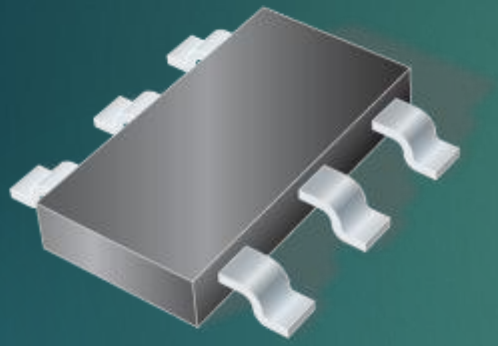


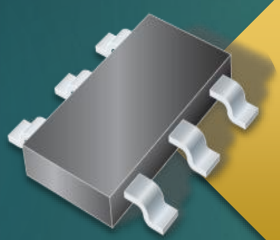
Electronic Devices & Circuits II

MUHAMMAD OBAIDULLAH

OUTLINE

Chapter – 11: Feedback

- General Feedback Structure
- Feedback Topologies

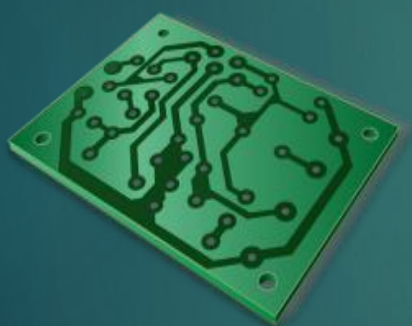


Chapter – 12: Power Amplifiers

- Understanding Amplifiers
- Different Classes of Amplifiers

Chapter – 13: Waveform Generators

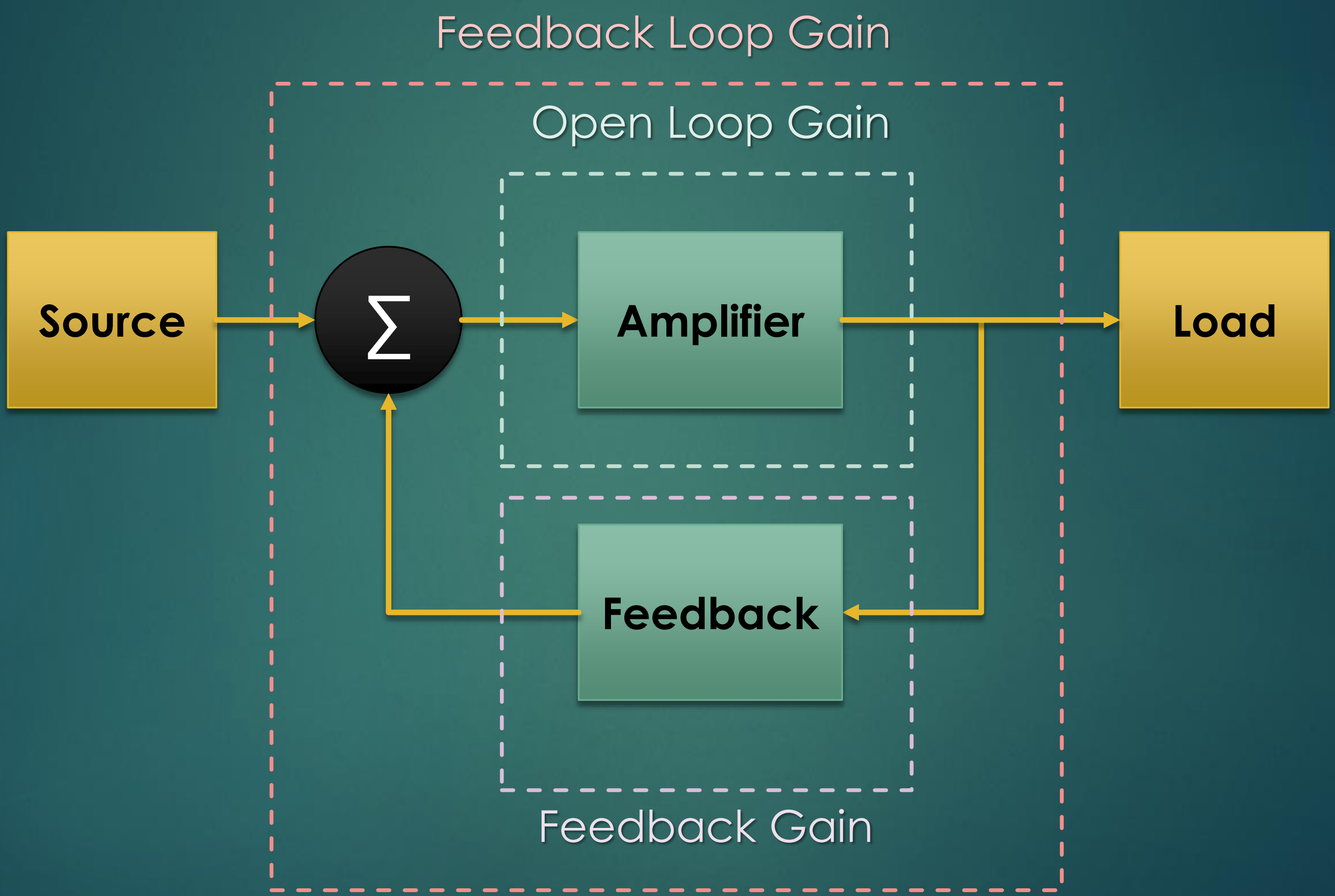
- Phase Shift Oscillators
- Comparators
- Multivibrators



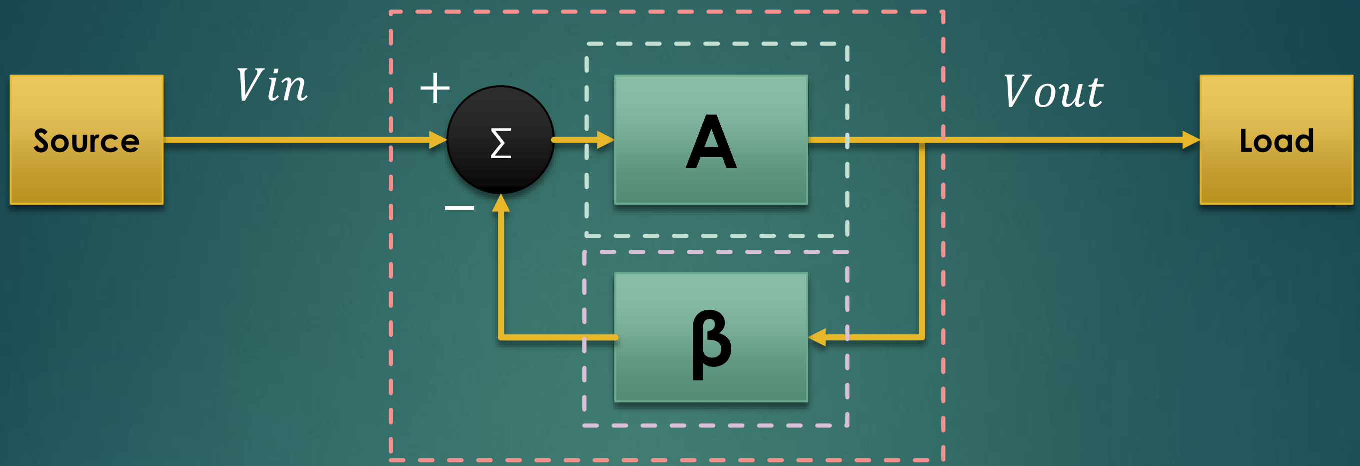
CHAPTER 11

FEEDBACK

BASIC FEEDBACK



CALCULATING GAINS



Open Loop Gain = A

Closed Loop Gain = β

Feedback Loop Gain = $A_f = \frac{Vout}{Vin} = \frac{A}{1+A\beta}$

$$Vout = A(Vin - Vout.\beta)$$

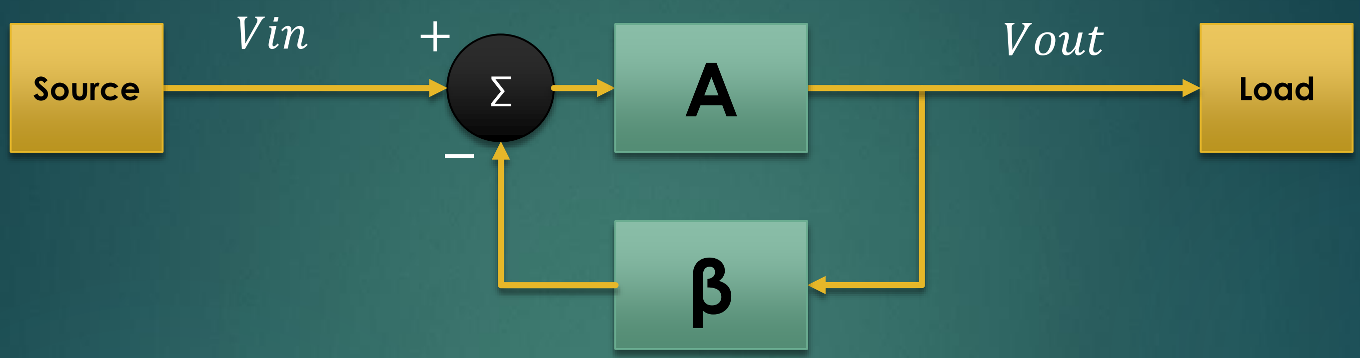
$$Vout = A.Vin - A\beta.Vout$$

$$Vout + A\beta.Vout = A.Vin$$

$$Vout(1 + A\beta) = A.Vin$$

$$\frac{Vout}{Vin} = \frac{A}{1 + A\beta}$$

GAIN SENSITIVITY



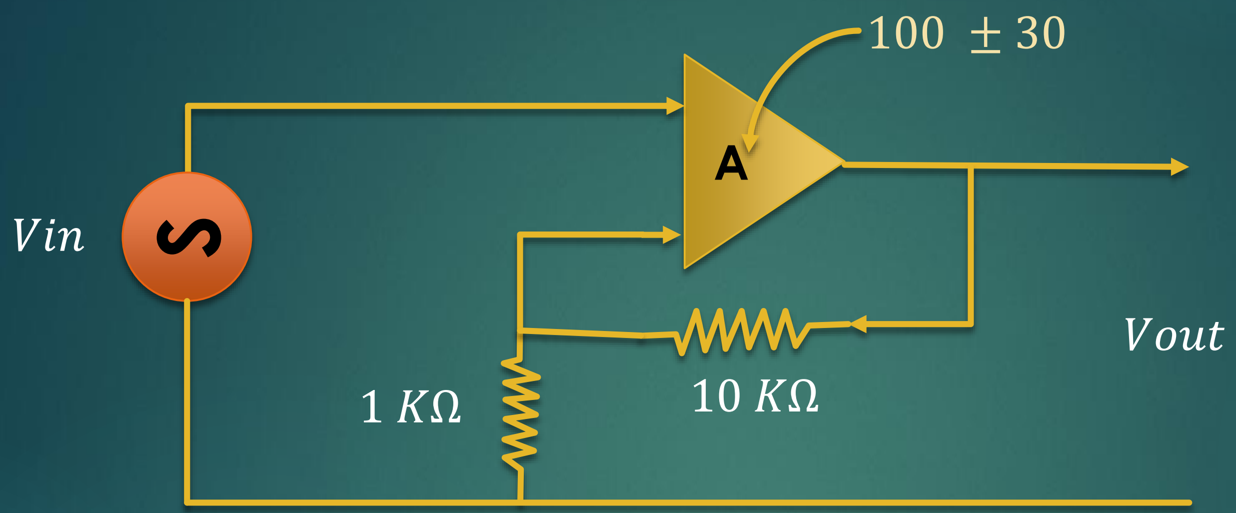
Relative Change in Feedback Loop Gain

Sensitivity Function

$$\frac{\Delta Af}{Af} = \frac{\Delta A}{A}\left(\frac{1}{1 + A\beta}\right)$$

Relative Change in Open Loop Gain

EXAMPLE



Calculate Feedback Loop Gain

$\therefore Af = 10 \pm 0.3$

Step 1:

$$\beta = \frac{R1}{R1 + R2}$$

$$\beta = \frac{1K}{1K+10K} = \frac{1}{11}$$

Step 2:

$$Af = \frac{A}{1 + A\beta}$$

$$Af = \frac{100}{1 + 100 \times \frac{1}{11}} = 10$$

Step 3:

$$\frac{\Delta Af}{Af} = \frac{\Delta A}{A}\left(\frac{1}{1 + A\beta}\right)$$

$$\Delta Af = \frac{30}{100}\left(\frac{1}{1 + \frac{100}{11}}\right) \times 10$$

$$\Delta Af = 0.3$$

BANDWIDTH EXTENSION

Normal Open Loop Amplifier Gain: $A_{OL} = \dfrac{Ao}{1 + j\dfrac{f}{fc}}$

Zero Frequency Gain

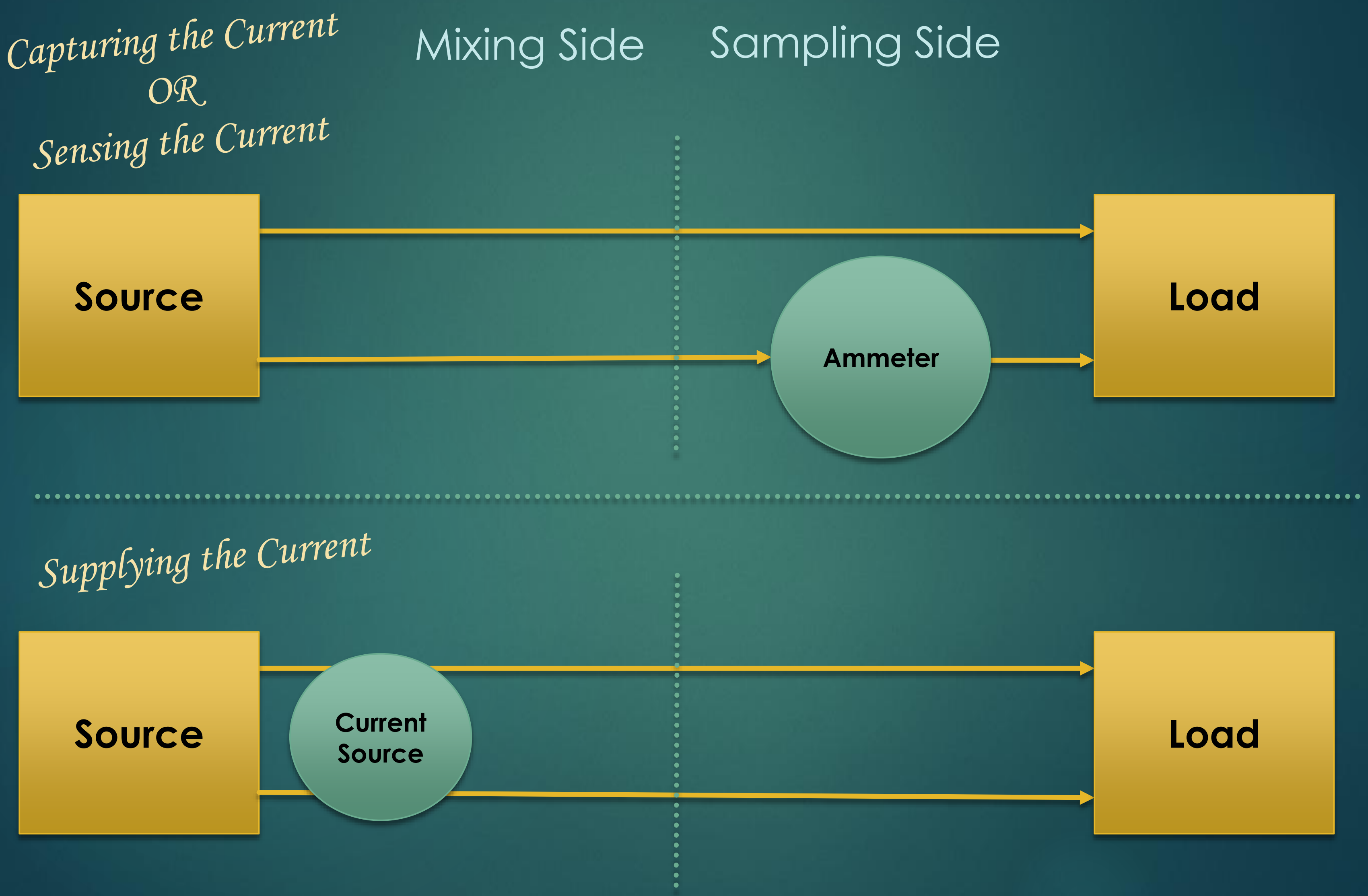
Feedback Gain: $\text{Af} = \dfrac{A_{OL}}{1 + \beta A_{OL}}$

$$\text{Af} = \frac{A_O}{1 + j\dfrac{f}{fc} + \beta A_O}$$

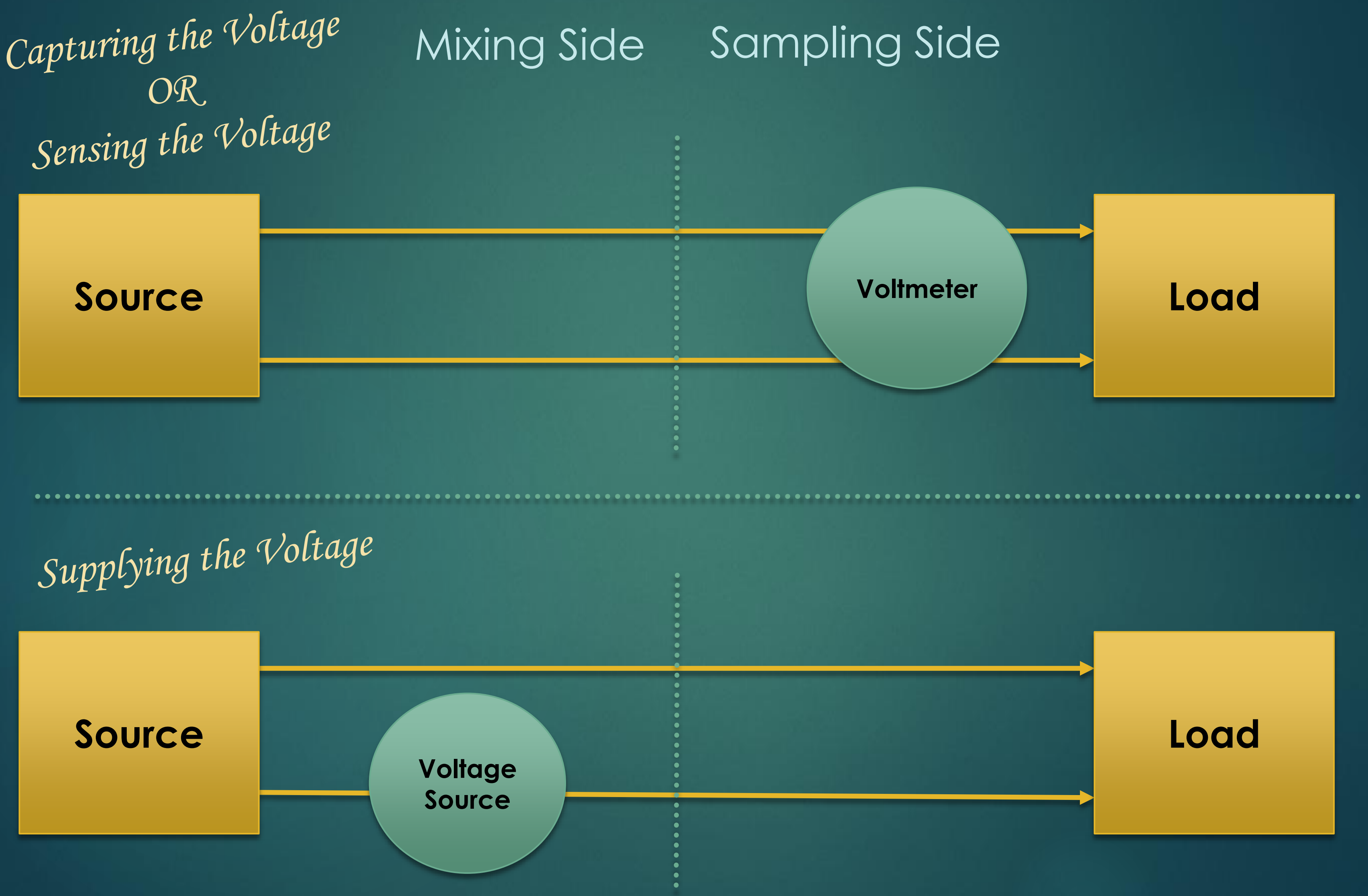
$$\text{Af} = \frac{A_O}{(1 + \beta A_O)\left(1 + j\dfrac{f}{(1 + \beta Ao)fc}\right)}$$

$$\text{Af} = \frac{A_O}{(1 + \beta A_O)} \times \frac{1}{\left(1 + j\dfrac{f}{(1 + \beta Ao)fc}\right)}$$

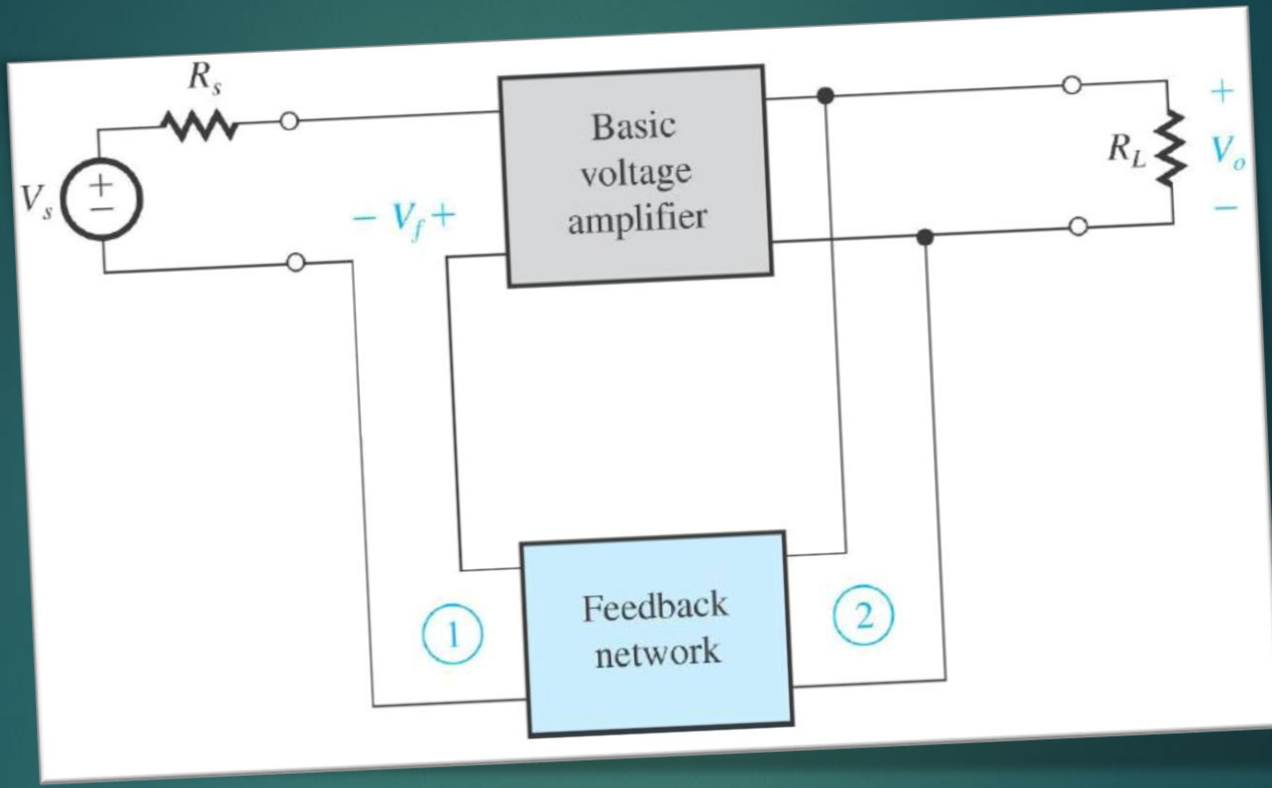
CURRENT CAPTURE AND SUPPLY



VOLTAGE CAPTURE AND SUPPLY



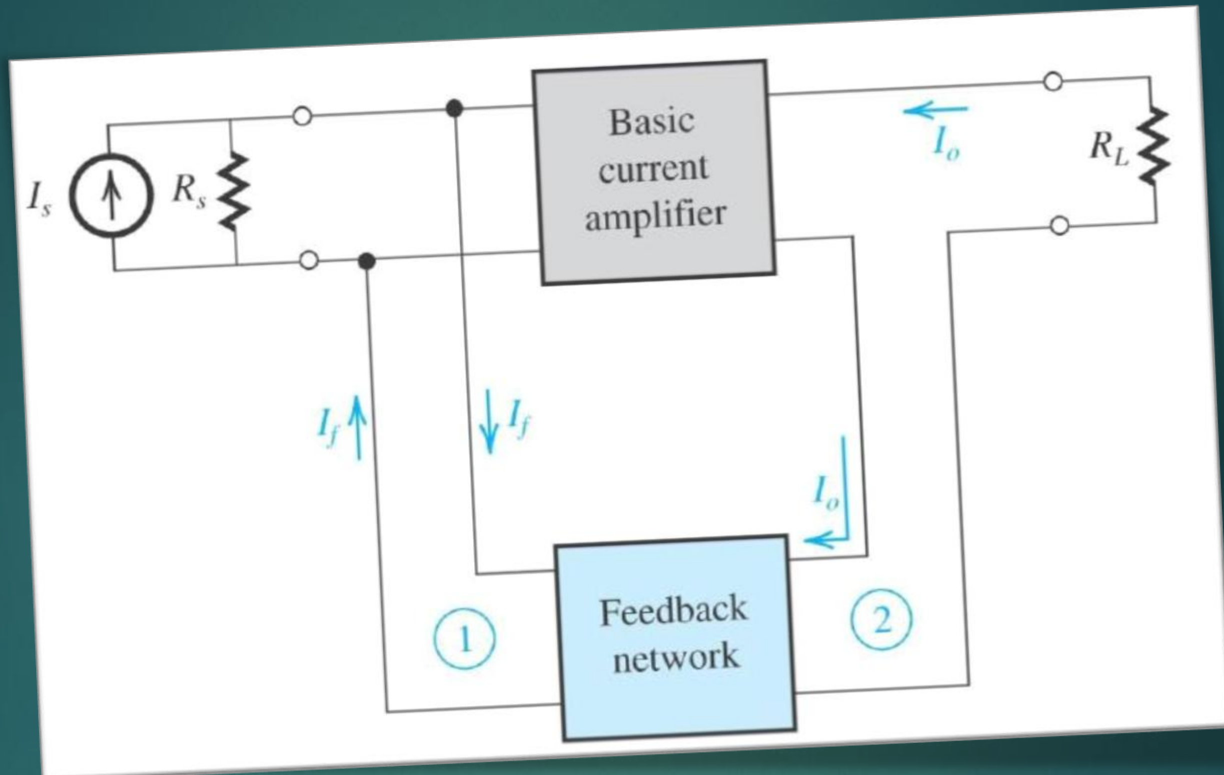
VOLTAGE CAPTURE VOLTAGE SUPPLY



Output Resistance

Input Resistance

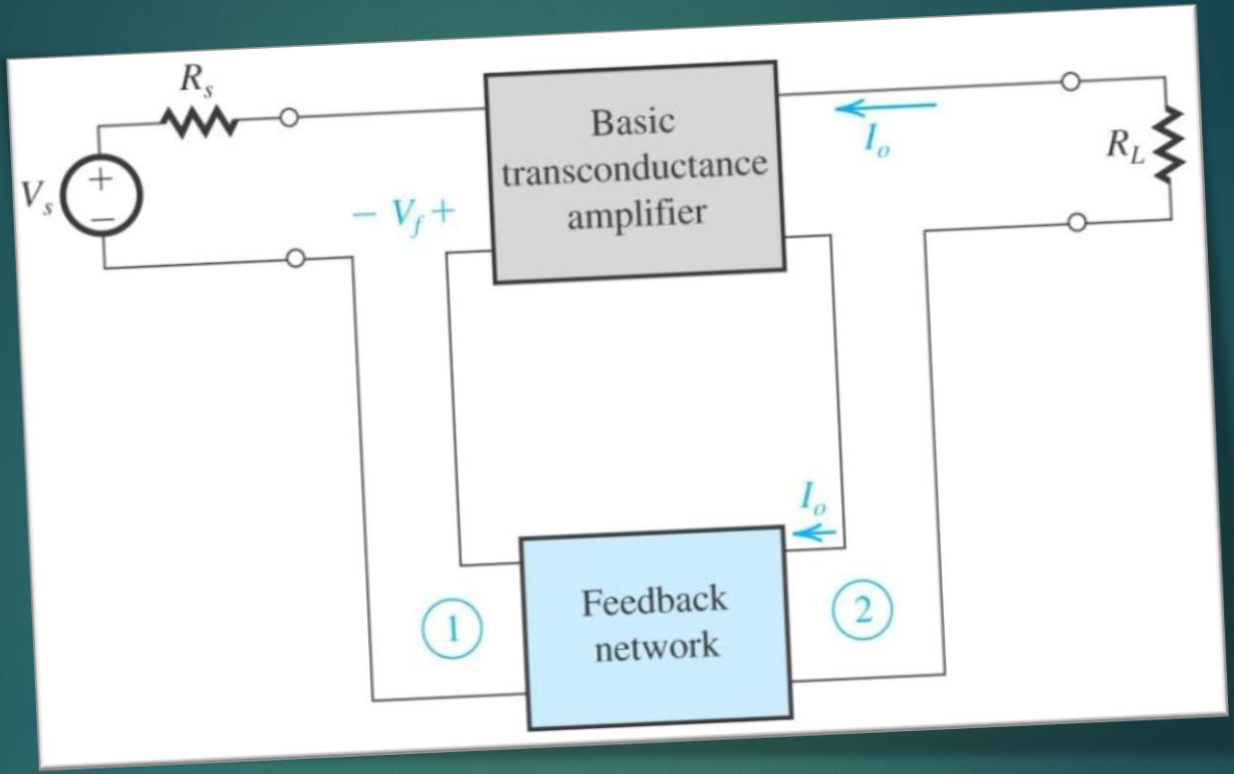
CURRENT CAPTURE CURRENT SUPPLY



Output Resistance

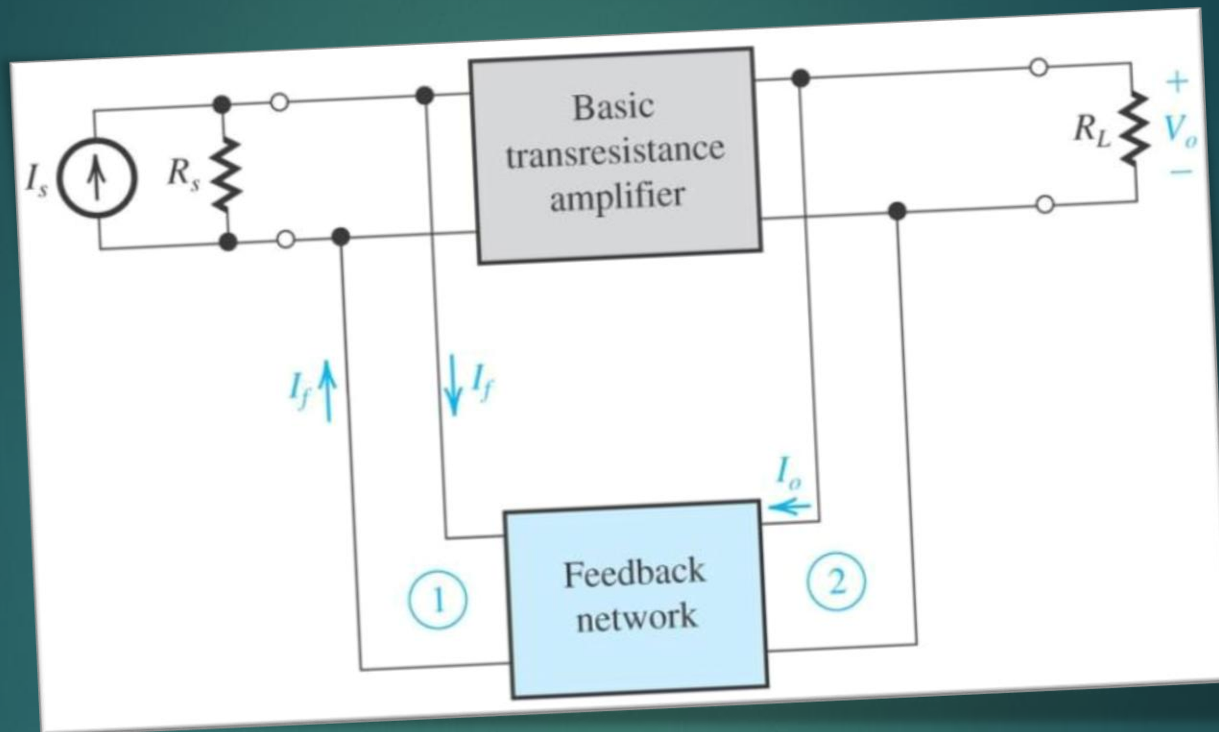
Input Resistance

CURRENT CAPTURE VOLTAGE SUPPLY



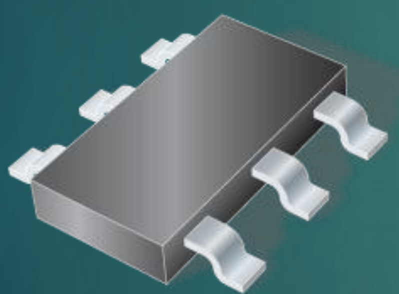
↑ Output Resistance ↑ Input Resistance

VOLTAGE CAPTURE CURRENT SUPPLY



Output Resistance

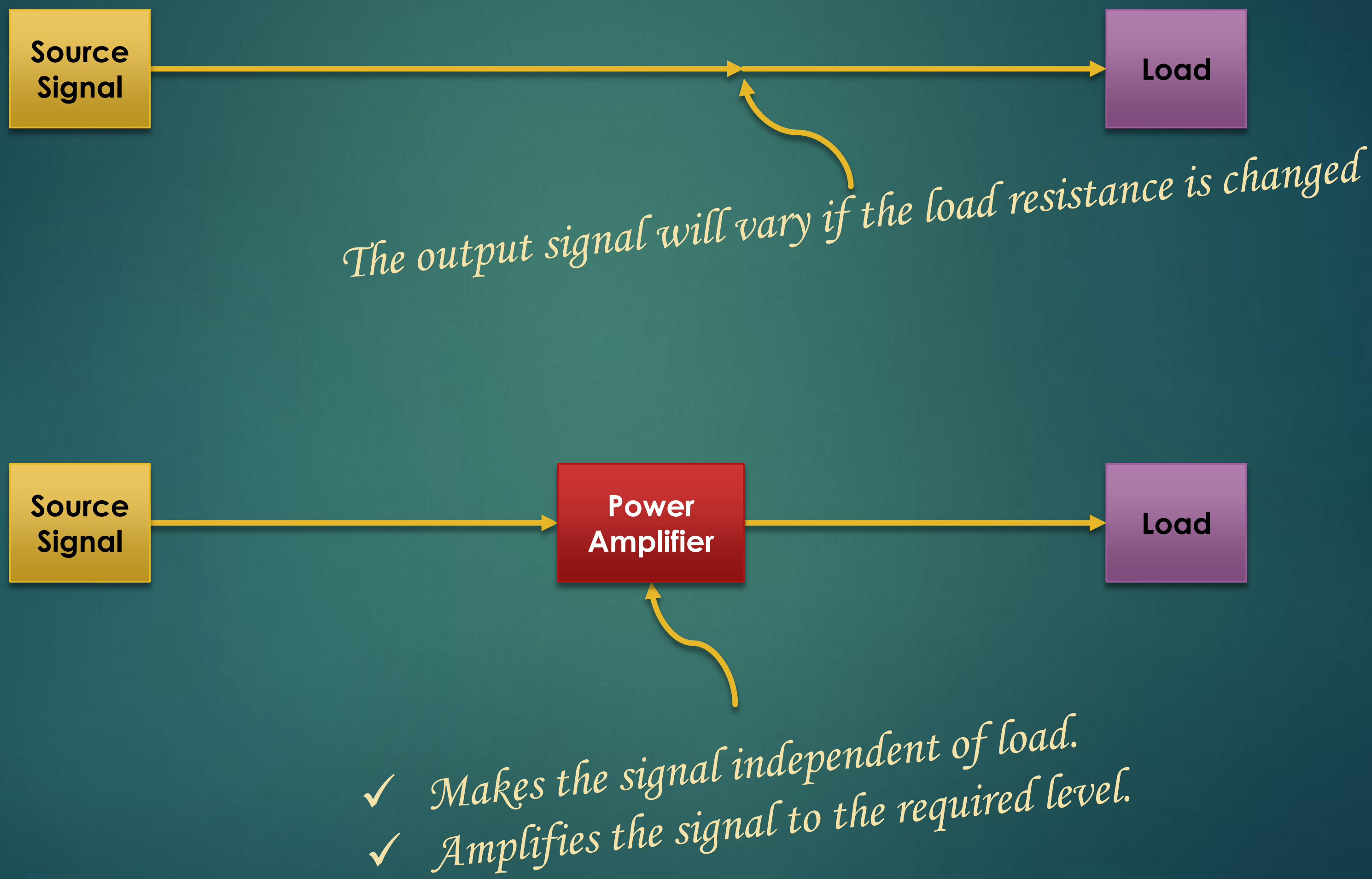
Input Resistance



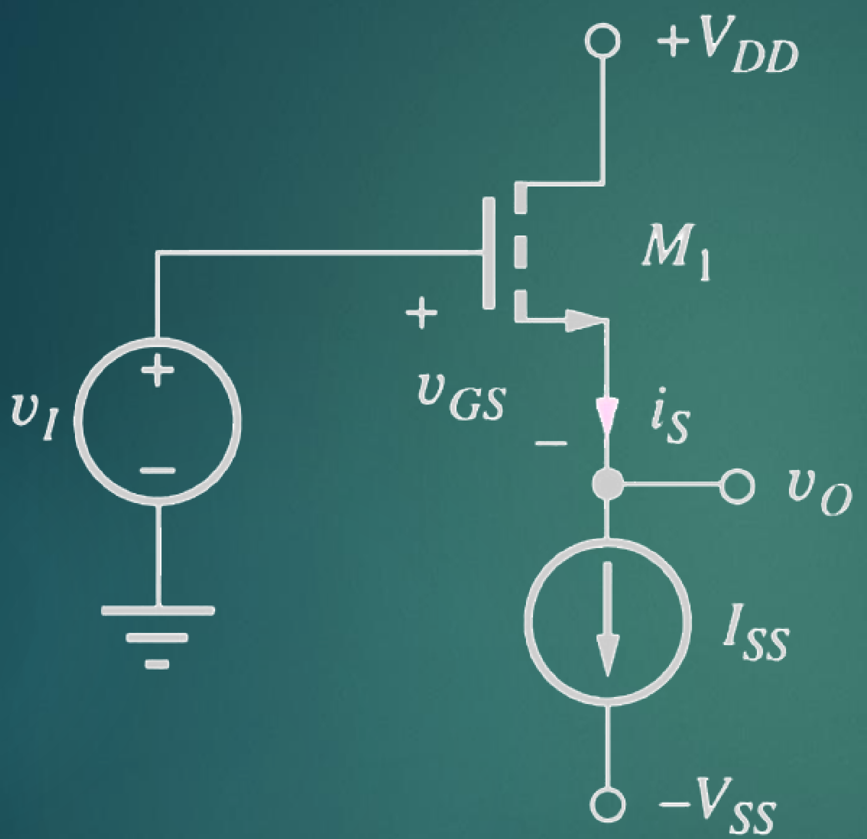
CHAPTER 12

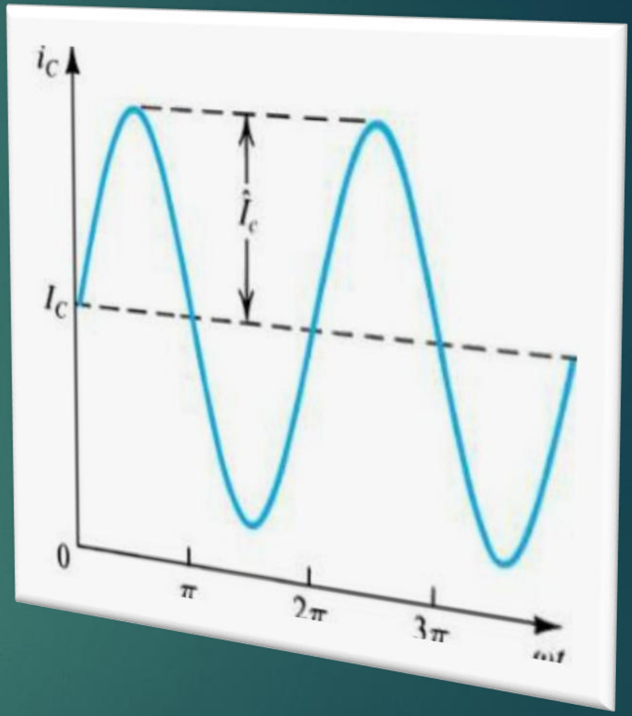
POWER AMPLIFIERS

WHY USE POWER AMPLIFIERS ?



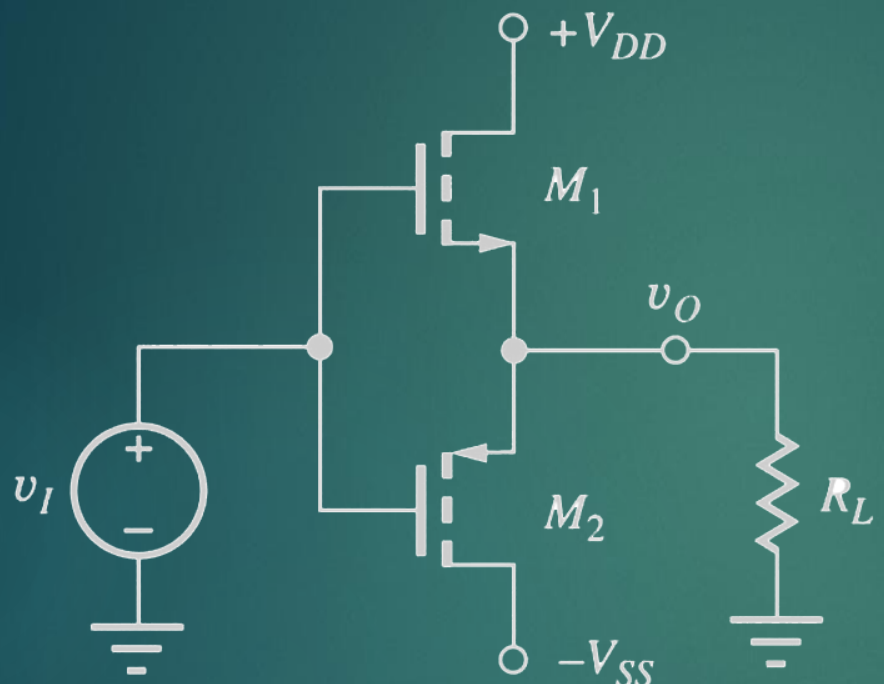
CLASS A

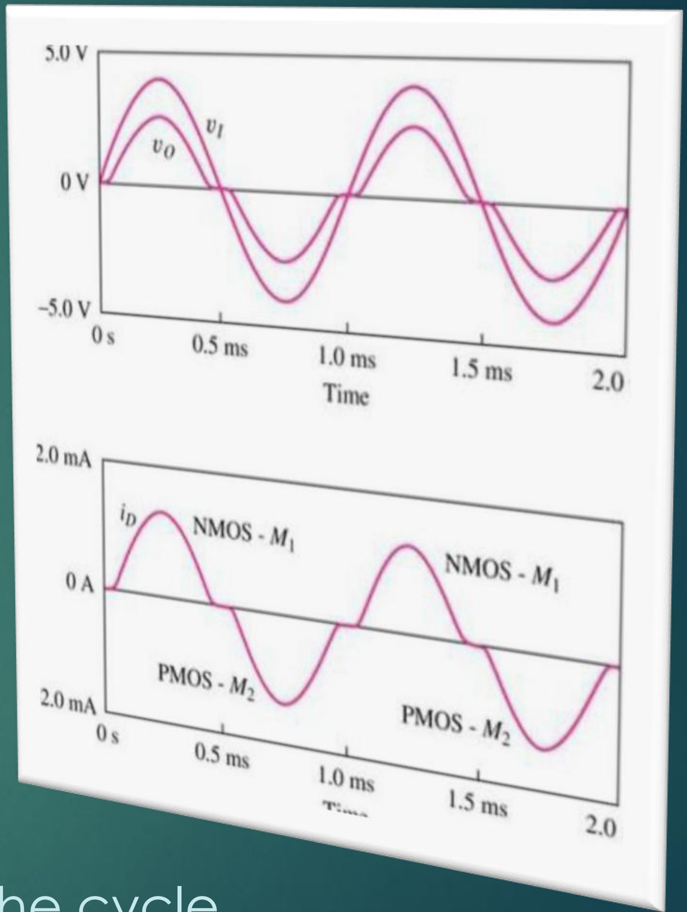




- Conducts for the whole cycle
- Output is shifted by some DC value
- Always biased to operate in active mode by Iss

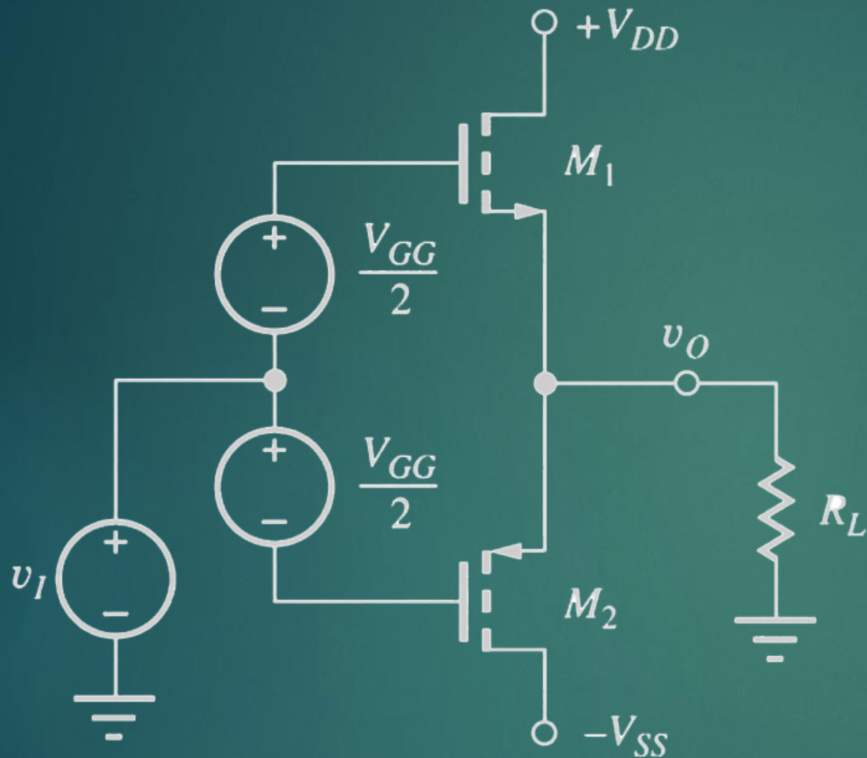
CLASS B

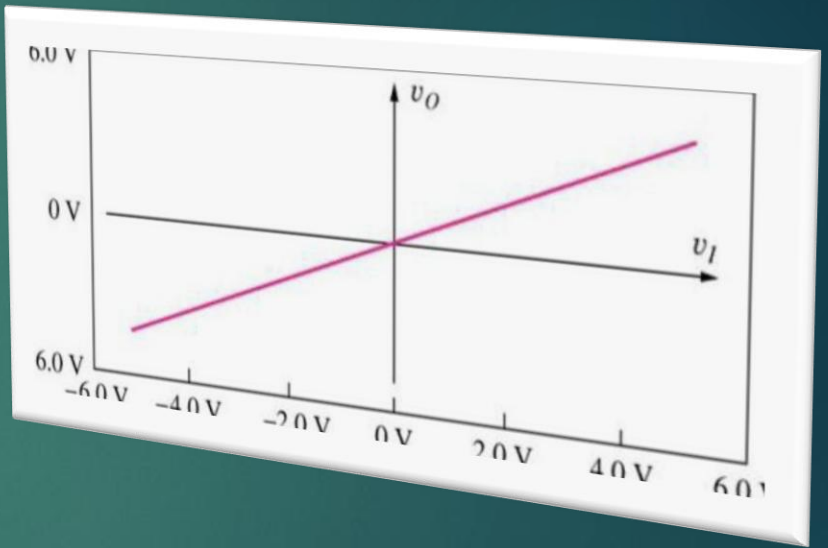




- Each transistor conducts for half the cycle
- Output is not shifted by some DC value
- No output voltage is produced when Vi<0.7

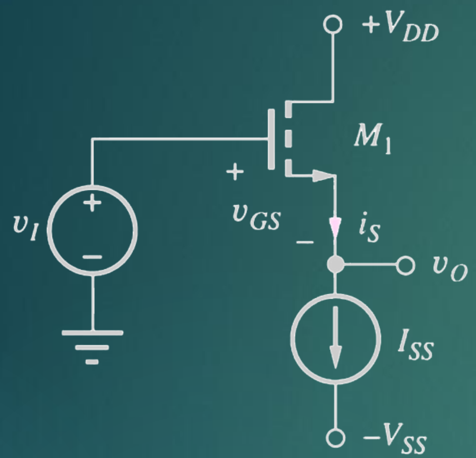
CLASS AB



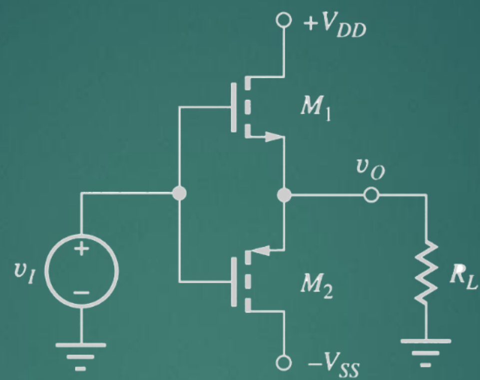


- Conducts for the whole cycle
- Output is not shifted by some DC value
- Always biased to operate in active mode by V_{GG}

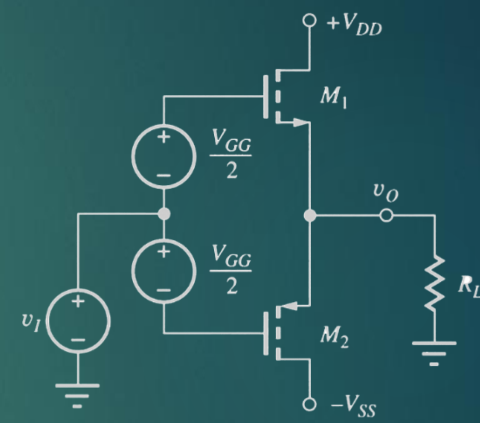
CLASSES OF POWER AMPLIFIERS



CLASS A



CLASS B



CLASS AB

S.NO.	CLASS	EFFICIECY	CONDUCTION ANGLE	DISTORTION
1	A	25%	Θ = 360	NO
2	B	78.5%	Θ = 180	YES
3	AB	25%↔78.5%	360> θ >180	NO
4	C	>78.5%	Θ < 180	YES

CHAPTER 13

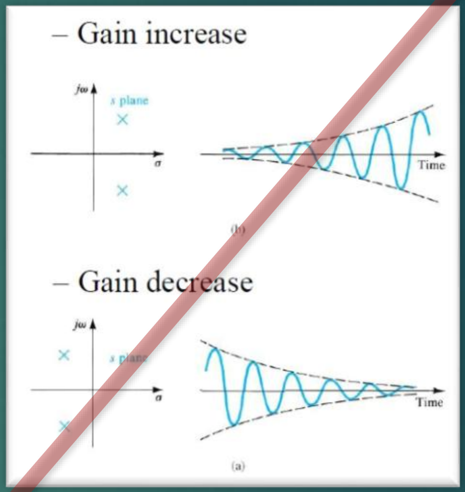
WAVEFORM GENERATORS

CONDITIONS FOR OSCILLATIONS

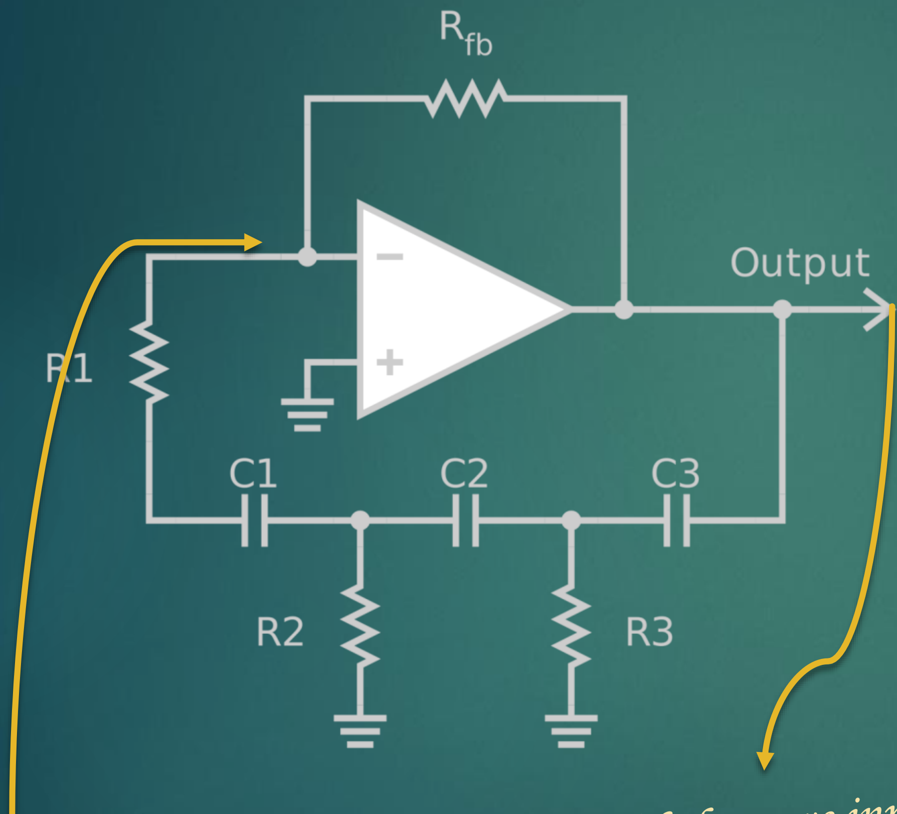
Barkhausen Stability Criterion

Loop Gain = |Aβ| = 1

Phase Shift = 0 or 2Πn



PHASE SHIFT OSCILLATIOR

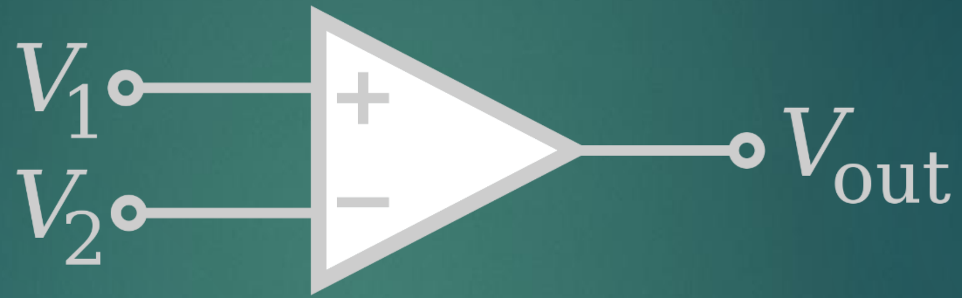


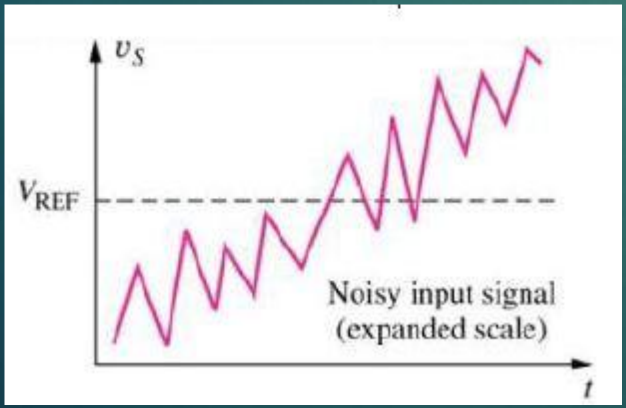
$$f_{oscillation} = \frac{1}{2\pi RC\sqrt{6}}$$

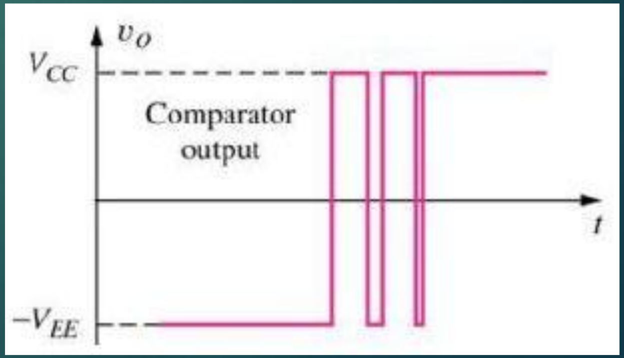
$$R_{fb} = 29\ \mathrm{R}$$

The output is phase shifted 180 and fed to –ve input of amplifier

COMPARATORS







MULTIVIBRATORS

Astable

The circuit is not stable in either state —it continually switches from one state to the other. It functions as a relaxation oscillator.

Monostable

One of the states is stable, but the other state is unstable (transient). A trigger pulse causes the circuit to enter the unstable state. After entering the unstable state, the circuit will return to the stable state after a set time.

Bistable

The circuit is stable in either state. It can be flipped from one state to the other by an external trigger pulse.

Thank You