

PBRN123E series

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

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

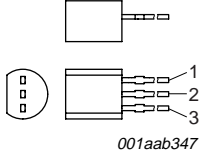
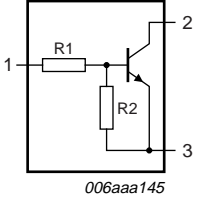
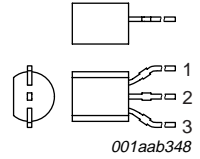
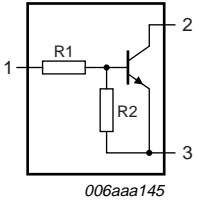
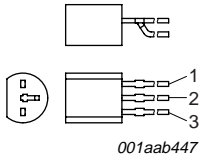
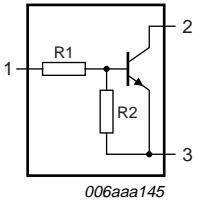
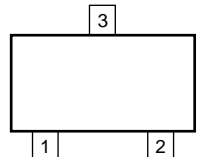
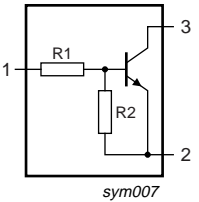
Table 2. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{ORM}	repetitive peak output current					
	PBRN123EK, PBRN123ET	t _p ≤ 1 ms; δ ≤ 0.33	-	-	800	mA
R1	bias resistor 1 (input)		1.54	2.2	2.86	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
SOT54			
1	input (base)	 <p>001aab347</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
SOT54A			
1	input (base)	 <p>001aab348</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
SOT54 variant			
1	input (base)	 <p>001aab447</p>	 <p>006aaa145</p>
2	output (collector)		
3	GND (emitter)		
SOT23; SOT346			
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		
	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).

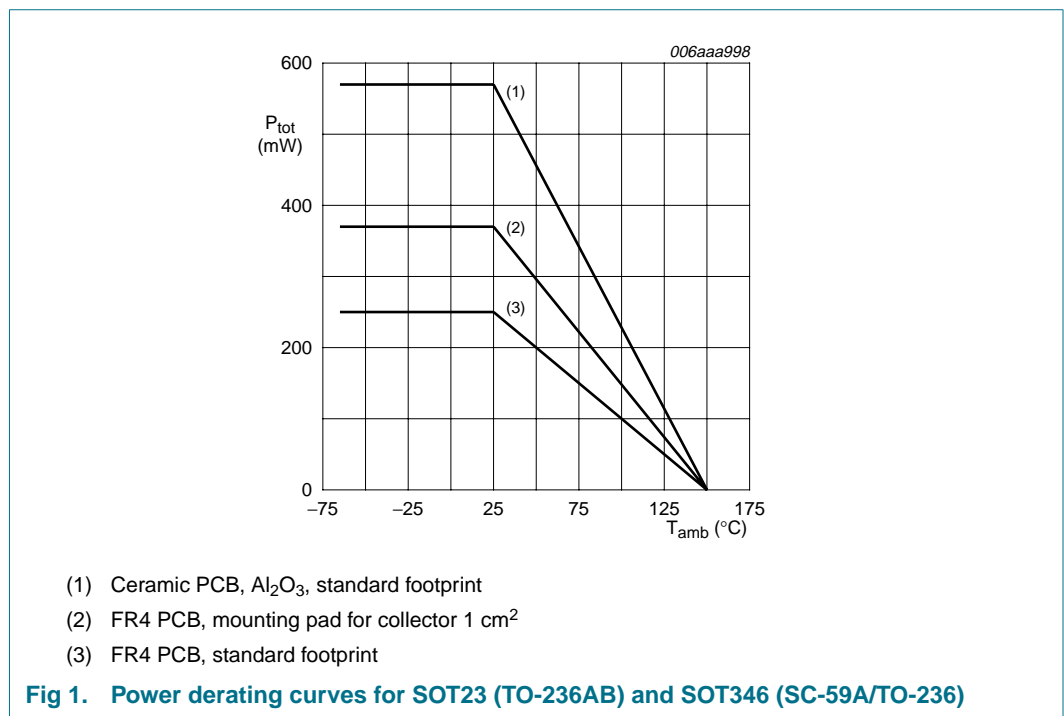
Symbol	Parameter	Conditions	Min	Max	Unit
V _{CBO}	collector-base voltage	open emitter	-	40	V
V _{CEO}	collector-emitter voltage	open base	-	40	V
V _{EBO}	emitter-base voltage	open collector	-	10	V
V _I	input voltage				
	positive		-	+22	V
	negative		-	-10	V
I _O	output current				
	PBRN123EK, PBRN123ET		^[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

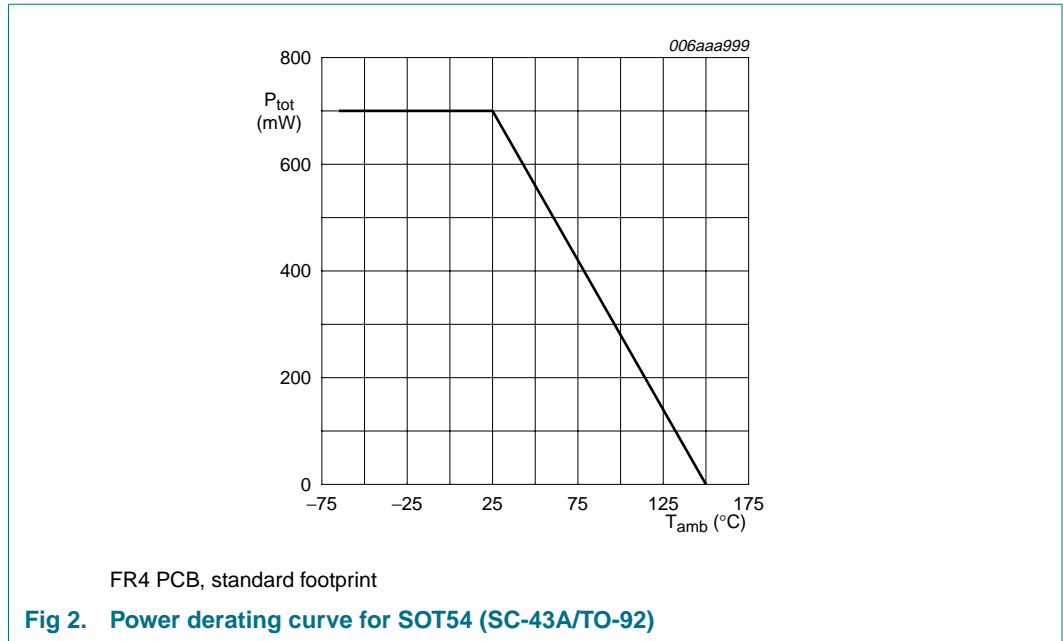
Table 6. Limiting values ...continued

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.





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						
			PBRN123EK, PBRN123ET	[1]	-	-	500	K/W
				[2]	-	-	338	K/W
				[3]	-	-	219	K/W
	PBRN123ES		[1]	-	-	179	K/W	
R _{th(j-sp)}	thermal resistance from junction to solder point							
		PBRN123EK, PBRN123ET		-	-	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.

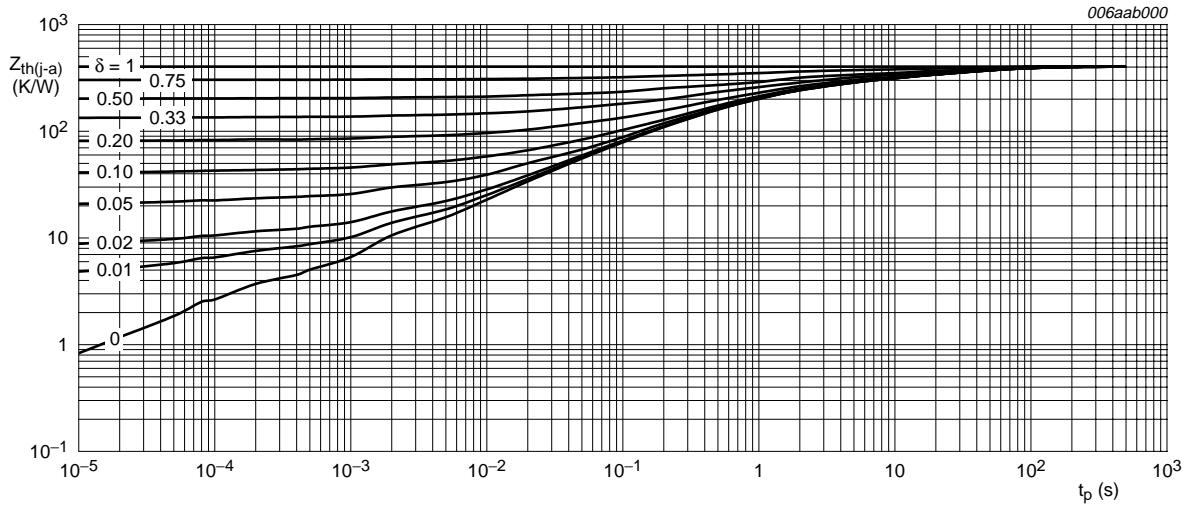


Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values

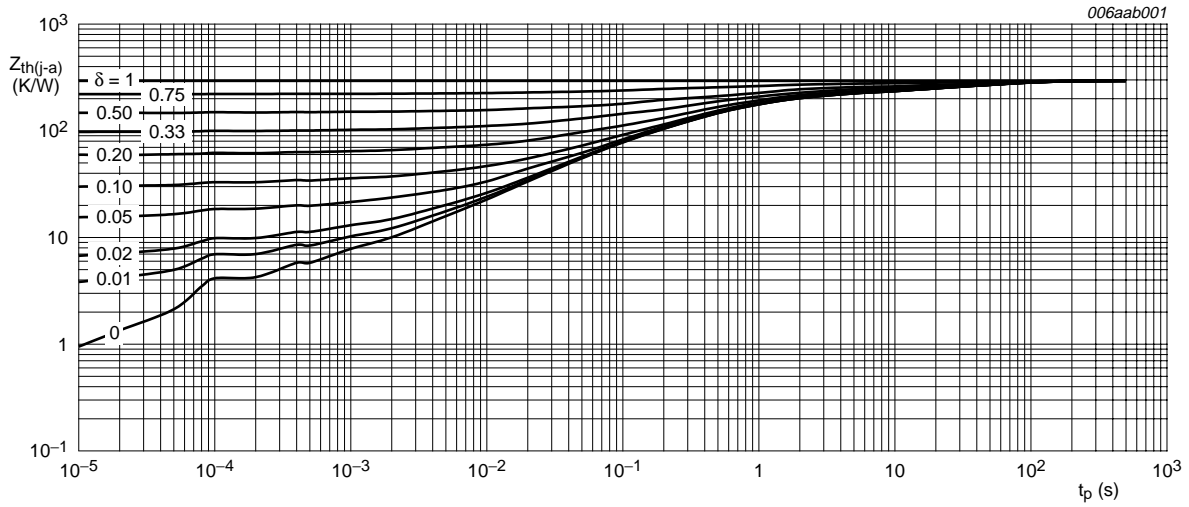
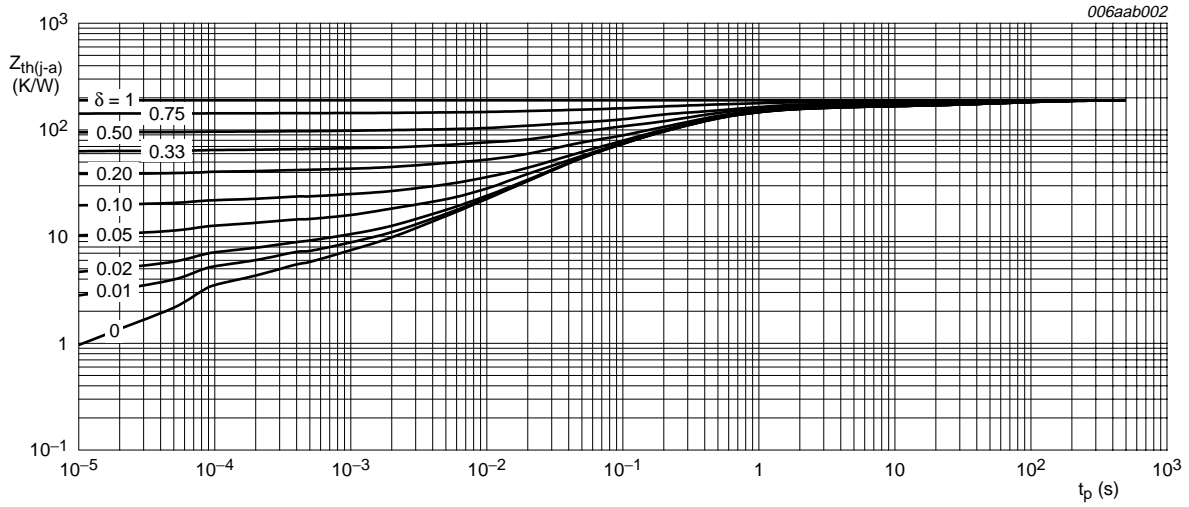
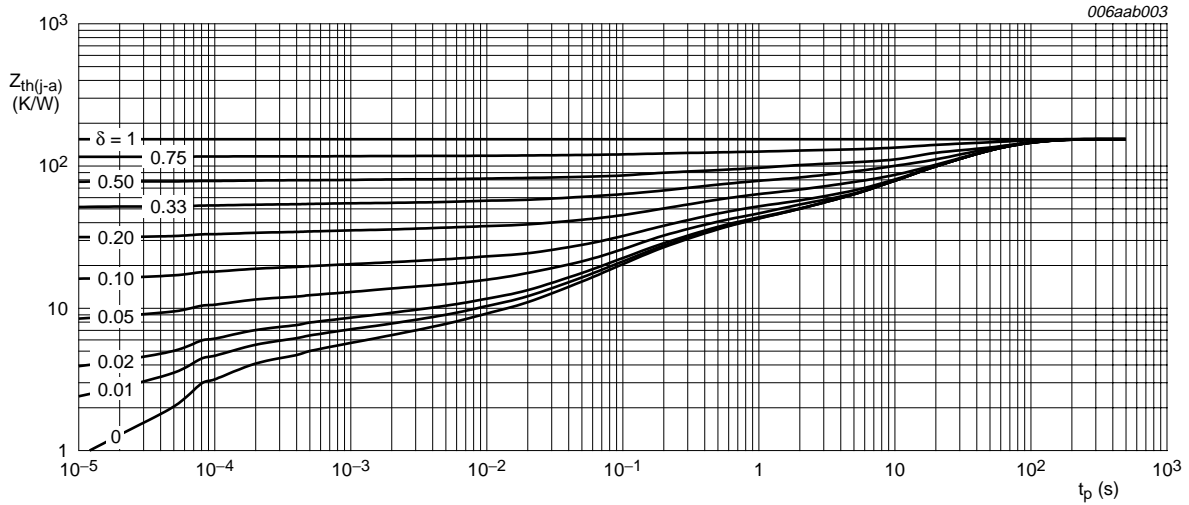


Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT23 (TO-236AB) and SOT346 (SC-59A/TO-236); typical values



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

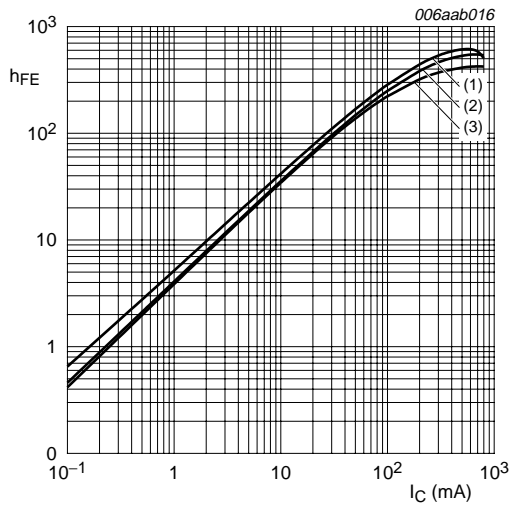
Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT54 (SC-43A/TO-92); typical values

7. Characteristics

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

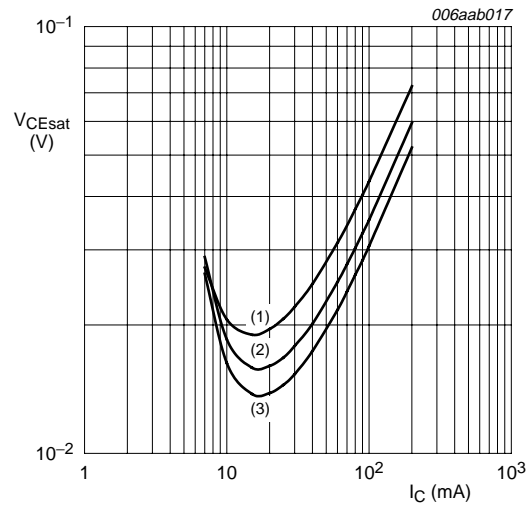
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{CBO}	collector-base cut-off current	V _{CB} = 30 V; I _E = 0 A	-	-	100	nA
I _{CEO}	collector-emitter cut-off current	V _{CE} = 30 V; I _B = 0 A	-	-	0.5	μ A
I _{EBO}	emitter-base cut-off current	V _{EB} = 5 V; I _C = 0 A	-	-	2	mA
h _{FE}	DC current gain	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 \leq 300 μ s; $\delta \leq$ 0.02.



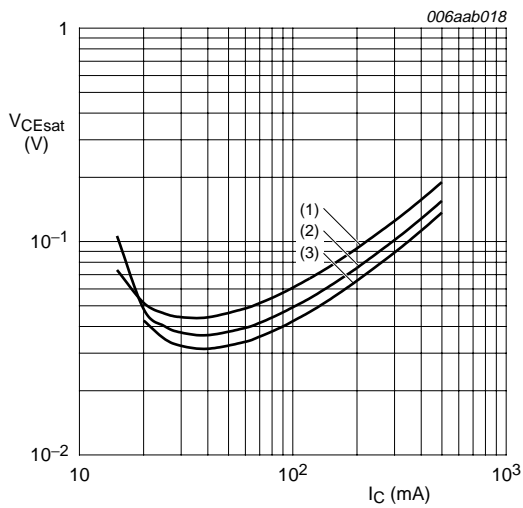
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



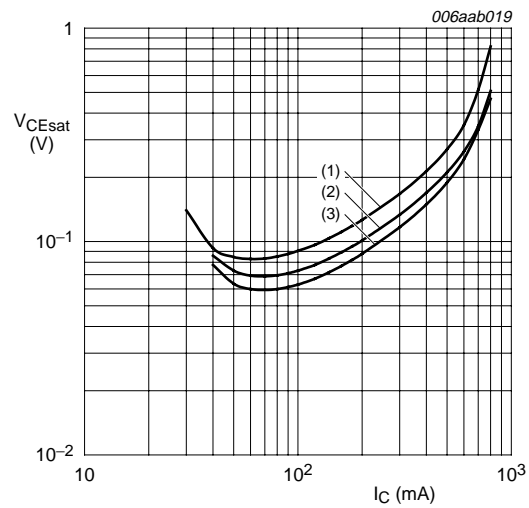
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



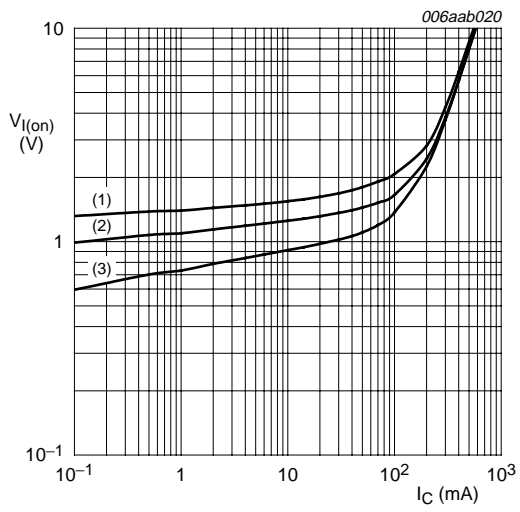
$I_C/I_B = 50$
 (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



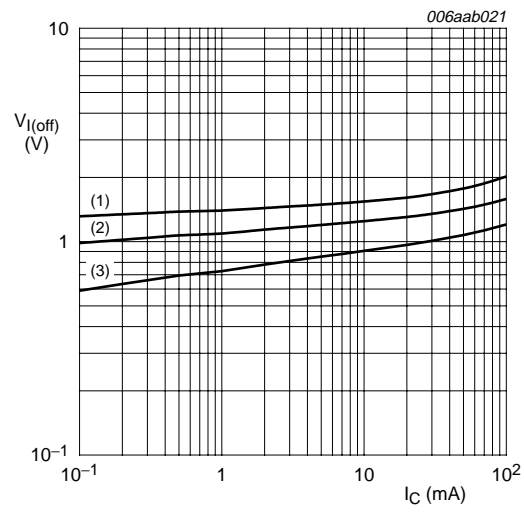
$I_C/I_B = 100$
 (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



$V_{CE} = 0.3 \text{ V}$
 (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

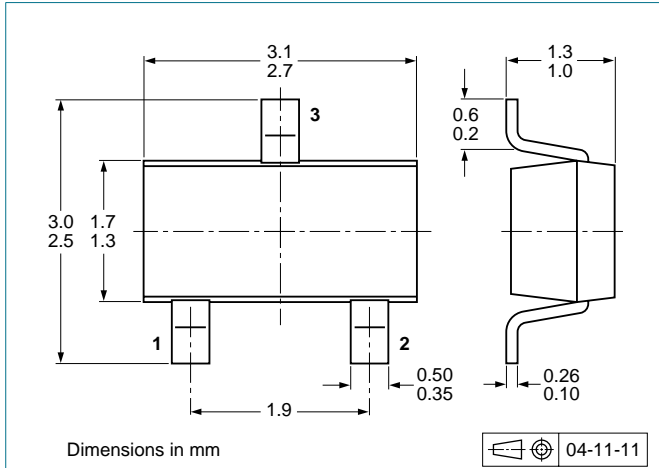


Fig 13. Package outline SOT346 (SC-59A/TO-236)

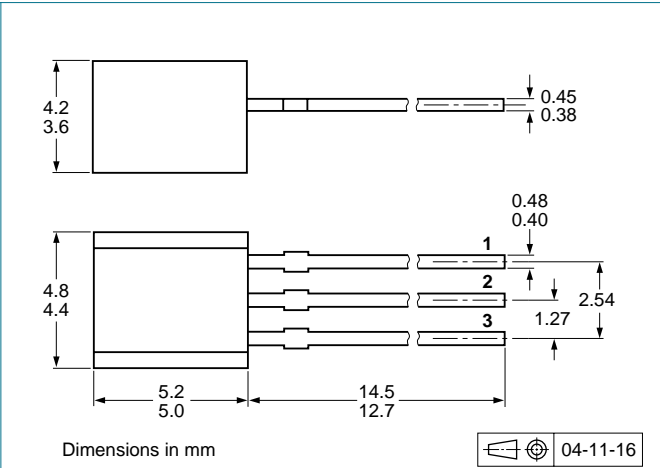


Fig 14. Package outline SOT54 (SC-43A/TO-92)

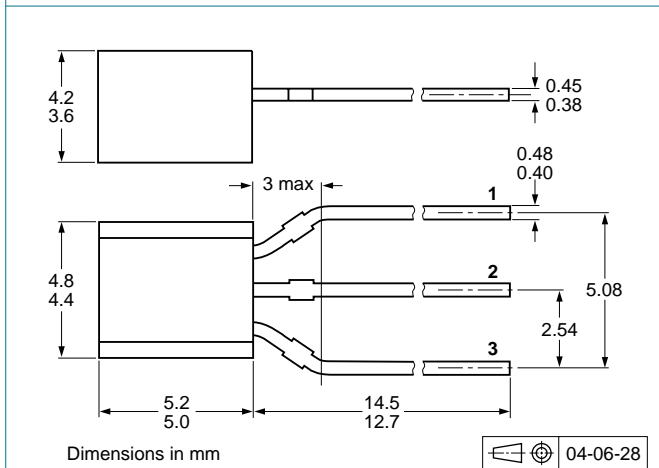


Fig 15. Package outline SOT54A

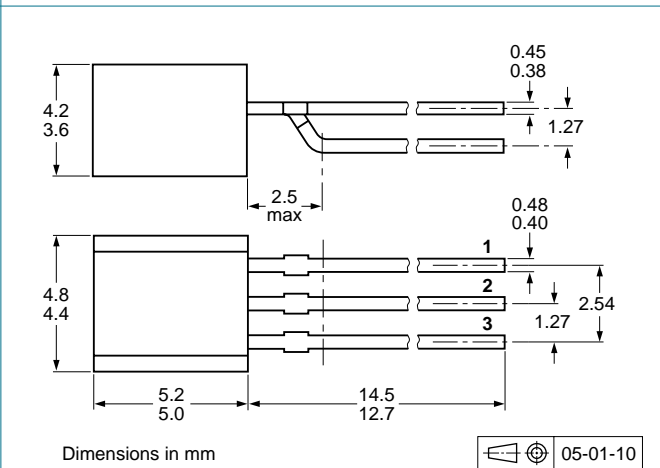


Fig 16. Package outline SOT54 variant

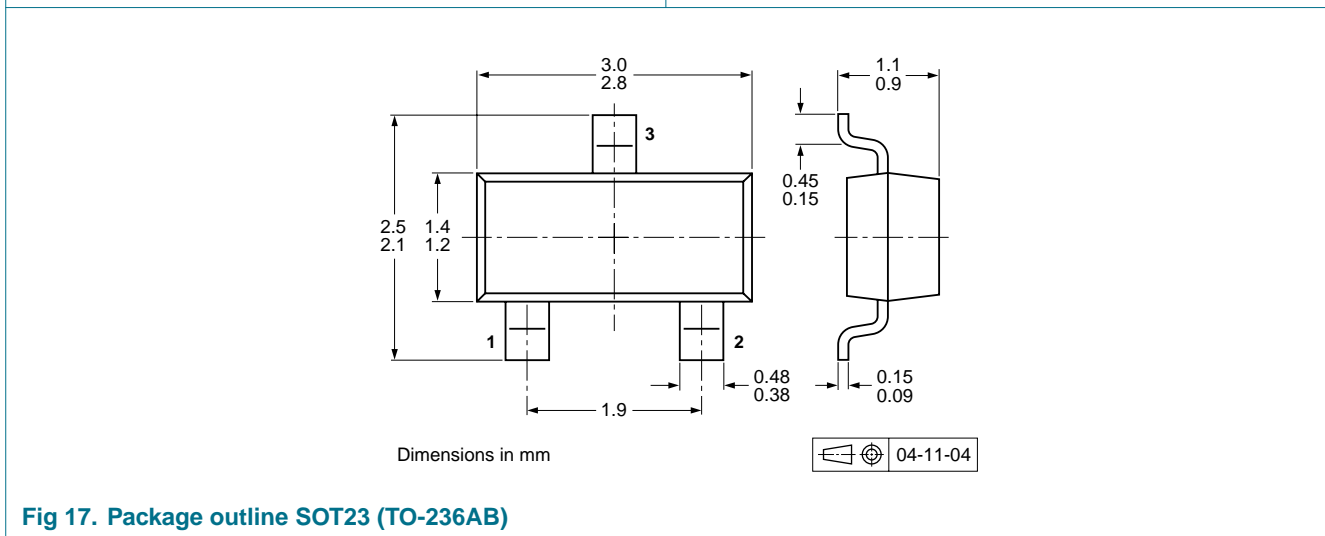


Fig 17. Package outline SOT23 (TO-236AB)

9. Packing information

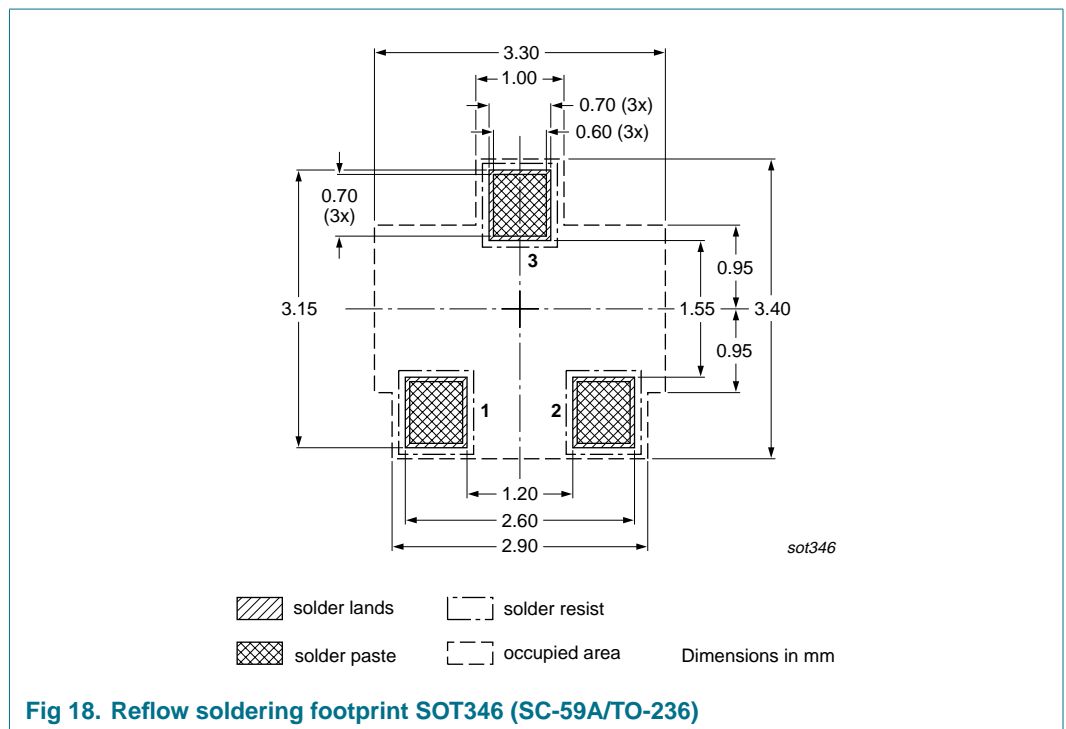
Table 9. Packing methods

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



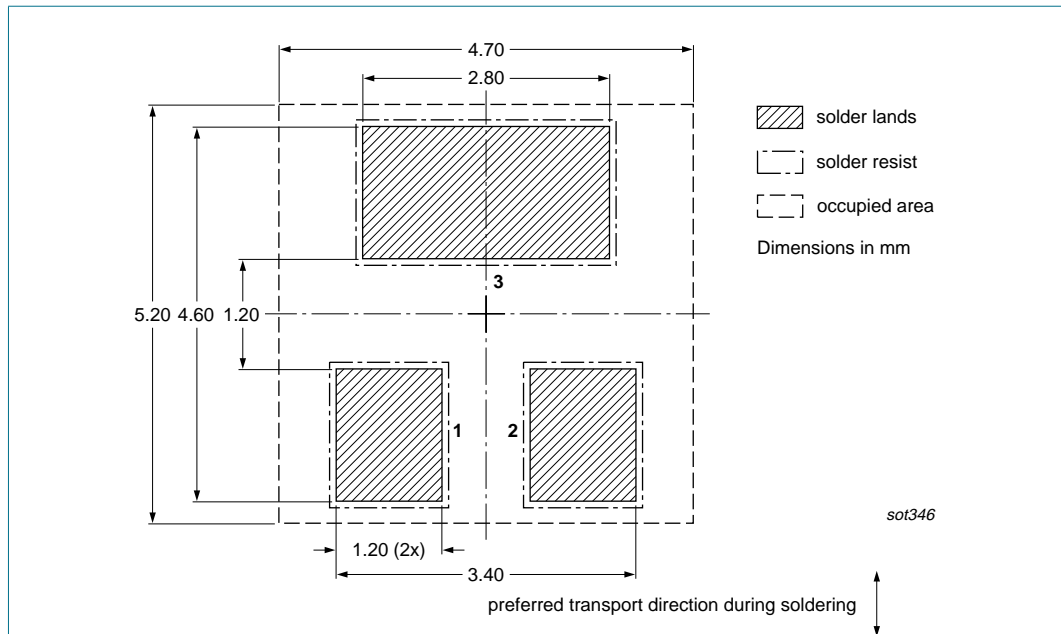


Fig 19. Wave soldering footprint SOT346 (SC-59A/TO-236)

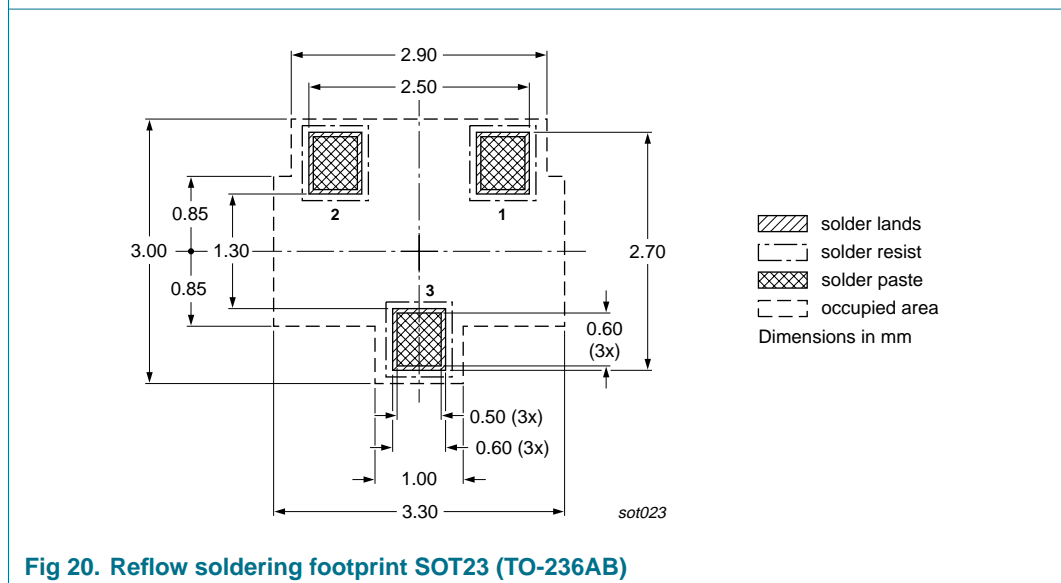
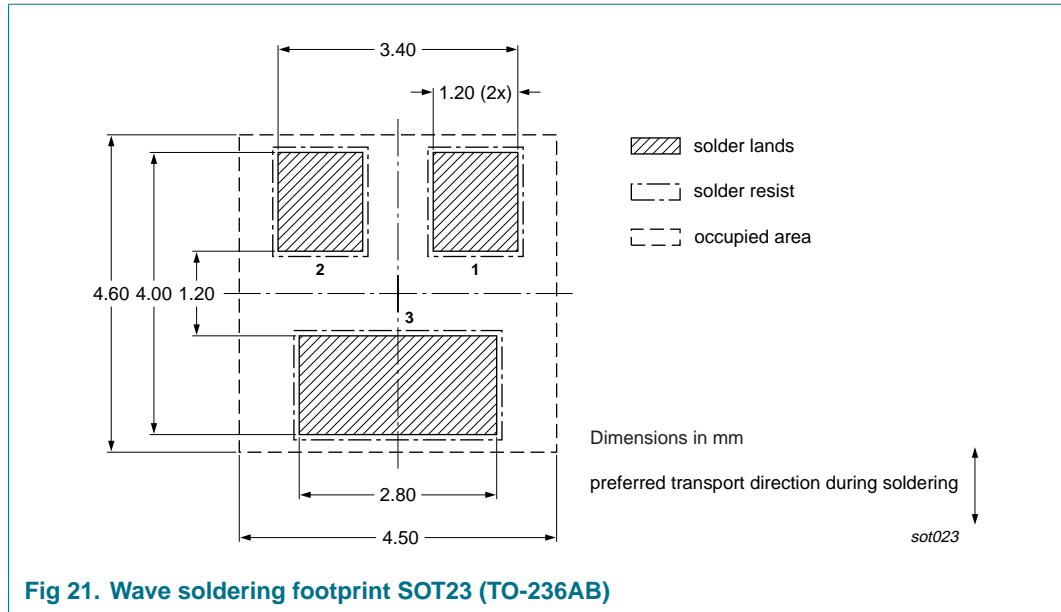


Fig 20. Reflow soldering footprint SOT23 (TO-236AB)



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".

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Date of release: 27 February 2007

Document identifier: PBRN123E_SER_1