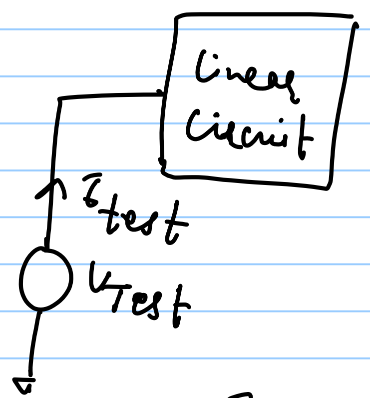
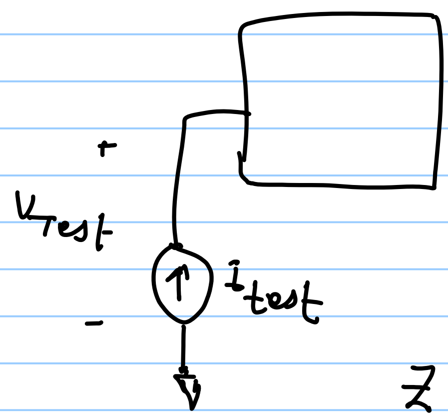
EE2019 Analog System & Lab

Note Title 2/14/2020



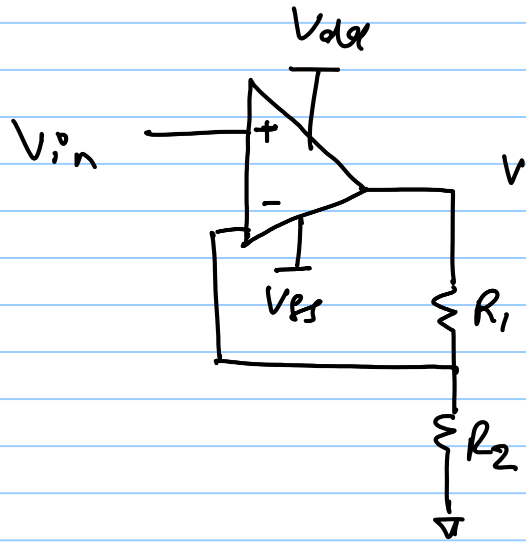
$$Z = \frac{V_{Test}}{I_{Test}}$$

or



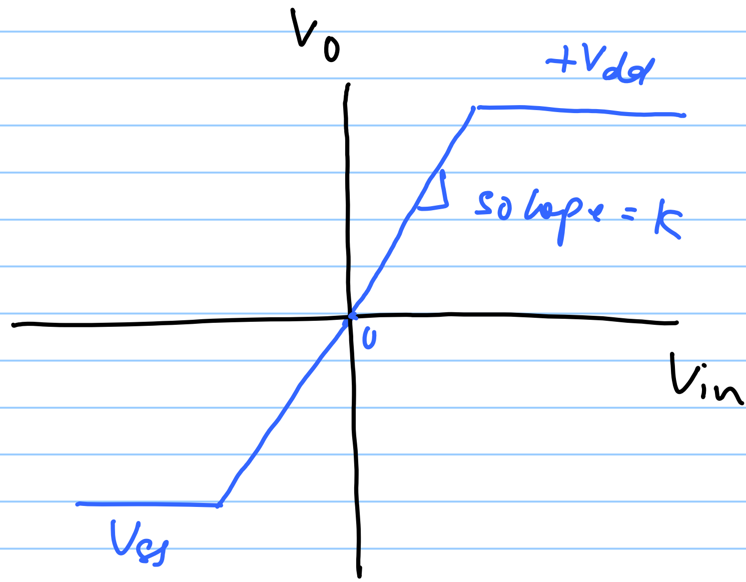
$$Z = \frac{V_{Test}}{I_{Test}}$$

Biasing a non-inverting amplifier



$$V_0 = \left(1 + \frac{R_1}{R_2}\right) V_{in}$$

$$= k\, V_{in}$$



If $V_{ss} = 0$ & $V_{dd} = 10\ V$

$K = 2 \quad (R_1 = R_2)$

Case-1, input dc = 0

$V_{in} = V_{in}(ac) + V_{dc}$

$V_{dc} = 0$

No negative cycle in output becase $V_{out}(dc) = 0$

Case-2 $V_{dc} = 5\ V$

$V_{out}(dc) = 10\ V$ → no positive cycle in Vout because $V_{out}(dc) = 10\ V$

Case-3 $V_{dc} = 2.5V \rightarrow V_{out}(dc) = 5V$

amplifier is properly biased at mid-point

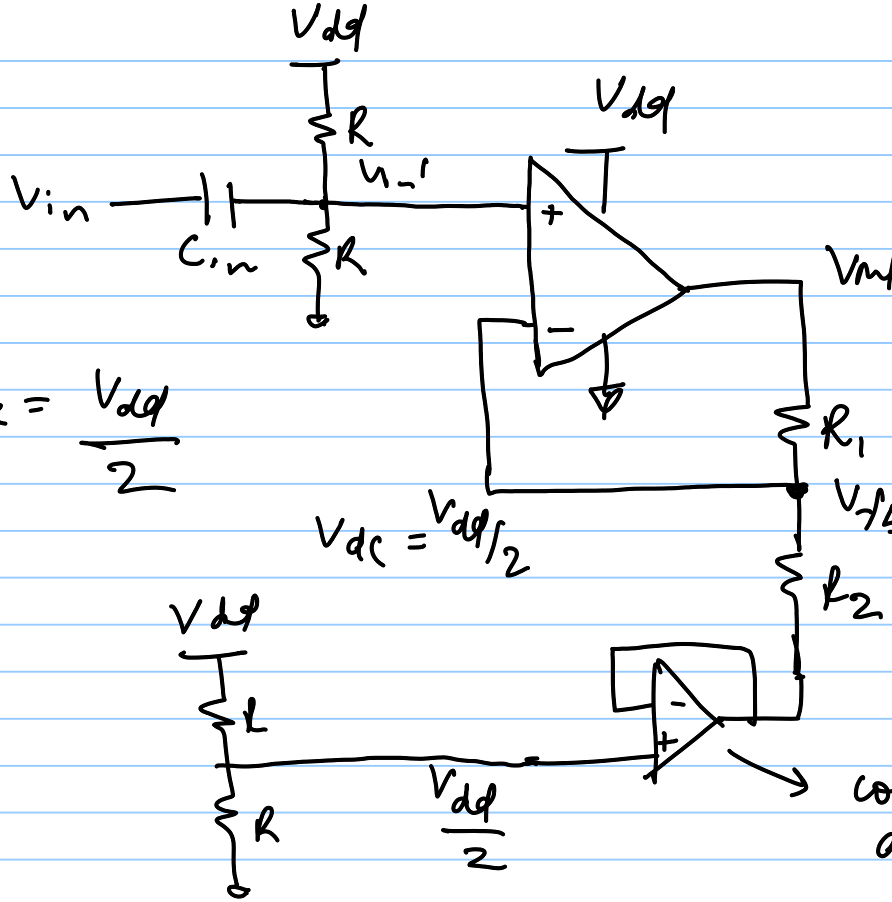
$V_{out}(dc)$ is function of amplifier gain.

we want

$$V_{out} = K V_{in} + V_{dc}$$

we want to bias amplifier in such a way that dc level is independent of gain

$V_{dc} = \frac{V_{dd}}{2}$

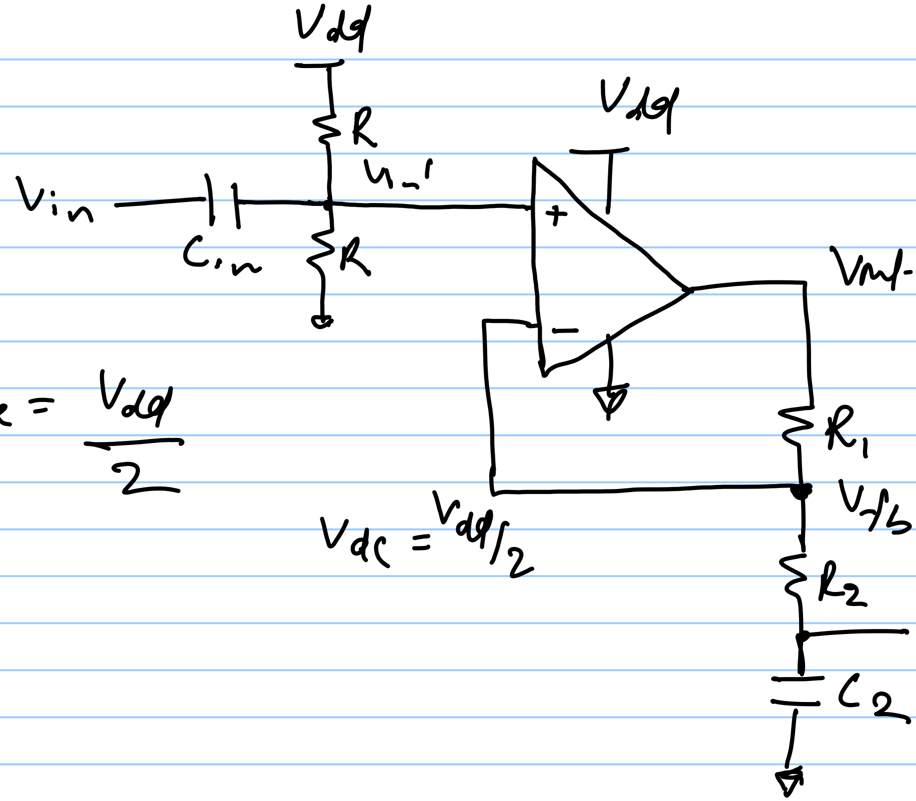


$V_{out} = k V_{in} + \frac{V_{dd}}{2}$

$V_{fb} = V_{in}(ac) + \frac{V_{dd}}{2}$

→ costs us an op-amp so not a preferred method

$V_{dc} = \frac{V_{dd}}{2}$



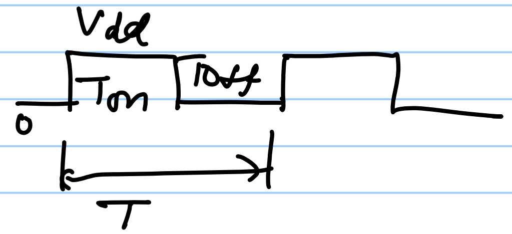
$V_{out} = k\,V_{in} + \frac{V_{dd}}{2}$

$V_{fb} = V_{in}(ac) + \frac{V_{dd}}{2}$

dc level = same as $V_{fb} \rightarrow \frac{V_{dd}}{2}$

$C_2 \rightarrow$ open at dc

Pulse Width Modulation (PWM)



Duty cycle, $D = \frac{T_{on}}{T}$

$D' = 1 - D = \frac{T_{OFF}}{T}$

max $D = 1$

min $D = 0$

PWM → converts voltage information into time.

Behaves like continuous time digital signal.

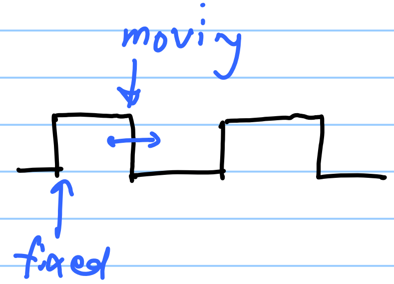
→ Less sensitive to noise because we have only two voltage levels (0 & V_{dd})

Applications:

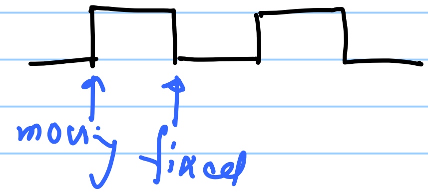
1. Audio amplifiers → Lab
2. Motor drive
3. Switching Regulators → Lab

Types of PWM

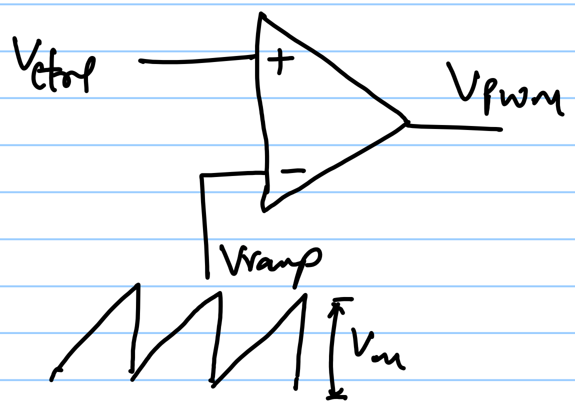
1. single edge Modulation
   - → Trailing edge

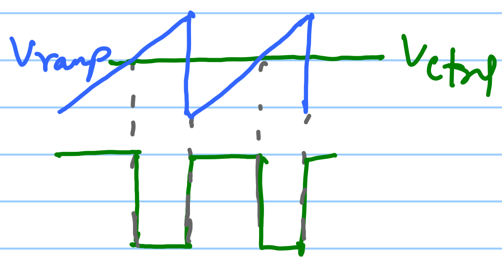


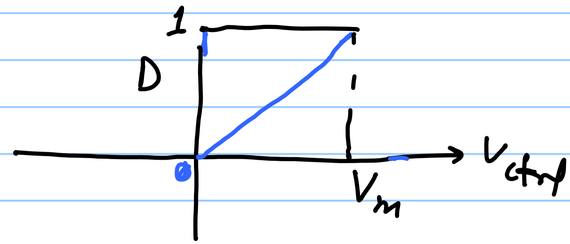
   - → leading edge



Trailing Edge PWM

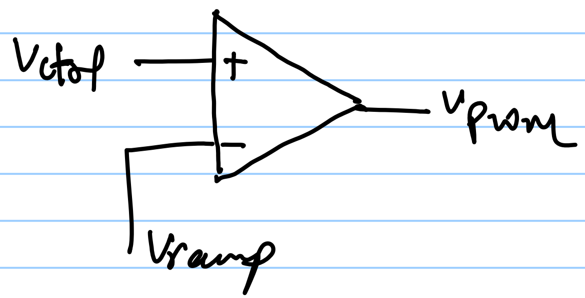


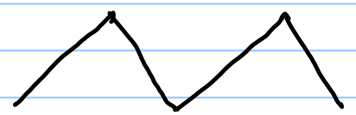


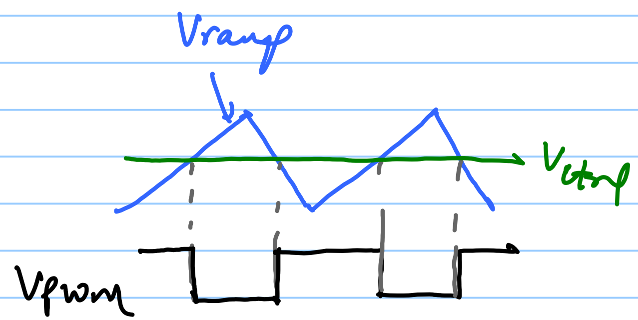


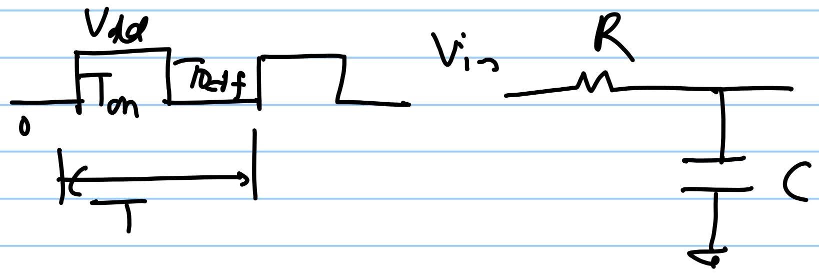
$$D = \frac{T_{on}}{T} = \frac{V_{ctrl}}{V_m}$$

Dual Edge PWM





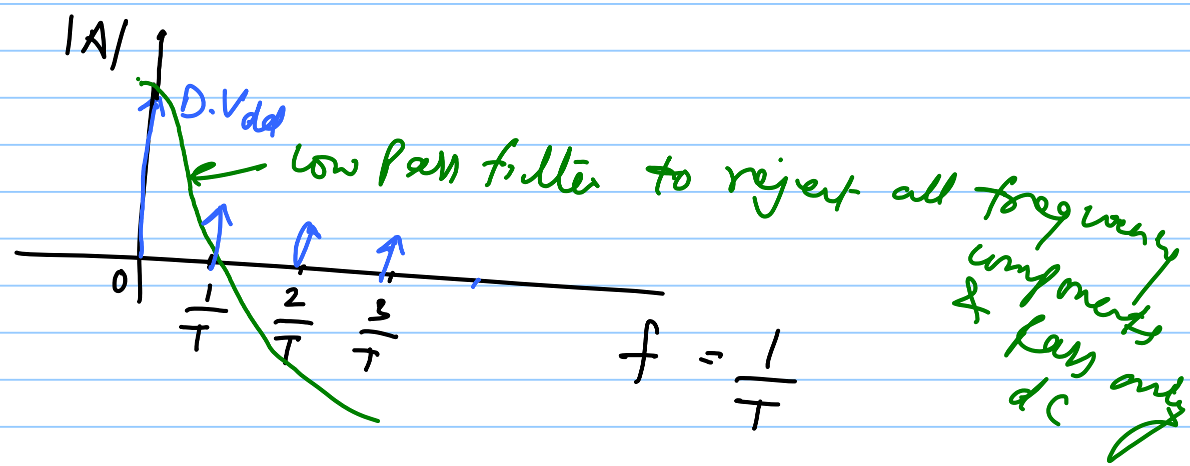


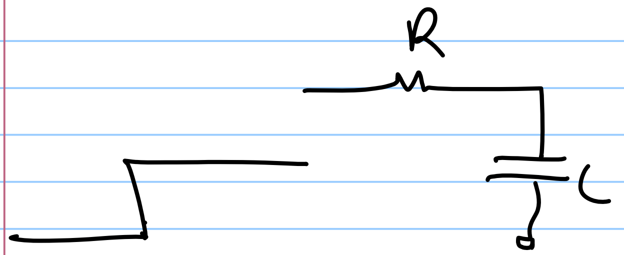


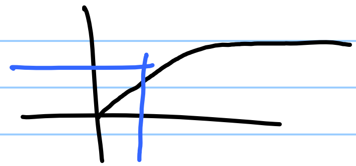
V_{out} = average of V_{in} $= \frac{T_{on}}{T} \times V_{dd}$

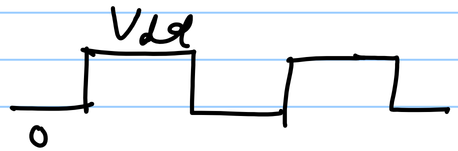
$= D \cdot V_{dd}$

$RC >> T$





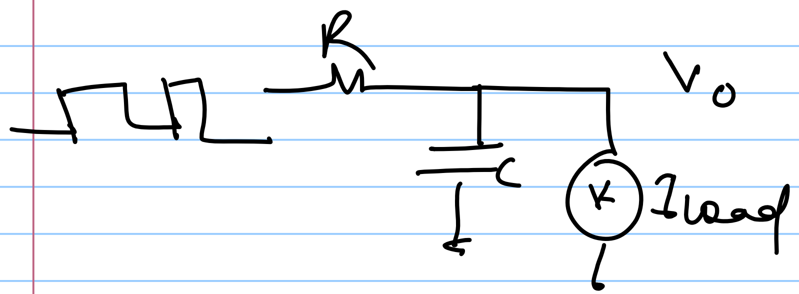




 average = D. Vdd

peak-to-peak ripple depends upon RC time constant and T

for smaller ripple $RC >> T$



V_o will drop as I_{Load} increases