



# PBSS5360PAS

60 V, 3A PNP low  $V_{CEsat}$  (BISS) transistor

12 October 2015

Product data sheet

## 1. General description

PNP low  $V_{CEsat}$  Breakthrough in a Small Signal (BISS) transistor, encapsulated in an ultra thin DFN2020D-3 (SOT1061D) leadless small Surface-Mounted Device (SMD) plastic package with medium power capability and visible and solderable side pads.

NPN complement: PBSS4360PAS

## 2. Features and benefits

- Low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- High collector current gain ( $h_{FE}$ ) at high  $I_C$
- High efficiency due to less heat generation
- High temperature applications up to 175 °C
- Reduced Printed-Circuit Board (PCB) area requirements
- Leadless small SMD plastic package with solderable side pads
- Exposed heat sink for excellent thermal and electrical conductivity
- Suitable for Automatic Optical Inspection (AOI) of solder joint
- AEC-Q101 qualified

## 3. Applications

- Loadswitch
- Battery-driven devices
- Power management
- Charging circuits
- Power switches (e.g. motors, fans)

## 4. Quick reference data

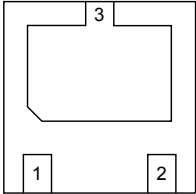
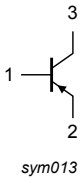
Table 1. Quick reference data

| Symbol      | Parameter                               | Conditions   | Min | Typ | Max | Unit       |
|-------------|---|--|-----|-----|-----|------------|
| $V_{CEO}$   | collector-emitter voltage               | open base  | -   | -   | -60 | V          |
| $I_C$       | collector current                       |  | -   | -   | -3  | A          |
| $I_{CM}$    | peak collector current                  | single pulse; $t_p \leq 1$ ms  | -   | -   | -6  | A          |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = -3$ A; $I_B = -300$ mA; pulsed;<br>$t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C | -   | 87  | 150 | m $\Omega$ |



## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline   | Graphic symbol  |
|-----|--------|-------------|--|---|
| 1   | B      | base        |  <p>Transparent top view<br/><b>DFN2020D-3 (SOT1061D)</b></p> |  <p>sym013</p> |
| 2   | E      | emitter     |  |   |
| 3   | C      | collector   |  |   |

## 6. Ordering information

Table 3. Ordering information

| Type number | Package    |  |          |
|-------------|------------|--|----------|
|             | Name       | Description  | Version  |
| PBSS5360PAS | DFN2020D-3 | DFN2020D-3: plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 2 x 2 x 0.65 mm | SOT1061D |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PBSS5360PAS | EA           |

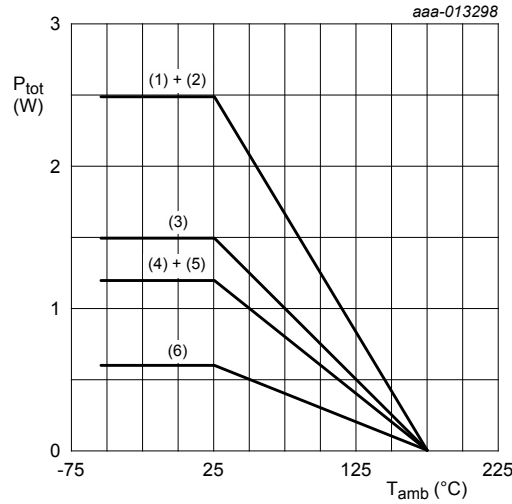
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol    | Parameter                 | Conditions                    |        | Min | Max  | Unit |
|-----------|---------------------------|-------------------------------|--------|-----|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                  |        | -   | -80  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                     |        | -   | -60  | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                |        | -   | -8   | V    |
| $I_C$     | collector current         |                               |        | -   | -3   | A    |
| $I_{CM}$  | peak collector current    | single pulse; $t_p \leq 1$ ms |        | -   | -6   | A    |
| $I_B$     | base current              |                               |        | -   | -500 | mA   |
| $I_{BM}$  | peak base current         |                               |        | -   | -1   | A    |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C          | [1]    | -   | 0.6  | W    |
|           |                           |                               | [2][3] | -   | 1.2  | W    |
|           |                           |                               | [4]    | -   | 1.5  | W    |
|           |                           |                               | [5][6] | -   | 2.5  | W    |
| $T_j$     | junction temperature      |                               |        | -   | 175  | °C   |
| $T_{amb}$ | ambient temperature       |                               |        | -55 | 175  | °C   |
| $T_{stg}$ | storage temperature       |                               |        | -65 | 175  | °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, 4-layer copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and mounting pad for collector 1 cm<sup>2</sup>.
- [6] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



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

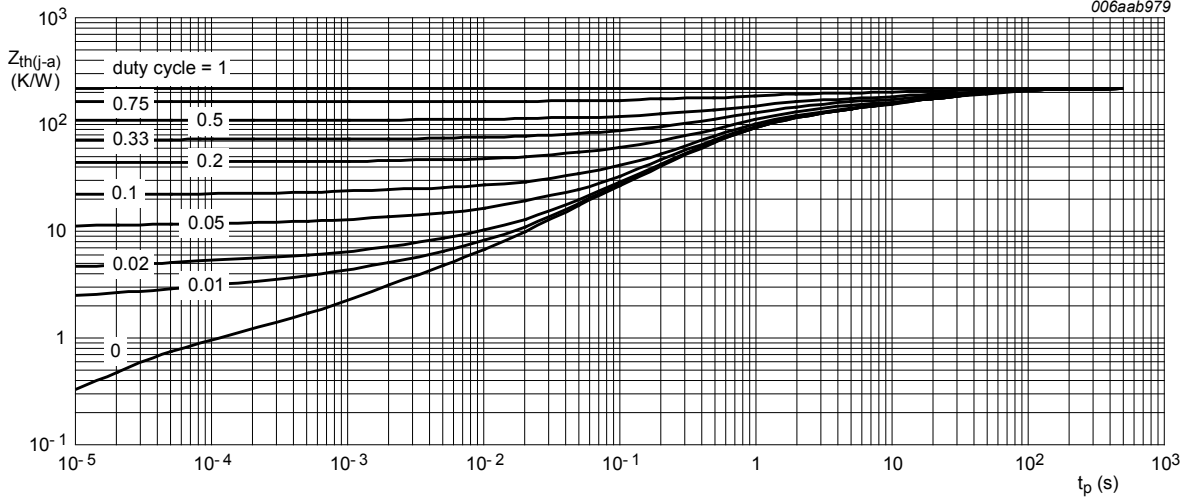
Fig. 1. Power derating curves

## 9. Thermal characteristics

Table 6. Thermal characteristics

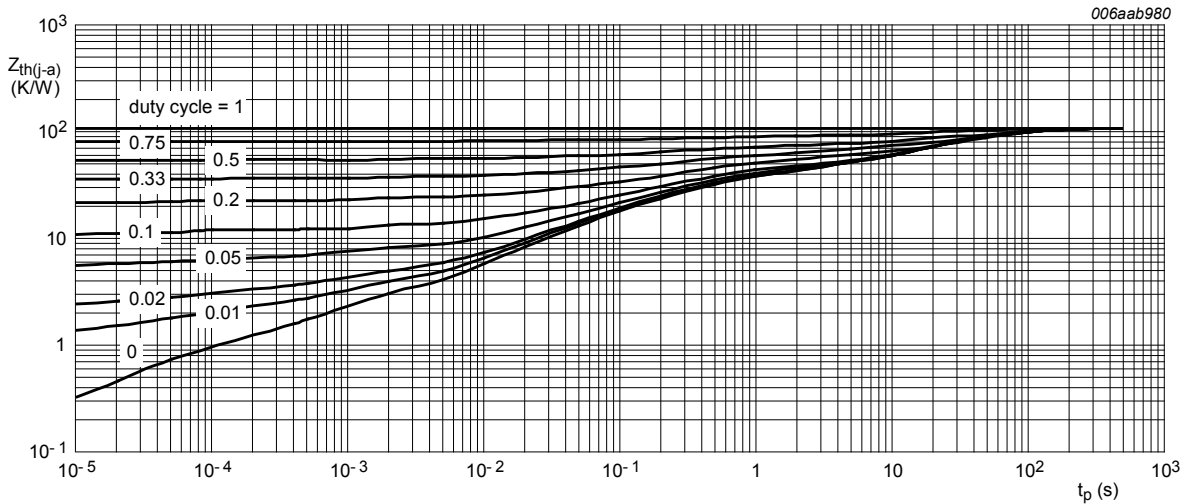
| Symbol               | Parameter                                   | Conditions  | Min    | Typ | Max | Unit |     |
|----------------------|---|-------------|--------|-----|-----|------|-----|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | [1]    | -   | -   | 250  | K/W |
|                      |   |             | [2][3] | -   | -   | 125  | K/W |
|                      |   |             | [4]    | -   | -   | 100  | K/W |
|                      |   |             | [5][6] | -   | -   | 60   | 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, 4-layer copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [5] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.
- [6] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and mounting pad for collector 1 cm<sup>2</sup>.



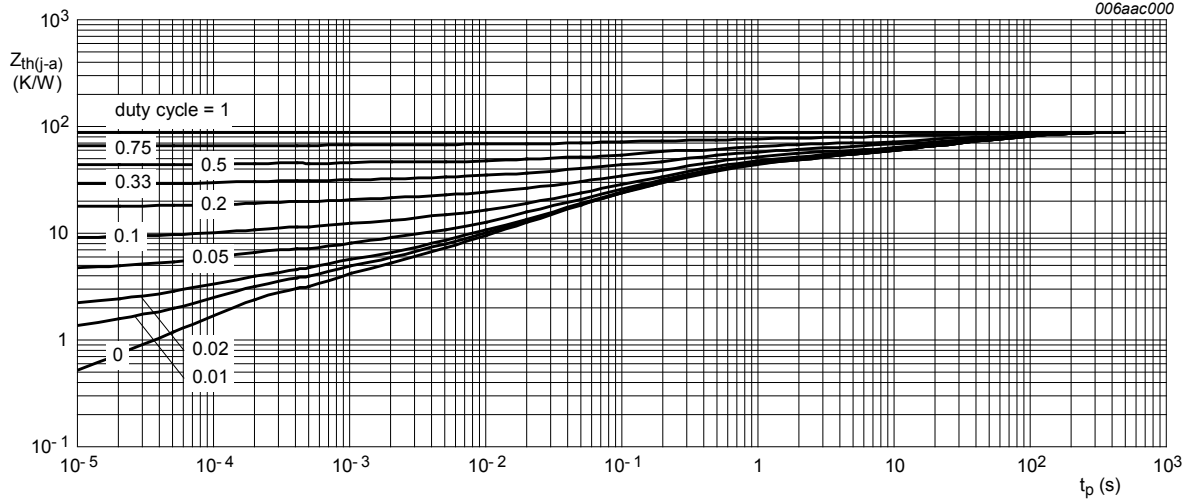
FR4 PCB, standard footprint

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



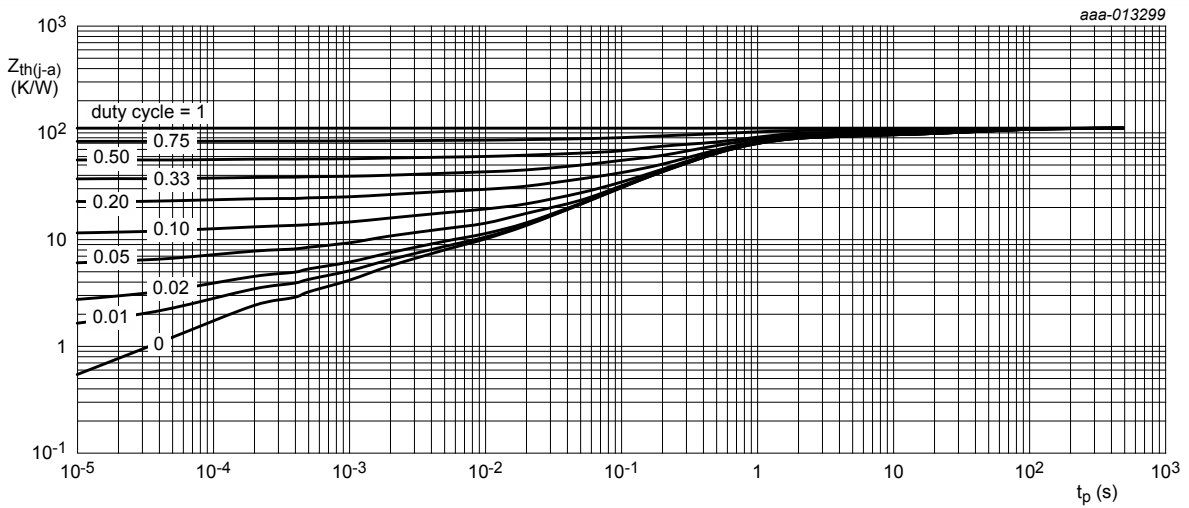
FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

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



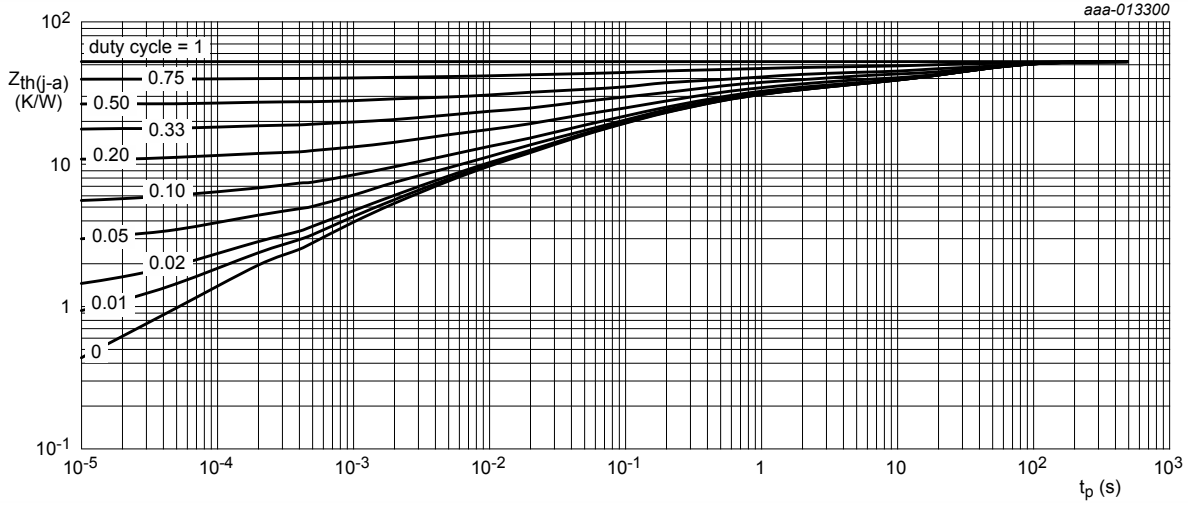
FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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



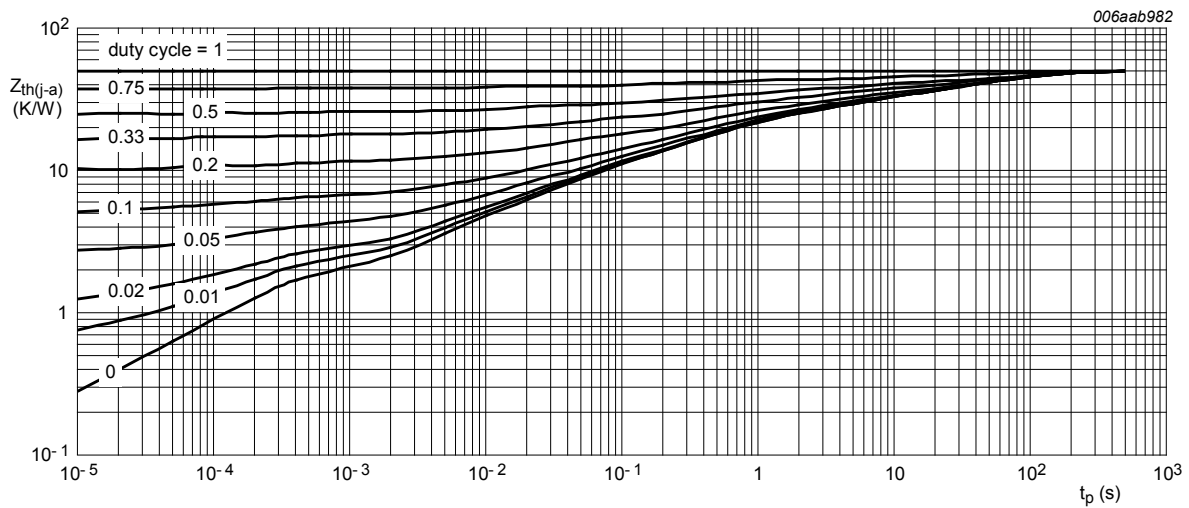
FR4 PCB, 4-layer copper, standard footprint

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



FR4 PCB, 4-layer copper, mounting pad for collector  $1 \text{ cm}^2$

Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



Ceramic PCB,  $\text{Al}_2\text{O}_3$ , standard footprint

Fig. 7. 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 <sub>CBO</sub>   | collector-base cut-off current          | V <sub>CB</sub> = -64 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C  | -  | -    | -100 | nA   |
|                    |   | V <sub>CB</sub> = -64 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> = -48 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> = -6.4 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> = -5 V; I <sub>C</sub> = -50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C  | 150  | 250  | -    |      |
|                    |   | V <sub>CE</sub> = -5 V; I <sub>C</sub> = -500 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C | 130  | 220  | -    |      |
|                    |   | V <sub>CE</sub> = -5 V; I <sub>C</sub> = -2 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C    | 120  | 200  | -    |      |
|                    |   | V <sub>CE</sub> = -5 V; I <sub>C</sub> = -2 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C    | 100  | 160  | -    |      |
| V <sub>CEsat</sub> | collector-emitter saturation voltage    | I <sub>C</sub> = -0.5 A; I <sub>B</sub> = -50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C | -  | -55  | -100 | mV   |
|                    |   | I <sub>C</sub> = -1 A; I <sub>B</sub> = -100 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C  | -  | -95  | -170 | mV   |
|                    |   | I <sub>C</sub> = -2 A; I <sub>B</sub> = -200 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C  | -  | -170 | -320 | mV   |
|                    |   | I <sub>C</sub> = -3 A; I <sub>B</sub> = -300 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C  | -  | -260 | -450 | mV   |
| R <sub>CEsat</sub> | collector-emitter saturation resistance | t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C   | -  | 87   | 150  | mΩ   |
| V <sub>BEsat</sub> | base-emitter saturation voltage         | I <sub>C</sub> = -2 A; I <sub>B</sub> = -100 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C  | -  | -0.9 | -1   | V    |
| V <sub>BEon</sub>  | base-emitter turn-on voltage            | V <sub>CE</sub> = -5 V; I <sub>C</sub> = -1 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; T <sub>amb</sub> = 25 °C    | -  | -0.8 | -1   | V    |
| t <sub>d</sub>     | delay time                              | I <sub>C</sub> = -2 A; I <sub>Bon</sub> = -0.1 A; I <sub>Boff</sub> = 0.1 A; T <sub>amb</sub> = 25 °C                  | -  | 12   | -    | ns   |
| t <sub>r</sub>     | rise time                               |  | -  | 95   | -    | ns   |
| t <sub>on</sub>    | turn-on time                            |  | -  | 107  | -    | ns   |
| t <sub>s</sub>     | storage time                            |  | -  | 160  | -    | ns   |
| t <sub>f</sub>     | fall time                               |  | -  | 50   | -    | ns   |
| t <sub>off</sub>   | turn-off time                           |  | -  | 210  | -    | ns   |
| f <sub>T</sub>     | transition frequency                    |  | V <sub>CE</sub> = -10 V; I <sub>C</sub> = -100 mA; f = 100 MHz; T <sub>amb</sub> = 25 °C | 65   | 120  | -    |



| Symbol | Parameter             | Conditions   | Min | Typ | Max | Unit |
|--------|-----------------------|--|-----|-----|-----|------|
| $C_c$  | collector capacitance | $V_{CB} = -10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A};$<br>$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$ | -   | 28  | 32  | pF   |

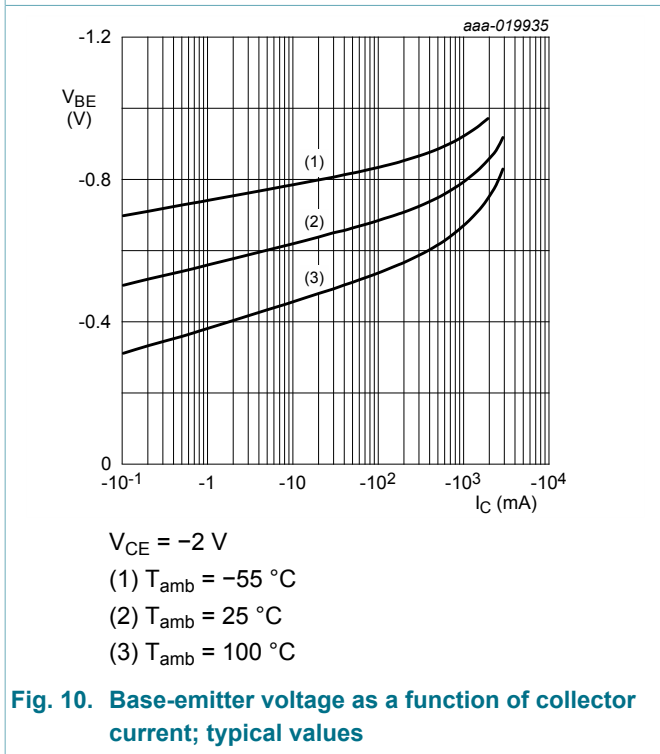
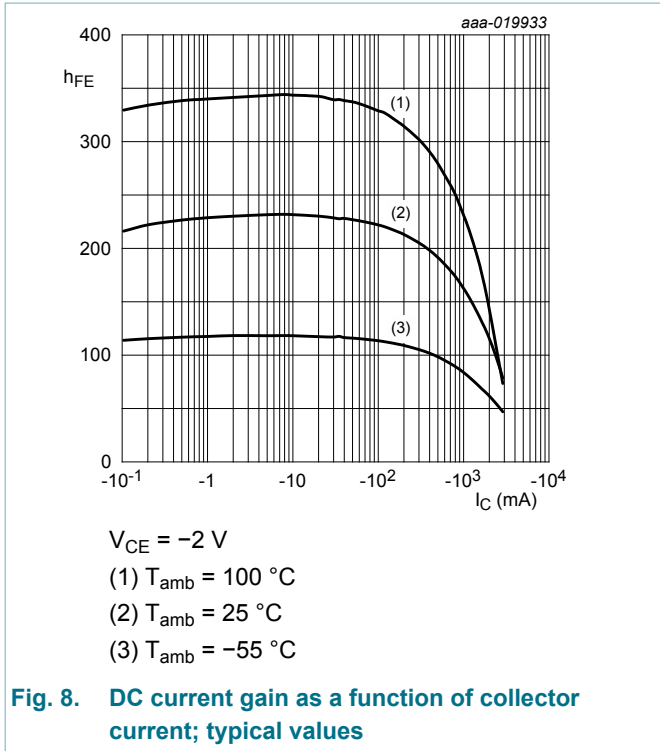


Fig. 10. Base-emitter voltage as a function of collector current; typical values

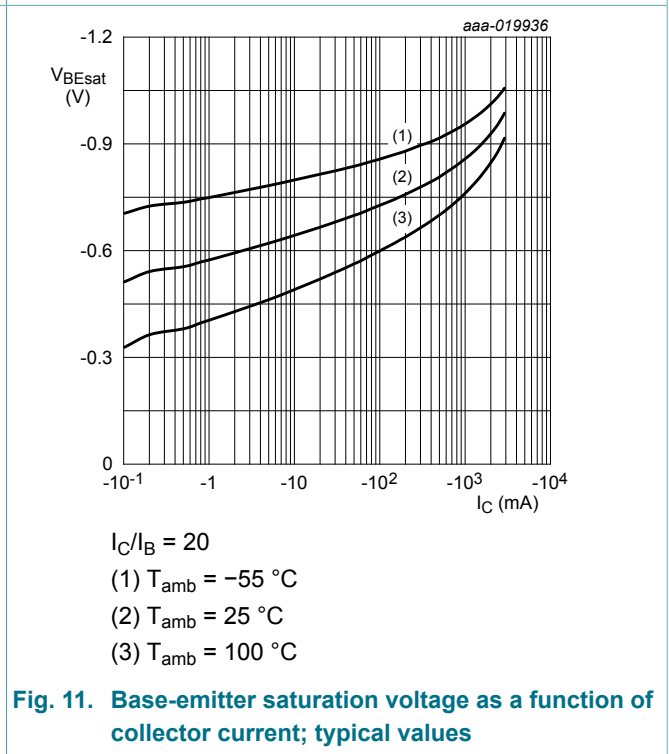
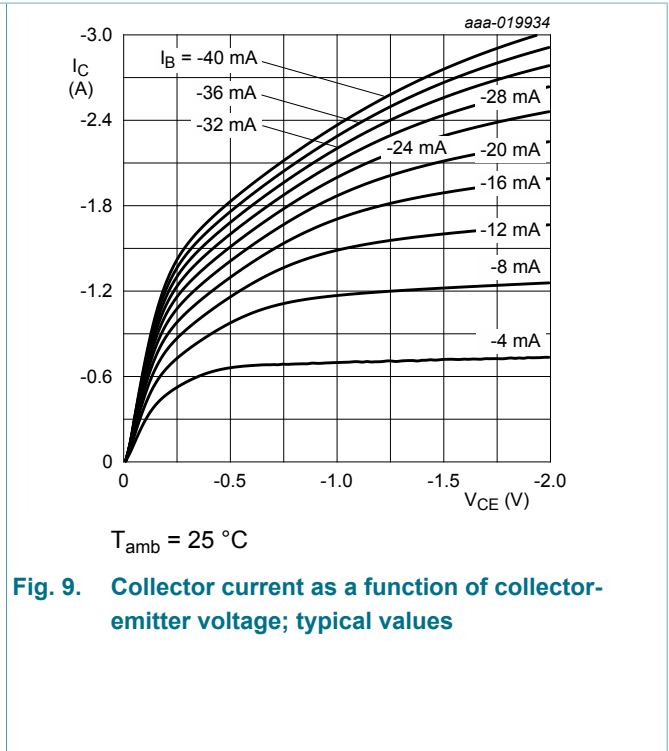
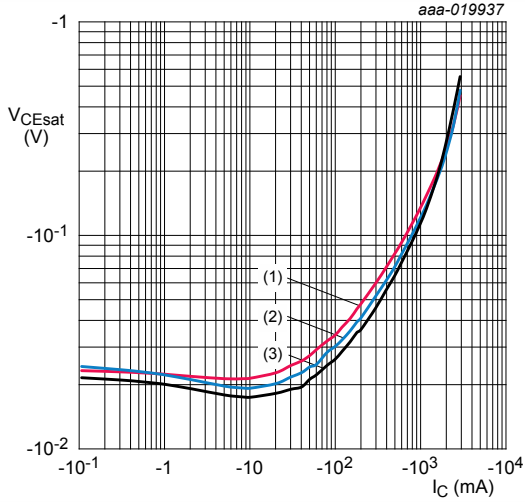
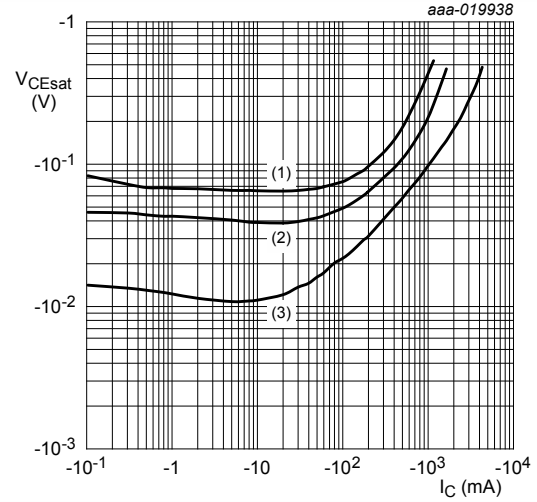


Fig. 9. Collector current as a function of collector-emitter voltage; typical values



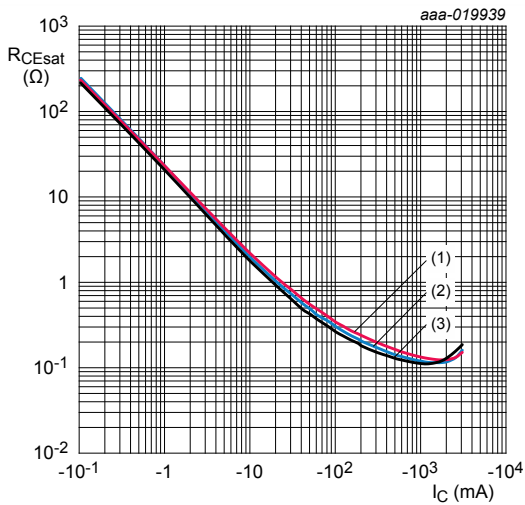
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



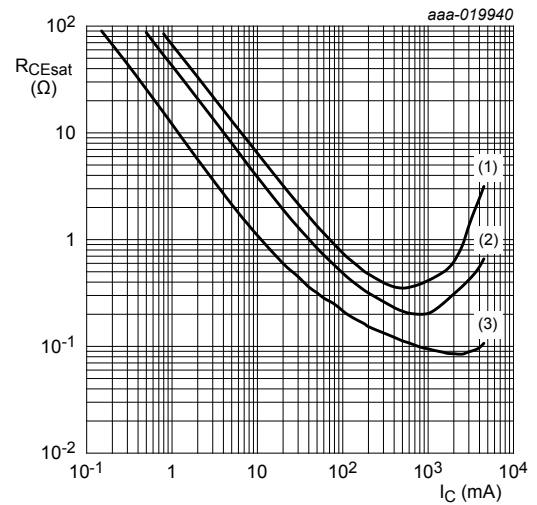
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

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



$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

Fig. 15. Collector-emitter saturation resistance as a function of collector current; typical values

### 11. Test information

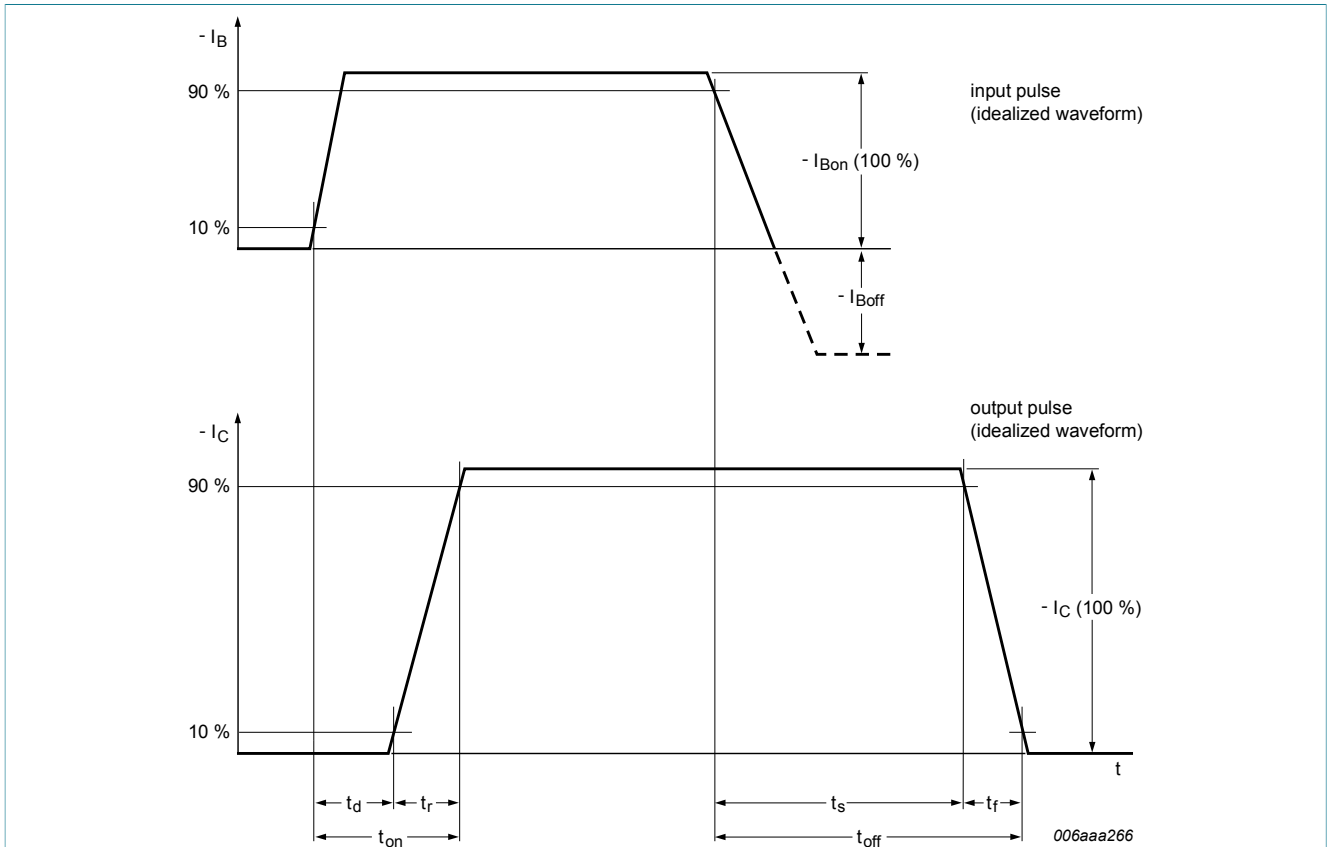


Fig. 16. BISS transistor switching time definition

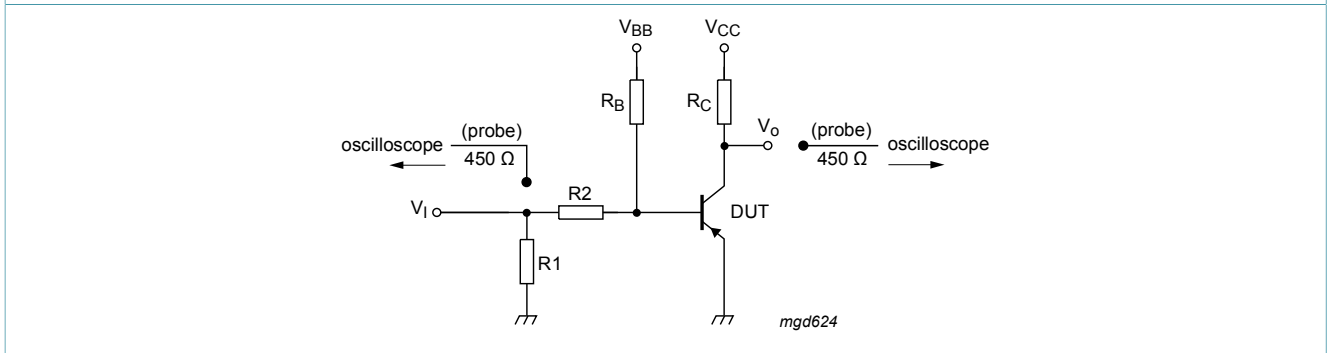


Fig. 17. Test circuit for switching times

#### 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

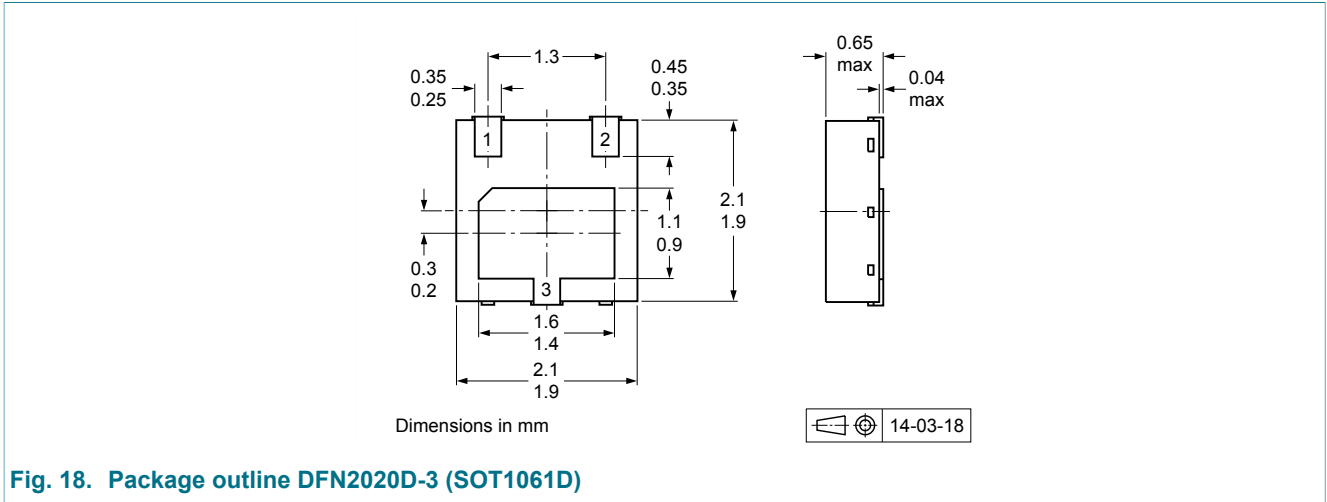


Fig. 18. Package outline DFN2020D-3 (SOT1061D)

### 13. Soldering

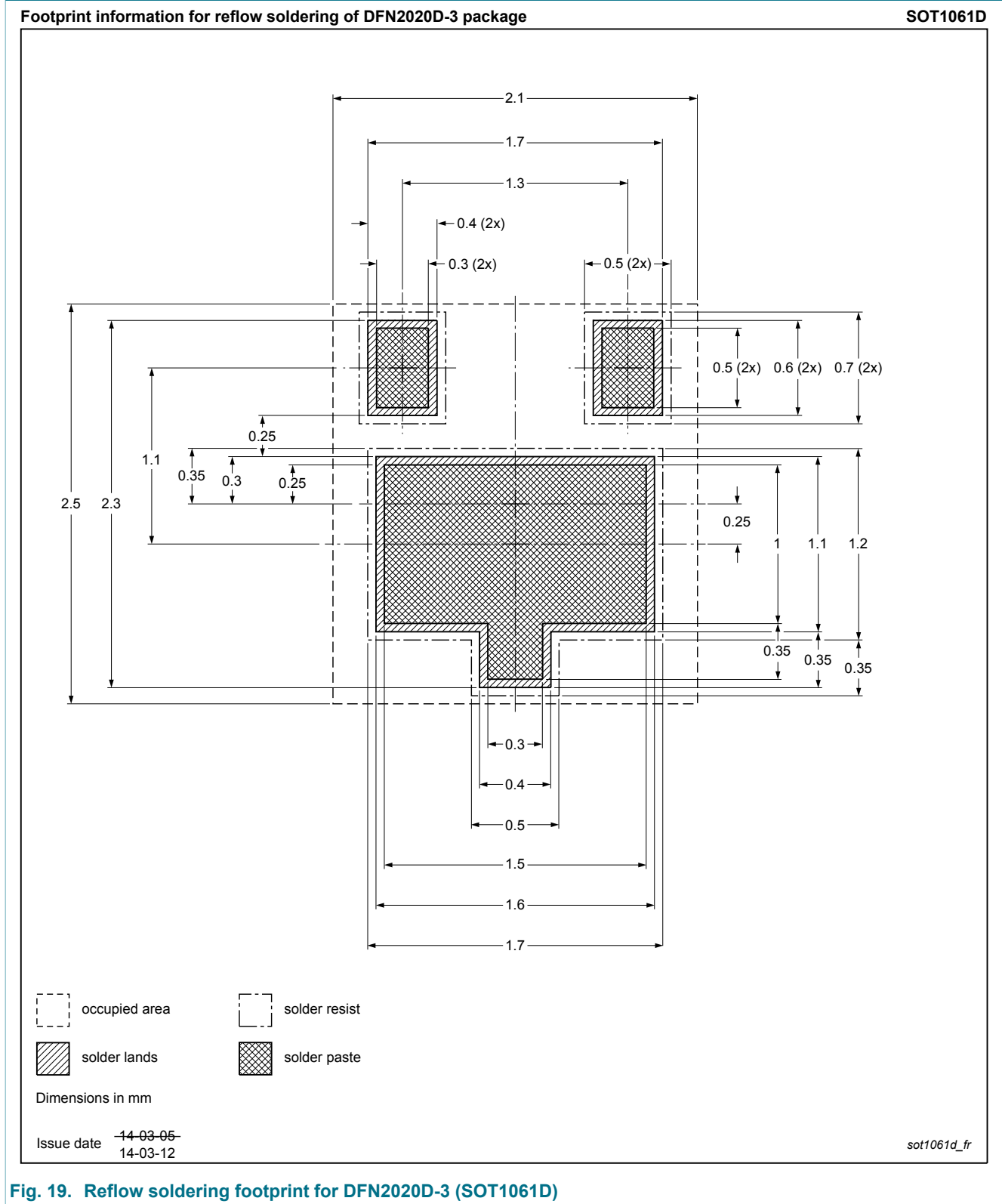


Fig. 19. Reflow soldering footprint for DFN2020D-3 (SOT1061D)

## 14. Revision history

Table 8. Revision history

| Data sheet ID   | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| PBSS5360PAS v.1 | 20151012     | 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.nxp.com>.

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