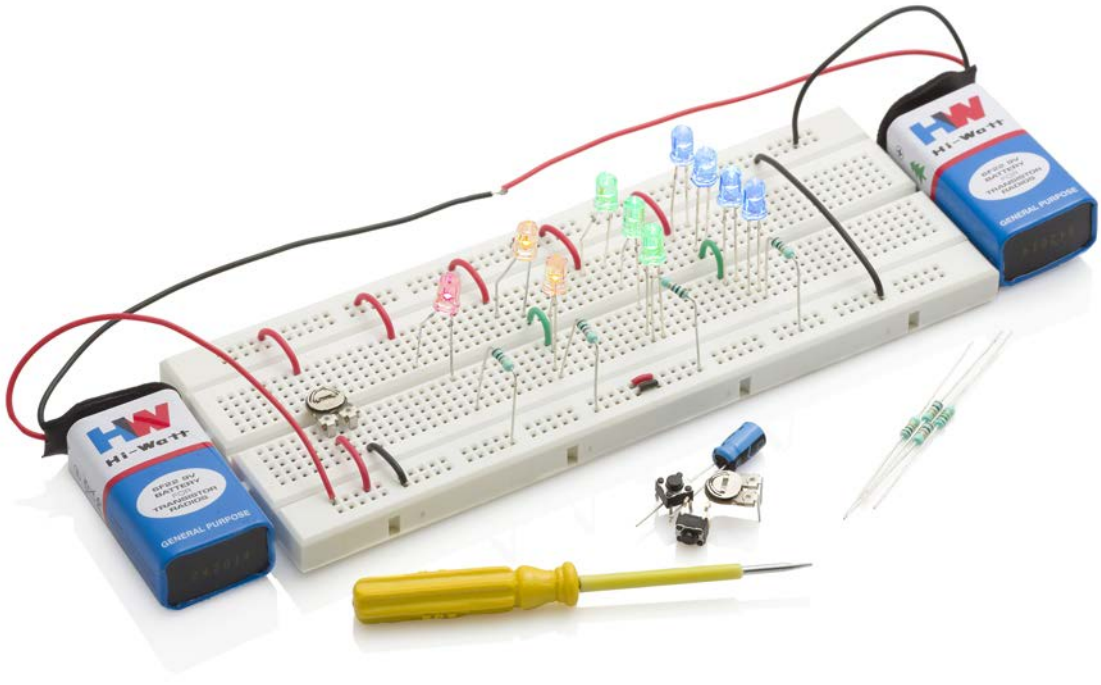
Mand Labs

step by step electronics

Teach Electronics Program

Kit + Curriculum + Support

Classroom Circuit Workbook



- email: **support@mandlabs.com**
- website: **www.mandlabs.com**

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List of Components in KIT-1 Premium Edition:

S. No.	Piece/Component	Quantity
1	Breadboard GL-12	1
2	Mini BreadBoard KH-102	1
3	Wire Cutter and Stripper	1
4	Screw Driver	1
5	Mastech Multimeter	1
6	9V Carbon Zinc Battery	2
7	1.5V Carbon Zinc Battery	2
8	Relay (12V DC)	2
9	DC Motor	1
10	Micro (Bump) Switch	1
11	Potentiometer (10K)	1
12	SPDT (Single Pole Double Throw) Switch	2
13	Jumper Wire Pack	1
14	Jumper Wire (Rolls- Red, Black, Green, Blue)	4
15	LED 5 mm W/R SB	10
16	LED 5 mm W/O SB	10
17	LED 5 mm W/B SB	10
18	LED 5mm W/PG	10
19	Diode 4007	5
20	Zener Diode 5V6	2
21	Motor Propeller	1
22	NPN Transistor (547B)	5
23	PNP Transistor (557B)	5
24	Capacitor- 1MFD	2
25	Capacitor-100 MFD	2
26	Capacitor-1000 MFD	2
27	Capacitor- 10pF	2
28	Capacitor- 10 MFD	2
29	LDR	2
30	Preset-1K	1
31	Preset-10K	2
32	Preset-50K	1
33	Preset-100k	1
34	Buzzer HYDZ	1
35	Resistor- 5.6R	5
36	Resistor- 100R	5
37	Resistor- 330R	5

38	Resistor- 1K	5
38	Resistor-10K	5
39	Resistor- 220K	5
40	Resistor- 1M	5
41	Resistor- 10M	5
42	Resistor- 100k	5
43	Push Button Switch	5
44	IR LED 5 mm	2
45	Photodiode 5 mm	2
46	Thermistor NTC 502	2
47	Cell Holder	1
48	Inductor Coil	1
49	Book-1	1
50	Book-2	1
51	Flash Drive	1
52	Component Trays	2
53	Breadboard Carrybox	1
54	Mand Labs Hardboard Box	1

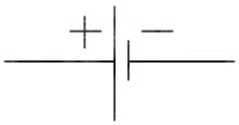
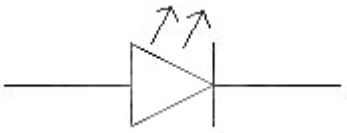
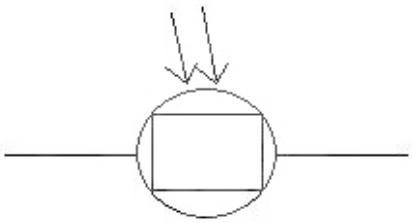
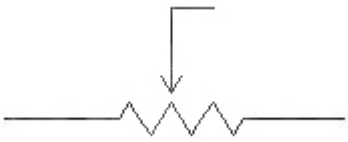
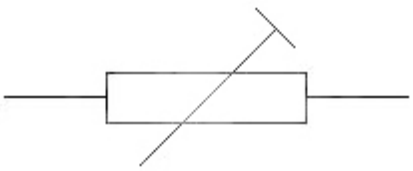
Resistance Table

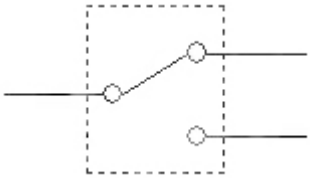
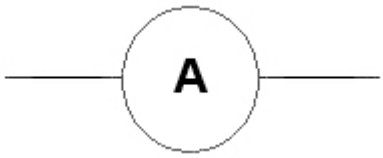
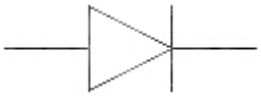
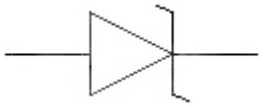
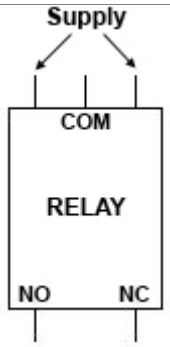
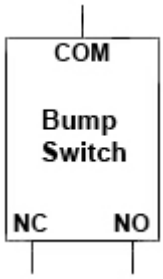
S.No.	Value (in Ω)	Color Code (Fourth Band – Gold)	Quantity
1	5.6	Green Blue Gold	5
2	100	Brown Black Brown	5
3	330	Orange Orange Brown	5
4	1k	Brown Black Red	5
5	10k	Brown Black Orange	5
6	220k	Red Red Yellow	5
7	1M	Brown Black Green	5
8	10M	Brown Black Blue	5

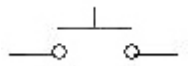
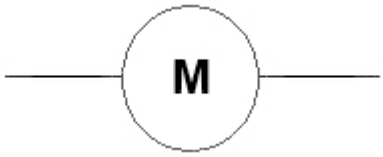
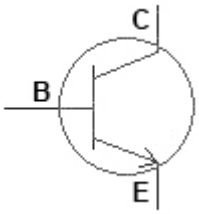
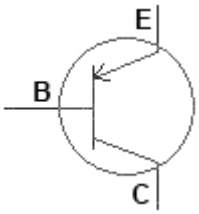
Capacitance Table

S.No.	Value	Quantity
1	10 pf	2
2	1 µF	2
3	10 µF	2
4	100 µF	2
5	1000 µF	2

Symbols of Components used in Schematics

S. No.	Component	Symbol	Function of Component
1)	Battery		It supplies electrical energy or power to the circuit. The longer terminal on the left side is positive and the shorter terminal on the right side is negative.
2)	LED		An LED stands for light emitting diode. It converts electrical energy to light energy.
3)	Resistor		It restricts the flow of current.
4)	Light Dependent Resistor (LDR)		A transducer which changes its resistance with the change in intensity of light falling on its surface. Its resistance decreases in the light and increases in the dark.
5)	Potentiometer		A three terminal resistor with a sliding contact that forms an adjustable voltage divider. It can also be used as a variable resistor.
6)	Preset		This is also a type of variable resistor, which is operated with a small screwdriver or a similar tool.
7)	Buzzer		It converts electrical energy to sound energy.
8)	Single Pole Single Throw (SPST) switch		An on-off switch which allows current to flow only when it is closed (ON).

9)	Single Pole Double Throw (SPDT) switch		A two way changeover switch, which allows the current flow to one of the two ways depending upon its position.
10)	Capacitor		A capacitor that can be used to store electric charge.
11)	Ammeter		An Ammeter, which is used to measure current.
12)	Positive Supply	**Vcc**	Vcc stands for positive terminal of the battery.
13)	Negative Supply or Ground		Ground stands for negative terminal of the battery.
14)	Junction		A point where two or more wires are joined.
14)	Diode		A semiconductor, which allows the current to flow in only one direction.
15)	Zener Diode		A special diode, which conducts in reverse direction and is used to maintain a fixed voltage across its terminals.
16)	Relay		An electromagnetic switch which can be operated electrically COM – Common NO – Normally Open NC – Normally Closed
17)	Bump Switch		A special type of switch, which is operated mechanically.

18)	Push Switch		It allows the current to flow only when the button is pressed.
19)	Jumper		It is a bridge symbol which denotes a wire crossing another wire even though they are not connected.
21)	Motor		A device which converts electrical energy into mechanical energy.
22)	NPN Transistor		A semiconductor device with three terminals, which can be used as an amplifier and a switch. Its legs are denoted as E– Emitter, B – Base and C – Collector.
23)	PNP Transistor		A semiconductor device with three terminals, which can be used as an amplifier and a switch. Its legs are denoted as E– Emitter, B – Base and C – Collector.

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Circuit Diagrams

Level I

Experiment: Measure battery voltage using a multimeter

Step 1: Connect the red probe of the multimeter to VΩmA and the black probe to COM.
"COM" stands for "Common".
Step 2: Rotate the knob of the multimeter to 20 in V− (DC) region. This is DC (Direct Current) region that can only measure DC Voltages.
Step 3: Connect the red probe of multimeter to the positive terminal and the black probe to the negative terminal of the battery.
Step 4: Note the reading and crosscheck with what is written on your battery.

Observation:

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Experiment: Measure resistance using a multimeter and tally color codes

1. Set the multimeter dial to 20k in the DMM (Digital Multimeter) in the ohm(Ω) region.
2. Connect the red probe of the multimeter to any one terminal of the resistor.
3. Now connect the black probe of the DMM to the other end of the resistor.
4. If the meter shows the reading 1 on the extreme left side, then you will have to move the dial to either higher or lower range. In brief, we are adjusting the range to obtain the reading.
5. If the meter shows the reading 1 on the extreme right side, then you will again need to move the dial to a higher or lower range. In short, we are adjusting the range to obtain the accurate reading. "1" is also a reading.
6. If your meter is set on 20k, 200k or 200k, multiply the reading with 1000.

Fill the table and cross check the value with the "Resistance Table" on page 4.

S. No.	Resistor Code	Value on Multimeter Meter
1)	Green Blue Gold Gold	
2)	Brown Black Brown Gold	
3)	Orange Orange Brown Gold	
4)	Brown Black Red Gold	
5)	Brown Black Orange Gold	
6)	Red Red Yellow Gold	
7)	Brown Black Green Gold	
8)	Brown Black Blue Gold	

Experiment: Continuity Test of an LED

Continuity test of an LED is used to find out whether the LED is in a working state or not.
Follow the steps below:

1. Set the multimeter knob to beep symbol .)))
2. Connect the red probe of the multimeter to the anode (longer leg) of the LED.
3. Connect the black probe of the multimeter to the cathode (shorter leg) of the LED.

Observation

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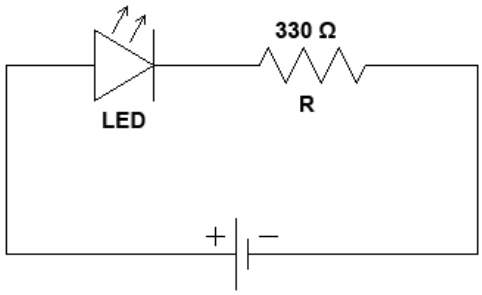
Experiment: Glowing an LED



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	1
2)	Resistor	330 Ω	1
3)	Battery	9V DC	1
4)	Connecting Wire	Single Core	Pieces

Observation

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Inference

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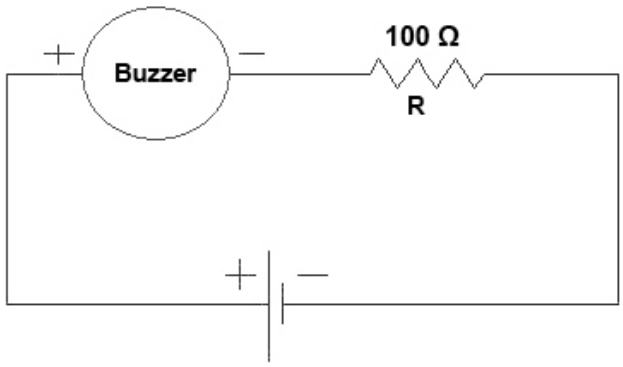
Activity:

1. Measure the voltage across the LED and the 330 ohm resistor using multimeter. Add up the individual voltages and check whether the sum of voltages equal to the battery voltage.

2. Reverse the connections of the LED and see if it glows. If it does not glow, what is the reason?

Experiment: Beep a Buzzer



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	Buzzer	HYDZ	1
2)	Resistor	100 Ω	1
3)	Battery	9V DC	1
4)	Connecting Wire	Single Core	Pieces

Observation

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Inference

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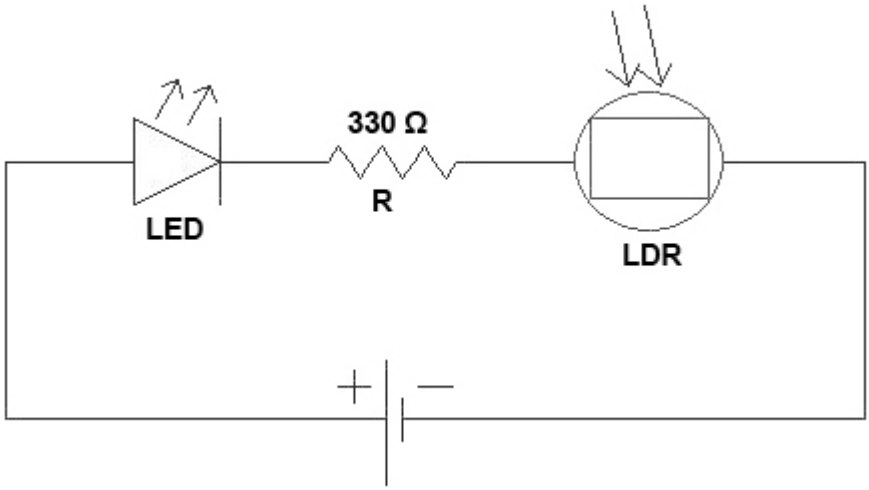
Experiment: Glowing an LED using an LDR



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	1
2)	Resistor	330 Ω	1
3)	LDR	Light Dependent Resistor	1
4)	Battery	9V DC	1
5)	Connecting Wire	Single Core	Pieces

After the circuit is complete, place your finger on the top surface of LDR and observe how the intensity of the LED changes. You can also take your circuit into the dark and observe the effect.

Observation

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Inference

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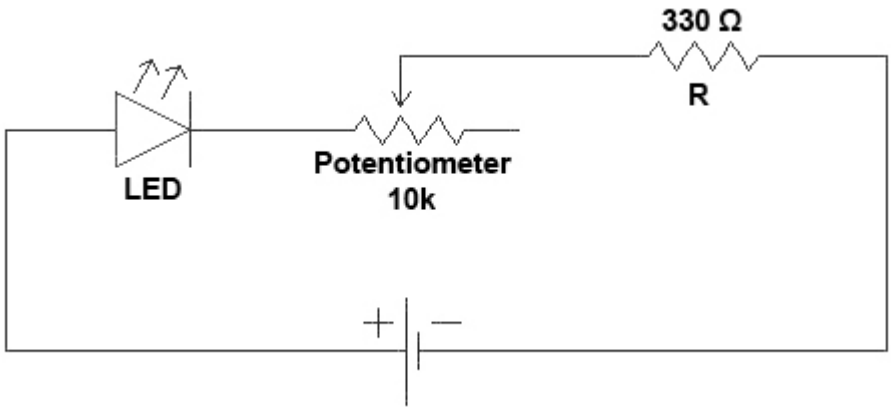
Experiment: Glowing an LED Using a Potentiometer



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	1
2)	Resistor	330 Ω	1
3)	Potentiometer	10k Ω	1
4)	Battery	9V DC	1
5)	Connecting Wire	Single Core	Pieces

After your circuit is complete, rotate the knob of the potentiometer.

Observation

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Inference

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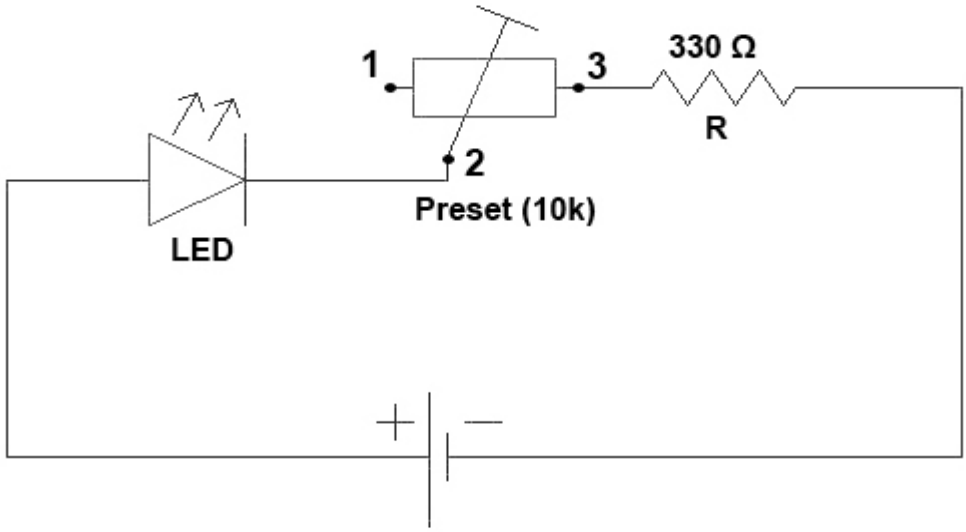
Experiment: Varying Intensity of Light Using a Preset



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	1
2)	Resistor	330 Ω	1
3)	Preset	10k Ω	1
4)	Battery	9V DC	1
5)	Connecting Wire	Single Core	Pieces

After the circuit is complete, take a screw driver and put it inside the slot on the preset. Rotate the slot slowly from extreme left to right or vice versa. Observe the change in the intensity of the LED.

Observation

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Inference

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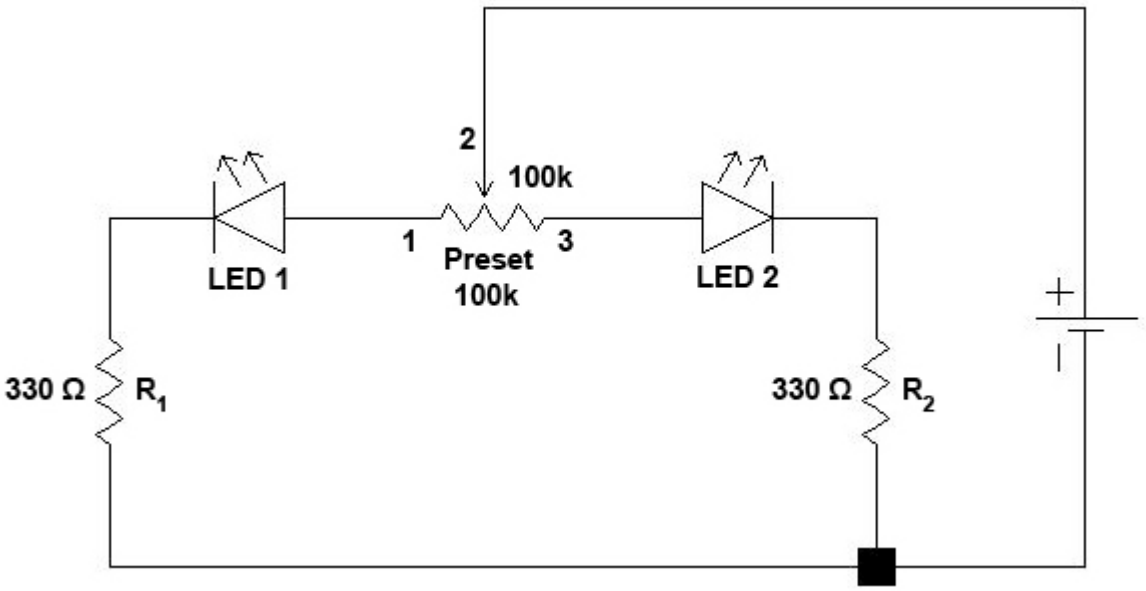
Experiment: Alternate Change in Intensity of LEDs using a Preset



Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	2
2)	Resistor	330 Ω	1
3)	Preset	100k Ω	1
4)	Battery	9V DC	1
5)	Connecting Wire	Single Core	Pieces

After the circuit is complete, rotate the slot on the preset from extreme left to right or vice versa.

Observation

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Inference

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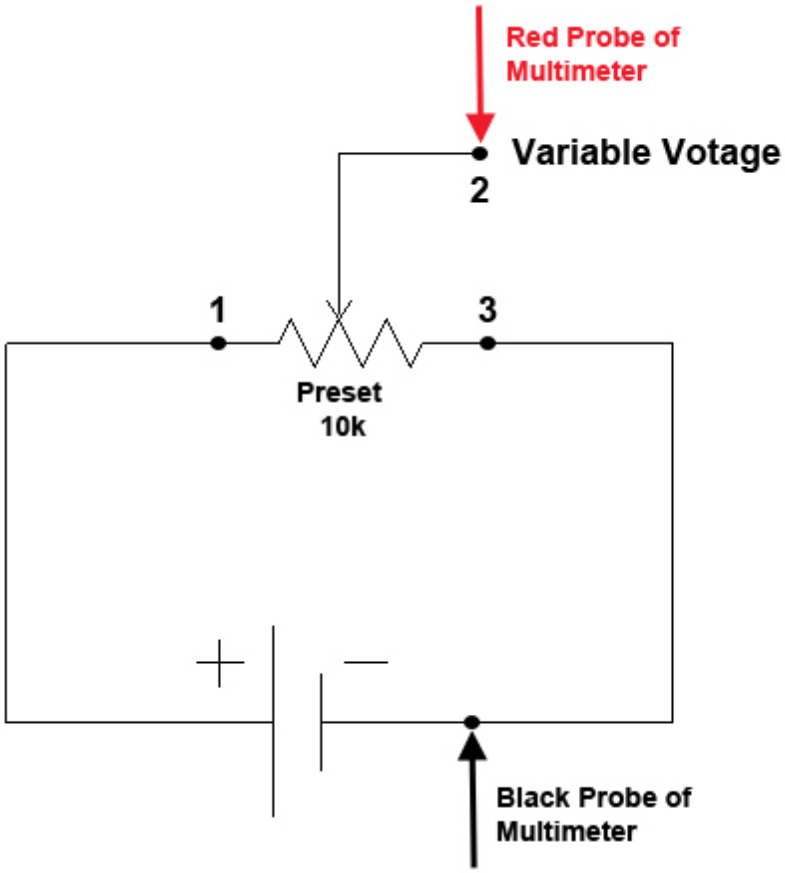
Experiment: Voltage Regulator using Preset

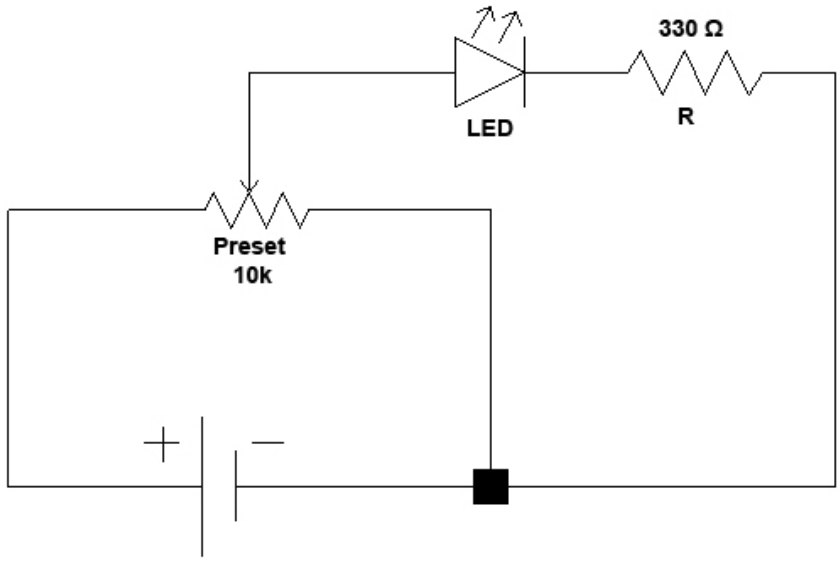
A voltage divider is used to provide variable voltage to a circuit. Given below is the schematic of “Preset as Voltage Regulator”.



Terminal 1 of preset is given Vcc (positive) and terminal 3 is grounded (negative). Output is taken from terminal 2. Say, your preset is of 10k Ω. So, output from terminal 2 is a variable voltage source. We can think of a voltage diver as a variable battery, which can provide voltage varying from zero to a rated value (maximum).

We can vary the voltage across terminals 1 and 2 from zero to a certain value by simply rotating the preset. Measure the voltage between terminals 2 and 3 (ground) of the preset using a multimeter. Rotate the preset. You will observe a rising voltage reading with the preset rotation.

Circuit Modification



After the circuit is complete, rotate the preset.

Observation

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Inference

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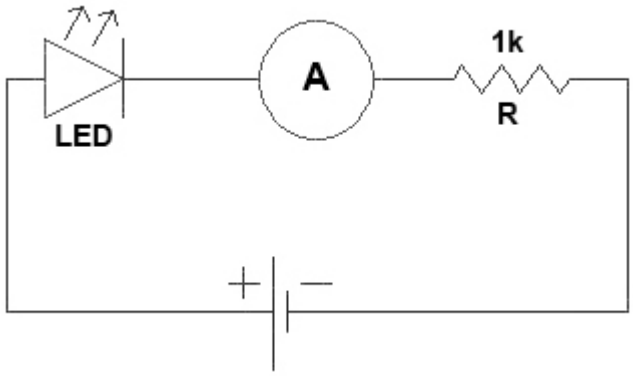
Experiment: Measure Current Using a Multimeter



An Ammeter is a device that measures current and is always connected in series with the circuit. It is denoted by symbol 'A'. We can use a multimeter in ammeter mode.

To measure the current in a circuit we need to insert the meter in series with the circuit. This is done by creating a gap in the circuit and then filling it with the multimeter leads.

To measure DC current, rotate the dial of the multimeter meter to DC region denoted by "A ---". Initially, you can move the dial to 200m position. At 200m position, we will be able to measure all currents that are less than or equal to 0.2A or 200 mA. The meter in the kit can measure current from 2000µ to 200m on A --- scale.

2000µ = 2000 micro = 2000×10^{-6} = 0.002 A 20m = 20 milli = 20×10^{-3} = 0.02 A

200m = 200 milli = 200×10^{-3} = 0.2 A

Bill of Material

S. No.	Name of Component	Description	Quantity
1)	LED	Any Color	1
2)	Resistor	1k Ω	1
3)	Multimeter	Digital	1
4)	Battery	9V DC	1
5)	Connecting Wire	Single Core	Pieces

Observation

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Inference

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Ohm's Law Verification

In this circuit, let us find out the theoretical value of current. We know two quantities here:

1. Voltage, V = 9 Volt
2. Resistance, R = 1k ohm = 1000 ohm

According to Ohm's law, $V = R \times I$

The voltage, V, is the total voltage available to the circuit.
Battery Voltage = Voltage across LED + Voltage across 1k resistor

A LED needs a minimum voltage of 1.8-2V to light up. In doing so, a voltage drop of approximately 2V takes place across the LED. Hence, Voltage across LED = 2V

Voltage across 1k resistor = Battery Voltage - Voltage across LED = 9 − 2 = 7 V
Thus, I = Current through 1k resistor = Voltage across 1k resistor/1k ohm
I = 7/1000 = 0.007 A (Ampere)
I = 0.009 A

We can convert the current into mili-amperes by multiplying its value with 1000.
So, I = 0.007 × 1000 = 7 milliamps = 7 mA

Please note that 1 milli stands for 10^{-3} = 1/1000

Activity:

Does the 7mA value match with the practical value of the current in the circuit. If not, why?

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step by step
Everything you can imagine is real.
Pablo Picasso
Mand Labs