DATA SHEET

BFR94A
NPN 3.5 GHz wideband transistor

Product specification
File under Discrete Semiconductors, SC14

September 1995

Philips Semiconductors

PHILIPS

NPN 3.5 GHz wideband transistor BFR94A

DESCRIPTION

NPN resistance-stabilized transistor in a SOT122E capstan envelope.

It features extremely low cross modulation, intermodulation and second order intermodulation distortion. Due to its high transition frequency, it has a high power gain, in conjunction with good wideband properties, and low noise up to high frequencies.

It is primarily intended for CATV and MATV applications.

The BFR94A is a replacement for the BFR94. The SOT122E footprint is similar to that of the SOT48, used for the BFR94.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

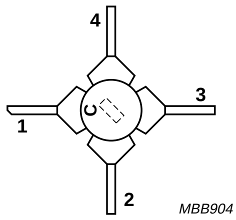


Fig.1 SOT122E.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_c = 145 °C; f > 1 MHz	–	3.5	W
f_T	transition frequency	I_c = 90 mA; V_{CE} = 20 V; f = 500 MHz; T_j = 25 °C	3.5	–	GHz
F	noise figure	I_c = 90 mA; V_{CE} = 20 V; f = 200 MHz; T_{amb} = 25 °C	8	10	dB
d_{im}	intermodulation distortion	I_c = 90 mA; V_{CE} = 20 V; V_o = 60 dBmV; $f_{(p+q-r)}$ = 194.25 MHz	–63	–	dB
d_2	second order intermodulation distortion	I_c = 90 mA; V_{CE} = 20 V; V_o = 48 dBmV; $f_p + f_q$ = 210 MHz	–	–56	dB

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	35	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	150	mA
I_{CM}	peak collector current	f > 1 MHz	–	300	mA
P_{tot}	total power dissipation	up to T_c = 145 °C; f > 1 MHz	–	3.5	W
T_{stg}	storage temperature		–65	200	°C
T_j	junction temperature		–	200	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}c}$	thermal resistance from junction to case	15 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

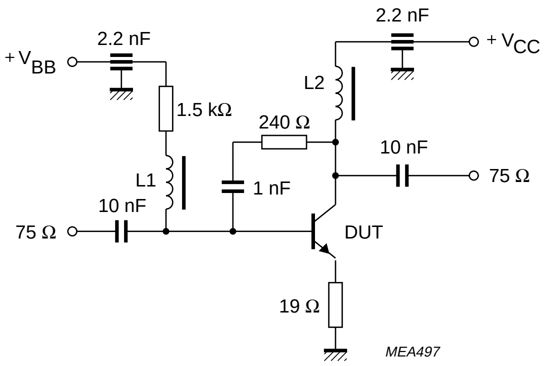
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	–	50	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 20 V	30	–	–	
		I_C = 150 mA; V_{CE} = 20 V	30	–	–	
f_T	transition frequency	I_C = 90 mA; V_{CE} = 20 V; f = 500 MHz	–	3.5	–	GHz
		I_C = 150 mA; V_{CE} = 20 V; f = 500 MHz	–	3.5	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 20 V; f = 1 MHz	–	3.5	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	12	–	pF
C_{re}	feedback capacitance	I_C = 10 mA; V_{CE} = 20 V; f = 1 MHz	–	1.3	–	pF
C_{cs}	collector-stud capacitance	f = 1 MHz	–	2	–	pF
G_{UM}	maximum unilateral power gain (note 1)	I_C = 90 mA; V_{CE} = 20 V; f = 500 MHz; T_{amb} = 25 °C	–	13.5	–	dB
F	noise figure	I_C = 90 mA; V_{CE} = 20 V; f = 200 MHz; T_{amb} = 25 °C	–	8	10	dB
		I_C = 90 mA; V_{CE} = 20 V; f = 500 MHz; T_{amb} = 25 °C	–	5	–	dB
d_{im}	intermodulation distortion	note 2	–	–63	–	dB
d_2	second order intermodulation distortion	note 3	–	–	–56	dB
V_o	output voltage	see Fig.2 and note 4	–	700	–	mV

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

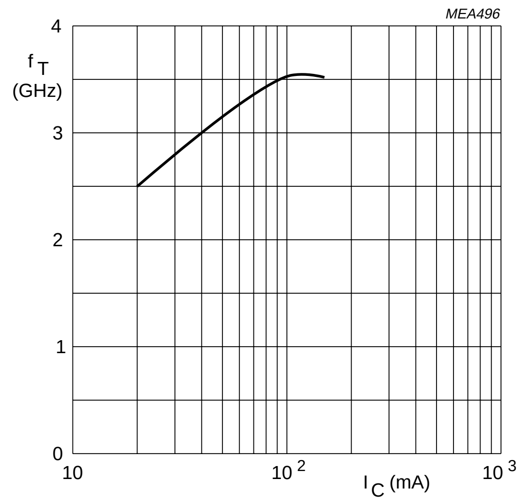
$$G_{UM} = 10 \log \frac{|S_{21}|^2}{\left(1-|S_{11}|^2\right)\left(1-|S_{22}|^2\right)} \text{ dB.}$$

2. I_C = 90 mA; V_{CE} = 20 V; R_L = 75 Ω;
   $V_p = V_o$ = 60 dBmV at f_p = 196.25 MHz;
   $V_q = V_o$ –6 dB at f_q = 203.25 MHz;
   $V_r = V_o$ –6 dB at f_r = 205.25 MHz;
   measured at $f_{(p+q-r)}$ = 194.25 MHz.
3. I_C = 90 mA; V_{CE} = 20 V;
   f_p = 66 MHz; f_q = 144 MHz; $f_p + f_q$ = 210 MHz; V_o = 48 dBmV.
4. d_{im} = –60 dB (DIN 45004B); I_c = 90 mA; V_{CE} = 20 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_o$ at d_{im} = –60 dB; f_p = 495.25 MHz;
   $V_q = V_o$ –6 dB; f_q = 503.25 MHz;
   $V_r = V_o$ –6 dB; f_r = 505.25 MHz;
   measured at $f_{(p+q-r)}$ = 493.25 MHz.



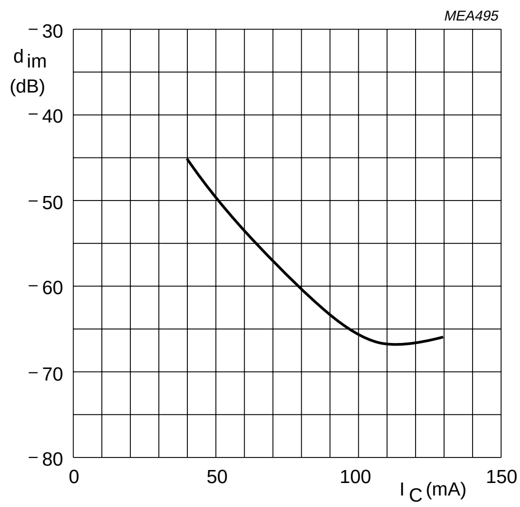
L1 = L2 = 5 µH Ferroxcube choke, catalogue number 3122 108 20153.

Fig.2 Intermodulation distortion MATV test circuit.



V_{CE} = 20 V; f = 500 MHz; T_j = 25 °C.

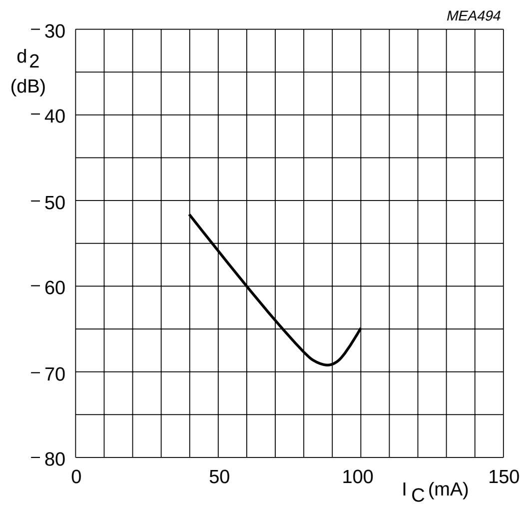
Fig.3 Transition frequency as a function of collector current.



Measured in CATV test circuit.

V_{CE} = 20 V; V_o = 60 dBmV;
$f_{(p+q-r)}$ = 194. 25 MHz.

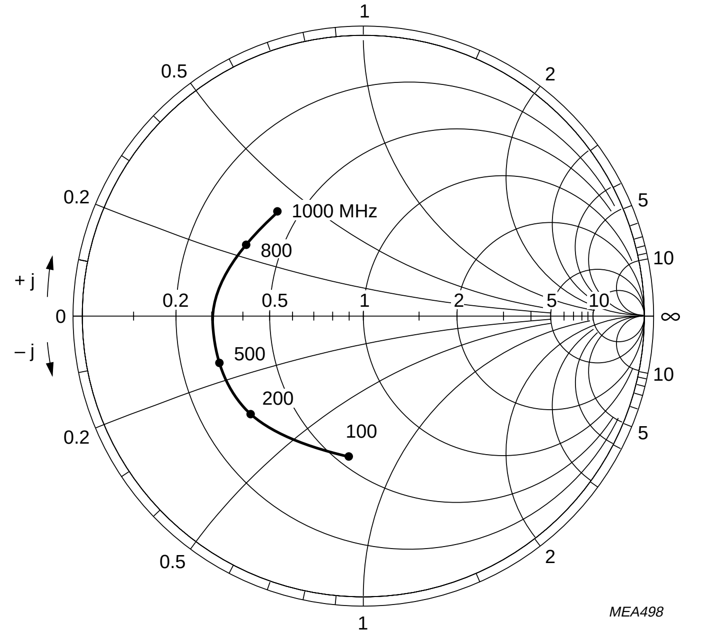
Fig.4 Intermodulation distortion as a function of collector current.



Measured in CATV test circuit.

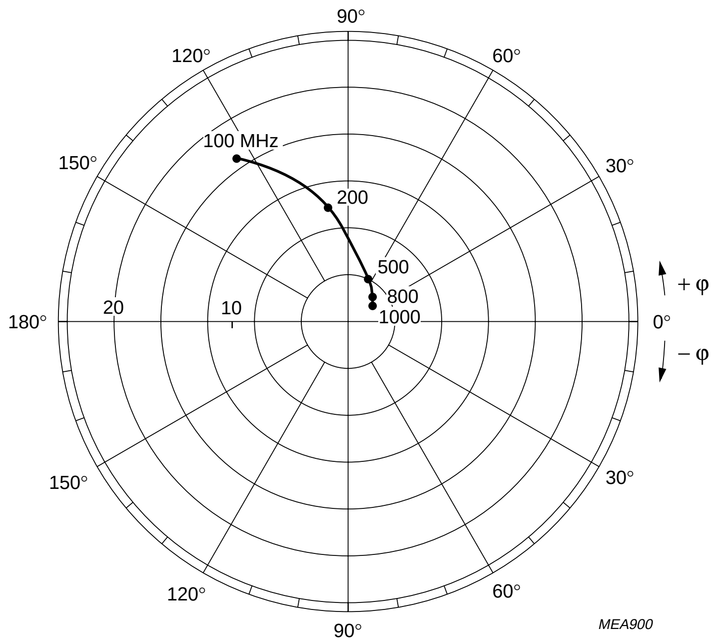
V_{CE} = 20 V; V_o = 48 dBmV; f = 210 MHz.

Fig.5 Second order intermodulation distortion as a function of collector current.



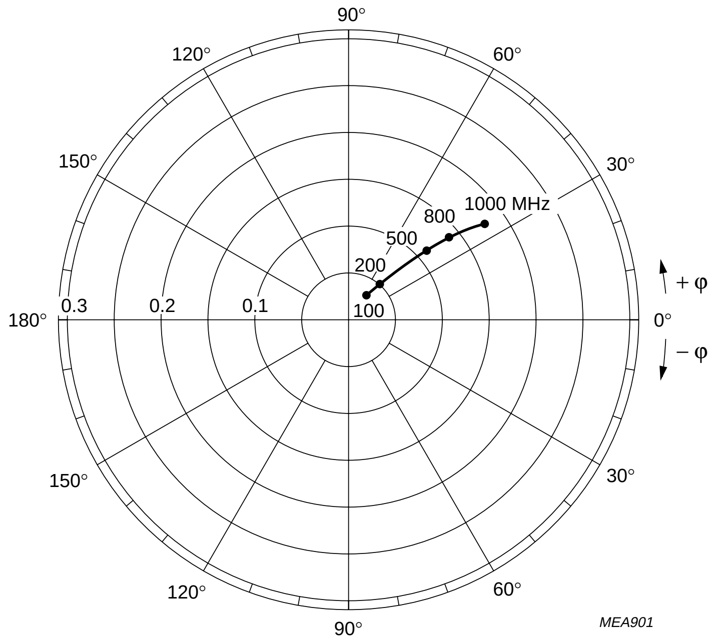
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.6 Common emitter input reflection coefficient (S_{11}).



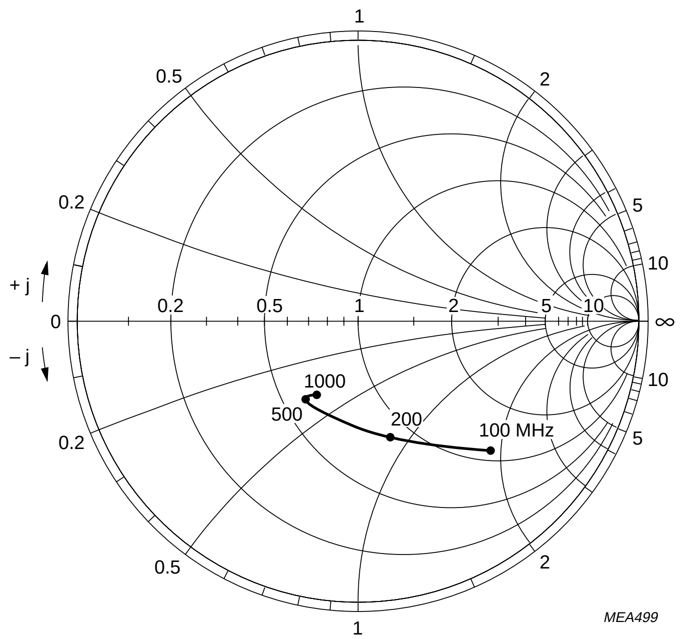
I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.

Fig.7 Common emitter forward transmission coefficient (S_{21}).



I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.

Fig.8 Common emitter reverse transmission coefficient (S_{12}).

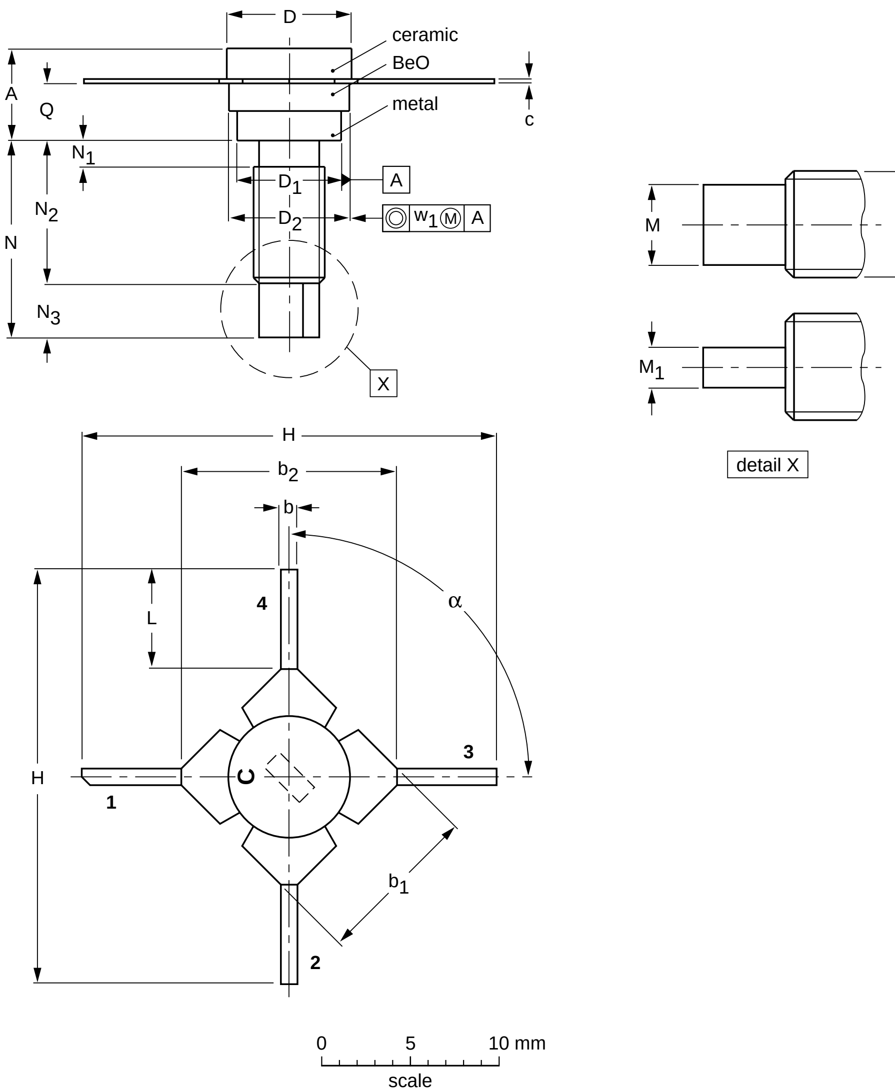


I_C = 90 mA; V_{CE} = 20 V; T_{amb} = 25 °C.
Z_o = 50 Ω.

Fig.9 Common emitter output reflection coefficient (S_{22}).

PACKAGE OUTLINE

Studded ceramic package; 4 leads **SOT122E**



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

UNIT	A	b	b_1	b_2	c	D	D_1	D_2	H	L	M	M_1	N	N_1 max.	N_2	N_3	Q	W	w_1	α
mm	5.97 4.80	1.05 0.73	10.75 10.43	14.25 13.94	0.18 0.14	7.50 7.23	6.46 6.25	7.19 6.93	27.56 25.78	6.84 5.30	3.18 2.92	1.63 1.42	11.82 11.04	1.02	8.89 7.36	3.68 2.92	3.38 2.79	8-32 UNC	0.381	90°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122E						97-04-18

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

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