

# DATA SHEET

## **74LVT162245B**

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

Product specification  
Supersedes data of 1995 Aug 22  
IC23 Data Handbook

1998 Feb 19

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

## 74LVT162245B

### FEATURES

- 16-bit bidirectional bus interface
- 3-State buffers
- 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
- Same part as 74LVT16245B-1

### DESCRIPTION

The 74LVT162245B is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3V.

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 74LVT162245B 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.

The 74LVT162245B is the same as the 74LVT16245B-1. The part number has been changed to reflect industry standards.

### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                                     | CONDITIONS<br>$T_{amb} = 25^{\circ}\text{C}$    | TYPICAL | UNIT |
|------------------------|-----------------------------------------------|-------------------------------------------------|---------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nBx or nBx to nAx | $C_L = 50\text{pF}$ ;<br>$V_{CC} = 3.3\text{V}$ | 2.5     | ns   |
| $C_{IN}$               | Input capacitance DIR, $\overline{nOE}$       | $V_I = 0\text{V}$ or 3.0V                       | 3       | pF   |
| $C_{I/O}$              | I/O pin capacitance                           | $V_{I/O} = 0\text{V}$ or 3.0V                   | 9       | pF   |
| $I_{CCZ}$              | Total supply current                          | Outputs disabled; $V_{CC} = 3.6\text{V}$        | 70      | μA   |

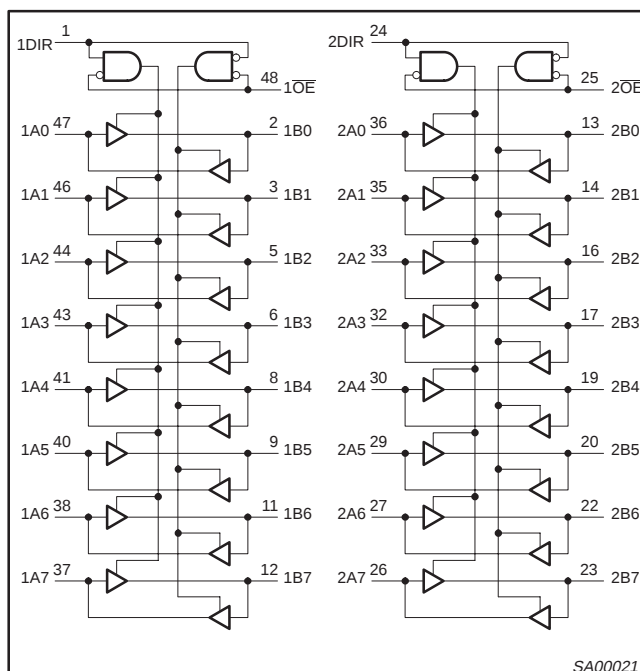
### ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|-------------------|-----------------------|---------------|------------|
| 48-Pin Plastic SSOP Type III | -40°C to +85°C    | 74LVT162245B DL       | VT162245B DL  | SOT370-1   |
| 48-Pin Plastic TSSOP Type II | -40°C to +85°C    | 74LVT162245B DGG      | VT162245B 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          |

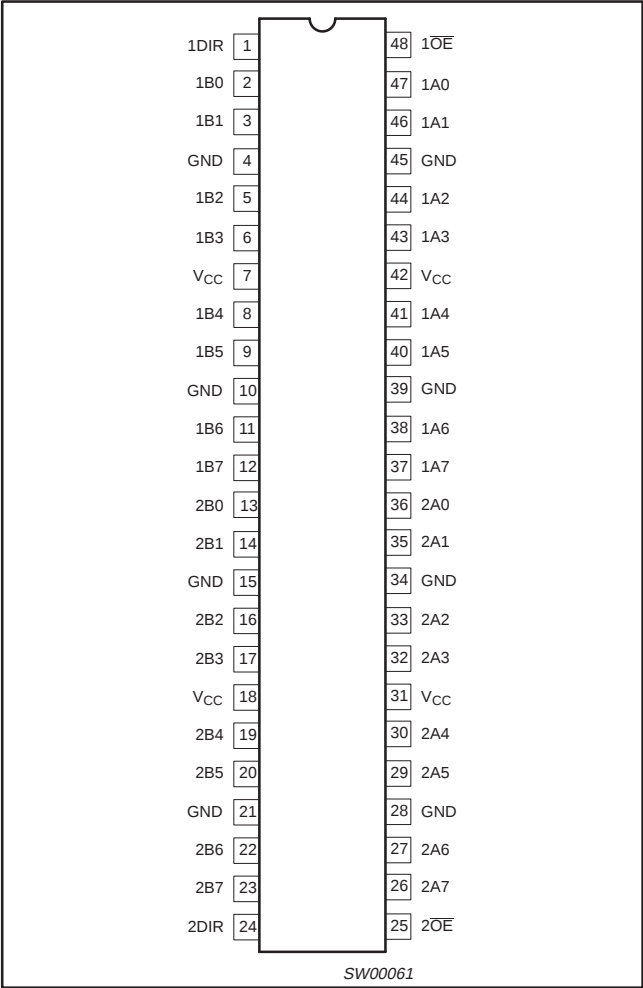
### LOGIC SYMBOL



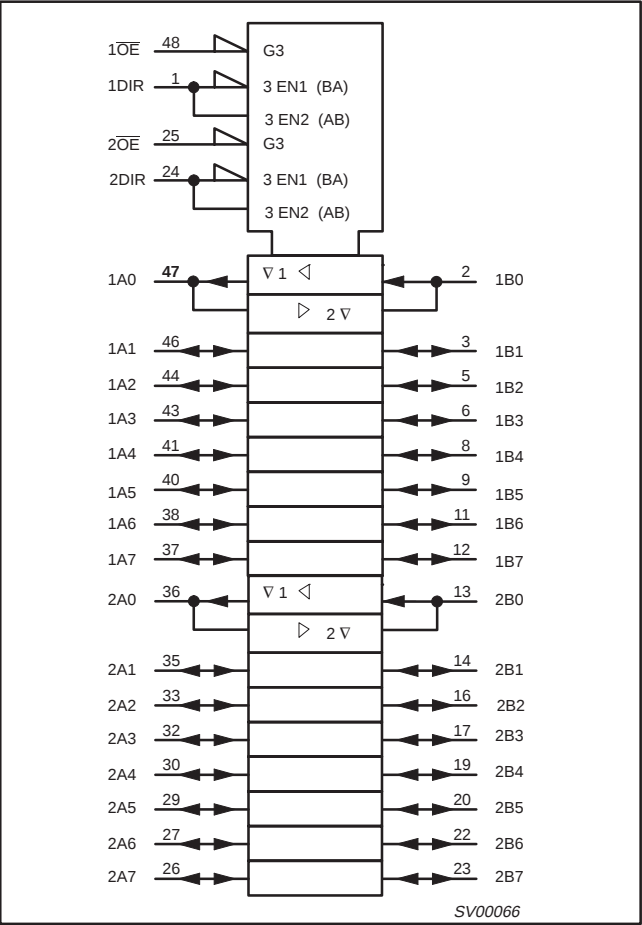
3.3V 16-bit transceiver with 30Ω termination resistors (3-State)

74LVT162245B

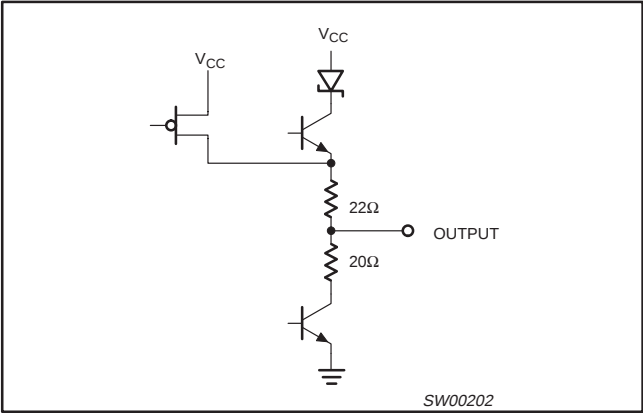
PIN CONFIGURATION



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

# 3.3V 16-bit transceiver with 30 $\Omega$ termination resistors (3-State)

74LVT162245B

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

| SYMBOL           | PARAMETER                      | CONDITIONS                  | RATING       | UNIT |
|------------------|--------------------------------|-----------------------------|--------------|------|
| V <sub>CC</sub>  | DC supply voltage              |                             | −0.5 to +4.6 | V    |
| I <sub>IK</sub>  | DC input diode current         | V <sub>I</sub> < 0          | −50          | mA   |
| V <sub>I</sub>   | DC input voltage <sup>3</sup>  |                             | −0.5 to +7.0 | V    |
| I <sub>OK</sub>  | DC output diode current        | V <sub>O</sub> < 0          | −50          | mA   |
| V <sub>OUT</sub> | DC output voltage <sup>3</sup> | Output in Off or High state | −0.5 to +7.0 | V    |
| I <sub>OUT</sub> | DC output current              | Output in Low state         | 128          | mA   |
|                  |                                | Output in High state        | −64          |      |
| T <sub>stg</sub> | 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                                           | LIMITS |     | UNIT |
|---------------------|-----------------------------------------------------|--------|-----|------|
|                     |                                                     | MIN    | MAX |      |
| V <sub>CC</sub>     | DC supply voltage                                   | 2.7    | 3.6 | V    |
| V <sub>I</sub>      | Input voltage                                       | 0      | 5.5 | V    |
| V <sub>IH</sub>     | High-level input voltage                            | 2.0    |     | V    |
| V <sub>IL</sub>     | Input voltage                                       |        | 0.8 | V    |
| I <sub>OH</sub>     | High-level output current                           |        | −12 | mA   |
| I <sub>OL</sub>     | Low-level output current                            |        | 12  | mA   |
| $\Delta t/\Delta v$ | Input transition rise or fall rate; Outputs enabled |        | 10  | ns/V |
| T <sub>amb</sub>    | Operating free-air temperature range                | −40    | +85 | °C   |

# 3.3V 16-bit transceiver with 30 $\Omega$ termination resistors (3-State)

74LVT162245B

## DC ELECTRICAL CHARACTERISTICS

| 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> = 2.7V; I <sub>IK</sub> = -18mA                                                                                 |                            |                       | 0.8              | -1.2 | V    |
| V <sub>OH</sub>    | High-level output voltage                                                      | V <sub>CC</sub> = 3.0V; I <sub>OH</sub> = -12mA                                                                                 |                            | 2.0                   | 2.5              |      | V    |
| V <sub>OL</sub>    | Low-level output voltage                                                       | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 12mA                                                                                  |                            |                       | 0.3              | 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                                                                              |                            |                       | 0.1              | 10   |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub>                                                                        | I/O Data pins <sup>4</sup> |                       | 0.5              | 10   |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 0                                                                                      |                            |                       | 0.1              | -5   |      |
| I <sub>OFF</sub>   | Output 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<br>A or B outputs <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                   | -130             |      |      |
|                    |                                                                                | 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                                                                                   |                            |                       | 75               | 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             | 0.12 | 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                               |                            |                       | 4.2              | 6    |      |
| 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             | 0.12 |      |
| 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                        |                            |                       | 0.1              | 0.2  | 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 to V<sub>CC</sub> or GND.
6. This is the bus hold overdrive current required to force the input to the opposite logic state.

## 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        | MAX                    |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>nAx to bBx or bBx to nAx  | 1        | 1.0<br>1.0                    | 2.5<br>2.2       | 3.5<br>3.5 | 3.9<br>3.9             | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>to High and Low level    | 2        | 1.5<br>1.5                    | 3.5<br>3.2       | 5.3<br>4.4 | 6.4<br>5.0             | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>from High and Low Level | 2        | 1.5<br>1.5                    | 3.5<br>4.3       | 4.8<br>6.7 | 5.1<br>5.9             | ns   |

### NOTE:

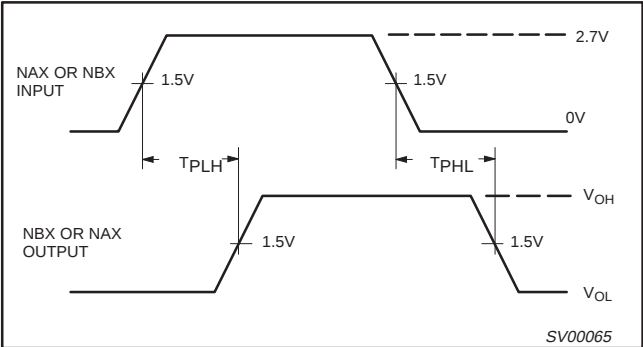
1. All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.

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

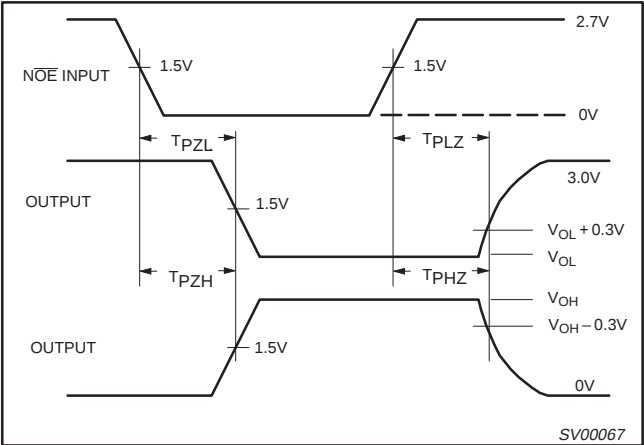
74LVT162245B

AC WAVEFORMS

$V_M = 1.5V$ ,  $V_{IN} = GND$  to  $2.7V$



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     |
| $t_{PLH}/t_{PHL}$ | 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.

**$V_M = 1.5V$**   
Input Pulse Definition

| FAMILY  | INPUT PULSE REQUIREMENTS |              |       |              |              |
|---------|--------------------------|--------------|-------|--------------|--------------|
|         | Amplitude                | Rep. Rate    | $t_W$ | $t_R$        | $t_F$        |
| 74LVT16 | 2.7V                     | $\leq 10MHz$ | 500ns | $\leq 2.5ns$ | $\leq 2.5ns$ |

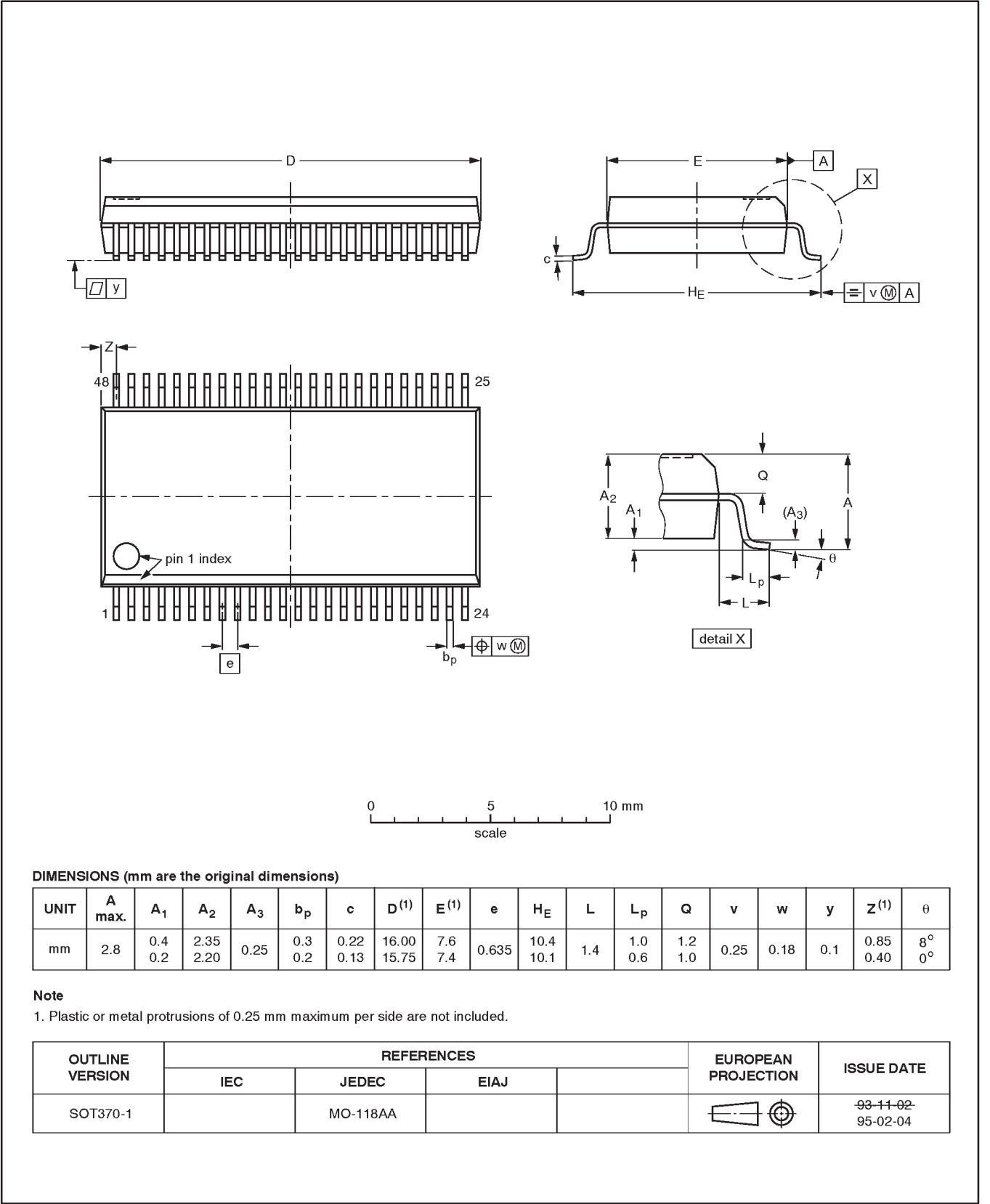
SW00003

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

74LVT162245B

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

SOT370-1

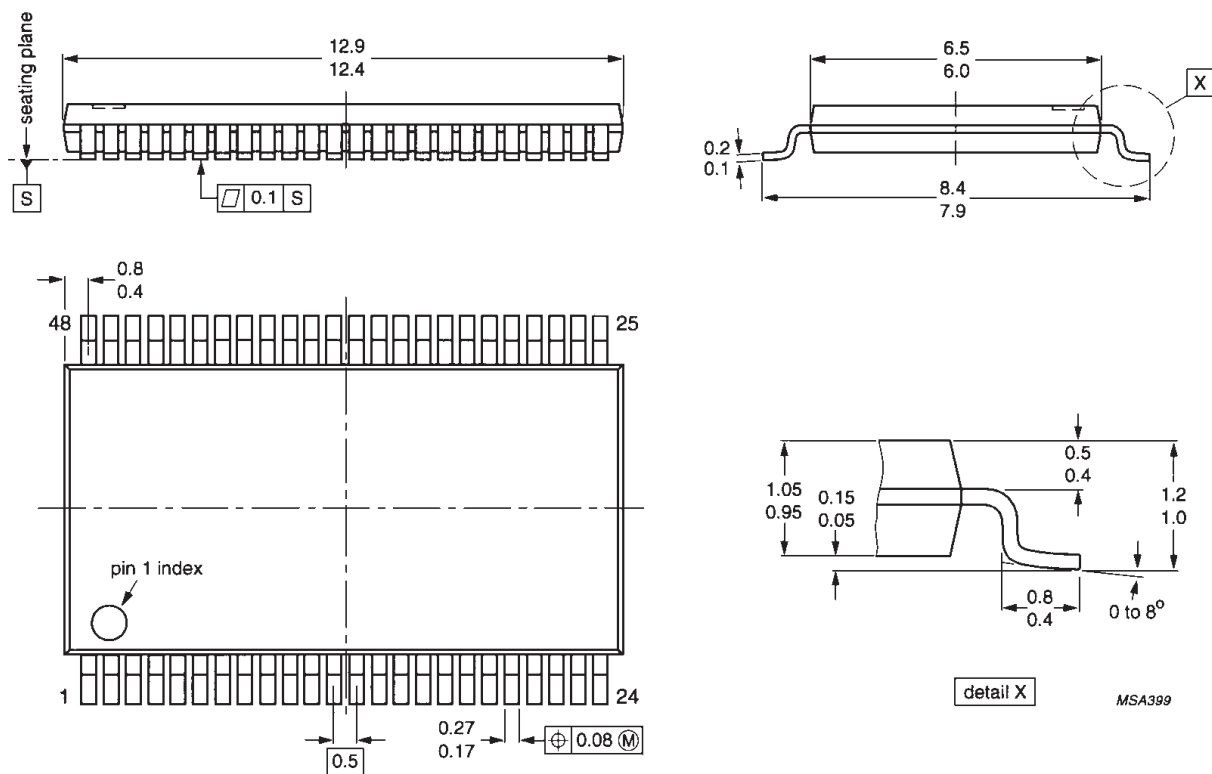


# 3.3V LVT 16-bit transceiver with 30Ω termination resistors (3-State)

74LVT162245B

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

SOT362-1



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**3.3V LVT 16-bit transceiver  
with 30 $\Omega$  termination resistors (3-State)**

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**74LVT162245B****NOTES**

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

74LVT162245B

## 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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