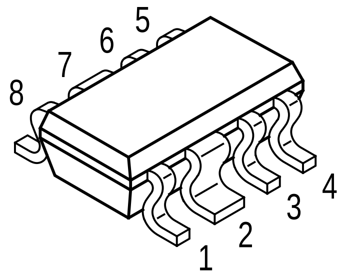
Self-Biased BFP405

- 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)

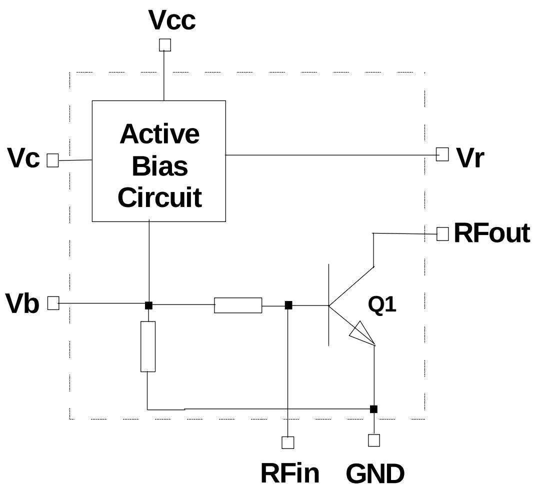


VPW05982

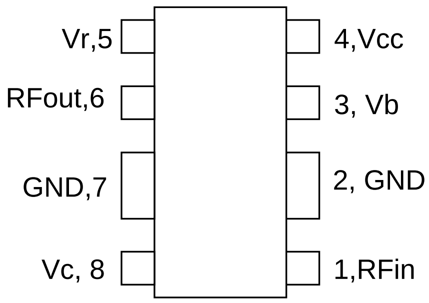
ESD: **E**lectro**s**tatic **d**ischarge sensitive device, observe handling precautions!

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	Vcc	4.5	V
Total power dissipation, $T_s \leq$ 120°C [1]	P_{tot}	54	mW
Control voltage	Vc	Vcc+0.5	V
Input Current for pin 1	Ir	380	µA
Junction temperature	T_j	150	°C
Ambient temperature range	T_A	-65...+150	°C
Storage temperature range	T_{stg}	-65...+150	°C

Thermal Resistance

Junction-soldering point [1]	$R_{th\ JS}$	$\leq$ 530	K/W

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

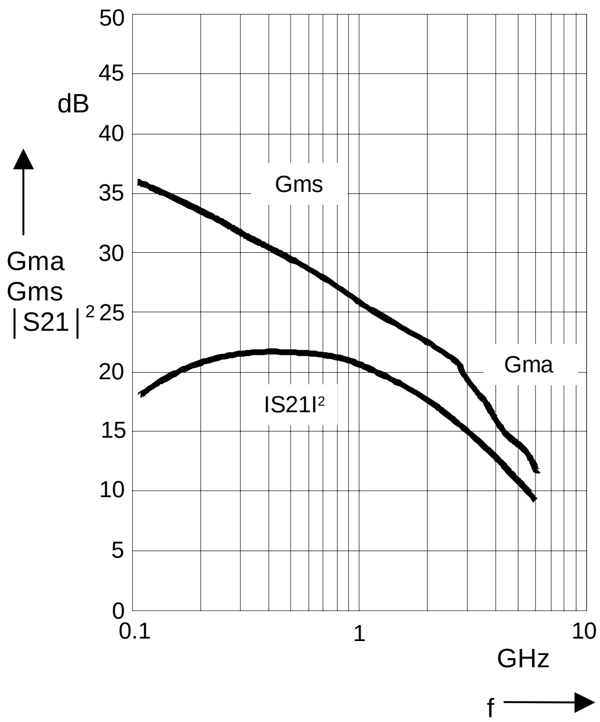
Electrical Specifications (Measured in Test Fixture applying the circuit specified in Figure 1 with Rx=82Ω), Tc=25°C, Vcc=3V, $I_{CC}\approx$7mA unless noted

Symbol	Parameter		Unit	Min	Typ	Max
Gp	Power Gain ($\lvert S_{21}\rvert^2$)	f=900MHz	dB	19.5	21	
		f=1.8GHz		16.5	18	
NF	Noise Figure (in 50Ω System)	f=900MHz	dB		1.8	2.1
		f=1.8GHz			2.0	2.3
P_{-1dB}	Output Power at 1dB Gain Compression	f=900MHz	dBm		1	
	(in 50Ω System)	f=1.8GHz			0.5	
IP_3	Third Order Intercept Point	f=900MHz	dBm		15	
	(Output,Γ_{Opt})	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}	Controll Pin (Vc) Current in Active Mode[2]		µA		35	
I_{VcOff}	Controll Pin (Vc) Current in Sleep Mode[2]		nA		-60	
V_{cmin}	Minimum Voltage at Vc for Sleep Mode		V		V_{cc} - 0.3V	
V_{cmax}	Maximum Voltage at Vc for Active Mode		V		0V+0.3V	

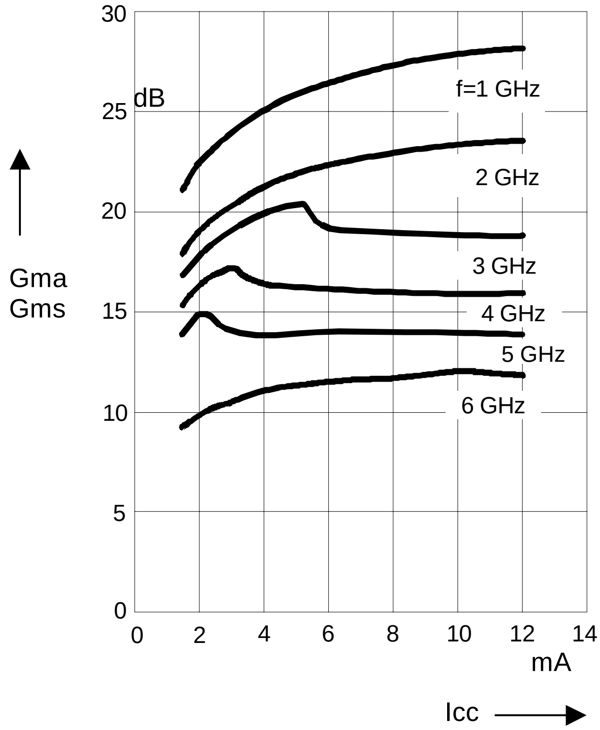
2) A positive sign denotes a current flowing form the Pin to the external circuit.

3) This values are valid for C2=1nF, C3=100pF and 220pF Coupling capacitors at RFin and RFout.

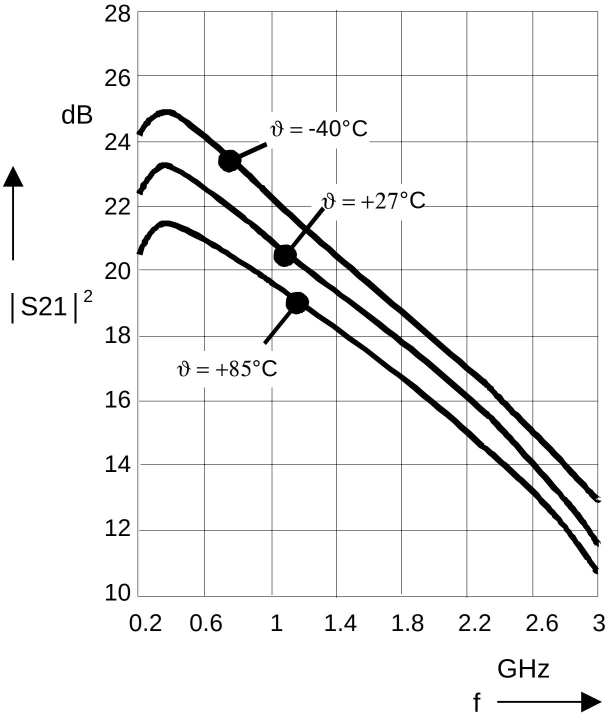
Power Gain
versus Frequency
Vcc=3V, Icc=5mA



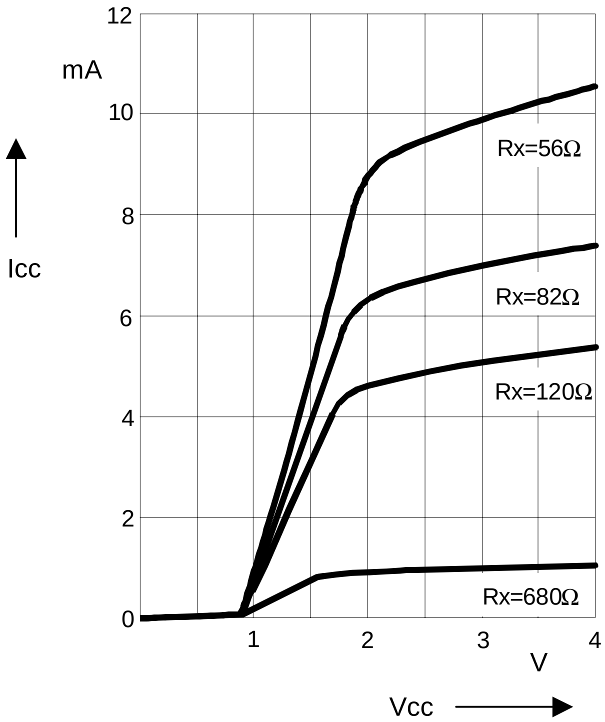
Power Gain
versus Device Current
Vcc=3V



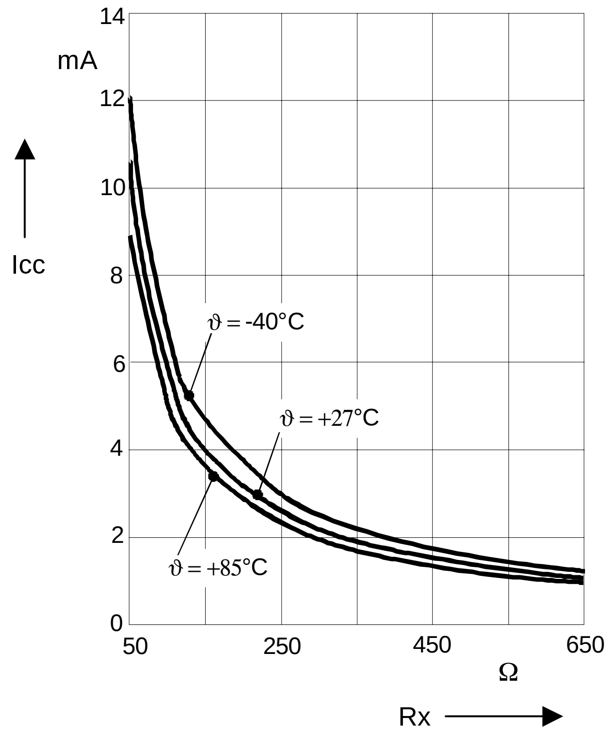
|S21|²
versus Frequency and Temperature
Vcc=3V, Icc=7mA



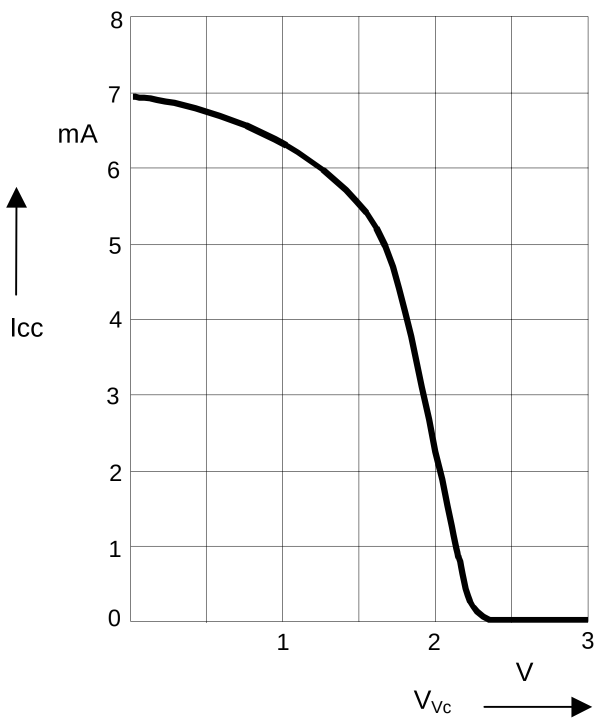
Device Current versus Device Voltage



Device Current versus Rx and Temperature Vcc=3V



Device Current versus Voltage at Vc Vcc=3V; Rx=82Ω



Typical Application

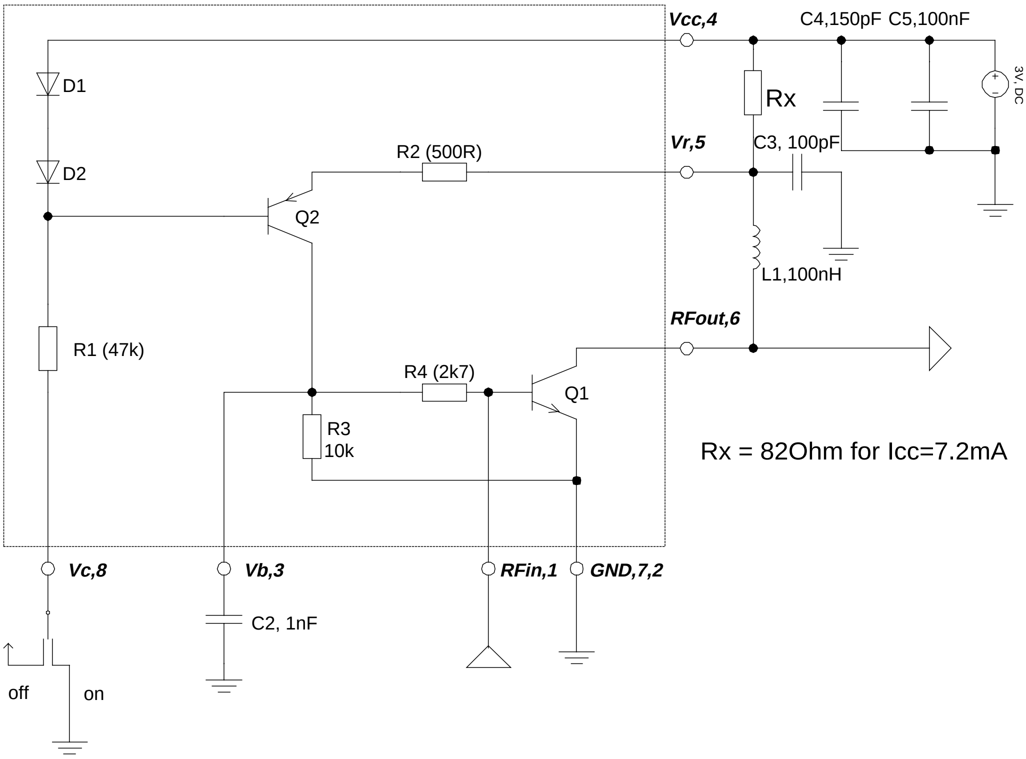


Figure 1. Typical Application and Internal Circuit

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 Ic=0.6V / Rx[Ω].
4) Place C2 as close to the device as possible.

Layout Proposal

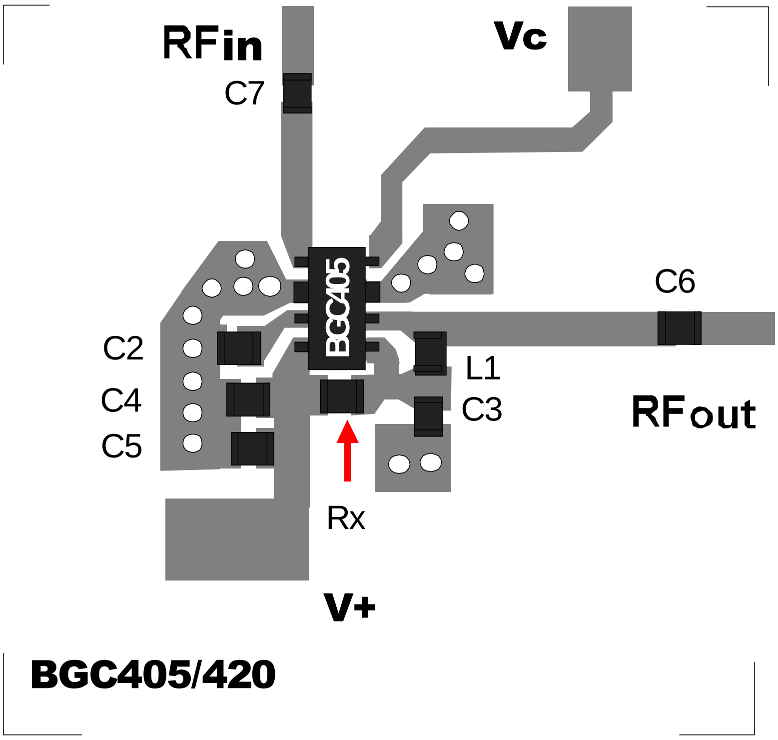


Figure 2. Layout Proposal

Part List for Vcc=3V, I_{CC}≈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,ε_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.

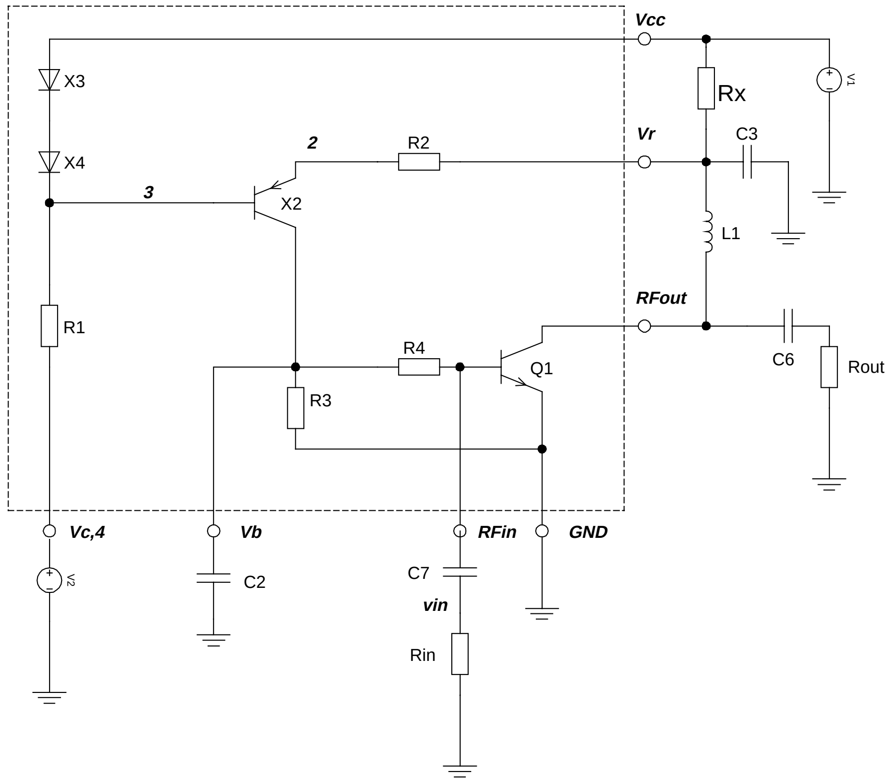


Figure. 3: Circuit used in the SPICE File

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* Preliminary SPICE Model for BGC405
* SIEMENS HIGH FREQUENCY PRODUCTS
*   Small Scale MMIC Design Group

.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
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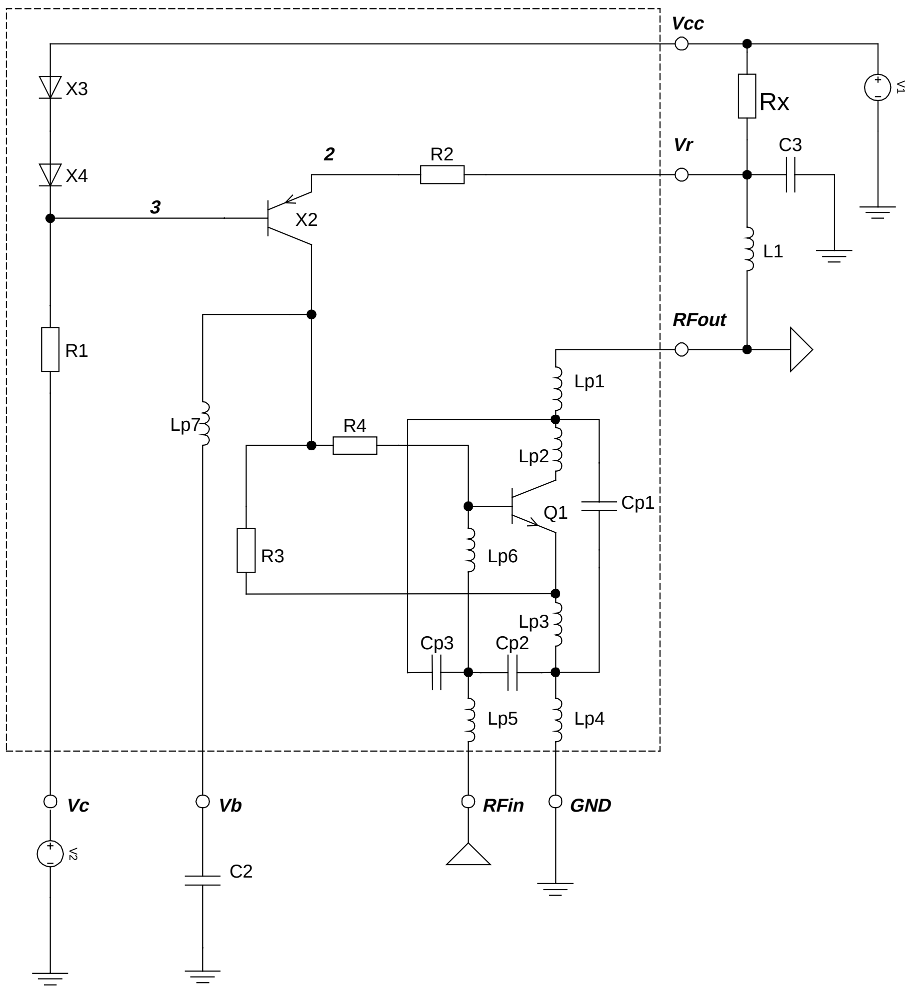
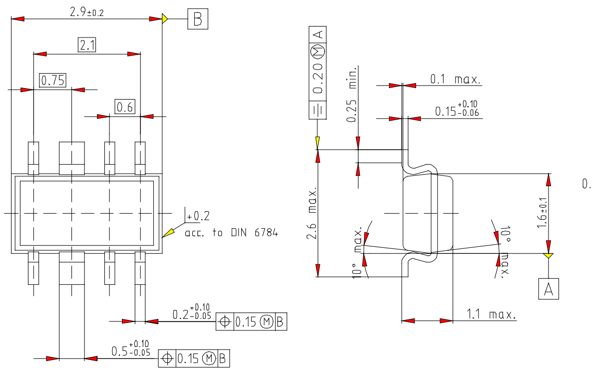


Figure 4. Parasitic circuit elements for frequencies above 100MHz

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



Published by
Infineon Technologies AG i Gr.,
Bereichs Kommunikation
St.-Martin-Strasse 76,
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