



PBSS5160PAPS

60 V, 1 A PNP/PNP low V_{CEsat} (BISS) transistor

24 November 2014

Product data sheet

1. General description

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

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

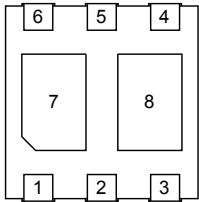
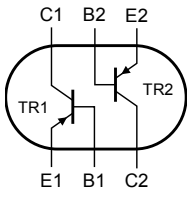
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|---|--|-----|-----|------|------------|
| Per transistor | | | | | | |
| V_{CEO} | collector-emitter voltage | open base | - | - | -60 | V |
| I_C | collector current | | - | - | -1 | A |
| I_{CM} | peak collector current | single pulse; $t_p \leq 1$ ms | - | - | -1.5 | A |
| Per transistor | | | | | | |
| R_{CEsat} | collector-emitter saturation resistance | $I_C = -0.5$ A; $I_B = -50$ mA; pulsed; $t_p \leq 300$ μ s; $\delta \leq 0.02$; $T_{amb} = 25$ °C | - | - | 360 | m Ω |



5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|---------------|--|---|
| 1 | E1 | emitter TR1 |  <p>Transparent top view DFN2020D-6 (SOT1118D)</p> |  <p>sym138</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 |
| PBSS5160PAPS | 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. Limiting values

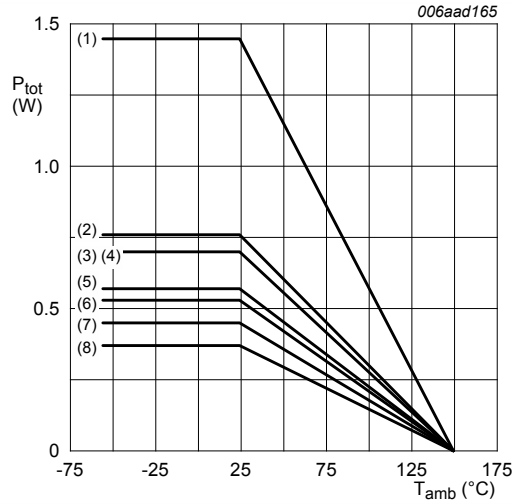
Table 4. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|-----------------------|---------------------------|-------------------------------------|-----|------|------|----|
| Per transistor | | | | | | |
| V _{CB0} | collector-base voltage | open emitter | - | -60 | V | |
| V _{CEO} | collector-emitter voltage | open base | - | -60 | V | |
| V _{EBO} | emitter-base voltage | open collector | - | -7 | V | |
| I _C | collector current | | - | -1 | A | |
| I _{CM} | peak collector current | single pulse; t _p ≤ 1 ms | - | -1.5 | A | |
| I _B | base current | | - | -0.3 | A | |
| I _{BM} | peak base current | single pulse; t _p ≤ 1 ms | - | -1 | A | |
| P _{tot} | total power dissipation | T _{amb} ≤ 25 °C | [1] | - | 370 | mW |
| | | | [2] | - | 570 | mW |
| | | | [3] | - | 530 | mW |
| | | | [4] | - | 700 | mW |

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|-------------------|-------------------------|--------------------------|-----|-----|------|------|
| | | | [5] | - | 450 | mW |
| | | | [6] | - | 760 | mW |
| | | | [7] | - | 700 | mW |
| | | | [8] | - | 1450 | mW |
| Per device | | | | | | |
| P _{tot} | total power dissipation | T _{amb} ≤ 25 °C | [1] | - | 510 | mW |
| | | | [2] | - | 780 | mW |
| | | | [3] | - | 730 | mW |
| | | | [4] | - | 960 | mW |
| | | | [5] | - | 620 | mW |
| | | | [6] | - | 1040 | mW |
| | | | [7] | - | 960 | mW |
| | | | [8] | - | 2000 | mW |
| T _j | junction temperature | | | - | 150 | °C |
| T _{amb} | ambient temperature | | | -55 | 150 | °C |
| T _{stg} | storage temperature | | | -65 | 150 | °C |

- [1] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [3] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated and standard footprint.
- [4] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [5] Device mounted on an FR4 PCB, single-sided 70 µm copper strip line, tin-plated and standard footprint.
- [6] Device mounted on an FR4 PCB, single-sided 70 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [7] Device mounted on 4-layer PCB 70 µm copper strip line, tin-plated and standard footprint.
- [8] Device mounted on 4-layer PCB 70 µm copper strip line, tin-plated, mounting pad for collector 1 cm².



- (1) 4-layer PCB 70 μm, mounting pad for collector 1 cm²
- (2) FR4 PCB 70 μm, mounting pad for collector 1 cm²
- (3) 4-layer PCB 70 μm, standard footprint
- (4) 4-layer PCB 35 μm, mounting pad for collector 1 cm²
- (5) FR4 PCB 35 μm, mounting pad for collector 1 cm²
- (6) 4-layer PCB 35 μm, standard footprint
- (7) FR4 PCB 70 μm, standard footprint
- (8) FR4 PCB 35 μm, standard footprint

Fig. 1. Per transistor: power derating curves

8. Thermal characteristics

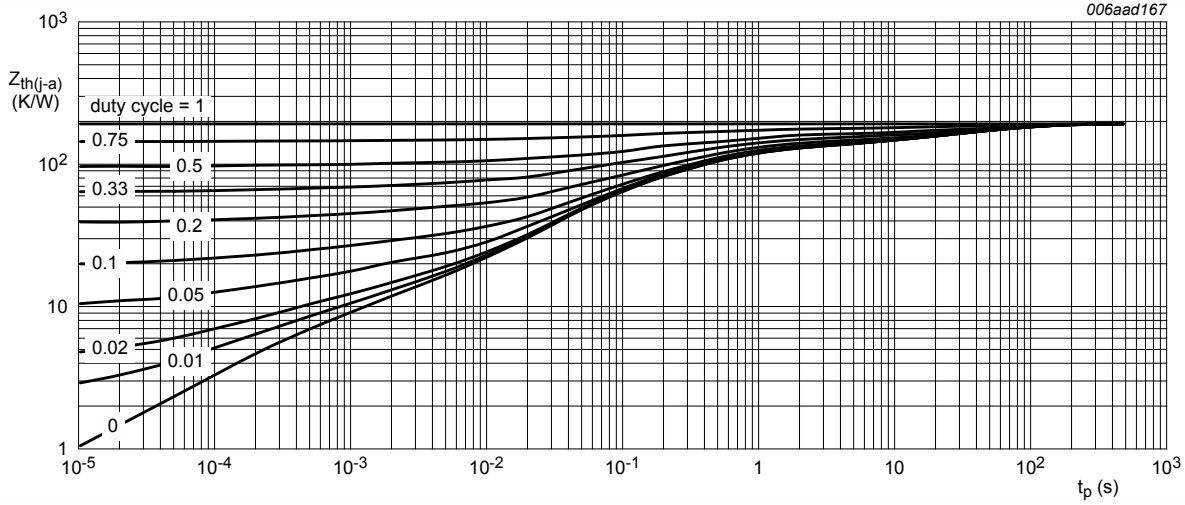
Table 5. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|-----------------------|--|-------------|-----|-----|-----|------|-----|
| Per transistor | | | | | | | |
| R _{th(j-a)} | 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 |
| | | | [5] | - | - | 278 | K/W |
| | | | [6] | - | - | 164 | K/W |
| | | | [7] | - | - | 179 | K/W |
| | | | [8] | - | - | 86 | K/W |
| R _{th(j-sp)} | thermal resistance from junction to solder point | | - | - | 30 | K/W | |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|----------------------|---|-------------|-----|-----|-----|-----|------|
| Per device | | | | | | | |
| R _{th(j-a)} | thermal resistance from junction to ambient | in free air | [1] | - | - | 245 | K/W |
| | | | [2] | - | - | 160 | K/W |
| | | | [3] | - | - | 171 | K/W |
| | | | [4] | - | - | 130 | K/W |
| | | | [5] | - | - | 202 | K/W |
| | | | [6] | - | - | 120 | K/W |
| | | | [7] | - | - | 130 | K/W |
| | | | [8] | - | - | 63 | K/W |

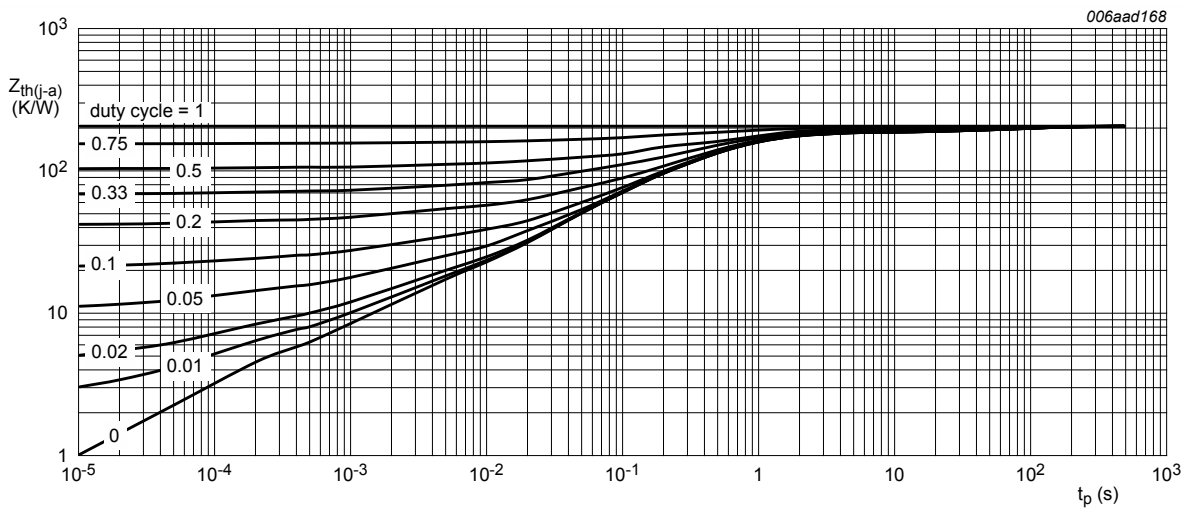
- [1] Device mounted on an FR4 PCB, single-sided 35 μm copper strip line, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided 35 μm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [3] Device mounted on 4-layer PCB 35 μm copper strip line, tin-plated and standard footprint.
- [4] Device mounted on 4-layer PCB 35 μm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [5] Device mounted on an FR4 PCB, single-sided 70 μm copper strip line, tin-plated and standard footprint.
- [6] Device mounted on an FR4 PCB, single-sided 70 μm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [7] Device mounted on 4-layer PCB 70 μm copper strip line, tin-plated and standard footprint.
- [8] Device mounted on 4-layer PCB 70 μm copper strip line, tin-plated, mounting pad for collector 1 cm².





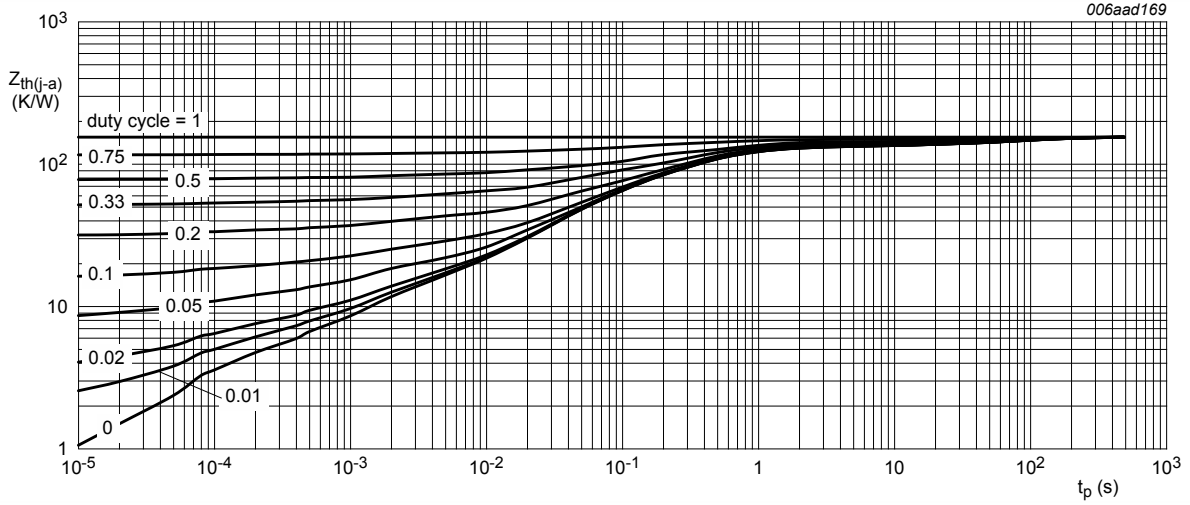
FR4 PCB 35 μ m, mounting pad for collector 1 cm²

Fig. 3. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



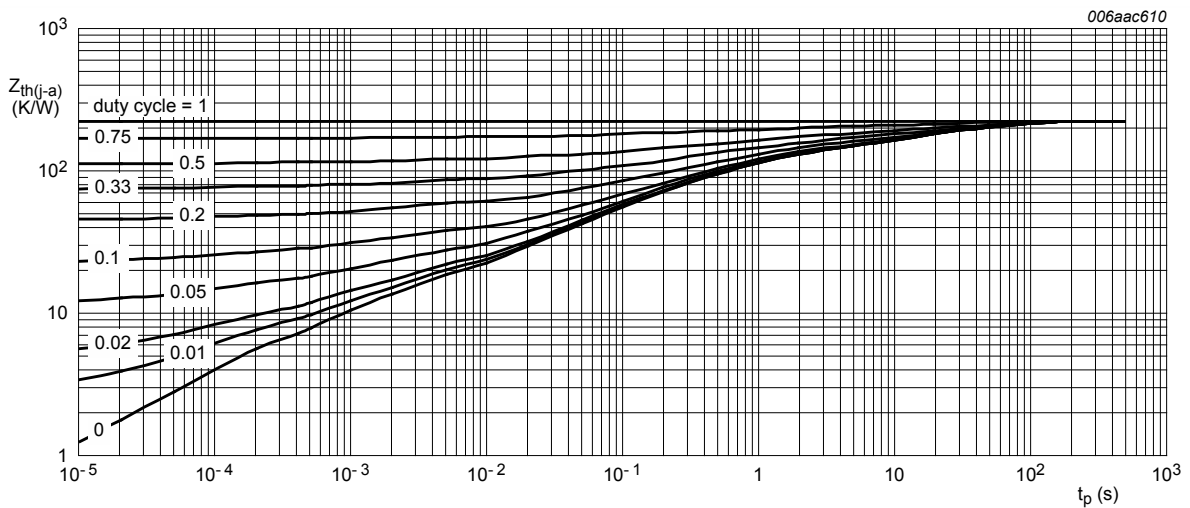
4-layer PCB 35 μ m, standard footprint

Fig. 4. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



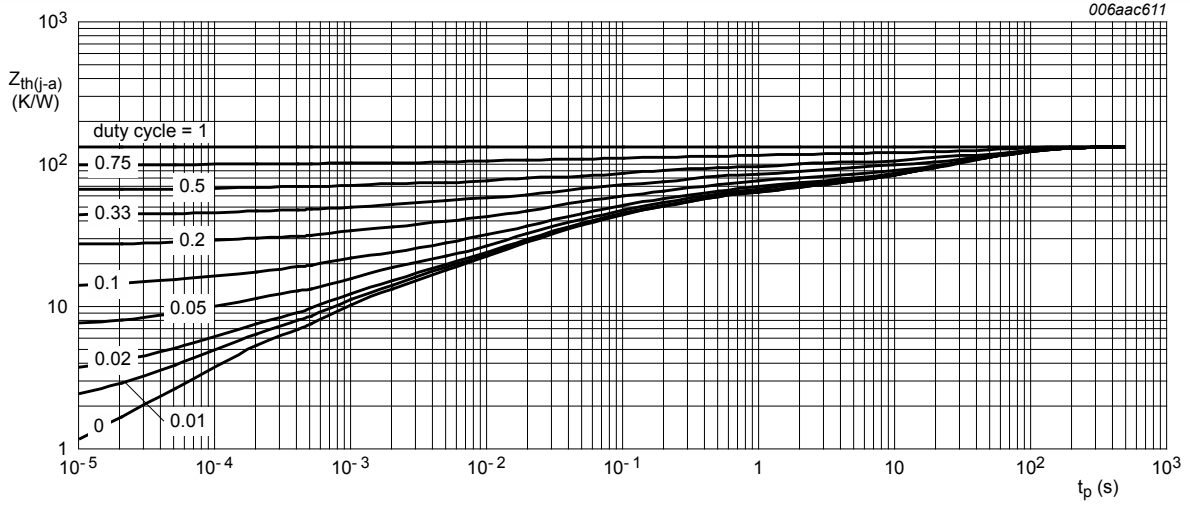
4-layer PCB 35 μ m, mounting pad for collector 1 cm²

Fig. 5. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



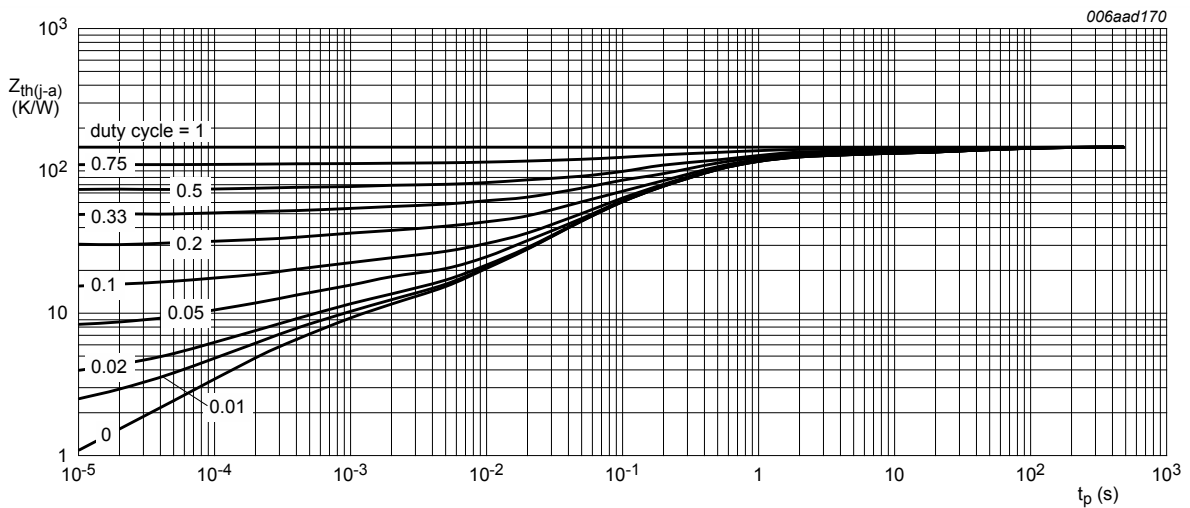
FR4 PCB 70 μ m, standard footprint

Fig. 6. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



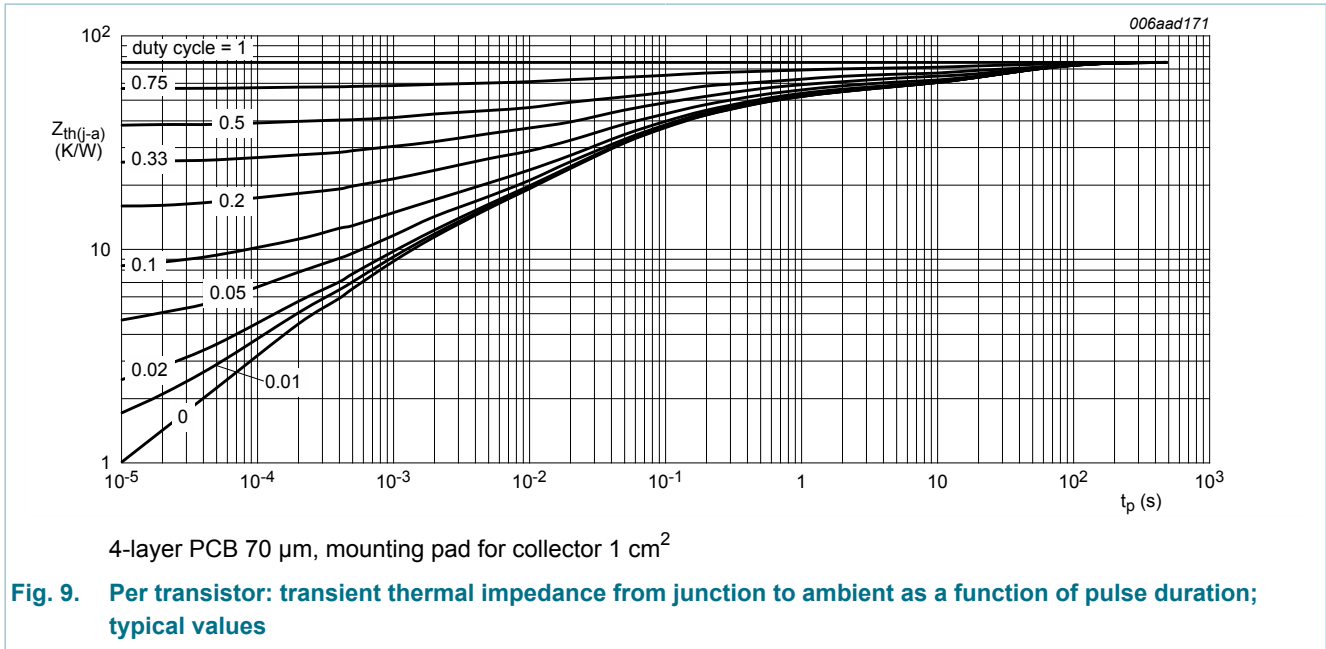
FR4 PCB 70 μm , mounting pad for collector 1 cm^2

Fig. 7. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



4-layer PCB 70 μm , standard footprint

Fig. 8. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

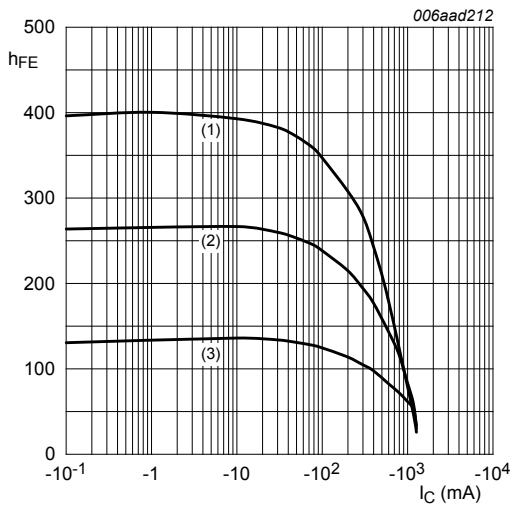


9. Characteristics

Table 6. Characteristics

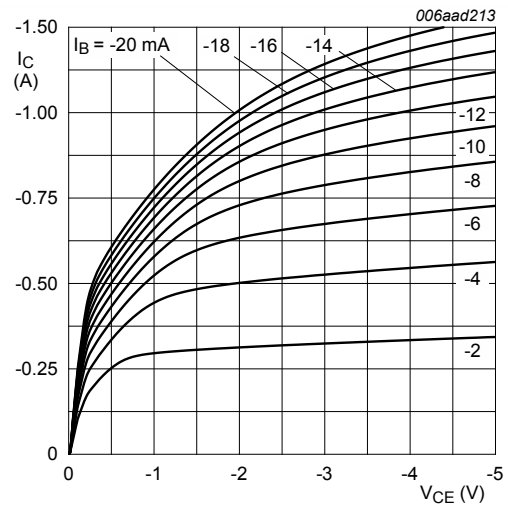
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|---|---|-----|------|------|------------------|
| Per transistor | | | | | | |
| I_{CBO} | collector-base cut-off current | $V_{CB} = -48 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$ | - | - | -100 | nA |
| | | $V_{CB} = -48 \text{ V}; I_E = 0 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$ | - | - | -50 | μA |
| 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 | $V_{CE} = -2 \text{ V}; I_C = -100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | 170 | 245 | - | |
| | | $V_{CE} = -2 \text{ V}; I_C = -500 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | 120 | 170 | - | |
| | | $V_{CE} = -2 \text{ V}; I_C = -1 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | 70 | 100 | - | |
| V_{CEsat} | collector-emitter saturation voltage | $I_C = -500 \text{ mA}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | - | -125 | -180 | mV |
| | | $I_C = -1 \text{ A}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | - | -390 | -550 | mV |
| | | $I_C = -1 \text{ A}; I_B = -100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | - | -240 | -340 | mV |
| R_{CEsat} | collector-emitter saturation resistance | $I_C = -0.5 \text{ A}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$ | - | - | 360 | $\text{m}\Omega$ |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------|---------------------------------|---|--|-----|------|------|
| V_{BEsat} | base-emitter saturation voltage | $I_C = -50\text{ mA}; I_B = -50\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$ | - | - | -1 | V |
| | | $I_C = -1\text{ A}; I_B = -50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$ | - | - | -1 | V |
| | | $I_C = -1\text{ A}; I_B = -100\text{ mA}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$ | - | - | -1.1 | V |
| V_{BEon} | base-emitter turn-on voltage | $V_{CE} = -2\text{ V}; I_C = -0.5\text{ A}; \text{pulsed}; t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$ | - | - | -0.9 | V |
| t_d | delay time | $V_{CC} = -10\text{ V}; I_C = -0.5\text{ A}; I_{Bon} = -25\text{ mA}; I_{Boff} = 25\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$ | - | 15 | - | ns |
| t_r | rise time | | - | 40 | - | ns |
| t_{on} | turn-on time | | - | 55 | - | ns |
| t_s | storage time | | - | 95 | - | ns |
| t_f | fall time | | - | 40 | - | ns |
| t_{off} | turn-off time | | - | 135 | - | ns |
| f_T | transition frequency | | $V_{CE} = -10\text{ V}; I_C = -50\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$ | 65 | 125 | - |
| C_c | collector capacitance | $V_{CB} = -10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$ | - | 9.5 | 13 | pF |



$V_{CE} = -2\text{ V}$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -55\text{ }^\circ\text{C}$

Fig. 10. DC current gain as a function of collector current; typical values



$T_{amb} = 25\text{ }^\circ\text{C}$

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

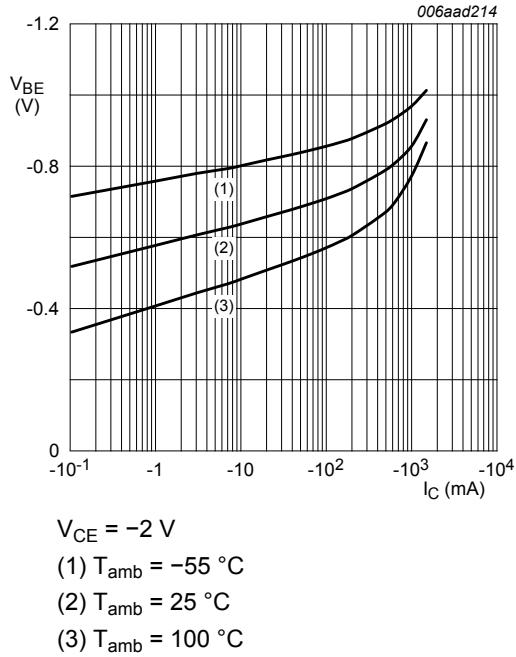


Fig. 12. Base-emitter voltage as a function of collector current; typical values

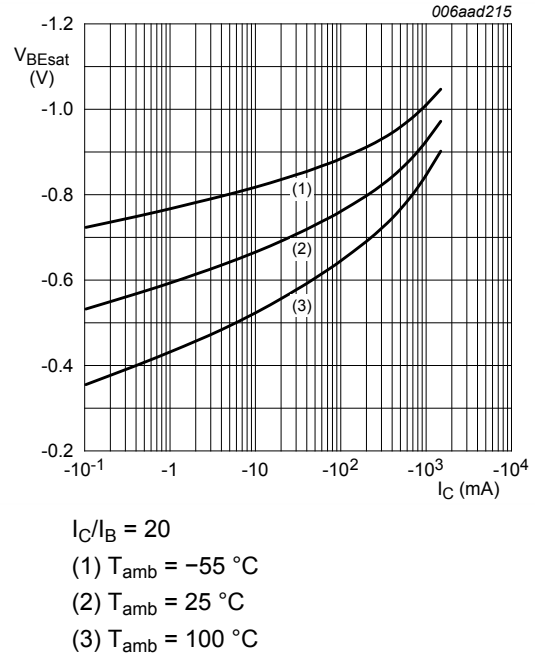


Fig. 13. Base-emitter saturation voltage as a function of collector current; typical values

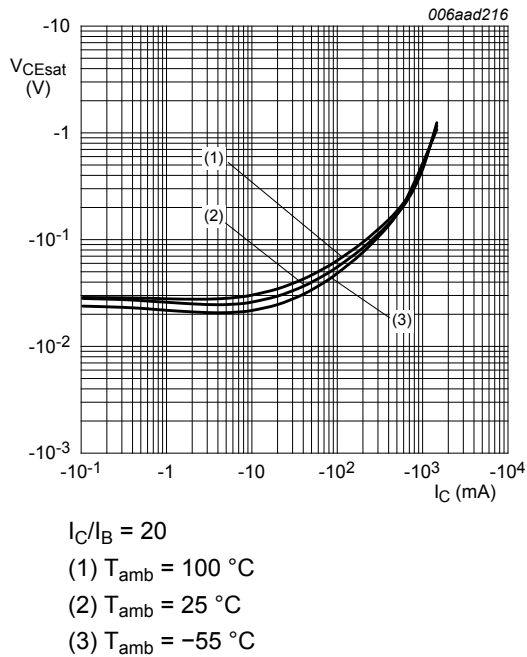


Fig. 14. Collector-emitter saturation voltage as a function of collector current; typical values

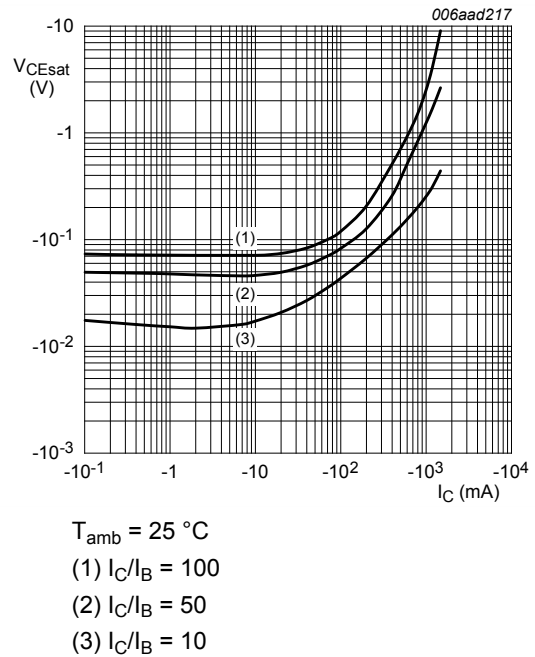
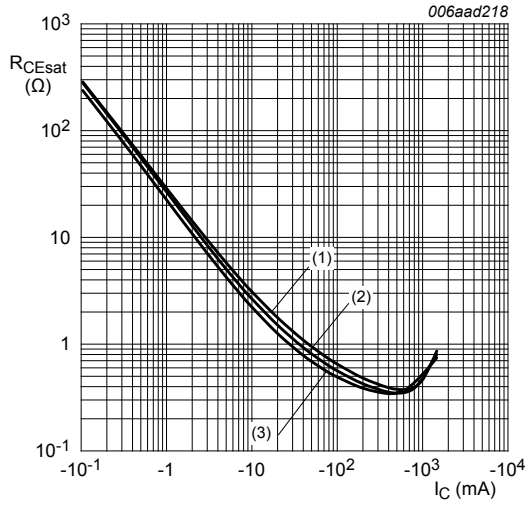
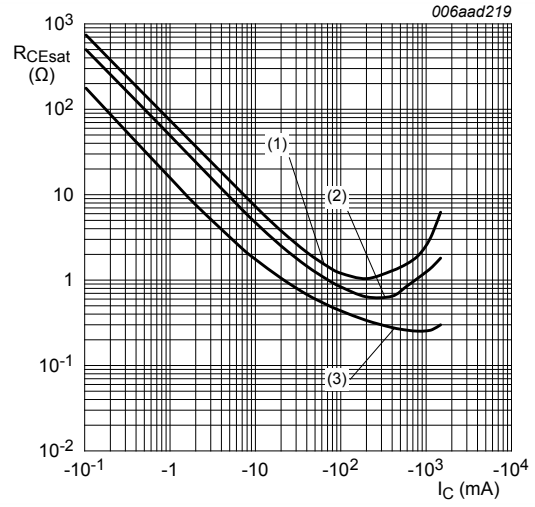


Fig. 15. Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig. 16. Collector-emitter saturation resistance as a function of collector current; typical values



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

Fig. 17. Collector-emitter saturation resistance as a function of collector current; typical values

10. Test information

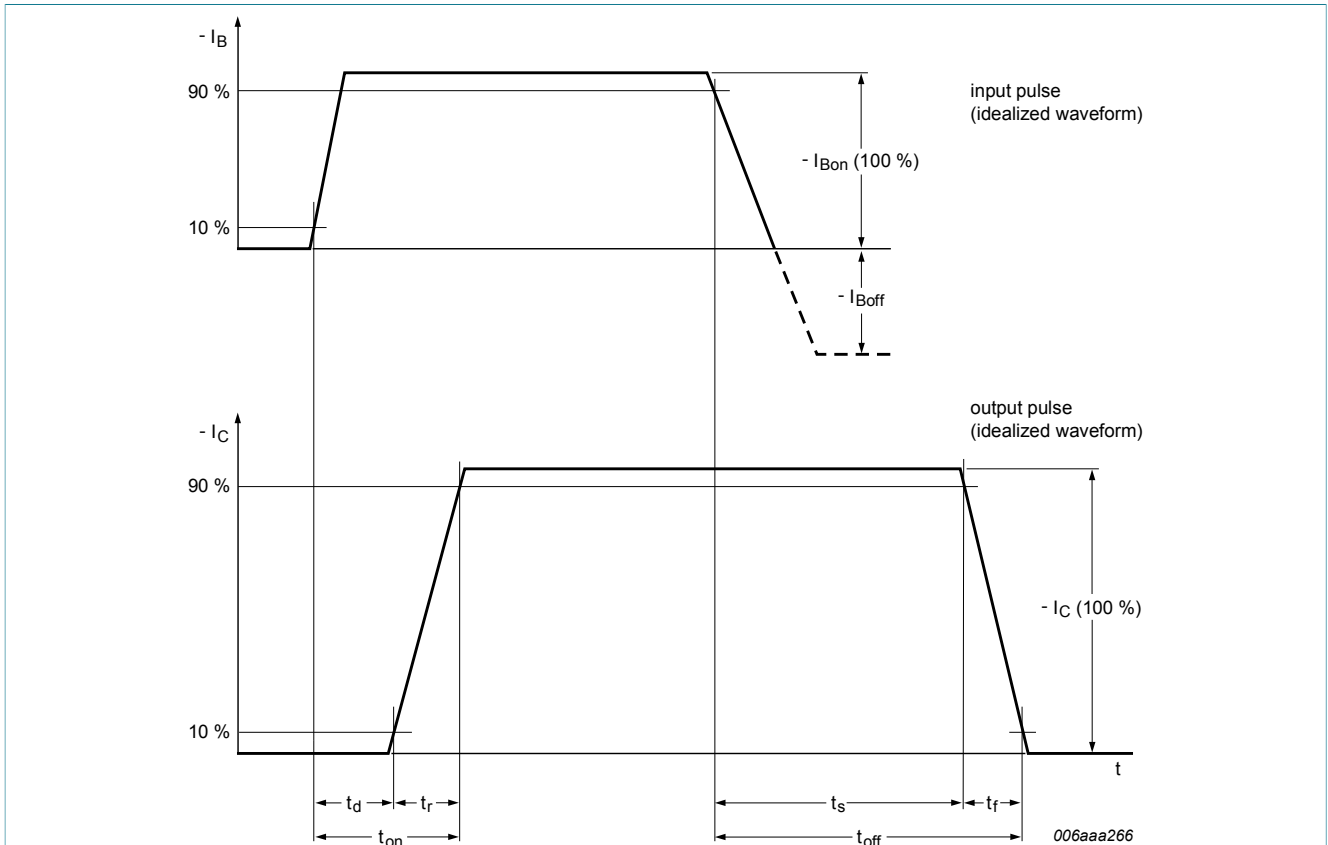


Fig. 18. BISS transistor switching time definition

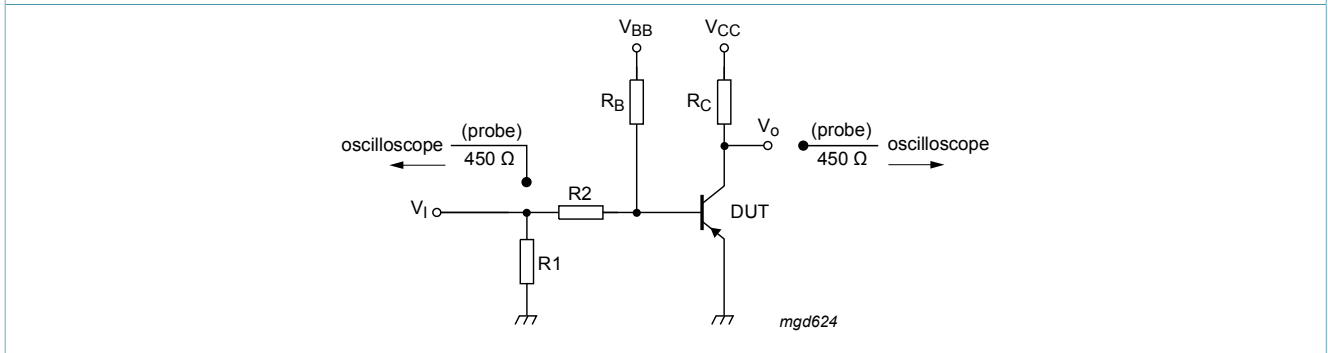


Fig. 19. Test circuit for switching times

10.1 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.

11. Package outline

DFN2020D-6: plastic, thermally enhanced ultra thin and small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm

SOT1118D

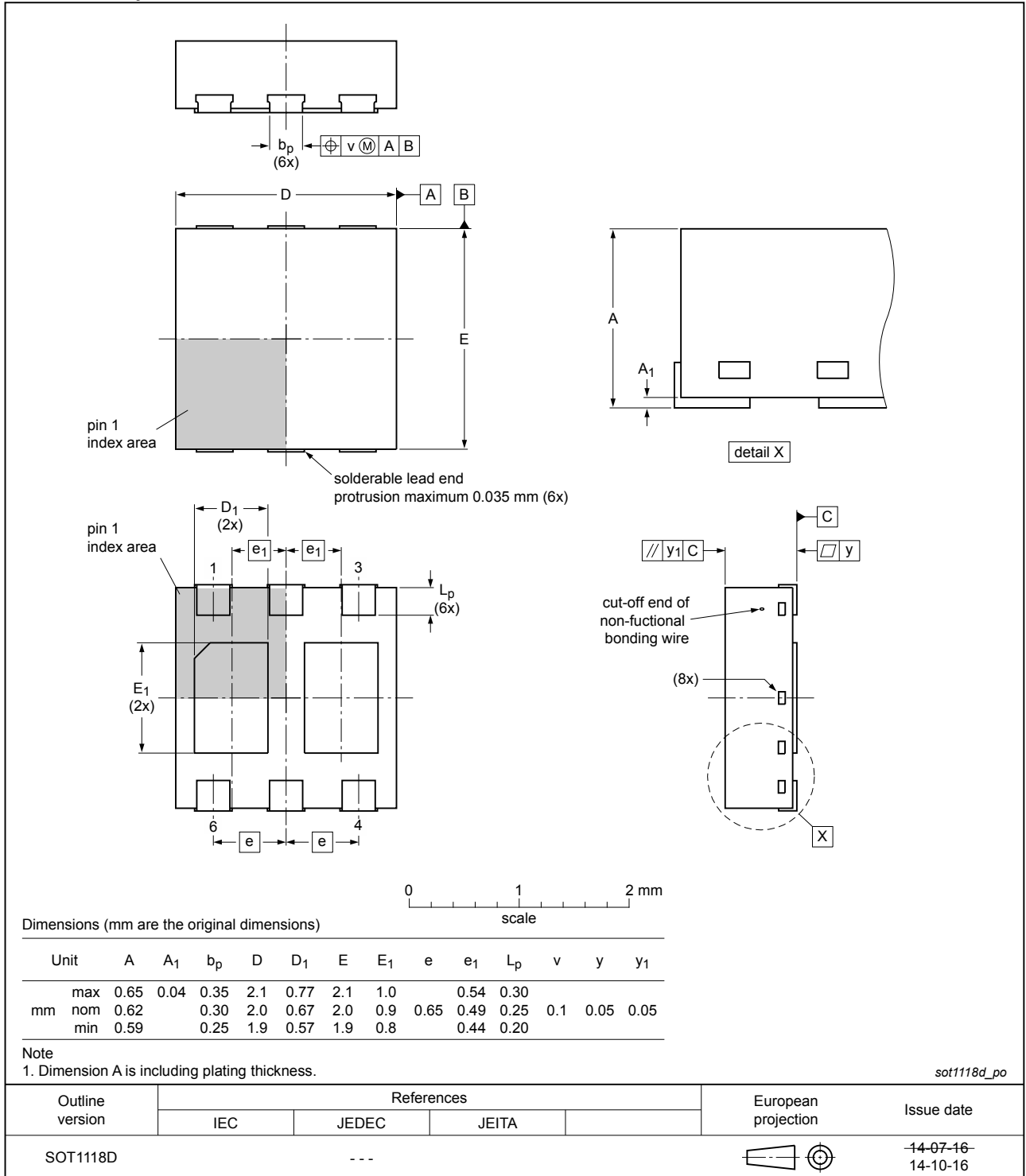


Fig. 20. Package outline DFN2020D-6 (SOT1118D)

12. Soldering

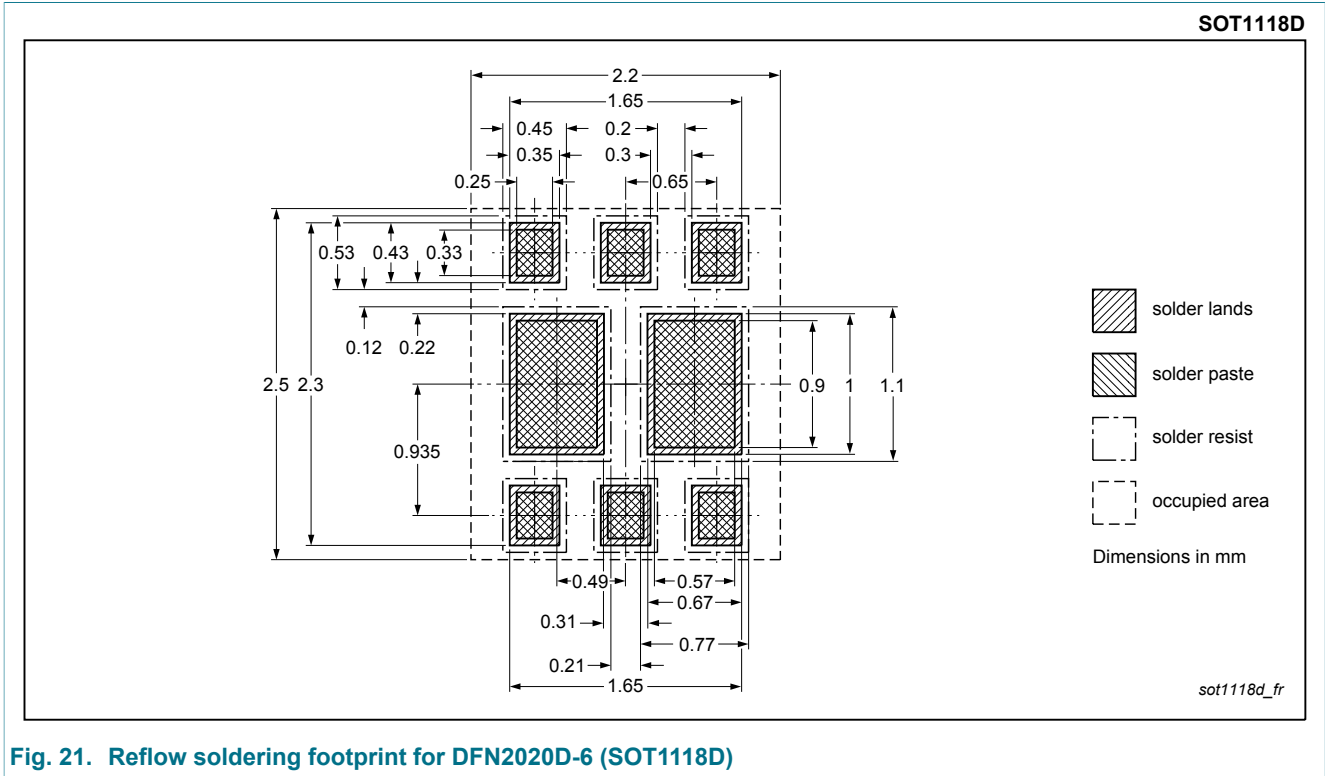


Fig. 21. Reflow soldering footprint for DFN2020D-6 (SOT1118D)

13. Revision history

Table 7. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|--------------|--------------------|---------------|------------|
| PBSS5160PAPS v.1 | 20141124 | Product data sheet | - | - |

14. Legal information

14.1 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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15. 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 | Limiting values | 2 |
| 8 | Thermal characteristics | 4 |
| 9 | Characteristics | 9 |
| 10 | Test information | 13 |
| 10.1 | Quality information | 13 |
| 11 | Package outline | 14 |
| 12 | Soldering | 15 |
| 13 | Revision history | 16 |
| 14 | Legal information | 17 |
| 14.1 | Data sheet status | 17 |
| 14.2 | Definitions | 17 |
| 14.3 | Disclaimers | 17 |
| 14.4 | Trademarks | 18 |

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