ATMEL Wireless & Microcontrollers

Varaktormodellierung

Bipolar-Arbeitskreis
26.10.2001
Frankfurt/Oder

Gliederung

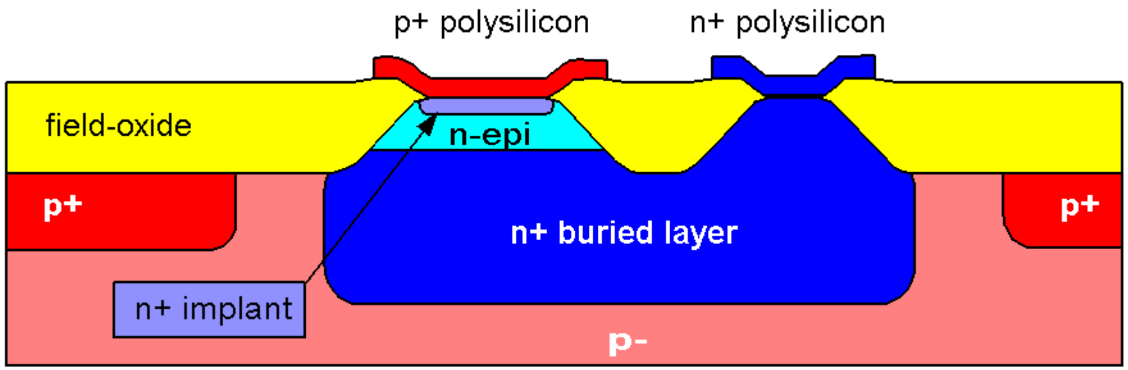
- Anforderungen
- Realisierung
- Approximation der C(U)-Kennlinie
- Ersatzschaltung
- Ergebnis
- Implementierung

Anforderungen

- ausreichender normierter Kapazitätshub
- Soll-Kennlinienverlauf
- laterale Skalierbarkeit
- Deaktivierung von nicht angeschlossenen Streifen (“spare parts”)
- Implementierung für ELDO, HPEESOFSIM, SPECTRE
- Unterstützung worst-case Simulation

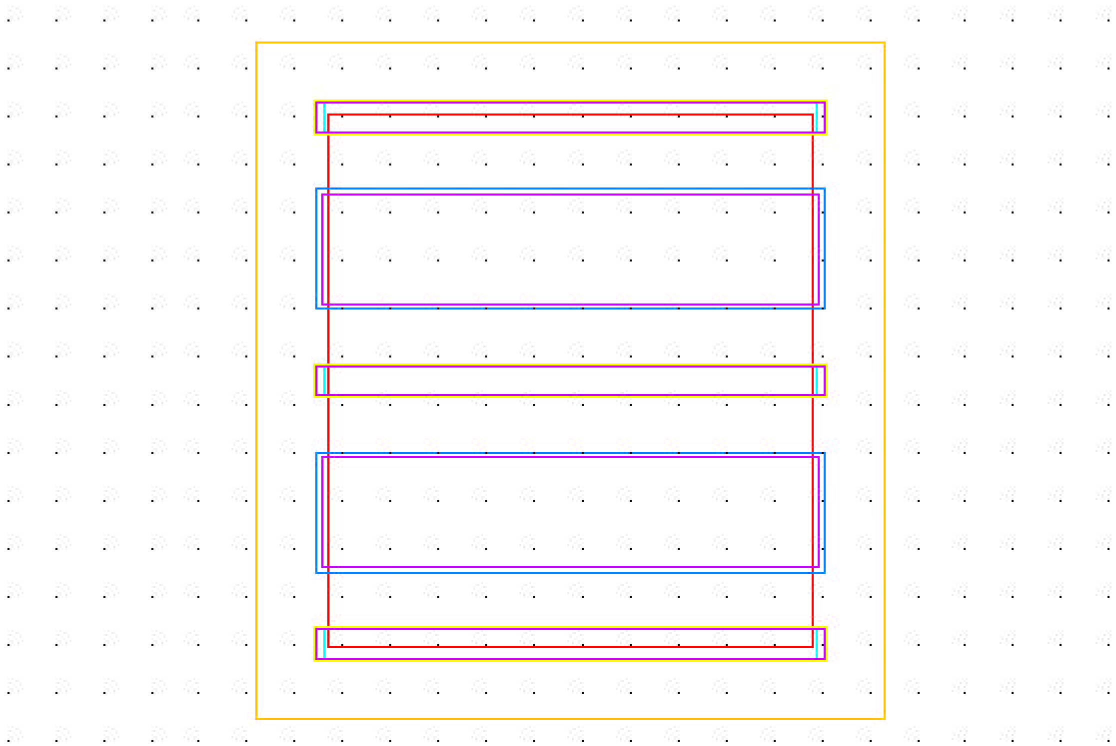
Realisierung

- zusätzliche As-Implantation (Prozeßopotion)
- Querschnitt



Parameter : Länge, Weite, Anzahl Streifen, Anzahl nicht angeschlossener Streifen

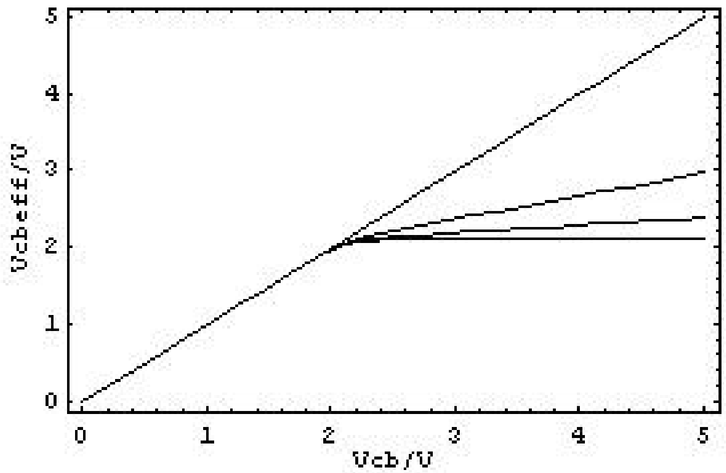
Layout:



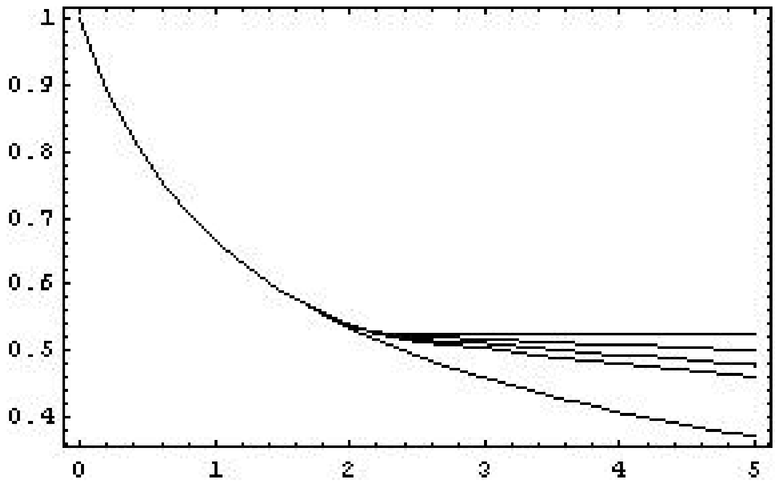
Kennlinienapproximation: Vcbeff

```
minlogexp[x_, x0_, eps_] := Module[
  {y},
  y = Min[x, x0] - Abs[eps] Log[1 + Exp[-Abs[(x - x0) / eps]]];
  Return[y]
 ]
vcbeff[v_, vclip_, eps_, slope_] := Module[{vcb1, y},
  vcb1 = vclip + slope * (v - vclip);
  y = minlogexp[v, vcb1, eps];
  Return[y];
 ]
```

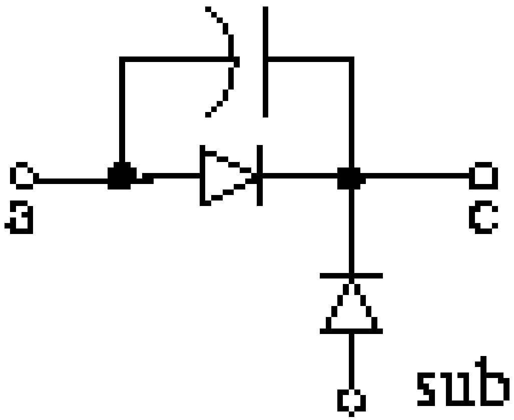
Kennlinienapproximation: Vcbeff



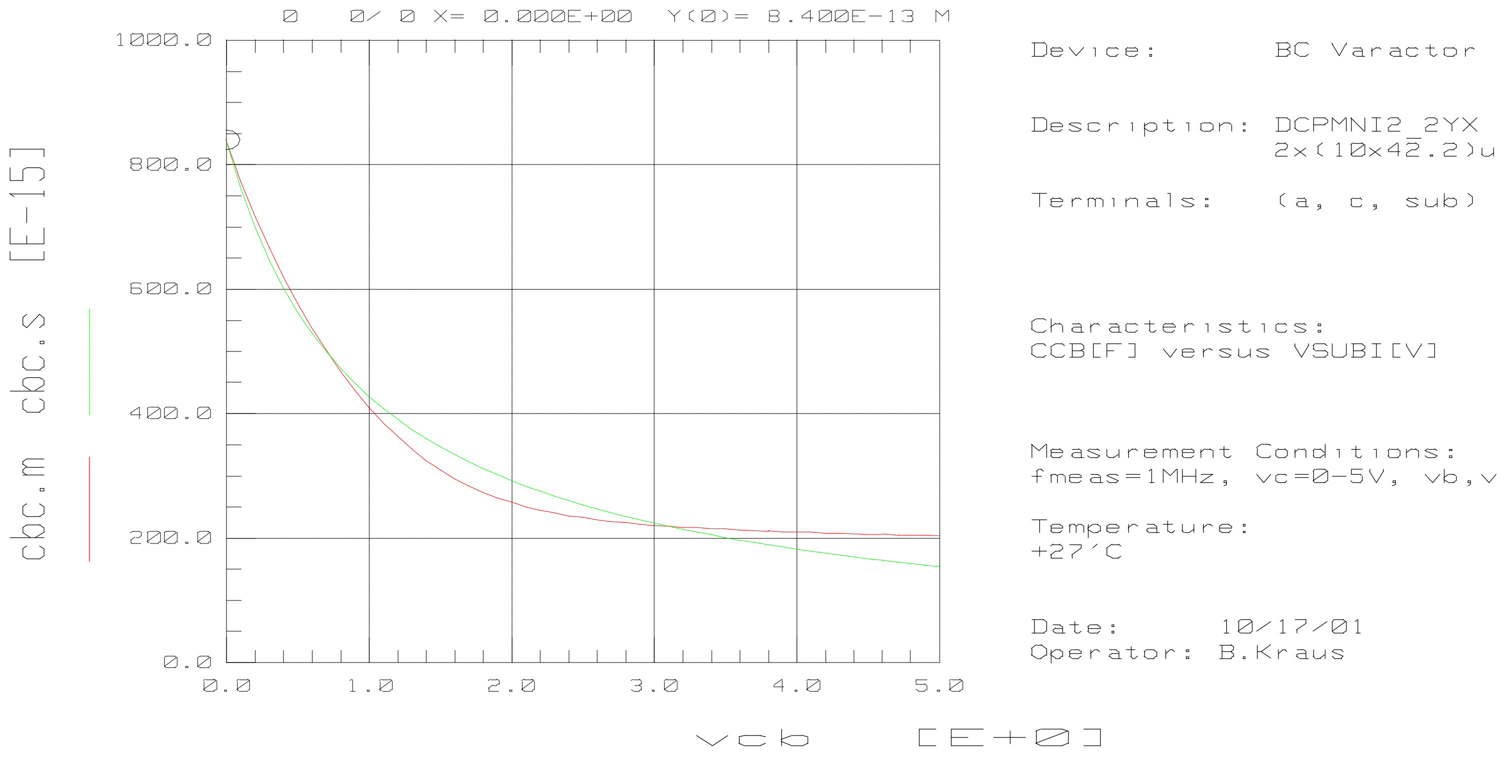
Kennlinienapproximation: Vcbeff



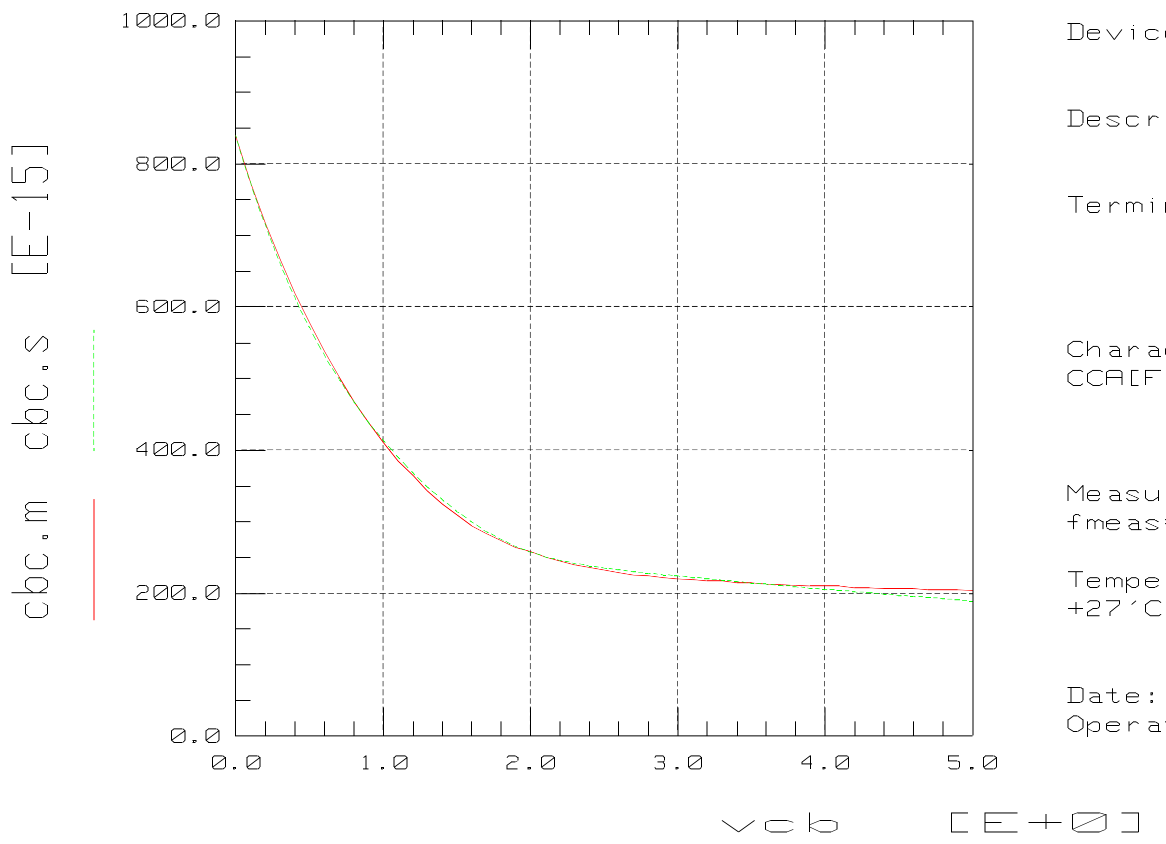
Ersatzschaltung



Resultat: Standarddiodenmodell



Resultat: verbessertes Modell



Device: BC Varactor Diode

Description: DCPMNI2_2YX
2x(10x42.2)um2

Terminals: (a, c, sub)

Characteristics:
CCA[F] versus VC[V]

Measurement Conditions:
fmeas=1MHz, vc=0-5V, va,vsub=0V

Temperature:
+27'C

Date: 07/19/01
Operator: B.Kraus

;* Simulation model: Scalable Macro Model (anode=a, cathode=c, substrate=sub, n=number of stripes, nnu=number of not used stripes)
;* Simulator: HPEESOFSIM v150 rev. 204

```
define DCPMNI21 (a c sub)

parameters \
W=5u L=21.2u N=2 NNU=0
.
.
.
NEFF=max(1,N-NNU)

SDD:SDDNP2 a b f 0 I[1,0]=-_i2*c_v F[2,0]=_v1-_v2
C:CC  f 0  C=CACA+CACP
vcb1=VCLIP+slope*(_v1-VCLIP)
vcbeff=max(_v1,vcb1)+abs(E)*ln(1+exp(-abs(_v1-vcb1)/E))
c_v=(1-vcbeff/VD)^-M
```

ELDO:

```
GC a b value={(1-(dmax(VCLIP+slope*(V(a,b)-VCLIP),V(a,b))+abs(E)*log(1+exp(-abs(VCLIP+slope*(V(a,b)-VCLIP)-V(a,b))/E)))/VD)^-M*I(VMC)}
```

SPECTRE:

```
CCB (a b e f) hccs4varactor_hdl
```

```
‘include “discipline.h”
‘include “constants.h”
//--------------------
// hccs4varactor_hdl
//
// -  hybrid (voltage & current) controlled current source
//    for voltage dependent capacitance
//    CAS, May 1990, p. 9-11
analog begin
    v = V(iout_p, iout_n);
    vcb1 = vclip+slope*(v-vclip);
    vcbeff=max(v,vcb1)+abs(eps)*ln(1+exp(-abs((v-vcb1)/eps)));
    c_v=pow((1-vcbeff/vd),(-m));
    I(iout_p, iout_n) <+ c_v*I(iin_p, iin_n);
end
endmodule
```