



# XC7WH14

Triple inverting Schmitt trigger

Rev. 7 — 3 January 2024

Product data sheet

## 1. General description

The XC7WH14 is a high-speed Si-gate CMOS device. This device provides three inverting buffers with Schmitt trigger action. This device is capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

## 2. Features and benefits

- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- CMOS input levels
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

## 3. Applications

- Wave and pulse shaper for highly noisy environment
- Astable multivibrator
- Monostable multivibrator

## 4. Ordering information

Table 1. Ordering information

| Type number               | Package           |        |                                                                                             |                          |
|---------------------------|-------------------|--------|---------------------------------------------------------------------------------------------|--------------------------|
|                           | Temperature range | Name   | Description                                                                                 | Version                  |
| <a href="#">XC7WH14DP</a> | -40 °C to +125 °C | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm     | <a href="#">SOT505-2</a> |
| <a href="#">XC7WH14DC</a> | -40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm                  | <a href="#">SOT765-1</a> |
| <a href="#">XC7WH14GT</a> | -40 °C to +125 °C | XSON8  | plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm | <a href="#">SOT833-1</a> |

5. Marking

Table 2. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| XC7WH14DP   | f14             |
| XC7WH14DC   | f14             |
| XC7WH14GT   | f14             |

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

6. Functional diagram

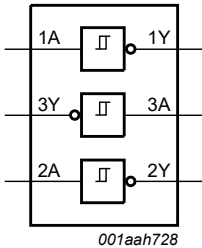


Fig. 1. Logic symbol

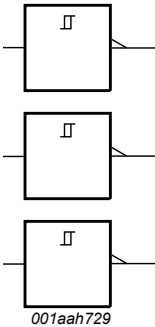


Fig. 2. IEC logic symbol

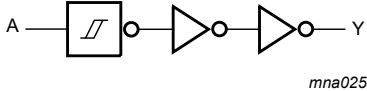
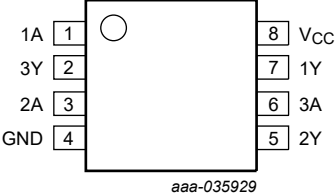


Fig. 3. Logic diagram (one Schmitt trigger)

7. Pinning information

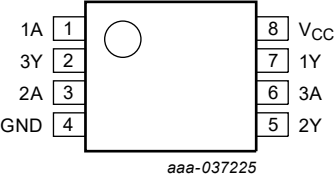
7.1. Pinning

**DP package**  
**SOT505-2 (TSSOP8)**



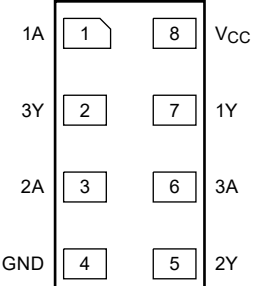
aaa-035929

**DC package**  
**SOT765-1 (VSSOP8)**



aaa-037225

**GT package**  
**SOT833-1 (XSON8)**



aaa-037231

Transparent top view

7.2. 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 |

8. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level

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

9. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol           | Parameter               | Conditions                                                              | Min  | Max  | Unit |
|------------------|-------------------------|-------------------------------------------------------------------------|------|------|------|
| V <sub>CC</sub>  | supply voltage          |                                                                         | -0.5 | +7.0 | V    |
| V <sub>I</sub>   | input voltage           |                                                                         | -0.5 | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V                                                 | -20  | -    | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V [1] | -    | ±20  | mA   |
| I <sub>O</sub>   | output current          | -0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V                       | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                         | -    | 75   | mA   |
| I <sub>GND</sub> | ground current          |                                                                         | -75  | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                         | -65  | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C [2]                                | -    | 250  | mW   |

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
[2] For SOT505-2 (TSSOP8) package: P<sub>tot</sub> derates linearly with 4.6 mW/K above 96 °C.  
For SOT765-1 (VSSOP8) package: P<sub>tot</sub> derates linearly with 4.9 mW/K above 99 °C.  
For SOT833-1 (XSON8) package: P<sub>tot</sub> derates linearly with 3.1 mW/K above 68 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

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

| Symbol           | Parameter           | Conditions | Min | Typ | Max             | Unit |
|------------------|---------------------|------------|-----|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage      |            | 2.0 | 5.0 | 5.5             | V    |
| V <sub>I</sub>   | input voltage       |            | 0   | -   | 5.5             | V    |
| V <sub>O</sub>   | output voltage      |            | 0   | -   | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature |            | -40 | +25 | +125            | °C   |

11. Static characteristics

Table 7. Static characteristics

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  |      |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>                                       |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 2.0 V                                          | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 3.0 V                                          | 2.9   | 3.0 | -    | 2.9              | -    | 2.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -50 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> = 3.0 V                                         | 2.58  | -   | -    | 2.48             | -    | 2.40              | -    | V    |
|                 |                           | I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V                                         | 3.94  | -   | -    | 3.8              | -    | 3.70              | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>                                       |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 2.0 V                                           | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 3.0 V                                           | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 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> = 3.0 V                                          | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
|                 |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V                                          | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                          | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | µA   |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -     | -   | 1.0  | -                | 10   | -                 | 40   | µA   |
| C <sub>I</sub>  | input capacitance         |                                                                                           | -     | 1.5 | 10   | -                | 10   | -                 | 10   | pF   |

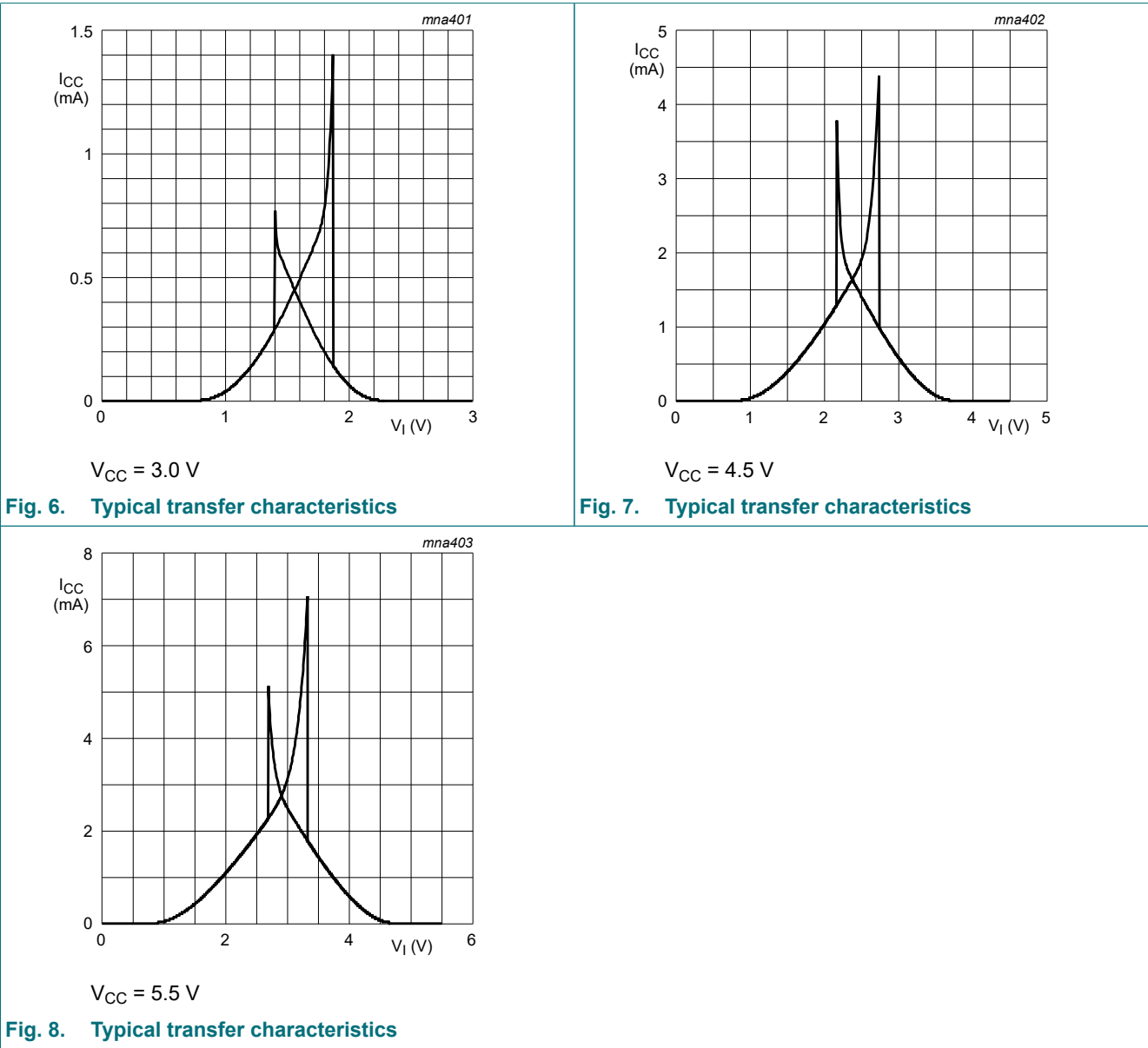
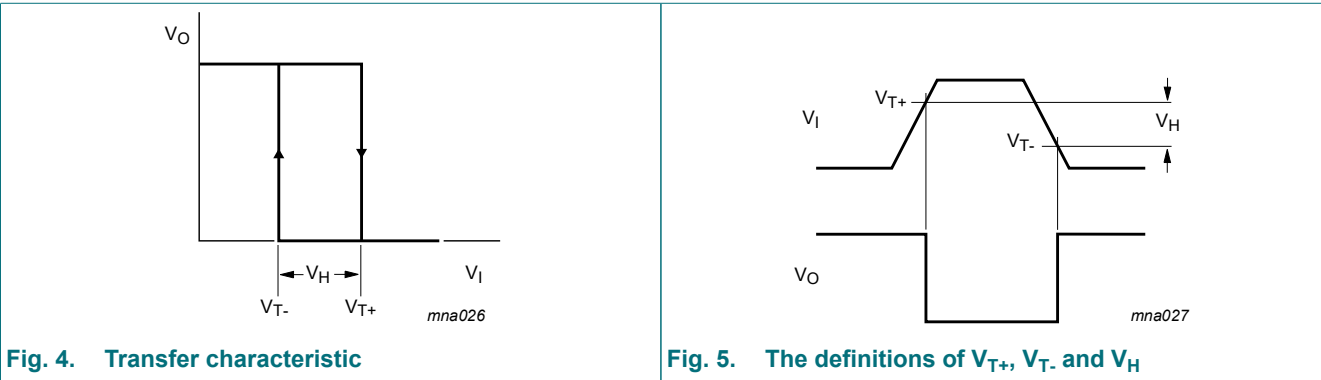
11.1. Transfer characteristics

Table 8. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). See Fig. 4 to Fig. 8.

| Symbol          | Parameter                        | Conditions              | 25 °C |     |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-----------------|----------------------------------|-------------------------|-------|-----|------|------------------|------|-------------------|------|------|
|                 |                                  |                         | Min   | Typ | Max  | Min              | Max  | Min               | Max  |      |
| V <sub>T+</sub> | positive-going threshold voltage | V <sub>CC</sub> = 3.0 V | -     | -   | 2.2  | -                | 2.2  | -                 | 2.2  | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | -     | -   | 3.15 | -                | 3.15 | -                 | 3.15 | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | -     | -   | 3.85 | -                | 3.85 | -                 | 3.85 | V    |
| V <sub>T-</sub> | negative-going threshold voltage | V <sub>CC</sub> = 3.0 V | 0.9   | -   | -    | 0.9              | -    | 0.9               | -    | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | 1.35  | -   | -    | 1.35             | -    | 1.35              | -    | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | 1.65  | -   | -    | 1.65             | -    | 1.65              | -    | V    |
| V <sub>H</sub>  | hysteresis voltage               | V <sub>CC</sub> = 3.0 V | 0.3   | -   | 1.2  | 0.3              | 1.2  | 0.25              | 1.2  | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | 0.4   | -   | 1.4  | 0.4              | 1.4  | 0.35              | 1.4  | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | 0.5   | -   | 1.6  | 0.5              | 1.6  | 0.45              | 1.6  | V    |

11.2. Transfer characteristic waveforms



12. Dynamic characteristics

Table 9. Dynamic characteristics

GND = 0 V; for test circuit see Fig. 10.

| Symbol          | Parameter                     | Conditions                                                                                              | 25 °C |     |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-----------------|-------------------------------|---------------------------------------------------------------------------------------------------------|-------|-----|------|------------------|------|-------------------|------|------|
|                 |                               |                                                                                                         | Min   | Typ | Max  | Min              | Max  | Min               | Max  |      |
| t <sub>pd</sub> | propagation delay             | nA to nY; see Fig. 9 [1]                                                                                |       |     |      |                  |      |                   |      |      |
|                 |                               | V <sub>CC</sub> = 3.0 V to 3.6 V [2]                                                                    |       |     |      |                  |      |                   |      |      |
|                 |                               | C <sub>L</sub> = 15 pF                                                                                  | -     | 4.2 | 12.8 | 1.0              | 15.0 | 1.0               | 16.5 | ns   |
|                 |                               | C <sub>L</sub> = 50 pF                                                                                  | -     | 6.0 | 16.3 | 1.0              | 18.5 | 1.0               | 20.5 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V to 5.5 V [3]                                                                    |       |     |      |                  |      |                   |      |      |
|                 |                               | C <sub>L</sub> = 15 pF                                                                                  | -     | 3.2 | 8.6  | 1.0              | 10.0 | 1.0               | 11.0 | ns   |
|                 |                               | C <sub>L</sub> = 50 pF                                                                                  | -     | 4.6 | 10.6 | 1.0              | 12.0 | 1.0               | 13.5 | ns   |
| C <sub>PD</sub> | power dissipation capacitance | per buffer; C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz; V <sub>i</sub> = GND to V <sub>CC</sub> [4] | -     | 10  | -    | -                | -    | -                 | -    | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.  
[2] Typical values are measured at V<sub>CC</sub> = 3.3 V.  
[3] Typical values are measured at V<sub>CC</sub> = 5.0 V.  
[4] C<sub>PD</sub> is used to determine the dynamic power dissipation P<sub>D</sub> (μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma(C_L \times V_{CC}^2 \times f_o)$  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;  
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

12.1. Waveforms and test circuit

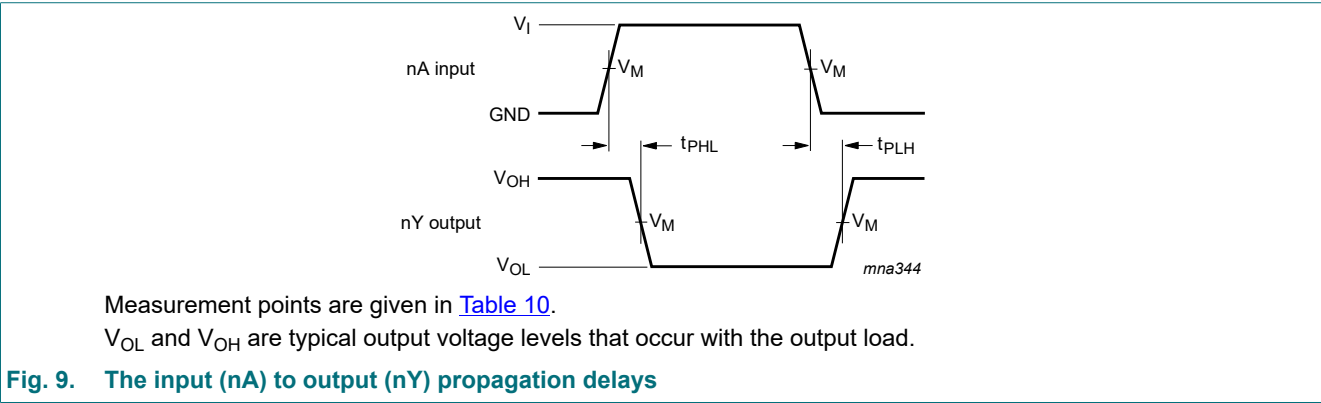
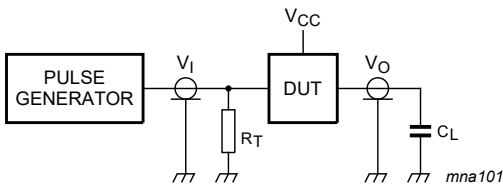


Table 10. Measurement points

| Type number | Input                  |                       | Output                |
|-------------|------------------------|-----------------------|-----------------------|
|             | V <sub>I</sub>         | V <sub>M</sub>        | V <sub>M</sub>        |
| XC7WH14     | GND to V <sub>CC</sub> | 0.5 × V <sub>CC</sub> | 0.5 × V <sub>CC</sub> |



Test data is given in [Table 11](#).  
Definitions for test circuit:  
 $C_L$  = Load capacitance including jig and probe capacitance;  
 $R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

Fig. 10. Test circuit for measuring switching times

Table 11. Test data

| Type    | Input    |                       | Load         | Test               |
|---------|----------|-----------------------|--------------|--------------------|
|         | $V_I$    | $t_r, t_f$            | $C_L$        |                    |
| XC7WH14 | $V_{CC}$ | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

## 13. Application information

The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

$P_{\text{add}} = f_i \times (t_r \times \Delta I_{\text{CC(AV)}} + t_f \times \Delta I_{\text{CC(AV)}}) \times V_{\text{CC}}$  where:

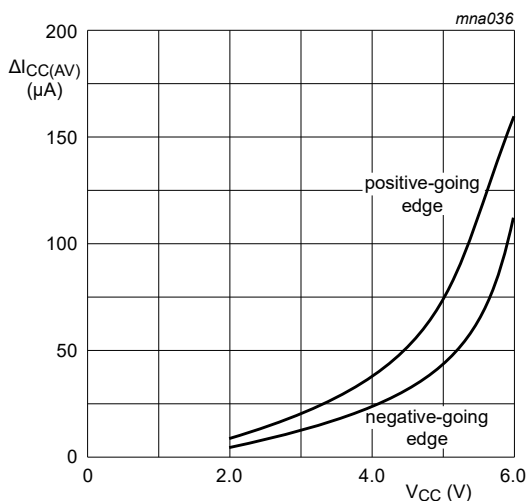
- $P_{\text{add}}$  = additional power dissipation ( $\mu\text{W}$ );
- $f_i$  = input frequency (MHz);
- $t_r$  = input rise time (ns); 10 % to 90 %;
- $t_f$  = input fall time (ns); 90 % to 10 %;
- $\Delta I_{\text{CC(AV)}}$  = average additional supply current ( $\mu\text{A}$ ).

$\Delta I_{\text{CC(AV)}}$  differs with positive or negative input transitions, as shown in Fig. 11.

For XC7WH14 used in relaxation oscillator circuit, see Fig. 12.

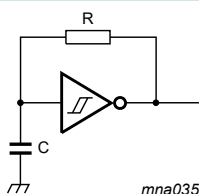
### Note to the application information:

1. All values given are typical unless otherwise specified.



Linear change of  $V_i$  between  $0.1V_{\text{CC}}$  to  $0.9V_{\text{CC}}$

Fig. 11. Average additional  $I_{\text{CC}}$



$$f = \frac{1}{T} \approx \frac{1}{0.55 \times RC}$$

Fig. 12. Relaxation oscillator using the XC7WH14

14. Package outline

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

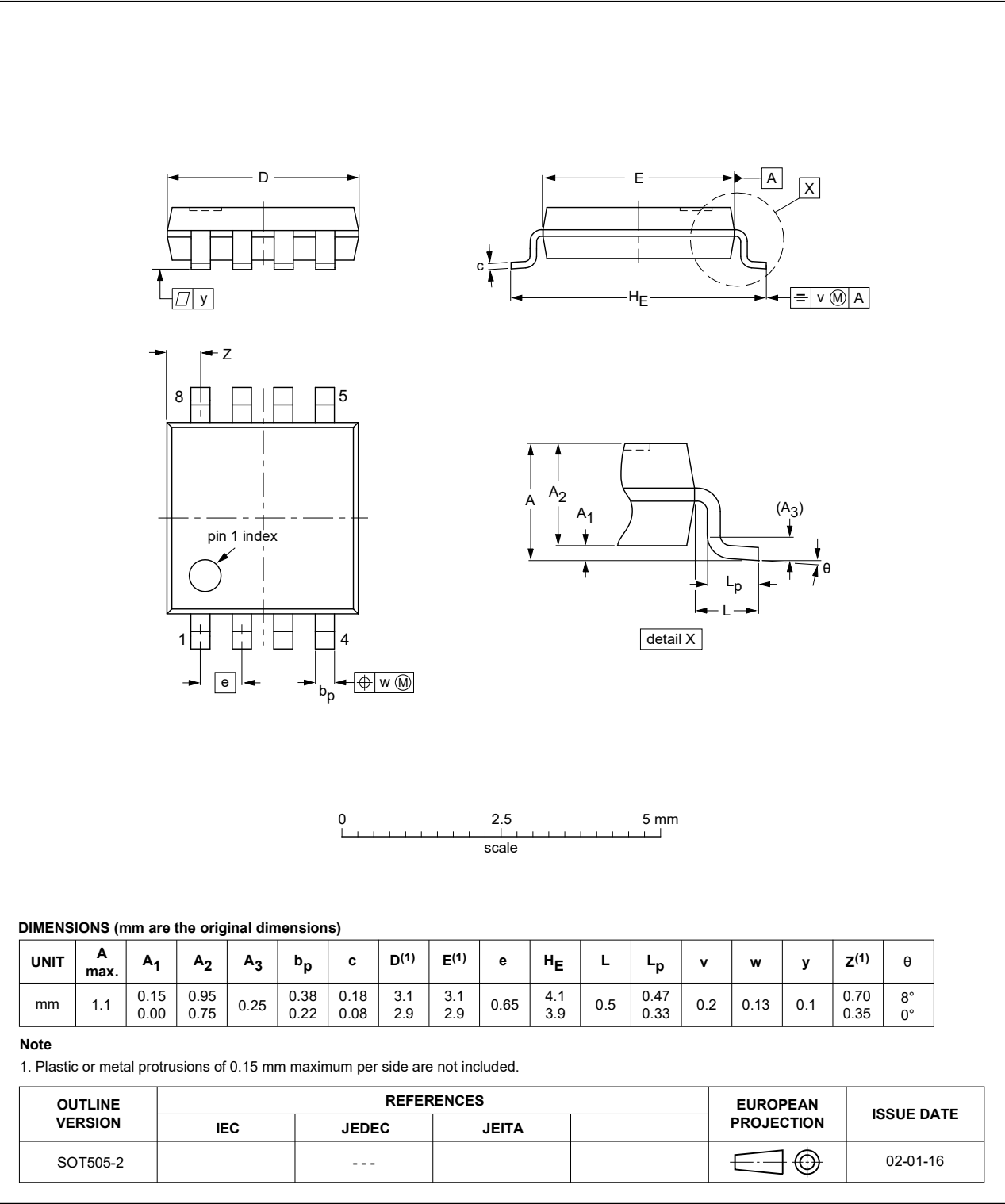


Fig. 13. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

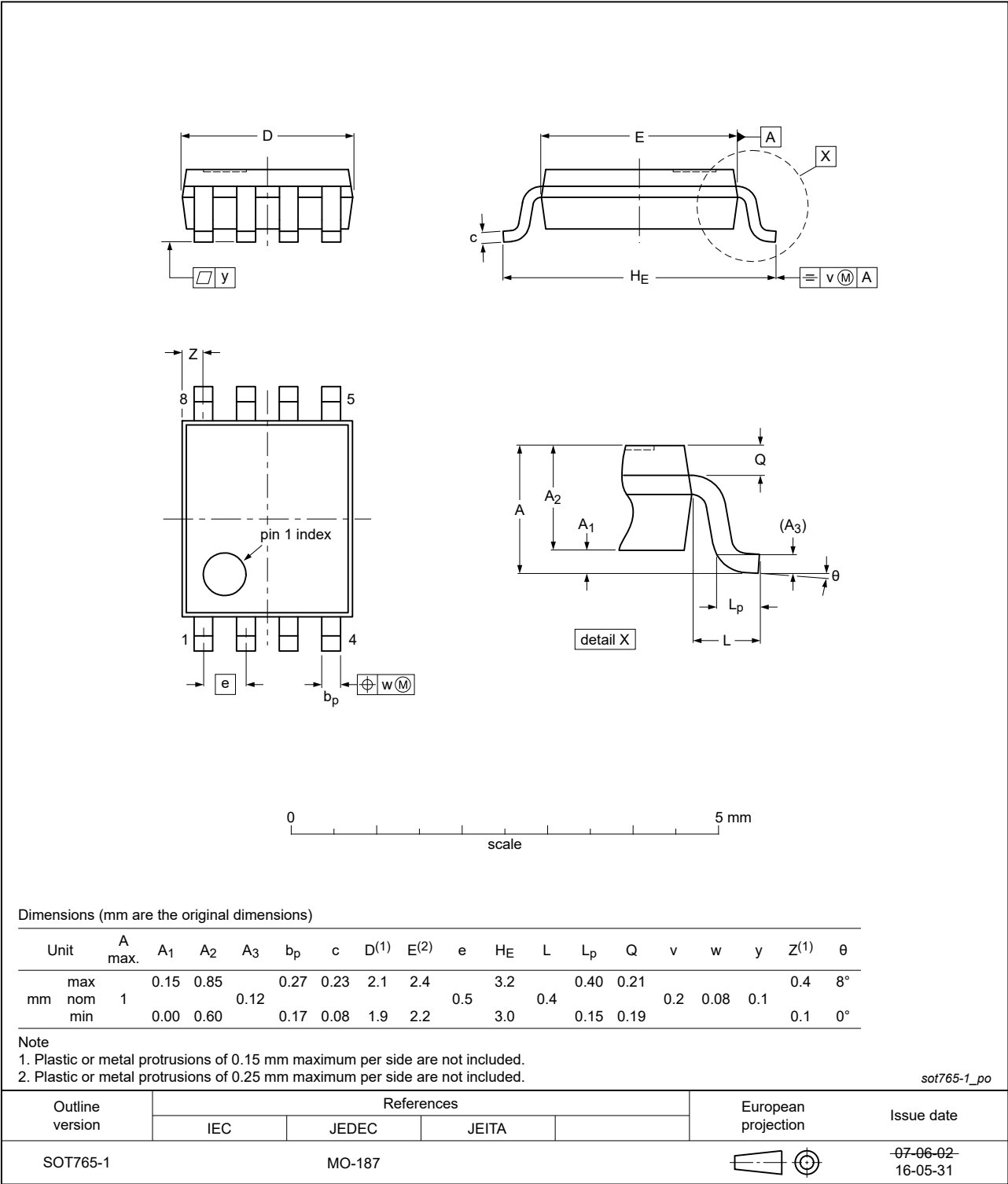


Fig. 14. Package outline SOT765-1 (VSSOP8)

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm

SOT833-1

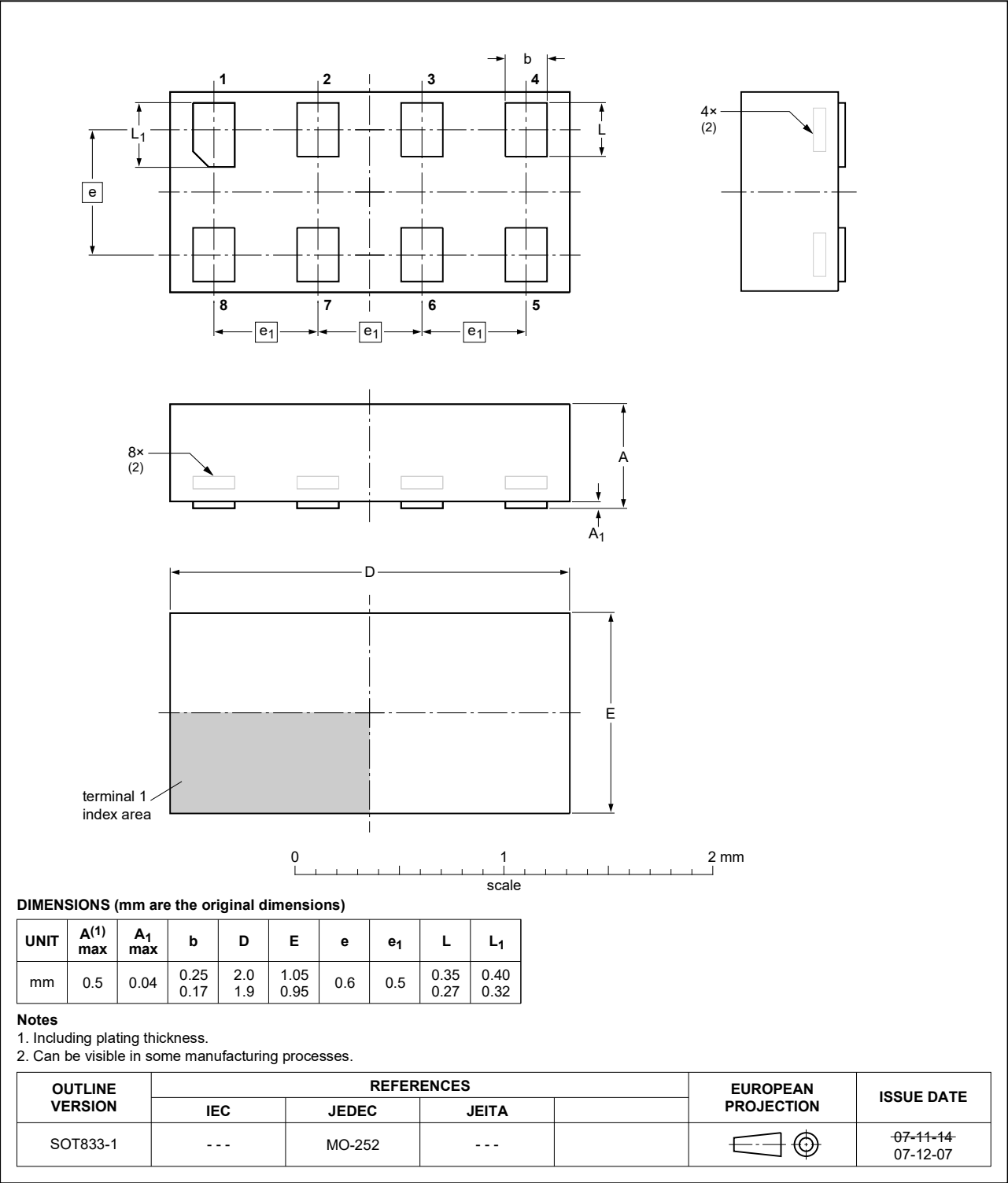


Fig. 15. Package outline SOT833-1 (XSON8)

15. Abbreviations

Table 12. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CDM     | Charged Device Model                    |
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |

16. Revision history

Table 13. Revision history

| Document ID    | Release date                                                                                                                                                                                                                                                                                                                                                 | Data sheet status  | Change notice | Supersedes  |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------|
| XC7WH14 v.7    | 20240103                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.6 |
| Modifications: | <ul style="list-style-type: none"><li>Section 2: ESD specification updated according to the latest JEDEC standard.</li><li>Section 9: Derating values for P<sub>tot</sub> total power dissipation updated.</li></ul>                                                                                                                                         |                    |               |             |
| XC7WH14 v.6    | 20190222                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.5 |
| Modifications: | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li>Type number XC7WH14GD (SOT996-2 / (XSON8) removed.</li><li>Fig. 14: package outline drawing SOT765-1 changed.</li></ul> |                    |               |             |
| XC7WH14 v.5    | 20130207                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.4 |
| Modifications: | <ul style="list-style-type: none"><li>For type number XC7WH14GD XSON8U has changed to XSON8.</li></ul>                                                                                                                                                                                                                                                       |                    |               |             |
| XC7WH14 v.4    | 20111103                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.3 |
| XC7WH14 v.3    | 20101118                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.2 |
| XC7WH14 v.2    | 20101021                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | XC7WH14 v.1 |
| XC7WH14 v.1    | 20090907                                                                                                                                                                                                                                                                                                                                                     | Product data sheet | -             | -           |

## 17. 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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Contents

1. General description..... 1

2. Features and benefits..... 1

3. Applications..... 1

4. Ordering information..... 1

5. Marking..... 2

6. Functional diagram..... 2

7. Pinning information..... 2

7.1. Pinning..... 2

7.2. Pin description..... 3

8. Functional description..... 3

9. Limiting values..... 3

10. Recommended operating conditions..... 3

11. Static characteristics..... 4

11.1. Transfer characteristics..... 4

11.2. Transfer characteristic waveforms..... 5

12. Dynamic characteristics..... 6

12.1. Waveforms and test circuit..... 6

13. Application information..... 8

14. Package outline..... 9

15. Abbreviations..... 12

16. Revision history..... 12

17. Legal information..... 13

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Date of release: 3 January 2024