BFR92A

NPN 5 GHz wideband transistor

Rev. 04 — 2 March 2009 **Product data sheet**

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NPN 5 GHz wideband transistor BFR92A

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion.

APPLICATIONS

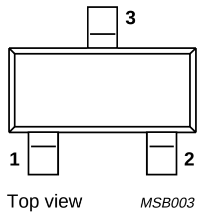
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT92.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: P2%.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage		–	20	V
V_{CEO}	collector-emitter voltage		–	15	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C	–	300	mW
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C	2.1	–	dB
V_O	output voltage	$d_{im} = -60$ dB; $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $f_p + f_q - f_r = 793.25$ MHz	150	–	mV

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	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	25	mA
P_{tot}	total power dissipation	$T_s \leq 95$ °C; note 1; see Fig.3	–	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.

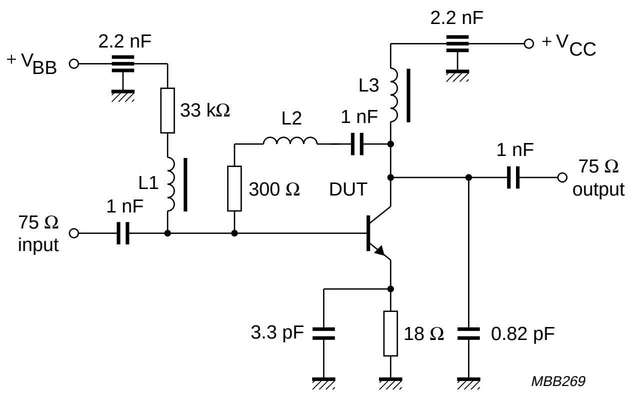
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector leakage current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V; see Fig.4	65	90	135	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz; see Fig.5	–	0.6	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 10$ V; f = 1 MHz	–	1.2	–	pF
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz; see Fig.6	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	14	–	dB
		$I_C = 15$ mA; $V_{CE} = 10$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	8	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; f = 1 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C; see Figs 13 and 14	–	2.1	–	dB
		$I_C = 5$ mA; $V_{CE} = 10$ V; f = 2 GHz; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25$ °C; see Figs 13 and 14	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	150	–	mV
d_2	second order intermodulation distortion	notes 2 and 4; see Fig.16	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}\ \text{dB}$.
2. Measured on the same die in a SOT37 package (BFR90A).
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °C
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 795.25$ MHz;
   $V_q = V_O$ –6 dB; $f_q = 803.25$ MHz;
   $V_r = V_O$ –6 dB; $f_r = 805.25$ MHz;
   measured at $f_p + f_q - f_r = 793.25$ MHz.
4. $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °C
   $V_p = 60$ mV at $f_p = 250$ MHz;
   $V_q = 60$ mV at $f_q = 560$ MHz;
   measured at $f_p + f_q = 810$ MHz.



L1 = L3 = 5 μH choke.

L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

Fig.2 Intermodulation distortion and second harmonic distortion MATV test circuit.

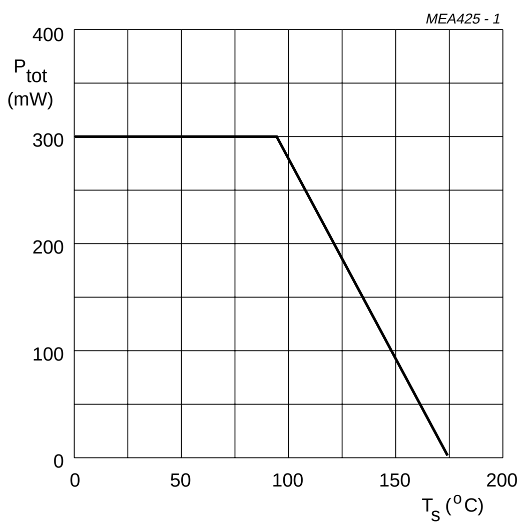
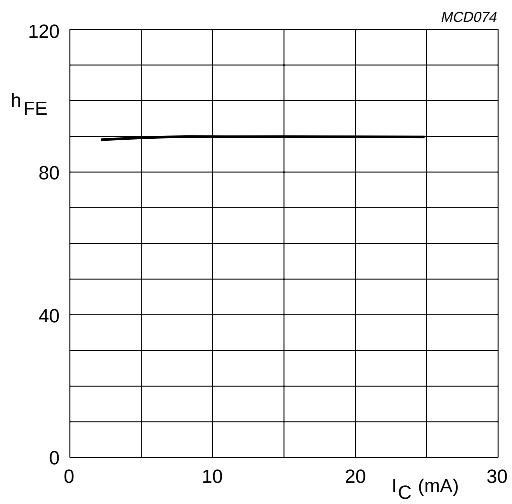
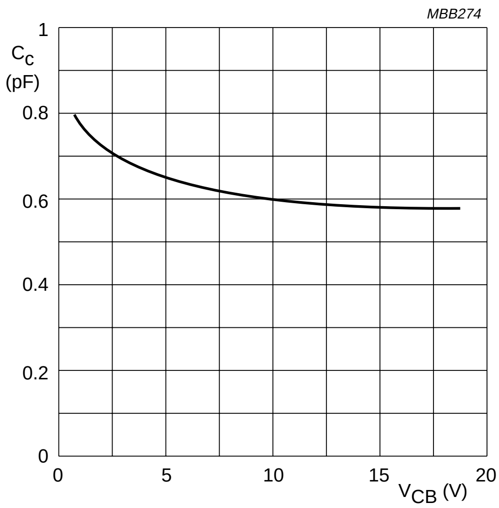


Fig.3 Power derating curve.



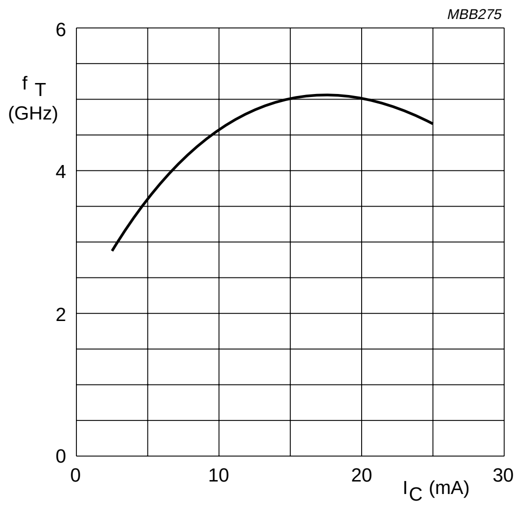
V_{CE} = 10 V; T_j = 25 °C.

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



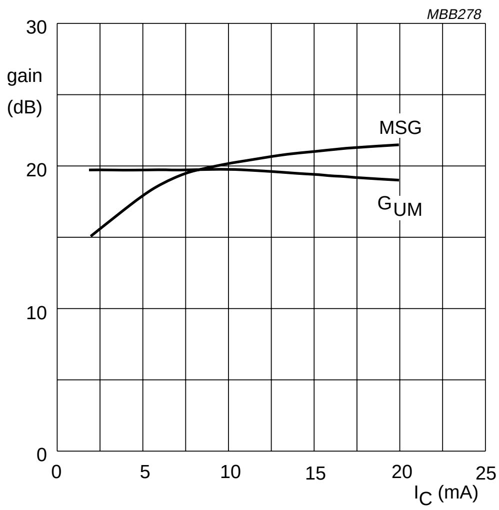
$I_C = i_c = 0$; f = 1 MHz; T_j = 25 °C.

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



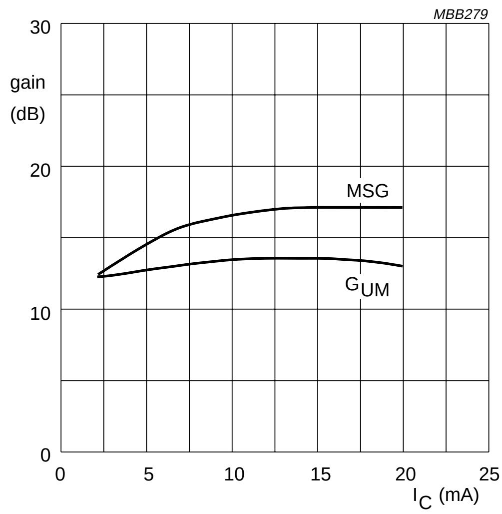
V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C.

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



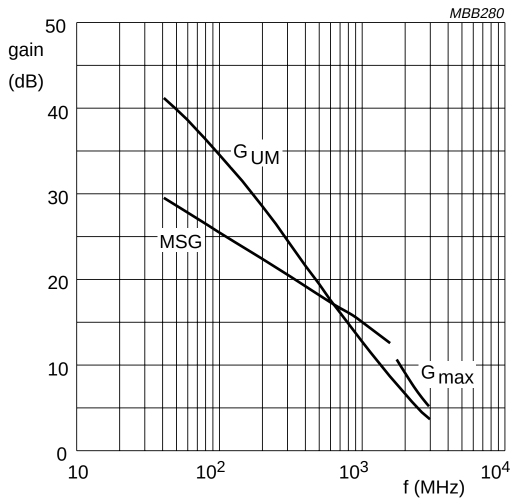
V_{CE} = 10 V; f = 500 MHz.
MSG = maximum stable gain;
G_{UM} = maximum unilateral power gain.

Fig.7 Gain as a function of collector current; typical values.



V_{CE} = 10 V; f = 1 GHz.
MSG = maximum stable gain;
G_{UM} = maximum unilateral power gain.

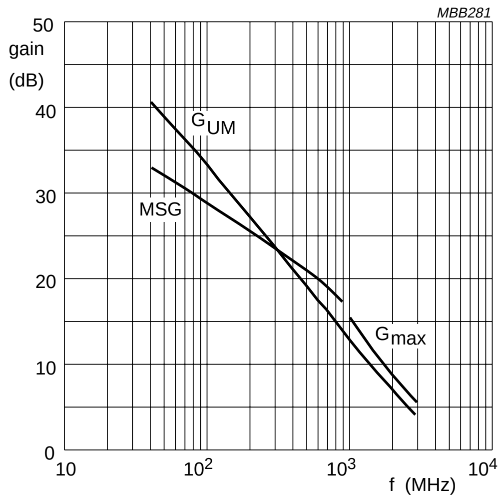
Fig.8 Gain as a function of collector current; typical values.



I_C = 5 mA; V_{CE} = 10 V.

G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.

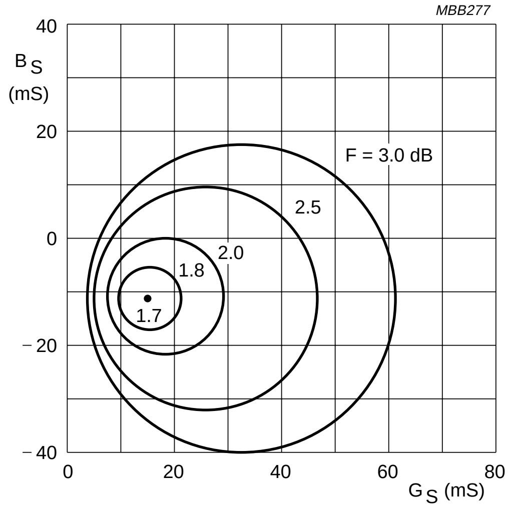
Fig.9 Gain as a function of frequency; typical values.



I_C = 15 mA; V_{CE} = 10 V.

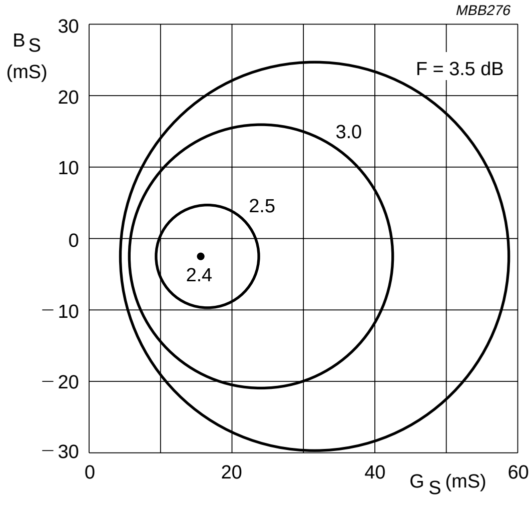
G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.

Fig.10 Gain as a function of frequency; typical values.



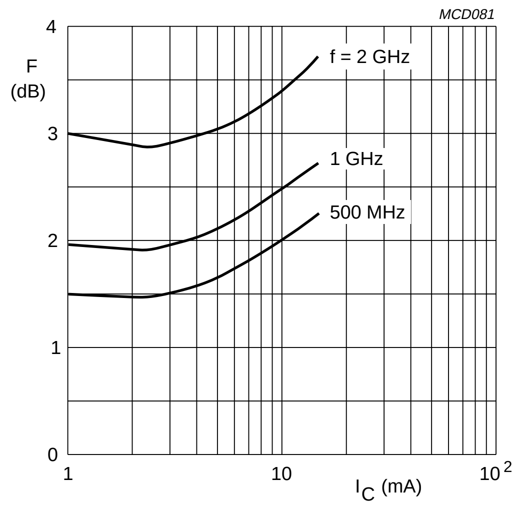
I_C = 4 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.11 Circles of constant noise figure; typical values.



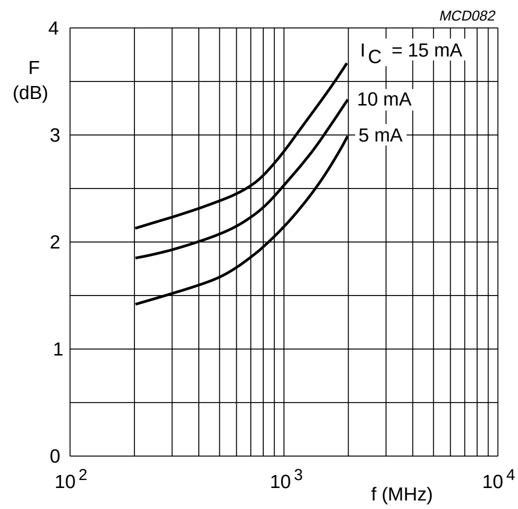
I_C = 14 mA; V_{CE} = 10 V; f = 800 MHz.

Fig.12 Circles of constant noise figure; typical values.



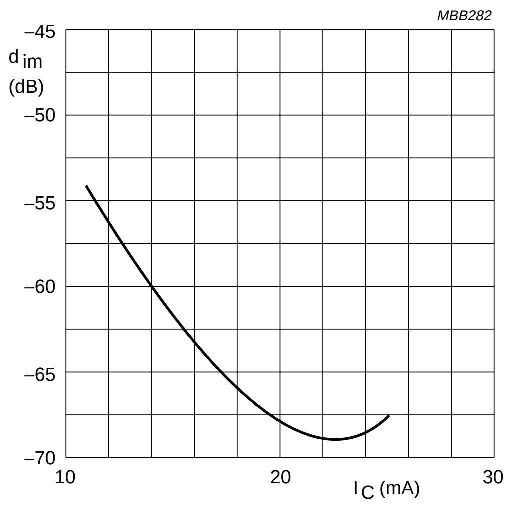
V_{CE} = 10 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



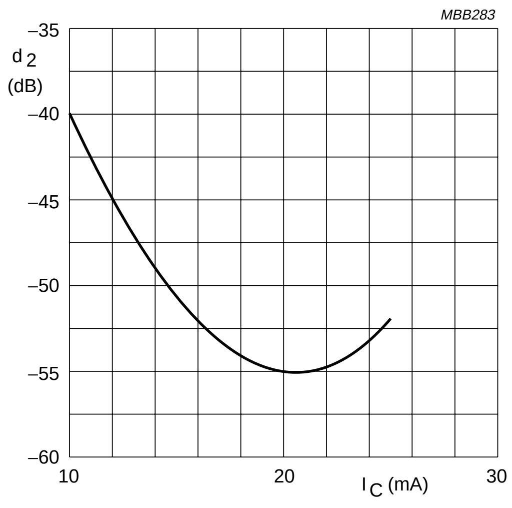
V_{CE} = 10 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



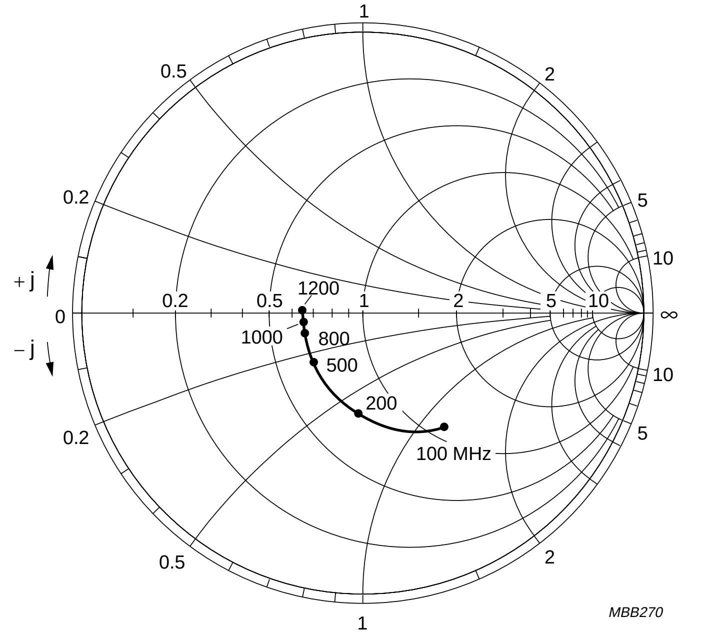
V_{CE} = 10 V; V_O = 150 mV (43.5 dBmV);
$f_p + f_q - f_r$ = 793.25 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.15 Intermodulation distortion; typical values.



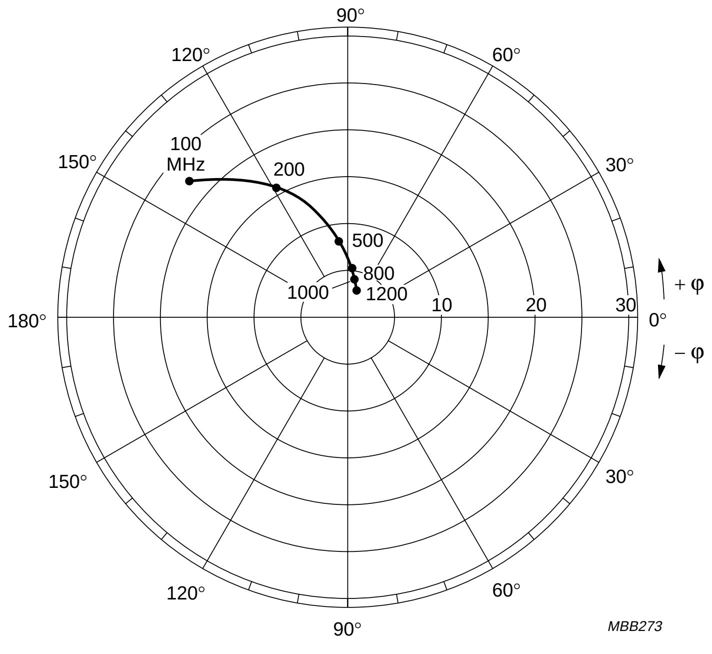
V_{CE} = 10 V; V_O = 60 mV; $f_p + f_q - f_r$ = 810 MHz; T_{amb} = 25 °C.
Measured in MATV test circuit (see Fig.2).

Fig.16 Second order intermodulation distortion; typical values.



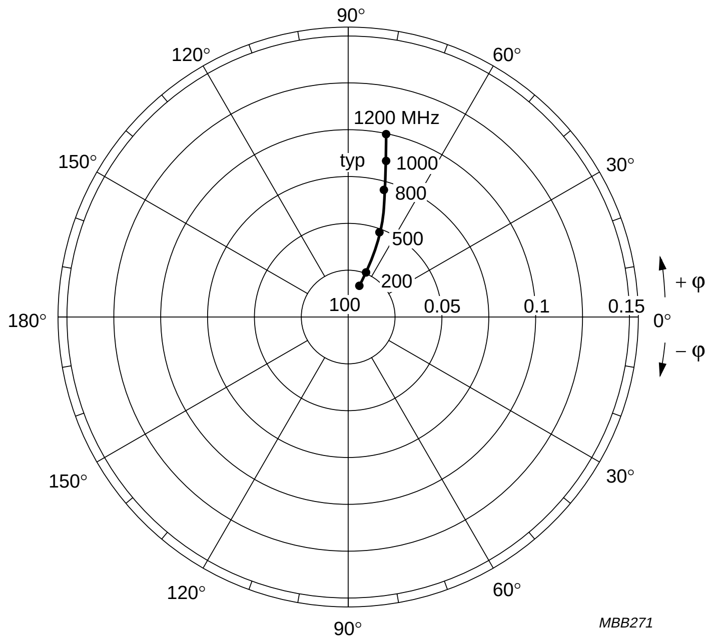
I_C = 14 mA; V_{CE} = 10 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.17 Common emitter input reflection coefficient (S_{11}); typical values.



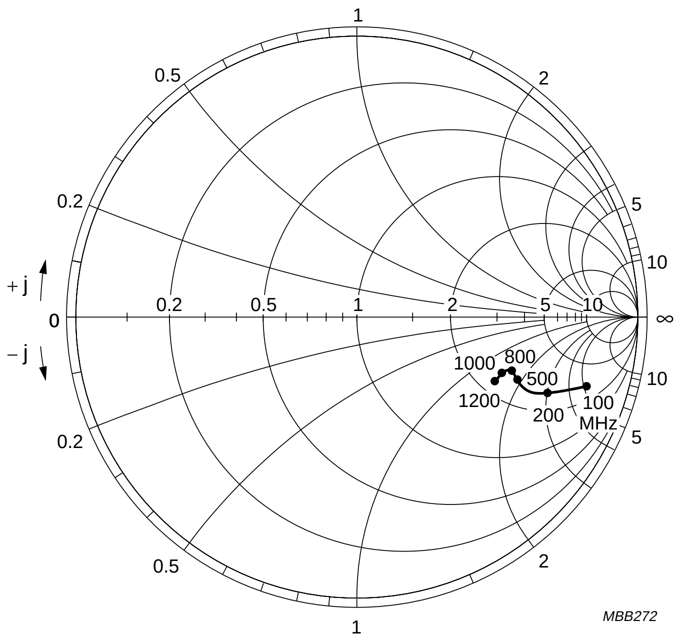
I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.18 Common emitter forward transmission coefficient (S_{21}); typical values.



I_C = 14 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.19 Common emitter reverse transmission coefficient (S_{12}); typical values.

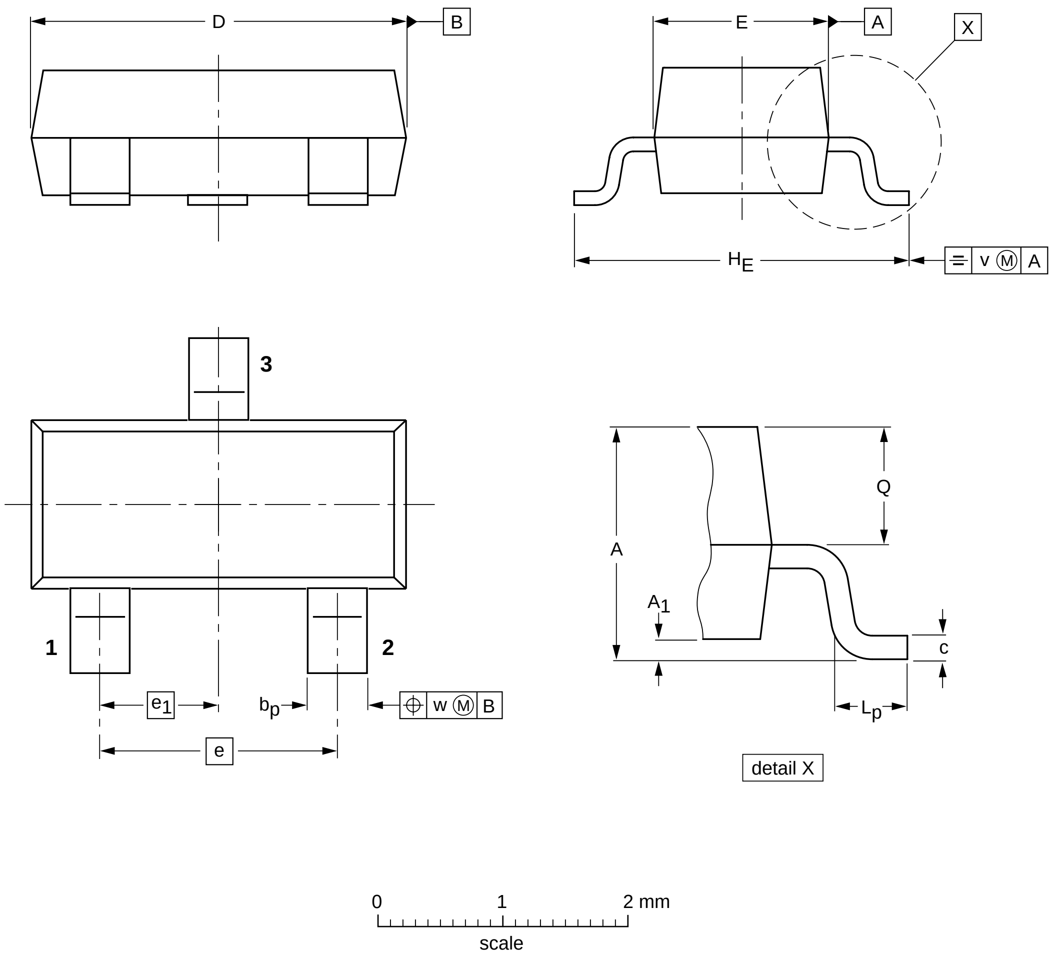


I_C = 14 mA; V_{CE} = 10 V; Z_o = 50 Ω; T_{amb} = 25 °C.

Fig.20 Common emitter output reflection coefficient (S_{22}); typical values.

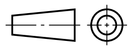
PACKAGE OUTLINE

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

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Document status[1][2]	Product status[3]	Definition
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Revision history

Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFR92A_N_4	20090302	Product data sheet	-	BFR92A_N_3
Modifications:	• Fig.1 on page 2; Figure note changed			
BFR92A_N_3	20080307	Product data sheet	-	BFR92A_2
BFR92A_2 (9397 750 02766)	19971029	Product specification	-	BFR92A_1
BFR92A_1	19950901	-	-	-

Date of release: 2 March 2009
Document identifier: BFR92A_N_4