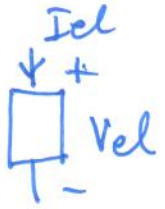
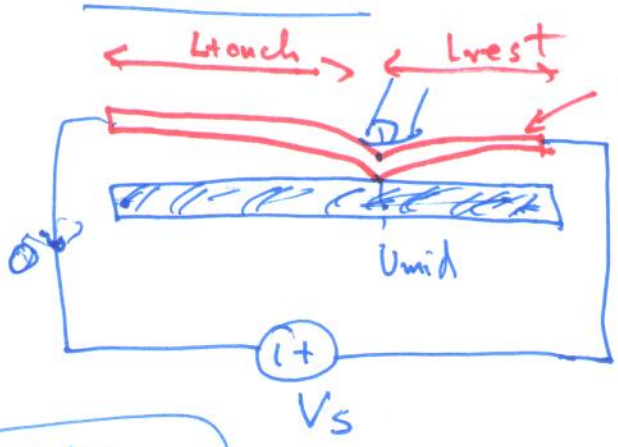
EE16A Touchscreen lecture #3

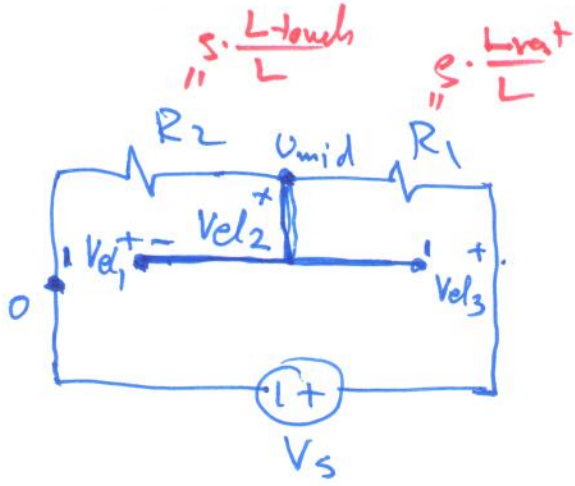
* Revisit 1D Touchscreen
* Measuring voltage and current
* Power
* 2D Touchscreen

el: 

1D Touch:



$\Rightarrow$ Model 1



Model 2

$\Downarrow$

imperfect conductor (resistor) 

ideal wire (conductor) 

el 1: open-circuit

el 3: open-circuit

el 2: wire

KVL:

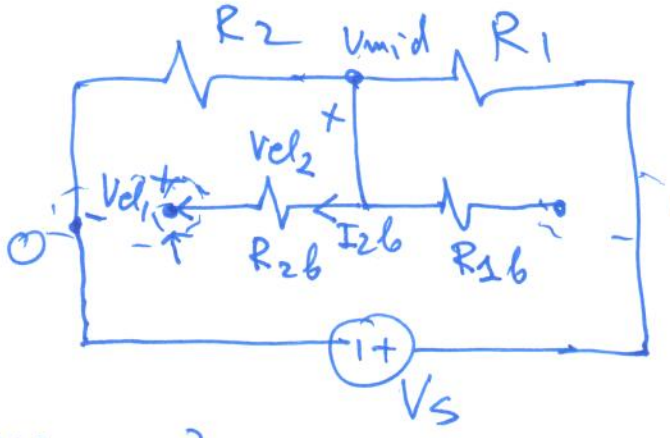
$$V_{mid} - 0 = V_{el1} + V_{el2}$$

$V_{el2} = 0$ b.c. el 2 is a wire

$$\boxed{V_{mid} = V_{el1}}$$

what I wanted.

(l2)



el1: open-circuit: $I_1 = 0$

el2: resistor : $V_{el_2} = I_{2b} R$

KVL:

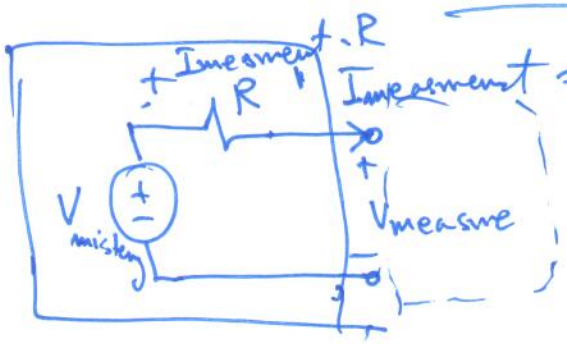
$V_{mid} - 0 = V_{el_1} + V_{el_2}$

KCL: $I_1 \overset{?}{=} I_{2b} = 0$

el1 definition

$V_{mid} = V_{el_1} + R_{2b} \cdot I_{2b}$ ← Ohm's law

$V_{mid} = V_{el_1}$



Measure

$V_{mistery}$

KVL

$V_{measure} + I_{measure} \cdot R = V_{mistery}$

Measurements should not change the energy of the ckt (cause energy dissipation).

$$V_{AB} = \frac{dE}{dq}$$

Power : $P = \frac{dE}{dt} = \frac{dE}{dq} \cdot \frac{dq}{dt}$

$[W]$ — $\frac{dE}{dq}$: V [V], $\frac{dq}{dt}$: I [A]

passive-sign convention

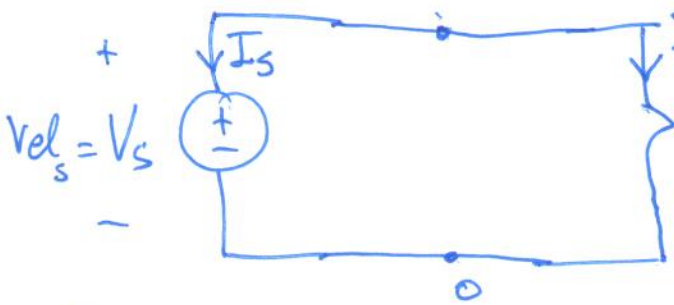
$P_{element} = V_{element} \cdot I_{element}$

$= V_{element} \cdot \frac{V_{element}}{R} = \left[\frac{V_{element}^2}{R}\right] \geq 0$ (+ / −)

if element is R

$= I_{elent} \cdot R \cdot I_{elent}$ dissipated energy ⇒ power has + sign.

$= \boxed{I_{elent}^2 \cdot R}$



$P_L = V_L \cdot I_L \geq 0$

$= R_L I_L \cdot I_L = R_L \cdot I_L^2 \geq 0$

$P_S = V_S \cdot I_S$

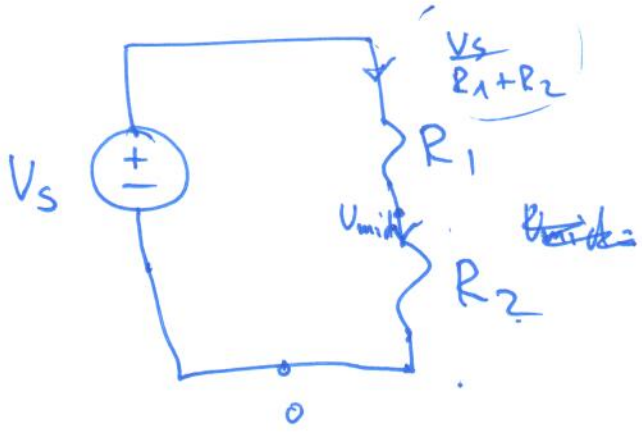
$= V_L \cdot (-I_L)$

$= -P_L \leq 0$

$\Leftarrow$ { $V_S = V_L$ KVL ; $I_S = -I_L$ KCL

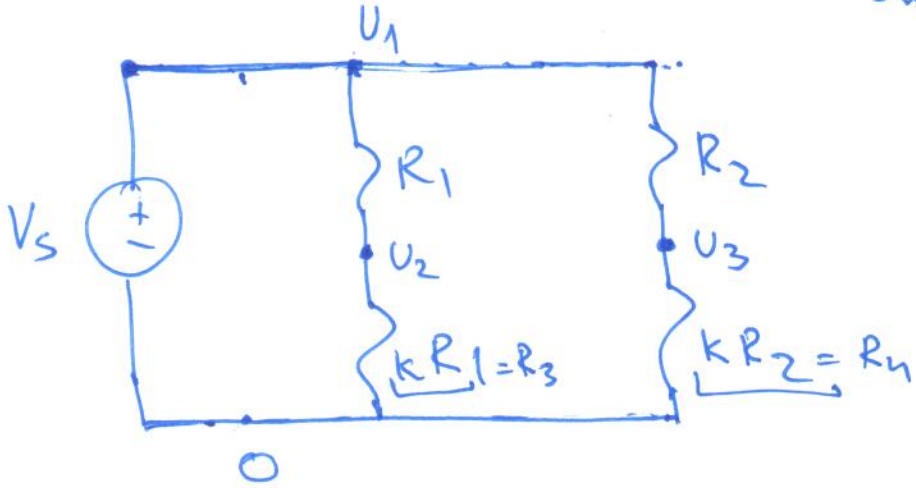
(l4)

2D touch:



$$U_{mid} = V_S \cdot \frac{R_2}{R_1+R_2}$$

Interesting ckt:



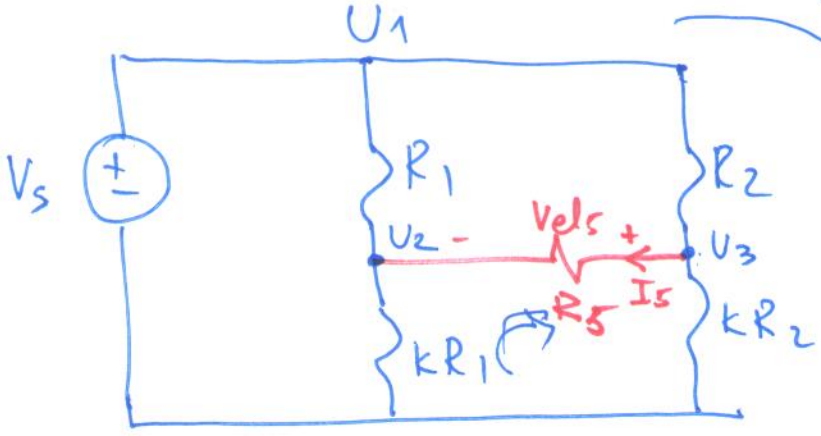
$U_1 = V_S$ Key.

$$U_2 = \frac{kR_1}{R_1+kR_1} \cdot U_1 \quad (U_1 = V_S)$$

$$U_3 = \frac{(kR_2 = R_4)}{R_2+kR_2} \cdot U_1 \quad (U_1 = V_S)$$

$U_2 = U_3$

Add a resistor:



$V_{el5} = R_5 \cdot I_{el5}$

$U_2 + V_{el5} = U_3$: KVL

Bold assumption $V_{el5} = 0$

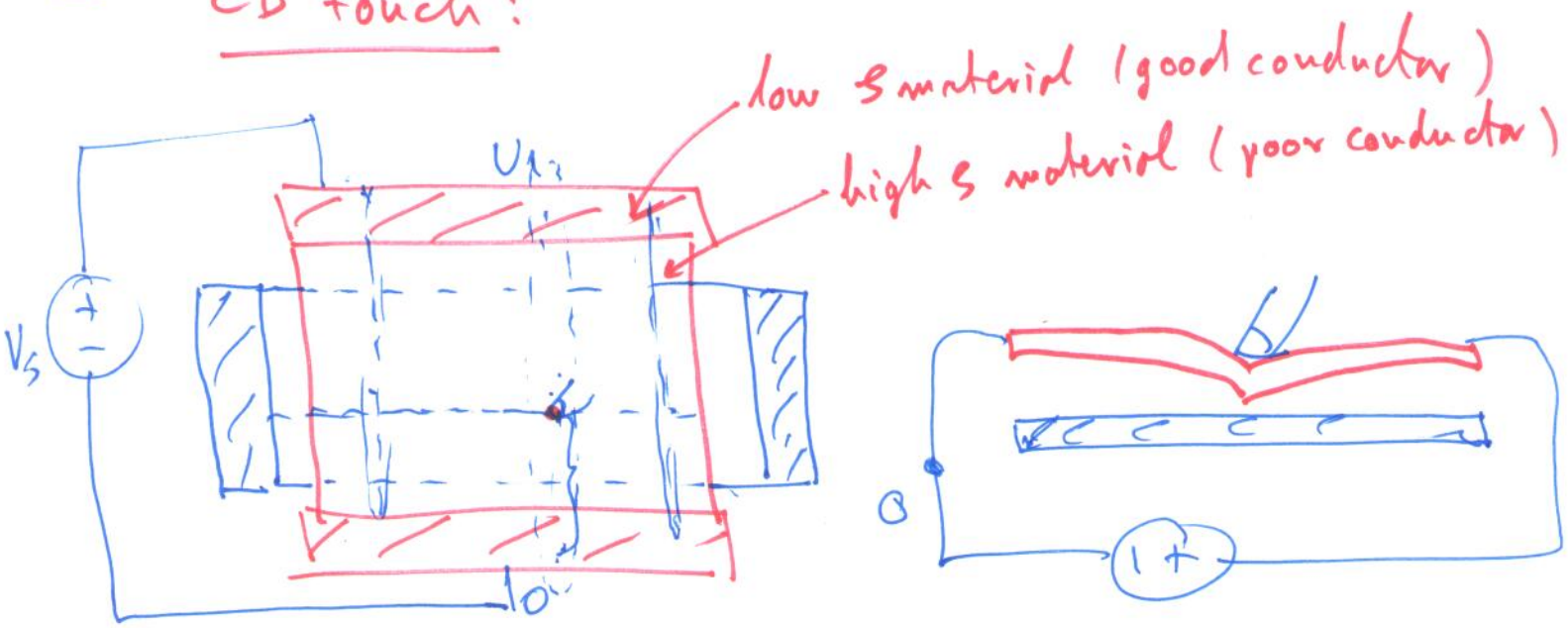
or $U_2 = U_3$

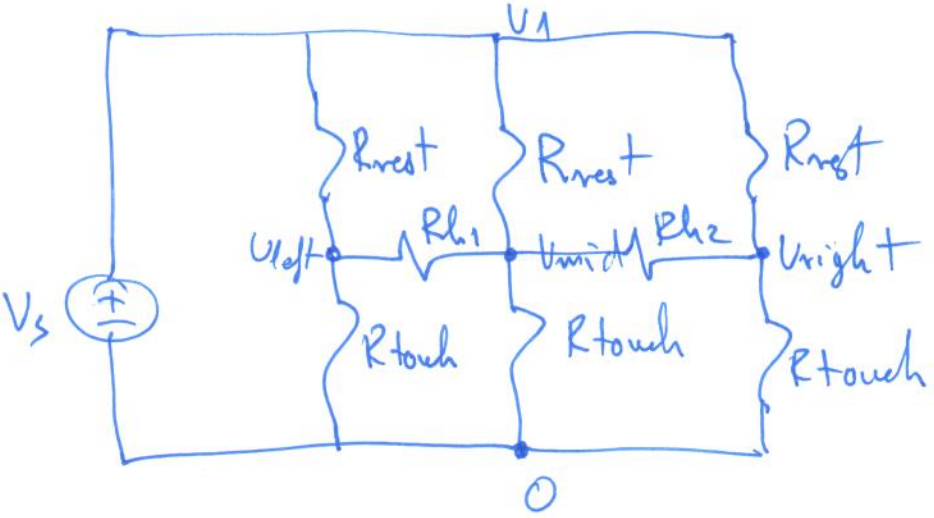
$\Downarrow$ Ohm's law

$I_{el5} = 0$

(15)

2D touch:





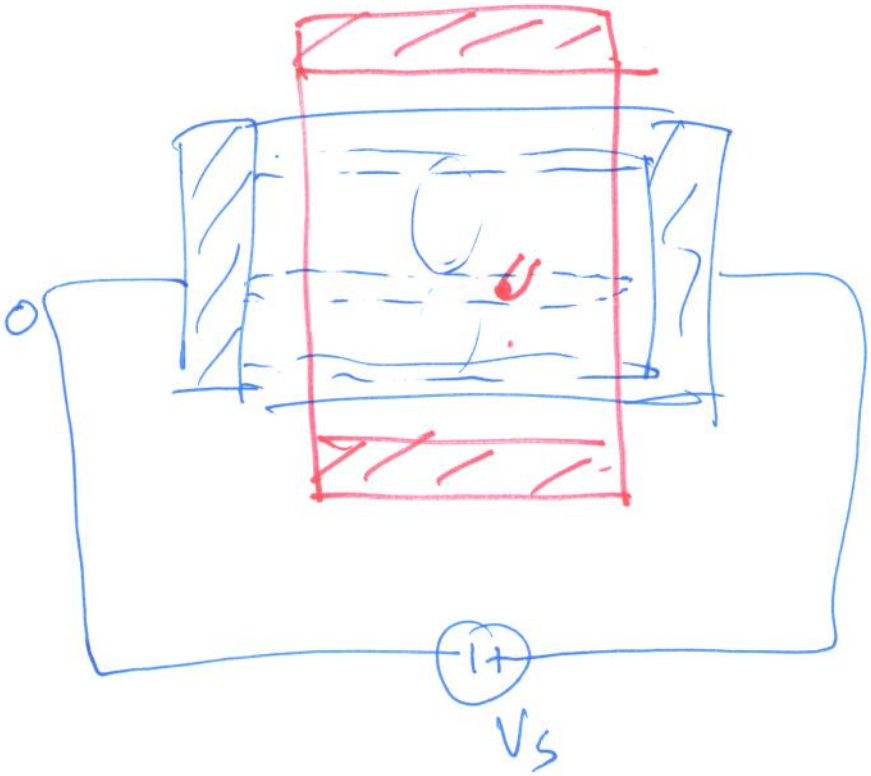
$$I_{Rh1} = I_{Rh2} = 0$$

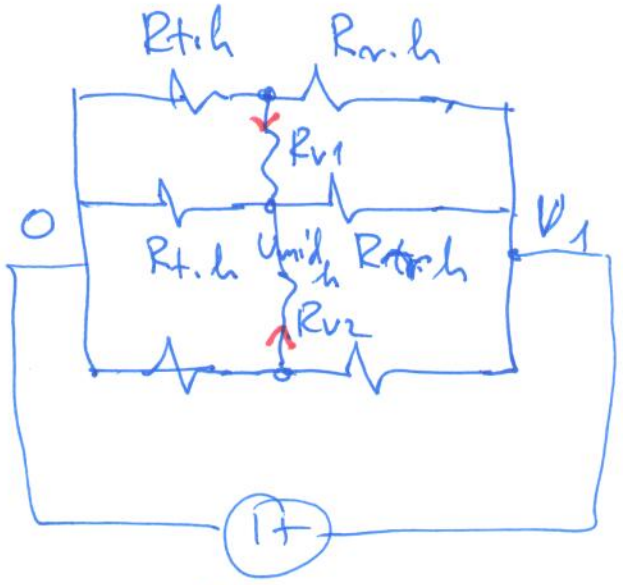
$$\Downarrow$$

replace $R_{h1,2}$ with o.c and solve like 1D

$$V_{mid} = \frac{R_{touch}}{R_{rest} + R_{touch}} \cdot V_S$$

(16)





$I_{Rv1,2} = 0$

$$U_{mid_V} = \frac{R_{t.h}}{R_{v.h} + R_{t.h}} \cdot V_S$$