

# 74HC3G04-Q100; 74HCT3G04-Q100

## Inverter

Rev. 2 — 18 November 2013

Product data sheet

## 1. General description

The 74HC3G04-Q100; 74HCT3G04-Q100 is a triple inverter. 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 at 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  $+125\text{ }^{\circ}\text{C}$
- Input levels:
  - ◆ For 74HC3G04-Q100: CMOS level
  - ◆ For 74HCT3G04-Q100: TTL level
- Wide supply voltage range from 2.0 V to 6.0 V
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )



3. Ordering information

Table 1. Ordering information

| Type number                         | Package           |        |                                                                                          |          |
|-------------------------------------|-------------------|--------|------------------------------------------------------------------------------------------|----------|
|                                     | Temperature range | Name   | Description                                                                              | Version  |
| 74HC3G04DP-Q100<br>74HCT3G04DP-Q100 | −40 °C to +125 °C | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm  | SOT505-2 |
| 74HC3G04DC-Q100<br>74HCT3G04DC-Q100 | −40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm               | SOT765-1 |
| 74HC3G04GD-Q100<br>74HCT3G04GD-Q100 | −40 °C to +125 °C | XSON8  | plastic extremely thin small outline package; no leads; 8 terminals; body 3 × 2 × 0.5 mm | SOT996-2 |

4. Marking

Table 2. Marking codes

| Type number      | Marking code <sup>[1]</sup> |
|------------------|-----------------------------|
| 74HC3G04DP-Q100  | H04                         |
| 74HCT3G04DP-Q100 | T04                         |
| 74HC3G04DC-Q100  | H04                         |
| 74HCT3G04DC-Q100 | T04                         |
| 74HC3G04GD-Q100  | H04                         |
| 74HCT3G04GD-Q100 | T04                         |

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram

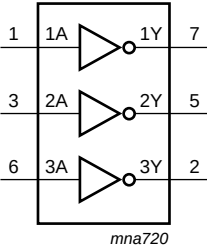


Fig 1. Logic symbol

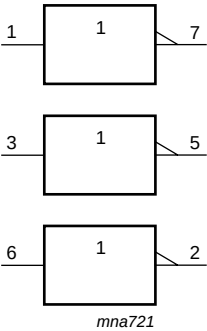


Fig 2. IEC logic symbol

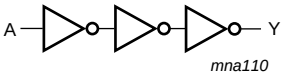
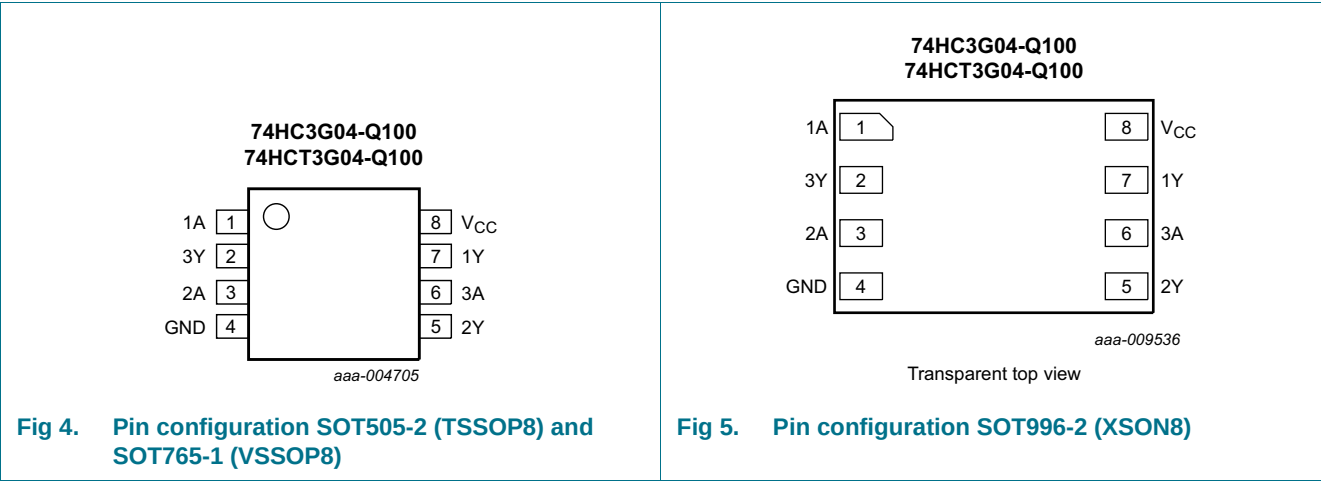


Fig 3. Logic diagram (one gate)

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 3. Pin description

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

7. Functional description

Table 4. Function table<sup>[1]</sup>

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

[1] H = HIGH voltage level; L = LOW voltage level.

## 8. Limiting values

**Table 5. 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    |
| $I_{IK}$  | input clamping current    | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | [1] -   | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current   | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | [1] -   | $\pm 20$ | mA   |
| $I_O$     | output current            | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$     | [1] -   | 25       | mA   |
| $I_{CC}$  | supply current            |                                                        | [1] -   | 50       | mA   |
| $I_{GND}$ | ground current            |                                                        | [1] -50 | -        | mA   |
| $T_{stg}$ | storage temperature       |                                                        | -65     | +150     | °C   |
| $P_D$     | dynamic power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$          | [2] -   | 300      | mW   |

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

[2] For TSSOP8 package: above 55 °C the value of  $P_{tot}$  derates linearly with 2.5 mW/K.

For VSSOP8 package: above 110 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.

For XSON8 package: above 45 °C the value of  $P_{tot}$  derates linearly with 2.4 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V).

| Symbol              | Parameter                           | Conditions              | 74HC3G04-Q100 |      |          | 74HCT3G04-Q100 |      |          | Unit |
|---------------------|-------------------------------------|-------------------------|---------------|------|----------|----------------|------|----------|------|
|                     |                                     |                         | Min           | Typ  | Max      | Min            | Typ  | Max      |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0           | 5.0  | 6.0      | 4.5            | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0             | -    | $V_{CC}$ | 0              | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0             | -    | $V_{CC}$ | 0              | -    | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |                         | -40           | +25  | +125     | -40            | +25  | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -             | -    | 625      | -              | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -             | 1.67 | 139      | -              | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -             | -    | 83       | -              | -    | -        | ns/V |

## 10. Static characteristics

**Table 7. Static characteristics**

Voltages are referenced to GND (ground = 0 V). All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

| Symbol          | Parameter                 | Conditions                                                                                             | 25 °C |      |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|--------------------------------------------------------------------------------------------------------|-------|------|------|------------------|------|-------------------|------|------|
|                 |                           |                                                                                                        | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| 74HC3G04-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                                                      | 4.18  | 4.32 | -    | 4.13             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = –5.2 mA; V <sub>CC</sub> = 6.0 V                                                      | 5.68  | 5.81 | -    | 5.63             | -    | 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 | -                | ±1.0 | -                 | ±1.0 | μA   |
| I <sub>CC</sub> | supply current            | per input pin; V <sub>CC</sub> = 6.0 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; | -     | -    | 1.0  | -                | 10   | -                 | 20   | μA   |
| C <sub>I</sub>  | input capacitance         |                                                                                                        | -     | 1.5  | -    | -                | -    | -                 | -    | pF   |

**Table 7.** Static characteristics ...continued

Voltages are referenced to GND (ground = 0 V). All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

| Symbol           | Parameter                 | Conditions                                                                                                  | 25 °C |      |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|------------------|---------------------------|-------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|------|-------------------|------|------|
|                  |                           |                                                                                                             | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| 74HCT3G04-Q100   |                           |                                                                                                             |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                            | 2.0   | 1.6  | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                            | -     | 1.2  | 0.8  | -                | 0.8  | -                 | 0.8  | 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> = 4.5 V                                                            | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = –4.0 mA; V <sub>CC</sub> = 4.5 V                                                           | 4.18  | 4.32 | -    | 4.13             | -    | 3.7               | -    | 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> = 4.5 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>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V                                            | -     | -    | ±0.1 | -                | ±1.0 | -                 | ±1.0 | μA   |
| I <sub>CC</sub>  | supply current            | per input pin; V <sub>CC</sub> = 5.5 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;      | -     | -    | 1.0  | -                | 10   | -                 | 20   | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>I</sub> = V <sub>CC</sub> – 2.1 V; I <sub>O</sub> = 0 A | -     | -    | 300  | -                | 375  | -                 | 410  | μA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                             | -     | 1.5  | -    | -                | -    | -                 | -    | pF   |

## 11. Dynamic characteristics

**Table 8.** Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); all typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; for test circuit, see [Figure 7](#).

| Symbol          | Parameter                     | Conditions                                                  | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|-------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                             | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC3G04-Q100   |                               |                                                             |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay             | nA to nY; see <a href="#">Figure 6</a> <a href="#">[1]</a>  |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                     | -     | 22  | 75  | -                | 90  | -                 | 110 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                     | -     | 8   | 15  | -                | 18  | -                 | 22  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                     | -     | 6   | 13  | -                | 16  | -                 | 20  | ns   |
| t <sub>t</sub>  | transition time               | see <a href="#">Figure 6</a> <a href="#">[2]</a>            |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                     | -     | 18  | 75  | -                | 95  | -                 | 125 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                     | -     | 6   | 15  | -                | 19  | -                 | 25  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                     | -     | 5   | 13  | -                | 16  | -                 | 20  | ns   |
| C <sub>PD</sub> | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[3]</a> | -     | 9   | -   | -                | -   | -                 | -   | pF   |

**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V); all typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; for test circuit, see [Figure 7](#).

| Symbol          | Parameter                     | Conditions                                                                            | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|---------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                                                       | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HCT3G04-Q100  |                               |                                                                                       |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay             | nA to nY; see <a href="#">Figure 6</a> <a href="#">[1]</a><br>V <sub>CC</sub> = 4.5 V | -     | 10  | 18  | -                | 23  | -                 | 29  | ns   |
| t <sub>t</sub>  | transition time               | V <sub>CC</sub> = 4.5 V; see <a href="#">Figure 6</a> <a href="#">[2]</a>             | -     | 6   | 15  | -                | 19  | -                 | 22  | ns   |
| C <sub>PD</sub> | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> – 1.5 V <a href="#">[3]</a>                   | -     | 9   | -   | -                | -   | -                 | -   | pF   |

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

[2]  $t_t$  is the same as  $t_{TLH}$  and  $t_{THL}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

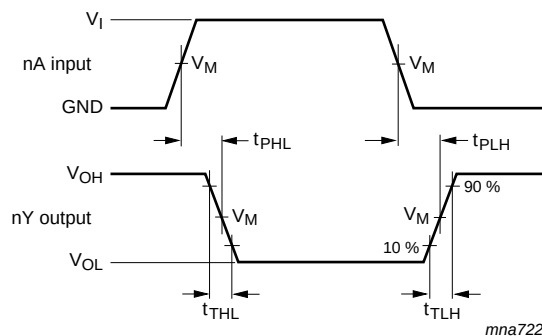
$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## 12. Waveforms



Measurement points are given in [Table 9](#).

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

**Fig 6. The data input (nA) to output (nY) propagation delays**

**Table 9. Measurement points**

| Type           | Input               | Output              |
|----------------|---------------------|---------------------|
|                | $V_M$               | $V_M$               |
| 74HC3G04-Q100  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT3G04-Q100 | 1.3 V               | 1.3 V               |

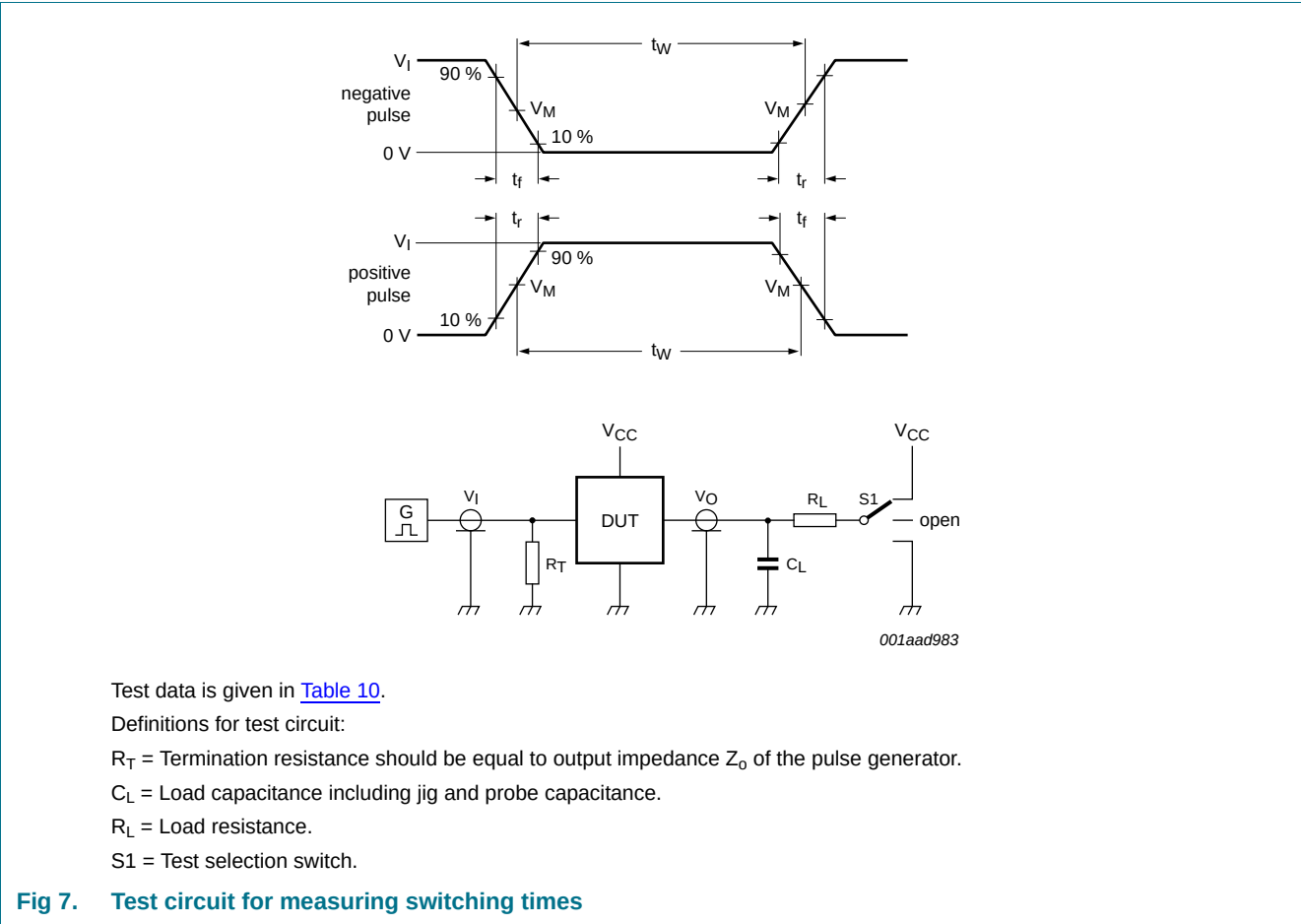


Table 10. Test data

| Type           | Input    |                     | Load  |              | S1 position        |
|----------------|----------|---------------------|-------|--------------|--------------------|
|                | $V_I$    | $t_r, t_f$          | $C_L$ | $R_L$        | $t_{PHL}, t_{PLH}$ |
| 74HC3G04-Q100  | $V_{CC}$ | $\leq 6 \text{ ns}$ | 50 pF | 1 k $\Omega$ | open               |
| 74HCT3G04-Q100 | 3 V      | $\leq 6 \text{ ns}$ | 50 pF | 1 k $\Omega$ | open               |



13. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm    SOT505-2

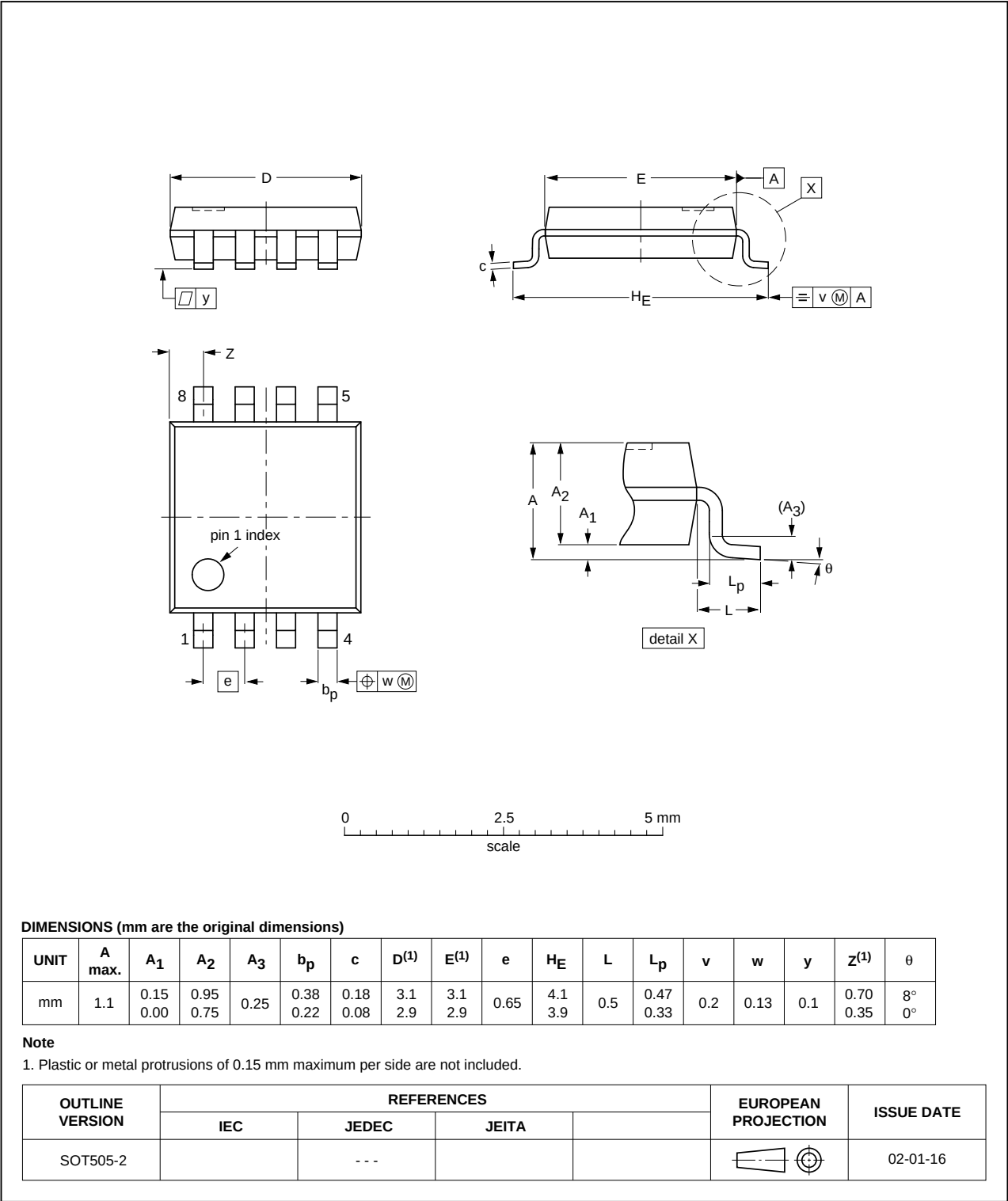


Fig 8. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm

SOT765-1

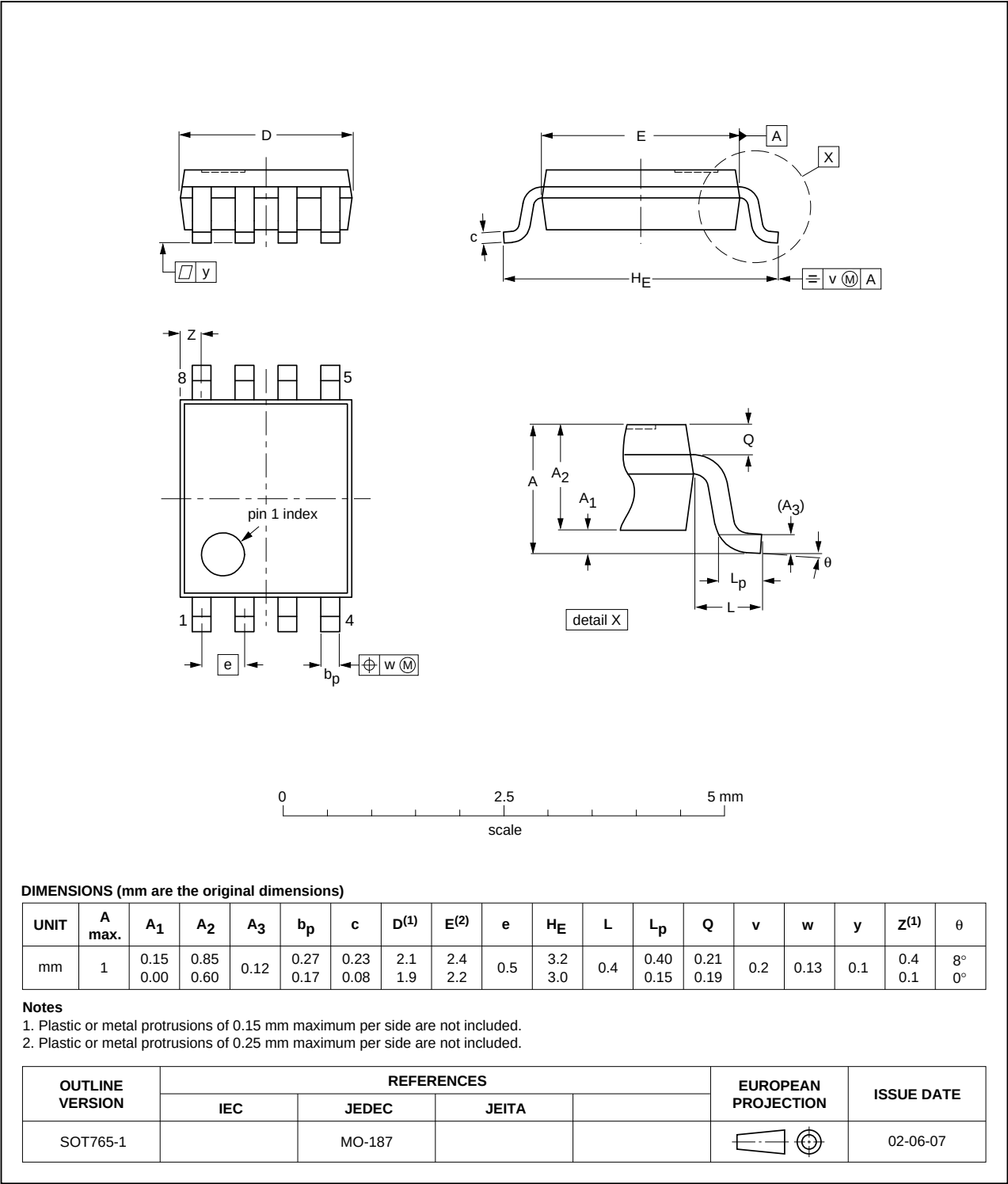


Fig 9. Package outline SOT765-1 (VSSOP8)

XSON8: plastic extremely thin small outline package; no leads;  
8 terminals; body 3 x 2 x 0.5 mm

SOT996-2

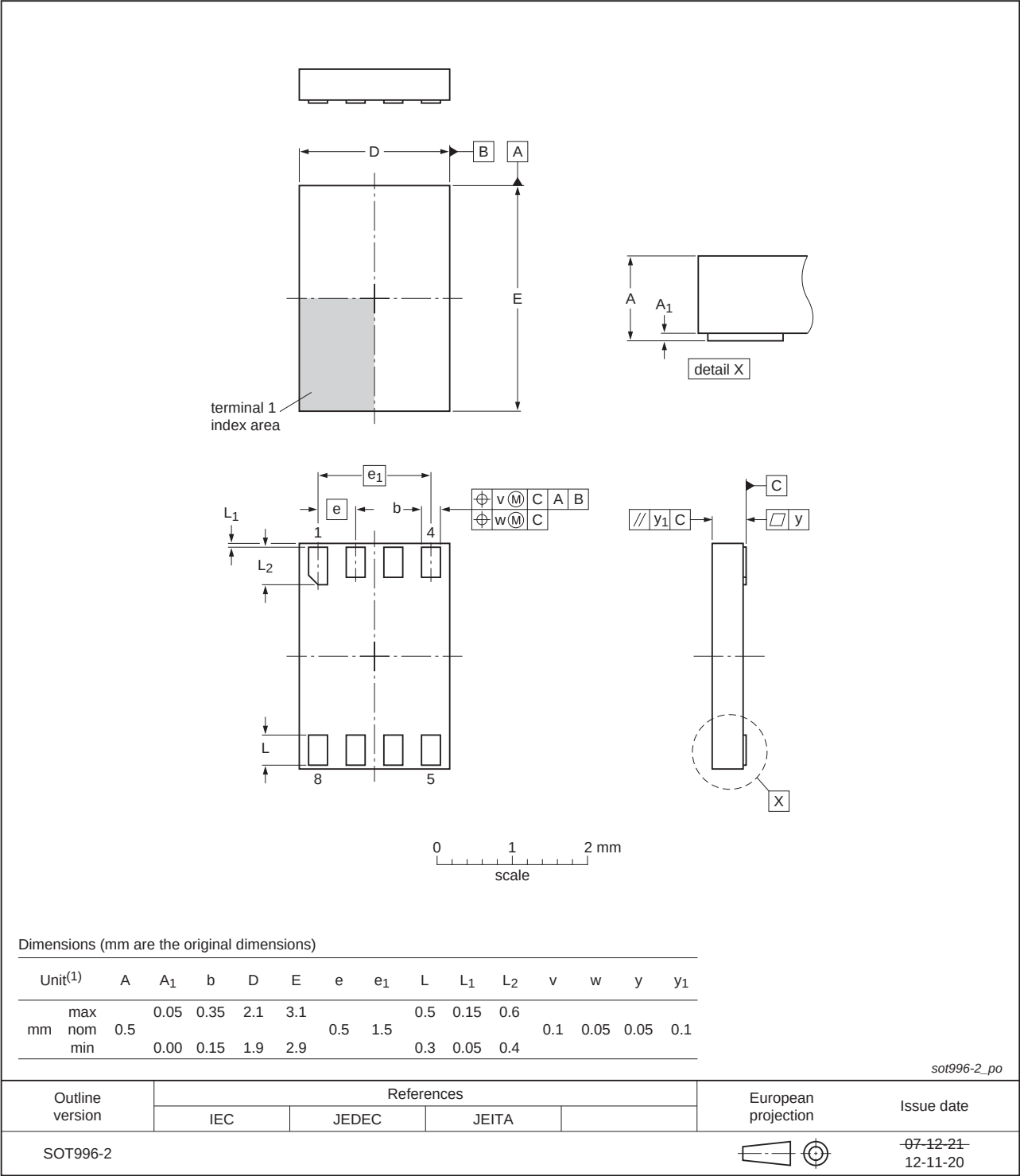


Fig 10. Package outline SOT996-2 (XSON8)

## 14. Abbreviations

Table 11. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| 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             |

## 15. Revision history

Table 12. Revision history

| Document ID           | Release date                                                                                                            | Data sheet status  | Change notice | Supersedes            |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-----------------------|
| 74HC_HCT3G04_Q100 v.2 | 20131118                                                                                                                | Product data sheet | -             | 74HC_HCT3G04_Q100 v.1 |
| Modifications:        | <ul style="list-style-type: none"><li>Added type numbers 74HC3G04GD-Q100 and 74HCT3G04GD-Q100 (XSON8 package)</li></ul> |                    |               |                       |
| 74HC_HCT3G04_Q100 v.1 | 20120827                                                                                                                | Product data sheet | -             | -                     |

## 16. Legal information

### 16.1 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.nxp.com>.

### 16.2 Definitions

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