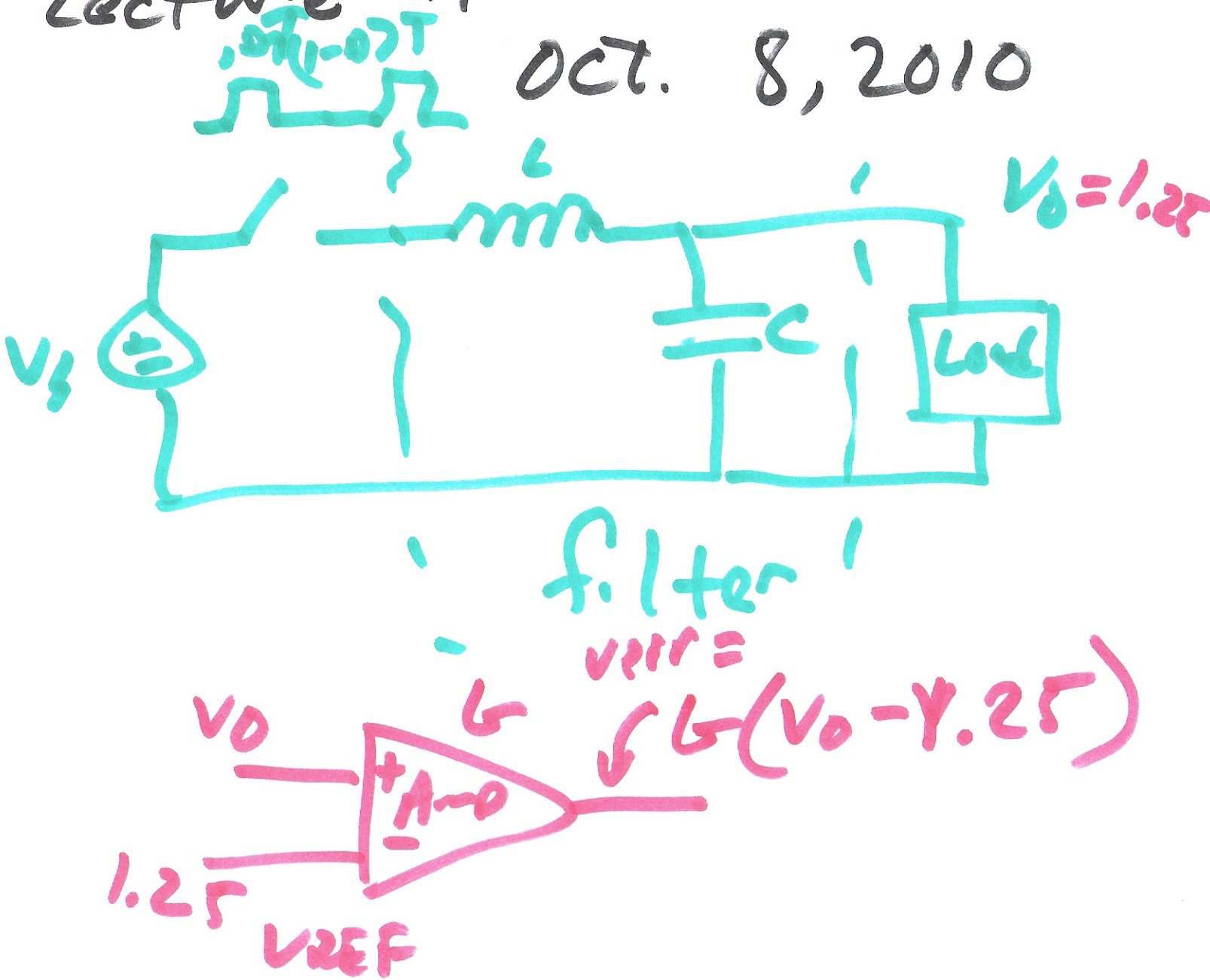
ECE 5/472 Power Electronics

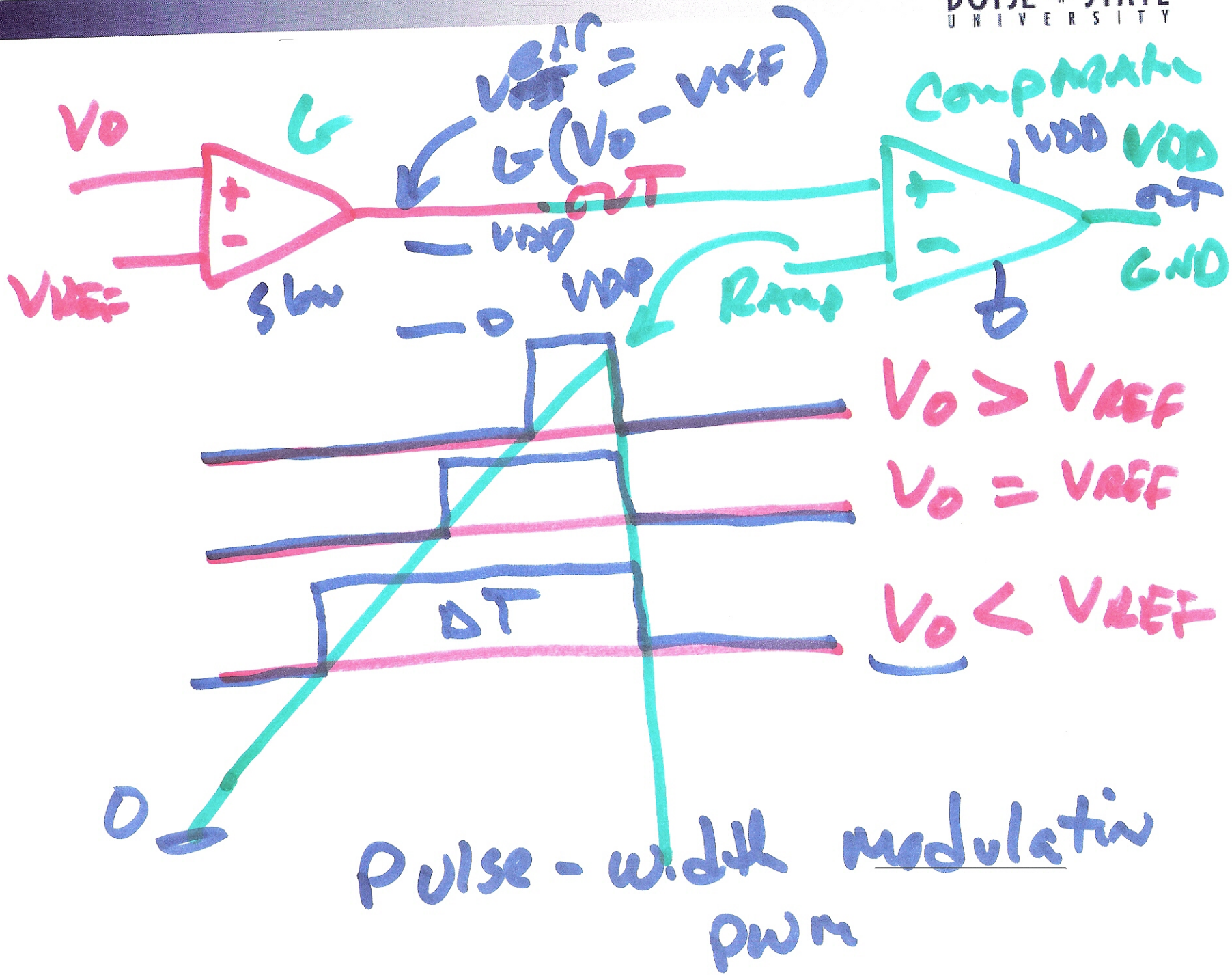
BOISE STATE UNIVERSITY

Lecture 19

Oct. 8, 2010



1)

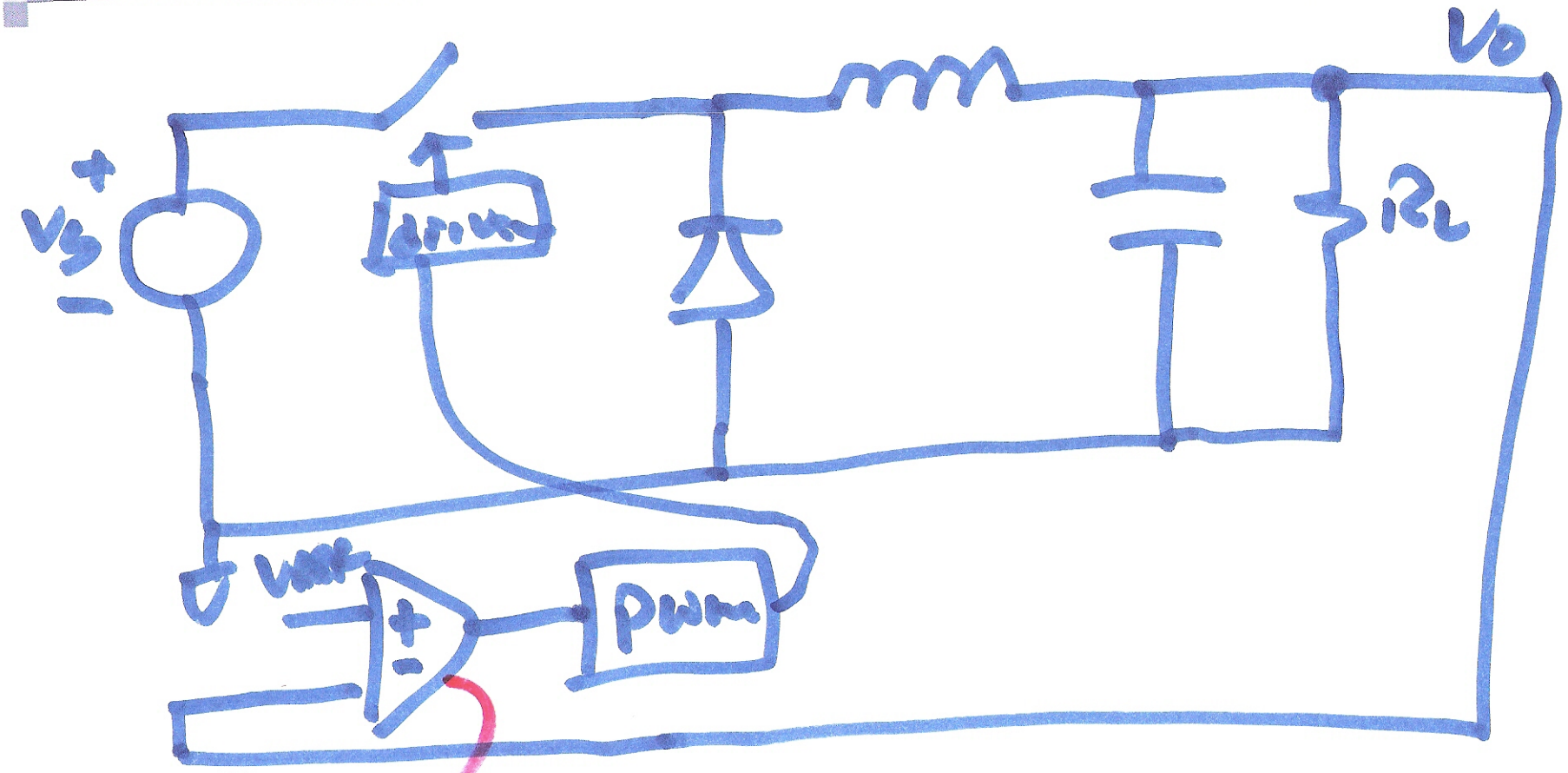


Pulse-width modulation

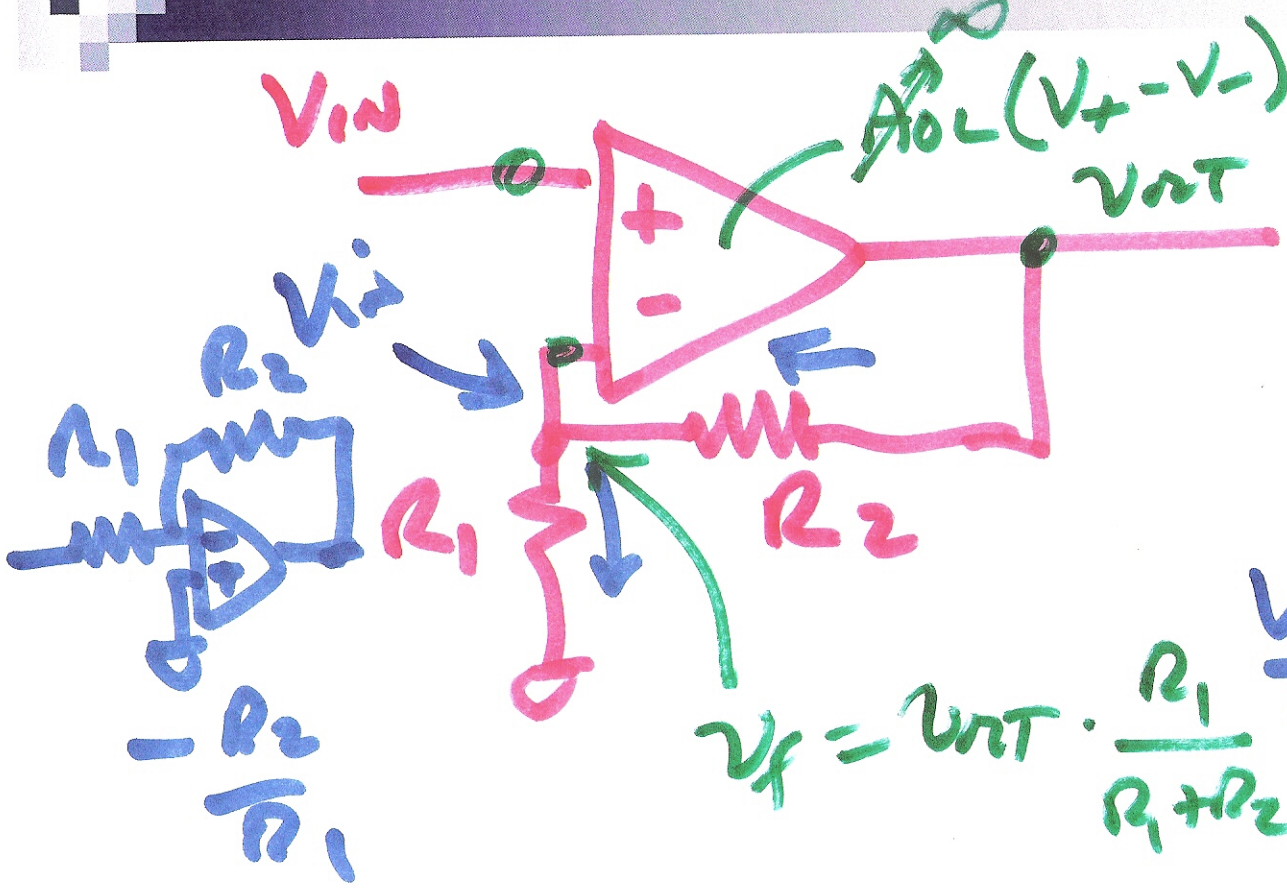
PWM

2)

PWM Control



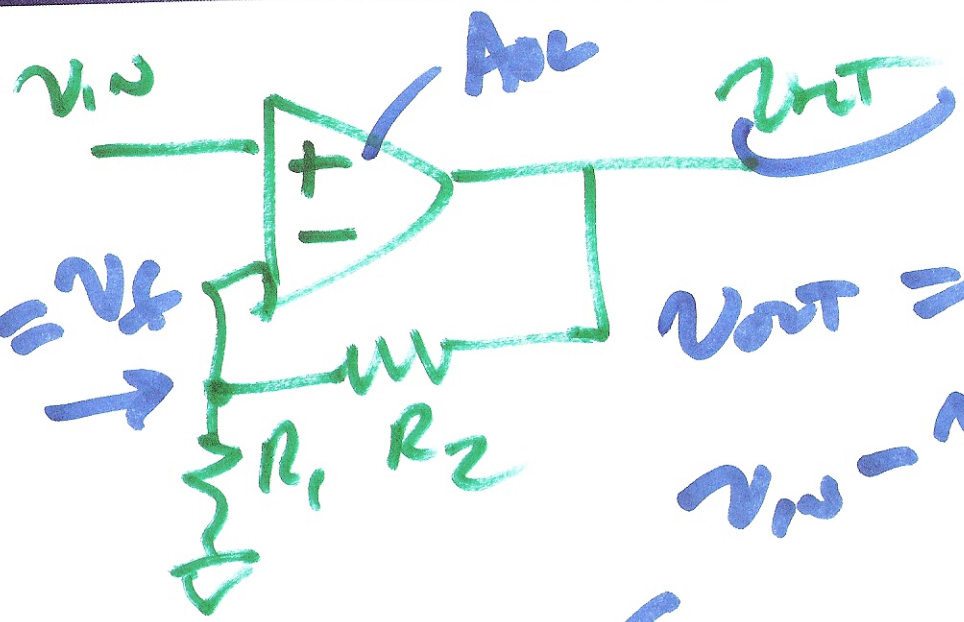
Basic f.b.



$$\frac{V_{in}}{R_1} = \frac{V_{OUT} - V_{in}}{R_2}$$

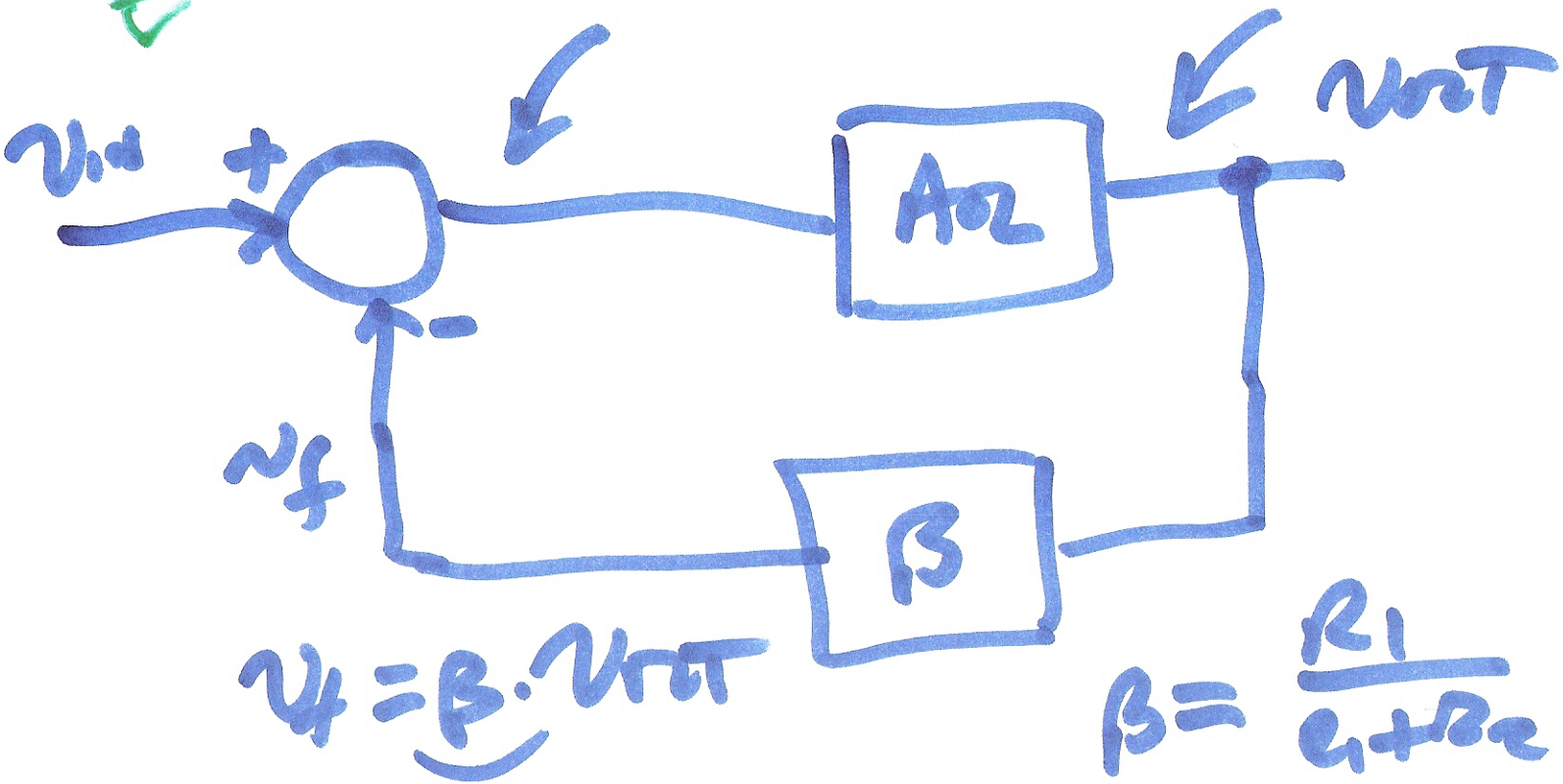
$$\frac{V_{OUT}}{V_{in}} = 1 + \frac{R_2}{R_1}$$

$$= \frac{R_2 + R_1}{R_1}$$



$$v_{OUT} = v_f \cdot \frac{R_1}{R_1 + R_2}$$

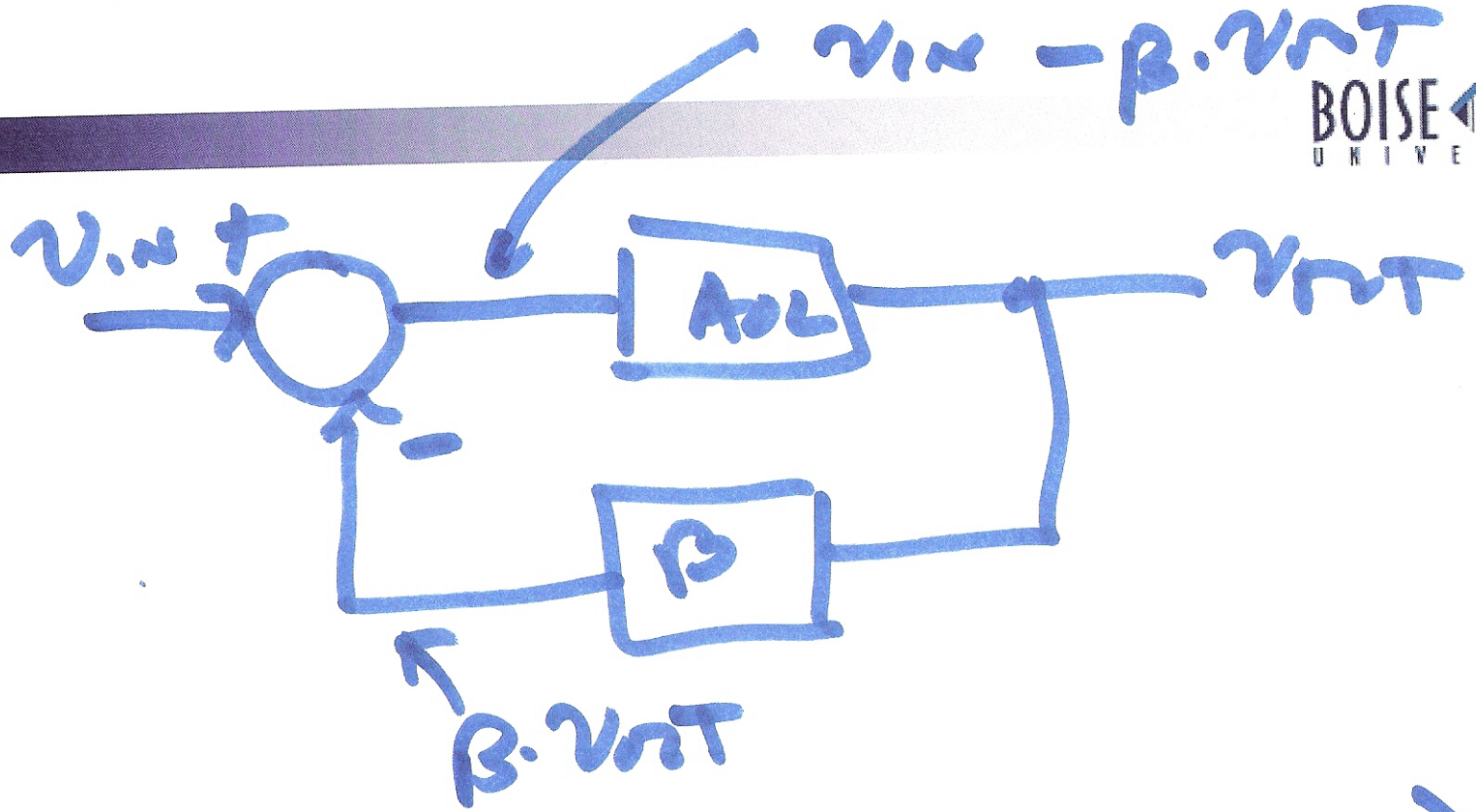
$$v_{in} - v_f \qquad (v_{in} - v_f) A_{OL}$$



$$v_f = B \cdot v_{OUT}$$

$$B = \frac{R_1}{R_1 + R_2}$$

5)



$$v_{out} = A_{OL}(v_{in} - \beta v_{out})$$

$$v_{out}(1 + \beta A_{OL}) = A_{OL} \cdot v_{in}$$

$$A_{CL} = \frac{v_{out}}{v_{in}} = \frac{A_{OL}}{1 + \beta \cdot A_{OL}}$$

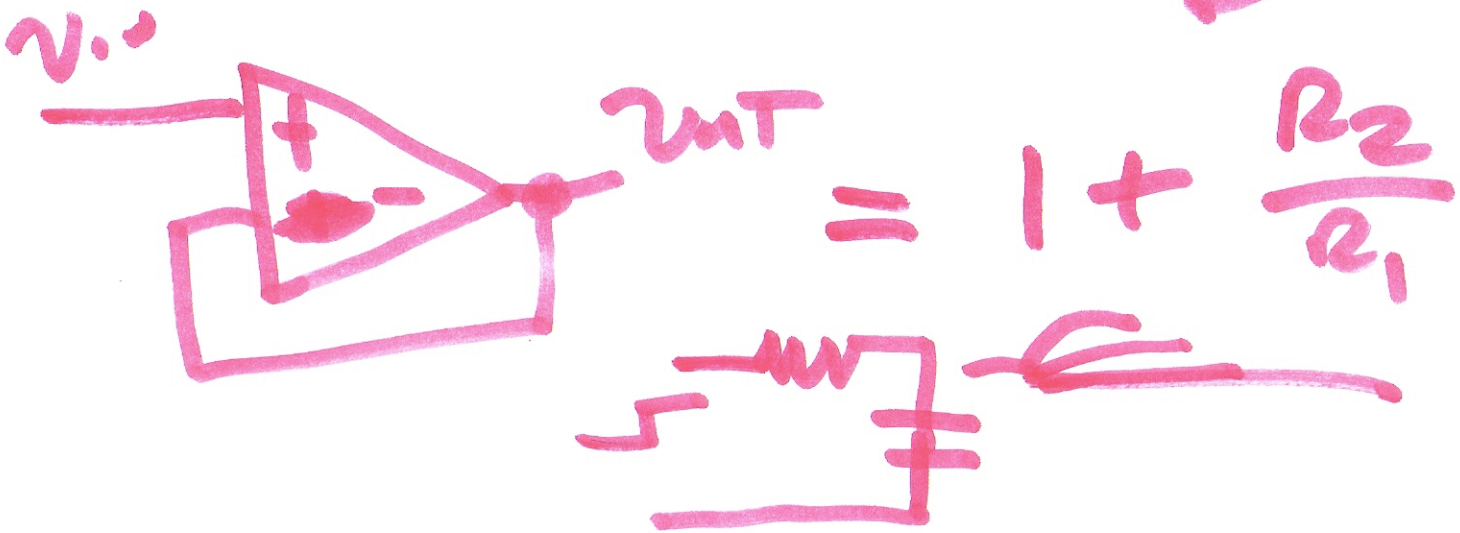
b)

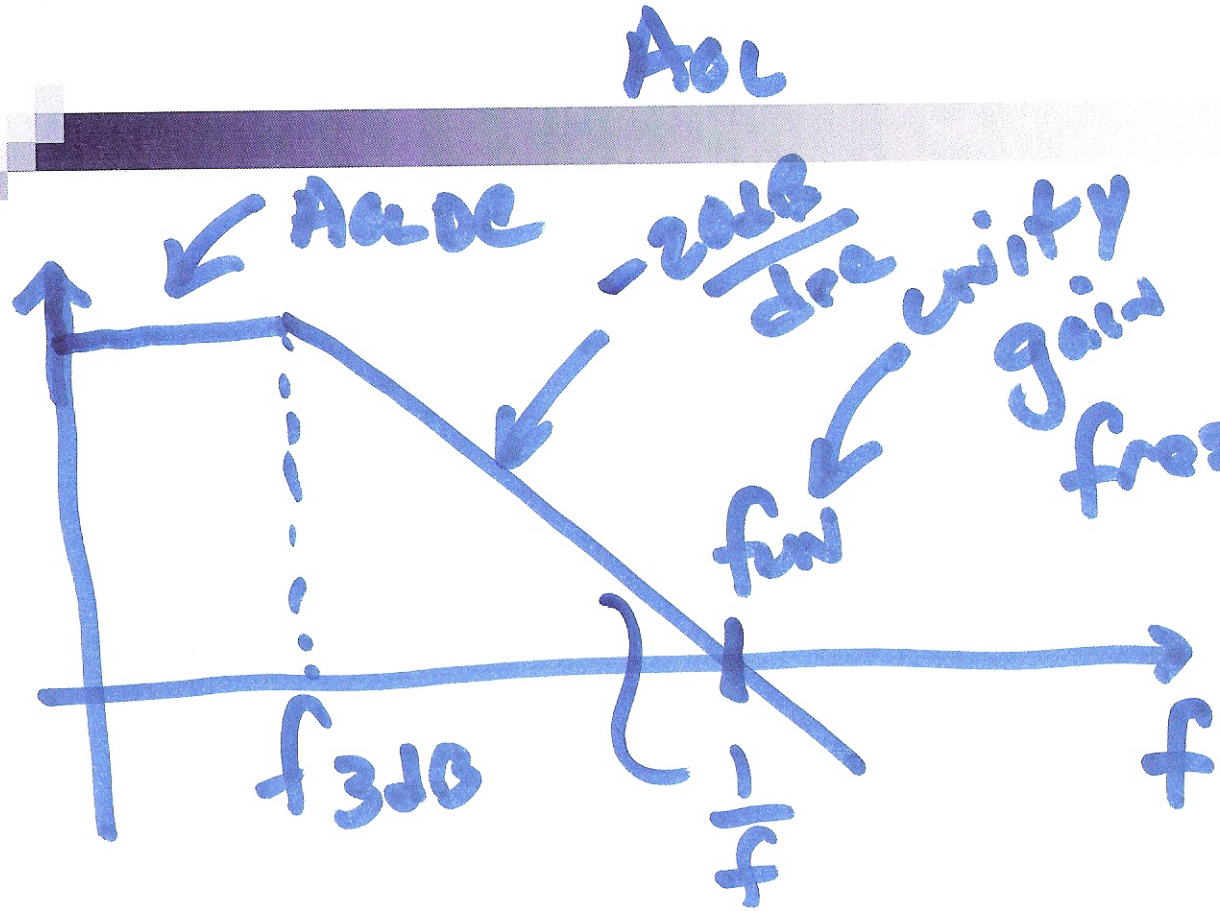
$$A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}}$$

$$= \frac{1}{\frac{1}{A_{OL}} + \beta}$$

$A_{OL} \to \infty$

$$A_{CL} = \frac{1}{\beta}$$





$$A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}}$$

$|\beta A_{OL}| = 1$

$\angle \beta \cdot A_{OL} = 180°$

1.2KHz ⇒ 12K

1dec

1.2KHz → 2.4K

3dB

1OCT

× 2

÷ 2

12dB × 4 $\beta = 1$

32dB × 40

× 10 × 2 × 2

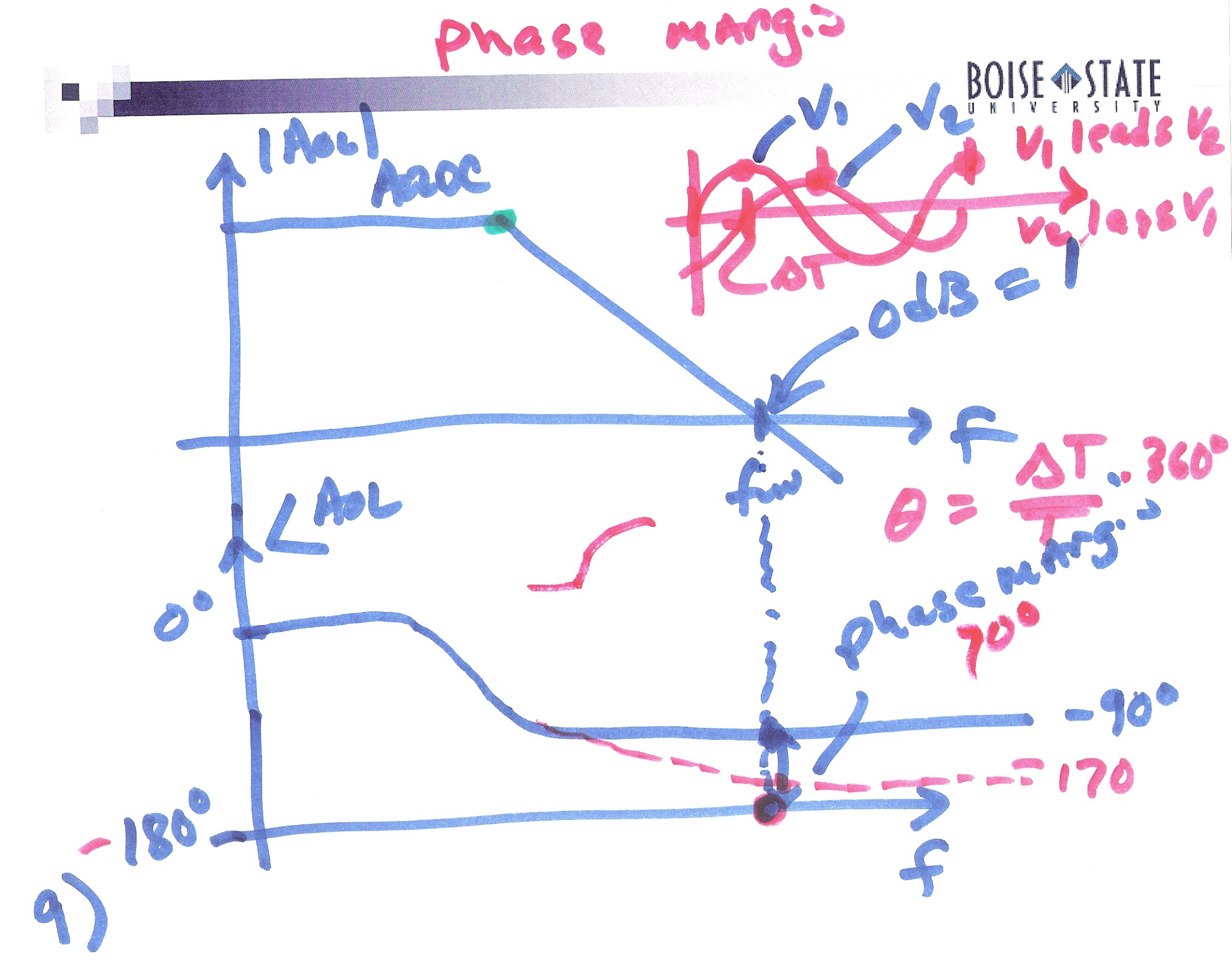
$|A_{OL}| = 1$

$\angle A_{OL} = 180°$

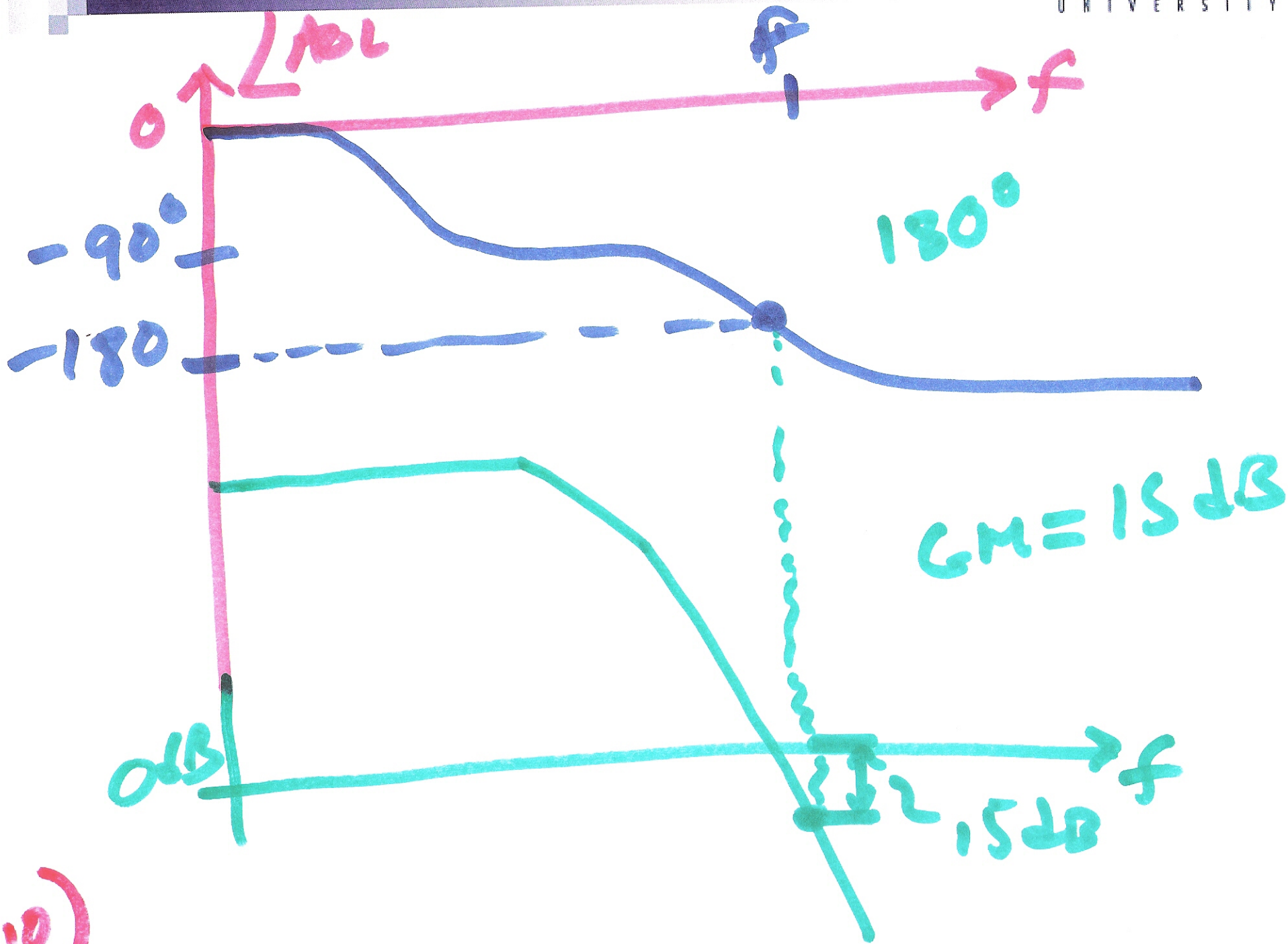
B) 6dB → × 2

-6dB ÷ 2

Phase marg.

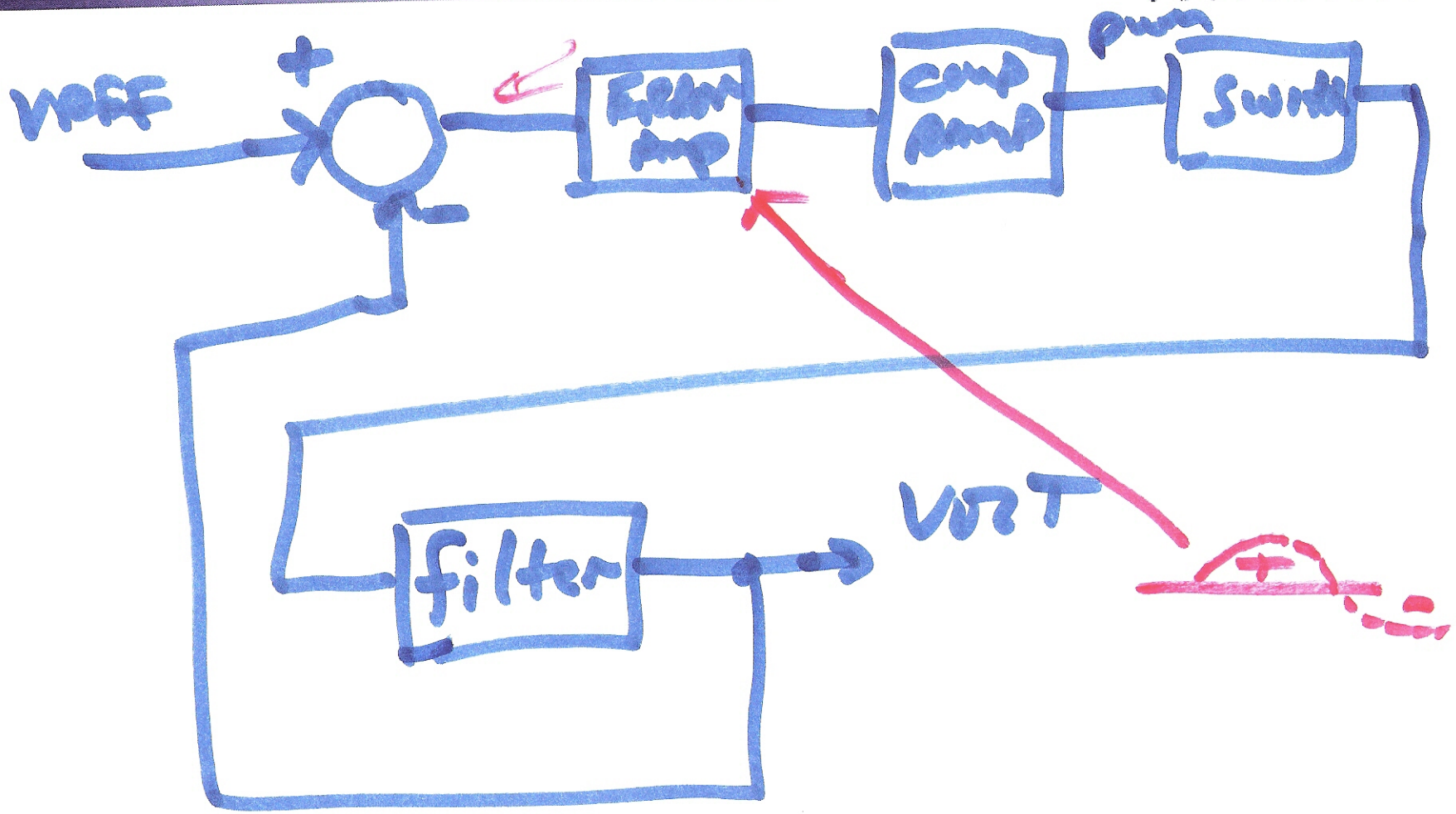

|Aol|
A2OC
V1
V2
V1 leads V2
V2 leads V1
ΔT
0dB = 1
f
fw
θ = ΔT/T .. 360°
<Aol
0°
phase marg.
70°
-90°
-170
-180°
f
9)

GAIN MARG:-



10)

PWM Block diagram



simple error Amp

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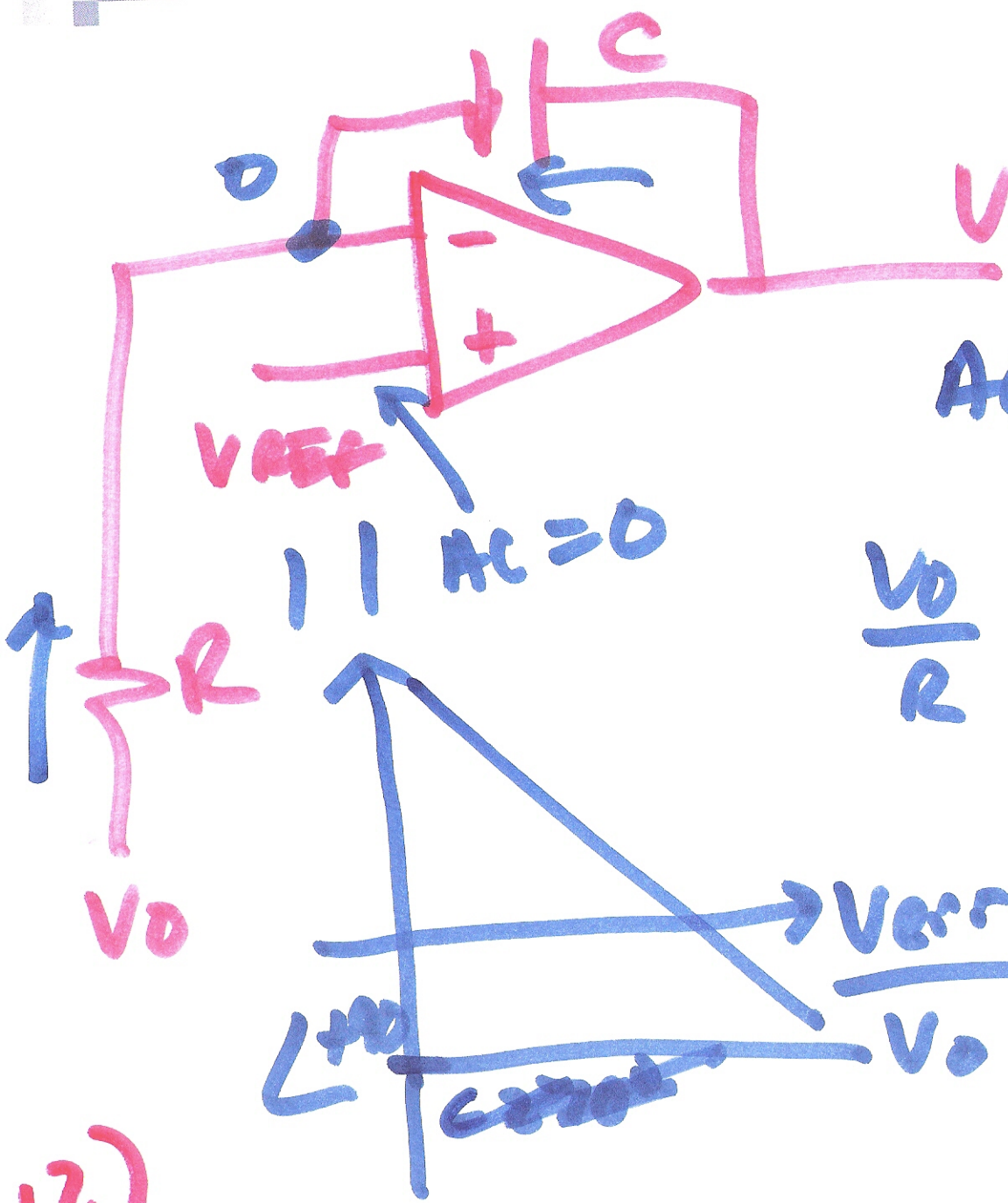
Integrator



AC Response

$$\frac{V_0}{R} + \frac{V_{err}}{1/j\omega C} = 0$$

$$\frac{V_{err}}{V_0} = \frac{-1}{j\omega RC} = \frac{j}{\omega RC}$$