# 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 $\overline{OE0}$ and $\overline{OE1}$. 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; body width 7.5 mm | SOT163-1 |
| 74ALVC541PW | −40 °C to +85 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| 74ALVC541BQ | −40 °C to +85 °C | DHVQFN20 | plastic dual-in-line compatible thermal enhanced very thin quad flat package no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm | SOT764-1 |

## 4. Functional diagram

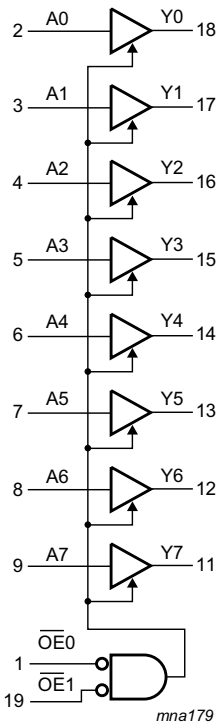



Fig 1. Logic symbol

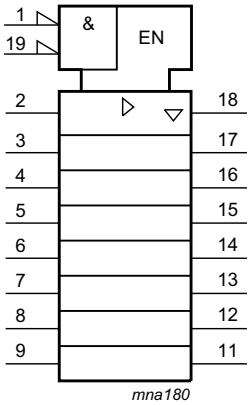



Fig 2. IEC logic symbol

# 5. Pinning information

## 5.1 Pinning

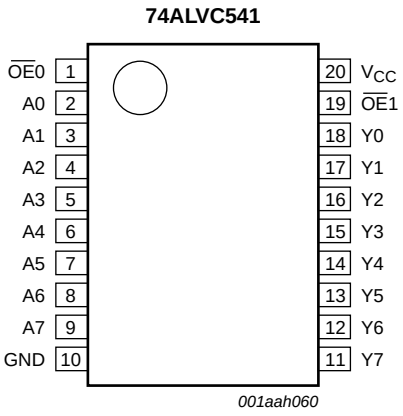
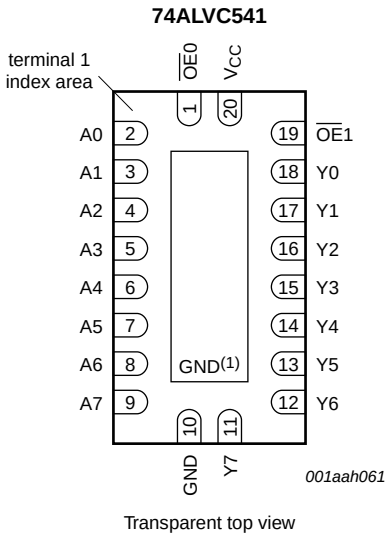



Fig 3. Pin configuration SO20, TSSOP20




Transparent top view

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 4. Pin configuration DHVQFN20

## 5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|---|---|---|
| $\overline{OE}0$ | 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 |
| $\overline{OE}1$ | 19 | output enable input (active LOW) |
| $V_{CC}$ | 20 | supply voltage |

# 6. Functional description

**Table 3. Functional table[1]**

| Control | | Input | Output |
|---|---|---|---|
| $\overline{OE0}$ | $\overline{OE1}$ | 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[1] | Max | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 1.65 V to 1.95 V | 0.65 × $V_{CC}$ | - | - | 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 × $V_{CC}$ | 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 μA; $V_{CC}$ = 1.65 V to 3.6 V | çXX–0.2 | - | - | V |
| | | $I_O$ = 6mA ; $V_{CC}$ = 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 μA; $V_{CC}$ = 1.65 V to 3.6 V | - | - | 0.2 | V |
| | | $I_O$ = –6mA ; $V_{CC}$ = 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; $V_{CC}$ = 3.6 V | - | ±0.1 | ±10.0 | μA |

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

*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[1] | Max | |
| $I_I$ | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC}$ = 3.6 V | - | ±0.1 | ±5.0 | µA |
| $I_{OFF}$ | power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V | - | ±0.1 | ±10.0 | µA |
| $I_{CC}$ | supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 3.6 V | - | 0.2 | 10 | µA |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_{CC}$ = 3.0 V to 3.6 V; $V_I = V_{CC} - 0.6$ V; $I_O$ = 0 A; | - | 5 | 750 | µA |
| $C_I$ | input capacitance | | - | 3.5 | - | pF |

[1] All typical values are measured at $V_{CC}$ = 3.3 V and Tamb = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

| Symbol | Parameter | Conditions | | $T_{amb}$ = –40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[1] | Max | |
| $t_{pd}$ | propagation delay | An to Yn; see Figure 5 | [2] | | | | |
| | | $V_{CC}$ = 1.65V to 1.95 V | | 1.0 | 3.0 | 4.6 | ns |
| | | $V_{CC}$ = 2.3V to 2.7 V | | 1.0 | 2.2 | 3.3 | ns |
| | | $V_{CC}$ = 27 V | | 1.0 | 2.5 | 3.3 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.0 | 2.3 | 3.0 | ns |
| $t_{en}$ | enable time | $\overline{OE}$n to Yn; see Figure 6 | [2] | | | | |
| | | $V_{CC}$ = 1.65V to 1.95 V | | 1.0 | 4.2 | 7.5 | ns |
| | | $V_{CC}$ = 2.3V to 2.7 V | | 1.0 | 3.3 | 5.4 | ns |
| | | $V_{CC}$ = 27 V | | 1.0 | 3.7 | 5.8 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.0 | 3.3 | 4.9 | ns |
| $t_{dis}$ | disable time | $\overline{OE}$n to Yn; see Figure 6 | [2] | | | | |
| | | $V_{CC}$ = 1.65V to 1.95 V | | 1.0 | 4.8 | 7.5 | ns |
| | | $V_{CC}$ = 2.3V to 2.7 V | | 1.0 | 3.1 | 4.5 | ns |
| | | $V_{CC}$ = 27 V | | 1.0 | 3.1 | 4.8 | ns |
| | | $V_{CC}$ = 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.*

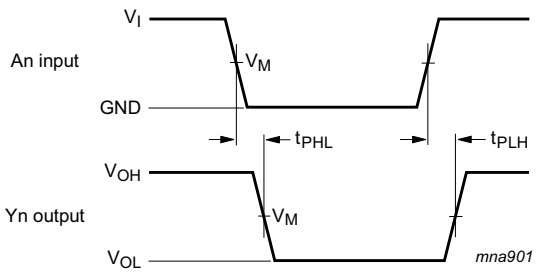
| Symbol | Parameter | Conditions | $T_{amb}$ = –40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | |
| $C_{PD}$ | power dissipation capacitance | per buffer; $V_I$ = GND to $V_{CC}$; $V_{CC}$ = 3.3 V [3] | | | | |
| | | outputs enabled | - | 25 | - | pF |
| | | outputs disabled | - | 0 | - | pF |

[1] All typical values are measured at Tamb = 25 °C and $V_{CC}$ = 1.8 V, 2.5 V, 2.7 V and 3.3 V.

[2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.
$t_{en}$ is the same as $t_{PZL}$ and $t_{PZH}$.
$t_{dis}$ is the same as $t_{PLZ}$ and $t_{PHZ}$.

[3] $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
$f_i$ = input frequency in MHz;
$f_o$ = output frequency in MHz;
$C_L$ = output load capacitance in pF;
$V_{CC}$ = supply voltage in V;
N = number of inputs switching;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

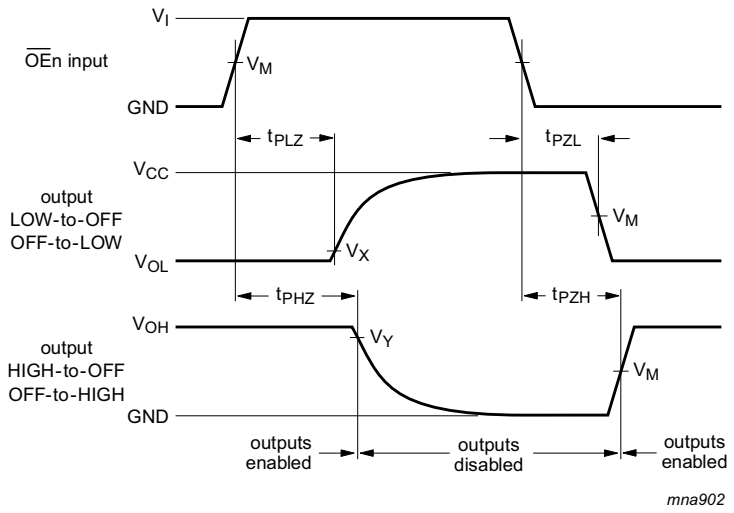
## 11. Waveforms




Measurement points are given in Table 8.

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

**Fig 5. Propagation delay input (An) to output (Yn)**



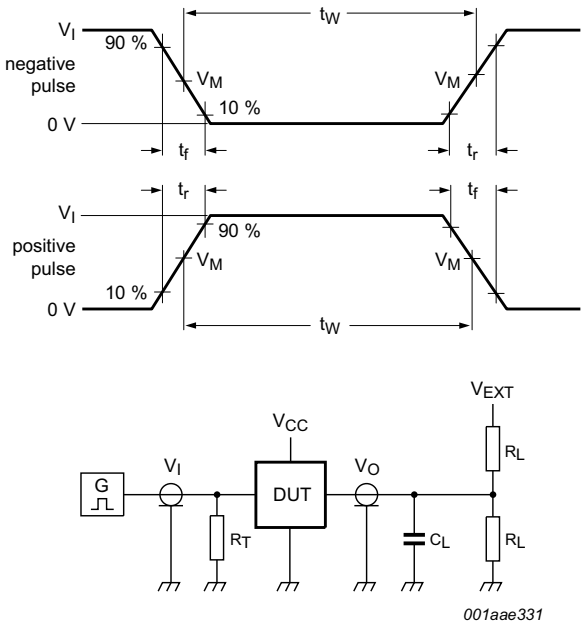

Measurement points are given in Table 8.

$V_{OL}$ 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 V | $V_{OH}$ − 0.15 V |
| 2.3 V to 2.7 V | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL}$ + 0.15 V | $V_{OH}$ − 0.15 V |
| 2.7 V | 2.7 V | 1.5 V | 1.5 V | $V_{OL}$ + 0.3 V | $V_{OH}$ − 0.3 V |
| 3.0 V to 3.6 V | 2.7 V | 1.5 V | 1.5 V | $V_{OL}$ + 0.3 V | $V_{OH}$ − 0.3 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

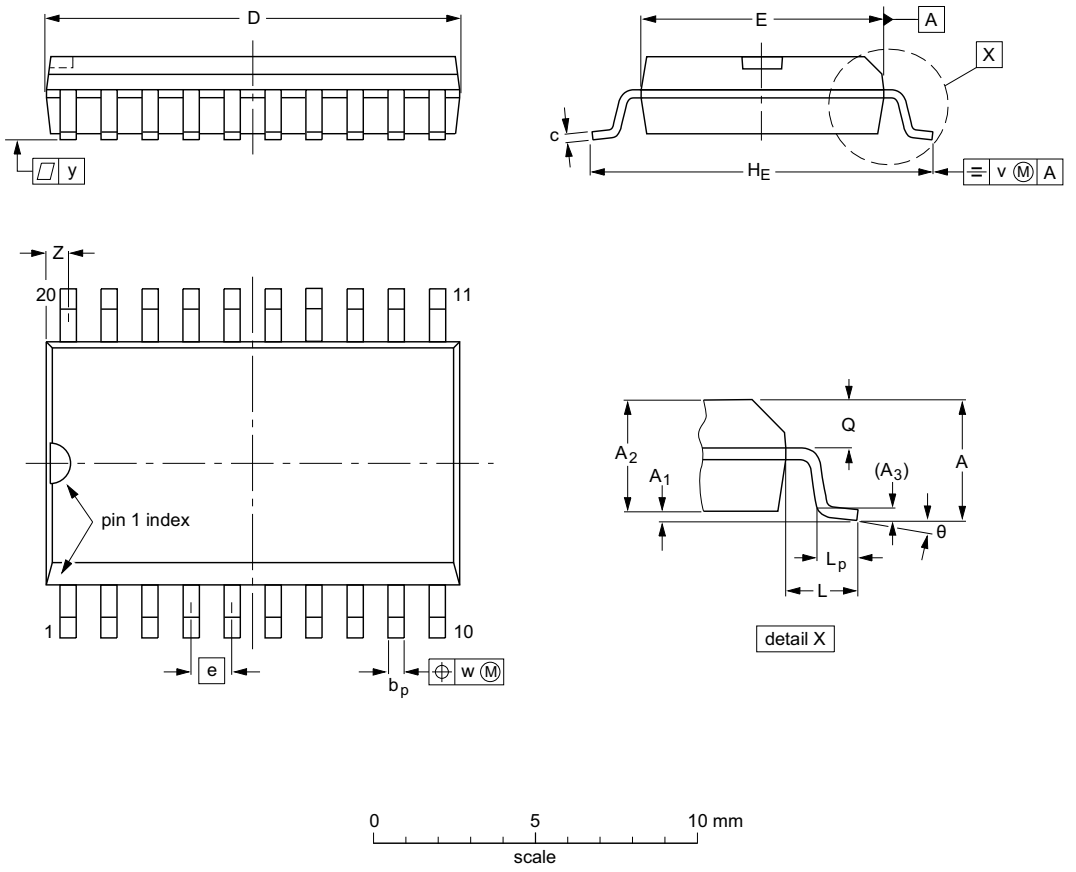
**Fig 7. Test circuit for measuring switching times**

**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 | $V_{CC}$ | ≤ 2.0 ns | 30 pF | 1 kΩ | open | 2 × $V_{CC}$ | GND |
| 2.3 V to 2.7 V | $V_{CC}$ | ≤ 2.0 ns | 30 pF | 500 Ω | open | 2 × $V_{CC}$ | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 6 | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 6 | GND |

## 12. Package outline

**SO20: plastic small outline package; 20 leads; body width 7.5 mm** **SOT163-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (1) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.65 | 0.3<br>0.1 | 2.45<br>2.25 | 0.25 | 0.49<br>0.36 | 0.32<br>0.23 | 13.0<br>12.6 | 7.6<br>7.4 | 1.27 | 10.65<br>10.00 | 1.4 | 1.1<br>0.4 | 1.1<br>1.0 | 0.25 | 0.25 | 0.1 | 0.9<br>0.4 | 8°<br>0° |
| inches | 0.1 | 0.012<br>0.004 | 0.096<br>0.089 | 0.01 | 0.019<br>0.014 | 0.013<br>0.009 | 0.51<br>0.49 | 0.30<br>0.29 | 0.05 | 0.419<br>0.394 | 0.055 | 0.043<br>0.016 | 0.043<br>0.039 | 0.01 | 0.01 | 0.004 | 0.035<br>0.016 | |

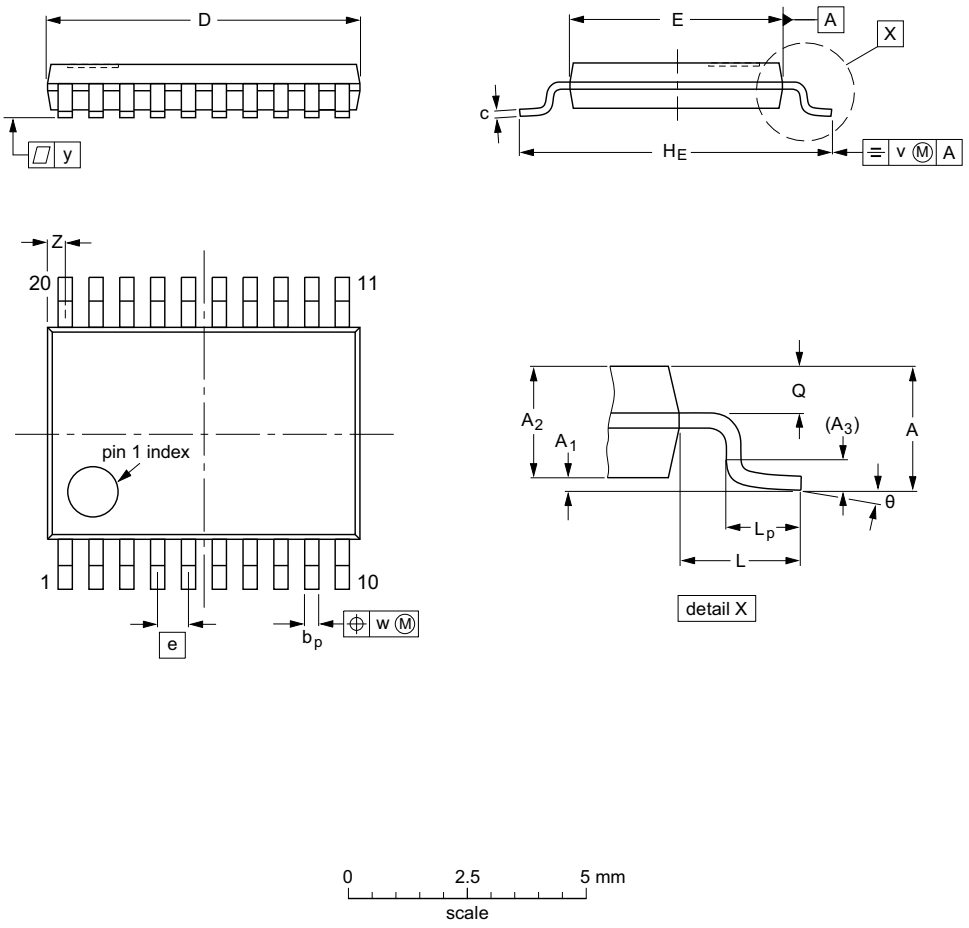
**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT163-1 | 075E04 | MS-013 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 8. Package outline SOT163-1 (SO20)**

**TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm** **SOT360-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 6.6<br>6.4 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.5<br>0.2 | 8°<br>0° |

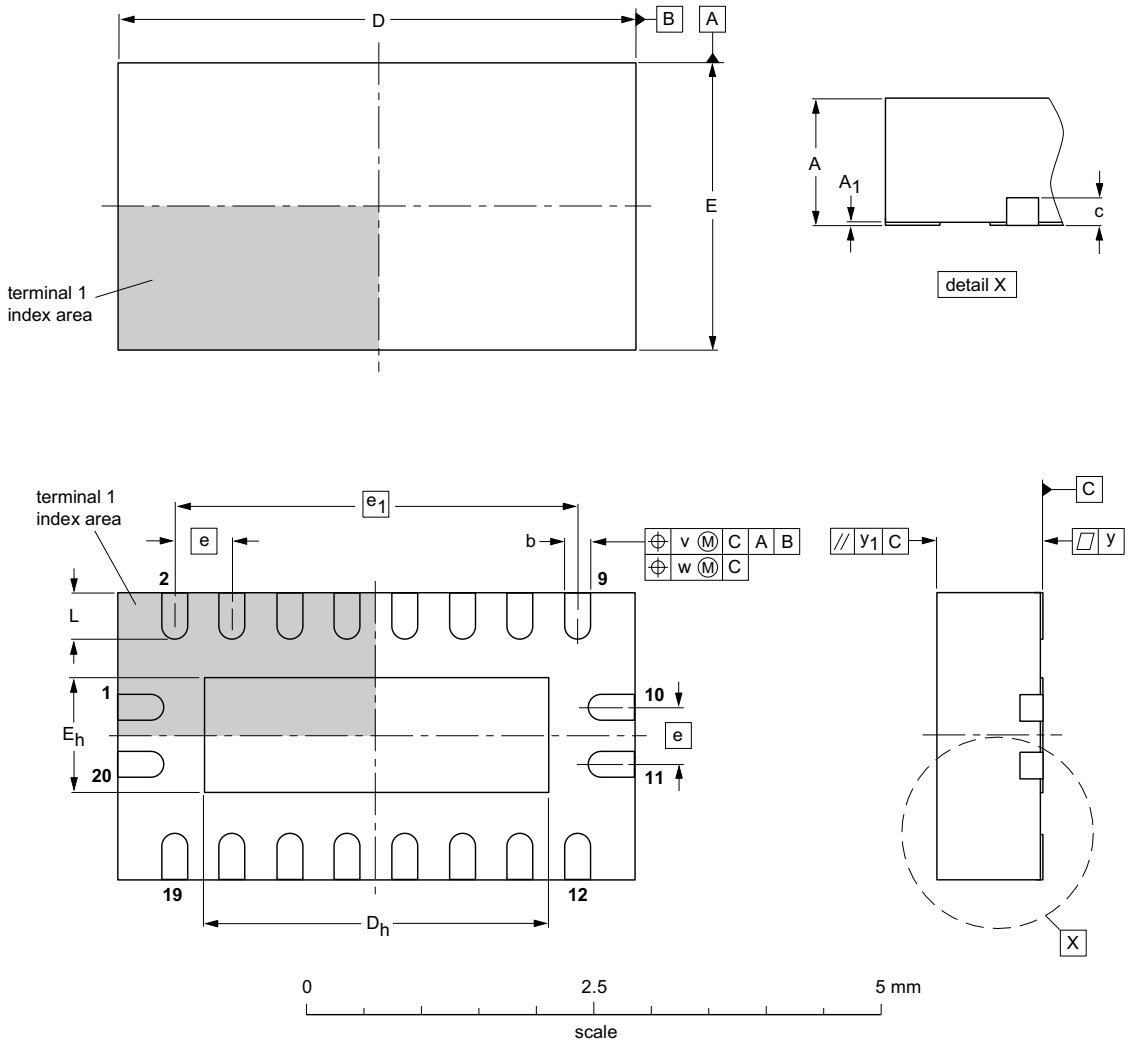
**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT360-1 | | MO-153 | | | | ~~99-12-27~~<br>03-02-19 |

**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**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | $A^{(1)}$ max. | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.30<br>0.18 | 0.2 | 4.6<br>4.4 | 3.15<br>2.85 | 2.6<br>2.4 | 1.15<br>0.85 | 0.5 | 3.5 | 0.5<br>0.3 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT764-1 | - - - | MO-241 | - - - | | | ~~02-10-17~~<br>03-01-27 |

**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 |
| | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| 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[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 URL http://www.nxp.com.

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## 16. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

## 17. Contents





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