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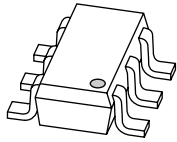
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# PBLS2024D

20 V, 1.8 A PNP BISS loadswitch

Rev. 02 — 6 September 2009

Product data sheet

## 1. Product profile

### 1.1 General description

PNP low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor and NPN Resistor-Equipped Transistor (RET) in a SOT457 (SC-74) small Surface-Mounted Device (SMD) plastic package.

### 1.2 Features

- Low  $V_{CEsat}$  (BISS) and resistor-equipped transistor in one package
- Low threshold voltage (<1 V) compared to MOSFET
- Space-saving solution
- Reduction of component count
- AEC-Q101 qualified

### 1.3 Applications

- Supply line switches
- Battery charger switches
- High-side switches for LEDs, drivers and backlights
- Portable equipment

### 1.4 Quick reference data

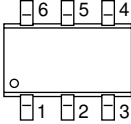
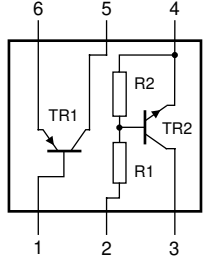
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1; PNP low <math>V_{CEsat}</math> transistor</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	-20	V
$I_C$	collector current		-	-	-1.8	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	-3	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -1.8$ A; $I_B = -100$ mA	[1]	78	117	m $\Omega$
<b>TR2; NPN resistor-equipped transistor</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	50	V
$I_O$	output current		-	-	100	mA
R1	bias resistor 1 (input)		15.4	22	28.6	k $\Omega$
R2/R1	bias resistor ratio		0.8	1	1.2	

[1] Pulse test:  $t_p \leq 300$   $\mu$ s;  $\delta \leq 0.02$ .

## 2. Pinning information

**Table 2. Pinning**

Pin	Description	Simplified outline	Graphic symbol
1	base TR1		
2	input (base) TR2		
3	output (collector) TR2		
4	GND (emitter) TR2		
5	collector TR1		
6	emitter TR1		

*006aab506*

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
PBLS2024D	SC-74	plastic surface-mounted package (TSOP6); 6 leads	SOT457

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code
PBLS2024D	KD

## 5. Limiting values

**Table 5. Limiting values**

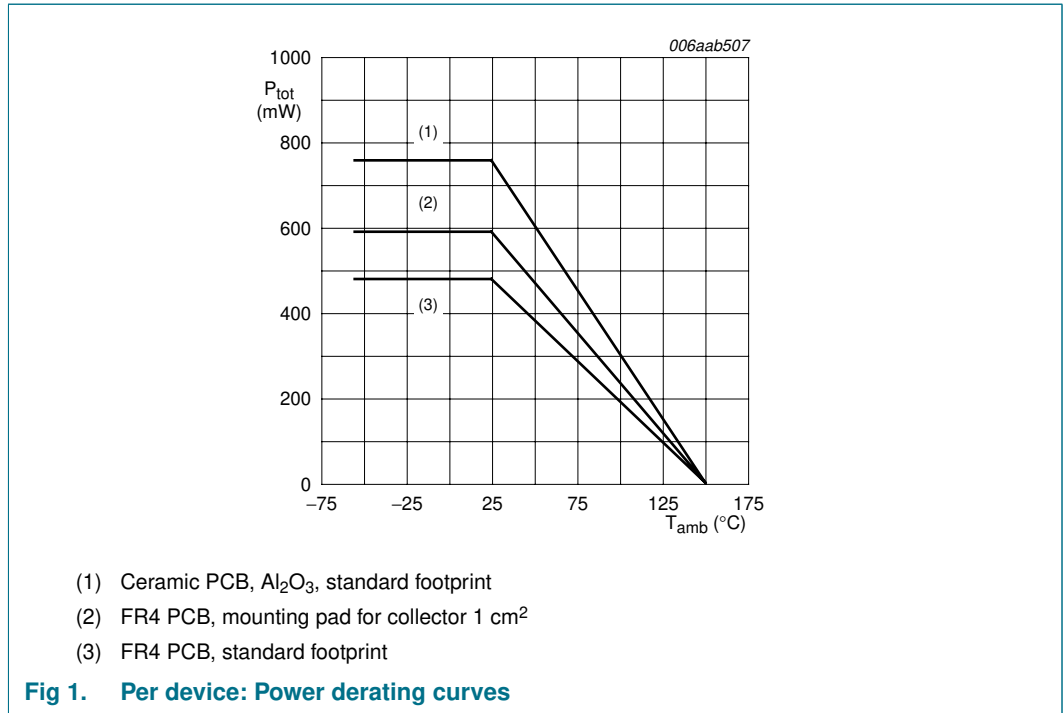
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

Symbol	Parameter	Conditions	Min	Max	Unit	
<b>TR1; PNP low <math>V_{CEsat}</math> transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter	-	-20	V	
$V_{CEO}$	collector-emitter voltage	open base	-	-20	V	
$V_{EBO}$	emitter-base voltage	open collector	-	-5	V	
$I_C$	collector current		-	-1.8	A	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-3	A	
$I_B$	base current		-	-300	mA	
$I_{BM}$	peak base current	single pulse; $t_p \leq 1$ ms	-	-1	A	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	370	mW
			[2]	-	480	mW
			[3]	-	630	mW
<b>TR2; NPN resistor-equipped transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter	-	50	V	
$V_{CEO}$	collector-emitter voltage	open base	-	50	V	
$V_{EBO}$	emitter-base voltage	open collector	-	10	V	
$V_I$	input voltage					
		positive	-	+40	V	
		negative	-	-10	V	
$I_O$	output current		-	100	mA	
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	100	mA	
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1][2]	-	200	mW
			[3]			
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	480	mW
			[2]	-	590	mW
			[3]	-	760	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, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



## 6. Thermal characteristics

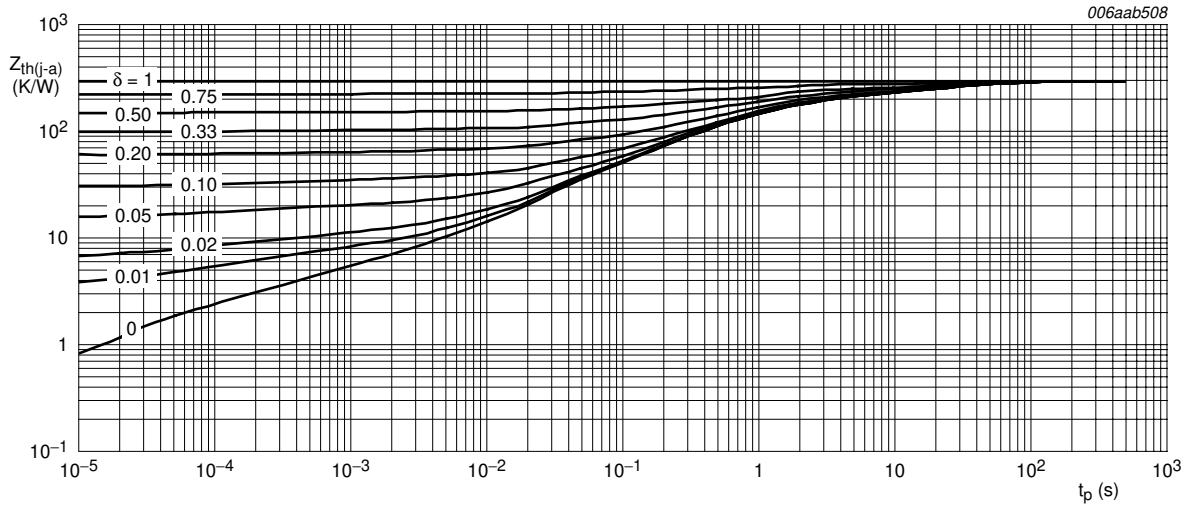
**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Per device</b>							
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	260	K/W
			[2]	-	-	211	K/W
			[3]	-	-	165	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		-	-	100	K/W	

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

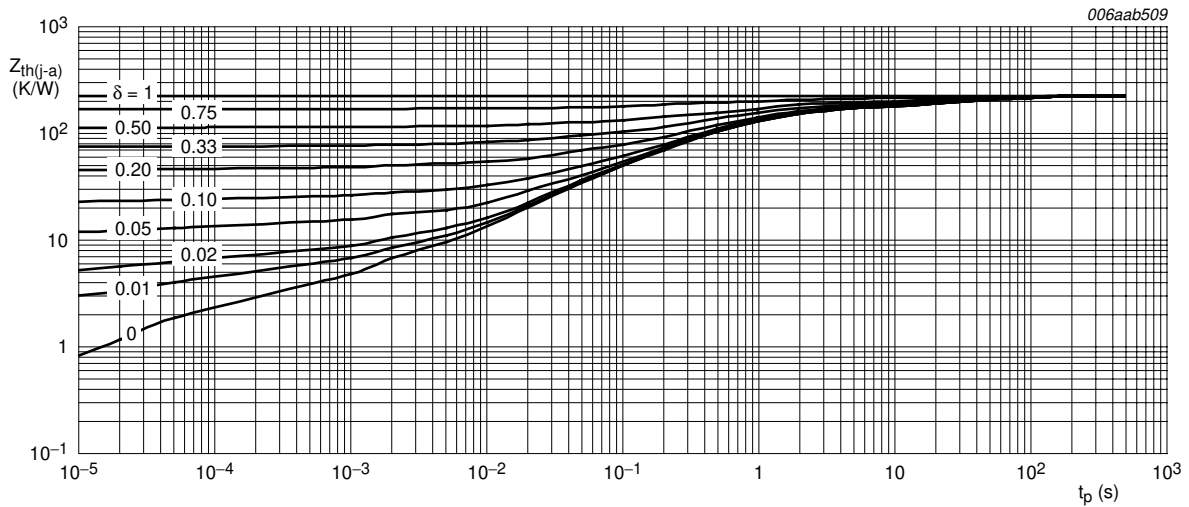
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



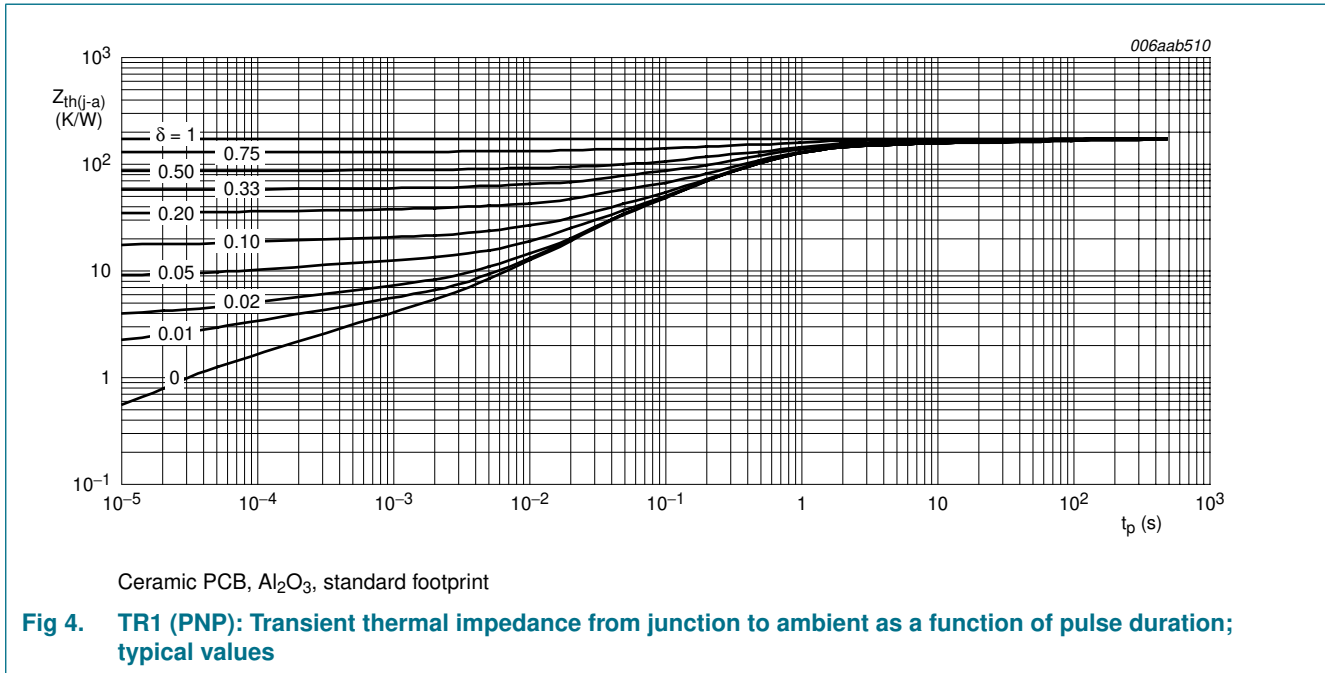
FR4 PCB, standard footprint

**Fig 2. TR1 (PNP): 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. TR1 (PNP): Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**



## 7. Characteristics

**Table 7. Characteristics**  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

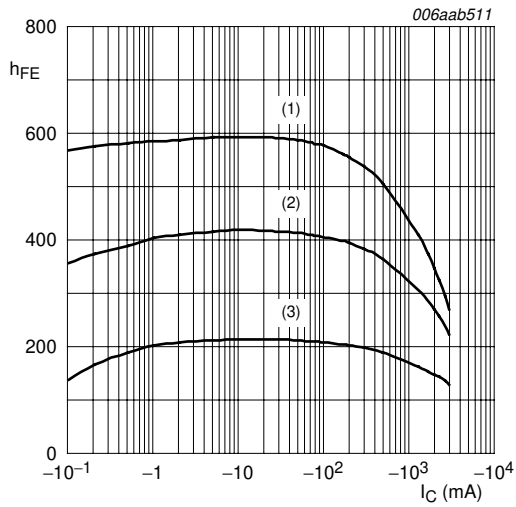
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1; PNP low V<sub>CEsat</sub> transistor</b>						
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = -20 V; I <sub>E</sub> = 0 A	-	-	-100	nA
		V <sub>CB</sub> = -20 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	-50	μA
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>CE</sub> = -16 V; V <sub>BE</sub> = 0 V	-	-	-100	nA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = -5 V; I <sub>C</sub> = 0 A	-	-	-100	nA
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = -2 V; I <sub>C</sub> = -100 mA	220	420	-	
		V <sub>CE</sub> = -2 V; I <sub>C</sub> = -500 mA	[1] 220	410	-	
		V <sub>CE</sub> = -2 V; I <sub>C</sub> = -1 A	[1] 200	320	-	
		V <sub>CE</sub> = -2 V; I <sub>C</sub> = -1.8 A	[1] 160	260	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = -0.5 A; I <sub>B</sub> = -50 mA	[1] -	-45	-70	mV
		I <sub>C</sub> = -1 A; I <sub>B</sub> = -50 mA	[1] -	-85	-130	mV
		I <sub>C</sub> = -1 A; I <sub>B</sub> = -100 mA	[1] -	-80	-120	mV
		I <sub>C</sub> = -1.8 A; I <sub>B</sub> = -100 mA	[1] -	-140	-210	mV
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = -1 A; I <sub>B</sub> = -100 mA	[1] -	80	120	mΩ
		I <sub>C</sub> = -1.8 A; I <sub>B</sub> = -100 mA	[1] -	78	117	mΩ
V <sub>BEsat</sub>	base-emitter saturation voltage	I <sub>C</sub> = -0.5 A; I <sub>B</sub> = -50 mA	[1] -	-0.85	-1	V
		I <sub>C</sub> = -1.8 A; I <sub>B</sub> = -100 mA	[1] -	-0.93	-1.1	V



**Table 7. Characteristics ...continued**  
 $T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified.

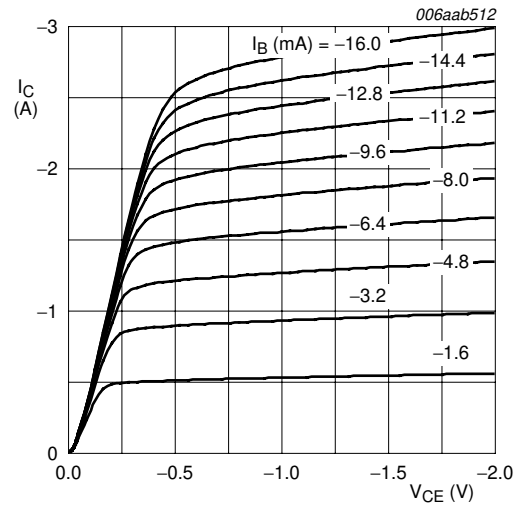
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = -10\text{ V}; I_C = -1\text{ A}$	[1] -	-0.73	-1.1	V
$t_d$	delay time	$V_{CC} = -10\text{ V}; I_C = -1\text{ A};$	-	17	-	ns
$t_r$	rise time	$I_{Bon} = -50\text{ mA};$	-	33	-	ns
$t_{on}$	turn-on time	$I_{Boff} = 50\text{ mA}$	-	50	-	ns
$t_s$	storage time		-	270	-	ns
$t_f$	fall time		-	60	-	ns
$t_{off}$	turn-off time		-	330	-	ns
$f_T$	transition frequency	$I_C = -50\text{ mA}; V_{CE} = -10\text{ V};$ $f = 100\text{ MHz}$	-	130	-	MHz
$C_c$	collector capacitance	$V_{CB} = -10\text{ V}; I_E = i_e = 0\text{ A};$ $f = 1\text{ MHz}$	-	45	-	pF
<b>TR2; NPN resistor-equipped transistor</b>						
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 50\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 30\text{ V}; I_B = 0\text{ A}$	-	-	1	$\mu\text{A}$
		$V_{CE} = 30\text{ V}; I_B = 0\text{ A};$ $T_j = 150^{\circ}\text{C}$	-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	180	$\mu\text{A}$
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}; I_C = 5\text{ mA}$	60	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$	-	-	150	mV
$V_{I(off)}$	off-state input voltage	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$	-	1.1	0.8	V
$V_{I(on)}$	on-state input voltage	$V_{CE} = 0.3\text{ V}; I_C = 5\text{ mA}$	2.5	1.7	-	V
R1	bias resistor 1 (input)		15.4	22	28.6	k $\Omega$
R2/R1	bias resistor ratio		0.8	1	1.2	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A};$ $f = 1\text{ MHz}$	-	-	2.5	pF

[1] Pulse test:  $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02$ .



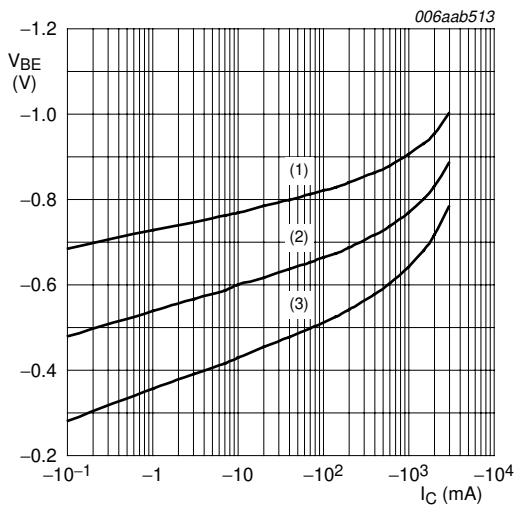
$V_{CE} = -2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig 5. TR1 (PNP): DC current gain as a function of collector current; typical values**



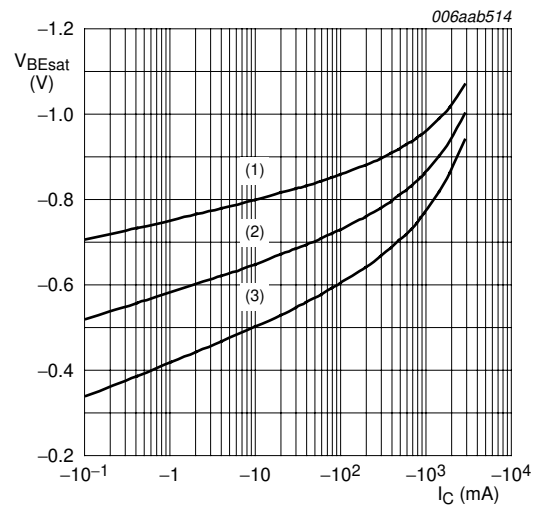
$T_{amb} = 25\text{ °C}$

**Fig 6. TR1 (PNP): Collector current as a function of collector-emitter voltage; typical values**



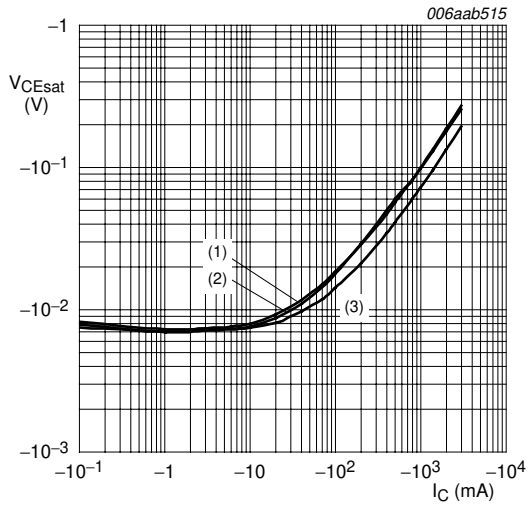
$V_{CE} = -2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig 7. TR1 (PNP): Base-emitter voltage as a function of collector current; typical values**



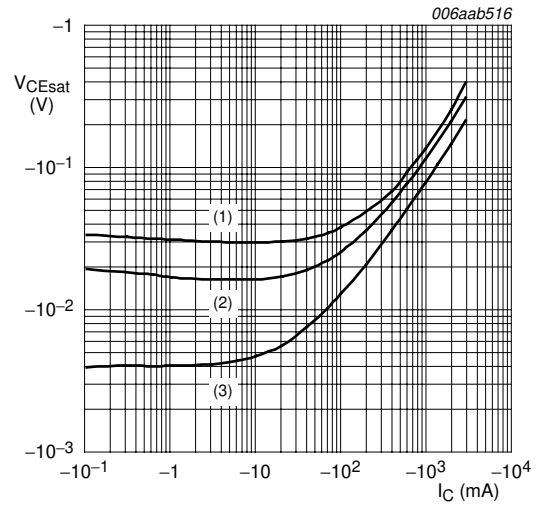
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig 8. TR1 (PNP): Base-emitter saturation voltage as a function of collector current; typical values**



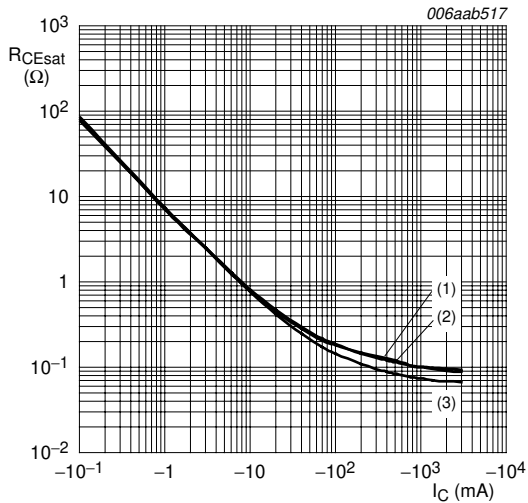
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

**Fig 9. TR1 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values**



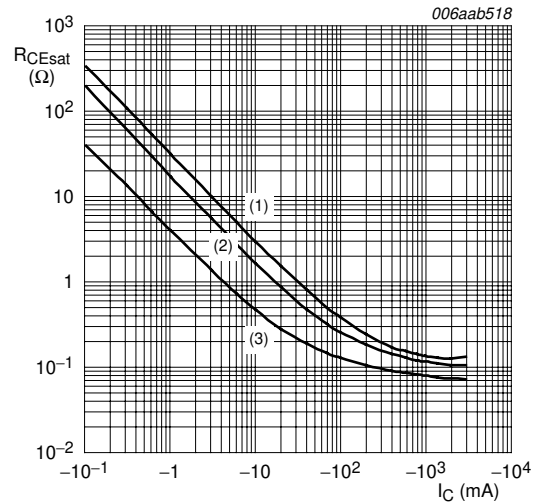
$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**Fig 10. TR1 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values**



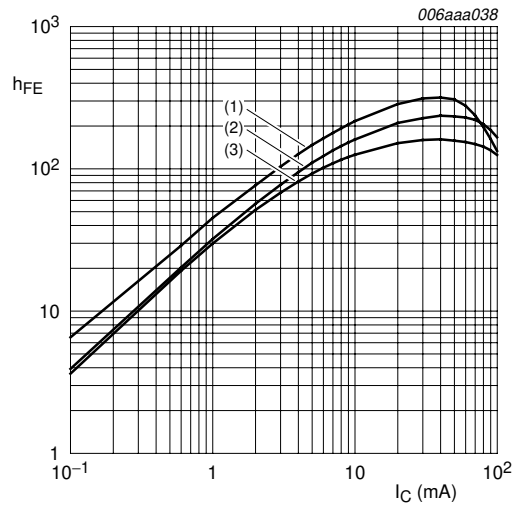
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

**Fig 11. TR1 (PNP): Collector-emitter saturation resistance as a function of collector current; typical values**



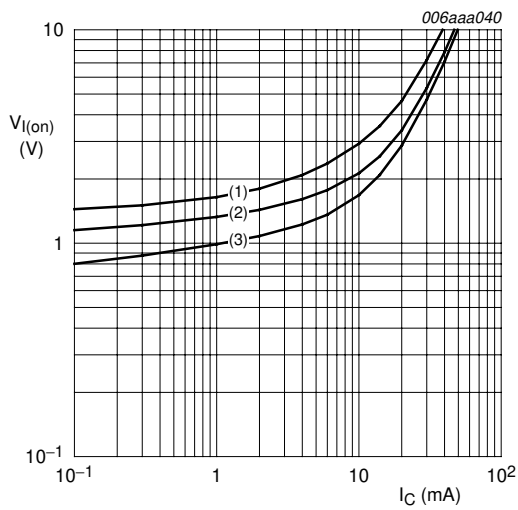
$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

**Fig 12. TR1 (PNP): Collector-emitter saturation resistance as a function of collector current; typical values**



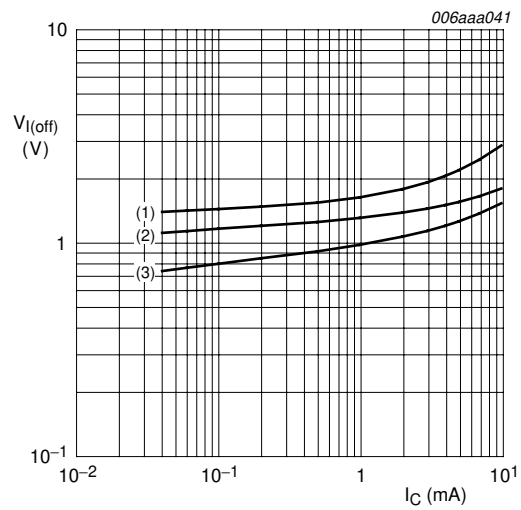
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = 150\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -40\text{ °C}$

**Fig 13. TR2 (NPN): DC current gain as a function of collector current; typical values**



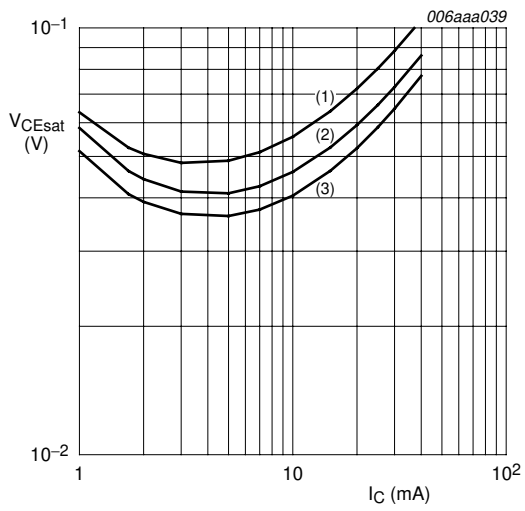
- $V_{CE} = 0.3\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

**Fig 14. TR2 (NPN): On-state input voltage as a function of collector current; typical values**



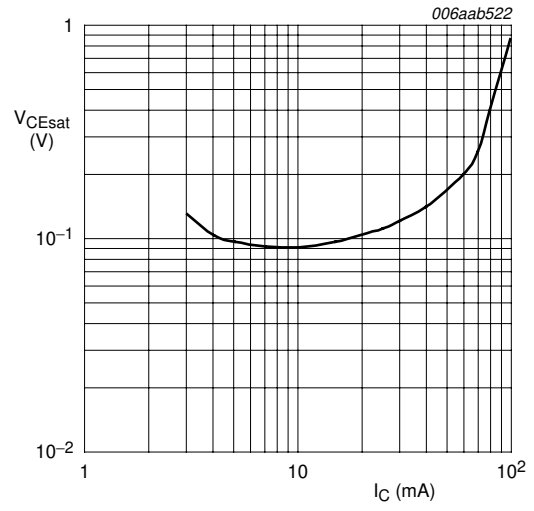
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -40\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = 100\text{ °C}$

**Fig 15. TR2 (NPN): Off-state input voltage as a function of collector current; typical values**



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

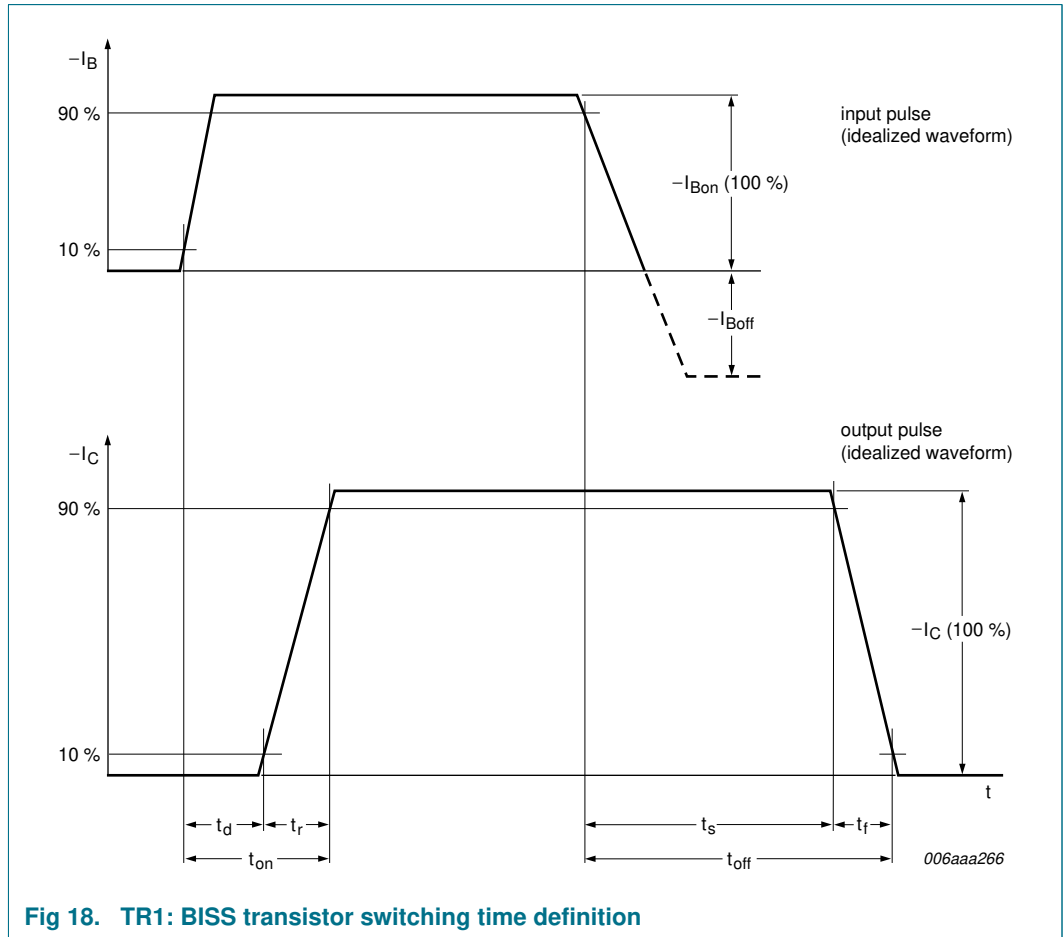
**Fig 16. TR2 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values**



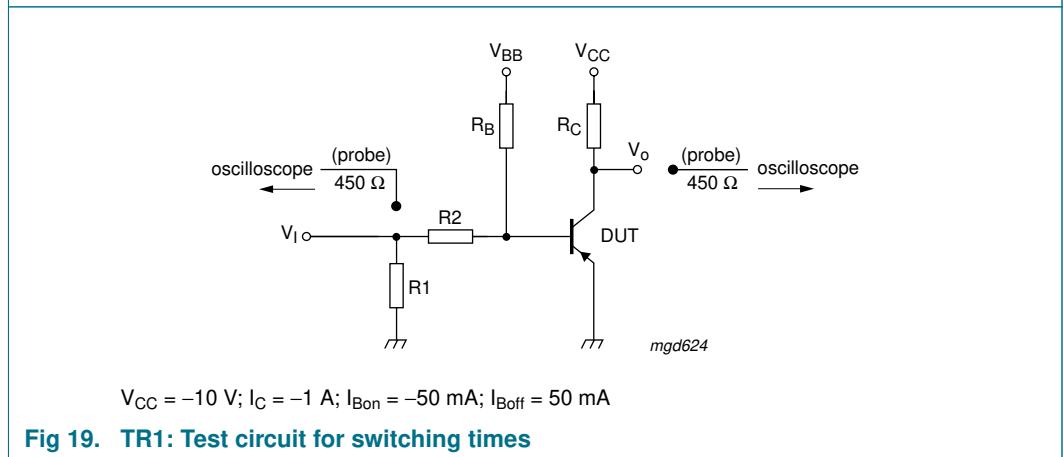
$I_C/I_B = 70; T_{amb} = 25\text{ °C}$

**Fig 17. TR2 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values**

## 8. Test information



**Fig 18. TR1: BISS transistor switching time definition**

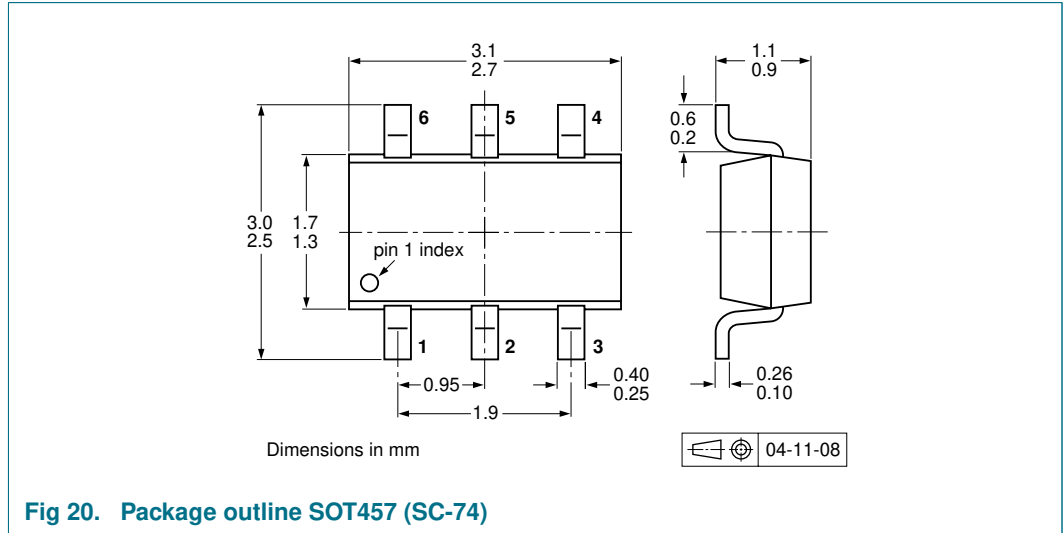


**Fig 19. TR1: Test circuit for switching times**

### 8.1 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.

**9. Package outline**



**10. Packing information**

**Table 8. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

Type number	Package	Description	Packing quantity	
			3000	10000
PBLS2024D	SOT457	4 mm pitch, 8 mm tape and reel; T1	<sup>[2]</sup> -115	-135
		4 mm pitch, 8 mm tape and reel; T2	<sup>[3]</sup> -125	-165

[1] For further information and the availability of packing methods, see [Section 13](#).

[2] T1: normal taping

[3] T2: reverse taping

## 11. Revision history

**Table 9.** Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBL2024D_2	20090906	Product data sheet	-	PBL2024D_1
Modifications:	<a href="#">Table 7 "Characteristics"</a> : I <sub>CES</sub> conditions amended			
PBL2024D_1	20090720	Product data sheet	-	-



## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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