



**THE DATASHEET OF  
PBRN113ET,215**





# 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  |        |          |
|--------------------------|----------|--------|----------|
|                          | Nexperia | 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   |

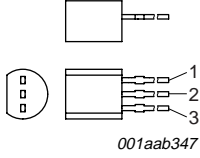
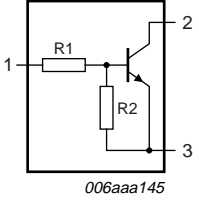
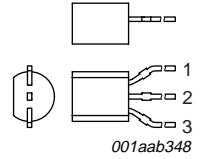
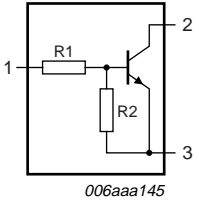
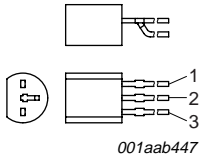
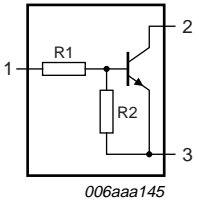
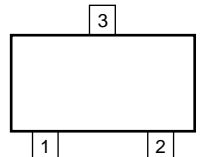
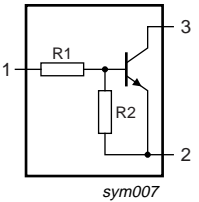
**Table 2. Quick reference data ...continued**

| 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).

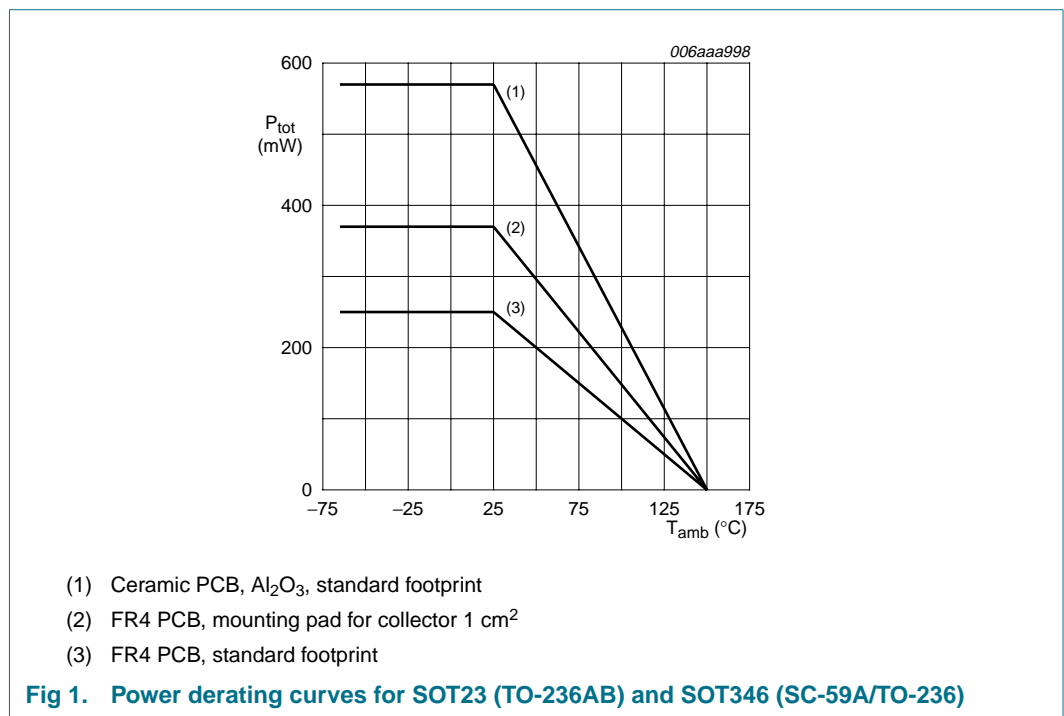
| Symbol    | Parameter                      | Conditions                          | Min                             | Max | Unit |
|-----------|--------------------------------|-------------------------------------|---------------------------------|-----|------|
| $V_{CBO}$ | collector-base voltage         | 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]</sup> <sup>[3]</sup> - | 700 | mA   |
|           | PBRN113ES                      |                                     | <sup>[1]</sup> -                | 800 | mA   |
| $I_{ORM}$ | repetitive peak output current |                                     |                                 |     |      |
|           | PBRN113EK, PBRN113ET           | $t_p \leq 1$ ms; $\delta \leq 0.33$ | -                               | 800 | mA   |

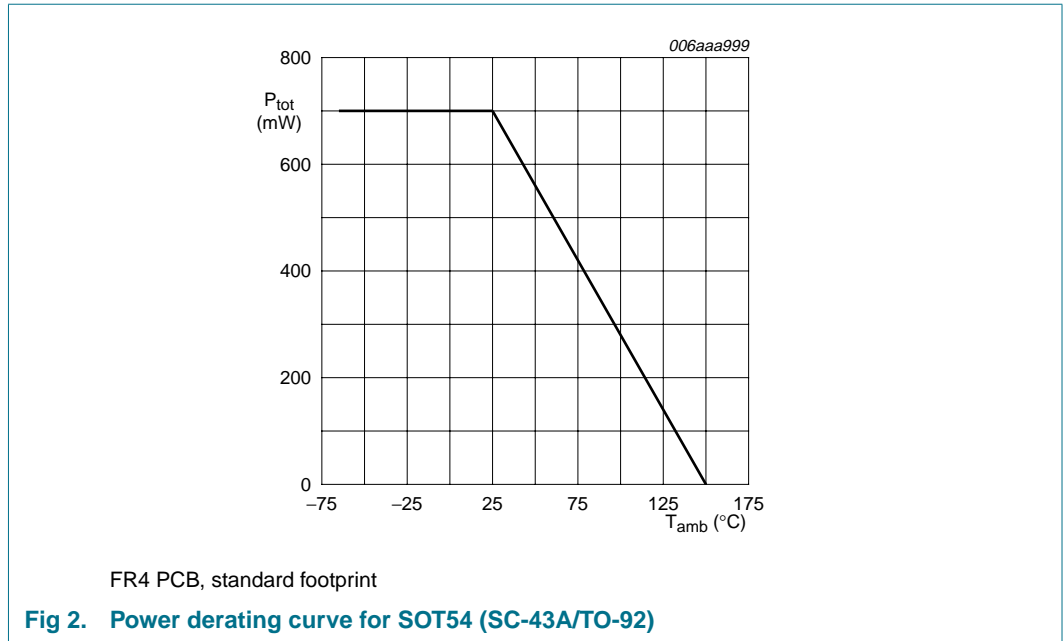
**Table 6. Limiting values ...continued**

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

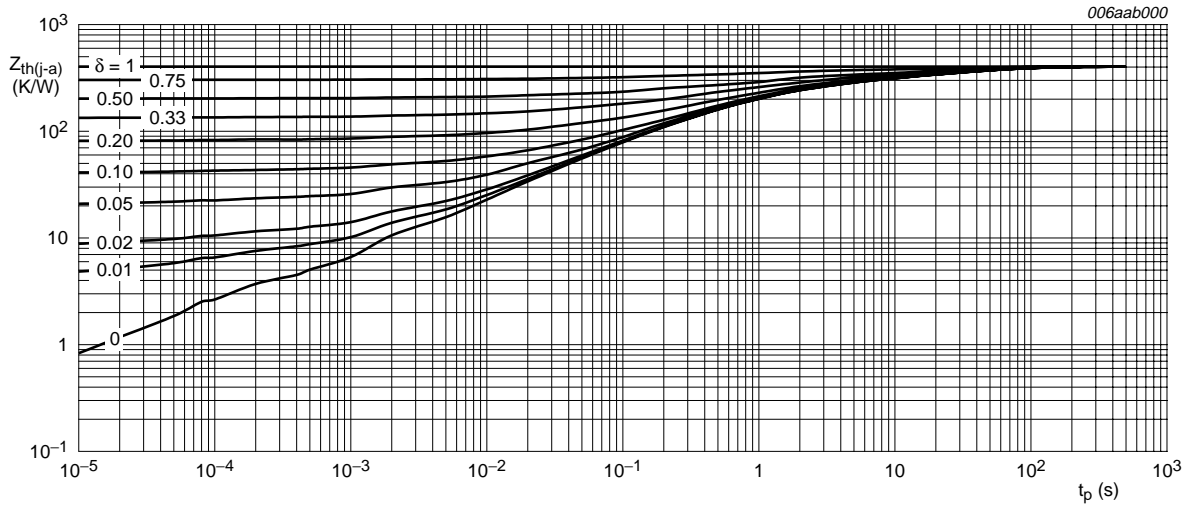
**Table 7. Thermal characteristics**

| 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 |     |

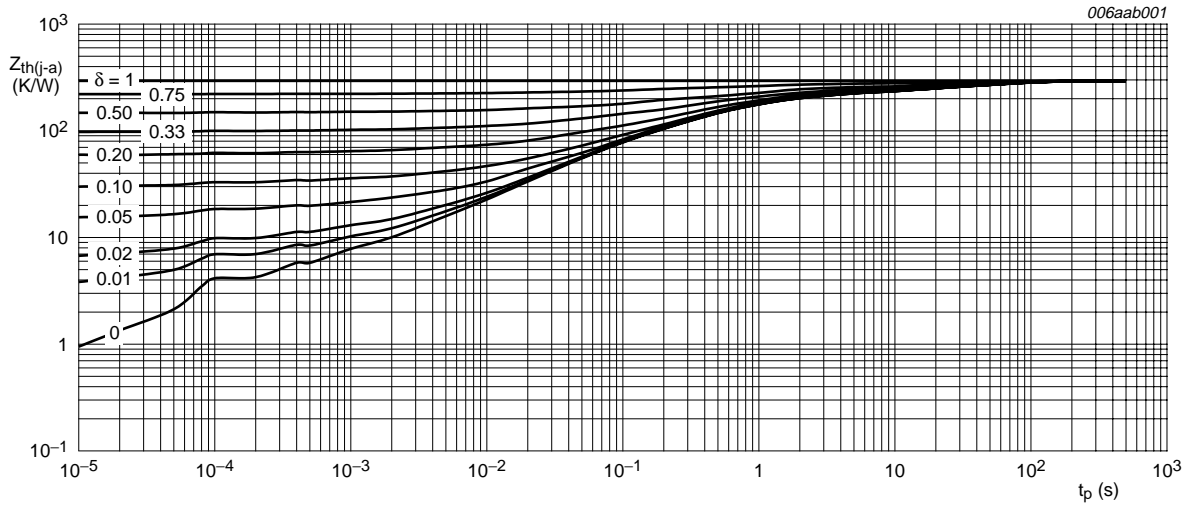
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

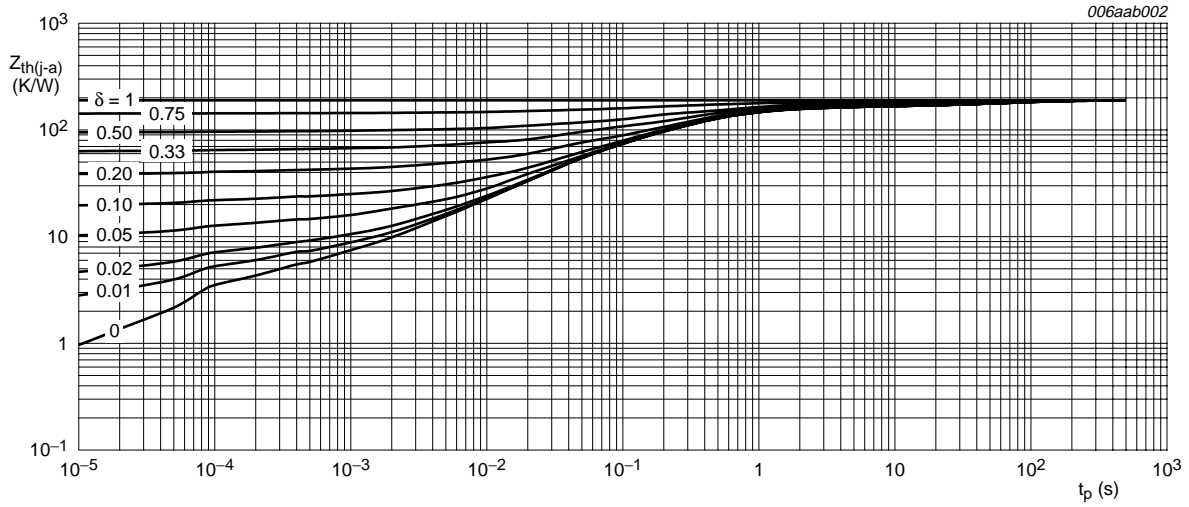
[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



**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**

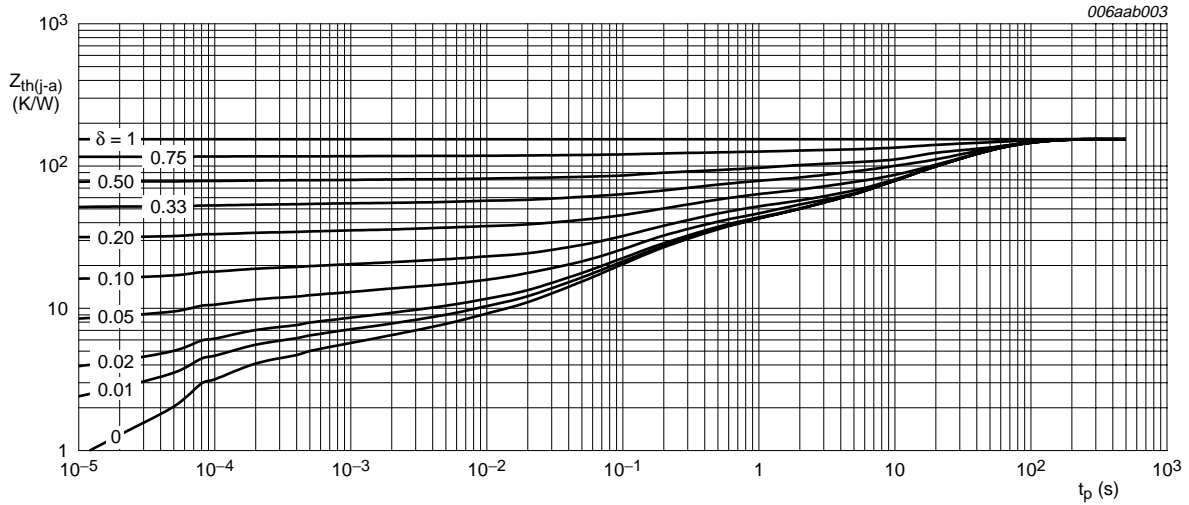


**Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values**



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

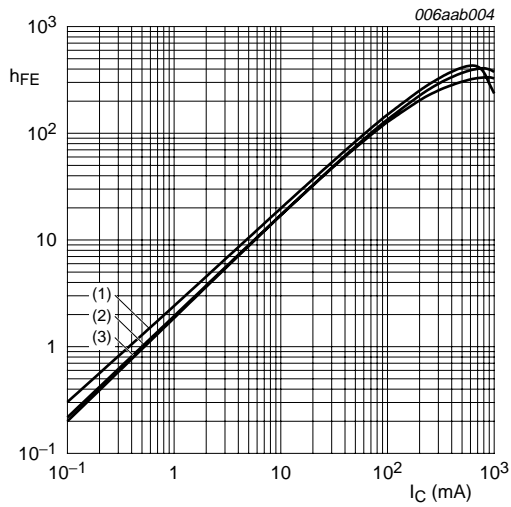
**Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT54 (SC-43A/TO-92); typical values**

## 7. Characteristics

**Table 8. Characteristics**
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol              | Parameter                            | Conditions   | Min     | Typ  | Max  | Unit       |
|---------------------|--------------------------------------|--|---------|------|------|------------|
| I <sub>CBO</sub>    | collector-base cut-off current       | V <sub>CB</sub> = 30 V;<br>I <sub>E</sub> = 0 A                                | -       | -    | 100  | nA         |
| I <sub>CEO</sub>    | collector-emitter cut-off current    | V <sub>CE</sub> = 30 V;<br>I <sub>B</sub> = 0 A                                | -       | -    | 0.5  | $\mu$ A    |
| I <sub>EBO</sub>    | emitter-base cut-off current         | V <sub>EB</sub> = 5 V;<br>I <sub>C</sub> = 0 A                                 | -       | -    | 4    | mA         |
| h <sub>FE</sub>     | DC current gain                      | V <sub>CE</sub> = 5 V;<br>I <sub>C</sub> = 50 mA                               | 40      | 75   | -    |            |
|                     |                                      | V <sub>CE</sub> = 5 V;<br>I <sub>C</sub> = 300 mA                              | [1] 180 | 300  | -    |            |
|                     |                                      | V <sub>CE</sub> = 5 V;<br>I <sub>C</sub> = 600 mA                              | [1] 250 | 400  | -    |            |
|                     |                                      | V <sub>CE</sub> = 5 V;<br>I <sub>C</sub> = 800 mA                              | [1] 270 | 420  | -    |            |
| V <sub>CEsat</sub>  | collector-emitter saturation voltage | I <sub>C</sub> = 50 mA;<br>I <sub>B</sub> = 2.5 mA                             | -       | 25   | 35   | mV         |
|                     |                                      | I <sub>C</sub> = 200 mA;<br>I <sub>B</sub> = 10 mA                             | -       | 60   | 85   | mV         |
|                     |                                      | I <sub>C</sub> = 500 mA;<br>I <sub>B</sub> = 10 mA                             | [1] -   | 160  | 220  | mV         |
|                     |                                      | I <sub>C</sub> = 600 mA;<br>I <sub>B</sub> = 6 mA                              | [1] -   | 320  | 550  | mV         |
|                     |                                      | I <sub>C</sub> = 800 mA;<br>I <sub>B</sub> = 8 mA                              | [1] -   | 0.68 | 1.15 | V          |
| V <sub>I(off)</sub> | off-state input voltage              | V <sub>CE</sub> = 5 V;<br>I <sub>C</sub> = 100 $\mu$ A                         | 0.6     | 1    | 1.5  | V          |
| V <sub>I(on)</sub>  | on-state input voltage               | V <sub>CE</sub> = 0.3 V;<br>I <sub>C</sub> = 20 mA                             | 1       | 1.3  | 1.8  | V          |
| R1                  | bias resistor 1 (input)              |  | 0.7     | 1    | 1.3  | k $\Omega$ |
| R2/R1               | bias resistor ratio                  |  | 0.9     | 1    | 1.1  |            |
| C <sub>c</sub>      | collector capacitance                | V <sub>CB</sub> = 10 V;<br>I <sub>E</sub> = I <sub>e</sub> = 0 A;<br>f = 1 MHz | -       | 7    | -    | pF         |

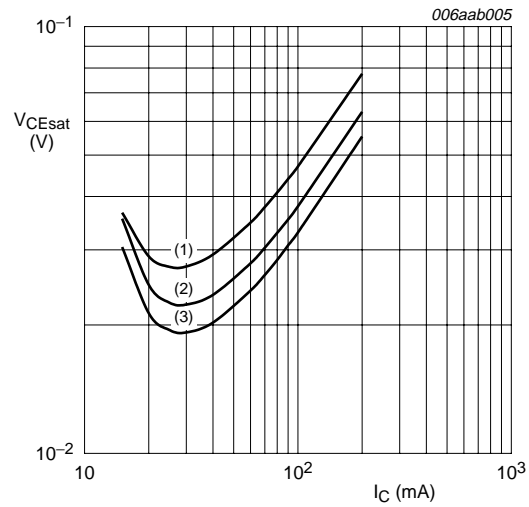
[1] Pulse test: t<sub>p</sub>  $\leq$  300  $\mu$ s;  $\delta \leq$  0.02.



$V_{CE} = 5\text{ V}$

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

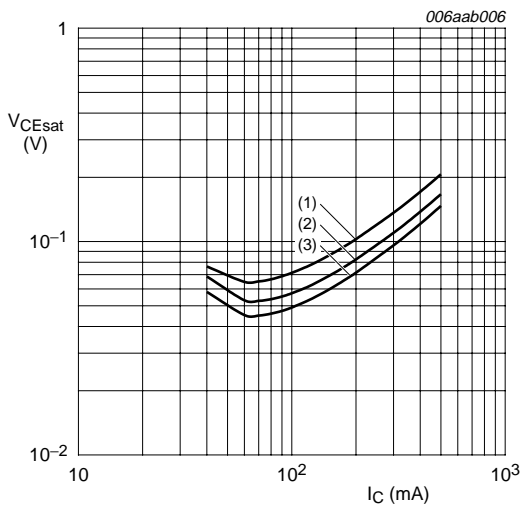
**Fig 7. DC current gain as a function of collector current; typical values**



$I_C/I_B = 20$

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

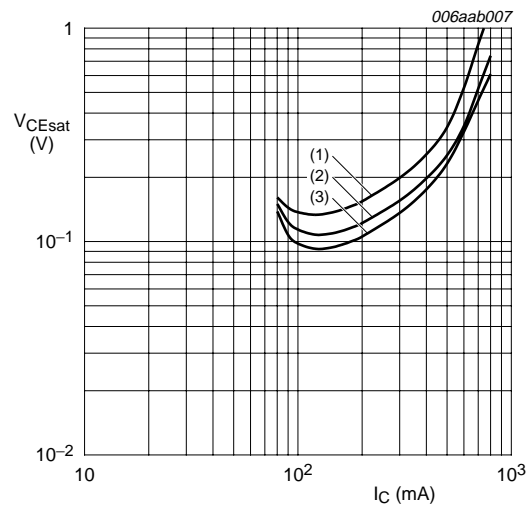
**Fig 8. Collector-emitter saturation voltage as a function of collector current; typical values**



$I_C/I_B = 50$

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

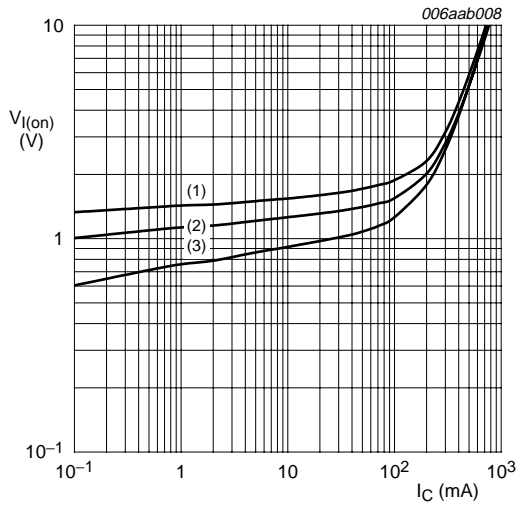
**Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values**



$I_C/I_B = 100$

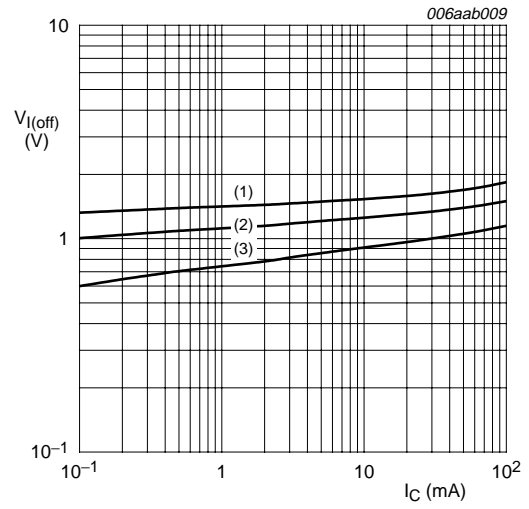
- (1)  $T_{amb} = 100\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -40\text{ °C}$

**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)  $T_{amb} = 100 \text{ }^\circ\text{C}$

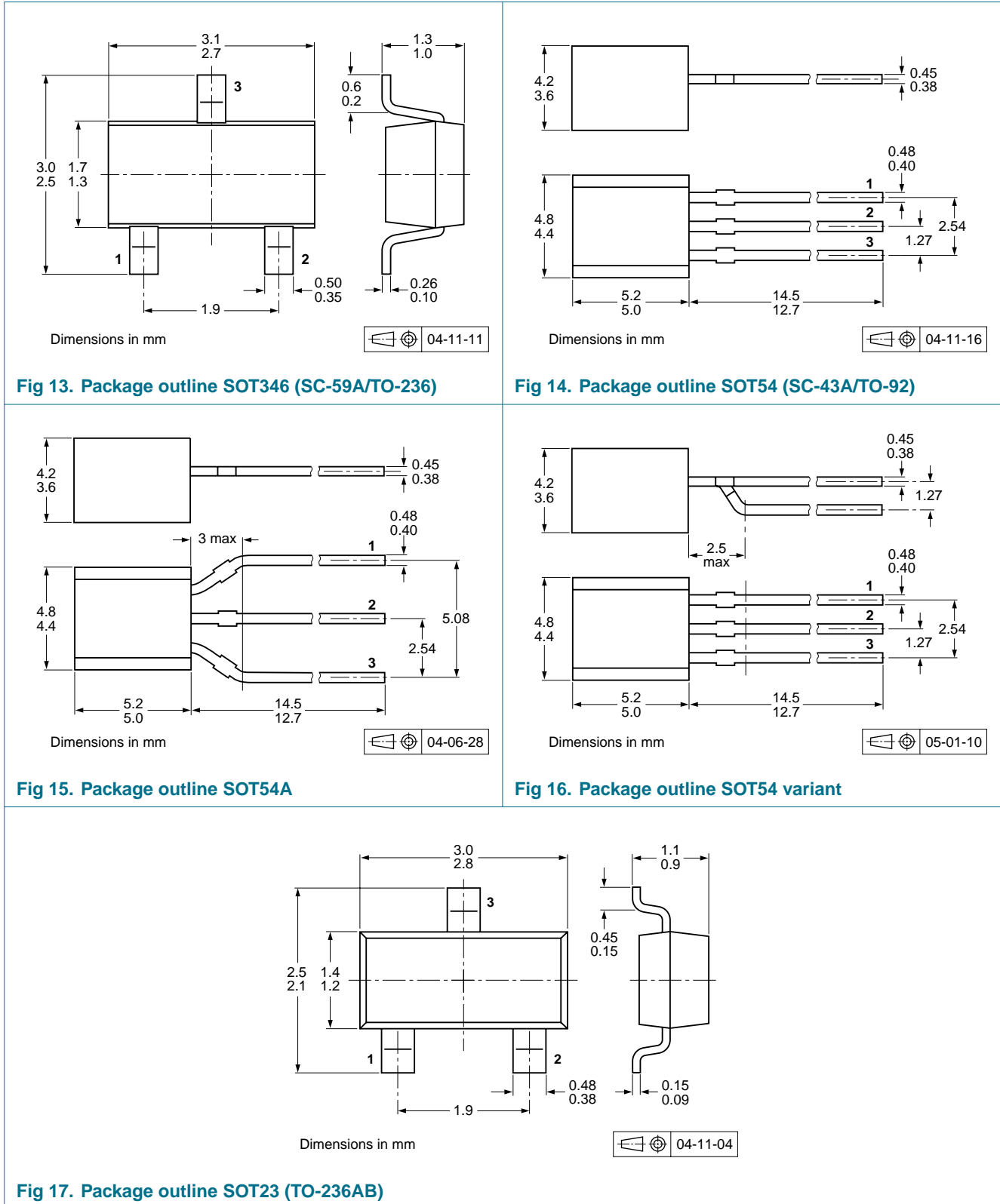
**Fig 11. On-state input voltage as a function of collector current; typical values**



$V_{CE} = 5 \text{ V}$   
 (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

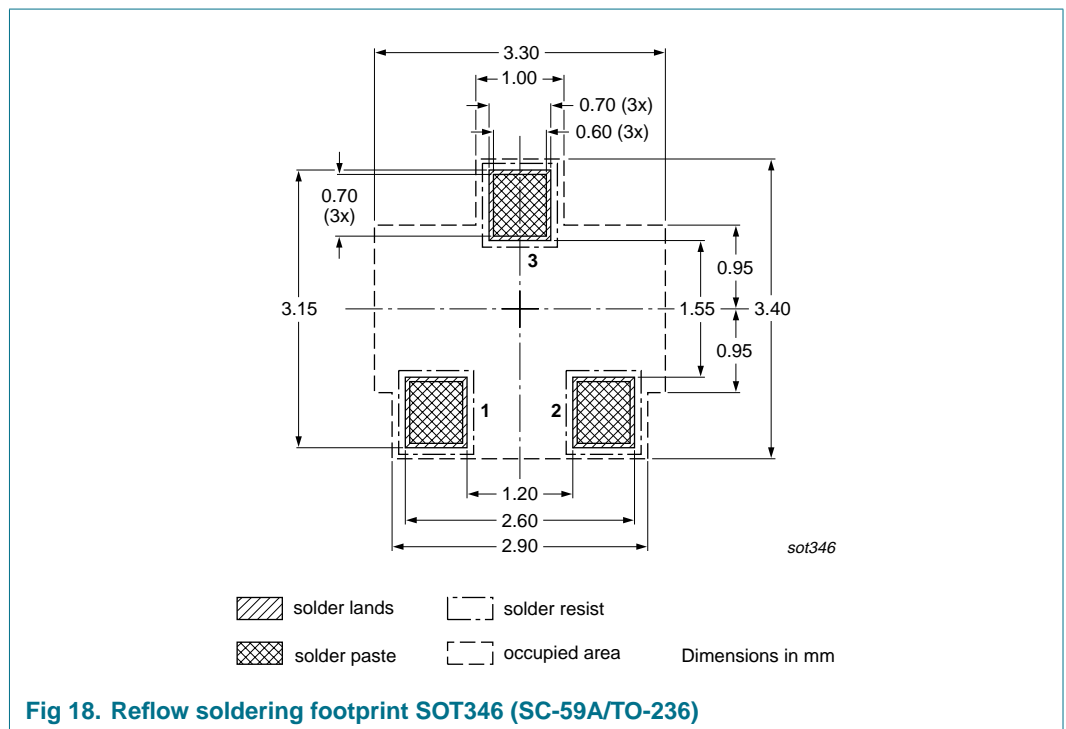
**Table 9. Packing methods**

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

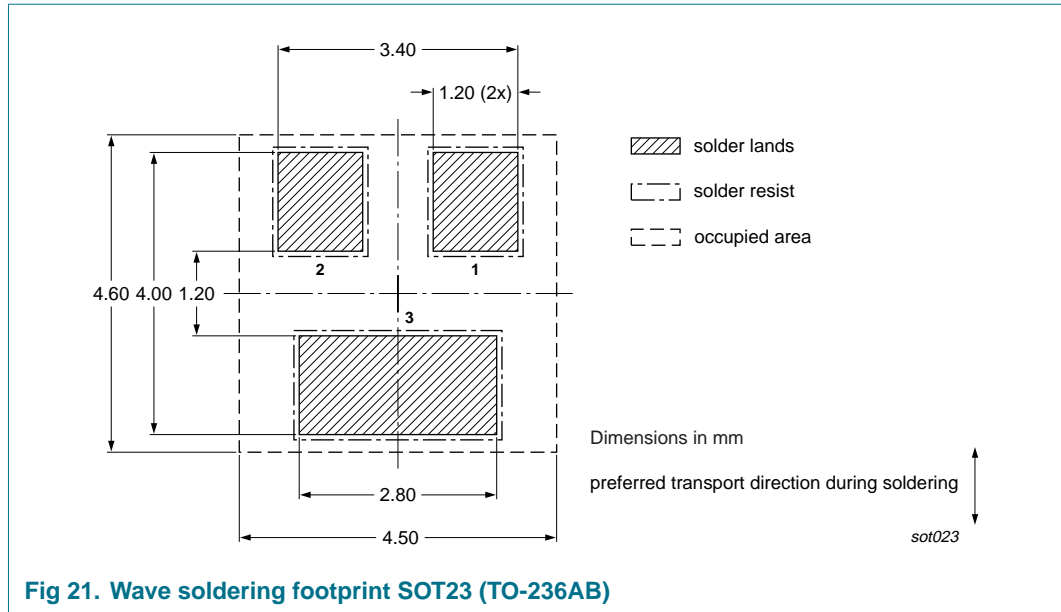
| Type number | Package       | Description                    | Packing quantity |      |       |
|-------------|---------------|--------------------------------|------------------|------|-------|
|             |               |                                | 3000             | 5000 | 10000 |
| PBRN113EK   | 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







## 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.nexperia.com>.

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## 14. Contents

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