

74LVC16245A; 74LVCH16245A

16-bit bus transceiver with direction pin; 5 V tolerant; 3-state

Rev. 14 — 24 September 2021

Product data sheet

1. General description

The 74LVC16245A; 74LVCH16245A is a 16-bit transceiver with 3-state outputs. The device can be used as two 8-bit transceivers or one 16-bit transceiver. The device features two output enables (1OE and 2OE) each controlling eight outputs, and two send/receive (1DIR and 2DIR) inputs for direction control. A HIGH on nOE causes the outputs to assume a high-impedance OFF-state. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

The 74LVCH16245A bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

2. Features and benefits

- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power dissipation
- 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
- I_{OFF} circuitry provides partial Power-down mode operation
- All data inputs have bus hold (74LVCH16245A only)
- Complies with JEDEC standard:
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A (2.3 V to 2.7 V)
 - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-B exceeds 200 V
 - CDM ANSI/ESDA/Jedec JS-002 exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

| Type number | Temperature range | Package | | |
|-----------------|-------------------|---------|---|----------|
| | | Name | Description | Version |
| 74LVC16245ADGG | -40 °C to +125 °C | TSSOP48 | plastic thin shrink small outline package; 48 leads; body width 6.1 mm | SOT362-1 |
| 74LVCH16245ADGG | | | | |
| 74LVC16245ADGV | -40 °C to +125 °C | TVSOP48 | plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm | SOT480-1 |
| 74LVCH16245ADGV | | | | |

4. Functional diagram

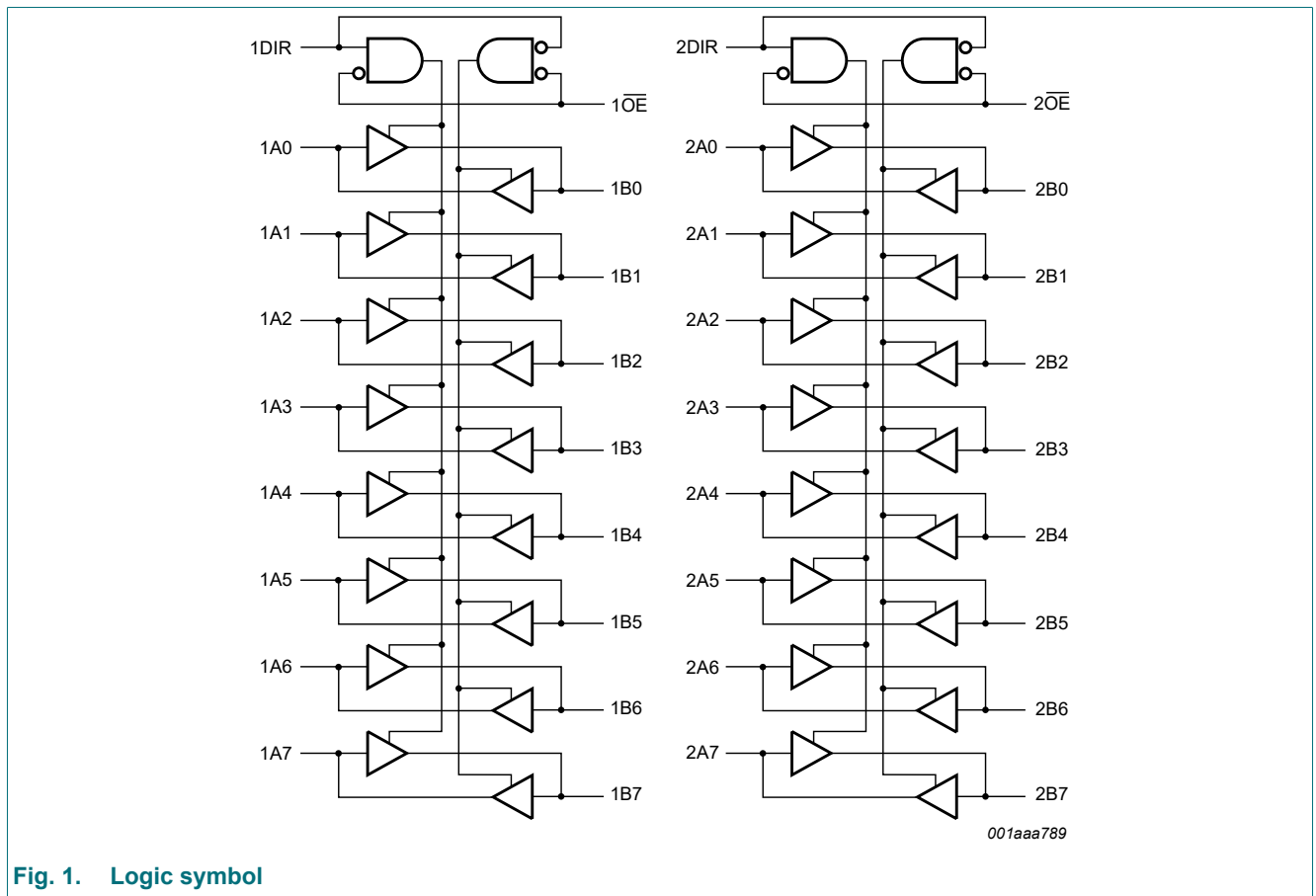


Fig. 1. Logic symbol

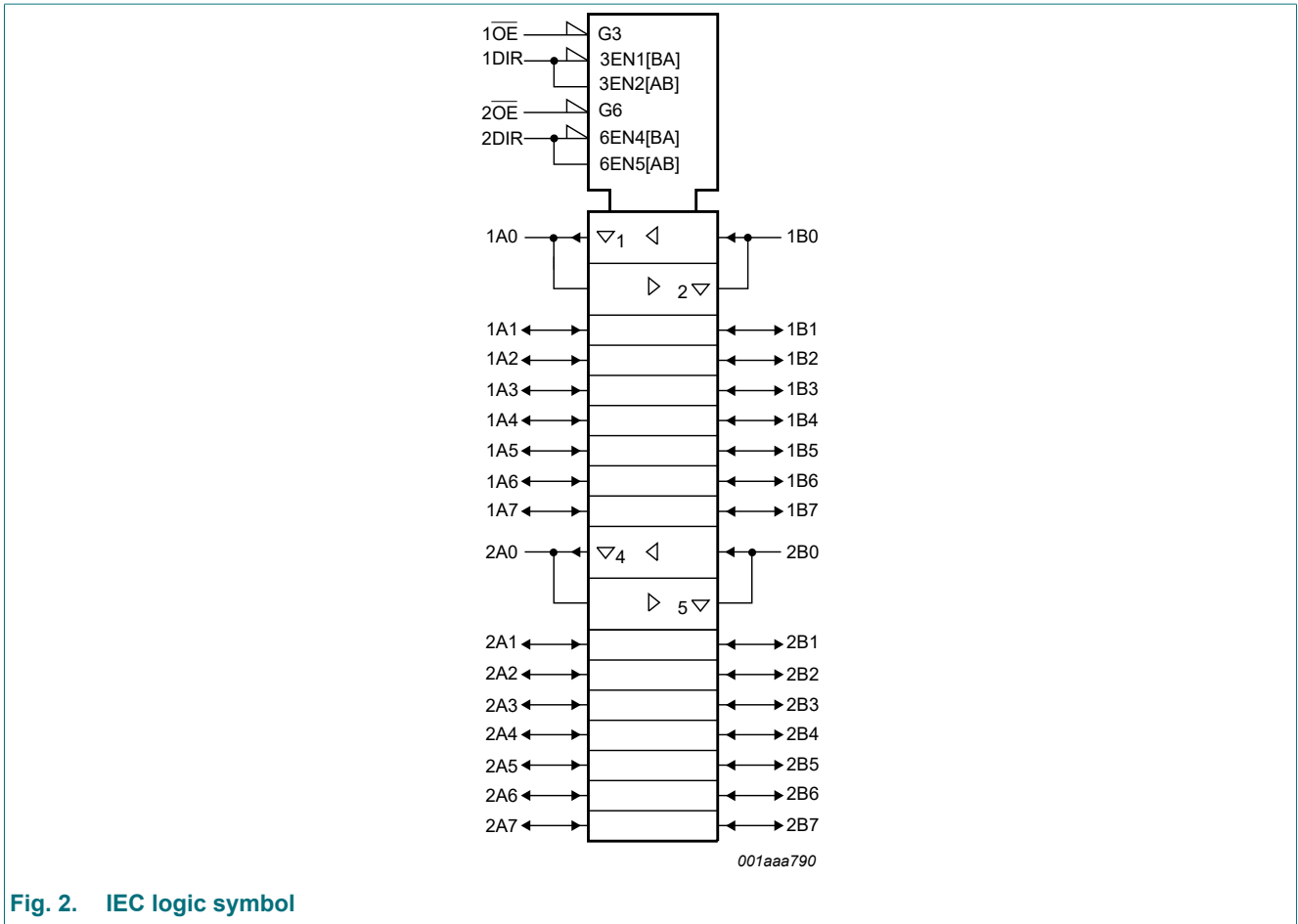


Fig. 2. IEC logic symbol

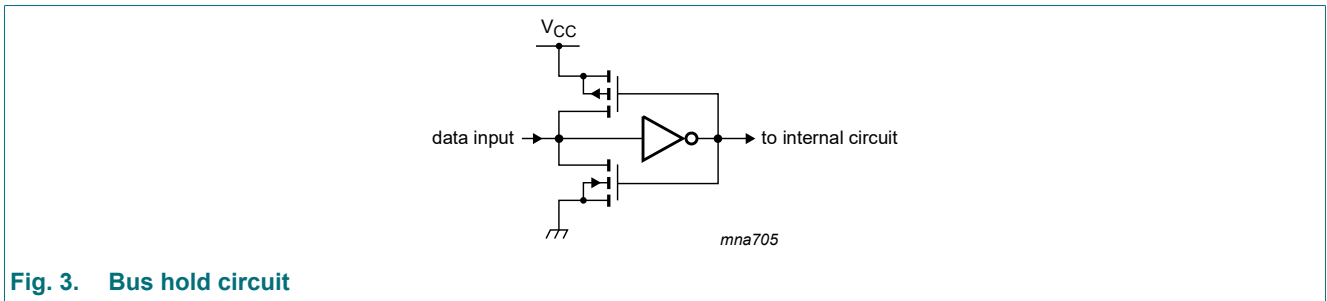


Fig. 3. Bus hold circuit

5. Pinning information

5.1. Pinning

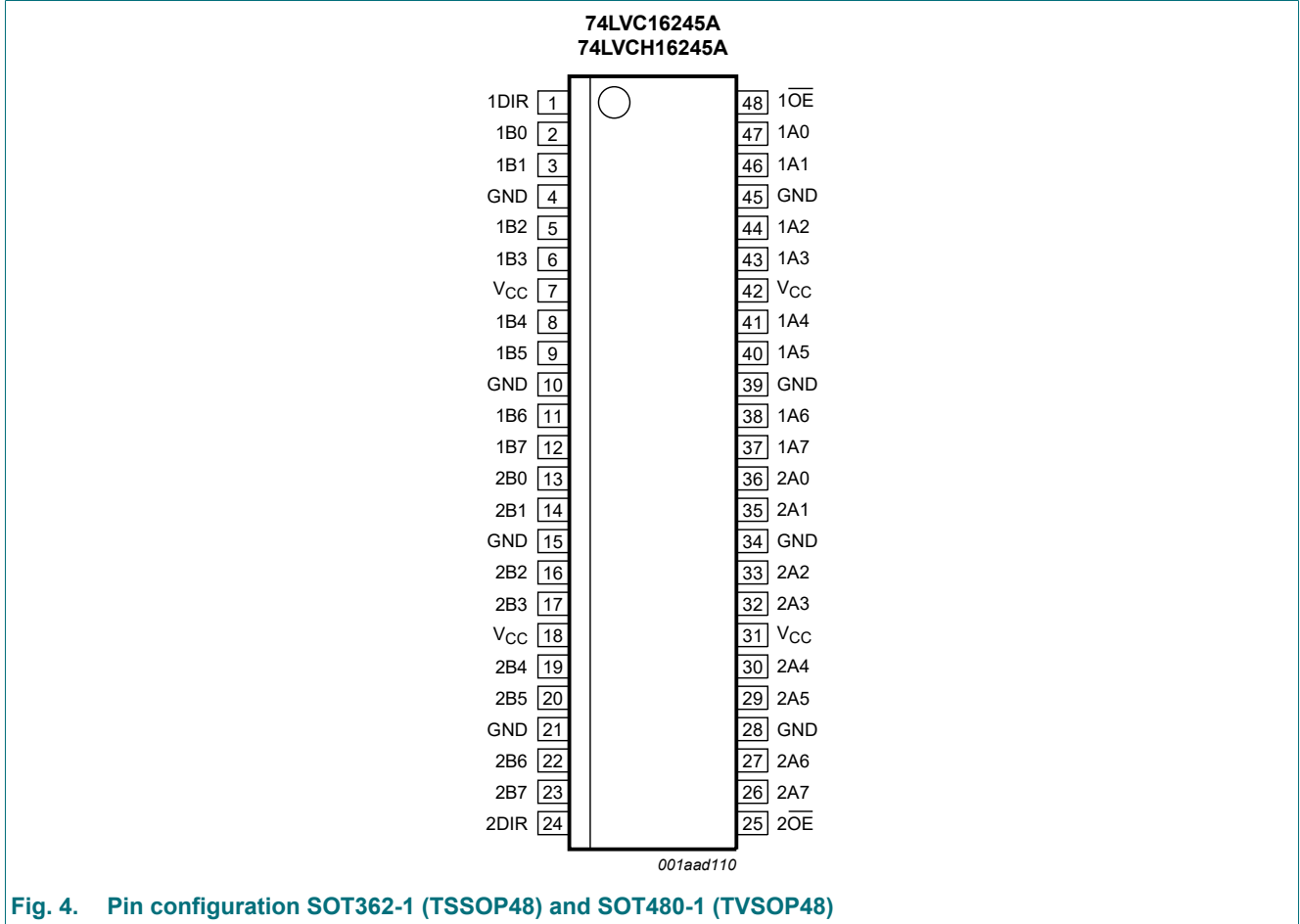


Fig. 4. Pin configuration SOT362-1 (TSSOP48) and SOT480-1 (TVSOP48)

5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--------------------------------|----------------------------------|
| 1DIR, 2DIR | 1, 24 | direction control input |
| 1B0 to 1B7 | 2, 3, 5, 6, 8, 9, 11, 12 | data input/output |
| 2B0 to 2B7 | 13, 14, 16, 17, 19, 20, 22, 23 | data input/output |
| GND | 4, 10, 15, 21, 28, 34, 39, 45 | ground (0 V) |
| V _{CC} | 7, 18, 31, 42 | supply voltage |
| 1OE, 2OE | 48, 25 | output enable input (active LOW) |
| 1A0 to 1A7 | 47, 46, 44, 43, 41, 40, 38, 37 | data input/output |
| 2A0 to 2A7 | 36, 35, 33, 32, 30, 29, 27, 26 | data input/output |

6. Functional description

Table 3. Function table

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

| Inputs | | Outputs | |
|--------|------|-----------|-----------|
| nOE | nDIR | nAn | nBn |
| L | L | nAn = nBn | inputs |
| L | H | inputs | nBn = nAn |
| H | X | Z | Z |

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|-------------------------------|------|----------------|------|
| V_{CC} | supply voltage | | -0.5 | +6.5 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | [1] | -0.5 | +6.5 | V |
| I_{OK} | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V | - | ± 50 | mA |
| V_O | output voltage | output HIGH or LOW | [2] | $V_{CC} + 0.5$ | V |
| | | output 3-state | [2] | +6.5 | V |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ± 50 | mA |
| I_{CC} | supply current | | - | 100 | mA |
| I_{GND} | ground current | | -100 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C | [3] | 500 | mW |

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] For SOT362-1 (TSSOP48) packages: P_{tot} derates linearly with 12.2 mW/K above 109 °C.
For SOT480-1 (TVSOP48) packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|---------------------------|------|-----|----------|------|
| V_{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | 3.6 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW | 0 | - | V_{CC} | V |
| | | output 3-state | 0 | - | 5.5 | V |
| T_{amb} | ambient temperature | in free air | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.2$ V to 2.7 V | 0 | - | 20 | ns/V |
| | | $V_{CC} = 2.7$ V to 3.6 V | 0 | - | 10 | ns/V |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit | |
|------------------|---------------------------|--|-----------------------|---------|---------------------|-----------------------|---------------------|------|----|
| | | | Min | Typ [1] | Max | Min | Max | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.2 V | 1.08 | - | - | 1.08 | - | V | |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65V _{CC} | - | - | 0.65V _{CC} | - | V | |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | - | - | 1.7 | - | V | |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | - | - | 2.0 | - | V | |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.2 V | - | - | 0.12 | - | 0.12 | V | |
| | | V _{CC} = 1.65 V to 1.95 V | - | - | 0.35V _{CC} | - | 0.35V _{CC} | V | |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.7 | - | 0.7 | V | |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 0.8 | - | 0.8 | V | |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 3.6 V | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | V | |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | V | |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | V | |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | V | |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | V | |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | V | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V | - | - | 0.2 | - | 0.3 | V | |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | 0.65 | V | |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | 0.8 | V | |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | 0.6 | V | |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | 0.8 | V | |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 3.6 V | [2] | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = 5.5 V or GND; V _{CC} = 3.6 V | [2][3] | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{OFF} | power-off leakage current | V _I or V _O = 5.5 V; V _{CC} = 0.0 V | | - | ±0.1 | ±10 | - | ±20 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V | | - | 0.1 | 20 | - | 80 | μA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 3.6 V | | - | 5 | 500 | - | 5000 | μA |
| C _I | input capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC} | | - | 5.0 | - | - | - | pF |
| C _{I/O} | input/output capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC} | | - | 10 | - | - | - | pF |
| I _{BHL} | bus hold LOW current | V _{CC} = 1.65; V _I = 0.58 V | [4][5] | 10 | - | - | 10 | - | μA |
| | | V _{CC} = 2.3; V _I = 0.7 V | | 30 | - | - | 25 | - | μA |
| | | V _{CC} = 3.0; V _I = 0.8 V | | 75 | - | - | 60 | - | μA |

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-------------------|---------------------------------|--|------------------|---------|-----|-------------------|-----|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| I _{BHH} | bus hold HIGH current | V _{CC} = 1.65; V _I = 1.07 V [4][5] | -10 | - | - | -10 | - | μA |
| | | V _{CC} = 2.3; V _I = 1.7 V | -30 | - | - | -25 | - | μA |
| | | V _{CC} = 3.0; V _I = 2.0 V | -75 | - | - | -60 | - | μA |
| I _{BHLO} | bus hold LOW overdrive current | V _{CC} = 1.95 V [4][6] | 200 | - | - | 200 | - | μA |
| | | V _{CC} = 2.7 V | 300 | - | - | 300 | - | μA |
| | | V _{CC} = 3.6 V | 500 | - | - | 500 | - | μA |
| I _{BHHO} | bus hold HIGH overdrive current | V _{CC} = 1.95 V [4][6] | -200 | - | - | -200 | - | μA |
| | | V _{CC} = 2.7 V | -300 | - | - | -300 | - | μA |
| | | V _{CC} = 3.6 V | -500 | - | - | -500 | - | μA |

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

[2] The bus hold circuit is switched off when V_I > V_{CC} allowing 5.5 V on the input terminal.

[3] For I/O ports the parameter I_{OZ} includes the input leakage current.

[4] Valid for data inputs of bus hold parts only (74LVCH16245A). Note that control inputs do not have a bus hold circuit.

[5] The specified sustaining current at the data input holds the input below the specified V_I level.

[6] The specified overdrive current at the data input forces the data input to the opposite input state.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|-------------------|--|------------------|---------|------|-------------------|------|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| t _{pd} | propagation delay | nAn to nBn; nBn to nAn; see Fig. 5 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 13.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.5 | 5.2 | 12.2 | 1.5 | 13.8 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 2.8 | 6.0 | 1.0 | 6.7 | ns |
| | | V _{CC} = 2.7 V | 1.0 | 2.7 | 4.7 | 1.0 | 6.0 | ns |
| t _{en} | enable time | nOE to nAn, nBn; see Fig. 6 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 15.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.5 | 5.9 | 15.0 | 1.5 | 16.9 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 3.3 | 7.9 | 1.0 | 8.8 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.5 | 6.7 | 1.5 | 8.5 | ns |
| t _{dis} | disable time | nOE to nAn, nBn; see Fig. 6 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 11.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.0 | 4.9 | 13.1 | 1.0 | 14.7 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 0.5 | 2.7 | 7.1 | 0.5 | 7.9 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.4 | 6.6 | 1.5 | 8.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.5 | 3.3 | 5.6 | 1.5 | 7.0 | ns |

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|------------------|---------|-----|-------------------|-----|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| C _{PD} | power dissipation capacitance | per input; V _I = GND to V _{CC} [3] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 11.5 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 15.2 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 18.5 | - | - | - | pF |

- [1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz; f_o = output frequency in MHz
 C_L = output load capacitance in pF
 V_{CC} = supply voltage in Volts
 N = number of inputs switching
 $\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

10.1. Waveforms and test circuit

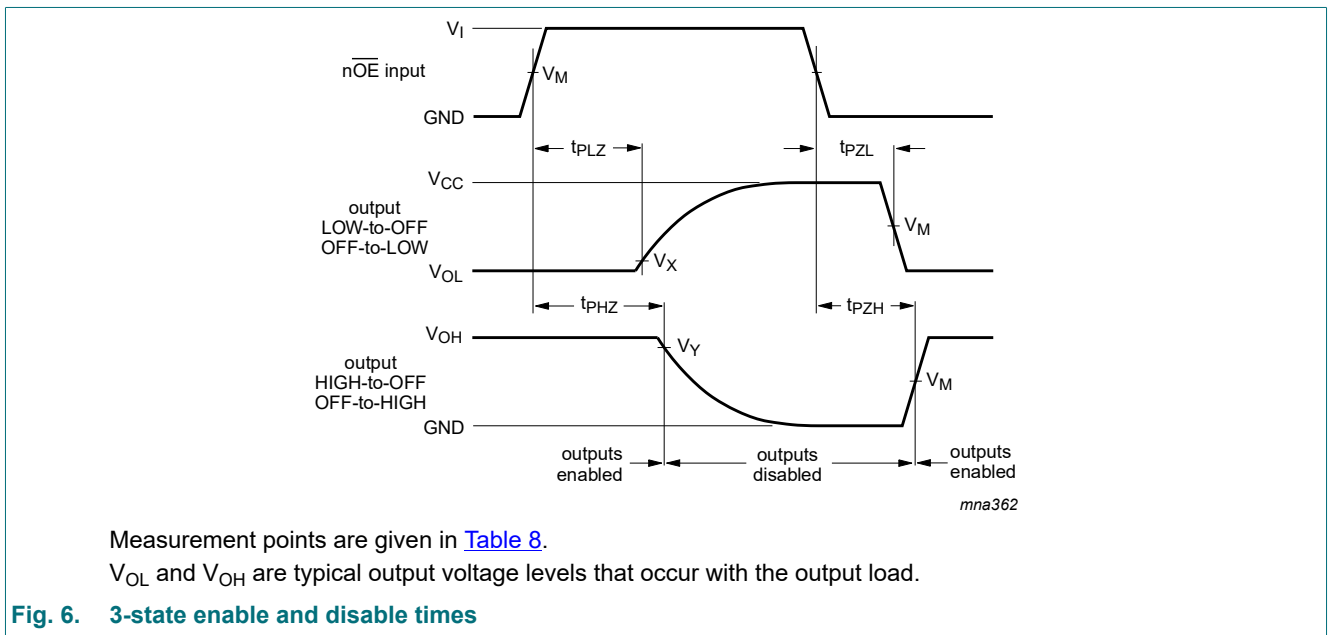
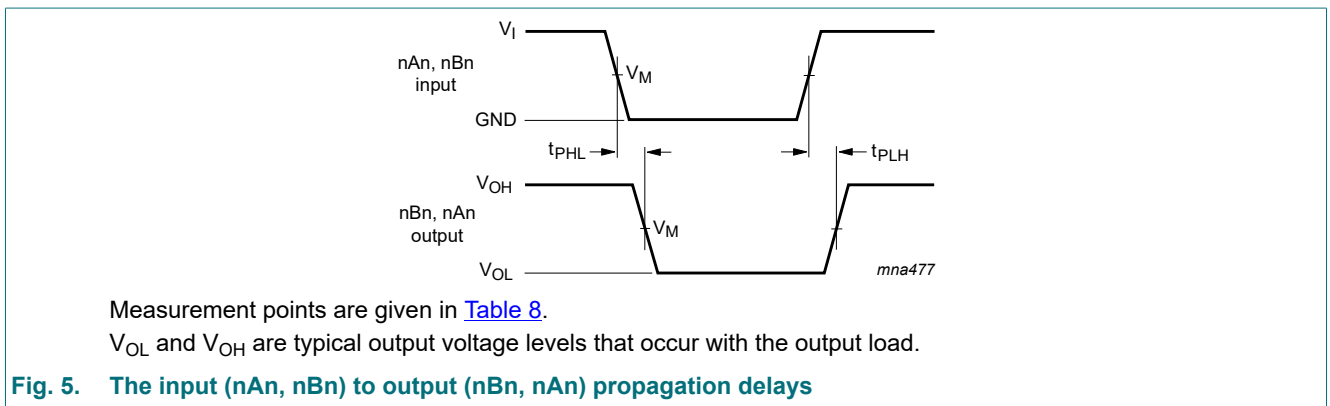
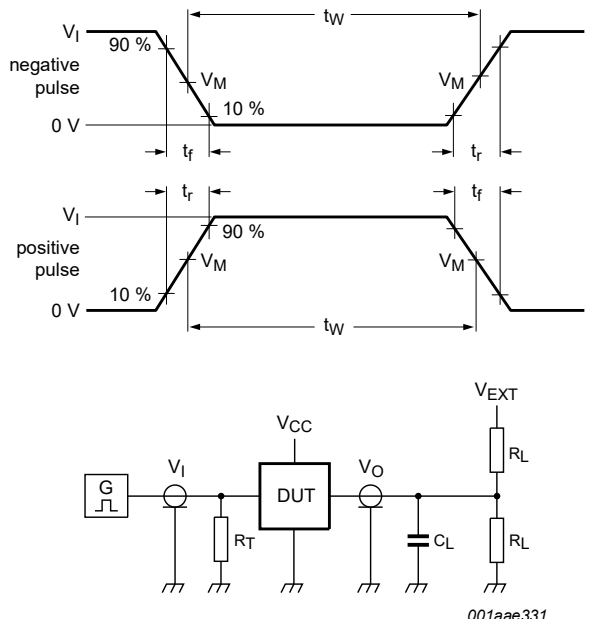


Table 8. Measurement points

| Supply voltage | Input | | Output | | |
|------------------|---------------------|----------|---------------------|---------------------------|---------------------------|
| V_{CC} | V_M | V_I | V_M | V_X | V_Y |
| 1.2 V | $0.5 \times V_{CC}$ | V_{CC} | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 1.65 V to 1.95 V | $0.5 \times V_{CC}$ | V_{CC} | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.3 V to 2.7 V | $0.5 \times V_{CC}$ | V_{CC} | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.7 V | 1.5 V | 2.7 V | 1.5 V | $V_{OL} + 0.3 \text{ V}$ | $V_{OH} - 0.3 \text{ V}$ |
| 3.0 V to 3.6 V | 1.5 V | 2.7 V | 1.5 V | $V_{OL} + 0.3 \text{ V}$ | $V_{OH} - 0.3 \text{ V}$ |



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Test data is given in Table 9.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig. 7. Test circuit for measuring switching times

Table 9. Test data

| Supply voltage | Input | | Load | | V_{EXT} | | |
|------------------|----------|-----------------------|-------|--------------|--------------------|--------------------|--------------------|
| | V_I | t_r, t_f | C_L | R_L | t_{PLH}, t_{PHL} | t_{PLZ}, t_{PZL} | t_{PHZ}, t_{PZH} |
| 1.2 V | V_{CC} | $\leq 2 \text{ ns}$ | 30 pF | 1 k Ω | open | $2 \times V_{CC}$ | GND |
| 1.65 V to 1.95 V | V_{CC} | $\leq 2 \text{ ns}$ | 30 pF | 1 k Ω | open | $2 \times V_{CC}$ | GND |
| 2.3 V to 2.7 V | V_{CC} | $\leq 2 \text{ ns}$ | 30 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 2.7 V | 2.7 V | $\leq 2.5 \text{ ns}$ | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 3.0 V to 3.6 V | 2.7 V | $\leq 2.5 \text{ ns}$ | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |

11. Package outline

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

SOT362-1

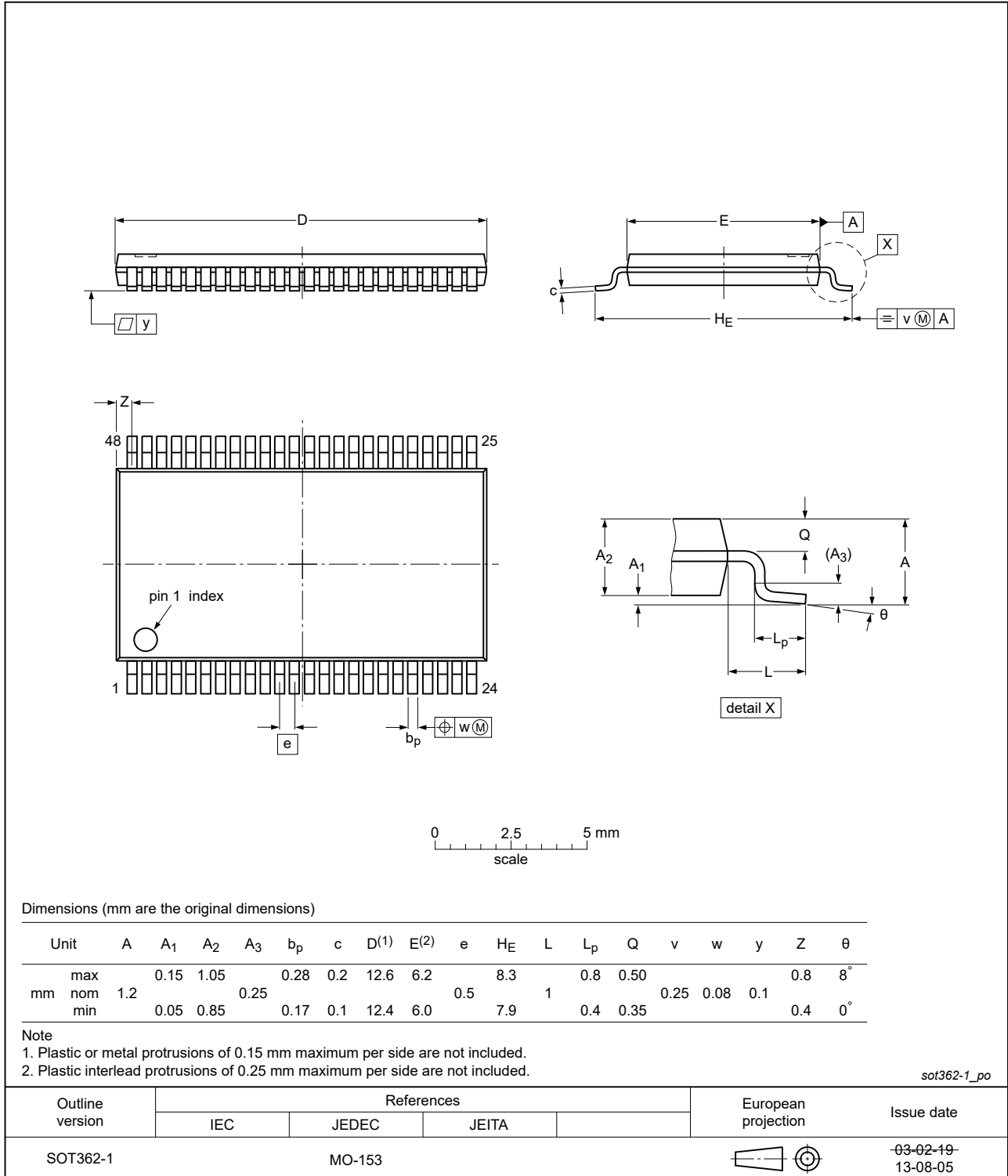


Fig. 8. Package outline SOT362-1 (TSSOP48)

TVSOP48: plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm

SOT480-1

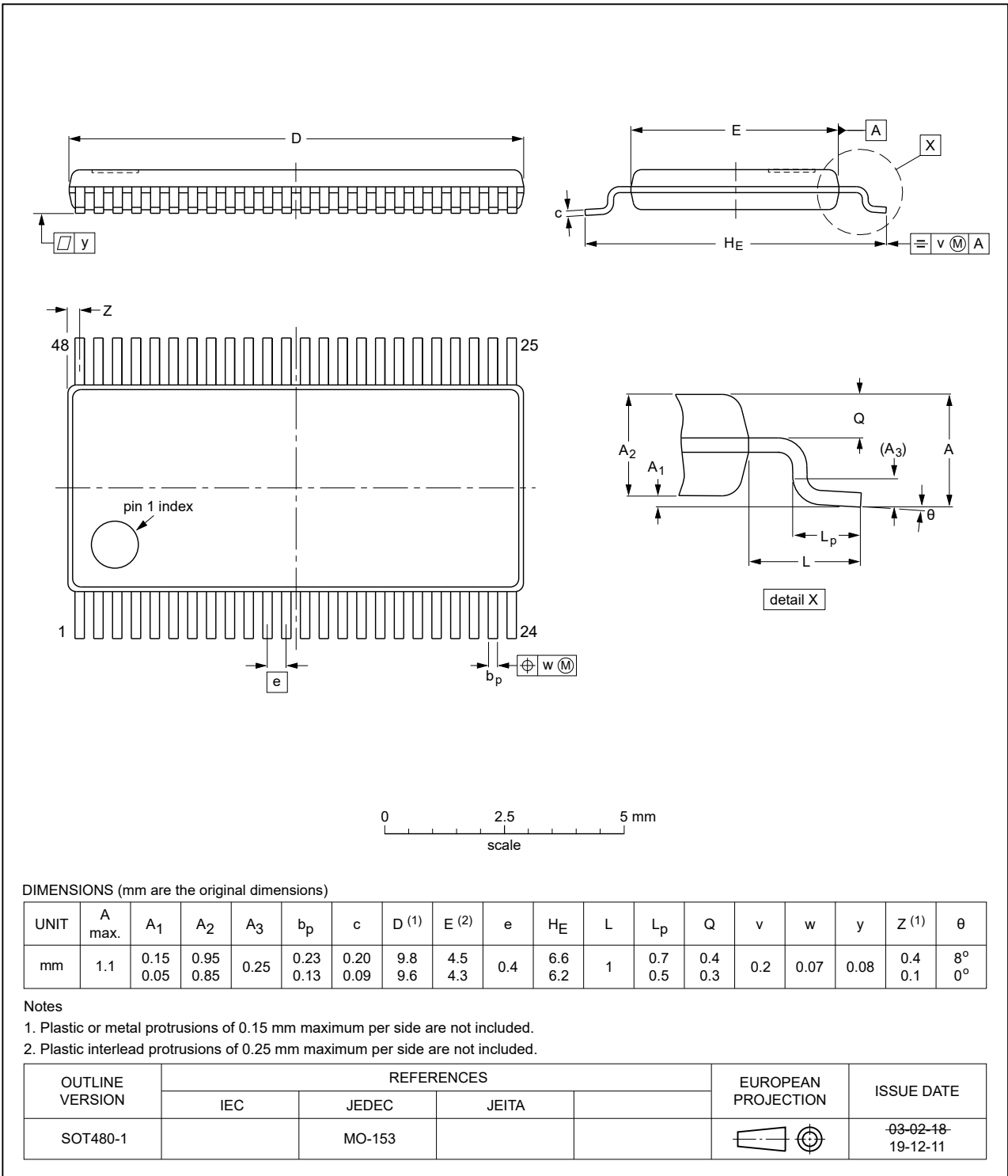


Fig. 9. Package outline SOT480-1 (TVSOP48)

12. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|---|
| CDM | Charged Device Model |
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------------------|--|-----------------------|---------------|------------------------------|
| 74LVC_LVCH16245A v.14 | 20210924 | Product data sheet | - | 74LVC_LVCH16245A v.13 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74LVC16245ADL and 74LVCH16245ADL (SOT370-1/SSOP48) removed. Section 1 and Section 2 updated. Table 4: Derating values for P_{tot} total power dissipation updated. Fig. 9: Package outline drawing SOT480-1 (TVSOP48) updated. | | | |
| 74LVC_LVCH16245A v.13 | 20190213 | Product data sheet | - | 74LVC_LVCH16245A v.12 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Type numbers 74LVC16245AEV and 74LVCH16245AEV (SOT702-1) removed. Type numbers 74LVC16245ABX and 74LVCH16245ABX (SOT1134-2) removed. Type numbers 74LVC16245ADGV and 74LVCH16245ADGV (SOT480-1) added. Package outline drawing Fig. 8 (TSSOP48) updated. | | | |
| 74LVC_LVCH16245A v.12 | 20120213 | Product data sheet | - | 74LVC_LVCH16245A v.11 |
| Modifications: | <ul style="list-style-type: none"> For type number 74LVC16245ABX and 74LVCH16245ABX the sot code has changed to SOT1134-2. | | | |
| 74LVC_LVCH16245A v.11 | 20111208 | Product data sheet | - | 74LVC_LVCH16245A v.10 |
| Modifications: | <ul style="list-style-type: none"> Table 4, Table 5, Table 6, Table 7, and Table 9: values added for lower voltage ranges. | | | |
| 74LVC_LVCH16245A v.10 | 20110623 | Product data sheet | - | 74LVC_LVCH16245A v.9 |
| Modifications: | <ul style="list-style-type: none"> type numbers 74LVC16245ABQ and 74LVCH16245ABQ changed to 74LVC16245ABX and 74LVCH16245ABX. Pin configuration SOT1134-2 (HXQFN60): figure note 1 changed. | | | |
| 74LVC_LVCH16245A v.9 | 20100329 | Product data sheet | - | 74LVC_LVCH16245A v.8 |
| 74LVC_LVCH16245A v.8 | 20081106 | Product data sheet | - | 74LVC_LVCH16245A v.7 |
| 74LVC_LVCH16245A v.7 | 20031125 | Product specification | - | 74LVC_LVCH16245A v.6 |
| 74LVC_LVCH16245A v.6 | 20030130 | Product specification | - | 74LVC_LVCH16245A v.5 |
| 74LVC_LVCH16245A v.5 | 20021030 | Product specification | - | 74LVC_H16245A v.4 |
| 74LVC_H16245A v.4 | 19970925 | Product specification | - | 74LVC16245A_74LVCH16245A v.3 |
| 74LVC16245A_74LVCH16245A v.3 | 19970925 | Product specification | - | 74LVC16245A v.2 |
| 74LVC16245A v.2 | 19970801 | Product specification | - | 74LVC16245A v.1 |
| 74LVC16245A v.1 | - | - | - | - |

14. Legal information

Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|--------------------------------|--------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

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Date of release: 24 September 2021
