

# 74HC11-Q100; 74HCT11-Q100

## Triple 3-input AND gate

Rev. 2 — 22 March 2013

Product data sheet

## 1. General description

The 74HC11-Q100; 74HCT11-Q100 is a triple 3-input AND gate. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

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

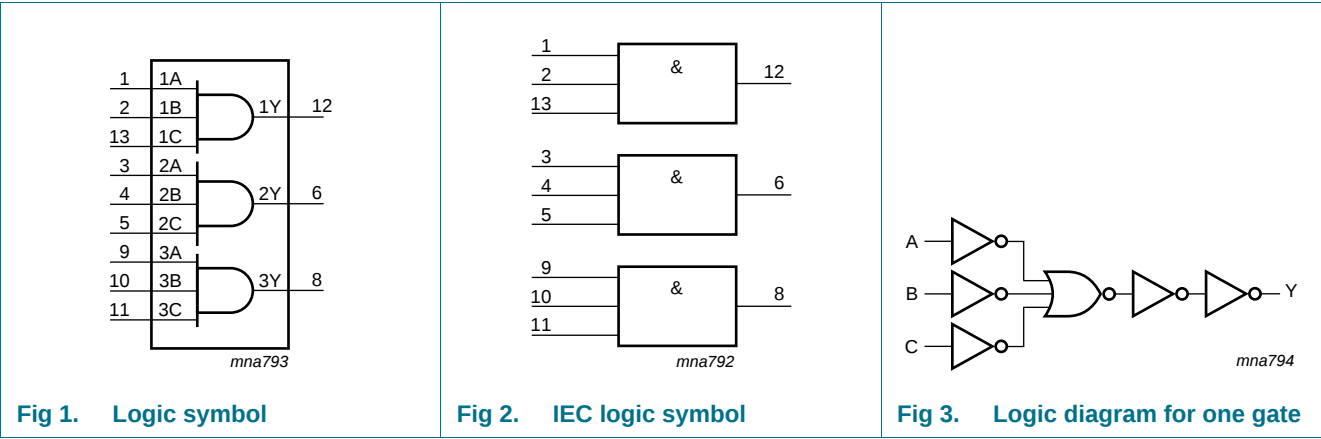
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD7A
- Input levels:
  - ◆ For 74HC11-Q100: CMOS level
  - ◆ For 74HCT11-Q100: TTL level
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

## 3. Ordering information

Table 1. Ordering information

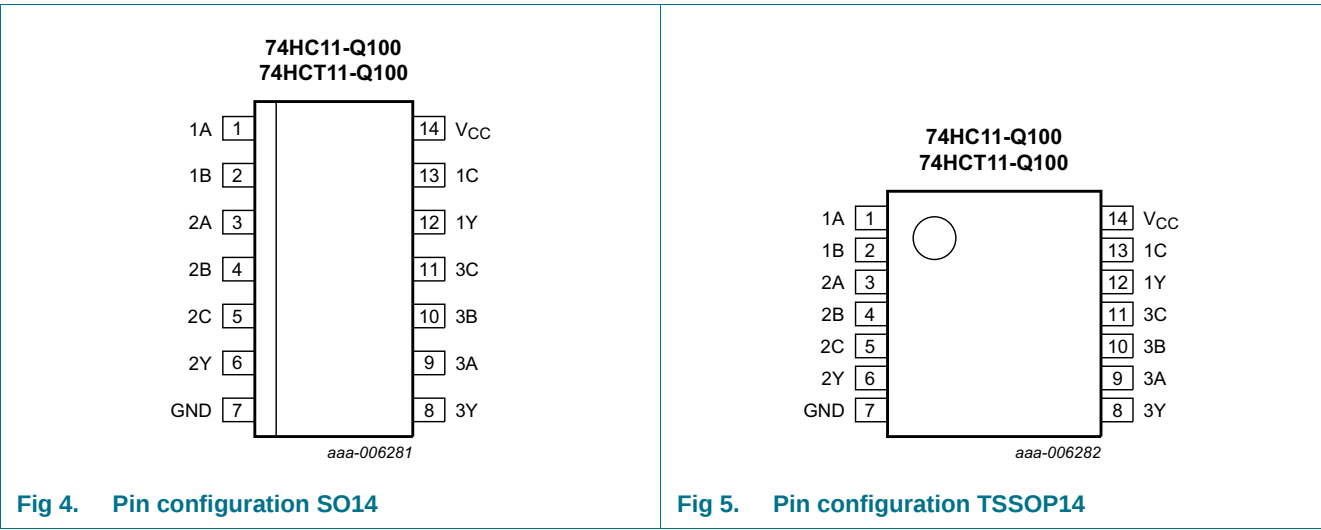
| Type number                     | Package                                                         |         |                                                                           |          |
|---------------------------------|-----------------------------------------------------------------|---------|---------------------------------------------------------------------------|----------|
|                                 | Temperature range                                               | Name    | Description                                                               | Version  |
| 74HC11D-Q100<br>74HCT11D-Q100   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO14    | plastic small outline package; 14 leads;<br>body width 3.9 mm             | SOT108-1 |
| 74HC11PW-Q100<br>74HCT11PW-Q100 | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP14 | plastic thin shrink small outline package;<br>14 leads; body width 4.4 mm | SOT402-1 |

4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol          | Pin       | Description    |
|-----------------|-----------|----------------|
| 1A, 2A, 3A      | 1, 3, 9   | data input     |
| 1B, 2B, 3B      | 2, 4, 10  | data input     |
| GND             | 7         | ground (0 V)   |
| 1C, 2C, 3C      | 13, 5, 11 | data input     |
| 1Y, 2Y, 3Y      | 12, 6, 8  | data output    |
| V <sub>CC</sub> | 14        | supply voltage |

## 6. Functional description

Table 3. Function selection<sup>[1]</sup>

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

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care

## 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   | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | <sup>[1]</sup> - | ±20  | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | <sup>[1]</sup> - | ±20  | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -                | ±25  | mA   |
| $I_{CC}$  | supply current          |                                                        | -                | 50   | mA   |
| $I_{GND}$ | ground current          |                                                        | -50              | -    | mA   |
| $T_{stg}$ | storage temperature     |                                                        | -65              | +150 | °C   |
| $P_{tot}$ | total power dissipation | SO14 and TSSOP14 packages                              | <sup>[2]</sup> - | 500  | mW   |

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

[2] For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
For TSSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC11-Q100 |      |                 | 74HCT11-Q100 |      |                 | Unit |
|------------------|-------------------------------------|-------------------------|-------------|------|-----------------|--------------|------|-----------------|------|
|                  |                                     |                         | Min         | Typ  | Max             | Min          | Typ  | Max             |      |
| V <sub>CC</sub>  | supply voltage                      |                         | 2.0         | 5.0  | 6.0             | 4.5          | 5.0  | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                         | 0           | -    | V <sub>CC</sub> | 0            | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                         | 0           | -    | V <sub>CC</sub> | 0            | -    | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                         | -40         | -    | +125            | -40          | -    | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V | -           | -    | 625             | -            | -    | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 4.5 V | -           | 1.67 | 139             | -            | 1.67 | 139             | ns/V |
|                  |                                     | V <sub>CC</sub> = 6.0 V | -           | -    | 83              | -            | -    | -               | 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  |      |
| 74HC11-Q100     |                           |                                                                                        |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                | 1.5   | 1.2  | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                | 3.15  | 2.4  | -    | 3.15             | -    | 3.15              | -    | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                | 4.2   | 3.2  | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                | -     | 0.8  | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                | -     | 2.1  | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                | -     | 2.8  | 1.8  | -                | 1.8  | -                 | 1.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |      |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 2.0 V                                       | 1.9   | 2.0  | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 4.5 V                                       | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 6.0 V                                       | 5.9   | 6.0  | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −4.0 mA; V <sub>CC</sub> = 4.5 V                                      | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = −5.2 mA; V <sub>CC</sub> = 6.0 V                                      | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |      |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V                                        | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V                                        | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V                                        | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                       | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -     | 0.16 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                       | -     | -    | ±0.1 | -                | ±1   | -                 | ±1   | μA   |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V | -     | -    | 2.0  | -                | 20   | -                 | 40   | μA   |

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

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     |               |
| $C_I$               | input capacitance         |                                                                                                                                                                | -     | 3.5  | -         | -                | -       | -                 | -       | pF            |
| <b>74HCT11-Q100</b> |                           |                                                                                                                                                                |       |      |           |                  |         |                   |         |               |
| $V_{IH}$            | HIGH-level input voltage  | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$                                                                                                                     | 2.0   | 1.6  | -         | 2.0              | -       | 2.0               | -       | V             |
| $V_{IL}$            | LOW-level input voltage   | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$                                                                                                                     | -     | 1.2  | 0.8       | -                | 0.8     | -                 | 0.8     | V             |
| $V_{OH}$            | HIGH-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}; V_{CC} = 4.5 \text{ V}$                                                                                                      |       |      |           |                  |         |                   |         |               |
|                     |                           | $I_O = -20 \mu\text{A}$                                                                                                                                        | 4.4   | 4.5  | -         | 4.4              | -       | 4.4               | -       | V             |
|                     |                           | $I_O = -4.0 \text{ mA}$                                                                                                                                        | 3.98  | 4.32 | -         | 3.84             | -       | 3.7               | -       | V             |
| $V_{OL}$            | LOW-level output voltage  | $V_I = V_{IH} \text{ or } V_{IL}; V_{CC} = 4.5 \text{ V}$                                                                                                      |       |      |           |                  |         |                   |         |               |
|                     |                           | $I_O = 20 \mu\text{A}; V_{CC} = 4.5 \text{ V}$                                                                                                                 | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V             |
| $I_I$               | input leakage current     | $V_I = V_{CC} \text{ or GND}; V_{CC} = 5.5 \text{ V}$                                                                                                          | -     | -    | $\pm 0.1$ | -                | $\pm 1$ | -                 | $\pm 1$ | $\mu\text{A}$ |
| $I_{CC}$            | supply current            | $V_I = V_{CC} \text{ or GND}; I_O = 0 \text{ A}; V_{CC} = 5.5 \text{ V}$                                                                                       | -     | -    | 2.0       | -                | 20      | -                 | 40      | $\mu\text{A}$ |
| $\Delta I_{CC}$     | additional supply current | per input pin;<br>$V_I = V_{CC} - 2.1 \text{ V}; I_O = 0 \text{ A};$<br>other inputs at $V_{CC} \text{ or GND};$<br>$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | -     | 100  | 360       | -                | 450     | -                 | 490     | $\mu\text{A}$ |
| $C_I$               | input capacitance         |                                                                                                                                                                | -     | 3.5  | -         | -                | -       | -                 | -       | pF            |

## 10. Dynamic characteristics

**Table 7.** Dynamic characteristics $GND = 0 \text{ V}; C_L = 50 \text{ pF};$  for test circuit see [Figure 7](#).

| Symbol          | Parameter                     | Conditions                                           | 25 °C               |     |     | −40 °C to +125 °C |              | Unit |
|-----------------|-------------------------------|------------------------------------------------------|---------------------|-----|-----|-------------------|--------------|------|
|                 |                               |                                                      | Min                 | Typ | Max | Max (85 °C)       | Max (125 °C) |      |
| 74HC11-Q100     |                               |                                                      |                     |     |     |                   |              |      |
| t <sub>pd</sub> | propagation delay             | nA, nB to nY; see <a href="#">Figure 6</a>           | <a href="#">[1]</a> |     |     |                   |              |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                              | -                   | 32  | 100 | 125               | 150          | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                              | -                   | 12  | 20  | 25                | 30           | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF      | -                   | 9   | -   | -                 | -            | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                              | -                   | 10  | 17  | 21                | 26           | ns   |
| t <sub>t</sub>  | transition time               | see <a href="#">Figure 6</a>                         | <a href="#">[2]</a> |     |     |                   |              |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                              | -                   | 19  | 75  | 95                | 110          | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                              | -                   | 7   | 15  | 19                | 22           | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                              | -                   | 6   | 13  | 16                | 19           | ns   |
| C <sub>PD</sub> | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> | <a href="#">[3]</a> | -   | 18  | -                 | -            | pF   |

Table 7. Dynamic characteristics  
GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see Figure 7.

| Symbol          | Parameter                     | Conditions                                                      | 25 °C               |     |     | –40 °C to +125 °C |                 | Unit |
|-----------------|-------------------------------|-----------------------------------------------------------------|---------------------|-----|-----|-------------------|-----------------|------|
|                 |                               |                                                                 | Min                 | Typ | Max | Max<br>(85 °C)    | Max<br>(125 °C) |      |
| 74HCT11-Q100    |                               |                                                                 |                     |     |     |                   |                 |      |
| t <sub>pd</sub> | propagation delay             | nA, nB to nY; see <a href="#">Figure 6</a>                      | <a href="#">[1]</a> |     |     |                   |                 |      |
|                 |                               | V <sub>CC</sub> = 4.5 V                                         | -                   | 16  | 24  | 30                | 36              | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                 | -                   | 11  | -   | -                 | -               | ns   |
| t <sub>t</sub>  | transition time               | V <sub>CC</sub> = 4.5 V; see <a href="#">Figure 6</a>           | <a href="#">[2]</a> | 7   | 15  | 19                | 22              | ns   |
| C <sub>PD</sub> | power dissipation capacitance | per package;<br>V <sub>I</sub> = GND to V <sub>CC</sub> – 1.5 V | <a href="#">[3]</a> | 20  | -   | -                 | -               | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:  
f<sub>i</sub> = input frequency in MHz;  
f<sub>o</sub> = output frequency in MHz;  
C<sub>L</sub> = output load capacitance in pF;  
V<sub>CC</sub> = supply voltage in V;  
N = number of inputs switching;  
Σ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

11. Waveforms

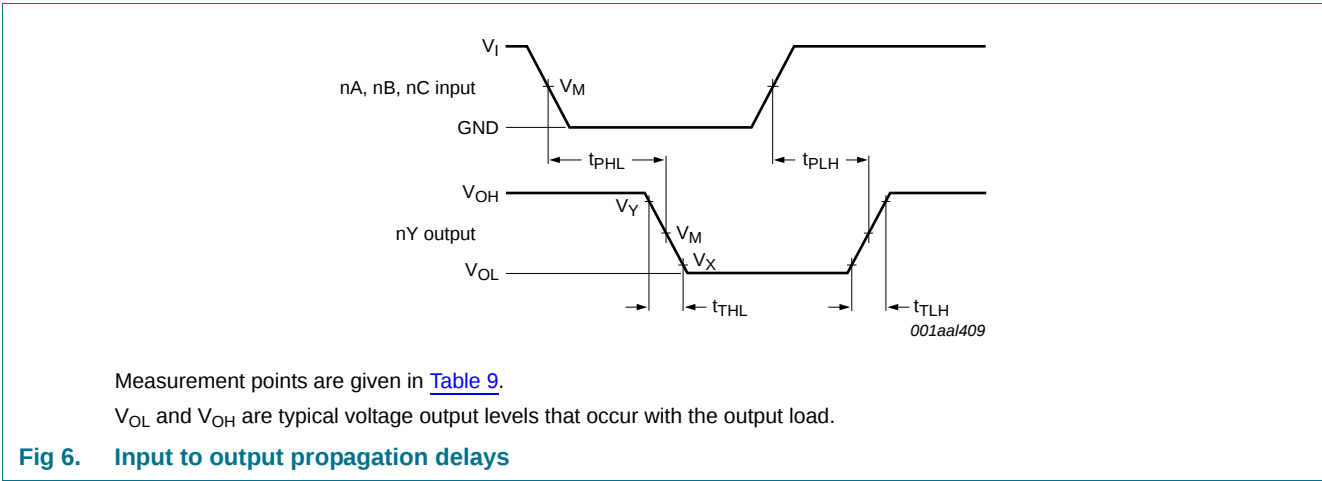
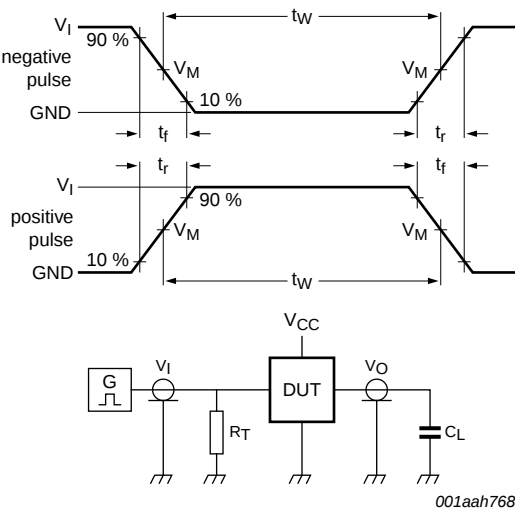


Table 8. Measurement points

| Type         | Input              | Output             |                    |                    |
|--------------|--------------------|--------------------|--------------------|--------------------|
|              | V <sub>M</sub>     | V <sub>M</sub>     | V <sub>X</sub>     | V <sub>Y</sub>     |
| 74HC11-Q100  | 0.5V <sub>CC</sub> | 0.5V <sub>CC</sub> | 0.1V <sub>CC</sub> | 0.9V <sub>CC</sub> |
| 74HCT11-Q100 | 1.3 V              | 1.3 V              | 0.1V <sub>CC</sub> | 0.9V <sub>CC</sub> |



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               |
|--------------|----------|------------|--------------|--------------------|
|              | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC11-Q100  | $V_{CC}$ | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT11-Q100 | 3.0 V    | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

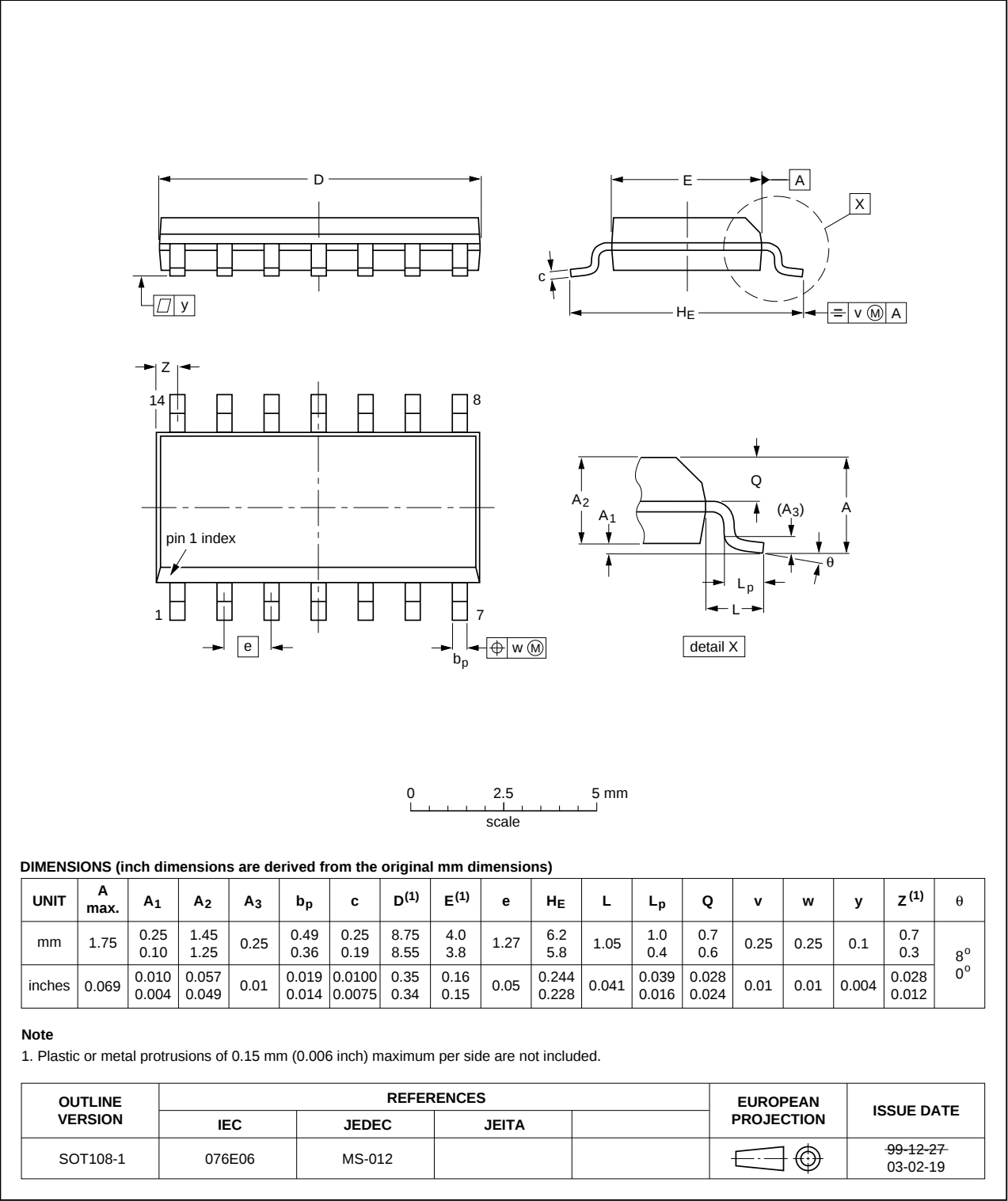


Fig 8. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

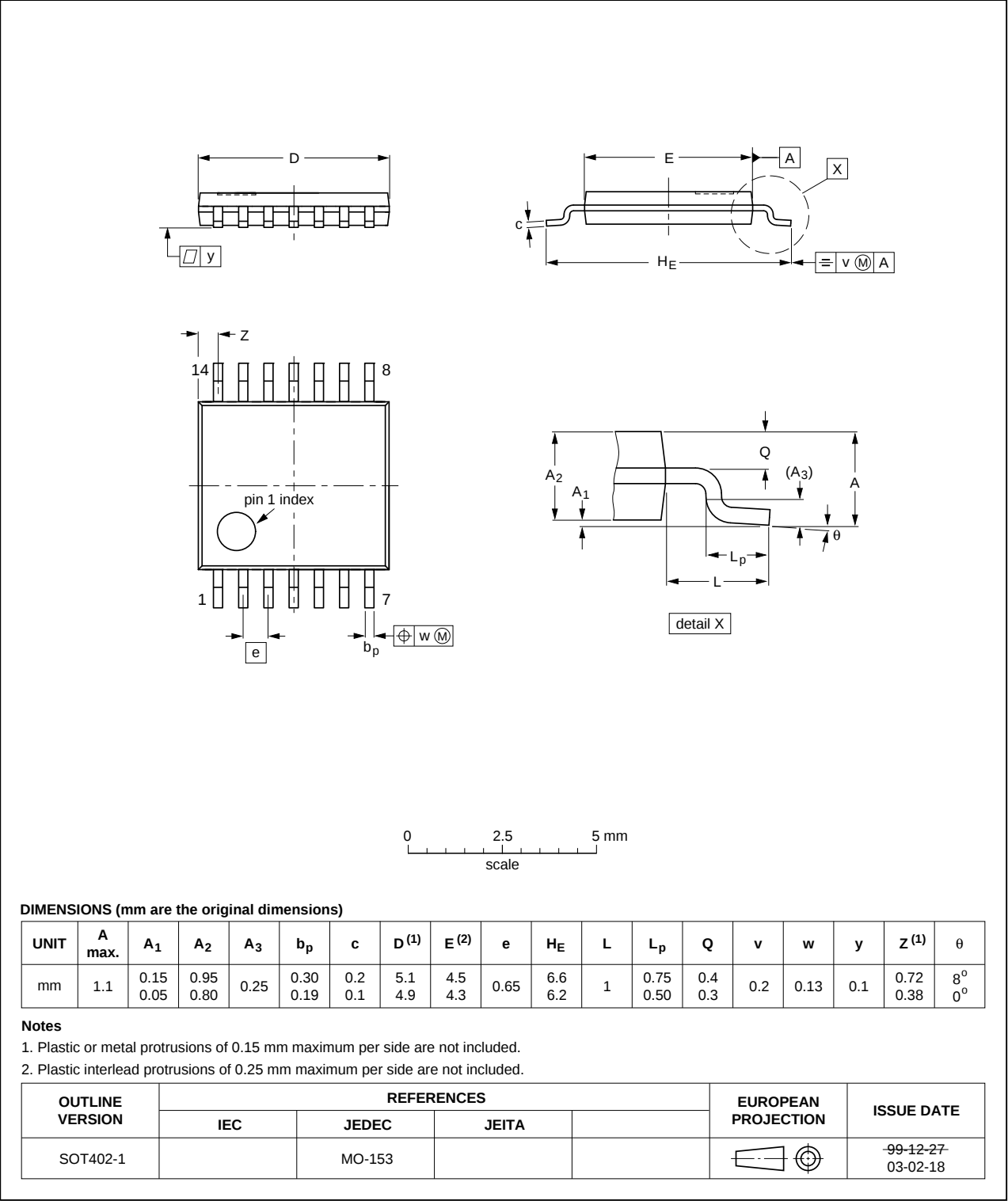


Fig 9. Package outline SOT402-1 (TSSOP14)

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

## 14. Revision history

Table 11. Revision history

| Document ID                                                                             | Release date | Data sheet status  | Change notice | Supersedes          |
|-----------------------------------------------------------------------------------------|--------------|--------------------|---------------|---------------------|
| 74HC_HCT11_Q100 v.2                                                                     | 20130322     | Product data sheet | -             | 74HC_HCT11_Q100 v.1 |
| Modifications:                                                                          |              |                    |               |                     |
| • <a href="#">Section 2 "Features and benefits"</a> removed redundant temperature range |              |                    |               |                     |
| 74HC_HCT11_Q100 v.1                                                                     | 20130228     | Product data sheet | -             | -                   |

## 15. Legal information

### 15.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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## 16. Contact information

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For more information, please visit: <http://www.nexperia.com>

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## 17. Contents

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|           |                                               |           |
|-----------|-----------------------------------------------|-----------|
| <b>1</b>  | <b>General description</b> .....              | <b>1</b>  |
| <b>2</b>  | <b>Features and benefits</b> .....            | <b>1</b>  |
| <b>3</b>  | <b>Ordering information</b> .....             | <b>1</b>  |
| <b>4</b>  | <b>Functional diagram</b> .....               | <b>2</b>  |
| <b>5</b>  | <b>Pinning information</b> .....              | <b>2</b>  |
| 5.1       | Pinning .....                                 | 2         |
| 5.2       | Pin description .....                         | 2         |
| <b>6</b>  | <b>Functional description</b> .....           | <b>3</b>  |
| <b>7</b>  | <b>Limiting values</b> .....                  | <b>3</b>  |
| <b>8</b>  | <b>Recommended operating conditions</b> ..... | <b>4</b>  |
| <b>9</b>  | <b>Static characteristics</b> .....           | <b>4</b>  |
| <b>10</b> | <b>Dynamic characteristics</b> .....          | <b>5</b>  |
| <b>11</b> | <b>Waveforms</b> .....                        | <b>6</b>  |
| <b>12</b> | <b>Package outline</b> .....                  | <b>8</b>  |
| <b>13</b> | <b>Abbreviations</b> .....                    | <b>10</b> |
| <b>14</b> | <b>Revision history</b> .....                 | <b>10</b> |
| <b>15</b> | <b>Legal information</b> .....                | <b>11</b> |
| 15.1      | Data sheet status .....                       | 11        |
| 15.2      | Definitions .....                             | 11        |
| 15.3      | Disclaimers .....                             | 11        |
| 15.4      | Trademarks .....                              | 12        |
| <b>16</b> | <b>Contact information</b> .....              | <b>12</b> |
| <b>17</b> | <b>Contents</b> .....                         | <b>13</b> |