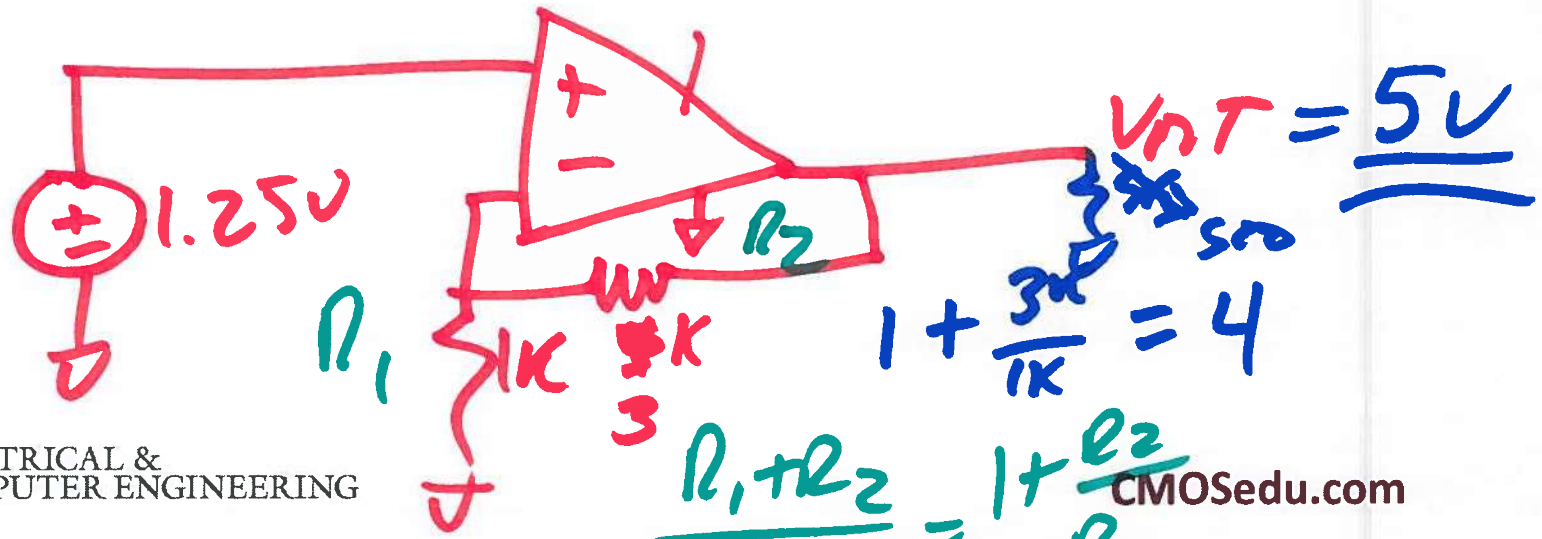
EE 421 / ECG 621
Digital IC Design
Lecture 14
Oct. 17, 2018

$-\frac{R_F}{R_{IN}}$

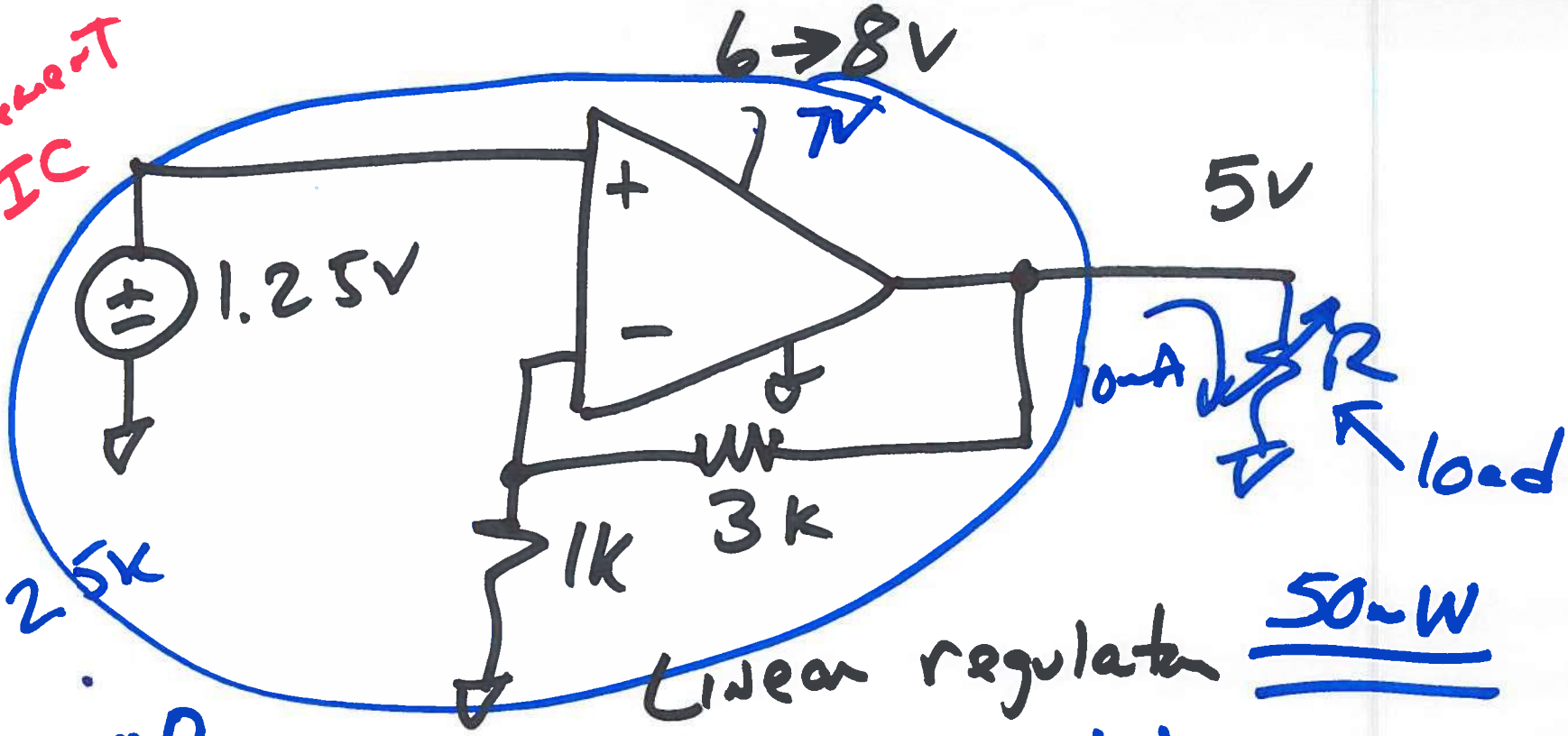
Boost switching power supply (SPS)

Linear power supply 6-7



Power management IC

PMIC



$\frac{S}{2mA} = 25K$

$\frac{S}{5mA} = 100$

Linear regulator 50mW

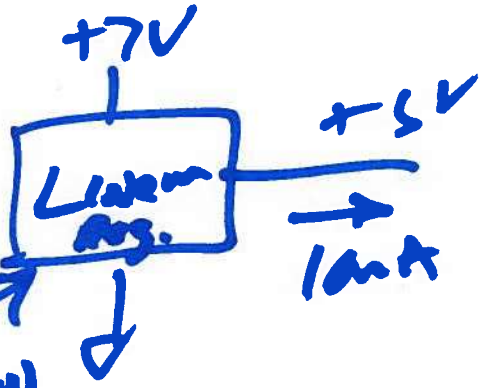
(power supply)

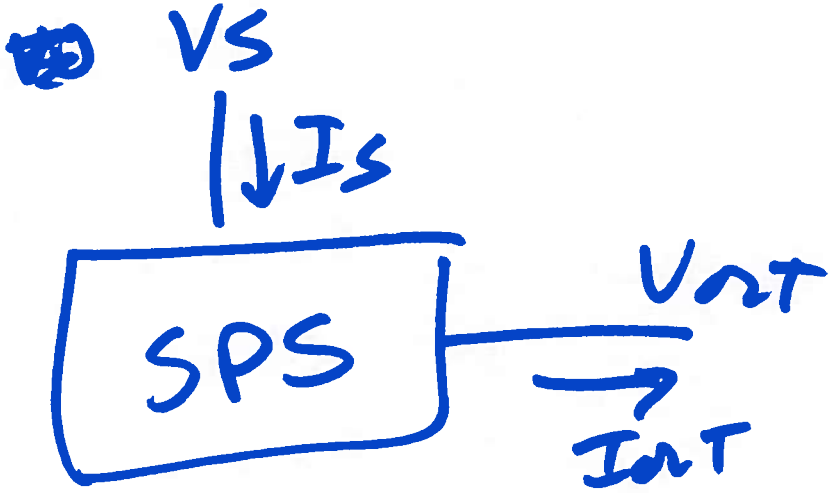
AA

1,000 mA·hr

1.5·hr = 1.5·3600

5400 J





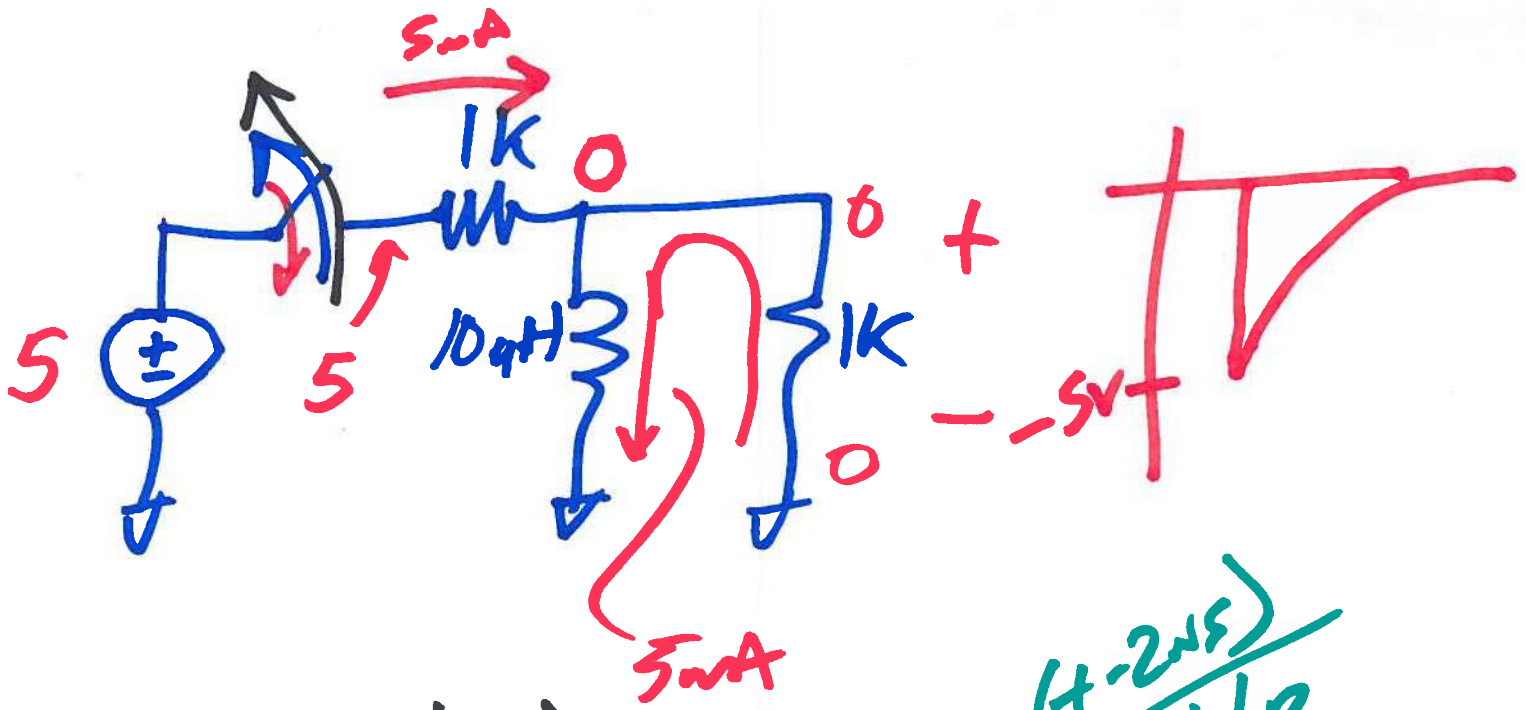
Ideally

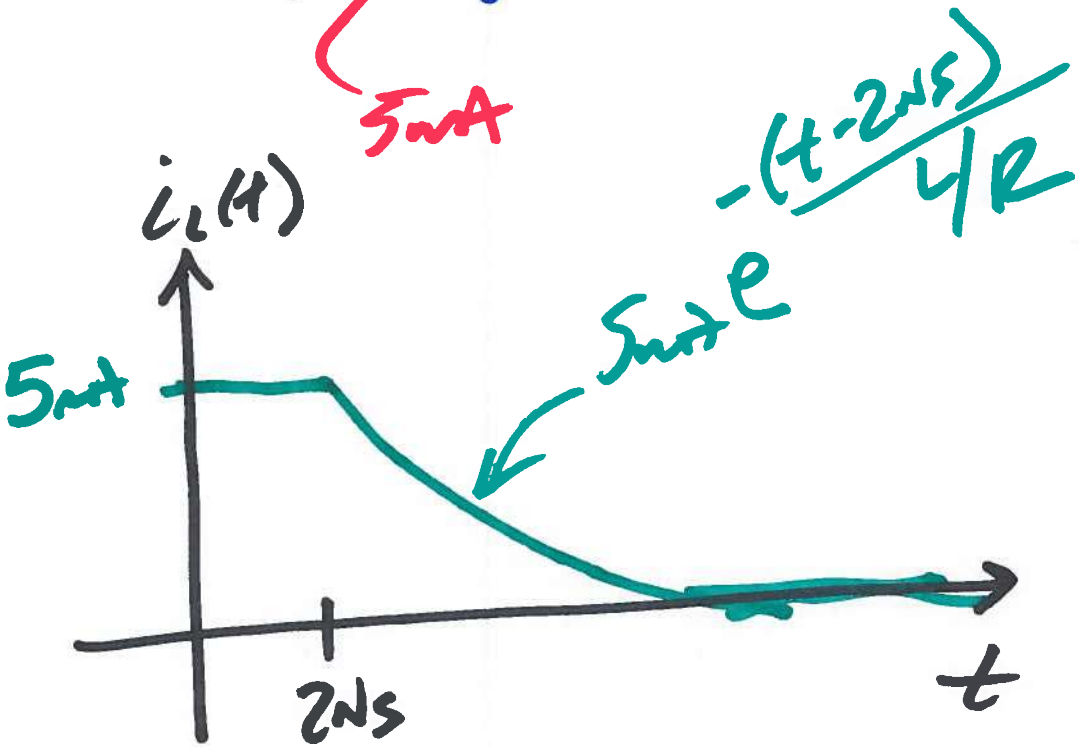
$$V_S I_S = V_{OUT} \cdot I_{OUT}$$

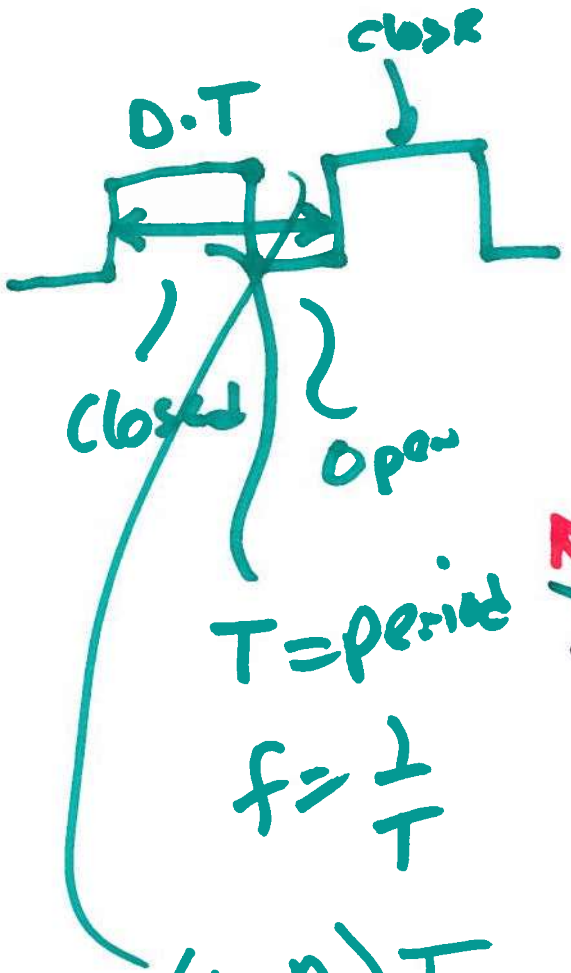
Reality

$$V_S \cdot I_S \cdot \eta = V_{OUT} I_{OUT}$$

$\eta > 90\%$


5mA
1K
0
0
+
5
5
10μH
1K
0
-5V
5mA

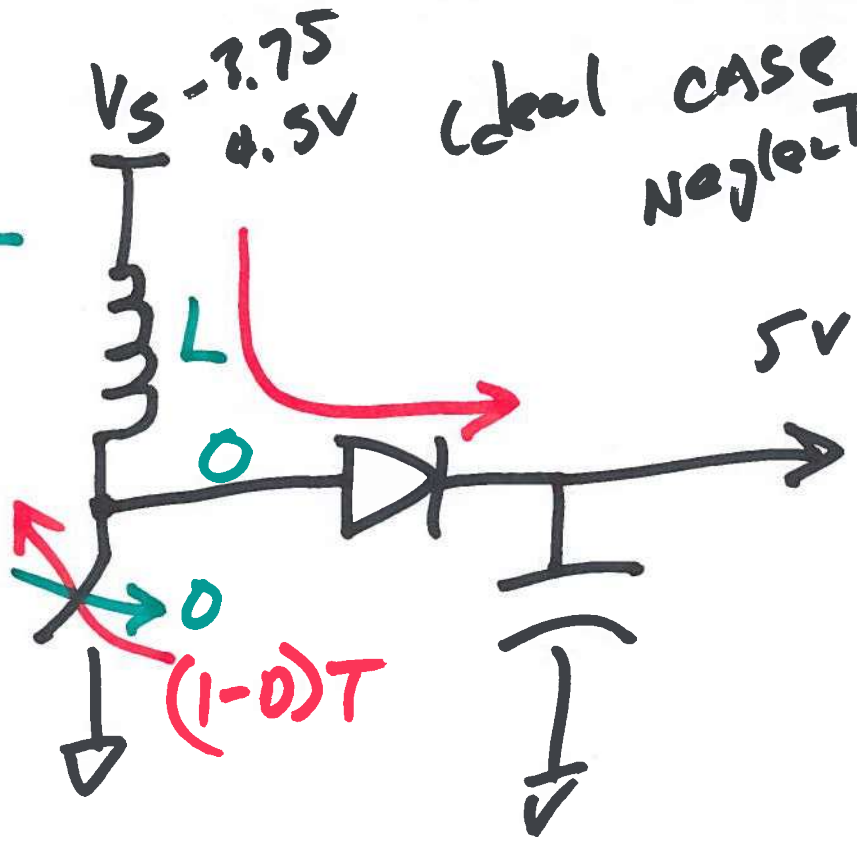

$i_L(t)$
$-(t-2ns)/4R$
5mA
5mA e
2ns
t



T = period

$f = \frac{1}{T}$

(1-D)T



Ideal case
Neglect diode drop

Boost

$V_{oT} > V_s$

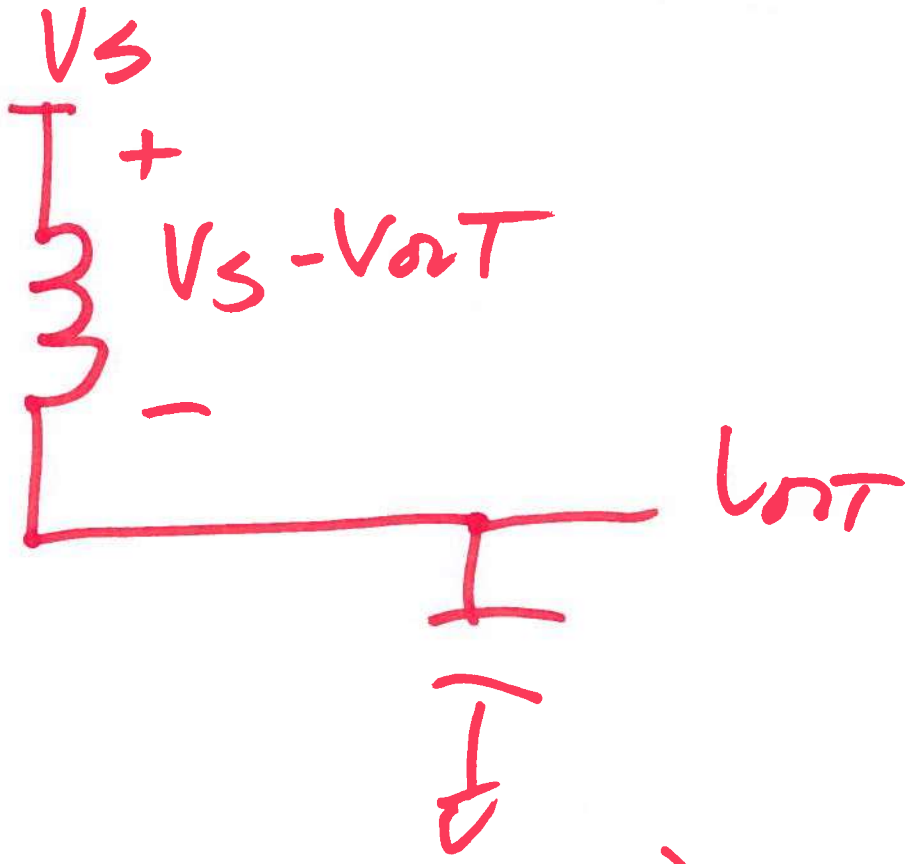
$L \frac{dI}{dT} = V = V_s - 0$

$V_s = L \cdot \frac{\Delta I}{D \cdot T}$

$\Delta I = \frac{V_s}{L} \cdot D \cdot T = \frac{V_s}{Lf} \cdot D$

$0 < D < 1$

↑ duty cycle



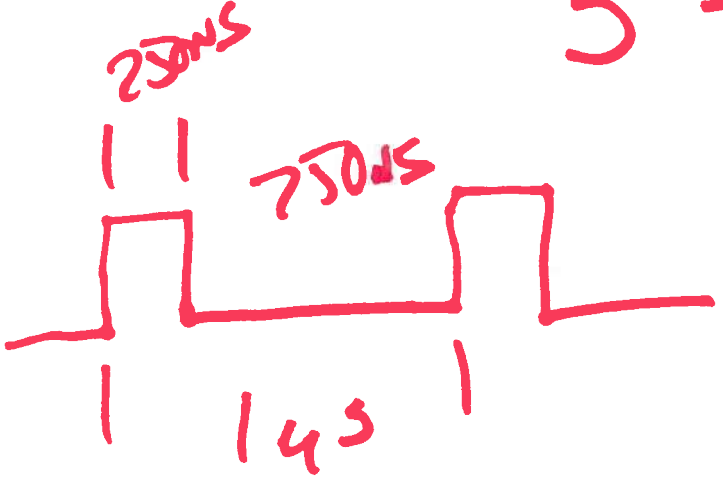
$$V = L\frac{di}{dt}$$

$$\Delta I = \frac{(V_S - V_{onT})}{L} \cdot (1-D)T$$

$$0 = \frac{V_S}{L} \cdot DT + \frac{V_S - V_{onT}}{L} \cdot (1-D)T$$

$$V_{OUT} = \frac{V_S}{1-D} \quad \text{(BOOST)}$$

$$5 = \frac{3.75}{1-D} = \frac{3.75}{.75} = 5$$



$$1-D = \frac{3.75}{5}$$

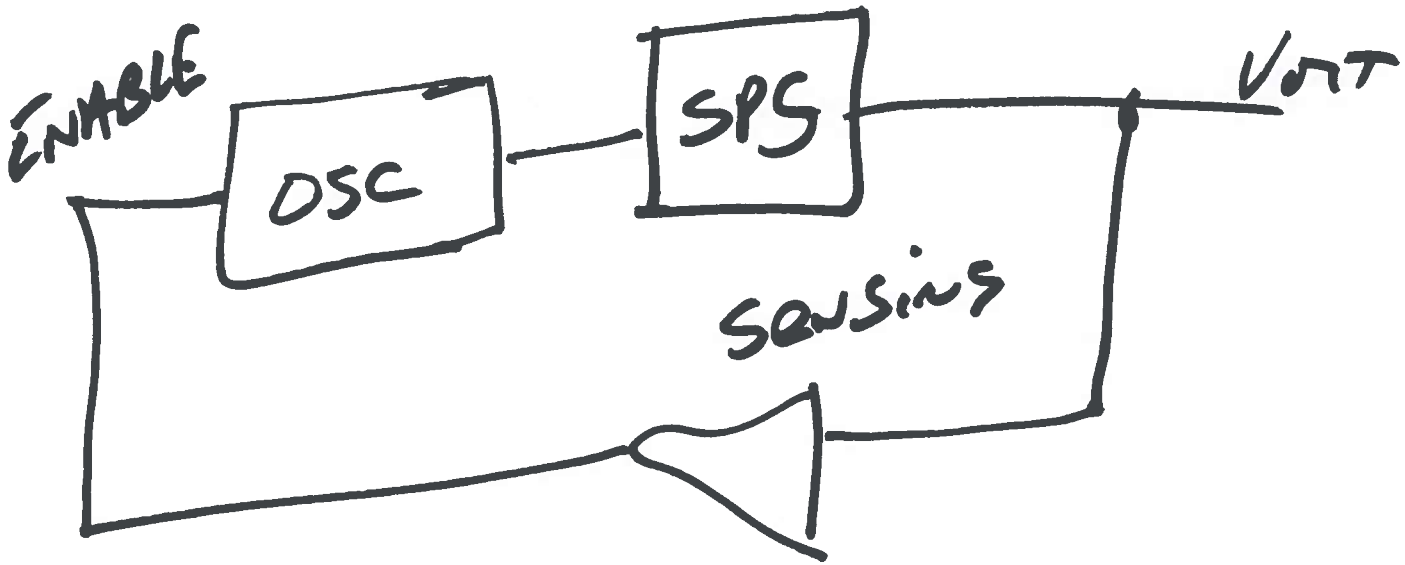
$$D = \frac{3.75}{D} + 1$$

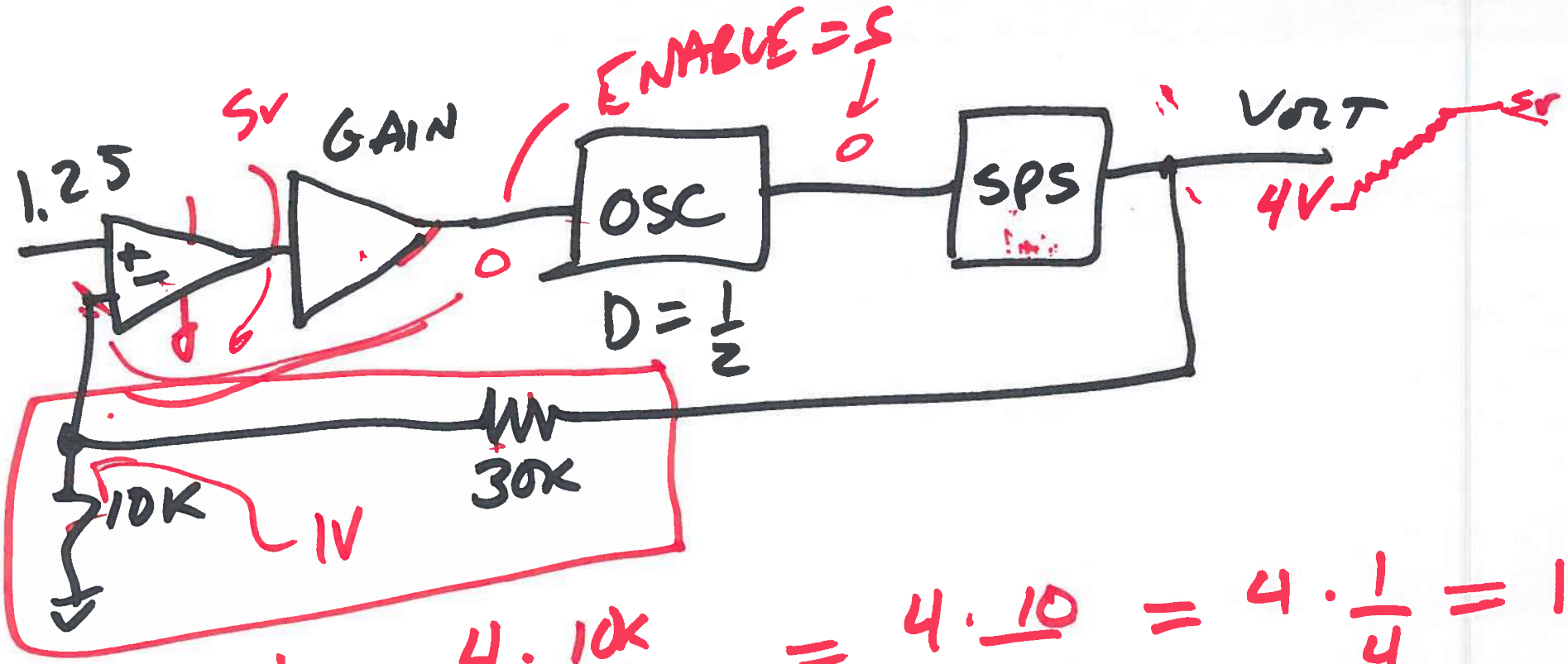
$$3.75 = 5 - 5D$$

$$1.25 = 5D$$

$$D = \frac{1.25}{5} = .25$$

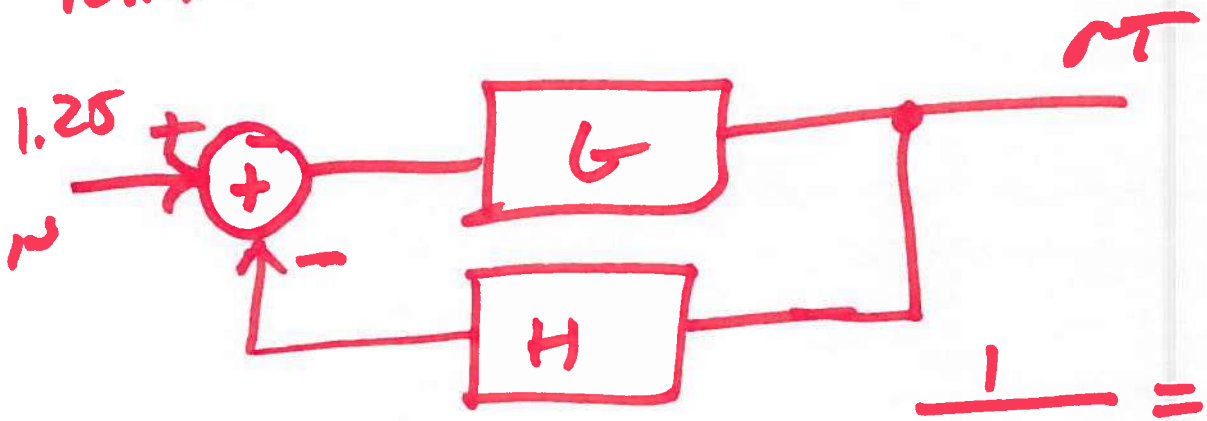
b)


ENABLE
OSC
SPS
VOUT
SENSING



$H = \frac{1}{4}$

$4 \cdot \frac{10k}{10k + 30\Omega} = 4 \cdot \frac{10}{40} = 4 \cdot \frac{1}{4} = 1V$



$\frac{OUT}{IN} = \frac{G}{1+GH} = \frac{\frac{1}{H}}{\frac{1}{GH}+1} = 4$

8)