

# 74CBTLVD3384

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

Rev. 2 — 16 December 2011

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  $\Omega$  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
- Multiple package options
- Specified from –40 °C to +85 °C and –40 °C to +125 °C

nexperia

3. Ordering information

Table 1. Ordering information

| Type number    | Package           |                       |                                                                                                                                |          |
|----------------|-------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------|----------|
|                | Temperature range | Name                  | Description                                                                                                                    | Version  |
| 74CBTLVD3384DK | −40 °C to +125 °C | SSOP24 <sup>[1]</sup> | plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm                                         | SOT556-1 |
| 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 |

[1] Also known as QSOP24 package

4. Functional diagram

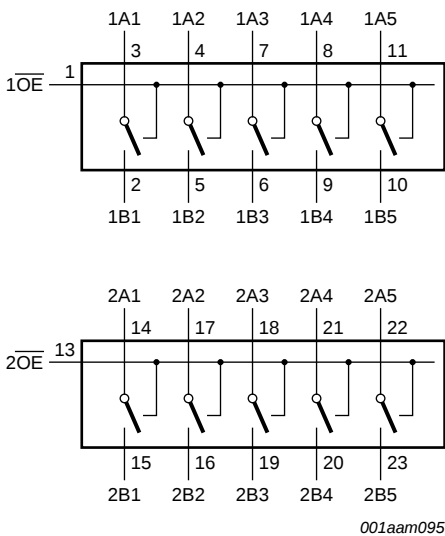


Fig 1. Logic symbol

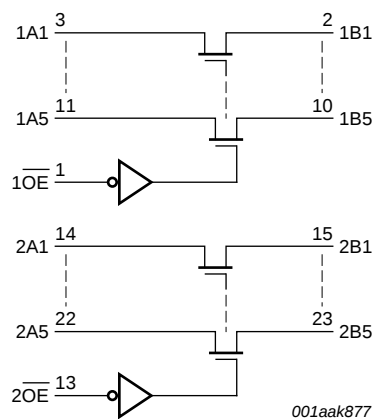


Fig 2. Logic diagram

5. Pinning information

5.1 Pinning

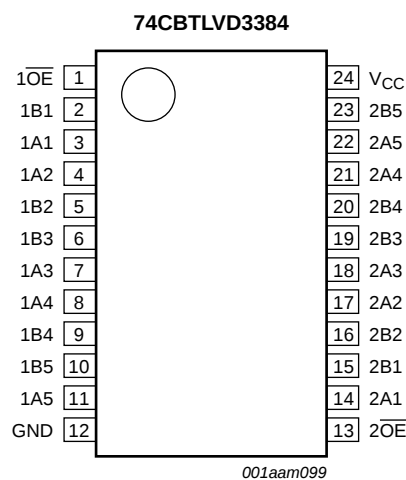


Fig 3. Pin configuration for TSSOP24 (SOT355-1)

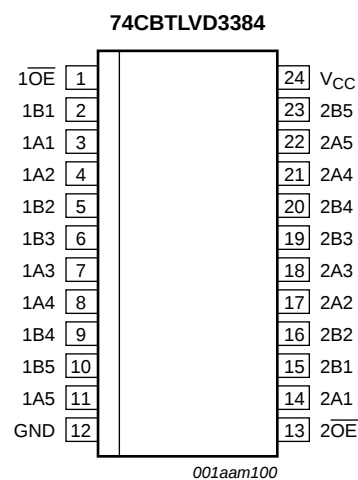
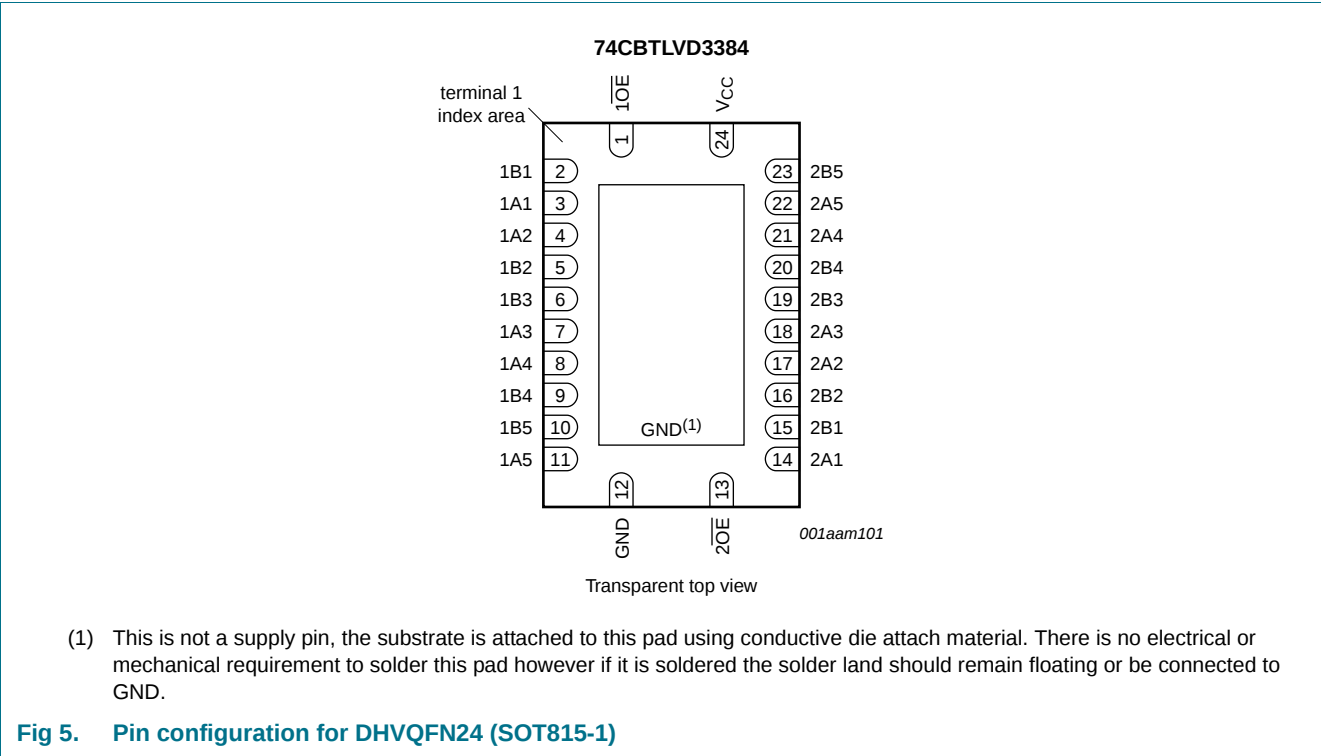


Fig 4. Pin configuration for SSOP24 (SOT556-1)



5.2 Pin description

Table 2. Pin description

| Symbol                              | Pin                | Description                      |
|-------------------------------------|--------------------|----------------------------------|
| $\overline{1OE}$ , $\overline{2OE}$ | 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 <sub>CC</sub>                     | 24                 | positive supply voltage          |

6. Functional description

Table 3. Function selection<sup>[1]</sup>

| Input            |                  | Input/output |           |
|------------------|------------------|--------------|-----------|
| $\overline{1OE}$ | $\overline{2OE}$ | 1An, 1Bn     | 2An, 2Bn  |
| L                | L                | 1An = 1Bn    | 2An = 2Bn |
| L                | H                | 1An = 1Bn    | Z         |
| H                | L                | Z            | 2An = 2Bn |
| H                | H                | Z            | Z         |

[1] H = HIGH voltage level; L = LOW voltage level; 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                | +4.6           | V    |
| $V_I$     | input voltage           |                               | <sup>[1]</sup> -0.5 | +4.6           | V    |
| $V_{SW}$  | switch voltage          | enable and disable mode       | <sup>[1]</sup> -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 | <sup>[2]</sup> -    | 500            | mW   |

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

[2] For SSOP24 and 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 | $V_{CC} = 3.0$ V to 3.6 V | <sup>[1]</sup> 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                                                                 | $T_{amb} = -40$ °C to +85 °C |                    |     | $T_{amb} = -40$ °C to +125 °C |     | Unit |
|------------|--------------------------|----------------------------------------------------------------------------|------------------------------|--------------------|-----|-------------------------------|-----|------|
|            |                          |                                                                            | Min                          | Typ <sup>[1]</sup> | Max | Min                           | Max |      |
| $V_{IH}$   | HIGH-level input voltage | $V_{CC} = 3.0$ V to 3.6 V                                                  | 2.0                          | -                  | -   | 2.0                           | -   | V    |
| $V_{IL}$   | LOW-level input voltage  | $V_{CC} = 3.0$ V to 3.6 V                                                  | -                            | -                  | 0.9 | -                             | 0.9 | V    |
| $I_I$      | input leakage current    | pin $\overline{nOE}$ ; $V_I = GND$ to $V_{CC}$ ;<br>$V_{CC} = 3.6$ V       | -                            | -                  | ±1  | -                             | ±20 | µA   |
| $V_{pass}$ | pass voltage             | $V_I = V_{CC}$ ; see <a href="#">Figure 9</a> to <a href="#">Figure 12</a> | -                            | -                  | -   | -                             | -   | V    |

Table 6. Static characteristics ...continued  
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

| Symbol              | Parameter                 | Conditions                                                                                                                                     | T <sub>amb</sub> = −40 °C to +85 °C |                    |     | T <sub>amb</sub> = −40 °C to +125 °C |      | Unit |
|---------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------|-----|--------------------------------------|------|------|
|                     |                           |                                                                                                                                                | Min                                 | Typ <sup>[1]</sup> | Max | Min                                  | Max  |      |
| I <sub>S(OFF)</sub> | OFF-state leakage current | V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 6</a>                                                                                          | -                                   | -                  | ±1  | -                                    | ±20  | μA   |
| I <sub>S(ON)</sub>  | ON-state leakage current  | V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 7</a>                                                                                          | -                                   | -                  | ±1  | -                                    | ±20  | μA   |
| I <sub>OFF</sub>    | power-off leakage current | V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V;<br>V <sub>CC</sub> = 0 V                                                                      | -                                   | -                  | ±10 | -                                    | ±50  | μA   |
| I <sub>CC</sub>     | supply current            | V <sub>I</sub> = V <sub>CC</sub> ; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V;<br>V <sub>SW</sub> = GND or V <sub>CC</sub>                  | -                                   | -                  | 20  | -                                    | 50   | μA   |
|                     |                           | V <sub>I</sub> = GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V;<br>V <sub>SW</sub> = GND or V <sub>CC</sub>                               | -                                   | -                  | 100 | -                                    | 150  | μA   |
| ΔI <sub>CC</sub>    | additional supply current | pin n $\overline{\text{OE}}$ ; V <sub>I</sub> = V <sub>CC</sub> − 0.6 V;<br>V <sub>SW</sub> = GND or V <sub>CC</sub> ; V <sub>CC</sub> = 3.6 V | -                                   | -                  | 300 | -                                    | 2000 | μA   |
| C <sub>I</sub>      | input capacitance         | pin n $\overline{\text{OE}}$ ; V <sub>CC</sub> = 3.3 V;<br>V <sub>I</sub> = 0 V to 3.3 V                                                       | -                                   | 0.9                | -   | -                                    | -    | pF   |
| C <sub>S(OFF)</sub> | OFF-state capacitance     | V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = 0 V to 3.3 V                                                                                         | -                                   | 2.5                | -   | -                                    | -    | pF   |
| C <sub>S(ON)</sub>  | ON-state capacitance      | V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = 0 V to 3.3 V                                                                                         | -                                   | 9.0                | -   | -                                    | -    | pF   |

- [1] All typical values are measured at T<sub>amb</sub> = 25 °C.  
[2] One input at 3 V, other inputs at V<sub>CC</sub> or GND.

9.1 Test circuits

V<sub>I</sub> = V<sub>CC</sub> or GND and V<sub>O</sub> = GND or V<sub>CC</sub>.

**Fig 6. Test circuit for measuring OFF-state leakage current (one switch)**

V<sub>I</sub> = V<sub>CC</sub> or GND and V<sub>O</sub> = open circuit.

**Fig 7. Test circuit for measuring ON-state leakage current (one switch)**

9.2 Typical pass voltage graphs

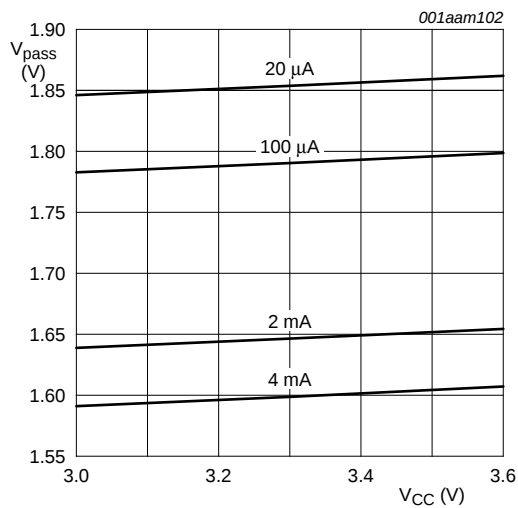


Fig 8. Pass voltage versus supply voltage;  
T<sub>amb</sub> = 125 °C (typical)

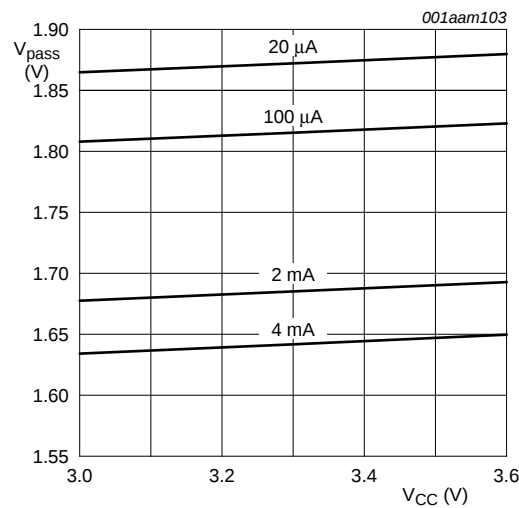


Fig 9. Pass voltage versus supply voltage;  
T<sub>amb</sub> = 85 °C (typical)

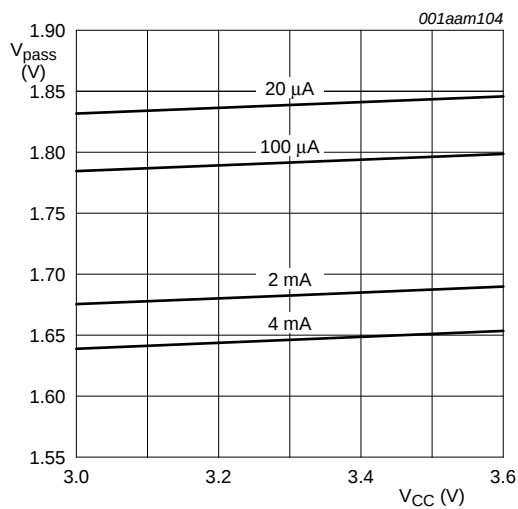


Fig 10. Pass voltage versus supply voltage;  
T<sub>amb</sub> = 25 °C (typical)

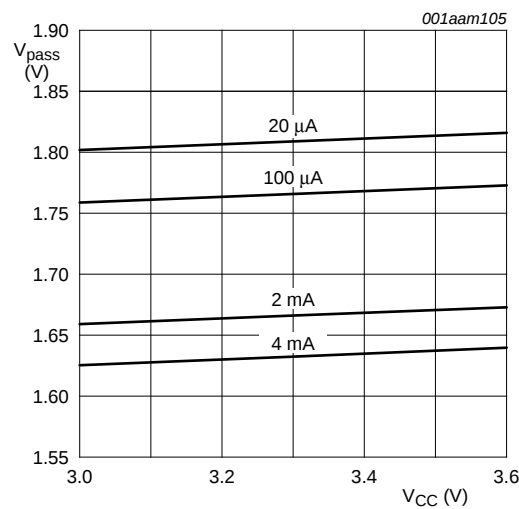


Fig 11. Pass voltage versus supply voltage;  
T<sub>amb</sub> = 0 °C (typical)

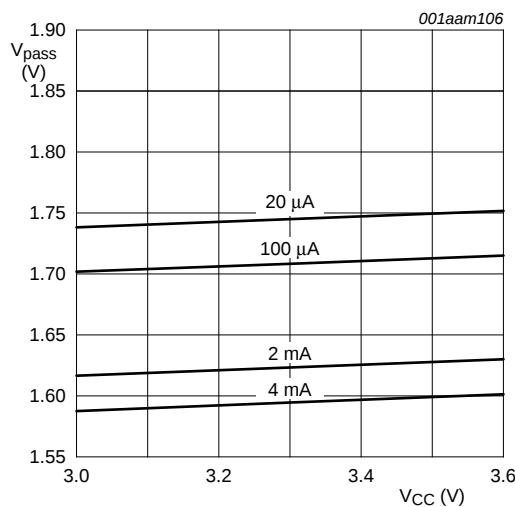


Fig 12. Pass voltage versus supply voltage; T<sub>amb</sub> = -40 °C (typical)

9.3 ON resistance

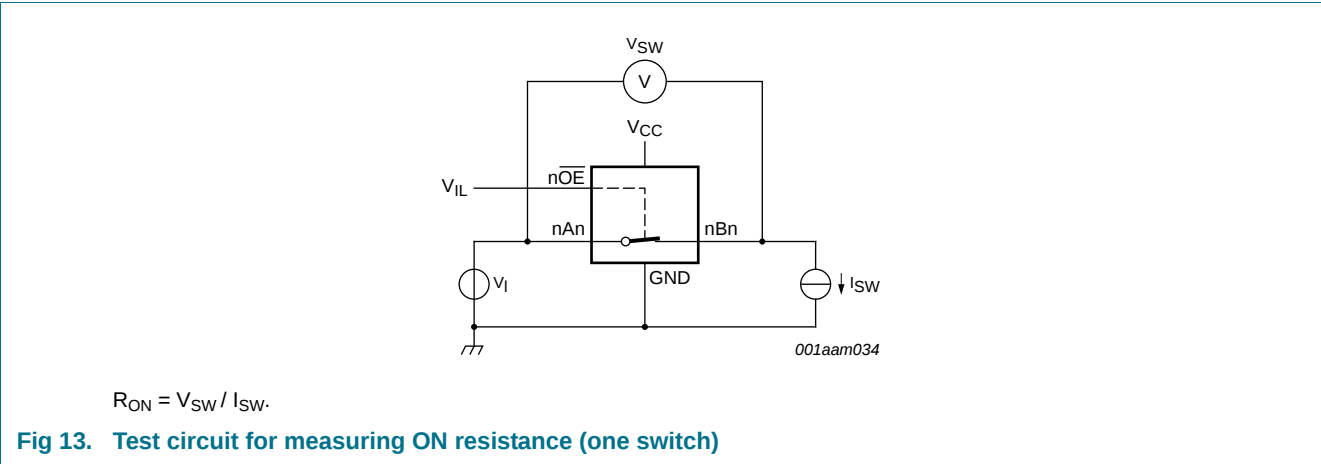
Table 7. Resistance R<sub>ON</sub>

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 13](#).

| Symbol          | Parameter     | Conditions                                      | T <sub>amb</sub> = −40 °C to +85 °C |                    |      | T <sub>amb</sub> = −40 °C to +125 °C |      | Unit |
|-----------------|---------------|-------------------------------------------------|-------------------------------------|--------------------|------|--------------------------------------|------|------|
|                 |               |                                                 | Min                                 | Typ <sup>[1]</sup> | Max  | Min                                  | Max  |      |
| R <sub>ON</sub> | ON resistance | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[2]</sup> |                                     |                    |      |                                      |      |      |
|                 |               | I <sub>SW</sub> = 64 mA; V <sub>I</sub> = 0 V   | -                                   | 3.7                | 7.0  | -                                    | 10.0 | Ω    |
|                 |               | I <sub>SW</sub> = 24 mA; V <sub>I</sub> = 0 V   | -                                   | 3.7                | 7.0  | -                                    | 10.0 | Ω    |
|                 |               | I <sub>SW</sub> = 15 mA; V <sub>I</sub> = 1.2 V | -                                   | 4.7                | 10.0 | -                                    | 12.0 | Ω    |

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

9.4 ON resistance test circuit



10. Dynamic characteristics

Table 8. Dynamic characteristics  
GND = 0 V; for test circuit see [Figure 16](#)

| Symbol           | Parameter         | Conditions                                                                                  | T <sub>amb</sub> = −40 °C to +85 °C |                    |      | T <sub>amb</sub> = −40 °C to +125 °C |      | Unit |
|------------------|-------------------|---------------------------------------------------------------------------------------------|-------------------------------------|--------------------|------|--------------------------------------|------|------|
|                  |                   |                                                                                             | Min                                 | Typ <sup>[1]</sup> | Max  | Min                                  | Max  |      |
| t <sub>pd</sub>  | propagation delay | nAn to nBn or nBn to nAn; see <a href="#">Figure 14</a><br>V <sub>CC</sub> = 3.0 V to 3.6 V | -                                   | -                  | 0.11 | -                                    | 0.22 | ns   |
| t <sub>en</sub>  | enable time       | nOE to nAn or nBn; see <a href="#">Figure 15</a><br>V <sub>CC</sub> = 3.0 V to 3.6 V        | 1.5                                 | 2.8                | 5.0  | 1.5                                  | 6.0  | ns   |
| t <sub>dis</sub> | disable time      | nOE to nAn or nBn; see <a href="#">Figure 15</a><br>V <sub>CC</sub> = 3.0 V to 3.6 V        | 0.8                                 | 3.2                | 7.0  | 0.8                                  | 8.0  | ns   |

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

11. Waveforms

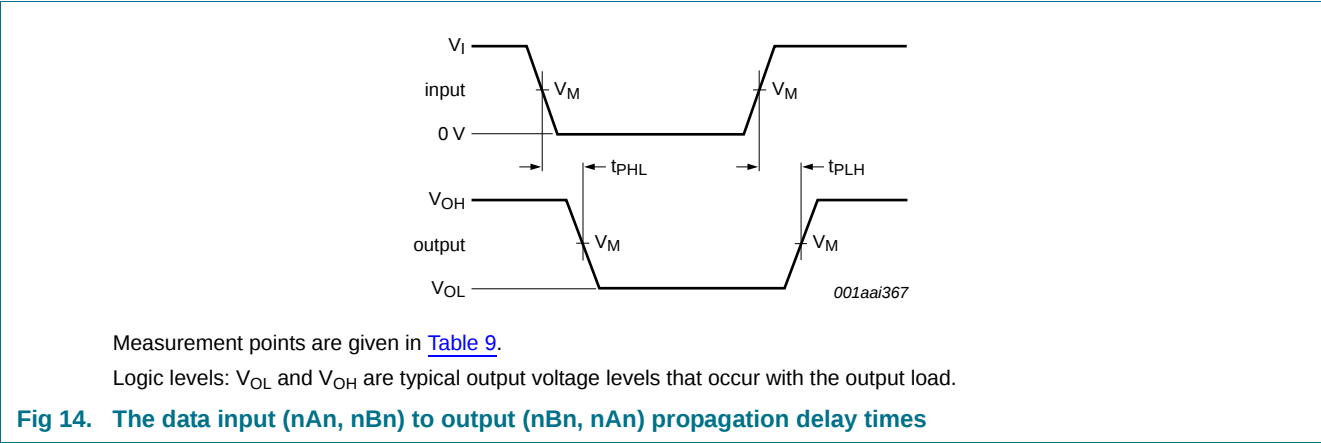
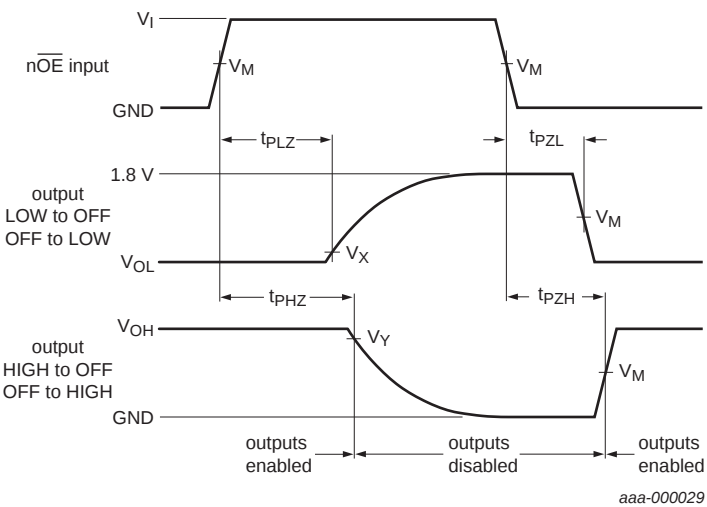


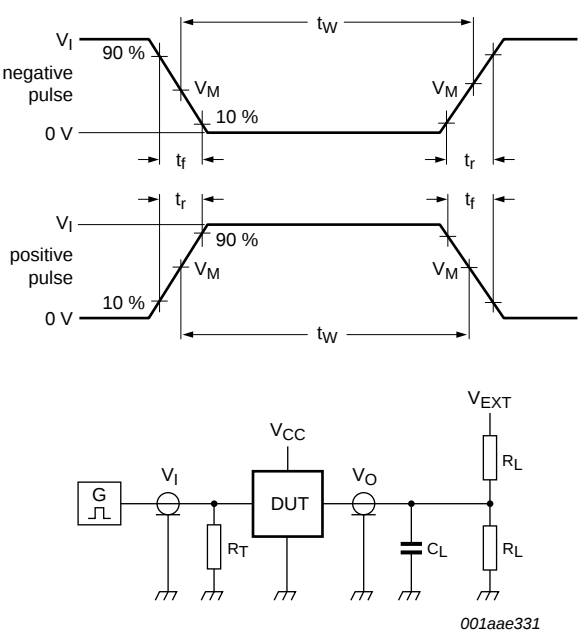
Table 9. Measurement points

| Supply voltage  | Input              |                 |                                 | Output         |                          |                          |
|-----------------|--------------------|-----------------|---------------------------------|----------------|--------------------------|--------------------------|
| V <sub>CC</sub> | V <sub>M</sub>     | V <sub>I</sub>  | t <sub>r</sub> = t <sub>f</sub> | V <sub>M</sub> | V <sub>X</sub>           | V <sub>Y</sub>           |
| 3.0 V to 3.6 V  | 0.5V <sub>CC</sub> | V <sub>CC</sub> | ≤ 2.0 ns                        | 0.9 V          | V <sub>OL</sub> + 0.15 V | V <sub>OH</sub> − 0.15 V |



Measurement points are given in [Table 9](#).  
Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 15. Enable and disable times**



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 16. 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              |

11.1 Additional dynamic characteristics

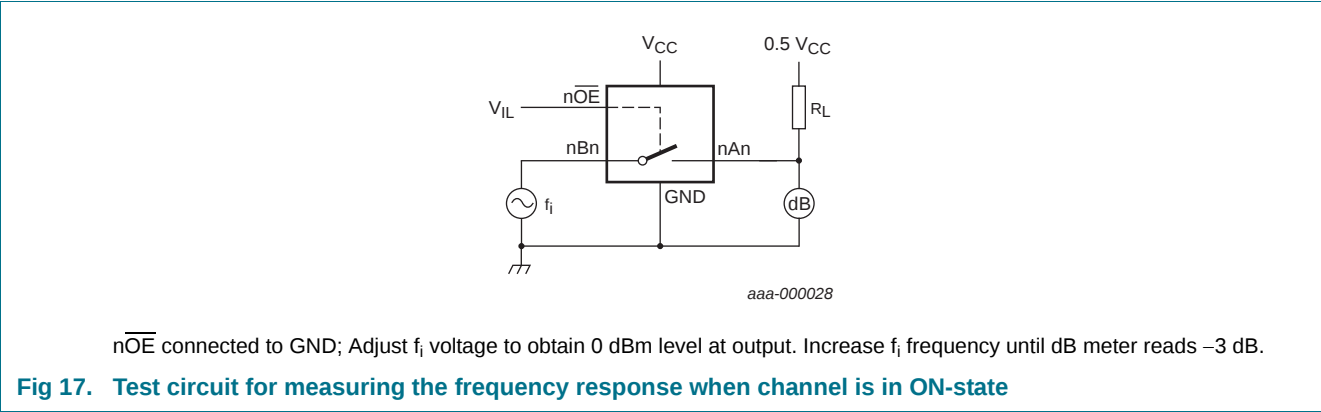
**Table 11. Additional dynamic characteristics**  
At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $V_I = \text{GND}$  or  $V_{CC}$  (unless otherwise specified);  $t_r = t_f \leq 2.5 \text{ ns}$ .

| Symbol              | Parameter                | Conditions                                                                                   | T <sub>amb</sub> = 25 °C |                    |     | Unit |
|---------------------|--------------------------|----------------------------------------------------------------------------------------------|--------------------------|--------------------|-----|------|
|                     |                          |                                                                                              | Min                      | Typ <sup>[1]</sup> | Max |      |
| f <sub>(-3dB)</sub> | -3 dB frequency response | V <sub>CC</sub> = 3.3 V; R <sub>L</sub> = 50 Ω; see <a href="#">Figure 17</a> <sup>[2]</sup> | -                        | 575                | -   | MHz  |

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

[2] f<sub>i</sub> is biased at 0.5V<sub>CC</sub>.

11.2 Test circuits



12. Package outline

SSOP24: plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm    SOT556-1

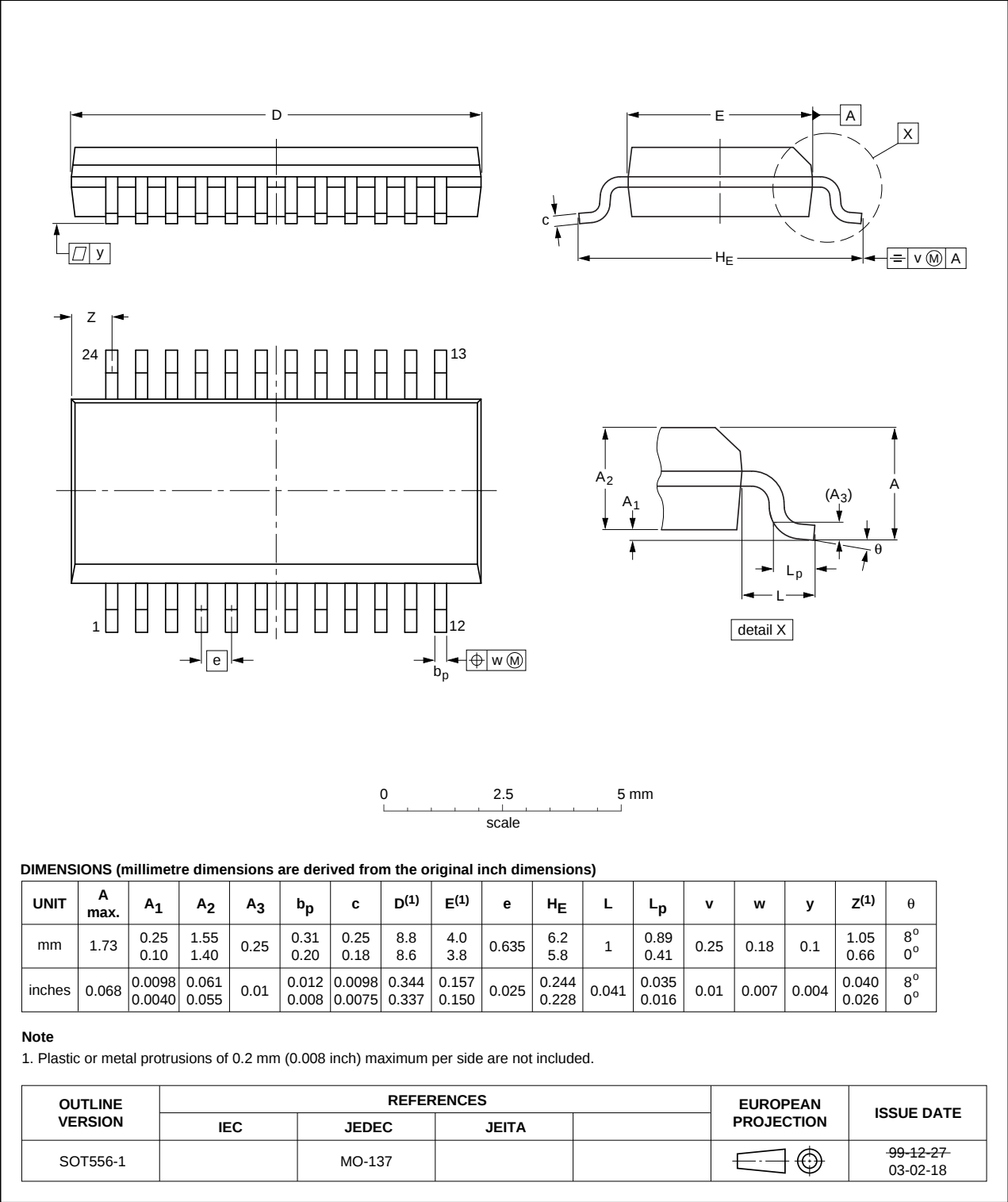
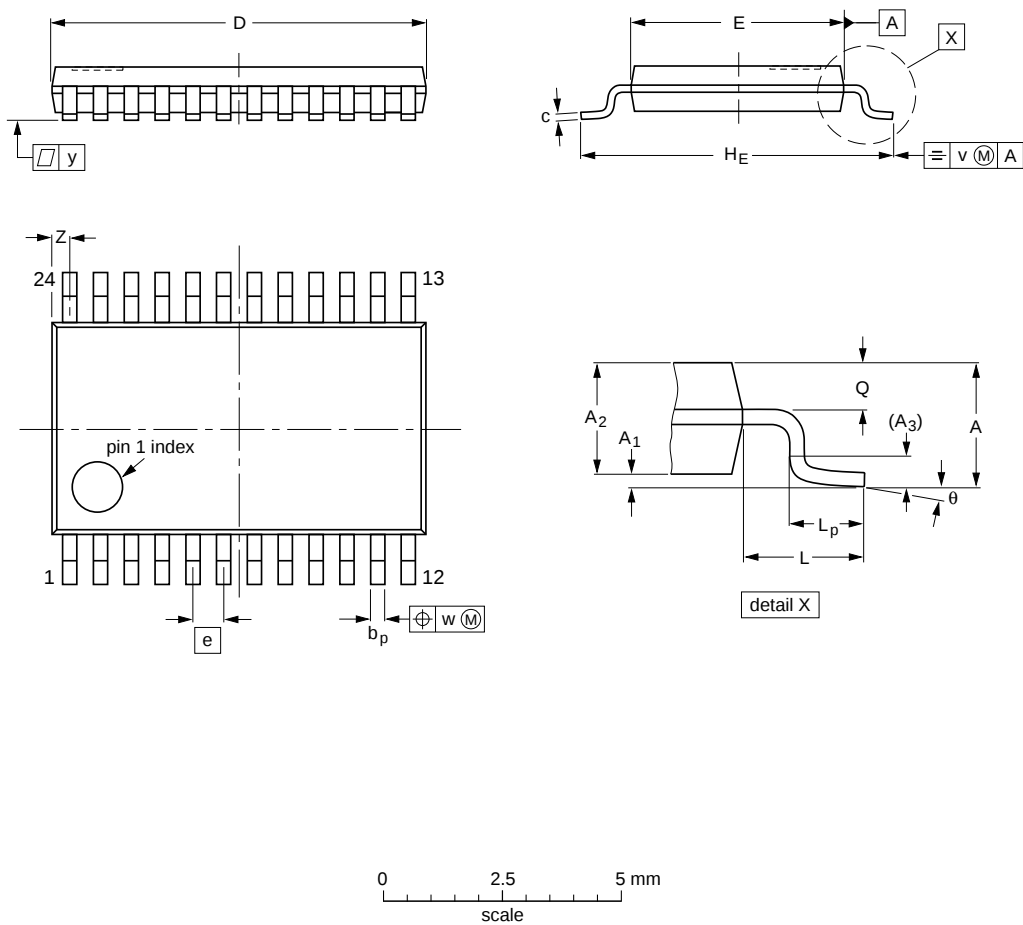


Fig 18. Package outline SOT556-1 (SSOP24)

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

SOT355-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 7.9<br>7.7       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.5<br>0.2       | 8°<br>0° |

Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                       |
| SOT355-1           |            | MO-153 |       |  |                        | -99-12-27<br>03-02-19 |

Fig 19. 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

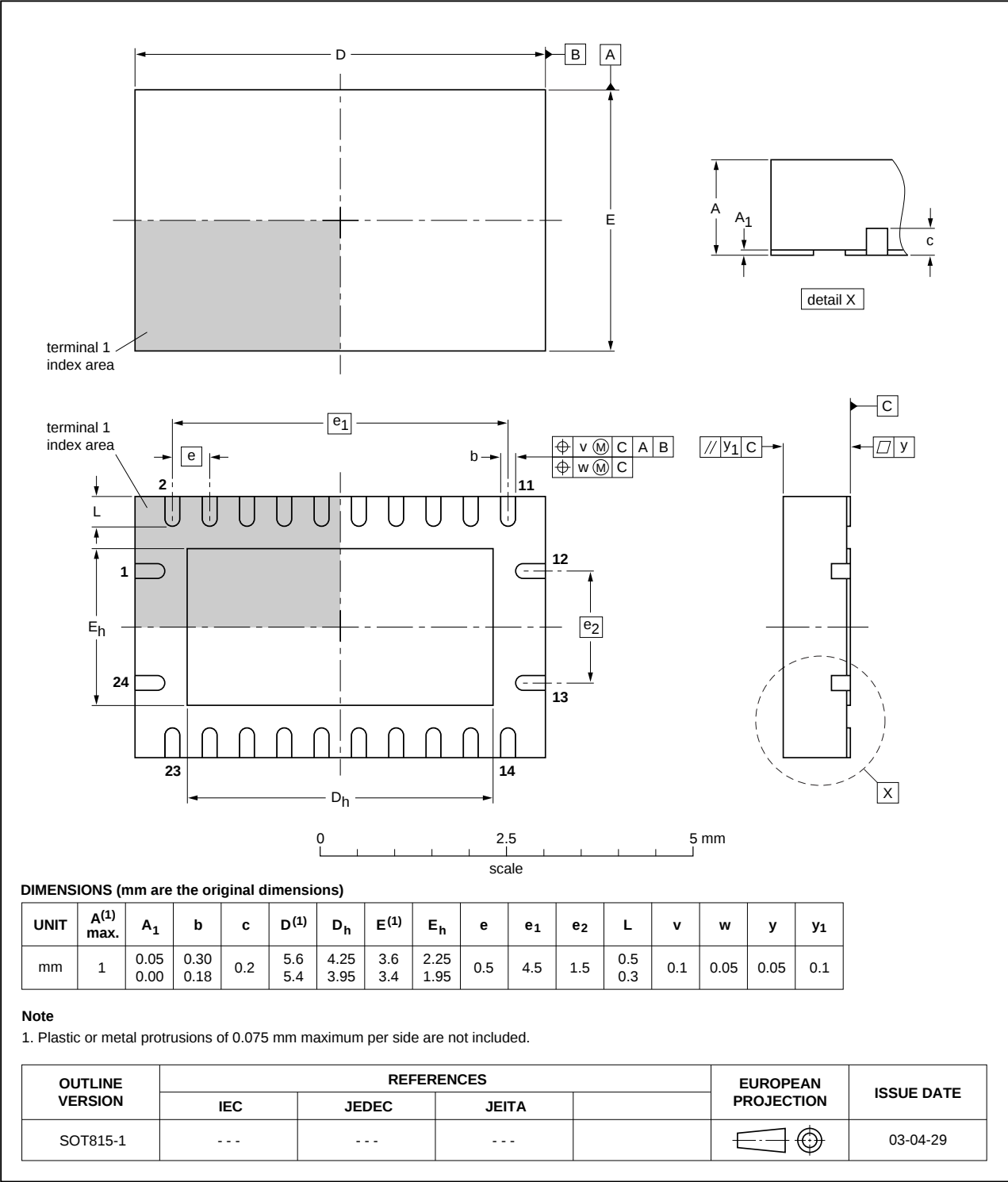


Fig 20. Package outline SOT815-1 (DHVQFN24)

## 13. 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                        |

## 14. Revision history

Table 13. Revision history

| Document ID      | Release date           | Data sheet status  | Change notice | Supersedes       |
|------------------|------------------------|--------------------|---------------|------------------|
| 74CBTLVD3384 v.2 | 20111216               | Product data sheet | -             | 74CBTLVD3384 v.1 |
| Modifications:   | • Legal pages updated. |                    |               |                  |
| 74CBTLVD3384 v.1 | 20110719               | Product data sheet | -             | -                |

## 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.nexperia.com>.

### 15.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification** — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

### 15.3 Disclaimers

**Limited warranty and liability** — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Nexperia.

**Right to make changes** — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or

malfunction of a Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia accepts no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

**Terms and conditions of commercial sale** — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Non-automotive qualified products** — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond

Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

## 15.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 16. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

## 17. Contents

---

|           |                                                   |           |
|-----------|---------------------------------------------------|-----------|
| <b>1</b>  | <b>General description</b> . . . . .              | <b>1</b>  |
| <b>2</b>  | <b>Features and benefits</b> . . . . .            | <b>1</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .             | <b>2</b>  |
| <b>4</b>  | <b>Functional diagram</b> . . . . .               | <b>2</b>  |
| <b>5</b>  | <b>Pinning information</b> . . . . .              | <b>3</b>  |
| 5.1       | Pinning . . . . .                                 | 3         |
| 5.2       | Pin description . . . . .                         | 4         |
| <b>6</b>  | <b>Functional description</b> . . . . .           | <b>4</b>  |
| <b>7</b>  | <b>Limiting values</b> . . . . .                  | <b>5</b>  |
| <b>8</b>  | <b>Recommended operating conditions</b> . . . . . | <b>5</b>  |
| <b>9</b>  | <b>Static characteristics</b> . . . . .           | <b>5</b>  |
| 9.1       | Test circuits . . . . .                           | 6         |
| 9.2       | Typical pass voltage graphs . . . . .             | 7         |
| 9.3       | ON resistance . . . . .                           | 9         |
| 9.4       | ON resistance test circuit . . . . .              | 9         |
| <b>10</b> | <b>Dynamic characteristics</b> . . . . .          | <b>10</b> |
| <b>11</b> | <b>Waveforms</b> . . . . .                        | <b>10</b> |
| 11.1      | Additional dynamic characteristics . . . . .      | 13        |
| 11.2      | Test circuits . . . . .                           | 13        |
| <b>12</b> | <b>Package outline</b> . . . . .                  | <b>14</b> |
| <b>13</b> | <b>Abbreviations</b> . . . . .                    | <b>17</b> |
| <b>14</b> | <b>Revision history</b> . . . . .                 | <b>17</b> |
| <b>15</b> | <b>Legal information</b> . . . . .                | <b>18</b> |
| 15.1      | Data sheet status . . . . .                       | 18        |
| 15.2      | Definitions . . . . .                             | 18        |
| 15.3      | Disclaimers . . . . .                             | 18        |
| 15.4      | Trademarks . . . . .                              | 19        |
| <b>16</b> | <b>Contact information</b> . . . . .              | <b>19</b> |
| <b>17</b> | <b>Contents</b> . . . . .                         | <b>20</b> |