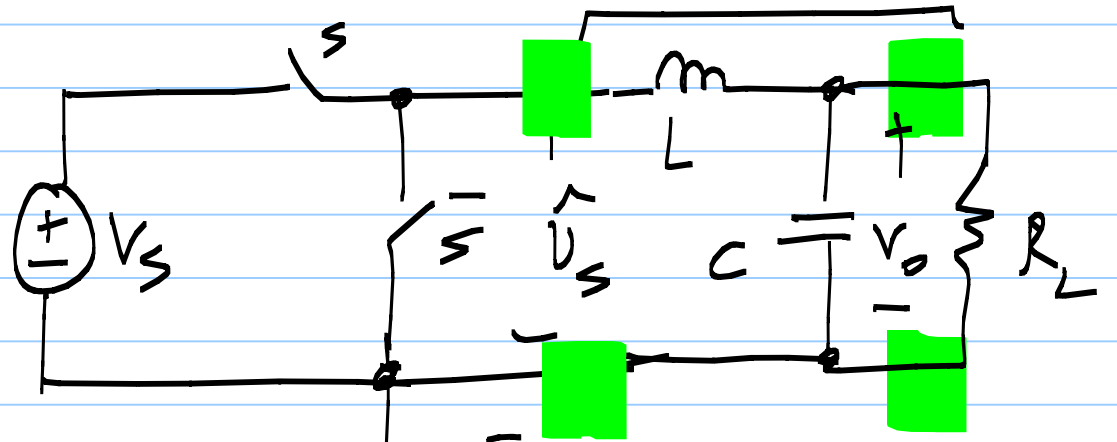
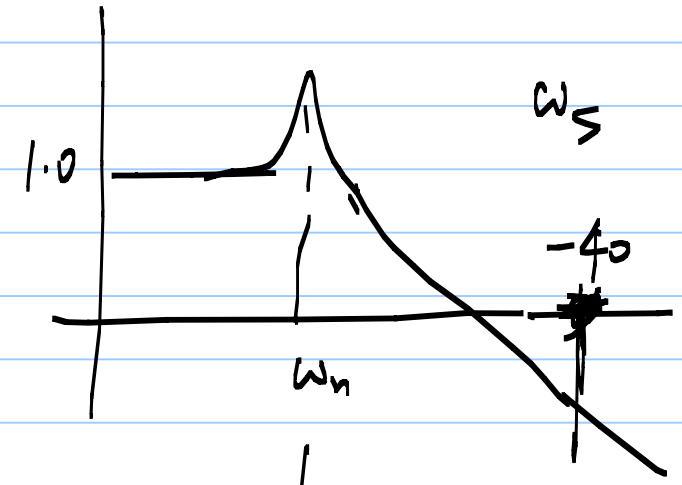
EE 2019

dc-dc converters

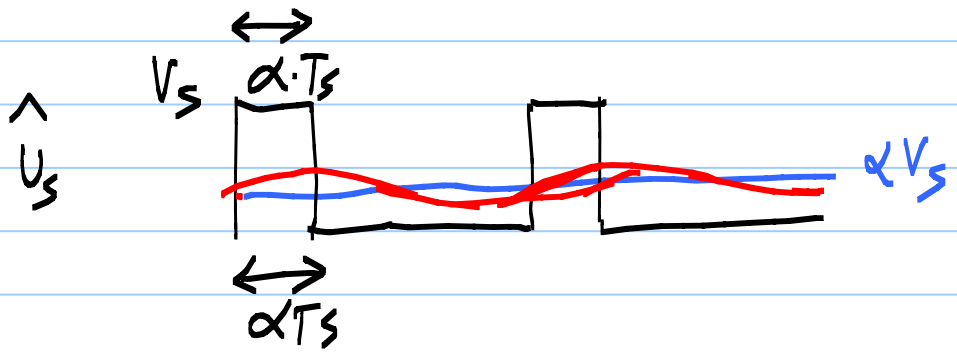
$R_L\sqrt{\frac{C}{L}}$

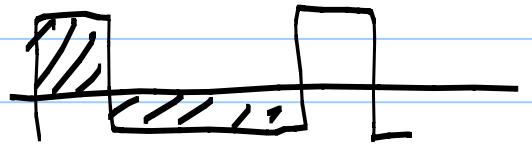
10/3/2017

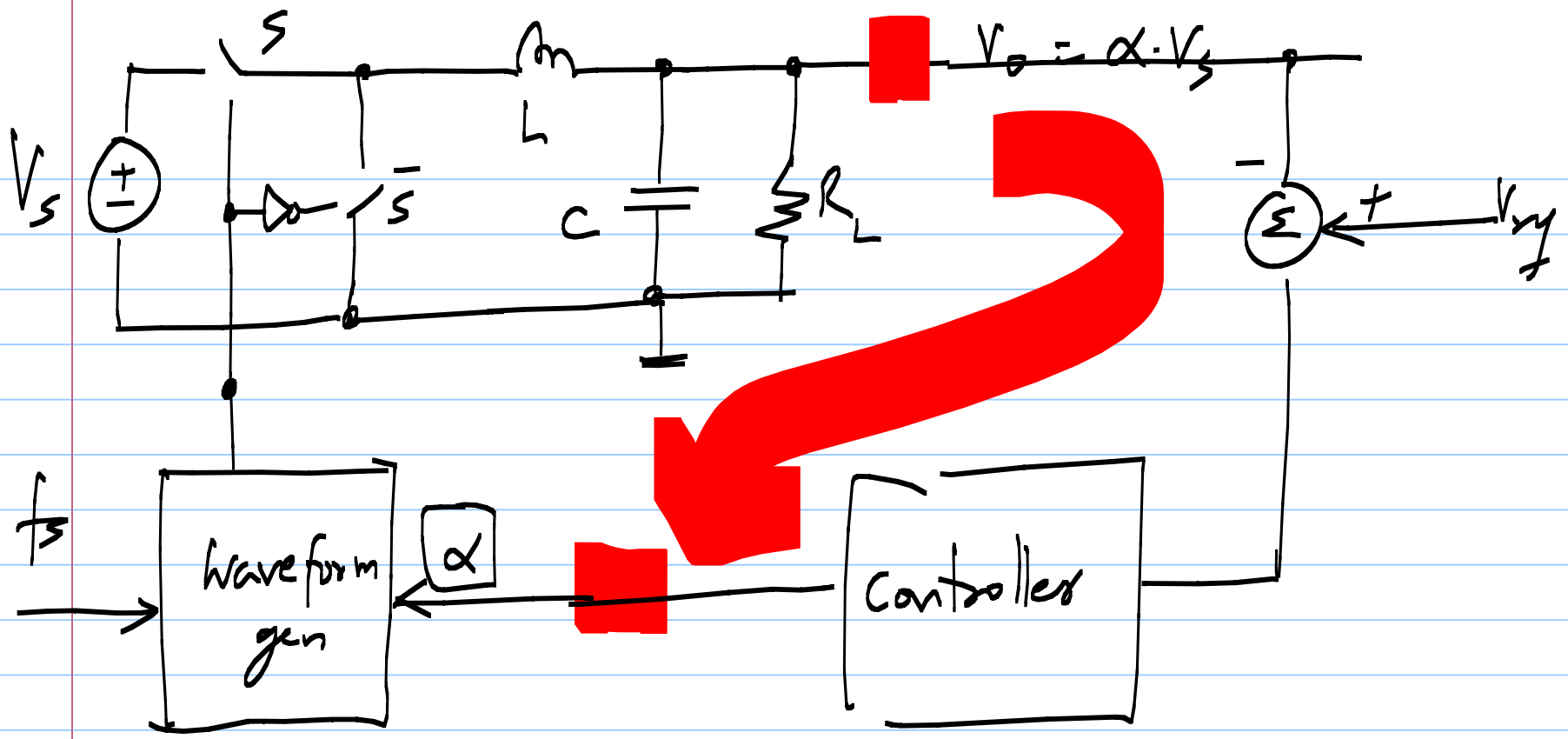


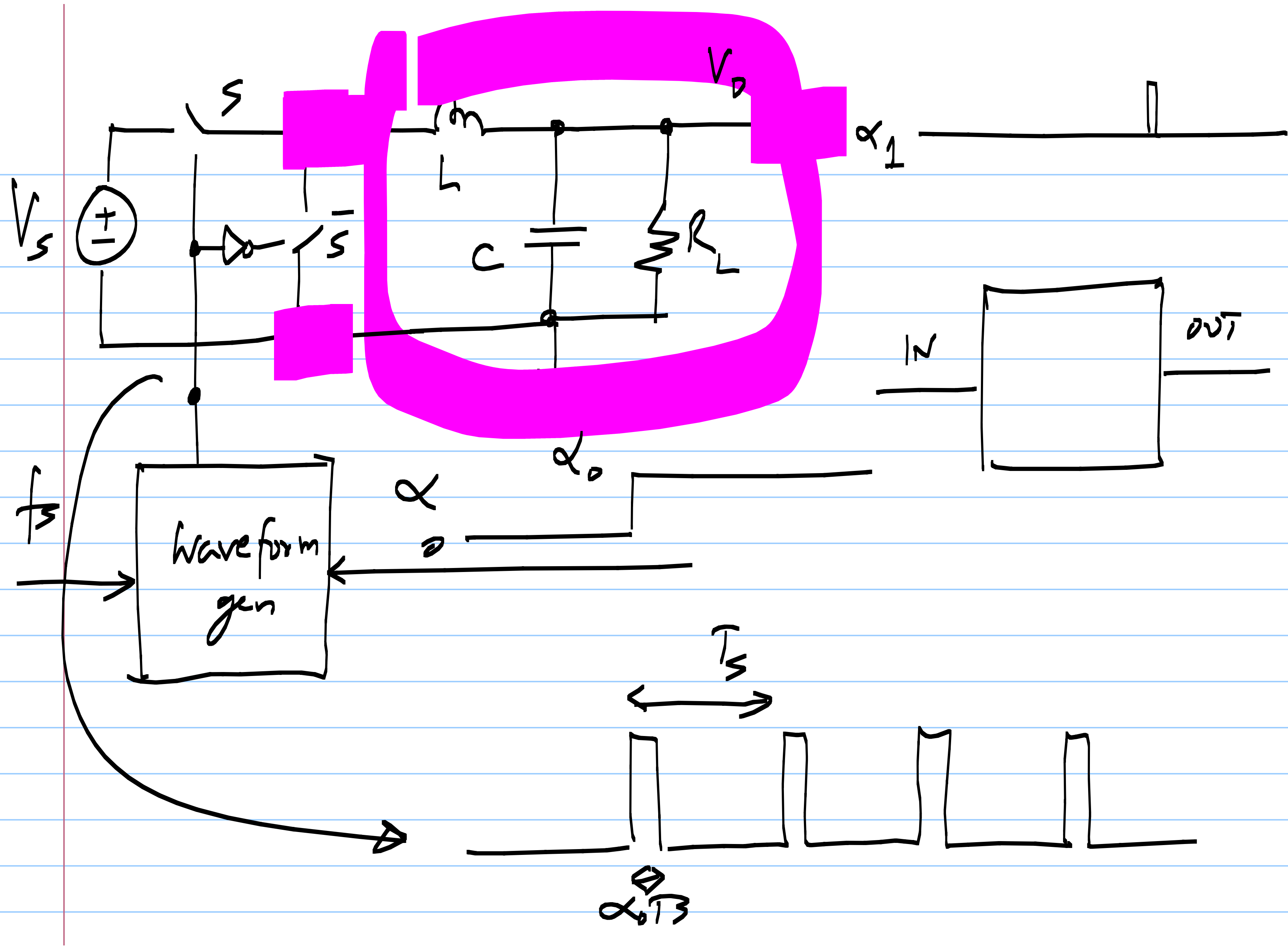


$$f_s \gg \frac{1}{2\pi\sqrt{LC}}$$

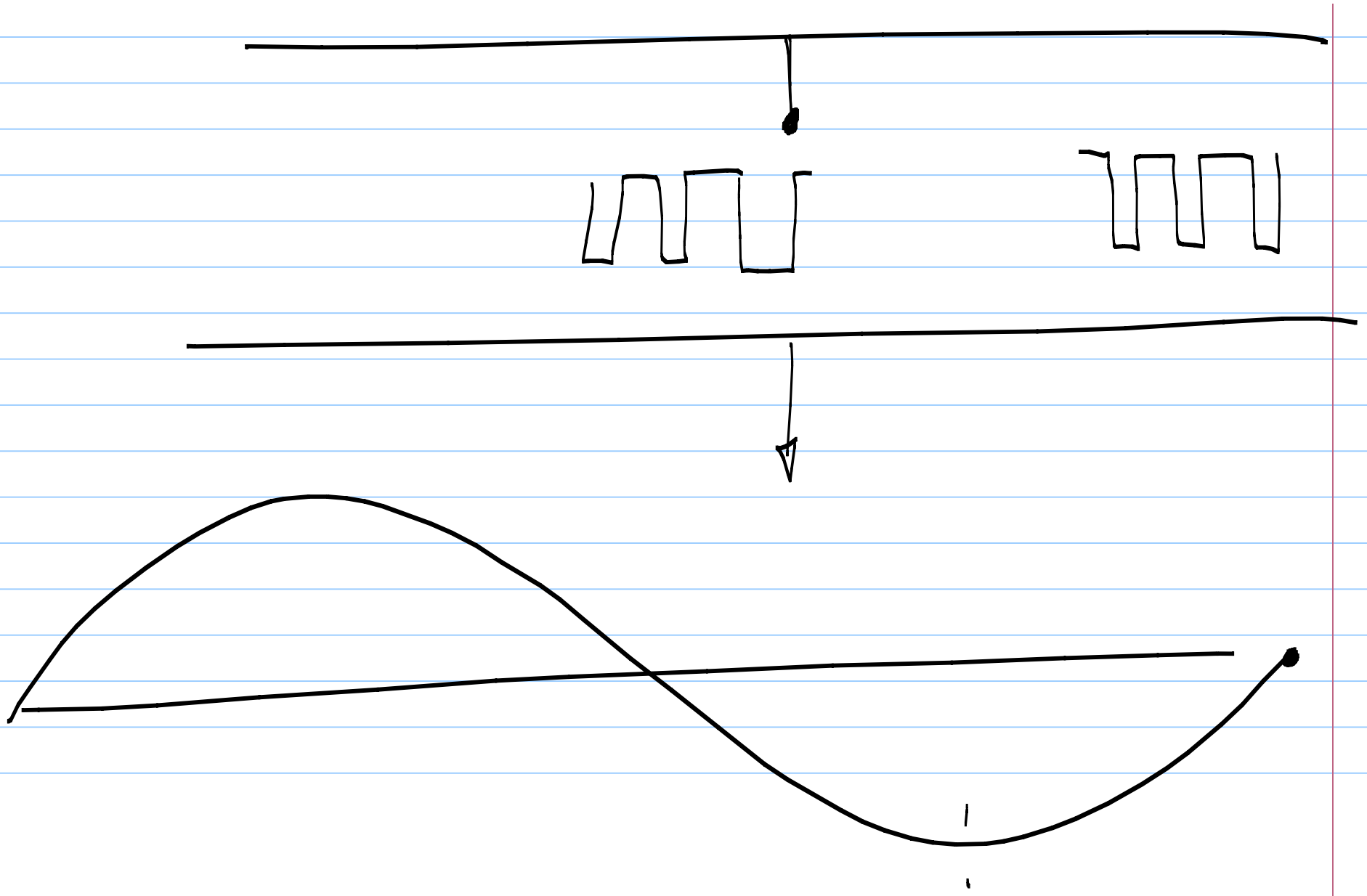


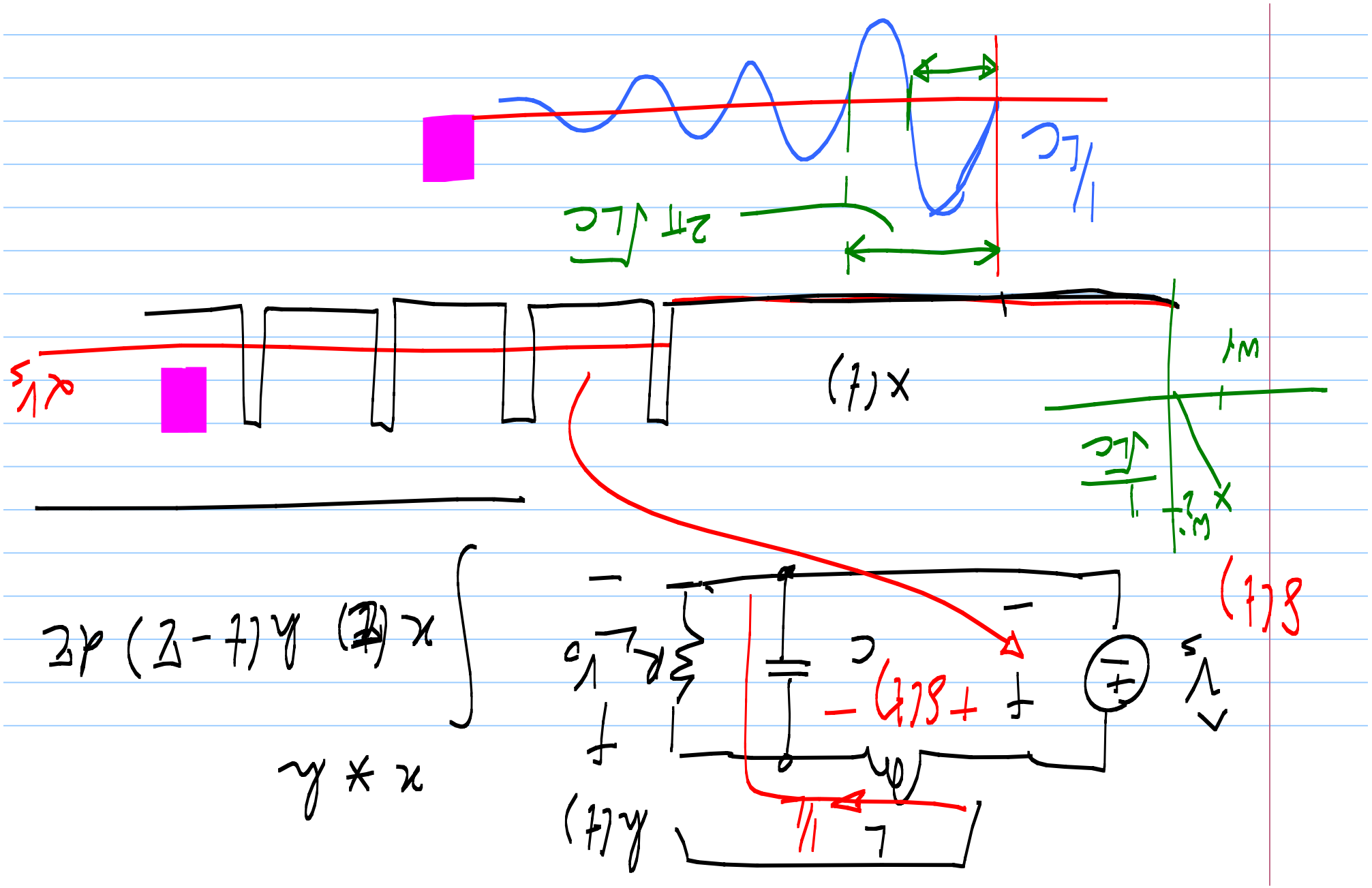



S
L
$V_o = \alpha \cdot V_s$
V_s
$\bar{S}$
C
R_L
V_{ref}
f_s
waveform gen
α
Controller

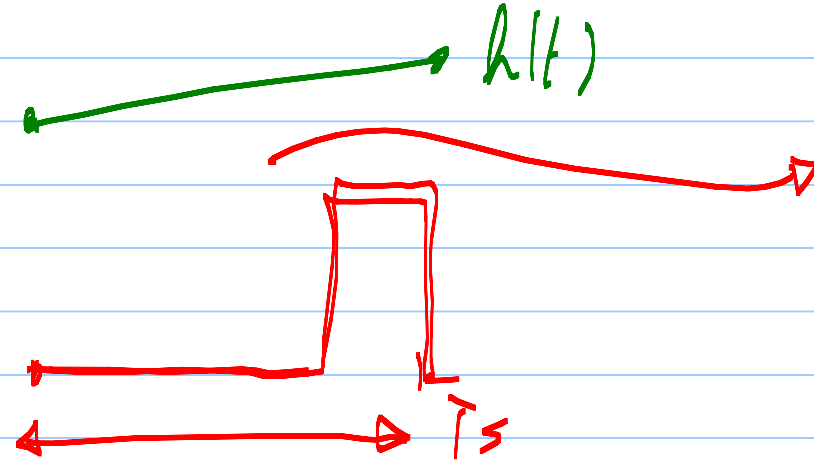


V_s
S
$\bar{S}$
L
C
R_L
V_o
α_1
α_0
α
f_s
Waveform gen
IN
OUT
T_s
$\alpha_0 T_s$




$1/LC$
$2\pi\sqrt{LC}$
$x(t)$
ω_1
$\sqrt{LC}$
ω_2
$g(t)$
$y(t)$
L
C
$+ g(t) -$
V_s
$x * y$
$\int x(\tau) y(t-\tau)\, d\tau$

$\simeq 2\pi\sqrt{LC} \gg T_s$

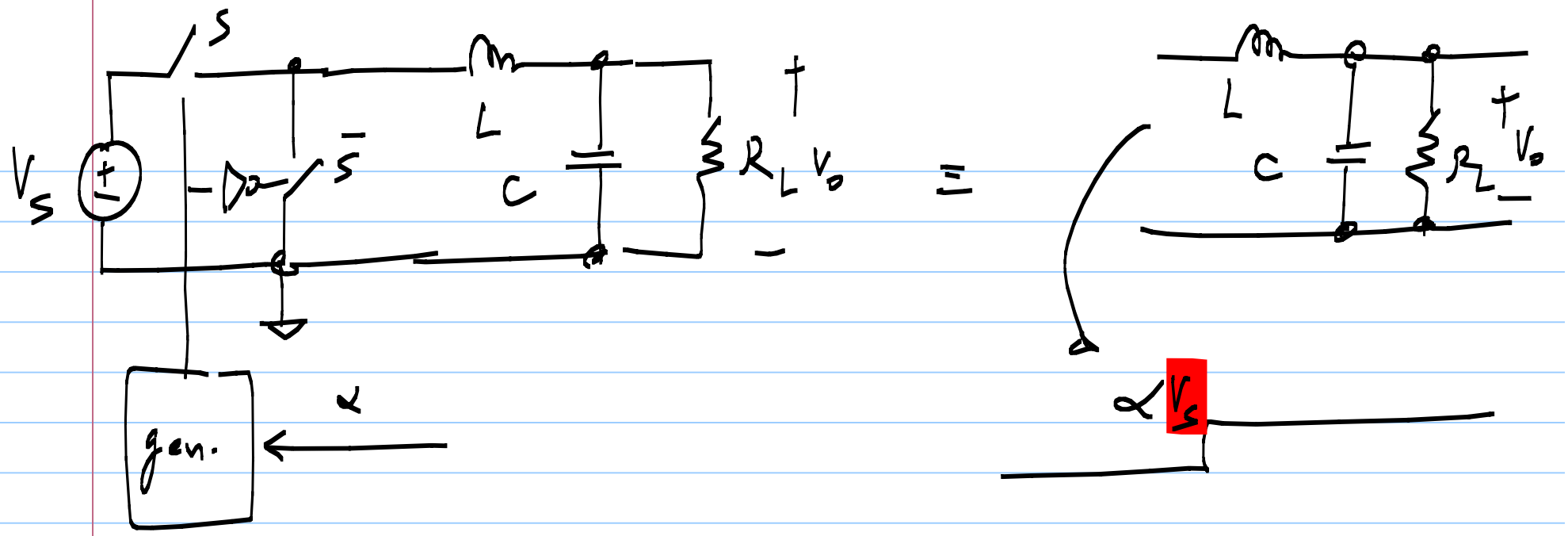


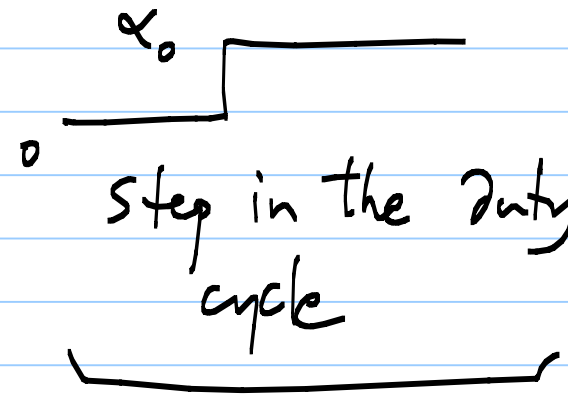
$$\int \underbrace{h(\tau)}_{h_o} x(t-\tau)\,d\tau$$

$$h_o \underbrace{\int x(t-\tau)\,d\tau}$$

* Impulse response of the LC filter hardly changes within a switching period.

⇒ * The input can be approximately represented by its average in each period.



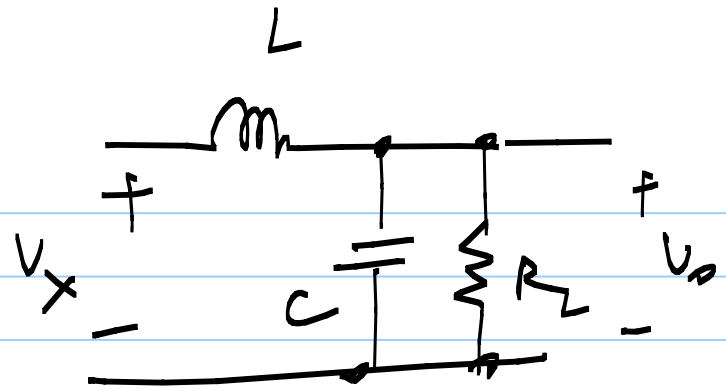


Step in the duty cycle

Response of the circuit to a step α_0 in the duty cycle $\simeq$

Response of the (LTI) LC lowpass filter to a step input $\alpha_0 V_s$

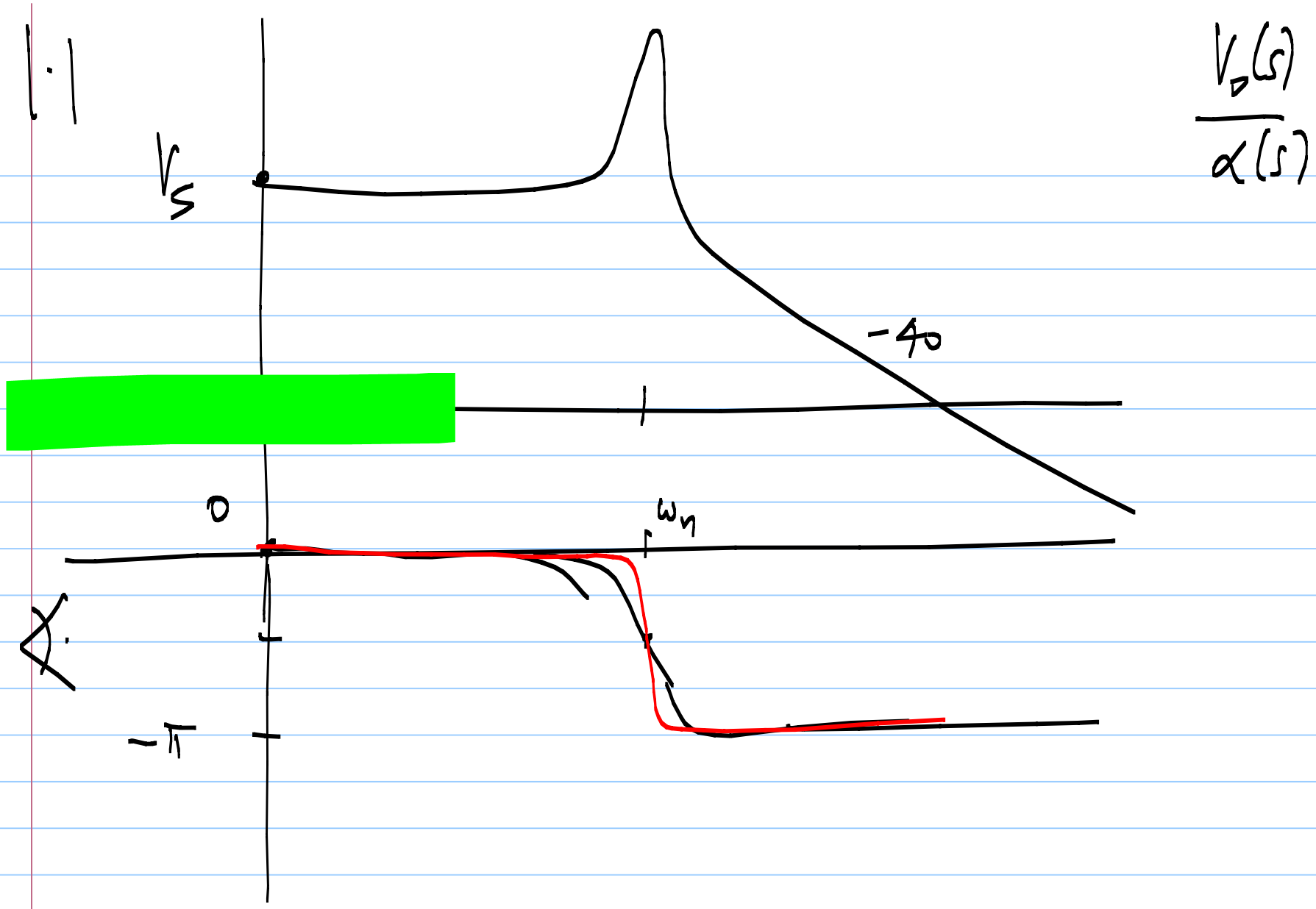
$$\frac{V_o(s)}{\alpha(s)} =$$



$$\frac{V_o(s)}{V_x(s)} = \frac{1}{s^2LC + s\frac{L}{R_L} + 1}$$

$$\alpha(s) \cdot V_s$$

$$\frac{V_o(s)}{\alpha(s)} = V_s \cdot \frac{1}{s^2LC + s\frac{L}{R_L} + 1}$$


1:1
V_s
$\frac{V_o(s)}{\alpha(s)}$
-40
0
ω_n
$\angle$
$-\pi$