
# PIMP31PA

## 50 V, 500 mA PNP/PNP Resistor-Equipped double Transistor; R1 = 1 kΩ, R2 = 10 kΩ

31 August 2023 Product data sheet

## 1. General description

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

NPN/NPN complement: PIMN31PA

NPN/PNP complement: PIMC31PA

## 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 series in digital applications
- Control of IC inputs
- Switching loads

## 4. Quick reference data

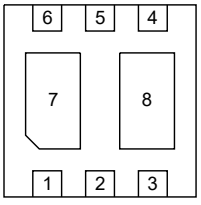
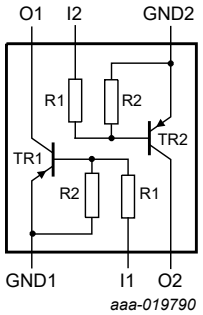
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $V_{CEO}$ | collector-emitter voltage | open base | | - | - | -50 | V |
| $I_O$ | output current | | | - | - | -500 | mA |
| R1 | bias resistor 1 (input) | $T_{amb}$ = 25 °C | [1] | 0.7 | 1 | 1.3 | kΩ |
| R2/R1 | bias resistor ratio | | [1] | 9 | 10 | 11 | |

[1] 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 |  Transparent top view **DFN2020-6 (SOT1118)** |  |
| 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 |
| PIMP31PA | 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 |
|---|---|
| PIMP31PA | 8G |

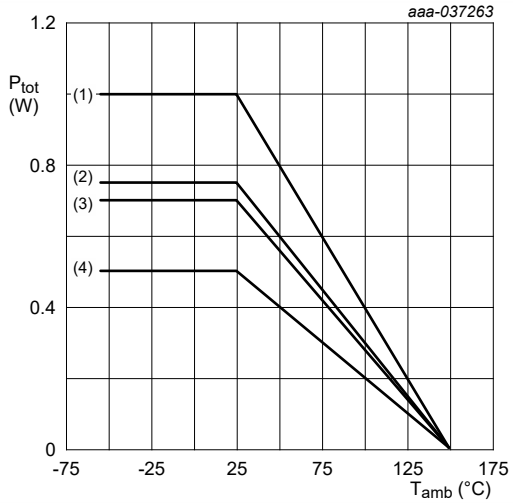
# 8. Limiting values

**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 | | - | -50 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | | - | -50 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | | - | -5 | V |
| $V_I$ | input voltage | | | -10 | 5 | V |
| $I_O$ | output current | | | - | -500 | mA |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [1] | - | 360 | mW |
| | | | [2] | - | 550 | mW |
| | | | [3] | - | 510 | mW |
| | | | [4] | - | 730 | mW |
| **Per device** | | | | | | |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [1] | - | 500 | mW |
| | | | [2] | - | 750 | mW |
| | | | [3] | - | 700 | mW |
| | | | [4] | - | 1 | W |
| $T_j$ | junction temperature | | | - | 150 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 150 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 150 | °C |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 µm copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided, 35µm copper, tin-plated; mounting pad for collector 1 $cm^2$.
[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 $cm^2$.




(1) FR4 PCB, 4-layer copper, 1 $cm^2$
(2) FR4 PCB, single-sided, 35µm copper, 1 $cm^2$
(3) FR4 PCB, 4-layer copper, standard footprint
(4) FR4 PCB, single-sided, 35µm copper, standard footprint

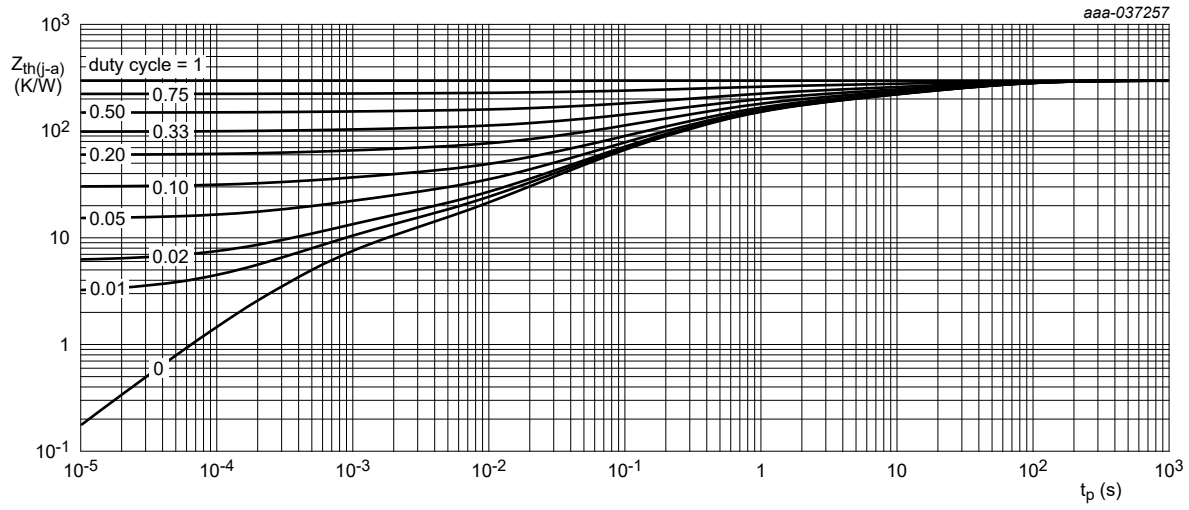
**Fig. 1. Per device: Power derating curves for DFN2020-6 (SOT1118)**

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

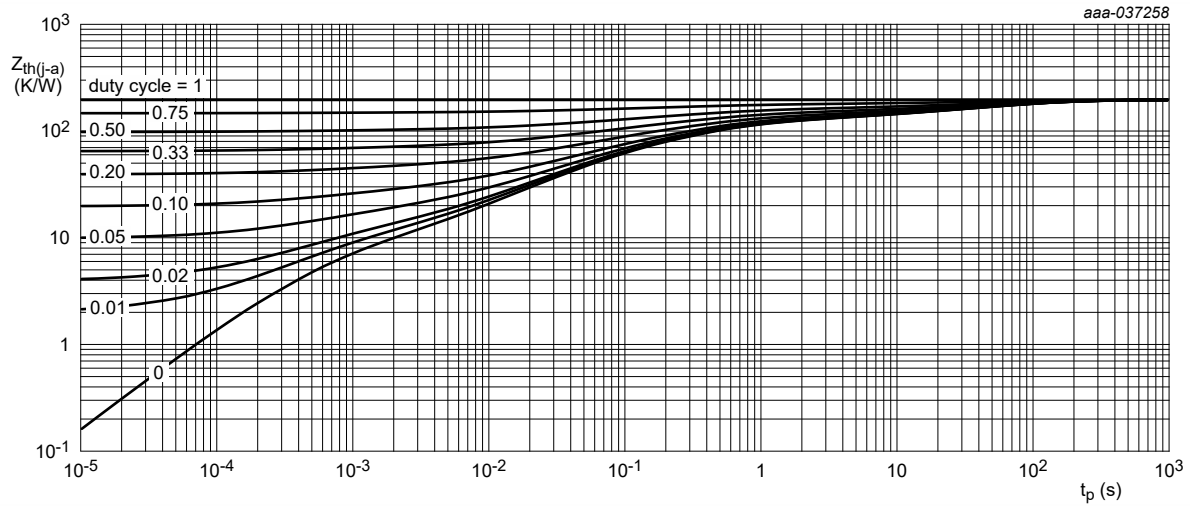
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 348 | K/W |
| | | | [2] | - | - | 228 | K/W |
| | | | [3] | - | - | 246 | K/W |
| | | | [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, 35µm copper, tin-plated; mounting pad for collector 1 $cm^2$.
[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 $cm^2$.



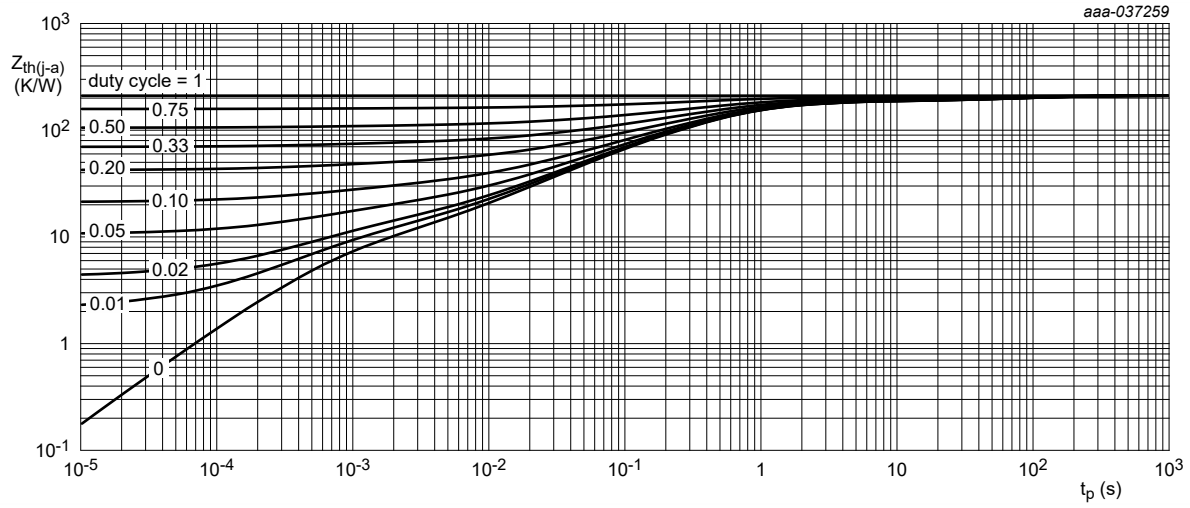

FR4 PCB, single-sided, 35µm copper, tin-plated and standard footprint

**Fig. 2. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**



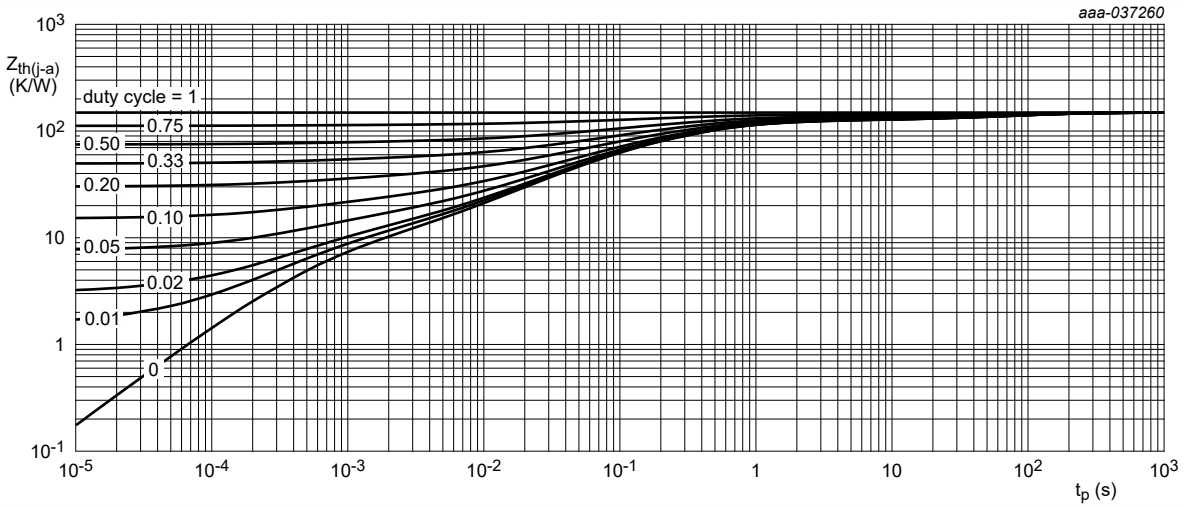

FR4 PCB, single-sided, 35µm copper, tin-plated, mounting pad for collector 1 $cm^2$.

**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**




FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 $cm^2$.

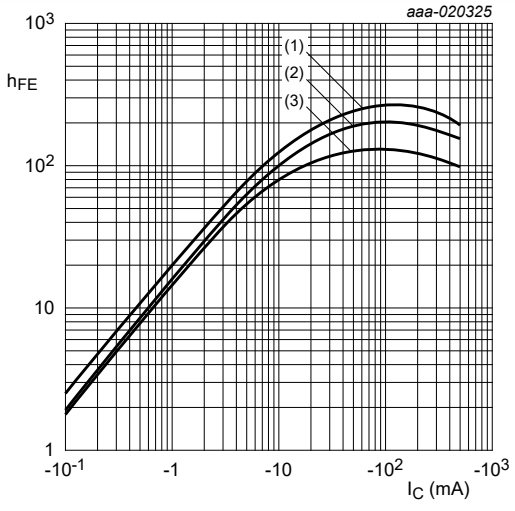
**Fig. 5. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

# 10. Characteristics

**Table 7. Characteristics**

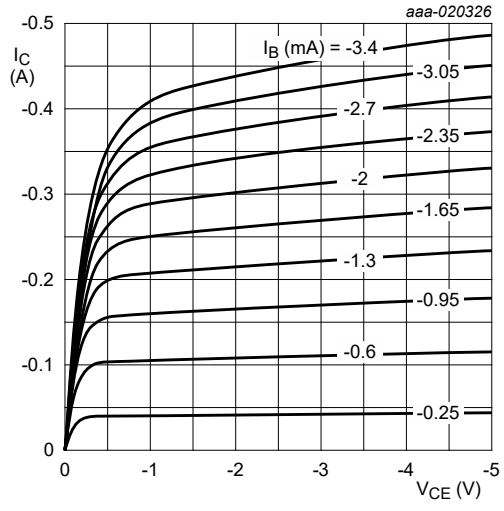
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C$ = -100 µA; $I_E$ = 0 A; $T_{amb}$ = 25 °C | | -50 | - | - | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown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

[1] See section "Test information" for resistor calculation and test conditions.
[2] Characteristics of built-in transistor.



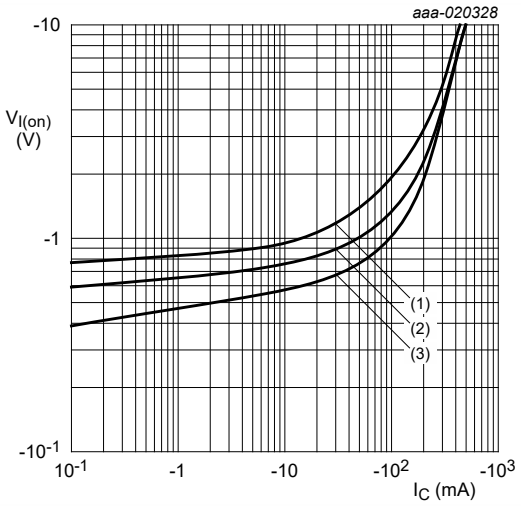

$V_{CE}$ = -5 V
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

**Fig. 6. DC current gain as a function of collector current; typical values**



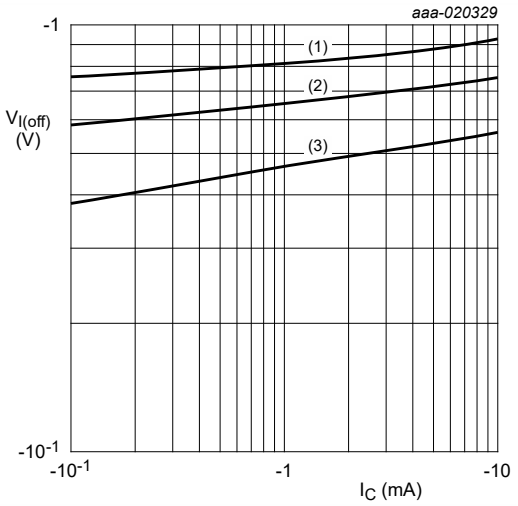

$T_{amb}$ = 25 °C

**Fig. 7. Collector current as a function of collector-emitter voltage; typical values**



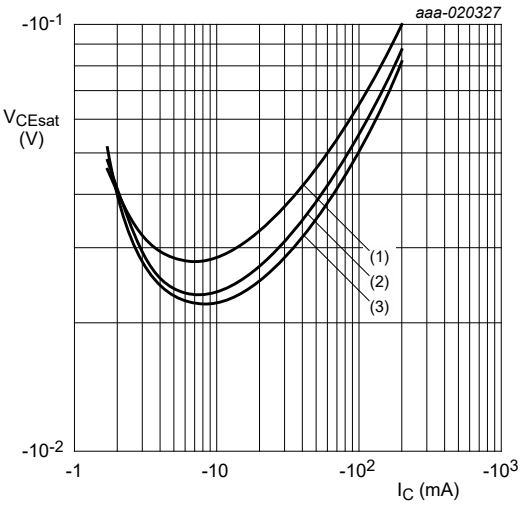

$V_{CE}$ = -0.3 V
(1) $T_{amb}$ = -40 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

**Fig. 8. On-state input voltage as a function of collector current; typical values**



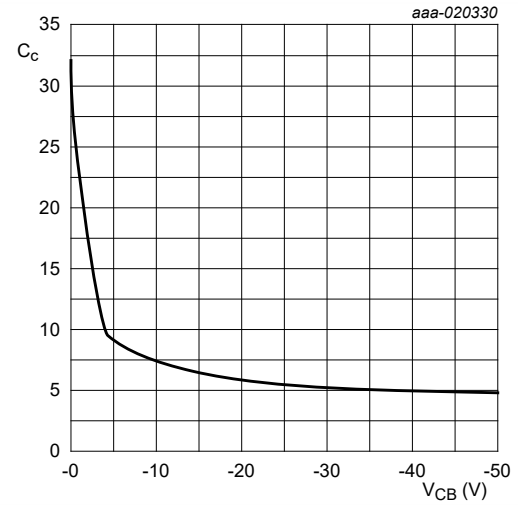

$V_{CE}$ = -5 V
(1) $T_{amb}$ = -40 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

**Fig. 9. Off-state input voltage as a function of collector current; typical values**



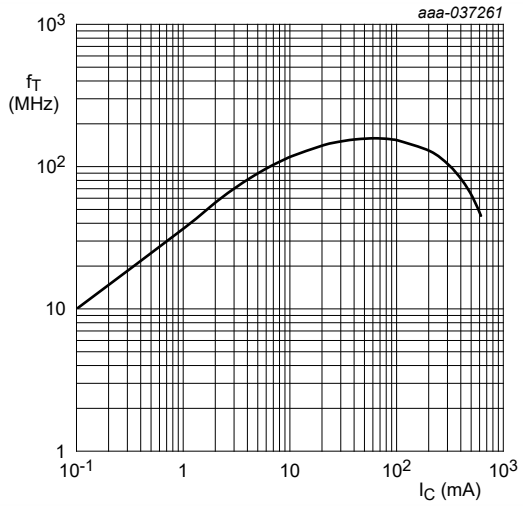

$I_C/I_B$ = 20
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −40 °C

**Fig. 10. Collector-emitter saturation voltage as a function of collector current; typical values**




f = 1 MHz
$T_{amb}$ = 25 °C

**Fig. 11. Collector capacitance as a function of collector-base voltage; typical values**




f = 100 MHz; $V_{CE}$ = 5 V $T_{amb}$ = 25 °C

**Fig. 12. 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):

$$\frac{R2}{R1} = \frac{V(I_4) - V(I_3)}{R1 \cdot (I_4 - I_3)} - 1$$

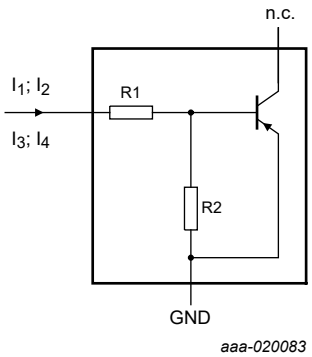



**Fig. 13. PNP transistor: Resistor test circuit**

## Resistor test conditions

**Table 8. Resistor test conditions**

| PIMP31PA | R1 (kΩ) | R2 (kΩ) | Test conditions | | | |
|---|---|---|---|---|---|---|
| | | | $I_1$ | $I_2$ | $I_3$ | $I_4$ |
| TR1/TR2 (PNP) | 1 | 10 | -0.7 mA | -0.8 mA | 0.45 mA | 0.55 mA |

## 12. Package outline

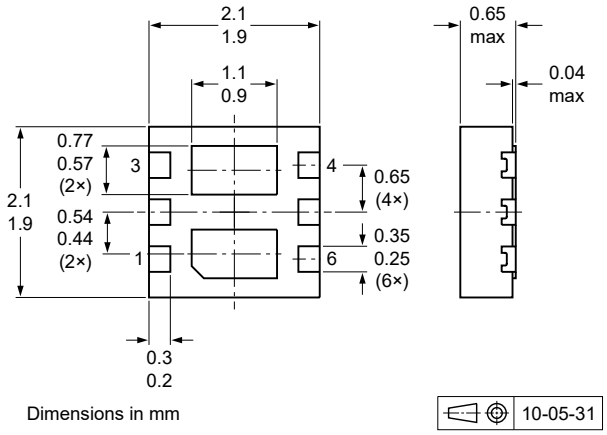



Fig. 14. Package outline DFN2020-6 (SOT1118)

## 13. Soldering

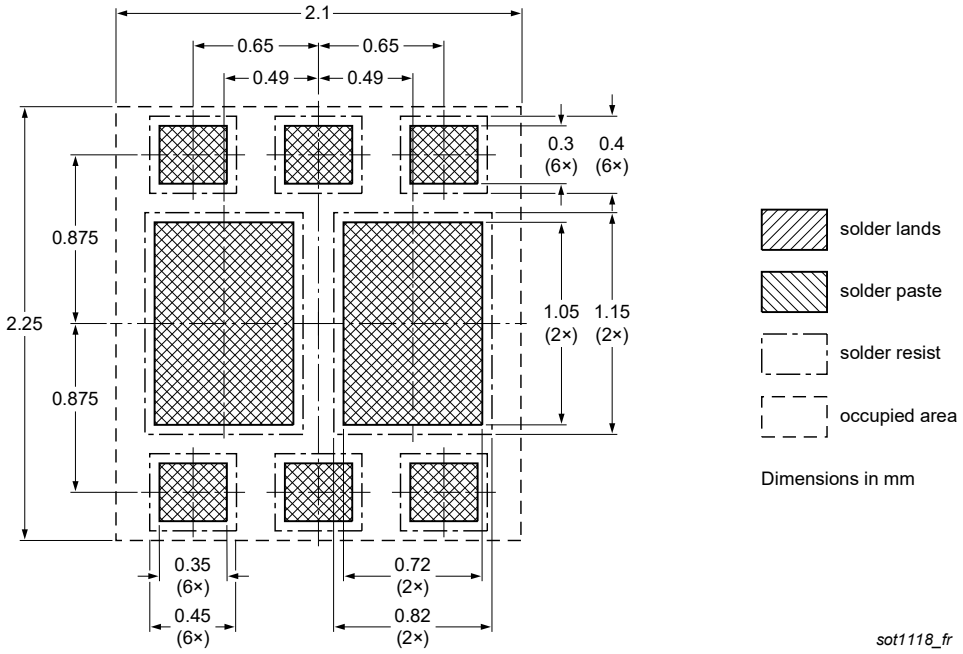



Fig. 15. Reflow soldering footprint for DFN2020-6 (SOT1118)

# 14. Revision history

**Table 9. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PIMP31PA 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. |
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**Date of release: 31 August 2023**

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