

PMBT3946YPN

40 V, 200 mA NPN/PNP general-purpose double transistor

Rev. 01 — 12 May 2009

Product data sheet

1. Product profile

1.1 General description

NPN/PNP general-purpose double transistor in a SOT363 (SC-88) very small Surface-Mounted Device (SMD) plastic package.

Table 1. Product overview

Type number	Package		NPN/PNP complement	PNP/PNP complement	Package configuration
	NXP	JEITA			
PMBT3946YPN	SOT363	SC-88	PMBT3904YS	PMBT3906YS	very small

1.2 Features

- General-purpose double transistor
- Board-space reduction

1.3 Applications

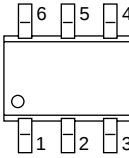
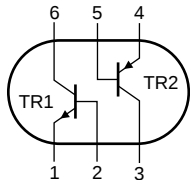
- General-purpose switching and amplification

1.4 Quick reference data

Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor; for the PNP transistor with negative polarity						
V_{CEO}	collector-emitter voltage	open base	-	-	40	V
I_C	collector current		-	-	200	mA
h_{FE}	DC current gain	$V_{CE} = 1\text{ V};$ $I_C = 10\text{ mA}$	100	180	300	

2. Pinning information

Table 3. Pinning			
Pin	Description	Simplified outline	Graphic symbol
1	emitter TR1		
2	base TR1		
3	collector TR2		
4	emitter TR2		
5	base TR2		
6	collector TR1		
sym019			

3. Ordering information

Table 4. Ordering information			
Type number	Package		
	Name	Description	Version
PMBT3946YPN	SC-88	plastic surface-mounted package; 6 leads	SOT363

4. Marking

Table 5. Marking codes	
Type number	Marking code ^[1]
PMBT3946YPN	BB*

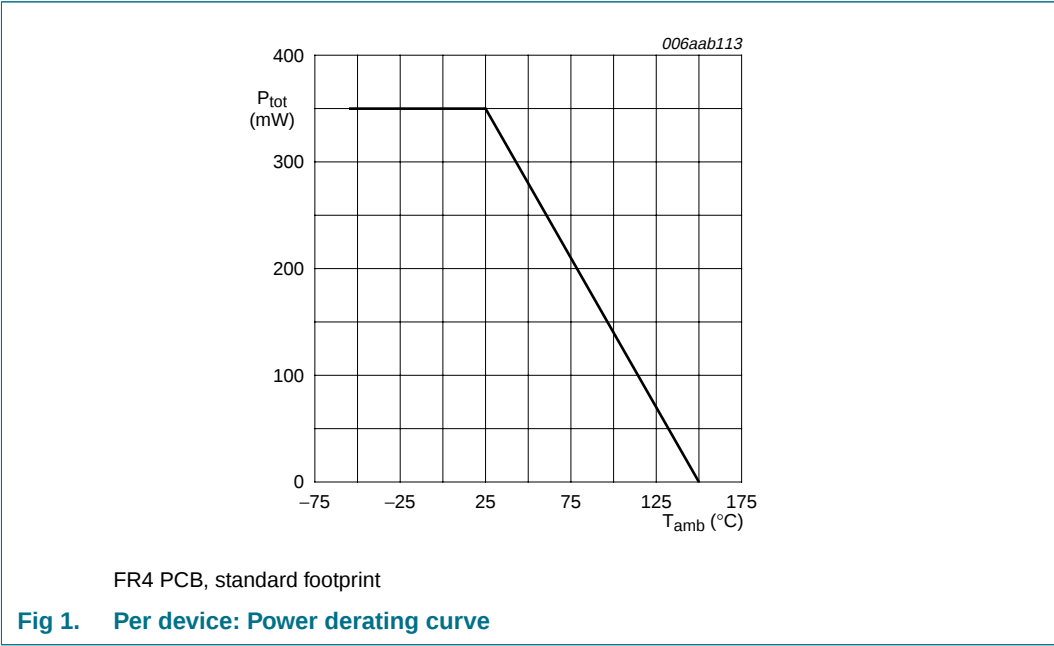
[1] * = -: made in Hong Kong
* = p: made in Hong Kong
* = t: made in Malaysia
* = W: made in China

5. Limiting values

Table 6. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
TR1 (NPN)					
V _{CBO}	collector-base voltage	open emitter	-	60	V
TR2 (PNP)					
V _{CBO}	collector-base voltage	open emitter	-	−40	V
Per transistor; for the PNP transistor with negative polarity					
V _{CEO}	collector-emitter voltage	open base	-	40	V
V _{EBO}	emitter-base voltage	open collector	-	6	V
I _C	collector current		-	200	mA
I _{CM}	peak collector current	single pulse; t _p ≤ 1 ms	-	200	mA
I _{BM}	peak base current	single pulse; t _p ≤ 1 ms	-	100	mA
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1] -	230	mW
Per device					
P _{tot}	total power dissipation	T _{amb} ≤ 25 °C	[1] -	350	mW
T _j	junction temperature		-	150	°C
T _{amb}	ambient temperature		−55	+150	°C
T _{stg}	storage temperature		−65	+150	°C

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

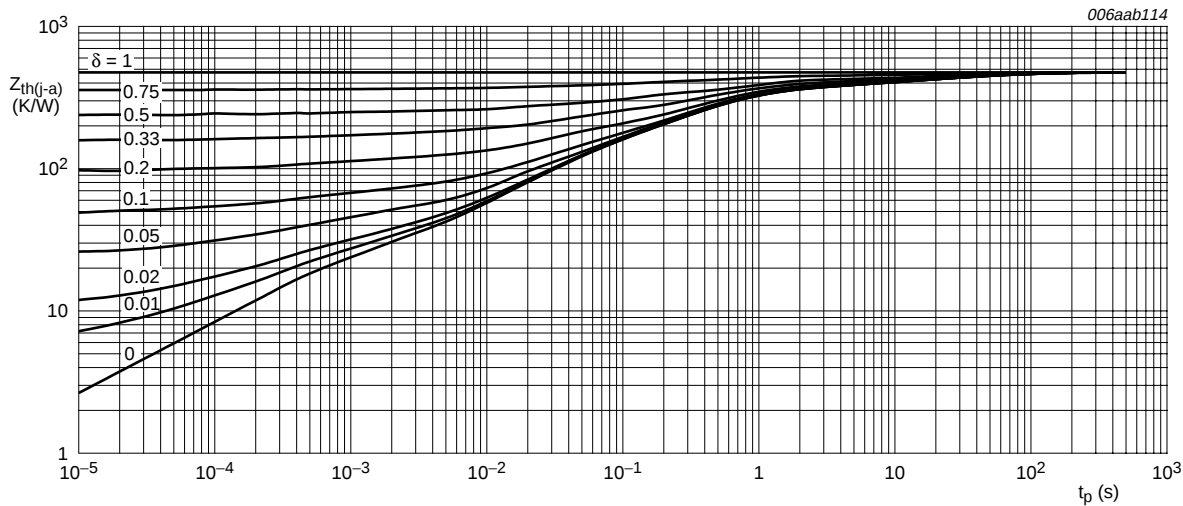


6. Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] -	-	543	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	290	K/W
Per device						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] -	-	357	K/W

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



FR4 PCB, standard footprint

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

7. Characteristics

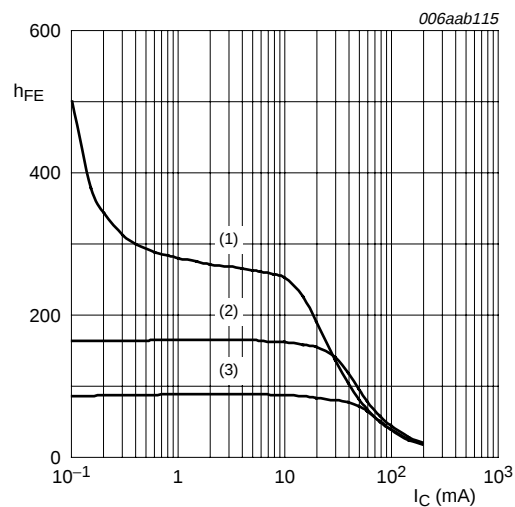
Table 8. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1 (NPN)						
I_{CBO}	collector-base cut-off current	$V_{CB} = 30\text{ V}; I_E = 0\text{ A}$	-	-	50	nA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 6\text{ V}; I_C = 0\text{ A}$	-	-	50	nA
h_{FE}	DC current gain	$V_{CE} = 1\text{ V}$			-	
		$I_C = 0.1\text{ mA}$	60	180	-	
		$I_C = 1\text{ mA}$	80	180	-	
		$I_C = 10\text{ mA}$	100	180	300	
		$I_C = 50\text{ mA}$	60	105	-	
		$I_C = 100\text{ mA}$	30	50	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 1\text{ mA}$	-	75	200	mV
		$I_C = 50\text{ mA}; I_B = 5\text{ mA}$	-	120	300	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 1\text{ mA}$	650	750	850	mV
		$I_C = 50\text{ mA}; I_B = 5\text{ mA}$	-	850	950	mV
f_T	transition frequency	$V_{CE} = 20\text{ V}; I_C = 10\text{ mA};$ $f = 100\text{ MHz}$	300	-	-	MHz
C_c	collector capacitance	$V_{CB} = 5\text{ V}; I_E = I_E = 0\text{ A};$ $f = 1\text{ MHz}$	-	-	4	pF
C_e	emitter capacitance	$V_{BE} = 0.5\text{ V}; I_C = I_C = 0\text{ A};$ $f = 1\text{ MHz}$	-	-	8	pF
NF	noise figure	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A};$ $R_S = 1\text{ k}\Omega;$ $f = 10\text{ Hz to }15.7\text{ kHz}$	-	-	5	dB
t_d	delay time	$V_{CC} = 3\text{ V}; I_C = 10\text{ mA};$	-	-	35	ns
t_r	rise time	$I_{Bon} = 1\text{ mA}; I_{Boff} = -1\text{ mA}$	-	-	35	ns
t_{on}	turn-on time		-	-	70	ns
t_s	storage time		-	-	200	ns
t_f	fall time		-	-	50	ns
t_{off}	turn-off time		-	-	250	ns

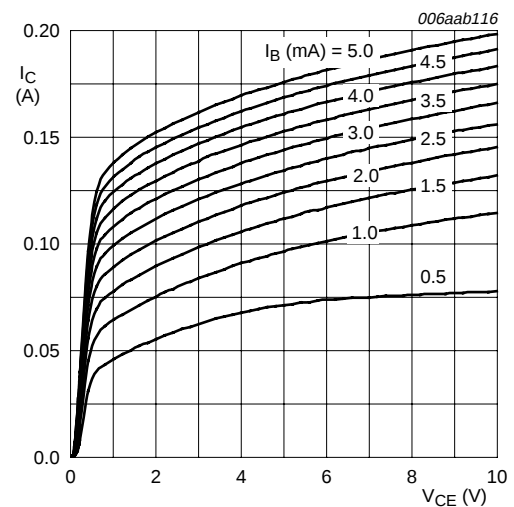
Table 8. Characteristics ...continued $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR2 (PNP)						
I_{CBO}	collector-base cut-off current	$V_{CB} = -30\text{ V}; I_E = 0\text{ A}$	-	-	-50	nA
I_{EBO}	emitter-base cut-off current	$V_{EB} = -6\text{ V}; I_C = 0\text{ A}$	-	-	-50	nA
h_{FE}	DC current gain	$V_{CE} = -1\text{ V}$				
		$I_C = -0.1\text{ mA}$	60	180	-	
		$I_C = -1\text{ mA}$	80	180	-	
		$I_C = -10\text{ mA}$	100	180	300	
		$I_C = -50\text{ mA}$	60	130	-	
		$I_C = -100\text{ mA}$	30	50	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10\text{ mA}; I_B = -1\text{ mA}$	-	-100	-250	mV
		$I_C = -50\text{ mA}; I_B = -5\text{ mA}$	-	-165	-400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10\text{ mA}; I_B = -1\text{ mA}$	-	-750	-850	mV
		$I_C = -50\text{ mA}; I_B = -5\text{ mA}$	-	-850	-950	mV
f_T	transition frequency	$V_{CE} = -20\text{ V}; I_C = -10\text{ mA}; f = 100\text{ MHz}$	250	-	-	MHz
C_c	collector capacitance	$V_{CB} = -5\text{ V}; I_E = I_C = 0\text{ A}; f = 1\text{ MHz}$	-	-	4.5	pF
C_e	emitter capacitance	$V_{CB} = -0.5\text{ V}; I_C = I_E = 0\text{ A}; f = 1\text{ MHz}$	-	-	10	pF
NF	noise figure	$V_{CE} = -5\text{ V}; I_C = -100\text{ }\mu\text{A}; R_S = 1\text{ k}\Omega; f = 10\text{ Hz to }15.7\text{ kHz}$	-	-	4	dB
t_d	delay time	$V_{CC} = -3\text{ V}; I_C = -10\text{ mA}; I_{Bon} = -1\text{ mA}; I_{Boff} = 1\text{ mA}$	-	-	35	ns
t_r	rise time		-	-	35	ns
t_{on}	turn-on time		-	-	70	ns
t_s	storage time		-	-	225	ns
t_f	fall time		-	-	75	ns
t_{off}	turn-off time		-	-	300	ns



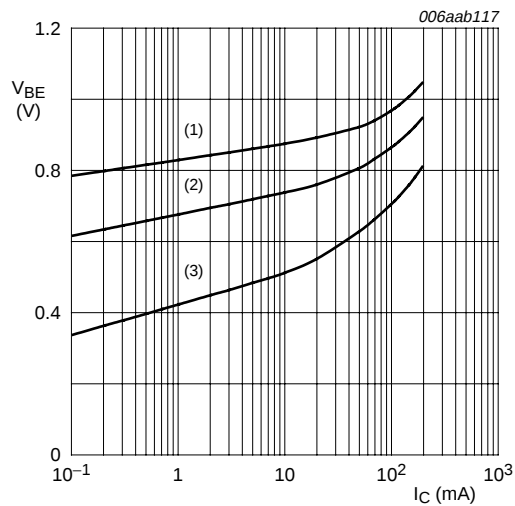
- $V_{CE} = 1\text{ V}$
- (1) $T_{amb} = 150\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = -55\text{ }^{\circ}\text{C}$

Fig 3. TR1 (NPN): DC current gain as a function of collector current; typical values



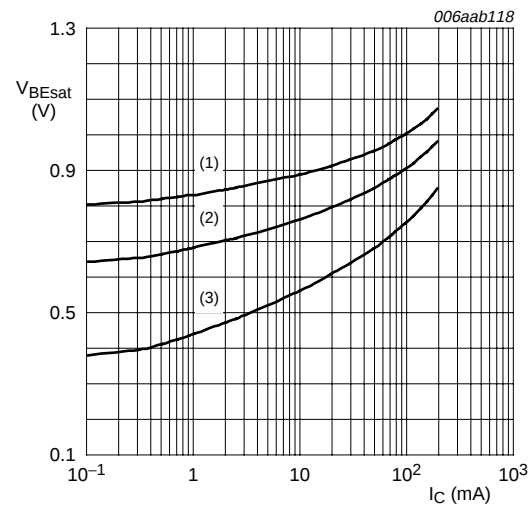
$T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig 4. TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values



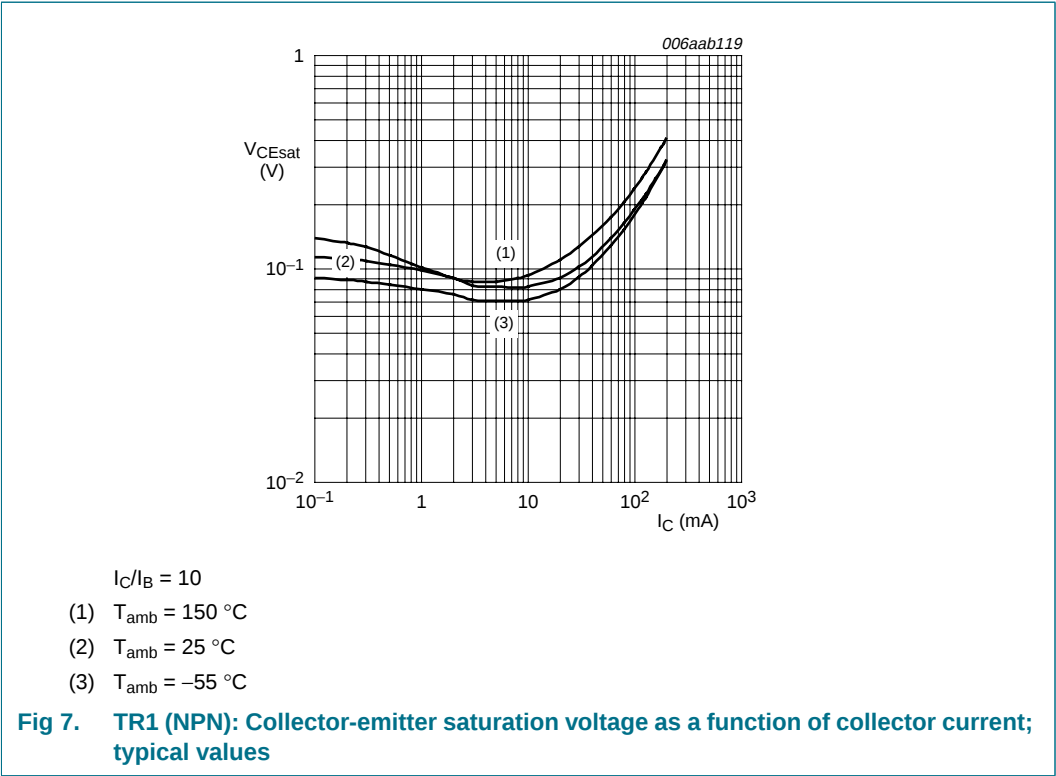
- $V_{CE} = 1\text{ V}$
- (1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 150\text{ }^{\circ}\text{C}$

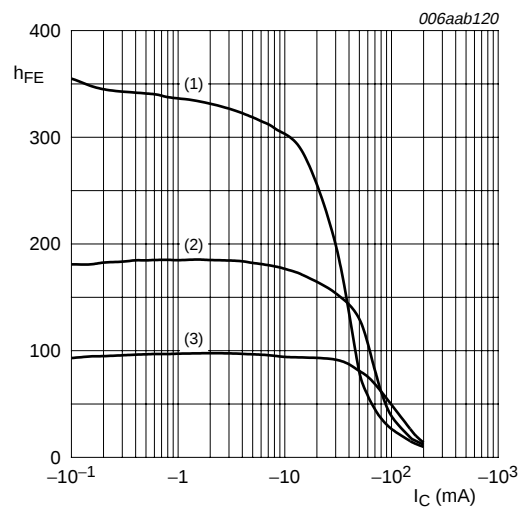
Fig 5. TR1 (NPN): Base-emitter voltage as a function of collector current; typical values



- $I_C/I_B = 10$
- (1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 150\text{ }^{\circ}\text{C}$

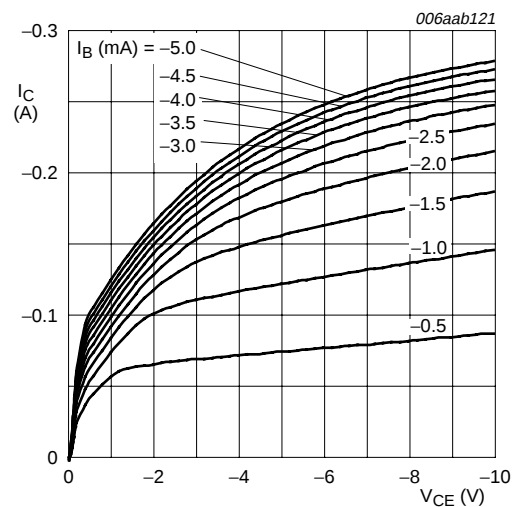
Fig 6. TR1 (NPN): Base-emitter saturation voltage as a function of collector current; typical values





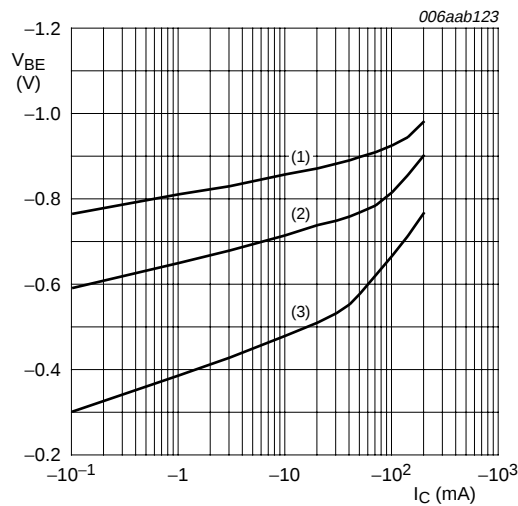
- $V_{CE} = -1\text{ V}$
- (1) $T_{amb} = 150\text{ °C}$
 - (2) $T_{amb} = 25\text{ °C}$
 - (3) $T_{amb} = -55\text{ °C}$

Fig 8. TR2 (PNP): DC current gain as a function of collector current; typical values



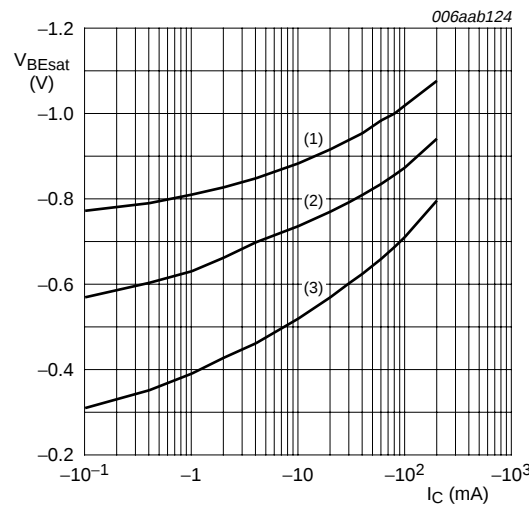
$T_{amb} = 25\text{ °C}$

Fig 9. TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values



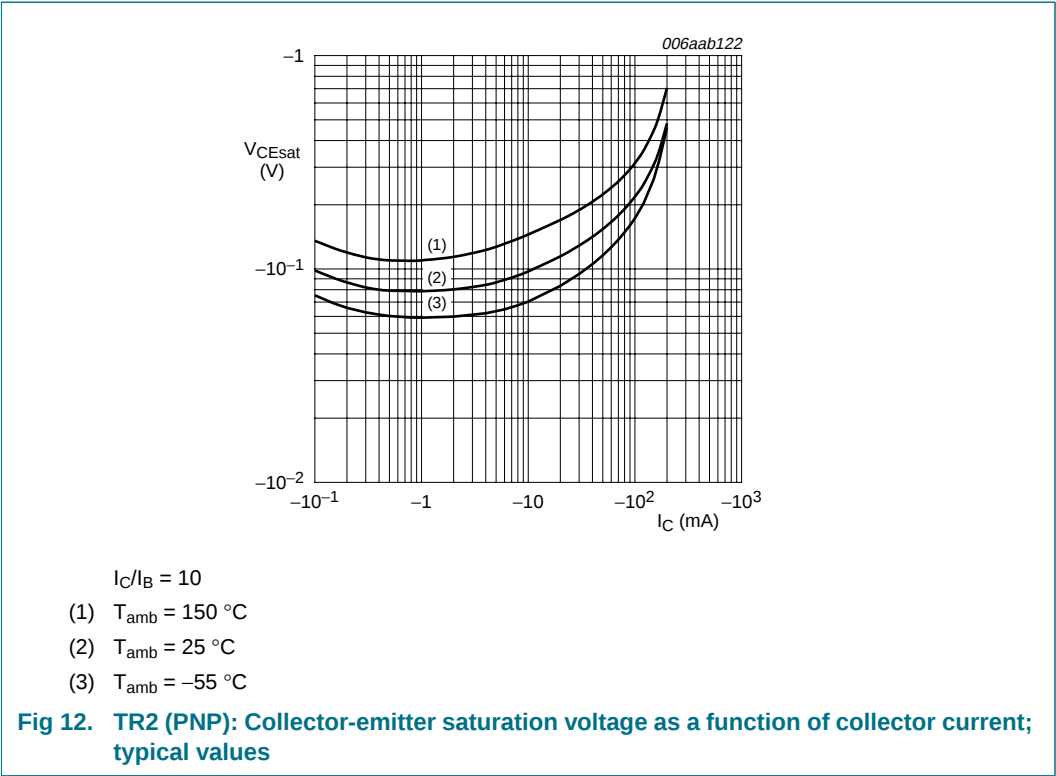
- $V_{CE} = -1\text{ V}$
- (1) $T_{amb} = -55\text{ °C}$
 - (2) $T_{amb} = 25\text{ °C}$
 - (3) $T_{amb} = 150\text{ °C}$

Fig 10. TR2 (PNP): Base-emitter voltage as a function of collector current; typical values

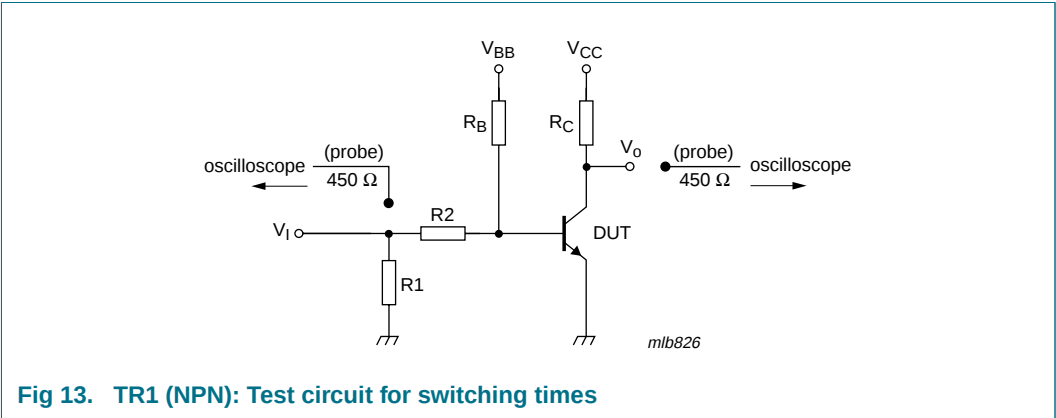


- $I_C/I_B = 10$
- (1) $T_{amb} = -55\text{ °C}$
 - (2) $T_{amb} = 25\text{ °C}$
 - (3) $T_{amb} = 150\text{ °C}$

Fig 11. TR2 (PNP): Base-emitter saturation voltage as a function of collector current; typical values



8. Test information



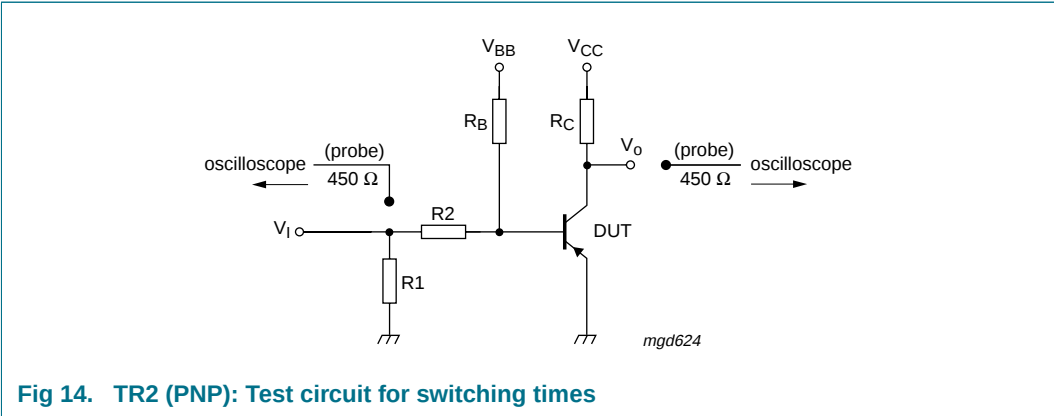


Fig 14. TR2 (PNP): Test circuit for switching times

9. Package outline

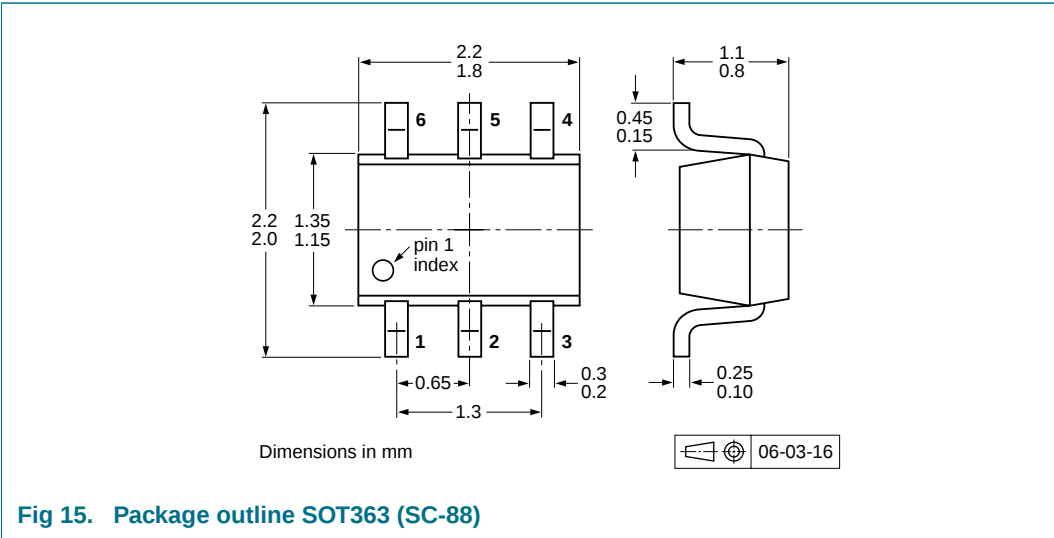


Fig 15. Package outline SOT363 (SC-88)

10. Packing information

Table 9. Packing methods

The indicated -xxx are the last three digits of the 12NC ordering code.^[1]

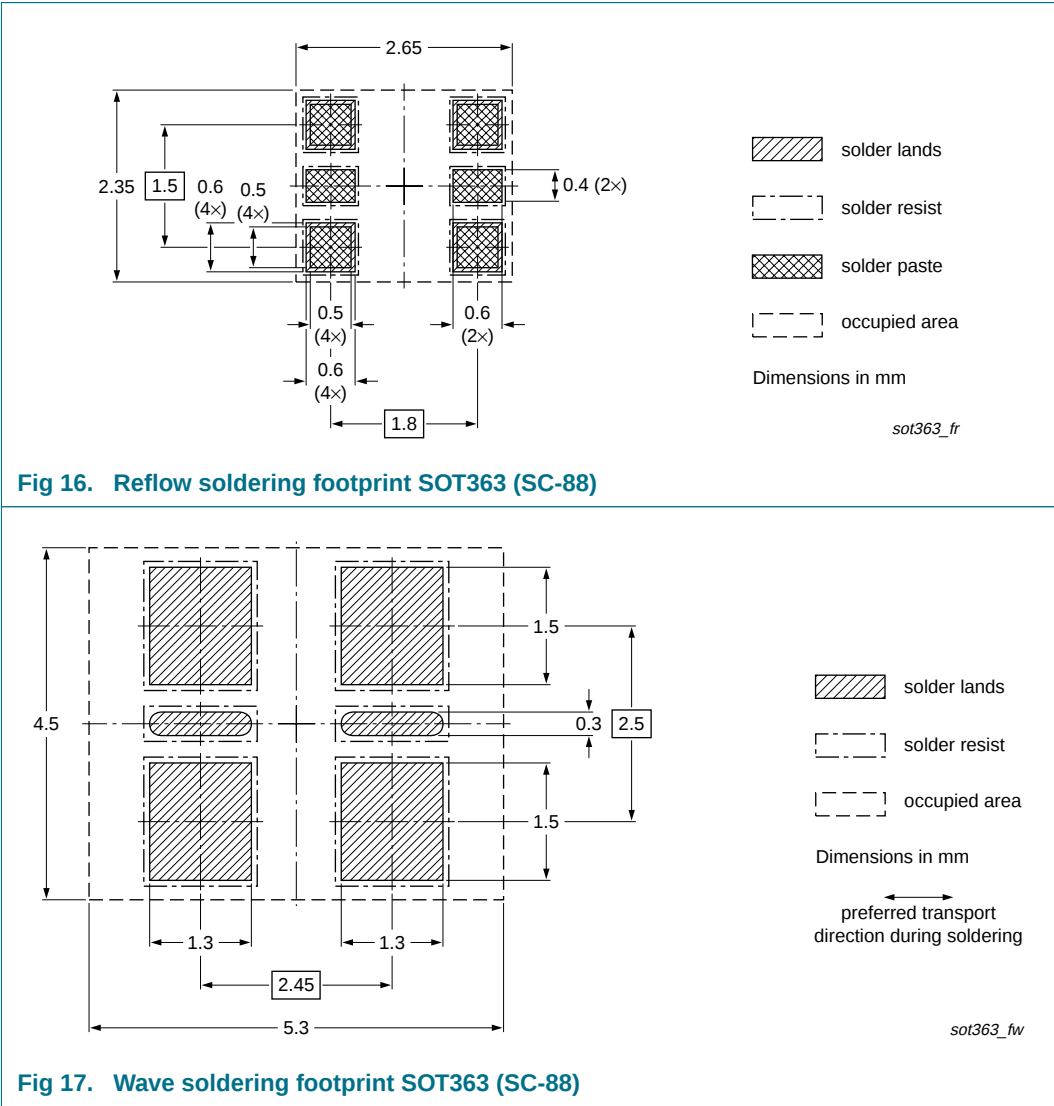
Type number	Package	Description	Packing quantity	
			3000	10000
PMBT3946YPN	SOT363	4 mm pitch, 8 mm tape and reel; T1	^[2] -115	-135
		4 mm pitch, 8 mm tape and reel; T2	^[3] -125	-165

[1] For further information and the availability of packing methods, see [Section 14](#).

[2] T1: normal taping

[3] T2: reverse taping

11. Soldering



12. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PMBT3946YPN_1	20090512	Product data sheet	-	-

13. Legal information

13.1 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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15. Contents

1 Product profile 1

1.1 General description..... 1

1.2 Features 1

1.3 Applications 1

1.4 Quick reference data..... 1

2 Pinning information..... 2

3 Ordering information..... 2

4 Marking 2

5 Limiting values..... 3

6 Thermal characteristics..... 4

7 Characteristics..... 5

8 Test information..... 10

9 Package outline 11

10 Packing information..... 11

11 Soldering 12

12 Revision history..... 13

13 Legal information..... 14

13.1 Data sheet status 14

13.2 Definitions..... 14

13.3 Disclaimers..... 14

13.4 Trademarks..... 14

14 Contact information..... 14

15 Contents 15



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