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Team Nexperia

# PBRN113E series

NPN 800 mA, 40 V BISS RETs; R1 = 1 k $\Omega$ , R2 = 1 k $\Omega$

Rev. 01 — 1 March 2007

Product data sheet

## 1. Product profile

### 1.1 General description

800 mA NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) Resistor-Equipped Transistors (RET) family in small plastic packages.

Table 1. Product overview

Type number	Package		
	NXP	JEITA	JEDEC
PBRN113EK	SOT346	SC-59A	TO-236
PBRN113ES <sup>[1]</sup>	SOT54	SC-43A	TO-92
PBRN113ET	SOT23	-	TO-236AB

[1] Also available in SOT54A and SOT54 variant packages (see [Section 2](#)).

### 1.2 Features

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

### 1.3 Applications

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

### 1.4 Quick reference data

Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	40	V
$I_O$	output current		<sup>[1]</sup>			
	PBRN113EK, PBRN113ET		-	-	600	mA
	PBRN113ES		-	-	800	mA

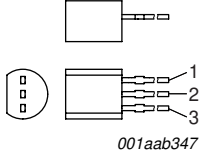
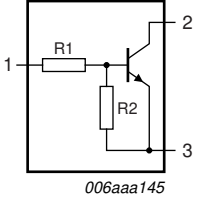
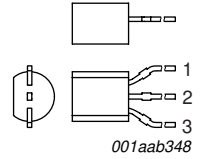
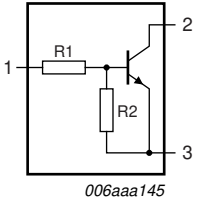
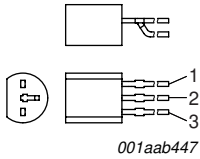
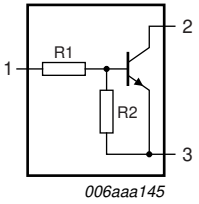
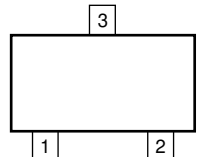
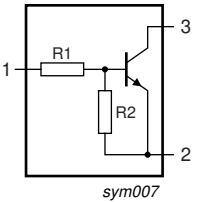
**Table 2. Quick reference data ...continued**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>ORM</sub>	repetitive peak output current					
	PBRN113EK, PBRN113ET	t <sub>p</sub> ≤ 1 ms; δ ≤ 0.33	-	-	800	mA
R1	bias resistor 1 (input)		0.7	1	1.3	kΩ
R2/R1	bias resistor ratio		0.9	1	1.1	

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

## 2. Pinning information

**Table 3. Pinning**

Pin	Description	Simplified outline	Symbol
<b>SOT54</b>			
1	input (base)	 <p>001aab347</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
<b>SOT54A</b>			
1	input (base)	 <p>001aab348</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
<b>SOT54 variant</b>			
1	input (base)	 <p>001aab447</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
<b>SOT23; SOT346</b>			
1	input (base)	 <p>006aaa144</p>	 <p>sym007</p>
2	GND (emitter)		
3	output (collector)		



### 3. Ordering information

**Table 4. Ordering information**

Type number	Package		Version
	Name	Description	
PBRN113EK	SC-59A	plastic surface-mounted package; 3 leads	SOT346
PBRN113ES <sup>[1]</sup>	SC-43A	plastic single-ended leaded (through hole) package; 3 leads	SOT54
PBRN113ET	-	plastic surface-mounted package; 3 leads	SOT23

[1] Also available in SOT54A and SOT54 variant packages (see [Section 2](#) and [Section 9](#)).

### 4. Marking

**Table 5. Marking codes**

Type number	Marking code <sup>[1]</sup>
PBRN113EK	G1
PBRN113ES	N113ES
PBRN113ET	*7G

[1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China

### 5. Limiting values

**Table 6. Limiting values**

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

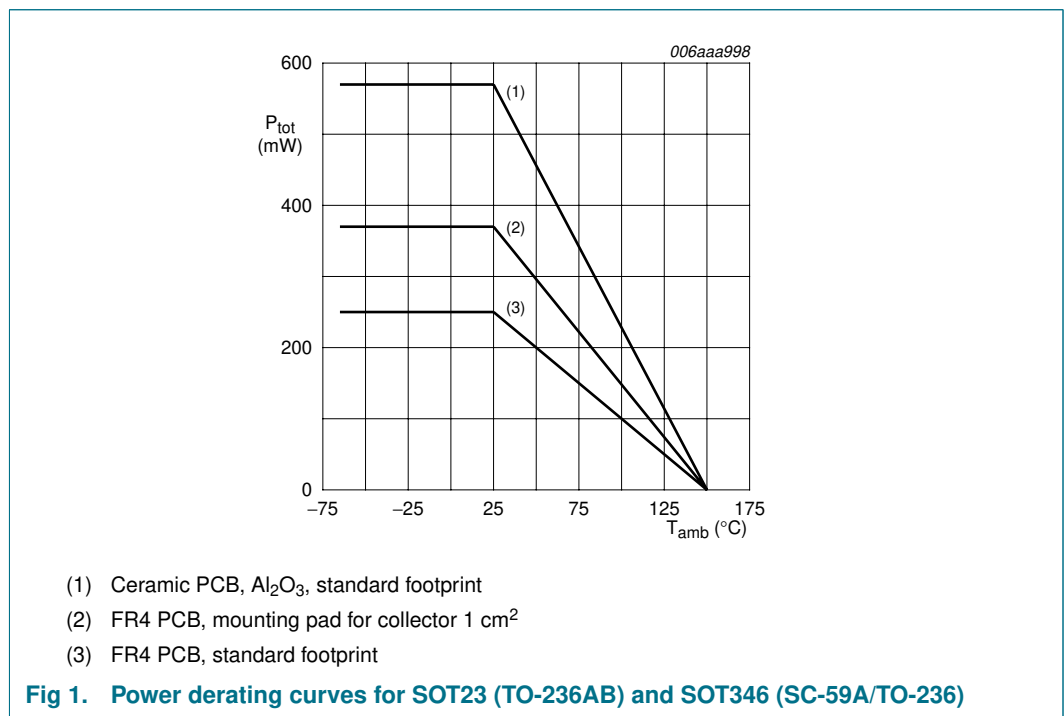
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	40	V
$V_{CEO}$	collector-emitter voltage	open base	-	40	V
$V_{EBO}$	emitter-base voltage	open collector	-	10	V
$V_I$	input voltage				
	positive		-	+10	V
	negative		-	-10	V
$I_O$	output current				
	PBRN113EK, PBRN113ET		<sup>[1]</sup> -	600	mA
			<sup>[2][3]</sup> -	700	mA
	PBRN113ES		<sup>[1]</sup> -	800	mA
$I_{ORM}$	repetitive peak output current				
	PBRN113EK, PBRN113ET	$t_p \leq 1 \text{ ms}; \delta \leq 0.33$	-	800	mA

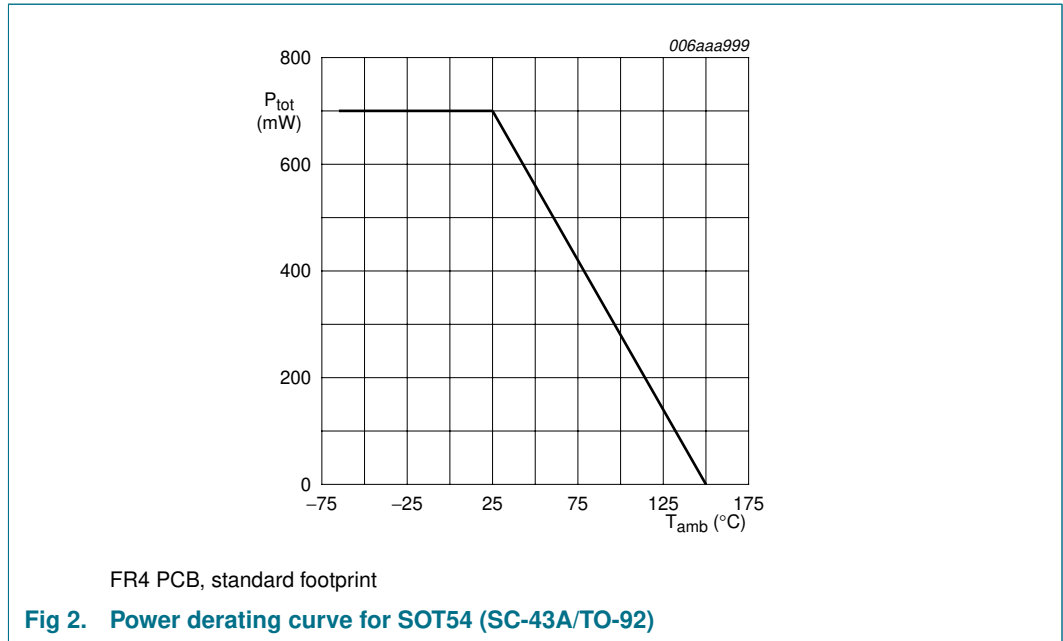
**Table 6. Limiting values ...continued**

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

Symbol	Parameter	Conditions	Min	Max	Unit		
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C					
			PBRN113EK, PBRN113ET	[1]	-	250	mW
				[2]	-	370	mW
				[3]	-	570	mW
	PBRN113ES		[1]	-	700	mW	
T <sub>j</sub>	junction temperature		-	150	°C		
T <sub>amb</sub>	ambient temperature		-65	+150	°C		
T <sub>stg</sub>	storage temperature		-65	+150	°C		

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



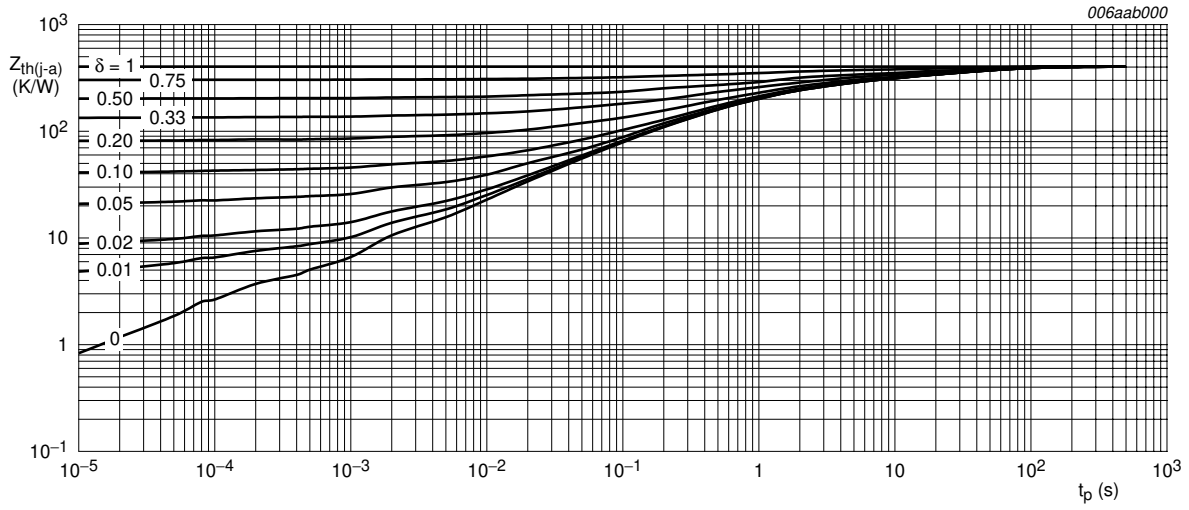


## 6. Thermal characteristics

**Table 7. Thermal characteristics**

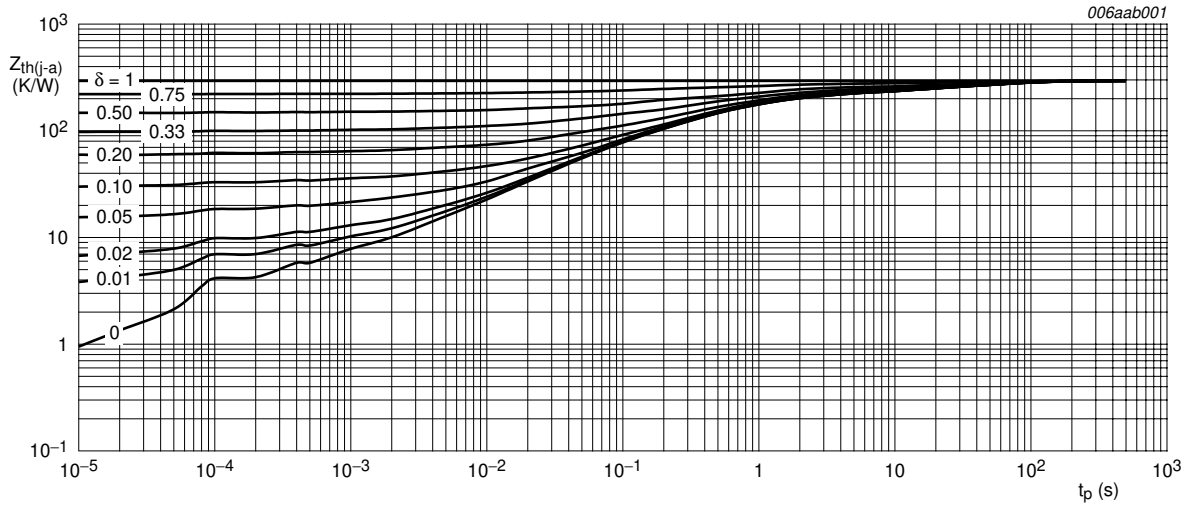
Symbol	Parameter	Conditions	Min	Typ	Max	Unit		
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air						
			PBRN113EK, PBRN113ET	[1]	-	-	500	K/W
				[2]	-	-	338	K/W
				[3]	-	-	219	K/W
	PBRN113ES		[1]	-	-	179	K/W	
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point							
		PBRN113EK, PBRN113ET		-	-	105	K/W	

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



FR4 PCB, standard footprint

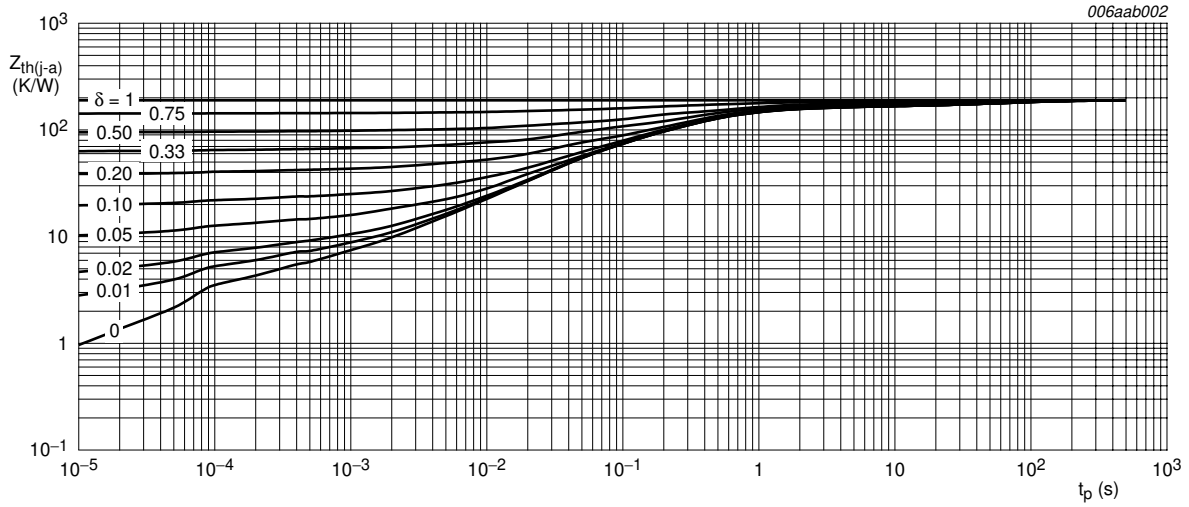
Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values



FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

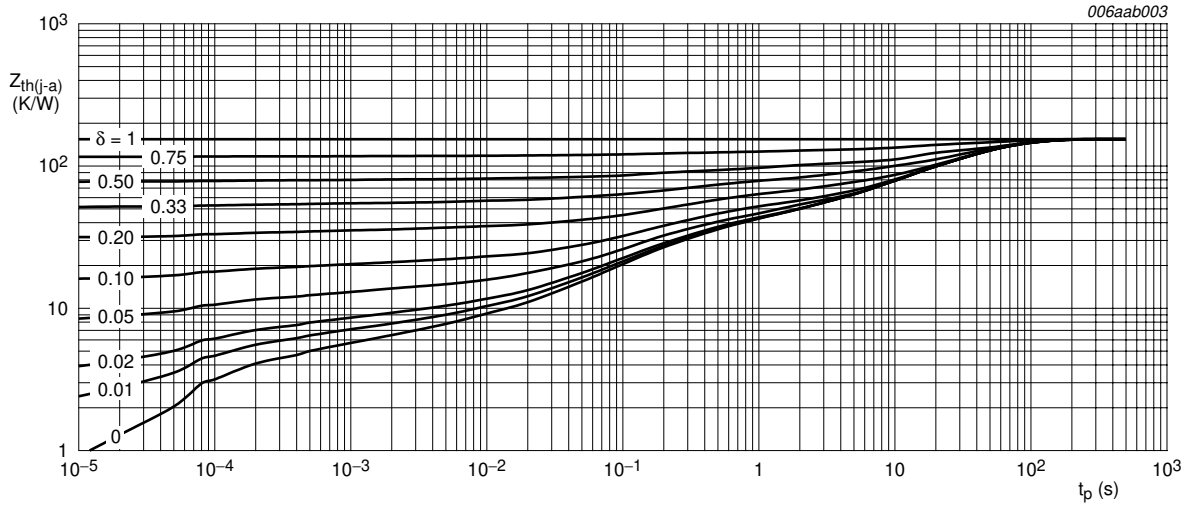
Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values





Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint

**Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values**



FR4 PCB, standard footprint

**Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT54 (SC-43A/TO-92); typical values**

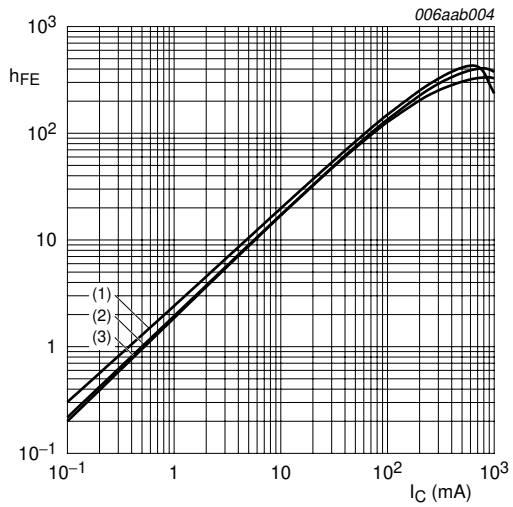
## 7. Characteristics

**Table 8. Characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

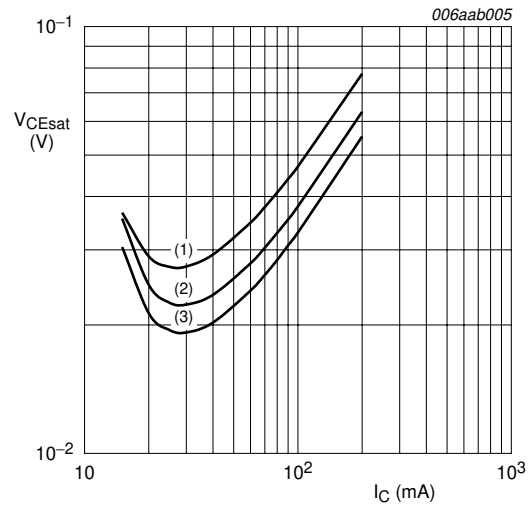
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 30\text{ V};$ $I_E = 0\text{ A}$	-	-	100	nA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 30\text{ V};$ $I_B = 0\text{ A}$	-	-	0.5	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V};$ $I_C = 0\text{ A}$	-	-	4	mA
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V};$ $I_C = 50\text{ mA}$	40	75	-	
		$V_{CE} = 5\text{ V};$ $I_C = 300\text{ mA}$	[1] 180	300	-	
		$V_{CE} = 5\text{ V};$ $I_C = 600\text{ mA}$	[1] 250	400	-	
		$V_{CE} = 5\text{ V};$ $I_C = 800\text{ mA}$	[1] 270	420	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 50\text{ mA};$ $I_B = 2.5\text{ mA}$	-	25	35	mV
		$I_C = 200\text{ mA};$ $I_B = 10\text{ mA}$	-	60	85	mV
		$I_C = 500\text{ mA};$ $I_B = 10\text{ mA}$	[1] -	160	220	mV
		$I_C = 600\text{ mA};$ $I_B = 6\text{ mA}$	[1] -	320	550	mV
		$I_C = 800\text{ mA};$ $I_B = 8\text{ mA}$	[1] -	0.68	1.15	V
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5\text{ V};$ $I_C = 100\text{ }\mu\text{A}$	0.6	1	1.5	V
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3\text{ V};$ $I_C = 20\text{ mA}$	1	1.3	1.8	V
R1	bias resistor 1 (input)		0.7	1	1.3	kΩ
R2/R1	bias resistor ratio		0.9	1	1.1	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V};$ $I_E = I_e = 0\text{ A};$ $f = 1\text{ MHz}$	-	7	-	pF

[1] Pulse test:  $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02$ .



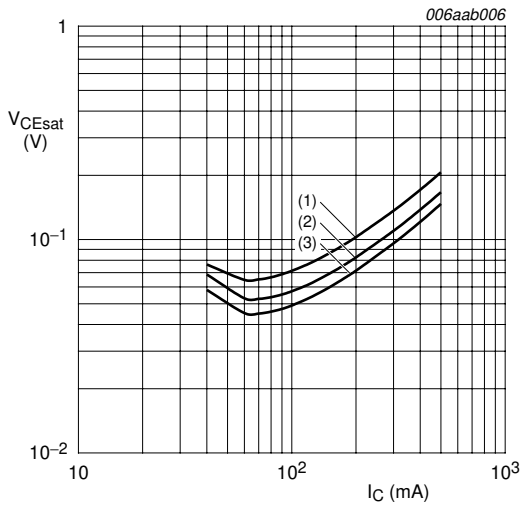
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig 7. DC current gain as a function of collector current; typical values**



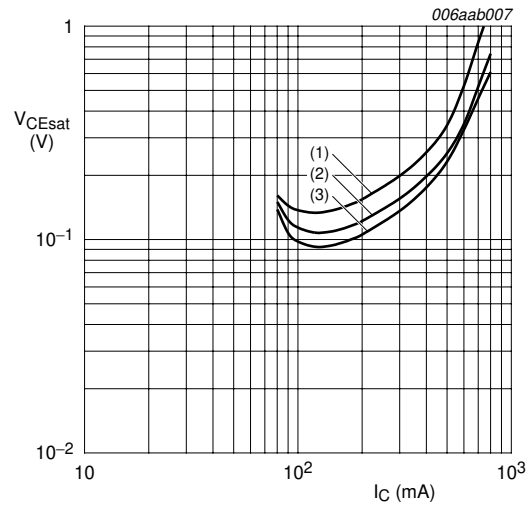
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig 8. Collector-emitter saturation voltage as a function of collector current; typical values**



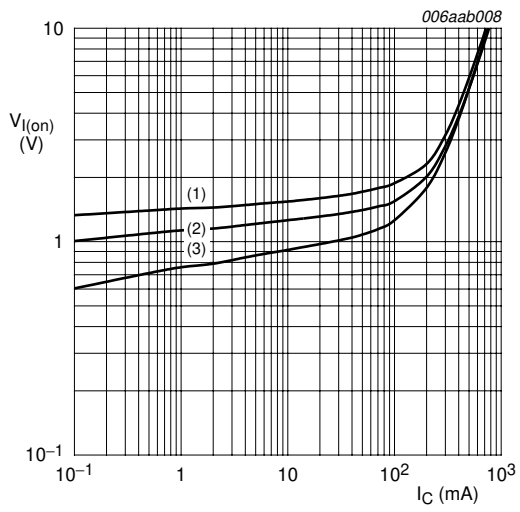
$I_C/I_B = 50$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values**



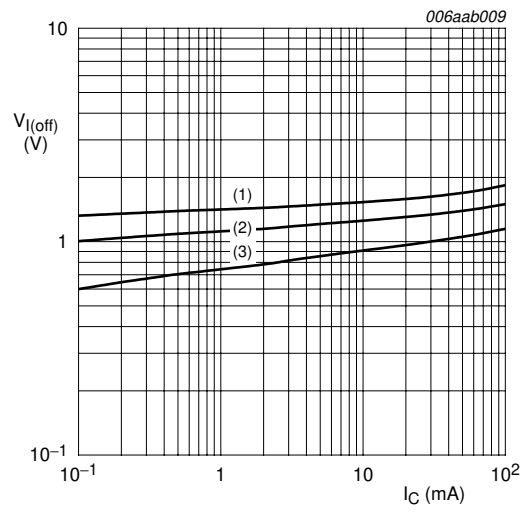
$I_C/I_B = 100$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig 10. Collector-emitter saturation voltage as a function of collector current; 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)  $T_{amb} = 100 \text{ }^\circ\text{C}$

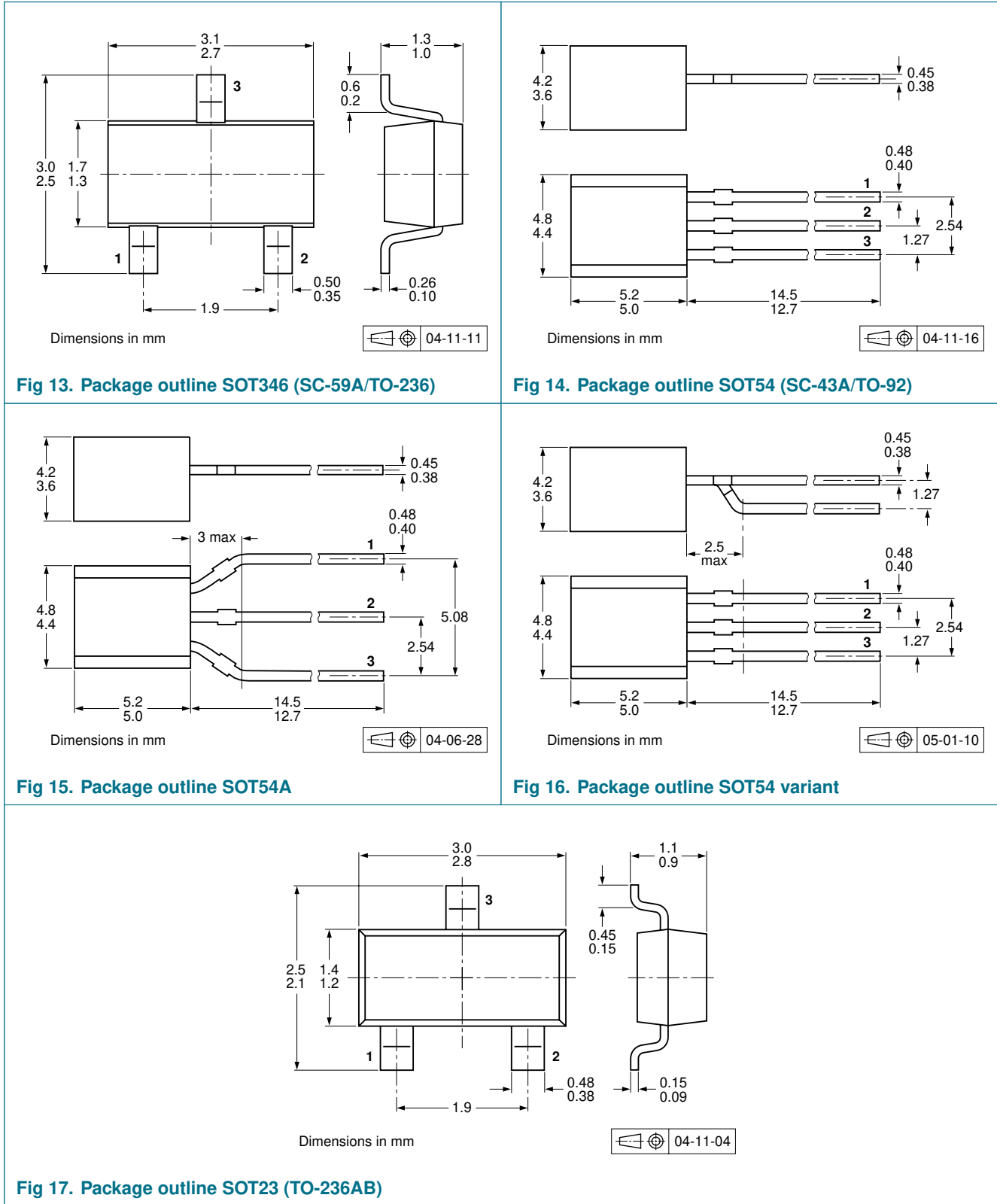
**Fig 11. On-state input voltage as a function of collector current; typical values**



$V_{CE} = 5 \text{ V}$   
 (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 12. Off-state input voltage as a function of collector current; typical values**

**8. Package outline**



## 9. Packing information

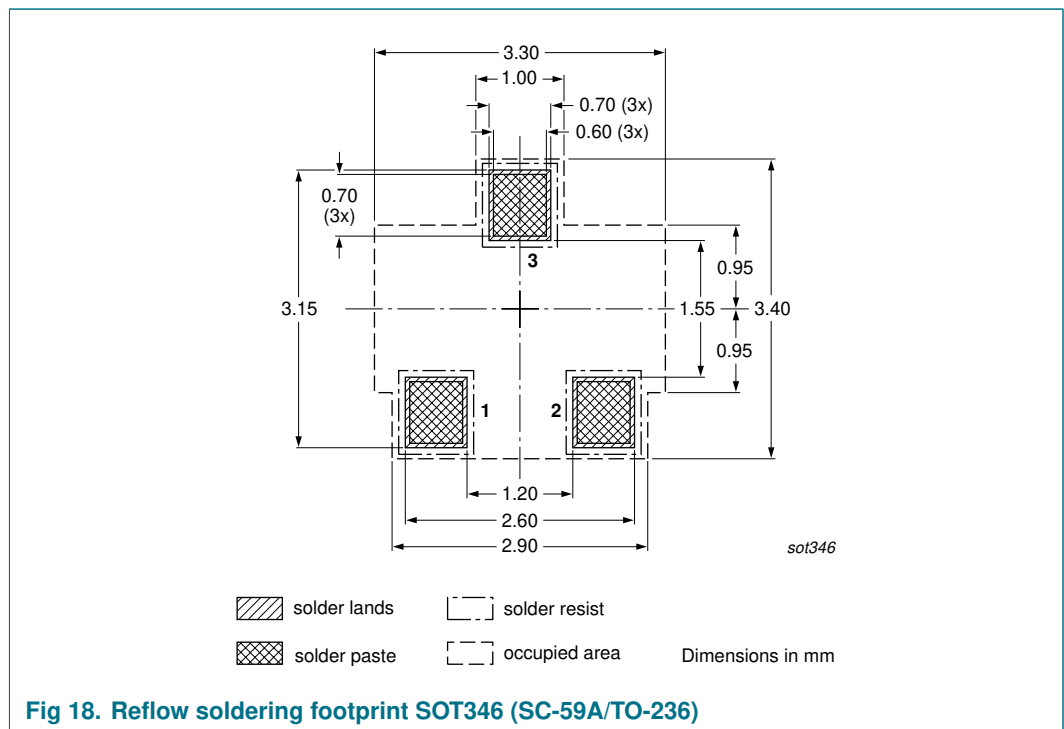
**Table 9. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

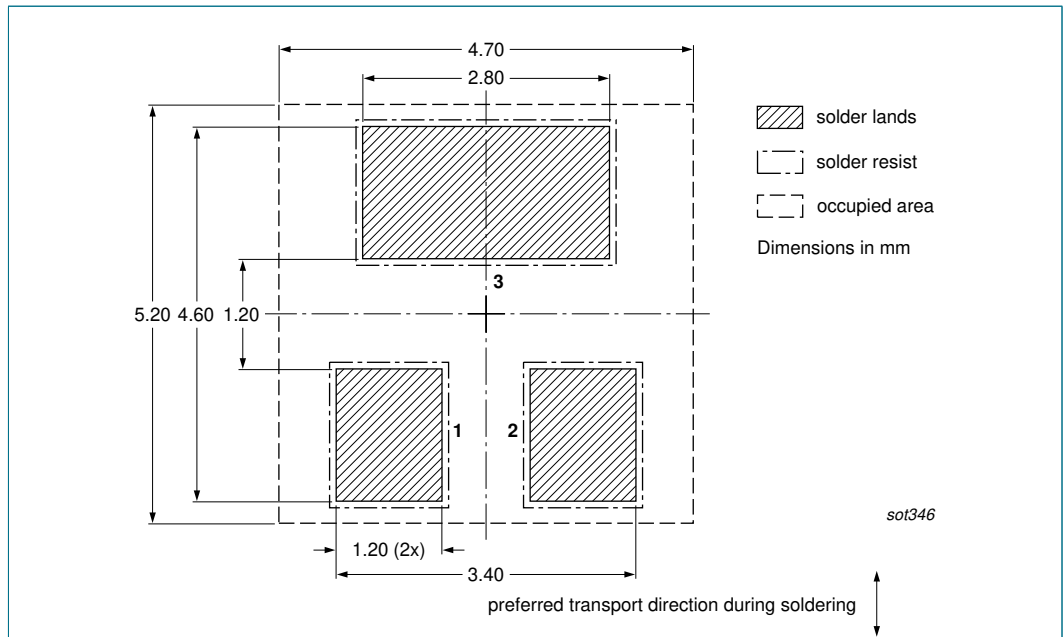
Type number	Package	Description	Packing quantity		
			3000	5000	10000
PBRN113EK	SOT346	4 mm pitch, 8 mm tape and reel	-115	-	-135
PBRN113ES	SOT54	bulk, straight leads	-	-412	-
	SOT54A	tape and reel, wide pitch	-	-	-116
		tape ammpack, wide pitch	-	-	-126
	SOT54 variant	bulk, delta pinning	-	-112	-
PBRN113ET	SOT23	4 mm pitch, 8 mm tape and reel	-215	-	-235

[1] For further information and the availability of packing methods, see [Section 13](#).

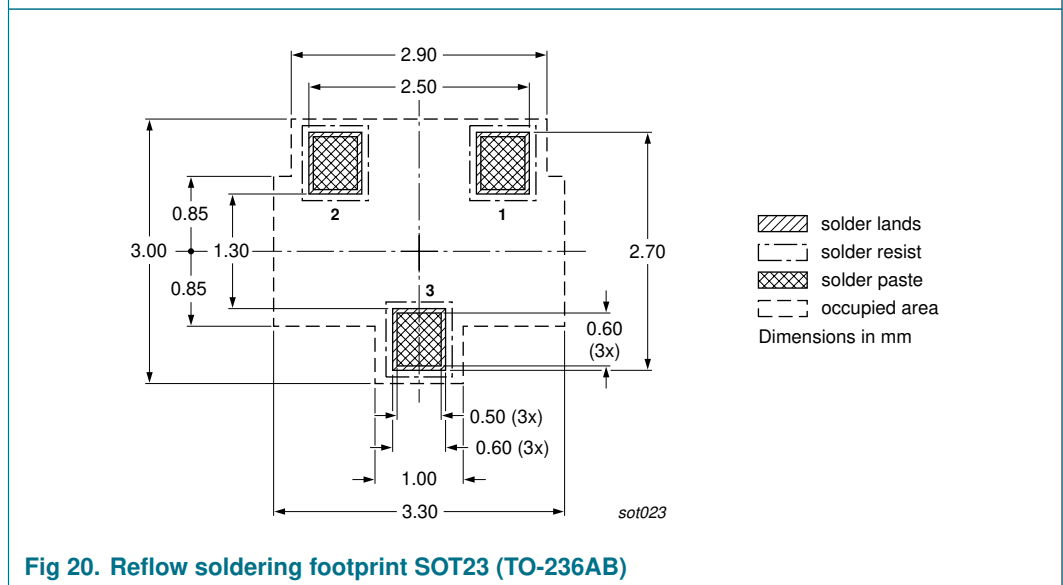
## 10. Soldering



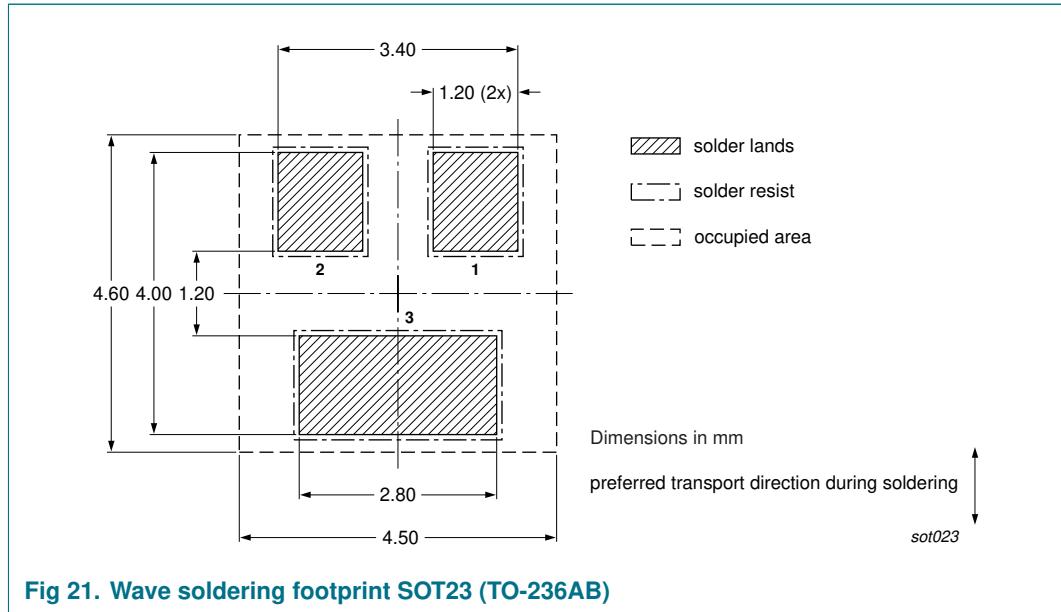




**Fig 19. Wave soldering footprint SOT346 (SC-59A/TO-236)**



**Fig 20. Reflow soldering footprint SOT23 (TO-236AB)**



## 11. Revision history

**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBRN113E_SER_1	20070301	Product data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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