**Karakteristik I-V dan Frekuensi Tinggi Transistor Bipolar**

Untuk mendapatkan Karakteristik I-V kita masukkan doping profile ke dalam file *bipolar.gr0*. Nilai-nilai parameter didapatkan dari tahap desain sebelumnya.

```
Title File : bipolar.gr0
mesh       rect nx=31 ny=31  smooth=1 diag.flip outf=doping.bip
x.m        n=1  l=0.0   r=1.0
x.m        n=31 l=300.0 r=1.0
y.m        n=1  l=0.0   r=1.0
y.m        n=31 l=90.0  r=1.0
$ Electrodes #1 Emitter; #2 Base; #3 Collector
region     num=1 iy.l=1  iy.h=31 ix.l=1  ix.h=31 silicon
elec       num=1 ix.l=1  ix.h=8  iy.l=1  iy.h=1
elec       num=2 ix.l=28 ix.h=31 iy.l=1  iy.h=1
elec       num=3 ix.l=1  ix.h=31 iy.l=31 iy.h=31
$ Impurity Profile
doping     uniform conc=1.0e15 n.type
doping     gauss   conc=5.0e18 p.type junc=25.0
doping         gauss     conc=5.0e19  n.type  junc=10.0  x.r=85.0
ratio=0.75
$ Plotting
plot.1d    dop x.s=0.0  x.e=300.0 y.s=0.0 y.e=0.0  abs log points
pa
plot.1d    dop x.s=0.00 x.e=0.0   y.s=0.0 y.e=90.0 abs log points
pa
plot.2d    grid boundary l.elect=1 l.bound=3 l.junct=6 pa
plot.2d    junction boundary l.elect=1 l.bound=3 l.junct=6 no.fill pa
end
```

Jadi diperoleh output plot :
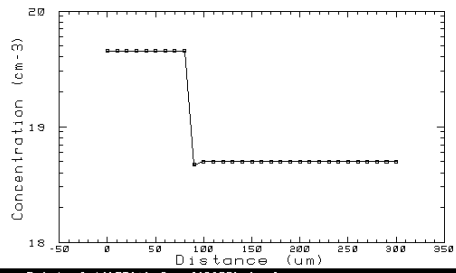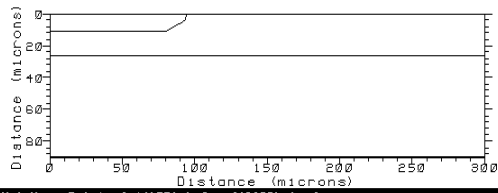
Title File : bipolar.gr1
mesh   inf=doping.bip
mater   region=1 taup0=3.5e-7 taun0=1.1e-6
models   srh auger conmob fldmob
$ Solve initial condition with zero carriers
symb   gummel carr=0
method   iccg damped
solve   init
solve   v3=18 local
$ Then redo with 2 carriers
symb   newton carr=2
method   xnorm autonr
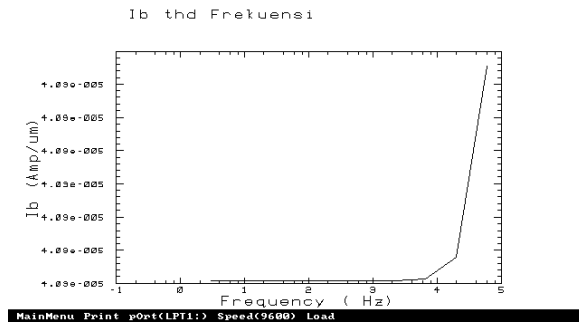solve   v3=18 outf=bip1
end
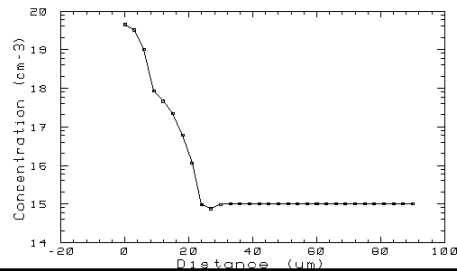
```
Title File : bipolar.gr2
mesh     inf=doping.bip
mater    region=1 taup0=3.5e-7 taun0=1.1e-6
models        srh auger conmob fldmob
load     inf=bip1
log      outf=bip2
symb    newton carr=2
method        xnorm   autonr
solve    v3=18 v2=0.1
solve    previous v2=0.2 vstep=0.1 nstep=5 electr=2
solve    previous v2=0.8 outf=bipsolv1
solve    previous v2=0.9 outf=bipsolv2
solve    previous v2=1.0 outf=bipsolv3
end

Title File : bipolar.gr3
$ Frequency analysis
mesh    inf=doping.bip
mater   region=1 taup0=3.5e-7 taun0=1.1e-6
models  srh auger conmob fldmob
load    inf=bipsolv1
symb    newton carr=2
method  xnorm autonr
log     acfile=ac.bip
solve   ac freq=1 fstep=3 mult.f nfstep=10 vss=0.01
+       max.inner=250 s.omega=0.30 terminal=2
end

Title File : bipolar.if1
$ Plot Ib vs Frequency
mesh    inf=doping.bip
plot.1d inf=ac.bip x.ax=freq x.log x.min=0.0 y.label=Ib y.ax=i2
abs
+       title="Ib thd Frekuensi" pa
end

Output plot :
```

Ib (Amp/Um)

4.09e-005
4.08e-005
4.09e-005
4.09e-005
4.09e-005
4.09e-005
4.09e-005

-1   0   1   2   3   4   5
Frequency (Hz)
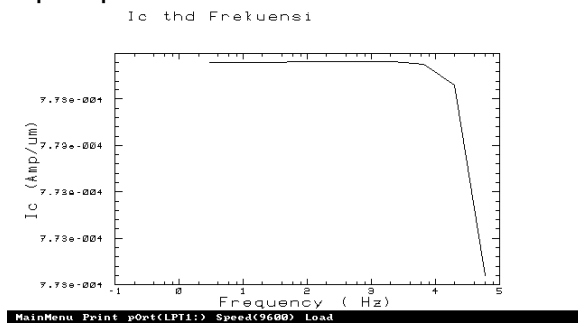MainMenu Print pOrt(LPT1:) Speed(9600) Load

Title File : bipolar.if2
$ Plot Ic vs Frequency
mesh   inf=doping.bip
plot.1d inf=ac.bip x.ax=freq x.log x.min=0.0 y.label=Ic y.ax=i3
abs
+   title="Ic thd Frekuensi" pa
end

Output plot :

Ic thd Frekuensi

Ic (Amp/Um)

7.73e-004
7.73e-004
7.73e-004
7.73e-004
7.73e-004

-1   0   1   2   3   4   5
Frequency (Hz)
MainMenu Print pOrt(LPT1:) Speed(9600) Load

Title File : bipolar.iv1
$ plotting forward characteristic
mesh   inf=doping.bip
plot.1d inf=bip2 x.ax=v2 y.ax=i3 x.label=Vbe y.label="Ib & Ic"
+   y.log min.value=-11 x.min=0.4 points
+   title="Ib & Ic thd Vbe"
plot.1d inf=bip2 x.ax=v2 y.ax=i2
+   y.log min.value=-11 x.min=0.4 points unch pa
end

Ib & Ic thd Vbe