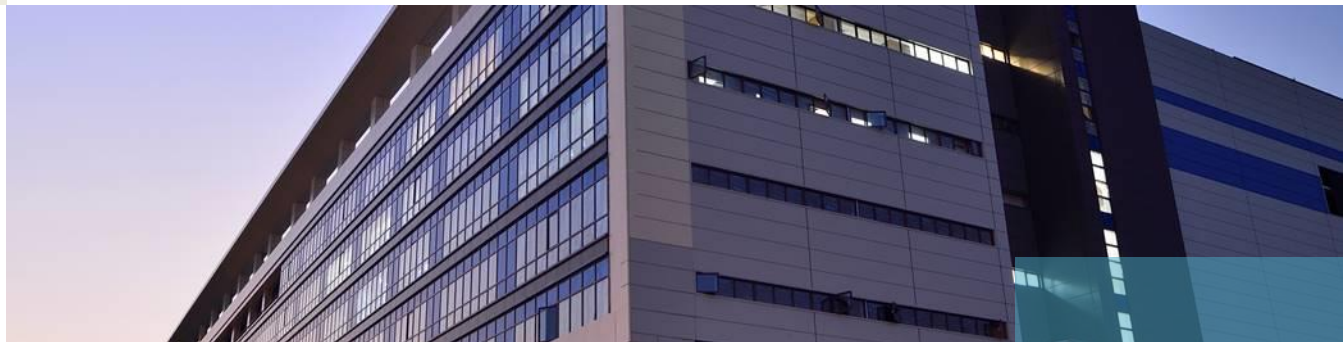


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NSC 110BCD introduction

2022.07.19

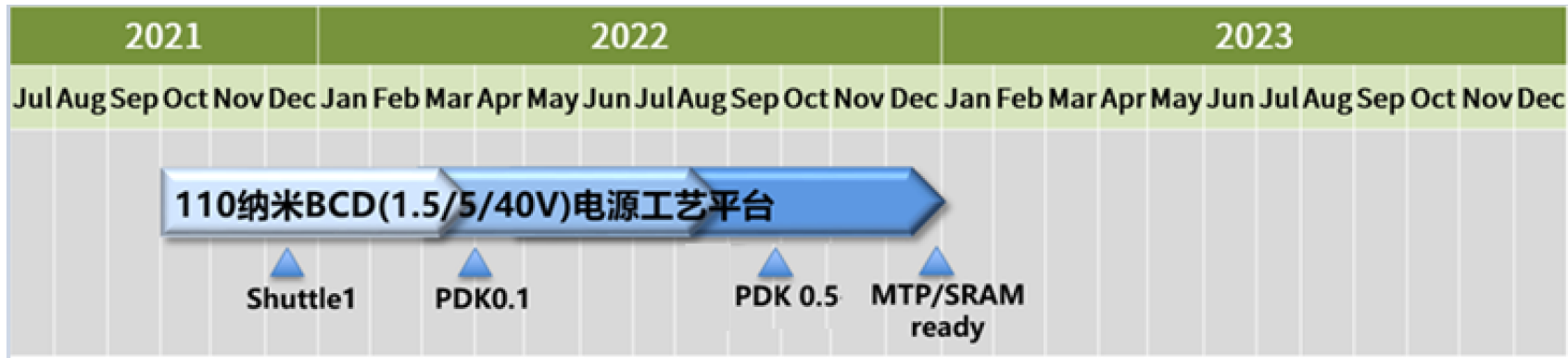
New Process Features for 110 BCD:

- Epi(fully isolation) and Non-Epi
- Epi - 1.5V_5V_40V platform
 - SOC (Logic, DECMOS/LDNMOS 20V/30V/40V, BJT, SRAM, MIM , MTP)
 - Supply Voltage: 1.5V LV device with RVT and LVT , 5V for MV device and 20/30/40V for HV device
- Non - Epi – 1.5V_5V_40V platform (wo HS NLDMOS)
 - SOC (Logic, DECMOS/LDNMOS 20V/30V/40V, BJT, SRAM, MIM , MTP)
- 1.5V provides LV LVT&RVT Device
- BEOL rule shrink / Metal Rs same as NSC 110 baseline
- IP – Standard cell, SRAM(1.32um²), OTP/MTP (CTM advise)

Schedule of Milestone



- The Schedule of Milestone
 - DRM 0.1 : 110LP2 1.5/5V + 110LP2 BEOL + DECMOS & LDNMOS 20/30V
 - PDK 0.5: Plan finished by 8/E
 - Deliver MTP/SRAM by the end of 2022
 - MTP vendors are ACTT and YMC, the same as 110LP2 1.5/5V MTP



110 BCD Key Design Rule



Process	BCD Epi	BCD Non-Epi
AA(OD)	0.16/0.16	0.16/0.16
LV&MV Well	0.75/0.75	0.75/0.75
Poly	0.11/0.20	0.11/0.20
MV LDD	0.31/0.31	0.31/0.31
LV LDD	0.31/0.31	0.31/0.31
S/D	0.31/0.31	0.31/0.31
CT	0.12/0.16	0.12/0.16
M1	0.144/0.144	0.144/0.144
Via n	0.16/0.20	0.16/0.20
nM	0.18/0.20	0.18/0.20
TM	0.39/0.40	0.39/0.40
SRAM	1.32um ²	1.32um ²

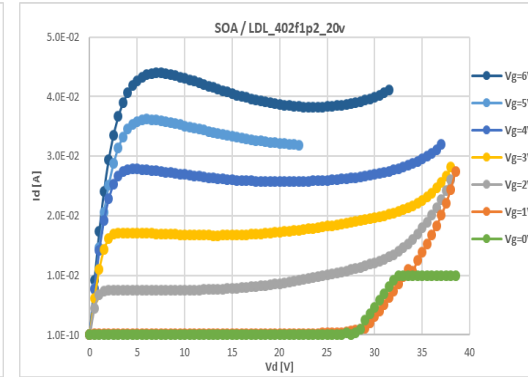
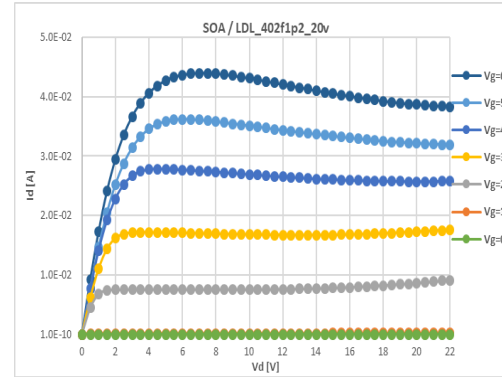
- 110 BCD Key Design Rule same as NSC 110 baseline.
- Top metal rule depend on metal thickness

LDMOS_20V_LS/HS_IV

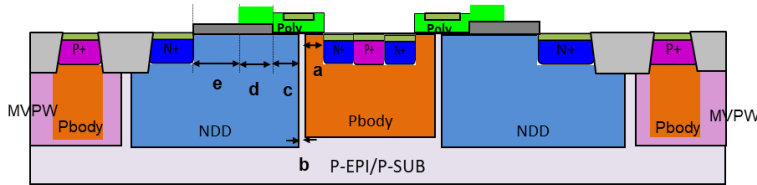
LDMOS_NMOS LS_20V
(NAY607.000#24)



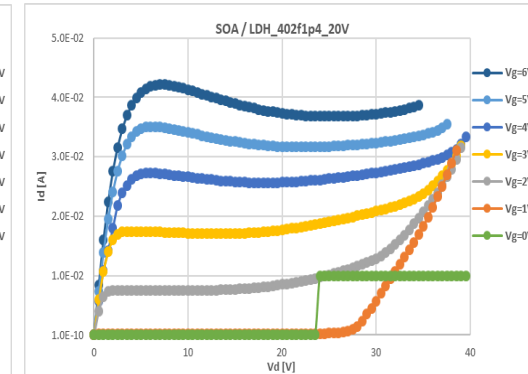
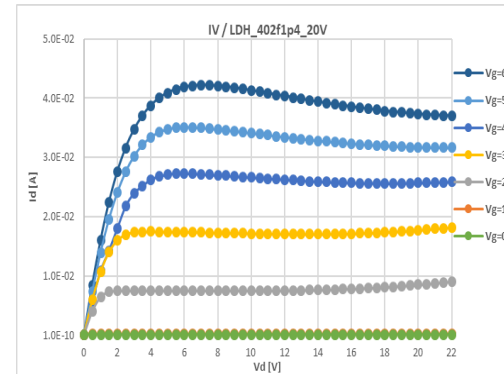
LDMOS_20V(NAY557.000 #15)			
		LDL_402f1p4_20V	LDH_402f1p5_20V
	Unit	WAT_spot	WAT_spot
Vtgm	V	1.13	1.12
Vtcl	V	1.00	0.98
Idl	uA/um	18.86	17.70
Ids	uA/um	369.39	359.58
If@Vd=Vcc	A/um	4.33E-14	1.54E-12
Vb	V	29.09	31.57
Ron	mohm*mm2	15.21	17.34



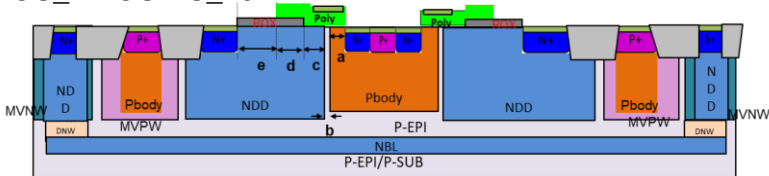
LDMOS_NMOS LS_20V



LDMOS_NMOS HS_20V
(NAY607.000#24)



LDMOS_NMOS HS_20V



2022/7/28

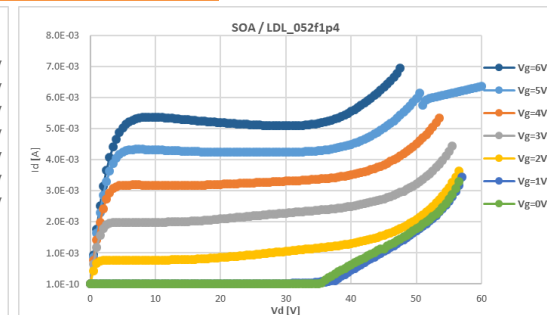
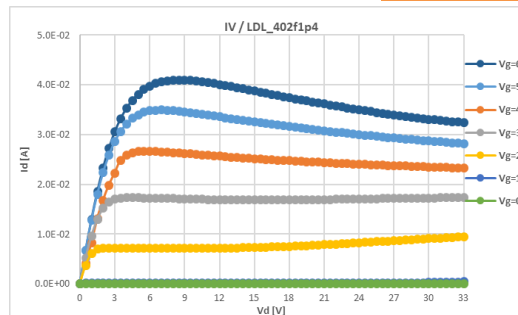
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LDMOS_30V_LS/HS_IV

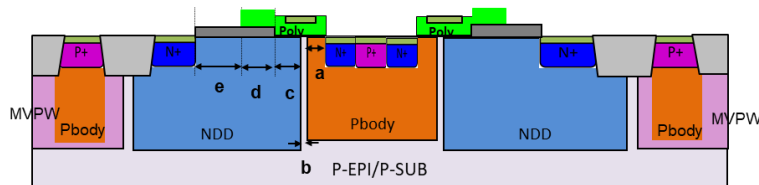


LDMOS_NMOS LS_30V
(NAY607.000#24)

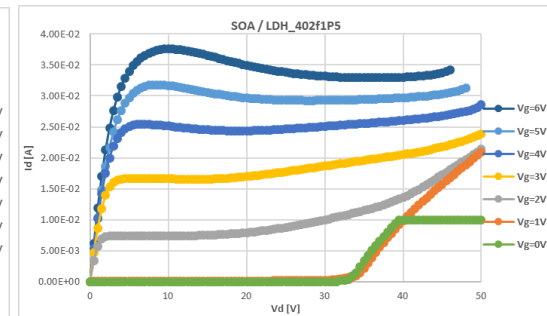
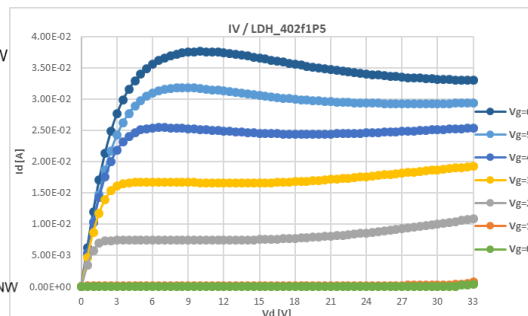
LDMOS_30V(NAY557.000 #15)			
		LDL_402f1p4_30V	LDH_402f1p5_30V
Vtgm	V	1.12	1.10
Vtcl	V	0.99	0.98
Idl	uA/um	15.20	13.88
Ids	uA/um	342.68	324.86
If@Vd=Vcc	A/um	4.77E-09	3.95E-12
Vb	V	46.85	40.96
Ron	mohm*mm2	24.12	27.15



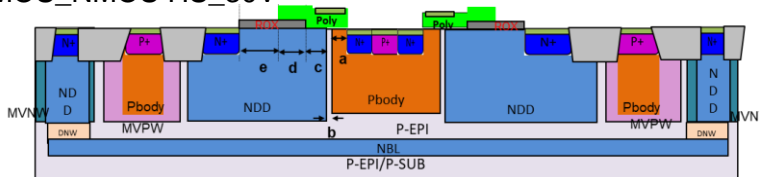
LDMOS_NMOS LS_30V



LDMOS_NMOS HS_30V
(NAY607.000#24)



LDMOS_NMOS HS_30V



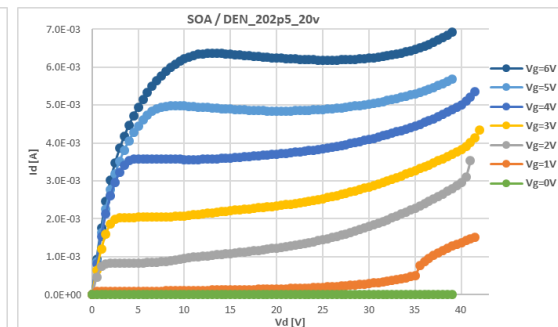
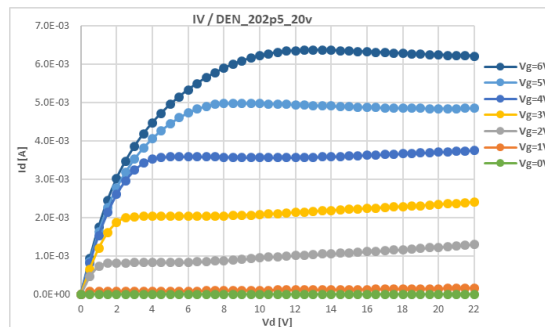
DEMOS_20V_IV



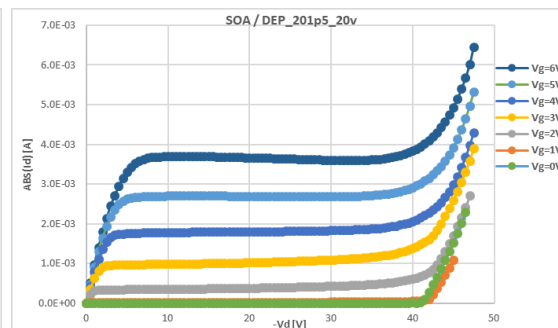
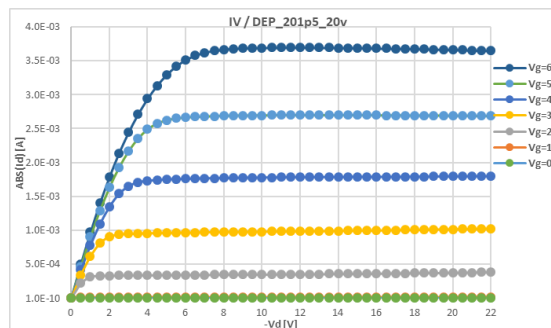
DEMOS_20V(NAY557.000 #15)

		DENMOS_202p5_20V	DEPMOS_201p5_20V
	Unit	WAT_spot	WAT_spot
Vtgm	V	0.83	-0.87
Vtcl	V	0.79	-0.89
Idl	uA/um	7.15	-4.56
Ids	uA/um	193.83	-130.26
If	A/um	1.12E-13	-1.15E-13
Vb	V	43.36	-43.24

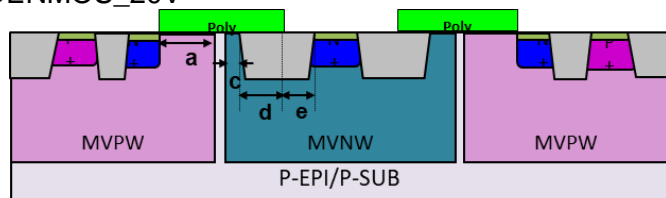
DENMOS_20V
(NAY607.000#24)



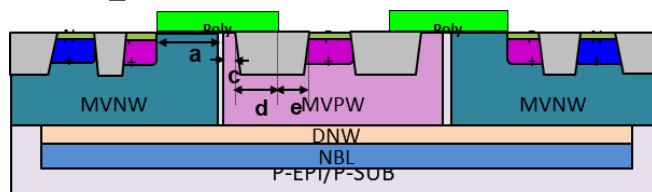
DEPMOS_20V
(NAY607.000#24)



DENMOS_20V



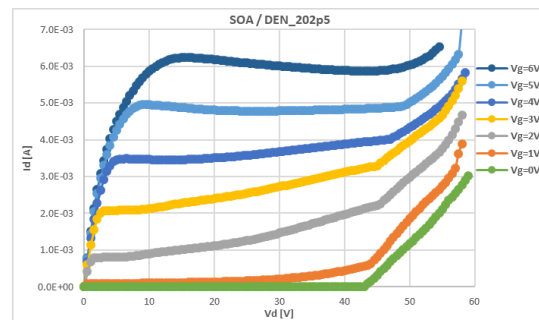
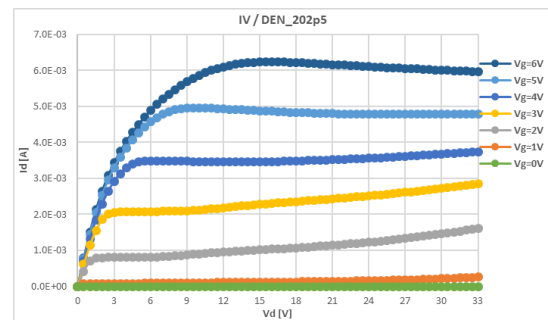
DEPMOS_20V



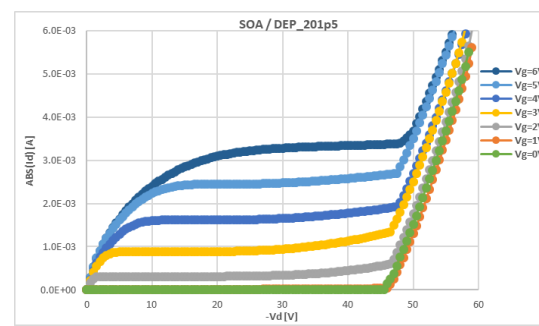
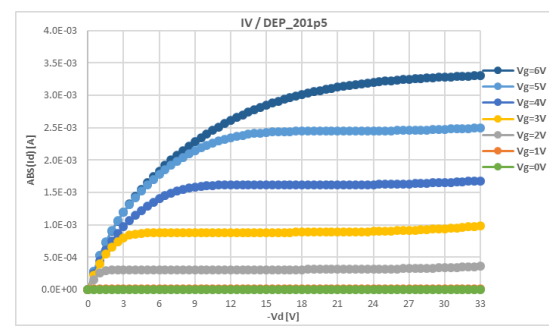
DEMOS_30V_IV



DENMOS_30V
(NAY607.000#24)

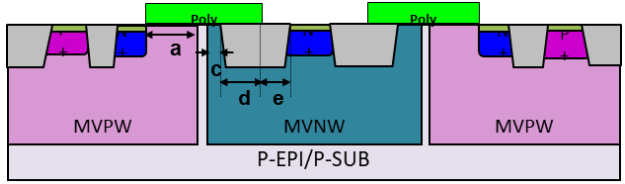


DEPMOS_30V
(NAY607.000#24)

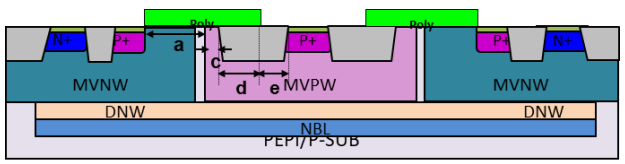


DEMOS_30V(NAY557.000 #15)			
		DENMOS_202p5_30V	DEPMOS_201p5_30V
	Unit	WAT_spot	WAT_spot
Vtgm	V	0.82	-0.87
Vtcl	V	0.79	-0.91
Idl	uA/um	6.39	-2.83
Ids	uA/um	184.30	-119.48
If	A/um	1.76E-13	-1.73E-13
Vb	V	43.00	-45.48

DENMOS_30V



DEPMOS_30V



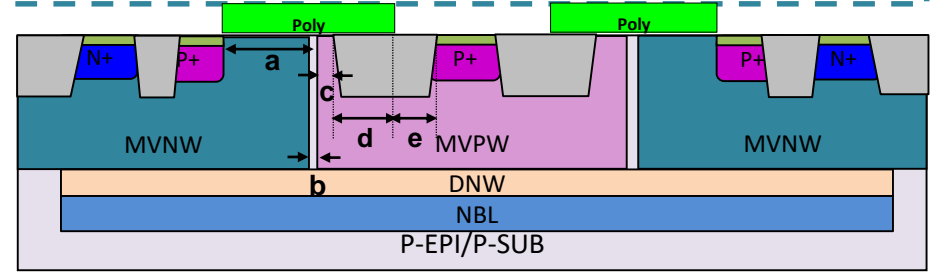
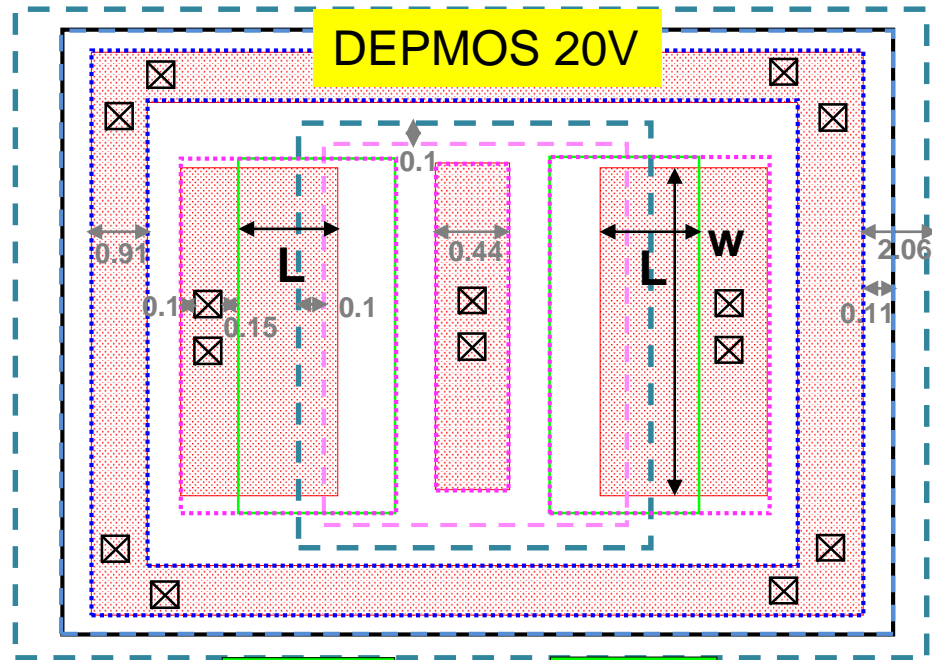
110 BCD Photo Mask Layers - Epi

NO.	Layer	Description	Photo type	Pellicle type		Mask Tone	Grade.	Minimum line/space (um)	Remark
1	5F	Zero Mask	KrF	KrF	Binary	Clear	B	1.0/1.0	
2	6I	NBL	I-line	KrF	Binary	Clear	D	3.8/3.8	
3	1F	AA	KrF	KrF	6%HT	Dark	I	0.16/0.16	
4	8N	NDD	KrF	KrF	Binary	Clear	E	0.8/0.8	
5	6E	ROX	KrF	KrF	Binary	Dark	E	0.6/0.8	Option(HV)
6	9P	P-body	KrF	KrF	Binary	Clear	I	1.28/1.28	
7	3D	MV Nwell	KrF	KrF	Binary	Clear	E	0.75/0.75	
8	4D	MV Pwell	KrF	KrF	Binary	Clear	E	0.75/0.75	
9	9D	LV Nwell	KrF	KrF	Binary	Clear	E	0.31/0.31	Option(1.5V)
10	8D	LV Pwell	KrF	KrF	Binary	Clear	E	0.31/0.31	Option(1.5V)
11	1I	DNW	I-line	KrF	Binary	Dark	J	2/2	
12	5D	LVRVT Vtp	I-line	KrF	Binary	Clear	D	0.75/0.75	Option(1.5V)
13	6D	LVRVT Vtn	I-line	KrF	Binary	Clear	D	0.75/0.75	Option(1.5V)
14	1D	SRAM Vtp	KrF	KrF	Binary	Clear	D	1/1	Option(1.5V)
15	2D	SRAM Vtn	KrF	KrF	Binary	Clear	D	1/1	Option(1.5V)
16	2E	MV Gate Oxide	KrF	KrF	Binary	Dark	C	0.6/0.8	Option(1.5V)
17	1G	Poly	KrF	KrF	6%HT	Dark	J	0.11/0.20	
18	5N	MV NLDD	KrF	KrF	Binary	Clear	D	0.31/0.31	
19	5P	MV PLDD	KrF	KrF	Binary	Clear	D	0.31/0.31	

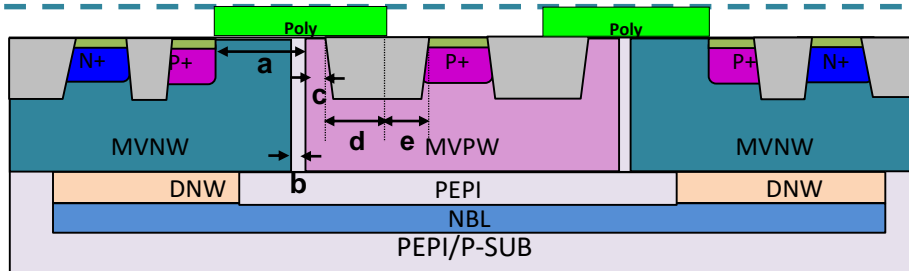
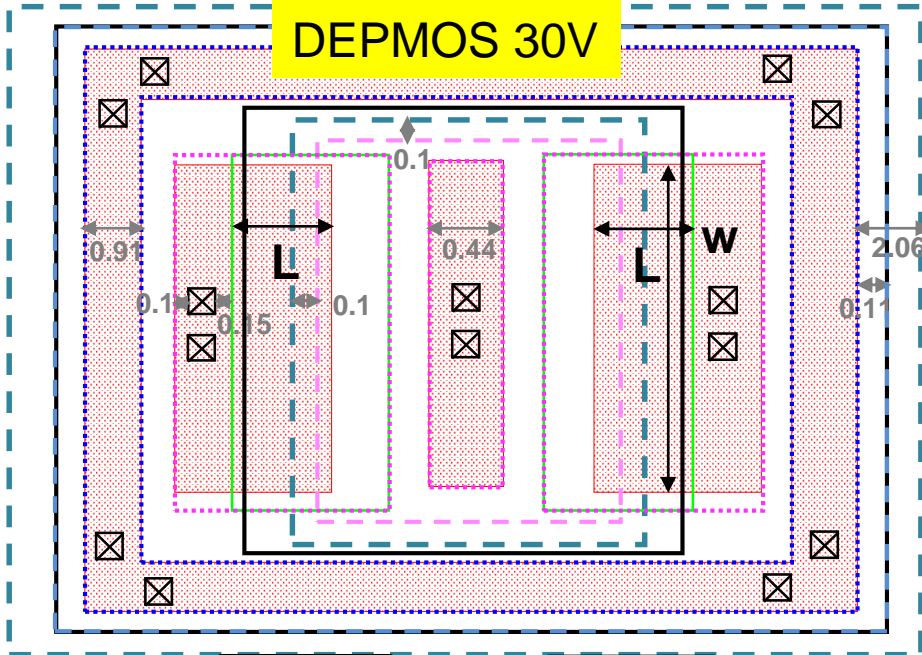
110 BCD Photo Mask Layers - Epi

NO.	Layer	Description	Photo type	Pellicle type		Mask Tone	Grade.	Minimum line/space (um)	Remark
20	1N	LV NLDD	KrF	KrF	Binary	Clear	D	0.31/0.31	
21	1P	LV PLDD	KrF	KrF	Binary	Clear	D	0.31/0.31	
22	2P	P+	KrF	KrF	Binary	Clear	D	0.31/0.31	
23	2N	N+	KrF	KrF	Binary	Clear	D	0.31/0.31	
24	3E	SAB	I-line	KrF	Binary	Dark	C	0.42/0.42	
25	1C	CONTACT	KrF	KrF	6%HT	Clear	J	0.12/0.16	
26	1M	METAL(1)	KrF	KrF	6%HT	Dark	I	0.144/0.144	
27	nT	Inter-via	KrF	KrF	6%HT	Clear	I	0.16/0.20	
28	nM	Inter-metal	KrF	KrF	6%HT	Dark	G	0.18/0.20	
29	NK	MIM	KrF	KrF	Binary	Dark	C	4/0.8	
30	TV	Top Via	KrF	KrF	6%HT	Clear	I	0.16/0.20	
31	TM	METAL(6)	KrF	KrF	Binary	Dark	D	0.39/0.40	
32	PV	PASSIVATION	I-line	KrF	Binary	Clear	B	1.5/1.5	

DEMOS_PMOS 20V/30V/40V

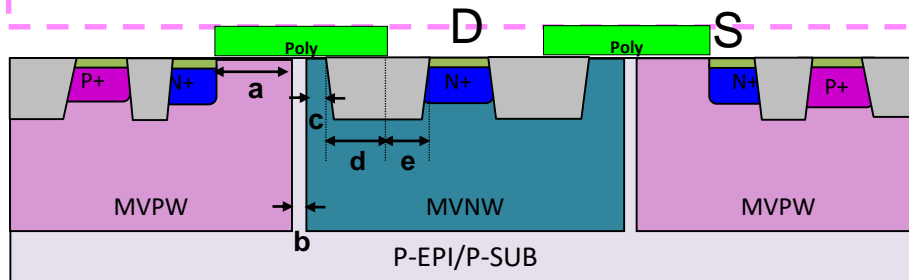
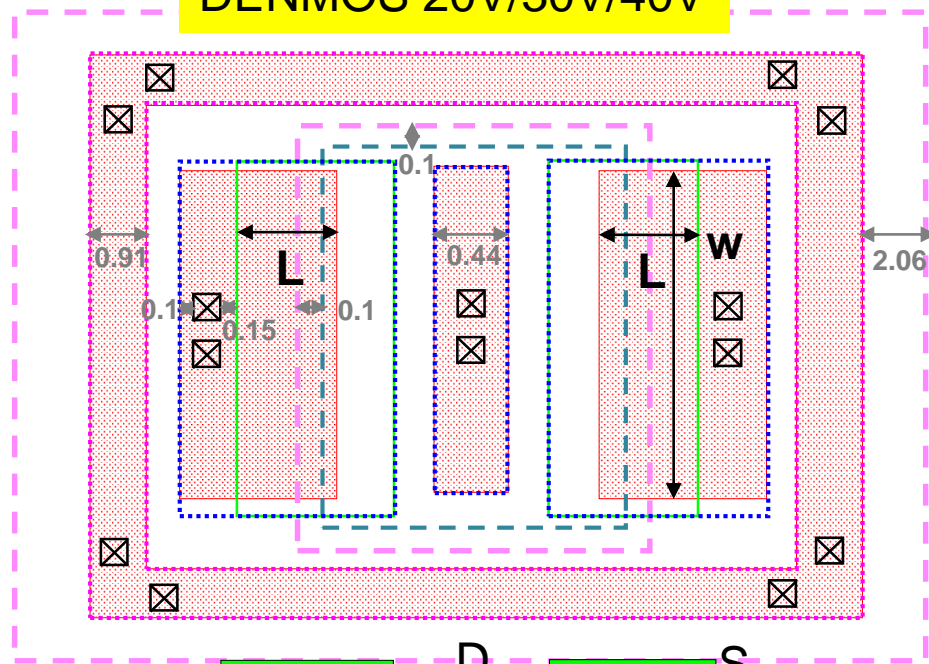


DEMOS_PMOS 20V/30V/40V

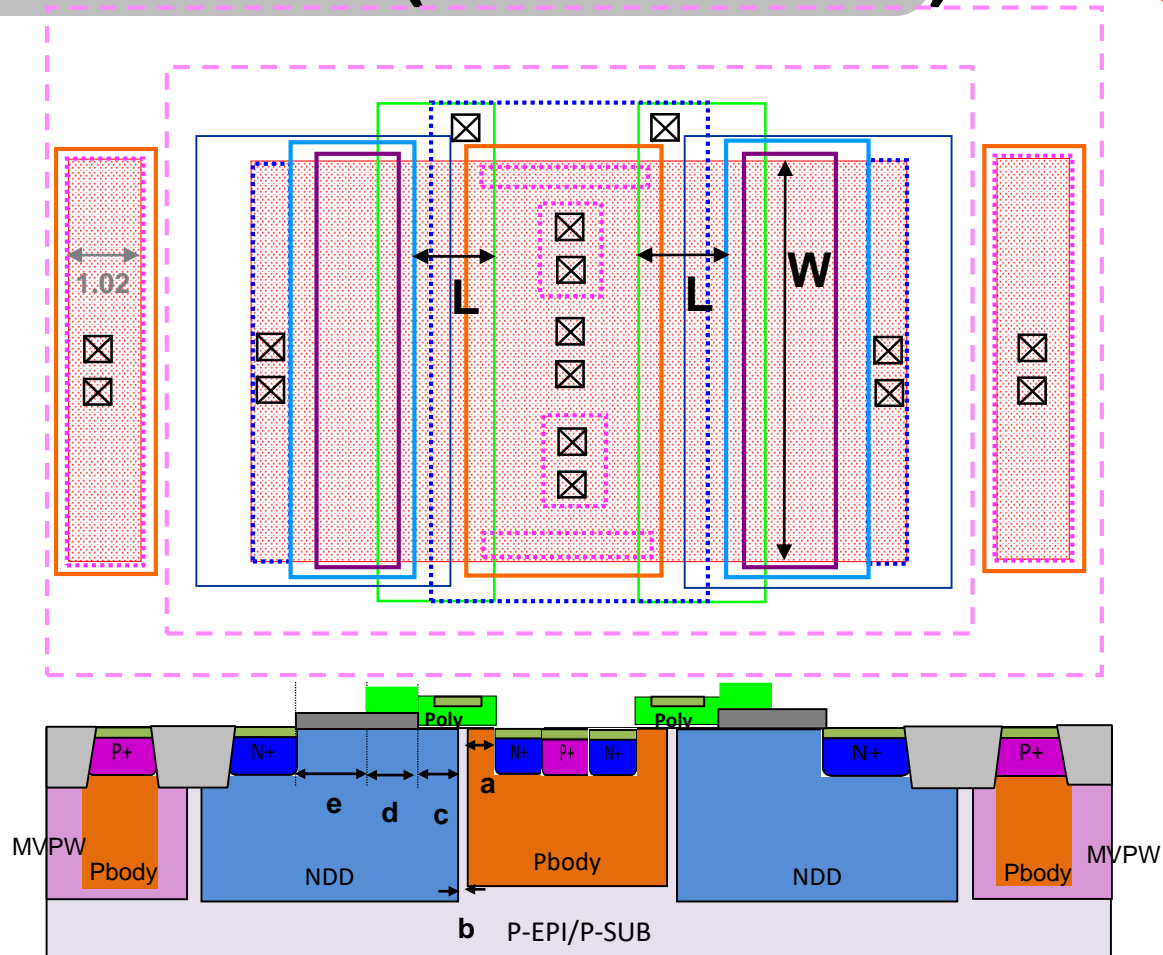


DEMOS_NMOS 20/30/40V

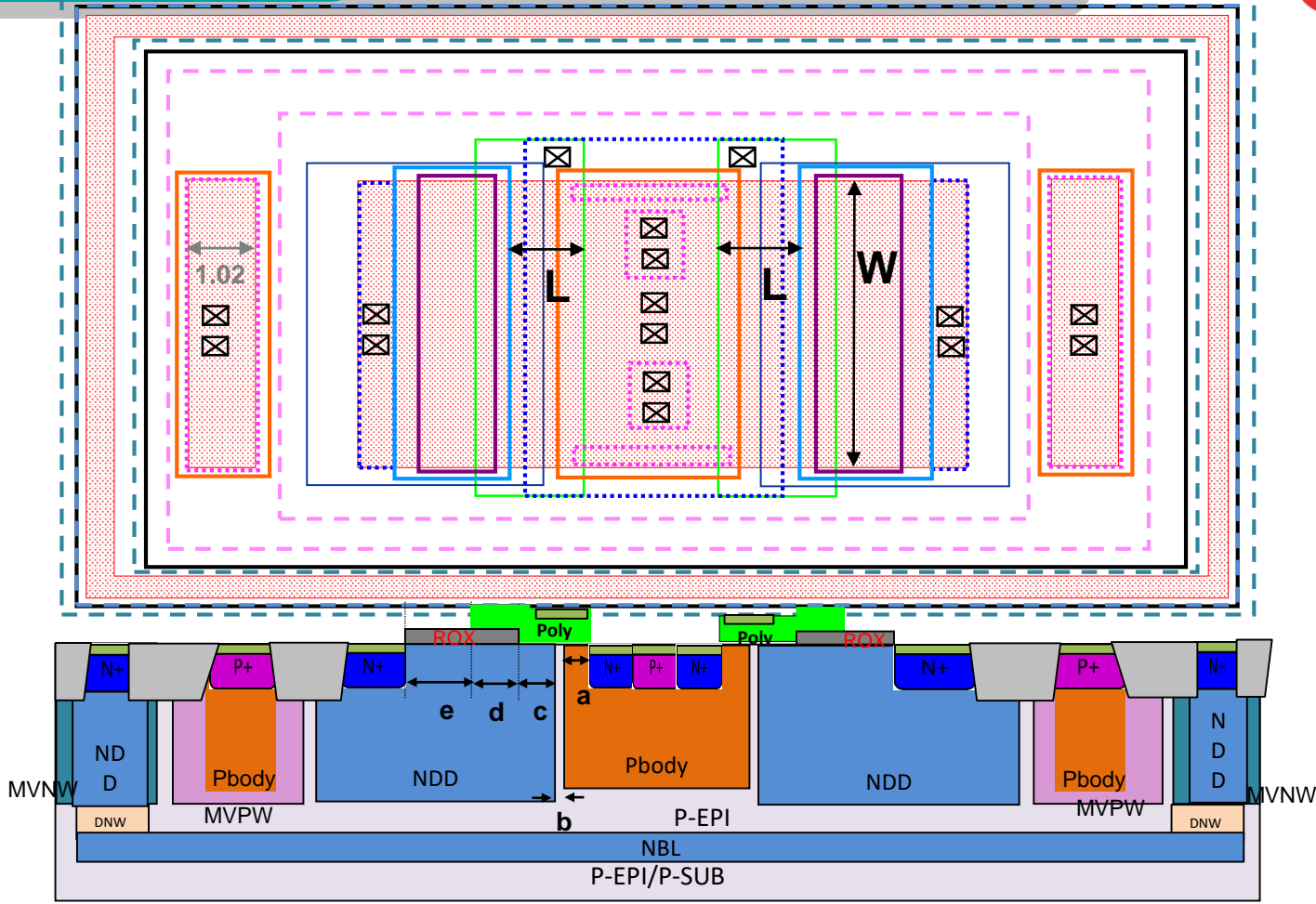
DENMOS 20V/30V/40V



LDMOS_NMOS LS (20V/30V/40V)

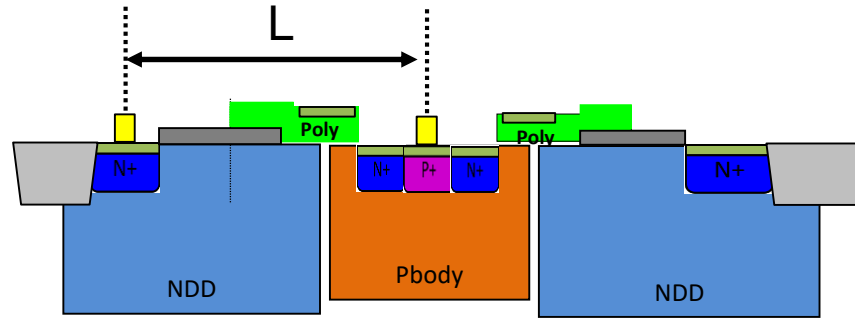


LDMOS_NMOS_HS (20/30/40V)

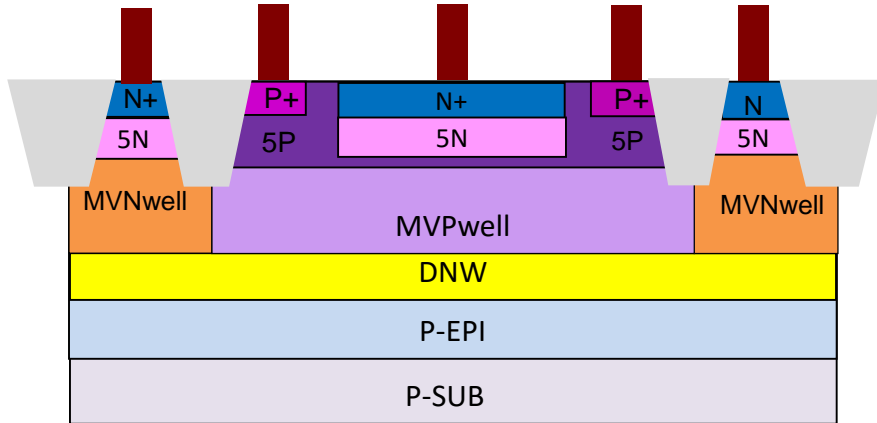


LDMOS_NMOS_30V half pitch size

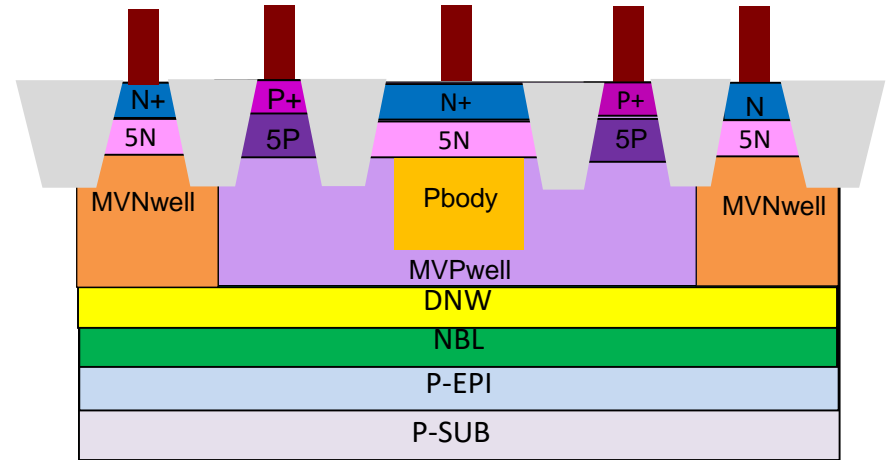
$L(\text{LDMOS}_{\text{LS}}_{30\text{V}})=3.67\mu\text{m}$
 $L(\text{LDMOS}_{\text{HS}}_{30\text{V}})=3.77\mu\text{m}$



ZN_5V (N+/PLDD)



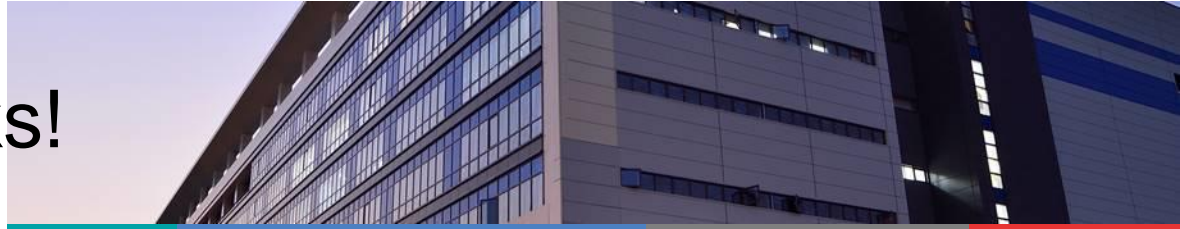
ZN_br (N+/Pbody)

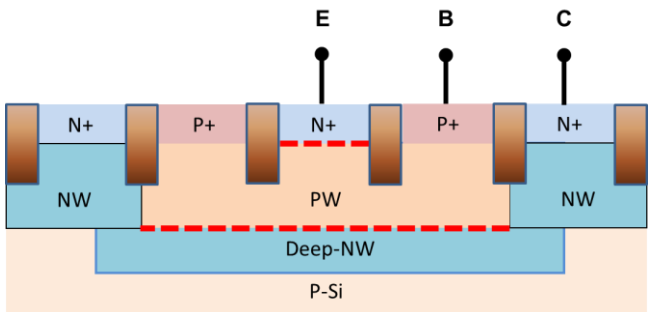


Type	NSC device name	Parameter	Unit	NSC实测 data
Zener diode	BVZN_5V	BV	V	6.50
	JLZN_5V	I_leak	Log10(A/um2)	2.35E-09
	VfZN_5V	Vf	V	0.66
	BVZN_br	BV	V	6.60
	JLZN_br	I_leak	Log10(A/um2)	2.41E-12
	VfZN_br	Vf	V	-0.67

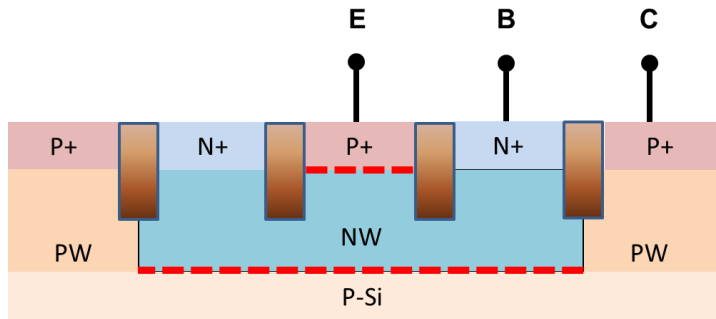
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Thanks!

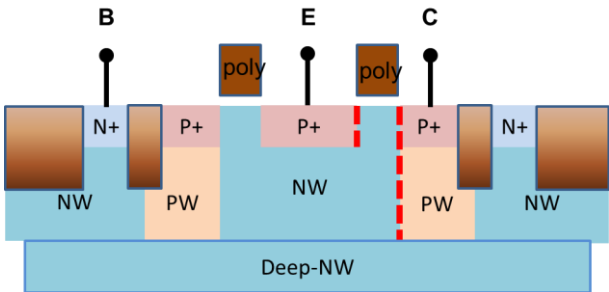




VNP (DNW)



VPNP



LPNP (DNW)

1.5V NMOS(RVT)

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.11	V	0.536	0.61	0.684	Gm Max method @ Vd=0.1V
I _{dsat_nom}	10 / 0.11	uA/um	297.4	425	552.6	V _{ds} =V _{gs} =1.5V
I _{off_nom}	10 / 0.11	pA/um	*	2	*	V _d =1.5V, V _g =0V
BV _{dss}	10 / 0.11	V	3.5	*	*	V _d @ V _g =V _s =0V, I _d =1uA
BV _{gox}	90 * 35	V	*	*	-3.5	V _g @ V _b =0V, I _g =-1uA

1.5V PMOS(RVT)

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.11	V	-0.67	-0.61	-0.55	Gm Max method @ Vd=-0.1V
I _{dsat_nom}	10 / 0.11	uA/um	-221	-170	-119	V _{ds} =V _{gs} =-1.5V
I _{off_nom}	10 / 0.11	pA/um	*	-2	*	V _d =-1.5V, V _g =0V
BV _{dss}	10 / 0.11	V	*	*	-3.5	V _d @ V _g =V _s =0V, I _d =-1uA
BV _{gox}	90 * 35	V	3.5	*	*	V _g @ V _b =0V, I _g =1uA

1.5V NMOS(LVT)

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.11	V	0.345	0.435	0.525	Gm Max method @ Vd=0.1V
I _{dsat_nom}	10 / 0.11	uA/um	395.4	565	734.6	V _{ds} =V _{gs} =1.5V
I _{off_nom}	10 / 0.11	pA/um	*	500	*	V _d =1.5V, V _g =0V
BV _{dss}	10 / 0.11	V	3.0	*	*	V _d @ V _g =V _s =0V, I _d =1uA
BV _{gox}	90 * 35	V	*	*	-3.5	V _g @ V _b =0V, I _g =-1uA

1.5V PMOS(LVT)

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.11	V	-0.55	-0.48	-0.41	Gm Max method @ Vd=-0.1V
I _{dsat_nom}	10 / 0.11	uA/um	-286	-220	-154	V _{ds} =V _{gs} =-1.5V
I _{off_nom}	10 / 0.11	pA/um	*	-50	*	V _d =-1.5V, V _g =0V
BV _{dss}	10 / 0.11	V	*	*	-3.5	V _d @ V _g =V _s =0V, I _d =-1uA
BV _{gox}	90 * 35	V	3.5	*	*	V _g @ V _b =0V, I _g =1uA

1 PMOS Pull Load

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remark
Vth	0.13 / 0.11	V	-0.65	-0.47	-0.29	Gm Max method @ Vd=0.1V
I _{dsat}	0.13 / 0.11	uA	-34.9	-26.6	-18.4	V _{ds} =V _{gs} =-1.5V
I _{off}	0.13 / 0.11	pA	-50	*	*	V _d =-1.5V, V _g =0V
Bvdss	0.13 / 0.11	V	*		-4	V _d @ V _g =V _s =0V, I _d =-1uA

2 NMOS Pass Gate

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remark
Vth	0.13 / 0.11	V	0.43	0.61	0.79	Gm Max method @ Vd=0.1V
I _{dsat}	0.13 / 0.11	uA	33	51	69	V _{ds} =V _{gs} =1.5V
I _{off}	0.13 / 0.11	pA	*	*	10	V _d =1.5V, V _g =0V
Bvdss	0.13 / 0.11	V	4		*	V _d @ V _g =V _s =0V, I _d =1uA

3 NMOS Pull Down

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remark
Vth	0.19 / 0.11	V	0.54	0.72	0.9	Gm Max method @ Vd=0.1V
I _{dsat}	0.19 / 0.11	uA	39.8	60.9	82	V _{ds} =V _{gs} =1.5V
I _{off}	0.19 / 0.11	pA	*	*	10	V _d =1.5V, V _g =0V
Bvdss	0.19 / 0.11	V	4		*	V _d @ V _g =V _s =0V, I _d =1uA

5V NMOS

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.5	V	0.55	0.68	0.81	Gm Max method @ Vd=0.1V
I _{dsat_nom}	10 / 0.5	uA/um	460	570	680	V _{ds} =V _{gs} =5.0V
I _{off_nom}	10 / 0.5	pA/um	*	*	10	V _d =5.0V, V _g =0V
BV _{dss}	10 / 0.5	V	7	*	*	V _d @ V _g =V _s =0V, I _d =1uA
BV _{gox}	90 * 35	V	*	*	-12	V _g @ V _b =0V, I _g =-1uA

5V PMOS

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Vth	10 / 0.5	V	-0.80	-0.67	-0.54	Gm Max method @ Vd=-0.1V
I _{dsat_nom}	10 / 0.5	uA/um	-400	-335	-270	V _{ds} =V _{gs} =-5.0V
I _{off_nom}	10 / 0.5	pA/um	-10	*	*	V _d =-5.0V, V _g =0V
BV _{dss}	10 / 0.5	V	*	*	-7	V _d @ V _g =V _s =0V, I _d =-1uA
BV _{gox}	90 * 35	V	12	*	*	V _g @ V _b =0V, I _g =1uA

Rs

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Rs_N+AA_NC	W=5um	ohm/sqr	47	82	117	V = 1V
Rs_P+AA_NC	W=5um	ohm/sqr	83	131	179	V = -1V
Rs_N+POLY_NC	W=5um	ohm/sqr	241	445	649	V = 1V
Rs_P+POLY_NC	W=5um	ohm/sqr	298	418	538	V = -1V
Rs_N+AA_CO	W=5um	ohm/sqr	5.3	8.3	11.3	V = 1V
Rs_P+AA_CO	W=5um	ohm/sqr	5.1	8.1	11.1	V = -1V
Rs_N+POLY_CO	W=5um	ohm/sqr	6	9	12	V = 1V
Rs_P+POLY_CO	W=5um	ohm/sqr	5.9	8.9	11.9	V = -1V
Rs_Metal 1(2.2K)	W=0.144um	ohm/sqr	0.180	0.350	0.510	V = 1V
Rs_Metal 1(4.1K)	W=0.18um	ohm/sqr	0.065	0.11	0.146	V = 1V
Rs_Metal n	W=0.18um	ohm/sqr	0.065	0.11	0.146	V = 1V
Rs_Top Metal(10K)	W=0.39um	ohm/sqr	0.008	0.029	0.052	V = 1V
Rs_Top Metal(12K)	W=0.6um	ohm/sqr	0.006	0.027	0.050	V = 1V
Rs_Top Metal(30K)	W=2.0um	ohm/sqr	0.001	0.0107	0.02	V = 1V
Rs_UHR(Hi-R Poly)	W=1.0um	ohm/sqr	1580	2100	2620	V = 1V

Rc

Item Name	(W / L) um	Unit	Lower	Target	Upper	Remarks
Rc_N+AA	0.12um	ohm/cont	8.5	14	21.5	V = 1V
Rc_P+AA	0.12um	ohm/cont	8.5	14	21.5	V = -1V
Rc_N+POLY	0.12um	ohm/cont	7.5	12	20.5	V = 1V
Rc_P+POLY	0.12um	ohm/cont	7.5	11.5	18.5	V = -1V
Rc_Via n	0.16um	ohm/via	2	10	22	V = 1V
Rc_Top Via TM(10K/12K)	0.16um	ohm/via	2	10	22	V = 1V
Rc_Top Via TM(30K)	0.36um	ohm/via	0.4	1.85	4	V = 1V