

74CBTLVD3384

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

Rev. 3 — 17 April 2019

Product data sheet

1. General description

The 74CBTLVD3384 is a dual 5-pole, single-throw bus switch. The device features two output enable inputs (\overline{nOE}) that each control five switch channels. The switches are disabled when the associated \overline{nOE} input is HIGH. Schmitt-trigger action at control inputs makes the circuit tolerant of slower input rise and fall times. This device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

2. Features and benefits

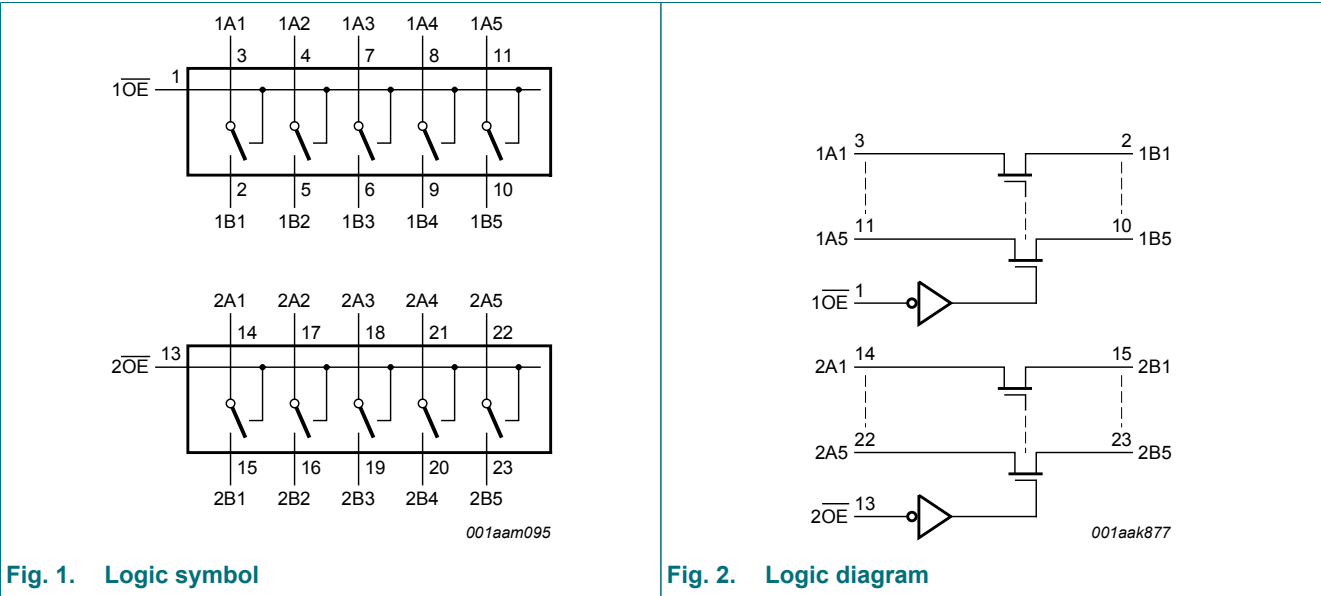
- Supply voltage range from 3.0 V to 3.6 V
- High noise immunity
- Complies with JEDEC standard:
 - JESD8-B/JESD36 (3.0 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - CDM AEC-Q100-011 revision B exceeds 1000 V
- 5 Ω switch connection between two ports
- -3 dB bandwidth at 600 MHz
- Rail to rail switching on data I/O ports
- CMOS low power consumption
- Latch-up performance exceeds 250 mA per JESD78B Class I level A
- I_{OFF} circuitry provides partial Power-down mode operation
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

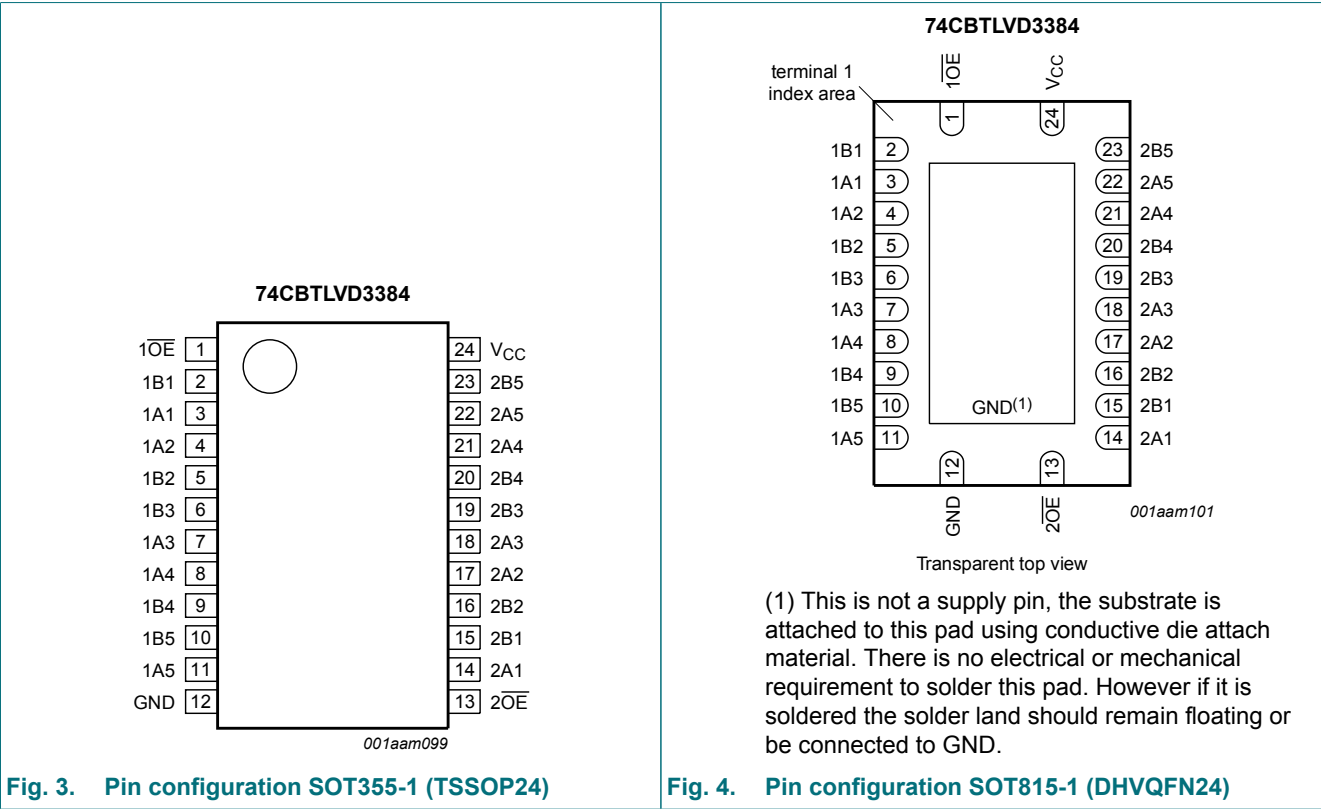
| Type number | Package | | | |
|----------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | Version |
| 74CBTLVD3384PW | -40 °C to +125 °C | TSSOP24 | plastic thin shrink small outline package; 24 leads; body width 4.4 mm | SOT355-1 |
| 74CBTLVD3384BQ | -40 °C to +125 °C | DHVQFN24 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 × 5.5 × 0.85 mm | SOT815-1 |

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-------------------------------------|--------------------|----------------------------------|
| $1\overline{OE}$, $2\overline{OE}$ | 1, 13 | output enable input (active LOW) |
| 1A1 to 1A5 | 3, 4, 7, 8, 11 | data input/output (A port) |
| 2A1 to 2A5 | 14, 17, 18, 21, 22 | data input/output (A port) |
| 1B1 to 1B5 | 2, 5, 6, 9, 10 | data input/output (B port) |
| 2B1 to 2B5 | 15, 16, 19, 20, 23 | data input/output (B port) |
| GND | 12 | ground (0 V) |
| V _{CC} | 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 | |
|------------------|------------------|--------------|-----------|
| $1\overline{OE}$ | $2\overline{OE}$ | 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). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|-------------------------|--|------|-----------------------|------|
| V _{CC} | supply voltage | | -0.5 | +4.6 | V |
| V _I | input voltage | [1] | -0.5 | +4.6 | V |
| V _{SW} | switch voltage | enable and disable mode [1] | -0.5 | V _{CC} + 0.5 | V |
| I _{IK} | input clamping current | V _{IO} < -0.5 V | -50 | - | mA |
| I _{SK} | switch clamping current | V _I < -0.5 V | -50 | - | mA |
| I _{SW} | switch current | V _{SW} = 0 V to V _{CC} | - | ±128 | mA |
| I _{CC} | supply current | | - | +100 | mA |
| I _{GND} | ground current | | -100 | - | mA |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| P _{tot} | total power dissipation | T _{amb} = -40 °C to +125 °C [2] | - | 500 | mW |

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

[2] For TSSOP24 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.
For DHVQFN24 package: P_{tot} derates linearly at 4.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------|-------------------------------------|---|-----|----------|------|
| V_{CC} | supply voltage | | 3.0 | 3.6 | V |
| V_I | input voltage | | 0 | 3.6 | V |
| V_{SW} | switch voltage | enable and disable mode | 0 | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [1] | 0 | 200 | ns/V |

[1] Applies to control signal levels.

9. Static characteristics

Table 6. Static characteristics

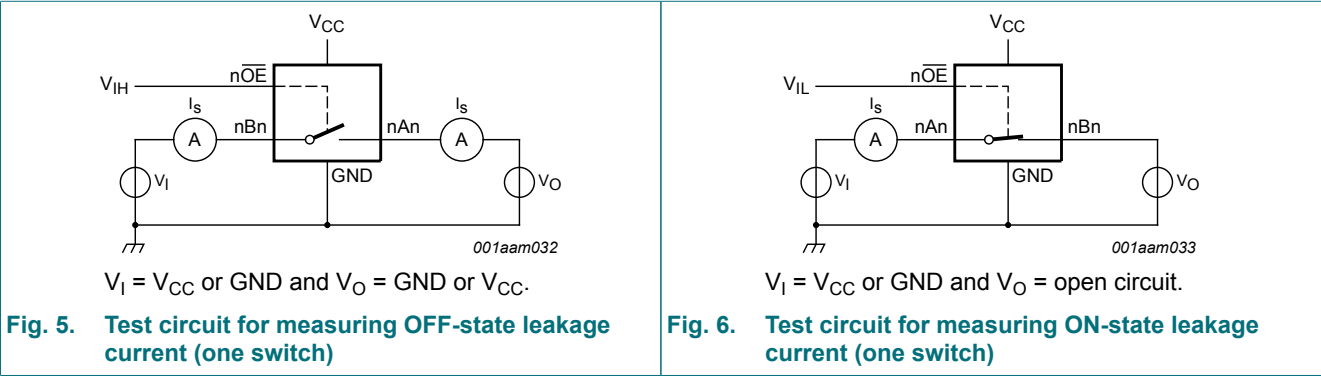
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

| 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 | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | 2.0 | - | - | 2.0 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | - | - | 0.9 | - | 0.9 | V |
| I_I | input leakage current | pin \overline{nOE} ; $V_I = \text{GND to }V_{CC}$; $V_{CC} = 3.6\text{ V}$ | - | - | ± 1 | - | ± 20 | μA |
| V_{pass} | pass voltage | $V_I = V_{CC}$; see Fig. 7 to Fig. 11 | - | - | - | - | - | V |
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{CC} = 3.6\text{ V}$; see Fig. 5 | - | - | ± 1 | - | ± 20 | μA |
| $I_{S(ON)}$ | ON-state leakage current | $V_{CC} = 3.6\text{ V}$; see Fig. 6 | - | - | ± 1 | - | ± 20 | μA |
| I_{OFF} | power-off leakage current | V_I or $V_O = 0\text{ V to }3.6\text{ V}$; $V_{CC} = 0\text{ V}$ | - | - | ± 10 | - | ± 50 | μA |
| I_{CC} | supply current | $V_I = V_{CC}$; $I_O = 0\text{ A}$; $V_{CC} = 3.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$ | - | - | 20 | - | 50 | μA |
| | | $V_I = \text{GND}$; $I_O = 0\text{ A}$; $V_{CC} = 3.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$ | - | - | 100 | - | 150 | μA |
| ΔI_{CC} | additional supply current | pin \overline{nOE} ; $V_I = V_{CC} - 0.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$; $V_{CC} = 3.6\text{ V}$ [2] | - | - | 300 | - | 2000 | μA |
| C_I | input capacitance | pin \overline{nOE} ; $V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$ | - | 0.9 | - | - | - | pF |
| $C_{S(OFF)}$ | OFF-state capacitance | $V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$ | - | 2.5 | - | - | - | pF |
| $C_{S(ON)}$ | ON-state capacitance | $V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$ | - | 9.0 | - | - | - | pF |

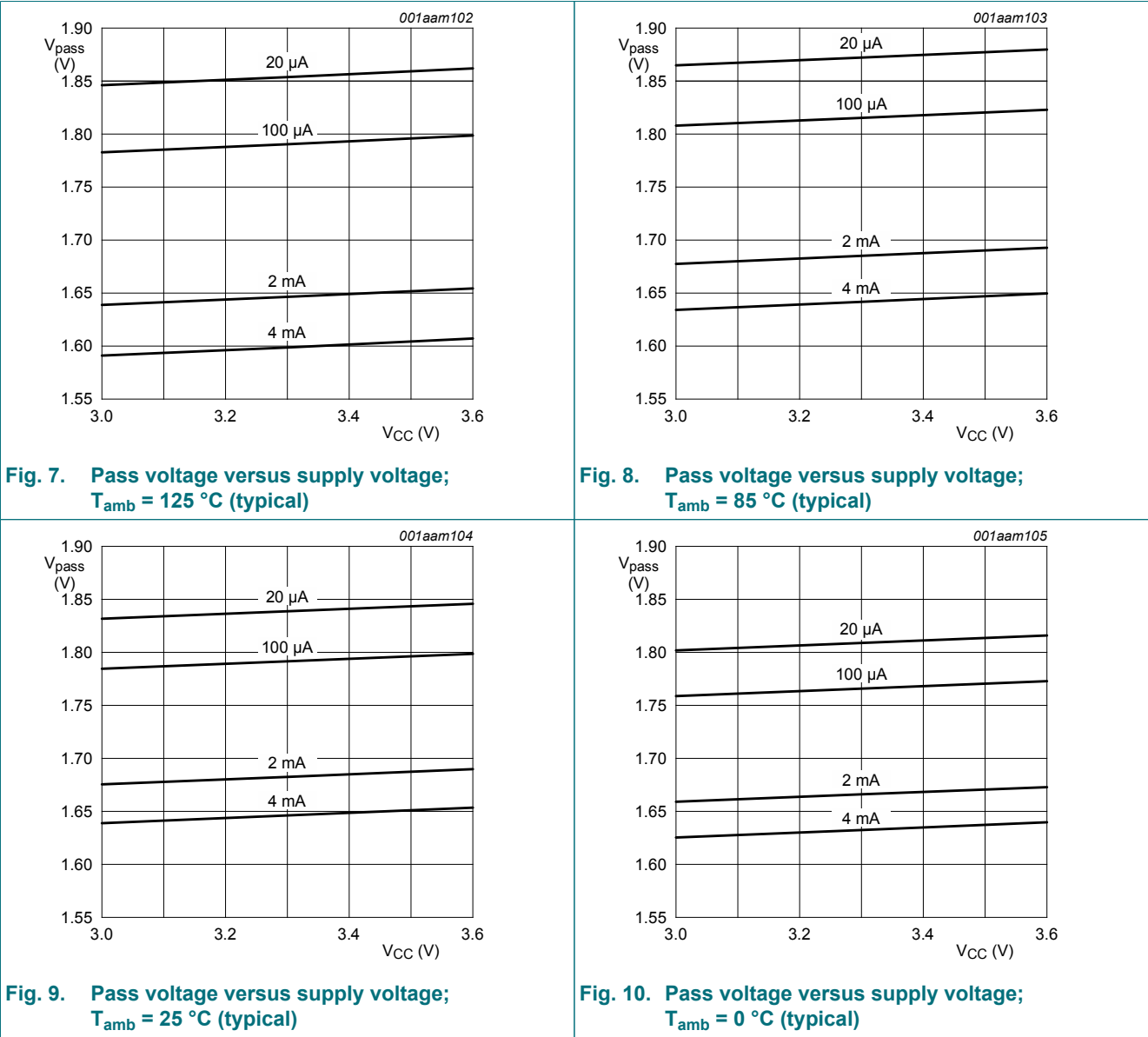
[1] All typical values are measured at $T_{amb} = 25\text{ °C}$.

[2] One input at 3 V, other inputs at V_{CC} or GND.

9.1. Test circuits



9.2. Typical pass voltage graphs



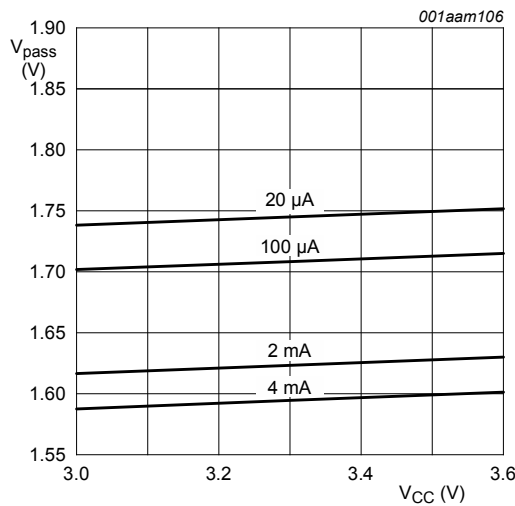


Fig. 11. Pass voltage versus supply voltage; $T_{amb} = -40\text{ }^{\circ}\text{C}$ (typical)

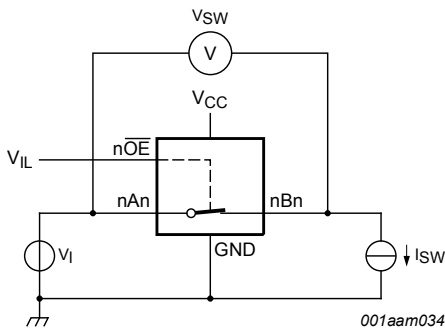
9.3. ON resistance

Table 7. Resistance R_{ON}

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 12.

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|----------|---------------|---|------------------|---------|------|-------------------|------|----------|
| | | | Min | Typ [1] | Max | Min | Max | |
| R_{ON} | ON resistance | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [2] | | | | | | |
| | | $I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$ | - | 3.7 | 7.0 | - | 10.0 | Ω |
| | | $I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$ | - | 3.7 | 7.0 | - | 10.0 | Ω |
| | | $I_{SW} = 15\text{ mA}; V_I = 1.2\text{ V}$ | - | 4.7 | 10.0 | - | 12.0 | Ω |

- [1] Typical values are measured at $T_{amb} = 25\text{ }^{\circ}\text{C}$ and nominal V_{CC} .
[2] Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.



$R_{ON} = V_{SW} / I_{SW}$.

Fig. 12. Test circuit for measuring ON resistance (one switch)

10. Dynamic characteristics

Table 8. Dynamic characteristics

GND = 0 V; for test circuit see Fig. 15

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|-------------------|---|------------------|---------|------|-------------------|------|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| t _{pd} | propagation delay | nAn to nBn or nBn to nAn; V _{CC} = 3.0 V to 3.6 V; see Fig. 13 [2][3] | - | - | 0.11 | - | 0.22 | ns |
| t _{en} | enable time | nOE to nAn or nBn; V _{CC} = 3.0 V to 3.6 V; see Fig. 14 [4] | 1.5 | 2.8 | 5.0 | 1.5 | 6.0 | ns |
| t _{dis} | disable time | nOE to nAn or nBn; V _{CC} = 3.0 V to 3.6 V; see Fig. 14 [5] | 0.8 | 3.2 | 7.0 | 0.8 | 8.0 | ns |

- [1] All typical values are measured at T_{amb} = 25 °C and at nominal V_{CC}.
- [2] The propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).
- [3] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [4] t_{en} is the same as t_{PZH} and t_{PZL}.
- [5] t_{dis} is the same as t_{PHZ} and t_{PLZ}.

10.1. Waveforms and test circuit

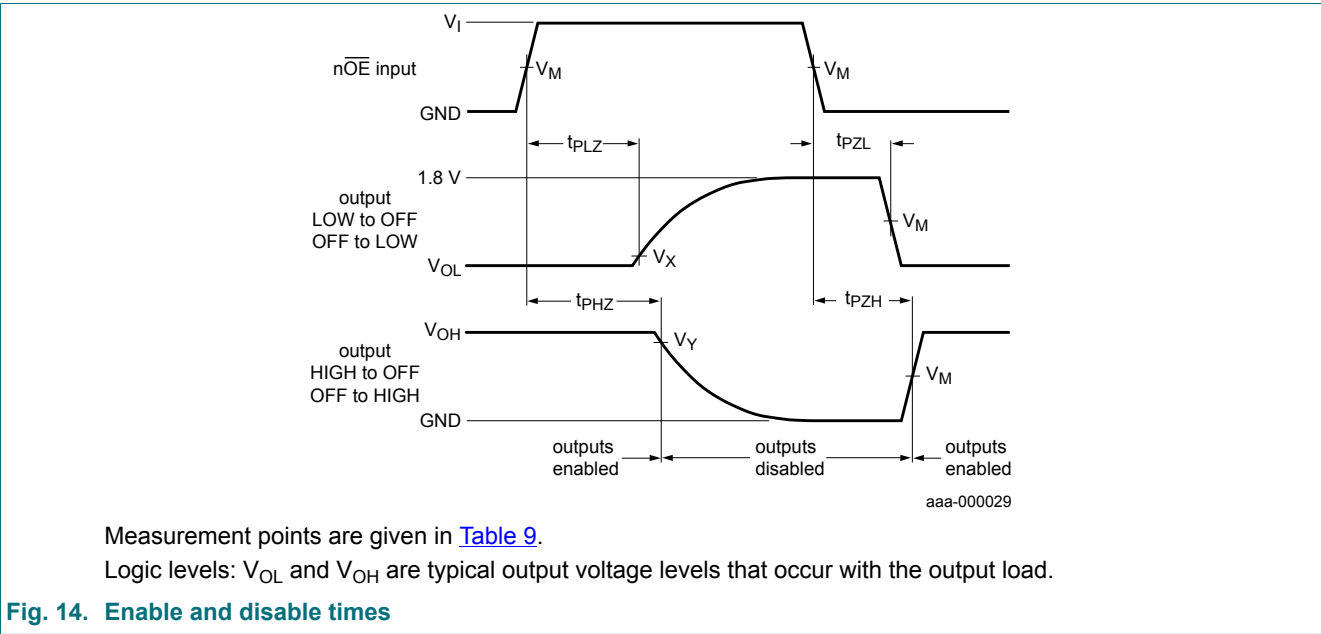
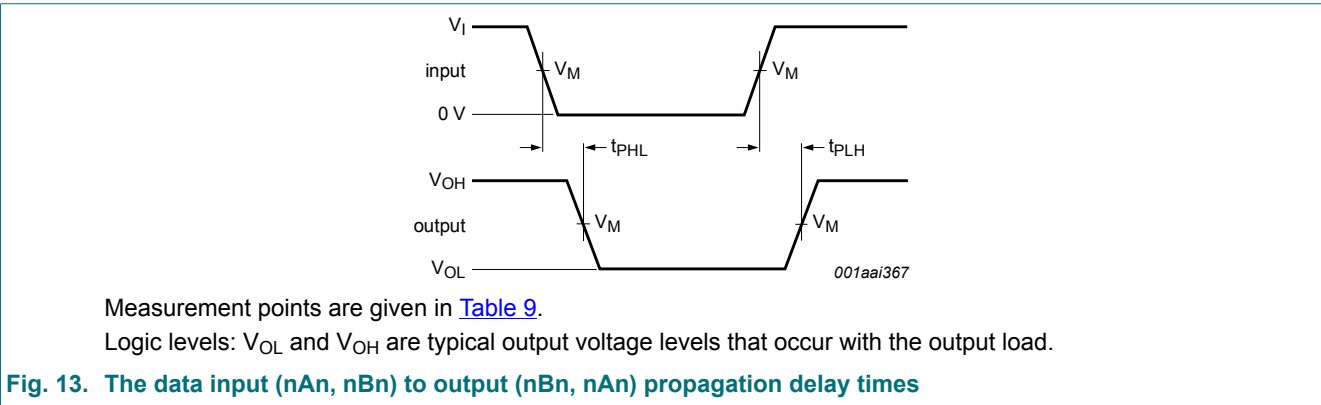
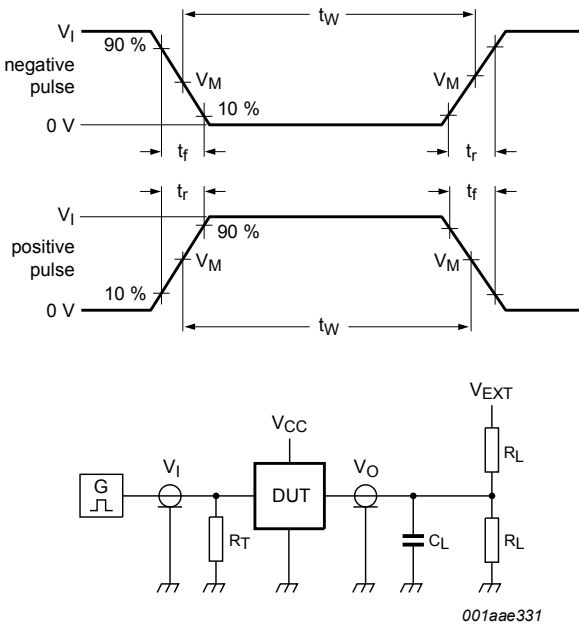


Table 9. Measurement points

| Supply voltage | Input | | | Output | | |
|-----------------|--------------------|-----------------|---------------------------------|----------------|--------------------------|--------------------------|
| V _{CC} | V _M | V _I | t _r = t _f | V _M | V _X | V _Y |
| 3.0 V to 3.6 V | 0.5V _{CC} | V _{CC} | ≤ 2.0 ns | 0.9 V | V _{OL} + 0.15 V | V _{OH} - 0.15 V |



Test data is given in [Table 10](#).
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 the output impedance Z_o of the pulse generator.
V_{EXT} = External voltage for measuring switching times.

Fig. 15. Test circuit for measuring switching times

Table 10. Test data

| Supply voltage | Load | | V _{EXT} | | |
|-----------------|----------------|----------------|-------------------------------------|-------------------------------------|-------------------------------------|
| V _{CC} | C _L | R _L | t _{PLH} , t _{PHL} | t _{PZH} , t _{PHZ} | t _{PZL} , t _{PLZ} |
| 3.0 V to 3.6 V | 30 pF | 1 kΩ | open | GND | 3.6 V |

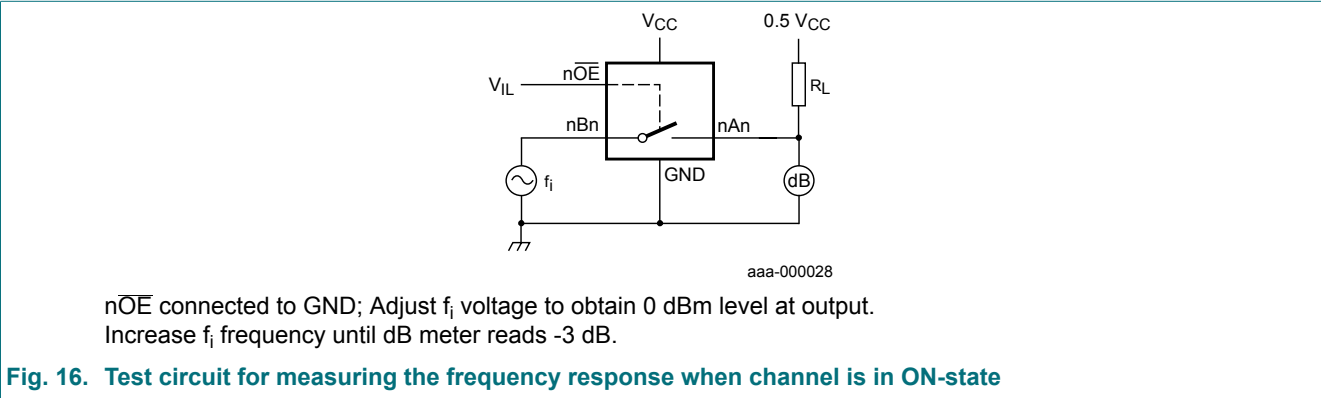
10.2. Additional dynamic characteristics

Table 11. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); $V_I = \text{GND}$ or V_{CC} (unless otherwise specified); $t_r = t_f \leq 2.5 \text{ ns}$.

| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | Unit |
|---------------------|--------------------------|---|--------------------------|---------|-----|------|
| | | | Min | Typ [1] | Max | |
| f _(-3dB) | -3 dB frequency response | V _{CC} = 3.3 V; R _L = 50 Ω; see Fig. 16 [2] | - | 575 | - | MHz |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 3.3 V.
[2] f_i is biased at 0.5V_{CC}.



11. Package outline

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

SOT355-1

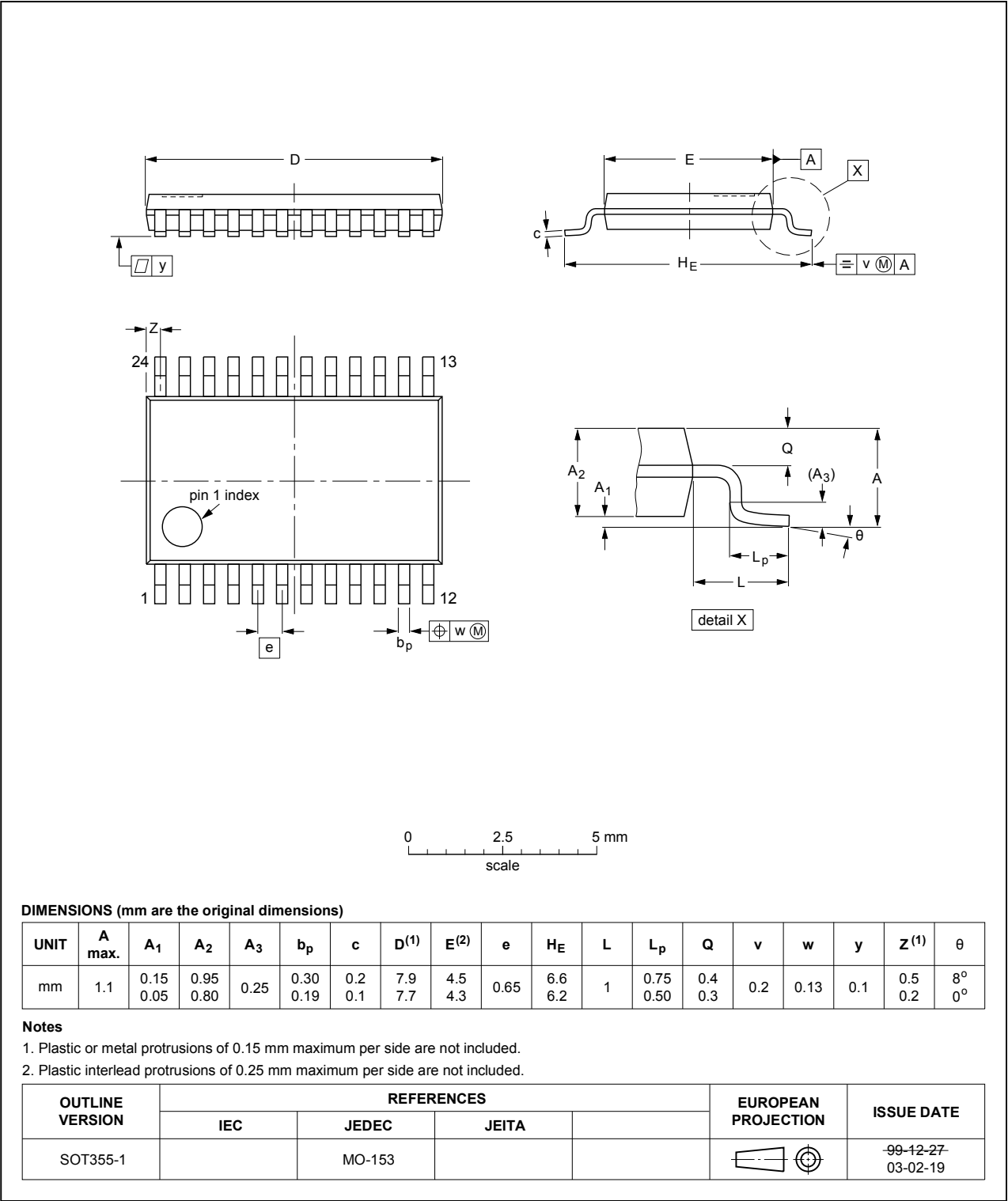


Fig. 17. Package outline SOT355-1 (TSSOP24)

DHVQFN24: plastic dual in-line compatible thermal enhanced very thin quad flat package;
no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm

SOT815-1

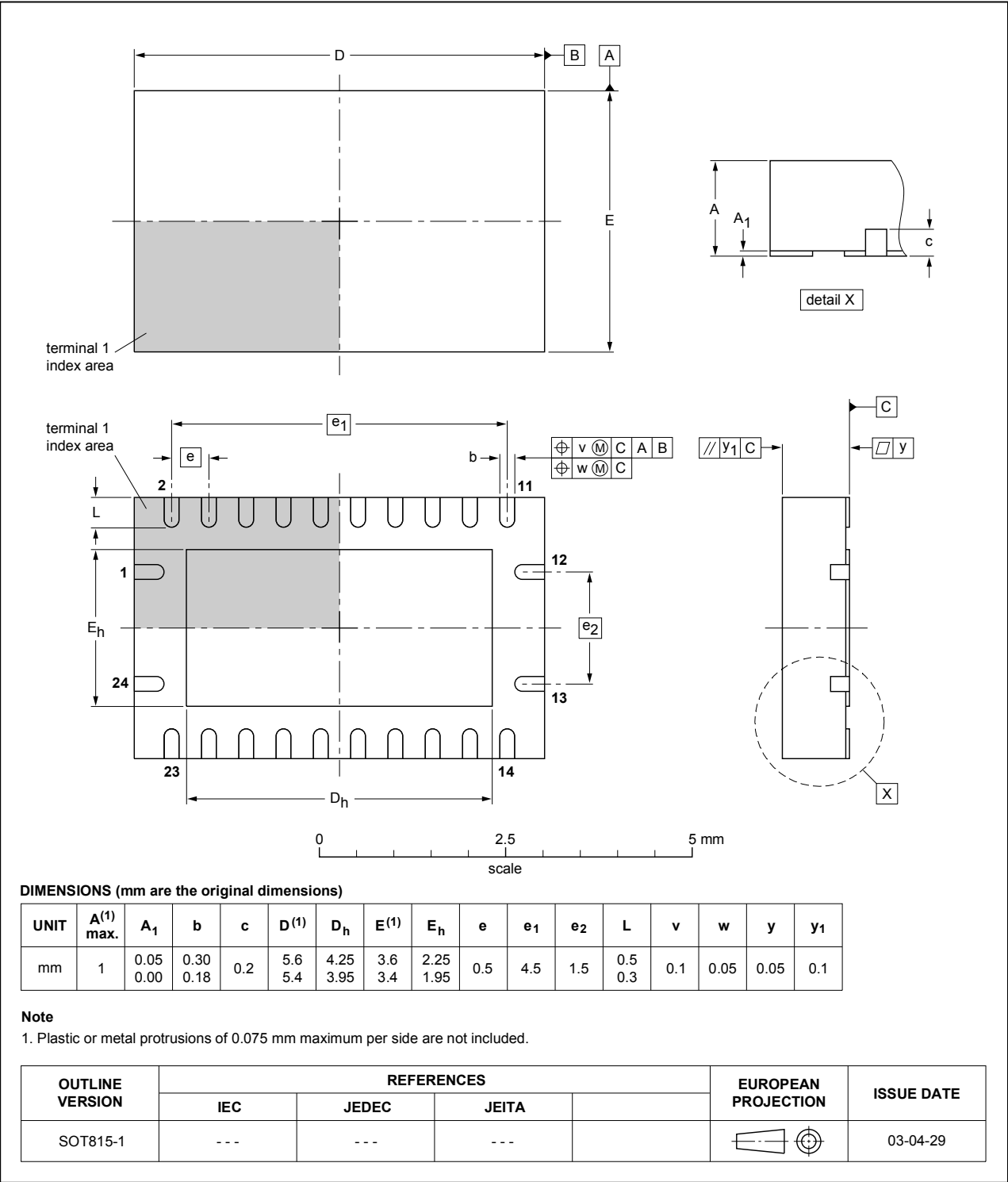


Fig. 18. Package outline SOT815-1 (DHVQFN24)

12. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|---|
| CDM | Charged Device Model |
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |

13. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|---|--------------------|---------------|------------------|
| 74CBTLVD3384 v.3 | 20190417 | Product data sheet | - | 74CBTLVD3384 v.2 |
| 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 74CBTLVD3384DK (SOT556-1) removed. | | | |
| 74CBTLVD3384 v.2 | 20111216 | Product data sheet | - | 74CBTLVD3384 v.1 |
| Modifications: | <ul style="list-style-type: none">Legal pages updated. | | | |
| 74CBTLVD3384 v.1 | 20110719 | Product data sheet | - | - |

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|--------------------------------|--------------------|---|
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- [2] The term 'short data sheet' is explained in section "Definitions".
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