



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)

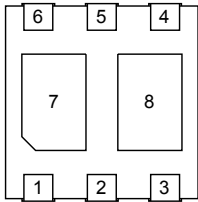
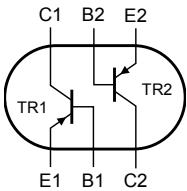
4. Quick reference data

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	 Transparent top view DFN2020D-6 (SOT1118D)	 sym138
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_{CBO}	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; $t_p \leq 1$ ms		-	-1.5	A
I_B	base current			-	-0.3	A
I_{BM}	peak base current	single pulse; $t_p \leq 1$ ms		-	-1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °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 μ m, mounting pad for collector 1 cm²
- (2) FR4 PCB 70 μ m, mounting pad for collector 1 cm²
- (3) 4-layer PCB 70 μ m, standard footprint
- (4) 4-layer PCB 35 μ m, mounting pad for collector 1 cm²
- (5) FR4 PCB 35 μ m, mounting pad for collector 1 cm²
- (6) 4-layer PCB 35 μ m, standard footprint
- (7) FR4 PCB 70 μ m, standard footprint
- (8) FR4 PCB 35 μ m, standard footprint

Fig. 1. Per transistor: power derating curves

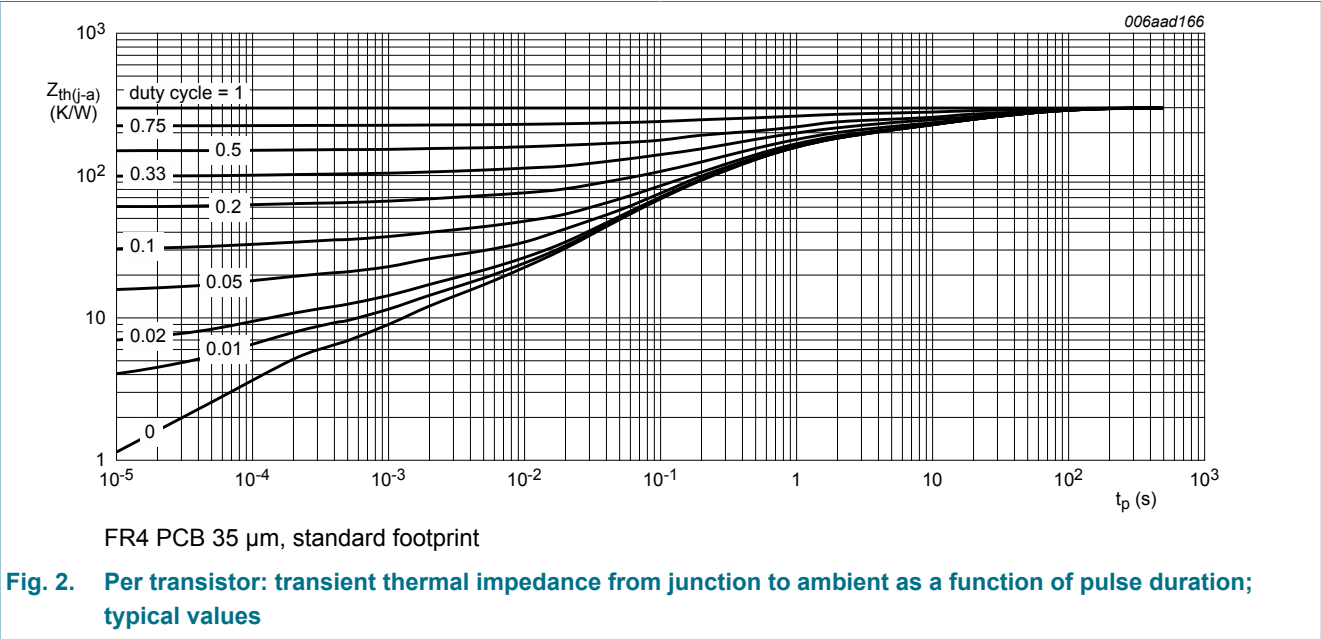
8. Thermal characteristics

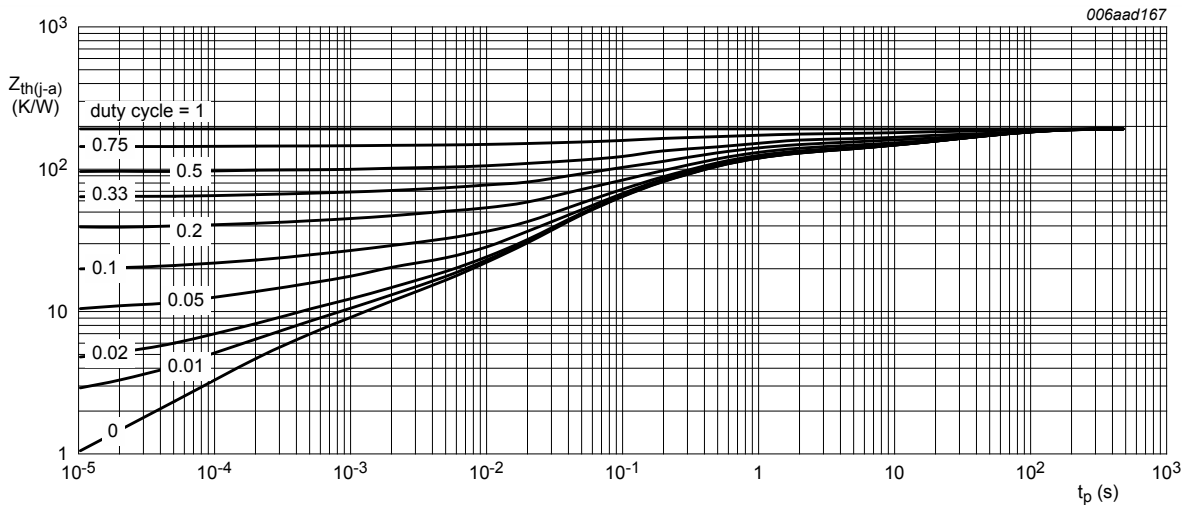
Table 5. Thermal characteristics

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

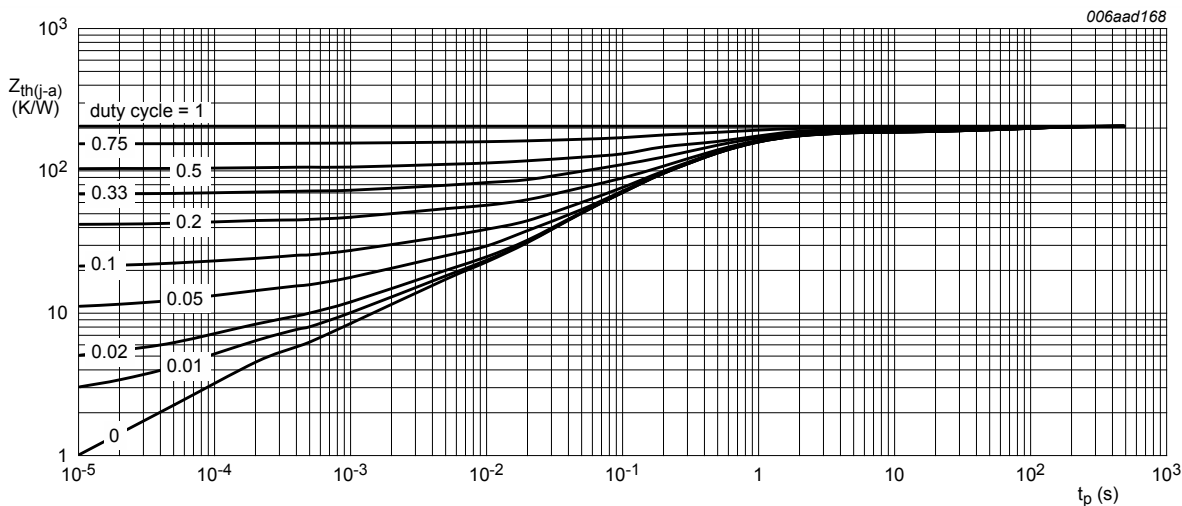
- [1] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [3] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated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





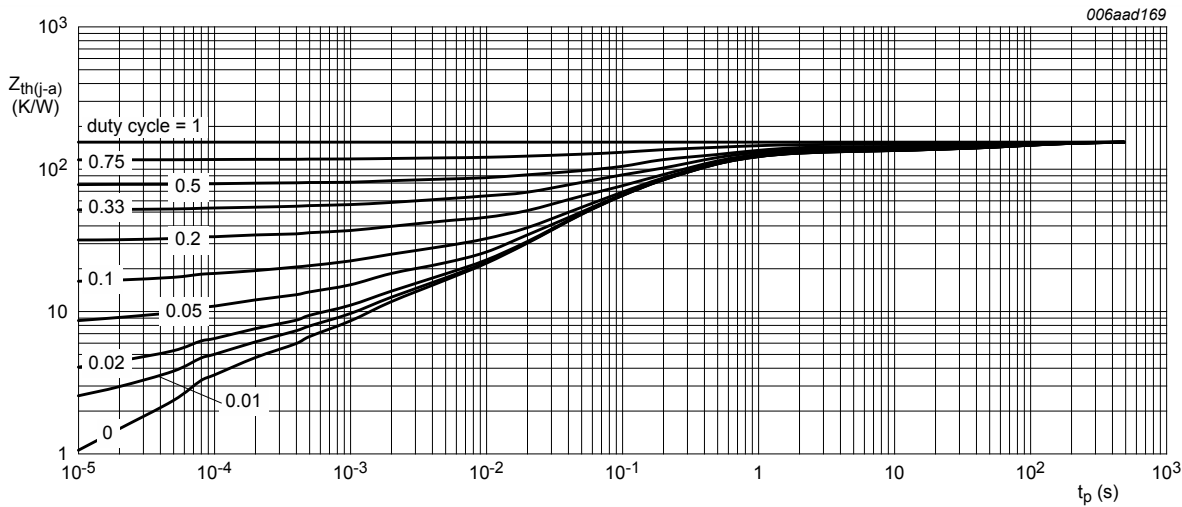
FR4 PCB 35 μ m, mounting pad for collector 1 cm²

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



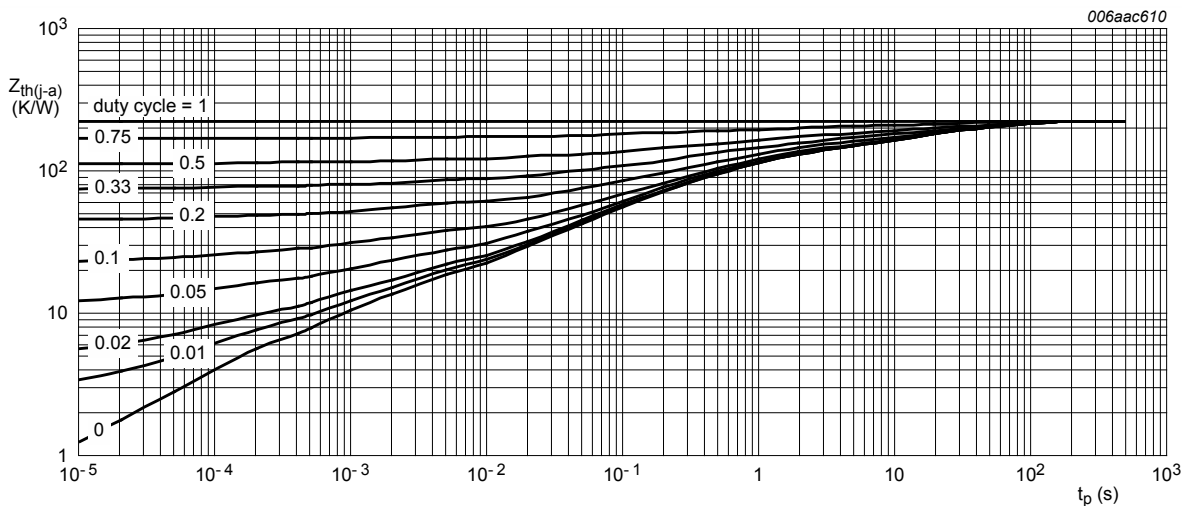
4-layer PCB 35 μ m, standard footprint

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



4-layer PCB 35 μm , mounting pad for collector 1 cm^2

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



FR4 PCB 70 μm , standard footprint

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



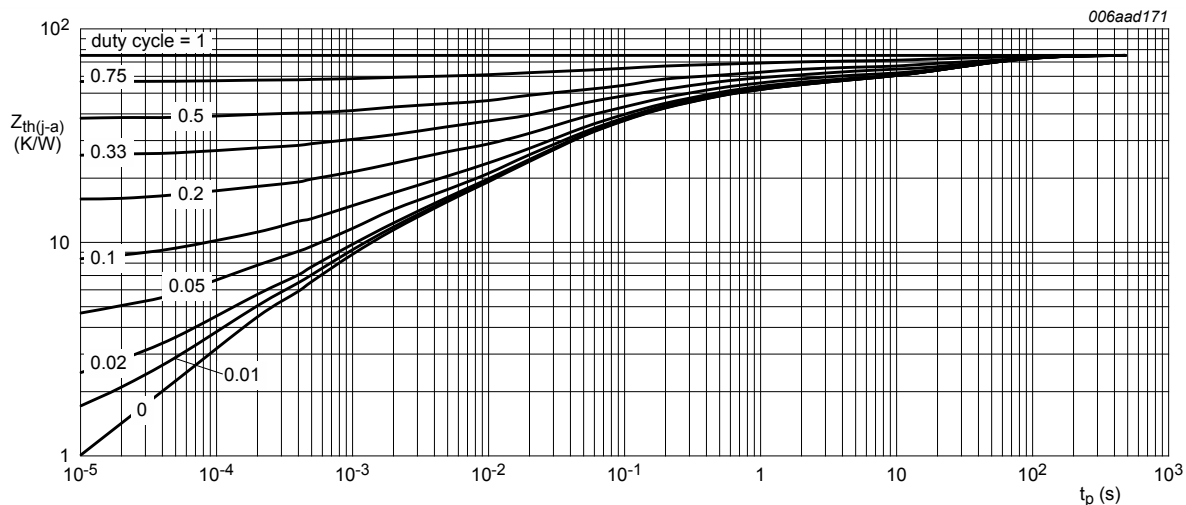
FR4 PCB 70 μ m, mounting pad for collector 1 cm²

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



4-layer PCB 70 μ 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 μm , mounting pad for collector 1 cm^2

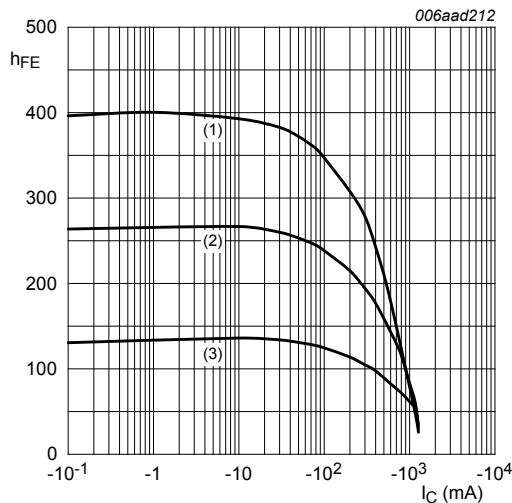
Fig. 9. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
I_{CBO}	collector-base cut-off current	$V_{\text{CB}} = -48 \text{ V}; I_{\text{E}} = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-	-100	nA
		$V_{\text{CB}} = -48 \text{ V}; I_{\text{E}} = 0 \text{ A}; T_{\text{j}} = 150 \text{ }^{\circ}\text{C}$	-	-	-50	μA
I_{EBO}	emitter-base cut-off current	$V_{\text{EB}} = -5 \text{ V}; I_{\text{C}} = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-	-100	nA
h_{FE}	DC current gain	$V_{\text{CE}} = -2 \text{ V}; I_{\text{C}} = -100 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	170	245	-	
		$V_{\text{CE}} = -2 \text{ V}; I_{\text{C}} = -500 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	120	170	-	
		$V_{\text{CE}} = -2 \text{ V}; I_{\text{C}} = -1 \text{ A}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	70	100	-	
V_{CEsat}	collector-emitter saturation voltage	$I_{\text{C}} = -500 \text{ mA}; I_{\text{B}} = -50 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-125	-180	mV
		$I_{\text{C}} = -1 \text{ A}; I_{\text{B}} = -50 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-390	-550	mV
		$I_{\text{C}} = -1 \text{ A}; I_{\text{B}} = -100 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-240	-340	mV
R_{CEsat}	collector-emitter saturation resistance	$I_{\text{C}} = -0.5 \text{ A}; I_{\text{B}} = -50 \text{ mA}; \text{pulsed}; t_{\text{p}} \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$	-	-	360	m Ω

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{BEsat}	base-emitter saturation voltage	$I_C = -500 \text{ mA}$; $I_B = -50 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-1	V
		$I_C = -1 \text{ A}$; $I_B = -50 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-1	V
		$I_C = -1 \text{ A}$; $I_B = -100 \text{ mA}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-1.1	V
V_{BEon}	base-emitter turn-on voltage	$V_{CE} = -2 \text{ V}$; $I_C = -0.5 \text{ A}$; pulsed; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$; $T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-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	-	MHz
C_c	collector capacitance	$V_{CB} = -10 \text{ V}$; $I_E = 0 \text{ A}$; $i_e = 0 \text{ A}$; $f = 1 \text{ MHz}$; $T_{amb} = 25 \text{ }^\circ\text{C}$	-	9.5	13	pF



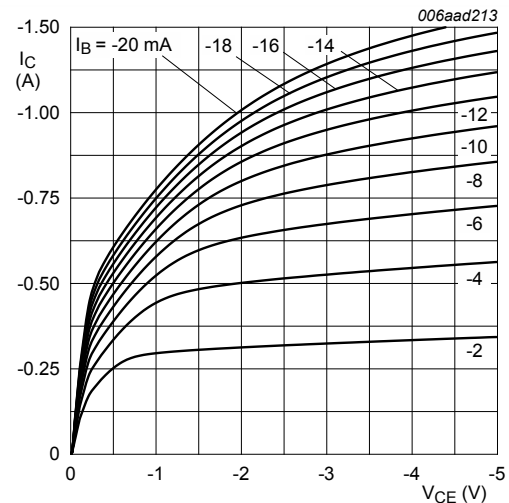
$V_{CE} = -2 \text{ V}$

(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

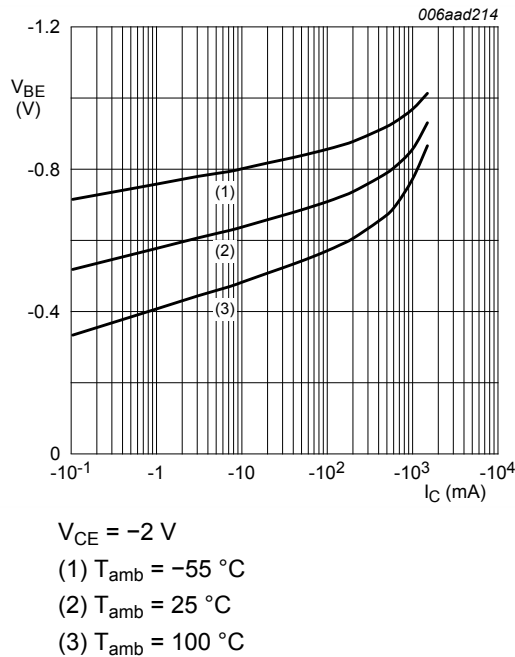


Fig. 12. Base-emitter voltage as a function of collector current; typical values

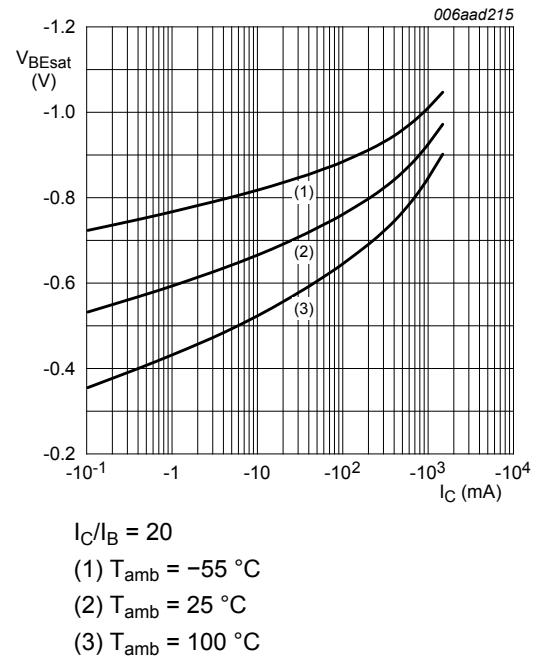


Fig. 13. Base-emitter saturation voltage as a function of collector current; typical values

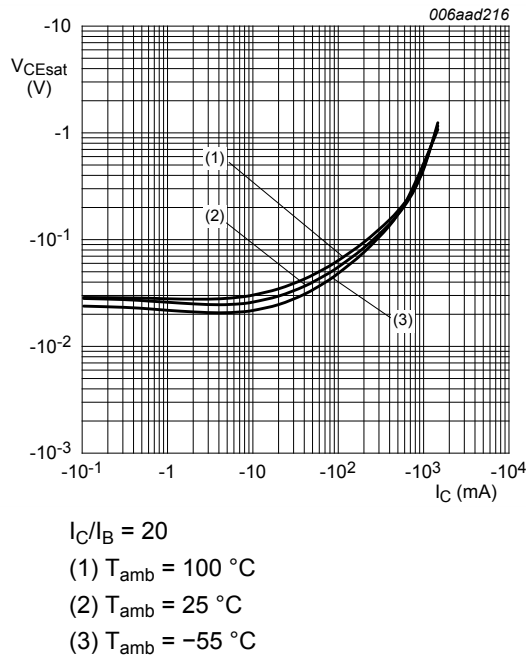


Fig. 14. Collector-emitter saturation voltage as a function of collector current; typical values

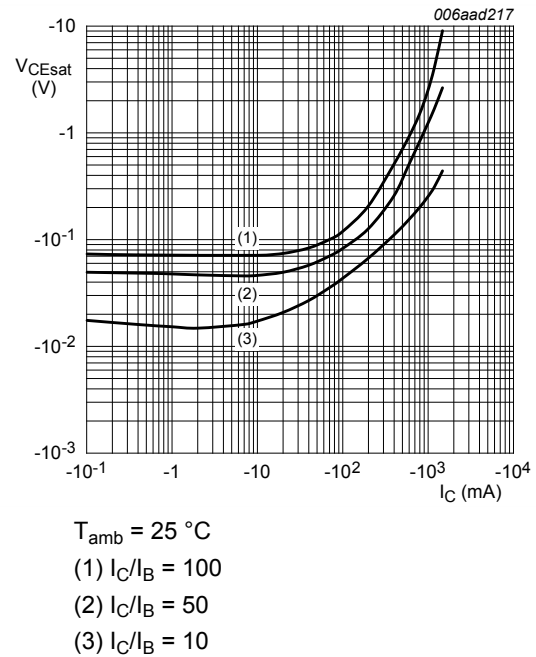
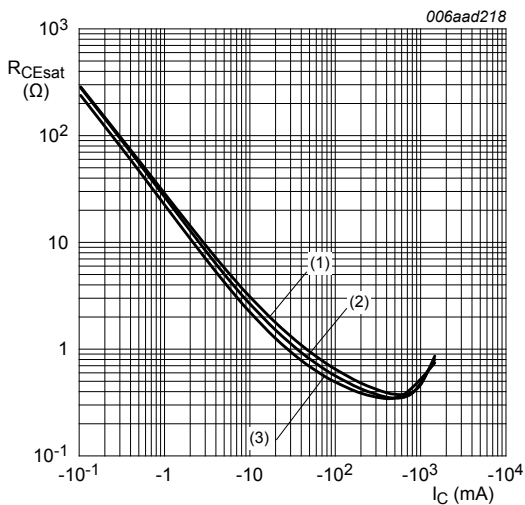
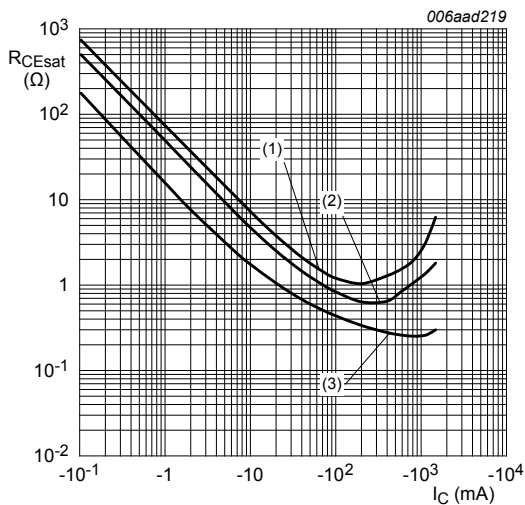


Fig. 15. Collector-emitter saturation voltage as a function of collector current; typical values



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

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



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

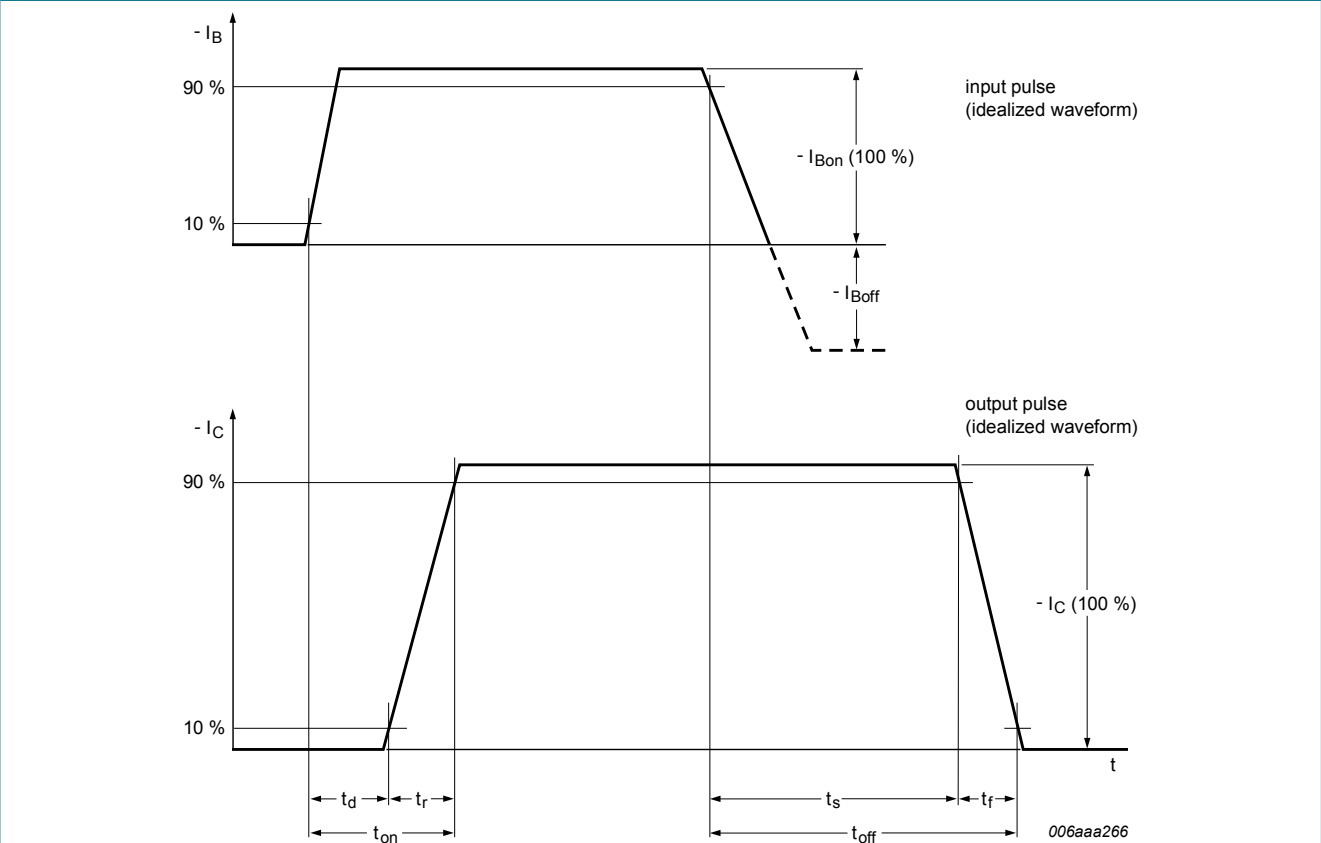


Fig. 18. BISS transistor switching time definition

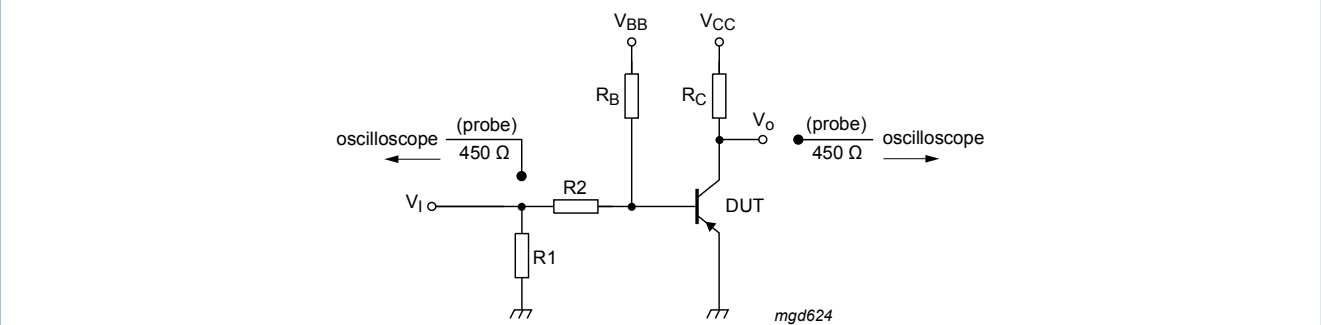


Fig. 19. Test circuit for switching times

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

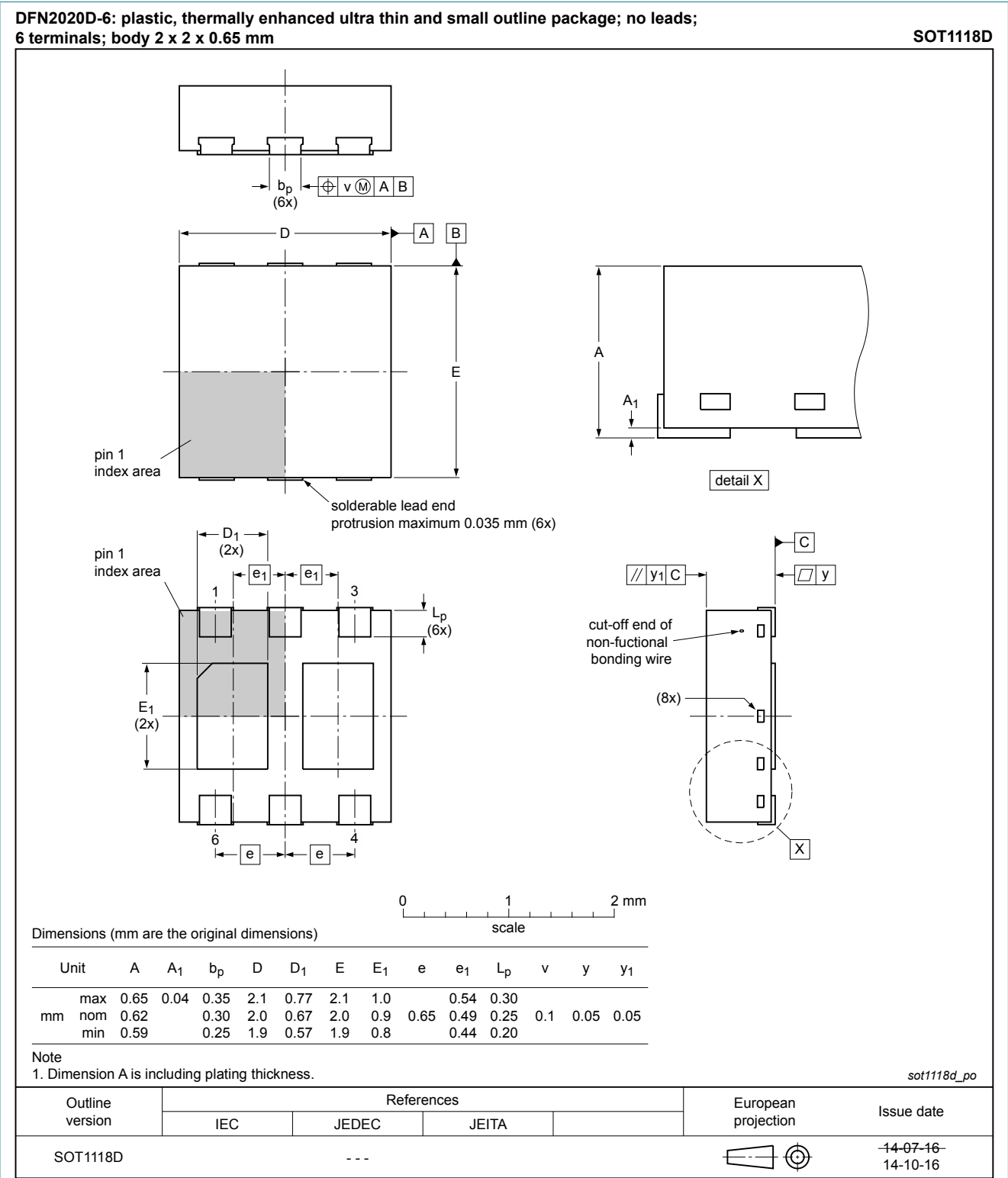
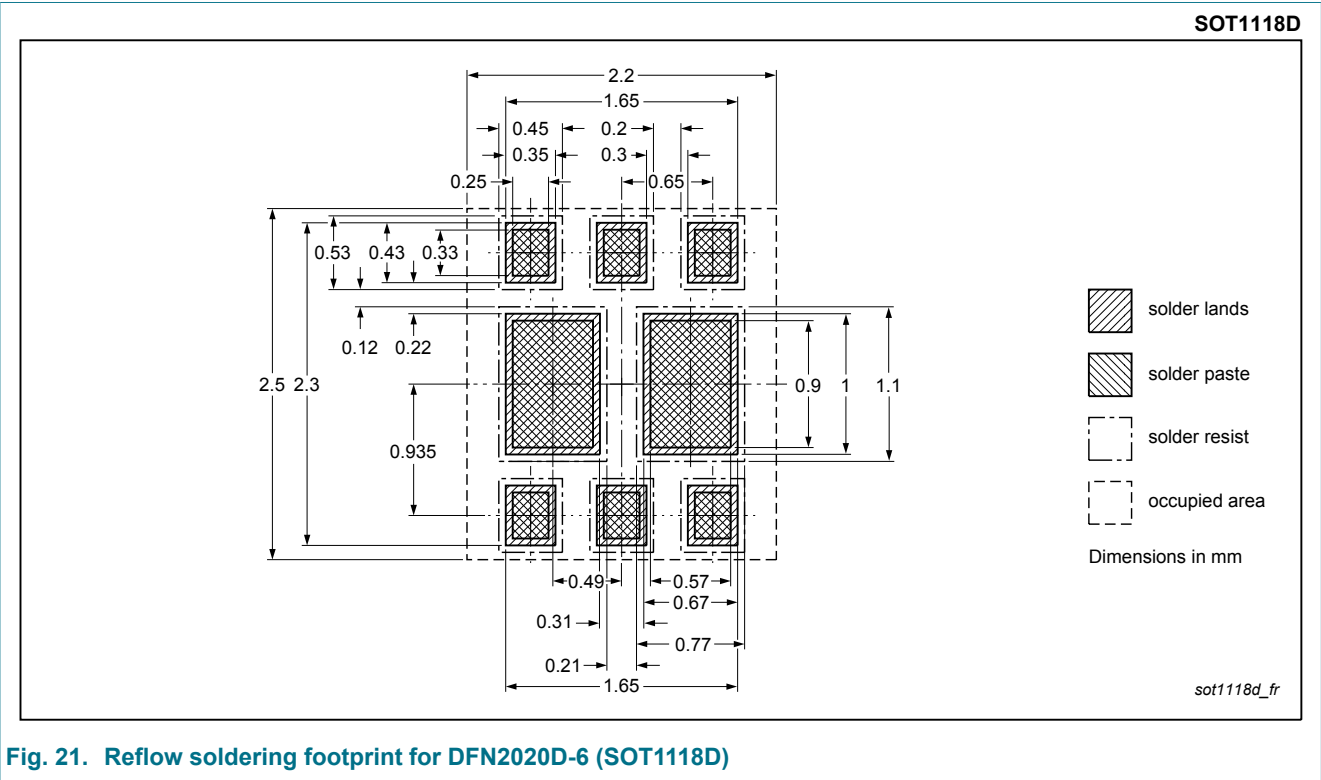


Fig. 20. Package outline DFN2020D-6 (SOT1118D)

12. Soldering



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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