DATA SHEET

BFG11; BFG11/X
NPN 2 GHz RF power transistor

Product specification
Supersedes data of November 1992
File under Discrete Semiconductors, SC14

1995 Apr 07

PHILIPS

NPN 2 GHz RF power transistor BFG11; BFG11/X

FEATURES

- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Common emitter class-AB operation in hand-held radio equipment at 1.9 GHz.

PINNING

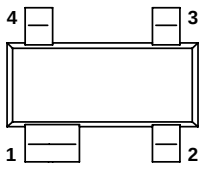
PIN	DESCRIPTION
BFG11 (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG11/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter

DESCRIPTION

NPN silicon planar epitaxial transistors encapsulated in a plastic, 4-pin dual-emitter SOT143 package.

MARKING

TYPE NUMBER	CODE
BFG11	N72
BFG11/X	N73



Top view MSB014

Fig.1 SOT143.

QUICK REFERENCE DATA

RF performance at T_{amb} = 25 °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle < 1 : 8	1.9	3.6	400	≥4	≥50

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	–	8	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	500	mA
$I_{C(AV)}$	average collector current		–	500	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; note 1; see Fig.2	–	400	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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; P_{tot} = 400 mW	290	K/W

Note to the “Limiting values” and “Thermal characteristics”

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

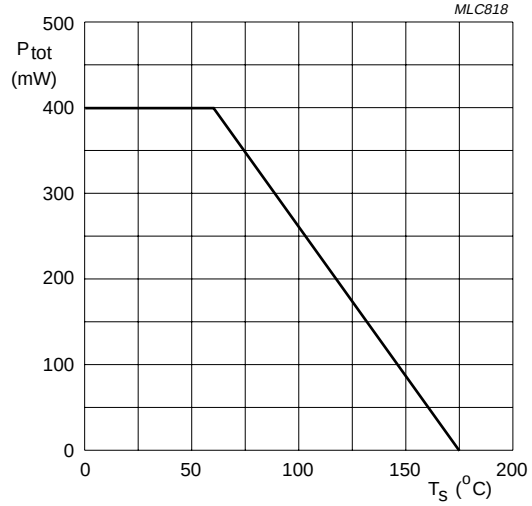
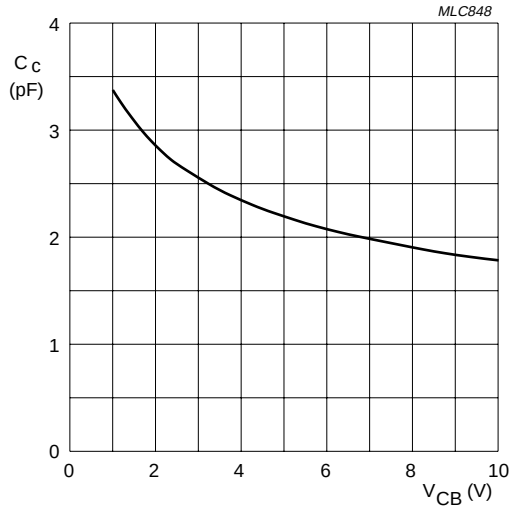


Fig.2 Power derating curve.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 0.1 mA; I_E = 0	20	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 10 mA; I_B = 0	8	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 0.1 mA; I_C = 0	2.5	–	V
I_{CES}	collector cut-off current	V_{CE} = 8 V; V_{BE} = 0	–	100	µA
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	25	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 3.6 V; f = 1 MHz	–	4	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 3.6 V; f = 1 MHz	–	3	pF



I_C = 0; f = 1 MHz.

Fig.3 Collector capacitance as a function of collector-base voltage; typical values.

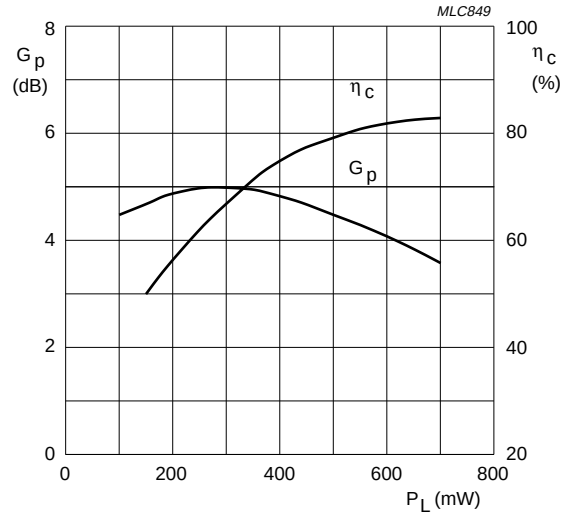
APPLICATION INFORMATION

RF performance at T_{amb} = 25 °C in a common-emitter test circuit (see Fig.7).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_L (mW)	G_p (dB)	η_c (%)
Pulsed, class-AB, duty cycle < 1 : 8	1.9	3.6	1	400	≥4 typ. 5	≥50 typ. 70

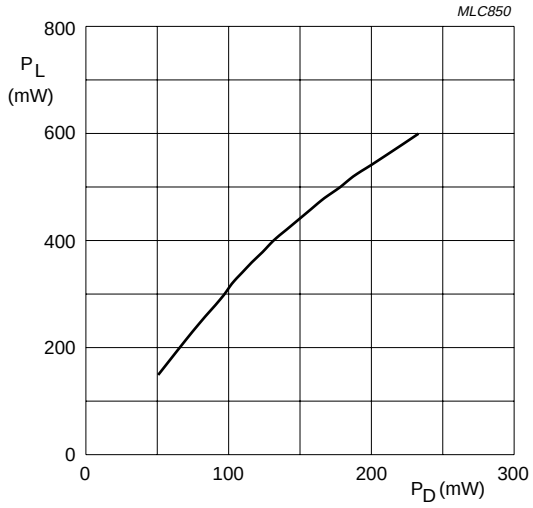
Ruggedness in class-AB operation

The BFG11 is capable of withstanding a load mismatch corresponding to VSWR = 8 : 1 through all phases, at rated output power under pulsed conditions up to a supply voltage of 8 V, f = 1.9 GHz and a duty cycle of 1 : 8.



Pulsed, class-AB operation.
V_{CE} = 3.6 V; V_{BE} = 0.65 V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for P_L = 400 mW.

Fig.4 Power gain and collector efficiency as functions of load power; typical values.



Pulsed, class-AB operation.
V_{CE} = 3.6 V; V_{BE} = 0.65 V; f = 1.9 GHz; duty cycle < 1 : 8.
Circuit optimized for P_L = 400 mW.

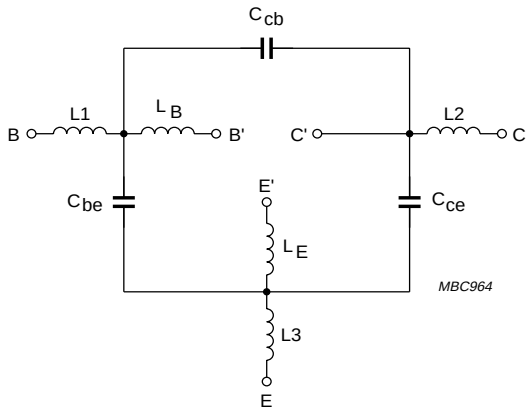
Fig.5 Load power as a function of drive power; typical values.

SPICE parameters for the BFG11 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	3.338	fA
2	BF	97.14	–
3	NF	0.988	–
4	VAF	31.40	V
5	IKF	51.45	A
6	ISE	23.53	pA
7	NE	2.386	–
8	BR	13.73	–
9	NR	0.989	–
10	VAR	2.448	V
11	IKR	100.0	A
12	ISC	54.10	fA
13	NC	1.224	–
14	RB	1.740	Ω
15	IRB	1.000	μA
16	RBM	1.740	Ω
17	RE	59.65	mΩ
18	RC	0.124	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	9.555	pF
23	VJE	0.600	V
24	MJE	0.315	–
25	TF	12.96	ps
26	XTF	400.0	–
27	VTF	0.866	V
28	ITF	5.940	A
29	PTF	0.000	deg
30	CJC	4.274	pF
31	VJC	0.650	V
32	MJC	0.392	–
33	XCJC	0.150	–
34(1)	TR	0.000	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.742	–

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 = 100 MHz.

Fig.6 Package equivalent circuit SOT143.

List of components (see Fig.6)

DESIGNATION	VALUE	UNIT
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

Test circuit information

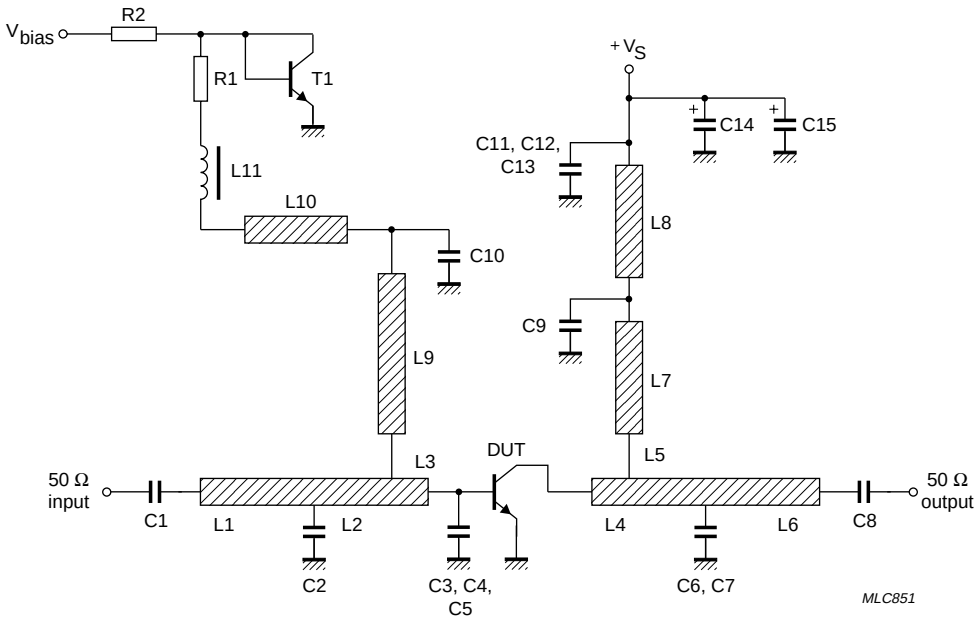


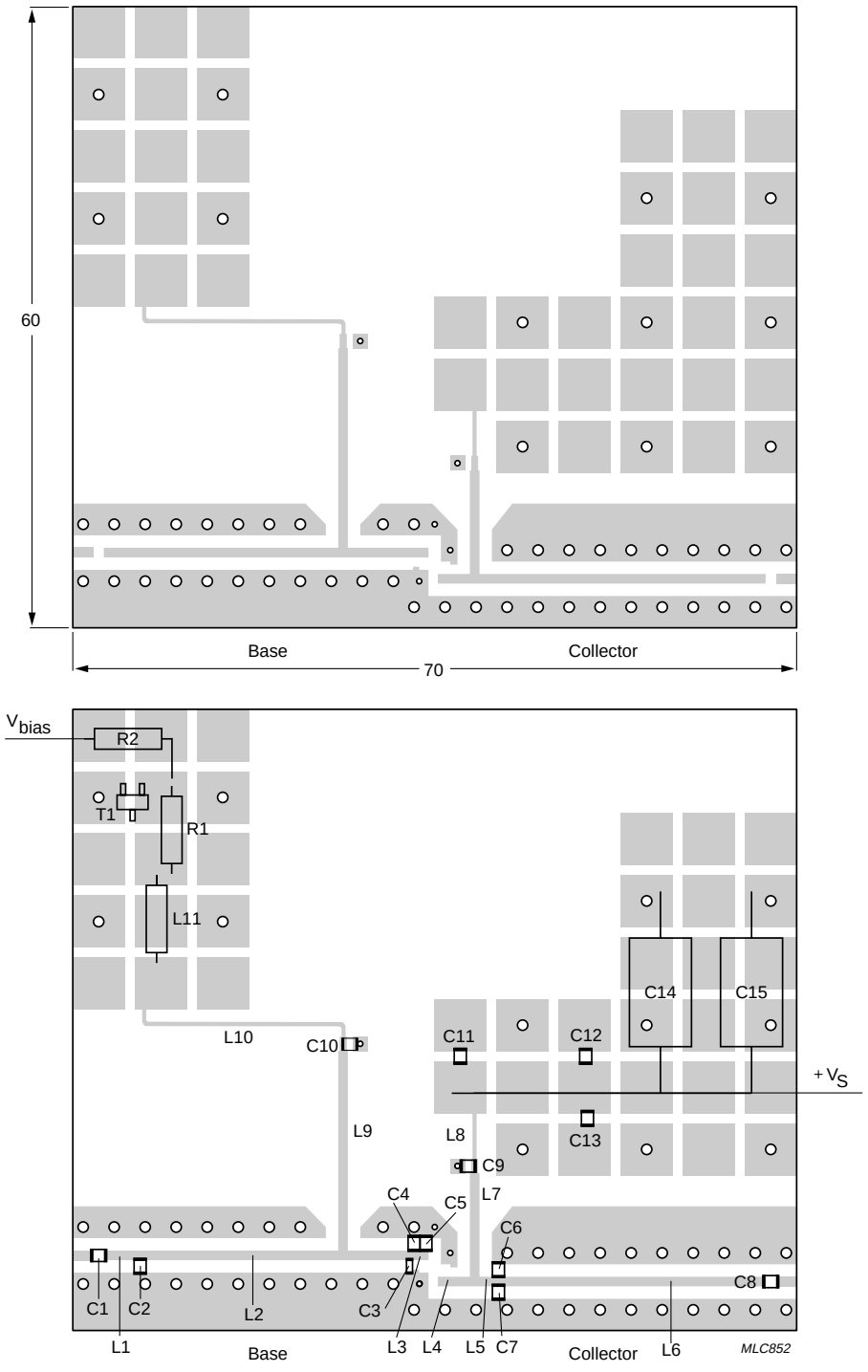
Fig.7 Common-emitter test circuit for class-AB operation at 1900 MHz.

List of components used in test circuit (see Fig.8)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE N0.
C1, C8, C9, C10	multilayer ceramic chip capacitor; note 1	24 pF		
C2	multilayer ceramic chip capacitor; note 1	0.4 pF		
C3	multilayer ceramic chip capacitor; note 1	0.6 pF		
C4, C7	multilayer ceramic chip capacitor; note 1	1 pF		
C5, C6,	multilayer ceramic chip capacitor; note 1	1.5 pF		
C11, C12,C13	multilayer ceramic chip capacitor; note 1	10 nF		
C14, C15	electrolytic capacitor	10 V; 470 μF		2222 031 34471
L1	stripline; note 2		length 4 mm width 0.93 mm	
L2	stripline; note 2		length 26 mm width 0.93 mm	
L3	stripline; note 2		length 1.9 mm width 0.93 mm	
L4	stripline; note 2		length 3.1 mm width 0.93 mm	
L5	stripline; note 2		length 1.8 mm width 0.93 mm	
L6	stripline; note 2		length 26.4 mm width 0.93 mm	
L7	stripline; note 2		length 10 mm width 0.93 mm	
L8	stripline; note 2		length 4.4 mm width 0.4 mm	
L9	stripline; note 2		length 19.3 mm width 0.93 mm	
L10	stripline; note 2		length 19.7 mm width 0.4 mm	
L11	micro choke			
T1	BD228			
R1	metal film resistor	20 Ω; 0.4 W		2322 157 10209
R2	metal film resistor	265 Ω; 0.4 W		2322 157 12651

Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a $\frac{1}{32}$ inch double copper-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 6$).

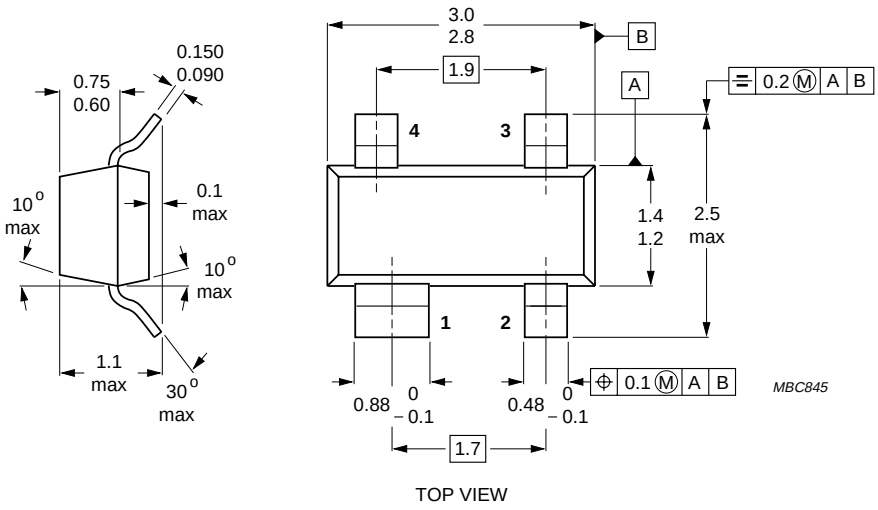


Dimensions in mm.

The components are situated on one side of the copper-clad PTFE microfibre-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.8 Printed-circuit board and component lay-out for common-emitter test circuit in Fig.7.

PACKAGE OUTLINE



Dimensions in mm.

Fig.9 SOT143.

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

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NOTES