DATA SHEET

BFR93
NPN 5 GHz wideband transistor

Product specification
1997 Oct 29
Supersedes data of September 1995
File under discrete semiconductors, SC14

Philips Semiconductors

PHILIPS

NPN 5 GHz wideband transistor BFR93

FEATURES

- Very low intermodulation distortion
- High power gain
- Excellent wideband properties and low noise up to high frequencies due to its very high transition frequency.

APPLICATIONS

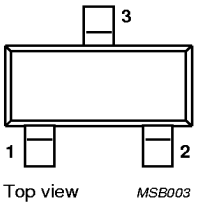
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: R1p.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C	–	300	mW
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz	0.8	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	16.5	–	dB
F	noise figure	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	1.9	–	dB
d_{im}	intermodulation distortion	I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V_O = 300 mV; $f_p + f_q - f_r$ = 493.25 MHz; T_{amb} = 25 °C	−60	–	dB

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	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C; note 1	–	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	175	°C

Note

1. T_s is the temperature at the soldering point of the collector pin.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 95$ °C; note 1	260	K/W

Note

1. T_s is the temperature at the soldering point of the collector pin.

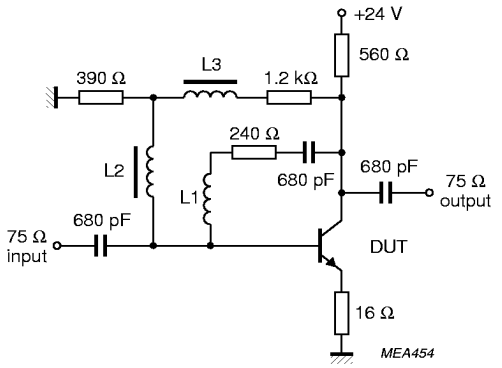
CHARACTERISTICS

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} = 10 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	40	90	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	0.7	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	1.8	–	pF
C_{re}	feedback capacitance	I_C = 2 mA; V_{CE} = 5 V; f = 1 MHz; T_{amb} = 25 °C	–	0.8	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	–	16.5	–	dB
F	noise figure (note 2)	I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; Z_S = opt.; T_{amb} = 25 °C	–	1.9	–	dB
d_{im}	intermodulation distortion	note 3	–	–60	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{\left(1-|S_{11}|^2\right)\left(1-|S_{22}|^2\right)}$ dB
2. Die mounted in a SOT37 package (BFR91).
3. I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; VSWR < 2; T_{amb} = 25 °C;
   $V_p = V_O$ = 300 mV at f_p = 495.25 MHz;
   $V_q = V_O$ –6 dB at f_q = 503.25 MHz;
   $V_r = V_O$ –6 dB at f_r = 505.25 MHz;
   measured at $f_p + f_q - f_r$ = 493.25 MHz.



L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.

L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

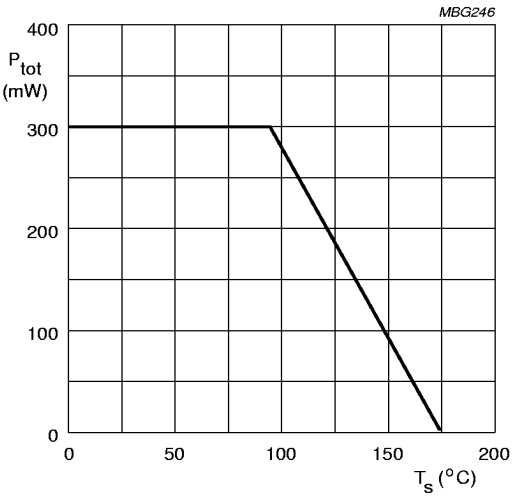
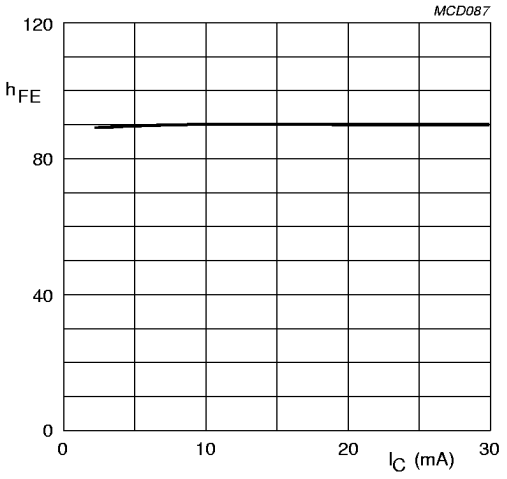
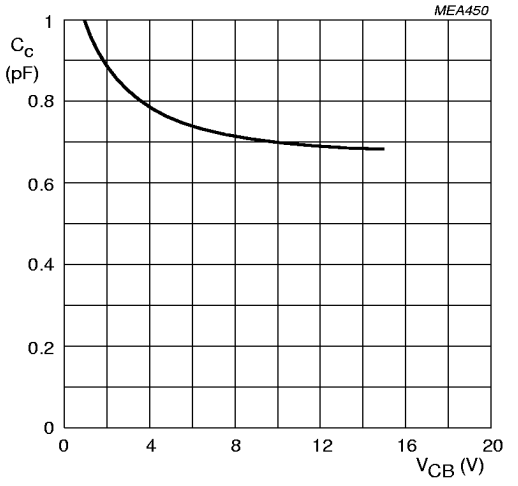


Fig.3 Power derating curve.



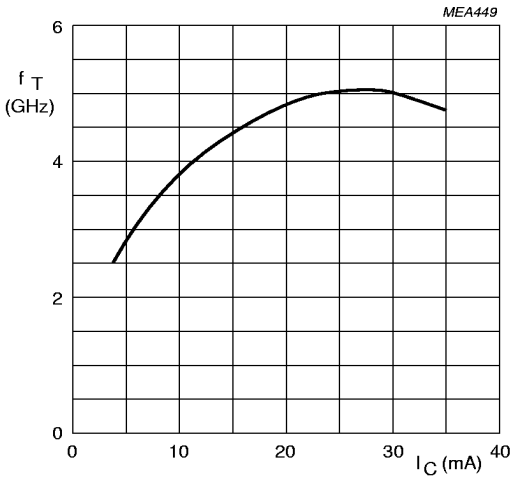
V_{CE} = 5 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current; typical values.



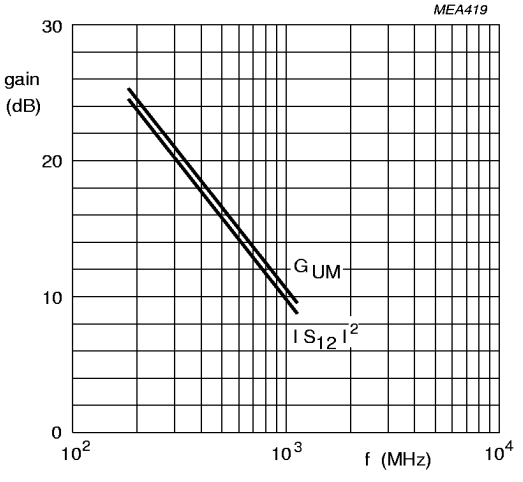
$I_E = i_e$ = 0; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage; typical values.



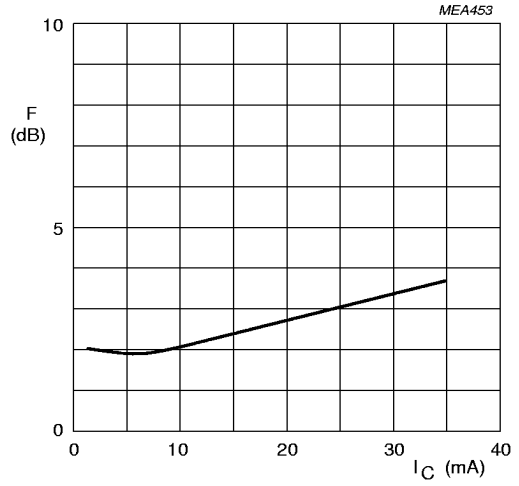
V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



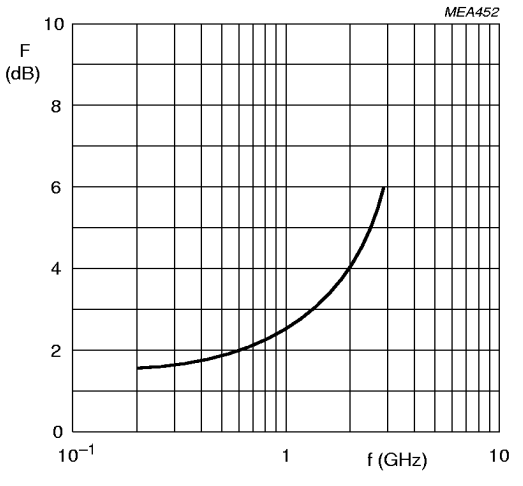
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.7 Gain as a function of frequency; typical values.



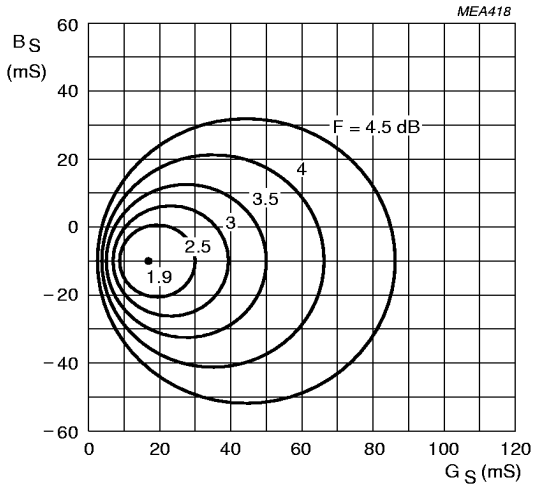
V_{CE} = 5 V; f = 500 MHz; Z_S = opt.; T_{amb} = 25 °C.

Fig.8 Minimum noise figure as a function of collector current; typical values.



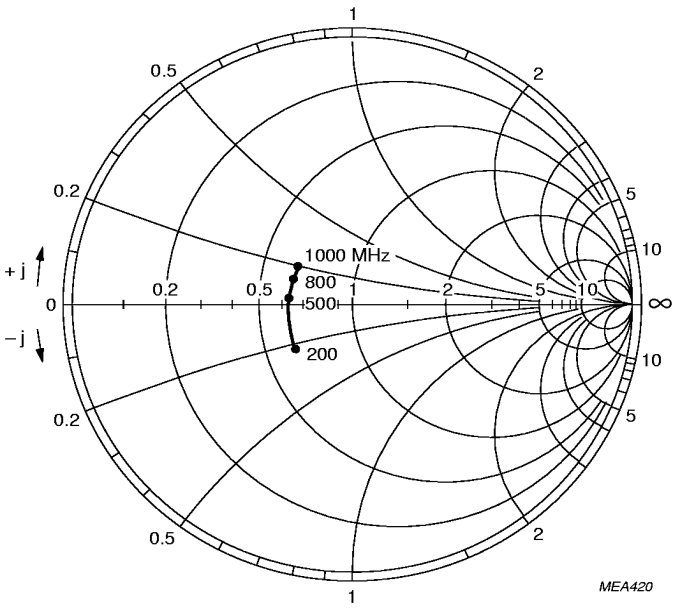
I_C = 2 mA; V_{CE} = 5 V; Z_S = opt.; T_{amb} = 25 °C.

Fig.9 Minimum noise figure as a function of frequency; typical values.



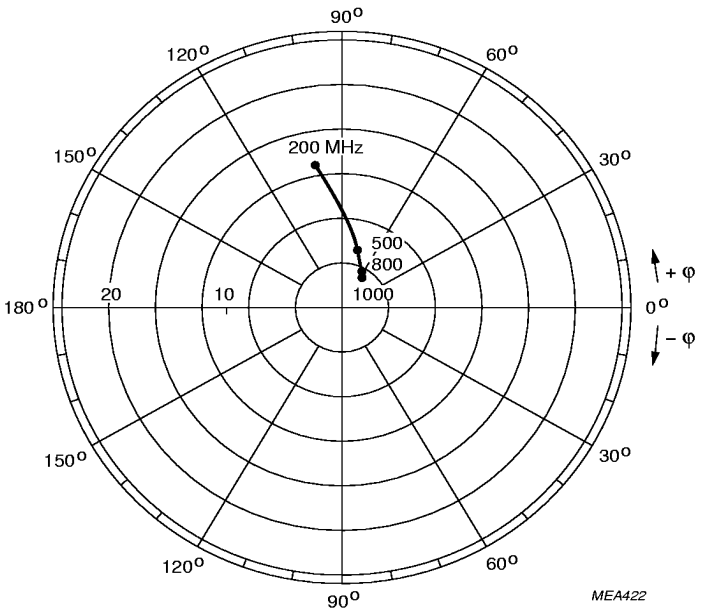
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig.10 Circles of constant noise figure; typical values.



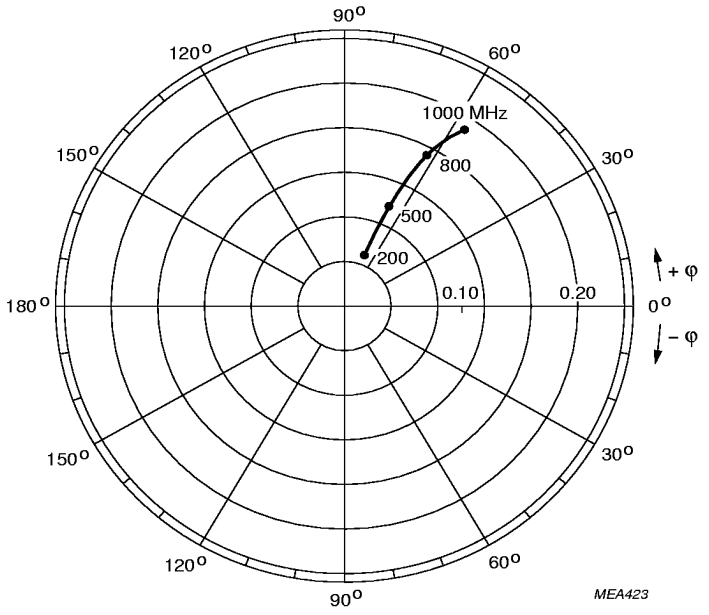
I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.11 Common emitter input reflection coefficient (S_{11}); typical values.



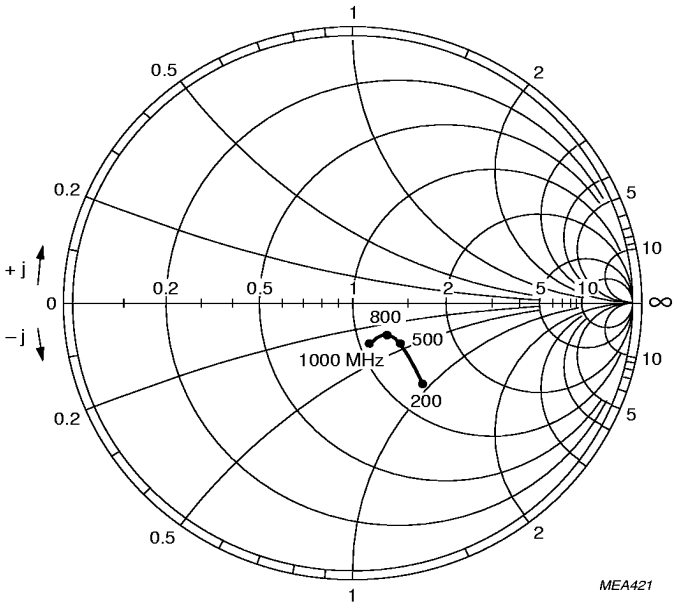
I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.12 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 30 mA; V_{CE} = 5 V; T_{amb} = 25 °C.

Fig.13 Common emitter reverse transmission coefficient (S_{12}); typical values.

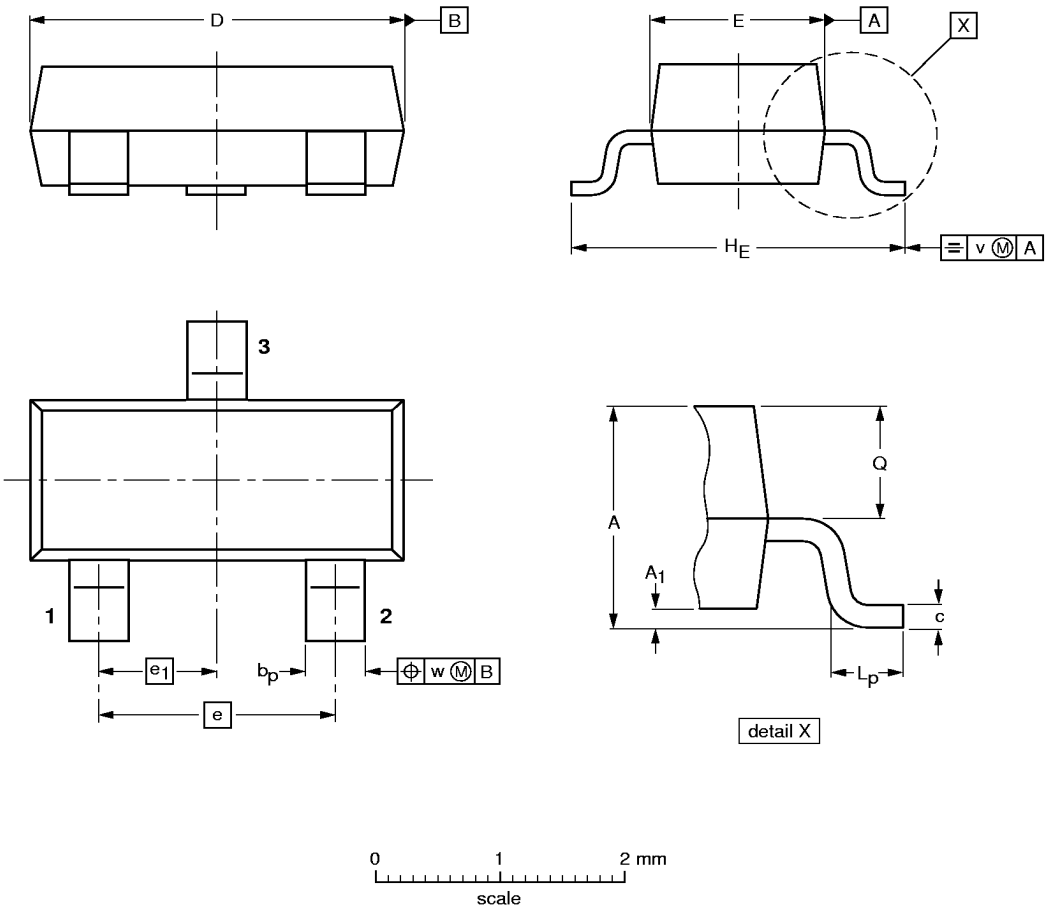


I_C = 30 mA; V_{CE} = 5 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.14 Common emitter output reflection coefficient (S_{22}); typical values.

PACKAGE OUTLINE

Plastic surface mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT23						97-02-28