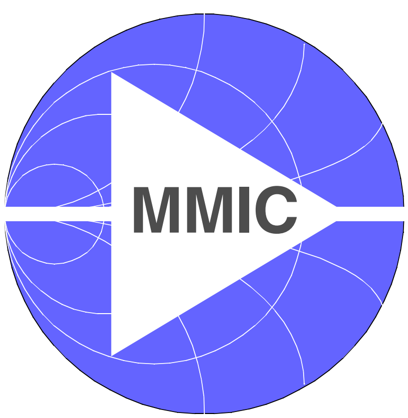
# BGB420

## Active Biased Transistor

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**BGB420**
**Data sheet**
**Revision History: 2001-08-10**

Previous Version: 2000-11-28

| 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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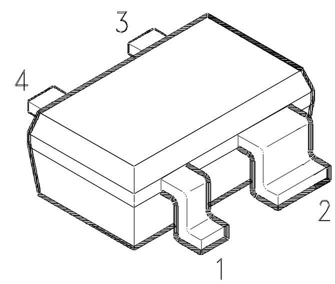
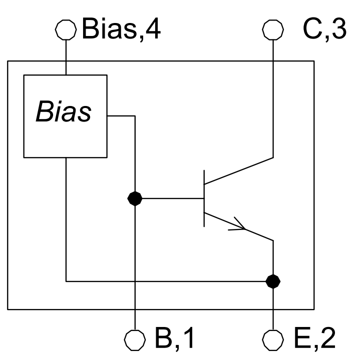
# BGB420 Active Biased Transistor

**BGB420**

## Features

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




## Description

SIEGET®-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*$I_{Bias}$ .

**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°C[1)] | $P_{tot}$ | 120 | mW |
| Junction temperature | $T_j$ | 150 | °C |
| Operating temperature range | $T_{OP}$ | -40 ..+85 | °C |
| Storage temperature range | $T_{STG}$ | -65 ... +150 | °C |
| Thermal resistance: junction-soldering point | $R_{th\ JS}$ | <270 | 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

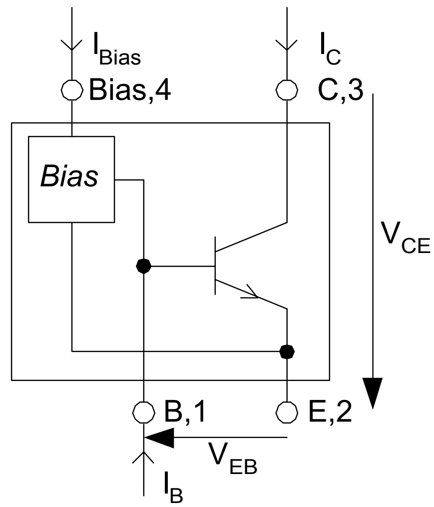



Fig. 1: Symbol definition

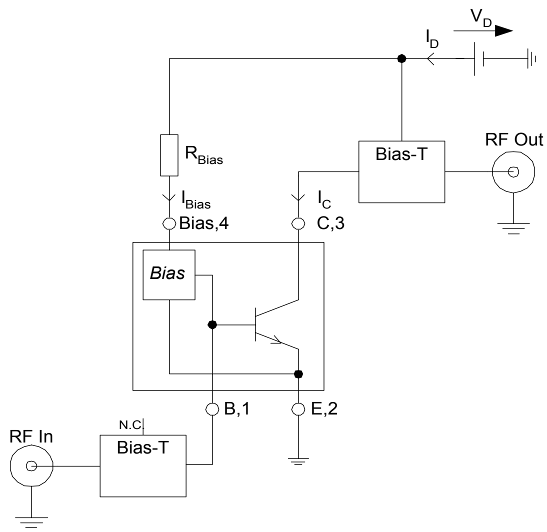



Fig. 2: Test Circuit for Electrical Characteristics and S-Parameter

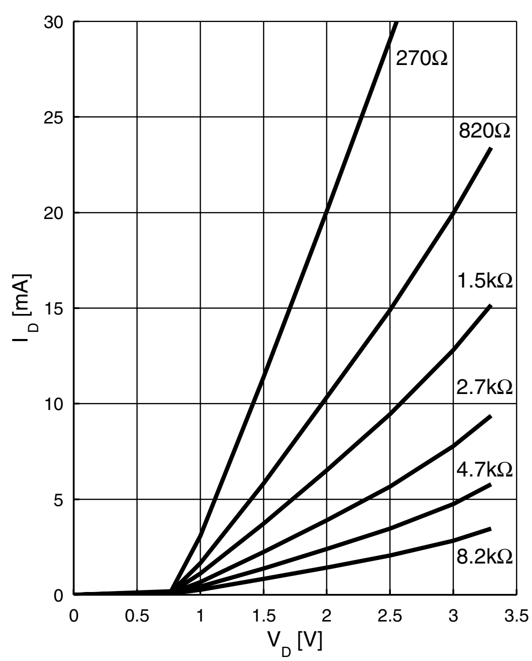
**Electrical Characteristics** at $T_A$=25°C (measured in test circuit specified in fig. 2, min./max. values verified by random sampling)

| **Parameter** | | **Symbol** | **min.** | **typ.** | **max.** | **Unit** |
|---|---|---|---|---|---|---|
| Maximum available power gain<br>$V_D$=2V, $I_c$=20mA, f=1.8GHz | | $G_{MA}$ | 16.0 | 17.5 | | dB |
| Insertion power gain<br>$V_D$=2V, $I_c$=20mA | f=0.9GHz<br>f=1.8GHz | $\|S_{21}\|^2$ | | 22<br>16 | | dB |
| Insertion loss<br>$V_D$=2V, $I_c$=0mA | f=0.9GHz<br>f=1.8GHz | IL | | 21<br>15 | | dB |
| Noise figure ($Z_S$=50Ω)<br>$V_D$=2V, $I_c$=5mA | f=0.9GHz<br>f=1.8GHz | $F_{50\Omega}$ | | 1.3<br>1.5 | 1.8<br>2.0 | dB |
| Output power at 1dB gain compression<br>$V_D$=2V, $I_c$=20mA, f=1.8GHz | $Z_L$=$Z_{LOPT}$<br>$Z_L$=50Ω | $P_{-1dB}$ | <br>7 | 12<br>10 | | dBm |
| Output third order intercept point<br>$V_D$=2V, $I_c$=20mA, f=1.8GHz | $Z_{L/S}$=$Z_{L/SOPT}$<br>$Z_{L/S}$=50Ω | $OIP_3$ | <br>17 | 22<br>20 | | dBm |
| Collector-base capacitance<br>$V_{CB}$=2V, f=1MHz | | $C_{CB}$ | | 0.16 | | pF |
| Current Ratio $I_C/I_{Bias}$<br>$I_{Bias}$=0.5mA, $V_D$=3V | | CR | 7 | 10 | 13 | |

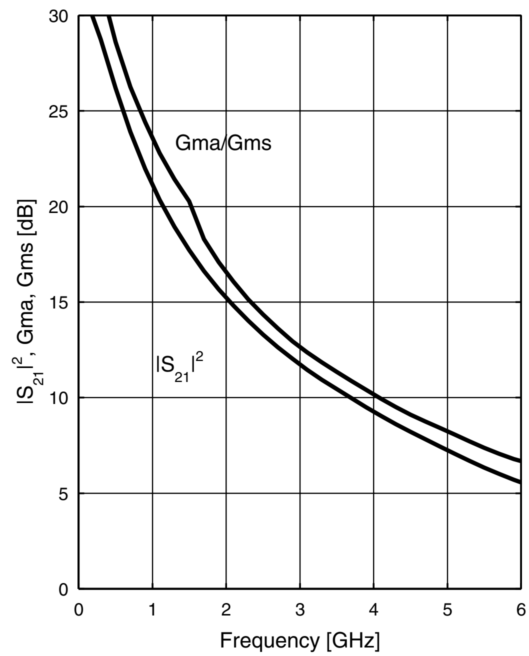
**S-Parameter** $V_D$=2V, $I_C$=20mA (see Electrical Characteristics for conditions)

| Frequency [GHz] | S11 Mag | S11 Ang | S21 Mag | S21 Ang | S12 Mag | S12 Ang | S22 Mag | S22 Ang |
|---|---|---|---|---|---|---|---|---|
| 0.1 | 0.4412 | -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 |

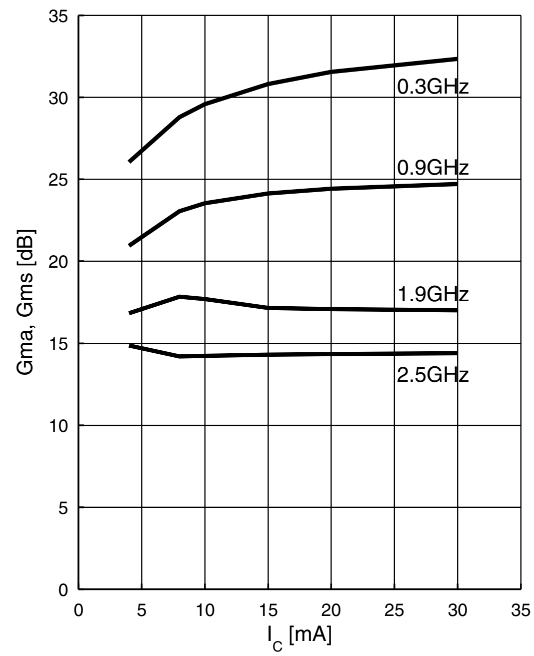
**Device Current** $I_D = f(V_D, R_{Bias})$



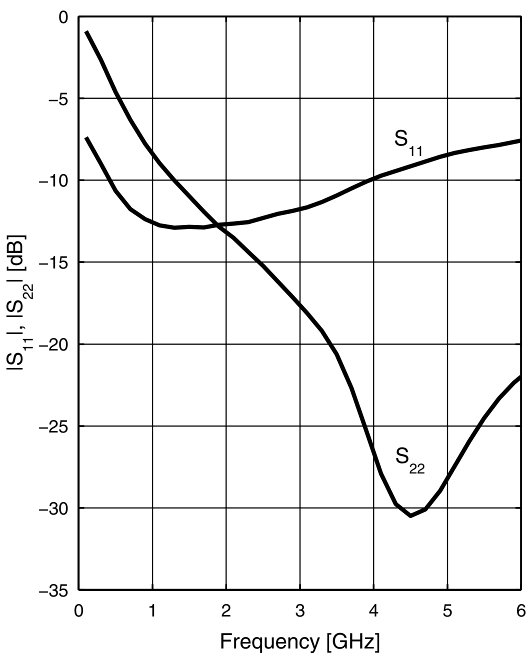
**Power Gain** $|S_{21}|^2$, Gma, Gms=f(f)
$V_D$ = 3V, $I_C$=20mA



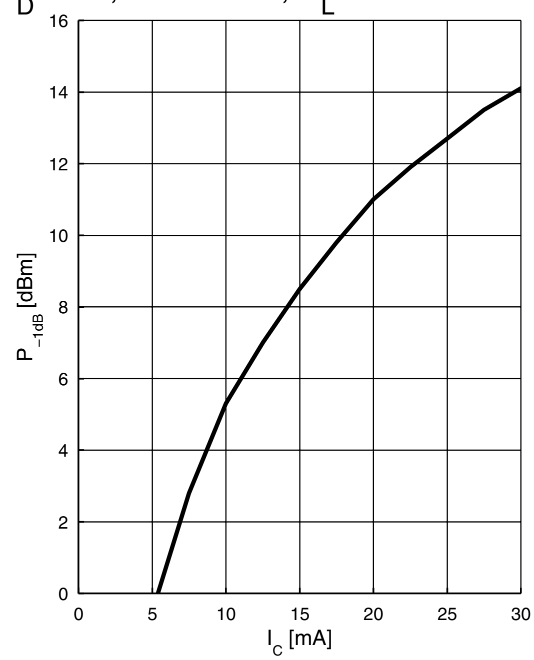

**Power Gain** Gma, Gms=f($I_C$)
$V_D$ = 3V




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

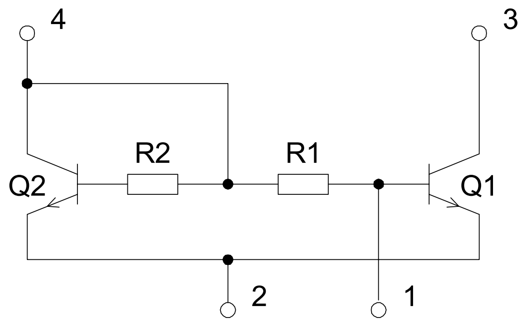



**Output Compression Point**
$P_{-1dB}$ = f($I_C$)
$V_D$ = 3V, f = 1.8GHz, $Z_L$ = 50Ω



## SPICE Model

### BGB420-Chip



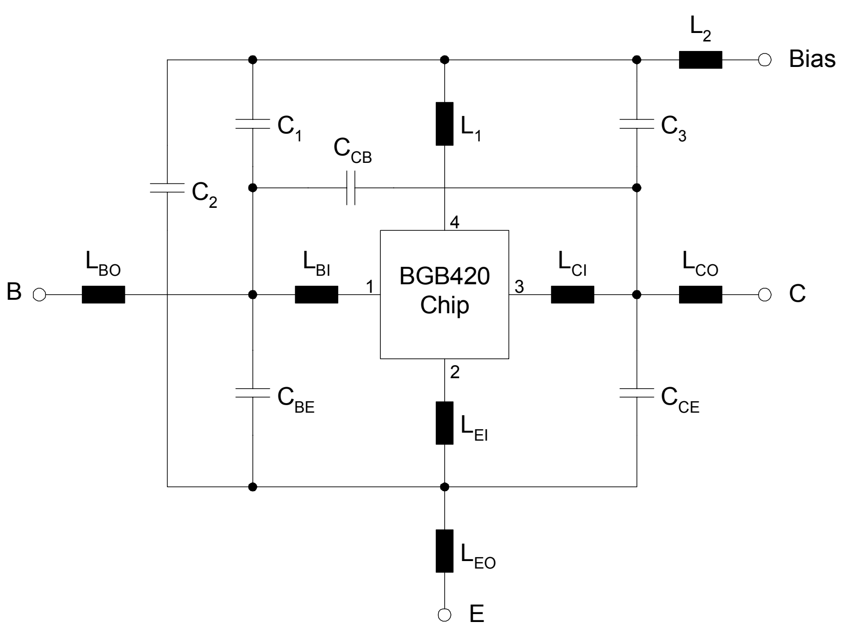

| | |
|---|---|
| Q1 | T502 |
| Q2 | T502 (area factor: 0.1) |
| R1 | 2.7kΩ |
| R2 | 27kΩ |

### 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




| | | |
|---|---|---|
| $L_{BI}$ | 0.36 | nH |
| $L_{BO}$ | 0.4 | nH |
| $L_{EI}$ | 0.3 | nH |
| $L_{EO}$ | 0.15 | nH |
| $L_{CI}$ | 0.36 | nH |
| $L_{CO}$ | 0.4 | nH |
| $L_1$ | 0.6 | nH |
| $L_2$ | 0.4 | nH |
| $C_{BE}$ | 95 | fF |
| $C_{CB}$ | 6 | fF |
| $C_{CE}$ | 132 | fF |
| $C_1$ | 28 | fF |
| $C_2$ | 88 | fF |
| $C_3$ | 8 | fF |

Valid up to 3GHz

## Typical Application

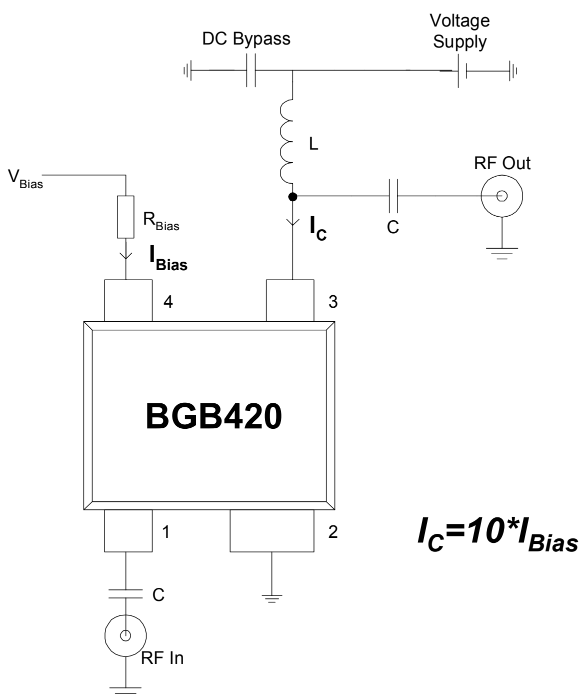



Fig. 3: Typical application circuit. This proposal demonstrates how to use the BGB420 as a Self-Biased Transistor. As for a discrete Transistor matching circuits have to be applied. A good starting point for various applications are the Application Notes provided for the BFP420.

## Package Outline