



# PBSS4160PANS

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

11 February 2015

Product data sheet

## 1. General description

NPN/NPN 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.

NPN/PNP complement: PBSS4160PANPS. PNP/PNP complement: PBSS5160PAPS.

## 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

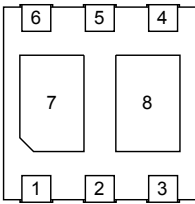
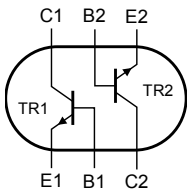
Table 1. Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
R <sub>CEsat</sub>	collector-emitter saturation resistance	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	-	-	240	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
PBSS4160PANS	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
PBSS4160PANS	3F

## 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		-	60	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	60	V
V <sub>EBO</sub>	emitter-base voltage	open collector		-	7	V
I <sub>C</sub>	collector current			-	1	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms		-	1.5	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
			[5]	-	450	mW
			[6]	-	760	mW
			[7]	-	700	mW
			[8]	-	1450	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
			[5]	-	620	mW
			[6]	-	1040	mW
			[7]	-	960	mW
			[8]	-	2000	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 PCB, single-sided 35 µm copper strip line, tin-plated and standard footprint.

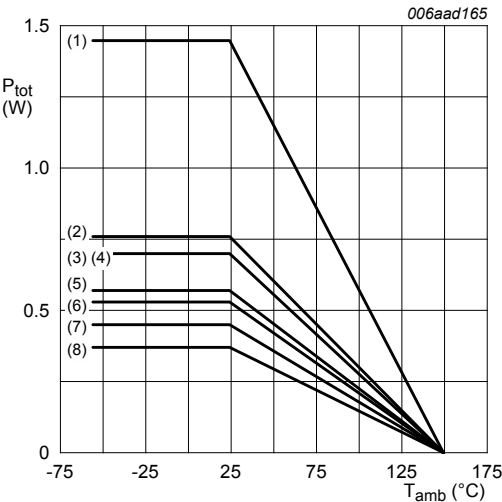
[2] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[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 cm<sup>2</sup>.

[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 cm<sup>2</sup>.
- [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 cm<sup>2</sup>.



- (1) 4-layer PCB 70 µm, mounting pad for collector 1 cm<sup>2</sup>
- (2) FR4 PCB 70 µm, mounting pad for collector 1 cm<sup>2</sup>
- (3) 4-layer PCB 70 µm, standard footprint
- (4) 4-layer PCB 35 µm, mounting pad for collector 1 cm<sup>2</sup>
- (5) FR4 PCB 35 µm, mounting pad for collector 1 cm<sup>2</sup>
- (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

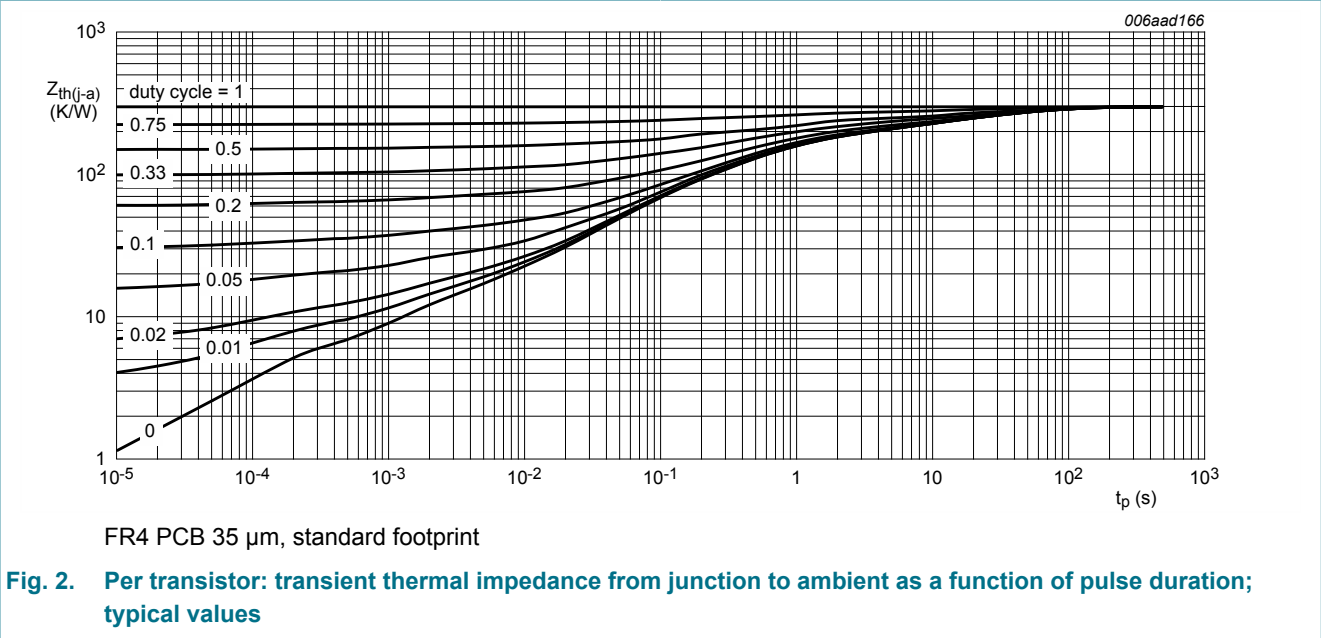
9. Thermal characteristics

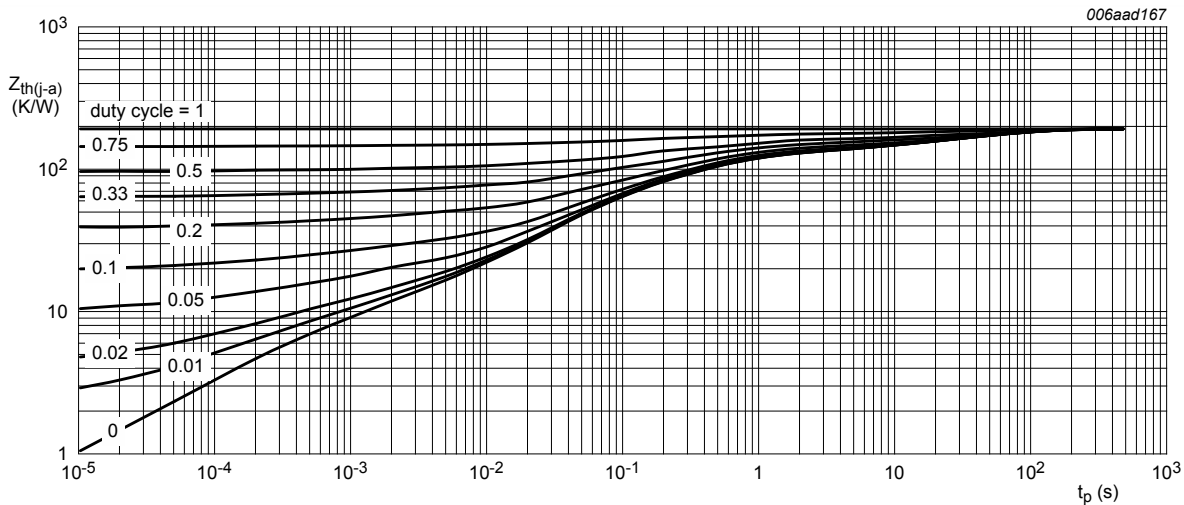
Table 6. Thermal characteristics

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
			[5]	-	-	278	K/W
			[6]	-	-	164	K/W
			[7]	-	-	179	K/W
			[8]	-	-	86	K/W

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	30	K/W
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

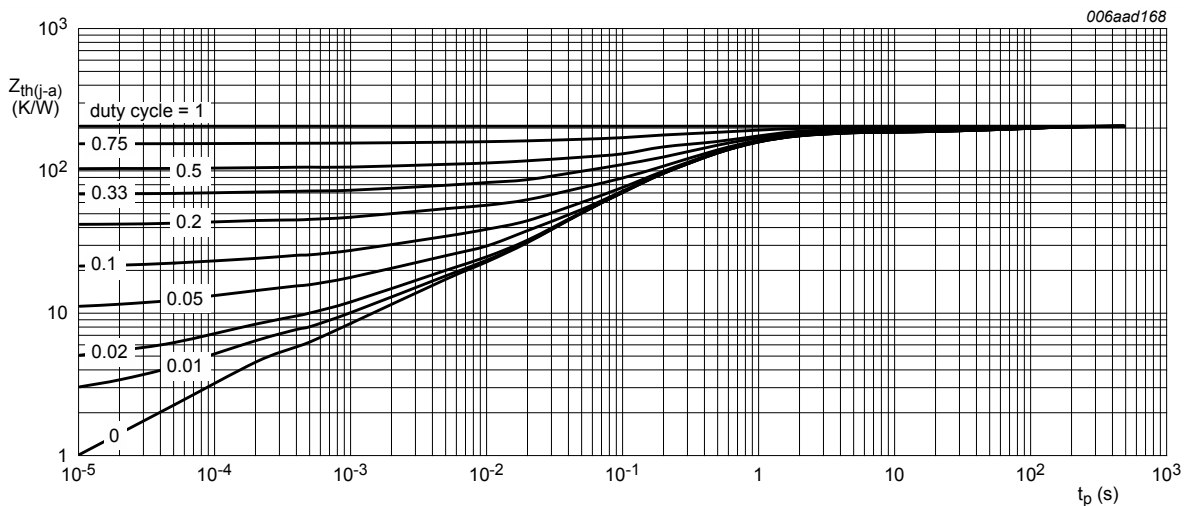
- [1] Device mounted on an FR4 PCB, single-sided 35  $\mu$ m copper strip line, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided 35  $\mu$ m copper strip line, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on 4-layer PCB 35  $\mu$ m copper strip line, tin-plated and standard footprint.
- [4] Device mounted on 4-layer PCB 35  $\mu$ m copper strip line, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [5] Device mounted on an FR4 PCB, single-sided 70  $\mu$ m copper strip line, tin-plated and standard footprint.
- [6] Device mounted on an FR4 PCB, single-sided 70  $\mu$ m copper strip line, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [7] Device mounted on 4-layer PCB 70  $\mu$ m copper strip line, tin-plated and standard footprint.
- [8] Device mounted on 4-layer PCB 70  $\mu$ m copper strip line, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.





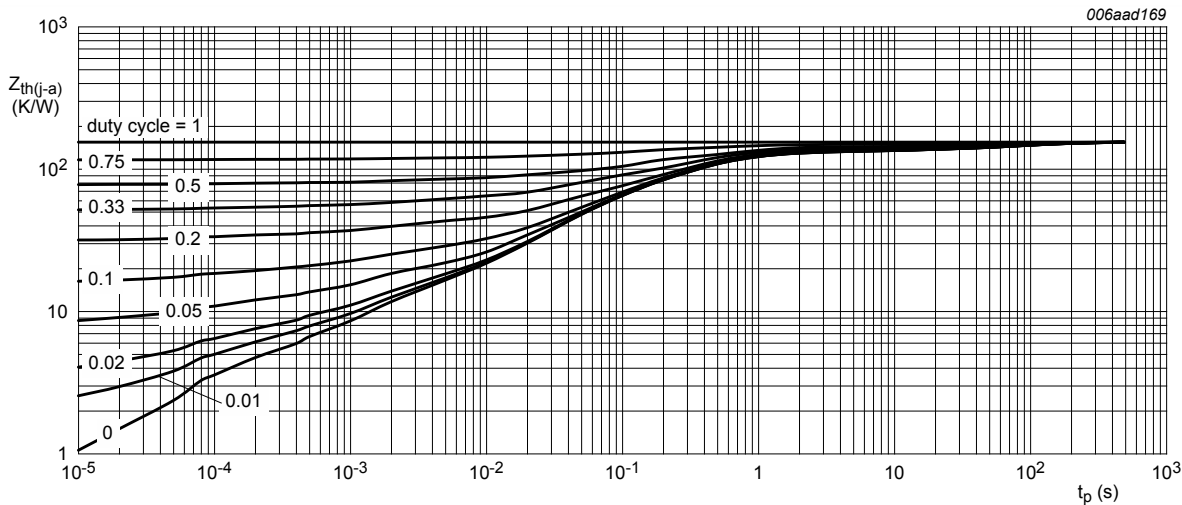
FR4 PCB 35  $\mu$ m, mounting pad for collector 1 cm<sup>2</sup>

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



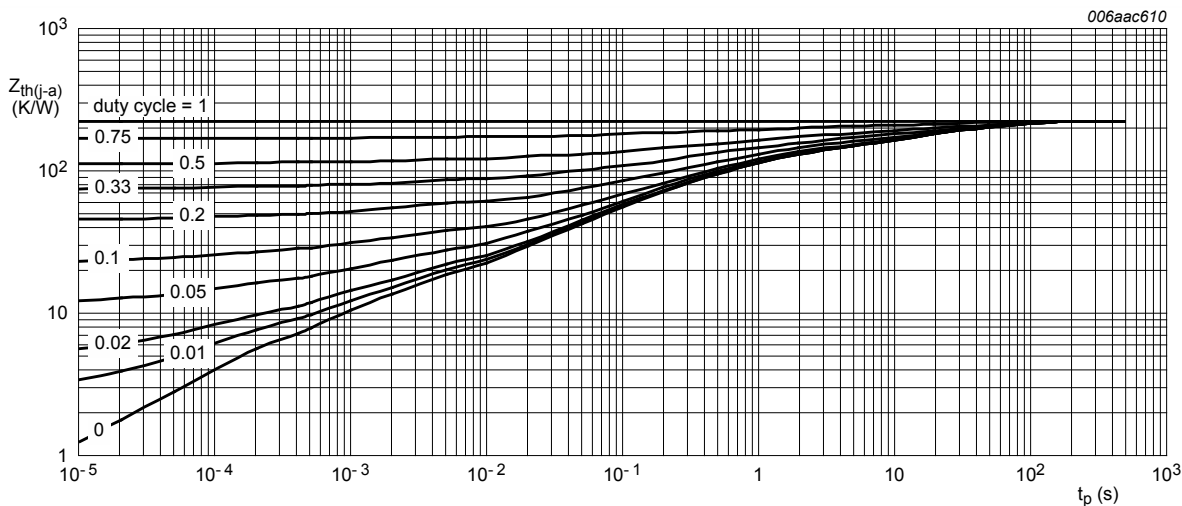
4-layer PCB 35  $\mu$ m, standard footprint

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



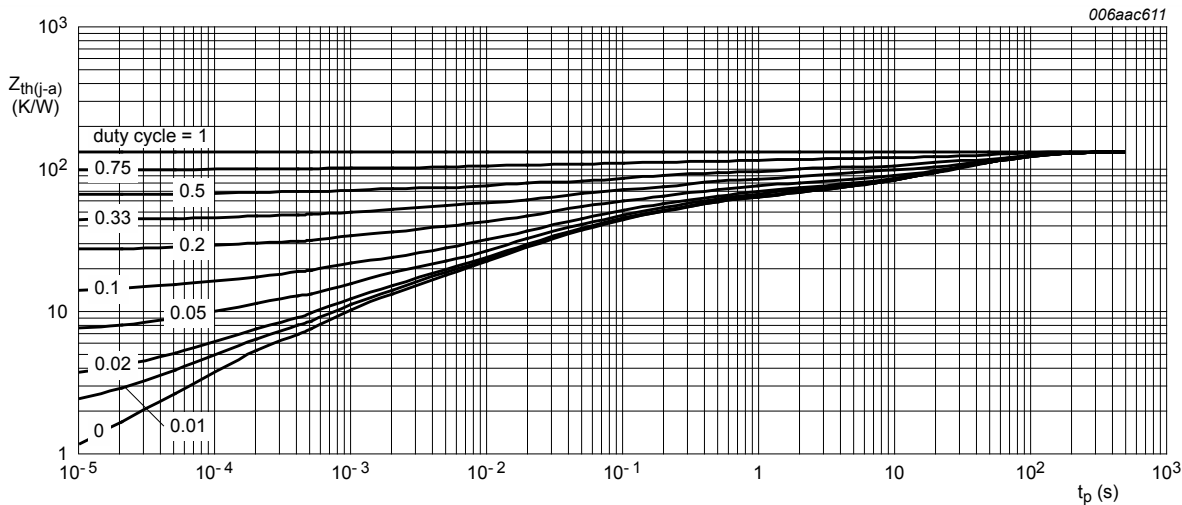
4-layer PCB 35  $\mu\text{m}$ , mounting pad for collector 1  $\text{cm}^2$

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



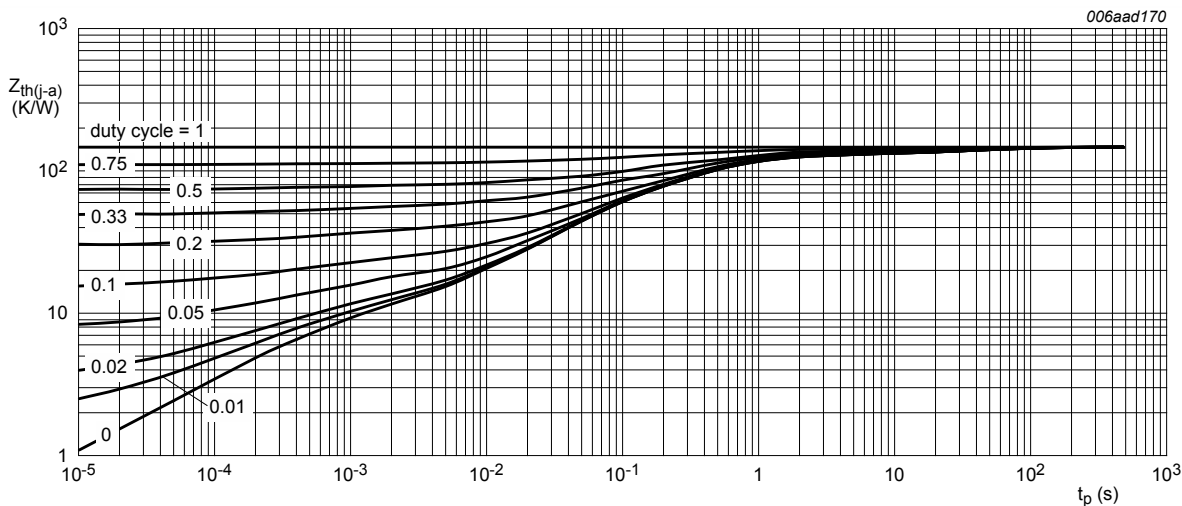
FR4 PCB 70  $\mu\text{m}$ , standard footprint

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



FR4 PCB 70  $\mu$ m, mounting pad for collector 1 cm<sup>2</sup>

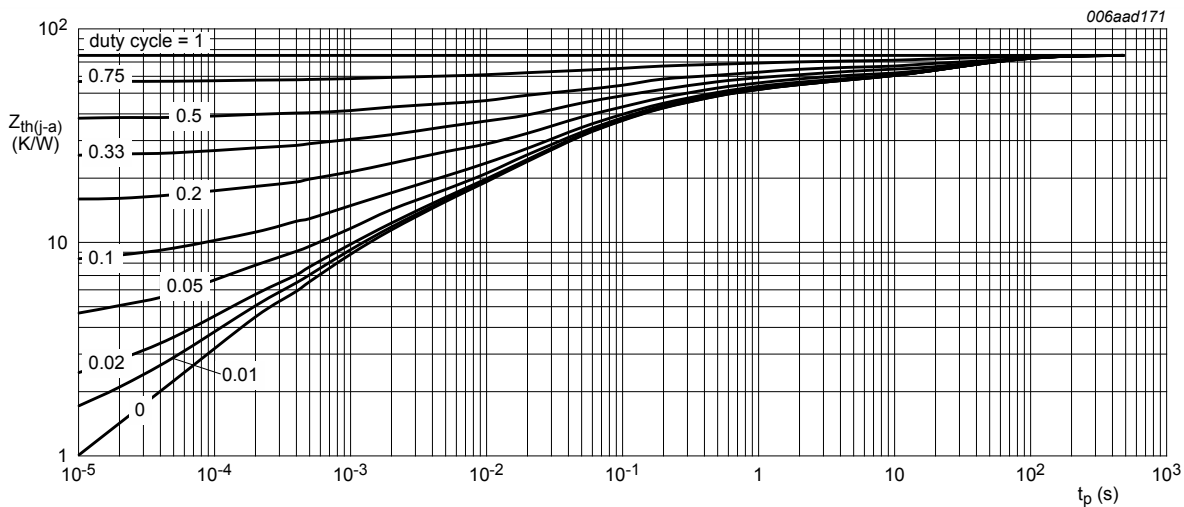
Fig. 7. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values



4-layer PCB 70  $\mu$ m, standard footprint

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





4-layer PCB 70  $\mu$ m, mounting pad for collector 1 cm<sup>2</sup>

**Fig. 9.** Per transistor: 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>						
$I_{CBO}$	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	$\mu\text{A}$
$I_{EBO}$	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	$V_{CE} = 2 \text{ V}; I_C = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	290	430	-	
		$V_{CE} = 2 \text{ V}; I_C = 500 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	150	220	-	
		$V_{CE} = 2 \text{ V}; I_C = 1 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	70	110	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	90	120	mV
		$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	185	240	mV
		$I_C = 1 \text{ A}; I_B = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	175	220	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 0.5 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	240	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	1	V
		$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	1.1	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	$V_{CC} = 10 \text{ V}; I_C = 500 \text{ mA}; I_{B(on)} = 25 \text{ mA}; I_{B(off)} = -25 \text{ mA}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	15	-	ns
$t_r$	rise time		-	90	-	ns
$t_{on}$	turn-on time		-	105	-	ns
$t_s$	storage time		-	410	-	ns
$t_f$	fall time		-	130	-	ns
$t_{off}$	turn-off time		-	540	-	ns
$f_T$	transition frequency	$V_{CE} = 10 \text{ V}; I_C = 50 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	90	175	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	4	6	pF

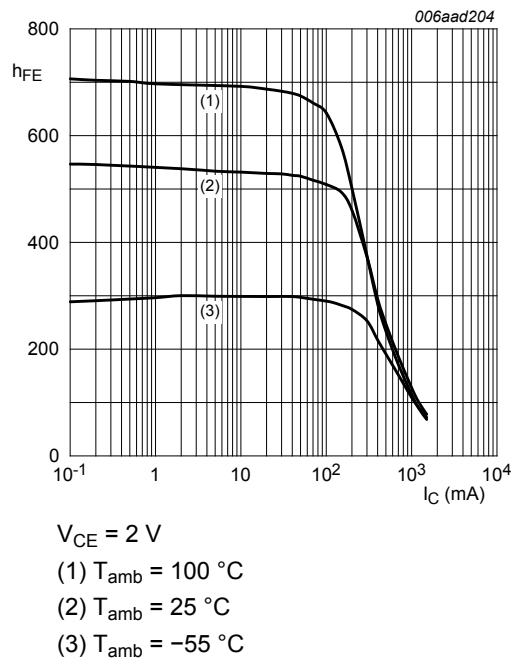


Fig. 10. DC current gain as a function of collector current; typical values

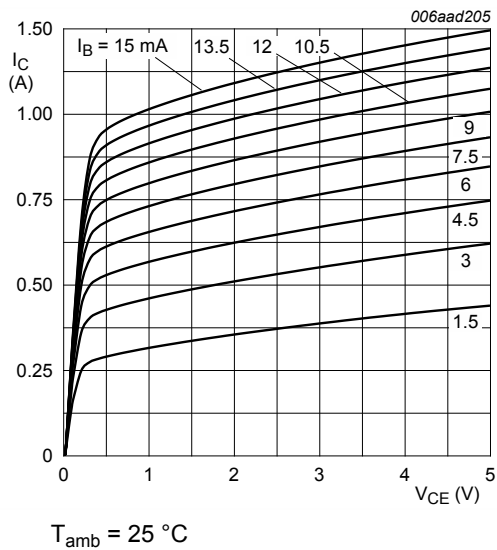


Fig. 11. Collector current as a function of collector-emitter voltage; typical values

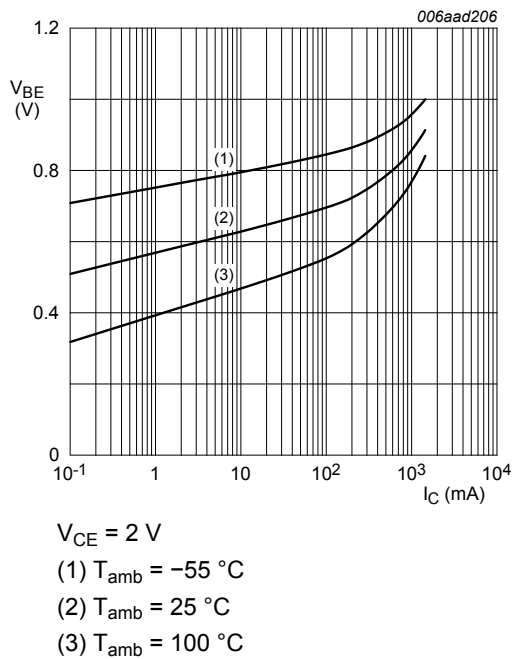


Fig. 12. Base-emitter voltage as a function of collector current; typical values

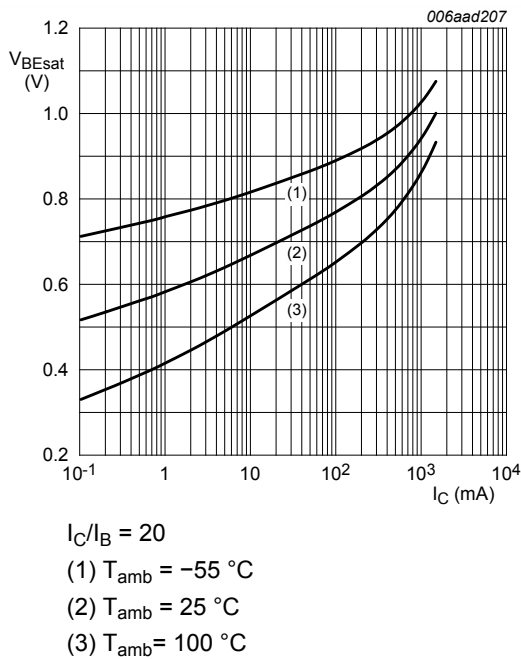


Fig. 13. Base-emitter saturation voltage as a function of collector current; typical values

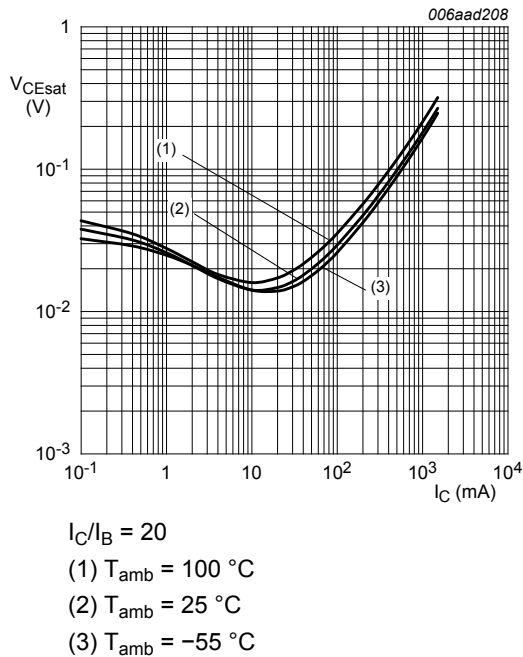


Fig. 14. Collector-emitter saturation voltage as a function of collector current; typical values

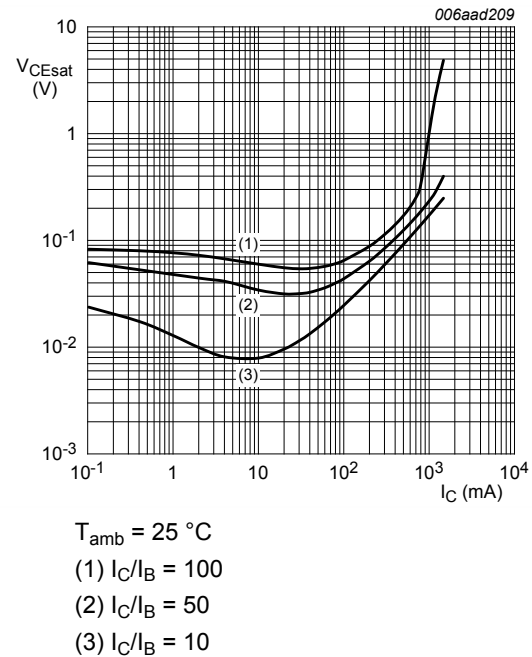


Fig. 15. Collector-emitter saturation voltage as a function of collector current; typical values

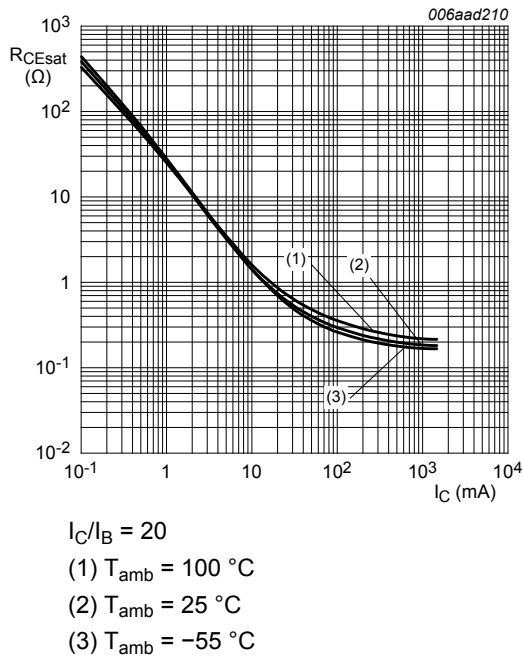


Fig. 16. Collector-emitter saturation resistance as a function of collector current; typical values

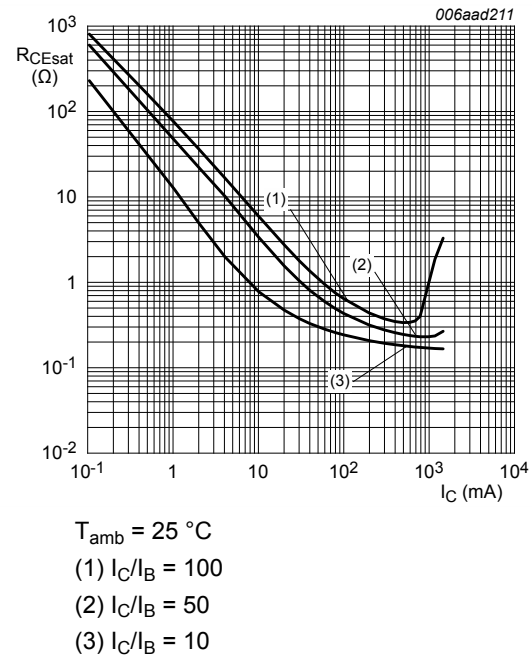


Fig. 17. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

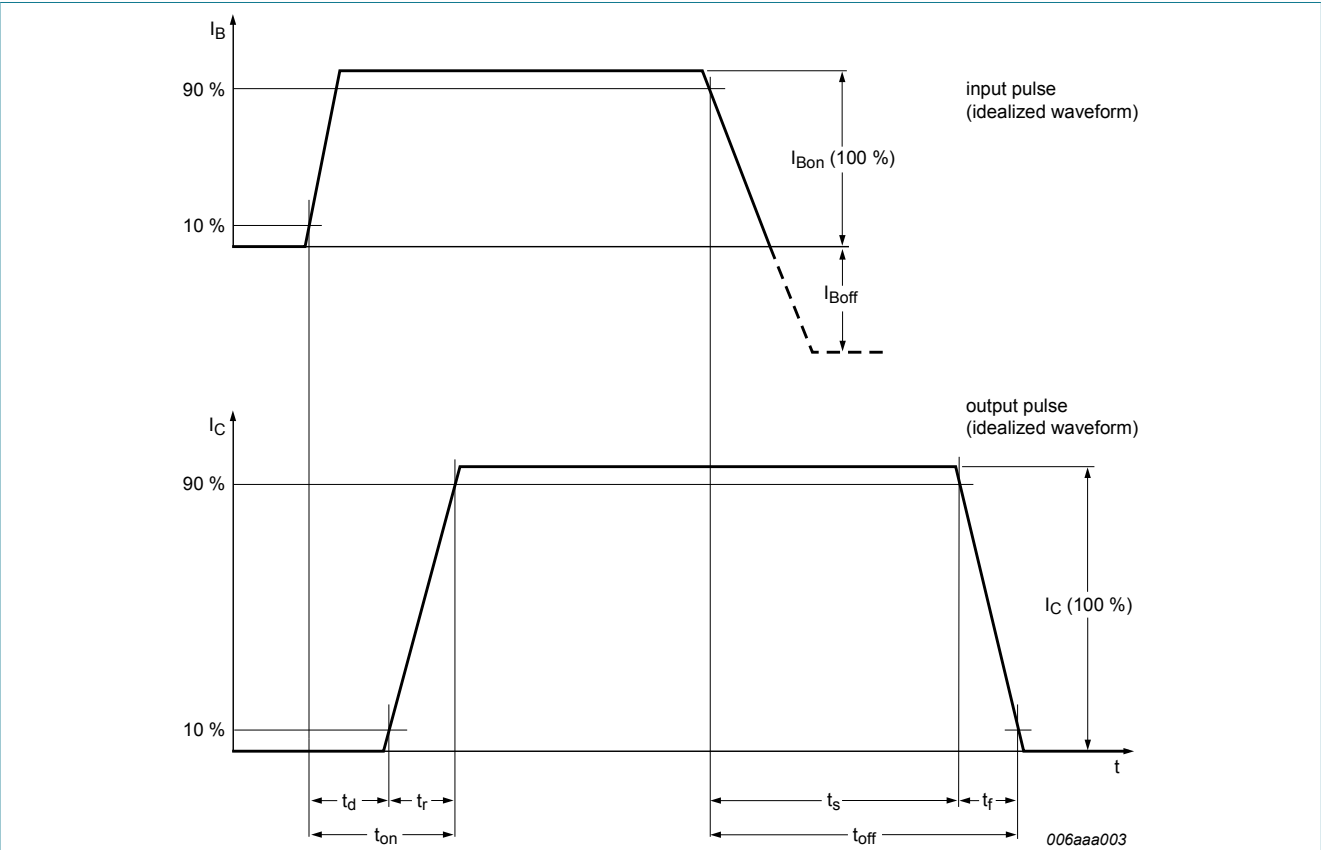


Fig. 18. BISS transistor switching time definition

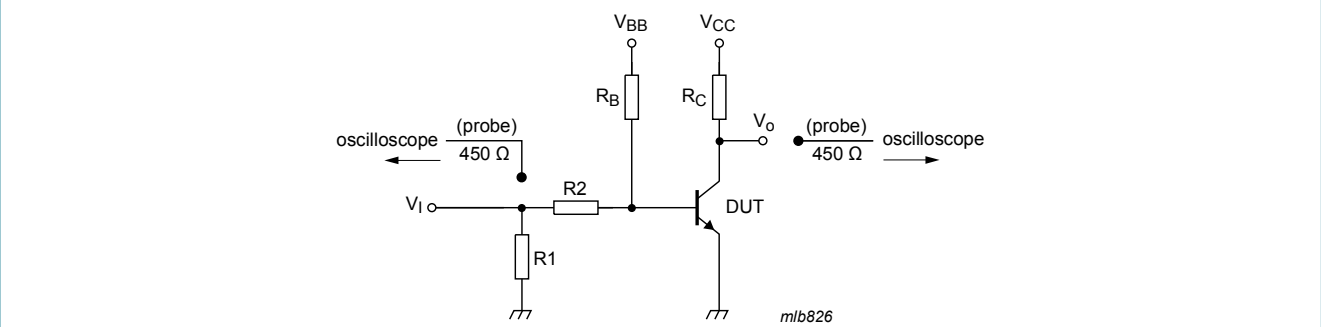


Fig. 19. Test circuit for switching times

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

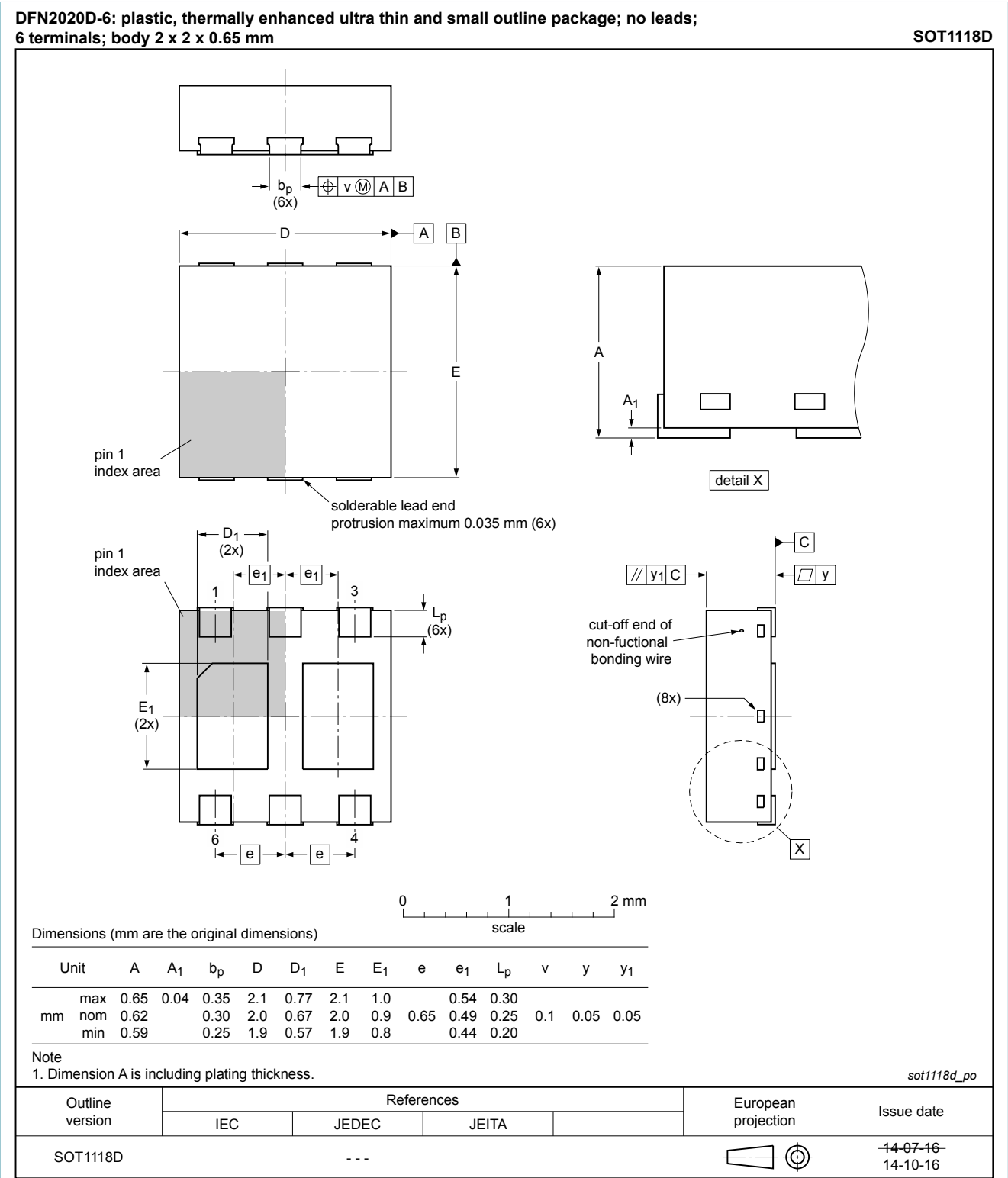
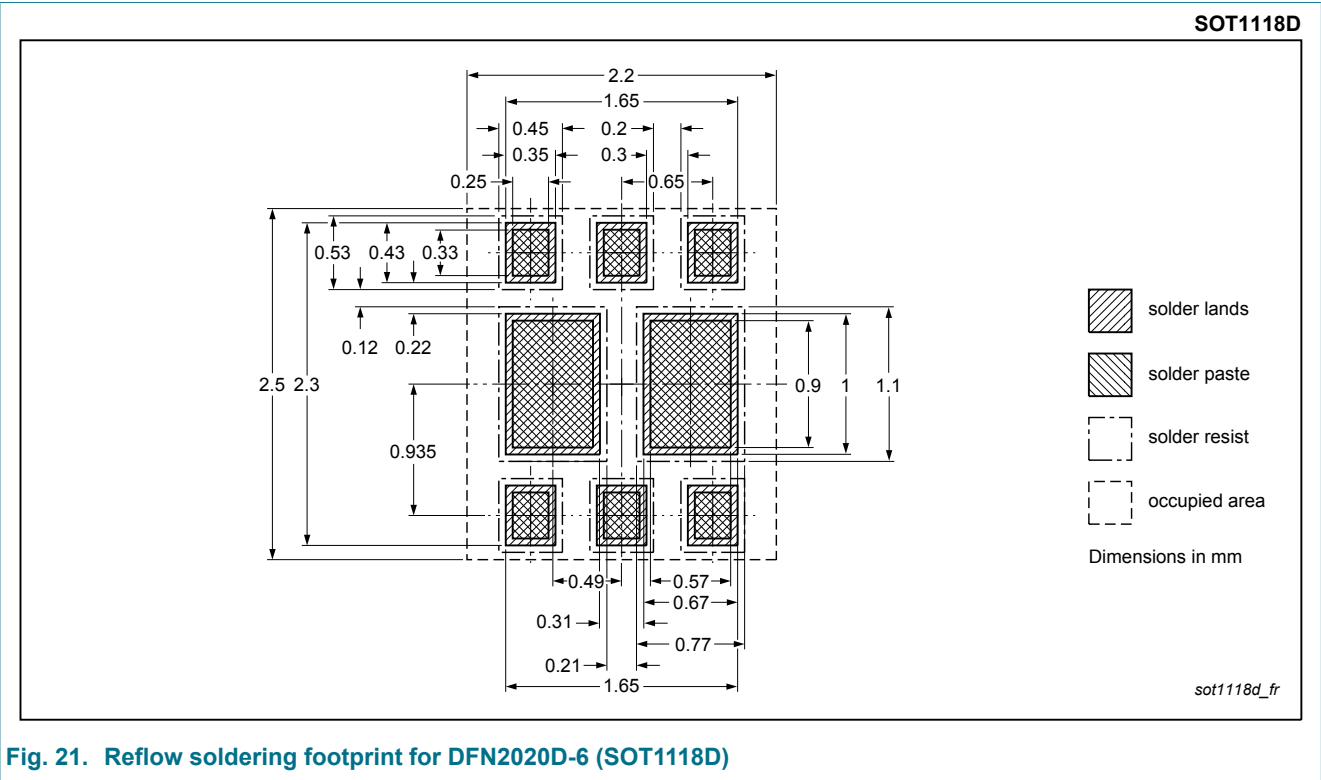


Fig. 20. Package outline DFN2020D-6 (SOT1118D)

13. Soldering



14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4160PANS v.1	20150211	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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