

74LV541

Octal buffer/line driver; 3-state

Rev. 03 — 14 April 2009

Product data sheet

1. General description

The 74LV541 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC541 and 74HCT541.

The 74LV541 has octal non-inverting buffer/line drivers with 3-state outputs. The 3-state outputs are controlled by the output enable inputs $\overline{OE}1$ and $\overline{OE}2$. A HIGH on $\overline{OE}n$ causes the outputs to assume a high-impedance OFF-state.

2. Features

- Optimized for low voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between $V_{CC} = 2.7$ V and $V_{CC} = 3.6$ V
- Typical output ground bounce < 0.8 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- Typical HIGH-level output voltage (V_{OH}) undershoot: > 2 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Non-inverting outputs
- Multiple package options
- Specified from -40 °C to $+85$ °C and from -40 °C to $+125$ °C

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|-----------------------|---------|---|----------|
| | Temperature range | Name | Description | Version |
| 74LV541N | -40 °C to $+125$ °C | DIP20 | plastic dual in-line package; 20 leads (300 mil) | SOT146-1 |
| 74LV541D | -40 °C to $+125$ °C | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74LV541DB | -40 °C to $+125$ °C | SSOP20 | plastic shrink small outline package; 20 leads; body width 5.3 mm | SOT339-1 |
| 74LV541PW | -40 °C to $+125$ °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |

4. Functional diagram

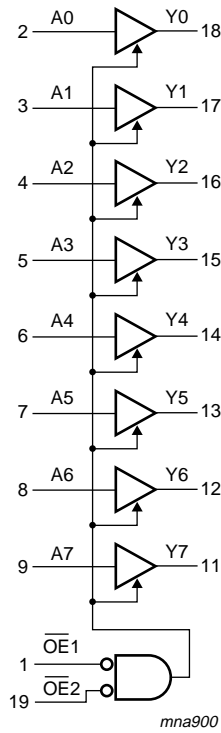


Fig 1. Logic symbol

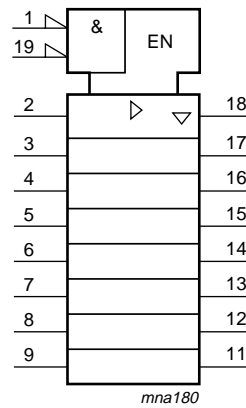


Fig 2. IEC logic symbol

5. Pinning information

5.1 Pinning

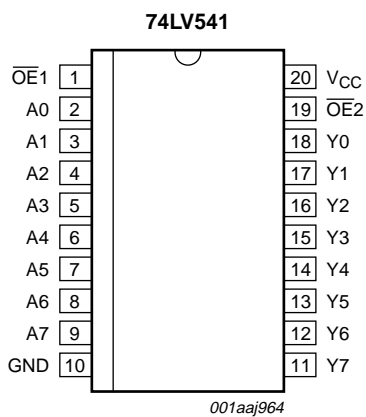


Fig 3. Pin configuration DIP20, SO20

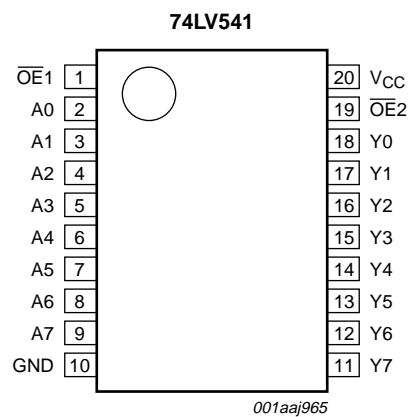


Fig 4. Pin configuration, (T)SSOP20

5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|------------------|--------------------------------|----------------------------------|
| $\overline{OE}1$ | 1 | output enable input (active LOW) |
| A0 to A7 | 2, 3, 4, 5, 6, 7, 8, 9 | data input |
| GND | 10 | ground (0 V) |
| Y0 to Y7 | 18, 17, 16, 15, 14, 13, 12, 11 | data output |
| $\overline{OE}2$ | 19 | output enable input (active LOW) |
| V_{CC} | 20 | supply voltage |

6. Functional description

Table 3. Functional table^[1]

| Control | | Input | Output |
|------------------|------------------|----------------|----------------|
| $\overline{OE}1$ | $\overline{OE}2$ | A _n | Y _n |
| 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 |
| I_{IK} | input clamping current | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | [1] - | 20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | [1] - | 50 | mA |
| I_O | output current | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$ | - | 35 | mA |
| I_{CC} | supply current | | - | 70 | mA |
| I_{GND} | ground current | | -70 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ | [2] | | |
| | | DIP20 | - | 750 | mW |
| | | SO20, SSOP20, TSSOP20 | - | 500 | mW |

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

[2] For DIP20 packages: above 70 °C the value of P_{tot} derates linearly with 12 mW/K.
 For SO20 packages: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
 For (T)SSOP20 packages: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|-------------------------------------|----------------------------------|-----|-----|-----------------|------|
| V _{CC} | supply voltage ^[1] | | 1.0 | 3.3 | 3.6 | V |
| V _I | input voltage | | 0 | - | V _{CC} | V |
| V _O | output voltage | | 0 | - | V _{CC} | V |
| T _{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 1.0 V to 2.0 V | - | - | 500 | ns/V |
| | | V _{CC} = 2.0 V to 2.7 V | - | - | 200 | ns/V |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 100 | ns/V |

[1] The static characteristics are guaranteed from V_{CC} = 1.2 V to V_{CC} = 3.6 V, but LV devices are guaranteed to function down to V_{CC} = 1.0 V (with input levels GND or V_{CC}).

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 | 0.9 | - | - | 0.9 | - | V |
| | | V _{CC} = 2.0 V | 1.4 | - | - | 1.4 | - | 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 | - | - | 0.3 | - | 0.3 | V |
| | | V _{CC} = 2.0 V | - | - | 0.6 | - | 0.6 | 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} = 1.2 V | - | 1.2 | - | - | - | V |
| | | I _O = -100 μA; V _{CC} = 2.0 V | 1.8 | 2.0 | - | 1.8 | - | V |
| | | I _O = -100 μA; V _{CC} = 2.7 V | 2.5 | 2.7 | - | 2.5 | - | V |
| | | I _O = -100 μA; V _{CC} = 3.0 V | 2.8 | 3.0 | - | 2.8 | - | V |
| | | I _O = -8 mA; V _{CC} = 3.0 V | 2.4 | 2.82 | - | 2.2 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = 100 μA; V _{CC} = 1.2 V | - | 0 | - | - | - | V |
| | | I _O = 100 μA; V _{CC} = 2.0 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 100 μA; V _{CC} = 2.7 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 100 μA; V _{CC} = 3.0 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 8 mA; V _{CC} = 3.0 V | - | 0.2 | 0.40 | - | 0.50 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 3.6 V | - | - | 1.0 | - | 1.0 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 3.6 V | - | - | 5 | - | 10 | μA |

Table 6. Static characteristics ...continued

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 | |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V | - | - | 20 | - | 160 | μA |
| ΔI _{CC} | additional supply current | per input; V _I = V _{CC} - 0.6 V; V _{CC} = 2.7 V to 3.6 V | - | - | 500 | - | 850 | μA |
| C _I | input capacitance | | - | 3.5 | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 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 | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|-------------------|---|------------------|--------------------|-----|-------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| t _{pd} | propagation delay | An to Y _n ; see Figure 5 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 60 | - | - | - | ns |
| | | V _{CC} = 2.0 V | - | 20 | 39 | - | 46 | ns |
| | | V _{CC} = 2.7 V | - | 15 | 29 | - | 34 | ns |
| | | V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF ^[3] | - | 10 | - | - | - | ns |
| t _{en} | enable time | V _{CC} = 3.0 V to 3.6 V ^[3] | - | 11 | 23 | - | 27 | ns |
| | | $\overline{O}E_n$ to Y _n ; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 100 | - | - | - | ns |
| | | V _{CC} = 2.0 V | - | 34 | 65 | - | 77 | ns |
| | | V _{CC} = 2.7 V | - | 25 | 48 | - | 56 | ns |
| t _{dis} | disable time | V _{CC} = 3.0 V to 3.6 V ^[3] | - | 19 | 38 | - | 45 | ns |
| | | $\overline{O}E_n$ to Y _n ; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 100 | - | - | - | ns |
| | | V _{CC} = 2.0 V | - | 36 | 66 | - | 78 | ns |
| | | V _{CC} = 2.7 V | - | 27 | 48 | - | 58 | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[3] | - | 21 | 39 | - | 47 | ns |

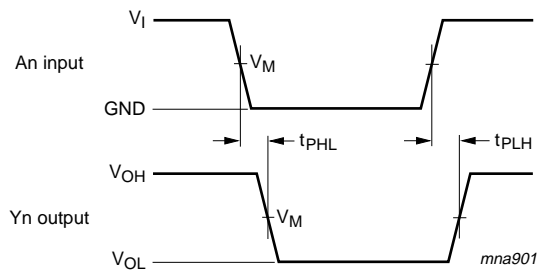
Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|------------------|--------------------|-----|-------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| C _{PD} | power dissipation capacitance | C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} | [4] - | 37 | - | - | - | pF |

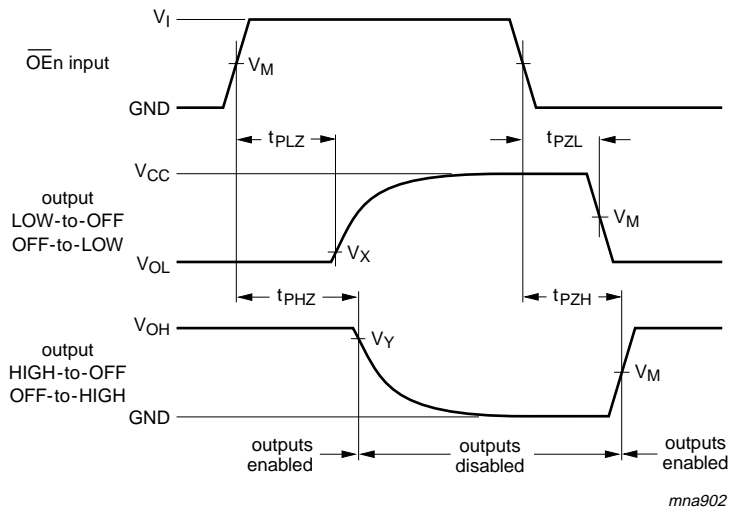
- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
- [3] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V).
- [4] C_{PD} is used to determine 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
 Σ(C_L × V_{CC}² × 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)

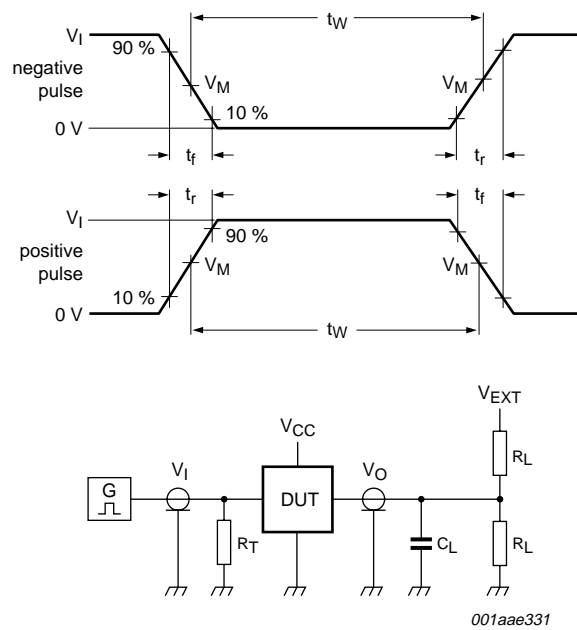


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 6. enable and disable times

Table 8. Measurement points

| Supply voltage | Input | Output | | |
|----------------|-------------|-------------|----------------------|----------------------|
| V_{CC} | V_M | V_M | V_X | V_Y |
| < 2.7 V | $0.5V_{CC}$ | $0.5V_{CC}$ | $V_{OL} + 0.1V_{CC}$ | $V_{OH} - 0.1V_{CC}$ |
| 2.7 V to 3.6 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 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_{CC} | V_I | t_r, t_f | C_L | R_L | t_{PHL}, t_{PLH} | t_{PZH}, t_{PHZ} | t_{PZL}, t_{PLZ} |
| < 2.7 V | V_{CC} | ≤ 2.5 ns | 50 pF | 1 k Ω | open | GND | $2V_{CC}$ |
| 2.7 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 15 pF, 50 pF | 1 k Ω | open | GND | $2V_{CC}$ |

12. Package outline

DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1

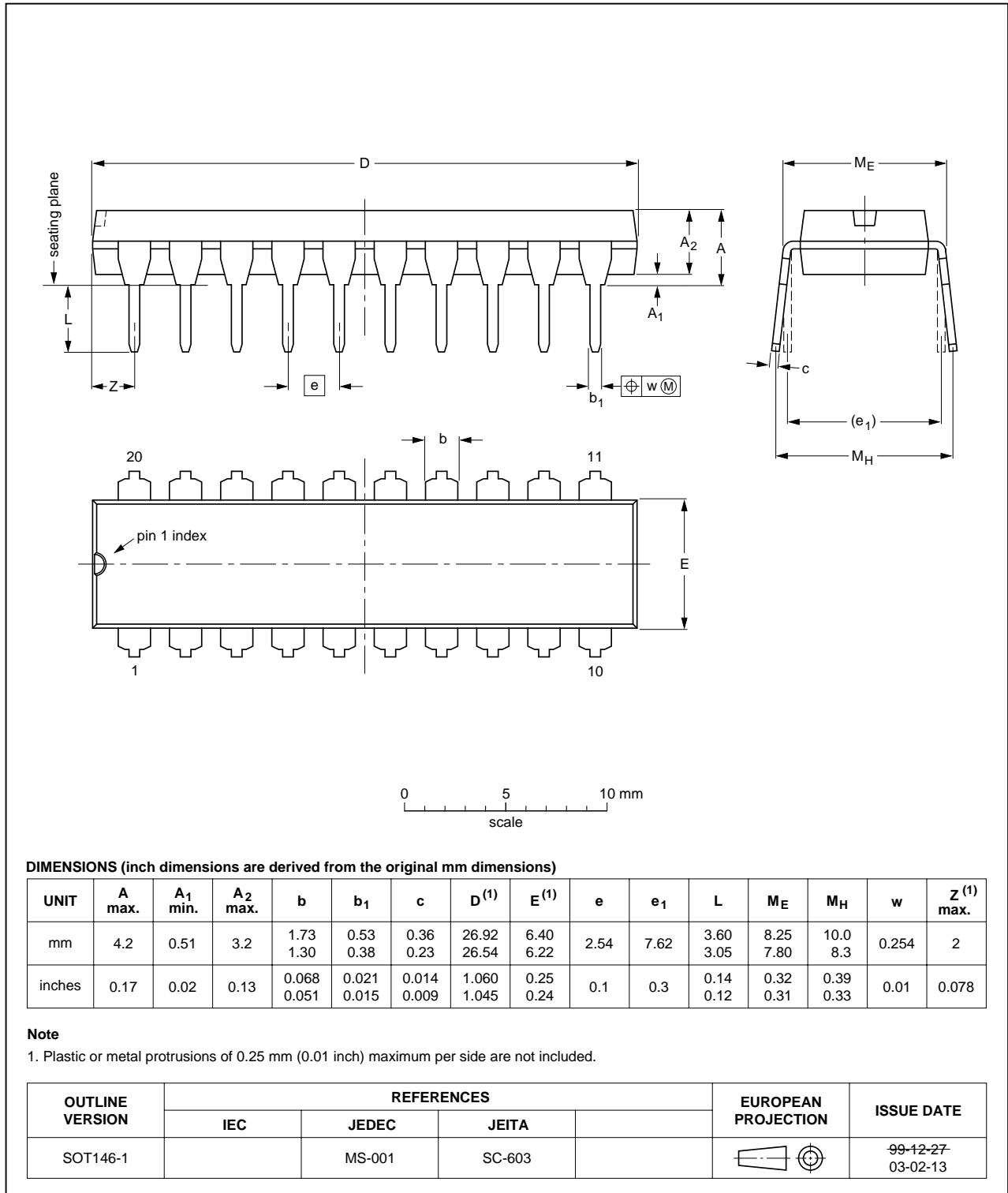


Fig 8. Package outline SOT146-1 (DIP20)

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

SOT163-1

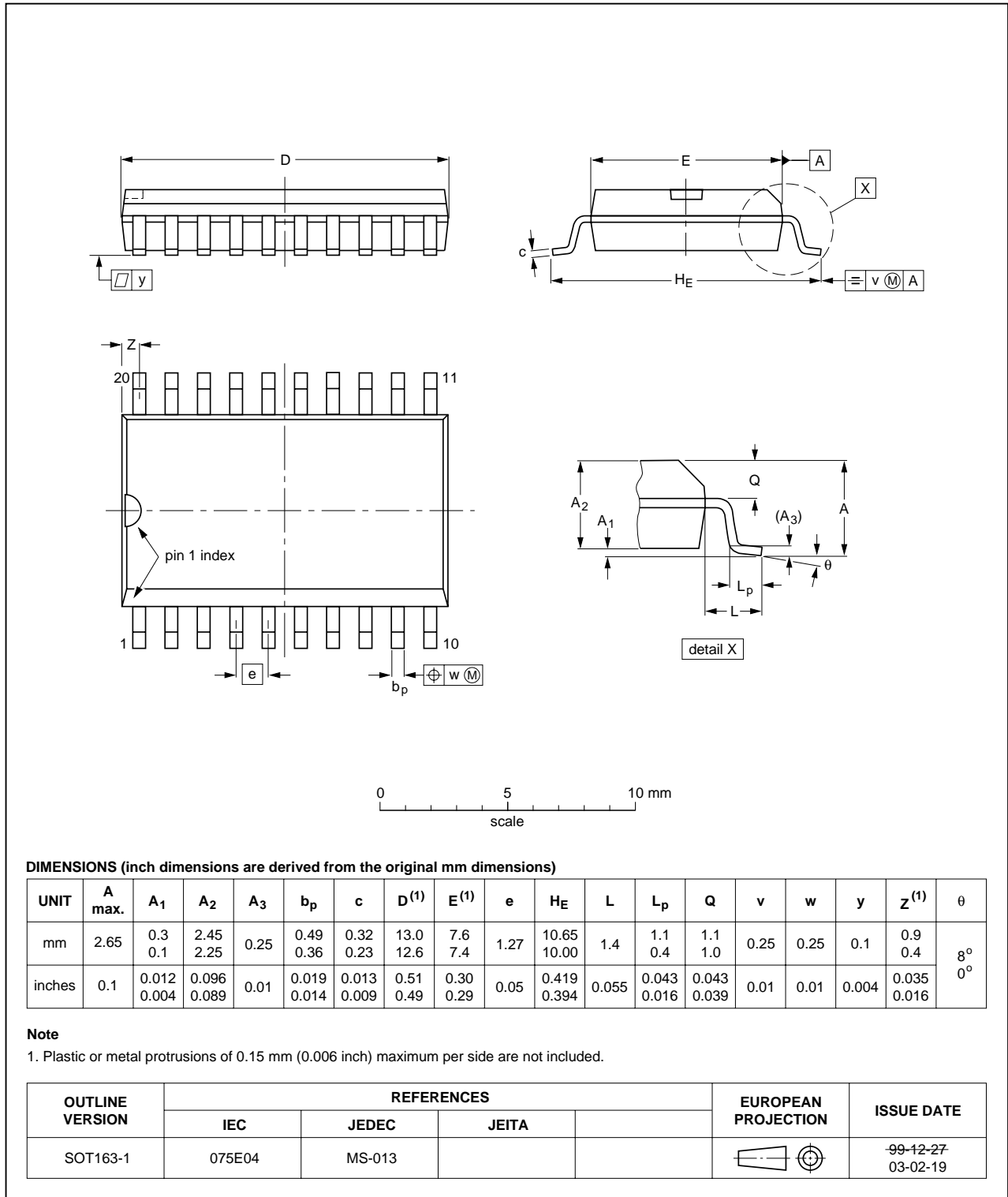


Fig 9. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

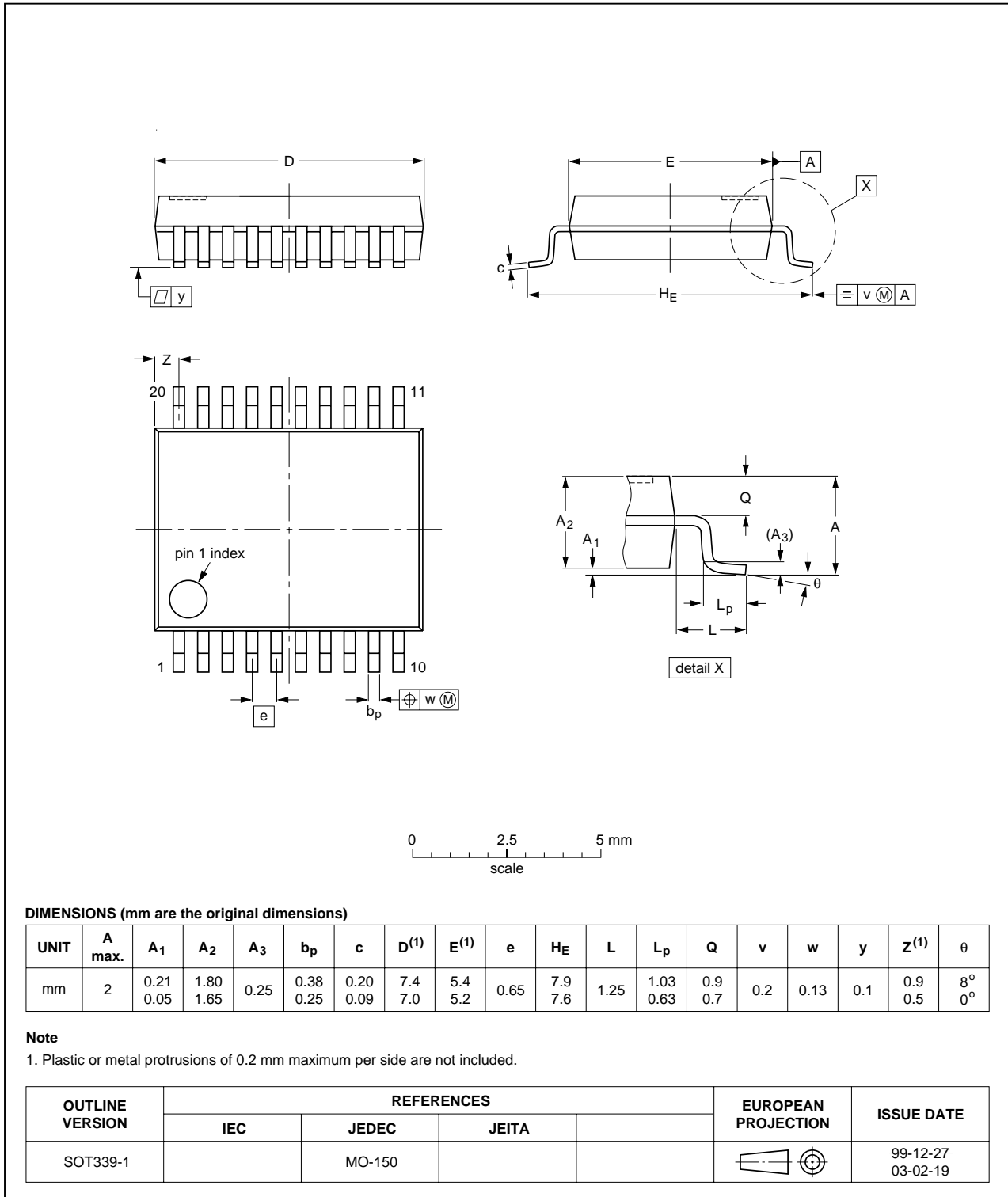


Fig 10. Package outline SOT339-1 (SSOP20)

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

SOT360-1

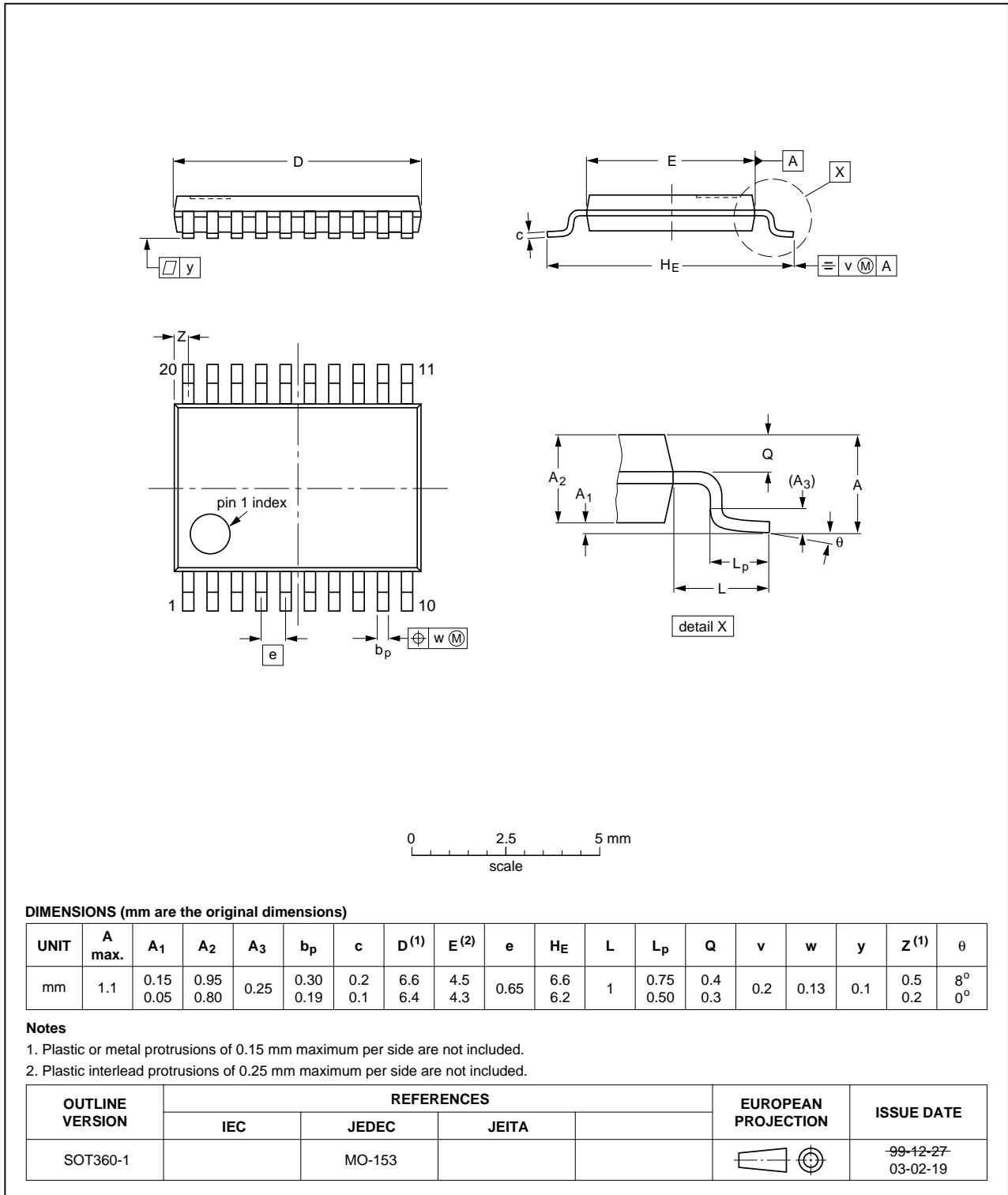


Fig 11. Package outline SOT360-1 (TSSOP20)

13. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|---|
| 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 |
|----------------|---|-----------------------|---------------|------------|
| 74LV541_3 | 20090414 | Product data sheet | - | 74LV541_2 |
| Modifications: | <ul style="list-style-type: none">The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.Legal texts have been adapted to the new company name when appropriate. | | | |
| 74LV541_2 | 19980610 | Product specification | - | 74LV541_1 |
| 74LV541_1 | 19970304 | Product specification | - | - |

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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. |
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[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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Date of release: 14 April 2009

Document identifier: 74LV541_3