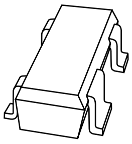

BFG520W; BFG520W/X

NPN 9 GHz wideband transistors

Rev. 04 — 21 November 2007 **Product data sheet**

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NPN 9 GHz wideband transistors BFG520W; BFG520W/X

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

RF front end wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV) and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

MARKING

TYPE NUMBER	CODE
BFG520W	N3
BFG520W/X	N4

PINNING

PIN	DESCRIPTION	
	BFG520W	BFG520W/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

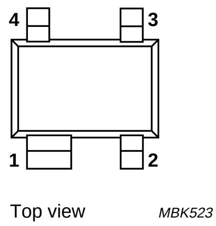


Fig.1 Simplified outline SOT343N.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	collector current (DC)		–	–	70	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C	–	–	500	mW
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 6$ V	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; f = 1 MHz	–	0.35	–	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	–	17	–	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 20$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz	–	1.1	1.6	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	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	70	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; see Fig.2; note 1	–	500	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	$T_s \leq 85$ °C; note 1	180	K/W

Note

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

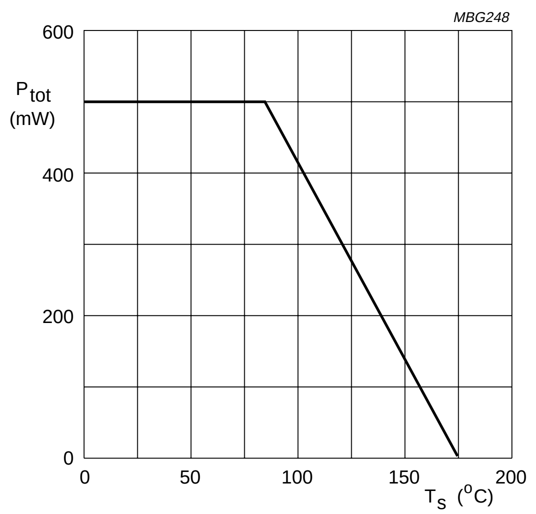


Fig.2 Power derating curve.

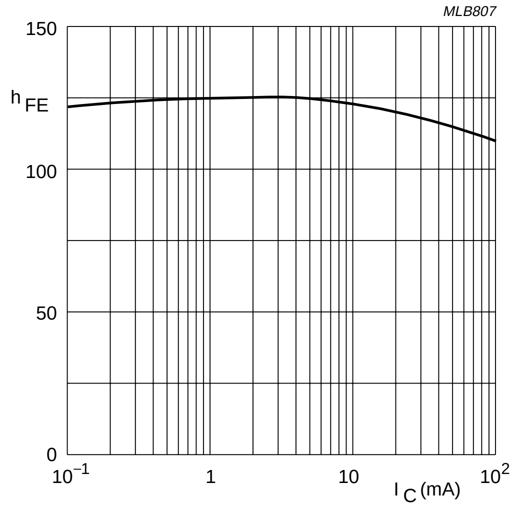
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C =10 µA; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 10 µA; R_{BE} = 0	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 µA; I_C = 0	2.5	–	–	V
I_{CBO}	collector leakage current	V_{CB} = 6 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 6 V; see Fig.3	60	120	250	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz; see Fig.4	–	0.35	–	pF
f_T	transition frequency	I_C = 20 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C; see Fig.5	–	9	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	–	17	–	dB
		I_C = 20 mA; V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C	–	11	–	dB
$\|S_{21}\|^2$	insertion power gain	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; T_{amb} = 25 °C	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 900 MHz	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 2 GHz	–	1.85	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 20 mA; V_{CE} = 6 V; f = 900 MHz; R_L = 50 Ω; T_{amb} = 25 °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm
V_o	output voltage	note 3	–	275	–	mV
d_2	second order intermodulation distortion	note 4	–	–50	–	dB

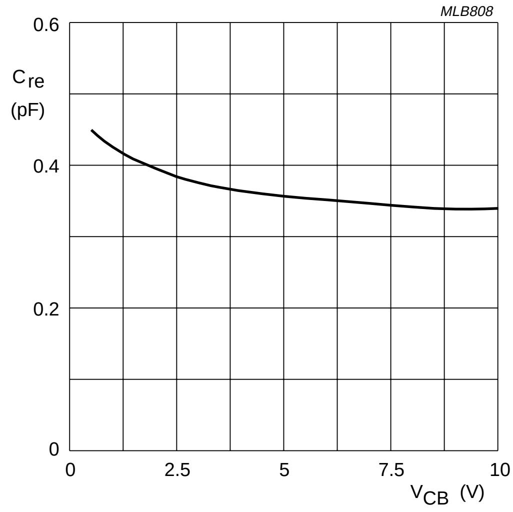
Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero. $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. I_C = 20 mA; V_{CE} = 6 V; R_L = 50 Ω; T_{amb} = 25 °C;
   f_p = 900 MHz; f_q = 902 MHz; measured at $2f_p - f_q$ = 898 MHz and $2f_q - f_p$ = 904 MHz.
3. d_{im} = –60 dB (DIN45004B); I_C = 20 mA; V_{CE} = 6 V; $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB; R_L = 75 Ω;
   f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_p + f_q - f_r$ = 793.25 MHz.
4. I_C = 20 mA; V_{CE} = 6 V; V_o = 75 mV; R_L = 75 Ω; T_{amb} = 25 °C;
   f_p = 250 MHz; f_q = 560 MHz; measured at $f_p + f_q$ = 810 MHz.



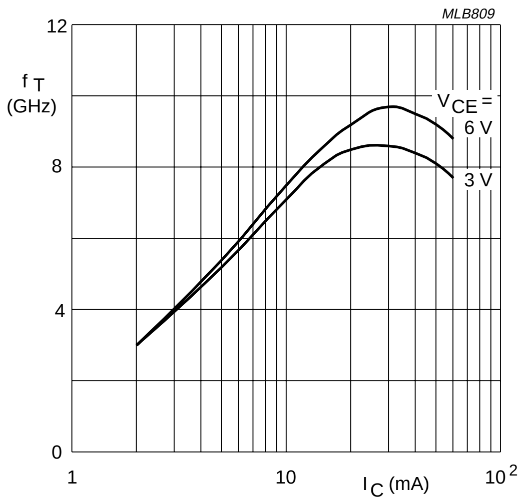
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



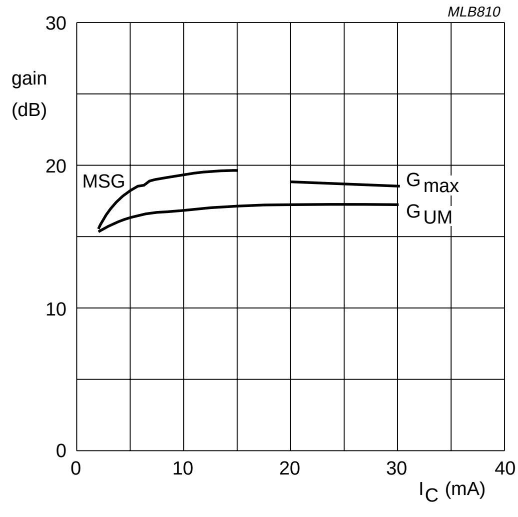
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



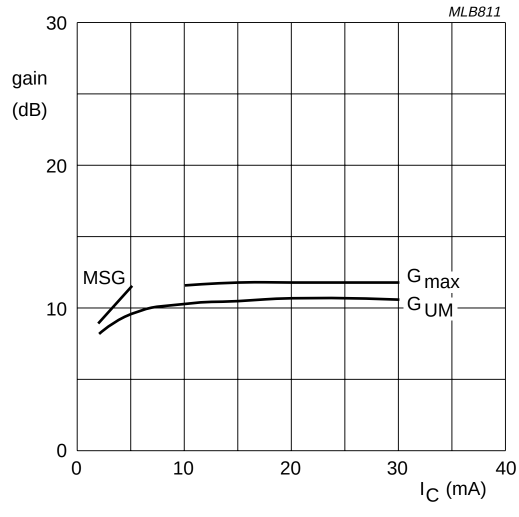
f = 1 GHz; T_{amb} = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



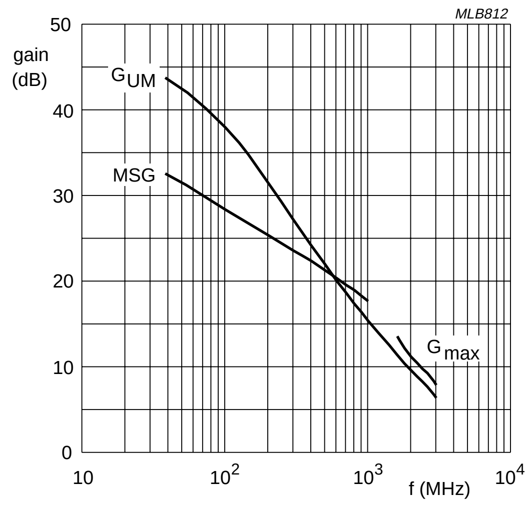
f = 900 MHz; V_{CE} = 6 V.

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



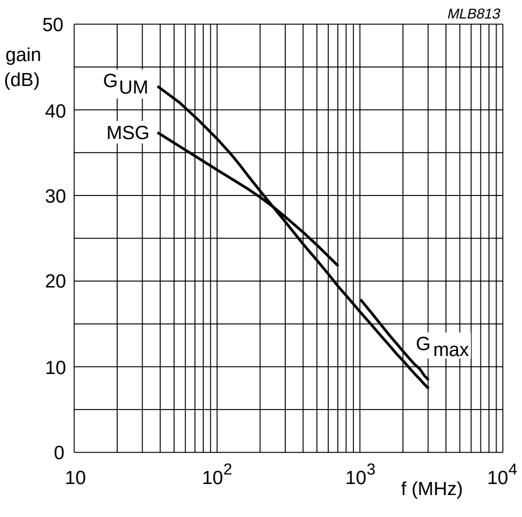
f = 2 GHz; V_{CE} = 6 V.

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



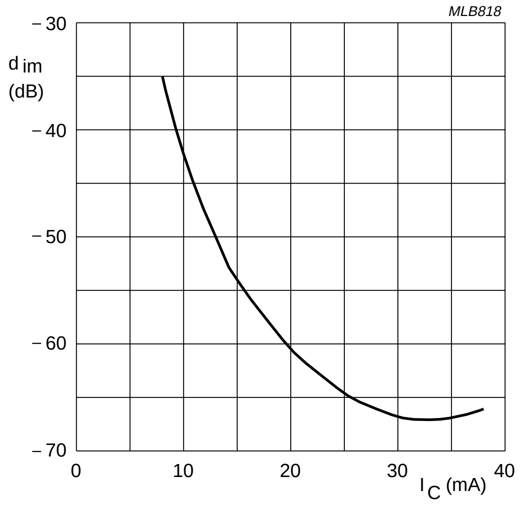
I_C = 5 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



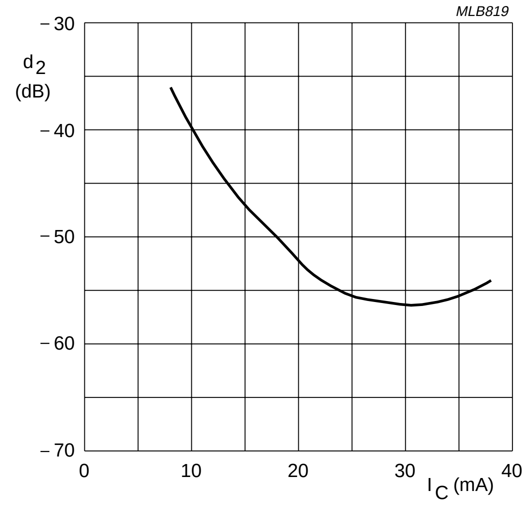
I_C = 20 mA; V_{CE} = 6 V.

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



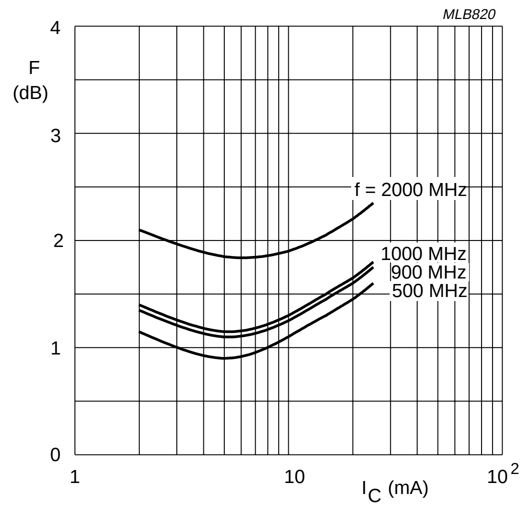
V_o = 275 mV; $f_p + f_q - f_r$ = 793.25 MHz; V_{CE} = 6 V;
R_L = 75 Ω; T_{amb} = 25 °C.

Fig.10 Intermodulation distortion as a function of collector current; typical values.



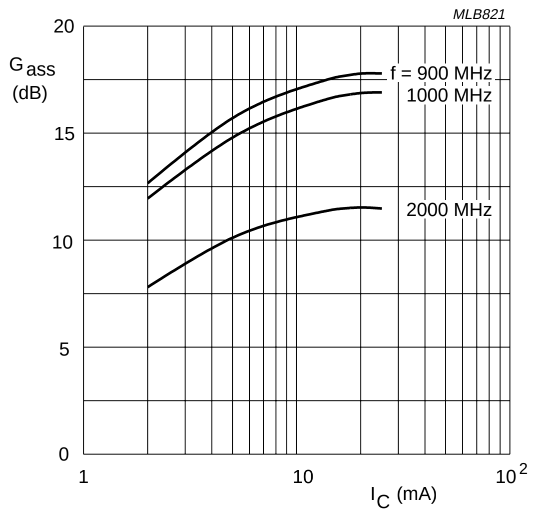
V_o = 75 mV; $f_p + f_q$ = 810 MHz; V_{CE} = 6 V;
R_L = 75 Ω T_{amb} = 25 °C.

Fig.11 Second order intermodulation distortion as a function of collector current; typical values.



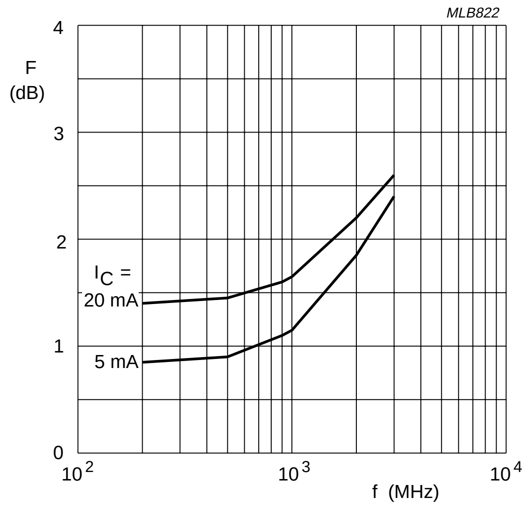
V_{CE} = 6 V.

Fig.12 Minimum noise figure as a function of collector current; typical values.



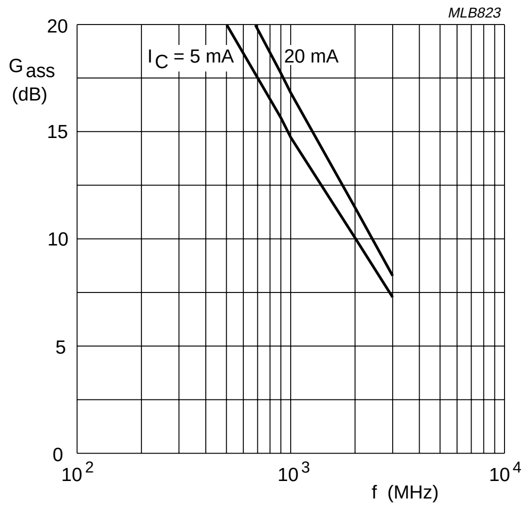
V_{CE} = 6 V.

Fig.13 Associated available gain as a function of collector current; typical values.



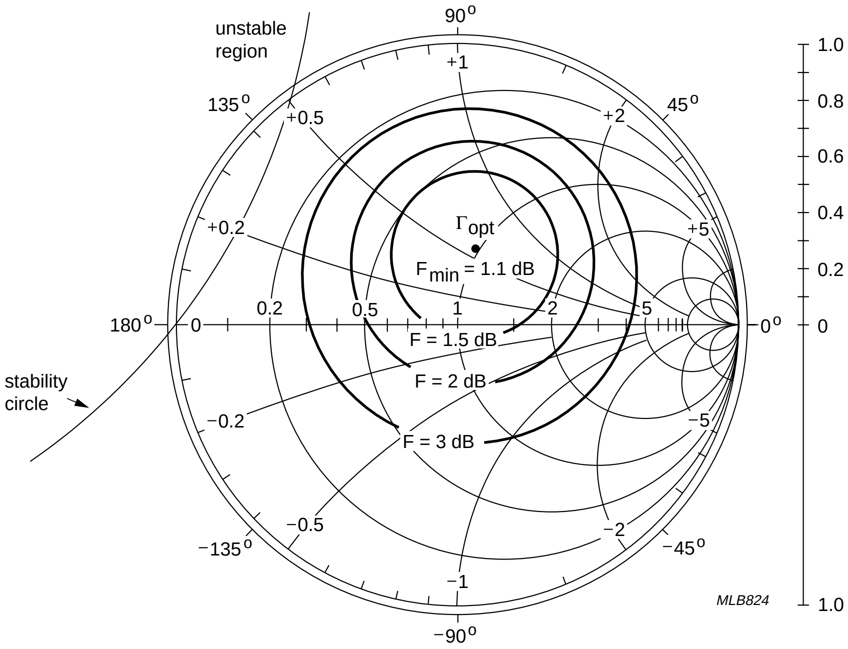
V_{CE} = 6 V.

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



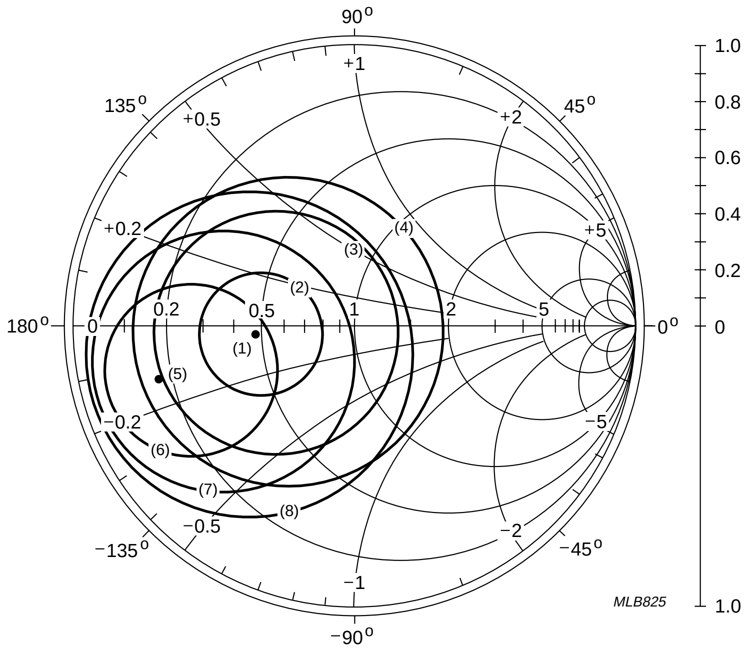
V_{CE} = 6 V.

Fig.15 Associated available gain as a function of frequency; typical values.



f = 900 MHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

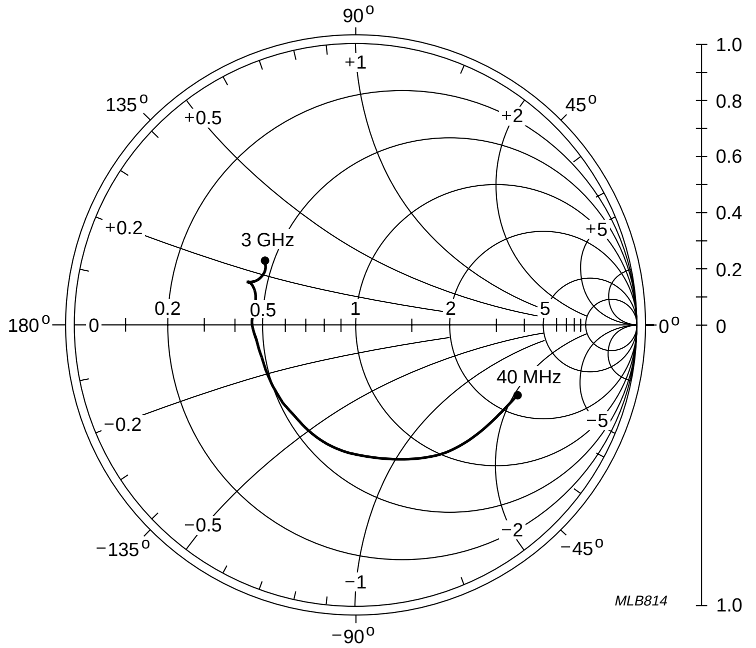
Fig.16 Common emitter noise figure circles; typical values.



(1) Γ_{opt}; F_{min} = 1.85 dB.
(2) F = 2 dB.
(3) F = 2.5 dB.
(4) F = 3 dB.
(5) Γ_{ms}; G_{max} = 11.8 dB.
(6) G = 11 dB.
(7) G = 10 dB.
(8) G = 9 dB.

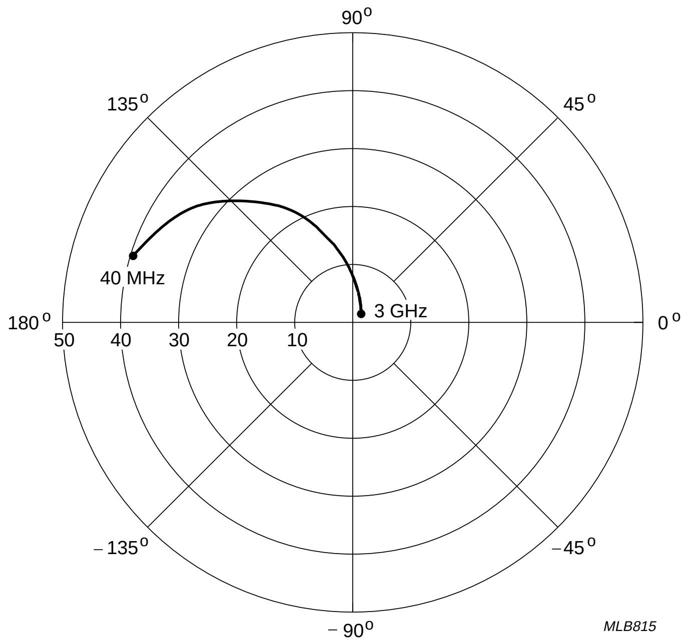
f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles; typical values.



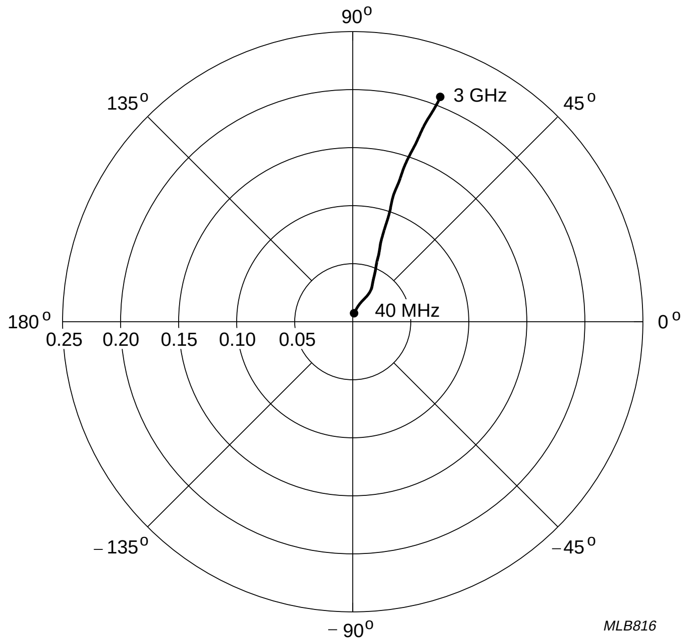
V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

Fig.18 Common emitter input reflection coefficient (S_{11}); typical values.



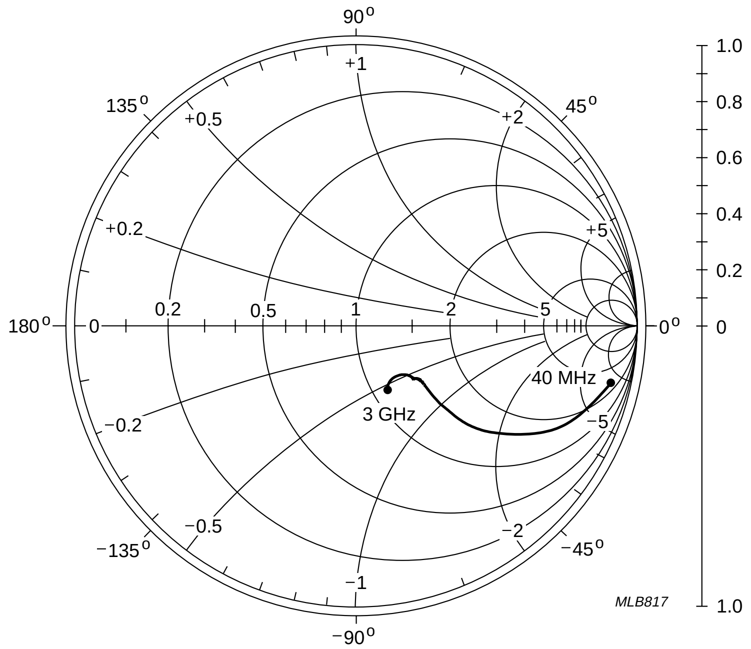
V_{CE} = 6 V; I_C = 20 mA.

Fig.19 Common emitter forward transmission coefficient (S_{21}); typical values.



V_{CE} = 6 V; I_C = 20 mA.

Fig.20 Common emitter reverse transmission coefficient (S_{12}); typical values.



V_{CE} = 6 V; I_C = 20 mA; Z_o = 50 Ω.

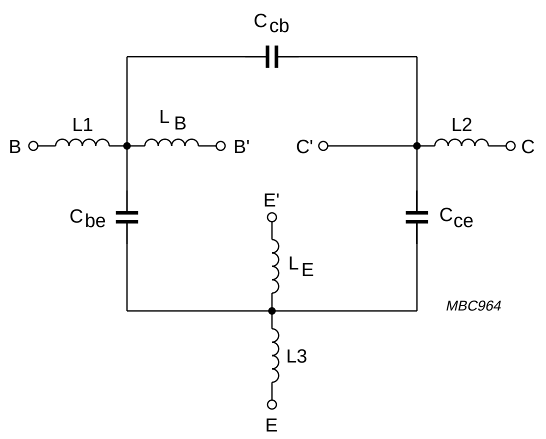
Fig.21 Common emitter output reflection coefficient (S_{22}); typical values.

SPICE parameters for the BFG520W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510	mA
6	ISE	283	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	775.3	mΩ
18	RC	2.210	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.070	–
33	XCJC	0.130	–
34	TR	543.7	ps
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.



QL_B = 50; QL_E = 50; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

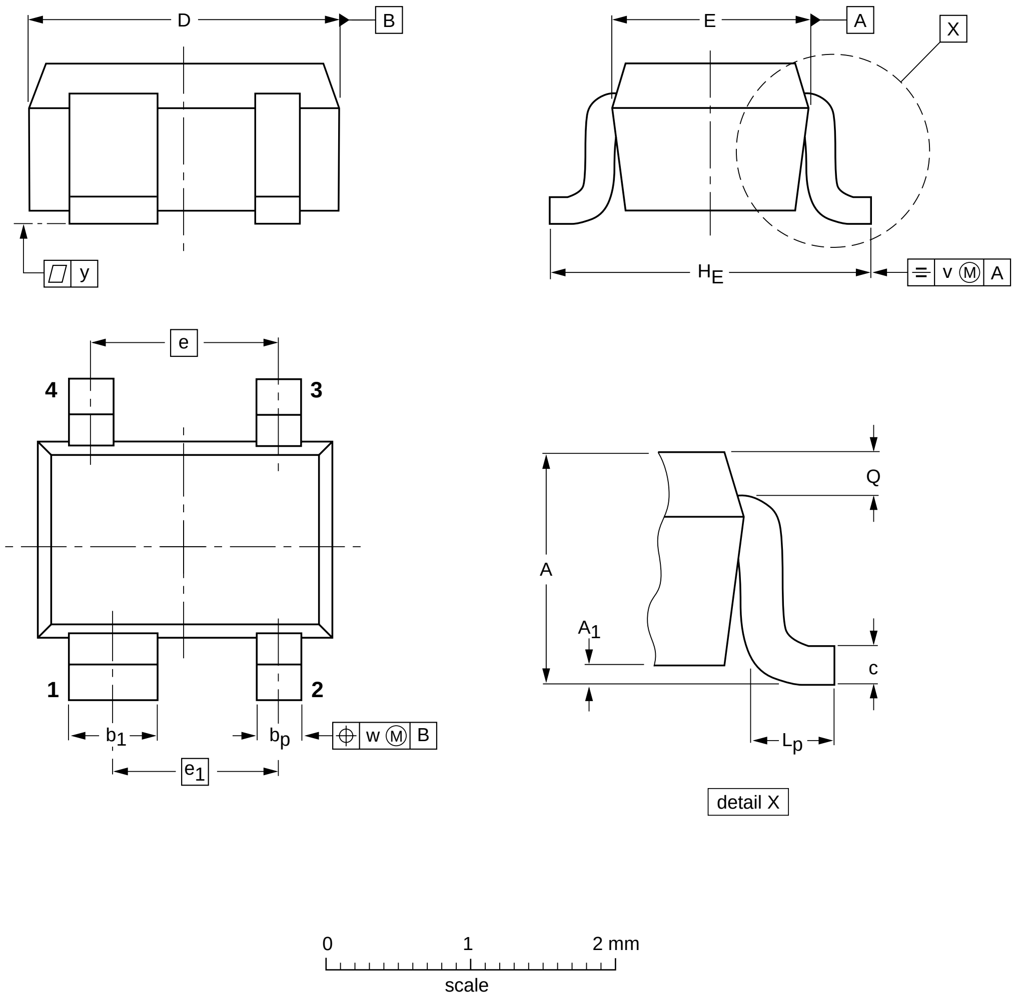
Fig.22 Package equivalent circuit SOT343N.

List of components (see Fig.22)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

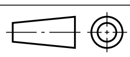
PACKAGE OUTLINE

Plastic surface mounted package; 4 leads **SOT343N**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343N						97-05-21

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Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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Revision history

Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFG520W_N_4	20071121	Product data sheet	-	BFG520W_X_3
Modifications:	• Page 2; text in Pinning table changed			
BFG520W_X_3	19981002	Product specification	-	BFG520W_2
BFG520W_2	19950824	Product specification	-	BFG520W_1
BFG520W_1	19940829	-	-	-

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Date of release: 21 November 2007
Document identifier: BFG520W_X_N_4