



# PMBT4401YS

40 V, 600 mA, double NPN switching transistor

2 July 2015

Product data sheet

## 1. General description

Double NPN switching transistor in a very small SOT363 (TSSOP6) Surface-Mounted Device (SMD) plastic package.

Double PNP complement: PMBT4403YS

## 2. Features and benefits

- Double general-purpose switching transistor
- High current (max. 600 mA)
- Voltage max. 40 V
- AEC-Q101 qualified

## 3. Applications

- Switching and linear amplification

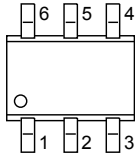
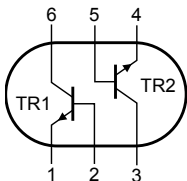
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{CE0}$	collector-emitter voltage	open base	-	-	40	V
$I_C$	collector current		-	-	600	mA
<b>Per transistor</b>						
$h_{FE}$	DC current gain	$V_{CE} = 1\text{ V}; I_C = 150\text{ mA}; t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	100	-	300	
		$V_{CE} = 2\text{ V}; I_C = 500\text{ mA}; t_p \leq 300\text{ }\mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	40	-	-	

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter TR1	 <p>TSSOP6 (SOT363)</p>	 <p>sym020</p>
2	B	base TR1		
3	C	collector TR2		
4	E	emitter TR2		
5	B	base TR2		
6	C	collector TR1		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMBT4401YS	TSSOP6	plastic surface-mounted package; 6 leads	SOT363

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PMBT4401YS	BG% [1]

[1] % = placeholder for manufacturing site code

## 8. Limiting values

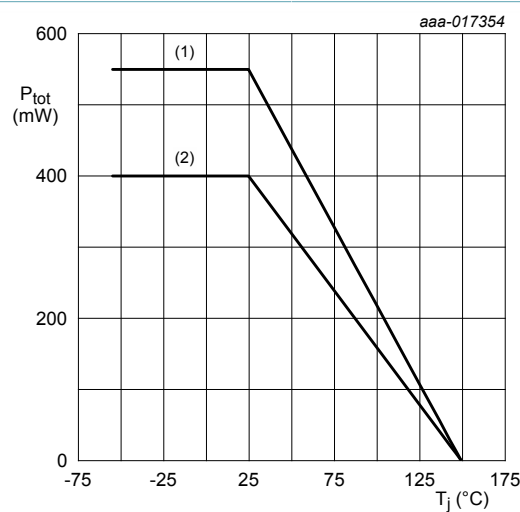
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	60	V
$V_{CEO}$	collector-emitter voltage	open base		-	40	V
$V_{EBO}$	emitter-base voltage	open collector		-	6	V
$I_C$	collector current			-	600	mA
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	800	mA
$I_{BM}$	peak base current			-	200	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	250	mW
			[2]	-	300	mW
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	400	mW
			[2]	-	550	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.

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



(1) FR4 PCB; mounting pad for collector 1 cm<sup>2</sup>

(2) FR4 PCB; standard footprint

**Fig. 1. Per device: Power derating curves SOT363 (SC-88)**

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	500	K/W
			[2]	-	-	417	K/W
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	313	K/W
			[2]	-	-	227	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 and mounting pad for collector 1 cm<sup>2</sup>.

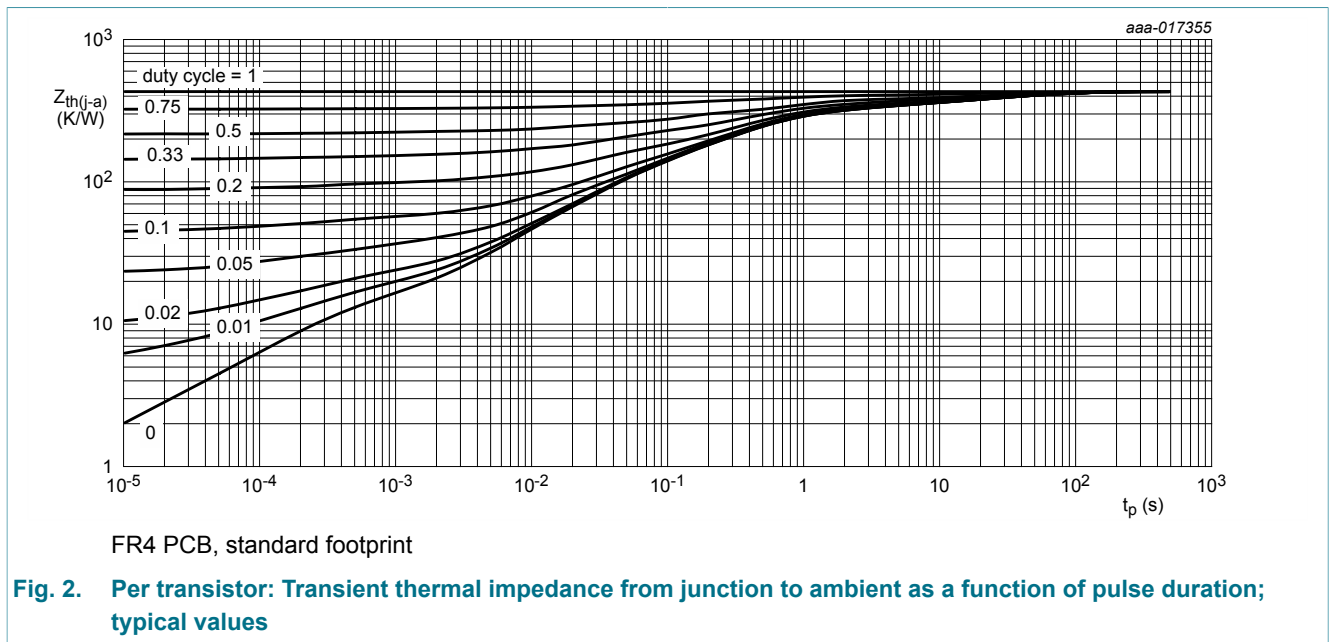
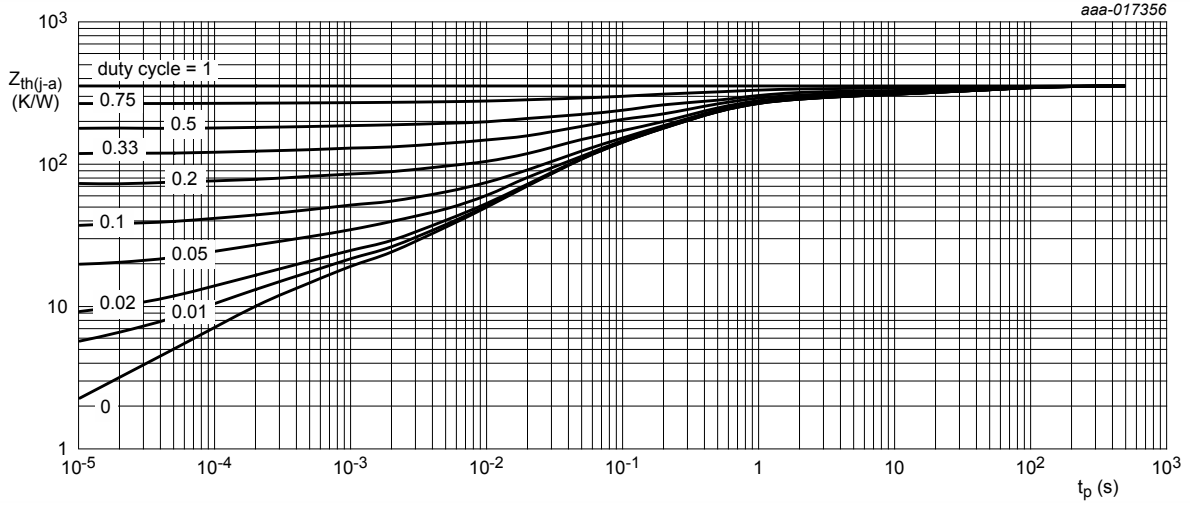


Fig. 2. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



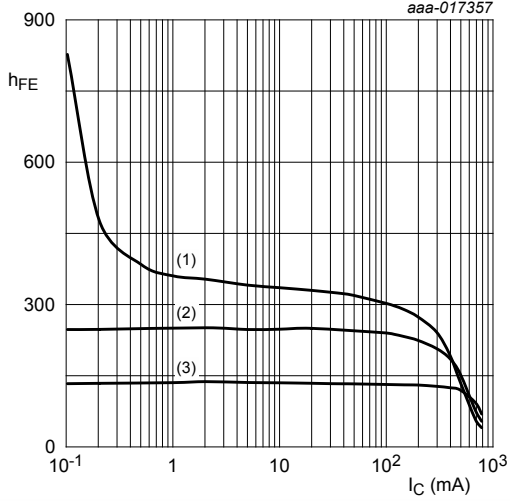
FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

**Fig. 3. Per Transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 10. Characteristics

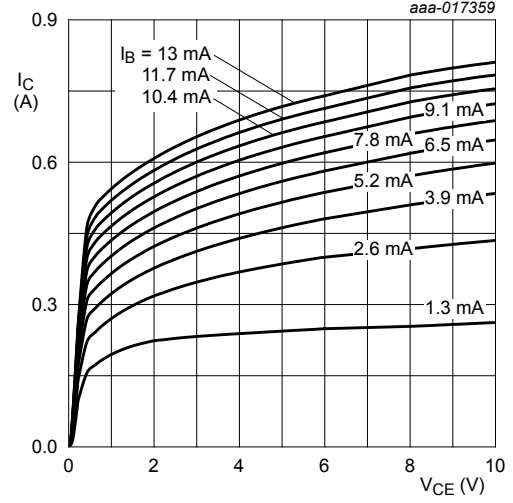
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 50 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	50	nA
		V <sub>CB</sub> = 50 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 125 °C	-	-	10	μA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 6 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	50	nA
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = 1 V; I <sub>C</sub> = 0.1 mA; T <sub>amb</sub> = 25 °C	20	-	-	
		V <sub>CE</sub> = 1 V; I <sub>C</sub> = 1 mA; T <sub>amb</sub> = 25 °C	40	-	-	
		V <sub>CE</sub> = 1 V; I <sub>C</sub> = 10 mA; T <sub>amb</sub> = 25 °C	80	-	-	
		V <sub>CE</sub> = 1 V; I <sub>C</sub> = 150 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	100	-	300	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	40	-	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 150 mA; I <sub>B</sub> = 15 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-	400	mV
		I <sub>C</sub> = 500 mA; I <sub>B</sub> = 50 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-	750	mV
V <sub>BEsat</sub>	base-emitter saturation voltage	I <sub>C</sub> = 150 mA; I <sub>B</sub> = 15 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-	950	mV
		I <sub>C</sub> = 500 mA; I <sub>B</sub> = 50 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-	1.2	V
t <sub>d</sub>	delay time	I <sub>C</sub> = 150 mA; I <sub>Bon</sub> = 15 mA; I <sub>Boff</sub> = -15 mA; T <sub>amb</sub> = 25 °C	-	-	10	ns
t <sub>r</sub>	rise time		-	-	25	ns
t <sub>on</sub>	turn-on time		-	-	35	ns
t <sub>s</sub>	storage time		-	-	200	ns
t <sub>f</sub>	fall time		-	-	60	ns
t <sub>off</sub>	turn-off time		-	-	250	ns
C <sub>C</sub>	collector capacitance		V <sub>CB</sub> = 10 V; I <sub>E</sub> = 0 A; i <sub>e</sub> = 0 A; f = 1 MHz; T <sub>amb</sub> = 25 °C	-	-	8
C <sub>E</sub>	emitter capacitance	V <sub>EB</sub> = 500 mV; I <sub>C</sub> = 0 A; f = 1 MHz; T <sub>amb</sub> = 25 °C	-	-	30	pF
f <sub>T</sub>	transition frequency	V <sub>CE</sub> = 20 V; I <sub>C</sub> = 20 mA; f = 100 MHz; T <sub>amb</sub> = 25 °C	250	-	-	MHz
NF	noise figure	V <sub>CE</sub> = 5 V; I <sub>C</sub> = 100 μA; R <sub>S</sub> = 1 kΩ; f = 1 kHz	-	-	4	dB



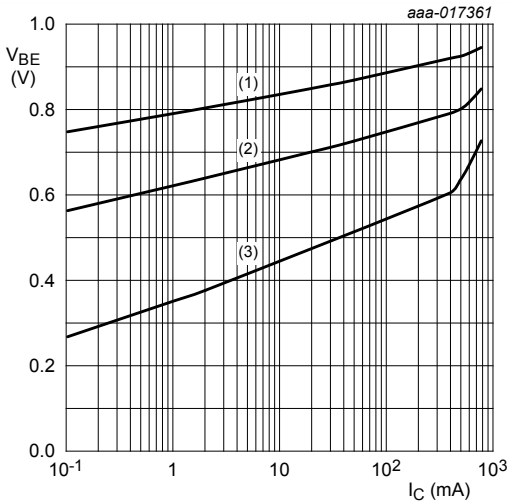
$V_{CE} = 10\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

**Fig. 4. DC current gain as a function of collector current; typical values**



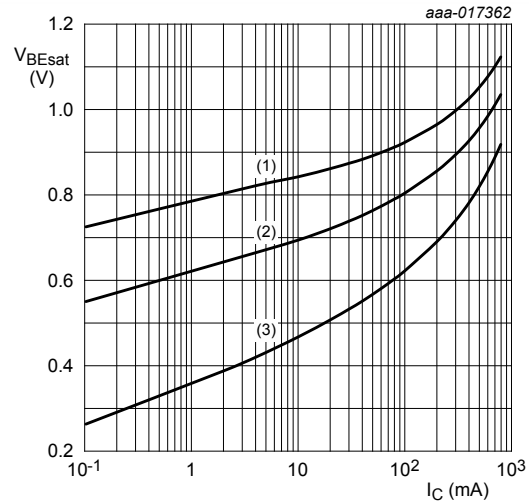
$T_{amb} = 25\text{ }^\circ\text{C}$

**Fig. 5. Collector current as a function of collector-emitter voltage; typical values**



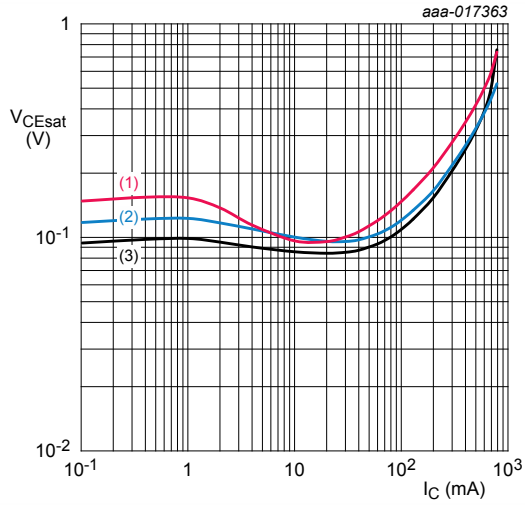
$V_{CE} = 10\text{ V}$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 150\text{ }^\circ\text{C}$

**Fig. 6. Base-emitter voltage as a function of collector current; typical values**



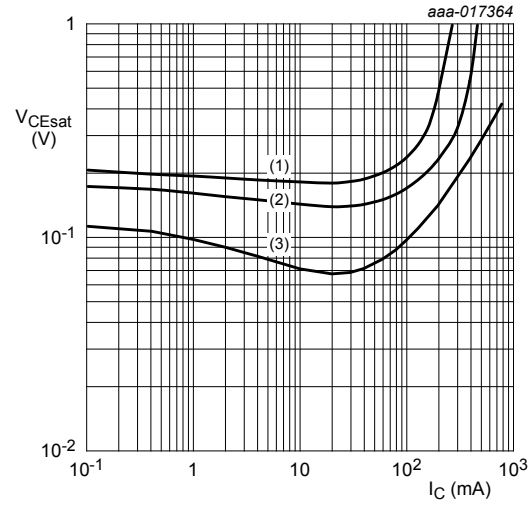
$I_C/I_B = 10$   
 (1)  $T_{amb} = -55\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 150\text{ }^\circ\text{C}$

**Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values**



$I_C/I_B = 20$   
 (1)  $T_{amb} = 150^\circ\text{C}$   
 (2)  $T_{amb} = 25^\circ\text{C}$   
 (3)  $T_{amb} = -55^\circ\text{C}$

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



$T_{amb} = 25^\circ\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

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



### 11. Test information

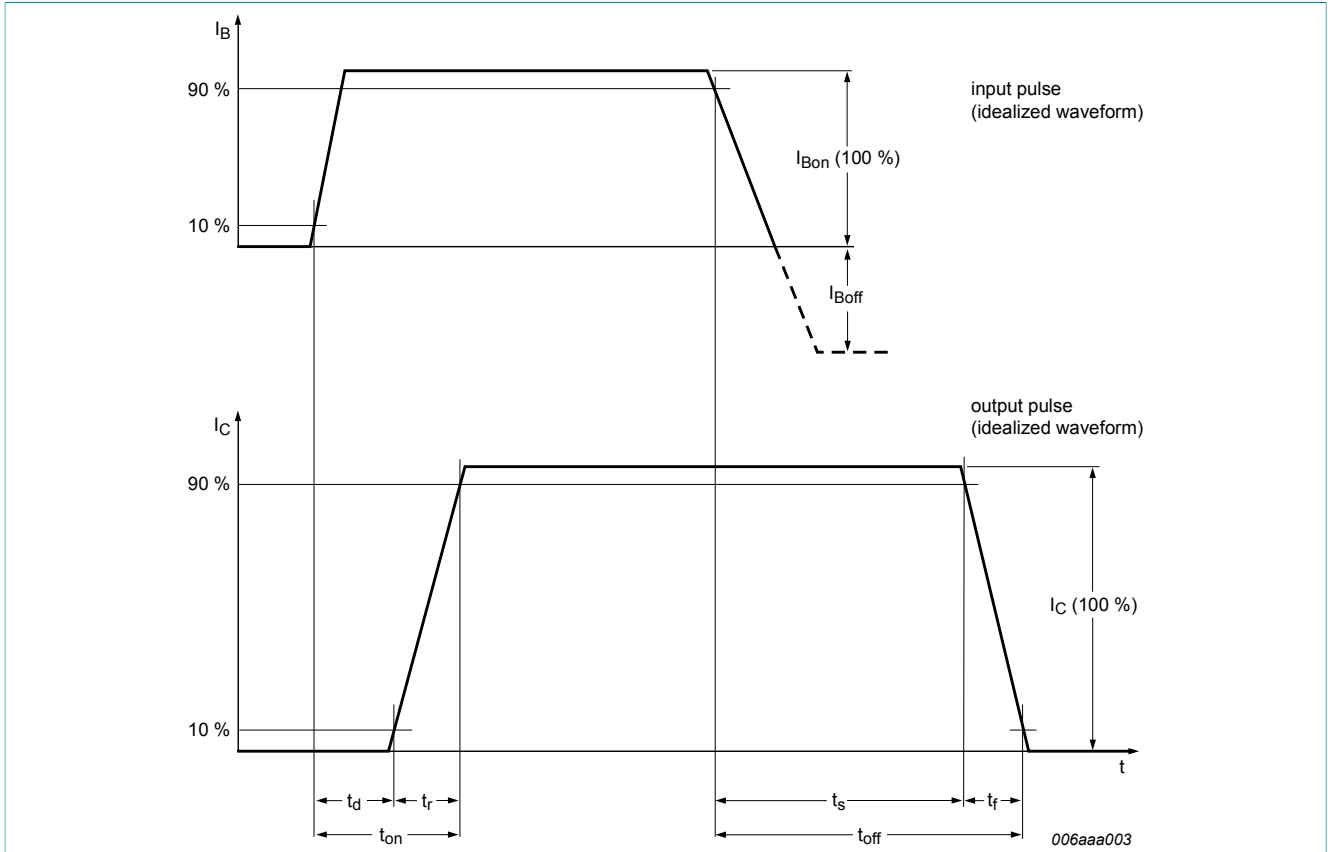


Fig. 10. BISS transistor switching time definition

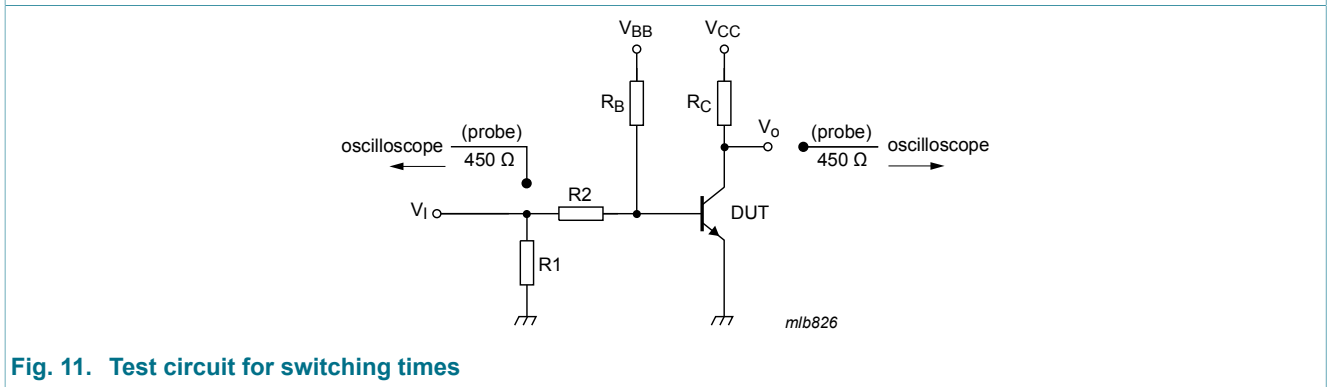


Fig. 11. Test circuit for switching times

#### 11.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

## 12. Package outline

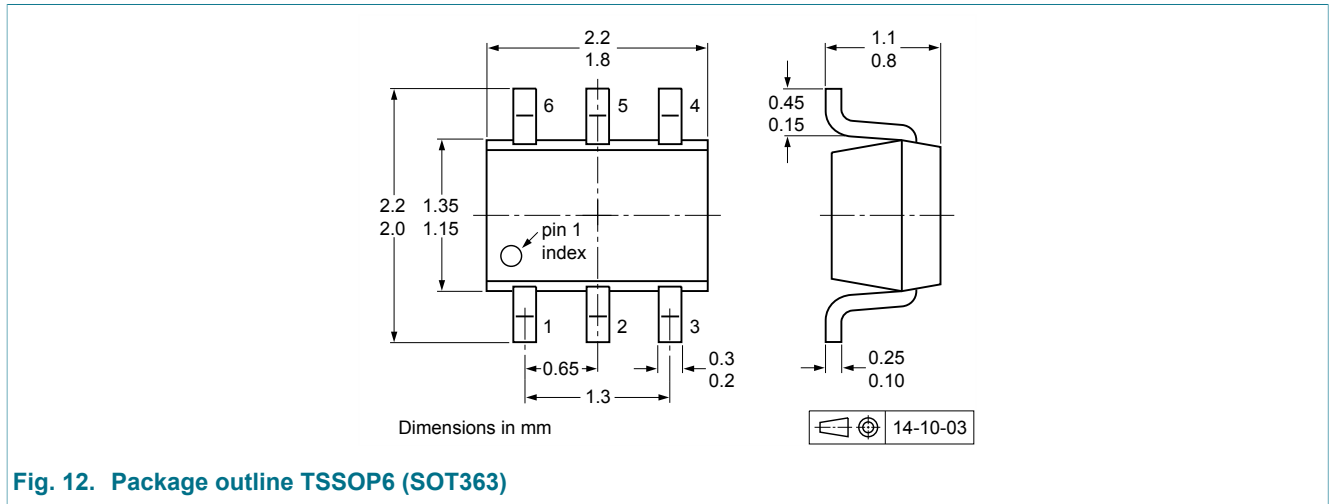


Fig. 12. Package outline TSSOP6 (SOT363)

## 13. Soldering

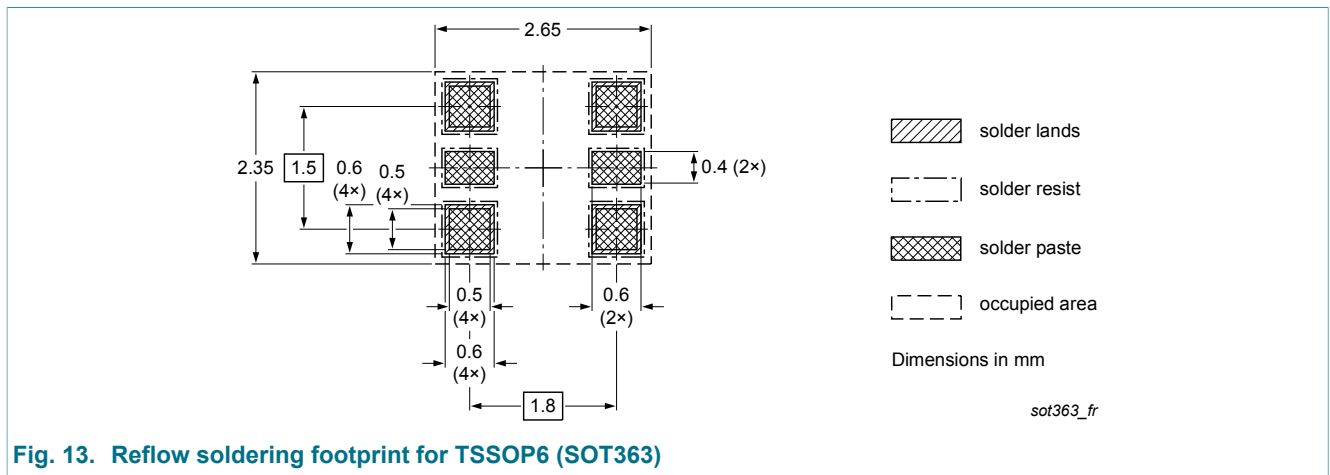


Fig. 13. Reflow soldering footprint for TSSOP6 (SOT363)

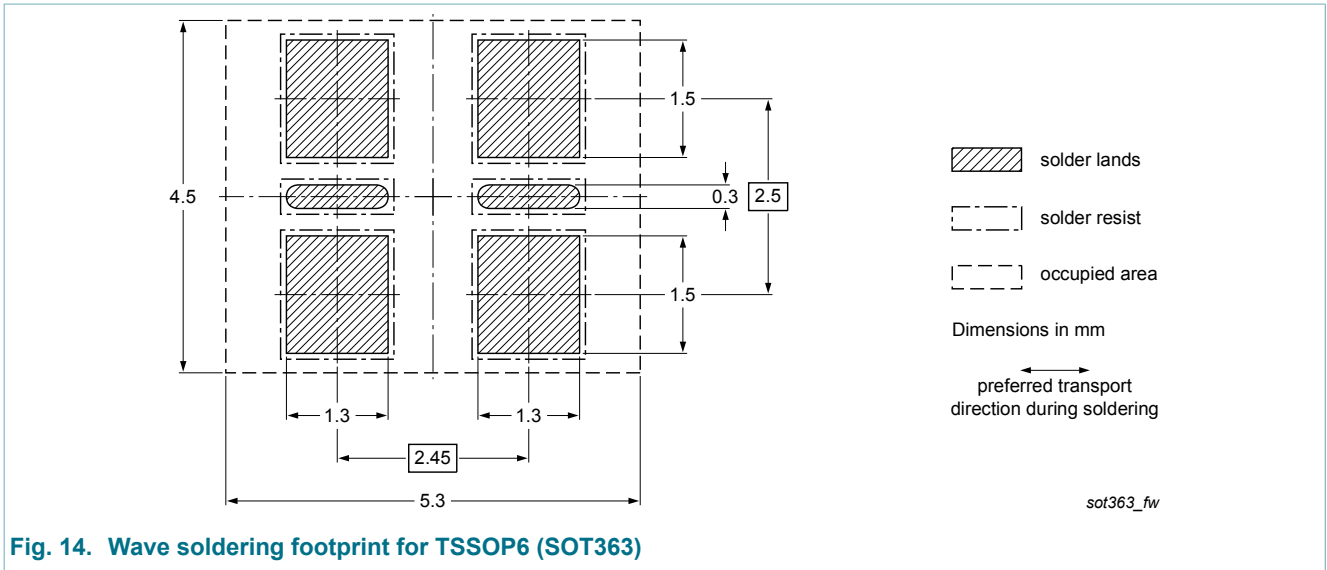


Fig. 14. Wave soldering footprint for TSSOP6 (SOT363)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMBT4401YS v.1	20150702	Product data sheet	-	-

## 15. Legal information

### 15.1 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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