NPN 7 GHz wideband transistor

BFG197W
BFG197W/X; BFG197W/XR

FEATURES

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

APPLICATIONS

They are intended primarily for wideband applications in the GHz range such as satellite television systems and repeater amplifiers in fibre-optic systems.

DESCRIPTION

Silicon NPN transistors in plastic, 4-pin dual-emitter SOT343 and SOT343R packages.

MARKING

TYPE NUMBER	CODE
BFG197W	V5
BFG197W/X	V8
BFG197W/XR	V9

PINNING

PIN	DESCRIPTION
BFG197W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG197W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG197W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

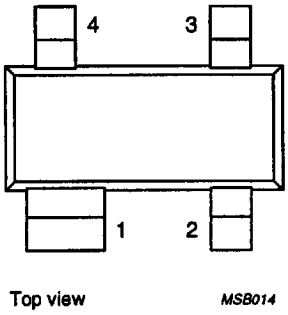


Fig.1 SOT343.

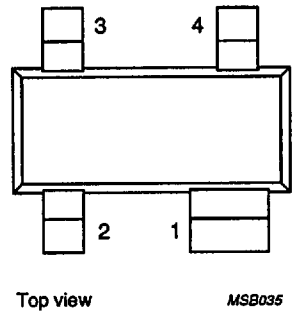


Fig.2 SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	–	10	V
I_C	collector current (DC)		–	–	100	mA
P_{tot}	total power dissipation	up to T_s = 60 °C	–	–	500	mW
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	110	–	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.75	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	14	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	I_C = 30 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 500 MHz	–	1.7	–	dB

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_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	100	mA
P_{tot}	total power dissipation	up to T_s = 60 °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
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 60 °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.

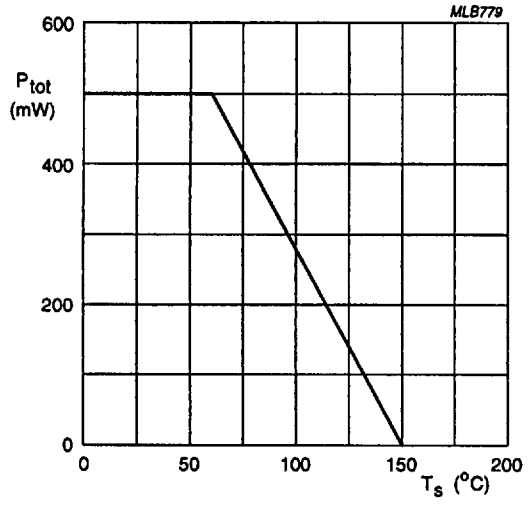


Fig.3 Power derating curve.

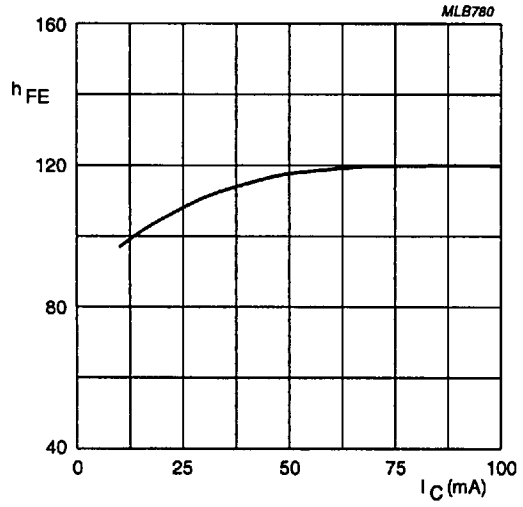
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.05 mA; I_E = 0	–	–	20	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	–	–	10	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.05 mA; I_C = 0	–	–	2.5	V
I_{CBO}	collector cut-off current	open emitter; I_E = 0; V_{CB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	40	110	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	3.3	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.75	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 4 V; f = 2 GHz; T_{amb} = 25 °C	–	7.5	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz; T_{amb} = 25 °C	–	14	–	dB
		I_C = 50 mA; V_{CE} = 6 V; f = 2 GHz; T_{amb} = 25 °C	–	9	–	dB
$\lvert s_{21}\rvert^2$	insertion power gain	I_C = 30 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 500 MHz	–	1.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 1 GHz	–	2.4	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 50 mA; V_{CE} = 6 V; f = 2 GHz	–	3.5	–	dB
V_o	output voltage	note 2	–	700	–	mV
d_2	second order intermodulation distortion	note 3	–	–55	–	dB

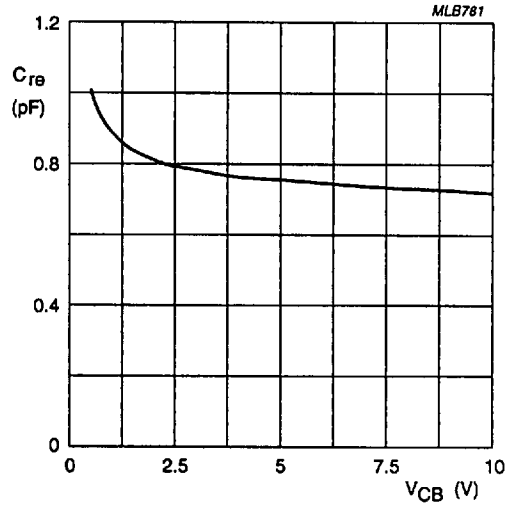
Notes

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.
2. d_{im} = –60 dB (DIN45004B); T_{amb} = 25 °C; I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB; f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_{(p+q-r)}$ = 793.25 MHz.
3. I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz.



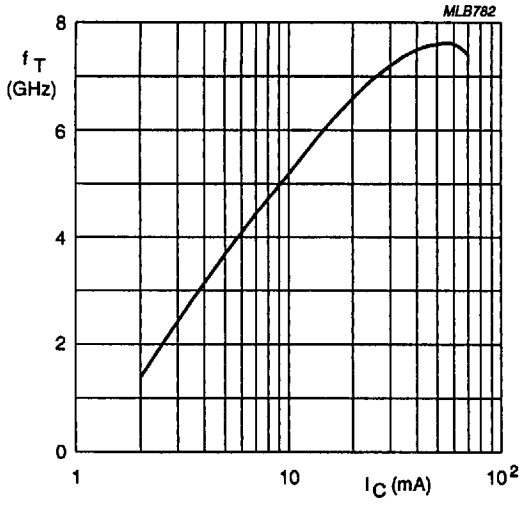
V_{CE} = 4 V.

Fig.4 DC current gain as a function of collector current; typical values.



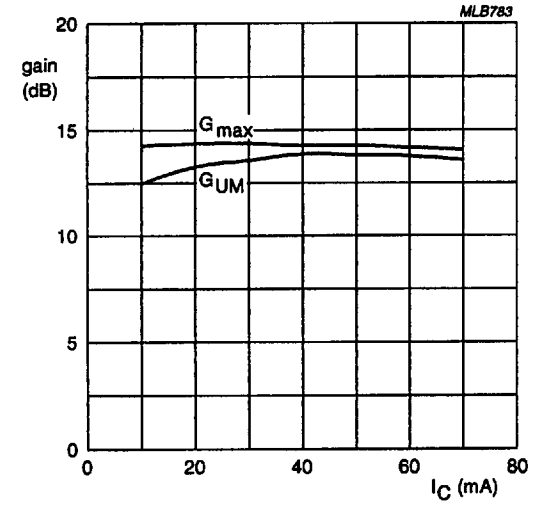
I_C = 0; f = 1 MHz.

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



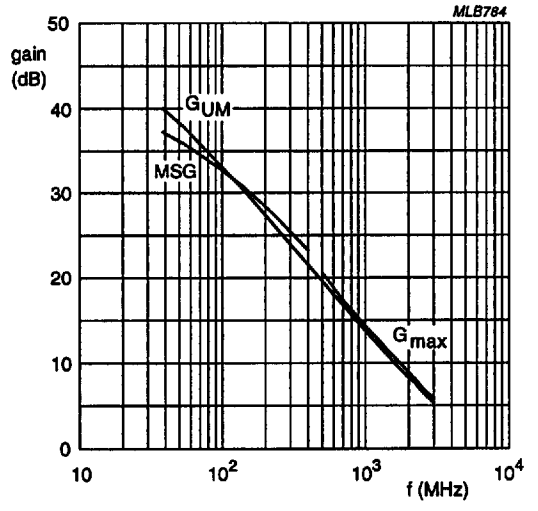
f = 2 GHz; V_{CE} = 4 V; T_{amb} = 25 °C.

Fig.6 Transition frequency as a function of collector current; typical values.



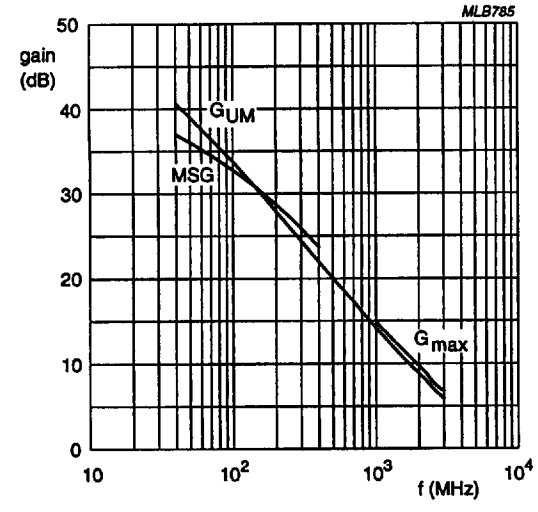
$f = 1$ GHz; $V_{CE} = 4$ V.

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



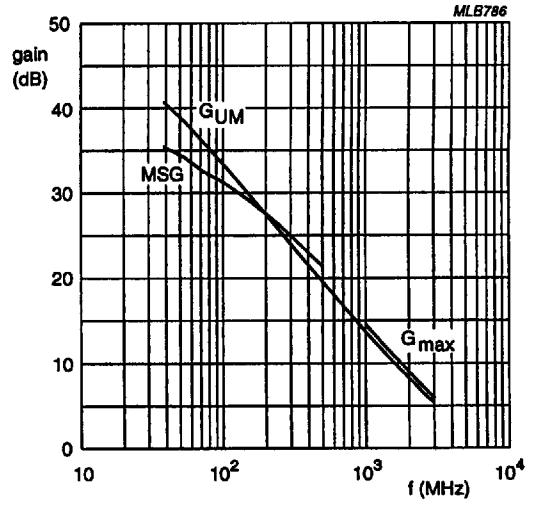
$I_C = 50$ mA; $V_{CE} = 4$ V.

Fig.8 Gain as a function of frequency; typical values.



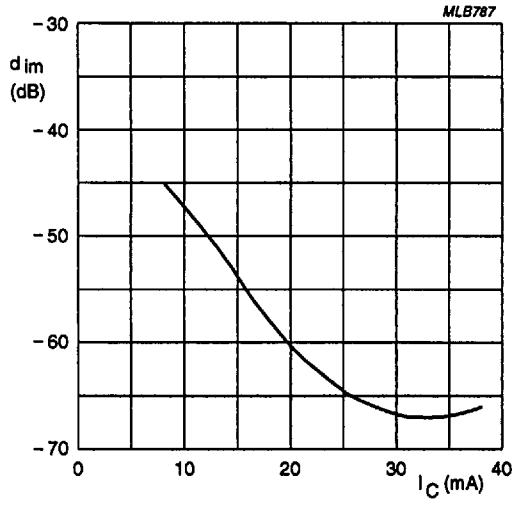
$I_C = 50$ mA; $V_{CE} = 6$ V.

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



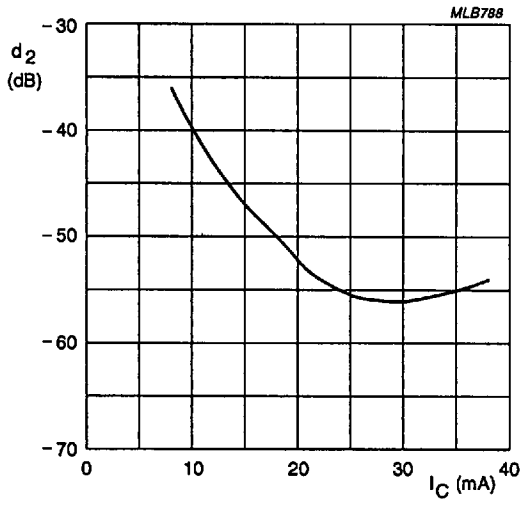
$I_C = 30$ mA; $V_{CE} = 8$ V.

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



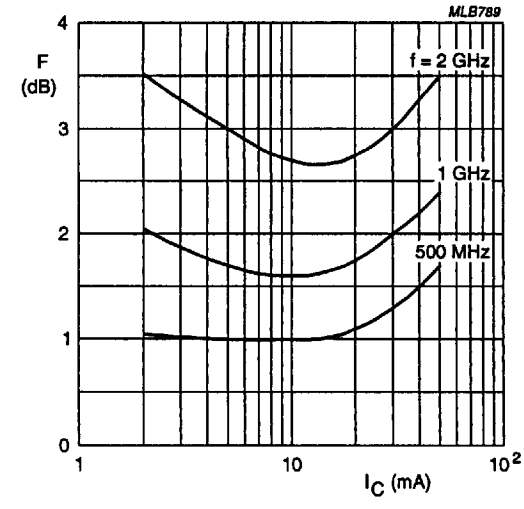
V_o = 700 mV; $f_{(p+q-r)}$ = 793.25 MHz; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



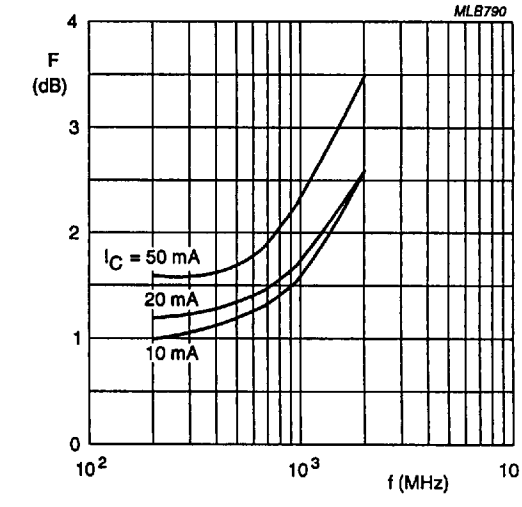
V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; V_{CE} = 8 V; T_{amb} = 25 °C.

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



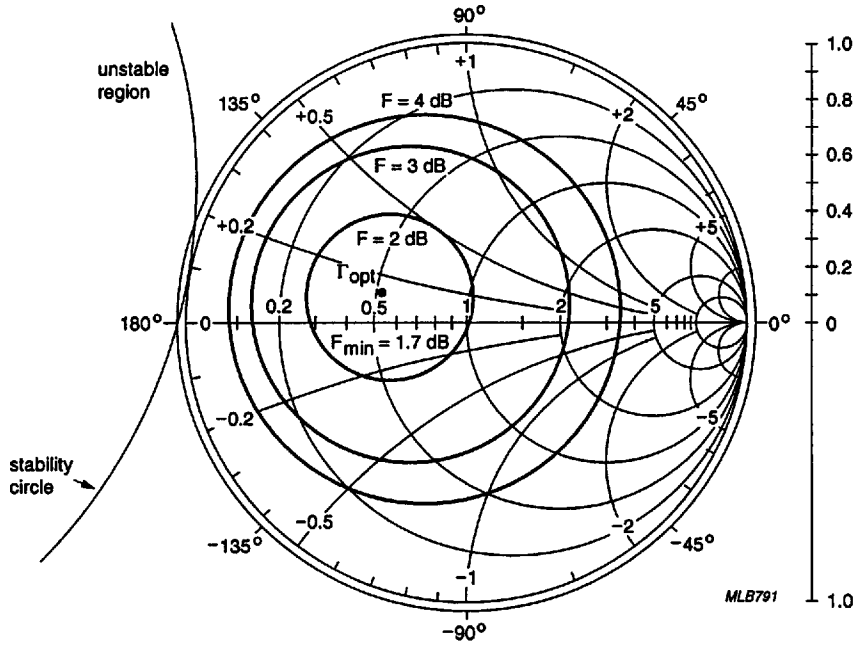
V_{CE} = 6 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



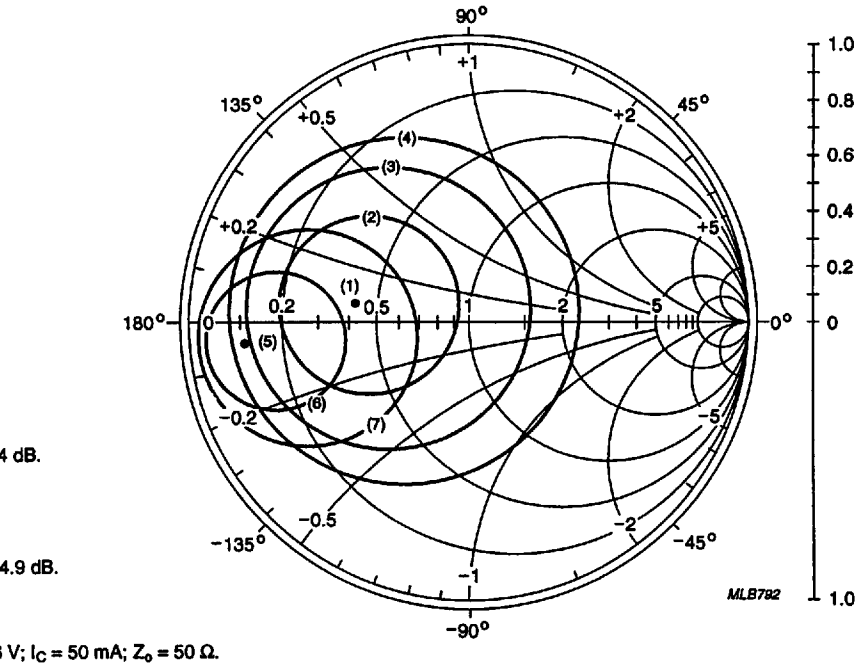
V_{CE} = 6 V.

Fig.14 Minimum noise figure as a function of frequency; typical values.



f = 500 MHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

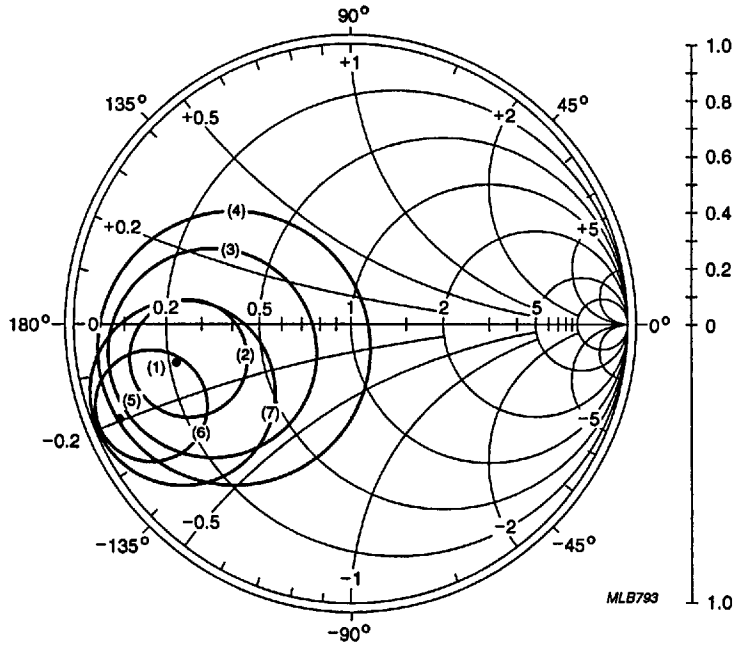
Fig.15 Common emitter noise figure circles; typical values.



(1) Γ_{opt}; F_{min} = 2.4 dB.
(2) F = 3 dB.
(3) F = 4 dB.
(4) F = 5 dB.
(5) Γ_{ms}; G_{max} = 14.9 dB.
(6) G = 14 dB.
(7) G = 13 dB.

f = 1 GHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

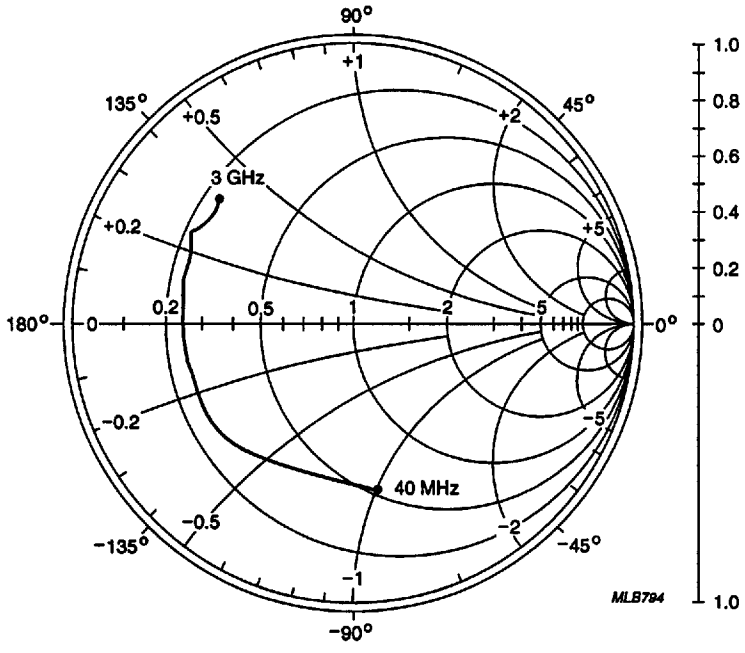
Fig.16 Common emitter noise figure circles; typical values.



(1) Γ_{opt}; F_{min} = 3.5 dB.
(2) F = 4 dB.
(3) F = 5 dB.
(4) F = 6 dB.
(5) Γ_{ms}; G_{max} = 9.8 dB.
(6) G = 9 dB.
(7) G = 8 dB.

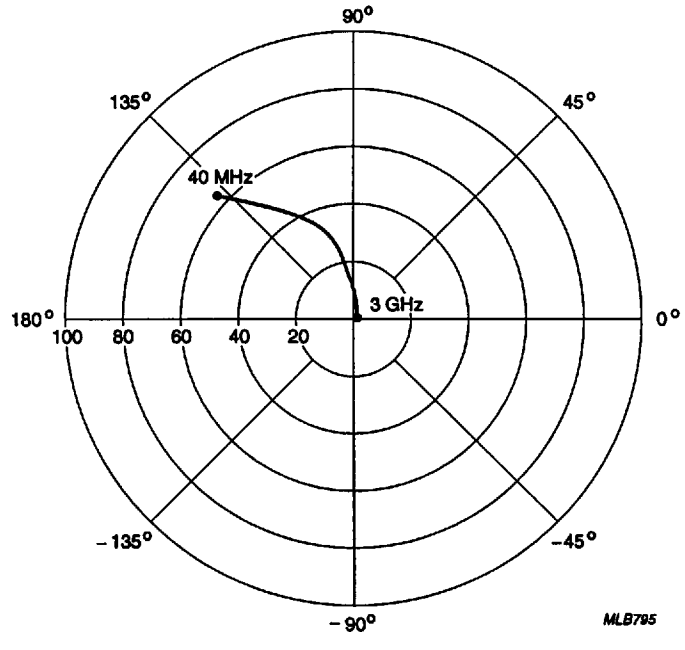
f = 2 GHz; V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

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



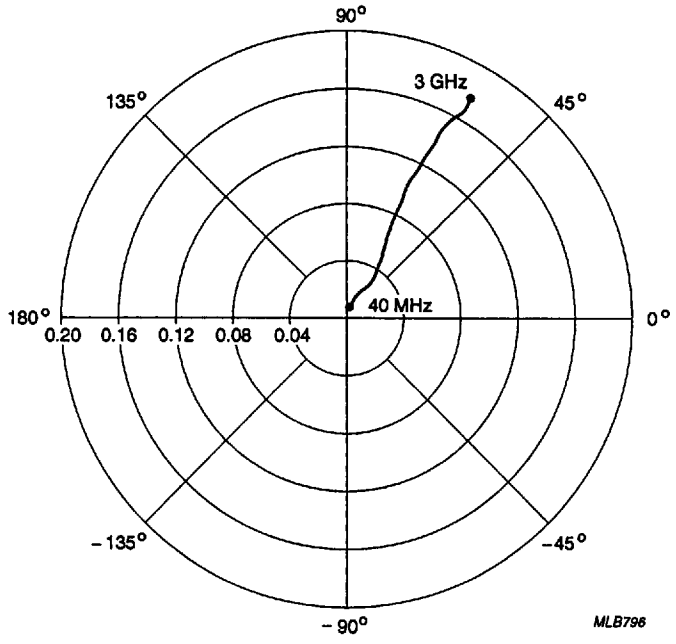
V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

Fig.18 Common emitter input reflection coefficient (s_{11}); typical values.



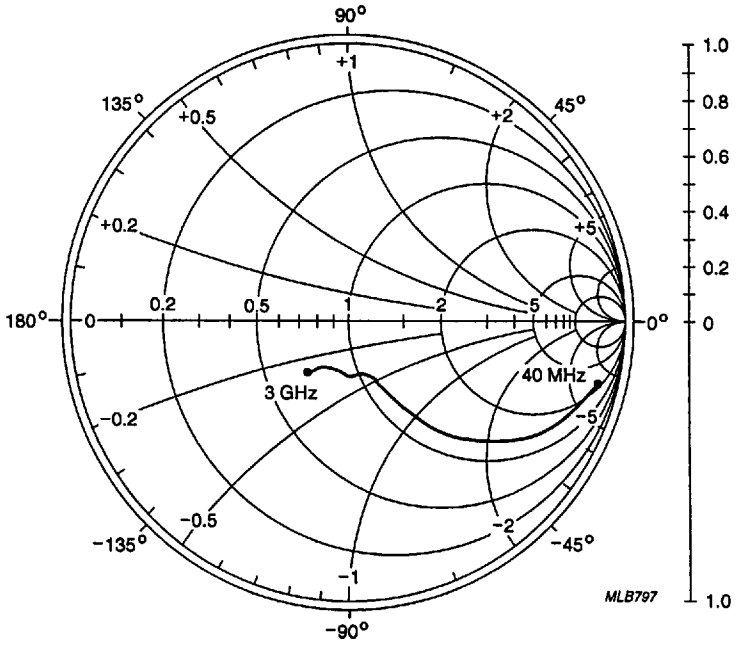
V_{CE} = 6 V; I_C = 50 mA.

Fig.19 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 50 mA.

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



V_{CE} = 6 V; I_C = 50 mA; Z_o = 50 Ω.

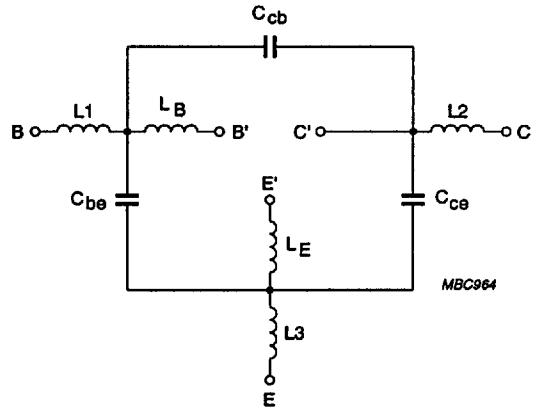
Fig.21 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFG197W crystal.

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.972	fA
2	BF	150.0	–
3	NF	0.990	–
4	VAF	54.72	V
5	IKF	30.00	A
6	ISE	47.82	fA
7	NE	1.580	–
8	BR	165.4	–
9	NR	0.993	–
10	VAR	2.351	V
11	IKR	9.967	A
12	ISC	3.510	fA
13	NC	1.124	–
14	RB	5.000	Ω
15	IRB	1.000	μA
16	RBM	5.000	Ω
17	RE	368.1	mΩ
18	RC	937.2	mΩ
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	3.388	pF
23	VJE	600.0	mV
24	MJE	0.302	–
25	TF	11.06	ps
26	XTF	30.02	–
27	VTF	1.649	V
28	ITF	401.9	mA
29	PTF	0.000	deg
30	CJC	1.190	pF
31	VJC	160.1	mV
32	MJC	0.089	–
33	XCJC	0.130	–
34	TR	2.148	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.785	–

Note

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



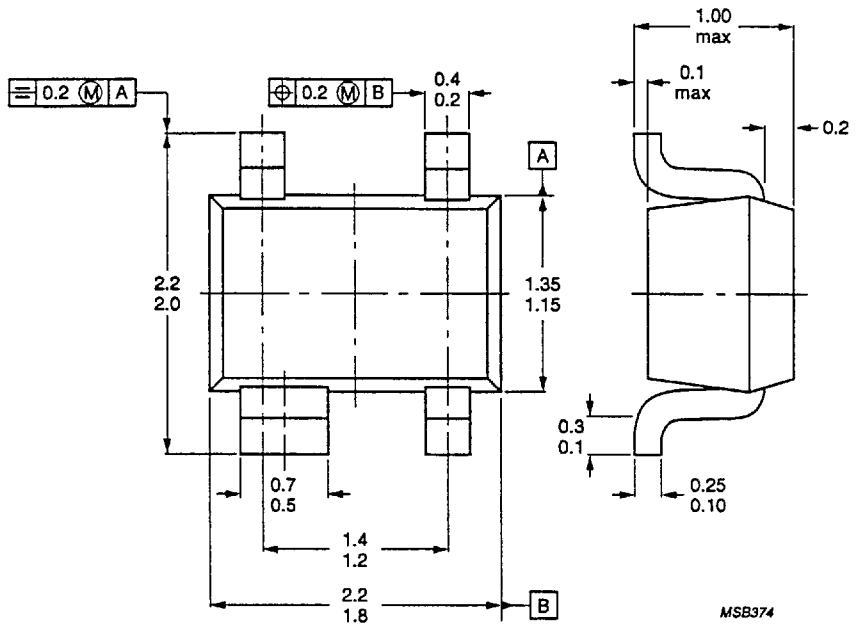
$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
f_c = scaling frequency = 1 GHz.

Fig.22 Package equivalent circuit SOT343; SOT343R.

List of components (see Fig.22).

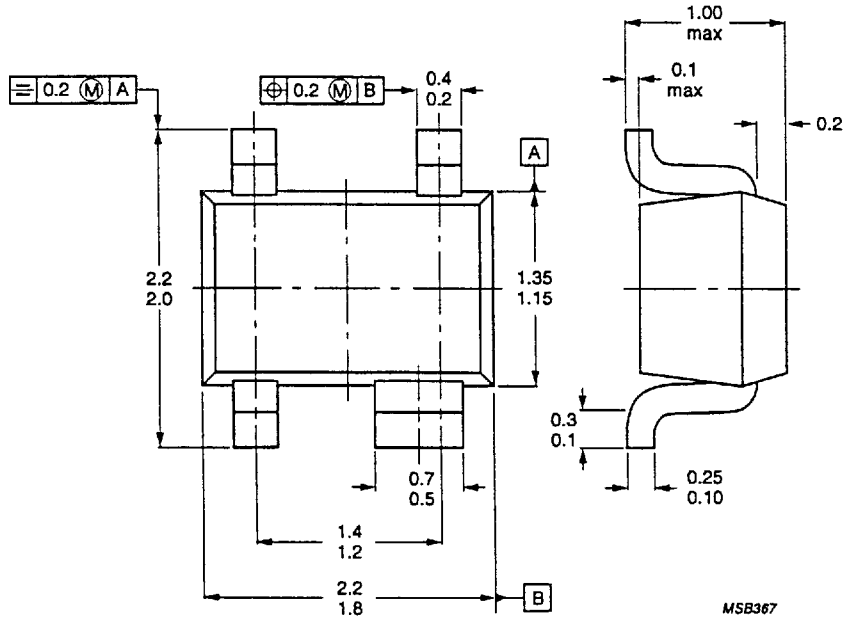
DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

PACKAGE OUTLINES



Dimensions in mm.

Fig.23 SOT343.



Dimensions in mm.

Fig.24 SOT343R.

DEFINITIONS

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.