

NPN 9 GHz wideband transistor**BFG520W
BFG520W/X; BFG520W/XR****FEATURES**

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

APPLICATIONS

They are intended for applications in the RF front end, in 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

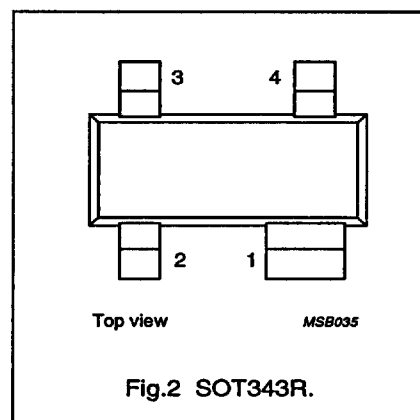
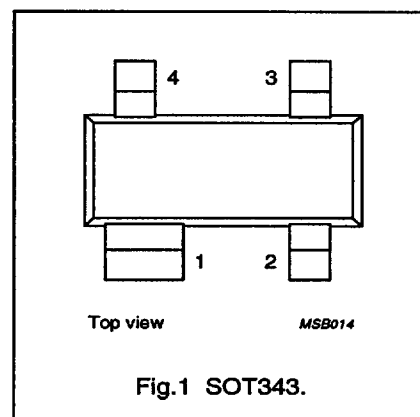
NPN silicon planar epitaxial transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG520W	N3
BFG520W/X	N4
BFG520W/XR	N5

PINNING

PIN	DESCRIPTION
BFG520W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG520W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG520W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

**QUICK REFERENCE DATA**

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	—	—	20	V
V_{CEO}	collector-emitter voltage	open base	—	—	15	V
I_C	collector current (DC)		—	—	70	mA
P_{tot}	total power dissipation	up to $T_s = 60\text{ °C}$	—	—	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

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LIMITING VALUES

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

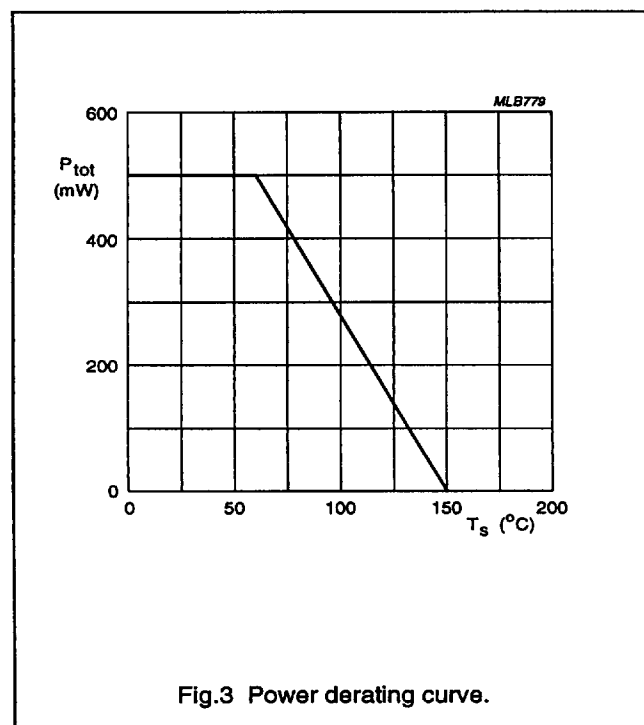
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CB0}	collector-base voltage	open emitter	–	20	V
V_{CE0}	collector-emitter voltage	open base	–	15	V
V_{EB0}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	70	mA
P_{tot}	total power dissipation	up to $T_s = 60\text{ °C}$; see Fig.3; 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”

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



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CHARACTERISTICS

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

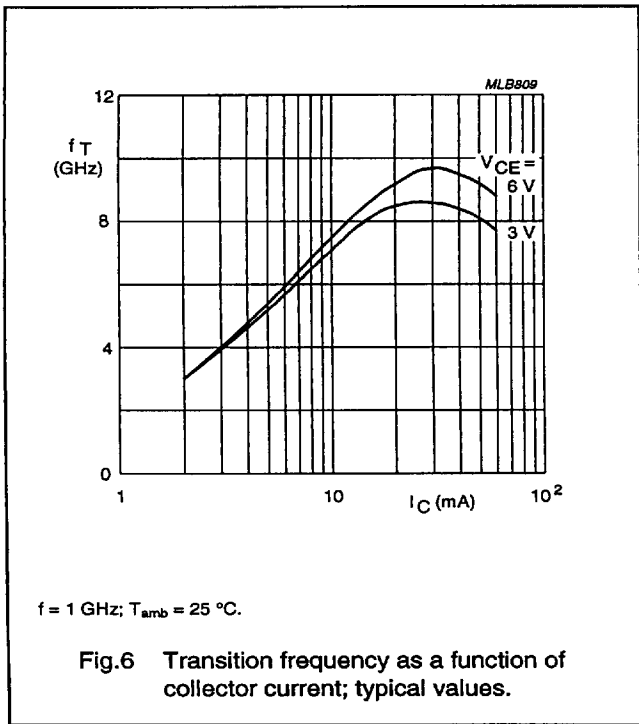
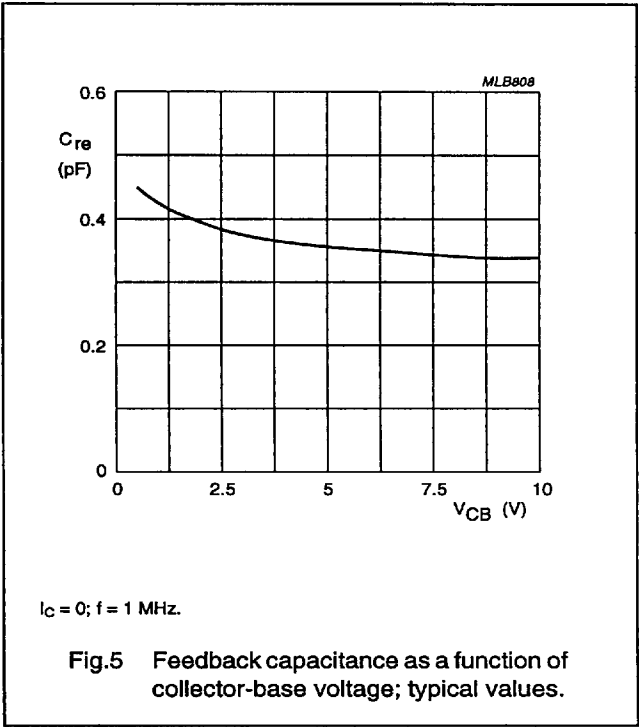
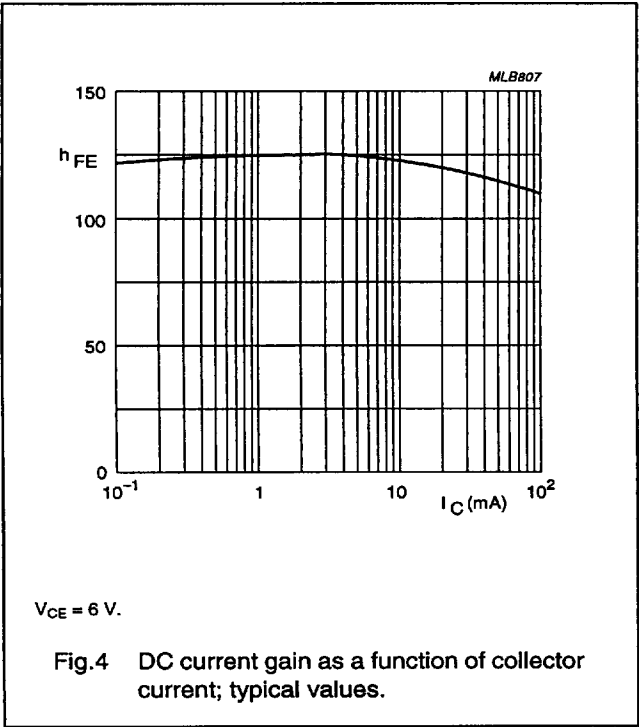
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; $I_C = 0.01\text{ mA}$; $I_E = 0$	—	—	20	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; $I_C = 10\text{ mA}$; $I_B = 0$	—	—	15	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; $I_E = 0.01\text{ mA}$; $I_C = 0$	—	—	2.5	V
I_{CBO}	collector cut-off current	open emitter; $V_{CB} = 6\text{ V}$; $I_E = 0$	—	—	50	nA
h_{FE}	DC current gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$	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	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	9	—	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	17	—	dB
		$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	11	—	dB
$ s_{21} ^2$	insertion power gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	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
P_{L1}	output power at 1 dB gain compression	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $R_L = 50\text{ }\Omega$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	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

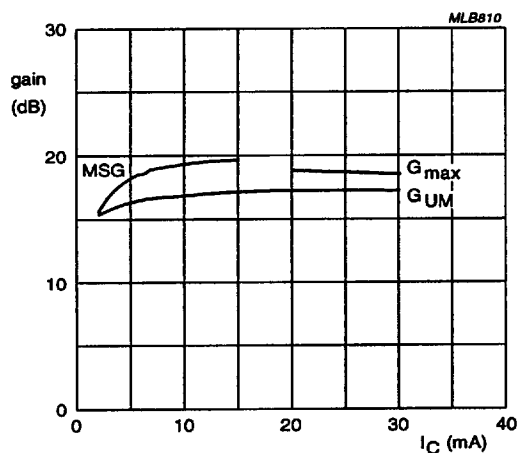
- G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)} \text{ dB}$.
- $I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $R_L = 50\text{ }\Omega$; $T_{amb} = 25\text{ }^{\circ}\text{C}$;
 $f_p = 900\text{ MHz}$; $f_q = 902\text{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

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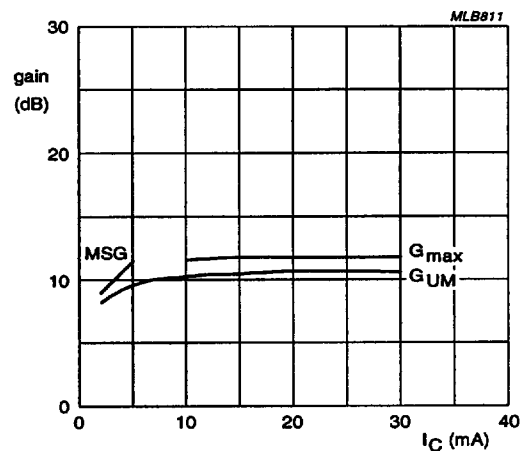


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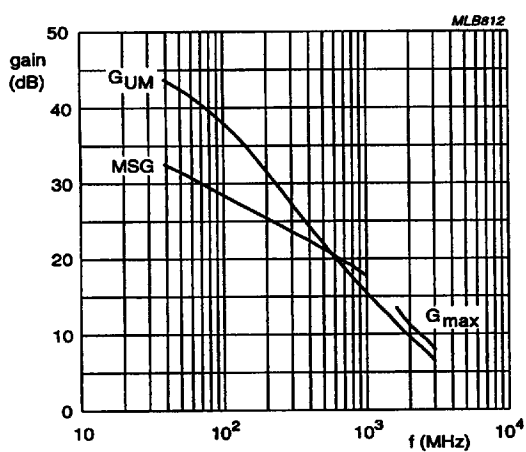
$f = 900 \text{ MHz}$; $V_{CE} = 6 \text{ V}$.

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



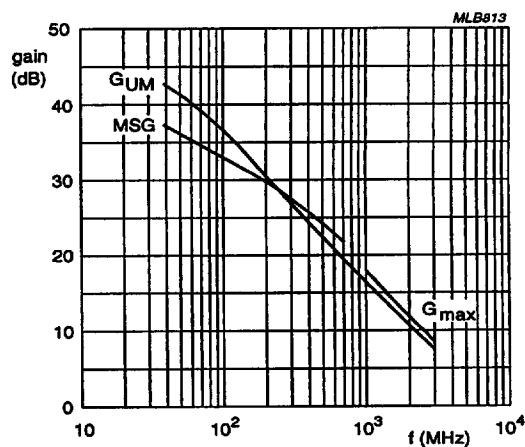
$f = 2 \text{ GHz}$; $V_{CE} = 6 \text{ V}$.

Fig.8 Gain as a function of collector current; typical values.



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

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

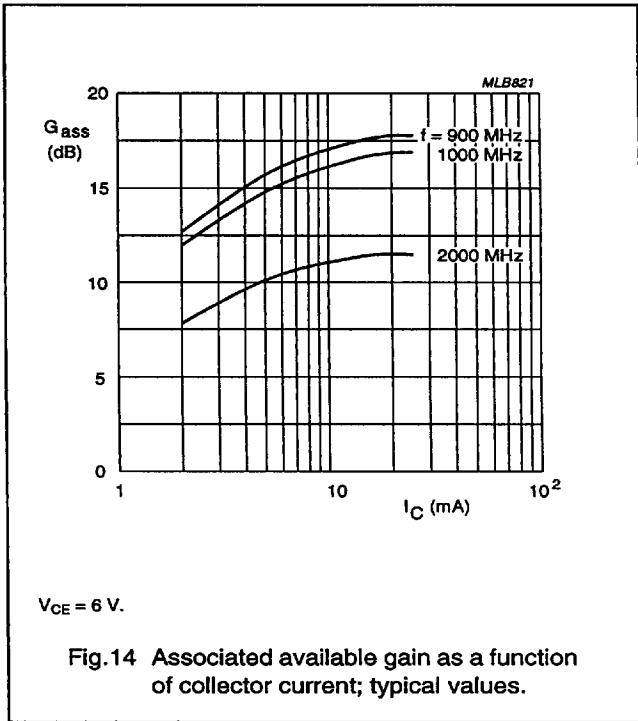
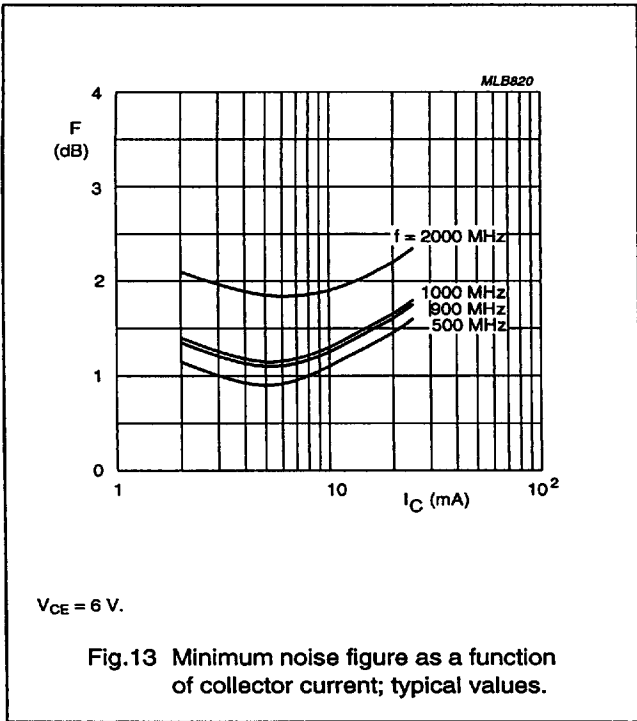
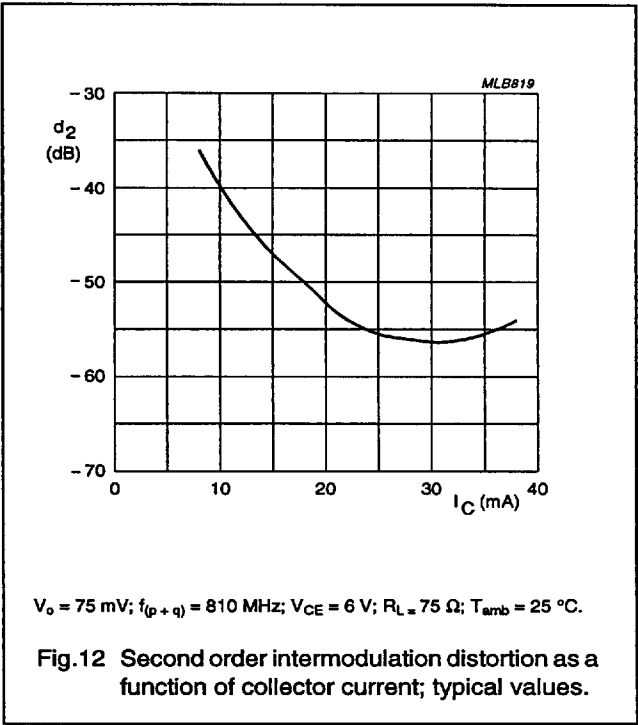
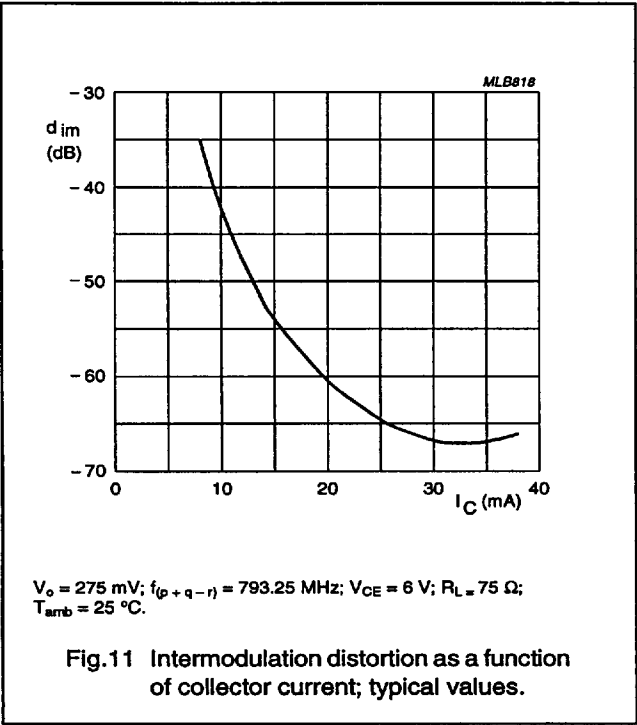


$I_C = 20 \text{ mA}$; $V_{CE} = 6 \text{ V}$.

Fig.10 Gain as a function of frequency; typical values.

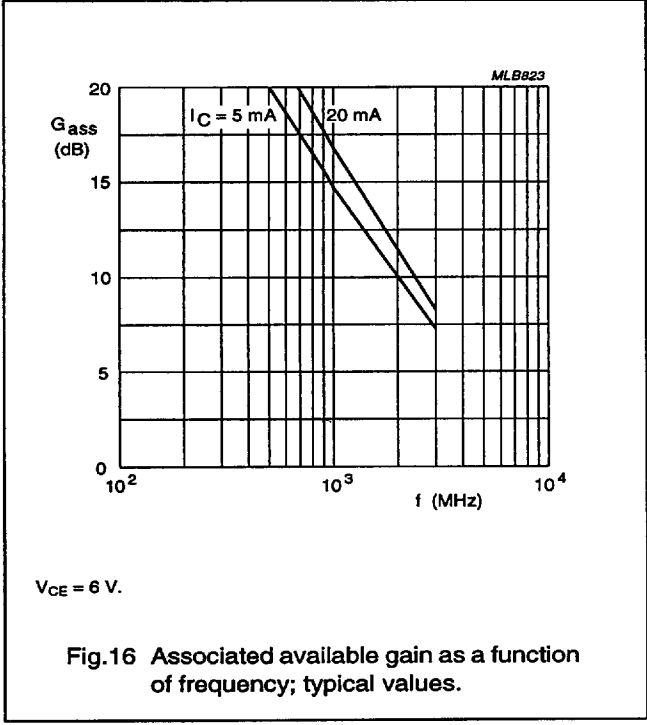
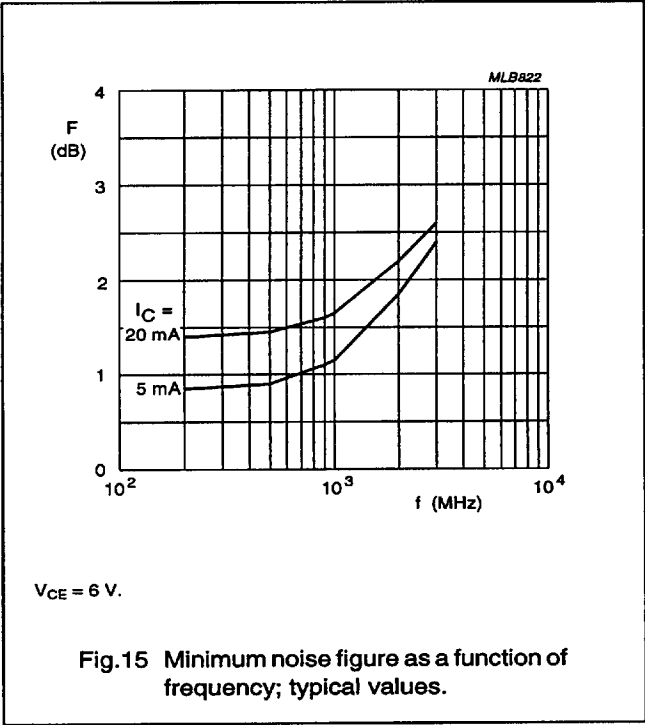
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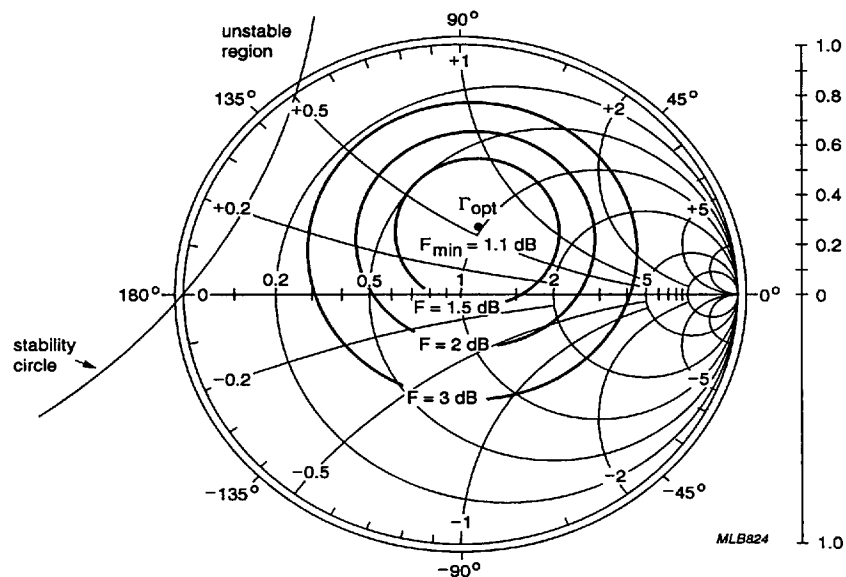


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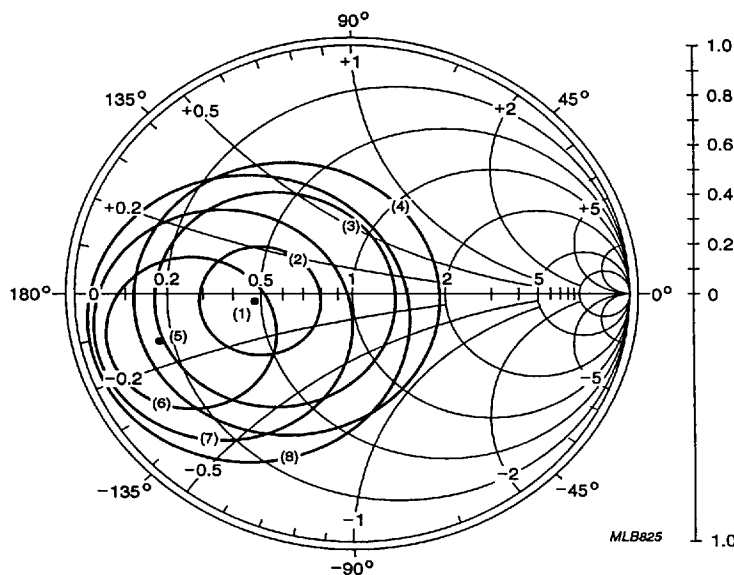


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$f = 900 \text{ MHz}$; $V_{CE} = 6 \text{ V}$; $I_C = 5 \text{ mA}$; $Z_0 = 50 \Omega$.

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

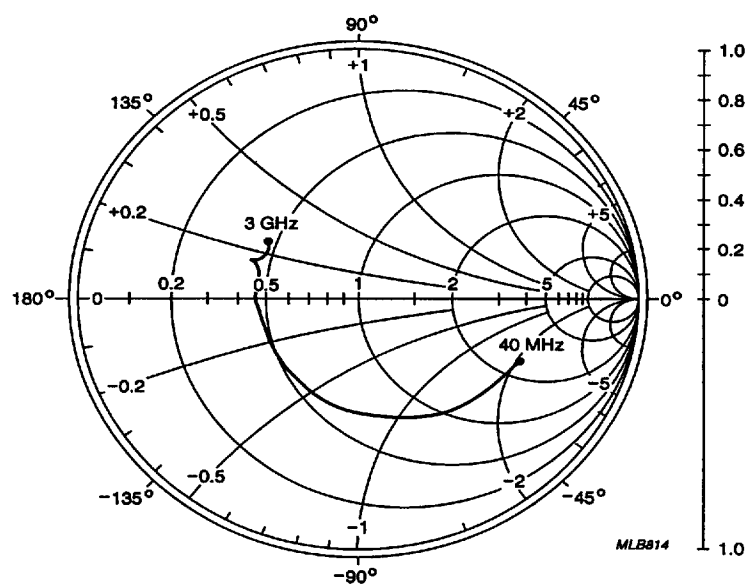
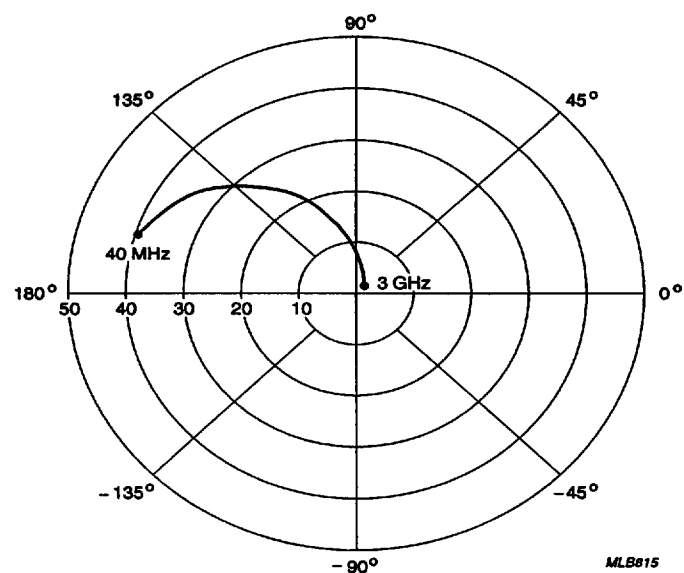


- (1) Γ_{opt} ; $F_{min} = 1.85 \text{ dB}$.
- (2) $F = 2 \text{ dB}$.
- (3) $F = 2.5 \text{ dB}$.
- (4) $F = 3 \text{ dB}$.
- (5) Γ_{ms} ; $G_{max} = 11.8 \text{ dB}$.
- (6) $G = 11 \text{ dB}$.
- (7) $G = 10 \text{ dB}$.
- (8) $G = 9 \text{ dB}$.

$f = 2 \text{ GHz}$; $V_{CE} = 6 \text{ V}$; $I_C = 5 \text{ mA}$; $Z_0 = 50 \Omega$.

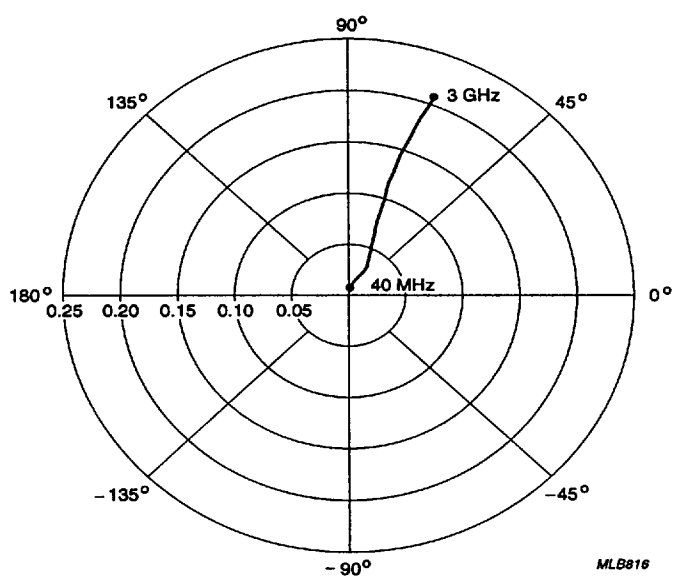
Fig.18 Common emitter noise figure circles; typical values.

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BFG520W/X; BFG520W/XR $V_{CE} = 6\text{ V}; I_C = 20\text{ mA}; Z_0 = 50\ \Omega$.Fig.19 Common emitter input reflection coefficient (s_{11}); typical values. $V_{CE} = 6\text{ V}; I_C = 20\text{ mA}$.Fig.20 Common emitter forward transmission coefficient (s_{21}); typical values.

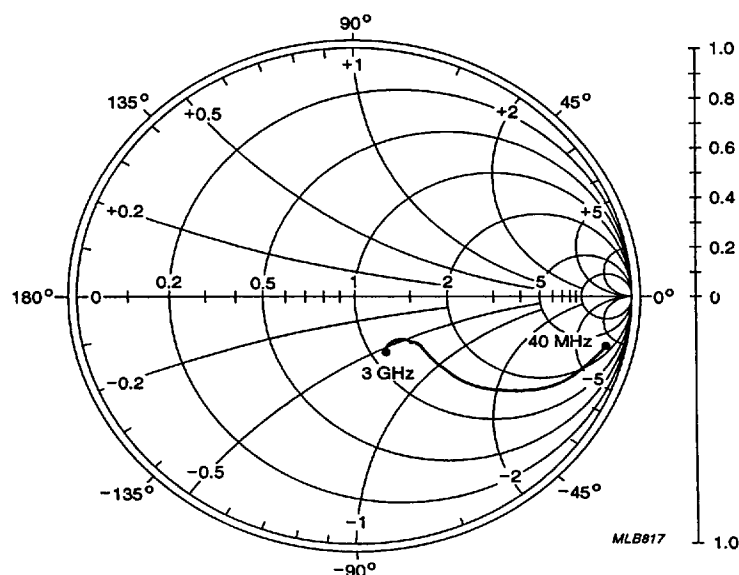
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$V_{CE} = 6 \text{ V}; I_C = 20 \text{ mA}$.

Fig.21 Common emitter reverse transmission coefficient (s_{12}); typical values.



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

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

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SPICE parameters for the BFG520W crystal

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	μ A
16	RBM	10.00	Ω
17	RE	775.3	m Ω
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

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

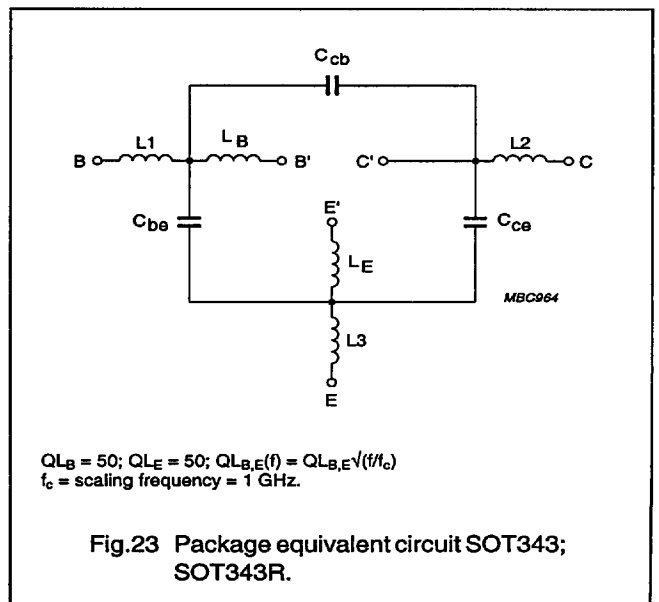


Fig.23 Package equivalent circuit SOT343;
SOT343R.

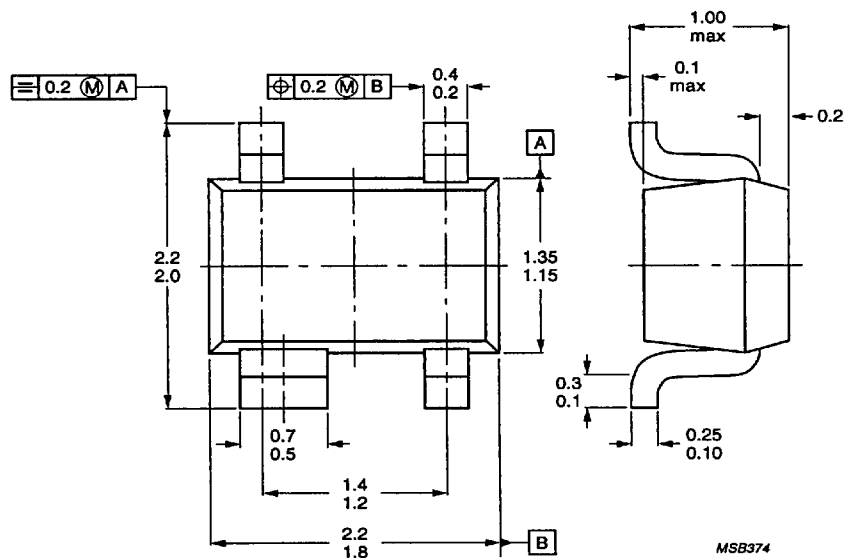
List of components (see Fig.23)

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L_1	0.34	nH
L_2	0.10	nH
L_3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

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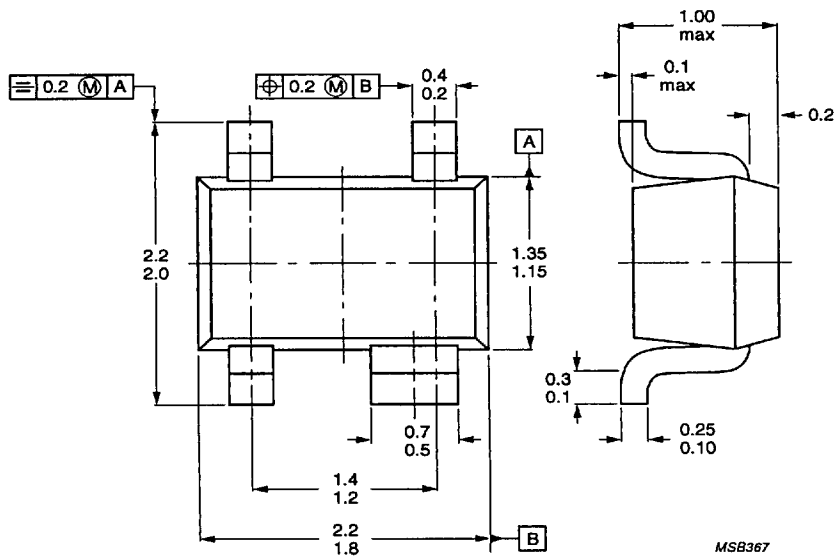
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PACKAGE OUTLINES



Dimensions in mm.

Fig.24 SOT343.



Dimensions in mm.

Fig.25 SOT343R.

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Data Sheet Status	
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.
Limiting values	
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.	
Application Information	
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.