# 74LVC162245A-Q100

## 16-bit transceiver with direction pin; 30 Ω series termination resistors; 5 V tolerant input/output; 3-state

Rev. 4 — 1 August 2023 Product data sheet

## 1. General description

The 74LVC162245A is a 16-bit transceiver with 30 Ω termination resistors and 3-state outputs. The device can be used as two 8-bit transceivers or one 16-bit transceiver. The device features two output enables (1$\overline{OE}$ and 2$\overline{OE}$) each controlling eight outputs, and two send/receive (1DIR and 2DIR) inputs for direction control. A HIGH on n$\overline{OE}$ 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- 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
- Integrated 30 Ω termination resistors
- $I_{OFF}$ circuitry provides partial Power-down mode operation
- 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: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74LVC162245ADGG-Q100 | -40 °C to +125 °C | TSSOP48 | plastic thin shrink small outline package; 48 leads; body width 6.1 mm | SOT362-1 |
| 74LVC162245ADGV-Q100 | -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 |

## 4. Functional diagram

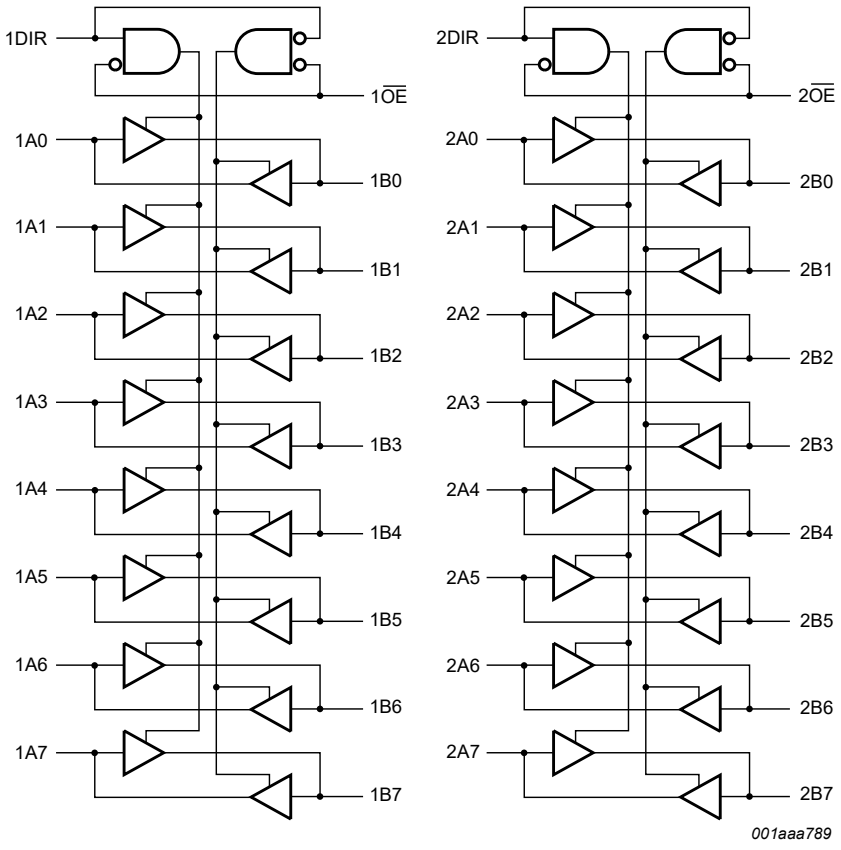



**Fig. 1. Logic symbol**

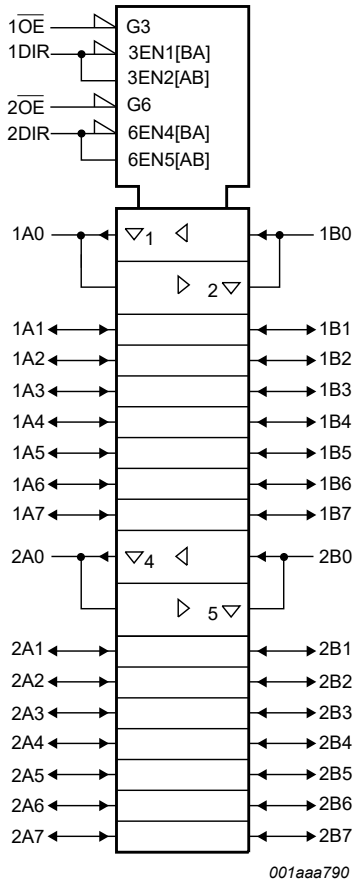



**Fig. 2. IEC logic symbol**

# 5. Pinning information

## 5.1. Pinning

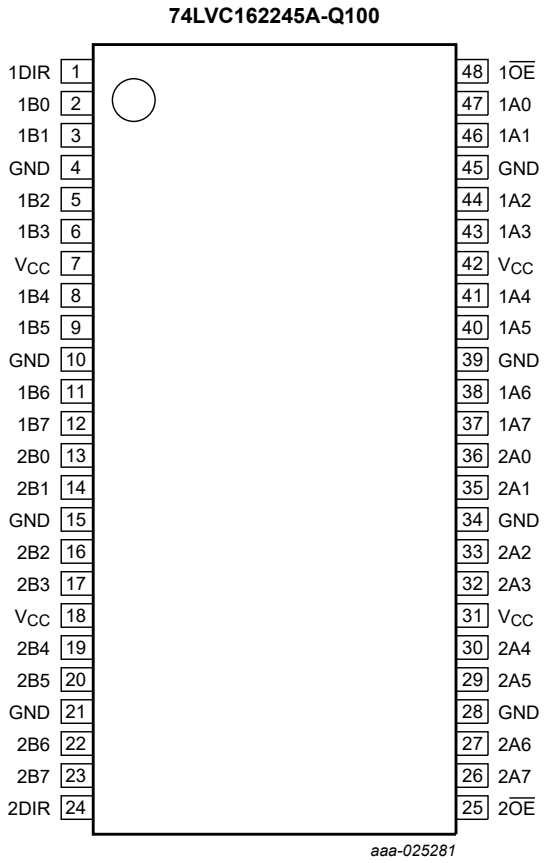



**Fig. 3. Pin configuration SOT362-1 (TSSOP48) and SOT480-1 (TVSOP48)**

## 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 |
| $1\overline{OE}$, $2\overline{OE}$ | 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 | |
|---|---|---|---|
| **n$\overline{OE}$** | **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] | -0.5 | $V_{CC}$ + 0.5 | V |
| | | output 3-state | [2] | -0.5 | +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 |
| Δt/ΔV | 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 | 0.65$V_{CC}$ | - | - | 0.65$V_{CC}$ | - | 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 | - | - | 0.35$V_{CC}$ | - | 0.35$V_{CC}$ | 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 | $V_{CC}$ | - | $V_{CC}$ - 0.3 | - | V |
| | | $I_O$ = -2 mA; $V_{CC}$ = 1.65 V | 1.2 | - | - | 1.05 | - | V |
| | | $I_O$ = -4 mA; $V_{CC}$ = 2.3 V | 1.8 | - | - | 1.65 | - | V |
| | | $I_O$ = -6 mA; $V_{CC}$ = 2.7 V | 2.2 | - | - | 2.05 | - | V |
| | | $I_O$ = -12 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 |
| | | $I_O$ = 2 mA; $V_{CC}$ = 1.65 V | - | - | 0.45 | - | 0.65 | V |
| | | $I_O$ = 4 mA; $V_{CC}$ = 2.3 V | - | - | 0.6 | - | 0.8 | V |
| | | $I_O$ = 6 mA; $V_{CC}$ = 2.7 V | - | - | 0.4 | - | 0.6 | V |
| | | $I_O$ = 12 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 | - | ±0.1 | ±5 | - | ±20 | µA |
| $I_{OZ}$ | OFF-state output current | $V_I$ = $V_{IH}$ or $V_{IL}$; [2] $V_O$ = 5.5 V or GND; $V_{CC}$ = 3.6 V | - | ±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 |
| $\Delta I_{CC}$ | 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 |

[1] All typical values are measured at $V_{CC}$ = 3.3 V (unless stated otherwise) and $T_{amb}$ = 25 °C.
[2] For I/O ports the parameter $I_{OZ}$ includes the input leakage current.

# 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

*Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 6.*

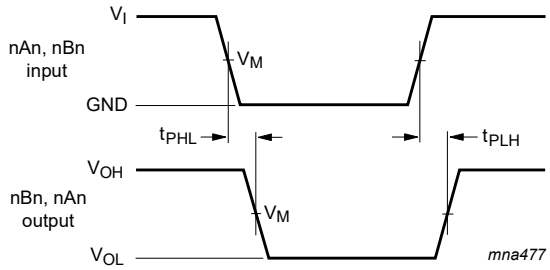
| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | |
| $t_{pd}$ | propagation delay | nAn to nBn; nBn to nAn; see Fig. 4 [2] | | | | | | |
| | | $V_{CC}$ = 1.2 V | - | 12 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 1.5 | 6.6 | 16.0 | 1.5 | 18.4 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.0 | 3.5 | 7.8 | 1.0 | 9.1 | ns |
| | | $V_{CC}$ = 2.7 V | 1.0 | 3.5 | 6.7 | 1.0 | 9.5 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.0 | 2.9 | 5.7 | 1.0 | 8.5 | ns |
| $t_{en}$ | enable time | $n\overline{OE}$ to nAn, nBn; see Fig. 5 [2] | | | | | | |
| | | $V_{CC}$ = 1.2 V | - | 18 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 2.0 | 7.7 | 17.2 | 2.0 | 19.8 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.5 | 4.3 | 9.4 | 1.5 | 10.9 | ns |
| | | $V_{CC}$ = 2.7 V | 1.5 | 4.6 | 8.5 | 1.5 | 9.5 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.0 | 3.5 | 7.5 | 1.0 | 7.5 | ns |
| $t_{dis}$ | disable time | $n\overline{OE}$ to nAn, nBn; see Fig. 5 [2] | | | | | | |
| | | $V_{CC}$ = 1.2 V | - | 10 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 2.8 | 4.6 | 11.0 | 2.8 | 12.7 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.0 | 2.6 | 6.3 | 1.0 | 7.3 | ns |
| | | $V_{CC}$ = 2.7 V | 1.5 | 3.4 | 7.5 | 1.5 | 11.0 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.5 | 3.2 | 6.5 | 1.5 | 8.5 | ns |
| $C_{PD}$ | power dissipation capacitance | per input; $V_I$ = GND to $V_{CC}$ [3] | | | | | | |
| | | $V_{CC}$ = 1.65 V to 1.95 V | - | 10.4 | - | - | - | pF |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | 14.0 | - | - | - | pF |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | 17.2 | - | - | - | 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).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

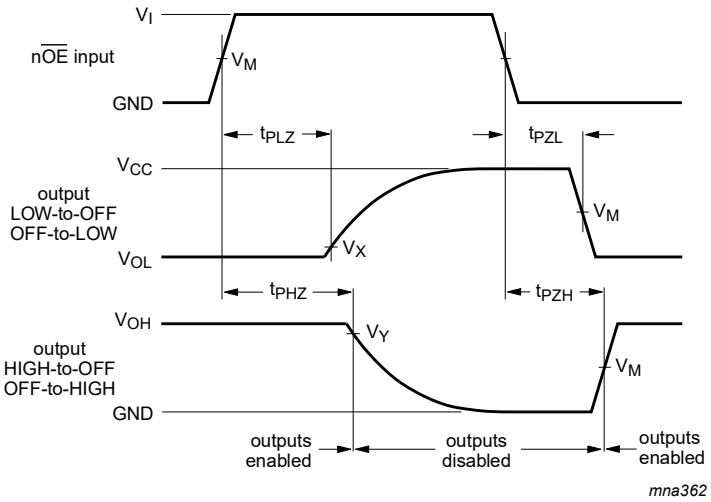
## 10.1. Waveforms and test circuit




Measurement points are given in Table 8.

$V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load.

**Fig. 4. The input (nAn, nBn) to output (nBn, nAn) propagation delays**



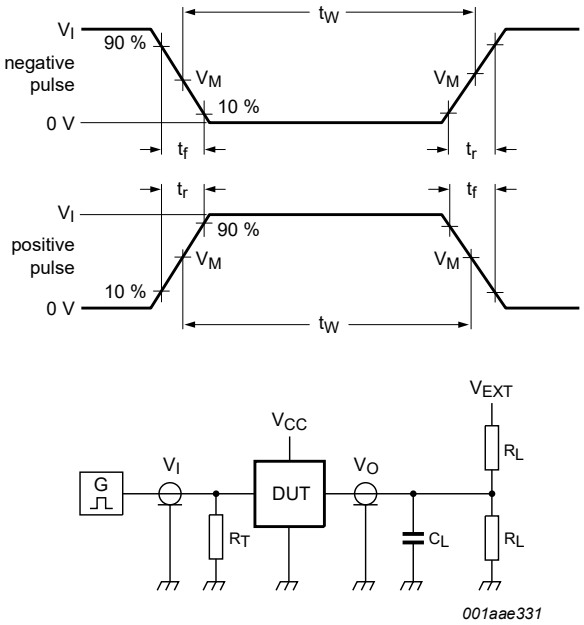

Measurement points are given in Table 8.

$V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load.

**Fig. 5. 3-state enable and disable times**

**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 × $V_{CC}$ | $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.15 V | $V_{OH}$ - 0.15 V |
| 1.65 V to 1.95 V | 0.5 × $V_{CC}$ | $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.15 V | $V_{OH}$ - 0.15 V |
| 2.3 V to 2.7 V | 0.5 × $V_{CC}$ | $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.15 V | $V_{OH}$ - 0.15 V |
| 2.7 V | 1.5 V | 2.7 V | 1.5 V | $V_{OL}$ + 0.3 V | $V_{OH}$ - 0.3 V |
| 3.0 V to 3.6 V | 1.5 V | 2.7 V | 1.5 V | $V_{OL}$ + 0.3 V | $V_{OH}$ - 0.3 V |




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.

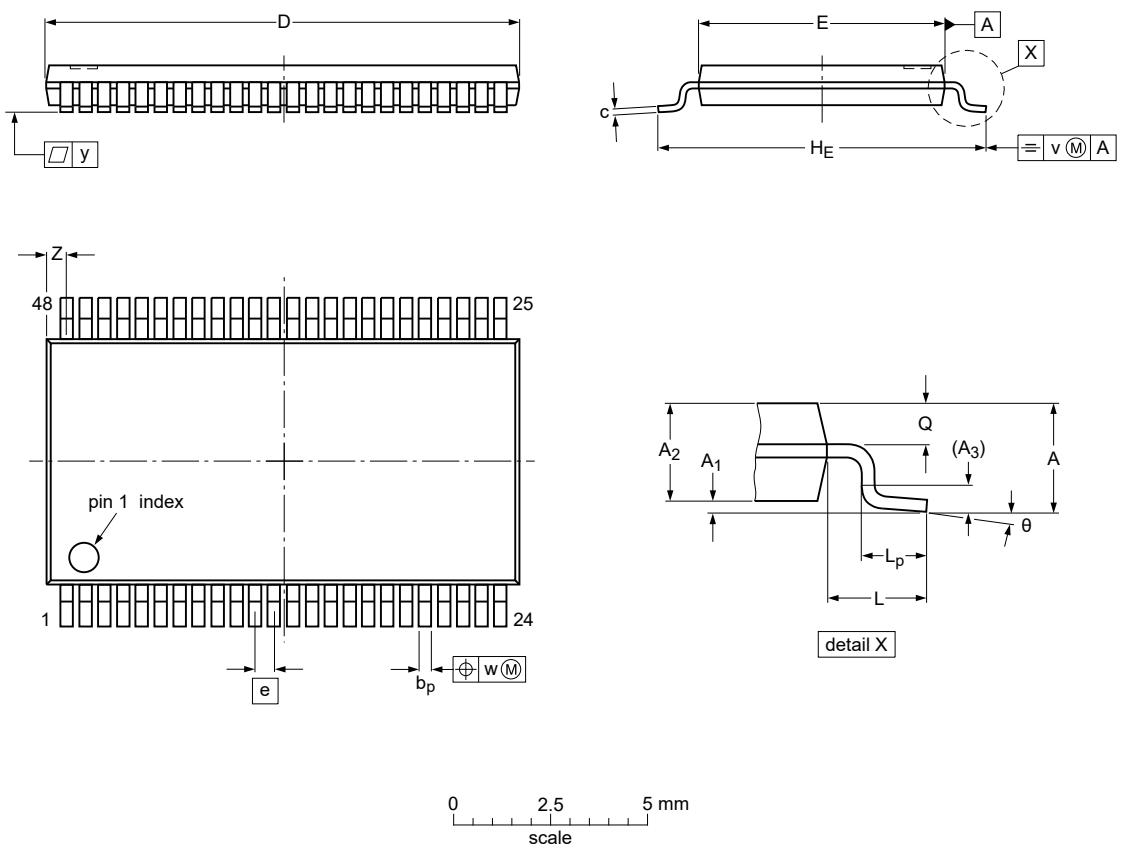
**Fig. 6. Test circuit for measuring switching times**

**Table 9. Test data**

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

# 11. Package outline

**TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm** **SOT362-1**




Dimensions (mm are the original dimensions)

| Unit | A | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(2)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| max | | 0.15 | 1.05 | | 0.28 | 0.2 | 12.6 | 6.2 | | 8.3 | | 0.8 | 0.50 | | | | 0.8 | 8° |
| mm nom | 1.2 | | | 0.25 | | | | | 0.5 | | 1 | | | 0.25 | 0.08 | 0.1 | | |
| min | | 0.05 | 0.85 | | 0.17 | 0.1 | 12.4 | 6.0 | | 7.9 | | 0.4 | 0.35 | | | | 0.4 | 0° |

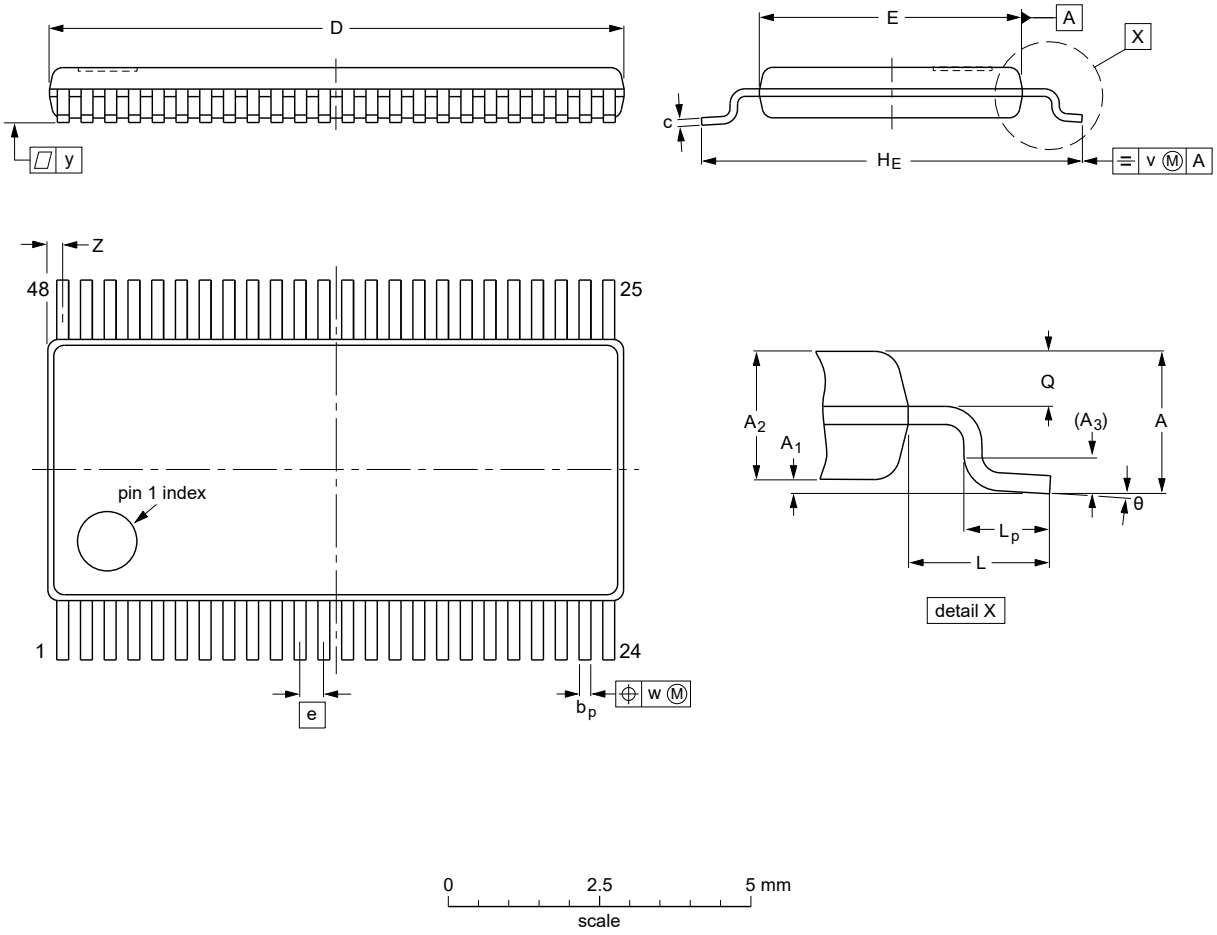
Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

*sot362-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT362-1 | | MO-153 | | | | ~~03-02-19~~ 13-08-05 |

**Fig. 7. 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**




DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.85 | 0.25 | 0.23<br>0.13 | 0.20<br>0.09 | 9.8<br>9.6 | 4.5<br>4.3 | 0.4 | 6.6<br>6.2 | 1 | 0.7<br>0.5 | 0.4<br>0.3 | 0.2 | 0.07 | 0.08 | 0.4<br>0.1 | 8°<br>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 | JEITA | | | |
| SOT480-1 | | MO-153 | | | | ~~03-02-18~~<br>19-12-11 |

**Fig. 8. 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 |
| TTL | Transistor-Transistor Logic |

# 13. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74LVC162245A_Q100 v.4 | 20230801 | Product data sheet | - | 74LVC162245A_Q100 v.3 |
| Modifications: | • Section 2: ESD specification updated according to the latest JEDEC standard. | | | |
| 74LVC162245A_Q100 v.3 | 20210923 | Product data sheet | - | 74LVC162245A_Q100 v.2 |
| Modifications: | • Section 1, Section 2 updated.<br>• Section 7: Derating values for $P_{tot}$ total power dissipation updated. | | | |
| 74LVC162245A_Q100 v.2 | 20190211 | Product data sheet | - | 74LVC162245A_Q100 v.1 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.<br>• Legal texts have been adapted to the new company name where appropriate.<br>• Type numbers 74LVC162245ADGV-Q100 (SOT480-1) added. | | | |
| 74LVC162245A_Q100 v.1 | 20161118 | Product data sheet | - | - |

# 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. |

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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