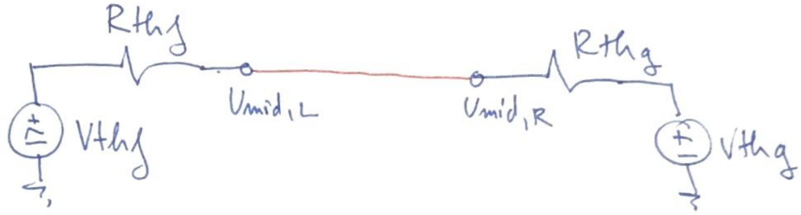
EE16A

Lecture 10 - Module 2

Today: Note 20

* Composing blocks (continued)
* Design procedure
* Design examples



$V_{mid,L\,oc} = V_{thf} \neq V_{mid,L} = \frac{R_{thg}}{R_{thg}+R_{thf}} \cdot V_{thf} + \frac{R_{thf}}{R_{thf}+R_{thg}} V_{thg}$

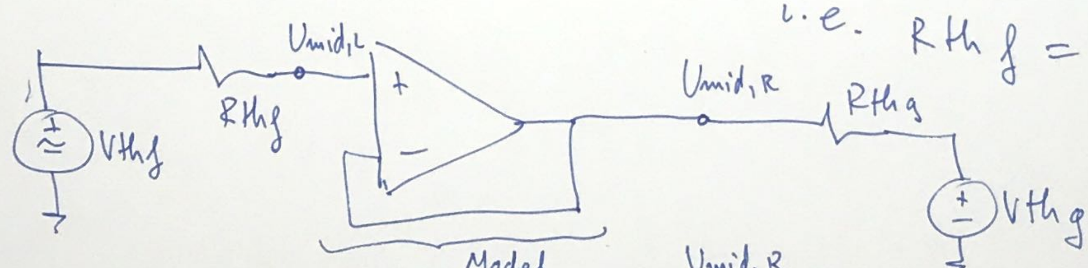
in general

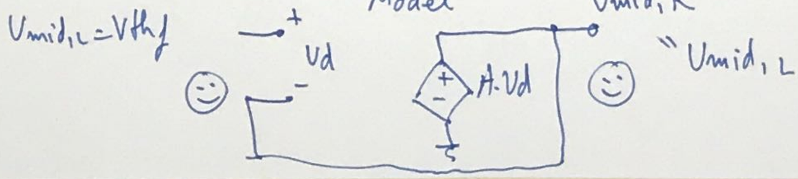
except when: $R_{thf} = 0$ or $R_{thg} \to \infty$ is o.c.

Ideal isolation:

From perspective of block f => see an open-circuit i.e. $R_{thg} \equiv$ o.c.

From perspective of block g => see a voltage source i.e. $R_{thf} = 0$

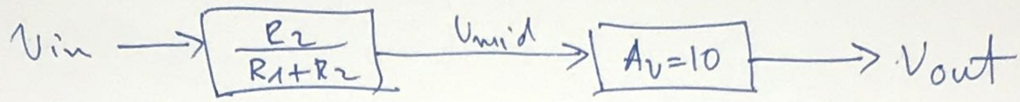




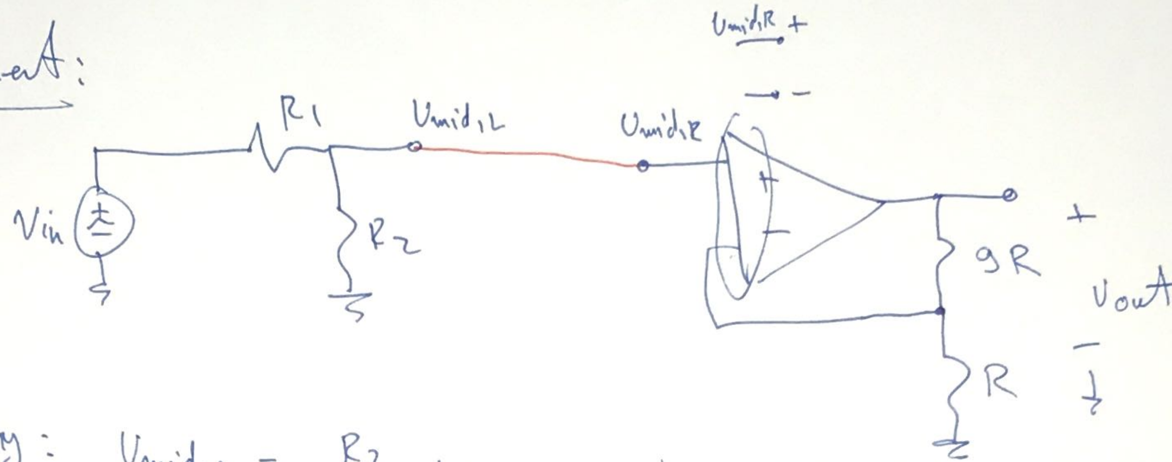
(2)

Example 1:

Want this:



Implement:

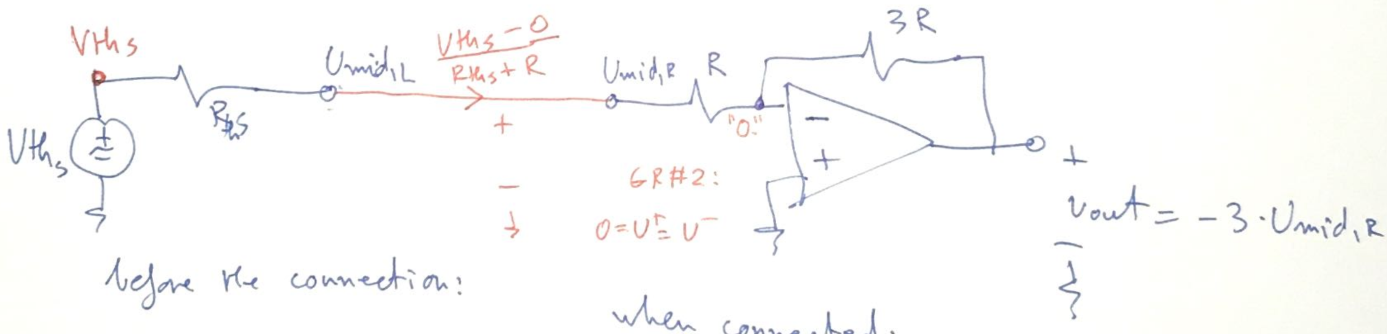


Verify: $U_{mid,L} = \frac{R_2}{R_1+R_2} V_{in}$

$U_{mid,L} = U_{mid,R}$ ☺

$A_v = \frac{V_{out}}{V_{mid,R}} = 10$

Example 2:



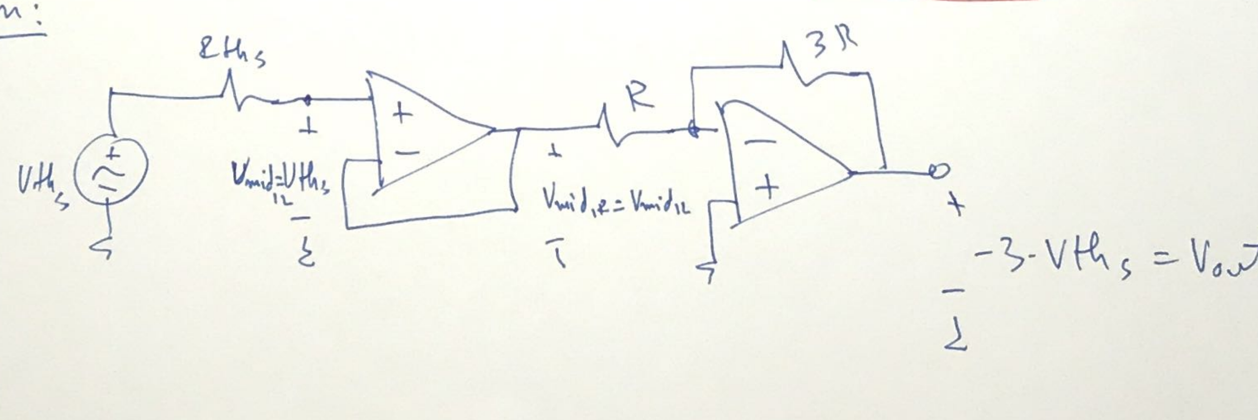
before the connection:

$U_{mid,L} = V_{th_S}$

when connected:

$U_{mid,L} = \frac{R}{R+R_{th_S}} \cdot V_{th_S} \neq V_{th_S}$

soln:



(l3)

Design procudere

step 1: (specification)

Concretely (re)state your goal for the design. (most often from a word spec)

step 2: (strategy)

Describe (often as a block diagram) the strategy to achieve the goal.

↳ often review what you can measure vs. what you wanted to know

↳ what is the relationship between the two (e.g. touch / no-touch)

[touch / no-touch] → [change in cap] → [change in voltage]

step 3: (Implementation)

Implement the componente within the strategy

↳ Remind yourself of blocks you know that can provide the desired block function

↳ Think about how to extend / modify the blocks you know (atlest #1000)

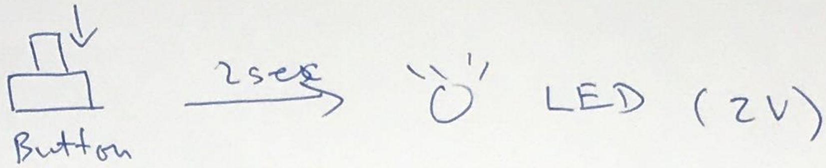
step 4: (Verification / analysis)

Does the implementation in step 3 do what is specified in step 1?

↳ check for block-to-block connections

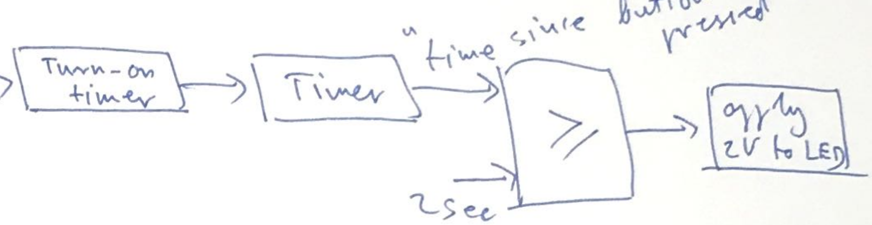
(4)

Example design #1: ("Countdown timer")



step 1: (spec) Build a circuit that after a button is pressed measures 2s and will then apply 2V across the LED. (I assume you can only push the button once)

step 2: Strategy Push the button →

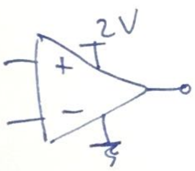


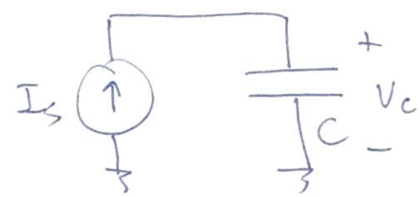
step 3: Implement

Turn-on circuit:

Timer:

$\geq$:

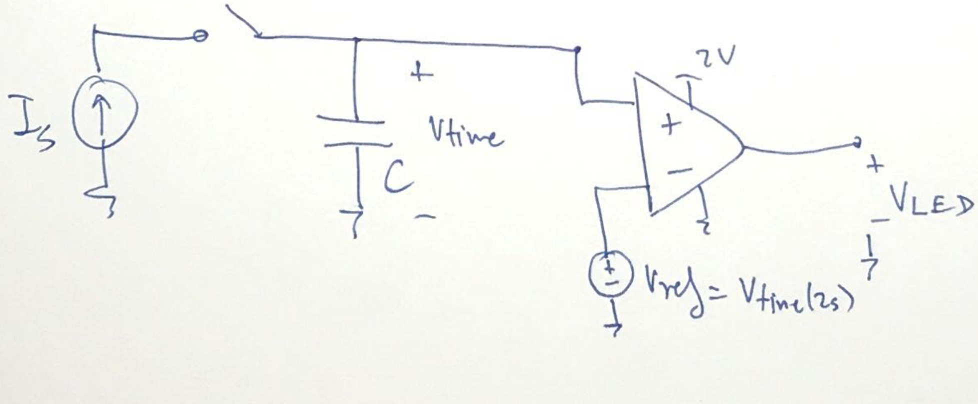




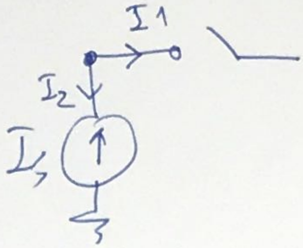
$$I_c = C\frac{dV_c}{dt}$$

$$\underbrace{V_c(t)}_{V_{time}} = \frac{I_s}{C}\cdot t + \underbrace{V_c(0)}_{=}$$

Together:



(5) step 4: Verify



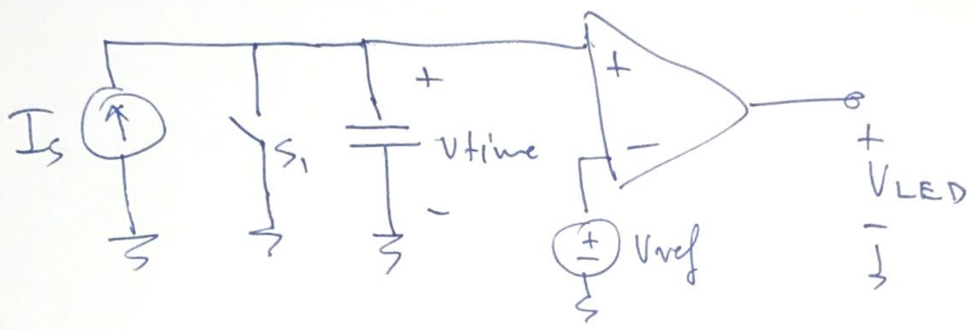
$I_1 = 0$ (o.c. def)

$I_2 = -I_s$ (curr. source elem. def)

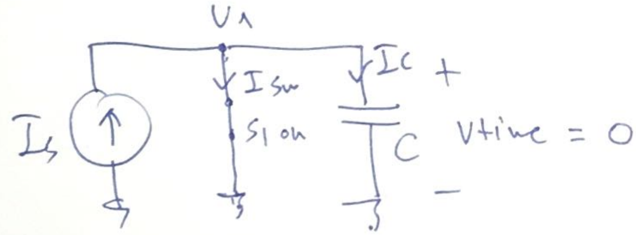
$I_1 + I_2 = 0$ (KCL)

$0 + (-I_s) = 0$ ✗ violation

revise:



Before the button is pushed: S1 is on



$V_1 = 0$ (wire def)

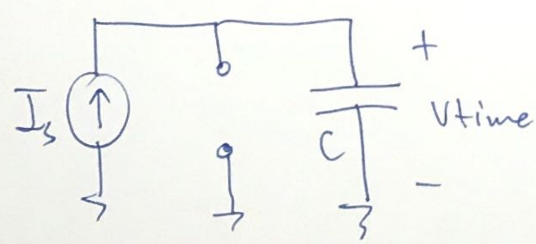
$V_{time} = V_1 = 0$

$I_C = C \frac{dV_{time}}{dt} = 0$

by KCL $I_s = I_{sw} + I_C$

$I_s = I_{sw}$

when you push the button: S1 is off @ t=to



$V_{time}(t_0) = 0$

$V_{time}(t) = \frac{I_s}{C} \cdot (t - t_0) + 0$ (2s)

$V_{time}(t_0 + 2s) = V_{ref}$