

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

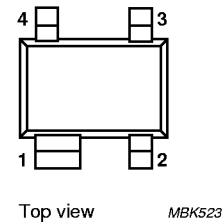


Fig.1 Simplified outline SOT343N.

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

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

Note

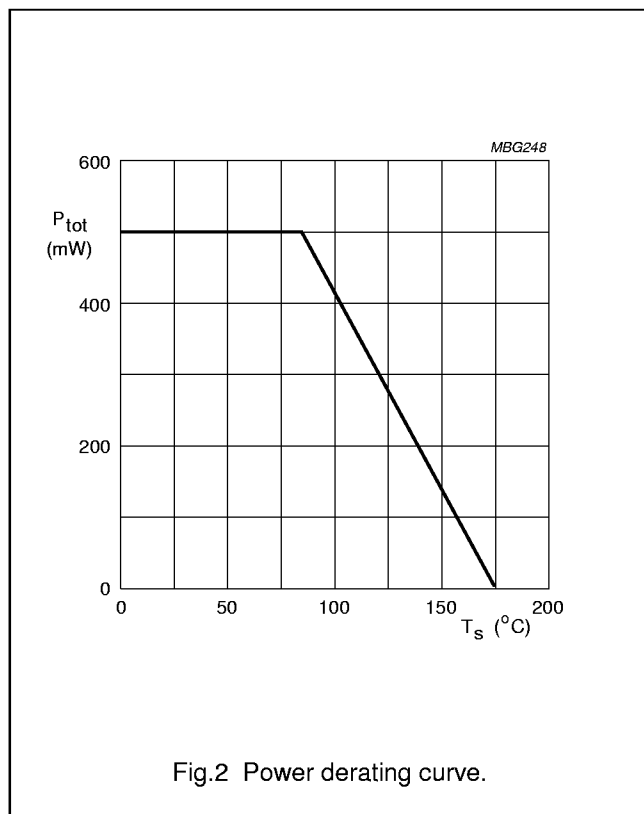
- T_s is the temperature at the soldering point of the collector pin.

THERMAL CHARACTERISTICS

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

Note

- 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.

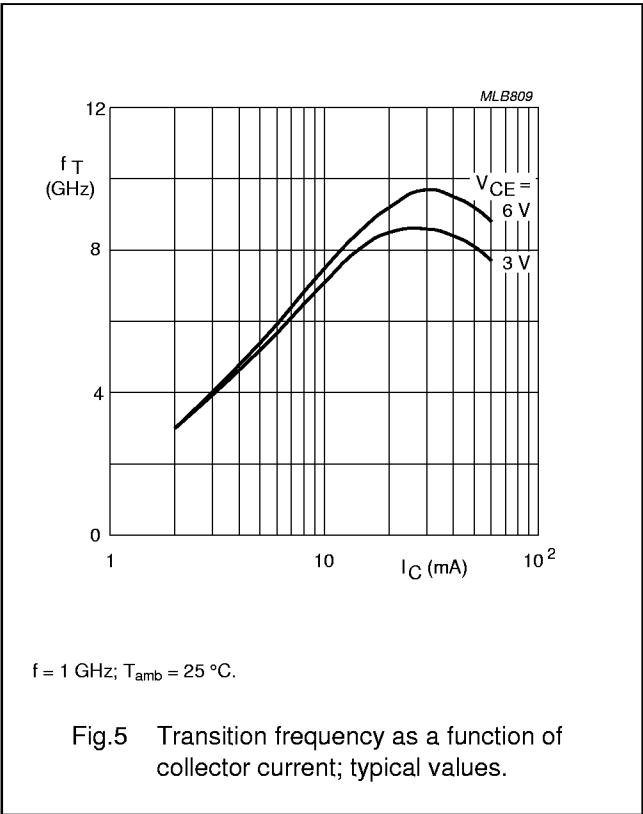
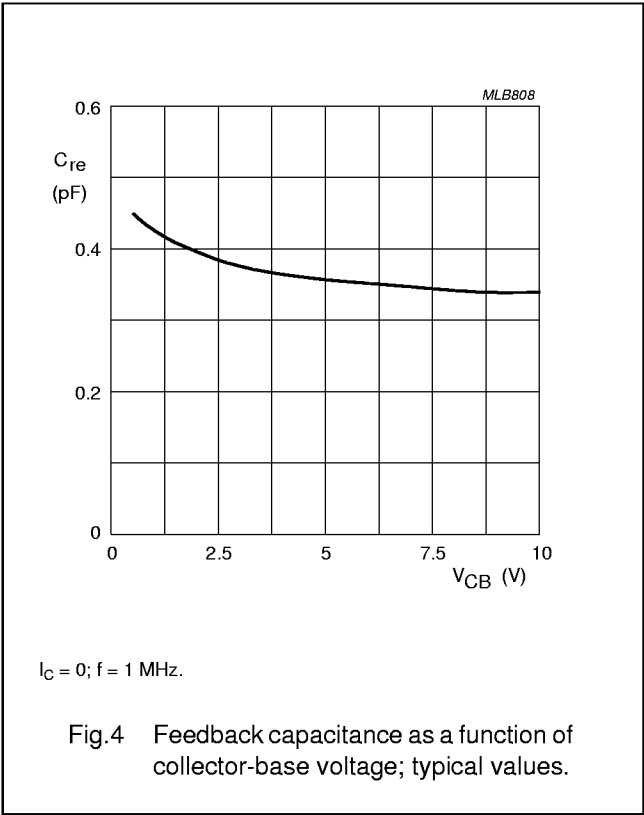
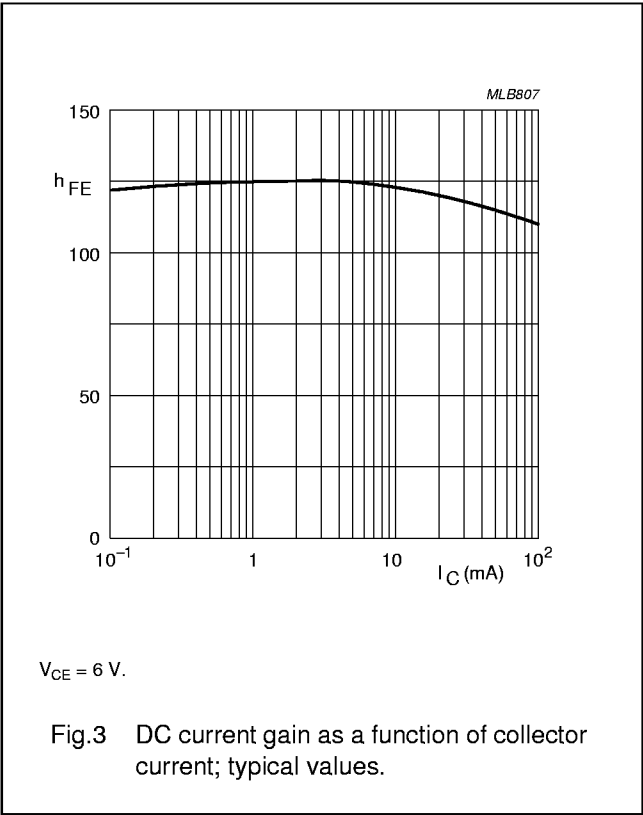
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 10\text{ }\mu\text{A}; I_E = 0$	20	—	—	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10\text{ }\mu\text{A}; R_{BE} = 0$	15	—	—	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 10\text{ }\mu\text{A}; I_C = 0$	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	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz};$ $T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.5	—	9	—	GHz
G_{UM}	maximum unilateral power gain; note 1	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz};$ $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	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. $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ 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 $2f_p - f_q = 898\text{ MHz}$ and $2f_q - f_p = 904\text{ MHz}.$
- $d_{im} = -60\text{ dB (DIN45004B)}; I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; V_p = V_o; V_q = V_o - 6\text{ dB}; V_r = V_o - 6\text{ dB}; R_L = 75\text{ }\Omega;$
 $f_p = 795.25\text{ MHz}; f_q = 803.25\text{ MHz}; f_r = 805.25\text{ MHz};$ measured at $f_p + f_q - f_r = 793.25\text{ MHz}.$
- $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; V_o = 75\text{ mV}; R_L = 75\text{ }\Omega; T_{amb} = 25\text{ }^{\circ}\text{C};$
 $f_p = 250\text{ MHz}; f_q = 560\text{ MHz};$ measured at $f_p + f_q = 810\text{ MHz}.$

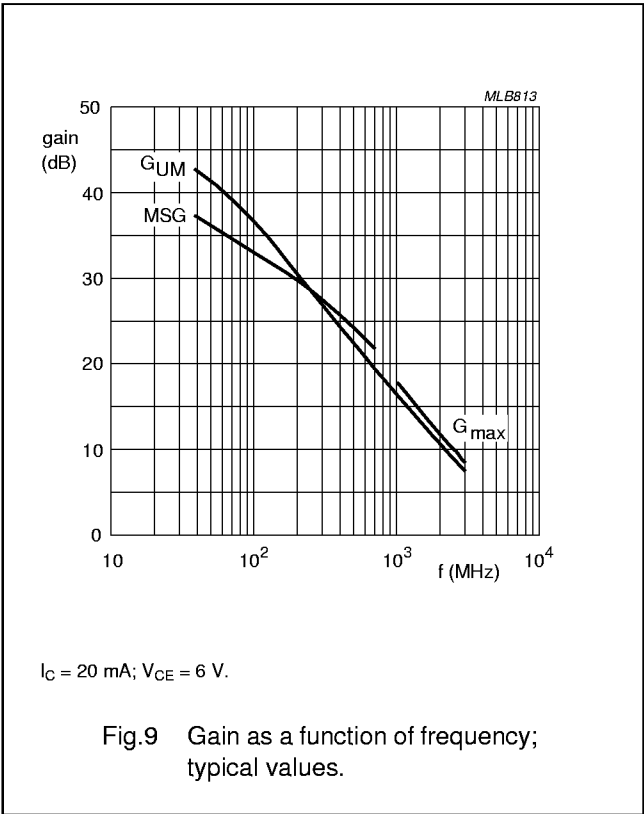
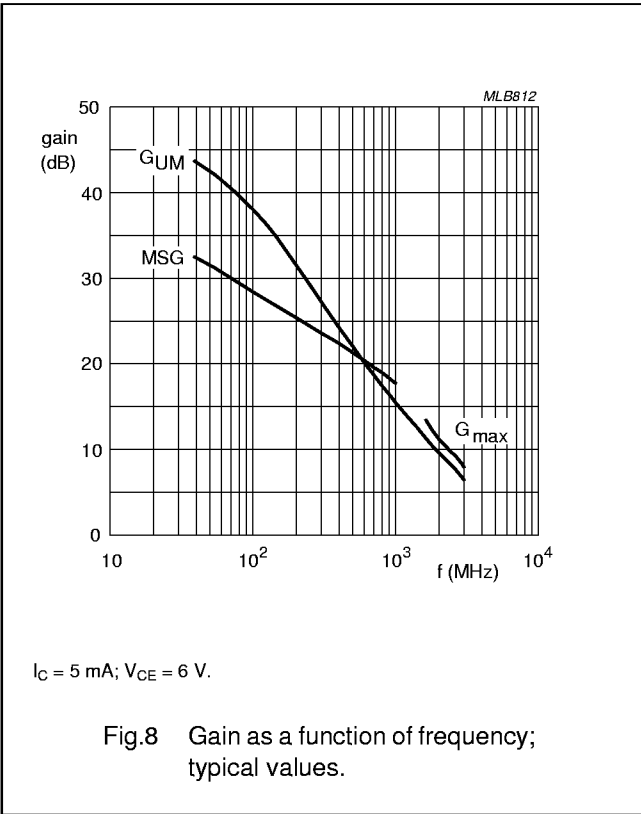
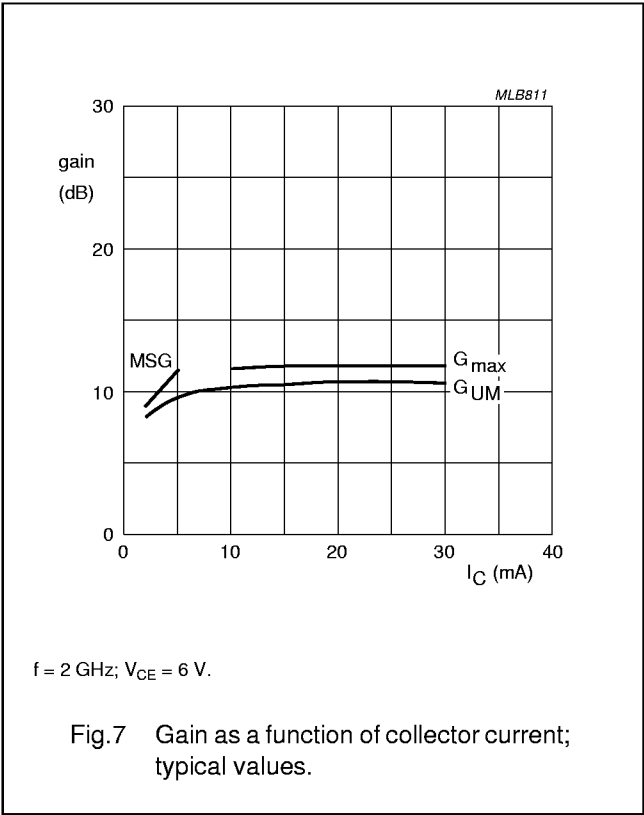
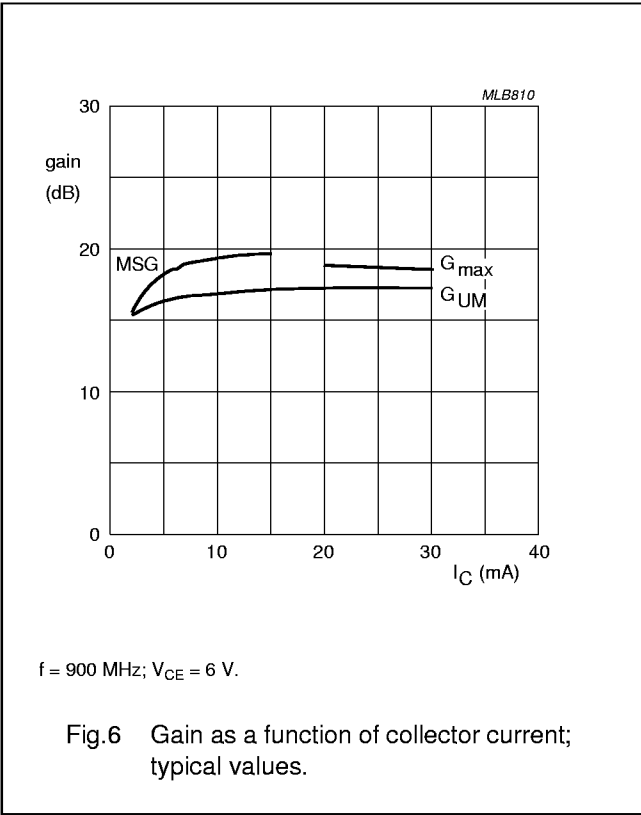
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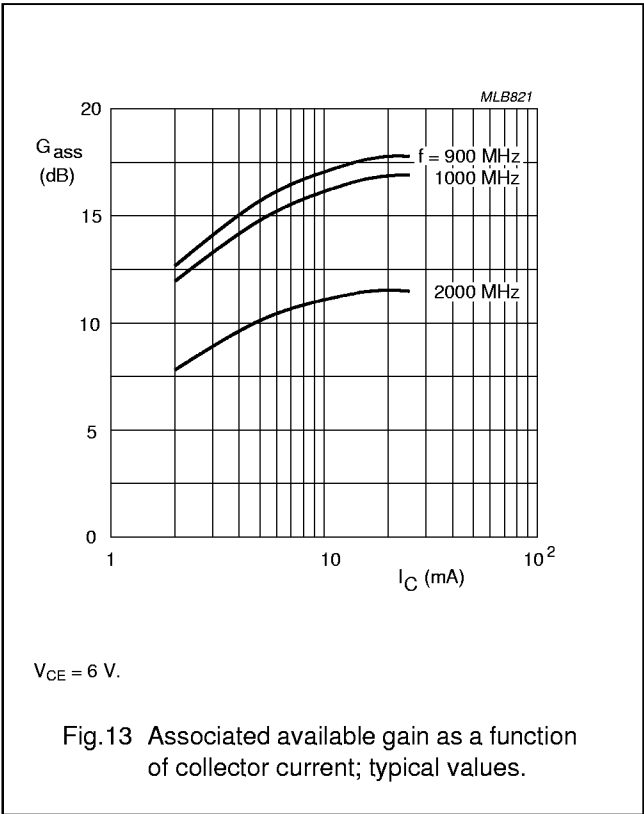
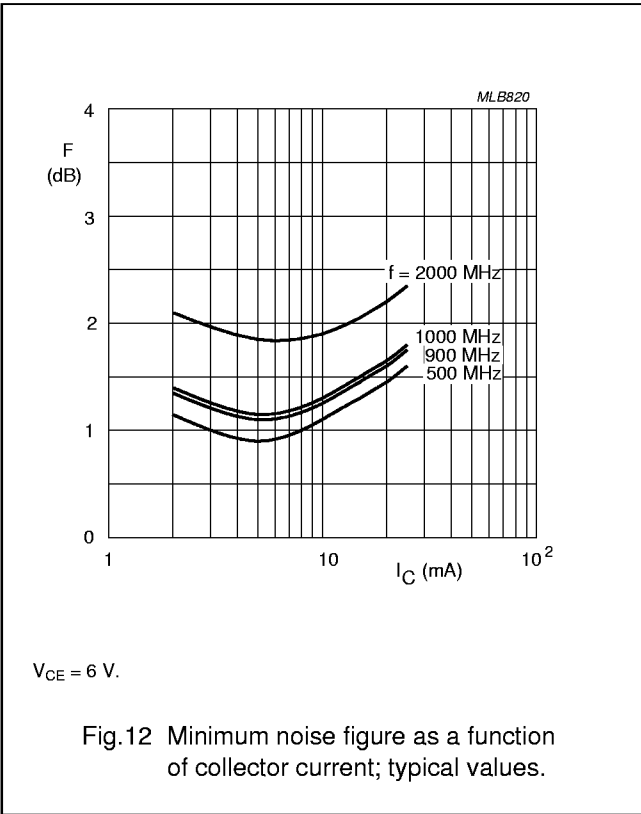
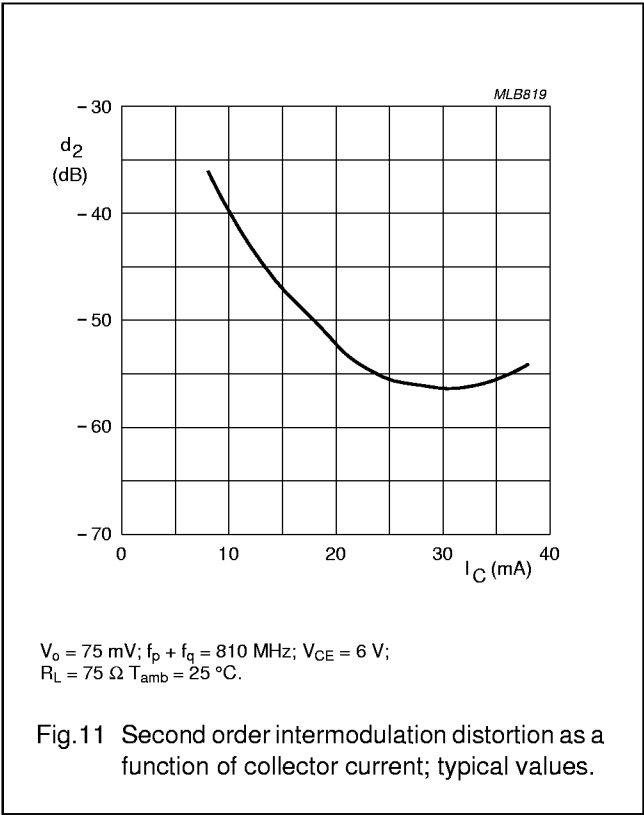
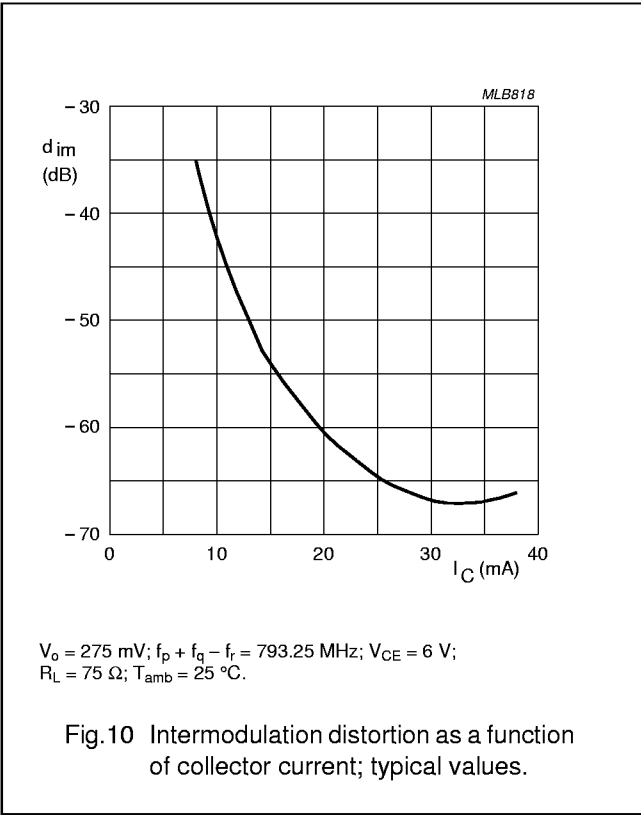
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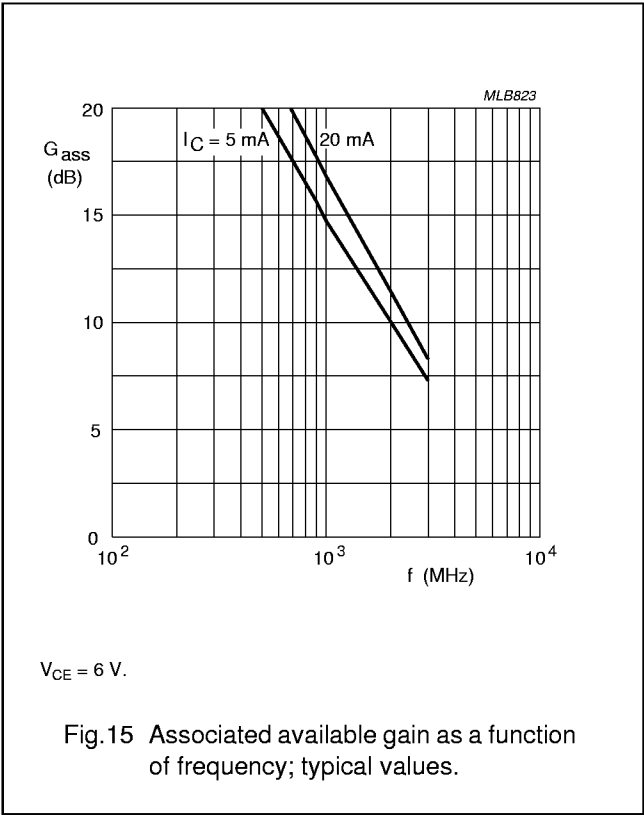
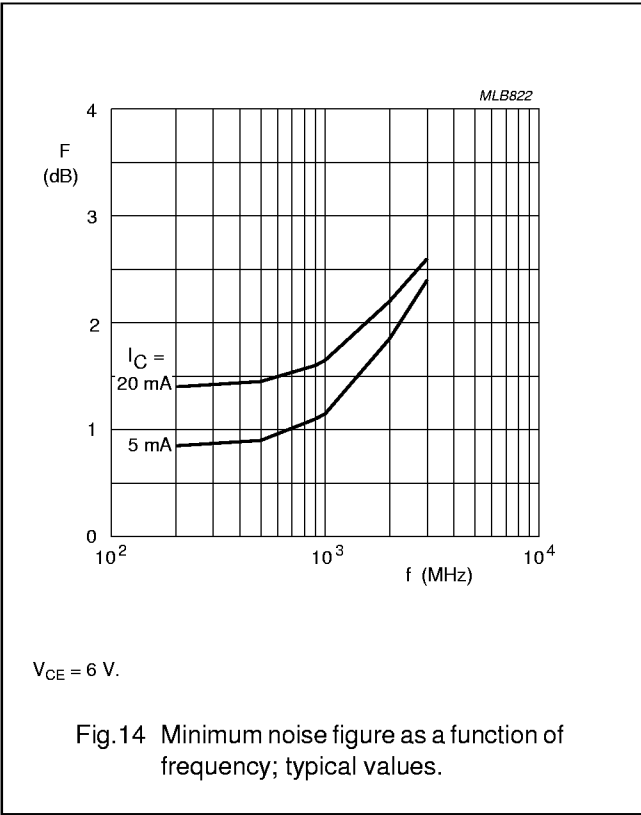
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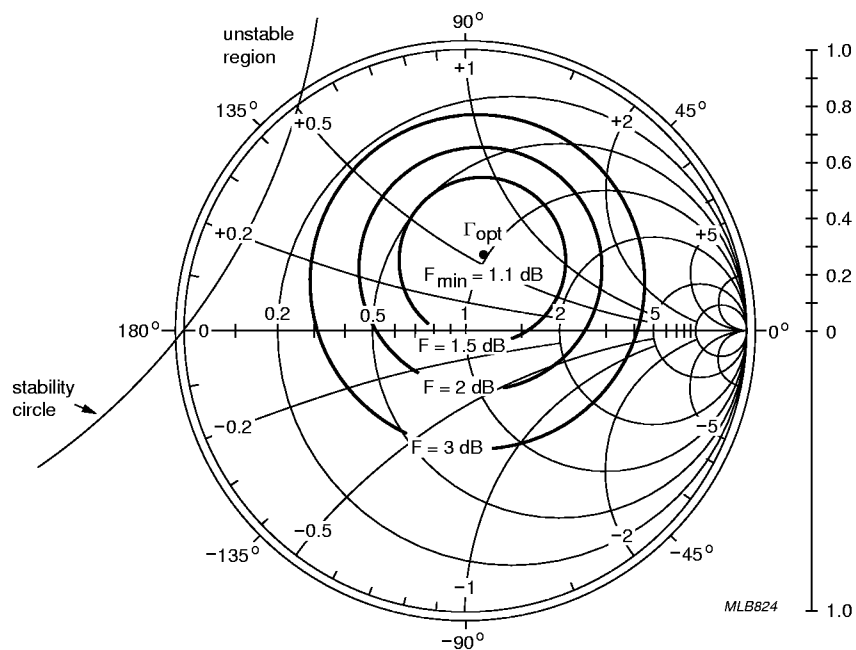
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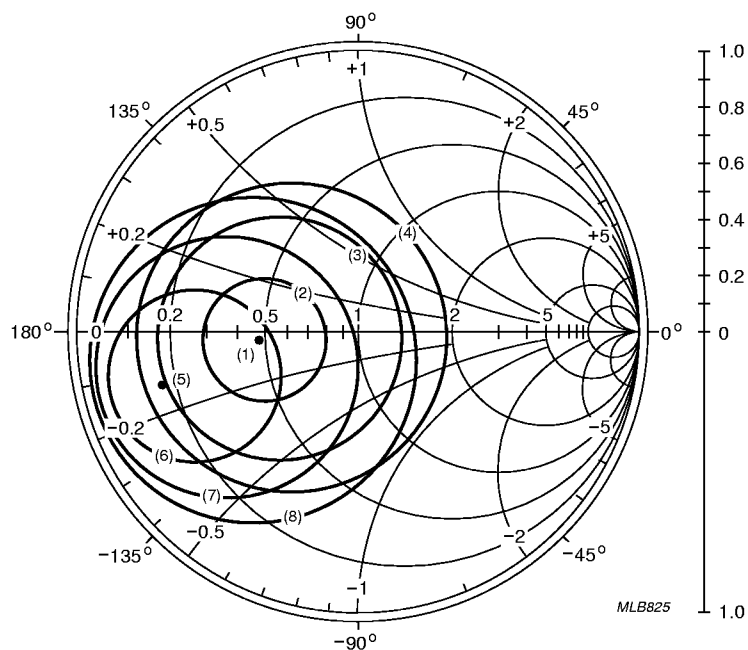
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$f = 900 \text{ MHz}$; $V_{CE} = 6 \text{ V}$; $I_C = 5 \text{ mA}$; $Z_0 = 50 \Omega$.

Fig.16 Common emitter noise figure circles; typical values.



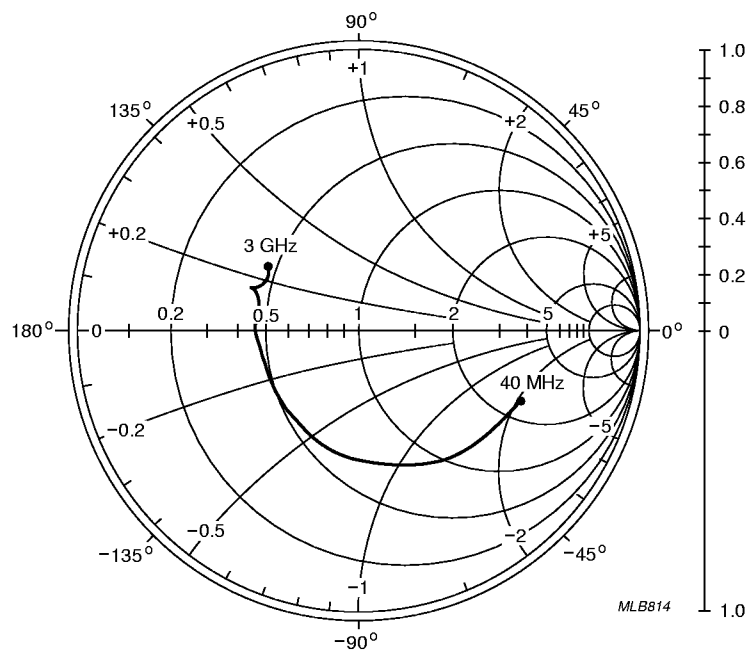
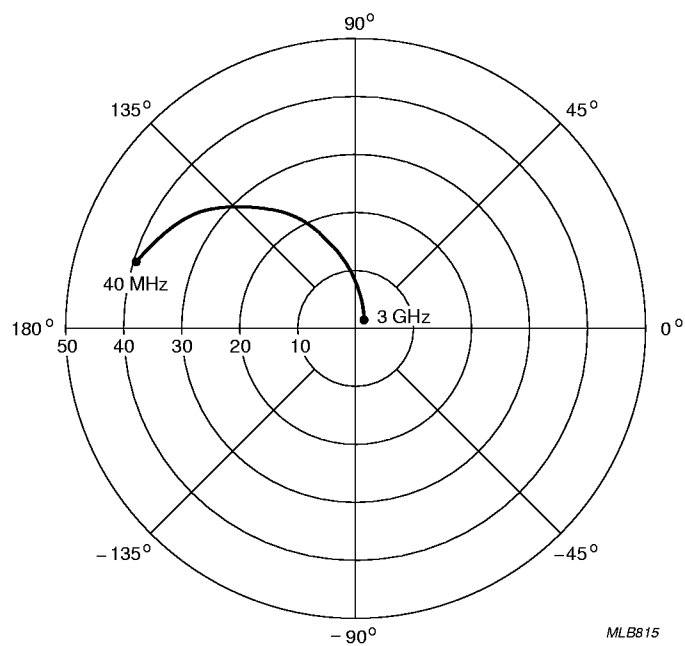
- (1) Γ_{opt} ; $F_{min} = 1.85 \text{ dB}$.
- (2) $F = 2 \text{ dB}$.
- (3) $F = 2.5 \text{ dB}$.
- (4) $F = 3 \text{ dB}$.
- (5) Γ_{ms} ; $G_{max} = 11.8 \text{ dB}$.
- (6) $G = 11 \text{ dB}$.
- (7) $G = 10 \text{ dB}$.
- (8) $G = 9 \text{ dB}$.

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

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

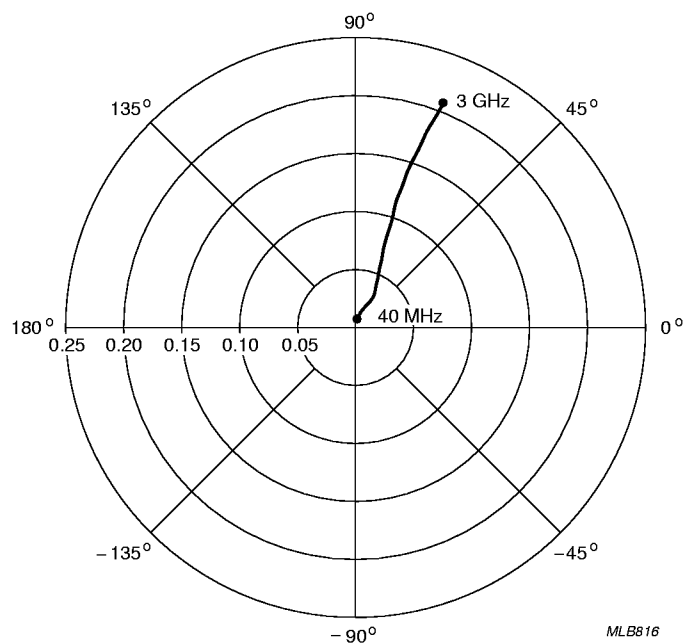
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Fig.18 Common emitter input reflection coefficient (S_{11}); typical values.Fig.19 Common emitter forward transmission coefficient (S_{21}); typical values.

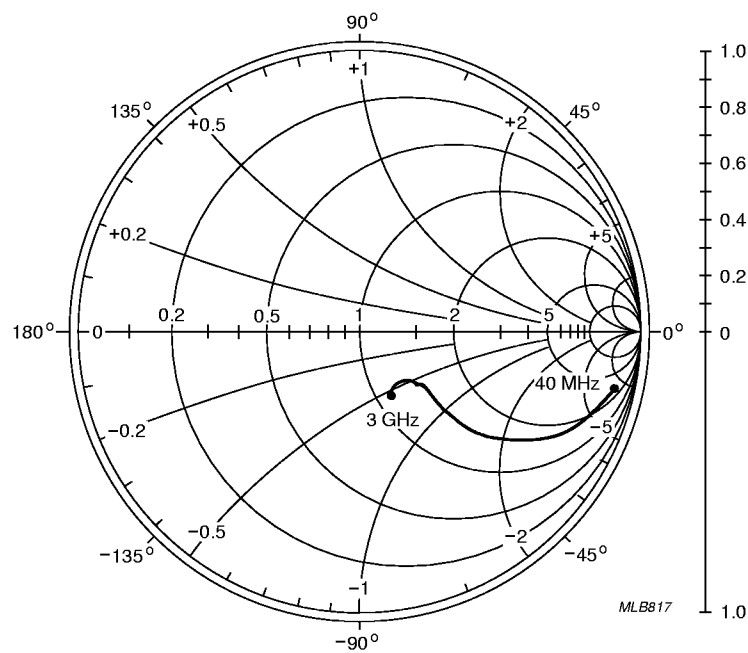
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$V_{CE} = 6\text{ V}$; $I_C = 20\text{ mA}$.

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.

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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	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.

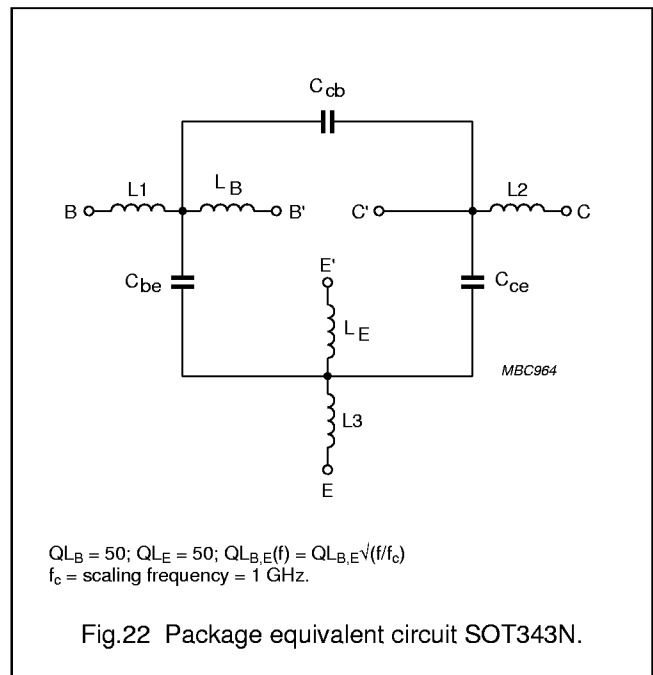


Fig.22 Package equivalent circuit SOT343N.

List of components (see Fig.22)

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 OUTLINE

Plastic surface mounted package; 4 leads

SOT343N

