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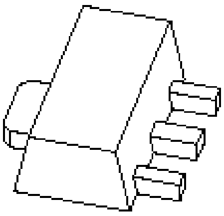
PNP Transistor BC869TR的失效探讨

被调查器件的规格书:

DISCRETE SEMICONDUCTORS

DATA SHEET



BC869
PNP medium power transistor

Product specification
Supersedes data of 1998 Jul 16

1999 Apr 08

Philips
Semiconductors

PHILIPS

PNP medium power transistor BC869

FEATURES

- High current (max. 1 A)
- Low voltage (max. 20 V).

APPLICATIONS

- Low voltage, high current LF applications.

DESCRIPTION

PNP medium power transistor in a SOT89 plastic package. NPN complement: BC868.

MARKING

TYPE NUMBER	MARKING CODE
BC869	CEC
BC869-16	CGC
BC869-25	CHC

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	base

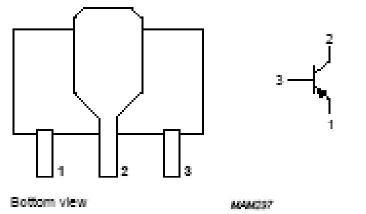


Fig.1 Simplified outline (SOT89) and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–32	V
V_{CEO}	collector-emitter voltage	open base	–	–20	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	1.35	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 6 cm^2.
For other mounting conditions, see *"Thermal considerations for SOT89 in the General Part of associated Handbook"*.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\,j\text{-}a}$	thermal resistance from junction to ambient	note 1	93	K/W
$R_{th\,j\text{-}s}$	thermal resistance from junction to soldering point		13	K/W

Note

1. Device mounted on a printed-circuit board, single sided copper, tinplated, mounting pad for collector 6 cm^2.
For other mounting conditions, see *"Thermal considerations for SOT89 in the General Part of associated Handbook"*.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = −25 V	–	–	−100	nA
		I_E = 0; V_{CB} = −25 V; T_j = 150 °C	–	–	−10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = −5 V	–	–	−100	nA
h_{FE}	DC current gain	I_C = −5 mA; V_{CE} = −10 V; see Fig.2	50	–	–	
		I_C = −500 mA; V_{CE} = −1 V; see Fig.2	100	–	375	
		I_C = −1 A; V_{CE} = −1 V; see Fig.2	60	–	–	
	DC current gain	I_C = −500 mA; V_{CE} = −1 V; see Fig.2				
	BC869-16		100	–	250	
	BC869-25		160	–	375	
V_{CEsat}	collector-emitter saturation voltage	I_C = −1 A; I_B = −100 mA	–	–	−500	mV
V_{BE}	base-emitter voltage	I_C = −5 mA; V_{CE} = −10 V	–	−620	–	mV
		I_C = −1 A; V_{CE} = −1 V	–	–	−1	V
f_T	transition frequency	I_C = −10 mA; V_{CE} = −5 V; f = 100 MHz	40	–	–	MHz

PNP medium power transistor BC869

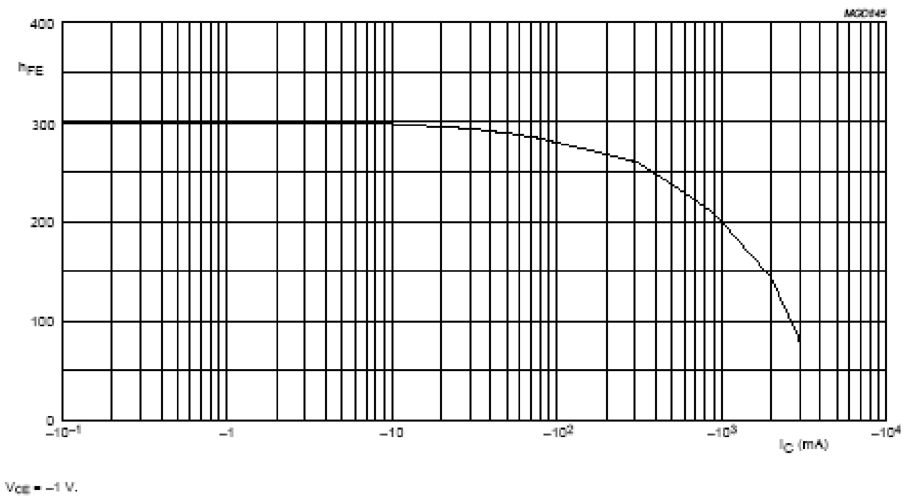
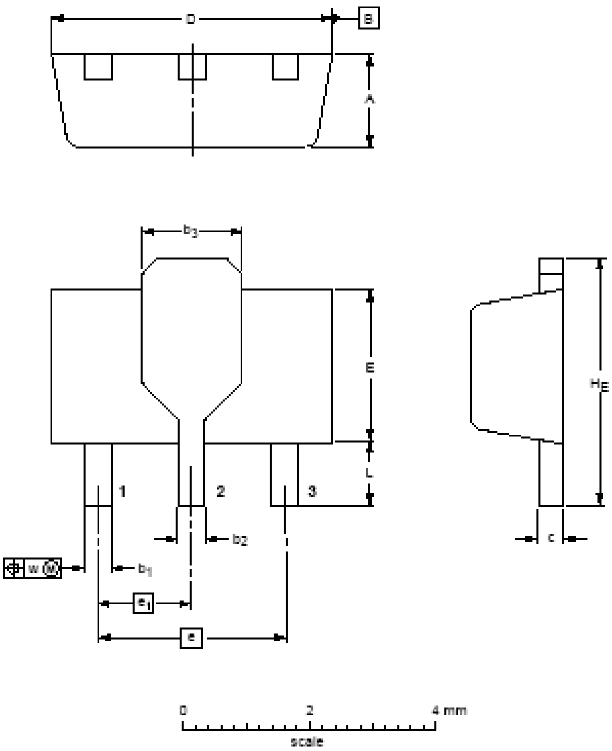


Fig.2 DC current gain; typical values.

PACKAGE OUTLINE

Plastic surface mounted package; collector pad for good heat transfer; 3 leads **SOT89**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_1	b_2	b_3	c	D	E	e	e_1	H_E	L min.	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.37	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT89						97-02-28

LINEAGE POWER

Philips Semiconductors | Product specification

PNP medium power transistor | BC869

DEFINITIONS

Data Sheet Status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

本探讨的目的:

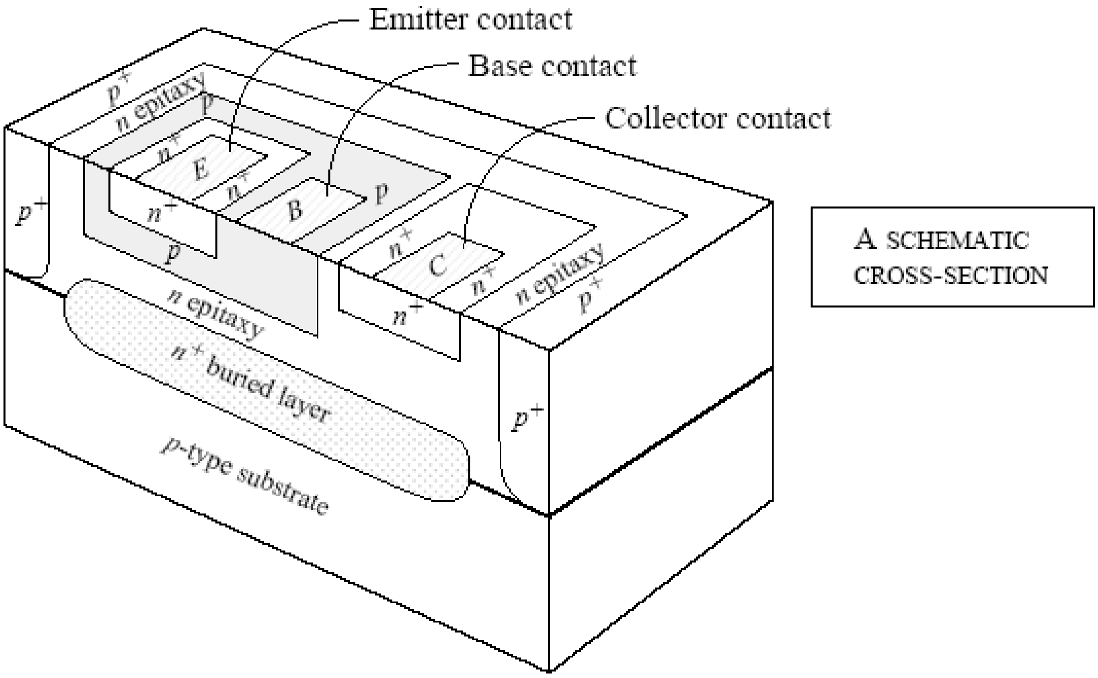
1. 调查BE间和BC间的PN结失效的模式是开路还是短路.
2. 调查当BE间PN结失效后,BC间的PN结是否还正常工作.

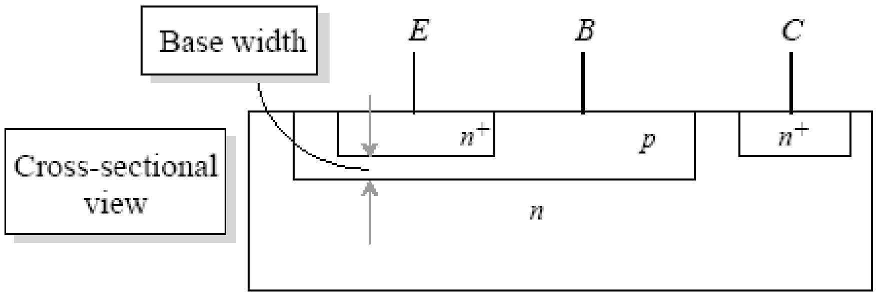
所用仪器:

Tektronix 370B 晶体管特性图示仪.

理论分析:

BC869TR 是个双极型PNP 晶体管. 其结构和下面所示的NPN管类似. 区别在于将相应的P区和N区转换成N区和P区. 从几何结构来看,B区是BE的PN结和BC的PN结共用的区域.理论上,当BE的PN结烧毁后,共同的B区被破坏,BC的PN结也同时被烧毁.最后的实验结果证实分析正确.





实验过程:

1. 取 4 片样品, S1, S2, S3, S4, 准备做实验。
2. 测试样品 S1. 将集电极 C 开路, 在基极B和发射集E之间的PN上加反偏. 当反偏电压加到10.5V时, BE间的漏电流达到20mA. BE间的PN结进入击穿状态.
3. 取消BE间的反偏电压,在基极B和集电极C之间的PN结上加反偏.当反偏电压加到66V时, BC间的漏电流达到30mA. BE间的PN结进入击穿状态.
4. 测试 S2. 重复2步和3步, BE结的击穿电压10.5V. BC结击穿电压66V.
5. 测试 S3. 重复2步和3步, BE结的击穿电压10.5V. BC结击穿电压66V.
6. 测试 S4. 重复2步和3步, BE结的击穿电压10.5V. BC结击穿电压66V.
7. 取样品S1, 重复2步, 当BE结进入击穿状态时,继续加大外加电压,这时发现BE间的PN结类似一个ZENER管或TVS管,将电压箝在10.5V和12V之间,漏电流随着外加电压增大而增大.当电流大到500mA时,PN结在几秒钟内烧毁,呈低阻抗短路状态.这时

测试BC间的PN结,发现也是低阻抗短路状态.

8. 取样品S2,重复7步,结果相同.
9. 取样品S3,重复7步,结果相同
10. 取样品S4,重复7步,结果相同

结论:

1. 该晶体管失效模式是短路.
2. 当BE短路时,BC,CE同时短路.
3. 理论分析正确.