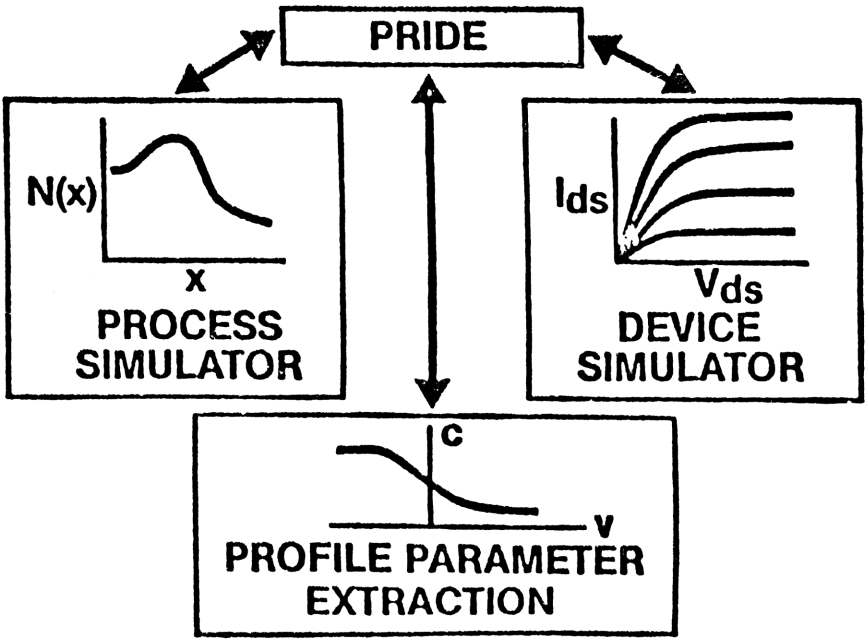
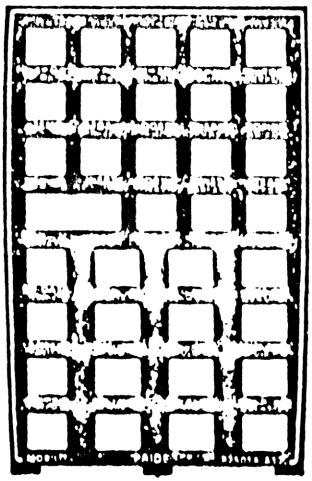
PRIDE
(PORTABLE PROCESS AND DEVICE DESIGN)

ABSTRACT

An efficient combination of analytical and numerical methods, PRIDE (Portable Process and Device Design) is a program written for the HP41-CV handheld calculator. It is compact, easy to use, and provides accuracy similar to numerical techniques. PRIDE integrates both process and device design by offering thermal oxidation calculations, chemical deposition and ion-implantation doping profile calculations, parameter extraction routines, and IGFET device analysis. IGFET channel profiles are calculated for multiple thermal steps including oxidizing conditions and fitted to a box profile to determine threshold voltage or a gaussian profile to determine subthreshold behavior and threshold voltage shifts relative to an unimplanted IGFET. Alternatively, threshold data is converted to box profile parameters to determine suitable process conditions. The ability to solve for oxidation time or oxide thickness and drive-in time or junction depth allow easy design for fixed process conditions. PRIDE may be used in a preprogrammed or interactive mode and is easily modified or enhanced for differences in process coefficients or analytical models. In addition, plotting capabilities provide quick visual inspection for process and device analysis. A five thermal step NMOS process modeled using PRIDE shows excellent agreement with results from SUPREM for the channel concentration profile. PRIDE may be used as a rapid handheld optimizer for IGFET processes by offering immediate access to process and device simulation models thereby reducing process development time.

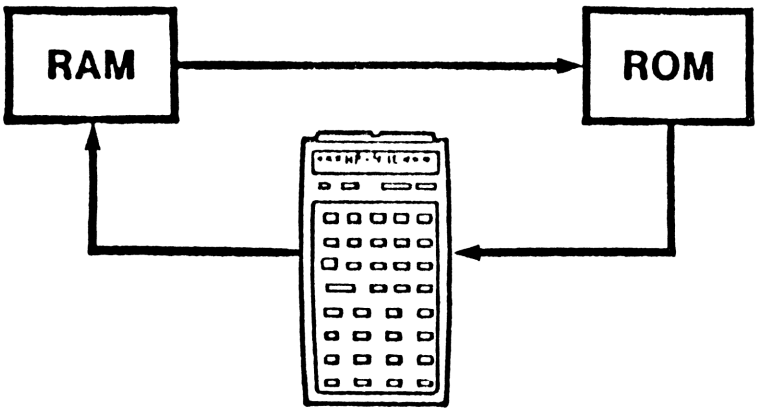




PRIDE
(PORTABLE PROCESS AND DEVICE DESIGN)

- ANALYTICAL SOLUTIONS
- PORTABLE
- EASY TO USE
- PROGRAMMABLE/ INTERACTIVE
- EASILY CUSTOMIZED
- MINIMIZED PROMPTING
- NON-SEQUENTIAL KEY STROKES

EASILY CUSTOMIZED DUE TO RAM SEARCH



BUILT-IN FUNCTIONS

dVT	Calculates the threshold shift for an implanted IGFET assuming a gaussian concentration profile.
EF	Calculates the error function (erf) value for the input in the X-Register.
IXQ	Calculates the charge for a gaussian concentration profile given Rp, dRp, Imax entered via the keyboard.
PRPLOTP	Programmable version of PRPLOT (see printer owner's manual).
RNG	Calculates the range data (Rp,dRp) for a gaussian profile given dopant type and energy entered via the keyboard.
IMP	Calculates Imax,Rp,dRp for a guassian profile given dopant type and dose,energy entered via the keyboard.

REGISTER ALLOCATION

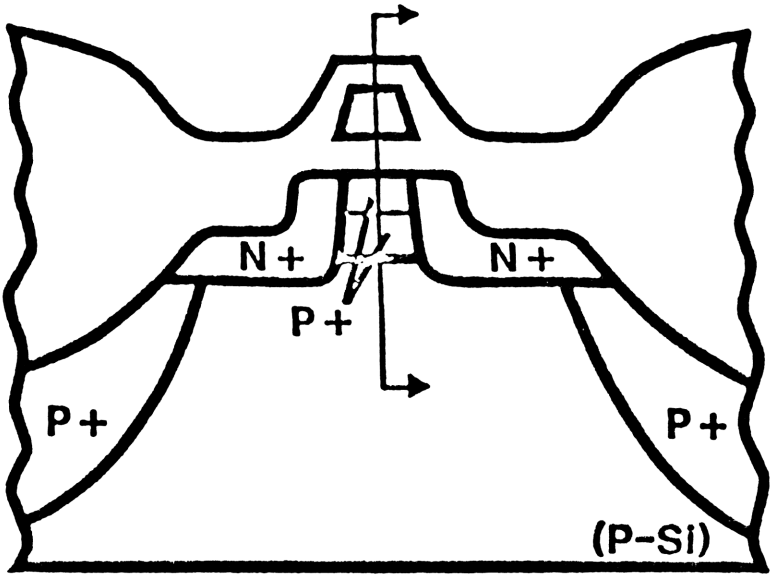
REGISTER	CONTENTS	REGISTER	CONTENTS	REGISTER	CONTENTS
00	SIGx,Cmax	34	C1 (wet)	68	Beta
01	SIGx2,Cmin	35	E1 (wet)	69	"OEDm"
02	SIGy,Na*	36	C2 (wet)	70	Nimv
03	SIGy2,Cfb	37	E2 (wet)	71	Eg(eV)
04	SIGsy,AREA	38	x0 (wet)	72	n (cm-3)
05	n	39	C1 (steam)	73	Xj (um)
06	r2	40	E1 (steam)	74	Co (cm-3)
07	ni	41	C2 (steam)	75	Rs (ohm/sq)
08	alpha	42	E2 (steam)	76	h (elect.)
09	al,b	43	x0 (steam)	77	N(x)
10	s0,Wbx*	44	B (cm2/sec)	78	x*
11	points	45	B/A (cm/sec)	79	xi,scratch
12	T(K)	46	A (cm)	80	scratch
13	Q(cm-2)	47	Tau (sec)	81	SIG(x)
14	t(sec)	48	1.68	82	segreg. coeff.
15	Dt (cm)	49	m0	83	A1
16	Rp-Tox (cm)	50	m1	84	A2
17	dRp (cm)	51	Vgs	85	A3
18	Tox (cm)	52	Deltai	86	x
19	Xox (cm)	53	X2,Deltau,cntr	87	t*
20	ni (cm-3)	54	psii,psi	88	psii*
21	D (cm2/sec)	55	psiu,psi*	89	psiu*
22	EO (KeV)	56	Vcsh,xi-1	90	xi,delvth
23	Imax (cm-3)	57	a	91	m
24	r	58	Vsb	92	F(W)
25	IHC1	59	Vth	93	W
26	Nd-Na,Nb	60	Vfb	94	F(X1)
27	B=-1,P=0,As=1	61	Wbx (cm)	95	F(X2),Ids
28	GAMMA	62	Nbx (cm-3)	96	F(X3),W/L
29	C1 (dry)	63	Dx=-1,Wx=0,Sx=1	97	Lb (cm)
30	E1 (dry)	64	O2/GAS	98	u (cm2/v*sec)
31	C2 (dry)	65	A (OAD), Y/X	99	Vds
32	E2 (dry)	66	(Siv)t		
33	x0 (dry)	67	(Siv)i,(Siv)t		

FLAG ALLOCATION

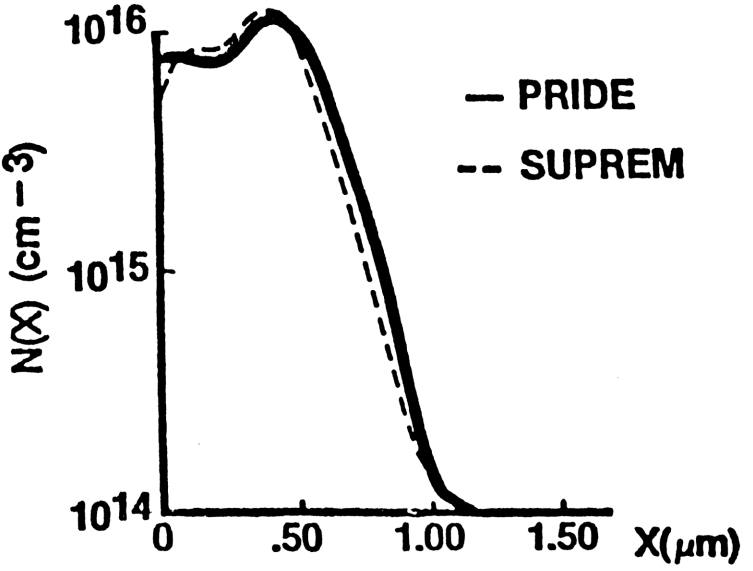
FLAG	1	0
00	IMPLANT	DRY/CHEMICAL
01	OXID AMBIENT	INERT AMBIENT
02	(100)	(111)
03	ENTER: Rp,dRp,Imax	ENTER: Q,EO
04	S/D DIFFUSION	LOW DOSE DIFFUSION
05	CHEMICAL PREDEP	CHEMICAL DRIVE-IN
06	O2/GAS#1	O2/GAS=1
07	IHC1≠0	IHC1=0
08	HEAVILY DOPED OXID	LIGHTLY DOPED OXID
09	MULTIPLE THERMAL CYCLES	NO PREVIOUS CYCLES
10	[illegible] AVIEW	AVIEW

ARSENIC	Used to specify arsenic as the type of dopant atom.
BORON	Used to specify boron as the type of dopant atom.
BOX	Used to calculate the box height (Nbx) and width (Wbx) for an ion-implanted enhancement-mode IGFET.
CLEAR	Used to clear the oxide and Dt register contents.
CV-DATA	Used to calculate Nb (cm-3),TOX (Å), and Cfb (pF) for a test capacitor given Cmax (pF),Cmin(pF), and capacitor area in (cm-2).
DOPING	Enter/View Nd-Na or Nb in cm-3.
DOSE	Enter/View dose in cm-2.
dRp	Enter/View projected straggle in angstroms.
DRY	Used to specify a dry oxidation ambient condition.
ENERGY	Enter/View energy in KeV for a given implant species.
%HCl	Enter/View the percent HCl used for dry oxidation.
Nmax	Enter/View the gaussian peak concentration in cm-3.
IMPLANT	Used to specify an implanted IGFET or implant conditions.
INERT	Used to specify an inert ambient condition.
INIT	Places default values for process conditions into the appropriate register locations.
MOBILITY	Enter/View mobility in cm^2/volt*sec.
NAT	Used to specify an unimplanted IGFET or chemical predep or drive-in conditions.
Nbx	Enter/View box profile height in cm-3.
Ninv	Enter/View inversion charge density in cm-3.
Nx>X	Enter the concentration in cm-3 to obtain the distance from the silicon-silica interface in um.
Nv>Vgs	Enter the inversion charge density in cm-3 to obtain the gate to source voltage in volts for an IGFET.
ORIENT	Enter/View the silicon substrate orientation (100,111).
%O2	Enter/View the percent of O2/GAS flow used for oxidation conditions.
PHOS	Used to specify phosphorous as the type of dopant atom.
PLOT	Used with the 82143A perpherial printer to produce plots for N(X)-"XN"; Vth(Vsb)-"VTH"; TOX(t)-"OXIDE"; Siv(T)-"SVT"; Di(T)-"TDF"; ni(T)-"TNI"; Ids(Vds)-"IDS"; and Vgs(Ninv)-"VGNV".
Q>t	Enter the dose in cm-2 with the time in HH.MMSS format displayed for the chemical predeposition.
Rp	Enter/View the projected range in angstroms.
STEAM	Used to specify a steam oxidation ambient condition.
T>Di	Enter the temperature in °C to obtain the diffusion coefficient in cm^2/volt*sec.
TEMP	Enter/View temperature in °C.
T>ni	Enter the temperature in °C to obtain the intrinsic carrier concentration in cm-3.
TOX	Enter/View oxide thickness in angstroms.
TOX>t	Enter oxide thickness in agnstroms to obtain the time in HH.MMSS format.
t>Ns	Enter the time in HH.MMSS format to obtain the surface concentration in cm-3.
t>Q	Enter the time in HH.MMSS format to obtain charge in cm-2 for the chemical predeposition.
t>TOX	Enter the time in HH.MMSS format to obtain the oxide thickness in angstroms.
t>SD	Enter the time in HH.MMSS format to obtain Xj in um,Rs in ohms per square, and surface concentration in cm-3 for a source/drain diffusion (inert ambient conditions only).
T>Siv	Enter temperature in °C to obtain the total silicon vacancy concentration in cm-3.
Vds	Enter/View the drain to source voltage in volts.
Vds>Ids	Enter Vds in volts to obtain the drain to source current for an enhancement-mode IGFET.
Vfb	Enter/View the flatband voltage in volts.
Vgs	Enter/View the gate to source voltage in volts.
Vsb	Enter/View the source to bulk voltage in volts.
Vsb>Vth	Enter the source to bulk voltage in volts to obtain the threshold voltage in volts.
Vt-DATA	User is prompted for (Vth,Vsb) to determine the curve-fitted profile parameters for the Vsb Vth key.
Vth	Enter/View the threshold voltage in volts.
Wbx	Enter/View the box profile width in um.
WET	Used to specify a wet oxidation ambient condition.
W/L	Enter/View the width to lenght aspect ratio for an IGFET.
X>Nx	Enter the distance from the silicon-silica interface in um to obtain the concentration in cm-3.
Xj>SD	Enter the junction depth in um to obtain the time in the HH.MMSS format for high dose drive-in (source/drain) diffusions (inert ambient conditions only).
Xj>t	Enter the junction depth in um to obtain the time in the HH.MMSS

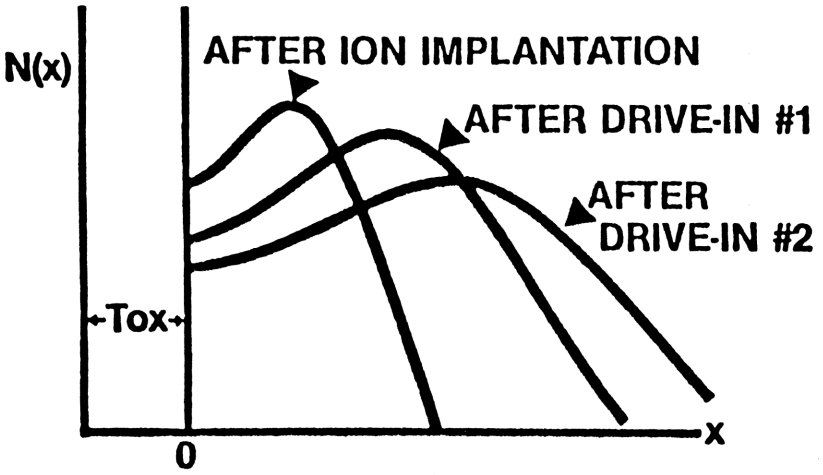
IGFET CHANNEL PROFILE



IGFET CHANNEL PROFILE



IGFET PROFILE EXAMPLE



IGFET PROFILE EXAMPLE

OXIDE GROWTH
Tox = 400 Å
DRY OXIDE 1000°C,<100>

↓

ION IMPLANT IMPURITY
B IMPURITY, 1.0×10^{12} cm^{-2}, 120 KeV

↓

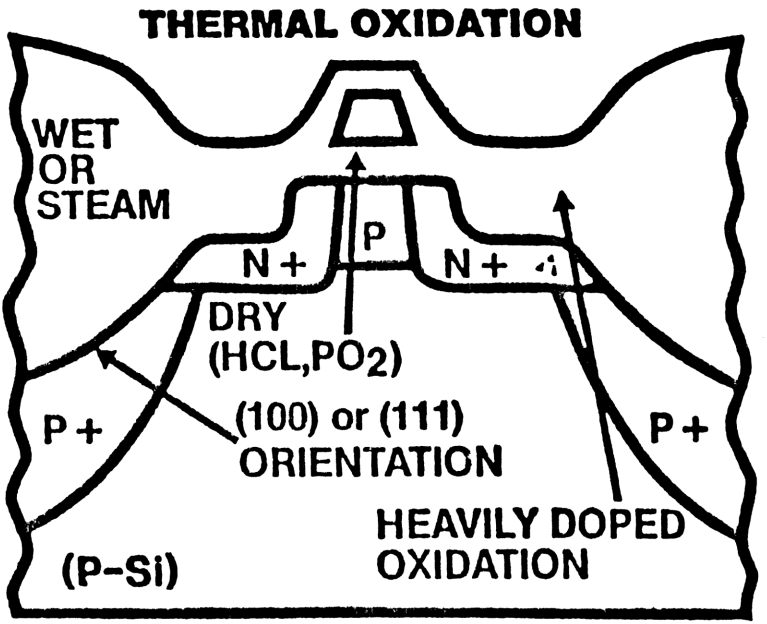
DRIVE-IN #1
INERT AMBIENT, 1 hr @ 1000°C

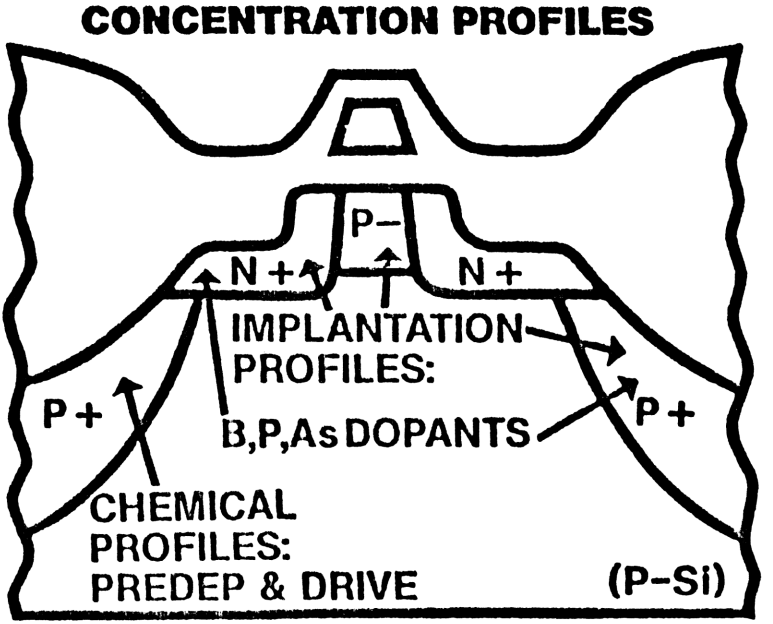
↓

DRIVE-IN #2
INERT AMBIENT, 1 hr 30 min @ 950°C

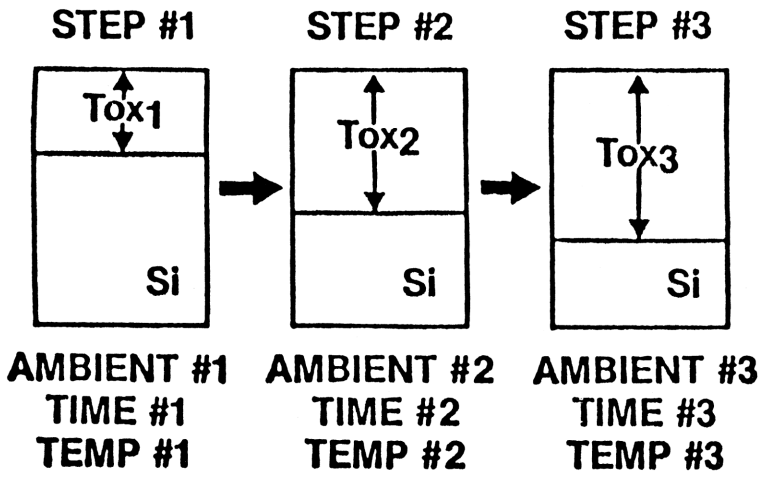
↓

PLOT PROFILE

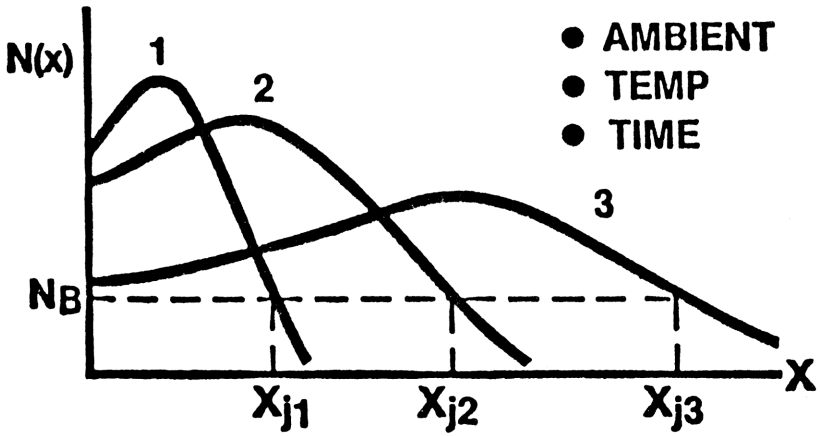

THERMAL OXIDATION
WET
OR
STEAM
N+
P
N+
DRY
(HCL,PO2)
P+
(100) or (111)
ORIENTATION
P+
HEAVILY DOPED
OXIDATION
(P-Si)


CONCENTRATION PROFILES
P-
N+
N+
IMPLANTATION
PROFILES:
P+
B,P,As DOPANTS
P+
CHEMICAL
PROFILES:
PREDEP & DRIVE
(P-Si)

MULTIPLE THERMAL STEP MODELING



MULTIPLE THERMAL STEP



IMPLANTED N-IGFET THRESHOLD VOLTAGE MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
2	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
3	Enter flatband voltage V1 (V)	V1	hit Vfb	VFB=V1
4	Enter box doping concentration height N2 (cm-3)	N2	hit Nbx	NBX=N2
5	Enter box width X3 (um)	X3	hit Wbx	WBX=X3
6	Declare implanted N-IGFET		hit IMPLANT	IMPLANTED
7	Enter substrate bias V2 (V) to obtain threshold voltage V3 (V)	V2	hit Vsb→Vth	VSB=V2 VTH=V3

UNIMPLANTED N-IGFET THRESHOLD VOLTAGE MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
2	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
3	Enter flatband voltage V1 (V)	V1	hit Vfb	VFB=V1
4	Declare unimplanted N-IGFET		hit NAT	UNIMPLANTED
5	Enter substrate bias V2 (V) to obtain threshold voltage V3 (V)	V2	hit Vsb→Vth	VSB=V2 VTH=V3

IMPLANTED N-IGFET THRESHOLD VOLTAGE SHIFT MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
2	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
3	Enter Peak concentration Imax1 (cm-3)	Imax1	hit Imax	IMAX=Imax1
4	Enter range Rp1 (Angstroms)	Rp1	hit Rp	RP=Rp1
5	Enter straggle dRp1 (Angstroms)	dRp1	hit dRp	dRP=dRp1
6	Enter inversion charge density N2 (cm-2) (Typical N2=1E14)	N2	hit Ninv	NINV=N2
7	Enter substrate bias V2 (V) to obtain threshold voltage shift V4 (V)	V2	XEQ ALPHA dVT ALPHA	VSB=V2 dVT=V4

IMPLANTED N-IGFET SUBTHRESHOLD MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
2	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
3	Enter substrate bias voltage V2 (V)	V2	hit VSB	VSB=V2
4	Enter Peak concentration Imax1 (cm-3)	Imax1	hit Imax	IMAX=Imax1
5	Enter range Rp1 (Angstroms)	Rp1	hit Rp	RP=Rp1
6	Enter straggle dRp1 (Angstroms)	dRp1	hit dRp	dRP=dRP1
7	Declare implanted N-IGFET		hit IMPLANT	IMPLANTED
8	Enter inversion charge density N2 (cm-2) to obtain the gate to source voltage (without flatband voltage) V5 (V)	N2	hit Nv→Vgs	NINV=N2 VGS=V5

UNIMPLANTED N-IGFET SUBTHRESHOLD MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
2	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
3	Enter substrate bias voltage V2 (V)	V2	hit Vsb	VSB=V2
4	Declare unimplanted N-IGFET		hit NAT	UNIMPLANTED
5	Enter inversion charge density N2 (cm-2) to obtain the gate to source voltage (without flatband voltage) V5 (V)	N2	hit Nv→Vgs	NINV=N2 VGS=V5

IGFET CURRENT MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter threshold voltage V3 (V)	V3	hit Vth	VTH=V3
2	Enter gate to source voltage V5 (V)	V5	hit Vgs	VGS=V5
3	Enter Gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
4	Enter mobility M1 ($cm^2/V*sec$)	M1	hit MOBILITY	U=M1
5	Enter channel W/L dimensions WL1	WL1	hit W/L	W/L=WL1
6	Enter drain to source voltage V6 (V) to obtain drain to	V6	hit Vds→Ids	VDS=V6 IDS=ID1

SILICON VACANCY CONCENTRATION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
2	Enter temperature T1 (^{o}C) to obtain silicon vacancy concentration N2 (cm-3)	T1	hit T→Siv	SIV=N2

IMPURITY DIFFUSION COEFFICIENT MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter dopant type (Boron, Phosphorous, Arsenic)		hit BORON hit PHOS hit ARSENIC	BORON PHOSPHOROUS ARSENIC
2	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	Nb=N1
3	Enter ambiant condition (Inert, Dry, Wet, Steam)		hit INERT hit DRY hit WET hit STEAM	INERT AMBT. DRY OXID WET OXID STEAM OXID
4	Perform oxidation calculation if oxidation ambient is chosen			
5	Enter temperature T1 (^{o}C) to obtain diffusion coefficient DC1 (cm^{2}/sec)	T1	hit t→Di	TEMP=T1 DX=DC1

INTRINSIC CARRIER CONCENTRATION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter temperature T1 (^{o}C) to obtain the intrinsic carrier concentration N1 (cm-3)	T1	hit T→ni	TEMP=T1 NI=N1

CV PROFILE PARAMETER EXTRACTION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter CV data to obtain background doping concentration N1 (cm-3), flatband capacitance C3 (pF), and gate oxide X1 (Ang-stroms)		hit CV-DATA	AREA(CM+2)?
2	Enter area of test capacitor in square centimeters A1	A1	hit R/S	CMAX(PF)?
3	Enter maximum capacitance C1 (pF)	C1	hit R/S	CMIN(PF)?
4	Enter minimum capacitance	C2	hit R/S	CV MEASURE TOX=X1 NB=N1 CFB=C3

IMPLANTED N-IGFET VT PROFILE PARAMETER EXTRACTION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
2	Enter background doping concentration N1 (cm-3)	N1	hit DOPING	NB=N1
3	Declare implanted N-IGFET		hit IMPLANT	IMPLANTED
4	Enter Vth,Vsb data to obtain box doping concentration height N2 (cm-3), box width X1 (um), flatband voltage V1 (V), critical back bias voltage V6 (V), and least squares fit correlation coefficient RCC1		hit Vt-DATA	VTH,VSB?
5	Enter first value for threshold voltage VT1 corresponding to its back bias voltage VS1	VT1	hit ENTER	VT1
6	Enter first value for back bias voltage VS1 (V) correspond -ing to the previous threshold voltage value VT1	VS1	hit R/S	VTH,VSB?
7	User is prompted for further inputs until required number of inputs are satisfied Repeat steps #5-6			IMPLANTED NBX=N2 WBX=X1 VFB=V1 VC=V6 R2=RCC1

UNIMPLANTED N-IGFET VT PROFILE PARAMETER EXTRACTION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter gate oxide thickness X2 (Angstroms)	X2	hit TOX	TOX=X2
2	Declare unimplanted N-IGFET		hit NAT	UNIMPLANTED
3	Enter number of data points (Vth,Vsb) to obtain back-ground doping concentration N1 (cm-3), flatband voltage V1 (V), and least squares fit correlation coefficient RCC1		hit Vt-DATA	POINTS?
4	Enter number of Vth,Vsb data points for calculation NN1	NN1	hit R/S	VTH,VSB?
5	Enter first value for thres-hold voltage VT1 corresponding to its back bias voltage VS1	VT1	hit ENTER	VT1
6	Enter first value for back bias voltage VS1 (V) corres-ponding to the previous threshold voltage value VT1	VS1	hit R/S	VTH,VSB?
7	User is prompted for further inputs until required number of inputs (NN1) are satisfied			UNIMPLANTED NB=N1 VFB=V1 R2=RCC1

ION-IMPLANTED DIFFUSION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Initialize thermal cycle modeling (Dt=0)		hit CLEAR	CLEAR
2	Enter Dopant type (Boron, Phosphorous, Arsenic)		hit BORON hit PHOS hit ARSENIC	BORON PHOSPHOROUS ARSENIC
3	Enter temperature T1 (^{o}C)	T1	hit TEMP	TEMP=T1
4	Enter ambient condition (Inert, Dry, Wet, Steam)		hit INERT hit DRY hit WET hit STEAM	INERT AMBT. DRY OXID WET OXID STEAM OXID
5	(Optional) Enter initial oxide thickness X1 (Angstroms)	X1	hit TOX	TOX=X1
6	(Optional) Enter silicon orientation nnn if oxidation ambient is chosen	nnn	hit ORIENT	ORIENT=nnn
7	(Optional) Enter partial pressure for %O2/Gas flow if oxidation ambient is chosen	PP1	hit %O2	O2/GAS=PP1
8	(Optional) Enter %HCl/Gas flow if dry oxidation ambient is chosen with HCl as well	PP2	hit %HCl	HCL=PP2
9	Specify implantation condition by entering dose Q1 (cm-2) and energy E1 (KeV)	Q1 E1	hit DOSE hit ENERGY	Q=Q1 EO=E1
	or			
	Specify implantation condition by entering peak concentration Imax1(cm-3), range Rp1 (Angstroms), and straggle dRp1 (Angstoms)	Imax1 Rp1 dRp	hit Imax hit Rp hit dRp	IMAX=Imax1 RP=Rp1 dRP=dRp1
10	Declare ion-implanted drive-in		hit IMPLANT	IMPLANTED
11	Enter drive-in time (HH.MMSS) t1 to obtain surface concentration Ns0 (cm-3)	t1	hit t-ΦNs	TEMP=T1 TIME=t1 N(0)=Ns0
12	Enter background doping concentration N1 (cm-3) for drive-in calculation	N1	hit DOPING	Nb=N1
13	Declare ion-implanted drive-in		hit IMPLANT	IMPLANTED
14	Enter final junction depth X2 (um) to obtain drive-in time (HH.MMSS) and the surface concentration N2 (cm-3)	X2	hit Xj-Φt	TEMP=T1 XJ=X2 TIME=t1 N(0)=N2

CHEMICAL PREDEPOSITION MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Initialize thermal cycle modeling (Dt=0)		hit CLEAR	CLEAR
2	Enter Dopant type (Boron, Phosphorous, Arsenic)		hit BORON hit PHOS hit ARSENIC	BORON PHOSPHOROUS ARSENIC
3	Enter temperature (^{o}C)	T1	hit TEMP	TEMP=T1
4	Enter surface concentration Nss (cm-3)	Nss	hit DOPING	Nb=Nss
5	Enter predeposition time t1 (HH.MMSS) to obtain final dose Q1 (cm-2)	t1	hit t→Q	TEMP=T1 TIME=t1 Q=Q1
6	Enter final dose Q1 (cm-2) to obtain predeposition time t1 (minutes)	Q1	hit Q→t	TEMP=T1 Q=Q1 TIME=t1

CHEMICAL DRIVE-IN MODELING

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Initialize thermal cycle modeling (Dt=0)		hit CLEAR	CLEAR
2	Enter Dopant type (Boron, Phosphorous, Arsenic)		hit BORON hit PHOS hit ARSENIC	BORON PHOSPHOROUS ARSENIC
3	Enter temperature T1 (^{o}C)	T1	hit TEMP	TEMP=T1
4	Enter ambient condition (Inert, Dry, Wet, Steam)		hit INERT hit DRY hit WET hit STEAM	INERT AMBT. DRY OXID WET OXID STEAM OXID
5	(Optional) Enter oxide thickness X1 (Angstroms)	X1	hit TOX	TOX=X1
6	(Optional) Enter silicon orientation nnn if oxidation ambient is chosen	nnn	hit ORIENT	ORIENT=nnn
7	Enter initial dose Q1 (cm-2)	Q1	hit DOSE	Q=Q1
8	Declare chemical drive-in		hit NAT	UNIMPLANTED
9	Enter drive-in time (HH.MMSS) t1 to obtain surface concentration Nso (cm-3)	t1	hit t→Ns	TEMP=T1 TIME=t1 N(0)=Nso
10	Enter background doping concentration N1 (cm-3) for drive-in time calculation	N1	hit DOPING	Nb=N1
11	Declare chemical drive-in		hit NAT	UNIMPLANTED
12	Enter final junction depth X2 (um) to obtain drive-in time (HH.MMSS) and the surface concentration N2 (cm-3)	X2	hit Xj→t	TEMP=T1 XJ=X2 TIME=t1 N(0)=N2

PLOTTING INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Connect printer to calculator			
2	Perform desired calculation for plotting			
3	Specify axis information for plot limits		hit PLOT	NAME?
4	Enter name for desired calculation: Name0 Ids(Vds)—IDS Vth(Vsb)—VTH Tox(t)—OXIDE N(x)—XN Vg(Ninv)—VGNV Siv(T)—SVT Di(T)—TDF ni(T)—TNI	Name0	hit R/S	YMIN?
5	Enter minimum y-value for desired calculation: Outputs Ids(Vds)—Ids (amperes) Vth(Vsb)—Vth (V) Tox(t)—Tox (Angstroms) N(x)—Log(Nx) Vg(Ninv)—Vgs (V) Siv(T)—Log(Siv) Di(T)—Log(Di) ni(T)—Log(ni)	Ymin1	hit R/S	YMAX?
6	Enter maximum y-value for desired calculation	Ymax1	hit R/S	AXIS?
7	Enter x-axis intersection with y-axis	X1	hit R/S	X MIN?
8	Enter minimum x-value for desired calculation	Xmin1	hit R/S	X MAX?
9	Enter maximum x-value for desired calculation: Inputs Ids(Vds)—Vds (V) Vth(Vsb)—Vsb (V) Tox(t)—time (minutes) N(x)—x (um) Vg(Ninv)—Log(Ninv) Siv(T)—T (^{o}C) Di(T)—T (^{o}C) ni(T)—T (^{o}C)	Xmax1	hit R/S	X INC?
10	Enter increment for x-axis to begin plotting procedure	Xincl	hit R/S