

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor BFG520; BFG520/X; BFG520/XR

FEATURES

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

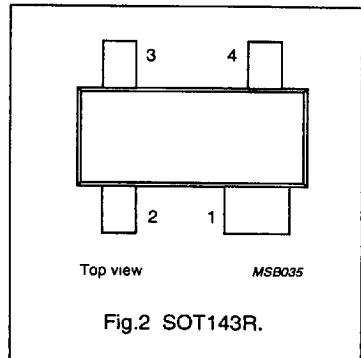
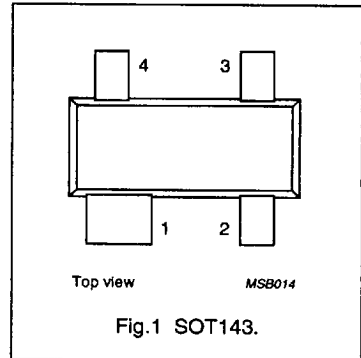
DESCRIPTION

NPN silicon planar epitaxial transistors, intended for applications in the RF frontend in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV) and repeater amplifiers in fibre-optic systems.

The transistors are encapsulated in 4-pin, dual-emitter plastic SOT143 and SOT143R envelopes.

PINNING

PIN	DESCRIPTION
BFG520 (Fig.1) Code: N36	
1	collector
2	base
3	emitter
4	emitter
BFG520/X (Fig.1) Code: N42	
1	collector
2	emitter
3	base
4	emitter
BFG520/XR (Fig.2) Code: N48	
1	collector
2	emitter
3	base
4	emitter



NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

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	DC collector current		—	—	70	mA
P_{tot}	total power dissipation	up to $T_s = 63\text{ °C}$ (note 1)	—	—	300	mW
h_{FE}	DC current gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $T_J = 25\text{ °C}$	60	120	250	
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6\text{ V}$; $f = 1\text{ MHz}$	—	0.3	—	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	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$	—	19	—	dB
		$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ °C}$	—	13	—	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$	17	18	—	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$	—	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$	—	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ °C}$	—	1.9	—	dB

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	—	20	V
V_{CEO}	collector-emitter voltage	open base	—	15	V
V_{EBO}	emitter-base voltage	open collector	—	2.5	V
I_C	DC collector current		—	70	mA
P_{tot}	total power dissipation	up to $T_s = 63\text{ °C}$ (note 1)	—	300	mW
T_{stg}	storage temperature		−65	150	°C
T_J	junction temperature		—	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j-s}$	thermal resistance from junction to soldering point	up to $T_s = 63\text{ °C}$ (note 1)	290 K/W

Note

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

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 6\text{ V}$	—	—	50	nA
h_{FE}	DC current gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$	60	120	250	
C_e	emitter capacitance	$I_C = I_E = 0$; $V_{EB} = 0.5\text{ V}$; $f = 1\text{ MHz}$	—	1	—	pF
C_c	collector capacitance	$I_E = I_C = 0$; $V_{CB} = 6\text{ V}$; $f = 1\text{ MHz}$	—	0.6	—	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6\text{ V}$; $f = 1\text{ MHz}$	—	0.3	—	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)	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	19	—	dB
		$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	13	—	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	17	18	—	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 5\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 5\text{ mA}$; $V_{CE} = 6\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	1.9	—	dB
P_{L1}	output power at 1 dB gain compression	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $R_L = 50\text{ }\Omega$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	—	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	$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $V_O = 75\text{ mV}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $f_{(p+q)} = 810\text{ MHz}$	—	-50	—	dB

Notes

- G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
- $I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $R_L = 50\text{ }\Omega$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$;
 $f_p = 900\text{ MHz}$; $f_q = 902\text{ MHz}$;
 measured at $f_{(2p-q)} = 898\text{ MHz}$ and $f_{(2q-p)} = 904\text{ MHz}$.
- $d_{im} = -60\text{ dB}$ (DIN 45004B);
 $V_p = V_O$; $V_q = V_O - 6\text{ dB}$; $V_r = V_O - 6\text{ dB}$;
 $f_p = 795.25\text{ MHz}$; $f_q = 803.25\text{ MHz}$; $f_r = 805.25\text{ MHz}$;
 measured at $f_{(p+q-r)} = 793.25\text{ MHz}$

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

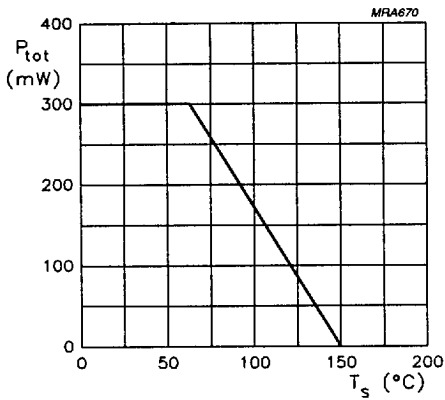
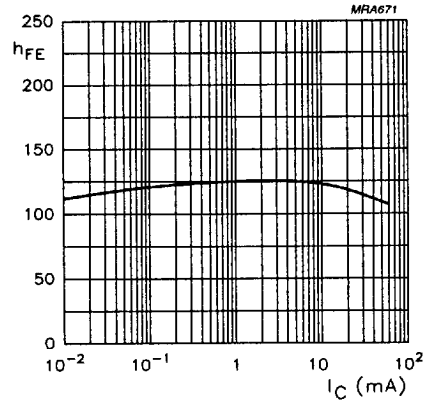
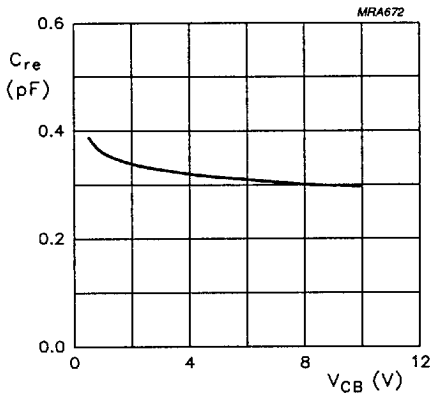


Fig.3 Power derating curve.



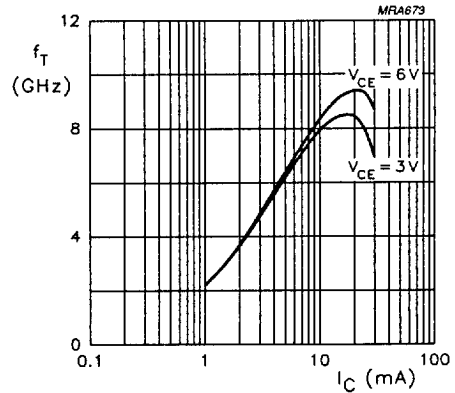
$V_{CE} = 6$ V; $T_J = 25$ °C.

Fig.4 DC current gain as a function of collector current.



$I_C = 0$; $f = 1$ MHz.

Fig.5 Feedback capacitance as a function of collector-base voltage.



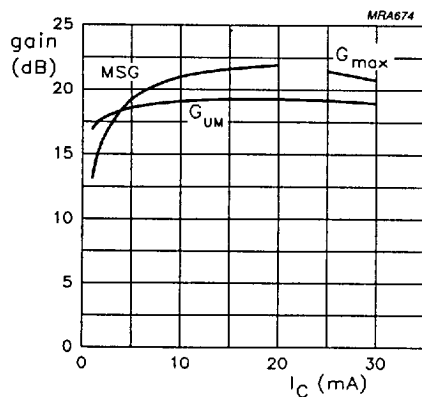
$f = 1$ GHz; $T_{amb} = 25$ °C.

Fig.6 Transition frequency as a function of collector current.

NPN 9 GHz wideband transistor

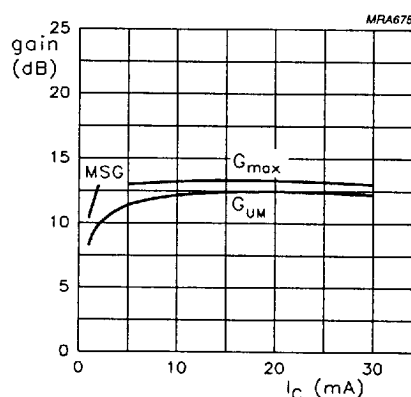
BFG520; BFG520/X; BFG520/XR

In Figs 7 to 10, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



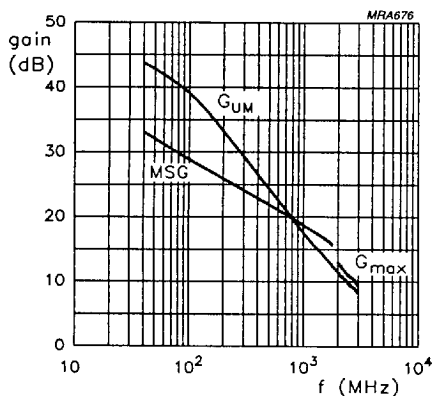
$V_{CE} = 6\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25^\circ\text{C}$.

Fig.7 Gain as a function of collector current.



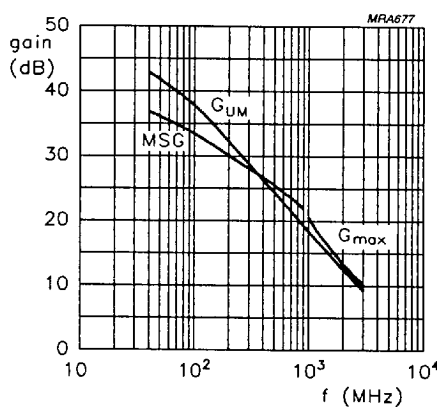
$V_{CE} = 6\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25^\circ\text{C}$.

Fig.8 Gain as a function of collector current.



$I_C = 5\text{ mA}$; $V_{CE} = 6\text{ V}$; $T_{amb} = 25^\circ\text{C}$.

Fig.9 Gain as a function of frequency.



$I_C = 20\text{ mA}$; $V_{CE} = 6\text{ V}$; $T_{amb} = 25^\circ\text{C}$.

Fig.10 Gain as a function of frequency.

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

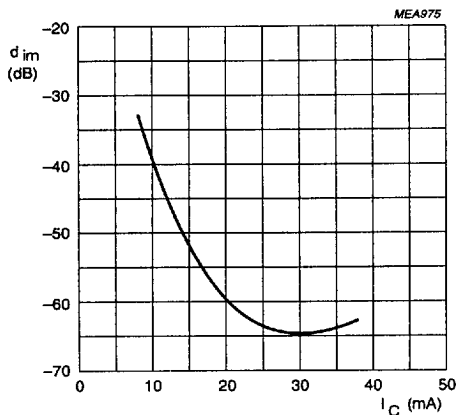


Fig.11 Intermodulation distortion as a function of collector current.

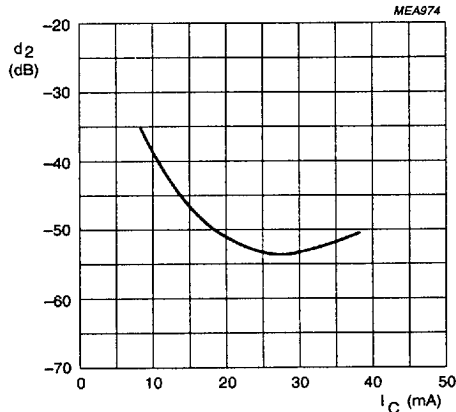


Fig.12 Second order intermodulation distortion as a function of collector current.

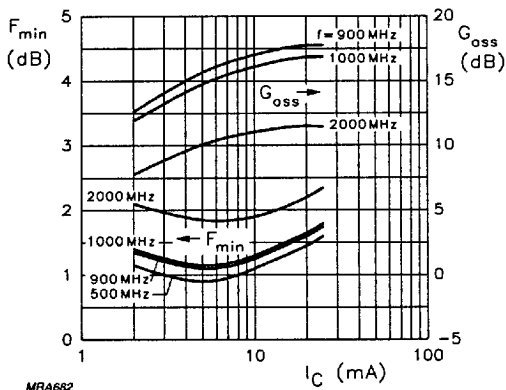
 $V_{CE} = 6$ V; $T_{amb} = 25$ °C.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.

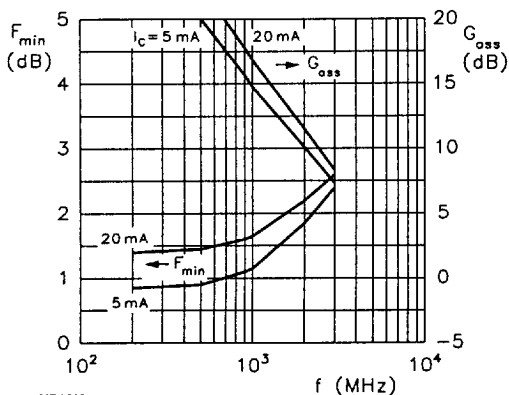
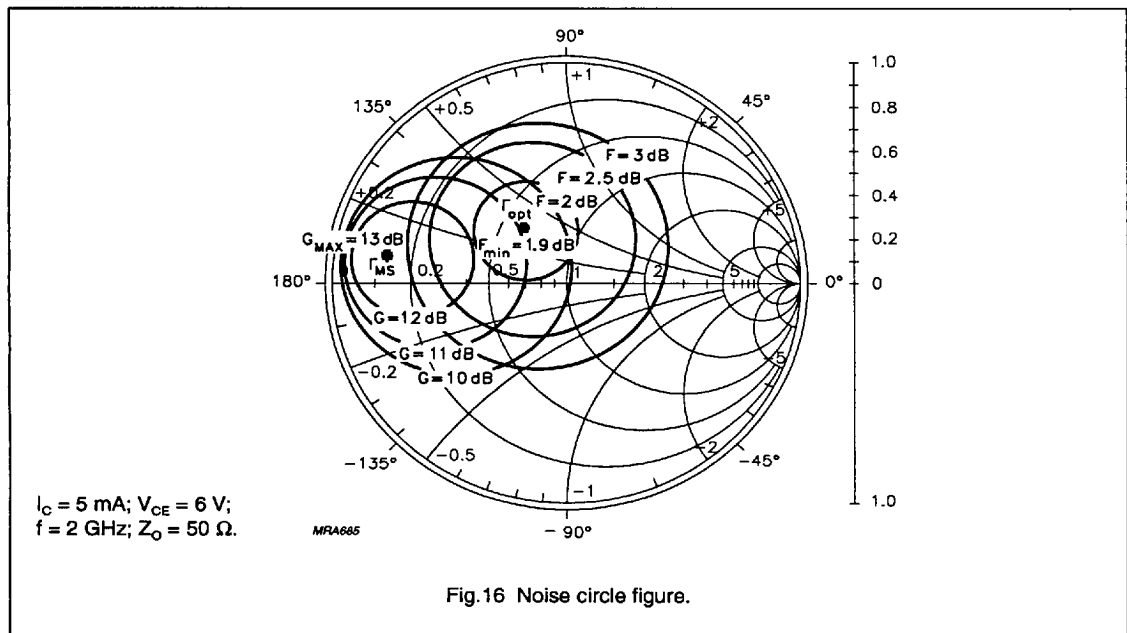
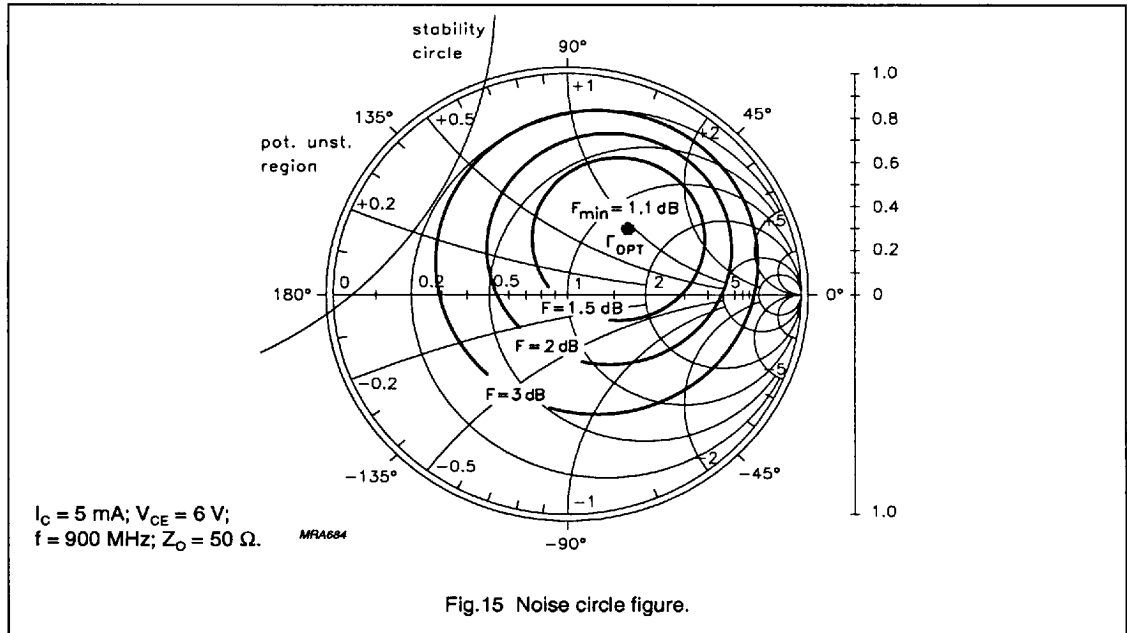
 $V_{CE} = 6$ V; $T_{amb} = 25$ °C.

Fig.14 Minimum noise figure and associated available gain as functions of frequency.

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

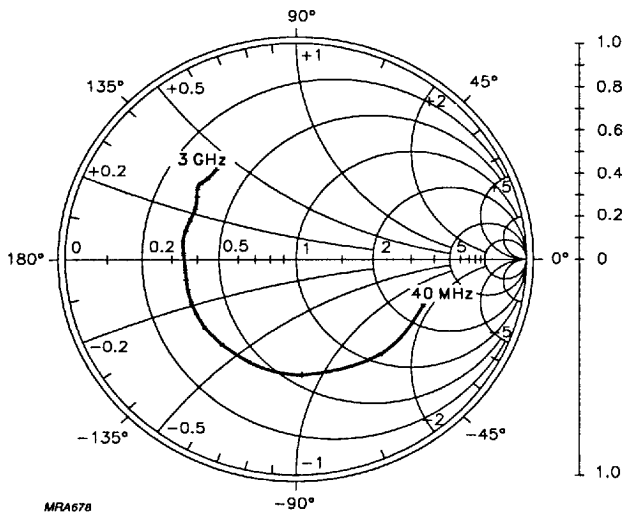
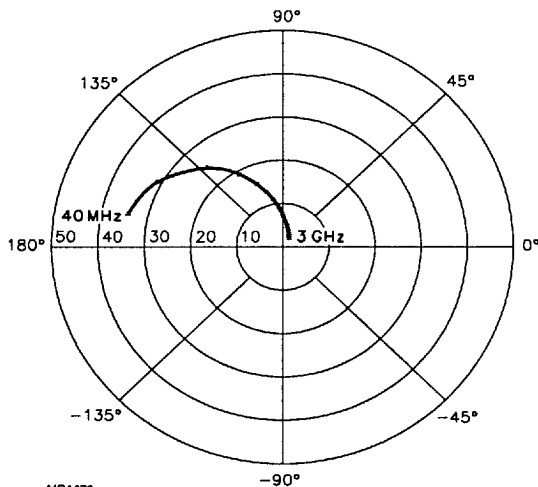
BFG520; BFG520/X; BFG520/XR

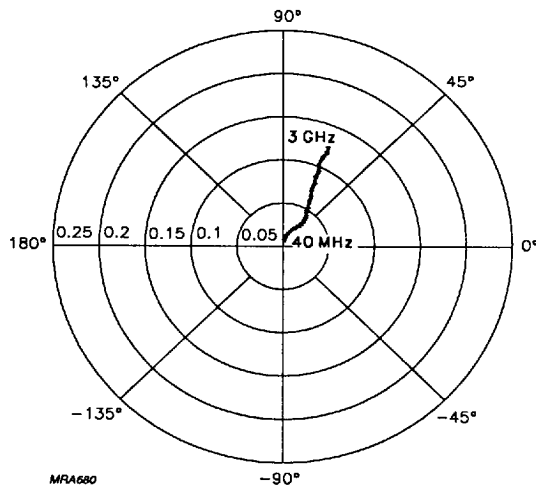
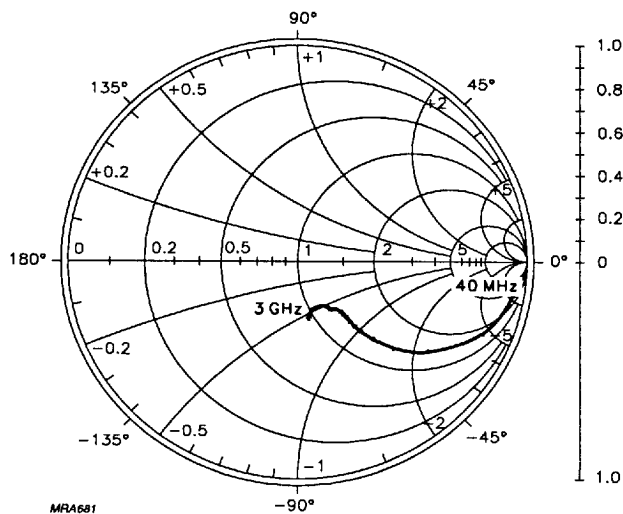


N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Fig.17 Common emitter input reflection coefficient (S_{11}).Fig.18 Common emitter forward transmission coefficient (S_{21}).

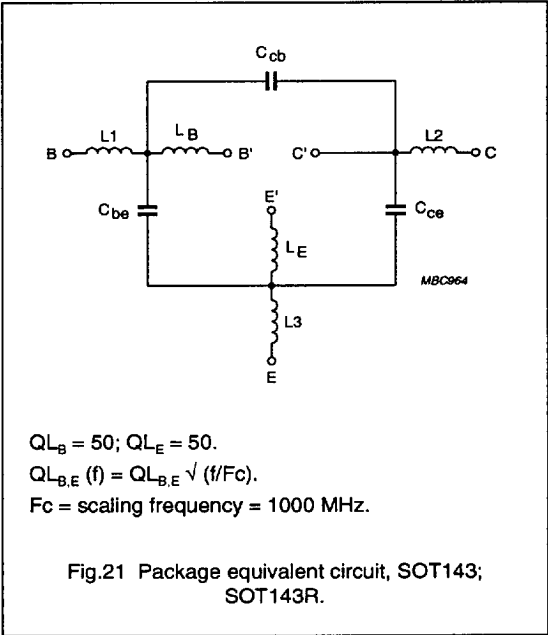
Fig.19 Common emitter reverse transmission coefficient (S_{12}).Fig.20 Common emitter output reflection coefficient (S_{22}).

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

SPICE parameters for BFR520 crystal

1	IS = 1.016	fA
2	BF = 220.1	—
3	NF = 1.000	—
4	VAF = 48.06	V
5	IKF = 510.0	mA
6	ISE = 283.0	fA
7	NE = 2.035	—
8	BR = 100.7	—
9	NR = 988.1	m
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 (note 1)	XTB = 0.000	—
20 (note 1)	EG = 1.110	EV
21 (note 1)	XTI = 3.000	—
22	CJE = 1.245	pF
23	VJE = 600.0	mV
24	MJE = 258.1	m
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 = 70.51	m
33	XCJC = 130.0	m
34	TR = 543.7	ps
35 (note 1)	CJS = 0.000	F
36 (note 1)	VJS = 750.0	mV
37 (note 1)	MJS = 0.000	—
38	FC = 780.2	m



List of components (see Fig.21)

DESIGNATION	VALUE
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

Note

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

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 1 Common emitter scattering parameters, $I_C = 2 \text{ mA}$; $V_{CE} = 3 \text{ V}$

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.903	-6.4	6.678	175.4	0.008	85.5	0.997	-2.7	46.7
100	0.895	-15.9	6.594	168.8	0.020	81.6	0.989	-7.0	40.1
200	0.873	-31.3	6.344	158.7	0.039	72.5	0.960	-13.4	33.4
300	0.845	-46.3	6.077	149.2	0.055	65.5	0.924	-19.0	29.5
400	0.814	-59.7	5.679	140.6	0.069	59.1	0.883	-24.0	26.4
500	0.788	-72.0	5.290	133.3	0.079	53.5	0.840	-28.1	24.0
600	0.760	-83.0	4.922	126.7	0.088	48.5	0.798	-31.5	22.0
700	0.736	-92.7	4.575	120.8	0.094	44.5	0.760	-34.3	20.4
800	0.707	-101.6	4.242	115.3	0.099	41.4	0.728	-36.6	18.8
900	0.677	-110.1	3.916	110.1	0.102	38.5	0.697	-38.8	17.4
1000	0.654	-117.9	3.633	105.8	0.105	36.3	0.670	-40.8	16.2
1200	0.621	-132.9	3.176	97.6	0.109	32.8	0.627	-44.5	14.3
1400	0.609	-145.6	2.850	90.1	0.111	29.6	0.602	-48.1	13.1
1600	0.601	-155.8	2.536	83.9	0.110	29.1	0.589	-50.7	11.9
1800	0.586	-165.2	2.287	79.1	0.112	28.5	0.572	-52.9	10.7
2000	0.574	-174.6	2.078	74.3	0.109	28.4	0.547	-55.5	9.6
2200	0.579	176.3	1.913	69.9	0.108	28.2	0.525	-60.0	8.8
2400	0.594	169.1	1.748	64.2	0.105	29.7	0.525	-65.5	8.1
2600	0.602	163.4	1.607	60.8	0.107	31.9	0.541	-69.7	7.6
2800	0.600	157.6	1.535	56.7	0.107	32.9	0.553	-71.8	7.2
3000	0.601	150.6	1.420	53.0	0.106	36.2	0.545	-73.9	6.5

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 2 Common emitter scattering parameters, $I_C = 5$ mA; $V_{CE} = 3$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.799	-10.3	14.524	173.1	0.008	84.1	0.989	-4.8	44.4
100	0.783	-25.3	14.070	163.5	0.019	77.0	0.965	-11.9	38.8
200	0.743	-48.5	12.891	149.4	0.034	66.6	0.894	-21.9	32.7
300	0.700	-69.2	11.585	137.5	0.046	58.1	0.813	-29.7	28.9
400	0.664	-86.3	10.193	128.0	0.055	52.3	0.736	-35.4	26.1
500	0.638	-100.5	9.020	120.4	0.060	47.6	0.670	-39.5	24.0
600	0.615	-112.1	8.033	114.1	0.065	44.7	0.615	-42.2	22.2
700	0.598	-121.7	7.204	108.9	0.068	42.6	0.571	-44.2	20.8
800	0.577	-130.4	6.491	104.2	0.070	41.7	0.535	-45.8	19.5
900	0.560	-138.4	5.868	100.1	0.072	41.1	0.504	-47.1	18.3
1000	0.546	-145.4	5.356	96.7	0.074	40.9	0.479	-48.4	17.2
1200	0.535	-158.4	4.556	90.3	0.078	40.6	0.442	-51.1	15.6
1400	0.536	-168.8	3.989	84.4	0.080	41.1	0.422	-54.0	14.3
1600	0.534	-176.7	3.507	79.5	0.083	43.4	0.413	-55.8	13.2
1800	0.527	175.3	3.144	75.5	0.088	44.4	0.402	-56.9	12.1
2000	0.524	167.1	2.847	71.7	0.090	46.6	0.380	-58.8	11.2
2200	0.540	159.7	2.610	68.2	0.094	47.7	0.360	-63.5	10.4
2400	0.558	154.5	2.372	63.8	0.096	50.1	0.360	-69.8	9.7
2600	0.565	150.3	2.183	60.9	0.104	51.9	0.380	-74.2	9.1
2800	0.559	145.5	2.065	57.2	0.109	52.4	0.392	-75.7	8.7
3000	0.565	139.3	1.918	54.1	0.113	54.8	0.386	-77.1	8.0

Table 3 Noise data, $I_C = 5$ mA; $V_{CE} = 3$ V

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	0.90	0.396	29.0	0.240
900	1.10	0.334	50.0	0.260
1000	1.15	0.355	55.0	0.260
2000	1.85	0.275	130.0	0.160

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 4 Common emitter scattering parameters, $I_C = 10 \text{ mA}$; $V_{CE} = 3 \text{ V}$

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.668	-15.5	23.878	170.3	0.007	81.8	0.977	-7.2	43.5
100	0.648	-38.0	22.433	157.3	0.017	73.4	0.926	-17.5	37.9
200	0.608	-69.8	19.090	139.8	0.029	61.1	0.801	-30.4	32.1
300	0.578	-94.6	15.944	126.9	0.037	53.9	0.684	-38.7	28.6
400	0.559	-112.5	13.292	117.8	0.042	50.3	0.592	-43.8	26.0
500	0.548	-126.0	11.320	110.9	0.045	47.5	0.524	-46.9	24.0
600	0.538	-136.3	9.809	105.5	0.049	46.9	0.473	-48.6	22.4
700	0.530	-144.3	8.626	101.0	0.051	47.1	0.434	-49.7	21.1
800	0.521	-151.7	7.669	97.2	0.054	47.8	0.405	-50.4	19.8
900	0.513	-158.5	6.874	93.9	0.056	49.0	0.380	-51.1	18.7
1000	0.507	-164.4	6.235	91.1	0.059	50.2	0.360	-51.9	17.8
1200	0.509	-174.9	5.249	85.9	0.064	51.5	0.332	-54.1	16.2
1400	0.517	177.1	4.552	80.9	0.069	53.0	0.320	-56.9	15.0
1600	0.517	170.7	3.987	76.8	0.075	56.2	0.316	-58.3	13.8
1800	0.513	163.7	3.566	73.2	0.082	57.1	0.308	-58.9	12.8
2000	0.514	156.4	3.228	70.0	0.087	59.0	0.289	-60.4	11.9
2200	0.534	150.2	2.952	66.8	0.094	59.6	0.270	-65.9	11.2
2400	0.553	146.2	2.680	63.2	0.098	61.3	0.273	-73.3	10.5
2600	0.559	143.0	2.469	60.5	0.108	61.9	0.294	-78.0	9.9
2800	0.551	138.8	2.324	57.2	0.115	61.5	0.308	-79.1	9.3
3000	0.557	132.8	2.162	54.2	0.121	62.8	0.302	-80.1	8.7

Table 5 Noise data, $I_C = 10 \text{ mA}$; $V_{CE} = 3 \text{ V}$

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	1.10	0.260	27.0	0.220
900	1.25	0.231	54.0	0.220
1000	1.30	0.240	58.0	0.240
2000	1.90	0.245	148.0	0.140

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 6 Common emitter scattering parameters, $I_C = 15 \text{ mA}$; $V_{CE} = 3 \text{ V}$

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.570	-20.7	30.262	168.2	0.007	80.6	0.964	-9.0	42.8
100	0.557	-49.3	27.641	152.7	0.015	71.7	0.890	-21.4	37.3
200	0.535	-86.5	22.173	133.7	0.026	58.7	0.731	-35.3	31.7
300	0.527	-111.9	17.699	120.8	0.032	52.8	0.601	-43.0	28.3
400	0.522	-128.6	14.354	112.3	0.036	50.8	0.511	-47.1	25.8
500	0.523	-140.5	12.018	106.0	0.039	49.8	0.449	-49.3	24.0
600	0.519	-149.3	10.302	101.2	0.042	50.4	0.404	-50.3	22.4
700	0.516	-156.1	8.995	97.2	0.045	51.4	0.372	-50.8	21.1
800	0.511	-162.5	7.959	93.8	0.048	52.8	0.347	-51.0	19.9
900	0.507	-168.4	7.116	90.8	0.050	54.8	0.327	-51.4	18.8
1000	0.504	-173.5	6.441	88.4	0.054	56.2	0.311	-52.0	17.9
1200	0.510	177.4	5.404	83.7	0.060	57.9	0.289	-54.2	16.3
1400	0.518	170.7	4.671	79.1	0.066	59.6	0.280	-57.0	15.1
1600	0.519	165.2	4.085	75.2	0.073	62.1	0.279	-58.4	13.9
1800	0.516	158.6	3.653	71.8	0.081	62.6	0.274	-58.9	12.9
2000	0.520	151.8	3.308	68.7	0.087	64.3	0.255	-60.3	12.1
2200	0.541	146.3	3.024	65.8	0.094	64.3	0.238	-66.3	11.4
2400	0.560	142.7	2.747	62.4	0.100	65.9	0.242	-74.5	10.7
2600	0.564	139.8	2.528	59.8	0.110	66.1	0.264	-79.5	10.0
2800	0.557	135.8	2.377	56.5	0.118	65.0	0.278	-80.4	9.5
3000	0.562	130.1	2.212	53.7	0.124	66.2	0.273	-81.2	8.9

Table 7 Noise data, $I_C = 15 \text{ mA}$; $V_{CE} = 3 \text{ V}$

f (MHz)	F _{min} (dB)	Γ _{opt}		R _n
		(RAT)	(DEG)	
500	1.30	0.161	31.0	0.210
900	1.45	0.155	63.0	0.200
1000	1.50	0.160	67.0	0.230
2000	2.05	0.230	165.0	0.140

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 8 Common emitter scattering parameters, $I_C = 20$ mA; $V_{CE} = 3$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.503	-25.2	34.613	166.5	0.006	78.4	0.950	-10.3	42.1
100	0.501	-59.1	30.839	149.3	0.014	68.8	0.858	-23.8	36.8
200	0.501	-98.9	23.669	129.5	0.023	57.2	0.679	-37.9	31.4
300	0.508	-123.2	18.370	117.0	0.028	53.0	0.547	-44.6	28.1
400	0.513	-138.4	14.678	109.0	0.032	52.7	0.463	-47.8	25.7
500	0.516	-148.9	12.176	103.2	0.035	52.1	0.406	-49.3	23.8
600	0.517	-156.7	10.381	98.7	0.039	53.2	0.368	-49.6	22.3
700	0.515	-162.8	9.027	95.0	0.041	54.8	0.340	-49.8	21.0
800	0.512	-168.5	7.974	91.8	0.044	56.8	0.319	-49.7	19.8
900	0.509	-173.8	7.115	89.0	0.048	59.0	0.303	-49.8	18.8
1000	0.508	-178.5	6.434	86.7	0.051	59.8	0.289	-50.4	17.8
1200	0.516	173.3	5.390	82.2	0.058	62.2	0.270	-52.6	16.3
1400	0.525	167.2	4.652	77.9	0.064	63.3	0.264	-55.5	15.1
1600	0.525	162.0	4.064	74.1	0.072	65.7	0.264	-57.0	13.9
1800	0.523	155.7	3.634	70.8	0.080	65.8	0.261	-57.4	12.9
2000	0.528	149.4	3.289	67.8	0.087	67.1	0.244	-59.1	12.0
2200	0.550	144.1	3.006	64.9	0.095	67.2	0.228	-65.1	11.4
2400	0.566	140.9	2.729	61.6	0.101	68.4	0.232	-73.7	10.6
2600	0.570	138.0	2.511	59.0	0.111	68.4	0.254	-79.0	10.0
2800	0.564	134.1	2.359	55.8	0.119	67.2	0.270	-80.0	9.4
3000	0.570	128.4	2.196	53.0	0.125	67.9	0.265	-80.8	8.8

Table 9 Noise data, $I_C = 20$ mA; $V_{CE} = 3$ V

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	1.45	0.103	38.0	0.210
900	1.60	0.104	84.0	0.220
1000	1.65	0.118	84.0	0.240
2000	2.20	0.231	-177.0	0.160

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 10 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 3$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.405	-37.6	38.295	163.1	0.007	75.3	0.907	-12.4	40.0
100	0.445	-80.9	32.269	142.8	0.013	64.8	0.781	-27.2	35.2
200	0.494	-120.9	22.824	122.3	0.021	54.9	0.583	-39.4	30.2
300	0.523	-141.4	16.960	110.8	0.024	52.4	0.465	-43.3	27.0
400	0.534	-153.3	13.272	103.6	0.027	54.0	0.399	-44.2	24.7
500	0.541	-161.4	10.877	98.4	0.031	55.0	0.357	-44.3	22.8
600	0.544	-167.4	9.206	94.4	0.034	57.2	0.331	-43.7	21.3
700	0.542	-172.3	7.970	91.1	0.037	59.0	0.314	-43.5	20.0
800	0.541	-177.1	7.019	88.2	0.041	61.1	0.300	-43.2	18.8
900	0.541	178.5	6.255	85.6	0.044	63.2	0.290	-43.4	17.8
1000	0.541	174.6	5.650	83.4	0.048	64.8	0.280	-44.1	16.9
1200	0.551	167.7	4.721	79.1	0.055	66.4	0.269	-46.6	15.4
1400	0.558	162.5	4.070	74.9	0.062	67.7	0.266	-50.1	14.1
1600	0.558	157.8	3.553	71.2	0.070	69.7	0.270	-52.3	13.0
1800	0.555	152.0	3.172	67.8	0.079	69.5	0.270	-53.4	12.0
2000	0.564	146.1	2.871	64.8	0.086	70.9	0.256	-55.5	11.1
2200	0.584	141.4	2.622	61.9	0.094	71.0	0.241	-61.8	10.4
2400	0.602	138.4	2.383	58.5	0.100	72.0	0.245	-70.4	9.8
2600	0.602	135.8	2.189	56.0	0.111	71.6	0.269	-76.2	9.1
2800	0.595	131.8	2.055	52.6	0.119	69.8	0.285	-77.6	8.5
3000	0.602	126.5	1.912	49.8	0.126	70.8	0.281	-78.9	7.9

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 11 Common emitter scattering parameters, $I_C = 2 \text{ mA}$; $V_{CE} = 6 \text{ V}$

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.910	-6.1	6.548	175.5	0.008	84.5	0.994	-2.6	43.5
100	0.903	-15.2	6.463	169.3	0.019	81.8	0.987	-6.5	39.6
200	0.881	-30.0	6.260	159.5	0.037	73.5	0.963	-12.6	33.8
300	0.853	-44.4	6.009	150.0	0.053	66.4	0.929	-18.1	29.8
400	0.824	-57.5	5.629	141.9	0.066	60.2	0.890	-22.8	26.7
500	0.797	-69.6	5.286	134.6	0.076	54.4	0.850	-26.9	24.4
600	0.768	-80.4	4.922	128.0	0.085	49.7	0.811	-30.3	22.4
700	0.745	-89.9	4.589	122.3	0.092	45.7	0.774	-33.1	20.7
800	0.714	-98.9	4.268	116.6	0.097	42.3	0.742	-35.5	19.2
900	0.684	-107.1	3.941	111.4	0.100	39.5	0.711	-37.6	17.7
1000	0.661	-115.0	3.672	107.1	0.103	37.2	0.684	-39.6	16.5
1200	0.623	-130.0	3.213	98.9	0.107	33.3	0.641	-43.4	14.6
1400	0.609	-143.0	2.888	91.3	0.109	30.1	0.617	-47.0	13.3
1600	0.601	-153.4	2.576	85.0	0.109	29.7	0.602	-49.6	12.1
1800	0.585	-162.9	2.326	80.2	0.110	29.2	0.585	-51.7	11.0
2000	0.570	-172.4	2.111	75.5	0.108	28.8	0.559	-54.3	9.8
2200	0.574	178.1	1.944	71.0	0.107	28.8	0.538	-58.7	9.0
2400	0.589	170.7	1.781	65.2	0.103	29.7	0.537	-64.0	8.3
2600	0.597	164.7	1.640	61.8	0.106	31.9	0.553	-68.2	7.8
2800	0.594	158.8	1.567	57.8	0.106	33.1	0.564	-70.4	7.5
3000	0.595	151.9	1.448	54.0	0.104	36.6	0.558	-72.4	6.7

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 12 Common emitter scattering parameters, $I_C = 5$ mA; $V_{CE} = 6$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.816	-9.6	14.372	173.3	0.007	84.3	0.987	-4.5	43.7
100	0.802	-23.7	13.946	164.2	0.018	78.1	0.966	-11.1	39.1
200	0.761	-45.9	12.883	150.6	0.033	67.3	0.901	-20.8	33.2
300	0.716	-65.9	11.658	138.8	0.045	59.2	0.824	-28.3	29.4
400	0.676	-82.4	10.313	129.5	0.053	53.4	0.750	-34.0	26.5
500	0.647	-96.6	9.188	121.9	0.059	48.8	0.686	-38.2	24.4
600	0.621	-108.1	8.202	115.5	0.064	45.8	0.632	-41.1	22.6
700	0.601	-117.8	7.379	110.3	0.067	43.2	0.587	-43.1	21.1
800	0.577	-126.6	6.665	105.5	0.070	42.3	0.552	-44.7	19.8
900	0.557	-134.5	6.028	101.3	0.072	41.6	0.519	-46.0	18.6
1000	0.542	-141.8	5.513	97.9	0.074	41.4	0.493	-47.3	17.6
1200	0.527	-155.4	4.695	91.4	0.077	41.0	0.455	-50.1	15.9
1400	0.527	-166.0	4.116	85.4	0.080	41.1	0.435	-53.0	14.6
1600	0.525	-174.4	3.623	80.5	0.083	43.3	0.425	-54.6	13.4
1800	0.516	177.5	3.250	76.5	0.088	44.6	0.412	-55.8	12.4
2000	0.512	169.1	2.941	72.8	0.089	46.6	0.390	-57.6	11.4
2200	0.526	161.4	2.695	69.2	0.093	47.4	0.370	-62.1	10.7
2400	0.546	155.8	2.454	64.8	0.096	49.9	0.370	-68.0	10.0
2600	0.553	151.7	2.259	61.9	0.103	51.8	0.387	-72.5	9.4
2800	0.548	146.7	2.138	58.3	0.108	52.2	0.400	-74.2	8.9
3000	0.552	140.3	1.982	55.1	0.111	54.5	0.395	-75.4	8.3

Table 13 Noise data, $I_C = 5$ mA; $V_{CE} = 6$ V

f (MHz)	F _{min} (dB)	Γ _{opt}		R _n
		(RAT)	(DEG)	
500	0.90	0.439	29.0	0.270
900	1.10	0.395	49.0	0.280
1000	1.15	0.400	53.0	0.290
2000	1.85	0.312	126.0	0.170

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 14 Common emitter scattering parameters, $I_C = 10$ mA; $V_{CE} = 6$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.711	-14.1	23.473	170.8	0.007	82.3	0.974	-6.8	43.5
100	0.690	-34.5	22.218	158.5	0.016	74.0	0.931	-16.3	38.5
200	0.640	-64.3	19.183	141.5	0.029	62.4	0.816	-28.8	32.7
300	0.597	-88.3	16.207	128.8	0.037	54.2	0.703	-37.1	29.1
400	0.569	-106.1	13.627	119.5	0.042	50.9	0.613	-42.4	26.4
500	0.553	-119.9	11.673	112.5	0.046	48.6	0.544	-45.7	24.5
600	0.538	-130.7	10.152	107.0	0.050	47.2	0.493	-47.6	22.8
700	0.526	-139.2	8.947	102.5	0.052	47.1	0.453	-48.8	21.4
800	0.514	-146.7	7.968	98.6	0.055	47.9	0.422	-49.5	20.2
900	0.503	-154.1	7.148	95.1	0.057	48.8	0.396	-50.2	19.1
1000	0.495	-160.2	6.488	92.4	0.059	49.7	0.374	-51.1	18.1
1200	0.494	-171.7	5.468	87.0	0.065	51.3	0.344	-53.4	16.5
1400	0.500	-131.8	4.748	82.0	0.069	52.5	0.331	-56.1	15.3
1600	0.500	173.3	4.159	77.8	0.075	55.2	0.326	-57.3	14.1
1800	0.494	166.0	3.722	74.3	0.082	56.4	0.317	-57.9	13.1
2000	0.496	158.4	3.368	71.0	0.087	58.2	0.297	-59.5	12.2
2200	0.515	151.9	3.080	67.9	0.093	59.0	0.279	-64.4	11.5
2400	0.535	147.6	2.798	64.2	0.097	60.7	0.280	-71.4	10.8
2600	0.540	144.2	2.579	61.6	0.107	61.3	0.298	-76.3	10.1
2800	0.534	139.8	2.428	58.2	0.114	60.9	0.313	-77.7	9.6
3000	0.541	133.9	2.259	55.3	0.120	62.3	0.309	-78.3	9.0

Table 15 Noise data, $I_C = 10$ mA; $V_{CE} = 6$ V

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	1.10	0.330	27.0	0.250
900	1.25	0.294	48.0	0.260
1000	1.30	0.298	52.0	0.270
2000	1.90	0.242	134.0	0.160

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 16 Common emitter scattering parameters, $I_C = 15$ mA; $V_{CE} = 6$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.642	-17.7	29.807	168.9	0.007	80.7	0.964	-8.4	43.3
100	0.620	-43.0	27.554	154.5	0.015	71.9	0.900	-19.7	38.1
200	0.573	-77.3	22.604	135.9	0.026	60.1	0.753	-33.4	32.4
300	0.544	-102.6	18.314	123.1	0.032	53.2	0.627	-41.5	28.9
400	0.526	-120.0	14.988	114.4	0.037	51.6	0.536	-46.0	26.4
500	0.519	-132.7	12.629	108.0	0.040	50.0	0.471	-48.6	24.5
600	0.510	-142.4	10.858	103.0	0.043	50.0	0.425	-49.9	22.9
700	0.503	-149.9	9.497	98.9	0.046	50.9	0.390	-50.4	21.5
800	0.495	-156.9	8.418	95.3	0.049	52.3	0.364	-50.7	20.3
900	0.488	-163.2	7.526	92.3	0.052	54.1	0.341	-51.1	19.2
1000	0.484	-168.8	6.819	89.8	0.055	55.5	0.323	-51.7	18.3
1200	0.487	-178.8	5.725	85.0	0.061	57.1	0.298	-53.9	16.7
1400	0.496	173.9	4.955	80.4	0.066	58.6	0.289	-56.6	15.5
1600	0.495	167.9	4.335	76.5	0.073	61.1	0.286	-57.8	14.3
1800	0.491	160.9	3.877	73.1	0.082	61.6	0.279	-58.0	13.3
2000	0.495	153.8	3.507	70.1	0.088	63.2	0.260	-59.6	12.4
2200	0.515	147.8	3.205	67.1	0.094	63.3	0.244	-65.0	11.7
2400	0.535	144.1	2.913	63.7	0.099	64.8	0.245	-72.9	11.0
2600	0.540	141.1	2.684	61.1	0.110	64.9	0.266	-78.1	10.4
2800	0.533	136.9	2.522	57.9	0.117	64.2	0.281	-79.1	9.8
3000	0.539	131.1	2.348	55.1	0.123	65.2	0.276	-79.5	9.3

Table 17 Noise data, $I_C = 15$ mA; $V_{CE} = 6$ V

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	1.30	0.256	27.0	0.250
900	1.45	0.228	52.0	0.250
1000	1.50	0.233	57.0	0.280
2000	2.05	0.215	147.0	0.170

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 18 Common emitter scattering parameters, $I_C = 20$ mA; $V_{CE} = 6$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.592	-20.9	34.283	167.4	0.007	78.3	0.953	-9.5	43.0
100	0.572	-49.9	31.035	151.5	0.014	70.8	0.874	-22.2	37.8
200	0.536	-87.3	24.483	132.1	0.024	59.1	0.706	-36.1	32.2
300	0.518	-112.5	19.296	119.4	0.030	53.3	0.576	-43.6	28.8
400	0.508	-129.0	15.549	111.2	0.033	52.2	0.488	-47.4	26.3
500	0.506	-140.8	12.978	105.2	0.036	51.5	0.428	-49.4	24.4
600	0.500	-149.6	11.093	100.5	0.040	52.5	0.387	-50.1	22.9
700	0.496	-156.3	9.666	96.7	0.042	53.6	0.356	-50.3	21.5
800	0.490	-162.7	8.549	93.4	0.045	55.7	0.333	-50.3	20.3
900	0.485	-168.6	7.631	90.6	0.049	57.7	0.313	-50.5	19.3
1000	0.482	-173.7	6.909	88.2	0.052	58.5	0.298	-50.9	18.3
1200	0.488	177.1	5.790	83.6	0.059	60.8	0.276	-53.2	16.8
1400	0.496	170.4	5.002	79.3	0.065	61.9	0.269	-56.0	15.5
1600	0.497	164.8	4.374	75.5	0.072	64.3	0.268	-57.0	14.4
1800	0.493	158.1	3.910	72.2	0.081	64.6	0.263	-57.2	13.4
2000	0.496	151.4	3.537	69.3	0.088	66.0	0.245	-58.9	12.5
2200	0.519	145.7	3.233	66.4	0.095	65.7	0.229	-64.6	11.8
2400	0.539	142.3	2.936	63.1	0.101	67.1	0.231	-72.8	11.1
2600	0.543	139.4	2.705	60.6	0.111	67.1	0.252	-78.3	10.4
2800	0.535	135.4	2.542	57.5	0.118	66.0	0.267	-79.3	9.9
3000	0.541	129.7	2.367	54.6	0.125	66.9	0.263	-79.7	9.3

Table 19 Noise data, $I_C = 20$ mA; $V_{CE} = 6$ V

f (MHz)	F _{min} (dB)	Γ_{opt}		R _n
		(RAT)	(DEG)	
500	1.45	0.204	28.0	0.250
900	1.60	0.183	56.0	0.260
1000	1.65	0.190	61.0	0.270
2000	2.20	0.216	156.0	0.170

N AMER PHILIPS/DISCRETE 67E D

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Table 20 Common emitter scattering parameters, $I_C = 30$ mA; $V_{CE} = 6$ V

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		G _{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.532	-26.6	39.491	165.1	0.006	76.9	0.932	-11.1	42.2
100	0.520	-61.8	34.496	146.9	0.014	67.5	0.828	-25.0	37.1
200	0.505	-101.9	25.639	126.7	0.022	56.6	0.638	-38.4	31.7
300	0.502	-126.0	19.503	114.5	0.026	53.0	0.511	-44.1	28.4
400	0.502	-140.6	15.434	107.0	0.030	53.5	0.433	-46.4	25.9
500	0.504	-150.7	12.756	101.5	0.033	54.3	0.383	-47.2	24.1
600	0.501	-158.4	10.828	97.2	0.036	55.9	0.350	-47.2	22.5
700	0.498	-164.2	9.398	93.8	0.039	57.7	0.326	-46.9	21.2
800	0.495	-169.8	8.287	90.7	0.042	59.8	0.309	-46.5	20.0
900	0.492	-175.0	7.386	88.1	0.046	61.4	0.294	-46.5	19.0
1000	0.491	-179.7	6.680	85.9	0.050	62.7	0.281	-47.0	18.1
1200	0.499	172.3	5.587	81.6	0.057	64.3	0.266	-49.2	16.5
1400	0.507	166.4	4.820	77.4	0.064	65.5	0.261	-52.3	15.3
1600	0.508	161.2	4.210	73.7	0.071	67.8	0.263	-53.7	14.1
1800	0.504	155.0	3.763	70.5	0.080	67.7	0.260	-54.2	13.1
2000	0.511	148.6	3.403	67.6	0.087	68.8	0.244	-55.9	12.2
2200	0.532	143.3	3.110	64.8	0.095	68.7	0.229	-61.7	11.5
2400	0.551	140.2	2.826	61.5	0.100	69.8	0.231	-70.1	10.8
2600	0.554	137.6	2.602	59.0	0.111	69.6	0.252	-75.9	10.2
2800	0.546	133.5	2.442	55.9	0.119	68.1	0.269	-77.2	9.6
3000	0.554	128.0	2.274	53.1	0.125	68.9	0.266	-77.8	9.0