# 74VHC32-Q100; 74VHCT32-Q100

## Quad 2-input OR gate

Rev. 2 — 3 September 2020 Product data sheet

## 1. General description

The 74VHC32-Q100; 74VHCT32-Q100 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard No. 7-A.

The 74VHC32-Q100; 74VHCT32-Q100 provide the 2-input OR function.

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
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than $V_{CC}$
- Input levels:
  - The 74VHC32-Q100 operates with CMOS input level
  - The 74VHCT32-Q100 operates with TTL input level
- 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)
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74VHC32D-Q100 | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74VHCT32D-Q100 | | | | |
| 74VHC32PW-Q100 | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74VHCT32PW-Q100 | | | | |
| 74VHC32BQ-Q100 | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |
| 74VHCT32BQ-Q100 | | | | |

nexperia

# 4. Functional diagram

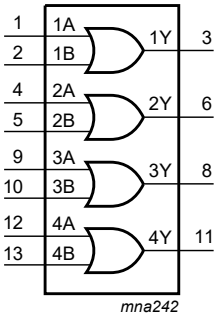



Fig. 1. Logic symbol

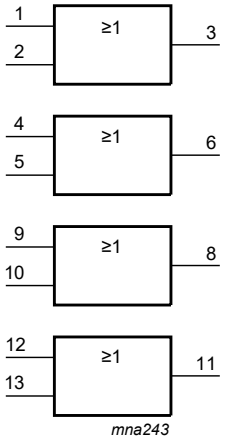



Fig. 2. IEC logic symbol

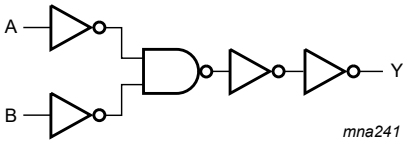



Fig. 3. Logic diagram (one gate)

# 5. Pinning information

## 5.1. Pinning

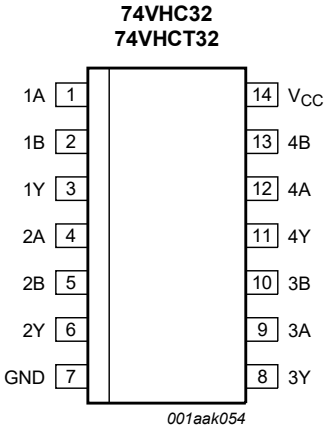
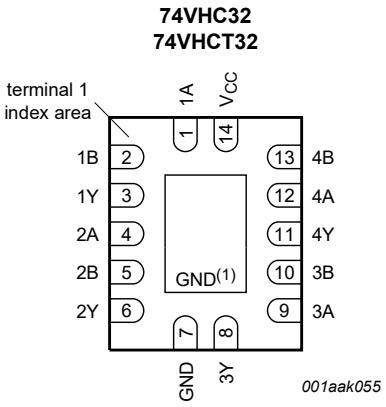



Fig. 4. Pin configuration SOT108-1 (SO14) and SOT402-1 (TSSOP14)




Transparent top view

(1) This is not a ground pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to GND.

Fig. 5. Pin configuration SOT762-1 (DHVQFN14)

### 5.2. Pin description

**Table 2. Pin description**

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

## 6. Functional description

**Table 3. Function table**

*H = HIGH voltage level; L = LOW voltage level; X = don't care.*

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

# 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 | +7.0 | V |
| $V_I$ | input voltage | | | -0.5 | +7.0 | V |
| $I_{IK}$ | input clamping current | $V_I$ < -0.5 V | [1] | -20 | - | mA |
| $I_{OK}$ | output clamping current | $V_O$ < -0.5 V or $V_O$ > $V_{CC}$ + 0.5 V | [1] | -20 | +20 | mA |
| $I_O$ | output current | $V_O$ = -0.5 V to ($V_{CC}$ + 0.5 V) | | -25 | +25 | mA |
| $I_{CC}$ | supply current | | | - | +75 | mA |
| $I_{GND}$ | ground current | | | -75 | - | mA |
| $T_{stg}$ | storage temperature | | | -65 | +150 | °C |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = -40 °C to +125 °C | [2] | - | 500 | mW |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For SOT108-1 (SO14) package: $P_{tot}$ derates linearly with 10.1 mW/K above 100 °C.
For SOT402-1 (TSSOP14) package: $P_{tot}$ derates linearly with 7.3 mW/K above 81 °C.
For SOT762-1 (DHVQFN14) package: $P_{tot}$ derates linearly with 9.6 mW/K above 98 °C.

# 8. Recommended operating conditions

**Table 5. Operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **74VHC32-Q100** | | | | | | |
| $V_{CC}$ | supply voltage | | 2.0 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | - | 5.5 | V |
| $V_O$ | output voltage | | 0 | - | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | -40 | +25 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | $V_{CC}$ = 3.0 V to 3.6 V | - | - | 100 | ns/V |
| | | $V_{CC}$ = 4.5 V to 5.5 V | - | - | 20 | ns/V |
| **74VHCT32-Q100** | | | | | | |
| $V_{CC}$ | supply voltage | | 4.5 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | - | 5.5 | V |
| $V_O$ | output voltage | | 0 | - | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | -40 | +25 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | $V_{CC}$ = 4.5 V to 5.5 V | - | - | 20 | ns/V |

# 9. Static characteristics

**Table 6. Static characteristics**

*At recommended operating conditions; voltages are referenced to GND (ground = 0 V).*

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| **74VHC32-Q100** | | | | | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.5 | - | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC}$ = 3.0 V | 2.1 | - | - | 2.1 | - | 2.1 | - | V |
| | | $V_{CC}$ = 5.5 V | 3.85 | - | - | 3.85 | - | 3.85 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0 V | - | - | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC}$ = 3.0 V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| | | $V_{CC}$ = 5.5 V | - | - | 1.65 | - | 1.65 | - | 1.65 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = -50 µA; $V_{CC}$ = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_O$ = -50 µA; $V_{CC}$ = 3.0 V | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | $I_O$ = -50 µA; $V_{CC}$ = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O$ = -4.0 mA; $V_{CC}$ = 3.0 V | 2.58 | - | - | 2.48 | - | 2.40 | - | V |
| | | $I_O$ = -8.0 mA; $V_{CC}$ = 4.5 V | 3.94 | - | - | 3.80 | - | 3.70 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = 50 µA; $V_{CC}$ = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 50 µA; $V_{CC}$ = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 50 µA; $V_{CC}$ = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| | | $I_O$ = 8.0 mA; $V_{CC}$ = 4.5 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| $I_I$ | input leakage current | $V_I$ = 5.5 V or GND; $V_{CC}$ = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | µA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 5.5 V | - | - | 2.0 | - | 20 | - | 40 | µA |
| $C_I$ | input capacitance | $V_I$ = $V_{CC}$ or GND | - | 3 | 10 | - | 10 | - | 10 | pF |
| $C_O$ | output capacitance | | - | 4 | - | - | - | - | - | pF |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| **74VHCT32-Q100** | | | | | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 4.5 V to 5.5 V | 2.0 | - | - | 2.0 | - | 2.0 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 4.5 V to 5.5 V | - | - | 0.8 | - | 0.8 | - | 0.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$; $V_{CC}$ = 4.5 V | | | | | | | | |
| | | $I_O$ = -50 µA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O$ = -8.0 mA | 3.94 | - | - | 3.80 | - | 3.70 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$; $V_{CC}$ = 4.5 V | | | | | | | | |
| | | $I_O$ = 50 µA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 8.0 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| $I_I$ | input leakage current | $V_I$ = 5.5 V or GND; $V_{CC}$ = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | µA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 5.5 V | - | - | 2.0 | - | 20 | - | 40 | µA |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_I$ = $V_{CC}$ - 2.1 V; other pins at $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 4.5 V to 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |
| $C_I$ | input capacitance | $V_I$ = $V_{CC}$ or GND | - | 3 | 10 | - | 10 | - | 10 | pF |
| $C_O$ | output capacitance | | - | 4 | - | - | - | - | - | pF |

# 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

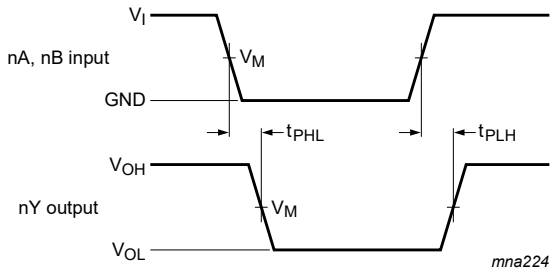
*Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7.*

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| **74VHC32-Q100** | | | | | | | | | | |
| $t_{pd}$ | propagation delay | nA, nB to nY; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | | | | | | | |
| | | $C_L$ = 15 pF | - | 3.9 | 7.9 | 1.0 | 9.5 | 1.0 | 10.0 | ns |
| | | $C_L$ = 50 pF | - | 5.6 | 11.4 | 1.0 | 13 | 1.0 | 14.5 | ns |
| | | $V_{CC}$ = 4.5 V to 5.5 V | | | | | | | | |
| | | $C_L$ = 15 pF | - | 2.8 | 5.5 | 1.0 | 6.5 | 1.0 | 7.0 | ns |
| | | $C_L$ = 50 pF | - | 4.1 | 7.5 | 1.0 | 8.5 | 1.0 | 9.5 | ns |
| $C_{PD}$ | power dissipation capacitance | $f_i$ = 1 MHz; $V_I$ = GND to $V_{CC}$ [3] | - | 10 | - | - | - | - | - | pF |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| **74VHCT32-Q100; $V_{CC}$ = 4.5 V to 5.5 V** | | | | | | | | | | |
| $t_{pd}$ | propagation delay | nA, nB to nY; see Fig. 6 [2] | | | | | | | | |
| | | $C_L$ = 15 pF | - | 3.1 | 6.9 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | $C_L$ = 50 pF | - | 4.3 | 7.9 | 1.0 | 9.0 | 1.0 | 10.0 | ns |
| $C_{PD}$ | power dissipation capacitance | $f_i$ = 1 MHz; $V_I$ = GND to $V_{CC}$ [3] | - | 12 | - | - | - | - | - | pF |

[1] Typical values are measured at nominal supply voltage ($V_{CC}$ = 3.3 V and $V_{CC}$ = 5.0 V).
[2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.
[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 V;
N = number of inputs switching;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

## 10.1. Waveforms

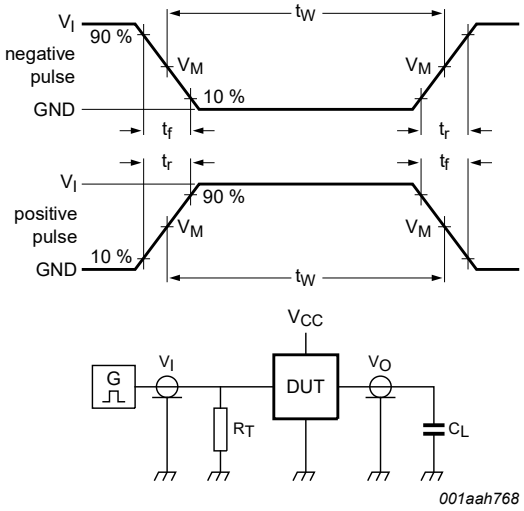



Measurement points are given in Table 8.
$V_{OL}$ and $V_{OH}$ are typical voltage output levels that occur with the output load.

**Fig. 6. Input to output propagation delays**

**Table 8. Measurement points**

| Type | Input | Output |
|---|---|---|
| | $V_M$ | $V_M$ |
| 74VHC32-Q100 | 0.5$V_{CC}$ | 0.5$V_{CC}$ |
| 74VHCT32-Q100 | 1.5 V | 0.5$V_{CC}$ |




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.

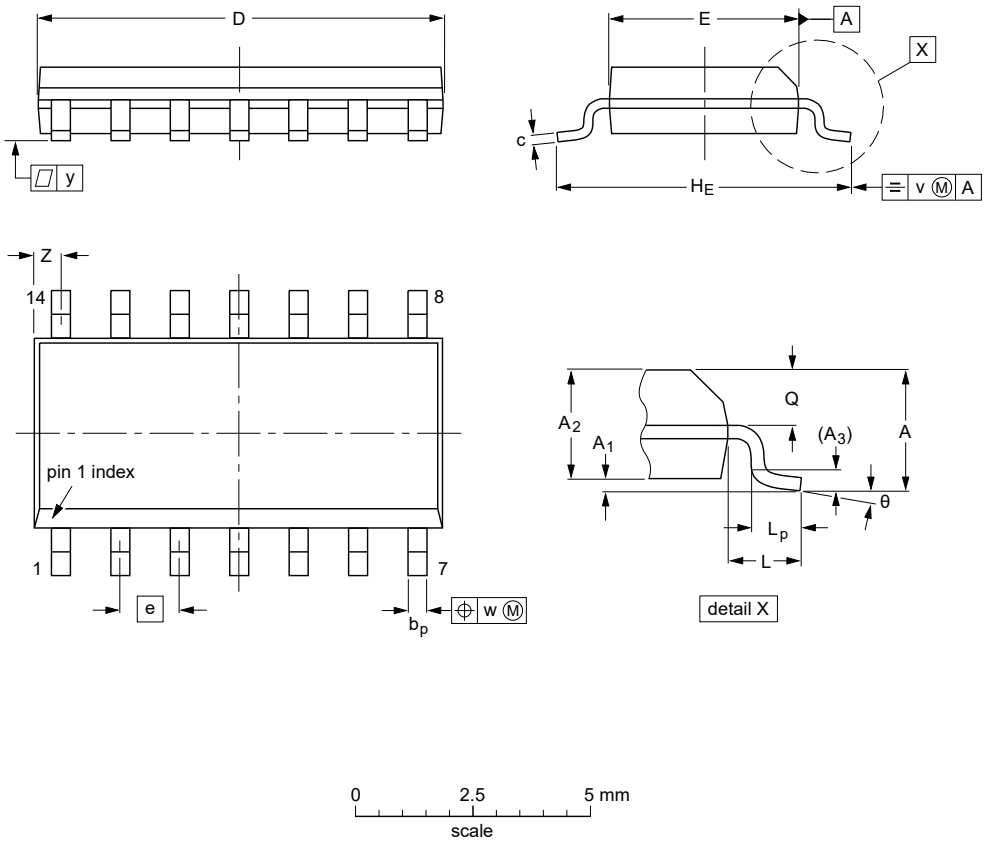
**Fig. 7. Test circuit for measuring switching times**

**Table 9. Test data**

| Type | Input | | Load | Test |
|---|---|---|---|---|
| | $V_I$ | $t_r$, $t_f$ | $C_L$ | |
| 74VHC32-Q100 | $V_{CC}$ | ≤ 3.0 ns | 15 pF, 50 pF | $t_{PLH}$, $t_{PHL}$ |
| 74VHCT32-Q100 | 3.0 V | ≤ 3.0 ns | 15 pF, 50 pF | $t_{PLH}$, $t_{PHL}$ |

# 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 | |

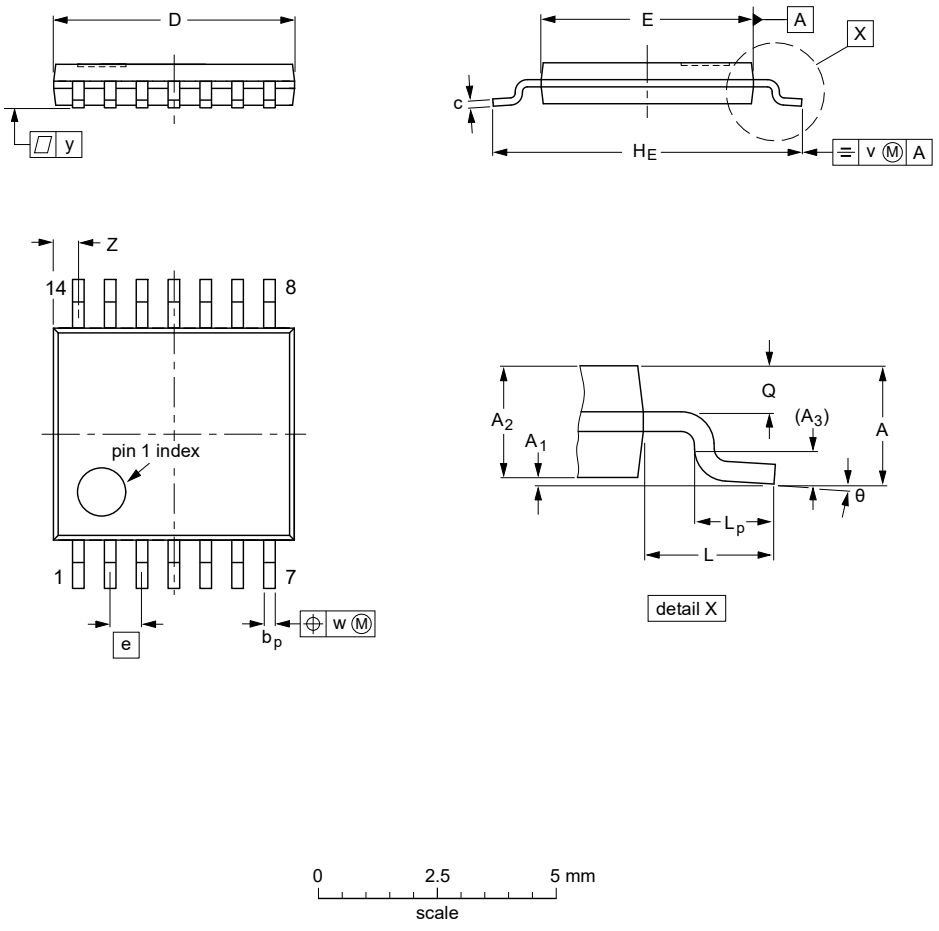
**Note**

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 |

**Fig. 8. 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°<br>0° |

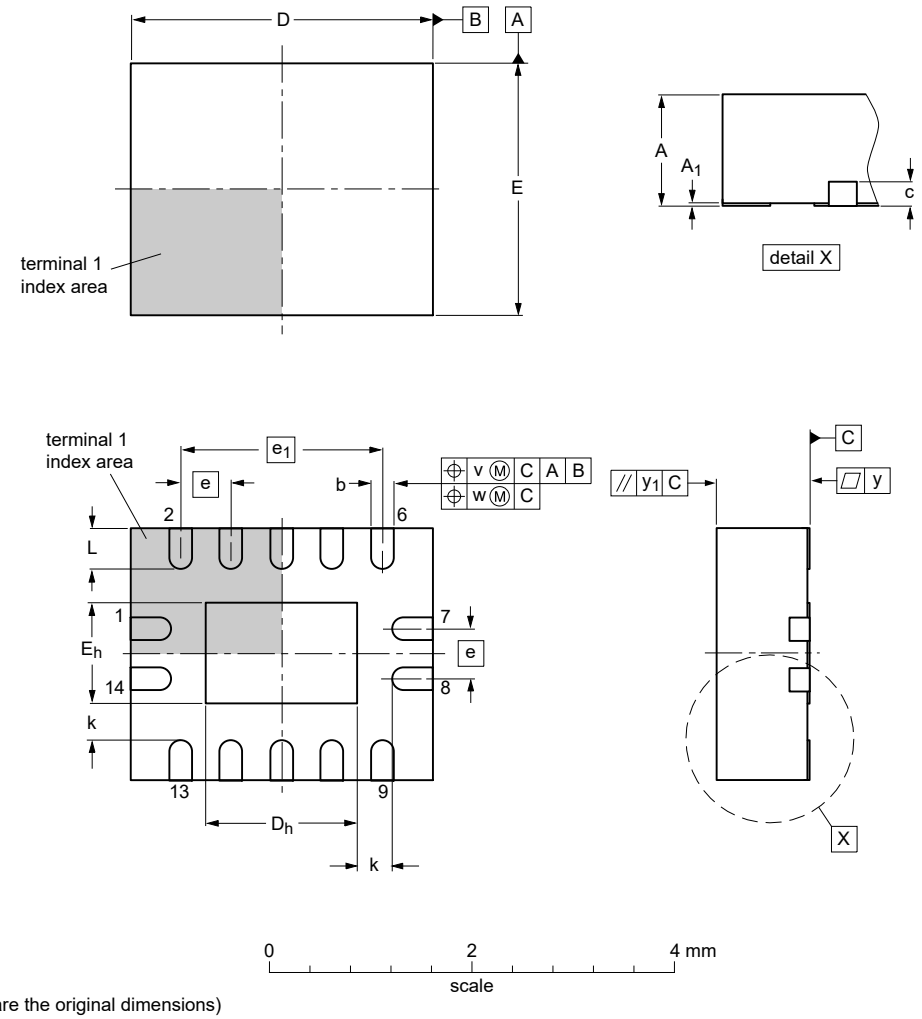
**Notes**

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

**Fig. 9. 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 |

**Fig. 10. 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 |
| LSTTL | Low-power Schottky Transistor-Transistor Logic |
| MIL | Military |
| MM | Machine Model |

# 13. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74VHC_VHCT32_Q100 v.2 | 20200903 | Product data sheet | - | 74VHC_VHCT32_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>• Section 2 updated.<br>• Table 4: Derating values for $P_{tot}$ total power dissipation have been updated.<br>• Fig. 10: Package outline drawing of SOT762-1 (DHVQFN14) updated. | | | |
| 74VHC_VHCT32_Q100 v.1 | 20131220 | 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".
[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 https://www.nexperia.com.

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