



THE DATASHEET OF 74LVC2244ABQ,115



74LVC2244A

Octal buffer/line driver; 30 Ω series termination; 5 V tolerant input/output; 3-state

Rev. 5 — 3 November 2011

Product data sheet

1. General description

The 74LVC2244A is an octal non-inverting buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable input pins $\overline{1OE}$ and $\overline{2OE}$. A HIGH on pin \overline{nOE} causes the outputs to assume a high-impedance OFF-state. Schmitt trigger action at all inputs makes the circuit highly tolerant for slower input rise and fall times. The device is designed with 30 Ω series termination resistors in both HIGH and LOW output stages to reduce line noise.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices as translators in mixed 3.3 V and 5 V applications.

2. Features and benefits

- 5 V tolerant inputs/outputs, for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- Direct interface with TTL levels
- Integrated 30 Ω termination resistors
- 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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|--------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74LVC2244AD | -40 °C to +125 °C | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74LVC2244ADB | -40 °C to +125 °C | SSOP20 | plastic shrink small outline package; 20 leads; body width 5.3 mm | SOT339-1 |
| 74LVC2244APW | -40 °C to +125 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| 74LVC2244ABQ | -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

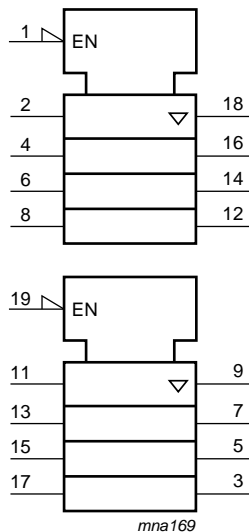


Fig 1. IEC logic symbol

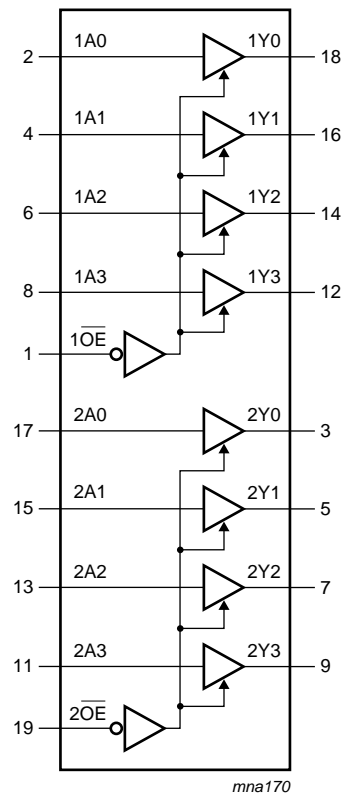
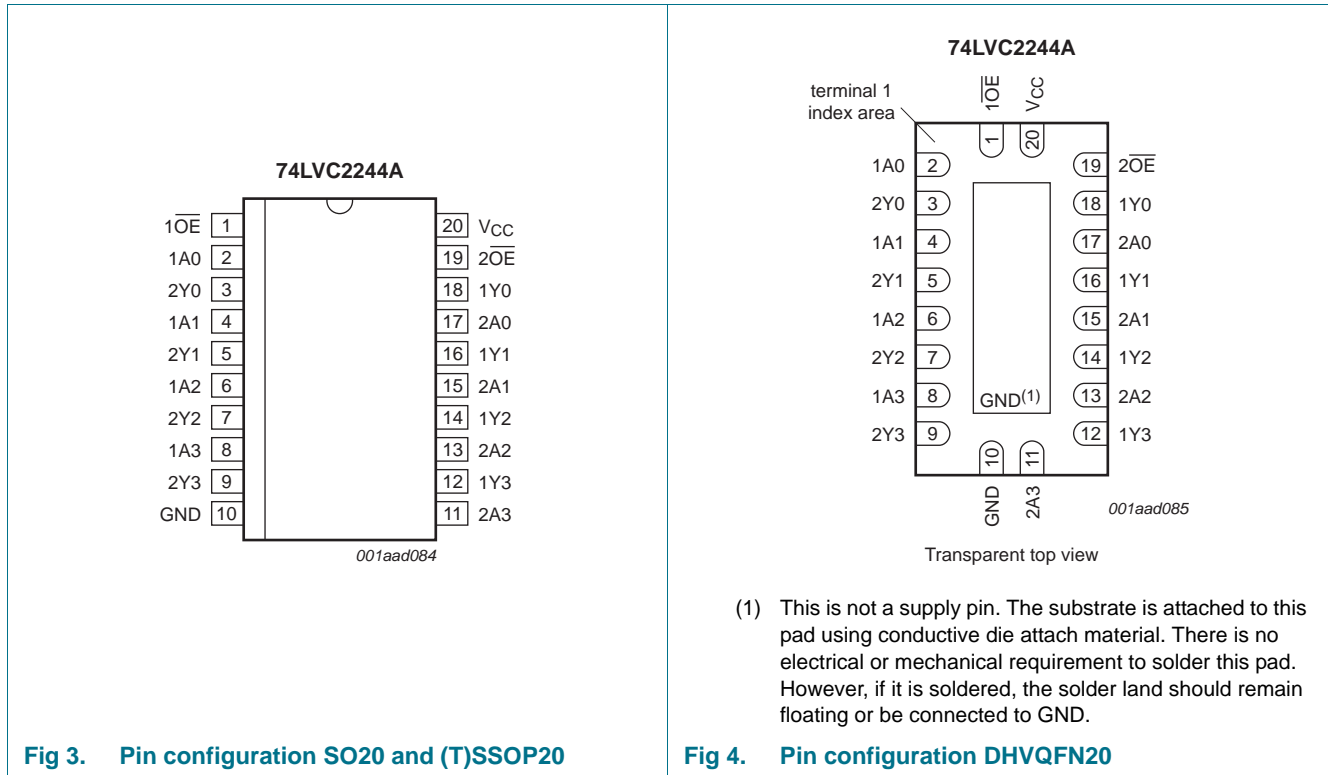


Fig 2. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Functional table^[1]

| Input | | Output |
|-------|-----|--------|
| nOE | nAn | nYn |
| L | L | L |
| L | H | H |
| H | 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 | +6.5 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | | ^[1] -0.5 | +6.5 | 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 | ^[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 | | -65 | +150 | $^{\circ}$ C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ $^{\circ}$ C to +125 $^{\circ}$ 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 SO20 packages: above 70 $^{\circ}$ C derate linearly with 8 mW/K.
 For (T)SSOP20 packages: above 60 $^{\circ}$ C derate linearly with 5.5 mW/K.
 For DHVQFN20 packages: above 60 $^{\circ}$ C derate linearly with 4.5 mW/K.

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 | $^{\circ}\text{C}$ |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65\text{ V to }2.7\text{ V}$ | 0 | - | 20 | ns/V |
| | | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$ | 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 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$ | | | -40 $^{\circ}\text{C}$ to +125 $^{\circ}\text{C}$ | | Unit |
|----------|---------------------------|---|--|--------------------|----------------------|---|----------------------|---------------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 1.2\text{ V}$ | 1.08 | - | - | 1.08 | - | V |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | $0.65 \times V_{CC}$ | - | - | $0.65 \times V_{CC}$ | - | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 1.7 | - | - | 1.7 | - | V |
| | | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$ | 2.0 | - | - | 2.0 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 1.2\text{ V}$ | - | - | 0.12 | - | 0.12 | V |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | - | - | $0.35 \times V_{CC}$ | - | $0.35 \times V_{CC}$ | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | - | - | 0.7 | - | 0.7 | V |
| | | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$ | - | - | 0.8 | - | 0.8 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | |
| | | $I_O = -100\ \mu\text{A}$; $V_{CC} = 1.65\text{ V to }3.6\text{ V}$ | $V_{CC} - 0.2$ | V_{CC} | - | $V_{CC} - 0.3$ | - | V |
| | | $I_O = -2\text{ mA}$; $V_{CC} = 1.65\text{ V}$ | 1.2 | - | - | 1.05 | - | V |
| | | $I_O = -4\text{ mA}$; $V_{CC} = 2.3\text{ V}$ | 1.8 | - | - | 1.65 | - | V |
| | | $I_O = -6\text{ mA}$; $V_{CC} = 2.7\text{ V}$ | 2.2 | - | - | 2.05 | - | V |
| | | $I_O = -9\text{ mA}$; $V_{CC} = 2.7\text{ V}$ | 2.4 | - | - | 2.25 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | |
| | | $I_O = 100\ \mu\text{A}$; $V_{CC} = 1.65\text{ V to }3.6\text{ V}$ | - | - | 0.2 | - | 0.3 | V |
| | | $I_O = 2\text{ mA}$; $V_{CC} = 1.65\text{ V}$ | - | - | 0.45 | - | 0.65 | V |
| | | $I_O = 4\text{ mA}$; $V_{CC} = 2.3\text{ V}$ | - | - | 0.6 | - | 0.8 | V |
| | | $I_O = 6\text{ mA}$; $V_{CC} = 2.7\text{ V}$ | - | - | 0.4 | - | 0.6 | V |
| | | $I_O = 12\text{ mA}$; $V_{CC} = 3.0\text{ V}$ | - | - | 0.55 | - | 0.8 | V |
| I_I | input leakage current | $V_{CC} = 3.6\text{ V}$; $V_I = 5.5\text{ V}$ or GND | - | ± 0.1 | ± 5 | - | ± 20 | 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_{OZ} | OFF-state output current | $V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 3.6$ V; $V_O = 5.5$ V or GND; | - | ± 0.1 | ± 5 | - | ± 20 | μ A |
| I_{OFF} | power-off leakage current | $V_{CC} = 0$ V; V_I or $V_O = 5.5$ V | - | ± 0.1 | ± 10 | - | ± 20 | μ A |
| I_{CC} | supply current | $V_{CC} = 3.6$ V; $V_I = V_{CC}$ or GND; $I_O = 0$ A | - | 0.1 | 10 | - | 40 | μ A |
| ΔI_{CC} | additional supply current | per input pin; $V_{CC} = 2.7$ V to 3.6 V; $V_I = V_{CC} - 0.6$ V; $I_O = 0$ A | - | 5 | 500 | - | 5000 | μ A |
| C_I | input capacitance | $V_{CC} = 0$ V to 3.6 V; $V_I = \text{GND to } V_{CC}$ | - | 4.0 | - | - | - | 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 [Figure 7](#).

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|--------------------|-------------------------------|---|-------------------------------------|--------------------|------|-------------------|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| t _{pd} | propagation delay | nAn to nYn; see Figure 5 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 35 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.9 | 7.8 | 17.7 | 1.9 | 18.6 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.5 | 4.1 | 8.7 | 1.5 | 9.6 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 4.1 | 6.4 | 1.5 | 7.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.5 | 3.5 | 5.5 | 1.5 | 8.0 | ns |
| t _{en} | enable time | nOE to nYn; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 38 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 2.3 | 8.9 | 19.7 | 2.3 | 20.7 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.9 | 5.0 | 10.3 | 1.9 | 11.4 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 5.1 | 8.1 | 1.5 | 9.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 4.0 | 7.1 | 1.0 | 10.5 | ns |
| t _{dis} | disable time | nOE to nYn; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 9.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 2.9 | 4.7 | 9.3 | 2.9 | 9.8 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 2.6 | 5.0 | 1.0 | 5.6 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.4 | 6.4 | 1.5 | 7.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.5 | 3.2 | 5.4 | 1.5 | 8.0 | ns |
| t _{sk(o)} | output skew time | V _{CC} = 3.0 V to 3.6 V ^[3] | - | - | 1.0 | - | 1.5 | ns |
| C _{PD} | power dissipation capacitance | per input; V _I = GND to V _{CC} ^[4] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 1.8 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 4.9 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 7.7 | - | - | - | 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] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz; f_o = output frequency in MHz

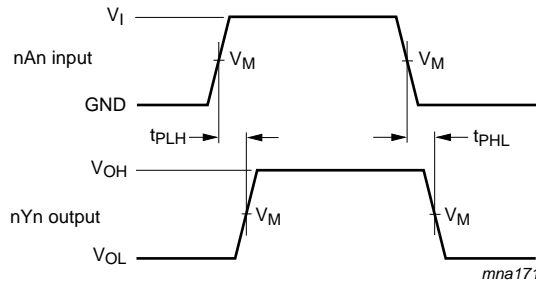
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

N = number of inputs switching

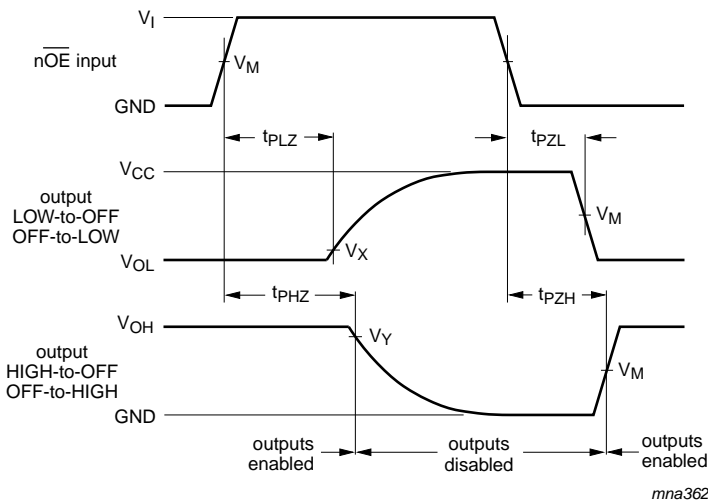
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs

11. Waveforms



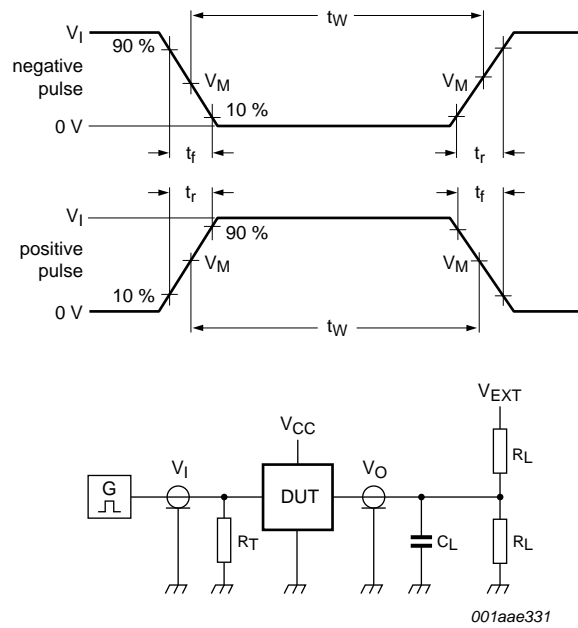
$V_M = 1.5 \text{ V}$ at $V_{CC} \geq 2.7 \text{ V}$.
 $V_M = 0.5 \times V_{CC}$ at $V_{CC} < 2.7 \text{ V}$.
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 5. The input (nAn) to output (nYn) propagation delays



$V_M = 1.5 \text{ V}$ at $V_{CC} \geq 2.7 \text{ V}$.
 $V_M = 0.5 \times V_{CC}$ at $V_{CC} < 2.7 \text{ V}$.
 $V_X = V_{OL} + 0.3 \text{ V}$ at $V_{CC} \geq 2.7 \text{ V}$;
 $V_X = V_{OL} + 0.15 \text{ V}$ at $V_{CC} < 2.7 \text{ V}$.
 $V_Y = V_{OH} - 0.3 \text{ V}$ at $V_{CC} \geq 2.7 \text{ V}$;
 $V_Y = V_{OH} - 0.15 \text{ V}$ at $V_{CC} < 2.7 \text{ V}$.
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 6. 3-state enable and disable times



Test data is given in [Table 8](#).

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 8. 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 | $2 \times V_{CC}$ | GND |
| 1.65 V to 1.95 V | V_{CC} | ≤ 2 ns | 30 pF | 1 kΩ | open | $2 \times V_{CC}$ | GND |
| 2.3 V to 2.7 V | V_{CC} | ≤ 2 ns | 30 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |

12. Package outline

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

SOT163-1

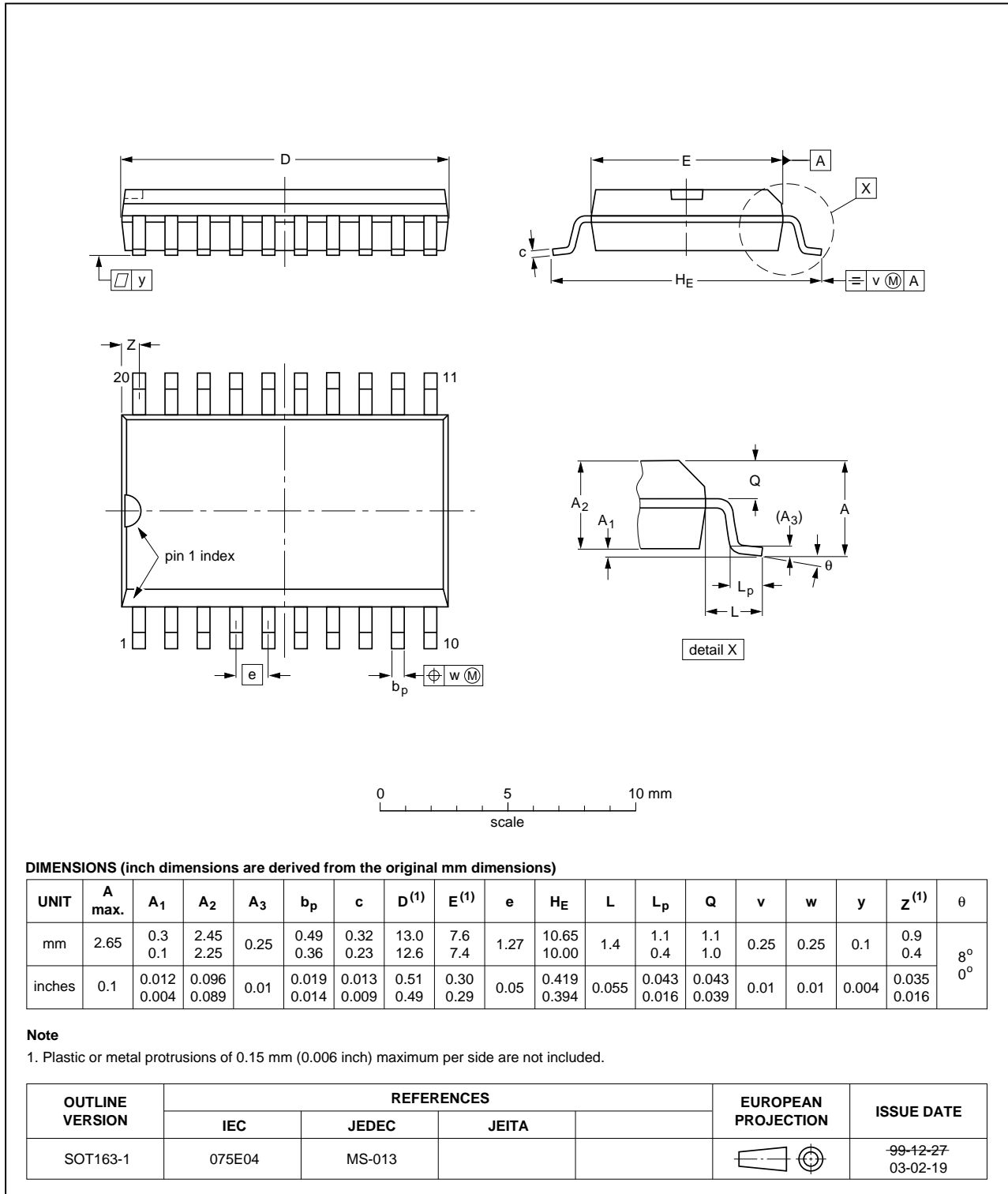


Fig 8. Package outline SOT163-1 (SO20)

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

SOT339-1

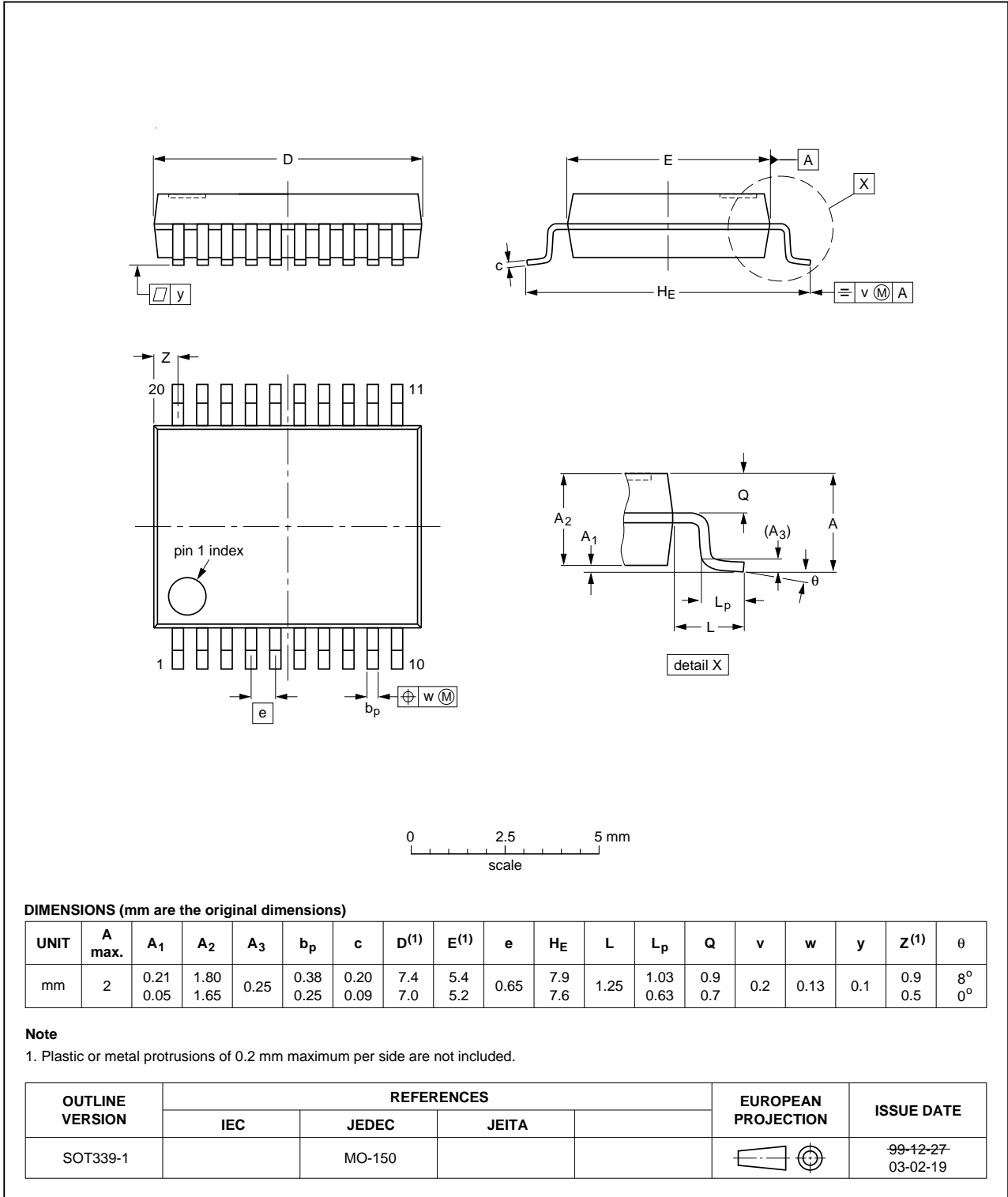


Fig 9. Package outline SOT339-1 (SSOP20)

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

SOT360-1

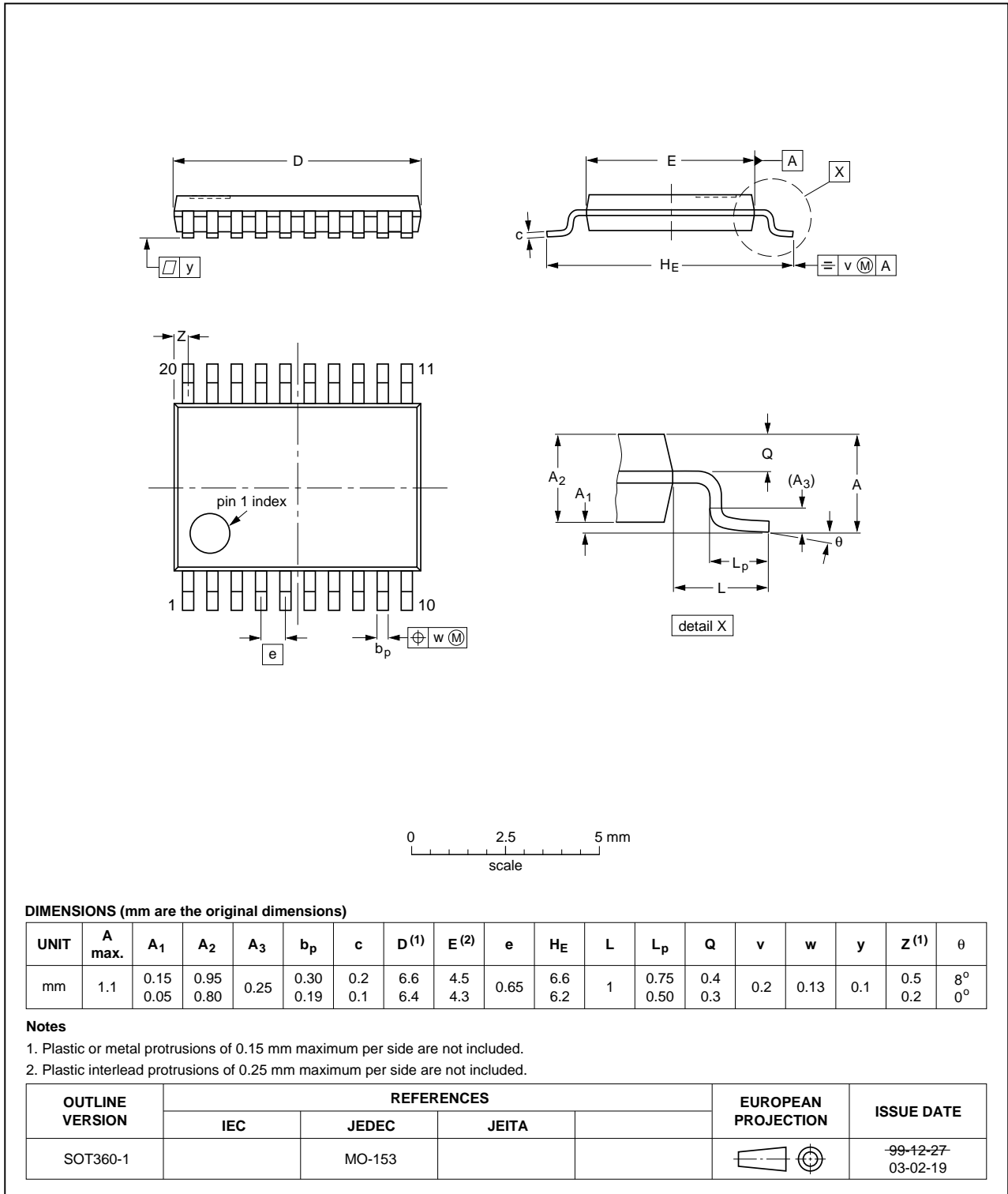


Fig 10. Package outline SOT360-1 (TSSOP20)

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

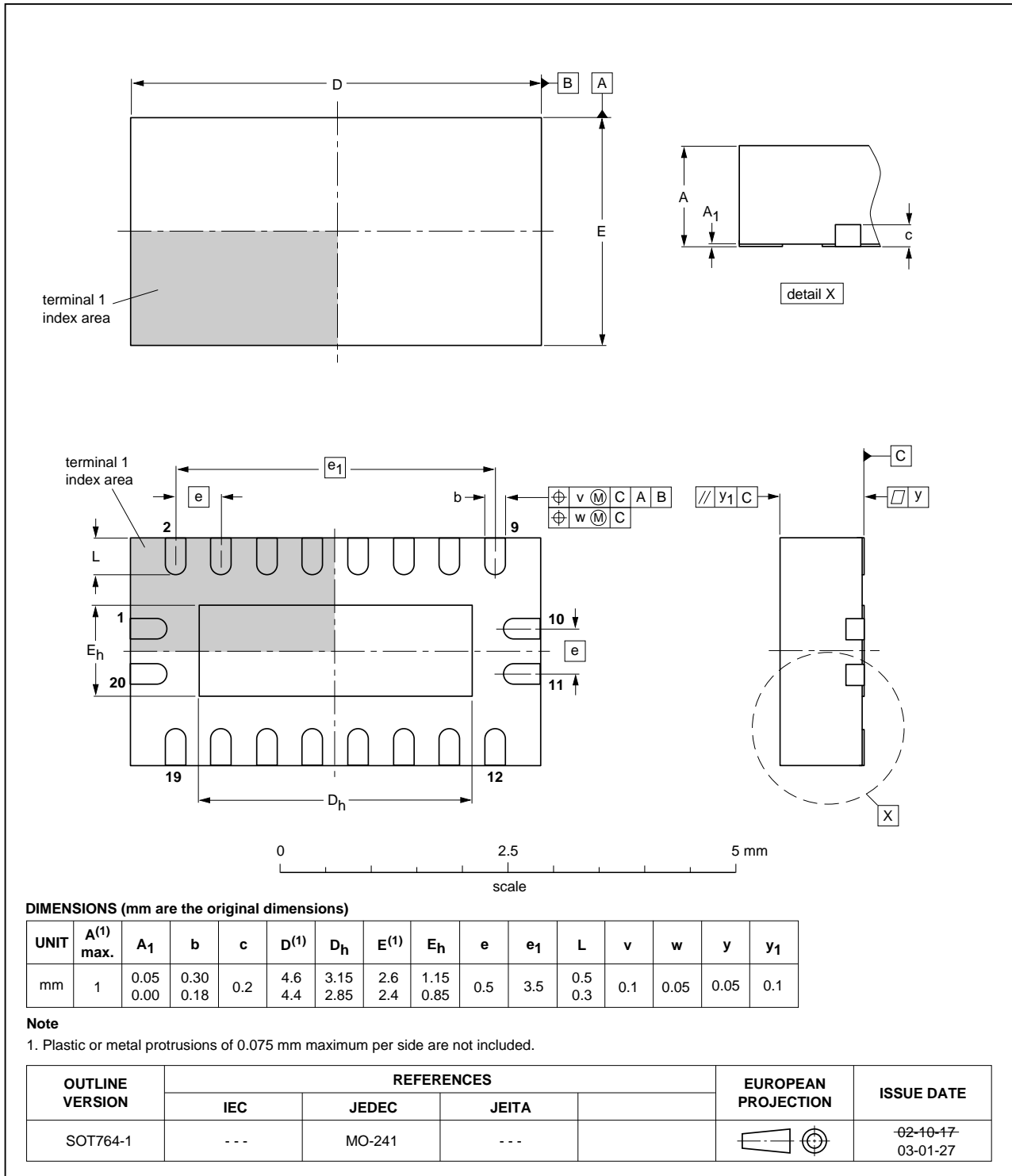


Fig 11. Package outline SOT764-1 (DHVQFN20)

13. Abbreviations

Table 9. Abbreviations

| Acronym | Description |
|---------|-----------------------------|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

14. Revision history

Table 10. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|----------------|
| 74LVC2244A v.5 | 20111103 | Product data sheet | - | 74LVC2244A v.4 |
| 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 8: values added for lower voltage ranges. | | | |
| 74LVC2244A v.4 | 20040407 | Product specification | - | 74LVC2244A v.3 |
| 74LVC2244A v.3 | 20021213 | Product specification | - | 74LVC2244A v.2 |
| 74LVC2244A v.2 | 20020618 | Product specification | - | 74LVC2244A v.1 |
| 74LVC2244A v.1 | 19990930 | 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.nexperia.com>.

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