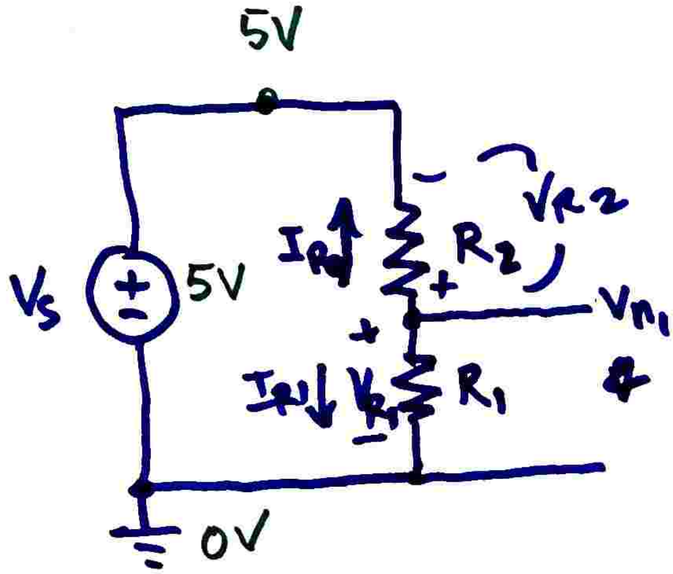
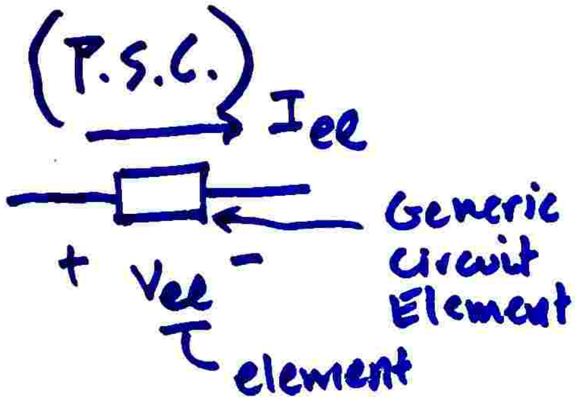
EECS 16A - Module 2 - Lecture 2



Passive Sign Convention (P.S.C.)



Approach to Circuit Analysis:

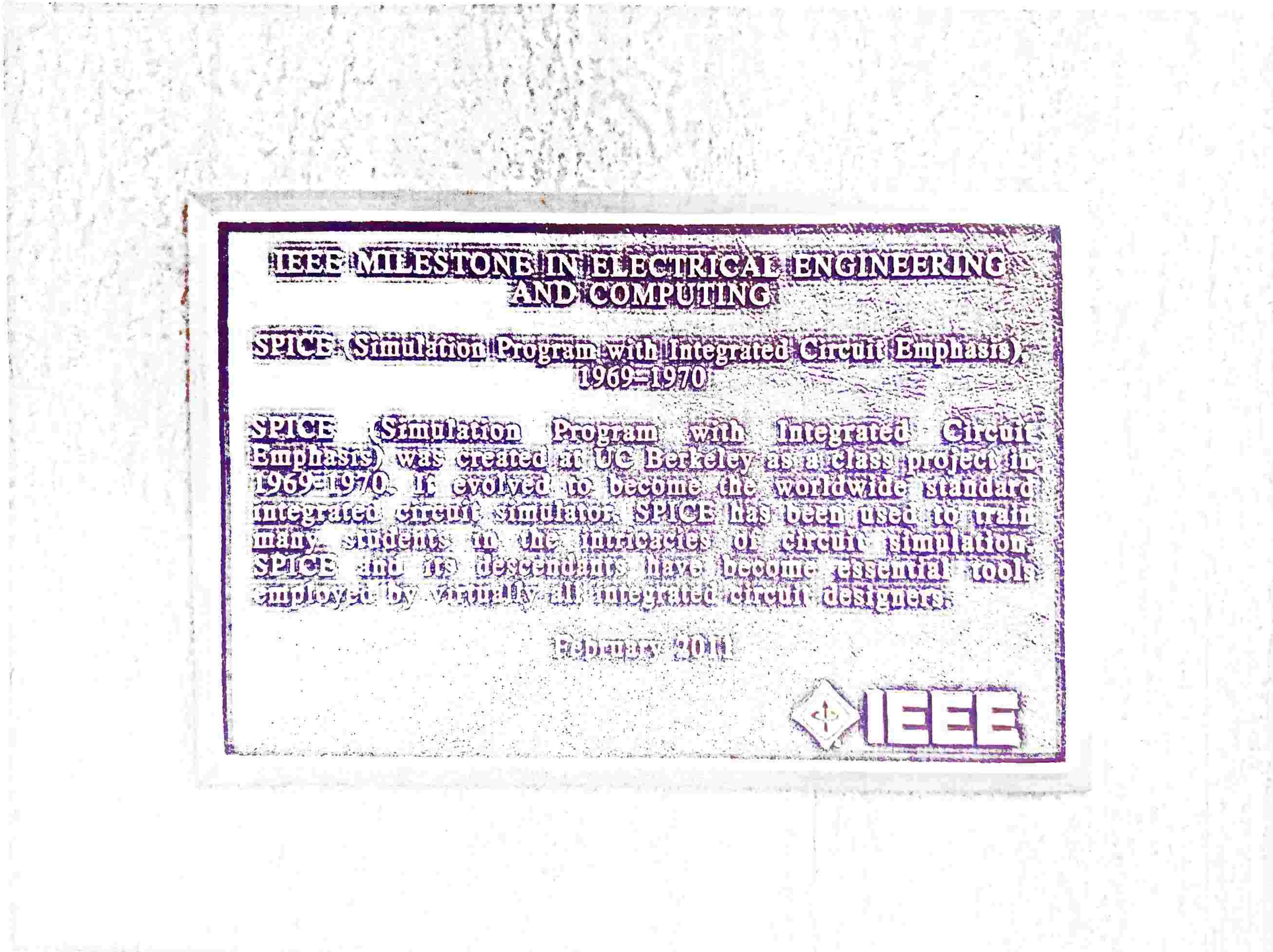
- KCL, KVL equations
- Component equations (Ohm's Law)

Technique:

Node Voltage Analysis (NVA)

(often implemented by computer programs like SPICE, which was invented at Berkeley)

2.2.1 (a)


IEEE MILESTONE IN ELECTRICAL ENGINEERING AND COMPUTING
SPICE (Simulation Program with Integrated Circuit Emphasis), 1969-1970
SPICE (Simulation Program with Integrated Circuit Emphasis) was created at UC Berkeley as a class project in 1969-1970. It evolved to become the worldwide standard integrated circuit simulator. SPICE has been used to train many students in the intricacies of circuit simulation. SPICE and its descendants have become essential tools employed by virtually all integrated circuit designers.
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Procedure:

STEP 1:

Choose a reference voltage
i.e. GND, ⏚ , 

STEP 2:

Mark the <u>known</u> voltages

STEP 3:

Mark the <u>unknown</u> voltages

STEP 4:

Mark the element I_{el}, V_{el}

STEP 5:

KCL for all nodes with <u>unknown</u> node voltages

$$I_{R_1} + I_{R_2} = \emptyset$$

STEP 6:

Write the component equations

...

STEP 6:

Write the component eqns.

$$I_{R_1} = \frac{V_{R_1}}{R_1} \qquad I_{R_2} = \frac{V_{R_2}}{R_2}$$

(ohm's Law : $V = IR$)

Replace component voltages ($V_{R_1}, \ldots$) with the node voltages (V_{n_1})

$$V_{R_1} = V_{n_1} - \emptyset$$

$$V_{R_2} = V_{n_1} - V_S$$

Rewrite Comp eqns in terms of node voltages

$$I_{R_1} = \frac{V_{R_1}}{R_1} = \frac{V_{n_1}}{R_1}$$

$$I_{R_2} = \frac{V_{R_2}}{R_2} = \frac{V_{n_1} - V_S}{R_2}$$

STEP 7:

Substitution (6) → (5)

Component eqns → KCL eqns

$$\frac{V_{n_1}}{R_1} + \frac{V_{n_1} - V_s}{R_2} = \emptyset$$

$$I_{R_1} + I_{R_2} = \emptyset$$

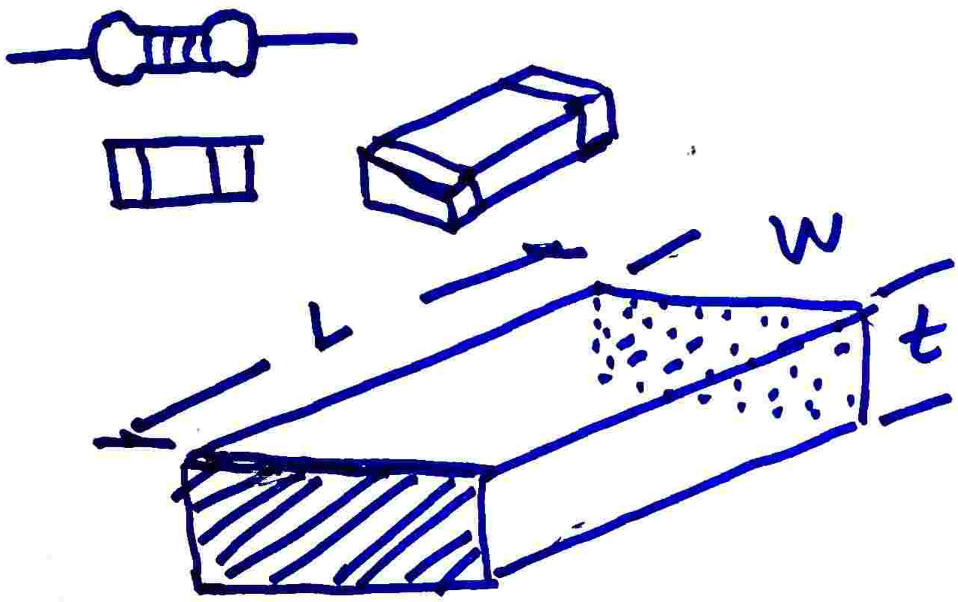
STEP 8:

Solve! (for V_{n_1})

$$V_{n_1} = V_s \cdot \frac{R_1}{R_1 + R_2}$$

Voltage Divider

RESISTORS



$$R \propto \frac{L}{W \cdot t} = \frac{L}{A}$$

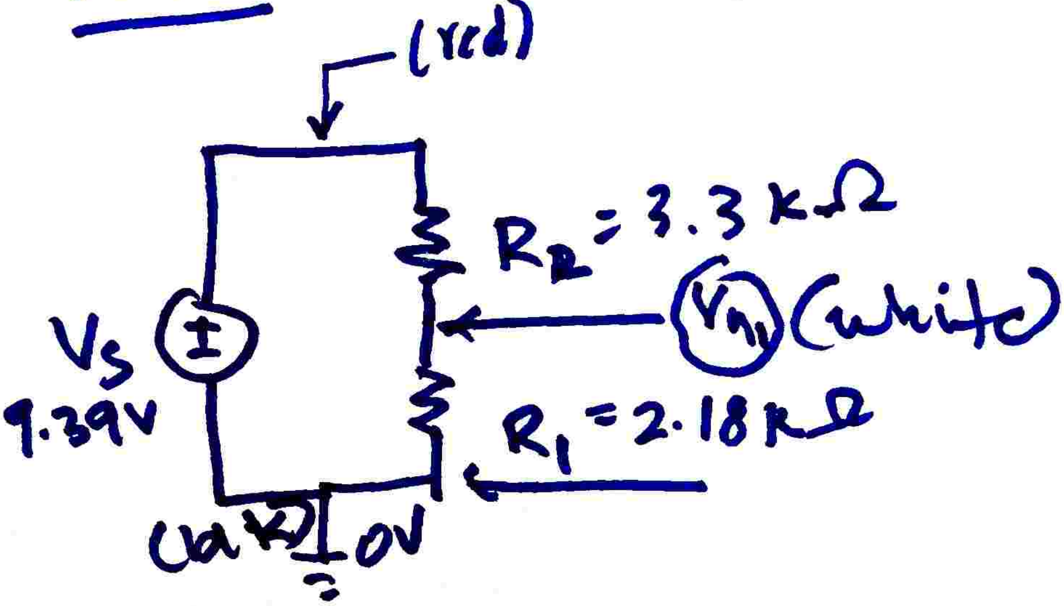
$$R = \rho \frac{L}{W \cdot t}$$

↑ Resistivity $[\Omega \cdot m]$

2.2.6a

Material	Resistivity / Ωm
copper	1.7×10^{-8}
aluminium	2.7×10^{-8}
graphite	8.0×10^{-6}
silicon	2.3×10^{3}
quartz	5.0×10^{16}

DEMO

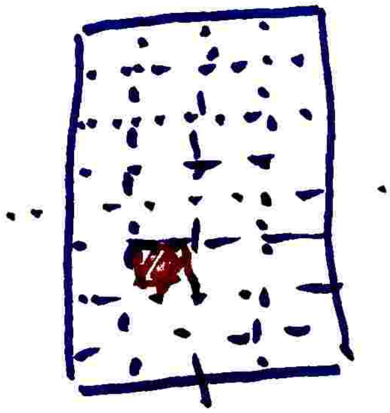


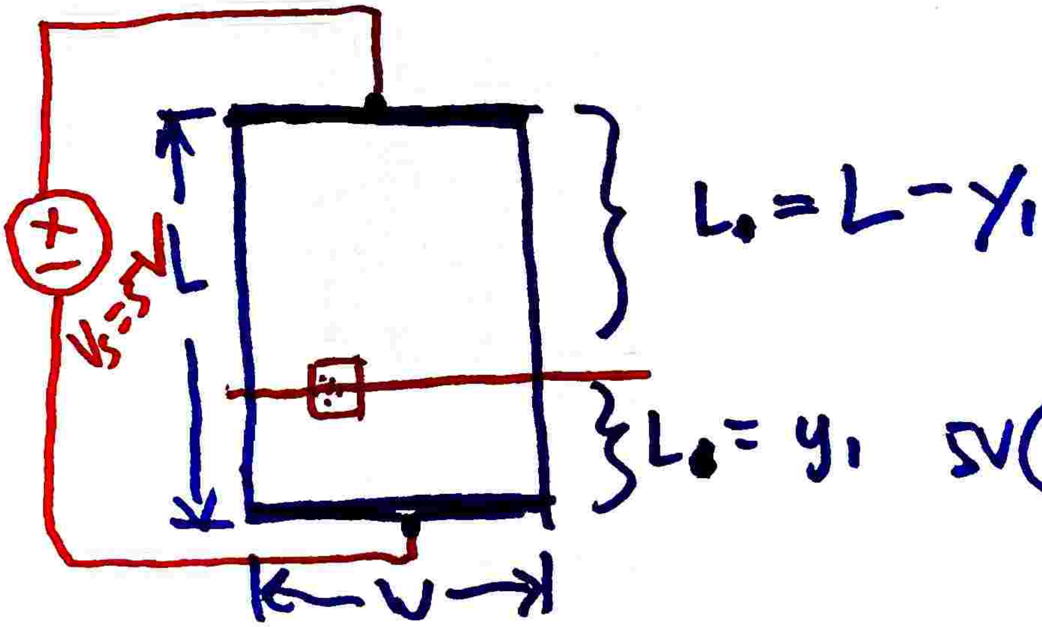
$$V_{n_1} = V_S\left(\frac{R_1}{R_1 + R_2}\right)$$

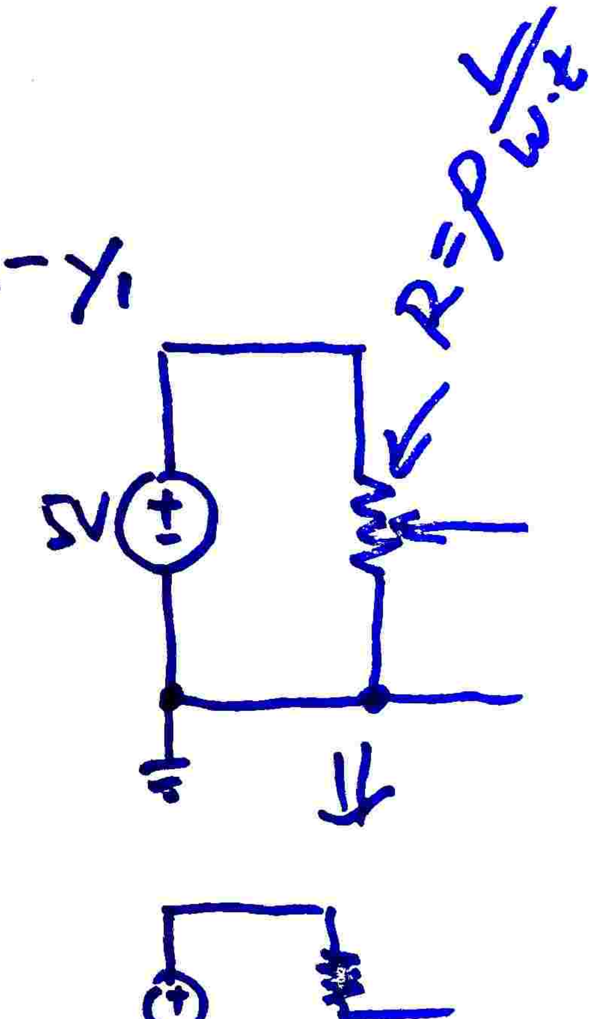
$$= 9.39V\left(\frac{2.18}{2.18 + 3.3}\right)$$

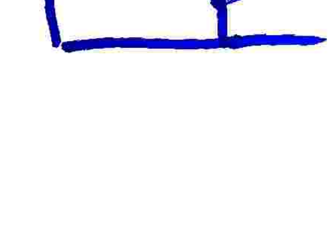
$$= 3.74V$$

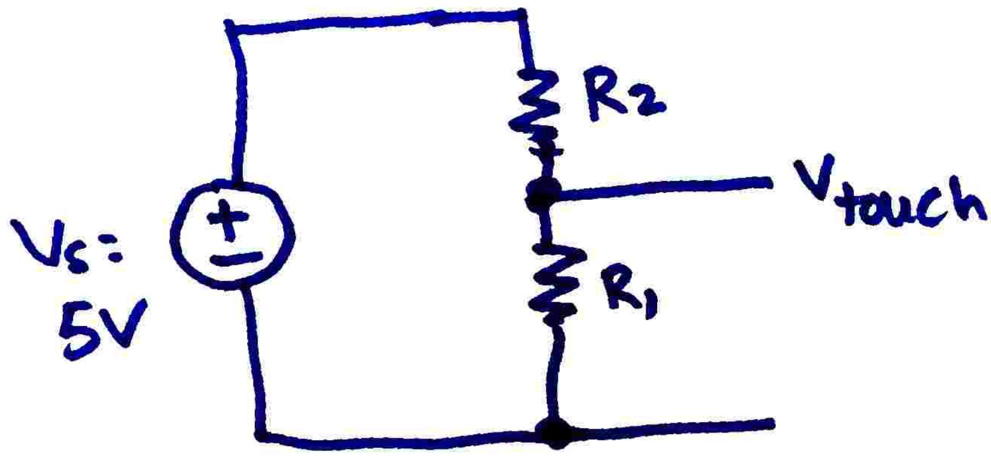
TOUCHSCREEN











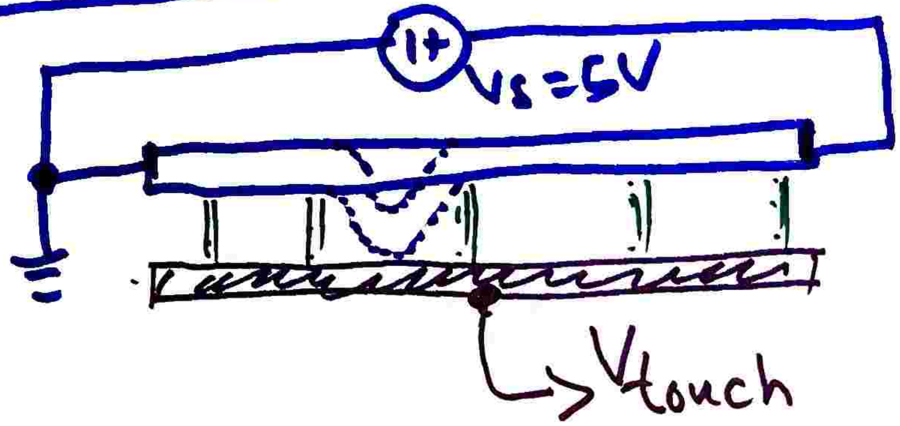
$$R_1 = \rho \frac{y_1}{W \cdot t}$$

$$R_2 = \rho \frac{L - y_1}{W \cdot t}$$

$$V_{touch} = V_S \frac{R_1}{R_1 + R_2}$$

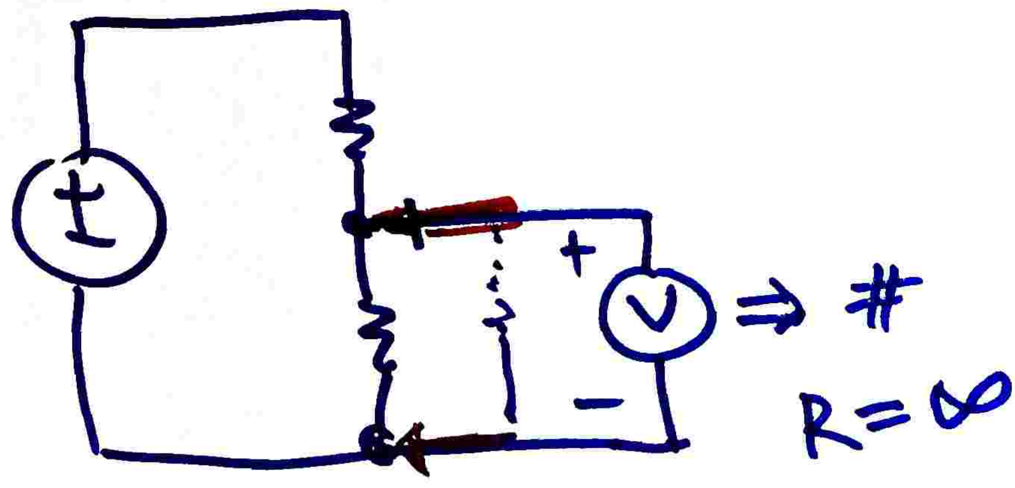
$$\boxed{V_{touch} = V_s \frac{y_1}{L}}$$

1D Touch Screen



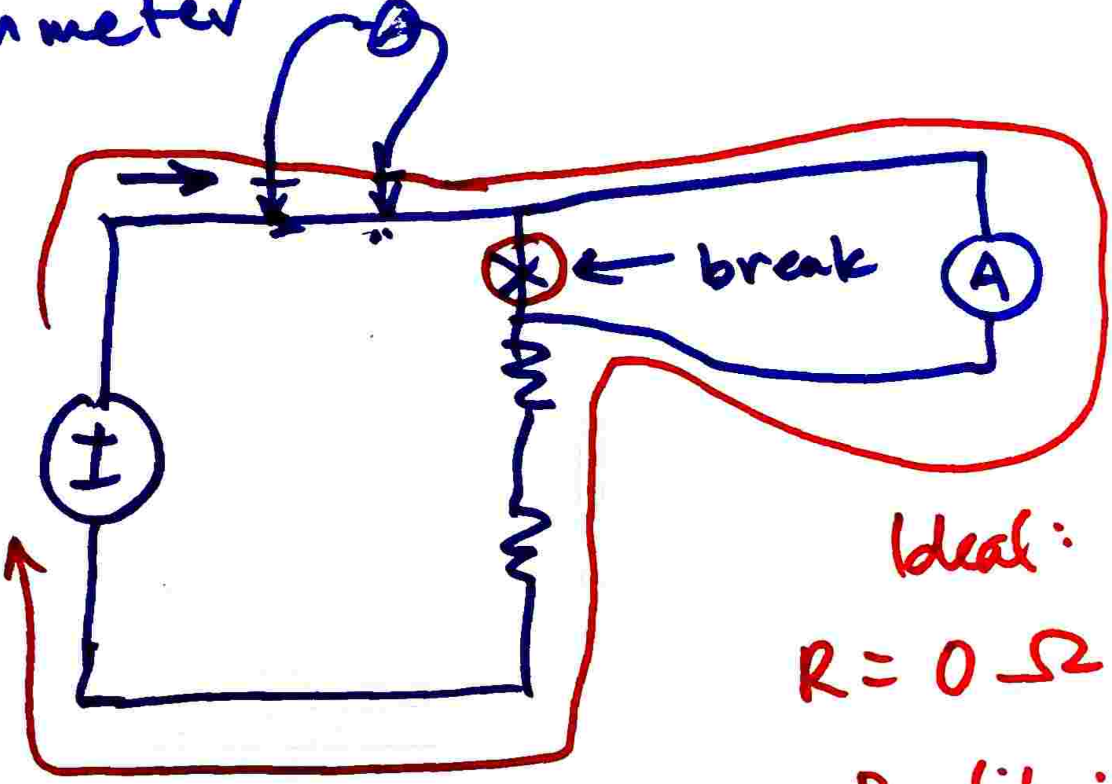
Voltmeter / Ammeter / DMM

Digital Multi Meter



2.2.10

Ammeter



Ideal:

$R = 0\ \Omega$

Reality:

$0.1\ \Omega$