

# BFG93A; BFG93A/X

NPN 6 GHz wideband transistors

Rev. 05 — 26 November 2007

Product data sheet

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# NPN 6 GHz wideband transistors

# BFG93A; BFG93A/X

### FEATURES

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

### APPLICATIONS

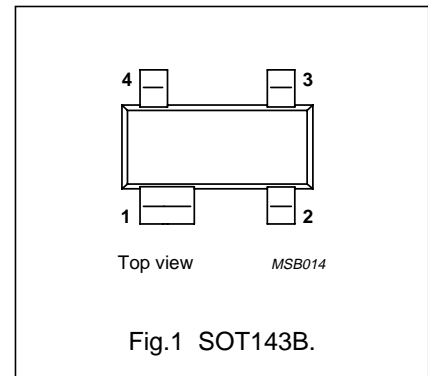
Wideband applications in the UHF and microwave range.

### DESCRIPTION

NPN transistor in a 4-pin, dual-emitter SOT143B plastic package.

### PINNING

PIN	DESCRIPTION
<b>BFG93A</b>	
1	collector
2	base
3	emitter
4	emitter
<b>BFG93A/X</b>	
1	collector
2	emitter
3	base
4	emitter



### MARKING

TYPE NUMBER	CODE
BFG93A	R8%
BFG93A/X	%MX

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CB0}$	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	$T_s \leq 85\text{ }^\circ\text{C}$	–	–	300	mW
$C_{re}$	feedback capacitance	$I_C = i_c = 0; V_{CB} = 5\text{ V}; f = 1\text{ MHz}$	–	0.6	–	pF
$f_T$	transition frequency	$I_C = 30\text{ mA}; V_{CE} = 5\text{ V}; f = 500\text{ MHz}$	4.5	6	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 1\text{ GHz}$	–	16	–	dB
		$I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 2\text{ GHz}$	–	10	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 1\text{ GHz}$	–	1.7	–	dB

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### LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>CBO</sub>	collector-base voltage	open emitter	–	15	V
V <sub>CEO</sub>	collector-emitter voltage	open base	–	12	V
V <sub>EBO</sub>	emitter-base voltage	open collector	–	2	V
I <sub>C</sub>	collector current (DC)		–	35	mA
P <sub>tot</sub>	total power dissipation	T <sub>s</sub> ≤ 85 °C; note 1	–	300	mW
T <sub>stg</sub>	storage temperature range		–65	+150	°C
T <sub>j</sub>	junction operating temperature		–	175	°C

#### Note

1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.

### THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R <sub>th j-s</sub>	thermal resistance from junction to soldering point	note 1	290	K/W

#### Note

1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.

### CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

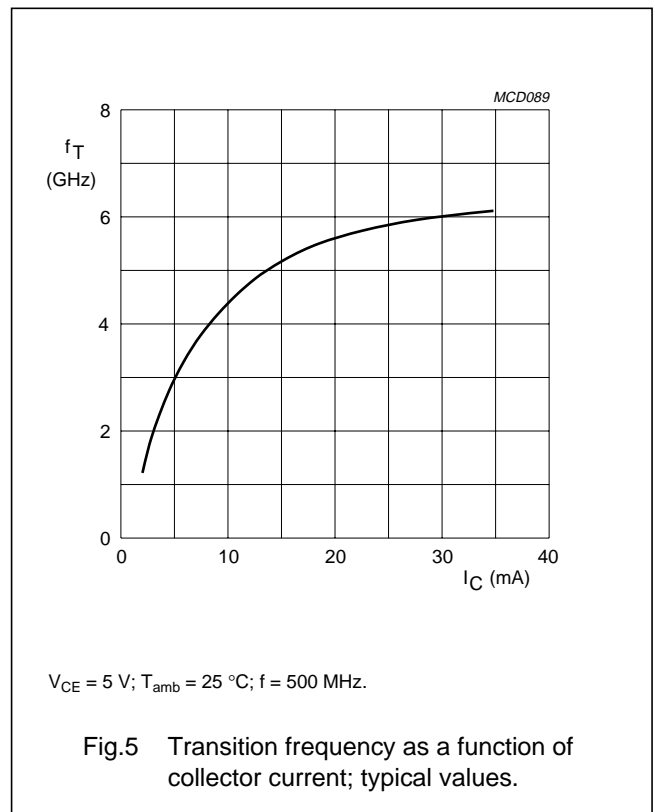
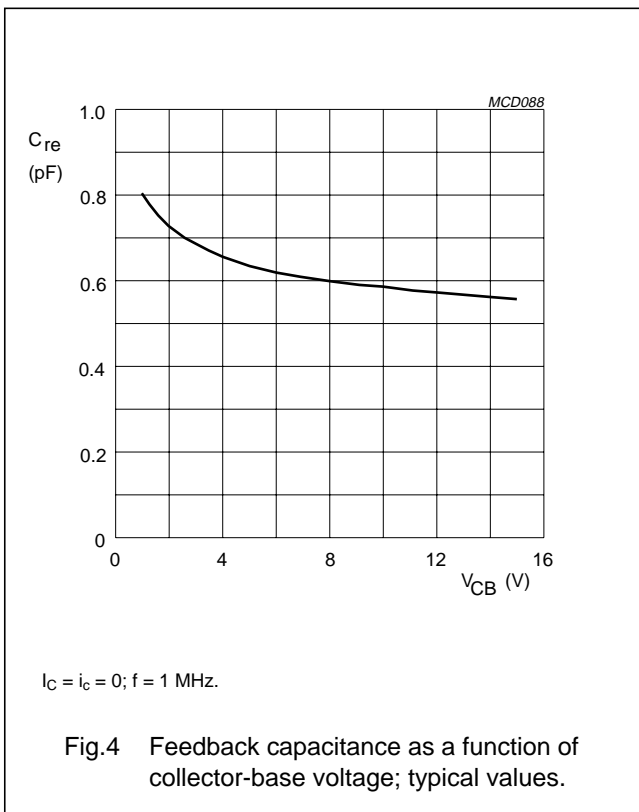
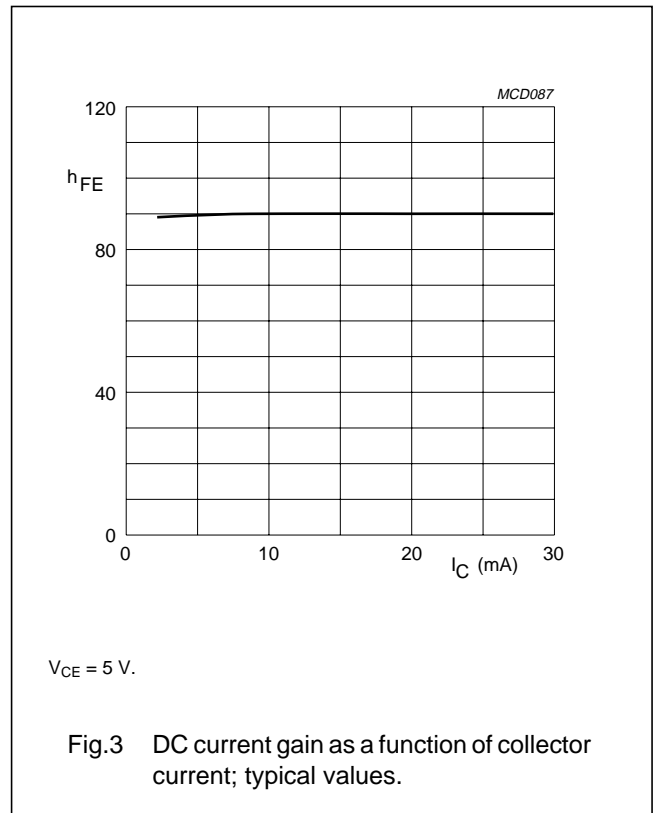
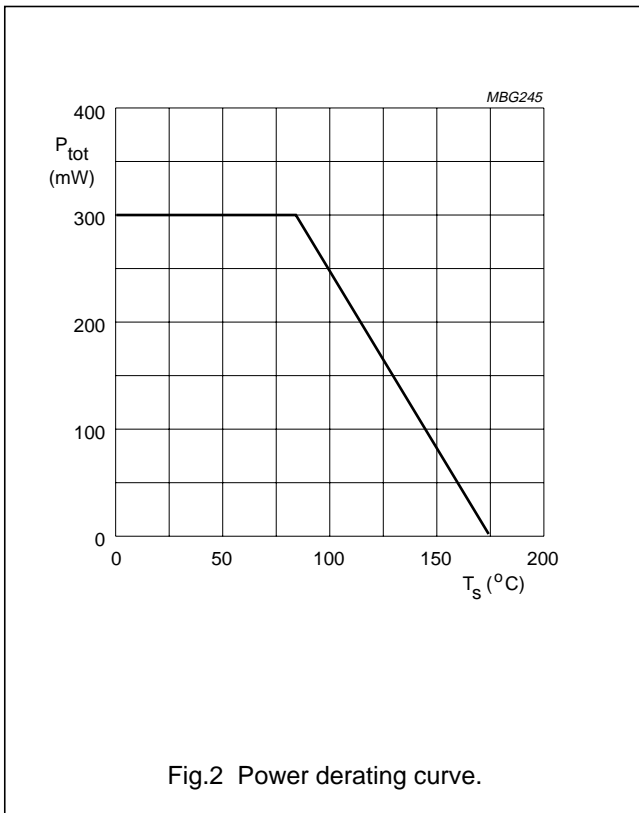
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I <sub>CBO</sub>	collector leakage current	I <sub>E</sub> = 0; V <sub>CB</sub> = 5 V	–	–	50	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 5 V	40	90	–	
C <sub>c</sub>	collector capacitance	I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = 5 V; f = 1 MHz	–	0.9	–	pF
C <sub>e</sub>	emitter capacitance	I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>EB</sub> = 5 V; f = 1 MHz	–	1.9	–	pF
C <sub>re</sub>	feedback capacitance	I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = 5 V; f = 1 MHz	–	0.6	–	pF
f <sub>T</sub>	transition frequency	I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 5 V; f = 500 MHz	4.5	6	–	GHz
G <sub>UM</sub>	maximum unilateral power gain; note 1	I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 8 V; T <sub>amb</sub> = 25 °C; f = 1 GHz	–	16	–	dB
		I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 8 V; T <sub>amb</sub> = 25 °C; f = 2 GHz	–	10	–	dB
F	noise figure	Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 8 V; T <sub>amb</sub> = 25 °C; f = 1 GHz	–	1.7	–	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 8 V; T <sub>amb</sub> = 25 °C; f = 2 GHz	–	2.3	–	dB

#### Note

1. G<sub>UM</sub> is the maximum unilateral power gain, assuming S<sub>12</sub> is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$  dB.

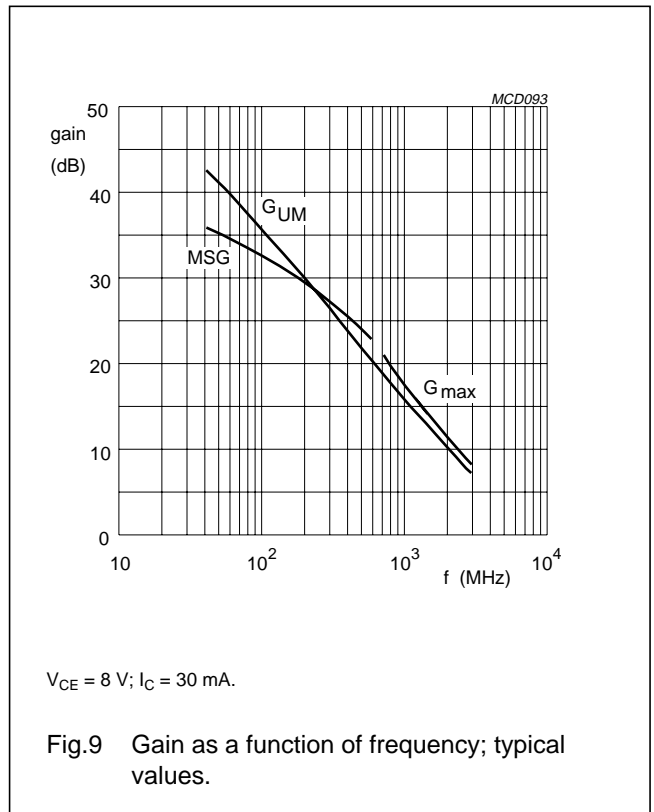
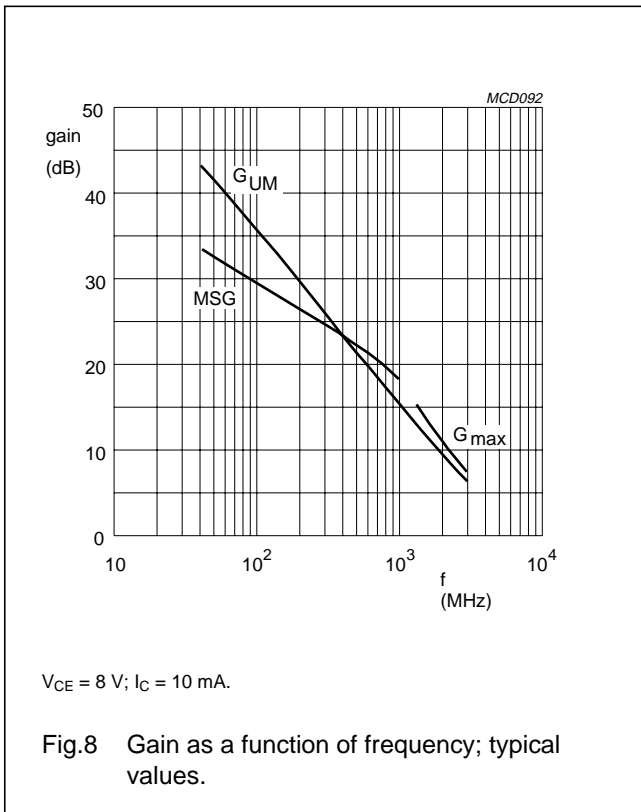
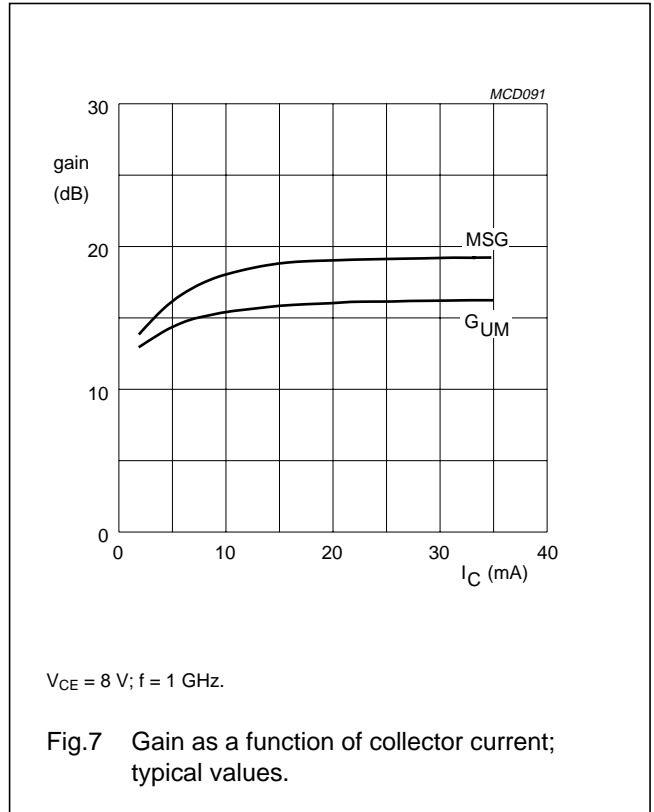
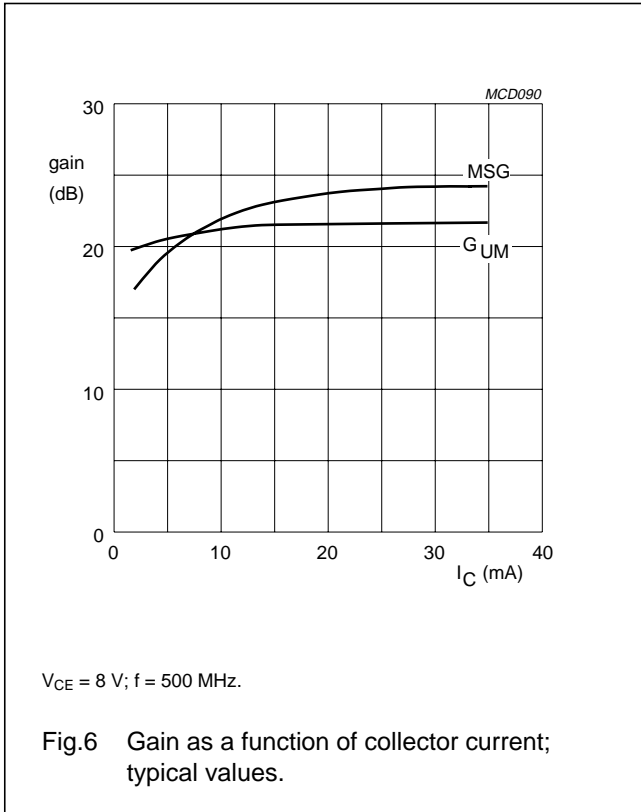
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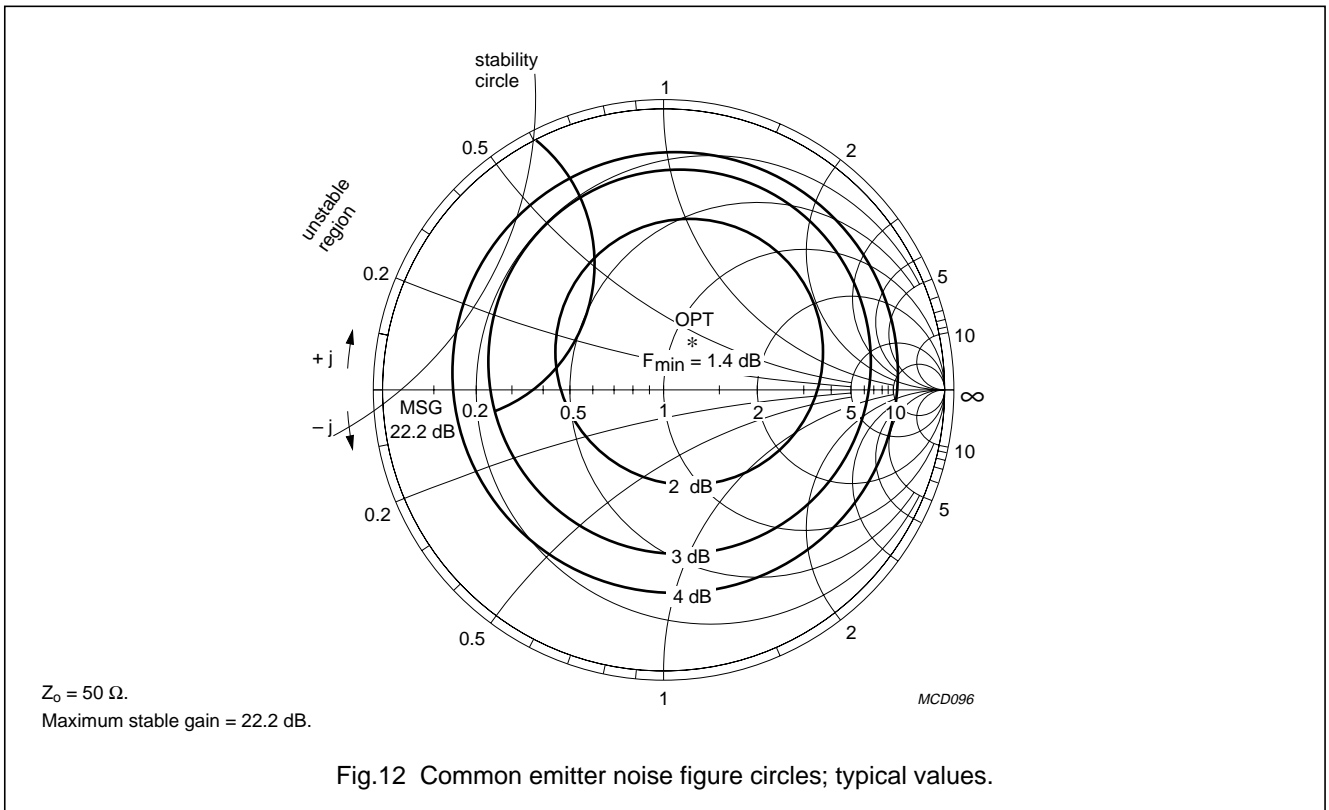
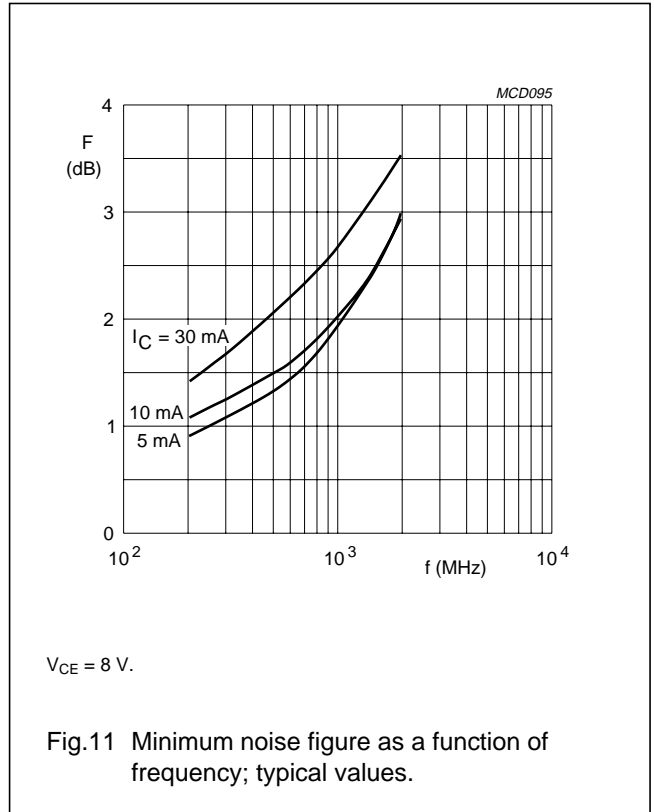
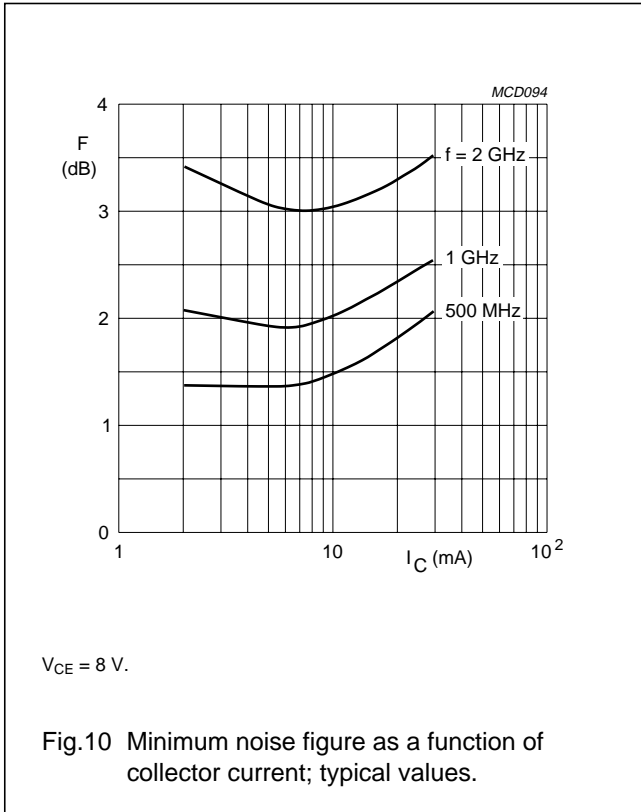
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



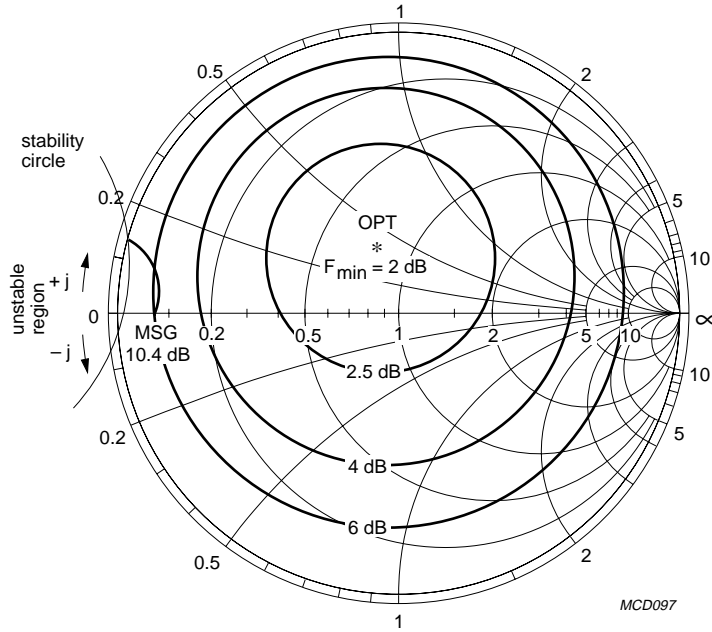
NPN 6 GHz wideband transistors

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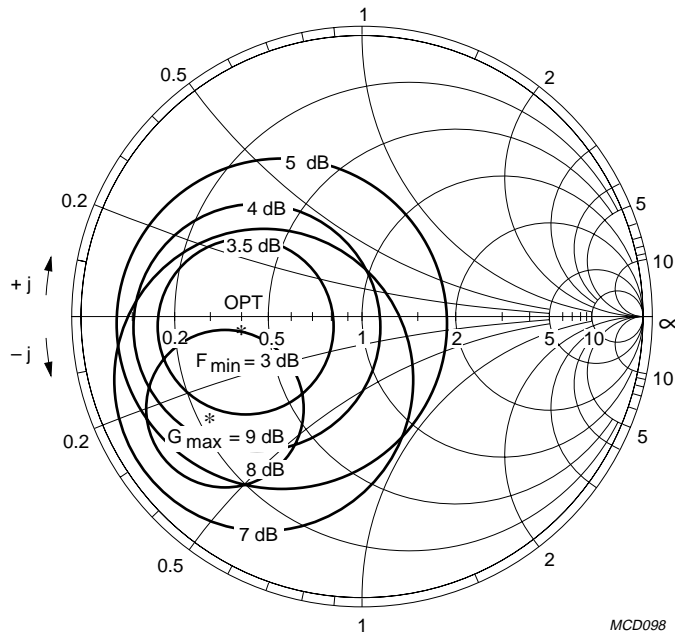
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



$Z_0 = 50 \Omega$ .  
Maximum stable gain = 10.4 dB.

Fig.13 Common emitter noise figure circles; typical values.

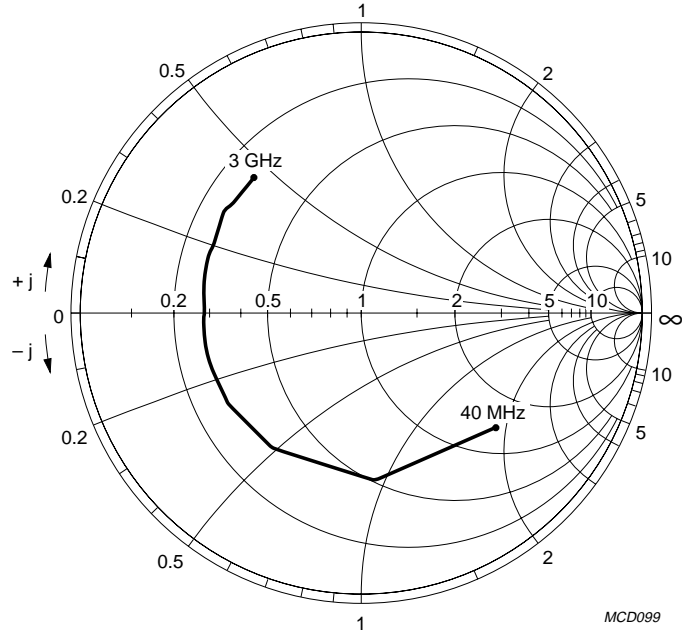


$Z_0 = 50 \Omega$ .

Fig.14 Common emitter noise figure circles; typical values.

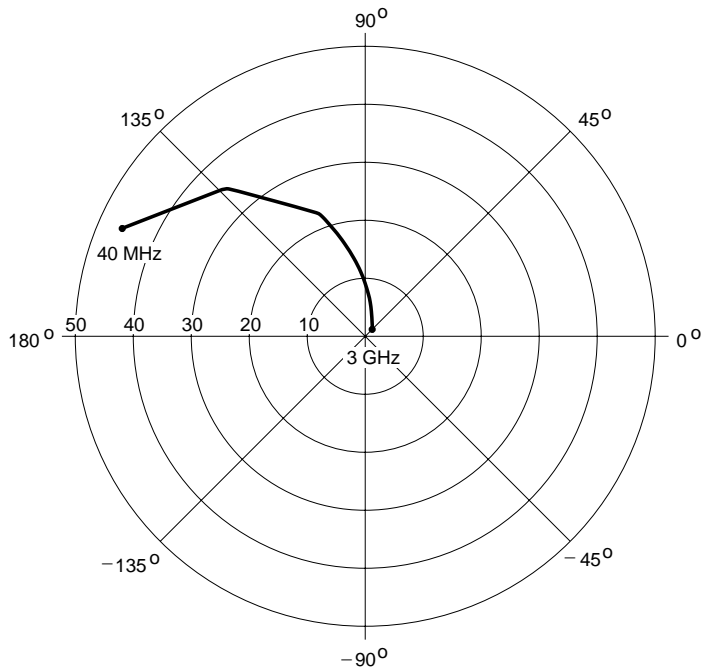
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$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; Z_o = 50\ \Omega.$

Fig.15 Common emitter input reflection coefficient ( $S_{11}$ ).



$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; R_{max} = 50\ \Omega.$

Fig.16 Common emitter forward transmission coefficient ( $S_{21}$ ).



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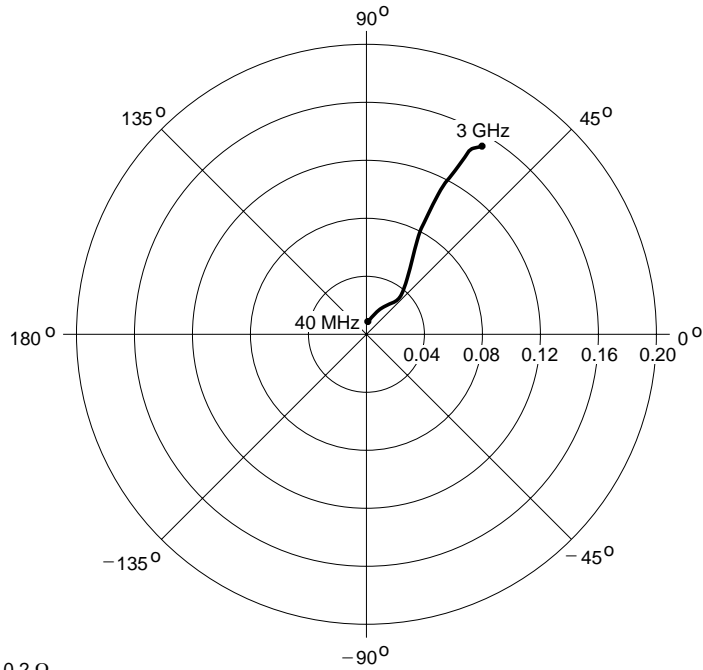
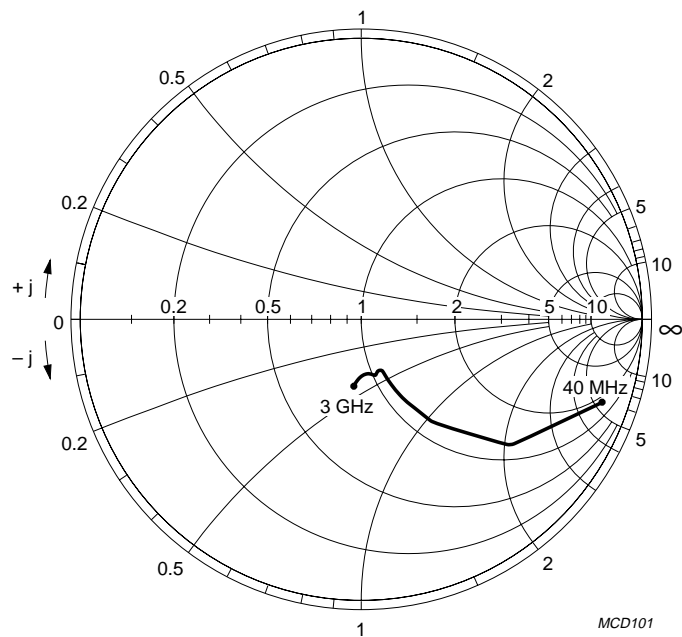


Fig.17 Common emitter reverse transmission coefficient ( $S_{12}$ ).



$V_{CE} = 10 \text{ V}; I_C = 15 \text{ mA}; Z_0 = 50 \Omega.$

Fig.18 Common emitter output reflection coefficient ( $S_{22}$ ).

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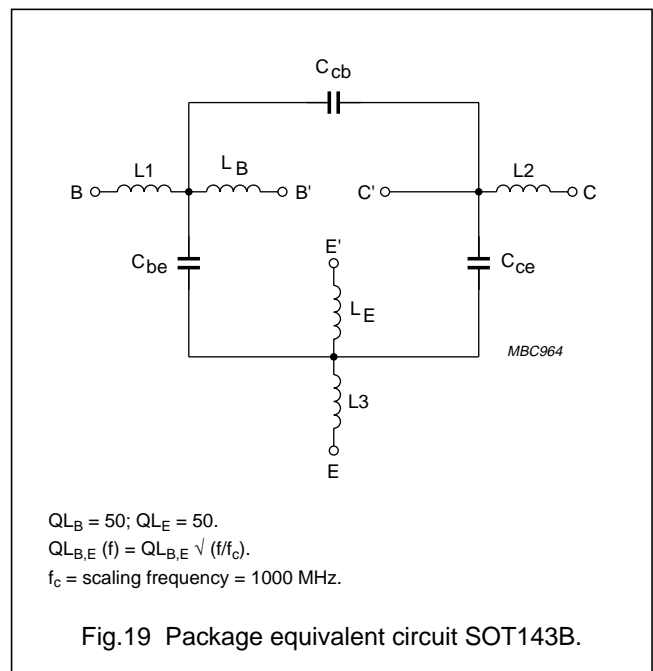
## SPICE parameters for BFR91A(X) die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.328	fA
2	BF	102.0	–
3	NF	1.000	–
4	VAF	51.90	V
5	IKF	8.155	A
6	ISE	13.90	fA
7	NE	15.12	–
8	BR	17.69	–
9	NR	994.0	m
10	VAR	3.280	V
11	IKR	10.00	A
12	ISC	1.043	aA
13	NC	1.189	–
14	RB	10.00	Ω
15	IRB	1.000	μA
16	RBM	10.00	Ω
17	RE	763.6	mΩ
18	RC	9.000	Ω
19 (note 1)	XTB	0.000	–
20 (note 1)	EG	1.110	EV
21 (note 1)	XTI	3.000	–
22	CJE	2.032	pF
23	VJE	600.0	mV
24	MJE	290.0	m
25	TF	6.557	ps
26	XTF	38.97	–
27	VTF	10.93	V
28	ITF	521.0	mA
29	PTF	0.000	deg
30	CJC	1.003	pF
31	VJC	340.8	mV
32	MJC	194.2	m
33	XCJC	120.0	m
34	TR	3.073	ns
35 (note 1)	CJS	0.000	F

SEQUENCE No.	PARAMETER	VALUE	UNIT
36 (note 1)	VJS	750.0	mV
37 (note 1)	MJS	0.000	–
38	FC	800.0	m

### Note

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



### List of components (see Fig.19)

DESIGNATION	VALUE	UNIT
$C_{be}$	84	fF
$C_{cb}$	17	fF
$C_{ce}$	191	fF
L1	0.12	nH
L2	0.21	nH
L3	0.06	nH
$L_B$	0.95	nH
$L_E$	0.40	nH

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PACKAGE OUTLINE

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

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### Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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
BFG93A_X_N_5	20071126	Product data sheet	-	BFG93A_X_4
Modifications:	<ul style="list-style-type: none"> <li>Marking table on page 2; changed code</li> </ul>			
BFG93A_X_4 (9397 750 04351)	19980923	Product specification	-	BFG93SERIES_3
BFG93SERIES_3	19950925	Product specification	-	BFG93SERIES_2
BFG93SERIES_2	-	Product specification	-	BFG93_SERIES_1
BFG93_SERIES_1	-	-	-	-

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