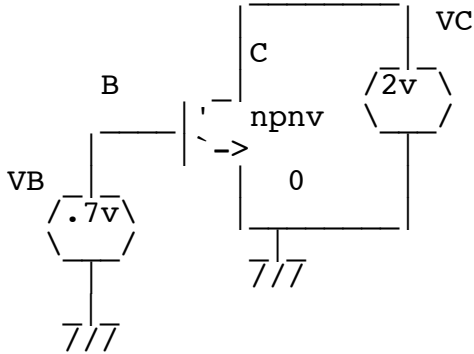


# NPN\_GUM

\* MEASURE IS, ISE, NF, NE, RE, IKF, BETA

\*  
\*  
\*  
\*  
\*  
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\*  
\*  
\*



```
VC      C  0  DC  2V
VB      B  0  0V
Q1      C  B  0  NPNV
```

.OPTIONS **GMIN=1e-15** METHOD=gear ABSTOL=1e-15

.control

```
dc vb .1V 1.4V .1V   vc 2V  5V 3V
plot mag(-i(vc)) mag(-i(vb)) vs mag(V(b))      ylog  title
Gummel
plot mag(i(vc)/i(vb)) vs mag(vc#branch) loglog title
Beta_vs_IC
plot mag(i(vc)/i(vb)) vs mag(v(b))      ylog  title
Beta_vs_Vb
.endc
```

.MODEL **NPNV**

```
NPN(
+ IS=15.51E-18 NF=1.005      BF=110      VAF=130.2      IKF=0.0057
+ NR=1.006      BR=0.4822      VAR=4.286      IKR=
0.0002472
+ ISE=9.15E-17 NE=2
+ ISC=1E-21      NC=2
+ RB=732      RBM=441.2      IRB=7.5E-04
+ RE=15.33      RC=109.1
+ CJE=1.727E-14 VJE=0.6408      MJE=0.2563
+ CJC=1.826E-14 VJC=0.6399      MJC=0.3531
+ CJS=2.939E-14 VJS=0.3488      MJS=0.1813      XCJC=0.4201
+ TF=1.65E-11   XTF=1.25      VTF=1      ITF=0.003532
+ TR=6E-09      FC=0.88      PTF=205
+ KF=1.000E-16 AF=1
+ XTB=2      EG=1.11      XTI=5      TNOM=25      )
```

.END



A

— mag(-i(vc))

— mag(-i(vb))

