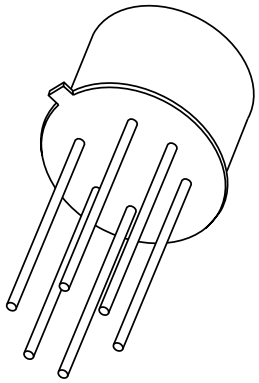
DATA SHEET



BCY87; BCY88; BCY89
NPN general purpose transistors

Product specification
1997 Jun 20
Supersedes data of September 1994
File under Discrete Semiconductors, SC04

Philips
Semiconductors

PHILIPS

NPN general purpose transistors BCY87; BCY88; BCY89

FEATURES

- Low current (max. 30 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Differential amplifier applications in general industrial service e.g. instrumentation and control
- The BCY87 and BCY88 are intended for use in pre-stages of differential amplifiers where low offset, low drift and low noise are of prime importance
- The BCY89 is intended for use in second stages of differential amplifiers, long-tailed pairs and more general applications.

DESCRIPTION

Matched dual NPN transistors in a TO-71; SOT31 metal package. Products are divided into 3 types according to their matching accuracy.

PINNING

PIN(1)	DESCRIPTION
1	emitter TR1
2	emitter TR2
3	collector TR2
4	basis TR2
5	basis TR1
6	collector TR1

Note

1. All leads insulated from the case.

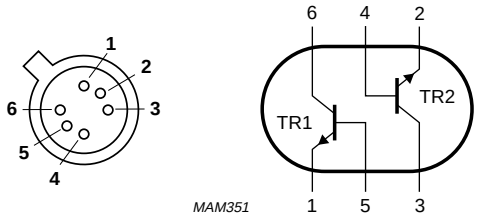


Fig.1 Simplified outline (TO-71; SOT31) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per transistor					
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
h_{FE}	DC current gain	V_{CE} = 10 V			
	BCY87	I_C = 5 μA	80	–	
	BCY88	I_C = 500 μA	120	600	
	BCY89	I_C = 10 mA	100	600	
h_{FE}	DC current gain	I_C = 50 μA; V_{CE} = 10 V	100	450	
f_T	transition frequency	I_C = –50 μA; V_{CE} = 10 V; f = 100 MHz	10	–	MHz
		I_C = –500 μA; V_{CE} = 10 V; f = 100 MHz	50	–	MHz

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	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	150	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	in free air	1	K/mW

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per transistor						
I_{CBO}	collector cut-off current	$I_E = 0$; V_{CB} = 20 V; T_{amb} = 90 °C				
	BCY87		–	–	5	nA
	BCY88		–	–	20	nA
I_{CBO}	collector cut-off current	$I_E = 0$; V_{CB} = 20 V				
	BCY89		–	–	10	nA
h_{FE}	DC current gain	V_{CE} = 10 V				
	BCY87	I_C = 5 μA	80	–	–	
	BCY88	I_C = 500 μA	120	–	600	
	BCY89	I_C = 10 mA	100	–	600	
h_{FE}	DC current gain	I_C = 50 μA; V_{CE} = 10 V	100	–	450	
C_c	collector capacitance	$I_E = i_e = 0$; V_{CB} = 10 V; f = 1 MHz	–	–	3.5	pF
f_T	transition frequency	I_E = –50 μA; V_{CE} = 10 V; f = 100 MHz	10	–	–	MHz
		I_E = –500 μA; V_{CE} = 10 V; f = 100 MHz	50	–	–	MHz
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 10 Hz to 15.7 kHz	–	–	4	dB
F	noise figure	I_C = 200 μA; V_{CE} = 5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz				
	BCY87		–	–	4	dB
	BCY88; BCY89		–	–	5	dB

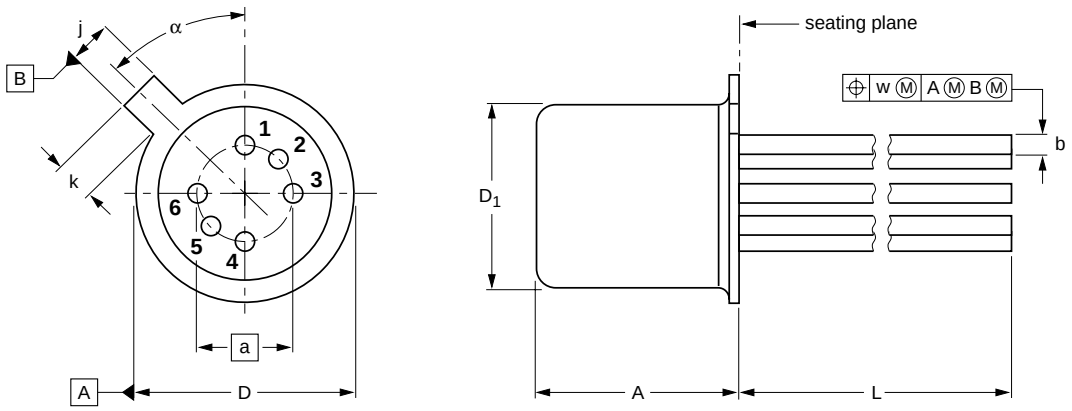
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Complete device; note 1						
$\frac{I_{1C}}{I_{2C}}$	ratio of collector currents	$V_{1B-1E} = V_{2B-2E}$				
	BCY87		0.9	–	1.11	
	BCY88		0.8	–	1.25	
	BCY89		0.67	–	1.5	
$\lvert V_{1B-1E} - V_{2B-2E}\rvert$	difference between base-emitter voltages	$I_{1C} = I_{2C}$				
	BCY87		–	–	3	mV
	BCY88		–	–	6	mV
	BCY89		–	–	10	mV
$\lvert I_{1B} - I_{2B}\rvert$	difference between base currents	$V_{1B-1E} = V_{2B-2E}$				
	BCY87		–	–	25	nA
	BCY88		–	–	80	nA
	BCY89		–	–	300	nA
$\frac{h_{1FE}}{h_{2FE}}$	DC current gain ratio	$I_{1C} = I_{2C}$				
	BCY87		0.9	–	1.11	
	BCY88		0.8	–	1.25	
$\left\lvert\frac{\Delta V}{\Delta T}\right\rvert$	equivalent differential voltage	T_{amb} = –20 °C to +90 °C				
	BCY87		–	1	3	μV/K
	BCY88		–	2	6	μV/K
	BCY89		–	4	10	μV/K
$\left\lvert\frac{\Delta I}{\Delta T}\right\rvert$	equivalent differential current	T_{amb} = –20 °C to +90 °C				
	BCY87		–	–	0.5	nA/K
	BCY88		–	–	2	nA/K
	BCY89		–	–	10	nA/K

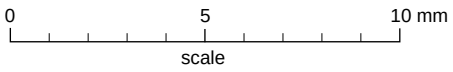
Note

1. These characteristics are valid under the following conditions:
   a) Collector-base voltage of both transistors not exceeding 10 V; ($V_{1C-1B} = V_{2C-2B} \leq 10$ V).
   b) Sum of the emitter currents from 10 to 100 μA; $-(I_{1E} + I_{2E})$ = 10 to 100 μA.

PACKAGE OUTLINE

Metal-can cylindrical single-ended package; 6 leads **SOT31**





DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A max.	a	b max.	D max.	D_1 max.	j max.	k max.	L min.	w	α
mm	5.3	2.54	0.51	5.8	4.8	1.16	1.17	12.7	0.35	45°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT31		TO-71				97-06-18

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.

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