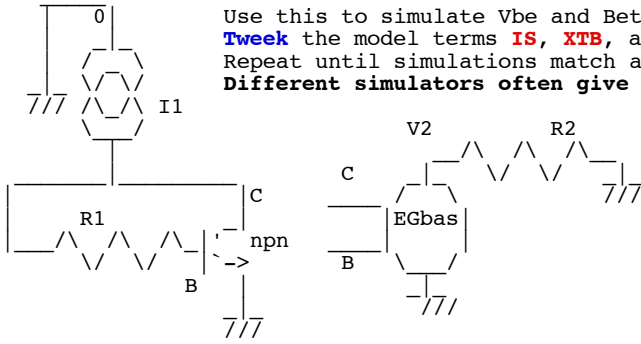


Test Match NPN TC to Silicon

*
 * Use this to simulate Vbe and Beta over temp.
 * **Tweek** the model terms **IS**, **XTB**, and **XTI**.
 * Repeat until simulations match actual silicon.
 * **Different simulators often give different results!**
 *



```

I1      0      C      DC      1e-6
R1      C      B      1
R2      V2     0      1k
Q1      C      B      0      npnv   1
EGbas   V2     0      C      B      1
  
```

.control

```

foreach tempval -55 -35 -15 5 25 45 65 85 105 125
set temp = $tempval
op
let beta = mag(1e-6/v2)
let vbe = mag(b)
echo Temp = $temp C_deg Vbe = $&vbe Beta = $&beta
end
  
```

.endc

.model

```

npnv      npn (
=====
+IS=1.1E-17 NF=1.0      BF=120      VAF=30      IKF=6e-03
+          NR=1.0      BR=0.5      VAR=4       IKR=3e-04
+ISE=9E-17  NE=2
+ISC=1E-21  NC=2
+RB=750     RBM=450      IRB=8E-04
+RE=17      RC=110
=====
+CJE=2E-14  VJE=0.65      MJE=0.3
+CJC=2E-14  VJC=0.65      MJC=0.3
+CJS=3E-14  VJS=0.35      MJS=0.19   XCJC=0.42
+TF=2E-11   XTF=1.25      VTF=1      ITF=0.0035
+TR=6E-09   FC=0.9      PTF=210
=====
+KF=1.0E-16 AF=1
+XTB=1.4     EG=1.11      XTI=8      TNOM=25
  
```

.end

*****Actual Silicon DATA*****

```

** Temp      NPN 1uA      Beta
** -55       8.23E-01     67%
** -35       7.87E-01
** -15       7.43E-01     75%
** 5         6.96E-01
** 25        6.53E-01     100%
** 45        6.09E-01
** 65        5.64E-01     125%
** 85        5.19E-01
** 105       4.74E-01
** 125       4.17E-01     160%
** tweek     XTI & IS     XTB
  
```

=====**Circuit: Test Match NPN TC to Silicon**=====

```

Temp = -55 C_deg      Vbe = 0.823219      Beta = 62.345
Temp = -35 C_deg      Vbe = 0.782302      Beta = 71.2528
Temp = -15 C_deg      Vbe = 0.740177      Beta = 80.6773
Temp = 5 C_deg        Vbe = 0.696933      Beta = 90.6231
Temp = 25 C_deg       Vbe = 0.652636      Beta = 101.095
Temp = 45 C_deg       Vbe = 0.607372      Beta = 112.1
Temp = 65 C_deg       Vbe = 0.561192      Beta = 123.644
Temp = 85 C_deg       Vbe = 0.514146      Beta = 135.734
Temp = 105 C_deg      Vbe = 0.466281      Beta = 148.378
Temp = 125 C_deg      Vbe = 0.417638      Beta = 161.583
  
```