

# DATA SHEET

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

Product specification

1998 May 19

IC24 Data Handbook

## 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  $\pm 24\text{mA}$  @ 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

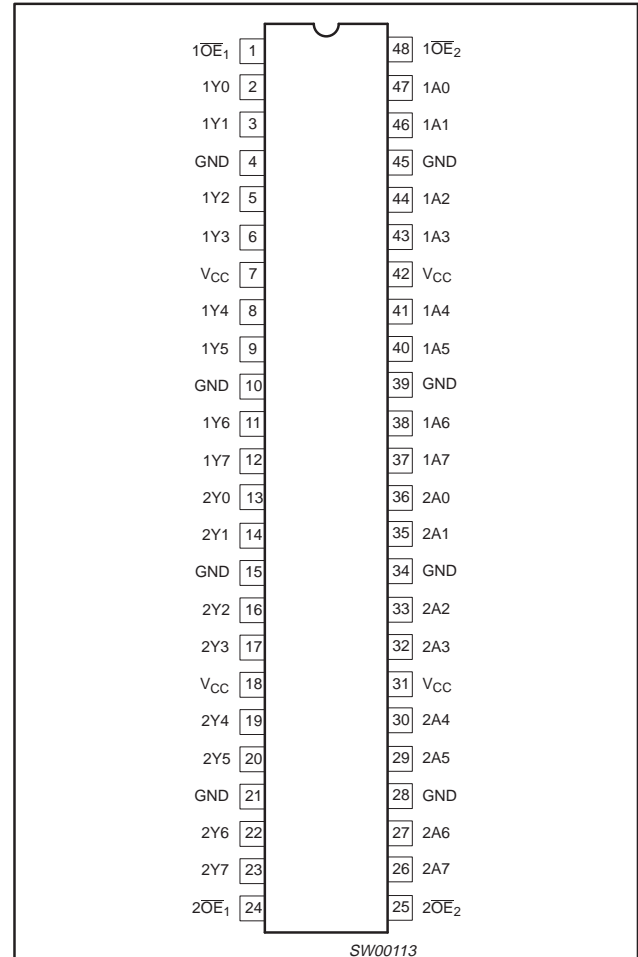
## DESCRIPTION

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

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$t_{PHL}/t_{PLH}$	Propagation delay 1An to 1Yn; 2An to 2Yn	$C_L = 50\text{pF}$ $V_{CC} = 3.3\text{V}$	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:

- $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ):  $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$  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	$-40^\circ\text{C}$ to $+85^\circ\text{C}$	74LVCH16541A DL	VCH16541A DL	SOT370-1
48-Pin Plastic TSSOP Type II	$-40^\circ\text{C}$ to $+85^\circ\text{C}$	74LVCH16541A DGG	VCH16541A DGG	SOT362-1

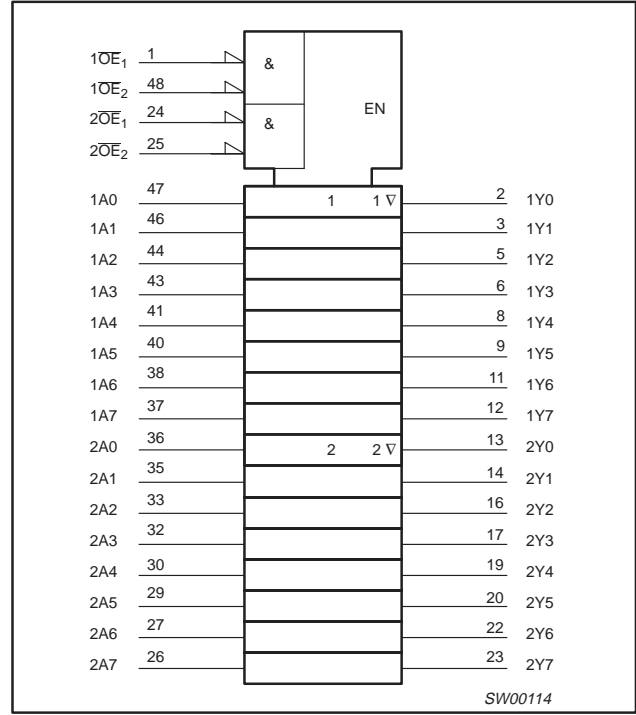
# 16-bit buffer/line driver; 5V tolerant I/O (3-State)

# 74LVCH16541A

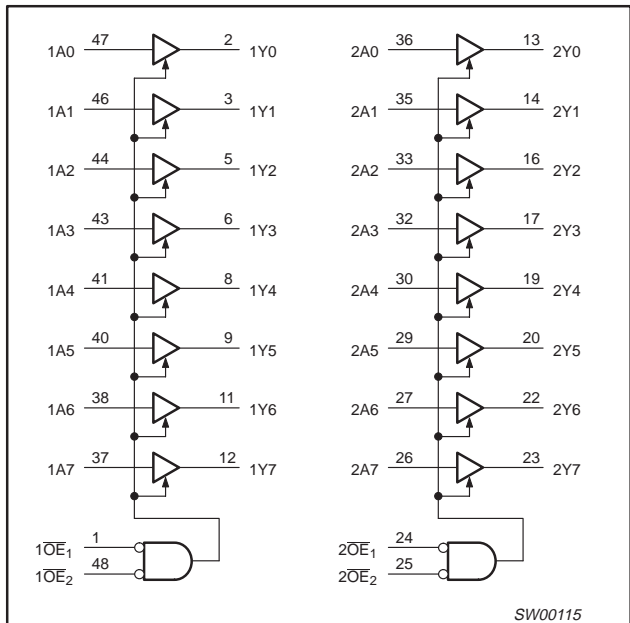
### PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1, 24	$\overline{nOE}_1$	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 <sub>CC</sub>	Positive supply voltage
13, 14, 16, 17, 19, 20, 22, 23	2Y0 to 2Y7	Data outputs
25, 48	$\overline{nOE}_2$	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

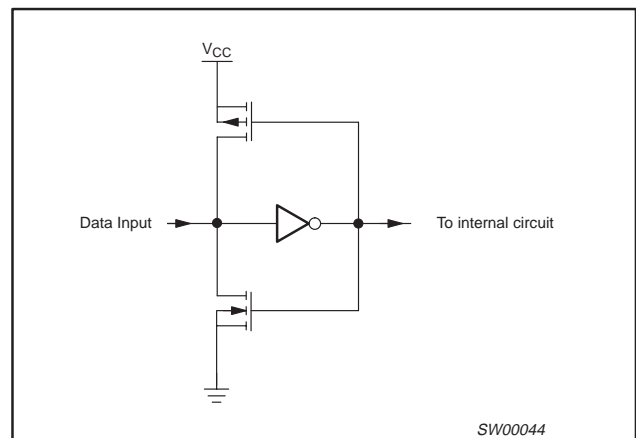
### LOGIC SYMBOL (IEEE/IEC)



### LOGIC SYMBOL



### BUSHOLD CIRCUIT



### FUNCTION TABLE

INPUTS			OUTPUT
$\overline{nOE}_1$	$\overline{nOE}_2$	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

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

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## 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 $2.7V$	0	20	ns/V
		$V_{CC} = 2.7$ to $3.6V$	0	10	

ABSOLUTE MAXIMUM VALUES<sup>1, 2</sup>

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	For temperature range: -40 to +125°C above +70°C derate linearly 8mW/K above +60°C derate linearly 5.5mW/K		500	mW
	- SSOP (plastic medium-shrink) - TSSOP (plastic thin-medium-shrink)			500	

## NOTES:

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

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

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**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 <sup>1</sup>	MAX	
V <sub>IH</sub>	HIGH level input voltage	V <sub>CC</sub> = 1.2V	V <sub>CC</sub>			V
		V <sub>CC</sub> = 2.7 to 3.6V	2.0			
V <sub>IL</sub>	LOW level input voltage	V <sub>CC</sub> = 1.2V			GND	V
		V <sub>CC</sub> = 2.7 to 3.6V			0.8	
V <sub>OH</sub>	HIGH level output voltage	V <sub>CC</sub> = 2.7; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA	V <sub>CC</sub> -0.5			V
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100μA	V <sub>CC</sub> -0.2	V <sub>CC</sub>		
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -18mA	V <sub>CC</sub> -0.6			
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -24mA	V <sub>CC</sub> -0.8			
V <sub>OL</sub>	LOW level output voltage	V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA			0.40	V
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100μA			0.20	
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 24mA			0.55	
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 5.5V or GND <sup>6</sup>		±0.1	±5	μA
I <sub>OZ</sub>	3-State output OFF-state current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5V or GND		0.1	±5	μA
I <sub>OFF</sub>	Power off leakage current	V <sub>CC</sub> = 0.0V; V <sub>I</sub> or V <sub>O</sub> = 5.5V		0.1	±10	μA
I <sub>CC</sub>	Quiescent supply current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0		0.1	20	μA
ΔI <sub>CC</sub>	Additional quiescent supply current given per input pin	V <sub>CC</sub> = 2.7 to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0		5	500	μA
I <sub>BHL</sub>	Bus hold LOW sustaining current	V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 0.8V <sup>2, 3, 4</sup>	75			μA
I <sub>BHH</sub>	Bus hold HIGH sustaining current	V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 2.0V <sup>2, 3, 4</sup>	-75			μA
I <sub>BHLO</sub>	Bus hold LOW overdrive current	V <sub>CC</sub> = 3.6V <sup>2, 3, 5</sup>	500			μA
I <sub>BHHO</sub>	Bus hold HIGH overdrive current	V <sub>CC</sub> = 3.6V <sup>2, 3, 5</sup>	-500			μA

**NOTES:**

- All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.
- Valid for data inputs of bus hold parts (LVCH16-A) only.
- For data inputs only, control inputs do not have a bus hold circuit.
- The specified sustaining current at the data input holds the input below the specified V<sub>I</sub> level.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.
- For bus hold parts, the bus hold circuit is switched off when V<sub>I</sub> exceeds V<sub>CC</sub> allowing 5.5V on the input terminal.

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

# 74LVCH16541A

## AC CHARACTERISTICS

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

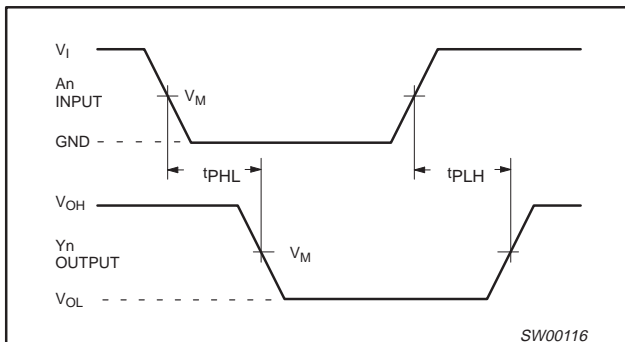
SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			$V_{CC} = 3.3V \pm 0.3V$			$V_{CC} = 2.7V$		
			MIN	TYP <sup>1</sup>	MAX	MIN	MAX	
$t_{PHL}$ $t_{PLH}$	Propagation delay 1An to 1Yn; 2An to 2Yn	1, 3	1.5	2.7	4.5	1.5	5.5	ns
$t_{PZH}$ $t_{PZL}$	3-State output enable time 1OE <sub>n</sub> to 1Y <sub>n</sub> ;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

**NOTE:**

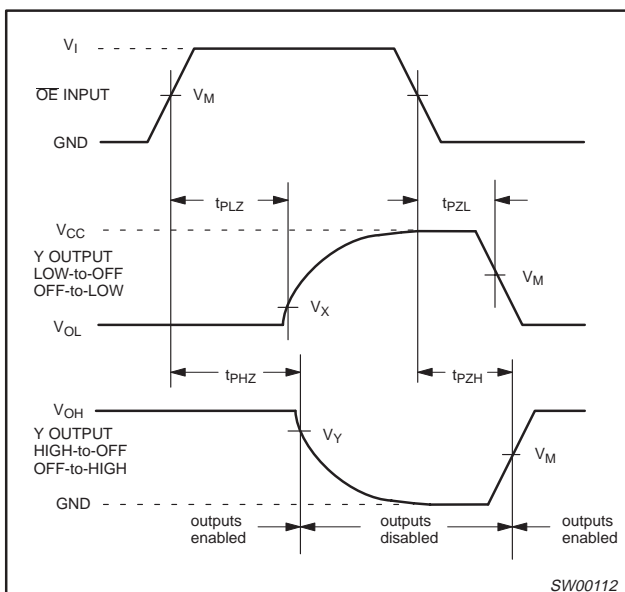
1. All typical values are at  $V_{CC} = 3.3V$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .

## AC WAVEFORMS

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

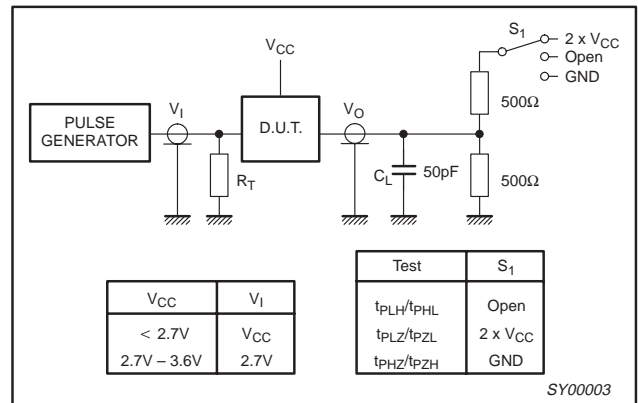


Waveform 1. Input (An) to output (Yn) propagation delay times



Waveform 2. 3-State enable and disable times

## TEST CIRCUIT



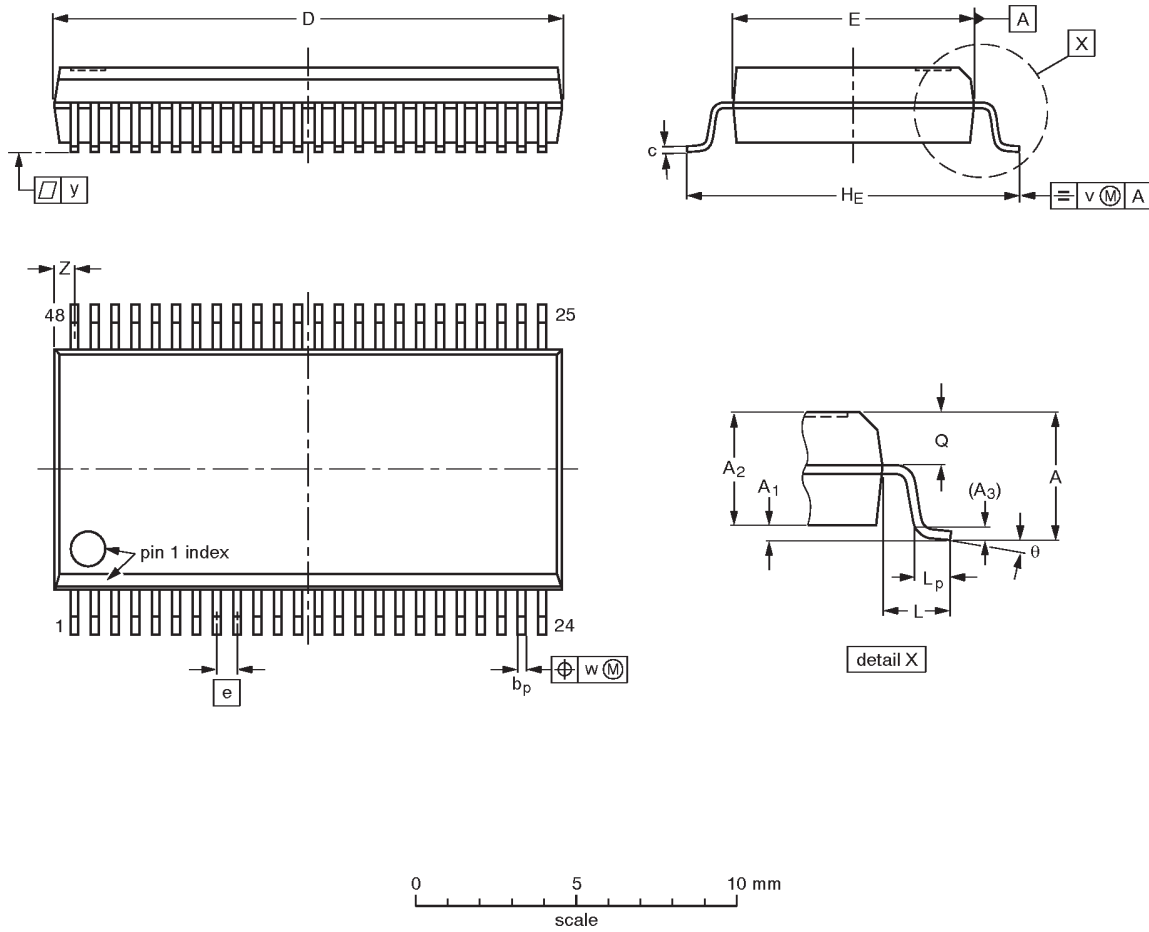
Waveform 3. Load circuitry for switching times

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

74LVCH16541A

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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	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.

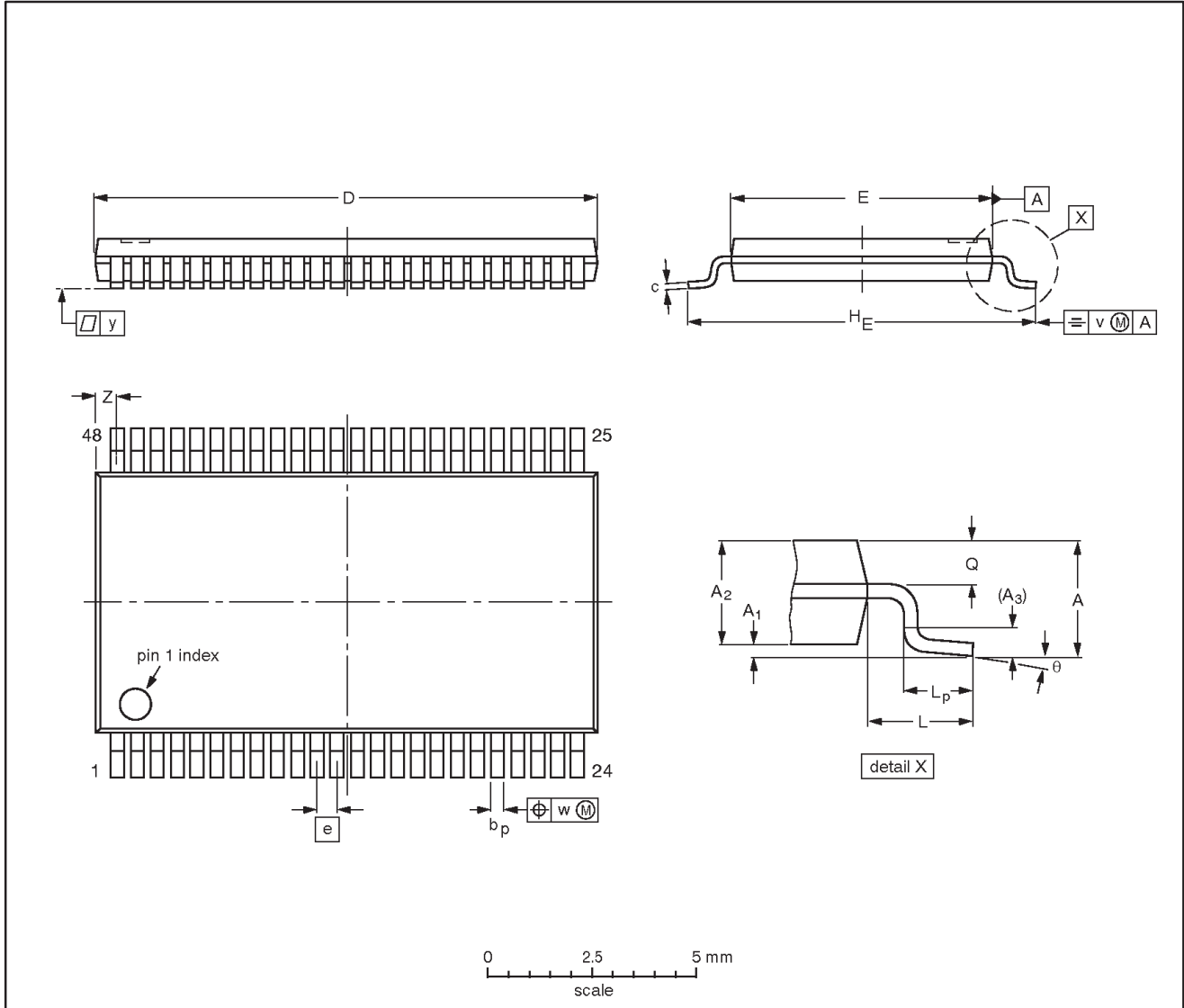
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT370-1		MO-118AA				93-11-02 95-02-04

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

74LVCH16541A

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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	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° 0°

**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



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

74LVCH16541A

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**NOTES**

## 16-bit buffer/line driver (3-State)

74LVCH16541A

## 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 changes at any time without notice in order to improve design and supply the best possible product.
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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**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.

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