

# 74LVT245B

## 3.3 V octal transceiver with direction pin (3-state)

Rev. 02 — 8 May 2008

Product data sheet

### 1. General description

The 74LVT245B is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

This device is an octal transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The control function implementation minimizes external timing requirements. The device features an output enable ( $\overline{OE}$ ) input for easy cascading and a direction (DIR) input for direction control.

### 2. Features

- 3-state buffers
- Octal bidirectional bus interface
- Input and output interface capability to systems at 5 V supply
- TTL input and output switching levels
- Output capability: +64 mA/−32 mA
- Latch-up protection exceeds 500 mA per JEDEC Std 17
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Bus-hold data inputs eliminate the need for external pull-up resistors for unused inputs
- Live insertion/extraction permitted
- Power-up 3-state
- No bus current loading when output is tied to 5 V bus

### 3. Ordering information

Table 1. Ordering information

| Type number | Package           |          |  |          |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  | Version  |
| 74LVT245BD  | −40 °C to +85 °C  | SO20     | plastic small outline package; 20 leads; body width 7.5 mm   | SOT163-1 |
| 74LVT245BDB | −40 °C to +85 °C  | SSOP20   | plastic shrink small outline package; 20 leads; body width 5.3 mm  | SOT339-1 |
| 74LVT245BPW | −40 °C to +85 °C  | TSSOP20  | plastic thin shrink small outline package; 20 leads; body width 4.4 mm   | SOT360-1 |
| 74LVT245BBQ | −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

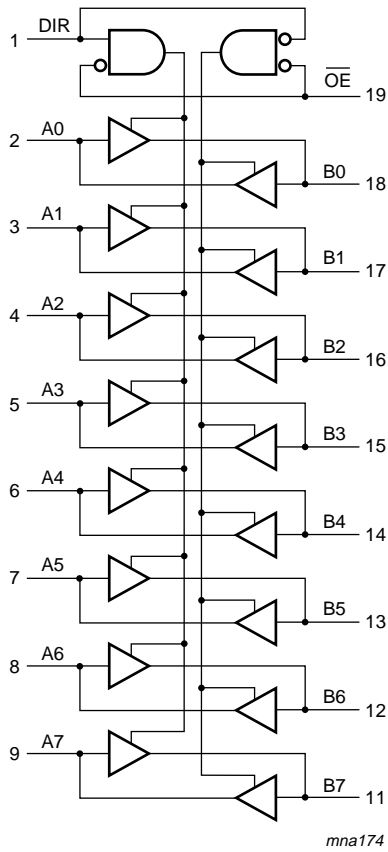


Fig 1. Logic diagram

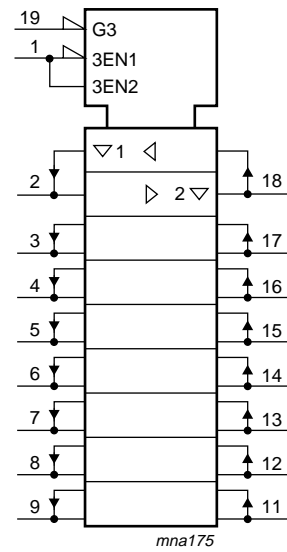
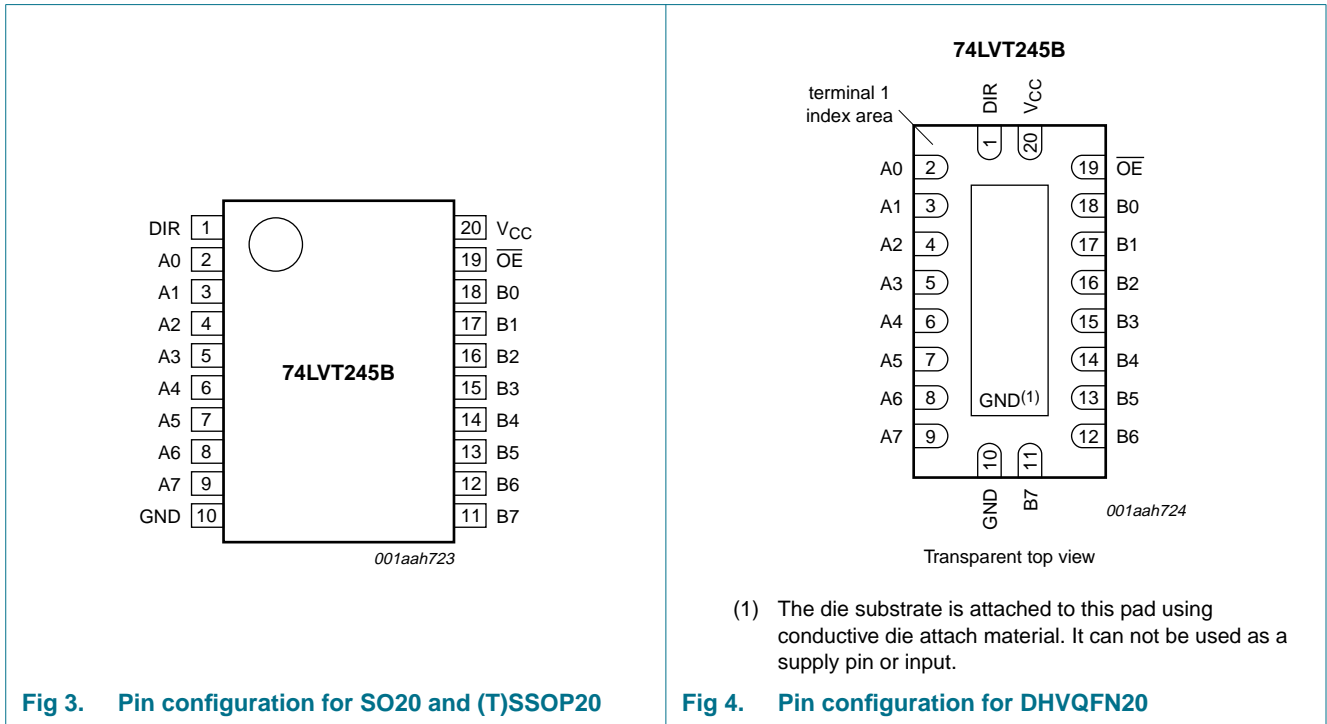


Fig 2. IEC logic symbol

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol          | Pin                            | Description                      |
|-----------------|--------------------------------|----------------------------------|
| DIR             | 1                              | direction control                |
| A0 to A7        | 2, 3, 4, 5, 6, 7, 8, 9         | data input/output                |
| GND             | 10                             | ground (0 V)                     |
| B0 to B7        | 18, 17, 16, 15, 14, 13, 12, 11 | data input/output                |
| OE              | 19                             | output enable input (active LOW) |
| V <sub>CC</sub> | 20                             | supply voltage                   |

## 6. Functional description

**Table 3. Function selection**

| Inputs          |     | Inputs/outputs |         |  |
|-----------------|-----|----------------|---------|--|
| $\overline{OE}$ | DIR | An             | Bn      |  |
| L               | L   | An = Bn        | inputs  |  |
| L               | H   | inputs         | Bn = An |  |
| H               | X   | Z              | 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).<sup>[1][2]</sup>

| Symbol    | Parameter               | Conditions                                 | Min                 | Max  | Unit |
|-----------|-------------------------|--|---------------------|------|------|
| $V_{CC}$  | supply voltage          |  | -0.5                | +4.6 | V    |
| $V_I$     | input voltage           |  | <sup>[3]</sup> -0.5 | +7.0 | V    |
| $V_O$     | output voltage          | output in OFF or HIGH state                | <sup>[3]</sup> -0.5 | +7.0 | V    |
| $I_{IK}$  | input clamping current  | $V_I < 0$                                  | -50                 | -    | mA   |
| $I_{OK}$  | output clamping current | $V_O < 0$                                  | -50                 | -    | mA   |
| $I_O$     | output current          | output in LOW state                        | -                   | 128  | mA   |
|           |                         | output in HIGH state                       | -64                 | -    | mA   |
| $T_{stg}$ | storage temperature     |  | -65                 | +150 | °C   |
| $T_j$     | junction temperature    |  | <sup>[2]</sup> -    | 150  | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | <sup>[4]</sup> -    | 500  | mW   |

- [1] Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- [2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.
- [3] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
- [4] For SO20 packages: above 70 °C derate linearly with 8 mW/K.  
 For SSOP20 and TSSOP20 packages: above 60 °C derate linearly with 5.5 mW/K.  
 For DHVQFN20 packages: above 60 °C derate linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol           | Parameter                           | Conditions  | Min | Max | Unit |
|------------------|-------------------------------------|---|-----|-----|------|
| V <sub>CC</sub>  | supply voltage                      |   | 2.7 | 3.6 | V    |
| V <sub>I</sub>   | input voltage                       |   | 0   | 5.5 | V    |
| I <sub>OH</sub>  | HIGH-level output current           |   | -   | -32 | mA   |
| I <sub>OL</sub>  | LOW-level output current            |   | -   | 32  | mA   |
|                  |                                     | current duty cycle ≤ 50 %; f <sub>i</sub> ≥ 1 kHz | -   | 64  | mA   |
| T <sub>amb</sub> | ambient temperature                 | in free air                                       | -40 | +85 | °C   |
| Δt/ΔV            | input transition rise and fall rate | output enabled                                    | 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      |                       |      | Unit |
|-----------------------|------------------------------------|---|-----------------------|-----------------------|------|------|
|                       |                                    |   | Min                   | Typ <sup>[1]</sup>    | Max  |      |
| V <sub>IK</sub>       | input clamping voltage             | V <sub>CC</sub> = 2.7 V; I <sub>IK</sub> = -18 mA   | -1.2                  | -0.9                  | -    | V    |
| V <sub>IH</sub>       | HIGH-level input voltage           |   | 2.0                   | -                     | -    | V    |
| V <sub>IL</sub>       | LOW-level input voltage            |   | -                     | -                     | 0.8  |      |
| V <sub>OH</sub>       | HIGH-level output voltage          | V <sub>CC</sub> = 2.7 V to 3.6 V; I <sub>OH</sub> = -100 μA   | V <sub>CC</sub> - 0.2 | V <sub>CC</sub> - 0.1 | -    | V    |
|                       |                                    | V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -8 mA  | 2.4                   | 2.5                   | -    |      |
|                       |                                    | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -32 mA   | 2.0                   | 2.2                   | -    | V    |
| V <sub>OL</sub>       | LOW-level output voltage           | V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 100 μA   |                       | 0.1                   | 0.2  | V    |
|                       |                                    | V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 24 mA  | -                     | 0.3                   | 0.5  | V    |
|                       |                                    | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA  | -                     | 0.25                  | 0.4  | V    |
|                       |                                    | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 32 mA  | -                     | 0.3                   | 0.5  | V    |
|                       |                                    | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 64 mA  | -                     | 0.4                   | 0.55 | V    |
| I <sub>I</sub>        | input leakage current              | control pins  |                       |                       |      |      |
|                       |                                    | V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V  | -                     | 1                     | 10   | μA   |
|                       |                                    | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND  | -                     | ±0.1                  | ±1   | μA   |
|                       |                                    | I/O data pins <sup>[2]</sup>  |                       |                       |      |      |
|                       |                                    | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V   | -                     | 1                     | 20   | μA   |
|                       |                                    | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub>   | -                     | 0.1                   | 1    | μA   |
|                       |                                    | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 0 V   | -5                    | -1                    | -    | μA   |
| I <sub>OFF</sub>      | power-off leakage current          | V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V  | -                     | 1                     | ±100 | μA   |
| I <sub>LO</sub>       | output leakage current             | V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.6 V; output HIGH  | -                     | 60                    | 125  | μA   |
| I <sub>O(pu/pd)</sub> | power-up/power-down output current | V <sub>CC</sub> ≤ 1.2 V V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; $\overline{OE}$ = don't care <sup>[3]</sup> | -                     | 15                    | ±100 | μA   |
| I <sub>BHL</sub>      | bus hold LOW current               | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V <sup>[4]</sup>  | 75                    | 150                   | -    | μA   |
| I <sub>BHH</sub>      | bus hold HIGH current              | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 2.0 V   | -150                  | -75                   | -    | μA   |
| I <sub>BHLO</sub>     | bus hold LOW overdrive current     | V <sub>CC</sub> = 0 V to 3.0 V; V <sub>I</sub> = 3.6 V  | 500                   | -                     | -    | 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 |                    |      | Unit |
|-------------------|---------------------------------|---|------------------|--------------------|------|------|
|                   |                                 |   | Min              | Typ <sup>[1]</sup> | Max  |      |
| I <sub>BHHO</sub> | bus hold HIGH overdrive current | V <sub>CC</sub> = 0 V to 3.0 V; V <sub>I</sub> = 3.6 V  | -                | -                  | -500 | μA   |
| I <sub>CC</sub>   | supply current                  | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A  |                  |                    |      |      |
|                   |                                 | outputs HIGH  | -                | 0.13               | 0.19 | mA   |
|                   |                                 | outputs LOW   | -                | 3                  | 12   | mA   |
|                   |                                 | outputs disabled  | -                | 0.13               | 0.19 | mA   |
| ΔI <sub>CC</sub>  | additional supply current       | per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V; one input = V <sub>CC</sub> - 0.6 V others = V <sub>CC</sub> or GND <sup>[5]</sup> | -                | 0.1                | 0.2  | mA   |
| C <sub>I</sub>    | input capacitance               | DIR and $\overline{OE}$ inputs; V <sub>I</sub> = 0 V or 3.0 V   | -                | 4                  | -    | pF   |
| C <sub>I/O</sub>  | input/output capacitance        | at input/output data pins, outputs disabled; V <sub>I/O</sub> = 0 V or 3.0 V  | -                | 10                 | -    | pF   |

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

[2] Unused pins at V<sub>CC</sub> or GND.

[3] This parameter is valid for any V<sub>CC</sub> between 0 V and 1.2 V with a transition time of up to 10 ms. From V<sub>CC</sub> = 1.2 V to V<sub>CC</sub> = 3.6 V a transition time of 100 ms is permitted. This parameter is valid for T<sub>amb</sub> = +25 °C only.

[4] This is the bus hold overdrive current required to force the input to the opposite logic state.

[5] This is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.

## 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 |                    |     | Unit |
|------------------|-------------------------------------|---------------------------------|------------------|--------------------|-----|------|
|                  |                                     |                                 | Min              | Typ <sup>[1]</sup> | Max |      |
| t <sub>PLH</sub> | LOW to HIGH propagation delay       | An to Bn or Bn to An            |                  |                    |     |      |
|                  |                                     | V <sub>CC</sub> = 2.7 V         | -                | -                  | 4.0 | ns   |
|                  |                                     | V <sub>CC</sub> = 3.3 V ± 0.3 V | 1.2              | 2.4                | 3.5 | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay       | An to Bn or Bn to An            |                  |                    |     |      |
|                  |                                     | V <sub>CC</sub> = 2.7 V         | -                | -                  | 4.0 | ns   |
|                  |                                     | V <sub>CC</sub> = 3.3 V ± 0.3 V | 1.2              | 2.4                | 3.5 | ns   |
| t <sub>PZH</sub> | OFF-state to HIGH propagation delay | see <a href="#">Figure 6</a>    |                  |                    |     |      |
|                  |                                     | V <sub>CC</sub> = 2.7 V         | -                | -                  | 7.1 | ns   |
|                  |                                     | V <sub>CC</sub> = 3.3 V ± 0.3 V | 1.3              | 3.3                | 5.5 | ns   |
| t <sub>PZL</sub> | OFF-state to LOW propagation delay  | see <a href="#">Figure 6</a>    |                  |                    |     |      |
|                  |                                     | V <sub>CC</sub> = 2.7 V         | -                | -                  | 6.5 | ns   |
|                  |                                     | V <sub>CC</sub> = 3.3 V ± 0.3 V | 1.7              | 3.2                | 5.5 | ns   |
| t <sub>PHZ</sub> | HIGH to OFF-state propagation delay | see <a href="#">Figure 6</a>    |                  |                    |     |      |
|                  |                                     | V <sub>CC</sub> = 2.7 V         | -                | -                  | 6.5 | ns   |
|                  |                                     | V <sub>CC</sub> = 3.3 V ± 0.3 V | 2.2              | 3.6                | 5.9 | ns   |

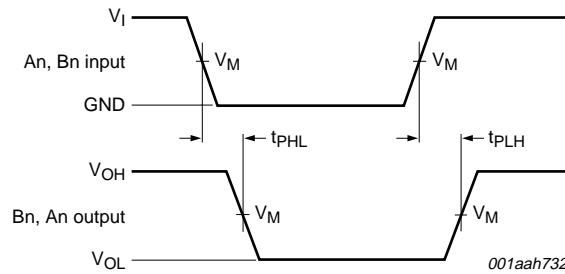
**Table 7. Dynamic characteristics ...continued**

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

| Symbol           | Parameter                          | Conditions                      | -40 °C to +85 °C |                    |     | Unit |
|------------------|------------------------------------|---------------------------------|------------------|--------------------|-----|------|
|                  |                                    |                                 | Min              | Typ <sup>[1]</sup> | Max |      |
| t <sub>PLZ</sub> | LOW to OFF-state propagation delay | see <a href="#">Figure 6</a>    |                  |                    |     |      |
|                  |                                    | V <sub>CC</sub> = 2.7 V         | -                | -                  | 5.1 | ns   |
|                  |                                    | V <sub>CC</sub> = 3.3 V ± 0.3 V | 2.2              | 3.4                | 5.0 | ns   |

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

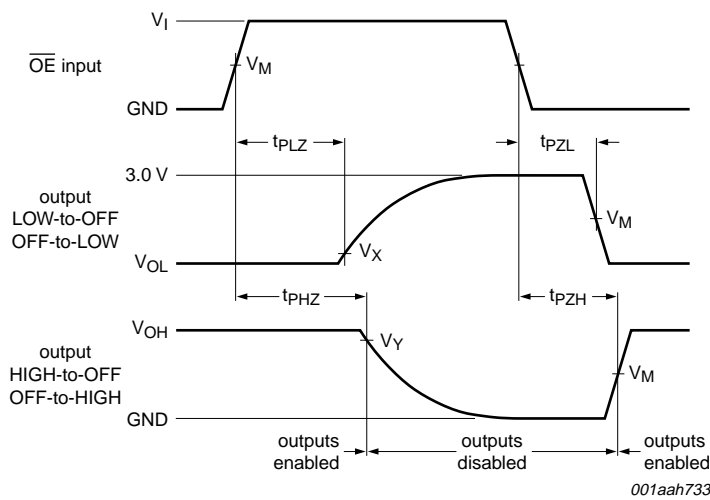
## 11. Waveforms



See [Table 8](#) for measurement points.

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

**Fig 5. Input (An, Bn) to output (Bn, An) propagation delays and output transition times**



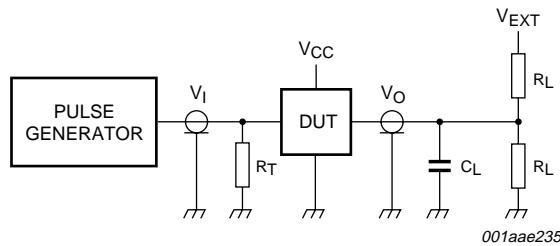
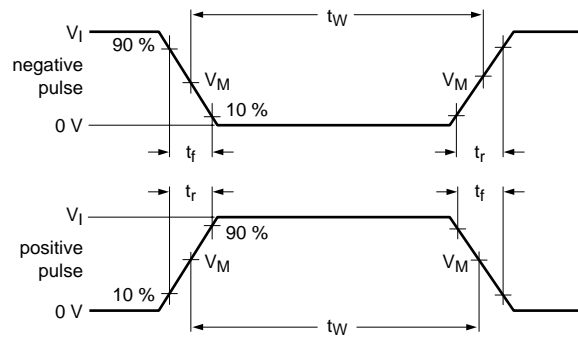
See [Table 8](#) for measurement points.

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

**Fig 6. 3-state output enable and disable times**

Table 8. Measurement points

| V <sub>CC</sub> | Input           |                | Output         |                         |                         |
|-----------------|-----------------|----------------|----------------|-------------------------|-------------------------|
|                 | V <sub>IN</sub> | V <sub>M</sub> | V <sub>M</sub> | V <sub>x</sub>          | V <sub>y</sub>          |
| 2.7 V to 3.6 V  | GND to 2.7 V    | 1.5 V          | 1.5 V          | V <sub>OL</sub> + 0.3 V | V <sub>OH</sub> - 0.3 V |



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

Definitions test circuit:

R<sub>L</sub> = Load resistance;

C<sub>L</sub> = Load capacitance including jig and probe capacitance;

R<sub>T</sub> = Termination resistance should be equal to output impedance Z<sub>o</sub> of the pulse generator;

V<sub>EXT</sub> = External voltage for measuring switching times.

Fig 7. Test circuit for switching times

Table 9. Test data

| Input          |                |                |                                 | Load           |                | V <sub>EXT</sub>                    |                                     |                                     |
|----------------|----------------|----------------|---------------------------------|----------------|----------------|-------------------------------------|-------------------------------------|-------------------------------------|
| V <sub>I</sub> | f <sub>i</sub> | t <sub>w</sub> | t <sub>r</sub> , t <sub>f</sub> | R <sub>L</sub> | C <sub>L</sub> | t <sub>PHZ</sub> , t <sub>PZH</sub> | t <sub>PLZ</sub> , t <sub>PZL</sub> | t <sub>PLH</sub> , t <sub>PHL</sub> |
| 2.7 V          | ≤ 10 MHz       | 500 ns         | ≤ 2.5 ns                        | 500 Ω          | 50 pF          | GND                                 | 6 V                                 | open                                |



12. Package outline

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

SOT163-1

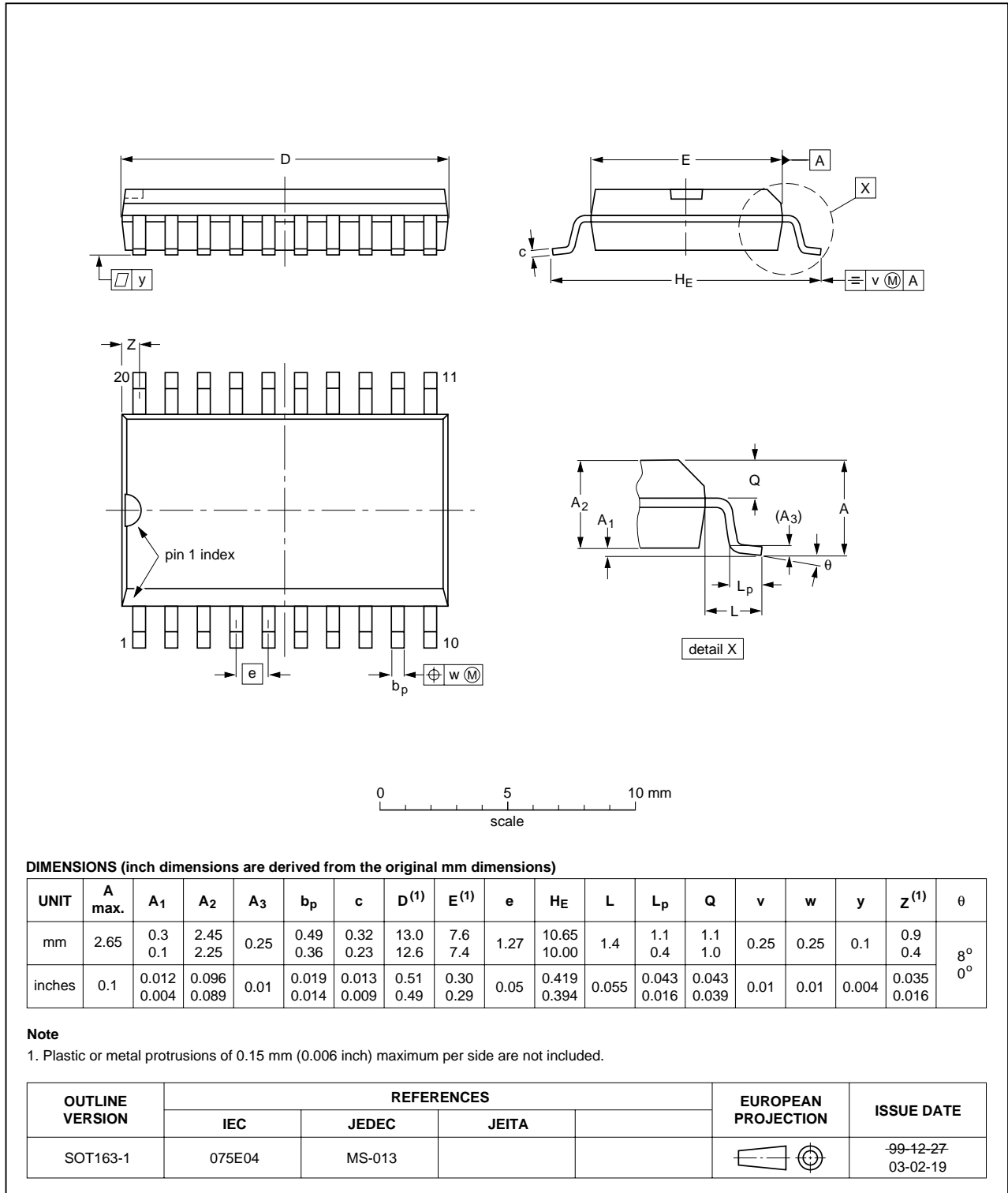


Fig 8. Package outline SOT163-1 (SO20)

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

SOT339-1

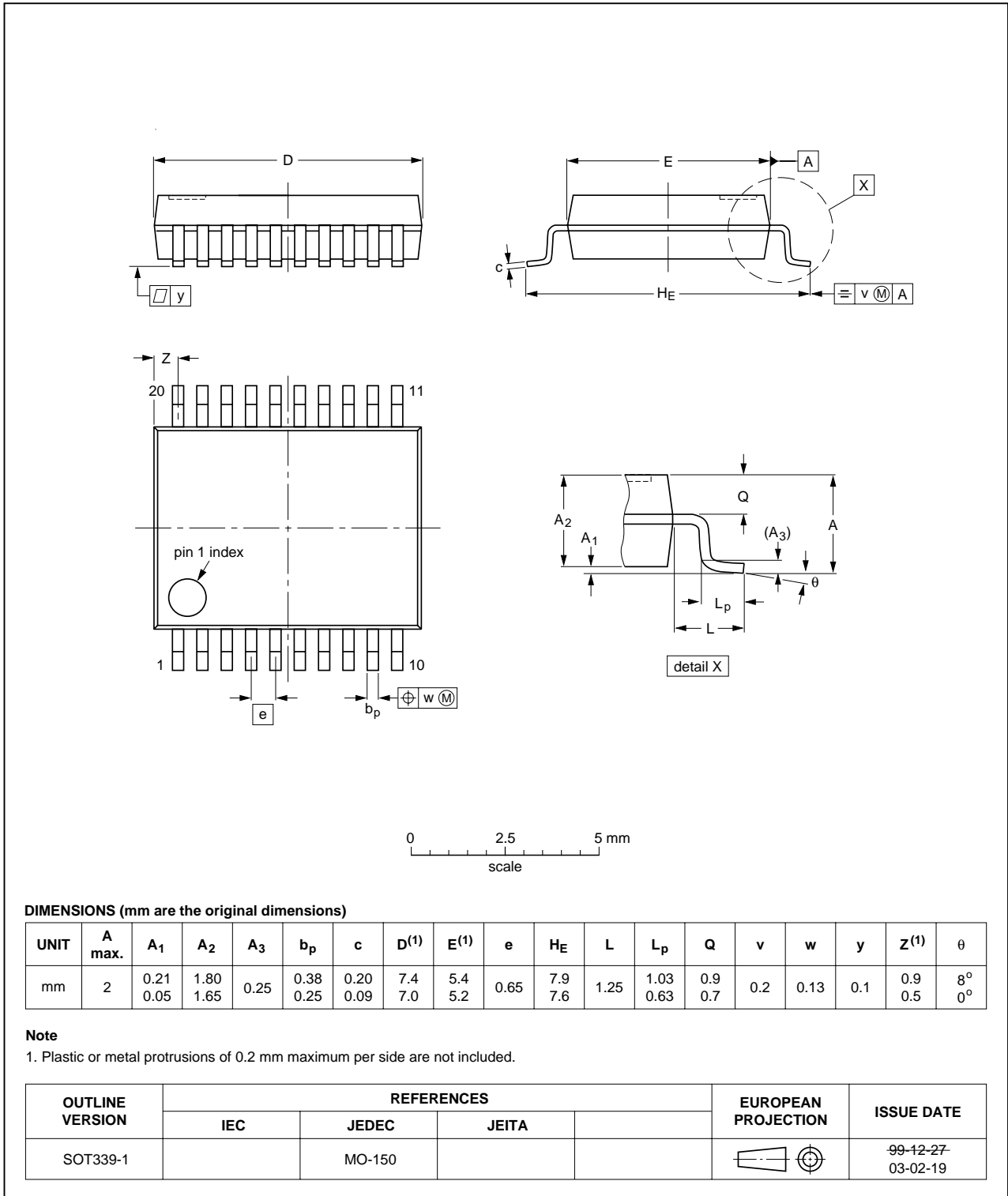


Fig 9. Package outline SOT339-1 (SSOP20)

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

SOT360-1

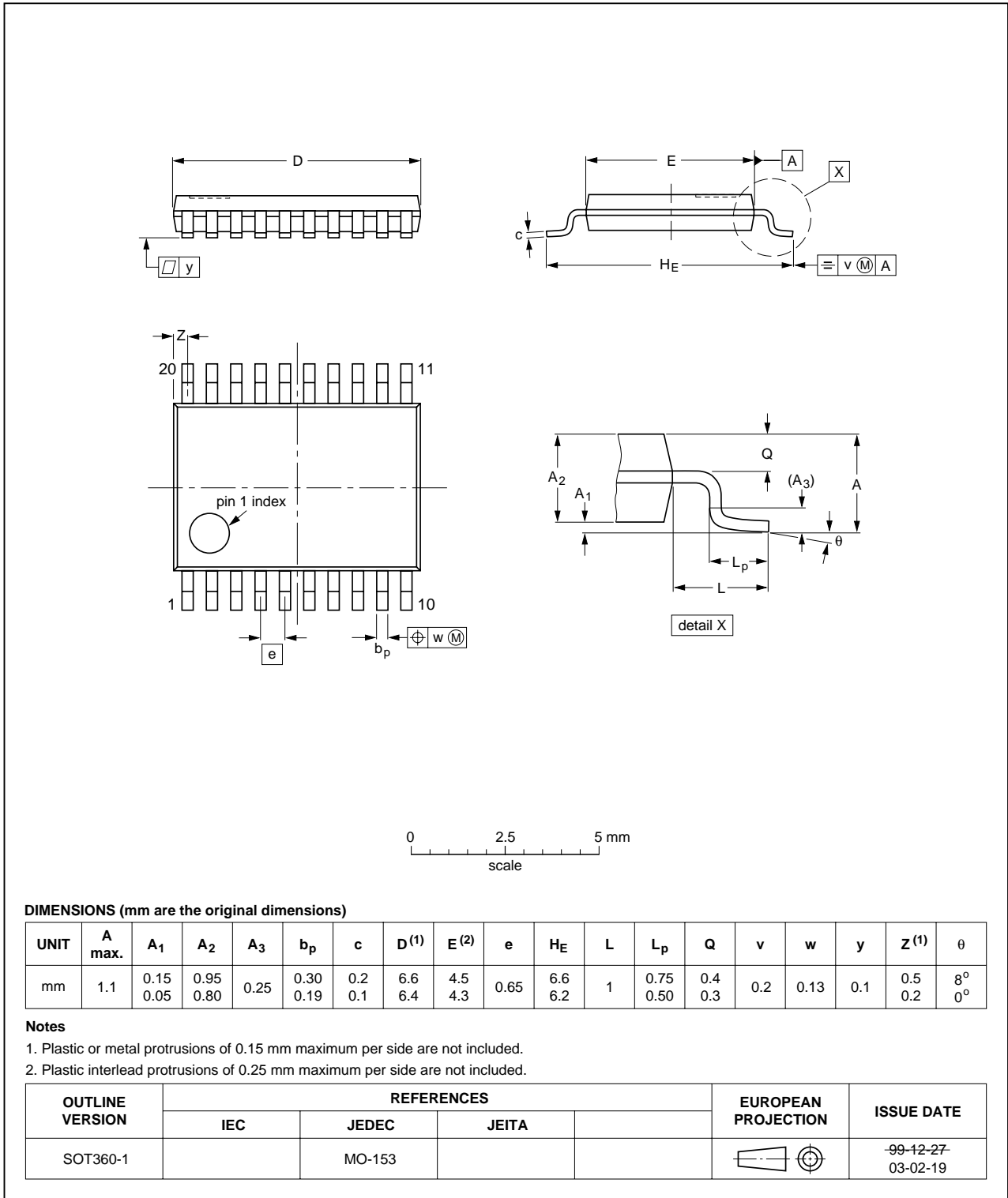


Fig 10. Package outline SOT360-1 (TSSOP20)

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

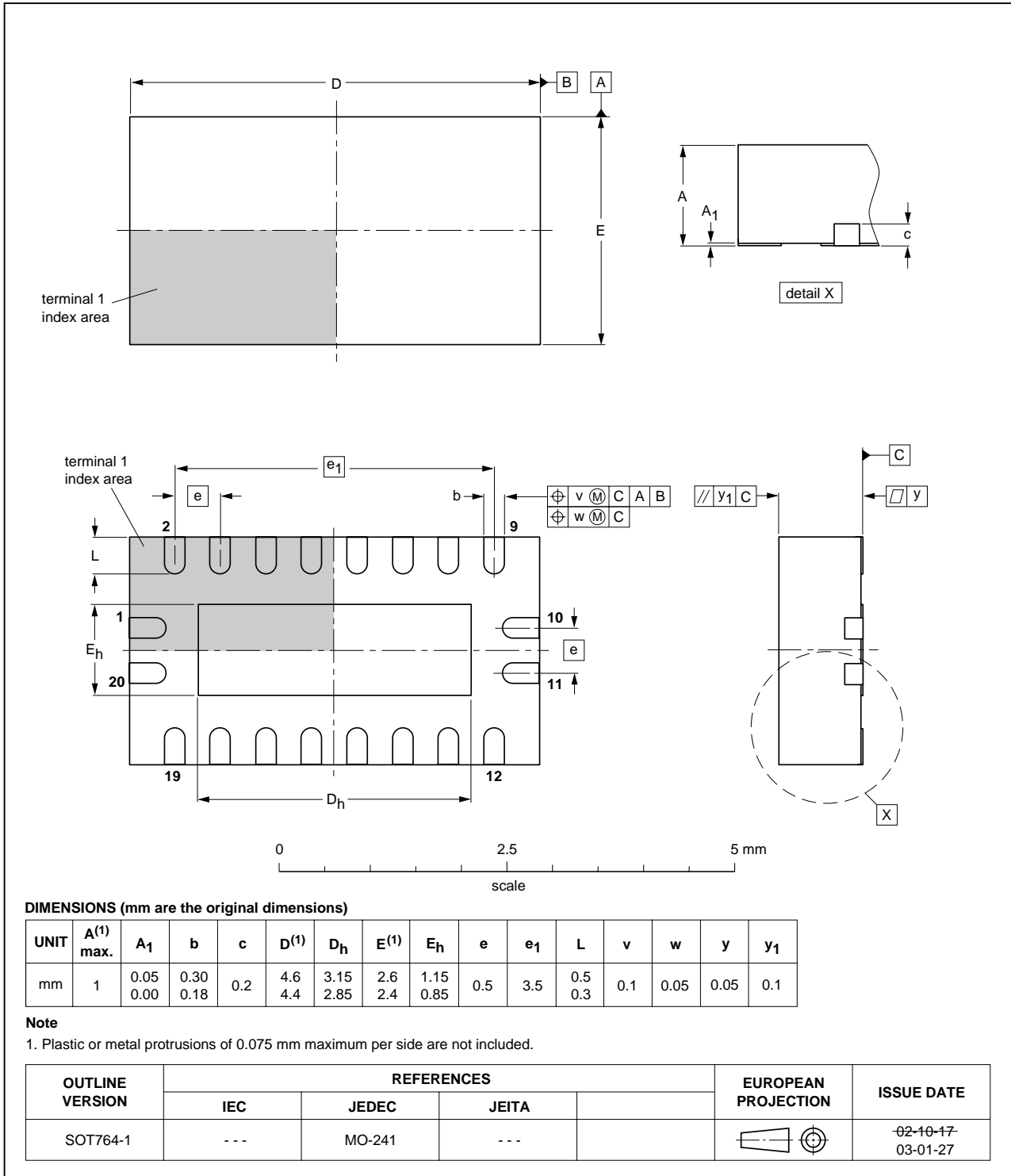


Fig 11. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

Table 10. Abbreviations

| Acronym | Description                                     |
|---------|---|
| BiCMOS  | Bipolar 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  |
|----------------|--|-----------------------|---------------|-------------|
| 74LVT245B_2    | 20080508   | Product data sheet    | ECN07_046     | 74LVT245B_1 |
| Modifications: | <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><li>• DHVQFN20 package added to <a href="#">Section 3 “Ordering information”</a> and <a href="#">Section 12 “Package outline”</a></li></ul> |                       |               |             |
| 74LVT245B_1    | 19990319   | 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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**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

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