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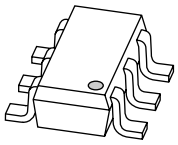


PBLS2024D

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

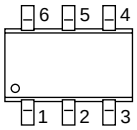
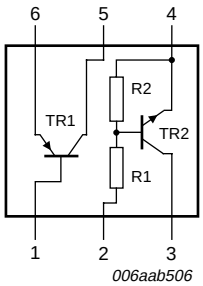
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
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	mΩ
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	kΩ
R2/R1	bias resistor ratio			0.8	1	1.2	

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

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		

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

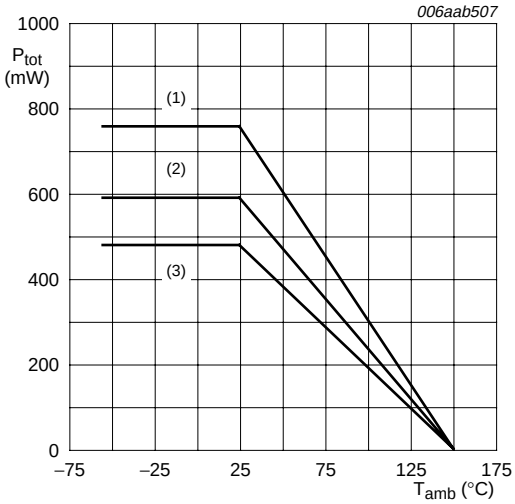
In accordance with the Absolute Maximum Rating System (IEC 60134).

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 cm^2.

[3] Device mounted on a ceramic PCB, Al_2O_3, standard footprint.



(1) Ceramic PCB, Al_2O_3, standard footprint

(2) FR4 PCB, mounting pad for collector 1 cm^2

(3) FR4 PCB, standard footprint

Fig 1. Per device: Power derating curves

6. Thermal characteristics

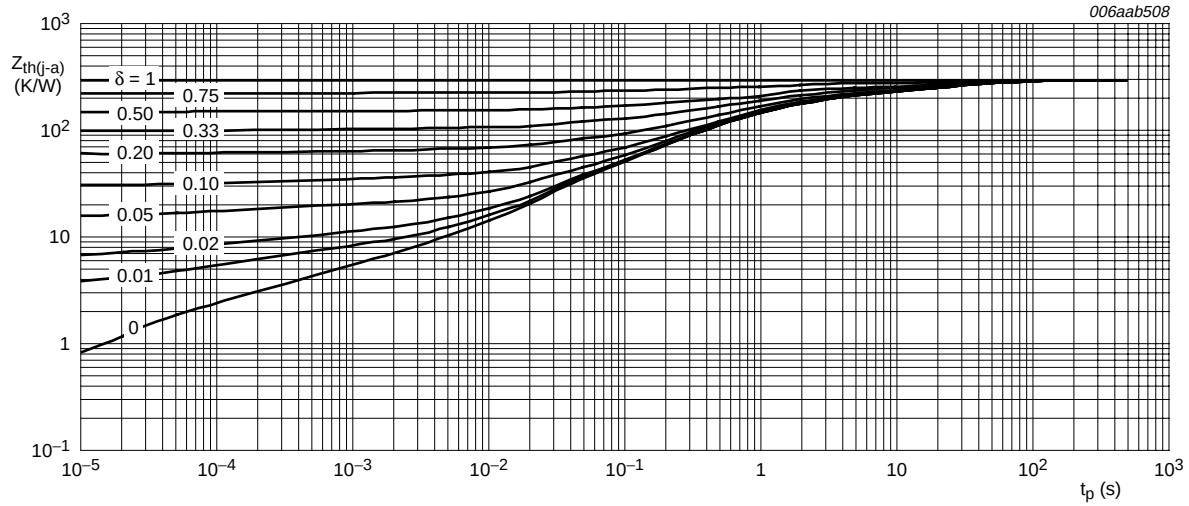
Table 6. Thermal characteristics

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.

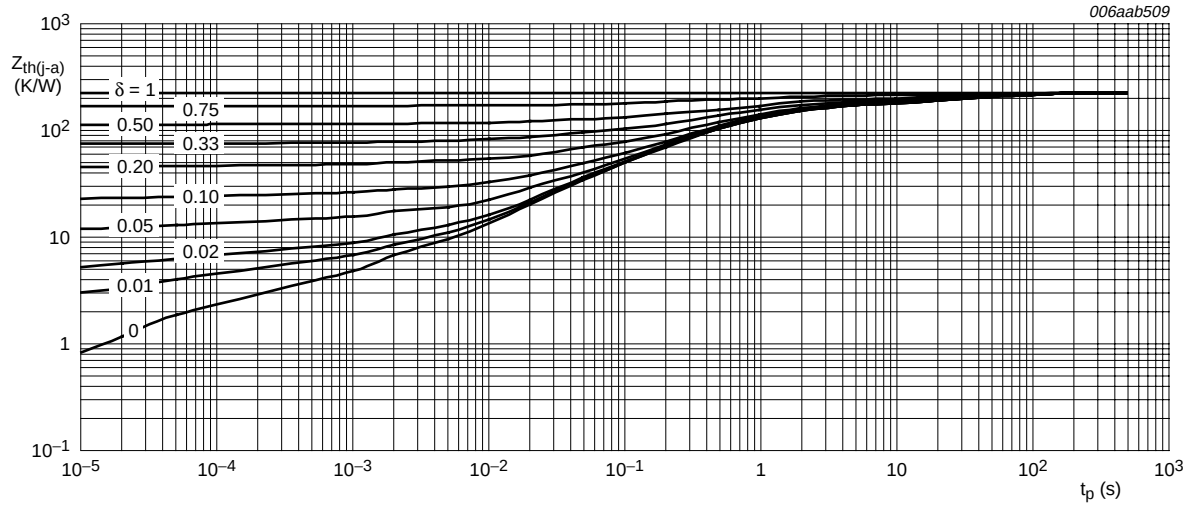
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm^2.

[3] Device mounted on a ceramic PCB, Al_2O_3, standard footprint.



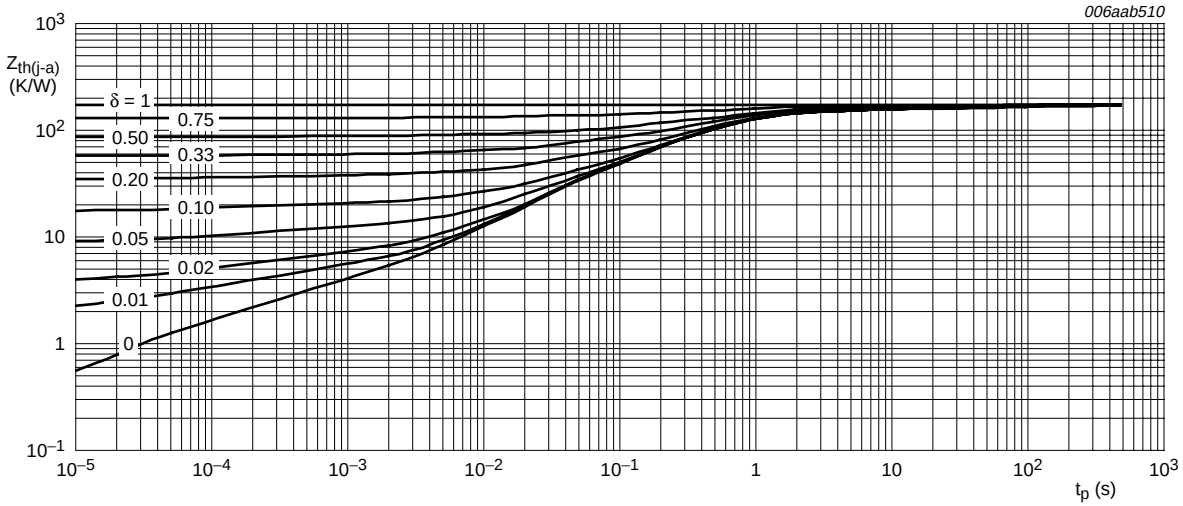
FR4 PCB, standard footprint

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^2

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



Ceramic PCB, Al_2O_3, 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 °C unless otherwise specified.

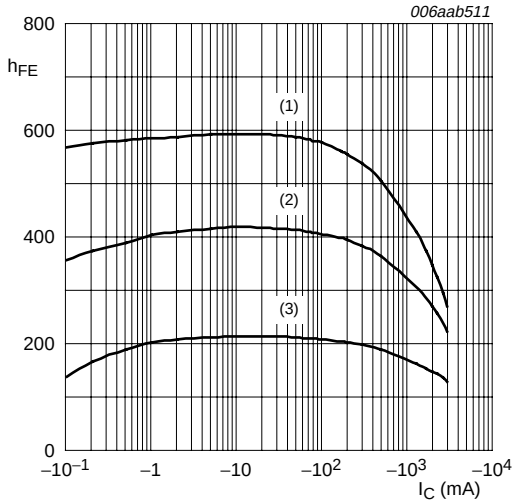
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
TR1; PNP low V_{CEsat} transistor							
I_{CBO}	collector-base cut-off current	V_{CB} = –20 V; I_E = 0 A		-	-	–100	nA
		V_{CB} = –20 V; I_E = 0 A; T_j = 150 °C		-	-	–50	µA
I_{CES}	collector-emitter cut-off current	V_{CE} = –16 V; V_{BE} = 0 V		-	-	–100	nA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

Table 7. Characteristics *...continued*

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{BEon}	base-emitter turn-on voltage	V_{CE} = –10 V; I_C = –1 A	[1]	-	–0.73	–1.1	V
t_d	delay time	V_{CC} = –10 V; I_C = –1 A; I_{Bon} = –50 mA; I_{Boff} = 50 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 mA; V_{CE} = –10 V; f = 100 MHz		-	130	-	MHz
C_c	collector capacitance	V_{CB} = –10 V; I_E = i_e = 0 A; f = 1 MHz		-	45	-	pF
TR2; NPN resistor-equipped transistor							
I_{CBO}	collector-base cut-off current	V_{CB} = 50 V; I_E = 0 A		-	-	100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 30 V; I_B = 0 A		-	-	1	µA
		V_{CE} = 30 V; I_B = 0 A; T_j = 150 °C		-	-	50	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0 A		-	-	180	µA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA		60	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA; I_B = 0.5 mA		-	-	150	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = 5 V; I_C = 100 µA		-	1.1	0.8	V
$V_{I(on)}$	on-state input voltage	V_{CE} = 0.3 V; I_C = 5 mA		2.5	1.7	-	V
R1	bias resistor 1 (input)			15.4	22	28.6	kΩ
R2/R1	bias resistor ratio			0.8	1	1.2	
C_c	collector capacitance	V_{CB} = 10 V; I_E = i_e = 0 A; f = 1 MHz		-	-	2.5	pF

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



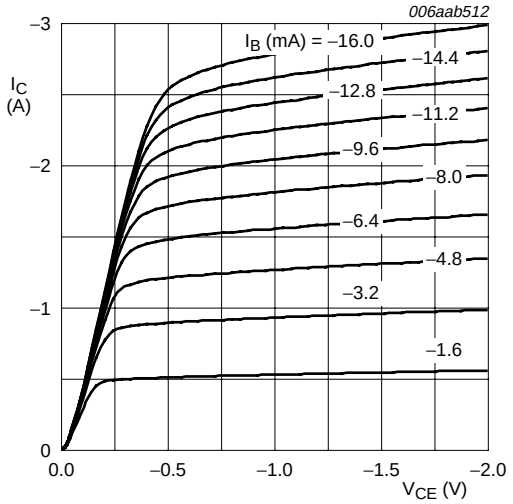
V_{CE} = −2 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

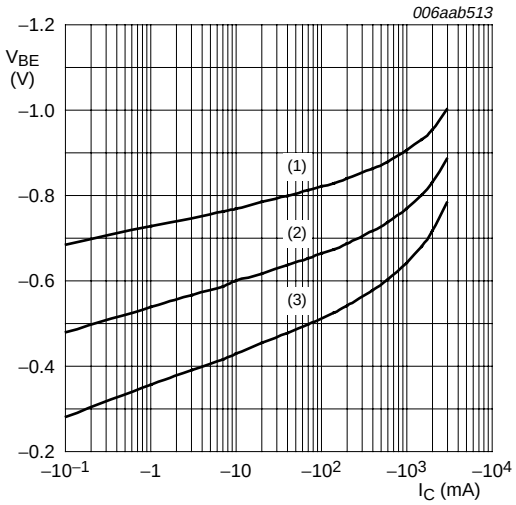
(3) T_{amb} = −55 °C

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



T_{amb} = 25 °C

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



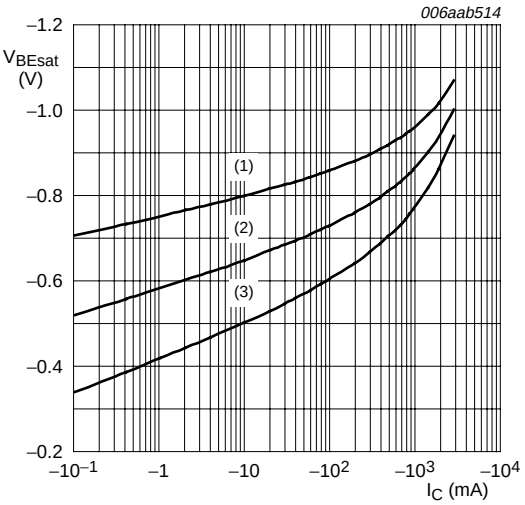
V_{CE} = −2 V

(1) T_{amb} = −55 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



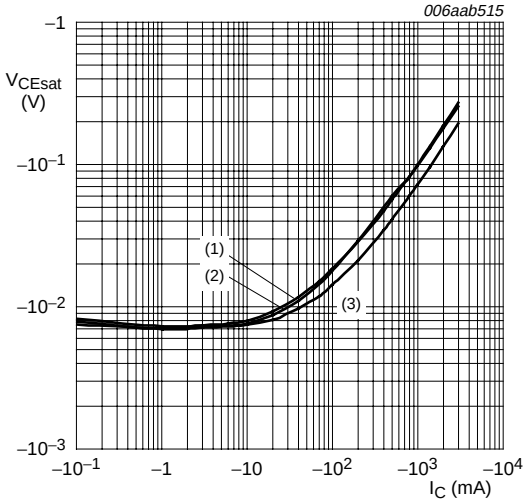
I_C/I_B = 20

(1) T_{amb} = −55 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



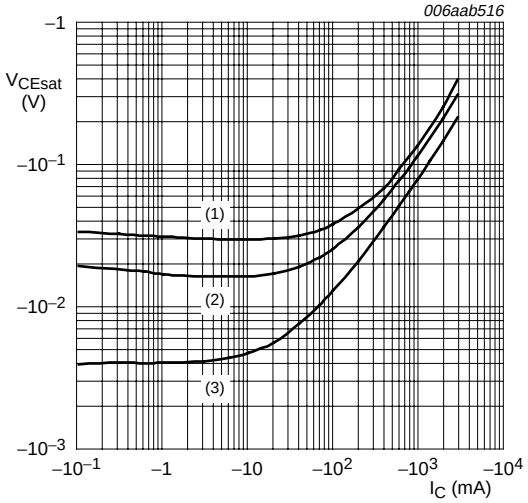
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −55 °C

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



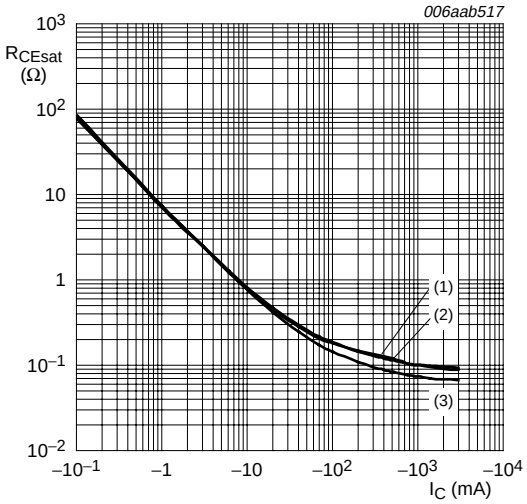
T_{amb} = 25 °C

(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



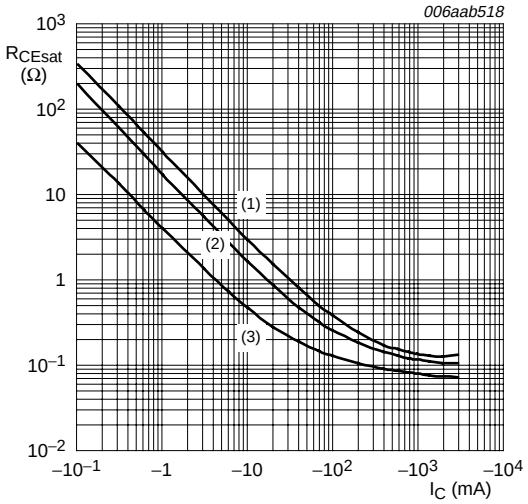
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −55 °C

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



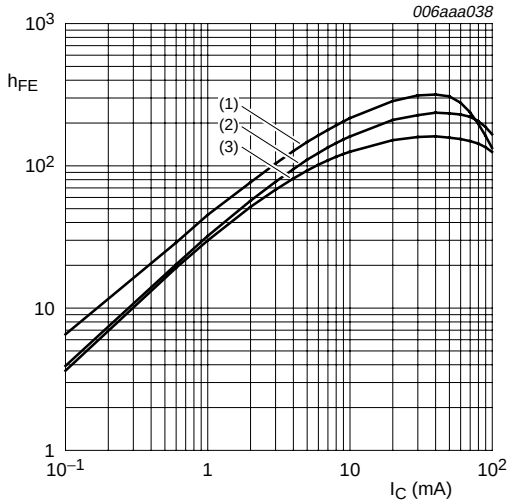
T_{amb} = 25 °C

(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



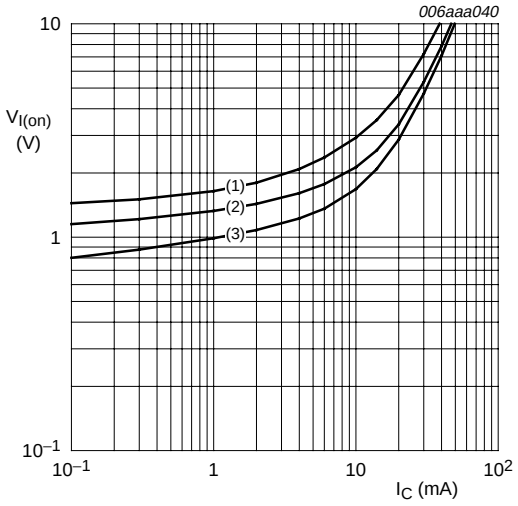
V_{CE} = 5 V

(1) T_{amb} = 150 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −40 °C

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



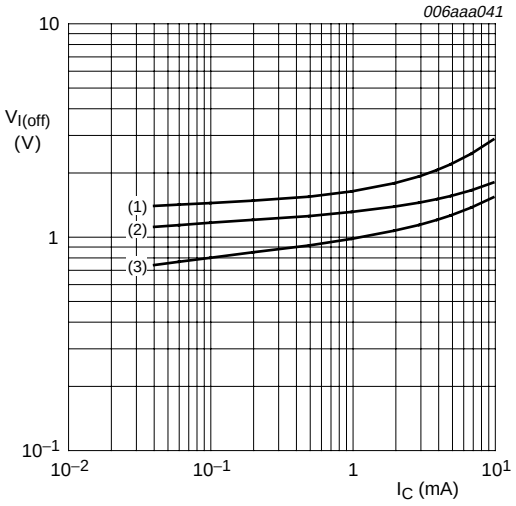
V_{CE} = 0.3 V

(1) T_{amb} = −40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



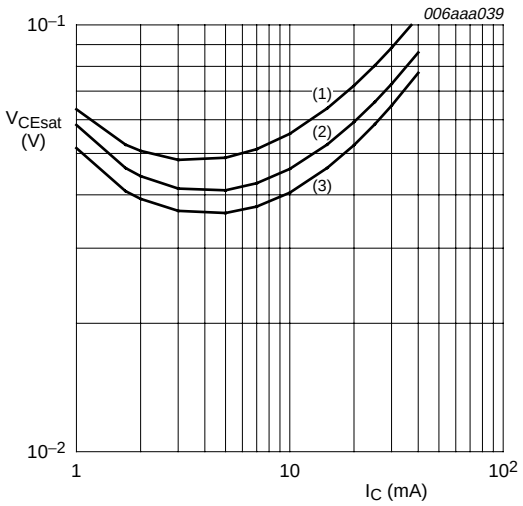
V_{CE} = 5 V

(1) T_{amb} = −40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

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



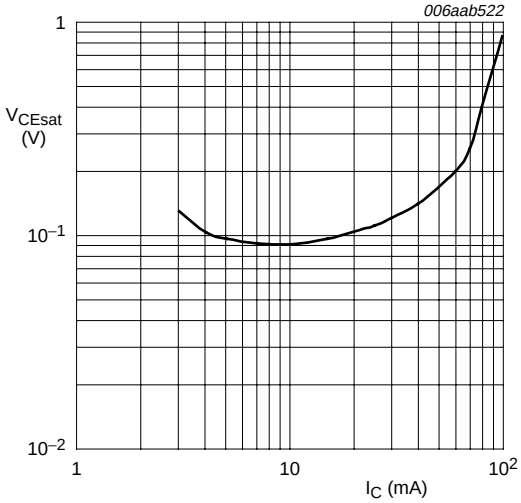
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −40 °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 °C

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

8. Test information

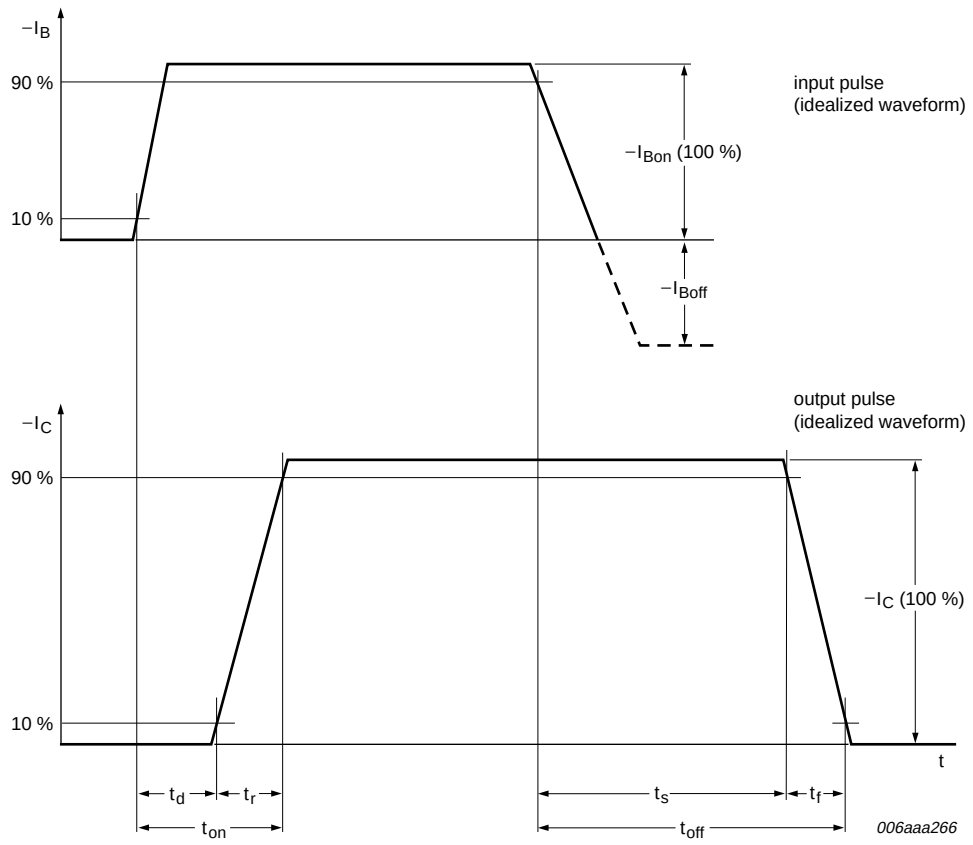
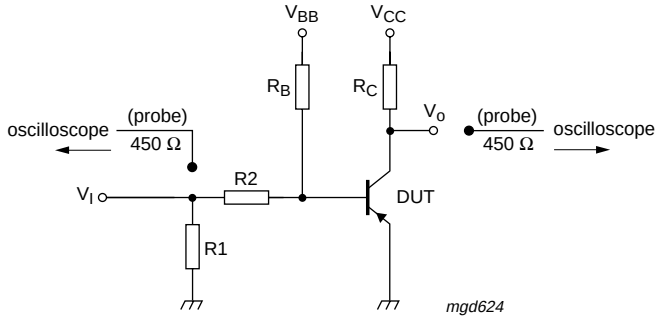


Fig 18. TR1: BISS transistor switching time definition



V_{CC} = −10 V; I_C = −1 A; I_{Bon} = −50 mA; I_{Boff} = 50 mA

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

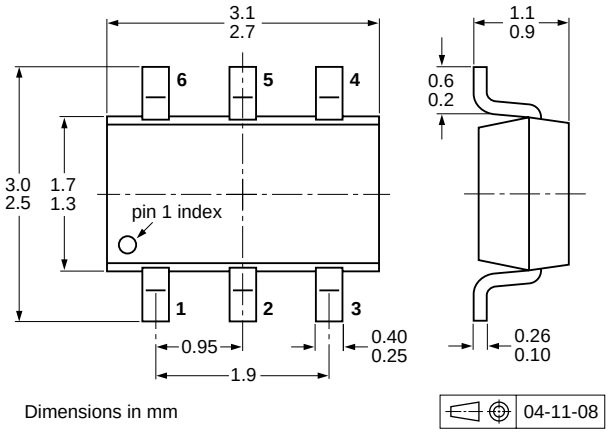


Fig 20. Package outline SOT457 (SC-74)

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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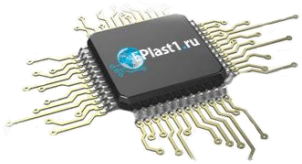

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