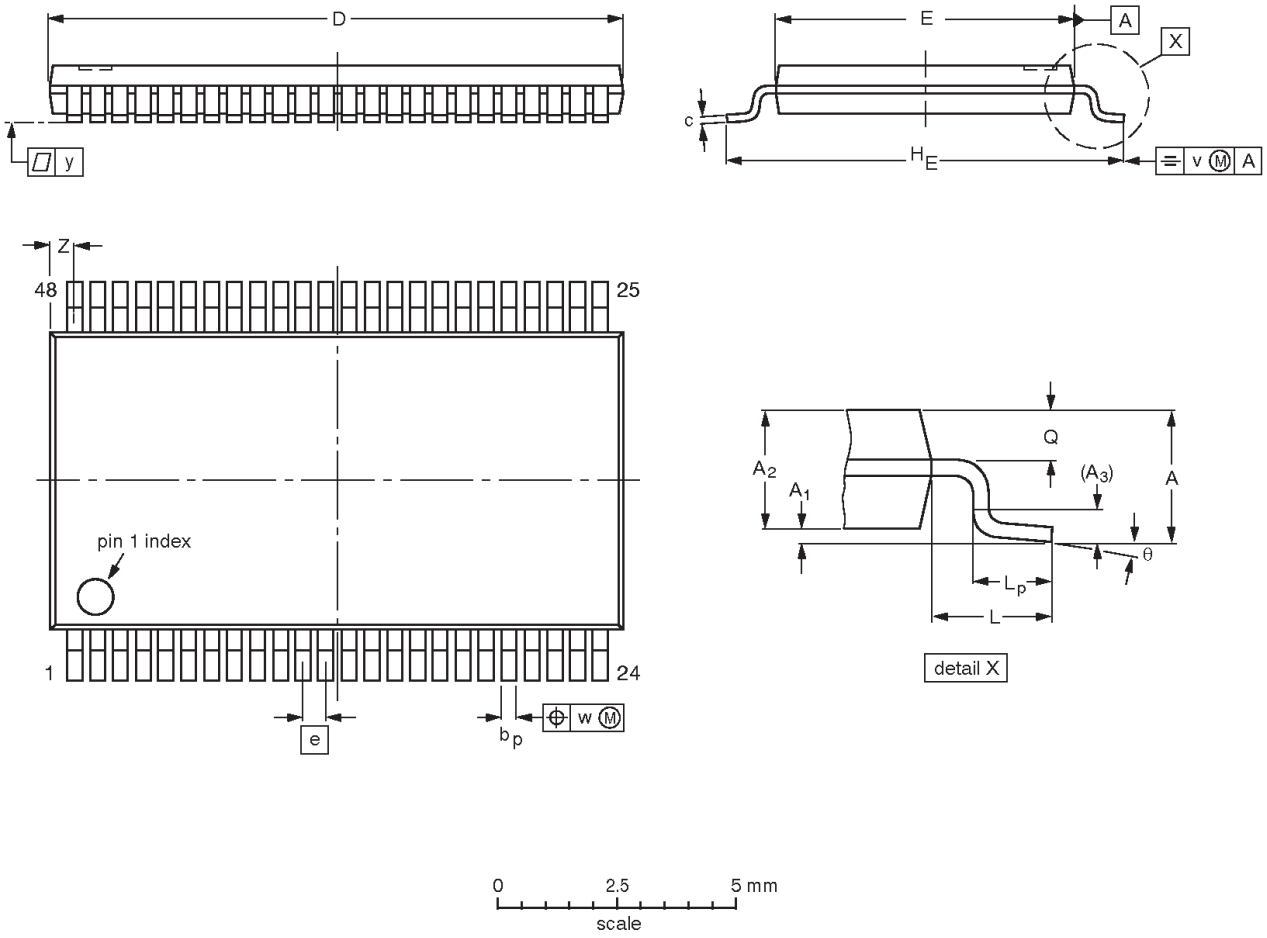
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

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~~ 95-02-04

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1mm 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

NOTES

2.5V/3.3V 16-bit buffer/line driver, inverting, 5V input tolerant (3-State)

74ALVCH16540

DEFINITIONS

Data Sheet Identification	Product Status	Definition
Objective Specification	Formative or in Design	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
Preliminary Specification	Preproduction Product	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product Specification	Full 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.

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