

# DATA SHEET

## **BFG93AW** **BFG93AW/X; BFG93AW/XR** NPN 7 GHz wideband transistor

Product specification  
File under Discrete Semiconductors, SC14

September 1994

**Philips Semiconductors**



**PHILIPS**

# NPN 7 GHz wideband transistor

# BFG93AW BFG93AW/X; BFG93AW/XR

## FEATURES

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

## APPLICATIONS

They are intended for wideband applications in the UHF and microwave ranges.

## DESCRIPTION

NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

## MARKING

TYPE NUMBER	CODE
BFG93AW	R8
BFG93AW/X	R9
BFG93AW/XR	R0

## PINNING

PIN	DESCRIPTION
<b>BFG93AW</b> (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
<b>BFG93AW/X</b> (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
<b>BFG93AW/XR</b> (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

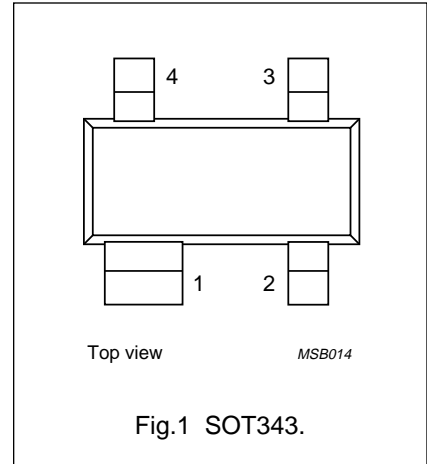


Fig.1 SOT343.

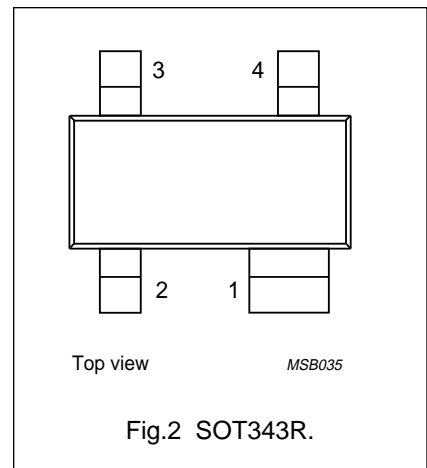


Fig.2 SOT343R.

## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	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	up to $T_s = 60\text{ °C}$	–	–	500	mW
$h_{FE}$	DC current gain	$I_C = 30\text{ mA}; V_{CE} = 5\text{ V}$	40	90	–	
$C_{re}$	feedback capacitance	$I_C = 0; V_{CE} = 5\text{ V}; f = 1\text{ MHz}$	–	0.6	–	pF
$f_T$	transition frequency	$I_C = 30\text{ mA}; V_{CE} = 5\text{ V}; f = 500\text{ MHz}; T_{amb} = 25\text{ °C}$	–	7	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; f = 1\text{ GHz}; T_{amb} = 25\text{ °C}$	–	14.5	–	dB
		$I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$	–	9	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; f = 1\text{ GHz}$	–	2	–	dB

## NPN 7 GHz wideband transistor

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

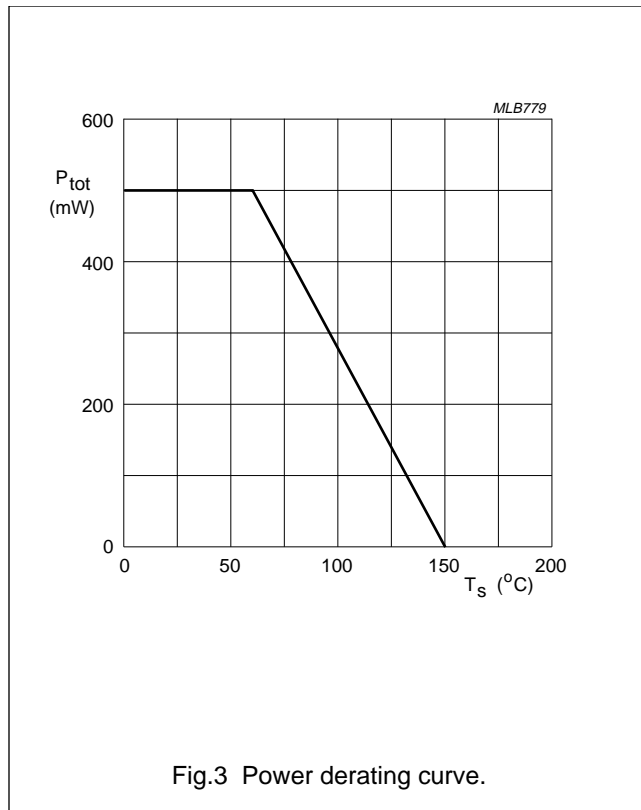
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CBO}$	collector-base voltage	open emitter	–	15	V
$V_{CEO}$	collector-emitter voltage	open base	–	12	V
$V_{EBO}$	emitter-base voltage	open collector	–	2	V
$I_C$	collector current (DC)		–	35	mA
$P_{tot}$	total power dissipation	up to $T_s = 60\text{ °C}$ ; see Fig.3; note 1	–	500	mW
$T_{stg}$	storage temperature		–65	+150	°C
$T_j$	junction temperature		–	150	°C

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	up to $T_s = 60\text{ °C}$ ; note 1	180	K/W

**Note to the “Limiting values” and “Thermal characteristics”**

- $T_s$  is the temperature at the soldering point of the collector pin.



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## CHARACTERISTICS

$T_j = 25\text{ °C}$  (unless otherwise specified).

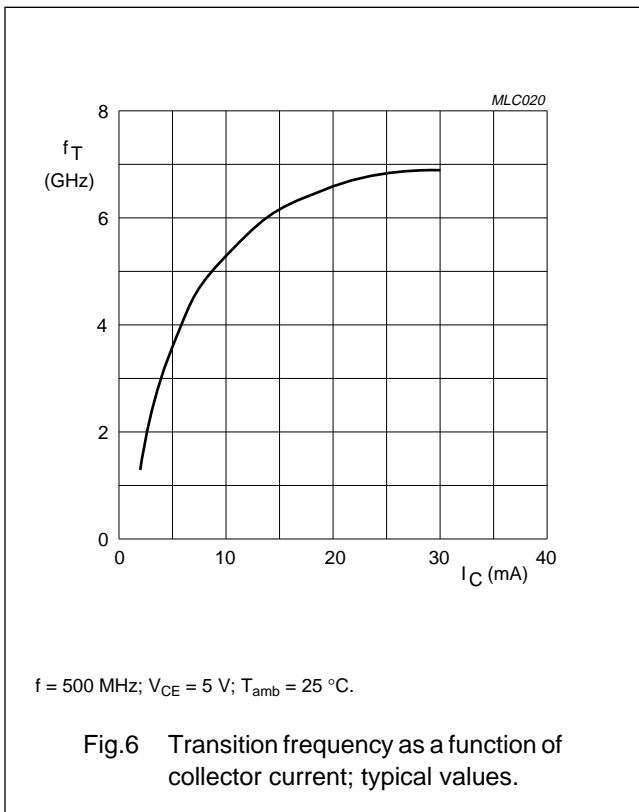
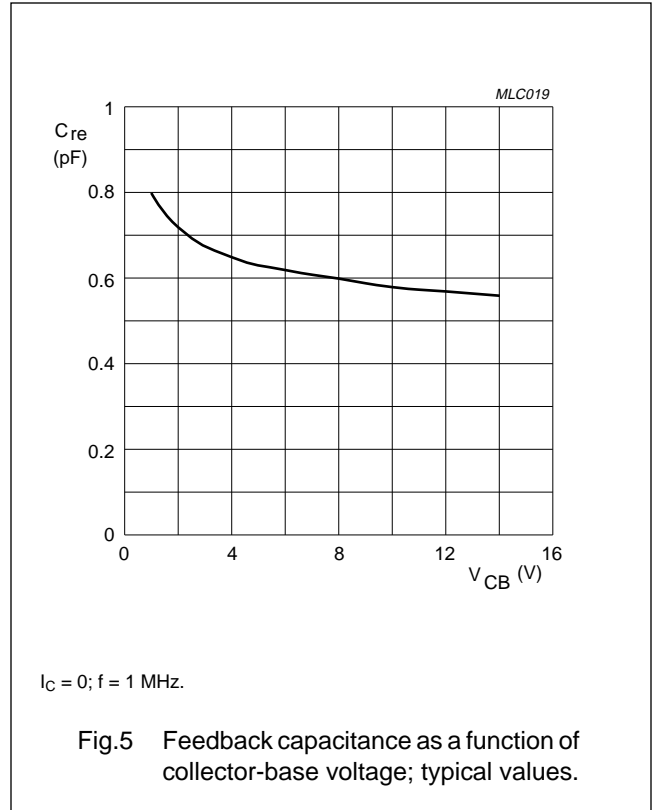
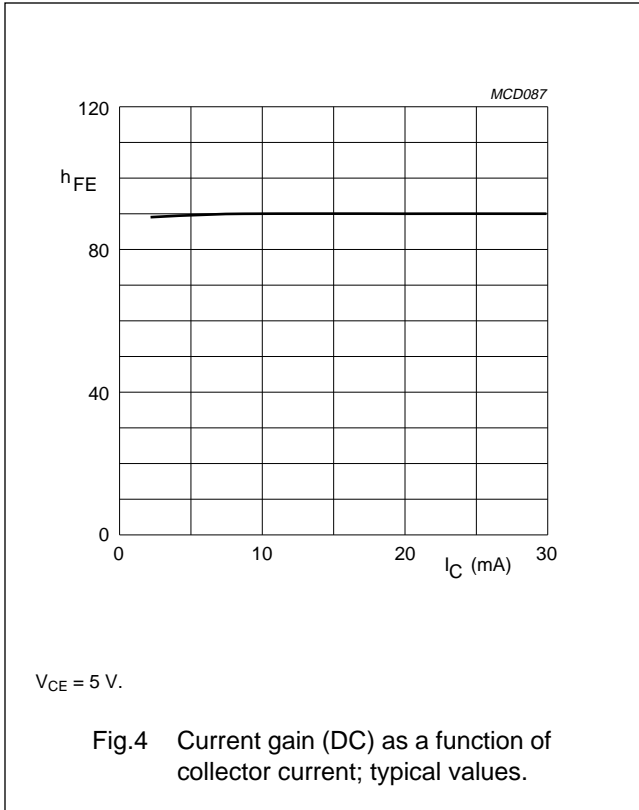
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 10\text{ }\mu\text{A}$ ; $I_E = 0$	–	–	15	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 10\text{ mA}$ ; $I_B = 0$	–	–	12	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 10\text{ }\mu\text{A}$ ; $I_C = 0$	–	–	2	V
$I_{CBO}$	collector cut-off current	open emitter; $V_{CB} = 5\text{ V}$ ; $I_E = 0$	–	–	50	nA
$h_{FE}$	DC current gain	$I_C = 30\text{ mA}$ ; $V_{CE} = 5\text{ V}$	40	90	–	
$f_T$	transition frequency	$I_C = 30\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	7	–	GHz
$C_C$	collector capacitance	$I_E = i_e = 0$ ; $V_{CE} = 5\text{ V}$ ; $f = 1\text{ MHz}$	–	0.9	–	pF
$C_e$	emitter capacitance	$I_C = i_c = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$	–	1.9	–	pF
$C_{re}$	feedback capacitance	$I_C = 0$ ; $V_{CE} = 5\text{ V}$ ; $f = 1\text{ MHz}$	–	0.6	–	pF
$G_{UM}$	maximum unilateral power gain; note 1	$I_C = 30\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	14.5	–	dB
		$I_C = 30\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$	–	2	–	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$	–	3	–	dB

## Note

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.

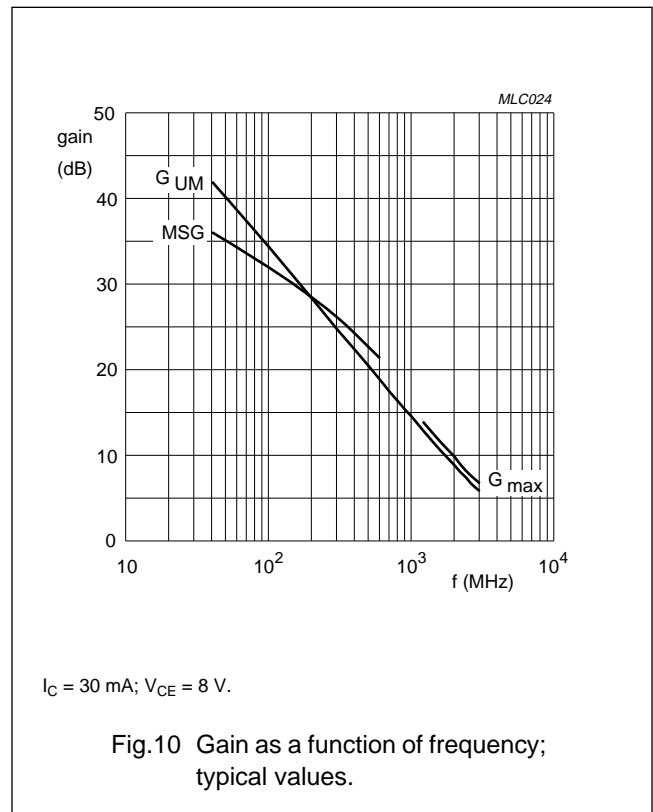
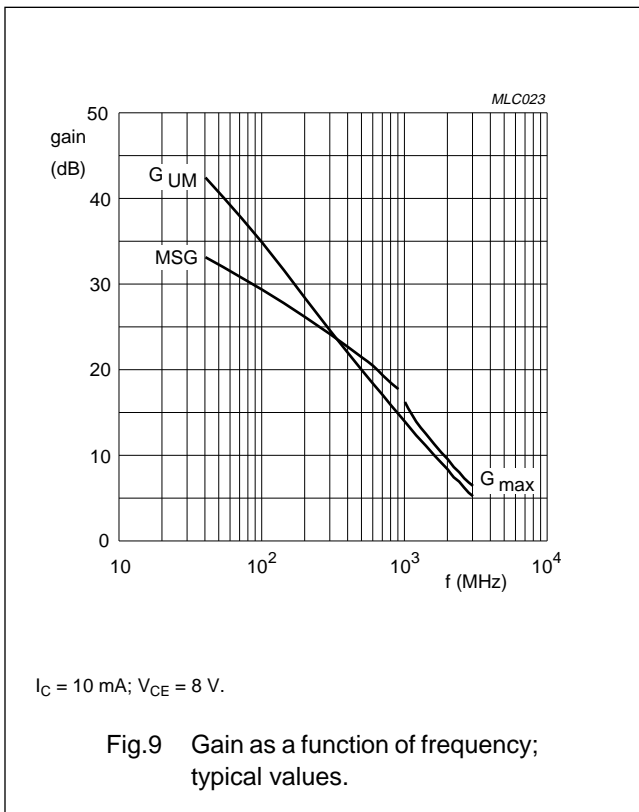
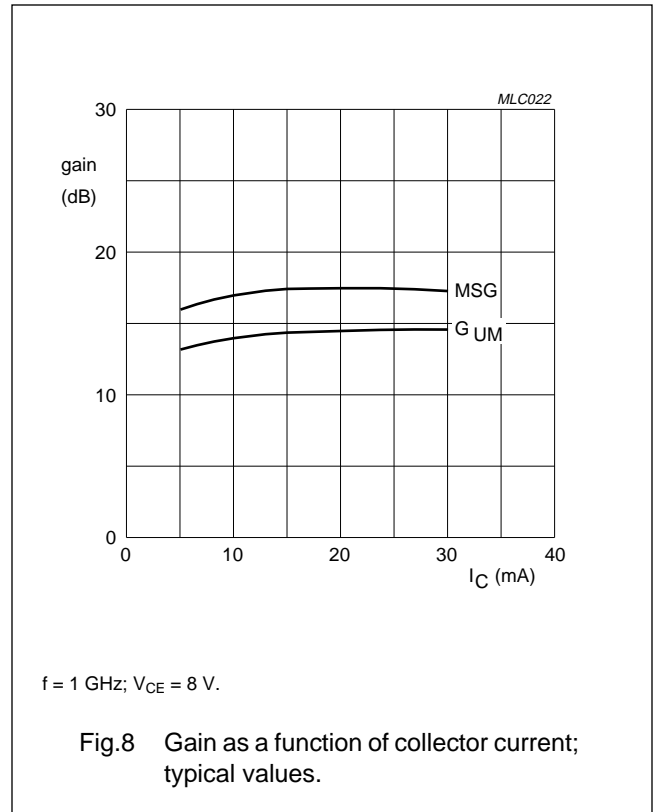
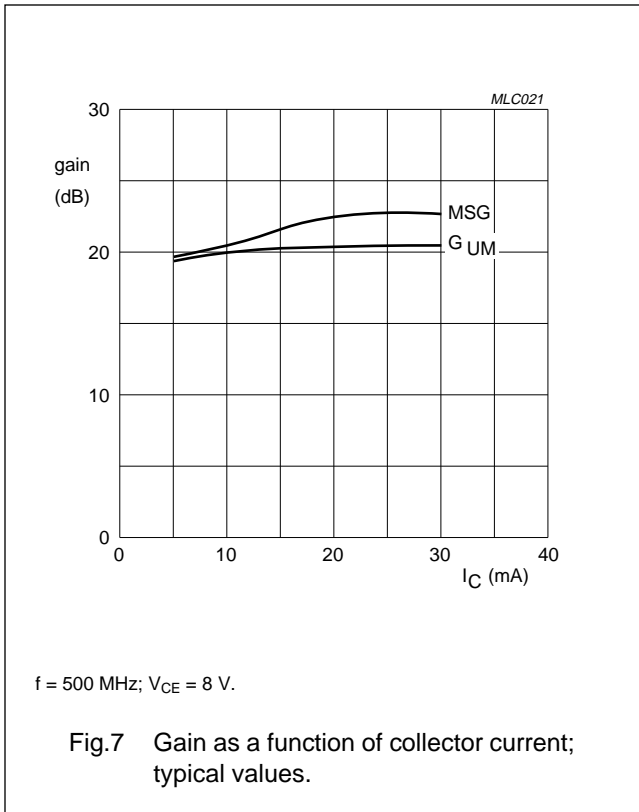
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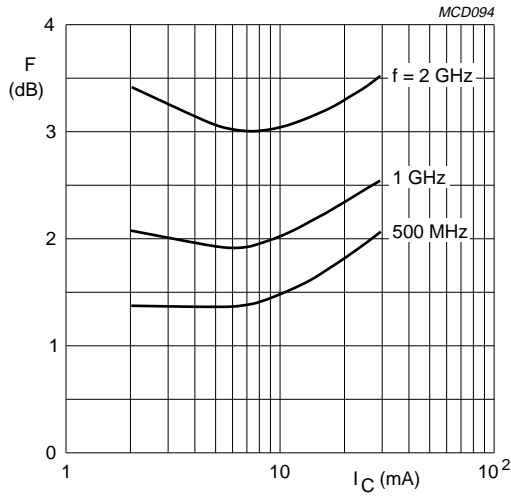
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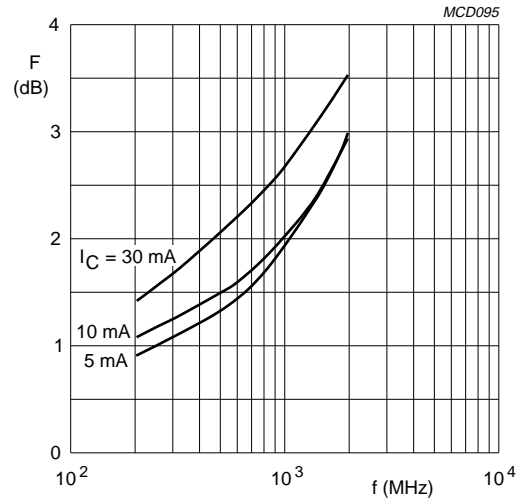
NPN 7 GHz wideband transistor

BFG93AW  
BFG93AW/X; BFG93AW/XR



$V_{CE} = 8 V.$

Fig.11 Minimum noise figure as a function of collector current; typical values.

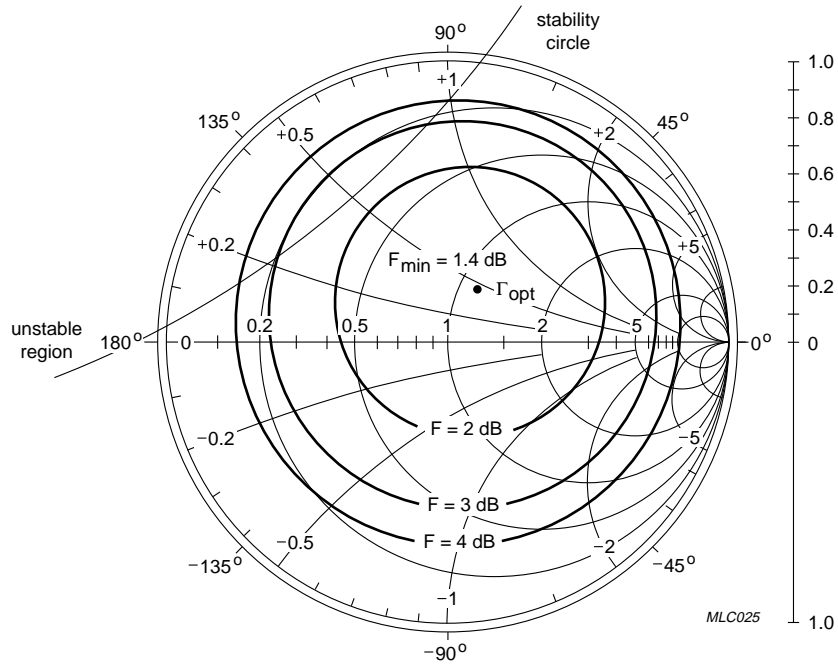


$V_{CE} = 8 V.$

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

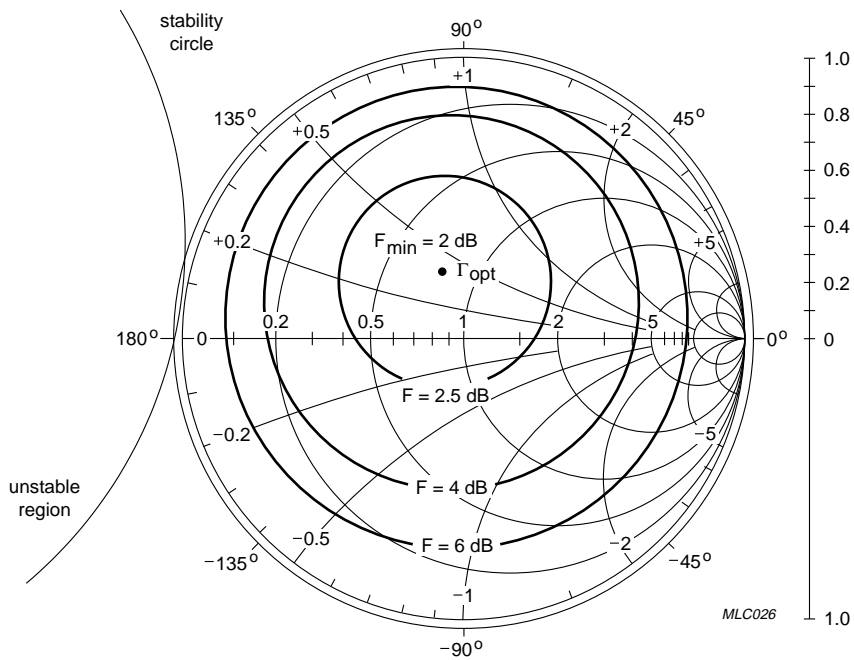
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f = 500 MHz; V<sub>CE</sub> = 8 V; I<sub>C</sub> = 10 mA; Z<sub>0</sub> = 50 Ω.

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



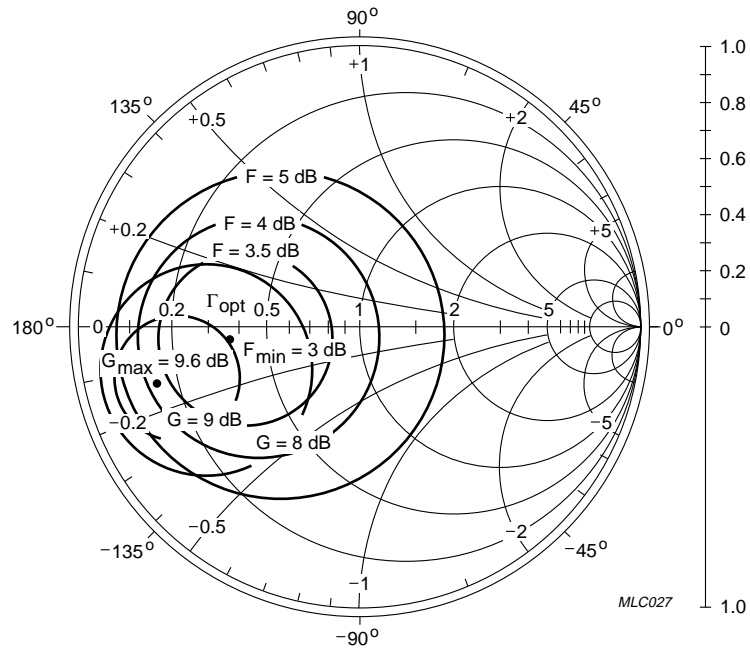
f = 1 GHz; V<sub>CE</sub> = 8 V; I<sub>C</sub> = 10 mA; Z<sub>0</sub> = 50 Ω.

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



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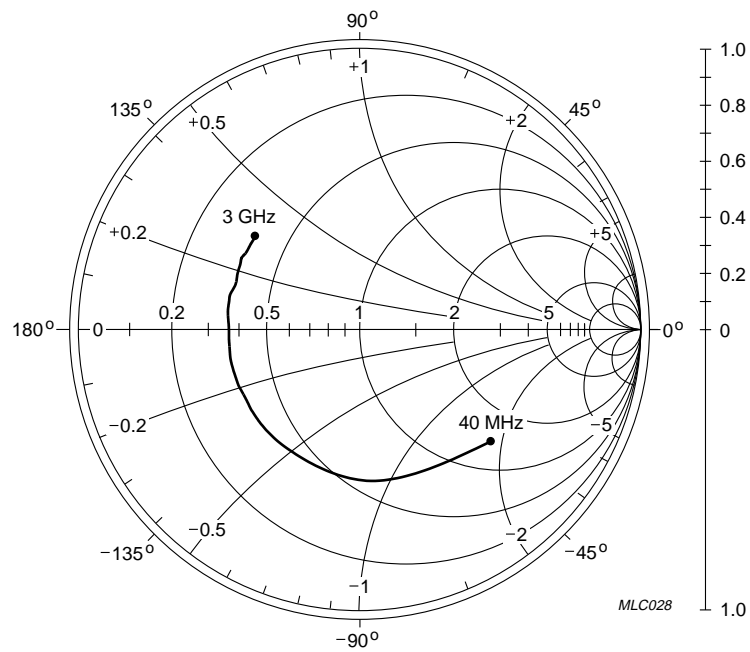


$f = 2 \text{ GHz}; V_{CE} = 8 \text{ V}; I_C = 10 \text{ mA}; Z_0 = 50 \Omega.$

Fig.15 Common emitter noise figure circles; typical values.

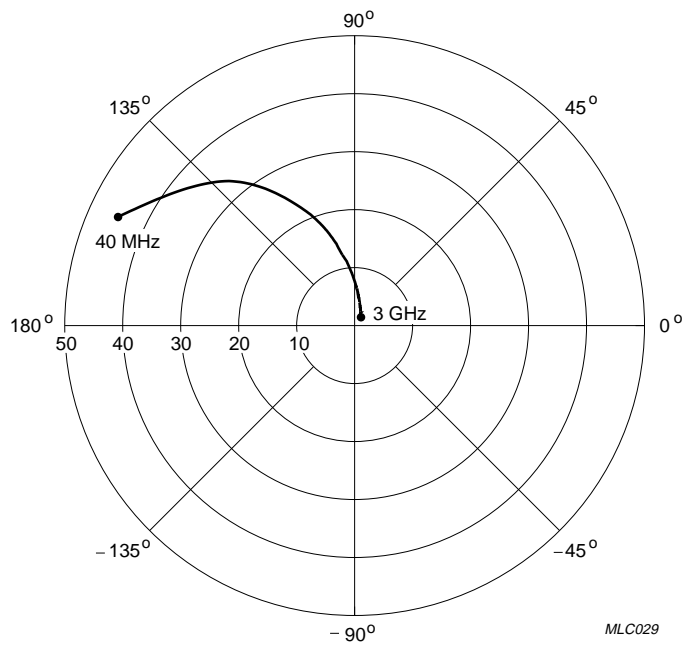
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$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; Z_o = 50\ \Omega.$

Fig.16 Common emitter input reflection coefficient ( $s_{11}$ ); typical values.

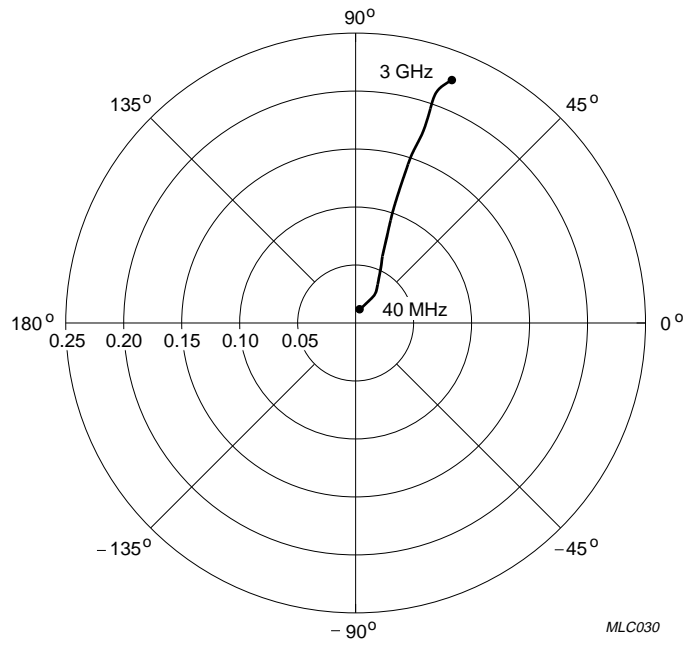


$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}.$

Fig.17 Common emitter forward transmission coefficient ( $s_{21}$ ); typical values.

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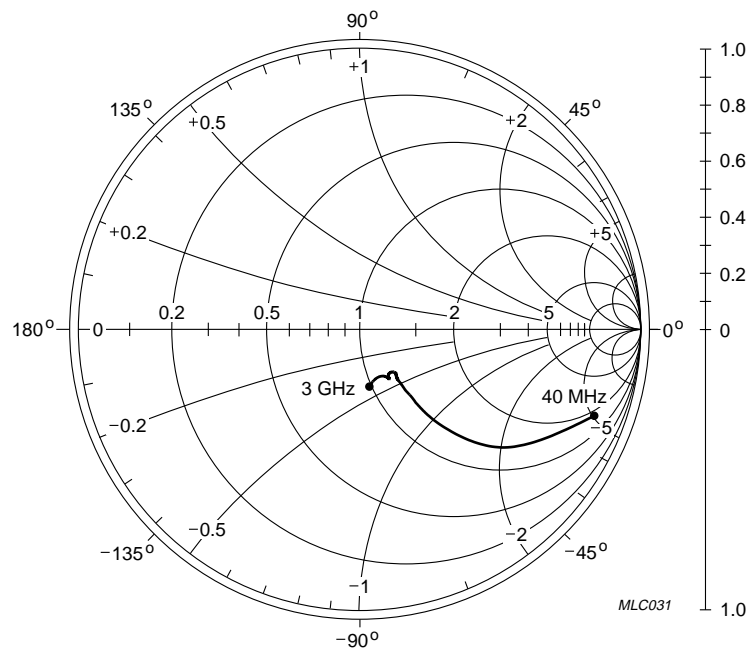
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$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}$ .

MLC030

Fig.18 Common emitter reverse transmission coefficient ( $s_{12}$ ); typical values.



$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; Z_0 = 50\ \Omega$ .

MLC031

Fig.19 Common emitter output reflection coefficient ( $s_{22}$ ); typical values.

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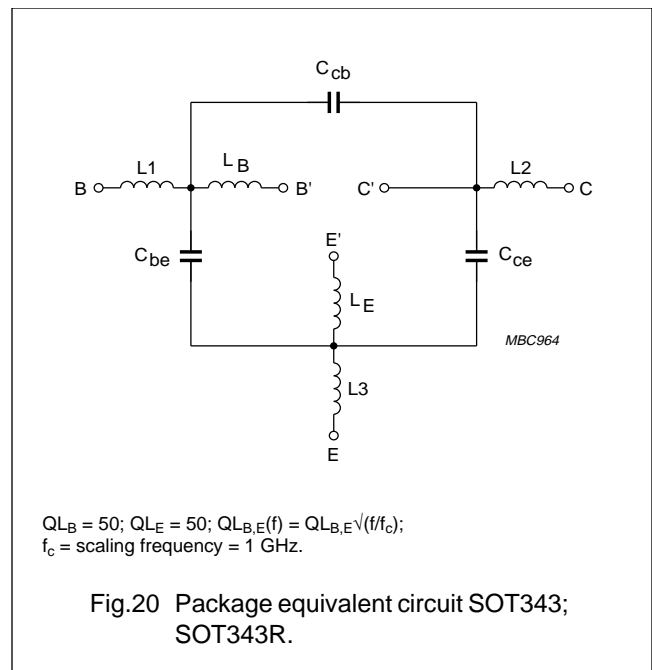
## SPICE parameters for the BFG93AW crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	411.8	aA
2	BF	102.6	–
3	NF	0.997	–
4	VAF	62.67	V
5	IKF	3.200	A
6	ISE	4.010	fA
7	NE	1.577	–
8	BR	18.10	–
9	NR	0.996	–
10	VAR	3.369	V
11	IKR	1.281	A
12	ISC	279.9	aA
13	NC	1.075	–
14	RB	10.00	$\Omega$
15	IRB	1.000	$\mu$ A
16	RBM	10.00	$\Omega$
17	RE	1.164	$\Omega$
18	RC	2.320	$\Omega$
19 <sup>(1)</sup>	XTB	0.000	–
20 <sup>(1)</sup>	EG	1.110	eV
21 <sup>(1)</sup>	XTI	3.000	–
22	CJE	890.5	fF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	15.49	ps
26	XTF	39.14	–
27	VTF	2.152	V
28	ITF	213.7	mA
29	PTF	0.000	deg
30	CJC	546.5	fF
31	VJC	380.8	mV
32	MJC	0.202	–
33	XCJC	0.150	–
34	TR	5.618	ns
35 <sup>(1)</sup>	CJS	0.000	F

SEQUENCE No.	PARAMETER	VALUE	UNIT
36 <sup>(1)</sup>	VJS	750.0	mV
37 <sup>(1)</sup>	MJS	0.000	–
38	FC	0.850	–

## Note

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



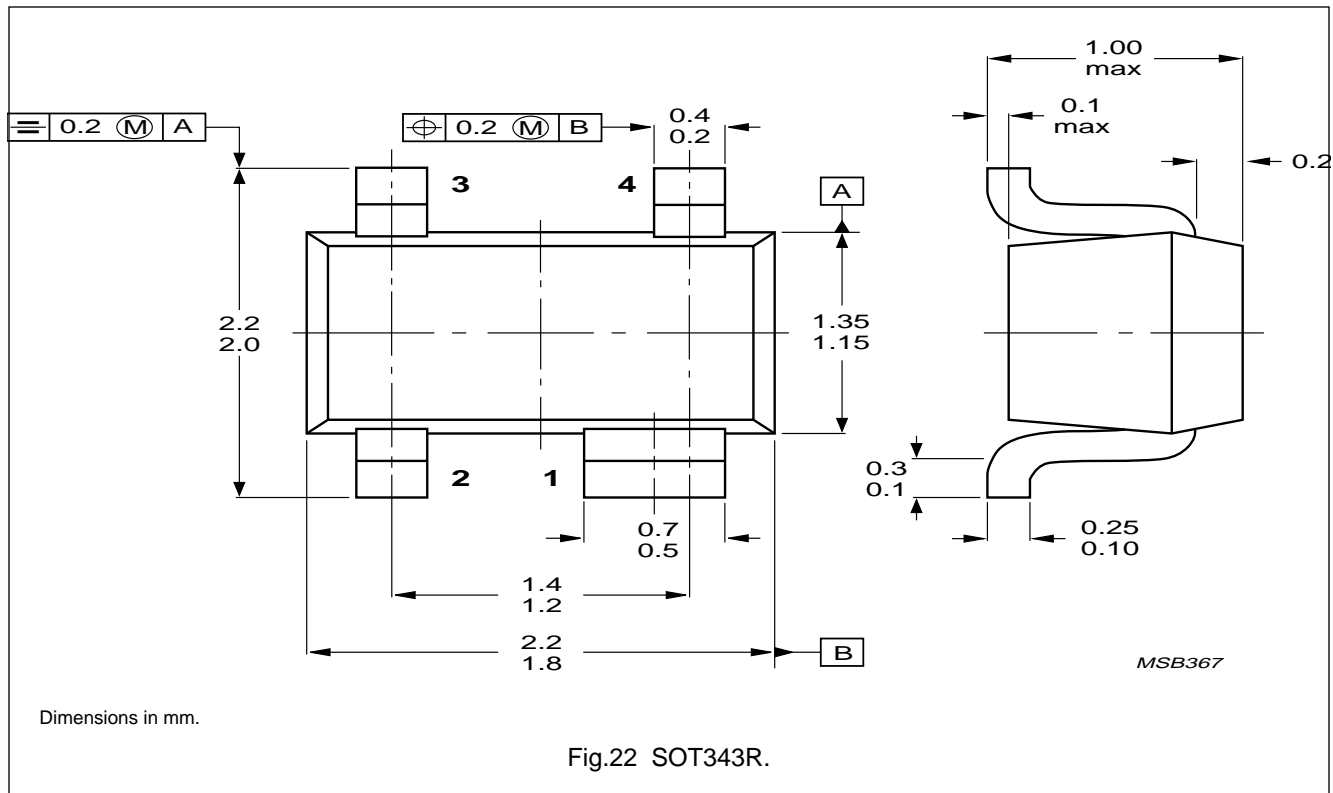
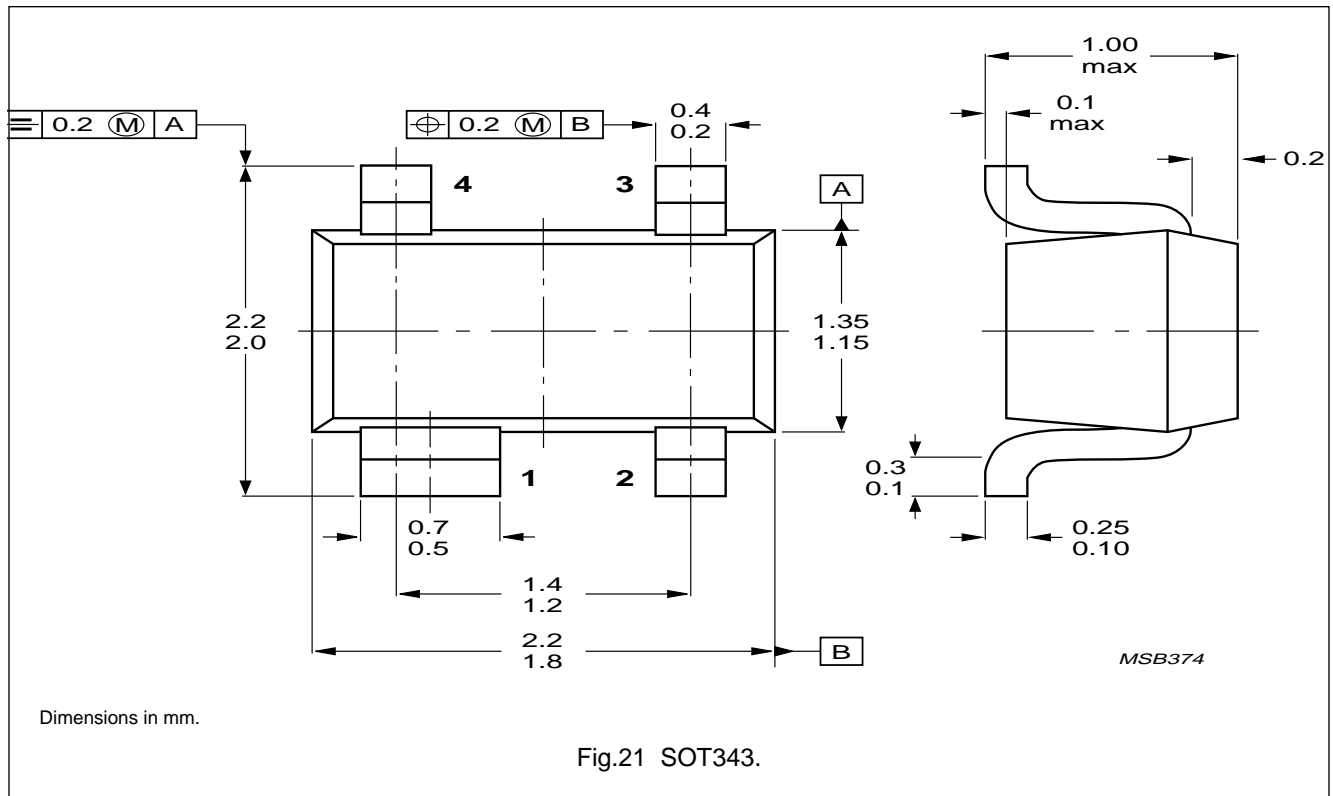
## List of components (see Fig.20)

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

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PACKAGE OUTLINES



## NPN 7 GHz wideband transistor

BFG93AW  
BFG93AW/X; BFG93AW/XR**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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These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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