# 74LVC16244A-Q100; 74LVCH16244A-Q100

## 16-bit buffer/line driver; 5 V input/output tolerant; 3-state

Rev. 2 — 27 September 2013 Product data sheet

## 1. General description

The 74LVC16244A-Q100; 74LVCH16244A-Q100 are 16-bit non-inverting buffer/line drivers with 3-state bus compatible outputs. The device can be used as four 4-bit buffers, two 8-bit buffers or one 16-bit buffer. It features four output enable inputs ($1\overline{OE}$ to $4\overline{OE}$) each controlling four of the 3-state outputs. 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. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices in mixed 3.3 V and 5 V applications.

The 74LVCH16244A-Q100 bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

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
- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Multibyte flow-through standard pinout architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- High-impedance when $V_{CC}$ = 0 V
- All data inputs have bus hold. (74LVCH16244A-Q100 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:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Temperature range | Package | | |
|---|---|---|---|---|
| | | Name | Description | Version |
| 74LVC16244ADGG-Q100 | −40 °C to +125 °C | TSSOP48 | plastic thin shrink small outline package; 48 leads; body width 6.1 mm | SOT362-1 |
| 74LVCH16244ADGG-Q100 | | | | |

## 4. Functional diagram

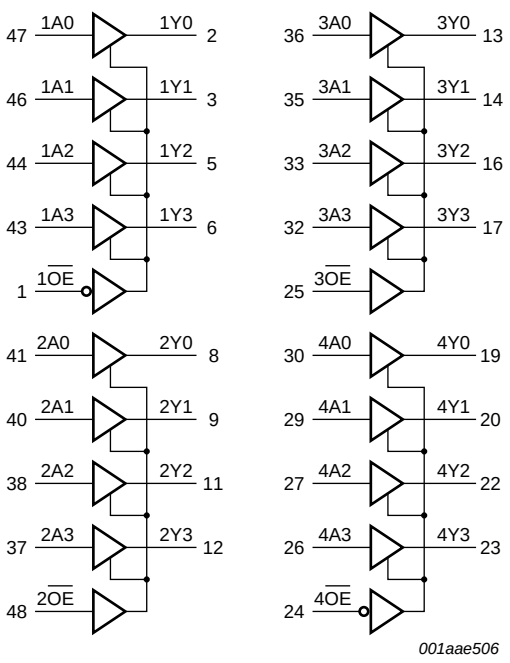



**Fig 1. Logic symbol**

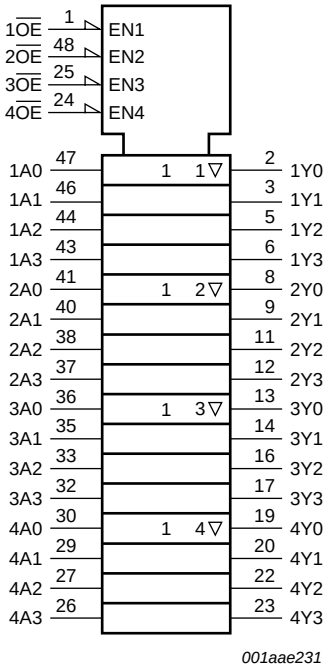



**Fig 2. IEC logic symbol**

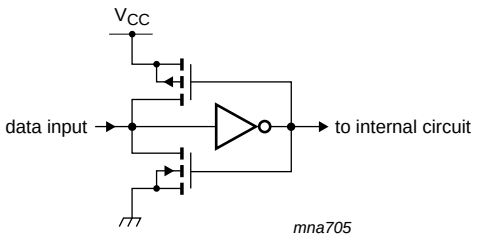



**Fig 3. Bus hold circuit**

# 5. Pinning information

## 5.1 Pinning

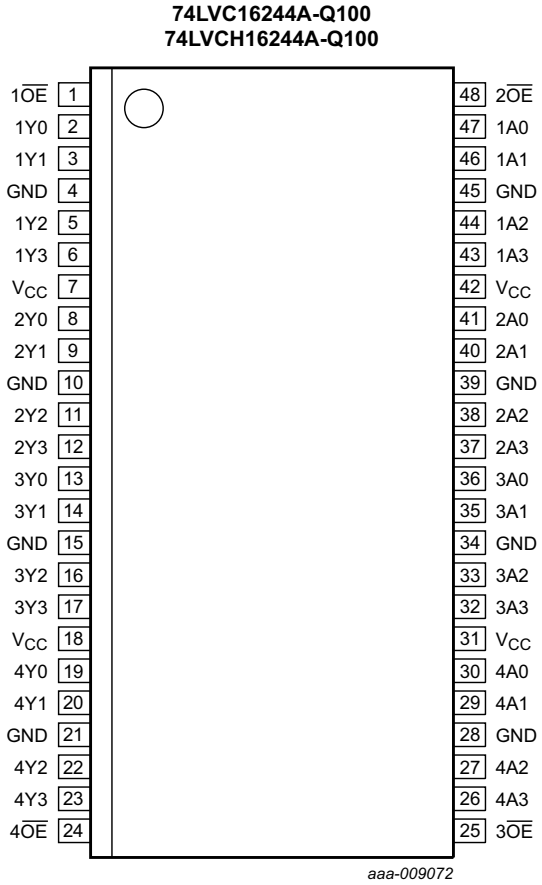



**Fig 4. Pin configuration SOT362-1 (TSSOP48)**

### 5.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| $1\overline{OE}$, $2\overline{OE}$, $3\overline{OE}$, $4\overline{OE}$ | 1, 48, 25, 24 | output enable input (active LOW) |
| 1Y0 to 1Y3 | 2, 3, 5, 6 | data output |
| 2Y0 to 2Y3 | 8, 9, 11, 12 | data output |
| 3Y0 to 3Y3 | 13, 14, 16, 17 | data output |
| 4Y0 to 4Y3 | 19, 20, 22, 23 | data output |
| GND | 4, 10, 15, 21, 28, 34, 39, 45 | ground (0 V) |
| $V_{CC}$ | 7, 18, 31, 42 | supply voltage |
| 1A0 to 1A3 | 47, 46, 44, 43 | data input |
| 2A0 to 2A3 | 41, 40, 38, 37 | data input |
| 3A0 to 3A3 | 36, 35, 33, 32 | data input |
| 4A0 to 4A3 | 30, 29, 27, 26 | data input |
| n.c. | - | not connected |

## 6. Functional description

**Table 3. Function table[1]**

| Control | Input | Output |
|---|---|---|
| $n\overline{OE}$ | nAn | nYn |
| L | L | L |
| L | H | H |
| H | X | Z |

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

# 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] Above 60 °C, the value of $P_{tot}$ derates linearly with 5.5 mW/K.

# 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 2.7 | - | 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 | | 0.65 × $V_{CC}$ | - | - | 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 | - | - | $V_{CC}$ – 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 | $V_{CC}$ = 3.6 V; $V_I$ = 5.5 V or GND | | - | ±0.1 | ±5 | - | ±20 | μA |
| $I_{OZ}$ | OFF-state output current | $V_I$ = $V_{IH}$ or $V_{IL}$; $V_{CC}$ = 3.6 V; $V_O$ = 5.5 V or GND; | [2] | - | ±0.1 | ±5 | - | ±20 | μA |
| $I_{OFF}$ | power-off leakage current | $V_{CC}$ = 0 V; $V_I$ or $V_O$ = 5.5 V | | - | ±0.1 | ±10 | - | ±20 | μA |
| $I_{CC}$ | supply current | $V_{CC}$ = 3.6 V; $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A | | - | 0.1 | 20 | - | 80 | μA |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_{CC}$ = 2.7 V to 3.6 V; $V_I$ = $V_{CC}$ – 0.6 V; $I_O$ = 0 A | | - | 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 |

**Table 6. Static characteristics** *...continued*

*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 | |
| $I_{BHL}$ | bus hold LOW current | $V_{CC}$ = 1.65; $V_I$ = 0.58 V | [3][4] | 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 |
| $I_{BHH}$ | bus hold HIGH current | $V_{CC}$ = 1.65; $V_I$ = 1.07 V | [3][4] | –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 | [3][5] | 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 | [3][5] | –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 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] Valid for data inputs only. Control inputs do not have a bus hold circuit.

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

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

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

| Symbol | Parameter | Conditions | | –40 °C to +85 °C | | | –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[2] | Max | Min | Max | |
| $t_{pd}$ | propagation delay | nAn to nYn; see Figure 5 | [1] | | | | | | |
| | | $V_{CC}$ = 1.2 V | | - | 11.0 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.5 | 4.8 | 10.7 | 1.5 | 11.3 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.0 | 2.6 | 5.3 | 1.0 | 5.9 | ns |
| | | $V_{CC}$ = 2.7 V | | 1.0 | 2.6 | 4.7 | 1.0 | 6.0 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.1 | 2.2 | 4.1 | 1.1 | 5.5 | ns |
| $t_{en}$ | enable time | $n\overline{OE}$ to nYn; see Figure 6 | [1] | | | | | | |
| | | $V_{CC}$ = 1.2 V | | - | 15.0 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.5 | 6.2 | 12.1 | 1.5 | 12.7 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.0 | 3.5 | 6.4 | 1.0 | 7.1 | ns |
| | | $V_{CC}$ = 2.7 V | | 1.0 | 3.3 | 5.8 | 1.0 | 7.5 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.0 | 2.8 | 4.6 | 1.0 | 6.0 | ns |

**Table 7. Dynamic characteristics** *...continued*

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

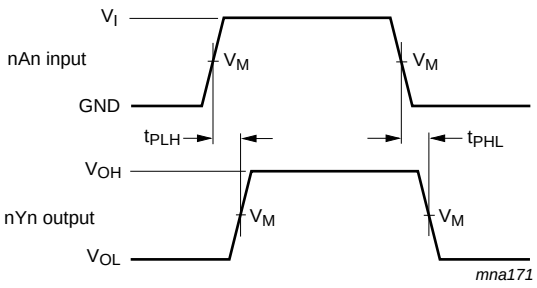
| Symbol | Parameter | Conditions | –40 °C to +85 °C | | | –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[2] | Max | Min | Max | |
| $t_{dis}$ | disable time | $n\overline{OE}$ to nYn; see Figure 6 [1] | | | | | | |
| | | $V_{CC}$ = 1.2 V | - | 10.0 | - | - | - | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 2.5 | 4.4 | 8.7 | 2.5 | 9.4 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.0 | 2.4 | 4.9 | 1.0 | 5.3 | ns |
| | | $V_{CC}$ = 2.7 V | 1.0 | 3.2 | 6.2 | 1.0 | 8.0 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.8 | 3.1 | 5.2 | 1.8 | 6.5 | ns |
| $C_{PD}$ | power dissipation capacitance | per input; $V_I$ = GND to $V_{CC}$ [3] | | | | | | |
| | | $V_{CC}$ = 1.65 V to 1.95 V | - | 4.8 | - | - | - | pF |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | 8.3 | - | - | - | pF |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | 11.4 | - | - | - | pF |

[1] $t_{pd}$ 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 $t_{PHZ}$.

[2] 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.

[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.

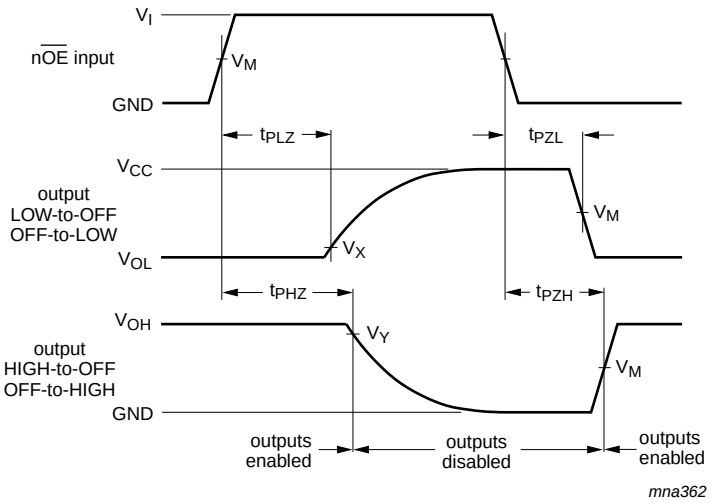
## 11. Waveforms




Measurement points are given in Table 8.

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

**Fig 5. The input (nAn) to output (nYn) propagation delays**



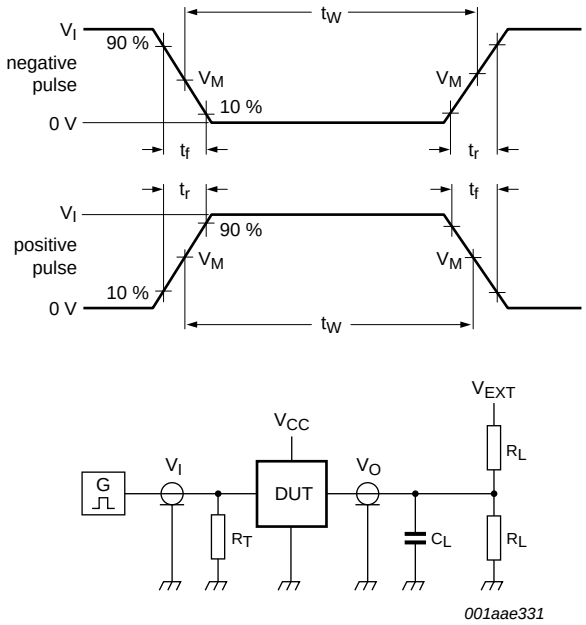

Measurement points are given in Table 8.

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

**Fig 6. 3-state enable and disable times.**

**Table 8. Measurement points**

| Supply voltage | $V_M$ | Input | | | |
|---|---|---|---|---|---|
| $V_{CC}$ | | $V_I$ | $t_r = t_f$ | $V_X$ | $V_Y$ |
| 1.2 V | $0.5 \times V_{CC}$ | $V_{CC}$ | ≤ 2.5 ns | $V_{OL}$ + 0.15 V | $V_{OH}$ − 0.15 V |
| 1.65 V to 1.95 V | $0.5 \times V_{CC}$ | $V_{CC}$ | ≤ 2.5 ns | $V_{OL}$ + 0.15 V | $V_{OH}$ − 0.15 V |
| 2.3 V to 2.7 V | $0.5 \times V_{CC}$ | $V_{CC}$ | ≤ 2.5 ns | $V_{OL}$ + 0.15 V | $V_{OH}$ − 0.15 V |
| 2.7 V | 1.5 V | 2.7 V | ≤ 2.5 ns | $V_{OL}$ + 0.3 V | $V_{OH}$ − 0.3 V |
| 3.0 V to 3.6 V | 1.5 V | 2.7 V | ≤ 2.5 ns | $V_{OL}$ + 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.

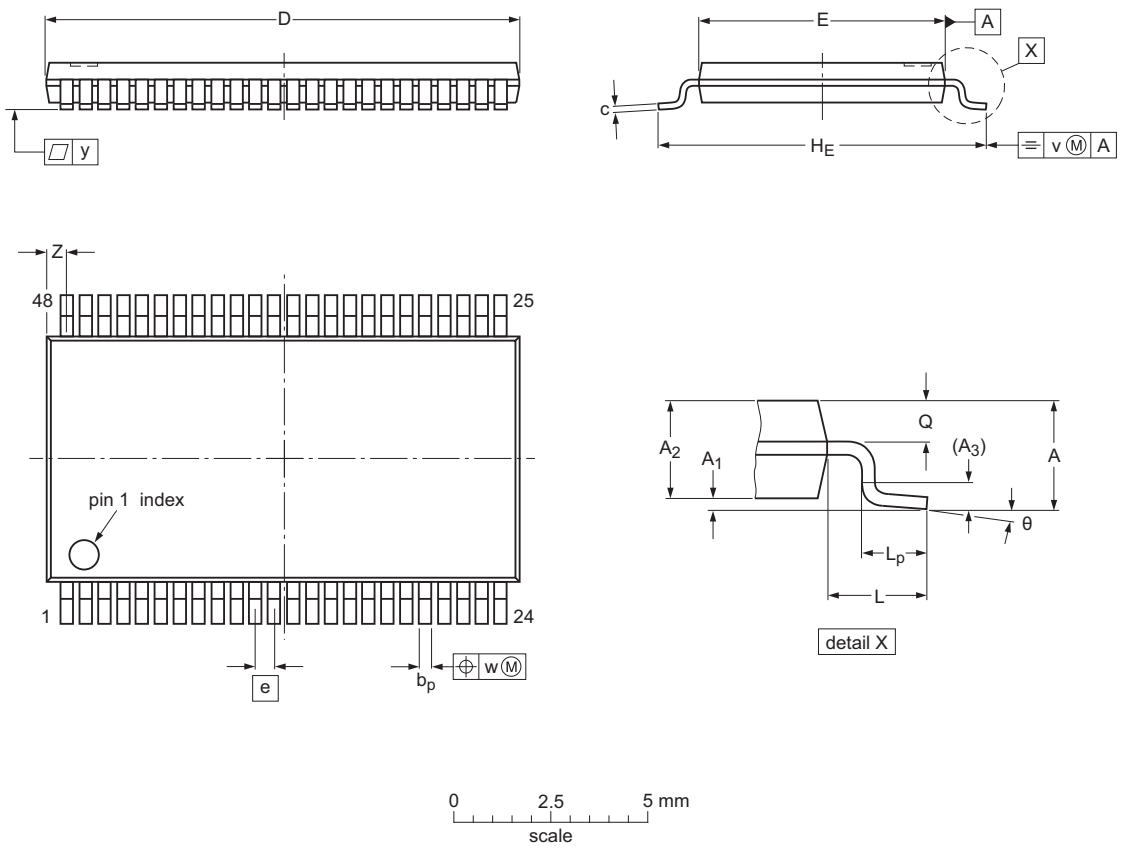
**Fig 7. Test circuit for measuring switching times**

**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 | $V_{CC}$ | ≤ 2 ns | 30 pF | 1 kΩ | open | $2 \times V_{CC}$ | GND |
| 1.65 V to 1.95 V | $V_{CC}$ | ≤ 2 ns | 30 pF | 1 kΩ | open | $2 \times V_{CC}$ | GND |
| 2.3 V to 2.7 V | $V_{CC}$ | ≤ 2 ns | 30 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |

## 12. 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 1.2 | 0.15 | 1.05 | 0.25 | 0.28 | 0.2 | 12.6 | 6.2 | 0.5 | 8.3 | 1 | 0.8 | 0.50 | 0.25 | 0.08 | 0.1 | 0.8 | 8° |
| | nom | | | | | | | | | | | | | | | | | | |
| | 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 8. Package outline SOT362-1 (TSSOP48)**

## 13. 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 |
| MIL | Military |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

## 14. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74LVC_LVCH16244A_Q100 v.2 | 20130927 | - | - | 74LVC_LVCH16244A_Q100 v.1 |
| Modifications: | • Typo removed from the title header. | | | |
| 74LVC_LVCH16244A_Q100 v.1 | 20130923 | Product data sheet | - | - |

# 15. Legal information

## 15.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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## 16. Contact information

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