



# PMBT2227AYS-Q

40 V, 600 mA, NPN/PNP double switching transistor

10 March 2022

Product data sheet

## 1. General description

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

NPN/PNP complement: PMBT2222AYS

PNP/PNP complement: PMBT2907AYS

## 2. Features and benefits

- Double general-purpose switching transistor
- High current (max. 600 mA)
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Switching and linear amplification

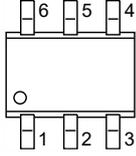
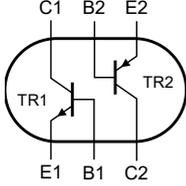
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (NPN)</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	40	V
$h_{FE}$	DC current gain	$V_{CE} = 10\text{ V}; I_C = 150\text{ mA}; \text{pulsed}; t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	100	-	300	
<b>TR2 (PNP)</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	-60	V
$h_{FE}$	DC current gain	$V_{CE} = -10\text{ V}; I_C = -150\text{ mA}; \text{pulsed}; t_p \leq 300\ \mu\text{s}; \delta \leq 0.02; T_{amb} = 25\text{ }^\circ\text{C}$	100	-	300	
<b>Per transistor; for the PNP transistor with negative polarity</b>						
$I_C$	collector current		-	-	600	mA
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1\text{ ms}$	-	-	800	mA

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E1	emitter TR1	 <p><b>TSSOP6 (SOT363)</b></p>	 <p><i>sym139</i></p>
2	B1	base TR1		
3	C2	collector TR2		
4	E2	emitter TR2		
5	B2	base TR2		
6	C1	collector TR1		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMBT2227AYS-Q	TSSOP6	plastic, surface-mounted package; 6 leads; 0.65 mm pitch; 2.1 mm x 1.25 mm x 0.95 mm body	SOT363

## 7. Marking

Table 4. Marking codes

Type number	Marking code <sup>[1]</sup>
PMBT2227AYS-Q	Y5%

[1] % = placeholder for manufacturing site code

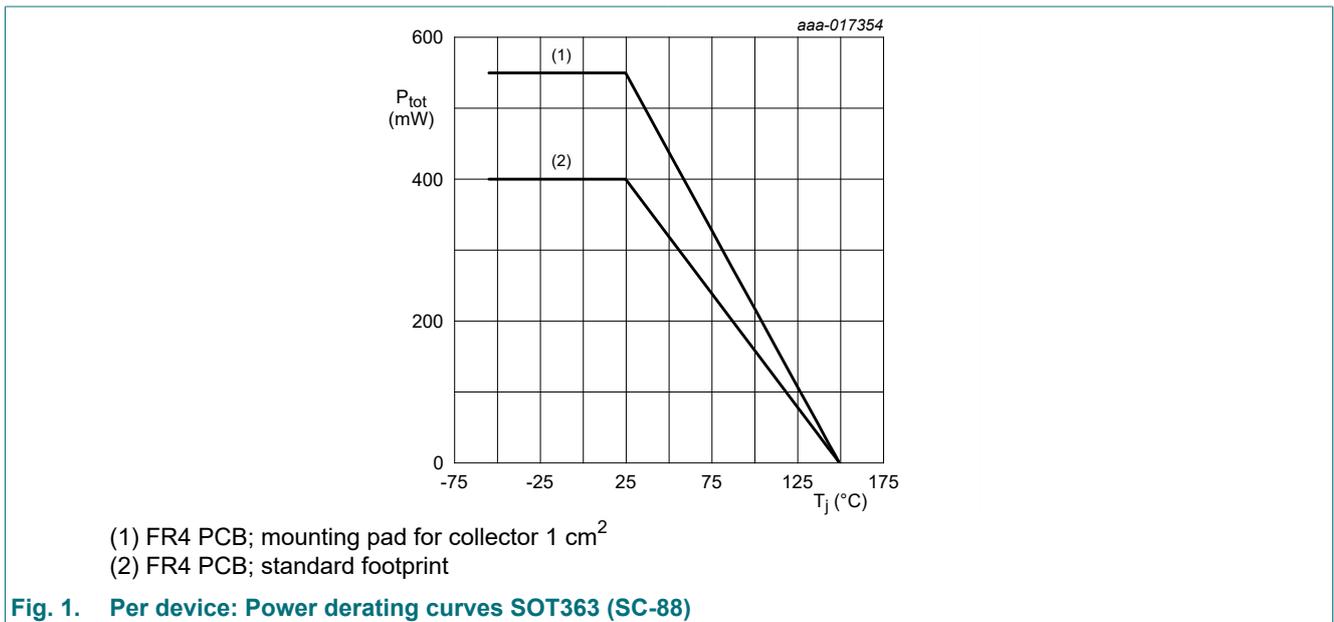
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>TR1 (NPN)</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	75	V
$V_{CEO}$	collector-emitter voltage	open base		-	40	V
<b>TR2 (PNP)</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	-60	V
$V_{CEO}$	collector-emitter voltage	open base		-	-60	V
<b>Per transistor; for the PNP transistor with negative polarity</b>						
$V_{EBO}$	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, 35 µm copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided, 35 µm copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.



## 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]	-	-	228	K/W

[1] Device mounted on an FR4 PCB, single-sided, 35  $\mu$ m copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided, 35  $\mu$ m copper, tin-plated; mounting pad for collector 1 cm<sup>2</sup>.

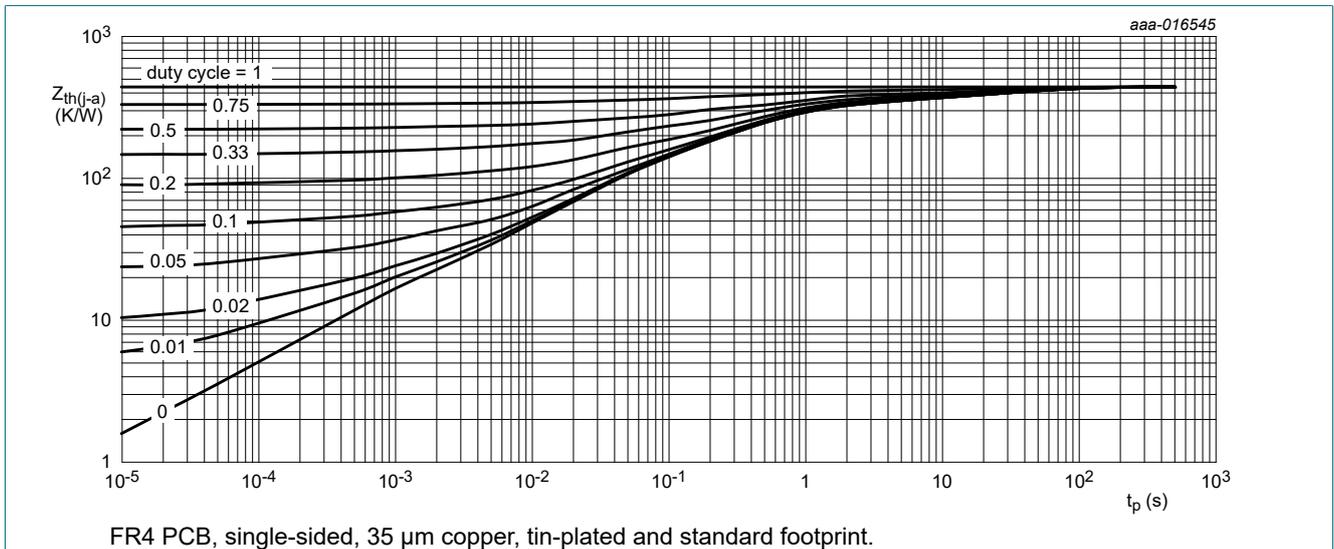


Fig. 2. Per transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

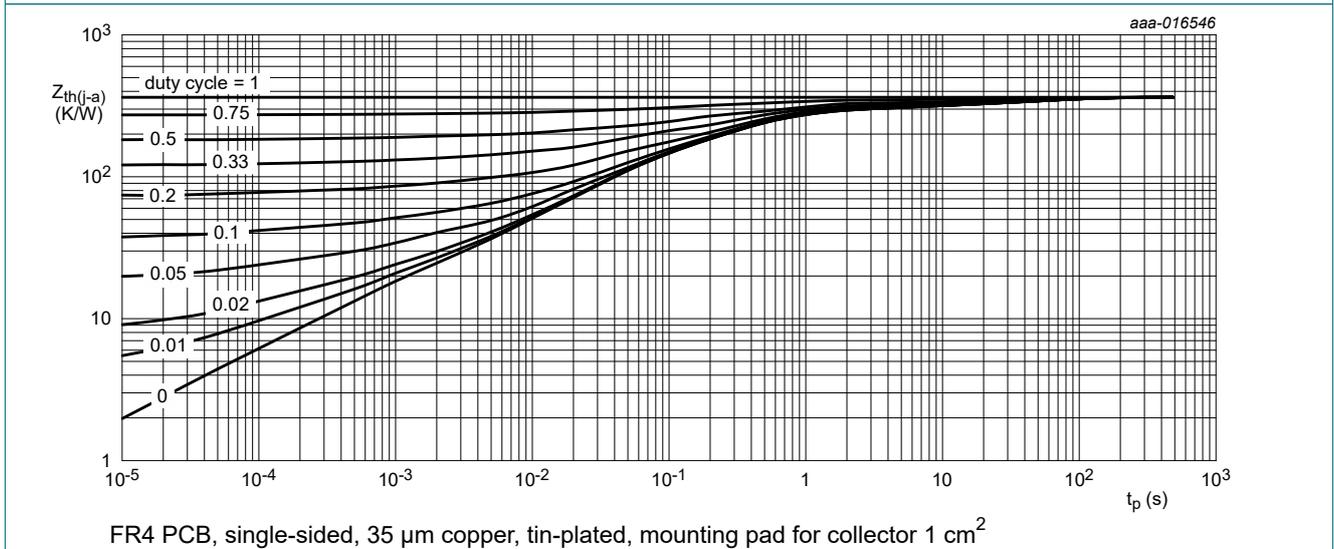


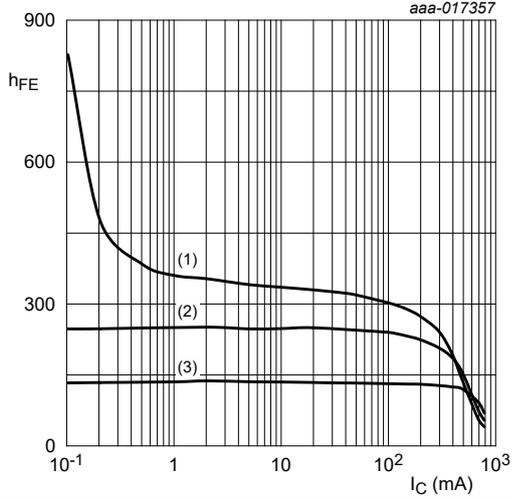
Fig. 3. Per Transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

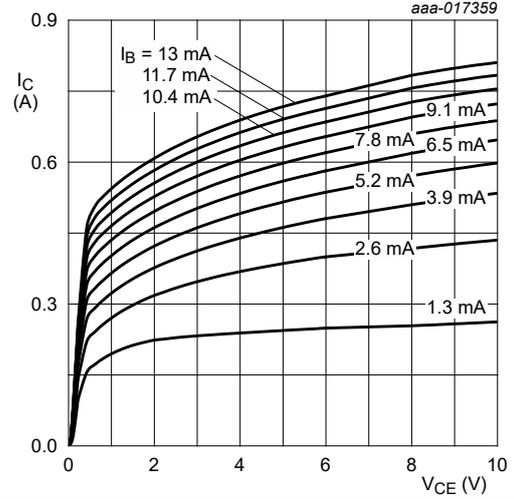
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (NPN)</b>						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu\text{A}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	75	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1 \text{ mA}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	40	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_C = 0 \text{ A}; I_E = 100 \mu\text{A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	6	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 60 \text{ V}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	10	nA
		$V_{CB} = 60 \text{ V}; I_E = 0 \text{ A}; T_j = 125 \text{ }^\circ\text{C}$	-	-	10	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5 \text{ V}; I_C = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	10	nA
$h_{FE}$	DC current gain	$V_{CE} = 10 \text{ V}; I_C = 1 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	50	-	-	
		$V_{CE} = 10 \text{ V}; I_C = 10 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	75	-	-	
		$V_{CE} = 10 \text{ V}; I_C = 150 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	100	-	300	
		$V_{CE} = 10 \text{ V}; I_C = 500 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02$	40	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 150 \text{ mA}; I_B = 15 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	300	mV
		$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	1	V
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 150 \text{ mA}; I_B = 15 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	0.6	-	1.2	V
		$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	2	V
$t_d$	delay time	$I_C = 150 \text{ mA}; I_{B\text{on}} = 15 \text{ mA}; I_{B\text{off}} = -15 \text{ mA}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	10	ns
$t_r$	rise time		-	-	25	ns
$t_{\text{on}}$	turn-on time		-	-	35	ns
$t_s$	storage time		-	-	200	ns
$t_f$	fall time		-	-	60	ns
$t_{\text{off}}$	turn-off time		-	-	260	ns
$C_c$	collector capacitance		$V_{CB} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	8
$C_e$	emitter capacitance	$V_{EB} = 0.5 \text{ V}; I_C = 0 \text{ A}; i_c = 0 \text{ A}; f = 1 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	25	pF
$f_T$	transition frequency	$V_{CE} = 20 \text{ V}; I_C = 20 \text{ mA}; f = 100 \text{ MHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	300	-	MHz
NF	noise figure	$V_{CE} = 5 \text{ V}; I_C = 0.1 \text{ mA}; R_S = 1 \text{ k}\Omega; f = 1 \text{ kHz}$	-	-	4	dB
<b>TR2 (PNP)</b>						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = -100 \mu\text{A}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-60	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = -10 \text{ mA}; I_B = 0 \text{ A}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-60	-	-	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_C = 0 \text{ A}; I_E = -100 \mu\text{A}; T_{amb} = 25 \text{ }^\circ\text{C}$	-6	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -50 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-10	nA
		$V_{CB} = -50 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 125 \text{ }^\circ\text{C}$	-	-	-10	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = -5 \text{ V}; I_C = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-50	nA
$h_{FE}$	DC current gain	$V_{CE} = -10 \text{ V}; I_C = -1 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	100	-	-	
		$V_{CE} = -10 \text{ V}; I_C = -10 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	100	-	-	
		$V_{CE} = -10 \text{ V}; I_C = -150 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	100	-	300	
		$V_{CE} = -10 \text{ V}; I_C = -500 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	50	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -150 \text{ mA}; I_B = -15 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-400	mV
		$I_C = -500 \text{ mA}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-1.6	V
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -150 \text{ mA}; I_B = -15 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-1.3	V
		$I_C = -500 \text{ mA}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	-2.6	V
$t_d$	delay time	$I_C = -150 \text{ mA}; I_{Bon} = -15 \text{ mA}; I_{Boff} = 15 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	12	ns
$t_r$	rise time		-	-	30	ns
$t_{on}$	turn-on time		-	-	42	ns
$t_s$	storage time		-	-	300	ns
$t_f$	fall time		-	-	65	ns
$t_{off}$	turn-off time		-	-	365	ns
$C_c$	collector capacitance		$V_{CB} = -10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	8
$C_e$	emitter capacitance	$V_{EB} = -2 \text{ V}; I_C = 0 \text{ A}; i_c = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	30	pF
$f_T$	transition frequency	$V_{CE} = -20 \text{ V}; I_C = -50 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	200	-	MHz



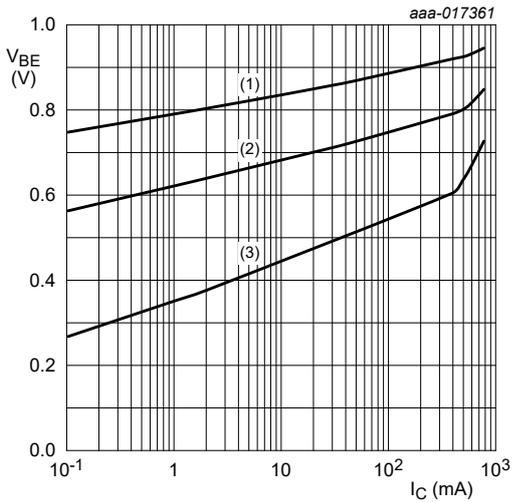
$V_{CE} = 10\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



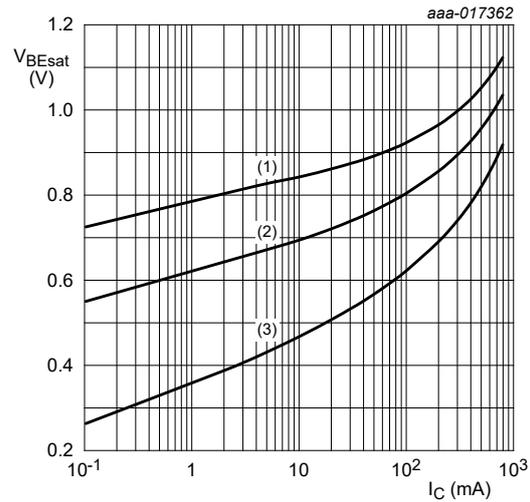
$T_{amb} = 25\text{ °C}$

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



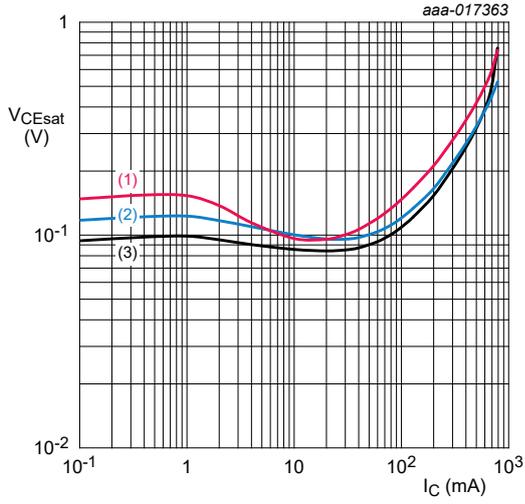
$V_{CE} = 10\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 150\text{ °C}$

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



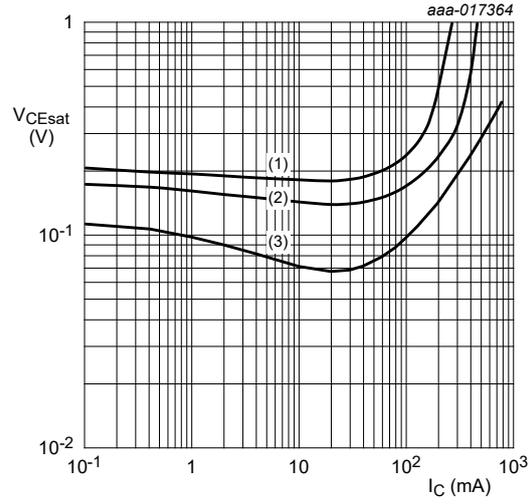
$I_C/I_B = 10$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 150\text{ °C}$

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



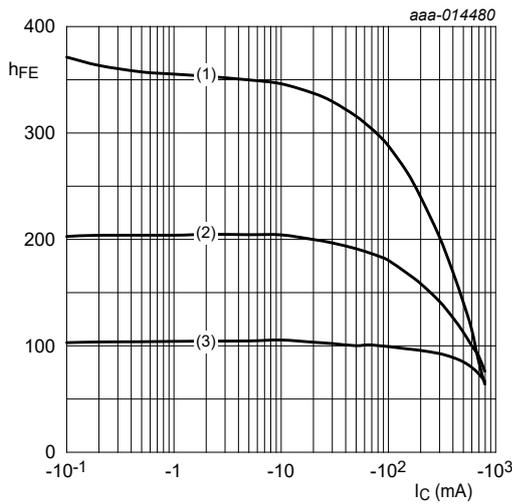
$I_C/I_B = 20$   
 (1)  $T_{amb} = 150\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



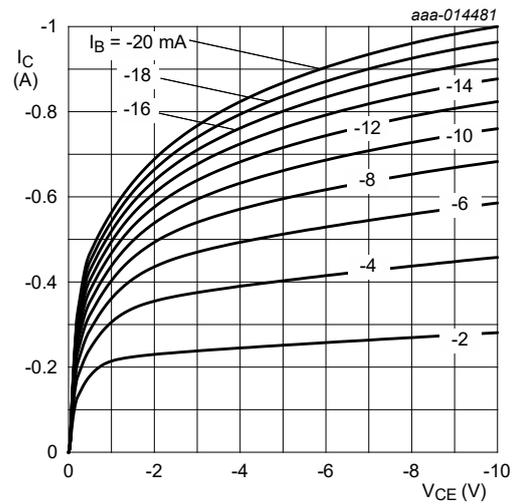
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

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



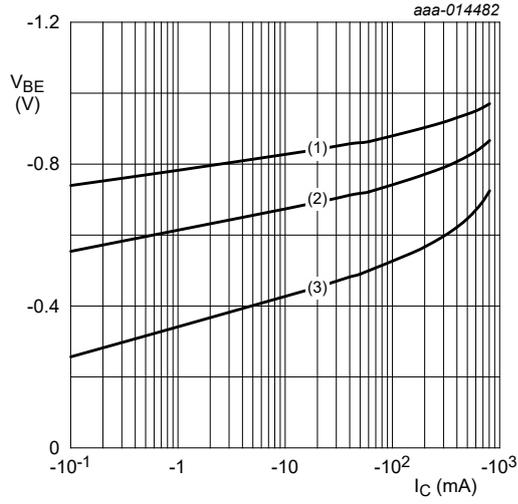
$V_{CE} = -10\text{ V}$   
 (1)  $T_{amb} = 150\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 10. PNP transistor: DC current gain as a function of collector current; typical values**



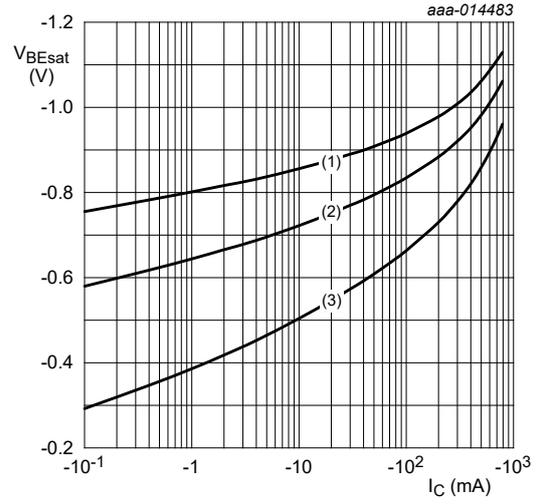
$T_{amb} = 25\text{ °C}$

**Fig. 11. PNP transistor: Collector current as a function of collector-emitter voltage; typical values**



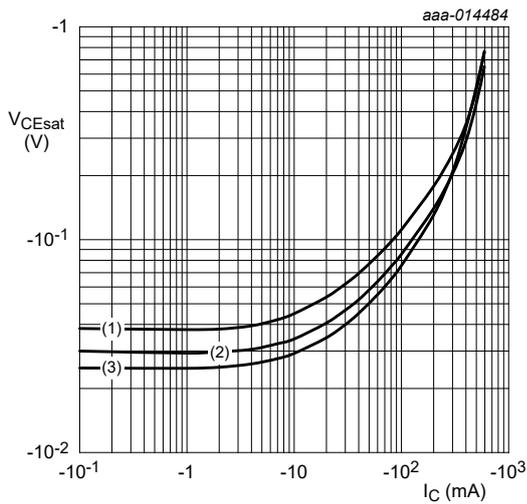
$V_{CE} = -10 \text{ V}$   
 (1)  $T_{amb} = -55 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 150 \text{ }^\circ\text{C}$

**Fig. 12. PNP transistor: Base-emitter voltage as a function of collector current; typical values**



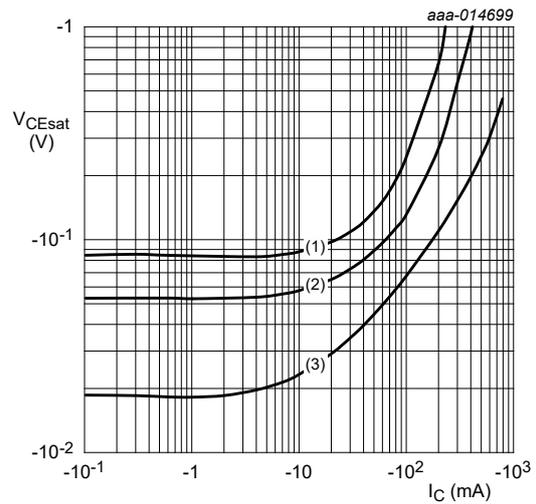
$I_C/I_B = 10$   
 (1)  $T_{amb} = -55 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 150 \text{ }^\circ\text{C}$

**Fig. 13. PNP transistor: Base-emitter saturation voltage as a function of collector current; typical values**



$I_C/I_B = 20$   
 (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. 14. PNP transistor: Collector-emitter saturation voltage as a function of collector current; typical values**



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

**Fig. 15. PNP transistor: Collector-emitter saturation voltage as a function of collector current; typical values**

### 11. Test information

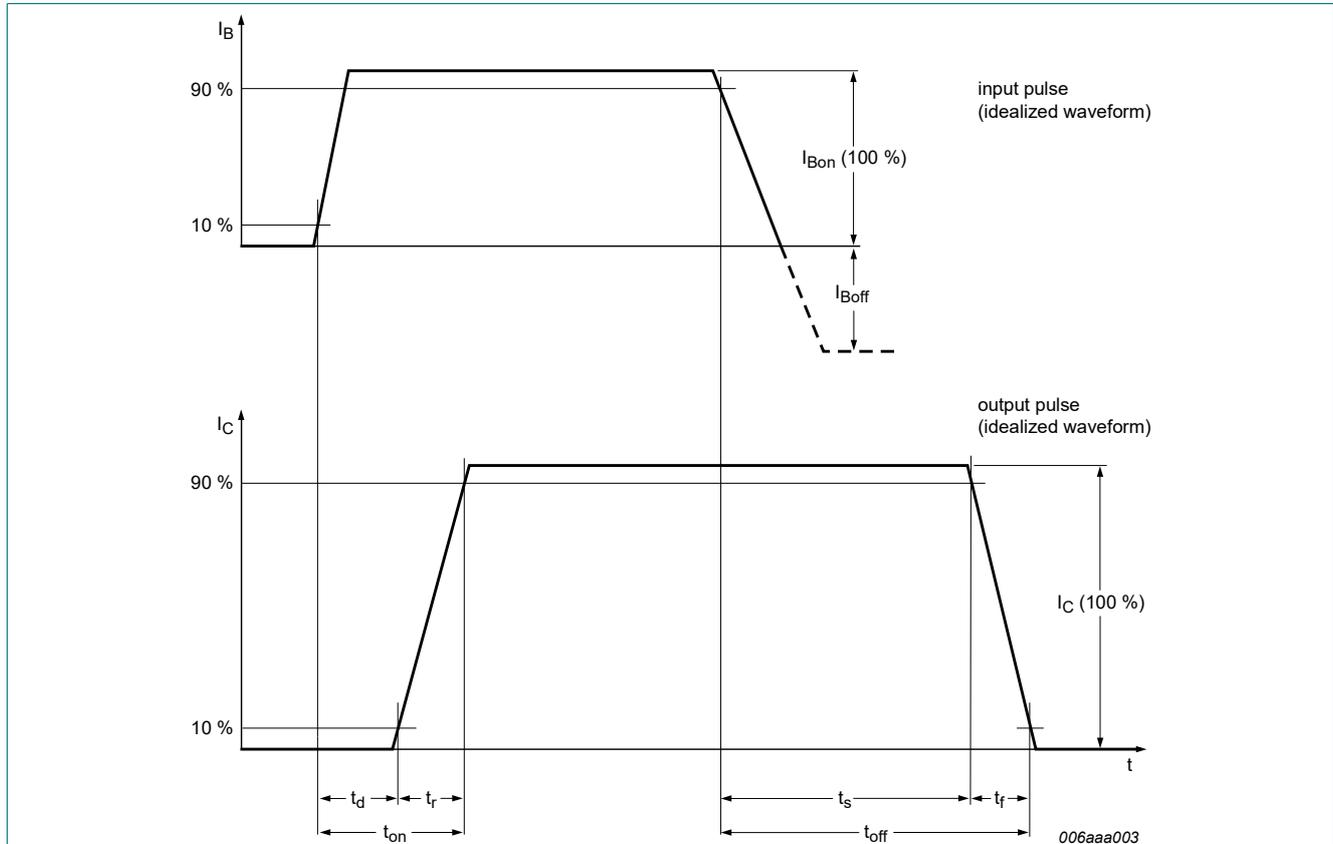


Fig. 16. TR1 (NPN): BISS transistor switching time definition

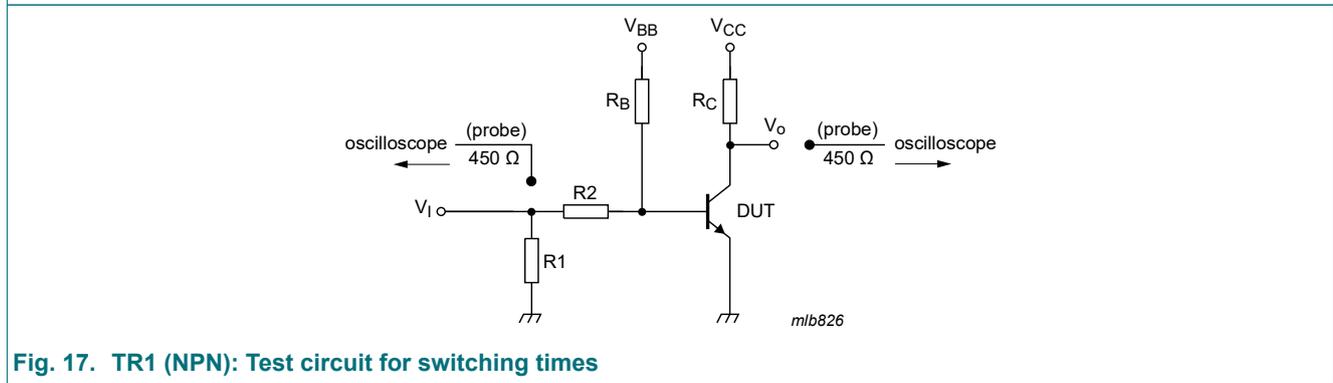


Fig. 17. TR1 (NPN): Test circuit for switching times

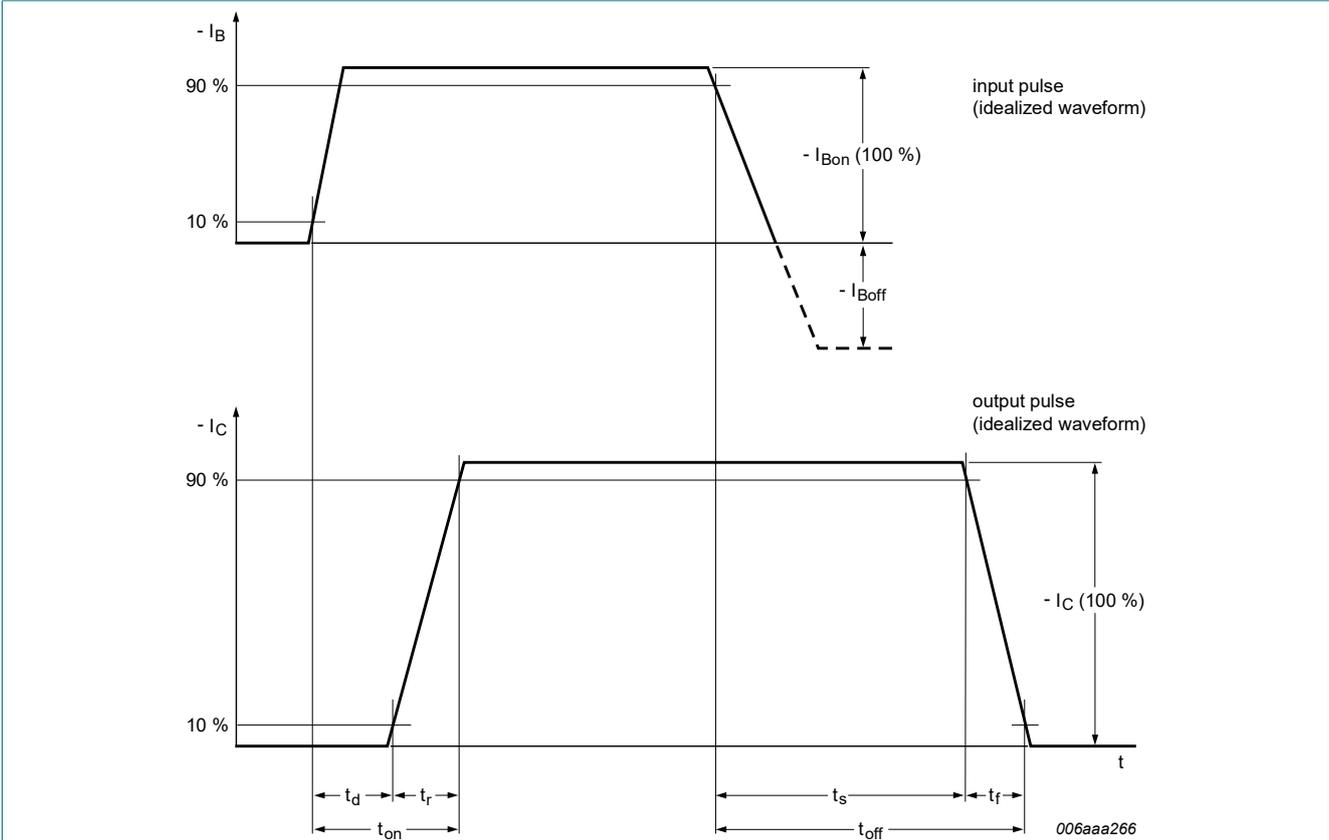


Fig. 18. TR2 (PNP): BISS transistor switching time definition

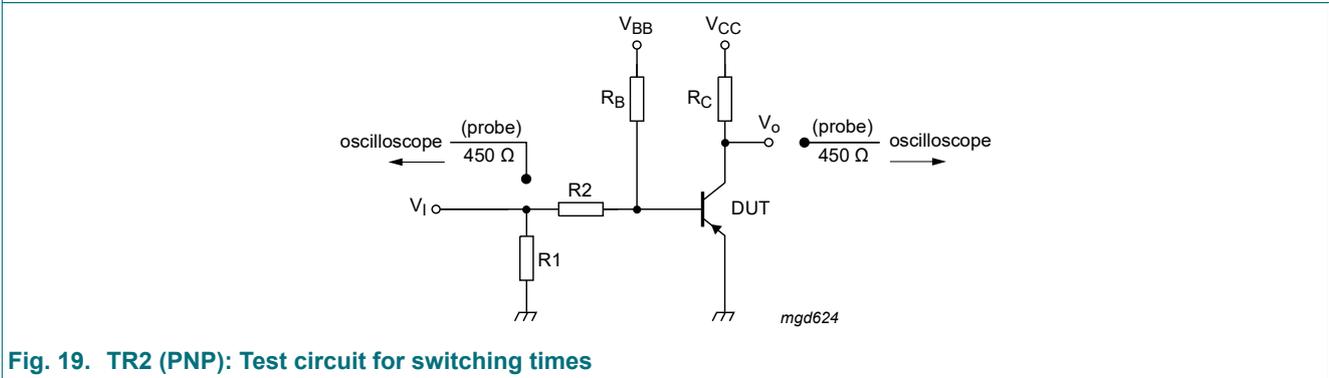


Fig. 19. TR2 (PNP): Test circuit for switching times

### 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

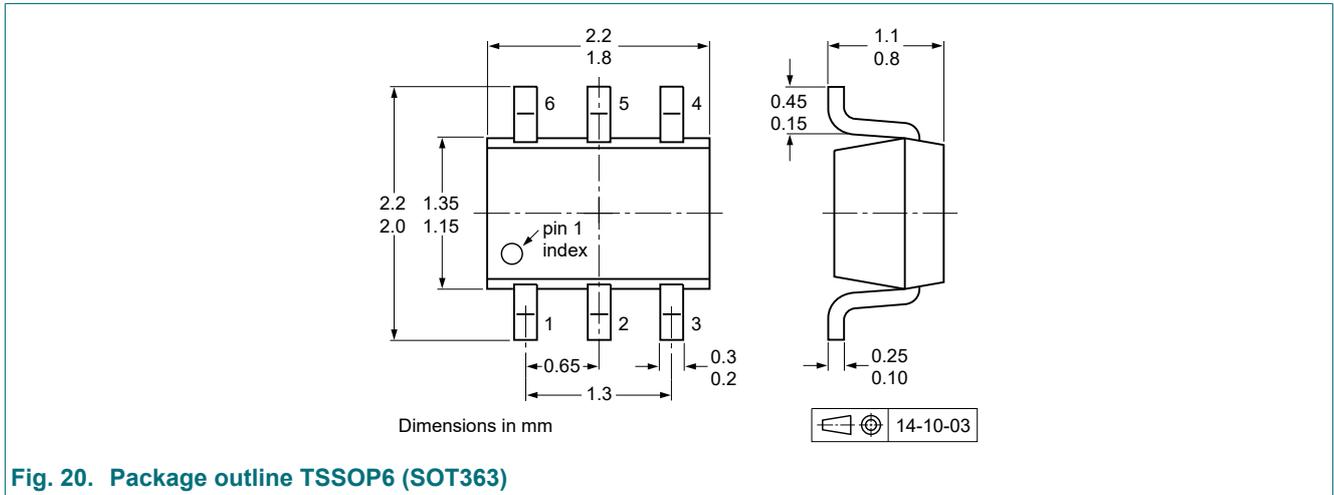


Fig. 20. Package outline TSSOP6 (SOT363)

## 13. Soldering

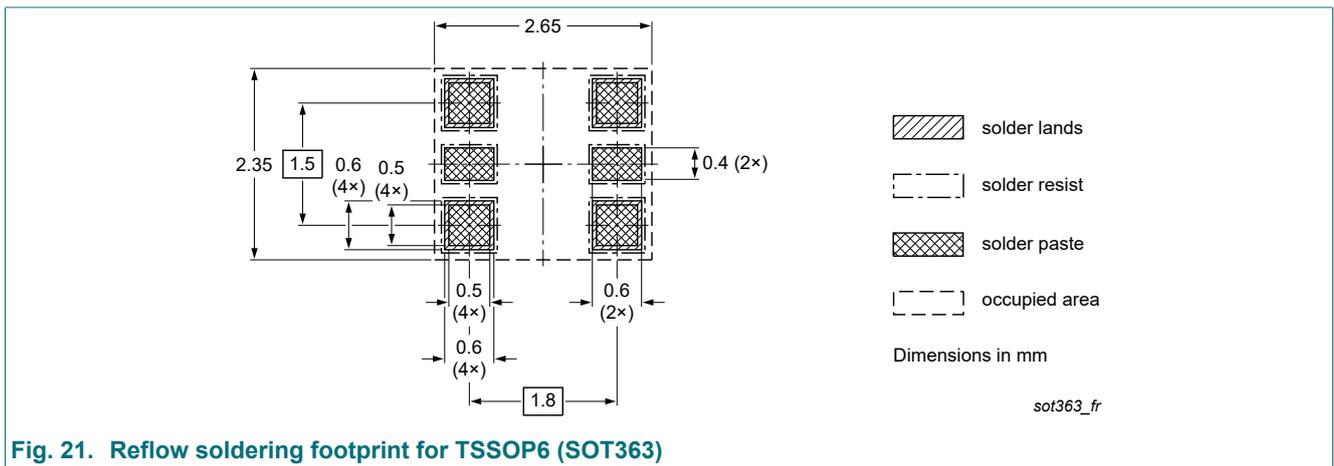


Fig. 21. Reflow soldering footprint for TSSOP6 (SOT363)

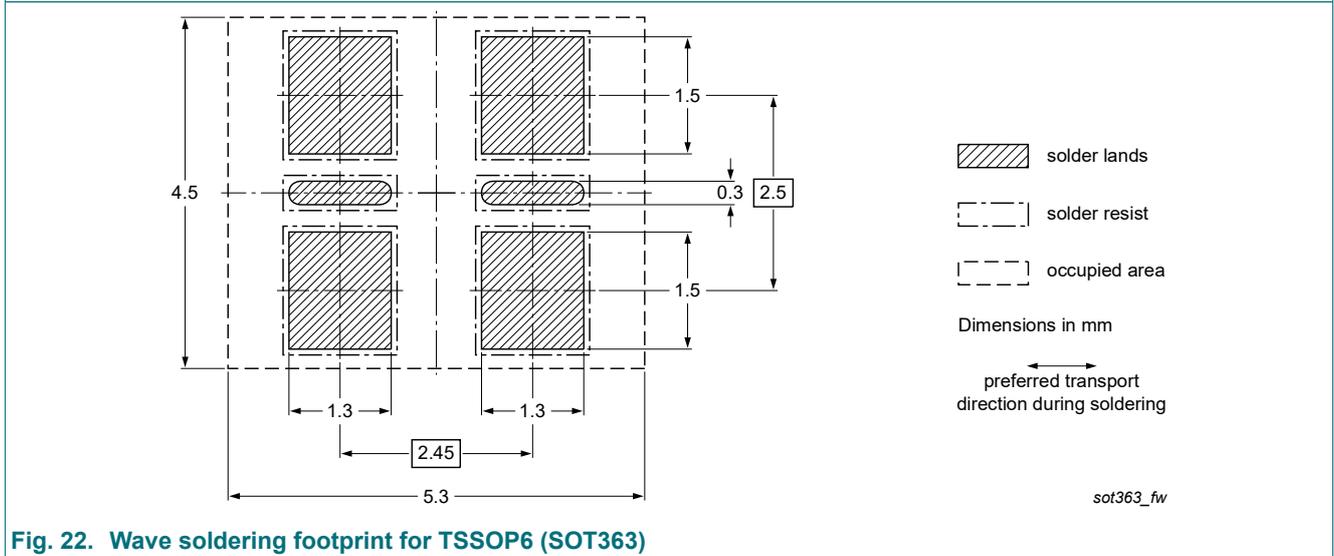


Fig. 22. Wave soldering footprint for TSSOP6 (SOT363)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMBT2227AYS-Q v.2	20220310	Product data sheet	-	PMBT2227AYS-Q v.1
Modifications:	• Product status changed			
PMBT2227AYS-Q v.1	20211220	Objective data sheet	-	-

## 15. Legal information

### 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.
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