

74LVC541A

Octal buffer/line driver with 5 V tolerant inputs/outputs;
3-state

Rev. 6 — 27 August 2021

Product data sheet

1. General description

The 74LVC541A is an 8-bit buffer/line driver with 3-state outputs. The device features two output enables ($\overline{OE}1$ and $\overline{OE}2$). A HIGH on $\overline{OE}n$ causes the associated outputs to assume a high-impedance OFF-state. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial power down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

2. Features and benefits

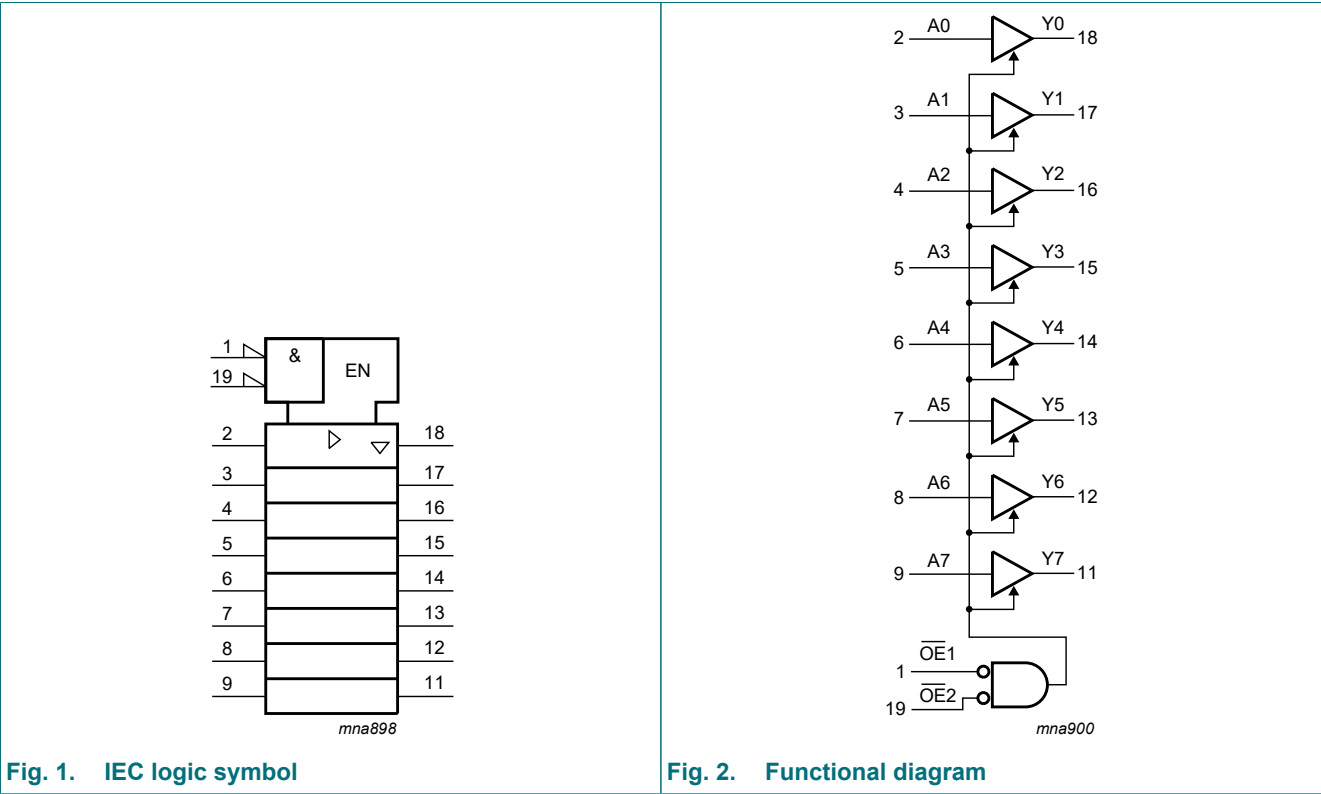
- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- I_{OFF} circuitry provides partial Power-down mode operation
- Complies with JEDEC standard:
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A (2.3 V to 2.7 V)
 - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115B exceeds 200 V
 - CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

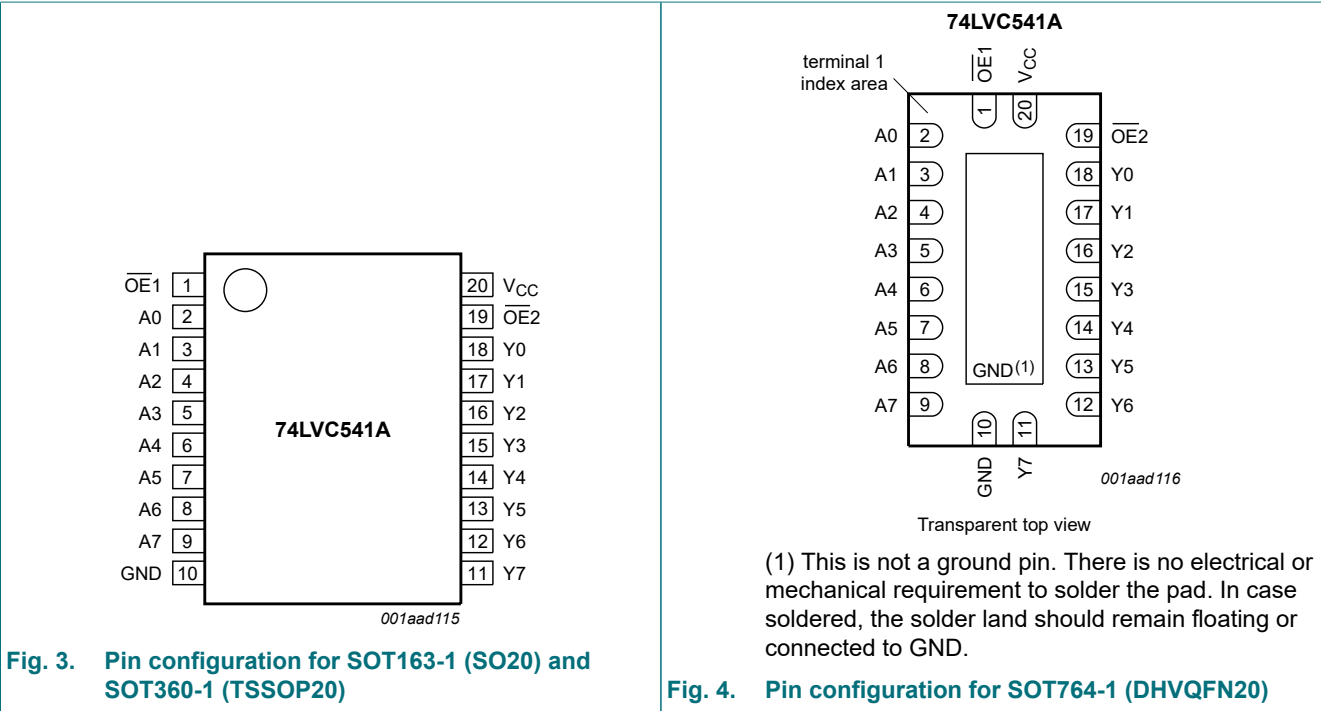
| Type number | Package | | | |
|-------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | Version |
| 74LVC541AD | -40 °C to +125 °C | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74LVC541APW | -40 °C to +125 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| 74LVC541ABQ | -40 °C to +125 °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



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|--------------------------------|--------------------------------|----------------------------------|
| OE1 | 1 | output enable input (active LOW) |
| A0, A1, A2, A3, A4, A5, A6, A7 | 2, 3, 4, 5, 6, 7, 8, 9 | data input |
| GND | 10 | ground (0 V) |
| Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7 | 18, 17, 16, 15, 14, 13, 12, 11 | bus output |
| OE2 | 19 | output enable input (active LOW) |
| V _{CC} | 20 | supply voltage |

6. Functional description

Table 3. Functional table

H = HIGH voltage level; L = LOW voltage level

X = don't care; Z = high-impedance OFF-state

| Input | | | Output |
|-------|-----|----|--------|
| OE1 | OE2 | An | Yn |
| L | L | L | L |
| L | L | H | H |
| X | H | X | Z |
| H | X | X | Z |

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 | +6.5 | V |
| I _{IK} | input clamping current | V _I < 0 V | -50 | - | mA |
| V _I | input voltage | [1] | -0.5 | +5.5 | V |
| 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 or power-down [2] | -0.5 | +6.5 | 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 | | -60 | +150 | °C |
| P _{tot} | total power dissipation | T _{amb} = -40 °C to +125 °C [3] | - | 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] For SOT163-1 (SO20) package: P_{tot} derates linearly with 12.3 mW/K above 109 °C.

For SOT360-1 (TSSOP20) package: P_{tot} derates linearly with 10.0 mW/K above 100 °C.

For SOT764-1 (DHVQFN20) package: P_{tot} derates linearly with 12.9 mW/K above 111 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|-------------------------------------|----------------------------------|------|-----|-----------------|------|
| V _{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | - | V |
| V _I | input voltage | | 0 | - | 5.5 | V |
| V _O | output voltage | output HIGH or LOW state | 0 | - | V _{CC} | V |
| | | output 3-state | 0 | - | 5.5 | V |
| T _{amb} | ambient temperature | | -40 | - | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 2.3 V to 2.7 V | 0 | - | 20 | ns/V |
| | | V _{CC} = 2.7 V to 3.6 V | 0 | - | 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 | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|--|-----------------------|--------|---------------------|-----------------------|---------------------|------|
| | | | Min | Typ[1] | Max | Min | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.2 V | 1.08 | - | - | 1.08 | - | V |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65V _{CC} | - | - | 0.65V _{CC} | - | V |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | - | - | 1.7 | - | V |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | - | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.2 V | - | - | 0.12 | - | 0.12 | V |
| | | V _{CC} = 1.65 V to 1.95 V | - | - | 0.35V _{CC} | - | 0.35V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.7 | - | 0.7 | V |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 0.8 | - | 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 | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | V |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | V |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | 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 | - | 0.3 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | 0.65 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | 0.8 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | 0.6 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | 0.8 | V |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 3.6 V | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = 5.5 V or GND; V _{CC} = 3.6 V | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{OFF} | power-off leakage current | V _I or V _O = 5.5 V; V _{CC} = 0.0 V | - | ±0.1 | ±10 | - | ±20 | μA |

Octal buffer/line driver with 5 V tolerant inputs/outputs; 3-state

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|------------------|--------|-----|-------------------|------|------|
| | | | Min | Typ[1] | Max | Min | Max | |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V | - | 0.1 | 10 | - | 40 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 3.6 V | - | 5 | 500 | - | 5000 | µA |
| C _I | input capacitance | | - | 5.0 | - | - | - | pF |

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|-------------------------------|--|------------------|---------|------|-------------------|------|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| t _{pd} | propagation delay | An to Yn; see Fig. 5 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 14.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.5 | 6.5 | 13.8 | 1.5 | 16.0 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 3.5 | 6.8 | 1.0 | 7.9 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.5 | 5.6 | 1.5 | 7.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 2.9 | 5.1 | 1.0 | 6.5 | ns |
| t _{en} | enable time | OE _n to Yn; see Fig. 6 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 20.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.8 | 7.7 | 16.0 | 1.8 | 18.5 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.5 | 4.3 | 8.8 | 1.5 | 10.2 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 4.4 | 7.5 | 1.5 | 9.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 3.5 | 7.0 | 1.0 | 9.0 | ns |
| t _{dis} | disable time | OE _n to Yn; see Fig. 6 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 11.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 3.0 | 4.9 | 10.3 | 3.0 | 11.9 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 2.7 | 5.9 | 1.0 | 6.8 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.7 | 7.0 | 1.5 | 9.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 3.3 | 6.0 | 1.0 | 7.5 | ns |
| C _{PD} | power dissipation capacitance | per input; V _I = GND to V _{CC} [3] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 7.7 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 11.3 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 14.4 | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[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 Volts

N = number of inputs switching

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

10.1. Waveforms and test circuit

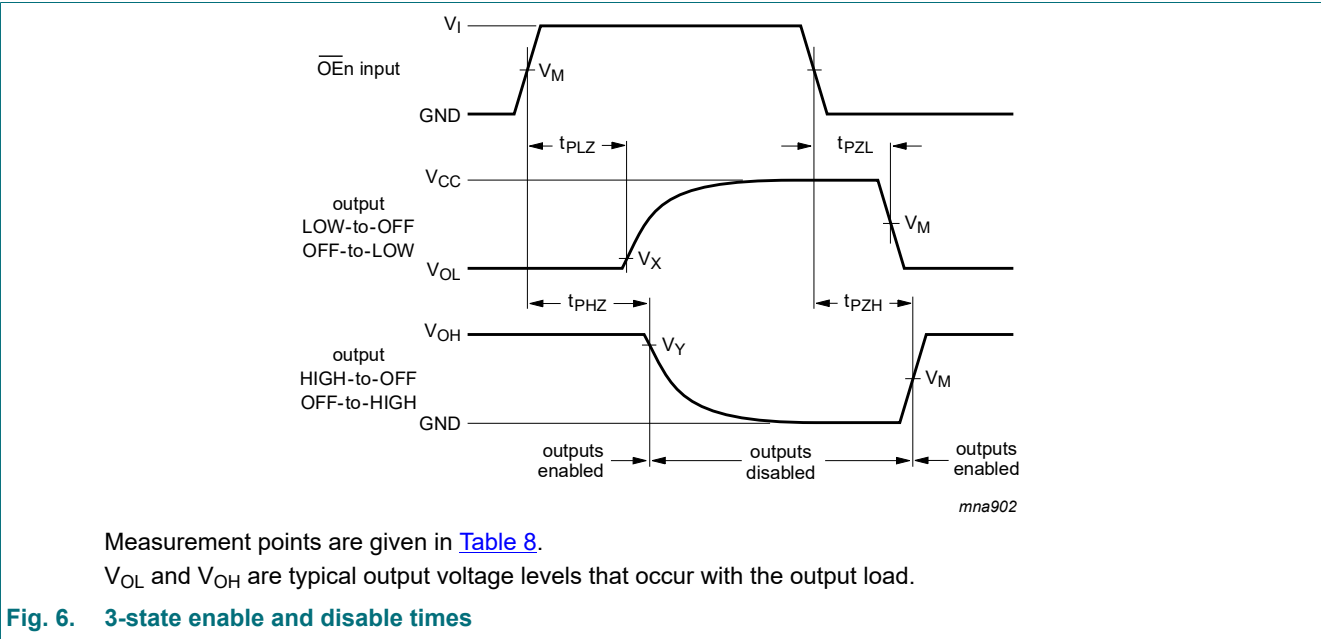
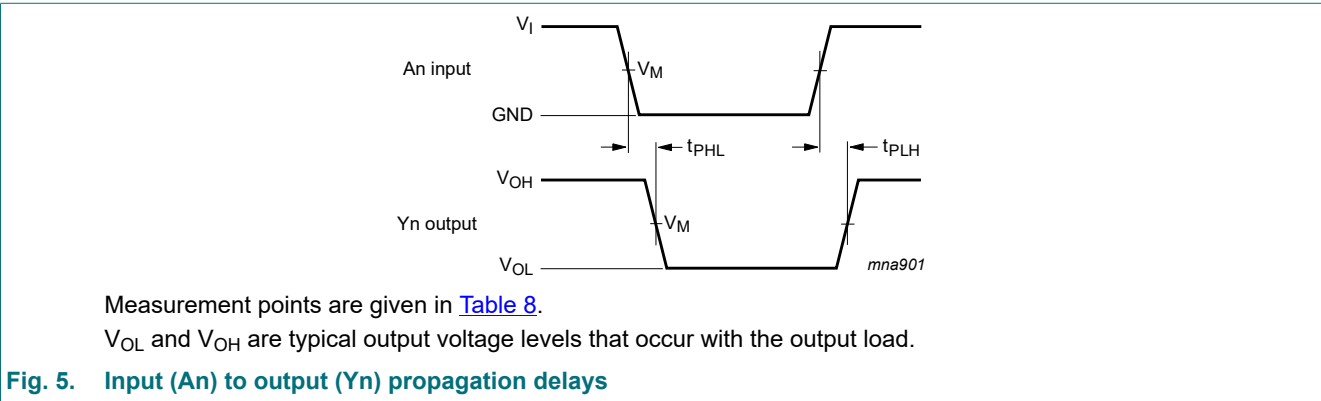
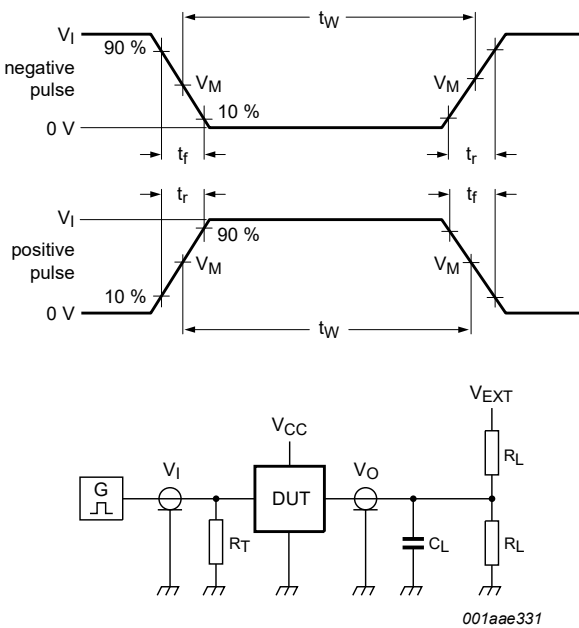


Table 8. Measurement points

| Supply voltage | Input | Output | | |
|---------------------|-------------|-------------|--------------------------|--------------------------|
| V_{CC} | V_M | V_M | V_X | V_Y |
| < 2.7 V | $0.5V_{CC}$ | $0.5V_{CC}$ | $V_{OL} + 0.15\text{ V}$ | $V_{OH} - 0.15\text{ V}$ |
| $\geq 2.7\text{ V}$ | 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 for test circuit:
 R_L = Load resistance.
 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.
 V_{EXT} = External voltage for measuring switching times.

Fig. 7. Test circuit for measuring switching times

Table 9. Test data

| Supply voltage | Input | | Load | | V _{EXT} | | |
|------------------|-----------------|---------------------------------|----------------|----------------|-------------------------------------|-------------------------------------|-------------------------------------|
| | V _I | t _r , t _f | C _L | R _L | t _{PLH} , t _{PHL} | t _{PLZ} , t _{PZL} | t _{PHZ} , t _{PZH} |
| 1.2 V | V _{CC} | ≤ 2 ns | 30 pF | 1 kΩ | open | 2 × V _{CC} | GND |
| 1.65 V to 1.95 V | V _{CC} | ≤ 2 ns | 30 pF | 1 kΩ | open | 2 × V _{CC} | GND |
| 2.3 V to 2.7 V | V _{CC} | ≤ 2 ns | 30 pF | 500 Ω | open | 2 × V _{CC} | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 2 × V _{CC} | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 2 × V _{CC} | GND |

11. Package outline

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

SOT163-1

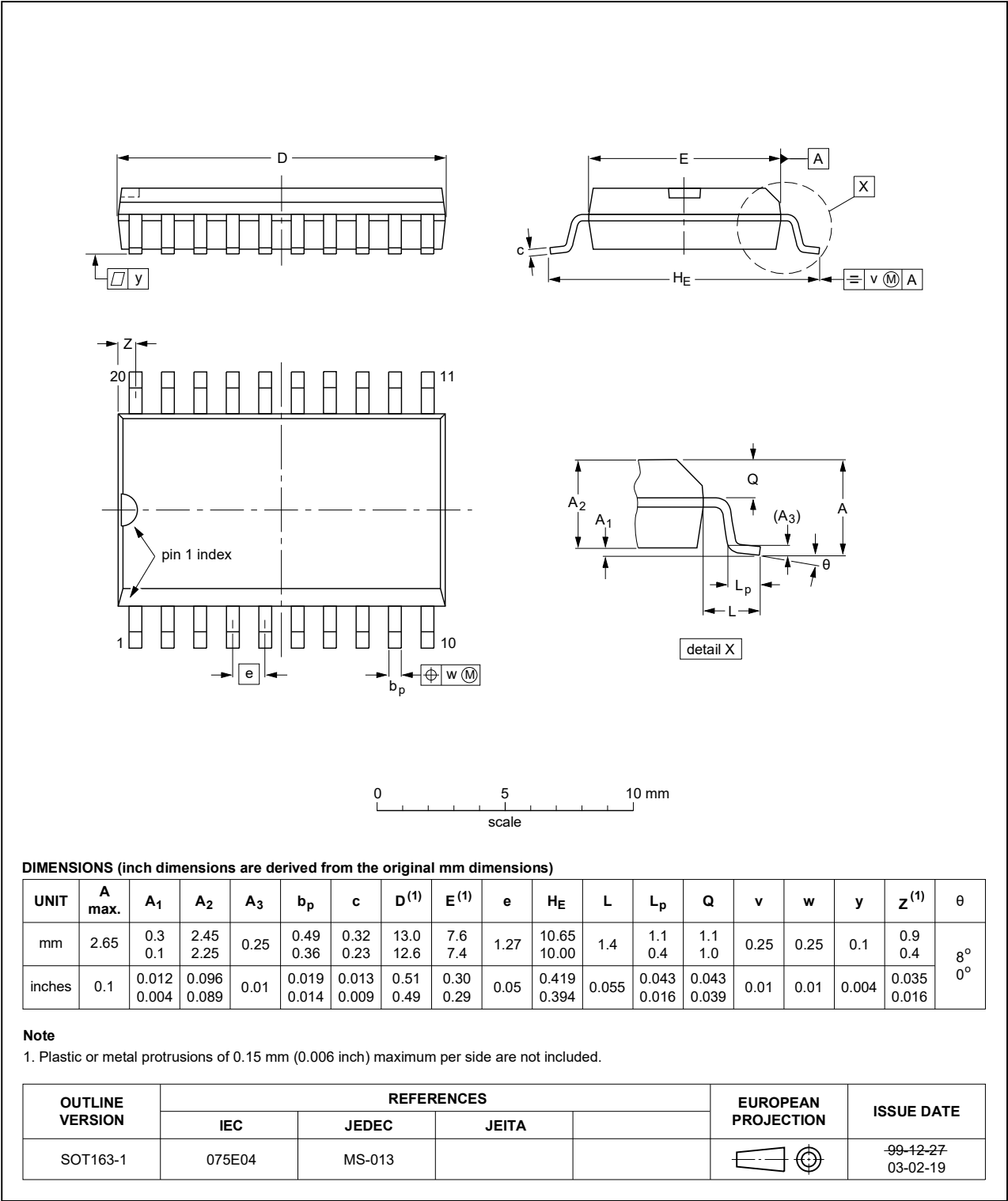


Fig. 8. Package outline SOT163-1 (SO20)

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

SOT360-1

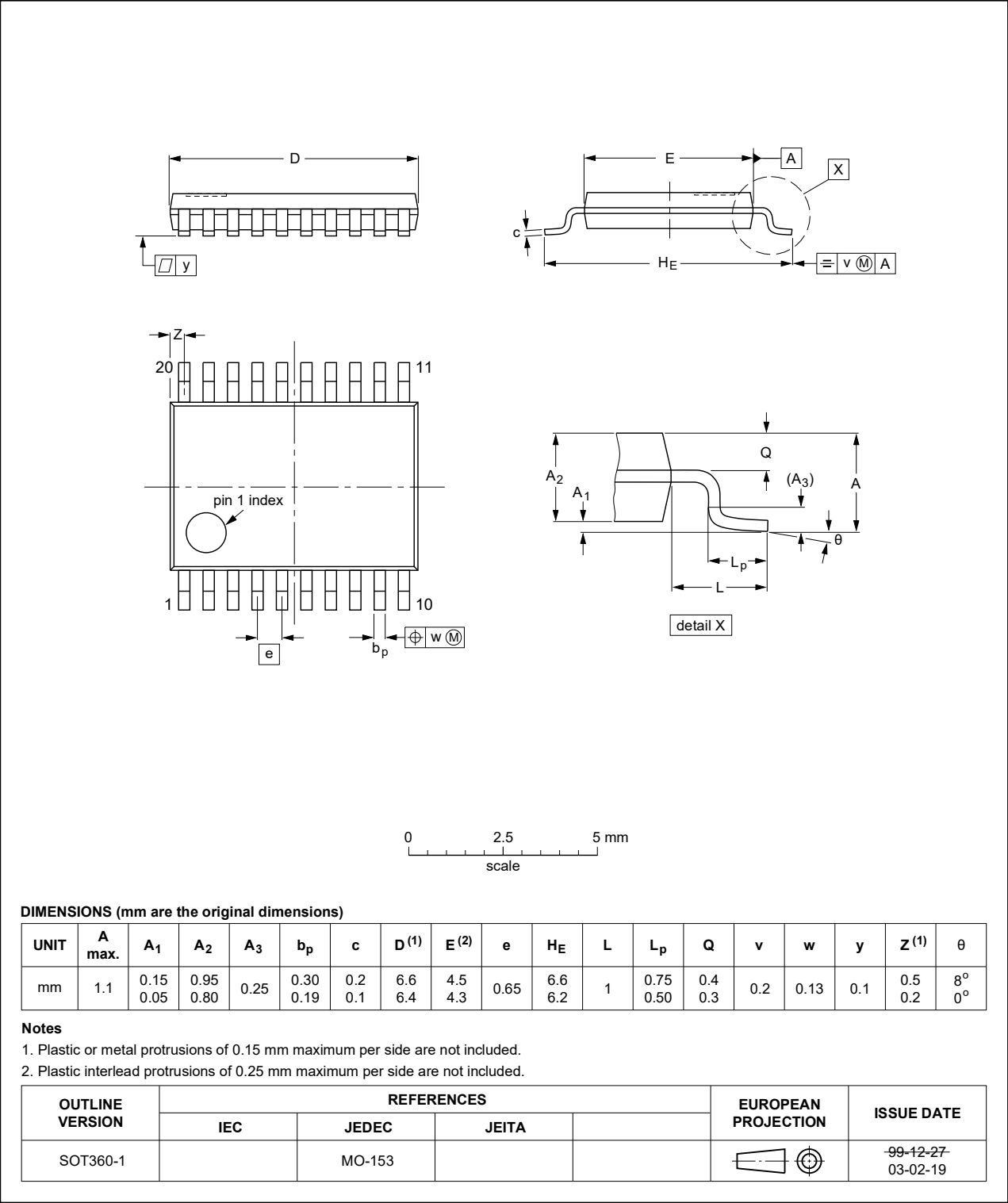


Fig. 9. Package outline SOT360-1 (TSSOP20)

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

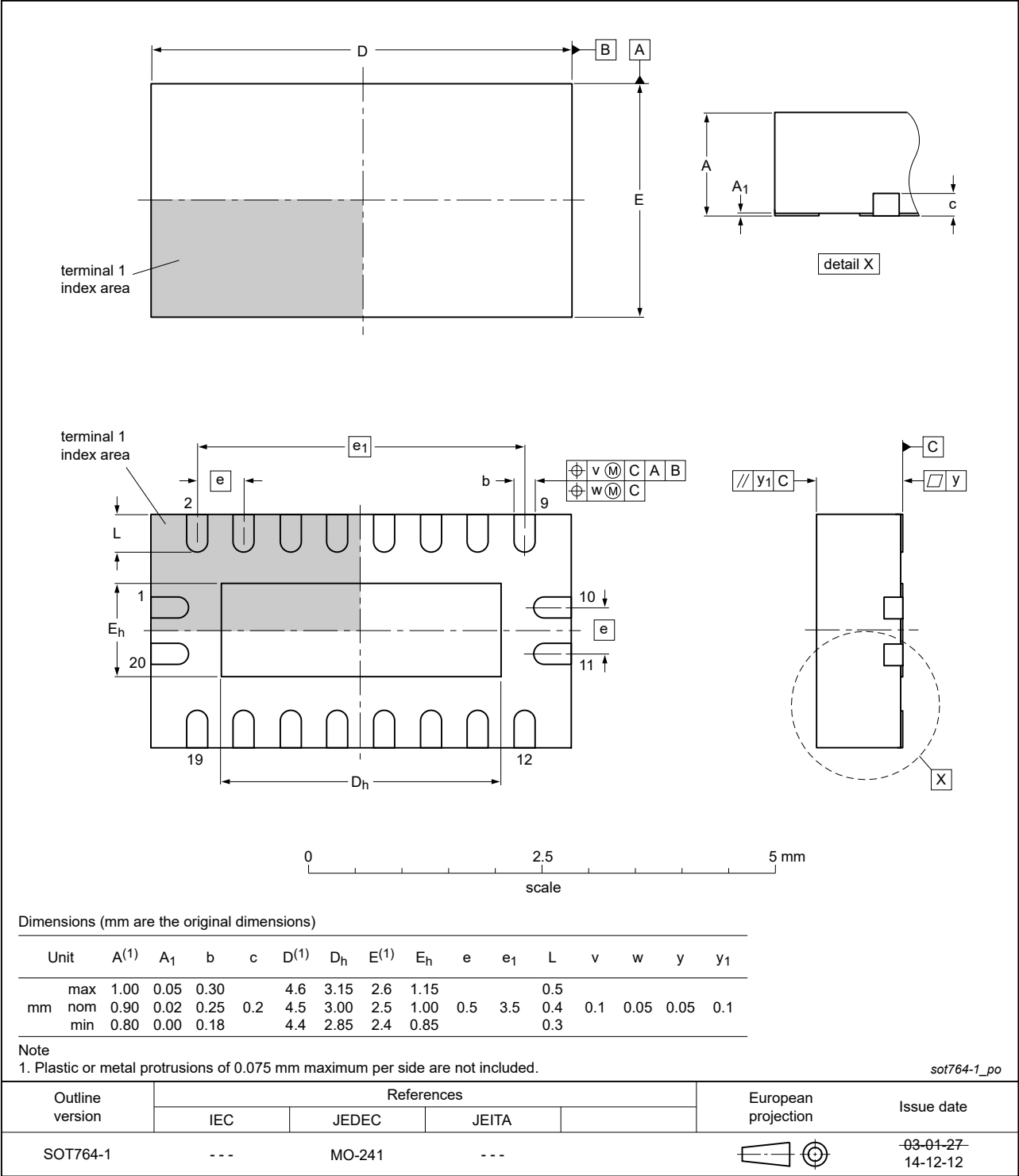


Fig. 10. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|---|
| CDM | Charged 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 |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|---------------|
| 74LVC541A v.6 | 20210827 | Product data sheet | - | 74LVC541A v.5 |
| Modifications: | <ul style="list-style-type: none"> Section 1 updated. Type number 74LVC541ADB (SOT339-1/SSOP20) removed. | | | |
| 74LVC541A v.5 | 20200313 | Product data sheet | - | 74LVC541A v.4 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Table 4: Derating values for P_{tot} total power dissipation updated. Measurements points table added. Package outline drawing SOT764-1 (DHVQFN20) updated. | | | |
| 74LVC541A v.4 | 20111125 | Product data sheet | - | 74LVC541A v.3 |
| Modifications: | <ul style="list-style-type: none"> The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Table 4, Table 5, Table 6, Table 7 and Table 9: values added for lower voltage ranges. | | | |
| 74LVC541A v.3 | 20031112 | Product specification | - | 74LVC541A v.2 |
| 74LVC541A v.2 | 20030514 | Product specification | - | 74LVC541A v.1 |
| 74LVC541A v.1 | 19980729 | Product specification | - | - |

14. 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".
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