Washington University in St. Louis

McKelvey School of Engineering

Spring Semester 2023

CSE463M: Digital Integrated Circuit Design and Architecture

Homework #5

1. **Consider the function $Y = (A\overline{B} + C)\overline{G} + E\overline{F}$**

   a. **Implement this function using CMOS logic and draw the circuit in Cadence. Assume that all signals and their respective inverse signals are available to the designer. Print the schematic.**

   b. **All transistors in the circuit have W/L = 1.8μm/1.8μm, V_{T0n} =0.8V, V_{T0p} =-0.9V, k'_{T0n} =110 μA/V^2, k'_{T0p} =38 μA /V^2. What is the value of the logic threshold when all inputs are connected to V_{TH}? Show all hand calculations and simulate the results in Spice. Print the Spice simulation.**

   c. **Simulate the circuit for all possible input transitions and plot the results.**

   d. **What is the common Euler path for the pMOS and nMOS network of transistors? Draw the optimized stick-diagram layout.**

   e. **Draw the optimized layout in Cadence. Perform DRC and LVS on the layout. Print the layout of the circuit, the DRC and the LVS messages.**

   f. **Simulate the circuit layout for all possible input transitions and plot the results and make sure that circuit schematic simulation and layout simulation have matching results.**

2. **Design a 2 to 1 Multiplexer using CMOS Transmission Gates in Cadence.**

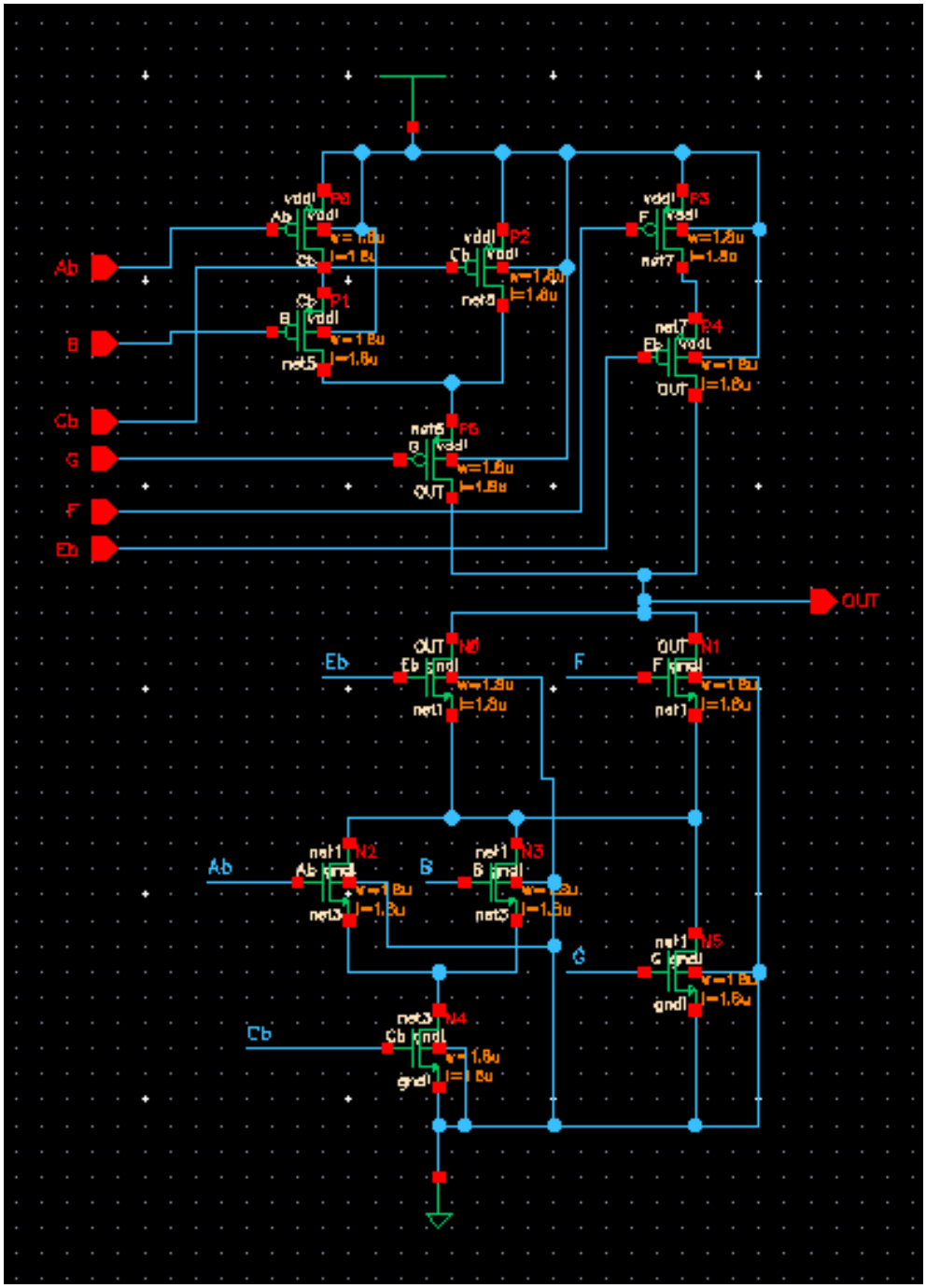
   a. Draw the schematic in Cadence and print it.

   b. Simulate the transient behavior of the circuit for all possible combinations. Print the transient behavior.

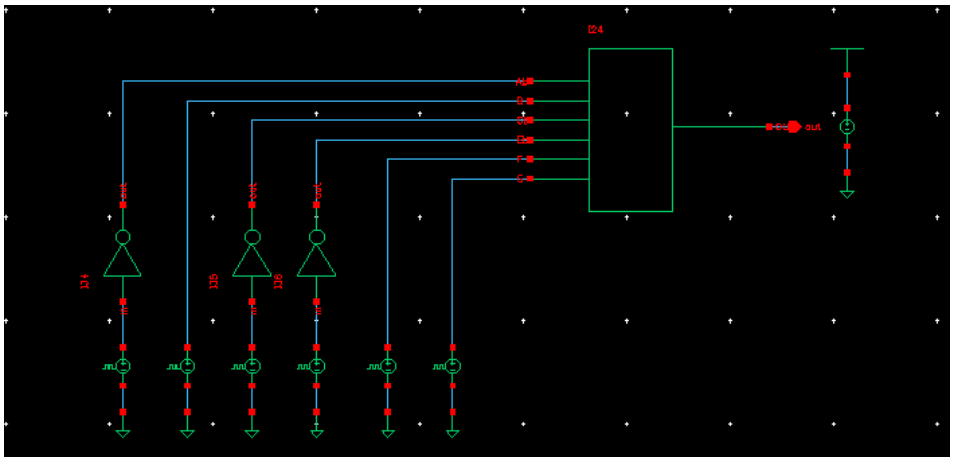
   c. Draw the layout of the circuit. Perform DRC and LVS on the layout. Print the layout of the circuit, the DRC and the LVS messages.

   d. Simulate the transient behavior of the circuit layout for all possible combinations. Print the transient behavior. Make sure that circuit schematic simulation and layout simulation have matching results.

1.a. + Here is the schematic for the function.



+ Here is the test schematic for the above schematic.



b. + Here is how to get Vth.

$$R_{eq,p} = \frac{1}{\frac{1}{\frac{1}{R_A+R_B}+\frac{1}{R_C}}+R_G} + \frac{1}{R_E+R_F} = \left(\frac{L}{W}\right)_{p,eq}$$

$$\left(\frac{W}{L}\right)_{p,eq} = \frac{1}{\frac{1}{\frac{1}{R_A+R_B}+\frac{1}{R_C}}+R_G} + \frac{1}{R_E+R_F}$$

$$= \frac{1}{\frac{2}{3}+1} + \frac{1}{2} = \frac{3}{5} + \frac{1}{2} = \frac{11}{10}$$

$$R_{eq,n} = \frac{1}{\frac{1}{R_E}+\frac{1}{R_F}} + \frac{1}{\frac{1}{\frac{1}{R_A}+\frac{1}{R_B}+\frac{1}{R_C}}+\frac{1}{R_G}} = \left(\frac{L}{W}\right)_{n,eq}$$

$$\left(\frac{L}{W}\right)_{n,eq} = \frac{1}{2} + \frac{1}{\frac{2}{3}+1}$$

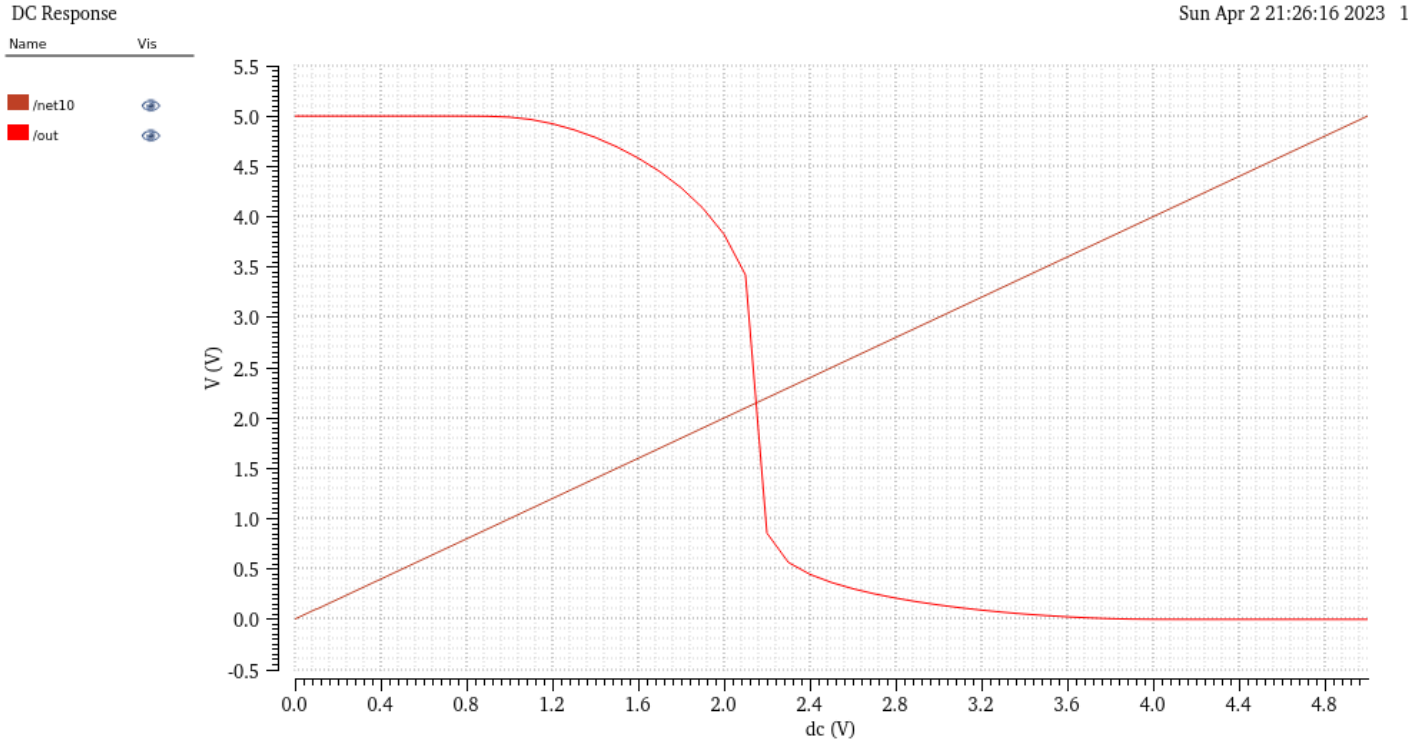
$$= \frac{1}{2} + \frac{3}{5} = \frac{11}{10}$$

$$\left(\frac{W}{L}\right)_{n,eq} = \frac{10}{11}$$

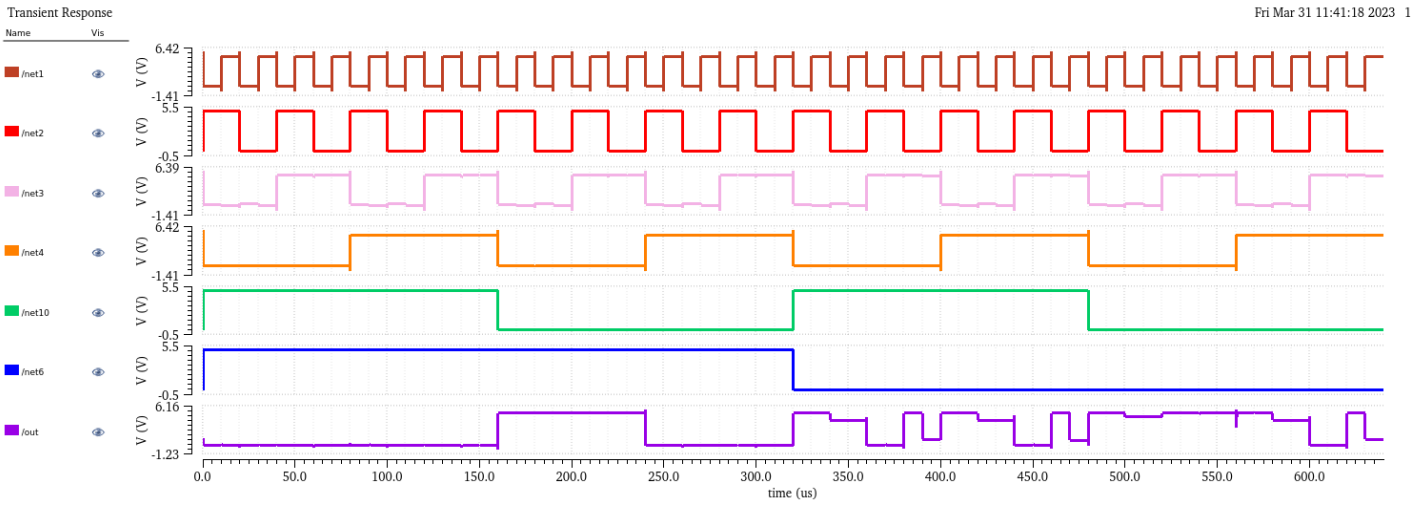
$$V_{th(inv)} = \frac{V_{Tn} + \sqrt{\frac{K_{PEQV}}{K_{NEQV}}}\left(V_{DD}+V_{TP}\right)}{1+\sqrt{\frac{K_{PEQV}}{K_{NEQV}}}} = \frac{0.8 + \sqrt{\frac{11/10}{10/11}}\left(5-0.9\right)}{1+\sqrt{\frac{11/10}{10/11}}}$$

$$= 2.52\ V$$

+ Here is the test result of Vth.



c) + Here is the result of all cases of the schematic. And the result shows the same result with the truth table of the function.

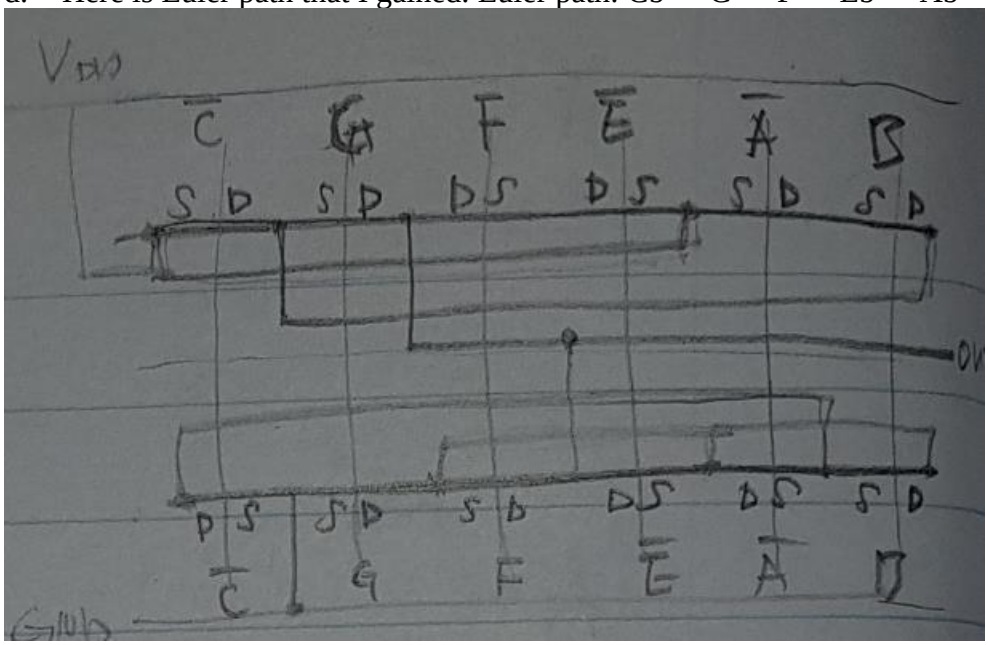


A	B	C	E	F	G	Output
1	1	1	1	1	1	F
0	1	1	1	1	1	F
1	0	1	1	1	1	F
0	0	1	1	1	1	F
1	1	0	1	1	1	F
0	1	0	1	1	1	F
1	0	0	1	1	1	F

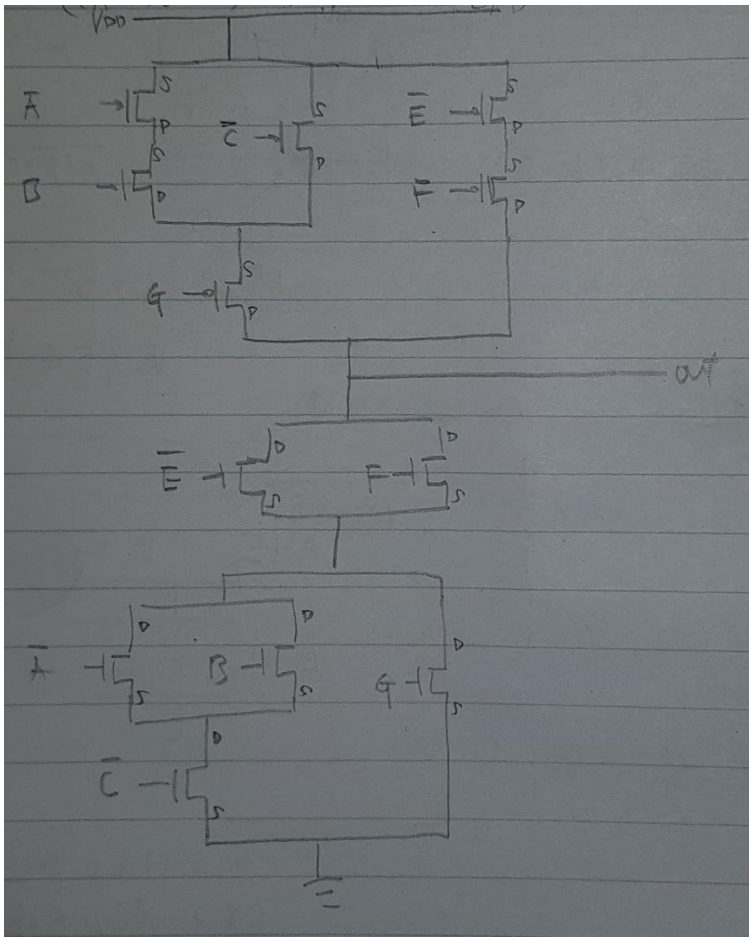
0	0	0	1	1	1	F
1	1	1	0	1	1	F
0	1	1	0	1	1	F
1	0	1	0	1	1	F
0	0	1	0	1	1	F
1	1	0	0	1	1	F
0	1	0	0	1	1	F
1	0	0	0	1	1	F
0	0	0	0	1	1	F
1	1	1	1	0	1	T
0	1	1	1	0	1	T
1	0	1	1	0	1	T
0	0	1	1	0	1	T
1	1	0	1	0	1	T
0	1	0	1	0	1	T
1	0	0	1	0	1	T
0	0	0	1	0	1	T
1	1	1	0	0	1	F
0	1	1	0	0	1	F
1	0	1	0	0	1	F
0	0	1	0	0	1	F
1	1	0	0	0	1	F
0	1	0	0	0	1	F
1	0	0	0	0	1	F
0	0	0	0	0	1	F
1	1	1	1	1	0	T
0	1	1	1	1	0	T
1	0	1	1	1	0	T
0	0	1	1	1	0	T
1	1	0	1	1	0	F
0	1	0	1	1	0	F
1	0	0	1	1	0	T
0	0	0	1	1	0	F
1	1	1	0	1	0	T
0	1	1	0	1	0	T
1	0	1	0	1	0	T
0	0	1	0	1	0	T

1	1	0	0	1	0	F
0	1	0	0	1	0	F
1	0	0	0	1	0	T
0	0	0	0	1	0	F
1	1	1	1	0	0	T
0	1	1	1	0	0	T
1	0	1	1	0	0	T
0	0	1	1	0	0	T
1	1	0	1	0	0	T
0	1	0	1	0	0	T
1	0	0	1	0	0	T
0	0	0	1	0	0	T
1	1	1	0	0	0	T
0	1	1	0	0	0	T
1	0	1	0	0	0	T
0	0	1	0	0	0	T
1	1	0	0	0	0	F
0	1	0	0	0	0	F
1	0	0	0	0	0	T
0	0	0	0	0	0	F

d. + Here is Euler path that I gained. Euler path: Cb -> G -> F -> Eb -> Ab -> B

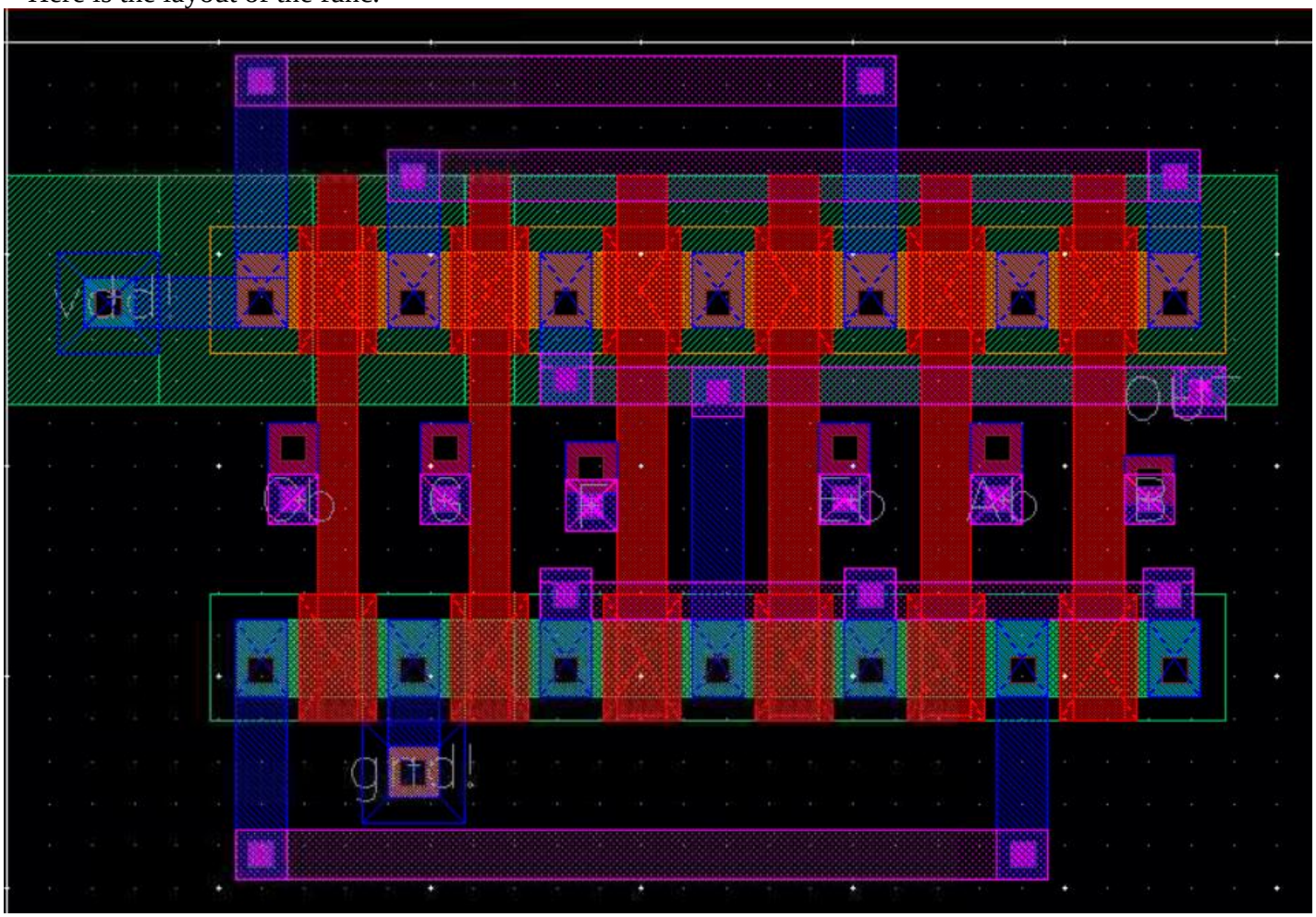


+ Here is the schematic with hands.



e.

+ Here is the layout of the func.



+ Here is the result of DRC

```
DRC started at Fri Mar 31 21:40:54 2023

Validating hierarchy instantiation for:
library: cse463
cell:    inv_homework51_func
view:    layout
Rules come from library NCSU_TechLib_ami06.
Rules path is divaDRC.rul.
Inclusion limit is set to 1000.
Running layout DRC analysis
Flat mode
Full checking.
executing: nodrc = geomOr("nodrc")
executing: gwell = geomOr(geomAndNot(("gwell" "drawing") nodrc))
executing: nwell = geomOr(geomAndNot(("nwell" "drawing") nodrc))
executing: pwell = geomOr(geomAndNot(("pwell" "drawing") nodrc))
executing: nactive = geomOr(geomAndNot(("nactive" "drawing") nodrc))
executing: pactive = geomOr(geomAndNot(("pactive" "drawing") nodrc))
executing: active = geomOr(geomAndNot(("active" "drawing") nodrc) nactive pactive)
executing: gselect = geomOr(geomAndNot(("gselect" "drawing") nodrc))
executing: nselect = geomOr(geomAndNot(("nselect" "drawing") nodrc))
executing: pselect = geomOr(geomAndNot(("pselect" "drawing") nodrc))
executing: poly = geomOr(geomAndNot(("poly" "drawing") nodrc))
executing: metal1 = geomOr(geomAndNot(("metal1" "drawing") nodrc))
executing: cc = geomOr(geomAndNot(("cc" "drawing") nodrc))
executing: metal2 = geomOr(geomAndNot(("metal2" "drawing") nodrc))
executing: via = geomOr(geomAndNot(("via" "drawing") nodrc))
executing: glass = geomOr(geomAndNot(("glass" "drawing") nodrc))
executing: pad = geomOr(geomAndNot(("pad" "drawing") nodrc))
executing: res_id = geomOr("res_id")
```

```
executing: metal3 = geomOr(geomAndNot(("metal3" "drawing") nodrc))
executing: via2 = geomOr(geomAndNot(("via2" "drawing") nodrc))
executing: highres = geomOr(geomAndNot(("highres" "drawing") nodrc))
executing: elec = geomOr(geomAndNot(("elec" "drawing") nodrc))
executing: ce = geomOr(geomOr(geomAndNot(("ce" "drawing") nodrc)) geomAnd(cc elec))
executing: cp = geomOr(geomOr(geomAndNot(("cp" "drawing") nodrc)) geomAnd(cc geomAndNot(poly ce)))
executing: ca = geomOr(geomOr(geomAndNot(("ca" "drawing") nodrc)) geomAnd(cc geomAndNot(active ...
executing: nActive = geomAnd(active nselect)
executing: pActive = geomAnd(active pselect)
executing: nBulk = geomOr(nwell)
executing: pBulk = geomOr(geomNot(nwell) geomAndNot(pwell nwell))
executing: nOhmic = geomAnd(nActive nwell)
        nNotOhmic = geomAndNot(nActive nwell)
executing: pOhmic = geomAndNot(pActive nwell)
        pNotOhmic = geomAnd(pActive nwell)
executing: nDiff = geomAndNot(nNotOhmic geomOr(poly elec))
executing: pDiff = geomAndNot(pNotOhmic geomOr(poly elec))
executing: nDiffContact = geomAnd(ca nDiff)
executing: pDiffContact = geomAnd(ca pDiff)
executing: nOhmicContact = geomAnd(ca nOhmic)
executing: pOhmicContact = geomAnd(ca pOhmic)
executing: Gate = geomAnd(geomOr(nNotOhmic pNotOhmic) poly)
executing: fieldPoly = geomAvoiding(poly Gate)
executing: elecGate = geomAnd(geomOr(nNotOhmic pNotOhmic) elec)
executing: fieldElec = geomAvoiding(elec elecGate)
executing: CapacitorElec = geomInside(elec poly)
executing: TransistorElec = geomOverlap(elec geomNot(poly))
executing: fieldPoly = geomAndNot(fieldPoly res_id)
executing: poly = geomAndNot(poly res_id)
executing: fieldElec = geomAndNot(fieldElec geomOr(res_id highres))
executing: elecRes = geomButting(geomAnd(res_id elec) fieldElec (keep == 2))
executing: elecHighres = geomButting(geomAnd(highres elec) fieldElec (keep == 2))
executing: elec = geomAndNot(elec geomOr(res_id highres))
executing: nBulk = geomAndNot(nBulk res_id)
executing: nwell = geomAndNot(nwell res_id)
executing: geomConnect((via nOhmicContact nOhmic nwell nBulk metal1) (via pOhmicContact pOhmic ...
executing: dubiousData(("gwell" "drawing") "Improperly formed shape - gwell")
executing: dubiousData(("nwell" "drawing") "Improperly formed shape - nwell")
executing: dubiousData(("pwell" "drawing") "Improperly formed shape - pwell")
executing: dubiousData(("active" "drawing") "Improperly formed shape - active, nactive or pacti...
executing: dubiousData(("gselect" "drawing") "Improperly formed shape - gselect")
executing: dubiousData(("nselect" "drawing") "Improperly formed shape - nselect")
executing: dubiousData(("pselect" "drawing") "Improperly formed shape - pselect")
executing: dubiousData(("poly" "drawing") "Improperly formed shape - poly")
executing: dubiousData(("metal1" "drawing") "Improperly formed shape - metal1")
executing: dubiousData(("ca" "drawing") "Improperly formed shape - ca")
executing: dubiousData(("cp" "drawing") "Improperly formed shape - cp")
executing: dubiousData(("metal2" "drawing") "Improperly formed shape - metal2")
executing: dubiousData(("via" "drawing") "Improperly formed shape - via")
executing: dubiousData(("glass" "drawing") "Improperly formed shape - glass")
executing: saveDerived(geomGetNon45(gwell) "Non-Manhattan shape - gwell")
executing: saveDerived(geomGetNon45(nwell) "Non-Manhattan shape - nwell")
executing: saveDerived(geomGetNon45(pwell) "Non-Manhattan shape - pwell")
executing: saveDerived(geomGetNon45(active) "Non-Manhattan shape - active, nactive or pactive")
executing: saveDerived(geomGetNon45(gselect) "Non-Manhattan shape - gselect")
executing: saveDerived(geomGetNon45(nselect) "Non-Manhattan shape - nselect")
executing: saveDerived(geomGetNon45(pselect) "Non-Manhattan shape - pselect")
executing: saveDerived(geomGetNon45(poly) "Non-Manhattan shape - poly")
executing: saveDerived(geomGetNon45(metal1) "Non-Manhattan shape - metal1")
executing: saveDerived(geomGetNon45(ca) "Non-Manhattan shape - ca")
executing: saveDerived(geomGetNon45(cp) "Non-Manhattan shape - cp")
executing: saveDerived(geomGetNon45(metal2) "Non-Manhattan shape - metal2")
executing: saveDerived(geomGetNon45(via) "Non-Manhattan shape - via")
executing: saveDerived(geomGetNon45(glass) "Non-Manhattan shape - glass")
executing: offGrid(gwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(nwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(pwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(active gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(gselect gridRes "(SCMOS Inst) Edge not on grid")
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executing: offGrid(nselect gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(pselect gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(poly gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(metal1 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(ca gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(cp gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(metal2 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(via gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(glass gridRes "(SCMOS Inst) Edge not on grid")
executing: dubiousData(("metal3" "drawing") "Improperly formed shape - metal3")
executing: dubiousData(("via2" "drawing") "Improperly formed shape - via2")
executing: saveDerived(geomGetNon45(metal3) "Non-Manhattan shape - metal3")
executing: saveDerived(geomGetNon45(via2) "Non-Manhattan shape - via2")
executing: offGrid(metal3 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(via2 gridRes "(SCMOS Inst) Edge not on grid")
executing: dubiousData(("elec" "drawing") "Improperly formed shape - elec")
executing: dubiousData(("ce" "drawing") "Improperly formed shape - ce")
executing: saveDerived(geomGetNon45(elec) "Non-Manhattan shape - elec")
executing: saveDerived(geomGetNon45(ce) "Non-Manhattan shape - ce")
executing: offGrid(elec gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(ce gridRes "(SCMOS Inst) Edge not on grid")
executing: nwellEdge = geomGetEdge(nwell)
executing: pwellEdge = geomGetEdge(pwell)
executing: activeEdge = geomGetEdge(active)
executing: nselectEdge = geomGetEdge(nselect)
executing: pselectEdge = geomGetEdge(pselect)
executing: polyEdge = geomGetEdge(poly)
executing: metal1Edge = geomGetEdge(metal1)
executing: caEdge = geomGetEdge(ca)
executing: cpEdge = geomGetEdge(cp)
executing: metal2Edge = geomGetEdge(metal2)
executing: viaEdge = geomGetEdge(via)
executing: glassEdge = geomGetEdge(glass)
executing: highresEdge = geomGetEdge(highres)
executing: ceEdge = geomGetEdge(ce)
executing: metal3Edge = geomGetEdge(metal3)
executing: via2Edge = geomGetEdge(via2)
executing: nBulkEdge = geomGetEdge(nBulk)
executing: pBulkEdge = geomGetEdge(pBulk)
executing: nOhmicEdge = geomGetEdge(nOhmic)
executing: pOhmicEdge = geomGetEdge(pOhmic)
executing: nNotOhmicEdge = geomGetEdge(nNotOhmic)
executing: pNotOhmicEdge = geomGetEdge(pNotOhmic)
executing: GateEdge = geomGetEdge(Gate)
executing: fieldPolyEdge = geomGetEdge(fieldPoly)
executing: CapacitorElecEdge = geomGetEdge(CapacitorElec)
executing: TransistorElecEdge = geomGetEdge(TransistorElec)
executing: elecHighresEdge = geomGetEdge(elecRes coincident elec)
executing: saveDerived(geomAndNot(active geomOr(nselect pselect)) "(DBM Rule 1.1) Active must b...
executing: saveDerived(geomAnd(poly nOhmic) "(DBM Rule 2.0) Poly cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(poly pOhmic) "(DBM Rule 2.0) Poly cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(elec nOhmic) "(DBM Rule 2.1) Elec cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(elec pOhmic) "(DBM Rule 2.1) Elec cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(pactive nselect) "(DBM Rule 3.1) Pactive and Nselect may not ove...
executing: saveDerived(geomAnd(nactive pselect) "(DBM Rule 3.2) Nactive and Pselect may not ove...
executing: saveDerived(geomAnd(active elec) "(DBM Rule 4.0, AMI 0.6um) Elec and active may not ...
executing: drc(nwellEdge (width < (lambda * 12.0)) errMesg)
        drc(nwellEdge (notch < (lambda * 6.0)) errMesg)
executing: drc(pwellEdge (width < (lambda * 12.0)) errMesg)
        drc(pwellEdge (notch < (lambda * 6.0)) errMesg)
executing: drc(nwell (sep < (lambda * 18.0)) diffNet errMesg)
        drc(nwell (sep < (lambda * 6.0)) sameNet errMesg)
executing: drc(pwell (sep < (lambda * 18.0)) diffNet errMesg)
        drc(pwell (sep < (lambda * 6.0)) sameNet errMesg)
executing: saveDerived(geomAnd(nwell pwell) "(SCMOS Rule 1 note) n-wells and p-wells may not ov...
executing: drc(activeEdge (width < (lambda * 3.0)) errMesg)
        drc(activeEdge (sep < (lambda * 3.0)) errMesg)
        drc(activeEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(nNotOhmicEdge nBulkEdge (sep < (lambda * 6.0)) errMesg)
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executing: drc(pNotOhmicEdge pBulkEdge (sep < (lambda * 6.0)) errMesg)
executing: drc(pBulkEdge nNotOhmicEdge (enc < (lambda * 6.0)) errMesg)
executing: drc(nBulkEdge pNotOhmicEdge (enc < (lambda * 6.0)) errMesg)
executing: drc(nBulkEdge nOhmicEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(nOhmicEdge pBulkEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(pOhmicEdge nBulkEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(pBulkEdge pOhmicEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(nNotOhmicEdge pOhmicEdge ((0 < sep) < (lambda * 4.0)) errMesg)
executing: drc(pNotOhmicEdge nOhmicEdge ((0 < sep) < (lambda * 4.0)) errMesg)
executing: drc(polyEdge (width < (lambda * 2.0)) errMesg)
        drc(polyEdge (sep < (lambda * 3.0)) errMesg)
        drc(polyEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(polyEdge activeEdge (enc < (lambda * 2.0)) errMesg)
        drc(activeEdge polyEdge (enc < (lambda * 3.0)) errMesg)
        drc(polyEdge activeEdge (sep < (lambda * 1.0)) errMesg)
executing: drc(nselectEdge geomGetEdge(polyEdge inside pNotOhmic) (sep < (lambda * 3.0)) (app >...
executing: drc(nselectEdge geomGetEdge(polyEdge inside nNotOhmic) (enc < (lambda * 3.0)) (app >...
executing: drc(pselectEdge geomGetEdge(polyEdge inside nNotOhmic) (sep < (lambda * 3.0)) (app >...
executing: drc(pselectEdge geomGetEdge(polyEdge inside pNotOhmic) (enc < (lambda * 3.0)) (app >...
executing: drc(geomOr(nselectEdge pselectEdge) activeEdge (sep < (lambda * 2.0)) errMesg)
        drc(geomOr(nselectEdge pselectEdge) activeEdge (enc < (lambda * 2.0)) errMesg)
executing: drc(nselectEdge caEdge (sep < (lambda * 1.0)) errMesg)
        drc(nselectEdge caEdge (enc < (lambda * 1.0)) errMesg)
executing: drc(pselectEdge caEdge (sep < (lambda * 1.0)) errMesg)
        drc(pselectEdge caEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomButting(geomAnd(ca nselect) geomAnd(ca pselect)) errMesg)
executing: drc(nselectEdge (width < (lambda * 2.0)) errMesg)
        drc(nselectEdge (sep < (lambda * 2.0)) errMesg)
        drc(nselectEdge (notch < (lambda * 2.0)) errMesg)
executing: drc(pselectEdge (width < (lambda * 2.0)) errMesg)
        drc(pselectEdge (sep < (lambda * 2.0)) errMesg)
        drc(pselectEdge (notch < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(nselect pselect) errMesg)
executing: drc(cpEdge (width < (lambda * 2.0)) errMesg)
        drc(cpEdge (sep < (lambda * 3.0)) errMesg)
        drc(cpEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(cp (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(polyEdge cpEdge (enc < (lambda * 1.0)) errMesg)
        drc(cpEdge polyEdge (sep < (lambda * 5.0)) errMesg)
executing: saveDerived(geomAndNot(cp poly) errMesg)
executing: saveDerived(geomAndNot(cc geomOr(poly elec active)) errMesg)
executing: drc(cpEdge GateEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(cpEdge activeEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(cp active) errMesg)
executing: saveDerived(geomGetLength(drc(cpEdge activeEdge (sep < (lambda * 3.0))) (length > (l...
executing: drc(caEdge (width < (lambda * 2.0)) errMesg)
        drc(caEdge (sep < (lambda * 3.0)) errMesg)
        drc(caEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(ca (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(activeEdge caEdge (enc < (lambda * 1.0)) errMesg)
        drc(caEdge activeEdge (sep < (lambda * 5.0)) errMesg)
executing: saveDerived(geomAndNot(ca active) errMesg)
executing: drc(caEdge GateEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(ca Gate) errMesg)
executing: drc(caEdge fieldPolyEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(ca fieldPoly) errMesg)
executing: saveDerived(geomGetLength(drc(caEdge fieldPolyEdge (sep < (lambda * 3.0))) (length >...
executing: drc(caEdge cpEdge (sep < (lambda * 4.0)) errMesg)
executing: saveDerived(geomAnd(ca cp) errMesg)
executing: drc(metal1Edge (width < (lambda * 3.0)) errMesg)
        drc(metal1Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal1Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal1Edge cpEdge (enc < (lambda * 1.0)) errMesg)
executing: drc(metal1Edge caEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(cp metal1) errMesg)
executing: saveDerived(geomAndNot(ca metal1) errMesg)
executing: drc(viaEdge (width < (lambda * 2.0)) errMesg)
        drc(viaEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(via (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1))))...
```

```
executing: drc(metal1Edge viaEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via metal1) errMesg)
executing: drc(metal2Edge (width < (lambda * 3.0)) errMesg)
        drc(metal2Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal2Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal2Edge viaEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via metal2) errMesg)
executing: BondingGlass = geomInside(glass pad)
        ProbeGlass = geomOutside(glass pad)
executing: saveDerived(geomStraddle(glass pad))
executing: BondingPad = geomAndNot(geomSize(BondingGlass 6.0) geomHoles(BondingGlass))
executing: ProbePad = geomAndNot(geomSize(ProbeGlass 6.0) geomHoles(ProbeGlass))
executing: Pad = geomOr(BondingPad ProbePad)
executing: BondingPadEdge = geomGetEdge(BondingPad not_over "nodrc")
executing: ProbePadEdge = geomGetEdge(ProbePad not_over "nodrc")
executing: PadEdge = geomGetEdge(Pad not_over "nodrc")
executing: Metal3EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal3" "glass" 36.0)) not_ov...
executing: Metal2EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal2" "glass" 36.0)) not_ov...
executing: Metal1EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal1" "glass" 21.0)) not_ov...
executing: PolyEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("poly" "glass" 21.0)) not_over "...
executing: ActiveEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("active" "glass" 21.0)) not_ov...
executing: ElecEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("elec" "glass" 21.0)) not_over "...
executing: drc(BondingPadEdge (width < 60.0) "(SCMOS Rule 10.1) bonding pad width: 60 um")
executing: drc(ProbePadEdge (width < 20.0) "(SCMOS Rule 10.2) probe pad width: 20 um")
executing: drc(Metal3EdgeNearPad glassEdge (enc < 6.0) "(SCMOS Rule 10.3) pad enclosure of glas...
executing: saveDerived(geomAndNot(glass metal3) "(SCMOS Rule 10.3) pad enclosure of glass: 6 um")
executing: drc(PadEdge Metal3EdgeNearPad (sep < 30.0) "(SCMOS Rule 10.4) pad to unrelated metal...
executing: drc(PadEdge Metal2EdgeNearPad (sep < 30.0) "(SCMOS Rule 10.4) pad to unrelated metal...
executing: drc(PadEdge Metal1EdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated metal...
executing: drc(PadEdge PolyEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated poly sp...
executing: drc(PadEdge ActiveEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated activ...
executing: drc(PadEdge ElecEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated elec sp...
executing: drc(CapacitorElecEdge (width < (lambda * 7.0)) errMesg)
        drc(CapacitorElecEdge (sep < (lambda * 3.0)) errMesg)
        drc(CapacitorElecEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(polyEdge CapacitorElecEdge (enc < (lambda * 5.0)) errMesg)
executing: drc(CapacitorElecEdge nBulkEdge (sep < (lambda * 2.0)) errMesg)
        drc(nBulkEdge CapacitorElecEdge (enc < (lambda * 2.0)) errMesg)
executing: drc(CapacitorElecEdge pBulkEdge (sep < (lambda * 2.0)) errMesg)
        drc(pBulkEdge CapacitorElecEdge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomStraddle(CapacitorElec nBulk) errMesg)
executing: saveDerived(geomStraddle(CapacitorElec pBulk) errMesg)
executing: drc(CapacitorElecEdge activeEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(CapacitorElec active) errMesg)
executing: drc(CapacitorElecEdge cpEdge (sep < (lambda * 6.0)) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal3") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal3 elec diffNet) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal2") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal2 elec diffNet) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal1") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal1 elec diffNet) errMesg)
executing: drc(TransistorElecEdge (width < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge (sep < (lambda * 3.0)) errMesg)
        drc(TransistorElecEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(TransistorElecEdge activeEdge (enc < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge activeEdge (sep < (lambda * 1.0)) errMesg)
executing: drc(TransistorElecEdge polyEdge (sep < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge polyEdge (ovlp < (lambda * 2.0)) errMesg)
executing: drc(TransistorElecEdge cpEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(TransistorElec cp) errMesg)
executing: drc(TransistorElecEdge caEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(TransistorElec ca) errMesg)
executing: drc(ceEdge (width < (lambda * 2.0)) errMesg)
        drc(ceEdge (sep < (lambda * 3.0)) errMesg)
        drc(ceEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(ce (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(CapacitorElecEdge ceEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(TransistorElecEdge ceEdge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAndNot(ce elec) "(SCMOS Rules 13.3,13.4) electrode enclosure of cont...
```

```
executing: drc(ceEdge polyEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomOutside(geomAnd(ce poly) CapacitorElec) errMesg)
executing: drc(ceEdge activeEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(ce active) errMesg)
executing: drc(via2Edge (width < (lambda * 2.0)) errMesg)
        drc(via2Edge (sep < (lambda * 3.0)) errMesg)
executing: drc(via2 (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))...
executing: drc(metal2Edge via2Edge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via2 metal2) errMesg)
executing: drc(metal3Edge (width < (lambda * 5.0)) errMesg)
        drc(metal3Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal3Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal3Edge via2Edge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAndNot(via2 metal3) errMesg)
executing: drc(highresEdge (width < (lambda * 4.0)) errMesg)
        drc(highresEdge (sep < (lambda * 4.0)) errMesg)
        drc(highresEdge (notch < (lambda * 4.0)) errMesg)
executing: drc(highresEdge caEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(highresEdge cpEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(highres ca) errMesg)
executing: saveDerived(geomAnd(highres cp) errMesg)
executing: drc(highresEdge activeEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(highresEdge geomGetEdge(geomAndNot(elec geomButting(elec elecHighres))) (sep < (...
executing: saveDerived(geomButting(elecHighres geomAndNot(elec elecHighres) (ignore == 2)) errM...
executing: saveDerived(geomAnd(elecHighres nwell) "(SCMOS Rule 27.6) resistor must be outside w...
executing: saveDerived(geomAnd(elecHighres active) "(SCMOS Rule 27.6) resistor must be outside ...
executing: drc(elecHighresEdge (width < (lambda * 5.0)) errMesg)
        drc(elecHighresEdge (sep < (lambda * 7.0)) errMesg)
        drc(elecHighresEdge (notch < (lambda * 7.0)) errMesg)
executing: drc(highresEdge elecHighresEdge (enc < (lambda * 2.0)) errMesg)
DRC started.......Fri Mar 31 21:40:54 2023
   completed ....Fri Mar 31 21:40:54 2023
   CPU TIME = 00:00:00  TOTAL TIME = 00:00:00
*********   Summary of rule violations for cell "inv_homework51_func layout"   *********
  Total errors found: 0
```

+ Here is the result of LVS

```
@(#)$CDS: LVS version 6.1.8-64b 08/09/2022 19:10 (sjfhw317) $

Command line: /project/engineering/cadence21/IC618/tools.lnx86/dfII/bin/64bit/LVS -dir /home/warehouse/b.gwak/cadence/LVS -l -s -t
/home/warehouse/b.gwak/cadence/LVS/layout /home/warehouse/b.gwak/cadence/LVS/schematic
Like matching is enabled.
Net swapping is enabled.
Using terminal names as correspondence points.

   Net-list summary for /home/warehouse/b.gwak/cadence/LVS/layout/netlist
     count
      14          nets
      9           terminals
      6           pmos
      6           nmos

   Net-list summary for /home/warehouse/b.gwak/cadence/LVS/schematic/netlist
     count
      14          nets
      9           terminals
      6           pmos
      6           nmos


   Terminal correspondence points
   N13     N11     Ab
   N10     N6      B
   N11     N7      Cb
```

```
   N6       N8       Eb
   N9       N10      F
   N8       N9       G
   N7       N5       OUT
   N5       N1       gnd!
   N12      N0       vdd!

Devices in the rules but not in the netlist:
      cap nfet pfet nmos4 pmos4

The net-lists match.

                      layout  schematic
                        instances
      un-matched            0       0
      rewired               0       0
      size errors           0       0
      pruned                0       0
      active               12      12
      total                12      12

                         nets
      un-matched            0       0
      merged                0       0
      pruned                0       0
      active               14      14
      total                14      14

                      terminals
      un-matched            0       0
      matched but
      different type        0       0
      total                 9       9


Probe files from /home/warehouse/b.gwak/cadence/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:


Probe files from /home/warehouse/b.gwak/cadence/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:
```

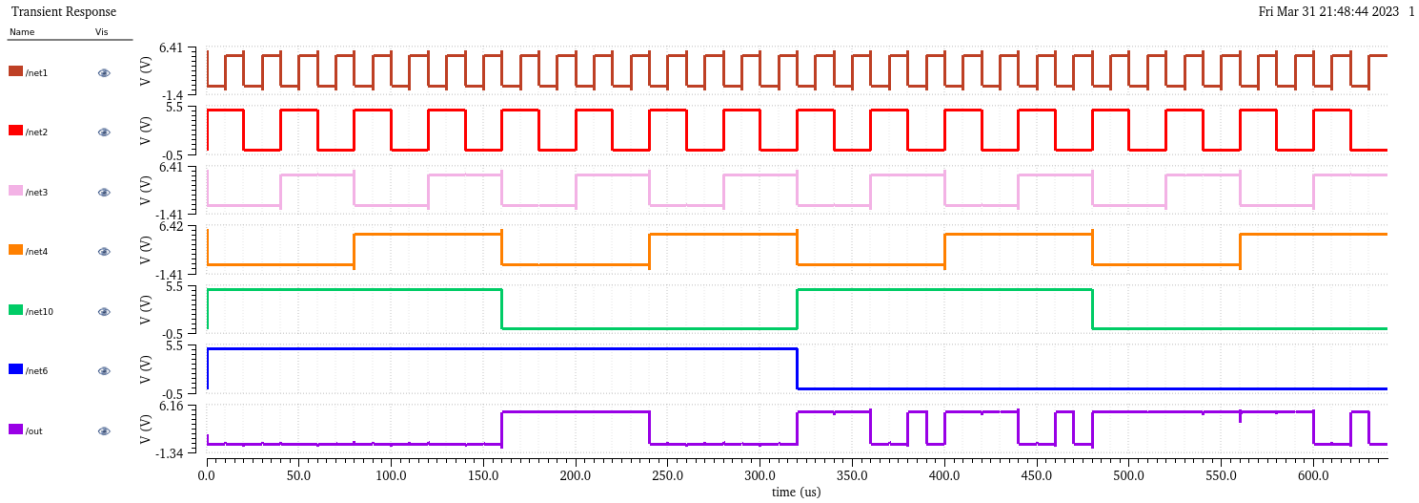
f)

+ Here is the proof that I test on the extracted version.

```
// Generated for: spectre
// Generated on: Mar 31 21:47:30 2023
// Design library name: cse463
// Design cell name: inv_homework51_test
// Design view name: schematic
simulator lang=spectre
global 0 vdd!
include "/project/linuxlab/cadence/CDK/ncsu/models/spectre/nom/ami06N.m"
include "/project/linuxlab/cadence/CDK/ncsu/models/spectre/nom/ami06P.m"

// Library name: cse463
// Cell name: inv_homework51_func
// View name: extracted
// View type: maskLayout
subckt inv_homework51_func_extracted Ab B Cb Eb F G OUT
   \+11 (12 B 14 vdd!) ami06P w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=2.7e-12 \
      ps=1.8e-06 pd=4.8e-06 m=1 region=sat
   \+10 (14 Ab vdd! vdd!) ami06P w=1.8e-06 l=1.8e-06 as=1.62e-12 \
      ad=1.62e-12 ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+9 (vdd! Eb 13 vdd!) ami06P w=1.8e-06 l=1.8e-06 as=1.62e-12 \
      ad=1.62e-12 ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+8 (13 F OUT vdd!) ami06P w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+7 (OUT G 12 vdd!) ami06P w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+6 (12 Cb vdd! vdd!) ami06P w=1.8e-06 l=1.8e-06 as=2.7e-12 \
      ad=1.62e-12 ps=4.8e-06 pd=1.8e-06 m=1 region=sat
   \+5 (11 B 10 0) ami06N w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=2.7e-12 \
      ps=1.8e-06 pd=4.8e-06 m=1 region=sat
   \+4 (10 Ab 11 0) ami06N w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+3 (11 Eb OUT 0) ami06N w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+2 (OUT F 11 0) ami06N w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+1 (11 G 0 0) ami06N w=1.8e-06 l=1.8e-06 as=1.62e-12 ad=1.62e-12 \
      ps=1.8e-06 pd=1.8e-06 m=1 region=sat
   \+0 (0 Cb 10 0) ami06N w=1.8e-06 l=1.8e-06 as=2.7e-12 ad=1.62e-12 \
      ps=4.8e-06 pd=1.8e-06 m=1 region=sat
ends inv_homework51_func_extracted
// End of subcircuit definition.

// Library name: cse463
// Cell name: inv_homework2
// View name: extracted
// View type: maskLayout
subckt inv_homework2_extracted in out
   \+1 (out in vdd! vdd!) ami06P w=6e-06 l=1.2e-06 as=1.08e-11 \
      ad=1.08e-11 ps=9.6e-06 pd=9.6e-06 m=1 region=sat
   \+6 (in 0) capacitor c=1.77444e-15 m=1
   \+5 (in vdd!) capacitor c=2.6784e-16 m=1
   \+4 (out 0) capacitor c=2.87292e-15 m=1
   \+3 (out vdd!) capacitor c=4.4736e-16 m=1
   \+2 (in 0) capacitor c=1.51224e-15 m=1
   \+0 (out in 0 0) ami06N w=2.7e-06 l=1.2e-06 as=4.86e-12 ad=4.86e-12 \
      ps=6.3e-06 pd=6.3e-06 m=1 region=sat
ends inv_homework2_extracted
// End of subcircuit definition.

// Library name: cse463
// Cell name: inv_homework51_test
// View name: schematic
I24 (net1 net2 net3 net4 net10 net6 out) inv_homework51_func_extracted
V1 (vdd! 0) vsource type=dc dc=5
I34 (net7 net1) inv_homework2_extracted
I35 (net8 net3) inv_homework2_extracted
```

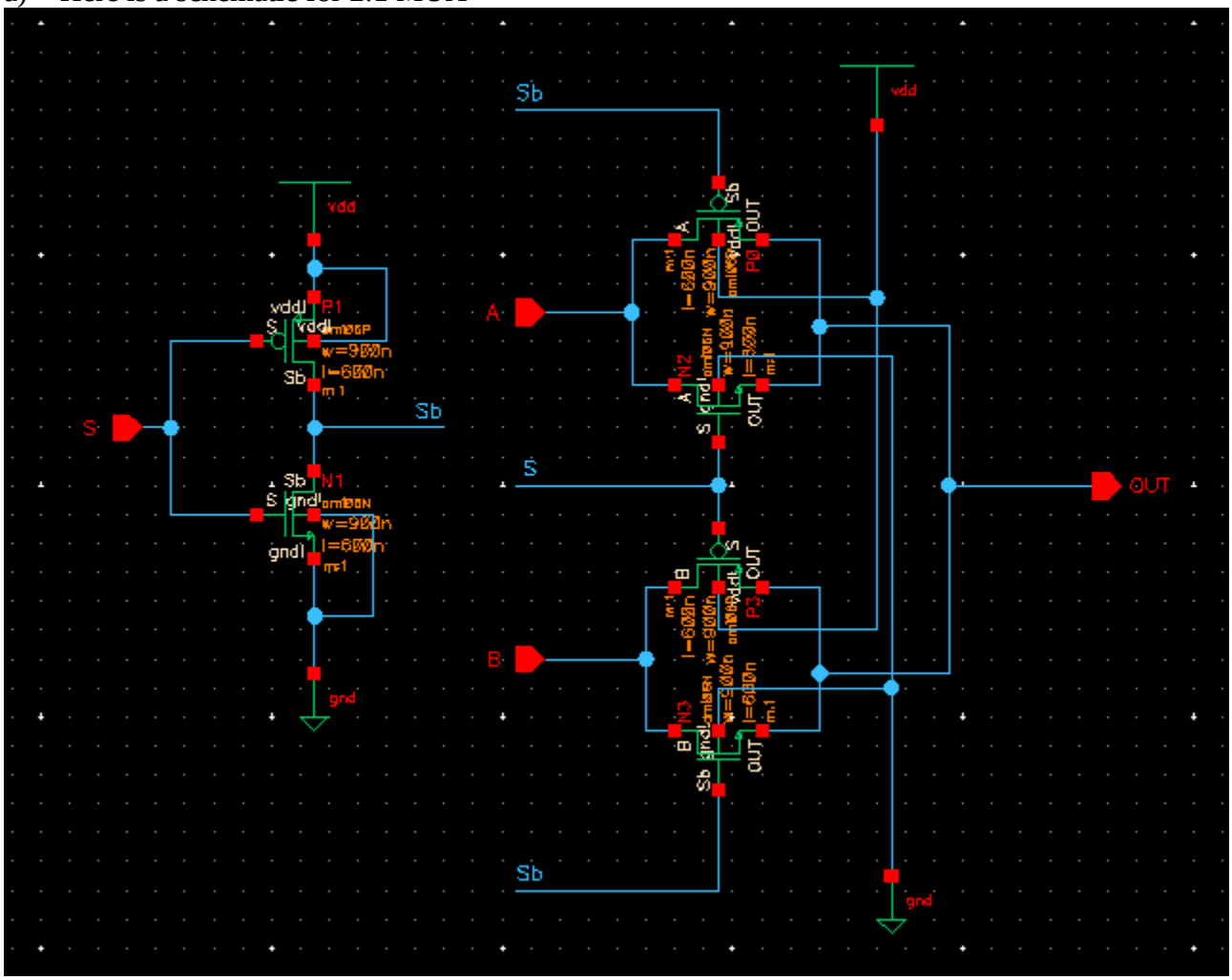
```
I36 (net9 net4) inv_homework2_extracted
V8 (net10 0) vsource type=pulse val0=0 val1=5 period=320u delay=0 rise=1p \
      fall=1p width=160u
V7 (net6 0) vsource type=pulse val0=0 val1=5 period=640u delay=0 rise=1p \
      fall=1p width=320u
V6 (net9 0) vsource type=pulse val0=0 val1=5 period=160u delay=0 rise=1p \
      fall=1p width=80u
V5 (net8 0) vsource type=pulse val0=0 val1=5 period=80u delay=0 rise=1p \
      fall=1p width=40u
V4 (net2 0) vsource type=pulse val0=0 val1=5 period=40u delay=0 rise=1p \
      fall=1p width=20u
V0 (net7 0) vsource type=pulse val0=0 val1=5 period=20u delay=0 rise=1p \
      fall=1p width=10u
ic out=0
simulatorOptions options psfversion="1.4.0" reltol=1e-3 vabstol=1e-6 \
    iabstol=1e-12 temp=27 tnom=27 scalem=1.0 scale=1.0 gmin=1e-12 rforce=1 \
    maxnotes=5 maxwarns=5 digits=5 cols=80 pivrel=1e-3 \
    sensfile="../psf/sens.output" checklimitdest=psf
tran tran stop=640u write="spectre.ic" writefinal="spectre.fc" \
    annotate=status maxiters=5
finalTimeOP info what=oppoint where=rawfile
modelParameter info what=models where=rawfile
element info what=inst where=rawfile
outputParameter info what=output where=rawfile
designParamVals info what=parameters where=rawfile
primitives info what=primitives where=rawfile
subckts info what=subckts where=rawfile
saveOptions options save=allpub
```

+ Here is the result of the extracted version. It shows that extracted version has the same result.

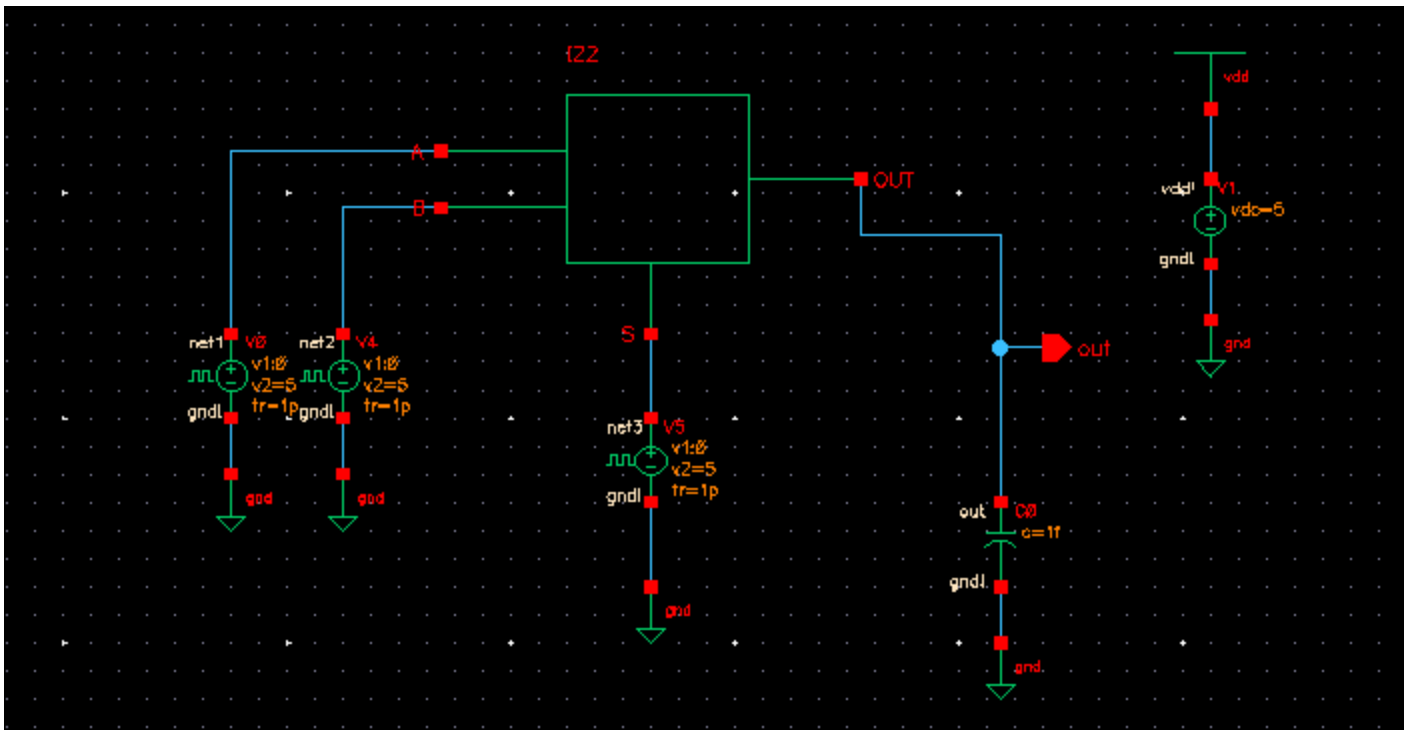


2.

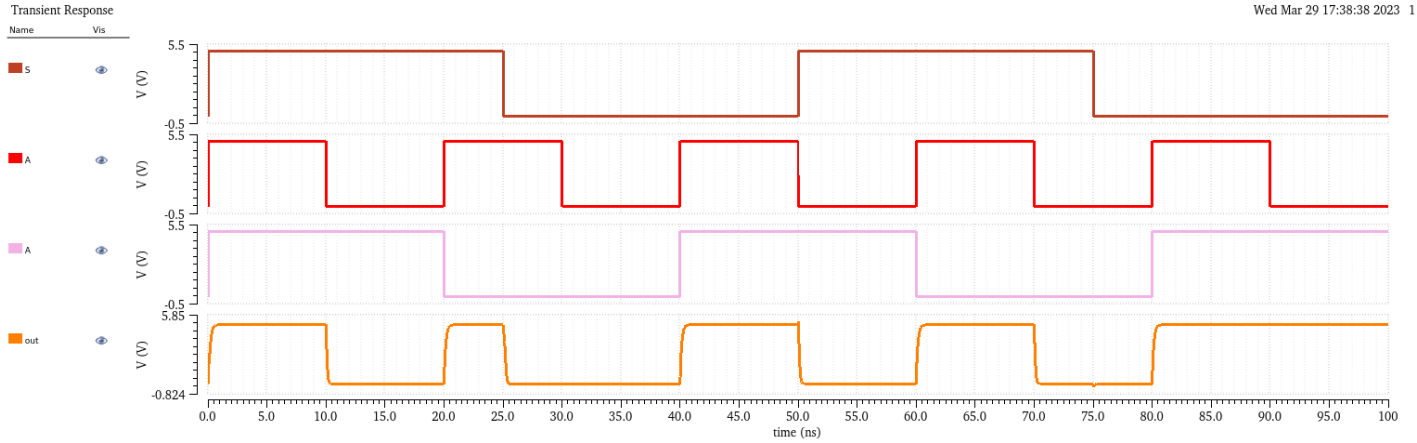
a) + Here is a schematic for 2:1 MUX



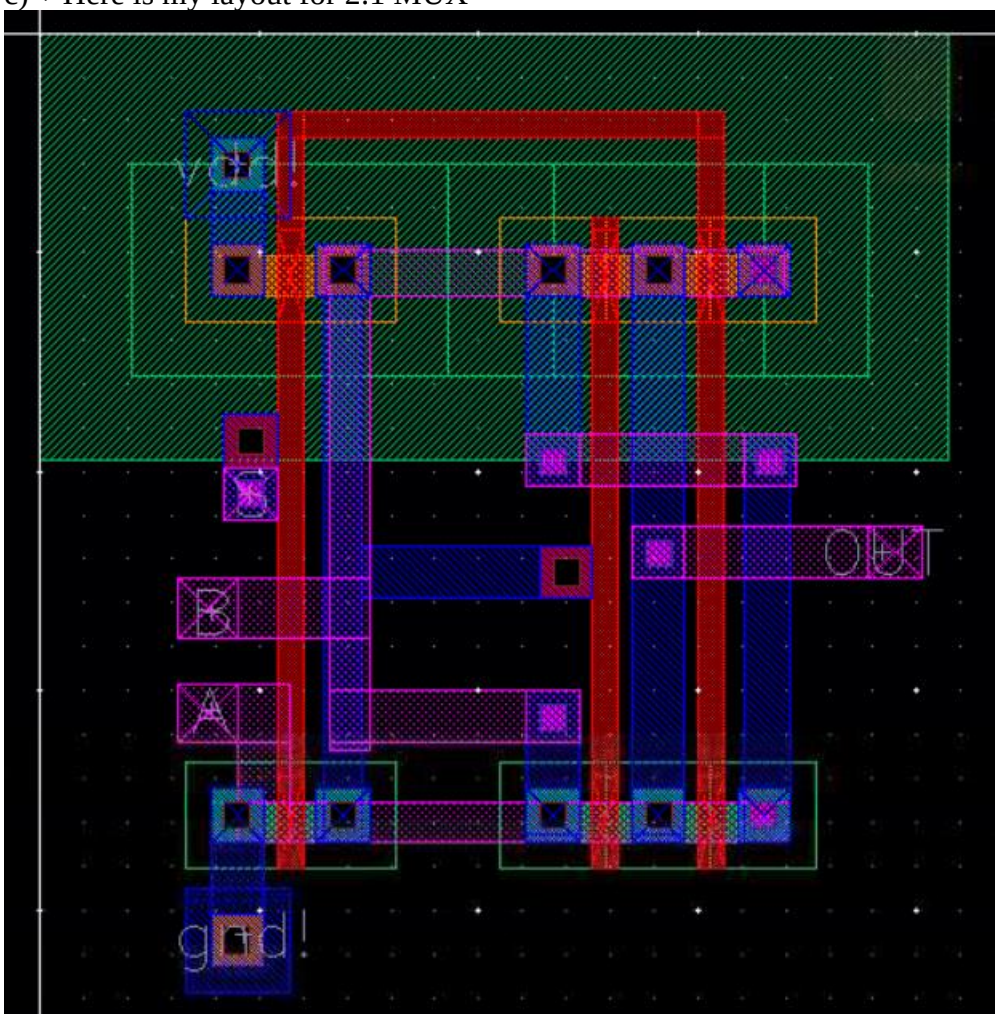
+ Here is a schematic for the TEST



b) + Here is the test result of the schematic.



c) + Here is my layout for 2:1 MUX



+ Here is DRC result.

DRC started at Fri Mar 31 10:07:15 2023

Validating hierarchy instantiation for:
library: cse463

```
cell:    inv_homework52_mul
view:    layout
Rules come from library NCSU_TechLib_ami06.
Rules path is divaDRC.rul.
Inclusion limit is set to 1000.
Running layout DRC analysis
Flat mode
Full checking.
executing: nodrc = geomOr("nodrc")
executing: gwell = geomOr(geomAndNot(("gwell" "drawing") nodrc))
executing: nwell = geomOr(geomAndNot(("nwell" "drawing") nodrc))
executing: pwell = geomOr(geomAndNot(("pwell" "drawing") nodrc))
executing: nactive = geomOr(geomAndNot(("nactive" "drawing") nodrc))
executing: pactive = geomOr(geomAndNot(("pactive" "drawing") nodrc))
executing: active = geomOr(geomAndNot(("active" "drawing") nodrc) nactive pactive)
executing: gselect = geomOr(geomAndNot(("gselect" "drawing") nodrc))
executing: nselect = geomOr(geomAndNot(("nselect" "drawing") nodrc))
executing: pselect = geomOr(geomAndNot(("pselect" "drawing") nodrc))
executing: poly = geomOr(geomAndNot(("poly" "drawing") nodrc))
executing: metal1 = geomOr(geomAndNot(("metal1" "drawing") nodrc))
executing: cc = geomOr(geomAndNot(("cc" "drawing") nodrc))
executing: metal2 = geomOr(geomAndNot(("metal2" "drawing") nodrc))
executing: via = geomOr(geomAndNot(("via" "drawing") nodrc))
executing: glass = geomOr(geomAndNot(("glass" "drawing") nodrc))
executing: pad = geomOr(geomAndNot(("pad" "drawing") nodrc))
executing: res_id = geomOr("res_id")
executing: metal3 = geomOr(geomAndNot(("metal3" "drawing") nodrc))
executing: via2 = geomOr(geomAndNot(("via2" "drawing") nodrc))
executing: highres = geomOr(geomAndNot(("highres" "drawing") nodrc))
executing: elec = geomOr(geomAndNot(("elec" "drawing") nodrc))
executing: ce = geomOr(geomOr(geomAndNot(("ce" "drawing") nodrc)) geomAnd(cc elec))
executing: cp = geomOr(geomOr(geomAndNot(("cp" "drawing") nodrc)) geomAnd(cc geomAndNot(poly ce)))
executing: ca = geomOr(geomOr(geomAndNot(("ca" "drawing") nodrc)) geomAnd(cc geomAndNot(active ...
executing: nActive = geomAnd(active nselect)
executing: pActive = geomAnd(active pselect)
executing: nBulk = geomOr(nwell)
executing: pBulk = geomOr(geomNot(nwell) geomAndNot(pwell nwell))
executing: nOhmic = geomAnd(nActive nwell)
        nNotOhmic = geomAndNot(nActive nwell)
executing: pOhmic = geomAndNot(pActive nwell)
        pNotOhmic = geomAnd(pActive nwell)
executing: nDiff = geomAndNot(nNotOhmic geomOr(poly elec))
executing: pDiff = geomAndNot(pNotOhmic geomOr(poly elec))
executing: nDiffContact = geomAnd(ca nDiff)
executing: pDiffContact = geomAnd(ca pDiff)
executing: nOhmicContact = geomAnd(ca nOhmic)
executing: pOhmicContact = geomAnd(ca pOhmic)
executing: Gate = geomAnd(geomOr(nNotOhmic pNotOhmic) poly)
executing: fieldPoly = geomAvoiding(poly Gate)
executing: elecGate = geomAnd(geomOr(nNotOhmic pNotOhmic) elec)
executing: fieldElec = geomAvoiding(elec elecGate)
executing: CapacitorElec = geomInside(elec poly)
executing: TransistorElec = geomOverlap(elec geomNot(poly))
executing: fieldPoly = geomAndNot(fieldPoly res_id)
executing: poly = geomAndNot(poly res_id)
executing: fieldElec = geomAndNot(fieldElec geomOr(res_id highres))
executing: elecRes = geomButting(geomAnd(res_id elec) fieldElec (keep == 2))
executing: elecHighres = geomButting(geomAnd(highres elec) fieldElec (keep == 2))
executing: elec = geomAndNot(elec geomOr(res_id highres))
executing: nBulk = geomAndNot(nBulk res_id)
executing: nwell = geomAndNot(nwell res_id)
executing: geomConnect((via nOhmicContact nOhmic nwell nBulk metal1) (via pOhmicContact pOhmic ...
executing: dubiousData(("gwell" "drawing") "Improperly formed shape - gwell")
executing: dubiousData(("nwell" "drawing") "Improperly formed shape - nwell")
executing: dubiousData(("pwell" "drawing") "Improperly formed shape - pwell")
executing: dubiousData(("active" "drawing") "Improperly formed shape - active, nactive or pacti...
executing: dubiousData(("gselect" "drawing") "Improperly formed shape - gselect")
executing: dubiousData(("nselect" "drawing") "Improperly formed shape - nselect")
executing: dubiousData(("pselect" "drawing") "Improperly formed shape - pselect")
```

```
executing: dubiousData(("poly" "drawing") "Improperly formed shape - poly")
executing: dubiousData(("metal1" "drawing") "Improperly formed shape - metal1")
executing: dubiousData(("ca" "drawing") "Improperly formed shape - ca")
executing: dubiousData(("cp" "drawing") "Improperly formed shape - cp")
executing: dubiousData(("metal2" "drawing") "Improperly formed shape - metal2")
executing: dubiousData(("via" "drawing") "Improperly formed shape - via")
executing: dubiousData(("glass" "drawing") "Improperly formed shape - glass")
executing: saveDerived(geomGetNon45(gwell) "Non-Manhattan shape - gwell")
executing: saveDerived(geomGetNon45(nwell) "Non-Manhattan shape - nwell")
executing: saveDerived(geomGetNon45(pwell) "Non-Manhattan shape - pwell")
executing: saveDerived(geomGetNon45(active) "Non-Manhattan shape - active, nactive or pactive")
executing: saveDerived(geomGetNon45(gselect) "Non-Manhattan shape - gselect")
executing: saveDerived(geomGetNon45(nselect) "Non-Manhattan shape - nselect")
executing: saveDerived(geomGetNon45(pselect) "Non-Manhattan shape - pselect")
executing: saveDerived(geomGetNon45(poly) "Non-Manhattan shape - poly")
executing: saveDerived(geomGetNon45(metal1) "Non-Manhattan shape - metal1")
executing: saveDerived(geomGetNon45(ca) "Non-Manhattan shape - ca")
executing: saveDerived(geomGetNon45(cp) "Non-Manhattan shape - cp")
executing: saveDerived(geomGetNon45(metal2) "Non-Manhattan shape - metal2")
executing: saveDerived(geomGetNon45(via) "Non-Manhattan shape - via")
executing: saveDerived(geomGetNon45(glass) "Non-Manhattan shape - glass")
executing: offGrid(gwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(nwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(pwell gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(active gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(gselect gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(nselect gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(pselect gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(poly gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(metal1 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(ca gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(cp gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(metal2 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(via gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(glass gridRes "(SCMOS Inst) Edge not on grid")
executing: dubiousData(("metal3" "drawing") "Improperly formed shape - metal3")
executing: dubiousData(("via2" "drawing") "Improperly formed shape - via2")
executing: saveDerived(geomGetNon45(metal3) "Non-Manhattan shape - metal3")
executing: saveDerived(geomGetNon45(via2) "Non-Manhattan shape - via2")
executing: offGrid(metal3 gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(via2 gridRes "(SCMOS Inst) Edge not on grid")
executing: dubiousData(("elec" "drawing") "Improperly formed shape - elec")
executing: dubiousData(("ce" "drawing") "Improperly formed shape - ce")
executing: saveDerived(geomGetNon45(elec) "Non-Manhattan shape - elec")
executing: saveDerived(geomGetNon45(ce) "Non-Manhattan shape - ce")
executing: offGrid(elec gridRes "(SCMOS Inst) Edge not on grid")
executing: offGrid(ce gridRes "(SCMOS Inst) Edge not on grid")
executing: nwellEdge = geomGetEdge(nwell)
executing: pwellEdge = geomGetEdge(pwell)
executing: activeEdge = geomGetEdge(active)
executing: nselectEdge = geomGetEdge(nselect)
executing: pselectEdge = geomGetEdge(pselect)
executing: polyEdge = geomGetEdge(poly)
executing: metal1Edge = geomGetEdge(metal1)
executing: caEdge = geomGetEdge(ca)
executing: cpEdge = geomGetEdge(cp)
executing: metal2Edge = geomGetEdge(metal2)
executing: viaEdge = geomGetEdge(via)
executing: glassEdge = geomGetEdge(glass)
executing: highresEdge = geomGetEdge(highres)
executing: ceEdge = geomGetEdge(ce)
executing: metal3Edge = geomGetEdge(metal3)
executing: via2Edge = geomGetEdge(via2)
executing: nBulkEdge = geomGetEdge(nBulk)
executing: pBulkEdge = geomGetEdge(pBulk)
executing: nOhmicEdge = geomGetEdge(nOhmic)
executing: pOhmicEdge = geomGetEdge(pOhmic)
executing: nNotOhmicEdge = geomGetEdge(nNotOhmic)
executing: pNotOhmicEdge = geomGetEdge(pNotOhmic)
```

```
executing: GateEdge = geomGetEdge(Gate)
executing: fieldPolyEdge = geomGetEdge(fieldPoly)
executing: CapacitorElecEdge = geomGetEdge(CapacitorElec)
executing: TransistorElecEdge = geomGetEdge(TransistorElec)
executing: elecHighresEdge = geomGetEdge(elecRes coincident elec)
executing: saveDerived(geomAndNot(active geomOr(nselect pselect)) "(DBM Rule 1.1) Active must b...
executing: saveDerived(geomAnd(poly nOhmic) "(DBM Rule 2.0) Poly cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(poly pOhmic) "(DBM Rule 2.0) Poly cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(elec nOhmic) "(DBM Rule 2.1) Elec cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(elec pOhmic) "(DBM Rule 2.1) Elec cannot overlap ohmic diffusion")
executing: saveDerived(geomAnd(pactive nselect) "(DBM Rule 3.1) Pactive and Nselect may not ove...
executing: saveDerived(geomAnd(nactive pselect) "(DBM Rule 3.2) Nactive and Pselect may not ove...
executing: saveDerived(geomAnd(active elec) "(DBM Rule 4.0, AMI 0.6um) Elec and active may not ...
executing: drc(nwellEdge (width < (lambda * 12.0)) errMesg)
        drc(nwellEdge (notch < (lambda * 6.0)) errMesg)
executing: drc(pwellEdge (width < (lambda * 12.0)) errMesg)
        drc(pwellEdge (notch < (lambda * 6.0)) errMesg)
executing: drc(nwell (sep < (lambda * 18.0)) diffNet errMesg)
        drc(nwell (sep < (lambda * 6.0)) sameNet errMesg)
executing: drc(pwell (sep < (lambda * 18.0)) diffNet errMesg)
        drc(pwell (sep < (lambda * 6.0)) sameNet errMesg)
executing: saveDerived(geomAnd(nwell pwell) "(SCMOS Rule 1 note) n-wells and p-wells may not ov...
executing: drc(activeEdge (width < (lambda * 3.0)) errMesg)
        drc(activeEdge (sep < (lambda * 3.0)) errMesg)
        drc(activeEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(nNotOhmicEdge nBulkEdge (sep < (lambda * 6.0)) errMesg)
executing: drc(pNotOhmicEdge pBulkEdge (sep < (lambda * 6.0)) errMesg)
executing: drc(pBulkEdge nNotOhmicEdge (enc < (lambda * 6.0)) errMesg)
executing: drc(nBulkEdge pNotOhmicEdge (enc < (lambda * 6.0)) errMesg)
executing: drc(nBulkEdge nOhmicEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(nOhmicEdge pBulkEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(pOhmicEdge nBulkEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(pBulkEdge pOhmicEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(nNotOhmicEdge pOhmicEdge ((0 < sep) < (lambda * 4.0)) errMesg)
executing: drc(pNotOhmicEdge nOhmicEdge ((0 < sep) < (lambda * 4.0)) errMesg)
executing: drc(polyEdge (width < (lambda * 2.0)) errMesg)
        drc(polyEdge (sep < (lambda * 3.0)) errMesg)
        drc(polyEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(polyEdge activeEdge (enc < (lambda * 2.0)) errMesg)
        drc(activeEdge polyEdge (enc < (lambda * 3.0)) errMesg)
        drc(polyEdge activeEdge (sep < (lambda * 1.0)) errMesg)
executing: drc(nselectEdge geomGetEdge(polyEdge inside pNotOhmic) (sep < (lambda * 3.0)) (app >...
executing: drc(nselectEdge geomGetEdge(polyEdge inside nNotOhmic) (enc < (lambda * 3.0)) (app >...
executing: drc(pselectEdge geomGetEdge(polyEdge inside nNotOhmic) (sep < (lambda * 3.0)) (app >...
executing: drc(pselectEdge geomGetEdge(polyEdge inside pNotOhmic) (enc < (lambda * 3.0)) (app >...
executing: drc(geomOr(nselectEdge pselectEdge) activeEdge (sep < (lambda * 2.0)) errMesg)
        drc(geomOr(nselectEdge pselectEdge) activeEdge (enc < (lambda * 2.0)) errMesg)
executing: drc(nselectEdge caEdge (sep < (lambda * 1.0)) errMesg)
        drc(nselectEdge caEdge (enc < (lambda * 1.0)) errMesg)
executing: drc(pselectEdge caEdge (sep < (lambda * 1.0)) errMesg)
        drc(pselectEdge caEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomButting(geomAnd(ca nselect) geomAnd(ca pselect)) errMesg)
executing: drc(nselectEdge (width < (lambda * 2.0)) errMesg)
        drc(nselectEdge (sep < (lambda * 2.0)) errMesg)
        drc(nselectEdge (notch < (lambda * 2.0)) errMesg)
executing: drc(pselectEdge (width < (lambda * 2.0)) errMesg)
        drc(pselectEdge (sep < (lambda * 2.0)) errMesg)
        drc(pselectEdge (notch < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(nselect pselect) errMesg)
executing: drc(cpEdge (width < (lambda * 2.0)) errMesg)
        drc(cpEdge (sep < (lambda * 3.0)) errMesg)
        drc(cpEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(cp (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(polyEdge cpEdge (enc < (lambda * 1.0)) errMesg)
        drc(cpEdge polyEdge (sep < (lambda * 5.0)) errMesg)
executing: saveDerived(geomAndNot(cp poly) errMesg)
executing: saveDerived(geomAndNot(cc geomOr(poly elec active)) errMesg)
executing: drc(cpEdge GateEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(cpEdge activeEdge (sep < (lambda * 2.0)) errMesg)
```

```
executing: saveDerived(geomAnd(cp active) errMesg)
executing: saveDerived(geomGetLength(drc(cpEdge activeEdge (sep < (lambda * 3.0))) (length > (l...
executing: drc(caEdge (width < (lambda * 2.0)) errMesg)
        drc(caEdge (sep < (lambda * 3.0)) errMesg)
        drc(caEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(ca (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(activeEdge caEdge (enc < (lambda * 1.0)) errMesg)
        drc(caEdge activeEdge (sep < (lambda * 5.0)) errMesg)
executing: saveDerived(geomAndNot(ca active) errMesg)
executing: drc(caEdge GateEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(ca Gate) errMesg)
executing: drc(caEdge fieldPolyEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(ca fieldPoly) errMesg)
executing: saveDerived(geomGetLength(drc(caEdge fieldPolyEdge (sep < (lambda * 3.0))) (length >...
executing: drc(caEdge cpEdge (sep < (lambda * 4.0)) errMesg)
executing: saveDerived(geomAnd(ca cp) errMesg)
executing: drc(metal1Edge (width < (lambda * 3.0)) errMesg)
        drc(metal1Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal1Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal1Edge cpEdge (enc < (lambda * 1.0)) errMesg)
executing: drc(metal1Edge caEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(cp metal1) errMesg)
executing: saveDerived(geomAndNot(ca metal1) errMesg)
executing: drc(viaEdge (width < (lambda * 2.0)) errMesg)
        drc(viaEdge (sep < (lambda * 3.0)) errMesg)
executing: drc(via (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1))))...
executing: drc(metal1Edge viaEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via metal1) errMesg)
executing: drc(metal2Edge (width < (lambda * 3.0)) errMesg)
        drc(metal2Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal2Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal2Edge viaEdge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via metal2) errMesg)
executing: BondingGlass = geomInside(glass pad)
        ProbeGlass = geomOutside(glass pad)
executing: saveDerived(geomStraddle(glass pad))
executing: BondingPad = geomAndNot(geomSize(BondingGlass 6.0) geomHoles(BondingGlass))
executing: ProbePad = geomAndNot(geomSize(ProbeGlass 6.0) geomHoles(ProbeGlass))
executing: Pad = geomOr(BondingPad ProbePad)
executing: BondingPadEdge = geomGetEdge(BondingPad not_over "nodrc")
executing: ProbePadEdge = geomGetEdge(ProbePad not_over "nodrc")
executing: PadEdge = geomGetEdge(Pad not_over "nodrc")
executing: Metal3EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal3" "glass" 36.0)) not_ov...
executing: Metal2EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal2" "glass" 36.0)) not_ov...
executing: Metal1EdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("metal1" "glass" 21.0)) not_ov...
executing: PolyEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("poly" "glass" 21.0)) not_over "...
executing: ActiveEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("active" "glass" 21.0)) not_ov...
executing: ElecEdgeNearPad = geomGetEdge(geomOr(geomGetByLayer("elec" "glass" 21.0)) not_over "...
executing: drc(BondingPadEdge (width < 60.0) "(SCMOS Rule 10.1) bonding pad width: 60 um")
executing: drc(ProbePadEdge (width < 20.0) "(SCMOS Rule 10.2) probe pad width: 20 um")
executing: drc(Metal3EdgeNearPad glassEdge (enc < 6.0) "(SCMOS Rule 10.3) pad enclosure of glas...
executing: saveDerived(geomAndNot(glass metal3) "(SCMOS Rule 10.3) pad enclosure of glass: 6 um")
executing: drc(PadEdge Metal3EdgeNearPad (sep < 30.0) "(SCMOS Rule 10.4) pad to unrelated metal...
executing: drc(PadEdge Metal2EdgeNearPad (sep < 30.0) "(SCMOS Rule 10.4) pad to unrelated metal...
executing: drc(PadEdge Metal1EdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated metal...
executing: drc(PadEdge PolyEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated poly sp...
executing: drc(PadEdge ActiveEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated activ...
executing: drc(PadEdge ElecEdgeNearPad (sep < 15.0) "(SCMOS Rule 10.5) pad to unrelated elec sp...
executing: drc(CapacitorElecEdge (width < (lambda * 7.0)) errMesg)
        drc(CapacitorElecEdge (sep < (lambda * 3.0)) errMesg)
        drc(CapacitorElecEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(polyEdge CapacitorElecEdge (enc < (lambda * 5.0)) errMesg)
executing: drc(CapacitorElecEdge nBulkEdge (sep < (lambda * 2.0)) errMesg)
        drc(nBulkEdge CapacitorElecEdge (enc < (lambda * 2.0)) errMesg)
executing: drc(CapacitorElecEdge pBulkEdge (sep < (lambda * 2.0)) errMesg)
        drc(pBulkEdge CapacitorElecEdge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomStraddle(CapacitorElec nBulk) errMesg)
executing: saveDerived(geomStraddle(CapacitorElec pBulk) errMesg)
executing: drc(CapacitorElecEdge activeEdge (sep < (lambda * 2.0)) errMesg)
```

```
executing: saveDerived(geomAnd(CapacitorElec active) errMesg)
executing: drc(CapacitorElecEdge cpEdge (sep < (lambda * 6.0)) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal3") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal3 elec diffNet) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal2") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal2 elec diffNet) errMesg)
executing: drc(geomGetEdge("elec") geomGetEdge("metal1") (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomOverlap(metal1 elec diffNet) errMesg)
executing: drc(TransistorElecEdge (width < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge (sep < (lambda * 3.0)) errMesg)
        drc(TransistorElecEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(TransistorElecEdge activeEdge (enc < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge activeEdge (sep < (lambda * 1.0)) errMesg)
executing: drc(TransistorElecEdge polyEdge (sep < (lambda * 2.0)) errMesg)
        drc(TransistorElecEdge polyEdge (ovlp < (lambda * 2.0)) errMesg)
executing: drc(TransistorElecEdge cpEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(TransistorElec cp) errMesg)
executing: drc(TransistorElecEdge caEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(TransistorElec ca) errMesg)
executing: drc(ceEdge (width < (lambda * 2.0)) errMesg)
        drc(ceEdge (sep < (lambda * 3.0)) errMesg)
        drc(ceEdge (notch < (lambda * 3.0)) errMesg)
executing: drc(ce (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))) ...
executing: drc(CapacitorElecEdge ceEdge (enc < (lambda * 3.0)) errMesg)
executing: drc(TransistorElecEdge ceEdge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAndNot(ce elec) "(SCMOS Rules 13.3,13.4) electrode enclosure of cont...
executing: drc(ceEdge polyEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomOutside(geomAnd(ce poly) CapacitorElec) errMesg)
executing: drc(ceEdge activeEdge (sep < (lambda * 3.0)) errMesg)
executing: saveDerived(geomAnd(ce active) errMesg)
executing: drc(via2Edge (width < (lambda * 2.0)) errMesg)
        drc(via2Edge (sep < (lambda * 3.0)) errMesg)
executing: drc(via2 (area > ((lambda * 2.0 * (lambda * 2.0)) + (lambda * 0.1 * (lambda * 0.1)))...
executing: drc(metal2Edge via2Edge (enc < (lambda * 1.0)) errMesg)
executing: saveDerived(geomAndNot(via2 metal2) errMesg)
executing: drc(metal3Edge (width < (lambda * 5.0)) errMesg)
        drc(metal3Edge (sep < (lambda * 3.0)) errMesg)
        drc(metal3Edge (notch < (lambda * 3.0)) errMesg)
executing: drc(metal3Edge via2Edge (enc < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAndNot(via2 metal3) errMesg)
executing: drc(highresEdge (width < (lambda * 4.0)) errMesg)
        drc(highresEdge (sep < (lambda * 4.0)) errMesg)
        drc(highresEdge (notch < (lambda * 4.0)) errMesg)
executing: drc(highresEdge caEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(highresEdge cpEdge (sep < (lambda * 2.0)) errMesg)
executing: saveDerived(geomAnd(highres ca) errMesg)
executing: saveDerived(geomAnd(highres cp) errMesg)
executing: drc(highresEdge activeEdge (sep < (lambda * 2.0)) errMesg)
executing: drc(highresEdge geomGetEdge(geomAndNot(elec geomButting(elec elecHighres))) (sep < (...
executing: saveDerived(geomButting(elecHighres geomAndNot(elec elecHighres) (ignore == 2)) errM...
executing: saveDerived(geomAnd(elecHighres nwell) "(SCMOS Rule 27.6) resistor must be outside w...
executing: saveDerived(geomAnd(elecHighres active) "(SCMOS Rule 27.6) resistor must be outside ...
executing: drc(elecHighresEdge (width < (lambda * 5.0)) errMesg)
        drc(elecHighresEdge (sep < (lambda * 7.0)) errMesg)
        drc(elecHighresEdge (notch < (lambda * 7.0)) errMesg)
executing: drc(highresEdge elecHighresEdge (enc < (lambda * 2.0)) errMesg)
DRC started.......Fri Mar 31 10:07:15 2023
   completed ....Fri Mar 31 10:07:15 2023
   CPU TIME = 00:00:00  TOTAL TIME = 00:00:00
**********   Summary of rule violations for cell "inv_homework52_mul layout"   **********
  Total errors found: 0
```

+ Here is LVS result.

```
@(#)$CDS: LVS version 6.1.8-64b 08/09/2022 19:10 (sjfhw317) $
```

Command line: /project/engineering/cadence21/IC618/tools.lnx86/dfII/bin/64bit/LVS -dir /home/warehouse/b.gwak/cadence/LVS -l -s -t /home/warehouse/b.gwak/cadence/LVS/layout /home/warehouse/b.gwak/cadence/LVS/schematic
Like matching is enabled.
Net swapping is enabled.
Using terminal names as correspondence points.

Net-list summary for /home/warehouse/b.gwak/cadence/LVS/layout/netlist

count	
7	nets
6	terminals
3	pmos
3	nmos

Net-list summary for /home/warehouse/b.gwak/cadence/LVS/schematic/netlist

count	
7	nets
6	terminals
3	pmos
3	nmos

Terminal correspondence points

N5	N7	A
N4	N4	B
N3	N3	OUT
N2	N5	S
N1	N0	gnd!
N6	N1	vdd!

Devices in the netlist but not in the rules:
pcapacitor
Devices in the rules but not in the netlist:
cap nfet pfet nmos4 pmos4

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	6	6
total	6	6
	nets	
un-matched	0	0
merged	0	0
pruned	0	0
active	7	7
total	7	7
	terminals	
un-matched	0	0
matched but different type	0	0
total	6	6

Probe files from /home/warehouse/b.gwak/cadence/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /home/warehouse/b.gwak/cadence/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

d) + Here is a proof that I tested on an extracted version.

```
// Generated for: spectre
// Generated on: Mar 31 09:58:23 2023
// Design library name: cse463
// Design cell name: inv_homework52_test
// Design view name: schematic
simulator lang=spectre
global 0 vdd!
include "/project/linuxlab/cadence/CDK/ncsu/models/spectre/nom/ami06N.m"
include "/project/linuxlab/cadence/CDK/ncsu/models/spectre/nom/ami06P.m"

// Library name: cse463
// Cell name: inv_homework52_mul
// View name: extracted
// View type: maskLayout
subckt inv_homework52_mul_extracted A B OUT S
    \+5 (B S OUT vdd!) ami06P w=9e-07 l=6e-07 as=9.9e-13 ad=1.71e-12 \
        ps=2.1e-06 pd=4.5e-06 m=1 region=sat
    \+4 (OUT 7 A vdd!) ami06P w=9e-07 l=6e-07 as=1.71e-12 ad=9.9e-13 \
        ps=4.5e-06 pd=2.1e-06 m=1 region=sat
    \+3 (7 S vdd! vdd!) ami06P w=9e-07 l=6e-07 as=1.71e-12 ad=1.71e-12 \
        ps=4.5e-06 pd=4.5e-06 m=1 region=sat
    \+30 (0 7) capacitor c=6.0264e-16 m=1
    \+29 (S 0) capacitor c=9.5418e-16 m=1
    \+28 (vdd! 7) capacitor c=2.5947e-16 m=1
    \+27 (vdd! S) capacitor c=1.40616e-15 m=1
    \+26 (0 7) capacitor c=2.17356e-15 m=1
    \+25 (S 0) capacitor c=3.2904e-16 m=1
    \+24 (OUT 0) capacitor c=1.5714e-15 m=1
    \+23 (B 0) capacitor c=5.361e-16 m=1
    \+22 (A 0) capacitor c=1.84881e-15 m=1
    \+21 (vdd! 7) capacitor c=7.683e-16 m=1
    \+20 (vdd! OUT) capacitor c=8.319e-16 m=1
    \+19 (vdd! A) capacitor c=1.13502e-15 m=1
    \+18 (OUT 0) capacitor c=5.295e-16 m=1
    \+17 (OUT S) capacitor c=1.8504e-16 m=1
    \+16 (B 7) capacitor c=1.91138e-15 m=1
    \+15 (B 0) capacitor c=1.10677e-15 m=1
    \+14 (B S) capacitor c=3.7008e-16 m=1
    \+13 (B OUT) capacitor c=3.0942e-16 m=1
    \+12 (A 7) capacitor c=6.1713e-16 m=1
    \+11 (A 0) capacitor c=1.19894e-15 m=1
    \+10 (A S) capacitor c=7.6242e-16 m=1
    \+9 (A OUT) capacitor c=8.991e-16 m=1
    \+8 (A B) capacitor c=5.8134e-16 m=1
    \+7 (vdd! B) capacitor c=7.09973e-16 m=1
    \+6 (vdd! A) capacitor c=1.5201e-16 m=1
    \+2 (A S OUT 0) ami06N w=9e-07 l=6e-07 as=9.9e-13 ad=1.71e-12 \
```

```
        ps=2.1e-06 pd=4.5e-06 m=1 region=sat
    \+1 (OUT 7 B 0) ami06N w=9e-07 l=6e-07 as=1.71e-12 ad=9.9e-13 \
        ps=4.5e-06 pd=2.1e-06 m=1 region=sat
    \+0 (7 S 0 0) ami06N w=9e-07 l=6e-07 as=1.71e-12 ad=1.71e-12 \
        ps=4.5e-06 pd=4.5e-06 m=1 region=sat
ends inv_homework52_mul_extracted
// End of subcircuit definition.

// Library name: cse463
// Cell name: inv_homework52_test
// View name: schematic
I22 (net1 net2 out net3) inv_homework52_mul_extracted
V1 (vdd! 0) vsource type=dc dc=5
C0 (out 0) capacitor c=1f m=1
V5 (net3 0) vsource type=pulse val0=0 val1=5 period=50n delay=0 rise=1p \
        fall=1p width=25n
V4 (net2 0) vsource type=pulse val0=0 val1=5 period=40n delay=0 rise=1p \
        fall=1p width=20n
V0 (net1 0) vsource type=pulse val0=0 val1=5 period=20n delay=0 rise=1p \
        fall=1p width=10n
simulatorOptions options psfversion="1.4.0" reltol=1e-3 vabstol=1e-6 \
    iabstol=1e-12 temp=27 tnom=27 scalem=1.0 scale=1.0 gmin=1e-12 rforce=1 \
    maxnotes=5 maxwarns=5 digits=5 cols=80 pivrel=1e-3 \
    sensfile="../psf/sens.output" checklimitdest=psf
tran tran stop=100n write="spectre.ic" writefinal="spectre.fc" \
    annotate=status maxiters=5
finalTimeOP info what=oppoint where=rawfile
modelParameter info what=models where=rawfile
element info what=inst where=rawfile
outputParameter info what=output where=rawfile
designParamVals info what=parameters where=rawfile
primitives info what=primitives where=rawfile
subckts info what=subckts where=rawfile
saveOptions options save=allpub
```

+ Here is an extracted test result. It has the same result with schematic version.