

FREE

IEEE - CSULB Branch
February 26, 2021
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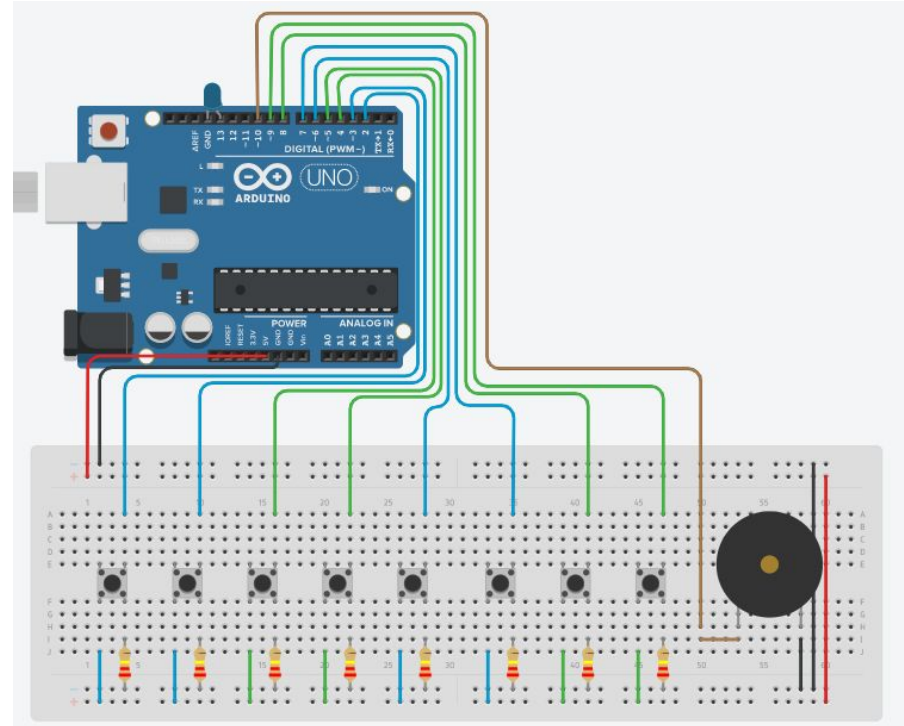
Agenda

- Project
- Resistors
- capacitors
- Inductors
- Breadboard

FREE

Project- Arduino Piano

- Sound Reactive Arduino Floor Piano
- Modules used
 - Arduino Uno/nano
- Components
 - Resistors
 - Jumper wires
 - Piezo



Resistor

- What is a resistor
 - A passive electrical component
 - create resistance in the flow of electric current
 - Reduces electric current
 - Divides voltages

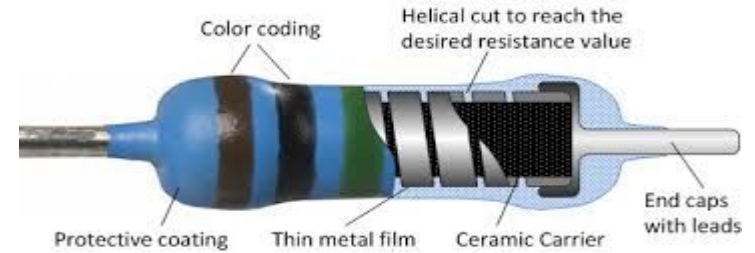
<p>0 1 2 3 4 5 6 7 8 9</p> <p>0 Black 1 Brown 2 Red 3 Orange 4 Yellow 5 Green 6 Blue 7 Purple 8 Grey 9 White</p> <p>±1% Brown ±2% Red ±5% Gold ±10% Silver</p>	<p>±1% ±2% ±5% ±10%</p> <p>27K EXAMPLE</p> <p>0 ×1 1 1 ×10 2 2 ×100 3 3 ×1000 4 4 ×10000 5 5 ×100000 6 6 ×1000000 7 7 ×10000000 8 8 ×100000000 9 9 ×1000000000</p> <p>±10 ±100</p>	<p>±1% ±2% ±5% ±10%</p> <p>15K EXAMPLE</p> <p>0 0 ×1 1 1 1 ×10 2 2 2 ×100 3 3 3 ×1000 4 4 4 ×10000 5 5 5 ×100000 6 6 6 ×1000000 7 7 7 ×10000000 8 8 8 ×100000000 9 9 9 ×1000000000</p> <p>±10 ±100</p>	<p>Temperature Coefficient</p> <p>±1% 100 50 ±2% 25 15 ±5% 10 5 ±10% 1</p> <p>620K EXAMPLE</p> <p>0 0 ×1 1 1 1 ×10 2 2 2 ×100 3 3 3 ×1000 4 4 4 ×10000 5 5 5 ×100000 6 6 6 ×1000000 7 7 7 ×10000000 8 8 8 ×100000000 9 9 9 ×1000000000</p> <p>±10 ±100</p>
Color Codes	4 Band Resistors	5 Band Resistors	6 Band Resistors

Resistors - continued

- Ohm's Law
 - To calculate the resistance in a circuit
 - $V = IR$
 - R = Resistance (ohms)
 - V = Voltage (volts)
 - I = current (amps)

Resistors- continued

- Types of resistors
 - Wire wound round resistors
 - Metal Film Resistors
 - Thick and thin film resistors
 - Surface mount resistors



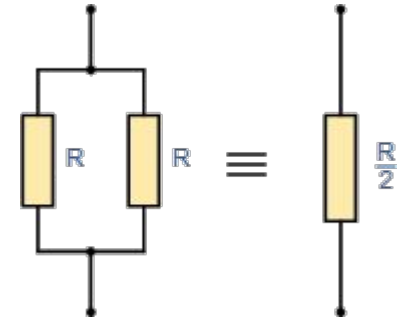
Resistor- Continued

- Resistors in Series

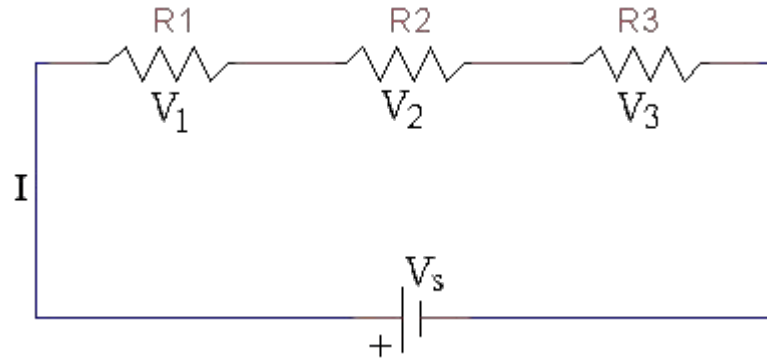
- $R_{\text{series}} = R_1 + R_2 + R_3$

- Parallel Resistors

- $R_{\text{parallel}} = 1 / ((1/R_1) + (1/R_2) + (1/R_3))$



Parallel Resistor



Series Resistor

Capacitors

- What are capacitors?
 - Stores and releases electrical energy
 - Same as a battery
 - Can charge and discharge faster
 - Capacitance is measured in farads
 - Mostly used μF

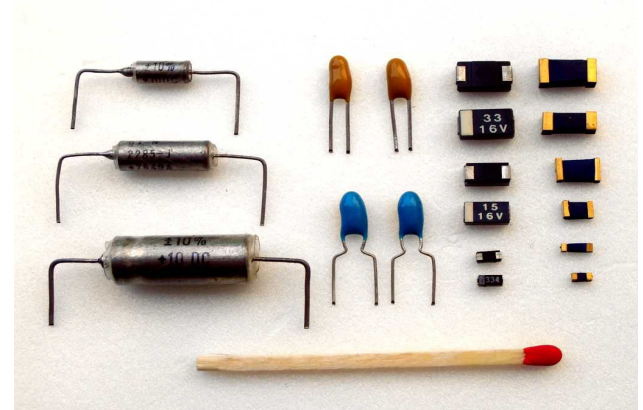
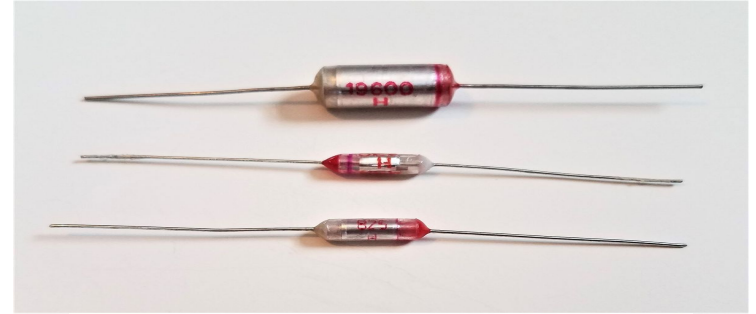


Capacitors- continued

- How to find the capacitance
 - **$I = C \, dv/dt$**
 - **I** = instantaneous current through the capacitor
 - **C** = capacitance in Farads
 - **dv/dt** = instantaneous rate of voltage change

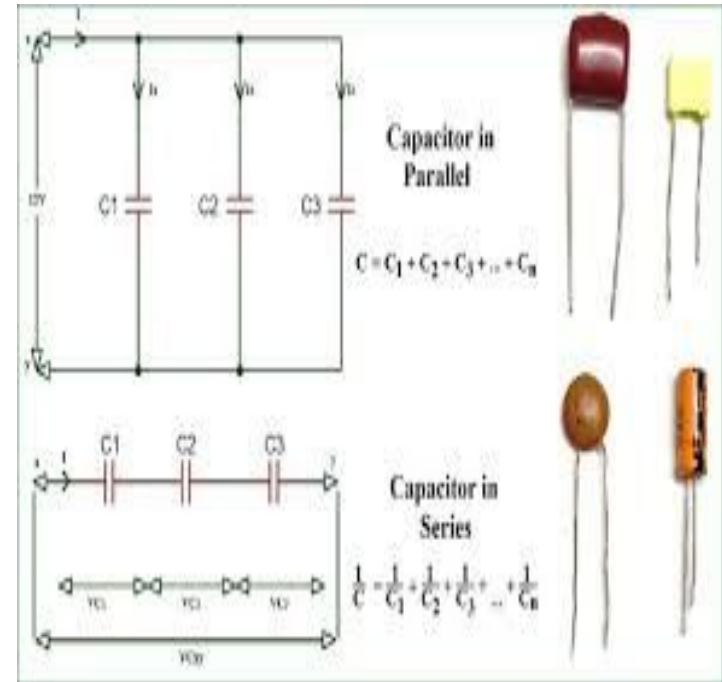
Capacitors- continued

- What is it made out of
 - Dielectric
 - Polyester
 - Polystyrene
 - Tantalum



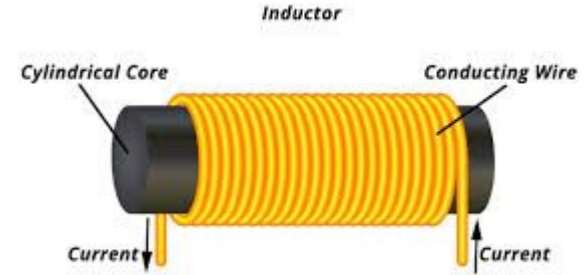
Capacitor - continued

- Parallel Capacitors
 - $C_{eq} = C_1 + C_2 + C_3 + \dots + C_n$
- Series Capacitors
 - $1/C_{eq} = (1/C_1) + (1/C_2) + (1/C_3) + \dots + (1/C_n)$



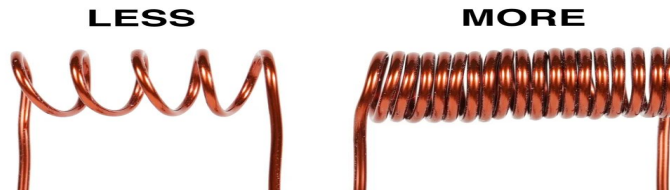
Inductors

- What are Inductors
 - Coil of conducting wires
 - Stores energy in electromagnetic field
- Inductance
 - Measured in Henrys
 - The greater number of turns of wire the greater inductance



$$L = \frac{n^2 \times \mu_0 \times a}{l}$$

where: L = inductance in henrys
 n = number of turns
 μ_0 = permeability of free space ($4\pi \times 10^{-7}$ henrys/metre)
 a = cross-sectional area of winding in square metres
 l = length of winding in metres



Inductor- continued

- Inductor Ohm's law
 - $V = L (di/dt)$
 - V = Voltage
 - L = Inductance in Henrys
 - di/dt = instantaneous rate of current change (amps per sec)

Inductances

$$L_{\text{series}} = L_1 + L_2 + \dots L_n$$

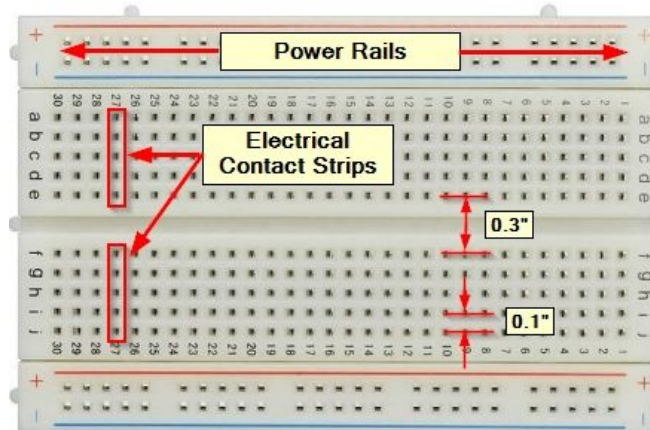
$$L_{\text{parallel}} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \dots \frac{1}{L_n}}$$

Where,

L = Inductance in henrys

Breadboards

- What are breadboards
 - “Circuit Builder”
 - Plastic board with arrays of metal contacts
 - Easy access through the holes
- Accept 22 American Wire Gauge (AWG)



Breadboard- continued

- What is American Wire Gauge (AWG) ?
 - Logarithmic Stepped Standard wire gauge
 - Copper wires
 - Best and cheapest conductor
 - Smaller the number the thicker the wire
 - Common AWG we use is 18-24 (AWG)

CIRCUIT TYPE				CURRENT FLOW IN AMPS											
10% VOLTAGE DROP Non Critical		3% VOLTAGE DROP Critical		5A	10A	15A	20A	25A	30A	40A	50A	60A	70A	80A	
CIRCUIT LENGTH	0 to 20 ft.	0 to 6.1 M	0 to 6 ft.	0 to 1.8 M											
	30 ft.	9.1 M	10 ft.	3.0 M	16 AWG	16 AWG	14 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG
	50 ft.	15.2 M	15 ft.	4.6 M		12 AWG	12 AWG	12 AWG	10 AWG	8 AWG	6 AWG		4 AWG	4 AWG	
	65 ft.	19.8 M	20 ft.	6.1 M	14 AWG		10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG
	80 ft.	24.4 M	25 ft.	7.6 M		10 AWG	8 AWG		6 AWG		4 AWG		2 AWG	1 AWG	1 AWG
	100 ft.	30.5 M	30 ft.	9.1 M	12 AWG			6 AWG		4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	1 AWG
	130 ft.	39.6 M	40 ft.	12.2 M		8 AWG				4 AWG	2 AWG	1 AWG	0 AWG	0 AWG	0 AWG
	165 ft.	50.3 M	50 ft.	15.2 M	10 AWG		6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG
	200 ft.	61.0 M	60 ft.	18.3 M		6 AWG					1 AWG	0 AWG	2 0 AWG	3 0 AWG	
			70 ft.	21.3 M		8 AWG	4 AWG		2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	
			80 ft.	24.4 M				2 AWG				2 0 AWG		4 0 AWG	
			90 ft.	27.4 M					1 AWG		2 0 AWG	3 0 AWG			
			100 ft.	30.5 M		4 AWG	2 AWG		1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG		
			110 ft.	33.5 M											
		120 ft.	36.6 M				1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG				
		130 ft.	39.6 M		2 AWG										

Breadboards - continued

- Why Breadboard
 - It is solderless circuit board
 - Good using before moving into an actual circuit board.

