

# DATA SHEET

## **74LVC162245A/ 74LVCH162245A**

16-bit bus transceiver with direction pin;  
30 $\Omega$  series termination resistors;  
5V Input/Outputs tolerant (3-State)

Product specification  
Supersedes data of 1997 Aug 01  
IC24 Data Handbook

1998 Feb 17

# 16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State) 74LVC162245A/74LVCH162245A

## FEATURES

- 5 volt tolerant inputs/outputs for interfacing with 5V logic
- Wide supply voltage range of 1.2V to 3.6V
- 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
- Bus hold on data inputs (74LVCH162245A only)
- Integrated 30Ω termination resistors

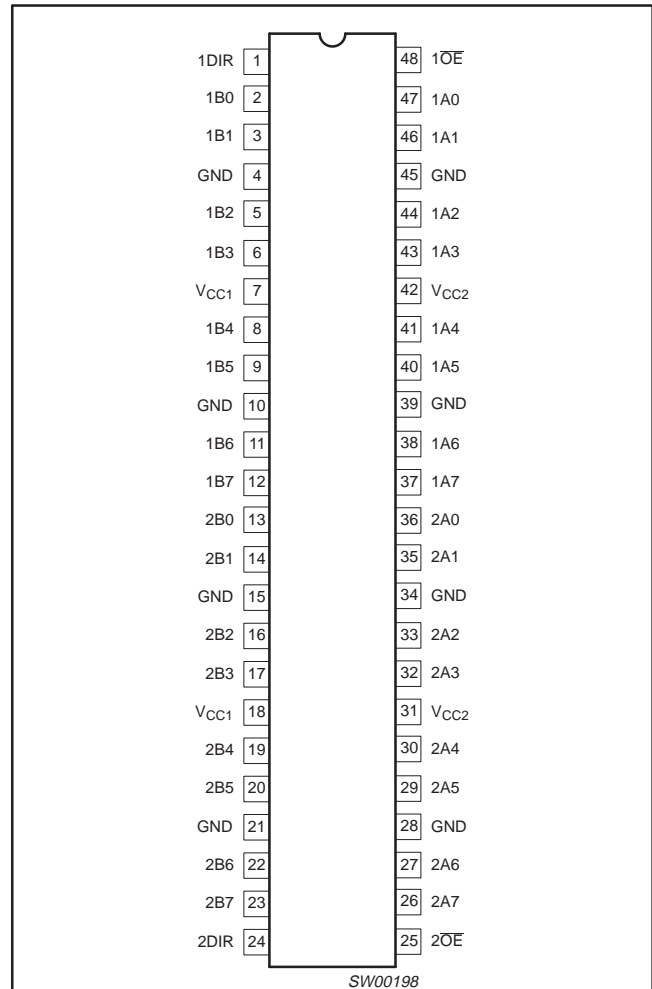
## DESCRIPTION

The 74LVC(H)162245A 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 74LVC(H)162245A is a 16-bit transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. The 74LVC(H)162245A features two output enable ( $\overline{nOE}$ ) inputs for easy cascading and two send/receive ( $\overline{nDIR}$ ) inputs for direction control.  $\overline{nOE}$  controls the outputs so that the buses are effectively isolated. The 74LVC(H)162245A is design with 30Ω series termination resistors in both HIGH and LOW output stages to reduce line noise. This device can be used as two 8-bit transceivers or one 16-bit transceiver.

The 74LVCH162245A bus hold data inputs eliminates the need for extreme pull up resistors to hold unused inputs.

## PIN CONFIGURATION



## ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	-40°C to +85°C	74LVC162245A DL	VC162245A DL	SOT370-1
48-Pin Plastic TSSOP Type II	-40°C to +85°C	74LVC162245A DGG	VC162245A DGG	SOT362-1
48-Pin Plastic SSOP Type III	-40°C to +85°C	74LVCH162245A DL	VCH162245A DL	SOT370-1
48-Pin Plastic TSSOP Type II	-40°C to +85°C	74LVCH162245A DGG	VCH162245A DGG	SOT362-1

## 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 An to Bn; Bn to An	$C_L = 50\text{pF}$ $V_{CC} = 3.3\text{V}$	3.3	ns
$C_I$	Input capacitance		5.0	pF
$C_{I/O}$	Input/output capacitance		10	pF
$C_{PD}$	Power dissipation capacitance per buffer	$V_I = \text{GND to } V_{CC}^1$	28	pF

## NOTES:

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  
 $f_i$  = input frequency in MHz;  $C_L$  = output load capacity in pF;  
 $f_o$  = output frequency in MHz;  $V_{CC}$  = supply voltage in V;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

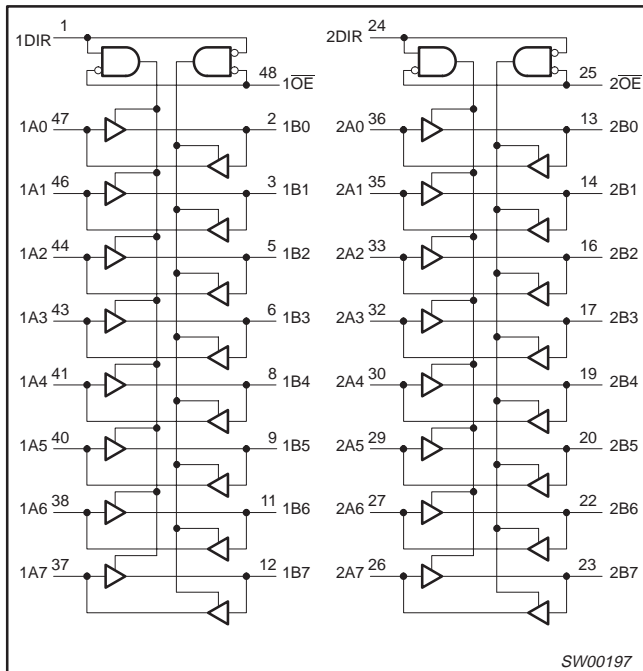
16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State)

74LVC162245A/  
74LVCH162245A

**PIN DESCRIPTION**

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1	1DIR	Direction control
2, 3, 5, 6, 8, 9, 11, 12	1B0 to 1B7	Data inputs/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	2B0 to 2B7	Data inputs/outputs
24	2DIR	Direction control
25	2OE	Output enable input (active LOW)
36, 35, 33, 32, 30, 29, 27, 26	2A0 to 2A7	Data inputs/outputs
47, 46, 44, 43, 41, 40, 38, 37	1A0 to 1A7	Data inputs/outputs
48	1OE	Output enable input (active LOW)

**LOGIC SYMBOL**

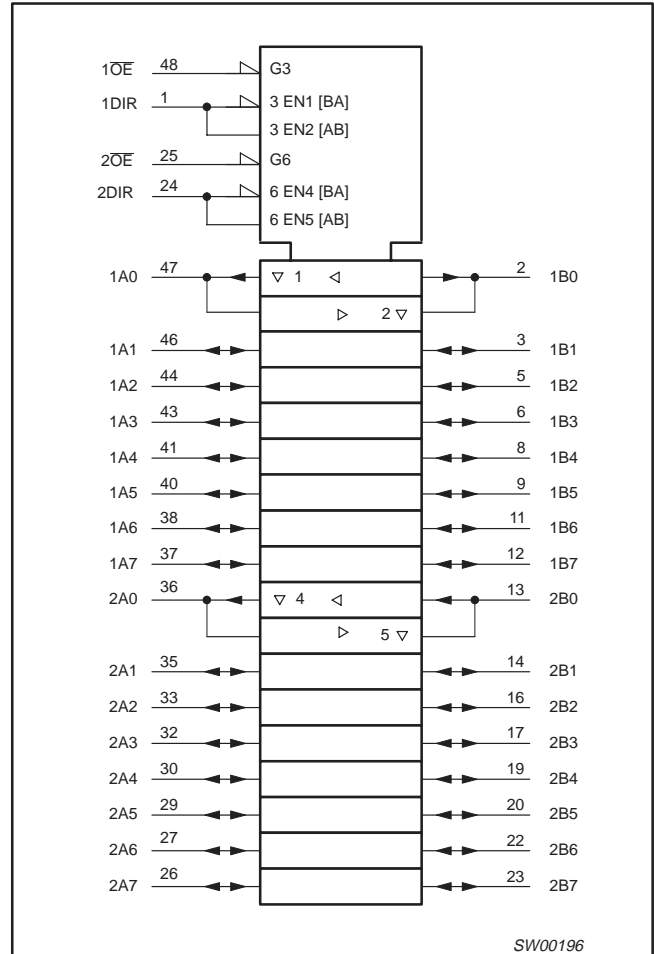


**FUNCTION TABLE**

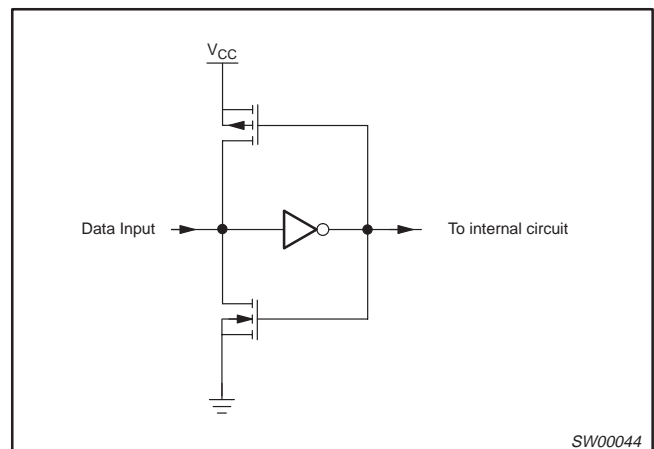
INPUTS		INPUTS/OUTPUT	
nOE	nDIR	nAn	nBn
L	L	A = B	inputs
L	H	inputs	B = A
H	X	Z	Z

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

**LOGIC SYMBOL (IEEE/IEC)**



**BUSHOLD CIRCUIT**



16-bit bus transceiver with direction pin; 30Ω series  
termination resistors; 5V Input/Outputs tolerant (3-State)

74LVC162245A/  
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### RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN.	MAX.	
V <sub>CC</sub>	DC supply voltage (for max. speed performance)		2.7	3.6	V
V <sub>CC</sub>	DC supply voltage (for low-voltage applications)		1.2	3.6	V
V <sub>I</sub>	DC Input voltage range		0	5.5	V
V <sub>O</sub>	DC output voltage range; output HIGH or LOW state		0	V <sub>CC</sub>	V
V <sub>O</sub>	DC output voltage range; output 3-State		0	5.5	V
T <sub>amb</sub>	Operating ambient temperature range in free air		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input rise and fall times	V <sub>CC</sub> = 1.2 to 2.7V V <sub>CC</sub> = 2.7 to 3.6V	0 0	20 10	ns/V

### ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

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

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V <sub>CC</sub>	DC supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	DC input diode current	V <sub>I</sub> < 0	-	-50	mA
V <sub>I</sub>	DC input voltage	Note 2	-0.5	+6.5	V
I <sub>OK</sub>	DC output diode current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0	-	±50	mA
V <sub>O</sub>	DC output voltage; output HIGH or LOW state	Note 2	-0.5	V <sub>CC</sub> + 0.5	V
V <sub>O</sub>	DC output voltage; output 3-State	Note 2	-0.5	6.5	V
I <sub>O</sub>	DC output source or sink current	V <sub>O</sub> = 0 to V <sub>CC</sub>	-	±50	mA
I <sub>GND</sub> , I <sub>CC</sub>	DC V <sub>CC</sub> or GND current		-	±100	mA
T <sub>stg</sub>	Storage temperature range		-65	+150	°C
P <sub>tot</sub>	Power dissipation per package – SSOP and TSSOP package	Above +60°C derate linearly 5.5mW/K		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 input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.

# 16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State)

## 74LVC162245A/ 74LVCH162245A

### DC ELECTRICAL 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> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -6mA	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> = -12mA	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> = 6mA			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> = 12mA			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 <sup>7</sup>	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 supply	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 per control pin	V <sub>CC</sub> = 2.7V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0		5	500	μA
ΔI <sub>CC</sub>	Additional quiescent supply current per data input pin	V <sub>CC</sub> = 2.7V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0		150	750	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>	450			μA
I <sub>BHHO</sub>	Bus hold HIGH overdrive current	V <sub>CC</sub> = 3.6V <sup>2, 3, 5</sup>	-450			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.
- For I/O ports the parameter I<sub>OZ</sub> includes the input leakage current.

### AC CHARACTERISTICS

GND = 0V; t<sub>R</sub> = t<sub>F</sub> = 2.5ns; C<sub>L</sub> = 50pF; R<sub>L</sub> = 500Ω; T<sub>amb</sub> = -40°C to +85°C.

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			V <sub>CC</sub> = 3.3V ± 0.3V			V <sub>CC</sub> = 2.7V		
			MIN	TYP <sup>1</sup>	MAX	MIN	MAX	
t <sub>PHL</sub> t <sub>PLH</sub>	Propagation delay nAn to nBn; nBn to nAn	1	1.5	3.3	5.7	1.5	6.7	ns
t <sub>PZH</sub> t <sub>PZL</sub>	3-State output enable time nOE to nAn; nOE to nBn	2, 3	1.5	4.3	7.5	1.5	8.5	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	3-State output disable time nOE to nAn; nOE to nBn	2, 3	1.5	4.0	6.5	1.5	7.5	ns

#### NOTE:

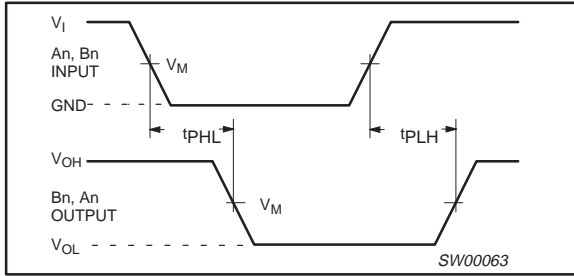
- All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.

16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State)

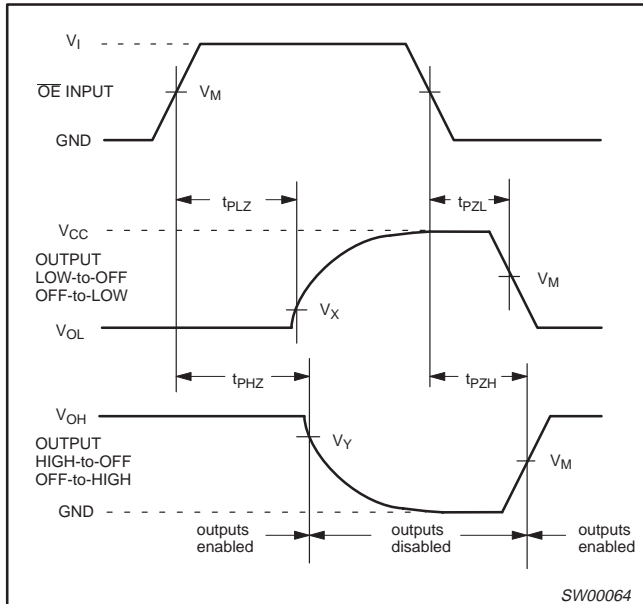
74LVC162245A/  
74LVCH162245A

**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  $V_{CC} < 2.7V$

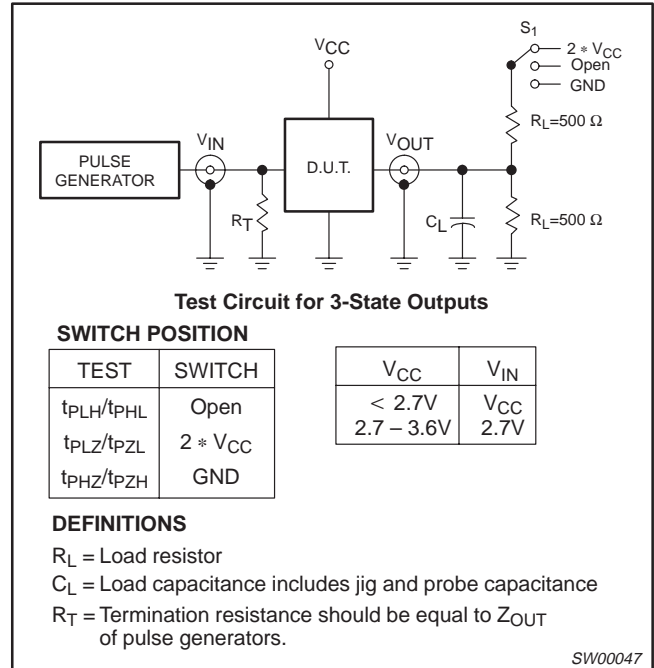


**Waveform 1. Input (nAn, nBn) to output (nBn, nAn) propagation delay times**



**Waveform 2. 3-State enable and disable times**

**TEST CIRCUIT**



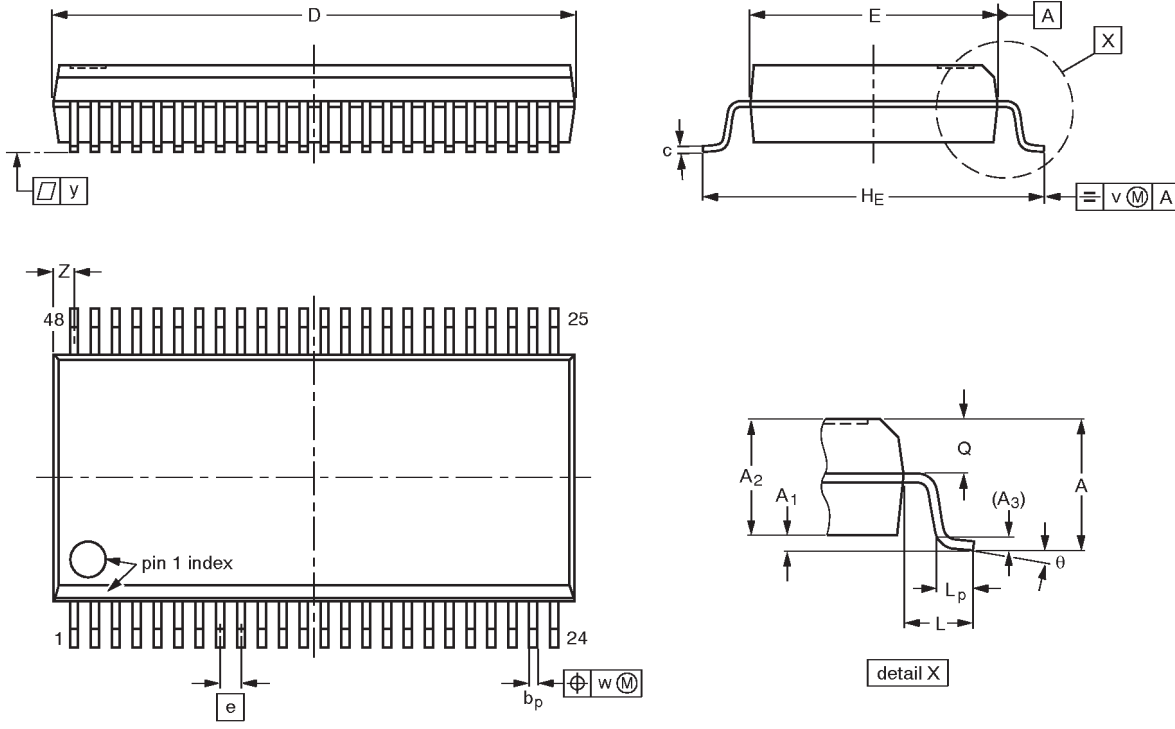
**Waveform 3. Load circuitry for switching times**

16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State)

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74LVCH162245A

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.

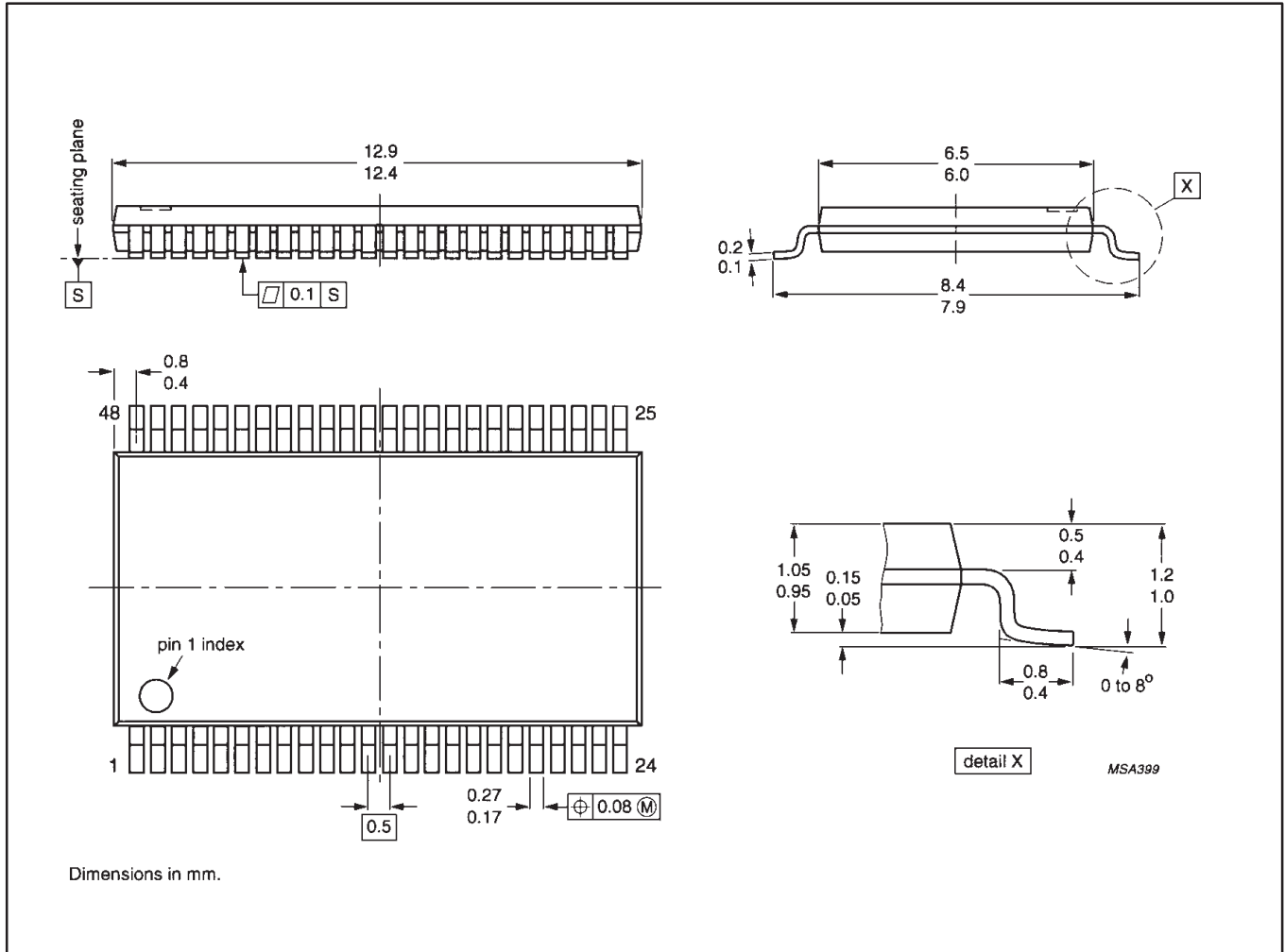
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT370-1		MO-118AA				93-11-02- 95-02-04

16-bit bus transceiver with direction pin; 30Ω series termination resistors; 5V Input/Outputs tolerant (3-State)

74LVC162245A/  
74LVCH162245A

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

SOT362-1





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16-bit bus transceiver with direction pin; 30 $\Omega$  series  
termination resistors; 5V Input/Outputs tolerant (3-State)

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74LVCH162245A

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### NOTES

16-bit bus transceiver with direction pin; 30Ω series  
termination resistors; 5V Input/Outputs tolerant (3-State)

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74LVCH162245A

### 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.
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.

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