

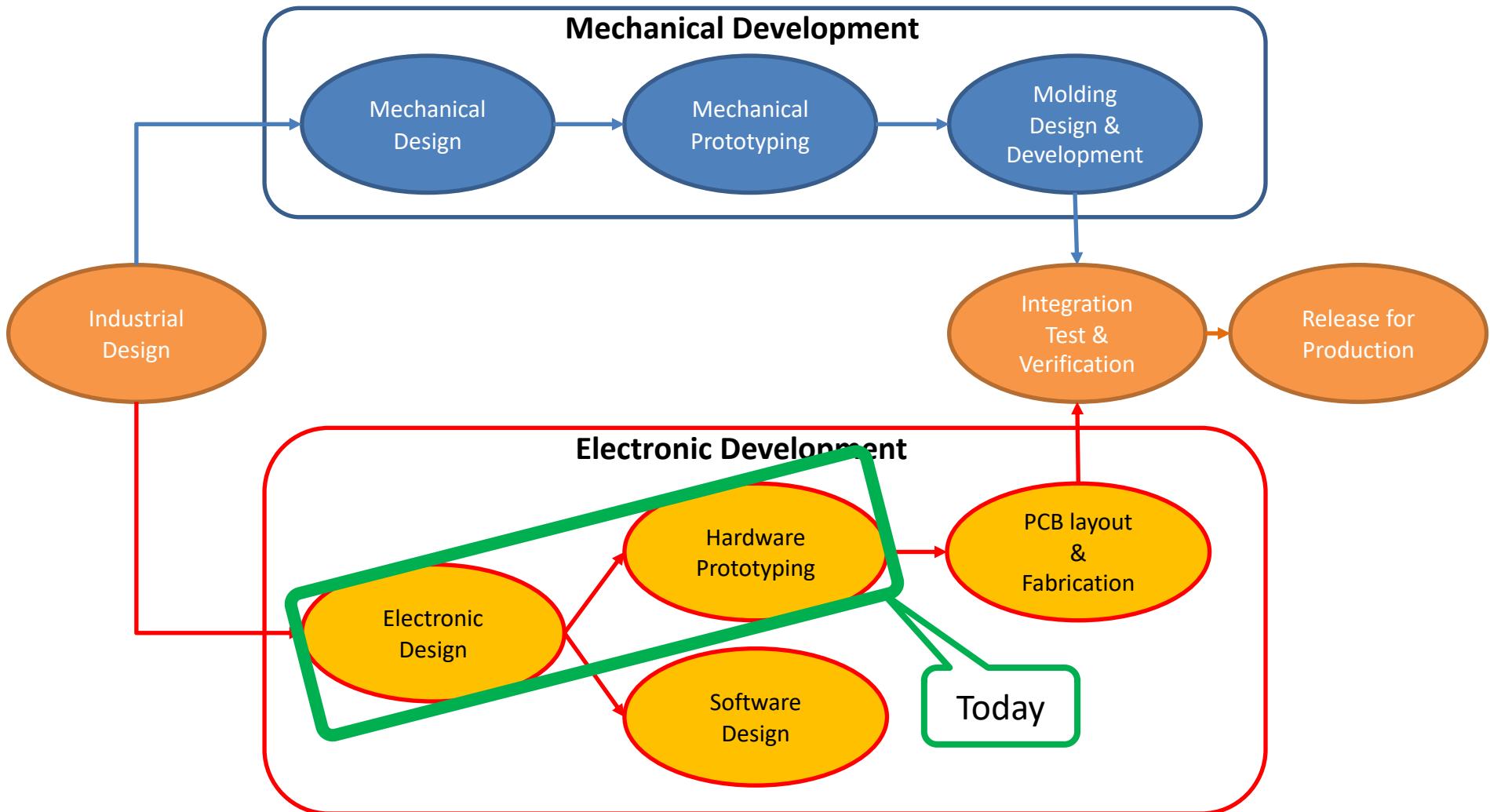
TM1105
E02

Electronic Rapid Prototyping
and
Basic Testing

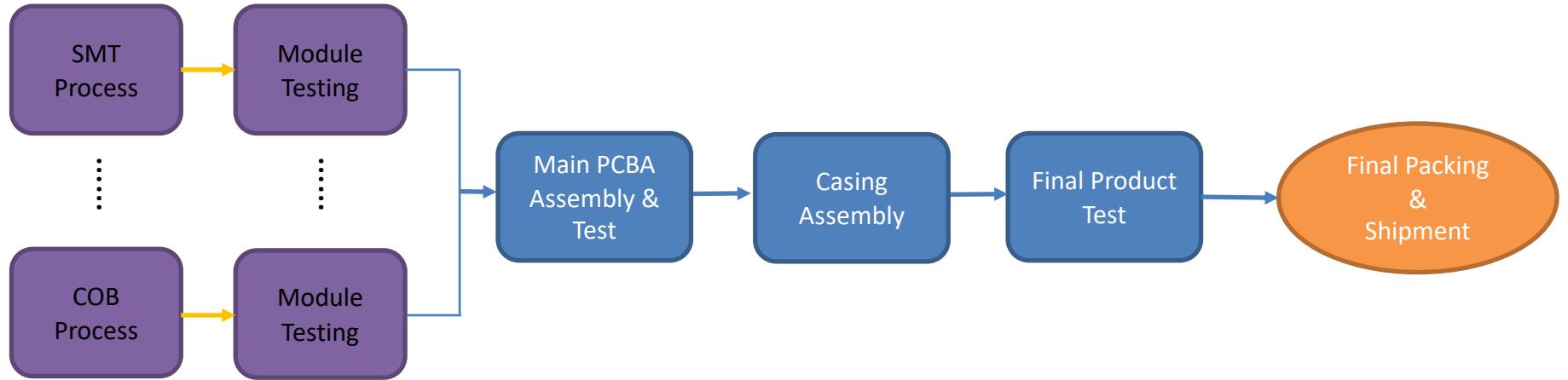


Teaching Plan

	15 Mins	=====
1	20 Mins – Presentation	Introduction
	20 Mins – Presentation & Demo	Part 01 : Build Your First Circuit
	20 Mins – Exercise 01	Components , Connection ,Breadboard
2	15 Mins – Presentation & Demo	Part 02 : How to make it work
	15 Mins – Exercise 02	Your Circuit, Power Supply, Multimeter
	10 Mins – Take a Break	=====
3	20 Mins – Presentation & Demo	Part 03 : Measure Signal Waveform
	30 Mins – Exercise 03	Your Circuit, Signal Generator, Oscilloscope
	15 Mins	=====



Product Development Flow



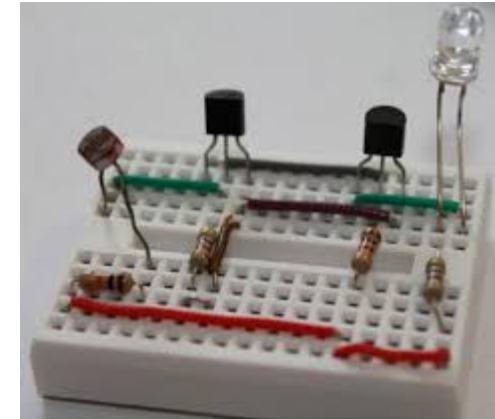
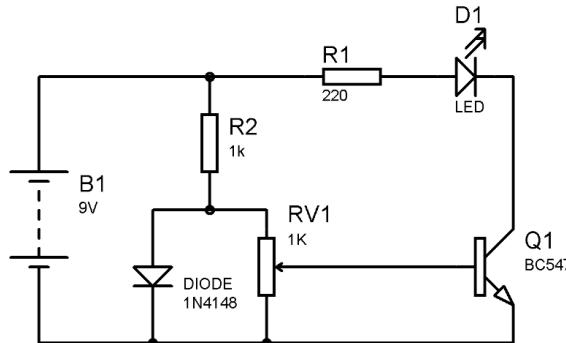
Product Production Flow

Teaching Plan

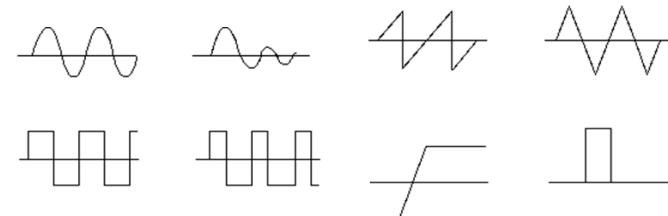
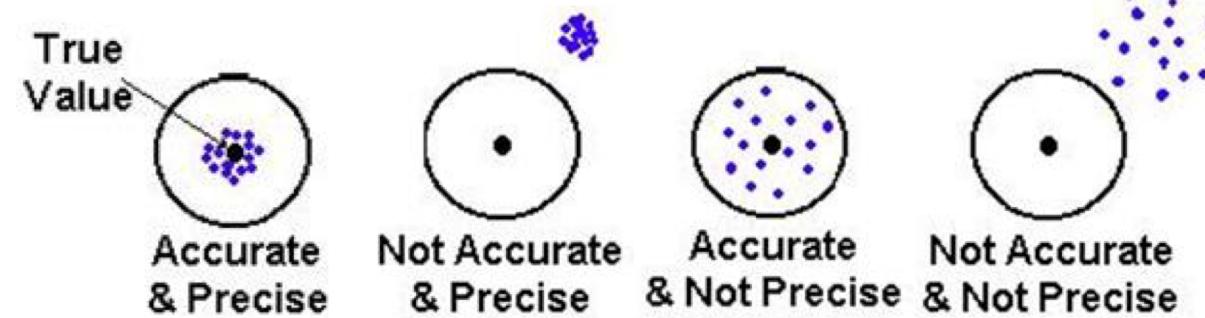
	15 Mins	=====
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	15 Mins – Exercise 02	Your Circuit, Power Supply, Multimeter
	10 Mins – Take a Break	=====
3	20 Mins – Presentation & Demo	Part 03 : Measure Signal Waveform
	30 Mins – Exercise 03	Your Circuit, Signal Generator, Oscilloscope
	15 Mins	=====

Introduction

- What is Circuit
 - Component
 - Breadboard
 - Connection

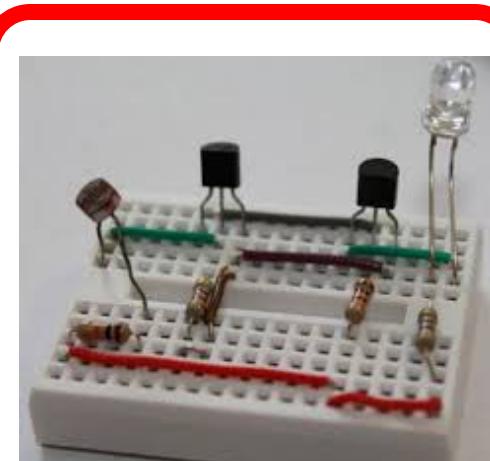
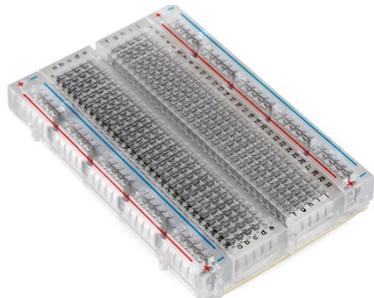


- Equipment and Instrument
 - Type of Equipment and Instrument
 - Measurement : Accuracy and Precision

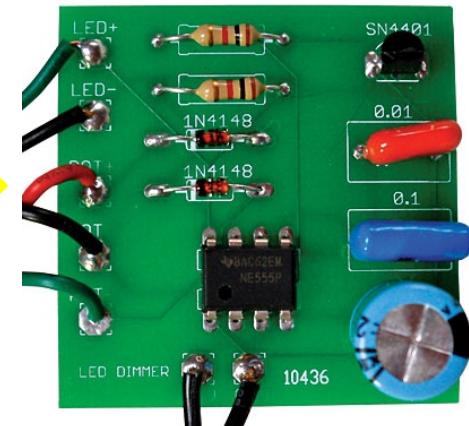
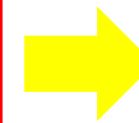
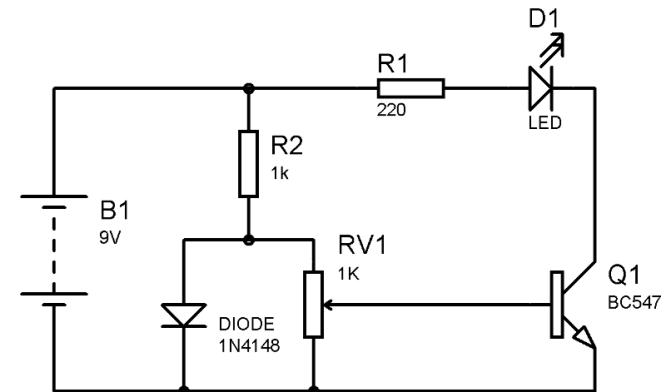


What is Circuit

- Component
- Connection
- Breadboard

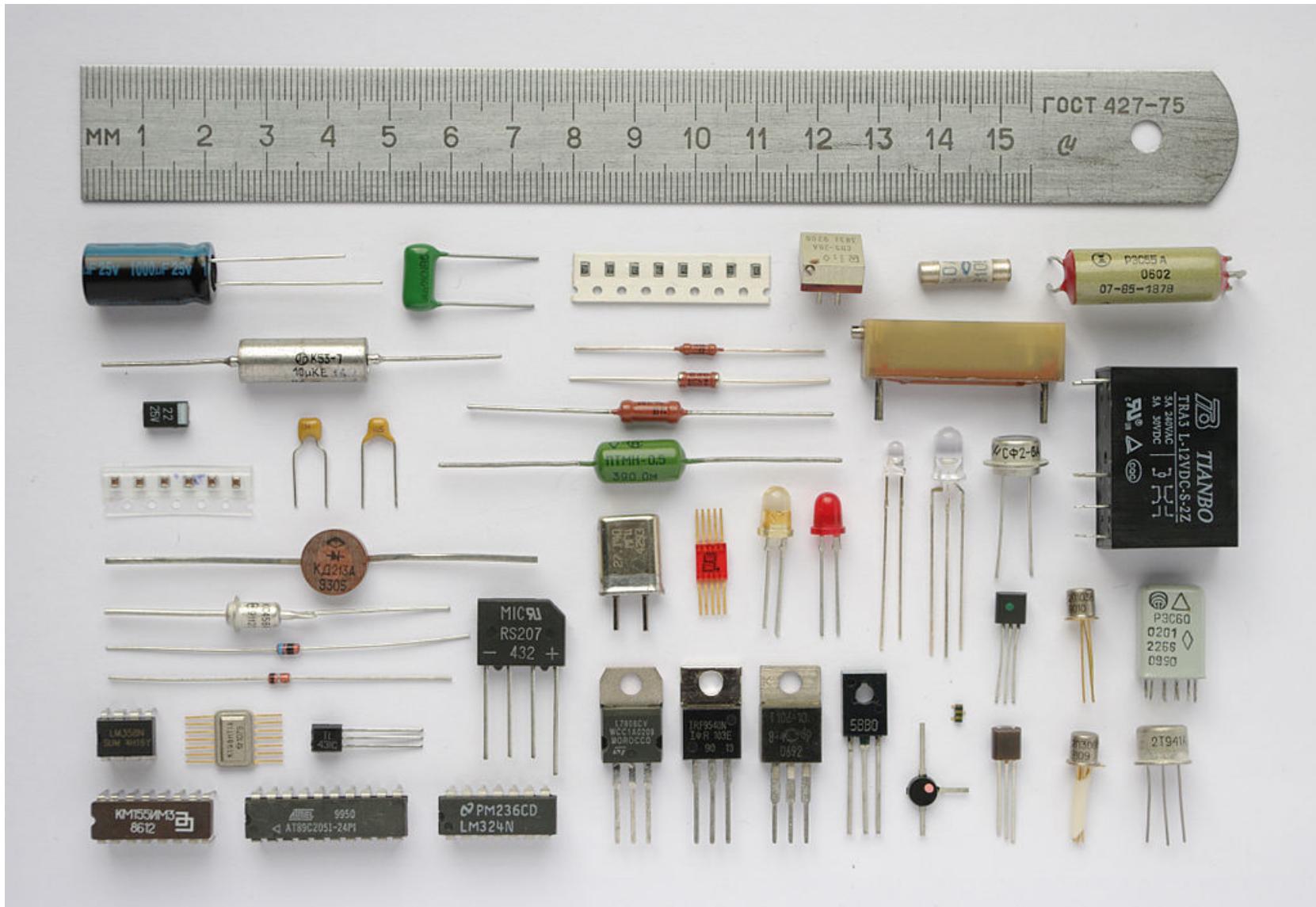


Breadboard

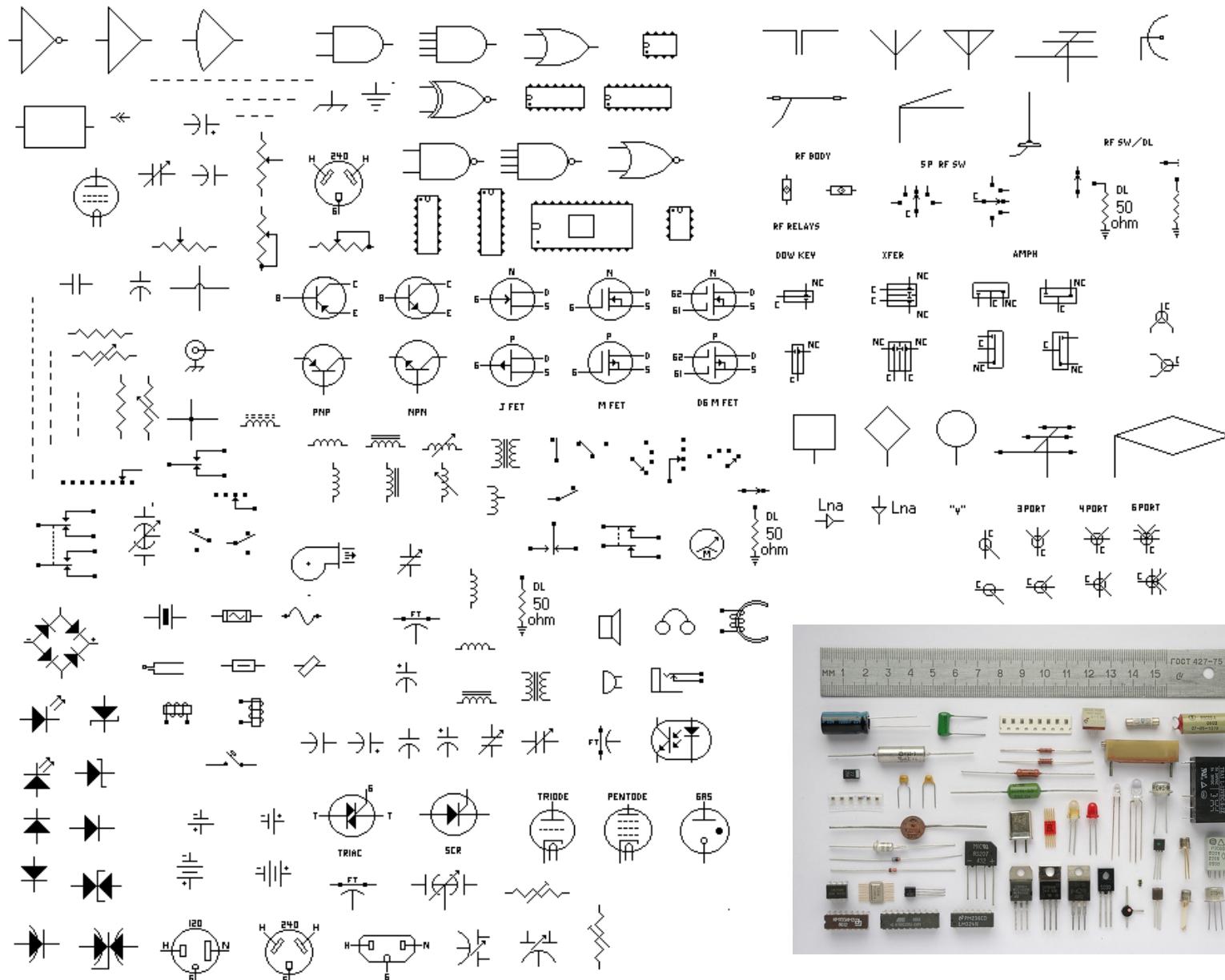


The Next PCB

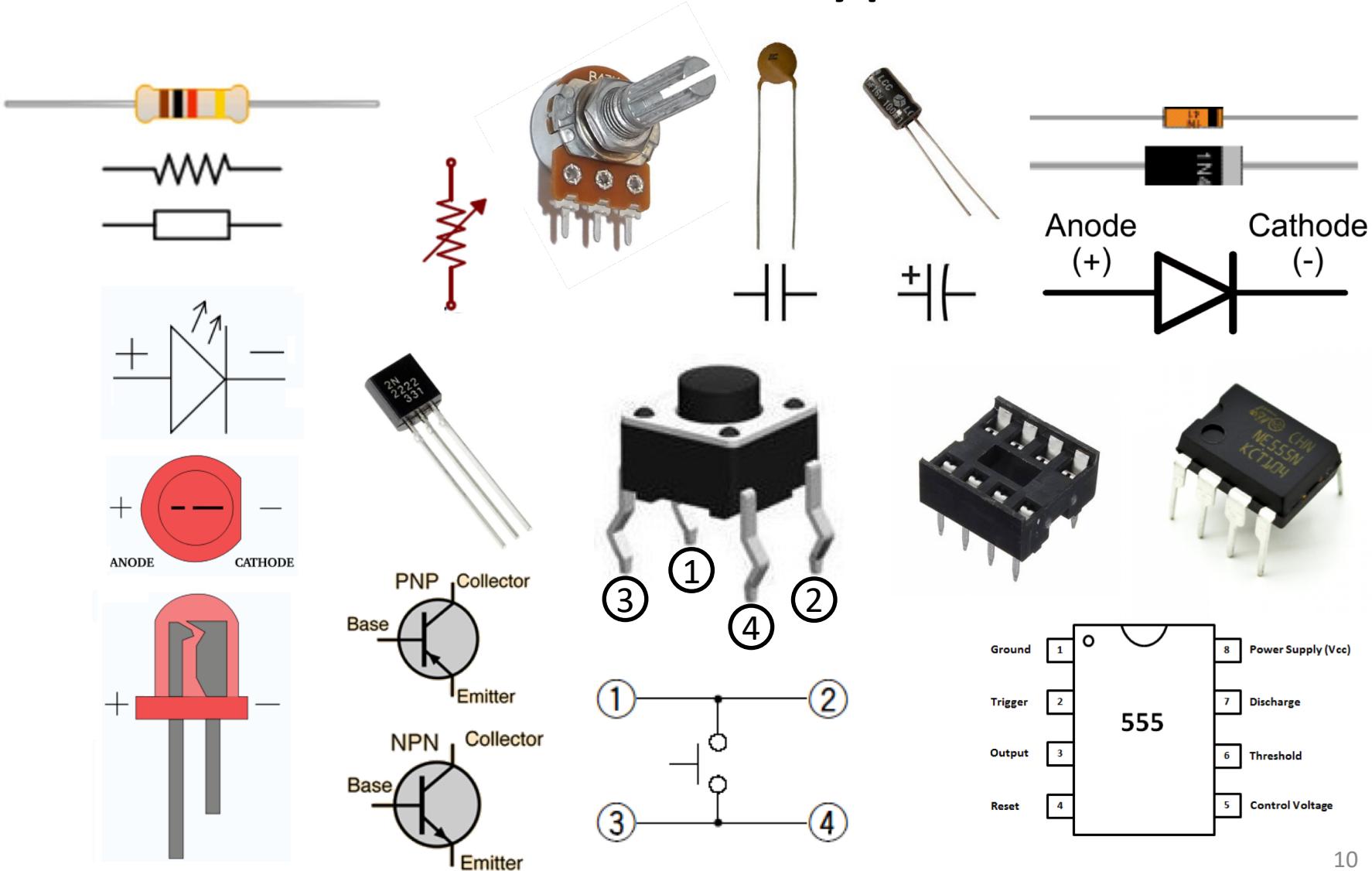
Electronic Component



Electronic Component Symbol

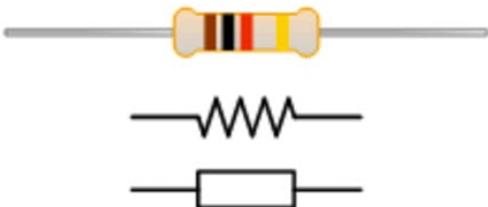


Electronic Component and Symbol Common Type



Electronic Component and Symbol

Resistor



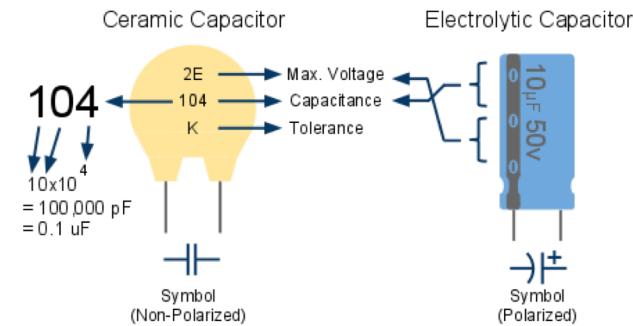
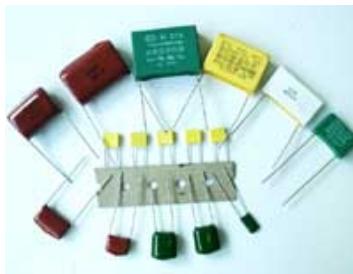
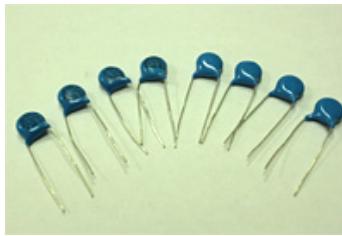
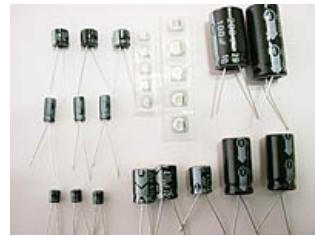
Variable Potentiometer



Color Codes	4 Band Resistors	5 Band Resistors	6 Band Resistors
 0 Black 1 Brown 2 Red 3 Orange 4 Yellow 5 Green 6 Blue 7 Purple 8 Grey 9 White $\pm 1\%$ Brown $\pm 2\%$ Red $\pm 5\%$ Gold $\pm 10\%$ Silver	 $\pm 1\%$ $\pm 2\%$ $\pm 5\%$ $\pm 10\%$ EXAMPLE 27K	 $\pm 1\%$ $\pm 2\%$ $\pm 5\%$ $\pm 10\%$ EXAMPLE 15K	 $\pm 1\%$ $\pm 2\%$ $\pm 5\%$ $\pm 10\%$ EXAMPLE 620K

Electronic Component and Symbol

Capacitor

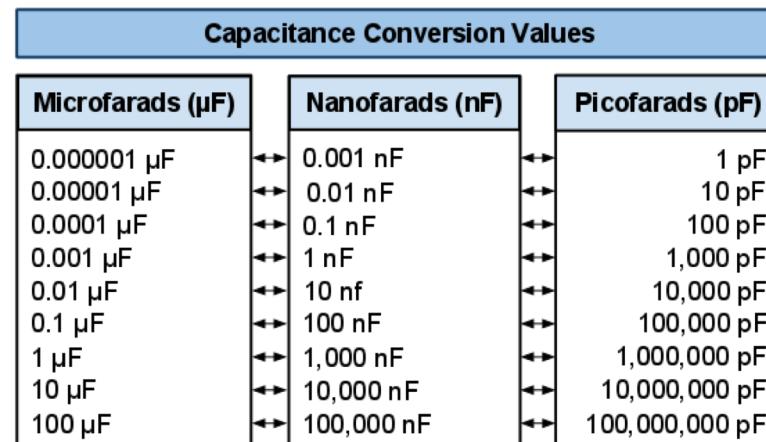
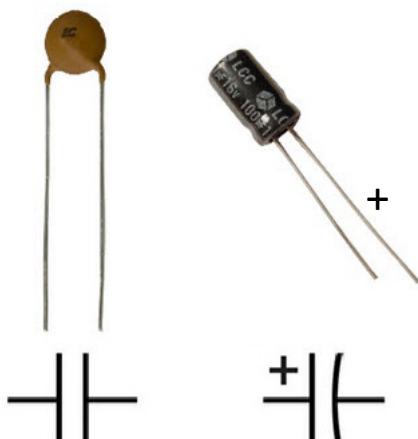


Max. Operating Voltage

Code	Max. Voltage
1H	50V
2A	100V
2T	150V
2D	200V
2E	250V
2G	400V
2J	630V

Tolerance

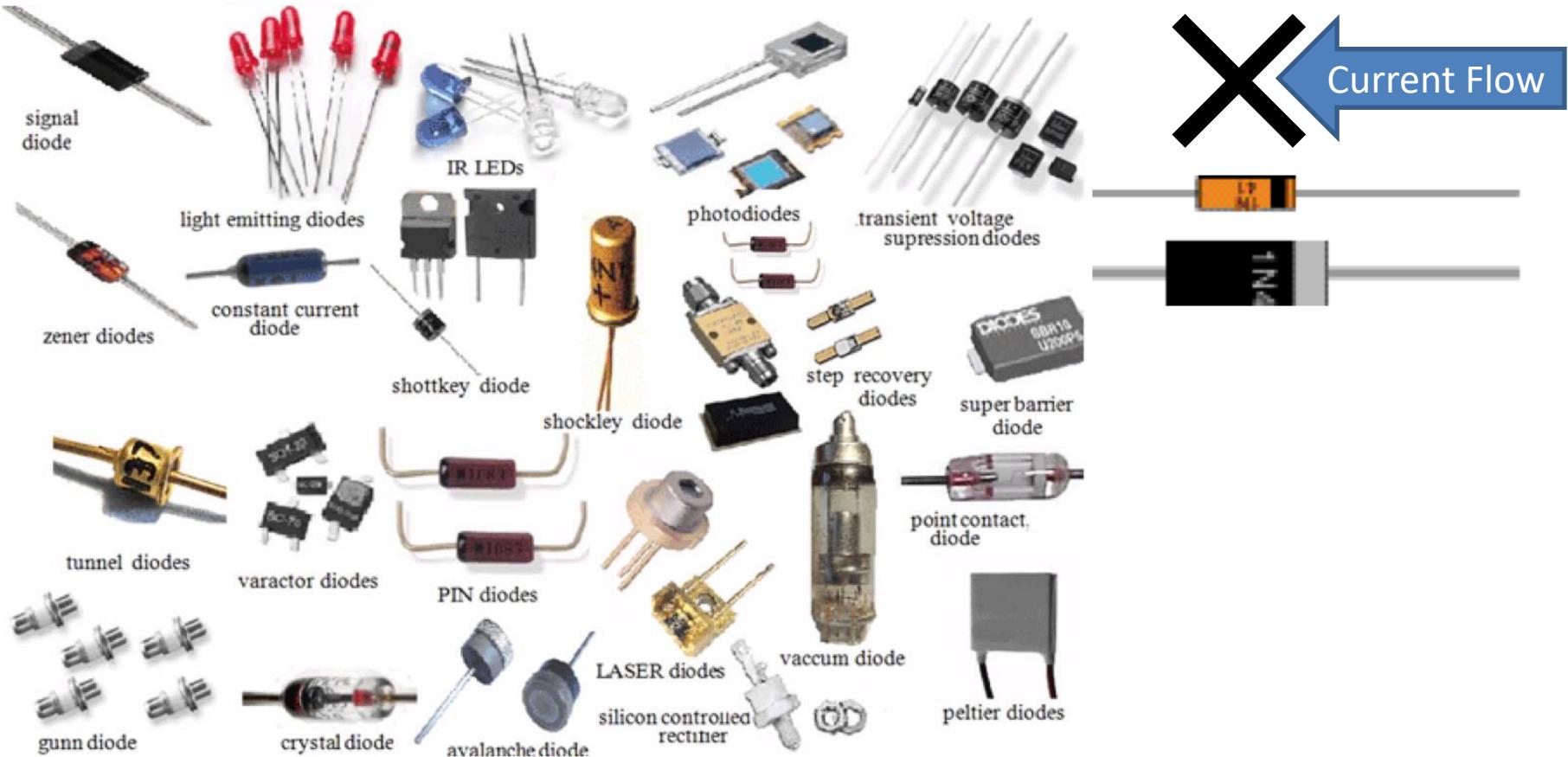
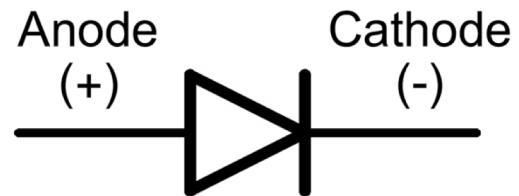
Code	Percentage
B	± 0.1 pF
C	± 0.25 pF
D	± 0.5 pF
F	$\pm 1\%$
G	$\pm 2\%$
H	$\pm 3\%$
J	$\pm 5\%$
K	$\pm 10\%$
M	$\pm 20\%$
Z	+80%, -20%



Electronic Component and Symbol

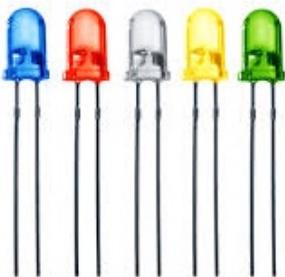
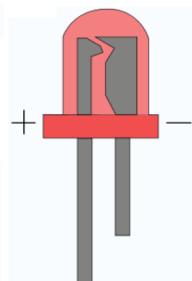
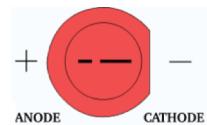
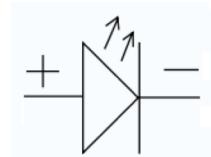
Diode

Direction of Current Flow

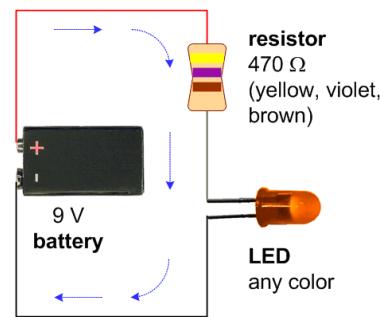


Electronic Component and Symbol

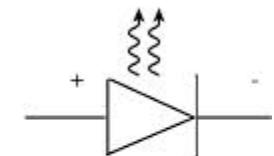
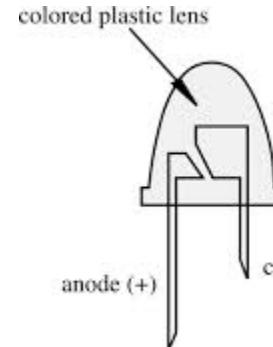
LED – Light Emitting Diode



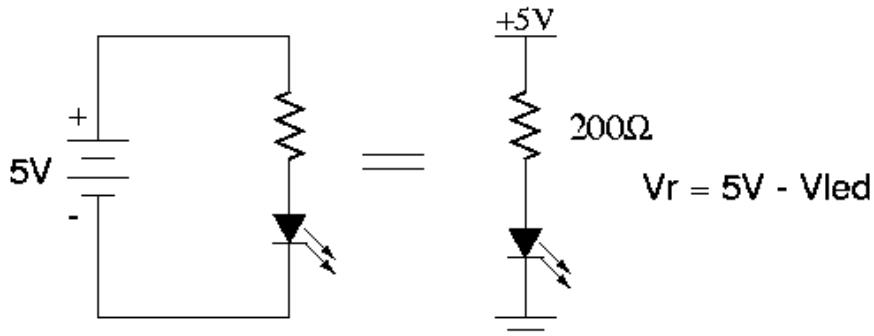
Application Circuit



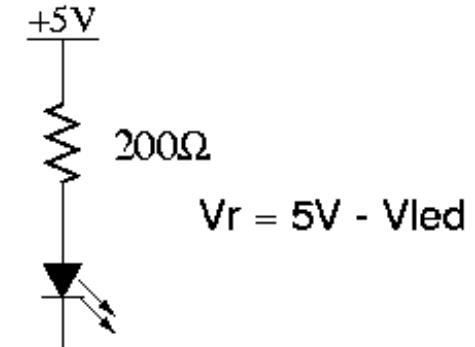
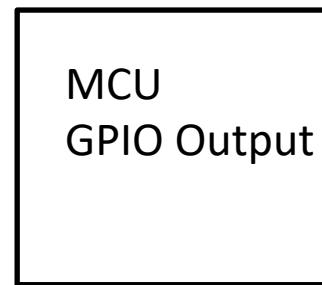
Component Diagram



schematic symbol

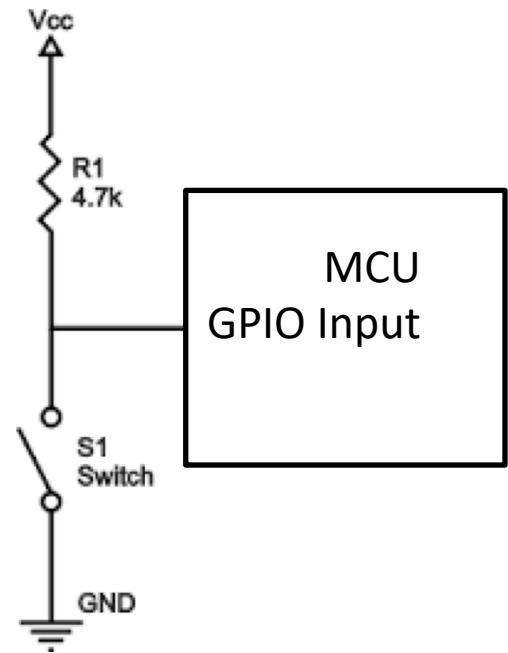
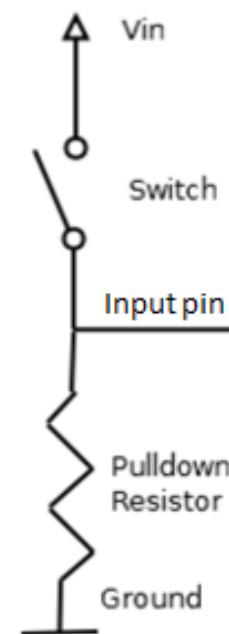
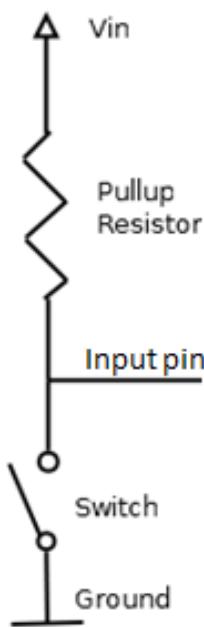
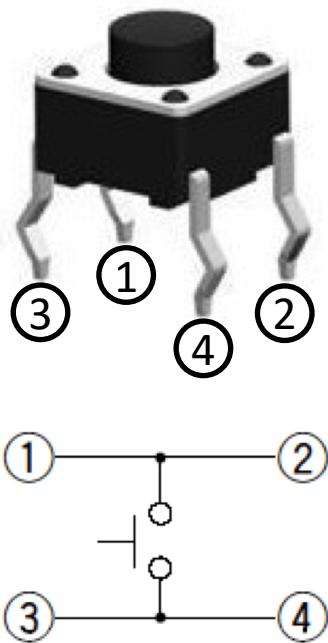
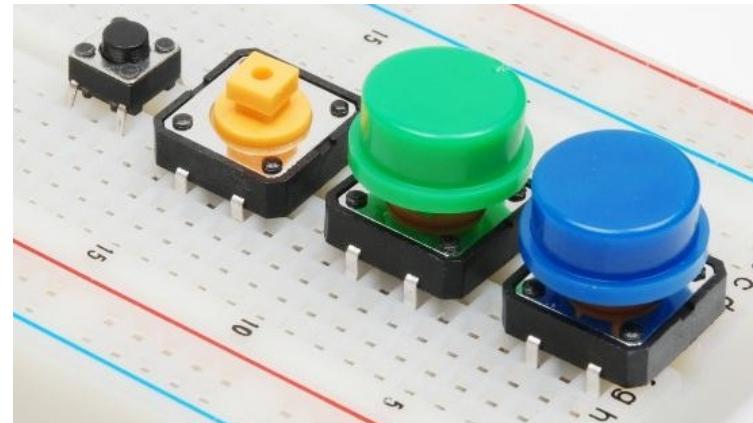
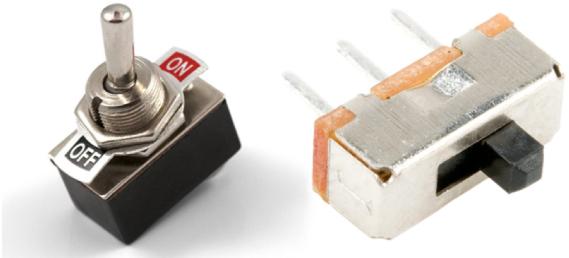


Diodes have a fixed Voltage drop.



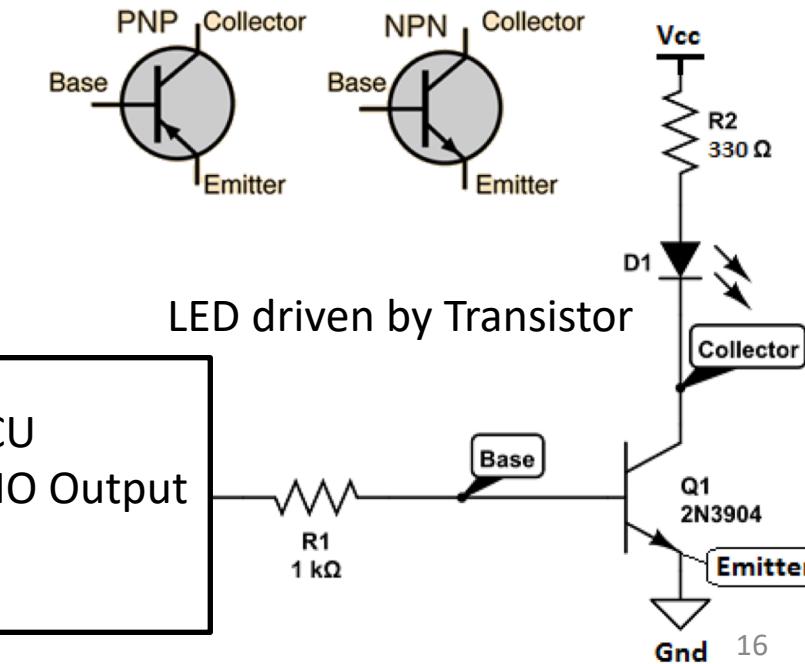
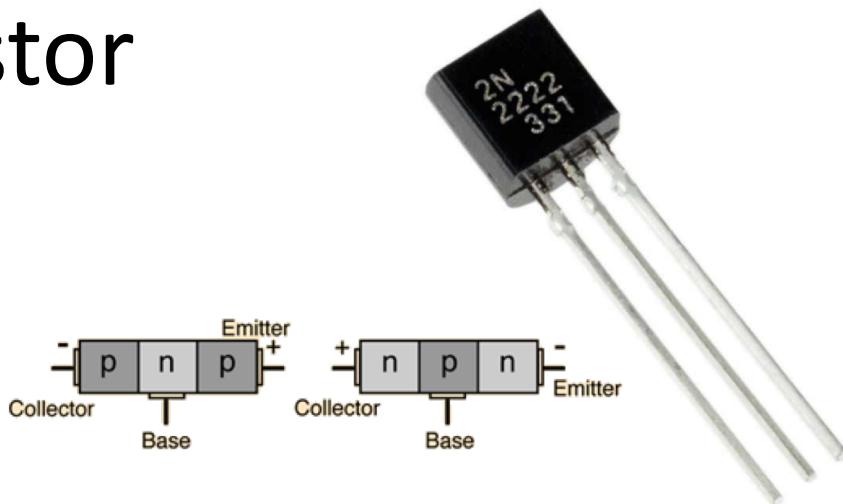
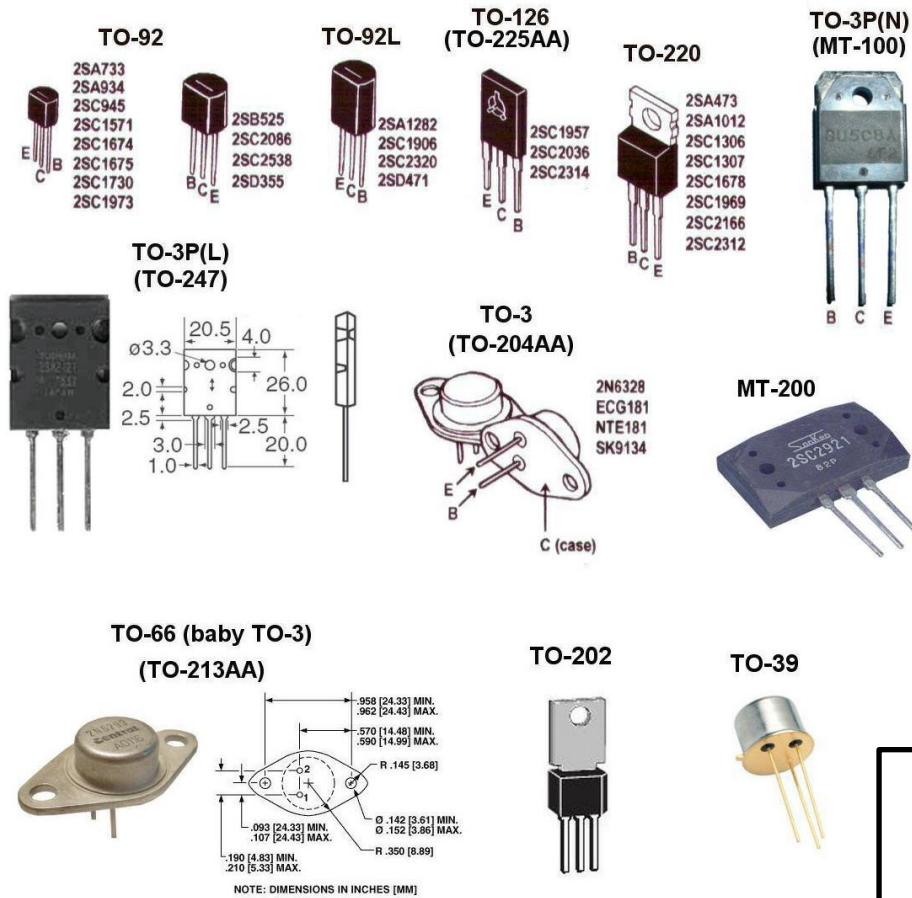
Electronic Component and Symbol

Button



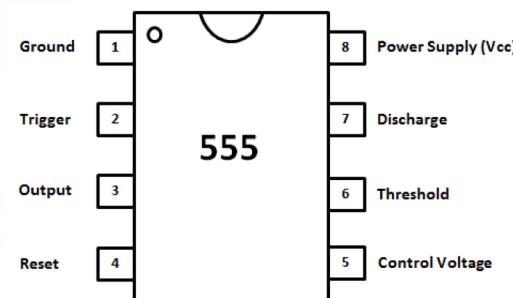
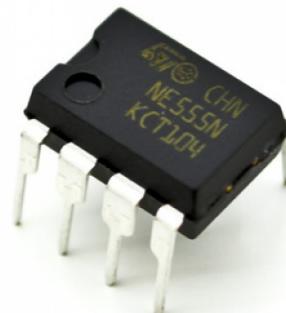
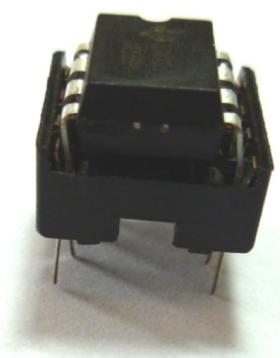
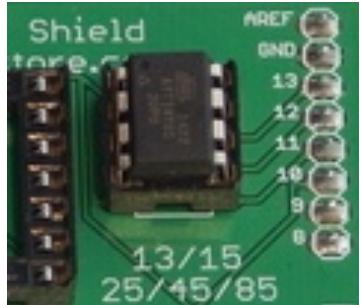
Electronic Component and Symbol

Transistor



Electronic Component and Symbol

IC – Integrated Circuit



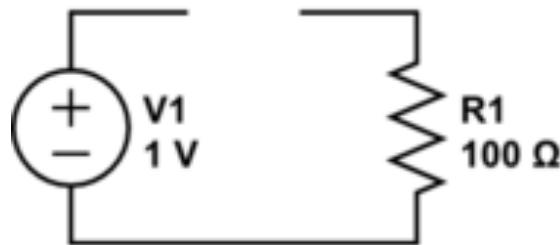
Value and Name of Component

- Think about ... How to read
You already learn the methods before

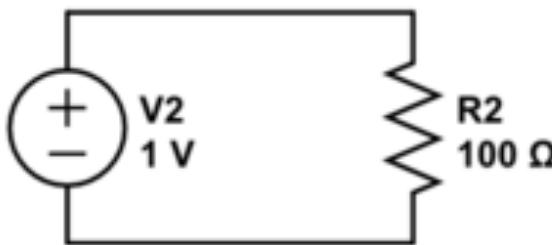


Connection

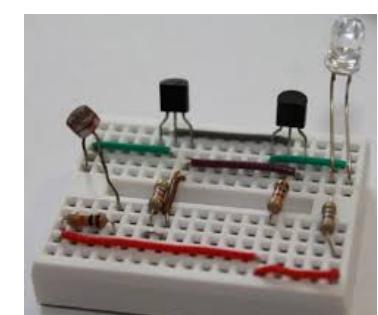
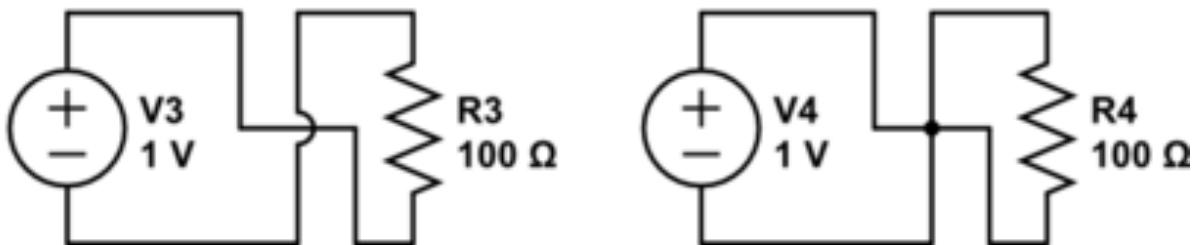
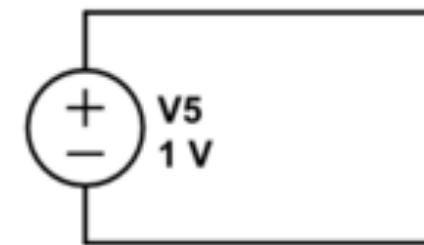
Open circuit



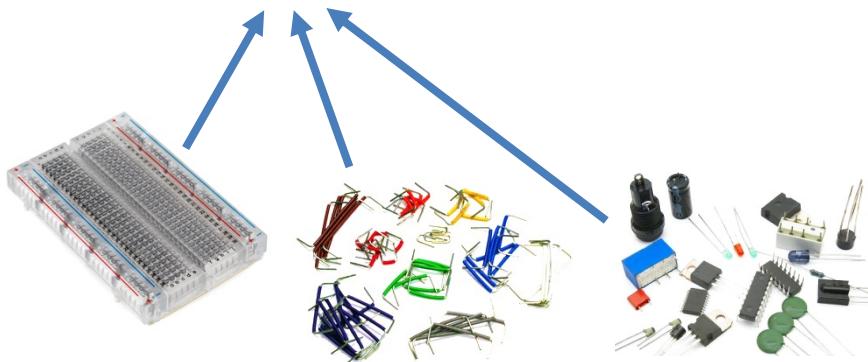
Closed circuit



Short circuit

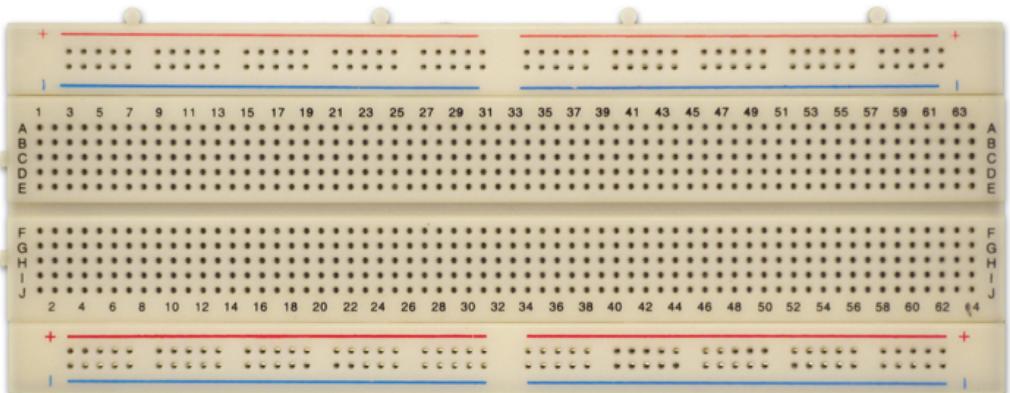
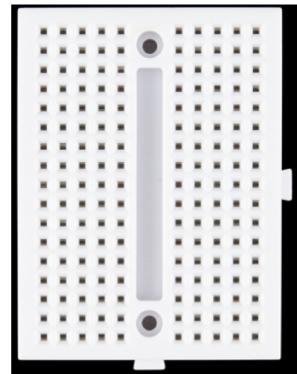
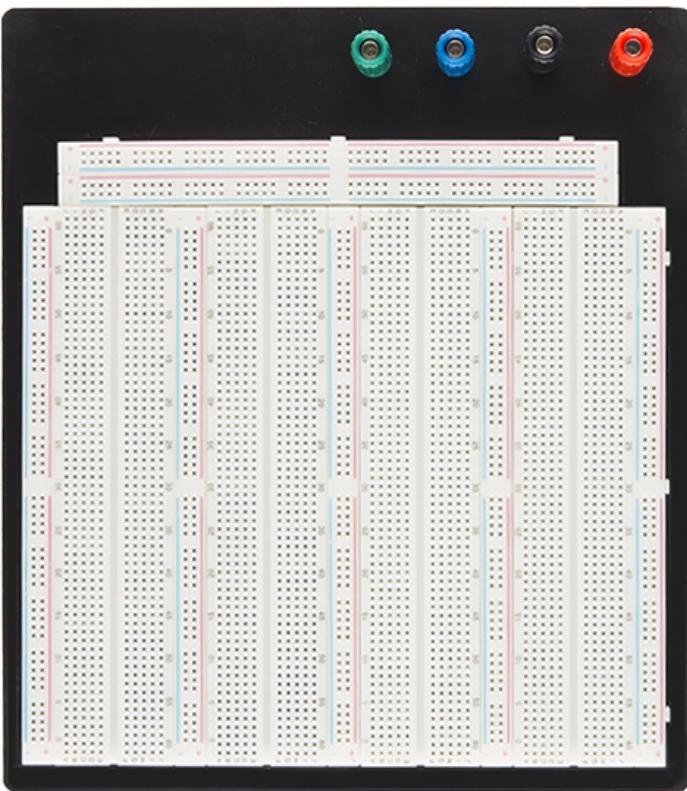
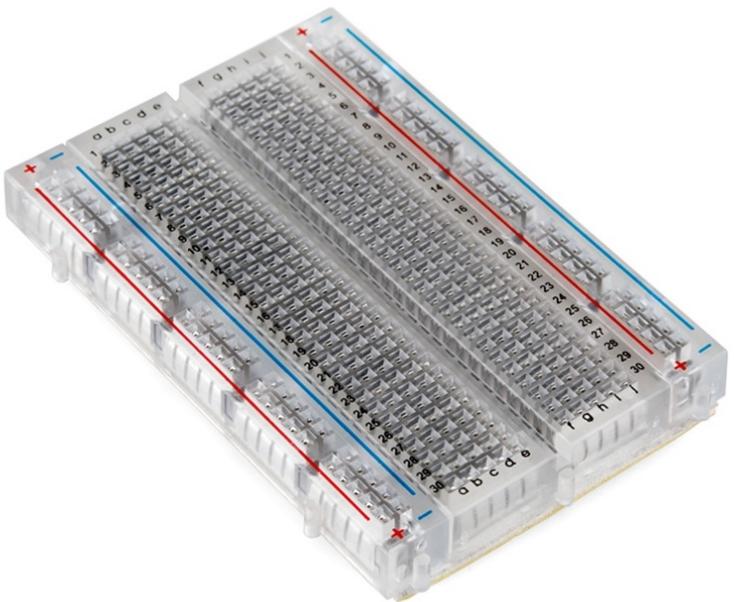


Status of Connection

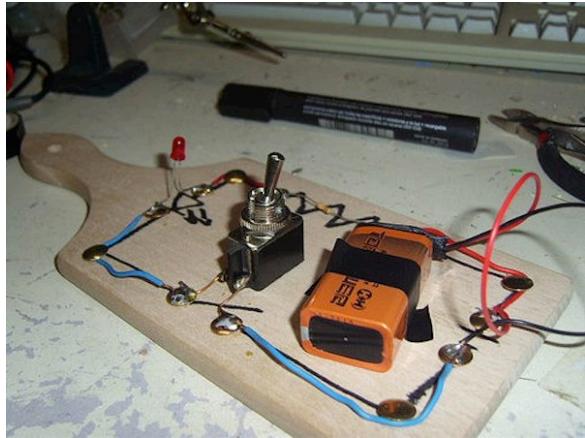


1. Open Circuit
2. Closed Circuit
3. Short Circuit

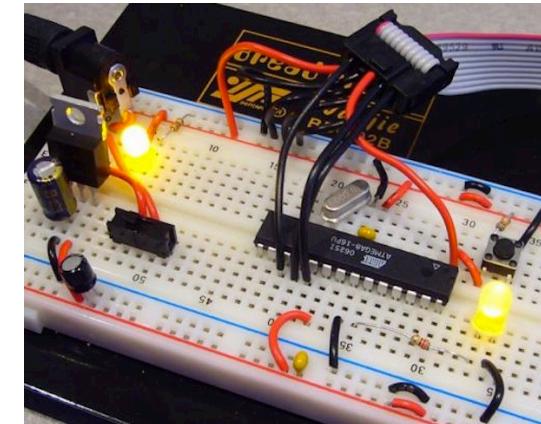
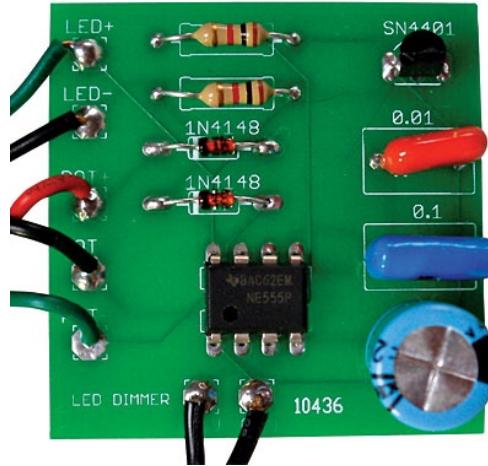
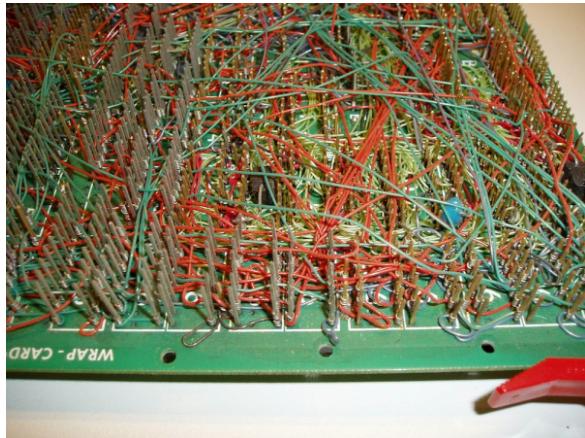
Breadboard



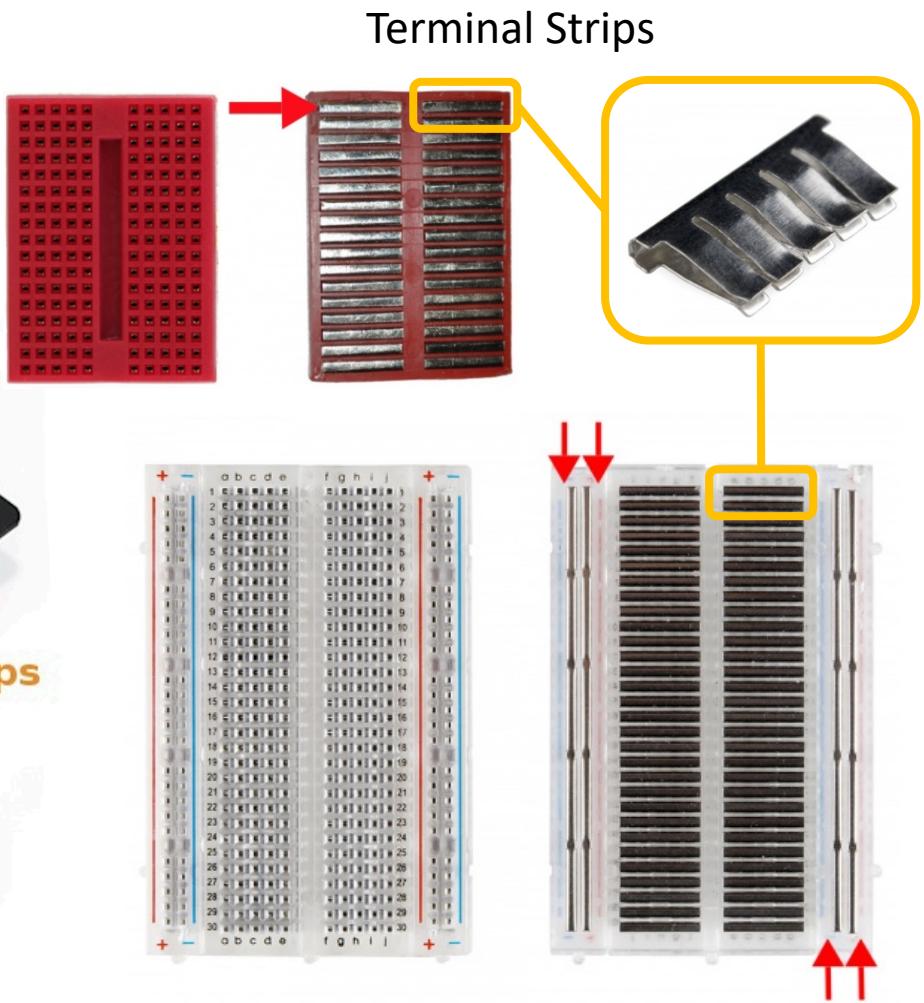
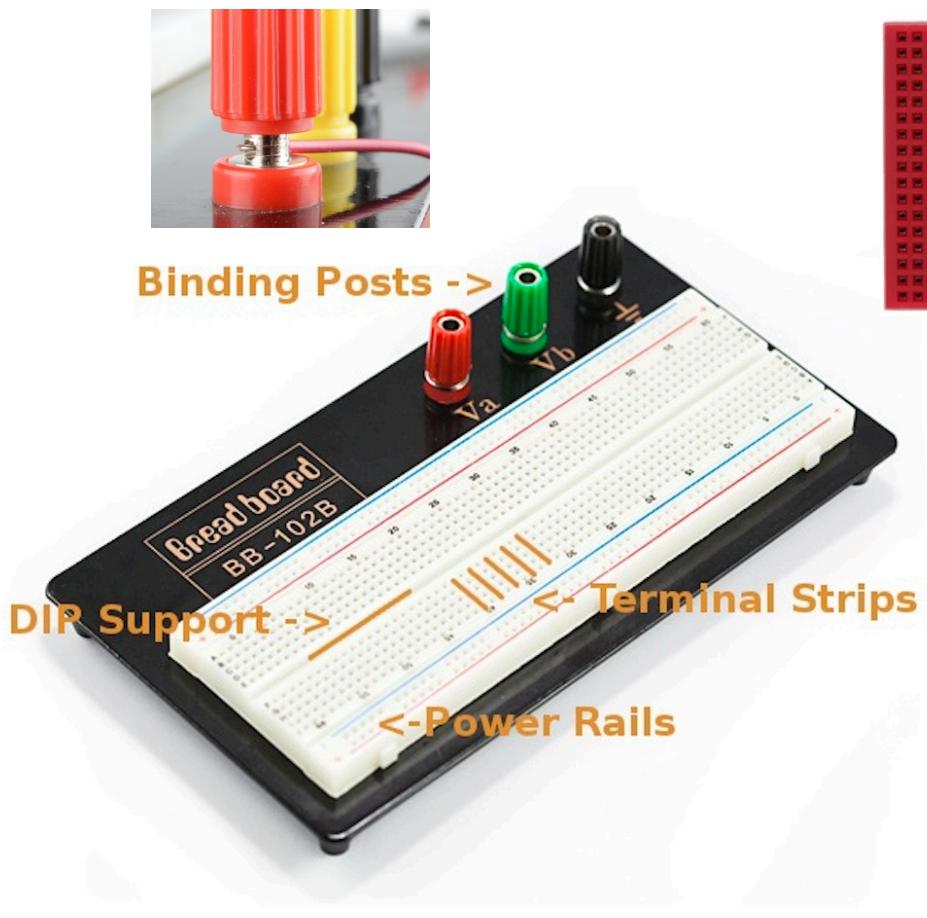
Why Use Breadboards?



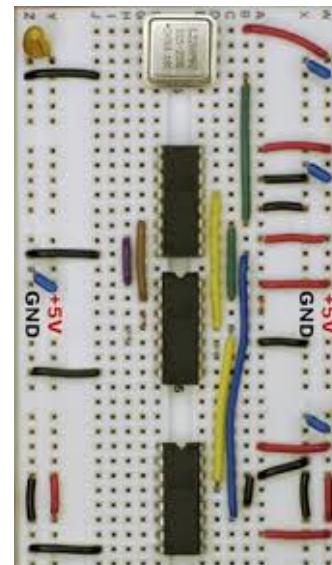
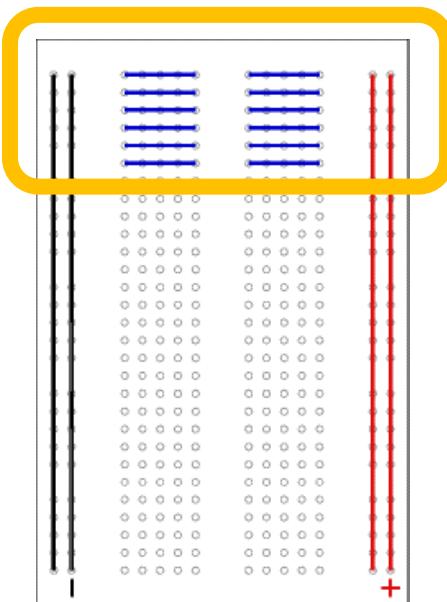
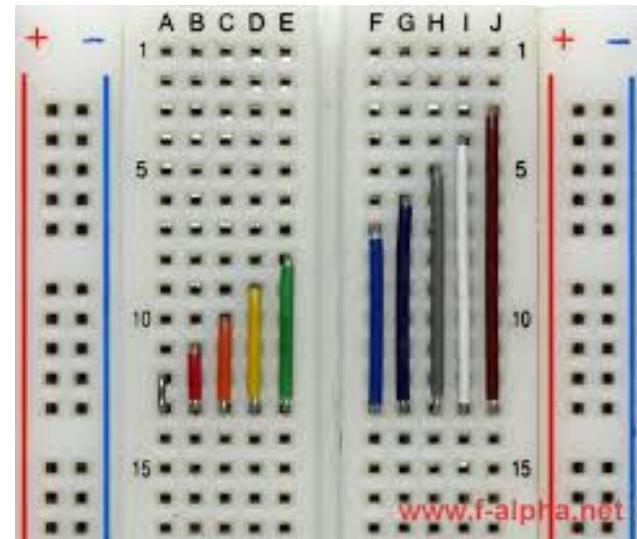
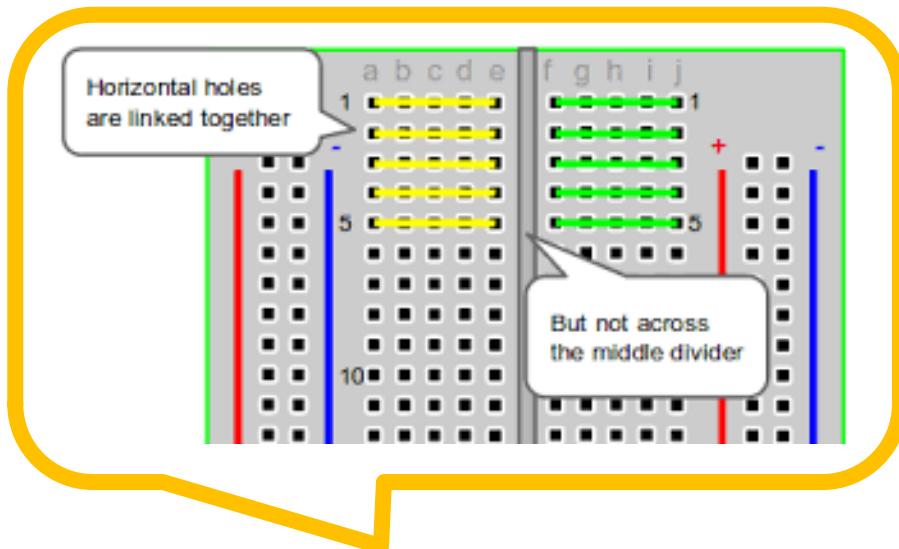
Prototyping is the process of testing out an idea by creating a preliminary model from which other forms are developed or copied, and it is one of the most common uses for breadboards. If you aren't sure how a circuit will react under a given set of parameters, it's best to build a prototype and test it out.



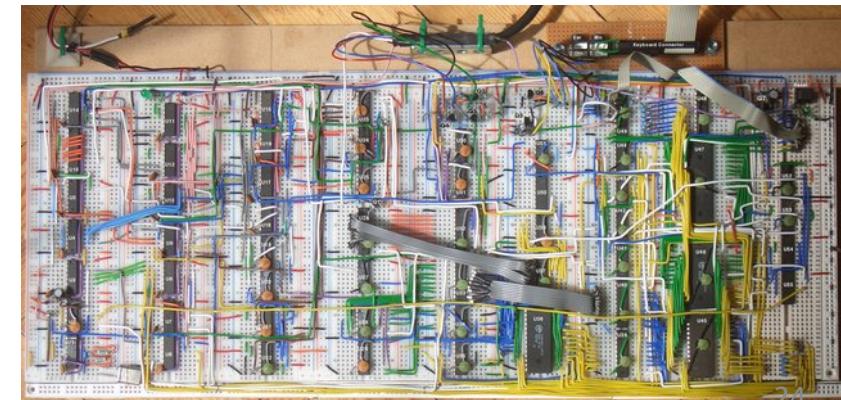
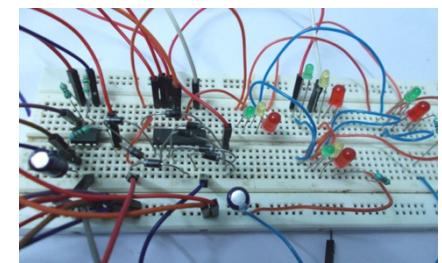
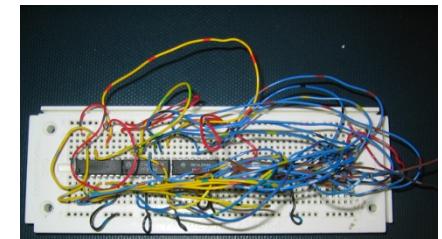
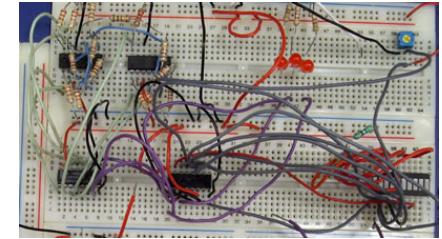
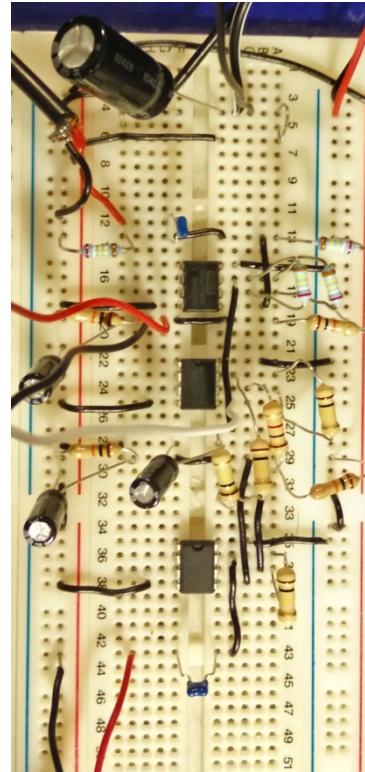
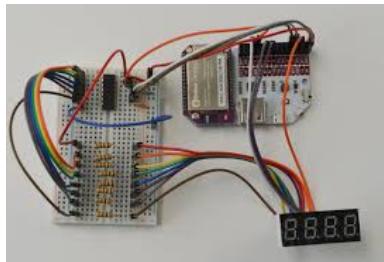
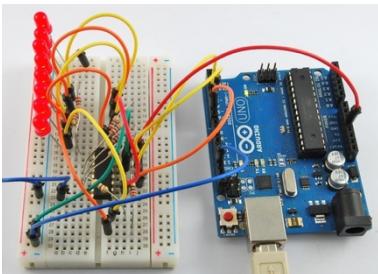
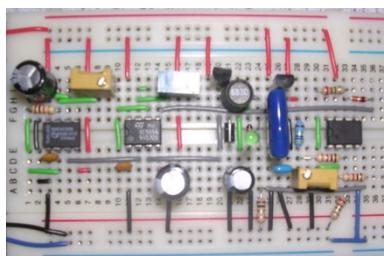
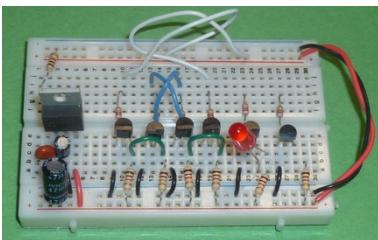
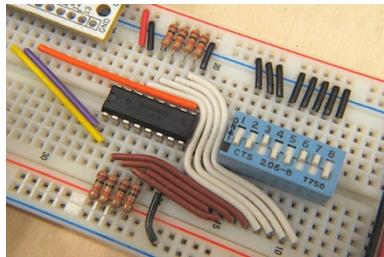
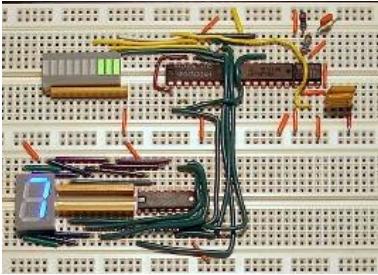
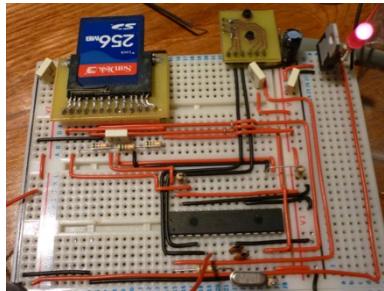
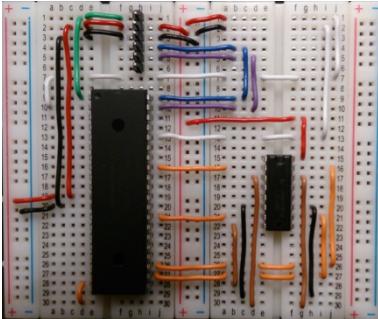
Structure of a Breadboard



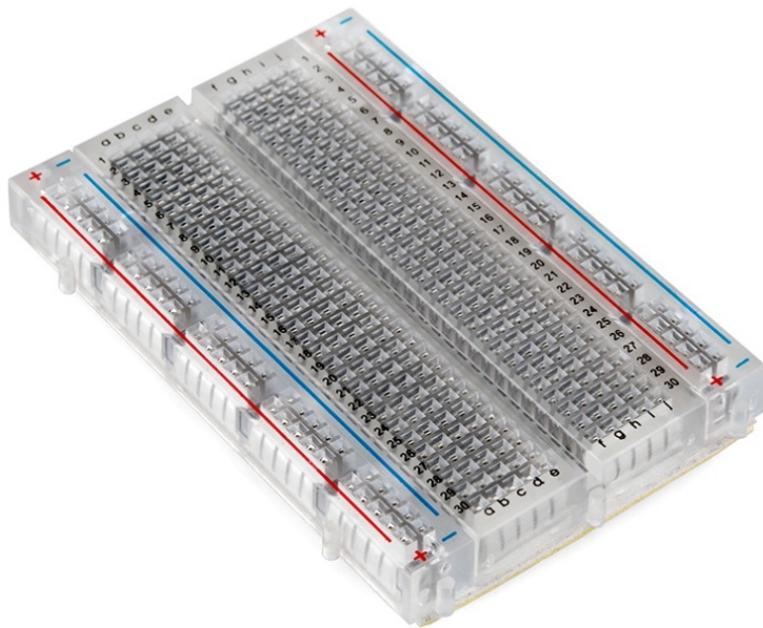
Connection in Breadboard



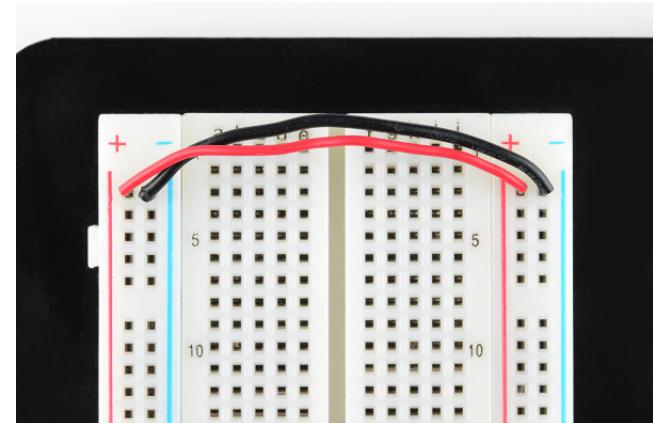
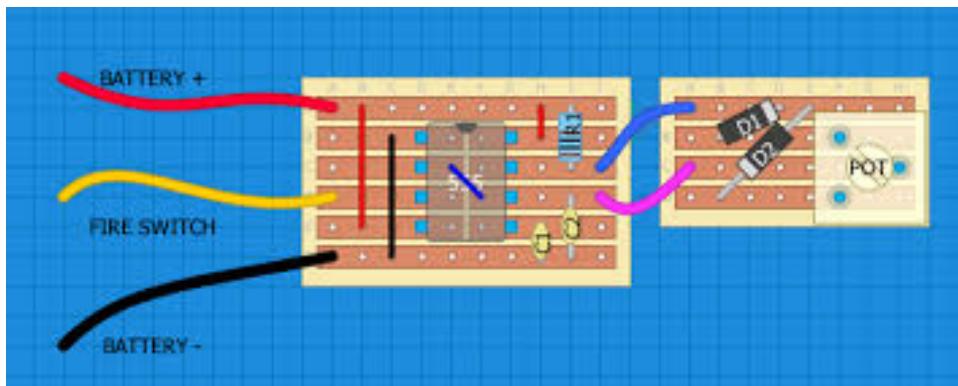
Good or Bad



How to Use a Breadboard



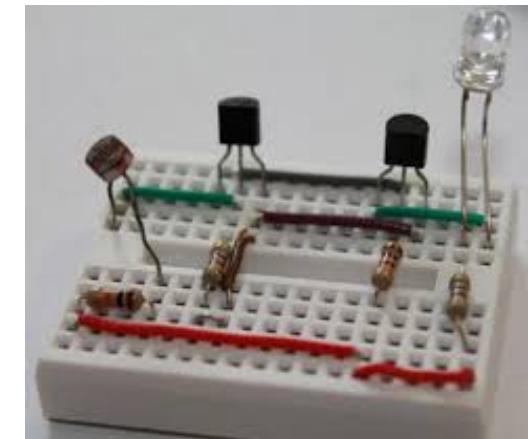
Breadboards are one of the most fundamental pieces when learning how to build circuits. In this tutorial, you will learn a little bit about what breadboards are, why they are called breadboards, and how to use one. Once you are done you should have a basic understanding of how breadboards work and be able to build a basic circuit on a breadboard.



Why Called Breadboard

The story goes that an engineer had an idea for a vacuum tube device late one night. Looking around the house, the only base for his prototype that he found was indeed his wife's breadboard, from the breadbox.

Now, I'm not endorsing *actually* using a real breadboard. It's your marital strife if you do.

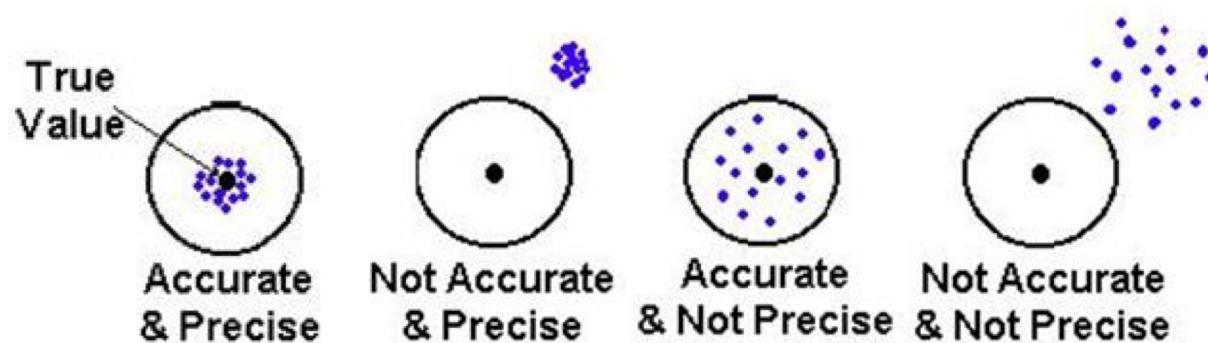


Equipment and Instrument

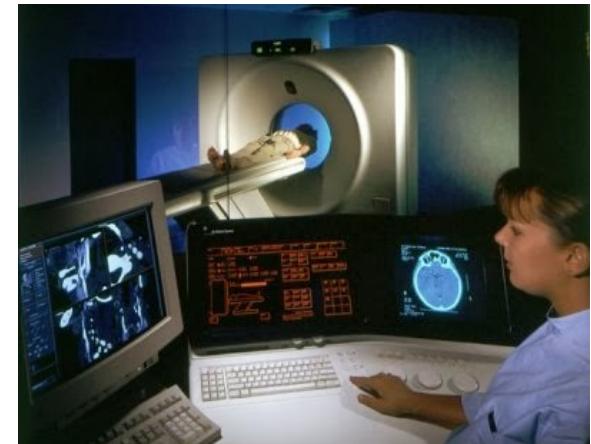
- Type of Equipment and Instrument



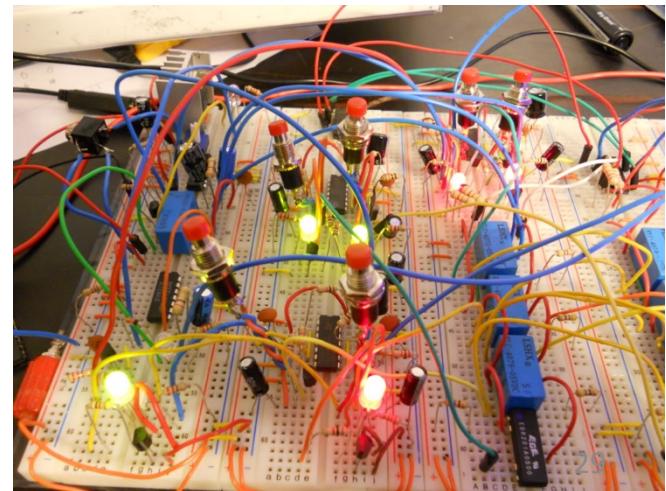
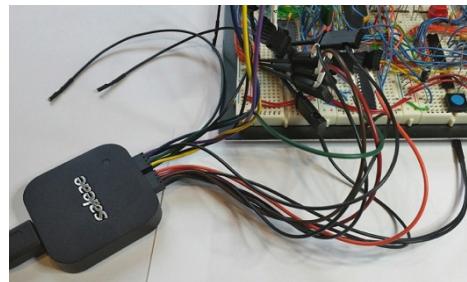
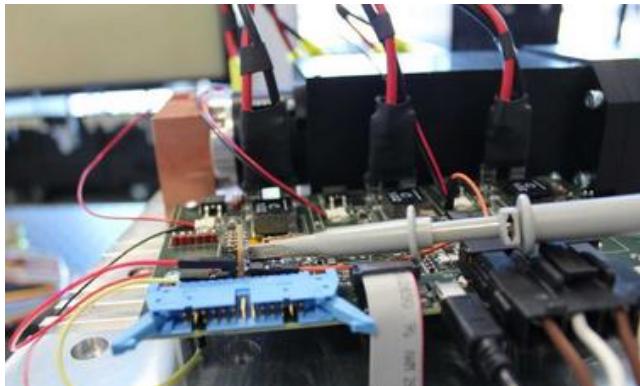
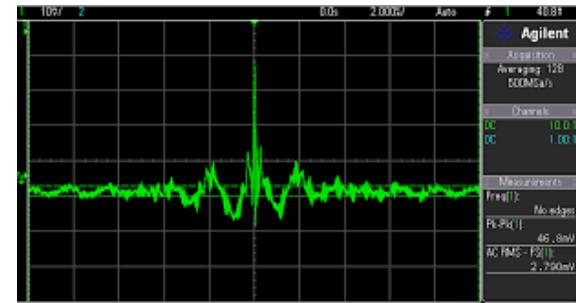
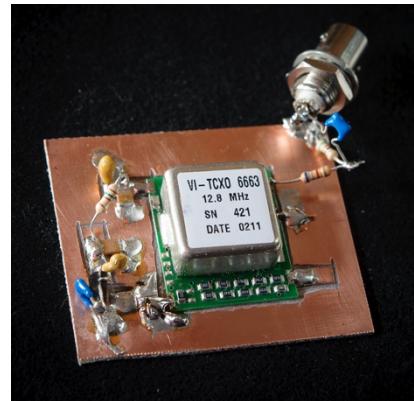
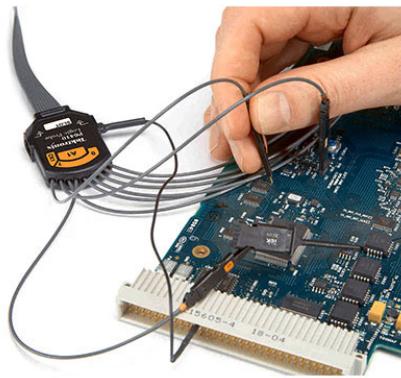
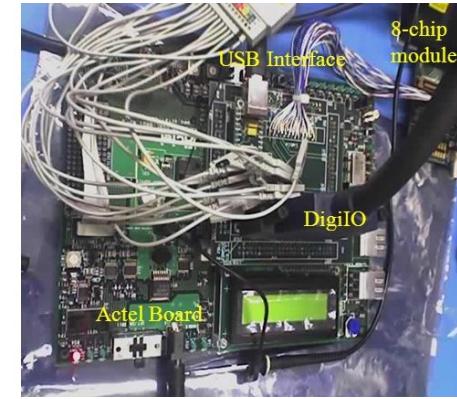
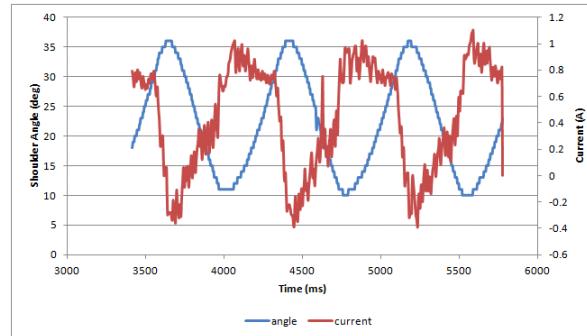
- Measurement : Accuracy and Precision



Equipment and Instrument In Hospital



Equipment and Instrument for Electronic Product Development



Equipment and Instrument

Input

Output

Power Supply



Signal Generator



Power Power

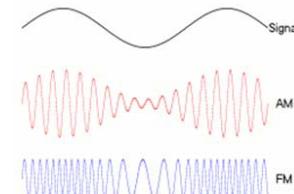
Measure

- Voltage
- Resistance
- Current



Multimeter

Generate Signal



Measure Signal



Digital Storage Oscilloscope – DSO

Power Supply

- Understand the key feature of Power Supply
 - Power On and Output On
 - Channel and Display
 - Voltage and Current
 - Current Limit
- The Key Function
 - Output DC Voltage



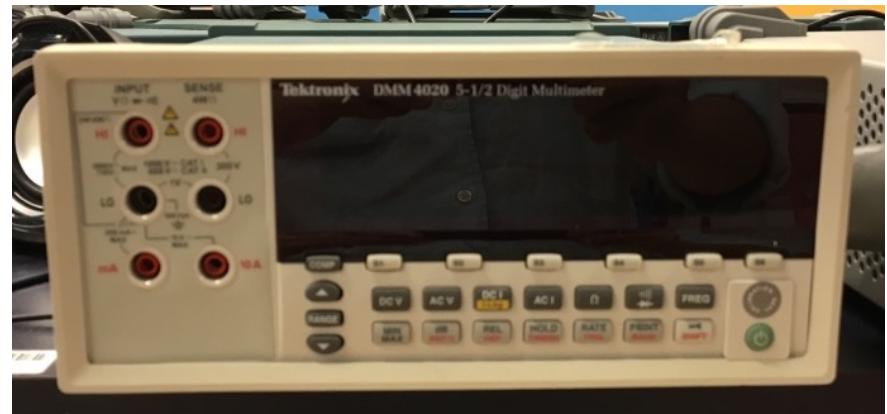
Multimeter

Analog Multimeter

- Type of Multimeter
 - Analog and Digital
- Measure
 - V – Voltage
 - R – Resistance
 - I – Current



Digital Multimeter



Analog Multimeter



Digital Multimeter



Equipment and Instrument

Input

Output

Power Supply



Power Power

Measure

- Voltage
- Resistance
- Current

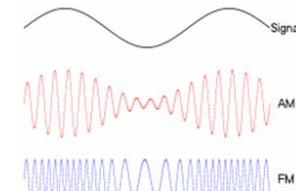


Multimeter

Signal Generator



Generate Signal



Measure Signal

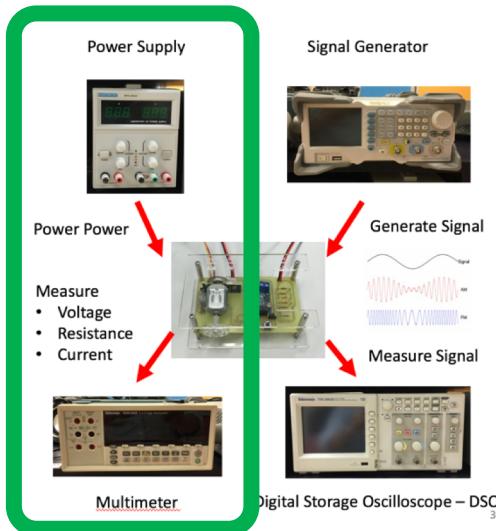


Digital Storage Oscilloscope – DSO

Basic Operation – Demo

Power Supply and Multimeter

- Power Supply
 - Setup Voltage
 - Setup Current Limit
- Multimeter
 - Measure Voltage
 - Measure Resistance



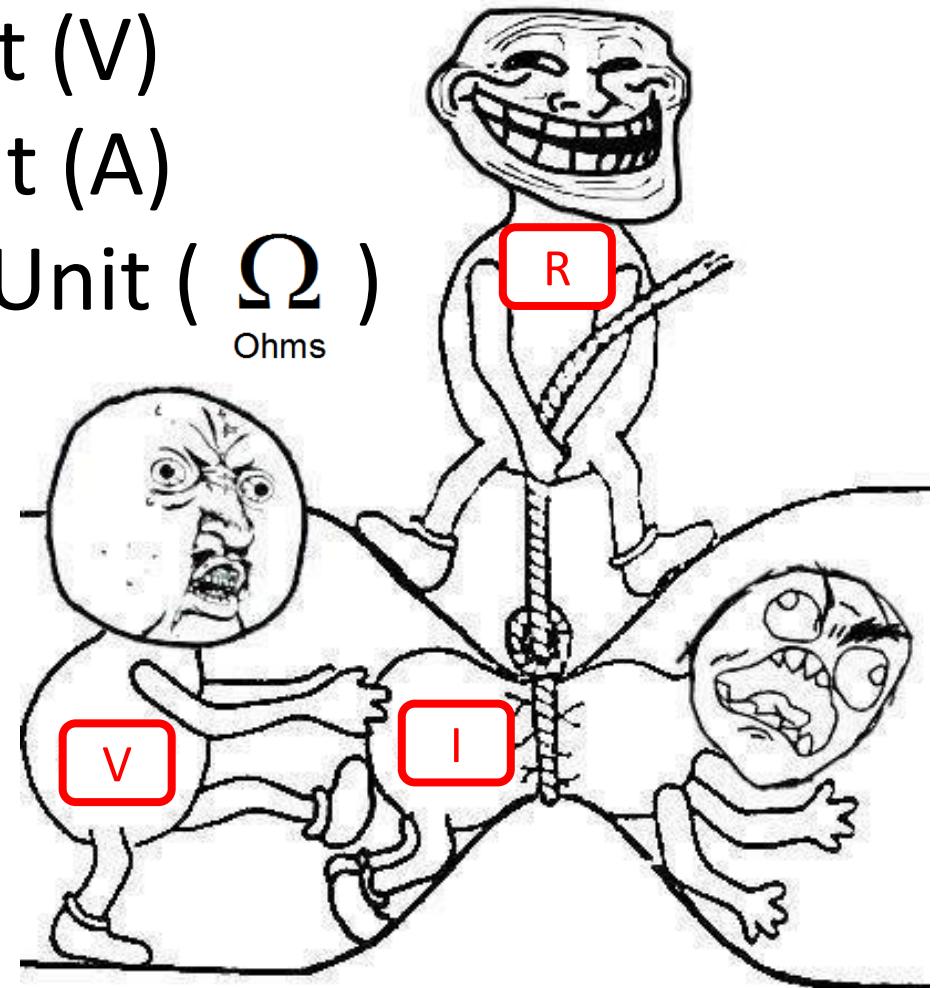
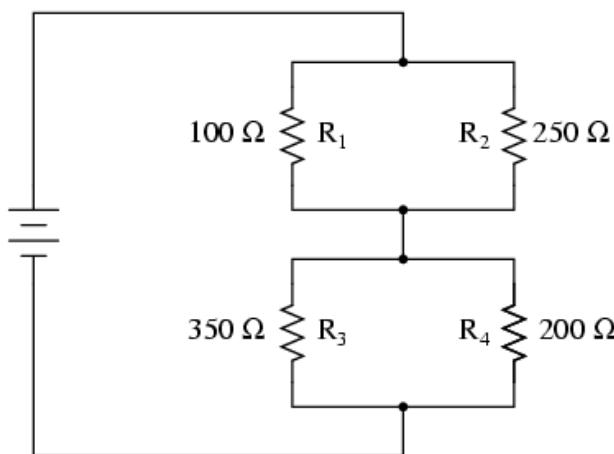
Basic Measurement

$$V = I R$$

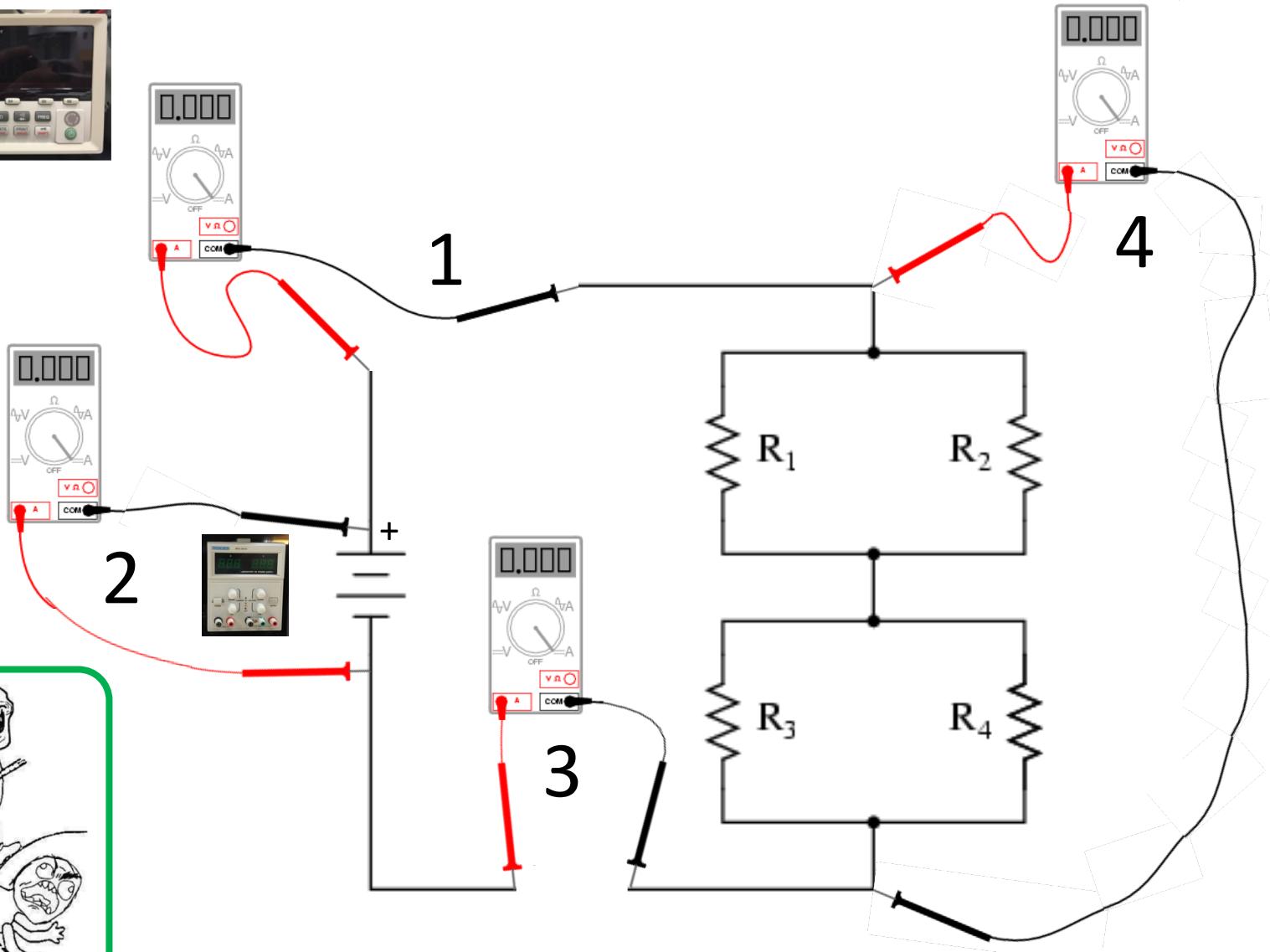
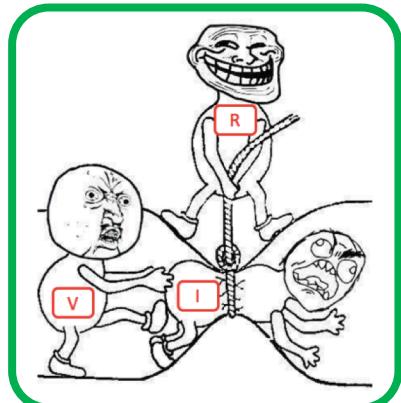
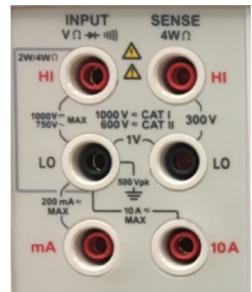
$V \rightarrow$ Voltage, Unit (V)

$I \rightarrow$ Current, Unit (A)

$R \rightarrow$ Resistance, Unit (Ω)

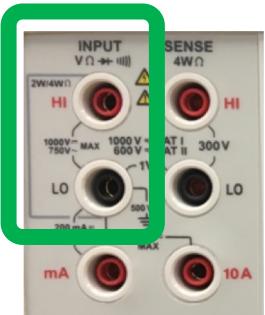


How to measure Voltage, Resistance, Current

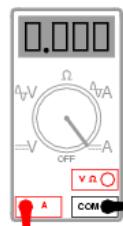


How to measure Voltage

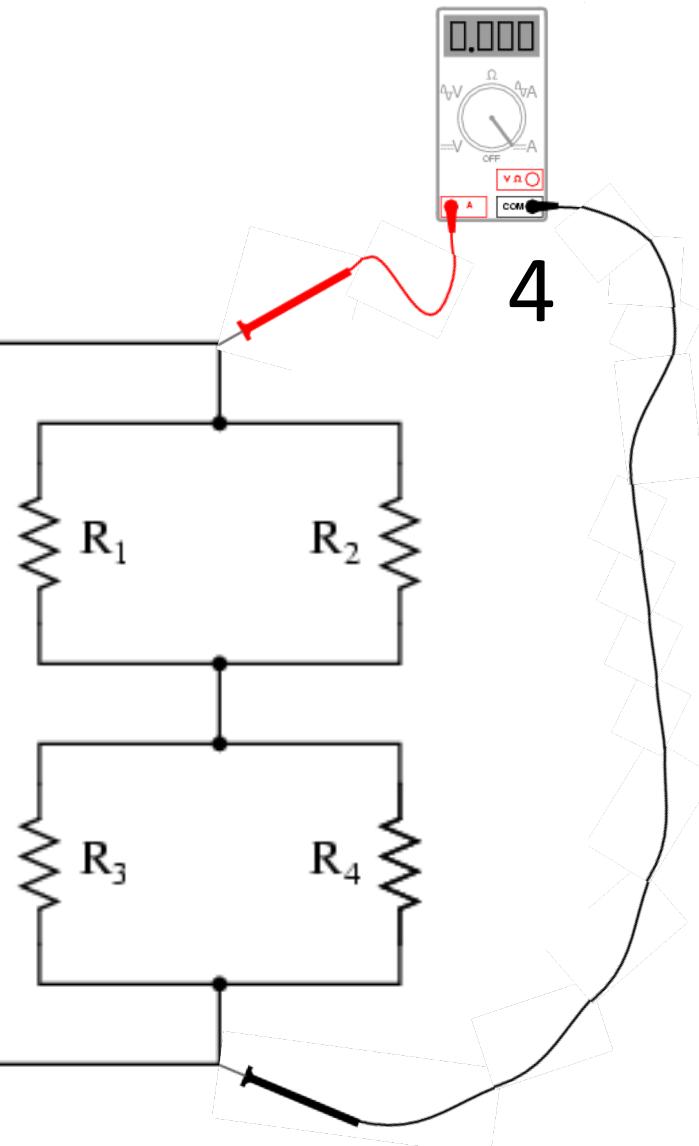
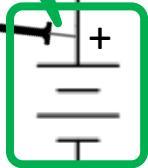
Which one is the best method to measure Voltage



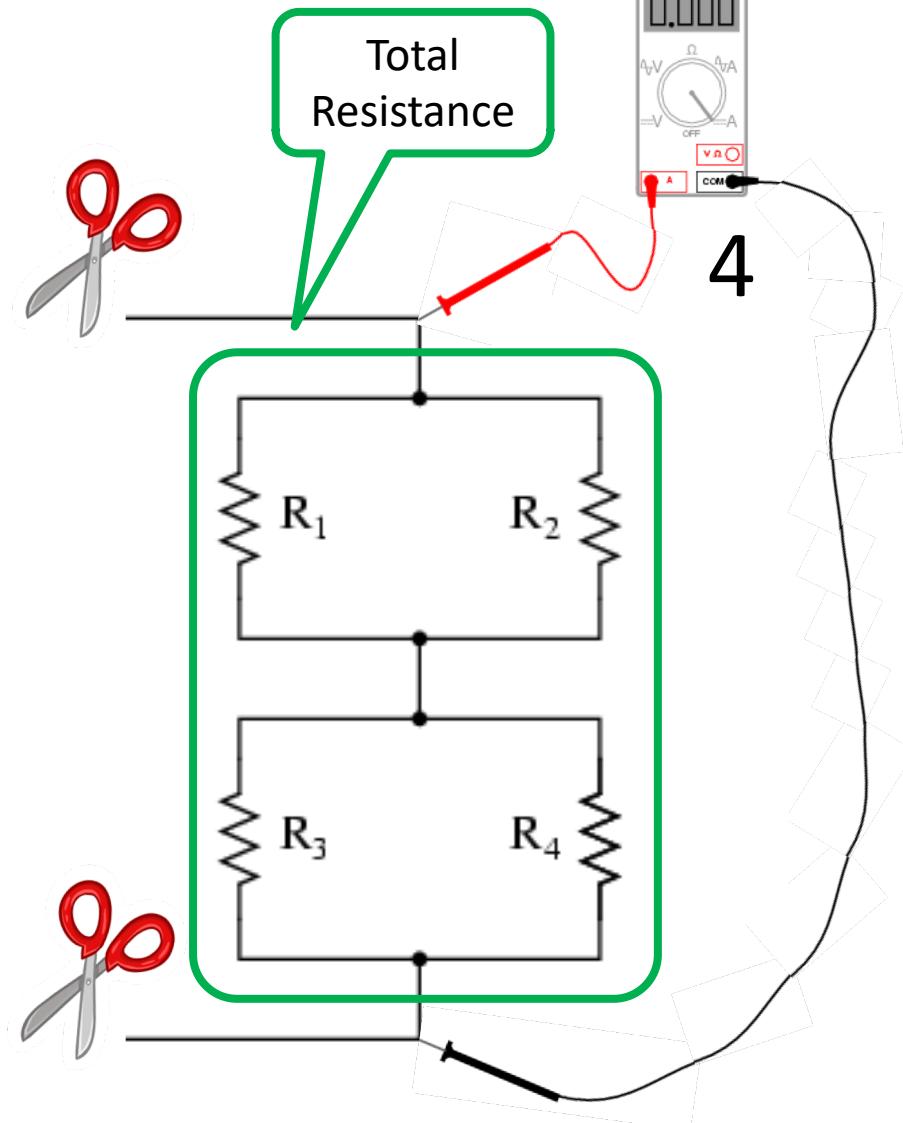
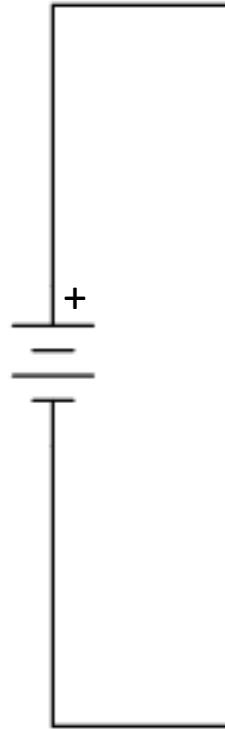
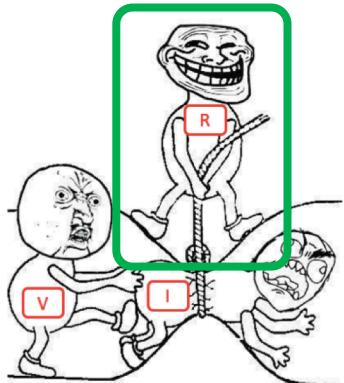
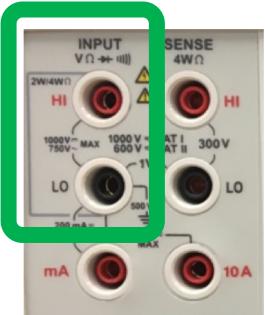
Power
Source
Voltage



2

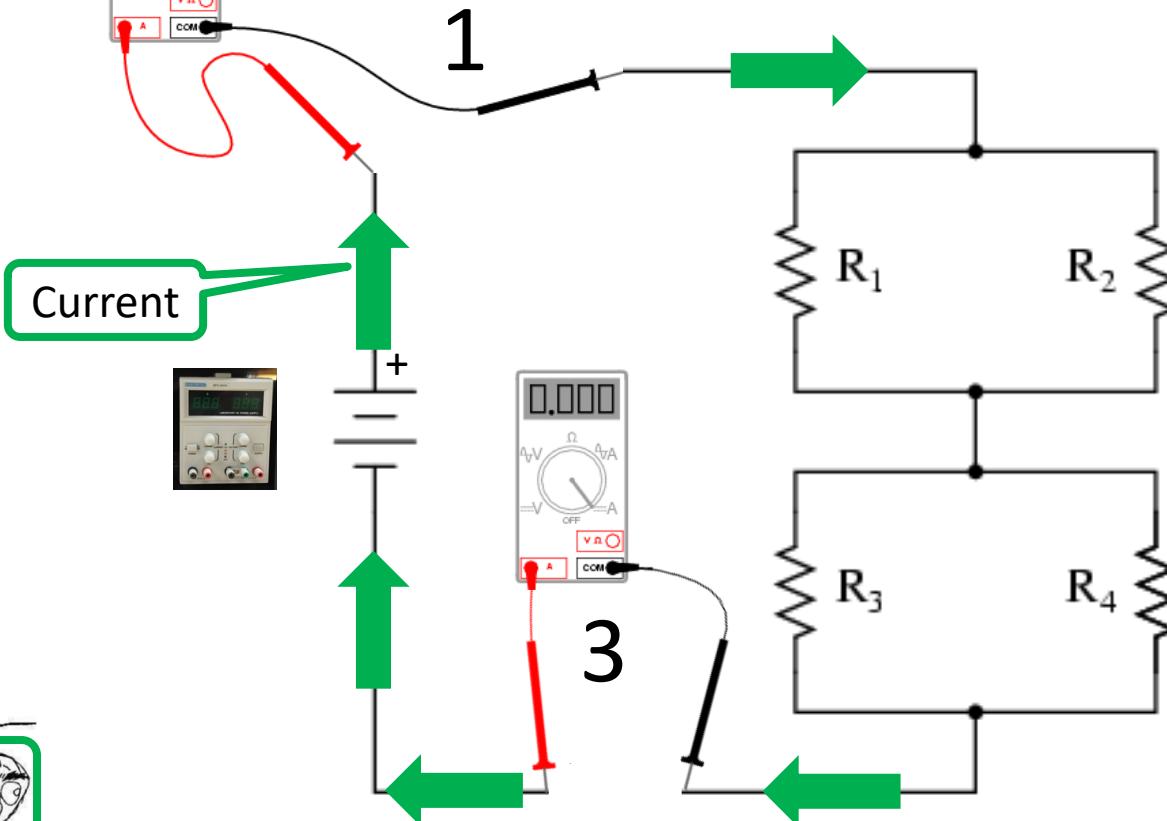
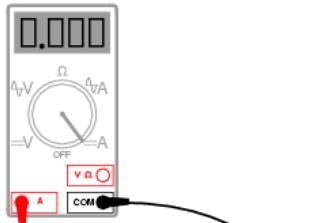
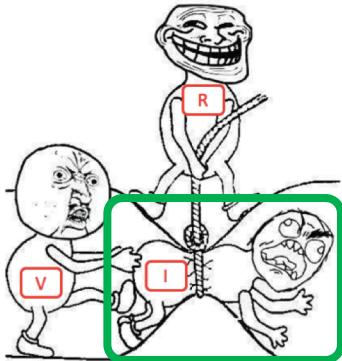
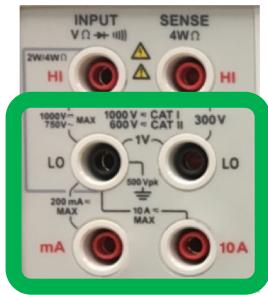


How to measure Resistance

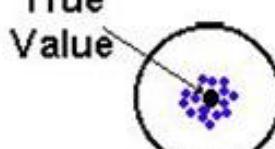
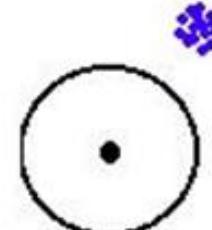
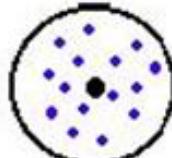
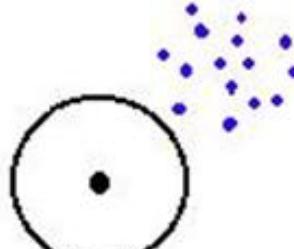


How to measure Current

Which one is the best method to measure Current



Measurement : Accuracy and Precision

		Accuracy	
		Accurate	Not Accurate
Precision	Precise	 Accurate & Precise	 Not Accurate & Precise
	Not Precise	 Accurate & Not Precise	 Not Accurate & Not Precise

Before you start to build the circuit

Equipment, Hand Tool, Material and Component



Power Supply



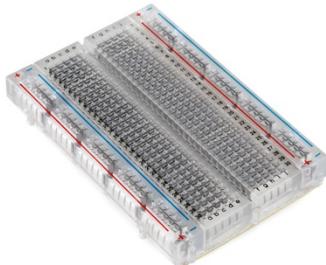
Multimeter



Oscilloscope



Signal Generator



Breadboard



Long Nose Pliers



Wire Stripper



Wire Cutter



Components



Wire

Teaching Plan

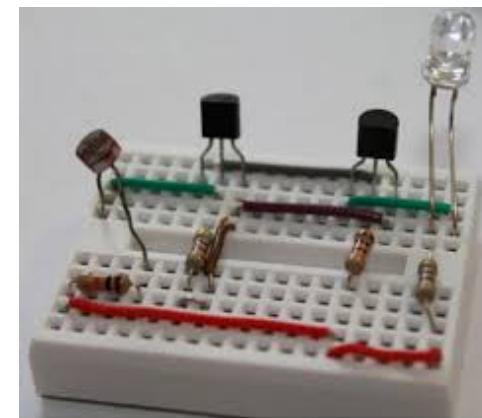
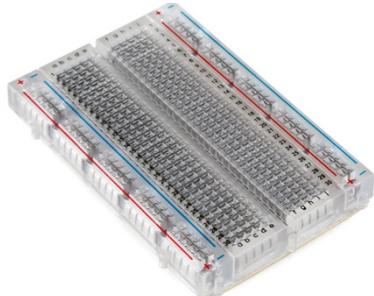
	15 Mins	=====
1	20 Mins - Presentation	Introduction
	20 Mins - Presentation & Demo	Part 01 : Build Your First Circuit
	20 Mins - Exercise 01 - A	Components , Connection ,Breadboard
2	15 Mins - Presentation	Part 02 : How to make it work
	15 Mins - Exercise 01 - B	Your Circuit, Power Supply, Multimeter
	10 Mins - Take a Break	=====
3	20 Mins - Presentation & Demo	Part 03 : Measure Signal Waveform
	30 Mins - Exercise 01 - C	Your Circuit, Signal Generator, Oscilloscope
	15 Mins	=====

Part 01 – Build Your First Circuit

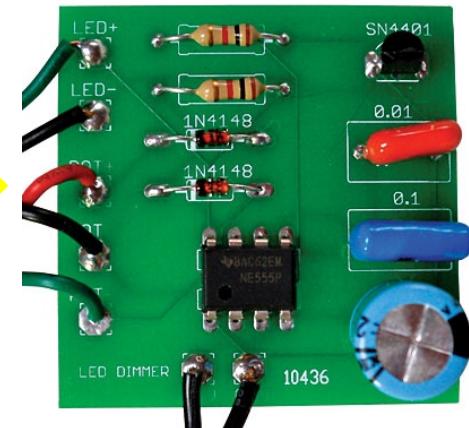
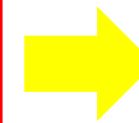
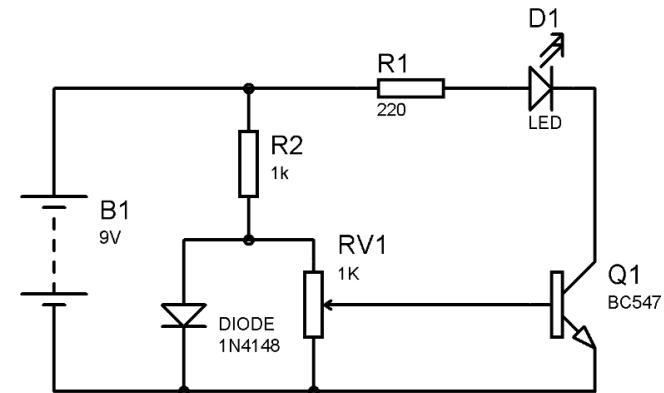
- Component, Breadboard, Connection
- Demonstration 01
- Exercise 01 - A

What is Circuit

- Component
- Connection
- Breadboard



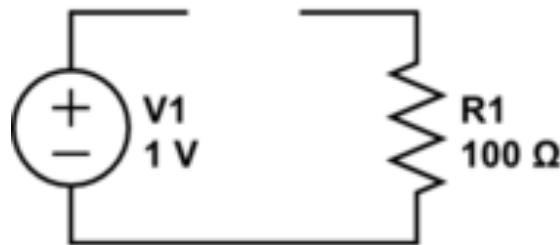
Breadboard



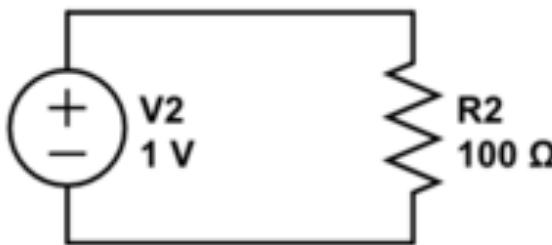
The Next PCB

Connection

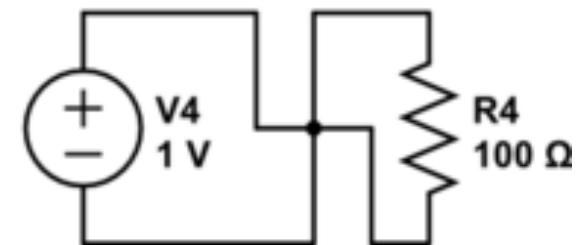
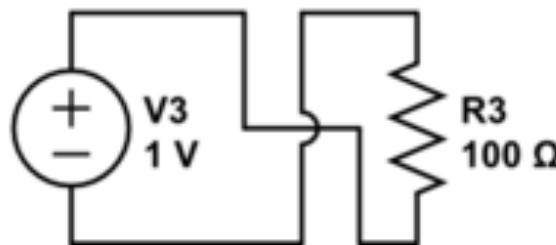
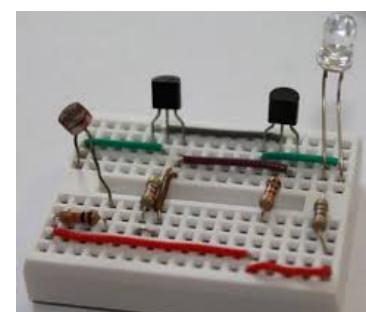
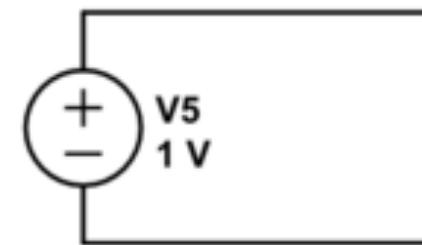
Open circuit



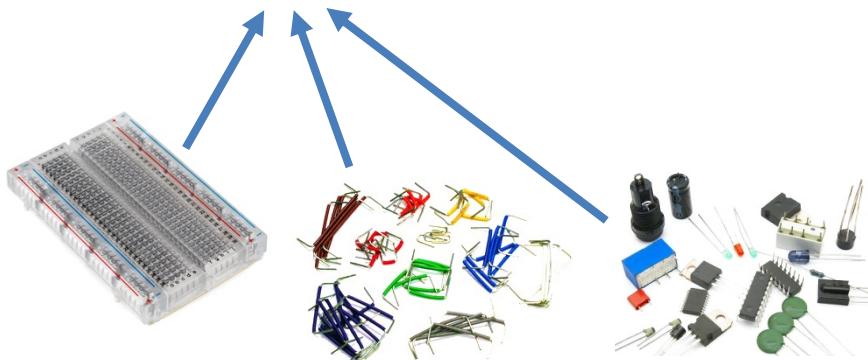
Closed circuit



Short circuit



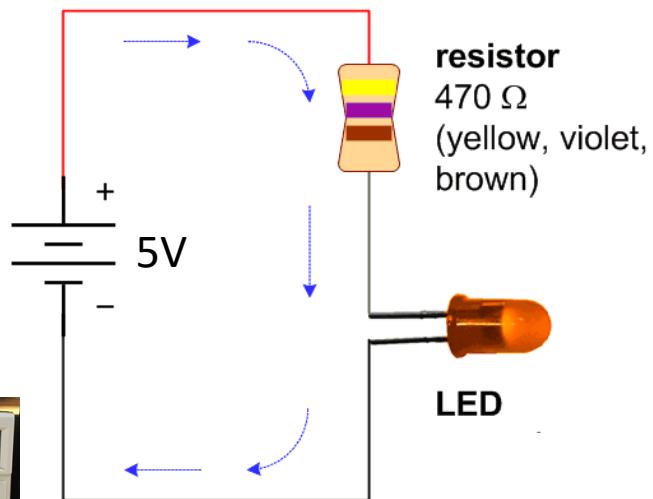
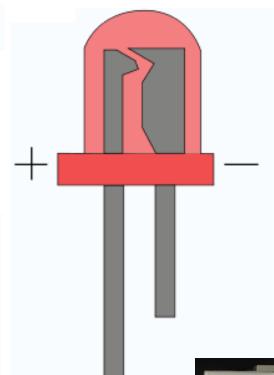
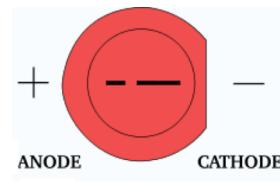
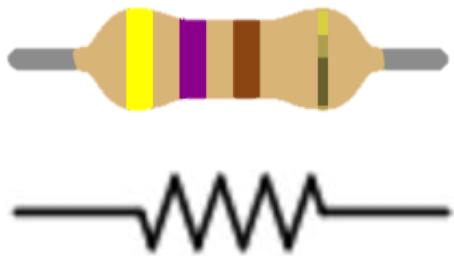
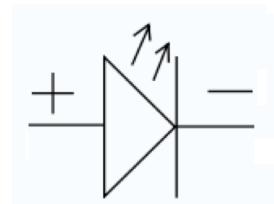
Status of Connection



1. Open Circuit
2. Closed Circuit
3. Short Circuit

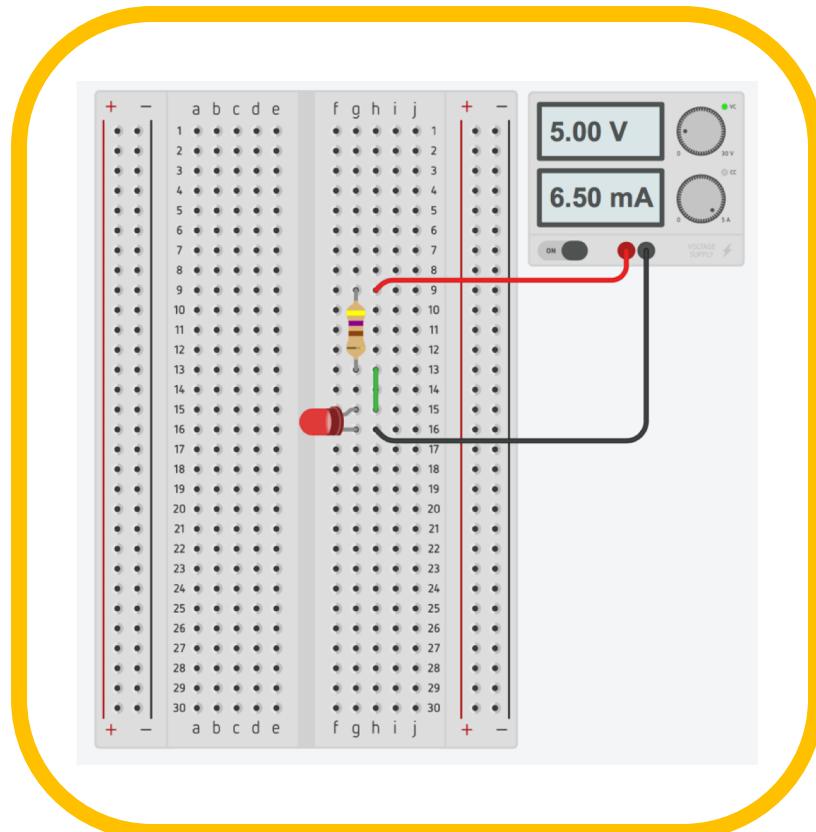
Basic Electronics Circuit – LED

Example 01



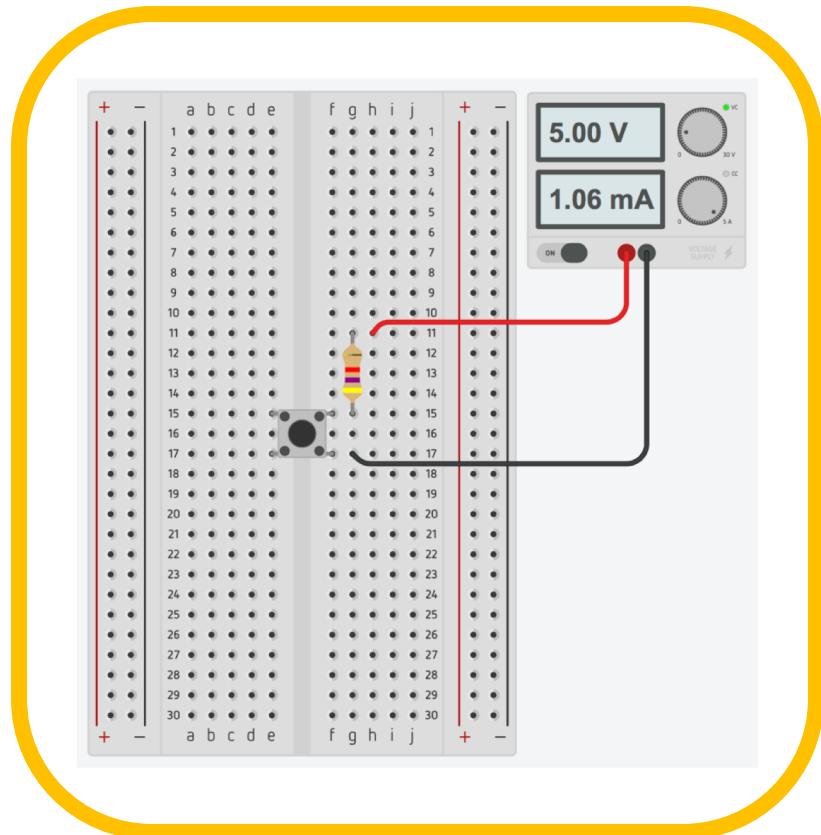
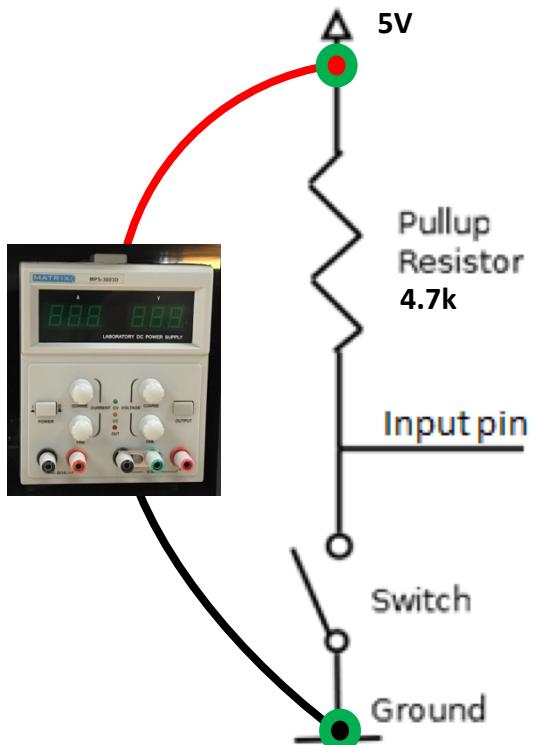
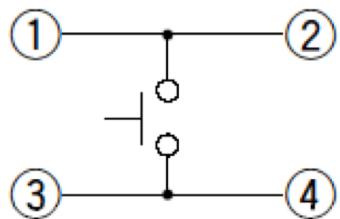
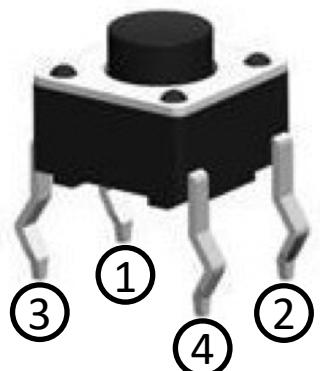
resistor
470 Ω
(yellow, violet, brown)

LED



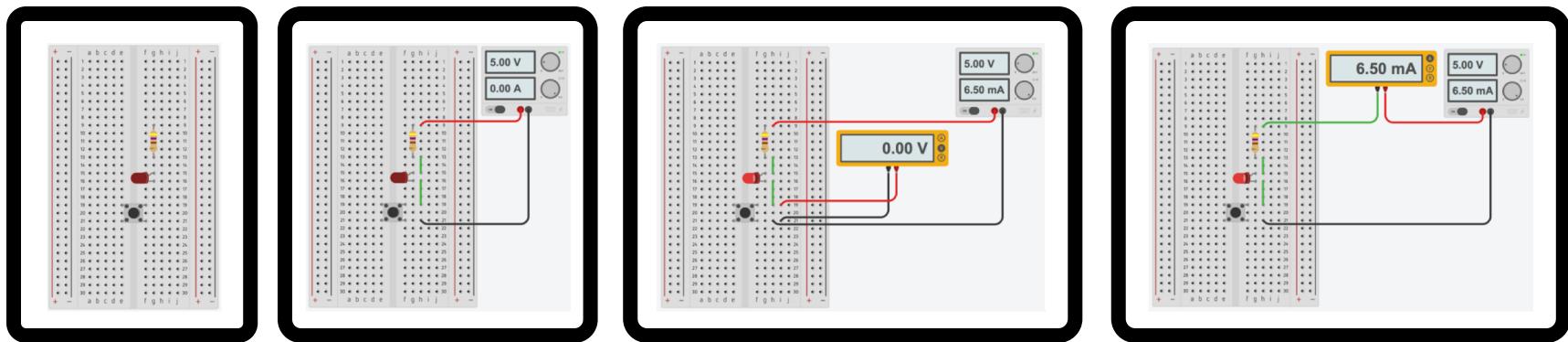
Basic Electronics Circuit – Button

Example 02

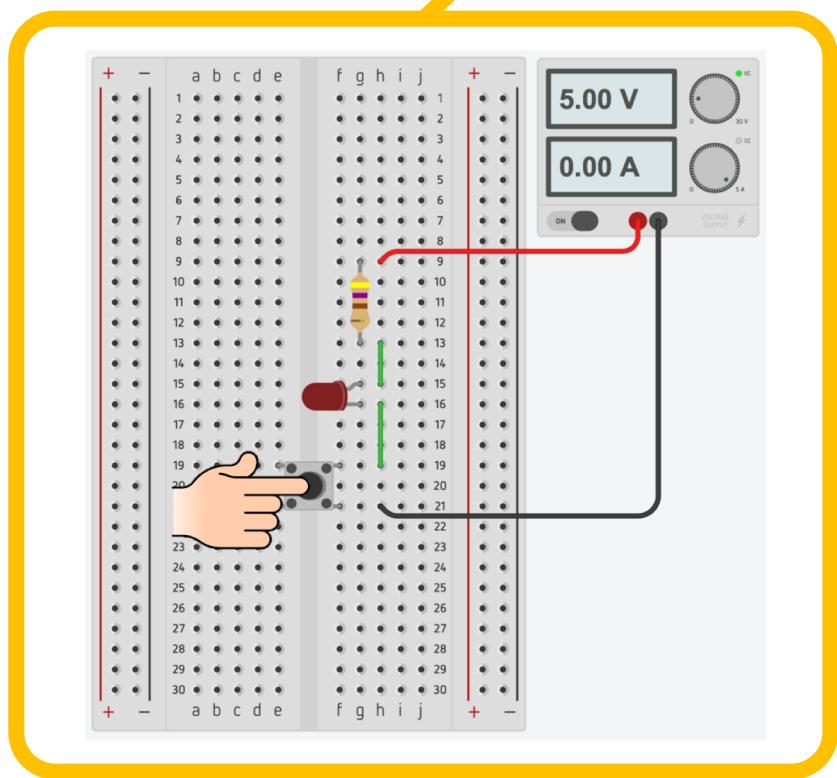
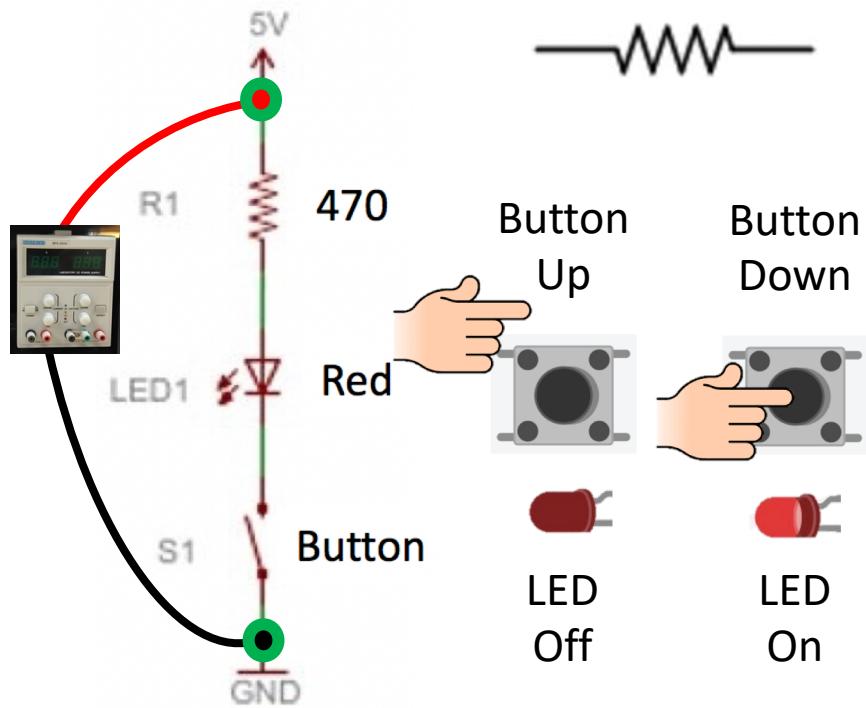
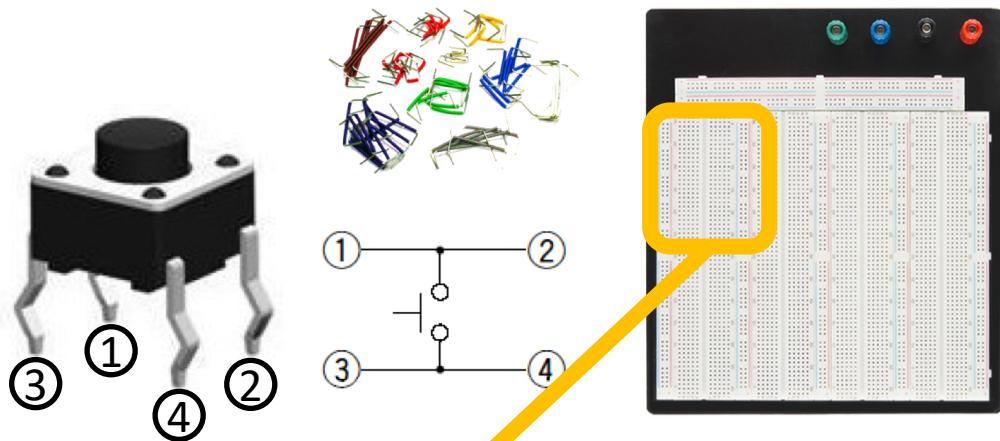
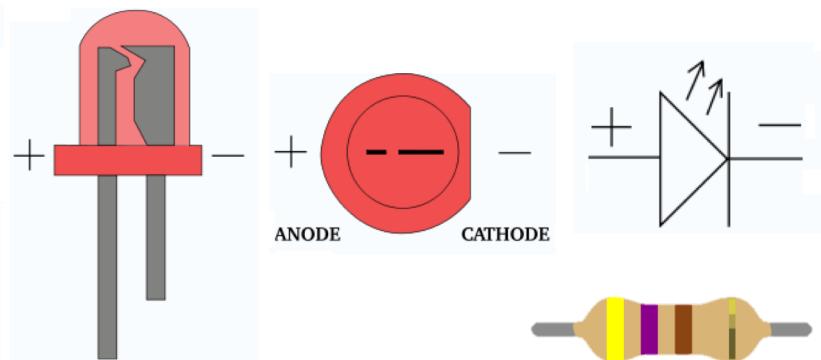


Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current

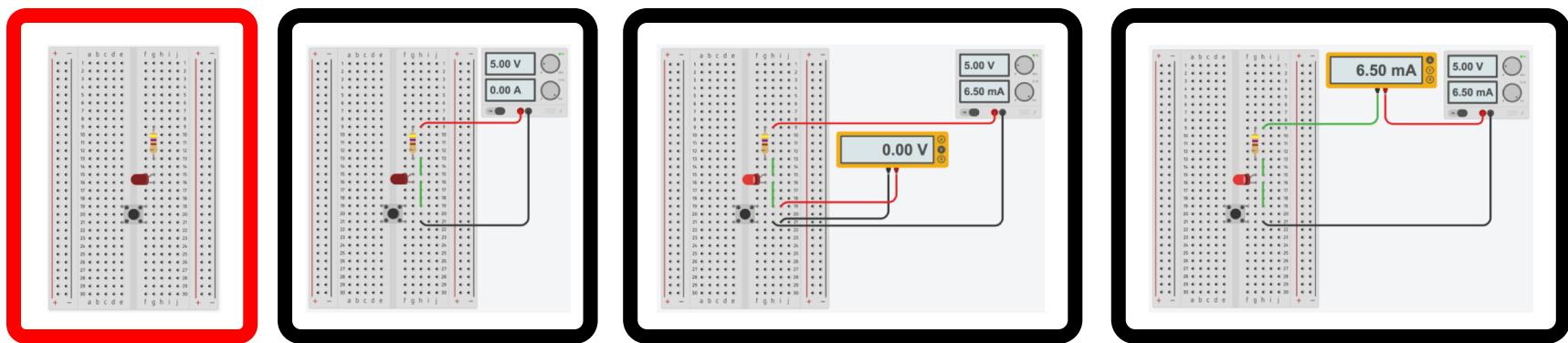


Demo 01 – LED and Button



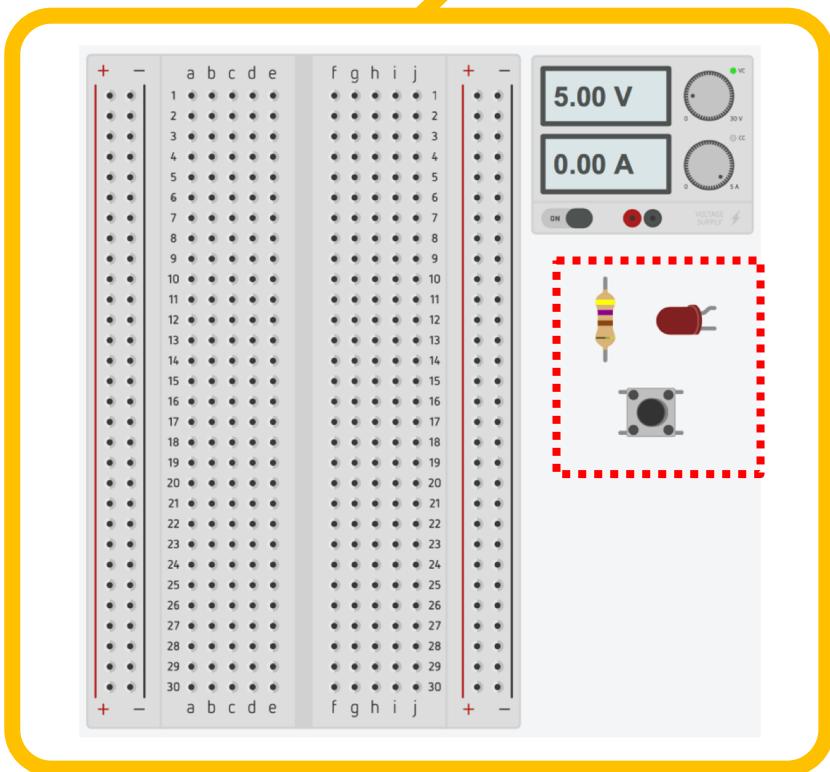
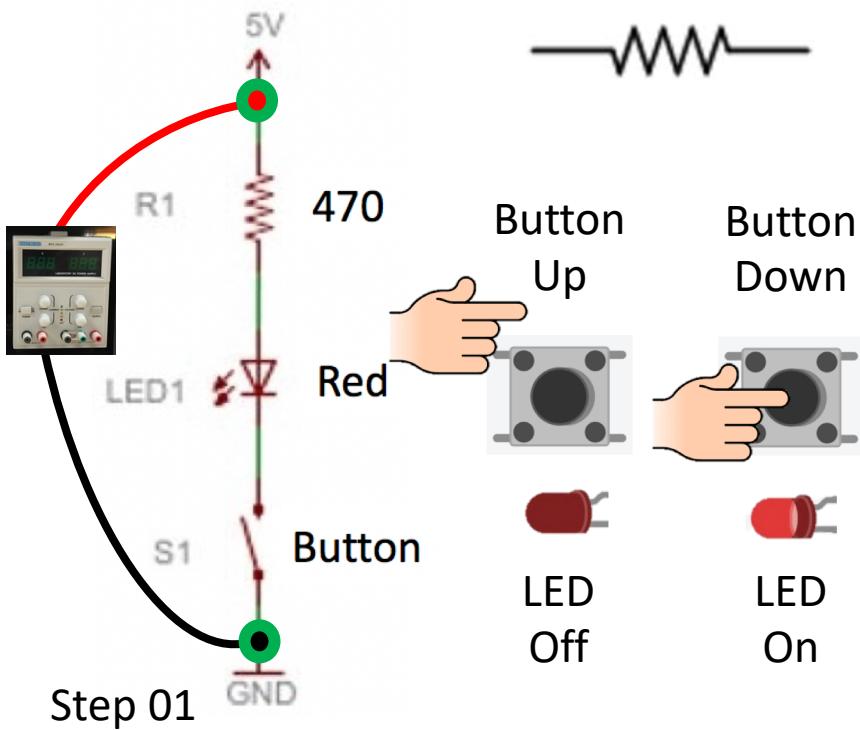
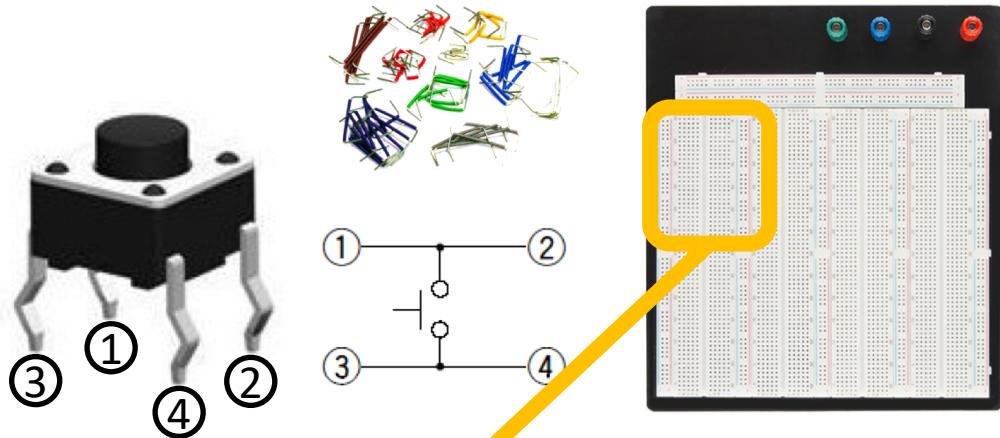
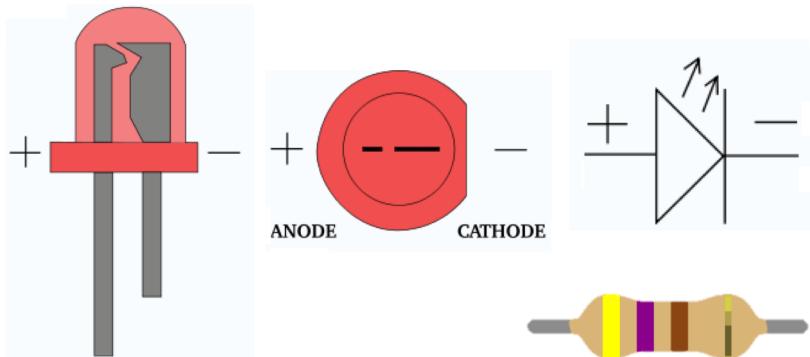
Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current



Demo 01 – Build a Circuit

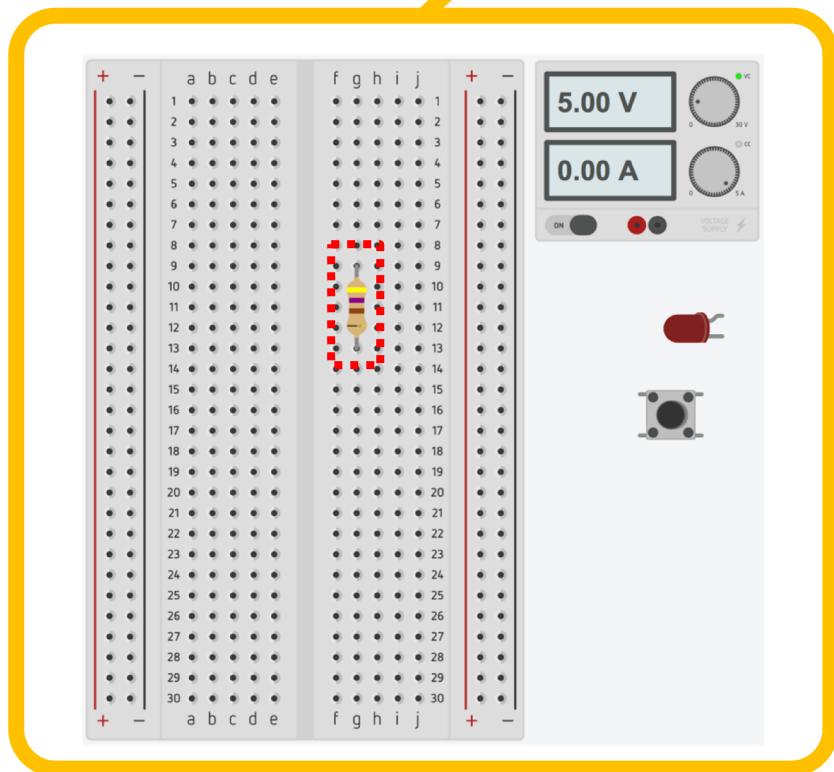
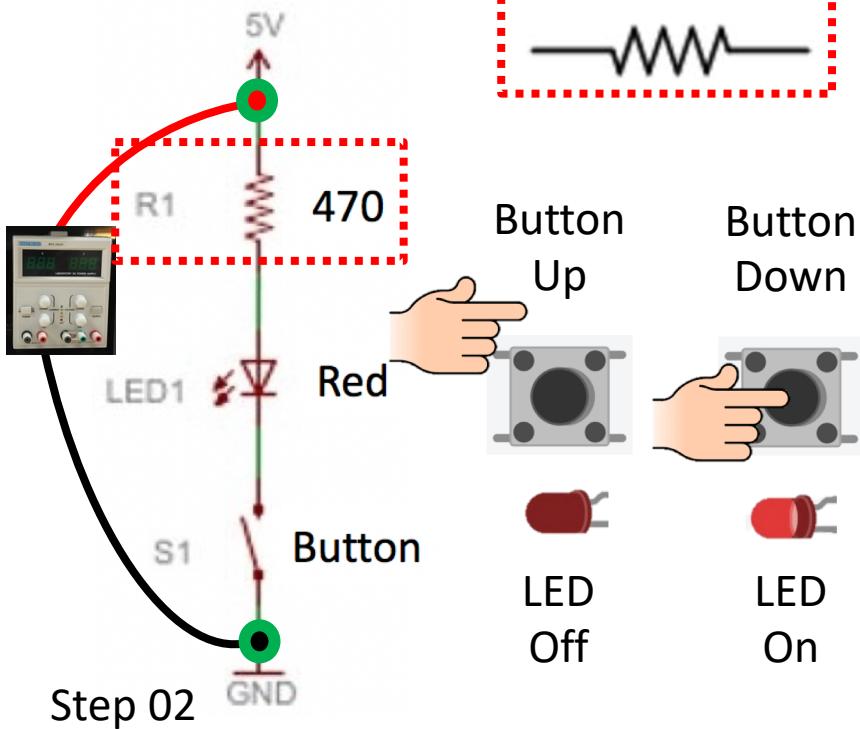
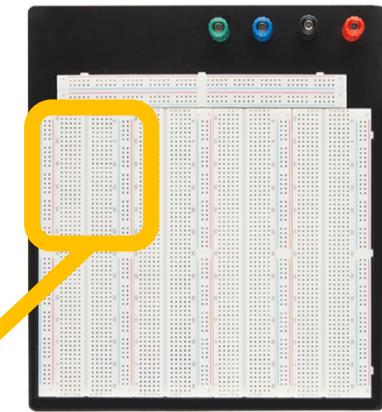
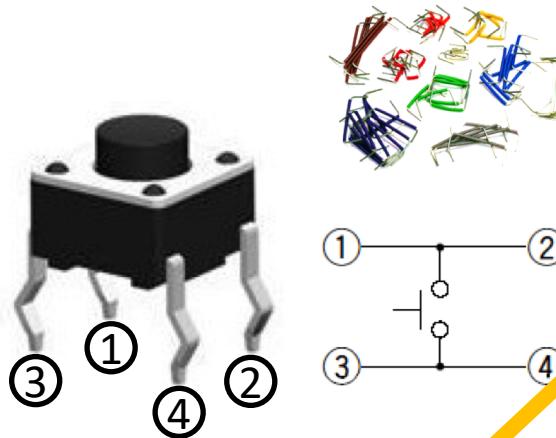
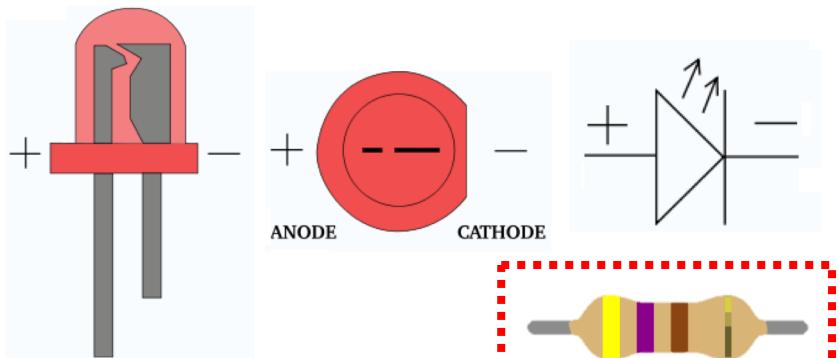
LED and Button



Step 01

Demo 01 – Build a Circuit

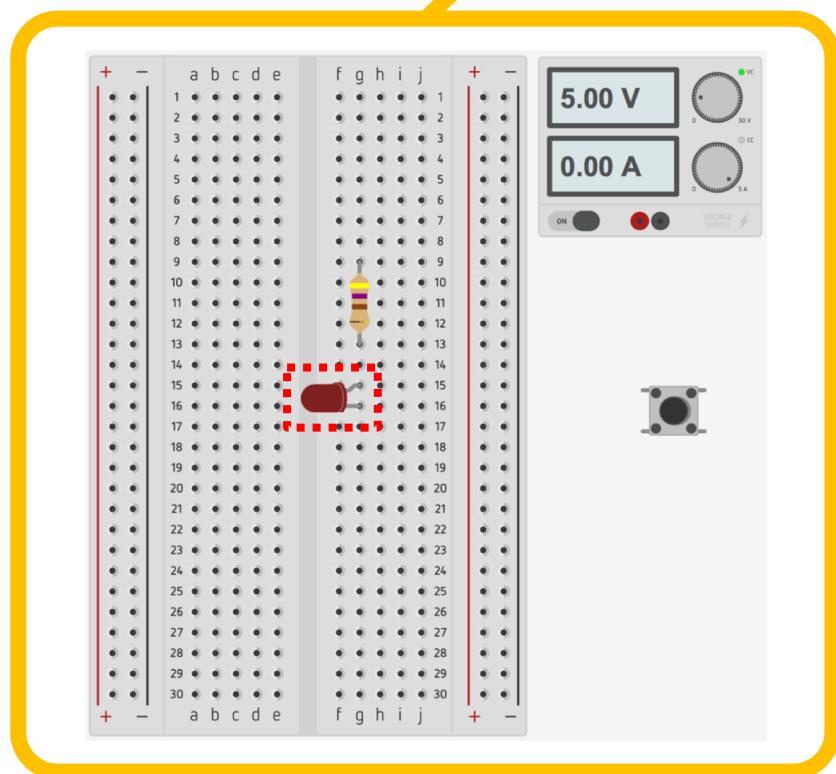
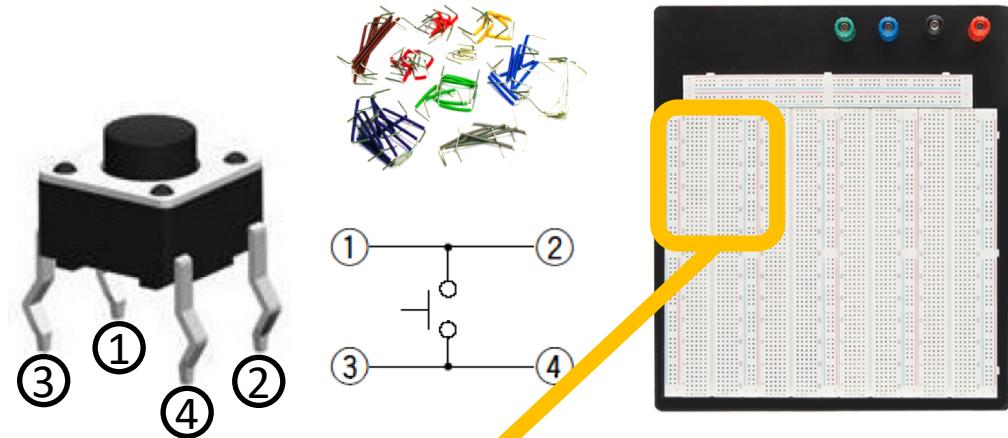
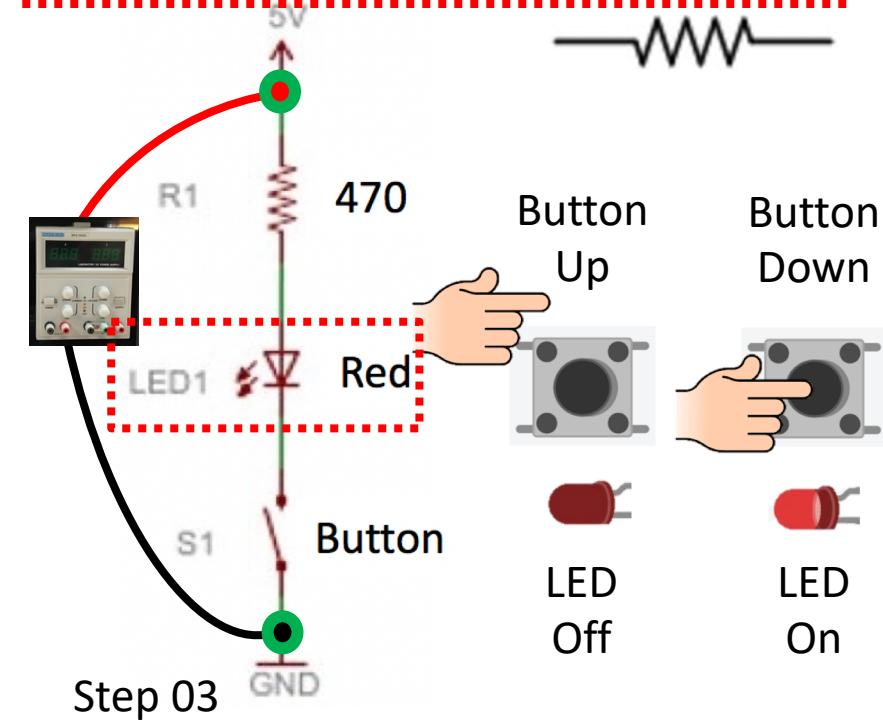
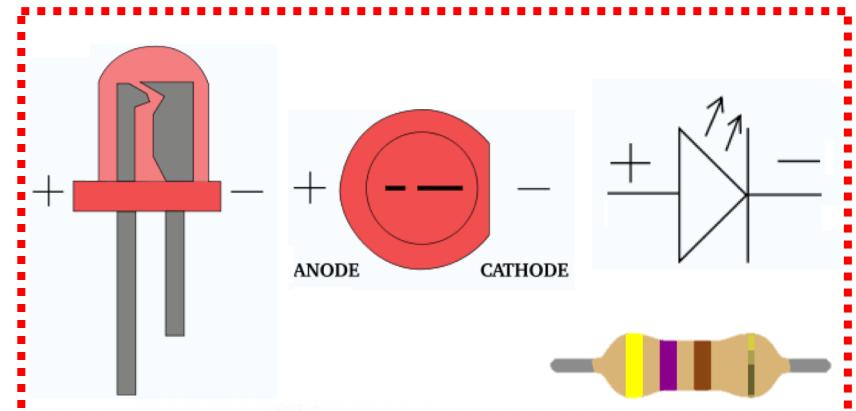
LED and Button



Step 02

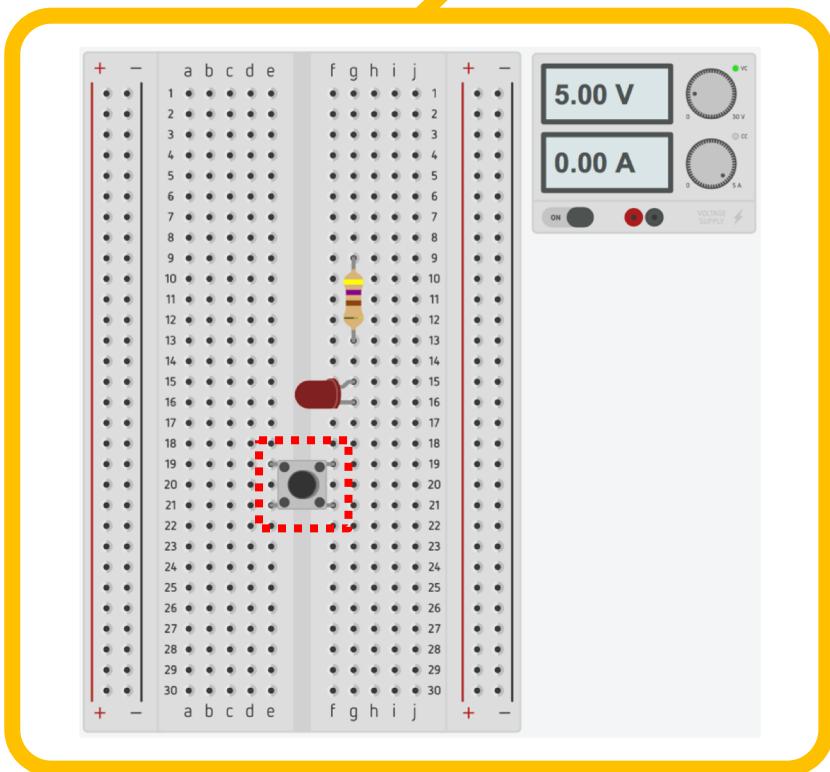
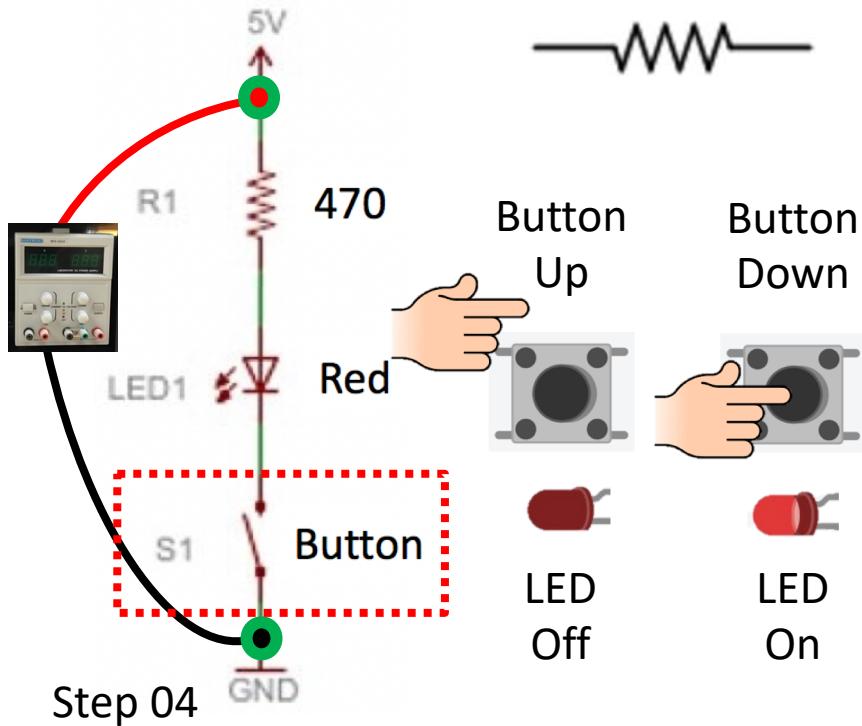
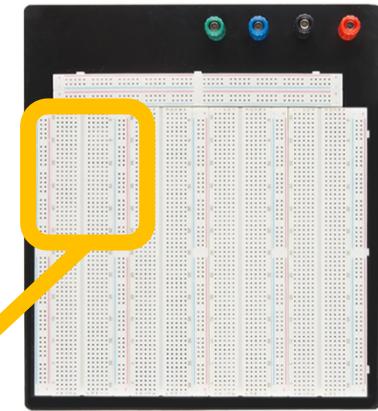
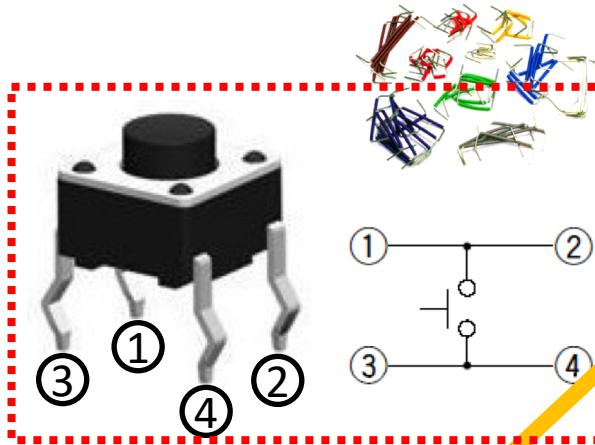
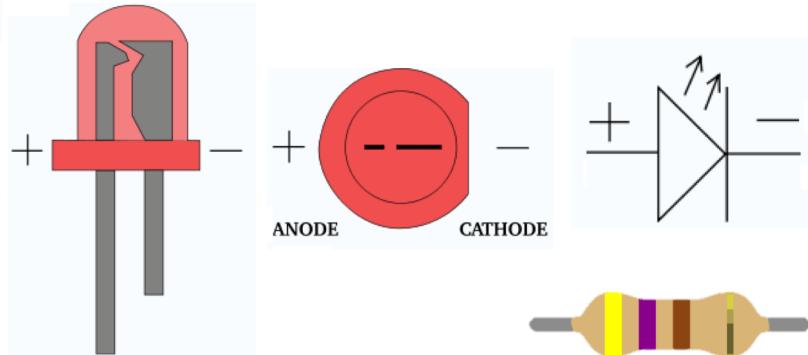
Demo 01 – Build a Circuit

LED and Button



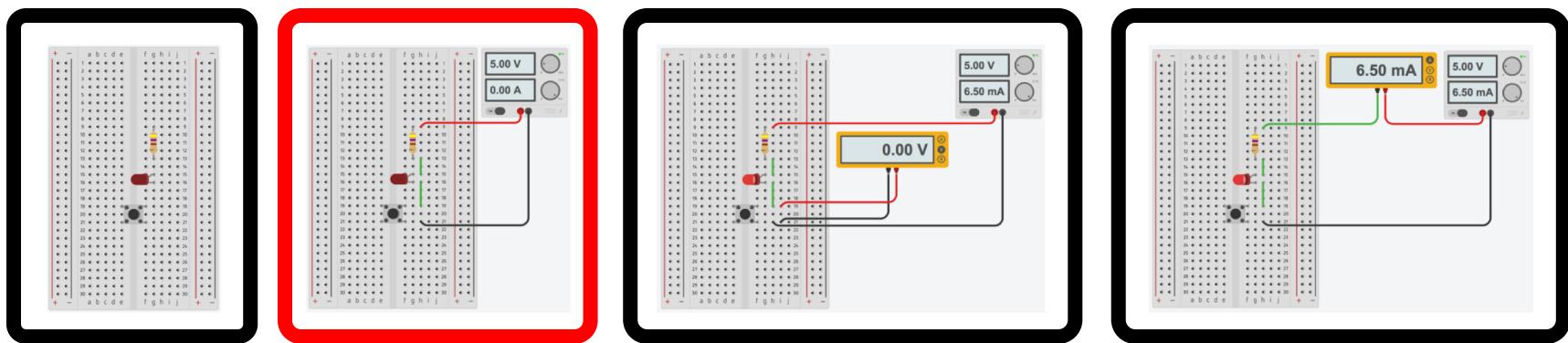
Demo 01 – Build a Circuit

LED and Button



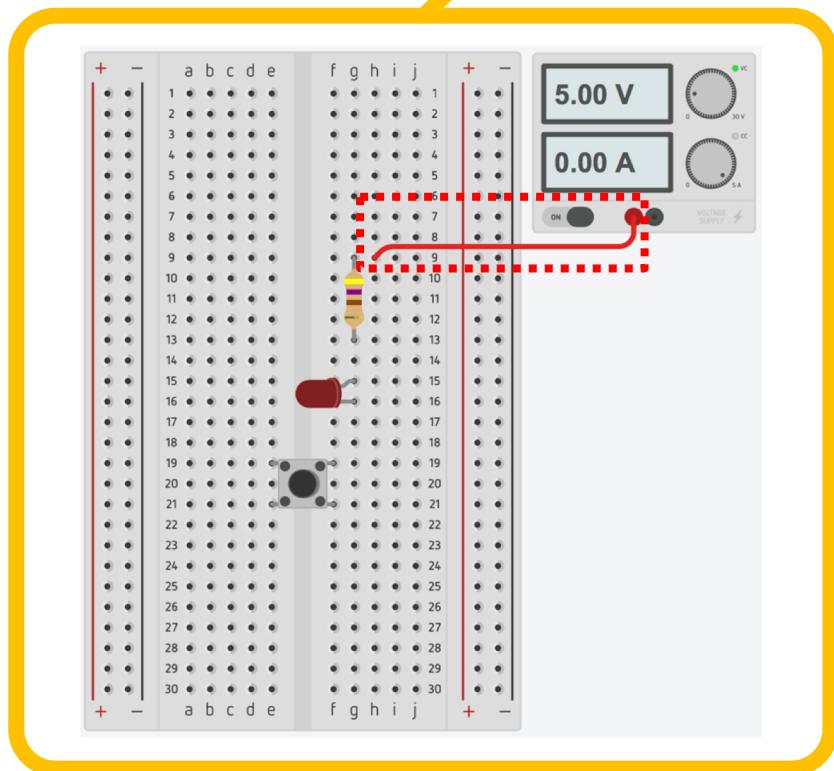
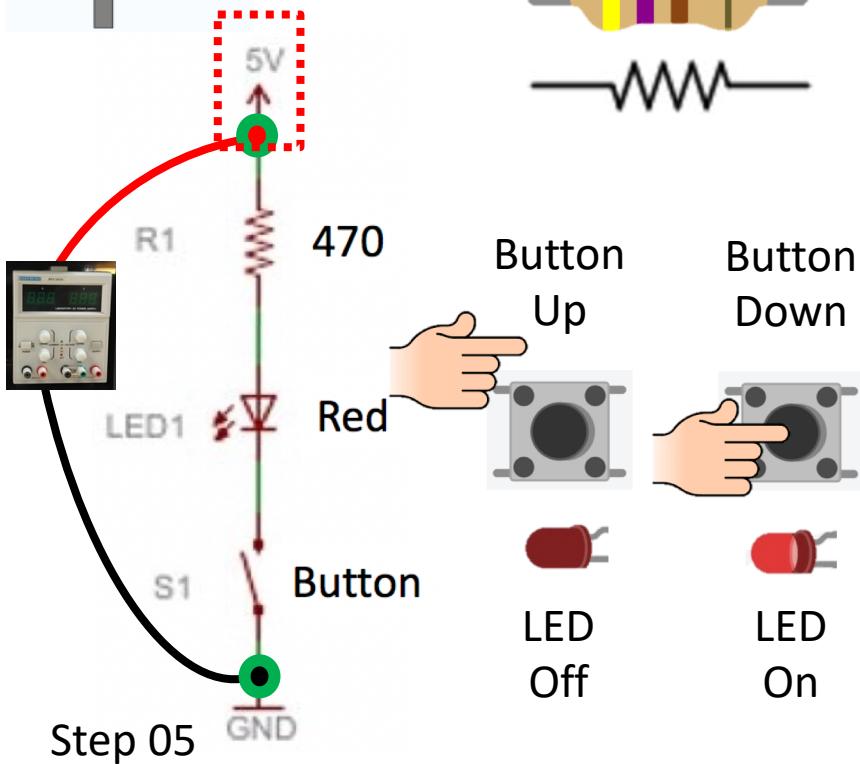
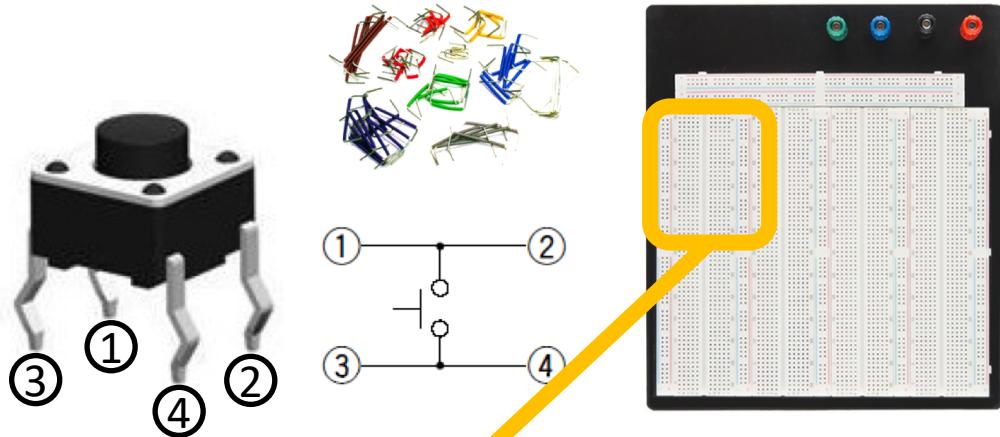
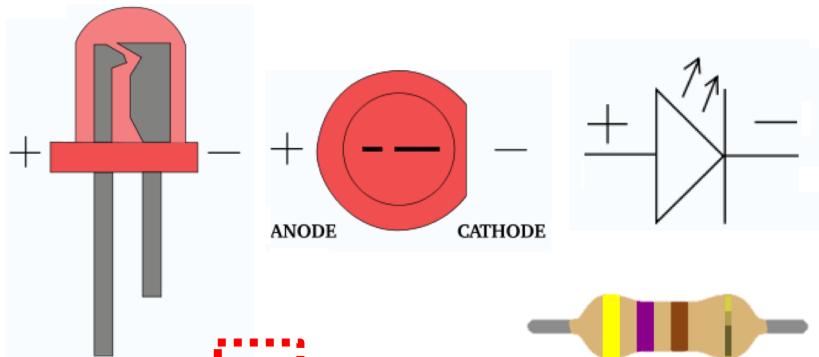
Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current



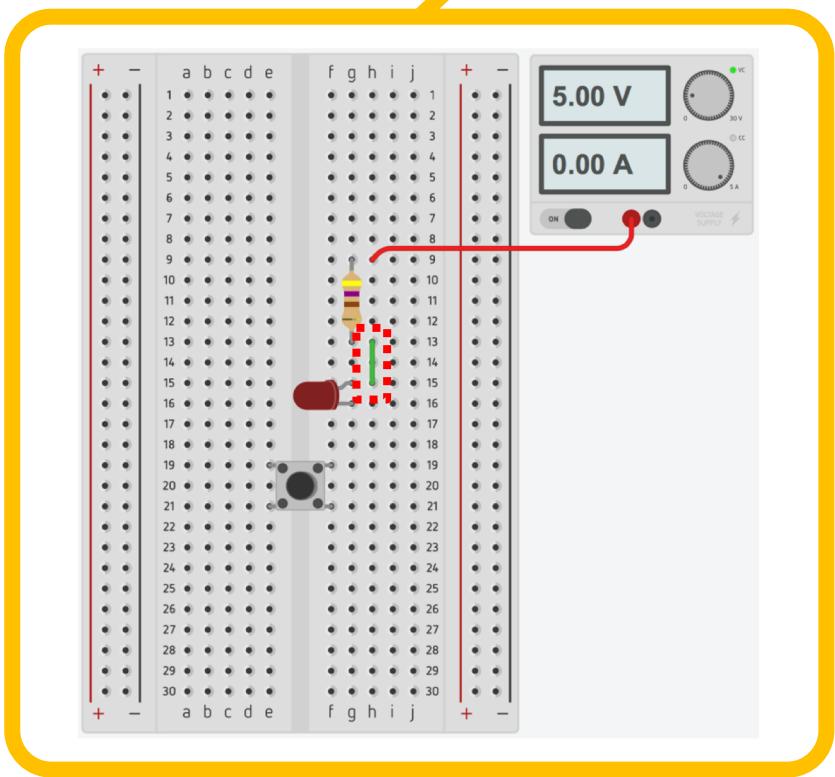
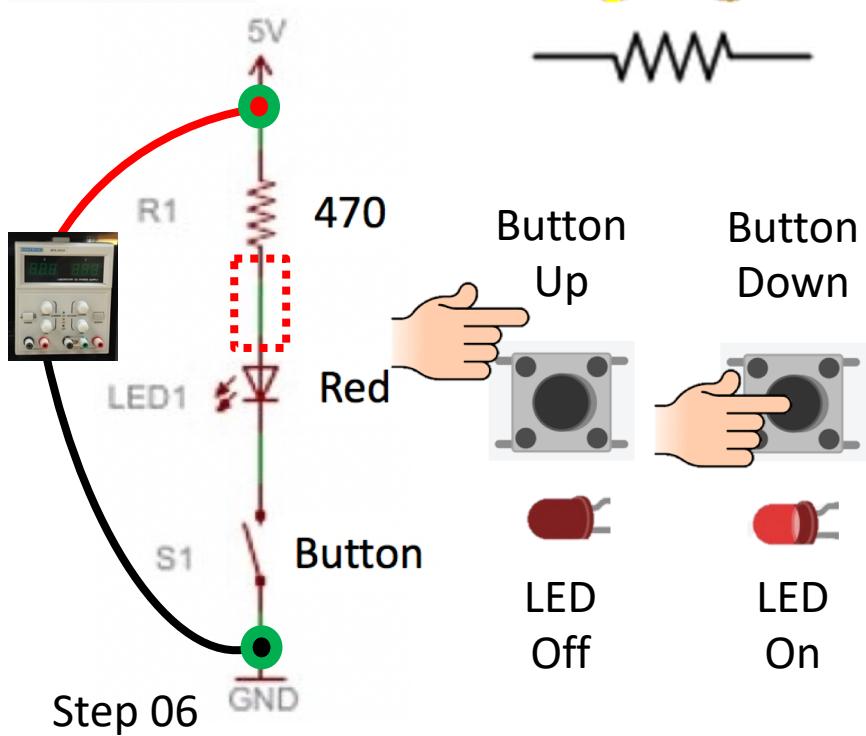
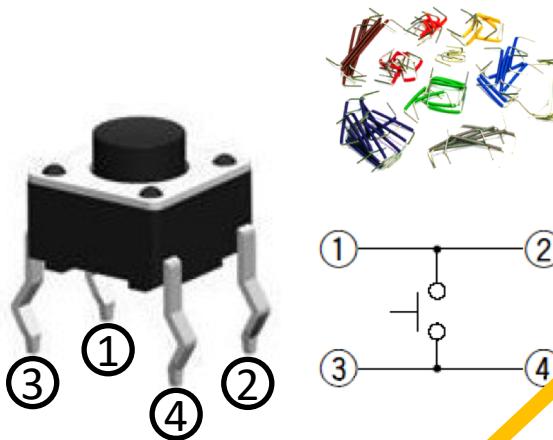
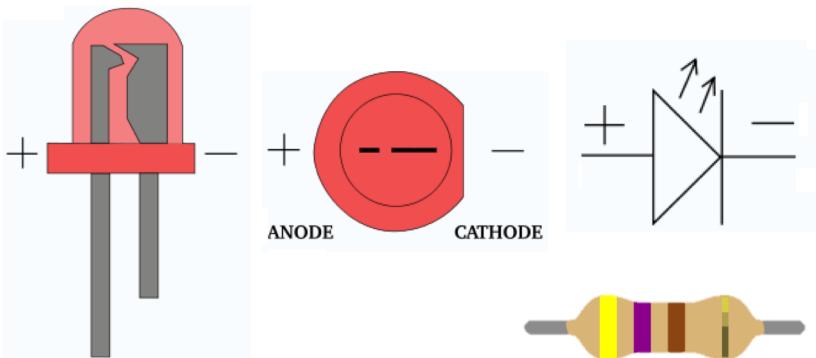
Demo 01 – Build a Circuit

LED and Button



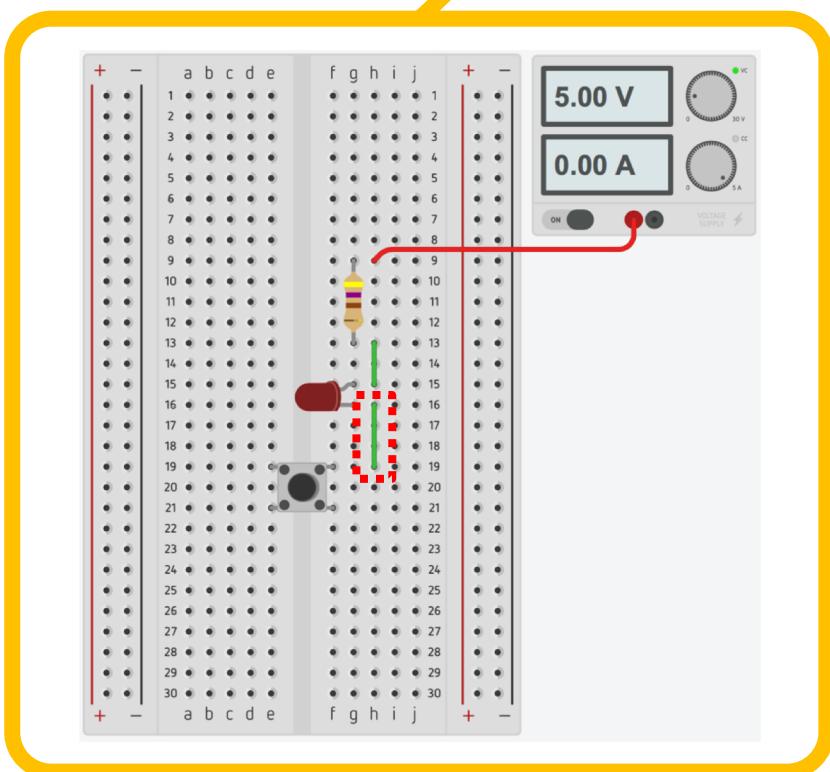
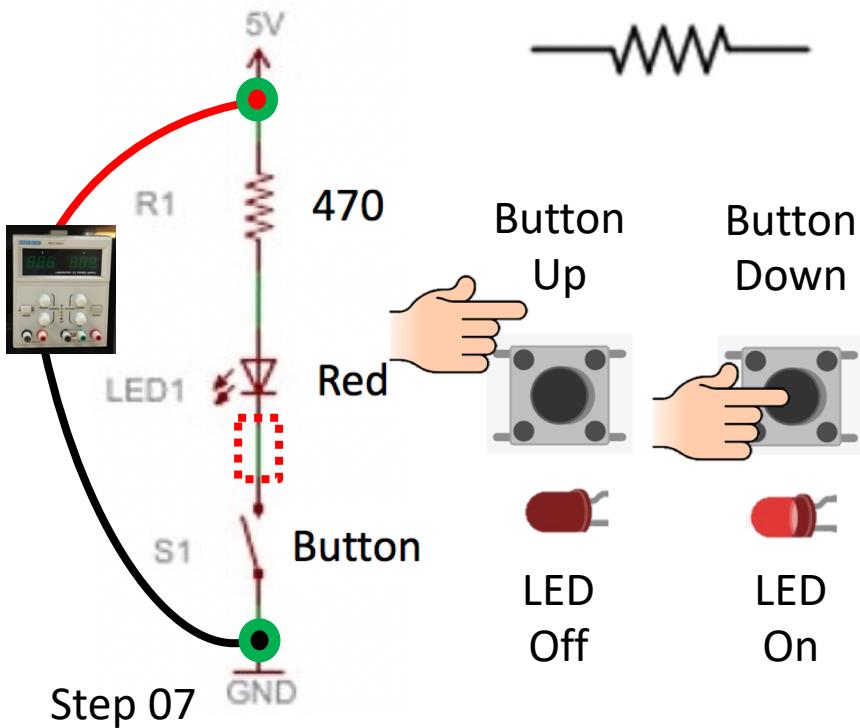
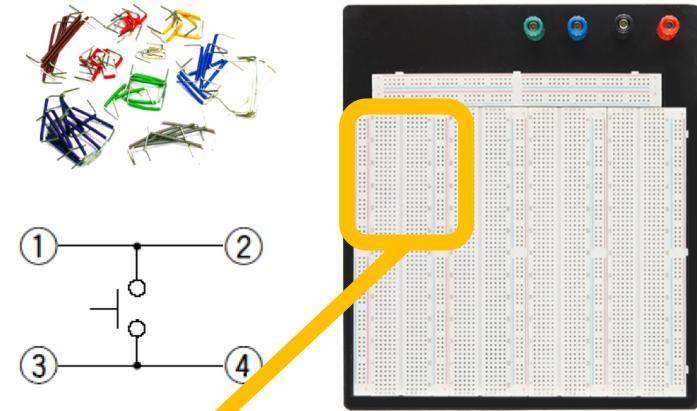
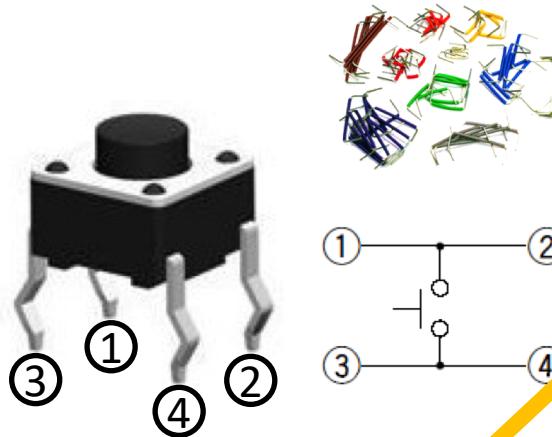
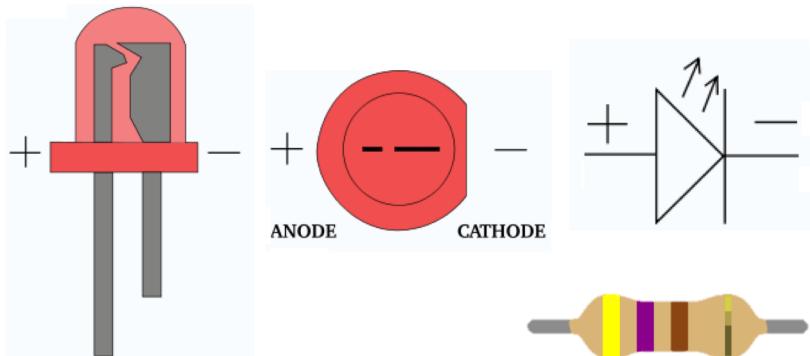
Demo 01 – Build a Circuit

LED and Button



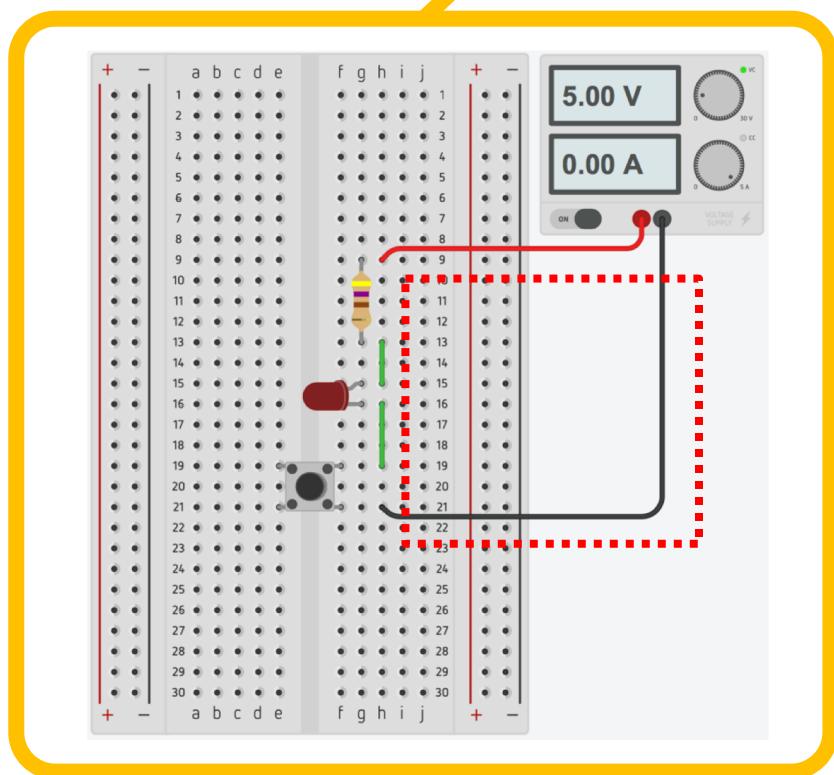
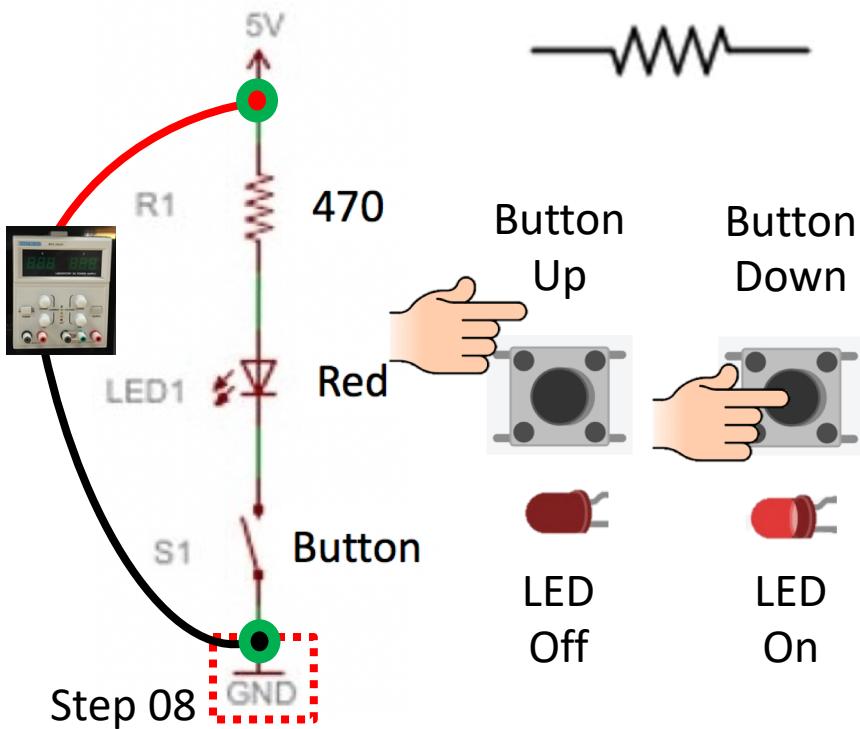
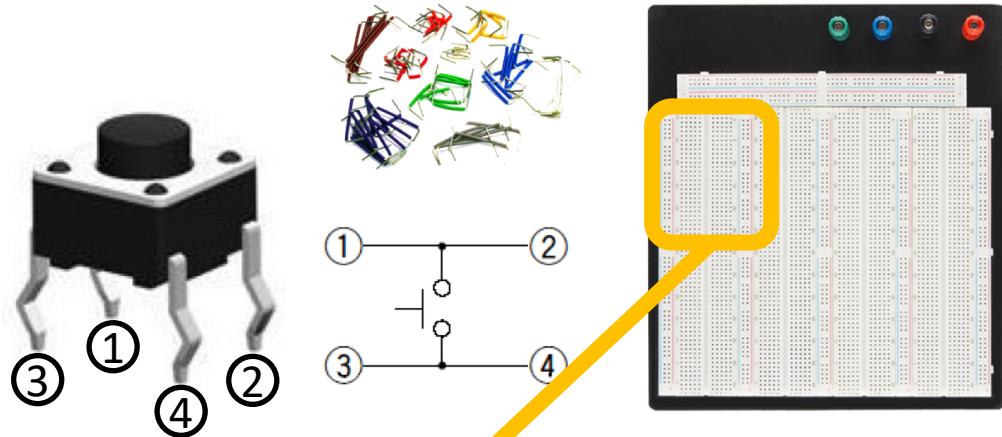
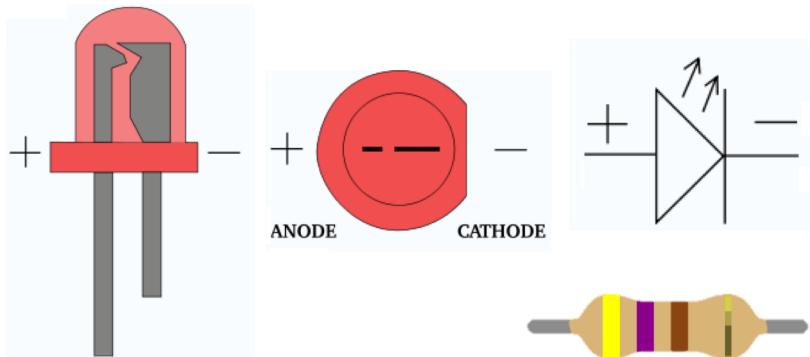
Demo 01 – Build a Circuit

LED and Button



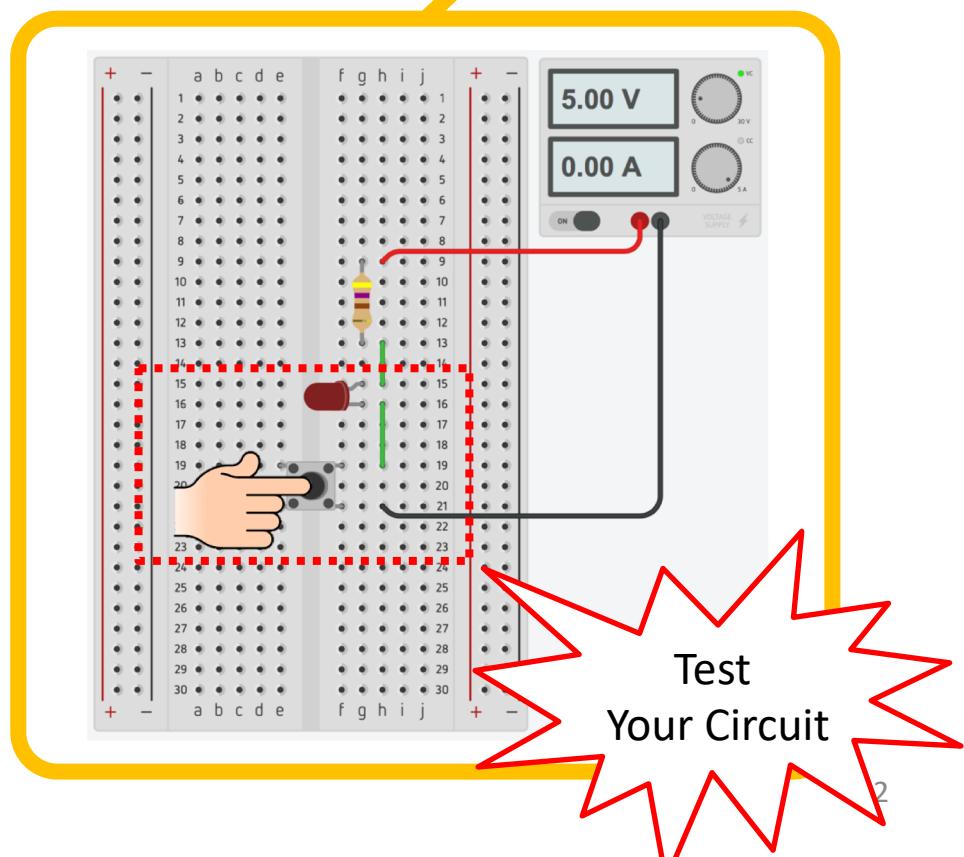
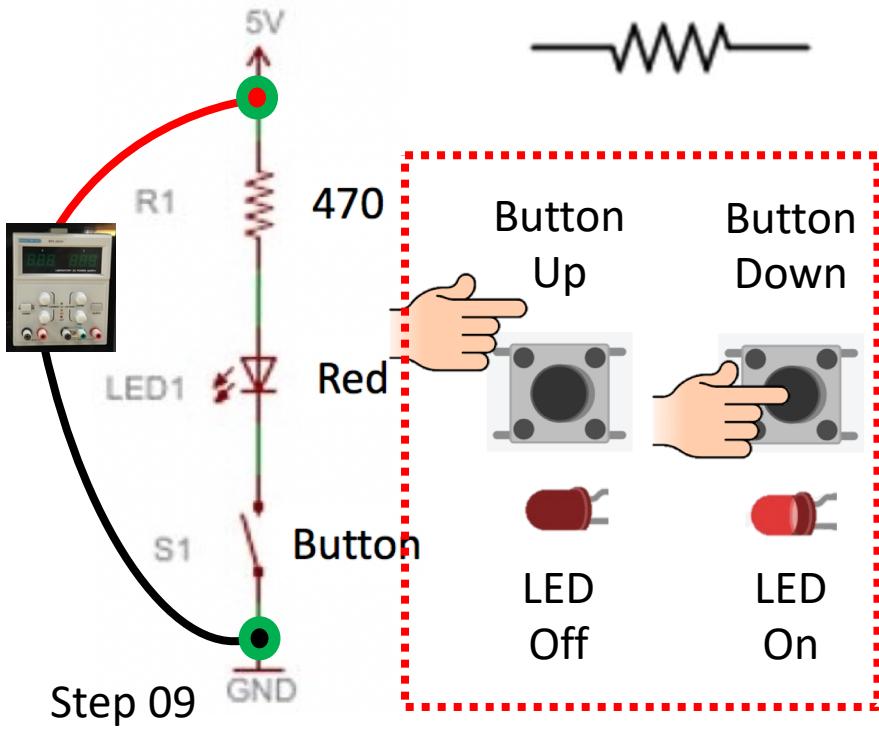
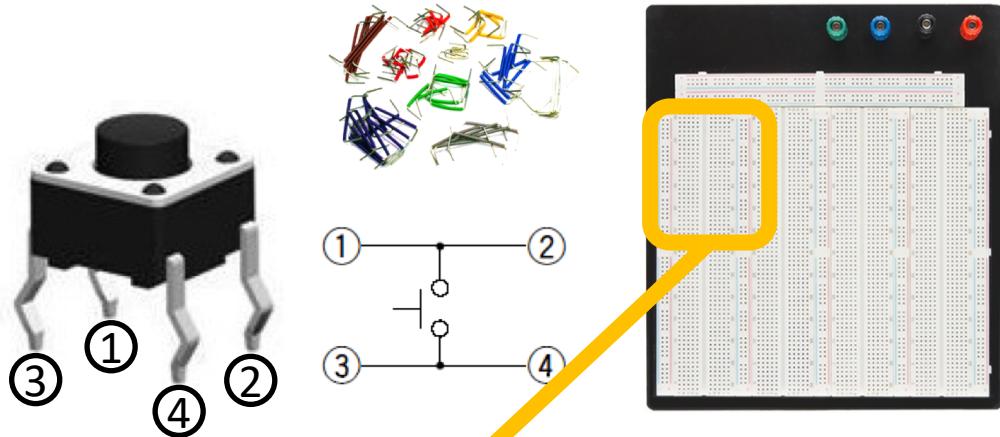
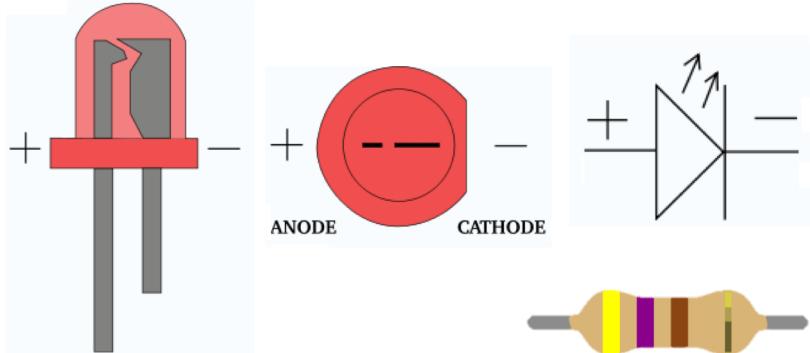
Demo 01 – Build a Circuit

LED and Button



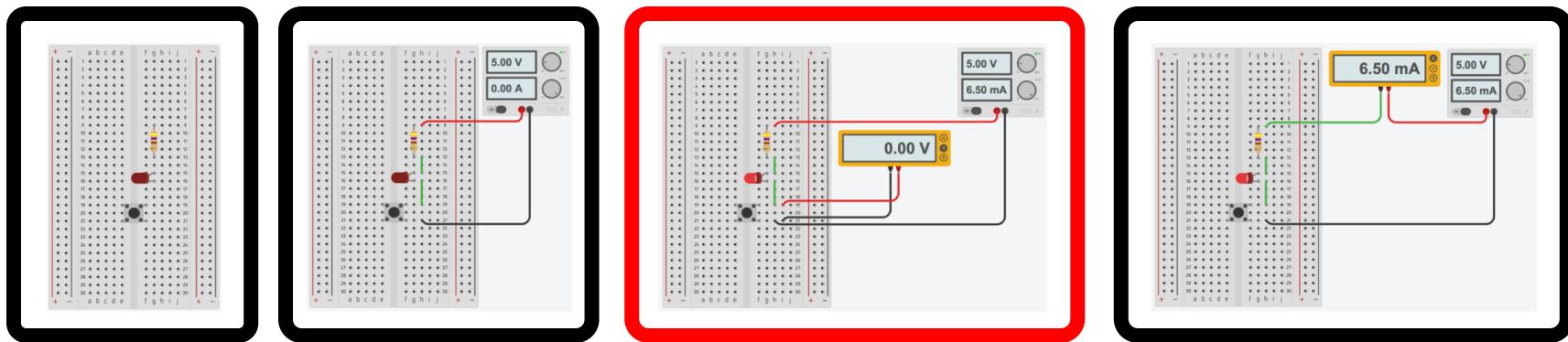
Demo 01 – Build a Circuit

LED and Button



Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current



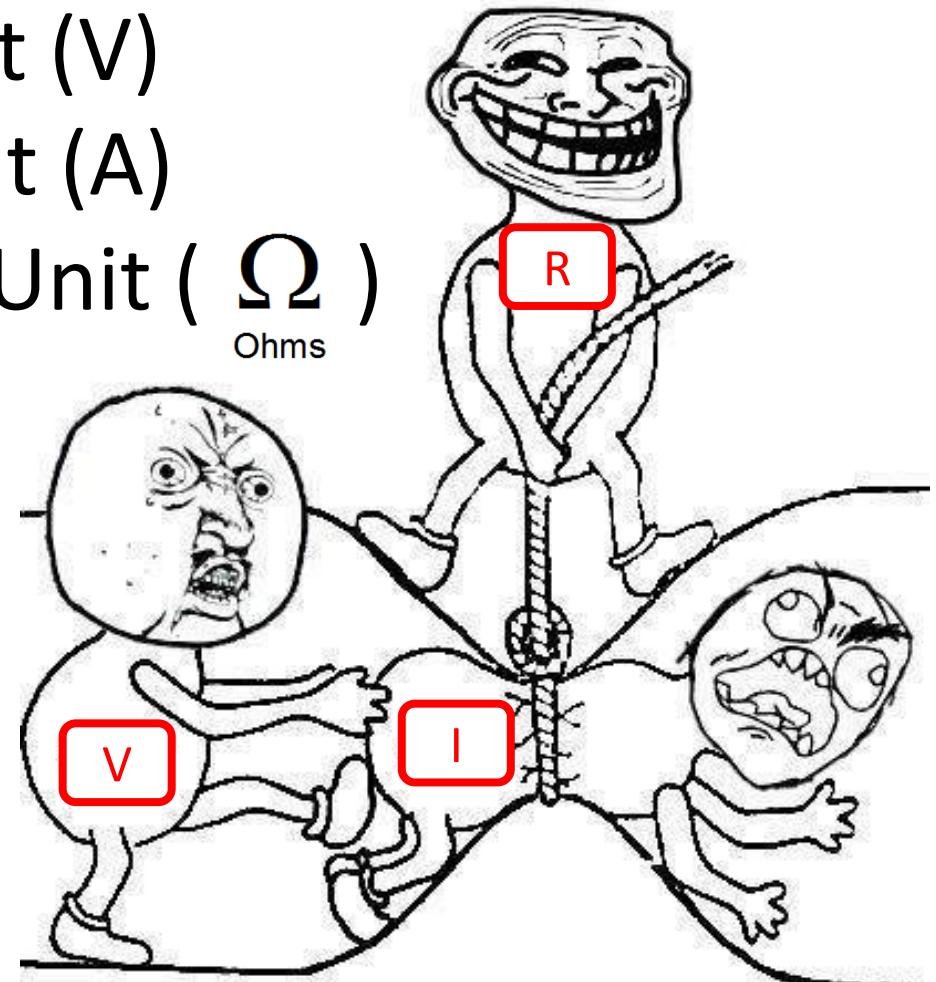
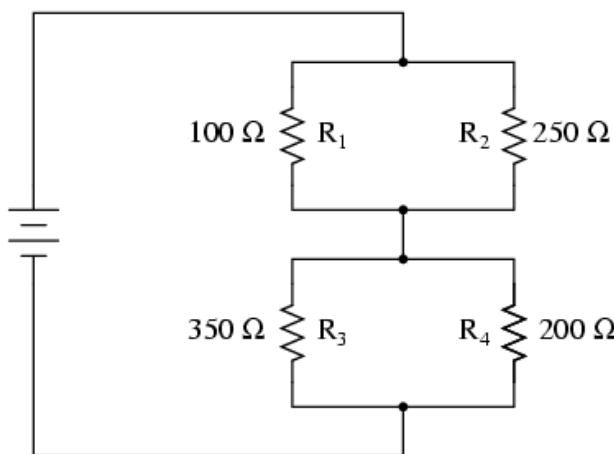
Basic Measurement

$$V = I R$$

$V \rightarrow$ Voltage, Unit (V)

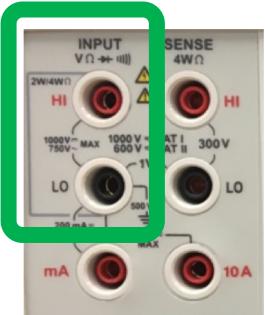
$I \rightarrow$ Current, Unit (A)

$R \rightarrow$ Resistance, Unit (Ω)



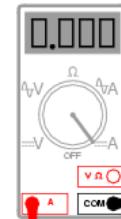
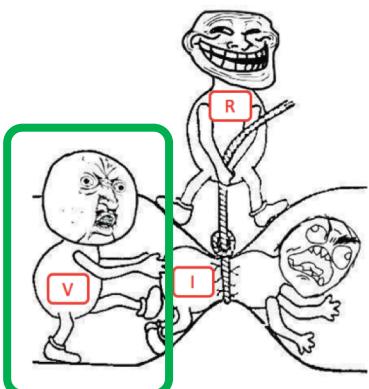
How to measure Voltage

Which one is the best method to measure Voltage

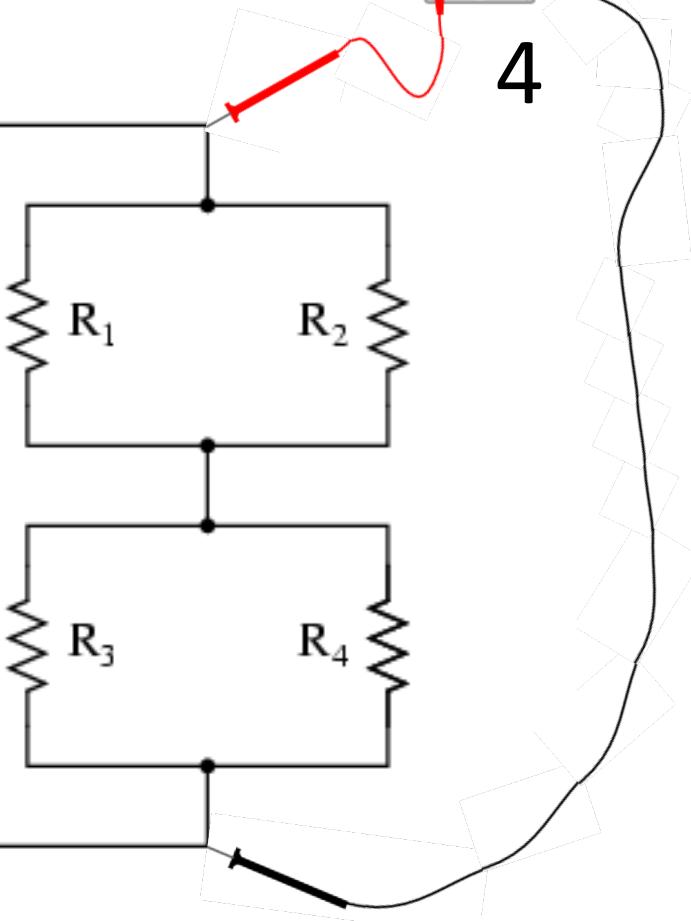


Power
Source
Voltage

2



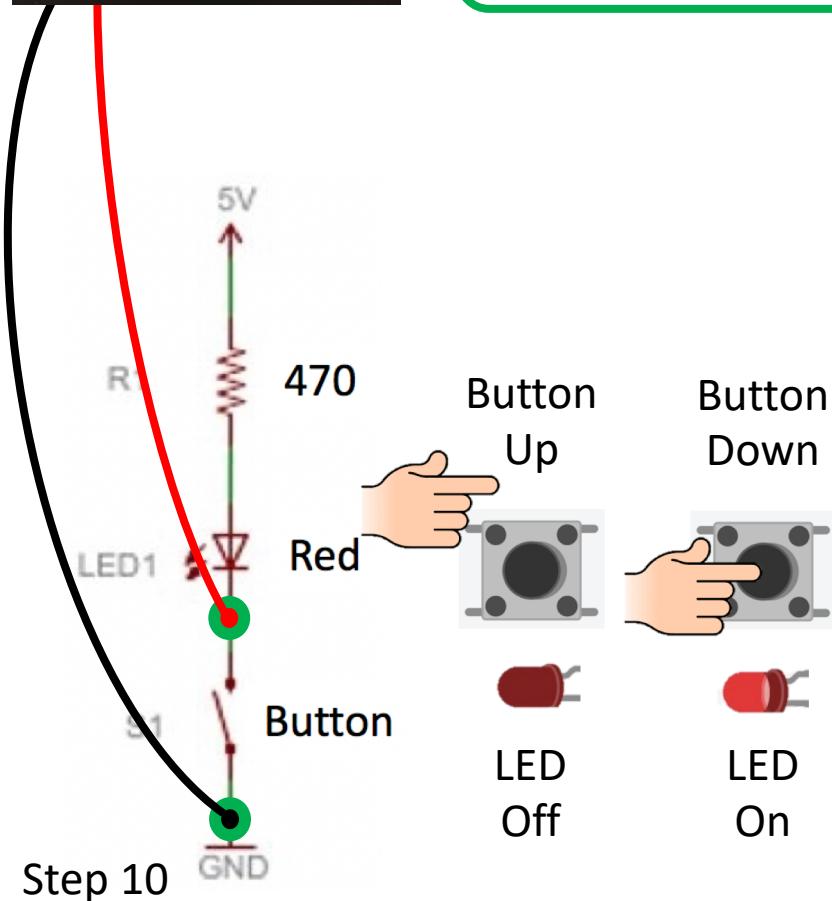
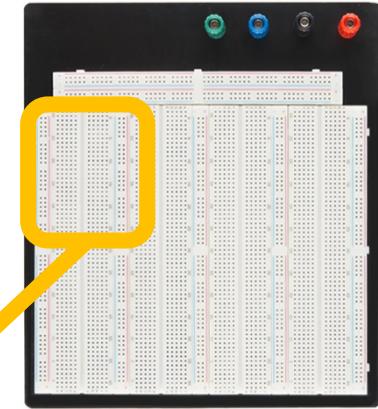
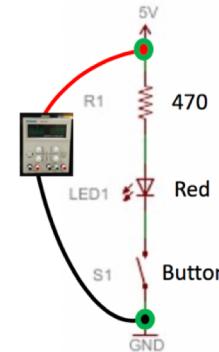
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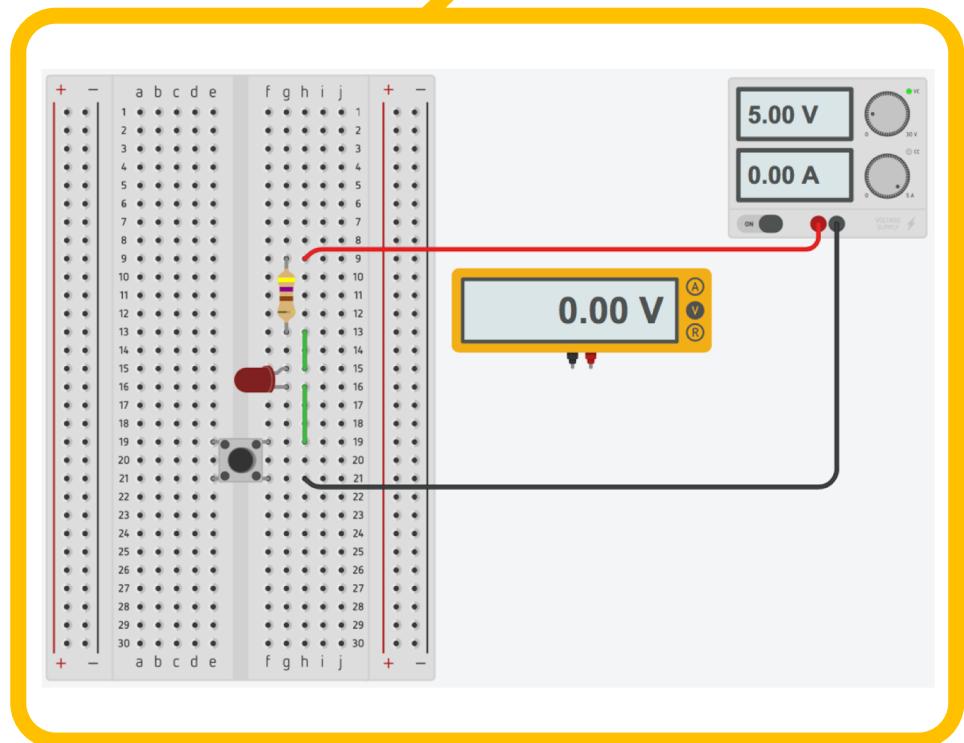
Demo 01 – Measure Voltage LED and Button



Measure Voltage
When Button Up : ____ V
When Button Down : ____ V



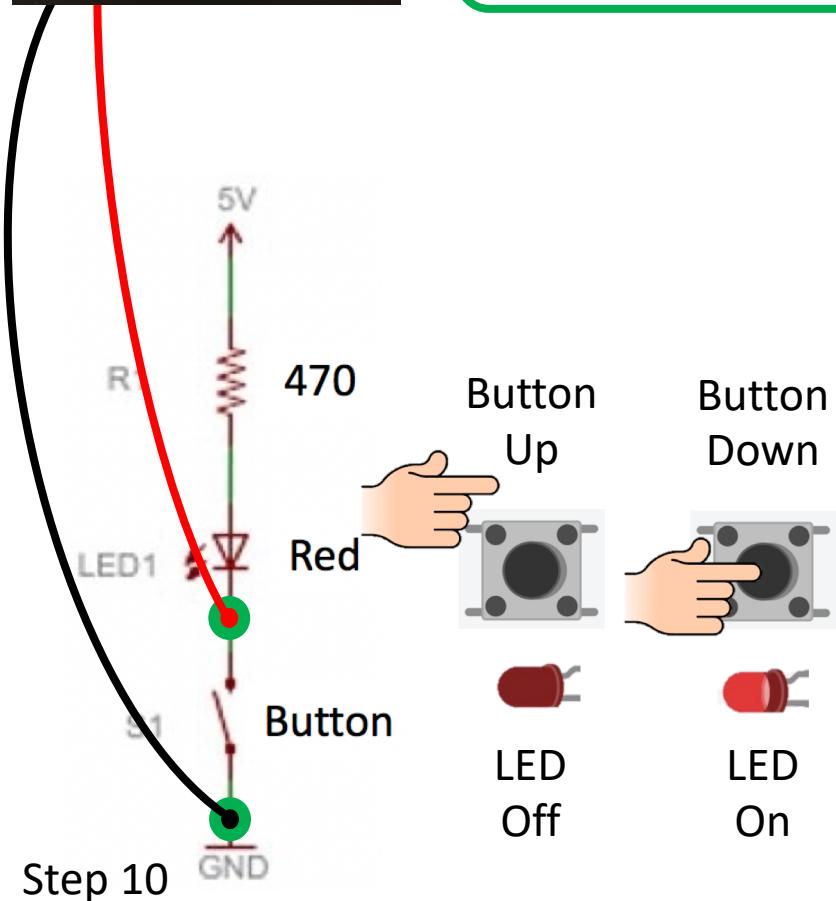
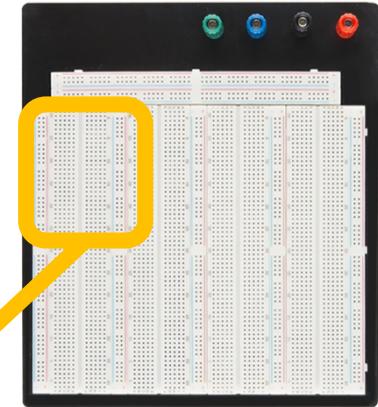
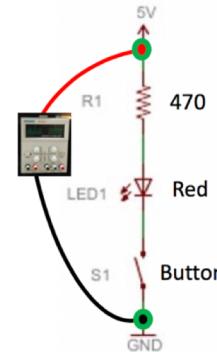
Step 10



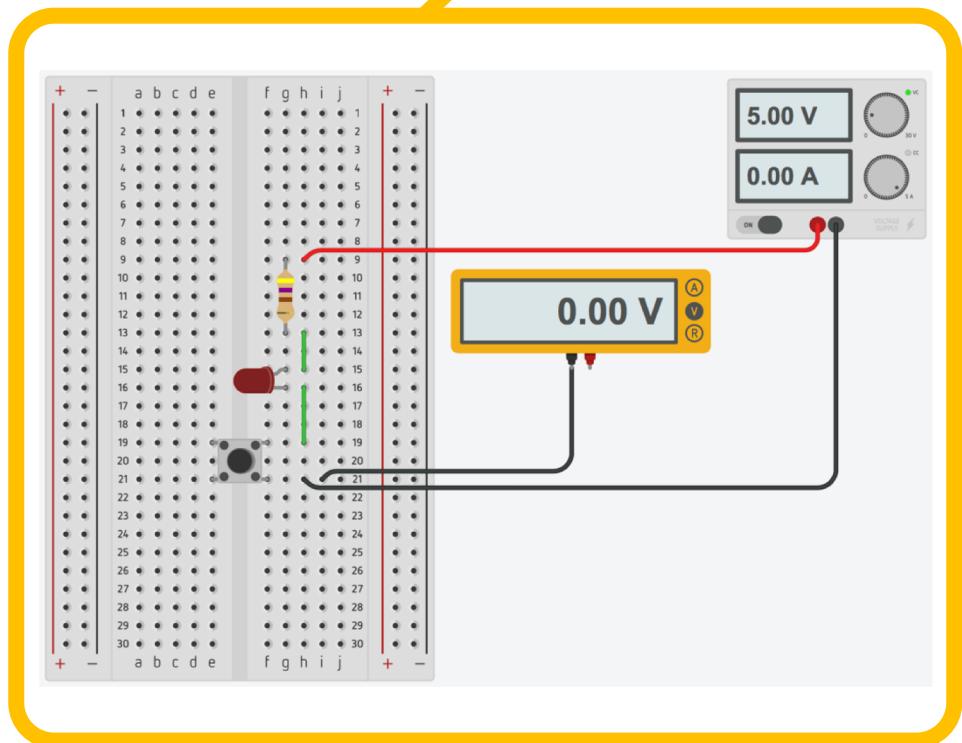
Demo 01 – Measure Voltage LED and Button



Measure Voltage
When Button Up : ____ V
When Button Down : ____ V



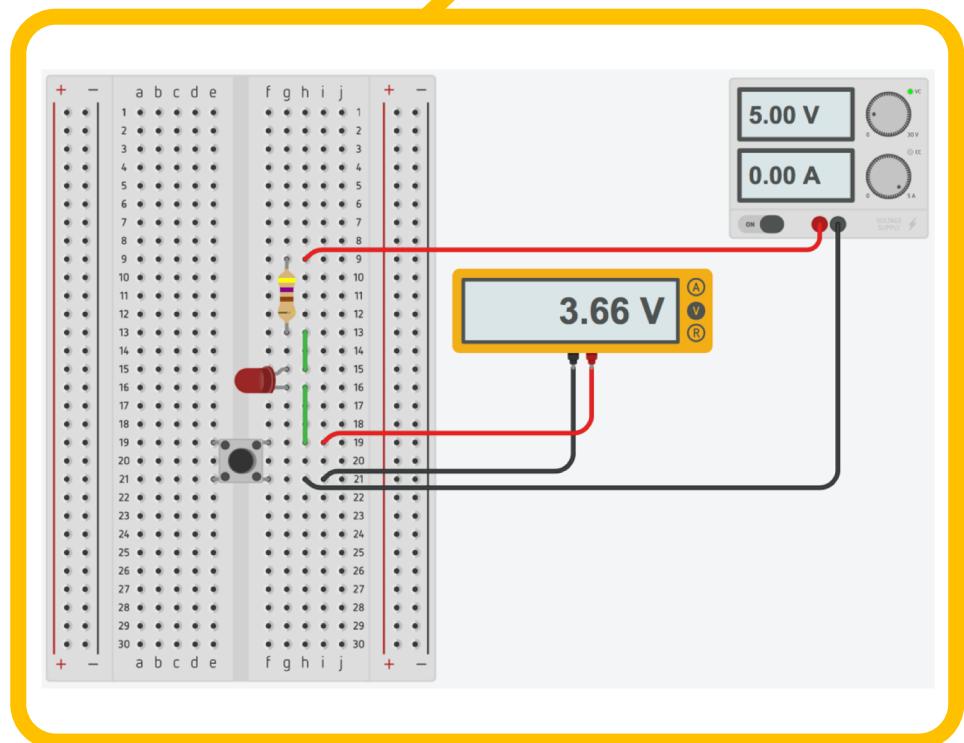
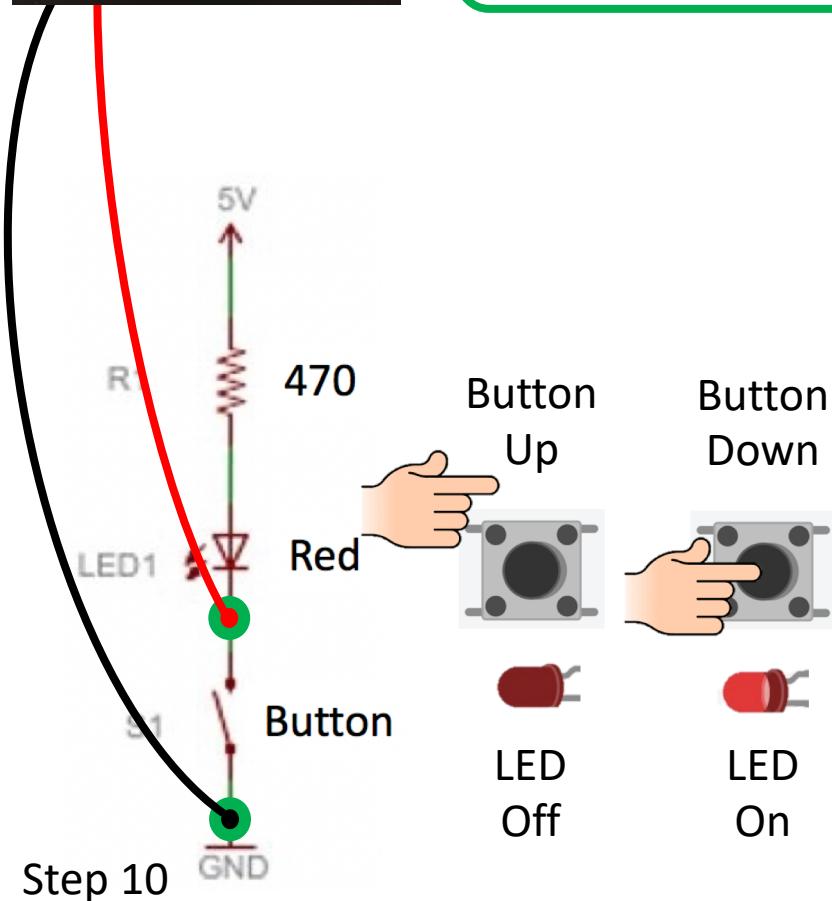
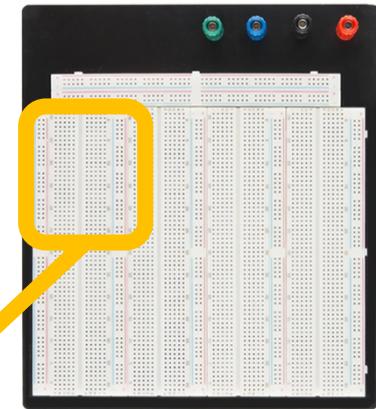
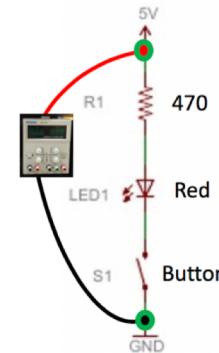
Step 10



Demo 01 – Measure Voltage LED and Button



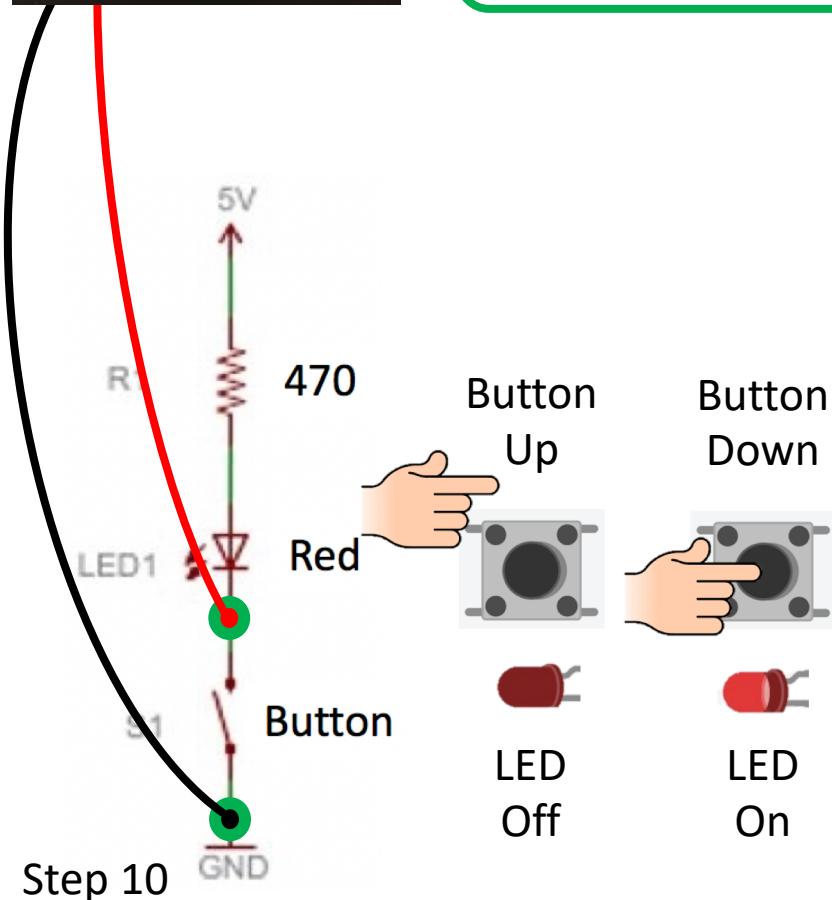
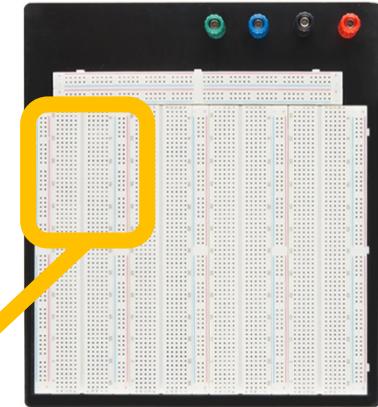
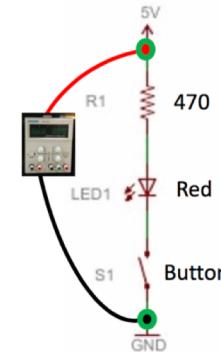
Measure Voltage
When Button Up : ____ V
When Button Down : ____ V



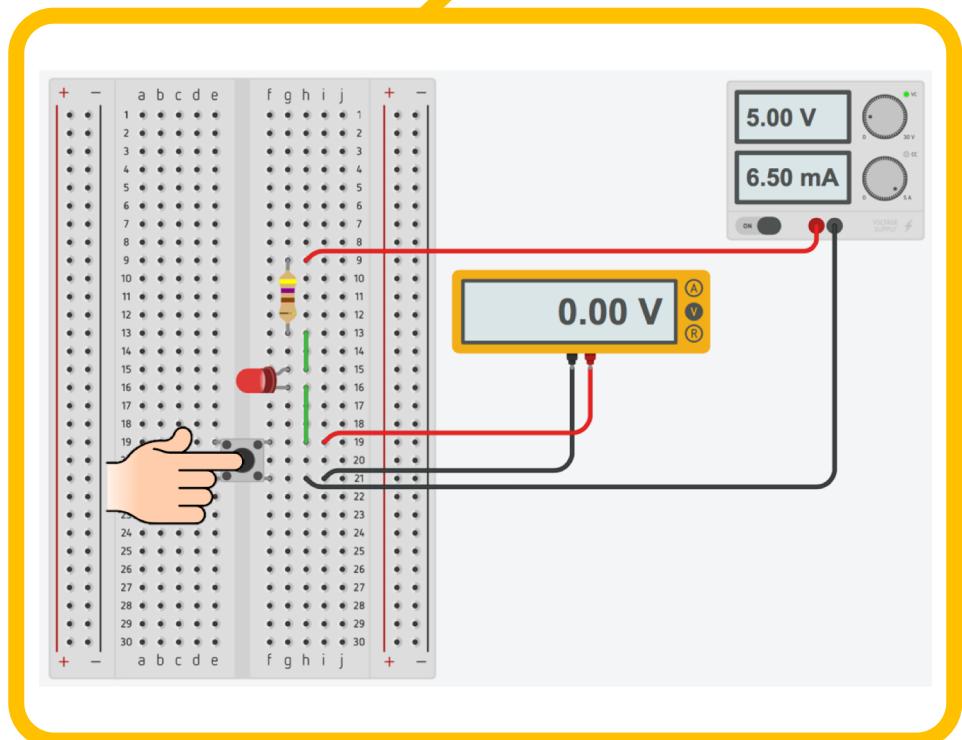
Demo 01 – Measure Voltage LED and Button



Measure Voltage
When Button Up : ____ V
When Button Down : ____ V

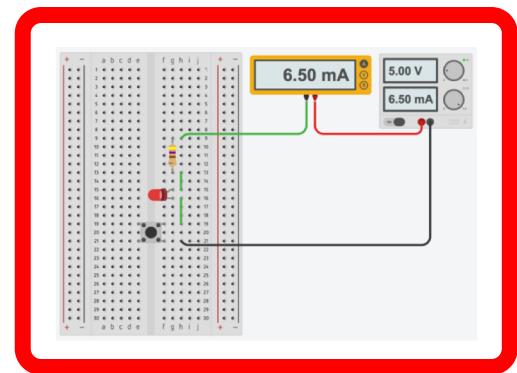
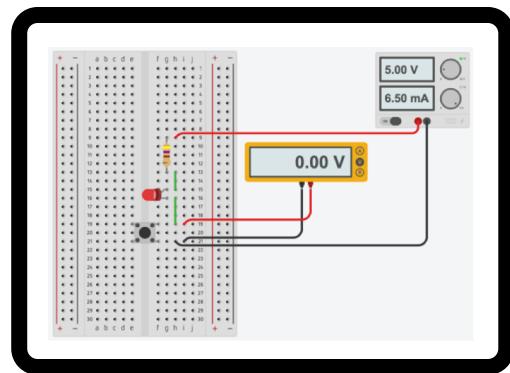
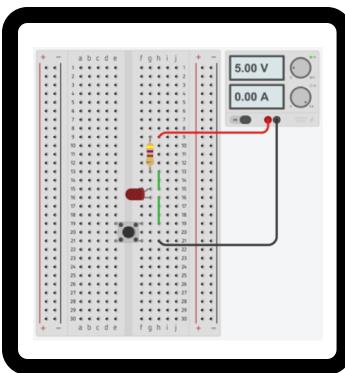
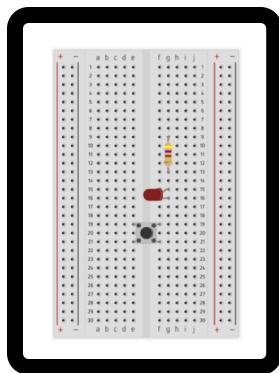


Step 10



Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current



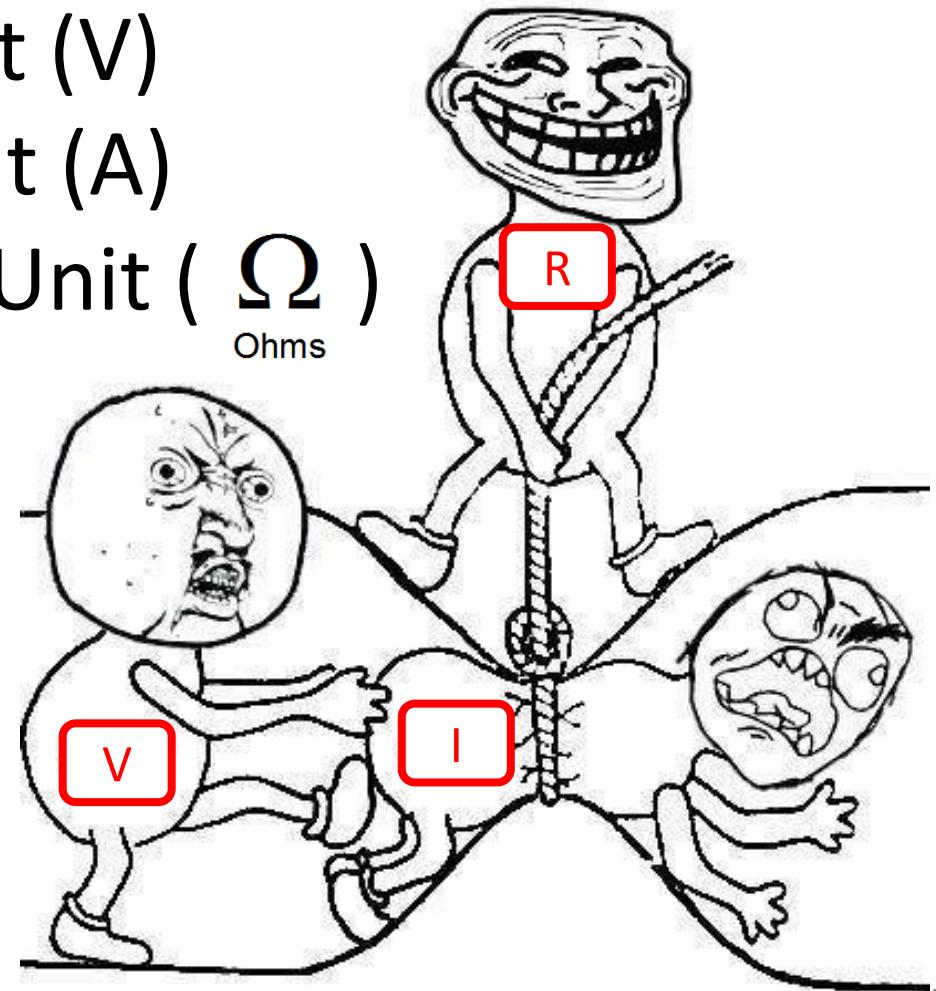
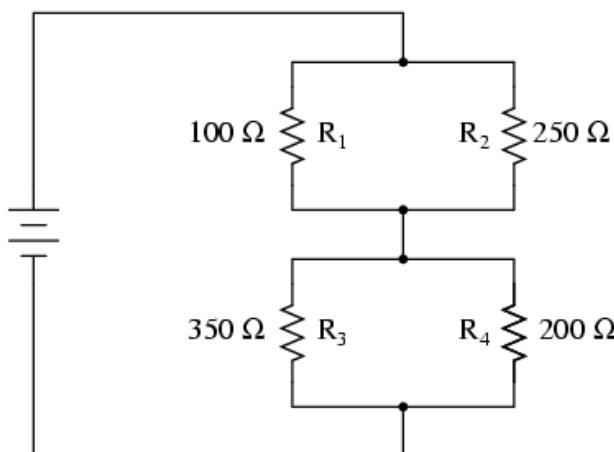
Basic Measurement

$$V = I R$$

$V \rightarrow$ Voltage, Unit (V)

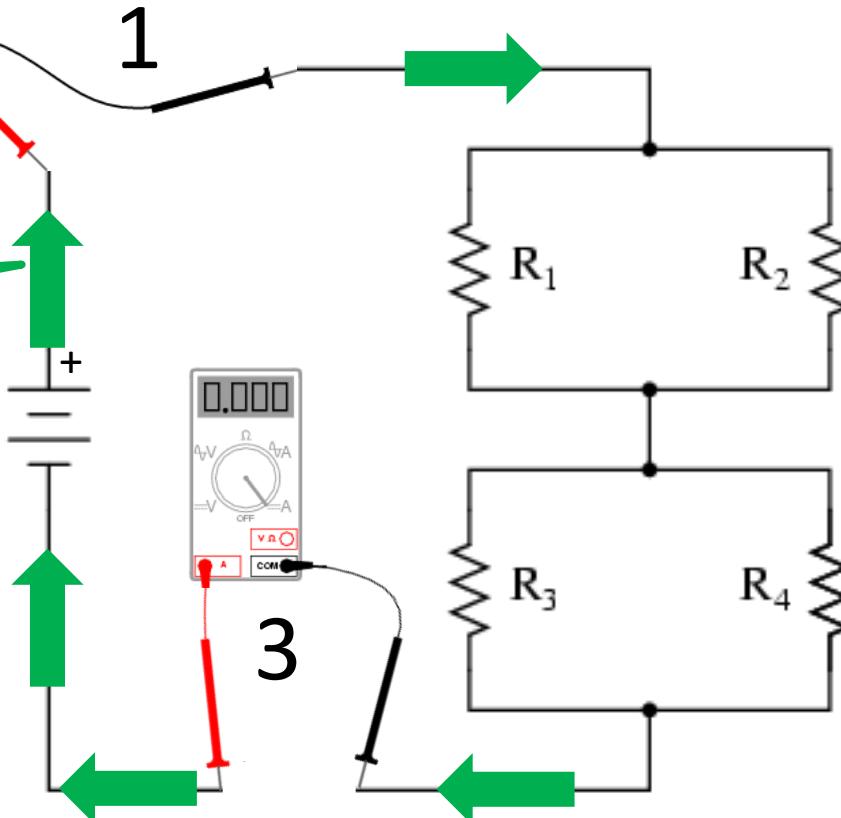
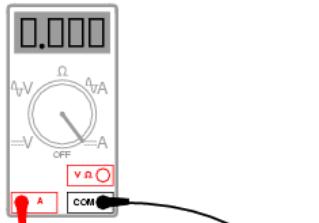
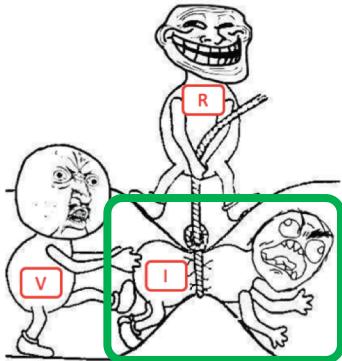
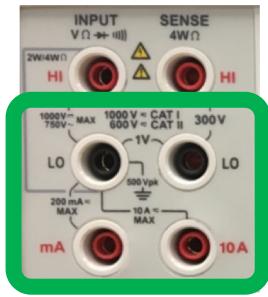
$I \rightarrow$ Current, Unit (A)

$R \rightarrow$ Resistance, Unit (Ω)

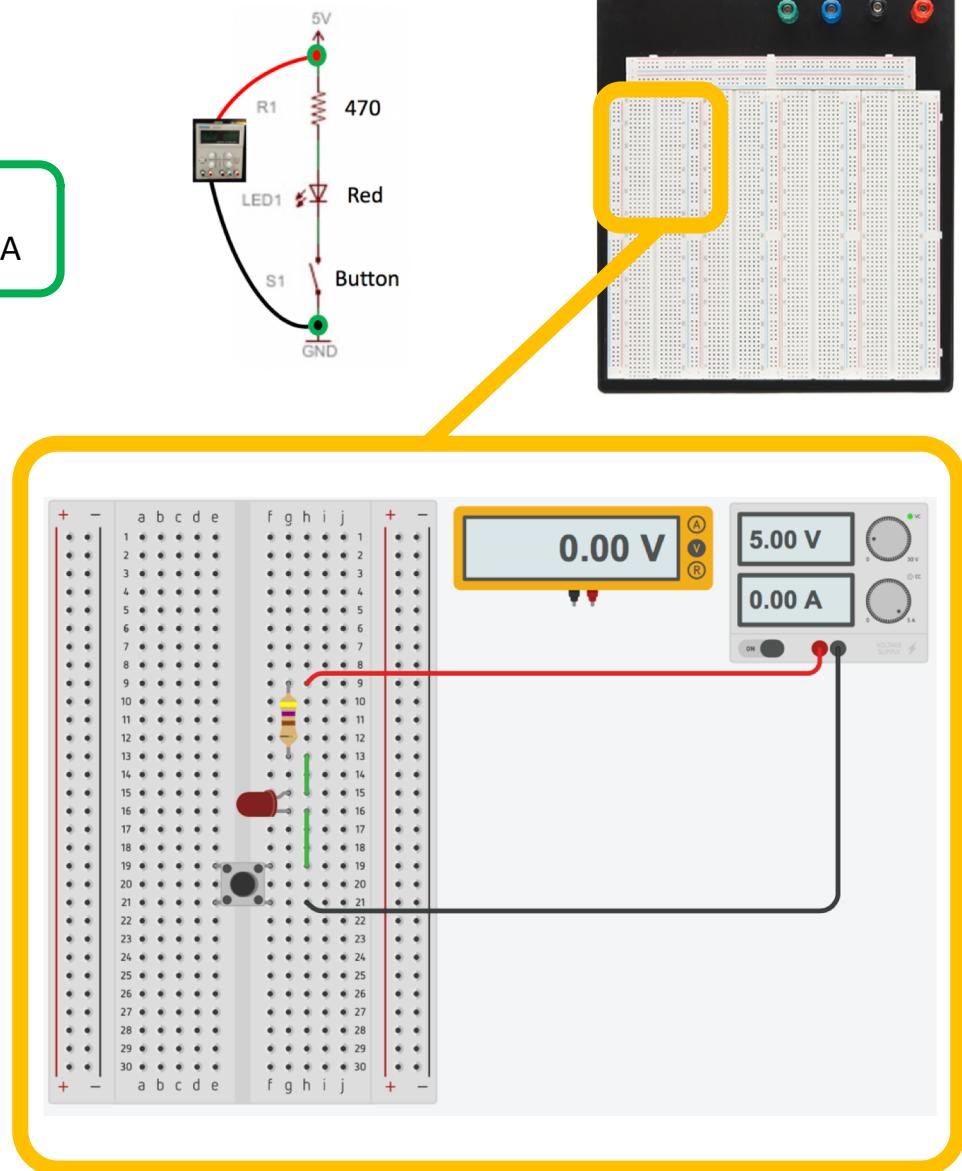
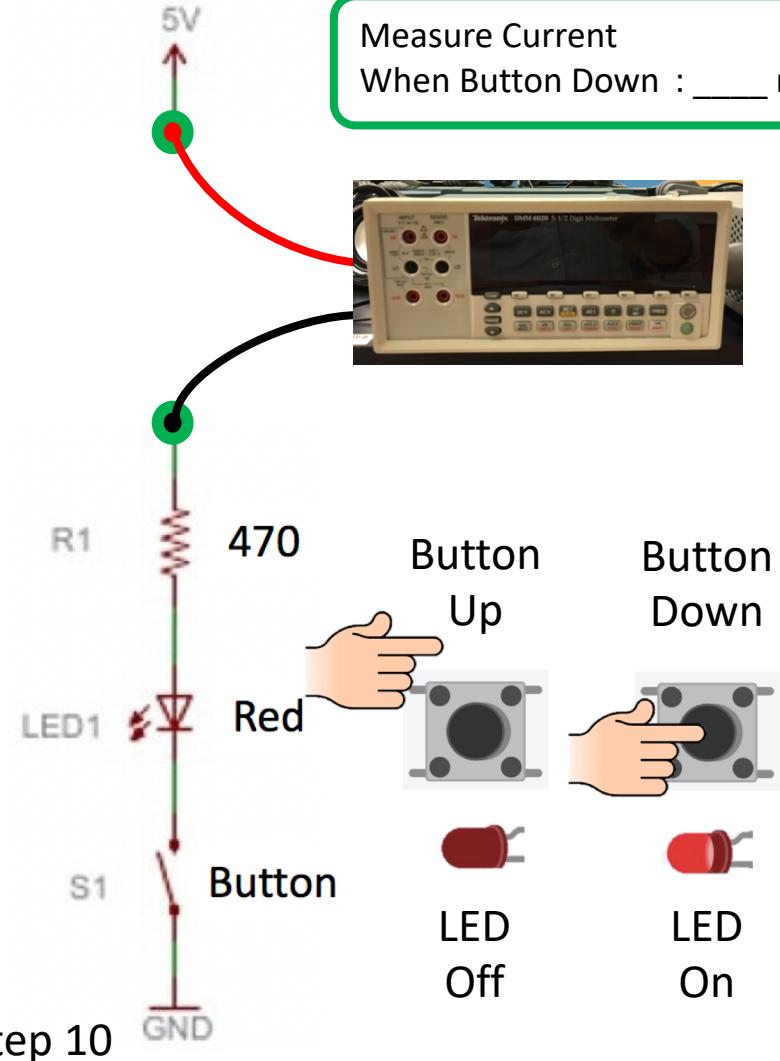


How to measure Current

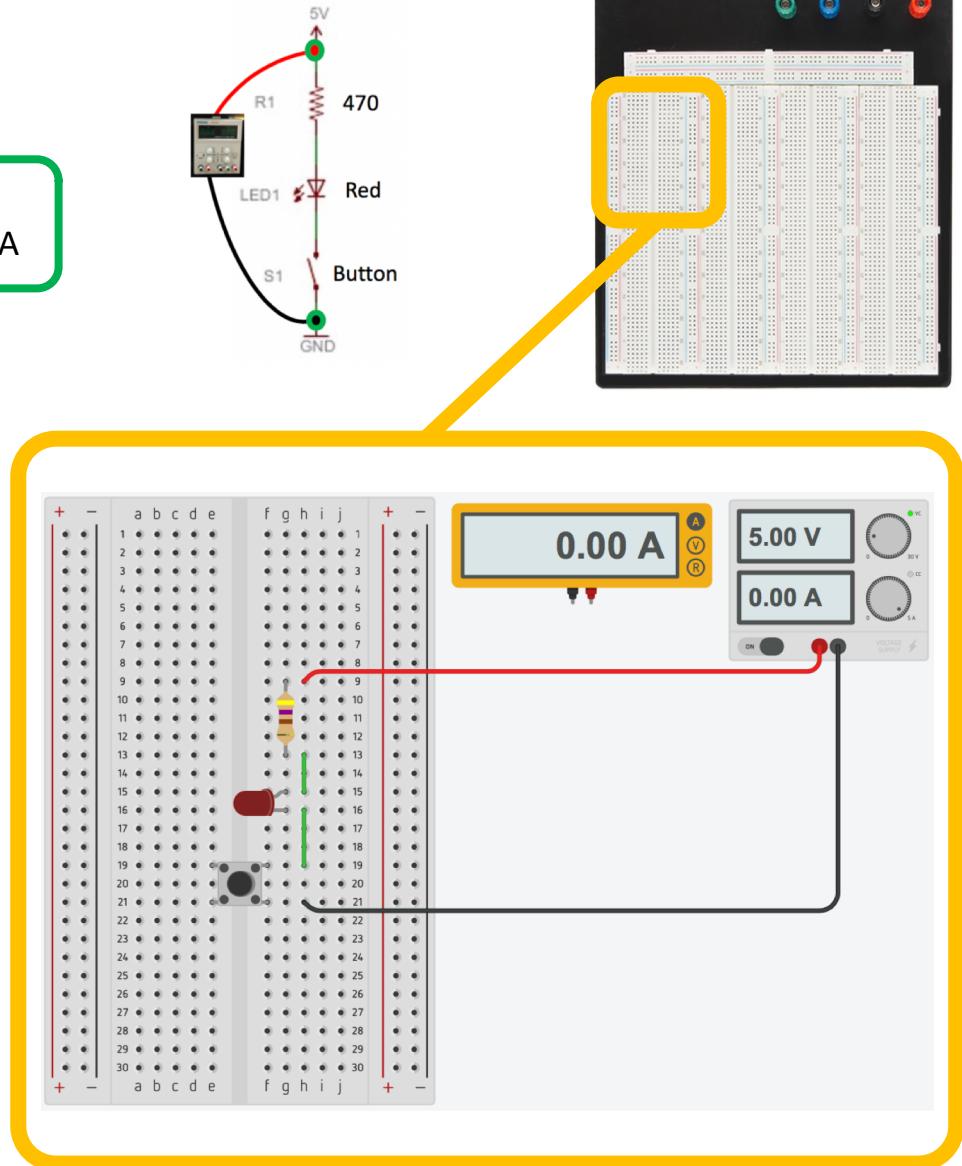
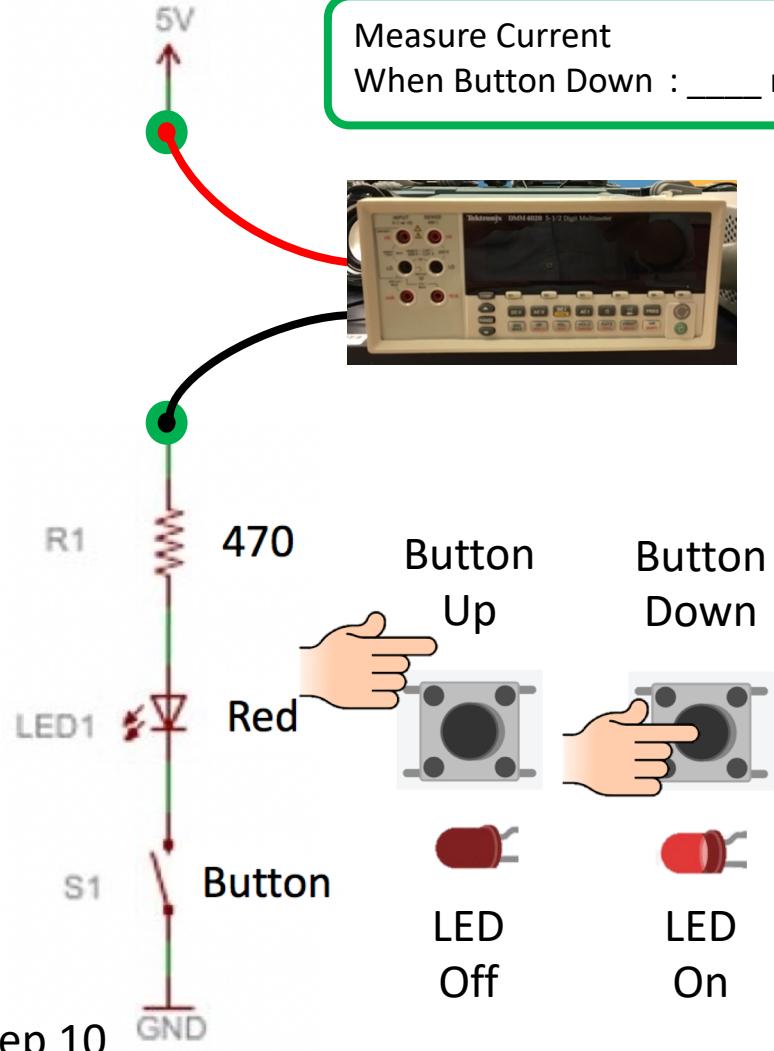
Which one is the best method to measure Current



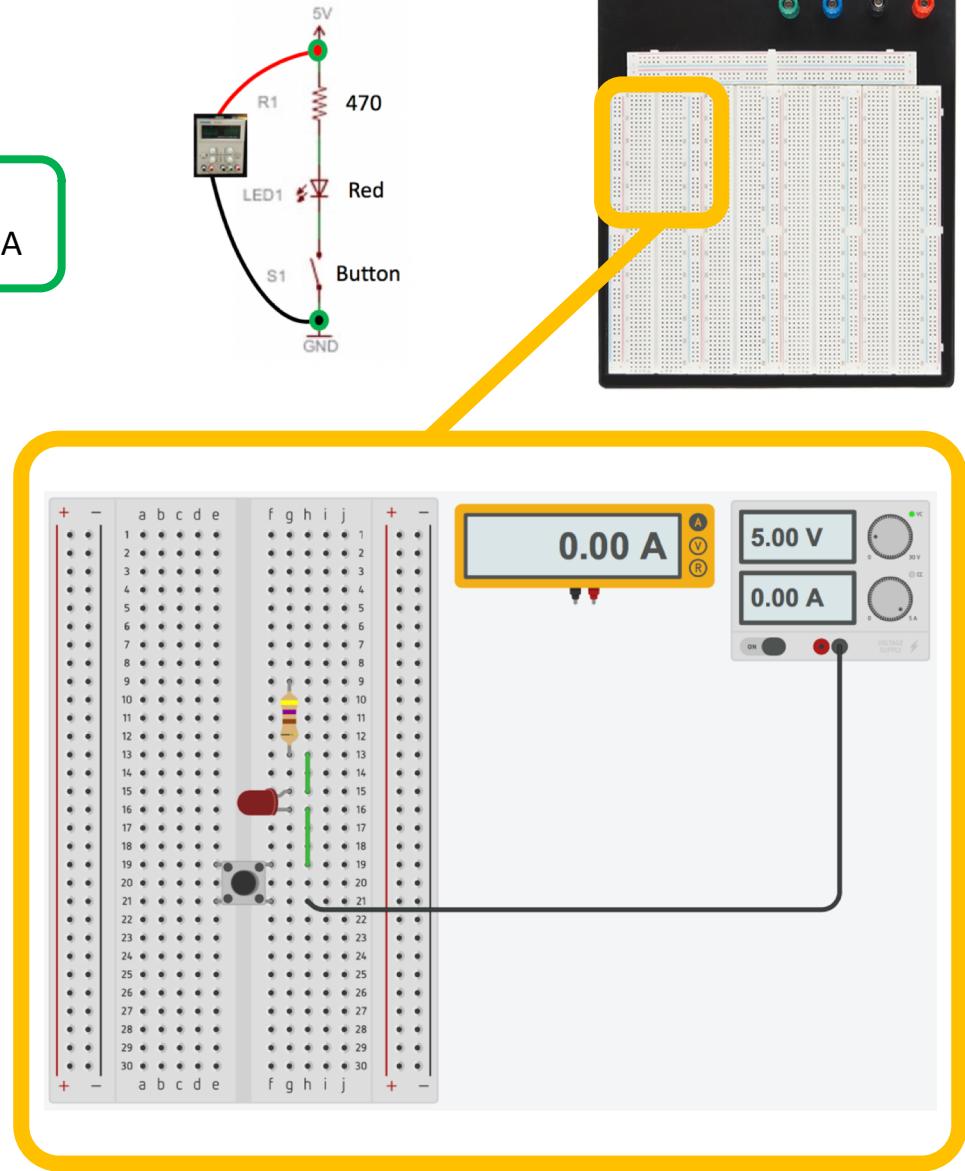
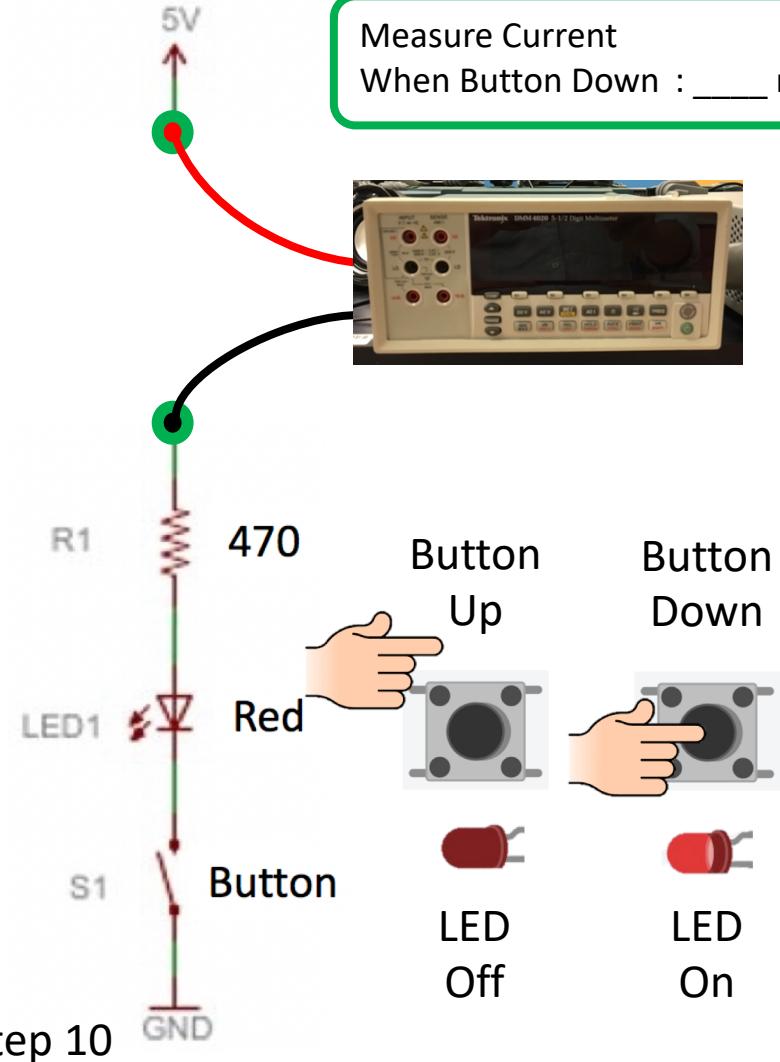
Demo 01 – Measure Current LED and Button



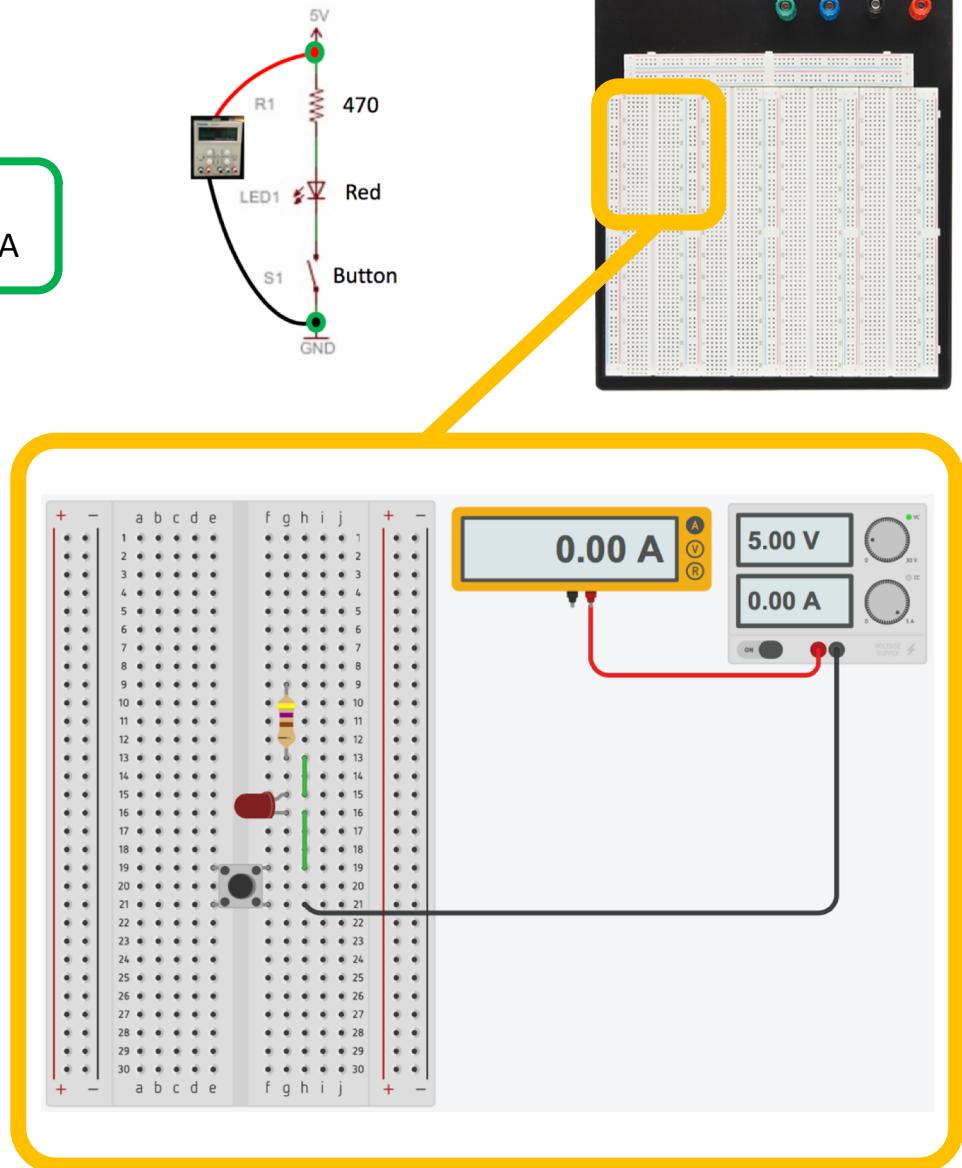
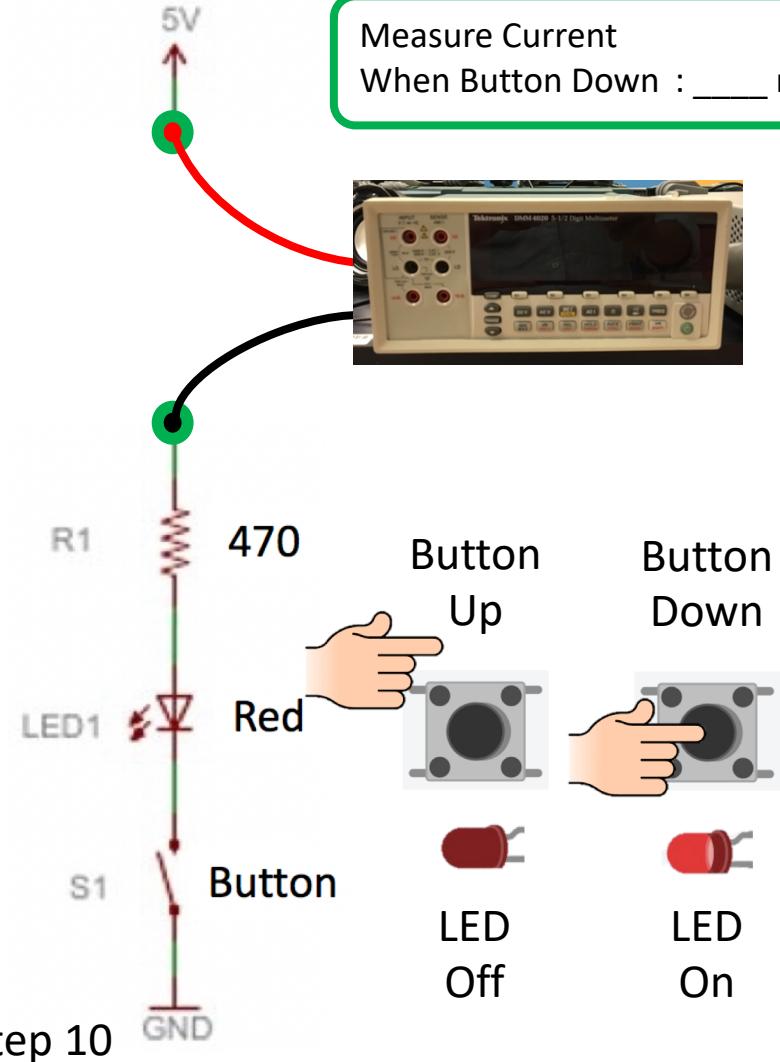
Demo 01 – Measure Current LED and Button



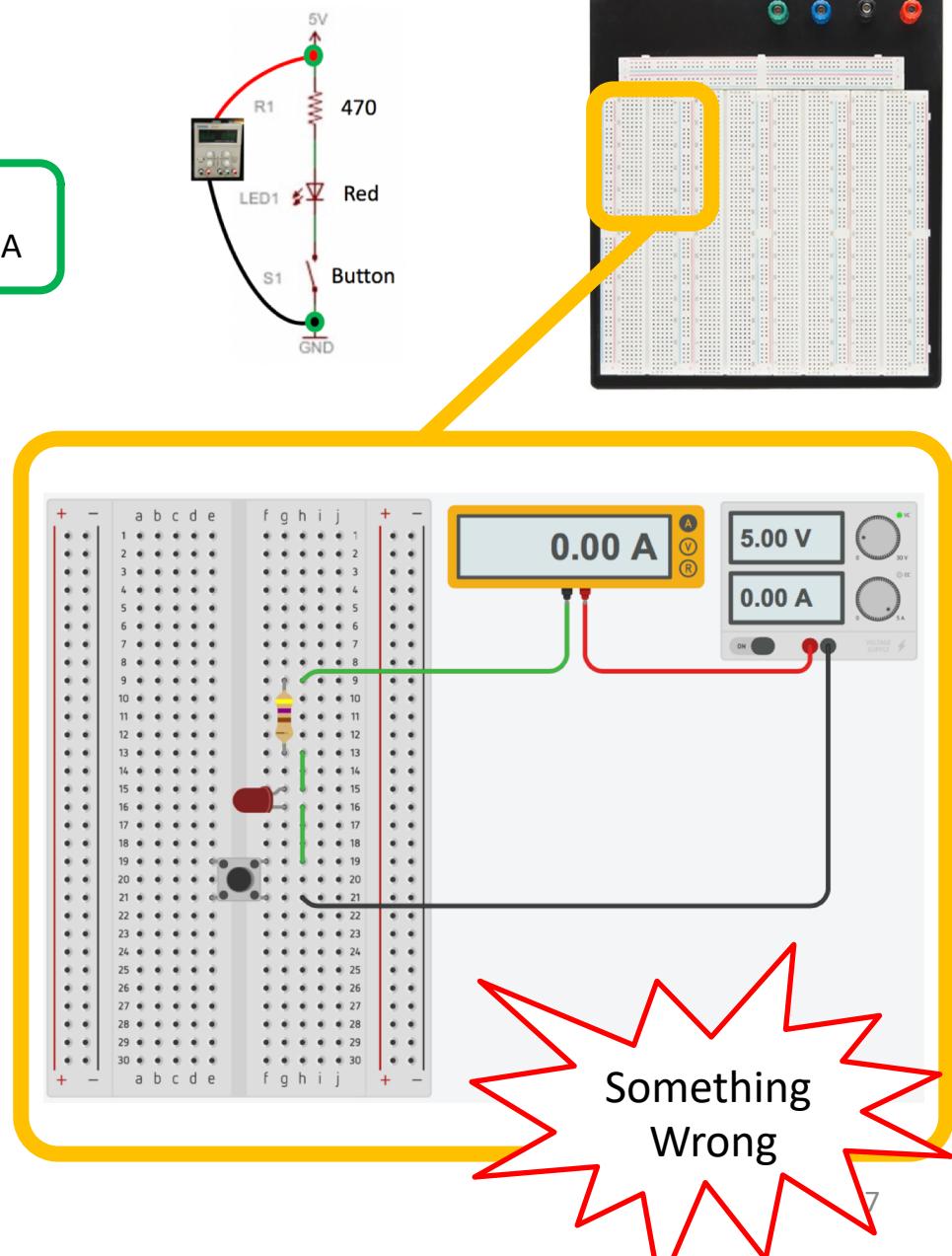
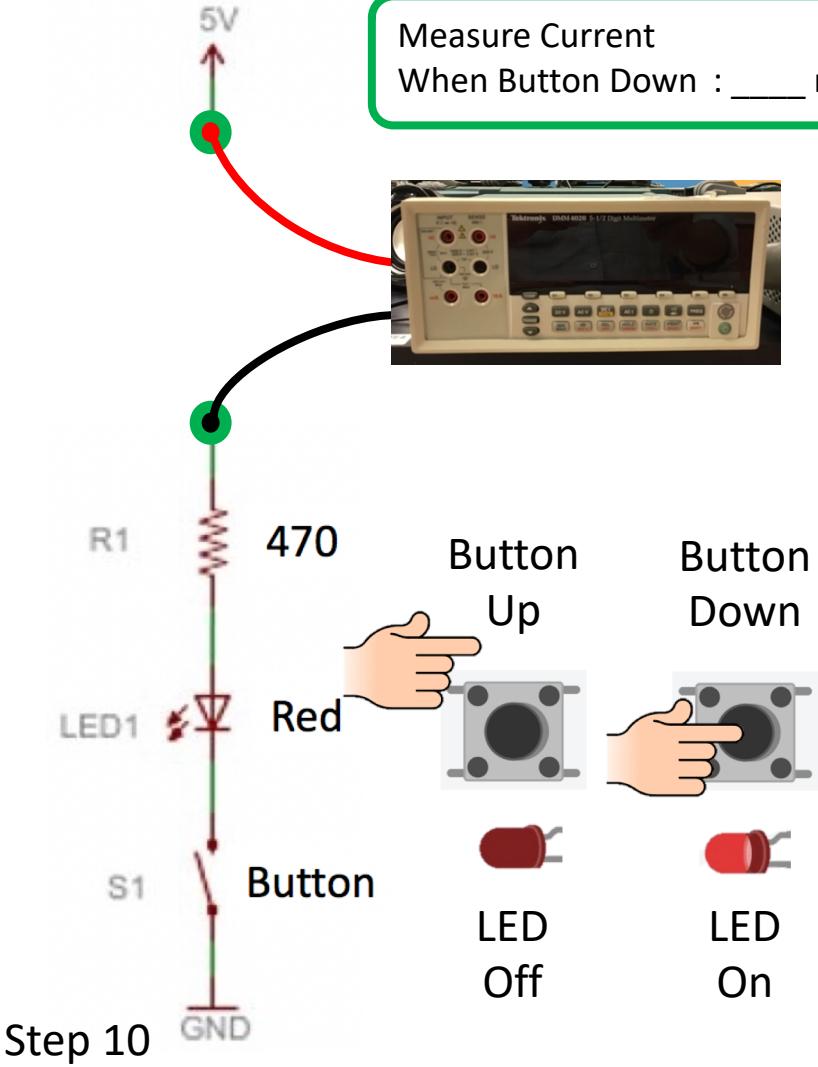
Demo 01 – Measure Current LED and Button



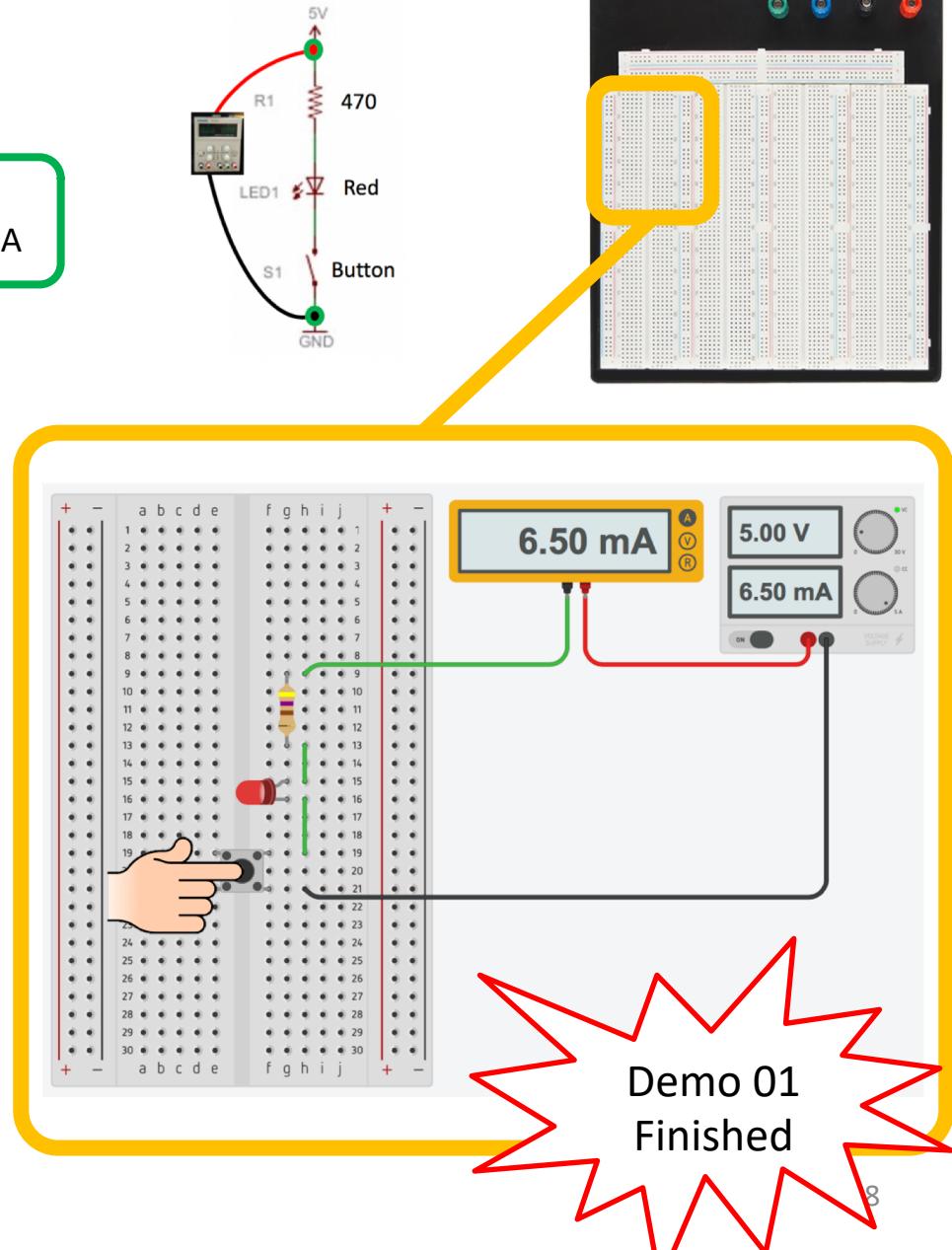
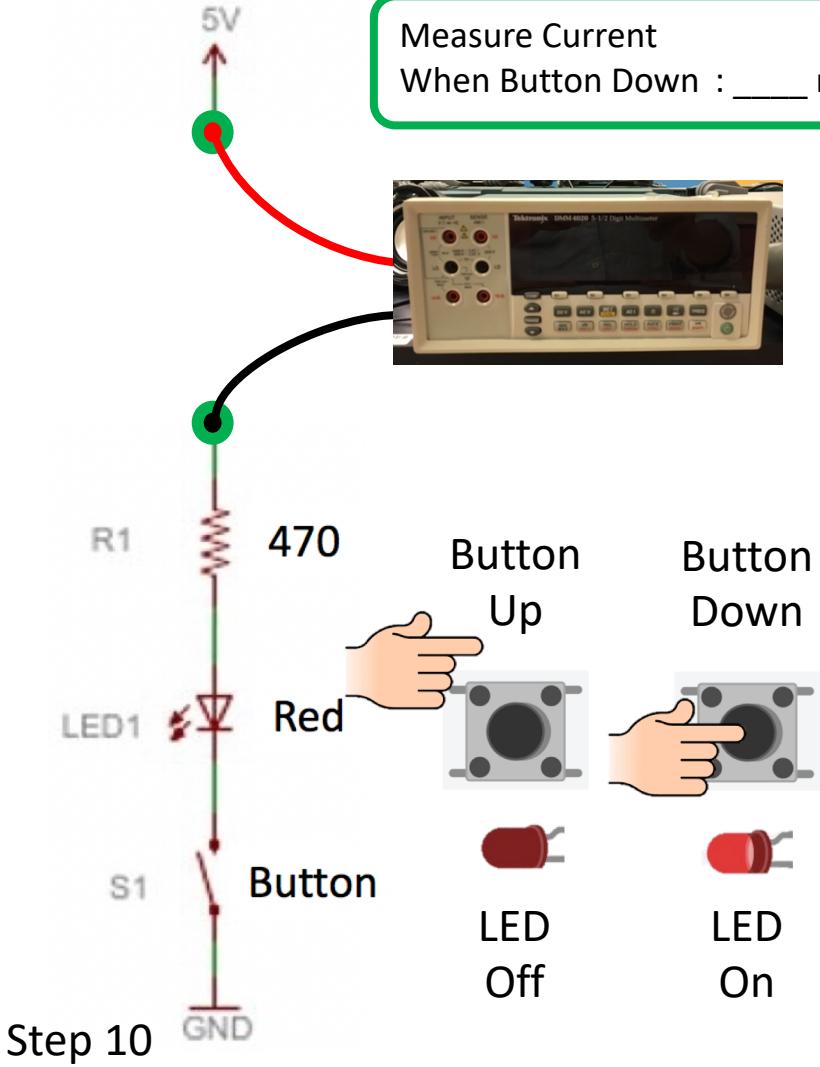
Demo 01 – Measure Current LED and Button



Demo 01 – Measure Current LED and Button

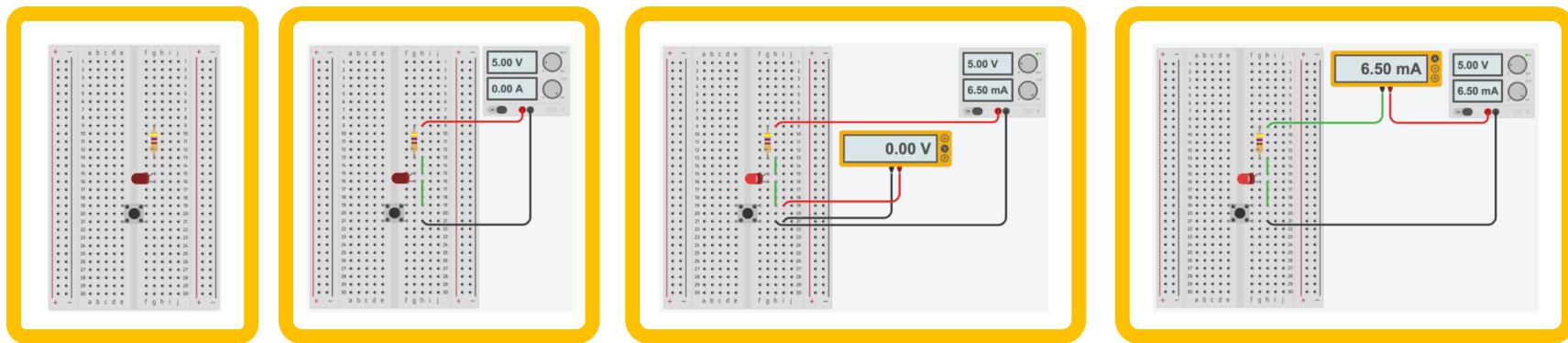


Demo 01 – Measure Current LED and Button



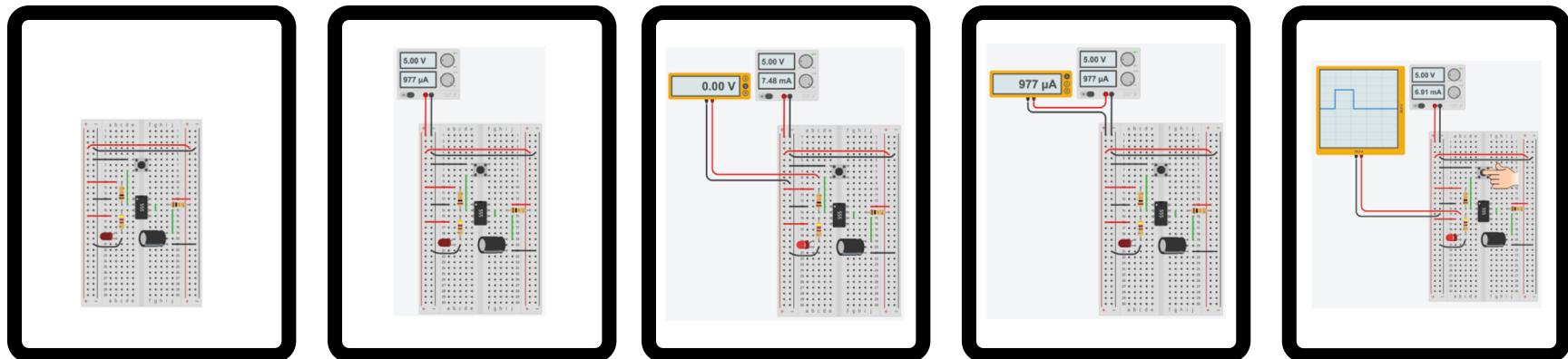
Demo 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current



Exercise 01

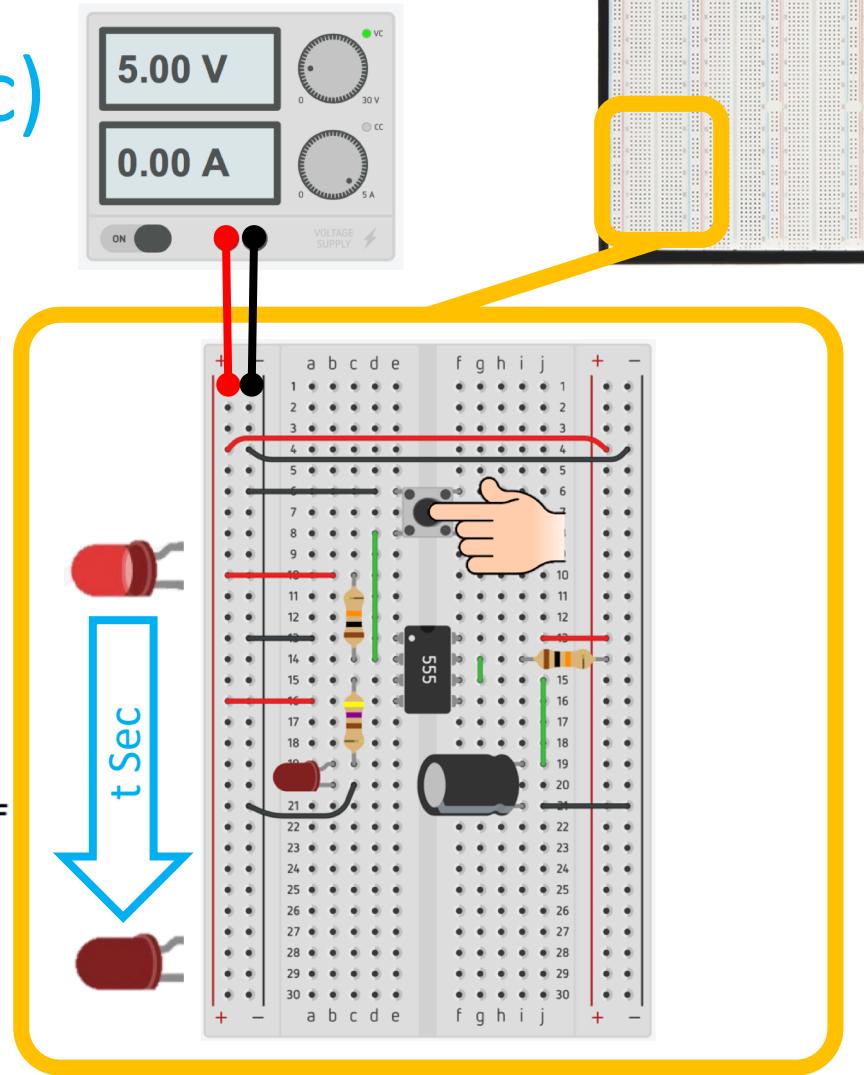
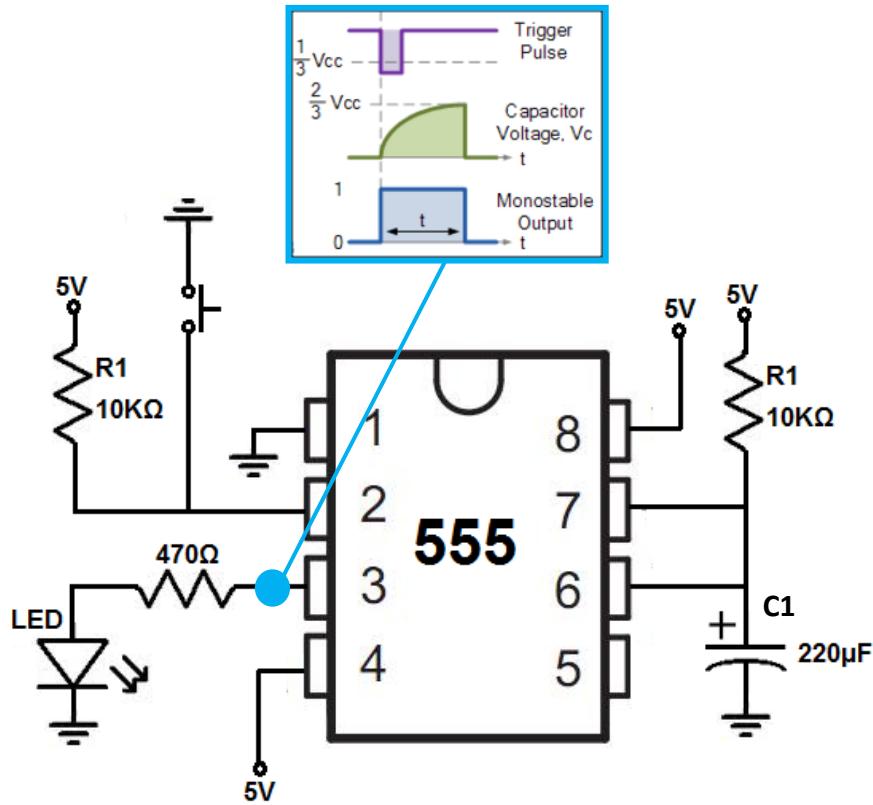
1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform



Exercise 01 – Build Circuit

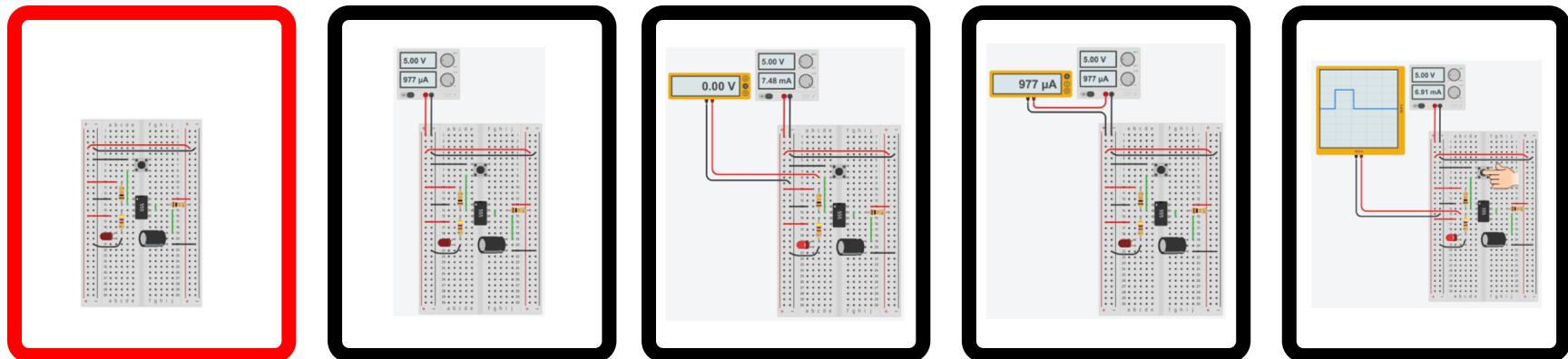
555 Monostable Timer Circuit

$$t = 1.1 \times R1 \times C1 \text{ (Sec)}$$



Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform

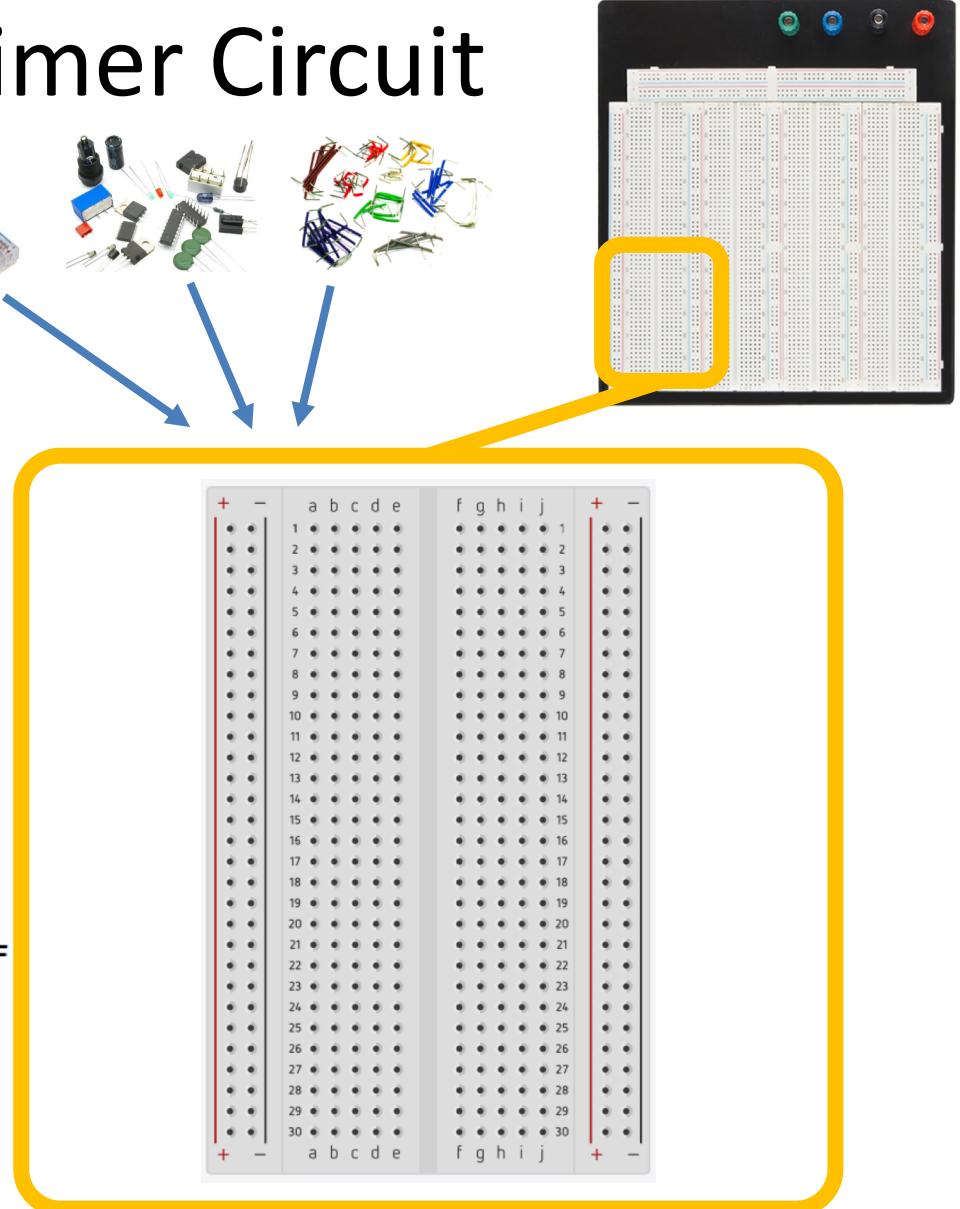
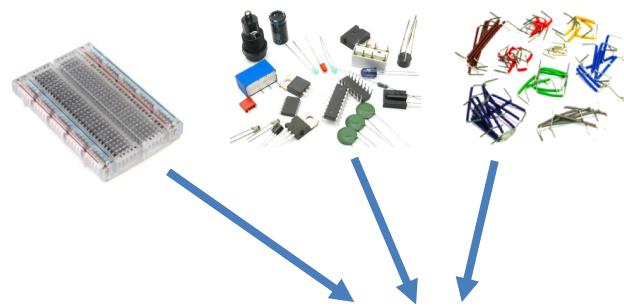
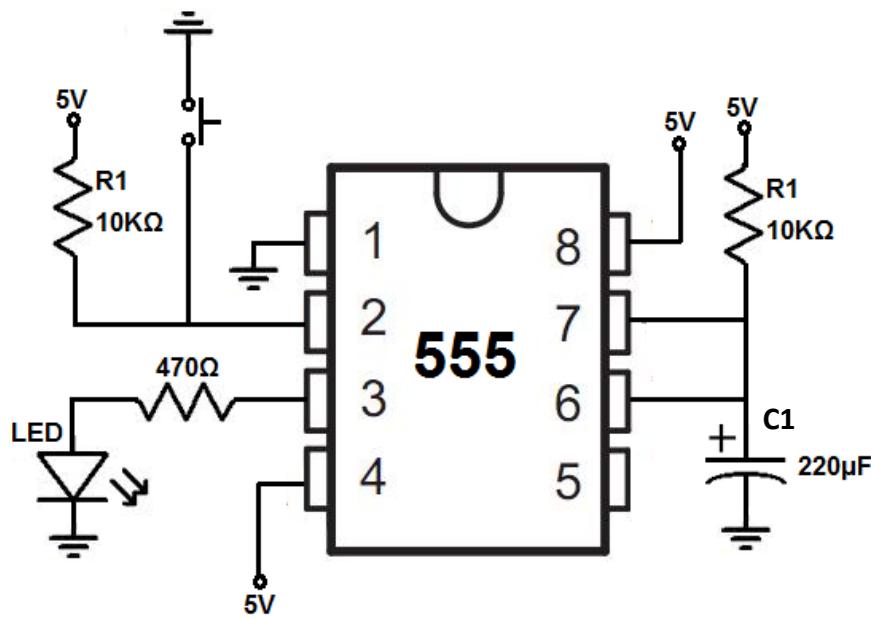


Exercise 01 – Build Circuit

555 Monostable Timer Circuit

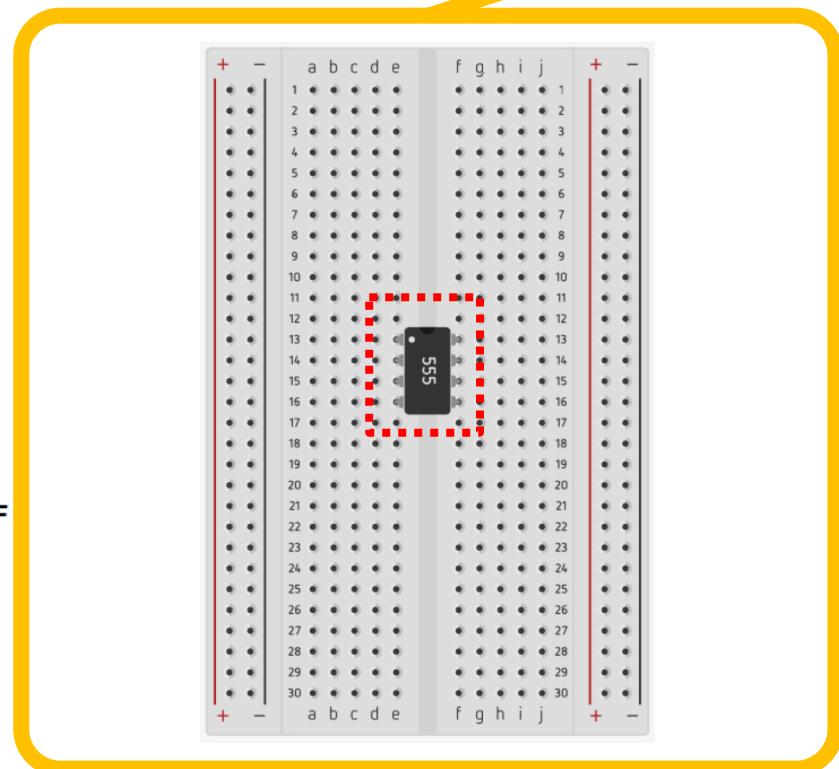
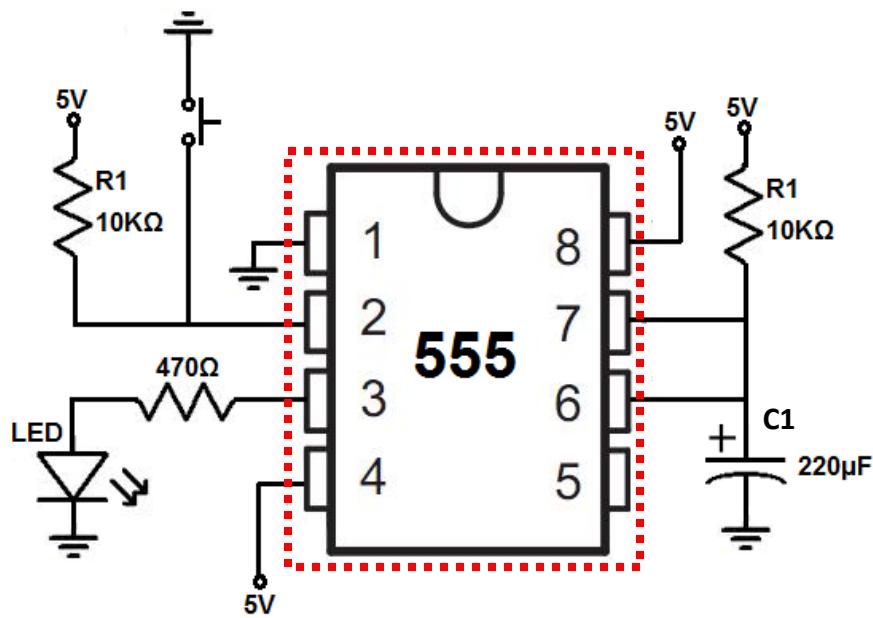
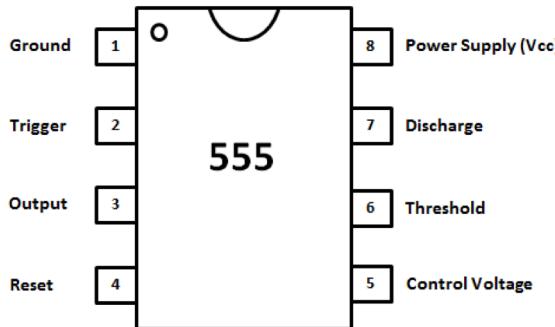
Please prepare

- Breadboard
- All Components
- Connection Wires



Exercise 01 – Build Circuit

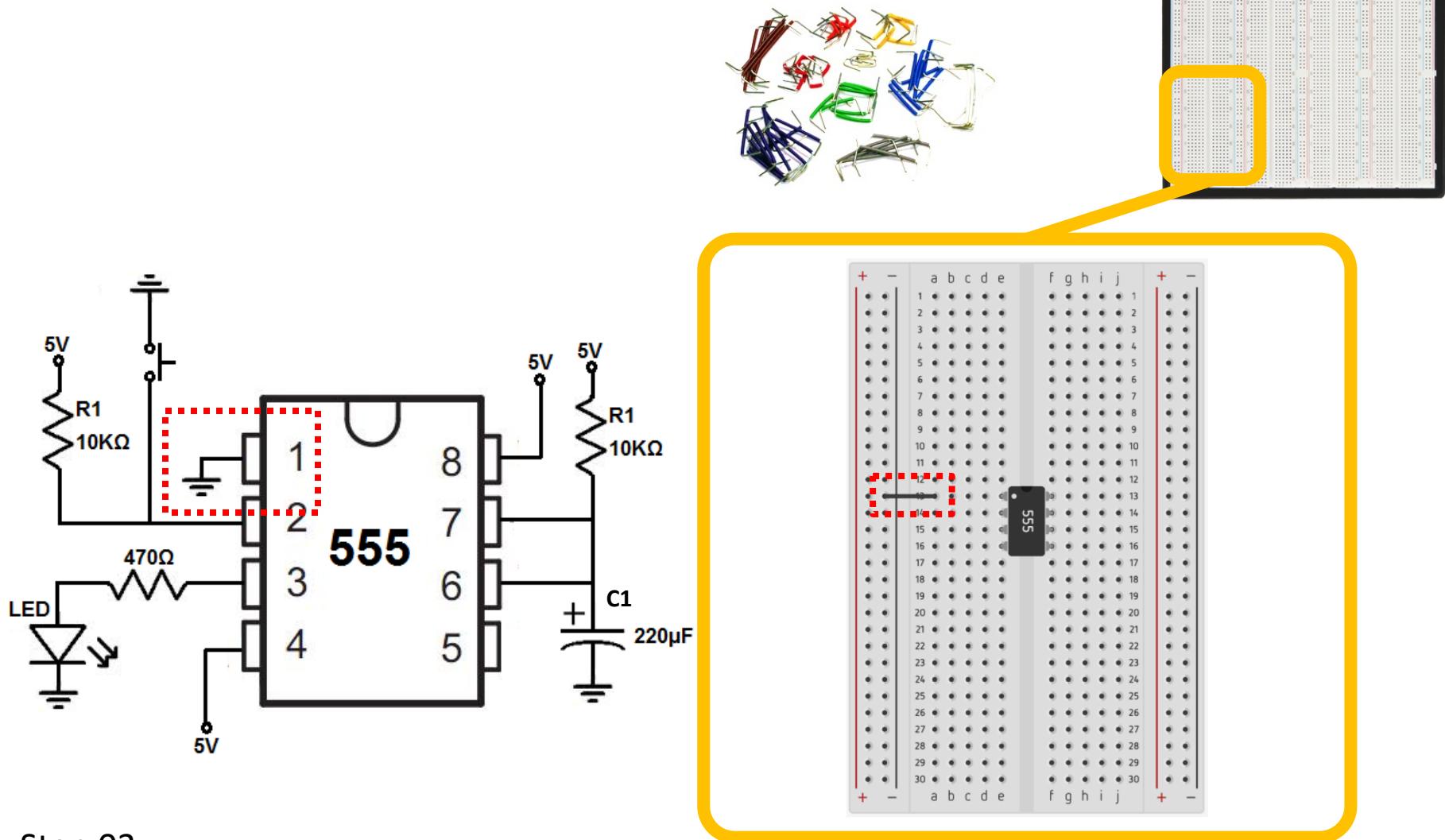
555 Monostable Timer Circuit



Step 02

Exercise 01 – Build Circuit

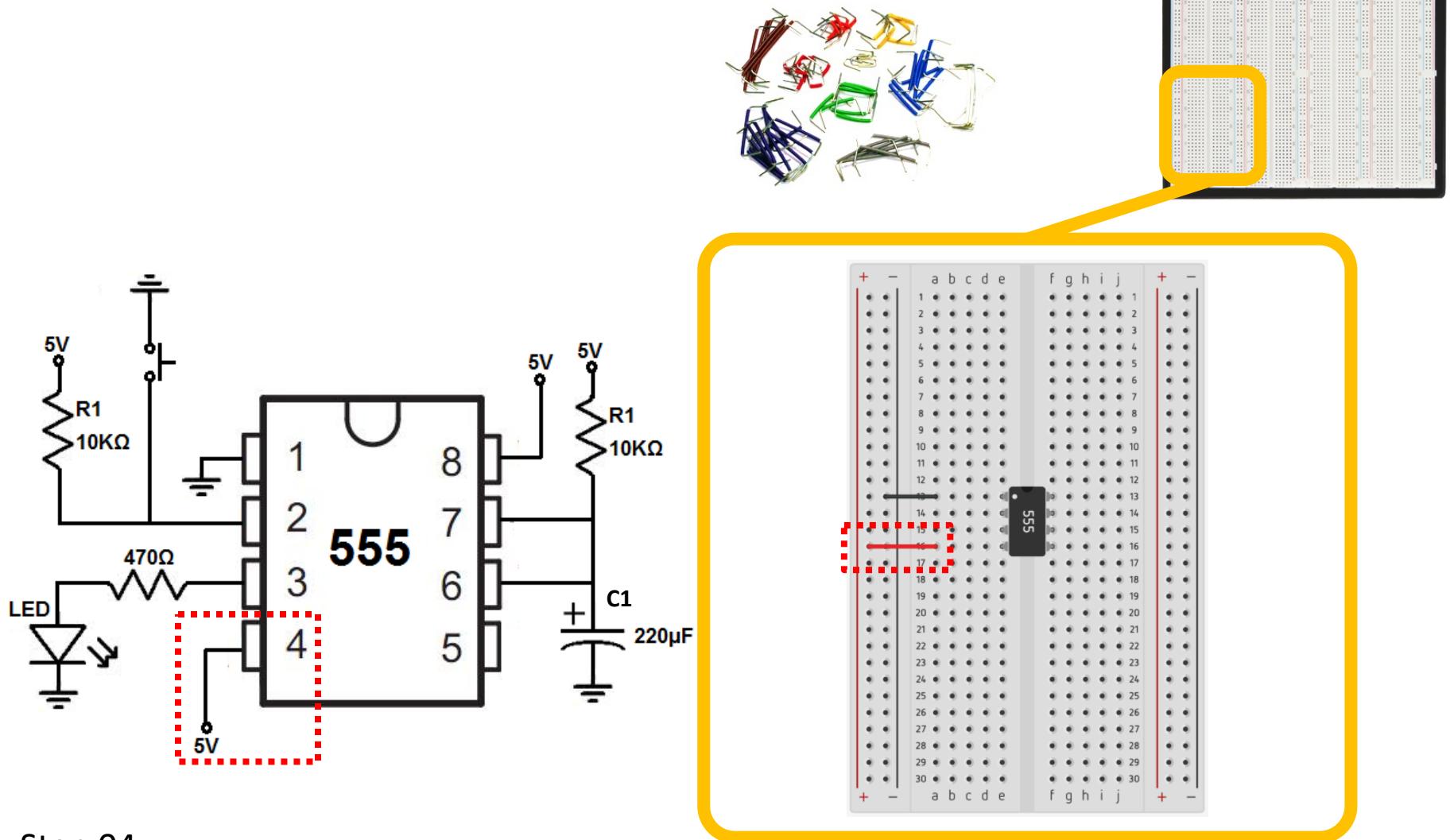
555 Monostable Timer Circuit



Step 03

Exercise 01 – Build Circuit

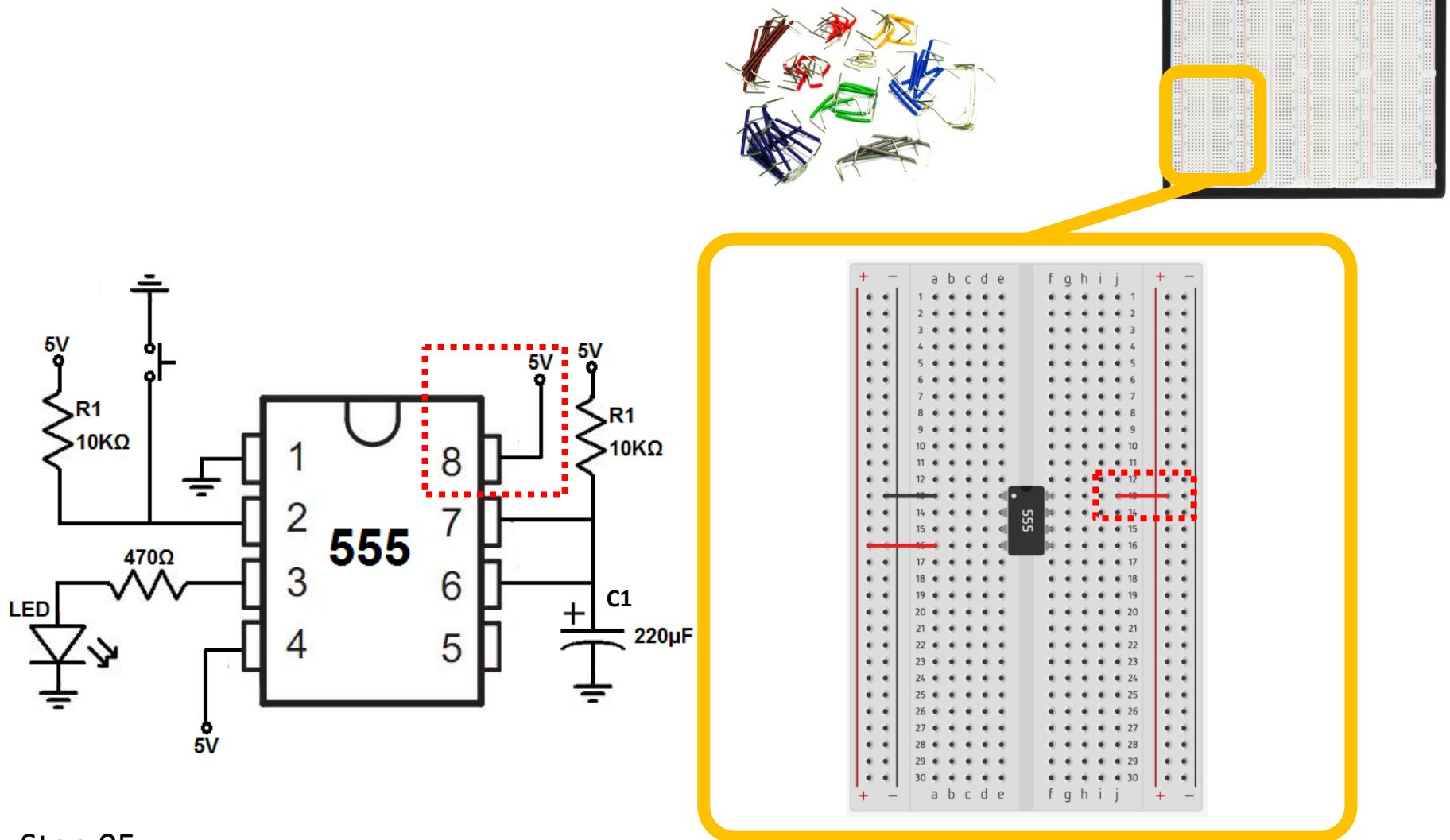
555 Monostable Timer Circuit



Step 04

Exercise 01 – Build Circuit

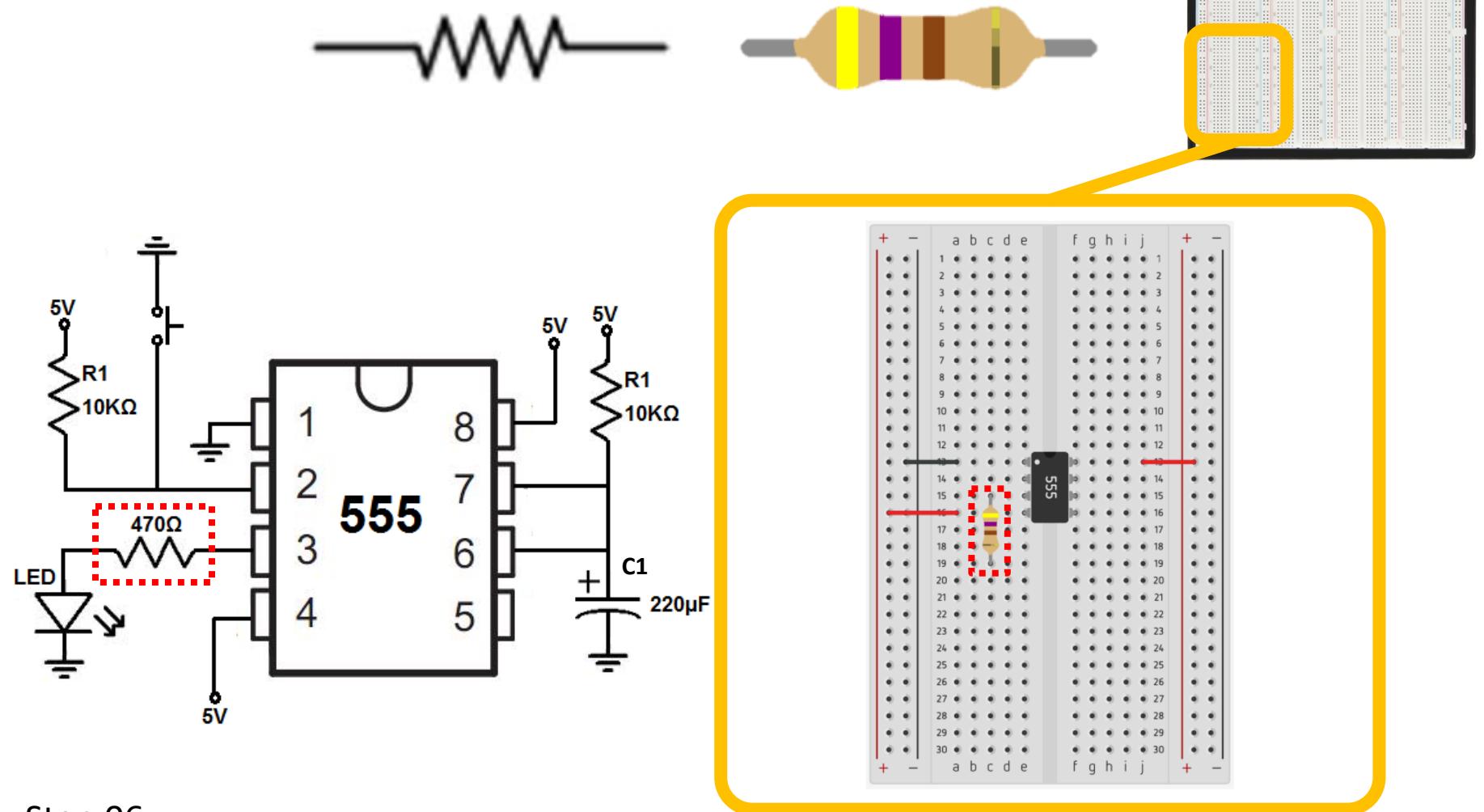
555 Monostable Timer Circuit



Step 05

Exercise 01 – Build Circuit

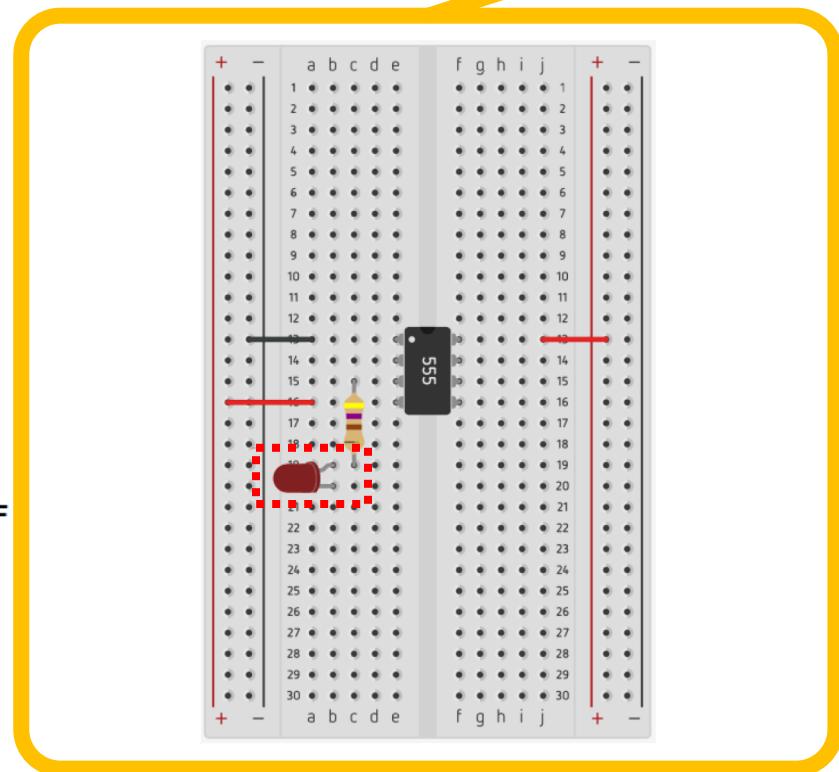
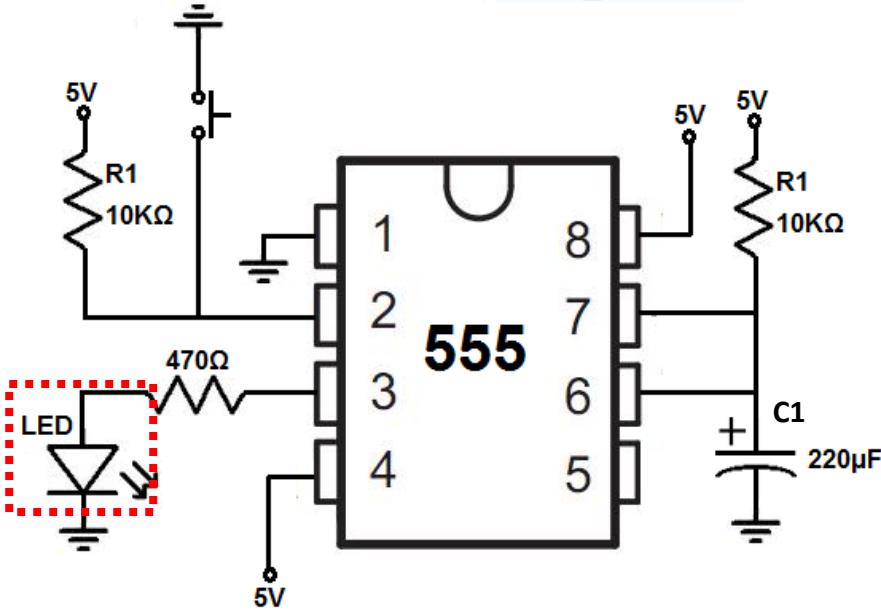
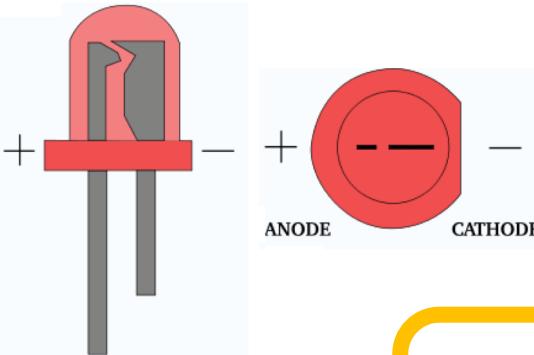
555 Monostable Timer Circuit



Step 06

Exercise 01 – Build Circuit

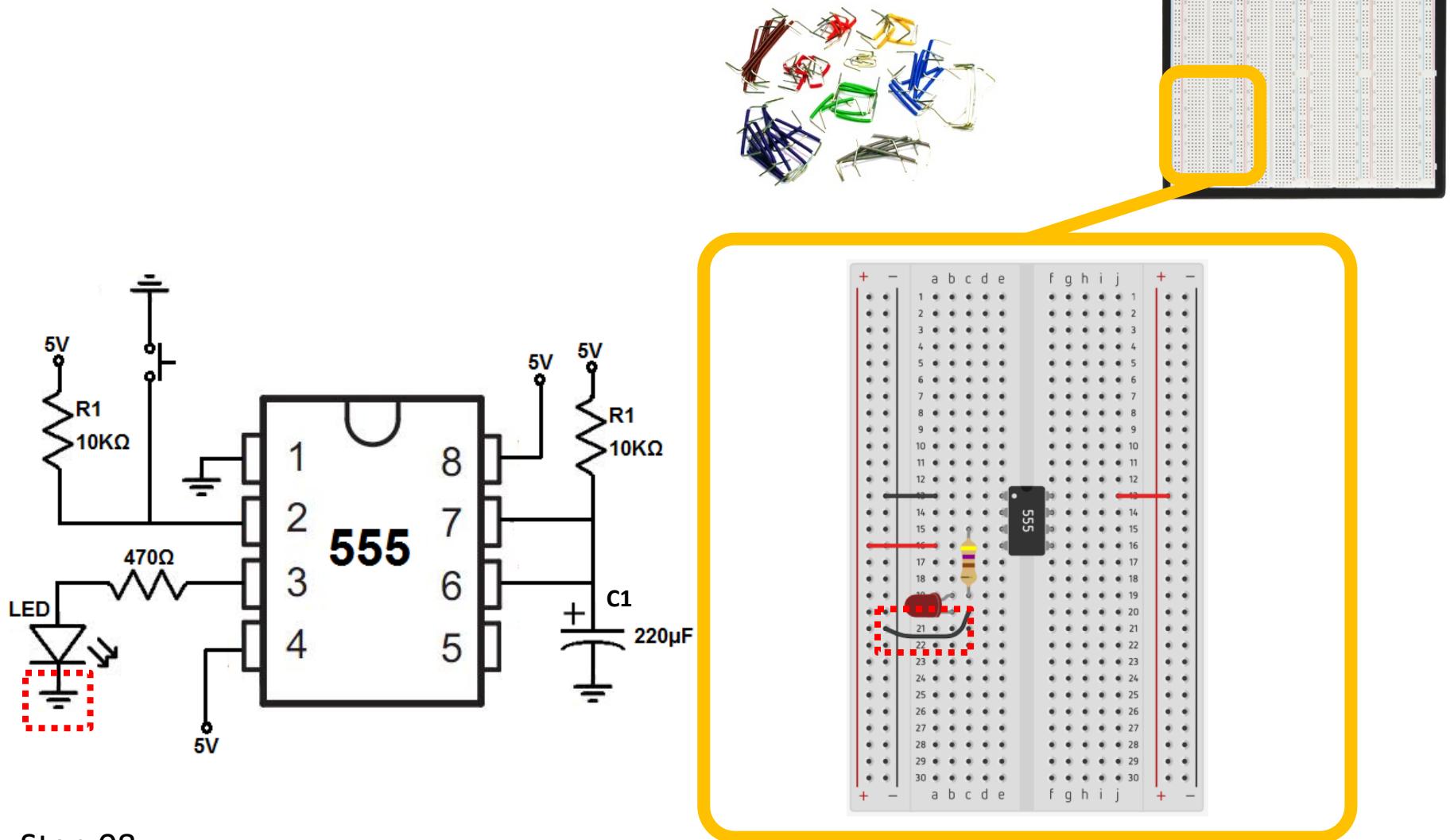
555 Monostable Timer Circuit



Step 07

Exercise 01 – Build Circuit

555 Monostable Timer Circuit

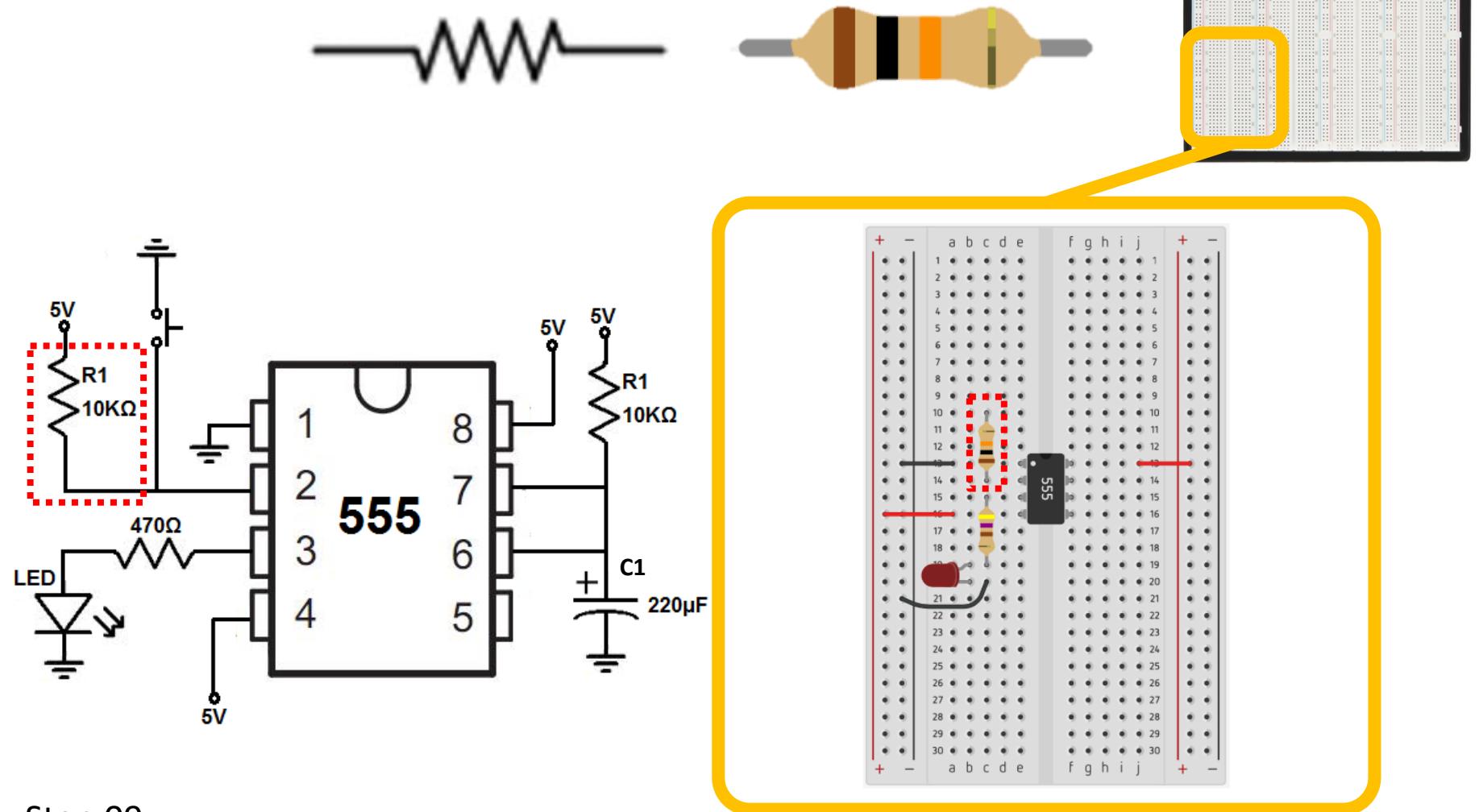


Step 08

90

Exercise 01 – Build Circuit

555 Monostable Timer Circuit

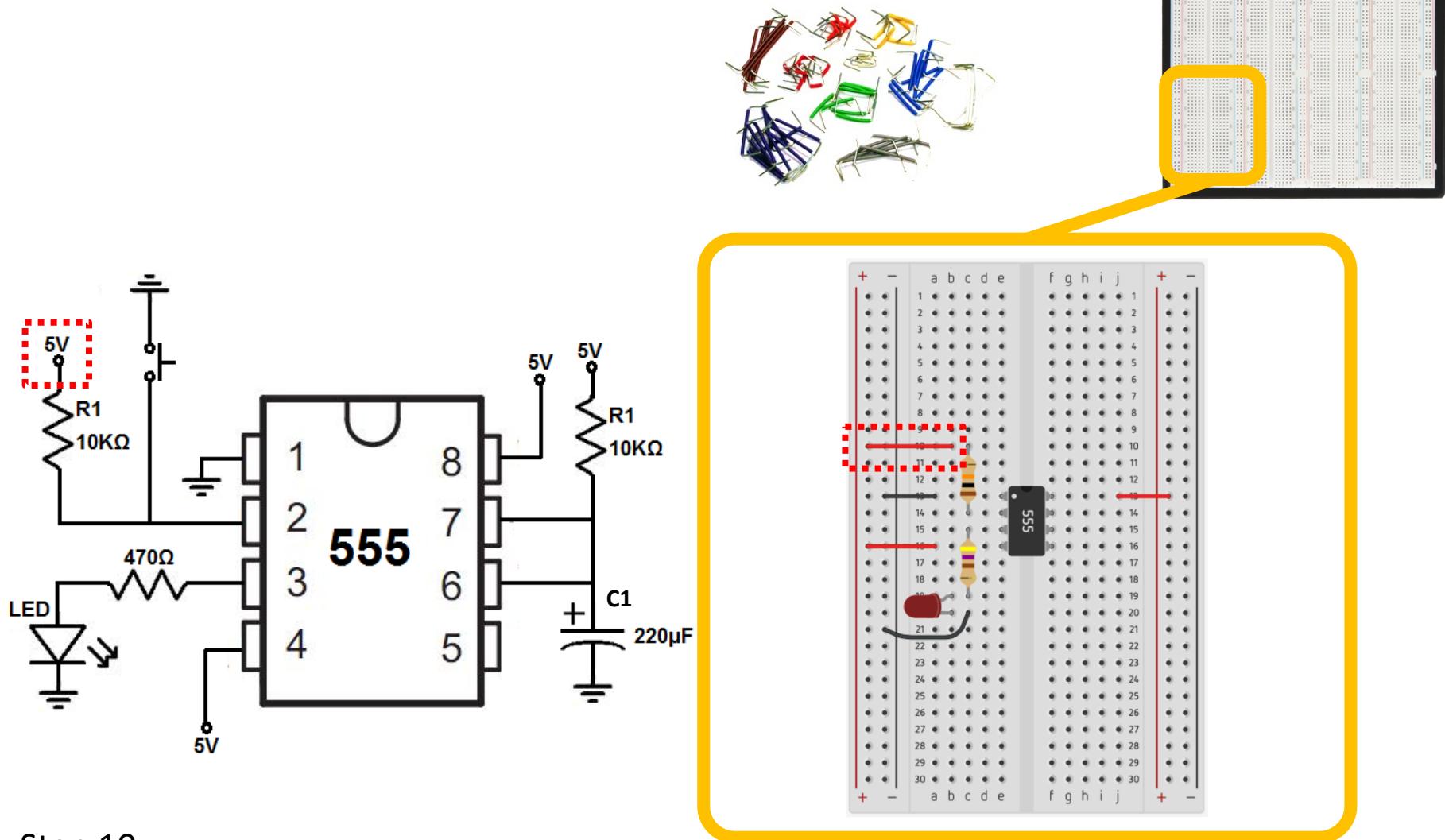


Step 09

91

Exercise 01 – Build Circuit

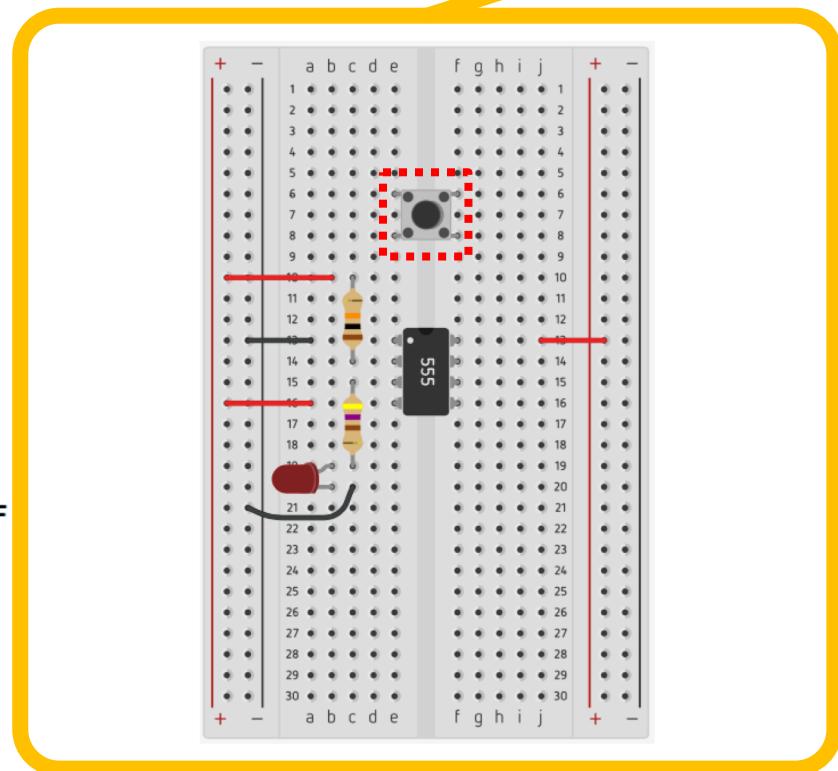
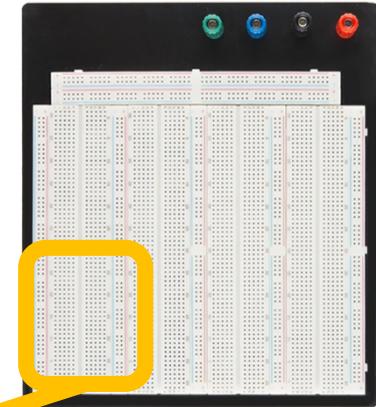
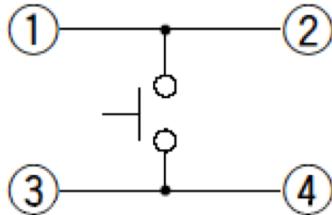
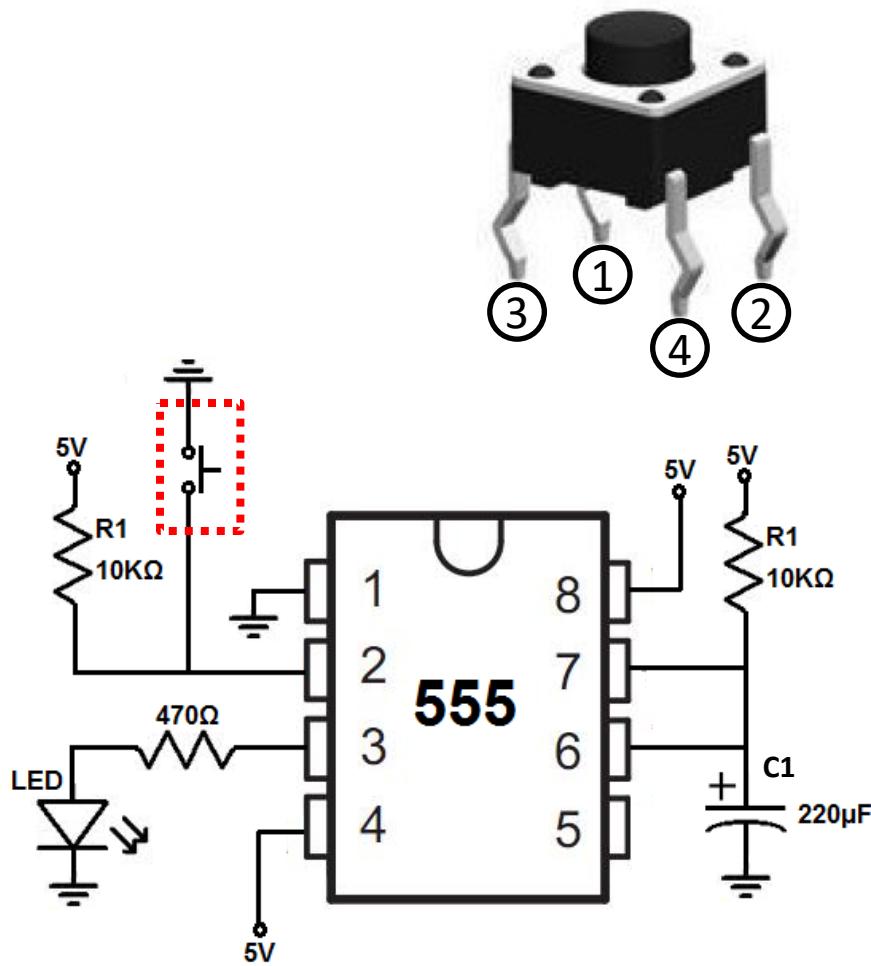
555 Monostable Timer Circuit



Step 10

Exercise 01 – Build Circuit

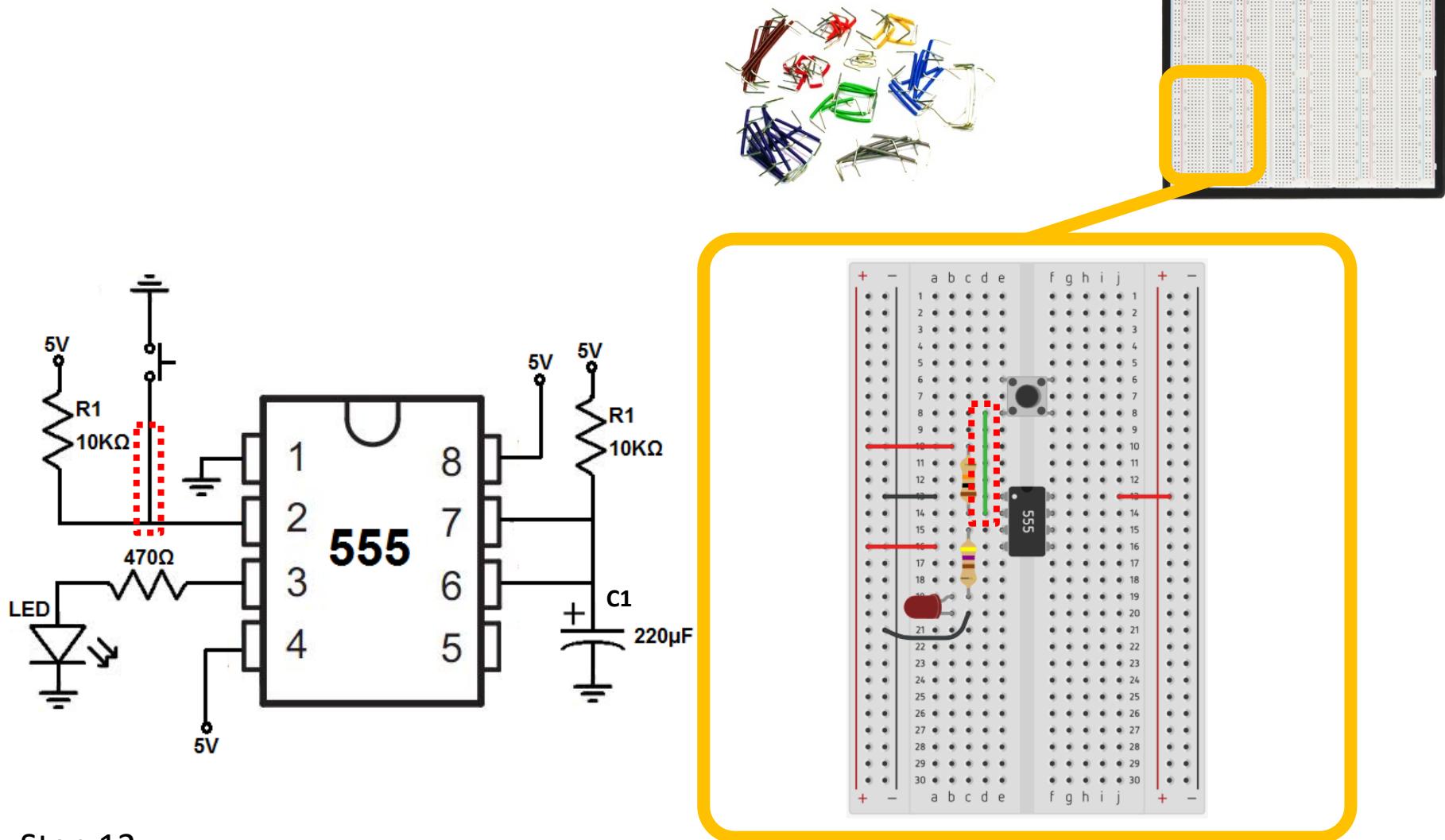
555 Monostable Timer Circuit



Step 11

Exercise 01 – Build Circuit

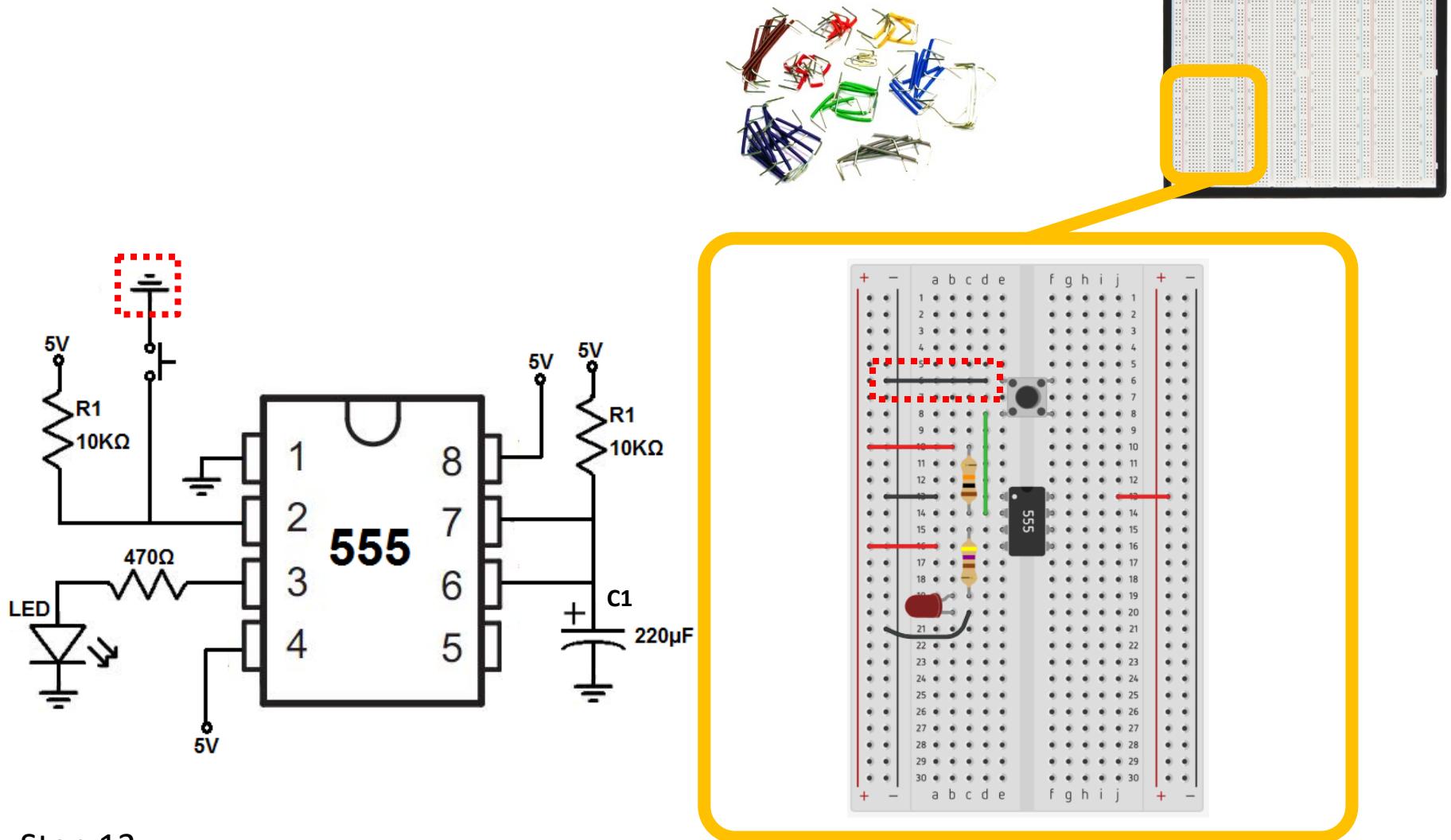
555 Monostable Timer Circuit



Step 12

Exercise 01 – Build Circuit

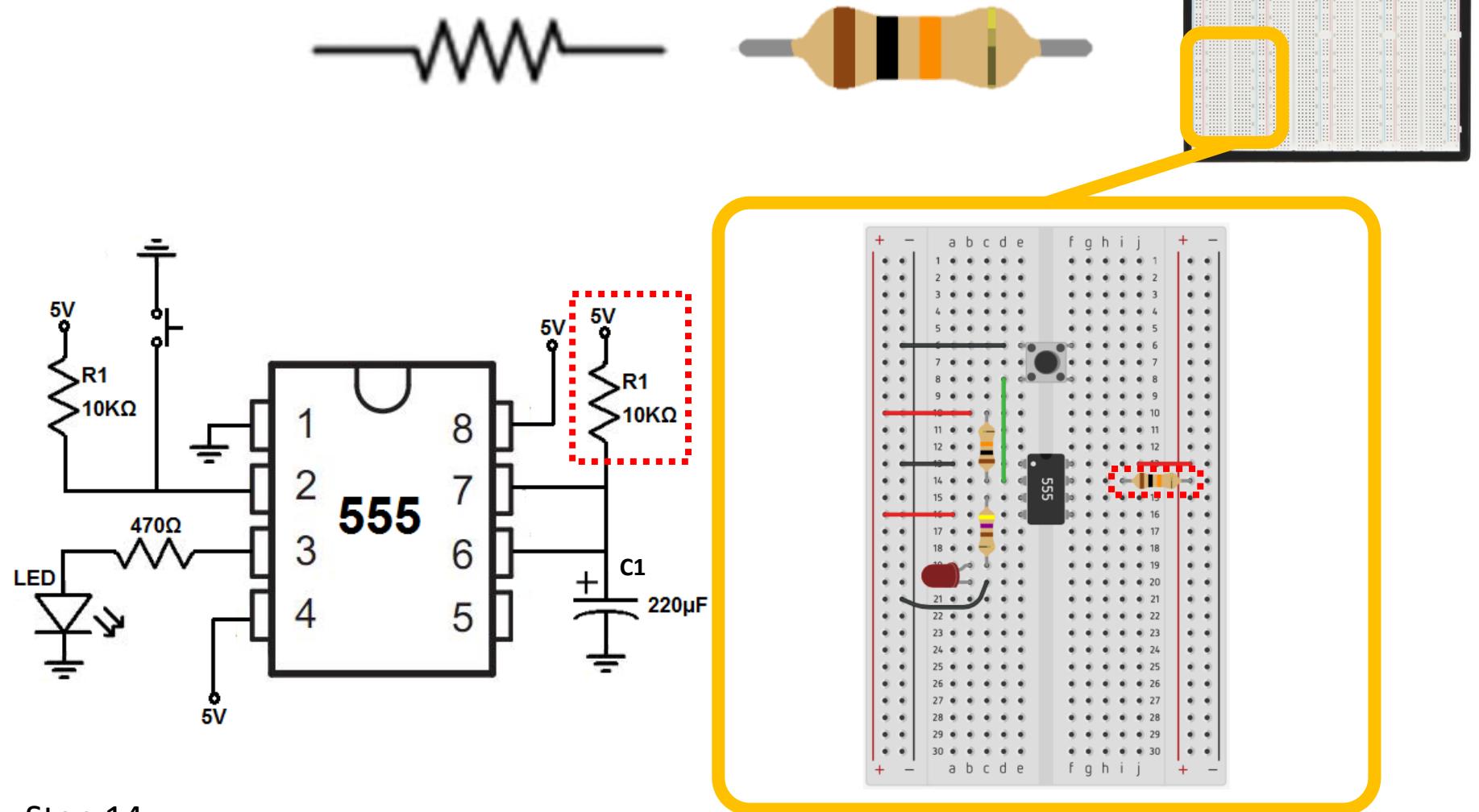
555 Monostable Timer Circuit



Step 13

Exercise 01 – Build Circuit

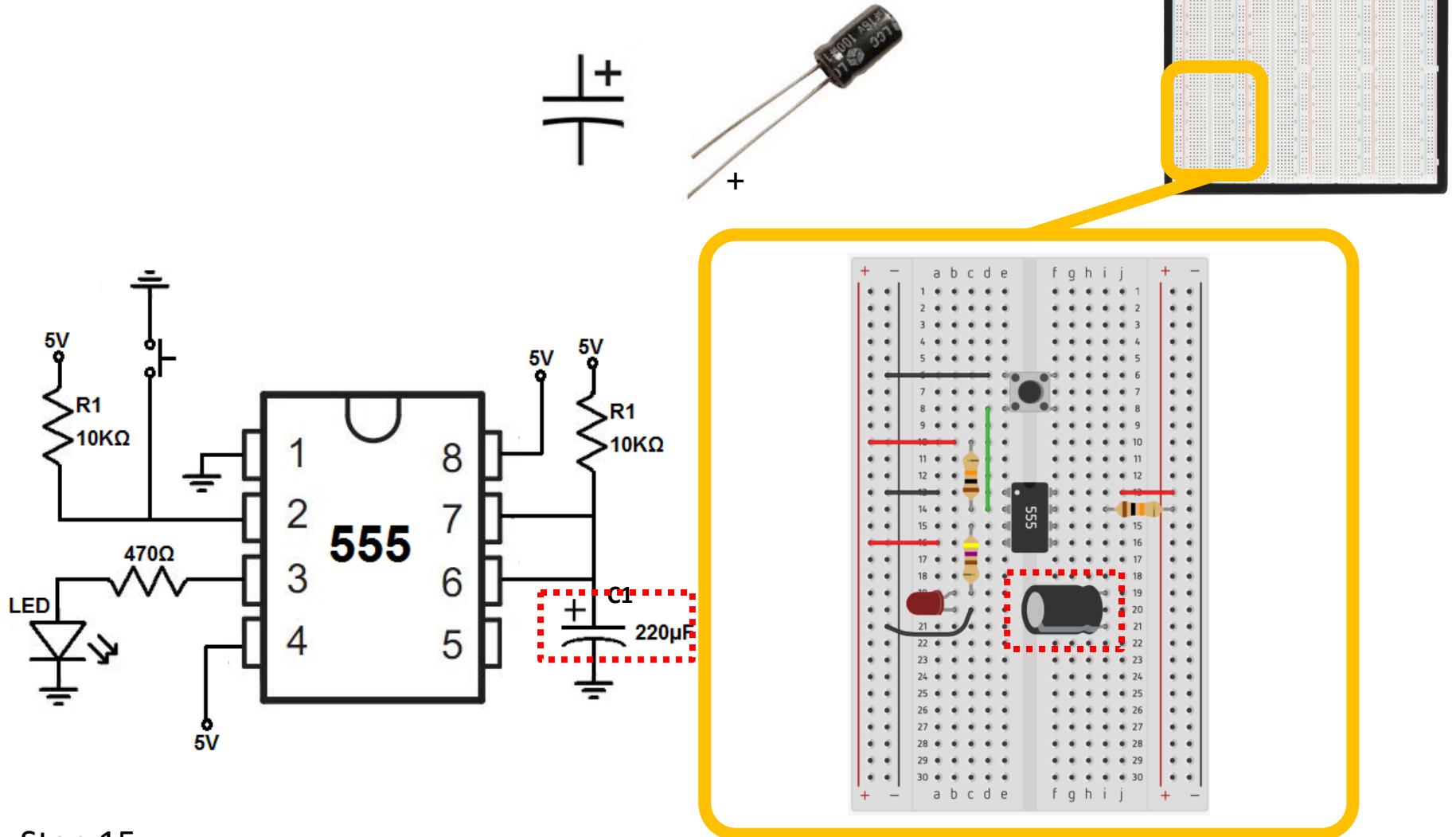
555 Monostable Timer Circuit



Step 14

Exercise 01 – Build Circuit

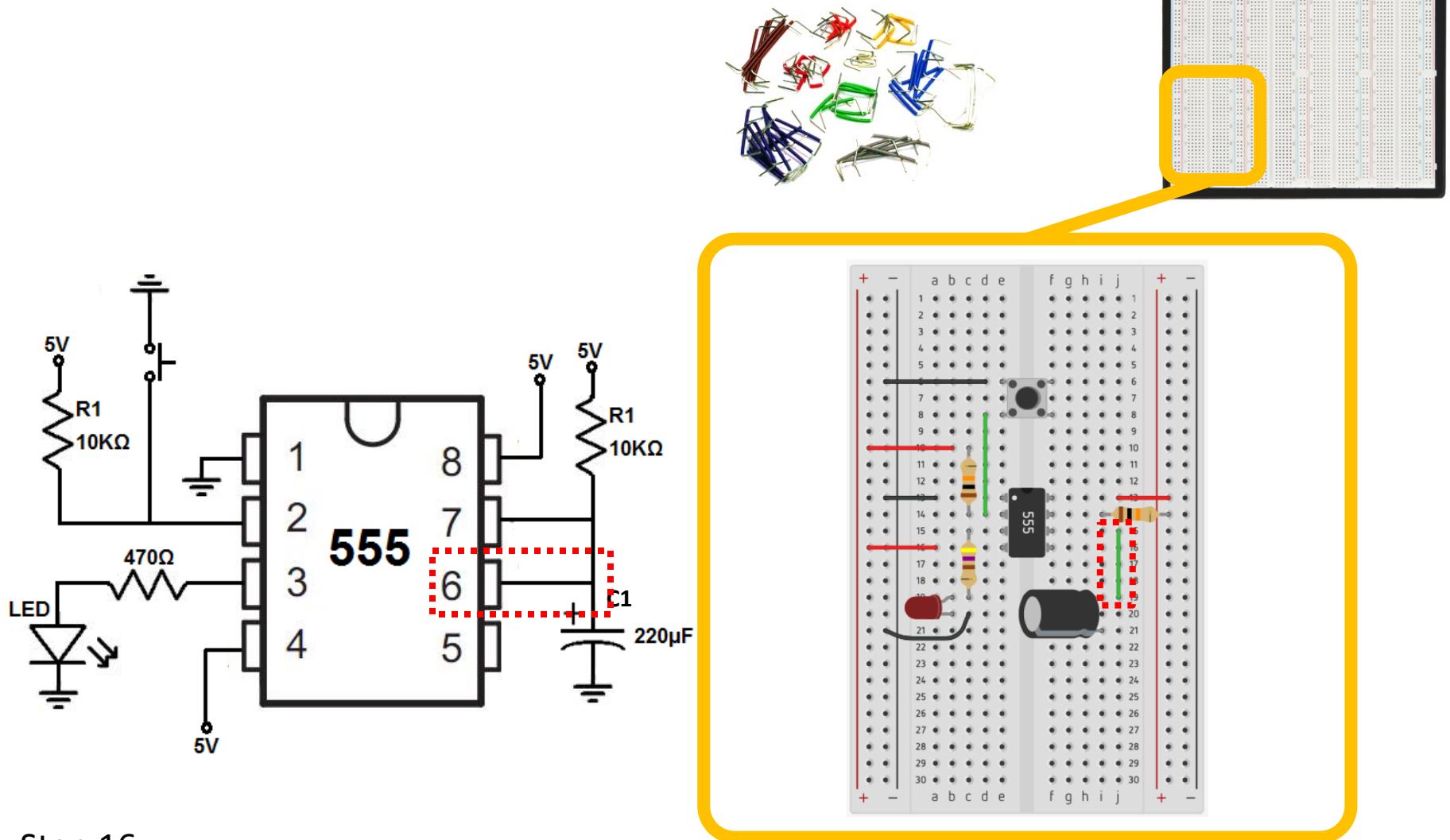
555 Monostable Timer Circuit



Step 15

Exercise 01 – Build Circuit

555 Monostable Timer Circuit

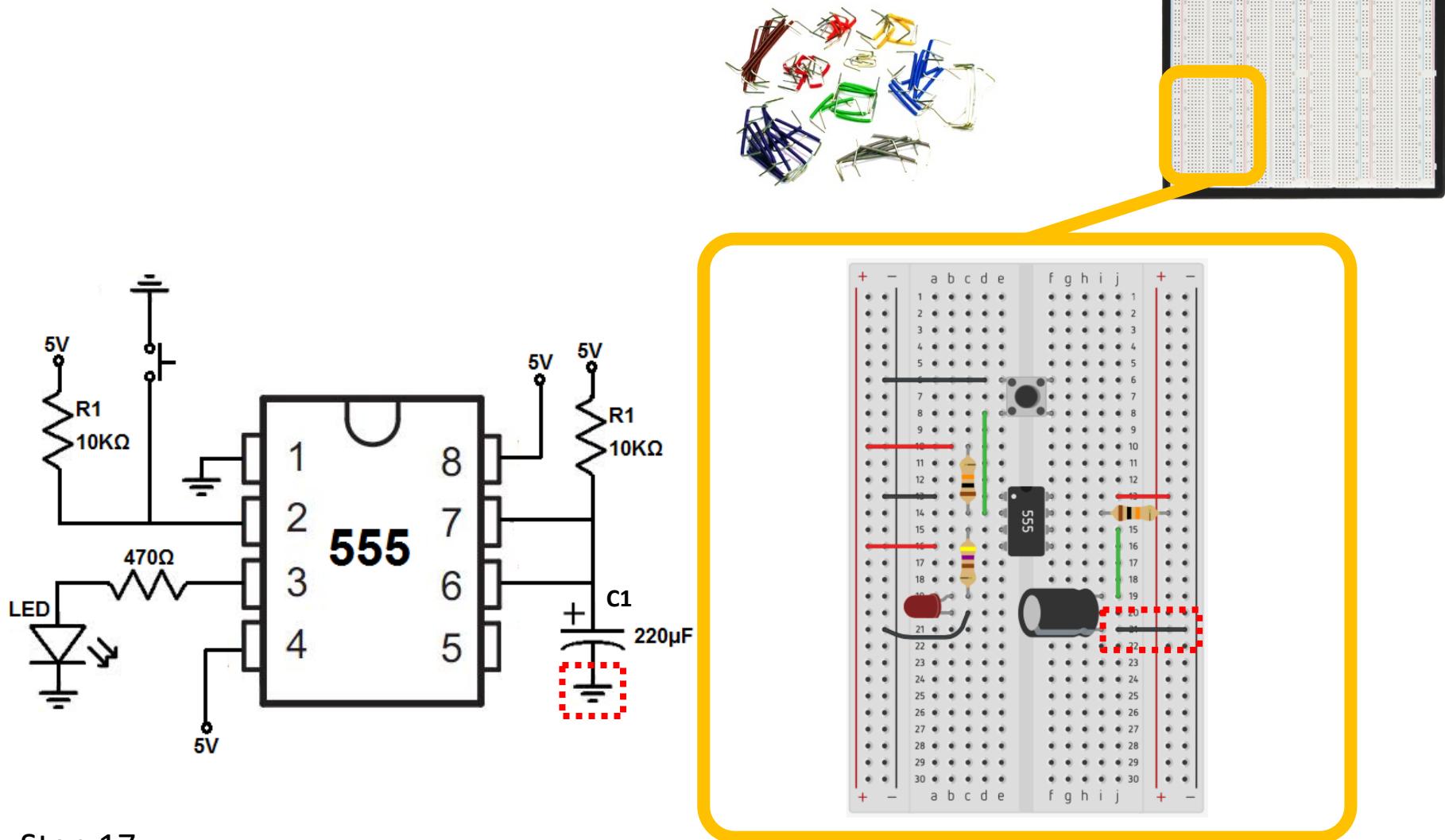


Step 16

98

Exercise 01 – Build Circuit

555 Monostable Timer Circuit

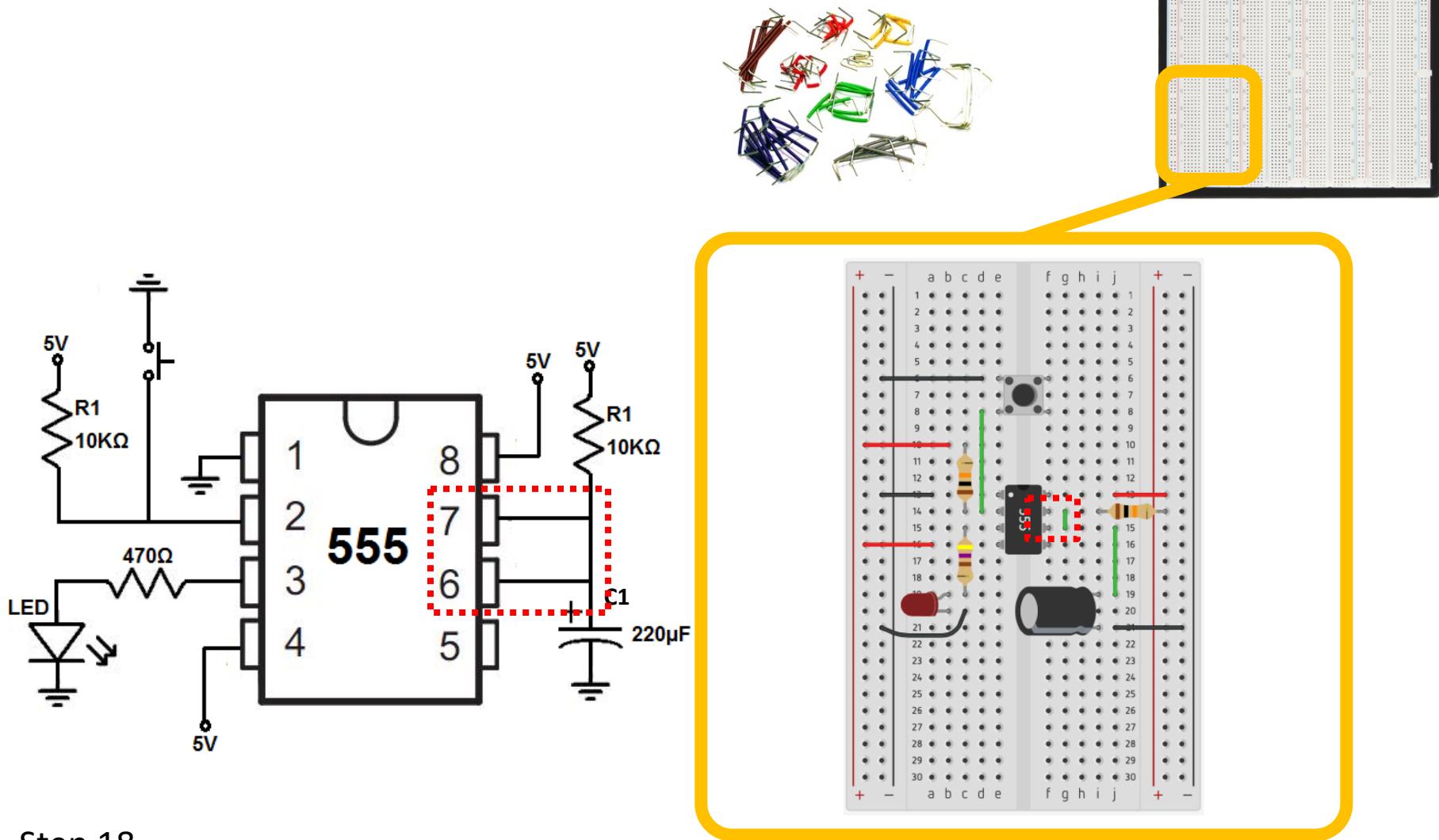


Step 17

99

Exercise 01 – Build Circuit

555 Monostable Timer Circuit



Step 18

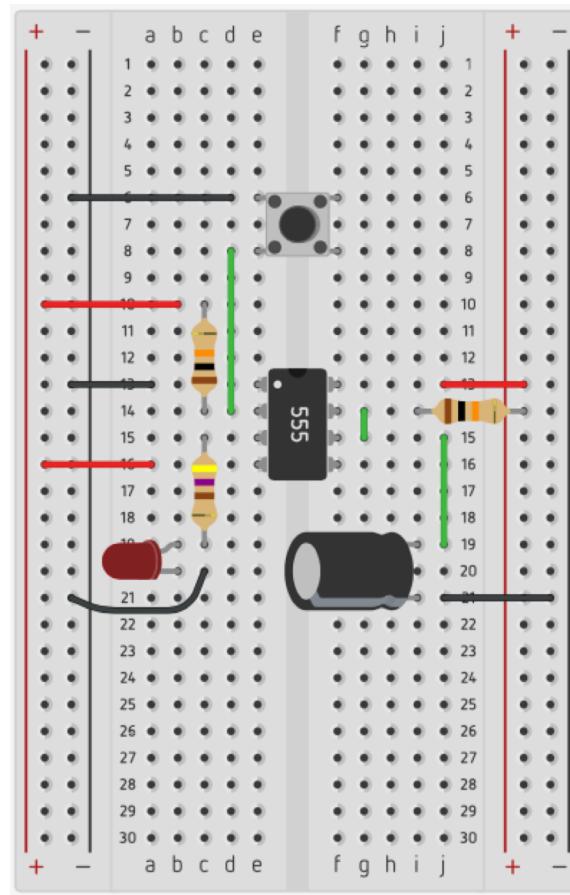
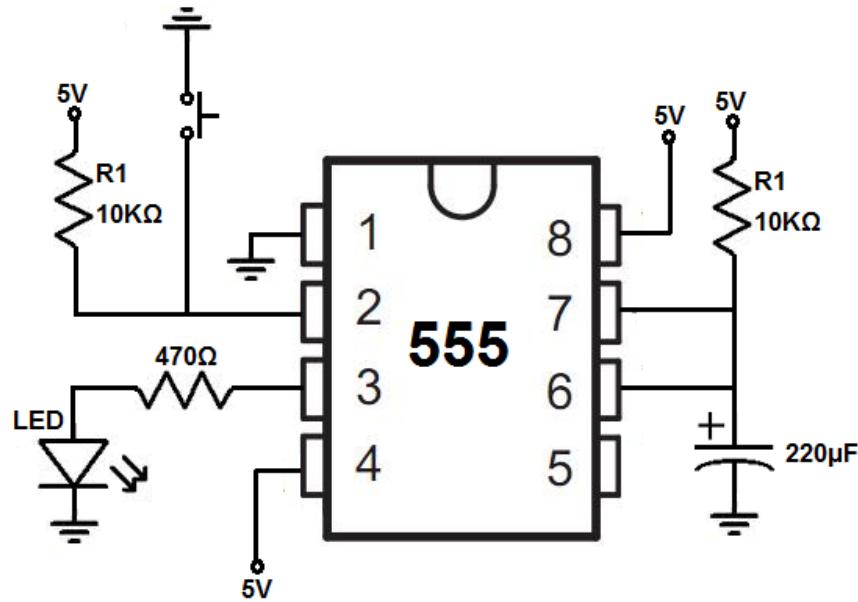
Teaching Plan

	15 Mins	=====
1	20 Mins - Presentation	Introduction
	20 Mins - Presentation & Demo	Part 01 : Build Your First Circuit
	20 Mins - Exercise 01	Components , Connection ,Breadboard
2	15 Mins - Presentation & Demo	Part 02 : How to make it work
	15 Mins - Exercise 02	Your Circuit, Power Supply, Multimeter
	10 Mins - Take a Break	=====
3	20 Mins - Presentation & Demo	Part 03 : Measure Signal Waveform
	30 Mins - Exercise 03	Your Circuit, Signal Generator, Oscilloscope
	15 Mins	=====

Part 02 – How to Make It Work

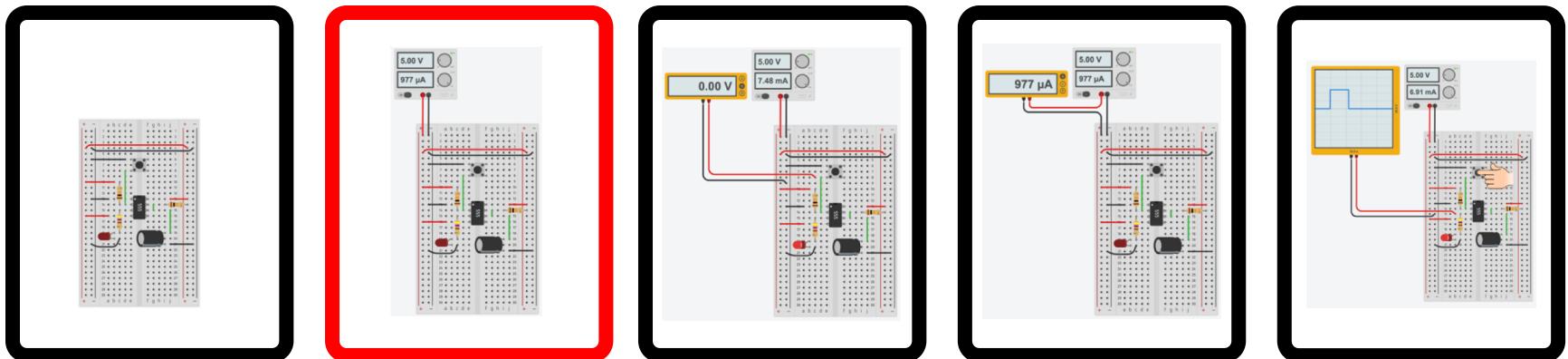
- Circuit, Power Supply, Multimeter
- Exercise 01

Here is Your Circuit



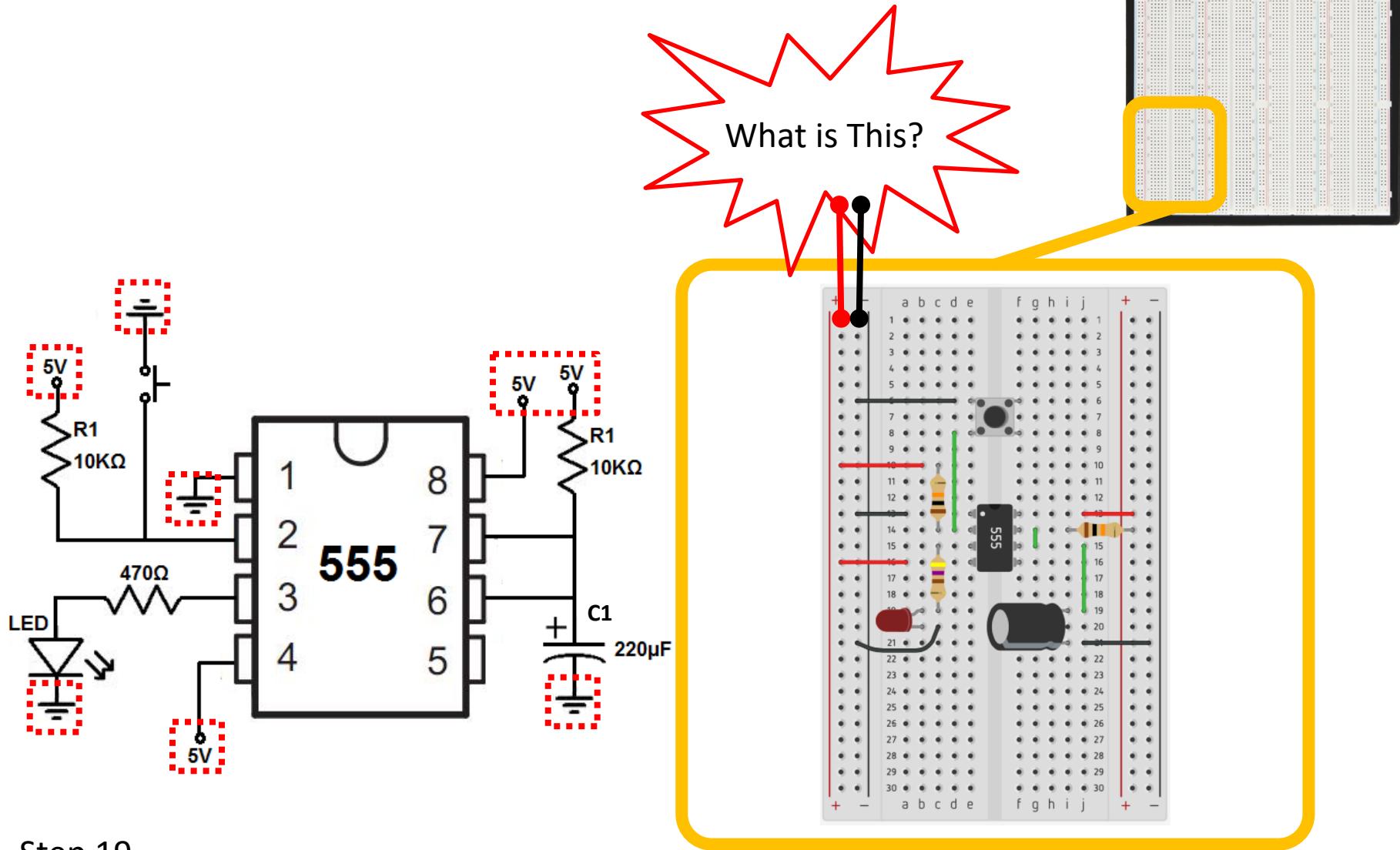
Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform



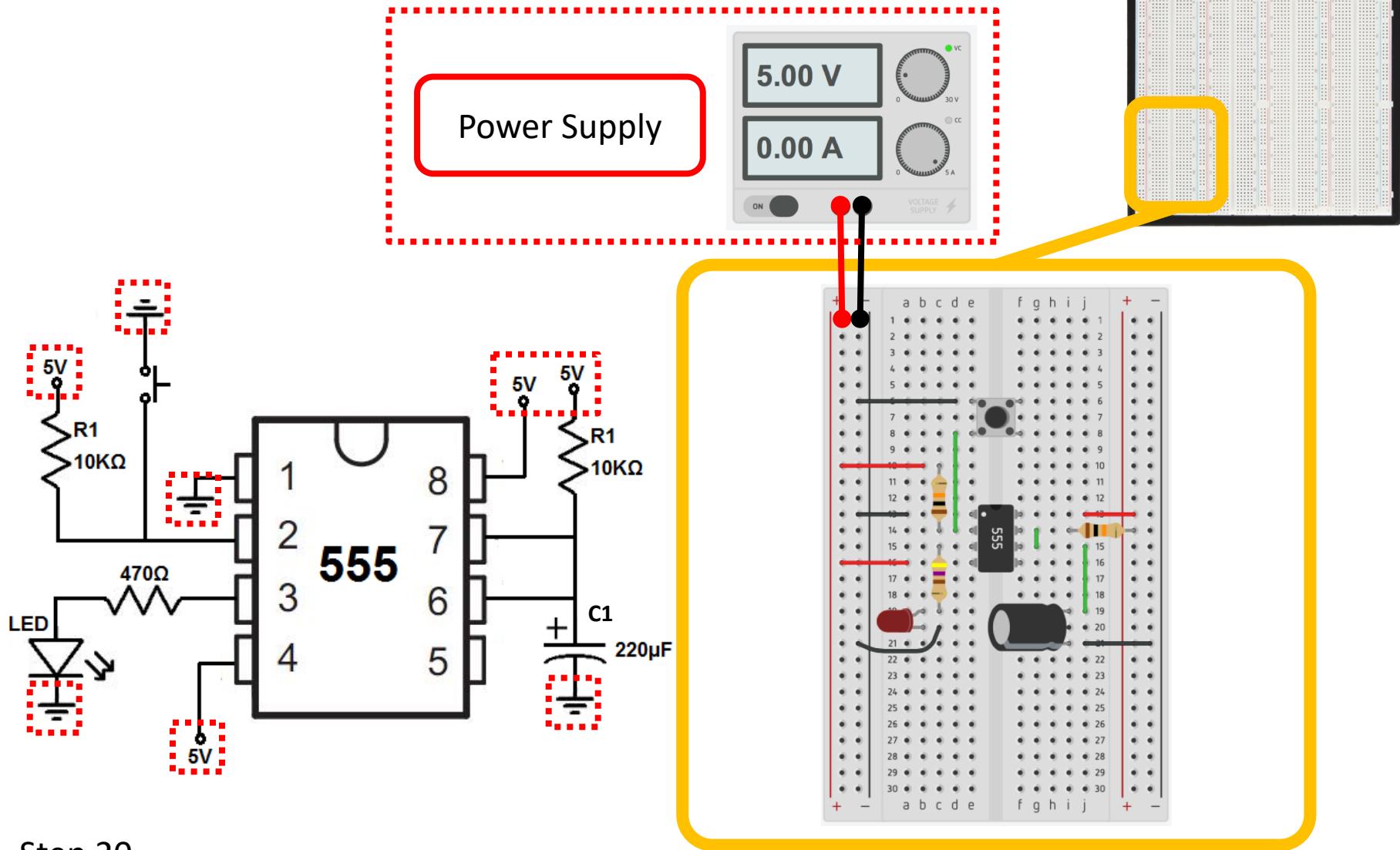
Exercise 01 – Power Supply

555 Monostable Timer Circuit



Exercise 01 – Power Supply

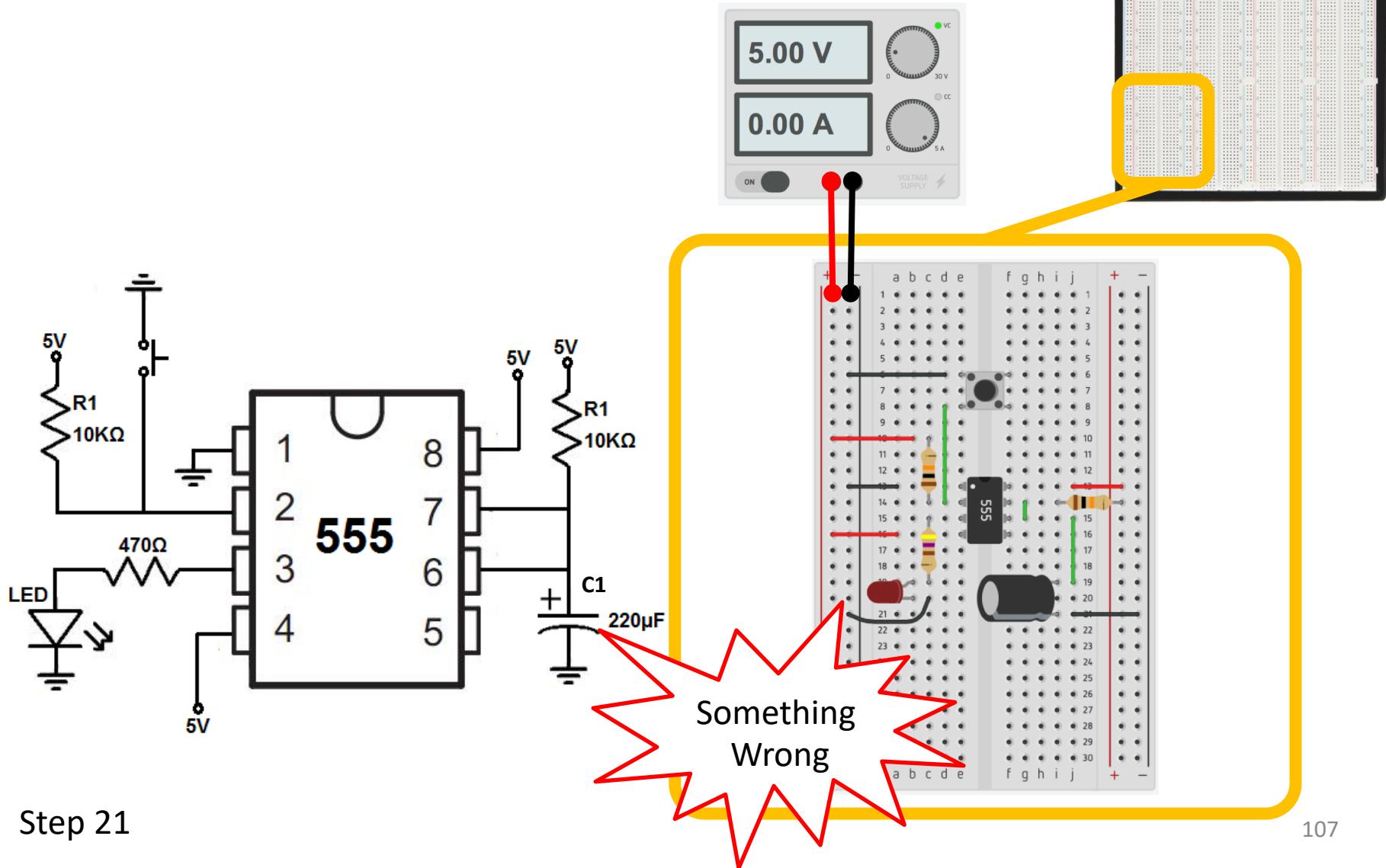
555 Monostable Timer Circuit



Step 20

Exercise 01 – Power Supply

555 Monostable Timer Circuit

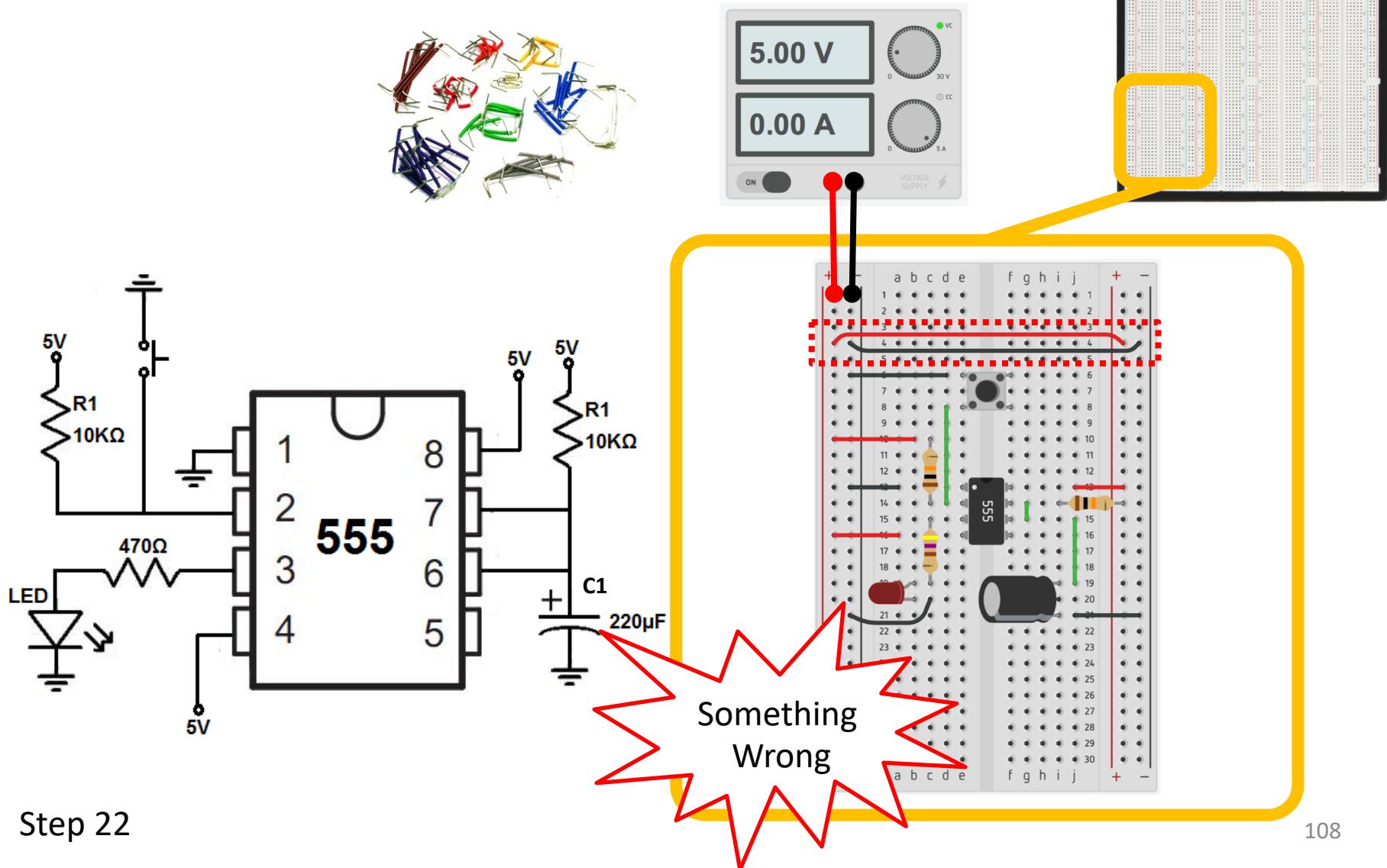


Step 21

107

Exercise 01 – Power Supply

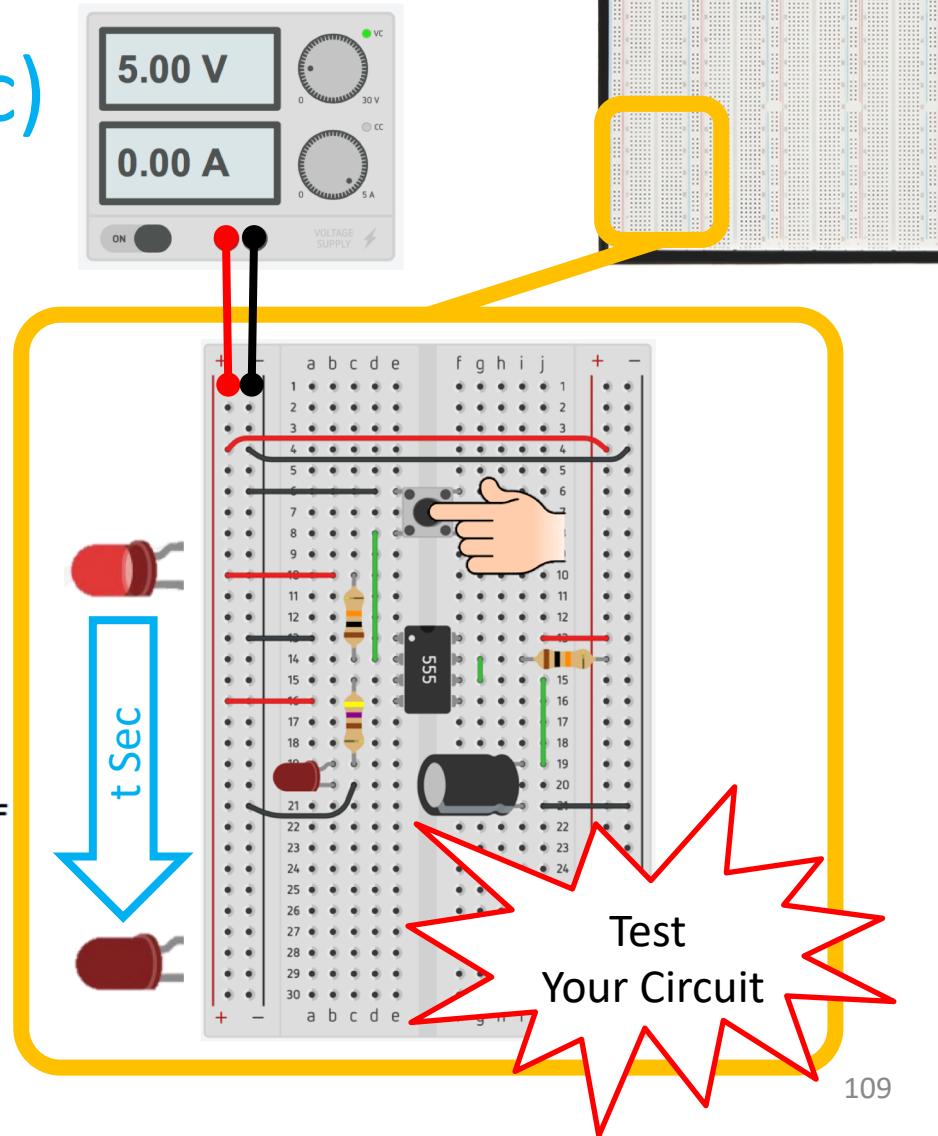
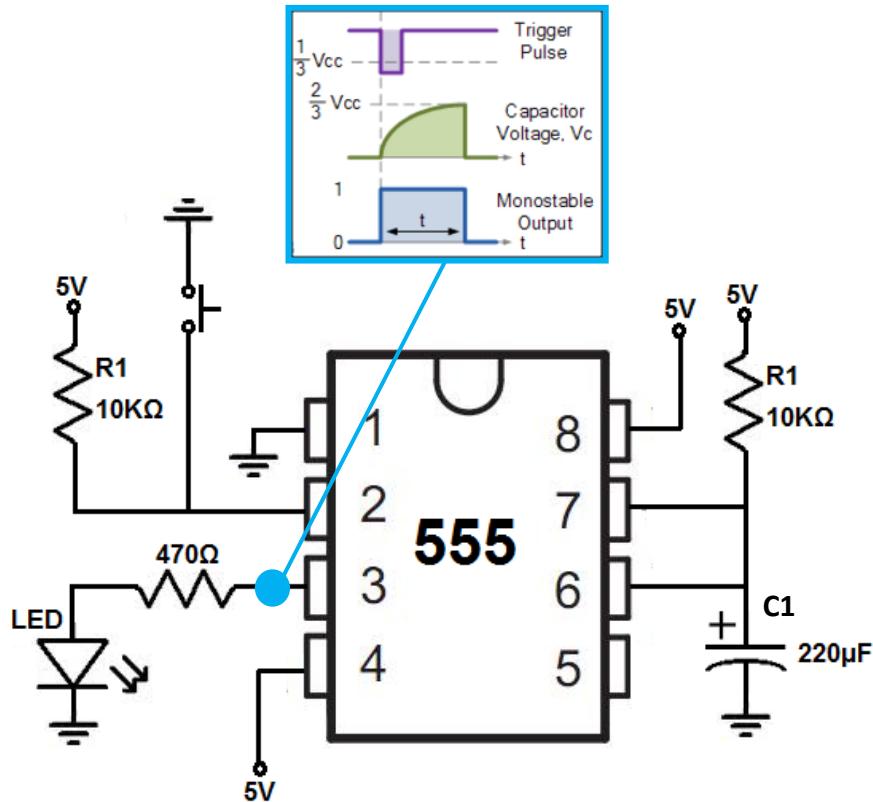
555 Monostable Timer Circuit



Exercise 01 – Power Supply

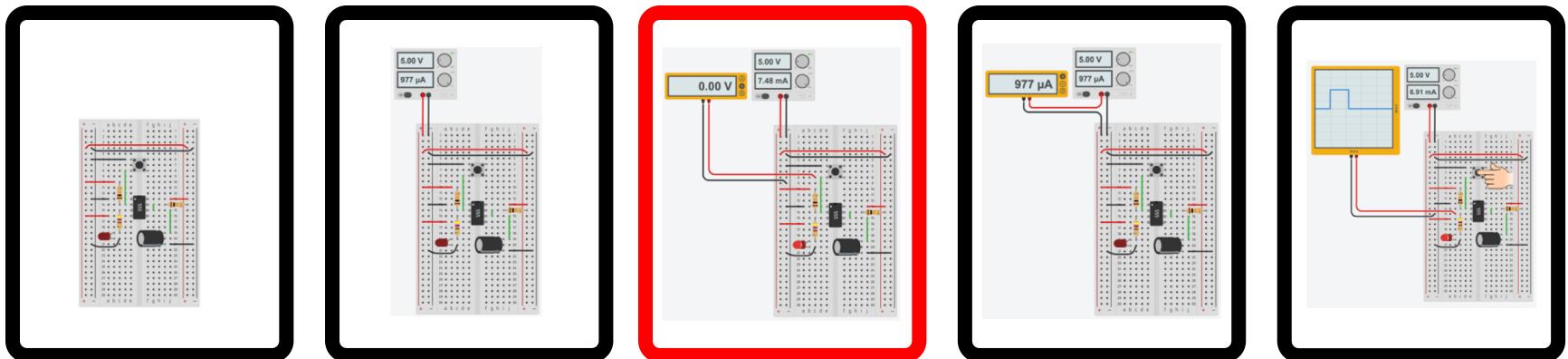
555 Monostable Timer Circuit

$$t = 1.1 \times R1 \times C1 \text{ (Sec)}$$



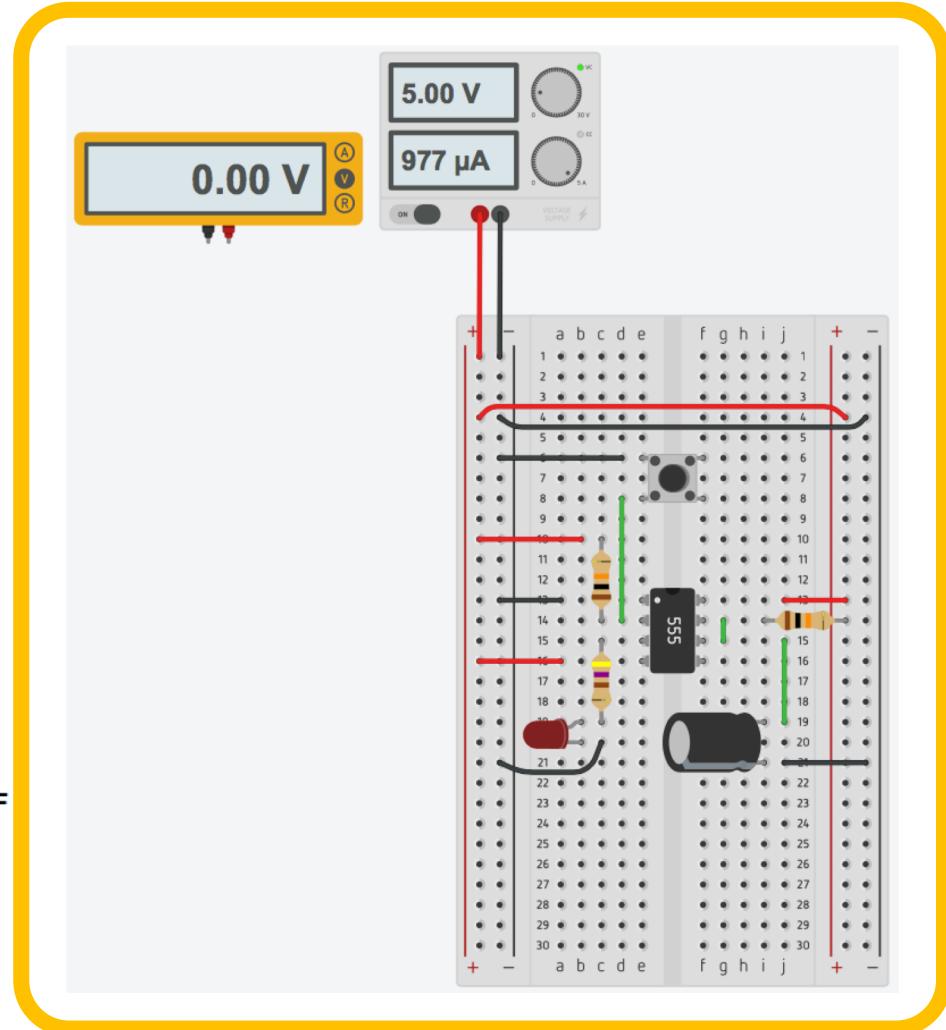
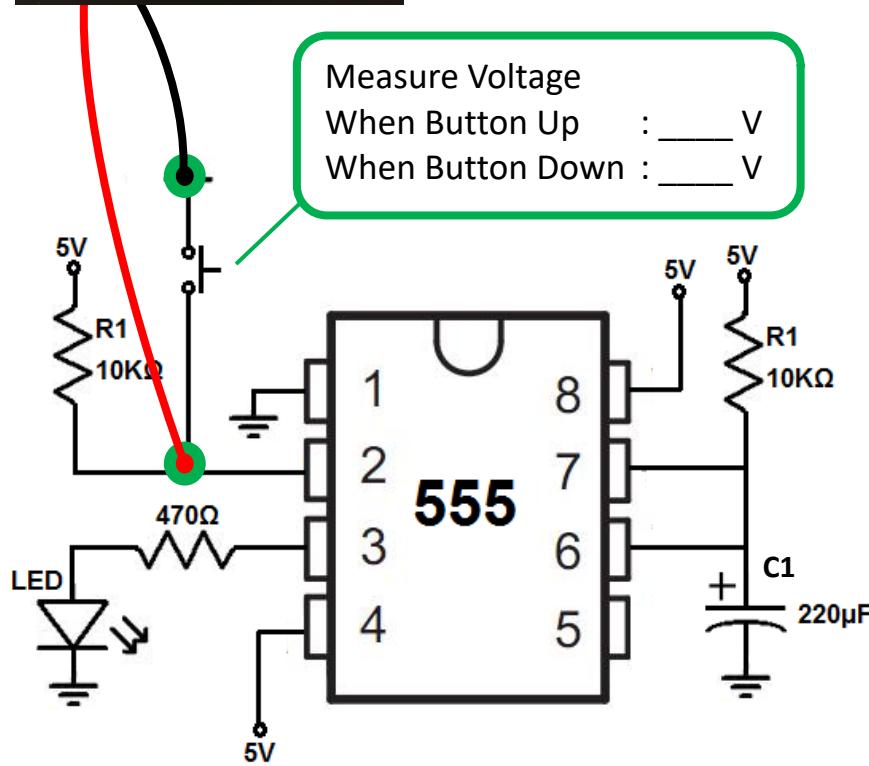
Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform

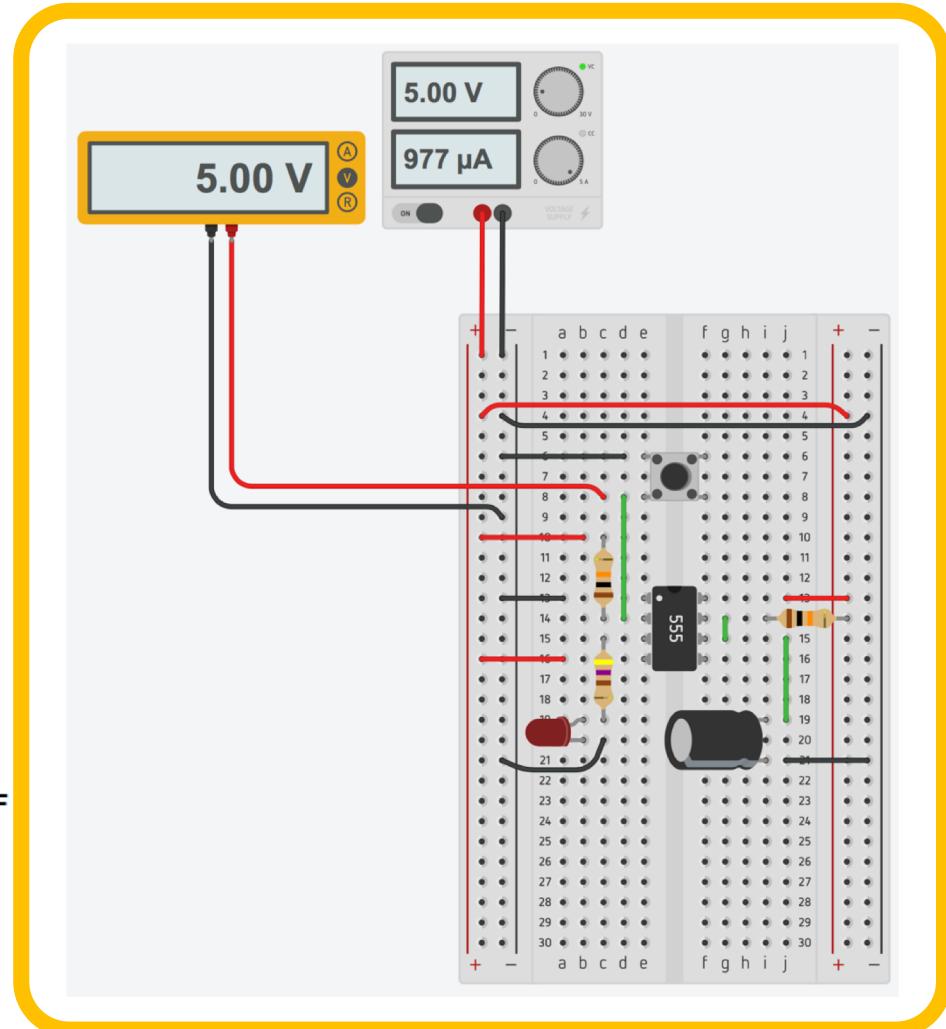
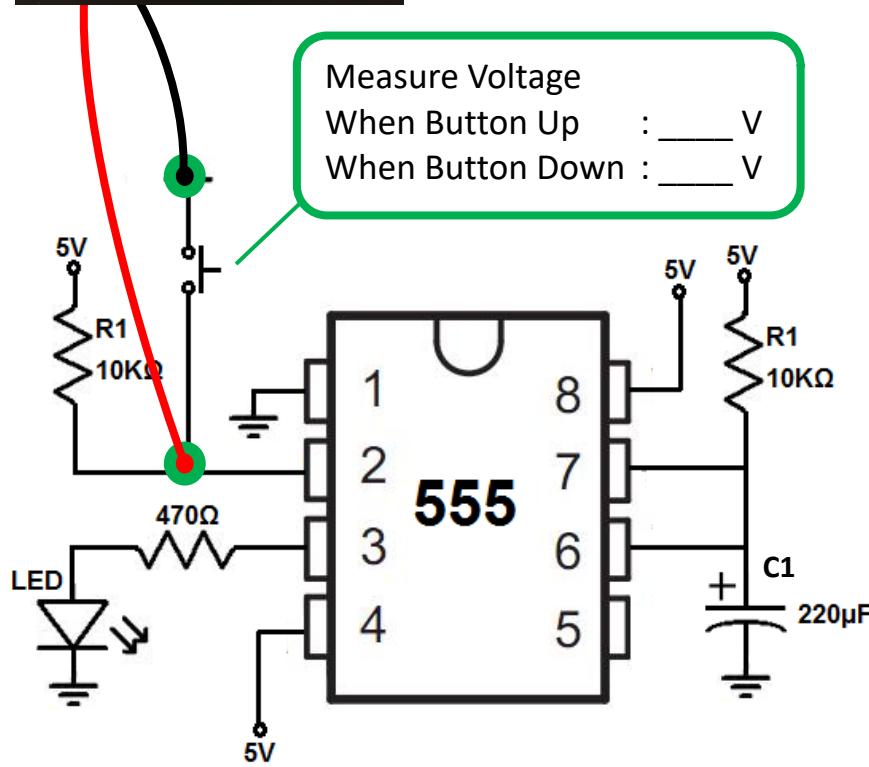


Exercise 01 – Measure Voltage

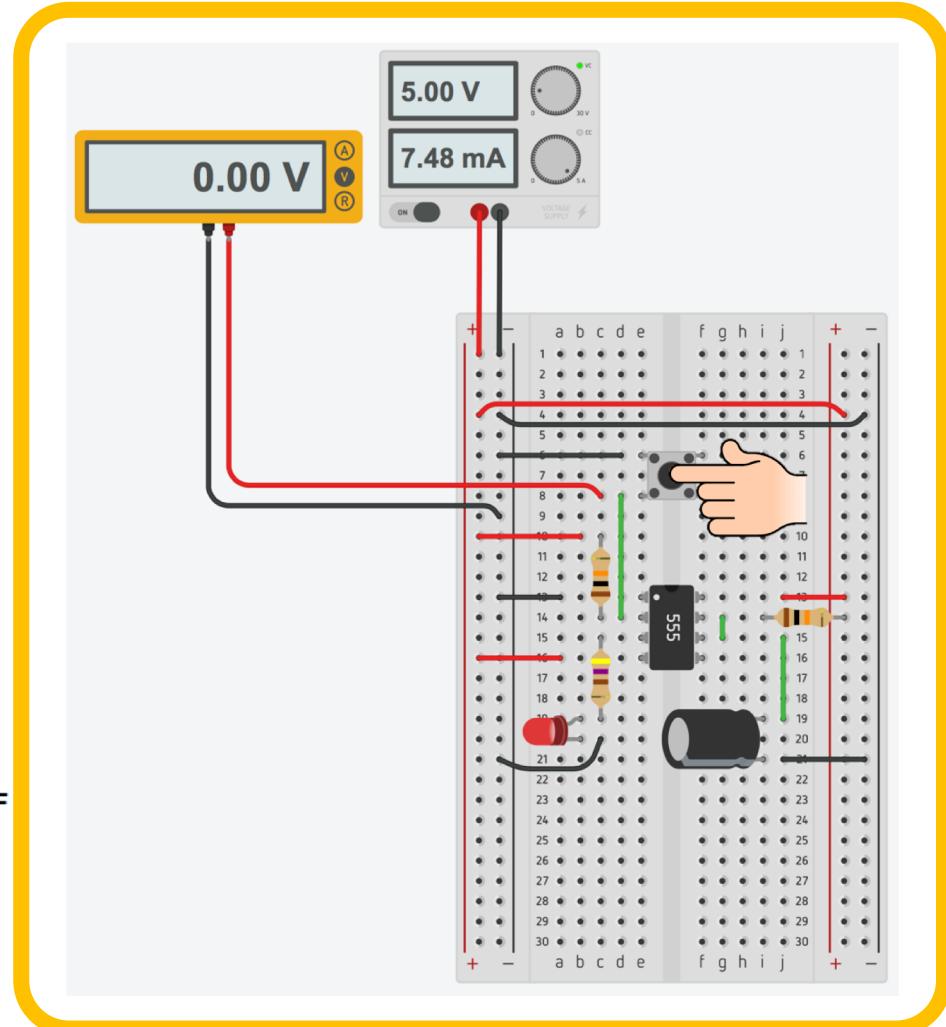
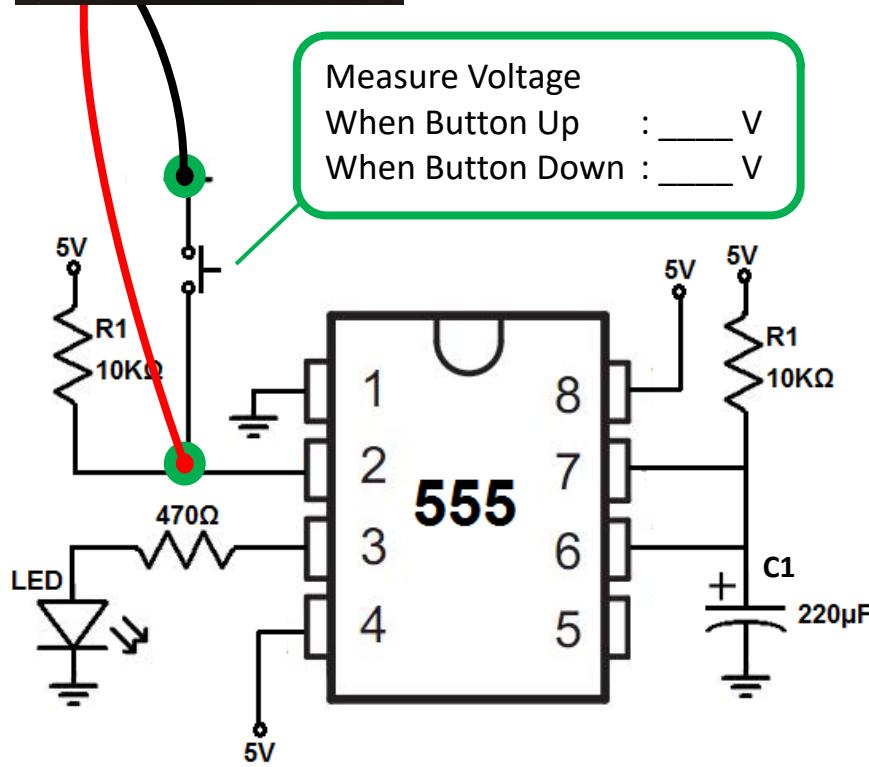
555 Monostable Timer Circuit



Exercise 01 – Measure Voltage 555 Monostable Timer Circuit

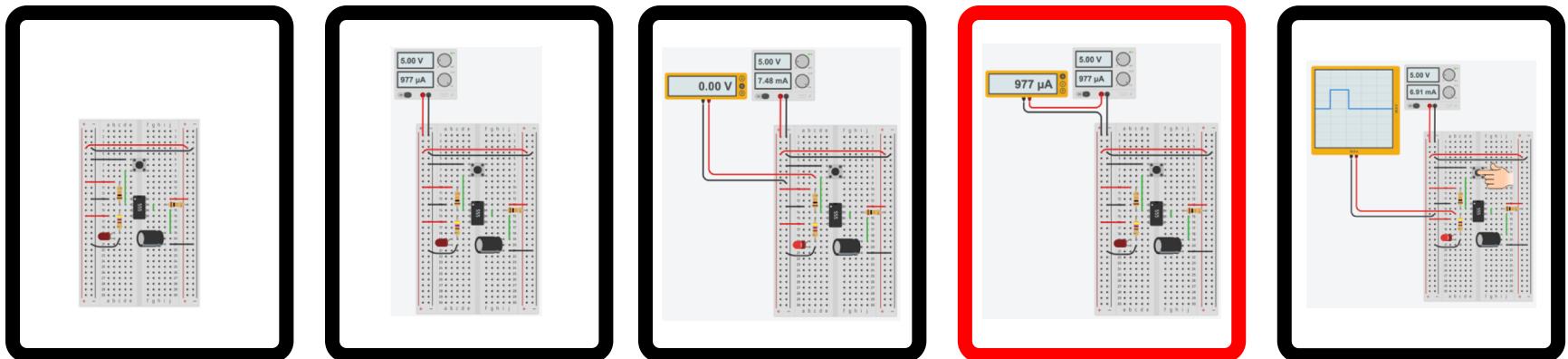


Exercise 01 – Measure Voltage 555 Monostable Timer Circuit



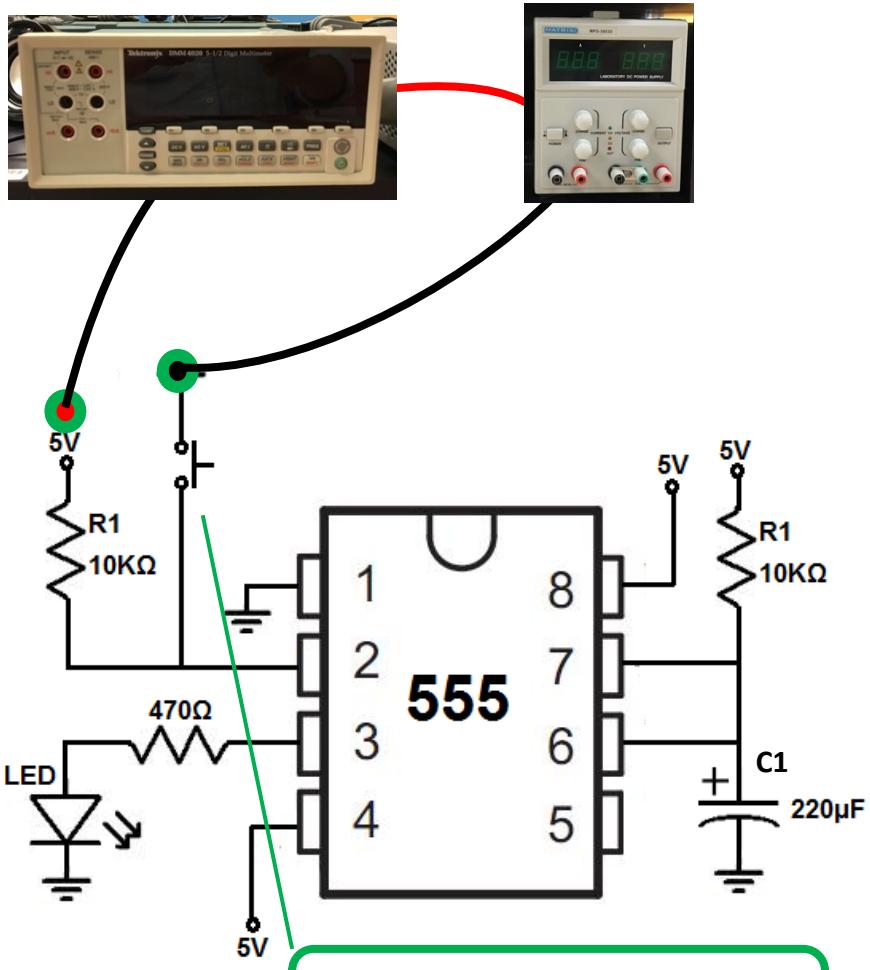
Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform

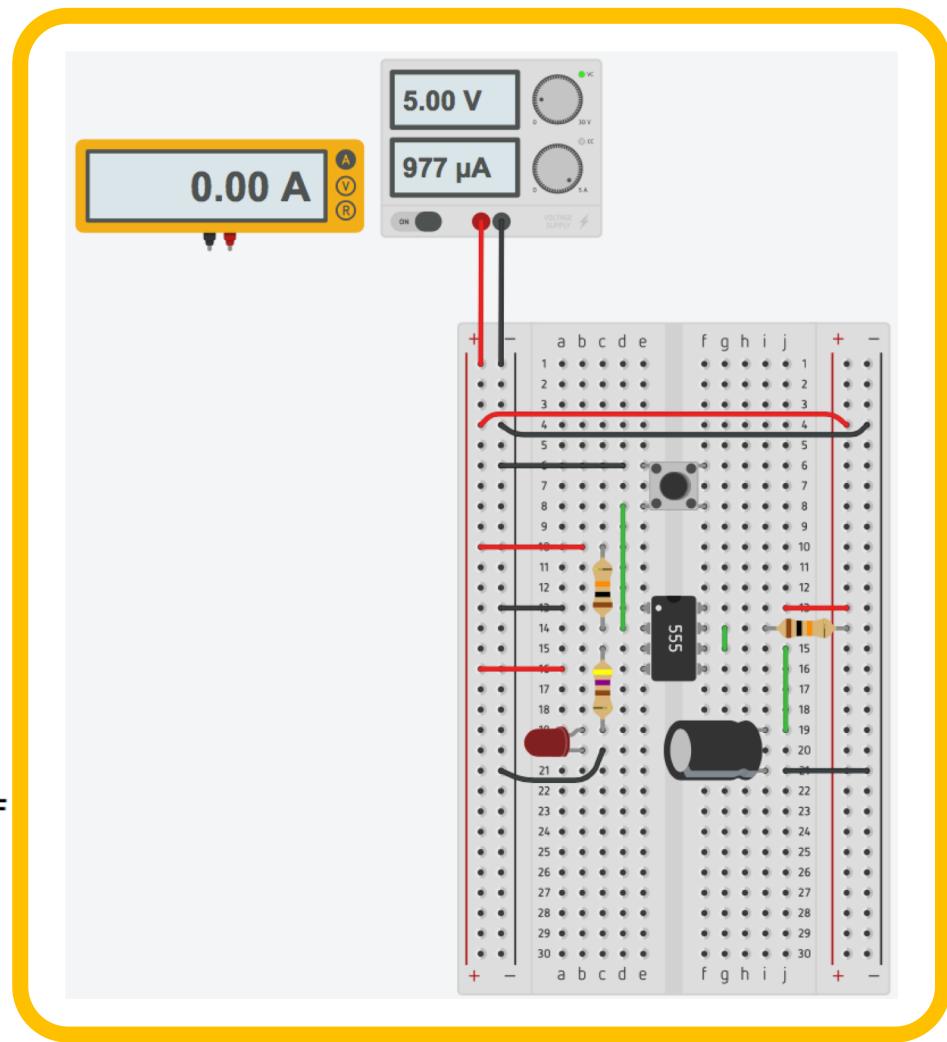


Exercise 01 – Measure Current

555 Monostable Timer Circuit

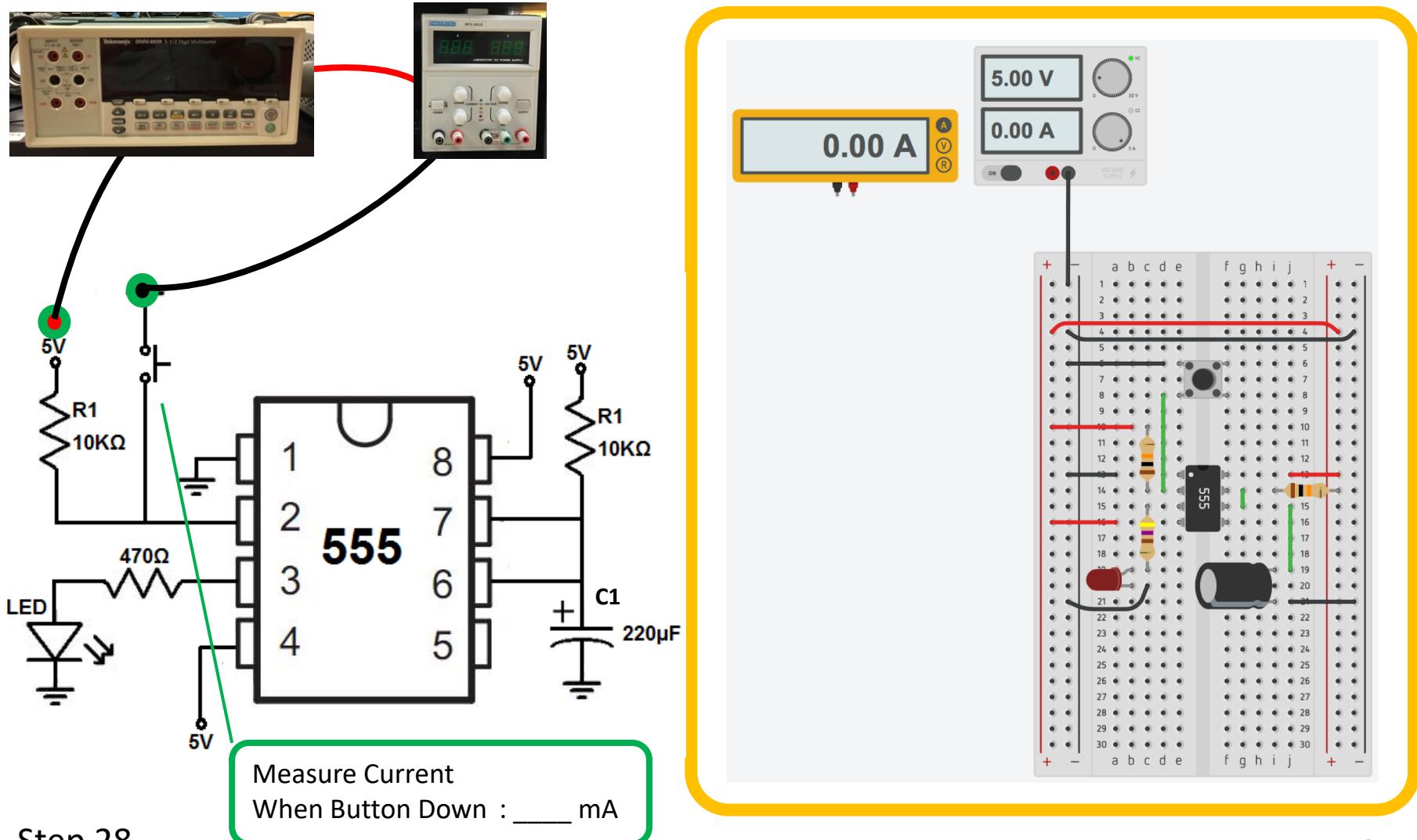


Step 27



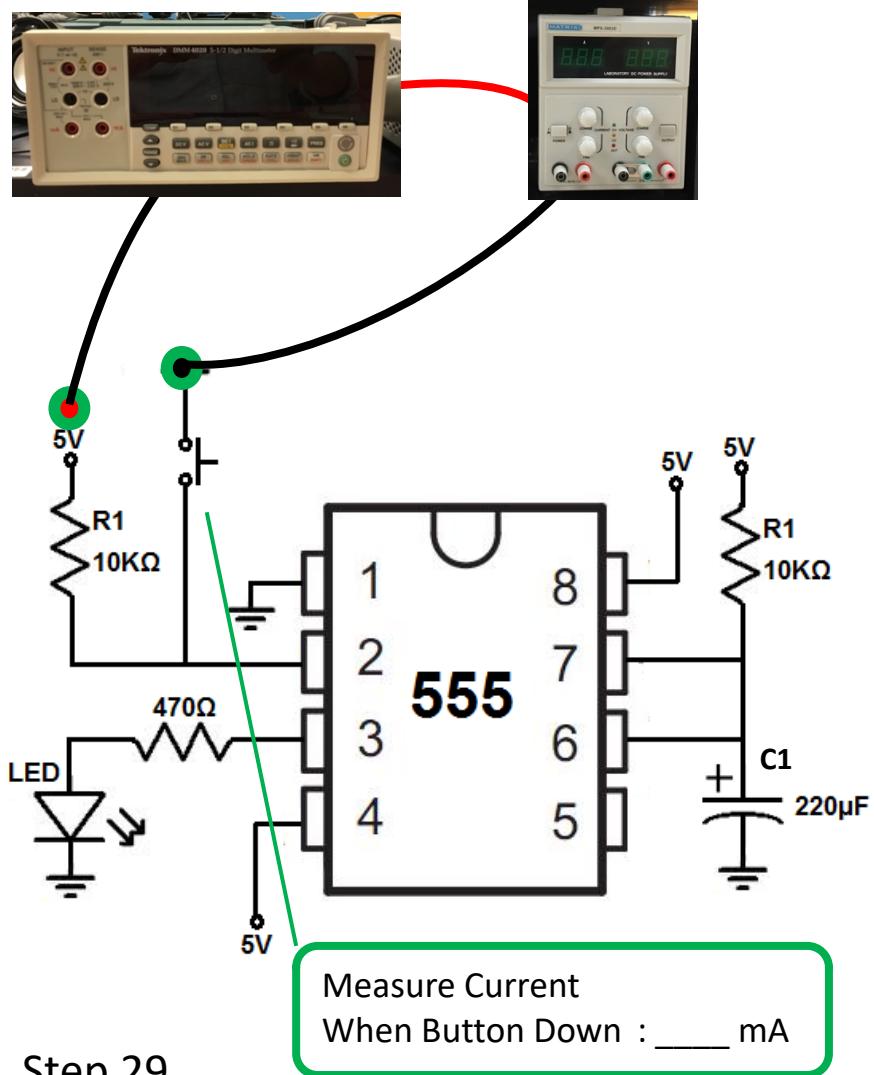
Exercise 01 – Measure Current

555 Monostable Timer Circuit

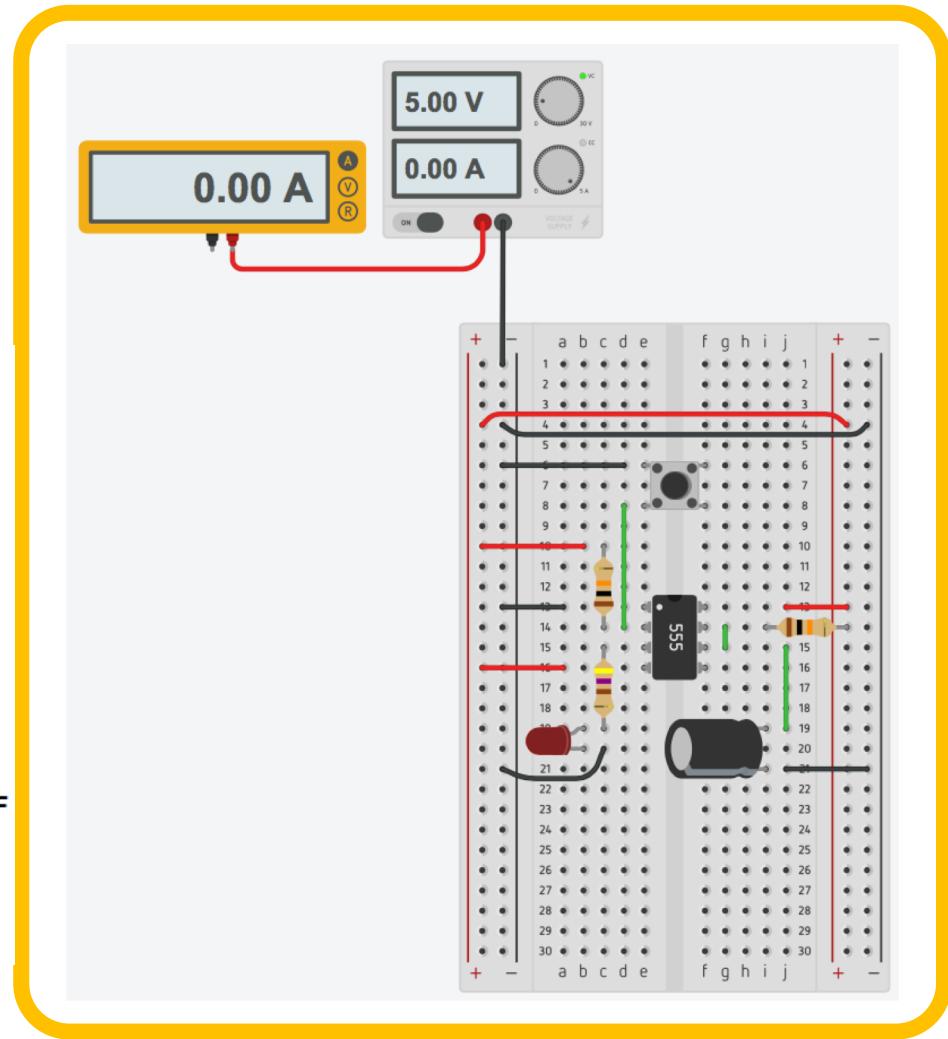


Exercise 01 – Measure Current

555 Monostable Timer Circuit

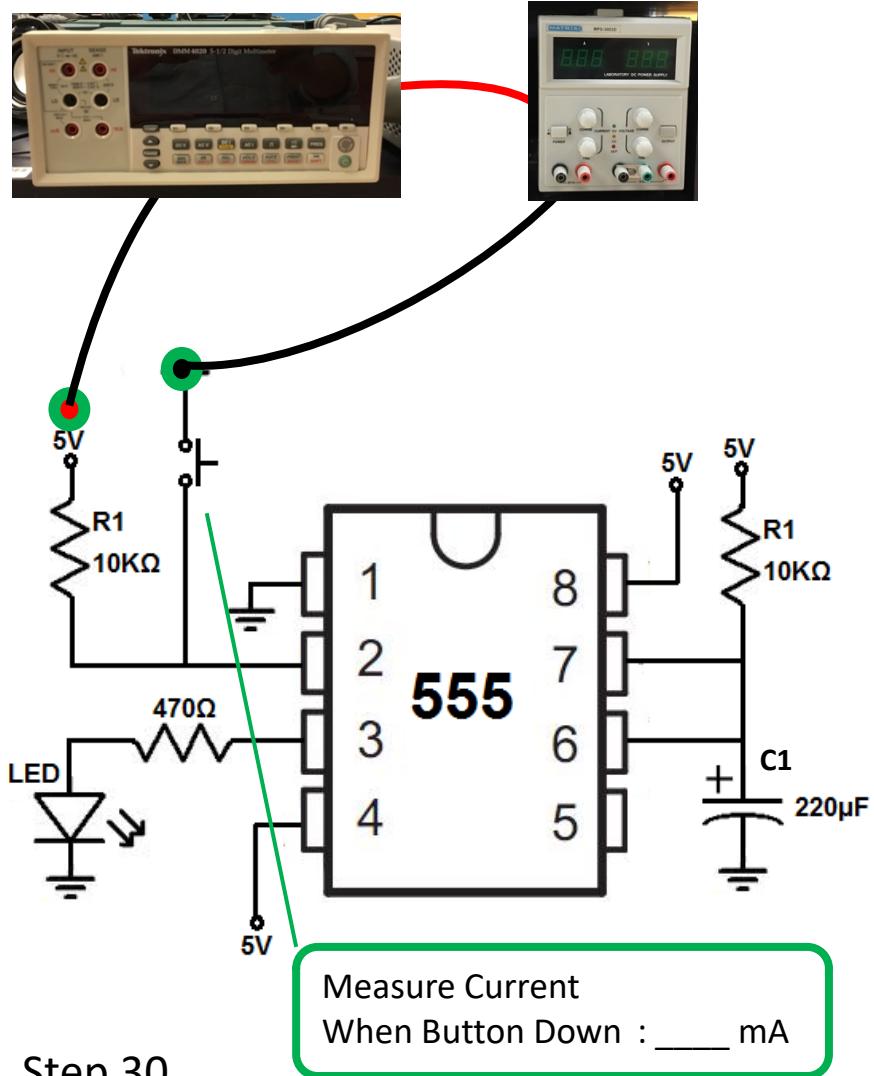


Step 29

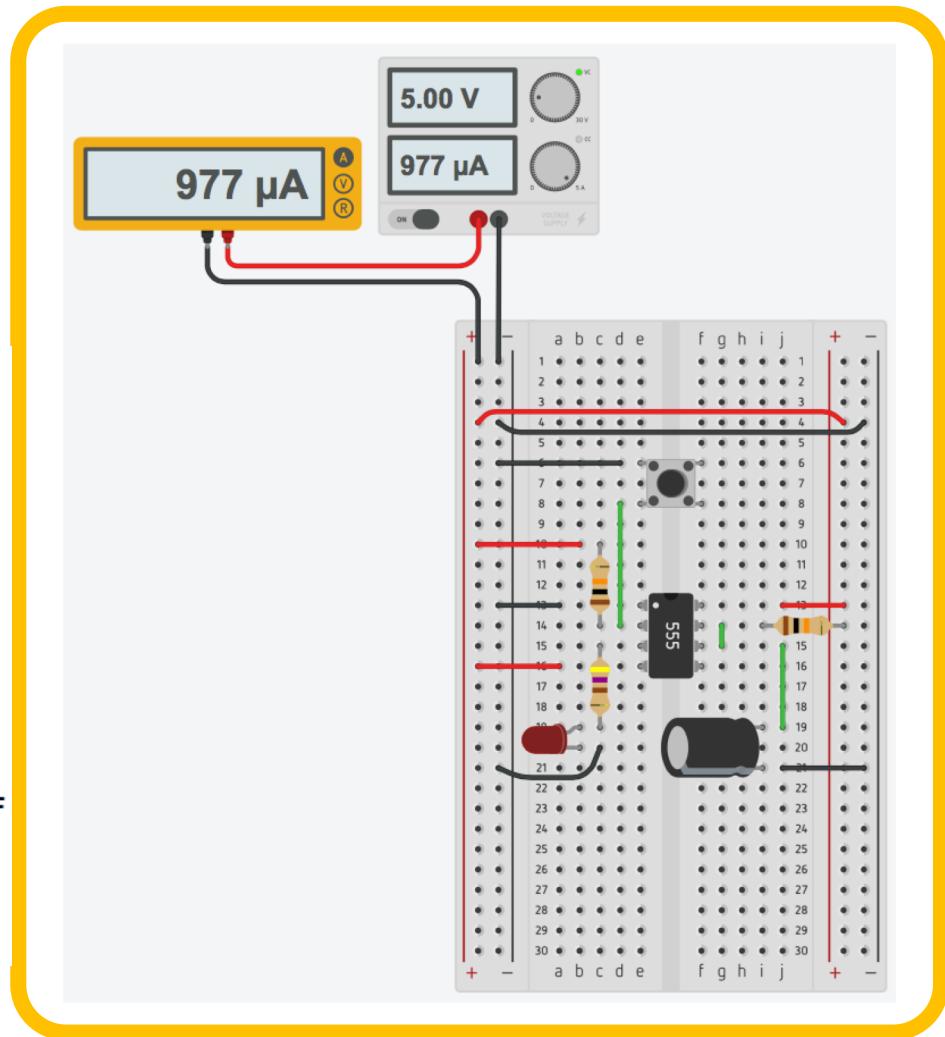


Exercise 01 – Measure Current

555 Monostable Timer Circuit



Step 30





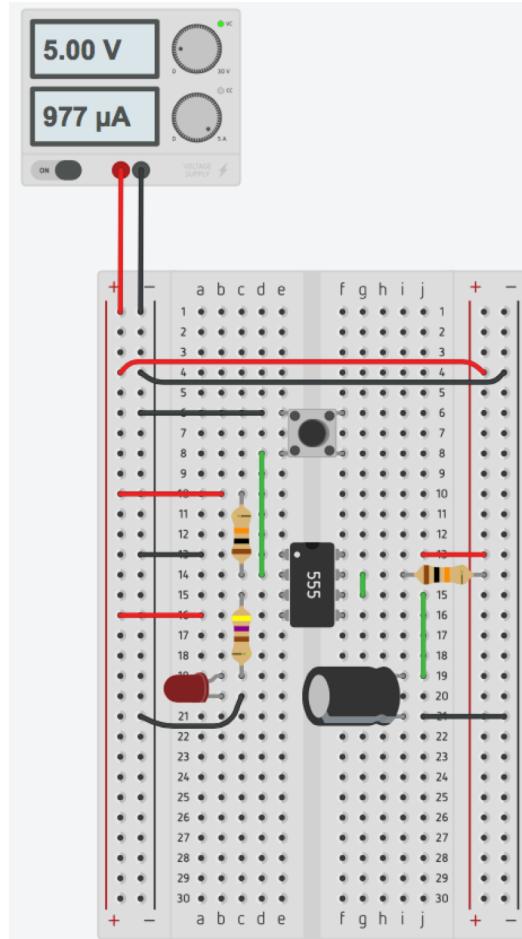
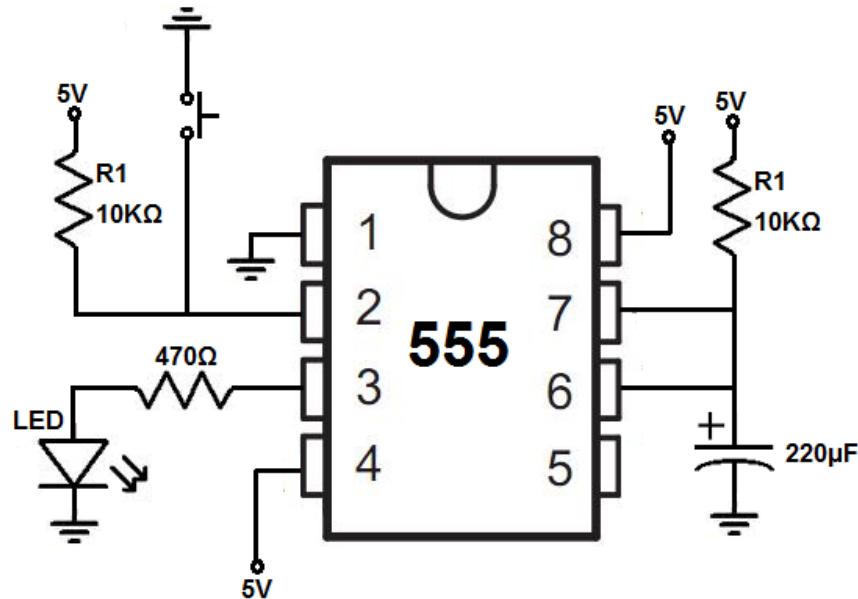
Teaching Plan

	15 Mins	=====
1	20 Mins - Presentation	Introduction
	20 Mins - Presentation & Demo	Part 01 : Build Your First Circuit
	20 Mins - Exercise 01	Components , Connection ,Breadboard
2	15 Mins - Presentation & Demo	Part 02 : How to make it work
	15 Mins - Exercise 02	Your Circuit, Power Supply, Multimeter
	10 Mins - Take a Break	=====
3	20 Mins - Presentation & Demo	Part 03 : Measure Signal Waveform
	30 Mins - Exercise 03	Your Circuit, Signal Generator, Oscilloscope
	15 Mins	=====

Part 03 – Measure Signal Waveform

- Circuit, Signal Generator, Oscilloscope
- Demonstration 03
- Exercise 03

Here is Your Circuit



Equipment and Instrument

Input



Multimeter

Output



Power Supply

Power Power



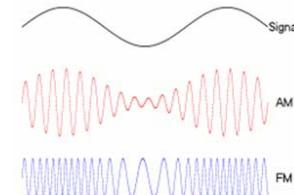
Measure

- Voltage
- Resistance
- Current

Signal Generator



Generate Signal



Measure Signal



Digital Storage Oscilloscope – DSO

Digital Storage Oscilloscope – DSO

- Understand the key feature of DSO
 - Testing Signal
 - Auto Scale
 - X-axis & Y-axis Control
 - Signal Triggering Level
 - Measurement Function

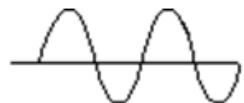


Signal Generator

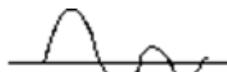
- Understand the key feature of Signal Generator
 - Type of Waveform
 - Frequency
 - Duty Cycle
 - Voltage
 - Offset Voltage



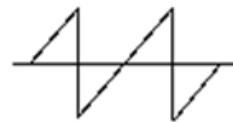
Type of Waveforms



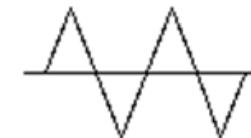
Sine Wave



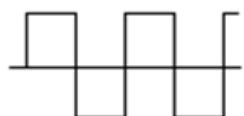
Damped Sine Wave



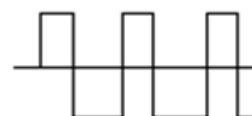
Sawtooth Wave



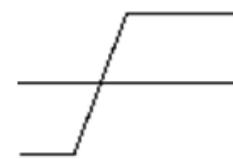
Triangle Wave



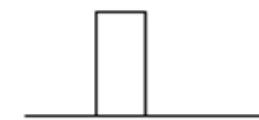
Square Wave



Rectangular Wave

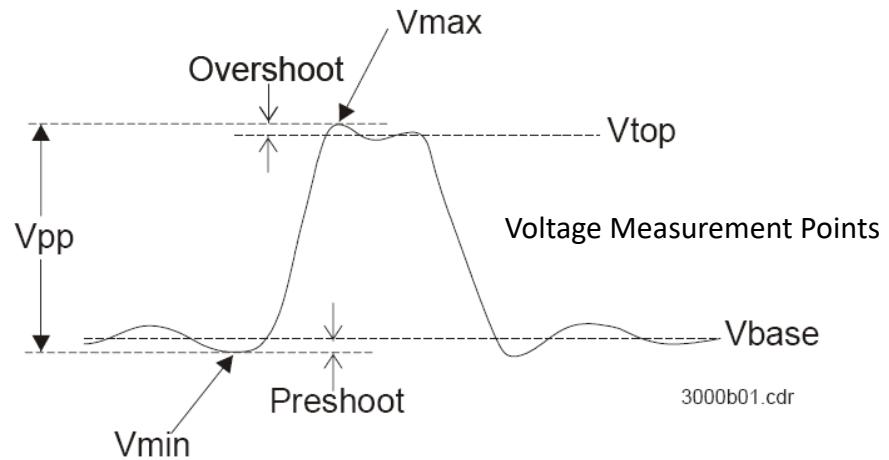
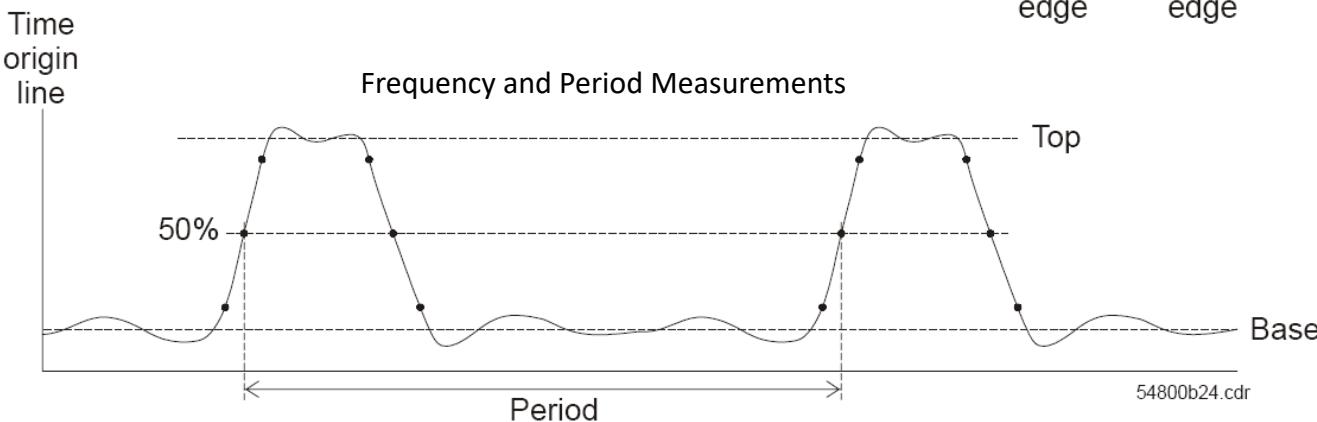
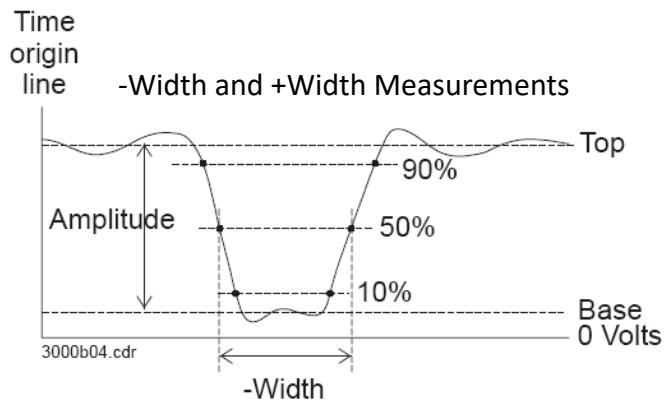
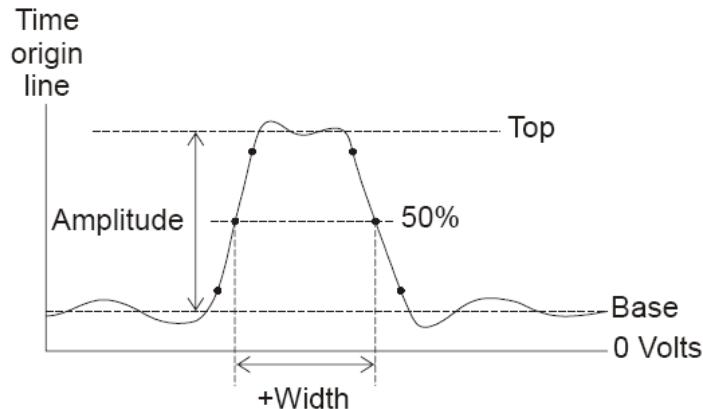


Step

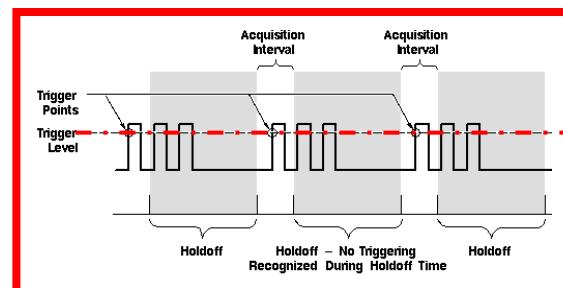
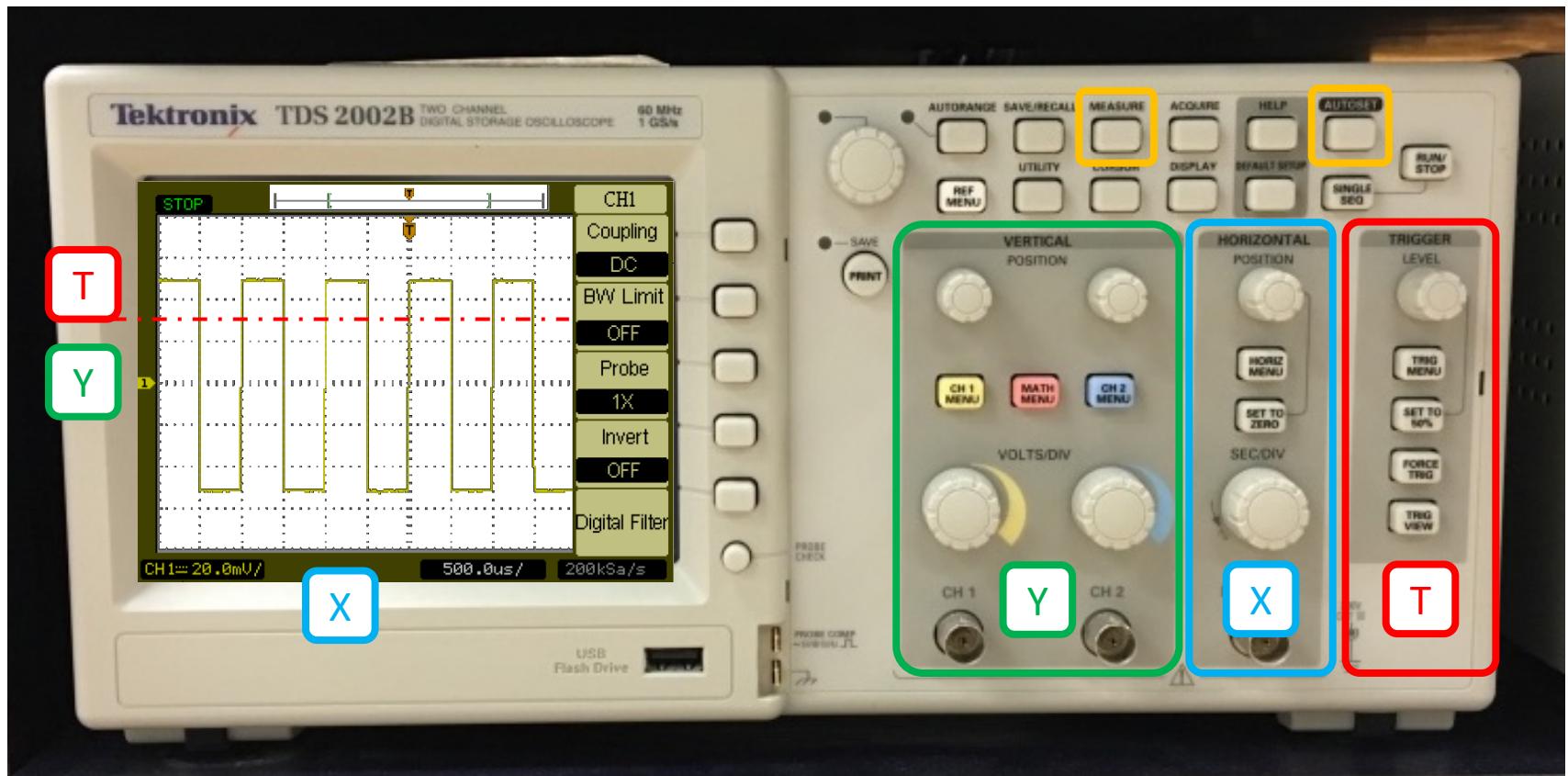


Pulse

Measurement of Waveform



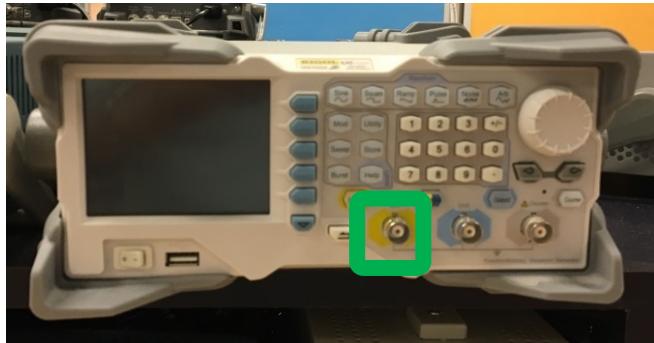
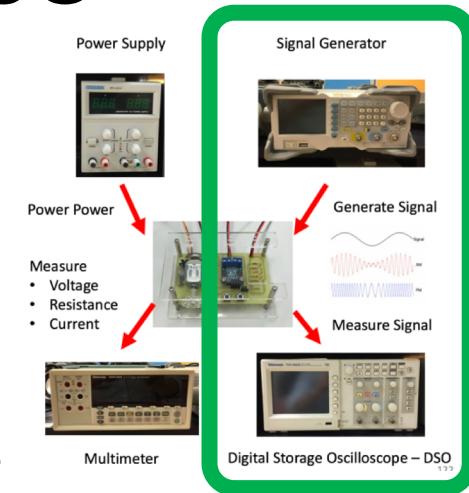
DSO – Front Panel and User Interface Descriptions



Basic Operation – Demo 03

Signal Generator and DSO

- Signal Generator
 - Setup and output signal to DSO
- DSO
 - Measure Signal from Signal Generator



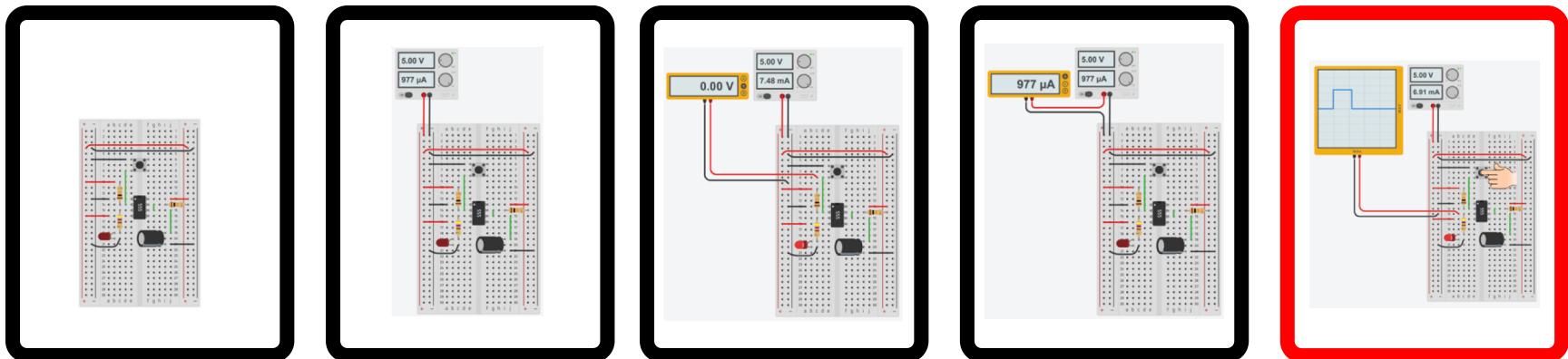
Signal Generator



Digital Storage Oscilloscope – DSO

Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform



Exercise 01 – Measure Signal Waveform

555 Monostable Timer Circuit

$t = 1.1 \times R1 \times C1$

By Calculation
t : _____

By Measurement
t : _____

Step 31

5.00 V
977 μA

10.0 s
2.00 mV

555

Tektronix TDS 2000B

130

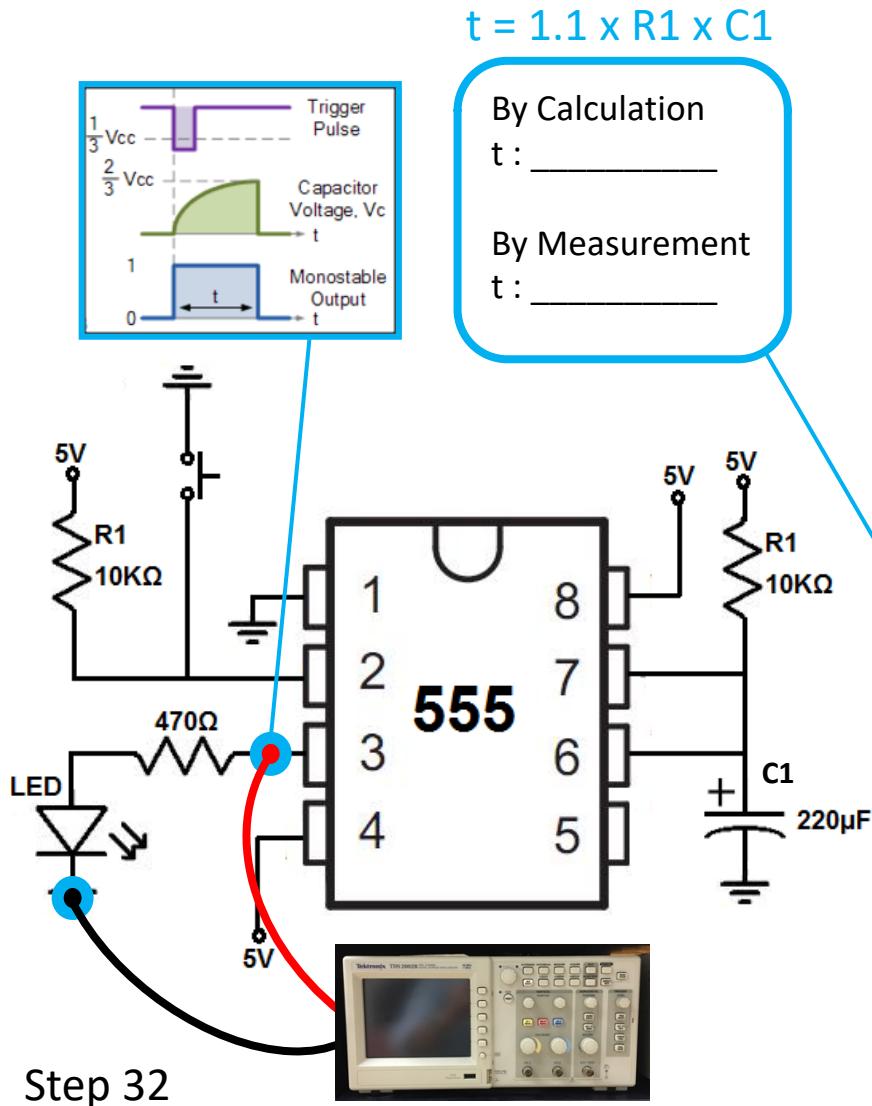
Exercise 01 – Measure Signal Waveform

555 Monostable Timer Circuit

$t = 1.1 \times R1 \times C1$

By Calculation
 $t :$ _____

By Measurement
 $t :$ _____



Step 32

Measurement Setup:

- Oscilloscope:** Tektronix TDS 2000B, connected to the output of the 555 circuit.
- Power Supply:** 5.00 V, 977 μA.
- Breadboard:** The circuit is built on a breadboard. Components include a 555 IC, a 220μF capacitor, a 10kΩ resistor, a 470Ω resistor, and an LED. The breadboard has columns labeled a-j and rows labeled 1-30.

The measurement setup shows the oscilloscope displaying a single pulse waveform, and the power supply showing 5.00 V and 977 μA.

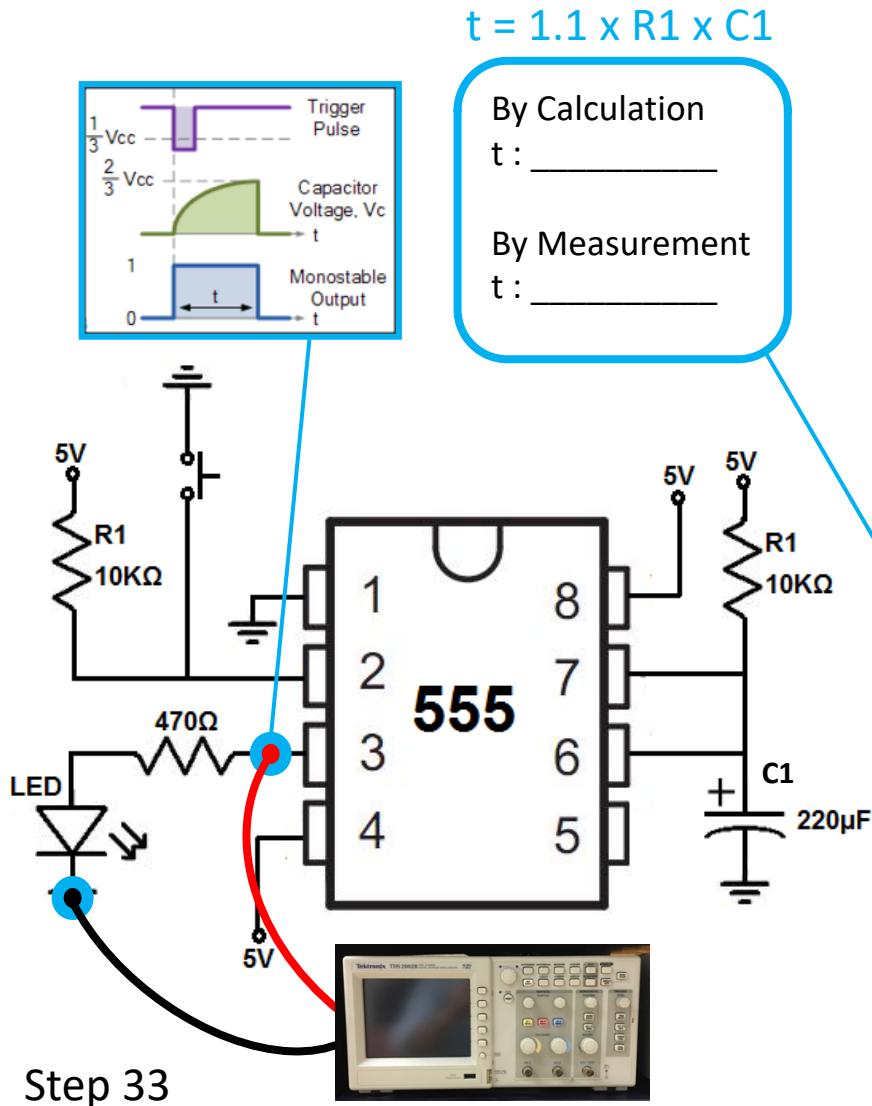
Exercise 01 – Measure Signal Waveform

555 Monostable Timer Circuit

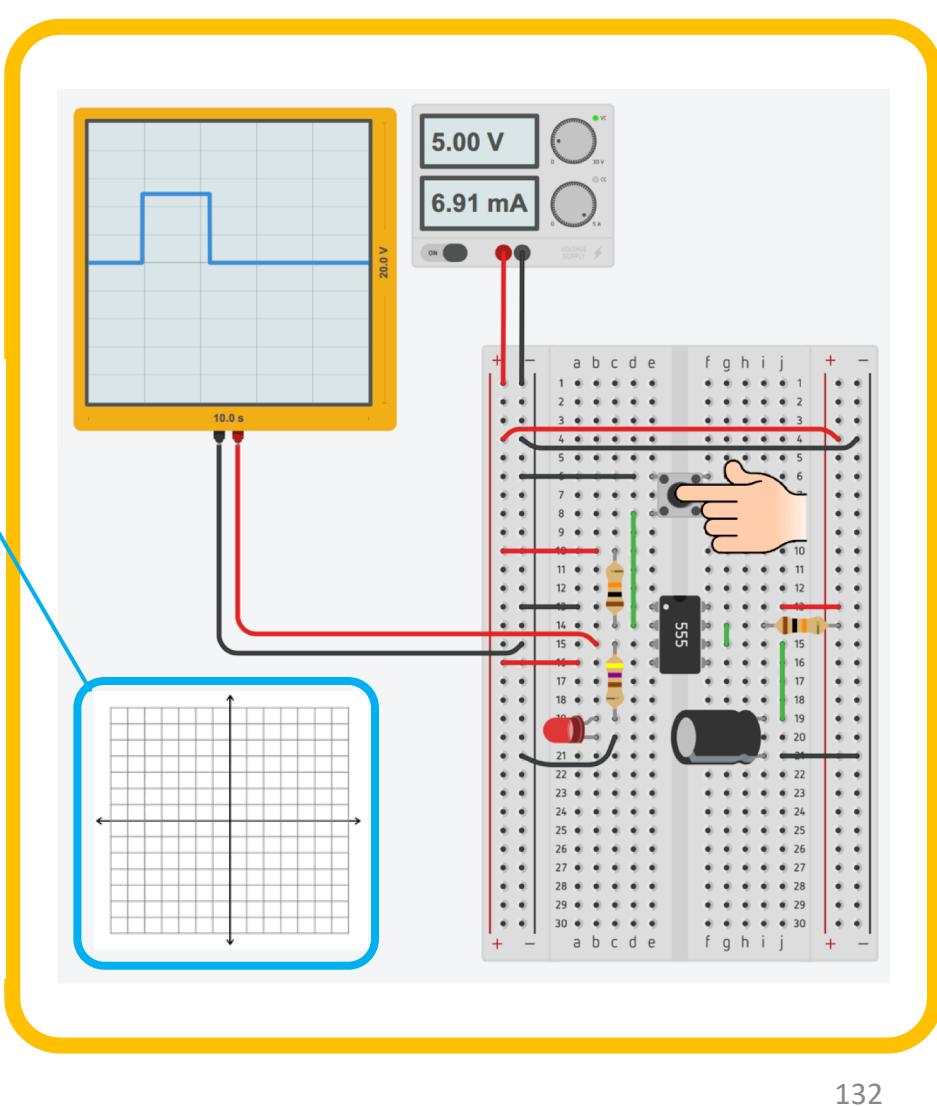
$t = 1.1 \times R1 \times C1$

By Calculation
 $t :$ _____

By Measurement
 $t :$ _____



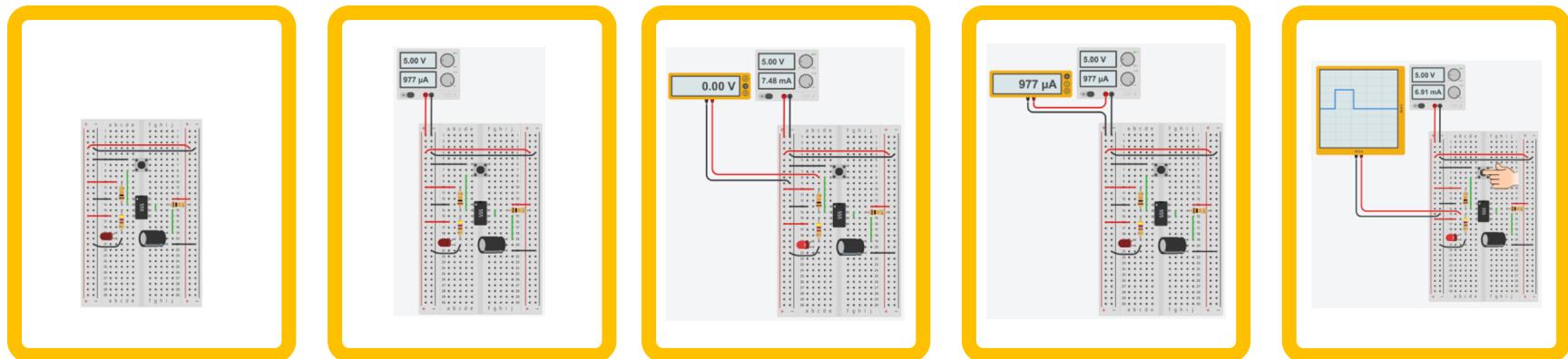
Step 33

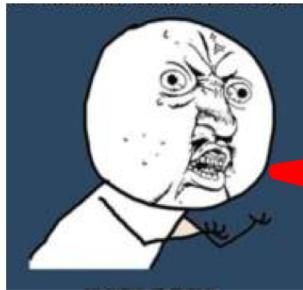


132

Exercise 01

1. Build a Circuit
2. Power Supply
3. Measure the Voltage
4. Measure the Current
5. Measure the Signal Waveform

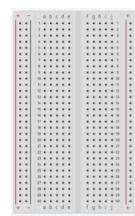
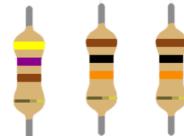
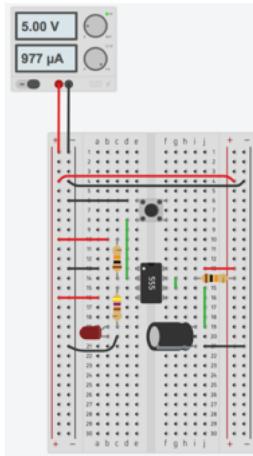
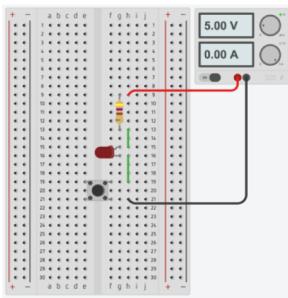




Please Help Me

Clean Up the Workbench

Your Circuits



END

Conclusion

Q&A