

# DATA SHEET

## **74ALVT162245**

**2.5V/3.3V ALVT 16-bit transceiver with  
30Ω termination resistors (3-State)**

Product specification  
Supersedes data of 1996 Mar 05  
IC23 Data Handbook

1998 Feb 13

# 2.5V/3.3V 16-bit transceiver with 30Ω termination resistors (3-State)

## 74ALVT162245

### FEATURES

- 16-bit bidirectional bus interface
- 3-State buffers
- 5V I/O compatible
- Output capability: +12mA/-12mA
- 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
- Outputs include series resistance of 30Ω making external termination resistors unnecessary
- 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 74ALVT162245 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 transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. The control function implementation minimizes external timing requirements. The device features an Output Enable ( $\overline{nOE}$ ) input for easy cascading and a Direction (DIR) input for direction control.

The 74ALVT162245 is designed with 30Ω series resistance in both the High and Low states of the output. This design reduces line noise in applications such as memory address drivers, clock drivers, and bus transceivers/transmitters.

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS $T_{amb} = 25^{\circ}\text{C}$	TYPICAL		UNIT
			2.5V	3.3V	
$t_{PLH}$ $t_{PHL}$	Propagation delay nAx to nBx or nBx to nAx	$C_L = 50\text{pF}$	2.9 2.4	2.3 2.0	ns
$C_{IN}$	Input capacitance DIR, $\overline{nOE}$	$V_I = 0\text{V}$ or $V_{CC}$	3	3	pF
$C_{I/O}$	I/O pin capacitance	$V_{I/O} = 0\text{V}$ or $V_{CC}$	9	9	pF
$I_{CCZ}$	Total supply current	Outputs disabled	40	70	μA

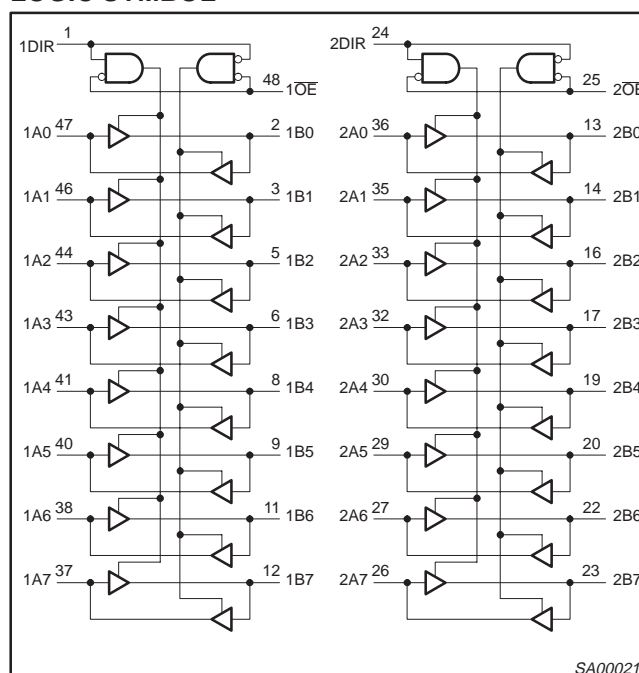
### ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	74ALVT162245 DL	AV162245 DL	SOT370-1
48-Pin Plastic TSSOP Type II	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	74ALVT162245 DGG	AV162245 DGG	SOT362-1

### PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1, 24	nDIR	Direction control input
47, 46, 44, 43, 41, 40, 38, 37, 36, 35, 33, 32, 30, 29, 27, 26	nA0 – nA7	Data inputs/outputs (A side)
2, 3, 5, 6, 8, 9, 11, 12, 13, 14, 16, 17, 19, 20, 22, 23	nB0 – nB7	Data inputs/outputs (B side)
25, 48	$\overline{nOE}$	Output enable input (active-Low)
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	$V_{CC}$	Positive supply voltage

### LOGIC SYMBOL

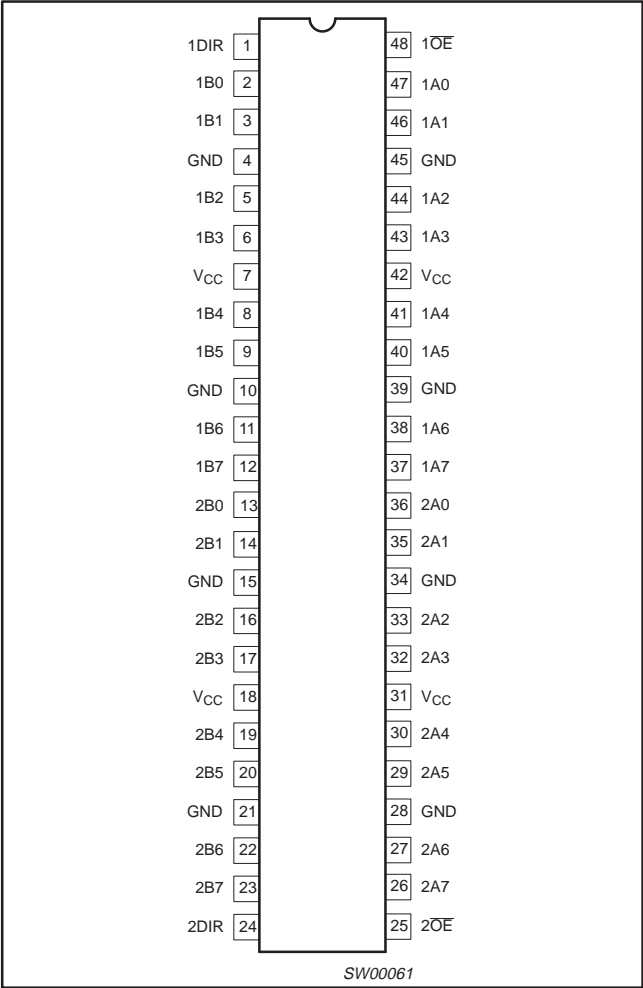


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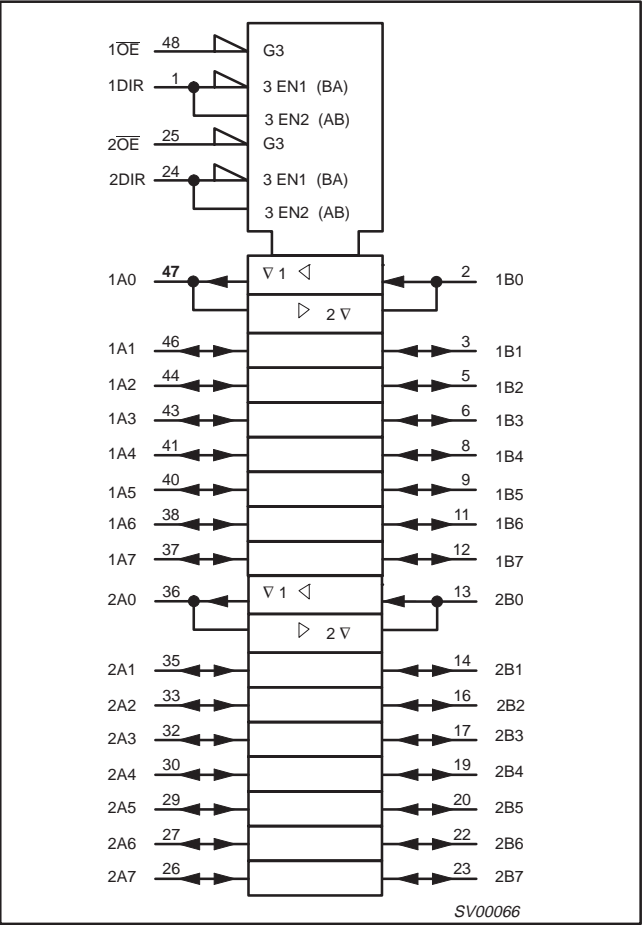
2.5V/3.3V 16-bit transceiver  
with 30Ω termination resistors (3-State)

74ALVT162245

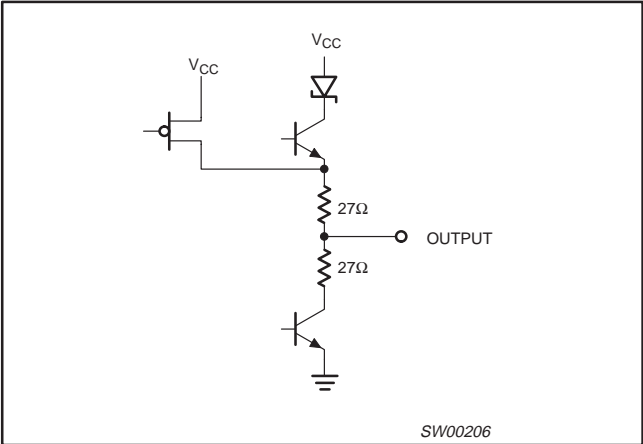
PIN CONFIGURATION



LOGIC SYMBOL (IEEE/IEC)



SCHEMATIC OF EACH OUTPUT



FUNCTION TABLE

INPUTS		INPUTS/OUTPUTS	
nOE	nDIR	nAx	nBx
L	L	nAx = nBx	Inputs
L	H	Inputs	nBx = nAx
H	X	Z	Z

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

# 2.5V/3.3V 16-bit transceiver with 30Ω termination resistors (3-State)

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## ABSOLUTE MAXIMUM RATINGS<sup>1,2</sup>

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 <sup>3</sup>		−0.5 to +7.0	V
$I_{OK}$	DC output diode current	$V_O < 0$	−50	mA
$V_{OUT}$	DC output voltage <sup>3</sup>	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:

- 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 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		−12	mA
$I_{OL}$	Low-level output current		12		12	mA
$\Delta t/\Delta v$	Input transition rise or fall rate; Outputs enabled		10		10	ns/V
$T_{amb}$	Operating free-air temperature range	−40	+85	−40	+85	°C

# 2.5V/3.3V 16-bit transceiver with 30Ω termination resistors (3-State)

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

SYMBOL	PARAMETER	TEST CONDITIONS		LIMITS			UNIT
				Temp = -40°C to +85°C			
				MIN	TYP <sup>1</sup>	MAX	
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = 3.0V; I <sub>IK</sub> = -18mA			-0.85	-1.2	V
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = 3.0V; I <sub>OH</sub> = -12mA		2.0	2.3		V
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 12mA			0.6	0.8	V
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND	Control pins		0.1	±1	μA
		V <sub>CC</sub> = 0 or 3.6V; V <sub>I</sub> = 5.5V			01.	10	
		V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub>	Data pins <sup>4</sup>		0.5	1	
		V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 0V			0.1	-5	
I <sub>OFF</sub>	Off current	V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V			0.1	±100	μA
I <sub>HOLD</sub>	Bus Hold current Data inputs <sup>6</sup>	V <sub>CC</sub> = 3V; V <sub>I</sub> = 0.8V		75	130		μA
		V <sub>CC</sub> = 3V; V <sub>I</sub> = 2.0V		-75	-140		
		V <sub>CC</sub> = 0V to 3.6V; V <sub>CC</sub> = 3.6V		±500			
I <sub>EX</sub>	Current into an output in the High state when V <sub>O</sub> > V <sub>CC</sub>	V <sub>O</sub> = 5.5V; V <sub>CC</sub> = 3.0V			50	125	μA
I <sub>PU/PD</sub>	Power up/down 3-State output current <sup>3</sup>	V <sub>CC</sub> ≤ 1.2V; V <sub>O</sub> = 0.5V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> OE/OE = Don't care			40	±100	μA
I <sub>CCH</sub>	Quiescent supply current	V <sub>CC</sub> = 3.6V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0			0.07	0.1	mA
I <sub>CCL</sub>		V <sub>CC</sub> = 3.6V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0			3.5	5	
I <sub>CCZ</sub>		V <sub>CC</sub> = 3.6V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0 <sup>5</sup>			0.07	0.1	
ΔI <sub>CC</sub>	Additional supply current per input pin <sup>2</sup>	V <sub>CC</sub> = 3V to 3.6V; One input at V <sub>CC</sub> -0.6V, Other inputs at V <sub>CC</sub> or GND			0.04	0.4	mA

### NOTES:

1. All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.
2. This is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.
3. This parameter is valid for any V<sub>CC</sub> between 0V and 1.2V with a transition time of up to 10msec. From V<sub>CC</sub> = 1.2V to V<sub>CC</sub> = 3.3V ± 0.3V a transition time of 100μsec is permitted. This parameter is valid for T<sub>amb</sub> = 25°C only.
4. Unused pins at V<sub>CC</sub> or GND.
5. I<sub>CCZ</sub> is measured with outputs pulled up to V<sub>CC</sub> 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<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			
			MIN	TYP <sup>1</sup>	MAX	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay nAx to nBx or nBx to nAx	1	0.5 0.5	2.3 2.0	3.6 3.1	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output enable time to High and Low level	2	1.0 1.0	3.0 2.6	5.0 3.9	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output disable time from High and Low Level	2	1.0 1.0	3.6 3.0	5.2 4.6	ns

### NOTE:

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

# 2.5V/3.3V 16-bit transceiver with 30Ω termination resistors (3-State)

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

SYMBOL	PARAMETER	TEST CONDITIONS		LIMITS			UNIT
				Temp = -40°C to +85°C			
				MIN	TYP <sup>1</sup>	MAX	
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = 2.3V; I <sub>IK</sub> = -18mA			-0.85	-1.2	V
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = 2.3V; I <sub>OH</sub> = -8mA		1.7			V
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = 2.3V; I <sub>OL</sub> = 12mA			0.6	0.7	
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>CC</sub> or GND	Control pins		0.1	±1	μA
		V <sub>CC</sub> = 0 or 2.7V; V <sub>I</sub> = 5.5V			0.1	10	
		V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>CC</sub>	Data pins <sup>4</sup>		0.1	1	
		V <sub>CC</sub> = 2.7V; V <sub>I</sub> = 0			0.1	-5	
I <sub>OFF</sub>	Off current	V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V			0.1	±100	μA
I <sub>HOLD</sub>	Bus Hold current	V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 0.7V			90		μA
	Data inputs <sup>6</sup>	V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 1.7V			-75		
I <sub>EX</sub>	Current into an output in the High state when V <sub>O</sub> > V <sub>CC</sub>	V <sub>O</sub> = 5.5V; V <sub>CC</sub> = 2.3V			20	125	μA
I <sub>PU/PD</sub>	Power up/down 3-State output current <sup>3</sup>	V <sub>CC</sub> ≤ 1.2V; V <sub>O</sub> = 0.5V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> OE/OE = Don't care			40	100	μA
I <sub>CCH</sub>	Quiescent supply current	V <sub>CC</sub> = 2.7V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0			0.04	0.1	mA
I <sub>CCL</sub>		V <sub>CC</sub> = 2.7V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0			2.5	4.5	
I <sub>CCZ</sub>		V <sub>CC</sub> = 2.7V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0 <sup>5</sup>			0.04	0.1	
ΔI <sub>CC</sub>	Additional supply current per input pin <sup>2</sup>	V <sub>CC</sub> = 2.3V to 2.7V; One input at V <sub>CC</sub> -0.6V, Other inputs at V <sub>CC</sub> or GND			0.05	0.4	mA

### NOTES:

1. All typical values are at  $V_{CC} = 2.5V$  and  $T_{amb} = 25^\circ C$ .
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  $V_{CC} = 2.5V \pm 0.2V$  a transition time of 100μsec is permitted. This parameter is valid for  $T_{amb} = 25^\circ C$  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;  $t_R = t_F = 2.5ns$ ;  $C_L = 50pF$ ;  $R_L = 500\Omega$ ;  $T_{amb} = -40^\circ C$  to  $+85^\circ C$ .

SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			V <sub>CC</sub> = 2.5V ±0.2V			
			MIN	TYP <sup>1</sup>	MAX	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay nAx to nBx or nBx to nAx	1	1.5 1.5	2.9 2.4	5.3 4.7	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output enable time to High and Low level	2	1.5 1.5	4.3 3.1	6.3 4.6	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output disable time from High and Low Level	2	1.5 1.5	4.2 3.3	6.2 5.1	ns

### NOTE:

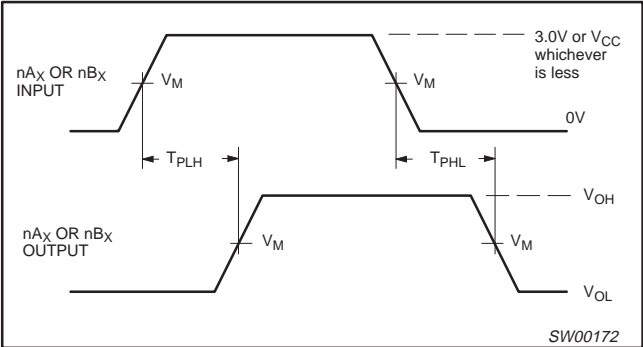
1. All typical values are at  $V_{CC} = 2.5V$  and  $T_{amb} = 25^\circ C$ .

2.5V/3.3V 16-bit transceiver  
with 30Ω termination resistors (3-State)

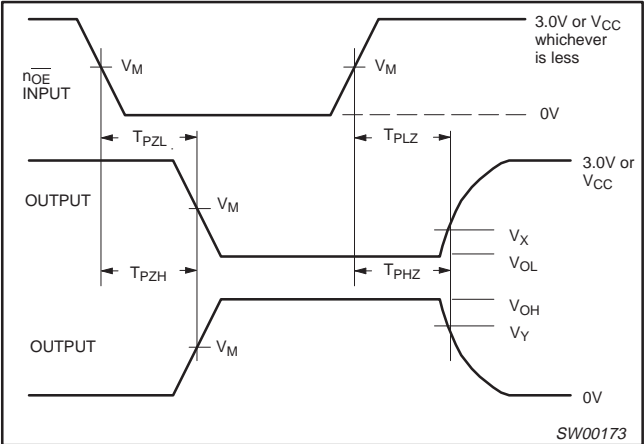
74ALVT162245

AC WAVEFORMS

- NOTES:
- $V_M = 1.5V$  at  $V_{CC} \geq 3.0V$ ,  $V_M = V_{CC}/2$  at  $V_{CC} \leq 2.7V$
  - $V_X = V_{OL} + 0.3V$  at  $V_{CC} \geq 3.0V$ ,  $V_X = V_{OL} + 0.1 \cdot V_{CC}$  at  $V_{CC} \leq 2.7V$
  - $V_Y = V_{OH} - 0.3V$  at  $V_{CC} \geq 3.0V$ ,  $V_Y = V_{OH} - 0.1 \cdot V_{CC}$  at  $V_{CC} \leq 2.7V$



Waveform 1. Input to Output Propagation Delays



Waveform 2. 3-State Output Enable and Disable Times

TEST CIRCUIT AND WAVEFORMS

Test Circuit for 3-State Outputs

**SWITCH POSITION**

TEST	SWITCH
$t_{PHZ}/t_{PZH}$	GND
$t_{PLZ}/t_{PZL}$	6V or $V_{CC} \times 2$
$t_{PLH}/t_{PHL}$	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.

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

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

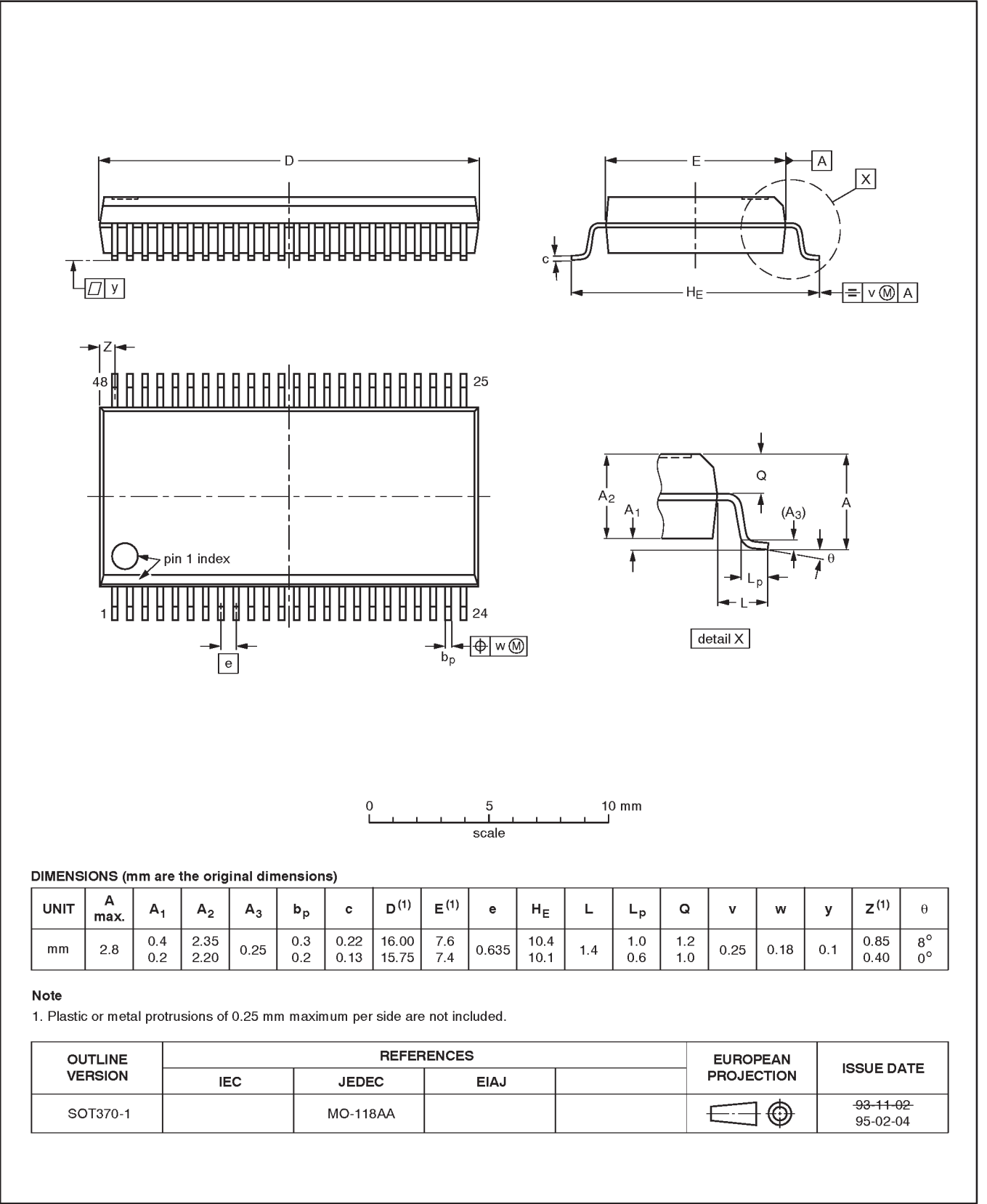
SW00162

2.5V/3.3V ALVT 16-bit transceiver  
with 30Ω termination resistors (3-State)

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SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1



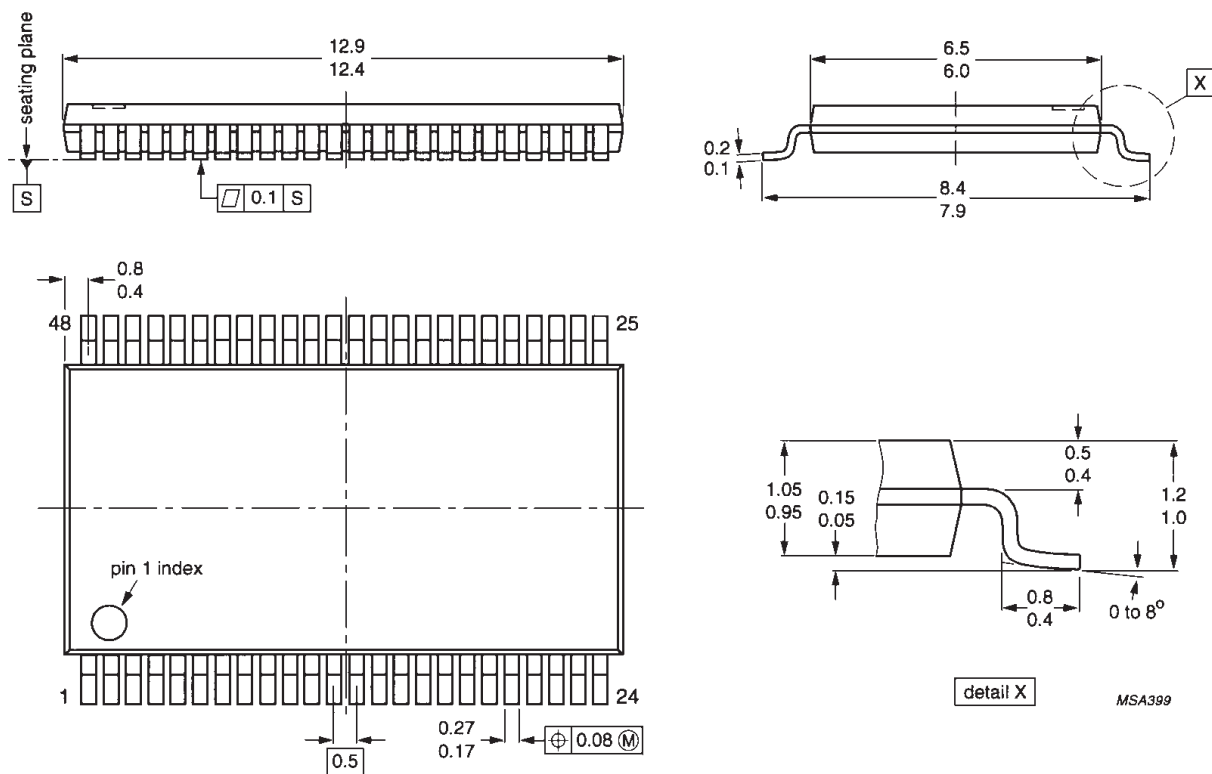


# 2.5V/3.3V ALVT 16-bit transceiver with 30Ω termination resistors (3-State)

74ALVT162245

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

SOT362-1



Dimensions in mm.

# 2.5V/3.3V ALVT 16-bit transceiver with 30Ω termination resistors (3-State)

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## 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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