

PBRN123E series

NPN 800 mA, 40 V BISS RETs; R1 = 2.2 kΩ, R2 = 2.2 kΩ

Rev. 01 — 27 February 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
PBRN123EK	SOT346	SC-59A	TO-236
PBRN123ES ^[1]	SOT54	SC-43A	TO-92
PBRN123ET	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		^[1]			
	PBRN123EK, PBRN123ET		-	-	600	mA
	PBRN123ES		-	-	800	mA

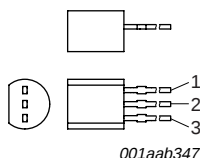
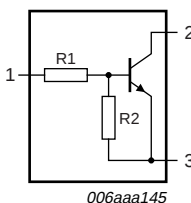
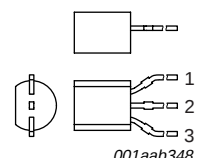
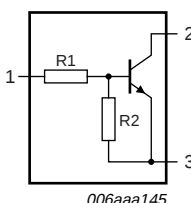
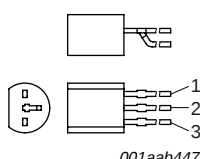
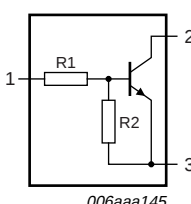
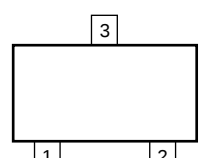
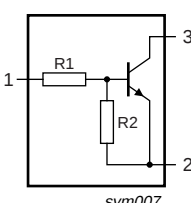
Table 2. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{ORM}	repetitive peak output current					
	PBRN123EK, PBRN123ET	$t_p \leq 1$ ms; $\delta \leq 0.33$	-	-	800	mA
R1	bias resistor 1 (input)		1.54	2.2	2.86	k Ω
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
SOT54			
1	input (base)	 001aab347	 006aaa145
2	output (collector)		
3	GND (emitter)		
SOT54A			
1	input (base)	 001aab348	 006aaa145
2	output (collector)		
3	GND (emitter)		
SOT54 variant			
1	input (base)	 001aab447	 006aaa145
2	output (collector)		
3	GND (emitter)		
SOT23; SOT346			
1	input (base)	 006aaa144	 sym007
2	GND (emitter)		
3	output (collector)		

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
PBRN123EK	SC-59A	plastic surface-mounted package; 3 leads	SOT346
PBRN123ES ^[1]	SC-43A	plastic single-ended leaded (through hole) package; 3 leads	SOT54
PBRN123ET	-	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 ^[1]
PBRN123EK	G3
PBRN123ES	N123ES
PBRN123ET	*7J

[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).

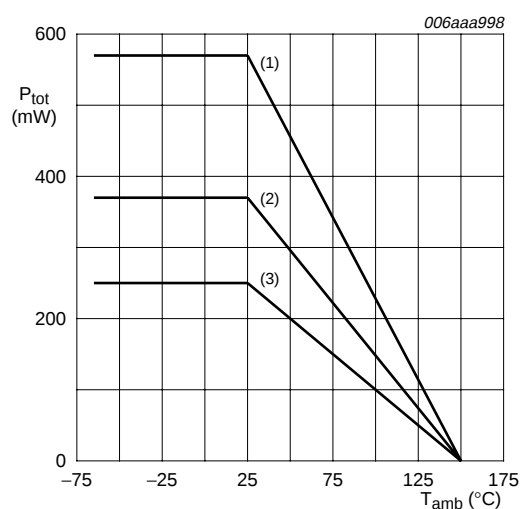
Symbol	Parameter	Conditions	Min	Max	Unit
V _{CBO}	collector-base voltage	open emitter	-	40	V
V _{CEO}	collector-emitter voltage	open base	-	40	V
V _{EBO}	emitter-base voltage	open collector	-	10	V
V _I	input voltage				
	positive		-	+22	V
	negative		-	-10	V
I _O	output current				
	PBRN123EK, PBRN123ET	^[1]	-	600	mA
		^{[2][3]}	-	700	mA
	PBRN123ES	^[1]	-	800	mA
I _{ORM}	repetitive peak output current				
	PBRN123EK, PBRN123ET	t _p ≤ 1 ms; δ ≤ 0.33	-	800	mA

Table 6. Limiting values ...continued

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

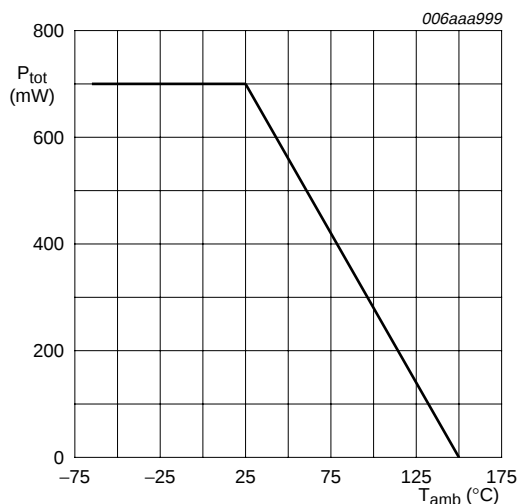
Symbol	Parameter	Conditions	Min	Max	Unit
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C			
	PBRN123EK, PBRN123ET		[1] -	250	mW
			[2] -	370	mW
			[3] -	570	mW
	PBRN123ES		[1] -	700	mW
T _j	junction temperature		-	150	°C
T _{amb}	ambient temperature		−65	+150	°C
T _{stg}	storage temperature		−65	+150	°C

[1] Device mounted on an FR4 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 cm².[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.

- (1) Ceramic PCB, Al₂O₃, standard footprint
- (2) FR4 PCB, mounting pad for collector 1 cm²
- (3) FR4 PCB, standard footprint

Fig 1. Power derating curves for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236)



FR4 PCB, standard footprint

Fig 2. Power derating curve for SOT54 (SC-43A/TO-92)

6. Thermal characteristics

Table 7. 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
			[3]	-	-	219 K/W
			[1]	-	-	179 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 copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm².[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.

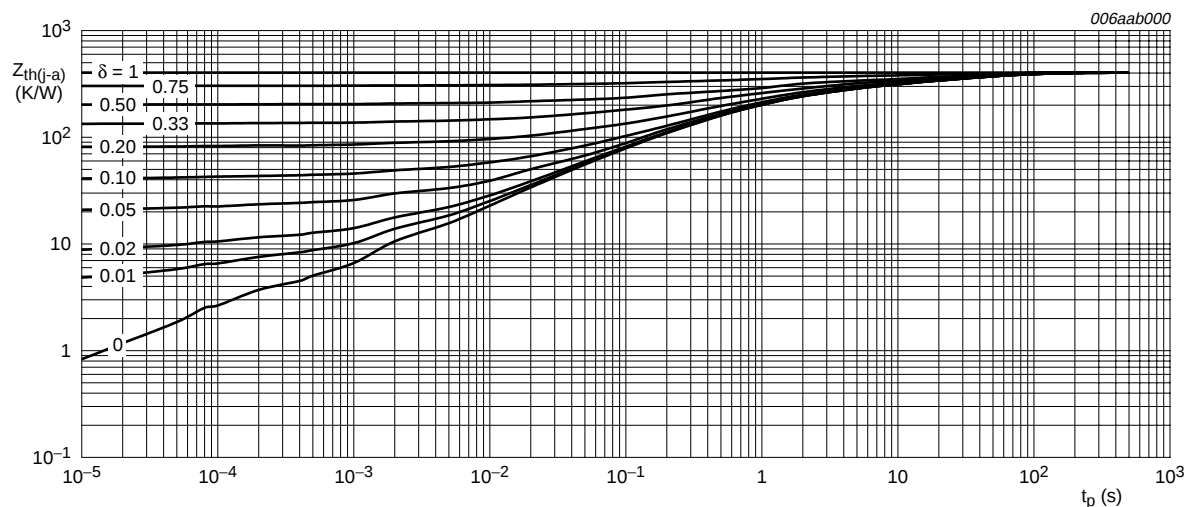


Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values

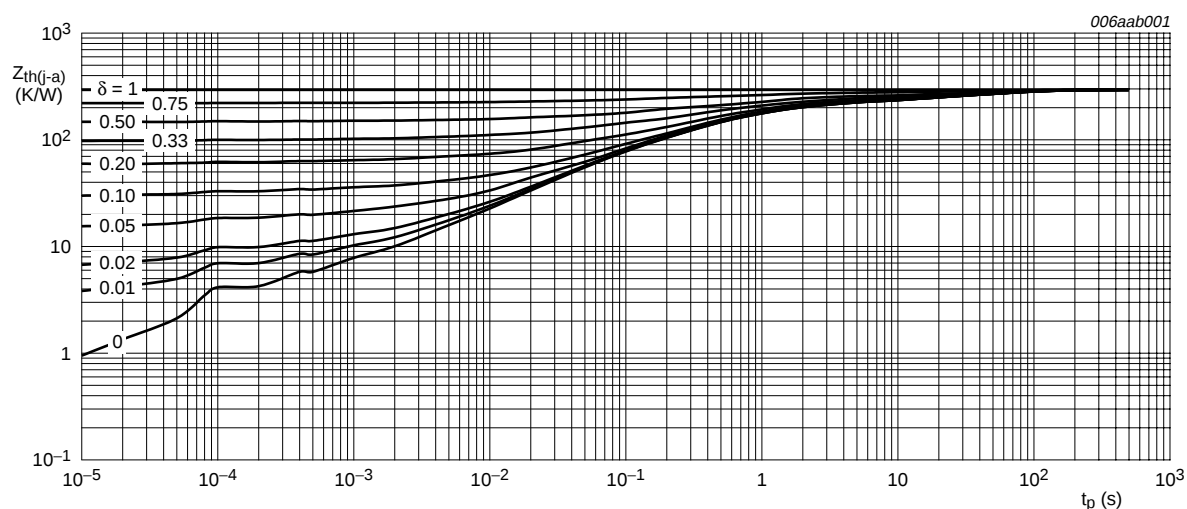


Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values

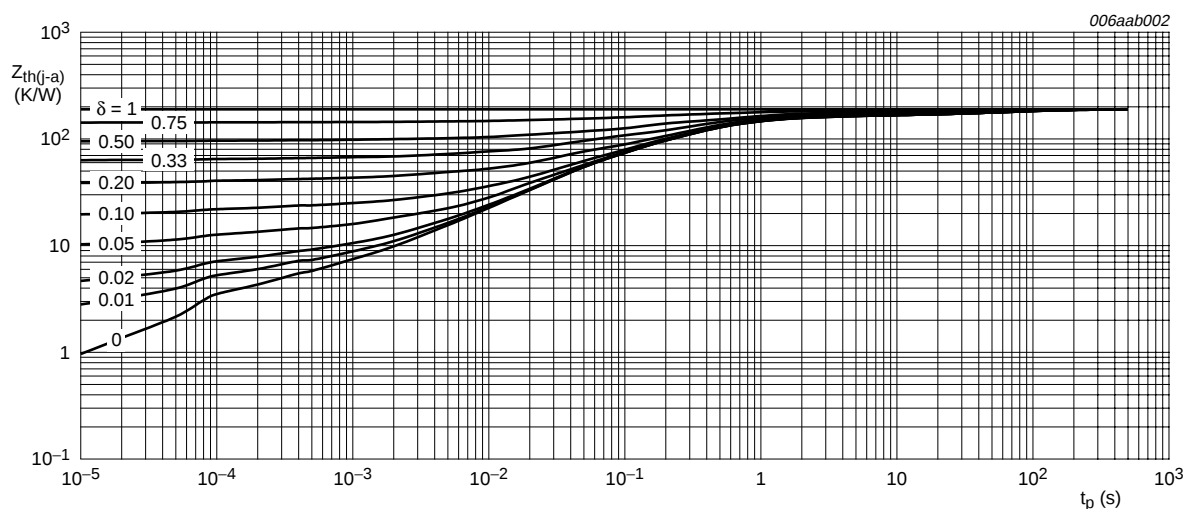
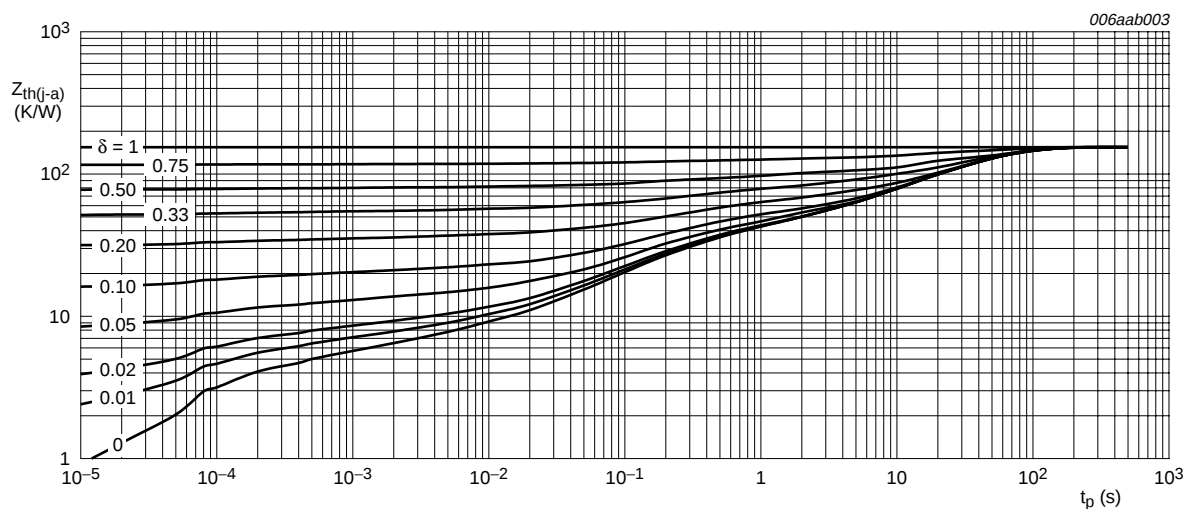
Ceramic PCB, Al₂O₃, standard footprint

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

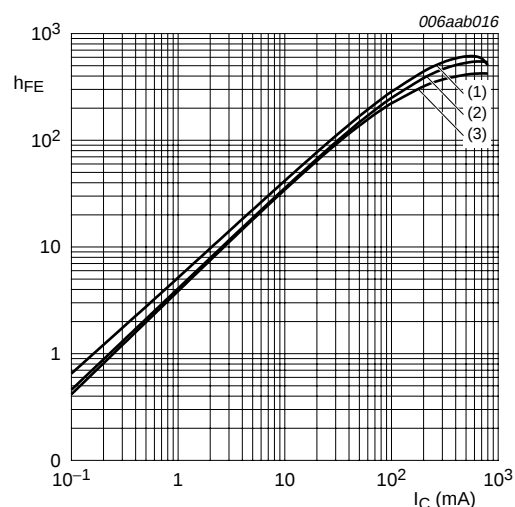
Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT54 (SC-43A/TO-92); typical values

7. Characteristics

Table 8. Characteristics*T_{amb} = 25 °C unless otherwise specified.*

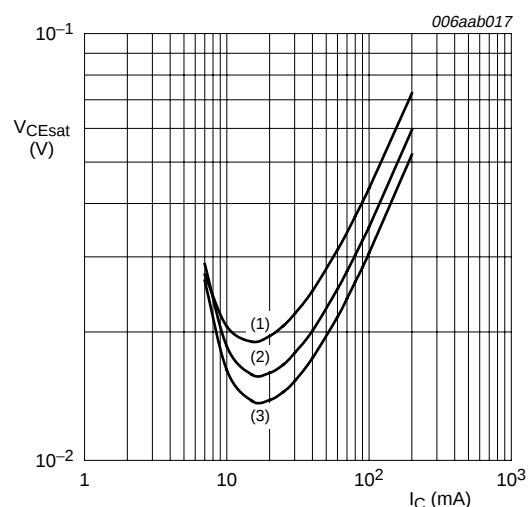
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{CBO}	collector-base cut-off current	V _{CB} = 30 V; I _E = 0 A	-	-	100	nA
I _{CEO}	collector-emitter cut-off current	V _{CE} = 30 V; I _B = 0 A	-	-	0.5	μ A
I _{EBO}	emitter-base cut-off current	V _{EB} = 5 V; I _C = 0 A	-	-	2	mA
h _{FE}	DC current gain	V _{CE} = 5 V; I _C = 50 mA	70	135	-	
		V _{CE} = 5 V; I _C = 300 mA	[1] 280	460	-	
		V _{CE} = 5 V; I _C = 600 mA	[1] 350	560	-	
		V _{CE} = 5 V; I _C = 800 mA	[1] 340	550	-	
V _{CEsat}	collector-emitter saturation voltage	I _C = 50 mA; I _B = 2.5 mA	-	25	35	mV
		I _C = 200 mA; I _B = 10 mA	-	60	85	mV
		I _C = 500 mA; I _B = 10 mA	[1] -	160	220	mV
		I _C = 600 mA; I _B = 6 mA	[1] -	290	550	mV
		I _C = 800 mA; I _B = 8 mA	[1] -	0.63	1.15	V
V _{I(off)}	off-state input voltage	V _{CE} = 5 V; I _C = 100 μ A	0.6	1	1.8	V
V _{I(on)}	on-state input voltage	V _{CE} = 0.3 V; I _C = 20 mA	1	1.3	2	V
R1	bias resistor 1 (input)		1.54	2.2	2.86	k Ω
R2/R1	bias resistor ratio		0.9	1	1.1	
C _c	collector capacitance	V _{CB} = 10 V; I _E = i _e = 0 A; f = 1 MHz	-	7	-	pF

[1] Pulse test: t_p ≤ 300 μ s; δ ≤ 0.02.


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

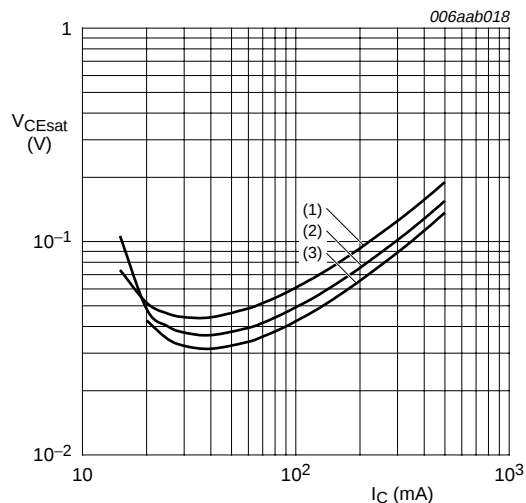
- (1) $T_{amb} = 100 \text{ }^{\circ}\text{C}$
- (2) $T_{amb} = 25 \text{ }^{\circ}\text{C}$
- (3) $T_{amb} = -40 \text{ }^{\circ}\text{C}$

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


 $I_C/I_B = 20$

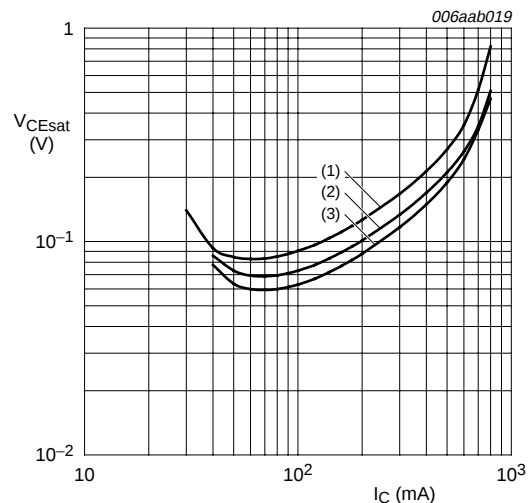
- (1) $T_{amb} = 100 \text{ }^{\circ}\text{C}$
- (2) $T_{amb} = 25 \text{ }^{\circ}\text{C}$
- (3) $T_{amb} = -40 \text{ }^{\circ}\text{C}$

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


 $I_C/I_B = 50$

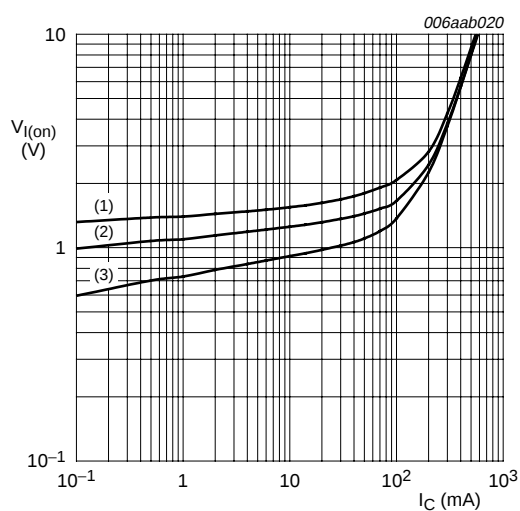
- (1) $T_{amb} = 100 \text{ }^{\circ}\text{C}$
- (2) $T_{amb} = 25 \text{ }^{\circ}\text{C}$
- (3) $T_{amb} = -40 \text{ }^{\circ}\text{C}$

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


 $I_C/I_B = 100$

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

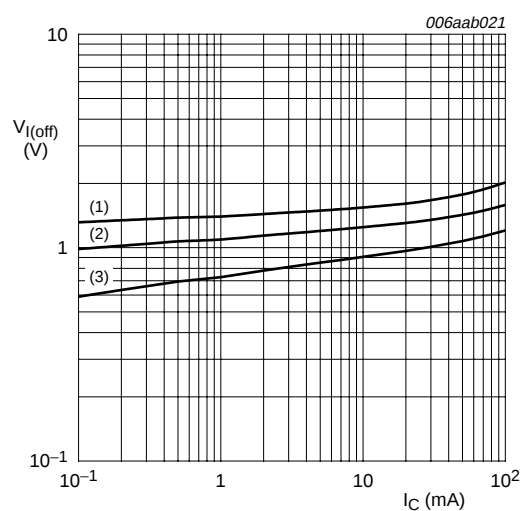
Fig 10. Collector-emitter saturation voltage as a function of collector current; typical values



$V_{CE} = 0.3$ V

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

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

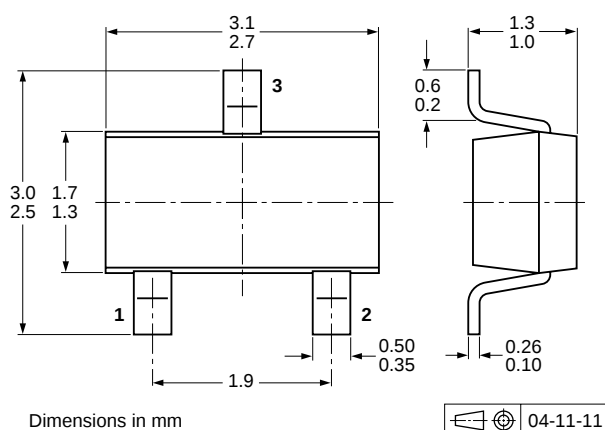
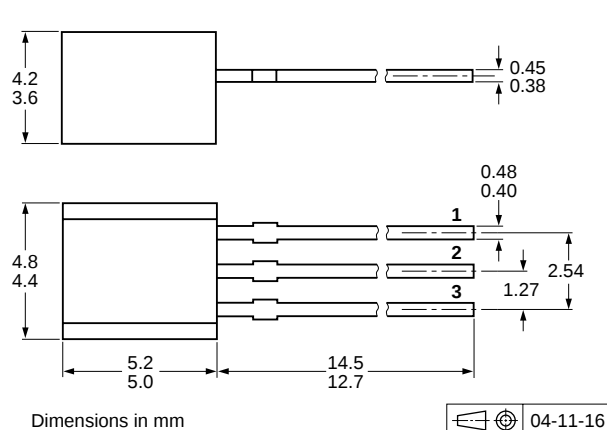
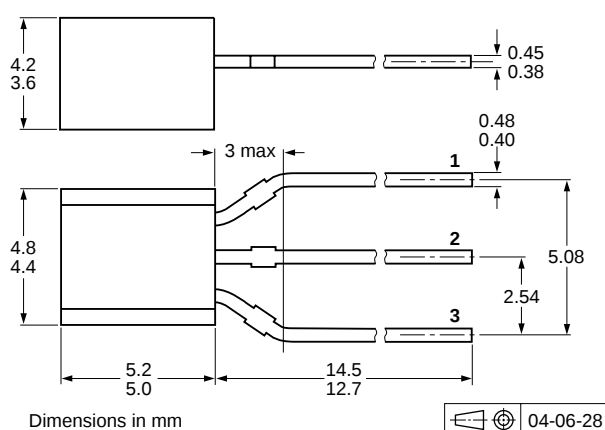
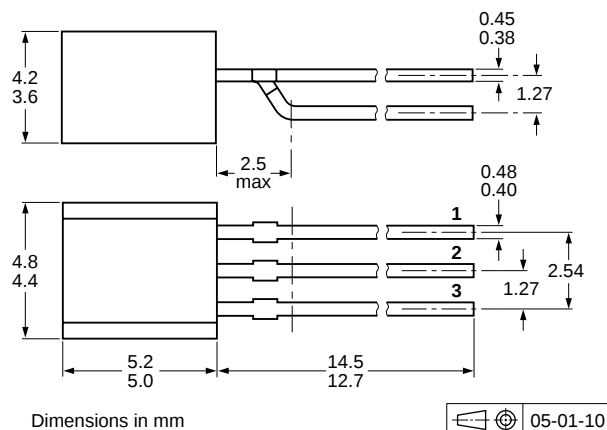
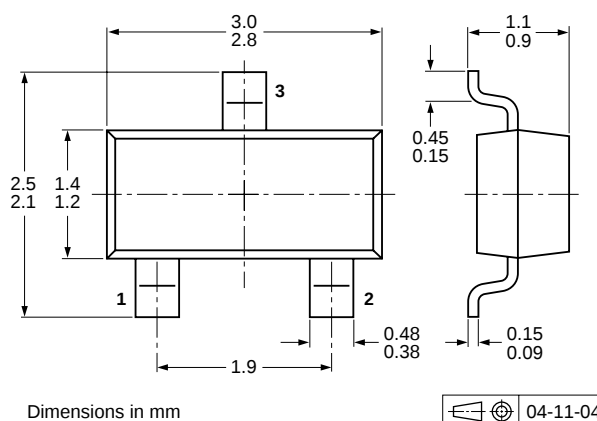


$V_{CE} = 5$ V

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

Fig 12. Off-state input voltage as a function of collector current; typical values

8. Package outline

**Fig 13. Package outline SOT346 (SC-59A/TO-236)****Fig 14. Package outline SOT54 (SC-43A/TO-92)****Fig 15. Package outline SOT54A****Fig 16. Package outline SOT54 variant****Fig 17. Package outline SOT23 (TO-236AB)**

9. Packing information

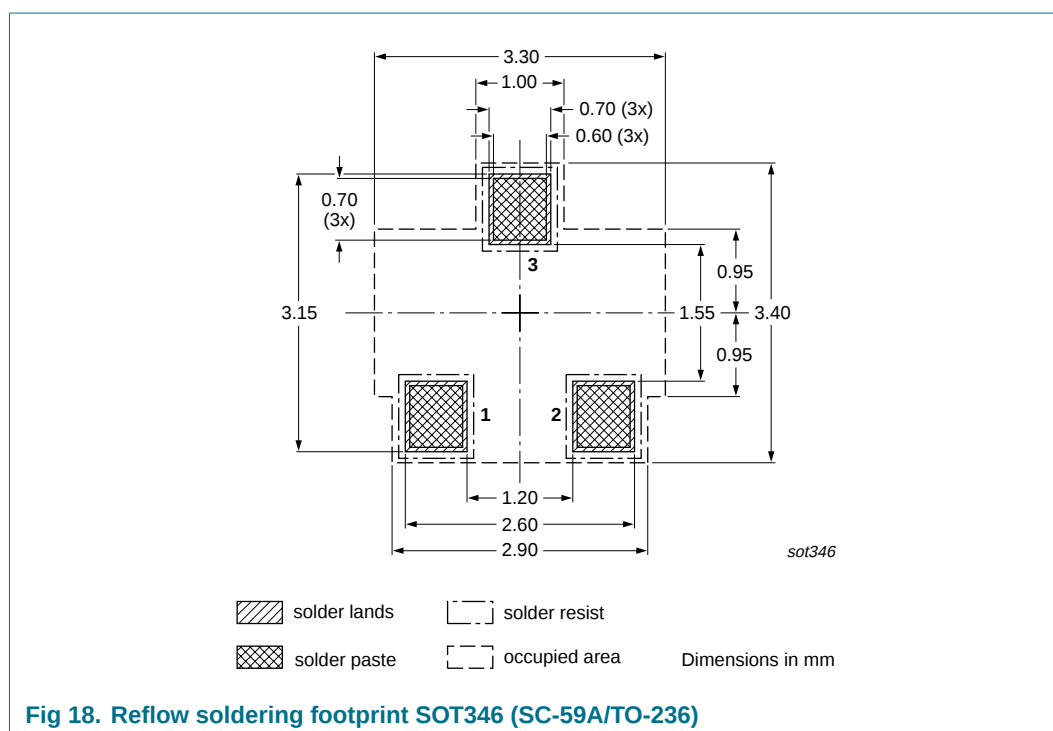
Table 9. Packing methods

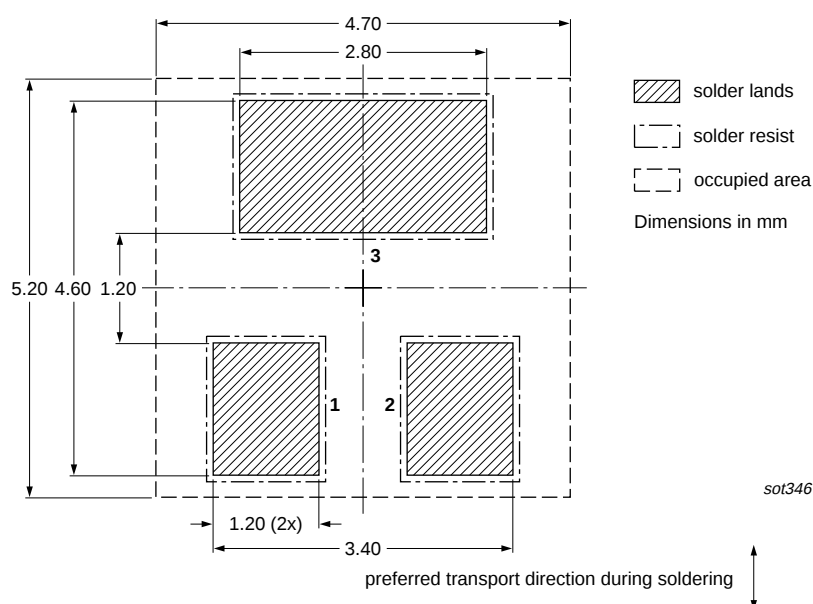
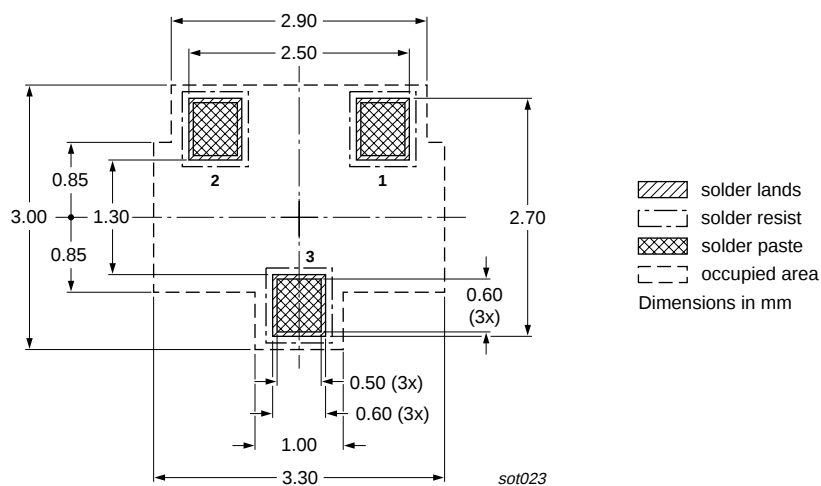
The indicated -xxx are the last three digits of the 12NC ordering code.[\[1\]](#)

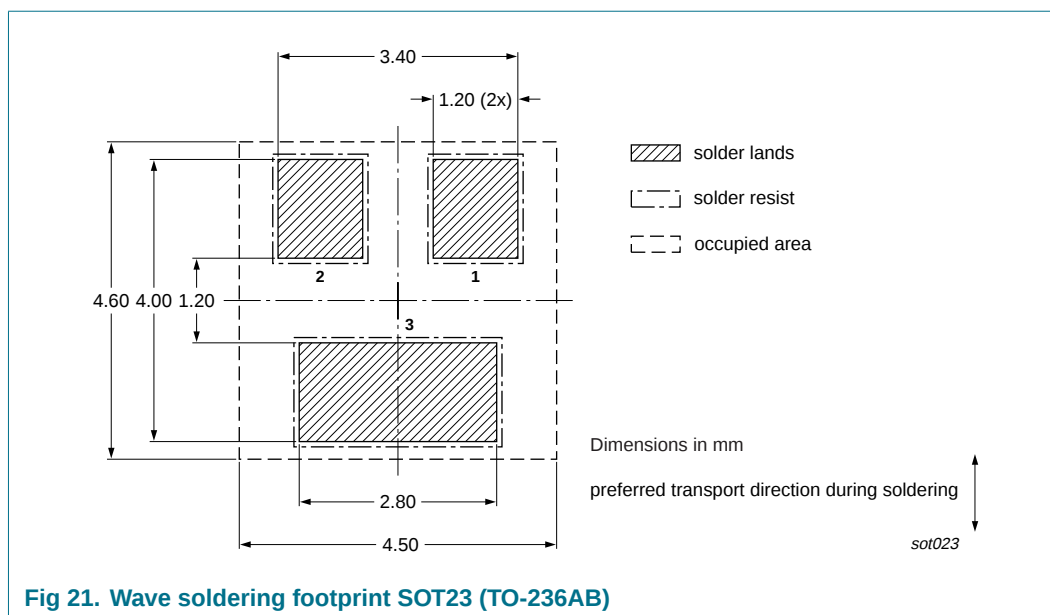
Type number	Package	Description	Packing quantity		
			3000	5000	10000
PBRN123EK	SOT346	4 mm pitch, 8 mm tape and reel	-115	-	-135
PBRN123ES	SOT54	bulk, straight leads	-	-412	-
	SOT54A	tape and reel, wide pitch	-	-	-116
		tape ammpack, wide pitch	-	-	-126
	SOT54 variant	bulk, delta pinning	-	-112	-
PBRN123ET	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
PBRN123E_SER_1	20070227	Product data sheet	-	-

12. Legal information

12.1 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".

[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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