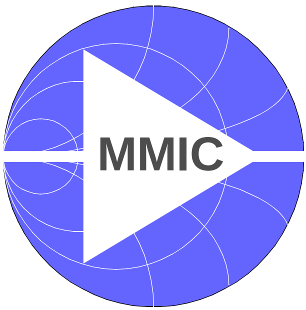
BGB540

Active Biased RF Transistor



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Silicon Discretes

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Edition 2002-09-11

**Published by Infineon Technologies AG,
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BGB540
Data sheet
Revision History: 2002-09-11

Previous Version: 2001-08-16

Page	Subjects (major changes since last revision)
4-9	RF parameters and SPICE model updated
	Preliminary status removed

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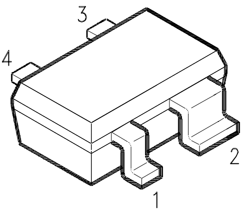
Active Biased RF Transistor

BGB540

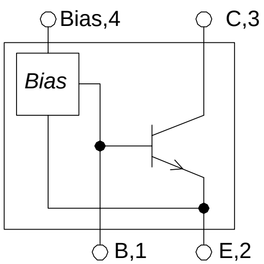
Features

- G_{ms}= 18dB at 1.8GHz
- Small SOT343 package
- Current easy adjustable by an external resistor
- Open collector output
- Typical supply voltage: 1.4-4.3V
- SIEGET®-45 technology



Applications

- For high gain low noise amplifiers
- Ideal for wideband applications, cellular phones, cordless telephones, SAT-TV and high frequency oscillators



Description

SIEGET®-45 NPN Transistor with integrated biasing for high gain low noise figure applications. I_C can be controlled using I_{Bias} according to I_C=10*I_{Bias} .

ESD: Electrostatic discharge sensitive device, observe handling precaution!

Type	Package	Marking	Chip
BGB540	SOT343	MCs	T0559

Maximum Ratings

Parameter	Symbol	Value	Unit
Maximum collector-emitter voltage	V_{CE}	4.5	V
Maximum collector current	I_C	80	mA
Maximum bias current	I_{Bias}	8	mA
Maximum emitter-base voltage	V_{EB}	1.2	V
Maximum base current	I_B	0.7	mA
Total power dissipation, T_S < 75°C[1)]	P_{tot}	250	mW
Junction temperature	T_j	150	°C
Ambient temperature	T_A	-65 ... +150	°C
Storage temperature	T_{STG}	-65 ... +150	°C
Thermal resistance: junction-soldering point	$R_{th\ JS}$	300	K/W

Notes:
For detailed symbol description refer to figure 1.
[1)] T_S is measured on the emitter lead at the soldering point to the PCB

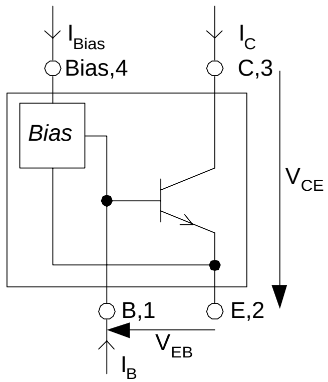


Fig. 1: Symbol definition

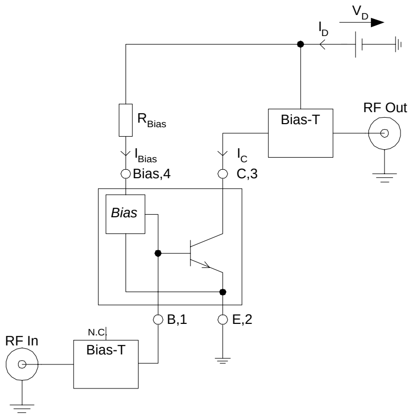


Fig. 2: Test Circuit for Electrical Characteristics and S-Parameter

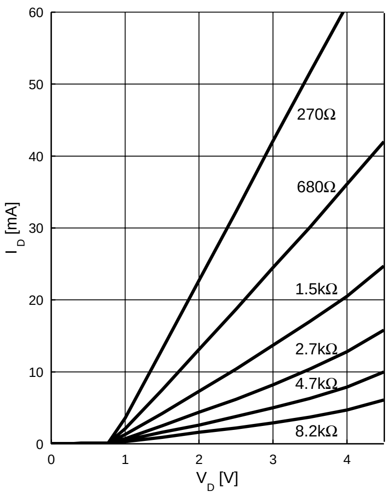
Electrical Characteristics at T_A=25°C (measured in test circuit specified in fig. 2)

Parameter		Symbol	min.	typ.	max.	Unit
Maximum stable power gain V_D=2V, I_c=20mA, f=1.8GHz		G_{ms}		18		dB
Insertion power gain V_D=2V, I_c=20mA	f=0.9GHz f=1.8GHz	$\|S_{21}\|^2$		21.5 16		dB
Insertion loss V_D=2V, I_c=0mA	f=0.9GHz f=1.8GHz	IL		21 16		dB
Noise figure (Z_S=50Ω) V_D=2V, I_c=5mA	f=0.9GHz f=1.8GHz	$F_{50\Omega}$		1.15 1.3		dB
Output power at 1dB gain compression V_D=2V, I_c=20mA, f=1.8GHz	 $Z_L=Z_{LOPT}$ Z_L=50Ω	P_{-1dB}		 12 10		dBm
Output third order intercept point V_D=2V, I_c=20mA, f=1.8GHz	 $Z_{L/S}=Z_{L/SOPT}$ $Z_{L/S}$=50Ω	OIP_3		 22 20		dBm
Collector-base capacitance V_{CB}=2V, f=1MHz		C_{CB}		0.15		pF
Current ratio I_C/I_{Bias} I_{Bias}=0.5mA, V_D=3V		CR	7	10	13	

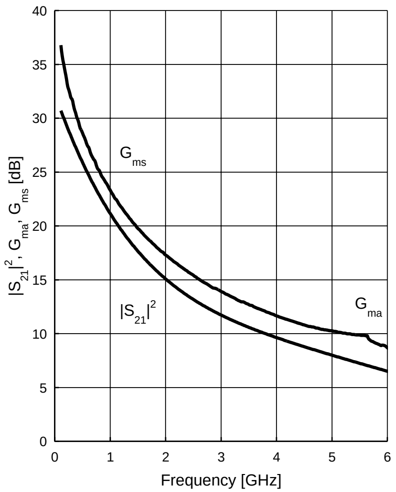
S-Parameter V_D=2V, I_C=20mA (see Electrical Characteristics for conditions)

Frequency [GHz]	**S11 Mag**	**S11 Ang**	**S21 Mag**	**S21 Ang**	**S12 Mag**	**S12 Ang**	**S22 Mag**	**S22 Ang**
0.1	0.5387	-17.8	35.6280	158.9	0.0064	75.4	0.9334	-11.8
0.2	0.4744	-35.8	31.0390	142.8	0.0141	76.8	0.8357	-20.9
0.4	0.3724	-60.7	22.5520	120.2	0.0241	75.4	0.6670	-29.7
0.6	0.2992	-74.7	16.8920	108.1	0.0335	75.3	0.5672	-31.0
0.8	0.2453	-88.7	13.3320	98.2	0.0439	74.7	0.5066	-33.0
1.0	0.2205	-100.1	10.9000	91.2	0.0547	73.4	0.4675	-33.8
1.2	0.1900	-111.0	9.1938	85.5	0.0663	71.5	0.4406	-35.1
1.4	0.1765	-122.0	7.9452	80.6	0.0785	69.3	0.4209	-36.8
1.6	0.1648	-132.7	6.9615	76.3	0.0901	66.5	0.4013	-38.7
1.8	0.1660	-142.5	6.2388	72.2	0.1014	63.5	0.3822	-41.5
2.0	0.1737	-153.1	5.6320	68.2	0.1125	60.5	0.3519	-43.6
3.0	0.1966	175.9	3.8040	51.6	0.1655	44.9	0.2868	-57.0
4.0	0.2486	156.8	2.9394	36.2	0.2151	29.1	0.2398	-76.1
5.0	0.3451	136.5	2.4109	20.7	0.2439	9.1	0.1506	-111.0
6.0	0.4645	117.1	2.0318	5.5	0.2362	-7.1	0.1196	168.0

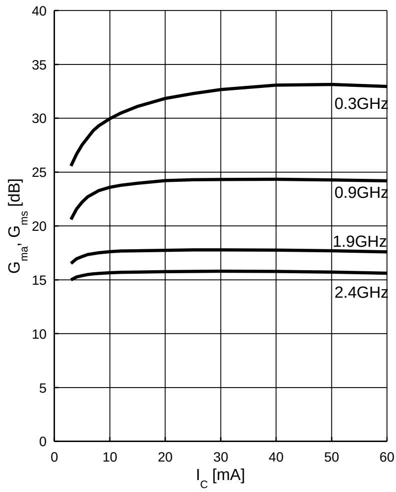
Device Current $I_D = f(V_D, R_{Bias})$



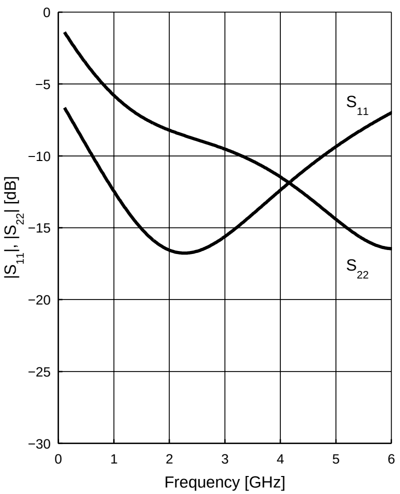
Power Gain $|S_{21}|^2$, G_{ma}, $G_{ms} = f(f)$
$V_D = 3V$, $I_C = 20mA$



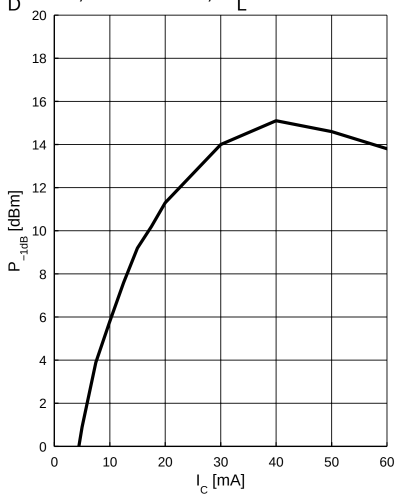
Power Gain G_{ma}, $G_{ms} = f(f)$
$V_D = 3V$



Matching $|S_{11}|$, $|S_{22}| = f(f)$
$V_D = 3V$, $I_C = 20mA$

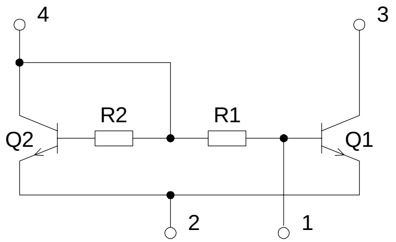


Output Compression Point
$P_{-1dB} = f(I_C)$
$V_D = 3V$, $f = 1.8GHz$, $Z_L = 50\Omega$



SPICE Model

BGB540-Chip

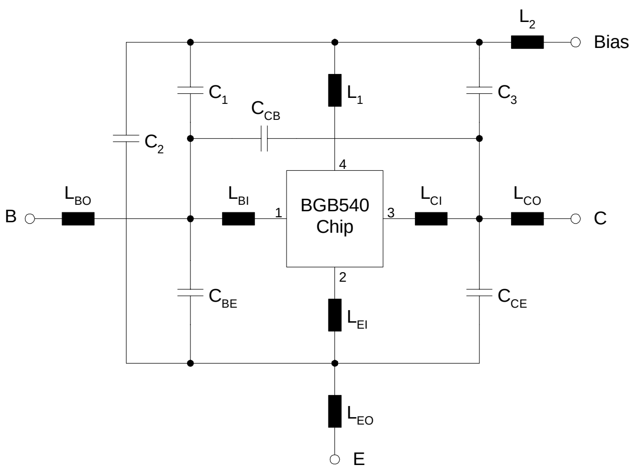


Q1	T513
Q2	T513 (area factor: 0.1)
R1	2.7kΩ
R2	27kΩ

Transistor Chip Data T513 (Berkley-SPICE 2G.6 Syntax)

```
.MODEL T513 NPN(
+ IS = 8.2840e-17     BF = 107.5        NF = 1.0            VAF = 28.383
+ IKF = 0.48731       ISE = 1.115e-11   NE = 3.19           BR = 5.5
+ NR = 1.0            VAR = 19.705      IKR = 0.02          ISC = 1.9237e-17
+ NC = 1.1720         RBM = 1.3         IRB = 0.00072983    RB = 5.4
+ RE = 0.31111        RC = 4.0          CJE = 1.8063e-15    VJE = 0.8051
+ MJE = 0.46576       TF = 6.76e-12     XTF = 0.4219        VTF = 0.23794
+ ITF = 0.001         PTF =  0          CJC = 2.34e-13      VJC = 0.81969
+ MJC = 0.30232       XCJC = 0.3        TR = 2.324E-09      CJS= 0
+ VJS = 0.75          MJS = 0           XTB = 0             EG = 1.11
+ XTI = 3             FC = 0.73234)
```

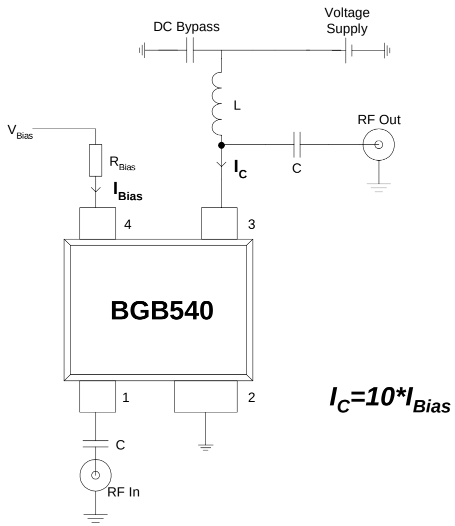
Package Equivalent Circuit



L_{BI}	0.36	nH
L_{B0}	0.42	nH
L_{EI}	0.35	nH
L_{EO}	0.27	nH
L_{CI}	0.56	nH
L_{CO}	0.58	nH
L_1	0.5	nH
L_2	0.58	nH
C_{BE}	120	fF
C_{CB}	6.9	fF
C_{CE}	134	fF
C_1	90	fF
C_2	120	fF
C_3	15	fF

Valid up to 3GHz

Typical Application



This proposal demonstrates how to use the BGB540 as a Self-Biased Transistor. As for a discrete Transistor matching circuits have to be applied. A good starting point for various applications are the Application Notes provided for the BFP540.

Fig. 3: Typical application circuit

Package Outline