



# PBHV9540X

400 V, 0.5 A PNP high-voltage low V<sub>CEsat</sub> (BISS) transistor

28 September 2017

Product data sheet

## 1. General description

PNP high-voltage low V<sub>CEsat</sub> Breakthrough In Small Signal (BISS) transistor in a SOT89 (SC-62) medium power and flat lead Surface-Mounted Device (SMD) plastic package.

NPN complement: PBHV8540X

## 2. Features and benefits

- High voltage
- Low collector-emitter saturation voltage V<sub>CEsat</sub>
- High collector current capability I<sub>C</sub> and I<sub>CM</sub>
- High collector current gain (h<sub>FE</sub>) at high I<sub>C</sub>
- AEC-Q101 qualified

## 3. Applications

- Electronic ballast for fluorescent lighting
- LED driver for LED chain module
- LCD backlighting
- High Intensity Discharge (HID) front lighting
- Automotive motor management
- Hook switch for wired telecom
- Switch mode power supply

## 4. Quick reference data

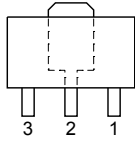
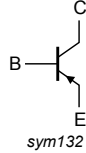
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	-400	V
I <sub>C</sub>	collector current		-	-	-0.5	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms	-	-	-1	A
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = -5 V; I <sub>C</sub> = -20 mA; T <sub>amb</sub> = 25 °C	140	-	450	
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = -200 mA; I <sub>B</sub> = -40 mA; T <sub>amb</sub> = 25 °C	[1]	-	2000	mΩ

[1] Pulse test: t<sub>p</sub> ≤ 300 μs; δ ≤ 0.02

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 <p style="text-align: center;"><b>SOT89</b></p>	 <p style="text-align: center;"><i>sym132</i></p>
2	C	collector		
3	B	base		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBHV9540X	SOT89	plastic surface-mounted package; die pad for good heat transfer; 3 leads	SOT89

## 7. Marking

Table 4. Marking codes

Type number	Marking code <sup>[1]</sup>
PBHV9540X	%4H

[1] % = placeholder for manufacturing site code

## 8. Limiting values

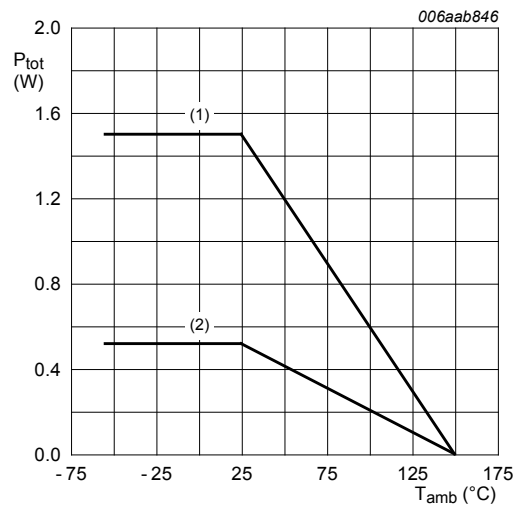
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{CBO}$	collector-base voltage	open emitter	-	-400	V	
$V_{CEO}$	collector-emitter voltage	open base	-	-400	V	
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0$ V	-	-400	V	
$V_{EBO}$	emitter-base voltage	open collector	-	-7	V	
$I_C$	collector current		-	-0.5	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-1	A	
$I_B$	base current		-	-250	mA	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	0.52	W
			[2]	-	1.5	W
$T_j$	junction temperature		-	150	°C	
$T_{amb}$	ambient temperature		-55	150	°C	
$T_{stg}$	storage temperature		-65	150	°C	

[1] Device mounted on an FR4 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 6 cm<sup>2</sup>.



(1) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

(2) FR4 PCB, standard footprint

**Fig. 1. Power derating curves**

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	240	K/W
			[2]	-	-	83	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	20	-	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 6 cm<sup>2</sup>.

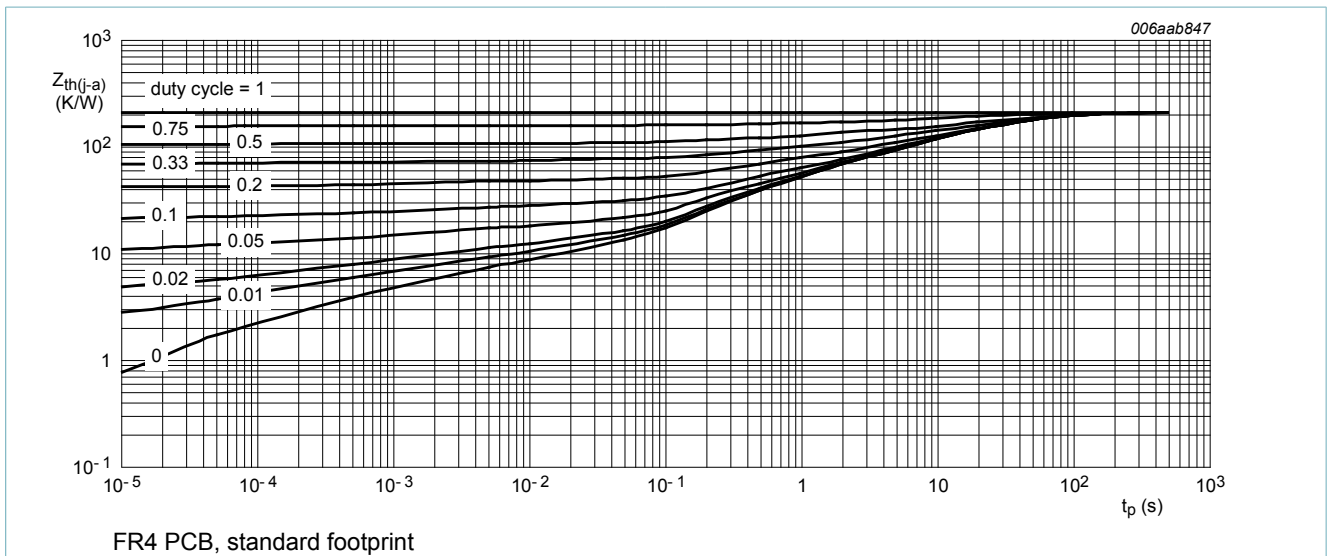


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

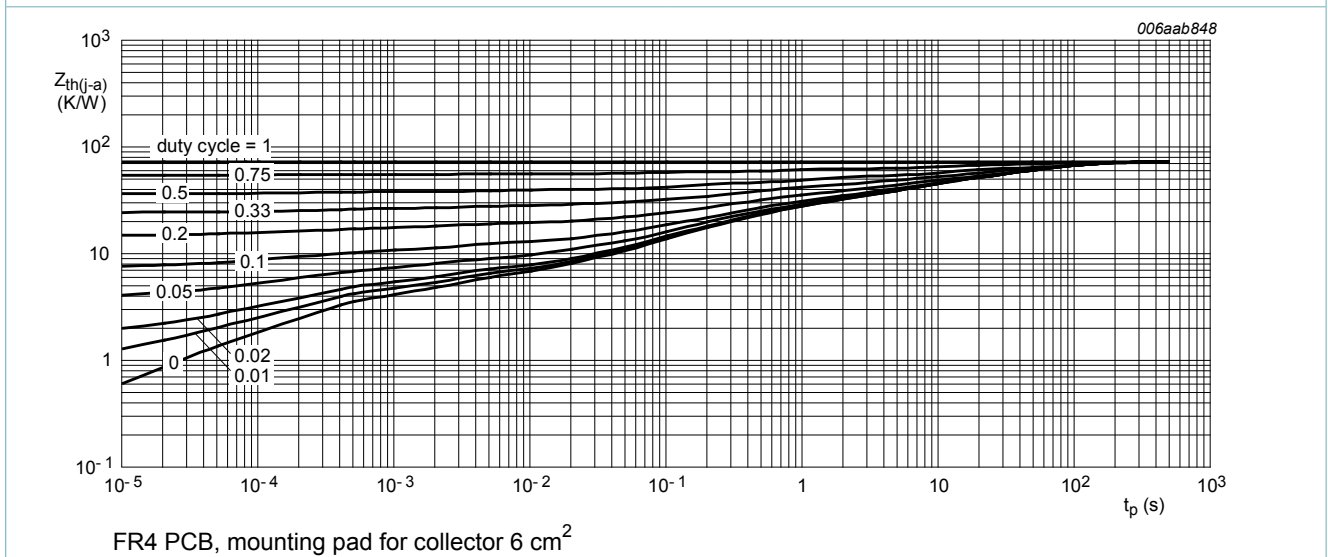


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

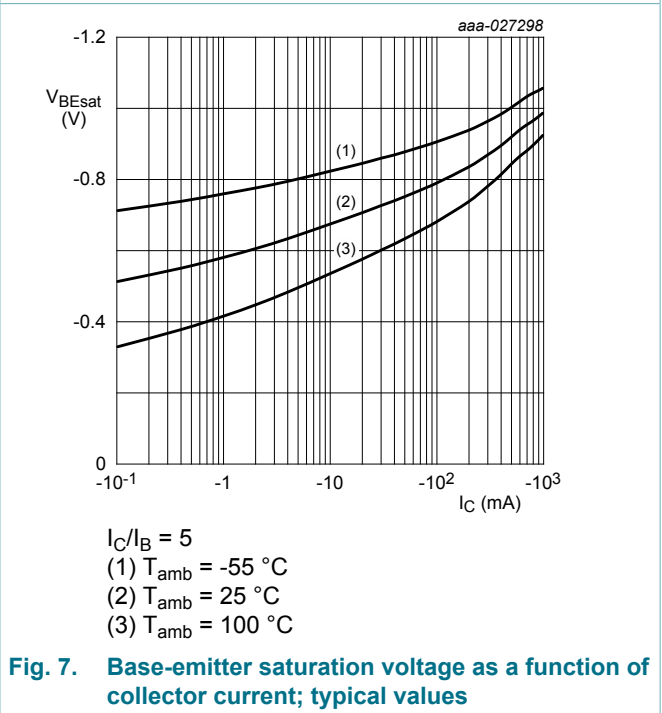
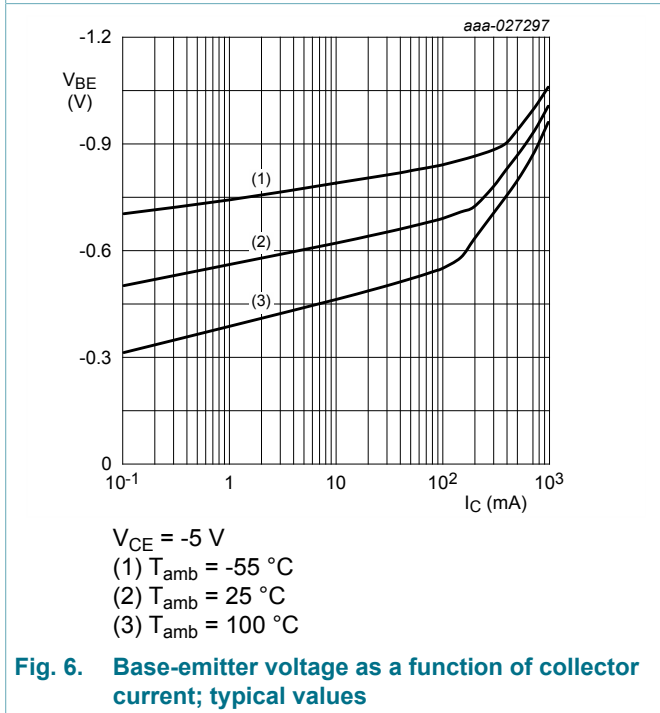
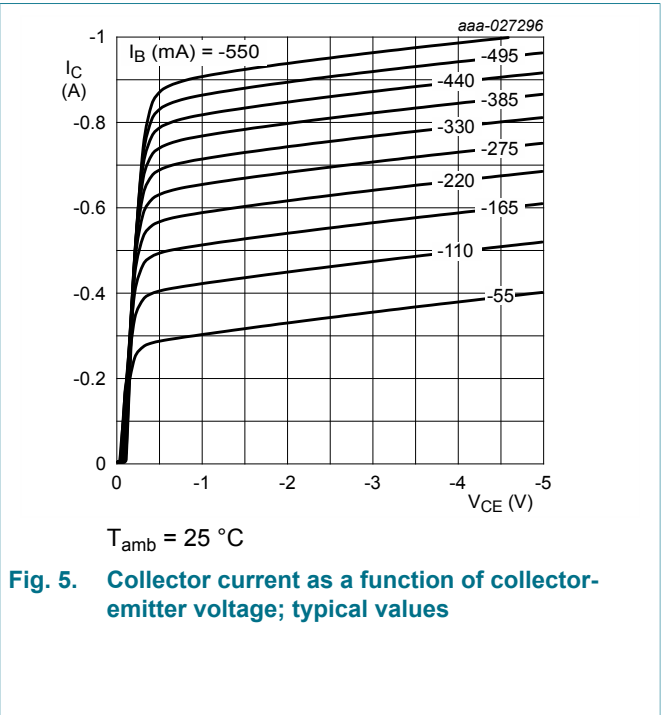
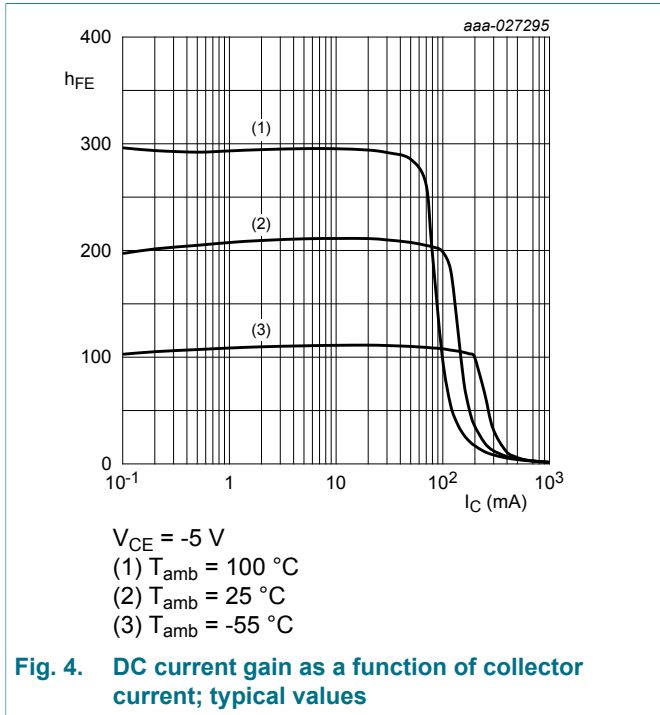
Table 7. Characteristics

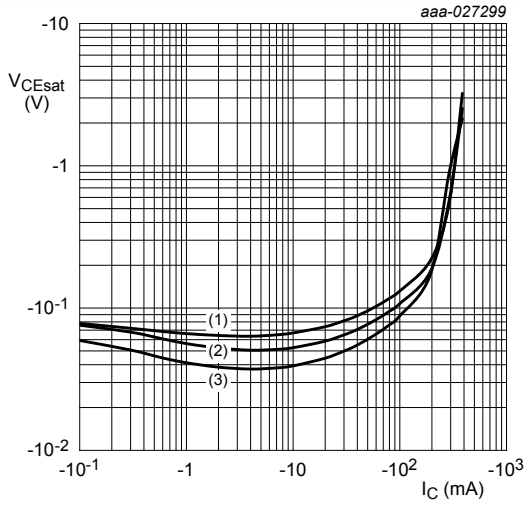
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = -100 \mu\text{A}$ ; $I_E = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-400	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = -2.5 \text{ mA}$ ; $I_B = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-400	-	-	V
$V_{(BR)CES}$	collector-emitter breakdown voltage (base shorted)	$I_C = -2.5 \text{ mA}$ ; $V_{BE} = 0 \text{ V}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-400	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage (collector open)	$I_E = -100 \mu\text{A}$ ; $I_C = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-7	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -320 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
		$V_{CB} = -320 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	-	-10	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = -320 \text{ V}$ ; $V_{BE} = 0 \text{ V}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = -7 \text{ V}$ ; $I_C = 0 \text{ A}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
$h_{FE}$	DC current gain	$V_{CE} = -5 \text{ V}$ ; $I_C = -20 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	140	-	450	
		$V_{CE} = -5 \text{ V}$ ; $I_C = -100 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	140	-	400	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -100 \text{ mA}$ ; $I_B = -20 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	-250	mV
		$I_C = -200 \text{ mA}$ ; $I_B = -40 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	-400	mV
$R_{CEsat}$	collector-emitter saturation resistance	$T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	2000	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -100 \text{ mA}$ ; $I_B = -10 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	-0.9	V
		$I_C = -200 \text{ mA}$ ; $I_B = -40 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	-1	V
$V_{BE}$	base-emitter voltage	$V_{CE} = -10 \text{ V}$ ; $I_C = -200 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ [1]	-	-	-0.9	V
$t_d$	delay time	$V_{CC} = -6.2 \text{ V}$ ; $I_C = -100 \text{ mA}$ ; $I_{Bon} = -10 \text{ mA}$ ; $I_{Boff} = 20 \text{ mA}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	60	-	ns
$t_r$	rise time		-	3650	-	ns
$t_{on}$	turn-on time		-	3710	-	ns
$t_s$	storage time		-	810	-	ns
$t_f$	fall time		-	900	-	ns
$t_{off}$	turn-off time		-	1710	-	ns
$f_T$	transition frequency		$V_{CE} = -5 \text{ V}$ ; $I_C = -50 \text{ mA}$ ; $f = 100 \text{ MHz}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	65	-
$C_c$	collector capacitance	$V_{CB} = -10 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $i_e = 0 \text{ A}$ ; $f = 1 \text{ MHz}$ ; $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$	-	14	-	pF

400 V, 0.5 A PNP high-voltage low VCEsat (BISS) transistor

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C <sub>e</sub>	emitter capacitance	V <sub>EB</sub> = -0.5 V; I <sub>C</sub> = 0 A; i <sub>c</sub> = 0 A; f = 1 MHz; T <sub>amb</sub> = 25 °C	-	235	-	pF

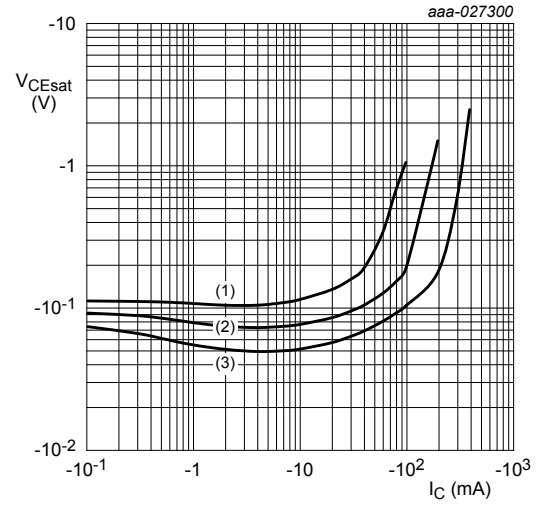
[1] Pulse test: t<sub>p</sub> ≤ 300 μs; δ ≤ 0.02





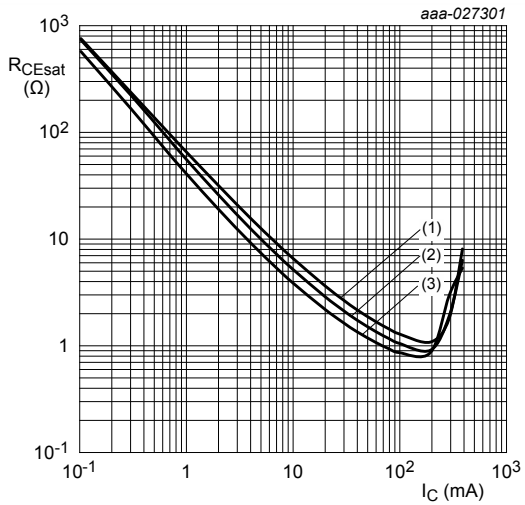
$I_C/I_B = 5$   
 (1)  $T_{amb} = 100^\circ\text{C}$   
 (2)  $T_{amb} = 25^\circ\text{C}$   
 (3)  $T_{amb} = -55^\circ\text{C}$

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



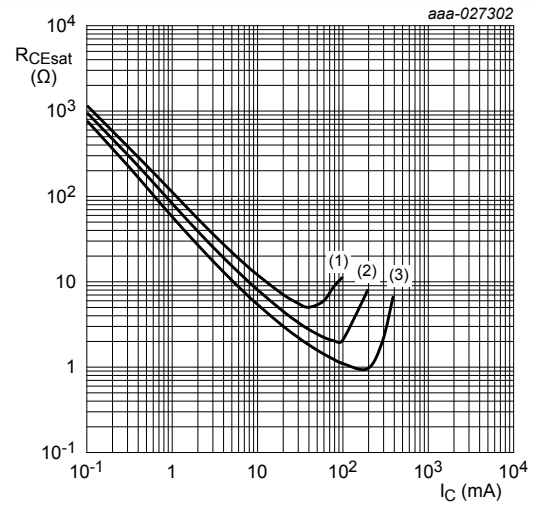
$T_{amb} = 25^\circ\text{C}$   
 (1)  $I_C/I_B = 20$   
 (2)  $I_C/I_B = 10$   
 (3)  $I_C/I_B = 5$

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



$I_C/I_B = 5$   
 (1)  $T_{amb} = 100^\circ\text{C}$   
 (2)  $T_{amb} = 25^\circ\text{C}$   
 (3)  $T_{amb} = -55^\circ\text{C}$

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



$T_{amb} = 25^\circ\text{C}$   
 (1)  $I_C/I_B = 20$   
 (2)  $I_C/I_B = 10$   
 (3)  $I_C/I_B = 5$

Fig. 11. Collector-emitter saturation resistance as a function of collector current; typical values

### 11. Test information

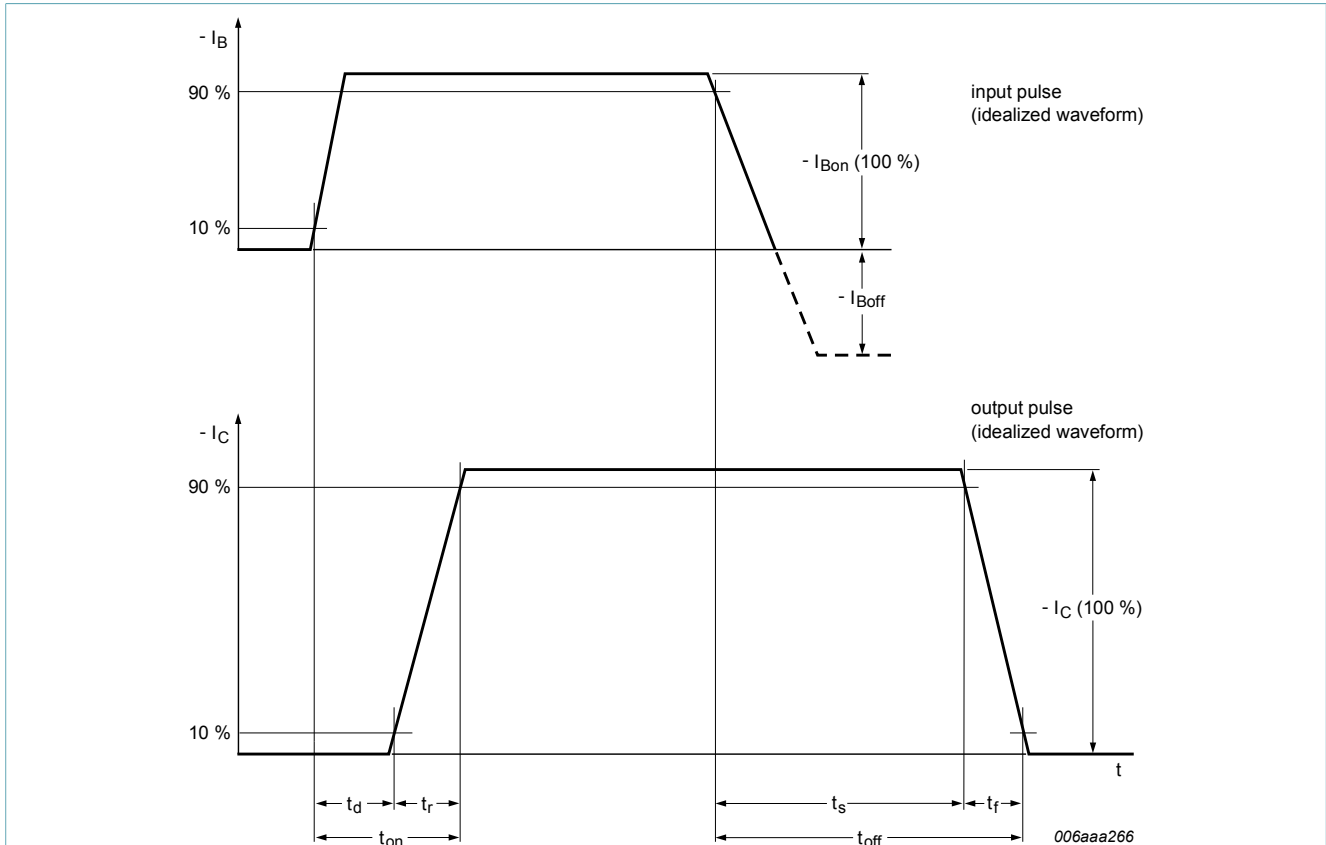


Fig. 12. BISS transistor switching time definition

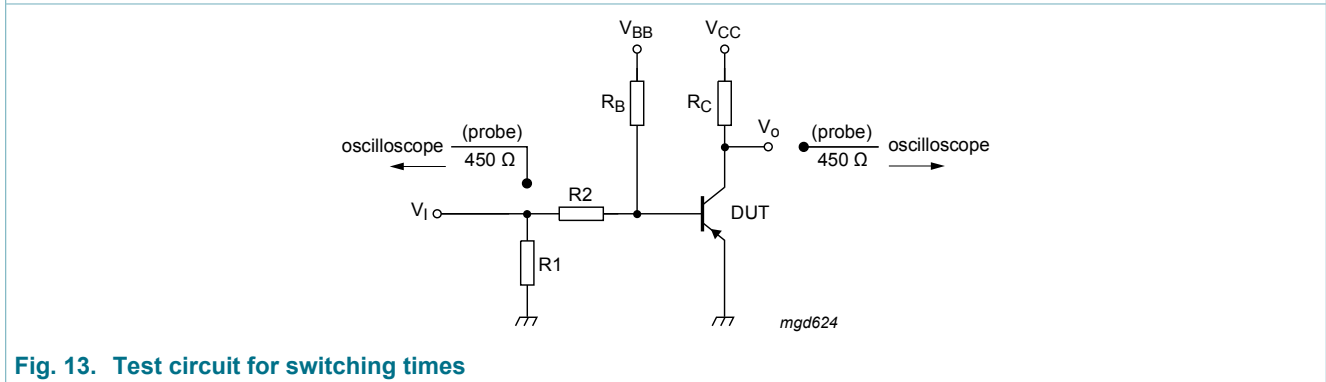


Fig. 13. Test circuit for switching times

### 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

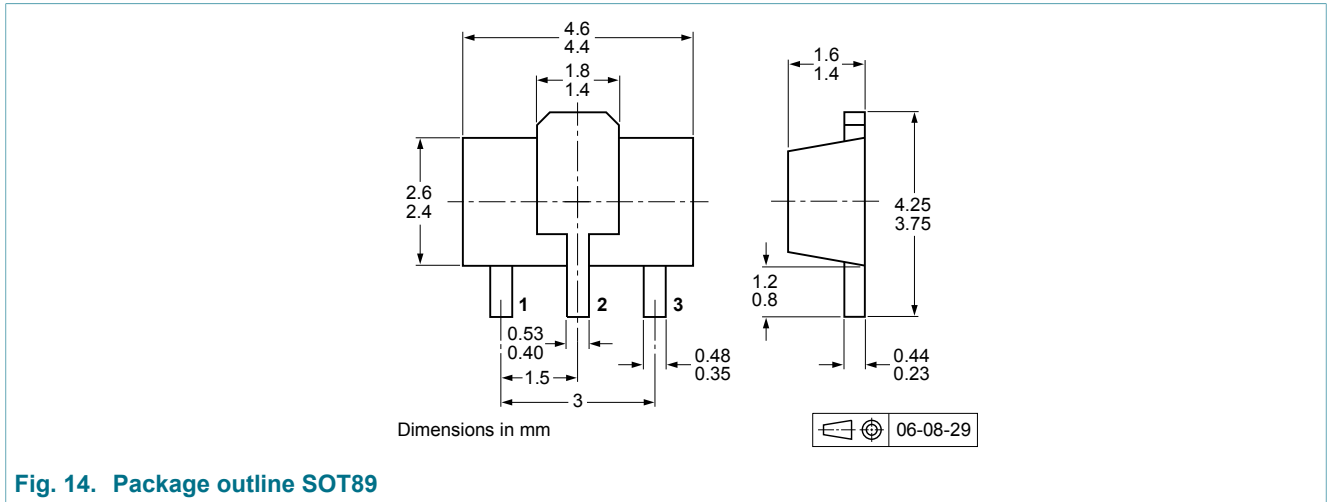


Fig. 14. Package outline SOT89

## 13. Soldering

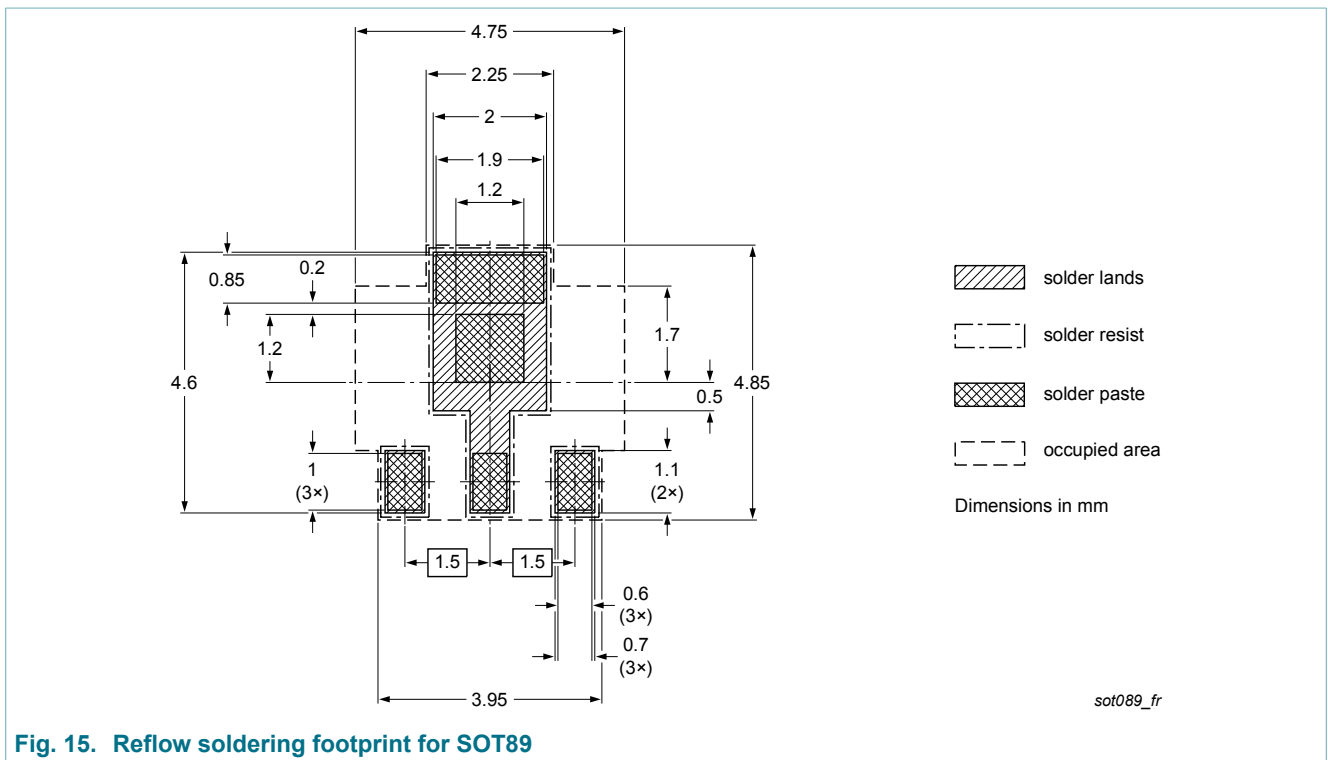


Fig. 15. Reflow soldering footprint for SOT89

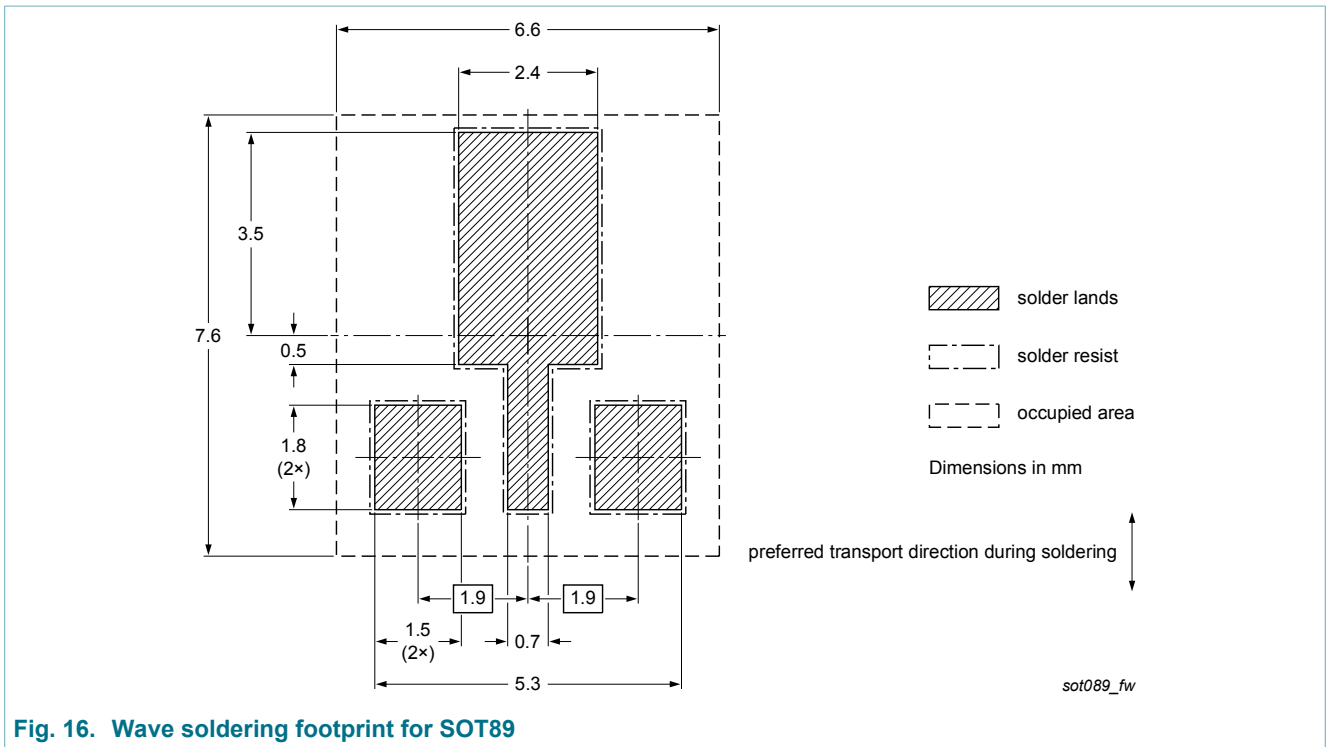


Fig. 16. Wave soldering footprint for SOT89

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBHV9540X v.1	20170928	Product 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.

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