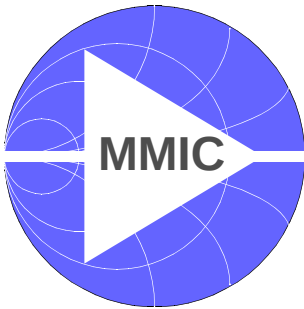


BGB540

Active Biased RF Transistor



Wireless
Silicon Discretes



Never stop thinking.

Edition 2002-09-11

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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

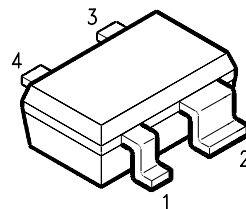
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Active Biased RF Transistor

BGB540

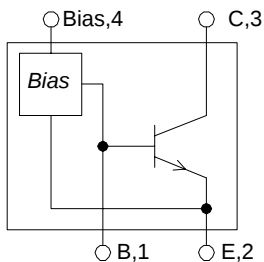
Features

- $G_{ms} = 18\text{dB}$ 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 $I_C = 10 \cdot I_{Bias}$.

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, $T_S < 75^\circ\text{C}^{1)}$	P_{tot}	250	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Ambient temperature	T_A	-65 ... +150	$^\circ\text{C}$
Storage temperature	T_{STG}	-65 ... +150	$^\circ\text{C}$
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

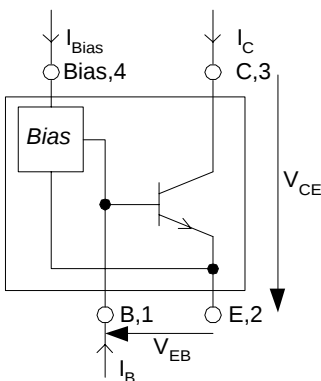


Fig. 1: Symbol definition

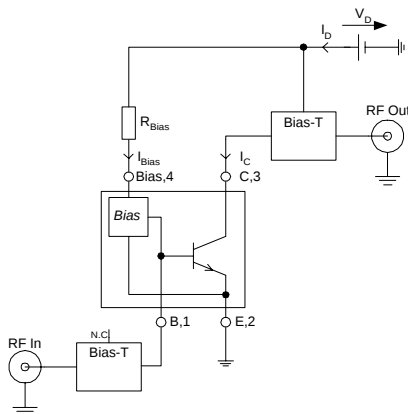


Fig. 2: Test Circuit for Electrical Characteristics and S-Parameter

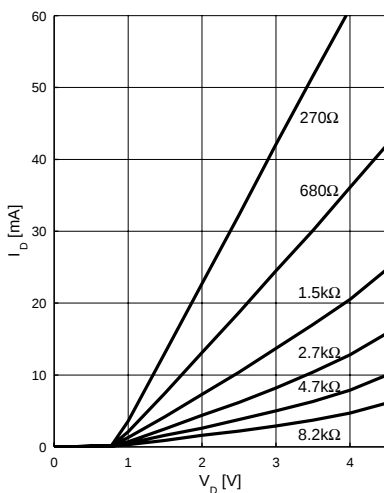
Electrical Characteristics at $T_A=25^{\circ}\text{C}$ (measured in test circuit specified in fig. 2)

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

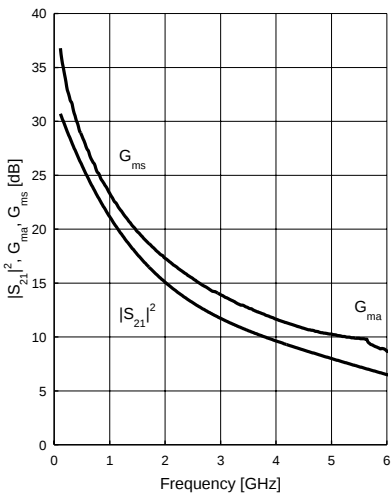
S-Parameter $V_D=2V$, $I_C=20mA$ (see Electrical Characteristics for conditions)

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

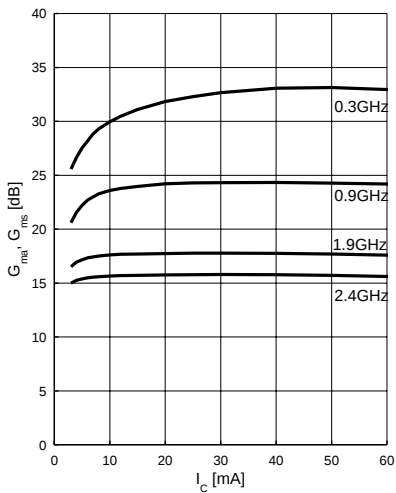
Device Current $I_D = f(V_D, R_{Bias})$



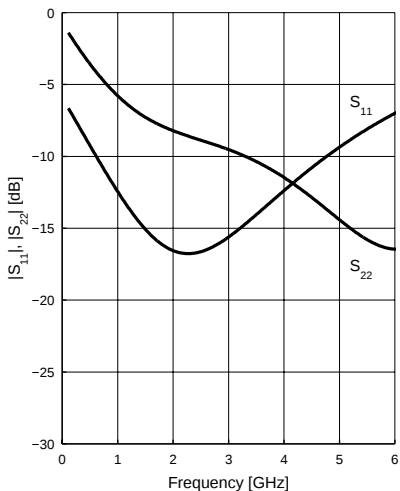
Power Gain $|S_{21}|^2$, G_{ma} , $G_{ms} = f(f)$
 $V_D = 3V$, $I_C = 20mA$



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

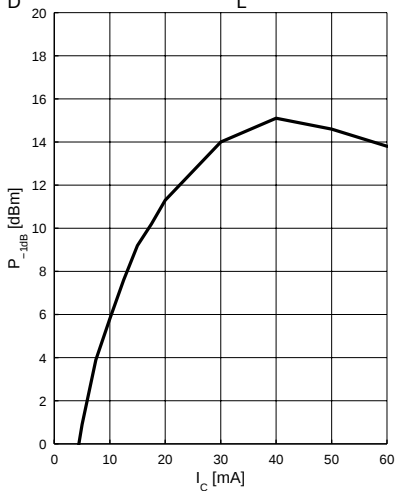


Matching $|S_{11}|$, $|S_{22}| = f(f)$
 $V_D = 3V$, $I_C = 20mA$



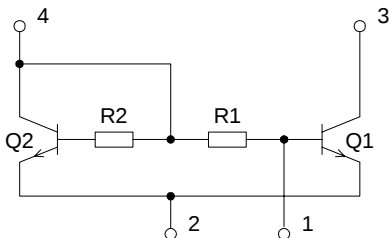
Output Compression Point

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



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

+ IKF = 0.48731

+ NR = 1.0

+ NC = 1.1720

+ RE = 0.31111

+ MJE = 0.46576

+ ITF = 0.001

+ MJC = 0.30232

+ VJS = 0.75

+ XTI = 3

BF = 107.5

ISE = 1.115e-11

VAR = 19.705

RBM = 1.3

RC = 4.0

TF = 6.76e-12

PTF = 0

XCJC = 0.3

MJS = 0

FC = 0.73234)

NF = 1.0

NE = 3.19

IKR = 0.02

IRB = 0.00072983

CJE = 1.8063e-15

XTF = 0.4219

CJC = 2.34e-13

TR = 2.324E-09

XTB = 0

VAF = 28.383

BR = 5.5

ISC = 1.9237e-17

RB = 5.4

VJE = 0.8051

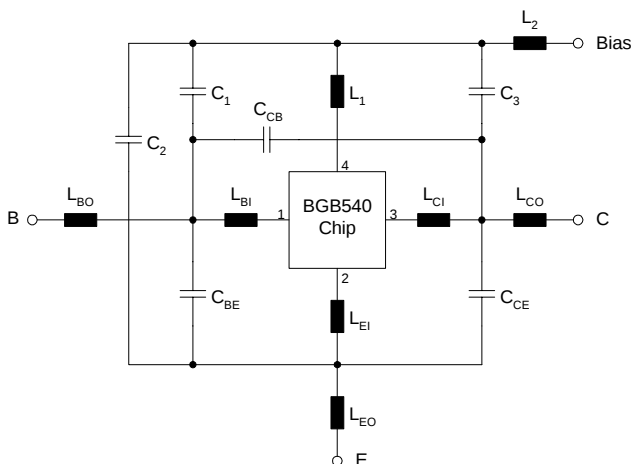
VTF = 0.23794

VJC = 0.81969

CJS = 0

EG = 1.11

Package Equivalent Circuit



L _{BI}	0.36	nH
L _{BO}	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

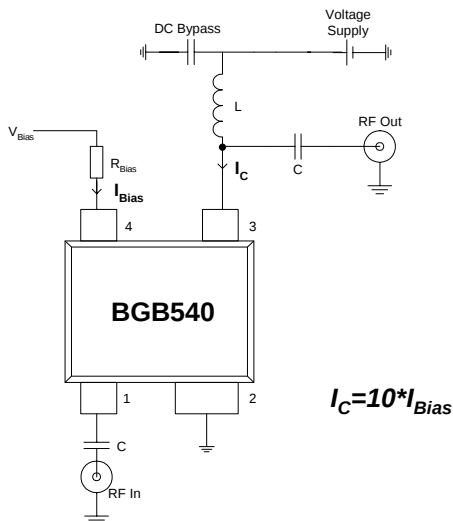
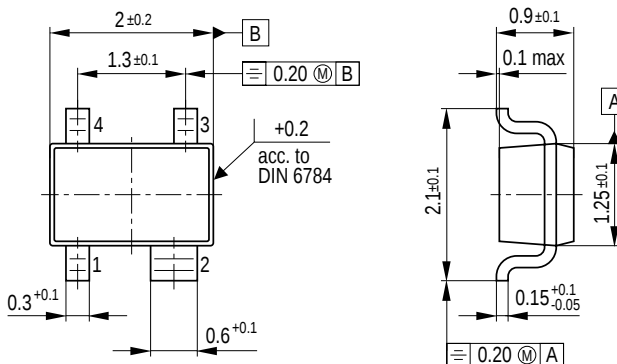


Fig. 3: Typical application circuit

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.

Package Outline



GPS05605