



PIMC31PA

50 V, 500 mA NPN/PNP Resistor-Equipped double Transistor;
R1 = 1 k Ω , R2 = 10 k Ω

31 August 2023

Product data sheet

1. General description

NPN/PNP Resistor-Equipped double Transistor (RET) in a medium power SOT1118 (DFN2020-6) leadless Surface-Mounted Device (SMD) plastic package.

NPN/NPN complement: PIMN31PA

PNP/PNP complement: PIMP31PA

2. Features and benefits

- 500 mA output current capability
- Built-in resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs

3. Applications

- Digital applications
- Cost-saving alternative to BC807 / BC817 series in digital applications
- Control of IC inputs
- Switching loads

4. Quick reference data

Table 1. Quick reference data

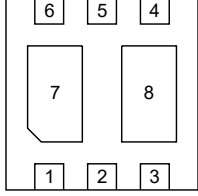
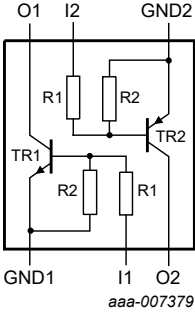
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per transistor							
V _{CEO}	collector-emitter voltage	open base	[1]	-	-	50	V
I _O	output current		[1]	-	-	500	mA
R1	bias resistor 1 (input)	T _{amb} = 25 °C	[2]	0.7	1	1.3	k Ω
R2/R1	bias resistor ratio		[2]	9	10	11	

[1] For the PNP transistor with negative polarity.

[2] See section "Test information" for resistor calculation and test conditions.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1	 <p>Transparent top view DFN2020-6 (SOT1118)</p>	 <p>aaa-007379</p>
2	I1	input (base) TR1		
3	O2	output (collector) TR2		
4	GND2	GND (emitter) TR2		
5	I2	input (base) TR2		
6	O1	output (collector) TR1		
7	O1	output (collector) TR1		
8	O2	output (collector) TR2		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PIMC31PA	DFN2020-6	plastic, leadless thermal enhanced ultra thin small outline package; no leads; 6 terminals; 0.65 mm pitch; 2 mm x 2 mm x 0.65 mm body	SOT1118

7. Marking

Table 4. Marking codes

Type number	Marking code
PIMC31PA	8E

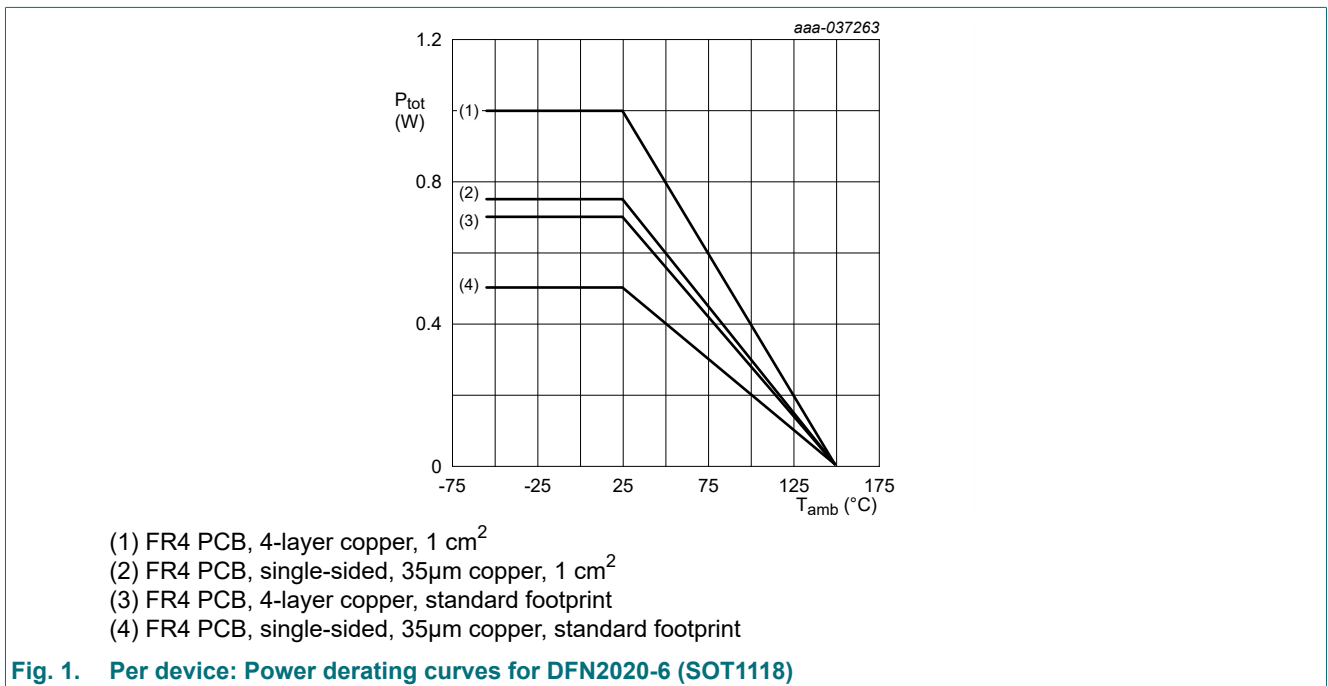
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
Per transistor						
V _{CBO}	collector-base voltage	open emitter	[1]	-	50	V
V _{CEO}	collector-emitter voltage	open base	[1]	-	50	V
V _{EBO}	emitter-base voltage	open collector	[1]	-	5	V
V _I	input voltage		[1]	-5	10	V
I _O	output current		[1]	-	500	mA
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[2]	-	360	mW
			[3]	-	550	mW
			[4]	-	510	mW
			[5]	-	730	mW
Per device						
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[2]	-	500	mW
			[3]	-	750	mW
			[4]	-	700	mW
			[5]	-	1	W
T _j	junction temperature			-	150	°C
T _{amb}	ambient temperature			-55	150	°C
T _{stg}	storage temperature			-65	150	°C

- [1] For the PNP transistor with negative polarity.
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 μm copper, tin-plated and standard footprint.
- [3] Device mounted on an FR4 PCB, single-sided, 35μm copper, tin-plated; mounting pad for collector 1 cm².
- [4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.
- [5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated; mounting pad for collector 1 cm².

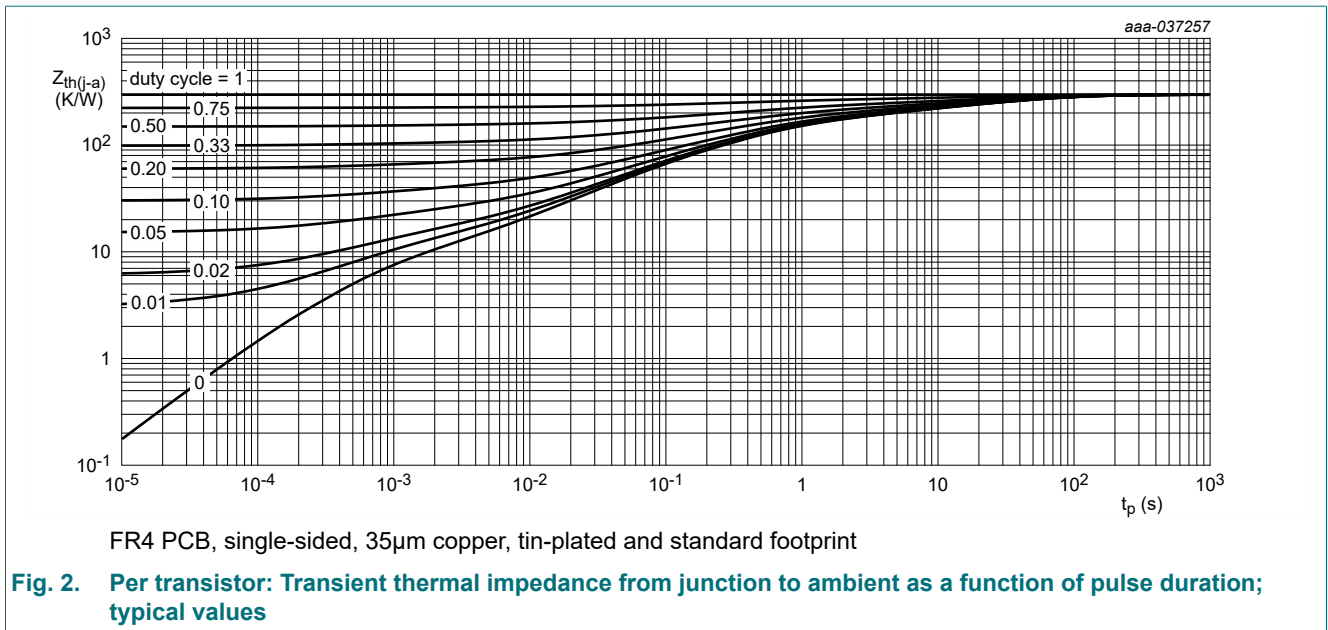


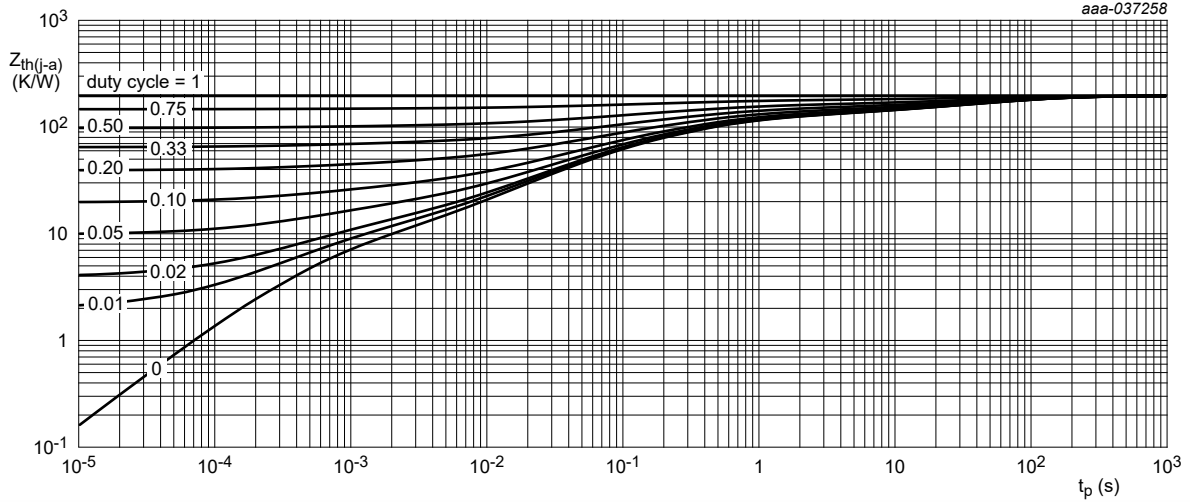
9. Thermal characteristics

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]	-	-	348	K/W
			[2]	-	-	228	K/W
			[3]	-	-	246	K/W
			[4]	-	-	172	K/W
Per device							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	250	K/W
			[2]	-	-	167	K/W
			[3]	-	-	179	K/W
			[4]	-	-	125	K/W

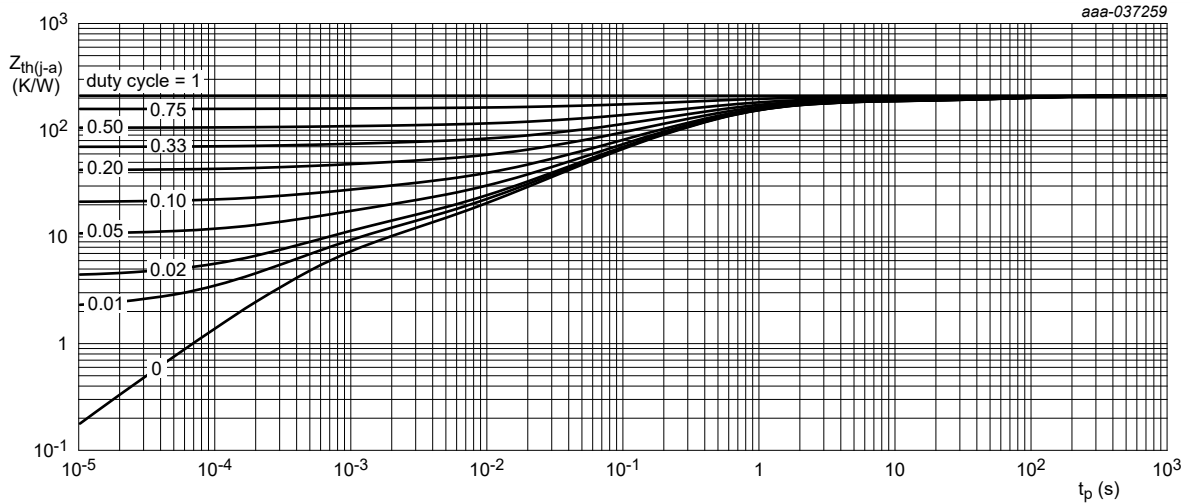
- [1] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated; mounting pad for collector 1 cm².
- [3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.
- [4]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





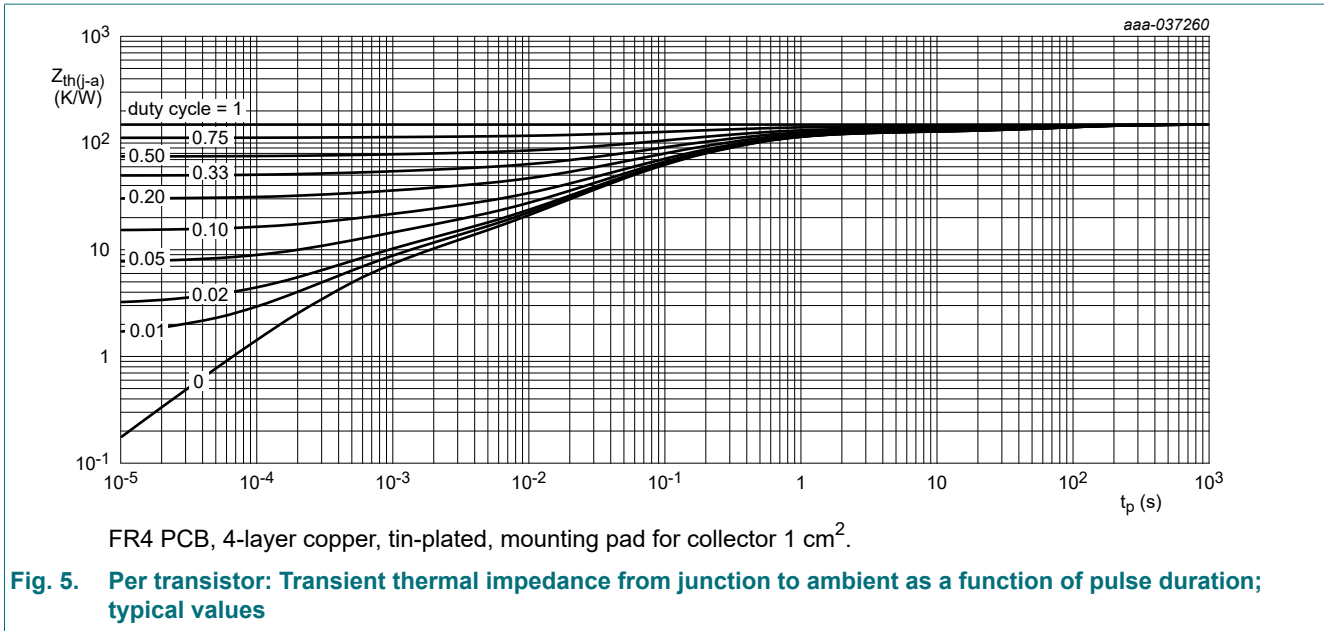
FR4 PCB, single-sided, 35μm copper, tin-plated, mounting pad for collector 1 cm².

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



FR4 PCB, 4-layer copper, tin-plated and standard footprint.

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



10. Characteristics

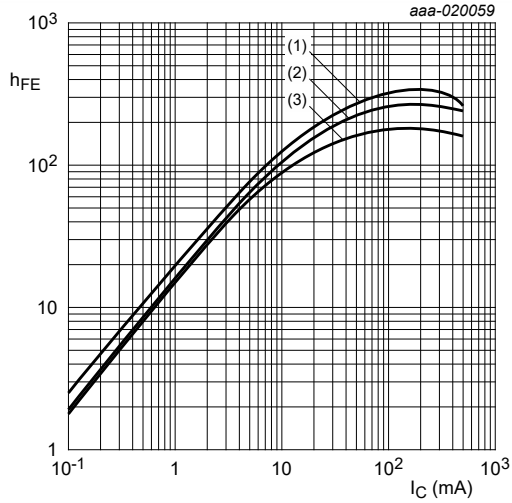
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per transistor							
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu A; I_E = 0 A; T_{amb} = 25 \text{ }^\circ C$	[1]	50	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10 \text{ mA}; I_B = 0 A; T_{amb} = 25 \text{ }^\circ C$	[1]	50	-	-	V
I_{CBO}	collector-base cut-off current	$V_{CB} = 50 \text{ V}; I_E = 0 A; T_{amb} = 25 \text{ }^\circ C$	[1]	-	-	100	nA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 50 \text{ V}; I_B = 0 A; T_{amb} = 25 \text{ }^\circ C$	[1]	-	-	0.5	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5 \text{ V}; I_C = 0 A; T_{amb} = 25 \text{ }^\circ C$	[1]	-	-	0.72	mA
h_{FE}	DC current gain	$V_{CE} = 5 \text{ V}; I_C = 50 \text{ mA}; T_{amb} = 25 \text{ }^\circ C$	[1]	70	-	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 50 \text{ mA}; I_B = 2.5 \text{ mA}; T_{amb} = 25 \text{ }^\circ C$	[1]	-	-	100	mV
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5 \text{ V}; I_C = 100 \mu A; T_{amb} = 25 \text{ }^\circ C$	[1]	0.3	0.6	1	V
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3 \text{ V}; I_C = 20 \text{ mA}; T_{amb} = 25 \text{ }^\circ C$	[1]	0.4	0.8	1.4	V
R1	bias resistor 1 (input)	$T_{amb} = 25 \text{ }^\circ C$	[2]	0.7	1	1.3	kΩ
R2/R1	bias resistor ratio		[2]	9	10	11	
TR1 (NPN)							
C_c	collector capacitance	$V_{CB} = 10 \text{ V}; I_E = 0 A; i_e = 0 A; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ C$		-	5	-	pF
f_T	transition frequency	$V_{CE} = 5 \text{ V}; I_C = 50 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^\circ C$	[3]	-	210	-	MHz
TR2 (PNP)							
C_c	collector capacitance	$V_{CB} = -10 \text{ V}; I_E = 0 A; i_e = 0 A; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ C$		-	7	-	pF
f_T	transition frequency	$V_{CE} = -5 \text{ V}; I_C = -50 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^\circ C$	[3]	-	150	-	MHz

[1] For the PNP transistor with negative polarity.

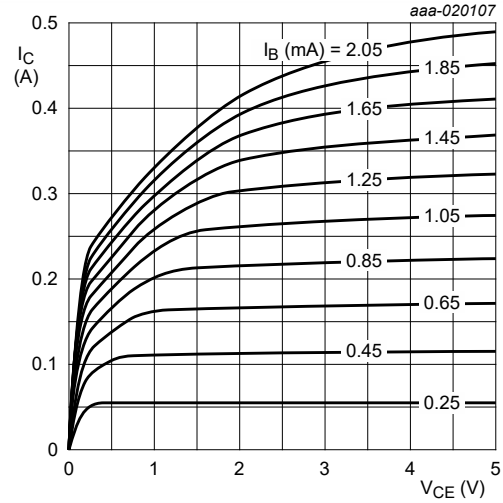
[2] See section "Test information" for resistor calculation and test conditions.

[3] Characteristics of built-in transistor.



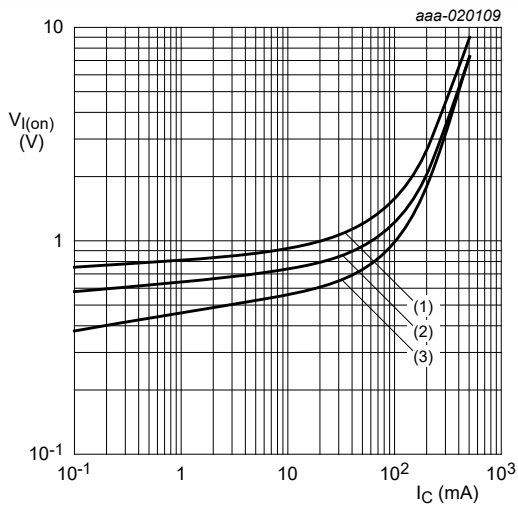
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -40\text{ }^\circ\text{C}$

Fig. 6. TR1 (NPN): DC current gain as a function of collector current; typical values



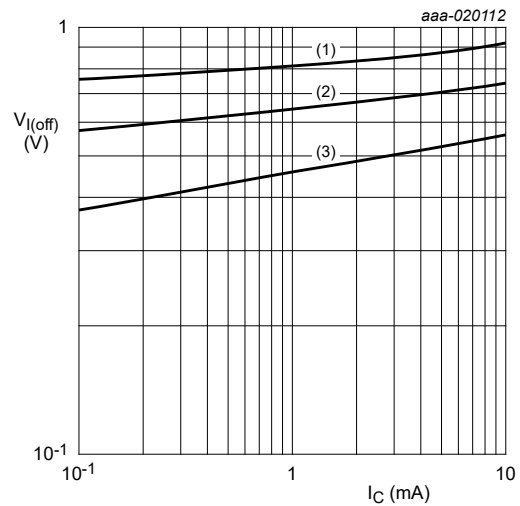
$T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 7. TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values



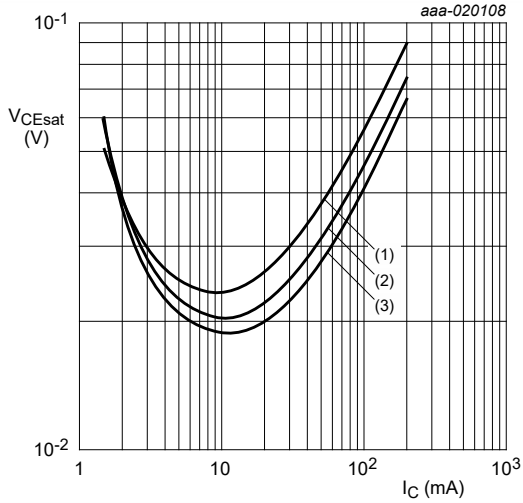
$V_{CE} = 0.3\text{ V}$
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = 100\text{ }^\circ\text{C}$

Fig. 8. TR1 (NPN): On-state input voltage as a function of collector current; typical values



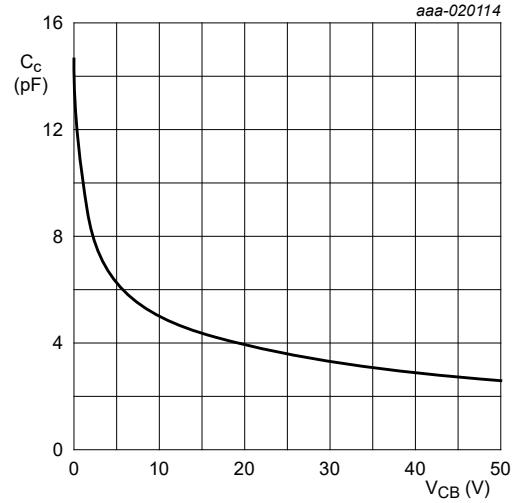
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = 100\text{ }^\circ\text{C}$

Fig. 9. TR1 (NPN): Off-state input voltage as a function of collector current; typical values



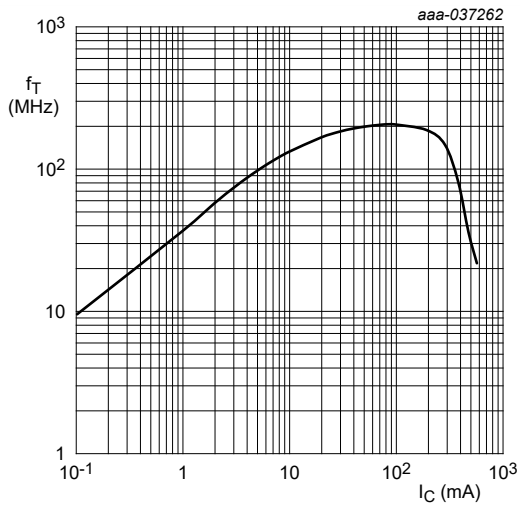
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -40\text{ }^\circ\text{C}$

Fig. 10. TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values



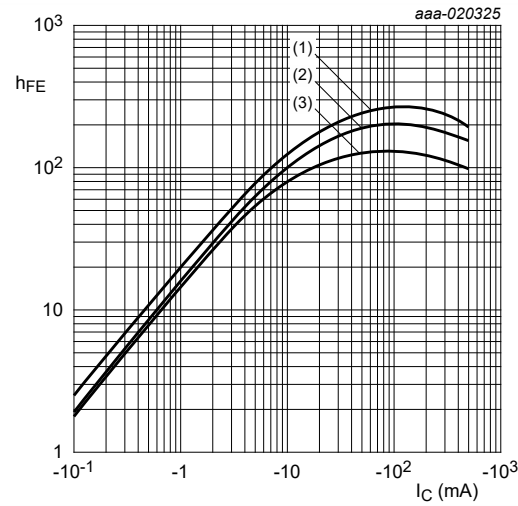
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ }^\circ\text{C}$

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



$f = 100\text{ MHz}$; $V_{CE} = -5\text{ V}$ $T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 12. TR2 (NPN): Transition frequency as a function of collector current; typical values of built-in transistor



$V_{CE} = -5\text{ V}$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -40\text{ }^\circ\text{C}$

Fig. 13. TR2 (PNP): DC current gain as a function of collector current; typical values

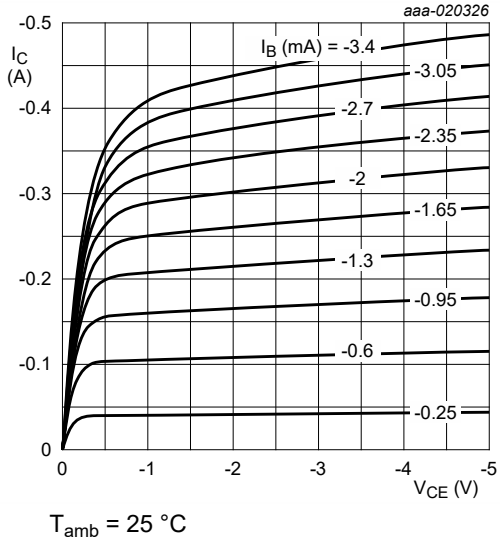


Fig. 14. TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values

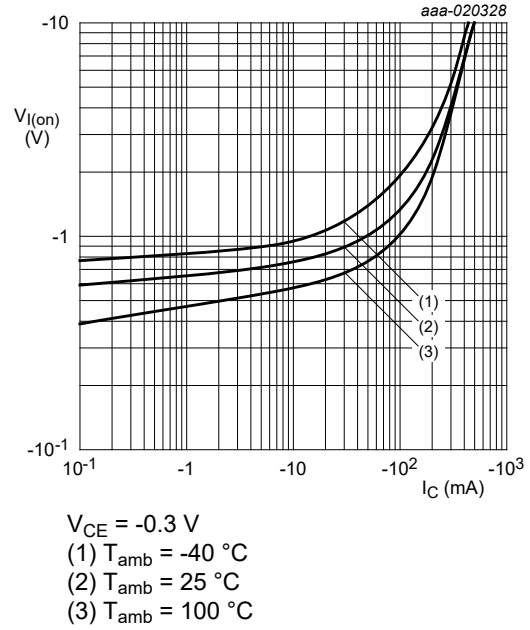


Fig. 15. TR2 (PNP): On-state input voltage as a function of collector current; typical values

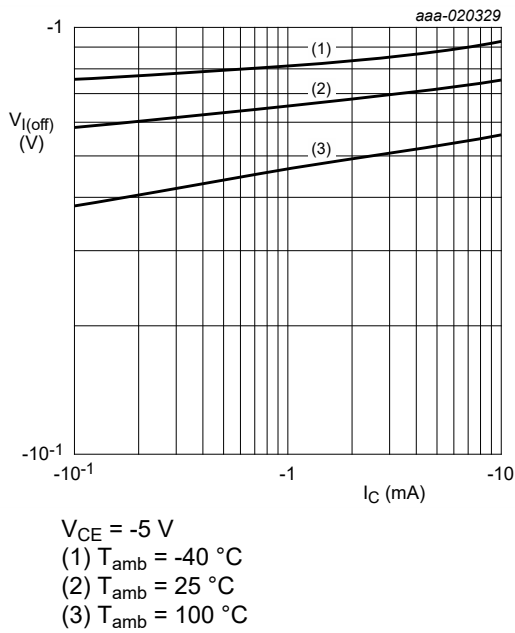


Fig. 16. TR2 (PNP): Off-state input voltage as a function of collector current; typical values

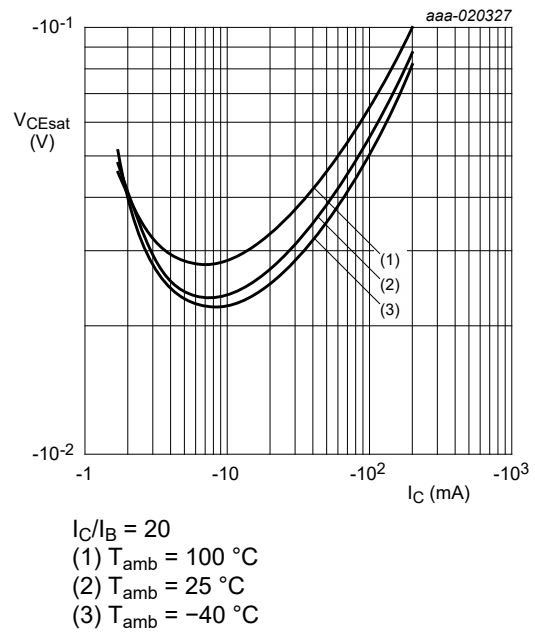
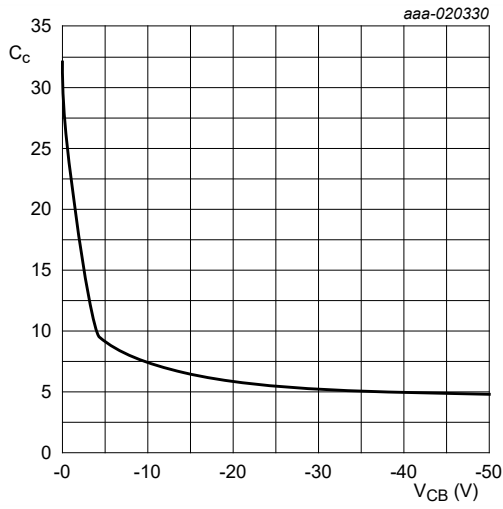
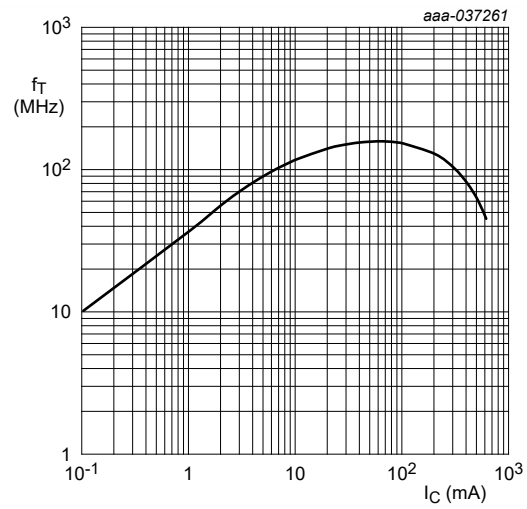


Fig. 17. TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



$f = 1 \text{ MHz}$
 $T_{amb} = 25 \text{ }^\circ\text{C}$

Fig. 18. TR2 (PNP): Collector capacitance as a function of collector-base voltage; typical values



$f = 100 \text{ MHz}; V_{CE} = 5 \text{ V } T_{amb} = 25 \text{ }^\circ\text{C}$

Fig. 19. TR1 (PNP): Transition frequency as a function of collector current; typical values of built-in transistor

11. Test information

Resistor calculation

- Calculation of bias resistor 1 (R1):

$$R_1 = \frac{V(I_2) - V(I_1)}{I_2 - I_1}$$

- Calculation of bias resistor ratio (R2/R1):

$$\frac{R_2}{R_1} = \frac{V(I_4) - V(I_3)}{R_1 \cdot (I_4 - I_3)} - 1$$

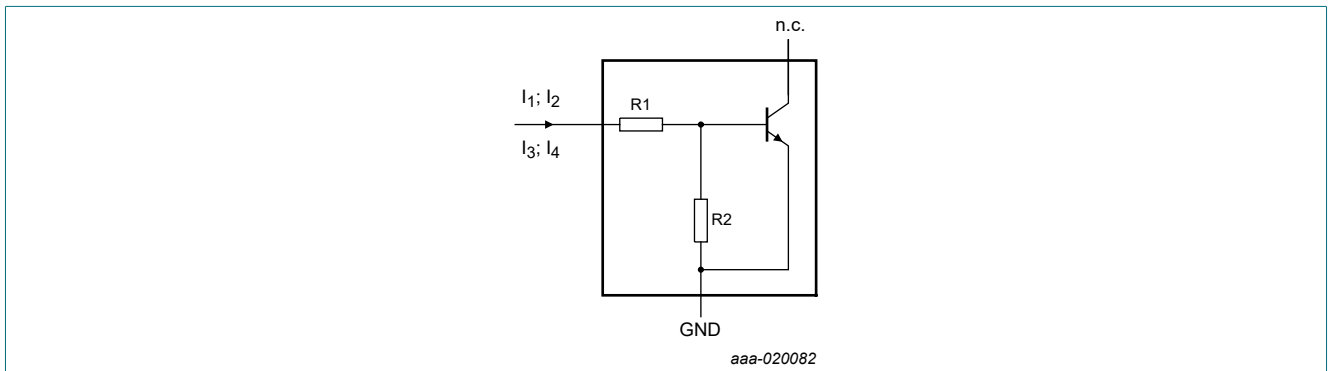


Fig. 20. NPN transistor: Resistor test circuit

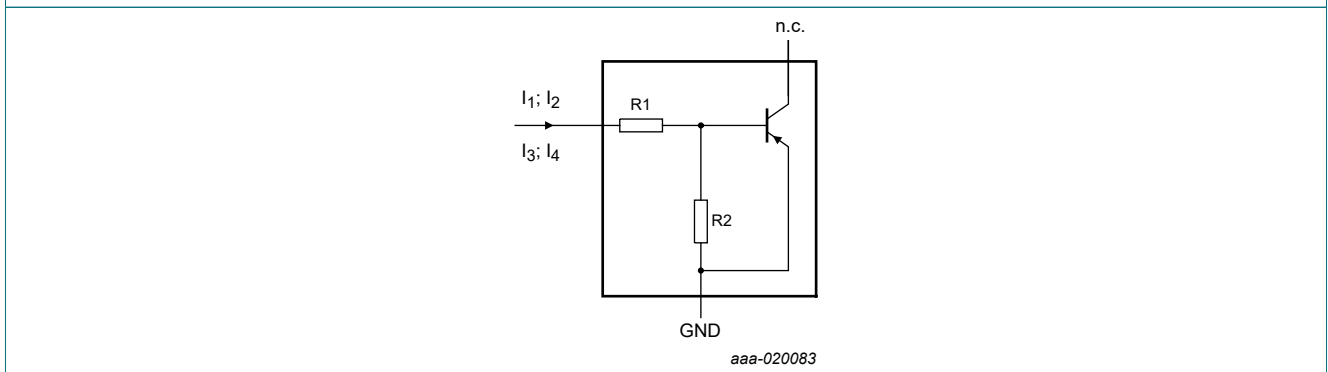


Fig. 21. PNP transistor: Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

PIMC31PA	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I ₁	I ₂	I ₃	I ₄
TR1 (NPN)	1	10	0.7 mA	0.8 mA	-0.45 mA	-0.55 mA
TR2 (PNP)			-0.7 mA	-0.8 mA	0.45 mA	0.55 mA

12. Package outline

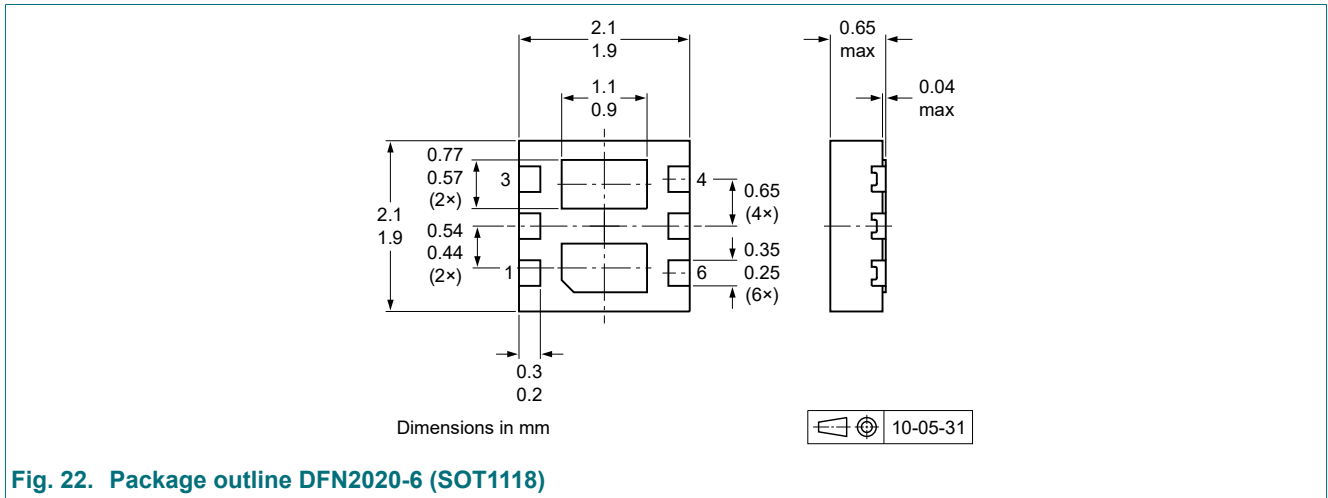


Fig. 22. Package outline DFN2020-6 (SOT1118)

13. Soldering

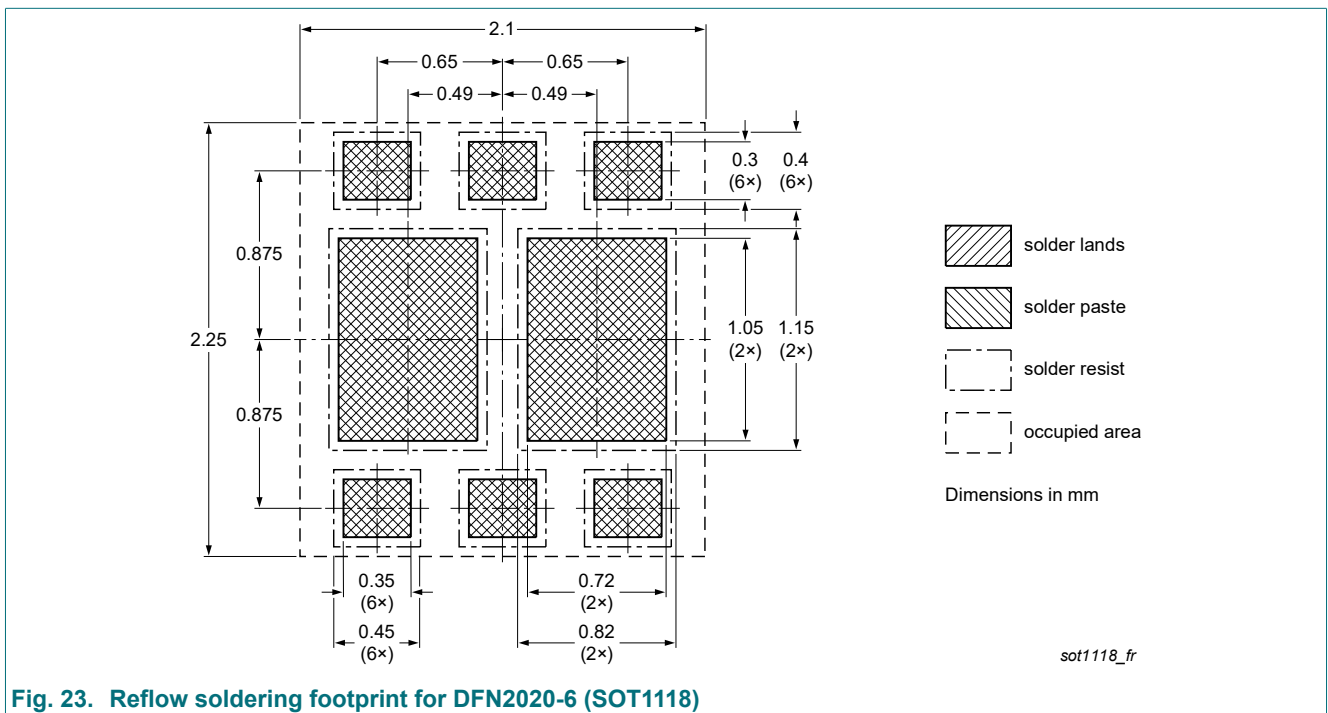


Fig. 23. Reflow soldering footprint for DFN2020-6 (SOT1118)

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PIMC31PA v.1	20230831	Product data sheet	-	-

15. Legal information

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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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