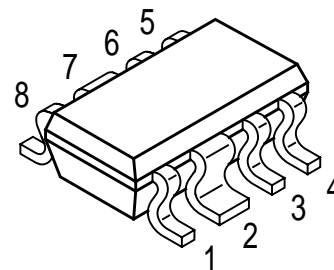


## Self-Biased BFP420

- SIEGET<sup>®</sup>25- Technology
- Small SCT598-Package
- Control Pin For Switching The Device Off
- Current Easy Adjustable By An External Resistor
- Voltage Independent Current (2V – 4.5V)

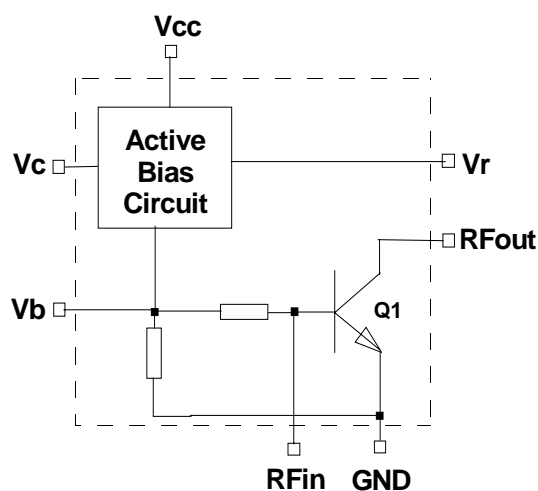


VPW05982

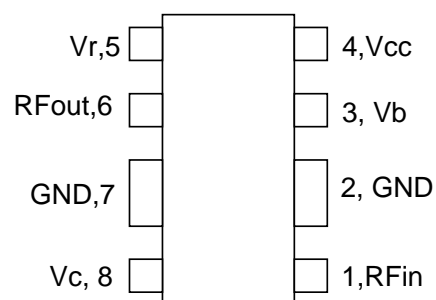
**ESD:** Electrostatic discharge sensitive device, observe handling precautions!

Type	Marking	Ordering Code (8-mm taped)	Pin Configuration (circuit Diagram)	Package
BGC420	42s	Q62702-G0092	see below	SCT598

### Equivalent Circuit



### Pin Connections, SCT598



Note: Top View

## Description

The BGC420 is a silicon self biased RF Transistor (Q1). It offers an adjustable collector current nearly independent from device voltage in the range from 2.0V to 4.5V. Additionally a control pin (Vc) for switching the device off is provided. The collector current can be adjusted by connecting a resistor (Rx) between Vcc and Vr.

### Maximum Ratings

Parameter	Symbol		Unit
Device current	$I_{CC}$	15	mA
Device voltage	$V_{CC}$	4.5	V
Total power dissipation, $T_s \leq 110^\circ\text{C}$ <sup>1)</sup>	$P_{tot}$	68	mW
Control voltage	$V_C$	$V_{CC}+0.5$	V
Input Current for pin 1	$I_r$	380	$\mu\text{A}$
Junction temperature	$T_j$	150	$^\circ\text{C}$
Ambient temperature range	$T_A$	-65...+150	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-65...+150	$^\circ\text{C}$

### Thermal Resistance

Junction-soldering point <sup>1)</sup>	$R_{th JS}$	$\leq 270$	K/W
--	-------------	------------	-----

<sup>1)</sup>  $T_S$  is measured on the Ground lead at the soldering point to the pcb.

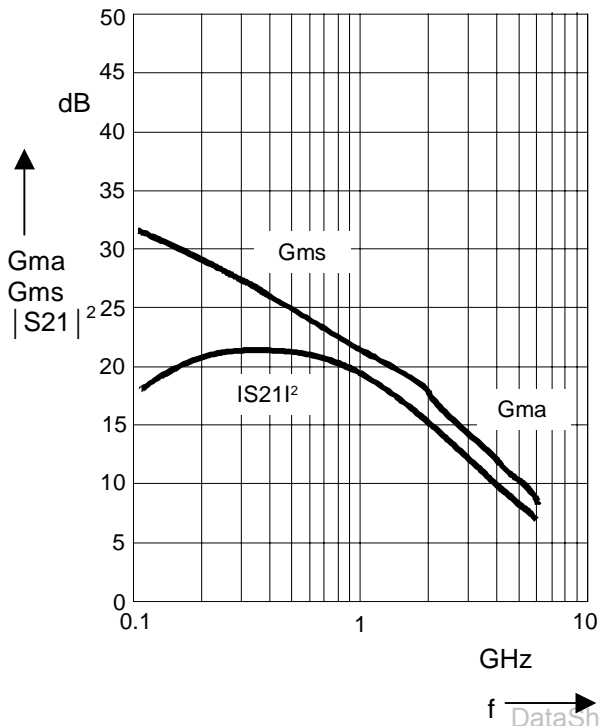
### Electrical Specifications (Measured in Test Fixture applying the circuit specified in Figure 1 with $R_x=82\Omega$ ), $T_c=25^\circ\text{C}$ , $V_{CC}=3\text{V}$ , $I_{CC}\approx 7\text{mA}$ unless noted

Symbol	Parameter	Unit	Min	Typ	Max
Gp	Power Gain ( $ S_{21} ^2$ )	f=900MHz	dB	17.5	19
				f=1.8GHz	14.5
NF	Noise Figure (in 50 $\Omega$ System)	f=900MHz	dB	1.3	1.5
				f=1.8GHz	1.5
P <sub>-1dB</sub>	Output Power at 1dB Gain Compression (in 50 $\Omega$ System)	f=900MHz	dBm	1	1
				f=1.8GHz	1
IP <sub>3</sub>	Third Order Intercept Point (Output, $\Gamma_{Opt}$ )	f=900MHz	dBm	15	15
				f=1.8GHz	15
RL <sub>in</sub>	Input Return Loss	f=900MHz	dB	7	7
				f=1.8GHz	9
RL <sub>out</sub>	Output Return Loss	f=900MHz	dB	4	4
				f=1.8GHz	7
t <sub>on</sub>	On Switching Time <sup>3)</sup>	$\mu\text{s}$		3.7	
t <sub>off</sub>	Off Switching Time <sup>3)</sup>	$\mu\text{s}$		2.5	
I <sub>leak</sub>	Leakage Current In Sleep Mode	$\mu\text{A}$		<10	
I <sub>VcOn</sub>	Control Pin (Vc) Current in Active Mode <sup>2)</sup>	$\mu\text{A}$		35	
I <sub>VcOff</sub>	Control Pin (Vc) Current in Sleep Mode <sup>2)</sup>	nA		-60	
V <sub>cmin</sub>	Minimum Voltage at Vc for Sleep Mode	V		$V_{CC} - 0.3\text{V}$	
V <sub>cmax</sub>	Maximum Voltage at Vc for Active Mode	V		$0\text{V}+0.3\text{V}$	

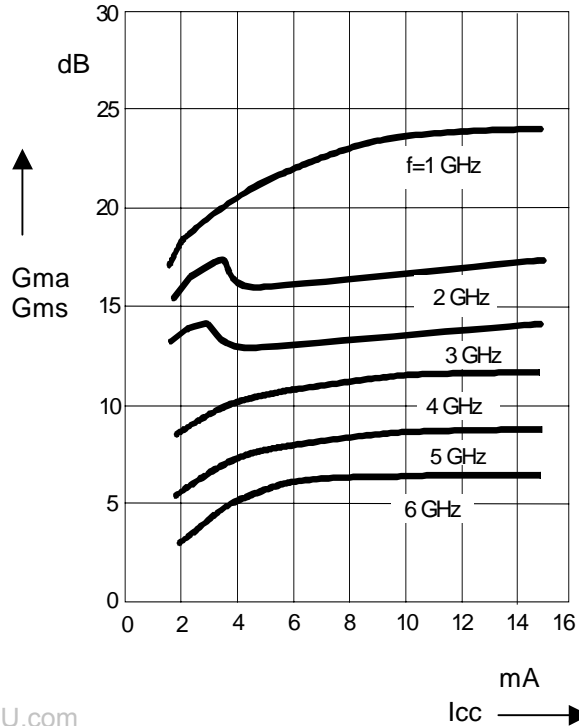
<sup>2)</sup> A positive sign denotes a current flowing from the Pin into the external circuit.

<sup>3)</sup> These values are valid for C2=1nF, C3=100pF and 220pF Coupling capacitors at RFin and RFOut.

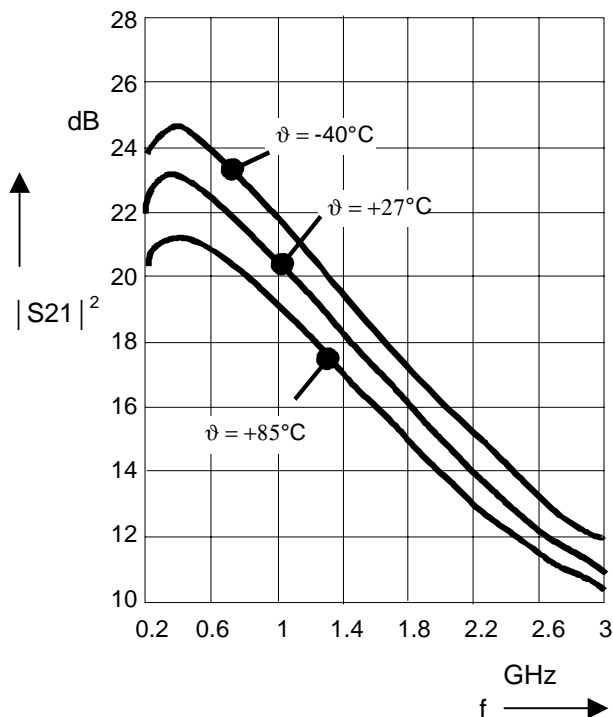
**Power Gain versus Frequency**  
**V<sub>cc</sub>=3V, I<sub>cc</sub>=5mA**



**Power Gain versus Device Current**  
**V<sub>cc</sub>=3V**



**|S<sub>21</sub>|<sup>2</sup> versus Frequency and Temperature**  
**V<sub>cc</sub>=3V, I<sub>cc</sub>=7mA**

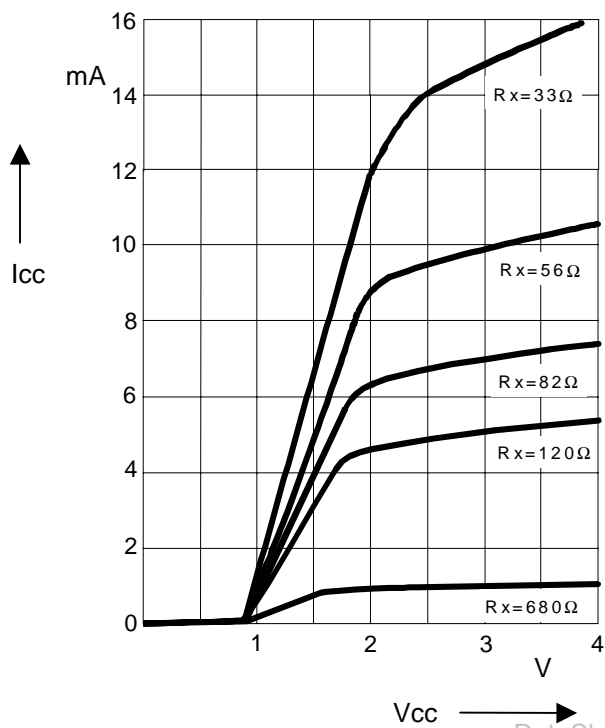


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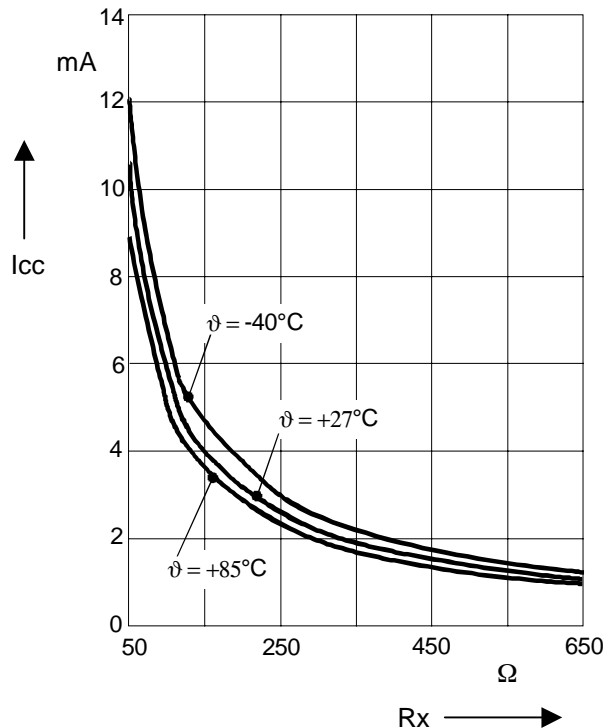
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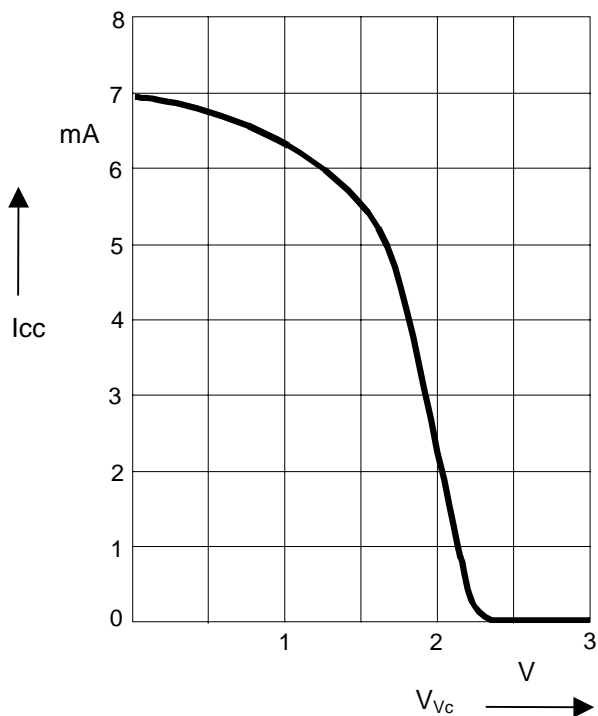
**Device Current versus Device Voltage**



**Device Current versus Rx and Temperature**  
V<sub>cc</sub>=3V



**Device Current versus Voltage at Vc**  
V<sub>cc</sub>=3V; R<sub>x</sub>=82Ω



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## Typical Application

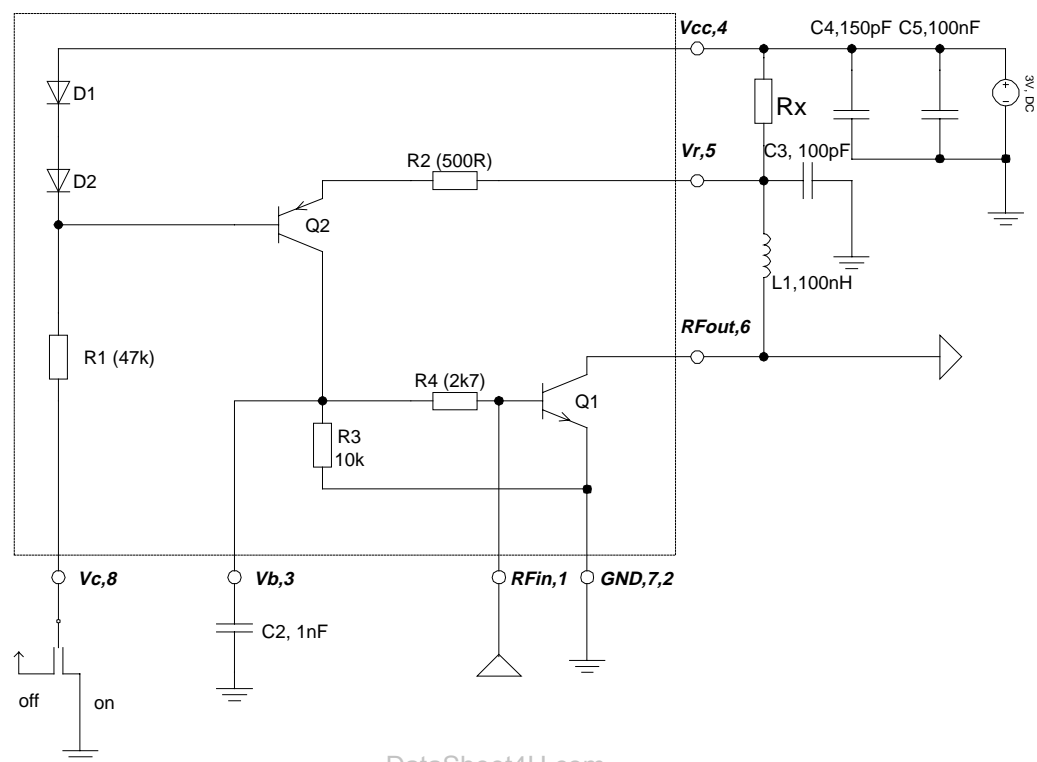


Figure 1. Typical Application and Internal Circuit

### Remarks:

- 1) To provide low frequency stability C2 should be 10 times C3.
- 2) Be aware that also coupling capacitors determine the switching times.
- 3) The collector current at Q1 can be estimated by  $I_c = 0.6V / R_x [\Omega]$ .
- 4) Place C2 as close to the device as possible.

## Layout Proposal

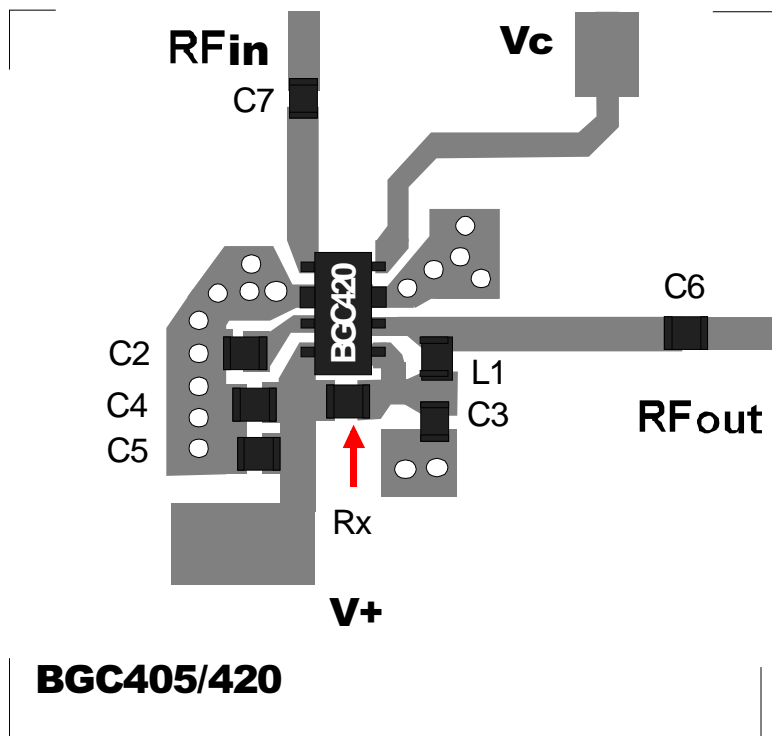


Figure 2. Layout Proposal

### Part List for $V_{CC}=3V$ , $I_{CC}\approx 7mA$

Component	Value	Comment
L1	100nH	RFC
C2	1nF	Compensation Capacitor for Low Frequency Stabilization
C3	100pF	RFC
C4	150pF	Blocking Capacitor
C5	100nF	Blocking Capacitor
C6	220pF	Coupling Capacitor
C7	220pF	Coupling Capacitor
Rx	82Ω	Current Adjust
Substrate	h=0.5mm	Fr4, $\epsilon_r=4.5$
BGC420		

This proposal demonstrates how to use the BGC420 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.

## SPICE Model

The following SPICE Listing describes the circuit shown in figure 3. It is valid for low frequencies. For frequencies above 100MHz the parasitic circuit elements noted in figure 4 and table 1 should be added.

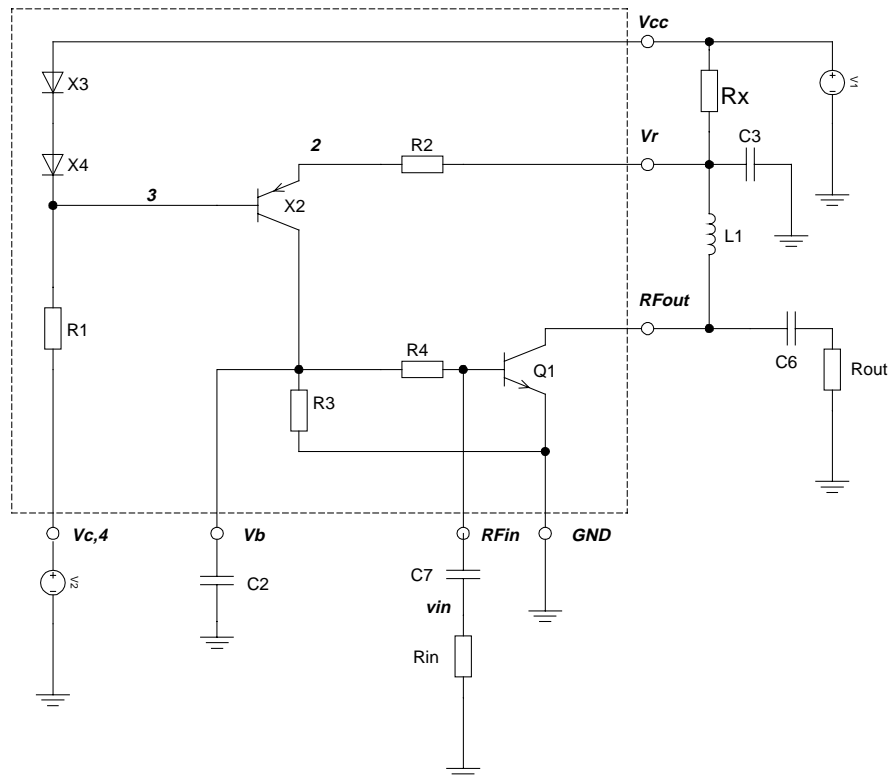


Figure. 3: Circuit used in the SPICE File

```
* Preliminary SPICE Model for BGC420 (valid for frequencies below 100MHz)
* SIEMENS HIGH FREQUENCY PRODUCTS
* Small Scale MMIC Design Group
```

```
.PARAM R=82
```

```
** Analysis setup **
```

```
*.TRAN 2ns 15u 0 2n
```

```
.TEMP +27
```

```
.DC LIN V1 0V 4V 0.1V
```

```
*.DC LIN V2 0V 3V 0.1V
```

```
.STEP PARAM R LIST 56 82 120 680
```

```
* Voltage supply
```

```
V1 Vcc 0 DC 3.0V
```

```
V2 Vc 0 DC 0.0V
```

```
*Vpul Vc 0 PULSE(0 3V 100ns 0 0 9us 1000m)
```



## \* Internal Resistors

```
R1 3 Vc 47k TC=-0.0006,0.0000025
R2 Vr 2 500 TC=-0.0006,0.0
R3 Vb 0 10k TC=-0.0006,0.0000025
R4 Vb rfin 2.7k TC=-0.0006,0.0
```

## \* External Resistors

```
Rx Vcc Vr {R} TC=+0.000050,0.0
Rout vout 0 50
Rin vin 0 50
```

## \* External Capacitors

```
C2 Vb 0 1nF
C3 Vr 0 100pF
C7 rfin vin 220pF
C6 rfout vout 220pF
```

## \* Inductors (external)

```
L1 Vr rfout 100nH
```

## \* Transistors

```
Q1 rfout rfin 0 BFP420
X2 2 3 Vb 0 8PL18
X3 Vcc 5 5 0 2PL18
X4 5 3 3 0 2PL18
```

## .PROBE

## .MODEL BFP420 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 = 3.4849 IRB = 0.00072983
+ RBM = 8.5757 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)
```

## \* PNP: PL18 E B C Bulk

## .SUBCKT 8PL18 3 2 1 94

```
Q1 993 2 3 94 TL18 8
Q2 94 2 3 94 VSL18 8
Q3 94 2 993 94 LSL18 8
RCEX 993 1 0.204
.ENDS
```

## .SUBCKT 2PL18 3 2 1 94

```
Q1 993 2 3 94 TL18 2
Q2 94 2 3 94 VSL18 2
Q3 94 2 993 94 LSL18 2
RCEX 993 1 0.816
.ENDS
```





\*\*\*\*\*

```

.MODEL          TL18          PNP
+IS             = 2.914E-17    NF             = 1.000E+00    BF             = 4.005E+02
+NE             = 1.553E+00    ISE            = 6.923E-16    NR             = 1.000E+00
+BR             = 2.869E+01    NC             = 1.500E+00    ISC            = 8.190E-15
+VAF            = 6.000E+01    IKF            = 1.676E-04    VAR            = 2.214E+00
+IKR            = 2.474E-05    RB             = 6.000E+01    IRB            = 0.000E+00
+RBM            = 4.000E+01    RE             = 2.597E+00    RC             = 4.000E+00
+XTB            = -6.000E-01   EG             = 1.156E+00    XTI            = 3.000E+00
+CJE            = 1.200E-14    VJE            = 4.900E-01    MJE            = 1.360E-01
+TF             = 7.600E-10    XTF            = 2.872E-01    VTF            = 1.000E+03
+ITF            = 1.400E-02    CJC            = 4.700E-13   VJC            = 7.610E-01
+MJC            = 3.760E-01    XCJC           = 1.000E+00    TR             = 0.000E+00
+CJS            = 0.000E+00    VJS            = 7.500E-01   MJS            = 0.000E+00
+PTF            = 0.000E+00    FC             = 5.000E-01

```

\*\*\*\*\*

```

.MODEL          VSL18         PNP
+IS             = 1.630E-19    NF             = 1.000E+00    BF             = 1.000E+09
+NE             = 1.500E+00    ISE            = 0.000E+00    NR             = 1.000E+00
+BR             = 1.000E+09    NC             = 2.000E+00    ISC            = 0.000E+00
+VAF            = 1.000E+02    IKF            = 1.794E-04    VAR            = 1.700E+00
+IKR            = 1.000E+00    RB             = 0.000E+00    IRB            = 0.000E+00
+RBM            = 0.000E+00    RE             = 0.000E+00    RC             = 0.000E+00
+XTB            = 0.000E+00    EG             = 1.122E+00    XTI            = 3.000E+00
+CJE            = 0.000E+00    VJE            = 6.800E-01    MJE            = 3.400E-01
+TF             = 2.000E-09    XTF            = 0.000E+00    VTF            = 1.000E+03
+ITF            = 1.000E+06    CJC            = 1.950E-13   VJC            = 5.500E-01
+MJC            = 3.770E-01    XCJC           = 0.000E+00    TR             = 0.000E+00
+CJS            = 0.000E+00    VJS            = 7.500E-01   MJS            = 0.000E+00
+PTF            = 0.000E+00    FC             = 5.000E-01

```

\*\*\*\*\*

```

.MODEL          LSL18         PNP
+IS             = 4.261E-17    NF             = 1.000E+00    BF             = 1.000E+09
+NE             = 1.500E+00    ISE            = 0.000E+00    NR             = 1.000E+00
+BR             = 1.000E+09    NC             = 2.000E+00    ISC            = 0.000E+00
+VAF            = 6.000E+01    IKF            = 9.648E-05    VAR            = 1.700E+00
+IKR            = 1.000E+00    RB             = 0.000E+00    IRB            = 0.000E+00
+RBM            = 0.000E+00    RE             = 0.000E+00    RC             = 0.000E+00
+XTB            = 0.000E+00    EG             = 1.158E+00    XTI            = 3.000E+00
+CJE            = 0.000E+00    VJE            = 6.800E-01    MJE            = 3.400E-01
+TF             = 1.000E-09    XTF            = 0.000E+00    VTF            = 1.000E+03
+ITF            = 1.000E+06    CJC            = 0.000E+00    VJC            = 4.600E-01
+MJC            = 3.000E-01    XCJC           = 0.000E+00    TR             = 0.000E+00
+CJS            = 0.000E+00    VJS            = 7.500E-01   MJS            = 0.000E+00
+PTF            = 0.000E+00    FC             = 5.000E-01

```

\*\*\*\*\*

.END

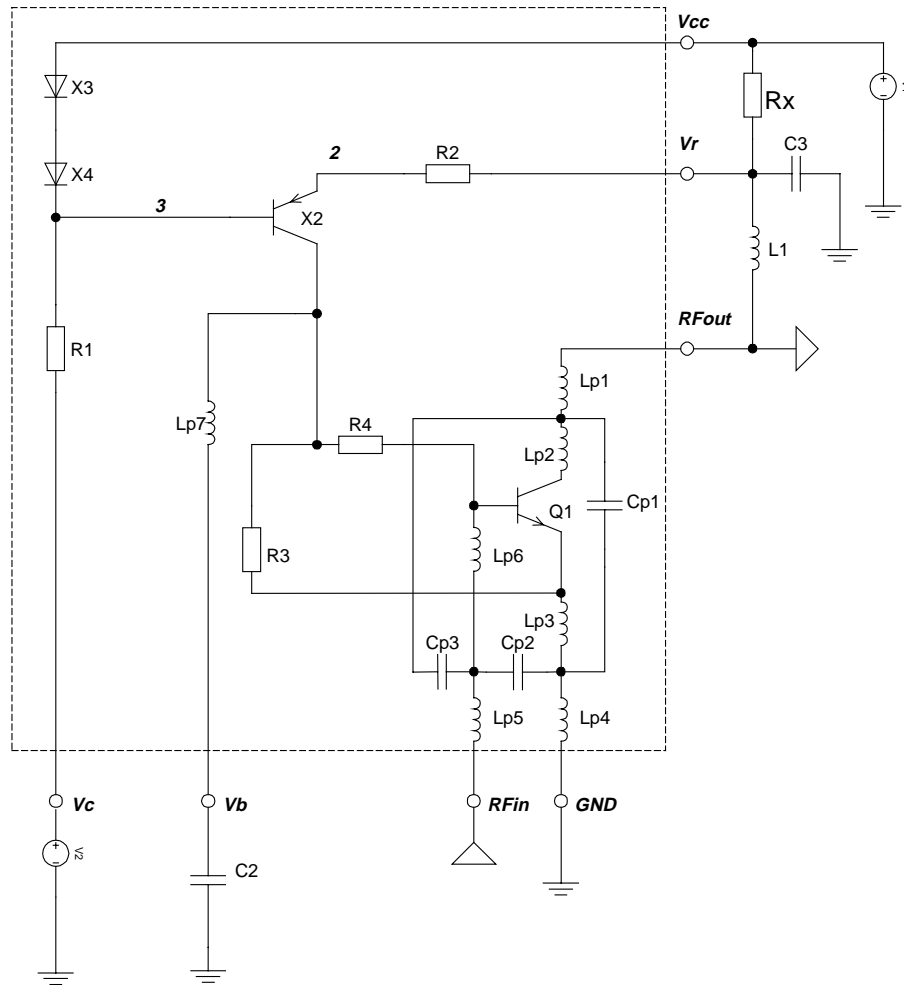
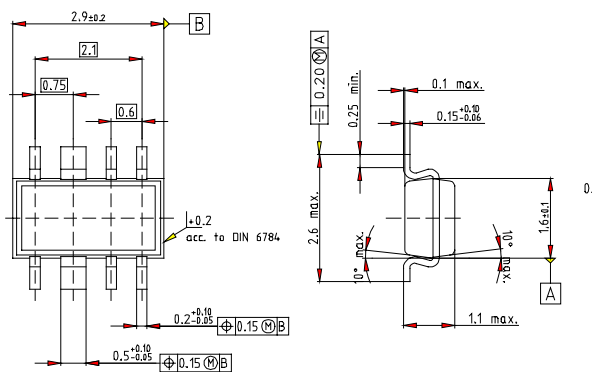


Figure 4. Parasitic circuit elements for frequencies above 100MHz

Element	Value
Lp1	0.58nH
Lp2	0.56nH
Lp3	0.23nH
Lp4	0.05nH
Lp5	0.53nH
Lp6	0.47nH
Lp7	1nH
Cp1	134fF
Cp2	136fF
Cp3	6.9fF

Table 1. Parasitic circuit elements for frequencies above 100MHz

## Package



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