



CBTD3384

10-bit level shifting bus switch with 5-bit output enables

Rev. 11 — 20 October 2023

Product data sheet

1. General description

The CBTD3384 is a dual 5-pole, single-throw bus switch. The device features two output enable inputs ($n\overline{OE}$) that each control five switch channels. The switches are disabled when the associated $n\overline{OE}$ input is HIGH. CBTD3384 is specifically designed for 5 V to 3.3 V level shifting applications. This device is fully specified for partial power down applications using I_{OFF} .

2. Features and benefits

- Designed to be used in 5 V to 3.3 V level shifting applications with internal diode
- 5 Ω switch connection between two ports
- Direct interface with TTL levels
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up protection exceeds 100 mA per JESD78
- ESD protection:
 - HBM JESD22-A114E exceeds 2000 V
 - CDM JESD22-C101C exceeds 1000 V
- Specified from -40 °C to +85 °C

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|----------------------------|-------------------|---------|--|--------------------------|
| | Temperature range | Name | Description | Version |
| CBTD3384D | -40 °C to +85 °C | SO24 | plastic small outline package; 24 leads; body width 7.5 mm | SOT137-1 |
| CBTD3384PW | -40 °C to +85 °C | TSSOP24 | plastic thin shrink small outline package; 24 leads; body width 4.4 mm | SOT355-1 |

4. Functional diagram

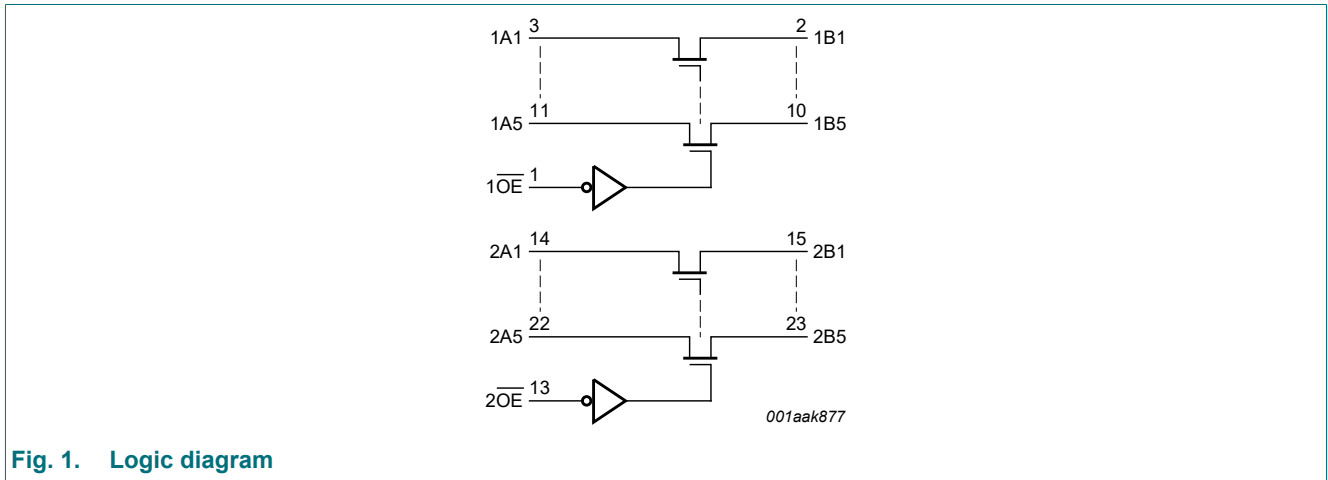
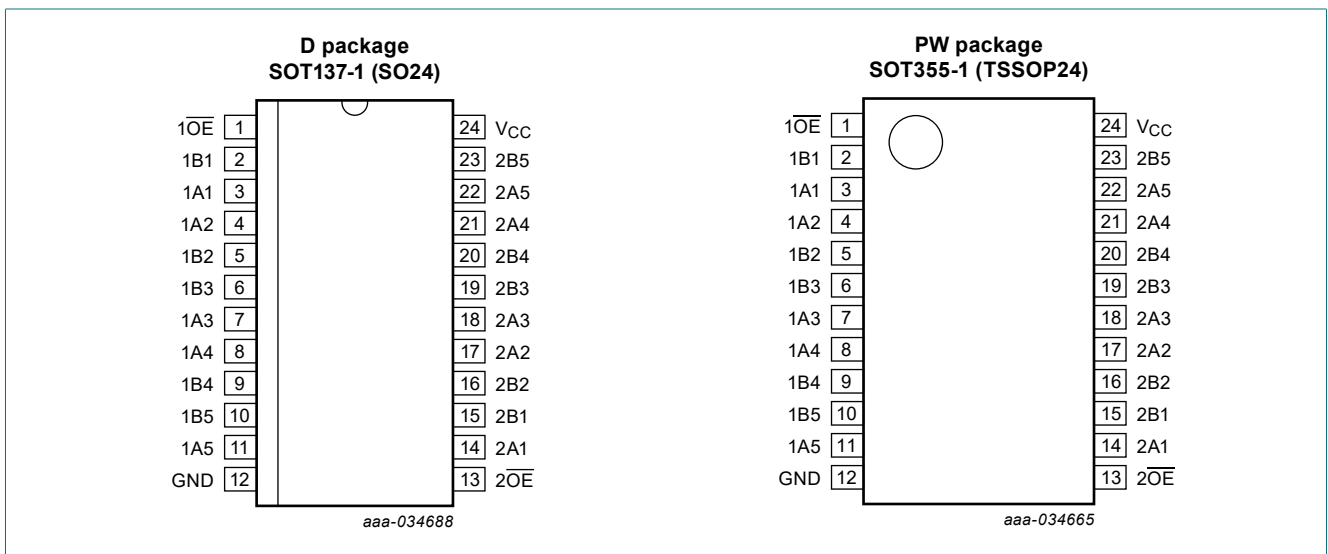


Fig. 1. Logic diagram

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-------------------------|--------------------|----------------------------------|
| 1OE, 2OE | 1, 13 | output enable input (active LOW) |
| 1A1, 1A2, 1A3, 1A4, 1A5 | 3, 4, 7, 8, 11 | data input/output (A port) |
| 2A1, 2A2, 2A3, 2A4, 2A5 | 14, 17, 18, 21, 22 | data input/output (A port) |
| 1B1, 1B2, 1B3, 1B4, 1B5 | 2, 5, 6, 9, 10 | data input/output (B port) |
| 2B1, 2B2, 2B3, 2B4, 2B5 | 15, 16, 19, 20, 23 | data input/output (B port) |
| GND | 12 | ground (0 V) |
| VCC | 24 | positive supply voltage |

6. Functional description

Table 3. Function selection

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

| Input | | Input/output | |
|-------|-----|--------------|-----------|
| 1OE | 2OE | 1An, 1Bn | 2An, 2Bn |
| L | L | 1An = 1Bn | 2An = 2Bn |
| L | H | 1An = 1Bn | Z |
| H | L | Z | 2An = 2Bn |
| H | H | Z | Z |

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

T_{amb} = -40 °C to +85 °C, unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|------------------------|------------------------|------|------|------|
| V _{CC} | supply voltage | | -0.5 | +7.0 | V |
| V _I | input voltage | [1] | -0.5 | +7.0 | V |
| I _O | output current | V _O < 0 V | - | ±128 | mA |
| I _{IK} | input clamping current | V _{I/O} = 0 V | -50 | - | mA |
| T _{stg} | storage temperature | | -65 | +150 | °C |

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

8. Recommended operating conditions

Table 5. Operating conditions

All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|--------------------------|-----------------------|-----|-----|-----|------|
| V _{CC} | supply voltage | | 4.5 | - | 5.5 | V |
| V _{IH} | HIGH-level input voltage | | 2.0 | - | - | V |
| V _{IL} | LOW-level input voltage | | - | - | 0.8 | V |
| T _{amb} | ambient temperature | operating in free air | -40 | - | +85 | °C |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit |
|----------------------|------------------------------------|--|-------------------------------------|--------|------|------|
| | | | Min | Typ[1] | Max | |
| V _{IK} | input clamping voltage | V _{CC} = 4.5 V; I _I = -18 mA | - | - | -1.2 | V |
| I _I | input leakage current | V _{CC} = 5.5 V; V _I = GND or 5.5 V | - | - | ±1 | µA |
| I _{CC} | supply current | V _{CC} = 5.5 V; I _O = 0 mA; V _I = V _{CC} or GND | - | - | 1.5 | mA |
| ΔI _{CC} | additional supply current | per input pin; V _{CC} = 5.5 V; one input at 3.4 V, other inputs at V _{CC} or GND [2] | - | - | 2.5 | mA |
| V _{pass} | pass voltage | see Fig. 2 to Fig. 6 | - | - | - | V |
| C _I | input capacitance | control pins; V _I = 3 V or 0 V | - | 3.2 | - | pF |
| C _{io(off)} | off-state input/output capacitance | port off; V _I = 3 V or 0 V; n \overline{OE} = V _{CC} | - | 6.0 | - | pF |
| R _{ON} | ON resistance | V _{CC} = 4.5 V; V _I = 0 V; I _I = 64 mA [3] | - | 5 | 7 | Ω |
| | | V _{CC} = 4.5 V; V _I = 0 V; I _I = 30 mA [3] | - | 5 | 7 | Ω |
| | | V _{CC} = 4.5 V; V _I = 2.4 V; I _I = -15 mA [3] | - | 17 | 50 | Ω |

[1] All typical values are at V_{CC} = 5 V, T_{amb} = 25 °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 nAn and the nBn terminals at the indicated current through the switch. ON resistance is determined by the lowest voltage of the two (nAn or nBn) terminals.

9.1. Typical pass voltage graphs

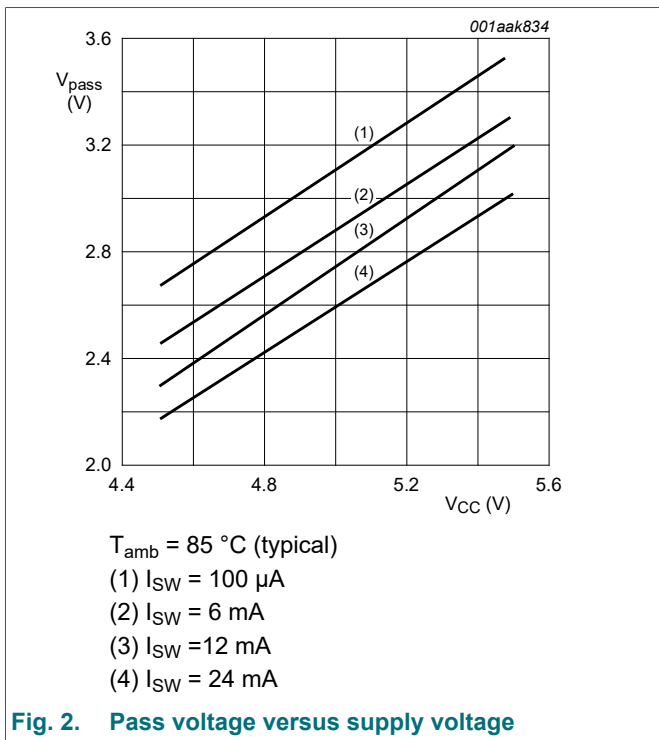


Fig. 2. Pass voltage versus supply voltage

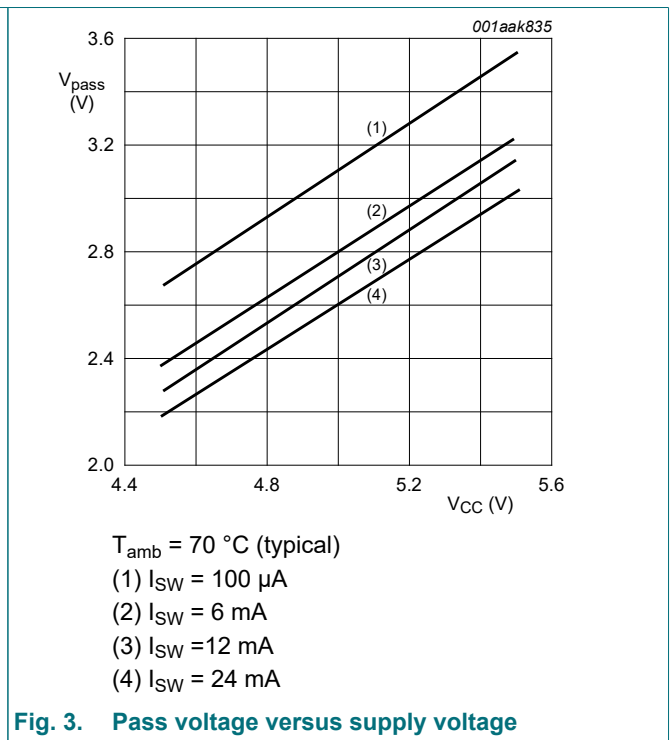


Fig. 3. Pass voltage versus supply voltage

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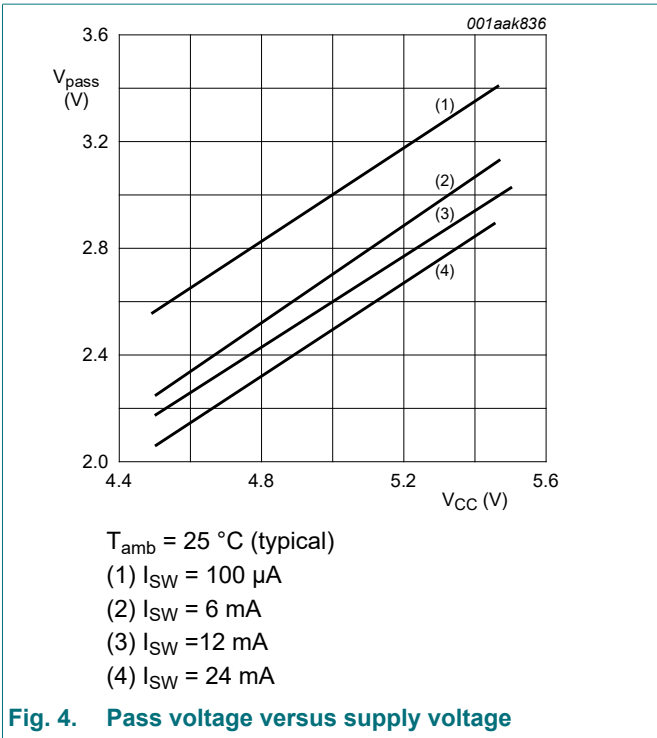


Fig. 4. Pass voltage versus supply voltage

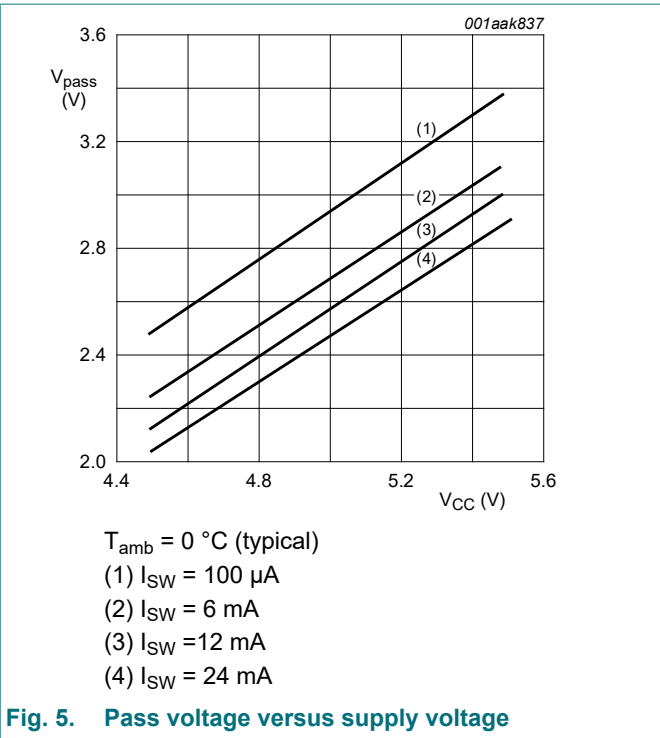


Fig. 5. Pass voltage versus supply voltage

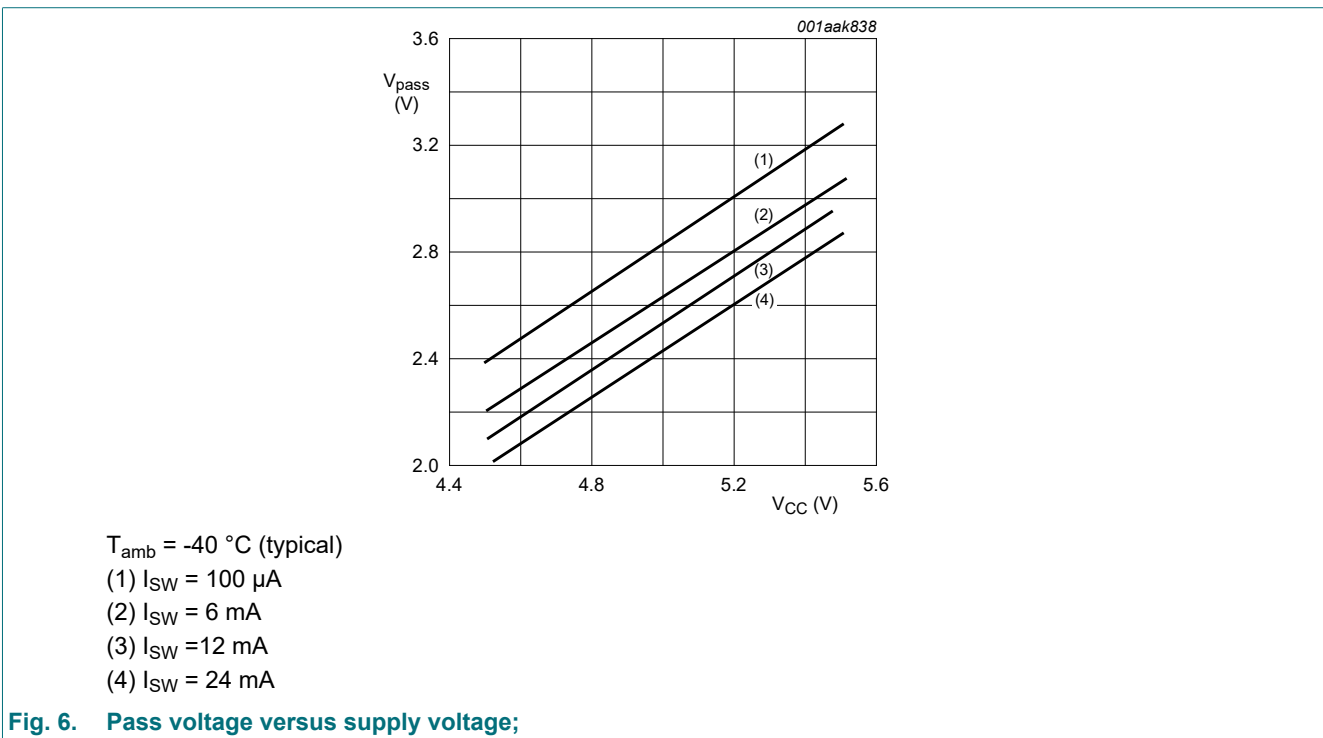


Fig. 6. Pass voltage versus supply voltage;

10. Dynamic characteristics

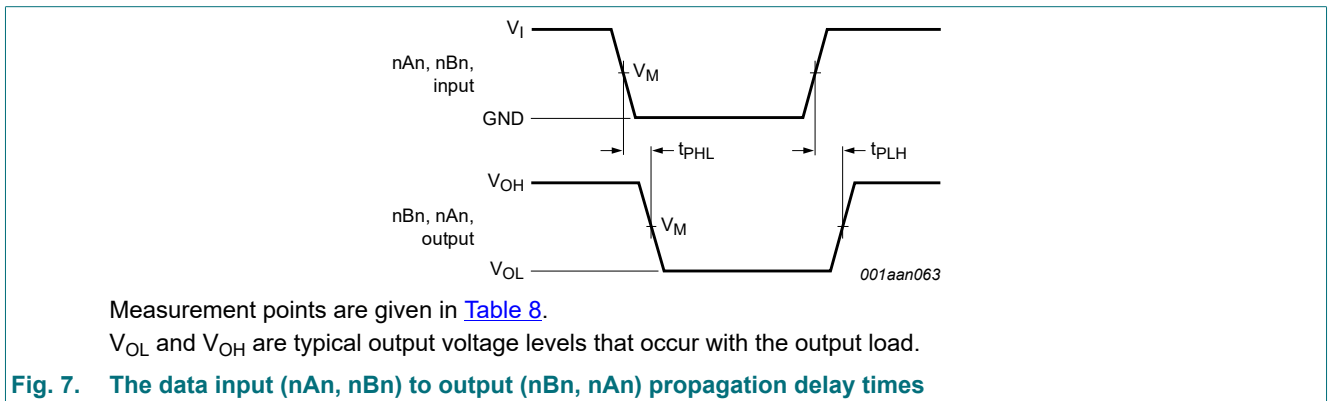
Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 9.

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit |
|------------------|-------------------|---|-------------------------------------|-----|------|------|
| | | | Min | Typ | Max | |
| t _{pd} | propagation delay | nAn, nBn to nBn, nAn; see Fig. 7 [1] [2] | | | | |
| | | V _{CC} = 5.0 V ± 0.5 V | - | - | 0.25 | ns |
| t _{en} | enable time | n $\overline{O}E$ to nAn or nBn; see Fig. 8 [2] | | | | |
| | | V _{CC} = 5.0 V ± 0.5 V | 1.2 | 4.3 | 7.0 | ns |
| t _{dis} | disable time | n $\overline{O}E$ to nAn or nBn; see Fig. 8 [2] | | | | |
| | | V _{CC} = 5.0 V ± 0.5 V | 1.7 | 3.0 | 5.3 | ns |

- [1] The propagation delay is the calculated RC time constant of the typical ON resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).
- [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}.

10.1. Waveforms and test circuit



10-bit level shifting bus switch with 5-bit output enables

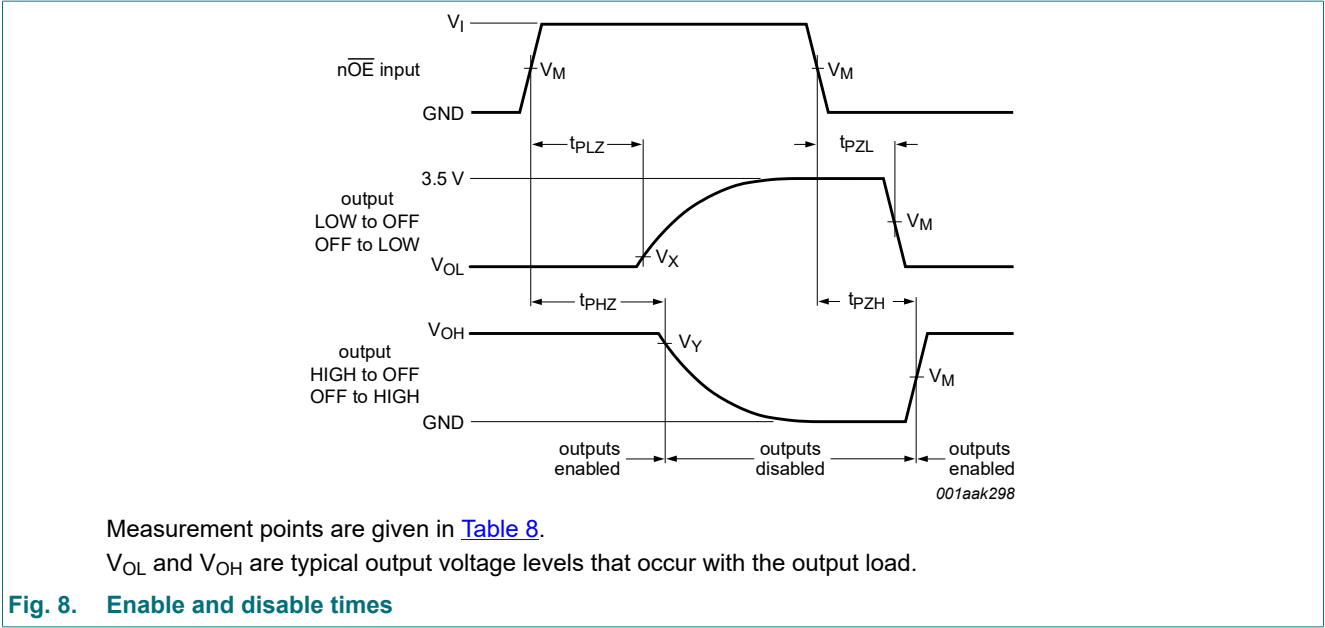
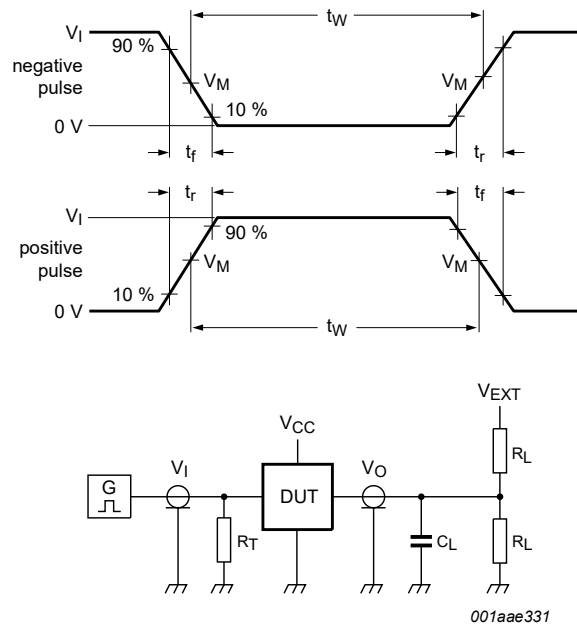


Table 8. Measurement points

| Supply voltage | Input | | Output | | |
|--|--------------|-------|--------|-------------------------|-------------------------|
| V_{CC} | V_I | V_M | V_M | V_X | V_Y |
| $V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ | GND to 3.0 V | 1.5 V | 1.5 V | $V_{OL} + 0.3\text{ V}$ | $V_{OH} - 0.3\text{ V}$ |

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Test data is given in [Table 9](#).
 All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz; Z_o = 50 Ω.
 The outputs are measured one at a time with one transition per measurement.
 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. 9. 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} |
| V _{CC} = 5.0 V ± 0.5 V | GND to 3.0 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | 7.0 V | open |

11. Package outline

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

SOT137-1

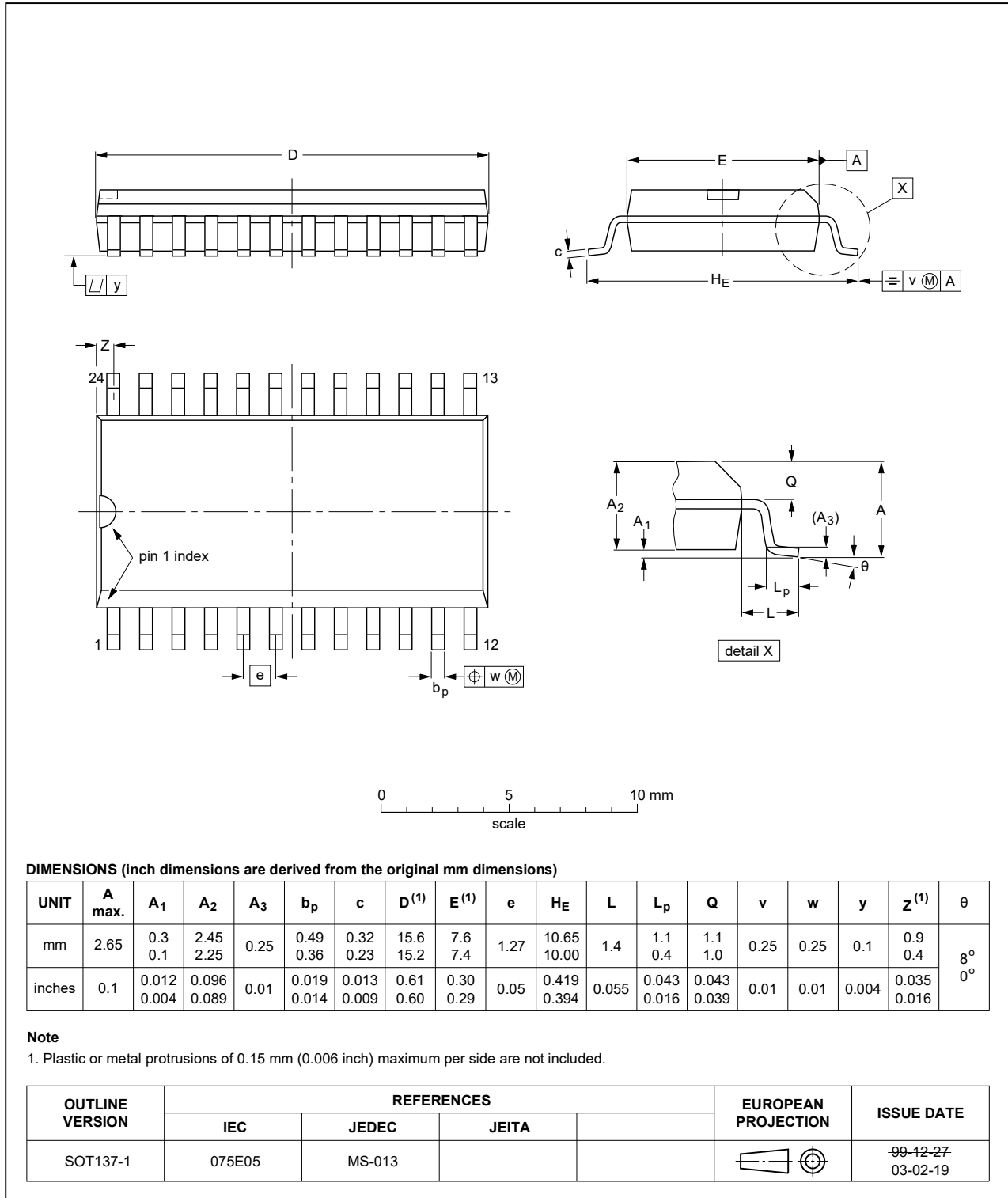


Fig. 10. Package outline SOT137-1 (SO24)

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

SOT355-1

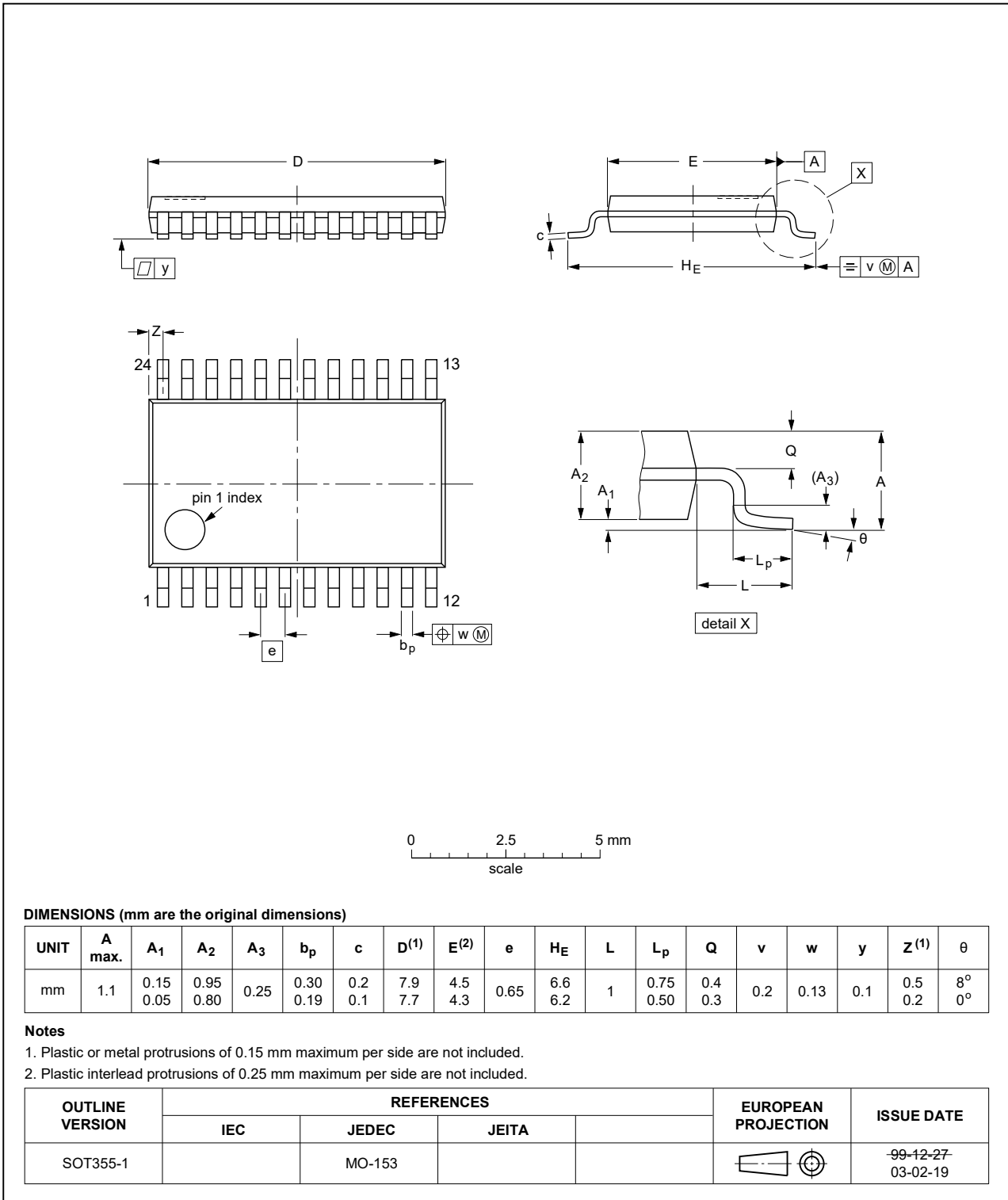


Fig. 11. Package outline SOT355-1 (TSSOP24)

12. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|-----------------------------|
| CDM | Charged Device Model |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| PRR | Pulse Rate Repetition |
| TTL | Transistor-Transistor Logic |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|---------------|
| CBTD3384 v.11 | 20231020 | Product data sheet | - | CBTD3384 v.10 |
| Modifications: | <ul style="list-style-type: none"> Section 1 and Section 2 updated. | | | |
| CBTD3384 v.10 | 20210312 | Product data sheet | - | CBTD3384 v.9 |
| Modifications: | <ul style="list-style-type: none"> Type number CBTD3384DB (SOT340-1 / SSOP24) removed. | | | |
| CBTD3384 v.9 | 20190306 | Product data sheet | - | CBT3384 v.8 |
| 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. Type number CBTD3384DK (SOT556-1) removed. | | | |
| CBTD3384 v.8 | 20121212 | Product data sheet | - | CBT3384 v.7 |
| Modifications: | <ul style="list-style-type: none"> Table 1: changed +125 °C into +85 °C (errata). | | | |
| CBTD3384 v.7 | 20121119 | Product data sheet | - | CBT3384 v.6 |
| Modifications: | <ul style="list-style-type: none"> Table 1: changed +85 °C into +125 °C (errata). | | | |
| CBTD3384 v.6 | 20111121 | Product data sheet | - | CBTD3384 v.5 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. | | | |
| CBTD3384 v.5 | 20101119 | Product data sheet | - | CBTD3384 v.4 |
| CBTD3384 v.4 | 20011220 | Product specification | - | CBTD3384 v.3 |
| CBTD3384 v.3 | 20000830 | Product specification | - | CBTD3384 v.2 |
| CBTD3384 v.2 | 20000830 | 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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