DATA SHEET

74LVCH16541A
16-bit buffer/line driver (3-State)

Product specification

1998 May 19

IC24 Data Handbook

Philips
Semiconductors

PHILIPS

16-bit buffer/line driver; 5V tolerant I/O (3-State) 74LVCH16541A

FEATURES

- 5 volt tolerant inputs/outputs for interfacing with 5V logic
- Wide supply voltage range of 1.2 V to 3.6 V
- Drive capability ±24mA @ 3.3V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- MULTIBYTE™ flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- All data inputs have bushold
- Bushold inputs eliminate the need for external pull-up resistors to hold unused inputs

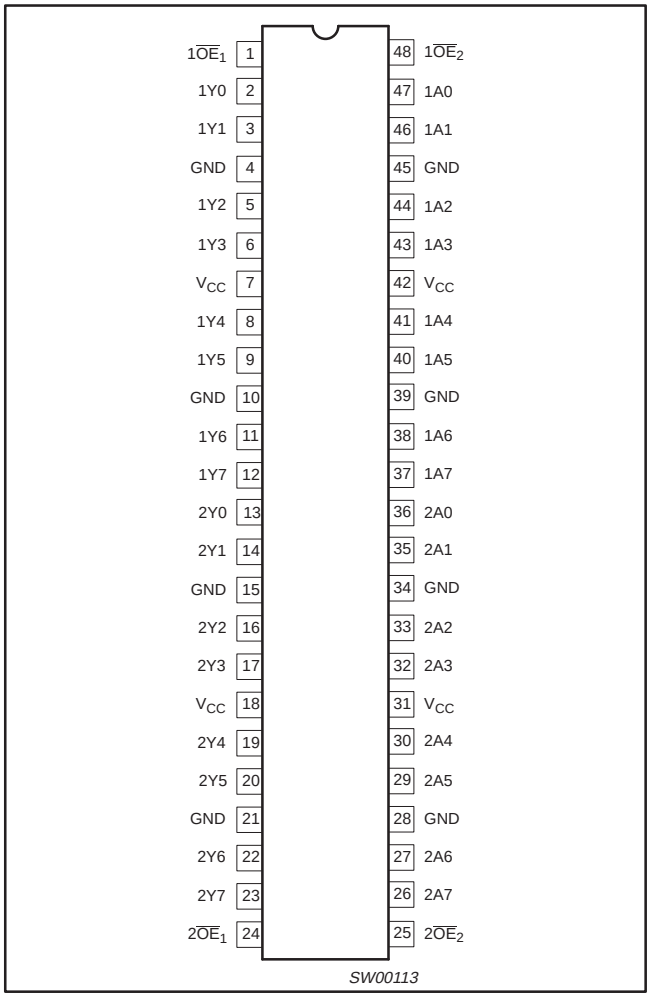
DESCRIPTION

The 74LVCH16541A 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 3.3V or 5V devices. In 3-State operation, outputs can handle 5V. These features allow the use of these devices in a mixed 3.3V/5V environment.

The 74LVCH16541A 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.

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

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	2.7	ns
C_I	Input capacitance		5.0	pF
C_{PD}	Power dissipation capacitance per buffer	V_I = GND to V_{CC}[1] outputs enabled output disabled	32 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.

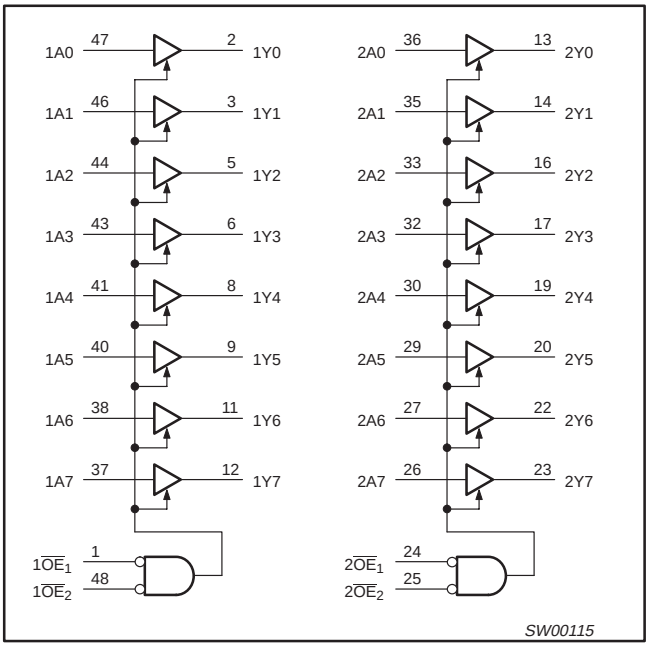
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	–40°C to +85°C	74LVCH16541A DL	VCH16541A DL	SOT370-1
48-Pin Plastic TSSOP Type II	–40°C to +85°C	74LVCH16541A DGG	VCH16541A 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
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V_{CC}	Positive supply voltage
13, 14, 16, 17, 19, 20, 22, 23	2Y0 to 2Y7	Data outputs
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	Data inputs

LOGIC SYMBOL

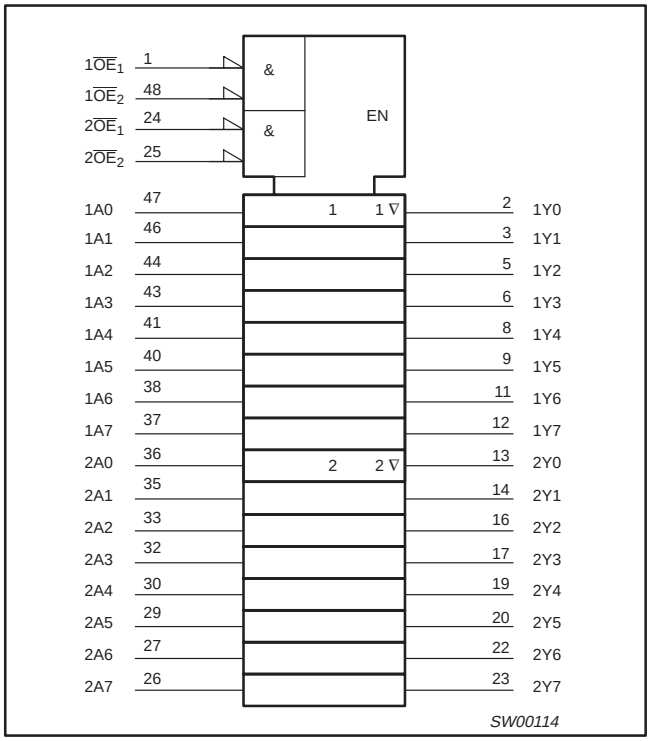


FUNCTION TABLE

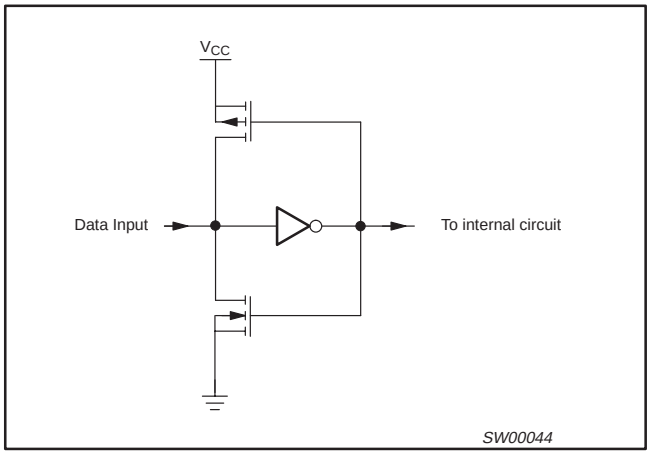
INPUTS			OUTPUT
$n\overline{OE}_1$	$n\overline{OE}_2$	nAn	nYn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

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

LOGIC SYMBOL (IEEE/IEC)



BUSHOLD CIRCUIT



RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	DC supply voltage (for maximum speed performance)		2.7	3.6	V
	DC supply voltage (for low-voltage applications)		1.2	3.6	
V_I	DC Input voltage range	For data input pins with bus hold	0	V_{CC}	V
		For data input pins without bus hold	0	5.5	
V_O	DC output voltage range; output HIGH or LOW state		0	V_{CC}	V
	DC output voltage range; output 3-State		0	5.5	
T_{amb}	Operating ambient temperature range in free air		–40	+85	°C
t_r, t_f	Input rise and fall times	V_{CC} = 1.2 to 2.7V V_{CC} = 2.7 to 3.6V	0 0	20 10	ns/V

ABSOLUTE MAXIMUM VALUES[1, 2]

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

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{CC}	DC supply voltage		–0.5	+6.5	V
I_{IK}	DC input diode current	$V_I < 0$	–	–50	mA
V_I	DC input voltage	Note 3	–0.5	+6.5	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 3	–0.5	V_{CC} + 0.5	V
	DC output voltage; output 3-State		–0.5	6.5	
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 – SSOP (plastic medium-shrink) – TSSOP (plastic thin-medium-shrink)	For temperature range: –40 to +125°C above +70°C derate linearly 8mW/K above +60°C derate linearly 5.5mW/K		 500 500	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 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 voltage ratings may be exceeded if the input and output clamp current ratings are observed.

DC CHARACTERISTICS

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

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} = 2.7 to 3.6V	2.0			
V_{IL}	LOW level input voltage	V_{CC} = 1.2V			GND	V
		V_{CC} = 2.7 to 3.6V			0.8	
V_{OH}	HIGH level output voltage	V_{CC} = 2.7; V_I = V_{IH} or V_{IL}; I_O = –12mA	V_{CC}-0.5			V
		V_{CC} = 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 = –18mA	V_{CC}-0.6			
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = –24mA	V_{CC}-0.8			
V_{OL}	LOW level output voltage	V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = 12mA			0.40	V
		V_{CC} = 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[6]		±0.1	±5	µA
I_{OZ}	3-State output OFF-state current	V_{CC} = 3.6V; V_I = V_{IH} or V_{IL}; V_O = 5.5V or GND		0.1	±5	µA
I_{OFF}	Power off leakage current	V_{CC} = 0.0V; V_I or V_O = 5.5V		0.1	±10	µA
I_{CC}	Quiescent supply current	V_{CC} = 3.6V; V_I = V_{CC} or GND; I_O = 0		0.1	20	µA
ΔI_{CC}	Additional quiescent supply current given per input pin	V_{CC} = 2.7 to 3.6V; V_I = V_{CC} – 0.6V; I_O = 0		5	500	µA
I_{BHL}	Bus hold LOW sustaining current	V_{CC} = 3.0V; V_I = 0.8V[2, 3, 4]	75			µA
I_{BHH}	Bus hold HIGH sustaining current	V_{CC} = 3.0V; V_I = 2.0V[2, 3, 4]	–75			µA
I_{BHLO}	Bus hold LOW overdrive current	V_{CC} = 3.6V[2, 3, 5]	500			µA
I_{BHHO}	Bus hold HIGH overdrive current	V_{CC} = 3.6V[2, 3, 5]	–500			µA

NOTES:
1. All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
2. Valid for data inputs of bus hold parts (LVCH16-A) only.
3. For data inputs only, control inputs do not have a bus hold circuit.
4. The specified sustaining current at the data input 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.
6. For bus hold parts, the bus hold circuit is switched off when V_i exceeds V_{CC} allowing 5.5V on the input terminal.

AC CHARACTERISTICS

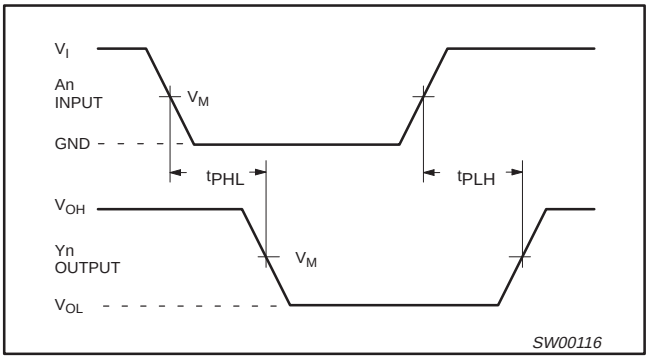
GND = 0V; $t_R = t_F \leq 2.5$ns; $C_L = 50$pF; $R_L = 500\Omega$; $T_{amb} = -40°C$ to $+85°C$.

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			V_{CC} = 3.3V ±0.3V			V_{CC} = 2.7V		
			MIN	TYP[1]	MAX	MIN	MAX	
t_{PHL} t_{PLH}	Propagation delay 1An to 1Yn; 2An to 2Yn	1, 3	1.5	2.7	4.5	1.5	5.5	ns
t_{PZH} t_{PZL}	3-State output enable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	2, 3	1.5	3.5	5.9	1.5	6.9	ns
t_{PHZ} t_{PLZ}	3-State output disable time 1$\overline{OE}$n to 1Yn; 2$\overline{OE}$n to 2Yn	2, 3	1.5	3.9	5.5	1.5	6.5	ns

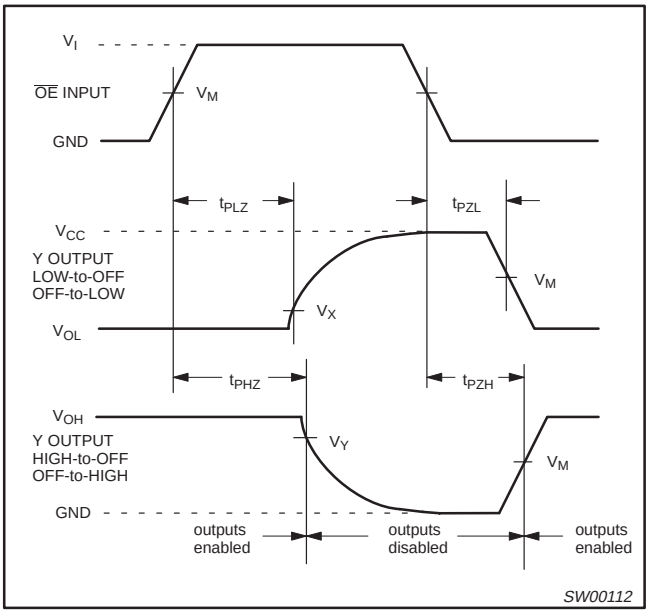
NOTE:
1. All typical values are at $V_{CC} = 3.3$V and $T_{amb} = 25°C$.

AC WAVEFORMS

$V_M = 1.5$V at $V_{CC} \geq 2.7$V; $V_M = 0.5\ V_{CC}$ at $V_{CC} < 2.7$V.
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
$V_X = V_{OL} + 0.3$V at $V_{CC} \geq 2.7$V; $V_X = V_{OL} + 0.1\ V_{CC}$ at $V_{CC} < 2.7$V
$V_Y = V_{OH} - 0.3$V at $V_{CC} \geq 2.7$V; $V_Y = V_{OH} - 0.1\ V_{CC}$ at $V_{CC} < 2.7$V

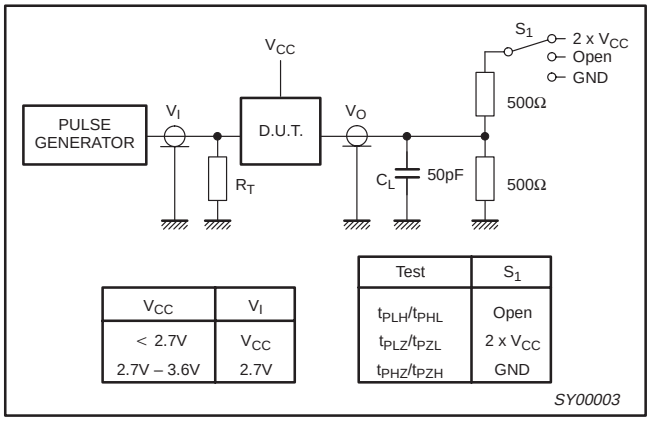


Waveform 1. Input (An) to output (Yn) propagation delay times



Waveform 2. 3-State enable and disable times

TEST CIRCUIT

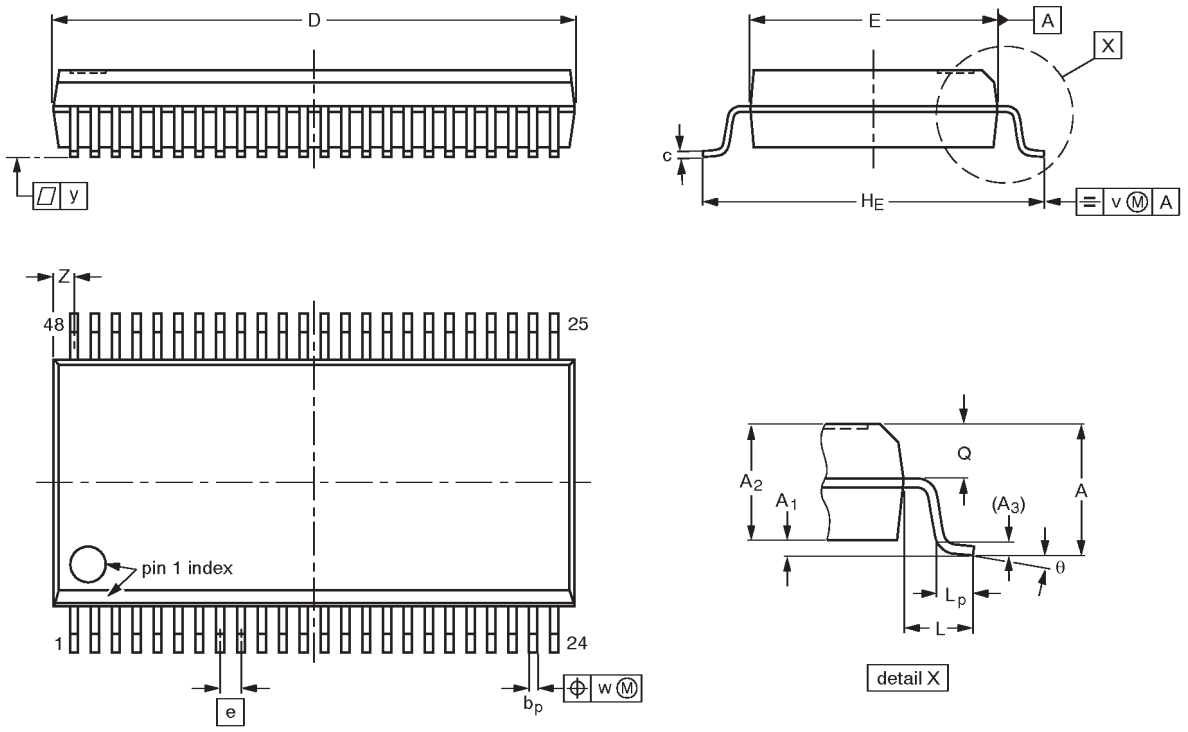


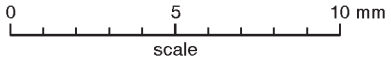
V_{CC}	V_I
< 2.7V	V_{CC}
2.7V – 3.6V	2.7V

Test	S_1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 x V_{CC}
t_{PHZ}/t_{PZH}	GND

Waveform 3. 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)

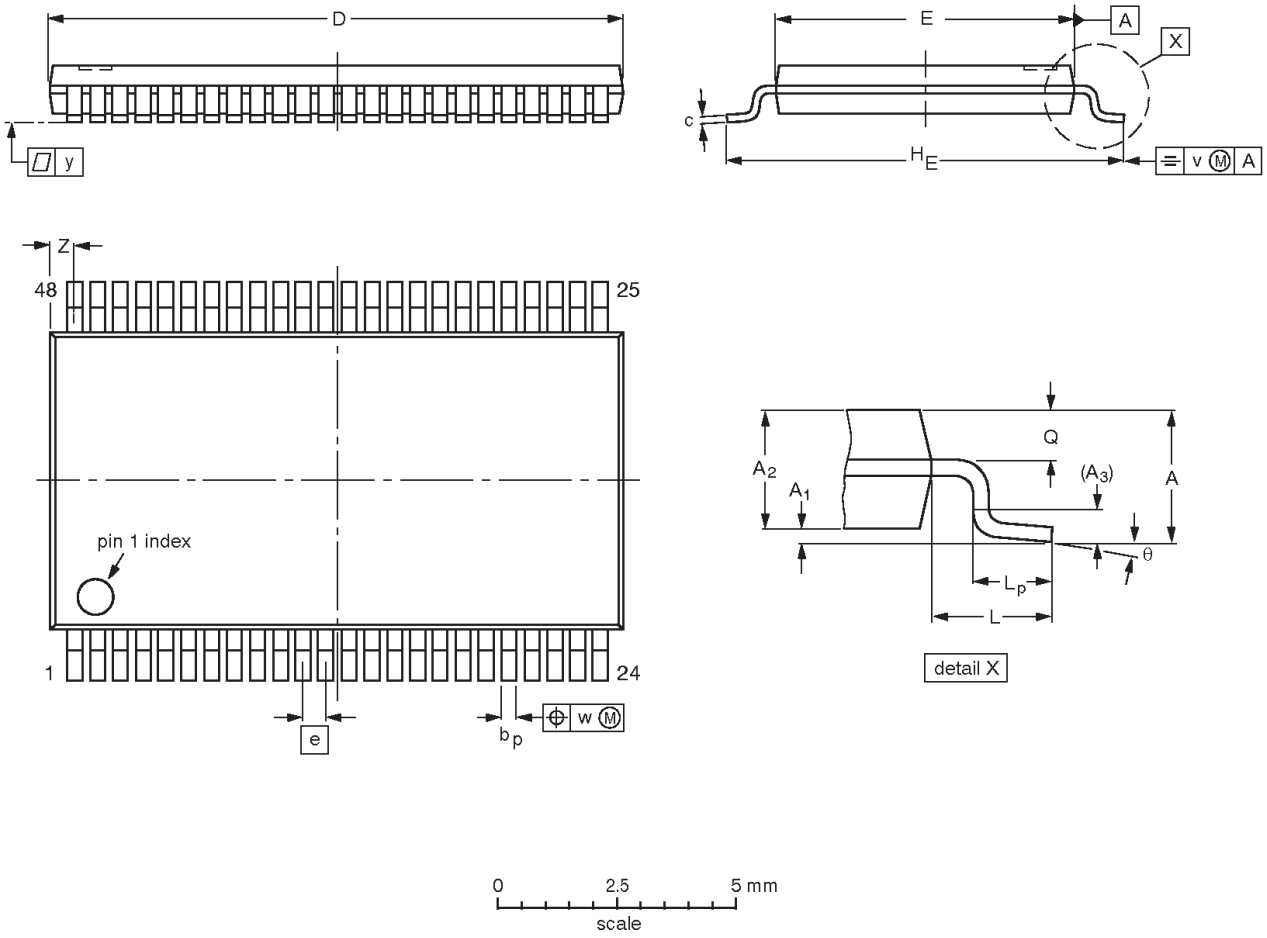
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

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

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.

Disclaimers

Life support — 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 Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors
811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088–3409
Telephone 800-234-7381

print code Date of release: 08-98

Document order number: 9397-750-04535

Let's make things better.

Philips Semiconductors

PHILIPS