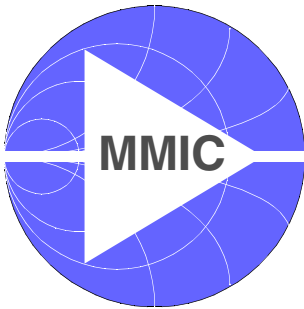


# BGB420

## Active Biased Transistor



Wireless  
Silicon Discretes



Never stop thinking.

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**BGB420****Data sheet****Revision History:        2001-08-10**Previous Version:        2000-11-28

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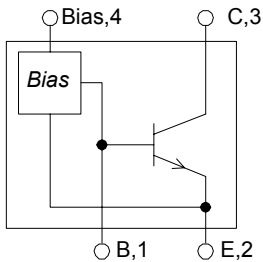
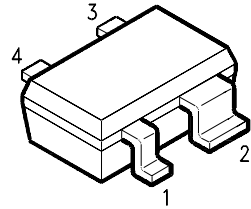
Page	Subjects (major changes since last revision)
7	S-Parameter table added
8	Figure "Output Compression Point" added
9	SPICE Model added

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**Features**

- For high gain low noise amplifiers
- Ideal for wideband applications, cellular telephones, cordless telephones, SAT-TV and high frequency oscillators
- $G_{ma}=17.5\text{dB}$  at 1.8GHz
- Small SOT343 package
- Current easy adjustable by an external resistor
- Open collector output
- Typical supply voltage: 1.4-3.3V
- SIEGET<sup>®</sup>-25 technology



**Description**

SIEGET<sup>®</sup>-25 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
BGB420	SOT343	MBs	T0514

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Maximum collector-emitter voltage	$V_{CE}$	3.5	V
Maximum collector current	$I_C$	30	mA
Maximum bias current	$I_{Bias}$	3	mA
Maximum emitter-base voltage	$V_{EB}$	1.5	V
Maximum base current	$I_B$	0.7	mA
Total power dissipation, $T_S < 107^\circ\text{C}^{1)}$	$P_{tot}$	120	mW
Junction temperature	$T_j$	150	$^\circ\text{C}$
Operating temperature range	$T_{OP}$	-40 ..+85	$^\circ\text{C}$
Storage temperature range	$T_{STG}$	-65 ... +150	$^\circ\text{C}$
Thermal resistance: junction-soldering point	$R_{th JS}$	<270	K/W

Notes:

For detailed symbol description refer to figure 1.

<sup>1)</sup>  $T_S$  is measured on the emitter lead at the soldering point to the PCB

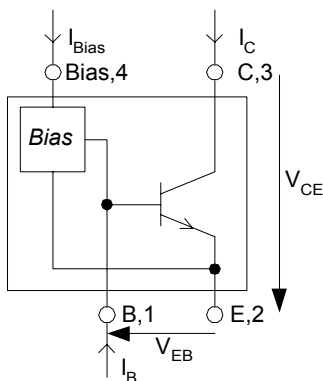


Fig. 1: Symbol definition

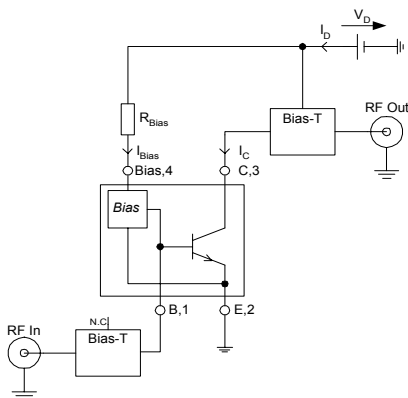


Fig. 2: Test Circuit for Electrical Characteristics and S-Parameter

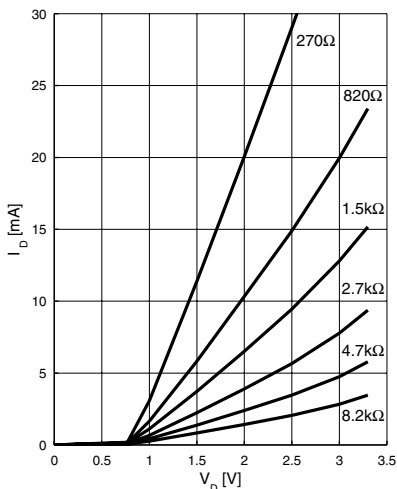
**Electrical Characteristics** at  $T_A=25^\circ\text{C}$  (measured in test circuit specified in fig. 2, min./max. values verified by random sampling)

Parameter	Symbol	min.	typ.	max.	Unit
Maximum available power gain $V_D=2\text{V}$ , $I_C=20\text{mA}$ , $f=1.8\text{GHz}$	$G_{\text{MA}}$	16.0	17.5		dB
Insertion power gain $V_D=2\text{V}$ , $I_C=20\text{mA}$	$ S_{21} ^2$		22 16		dB
Insertion loss $V_D=2\text{V}$ , $I_C=0\text{mA}$	IL		21 15		dB
Noise figure ( $Z_S=50\Omega$ ) $V_D=2\text{V}$ , $I_C=5\text{mA}$	$F_{50\Omega}$		1.3 1.5	1.8 2.0	dB
Output power at 1dB gain compression $V_D=2\text{V}$ , $I_C=20\text{mA}$ , $f=1.8\text{GHz}$ $Z_L=Z_{\text{LOPT}}$ $Z_L=50\Omega$	$P_{-1\text{dB}}$	7	12 10		dBm
Output third order intercept point $V_D=2\text{V}$ , $I_C=20\text{mA}$ , $f=1.8\text{GHz}$ $Z_{L/S}=Z_{L/S\text{OPT}}$ $Z_{L/S}=50\Omega$	$\text{OIP}_3$	17	22 20		dBm
Collector-base capacitance $V_{\text{CB}}=2\text{V}$ , $f=1\text{MHz}$	$C_{\text{CB}}$		0.16		pF
Current Ratio $I_C/I_{\text{Bias}}$ $I_{\text{Bias}}=0.5\text{mA}$ , $V_D=3\text{V}$	CR	7	10	13	

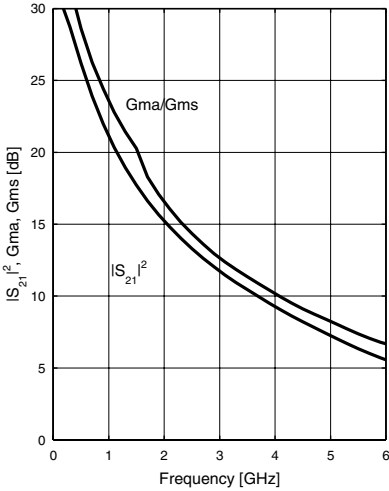
**S-Parameter**  $V_D=2V$ ,  $I_C=20mA$  (see Electrical Characteristics for conditions)

Frequency [GHz]	S11 Mag	S11 Ang	S21 Mag	S21 Ang	S12 Mag	S12 Ang	S22 Mag	S22 Ang
0.1	0.4412	-24.8	35.7070	160.6	0.0078	83.5	0.9225	-14.1
0.2	0.4064	-47.4	31.7670	143.9	0.0157	77.5	0.8321	-26.2
0.4	0.3261	-81.6	23.1980	120.9	0.0261	70.9	0.6380	-41.4
0.6	0.2854	-105.8	17.2590	106.9	0.0351	69.4	0.5012	-49.6
0.8	0.2615	-124.2	13.5050	97.5	0.0444	68.9	0.4100	-54.2
1.0	0.2525	-136.4	10.9810	90.6	0.0537	68.2	0.3435	-57.4
1.2	0.2505	-148.9	9.1940	84.8	0.0628	67.3	0.2946	-60.2
1.4	0.2476	-158.2	7.8930	80.1	0.0720	65.9	0.2571	-62.6
1.6	0.2533	-167.1	6.9070	75.6	0.0819	64.6	0.2228	-64.2
1.8	0.2579	-173.3	6.1460	71.7	0.0915	62.9	0.1966	-66.0
2.0	0.2584	-178.7	5.5300	68.2	0.1009	61.4	0.1751	-66.3
3.0	0.2874	157.6	3.6990	51.6	0.1495	51.7	0.0802	-70.1
4.0	0.3505	139.0	2.7770	36.1	0.1970	40.4	0.0366	-178.8
5.0	0.4061	125.9	2.1930	21.5	0.2392	29.4	0.0913	126.7
6.0	0.4450	117.1	1.8050	8.6	0.2864	18.9	0.1340	99.8

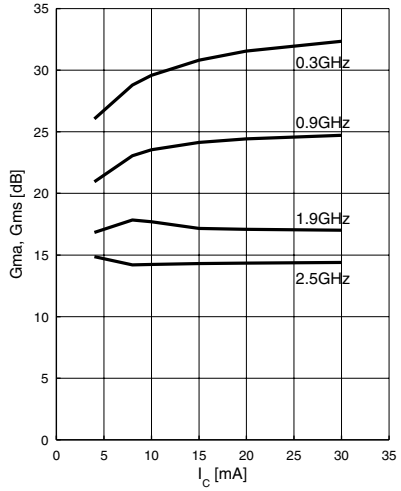
**Device Current**  $I_D = f(V_D, R_{Bias})$



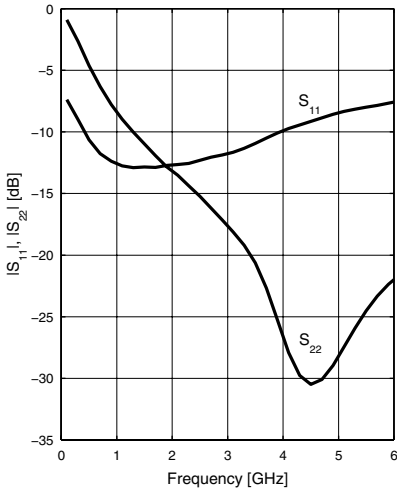
**Power Gain**  $|S_{21}|^2$ , Gma, Gms=f(f)  
 $V_D = 3V, I_C = 20mA$



**Power Gain** Gma, Gms=f( $I_C$ )  
 $V_D = 3V$

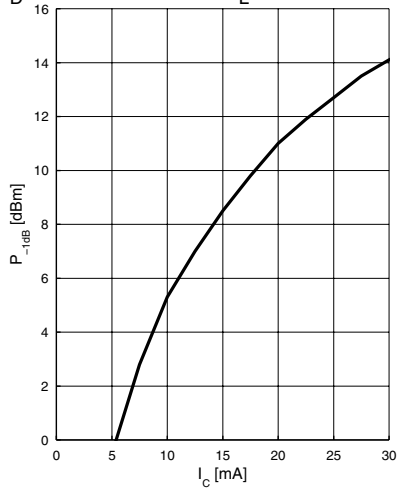


**Matching**  $|S_{11}|, |S_{22}|=f(f)$   
 $V_D = 3V, I_C = 20mA$



**Output Compression Point**

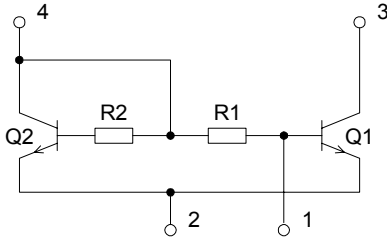
$P_{-1dB} = f(I_C)$   
 $V_D = 3V, f = 1.8GHz, Z_L = 50\Omega$





## SPICE Model

### BGB420-Chip



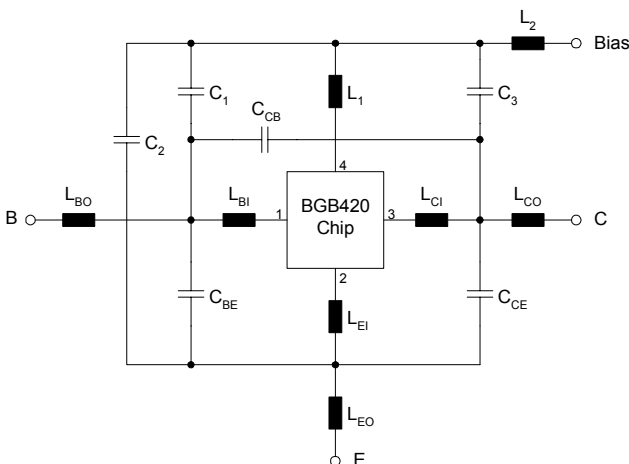
Q1	T502
Q2	T502 (area factor: 0.1)
R1	2.7kΩ
R2	27kΩ

### Transistor Chip Data T502 (Berkley-SPICE 2G.6 Syntax)

.MODEL T502 NPN(

+ IS = 2.0045e-16	BF = 72.534	NF = 1.2432	VAF = 28.383
+ IKF = 0.48731	ISE = 1.9049e-14	NE = 2.0518	BR = 7.8287
+ NR = 1.3325	VAR = 19.705	IKR = 0.69141	ISC = 1.9237e-17
+ NC = 1.1724	RB = 8.5757	IRB = 0.00072983	RBM = 3.4849
+ RE = 0.31111	RC = 0.10105	CJE = 1.8063e-15	VJE = 0.8051
+ MJE = 0.46576	TF = 6.7661e-12	XTF = 0.42199	VTF = 0.23794
+ ITF = 0.001	PTF = 0	CJC = 2.3453e-13	VJC = 0.81969
+ MJC = 0.30232	XCJC = 0.3	TR = 2.3249e-09	CJS = 0
+ VJS = 0.75	MJS = 0	XTB = 0	EG = 1.11
+ XTI = 3	FC = 0.73234)		

### Package Equivalent Circuit



L <sub>BI</sub>	0.36 nH
L <sub>BO</sub>	0.4 nH
L <sub>EI</sub>	0.3 nH
L <sub>EO</sub>	0.15 nH
L <sub>CI</sub>	0.36 nH
L <sub>CO</sub>	0.4 nH
L <sub>1</sub>	0.6 nH
L <sub>2</sub>	0.4 nH
C <sub>BE</sub>	95 fF
C <sub>CB</sub>	6 fF
C <sub>CE</sub>	132 fF
C <sub>1</sub>	28 fF
C <sub>2</sub>	88 fF
C <sub>3</sub>	8 fF

Valid up to 3GHz

### Typical Application

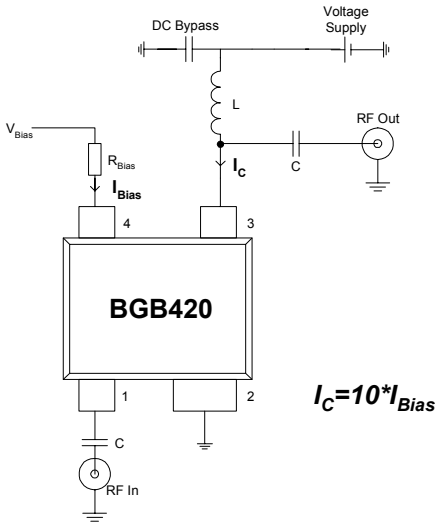
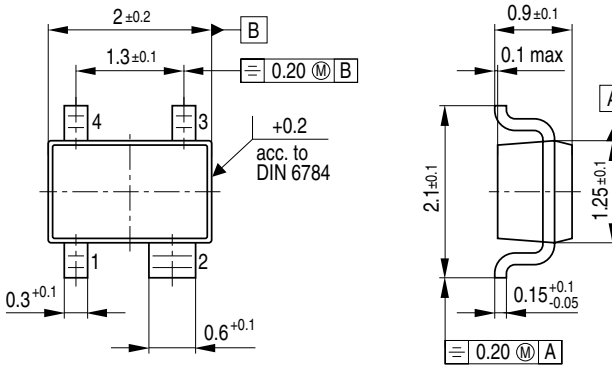


Fig. 3: Typical application circuit. This proposal demonstrates how to use the BGB420 as a Self-Biased Transistor. As for a discrete Transistor matching circuits have to be applied. A good starting point for various applications are the Application Notes provided for the BFP420.

### Package Outline



GPS05605