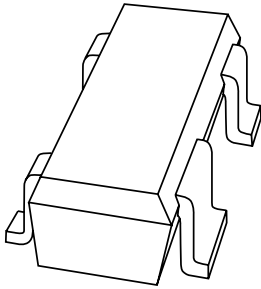


# DATA SHEET



## **BFG520W; BFG520W/X** NPN 9 GHz wideband transistors

Product specification  
Supersedes data of August 1995

1998 Oct 02

# 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	
	BFG250W	BFG250W/X
1	collector	collector
2	base	emitter
3	emitter	base
4	emitter	emitter

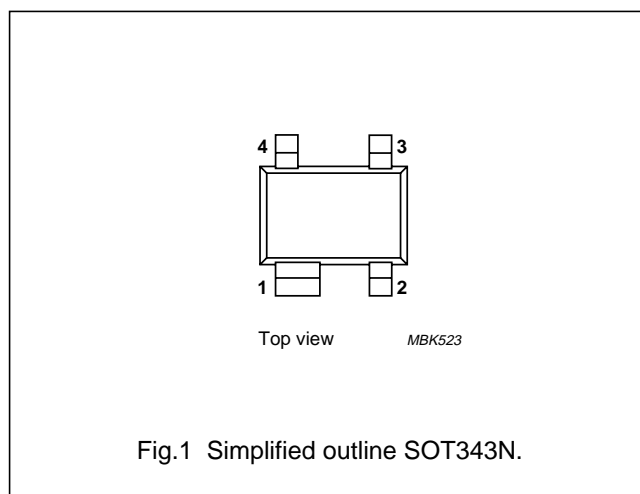


Fig.1 Simplified outline SOT343N.

## 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	$T_s \leq 85\text{ °C}$	–	–	500	mW
$h_{FE}$	DC current gain	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$	–	0.35	–	pF
$f_T$	transition frequency	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz}; T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$	–	17	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}$	–	1.1	1.6	dB

NPN 9 GHz wideband transistors

BFG520W; BFG520W/X

**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	$T_s \leq 85\text{ °C}$ ; see Fig.2; note 1	–	500	mW
$T_{stg}$	storage temperature		–65	+150	°C
$T_j$	junction temperature		–	175	°C

**Note**

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

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$T_s \leq 85\text{ °C}$ ; note 1	180	K/W

**Note**

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

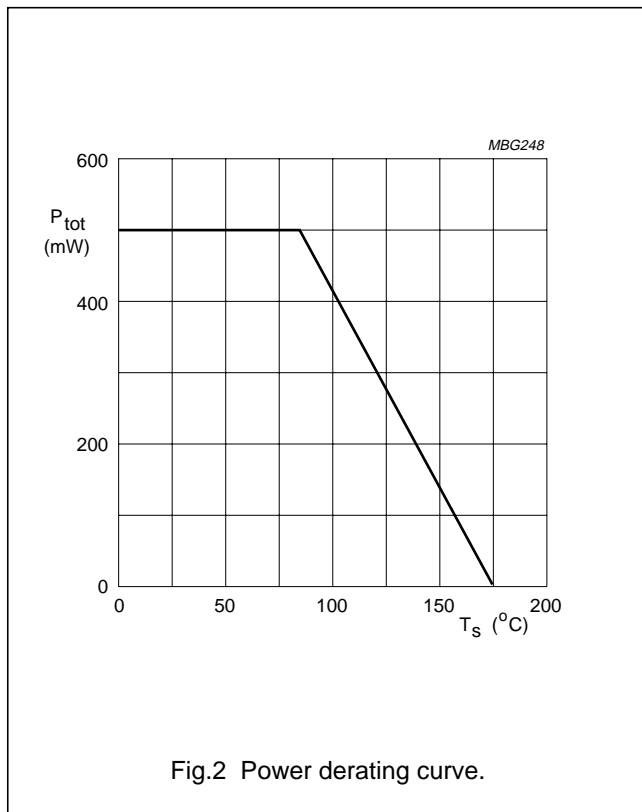


Fig.2 Power derating curve.

## NPN 9 GHz wideband transistors

## BFG520W; BFG520W/X

## CHARACTERISTICS

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

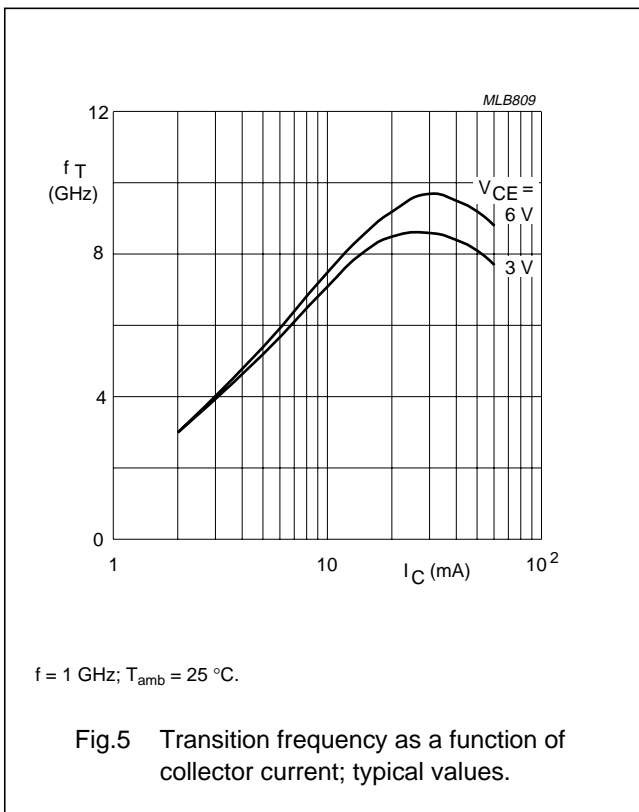
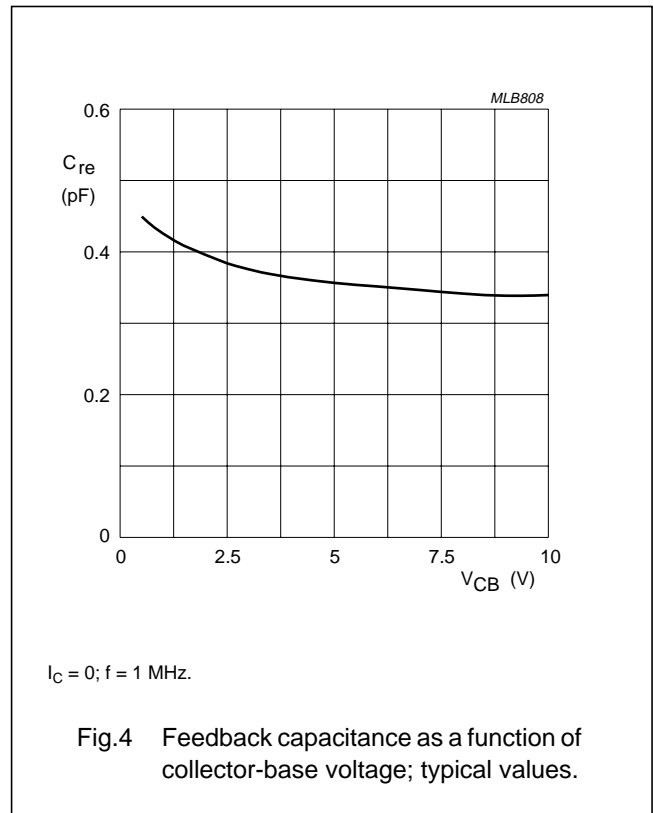
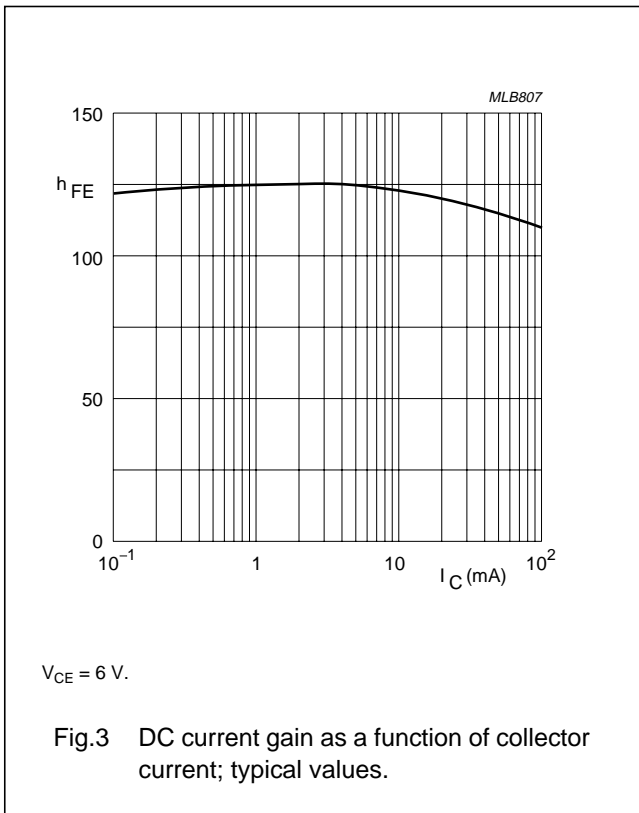
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 10\ \mu\text{A}; I_E = 0$	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10\ \mu\text{A}; R_{BE} = 0$	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 10\ \mu\text{A}; I_C = 0$	2.5	–	–	V
$I_{CBO}$	collector leakage current	$V_{CB} = 6\ \text{V}; I_E = 0$	–	–	50	nA
$h_{FE}$	DC current gain	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V};$ see Fig.3	60	120	250	
$C_{re}$	feedback capacitance	$I_C = 0; V_{CB} = 6\ \text{V}; f = 1\ \text{MHz};$ see Fig.4	–	0.35	–	pF
$f_T$	transition frequency	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 1\ \text{GHz};$ $T_{amb} = 25\text{ °C};$ see Fig.5	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain; note 1	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $T_{amb} = 25\text{ °C}$	–	17	–	dB
		$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 2\ \text{GHz};$ $T_{amb} = 25\text{ °C}$	–	11	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $T_{amb} = 25\text{ °C}$	16	17	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 900\ \text{MHz}$	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}; I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 900\ \text{MHz}$	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 2\ \text{GHz}$	–	1.85	–	dB
$PL_1$	output power at 1 dB gain compression	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $R_L = 50\ \Omega; T_{amb} = 25\text{ °C}$	–	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

- $G_{UM}$  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.
- $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; R_L = 50\ \Omega; T_{amb} = 25\text{ °C};$   
 $f_p = 900\ \text{MHz}; f_q = 902\ \text{MHz};$  measured at  $2f_p - f_q = 898\ \text{MHz}$  and  $2f_q - f_p = 904\ \text{MHz}.$
- $d_{im} = -60\ \text{dB}$  (DIN45004B);  $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; V_p = V_o; V_q = V_o - 6\ \text{dB}; V_r = V_o - 6\ \text{dB}; R_L = 75\ \Omega;$   
 $f_p = 795.25\ \text{MHz}; f_q = 803.25\ \text{MHz}; f_r = 805.25\ \text{MHz};$  measured at  $f_p + f_q - f_r = 793.25\ \text{MHz}.$
- $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; V_o = 75\ \text{mV}; R_L = 75\ \Omega; T_{amb} = 25\text{ °C};$   
 $f_p = 250\ \text{MHz}; f_q = 560\ \text{MHz};$  measured at  $f_p + f_q = 810\ \text{MHz}.$

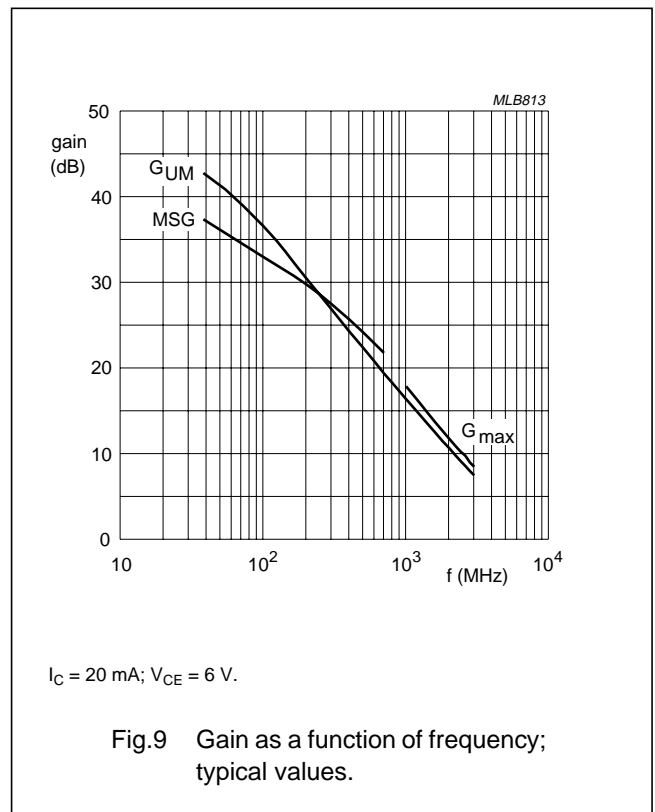
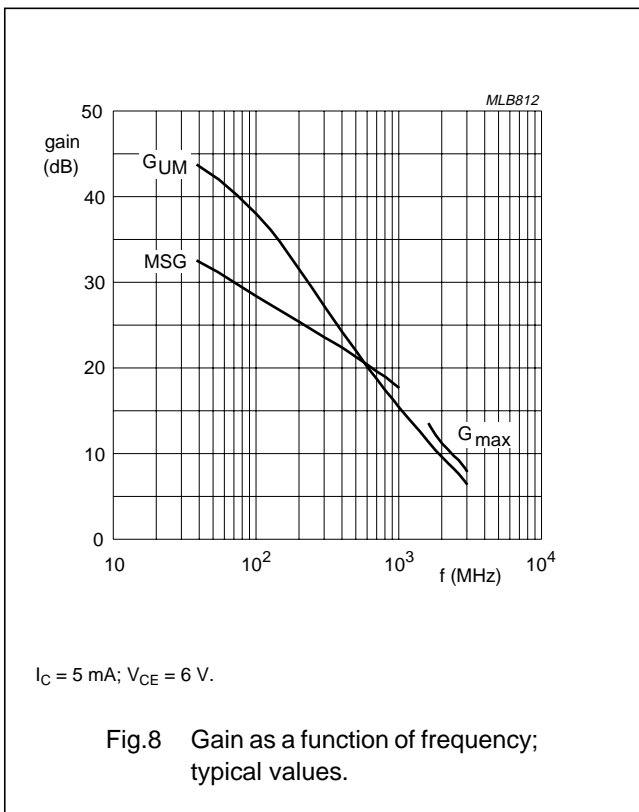
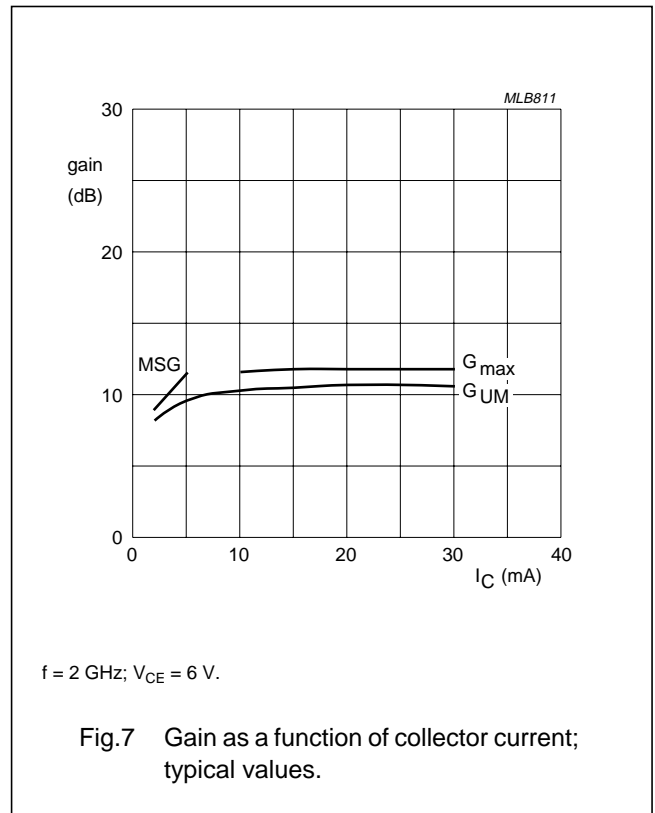
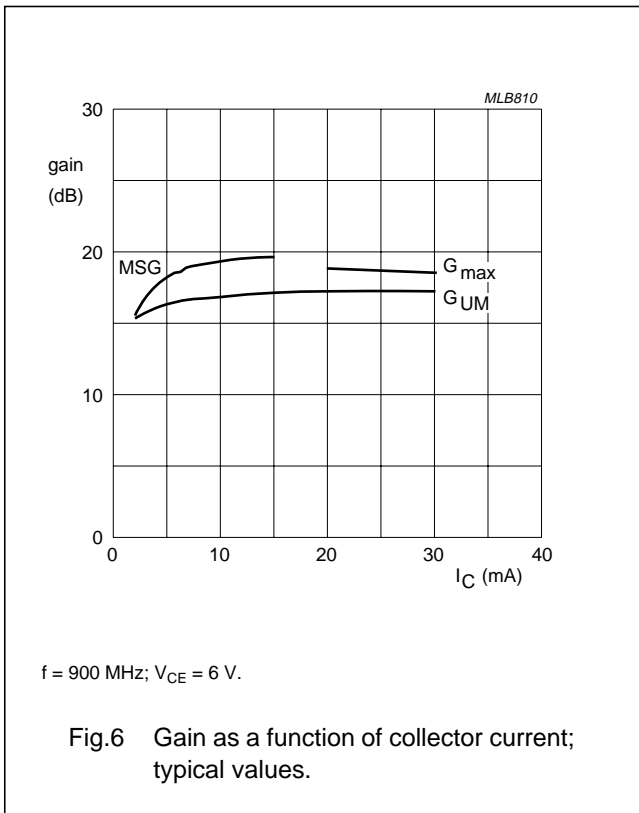
NPN 9 GHz wideband transistors

BFG520W; BFG520W/X



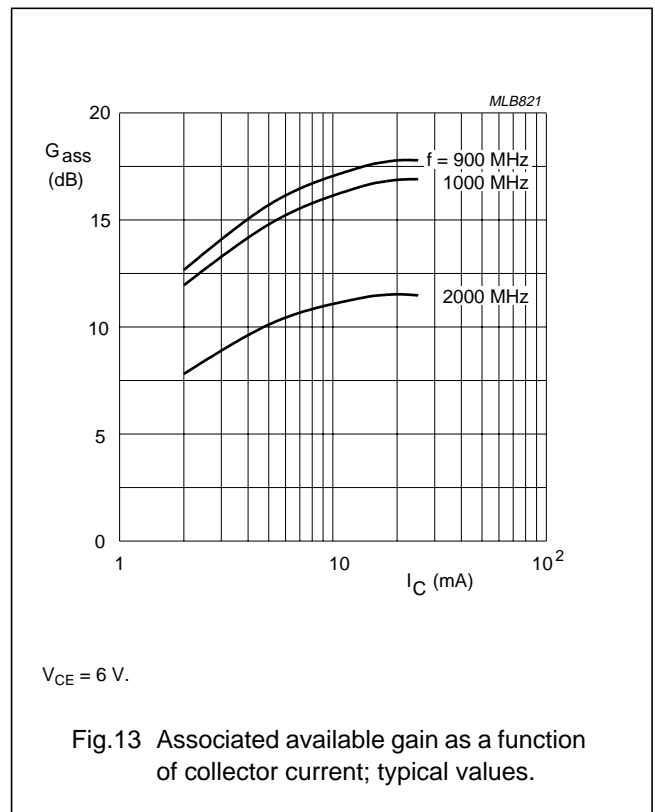
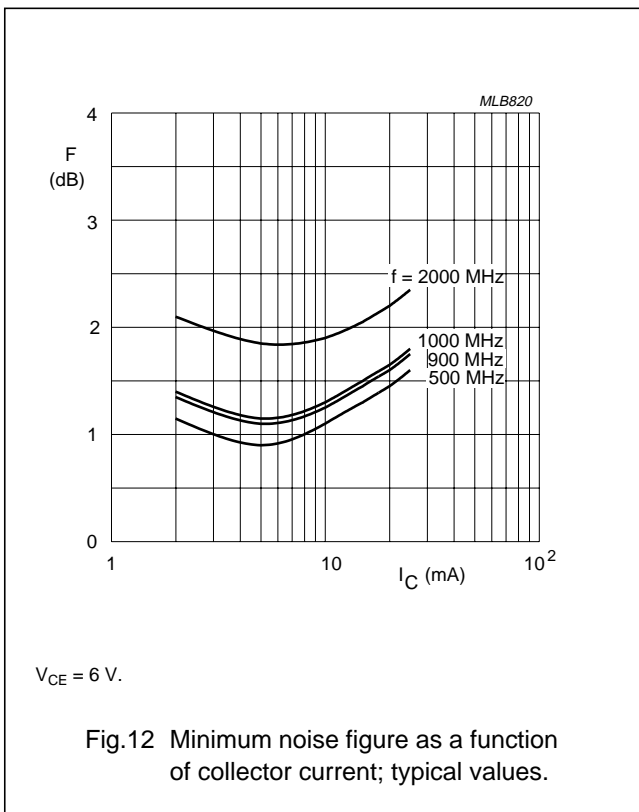
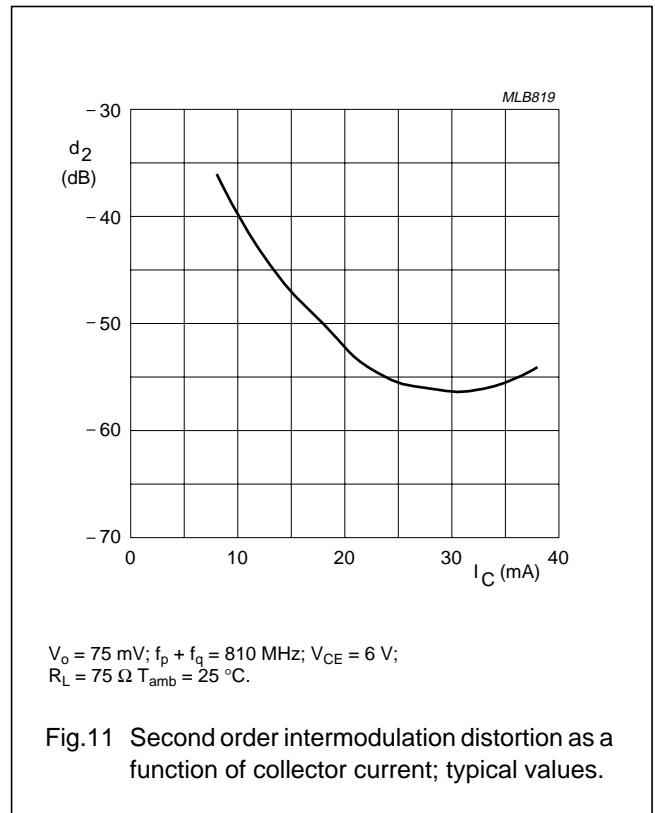
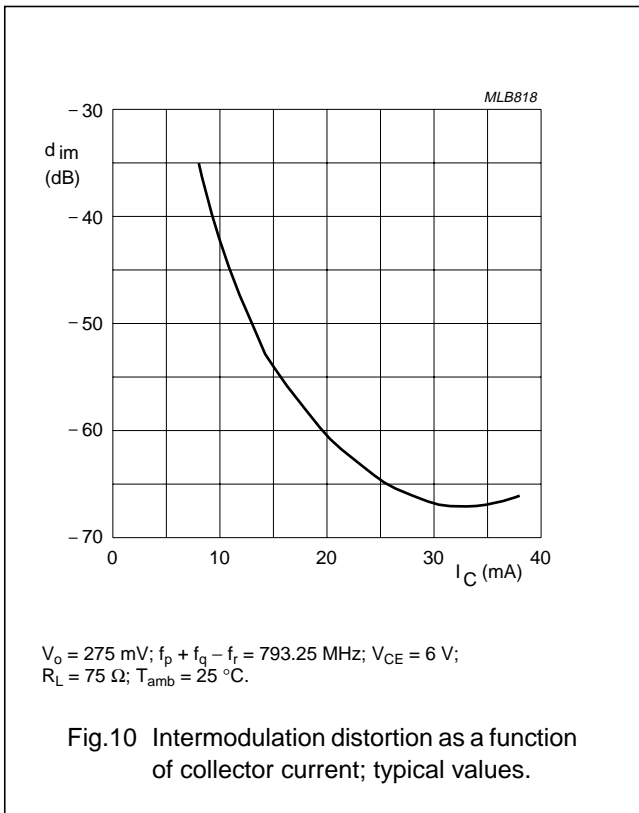
NPN 9 GHz wideband transistors

BFG520W; BFG520W/X



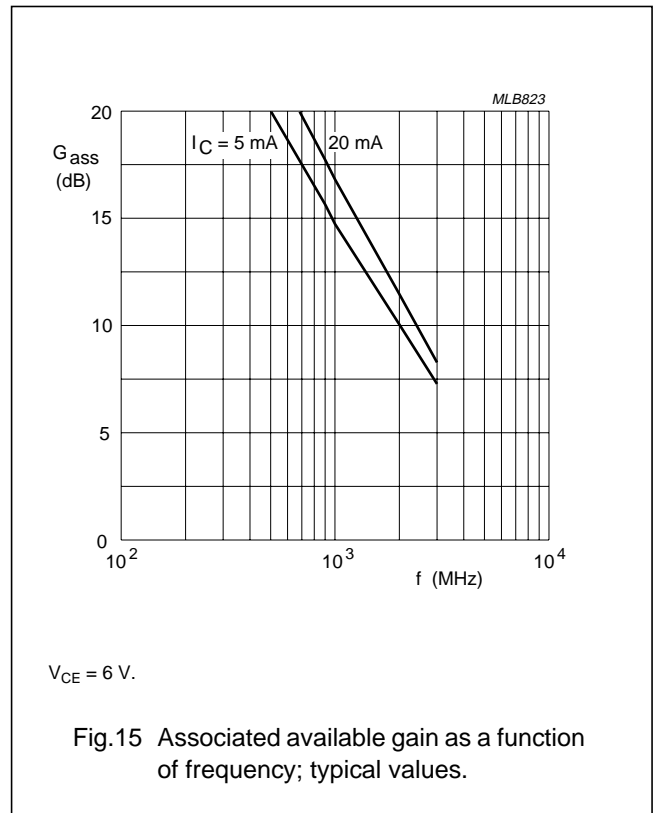
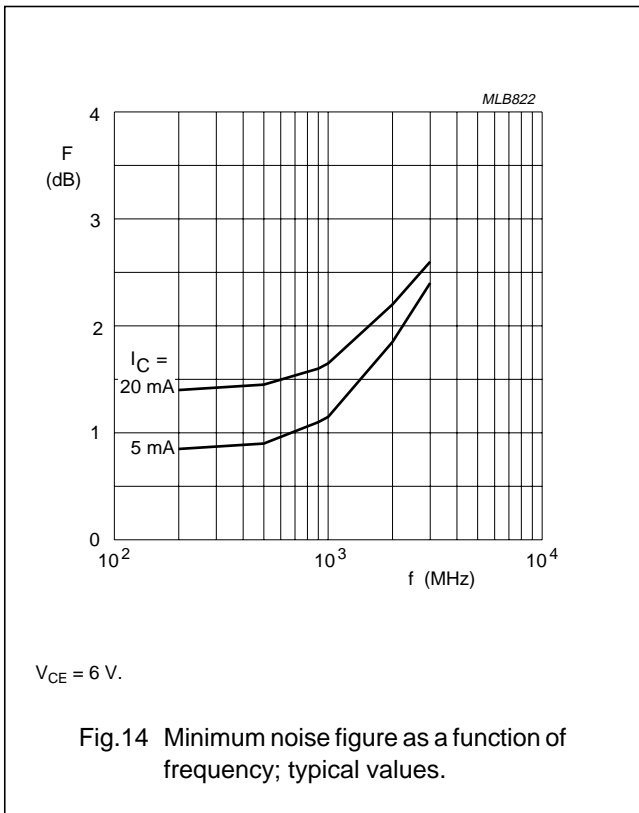
NPN 9 GHz wideband transistors

BFG520W; BFG520W/X



NPN 9 GHz wideband transistors

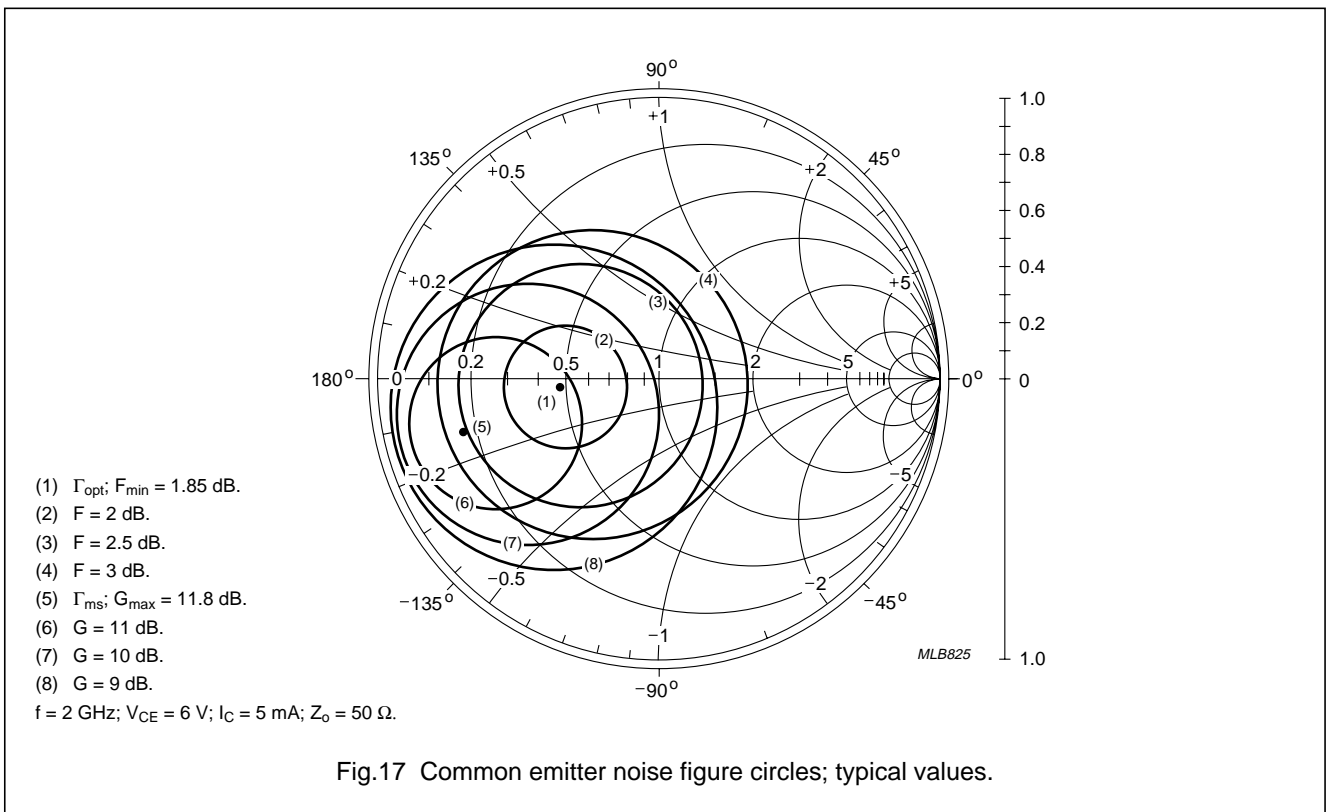
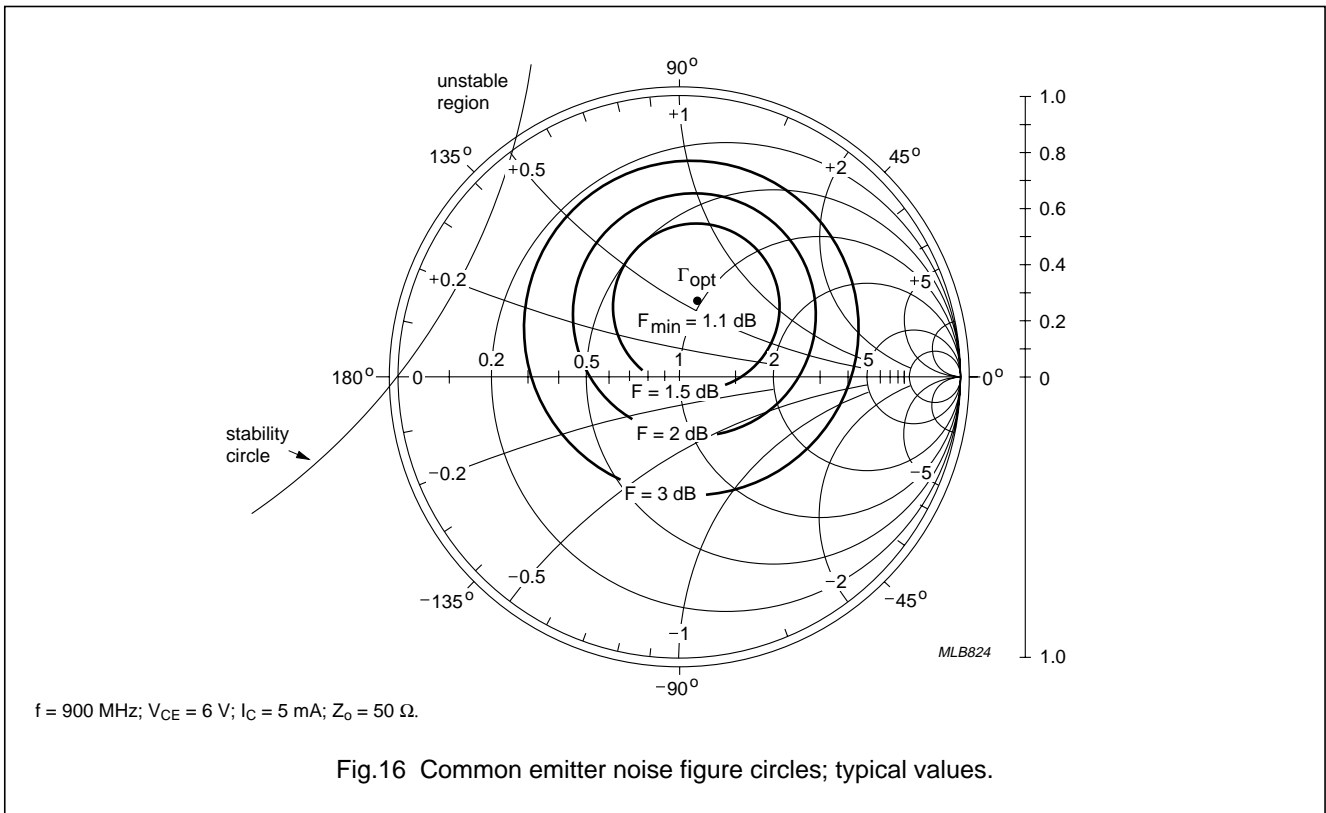
BFG520W; BFG520W/X





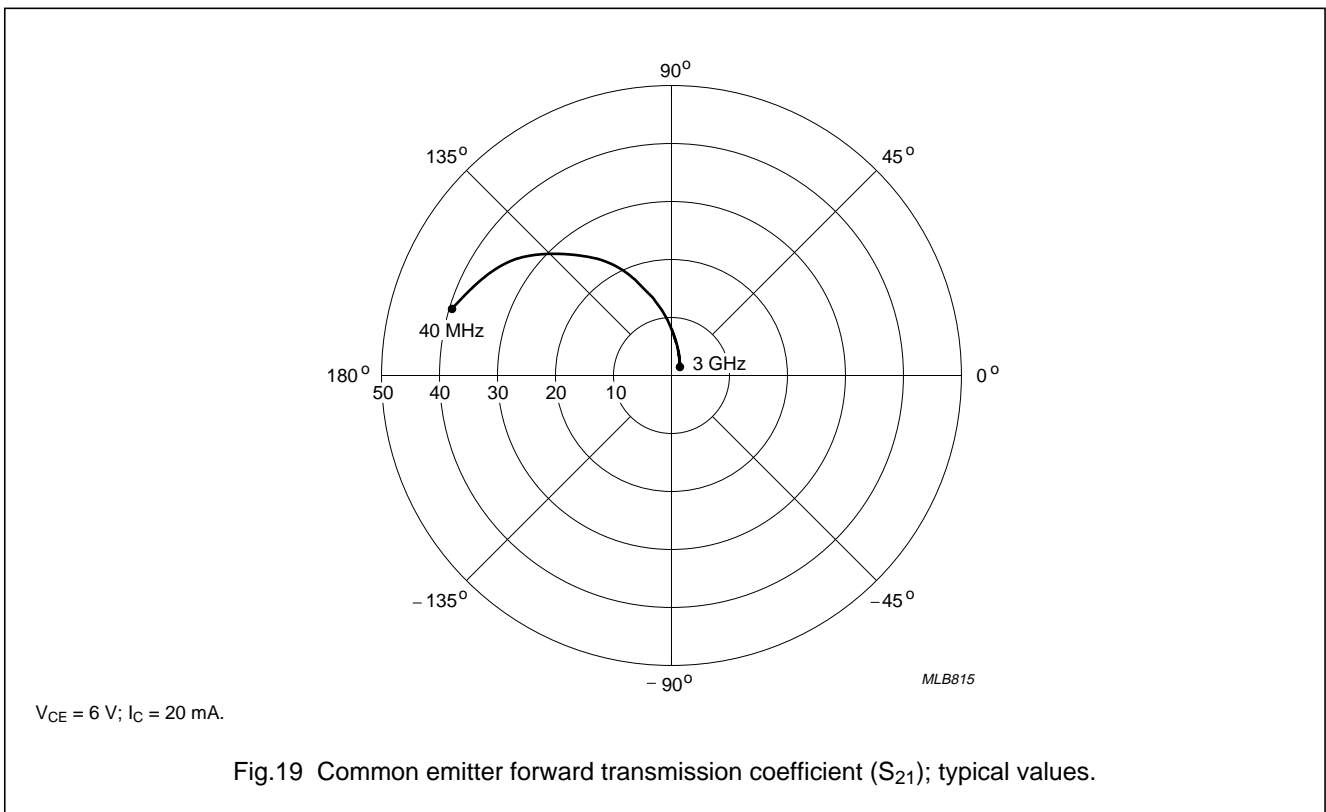
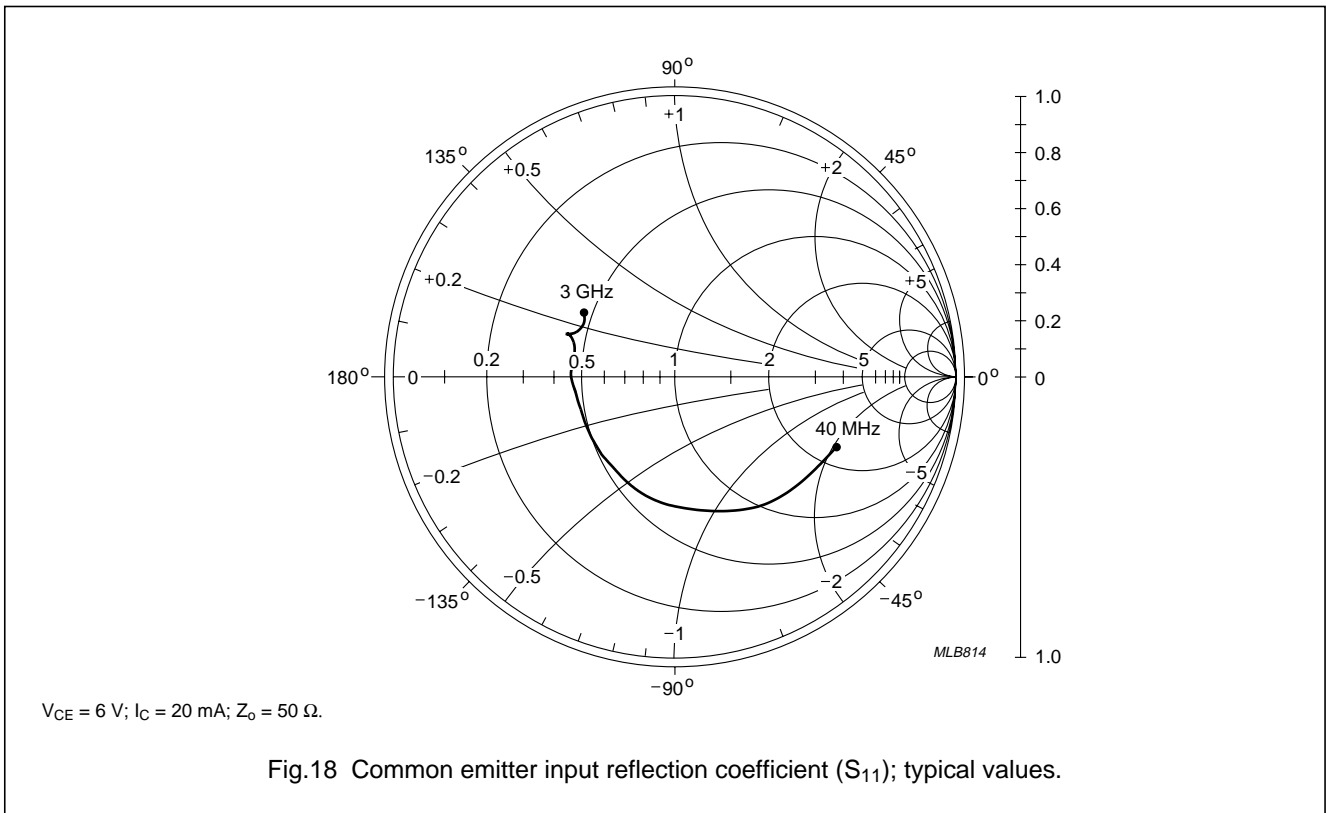
NPN 9 GHz wideband transistors

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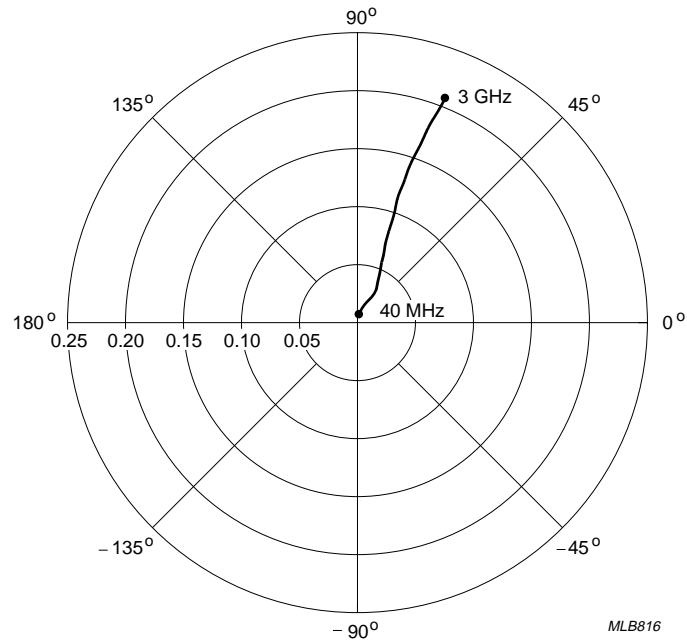
NPN 9 GHz wideband transistors

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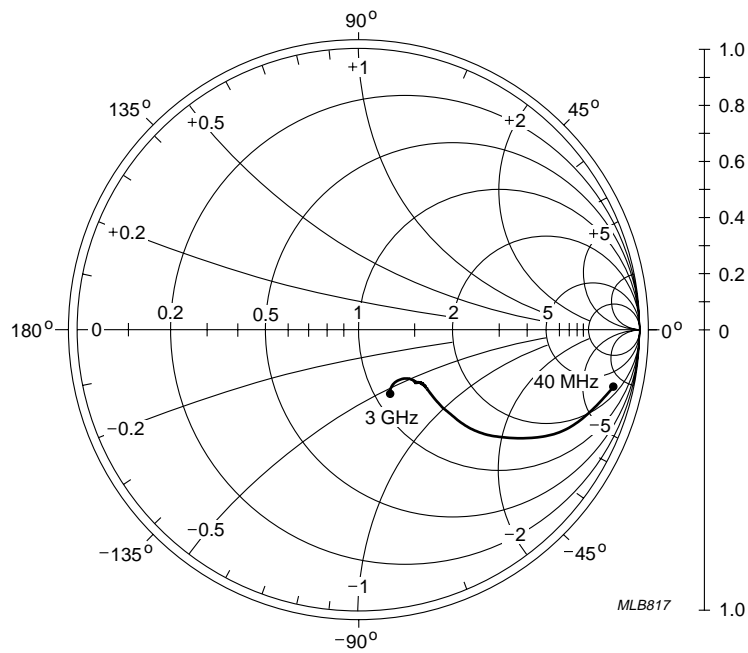
NPN 9 GHz wideband transistors

BFG520W; BFG520W/X



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

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



$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}; Z_0 = 50\ \Omega$ .

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

NPN 9 GHz wideband transistors

BFG520W; BFG520W/X

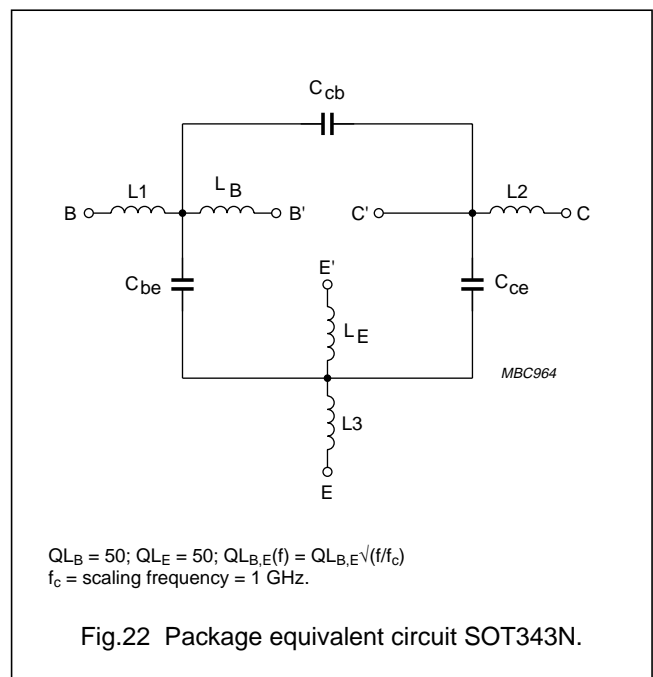
SPICE parameters for the BFG520W die

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

SEQUENCE No.	PARAMETER	VALUE	UNIT
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.



List of components (see Fig.22)

DESIGNATION	VALUE	UNIT
C <sub>be</sub>	70	fF
C <sub>cb</sub>	50	fF
C <sub>ce</sub>	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L <sub>B</sub>	0.40	nH
L <sub>E</sub>	0.40	nH

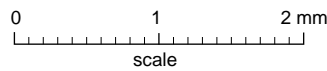
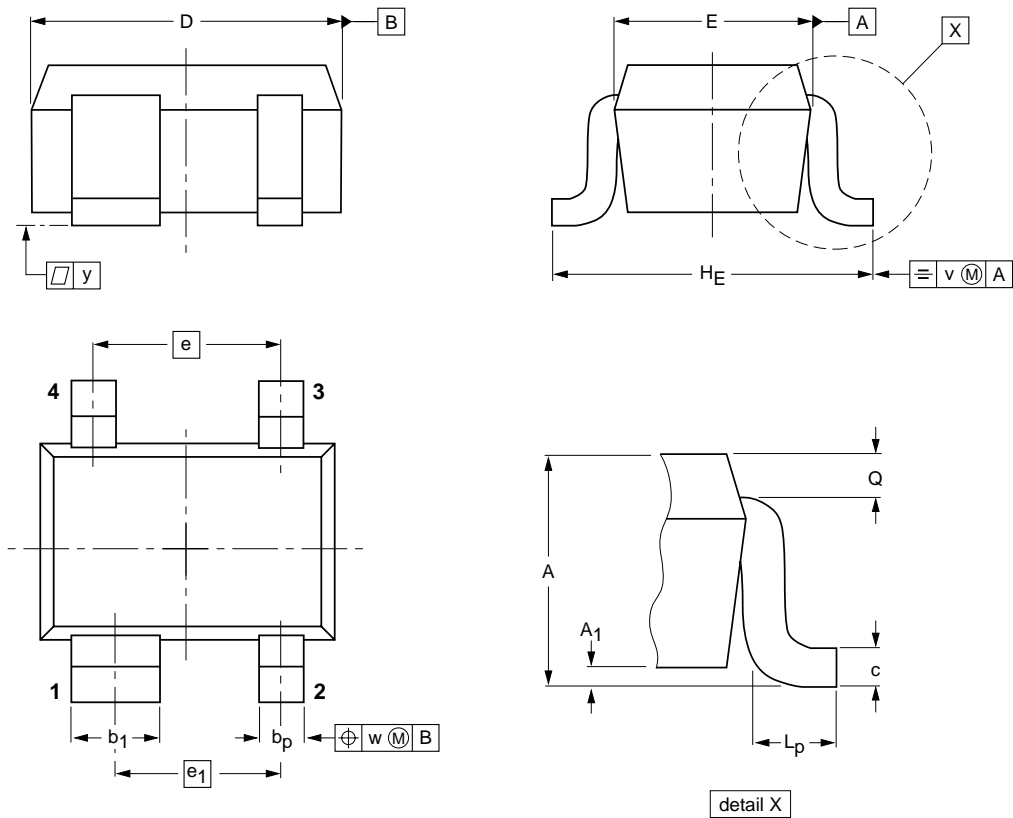
NPN 9 GHz wideband transistors

BFG520W; BFG520W/X

PACKAGE OUTLINE

Plastic surface mounted package; 4 leads

SOT343N



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 0.8	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

## NPN 9 GHz wideband transistors

## BFG520W; BFG520W/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.	

**LIFE SUPPORT APPLICATIONS**

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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BFG520W; BFG520W/X

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