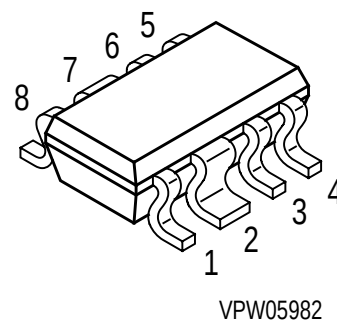


Self-Biased BFP405

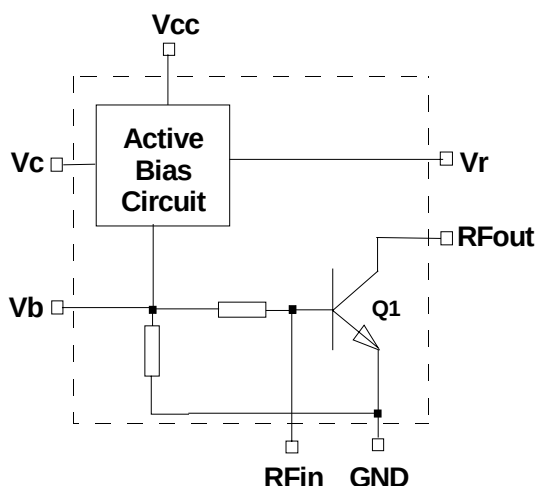
- SIEGET[®]25- Technology
- Small SCT598-Package
- Control Pin For Switching The Device Off
- Current Easy Adjustable By An External Resistor
- Voltage Independent Current (2V – 4.5V)



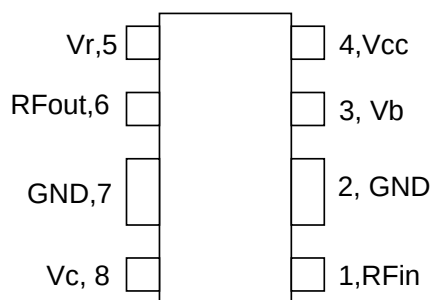
ESD: Electrostatic discharge sensitive device, observe handling precautions!

Type	Marking	Ordering Code (8-mm taped)	Pin Configuration (circuit Diagram)	Package
BGC405	40s	Q62702-G0091	see below	SCT598

Equivalent Circuit



Pin Connections, SCT598



Note: Top View

Description

The BGC405 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}	12	mA
Device voltage	V_{CC}	4.5	V
Total power dissipation, $T_s \leq 120^\circ\text{C}$ ¹⁾	P_{tot}	54	mW
Control voltage	V_C	$V_{CC}+0.5$	V
Input Current for pin 1	I_r	380	μA
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 ¹⁾	$R_{th JS}$	≤ 530	K/W
--	-------------	------------	-----

¹⁾ T_S is measured on the Ground lead at the soldering point to the pcb.

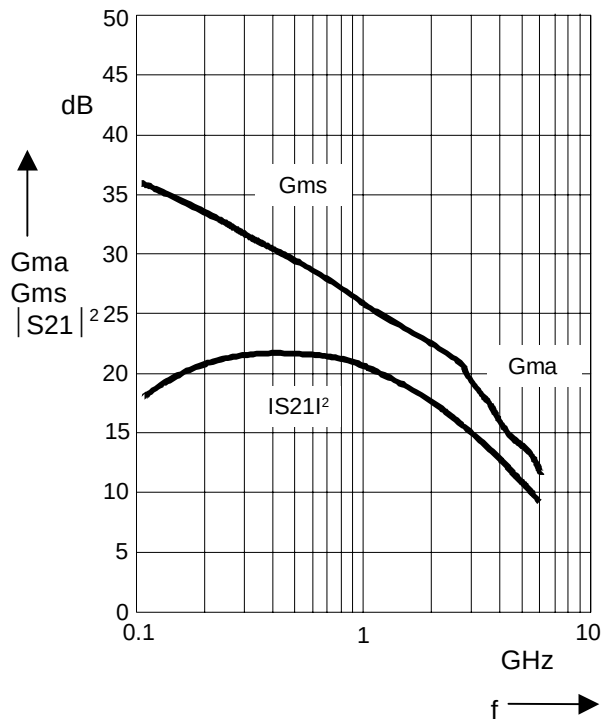
Electrical Specifications (Measured in Test Fixture applying the circuit specified in Figure 1 with $R_x=82\Omega$, $T_c=25^\circ\text{C}$, $V_{CC}=3\text{V}$, $I_{CC}\approx 7\text{mA}$ unless noted)

Symbol	Parameter	Unit	Min	Typ	Max
Gp	Power Gain ($ S_{21} ^2$) f=900MHz	dB	19.5	21	
	f=1.8GHz		16.5	18	
NF	Noise Figure (in 50 Ω System) f=900MHz	dB		1.8	2.1
	f=1.8GHz			2.0	2.3
P_{-1dB}	Output Power at 1dB Gain Compression (in 50 Ω System) f=900MHz	dBm		1	
	f=1.8GHz			0.5	
IP_3	Third Order Intercept Point (Output, Γ_{opt}) f=900MHz	dBm		15	
	f=1.8GHz			15	
RL_{in}	Input Return Loss f=900MHz	dB		5	
	f=1.8GHz			8	
RL_{out}	Output Return Loss f=900MHz	dB		1.5	
	f=1.8GHz			3	
t_{on}	On Switching Time ³⁾	μs		3.7	
t_{off}	Off Switching Time ³⁾	μs		2.5	
I_{leak}	Leakage Current In Sleep Mode	μA		<10	
I_{VcOn}	Control Pin (Vc) Current in Active Mode ²⁾	μA		35	
I_{VcOff}	Control Pin (Vc) Current in Sleep Mode ²⁾	nA		-60	
V_{cmin}	Minimum Voltage at Vc for Sleep Mode	V		$V_{CC} - 0.3\text{V}$	
V_{cmax}	Maximum Voltage at Vc for Active Mode	V		$0\text{V}+0.3\text{V}$	

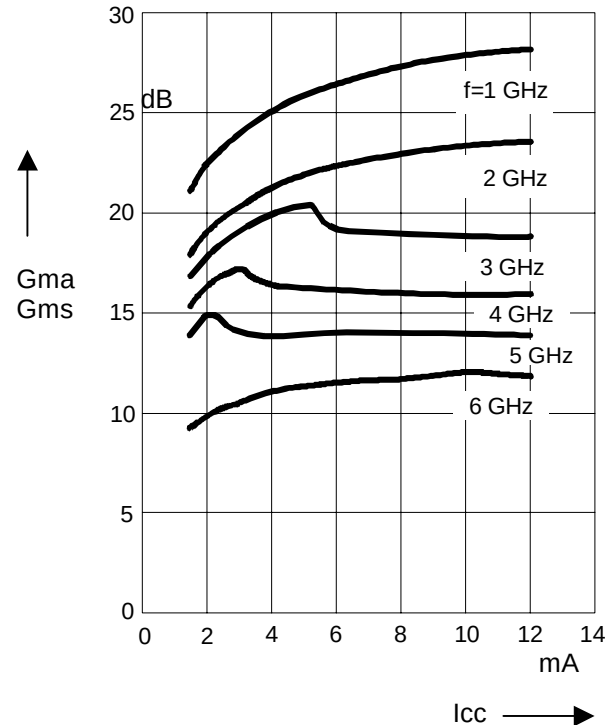
²⁾ A positive sign denotes a current flowing from the Pin to the external circuit.

³⁾ These values are valid for $C_2=1\text{nF}$, $C_3=100\text{pF}$ and 220pF Coupling capacitors at R_{Fin} and R_{Fout} .

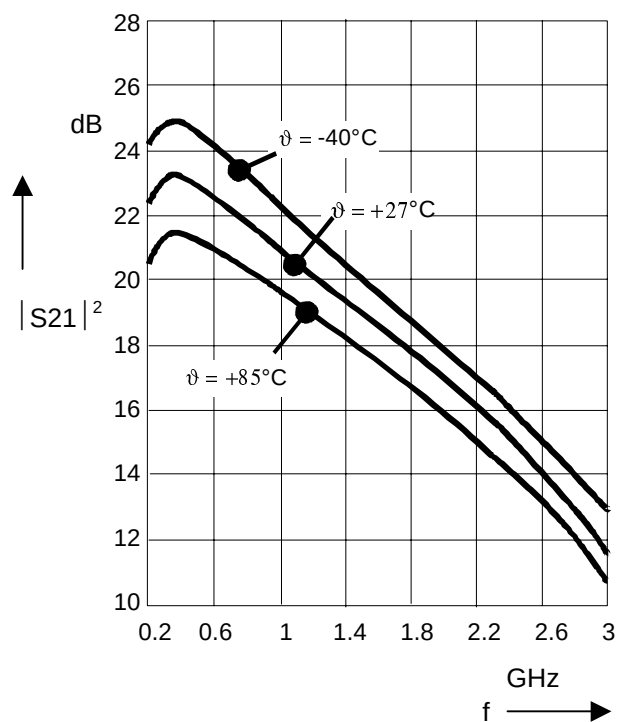
**Power Gain
versus Frequency**
 $V_{CC}=3V$, $I_{CC}=5mA$



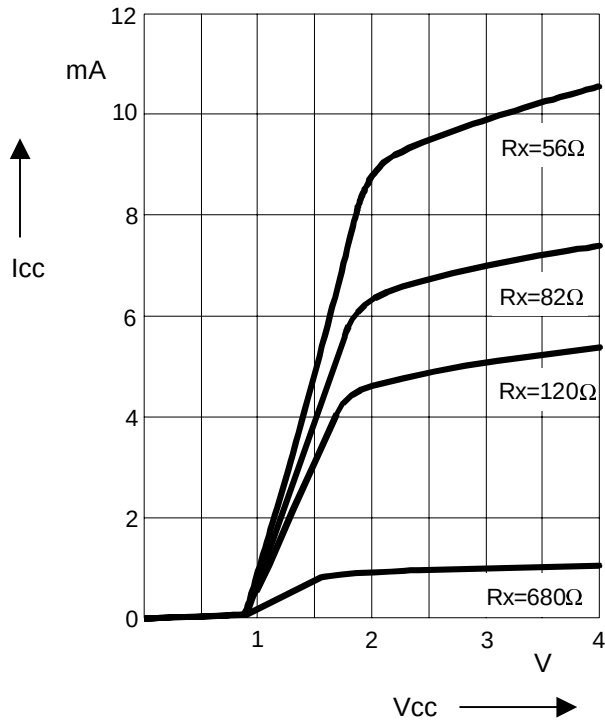
**Power Gain
versus Device Current**
 $V_{CC}=3V$



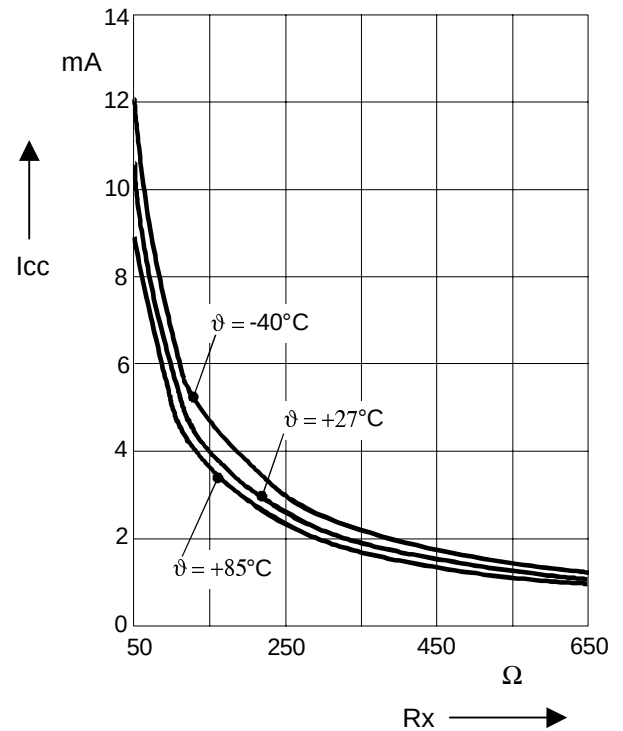
**$|S_{21}|^2$
versus Frequency and Temperature**
 $V_{CC}=3V$, $I_{CC}=7mA$



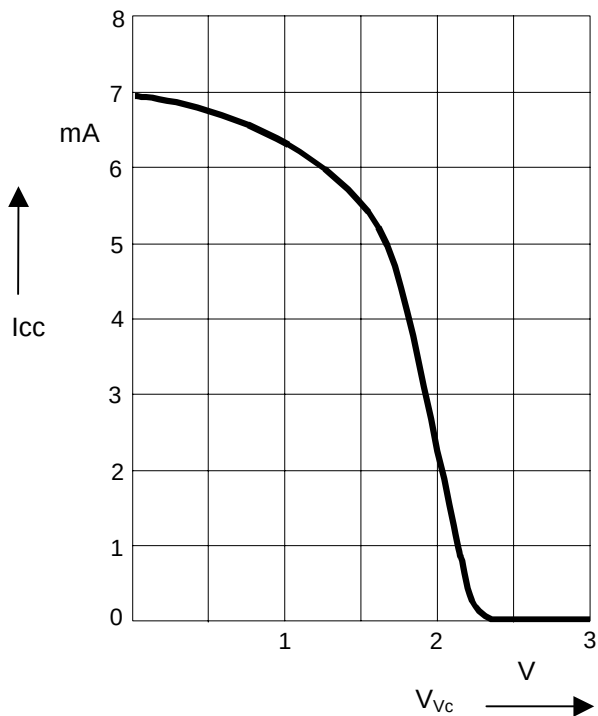
**Device Current
versus Device Voltage**



**Device Current
versus R_x and Temperature
 $V_{cc}=3V$**



**Device Current
versus Voltage at V_c
 $V_{cc}=3V$; $R_x=82\Omega$**



Typical Application

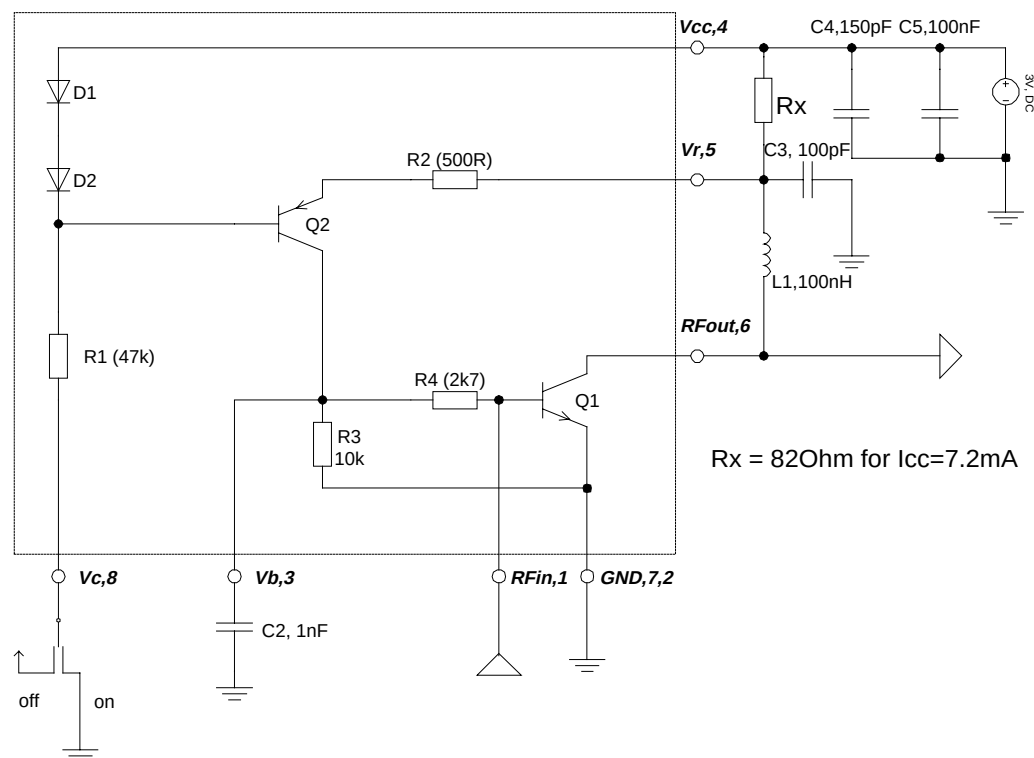


Figure 1. Typical Application and Internal Circuit

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 $I_c = 0.6\text{V} / R_x[\Omega]$.
- 4) Place C2 as close to the device as possible.

Layout Proposal

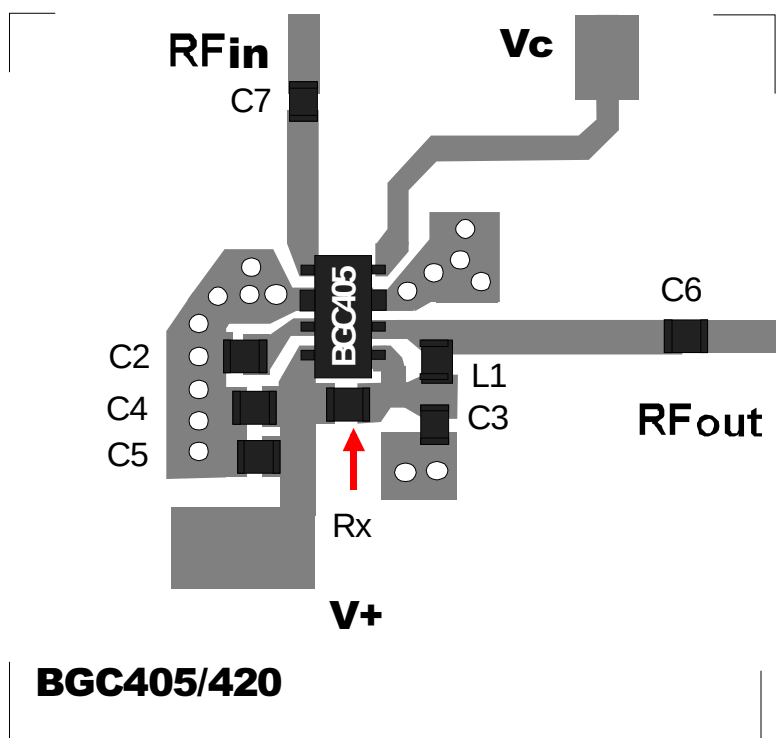


Figure 2. Layout Proposal

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, $\epsilon_r=4.5$
BGC405		

This proposal demonstrates how to use the BGC405 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 BFP405.

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.

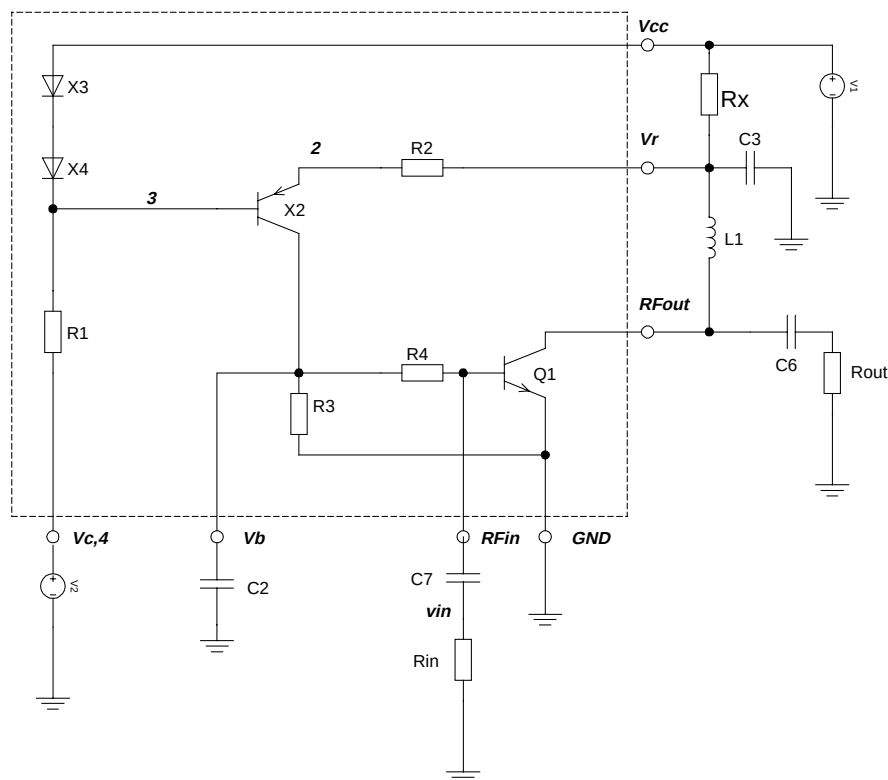


Figure. 3: Circuit used in the SPICE File

* Preliminary SPICE Model for BGC405

.PARAM R=82

** Analysis setup **

*.TRAN 2ns 15u 0 2n

.TEMP +27 -40 +85

.DC LIN V1 0V 4V 0.1V

*.DC LIN V2 0V 3V 0.1V

*.STEP PARAM R LIST 33 47 68 100 150

* 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      BFP405
X2      2 3 Vb 0      8PL18
X3      Vcc 5 5 0      2PL18
X4      5 3 3 0      2PL18
```

.PROBE

.MODEL BFP405 NPN(

```
+ IS = 1.9969e-16      BF = 83.23      NF = 1.0405
+ VAF = 39.251      IKF = 0.16493      ISE = 1.5761e-14
+ NE = 1.7763      BR = 10.526      NR = 0.96647
+ VAR = 34.368      IKR = 0.25052      ISC = 3.7223e-17
+ NC = 1.3152      RB = 15      IRB = 0.00021215
+ RBM = 1.3491      RE = 1.9289      RC = 0.12691
+ CJE = 3.7265e-15      VJE = 0.70367      MJE = 0.37747
+ TF = 4.5899e-12      XTF = 0.3641      VTF = 0.19762
+ ITF = 0.0013364      PTF = 0      CJC = 9.6941e-14
+ VJC = 0.99532      MJC = 0.48652      XCJC = 0.08161
+ TR = 1.4935e-09      CJS= 0      VJS = 0.75
+ MJS = 0      XTB = 0      EG = 1.11
+ XTI = 3      FC = 0.99469)
```

* 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

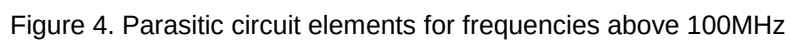


Table 1. Parasitic circuit elements for frequencies above 100MHz