



# PBHV8515QA

150 V, 500 mA NPN high-voltage low V<sub>CEsat</sub> (BISS) transistor  
19 November 2015

Product data sheet

## 1. General description

NPN high-voltage low V<sub>CEsat</sub> Breakthrough In Small Signal (BISS) transistor in a leadless ultra small DFN1010D-3 (SOT1215) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads.

PNP complement: PBHV9515QA.

## 2. Features and benefits

- High voltage
- Low collector-emitter saturation voltage V<sub>CEsat</sub>
- High collector current capability I<sub>C</sub> and I<sub>CM</sub>
- High collector current gain (h<sub>FE</sub>) at high I<sub>C</sub>
- Low package height of 0.37 mm
- AEC-Q101 qualified
- Suitable for Automatic Optical Inspection (AOI) of solder joint

## 3. Applications

- LED driver for LED chain module
- High Intensity Discharge (HID) front lighting
- Automotive motor management
- Switch Mode Power Supply (SMPS)

## 4. Quick reference data

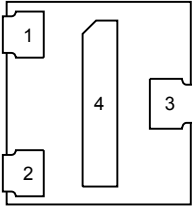
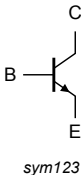
Table 1. Quick reference data

| Symbol           | Parameter                 | Conditions                                                                                                              | Min | Typ | Max | Unit |
|------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| V <sub>CEO</sub> | collector-emitter voltage | open base                                                                                                               | -   | -   | 150 | V    |
| I <sub>C</sub>   | collector current         |                                                                                                                         | -   | -   | 500 | mA   |
| h <sub>FE</sub>  | DC current gain           | V <sub>CE</sub> = 10 V; I <sub>C</sub> = 100 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C | 100 | 215 | -   |      |



5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                                                     | Graphic symbol                                                                                    |
|-----|--------|-------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | B      | base        |  <p>Transparent top view<br/>DFN1010D-3 (SOT1215)</p> |  <p>sym123</p> |
| 2   | E      | emitter     |                                                                                                                                        |                                                                                                   |
| 3   | C      | collector   |                                                                                                                                        |                                                                                                   |
| 4   | C      | collector   |                                                                                                                                        |                                                                                                   |

6. Ordering information

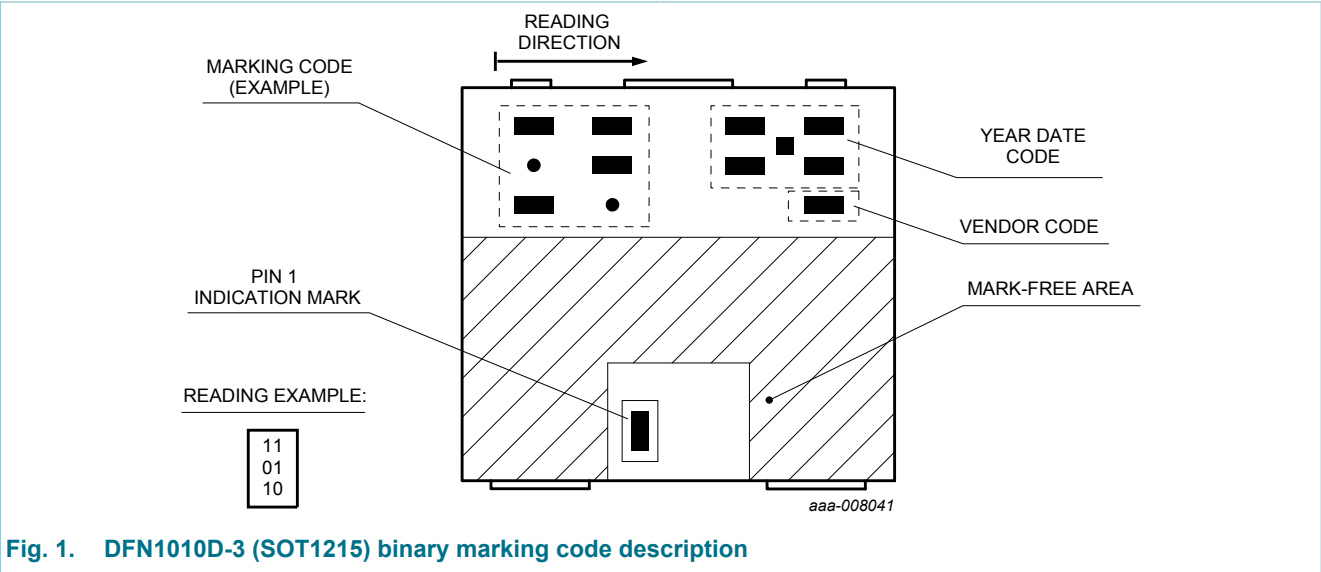
Table 3. Ordering information

| Type number | Package    |                                                                                                                        |         |
|-------------|------------|------------------------------------------------------------------------------------------------------------------------|---------|
|             | Name       | Description                                                                                                            | Version |
| PBHV8515QA  | DFN1010D-3 | DFN1010D-3: plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 1.1 x 1.0 x 0.37 mm | SOT1215 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PBHV8515QA  | 00 00 11     |



## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol           | Parameter                 | Conditions                    |     | Min | Max | Unit |
|------------------|---------------------------|-------------------------------|-----|-----|-----|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter                  |     | -   | 150 | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                     |     | -   | 150 | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                |     | -   | 6   | V    |
| I <sub>C</sub>   | collector current         |                               |     | -   | 500 | mA   |
| I <sub>CM</sub>  | peak collector current    | single pulse; $t_p \leq 1$ ms |     | -   | 1   | A    |
| I <sub>BM</sub>  | peak base current         |                               |     | -   | 200 | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C      | [1] | -   | 325 | mW   |
|                  |                           |                               | [2] | -   | 600 | mW   |
|                  |                           |                               | [3] | -   | 740 | mW   |
|                  |                           |                               | [4] | -   | 540 | mW   |
|                  |                           |                               | [5] | -   | 1   | W    |
| T <sub>j</sub>   | junction temperature      |                               |     | -   | 150 | °C   |
| T <sub>amb</sub> | ambient temperature       |                               |     | -55 | 150 | °C   |
| T <sub>stg</sub> | storage temperature       |                               |     | -65 | 150 | °C   |

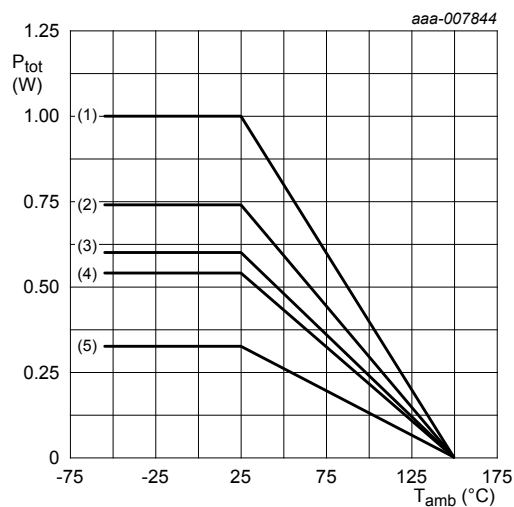
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

[4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



- (1) FR4 PCB, 4-layer copper, 1 cm<sup>2</sup>
- (2) FR4 PCB, single-sided copper, 6 cm<sup>2</sup>
- (3) FR4 PCB, single-sided copper, 1 cm<sup>2</sup>
- (4) FR4 PCB, 4-layer copper, standard footprint
- (5) FR4 PCB, single-sided copper, standard footprint

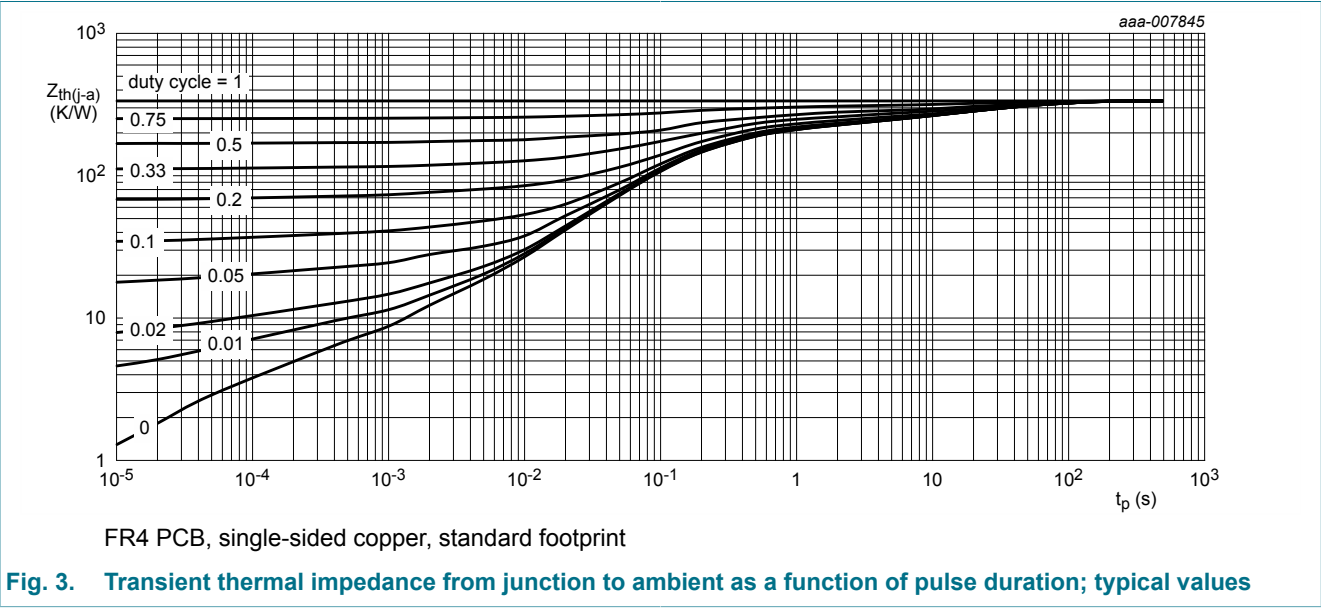
**Fig. 2. Power derating curves**

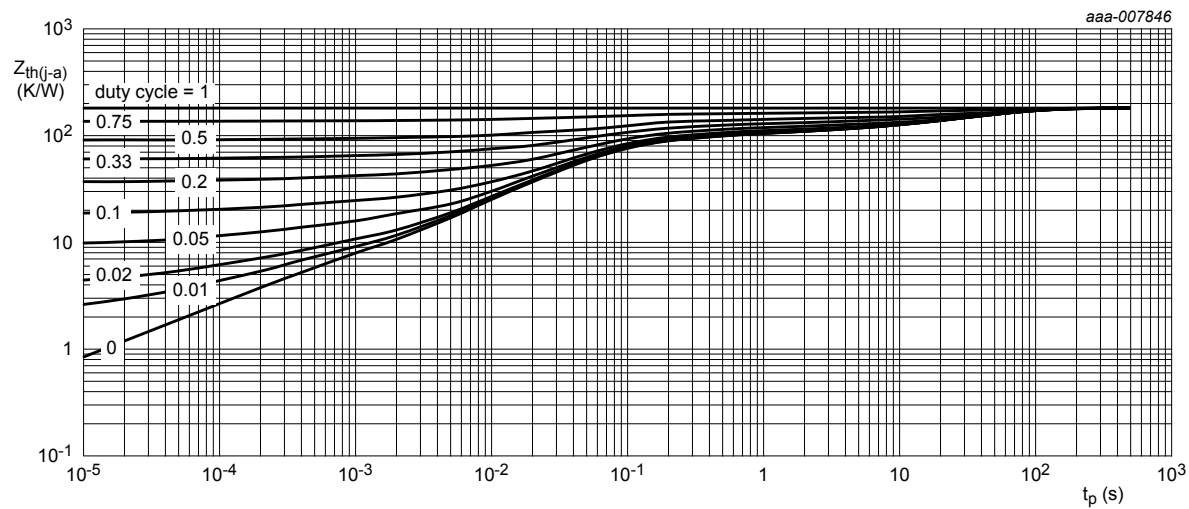
9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol               | Parameter                                   | Conditions  |     | Min | Typ | Max | Unit |
|----------------------|---------------------------------------------|-------------|-----|-----|-----|-----|------|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1] | -   | -   | 385 | K/W  |
|                      |                                             |             | [2] | -   | -   | 209 | K/W  |
|                      |                                             |             | [3] | -   | -   | 169 | K/W  |
|                      |                                             |             | [4] | -   | -   | 232 | K/W  |
|                      |                                             |             | [5] | -   | -   | 125 | K/W  |

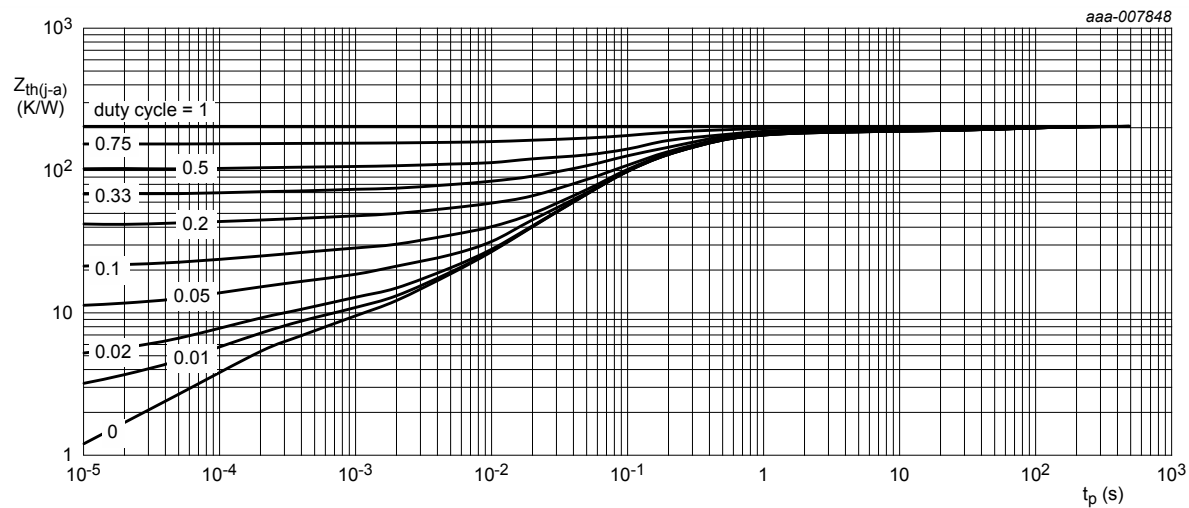
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.
- [5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.





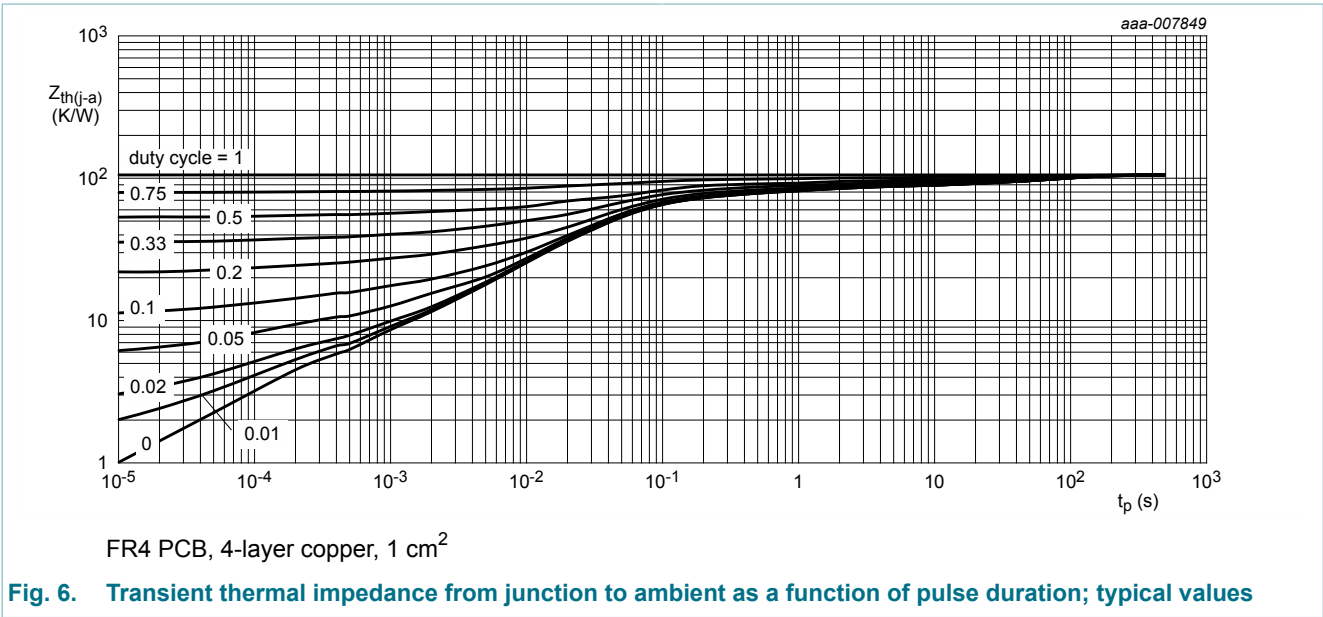
FR4 PCB, single-sided copper,  $1\text{ cm}^2$

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, 4-layer copper, standard footprint

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



## 10. Characteristics

Table 7. Characteristics

| Symbol      | Parameter                            | Conditions                                                                                                                                          | Min | Typ  | Max | Unit          |
|-------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|---------------|
| $I_{CBO}$   | collector-base cut-off current       | $V_{CB} = 120\text{ V}; I_E = 0\text{ A}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                     | -   | -    | 100 | nA            |
|             |                                      | $V_{CB} = 120\text{ V}; I_E = 0\text{ A}; T_J = 150\text{ }^{\circ}\text{C}$                                                                        | -   | -    | 10  | $\mu\text{A}$ |
| $I_{CES}$   | collector-emitter cut-off current    | $V_{CE} = 120\text{ V}; V_{BE} = 0\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                  | -   | -    | 100 | nA            |
| $I_{EBO}$   | emitter-base cut-off current         | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                       | -   | -    | 100 | nA            |
| $h_{FE}$    | DC current gain                      | $V_{CE} = 10\text{ V}; I_C = 50\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$  | 100 | 215  | -   |               |
|             |                                      | $V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$ | 100 | 215  | -   |               |
|             |                                      | $V_{CE} = 10\text{ V}; I_C = 200\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$ | 100 | 200  | -   |               |
|             |                                      | $V_{CE} = 10\text{ V}; I_C = 500\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$ | 35  | 60   | -   |               |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 50\text{ mA}; I_B = 5\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                       | -   | 30   | 60  | mV            |
|             |                                      | $I_C = 100\text{ mA}; I_B = 10\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$   | -   | 45   | 80  | mV            |
|             |                                      | $I_C = 100\text{ mA}; I_B = 20\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$   | -   | 35   | 70  | mV            |
|             |                                      | $I_C = 200\text{ mA}; I_B = 40\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$   | -   | 60   | 100 | mV            |
|             |                                      | $I_C = 500\text{ mA}; I_B = 100\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$  | -   | 120  | 200 | mV            |
| $V_{BEsat}$ | base-emitter saturation voltage      | $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                           | -   | 0.95 | 1.2 | V             |
| $t_d$       | delay time                           | $V_{CC} = 10\text{ V}; I_C = 100\text{ mA}; I_{B(on)} = 20\text{ mA}; I_{B(off)} = -20\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}$             | -   | 15   | -   | ns            |
| $t_r$       | rise time                            |                                                                                                                                                     | -   | 155  | -   | ns            |
| $t_{on}$    | turn-on time                         |                                                                                                                                                     | -   | 170  | -   | ns            |
| $t_s$       | storage time                         |                                                                                                                                                     | -   | 650  | -   | ns            |
| $t_f$       | fall time                            |                                                                                                                                                     | -   | 170  | -   | ns            |
| $t_{off}$   | turn-off time                        |                                                                                                                                                     | -   | 820  | -   | ns            |
| $f_T$       | transition frequency                 | $V_{CE} = 10\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                                | -   | 75   | -   | MHz           |
| $C_c$       | collector capacitance                | $V_{CB} = 20\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                  | -   | 2.4  | -   | pF            |

| Symbol         | Parameter           | Conditions                                                                                                  | Min | Typ | Max | Unit |
|----------------|---------------------|-------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| C <sub>e</sub> | emitter capacitance | V <sub>EB</sub> = 0.5 V; I <sub>C</sub> = 0 A; i <sub>c</sub> = 0 A;<br>f = 1 MHz; T <sub>amb</sub> = 25 °C | -   | 125 | -   | pF   |

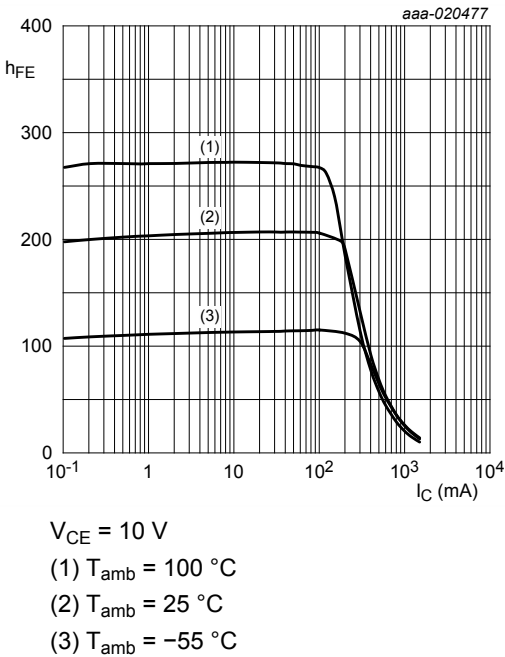


Fig. 7. DC current gain as a function of collector current; typical values

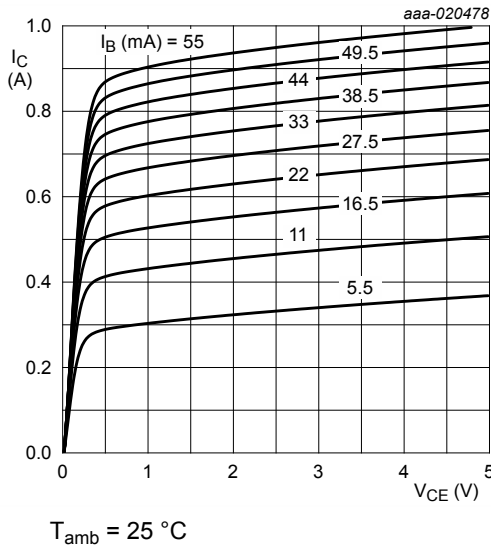


Fig. 8. Collector current as a function of collector-emitter voltage; typical values

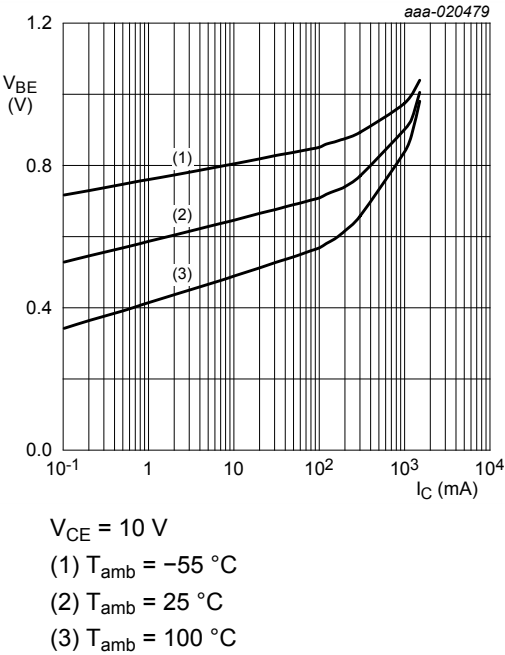


Fig. 9. Base-emitter voltage as a function of collector current; typical values

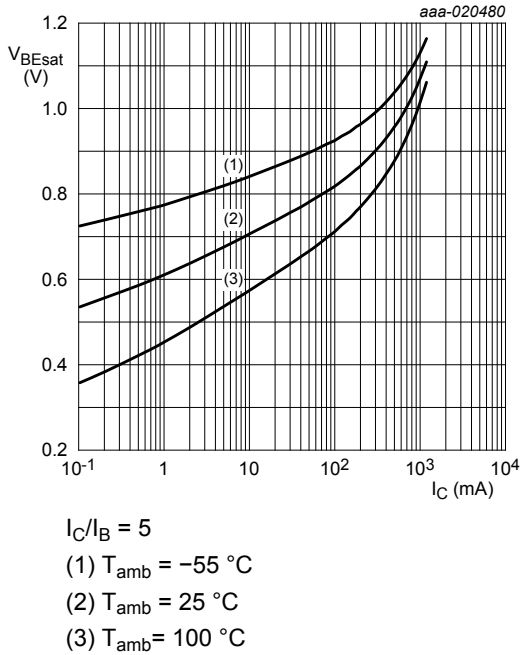


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

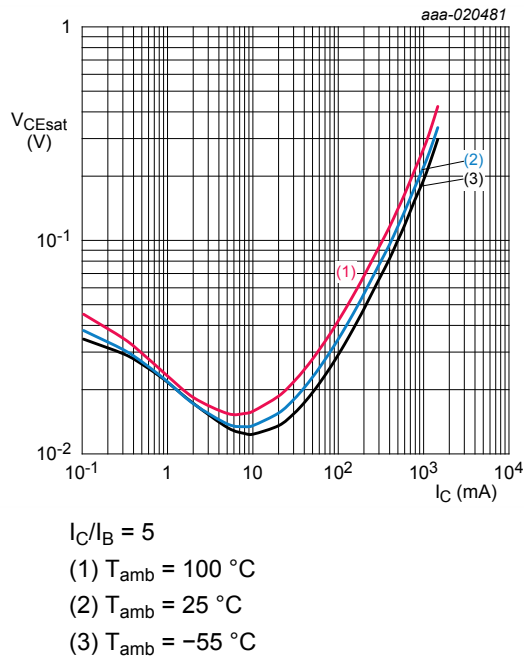


Fig. 11. Collector-emitter saturation voltage as a function of collector current; typical values

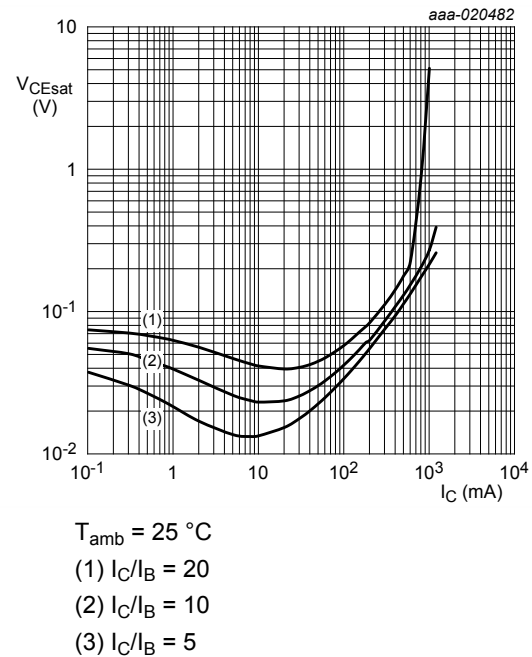


Fig. 12. Collector-emitter saturation voltage as a function of collector current; typical values

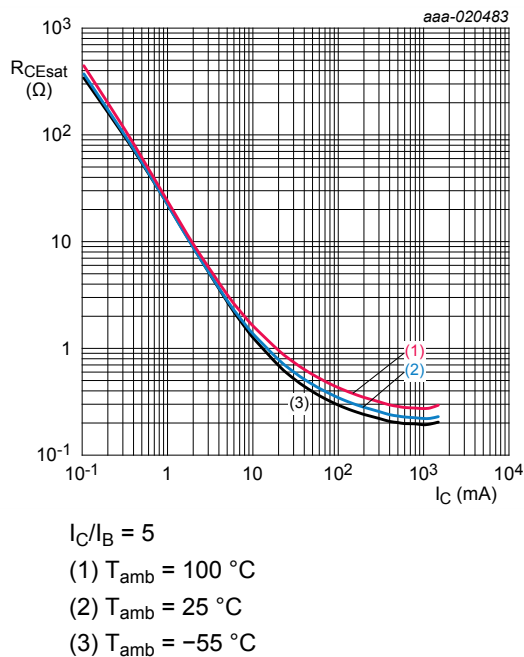


Fig. 13. Collector-emitter saturation resistance as a function of collector current; typical values

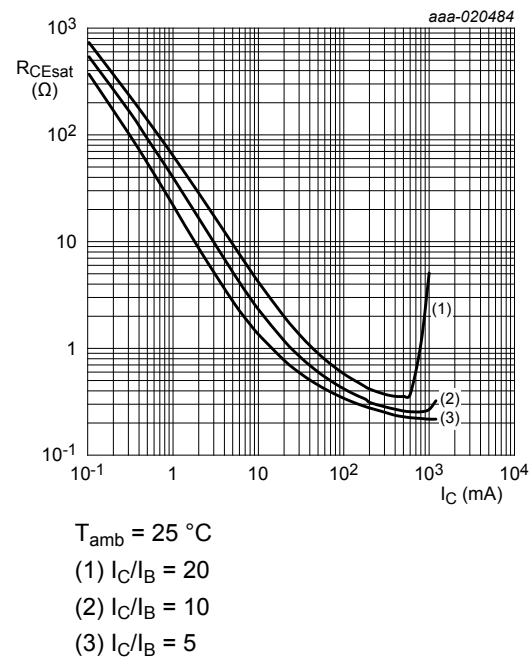


Fig. 14. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

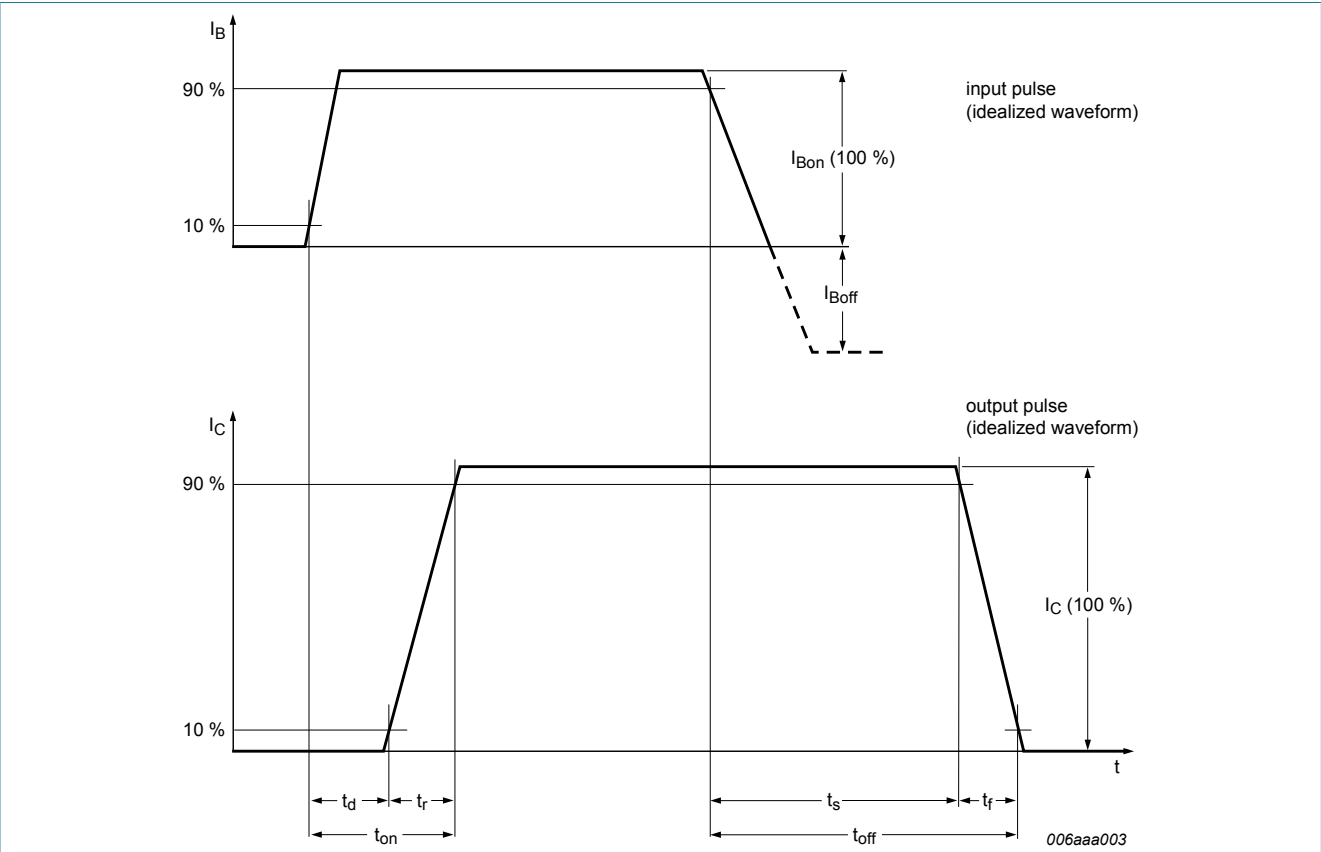


Fig. 15. BISS transistor switching time definition

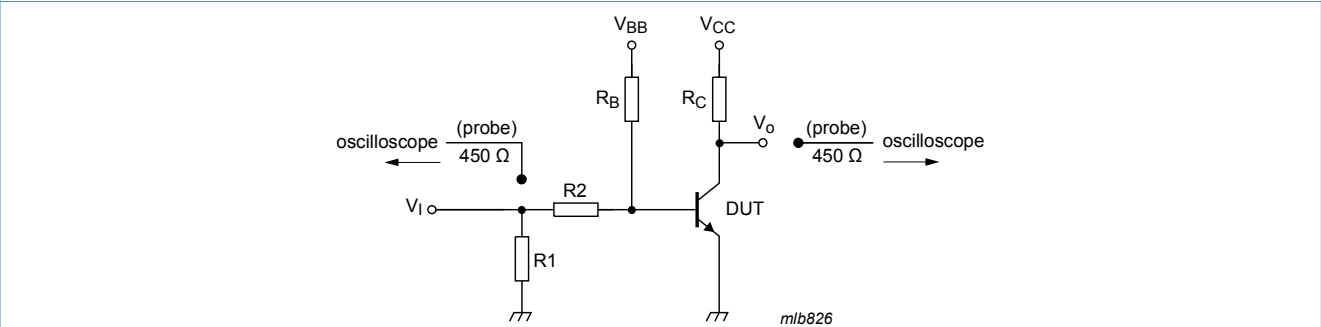


Fig. 16. Test circuit for switching times

11.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

12. Package outline

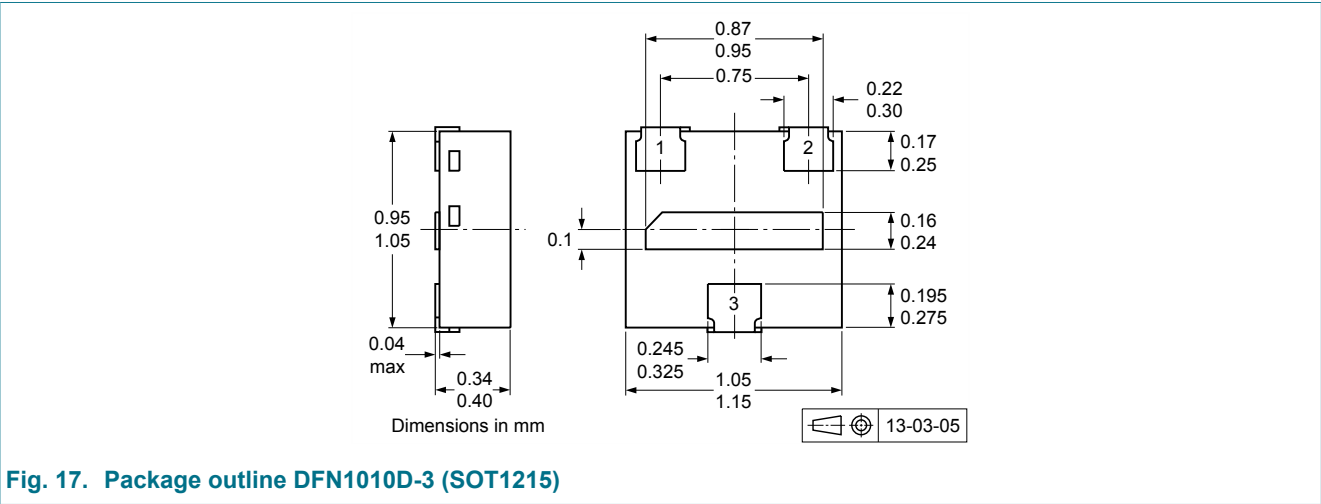


Fig. 17. Package outline DFN1010D-3 (SOT1215)

13. Soldering

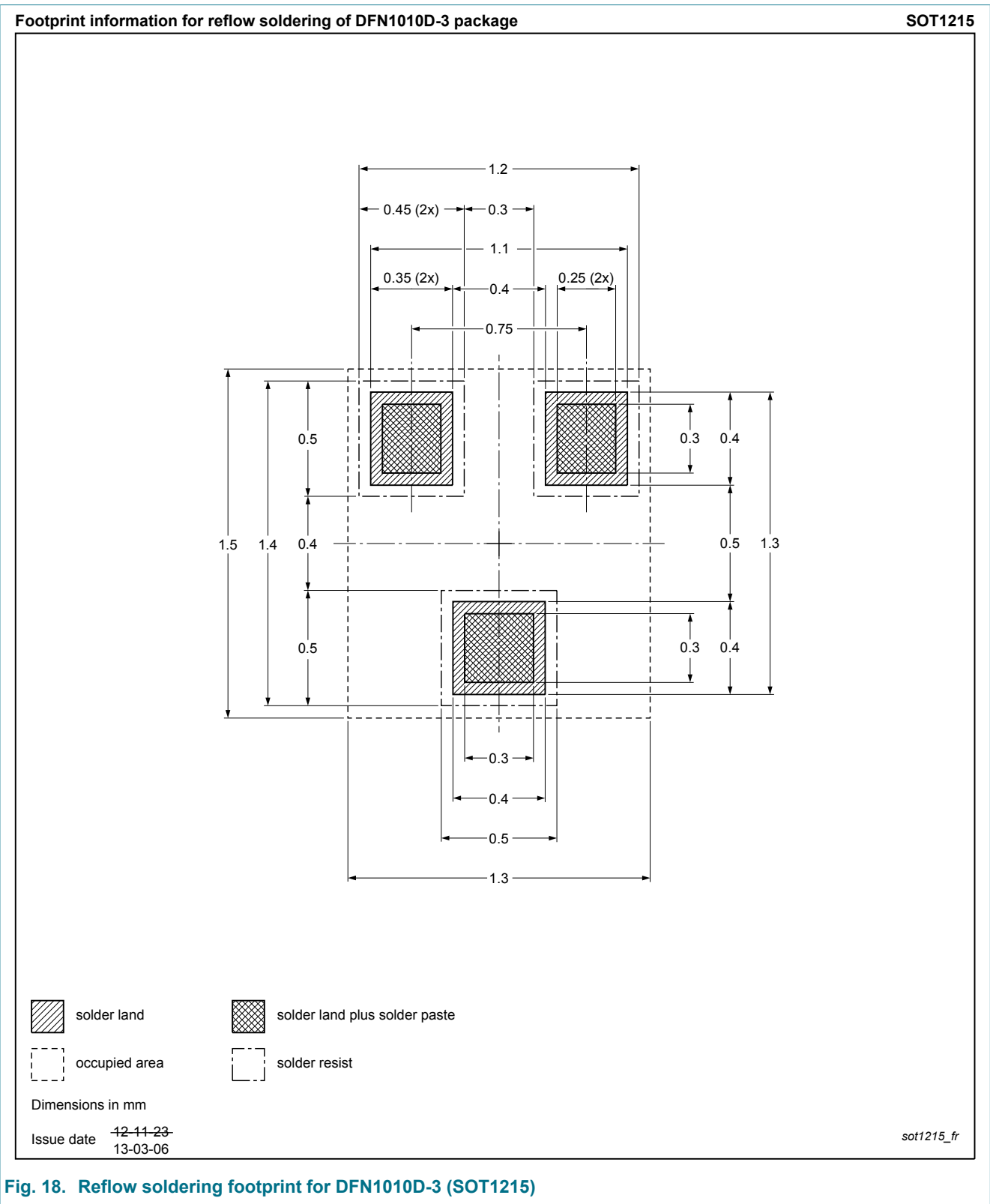


Fig. 18. Reflow soldering footprint for DFN1010D-3 (SOT1215)

## 14. Revision history

Table 8. Revision history

| Data sheet ID  | Release date | Data sheet status  | Change notice | Supersedes |
|----------------|--------------|--------------------|---------------|------------|
| PBHV8515QA v.1 | 20151119     | Product data sheet | -             | -          |

## 15. Legal information

### 15.1 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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## 16. Contents

|      |                               |    |
|------|-------------------------------|----|
| 1    | General description .....     | 1  |
| 2    | Features and benefits .....   | 1  |
| 3    | Applications .....            | 1  |
| 4    | Quick reference data .....    | 1  |
| 5    | Pinning information .....     | 2  |
| 6    | Ordering information .....    | 2  |
| 7    | Marking .....                 | 2  |
| 8    | Limiting values .....         | 3  |
| 9    | Thermal characteristics ..... | 5  |
| 10   | Characteristics .....         | 8  |
| 11   | Test information .....        | 11 |
| 11.1 | Quality information .....     | 11 |
| 12   | Package outline .....         | 12 |
| 13   | Soldering .....               | 13 |
| 14   | Revision history .....        | 14 |
| 15   | Legal information .....       | 15 |
| 15.1 | Data sheet status .....       | 15 |
| 15.2 | Definitions .....             | 15 |
| 15.3 | Disclaimers .....             | 15 |
| 15.4 | Trademarks .....              | 16 |

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