Reference 40nm Design Rule Manual

Process-1P10M 0.9V-1.8V-2.5V-3.3V, Logic (G)

Version 0.4

Dated:- 23rd Feb 2011

Notes: Note1   Manufacturing Grid is 0.005um or 5nm
Note2   Design rule number with an 'R' are recommended rules
Note3   All values are in microns unless specified otherwise

Layer	Rule Number	Description	Reference 40nm Value (um)
NWELL			
	nwell.w.1	Min Width	0.350
	nwell.s.1	min space and notch	0.350
	nwell.s.3	min space to N+ diff	0.090
	nwell.s.3.1	min space to N+ diff (at least one edge at each corner)	0.180
	nwell.s.3.2	min space to Pwell Strap	0.090
	nwell.ex.3	min extension over P+ diff	0.090
	nwell.ex.3.1	min extension over P+ diff (at least one edge at each corner)	0.180
	nwell.ex.3.2	min extension over Nwell(Nplus) Strap	0.090
	nwell.a.1	min area	0.810
	nwell.a.2	min enclosed area	0.810
DIFF			
	diff.w.1	Min Width	0.070
	diff.w.1R	Min Width recommended	0.100
	diff.w.2	min mosfet channel width	0.140
	diff.w.3	max mosfet channel width	10.000
	diff.w.4	max mosfet channel width for core PMOS devices	2.000
	diff.w.5	Minimum mosfet channel width for thick oxide devices	0.300
	diff.s.1	min space to diff	0.090
	diff.s.1R	min space and notch recommended	0.120
	diff.s.2	min space to diff is (w> 0.12um) and (CR>= 0.14um)	0.100
	diff.s.2.1	min space to diff is (w> 0.12um) and (CR>= 0.14um) IN POLY gate direction	0.120
	diff.s.3	net separation between the strap and the diffusion	0.150
	diff.ex.1	min extension over Poly	0.070
	diff.ex.1R	Recommended extension over Poly	0.120
	diff.a.1	min area	0.030
	diff.a.3	min enclosed area	0.044
	diff.L.1	Length of 45-degree bent Diffusion (minimum edge length)	0.300
	diff.L.2	maximum diff length of core device	10.000
	diff.dn.1	diff density across full chip	>=25%, <75%
POLY			

	poly.w.1	min width	**0.040**
	poly.w.2	max poly width	**20.000**
	poly.w.3	min gate length and allowed length	**0.04/0.045/0.0 5/0.06/0.07/0.0 8~10**
	poly.w.4	max gate length	**12.000**
	poly.w.5	min gate length for thick oxide devices	**0.160**
	poly.s.1	min space poly	**0.080**
	poly.s.1.R	min space poly recommended	**0.100**
	poly.s.1.1	Poly gate space range to neighbouring POLY or Dummy Poly (For channel length < 0.08)	**0.15/0.17/0.22**
	poly.s.1.2	min poly gate space	**0.150**
	poly.s.3	gate to gate space [If either mosfet length] >=0.08	**0.140**
	poly.s.4	Maximum gate space [If either mosfet length] >=0.08 to neighboring Poly or dummy poly in core devices	**0.300**
	poly.s.5	poly to diff space (for field poly)	**0.035**
	poly.s.6	poly space to L-shape diff	**0.120**
	poly.s.6R	poly space to L-shape diff Recommended	**0.150**
	poly.s.7	L-shape poly space diff	**0.050**
	poly.s.7R	L-shape poly space diff Recommeneded	**0.120**
	poly.s.10	Space if at least one {POLY or dummy POLY} width > 0.12um and the {POLY or Dummy Poly} parallel run length > 0.14um	**0.160**
	poly.s.11	Space {in the same RPO}	**0.170**
	poly.s.12	Space at line end	**0.120**
	poly.s.13	Large Poly to gate Space	**1.000**
	poly.l.1	min poly edge length	**0.090**
	poly.l.3	maximum length of the Poly between two contacts	**20.000**
	poly.ex.1	poly extension over diff (mosfet poly endcap)	**0.100**
	poly.ex.1R	poly extension over diff (mosfet poly endcap) Recommened	**0.120**
	poly.ex.2	poly extension over diff (mosfet poly endcap) if poly space to L-shaped diff is < 0.10	**0.100**
	poly.ex.2R	maximum recommended poly extension over diff (mosfet poly endcap)	**0.300**
	poly.ex.3	poly extension over rpoly	**0.220**
	poly.a.1	min poly area	**0.025**
	poly.a.2	min poly area if all edges < 0.21	**0.060**
	poly.a.3	min poly enclosed area	**0.050**
	poly.dn.1	Poly Density across full chip	**>=14% <=50%**
	poly.sglv.1	Gate with Width < 0.180um needs to covered by with dummy poly layer	
	poly.sglv.2	Gate with Width < 0.180um extended by 0.02um from the edges of the dfiffusion requires having another GATE/Poly/dummypoly adjacent to it satisfying poly.s.4 rule	
	poly.sglv.3	dummy poly layer to poly spacing	**0.15/0.17/0.22**
	poly.R.1	Gate Bends Not Allowed	
	poly.R.2	45 degre bends are not allowed for poly	

RPOLY

	rpoly.w.1	min width	**0.360**

	rpoly.s.1	min space	0.360
	rpoly.s.2	min spacing from contact to rpoly	0.200
	rpoly.s.3	min spacing from poly to rpoly	0.200
	rpoly.s.4	min spacing from diffusion to rpoly	0.200
	rpoly.ex.1	min Extension of RPOLY over POLY	0.200
	rpoly.ex.2	min extension of rpoly over diffusion	0.200
	rpoly.ex.3	min overlap over P-plus	0.050
	rpoly.ex.4	min overlap over N-plus	0.050
	rpoly.a.1	min area	0.950
	rpoly.a.2	min Enclosed Area	0.950

PPLUS

	pplus.w.1	min width	0.200
	pplus.s.1	min space	0.200
	pplus.s.2	min space to diff	0.060
	pplus.s.3	min space to abutted Nplus	0.000
	pplus.s.4	min space to strap diff (not abutted)	0.030
	pplus.s.5	pplus over diff space to gate	0.090
	pplus.ex.1	pplus extension of poly	0.090
	pplus.ex.2	pplus extension of diff	0.090
	pplus.ex.3	pplus extension of strap diff	0.030
	pplus.ex.4	pplus extension over contact	0.030
	pplus.a.1	min area	0.080
	pplus.a.2	min enclosed area	0.080

NPLUS

	nplus.w.1	min width	0.200
	nplus.s.1	min space	0.200
	nplus.s.2	min space to diff	0.060
	nplus.s.3	min space to abutted Pplus	0.000
	nplus.s.4	min space to strap diff (not abutted)	0.030
	nplus.s.5	nplus over diff space to gate	0.090
	nplus.ex.1	nplus extension of poly	0.090
	nplus.ex.2	nplus extension of diff	0.090
	nplus.ex.3	nplus extension of strap diff	0.030
	nplus.ex.4	nplus extension over contact	0.030
	nplus.a.1	min area	0.080
	pplus.a.2	min enclosed area	0.080

LOWVTN

	lowvtn.w.1	min width	0.200
	lowvtn.s.1	min space	0.200
	lowvtn.s.2	space to gate in poly endcap dir	0.120
	lowvtn.s.3	space to gate in diff s/d direction	0.120
	lowvtn.ex.1	extension over gate in diff s/d dir	0.120
	lowvtn.ex.2	extension over gate in poly endcap dir	0.120
	lowvtn.a.1	min area	0.210
	lowvtn.a.2	min enclosed area	0.210

LOWVTP

	lowvtp.w.1	min width	0.200
	lowvtp.s.1	min space	0.200
	lowvtp.s.2	space to gate in poly endcap dir	0.120
	lowvtp.s.3	space to gate in diff s/d direction	0.120
	lowvtp.ex.1	extension over gate in diff s/d dir	0.120

	lowvtp.ex.2	extension over gate in poly endcap dir	**0.120**
	lowvtp.a.1	min area	**0.210**
	lowvtp.a.2	min enclosed area	**0.210**

HIGHVTN

	highvtn.w.1	min width	**0.200**
	highvtn.s.1	min space	**0.200**
	highvtn.s.2	space to gate in poly endcap dir	**0.120**
	highvtn.s.3	space to gate in diff s/d direction	**0.120**
	highvtn.ex.1	extension over gate in diff s/d dir	**0.120**
	highvtn.ex.2	extension over gate in poly endcap dir	**0.120**
	highvtn.a.1	min area	**0.210**
	highvtn.a.2	min enclosed area	**0.210**

HIGHVTP

	highvtp.w.1	min width	**0.200**
	highvtp.s.1	min space	**0.200**
	highvtp.s.2	space to gate in poly endcap dir	**0.120**
	highvtp.s.3	space to gate in diff s/d direction	**0.120**
	highvtp.ex.1	extension over gate in diff s/d dir	**0.120**
	highvtp.ex.2	extension over gate in poly endcap dir	**0.120**
	highvtp.a.1	min area	**0.210**
	highvtp.a.2	min enclosed area	**0.210**

DIFF18

	diff18.w.1	min width	**0.320**
	diff18.s.1	min space	**0.320**
	diff18.ex.1	min extension over gate	**0.350**
	diff18.ex.2	min extension over diff	**0.300**

DIFF25

	diff25.w.1	min width	**0.320**
	diff25.s.1	min space	**0.320**
	diff25.ex.1	min extension over gate	**0.350**
	diff25.ex.2	min extension over diff	**0.300**

DIFF33

	diff33.w.1	min width	**0.320**
	diff33.s.1	min space	**0.320**
	diff33.ex.1	min extension over gate	**0.350**
	diff33.ex.2	min extension over diff	**0.300**

CONT

	cont.w.1	width, maximum = minimum	**0.060**
	cont.s.1	min space	**0.080**
	cont.s.1R	recommended min Center to Center spacing	**0.210**
	cont.s.2	min space if 3 or more contacts within 0.11um	**0.110**
	cont.s.3	min space if contacts on different net	**0.120**
	cont.s.4	cont space to gate	**0.045**
	cont.s.4R	cont space to gate recommended	**0.060**
	cont.s.5	cont (inside poly) space to diff	**0.060**
	cont.s.6R	Recommended cont (inside poly) space to cont (inside diff) when CR > 0	**0.170**

	cont.s.6.1R	Recommended cont(inside poly) space to cont (inside diff) when CR = 0	**0.150**
	cont.ex.1	diff extension over cont	**0.010/0.030**
	cont.ex.1.R	diff extension over cont Recommended	**0.010/0.040**
	cont.ex.2	diff extension over cont four sides	**0.020**
	cont.ex.3	poly extension over cont	**0.010/0.03**
	cont.ex.3R	poly extension over cont	**0.010/0.040**
	cont.ex.4	polyextension over cont four sides	**0.060**
	cont.R.1	45 degree rotated Contacts not allowed	
	cont.R.2	Recommended minimum number of cuts for mosfets with width > 2um	**2.000**

M1

	m1.w.1	min width	**0.070**
	m1.w.2	max width	**5.000**
	m1.s.1	min space m1-m1	**0.080**
	m1.s.1R	min space m1-m1 Recommended	**0.100**
	m1.s.1.1R	min space m1-m1 Recommended for same net	**0.130**
	m1.s.3	min space m1-m1 if w> 0.17 and CR > 0.27	**0.100**
	m1.s.4	min space m1-m1 if w> 0.24 and CR > 0.27	**0.120**
	m1.s.5	min space m1-m1 if w> 0.31 and CR > 0.4	**0.140**
	m1.s.6	min space m1-m1 if w> 0.62 and CR > 0.62	**0.210**
	m1.s.7	min space m1-m1 if w> 1.5 and CR > 1.5	**0.500**
	m1.s.8	min space at line end (dense line end)if W < 0.090; CR length > 0.090um	**0.080**
	m1.ex.1	m1 extension over cont	**0.00/0.030**
	m1.ex.1R	m1 extension over contRecommended	**0.03/0.05**
	m1.ex.3	m1 extension over cont (four sides)	**0.020**
	m1.ex.3R	m1 extension over cont (four sides) recommended	**0.030**
	m1.ex.4	m1 extension over cont if m1 W > 0.7	**0.030**
	m1.ex.5	m1 extension over cont if m1 W > 0.11 ; sep to M1 < 0.08 ; CR to m1 >0.27	**0.015**
	m1.a.1	min area	**0.0225**
	m1.a.1.R	min area Recommended	**0.0325**
	m1.a.2	min enclosed area	**0.220**
	m1.l.1	Concave/Convex corner rule	**0.070**
	m1.dn.1	Metal density range	**>=10% <=75%**

Vx (where x=1-9)

	vx.w.1	min width	**0.070**
	vx.s.1	min space	**0.080**
	vx.s.2	min space with 3 neighboring vias within 0.11 distance	**0.110**
	vx.s.3	min space to vx of different net	**0.100**
	vx.ex.1	mx extension over vx	**0.00/0.04**
	vx.ex.1R	mx extension over vx Recommended	**0.05/0.05**
	vx.ex.2	mx extension over vx (4 sides)	**0.025**
	vx.ex.4	m1 extension over v1 if M1 w > 0.11 & sep < 0.8 & CR > 0.27	**0.020**
	vx.st.1	Via stacking allowed for vx and V(x+1)	
	vx.R.1	45 degree rotated via is not allowed	
	vx.R.2	Atleast two Viax with space <= 0.3 are required to connect Mx and M(x+1), when either of the two metals has a width and length >= 0.7	

	vx.R.3	Recommended maximum consequative stacked Vx layer, which has only one via for each Vx layer to avoid high Rc. Rule not applicable to top via (V8 and V9)	**3.000**

Mx (where x=2-10)

	mx.w.1	min width	**0.070**
	mx.w.2	max width	**5.000**
	mx.s.1	min space mx-mx	**0.090**
	mx.s.1R	min space mx-mx Recommended	**0.100**
	mx.s.3	min space mx-mx if w> 0.17 and CR > 0.27	**0.100**
	mx.s.4	min space mx-mx if w> 0.24 and CR > 0.27	**0.120**
	mx.s.5	min space mx-mx if w> 0.31 and CR > 0.4	**0.150**
	mx.s.6	min space mx-mx if w> 0.62 and CR > 0.62	**0.210**
	mx.s.7	min space mx-mx if w> 1.5 and CR > 1.5	**0.500**
	mx.s.8	min space at line end (dense line end)if W < 0.1; CR length > 0.035um	**0.110**
	mx.ex.1	mx extension over vx	**0.000/0.040**
	mx.ex.1R	mx extension over vx Recommended	**0.000/0.050**
	mx.ex.3	mx extension over vx (four sides)	**0.025**
	mx.ex.4	mx extension over vx if mx W > 0.6	**0.300**
	mx.ex.5	mx extension over vx if mx W > 0.6 ; sep to mx < 0.09 ; CR to mx >0.30	**0.050**
	mx.a.1	min area	**0.030**
	mx.a.1.R	min area recommended	**0.035**
	mx.a.2	min enclosed area	**0.220**

VARMARKER

	var.w.1	moscap min channel length	**0.180**
	var.w.2	high voltage moscap min channel length	**0.360**
	var.w.3	moscap min channel width	**0.300**
	var.s.1	min space to Active region	**0.120**
	var.a.1	Maximum core (not hv) varactor gate area (um2)	**20.000**
	var.ex.1	min enclosure with diffusion region	**0.150**
	var.r.1	varmarker layer must be drawn to fully cover varactor device	

RESISTOR RULES

	np.s.6	space to P type unsalicided OD/PO resistor	**0.120**
	np.ex.5	extension of n-type unsalicided OD/PO resistor	**0.130**
	res.w.1	Width of unsalicided OD/PO resistor	**0.450**
	res.l.1	Length of unsalicided OD/PO resistor	**0.500**
	res.r.1	Square (length/width) for OD/PO resistor	**>=1**
	res.ex.1	Resistor marker enclosure of unsalicided/salisided OD/PO resistor	**0.180**

*Mos specific rules can be found in DIFF and POLY sections.

Notes