

PBL S2024D

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

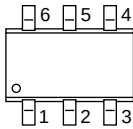
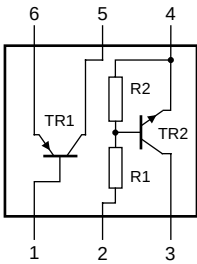
1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1; PNP low V_{CEsat} transistor						
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 Ω
TR2; NPN resistor-equipped transistor						
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 Ω
R2/R1	bias resistor ratio		0.8	1	1.2	

[1] Pulse test: $t_p \leq 300$ μ 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

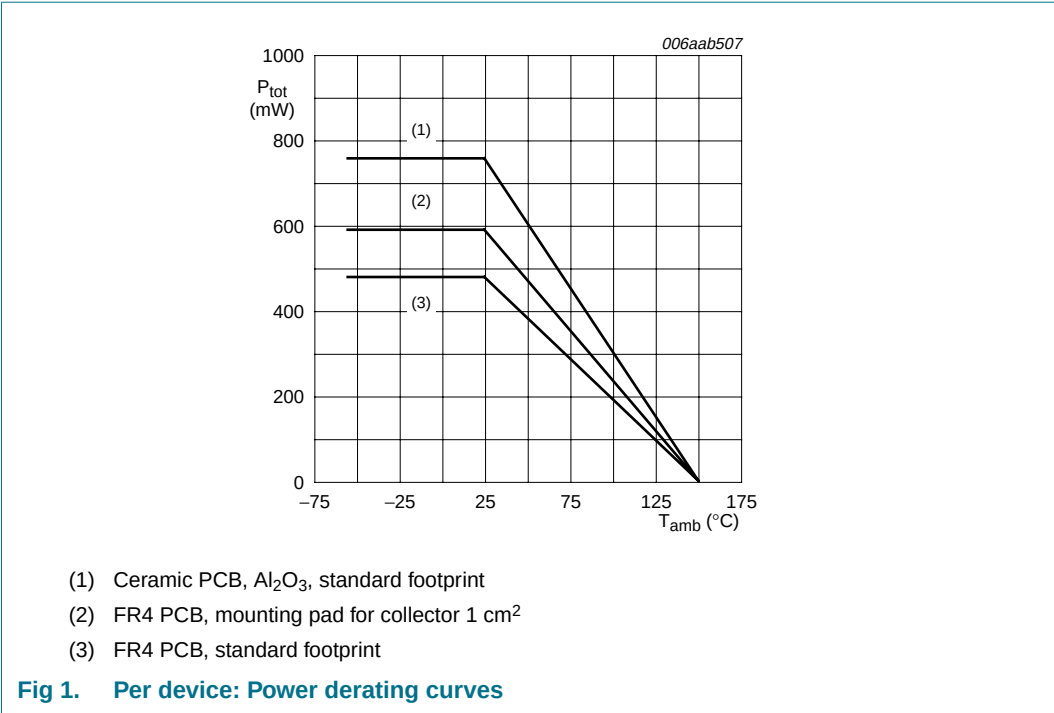
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
TR1; PNP low V_{CEsat} transistor					
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
TR2; NPN resistor-equipped transistor					
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] [3] -	200	mW
Per device					
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 cm².

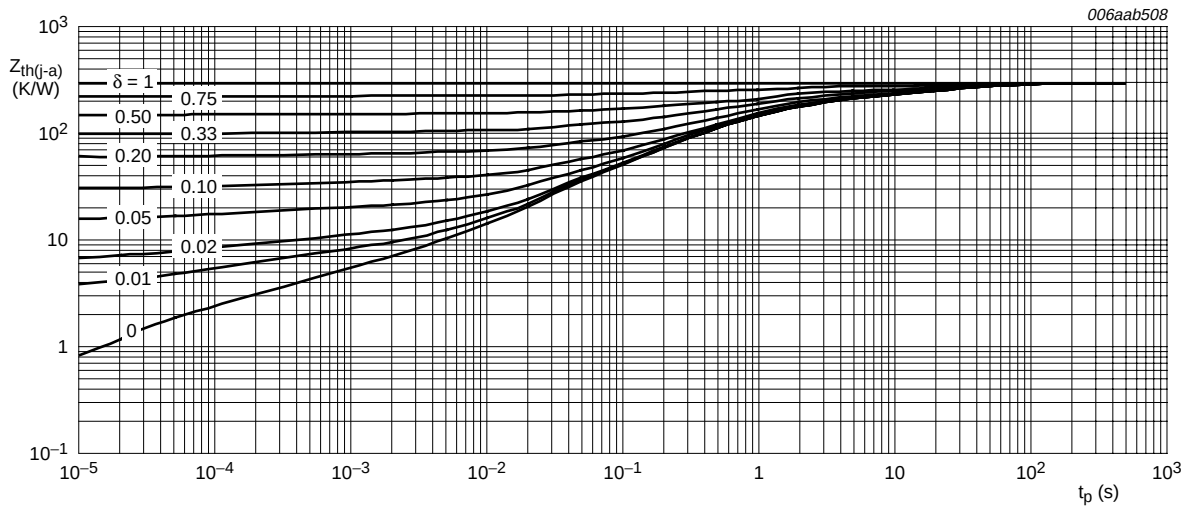
[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.



6. Thermal characteristics

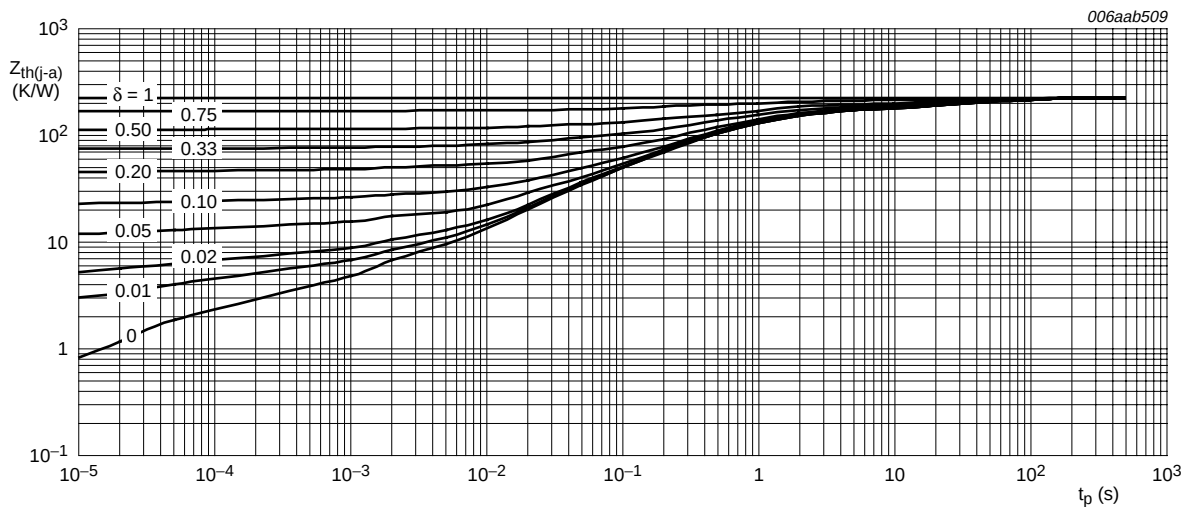
Table 6. Thermal characteristics						
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per device						
R _{th(j-a)}	thermal resistance from junction to ambient	in free air	[1]	-	-	260 K/W
			[2]	-	-	211 K/W
			[3]	-	-	165 K/W
R _{th(j-sp)}	thermal resistance from junction to solder point		-	-	100	K/W

[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 cm².
[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.



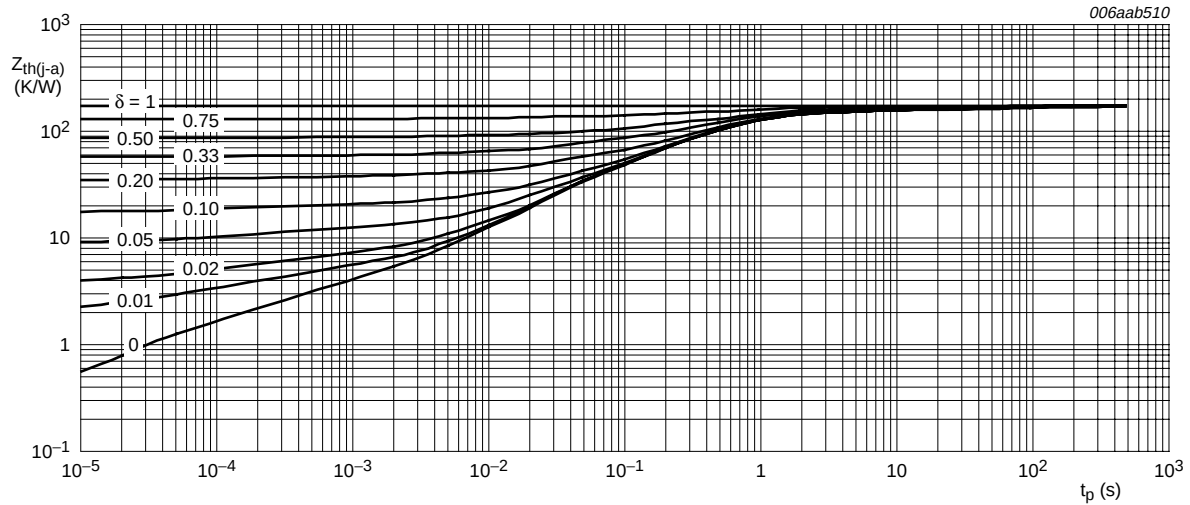
FR4 PCB, standard footprint

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 cm²

Fig 3. TR1 (PNP): Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



Ceramic PCB, Al₂O₃, standard footprint

Fig 4. TR1 (PNP): Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

7. Characteristics

Table 7. Characteristics

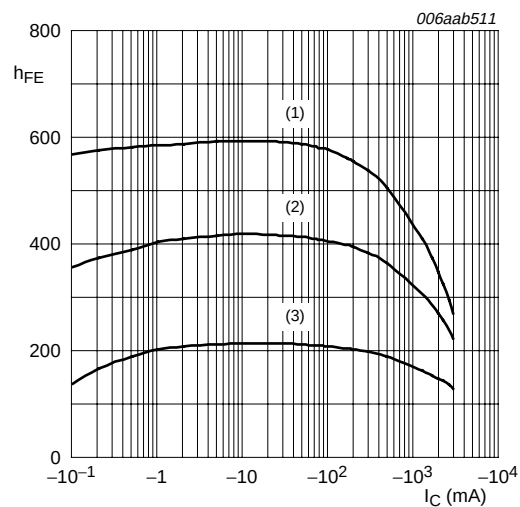
$T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1; PNP low V_{CEsat} transistor						
I_{CBO}	collector-base cut-off current	$V_{CB} = -20\text{ V}; I_E = 0\text{ A}$	-	-	-100	nA
		$V_{CB} = -20\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	-50	μA
I_{CES}	collector-emitter cut-off current	$V_{CE} = -16\text{ V}; V_{BE} = 0\text{ V}$	-	-	-100	nA
I_{EBO}	emitter-base cut-off current	$V_{EB} = -5\text{ V}; I_C = 0\text{ A}$	-	-	-100	nA
h_{FE}	DC current gain	$V_{CE} = -2\text{ V}; I_C = -100\text{ mA}$	220	420	-	
		$V_{CE} = -2\text{ V}; I_C = -500\text{ mA}$	[1] 220	410	-	
		$V_{CE} = -2\text{ V}; I_C = -1\text{ A}$	[1] 200	320	-	
		$V_{CE} = -2\text{ V}; I_C = -1.8\text{ A}$	[1] 160	260	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -0.5\text{ A}; I_B = -50\text{ mA}$	[1] -	-45	-70	mV
		$I_C = -1\text{ A}; I_B = -50\text{ mA}$	[1] -	-85	-130	mV
		$I_C = -1\text{ A}; I_B = -100\text{ mA}$	[1] -	-80	-120	mV
		$I_C = -1.8\text{ A}; I_B = -100\text{ mA}$	[1] -	-140	-210	mV
R_{CEsat}	collector-emitter saturation resistance	$I_C = -1\text{ A}; I_B = -100\text{ mA}$	[1] -	80	120	m Ω
		$I_C = -1.8\text{ A}; I_B = -100\text{ mA}$	[1] -	78	117	m Ω
V_{BEsat}	base-emitter saturation voltage	$I_C = -0.5\text{ A}; I_B = -50\text{ mA}$	[1] -	-0.85	-1	V
		$I_C = -1.8\text{ A}; I_B = -100\text{ mA}$	[1] -	-0.93	-1.1	V

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

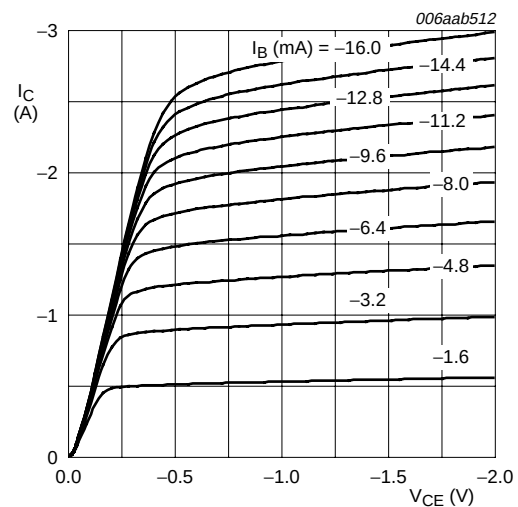
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{BEon}	base-emitter turn-on voltage	$V_{CE} = -10\text{ V}$; $I_C = -1\text{ A}$	[1] -	-0.73	-1.1	V
t_d	delay time	$V_{CC} = -10\text{ V}$; $I_C = -1\text{ A}$; $I_{Bon} = -50\text{ mA}$; $I_{Boff} = 50\text{ mA}$	-	17	-	ns
t_r	rise time		-	33	-	ns
t_{on}	turn-on time		-	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
TR2; NPN resistor-equipped transistor						
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	μA
		$V_{CE} = 30\text{ V}$; $I_B = 0\text{ A}$; $T_J = 150\text{ }^{\circ}\text{C}$	-	-	50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5\text{ V}$; $I_C = 0\text{ A}$	-	-	180	μA
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 Ω
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: $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.02$.



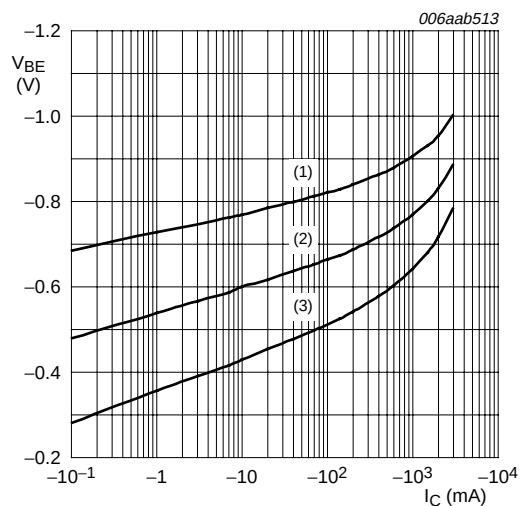
$V_{CE} = -2\text{ V}$
(1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
(2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
(3) $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



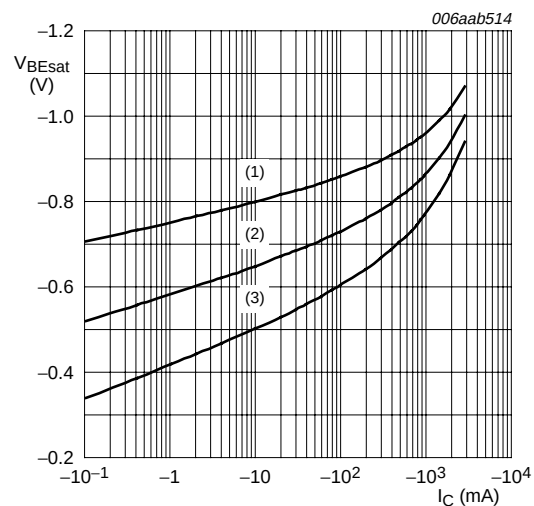
$T_{amb} = 25\text{ }^{\circ}\text{C}$

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



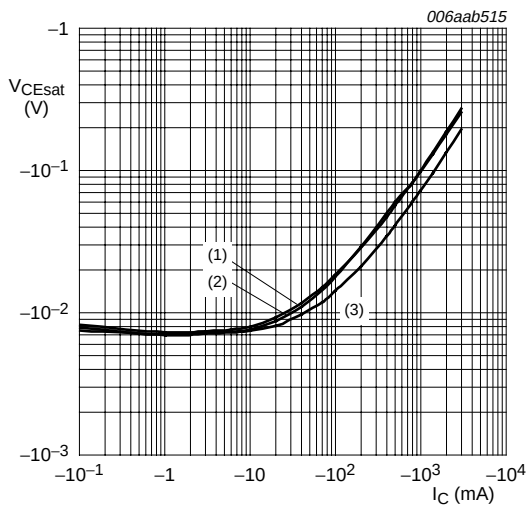
$V_{CE} = -2\text{ V}$
(1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
(2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
(3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



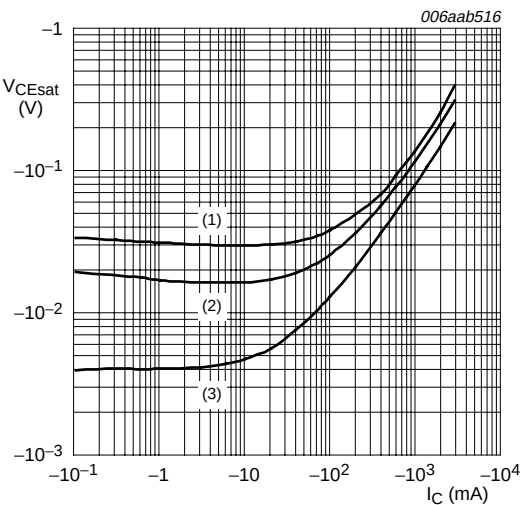
$I_C/I_B = 20$
(1) $T_{amb} = -55\text{ }^{\circ}\text{C}$
(2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
(3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



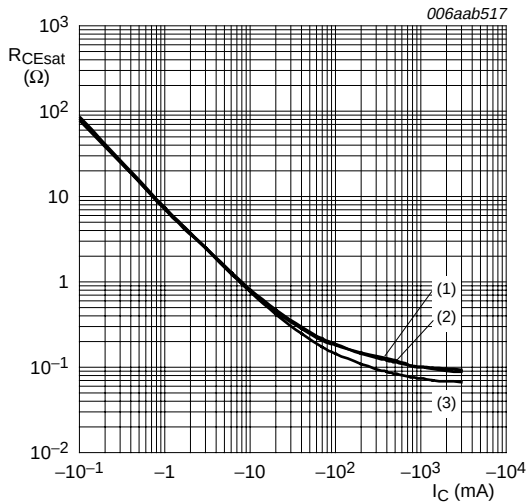
- $I_C/I_B = 20$
- (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



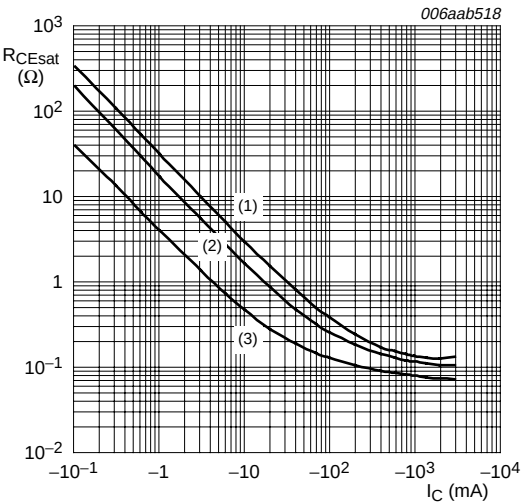
- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1) $I_C/I_B = 100$
 - (2) $I_C/I_B = 50$
 - (3) $I_C/I_B = 10$

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



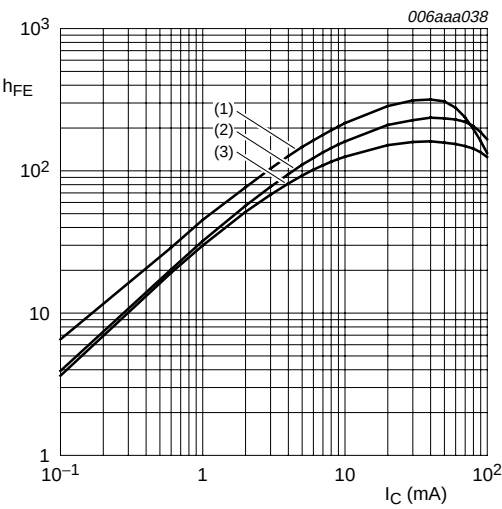
- $I_C/I_B = 20$
- (1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



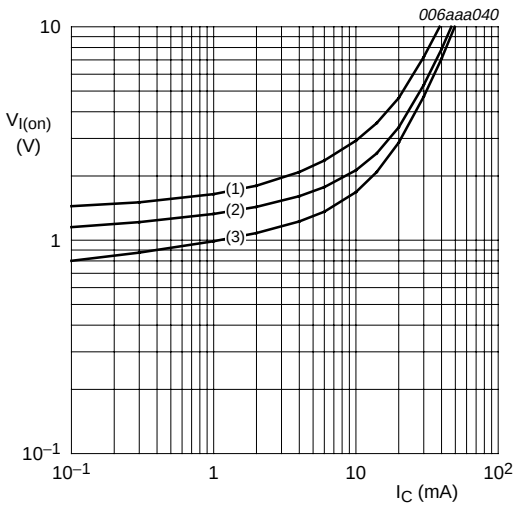
- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1) $I_C/I_B = 100$
 - (2) $I_C/I_B = 50$
 - (3) $I_C/I_B = 10$

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



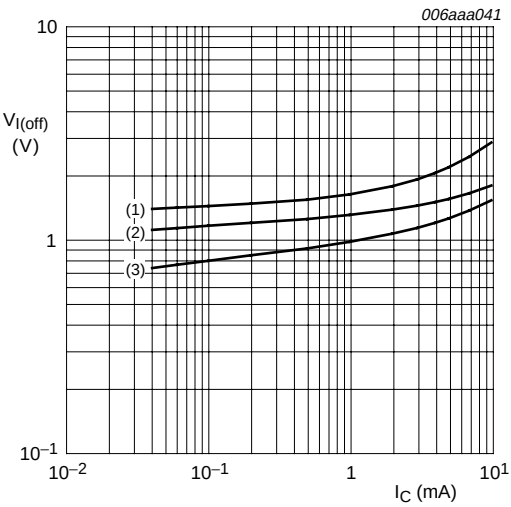
- $V_{CE} = 5\text{ V}$
- (1) $T_{amb} = 150\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



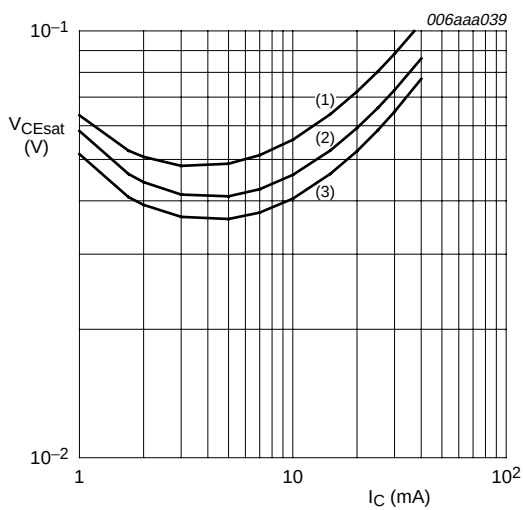
- $V_{CE} = 0.3\text{ V}$
- (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



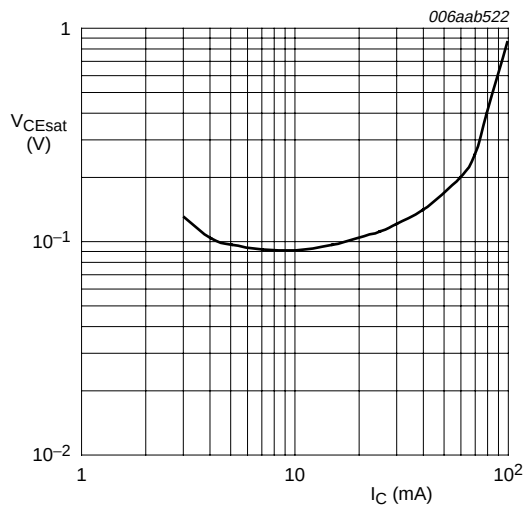
- $V_{CE} = 5\text{ V}$
- (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
 - (3) $T_{amb} = 100\text{ }^{\circ}\text{C}$

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



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

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



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

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

8. Test information

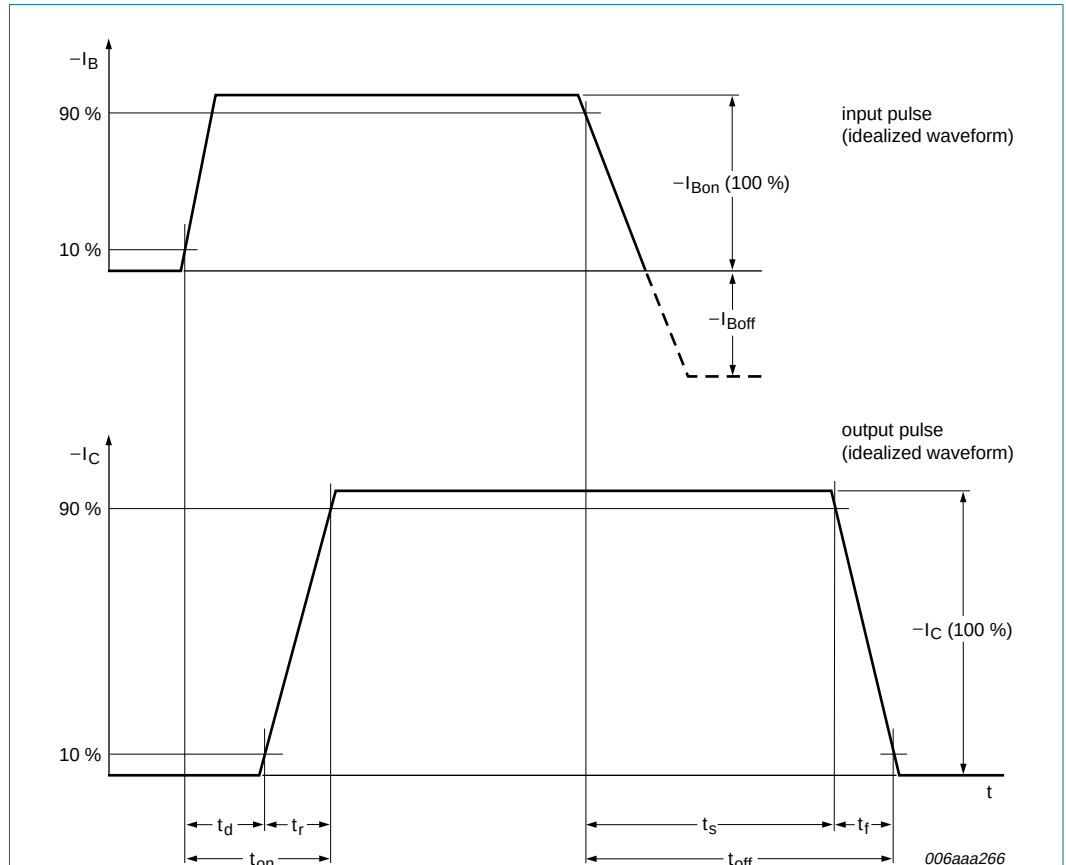


Fig 18. TR1: BISS transistor switching time definition

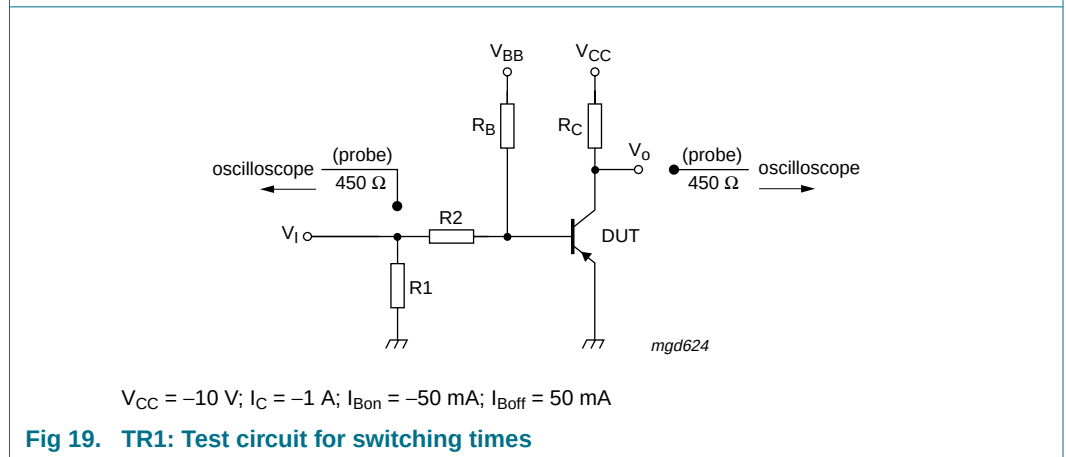
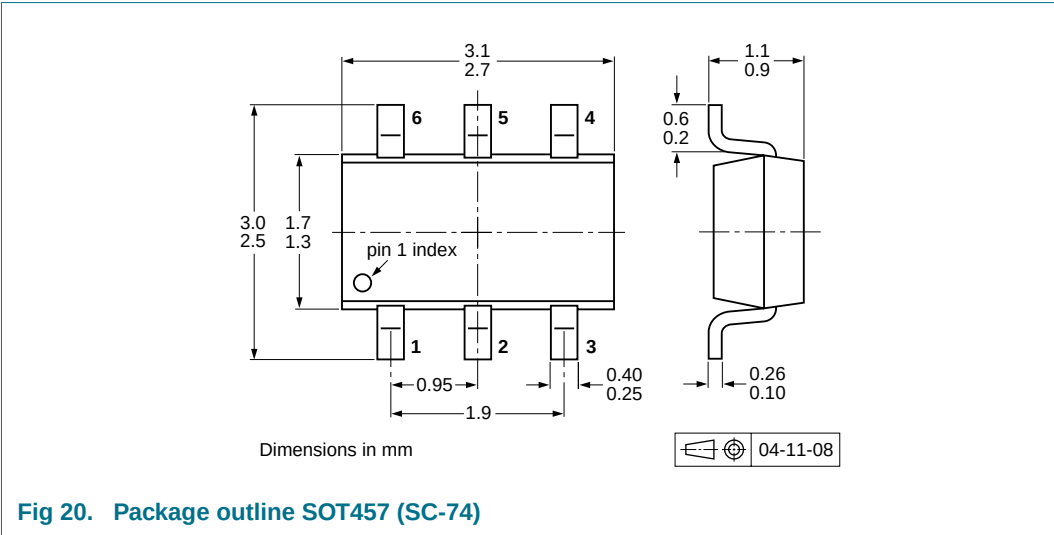


Fig 19. TR1: Test circuit for switching times

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. ^[1]					
Type number	Package	Description	Packing quantity		
			3000	10000	
PBLS2024D	SOT457	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 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
PBLS2024D_2	20090906	Product data sheet	-	PBLS2024D_1
Modifications:	Table 7 “Characteristics” : I _{CES} conditions amended			
PBLS2024D_1	20090720	Product data sheet	-	-

12. Legal information

12.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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13. Contact information

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For sales office addresses, please send an email to: salesaddresses@nxp.com

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