

PBSS4230PANP

30 V, 2 A NPN/PNP low V_{CEsat} (BISS) transistor

14 December 2012

Product data sheet

1. General description

NPN/PNP low V_{CEsat} Breakthrough In Small Signal (BISS) transistor in a leadless medium power DFN2020-6 (SOT1118) Surface-Mounted Device (SMD) plastic package.

NPN/NPN complement: PBSS4230PAN. PNP/PNP complement: PBSS5230PAP.

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
- High efficiency due to less heat generation
- AEC-Q101 qualified

3. Applications

- Load switch
- 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
Per transistor; for the PNP transistor with negative polarity						
V_{CEO}	collector-emitter voltage	open base	-	-	30	V
I_C	collector current		-	-	2	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	3	A
TR1 (NPN)						
R_{CEsat}	collector-emitter saturation resistance	$I_C = 1$ A; $I_B = 100$ mA; pulsed; $t_p \leq 300$ μ s; $\delta \leq 0.02$; $T_{amb} = 25$ °C	-	-	145	m Ω



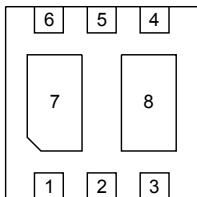
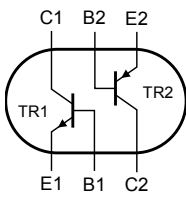
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR2 (PNP)						
R _{CEsat}	collector-emitter saturation resistance	I _C = -1 A; I _B = -100 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	-	-	195	mΩ

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E1	emitter TR1	 <p>Transparent top view DFN2020-6 (SOT1118)</p>	 <p><i>sym139</i></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
PBSS4230PANP	DFN2020-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm	SOT1118

7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS4230PANP	2J

8. Limiting values

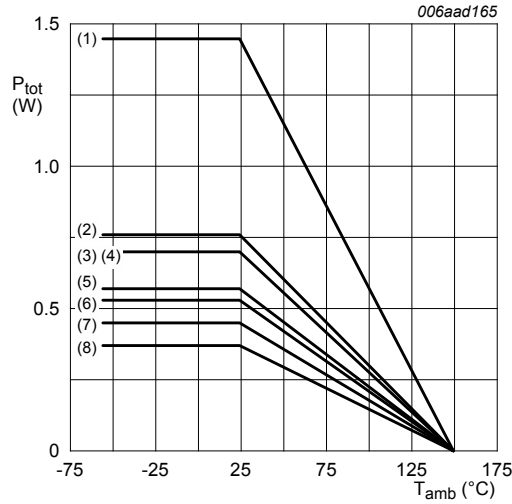
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
Per transistor; for the PNP transistor with negative polarity					
V _{CBO}	collector-base voltage	open emitter	-	30	V
V _{CEO}	collector-emitter voltage	open base	-	30	V

Symbol	Parameter	Conditions		Min	Max	Unit
V _{EBO}	emitter-base voltage	open collector		-	7	V
I _C	collector current			-	2	A
I _{CM}	peak collector current	single pulse; t _p ≤ 1 ms		-	3	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
			[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

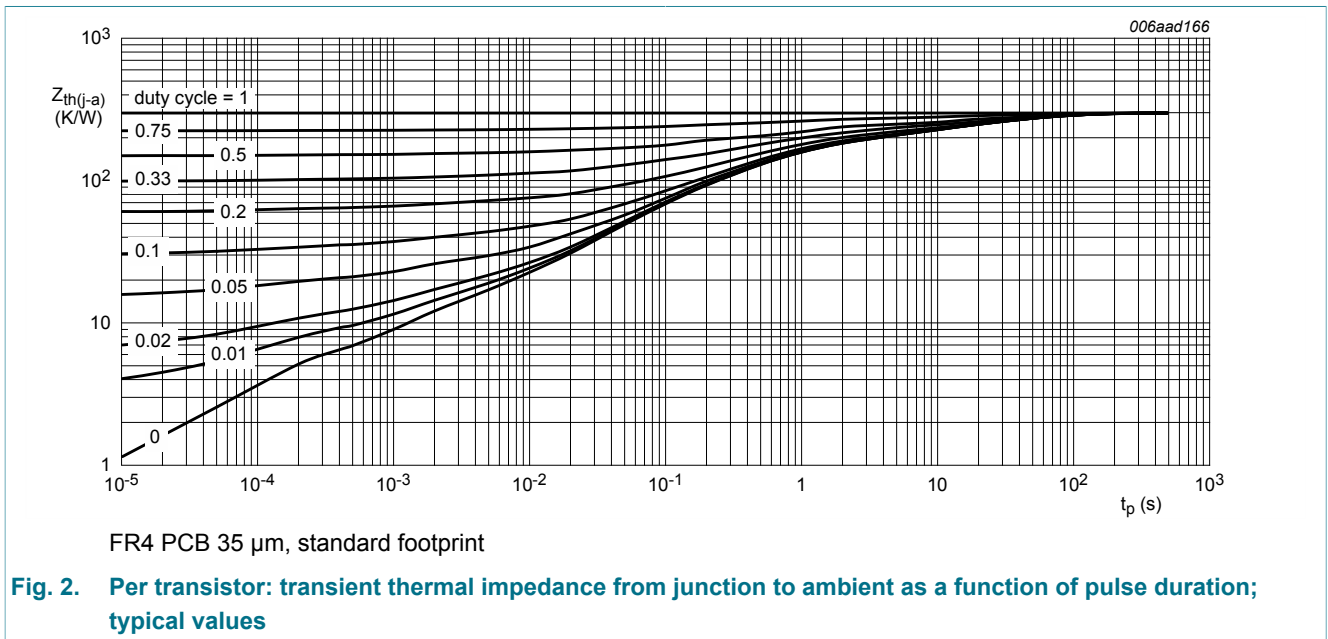
9. Thermal characteristics

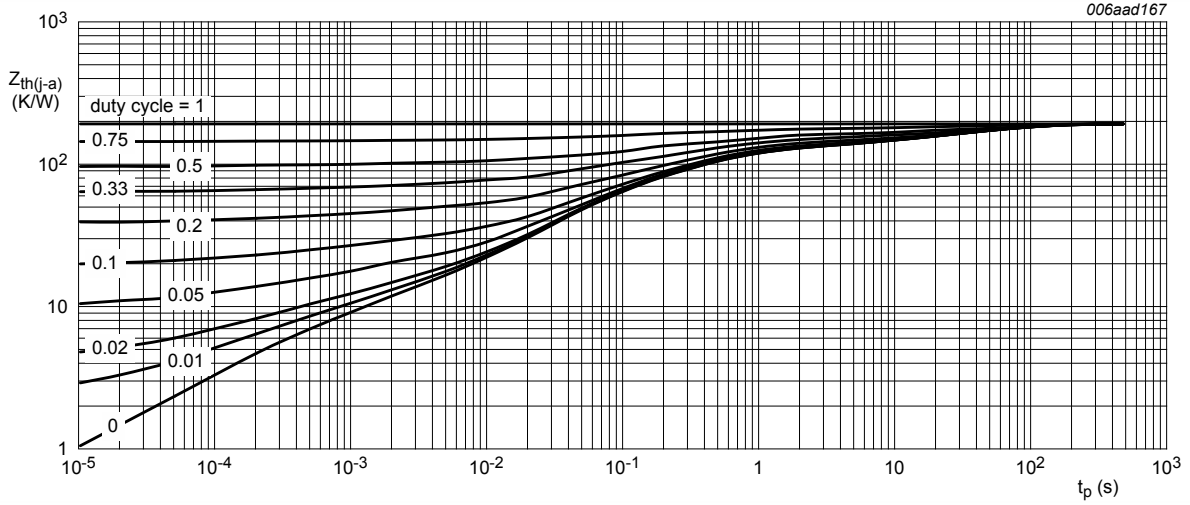
Table 6. Thermal characteristics

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

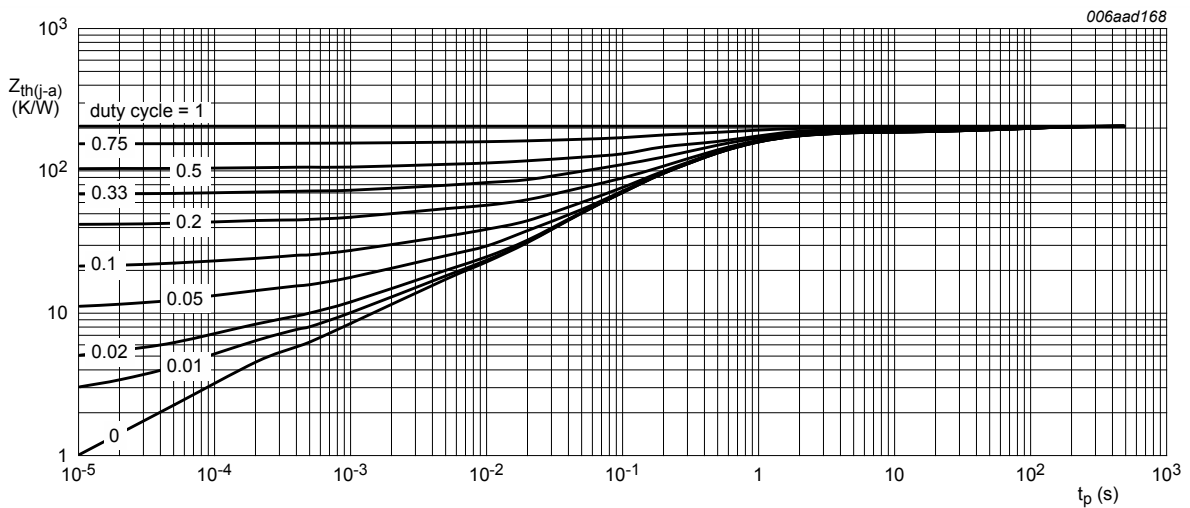
- [1] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
- [3] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated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





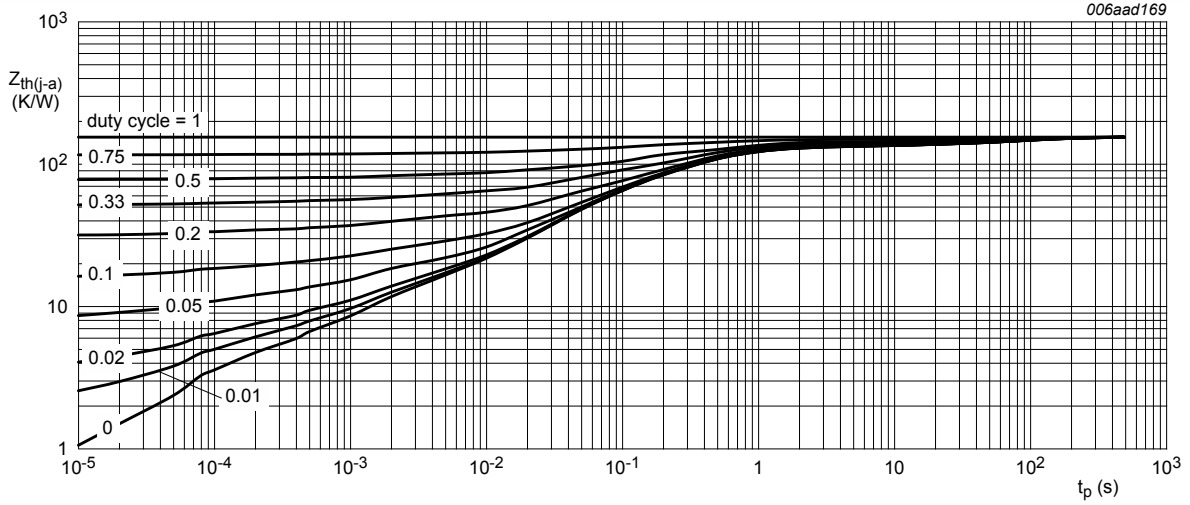
FR4 PCB 35 μm, mounting pad for collector 1 cm²

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



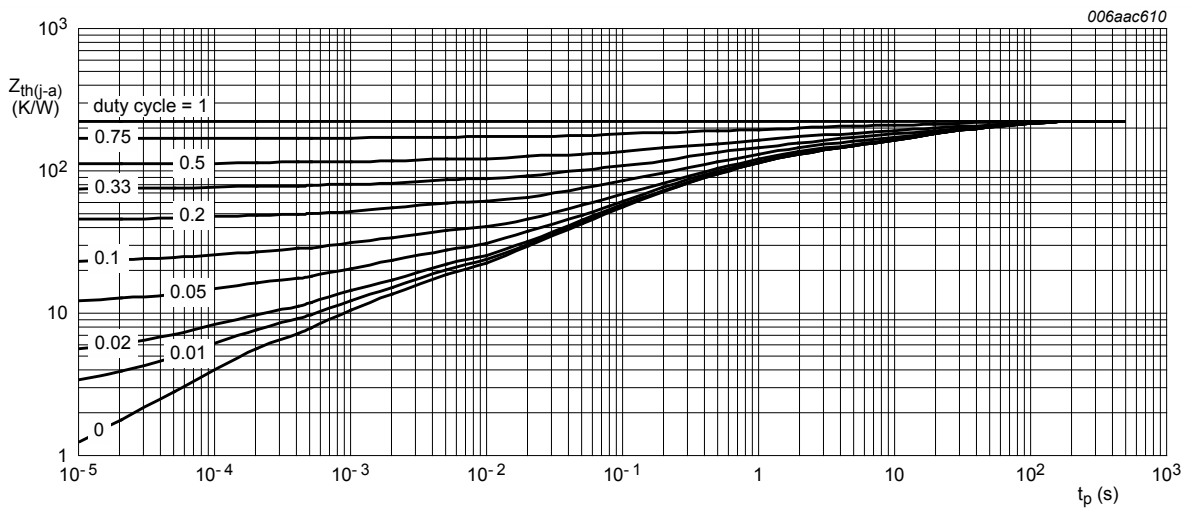
4-layer PCB 35 μm, standard footprint

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



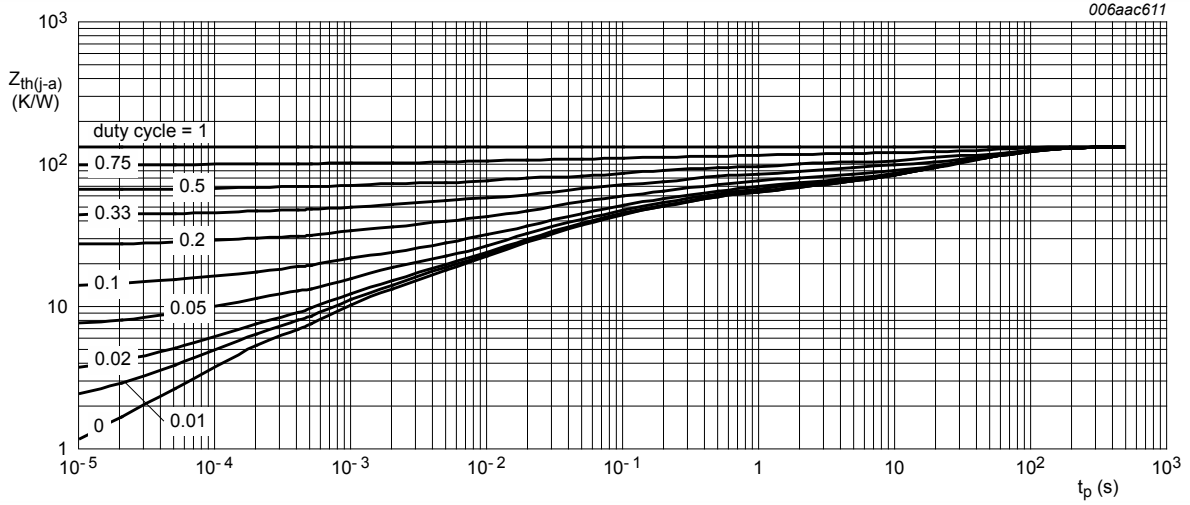
4-layer PCB 35 μ m, mounting pad for collector 1 cm²

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



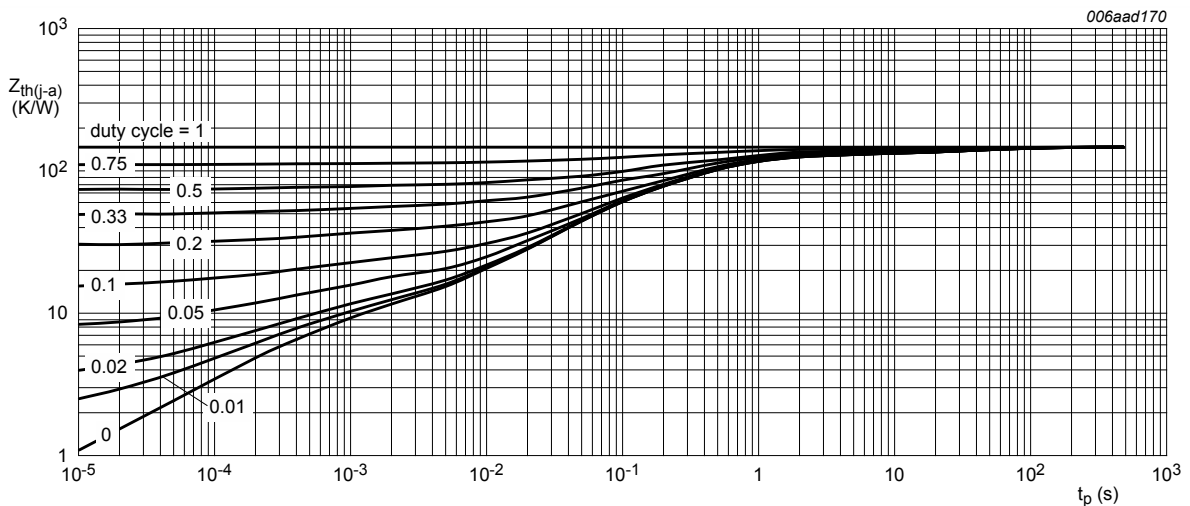
FR4 PCB 70 μ m, standard footprint

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



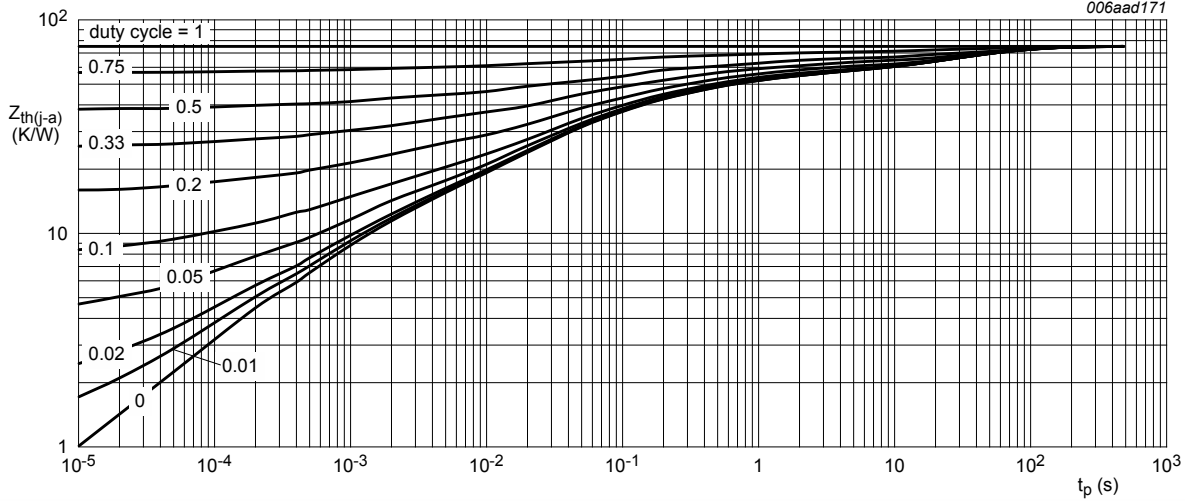
FR4 PCB 70 μ m, mounting pad for collector 1 cm²

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 cm²

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
TR1 (NPN)						
I _{CBO}	collector-base cut-off current	V _{CB} = 24 V; I _E = 0 A; T _{amb} = 25 °C	-	-	100	nA
		V _{CB} = 24 V; I _E = 0 A; T _j = 150 °C	-	-	50	μA
I _{EBO}	emitter-base cut-off current	V _{EB} = 5 V; I _C = 0 A; T _{amb} = 25 °C	-	-	100	nA
h _{FE}	DC current gain	V _{CE} = 2 V; I _C = 100 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	250	380	-	
		V _{CE} = 2 V; I _C = 500 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	230	350	-	
		V _{CE} = 2 V; I _C = 1 A; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	200	310	-	
		V _{CE} = 2 V; I _C = 2 A; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	150	230	-	
V _{CEsat}	collector-emitter saturation voltage	I _C = 500 mA; I _B = 50 mA; T _{amb} = 25 °C	-	60	80	mV
		I _C = 1 A; I _B = 50 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	-	120	160	mV
		I _C = 2 A; I _B = 100 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	-	230	300	mV
		I _C = 2 A; I _B = 200 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C	-	220	290	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{CEsat}	collector-emitter saturation resistance	$I_C = 1\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	145	m Ω
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
		$I_C = 1\text{ A}; I_B = 50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	1	V
		$I_C = 2\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	1.1	V
		$I_C = 2\text{ A}; I_B = 200\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-	1.2	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	$V_{CC} = 12.5\text{ V}; I_C = 1\text{ A}; I_{Bon} = 50\text{ mA};$ $I_{Boff} = -50\text{ mA}; T_{amb} = 25\text{ }^\circ\text{C}$	-	10	-	ns
t_r	rise time		-	50	-	ns
t_{on}	turn-on time		-	60	-	ns
t_s	storage time		-	310	-	ns
t_f	fall time		-	60	-	ns
t_{off}	turn-off time		-	370	-	ns
f_T	transition frequency		$V_{CE} = 10\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz};$ $T_{amb} = 25\text{ }^\circ\text{C}$	60	120	-
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	18	pF
TR2 (PNP)						
I_{CBO}	collector-base cut-off current	$V_{CB} = -24\text{ V}; I_E = 0\text{ A}$	-	-	-100	nA
		$V_{CB} = -24\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^\circ\text{C}$	-	-	-50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = -5\text{ V}; I_C = 0\text{ A}$	-	-	-100	nA
h_{FE}	DC current gain	$V_{CE} = -2\text{ V}; I_C = -100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	260	370	-	
		$V_{CE} = -2\text{ V}; I_C = -500\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	210	290	-	
		$V_{CE} = -2\text{ V}; I_C = -1\text{ A};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	160	230	-	
		$V_{CE} = -2\text{ V}; I_C = -2\text{ A};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	100	145	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -500\text{ mA}; I_B = -50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-75	-110	mV
		$I_C = -1\text{ A}; I_B = -50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	-	-155	-220	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$I_C = -2\text{ A}; I_B = -100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-295	-420	mV
		$I_C = -2\text{ A}; I_B = -200\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-275	-390	mV
R_{CEsat}	collector-emitter saturation resistance	$I_C = -1\text{ A}; I_B = -100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	195	m Ω
V_{BEsat}	base-emitter saturation voltage	$I_C = -500\text{ mA}; I_B = -50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	-1	V
		$I_C = -1\text{ A}; I_B = -50\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	-1	V
		$I_C = -2\text{ A}; I_B = -100\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	-1.1	V
		$I_C = -2\text{ A}; I_B = -200\text{ mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	-1.2	V
V_{BEon}	base-emitter turn-on voltage	$V_{\text{CE}} = -2\text{ V}; I_C = -0.5\text{ A};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	-	-0.9	V
t_d	delay time	$V_{\text{CC}} = -12.5\text{ V}; I_C = -1\text{ A}; I_{\text{Bon}} = -0.05\text{ A};$ $I_{\text{Boff}} = 0.05\text{ A}; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	10	-	ns
t_r	rise time		-	50	-	ns
t_{on}	turn-on time		-	60	-	ns
t_s	storage time		-	200	-	ns
t_f	fall time		-	45	-	ns
t_{off}	turn-off time		-	245	-	ns
f_T	transition frequency		$V_{\text{CE}} = -10\text{ V}; I_C = -50\text{ mA}; f = 100\text{ MHz};$ $T_{\text{amb}} = 25\text{ }^\circ\text{C}$	50	95	-
C_c	collector capacitance	$V_{\text{CB}} = -10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A};$ $f = 1\text{ MHz}; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	22	29	pF

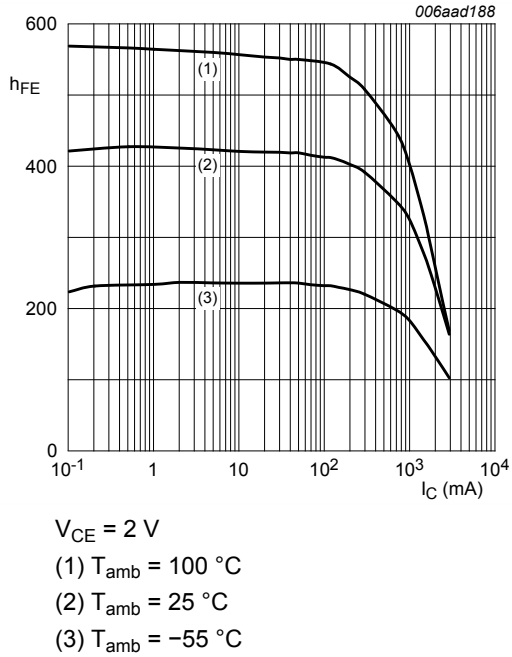


Fig. 10. TR1 (NPN): DC current gain as a function of collector current; typical values

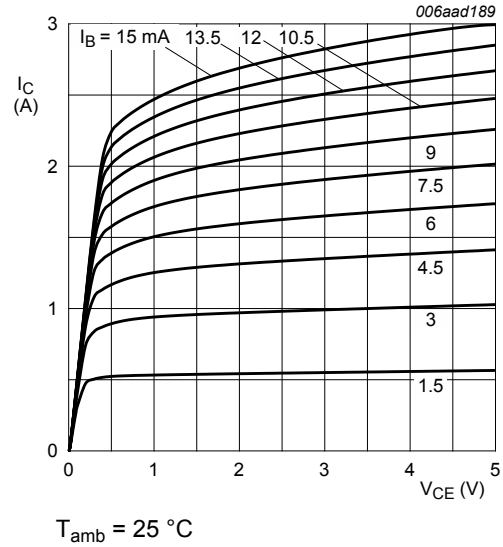


Fig. 11. TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values

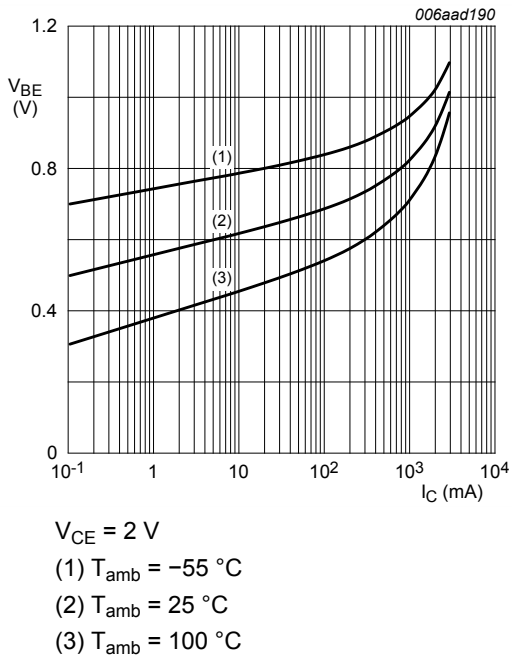


Fig. 12. TR1 (NPN): Base-emitter voltage as a function of collector current; typical values

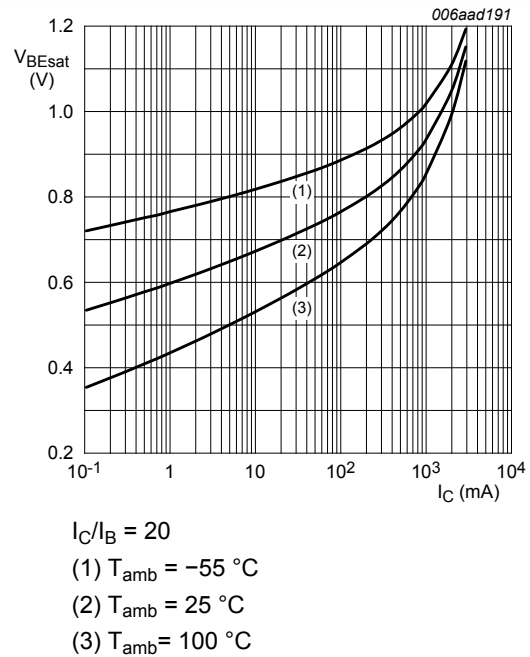
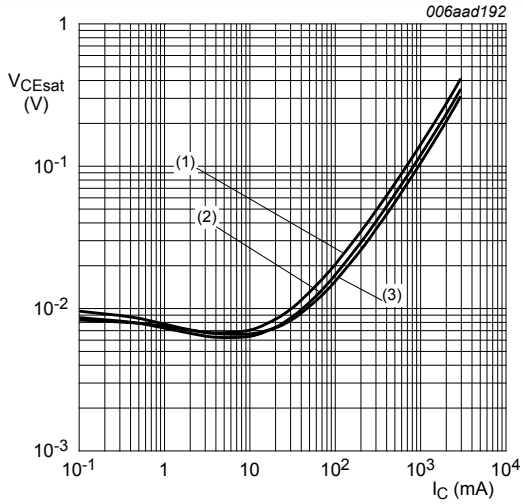
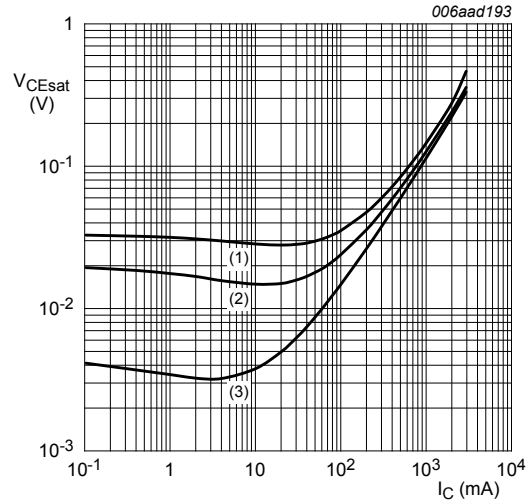


Fig. 13. TR1 (NPN): Base-emitter saturation voltage as a function of collector current; typical values



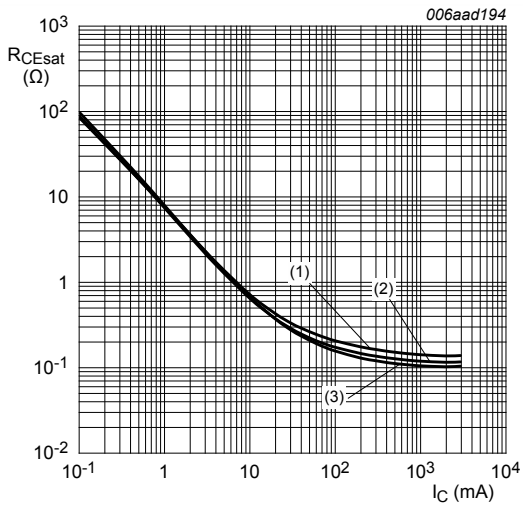
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -55\text{ }^\circ\text{C}$

Fig. 14. TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values



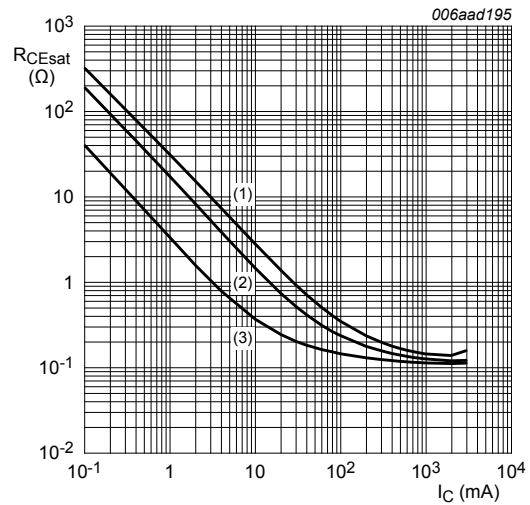
$T_{amb} = 25\text{ }^\circ\text{C}$
 (1) $I_C/I_B = 100$
 (2) $I_C/I_B = 50$
 (3) $I_C/I_B = 10$

Fig. 15. TR1 (NPN): 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. TR1 (NPN): 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. TR1 (NPN): Collector-emitter saturation resistance as a function of collector current; typical values

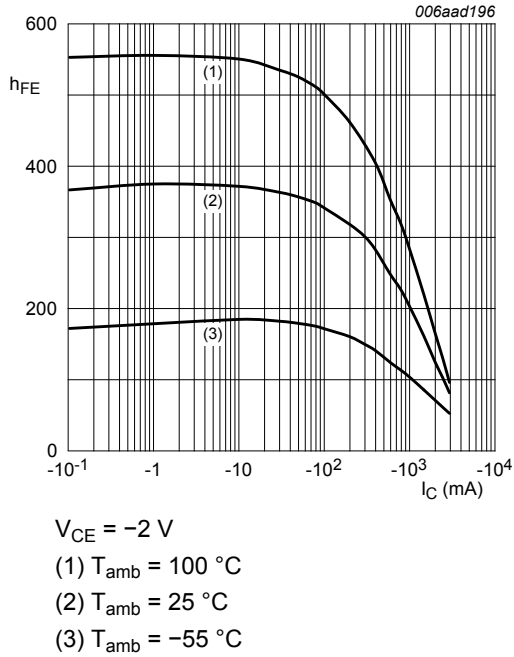


Fig. 18. TR2 (PNP): DC current gain as a function of collector current; typical values

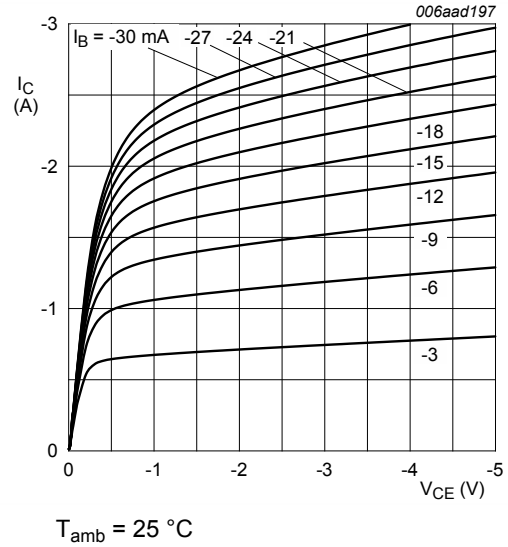


Fig. 19. TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values

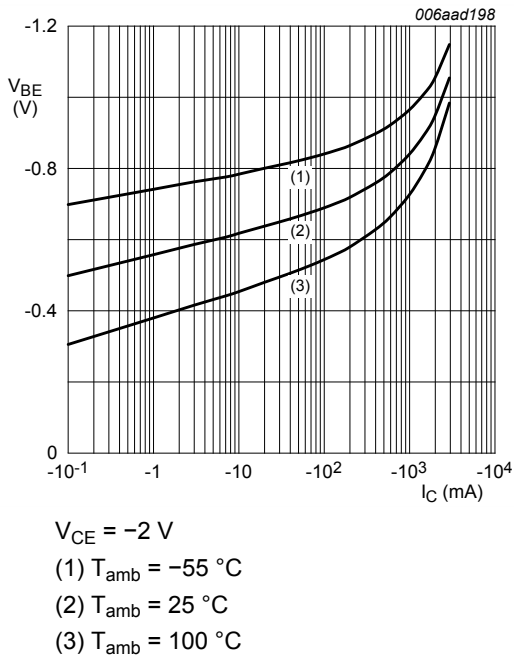


Fig. 20. TR2 (PNP): Base-emitter voltage as a function of collector current; typical values

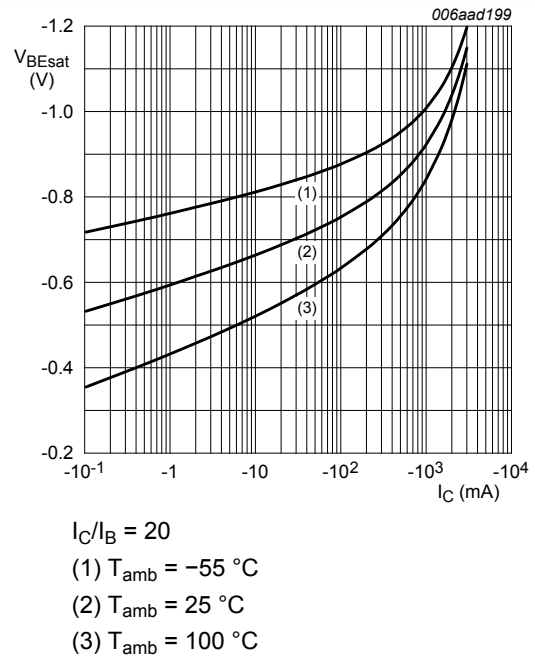
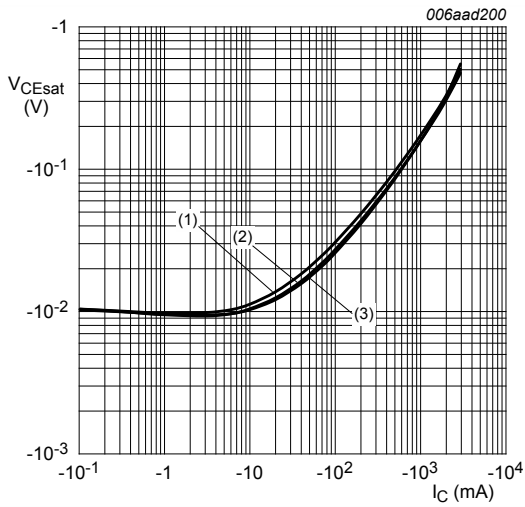
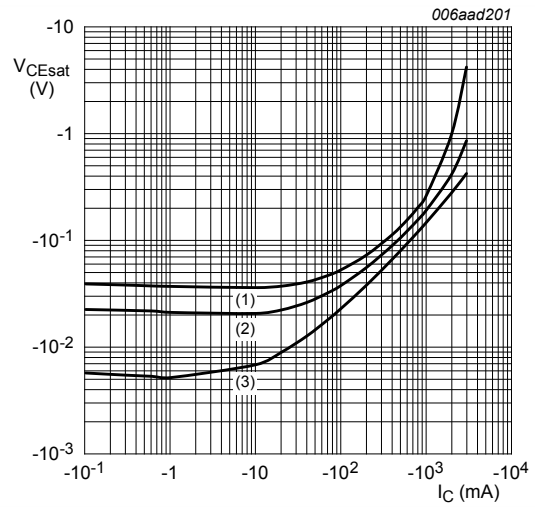


Fig. 21. TR2 (PNP): Base-emitter saturation voltage as a function of collector current; typical values



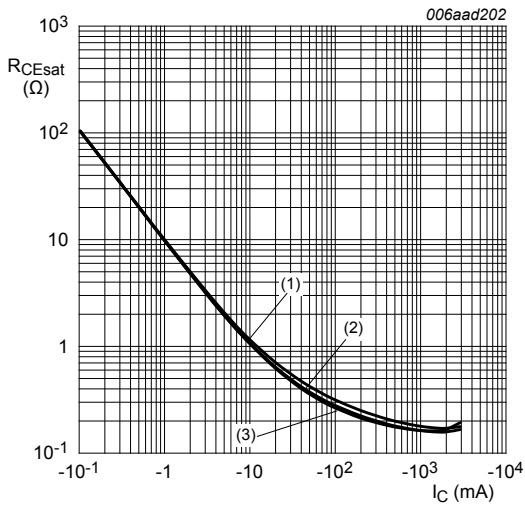
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -55\text{ °C}$

Fig. 22. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



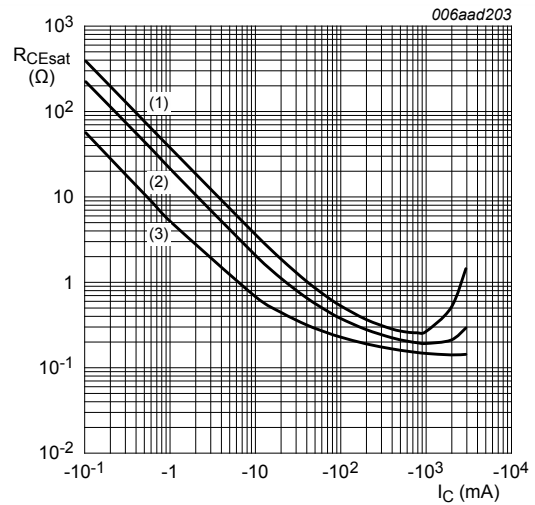
$T_{amb} = 25\text{ °C}$
 (1) $I_C/I_B = 100$
 (2) $I_C/I_B = 50$
 (3) $I_C/I_B = 10$

Fig. 23. TR2 (PNP): 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. 24. TR2 (PNP): 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. 25. TR2 (PNP): Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

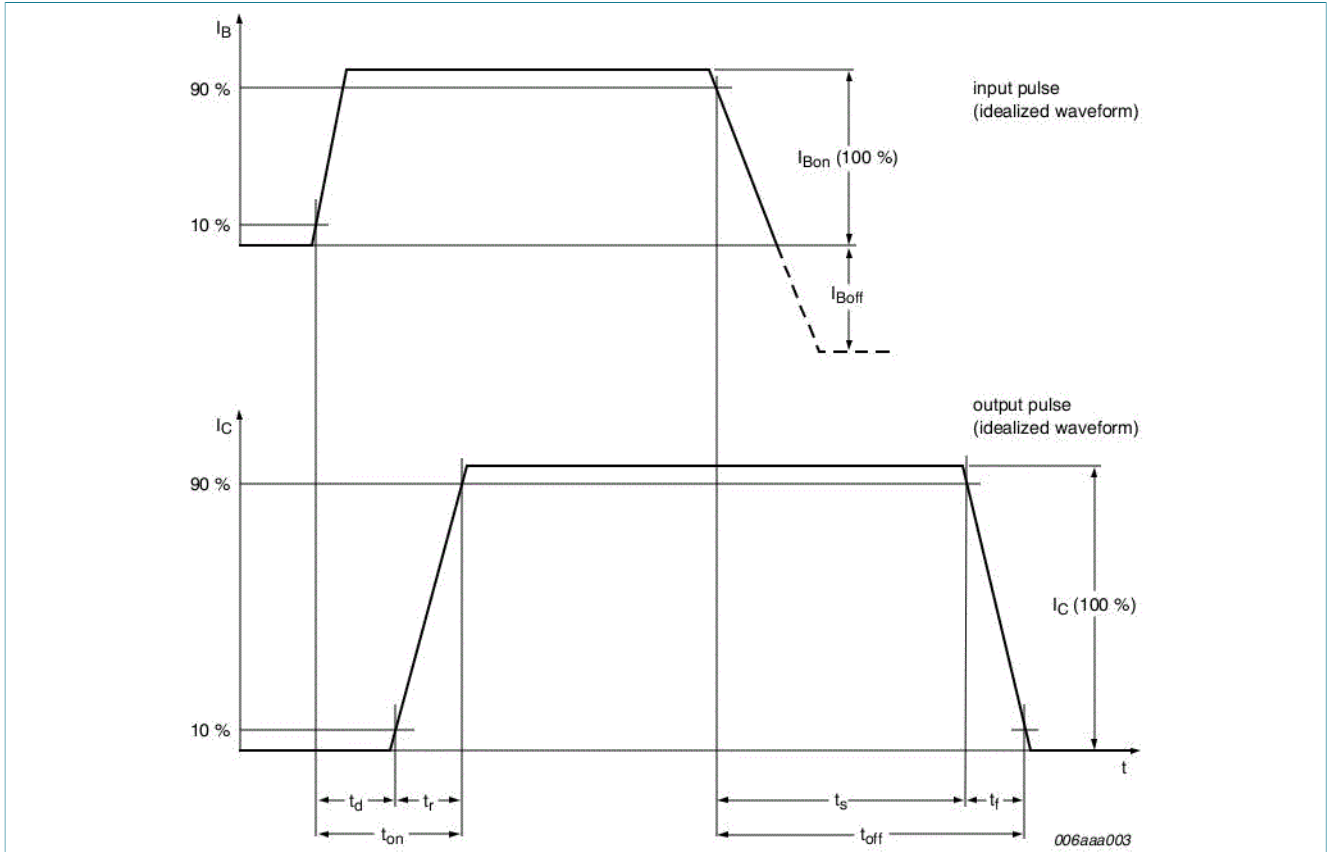


Fig. 26. TR1 (NPN): BISS transistor switching time definition

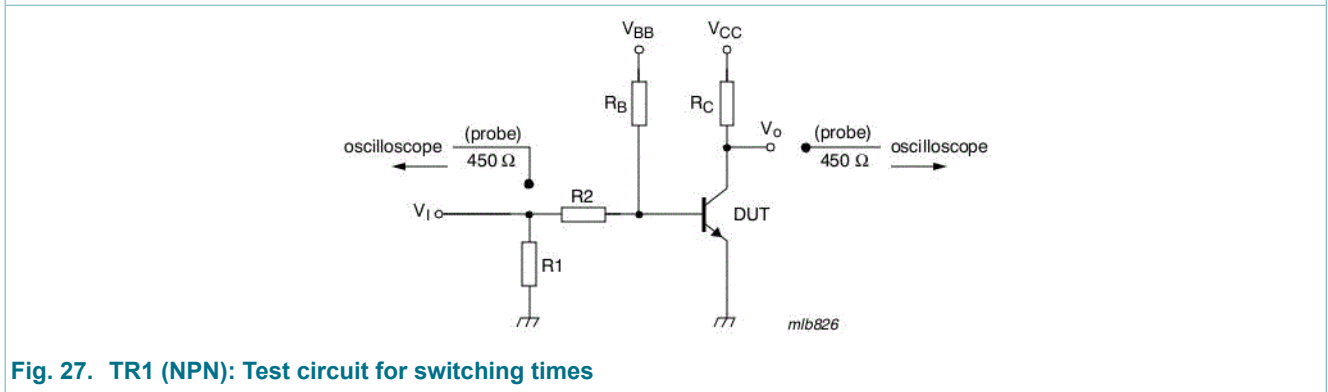


Fig. 27. TR1 (NPN): Test circuit for switching times

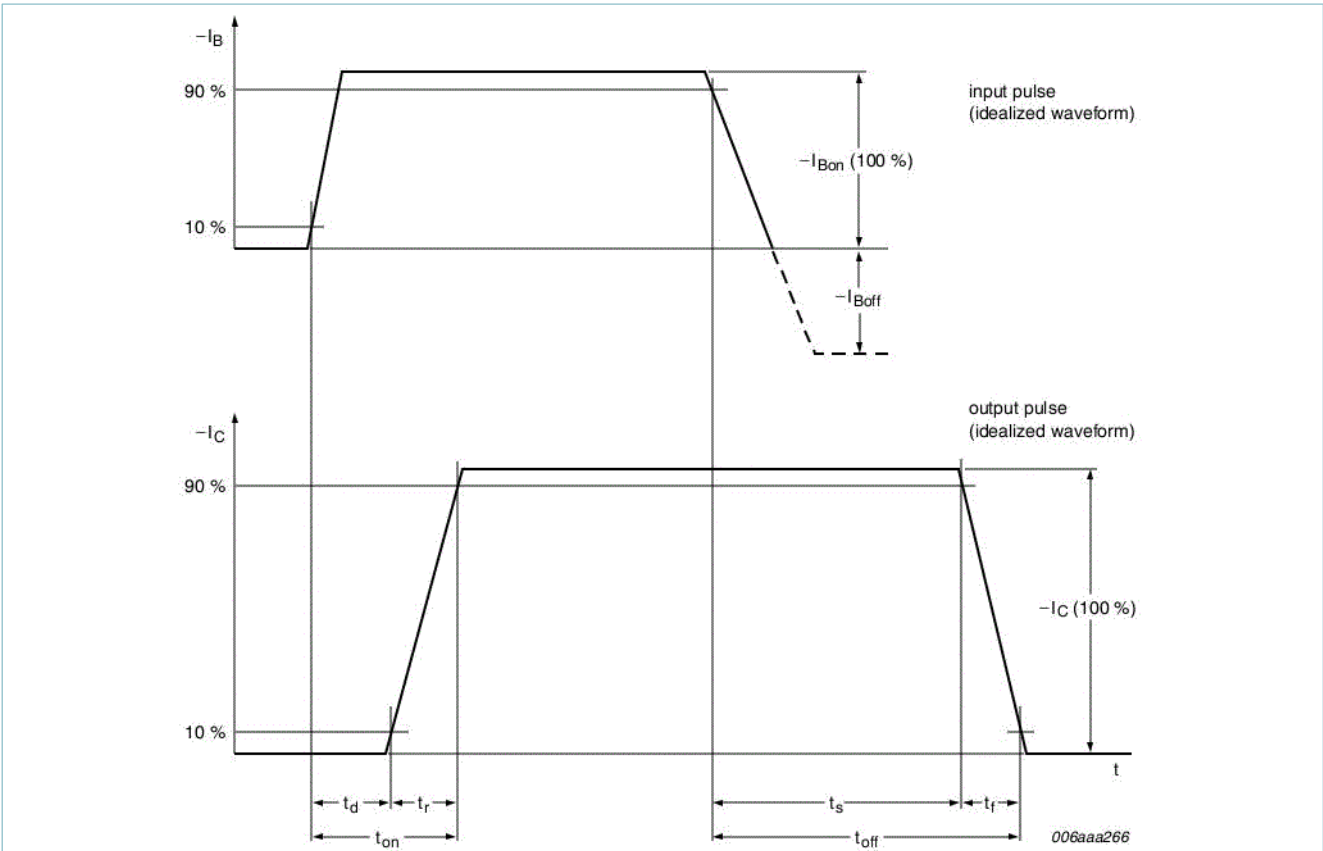


Fig. 28. TR2 (PNP): BISS transistor switching time definition

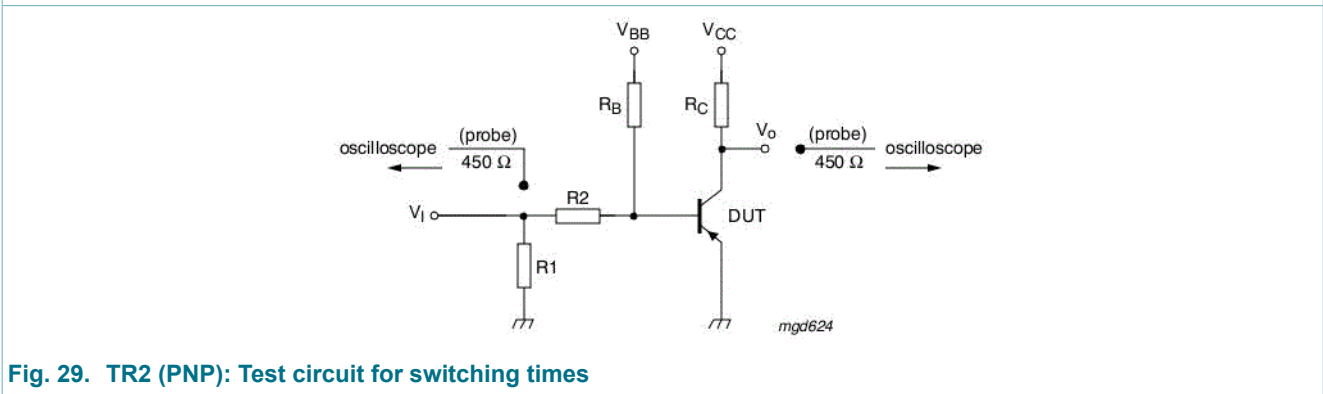


Fig. 29. TR2 (PNP): Test circuit for switching times

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

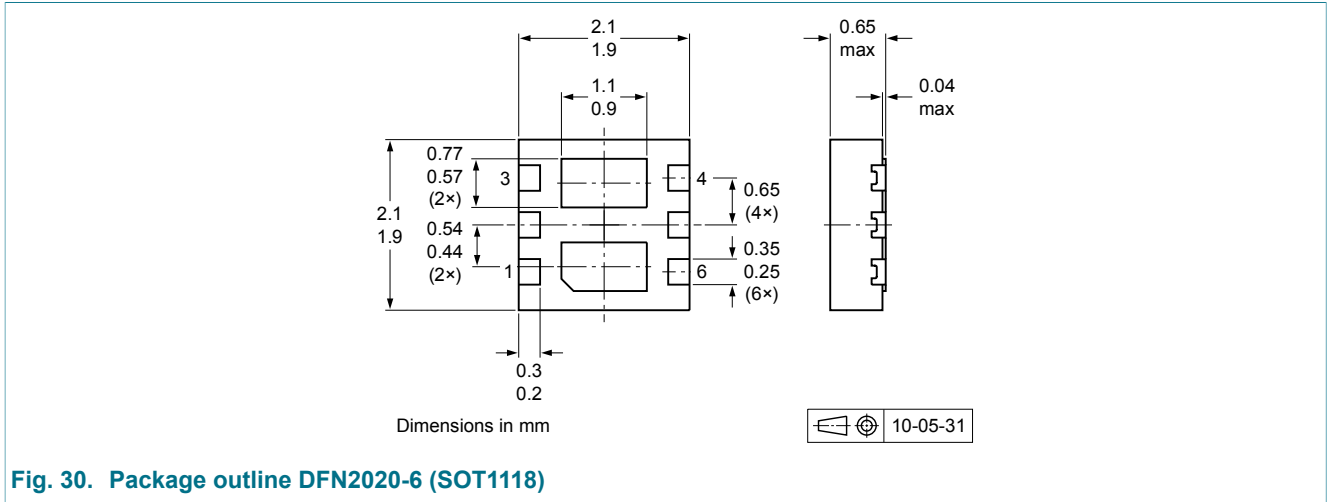


Fig. 30. Package outline DFN2020-6 (SOT1118)

13. Soldering

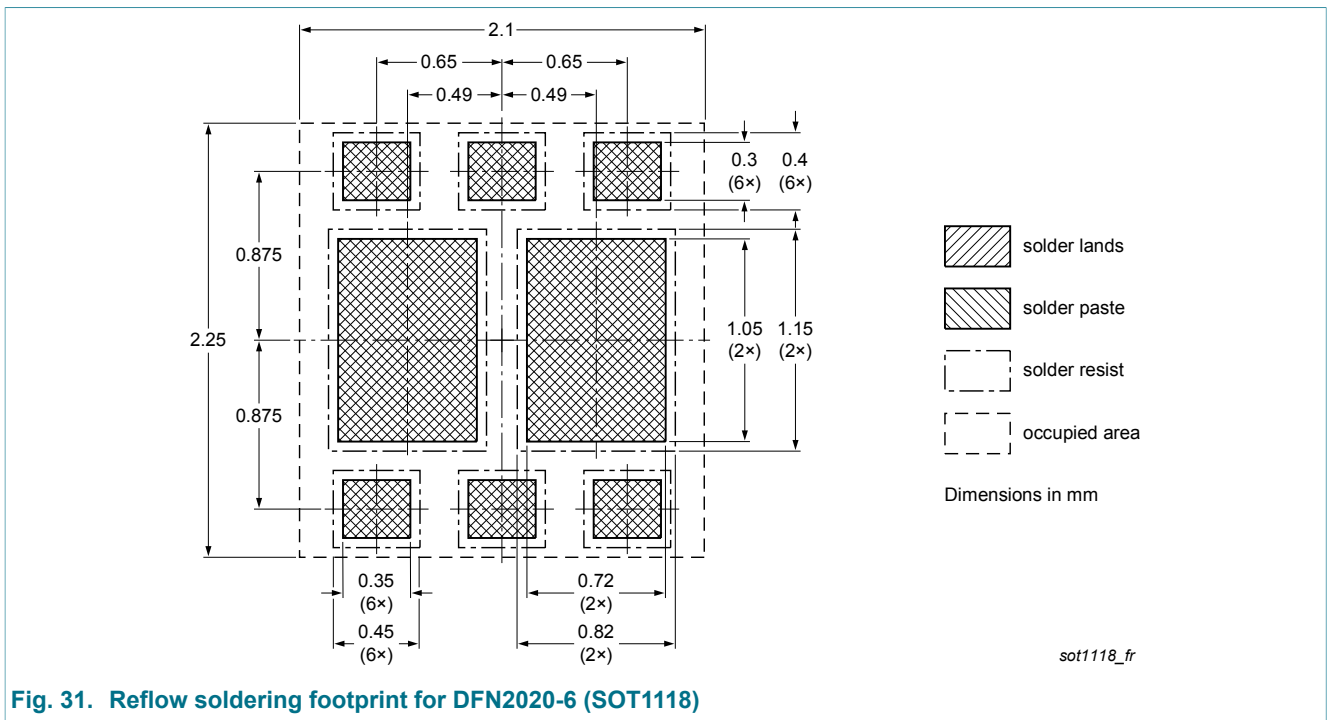


Fig. 31. Reflow soldering footprint for DFN2020-6 (SOT1118)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4230PANP v.1	20121214	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".
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