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# CP

조교 조성근

# 개요

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- Constant Gm Bias 회로
- DC Operating Point 보는 법
- CP
- DC Sweep

# Constant Gm Bias 회로

$$I_{REF} = \frac{1}{2} \mu_n C_{ox} \left( \frac{W}{L} \right)_{12} (V_{GS12} - V_t)^2$$

$$I_{REF} = \frac{1}{2} \mu_n C_{ox} \left( \frac{W}{L} \right)_{13} (V_{GS13} - V_t)^2$$

Loop:  $V_{GS13} = V_{GS12} + I_{REF} R_B$

$$\sqrt{\frac{2I_{REF}}{\mu_n C_{ox} \left( \frac{W}{L} \right)_{13}}} = \sqrt{\frac{2I_{REF}}{\mu_n C_{ox} \left( \frac{W}{L} \right)_{12}}} + I_{REF} R_B$$

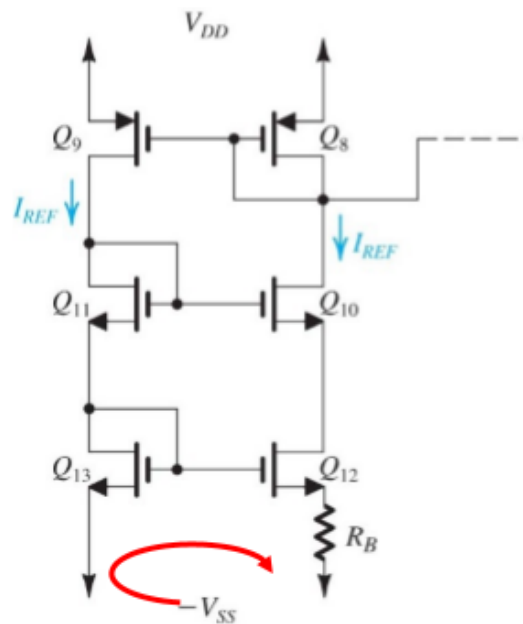
$$R_B = \frac{2}{g_m} \left( \sqrt{\frac{(W/L)_{12}}{(W/L)_{13}}} - 1 \right)$$

$$\therefore g_{m12} = \frac{2}{R_B} \left( \sqrt{\frac{(W/L)_{12}}{(W/L)_{13}}} - 1 \right)$$

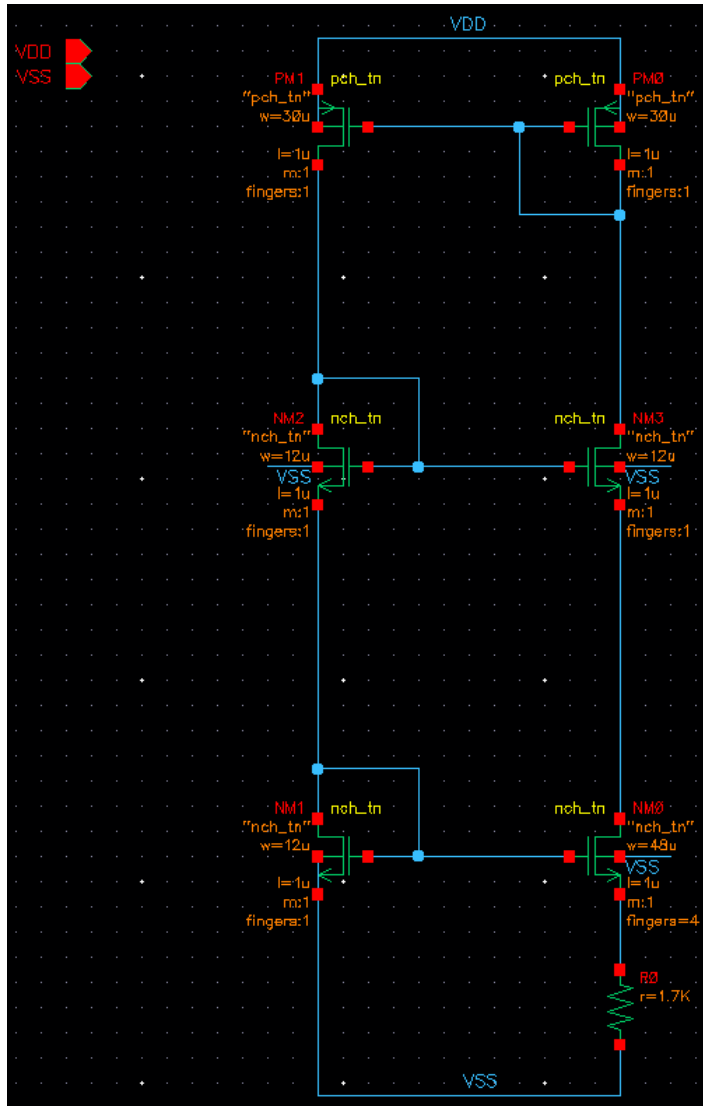
$$I_{REF} = \frac{2}{R_B^2 \left[ \mu_n C_{ox} \left( \frac{W}{L} \right)_{12} \right]} (1 - \sqrt{1/K})^2$$

만약  $\frac{(W/L)_{12}}{(W/L)_{13}} = K = 4 \Rightarrow g_{m12} = 2/R_B$

$K=4, I_{REF} = 20\mu A \rightarrow R \sim 6K\Omega$

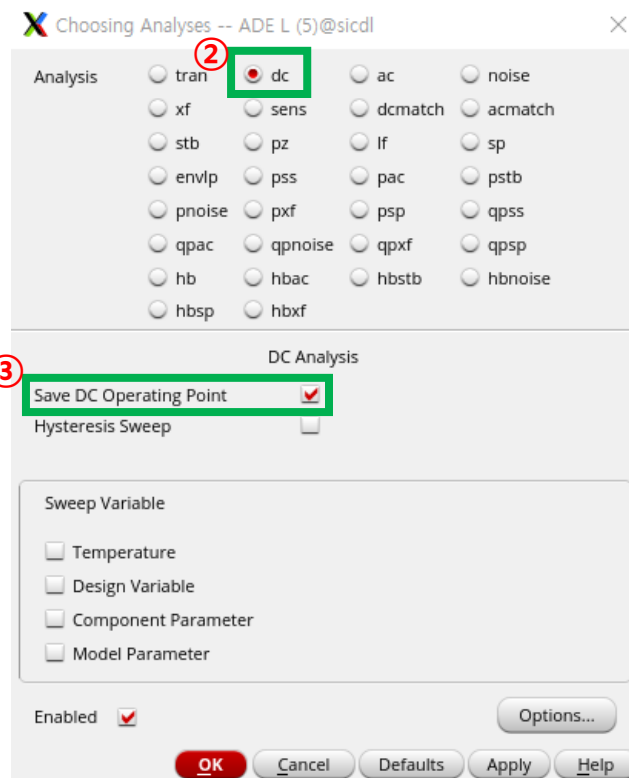
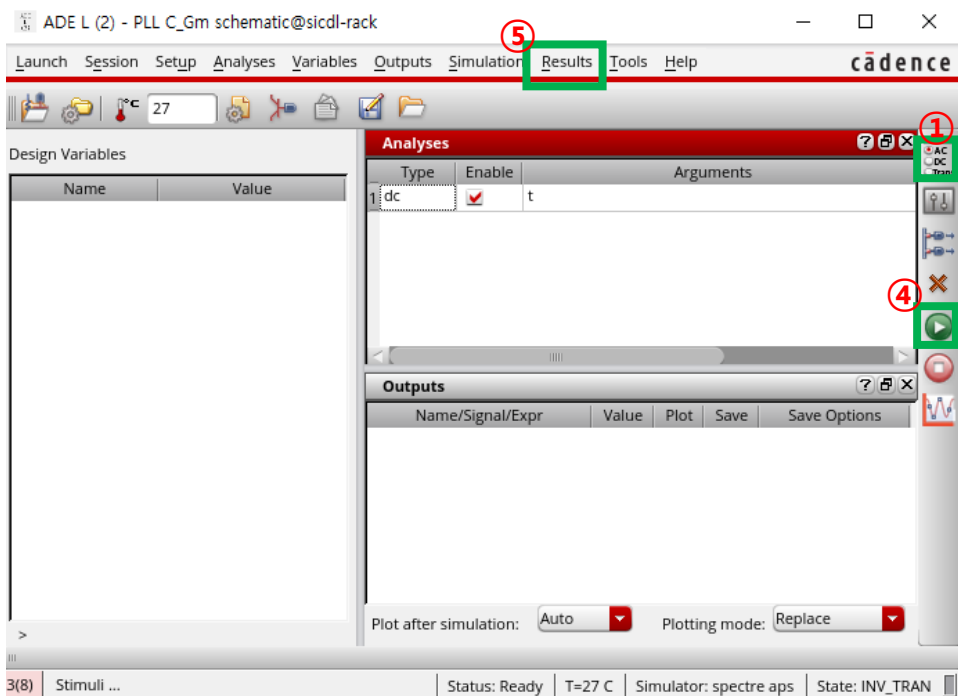


# Constant Gm Bias 회로

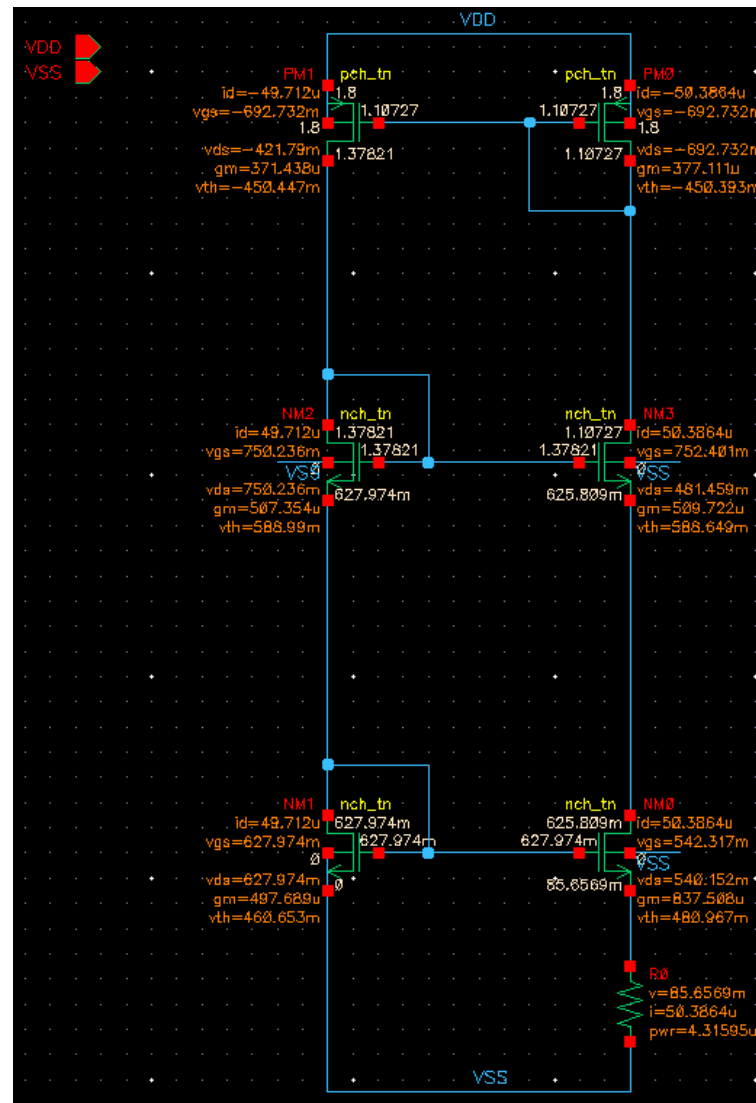


- 전류 size =  $50\mu A$

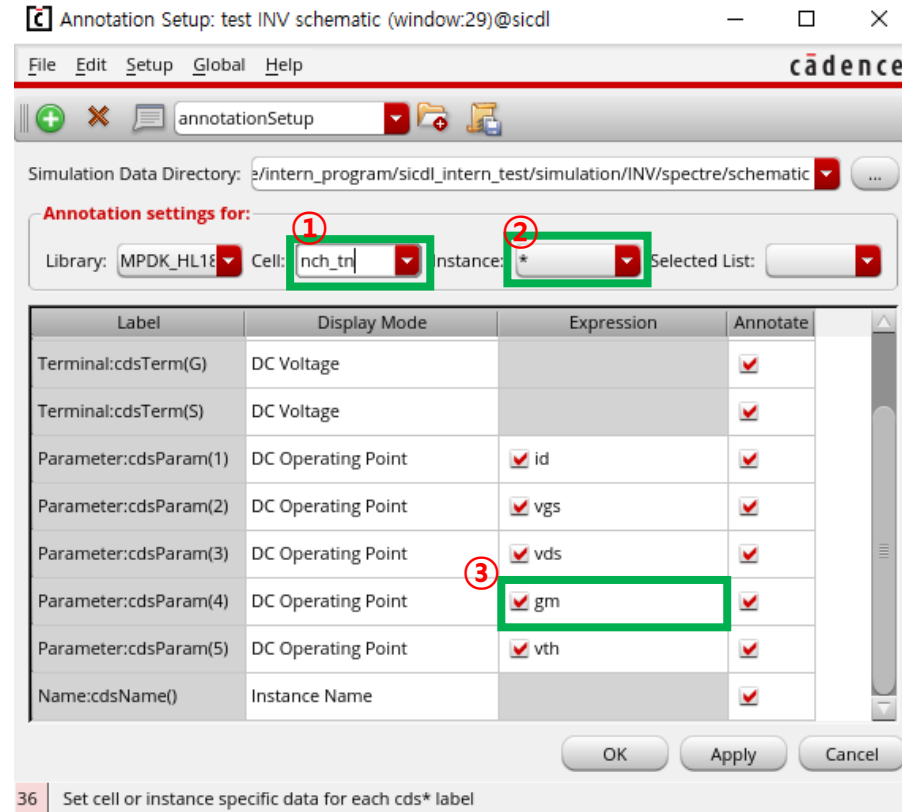
# DC Operating Points 보는 법



- ⑤ Results -> Annotate -> DC Operating Points



# DC Operating Points 보는 법(Region)



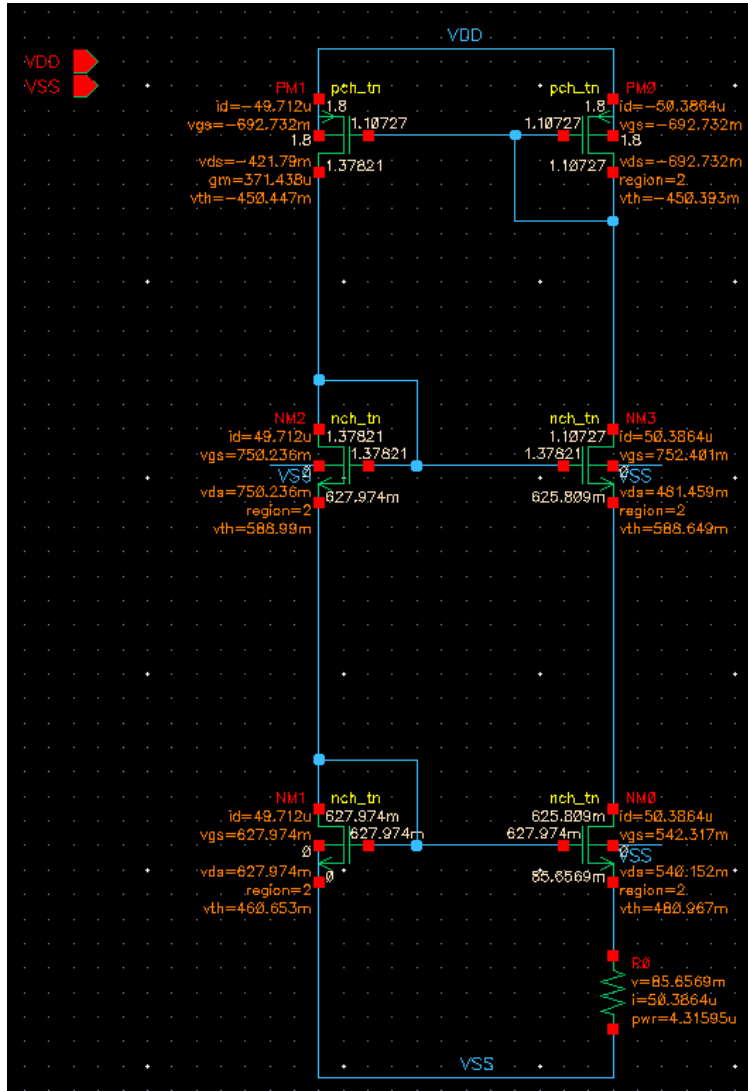
① pch\_tn 혹은 nch\_tn 선택

② \* 선택  
-> 모든 소자 선택 의미

③ region 선택

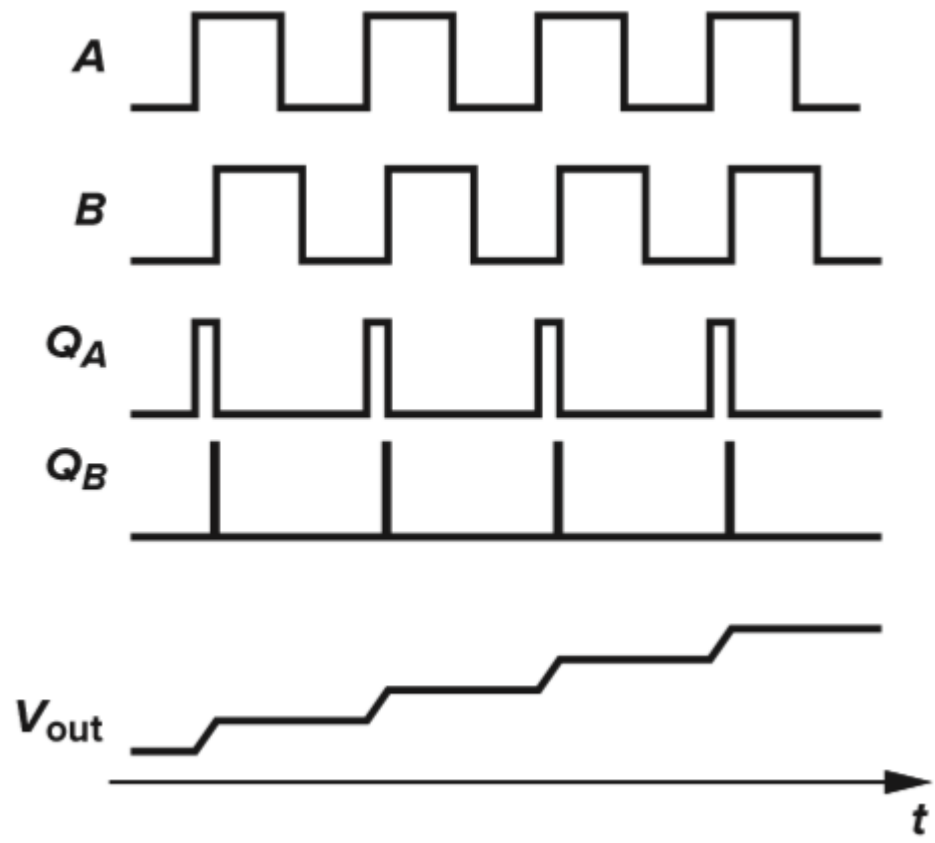
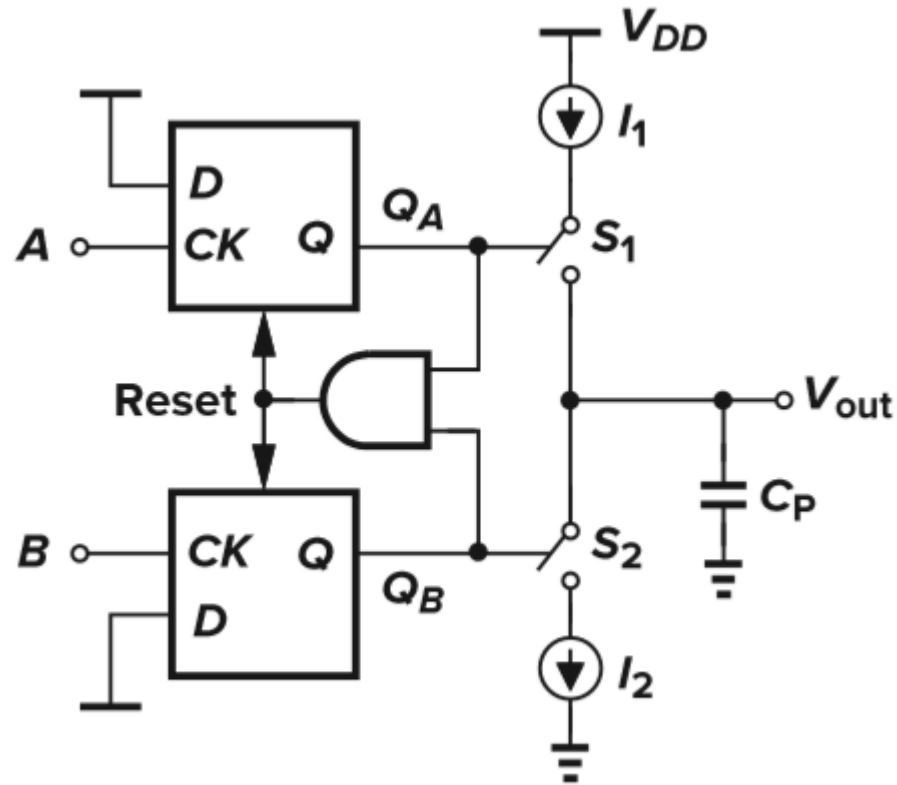
- DC Operating Points 띄워 놓은 상태에서 소자에 우클릭
- Annotations -> Setup

# DC Operating Points 보는 법 (Region)



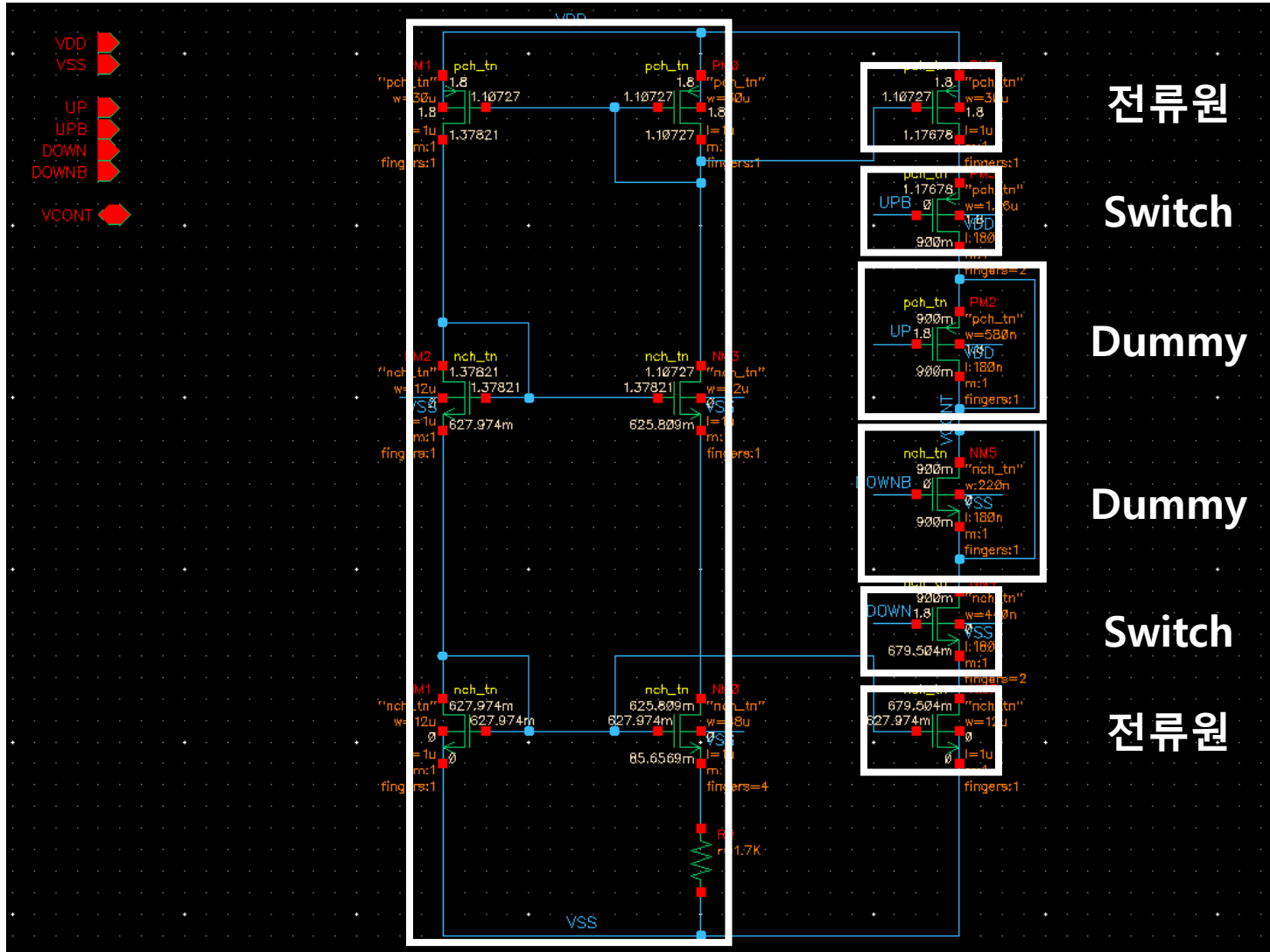
- 0 : Cut-off
- 1 : Linear
- 2 : Saturation
- 3 : Subthreshold

# CP





# CP 설계



**전류원**

# Switch

# Dummy

# Dummy

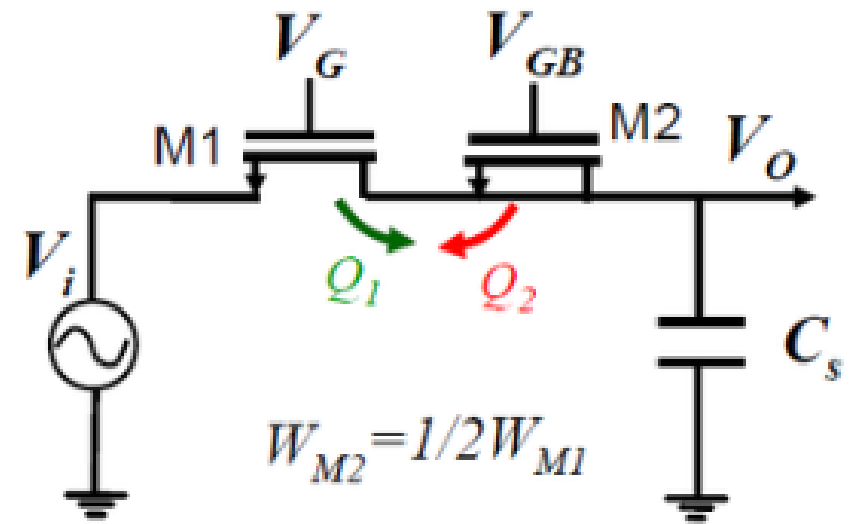
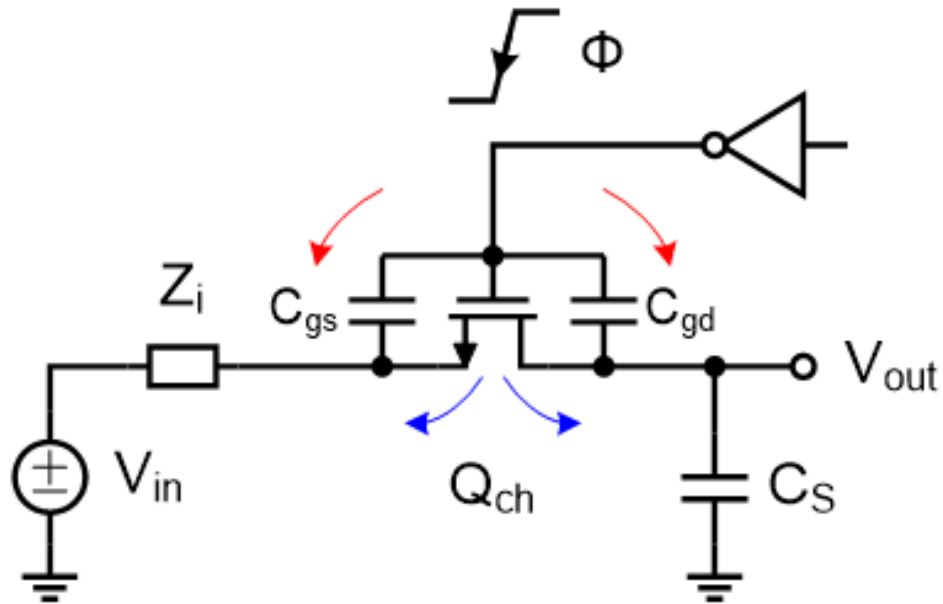
# Switch

**전류원**

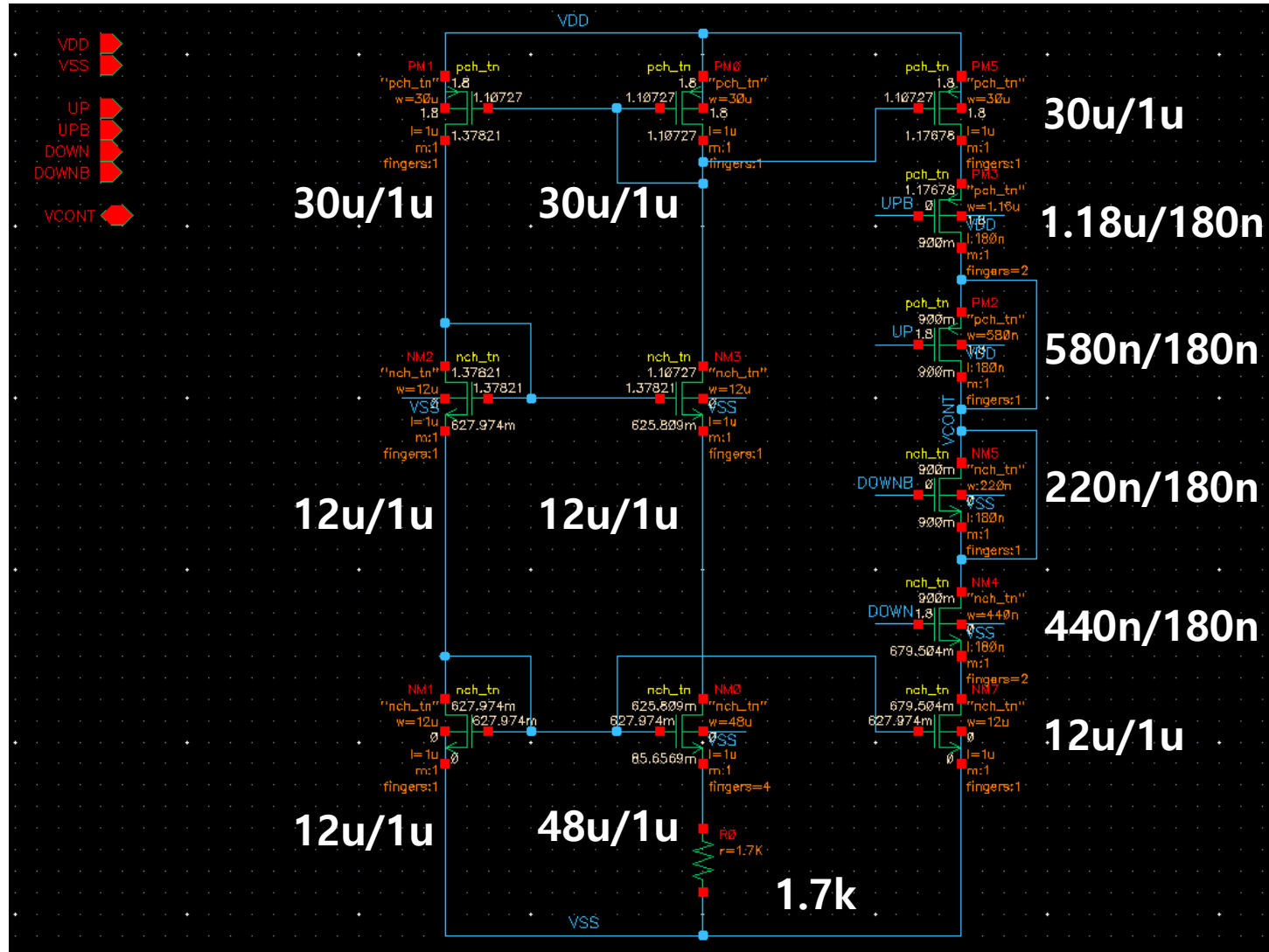
- 전류 size
  - 50  $\mu$ A

# CP 설계

- Clock Feed-through & Charge Injection
  - Clock 속도 느리게
  - Size 작게
  - Dummy switch



# CP 설계



- 전류 size  
- 50  $\mu\text{A}$

# DC sweep

Setup Analog Stimuli@sicdl-rack

Stimulus Type ☒ Inputs ☐ Global Sources

ON VSS /gnd! Voltage dc "DC voltage"=0  
ON VDD /gnd! Voltage dc "DC voltage"=1.8  
ON VCONT /gnd! Voltage dc "DC voltage"=X  
ON DOWNB /gnd! Voltage dc "DC voltage"=0  
ON DOWN /gnd! Voltage dc "DC voltage"=1.8  
ON UPB /gnd! Voltage dc "DC voltage"=0  
ON UP /gnd! Voltage dc "DC voltage"=1.8

Enabled ☒ Function dc Type Voltage

DC voltage 0  
AC magnitude  
AC phase  
XF magnitude  
PAC magnitude  
PAC phase  
Temperature coefficient 1  
Temperature coefficient 2  
Nominal temperature  
Source type dc  
Noise file name  
Number of noise/freq pairs 0  
Freq 1  
Noise 1

OK Cancel Apply Change Help

Choosing Analyses -- ADE L (3)@sicdl-rack

Analysis ☐ tran ☒ dc ☐ ac ☐ noise  
☐ xf ☐ sens ☐ dcmatch ☐ acmatch  
☐ stb ☐ pz ☐ lf ☐ sp  
☐ envlp ☐ pss ☐ pac ☐ pstb  
☐ pnoise ☐ pxf ☐ psp ☐ qpss  
☐ qpac ☐ qpnoise ☐ qpxf ☐ qpss  
☐ hb ☐ hbac ☐ hbstb ☐ hbnoise  
☐ hbsp ☐ hbx

DC Analysis

Save DC Operating Point ☒  
Hysteresis Sweep ☐

Sweep Variable  
☐ Temperature  
☒ Design Variable Variable Name X  
☐ Component Parameter Select Design Variable  
☐ Model Parameter

Sweep Range  
☒ Start-Stop Start 0 Stop 1.8  
☐ Center-Span

Sweep Type  
Automatic

Add Specific Points ☐  
Add Points By File ☐

Enabled ☒ Options...

OK Cancel Defaults Apply Help

ADE L (3) - PLL CP\_3 schematic@sicdl-rack

Launch Session Setup Analyses Variables Outputs Simulation Results Tools Help

Design Variables

Name	Value
1 X	900m

Analyses

Type	Enable	Arguments
1 dc	<input checked="" type="checkbox"/>	t 0 1.8 Automatic Start-Stop

Outputs

Name/Signal/Expr	Value	Plot	Save	Save Options
1 PM3/S		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	yes
2 NM4/D		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	yes

Plot after simulation: Auto Plotting mode: Replace

> Results in ...ern\_program/sicdl\_ms\_02/simulat

4(12) Choose Analyses ... Status: Ready T=27 C Simulator: spectre aps State: CP

# DC sweep

