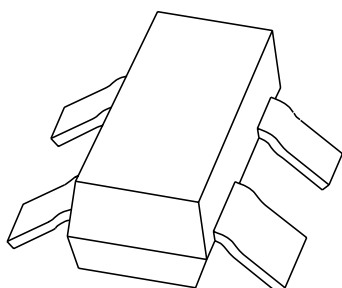


# DATA SHEET



## **BFG93A; BFG93A/X** NPN 6 GHz wideband transistors

Product specification  
Supersedes data of 1995 Sep 25

1998 Sep 23

# NPN 6 GHz wideband transistors

# BFG93A; BFG93A/X

### FEATURES

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

### APPLICATIONS

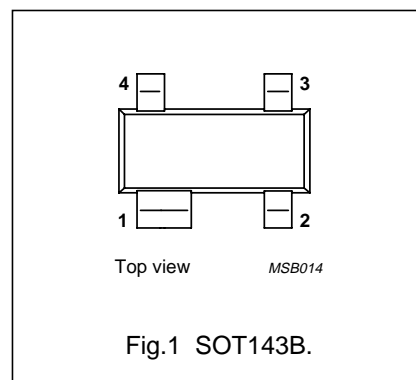
Wideband applications in the UHF and microwave range.

### 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	V15

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CB0}$	collector-base voltage	open emitter	–	–	15	V
$V_{CE0}$	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

## NPN 6 GHz wideband transistors

## BFG93A; BFG93A/X

## 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.

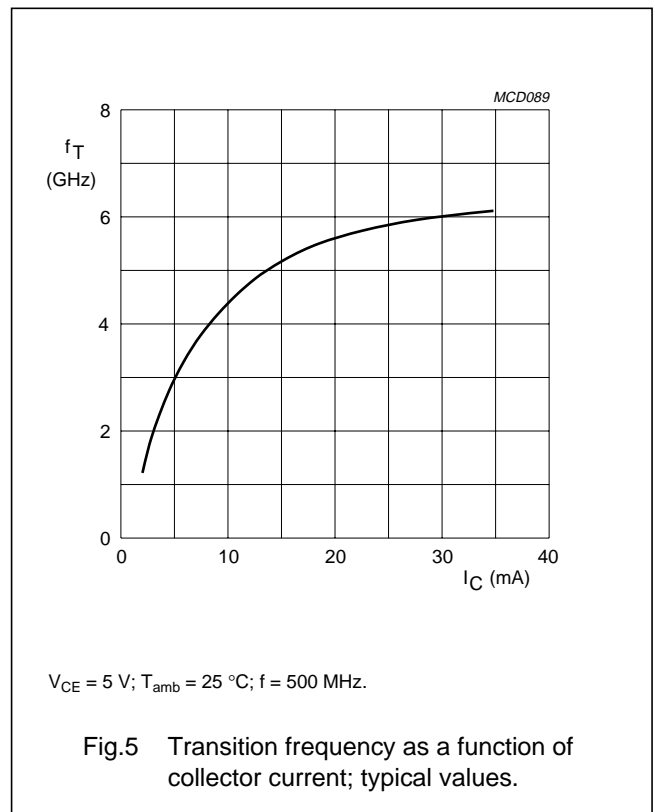
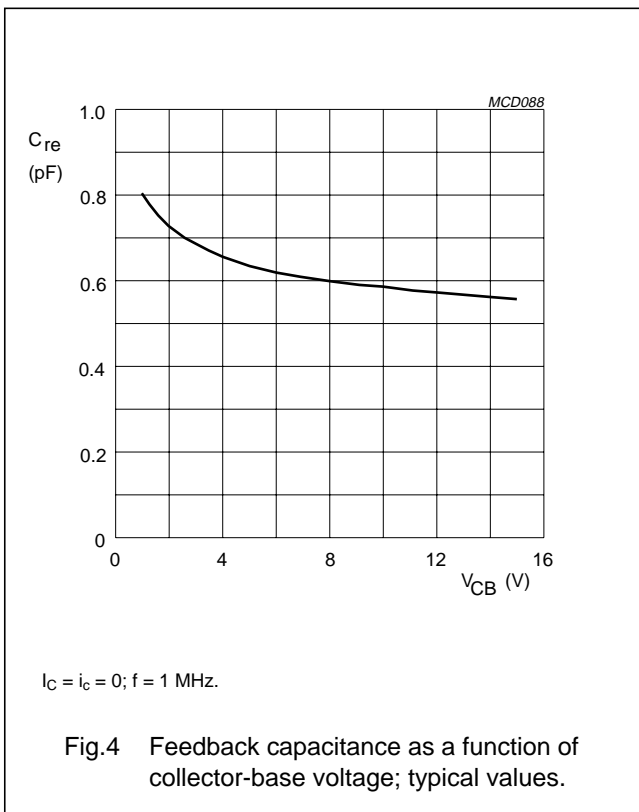
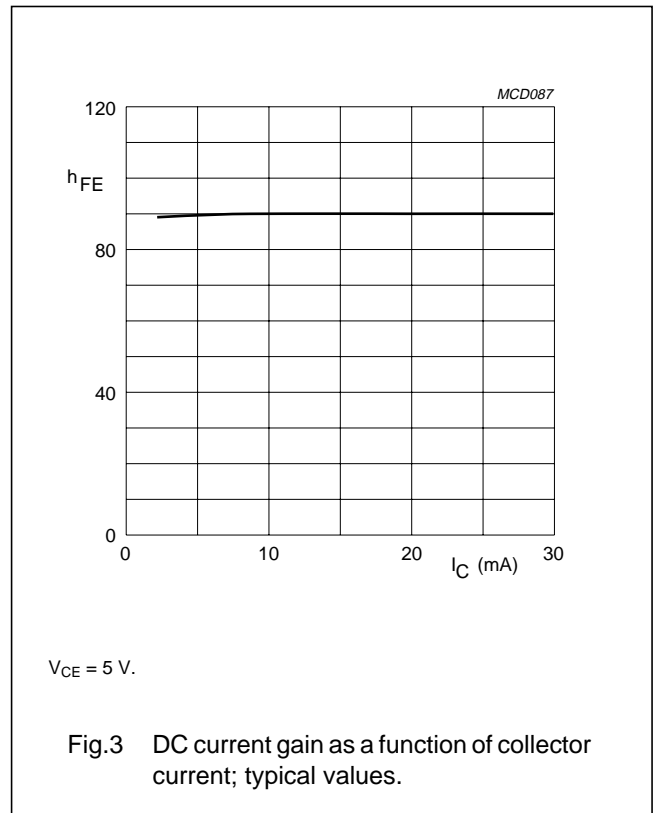
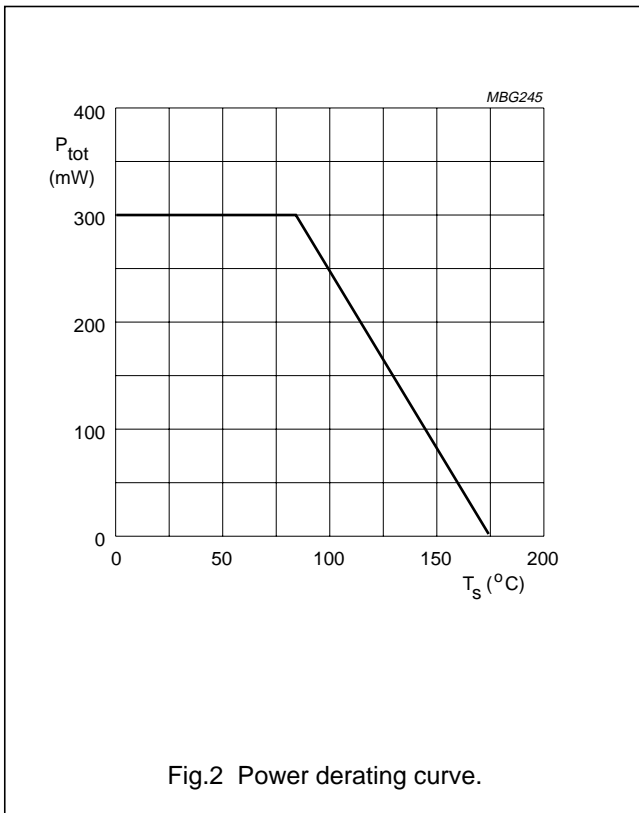
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I <sub>CBO</sub>	collector leakage current	I <sub>E</sub> = 0; V <sub>CB</sub> = 5 V	–	–	50	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 5 V	40	90	–	
C <sub>c</sub>	collector capacitance	I <sub>E</sub> = i <sub>e</sub> = 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.

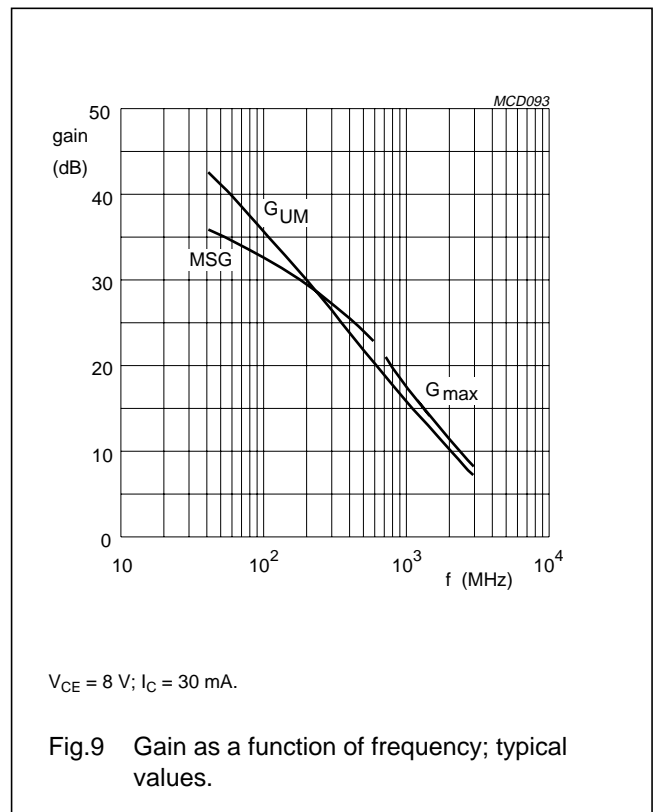
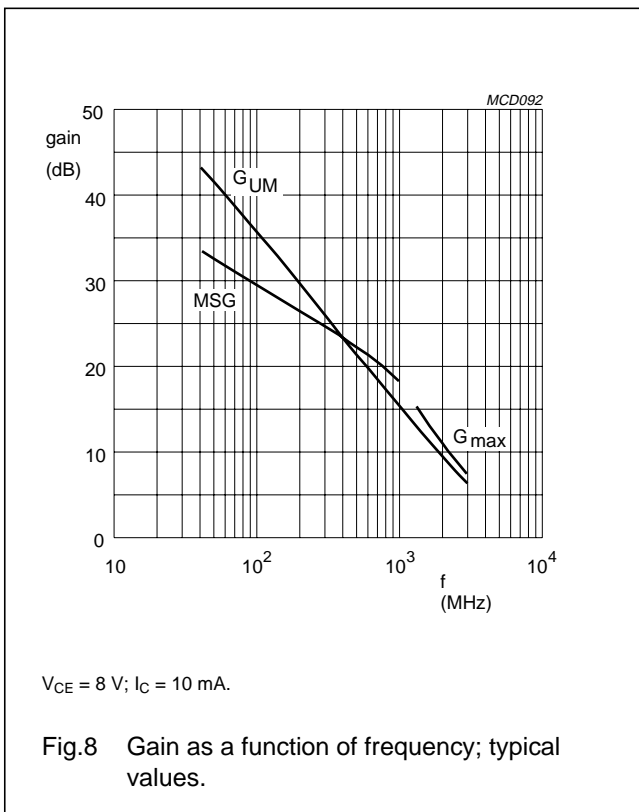
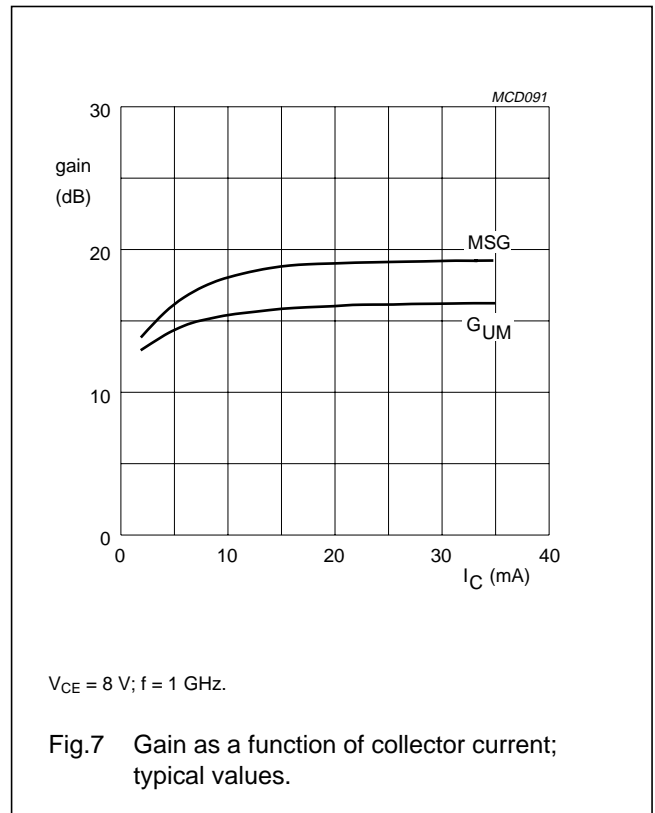
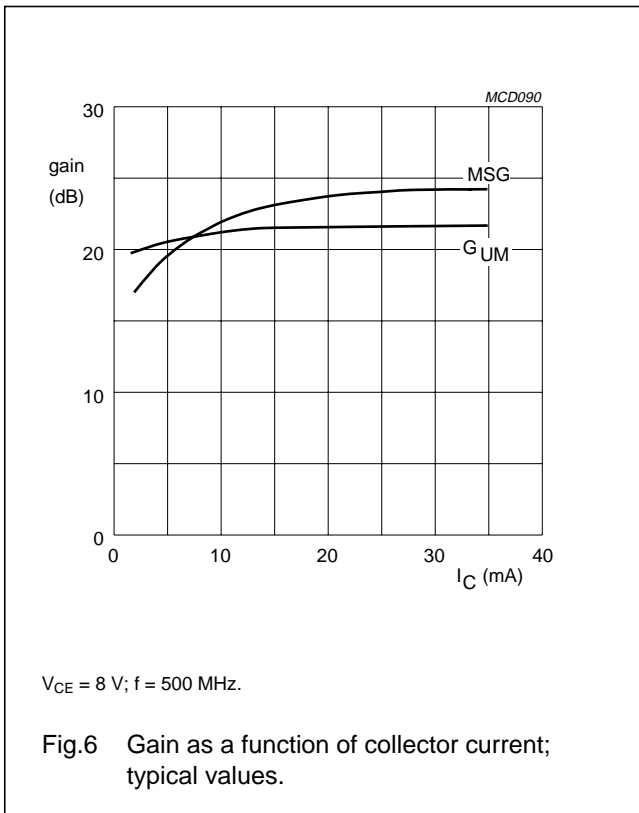
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BFG93A; BFG93A/X



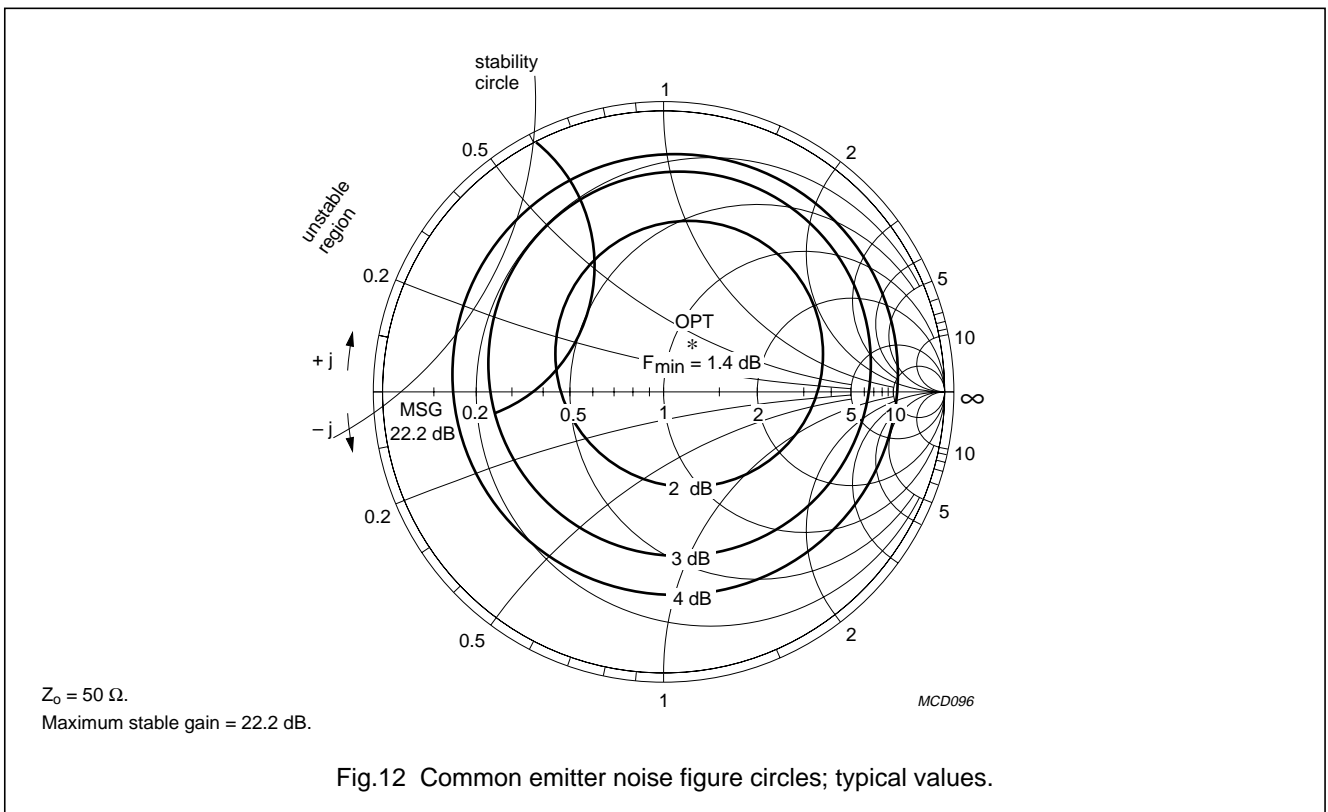
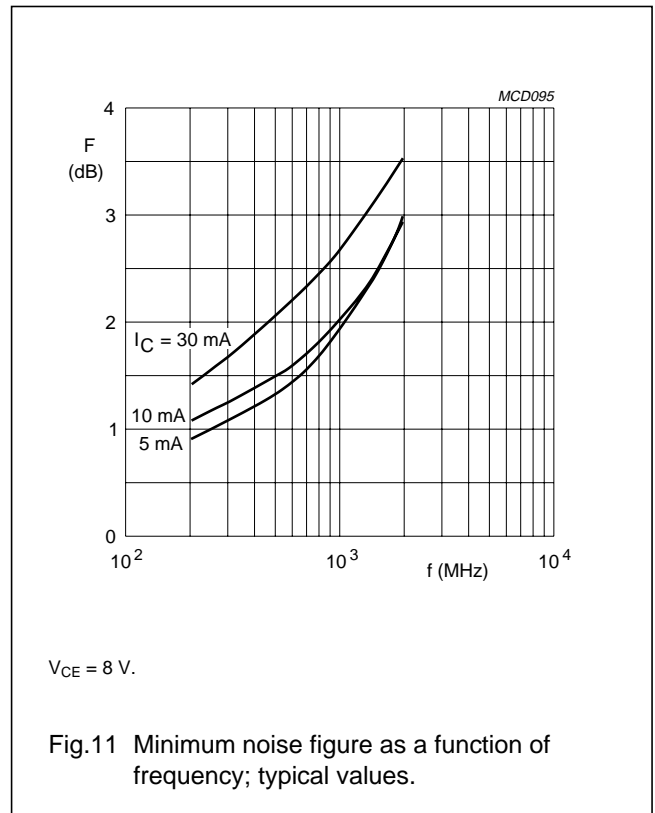
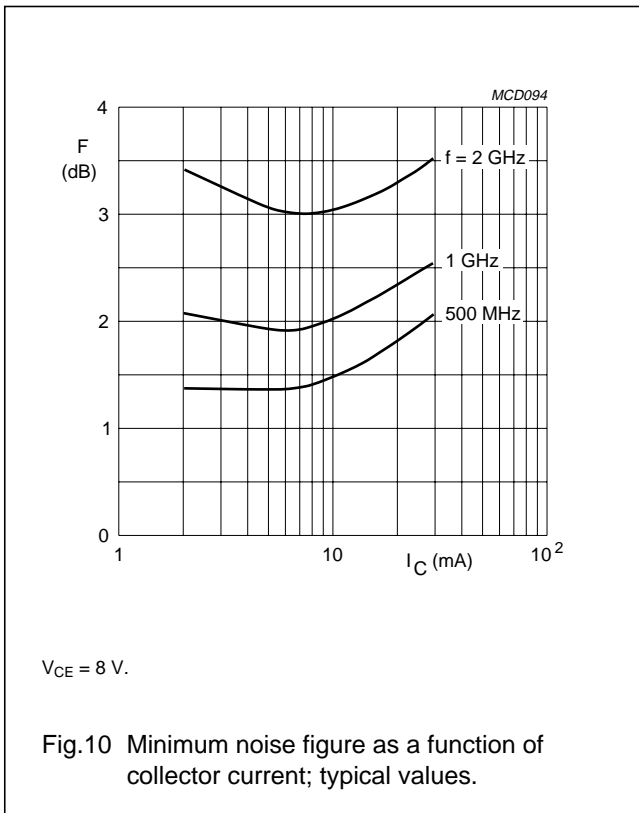
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



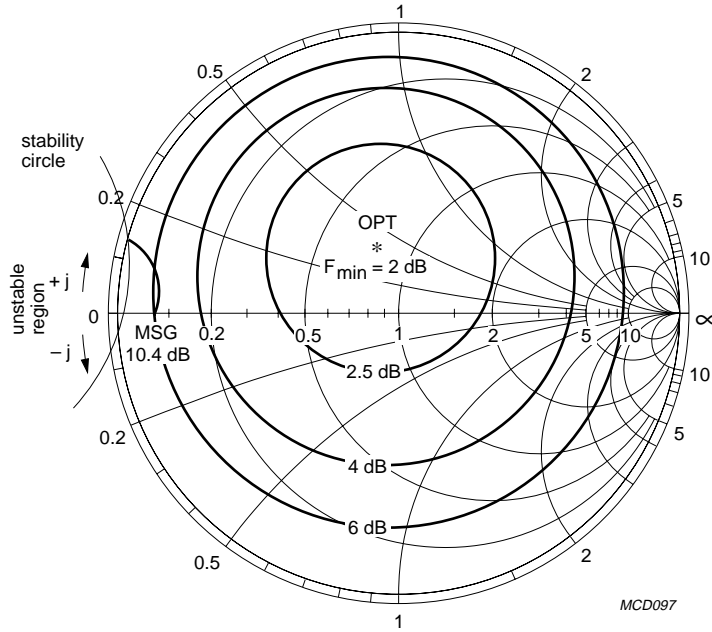
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



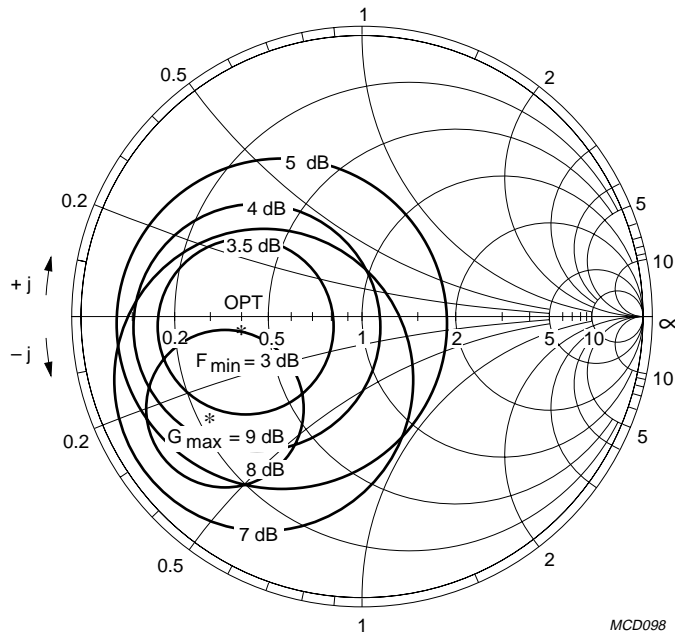
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



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

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

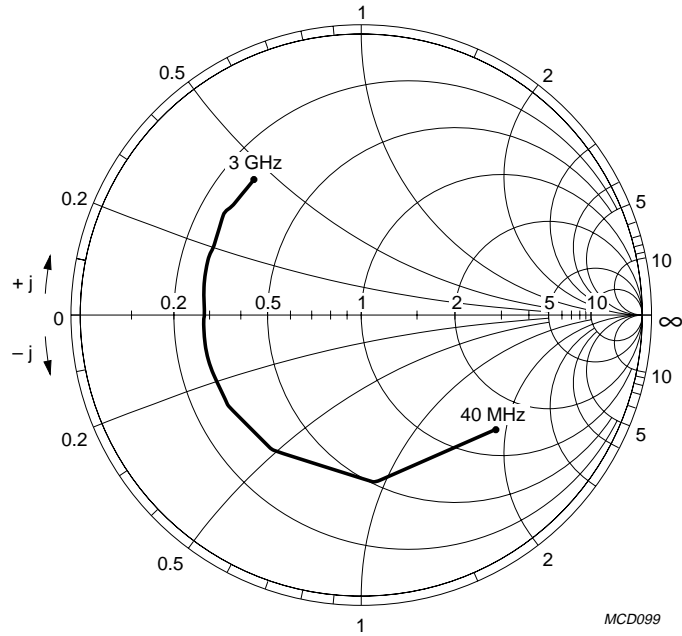


$Z_0 = 50 \Omega$ .

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

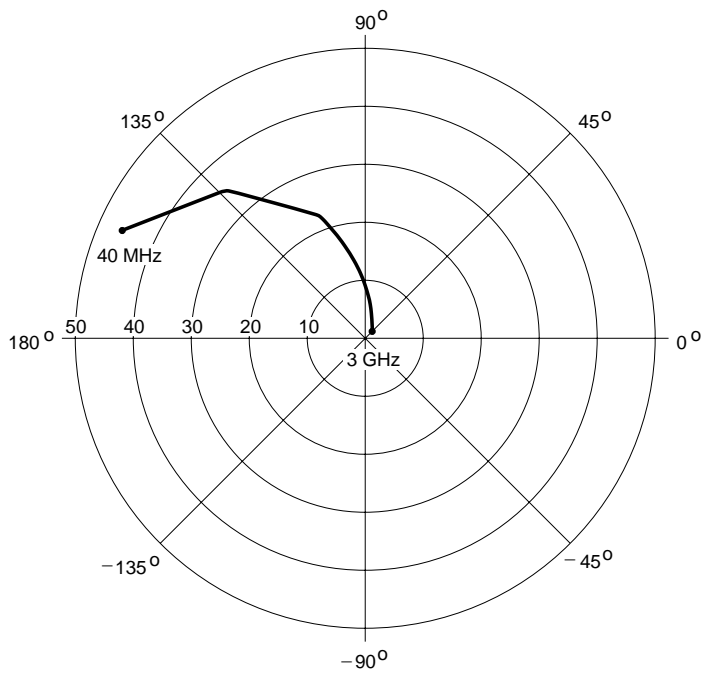
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



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

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 ( $S_{21}$ ).



NPN 6 GHz wideband transistors

BFG93A; BFG93A/X

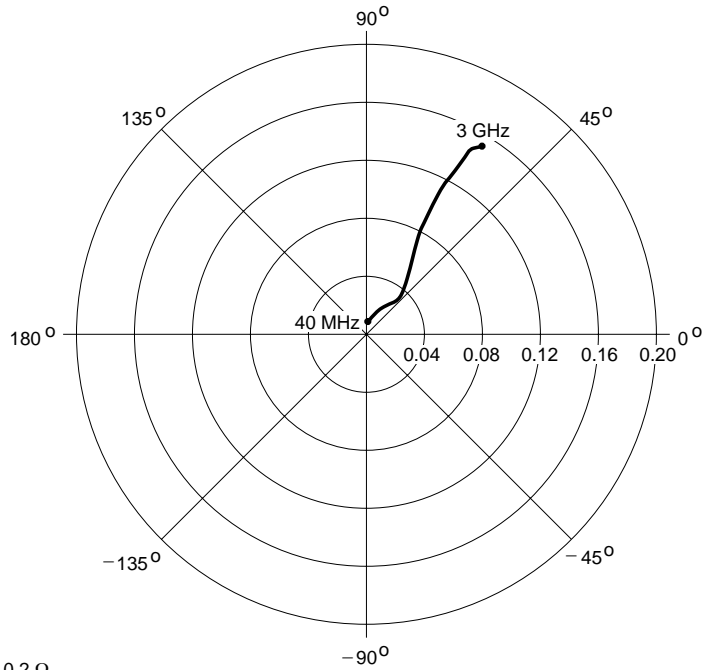


Fig.17 Common emitter reverse transmission coefficient ( $S_{12}$ ).

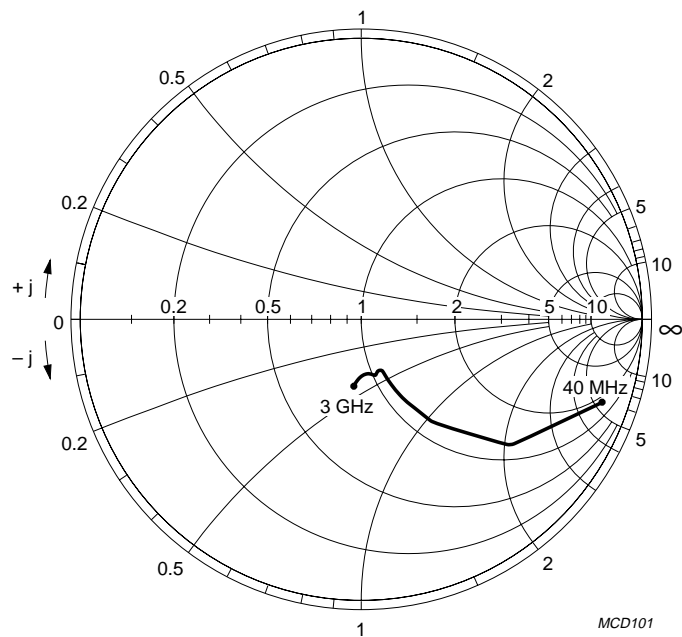


Fig.18 Common emitter output reflection coefficient ( $S_{22}$ ).

NPN 6 GHz wideband transistors

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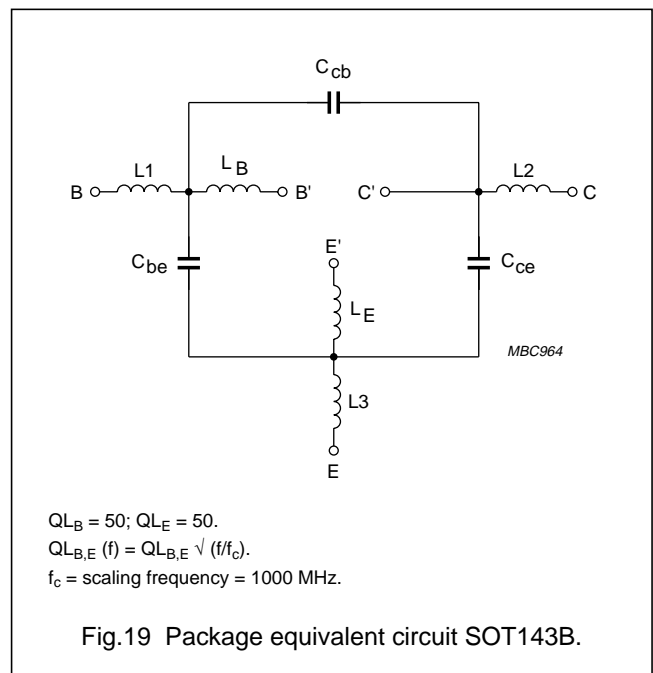
SPICE parameters for BFR91A(X) die

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

NPN 6 GHz wideband transistors

BFG93A; BFG93A/X

PACKAGE OUTLINES

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

## NPN 6 GHz wideband transistors

## BFG93A; BFG93A/X

**DEFINITIONS**

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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NPN 6 GHz wideband transistors

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**NOTES**

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**NOTES**

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**NOTES**

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