

# 74ALVC541

Octal buffer/line driver; 3-state

Rev. 3 — 20 January 2014

Product data sheet

## 1. General description

The 74ALVC541 is an octal non-inverting buffer/line drivers with 3-state bus compatible outputs. The 3-state outputs are controlled by the output enable inputs  $\overline{OE}0$  and  $\overline{OE}1$ . A HIGH on  $\overline{OE}n$  causes the outputs to assume a high-impedance OFF-state.

## 2. Features and benefits

- Wide supply voltage range from 1.65 V to 3.6 V
- Complies with JEDEC standard:
  - ◆ JESD8-7 (1.65 V to 1.95 V)
  - ◆ JESD8-5 (2.3 V to 2.5 V)
  - ◆ JESD8B/JESD36 (2.7 V to 3.6 V)
- 3.6 V tolerant inputs/outputs
- CMOS LOW power consumption
- Direct interface with TTL levels (2.7 V to 3.6 V)
- Power-down mode
- Latch-up performance exceeds 250 mA
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

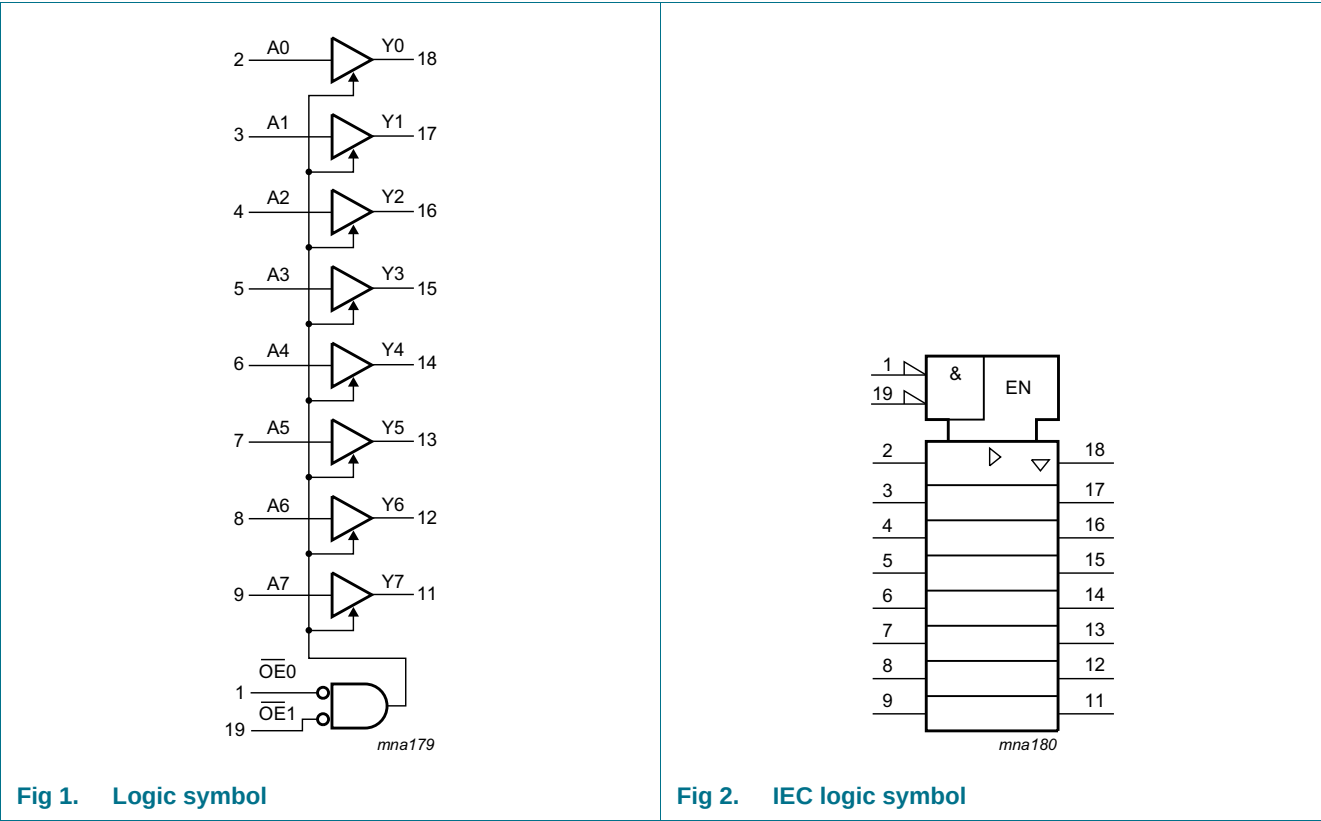
## 3. Ordering information

Table 1. Ordering information

| Type number | Package           |          |                                                                                                                                     |          |
|-------------|-------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range | Name     | Description                                                                                                                         | Version  |
| 74ALVC541D  | −40 °C to +85 °C  | SO20     | plastic small outline package; 20 leads;<br>body width 7.5 mm                                                                       | SOT163-1 |
| 74ALVC541PW | −40 °C to +85 °C  | TSSOP20  | plastic thin shrink small outline package; 20 leads;<br>body width 4.4 mm                                                           | SOT360-1 |
| 74ALVC541BQ | −40 °C to +85 °C  | DHVQFN20 | plastic dual-in-line compatible thermal enhanced<br>very thin quad flat package no leads; 20 terminals;<br>body 2.5 × 4.5 × 0.85 mm | SOT764-1 |

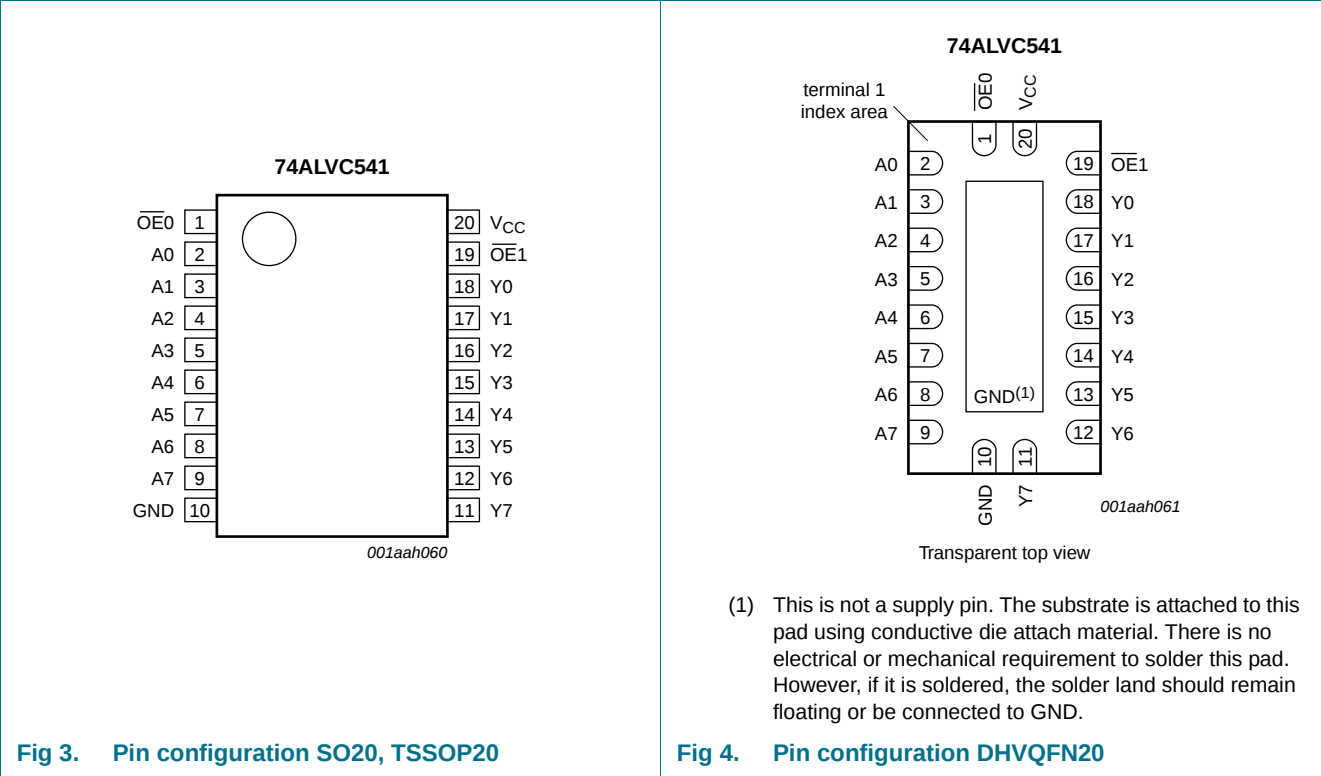


4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

| Table 2. Pin description |                                |                                  |
|--------------------------|--------------------------------|----------------------------------|
| Symbol                   | Pin                            | Description                      |
| OE0                      | 1                              | output enable input (active LOW) |
| A[0:7]                   | 2, 3, 4, 5, 6, 7, 8, 9         | data input                       |
| GND                      | 10                             | ground (0 V)                     |
| Y[0:7]                   | 18, 17, 16, 15, 14, 13, 12, 11 | data output                      |
| OE1                      | 19                             | output enable input (active LOW) |
| VCC                      | 20                             | supply voltage                   |

## 6. Functional description

Table 3. Functional table<sup>[1]</sup>

| Control |     | Input | Output |
|---------|-----|-------|--------|
| OE0     | OE1 | An    | Yn     |
| L       | L   | L     | L      |
| L       | L   | H     | H      |
| X       | H   | X     | Z      |
| H       | X   | X     | Z      |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

## 7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol    | Parameter               | Conditions                      | Min      | Max            | Unit |
|-----------|-------------------------|---------------------------------|----------|----------------|------|
| $V_{CC}$  | supply voltage          |                                 | -0.5     | +4.6           | V    |
| $V_I$     | input voltage           |                                 | -0.5     | +4.6           | V    |
| $I_{IK}$  | input clamping current  | $V_I < 0$ V                     | [1] -50  | -              | mA   |
| $I_{OK}$  | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V   | -        | ±50            | mA   |
| $V_O$     | output voltage          | output HIGH or LOW state        | [2] -0.5 | $V_{CC} + 0.5$ | V    |
|           |                         | output 3-state                  | [2] -0.5 | +4.6           | V    |
|           |                         | power-down mode, $V_{CC} = 0$ V | [3] -0.5 | +4.6           | V    |
| $I_O$     | output current          | $V_O = 0$ V to $V_{CC}$         | -        | ±50            | mA   |
| $I_{CC}$  | supply current          |                                 | -        | 100            | mA   |
| $I_{GND}$ | ground current          |                                 | -100     | -              | mA   |
| $T_{stg}$ | storage temperature     |                                 | -65      | +150           | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +85 °C    |          |                |      |
|           | SO20 package            |                                 | [4] -    | 500            | mW   |
|           | TSSOP20 package         |                                 | [5] -    | 500            | mW   |
|           | DHVQFN20 package        |                                 | [6] -    | 500            | mW   |

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] When  $V_{CC} = 0$  V (Power-down mode), the output voltage can be 3.6 V in normal operation.

[4]  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[5]  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

[6]  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions                      | Min  | Max      | Unit |
|---------------------|-------------------------------------|---------------------------------|------|----------|------|
| $V_{CC}$            | supply voltage                      |                                 | 1.65 | 3.6      | V    |
| $V_I$               | input voltage                       |                                 | 0    | 3.6      | V    |
| $V_O$               | output voltage                      | output HIGH or LOW state        | 0    | $V_{CC}$ | V    |
|                     |                                     | output 3-state                  | 0    | 3.6      | V    |
|                     |                                     | power-down mode, $V_{CC} = 0$ V | 0    | 3.6      | V    |
| $T_{amb}$           | ambient temperature                 |                                 | -40  | +85      | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65$ V to 2.7 V      | -    | 20       | ns/V |
|                     |                                     | $V_{CC} = 2.7$ V to 3.6 V       | -    | 10       | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol   | Parameter                 | Conditions                                                              | $T_{amb} = -40$ °C to +85 °C |                    |                      | Unit    |
|----------|---------------------------|-------------------------------------------------------------------------|------------------------------|--------------------|----------------------|---------|
|          |                           |                                                                         | Min                          | Typ <sup>[1]</sup> | Max                  |         |
| $V_{IH}$ | HIGH-level input voltage  | $V_{CC} = 1.65$ V to 1.95 V                                             | $0.65 \times V_{CC}$         | -                  | -                    | V       |
|          |                           | $V_{CC} = 2.3$ V to 2.7V                                                | 1.7                          | -                  | -                    | V       |
|          |                           | $V_{CC} = 2.7$ V to 3.6 V                                               | 2.0                          | -                  | -                    | V       |
| $V_{IL}$ | LOW-level input voltage   | $V_{CC} = 1.65$ V to 1.95 V                                             | -                            | -                  | $0.35 \times V_{CC}$ | V       |
|          |                           | $V_{CC} = 2.3$ V to 2.7V                                                | -                            | -                  | 0.7                  | V       |
|          |                           | $V_{CC} = 2.7$ V to 3.6 V                                               | -                            | -                  | 0.8                  | V       |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$                                              |                              |                    |                      |         |
|          |                           | $I_O = 100$ $\mu$ A; $V_{CC} = 1.65$ V to 3.6 V                         | $\zeta_{XX}-0.2$             | -                  | -                    | V       |
|          |                           | $I_O = 6$ mA; $V_{CC} = 1.65$ V                                         | 1.25                         | -                  | -                    | V       |
|          |                           | $I_O = 12$ mA; $V_{CC} = 2.3$ V                                         | 1.8                          | -                  | -                    | V       |
|          |                           | $I_O = 18$ mA; $V_{CC} = 2.3$ V                                         | 1.7                          | -                  | -                    | V       |
|          |                           | $I_O = 12$ mA; $V_{CC} = 2.7$ V                                         | 2.2                          | -                  | -                    | V       |
|          |                           | $I_O = 18$ mA; $V_{CC} = 3.0$ V                                         | 2.4                          | -                  | -                    | V       |
|          |                           | $I_O = 24$ mA; $V_{CC} = 3.0$ V                                         | 2.2                          | -                  | -                    | V       |
| $V_{OL}$ | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$                                              |                              |                    |                      |         |
|          |                           | $I_O = -100$ $\mu$ A; $V_{CC} = 1.65$ V to 3.6 V                        | -                            | -                  | 0.2                  | V       |
|          |                           | $I_O = -6$ mA; $V_{CC} = 1.65$ V                                        | -                            | -                  | 0.3                  | V       |
|          |                           | $I_O = -12$ mA; $V_{CC} = 2.3$ V                                        | -                            | -                  | 0.4                  | V       |
|          |                           | $I_O = -18$ mA; $V_{CC} = 2.3$ V                                        | -                            | -                  | 0.6                  | V       |
|          |                           | $I_O = -12$ mA; $V_{CC} = 2.7$ V                                        | -                            | -                  | 0.4                  | V       |
|          |                           | $I_O = -18$ mA; $V_{CC} = 3.0$ V                                        | -                            | -                  | 0.4                  | V       |
|          |                           | $I_O = -24$ mA; $V_{CC} = 3.0$ V                                        | -                            | -                  | 0.55                 | V       |
| $I_{OZ}$ | OFF-state output current  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND;<br>$V_{CC} = 3.6$ V | -                            | $\pm 0.1$          | $\pm 10.0$           | $\mu$ A |

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

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

| Symbol           | Parameter                 | Conditions                                                                                                          | T <sub>amb</sub> = -40 °C to +85 °C |                    |       | Unit |
|------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------|-------|------|
|                  |                           |                                                                                                                     | Min                                 | Typ <sup>[1]</sup> | Max   |      |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.6 V                                                    | -                                   | ±0.1               | ±5.0  | μA   |
| I <sub>OFF</sub> | power-off leakage current | V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 0 V                                              | -                                   | ±0.1               | ±10.0 | 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> = 3.6 V                              | -                                   | 0.2                | 10    | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V;<br>V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; | -                                   | 5                  | 750   | μA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                     | -                                   | 3.5                | -     | pF   |

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7.** Dynamic characteristicsVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#).

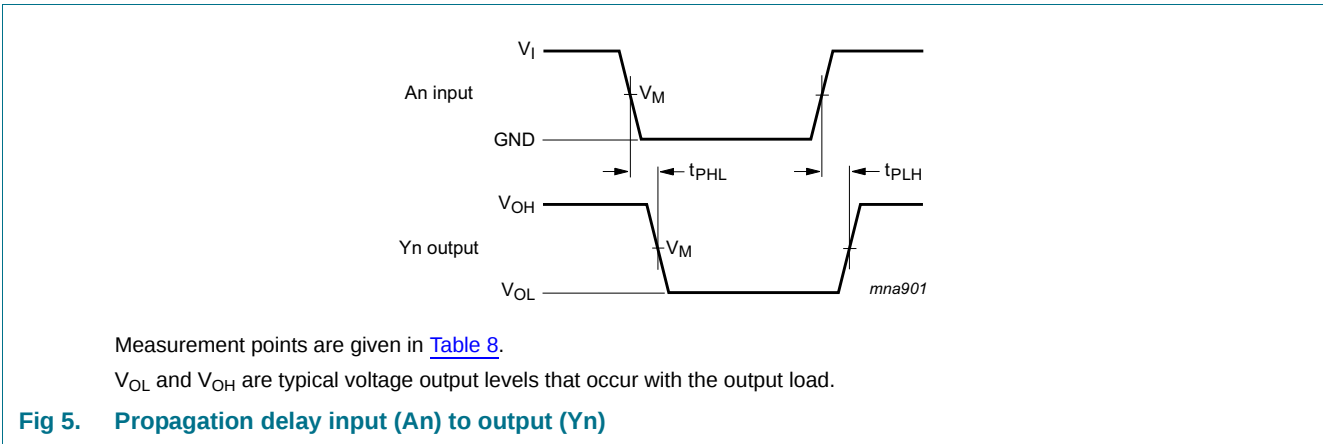
| Symbol           | Parameter         | Conditions                                                                 | T <sub>amb</sub> = -40 °C to +85 °C |                    |     | Unit |
|------------------|-------------------|----------------------------------------------------------------------------|-------------------------------------|--------------------|-----|------|
|                  |                   |                                                                            | Min                                 | Typ <sup>[1]</sup> | Max |      |
| t <sub>pd</sub>  | propagation delay | An to Yn; see <a href="#">Figure 5</a> <sup>[2]</sup>                      |                                     |                    |     |      |
|                  |                   | V <sub>CC</sub> = 1.65V to 1.95 V                                          | 1.0                                 | 3.0                | 4.6 | ns   |
|                  |                   | V <sub>CC</sub> = 2.3V to 2.7 V                                            | 1.0                                 | 2.2                | 3.3 | ns   |
|                  |                   | V <sub>CC</sub> = 27 V                                                     | 1.0                                 | 2.5                | 3.3 | ns   |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                           | 1.0                                 | 2.3                | 3.0 | ns   |
| t <sub>en</sub>  | enable time       | $\overline{\text{OEn}}$ to Yn; see <a href="#">Figure 6</a> <sup>[2]</sup> |                                     |                    |     |      |
|                  |                   | V <sub>CC</sub> = 1.65V to 1.95 V                                          | 1.0                                 | 4.2                | 7.5 | ns   |
|                  |                   | V <sub>CC</sub> = 2.3V to 2.7 V                                            | 1.0                                 | 3.3                | 5.4 | ns   |
|                  |                   | V <sub>CC</sub> = 27 V                                                     | 1.0                                 | 3.7                | 5.8 | ns   |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                           | 1.0                                 | 3.3                | 4.9 | ns   |
| t <sub>dis</sub> | disable time      | $\overline{\text{OEn}}$ to Yn; see <a href="#">Figure 6</a> <sup>[2]</sup> |                                     |                    |     |      |
|                  |                   | V <sub>CC</sub> = 1.65V to 1.95 V                                          | 1.0                                 | 4.8                | 7.5 | ns   |
|                  |                   | V <sub>CC</sub> = 2.3V to 2.7 V                                            | 1.0                                 | 3.1                | 4.5 | ns   |
|                  |                   | V <sub>CC</sub> = 27 V                                                     | 1.0                                 | 3.1                | 4.8 | ns   |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                           | 1.0                                 | 2.9                | 4.6 | ns   |

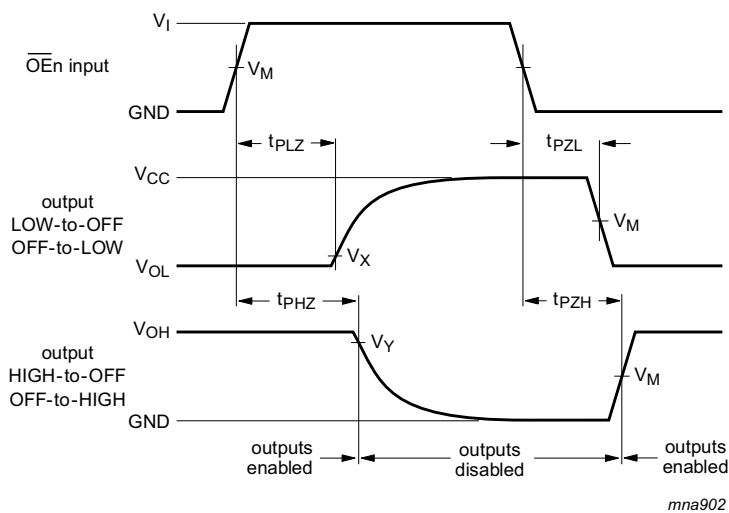
**Table 7. Dynamic characteristics ...continued**  
Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#).

| Symbol          | Parameter                     | Conditions                                                                                   | T <sub>amb</sub> = -40 °C to +85 °C |                    |     | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------|-------------------------------------|--------------------|-----|------|
|                 |                               |                                                                                              | Min                                 | Typ <sup>[1]</sup> | Max |      |
| C <sub>PD</sub> | power dissipation capacitance | per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 3.3 V <sup>[3]</sup> |                                     |                    |     |      |
|                 |                               | outputs enabled                                                                              | -                                   | 25                 | -   | pF   |
|                 |                               | outputs disabled                                                                             | -                                   | 0                  | -   | pF   |

- [1] All typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.8 V, 2.5 V, 2.7 V and 3.3 V.
- [2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.  
t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.  
t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<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;  
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

11. Waveforms



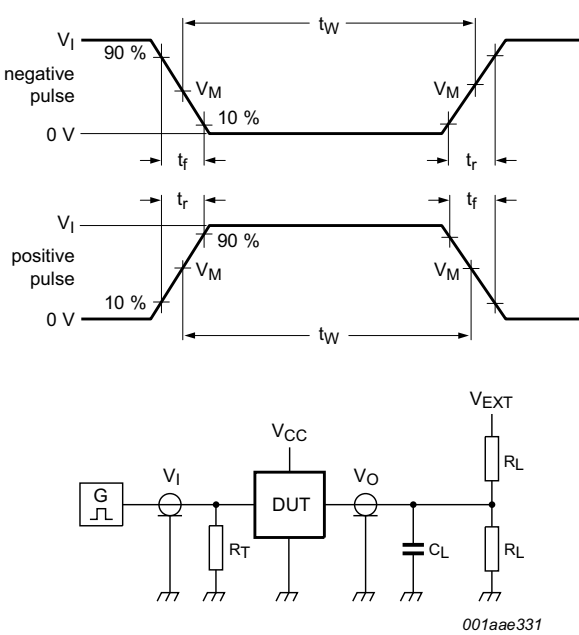


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 6. Enable and disable times

Table 8. Measurement points

| Supply voltage  | Input    |                     | Output              |                           |                           |
|-----------------|----------|---------------------|---------------------|---------------------------|---------------------------|
| $V_{CC}$        | $V_I$    | $V_M$               | $V_M$               | $V_X$                     | $V_Y$                     |
| 1.65 V to 1.65V | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.3 V to 2.7 V  | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.7 V           | 2.7 V    | 1.5 V               | 1.5 V               | $V_{OL} + 0.3 \text{ V}$  | $V_{OH} - 0.3 \text{ V}$  |
| 3.0 V to 3.6 V  | 2.7 V    | 1.5 V               | 1.5 V               | $V_{OL} + 0.3 \text{ V}$  | $V_{OH} - 0.3 \text{ V}$  |



Test data is given in [Table 9](#).

Definitions test circuit:

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

$C_L$  = Load capacitance including jig and probe capacitance

$R_L$  = Load resistor

Fig 7. Test circuit for measuring switching times

Table 9. Test data

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

12. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1

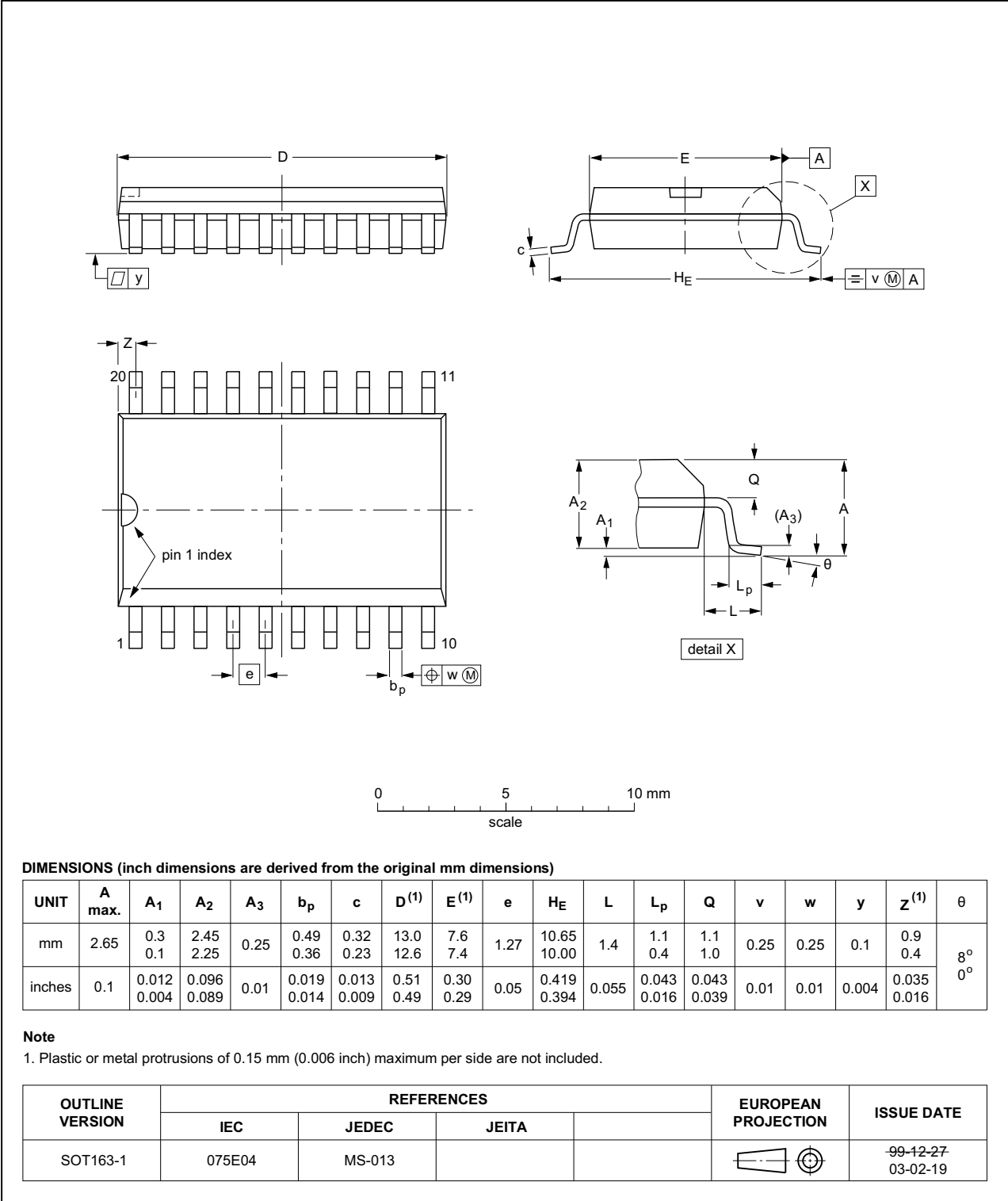


Fig 8. Package outline SOT163-1 (SO20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

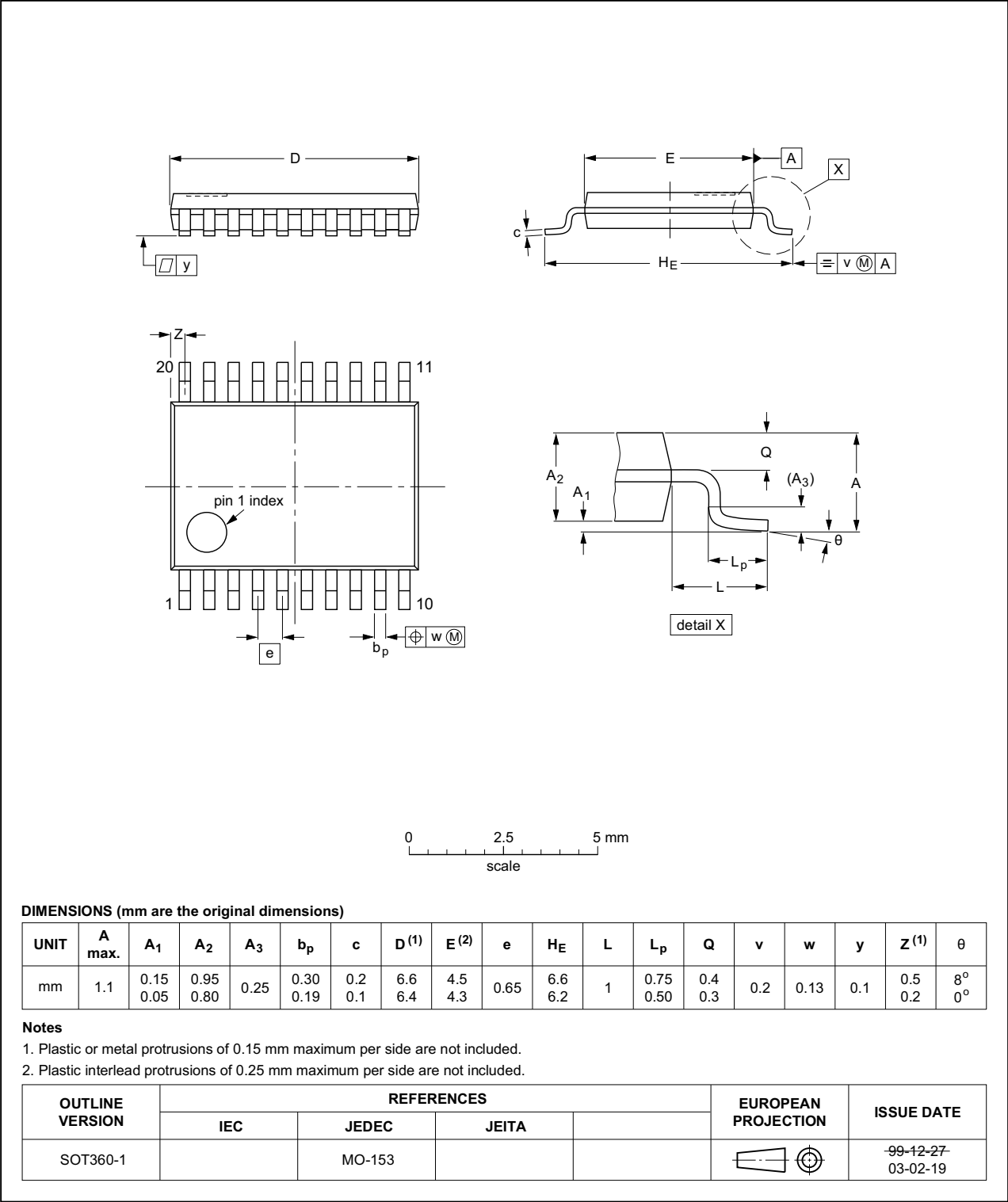


Fig 9. Package outline SOT360-1 (TSSOP20)

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm SOT764-1

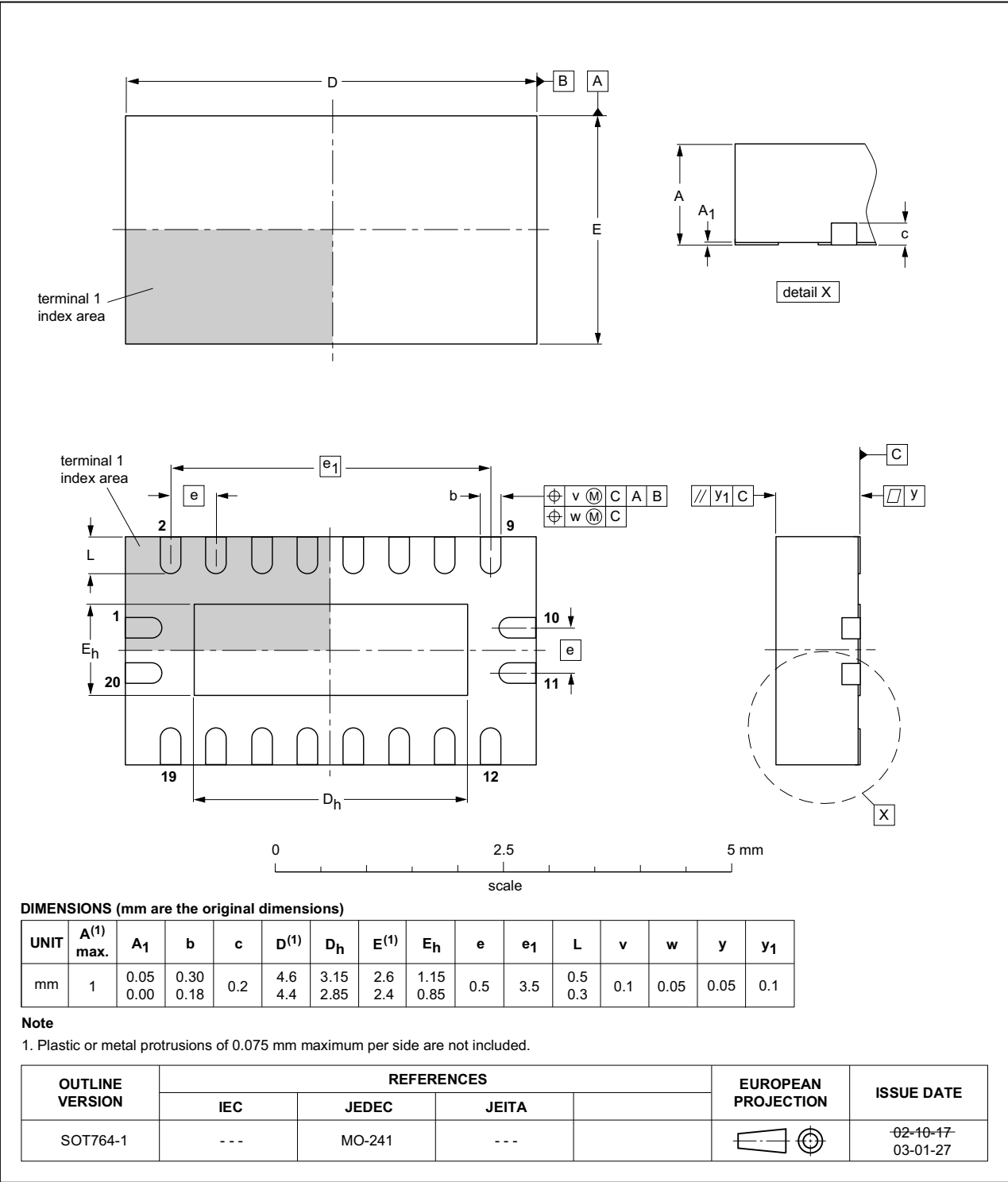


Fig 10. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

Table 10. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CDM     | Charge Device Model                     |
| CMOS    | Complementary Metal Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 14. Revision history

Table 11. Revision history

| Document ID   | Release date                                                                                                                                                                                                                                         | Data sheet status     | Change notice | Supersedes    |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|---------------|
| 74ALVC541 v.3 | 20140120                                                                                                                                                                                                                                             | Product data sheet    | -             | 74ALVC541 v.2 |
|               | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>Legal texts have been adapted to the new company name where appropriate.</li></ul> |                       |               |               |
| 74ALVC541 v.2 | 20071210                                                                                                                                                                                                                                             | Product data sheet    | -             | 74ALVC541 v.1 |
| 74ALVC541 v.1 | 20021115                                                                                                                                                                                                                                             | Product specification | -             | -             |

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

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