# 74ALVC02

## Quad 2-input NOR gate

Rev. 3 — 7 September 2017 Product data sheet

## 1 General description

The 74ALVC02 is a quad 2-input NOR gate.

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

## 2 Features and benefits

- Wide supply voltage range from 1.65 V to 3.6 V
- 3.6 V tolerant inputs/outputs
- CMOS low power consumption
- Direct interface with TTL levels (2.7 V to 3.6 V)
- Power-down mode
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standards:
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF; R = 0 Ω
- Specified from -40 °C to +85 °C

## 3 Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74ALVC02D | -40 °C to +85 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74ALVC02PW | -40 °C to +85 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74ALVC02BQ | -40 °C to +85 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm | SOT762-1 |

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# 4 Functional diagram

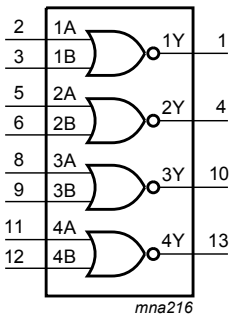



Figure 1. Logic symbol

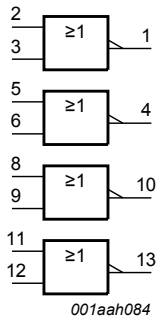



Figure 2. IEC logic symbol

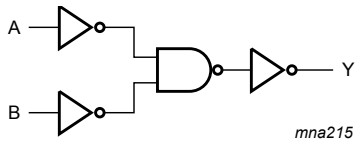



Figure 3. Logic diagram (one gate)

# 5 Pinning information

## 5.1 Pinning

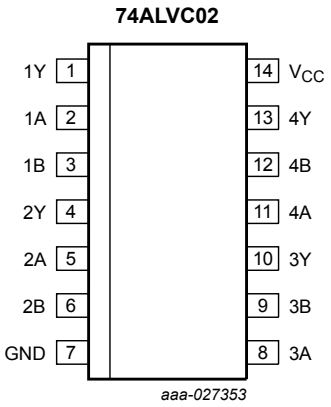



Figure 4. Pin configuration SO14

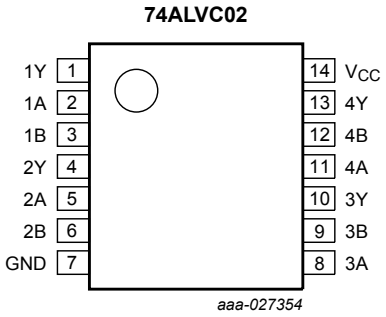
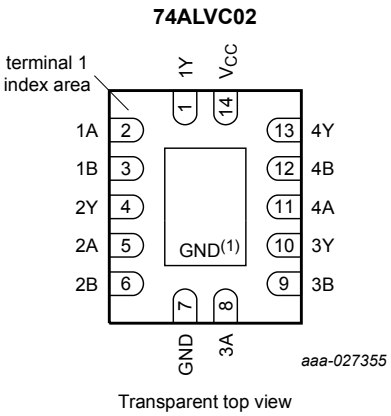



Figure 5. Pin configuration TSSOP14




Transparent top view

(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad however if it is soldered the solder land should remain floating or be connected to GND.

Figure 6. Pin configuration DHVQFN14

### 5.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| 1Y, 2Y, 3Y, 4Y | 1, 4, 10, 13 | data output |
| 1A, 2A, 3A, 4A | 2, 5, 8, 11 | data input |
| 1B, 2B, 3B, 4B | 3, 6, 9,12 | data input |
| GND | 7 | ground (0 V) |
| $V_{CC}$ | 14 | supply voltage |

## 6 Functional description

**Table 3. Function table**

*H = HIGH voltage level; L = LOW voltage level.*

| Input | | Output |
|---|---|---|
| nA | nB | nY |
| L | L | H |
| L | H | L |
| H | L | L |
| H | H | L |

# 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 | +4.6 | V |
| $V_I$ | input voltage | | [1] | -0.5 | +4.6 | V |
| $V_O$ | output voltage | output HIGH or LOW state | [1] [2] | -0.5 | $V_{CC}$ + 0.5 | V |
| | | power-down mode, $V_{CC}$ = 0 V | [2] | -0.5 | +4.6 | V |
| $I_{IK}$ | input clamping current | $V_I$ < 0 V | | -50 | - | mA |
| $I_{OK}$ | output clamping current | $V_O$ > $V_{CC}$ or $V_O$ < 0 V | | - | ±50 | mA |
| $I_O$ | 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 +85 °C | [3] | - | 500 | mW |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] When $V_{CC}$ = 0 V (power-down mode), the output voltage can be 3.6 V in normal operation.
[3] For SO14 packages: above 70 °C derate linearly with 8 mW/K.
For TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.
For DHVQFN14 packages: above 60 °C derate linearly with 4.5 mW/K.

# 8 Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 1.65 | 3.6 | V |
| $V_I$ | input voltage | | 0 | 3.6 | V |
| $V_O$ | output voltage | $V_{CC}$ = 1.65 to 3.6 V | 0 | $V_{CC}$ | V |
| | | power-down mode; $V_{CC}$ = 0 V | 0 | 4.6 | V |
| $T_{amb}$ | ambient temperature | | -40 | +85 | °C |
| Δt/ΔV | input transition rise and fall rate | $V_{CC}$ = 1.65 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 | $T_{amb}$ = -40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 1.65 V to 1.95 V | 0.65 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.7 | - | - | V |
| | | $V_{CC}$ = 2.7 V to 3.6 V | 2.0 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 1.65 V to 1.95 V | - | - | 0.35 × $V_{CC}$ | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | - | 0.7 | V |
| | | $V_{CC}$ = 2.7 V to 3.6 V | - | - | 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 |
| | | $I_O$ = -6 mA; $V_{CC}$ = 1.65 V | 1.25 | 1.51 | - | V |
| | | $I_O$ = -12 mA; $V_{CC}$ = 2.3 V | 1.8 | 2.10 | - | V |
| | | $I_O$ = -18 mA; $V_{CC}$ = 2.3 V | 1.7 | 2.01 | - | V |
| | | $I_O$ = -12 mA; $V_{CC}$ = 2.7 V | 2.2 | 2.53 | - | V |
| | | $I_O$ = -18 mA; $V_{CC}$ = 3.0 V | 2.4 | 2.76 | - | V |
| | | $I_O$ = -24 mA; $V_{CC}$ = 3.0 V | 2.2 | 2.68 | - | 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 | V |
| | | $I_O$ = 6 mA; $V_{CC}$ = 1.65 V | - | 0.11 | 0.3 | V |
| | | $I_O$ = 12 mA; $V_{CC}$ = 2.3 V | - | 0.17 | 0.4 | V |
| | | $I_O$ = 18 mA; $V_{CC}$ = 2.3 V | - | 0.25 | 0.6 | V |
| | | $I_O$ = 12 mA; $V_{CC}$ = 2.7 V | - | 0.16 | 0.4 | V |
| | | $I_O$ = 18 mA; $V_{CC}$ = 3.0 V | - | 0.23 | 0.4 | V |
| | | $I_O$ = 24 mA; $V_{CC}$ = 3.0 V | - | 0.30 | 0.55 | V |
| $I_I$ | input leakage current | $V_{CC}$ = 3.6 V; $V_I$ = 3.6 V or GND | - | ±0.1 | ±5 | µA |
| $I_{OFF}$ | power-off leakage current | $V_{CC}$ = 0 V; $V_I$ or $V_O$ = 0 V to 3.6 V | - | ±0.1 | ±10 | µA |
| $I_{CC}$ | supply current | $V_{CC}$ = 3.6 V; $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A | - | 0.2 | 20 | µA |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_{CC}$ = 3.0 V to 3.6 V; $V_I$ = $V_{CC}$ - 0.6 V; $I_O$ = 0 A | - | 5 | 750 | µA |
| $C_I$ | input capacitance | | - | 3.5 | - | pF |

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

# 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

*Voltages are referenced to GND (ground = 0 V). For test circuit, see Figure 8.*

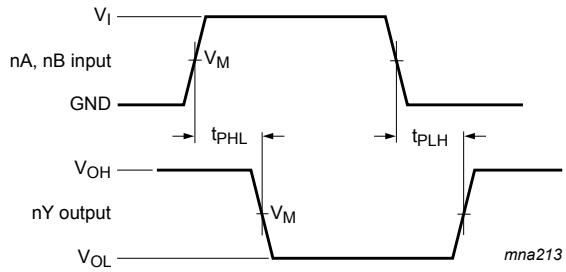
| Symbol | Parameter | Conditions | $T_{amb}$ = −40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ [1] | Max | |
| $t_{pd}$ | propagation delay | nA, nB to nY; see Figure 7 [2] | | | | |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 1.0 | 2.8 | 4.7 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.0 | 2.0 | 3.1 | ns |
| | | $V_{CC}$ = 2.7 V | 1.0 | 2.5 | 2.9 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.0 | 2.2 | 2.8 | ns |
| $C_{PD}$ | power dissipation capacitance | per gate; $V_I$ = GND to $V_{CC}$; $V_{CC}$ = 3.3 V [3] | - | 32 | - | pF |

[1] Typical values are measured at $T_{amb}$ = 25 °C.
Typical values for $V_{CC}$ = 1.65 V to 1.95 V are measured at $V_{CC}$ = 1.8 V.
Typical values for $V_{CC}$ = 2.3 V to 2.7 V are measured at $V_{CC}$ = 2.5 V.
Typical values for $V_{CC}$ = 3.0 V to 3.6 V are measured at $V_{CC}$ = 3.3 V.

[2] $t_{pd}$ is the same as $t_{PHL}$ and $t_{PLH}$.

[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



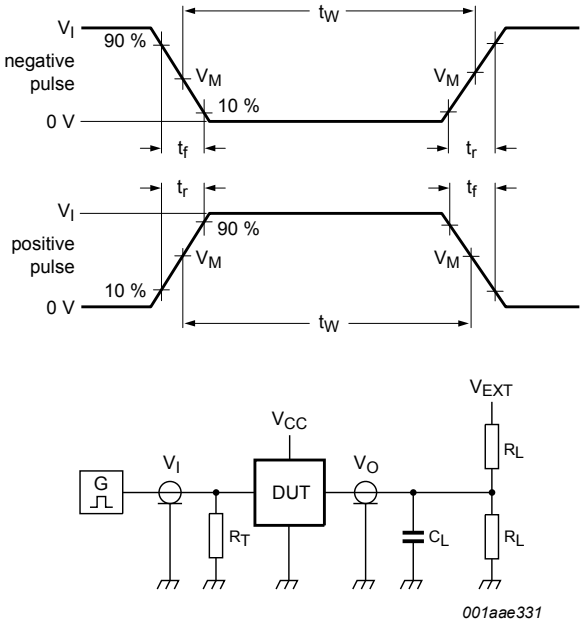

Measurement points are given in Table 8.

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

**Figure 7. Input (nA, nB) to output (nY) propagation delays**

**Table 8. Measurement points**

| Supply voltage $V_{CC}$ | Input $V_I$ | $V_M$ |
|---|---|---|
| 1.65 V to 1.95 V | $V_{CC}$ | 0.5 x $V_{CC}$ |
| 2.3 V to 2.7 V | $V_{CC}$ | 0.5 x $V_{CC}$ |
| 2.7 V | 2.7 V | 1.5 V |
| 3.0 V to 3.6 V | 2.7 V | 1.5 V |




Test data is given in Table 9.

Definitions test circuit:

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

$C_L$ = Load capacitance including jig and probe capacitance.

$R_L$ = Load resistance.

$V_{EXT}$ = Test voltage for switching times.

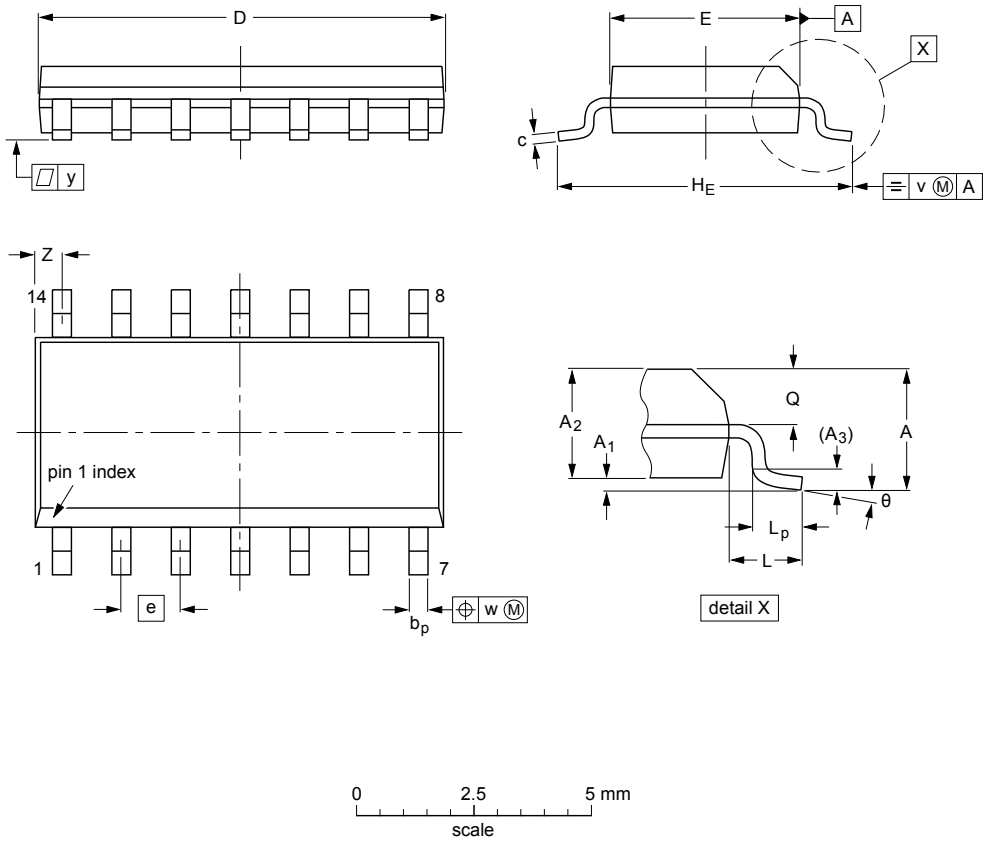
**Figure 8. Test circuit for measuring switching times**

**Table 9. Test data**

| Supply voltage | Input | | Load | | $V_{EXT}$ | | |
|---|---|---|---|---|---|---|---|
| $V_{CC}$ | $V_I$ | $t_r$, $t_f$ | $C_L$ | $R_L$ | $t_{PLH}$, $t_{PHL}$ | $t_{PLZ}$, $t_{PZL}$ | $t_{PHZ}$, $t_{PZH}$ |
| 1.65 V to 1.95 V | $V_{CC}$ | ≤ 2.0 ns | 30 pF | 1 kΩ | open | 2 × $V_{CC}$ | GND |
| 2.3 V to 2.7 V | $V_{CC}$ | ≤ 2.0 ns | 30 pF | 500 Ω | open | 2 × $V_{CC}$ | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 6 V | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 6 V | GND |

# 11 Package outline

**SO14: plastic small outline package; 14 leads; body width 3.9 mm** **SOT108-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 8.75<br>8.55 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

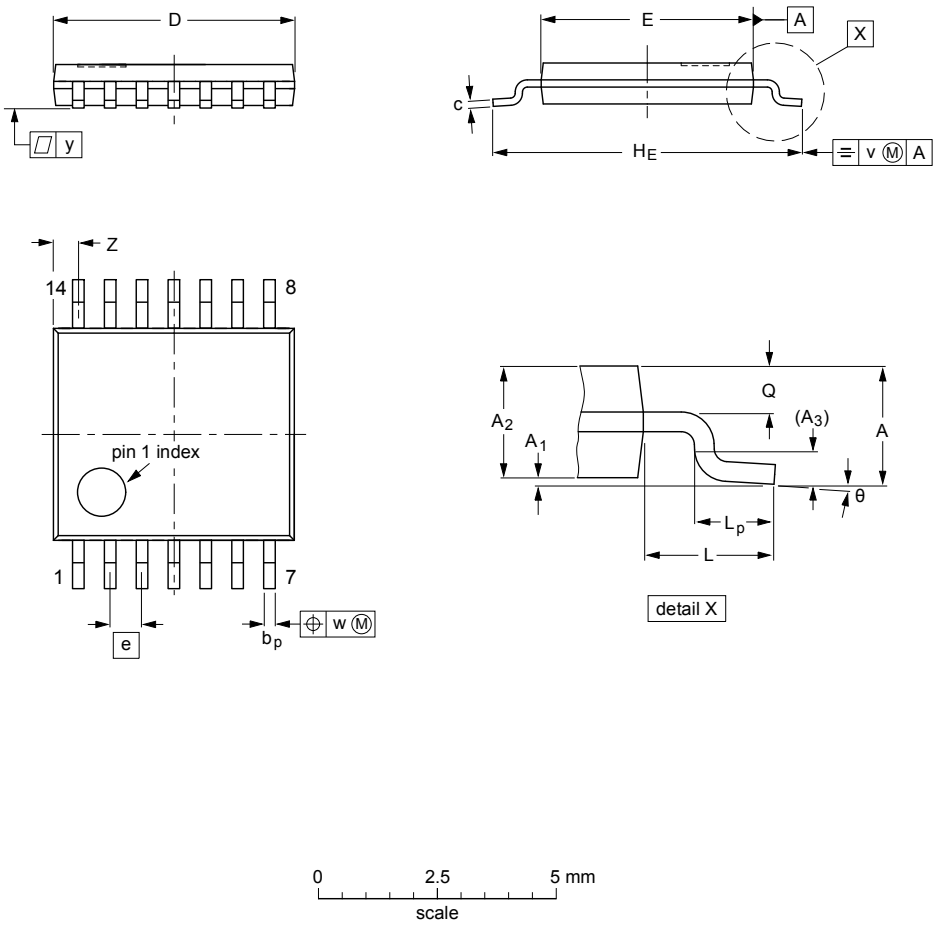
**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT108-1 | 076E06 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**Figure 9. Package outline SOT108-1 (SO14)**

**TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm** **SOT402-1**




**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>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38 | $8^o$<br>$0^o$ |

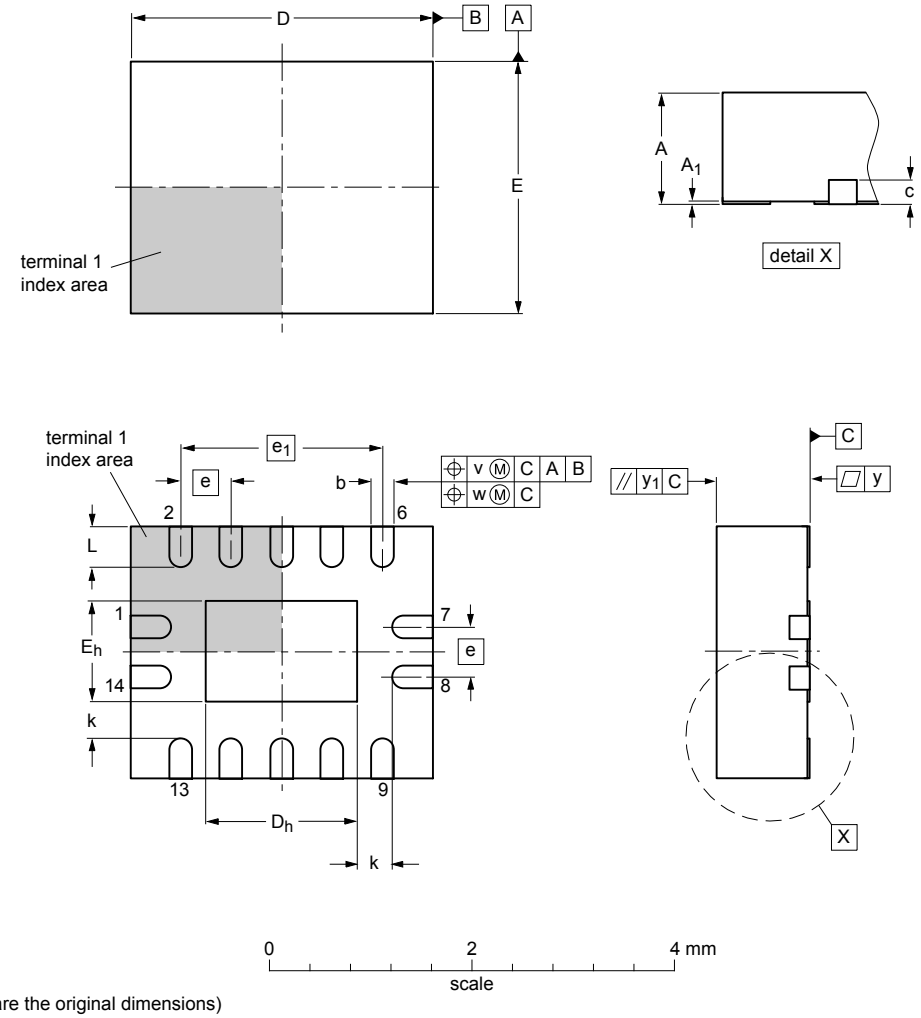
**Notes**

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 | | | |
| SOT402-1 | | MO-153 | | | | ~~99-12-27~~<br>03-02-18 |

**Figure 10. Package outline SOT402-1 (TSSOP14)**

**DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm** **SOT762-1**




Dimensions (mm are the original dimensions)

| Unit | | $A^{(1)}$ | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | k | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 1 | 0.05 | 0.30 | | 3.1 | 1.65 | 2.6 | 1.15 | | | | 0.5 | | | | |
| mm | nom | | 0.02 | 0.25 | 0.2 | 3.0 | 1.50 | 2.5 | 1.00 | 0.5 | 2 | | 0.4 | 0.1 | 0.05 | 0.05 | 0.1 |
| | min | | 0.00 | 0.18 | | 2.9 | 1.35 | 2.4 | 0.85 | | | 0.2 | 0.3 | | | | |

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot762-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT762-1 | | MO-241 | | | | ~~15-04-10~~ 15-05-05 |

**Figure 11. Package outline SOT762-1 (DHVQFN14)**

## 12 Abbreviations

**Table 10. Abbreviations**

| Acronym | Description |
|---|---|
| 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 |
|---|---|---|---|---|
| 74ALVC02 v.3 | 20170907 | Product data sheet | - | 74ALVC02 v.2 |
| 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. | | | |
| 74ALVC02 v.2 | 20030714 | Product specification | - | 74ALVC02 v.1 |
| 74ALVC02 v.1 | 20030205 | Product specification | - | - |

# 14 Legal information

## 14.1 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.nexperia.com.

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