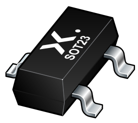

PBRN113ET

40 V, 600 mA NPN PB RET; R1 = 1 kΩ, R2 = 1 kΩ

31 March 2021 Product data sheet

1. General description

NPN low V_{CEsat} Performance-Based (PB) Resistor-Equipped Transistor (RET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package.

PNP complement: PBRP113ET

2. Features and benefits

- 600 mA output current capability
- Low collector-emitter saturation voltage V_{CEsat}
- High current gain h_{FE}
- Reduces component count
- Built-in bias resistors
- Reduces pick and place costs
- Simplifies circuit design
- ± 10 % resistor ratio tolerance

3. Applications

- Digital application in automotive and industrial segments
- Switching loads
- Medium current peripheral driver

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base		-	-	40	V
I_O	output current		[1]	-	-	600	mA
R1	bias resistor 1		[2]	0.7	1	1.3	kΩ
R2/R1	bias resistor ratio		[2]	0.9	1	1.1	

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 µm copper, tin-plated and standard footprint.
[2] See section "Test information" for resistor calculation and test conditions

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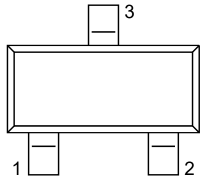
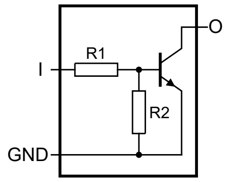
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	I	input (base)	 SOT23	 aaa-019964
2	GND	ground (emitter)		
3	O	output (collector)		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBRN113ET	SOT23	plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body	SOT23

7. Marking

Table 4. Marking codes

Type number	Marking code[1]
PBRN113ET	%7G

[1] % = placeholder for manufacturing site code

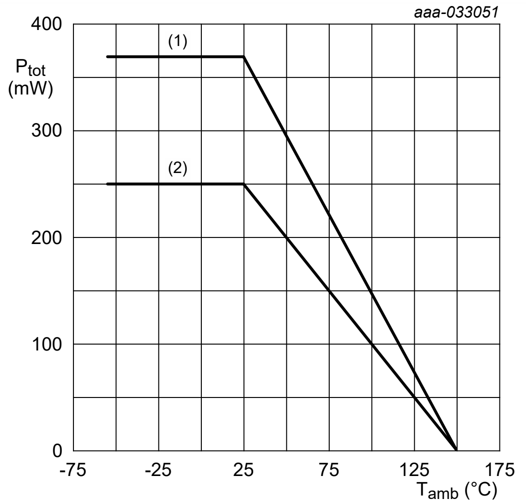
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter		-	40	V
V_{CEO}	collector-emitter voltage	open base		-	40	V
V_{EBO}	emitter-base voltage	open collector		-	10	V
V_I	input voltage	positive		-	10	V
		negative		-	-10	V
I_O	output current		[1]	-	600	mA
			[2]	-	700	mA
I_{ORM}	repetitive peak output current	$t_p \leq 1$ ms; $\delta \leq 0.33$		-	800	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	250	mW
			[2]	-	370	mW
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			-65	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, 35 µm copper, tin-plated, mounting pad for collector 1 cm^2.



(1) FR4 PCB, single-sided, 35 µm copper, tin-plated, mounting pad for collector 1 cm^2
(2) FR4 PCB, single-sided, 35 µm copper, tin-plated and standard footprint

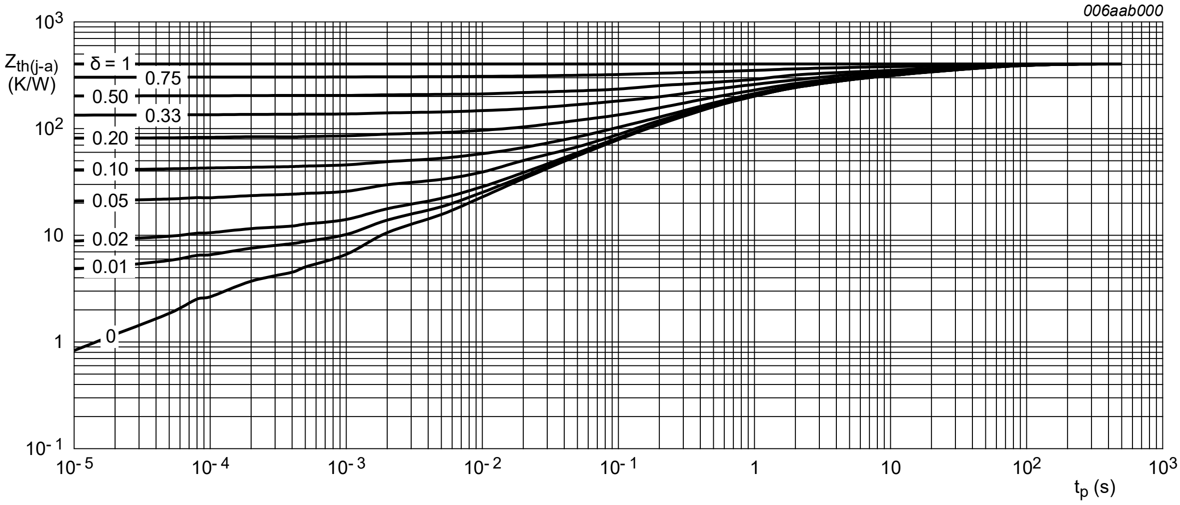
Fig. 1. Power derating curve

9. Thermal characteristics

Table 6. Thermal characteristics

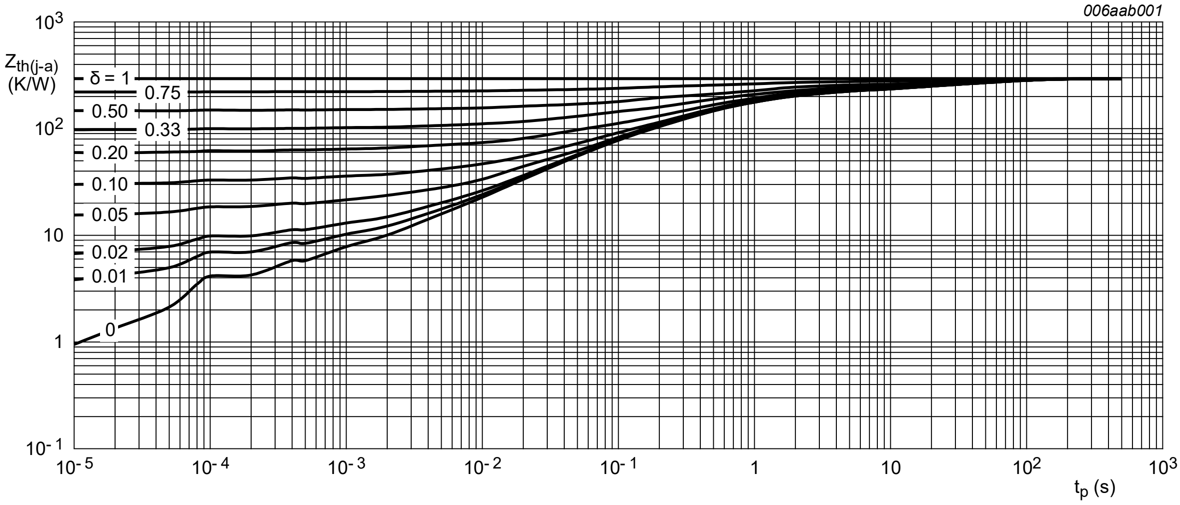
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	500	K/W
			[2]	-	-	338	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	105	K/W

[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 cm^2.



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

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



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

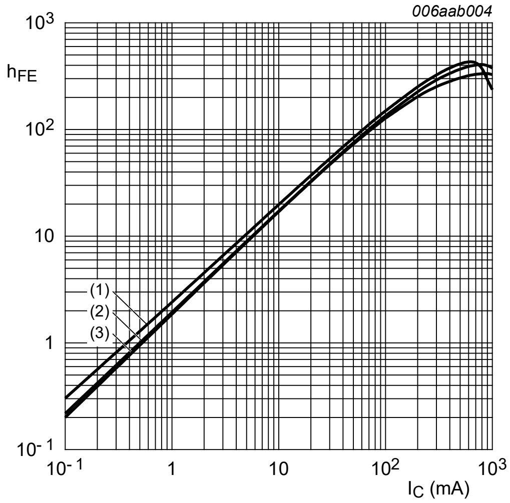
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

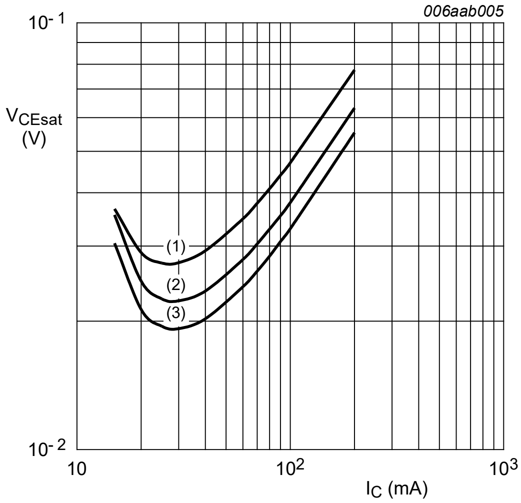
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 μA; I_E = 0 A; T_{amb} = 25 °C		40	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0 A; T_{amb} = 25 °C		40	-	-	V
I_{CBO}	collector-base cut-off current	V_{CB} = 30 V; I_E = 0 A; T_{amb} = 25 °C		-	-	100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 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		-	-	4	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 50 mA; T_{amb} = 25 °C		40	75	-	
		V_{CE} = 5 V; I_C = 300 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		180	300	-	
		V_{CE} = 5 V; I_C = 600 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		250	400	-	
		V_{CE} = 5 V; I_C = 800 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		270	420	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 50 mA; I_B = 2.5 mA; T_{amb} = 25 °C		-	25	35	mV
		I_C = 200 mA; I_B = 10 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		-	60	85	mV
		I_C = 500 mA; I_B = 10 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		-	160	220	mV
		I_C = 600 mA; I_B = 6 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		-	320	550	mV
		I_C = 800 mA; I_B = 8 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.02; T_{amb} = 25 °C		-	680	1150	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = 5 V; I_C = 100 μA; T_{amb} = 25 °C		0.6	1	1.5	V
$V_{I(on)}$	on-state input voltage	V_{CE} = 0.3 V; I_C = 20 mA; T_{amb} = 25 °C		1	1.3	1.8	V
R1	bias resistor 1		[1]	0.7	1	1.3	kΩ
R2/R1	bias resistor ratio		[1]	0.9	1	1.1	
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

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



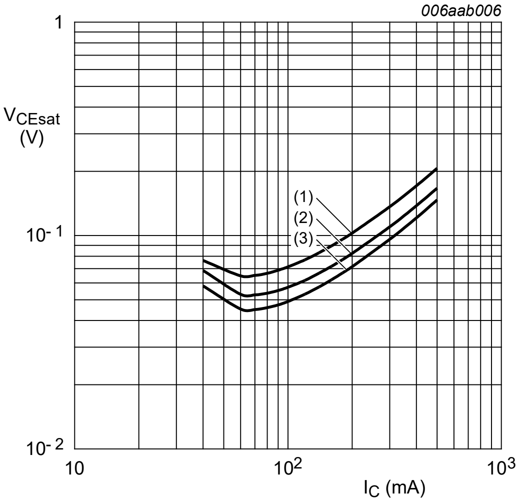
V_{CE} = 5 V
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = −40 °C

Fig. 4. DC current gain as a function of collector current; typical values



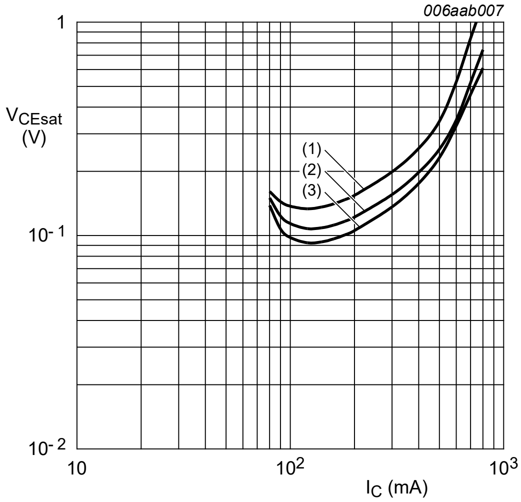
I_C/I_B = 20
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = −40 °C

Fig. 5. Collector-emitter saturation voltage as a function of collector current; typical values



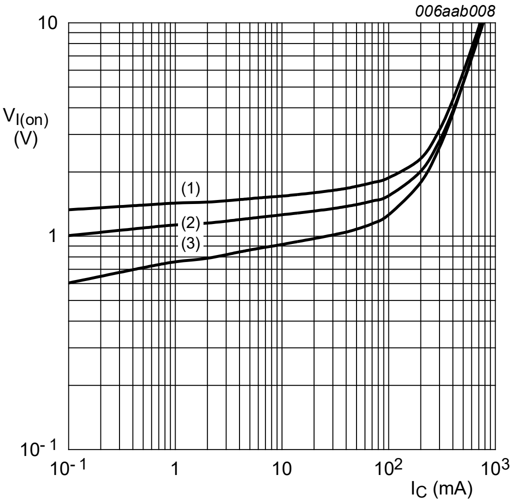
I_C/I_B = 50
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = −40 °C

Fig. 6. Collector-emitter saturation voltage as a function of collector current; typical values



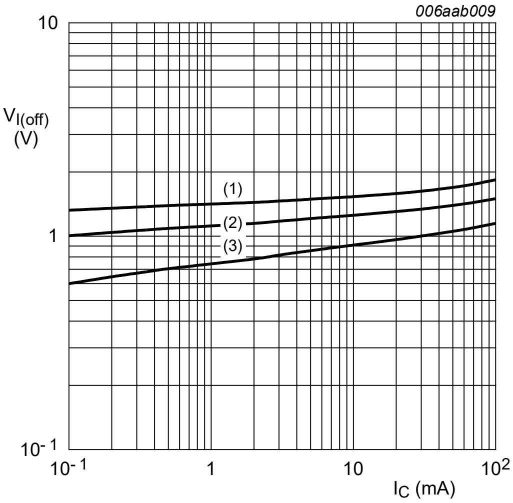
I_C/I_B = 100
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = −40 °C

Fig. 7. Collector-emitter saturation voltage as a function of collector current; 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

11. Test information

Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R_1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R2}{R1} = \frac{V(I_{I3})}{R1 \cdot I_{I3}} - 1$$

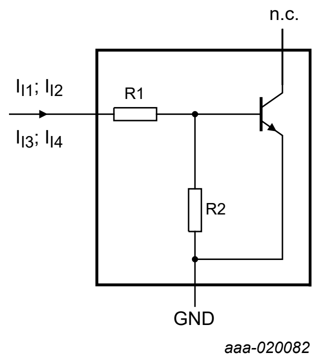


Fig. 10. Resistor test circuit

Resistor test conditions

Table 8. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions		
			I_{I1}	I_{I2}	I_{I3}
PBRN113ET	1	1	1.6 mA	1.7 mA	-1.65 mA

12. Package outline

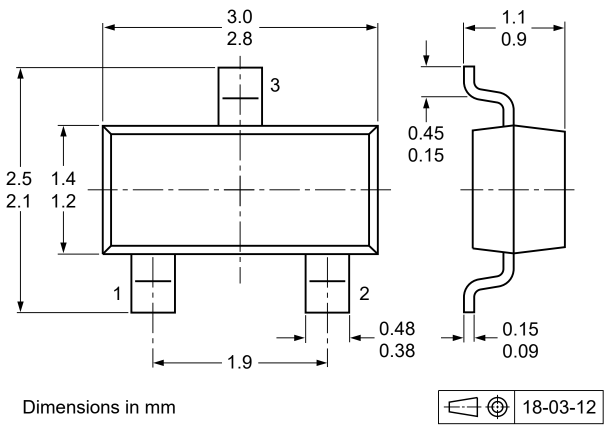


Fig. 11. Package outline SOT23

13. Soldering

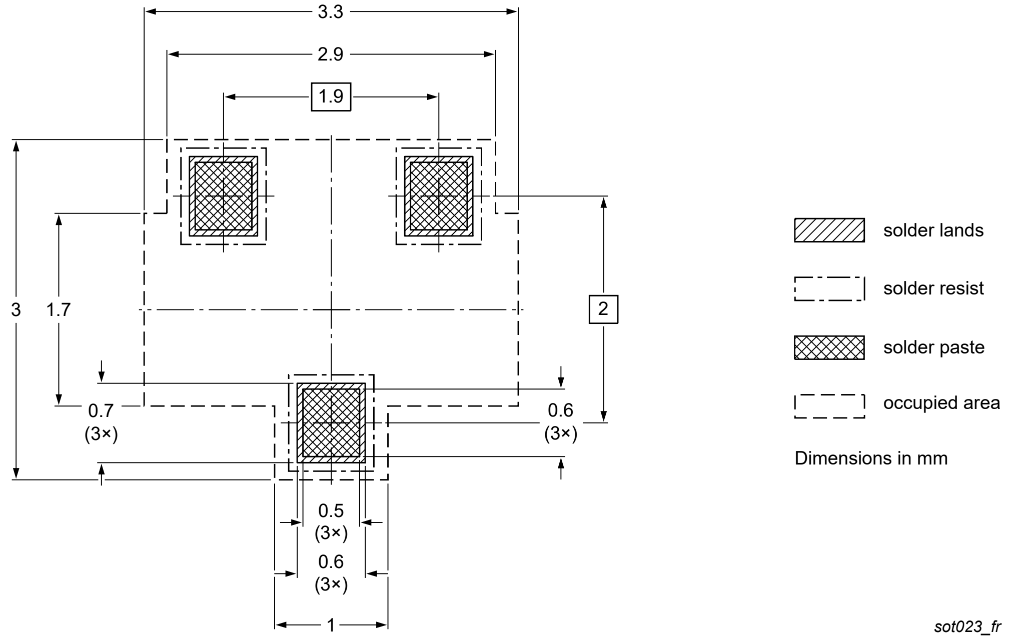


Fig. 12. Reflow soldering footprint for SOT23

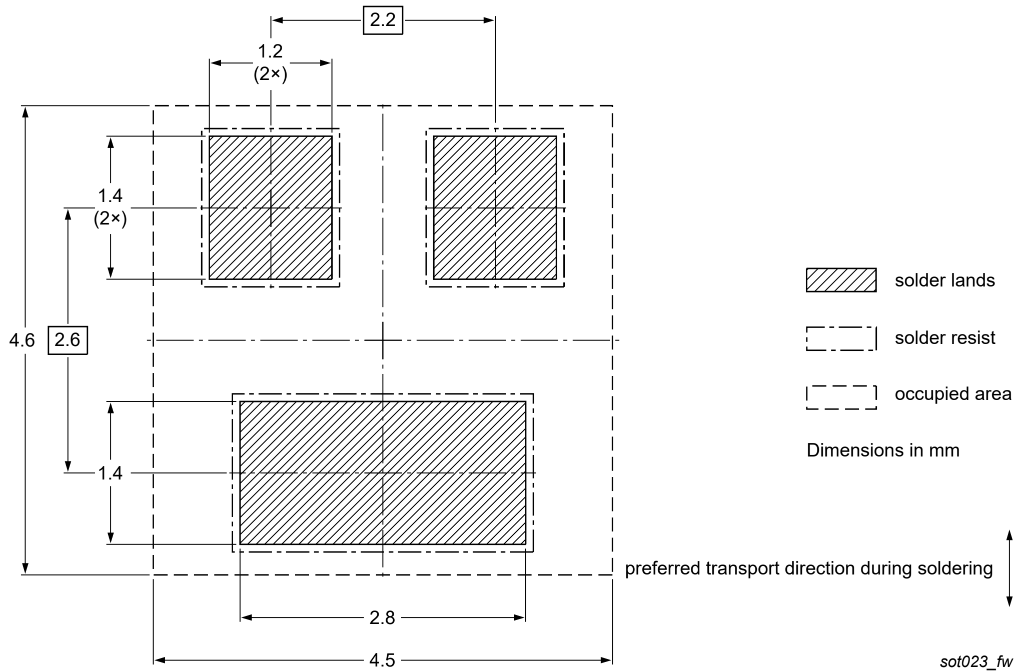


Fig. 13. Wave soldering footprint for SOT23

14. Revision history

Table 9. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBRN113ET v.2	20210331	Product data sheet	-	PBRN113E_SER_1
Modifications:	• Types in SOT346 and SOT54 are obsolete • Product description changed from BISS to PB RET			
PBRN113E_SER_1	20070301	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.

[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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