

AIC HW2



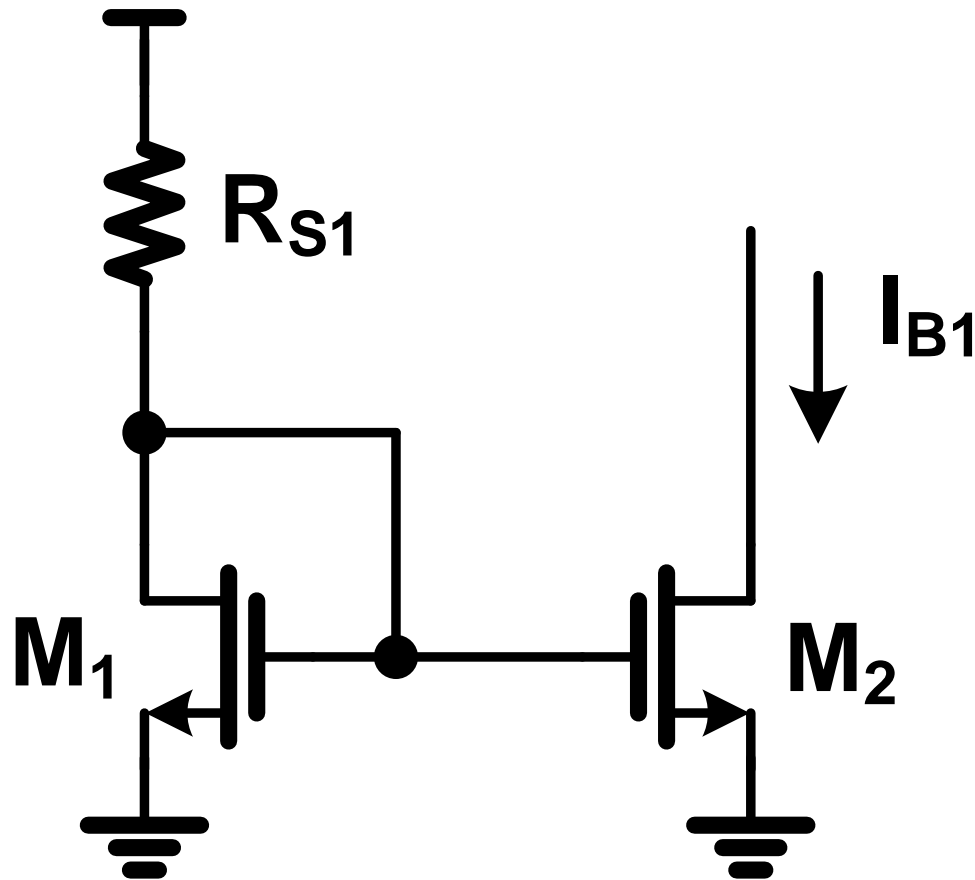
2024/10/29~11/12

Current Source Design

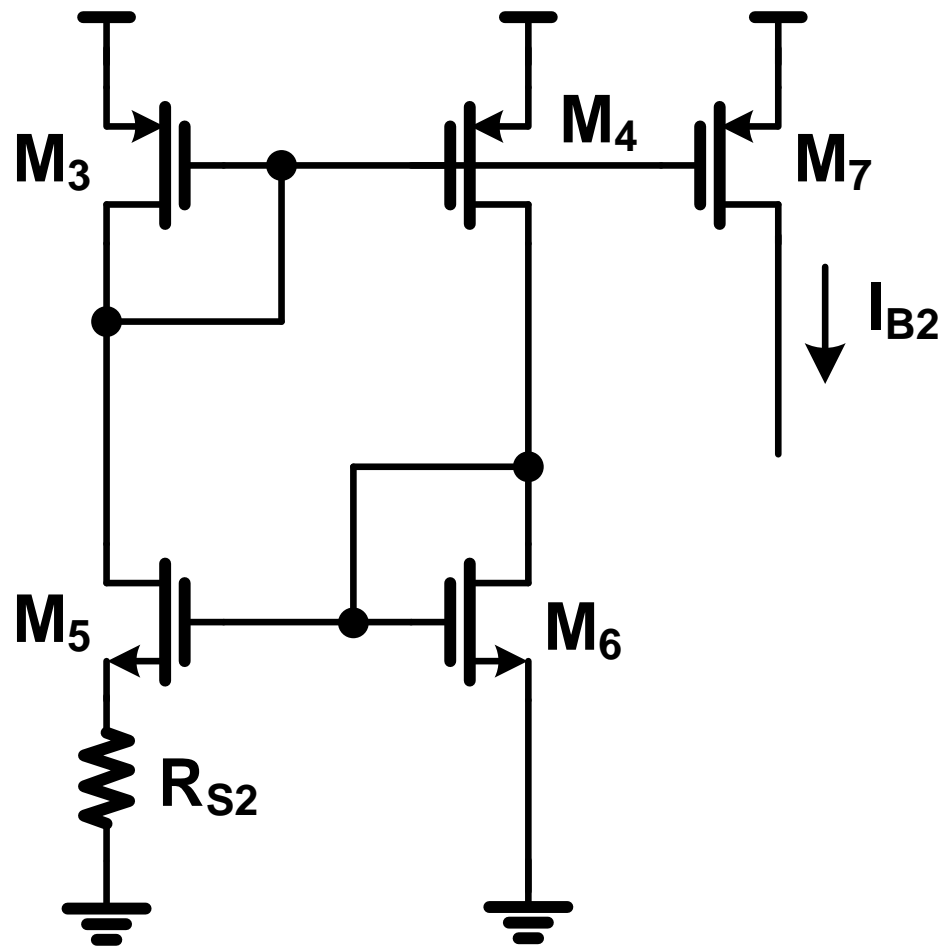
Outline

- ❑ Simple Current Source
- ❑ Self-Biasing g_m Current Source
- ❑ Self-Biasing g_m Current Source with Cascode Stage
- ❑ Self-Biasing V_{BE} and V_T Current Source
- ❑ Self-Biasing g_m Current Source with Start-up Circuit
- ❑ Detail description

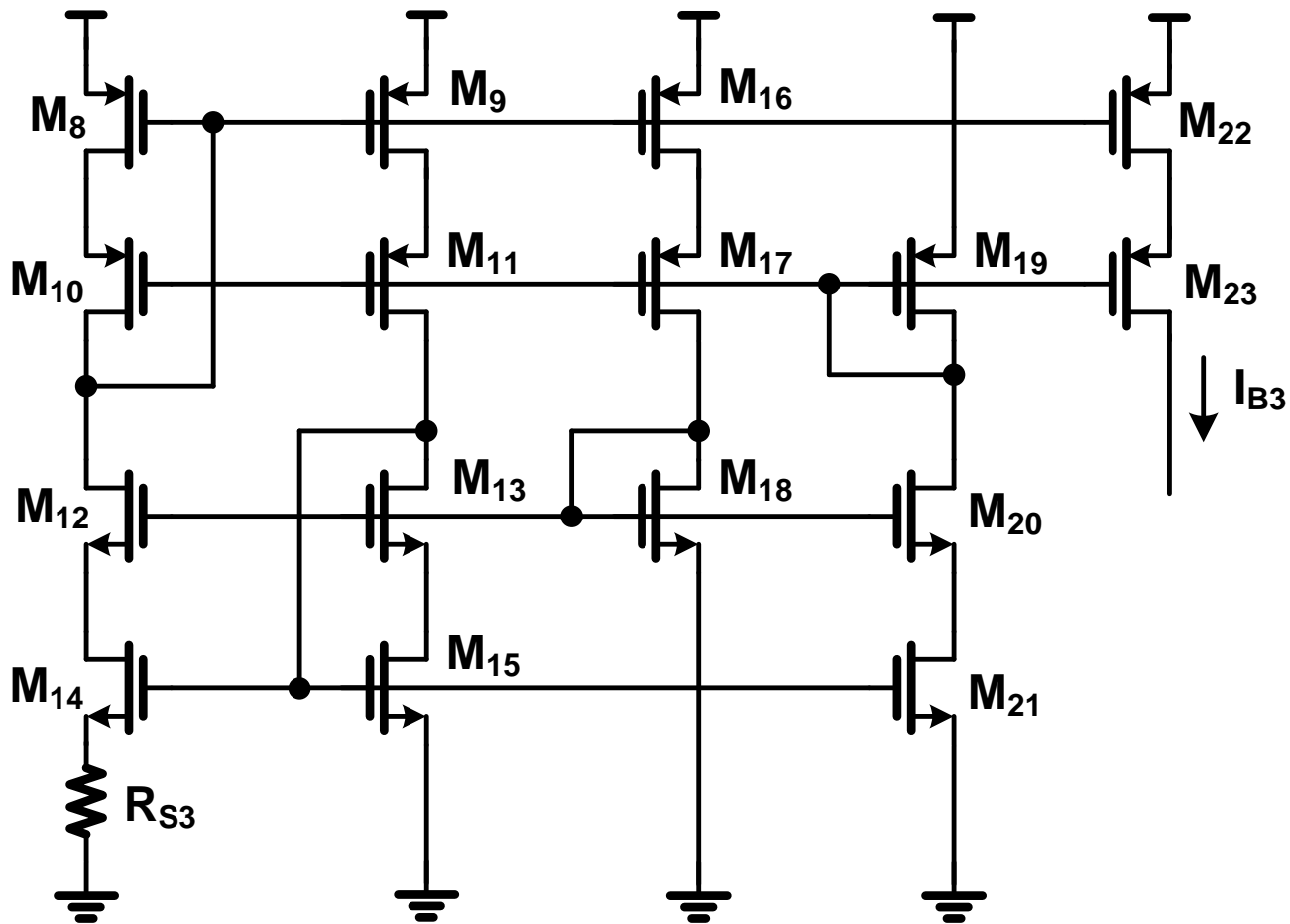
1. Simple Current Source



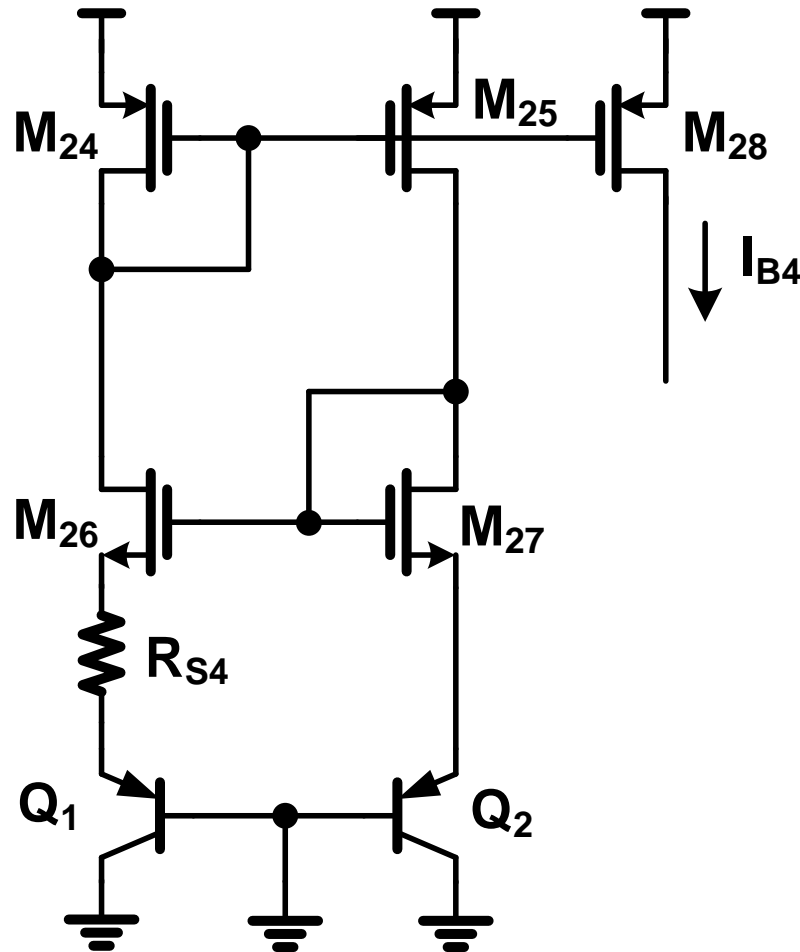
2. Self-Biasing g_m Current Source



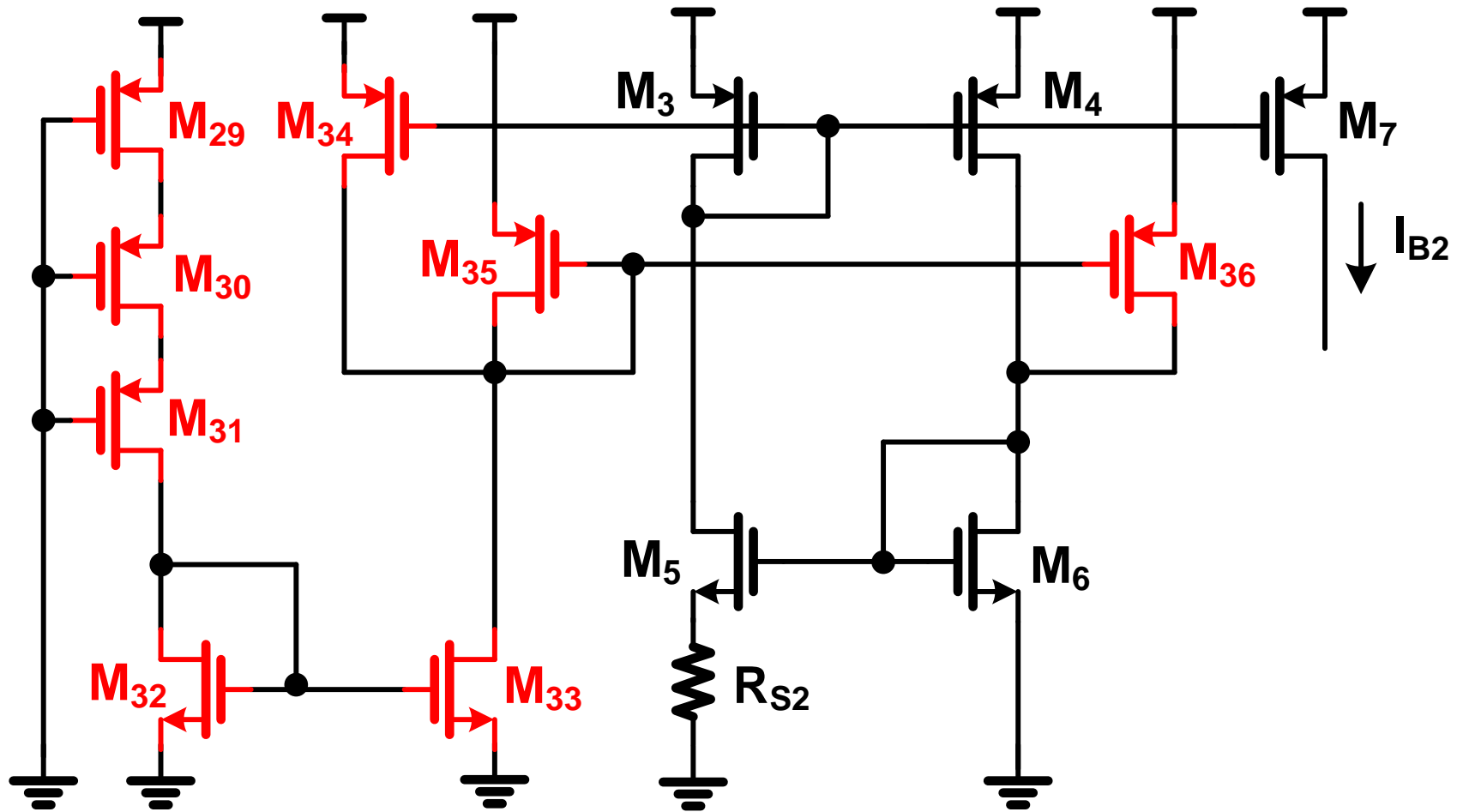
3. Self-Biasing g_m Current Source with Cascode Stage



4. Self-Biasing V_{BE} and V_T Current Source



5. Self-Biasing g_m Current Source with Start-up Circuit



Detail description

□ Please design the above five current source structures

1. Simple Current Source
2. Self-Biasing g_m Current Source
3. Self-Biasing g_m Current Source with Cascode Stage
4. Self-Biasing V_{BE} and V_T Current Source
5. Self-Biasing g_m Current Source with Start-up Circuit (Bonus!): Ensuring the startup circuit can be shut down in steady state.

□ Specifications

- $V_{DD}=2.7V\sim 3.3V$
- **2 μ A** output current (I_{B1} , I_{B2} , I_{B3} , I_{B4}) @ $V_{DD}=3.3V$, $T_{emp}=50$, Process=TT

□ Current source design

- Plot three process corner simulation results (TT,FF,SS) of the output current with each above structure by DC sweep.
.dc temp -40 140 1 sweep VDD 2.7 3.3 0.1
- The process variation should contains the MOSFETs and Resistors.

Detail (con't)

- Resistor model (Use N-well resistor)

.LIB RES

.subckt rnwod n1 n2 l=length w=width

- You have to derive the **output current variation** under the different PVT (Process, Voltage, Temperature) conditions and explain the reason with each structure in your report.

□ Start-up mechanism

- Add the MOSFETs of $M_{29} \sim M_{36}$ into the Self-Biasing g_m Current Source structure to achieve the start-up mechanism.
- Plot the transient simulation results (I_{B2} , $I_{M29} \sim I_{M36}$)(**TT,FF,SS**) of this start-up mechanism.

VDD VDD 0 pwl(0us 0v 50us 3.3v)

□ Spice model (0.18um process)

- 3.3V MOSFET
- N-well resistor: rnwod (.LIB RES)
- PNP bipolar: pnnp10 (.LIB BIP)

Detail (con't)

- List all the design perimeters of MOSFETs and Resistors in your report.
- Resistor should be implemented with the non-ideal resistor model. (N-well resistor)

MOSFETs				
Name	Type (P or N)	Width	Length	Multiple
M_1				
:				
M_{36}				
Resistors				
	Width		Length	
R_{S1}				
:				
R_{S4}				

Detail (con't)

□ Homework2

- Design the different current source structures and explain the difference of these structures.

□ Use 0.18um technology 3.3V device

□ Your upload file must include

- 1. Report (.pdf), including the followings
 - (i) All the design parameters
 - (ii) Simulation results (With PVT variations and explain)
 - (iii) Discussion (You can derive the formula by hand and compared the results with the simulated result and explain it.)
 - (iv) Layout result (Print-screen picture)
- 2. Spice file (.sp)
- 3. Layout (.gds) (Bonus!)

Detail (con't)

- 作業請上傳到E3
 - Title: 學校_學號_hw2 (ex: NCTU_9812633_hw2)
 - 外校同學請務必在報告中註明姓名
- Your upload file must include (一律上傳壓縮檔)
 - Report (.pdf)
 - Spice file (.sp)
 - Layout (.gds) (Bonus!)
- 遲交分數會打折，不可抄襲
- Deadline: 2024/11/12