

# DATA SHEET

## **CBTS3384**

10-bit bus switch with 5-bit output enables  
and Schottky undershoot protection

Product data  
Supersedes data of 2001 Feb 13

2002 Dec 13

# 10-bit bus switch with 5-bit output enables and Schottky undershoot protection

CBTS3384

## FEATURES

- 5  $\Omega$  switch connection between two ports
- TTL compatible control input and output levels
- Undershoot protection included to prevent shoot through level changes
- Latch-up protection exceeds 500 mA per JESD78
- ESD protection exceeds 2000 V HBM per JESD22-A114, 200 V MM per JESD22-A115 and 1000 V CDM per JESD22-C101

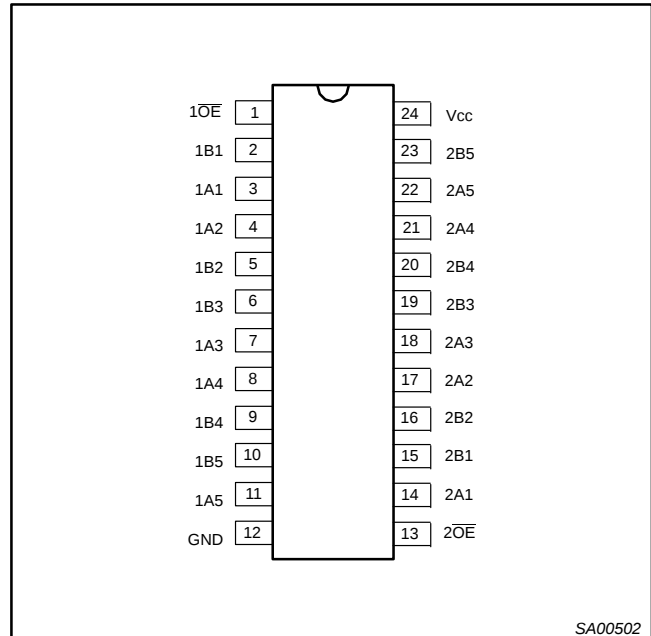
## DESCRIPTION

The CBTS3384 provides ten bits of high-speed TTL-compatible bus switching. The low on-state resistance of the switch allows connections to be made with minimal propagation delay.

The CBTS3384 device is organized as two 5-bit bus switches with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is LOW, the switch is on and port A is connected to B. When  $\overline{OE}$  is HIGH, the switch is open and high-impedance state exists between the two ports.

The CBTS3384 is characterized for operation from -40 to +85 °C.

## PIN CONFIGURATION



SA00502

## PIN DESCRIPTION

| PIN NUMBER         | SYMBOL                           | NAME AND FUNCTION       |
|--------------------|----------------------------------|-------------------------|
| 1, 13              | $\overline{1OE}, \overline{2OE}$ | Output enables          |
| 3, 4, 7, 8, 11     | 1A1-1A5                          | Inputs                  |
| 14, 17, 18, 21, 22 | 2A1-2A5                          | Inputs                  |
| 2, 5, 6, 9, 10     | 1B1-1B5                          | Outputs                 |
| 15, 16, 19, 20, 23 | 2B1-2B5                          | Outputs                 |
| 12                 | GND                              | Ground (0 V)            |
| 24                 | V <sub>CC</sub>                  | Positive supply voltage |

## QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                     | CONDITIONS<br>$T_{amb} = 25\text{ °C}; GND = 0\text{ V}$ | TYPICAL | UNIT          |
|------------------------|-------------------------------|----------------------------------------------------------|---------|---------------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>An to Yn | $C_L = 50\text{ pF}; V_{CC} = 5\text{ V}$                | 250     | ps            |
| $C_{IN}$               | Input capacitance             | $V_I = 0\text{ V or } V_{CC}$                            | 4       | pF            |
| $C_{OUT}$              | Output capacitance            | Outputs disabled; $V_O = 0\text{ V or } V_{CC}$          | 10      | pF            |
| $I_{CCZ}$              | Total supply current          | Outputs disabled; $V_{CC} = 5.5\text{ V}$                | 3       | $\mu\text{A}$ |

## ORDERING INFORMATION

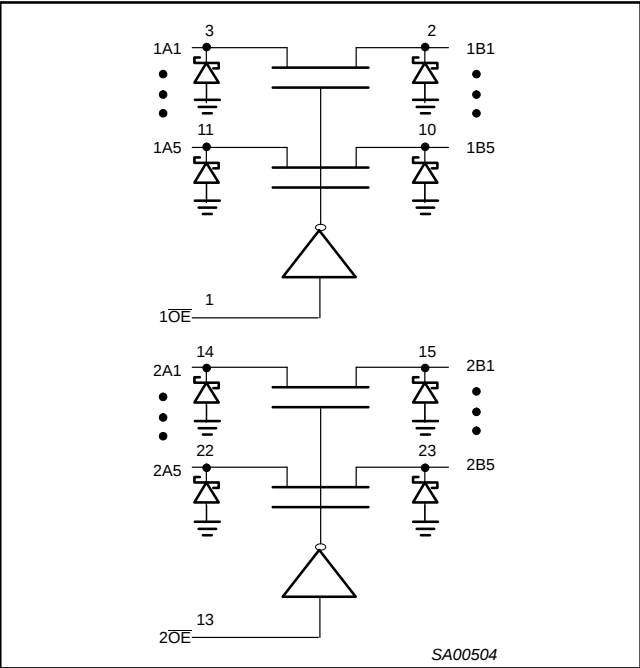
| PACKAGES                   | TEMPERATURE RANGE | ORDER CODE | DWG NUMBER |
|----------------------------|-------------------|------------|------------|
| 24-Pin Plastic SO          | -40 to +85 °C     | CBTS3384D  | SOT137-1   |
| 24-Pin Plastic SSOP        | -40 to +85 °C     | CBTS3384DB | SOT340-1   |
| 24-Pin Plastic SSOP (QSOP) | -40 to +85 °C     | CBTS3384DK | SOT556-1   |
| 24-Pin Plastic TSSOP       | -40 to +85 °C     | CBTS3384PW | SOT355-1   |

Standard packing quantities and other packaging data is available at [www.philipslogic.com/packaging](http://www.philipslogic.com/packaging).

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LOGIC SYMBOL



FUNCTION TABLE

| INPUTS |     | OUTPUTS |         |
|--------|-----|---------|---------|
| 1OE    | 2OE | 1A, 1B  | 2A, 2B  |
| L      | L   | 1A = 1B | 2A = 2B |
| L      | H   | 1A = 1B | Z       |
| H      | L   | Z       | 2A = 2B |
| H      | H   | Z       | Z       |

H = High voltage level  
L = Low voltage level  
Z = High impedance "off" state

ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>

| SYMBOL           | PARAMETER                     | CONDITIONS         | RATING       | UNIT |
|------------------|-------------------------------|--------------------|--------------|------|
| V <sub>CC</sub>  | DC supply voltage             |                    | -0.5 to +7.0 | V    |
| I <sub>IK</sub>  | DC input diode current        |                    | -50          | mA   |
| V <sub>I</sub>   | DC input voltage <sup>3</sup> |                    | -1.2 to +7.0 | V    |
| I <sub>SW</sub>  | DC output diode current       | V <sub>O</sub> < 0 | ±128         | mA   |
| T <sub>stg</sub> | Storage temperature range     |                    | -65 to +150  | °C   |

NOTES:

- 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.
- 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.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

| SYMBOL           | PARAMETER                            | LIMITS |     | UNIT |
|------------------|--------------------------------------|--------|-----|------|
|                  |                                      | Min    | Max |      |
| V <sub>CC</sub>  | DC supply voltage                    | 4.5    | 5.5 | V    |
| V <sub>IH</sub>  | High-level input voltage             | 2.0    |     | V    |
| V <sub>IL</sub>  | Low-level Input voltage              |        | 0.8 | V    |
| T <sub>amb</sub> | Operating free-air temperature range | -40    | +85 | °C   |

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## DC ELECTRICAL CHARACTERISTICS

| SYMBOL                       | PARAMETER                                            | TEST CONDITIONS                                                                                          | LIMITS                           |                  |      | UNIT |
|------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------|------------------|------|------|
|                              |                                                      |                                                                                                          | T <sub>amb</sub> = -40 to +85 °C |                  |      |      |
|                              |                                                      |                                                                                                          | Min                              | Typ <sup>1</sup> | Max  |      |
| V <sub>IK</sub>              | Input clamp voltage                                  | V <sub>CC</sub> = 4.5 V; I <sub>I</sub> = -18 mA                                                         | —                                | —                | -1.2 | V    |
| I <sub>I</sub>               | Input leakage current                                | V <sub>CC</sub> = 5.5 V; V <sub>I</sub> = GND or 5.5 V                                                   | —                                | —                | ±1   | μA   |
| I <sub>CC</sub>              | Quiescent supply current <sup>2</sup>                | V <sub>CC</sub> = 5.5 V; I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND                     | —                                | —                | 3    | μA   |
| ΔI <sub>CC</sub>             | Additional supply current per input pin <sup>2</sup> | V <sub>CC</sub> = 5.5 V, one input at 3.4 V, other inputs at V <sub>CC</sub> or GND                      | —                                | —                | 2.5  | mA   |
| C <sub>I</sub>               | Control pins                                         | V <sub>I</sub> = 3.0 V or 0                                                                              | —                                | 4                | —    | pF   |
| C <sub>I(OFF)</sub>          | Power-off leakage current                            | V <sub>O</sub> = 3.0 V or 0, $\overline{\text{OE}}$ = V <sub>CC</sub>                                    | —                                | 10               | —    | pF   |
| r <sub>on</sub> <sup>3</sup> | On-resistance                                        | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = 0 V; I <sub>I</sub> = 64 mA                                    | —                                | 5                | 7    | Ω    |
|                              |                                                      | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = 0 V; I <sub>I</sub> = 30 mA                                    | —                                | 5                | 7    |      |
|                              |                                                      | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = 2.4 V; I <sub>I</sub> = -15 mA                                 | —                                | 10               | 15   |      |
| V <sub>P</sub>               | Pass voltage                                         | V <sub>I</sub> = V <sub>CC</sub> = 5.0 V; I <sub>O</sub> = -100 μA                                       | 3.4                              | 3.6              | 3.9  | V    |
| I <sub>UCP</sub>             | Undershoot static current protection                 | V <sub>CC</sub> = 5.0 V, I <sub>B</sub> = 400 μA; $\overline{\text{OE}}$ = 5.0 V; V <sub>B</sub> ≥ 3.0 V | —                                | 8                | —    | mA   |

### NOTES:

1. All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .
2. This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.
3. Measured by the voltage drop between the A and the B terminals at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two (A or B) terminals.

## AC CHARACTERISTICS

GND = 0 V;  $t_R$ ;  $C_L = 50 \text{ pF}$ 

| SYMBOL           | PARAMETER                                   | FROM<br>(INPUT) | TO<br>(OUTPUT) | LIMITS                          |      | UNIT |
|------------------|---------------------------------------------|-----------------|----------------|---------------------------------|------|------|
|                  |                                             |                 |                | V <sub>CC</sub> = +5.0 V ±0.5 V |      |      |
|                  |                                             |                 |                | Min                             | Max  |      |
| t <sub>pd</sub>  | Propagation delay <sup>1</sup>              | A or B          | B or A         | —                               | 0.25 | ns   |
| t <sub>en</sub>  | Output enable time to High and Low level    | $\overline{OE}$ | A or B         | 1.0                             | 5.7  | ns   |
| t <sub>dis</sub> | Output disable time from High and Low level | $\overline{OE}$ | A or B         | 1.0                             | 5.2  | ns   |

### NOTE:

1. This parameter is warranted but not production tested. The propagation delay is based on the RC time constant of the typical on-state resistance of the switch and a load capacitance of 50 pF, when driven by an ideal voltage source (zero output impedance).

| SYMBOL           | PARAMETER DESCRIPTION              | LIMITS                                         |      |      | UNIT |
|------------------|------------------------------------|------------------------------------------------|------|------|------|
|                  |                                    | -40 to +85° C<br>V <sub>CC</sub> = 5 V, ±0.5 V |      |      |      |
|                  |                                    | MIN.                                           | MEAN | MAX. |      |
| t <sub>PD</sub>  | Propagation delay (see Note 1)     | —                                              | —    | 250  | pS   |
| t <sub>PZH</sub> | Output enable time to High level   | 1.6                                            | 3.4  | 5.6  | nS   |
| t <sub>PHZ</sub> | Output enable time from High level | 1.7                                            | 3.3  | 5.5  | nS   |
| t <sub>PZL</sub> | Output enable time to Low level    | 2.3                                            | 4    | 6    | nS   |
| t <sub>PLZ</sub> | Output enable time from Low level  | 2.5                                            | 4.5  | 6.6  | nS   |

### NOTE:

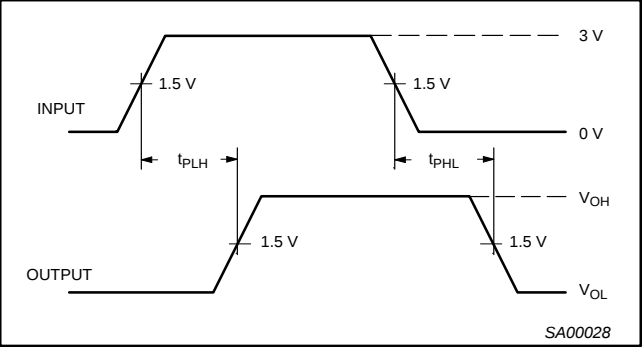
1. This parameter is warranted but not production tested. The propagation delay is based on the RC time constant of the typical on-state resistance of the switch and a load capacitance of 50 pF, when driven by an ideal voltage source (zero output impedance); at  $+25 \text{ }^{\circ}\text{C}$ .

10-bit bus switch with 5-bit output enables  
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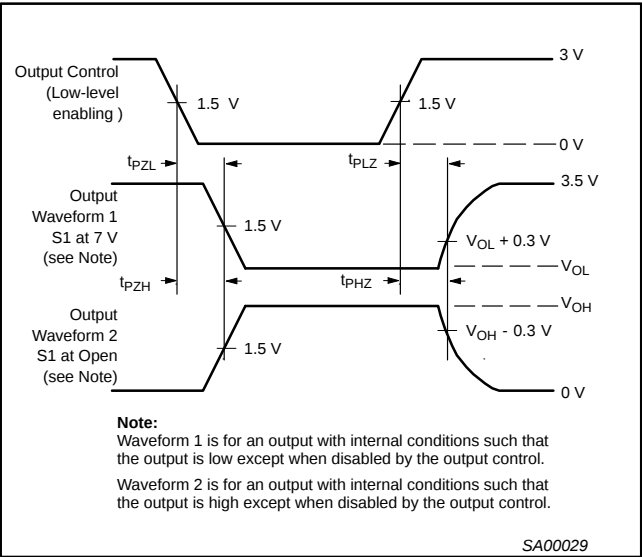
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AC WAVEFORMS

$V_M = 1.5\text{ V}$ ,  $V_{IN} = \text{GND to } 3.0\text{ V}$



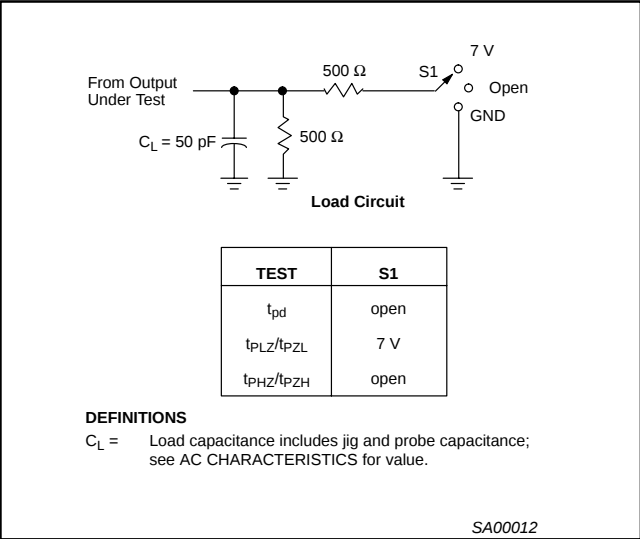
Waveform 1. Input (An) to Output (Yn) Propagation Delays



**Note:**  
Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.  
Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.

Waveform 2. 3-State Output Enable and Disable Times

TEST CIRCUIT AND WAVEFORMS



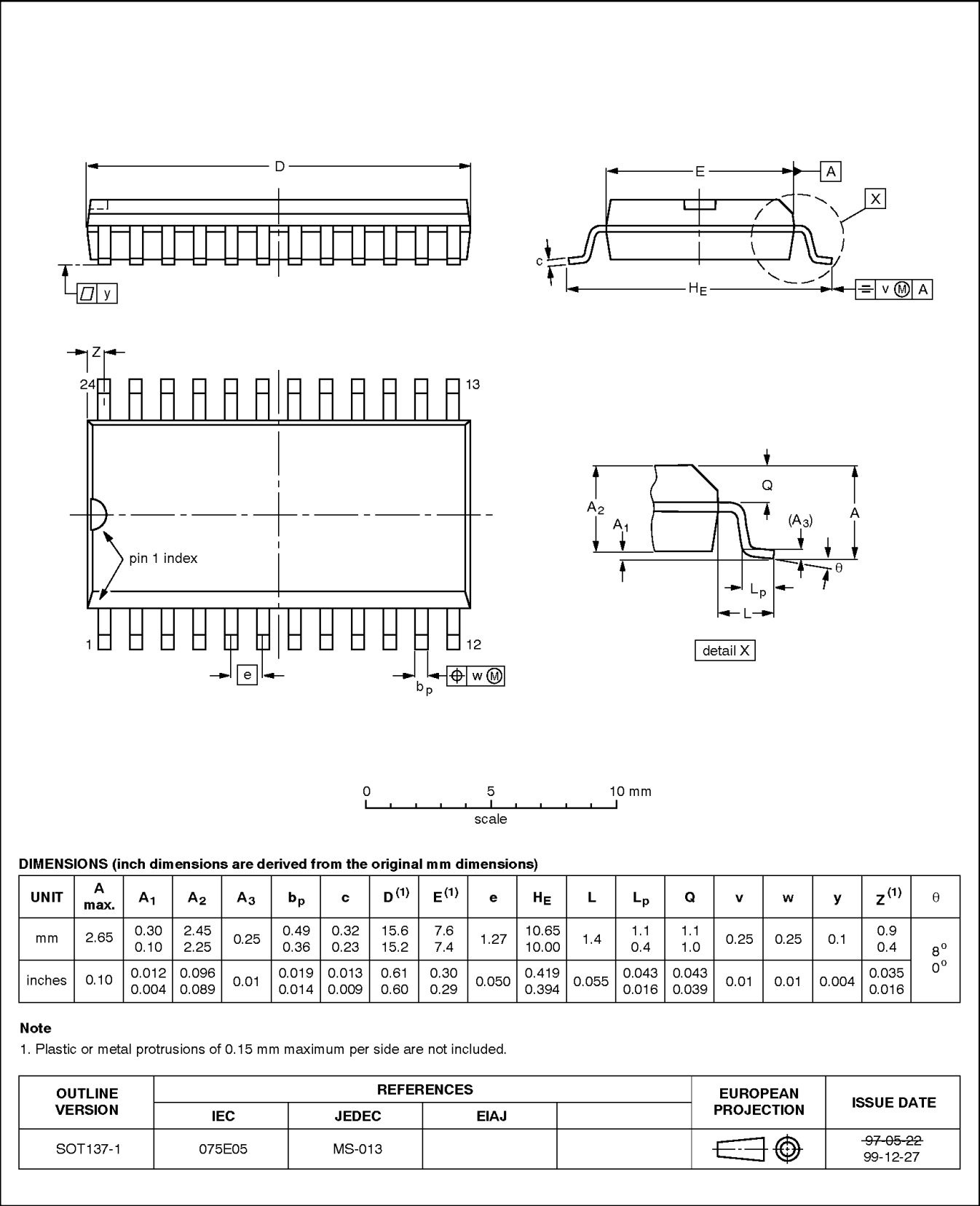
- NOTES:**
1. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\text{ }\Omega$ ,  $t_r \leq 2.5\text{ ns}$ ,  $t_f \leq 2.5\text{ ns}$ .
  2. The outputs are measured one at a time with one transition per measurement.

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SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1

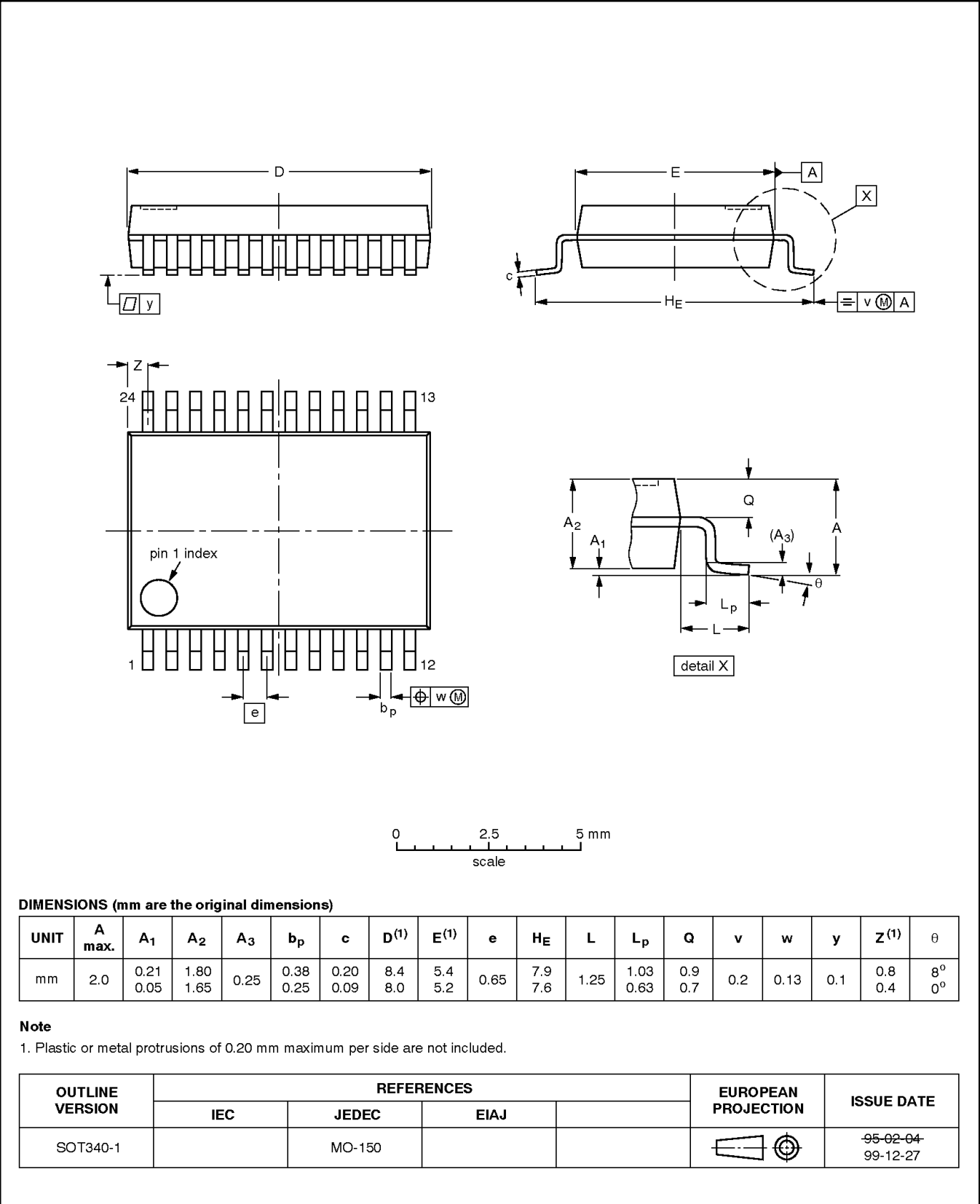


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SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1

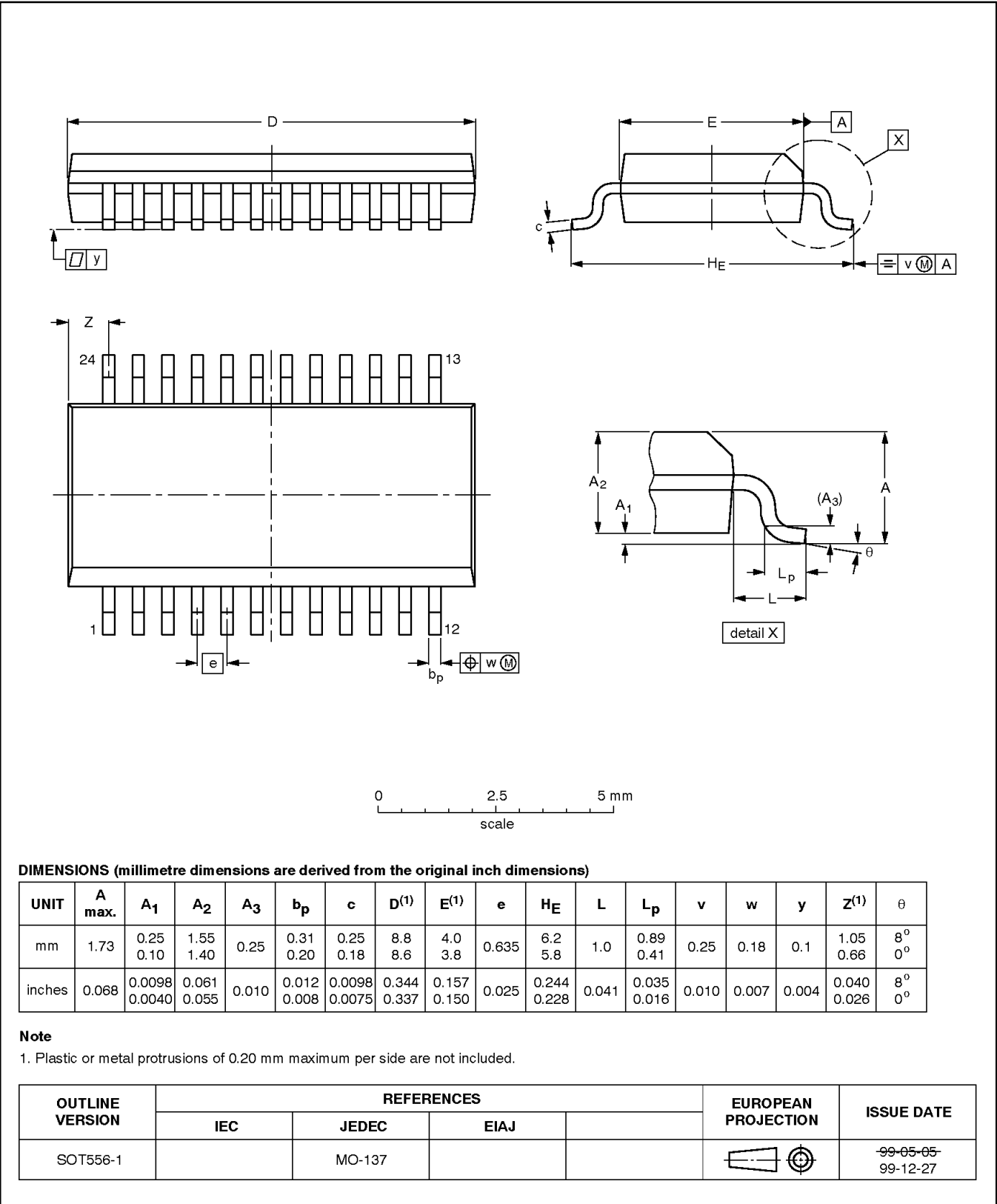


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SSOP24: plastic shrink small outline package; 24 leads;  
body width 3.9 mm; lead pitch 0.635 mm

SOT556-1

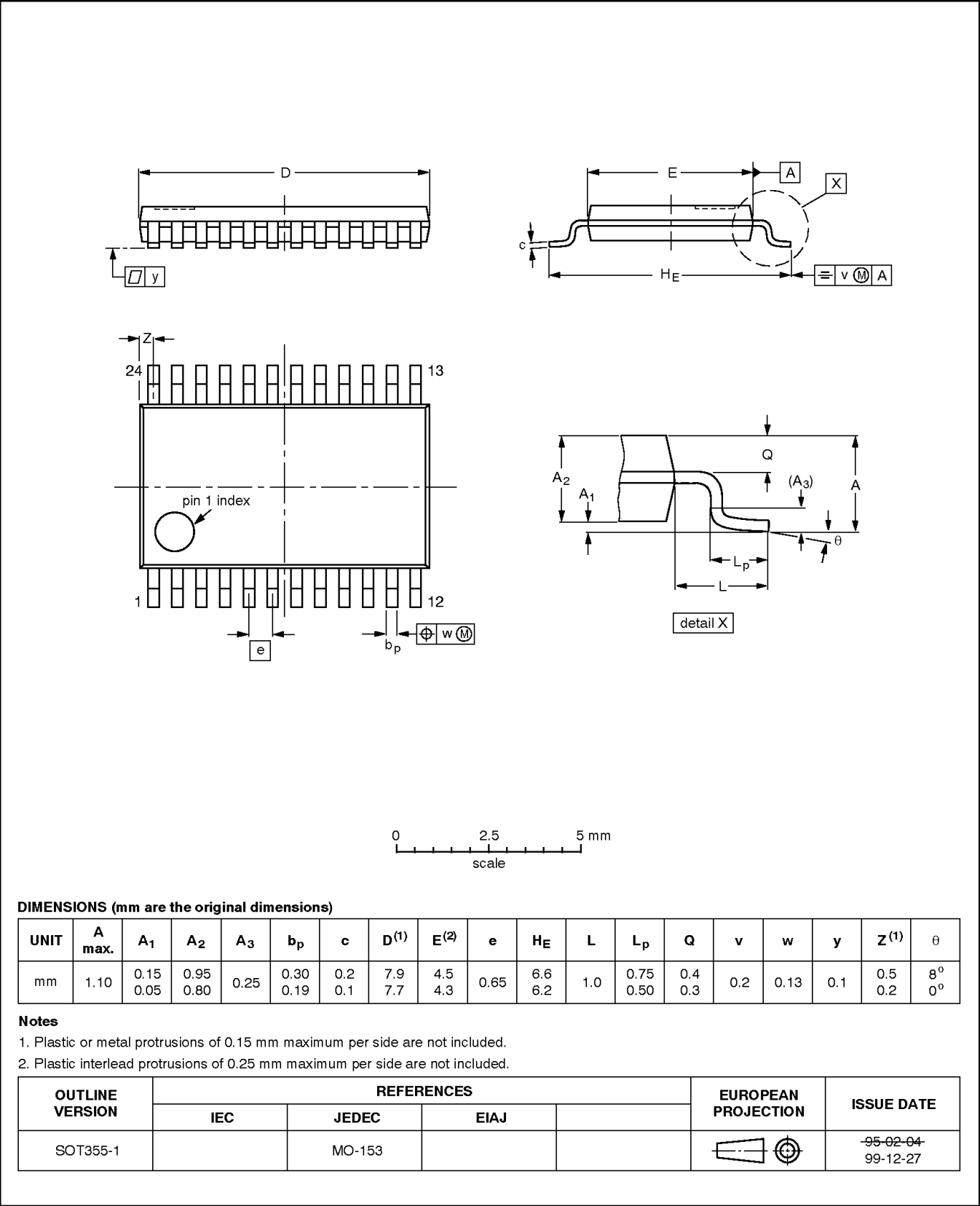


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TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1



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**CBTS3384****REVISION HISTORY**

| Rev | Date     | Description                                                                                                                                                     |
|-----|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| _2  | 20021213 | Product data (9397 750 09249); ECN 853-2238 27501 of 20 December 2001.<br>Modifications: <ul style="list-style-type: none"><li>• New package release.</li></ul> |
| _1  | 20010213 | Product data (9397 750 08073); ECN 853-2238 25635 of 13 February 2001.                                                                                          |

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## Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | Definitions                                                                                                                                                                                                                                                                                    |
|-------|----------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | Objective data                   | Development                       | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                    |
| II    | Preliminary data                 | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
| III   | Product data                     | Production                        | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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