

# Lab 5

# Gilbert Multiplier

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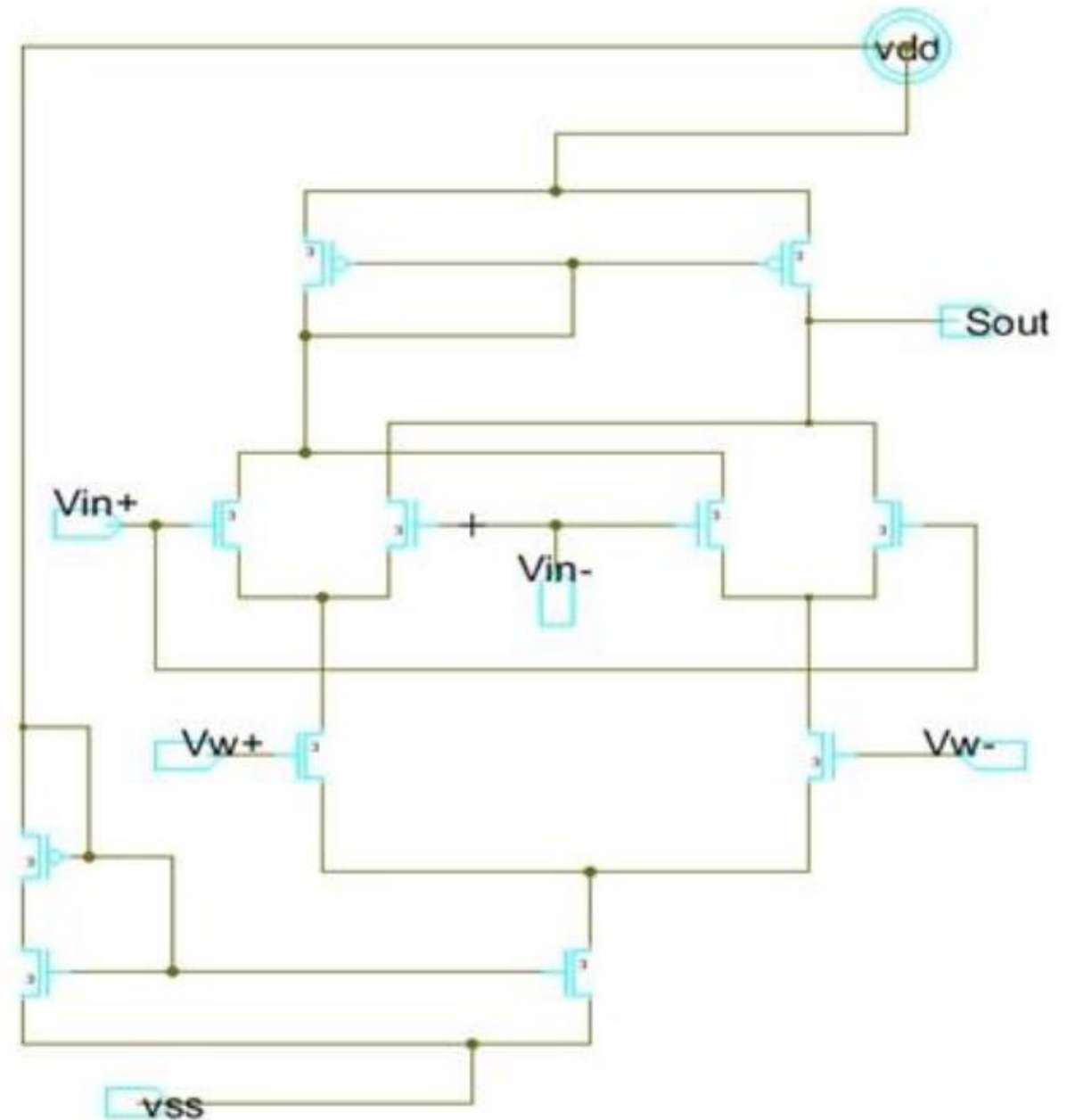
## Analog Gilbert Multiplier

The synapse is an important element in artificial neural networks. The basic role of a synapse element is to multiply the input signals with stored weight values and later adapt those values through some learning algorithm.

$$I_o = \sqrt{2K_a K_b} V_{in} V_w$$

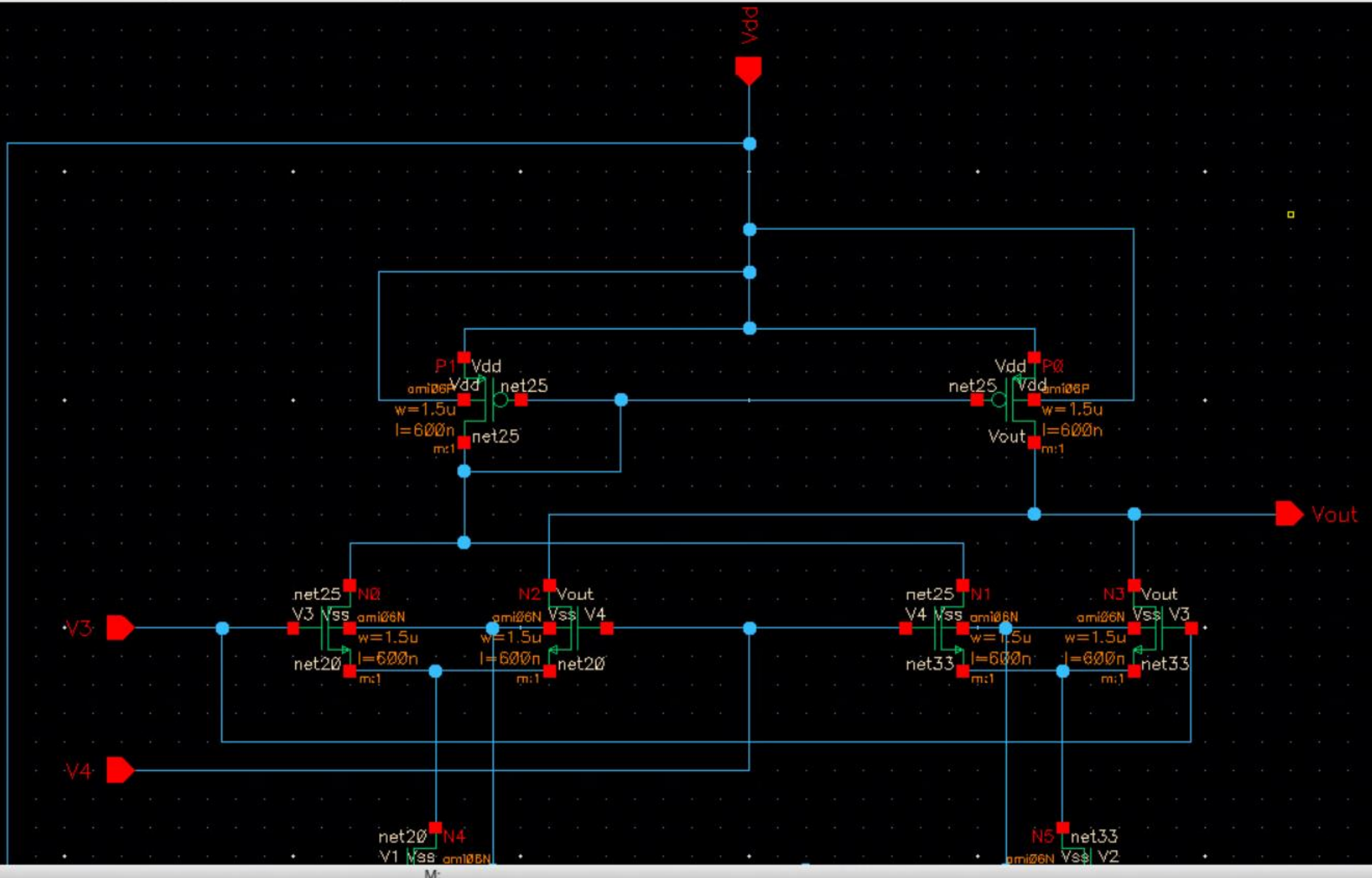
Where  $K_a$  and  $K_b$  are the transconductance of the PMOS and NMOS.

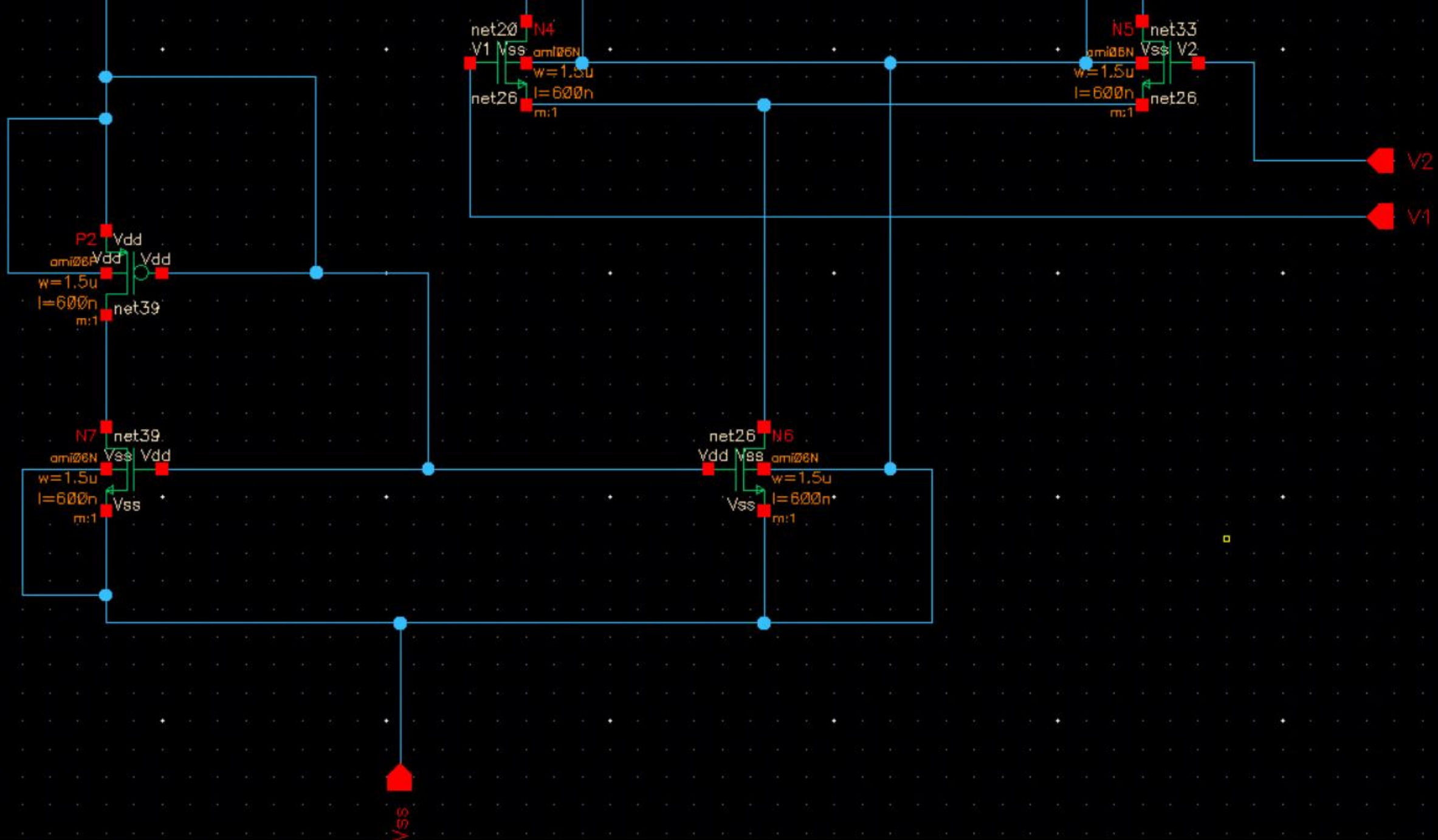
For most of the analog multipliers such as Gilbert multiplier or VGA(Variable gain amplifier-based) multiplier, the output should be current.



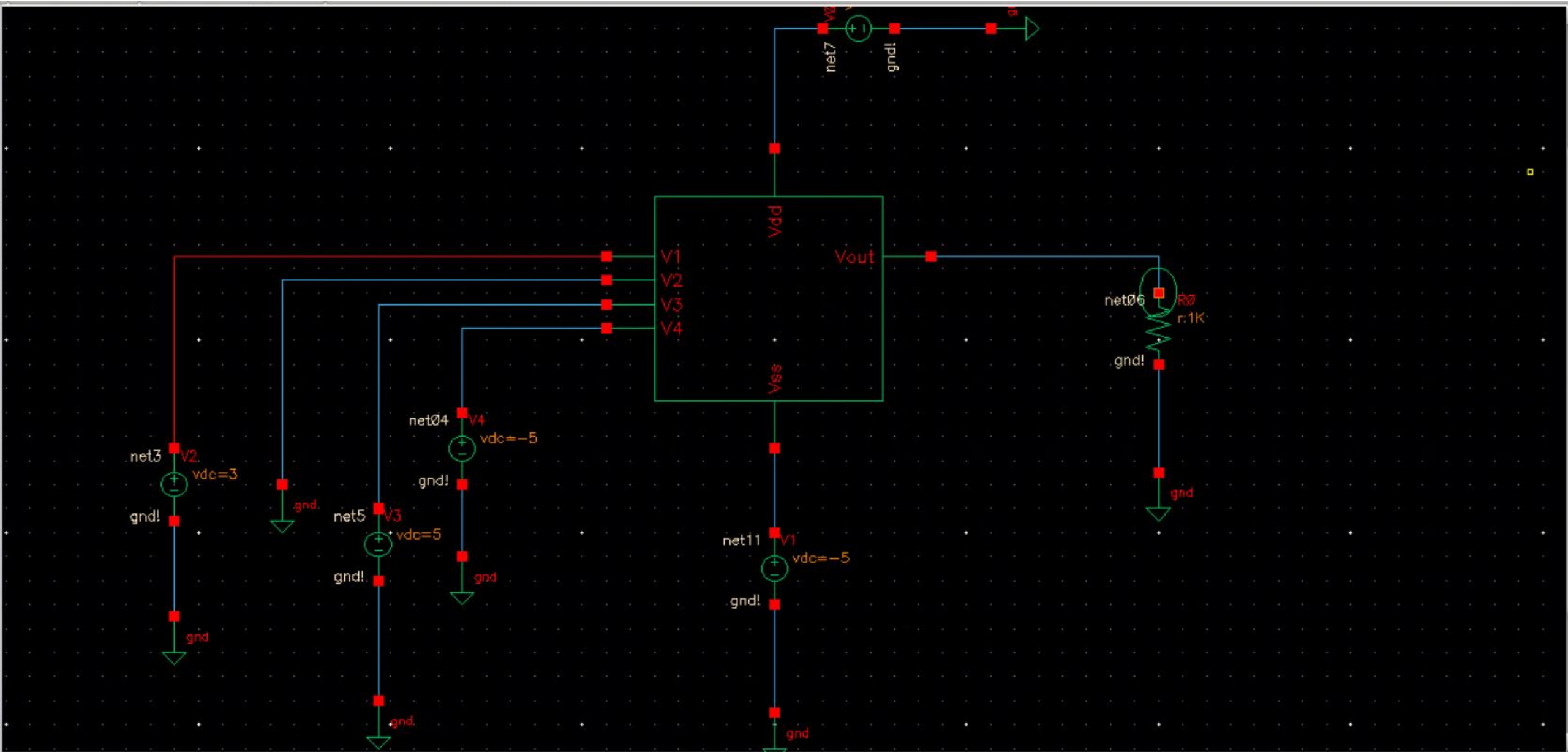
(a)

Patki, Mayuresh Premanand. "A Low Power and Area Efficient CMOS Implementation of Multilayer Feedforward Artificial Neural Network." (2017).





Save as symbol and create a Testbench



# Choosing Analyses -- ADE L (6)



Sweep V1

The output should be the current

Analysis

<input type="radio"/> tran	<input checked="" type="radio"/> dc	<input type="radio"/> ac	<input type="radio"/> noise
<input type="radio"/> xf	<input type="radio"/> sens	<input type="radio"/> dcmatch	<input type="radio"/> acmatch
<input type="radio"/> stb	<input type="radio"/> pz	<input type="radio"/> lf	<input type="radio"/> sp
<input type="radio"/> envlp	<input type="radio"/> pss	<input type="radio"/> pac	<input type="radio"/> pstb
<input type="radio"/> pnoise	<input type="radio"/> pxf	<input type="radio"/> psp	<input type="radio"/> qpss
<input type="radio"/> qpac	<input type="radio"/> qpnoise	<input type="radio"/> qpxf	<input type="radio"/> qpsp
<input type="radio"/> hb	<input type="radio"/> hbac	<input type="radio"/> hbstb	<input type="radio"/> hbnoise
<input type="radio"/> hbsp	<input type="radio"/> hbxf		

## DC Analysis

Save DC Operating Point ☒  
Hysteresis Sweep ☐

## Sweep Variable

- ☐ Temperature  
☐ Design Variable  
☒ Component Parameter  
☐ Model Parameter

Component Name

/V

Select Component

Parameter Name

dc

## Sweep Range

- ☒ Start-Stop  
☐ Center-Span

Start

0

Stop

1

## Sweep Type

Automatic

Add Specific Points ☐

Enabled ☒

Options...

# ADE L (6) - ECE6217\_lab Gilbert\_Cell\_2\_TB schematic



Session Setup Analyses Variables Outputs Simulation Results Tools Help

cadence

27

## Design Variables

Name	Value
1 p5vonly	0

## Analyses

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

## Outputs

Name/Signal/Expr	Value	Plot	Save	Save Options
1 net3		<input checked="" type="checkbox"/>	<input type="checkbox"/>	allv
2 R0/PLUS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	yes

Plot after simulation:

Auto

Plotting mode:

Replace

> Results in ...57/cadence/simulation/Gilbert\_Ce

20(37)

Choose Analyses ...

Status: Ready

T=27 C

Simulator: spectre



Note that:  
Gilbert Multiplier only  
works for small input  
voltage(0-1V in our case).

