



# PBSS4220PANS

20 V, 2 A NPN/NPN low  $V_{CEsat}$  BISS double transistor

14 December 2015

Product data sheet

## 1. General description

NPN/NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) double transistor in a leadless medium power DFN2020D-6 (SOT1118D) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads.

PNP/PNP complement: PBSS5220PAPS

## 2. Features and benefits

- Very low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- High collector current gain  $h_{FE}$  at high  $I_C$
- Reduced Printed-Circuit Board (PCB) requirements
- Exposed heat sink for excellent thermal and electrical conductivity
- High energy efficiency due to less heat generation
- Suitable for Automatic Optical Inspection (AOI) of solder joints
- AEC-Q101 qualified

## 3. Applications

- Load switch
- Battery-driven devices
- Power management
- Charging circuits
- LED lighting
- Power switches (e.g. motors, fans)

## 4. Quick reference data

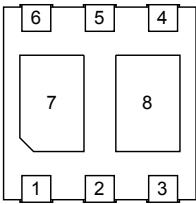
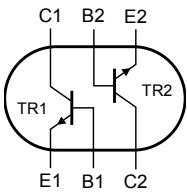
Table 1. Quick reference data

| Symbol                | Parameter                 | Conditions                    | Min | Typ | Max | Unit |
|-----------------------|---------------------------|-------------------------------|-----|-----|-----|------|
| <b>Per transistor</b> |                           |                               |     |     |     |      |
| $V_{CEO}$             | collector-emitter voltage | open base                     | -   | -   | 20  | V    |
| $I_C$                 | collector current         |                               | -   | -   | 2   | A    |
| $I_{CM}$              | peak collector current    | single pulse; $t_p \leq 1$ ms | -   | -   | 3   | A    |

| Symbol             | Parameter                               | Conditions                                                                                                            | Min | Typ | Max | Unit |
|--------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| Per transistor     |                                         |                                                                                                                       |     |     |     |      |
| R <sub>CEsat</sub> | collector-emitter saturation resistance | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C | -   | -   | 170 | mΩ   |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description   | Simplified outline                                                                                                                                | Graphic symbol                                                                                    |
|-----|--------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | E1     | emitter TR1   |  <p>Transparent top view</p> <p><b>DFN2020D-6 (SOT1118D)</b></p> |  <p>sym140</p> |
| 2   | B1     | base TR1      |                                                                                                                                                   |                                                                                                   |
| 3   | C2     | collector TR2 |                                                                                                                                                   |                                                                                                   |
| 4   | E2     | emitter TR2   |                                                                                                                                                   |                                                                                                   |
| 5   | B2     | base TR2      |                                                                                                                                                   |                                                                                                   |
| 6   | C1     | collector TR1 |                                                                                                                                                   |                                                                                                   |
| 7   | C1     | collector TR1 |                                                                                                                                                   |                                                                                                   |
| 8   | C2     | collector TR2 |                                                                                                                                                   |                                                                                                   |

6. Ordering information

Table 3. Ordering information

| Type number  | Package    |                                                                                                                           |          |
|--------------|------------|---------------------------------------------------------------------------------------------------------------------------|----------|
|              | Name       | Description                                                                                                               | Version  |
| PBSS4220PANS | DFN2020D-6 | DFN2020D-6: plastic, thermally enhanced ultra thin and small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm | SOT1118D |

7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| PBSS4220PANS | 3M           |

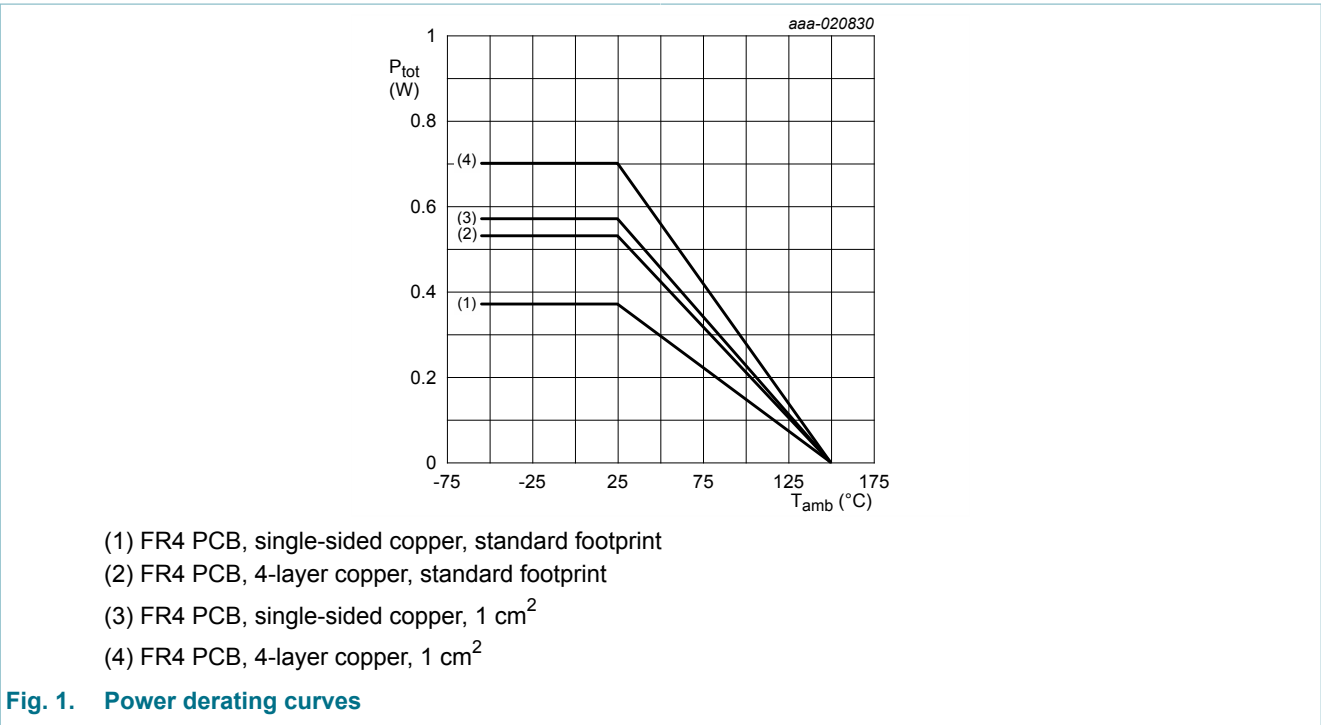
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol           | Parameter                 | Conditions                          |     | Min | Max | Unit |
|------------------|---------------------------|-------------------------------------|-----|-----|-----|------|
| Per transistor   |                           |                                     |     |     |     |      |
| V <sub>CBO</sub> | collector-base voltage    | open emitter                        |     | -   | 20  | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                           |     | -   | 20  | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                      |     | -   | 7   | V    |
| I <sub>C</sub>   | collector current         |                                     |     | -   | 2   | A    |
| I <sub>CM</sub>  | peak collector current    | single pulse; t <sub>p</sub> ≤ 1 ms |     | -   | 3   | A    |
| I <sub>B</sub>   | base current              |                                     |     | -   | 0.3 | A    |
| I <sub>BM</sub>  | peak base current         | single pulse; t <sub>p</sub> ≤ 1 ms |     | -   | 1   | A    |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C            | [1] | -   | 370 | mW   |
|                  |                           |                                     | [2] | -   | 570 | mW   |
|                  |                           |                                     | [3] | -   | 530 | mW   |
|                  |                           |                                     | [4] | -   | 700 | mW   |
| Per device       |                           |                                     |     |     |     |      |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C            | [1] | -   | 510 | mW   |
|                  |                           |                                     | [2] | -   | 780 | mW   |
|                  |                           |                                     | [3] | -   | 730 | mW   |
|                  |                           |                                     | [4] | -   | 960 | mW   |
| 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 Printed-Circuit Board (PCB), single sided copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 Printed-Circuit Board (PCB), 4-layer copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 Printed-Circuit Board (PCB), 4-layer copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.



9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol               | Parameter                                   | Conditions  |     | Min | Typ | Max | Unit |
|----------------------|---------------------------------------------|-------------|-----|-----|-----|-----|------|
| Per transistor       |                                             |             |     |     |     |     |      |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1] | -   | -   | 338 | K/W  |
|                      |                                             |             | [2] | -   | -   | 219 | K/W  |
|                      |                                             |             | [3] | -   | -   | 236 | K/W  |
|                      |                                             |             | [4] | -   | -   | 179 | K/W  |
| Per device           |                                             |             |     |     |     |     |      |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1] | -   | -   | 246 | K/W  |
|                      |                                             |             | [2] | -   | -   | 161 | K/W  |
|                      |                                             |             | [3] | -   | -   | 172 | K/W  |
|                      |                                             |             | [4] | -   | -   | 131 | K/W  |

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

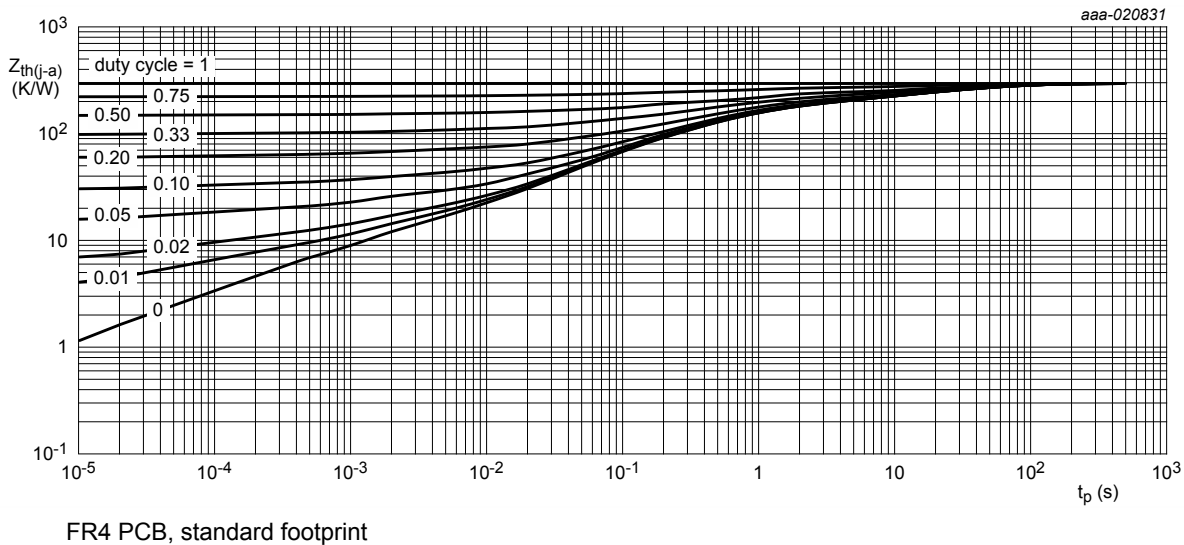


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

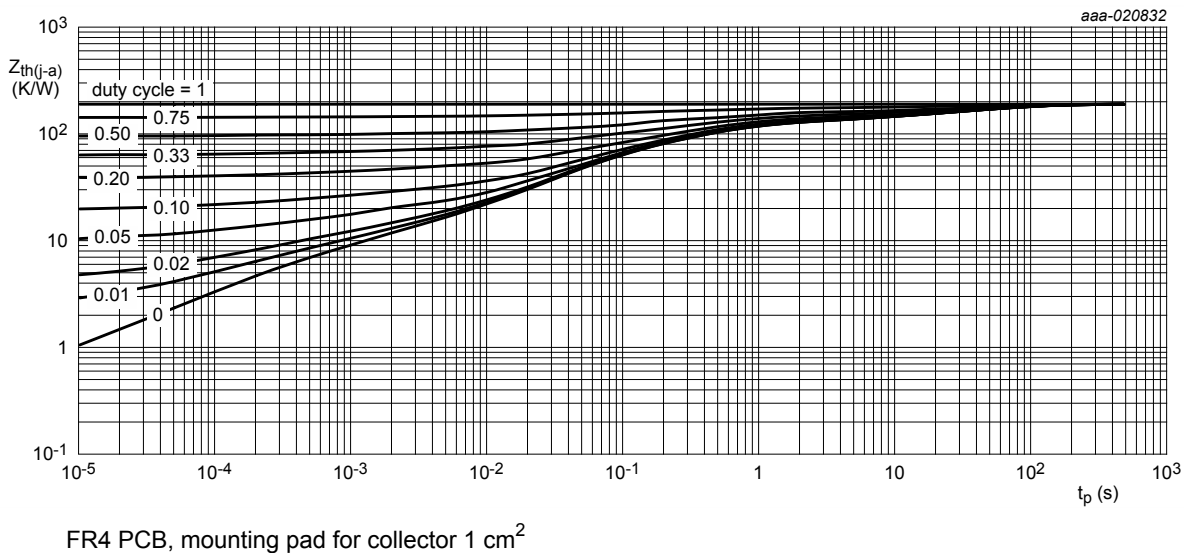
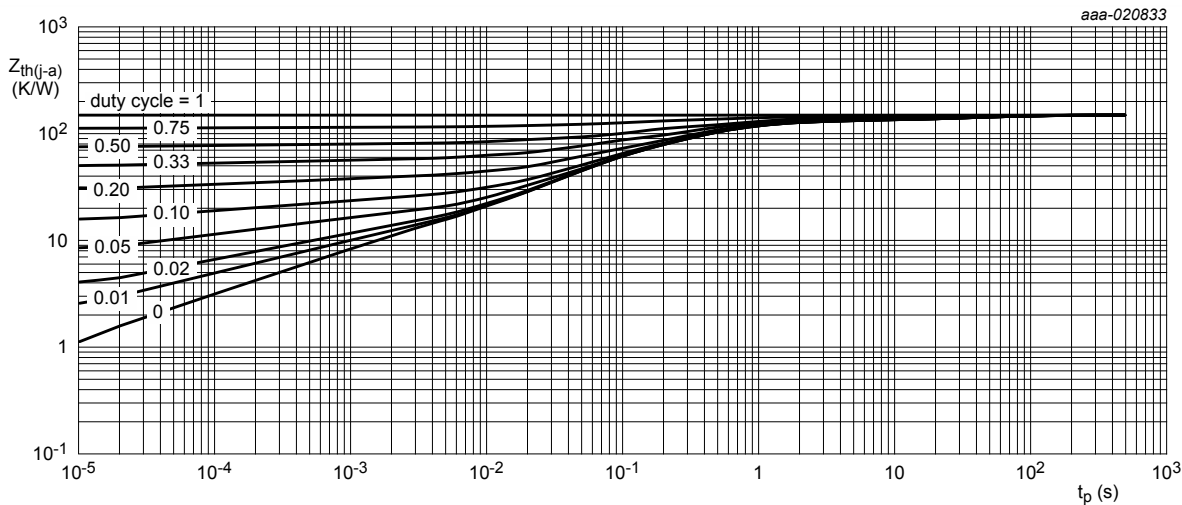
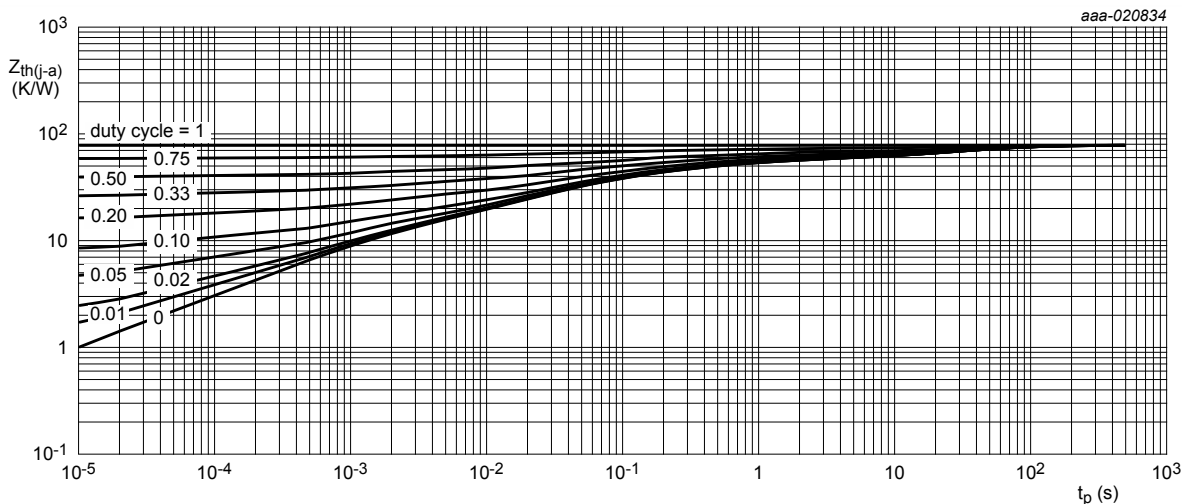


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, 4-layer copper, standard footprint

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



FR4 PCB, 4-layer copper, mounting pad for collector 1 cm<sup>2</sup>

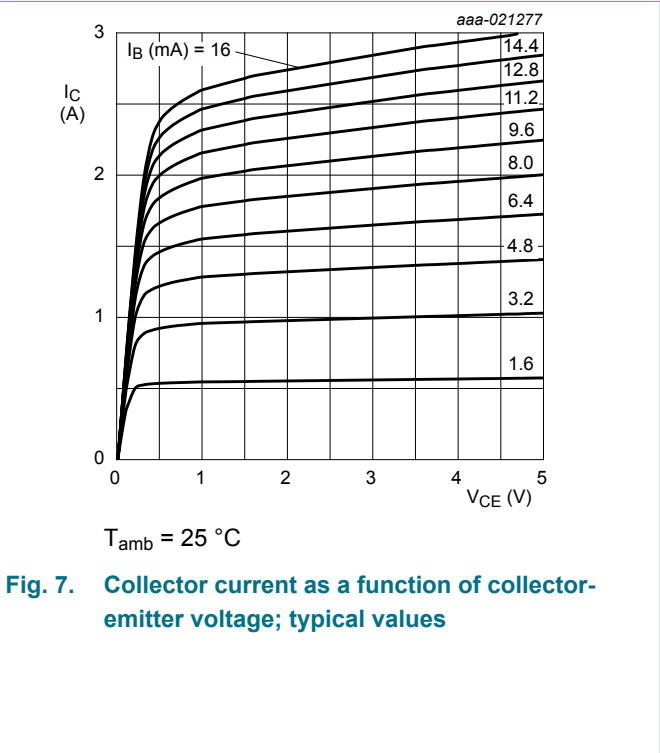
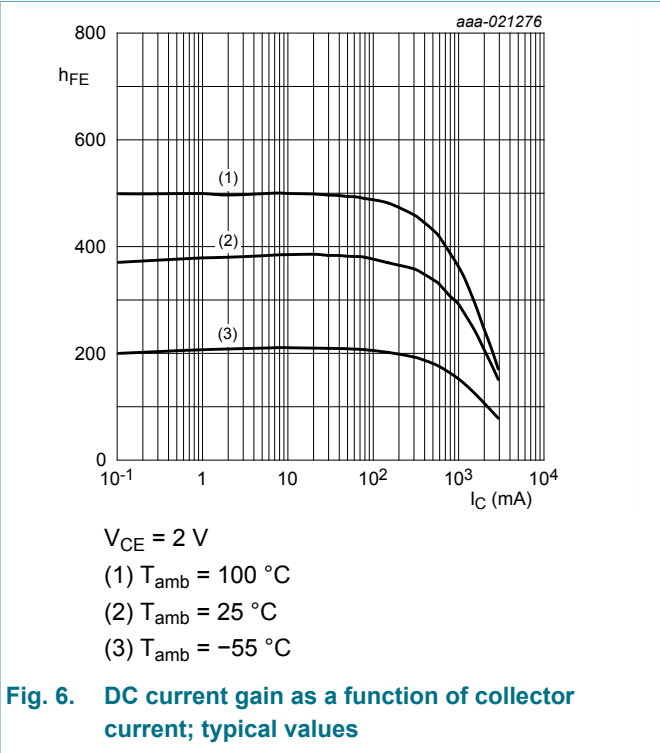
Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

| Symbol                | Parameter                               | Conditions                                                                                                                              |  | Min | Typ  | Max | Unit |
|-----------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--|-----|------|-----|------|
| <b>Per transistor</b> |                                         |                                                                                                                                         |  |     |      |     |      |
| I <sub>CBO</sub>      | collector-base cut-off current          | V <sub>CB</sub> = 16 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C                                                                  |  | -   | -    | 100 | nA   |
|                       |                                         | V <sub>CB</sub> = 16 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C                                                                   |  | -   | -    | 50  | μA   |
| I <sub>CES</sub>      | collector-emitter cut-off current       | V <sub>CE</sub> = 16 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C                                                                 |  | -   | -    | 100 | nA   |
| I <sub>EBO</sub>      | emitter-base cut-off current            | V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C                                                                   |  | -   | -    | 100 | nA   |
| h <sub>FE</sub>       | DC current gain                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 100 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                  |  | 250 | 450  | -   |      |
|                       |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                  |  | 230 | 400  | -   |      |
|                       |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 1 A; pulsed; t <sub>p</sub> ≤ 300 μs;<br>δ ≤ 0.02; T <sub>amb</sub> = 25 °C                     |  | 200 | 350  | -   |      |
|                       |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 2 A; pulsed; t <sub>p</sub> ≤ 300 μs;<br>δ ≤ 0.02                                               |  | 150 | 260  | -   |      |
| V <sub>CEsat</sub>    | collector-emitter saturation voltage    | I <sub>C</sub> = 0.5 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C                 |  | -   | 60   | 90  | mV   |
|                       |                                         | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C                   |  | -   | 125  | 170 | mV   |
|                       |                                         | I <sub>C</sub> = 2 A; I <sub>B</sub> = 200 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C                  |  | -   | 240  | 320 | mV   |
| R <sub>CEsat</sub>    | collector-emitter saturation resistance | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C                   |  | -   | -    | 170 | mΩ   |
| V <sub>BEsat</sub>    | base-emitter saturation voltage         | I <sub>C</sub> = 0.5 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C                 |  | -   | 0.92 | 1   | V    |
|                       |                                         | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                    |  | -   | 0.96 | 1.1 | V    |
|                       |                                         | I <sub>C</sub> = 2 A; I <sub>B</sub> = 200 mA; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                   |  | -   | 1.18 | 1.3 | V    |
| V <sub>BE</sub>       | base-emitter voltage                    | I <sub>C</sub> = 0.5 A; V <sub>CE</sub> = 2 V; pulsed;<br>t <sub>p</sub> ≤ 300 μs; δ <sub>factor</sub> ≤ 0.02; T <sub>amb</sub> = 25 °C |  | -   | 0.77 | 0.9 | V    |
| t <sub>d</sub>        | delay time                              | I <sub>C</sub> = 1 A; I <sub>Bon</sub> = 50 mA; I <sub>Boff</sub> = -50 mA;<br>T <sub>amb</sub> = 25 °C                                 |  | -   | 10   | -   | ns   |
| t <sub>r</sub>        | rise time                               |                                                                                                                                         |  | -   | 50   | -   | ns   |
| t <sub>on</sub>       | turn-on time                            |                                                                                                                                         |  | -   | 60   | -   | ns   |
| t <sub>s</sub>        | storage time                            |                                                                                                                                         |  | -   | 310  | -   | ns   |

| Symbol    | Parameter             | Conditions                                                                                                         | Min | Typ  | Max | Unit |
|-----------|-----------------------|--------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| $t_f$     | fall time             |                                                                                                                    | -   | 60   | -   | ns   |
| $t_{off}$ | turn-off time         |                                                                                                                    | -   | 370  | -   | ns   |
| $f_T$     | transition frequency  | $V_{CE} = 10\text{ V}; I_C = 500\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$              | -   | 120  | -   | MHz  |
| $C_c$     | collector capacitance | $V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$ | -   | 13.5 | -   | pF   |



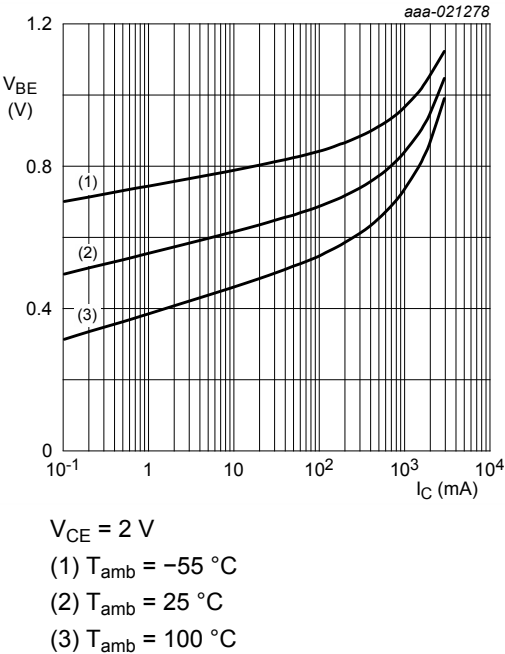


Fig. 8. Base-emitter voltage as a function of collector current; typical values

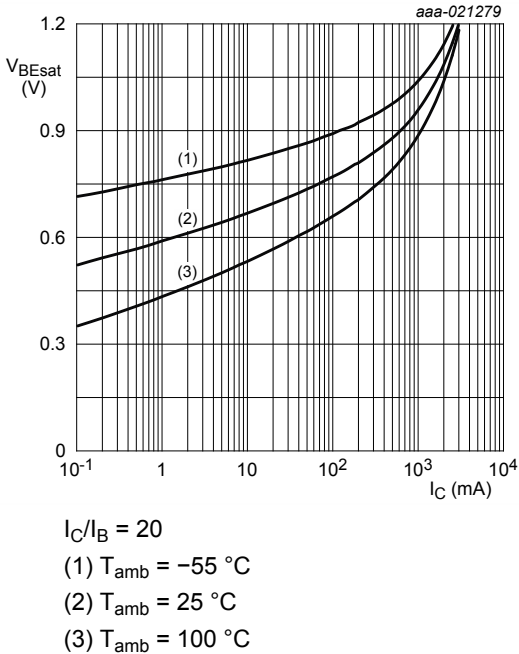


Fig. 9. Base-emitter saturation voltage as a function of collector current; typical values

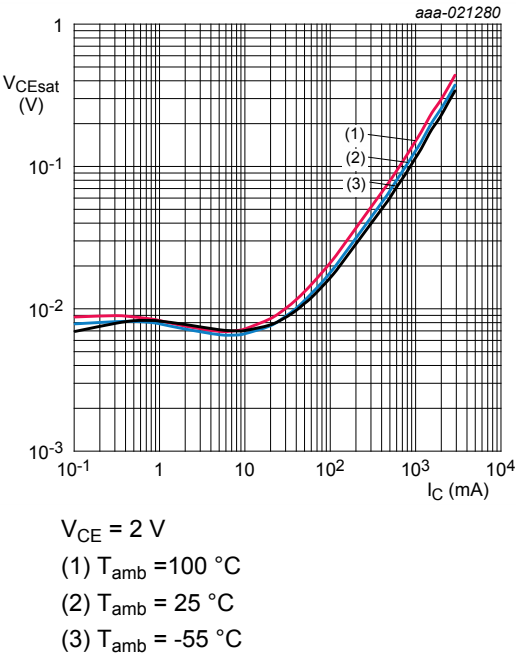


Fig. 10. Collector-emitter saturation voltage as a function of collector current; typical values

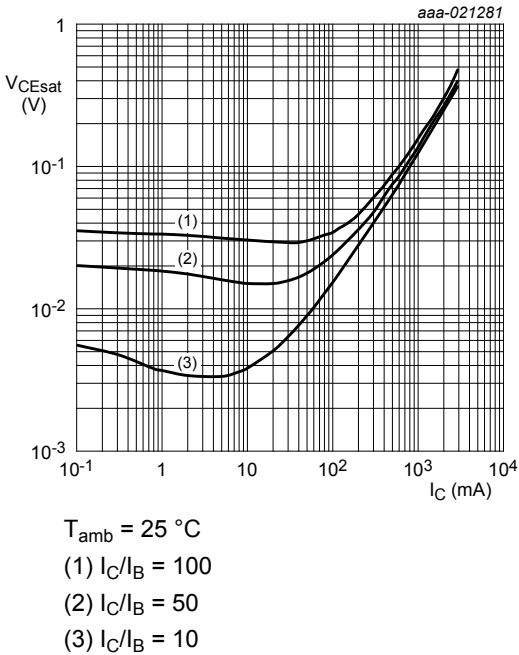
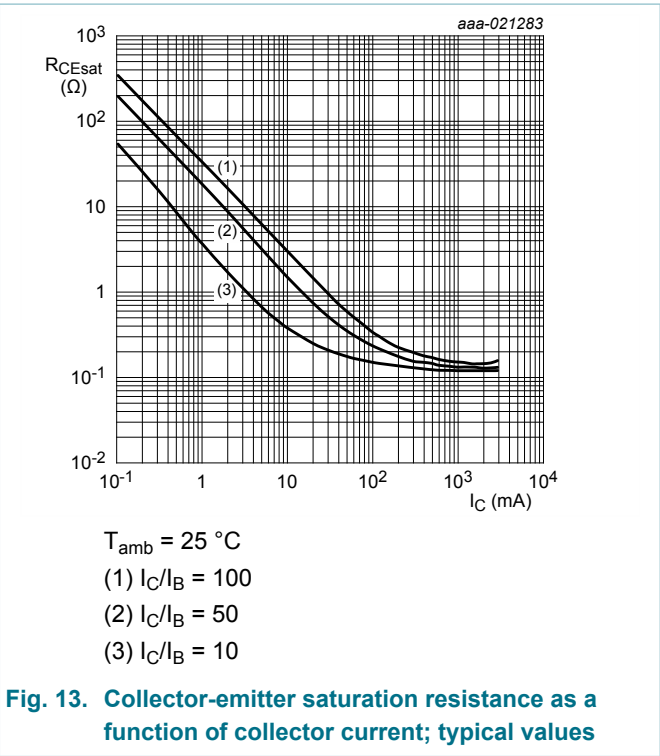
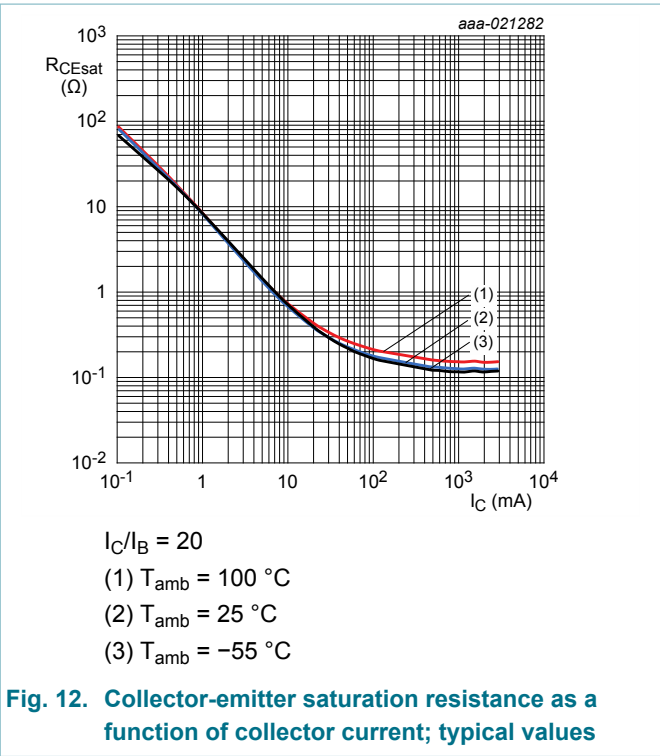


Fig. 11. Collector-emitter saturation voltage as a function of collector current; typical values



11. Test information

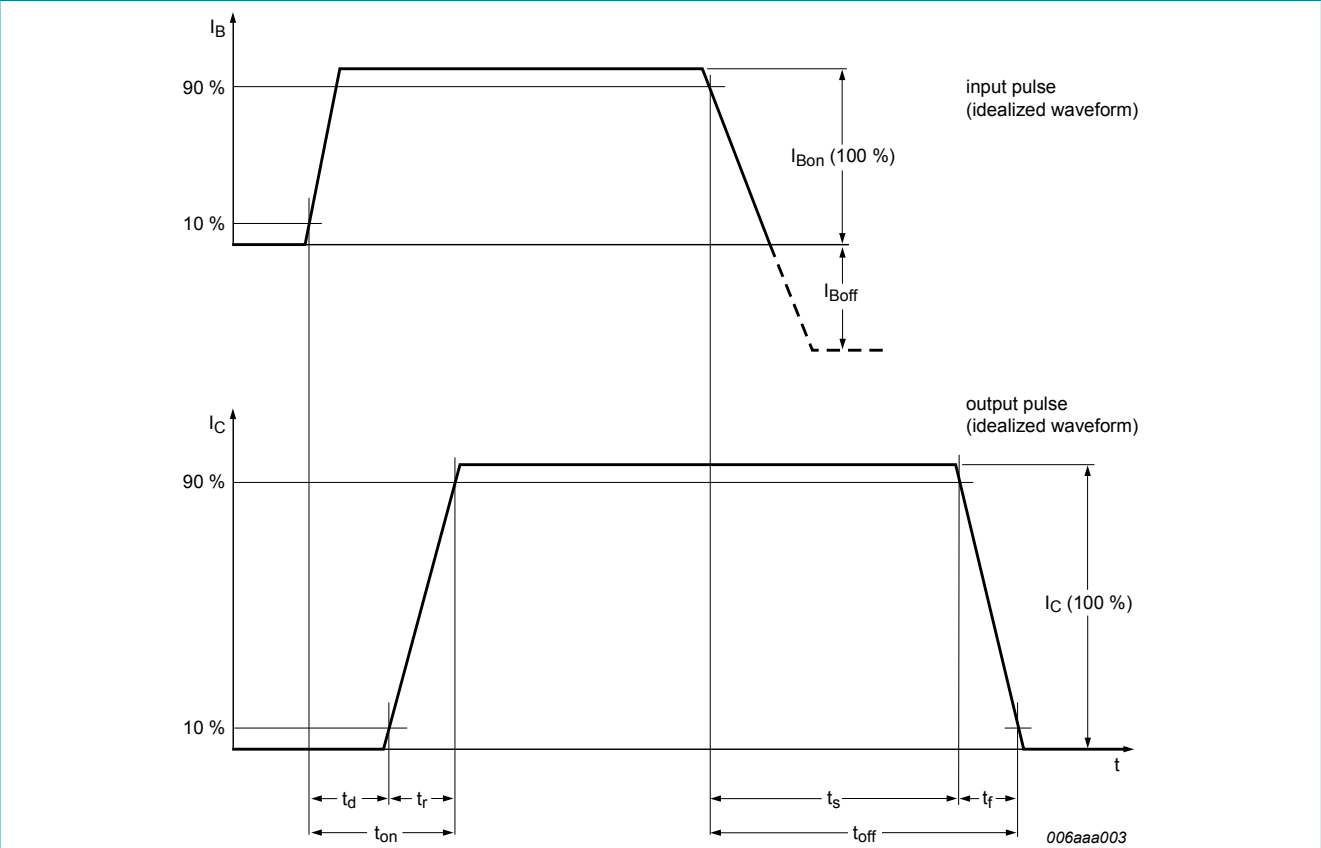


Fig. 14. BISS transistor switching time definition

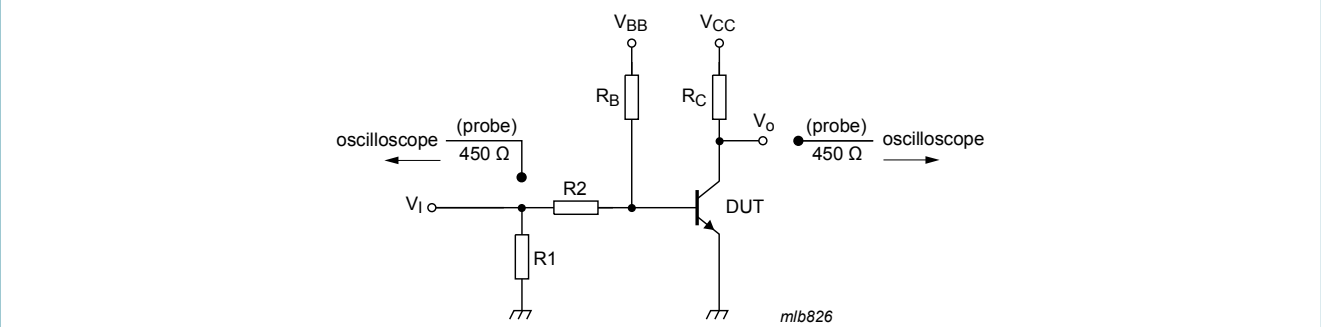


Fig. 15. Test circuit for switching times

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

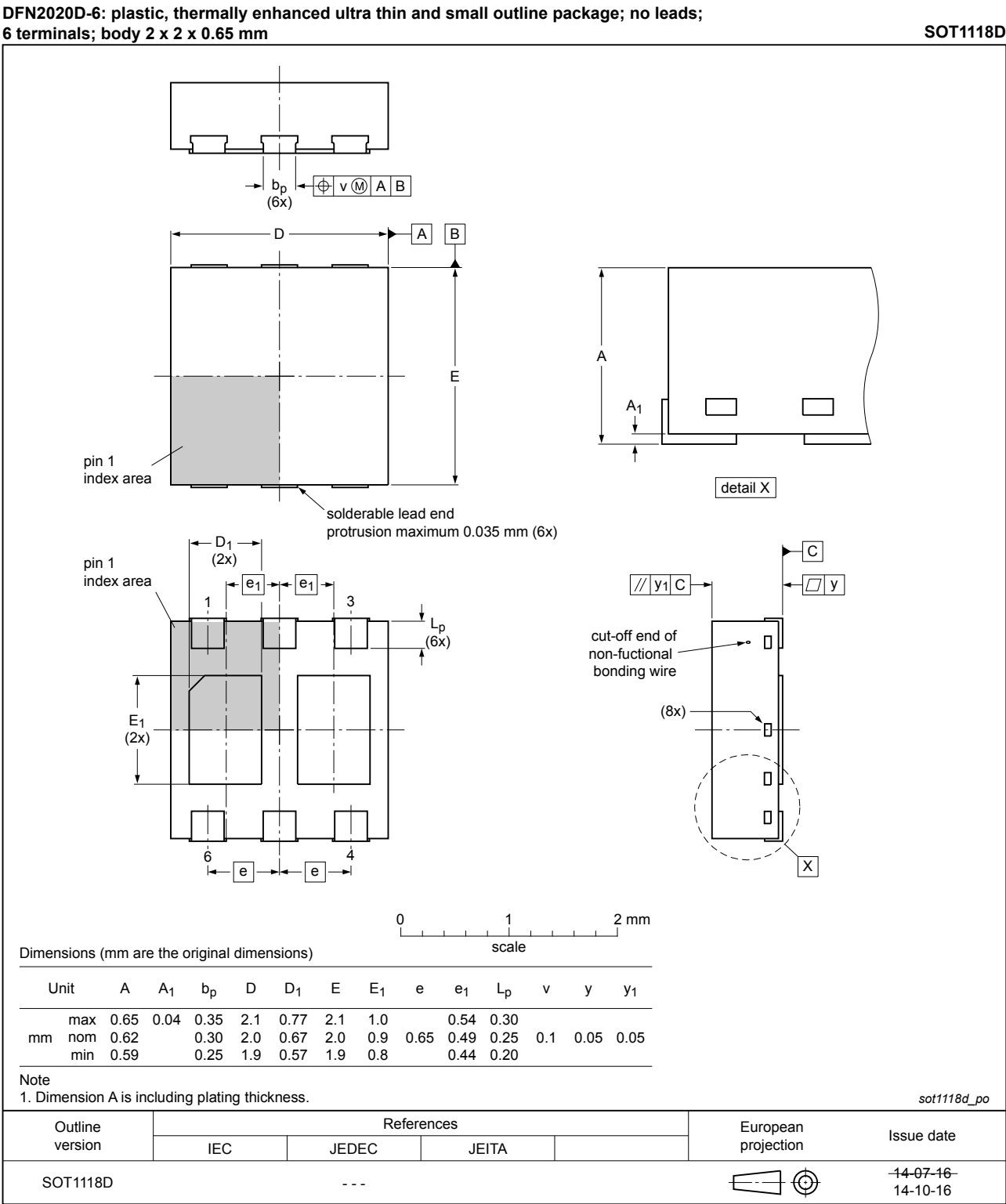
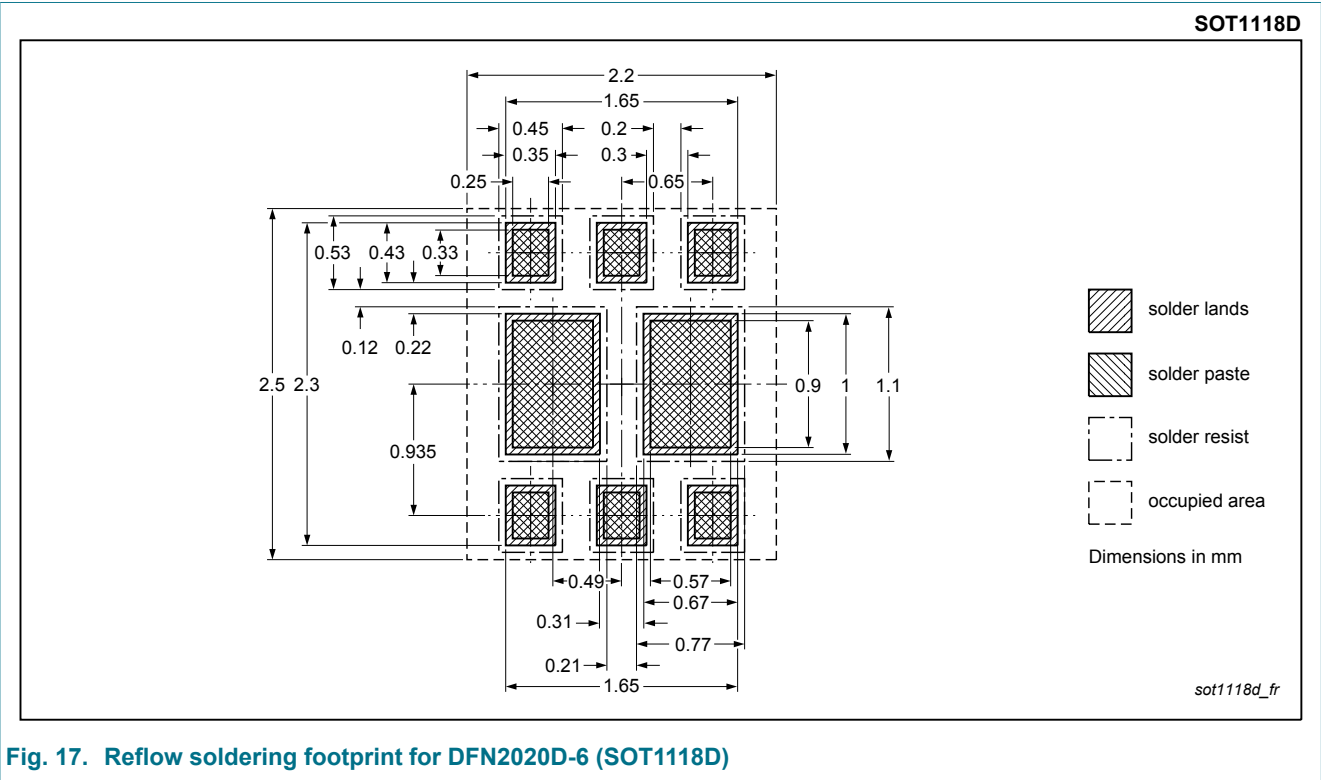


Fig. 16. Package outline DFN2020D-6 (SOT1118D)

13. Soldering



14. Revision history

Table 8. Revision history

| Data sheet ID    | Release date | Data sheet status  | Change notice | Supersedes |
|------------------|--------------|--------------------|---------------|------------|
| PBSS4220PANS v.1 | 20151214     | 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".
- [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>.

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16. Contents

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