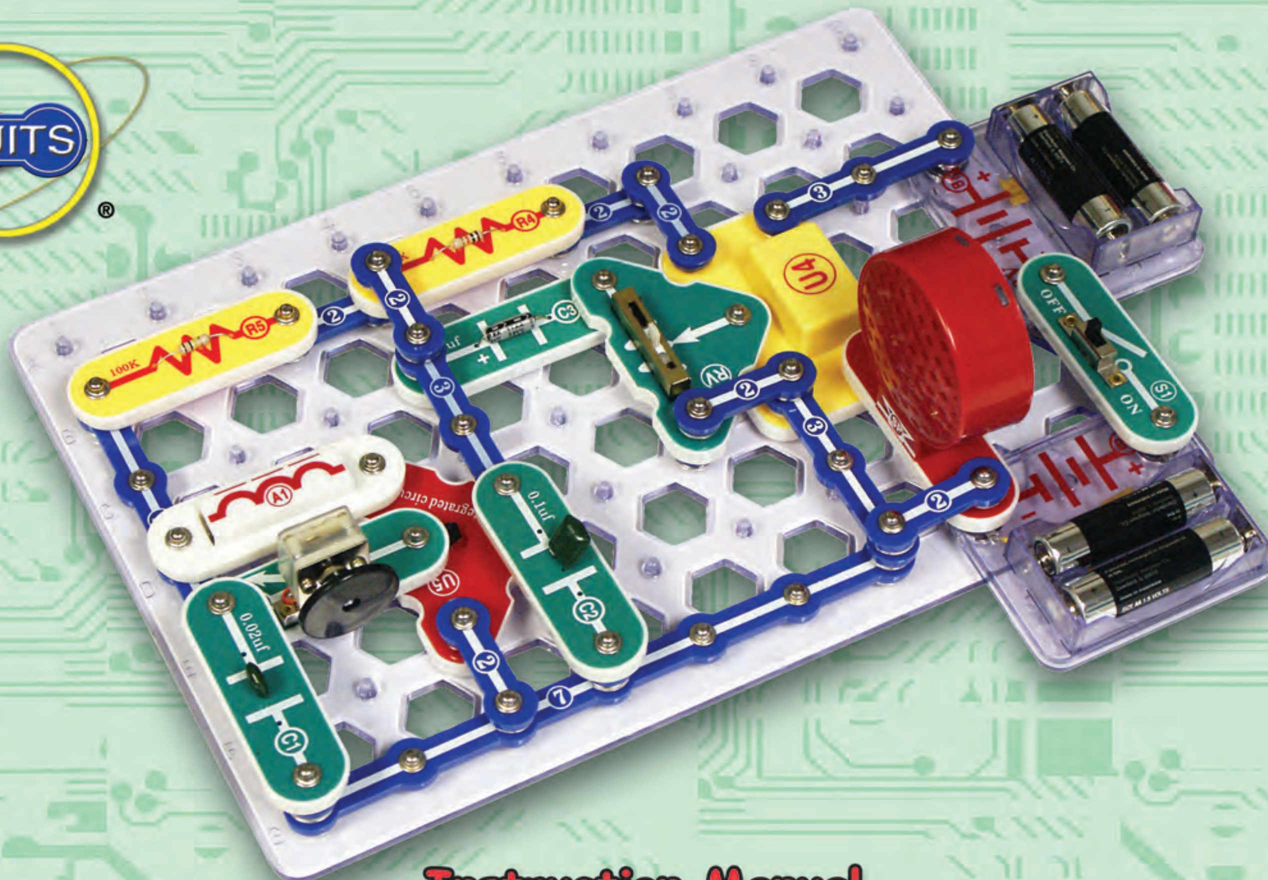
ELECTRONIC SNAP CIRCUITS®

Projects 102-305

SNAP CIRCUITS®

AGE 8 - 108



Project 242

Instruction Manual

ELENCO®

REV-H Revised 2012 753098

Patent #'s: 7,144,255, 7,273,377, & other patents pending

Table of Contents

Basic Troubleshooting

1. Most circuit problems are due to incorrect assembly. Always double-check that your circuit exactly matches the drawing for it.
2. Be sure that parts with positive/negative markings are positioned as per the drawing.
3. Be sure that all connections are securely snapped.
4. Try replacing the batteries.
5. If the motor spins but does not balance the fan, check the black plastic piece with three prongs on the motor shaft. Be sure that it is at the top of the shaft.

Elenco® is not responsible for parts damaged due to incorrect wiring.

Note: If you suspect you have damaged parts, you can follow the Advanced Troubleshooting procedure on page 5 to determine which ones need replacing.

WARNING: SHOCK HAZARD - Never connect Snap Circuits® to the electrical outlets in your home in any way!

WARNING: CHOKING HAZARD - Small parts. Not for children under 3 years.

WARNING FOR ALL PROJECTS WITH A ⚠ SYMBOL
Moving parts. Do not touch the motor or fan during operation. Do not lean over the motor. Do not launch the fan at people, animals, or objects. Eye protection is recommended.

Batteries:

- Use only 1.5V AA type, alkaline batteries (not included).
- Insert batteries with correct polarity.
- Non-rechargeable batteries should not be recharged. Rechargeable batteries should only be charged under adult supervision, and should not be recharged while in the product.
- Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- Do not mix old and new batteries.
- Remove batteries when they are used up.
- Do not short circuit the battery terminals.
- Never throw batteries in a fire or attempt to open its outer casing.
- Batteries are harmful if swallowed, so keep away from small children.
- Do not connect batteries or battery holders in parallel.

WARNING: Always check your wiring before turning on a circuit. Never leave a circuit unattended while the batteries are installed. Never connect additional batteries or any other power sources to your circuits. Discard any cracked or broken parts.

Adult Supervision: Because children's abilities vary so much, even with age groups, adults should exercise discretion as to which experiments are suitable and safe (the instructions should enable supervising adults to establish the experiment's suitability for the child). Make sure your child reads and follows all of the relevant instructions and safety procedures, and keeps them at hand for reference.

This product is intended for use by adults and children who have attained sufficient maturity to read and follow directions and warnings.

Never modify your parts, as doing so may disable important safety features in them, and could put your child at risk of injury.

Review of How To Use It (See page 3 of the Projects 1-101 manual for more details.)

The Snap Circuits® kit uses building blocks with snaps to build the different electrical and electronic circuits in the projects. These blocks are in different colors and have numbers on them so that you can easily identify them. The circuit you will build is shown in color and with numbers, identifying the blocks that you will use and snap together to form a circuit.

Next to each part in every circuit drawing is a small number in black. This tells you which level the component is placed at. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc.

A large clear plastic base grid is included with this kit to help keep the circuit block together. The base has rows labeled A-G and columns labeled 1-10.

Install two (2) "AA" batteries (not included) in the battery holder (B1). The 2.5V and 6V bulbs come packaged separate from their sockets. Install the 2.5V bulb in the L1 lamp socket, and the 6V bulb in the L2 lamp socket.

Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.

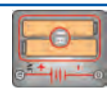
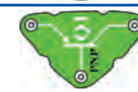
Some circuits use the red and black jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated.

Note: While building the projects, be careful not to accidentally make a direct connection across the battery holder (a "short circuit"), as this may damage and/or quickly drain the batteries.

Parts List (Colors and styles may vary) Symbols and Numbers

Note: There are additional part lists in your other project manuals.

Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free (800) 533-2441 or e-mail us at: help@elenco.com. Customer Service • 150 Carpenter Ave. • Wheeling, IL 60090 U.S.A.

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
❐ 3	①	1-Snap Wire		6SC01	❐ 1	(C3)	10μF Capacitor		6SCC3
❐ 3	②	2-Snap Wire		6SC02	❐ 1	(C4)	100μF Capacitor		6SCC4
❐ 1	③	3-Snap Wire		6SC03	❐ 1	(C5)	470μF Capacitor		6SCC5
❐ 1	④	4-Snap Wire		6SC04	❐ 1	(R2)	1kΩ Resistor		6SCR2
❐ 1	⑦	7-Snap Wire		6SC07	❐ 1	(R3)	5.1kΩ Resistor		6SCR3
❐ 1	(B1)	Battery Holder - uses 2 1.5V type AA (not Included)		6SCB1	❐ 1	(R4)	10kΩ Resistor		6SCR4
❐ 1	(A1)	Antenna Coil		6SCA1	❐ 1	(R5)	100kΩ Resistor		6SCR5
❐ 1	(D2)	Green Light Emitting Diode (LED)		6SCD2	❐ 1	(U5)	High Frequency Integrated Circuit		6SCU5
❐ 1	(L2)	6V Lamp		6SCL2	❐ 1	(Q1)	PNP Transistor		6SCQ1
❐ 1	(X1)	Microphone		6SCX1	❐ 1	(Q2)	NPN Transistor		6SCQ2
❐ 1	(U4)	Power Amplifier Integrated Circuit		6SCU4	❐ 1	(RV)	Adjustable Resistor		6SCRV
❐ 1	(C1)	0.02μF Capacitor		6SCC1	❐ 1	(CV)	Variable Capacitor		6SCCV
❐ 1	(C2)	0.1μF Capacitor		6SCC2					

You may order additional / replacement parts at our website: www.snapcircuits.net

MORE About Your Snap Circuits® Parts

Our Student Guides give much more information about your parts along with a complete lesson in basic electronics. See www.snapcircuits.net/learn.htm or page 74 for more information.

(Part designs are subject to change without notice).

Note: There is additional information in your other project manual.

The green **LED (D2)** works the same as the red LED (D1) and the **6V lamp (L2)** works the same as the 2.5V lamp; these are described in the projects 1-101 manual.

Resistors "resist" the flow of electricity and are used to control or limit the electricity in a circuit. Snap Circuits® includes **100Ω (R1), 1KΩ (R2), 5.1KΩ (R3), 10KΩ (R4), and 100KΩ (R5) resistors** ("K" symbolizes 1,000, so R3 is really 5,100Ω). Materials like metal have very low resistance (<1Ω) and are called conductors, while materials like paper, plastic, and air have near-infinite resistance and are called insulators.

The **adjustable resistor (RV)** is a 50KΩ resistor but with a center tap that can be adjusted between 0Ω and 50KΩ. At the 0Ω setting, the current must be limited by the other components in the circuit.

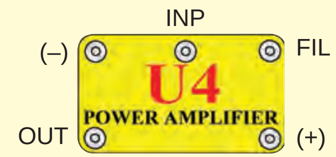
The **microphone (X1)** is actually a resistor that changes in value when changes in air pressure (sounds) apply pressure to its surface. Its resistance typically varies from around 1KΩ in silence to around 10KΩ when you blow on it.

Capacitors are components that can store electrical pressure (voltage) for periods of time, higher values have more storage. Because of this storage ability they block unchanging voltage signals and pass fast changing voltages. Capacitors are used for filtering and oscillation circuits. Snap Circuits® includes **0.02μF (C1), 0.1μF (C2), 10μF (C3), 10μF (C4), 470μF (C5) capacitors, and a variable capacitor (CV).** The variable capacitor can be adjusted from .00004 to .00022μF and is used in high frequency radio circuits for tuning. The whistle chip (WC) also acts like a 0.02μF capacitor in addition to its sound properties.

The **antenna (A1)** contains a coil of wire wrapped around an iron bar. Although it has magnetic effects similar to those in the motor, those effects are tiny and may be ignored except at high frequencies (like in AM radio). Its magnetic properties allow it to concentrate radio signals for reception. At lower frequencies the antenna acts like an ordinary wire.

The **PNP (Q1) and NPN (Q2) transistors** are components that use a small electric current to control a large current, and are used in switching, amplifier, and buffering applications. They are easy to miniaturize, and are the main building blocks of integrated circuits including the microprocessor and memory circuits in computers. Projects #124-125 and #128-133 demonstrate their properties. A high current may damage a transistor, so the current must be limited by other components in the circuit.

The **power amplifier IC (U4)** is a module containing an integrated circuit amplifier and supporting components that are always needed with it. A description of it is given here for those interested:

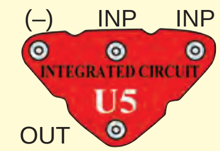


Power Amplifier IC:

(+) - power from batteries
(–) - power return to batteries
FIL - filtered power from batteries
INP - input connection
OUT - output connection

See project #242 for example of connections.

The **high frequency IC (U5)** is a specialized amplifier used only in high frequency radio circuits. A description of it is given here for those interested:



High Frequency IC:

INP - input connection (2 points are same)
OUT - output connection
(–) power return to batteries

See project #242 for example of connections.

DO's and DON'Ts of Building Circuits

After building the circuits given in this booklet, you may wish to experiment on your own. Use the projects in this booklet as a guide, as many important design concepts are introduced throughout them. Every circuit will include a power source (the batteries), a resistance (which might be a resistor, lamp, motor, integrated circuit, etc.), and wiring paths between them and back. You must be careful not to create "short circuits" (very low-resistance paths across the batteries, see examples below) as this will damage components and/or quickly drain your batteries. Only connect the ICs using configurations given in the projects, incorrectly doing so may damage them. **Elenco® is not responsible for parts damaged due to incorrect wiring.**

Here are some important guidelines:

ALWAYS **USE EYE PROTECTION WHEN EXPERIMENTING ON YOUR OWN.**

ALWAYS include at least one component that will limit the current through a circuit, such as the speaker, lamp, whistle chip, capacitors, ICs (which must be connected properly), motor, microphone, photoresistor, or resistors (the adjustable resistor doesn't count if it's set at/near minimum resistance).

ALWAYS use LEDs, transistors, the high frequency IC, the antenna, and switches in conjunction with other components that will limit the current through them. Failure to do so will create a short circuit and/or damage those parts.

ALWAYS connect the adjustable resistor so that if set to its 0 setting, the current will be limited by other components in the circuit.

ALWAYS connect position capacitors so that the "+" side gets the higher voltage.

ALWAYS disconnect your batteries immediately and check your wiring if something appears to be getting hot.

ALWAYS check your wiring before turning on a circuit.

ALWAYS connect ICs using configurations given in the projects or as per the connection descriptions for the parts.

NEVER try to use the high frequency IC as a transistor (the packages are similar, but the parts are different).

NEVER use the 2.5V lamp in a circuit with both battery holders unless you are sure that the voltage across it will be limited.

NEVER connect to an electrical outlet in your home in any way.

NEVER leave a circuit unattended when it is turned on.

NEVER touch the motor when it is spinning at high speed.

Note: If you have the more advanced Models SC-500 or SC-750, there are additional guidelines in your other project manual(s).

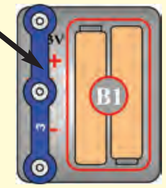
For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

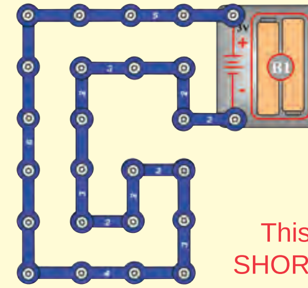
Warning to Snap Rover owners: Do not connect your parts to the Rover body except when using our approved circuits, the Rover body has a higher voltage which could damage your parts.

Examples of SHORT CIRCUITS - NEVER DO THESE!!!

Placing a 3-snap wire directly across the batteries is a SHORT CIRCUIT.

NEVER DO!



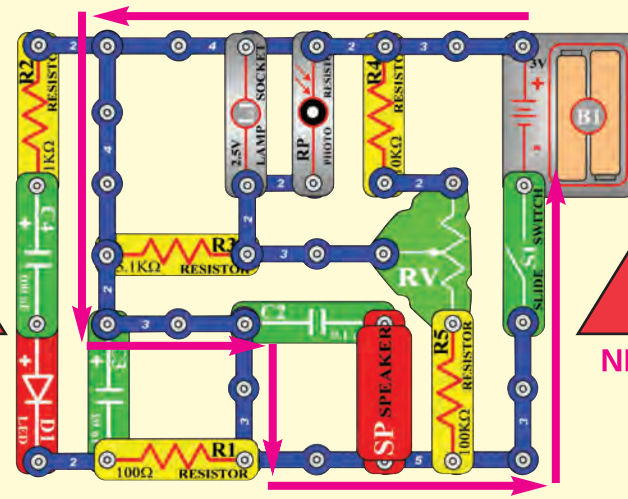


NEVER DO!

This is also a SHORT CIRCUIT.

When the slide switch (S1) is turned on, this large circuit has a SHORT CIRCUIT path (as shown by the arrows). The short circuit prevents any other portions of the circuit from ever working.

NEVER DO!



NEVER DO!

You are encouraged to tell us about new circuits you create. If they are unique, we will post them with your name and state on our website at **www.snapcircuits.net/kidkreations.htm**. Send your suggestions to Elenco®.

Elenco® provides a circuit designer so that you can make your own Snap Circuits® drawings. This Microsoft® Word document can be downloaded from **www.snapcircuits.net/SnapDesigner.doc** or through the **www.snapcircuits.net** website.

WARNING: SHOCK HAZARD - Never connect Snap Circuits® to the electrical outlets in your home in any way!

MORE Advanced Troubleshooting (Adult supervision recommended)

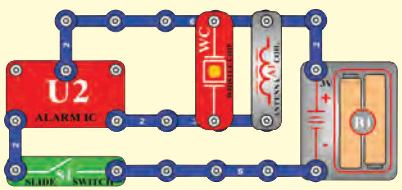
Elenco® is not responsible for parts damaged due to incorrect wiring.

If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

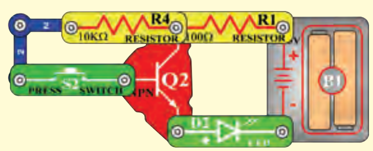
1. - 9. Refer to project manual 1 (projects 1-101) for testing steps 1-9, then continue below. Test both lamps (L1, L2) and battery holders in test step 1, all blue snap wires in step 3, and both LEDs (D1, D2) in step 5.

10. **1KΩ (R2), 5.1KΩ (R3), and 10KΩ (R4) resistors:** Build project #7 but use each of these resistors in place of the 100Ω resistor (R1), the LED should light and the brightness decreases with the higher value resistors.

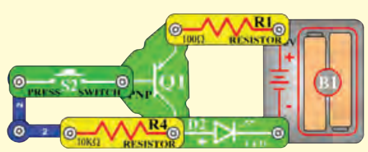
11. **Antenna (A1):** Build the mini-circuit shown here, you should hear sound.



12. **NPN transistor (Q2):** Build the mini-circuit shown here. The LED (D2) should only be on if the press switch (S2) is pressed. If otherwise, then the NPN is damaged.



13. **PNP transistor (Q1):** Build the mini-circuit shown here. The LED (D1) should only be on if the press switch (S2) is pressed. If otherwise, then the PNP is damaged.



14. **Adjustable resistor (RV):** Build project #261 but use the 100Ω resistor (R1) in place of the photoresistor (RP), the resistor control can turn the LED (D1) on and off.

15. **100ΩK resistor (R5) and 0.02μF (C1), 0.1μF (C2), and 10μF (C3) capacitors:** Build project #206, it makes sound unless the resistor is bad. Place the 0.02μF capacitor on top of the whistle chip (WC) and the sound changes (pitch is lower). Replace the 0.02μF with the 0.1μF and the pitch is even lower. Replace the 0.1μF with the 10μF and the circuit will “click” about once a second.

16. **100μF (C4) and 470μF (C5) capacitors:** Build project #225, press the press switch (S2) and turn on the slide switch (S1). The LED (D1) should be lit for about 15 seconds then go out (press the press switch again to reset this). Replace the 470μF with the 100μF and the LED is only lit for about 4 seconds now.

17. **Power Amplifier IC (U4):** Build project #293, the sound from the speaker (SP) should be loud.

18. **Microphone (X1):** Build project #109, blowing into the microphone should turn off the lamp (L2).

19. **Variable Capacitor (CV):** Build project #213 and place it near an AM radio, tune the radio and the capacitor to verify you hear the music on your radio.

20. **High Frequency IC (U5):** Build project #242 and adjust the variable capacitor (CV) and adjustable resistor (RV) until you hear a radio station.

Note: If you have the more advanced Models SC-500 or SC-750, there are additional tests in your other project manuals.

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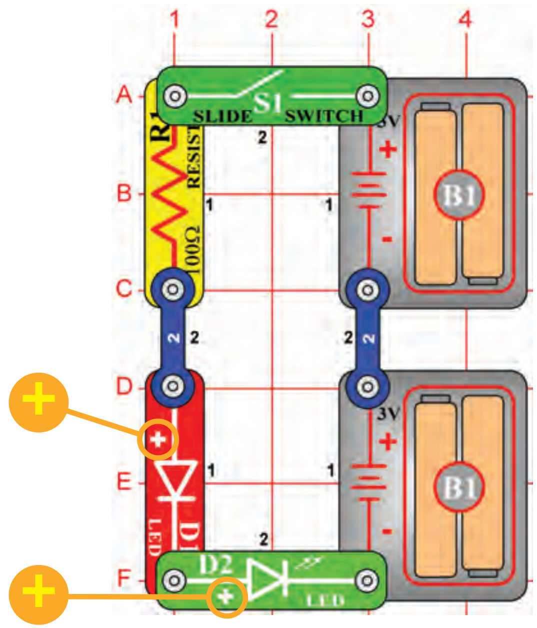
You may order additional / replacement parts at: www.snapcircuits.net

Project Listings

Project Listings

☐ Project #102 — Batteries in Series

OBJECTIVE: To show the increase in voltage when batteries are connected in series.

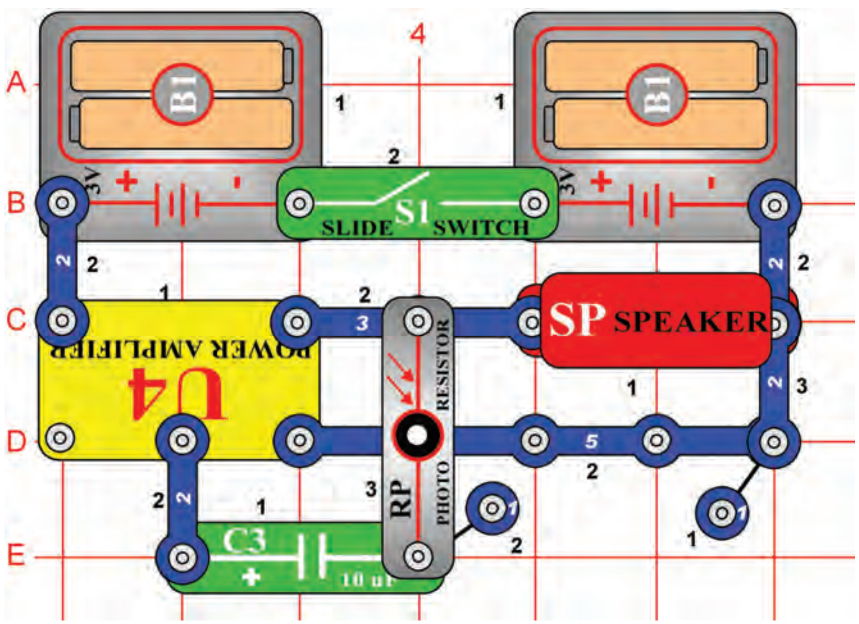


When you turn on the slide switch (S1), current flows from the batteries through the slide switch, the 100Ω resistor (R1), the LED (D1), through the LED (D2), and back to the second group of batteries (B1). Notice how both LED's are lit. The voltage is high enough to turn on both LED's when the batteries are connected in series. If only one set of batteries is used, the LED's will not light up.

Some devices use only one 1.5 volt battery, but they make hundreds of volts electronically from this small source. A flash camera is an example of this.

☐ Project #103 — Ticking Screecher

OBJECTIVE: To make fun sounds using light.



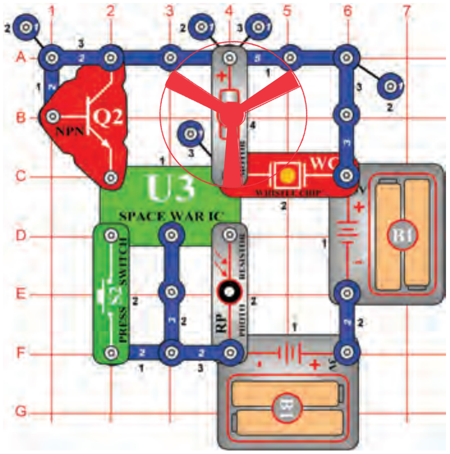
Build the circuit as shown, and turn on the slide switch (S1). Vary the amount of light to the photoresistor (RP) by partially covering it with your hand. You can make screeching sounds by allowing just a little light to reach the photoresistor.

If you replace the 10μF capacitor (C3) with a 3-snap wire or any of the other capacitors (C1, C2, C4, or C5), then the sound will be a little different.

Project #104

Spacey Fan

***OBJECTIVE:** To build a fan with sound that is activated by light.*



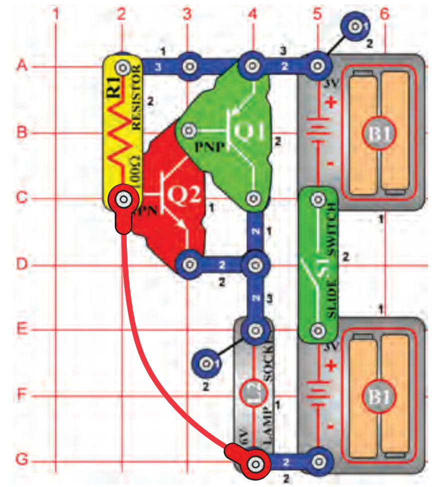
Place the fan onto the motor (M1). Sounds are heard if light shines on the photoresistor (RP) OR if you press the press switch (S2), the fan may start to spin, but will only get to high speed if you do BOTH. Try various combinations of shining light and holding down the press switch.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #105

Two-Transistor Light Alarm

***OBJECTIVE:** To compare transistor circuits.*

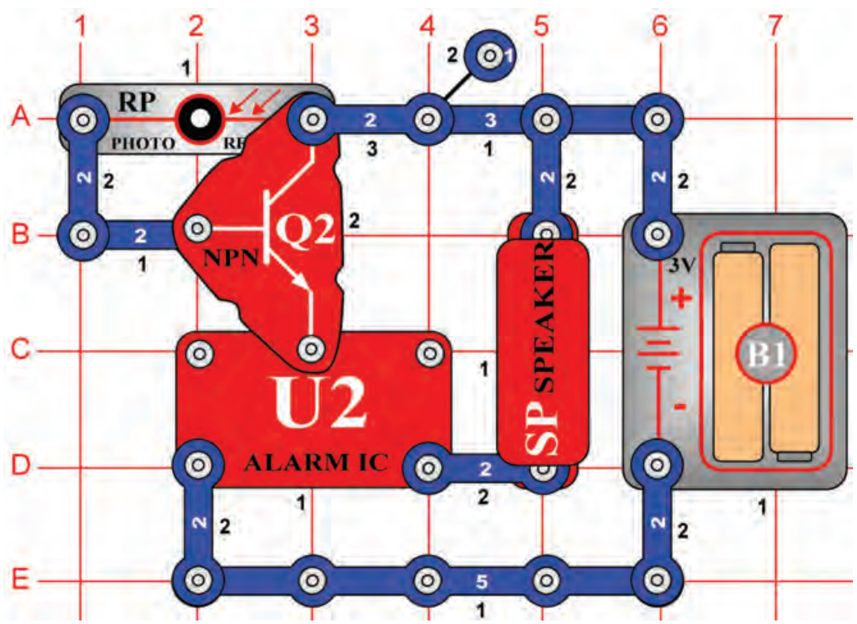


This light alarm circuit uses two transistors (Q1 & Q2) and both sets of batteries. Build the circuit with the jumper connected as shown, and turn it on. Nothing happens. Break the jumper connection and the lamp (L2) turns on. You could replace the jumper with a longer wire and run it across a doorway to signal an alarm when someone enters.

Project #106

Light-controlled Alarm

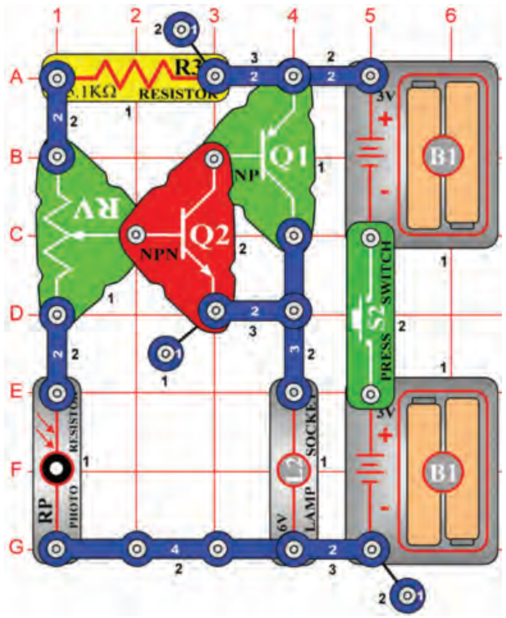
***OBJECTIVE:** To show how light is used to turn an alarm.*



The alarm will sound, as long as light is present. Slowly cover the photoresistor (RP), and the volume goes down. If you turn off the lights, the alarm will stop. The amount of light changes the resistance of the photoresistor (less light means more resistance). The photoresistor and transistor (Q2) act like a dimmer switch, adjusting the voltage applied to the alarm.

This type of circuit is used in alarm systems to detect light. If an intruder turned on a light or hit the sensor with a flashlight beam, the alarm would trigger and probably force the intruder to leave.

Project #107



Automatic Street Lamp

***OBJECTIVE:** To show how light is used to control a street lamp.*

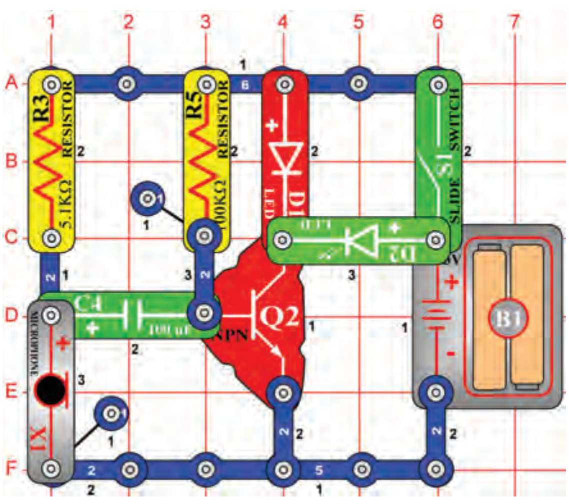
Press the press switch (S2) on and set the adjustable resistor (RV) so the lamp (L2) just lights. Slowly cover the photoresistor (RP) and the lamp brightens. If you place more light at the photoresistor the light dims.

This is an automatic street lamp that you can turn on by a certain darkness and turn off by a certain brightness. This type of circuit is installed on many outside lights and forces them to turn off and save electricity. They also come on when needed for safety.

Project #108

Voice-controlled Rays of Light

***OBJECTIVE:** To show how light is stimulated by sound.*

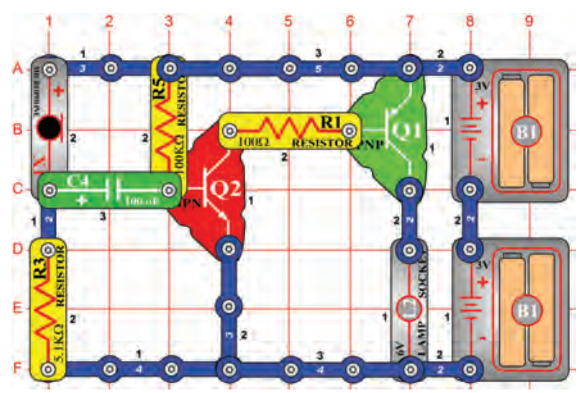


Turn the slide switch (S1) on. There will be only a weak light emitting from the green LED (D2). By blowing on the mic (X1) or putting it near a radio or TV set, the green LED will emit light, and its brightness changes as the loudness changes.

Project #109

Blowing Off the Electric Light

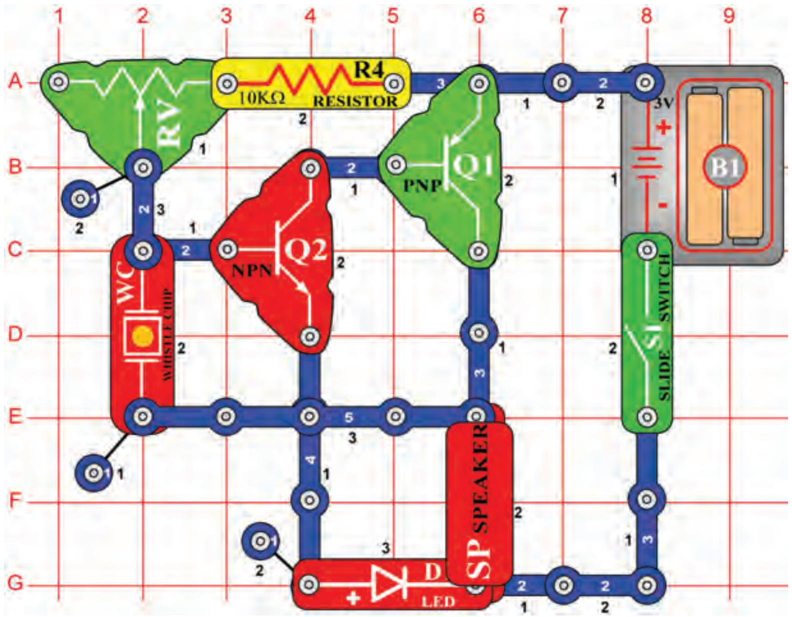
***OBJECTIVE:** To show how light is stimulated by sound.*



Install the parts. The lamp (L2) will be on. It will be off as long as you blow on the mic (X1). Speaking loud into the mic will change the brightness of the lamp.

Project #110

Adjustable Tone Generator



OBJECTIVE: To show how resistor values change the frequency of an oscillator.

Turn on the slide switch (S1); the speaker (SP) will sound and the LED (D1) will light. Adjust the adjustable resistor (RV) to make different tones. In an oscillator circuit, changing the values of resistors or capacitors can vary the output tone or pitch.

Project #111

Photosensitive Electronic Organ

OBJECTIVE: To show how resistor values change the frequency of an oscillator.

Use the circuit from project #110 shown above. Replace the 10kΩ resistor (R4) with the photoresistor (RP). Turn on the slide switch (S1). The speaker (SP) will sound and the LED (D1) will light. Move your hand up and down over the photoresistor and the frequency changes. Decreasing the light on the photoresistor increases the resistance and causes the circuit to oscillate at a lower frequency. Notice that the LED flashes also at the same frequency as the sound.

By using your finger, see if you can vary the sounds enough to make this circuit sound like an organ playing.

Project #112

Electronic Cicada

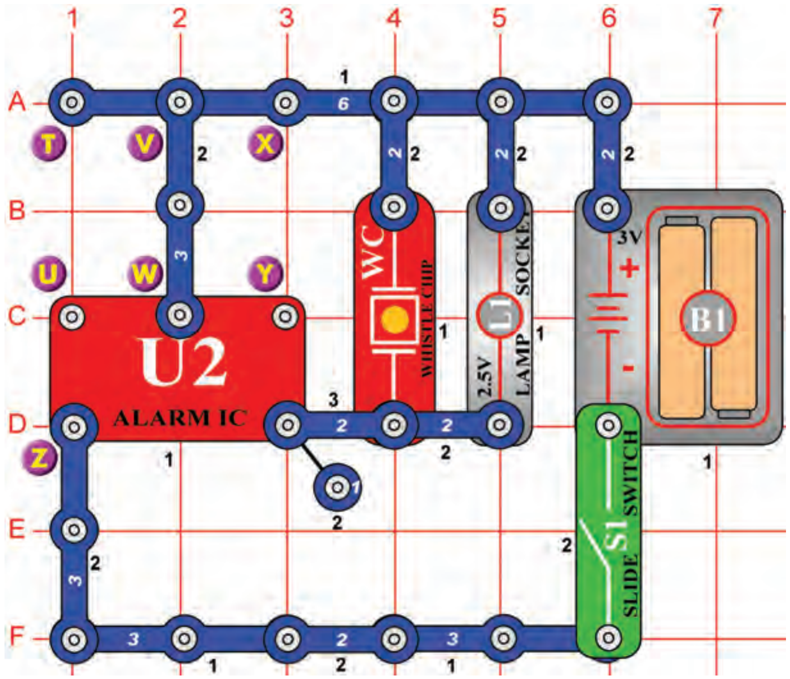
OBJECTIVE: To show how capacitors in parallel change the frequency of an oscillator.

Use the circuit from project #110 shown above, replace the photoresistor (RP) back to the 10kΩ resistor (R4). Place the 0.02μF capacitor (C1) on top of the whistle chip (WC). Place the slide switch (S1) on and adjust the adjustable resistor (RV). The circuit produces the sound of the cicada insect. By placing the 0.02μF capacitor on top of the whistle chip, the circuit oscillates at a lower frequency. Notice that the LED (D1) flashes also at the same frequency.

It is possible to pick resistors and capacitors that will make the pitch higher than humans can hear. Many animals, however, can hear these tones. For example, a parakeet can hear tones up to 50,000 cycles per second, but a human can only hear to 20,000.

Project #113 — Light & Sounds

OBJECTIVE: To build a police siren with light.



Turn on the slide switch (S1). A police siren is heard and the lamp (L1) lights.

Project #114 — More Light & Sounds

OBJECTIVE: To show a variation of the circuit in project #113.

Modify the last circuit by connecting points X & Y. The circuit works the same way but now it sounds like a machine gun.

Project #115 — More Light & Sounds (II)

OBJECTIVE: To show a variation of the circuit in project #113.

Now remove the connection between X & Y and then make a connection between T & U. Now it sounds like a fire engine.

Project #116 — More Light & Sounds (III)

OBJECTIVE: To show a variation of the circuit in project #113.

Now remove the connection between T & U and then make a connection between U & Z. Now it sounds like an ambulance.

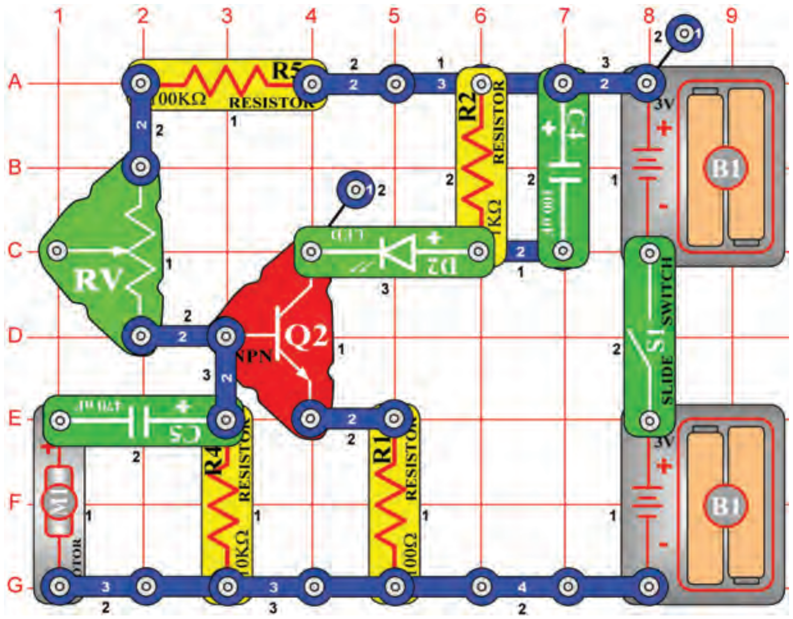
Project #117 — More Light & Sounds (IV)

OBJECTIVE: To show a variation of the circuit in project #113.

Now remove the connection between U & Z, then place the 470μF capacitor (C5) between T & U ("+" side to T). The sound changes after a few seconds.

Project #118 — Motor Speed Detector

OBJECTIVE: To show how to make electricity in one direction.

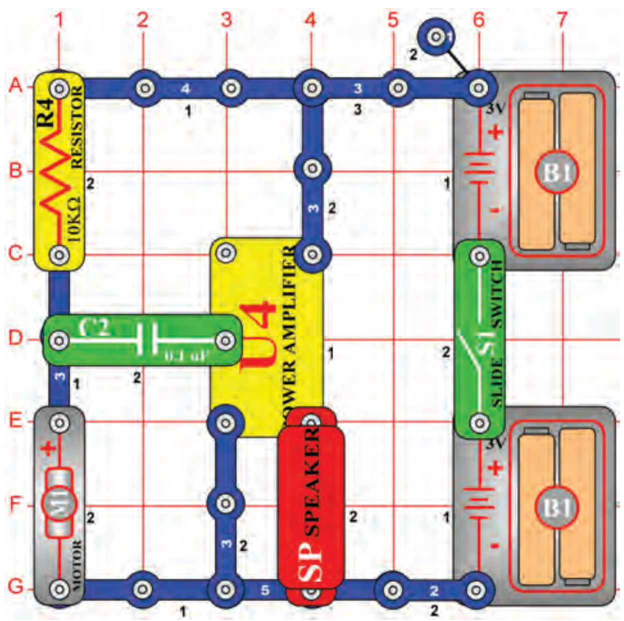


When building the circuit, be sure to position the motor (M1) with the positive (+) side snapped to the 470μF capacitor (C5). Turn on the slide switch (S1), nothing will happen. It is a motor speed detector, and the motor isn't moving. Watch the LED (D2) and give the motor a good spin CLOCKWISE with your fingers (don't use the fan blade); you should see a flash of light. The faster you spin the motor, the brighter the flash will be. As a game, see who can make the brightest flash.

Now try spinning the motor in the opposite direction (counter-clockwise) and see how bright the flash is — it won't flash at all because the electricity it produces, flows in the wrong direction and won't activate the diode. Flip the motor around (positive (+) side snapped to the 3-snap wire) and try again. Now the LED lights only if you spin the motor counter-clockwise.

Project #119 — Old-Style Typewriter

OBJECTIVE: To show how a generator works.



Turn on the slide switch (S1), nothing will happen. Turn the motor (M1) slowly with your fingers (don't use the fan blade), you will hear a clicking that sounds like an old-time manual typewriter keystrokes. Spin the motor faster and the clicking speeds up accordingly.

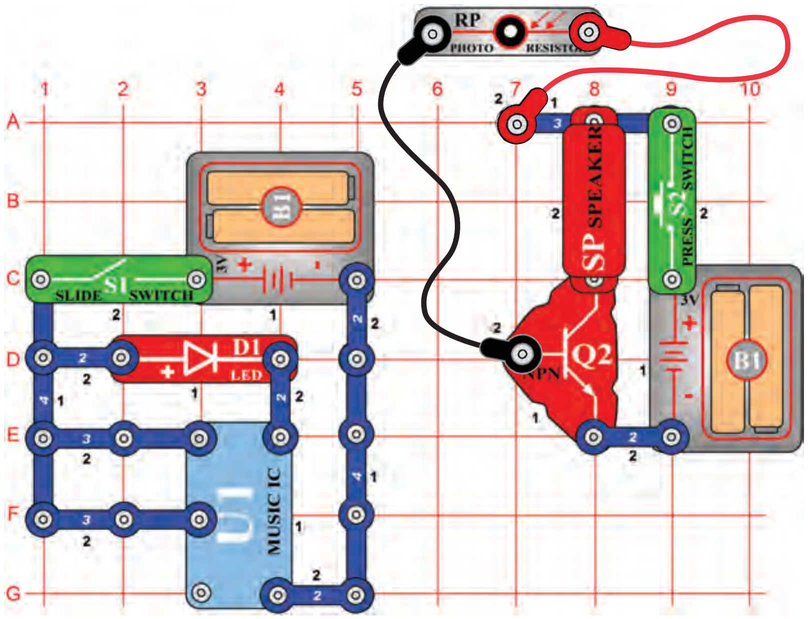
This circuit works the same if you spin the motor in either direction (unlike the Motor Speed Detector project).

By spinning the motor with your fingers, the physical effort you exert is converted into electricity. In electric power plants, steam is used to spin large motors like this, and the electricity produced is used to run everything in your town.

☐ ## Project #120

Optical Transmitter & Receiver

OBJECTIVE: To show how information can be transmitted using light.



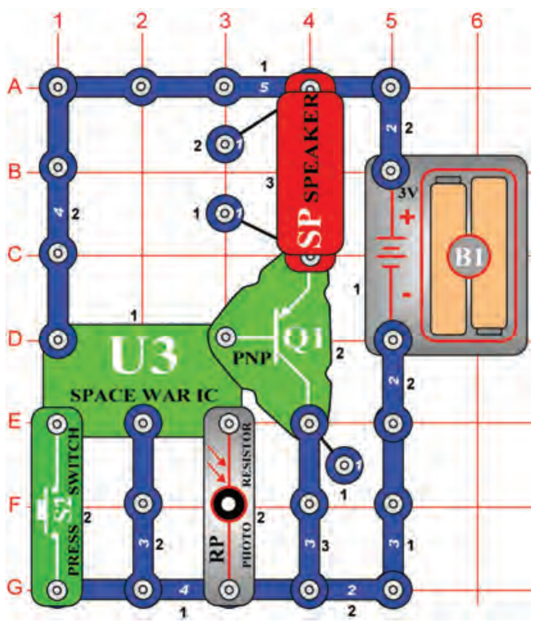
Build the circuit shown. Connect the photoresistor (RP) to the circuit using the red & black jumper wires. Place the photoresistor upside down over the red LED (D1), so the LED goes inside the photoresistor. Turn on both switches (hold down the press switch button). Music plays on the speaker, even though the two parts of the circuit are not electrically connected.

The left circuit, with the LED and music IC (U1) creates a music signal and transmits it as light. The right circuit, with the photoresistor and speaker, receives the light signal and converts it back to music. Here the photoresistor has to be on top of the LED for this to work, but better communication systems (such as fiber optic cables), can transmit information over enormous distances at very high speeds.

☐ ## Project #121

Space War Sounds Controlled By Light

OBJECTIVE: To change the sounds of a multiple space war with light.



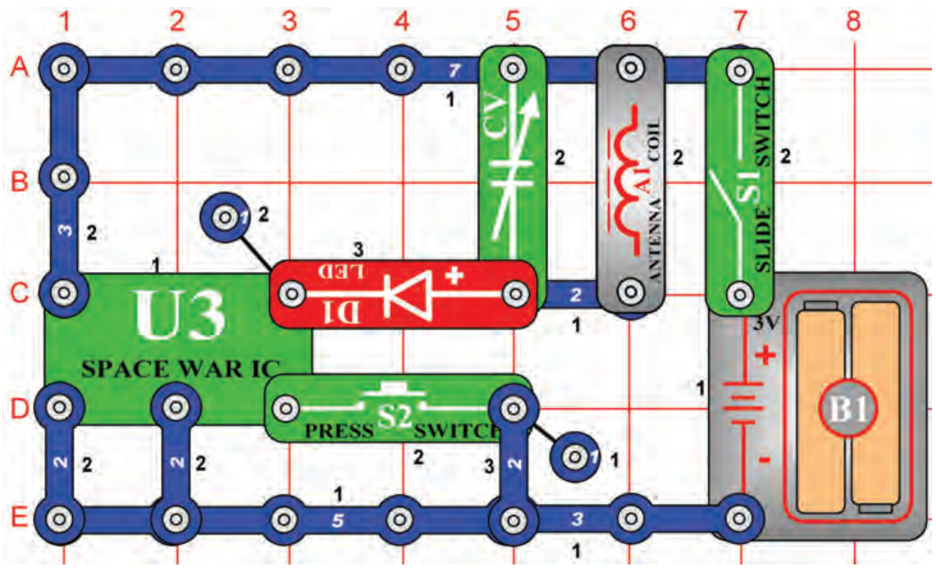
The space war IC (U3) will play a sound continuously. Block the light to the photoresistor (RP) with your hand. The sound will stop. Remove your hand and a different sound is played. Wave your hand over the photoresistor to hear all the different sounds.

Press the press switch down and now two space war sounds are played. If you hold the press switch down the sound repeats. Press the press switch again and a different sound is played. Keep pressing the press switch to hear all the different combinations of sounds.

☐ **Project #122**

Space War Radio

OBJECTIVE: To transmit Space War sounds to a AM radio.



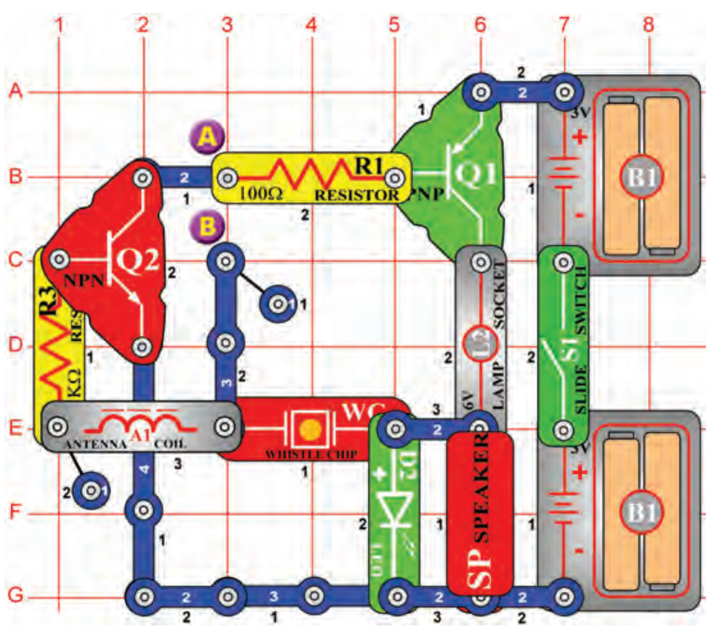
Place the circuit next to an AM radio. Tune the radio so no stations are heard and turn on the slide switch (S1). You should hear the space war sounds on the radio. The red LED (D1) should also be lit. Adjust the variable capacitor (CV) for the loudest signal. Push the press switch (S2) to change the sound.

You have just performed the experiment that took Marconi (who invented the radio) a lifetime to invent. The technology of radio transmission has expanded to the point that we take it for granted. There was a time, however, when news was only spread by word of mouth.

☐ **Project #123**

The Lie Detector

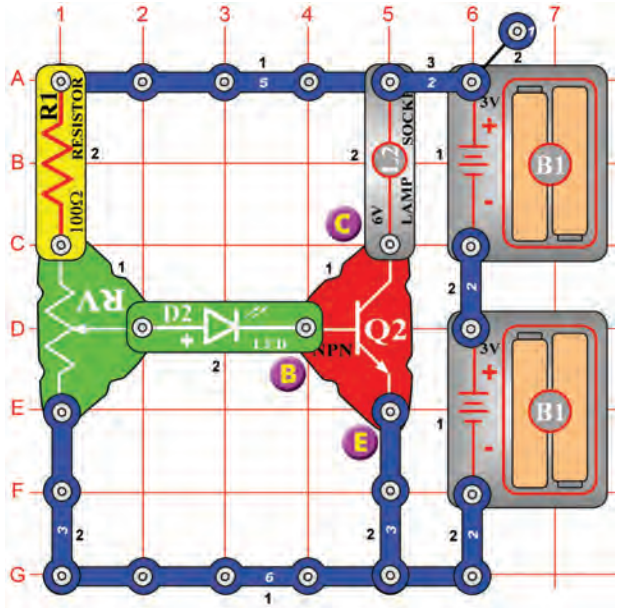
OBJECTIVE: To show how sweat makes a better conductor.



Turn on the slide switch (S1) and place your finger across points A & B. The speaker (SP) will output a tone and the LED (D2) will flash at the same frequency. Your finger acts as a conductor connecting points A & B. When a person is lying, one thing the body starts to do is sweat. The sweat makes the finger a better conductor by reducing its resistance.

As the resistance drops, the frequency of the tone increases. Lightly wet your finger and place it across the two points again. Both the output tone and LED flashing frequency increase, and the lamp (L2) may begin to light. If your finger is wet enough, then the lamp will be bright and the sound stops - indicating you are a big liar! Now change the wetness of your finger by drying it and see how it affects the circuit. This is the same principle used in lie detectors that are sold commercially.

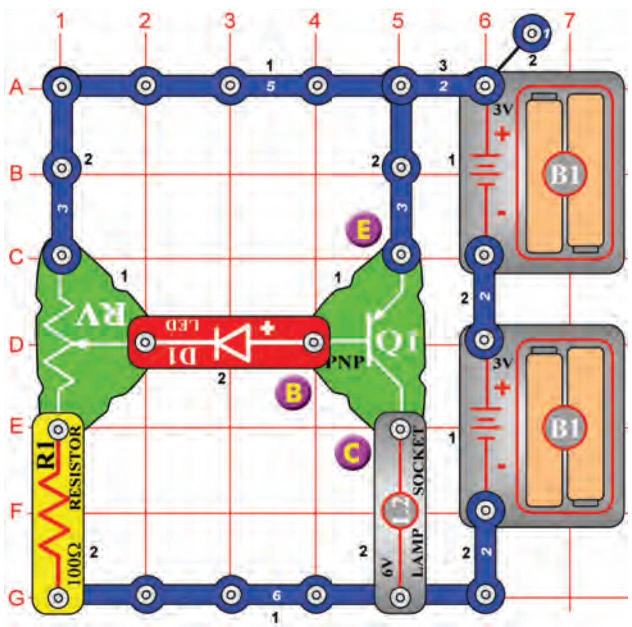
☐ Project #124 — NPN Amplifier



OBJECTIVE: To compare transistor circuits.

There are three connection points on an NPN transistor (Q2), called base (marked B), emitter (marked E), and collector (marked C). When a small electric current flows from the base to the emitter, a larger (*amplified*) current will flow from the collector to the emitter. Build the circuit and slowly move up the adjustable resistor (RV) control. When the LED (D2) becomes bright, the lamp (L2) will also turn on and will be much brighter.

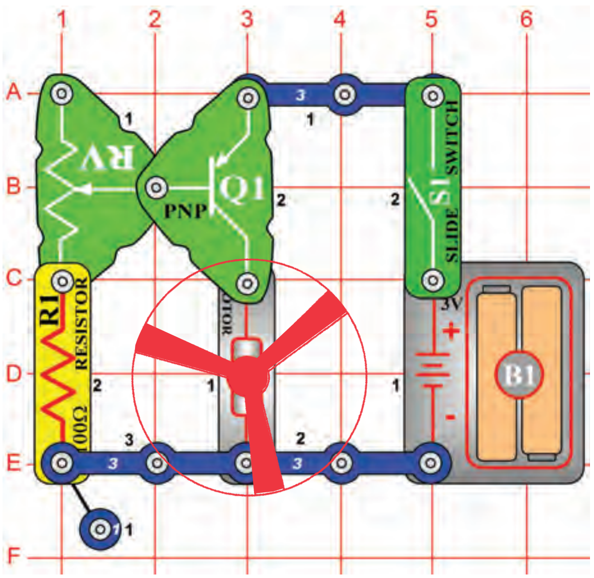
☐ Project #125 — PNP Amplifier



OBJECTIVE: To compare transistor circuits.

The PNP transistor (Q1) is similar to the NPN transistor (Q2) in project #166, except that the electric currents flow in the opposite directions. When a small electric current flows from the emitter to the base, a larger (*amplified*) current will flow from the emitter to the collector. Build the circuit and slowly move up the adjustable resistor (RV) control. When the LED (D1) becomes bright, the lamp (L2) will also turn on and will be much brighter.

Project #126 Sucking Fan



OBJECTIVE: To adjust the speed of a fan.

Build the circuit, and be sure to orient the motor (M1) with the positive (+) side down as shown. Turn it on, and set the adjustable resistor (RV) for the fan speed you like best. If you set the speed too fast then the fan may fly off the motor. Due to the shape of the fan blades and the direction the motor spins, air is sucked into the fan and towards the motor. Try holding a piece of paper just above the fan to prove this. If this suction is strong enough then it can lift the fan blades, just like in a helicopter.

The fan will not move on most settings of the resistor, because the resistance is too high to overcome friction in the motor. If the fan does not move at any resistor setting, then replace your batteries.

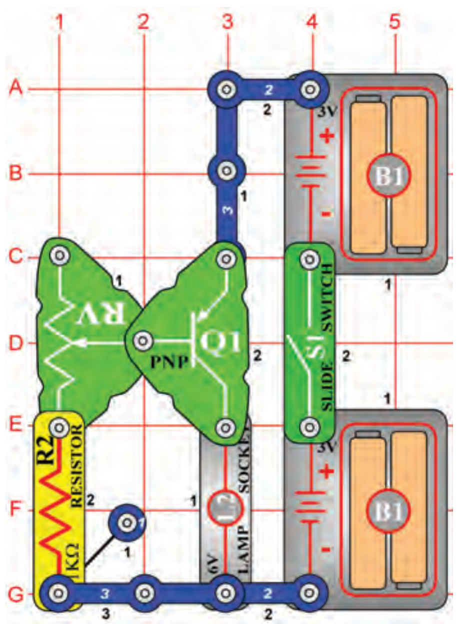
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #127 Blowing Fan

OBJECTIVE: To build a fan that won't come off.

Modify the circuit from project #126 by reversing the position of the motor (M1), so the positive (+) side is towards the PNP (Q1). Turn it on, and set the adjustable resistor (RV) for the fan speed you like best. Set it for full speed and see if the fan flies off - it won't! The fan is blowing air upward now! Try holding a piece of paper just above the fan to prove this.

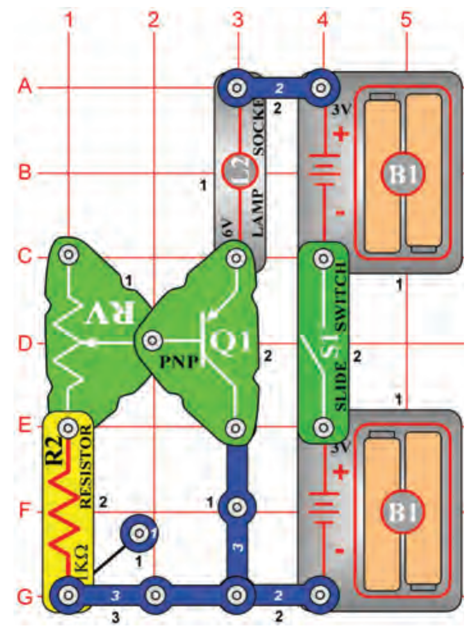
Project #128 PNP Collector



OBJECTIVE: To demonstrate adjusting the gain of a transistor circuit.

Build the circuit and vary the lamp (L2) brightness with the adjustable resistor (RV), it will be off for most of the resistor's range. The point on the PNP (Q1) that the lamp is connected to (point E4 on the base grid) is called the collector, hence the name for this project.

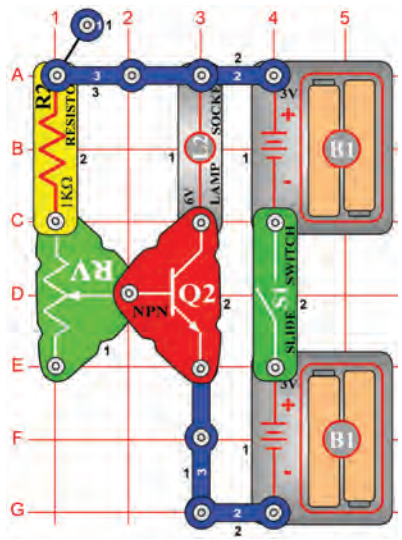
Project #129 PNP Emitter



OBJECTIVE: To compare transistor circuits.

Compare this circuit to that in project #128. The maximum lamp (L2) brightness is less here because the lamp resistance reduces the emitter-base current, which contacts the emitter-collector current (as per project #128). The point on the PNP (Q1) that the lamp is now connected to (grid point C4) is called the emitter.

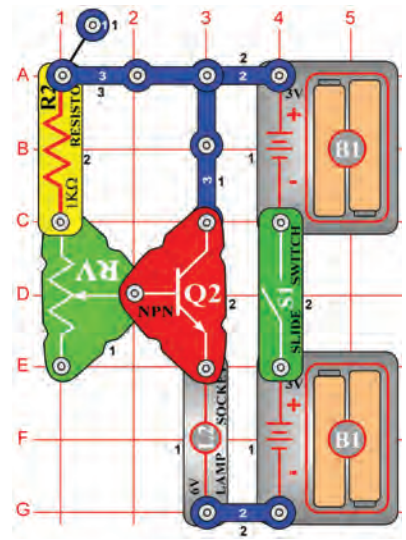
Project #130
NPN Collector



***OBJECTIVE:** To compare transistor circuits.*

Compare this circuit to that in project #128, it is the NPN transistor (Q2) version and works the same way. Which circuit makes the lamp (L2) brighter? (They are about the same because both transistors are made from the same materials).

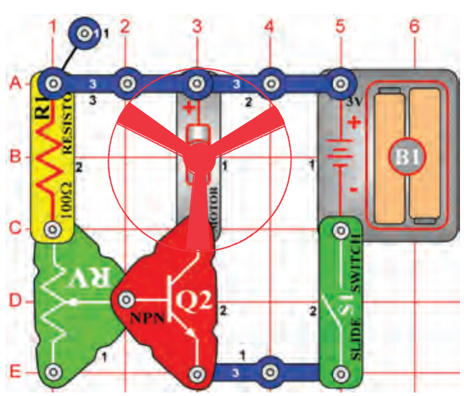
Project #131
NPN Emitter



***OBJECTIVE:** To compare transistor circuits.*

Compare this circuit to that in project #129. It is the NPN transistor (Q2) version and works the same way. The same principles apply here as in projects #128-#130, so you should expect it to be less bright than #130 but as bright as #129.

Project #132
NPN Collector - Motor



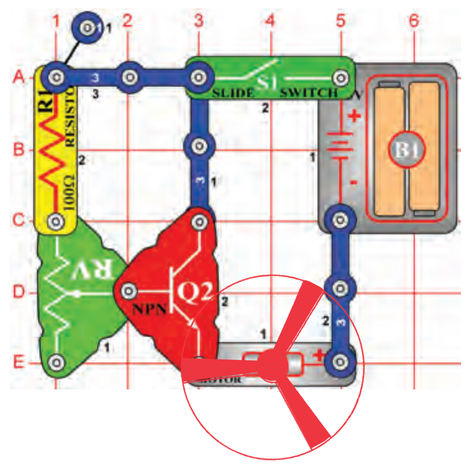
***OBJECTIVE:** To compare transistor circuits.*

This is the same circuit as in project #130, except that it has the motor (M1) instead of the lamp. Place the motor with the positive (+) side touching the NPN and put the fan on it.

The fan will not move on most settings of the resistor, because the resistance is too high to overcome friction in the motor. If the fan does not move at any resistor setting, then replace your batteries.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #133
NPN Emitter - Motor



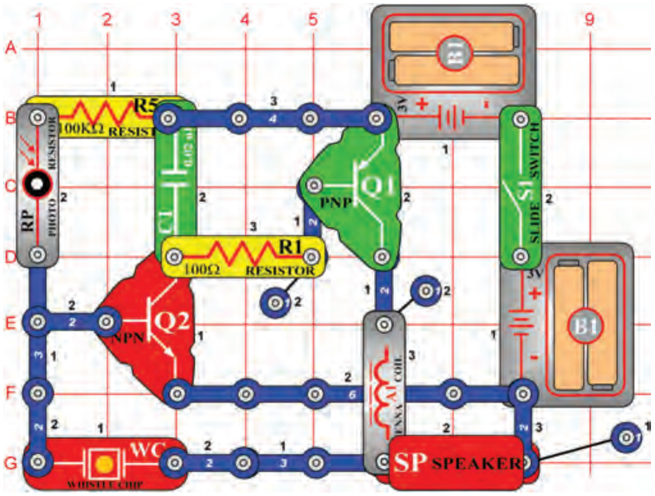
***OBJECTIVE:** To compare transistor circuits.*

This is the same circuit as in project #131, except that it has the motor (M1) instead of the lamp. Place the motor with the positive (+) side to the right and put the fan on it. Compare the fan speed to that in project #132. Just as the lamp was dimmer in the emitter configuration, the motor is not as fast now.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #134

Buzzing in the Dark



OBJECTIVE: To make a circuit that buzzes when the lights are off.

This circuit makes a high-frequency screaming sound when light shines on the photoresistor (RP), and makes a buzzing sound when you shield the photoresistor.

☐ Project #135

Touch Buzzer

OBJECTIVE: To build a human buzzer oscillator.

Remove the photoresistor (RP) from the circuit in project #134 and instead touch your fingers across where it used to be (points B1 and D1 on the grid) to hear a cute buzzing sound.
The circuit works because of the resistance in your body. If you put back the photoresistor and partially cover it, you should be able to make the same resistance your body did, and get the same sound.

☐ Project #136

High Frequency Touch Buzzer

OBJECTIVE: To build a high frequency human buzzer oscillator.

Replace the speaker (SP) with the 6V lamp (L2). Now touching your fingers between B1 and D1 creates a quieter but more pleasant buzzing sound.

☐ Project #137

High Frequency Water Buzzer

OBJECTIVE: To build a high frequency water buzzer oscillator.

Now connect two (2) jumpers to points B1 and D1 (that you were touching with your fingers) and place the loose ends into a cup of water. The sound will not be much different now, because your body is mostly water and so the circuit resistance has not changed much.

☐ Project #138

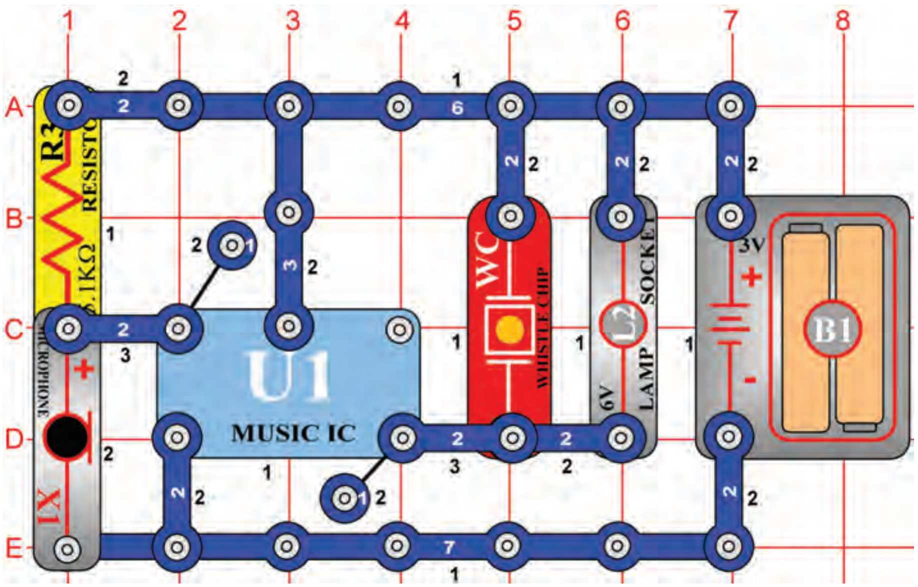
Mosquito

OBJECTIVE: To make a buzz like a mosquito.

Place the photoresistor (RP) into the circuit in project #137 across where you were connecting the jumpers (points B1 and D1 on the grid, and as shown in project #134). Now the buzz sounds like a mosquito.

Project #139

High Sensitivity Voice Doorbell



OBJECTIVE: To build a highly sensitive voice-activated doorbell.

Build the circuit and wait until the sound stops. Clap or talk loud a few feet away and the music plays again. The microphone (X1) is used here because it is very sensitive.

Project #140

Louder Doorbell

OBJECTIVE: To build a loud highly sensitive voice-activated doorbell.

Replace the 6V lamp (L2) with the antenna coil (A1), the sound is louder now.

Project #141

Very Loud Doorbell

OBJECTIVE: To build a very loud, highly-sensitive, voice-activated doorbell.

Replace the antenna coil (A1) with the speaker (SP), the sound is much louder now.

Project #142

Doorbell with Button

OBJECTIVE: To build a press-activated doorbell.

Replace the microphone (X1) with the press switch (S2) and wait until the music stops. Now you have to press the slide switch (S1) to activate the music, just like the doorbell on your house.

Project #143

Darkness Announcer

OBJECTIVE: To play music when it gets dark.

Replace the press switch (S2) with the photoresistor (RP) and wait until the sound stops. If you cover the photoresistor now the music will play once, signaling that it has gotten dark. If the speaker (SP) is too loud then you may replace it with the antenna coil (A1).

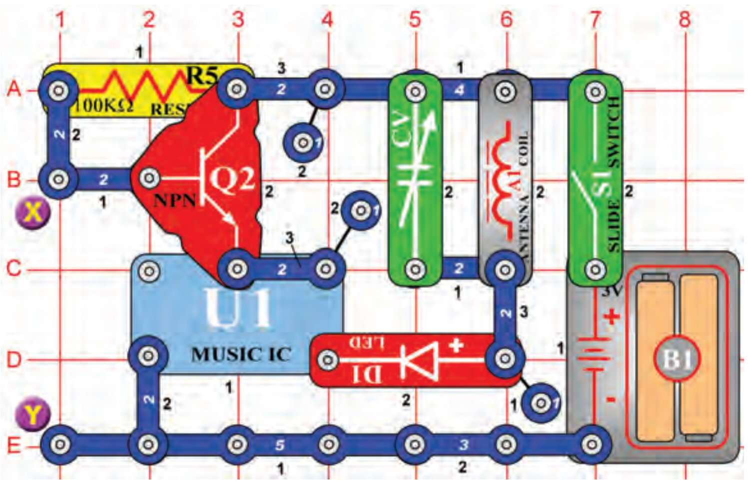
Project #144

Musical Motion Detector

OBJECTIVE: To detect when someone spins the motor.

Replace the photoresistor (RP) with the motor (M1), oriented in either direction. Now spinning the motor will re-activate the music.

Project #145 Radio Music Alarm



OBJECTIVE: To build a radio music alarm.

You need an AM radio for this project. Build the circuit on the left and turn on the slide switch (S1). Place it next to your AM radio and tune the radio frequency to where no other station is transmitting. Then, tune the adjustable capacitor (CV) until your music sounds best on the radio. Now connect a jumper wire between X and Y on the drawing, the music stops.

If you remove the jumper now, the music will play indicating your alarm wire has been triggered. You could use a longer wire and wrap it around a bike, and use it as a burglar alarm!

Project #146 Daylight Music Radio

OBJECTIVE: To build a light-controlled radio transmitter.

Remove the jumper wire. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Now your AM radio will play music as long as there is light in the room.

Project #147 Night Music Radio

OBJECTIVE: To build a dark-controlled radio transmitter.

Put the 100kΩ resistor back in as before and instead connect the photoresistor between X & Y (you also need a 1-snap and a 2-snap wire to do this). Now your radio plays music when it is dark.

Project #148 Night Gun Radio

OBJECTIVE: To build a dark-controlled radio transmitter.

Replace the music IC (U1) with the alarm IC (U2). Now your radio plays the sound of a machine gun when it is dark.

Project #149 Radio Gun Alarm

OBJECTIVE: To build a radio alarm.

Remove the photoresistor (RP). Now connect a jumper wire between X & Y on the drawing.
If you remove the jumper now, the machine gun sound will play on the radio indicating your alarm wire has been triggered.

Project #150 Daylight Gun Radio

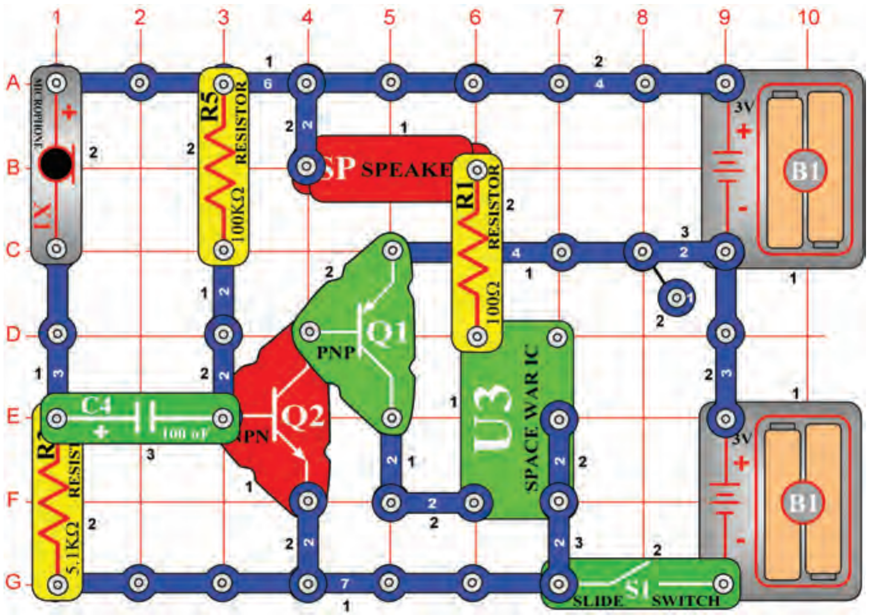
OBJECTIVE: To build a light-controlled radio transmitter.

Remove the jumper wire. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Now your AM radio will play the machine gun sound as long as there is light in the room.

To learn more about how circuits work, visit www.snapcircuits.net or page 74 to find out about our Student Guides.

Project #151 Blow Off a Space War

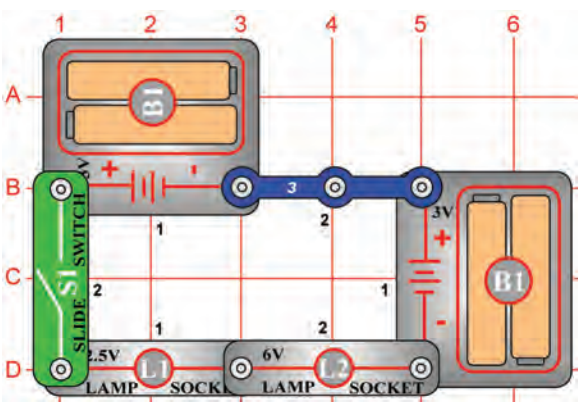
OBJECTIVE: To turn off a circuit by blowing on it.



Build the circuit and turn it on, you hear a space war. Since it is loud and annoying, try to shut it off by blowing into the microphone (X1). Blowing hard into the microphone stops the sound, and then it starts again.

Project #152 Series Lamps

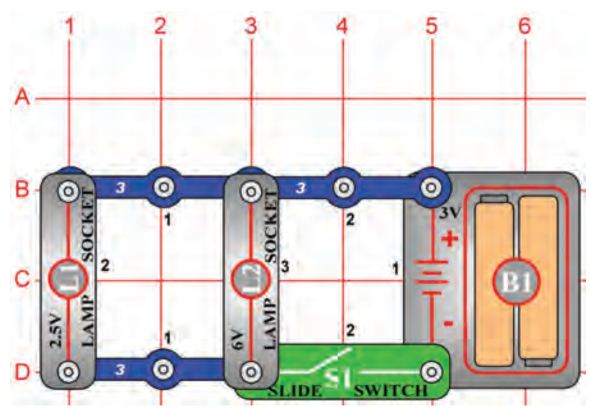
OBJECTIVE: To compare types of circuits.



Turn on the slide switch (S1) and both lamps (L1 & L2) will light. If one of the bulbs is broken then neither will be on, because the lamps are in series. An example of this is the strings of small Christmas lights; if one bulb is damaged then the entire string does not work.

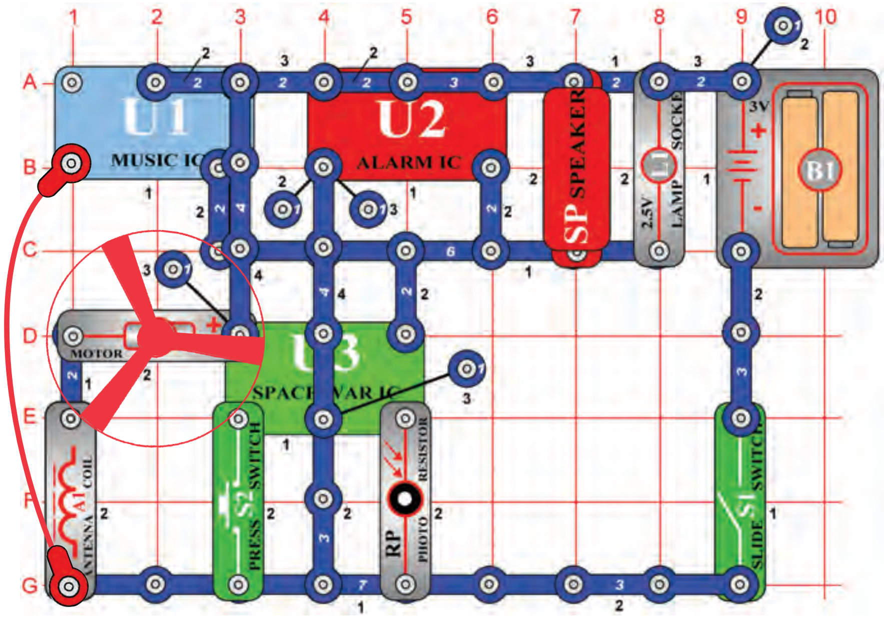
Project #153 Parallel Lamps

OBJECTIVE: To compare types of circuits.



Turn on the slide switch (S1) and both lamps (L1 & L2) will light. If one of the bulbs is broken then the other will still be on, because the lamps are in parallel. An example of this is most of the lights in your house; if a bulb is broken on one lamp then the other lamps are not affected.

Project #154 Fire Fan Symphony



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated circuits.

Build the circuit shown and add the jumper to complete it. Note that in one place two (2) single snaps are stacked on top of each other. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC). Turn it on and press the press switch (S2) several times and wave your hand over the photoresistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

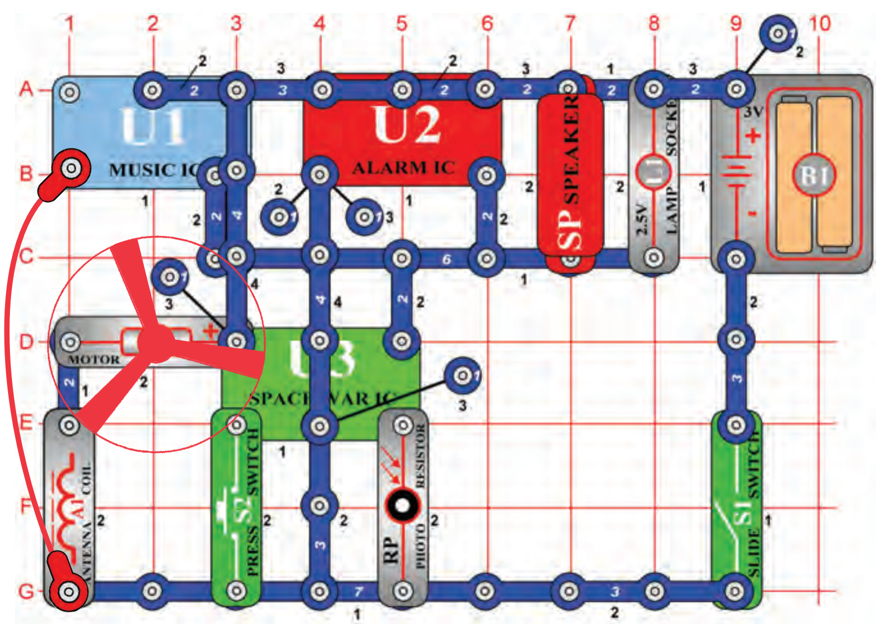
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #155 Fire Fan Symphony (II)

OBJECTIVE: See project #154.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #156 Fan Symphony



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated circuits.

Modify the circuit from project #154 to match the circuit shown on the left. The only differences are the connections around the alarm IC (U2). It works the same way.

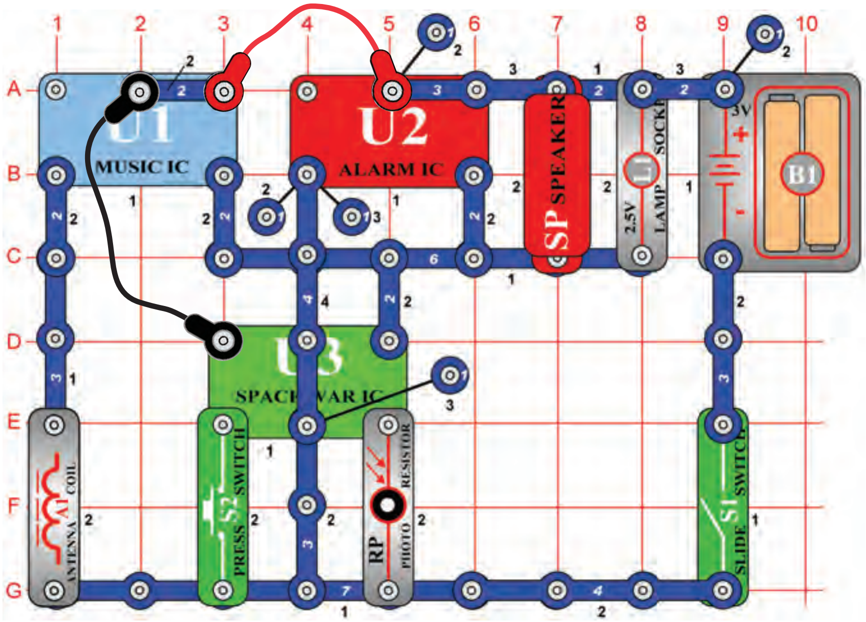
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #157 Fan Symphony (II)

OBJECTIVE: See project #156.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #158 Police Car Symphony



OBJECTIVE: To combine sounds from the integrated circuits.

Build the circuit shown and add the two (2) jumper wires to complete it. Note that in one place two (2) single snaps are stacked on top of each other. Turn it on and press the press switch (S2) several times and wave your hand over the photoresistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

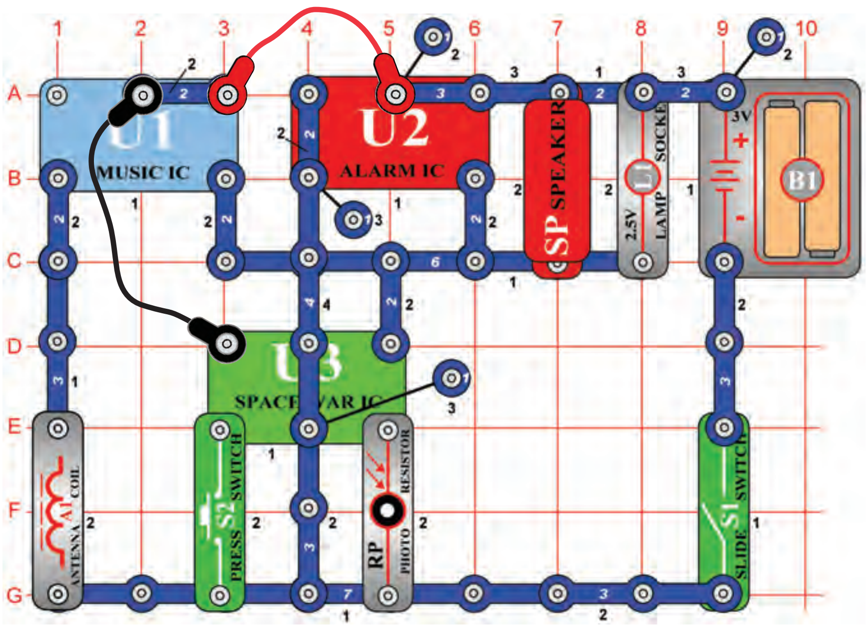
Do you know why the antenna (A1) is used in this circuit? It is being used as just a 3-snap wire, because it acts like an ordinary wire in low frequency circuits such as this. Without it, you don't have enough parts to build this complex circuit.

Project #159 Police Car Symphony (II)

OBJECTIVE: See project #158.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #160 Ambulance Symphony



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated circuits.

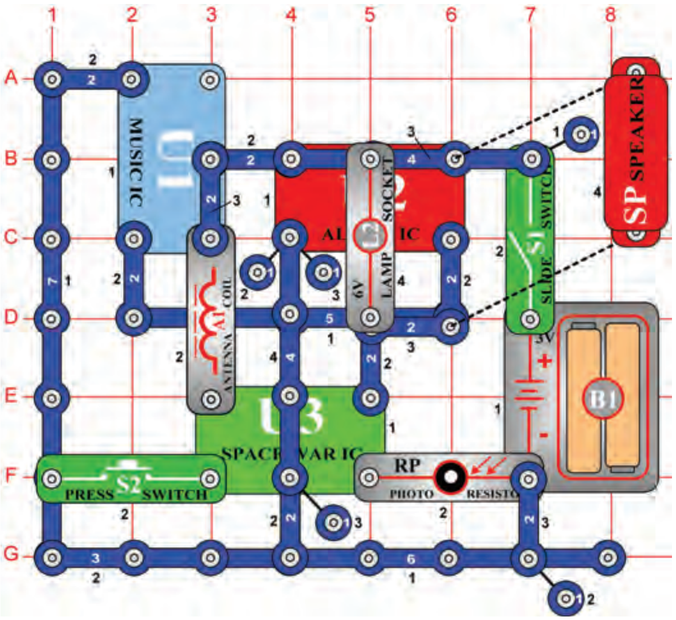
Modify the circuit from project #158 to match the circuit shown on the left. The only differences are the connections around the alarm IC (U2). It works the same way.

Project #161 Ambulance Symphony (II)

OBJECTIVE: See project #160.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

☐ Project #162 Static Symphony



OBJECTIVE: To combine sounds from the integrated circuits.

Build the circuit shown. Note that in some places parts are stacked on top of each other. Turn it on and press the press switch (S2) several times and wave your hand over the photoresistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

☐ Project #163 Static Symphony (II)

OBJECTIVE: *See project #162.*

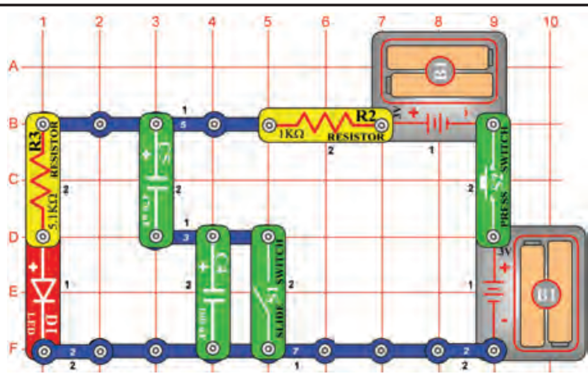
For a variation on the preceding circuit, you can replace the 6V lamp (L2) with the LED (D1), with the positive (+) side up, or the motor (M1) (do not place the fan on it).

☐ Project #164 Capacitors in Series

OBJECTIVE: To compare types of circuits.

Turn on the slide switch (S1), then press and release the press switch (S2). The LED (D1) becomes bright when the 470μF capacitor charges up with the press switch on, then the LED slowly gets dim after you release the press switch.

Now turn off the slide switch. Repeat the test with the slide swtich off; you'll notice the LED goes out much faster after you release the press switch. The much smaller 100μF capacitor (C4) is now in series with the 470μF and so reduces the total capacitance (electrical storage capacity), and they discharge much faster. (Note that this is opposite to how resistors in series work).

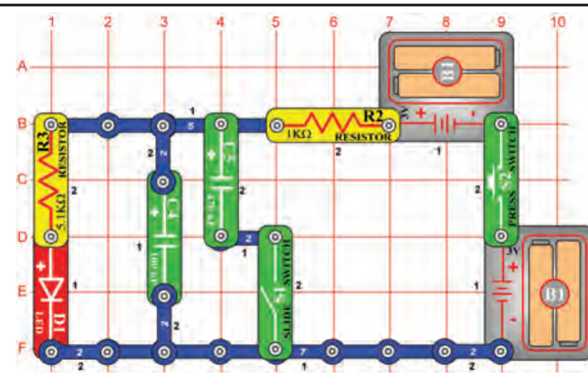


☐ Project #165 Capacitors in Parallel

OBJECTIVE: To compare types of circuits.

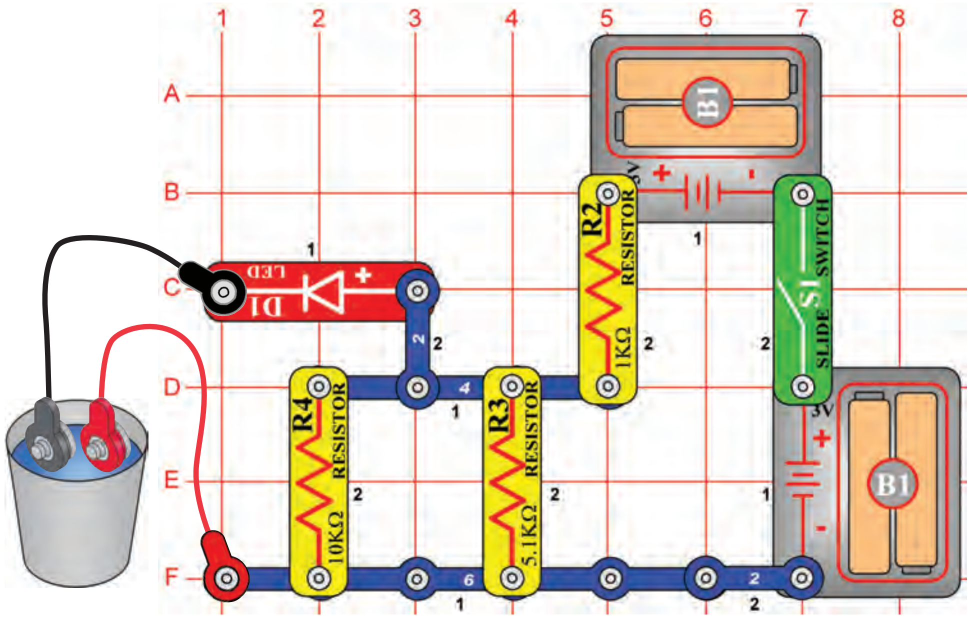
Turn off the slide switch (S1), then press and release the press switch (S2). The LED (D1) becomes bright when the 100μF capacitor charges up with the press switch on, then the LED slowly gets dim after you release the press switch.

Now turn on the slide switch and repeat the test; you'll notice the LED goes out much slower after you release the press switch. The much larger 470μF capacitor (C5) is now in parallel with the 100μF and so increases the total capacitance (electrical storage capacity), and they discharge much slower. (Note that this is opposite to how resistors in parallel work.)



Project #166 Water Detector

OBJECTIVE: To show how water conducts electricity.



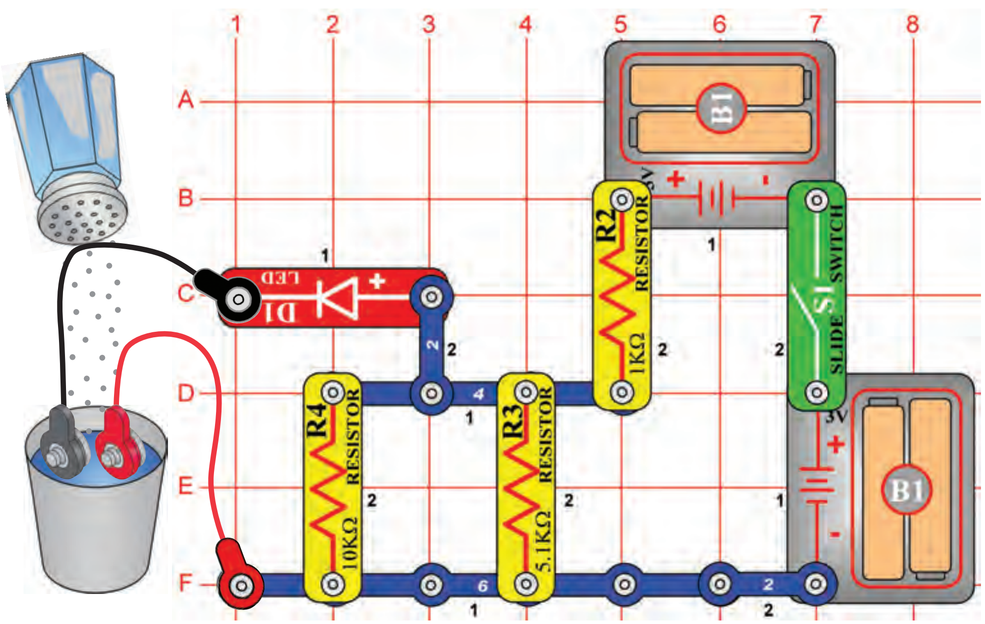
Build the circuit at left and connect the two jumpers to it, but leave the loose ends of the jumpers lying on the table initially. Turn on the slide switch (S1) - the LED (D1) will be dark because the air separating the jumpers has very high resistance. Touch the loose jumper ends to each other and the LED will be bright, because with a direct connection there is no resistance separating the jumpers.

Now take the loose ends of the jumpers and place them in a cup of water, without letting them touch each other. The LED should be dimly lit, indicating you have detected water!

For this experiment, your LED brightness may vary depending upon your local water supply. Pure water (like distilled water) has very high resistance, but drinking water has impurities mixed in that increase electrical conduction.

Project #167 Saltwater Detector

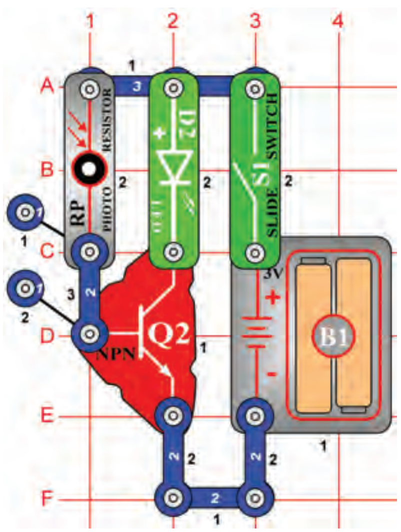
OBJECTIVE: To show how adding salt to water changes water's electrical characteristics.



Place the jumpers in a cup of water as in the preceding project; the LED (D1) should be dimly lit. Slowly add salt to the water and see how the LED brightness changes, mix it a little so it dissolves. It will slowly become very bright as you add more salt. You can use this bright LED condition as a saltwater detector! You can then reduce the LED brightness by adding more water to dilute the salt.

Take another cup of water and try adding other household substances like sugar to see if they increase the LED brightness as the salt did.

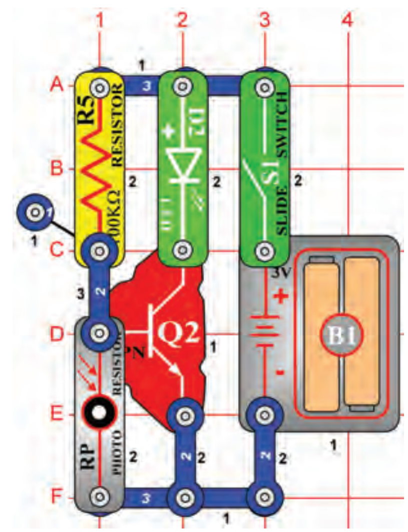
Project #168
NPN Light Control



***OBJECTIVE:** To compare transistor circuits.*

Turn on the slide switch (S1), the brightness of the LED (D2) depends on how much light shines on the photoresistor (RP). The resistance drops as more light shines, allowing more current to the NPN (Q2).

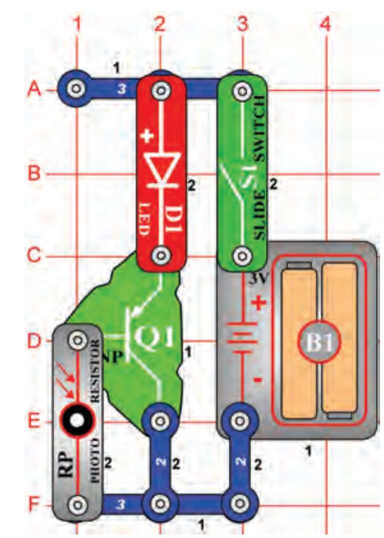
Project #169
NPN Dark Control



***OBJECTIVE:** To compare transistor circuits.*

Turn on the slide switch (S1), the brightness of the LED (D2) depends on how LITTLE light shines on the photoresistor (RP). The resistance drops as more light shines, diverting current away from the NPN (Q2).

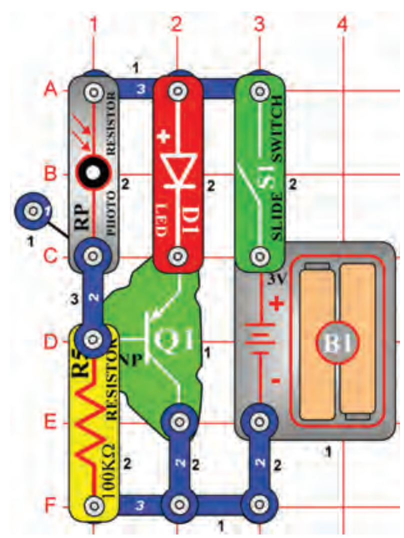
Project #170
PNP Light Control



***OBJECTIVE:** To compare transistor circuits.*

Turn on the slide switch (S1), the brightness of the LED (D1) depends on how much light shines on the photoresistor (RP). The resistance drops as more light shines, allowing more current through the PNP (Q1). This is similar to the NPN (Q2) circuit above.

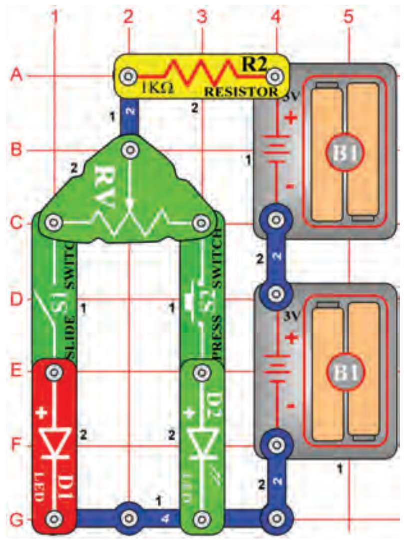
Project #171
PNP Dark Control



***OBJECTIVE:** To compare transistor circuits.*

Turn on the slide switch (S1), the brightness of the LED (D1) depends on how LITTLE light shines on the photoresistor (RP). The resistance drops as more light shines, so more current gets to the 100kΩ resistor (R5) from the photoresistor path and less from the PNP-diode path. This is similar to the NPN circuit above.

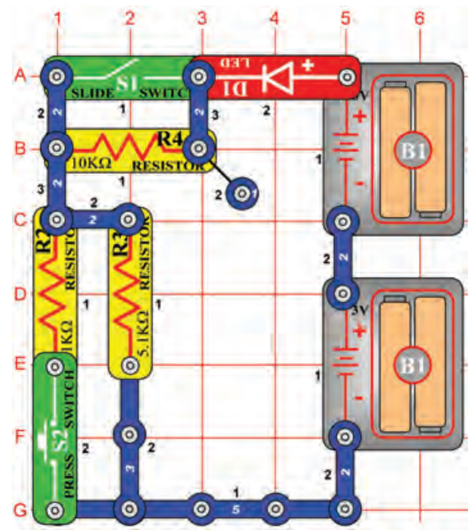
Project #172
Red & Green Control



OBJECTIVE: To demonstrate how the adjustable resistor works.

Turn on the circuit using the slide switch (S1) and/or the press switch (S2) and move the adjustable resistor's (RV) control lever around to adjust the brightness of the LED's (D1 & D2). When the adjustable resistor is set to one side, that side will have low resistance and its LED will be bright (assuming the switch on that side is ON) while the other LED will be dim or OFF.

Project #173
Current Controllers



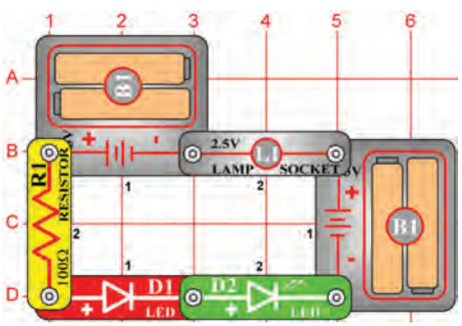
OBJECTIVE: To compare types of circuits.

Build the circuit and turn on the slide switch (S1), the LED (D1) will be lit. To increase the LED brightness, turn on the press switch (S2). To decrease the LED brightness, turn off the slide switch.

With the slide switch on, the 5.1KΩ resistor (R3) controls the current. Turning on the press switch places the 1KΩ resistor (R2) in parallel with it to decrease the total circuit resistance. Turning off the slide switch places the 10KΩ resistor (R4) in series with R2/R3 to increase the total resistance.

Project #174
Current Equalizing

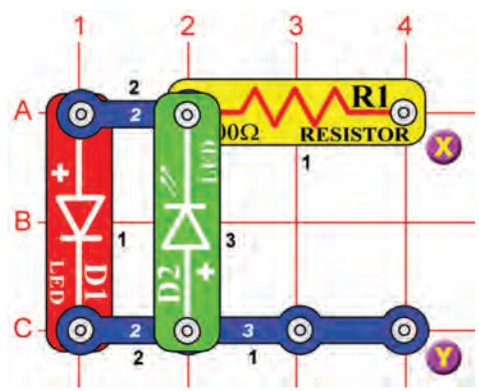
OBJECTIVE: To compare types of circuits.



In this circuit the LED's (D1 & D2) will have the same brightness, but the lamp (L1) will be off. When connected in series, all components will have equal electric current through them. The lamp is off because it requires a higher current through the circuit to turn on than the LED's do.

Project #175
Battery Polarity Tester

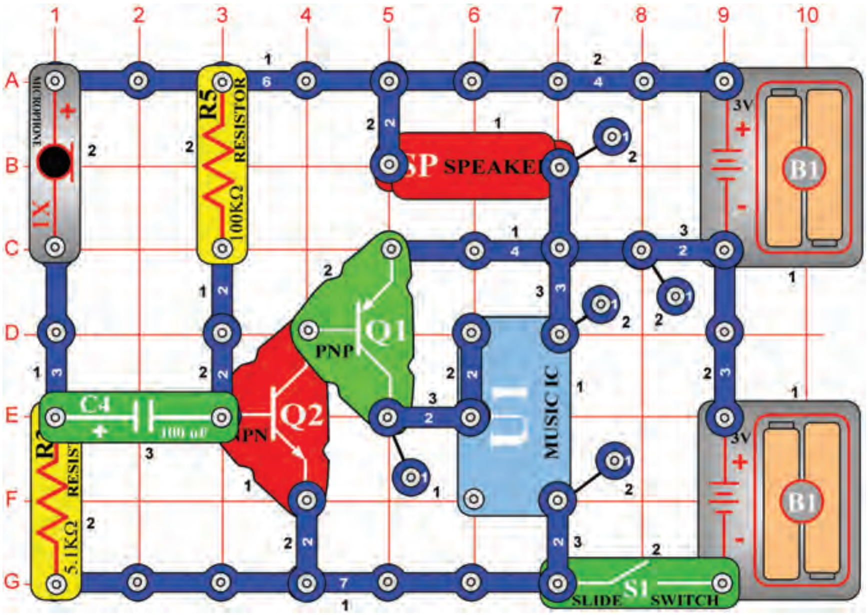
OBJECTIVE: To test the polarity of a battery.



Use this circuit to check the polarity of a battery. Connect your battery to X & Y on the drawing using the jumper cables (your 3V battery pack (B1) can also be snapped on directly instead). If the positive (+) side of your battery is connected to X, then the red LED (D1) will be on, if the negative (–) side is connected to X then the green LED (D2) will be on.

☐ Project #176 Blow Off a Doorbell

OBJECTIVE: To turn off a circuit by blowing on it.



Build the circuit and turn it on; music plays. Since it is loud and annoying, try to shut it off by blowing into the microphone (X1). Blowing hard into the microphone stops the music, and then it starts again.

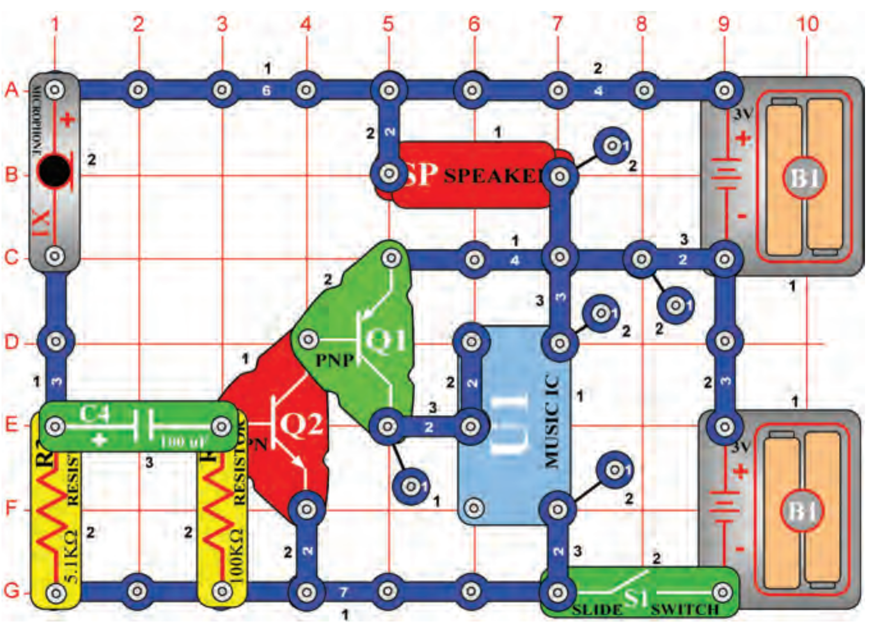
☐ Project #177 Blow Off a Candle

OBJECTIVE: To turn off a circuit by blowing on it.

Replace the speaker (SP) with the 6V lamp (L2). Blowing hard into the microphone (X1) turns off the light briefly.

☐ Project #178 Blow On a Doorbell

OBJECTIVE: To turn on a circuit by blowing on it.



Build the circuit and turn it on, music plays for a few moments and then stops. Blow into the microphone (X1) and it plays; it plays as long as you keep blowing.

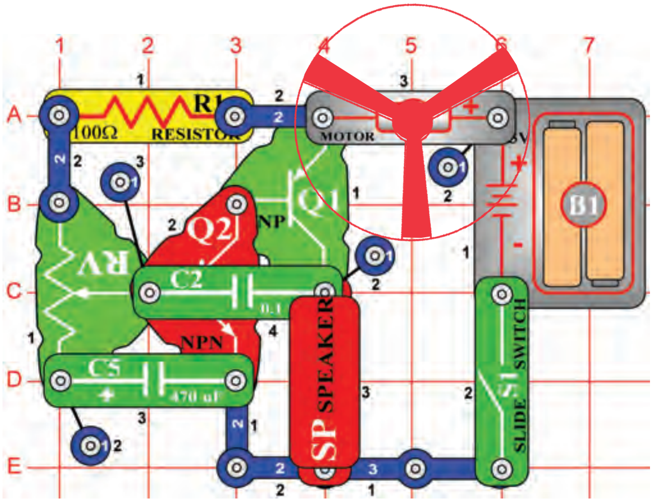
☐ Project #179 Blow On a Candle

OBJECTIVE: To turn on a circuit by blowing on it.

Replace the speaker (SP) with the 6V lamp (L2). Blowing into the microphone (X1) turns on the light, and then it goes off again.

☐ Project #180 Screaming Fan

OBJECTIVE: To have an adjustable resistance control a fan and sounds.



Build the circuit on the left and place the fan onto the motor (M1). Turn on the slide switch (S1) and move the setting on the adjustable resistor (RV) across its range. You hear screaming sounds and the fan spins.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #181 Whining Fan

OBJECTIVE: To make different sounds.

Replace the 0.1µF capacitor (C2) with the 0.02µF capacitor (C1). The sounds are now a high-pitch whine and the motor (M1) starts a little sooner.

☐ Project #182 Light Whining

OBJECTIVE: To make different sounds.

Replace the 100Ω resistor (R1) at the upper-left of the circuit (points A1 & A3 on the base grid) with the photoresistor (RP), and wave your hand over it. The whining sound has changed a little and can now be controlled by light.

☐ Project #183 More Light Whining

OBJECTIVE: To make different sounds.

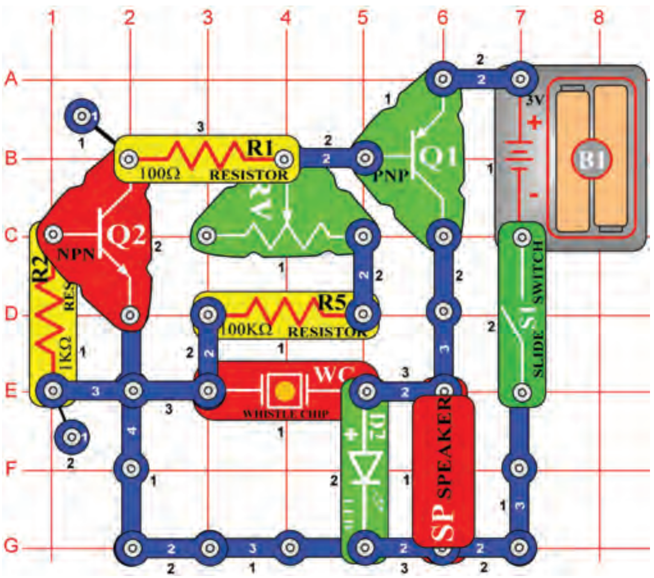
Replace the 0.02µF capacitor (C1) with the 0.1µF capacitor (C2). The sounds are lower in frequency and you can't make the fan spin now.

☐ Project #184 Motor That Won't Start

OBJECTIVE: To make different sounds.

Replace the 0.1µF capacitor (C2) with the 10µF capacitor (C3), put the positive (+) side towards the left). It now makes clicking sounds and the fan moves only in small bursts, like a motor that won't start.

☐ Project #185 Whiner



OBJECTIVE: To build a circuit that makes a loud whine.

Build the circuit, turn it on, and move the setting on the adjustable resistor (RV). It makes a loud, annoying whine sound. The green LED (D2) appears to be on, but it is actually flashing at a very fast rate.

☐ Project #186 Lower Pitch Whiner

OBJECTIVE: To show how adding capacitance reduces frequency.

Place the 0.02μF capacitor (C1) above the whistle chip (WC) and vary the adjustable resistor (RV) again. The frequency (or pitch) of the whine has been reduced by the added capacitance.

☐ Project #187 Hummer

OBJECTIVE: To show how adding capacitance reduces frequency.

Now place the 0.1μF capacitor (C2) above the whistle chip (WC) and vary the adjustable resistor (RV) again. The frequency (or pitch) of the whine has been reduced by the greater added capacitance and it sounds more like a hum now.

☐ Project #188 Adjustable Metronome

OBJECTIVE: To build an adjustable electronic metronome.

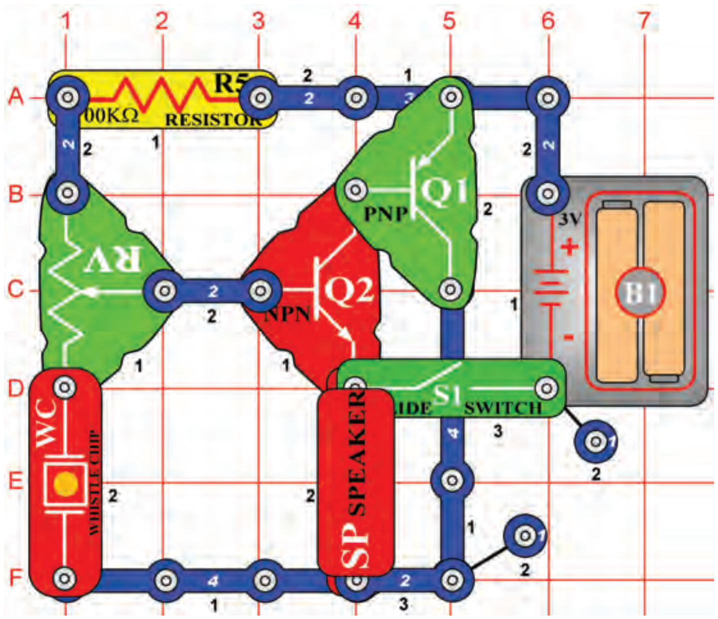
Now place the 10μF capacitor (C3, "+" side on right) above the whistle chip (WC) and vary the adjustable resistor (RV) again. There is no hum now but instead there is a click and a flash of light repeating about once a second, like the "beat" of a sound. It is like a metronome, which is used to keep time for the rhythm of a song.

☐ Project #189 Quiet Flasher

OBJECTIVE: To make a blinking flashlight.

Leave the 10μF capacitor (C3) connected but replace the speaker (SP) with the 2.5V lamp (L1).

Project #190 — Hissing Foghorn



OBJECTIVE: To build a transistor oscillator that can make a foghorn sound.

Build the circuit on the left and move the adjustable resistor (RV) setting. Sometimes it will make a foghorn sound, sometimes it will make a hissing sound, and sometimes it will make no sound at all.

Project #191 — Hissing & Clicking

OBJECTIVE: To build an adjustable clicking oscillator.

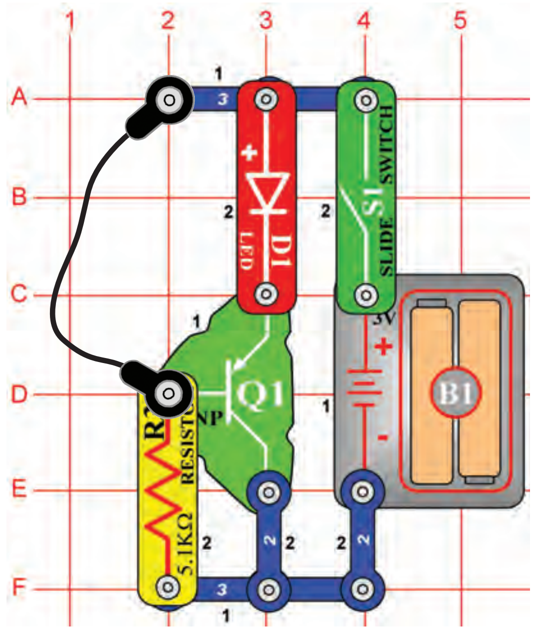
Modify the circuit in project #190 by replacing the 100kΩ resistor (R5) with the photoresistor (RP).
Move the adjustable resistor (RV) setting until you hear hissing sounds, and then shield the photoresistor while doing so and you hear clicking sounds.

Project #192 — Video Game Engine Sound

OBJECTIVE: To build a human oscillator.

Remove the photoresistor (RP) from the circuit in project #191 and instead touch your fingers between the contacts at points A4 and B2 on the base grid while moving the adjustable resistor (RV). You hear a clicking that sounds like the engine sound in auto-racing video games.

☐ Project #193 Light Alarm



***OBJECTIVE:* To build a transistor light alarm.**

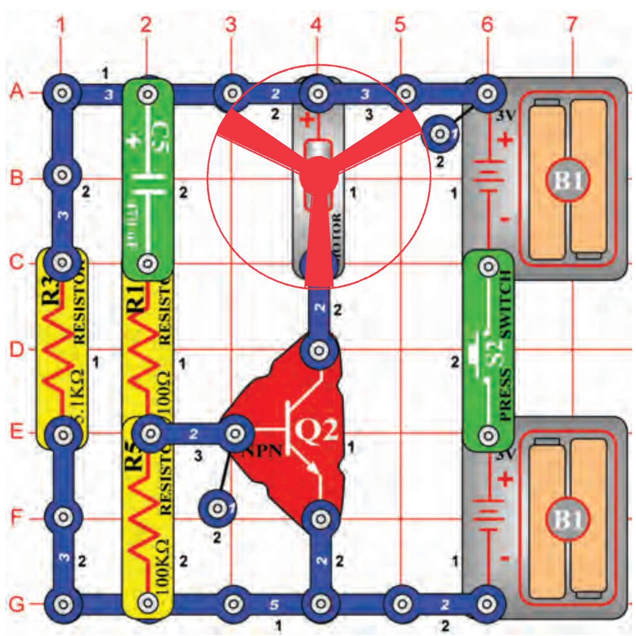
Build the circuit with the jumper connected as shown, and turn it on. Nothing happens. Break the jumper connection and the light turns on. You could replace the jumper with a longer wire and run it across a doorway to signal an alarm when someone enters.

☐ Project #194 Brighter Light Alarm

***OBJECTIVE:* To build a brighter transistor light alarm.**

Modify the circuit in project #193 by replacing the LED (D1) with the 2.5V lamp (L1) and replacing the 5.1kΩ resistor (R3) with the 100Ω resistor (R1). It works the same way but is brighter now.

☐ Project #195 Lazy Fan



***OBJECTIVE:* To build a fan that doesn't work well.**

Press the press switch (S2) and the fan will be on for a few turns. Wait a few moments and press again, and the fan will make a few more turns.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

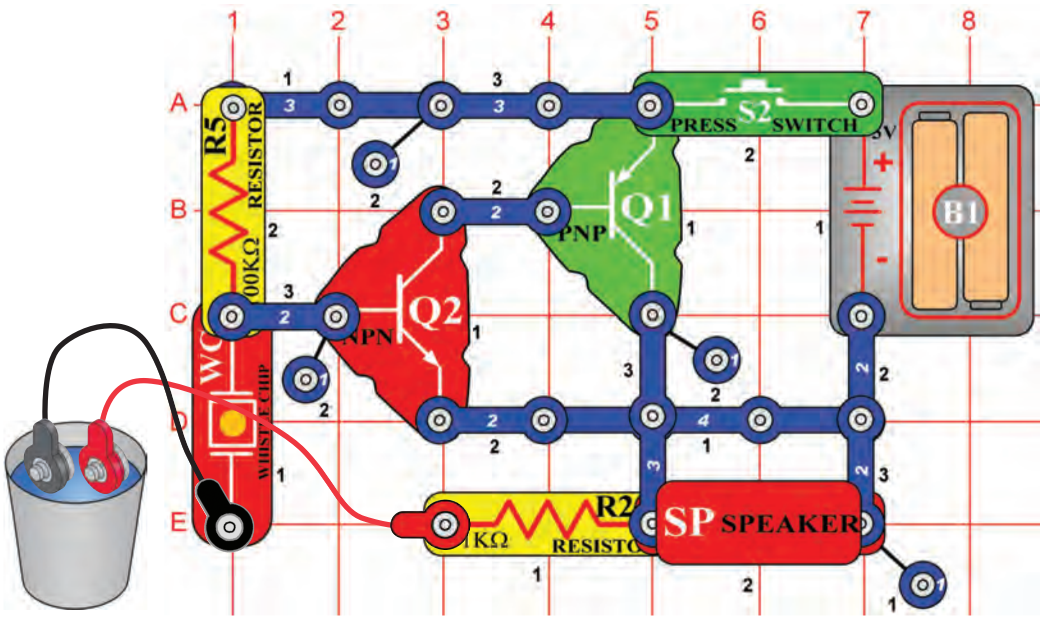
☐ Project #196 Laser Light

***OBJECTIVE:* To build a simple laser.**

Replace the motor (M1) with the 6V lamp (L2). Now pressing the press switch (S2) creates a blast of light like a laser.

☐ Project #197 Water Alarm

OBJECTIVE: To sound an alarm when water is detected, tone will vary with salt content.

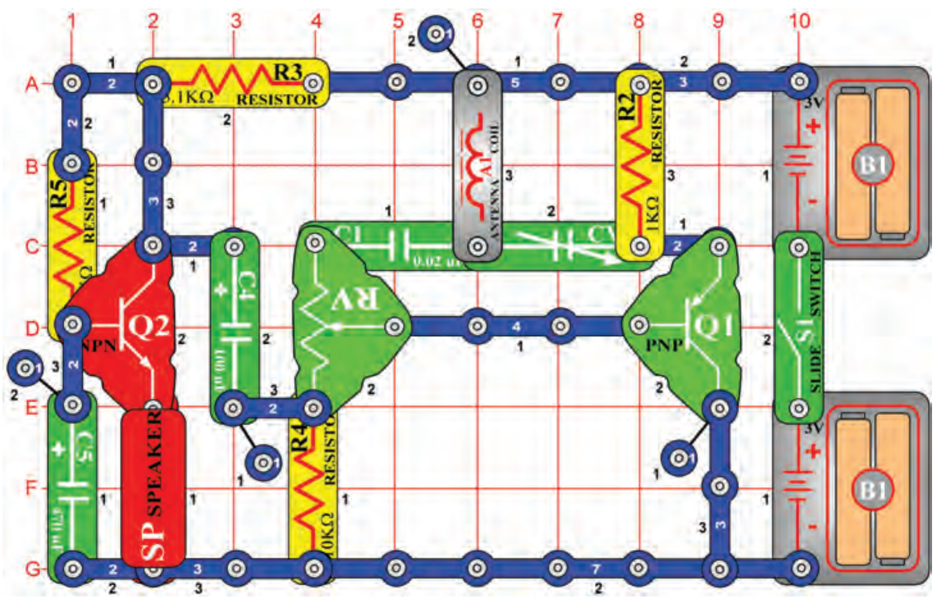


Build the circuit at left and connect the two (2) jumpers to it, place the loose ends of the jumpers into an empty cup (without them touching each other). Press the press switch (S2) - nothing happens. Add some water to the cup and an alarm will sound. Add salt to the water and the tone changes.

You can also test different liquids and see what tone they produce.

☐ Project #198 Radio Announcer

OBJECTIVE: To hear your voice on the radio.

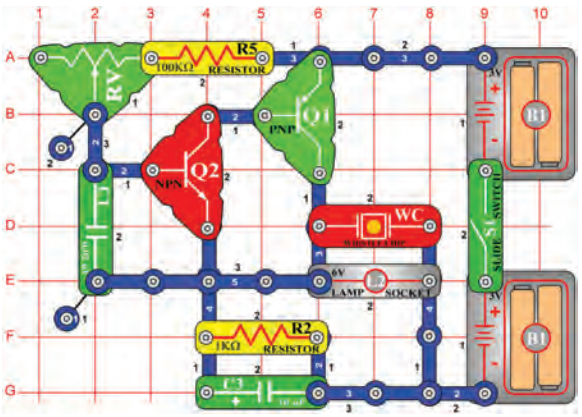


You need an AM radio for this project. Build the circuit shown but do not turn on the slide switch (S1). Place it within a foot of your AM radio and tune the radio frequency to the middle of the AM band (around 1000 kHz), where no other station is transmitting. Turn the volume up so you can hear the static. Set the adjustable resistor (RV) control to the middle setting. Turn on the slide switch and slowly tune the adjustable capacitor (CV) until the static on the radio becomes quiet. You may hear a whistle as you approach the proper tuning. In some cases you may also need to set the adjustable resistor slightly off-center.

When the radio static is gone, tap on the speaker (SP) with your finger and you should hear the sound of tapping on the radio. Now talk loudly into the speaker (used here as a microphone) and you will hear your voice on the radio. Set the adjustable resistor for best sound quality at the radio.

Project #199 Pitch

OBJECTIVE: To show how to change the pitch of a sound.



Build the circuit on the left, turn it on, and vary the adjustable resistor (RV). The *frequency* or *pitch* of the sound is changed. Pitch is the musical profession's word for frequency. If you've had music lessons, you may remember the music scale using chords such as A3, F5, and D2 to express the *pitch* of a sound. Electronics prefers the term *frequency*, as in when you adjust the frequency on your radio.

Project 200 Pitch (II)

OBJECTIVE: See project #199.

Since we've seen we can adjust the frequency by varying the resistance in the adjustable resistor, are there other ways to change frequency? You can also change frequency by changing the capacitance of the circuit. Place the 0.1μF capacitor (C2) on top of the 0.02μF capacitor (C1); notice how the sound has changed.

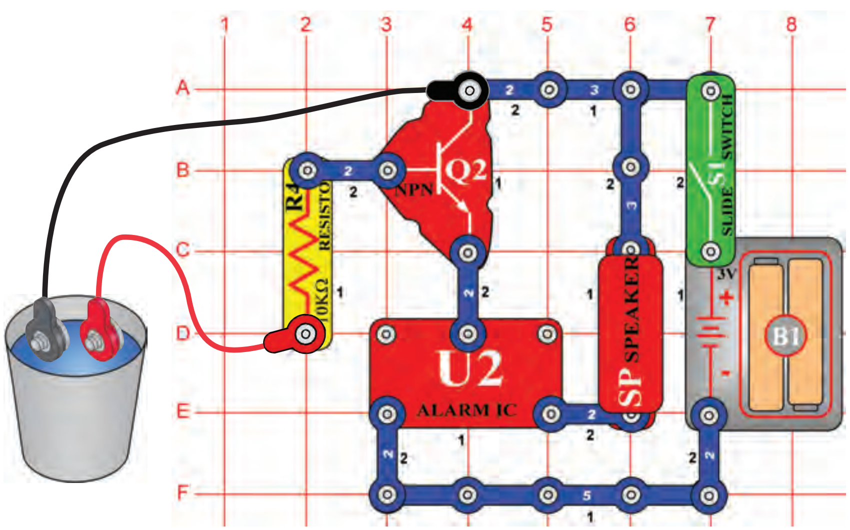
Project 201 Pitch (III)

OBJECTIVE: See project #199.

Remove the 0.1μF (C2) capacitor and replace the 100kΩ resistor (R5) wth the photoresistor (RP). Wave your hand up and down over the photoresistor to change the sound. Changing the light on the photoresistor changes the circuit resistance just like varying the adjustable resistance does. **Note:** If you have the adjustable resistor (RV) set to the right and light shining on the photoresistor, then you may not get any sound because the total resistance is too low for the circuit to operate.

Project #202 Flooding Alarm

OBJECTIVE: To sound an alarm when water is detected.



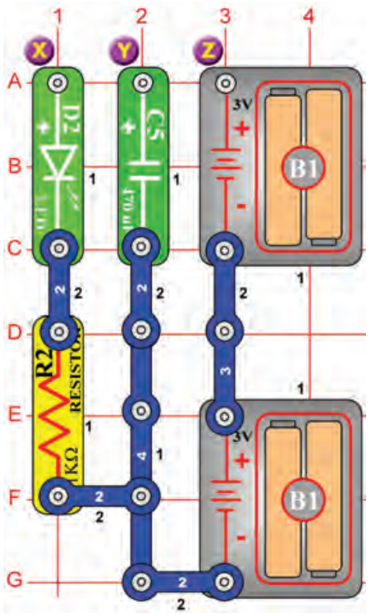
Build the circuit on the left and connect the two (2) jumpers to it, place the loose ends of the jumpers into an empty cup (without them touching each other). Turn on the slide switch (S1) - nothing happens. This circuit is designed to detect water and there is none in the cup. Add some water to the cup - an alarm sounds!

You can use longer jumper wires and hang them near your basement floor or next to your sump pump to give a warning if your basement is being flooded. Note that if the loose jumper ends accidentally touch then you will have a false alarm.

Project #203

Make Your Own Battery

OBJECTIVE: To demonstrate how batteries can store electricity.



Build the circuit, then connect points Y & Z (use a 2-snap wire) for a moment. Nothing appears to happen, but you just filled up the 470μF capacitor (C5) with electricity. Now disconnect Y & Z and instead touch a connection between X & Y. The green LED (D2) will be lit and then go out after a few seconds as the electricity you stored in it is discharged through the LED and resistor (R2).

Notice that a capacitor is not very efficient at storing electricity - compare how long the 470μF kept the LED lit for with how your batteries run all of your projects! That is because a capacitor stores electrical energy while a battery stores chemical energy.

Project #204

Make Your Own Battery (II)

OBJECTIVE: To demonstrate how batteries can store electricity.

In the preceding circuit, replace the 470μF capacitor (C5) with the 100μF capacitor (C3) and repeat the test. You see that the LED (D2) goes out faster, because the 100μF capacitor does not store as much electricity as the 470μF.

Project #205

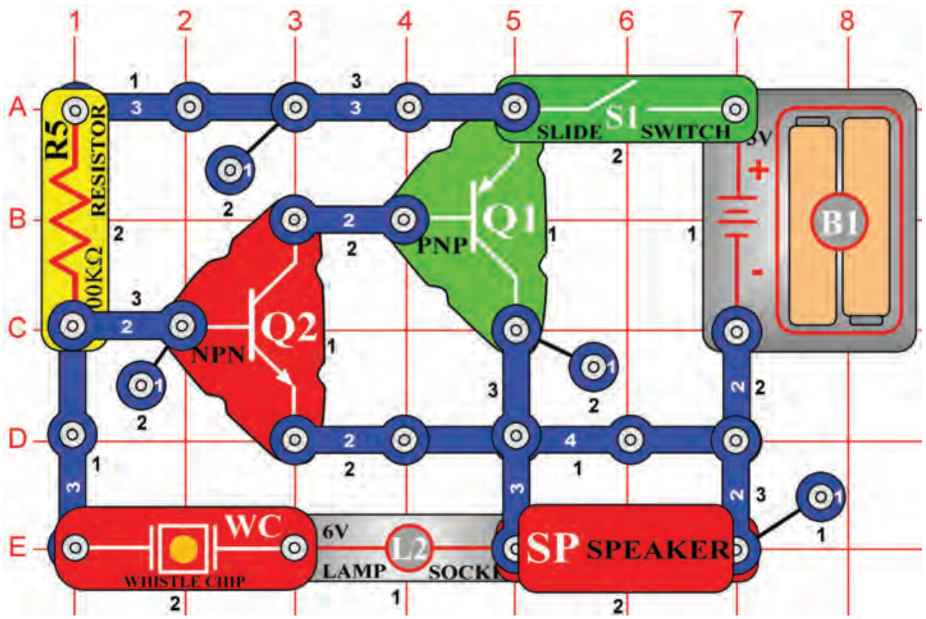
Make Your Own Battery (III)

OBJECTIVE: To demonstrate how batteries can store electricity.

Now replace the 1kΩ resistor (R2) with the 100Ω resistor (R1) and try it. The LED (D2) gets brighter but goes out faster because less resistance allows the stored electricity to dissipate faster.

Project #206 Tone Generator

OBJECTIVE: To build a high-frequency oscillator.



Build the circuit and turn it on, you hear a high-frequency sound.

Project #207 Tone Generator (II)

OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Place the 0.02μF capacitor (C1) on top of the whistle chip (WC) in the preceding circuit, you hear a middle-frequency sound. Why? The whistle chip is used here as a capacitor and by placing the 0.02μF on top (in parallel) we have increased the capacitance, and doing so lowers the frequency.

Project #208 Tone Generator (III)

OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Next, replace the 0.02μF capacitor (C1) and the whistle chip (WC) with the larger 0.1μF capacitor (C2). You now hear a low frequency sound, due to yet more capacitance.

Project #209 Tone Generator (IV)

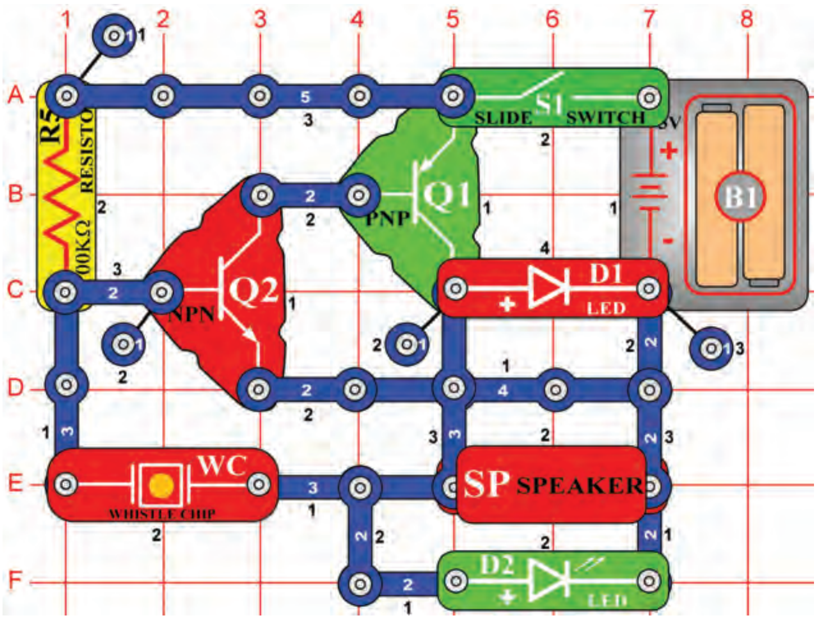
OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Now replace the 0.1μF (C2) with the much larger 10μF capacitor (C3), (orient with the positive (+) side towards the left); the circuit just clicks about once a second. There isn't a constant tone anymore due to other transistor properties. You need a different type of circuit to create very low frequency tones.

Project #210

More Tone Generator

OBJECTIVE: To build a middle-frequency oscillator.



Build the circuit, as the name suggests this circuit is similar to that in project #206. Turn it on, you hear a middle-frequency sound.

Project #211

More Tone Generator (II)

OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Place the 0.02μF capacitor (C1) or the 0.1μF capacitor (C2) on top of the whistle chip (WC). The sound is different now because the added capacitance has lowered the frequency. The LED's appear to be on, but are actually blinking at a very fast rate.

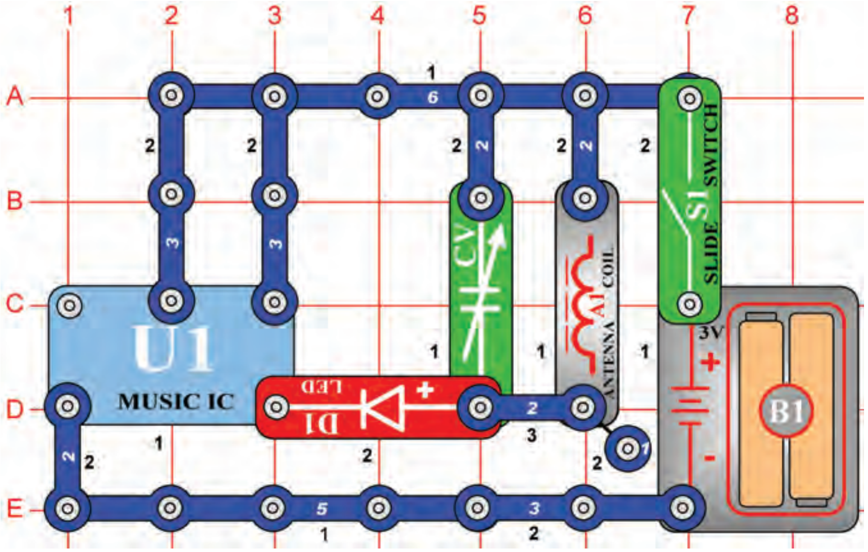
Project #212

More Tone Generator (III)

OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Now place the 10μF capacitor (C3) on top of the whistle chip (WC). You hear a clicking sound as the LED's blink about once a second.

☐ Project #213 Music Radio Station



OBJECTIVE: To create music and transmit it to a radio.

You need an AM radio for this project. Build the circuit shown on the left and turn on the slide switch (S1). Place it next to your AM radio and tune the radio frequency to where no other station is transmitting.

Then, tune the variable capacitor (CV) until your music sounds best on the radio.

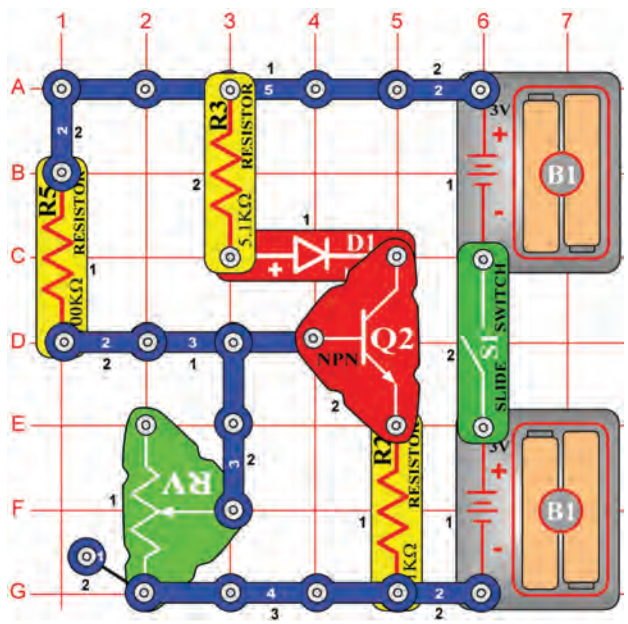
☐ Project #214 Alarm Radio Station

OBJECTIVE: To create music and transmit it to a radio.

Replace the music IC (U1) with the alarm IC (U2), and then you will hear a machine gun sound on the radio. You may need to re-tune the variable capacitor (CV).

☐ Project #215 Standard Transistor Circuit

OBJECTIVE: To save some electricity for later use.



Turn on the slide switch (S1) and move the adjustable resistor (RV) control lever across its range. When the lever is all the way down the LED (D1) will be off, as you move the lever up it will come on and reach full brightness.

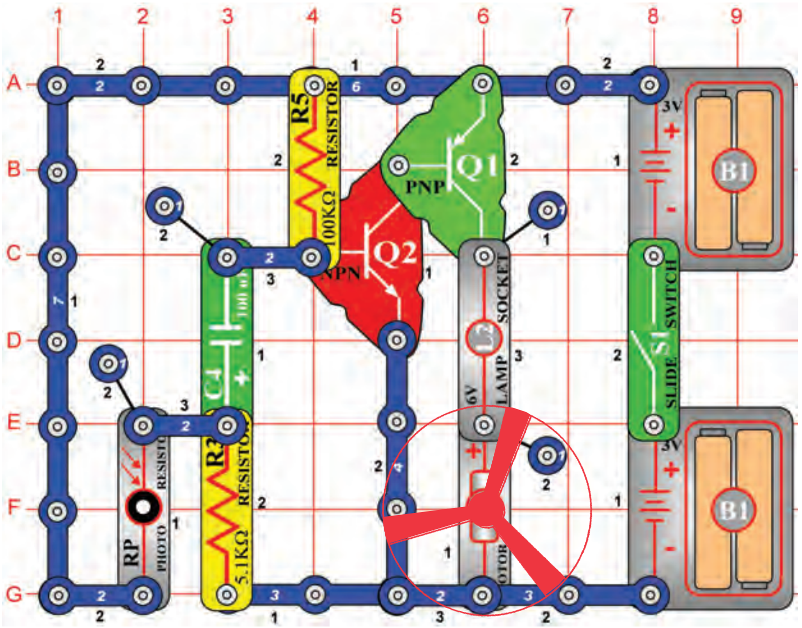
This circuit is considered the standard transistor configuration for amplifiers. The adjustable resistor control will normally be set so that the LED is at half brightness, since this minimizes distortion of the signal being amplified.

To learn more about how circuits work, visit www.snapcircuits.net or page 74 to find out about our Student Guides.

Project #216

Motor & Lamp by Sound

OBJECTIVE: To control a motor using light.



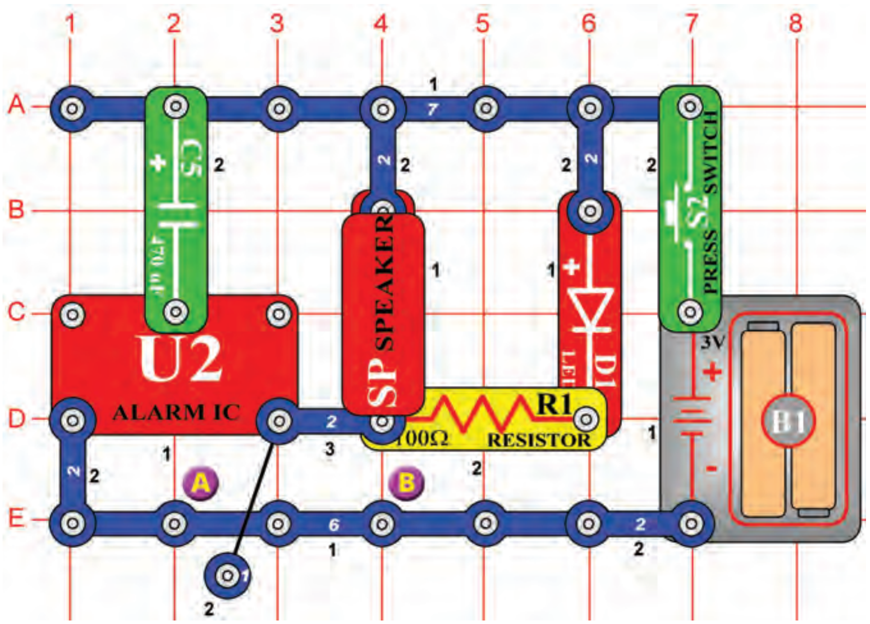
Turn the slide switch (S1) on, the motor (M1) spins and the lamp (L2) lights. As you move your hand over the photoresistor (RP), the motor slows. Now place finger onto the photoresistor to block the light. The motor slows down. In a few seconds, the motor speeds up again.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #217

Fading Siren

OBJECTIVE: To produce sound of a siren driving away into the distance.



Press the press switch (S2), the alarm IC (U2) should make the sound of an up-down siren that gets weaker with time. The fading is produced by the charging of the 470μF capacitor (C5). After it is charged the current stops and the sound is very weak.

To repeat this effect you must release the press switch, remove the capacitor, and discharge it by placing it across the snaps on the bottom bar marked A & B. Then, replace the capacitor and press the switch again.

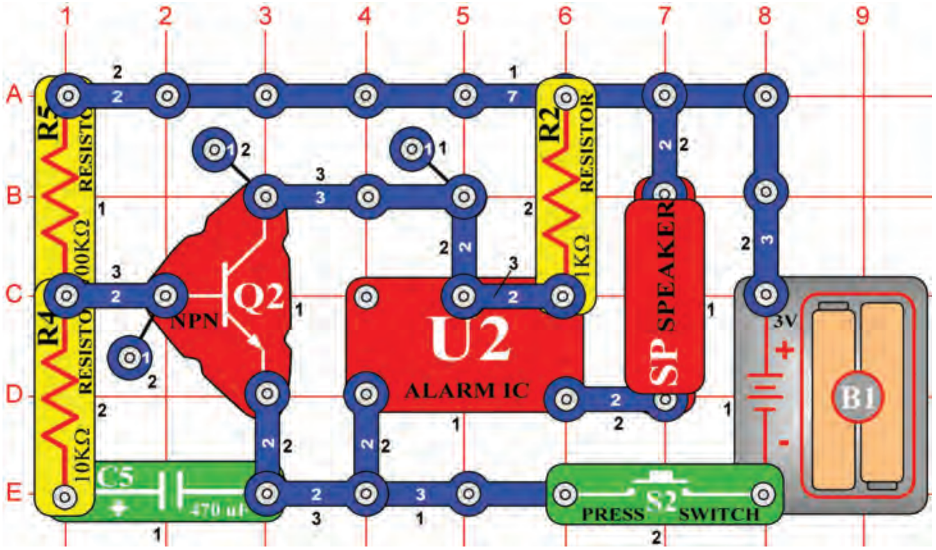
Project #218

Fast Fade Siren

OBJECTIVE: To produce sound of a siren driving away into the distance.

Replace the 470μF capacitor (C5) with the 100μF capacitor (C4), the siren fades faster.

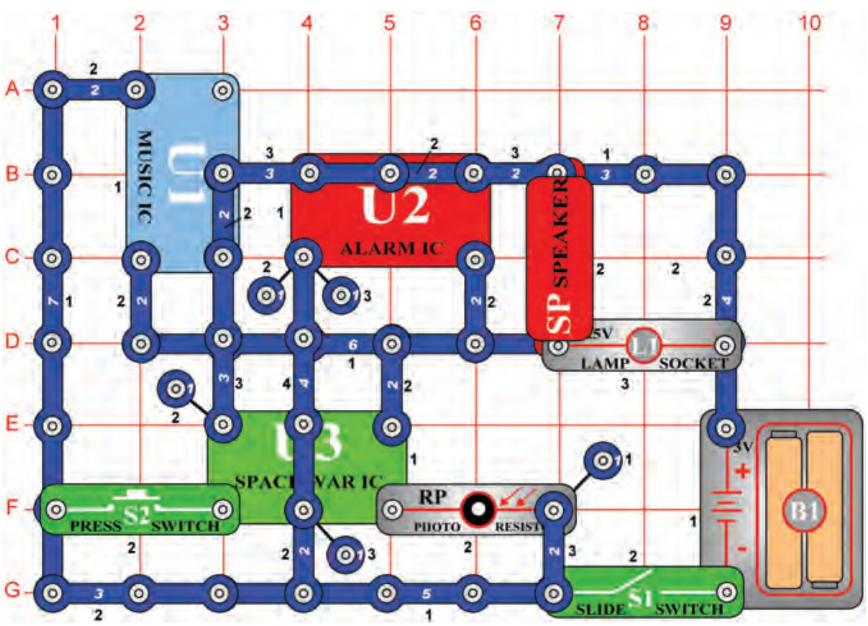
Project #219 Laser Gun with Limited Shots



OBJECTIVE: To build a circuit with laser gun sounds and a limited amount of shots.

When you press the press switch (S2), the alarm IC (U2) should start sounding a very loud laser gun sound. The speaker (SP) will sound, simulating a burst of laser energy. You can shoot long repeating laser burst, or short zaps by tapping the trigger switch. But be careful, this gun will run out of energy and you will have to wait for the energy pack (C5) to recharge. This type of gun is more like a real life laser gun because power would run out after a few shots due to energy drain. In a real laser, the energy pack would have to be replaced. Here you only have to wait a few seconds for recharge.

Project #220 Symphony of Sounds



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated circuits.

Build the circuit shown. Turn it on and press the press switch (S2) several times and wave your hand over the photoresistor (RP) to hear the full symphony of sounds that this circuit can create. Have fun!

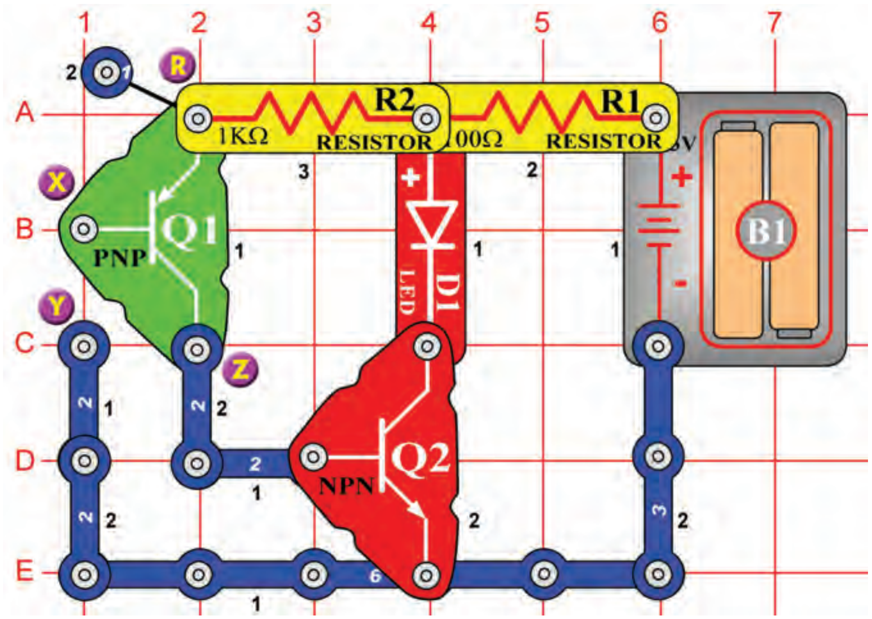
Project #221 Symphony of Sounds (II)

OBJECTIVE: See project #220.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

☐ Project #222 Transistor Amplifiers

OBJECTIVE: To learn about the most important component in electronics.



When you place one or more fingers across the two snaps marked X & Y you will notice the LED (D1) turns on. The two transistors are being used to amplify the very tiny current going through your body to turn on the LED. Transistors are actually electrical current amplifiers. The PNP transistor (Q1) has the arrow pointing into the transistor body. The NPN transistor (Q2) has the arrow pointing out of the transistor body. The PNP amplifies the current from your fingers first, then the NPN amplifies it more to turn on the LED.

☐ Project #223 Pressure Meter

OBJECTIVE: To show how electronic amplifiers can detect skin pressure on two contacts.

Use the circuit from project #222 shown above.

When you placed your fingers across the two snaps marked X & Y you noticed the LED (D1) came on in project #222. Repeat this process, but this time press very lightly on the two snaps marked X & Y. Notice how the brightness of the LED is dependent on the amount of pressure you use. Pressing hard makes the LED bright while pressing very gently makes it dim or even flash. This is due to what technicians call “contact resistance”. Even switches made to turn your lights on and off have some resistance in them. When large currents flow, this resistance will drop the voltage and produce the undesirable side effect of heat.

☐ Project #224 Resistance Meter

OBJECTIVE: To show how electronic amplifiers can detect different values of resistance.

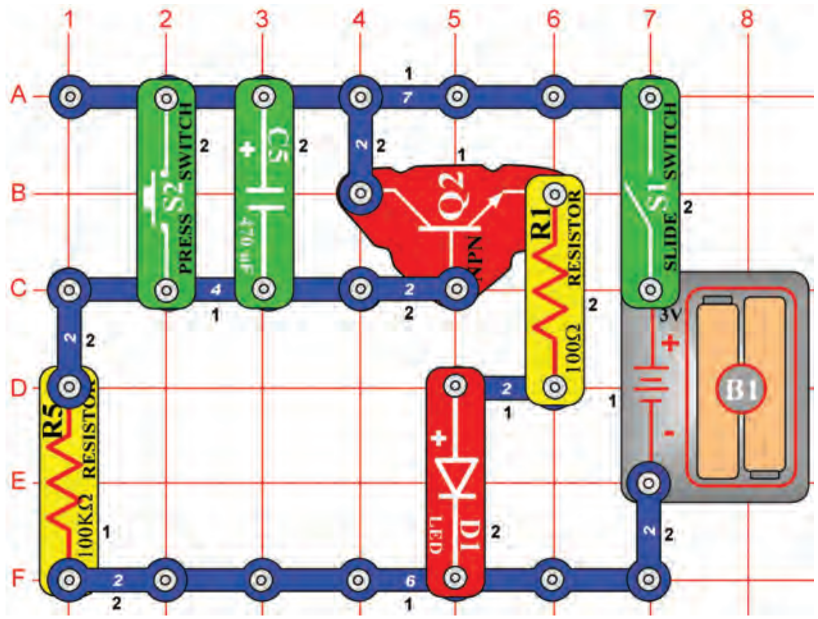
Use the circuit from project #222 shown above

When you placed your fingers across the two snaps marked X & Y you noticed the LED (D1) came on in project #222. In this project, you will place different resistors across R & Z and see how bright the LED glows. Do not snap them in; just press them up against the snaps labeled R & Z in the diagram above.
First, place the 100kΩ resistor (R5) across the R & Z snaps and note the brightness of the LED. Next, press the 5.1kΩ resistor (R3) across R & Z. Notice how the LED gets brighter when the resistance is less. This is because the NPN amplifier (Q2) gets more current at its input when the resistance is lower. The PNP amplifier (Q1) is not used in this test.

Project #225

Auto-Off Night-Light

OBJECTIVE: To learn about one device that is used to delay actions in electronics.



When you turn on the slide switch (S1) the first time the LED (D1) will come on and very slowly get dimmer and dimmer. If you turn the slide switch (S1) off and back on after the light goes out it will NOT come on again. The 470μF capacitor (C5) has charged up and the NPN transistor amplifier (Q2) can get no current at its input to turn it on.

This circuit would make a good night-light. It would allow you to get into bed, and then it would go out. No further current is taken from the battery so it will not drain the batteries (B1) even if left on all night.

Project #226

Discharging Caps

OBJECTIVE: To show how capacitor delays can be repeated by discharging the capacitor.

Use the circuit from project #225 shown above.

When you first turned on the slide switch (S1) in project #225, the LED (D1) came on and very slowly got dimmer and dimmer. When you turned the slide switch (S1) off and back on after the light went out, it did NOT come on again. The 470μF capacitor (C5) was charged and everything stopped. This time turn the slide switch off. Then press the press switch (S2) for a moment to discharge the 470μF capacitor. Now when you turn the slide switch back on the delay repeats. Shorting a capacitor with a low resistance will allow the charges on the capacitor to leave through the resistance. In this case, the low resistance was the press switch.

Project #227

Changing Delay Time

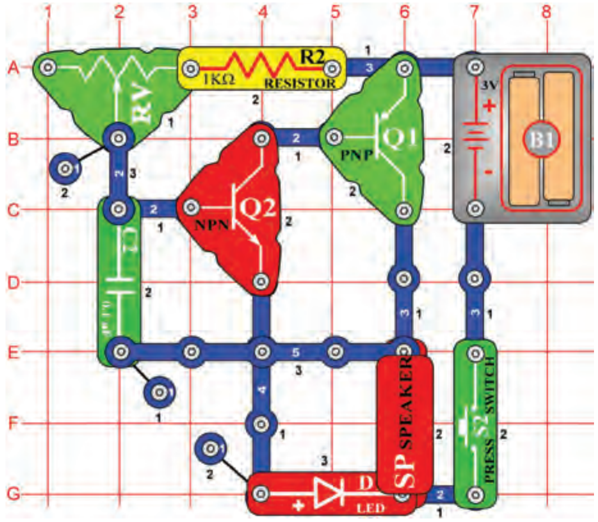
OBJECTIVE: To show how the size of the capacitor effects the delay time.

Use the circuit from project #225 shown above.

Change the 470μF capacitor (C5) to the 100μF capacitor (C4). Make sure the capacitor (C4) is fully discharged by pressing the press switch (S2) before closing the on-off slide switch (S1). When slide switch is turned on, notice how much quicker the LED (D1) goes out. Since 100μF is approximately 5 times smaller than 470μF, the LED will go out 5 times faster. The bigger the capacitor the longer the delay.

In electronics, capacitors are used in every piece of equipment to delay signal or tune circuits to a desired frequency.

Project #228 Morse Code Generator



OBJECTIVE: To make a Morse code generator and learn to generate code.

When you press down on the press switch (S2) you will hear a tone. By pressing and releasing the press switch you can generate long and short tones called Morse code. For International code, a short tone is represented by a "+", and a long tone by a "–". See the chart below for letter or number followed by code.

A +–	**G** ––+	**M** ––	**S** +++	**Y** –+––	**5** +++++
B –+++	**H** ++++	**N** –+	**T** –	**Z** ––++	**6** –++++
C –+–+	**I** ++	**O** –––	**U** ++–	**1** +––––	**7** ––+++
D –++	**J** +–––	**P** +––+	**V** +++–	**2** ++–––	**8** –––++
E +	**K** –+–	**Q** ––+–	**W** +––	**3** +++––	**9** ––––+
F ++–+	**L** +–++	**R** +–+	**X** –++–	**4** ++++–	**0** –––––

Project #229 LED Code Teacher

OBJECTIVE: A method of learning the Morse code without all the noise.

Use the circuit from project #228 shown above. Replace the speaker with a 100Ω resistor (R1) so you can practice generating the Morse code without the loud speaker. Have someone transmit code and watch the LED. Tell them the letter or number after each is generated. When you have learned code, replace the speaker.

Project #230 Ghost Shriek Machine

OBJECTIVE: To make a ghost like special effect from the Morse code generator.

Use the circuit from project #228 shown above, but change the 1kΩ resistor (R2) to a 10kΩ resistor (R4), and 0.1μF capacitor (C2) to the whistle chip (WC). While holding the press switch (S2) down, adjust both the adjustable resistor (RV) and the whistle chip for a ghost like sound. At certain settings, sound may stop or get very faint.

Project #231 LED & Speaker

OBJECTIVE: To improve Morse code skills and visual recognition.

Use the circuit from project #228 shown above. Try and find a person that already knows the Morse code to send you a message with both sound and LED flashing. Try in a dark room first so LED (D1) is easier to see. Morse code is still used by many amateur radio operators to send messages around the world.

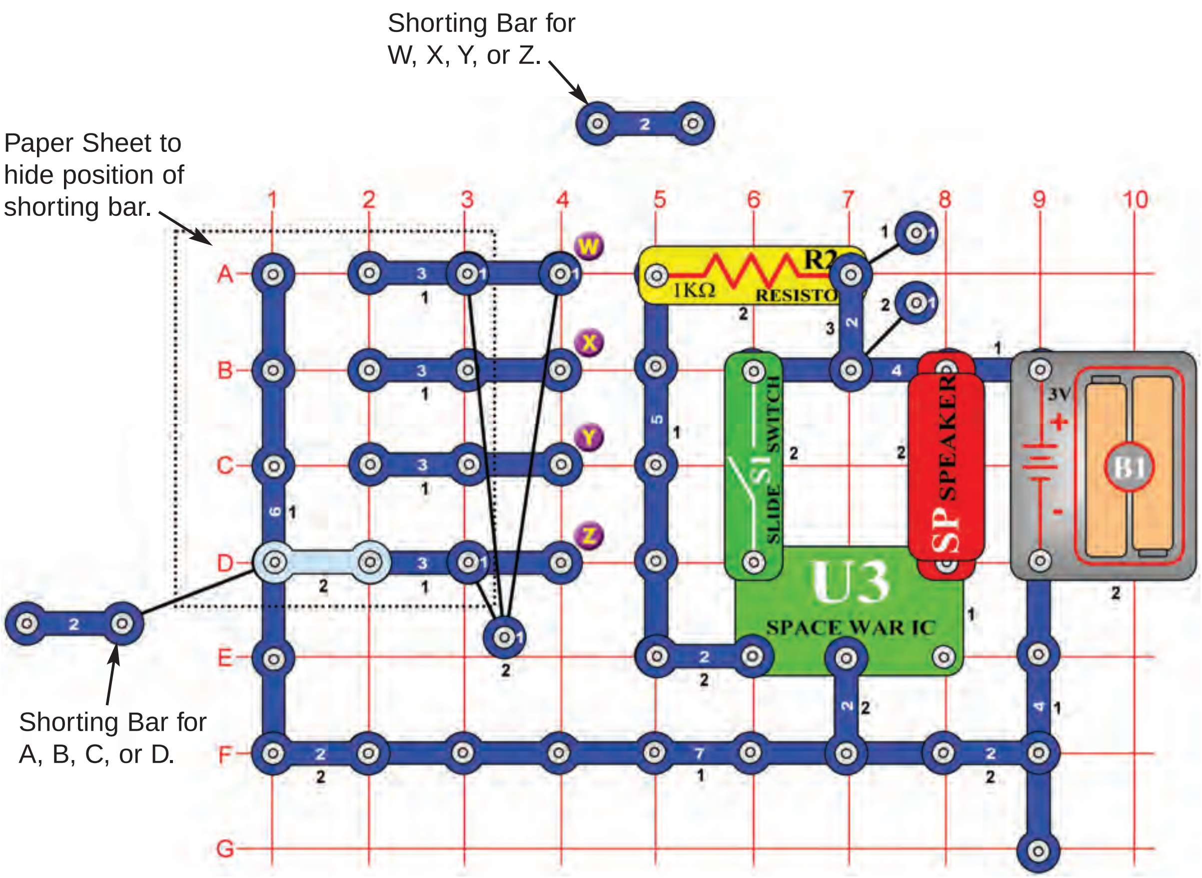
Project #232 Dog Whistle

OBJECTIVE: To make an oscillator that only a dog can hear.

Use the circuit from project #228 shown above, but change the 1kΩ resistor (R2) to the 100Ω resistor (R1). While holding down the press switch (S2), move the slider on the adjustable resistor (RV) around. When the slider is near the 100Ω resistor you won't hear any sound, but the circuit is still working. This oscillator circuit is making sound waves at a frequency too high for your ears to hear. But your dog may hear it, because dogs can hear higher frequencies than people can.

☐ Project #233 Mind Reading Game

OBJECTIVE: To make an electronic game of mind reading.



Build the circuit shown on the left. It uses two (2) 2-snap wires as shorting bars.

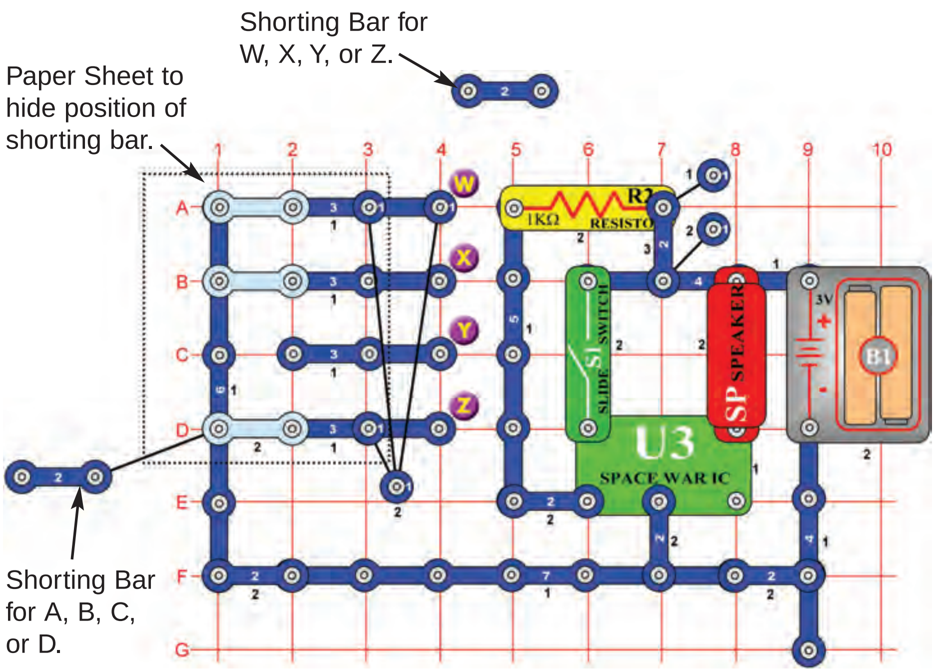
Setup: Player 1 sets up by placing one shorting bar under the paper on row A, B, C, or D. Player 2 must **NOT** know where the shorting bar is located under the paper.

The object is for Player 2 to guess the location by placing his shorting bar at positions W, X, Y, or Z. In the drawing on the left, Player 1 set up at position "D". If Player 2 places his shorting bar across "Z" on the first try, then he guessed correctly and marks a 1 on the score card sheet under that round number. If it takes three tries, then he gets a three.
Player 2 then sets the A, B, C, D side and Player 1 tries his luck. Each player records his score for each round. When all 18 rounds have been played, the player with the lowest score wins. Additional players can play. Use the score card below to determine the winner.

Round #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
Player 1	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	____
Player 2	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	____
Player 3	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	____
Player 4	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	____

Project #234

Enhanced Quiet Zone Game



OBJECTIVE: Make and play the electronic game of "Quiet Zone".

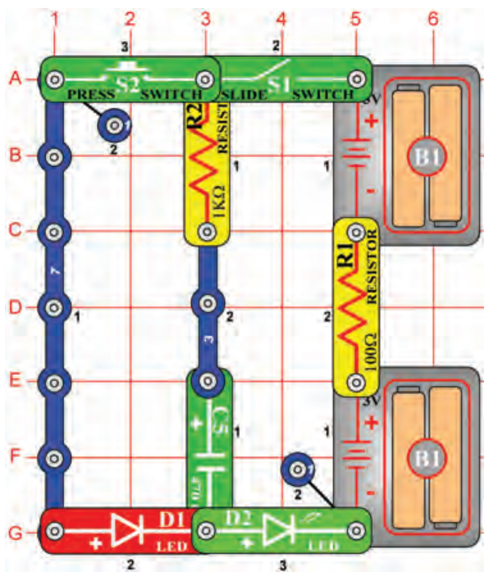
Use the circuit from project #233, but place three (3) 2-snap wires ("shorting bars") under paper as shown on left.

Setup: Player 1 sets the "Quiet Zone" by placing three (3) shorting bars under the paper on row A, B, C, or D, leaving only one open. Player 2 must **NOT** know where the shorting bars are located under the paper.

Both Player 1 and Player 2 are given 10 points. The object is for Player 2 to guess the location of the "Quiet Zone" by placing his shorting bar at positions W, X, Y, or Z. In the drawing on the left Player 1 set up the "Quiet Zone" at position "C". If Player 2 places his shorting bar across "Z" on the first try, the sounds played mean he has not found the "Quiet Zone" and he loses 1 point. He has 3 tries to find the zone on each turn. Each time sounds are made he loses a point.
Player 2 then sets the A, B, C, D side and Player 1 starts searching. Play continues until one player is at zero points and makes sound during that players turn.

Project #235

Capacitor Charge & Discharge



OBJECTIVE: To show how capacitors store and release electrical charge.

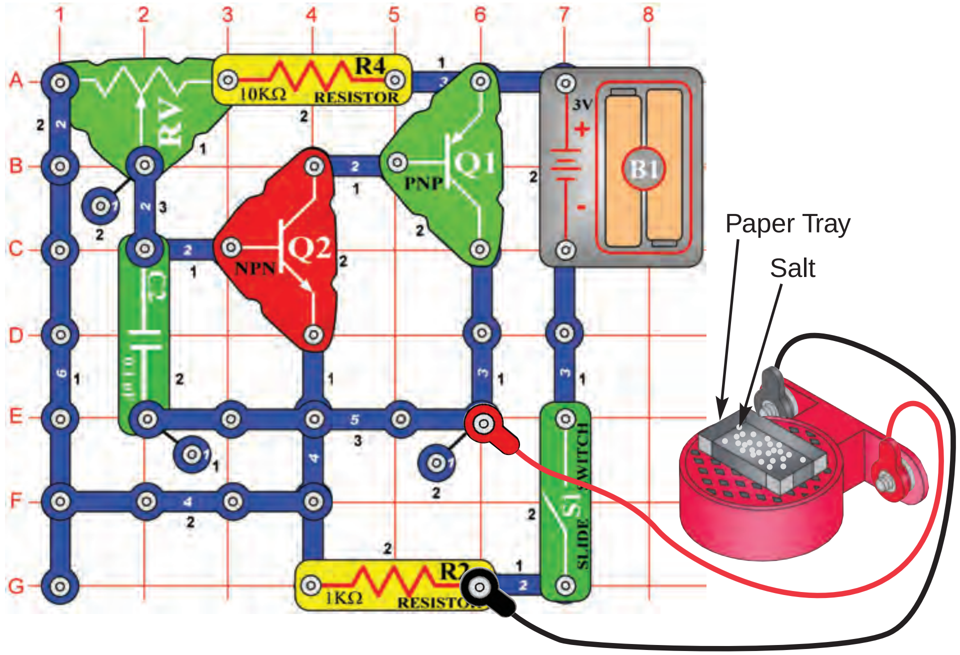
Turn on the slide switch (S1) for a few seconds, then turn it off. The green LED (D2) is initially bright but goes dim as the batteries (B1) charge up the 470μF capacitor (C5). The capacitor is storing electrical charge.

Now press the press switch (S2) for a few seconds. The red LED (D1) is initially bright but goes dim as the capacitor discharges itself through it.

The capacitor value (470μF) sets how much charge can be stored in it, and the resistor value (1kΩ) sets how quickly that charge can be stored or released.

Project #236 Sound Wave Magic

OBJECTIVE: To show how sound waves travel on a paper surface.

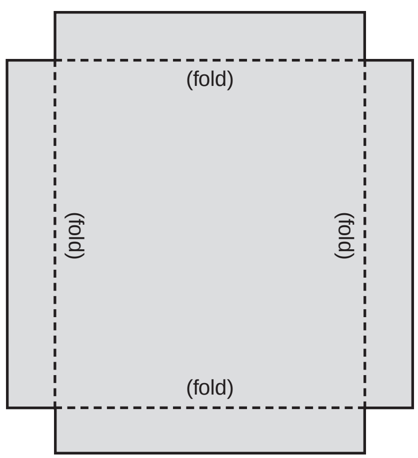


Build the circuit shown on the left and connect the speaker (SP) using the two (2) jumper wires. Then, lay the speaker on a flat hard surface.

Setup: Use some paper and scissors to cut out a rectangular pattern. Use the one shown below as a guide. Use colored paper if available. Fold at the points shown. Scotch tape the corners so the tray has no cracks at the corners. Place the tray over the speaker and sprinkle a small amount of white table salt in the tray. There should be enough salt to cover the bottom with a little space between each salt grain.

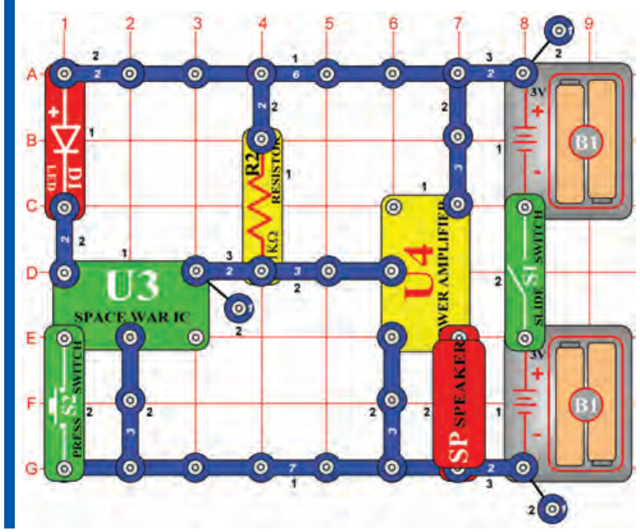
Sound Magic: Turn on the circuit by turning on the slide switch (S1). Adjust the adjustable resistor (RV) for different pitches and watch the salt particles. Particles that bounce high are directly over the vibrating paper and ones that do not move are in the nodes where the paper is not vibrating. Eventually, all the salt will move to the areas that have no vibration, and stay there.
Change the position of the tray and the material used to create different patterns due to the sound. Try sugar and coffee creamer, for example, to see if they move differently due to the sound waves.

Sample Cut-out Pattern

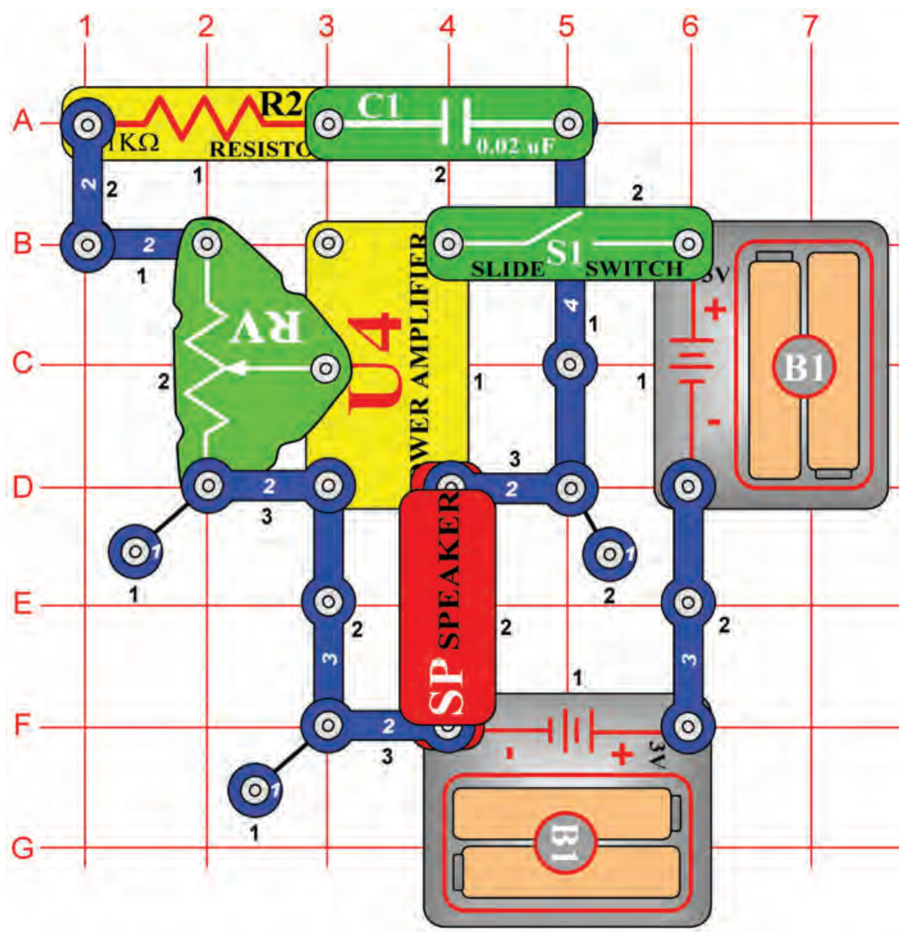


Project #237 Space War Amplifier

OBJECTIVE: To amplify sounds from the space war integrated circuit.



Build the circuit, turn on the slide switch (S1), and press the press switch (S2) several times. You will hear loud space war sounds, since the sound from the space war IC (U3) is amplified by the power amplifier IC (U4). Nearly all toys that make sound use a power amplifier of some sort.



Project #238
Trombone

OBJECTIVE: To build an electronic trombone that changes pitch of note with slider bar.

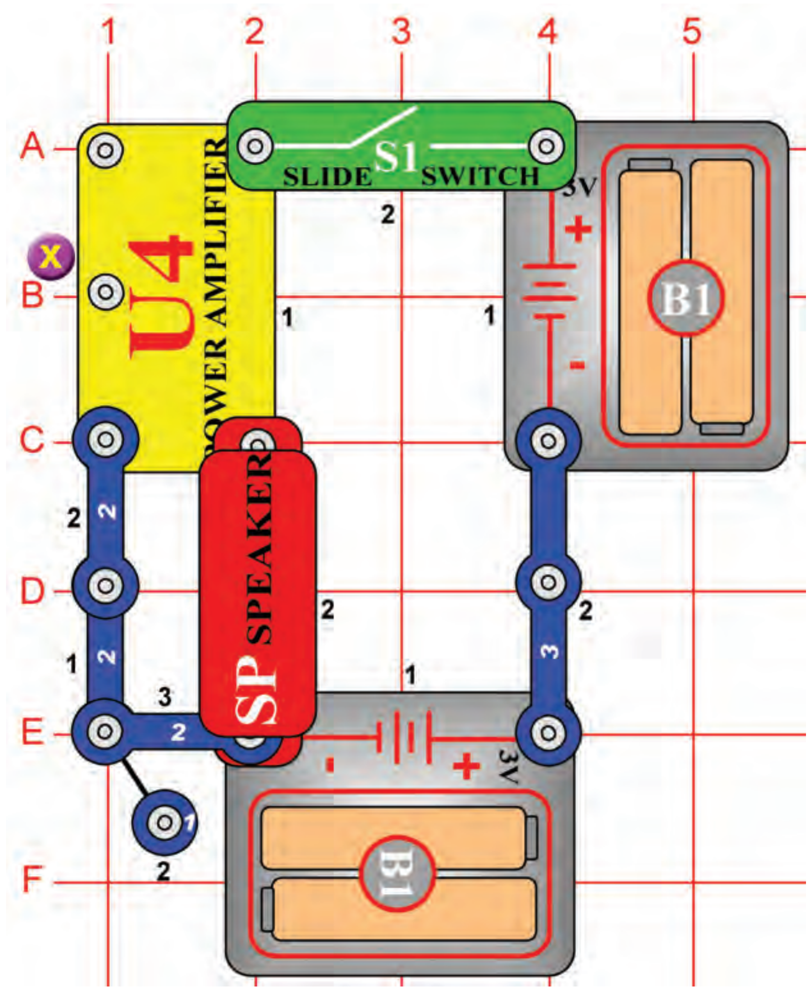
When you turn on the slide switch (S1) the trombone should start playing. To change the pitch of the note, simply slide the adjustable resistor (RV) control back and forth. By turning the slide switch on and off and moving the slider, you will be able to play a song much like a trombone player makes music. The switch represents air going through the trombone, and the adjustable resistor control is the same as a trombone slider bar. The circuit may be silent at some positions of the resistor control.

Project #239
Race Car Engine

OBJECTIVE: To show how changing frequency changes the sound to a different special effect.

Use the circuit from project #238 shown on the left, but change the 0.02μF capacitor (C1) to a 10μF capacitor (C3). Make sure the positive (+) mark on the capacitor is **NOT** on the resistor (R2) side when you snap it in.

When the slide switch (S1) is turned on, you should hear a very low frequency oscillation. By sliding the adjustable resistor (RV) control up and down, you should be able to make the sound of a race car engine as it's motor speeds up and slows down.



Project #240

Power Amplifier

OBJECTIVE: To check stability of power amplifier with open input.

When you turn on the slide switch (S1), the power amplifier IC (U4) should not oscillate. You should be able to touch point X with your finger and hear static. If you do not hear anything, listen closely and wet your finger that touches point X. High frequency clicks or static should be coming from speaker (SP) indicating that the amplifier is powered on and ready to amplify signals.

The power amplifier may oscillate on its own. Do not worry, this is normal with high gain high-powered amplifiers.

Project #241

Feedback Kazoo

OBJECTIVE: To show how electronic feedback can be used to make a musical instrument.

Use the circuit from project #240 shown on the left.

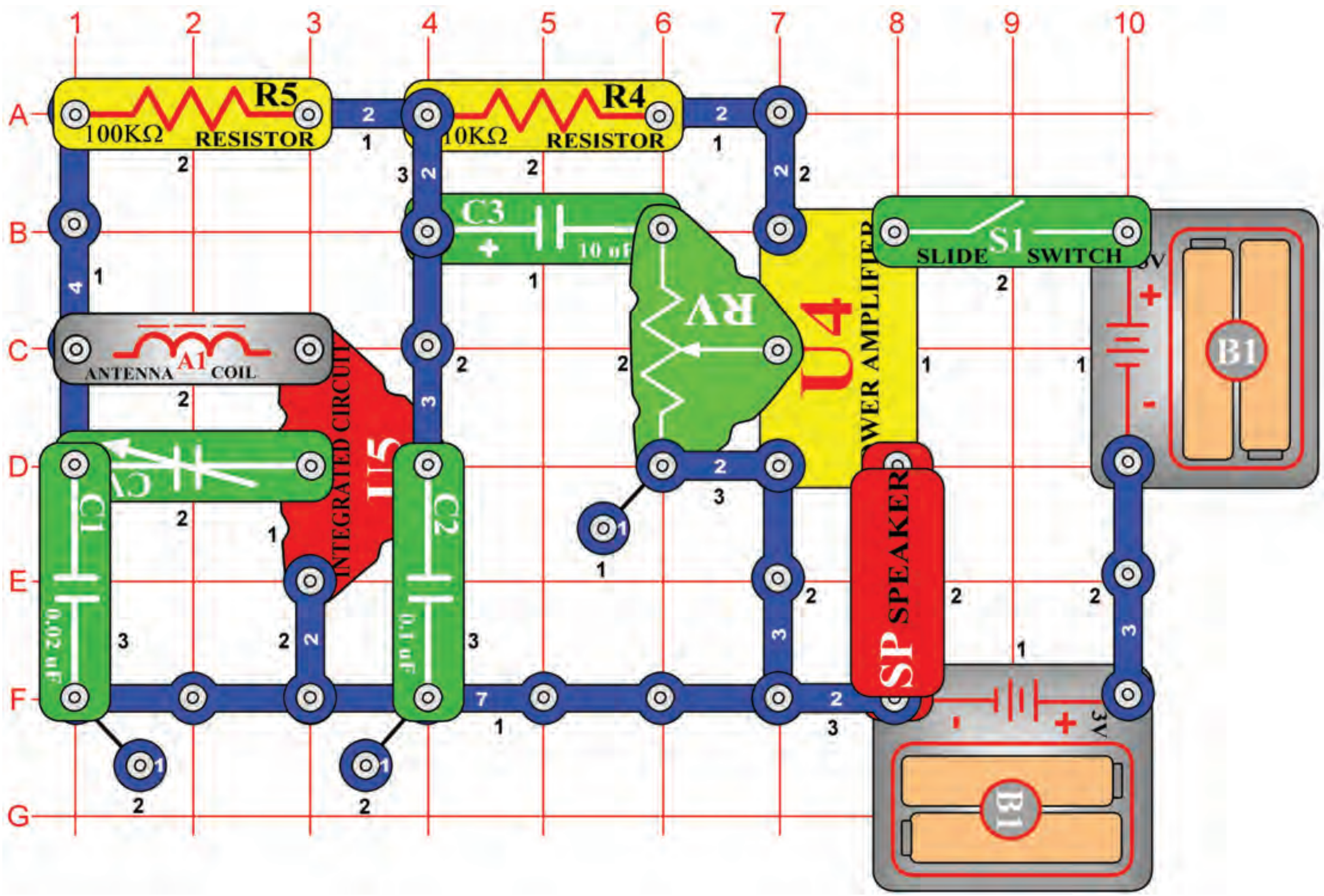
When you place one finger on point X and a finger from your other hand on the speaker (SP) snap that is not connected to the battery (B1), what happens? If the amplifier starts to oscillate it is due to the fact that you just provided a feedback path to make the amplifier into an oscillator. You may even be able to change the pitch of the oscillation by pressing harder on the snaps.

This is the principle used to make an electronic kazoo. If you practice and learn the amount of pressure required to make each note, you may even be able to play a few songs.

☐

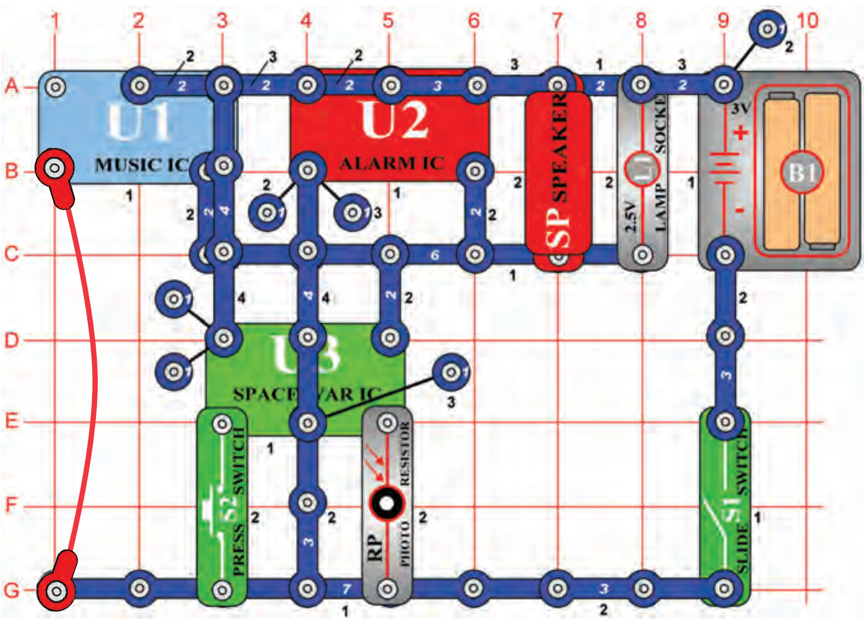
Project #242
AM Radio

OBJECTIVE: To make a complete working AM radio.



When you turn on the slide switch (S1), the integrated circuit (U5) should amplify and detect the AM radio waves all around you. The variable capacitor (CV) can be tuned to the desirable station. Varying the adjustable resistor (RV) will make the audio louder or softer. The power amplifier IC (U4) drives the speaker (SP) to complete the AM radio project.

☐ Project #243 Fire Engine Symphony



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated circuits.

Build the circuit shown and add the jumper to complete it. Note that in two places two single snaps are stacked on top of each other. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC, U1). Turn it on and press the press switch (S2) several times and wave your hand over the photoresistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

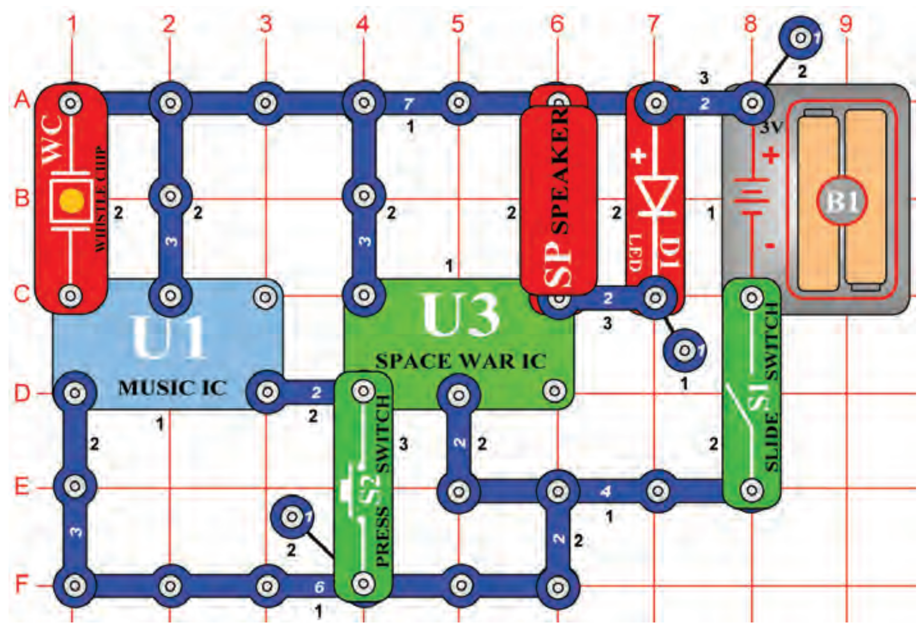
☐ Project #244 Fire Engine Symphony (II)

OBJECTIVE: See project #243.

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Can you guess why the jumper is used in this circuit? It is being used as just a 6-snap wire, because without it you don't have enough parts to build this complex circuit.

☐ Project #245 Vibration or Sound Indicator

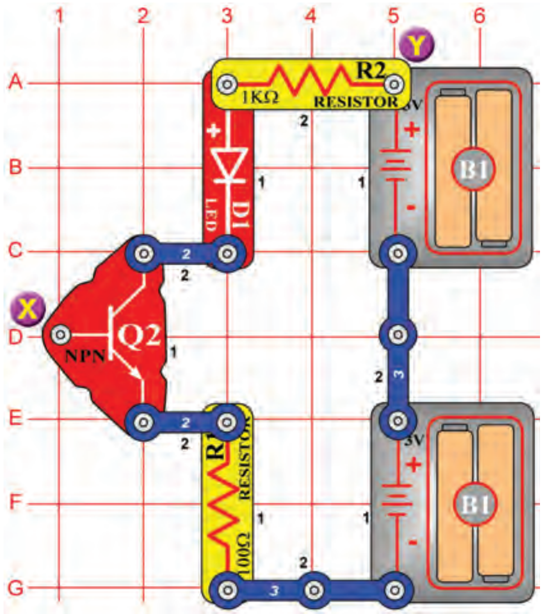


OBJECTIVE: To build a circuit that is activated by vibration or sound.

Turn on the slide switch (S1), the war sounds start playing and the LED (D1) flashes. When all of the sounds are played, the circuit stops. Clap your hands next to the whistle chip (WC) or tap on it. Any loud sound or vibration causes the whistle chip to produce a small voltage, which activates the circuit. You can repeat a sound by holding down the press switch (S2) while it is playing.

Project #246

Two-Finger Touch Lamp



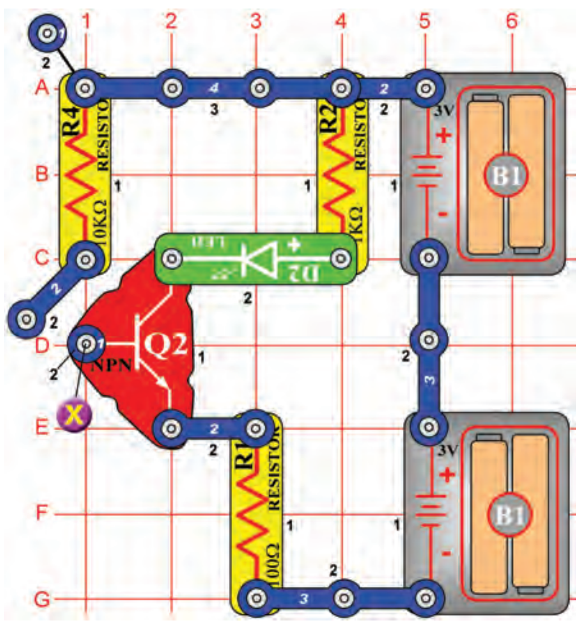
OBJECTIVE: To show that your body can be used as an electronic component.

Build the circuit on the left. You're probably wondering how it can work, since one of the points on the NPN transistor (Q2) is unconnected. It can't, but there is another component that isn't shown. That component is you.

Touch points X & Y with your fingers. The LED (D1) may be dimly lit. The problem is your fingers aren't making a good enough electrical contact with the metal. Wet your fingers with water or saliva and touch the points again. The LED should be very bright now. Think of this circuit as a touch lamp since when you touch it, the LED lights. You may have seen such a lamp in the store or already have one in your home.

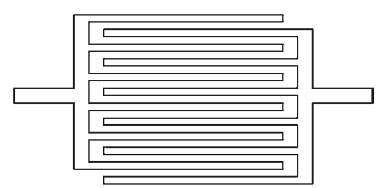
Project #247

One-Finger Touch Lamp



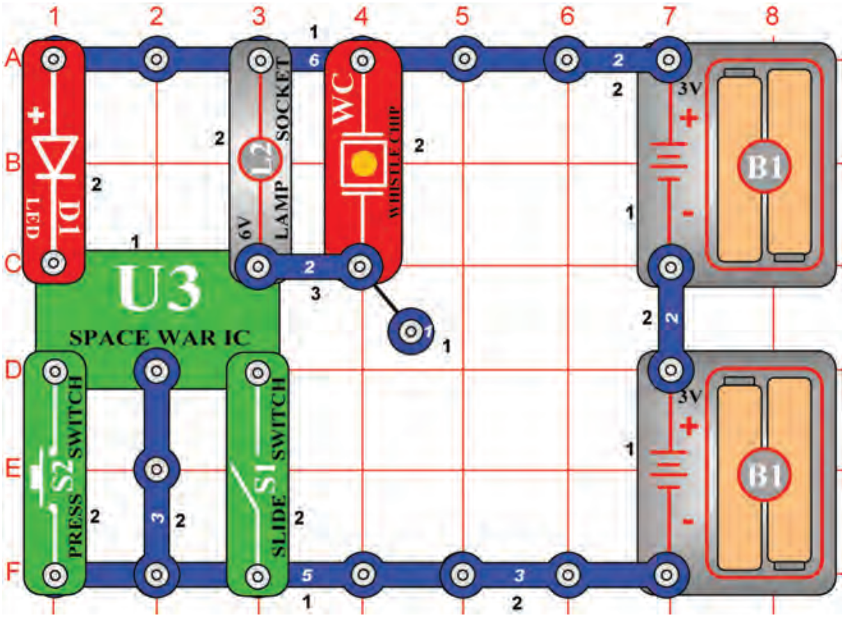
OBJECTIVE: To show you how finger touch lamps work.

The touch lamps you see in stores only need to be touched by one finger to light, not two. So let's see if we can improve the last circuit to only need one finger. Build the new circuit, note that near point X there is a 2-snap wire that is only mounted on one side, swing it so the plastic touches point X. Wet a large area of one of your fingers and touch it to both metal contacts at point X at the same time; the LED (D2) lights. To make it easier for one finger to touch the two contacts, touch lamps or other touch devices will have the metal contacts interweaved as shown below and will also be more sensitive so that you don't have to wet your finger to make good contact.



☐ Project #248 Space Battle

OBJECTIVE: To make space battle sounds.



Build the circuit shown on the left. Activate the circuit by turning on the slide switch (S1) or pressing the press switch (S2), do both several times and in combination. You will hear exciting sounds and see flashing lights, as if a space battle is raging!

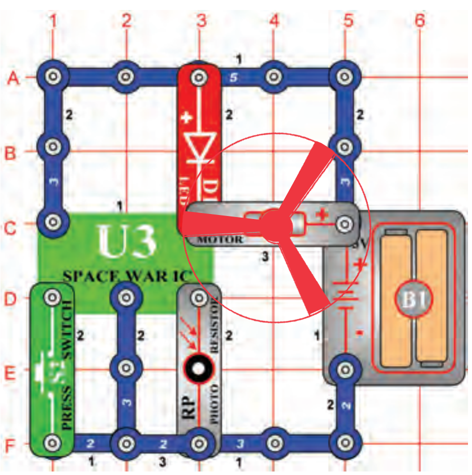
☐ Project #249 Space Battle (II)

OBJECTIVE: To show how light can turn “ON” an electronic device.

Replace the slide switch (S1) with the photoresistor (RP). Now covering and uncovering the photoresistor will change the sound.

☐ Project #250 Multi-Speed Light Fan

OBJECTIVE: To vary the speed of a fan activated by light.



Build the circuit shown on the left, with the fan on the motor (M1).

This circuit is activated by light on the photoresistor, (RP) though the fan will barely turn at all. Press the press switch (S2) and the fan will spin. If you hold the press switch down, the fan will spin faster. If you cover the photoresistor, the fan will stop unless the press switch is pressed.

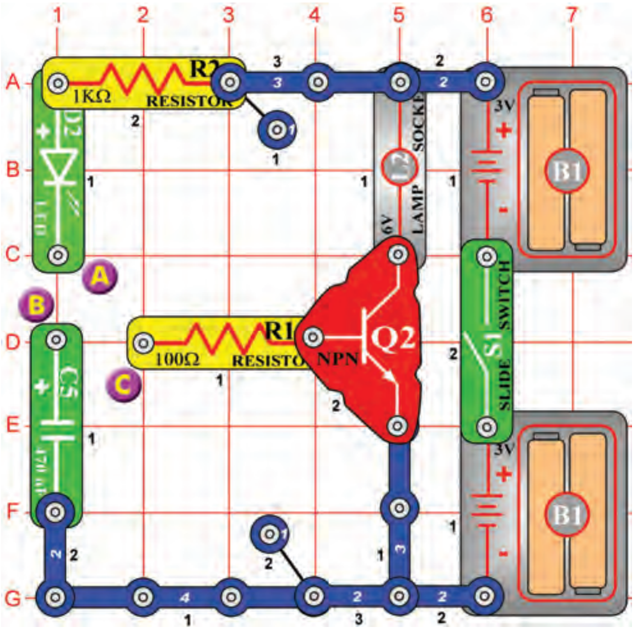
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #251 Light & Finger Light

OBJECTIVE: To show another way the Space War IC may be used.

In the circuit at left, replace the motor (M1) with the 2.5V lamp (L1) shown below. Vary the brightness of the lamp by covering the photoresistor (RP) and holding down the press switch (S2) in various combinations. Notice that pressing the press switch when the photoresistor is covered still turns on the lamp, while in project #250, doing this would turn off the motor.

☐ Project #252 Storing Electricity

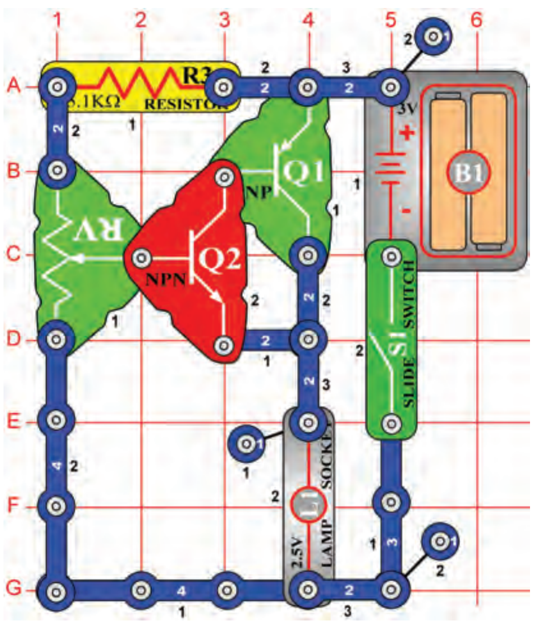


OBJECTIVE: To store electricity in a capacitor.

Turn the slide switch (S1) on and connect points A & B with a 2-snap wire. The green LED (D2) will flash and the 470μF capacitor (C5) will be charged with electricity. The electricity is now stored in the capacitor. Disconnect points A & B. Connect points B & C and there will be a flash from the 6V lamp (L2).

The capacitor discharges through the resistor to the base of the NPN transistor (Q2). The positive current turns on the transistor like a switch, connecting the lamp to the negative (–) side of the batteries. The light will go out after the capacitor discharges, because there is no more current at the base of the transistor.

☐ Project #253 Lamp Brightness Control



OBJECTIVE: To use a transistor combination to control a lamp.

Here is a combination with two transistors. This combination increases the amplifying power. By changing the resistance, the current at the base of the transistor is also changed. With this amplifying ability of the combination, there is a greater change of current to the lamp (L1). This changes the brightness.

☐ Project #254 Electric Fan

OBJECTIVE: To make an electric fan using a transistor circuit.

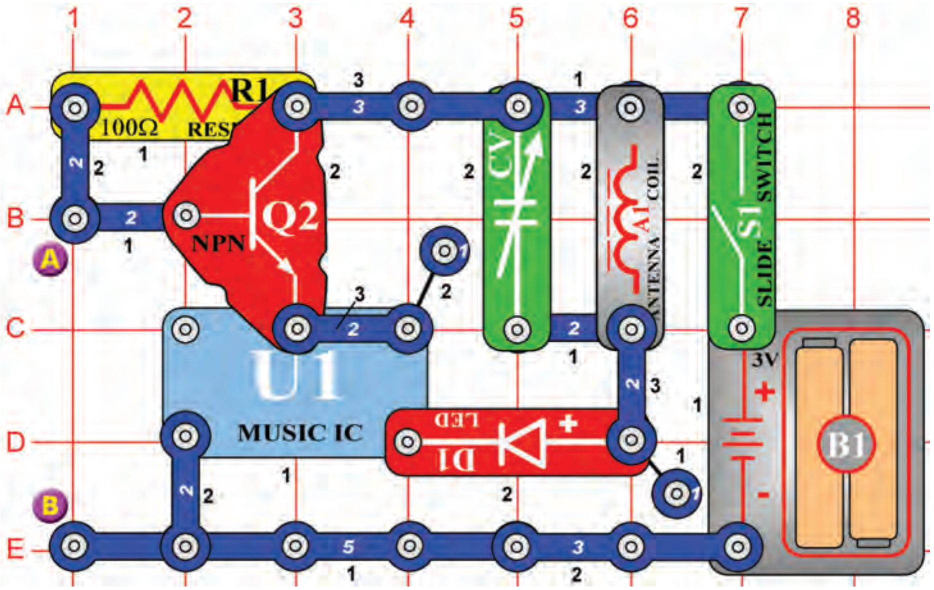
Use the circuit from project #253. Replace the lamp (L1) with the motor (M1) and install the fan. By controlling the adjustable resistor (RV), the speed of the fan changes. Now you can make your own speed changing electric fan.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #255

Radio Music Burglar Alarm

OBJECTIVE: To build an alarm that plays music on the radio.



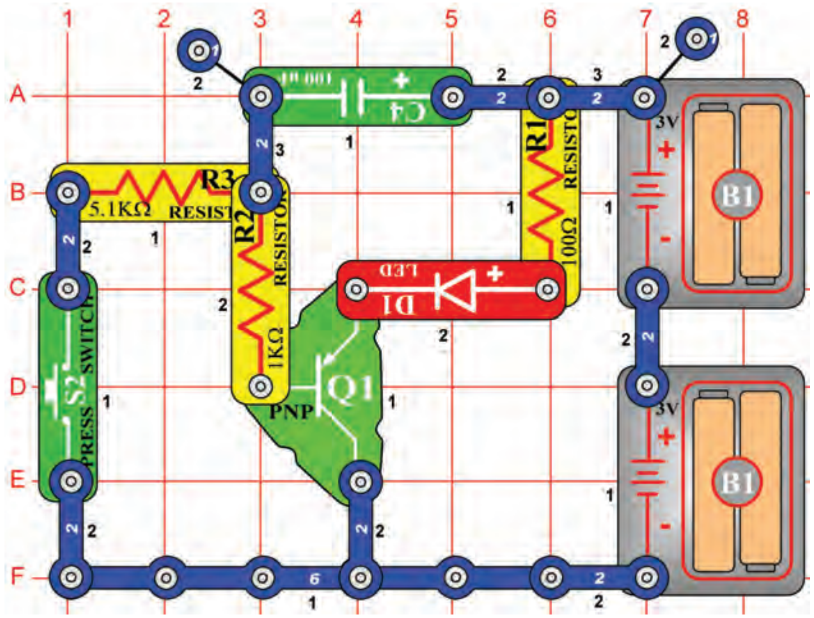
Place the circuit next to an AM radio. Tune the radio so no stations are heard. Set the slide switch (S1) on. You should hear the song play. The red LED (D1) should also be lit. Adjust the variable capacitor (CV) for the loudest signal.

Connect a jumper wire across points A & B and the music stops. The transistor (Q2) acts like a switch connecting power to the music IC (U1). Positive voltage on the base turns on the switch and negative voltage opens it. Connect a string to the jumper wire and the other end of the string to a door or window. Turn the slide switch on. If a thief comes in through the door or window, the string pulls the jumper off and the music plays on the radio.

Project #256

Light Dimmer

OBJECTIVE: To build a light dimmer.

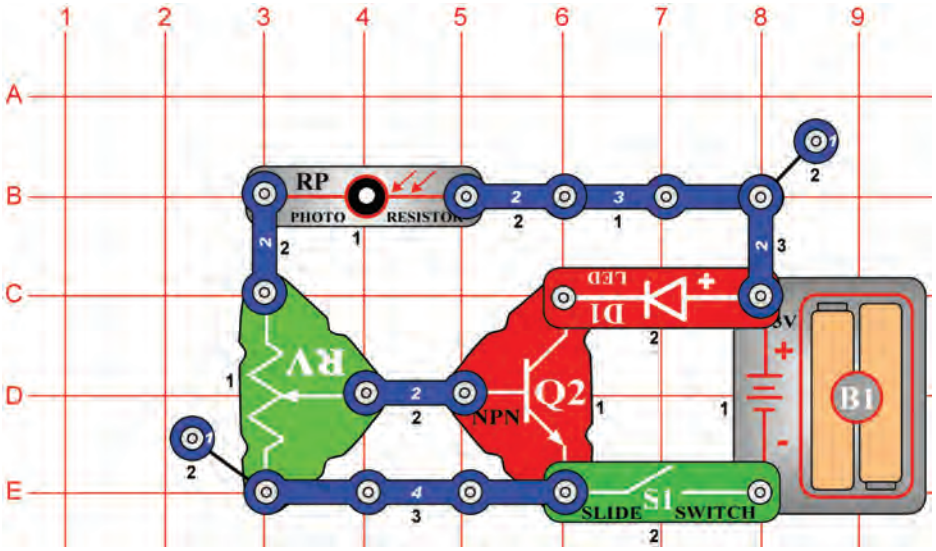


Press the press switch (S2) to complete the current's path flow. You might expect the LED (D1) to light instantly but it doesn't. The charging current flows into the 100μF capacitor (C4) first. As the capacitor charges, the charging current decreases, input current to the PNP transistor (Q1) increases. So current begins to flow to the LED and the LED gradually brightens.

Now release the press switch. The capacitor begins to discharge, sending input current to the transistor. As the capacitor discharges, the input current reduces to zero and gradually turns off the LED and the transistor.

Project #257 Motion Detector

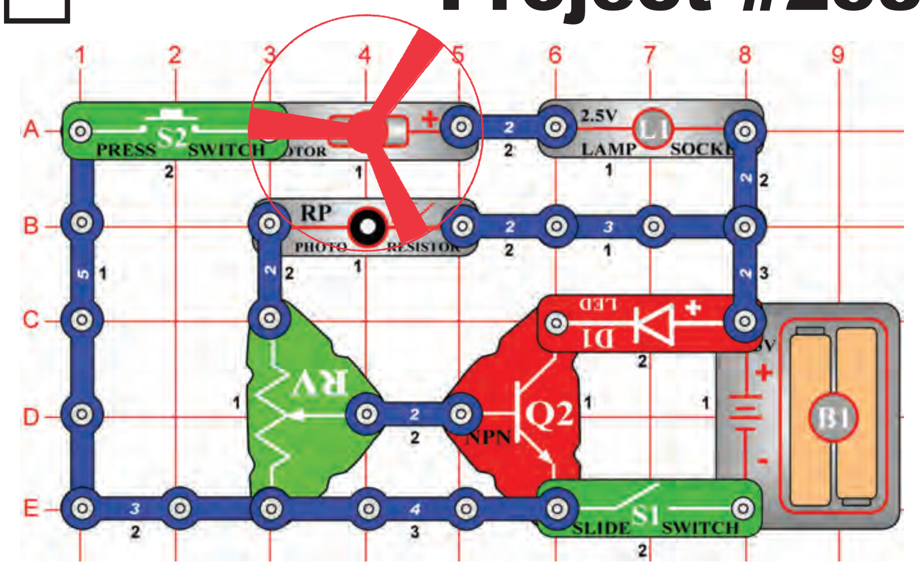
OBJECTIVE: Build a circuit that detects motion.



Set the adjustable resistor (RV) to the center position. Turn the slide switch (S1) on and the LED (D1) lights. Wave your hand over the photoresistor (RP) and the LED turns off and on. The resistance changes as the amount of light strikes the photoresistor. As the light decreases, the resistance increases. The increased resistance lowers the voltage at the base of the NPN transistor (Q2). This turns off the transistor, preventing current flowing through the LED to the negative (–) side of the battery (B1). Wave your hand over photoresistor at different distances. The LED gets brighter the farther away your hand is.

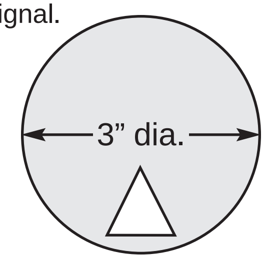
Project #258 Fan Modulator

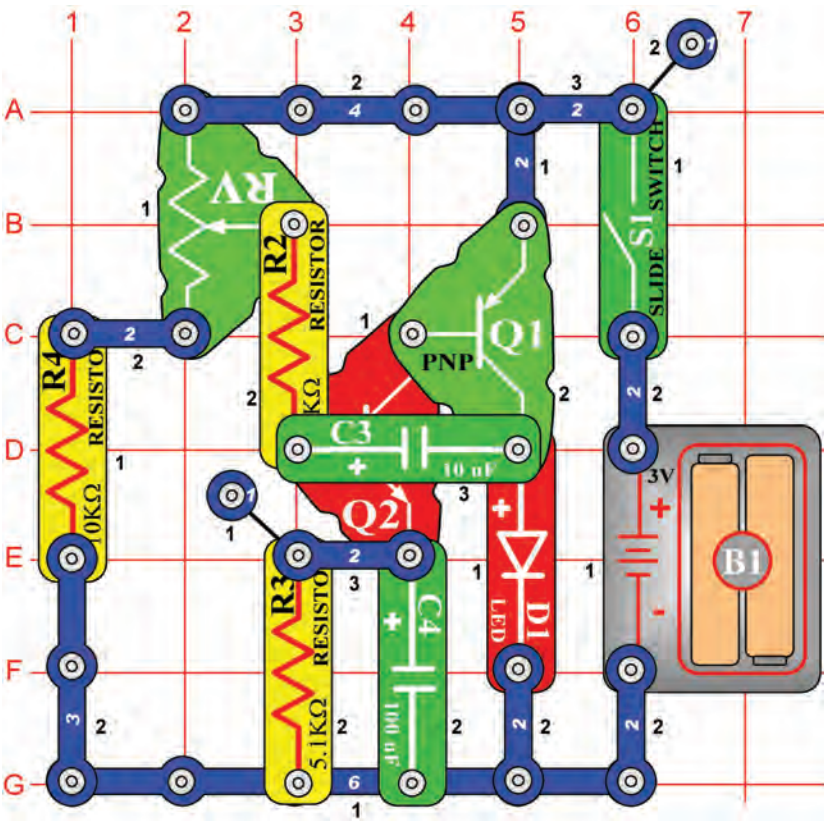
OBJECTIVE: To modulate the brightness of an LED.



WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Using the fan outline as a guide, cut a 3" circle out of a piece of paper. Then, cut a small triangle in it as shown. Tape the circle onto the fan and then place it onto the motor (M1). Set the adjustable resistor (RV) to the center position and turn the slide switch (S1) on. Press the press switch (S2), the fan spins and the lamp (L1) lights. As the triangle opening moves over the photoresistor (RP), more light strikes it. The brightness of the LED changes, or is *modulated*. As in AM or FM radio, modulation uses one signal to modify the amplitude or frequency of another signal.





Project #259

Oscillator 0.5 - 30Hz

OBJECTIVE: To build a 0.5Hz - 30Hz oscillator that will light an LED.

Set the adjustable resistor (RV) to the bottom position and then turn the slide switch (S1) on. The LED (D1) will start flashing at a frequency of 0.5Hz (once every two seconds). Slowly adjust the adjustable resistor and the LED flashes faster. As the frequency increases, the LED flashes faster. Eventually, the LED flashes so fast, it looks like it is on all of the time.

Project #260

Sound Pulse Oscillator

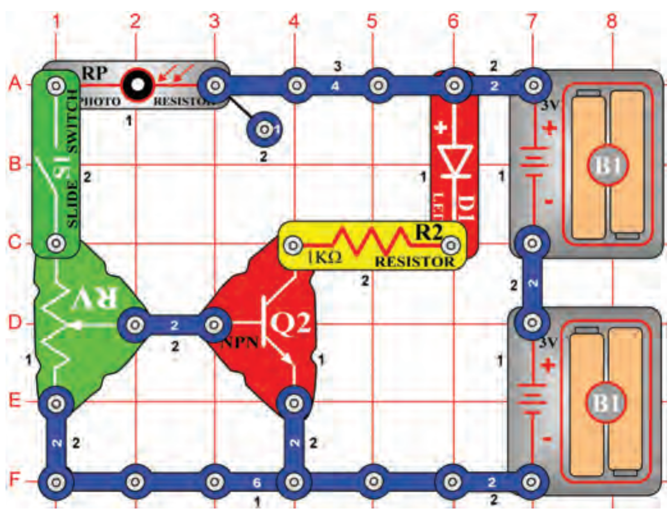
OBJECTIVE: To build a 0.5Hz - 30Hz oscillator and hear it on a speaker.

Use the circuit from project #259.
Connect a single snap under the speaker (SP) and then connect it across the LED (on level 4). Turn the slide switch (S1) on and now you can hear the oscillator. Adjust the adjustable resistor (RV) to hear the different frequencies. Now you can hear and see the frequencies. Note: You may not hear sounds at all settings of the adjustable resistor.

Project #261

Motion Detector (II)

OBJECTIVE: To build a motion detector that senses an objects movement.

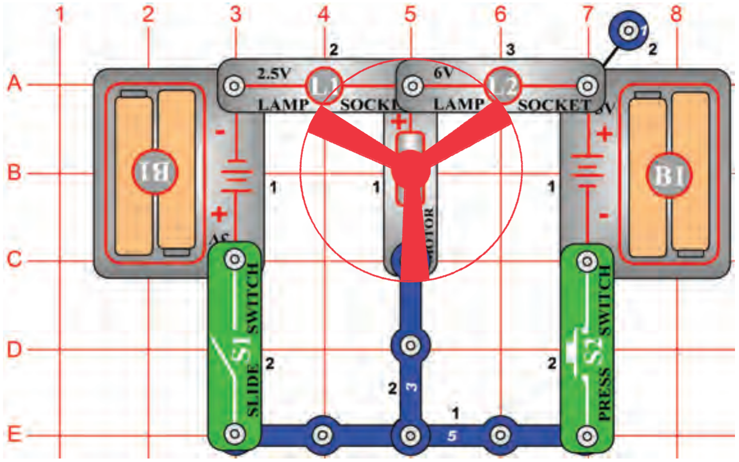


Turn the slide switch (S1) on and move the adjustable resistor (RV) control all the way up. The brightness of the LED (D1) is at maximum. Now, move the adjustable resistor control down until the LED goes out. Set the control up a little and the LED lights dimly.

Move your hand from side to side over the photoresistor (RP). As your hand blocks the light, the LED goes out.

The amount of light changes the resistance of the photoresistor and the current flow to the base of the NPN transistor (Q2). The transistor acts like a switch. Its base current is supplied through the photoresistor. As the base current changes, so does the current flow through the LED. With no base current, the LED goes out.

Project #262 — Motor Rotation



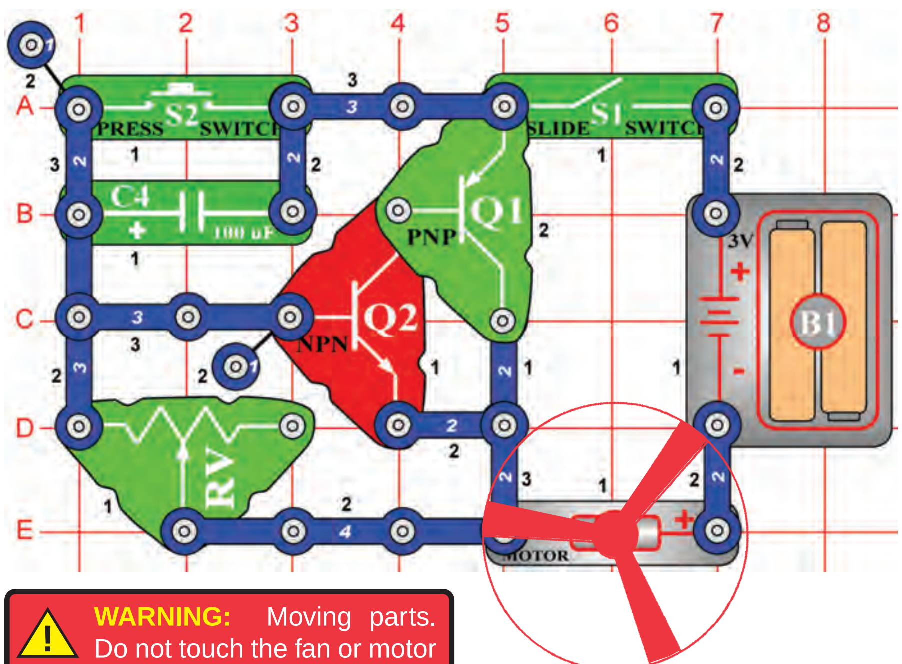
OBJECTIVE: To show how voltage polarity affects a DC motor.

Place the fan onto the motor (M1). Press the press switch (S2). The fan rotates clockwise. When you connect the positive (+) side of the battery (B1) to the positive (+) side of the motor, it spins clockwise. Release the press switch and turn on the slide switch (S1). Now the fan spins the other way. The positive (+) side of the battery is connected to the negative (–) side of the motor. The polarity on the motor determines which way it rotates.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #263 — Motor Delay Fan

OBJECTIVE: To build a circuit that controls how long the fan is on.



WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Place the fan onto the motor (M1) and set the adjustable resistor (RV) control to the far right. Turn the slide switch (S1) on and then press the press switch (S2) once. The motor will spin and then stop. Now set the resistor control to the far left and press the press switch again. The time the fan spins is much less now.

When the press switch is pressed, the current flows through the circuit and the fan spins. The 100µF capacitor (C4) charges up also. When the press switch is released, the capacitor discharges and supplies the current to keep the transistors (Q1 & Q2) on. The transistor acts like a switch connecting the fan to the battery. When the capacitor fully discharges, the transistors turn off and the motor stops. The adjustable resistor controls how fast the capacitor discharges. The more resistance, the longer the discharge time.

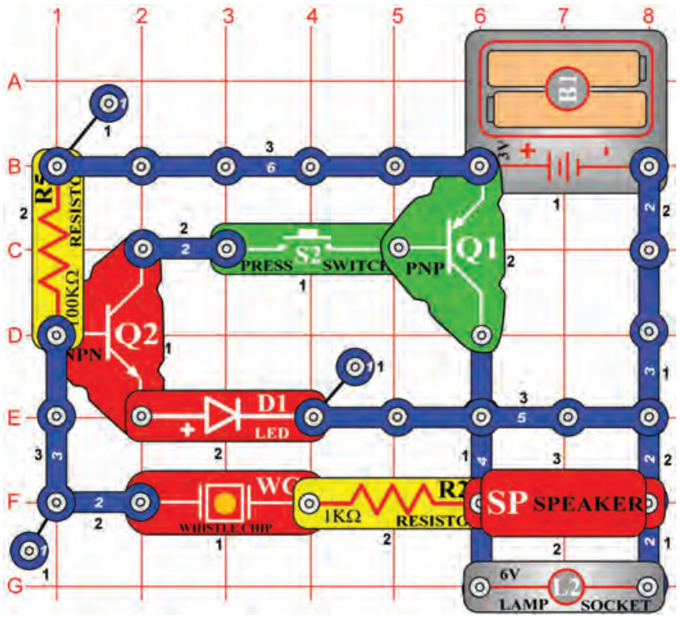
Project #264 — Motor Delay Fan (II)

OBJECTIVE: To change capacitance to affect time.

Use the circuit from project #263. Connect a single snap under the positive (+) side of the 470µF capacitor (C5) and then connect it over the top of the 100µF capacitor (C4). Turn the slide switch (S1) on and press the press switch (S2). Notice that the fan spins longer now. When capacitors are in parallel, the values are added, so now you have 570µF. The time it takes to discharge the capacitors is longer now, so the fan keeps spinning.

☐ Project #265 High Pitch Bell

OBJECTIVE: To build a high pitch bell.



Build the circuit shown and press the press switch (S2). The circuit starts to oscillate. This generates the sound of a high pitch bell.

☐ Project #266 Steamboat Whistle

OBJECTIVE: To build a steamboat whistle.

Using the circuit in project #265, connect the 0.02μF capacitor (C1) across the whistle chip (WC). Press the press switch (S2). The circuit now generates the sound of a steamboat.

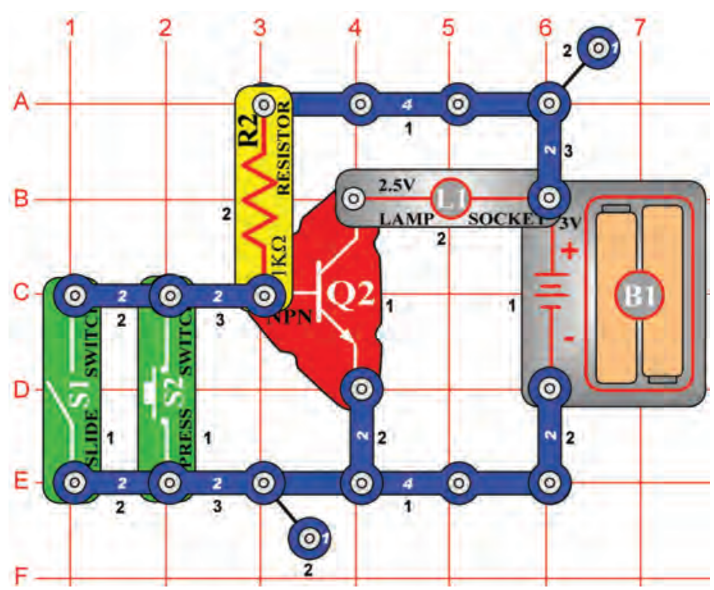
☐ Project #267 Steamship

OBJECTIVE: To generate the sound of a steamship.

Using the circuit in Project #265, connect the 0.1μF capacitor (C2) across the whistle chip. Press the press switch (S2). The circuit now generates the sound of a steamship.

☐ Project #268 Light NOR Gate

OBJECTIVE: To build a NOR gate.

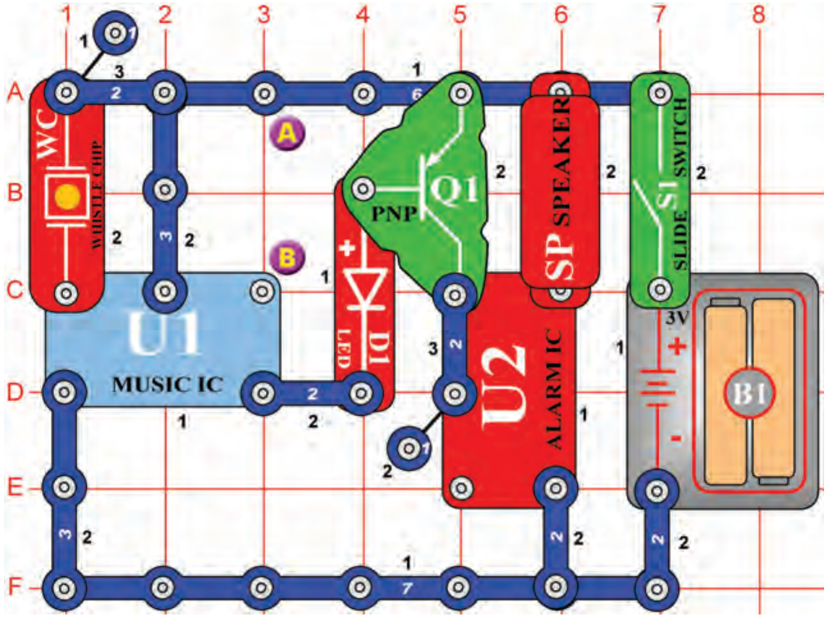


Build the circuit on the left. You will find that the lamp (L1) is on when neither the slide switch (S1) NOR the press switch (S2) are on. This is referred to as an NOR gate in electronics and is important in computer logic.

Example: If neither condition X NOR condition Y are true, then execute instruction Z.

Project #269

Noise-Activated Burglar Alarm



OBJECTIVE: To build a noise activated alarm.

Turn the slide switch (S1) on and wait for the sound to stop. Place the circuit into a room you want guarded. If a thief comes into the room and makes a loud noise, the speaker (SP) will sound again.

If you find that the sound does not turn off, then vibrations created by the speaker may be activating the whistle chip. Set the speaker on the table near the circuit and connect it to the same locations using the jumper wires to prevent this.

Project #270

Motor-Activated Burglar Alarm

OBJECTIVE: To build a motor-activated burglar alarm.

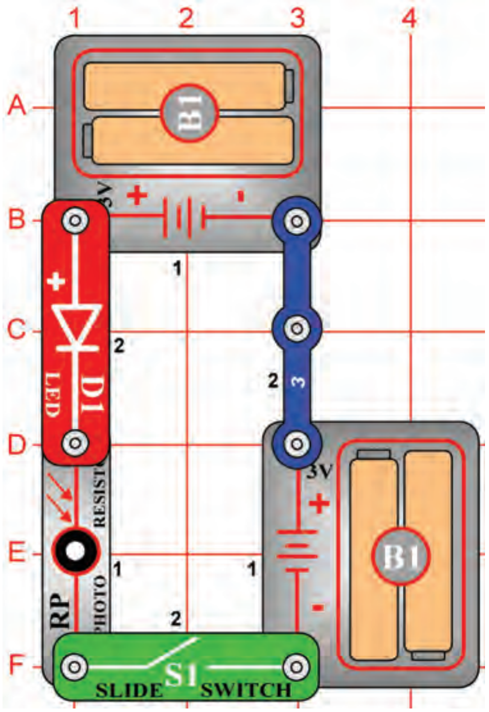
Use the circuit from project #269 shown above.
Replace the whistle chip (WC) with the motor (M1). Wind a piece of string around the axis of the motor so when you pull it the axes spins. Connect the other end of the string to a door or window. Turn the slide switch (S1) on and wait for the sound to stop. If a thief comes in through the door or window the string pulls and the axes spins. This will activate the sound.

Project #271

Light-Activated Burglar Alarm

OBJECTIVE: To build a light-activated burglar alarm.

Use the circuit from project #269 shown above.
Connect a photoresistor (RP) across points A & B and cover it or turn off the lights. Turn the slide switch (S1) on and wait for the sound to stop. At night, when the thief comes in and turns on the light, the speaker (SP) makes the sound of a machine gun.

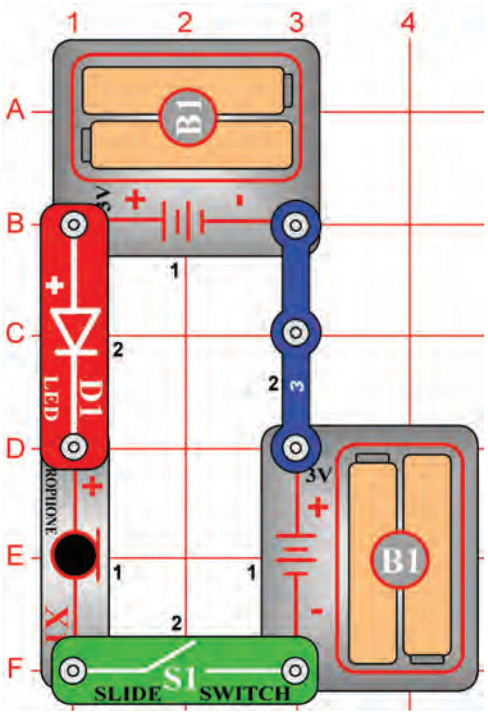


☐ Project #272
Photoresistor Control

OBJECTIVE: To use a photoresistor to control the brightness of an LED.

In this circuit, the brightness of the LED (D1) depends on how much light shines directly on the photoresistor (RP). If the photoresistor were held next to a flashlight or other bright light, then the LED would be very bright.

The resistance of the photoresistor decreases as more light shines on it. Photoresistors are used in applications such as streetlamps, which come on as it gets dark due to night or a severe storm.

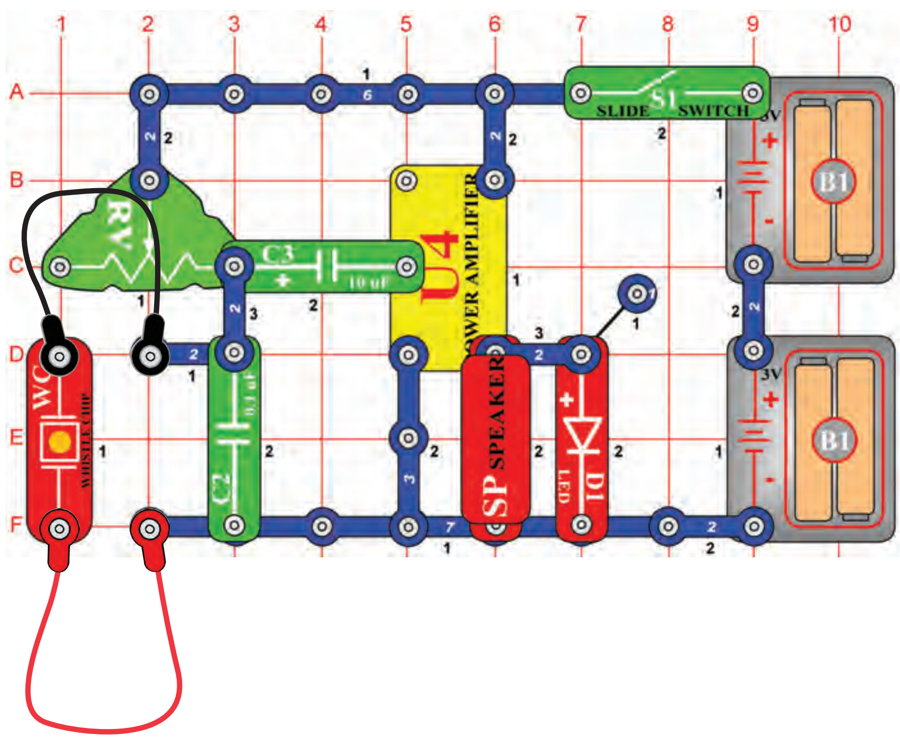


☐ Project #273
Microphone Control

OBJECTIVE: To use a microphone to control the brightness of an LED.

In this circuit, blowing on the microphone (X1) changes the LED (D1) brightness.

The resistance of the microphone changes when you blow on it. You can replace the microphone with one of the resistors to see what resistor value it is closest to.



Project #274
Pressure Alarm

OBJECTIVE: To build a pressure alarm circuit.

Connect two jumper wires to the whistle chip (WC) as shown. Set the control of the adjustable resistor (RV) to the far left and turn on the switch. There is no sound from the speaker (SP) and the LED (D1) is off. Tap the center of the whistle chip. The speaker sounds and the LED lights. The whistle chip has a piezocrystal between the two metal plates. The sound causes the plates to vibrate and produce a small voltage. The voltage is amplified by the power amplifier IC (U4), which drive the speaker and LED.

Place a small object in the center of the whistle chip. When you remove the object the speaker and LED are activated. In alarm systems, a siren would sound to indicate the object has been removed.

Project #275
Power Microphone

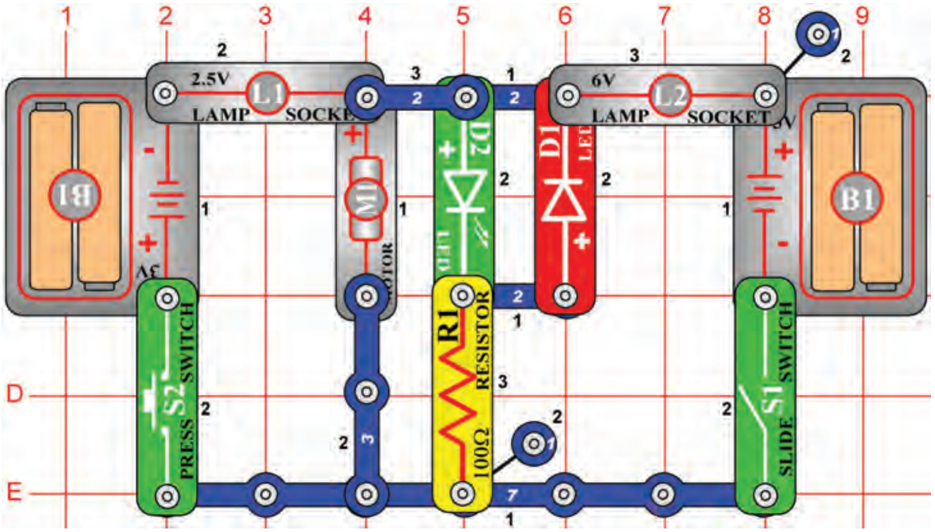
OBJECTIVE: To build a power microphone.

Use the circuit from project #274.

Replace the whistle chip with the microphone (X1), and hold it away from the speaker (SP). Set the control of the adjustable resistor (RV) to the far left. Turn on the slide switch (S1) and talk into the microphone. You now hear your voice on the speaker. The sound waves from your voice vibrate the microphone and produce a voltage. The voltage is amplified by the power amplifier IC (U4) and your voice is heard on the speaker.

Project #276 LED Fan Rotation Indicator

OBJECTIVE: To build an LED fan rotation indicator.



WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

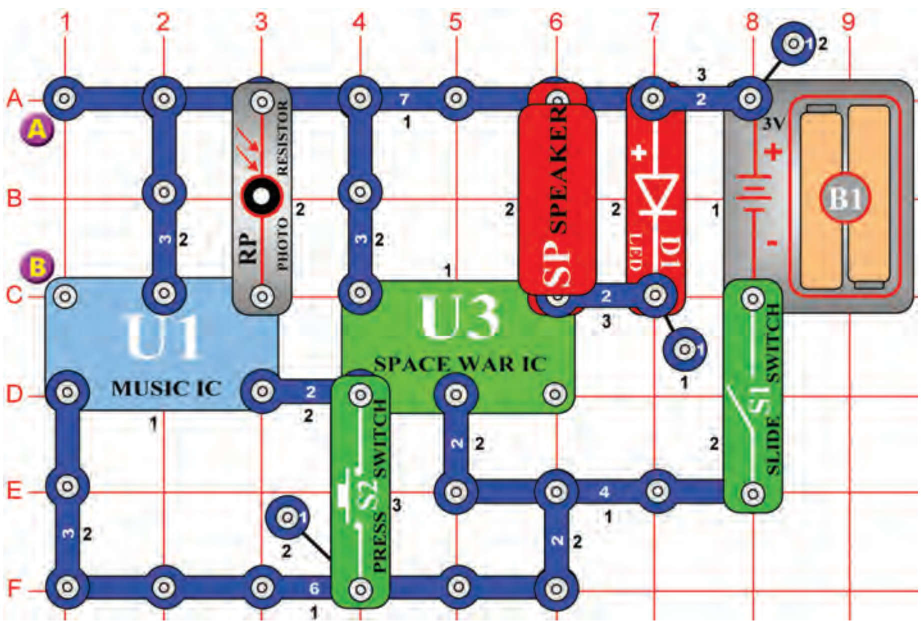
Do not place the fan onto the motor (M1). Turn the slide switch (S1) on. The motor rotates clockwise, and the green LED (D2) lights. When you connect the positive (+) side of the battery (B1) to the positive (+) side of the motor, it spins clockwise. Turn the slide switch off and press the press switch (S2). Now the fan spins the other way and the red LED (D1) lights. The positive (+) side of the battery is connected to the negative (–) side of the motor. The polarity on the motor determines which way it rotates.

Now place the fan on the motor, and turn on S1 or S2 (not both). Now one of the lamps (L1 or L2) lights as the motor spins, but the LED is dim.

The motor needs a lot of current to spin the fan, but only a little current to spin without it. In this circuit, a lamp lights when the motor current is high, and an LED lights when the motor current is low. The lamps also prevent a short circuit if both switches are on.

Project #277 Space War Sounds with LED

OBJECTIVE: To build a circuit that uses a programmed sound integrated circuit (IC).

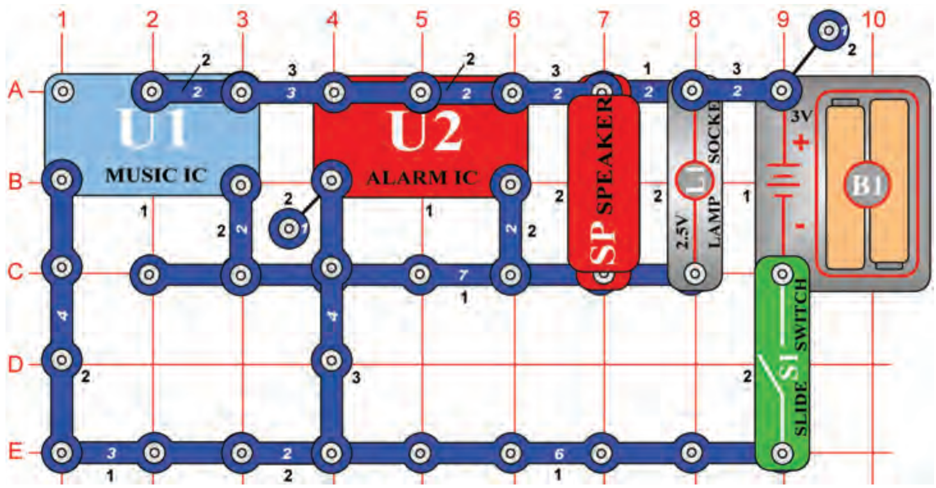


Build the circuit shown on the left, which uses the space war integrated circuit (U3). Turn the slide switch (S1) on. A space war sound plays, and the LED (D1) flashes. If there is no light on the photoresistor (RP) then the sound will stop after a while.

You also make sounds by pressing the press switch (S2). See how many sounds are programmed into the space war sound IC.

☐ Project #278 Sound Mixer

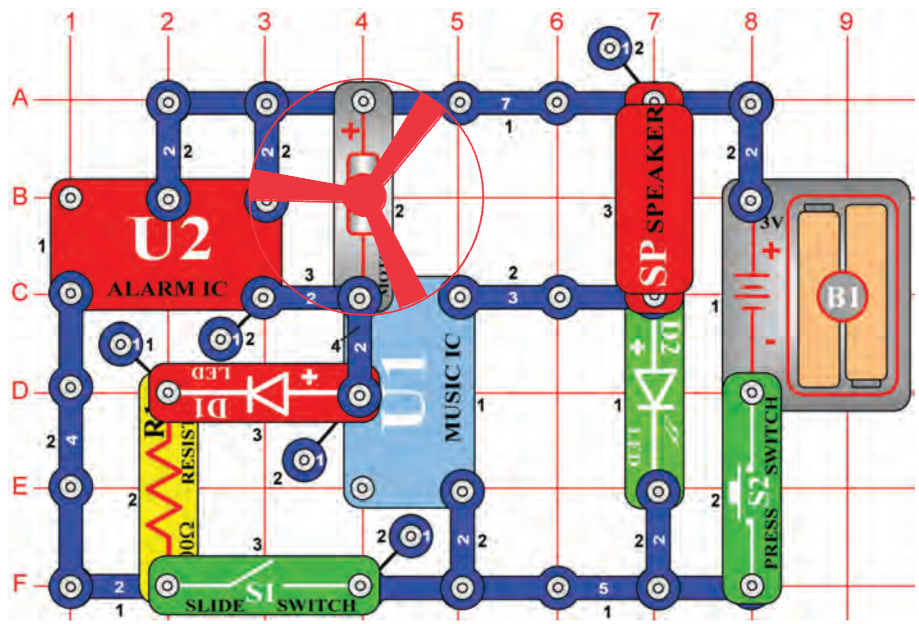
OBJECTIVE: To connect two sound IC's together.



In the circuit, the outputs from the alarm (U2) and music (U1) IC's are connected together. The sounds from both IC's are played at the same time.

☐ Project #279 Sound Mixer Fan Driver

OBJECTIVE: To connect two sound IC's together to drive two LED's and a motor.

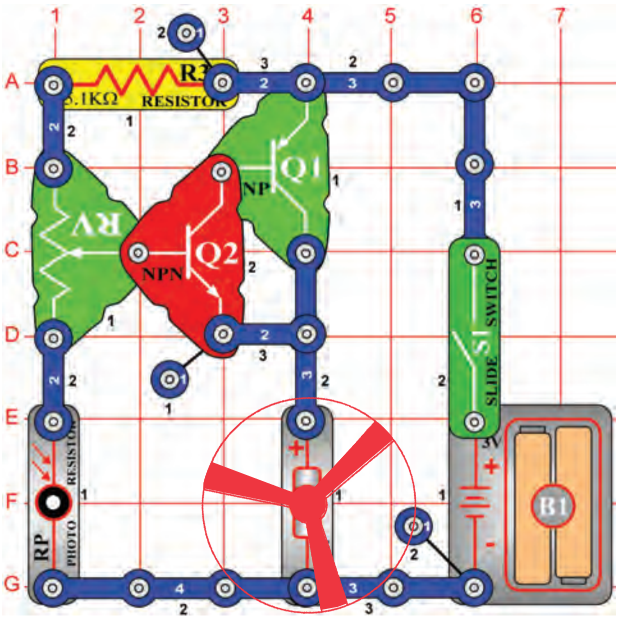


Build the circuit shown on the left. Place the fan onto the motor (M1).

In the circuit, the alarm IC (U2) and the music IC (U1) are connected together. The sounds from both IC's can be played at the same time. Press the press switch (S2). The music IC plays and the green LED (D2) lights. Now turn on the slide switch (S1) and press the press switch again. You should hear the sounds from both IC's playing. As the alarm IC plays, it also drives the fan and the red LED (D1).

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #280



Electric Fan Stopped by Light

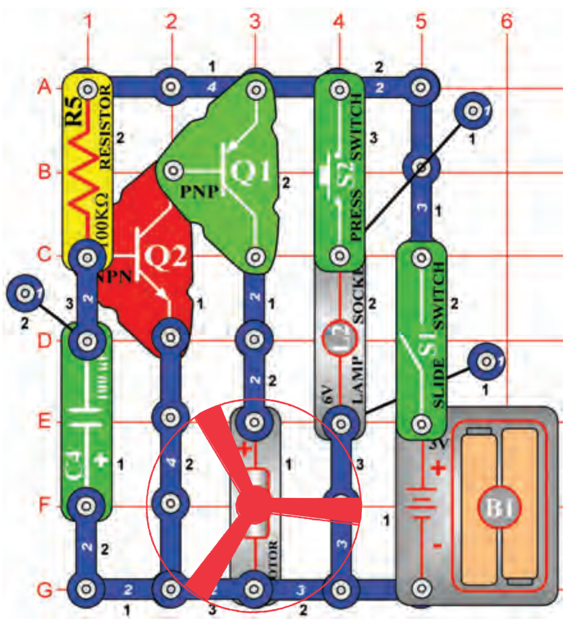
***OBJECTIVE:** To show how light can control a motor.*

Turn on the slide switch (S1) and set the adjustable resistor (RV) control so the motor (M1) just starts spinning. Slowly cover the photoresistor (RP) and the motor spins faster. By placing more light over the photoresistor, the motor slows.

The fan will not move on most settings of the resistor, because the resistance is too high to overcome friction in the motor. If the fan does not move at any resistor setting, then replace your batteries.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #281



Motor & Lamp

***OBJECTIVE:** To control large currents with a small one.*

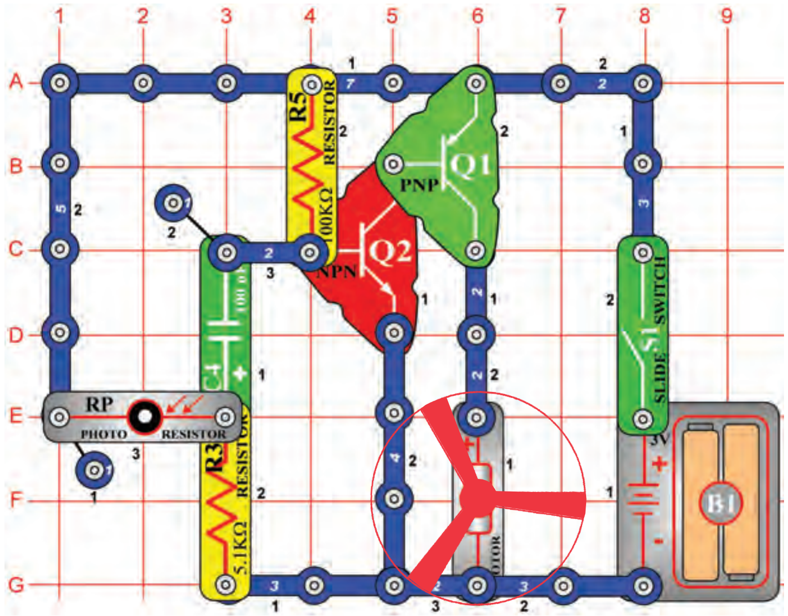
Place the fan on the motor (M1). Turn on the slide switch (S1) and the motor spins. The transistors are like two switches connected in series. A small current turns on the NPN transistor (Q2), which turns on the PNP transistor (Q1). The large current used to spin the motor now flows through the PNP. The combination allows a small current to control a much larger one.

Press the press switch (S2) and the lamp (L2) lights and slows the motor. When the lamp lights, the voltage across the motor decreases and slows it down.

The fan will not move on most settings of the resistor, because the resistance is too high to overcome friction in the motor. If the fan does not move at any resistor setting, then replace your batteries.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #282 Start-Stop Delay



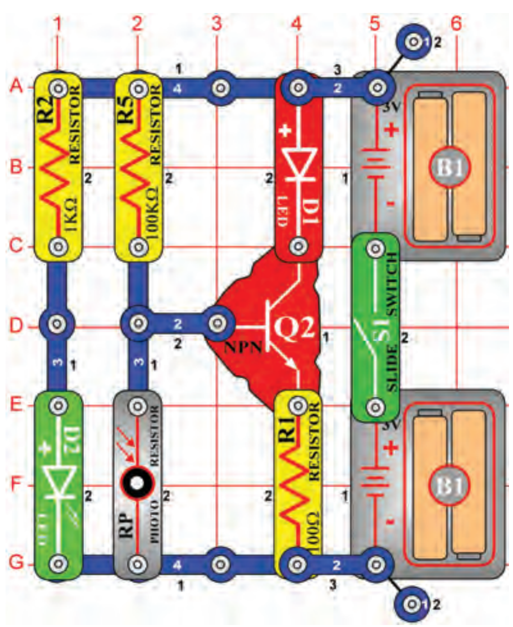
OBJECTIVE: To start and stop a motor with light.

Place the fan on the motor (M1). Turn on the slide switch (S1), the motor starts spinning. As you move your hand over the photoresistor, (RP) the motor slows. Now place a finger on top of the photoresistor to block the light. The motor slows down. In a few seconds the motor speeds up again.

The fan will not move on most settings of the resistor, because the resistance is too high to overcome friction in the motor. If the fan does not move at any resistor setting, then replace your batteries.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

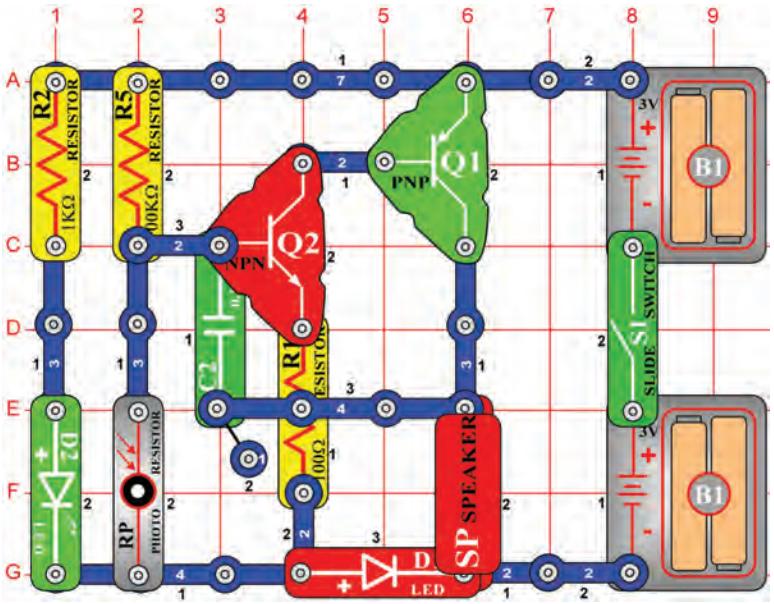
Project #283 Mail Notifying System



OBJECTIVE: To build a circuit to indicate if you have mail.

Turn on the slide switch (S1). If there is light on the photoresistor (RP) the red LED (D1) will not light. Place your finger over the photoresistor and now the red LED lights. A simple mail notifying system can be made using this circuit. Install the photoresistor and the green LED (D2) inside the mailbox facing each other. Place the red LED outside the mailbox. When there is mail, the light is blocked from the photoresistor and the red LED turns on.

☐ Project #284 Mail Notifying Electronic Bell



OBJECTIVE: To build a circuit to indicate if you have mail by sounding a tone.

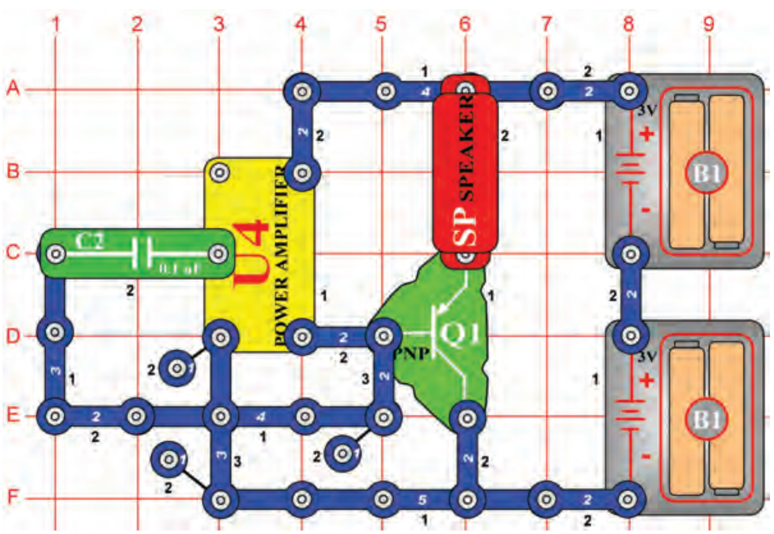
Turn on the slide switch (S1). If there is enough light on the photoresistor (RP), the speaker (SP) will not make any sound. Place your finger over the photoresistor and now the speaker sounds. The sound will stay on until you turn off the slide switch. A simple mail notifying system can be made using this circuit. Install the photoresistor and the green LED inside the mailbox facing each other. When there is mail, the light is blocked from the photoresistor and the speaker turns on.

☐ Project #285 Mail Notifying Electronic Lamp

OBJECTIVE: To build a circuit to indicate if you have mail by activating the lamp.

Replace the speaker (SP) with the lamp (L2). When there is mail, the light is blocked from the photoresistor (RP) and the lamp lights.

☐ Project #286 Twice-Amplified Oscillator



OBJECTIVE: To build an oscillating circuit.

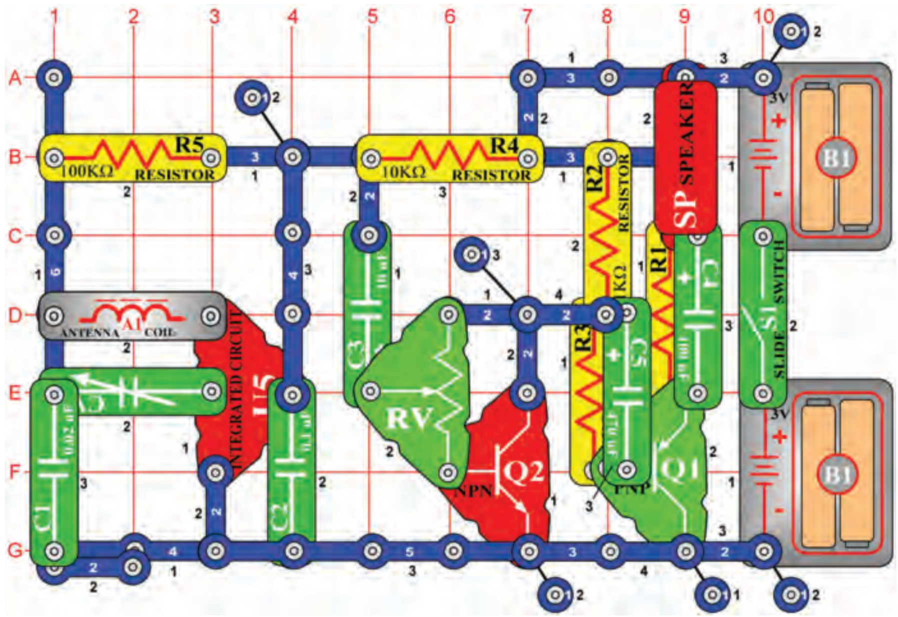
The tone you hear is the frequency of the oscillator. Install different values of capacitors in place of the 0.1μF capacitor (C2) to change the frequency.

☐ Project #287 Quick Flicking LED

OBJECTIVE: To build a flicking LED circuit.

Use the circuit from project #286. Replace the speaker (SP) with a red LED (D1, the “+” sign on top). Now you see the frequency of the oscillator. Install different values of capacitors to change the frequency.

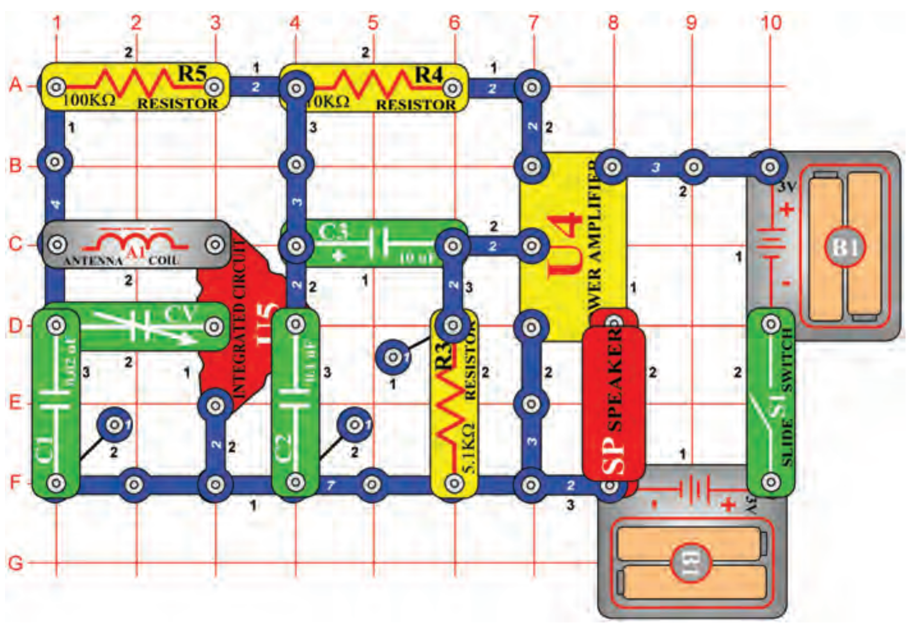
Project #288 — AM Radio with Transistors



OBJECTIVE: To build a complete, working AM radio with transistor output.

When you turn on the slide switch (S1), the integrated circuit (U5) should amplify and detect the AM radio waves. Tune the variable capacitor (CV) to the desirable station. Set the adjustable resistor (RV) for the best sound. The two transistors (Q1 & Q2) drive the speaker (SP) to complete the radio. The radio will not be very loud.

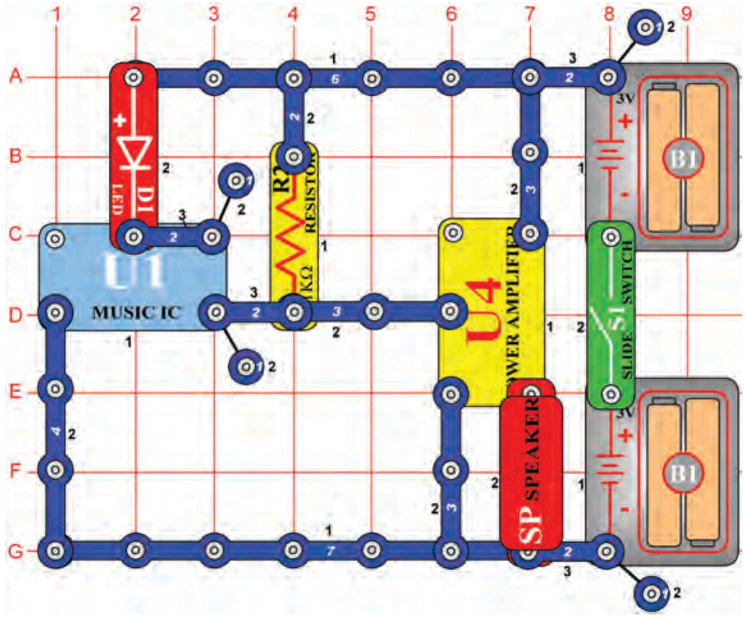
Project #289 — AM Radio (II)



OBJECTIVE: To build a complete, working AM radio.

When you close the slide switch (S1), the integrated circuit (U5) should detect and amplify the AM radio waves. The signal is then amplified using the power amplifier (U4), which drives the speaker (SP). Tune the variable capacitor (CV) to the desirable station.

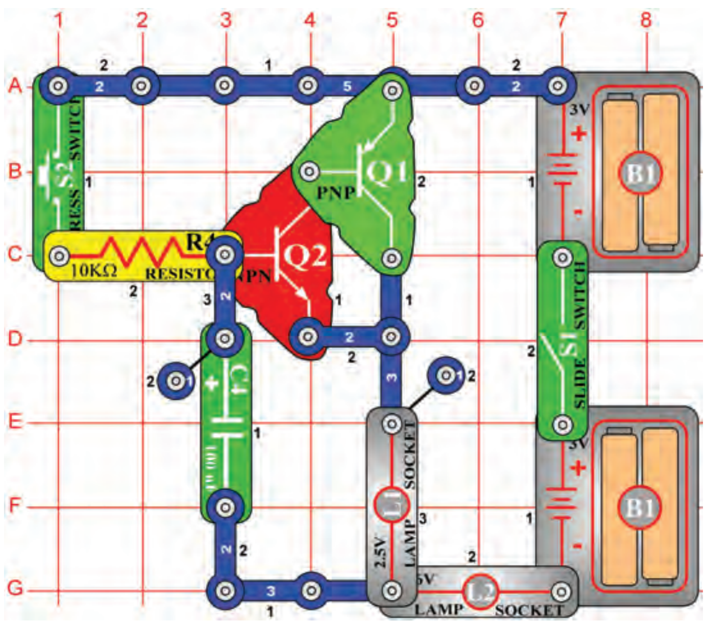
Project #290 Music Amplifier



OBJECTIVE: To amplify sounds from the music integrated circuit.

Build the circuit and turn on the slide switch (S1). You will hear loud music, since the sound from the music IC (U1) is amplified by the power amplifier IC (U4). All radios and stereos use a power amplifier.

Project #291 Delayed Action Lamp



OBJECTIVE: To build a lamp that stays on for a while.

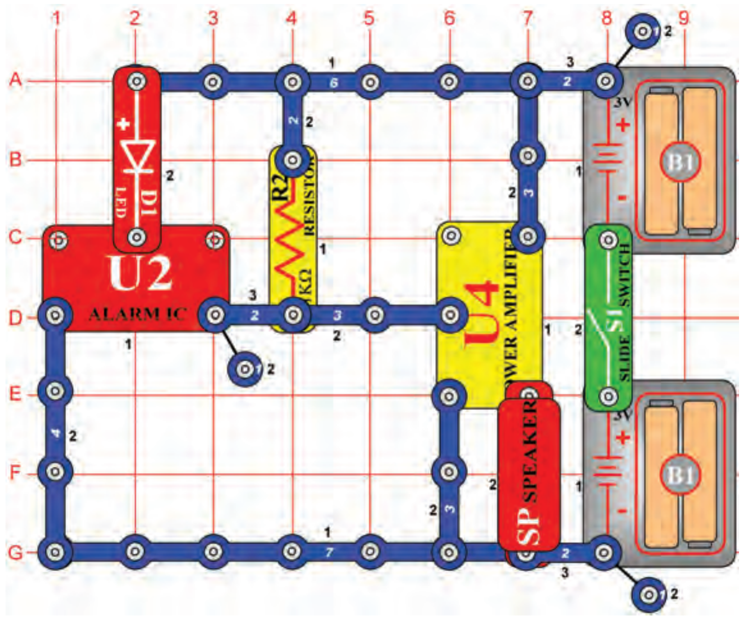
Turn on the slide switch (S1) and press the press switch (S2). The lamps (L1 & L2) turn on slowly, but stay on for a while after you release the press switch.

Project #292 Delayed Action Fan

OBJECTIVE: To build a fan that stays on for a while.

Replace the lamp (L1) with the motor (M1), positive (+) side up. Be sure to put on the fan. Turn on the slide switch (S1) and press the press switch (S2). The fan turns on slowly but stays on for a while after you release the press switch.

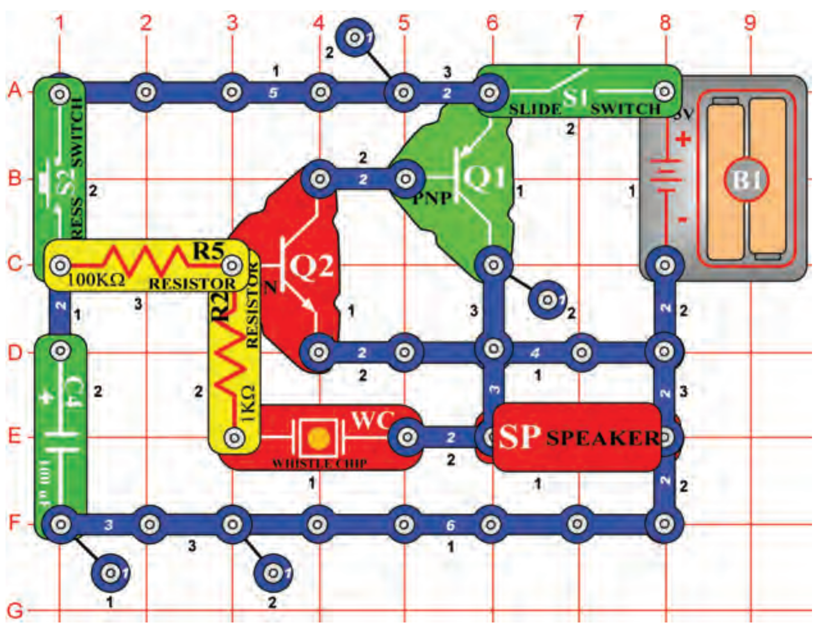
Project #293 Police Siren Amplifier



OBJECTIVE: To amplify sounds from the music integrated circuit.

Build the circuit and turn on the slide switch (S1). You will hear a very loud siren, since the sound from the alarm IC (U2) is amplified by the power amplifier IC (U4). Sirens on police cars use a similar circuit, with an IC to create the sound and a power amplifier to make it very loud.

Project #294 Lasting Doorbell



OBJECTIVE: To build a doorbell that stays on for a while.

Build the circuit at left, note that there is a 4-snap wire on layer 1 that is not connected to a 3-snap wire that runs over it on layer 3. Turn on the slide switch (S1), then press and release the press switch (S2). There is a doorbell sound that slowly fades away.

When the press switch is pressed, the transistors are supplied with current for oscillation. At the same time, the 100μF capacitor (C4) is being charged. When the press switch is released, the capacitor discharges and keeps the oscillation going for a while.

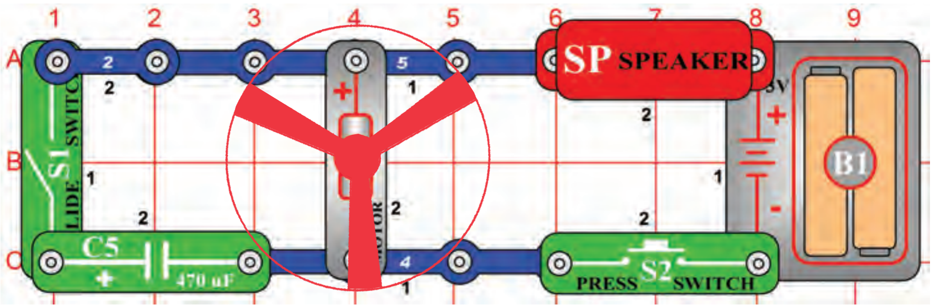
Project #295 Lasting Clicking

OBJECTIVE: To build a clicker that stays on for a while.

Place the 10μF capacitor (C3) on top of the whistle chip (WC). Press and release the press switch (S2). It makes a clicking sound that repeats for a while.

Project #296 Quieting a Motor

OBJECTIVE: To show how capacitors can filter out electrical disturbances.



Place the fan on the motor (M1) and turn off the slide switch (S1). Press the press switch (S2) and listen to the motor.

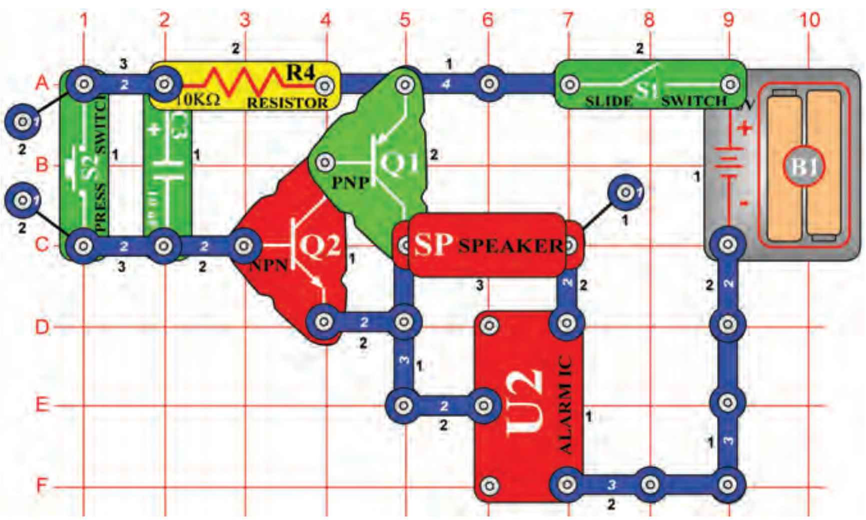
As the motor shaft spins around it connects/ disconnects several sets of electrical contacts. As these contacts are switched, an electrical disturbance is created, which the speaker converts into sound.

Turn on the slide switch and push the press switch again. The fan spins just as fast, but the sound is not as loud. Capacitors, like the 470μF capacitor (C5), are often used to filter out undesired electrical disturbances. If you replace C5 with one of the other capacitors in your set then the sound will not be changed as much.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #297 Transistor Fading Siren

OBJECTIVE: To build a siren that slowly fades away.



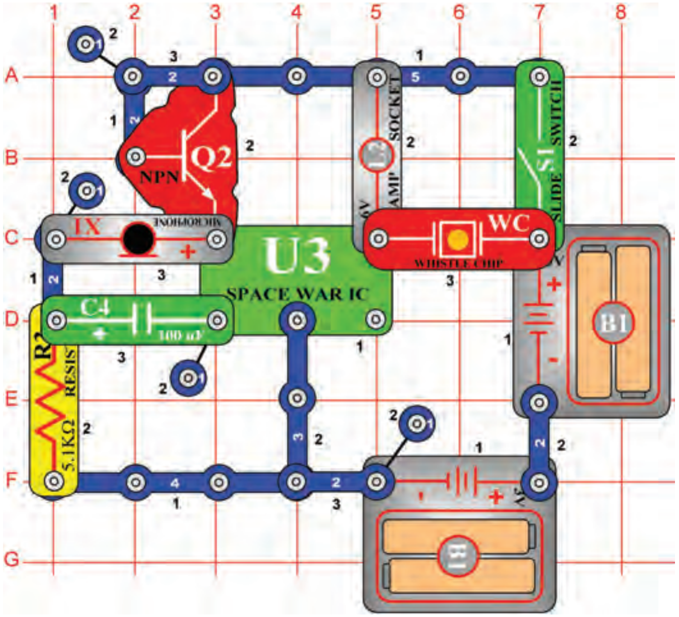
Turn on the slide switch (S1), then press and release the press switch (S2). You hear a siren that slowly fades away and eventually goes off. You can modify this circuit to make machine gun or ambulance sound instead like in the other projects. You can also replace the 10μF capacitor (C3) with the 100μF (C4) or 0.1μF (C2) to greatly slow down or speed up the fading.

Project #298 Fading Doorbell

OBJECTIVE: To build a doorbell that slowly fades away.

Replace the alarm IC (U2) with the music IC (U1). The circuit has a doorbell sound that plays and stops.

Project #299

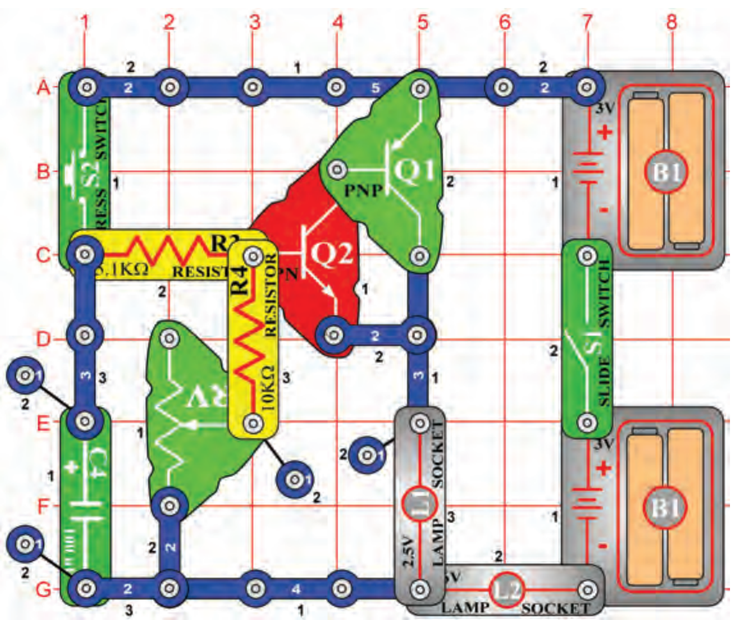


Blowing Space War Sounds

OBJECTIVE: To change space war sounds by blowing.

Turn on the slide switch (S1) and you will hear explosion sounds and the lamp is on or flashing. Blow into the microphone (X1) and you can change the sound pattern.

Project #300 Adjustable Time Delay Lamp



OBJECTIVE: To build a lamp that stays on for a while.

Turn on the slide switch (S1) and press the press switch (S2). The lamps stay on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

Project #301

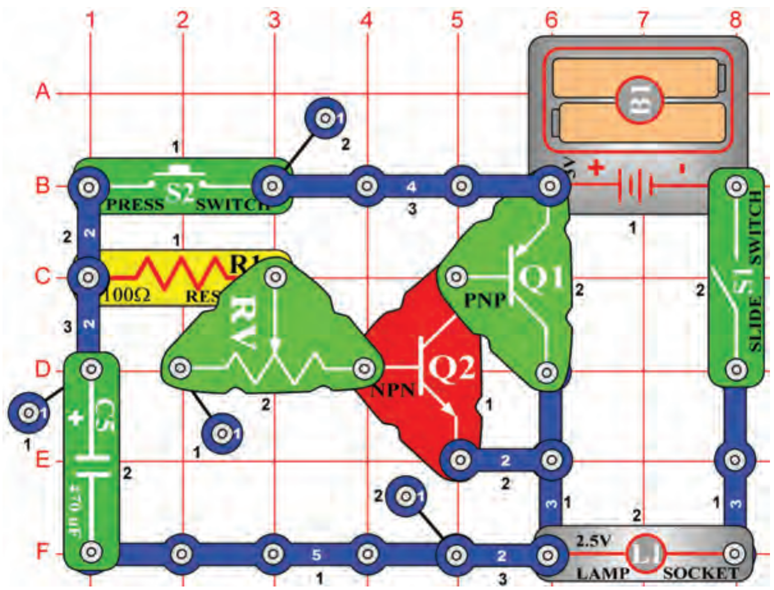
Adjustable Time Delay Fan

OBJECTIVE: To build a fan that stays on for a while.

Replace the lamp (L1) with the motor (M1), be sure to put on the fan. Turn on the slide switch (S1) and press the press switch (S2). The fan stays on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #302 Adjustable Time Delay Lamp (II)



OBJECTIVE: To build a lamp that stays on for a while.

Be sure to use the 2.5V lamp (L1) for this circuit. Turn on the switch and press the press switch (S2). The lamp stays on for a few seconds after you release the press switch. You can change the delay time with the adjustable resistor (RV).

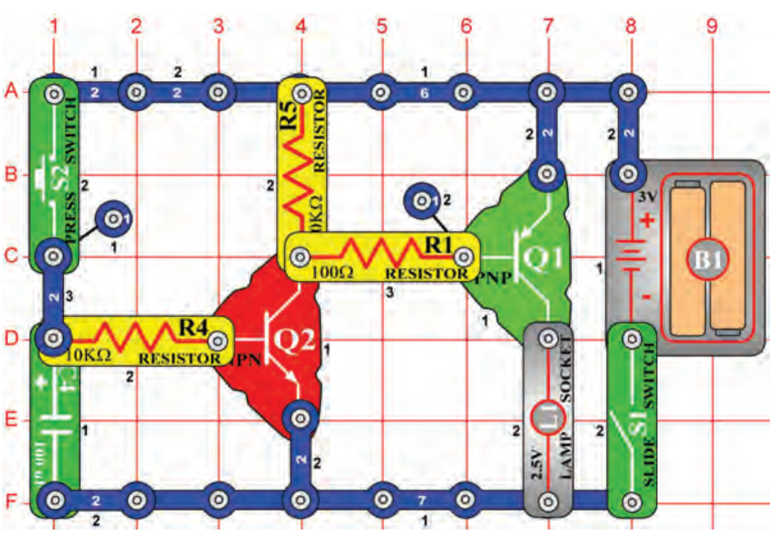
☐ Project #303 Adjustable Time Delay Fan (II)

OBJECTIVE: To build a fan that stays on for a while.

Replace the lamp (L1) with the motor (M1), be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan stays on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #304 Watch Light



OBJECTIVE: To build a lamp that stays on for a while.

Turn on the switch and press the press switch (S2). The lamp stays on for a few seconds after you release the press switch.

A miniature version of a circuit like this might be in your wristwatch - when you press a light button on the watch to read the time in the dark, a light comes on but automatically turns off after a few seconds to avoid draining the battery.

☐ Project #305 Delayed Bedside Fan

OBJECTIVE: To build a fan that stays on for a while.

Replace the lamp (L1) with the motor (M1, positive (+) side up), be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan stays on for a while after you release the press switch. This could have a longer delay and be near your bed, to turn off after you fall asleep.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

OTHER SNAP CIRCUITS® PROJECTS!

For a listing of local toy retailers who carry Snap Circuits®, please visit **www.elenco.com** or call us toll-free at (800) 533-2441. For Snap Circuits® upgrade kits, accessories, additional parts, and more information about your parts, please visit **www.snapcircuits.net**.

Upgrade Kit
Model UC-50

Build 200 Additional Projects

Including:

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- Music Meter
- Adjustable Light Control
- Digitally Tuned FM Radio
- Digital Voice Recorder
- Light Controlled Music
- AC Generator
- Flashing Numbers

Contains 12 New Parts

Including:

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- Analog Meter
- Recording IC Module
- Diode
- 7-Segment LED Display
- Relay
- SCR
- Transformer

Upgrade Kit
Model UC-70

Build Over 450 Additional Projects

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- Electromagnetism
- Electronic Kazoo
- Transistor AM Radio
- Rechargeable Battery
- Solar Batteries
- Mega Pulser and Flasher
- Paperclip Compass

Contains 22 New Parts

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- Bag of Paperclips

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Put your circuits in motion!

Deluxe Snap Rover®
Model SCROV-50

Introducing the next generation of the RC Snap Rover®! This version includes a disc launcher, digital voice recorder, and music sounds. Over 50 parts allow you to complete over 40 additional projects.

- **Includes 30 parts**
- **Build over 20 projects**
- **Full-color assembly manual**
- **Sound effects**

If you want to enhance your Snap Circuits® experience and get even smarter, then try

Snap Circuits® Student Guide
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For use with SC-300

Educational Series - teaches Basic Electricity and Electronics in the everyday world using our Learn By Doing® concept! 80 full-color pages, and written with the help of educators.

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Features:

- Infrared detector
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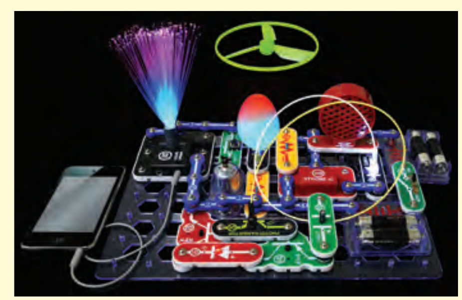
- Color changing LED
- Glow-in-the-dark fan
- Strobe integrated circuit (IC)
- Fiber optic communication
- Color organ controlled by iPod® or other MP3 player, voice, and fingers.

Build over 175 projects!

Contains over 60 parts



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ELECTRONIC SNAP CIRCUITS®

Projects 306-511

AGE
8 - 108

Project 317

SNAP CIRCUITS®

Instruction Manual

ELENCO®

REV-D Revised 2012 753104

Table of Contents

WARNING: SHOCK HAZARD - Never connect Snap Circuits® to the electrical outlets in your home in any way!

WARNING: CHOKING HAZARD - Small parts. Not for children under 3 years.

WARNING FOR ALL PROJECTS WITH A ⚠ SYMBOL Moving parts. Do not touch the motor or fan during operation. Do not lean over the motor. Do not launch the fan at people, animals, or objects. Eye protection is recommended.

Basic Troubleshooting

1. **Most circuit problems are due to incorrect assembly. Always double-check that your circuit exactly matches the drawing for it.**
2. **Be sure that parts with positive/negative markings are positioned as per the drawing.**
3. **Be sure that all connections are securely snapped.**
4. **Try replacing the batteries.**
5. **If the motor spins but does not balance the fan, check the black plastic piece with three prongs on the motor shaft. Be sure that it is at the top of the shaft.**

Elenco® is not responsible for parts damaged due to incorrect wiring.

Note: If you suspect you have damaged parts, you can follow the Advanced Troubleshooting procedure on page 4 to determine which ones need replacing.

Batteries:

- **Use only 1.5V AA type, alkaline batteries (not included).**
- **Insert batteries with correct polarity.**
- **Non-rechargeable batteries should not be recharged. Rechargeable batteries should only be charged under adult supervision, and should not be recharged while in the product.**
- **Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.**
- **Do not mix old and new batteries.**
- **Remove batteries when they are used up.**
- **Do not short circuit the battery terminals.**
- **Never throw batteries in a fire or attempt to open its outer casing.**
- **Batteries are harmful if swallowed, so keep away from small children.**
- **Do not connect batteries or battery holders in parallel.**

WARNING: Always check your wiring before turning on a circuit. Never leave a circuit unattended while the batteries are installed. Never connect additional batteries or any other power sources to your circuits. Discard any cracked or broken parts.

Adult Supervision: Because children's abilities vary so much, even with age groups, adults should exercise discretion as to which experiments are suitable and safe (the instructions should enable supervising adults to establish the experiment's suitability for the child). Make sure your child reads and follows all of the relevant instructions and safety procedures, and keeps them at hand for reference.

This product is intended for use by adults and children who have attained sufficient maturity to read and follow directions and warnings.

Never modify your parts, as doing so may disable important safety features in them, and could put your child at risk of injury.

Review of How To Use It (See page 3 of the Projects 1-101 manual for more details.)

The Snap Circuits® kit uses building blocks with snaps to build the different electrical and electronic circuits in the projects. These blocks are in different colors and have numbers on them so that you can easily identify them. The circuit you will build is shown in color and with numbers, identifying the blocks that you will use and snap together to form a circuit.

Next to each part in every circuit drawing is a small number in black. This tells you which level the component is placed at. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc.

A large clear plastic base grid is included with this kit to help keep the circuit block together. The base has rows labeled A-G and columns labeled 1-10.

Install two (2) "AA" batteries (not included) in the battery holder (B1). The 2.5V and 6V bulbs come packaged separate from their sockets. Install the 2.5V bulb in the L1 lamp socket, and the 6V bulb in the L2 lamp socket.

Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.

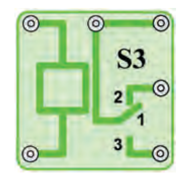
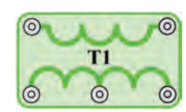
Some circuits use the red and black jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated.

Note: While building the projects, be careful not to accidentally make a direct connection across the battery holder (a "short circuit"), as this may damage and/or quickly drain the batteries.

Parts List (Colors and styles may vary) Symbols and Numbers

Note: There are additional part lists in your other project manuals. Part designs are subject to change without notice.

Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free (800) 533-2441 or e-mail us at: help@elenco.com. Customer Service • 150 Carpenter Ave. • Wheeling, IL 60090 U.S.A.

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
❒ 3	2	2-Snap Wire		6SC02	❒ 1	M2	Analog Meter		6SCM2
❒ 1	5	5-Snap Wire		6SC05	❒ 1	Q3	SCR		6SCQ3
❒ 1	D3	Diode 1N4001		6SCD3	❒ 1	S3	Relay		6SCS3
❒ 1	D7	7-Segment LED Display		6SCD7	❒ 1	T1	Transformer		6SCT1
❒ 1	FM	FM Module		6SCFM	❒ 1	U6	Recording Integrated Circuit		6SCU6

You may order additional / replacement parts at our website: www.snapcircuits.net

MORE About Your New Snap Circuits® Parts (Note: There is additional information in your other project manuals).

Our Student Guides give much more information about your parts, along with a complete lesson in basic electronics. See www.snapcircuits.net/learn.htm or page 62 for more information.

(Part designs are subject to change without notice).

The **FM module (FM)** contains an integrated FM radio circuit. Refer to the figure below for the pinout description.

FM Module:

(+) - power from batteries
(–) - power return to batteries
T - tune up
R - reset
OUT - output connection

See project #307 for example of proper connections.

The **meter (M2)** is a very important indicating and measuring device. You'll use it to measure the amount of current or voltage depending on the circuit configuration. Notice the meter has a "+" sign, indicating the positive terminal (+ power from the batteries). The other snap is the negative terminal (– power return to batteries). The meter has a switch to change between scales, indicated as LOW and HIGH (or 10mA and 1A).

Meter:

(+) - power from batteries
(–) - power return to batteries

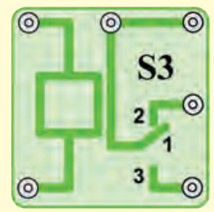
The **recording IC module (U6)** contains an integrated recording circuit. You can record a message up to five seconds long. There are also three pre-recorded songs. Refer to the figure below for the pinout descriptions.

Recording IC Module:

(+) - power from batteries
(–) - power return to batteries
RC - record
Play - play
OUT - output connection
Mic + - microphone input
Mic – - microphone input

See project #308 for example of proper connections.

The **relay (S3)** is an electronic switch with contacts that can be closed or opened. It contains a coil that generates a magnetic field when current flows through it. The magnetic field attracts an iron armature, which switches the contacts (see figure).

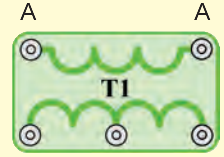


Relay:

Coil - connection to coil
Coil - connection to coil
NC - normally closed contact
NO - normally open contact
COM - Common

See project #341 for example of proper connections.

The **transformer (T1)** consists of two coil windings on one core. One coil is called the Primary (input) and the other the Secondary (output). The purpose of the transformer is to increase the amount of AC voltage applied to the primary. This transformer is a step-up transformer.



Transformer:

A - less windings side
A - less windings side
B - more windings side
B - more windings side
CT - center tap

See project #347 for example of proper connections.

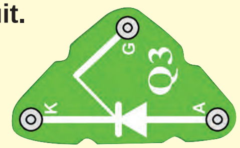
Diode (D3) - Think of a diode as a one-way valve that permits current flow in the direction of the arrow. The anode (arrow) is the positive side, and the cathode (bar) is the negative. The diode conducts or turns on when the voltage at the anode is 0.7V or greater.

Diode:

Anode - (+)
Cathode - (–)

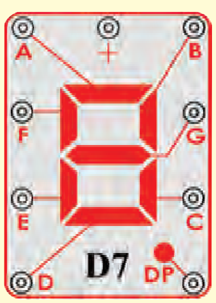
MORE About Your Snap Circuits® Parts (continued)

SCR (Q3) - An SCR is a three-pin (anode, cathode and gate) silicon-controlled rectifier diode. Like a standard diode, it permits current flow in only one direction. It will only conduct in the forward direction when triggered by a short pulse (or steady voltage applied) between the gate and cathode terminals. **A high current may damage this part, so the current must be limited by other components in the circuit.**



SCR:
A - Anode
K - Cathode
G - Gate

The **7-segment display (D7)** is found in many devices today. It contains 7 LED's that have been combined into one case to make a convenient device for displaying numbers and some letters. The display is a common anode version. That means that the positive leg of each LED is connected to a common point which is the snap marked "+". Each LED has a negative leg that is connected to one snap. To make it work you need to connect the "+" snap to positive three volts. Then to make each segment light up, connect the snaps of each LED to ground. In the projects, a resistor is always connected to the "+" snap to limit the current. **A high current may damage this part, so the current must be limited by other components in the circuit.**



7-segment Display:
(+) - power from batteries
A - Segment A
B - Segment B
C - Segment C
D - Segment D
E - Segment E
F - Segment F
G - Segment G
DP - Decimal Point

See project #337 for example of proper connections.

MORE Advanced Troubleshooting (Adult supervision recommended)

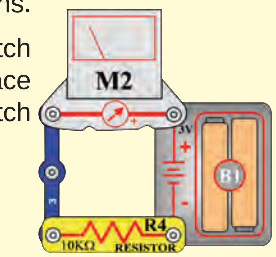
Elenco® is not responsible for parts damaged due to incorrect wiring.

If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

1 - 20. Refer to project manuals 1 & 2 (projects #1-101, #102-305) for testing steps 1-20, then continue below.

21. **FM Module (FM):** Build project #307, you should hear FM radio stations.

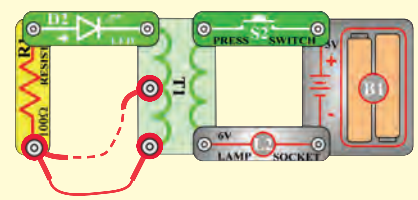
22. **Meter (M2):** Build the mini-circuit shown here and set the meter switch to LOW (or 10mA), the meter (M2) should deflect full scale. Then, replace the 10kΩ resistor (R4) with the 2.5V lamp (L1), and set the meter switch to HIGH (or 1A). The meter should deflect to 1 or higher.



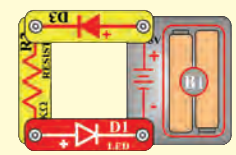
23. **Recording IC (U6):** Build project #308. Make an 8 second recording, then listen to the three prerecorded songs.

24. **Relay (S3):** Build project #341. The red LED (D1) should be on when the slide switch (S1) is on, and the green LED (D2) should be on when the switch is off.

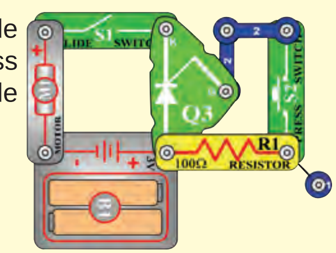
25. **Transformer (T1):** Build the mini-circuit shown here. Pressing the press switch (S2) flashes the green LED (D2). Connect the jumper wire to the CT point. Pressing the press switch flashes the green LED.



26. **Diode (D3):** Build the mini-circuit shown here, the red LED (D1) should light. Reverse the direction of the diode, the LED should not light now.



27. **SCR (Q3):** Build the mini-circuit shown here. Turn on the slide switch (S1) and the motor (M1) should not spin. Press the press switch (S2), the motor should start spinning. Now turn the slide switch off and on, the motor should not spin.



28. **7-Segment Display (D7):** Build project #337. All segments light, displaying the number 8.

MORE DO's and DON'Ts of Building Circuits

After building the circuits given in this booklet, you may wish to experiment on your own. Use the projects in this booklet as a guide, as many important design concepts are introduced throughout them. Every circuit will include a power source (the batteries), a resistance (which might be a resistor, lamp, motor, integrated circuit, etc.), and wiring paths between them and back. You must be careful not to create "short circuits" (very low-resistance paths across the batteries, see examples below) as this will damage components and/or quickly drain your batteries. Only connect the IC's using configurations given in the projects, incorrectly doing so may damage them. **Elenco® is not responsible for parts damaged due to incorrect wiring.**

Here are some important guidelines:

ALWAYS **USE EYE PROTECTION WHEN EXPERIMENTING ON YOUR OWN.**

ALWAYS include at least one component that will limit the current through a circuit, such as the speaker, lamp, whistle chip, capacitors, IC's (which must be connected properly), motor, microphone, photoresistor, or fixed resistors.

ALWAYS use the **7-segment display**, LED's, transistors, the high frequency IC, the **SCR**, the antenna, and switches **in conjunction with other components that will limit the current through them**. Failure to do so will create a short circuit and/or damage those parts.

ALWAYS connect the adjustable resistor so that if set to its 0 setting, the current will be limited by other components in the circuit.

ALWAYS connect position capacitors so that the "+" side gets the higher voltage.

ALWAYS disconnect your batteries immediately and check your wiring if something appears to be getting hot.

ALWAYS check your wiring before turning on a circuit.

ALWAYS **connect IC's, the FM module, and the SCR using configurations given in the projects or as per the connection descriptions for the parts.**

NEVER try to use the high frequency IC as a transistor (the packages are similar, but the parts are different).

NEVER use the 2.5V lamp in a circuit with both battery holders unless you are sure that the voltage across it will be limited.

NEVER connect to an electrical outlet in your home in any way.

NEVER leave a circuit unattended when it is turned on.

NEVER touch the motor when it is spinning at high speed.

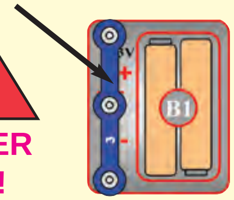
Note: If you have the more advanced Model SC-750, there are additional guidelines in your other project manual.

For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

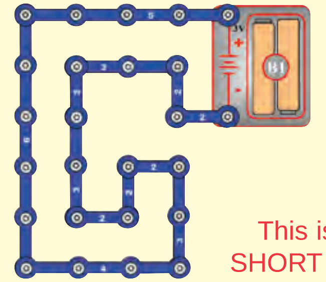
Warning to Snap Rover owners: Do not connect your parts to the Rover body except when using our approved circuits, the Rover body has a higher voltage which could damage your parts.

Examples of SHORT CIRCUITS - NEVER DO THESE!!!

Placing a 3-snap wire directly across the batteries is a SHORT CIRCUIT.



NEVER DO!

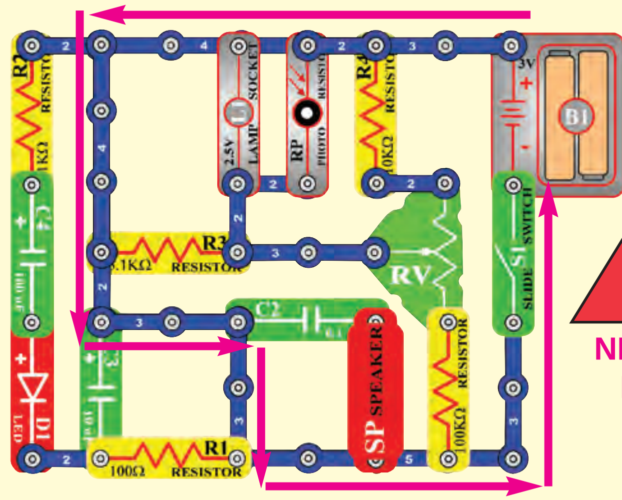


NEVER DO!

This is also a SHORT CIRCUIT.

When the slide switch (S1) is turned on, this large circuit has a SHORT CIRCUIT path (as shown by the arrows). The short circuit prevents any other portions of the circuit from ever working.

NEVER DO!



NEVER DO!

You are encouraged to tell us about new circuits you create. If they are unique, we will post them with your name and state on our website at **www.snapcircuits.net/kidkreations.htm**. Send your suggestions to Elenco®.

Elenco® provides a circuit designer so that you can make your own Snap Circuits® drawings. This Microsoft® Word document can be downloaded from **www.snapcircuits.net/SnapDesigner.doc** or through the **www.snapcircuits.net** web site.

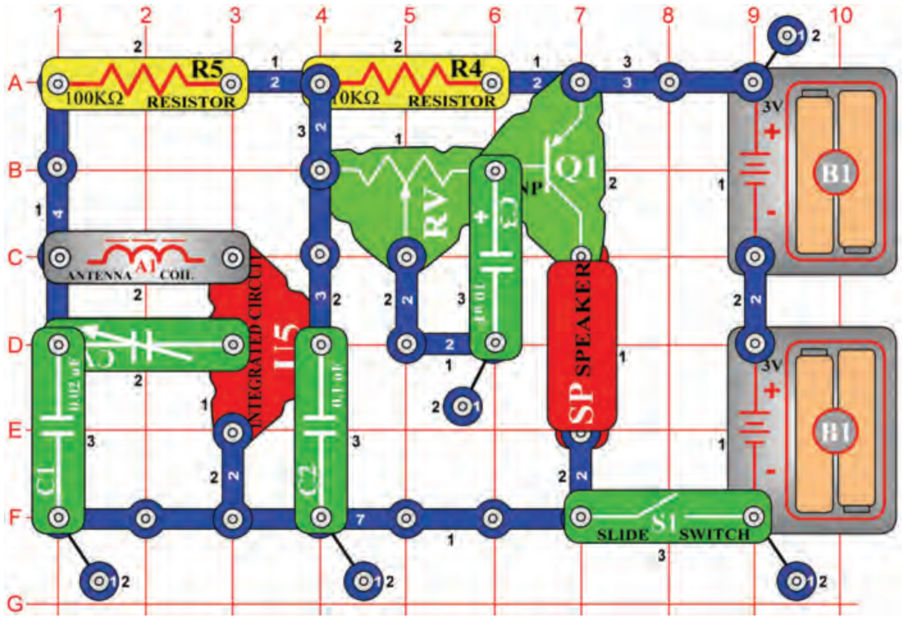
WARNING: SHOCK HAZARD - Never connect Snap Circuits® to the electrical outlets in your home in any way!

Project Listings

Project Listings

☐ Project #306 — AM Radio

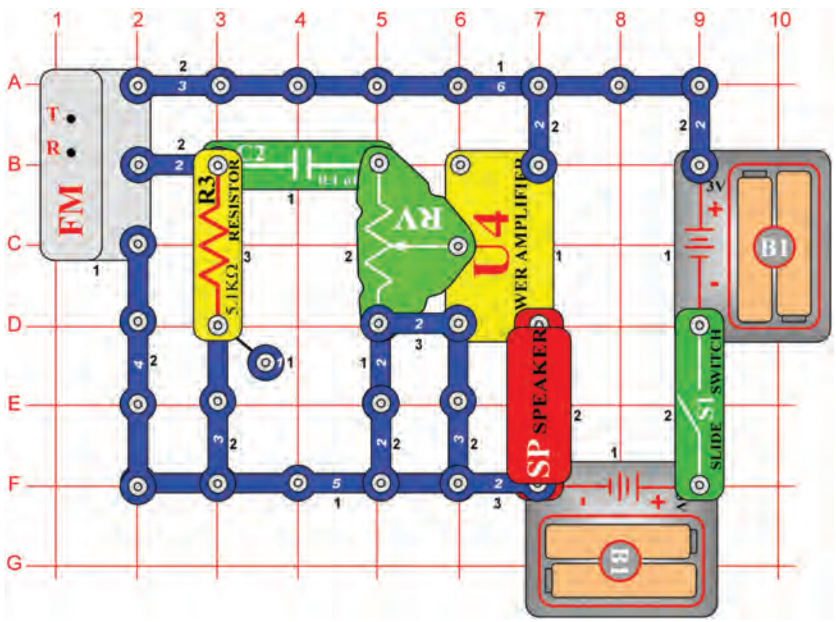
OBJECTIVE: To build a one-IC AM radio.



Turn on the slide switch (S1) and adjust the variable capacitor (CV) for a radio station. Make sure you set the variable resistor (RV) control to the left for louder sound.

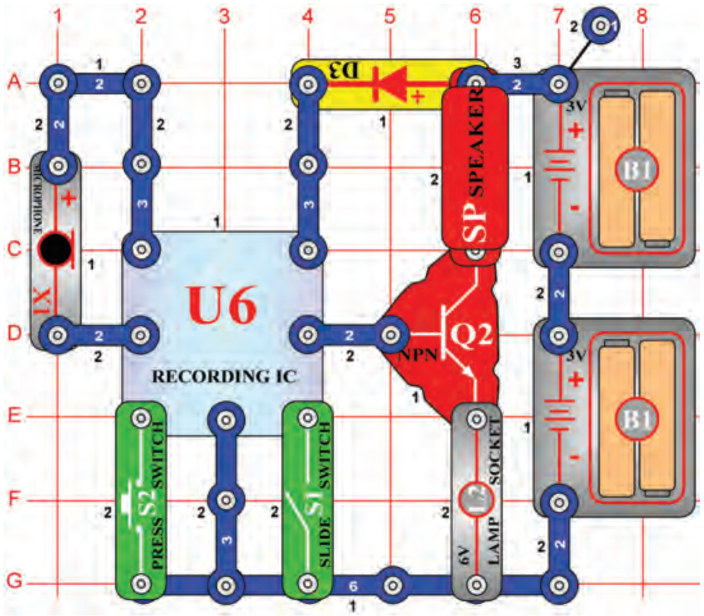
☐ Project #307 — Adjustable Volume FM Radio

OBJECTIVE: To build a working FM radio with adjustable volume.



Turn on the slide switch (S1) and press the R button. Now press the T button and FM module (FM) scans for a radio station. When a station is found, it locks on to it and you hear it on the speaker (SP). Adjust the volume using the adjustable resistor (RV). The resistor controls the amount of signal into the power amplifier IC (U4). Press the T button again for the next radio station. The module will scan up to 108MHz, the end of the FM band, and stop. You must then press reset (R) to start at 88MHz again.

Project #308 Playback & Record



OBJECTIVE: To demonstrate the capabilities of the recording integrated circuit.

Build the circuit shown. Turn on the slide switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone (X1) up to 5 seconds, and then turn off the slide switch (it also beeps after the 5 seconds expires).

Press the press switch (S2) for playback. It plays the recording you made followed by one of three songs. If you press the press switch before the song is over, music will stop. You may press the press switch several times to play all three songs. The lamp (L2) is used to limit current and will not light.

Project #309 Playing Music

OBJECTIVE: To play the three built-in songs on the recording IC.

Use the circuit in project #308. Turn on the slide switch (S1), then press the press switch (S2) to start the first song. When the music stops, press the press switch again to hear the second song. When the second song stops, press the press switch again, the third song plays.

Project #310 Light-Controlled Music

OBJECTIVE: To build a circuit that uses light to control the recording IC.

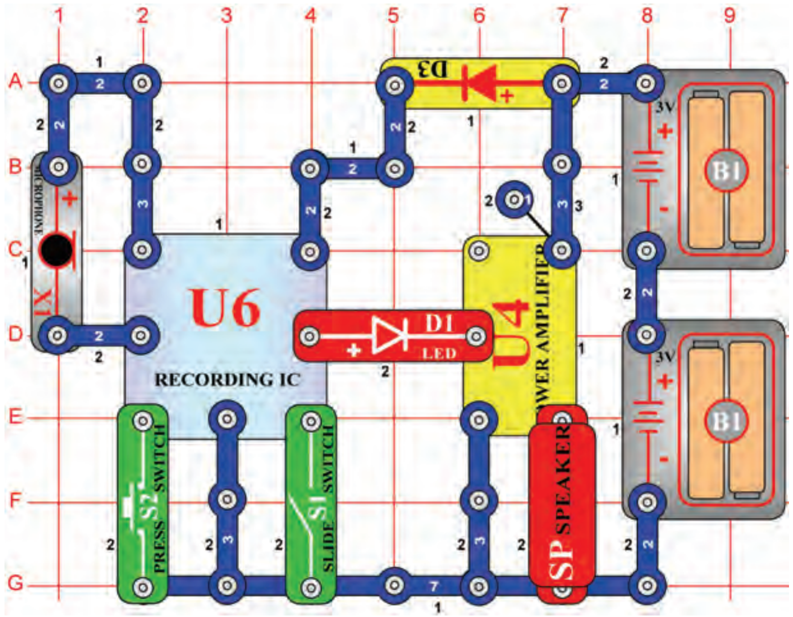
Use the circuit in project #308. Replace the press switch (S2) with the photoresistor (RP), then turn on the slide switch (S1). Turn the music on and off by waving your hand over photoresistor.

Project #311 Touch-Controlled Music

OBJECTIVE: To build a circuit that lets you control the recording IC with your fingers.

Use the circuit in project #308. Place a single snap on base grid point F1. Replace the press switch (S2) with the PNP transistor (Q1, with the arrow on point E2) and then turn on the slide switch (S1). Turn the music on and off by touching points F1 & G2 at the same time. You may need to wet your fingers.

☐ Project #312



Power Playback & Record

OBJECTIVE: To build a circuit that amplifies the recording IC.

Connecting the power amplifier IC (U4) to the output of the recording IC (U6), you can make much louder music than project #308.

Turn on the switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone up to 5 seconds, and then turn open the switch (it also beeps after the 5 seconds expires).

Press the press switch (S2) for playback. It plays the recording you made followed by one of three songs. If you press switch (S2) before the song is over, music will stop. You may press the press switch several times to play all three songs.

☐ Project #313

Power Amplified Playing Music

OBJECTIVE: To amplify the output of the recording IC.

Use the circuit in project #312. Turn on the switch (S1), then press the press switch (S2) to start the first song. When the music stops, press the press switch again to hear the second song. When the second song stops, press the press switch again, the third song plays.

☐ Project #314

Power Light-Controlled Music

OBJECTIVE: Show variations of project #312.

Use the circuit in project #312. Replace the press switch (S2) with the photoresistor (RP), then turn on the switch (S1). Turn the music on and off by waving your hand over photoresistor.

☐ Project #315

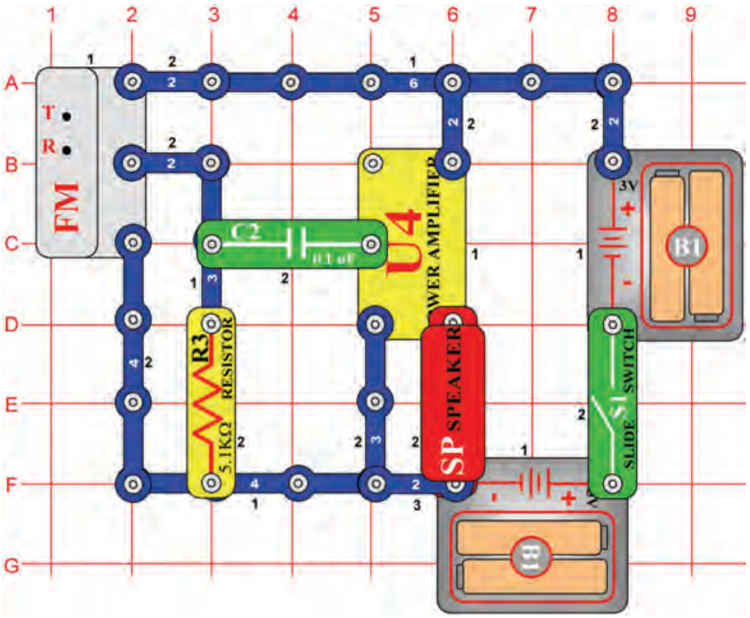
Power Touch-Controlled Music

OBJECTIVE: Show variations of project #312.

Use the circuit in project #312. Place a single snap on base grid point F1. Replace the press switch (S2) with the PNP transistor (Q1, with the arrow on point E2) and then turn on the slide switch (S1). Turn the music on and off by touching points F1 & G2 at the same time. You may need to wet your fingers.

Project #316 FM Radio

OBJECTIVE: To build a working FM radio.

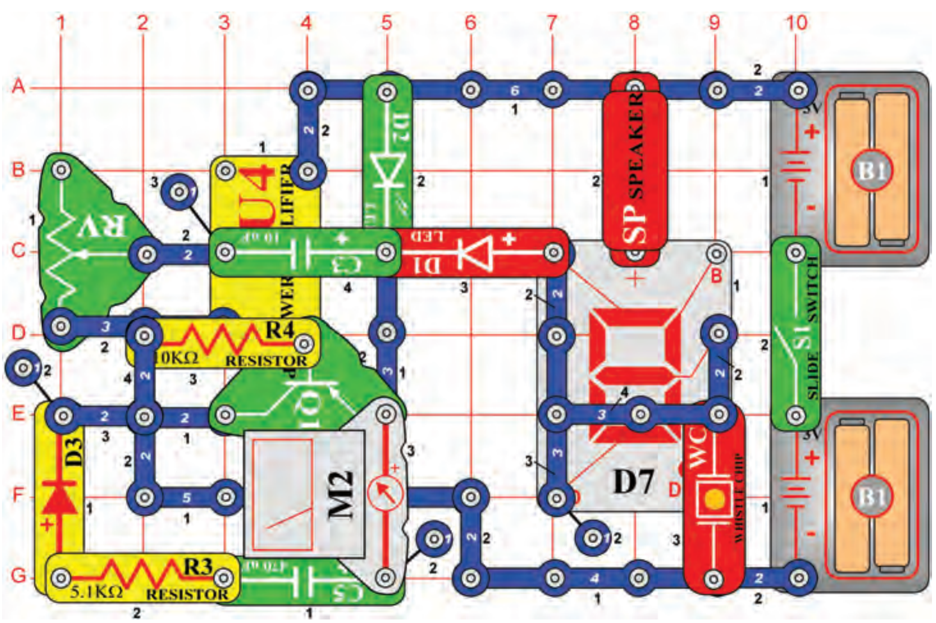


The FM module (FM) contains a scan (T) and a reset (R) button. The R button resets the frequency to 88MHz. This is the beginning of the FM range. Press the T button, the module scans for the next available radio station.

Turn on the slide switch (S1) and press the R button. Now press the T button and the FM module scans for an available radio station. When a station is found, it locks on to it and you hear it on the speaker. Press the T button again for the next radio station. The module will scan up to 108MHz, the end of the FM band, and stop. You must then press the reset (R) button to start at 88MHz again.

Project #317 Mega Circuit

OBJECTIVE: To build a complex circuit.



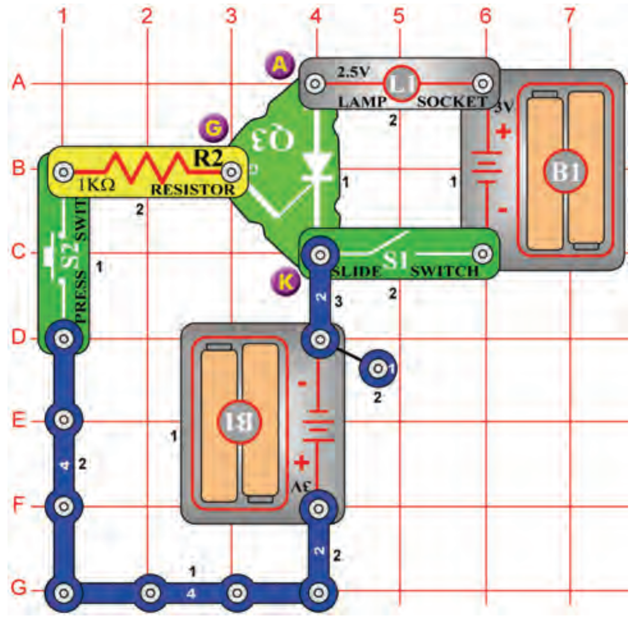
Note that there is a 3-snap wire between RV and U4, partially hidden under R4.

This is an example of using many parts to create an unusual circuit. Set the meter (M2) to the LOW (or 10mA) scale. Turn on the slide switch (S1). As the circuit oscillates, the 7-segment display (D7) flashes the number 5 and the LED's (D1 & D2) flash as well. The meter deflects back and forth and the speaker (SP) sounds a low tone at the same rate. The frequency of the circuit can be changed by adjusting the adjustable resistor (RV).

Next, place the 100Ω resistor (R1) directly over the diode (D3) using a 1-snap. See how this changes the circuit performance.

Project #318 SCR 2.5V Bulb

OBJECTIVE: To learn the principle of an SCR.

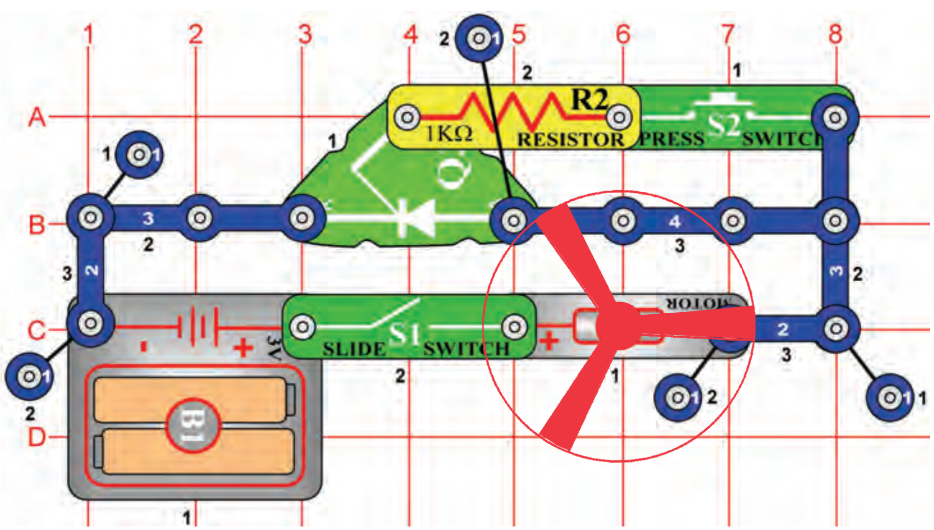


This circuit demonstrates the principle of the SCR (Q3). The SCR can be thought of as an electronic switch with three leads: anode, cathode, and gate. Like a standard diode, it permits current flow in only one direction. It will only conduct in the forward direction when triggered by a short pulse or steady voltage applied between the gate and cathode terminals. One set of batteries powers the lamp, the other is used to trigger the SCR.

Turn on the slide switch (S1) and the bulb (L1) should not light. Now press the press switch (S2); the SCR turns on and lights the bulb. To turn off the bulb you must turn off the slide switch (S1).

Project #319 SCR & Motor

OBJECTIVE: To activate a motor using an SCR.

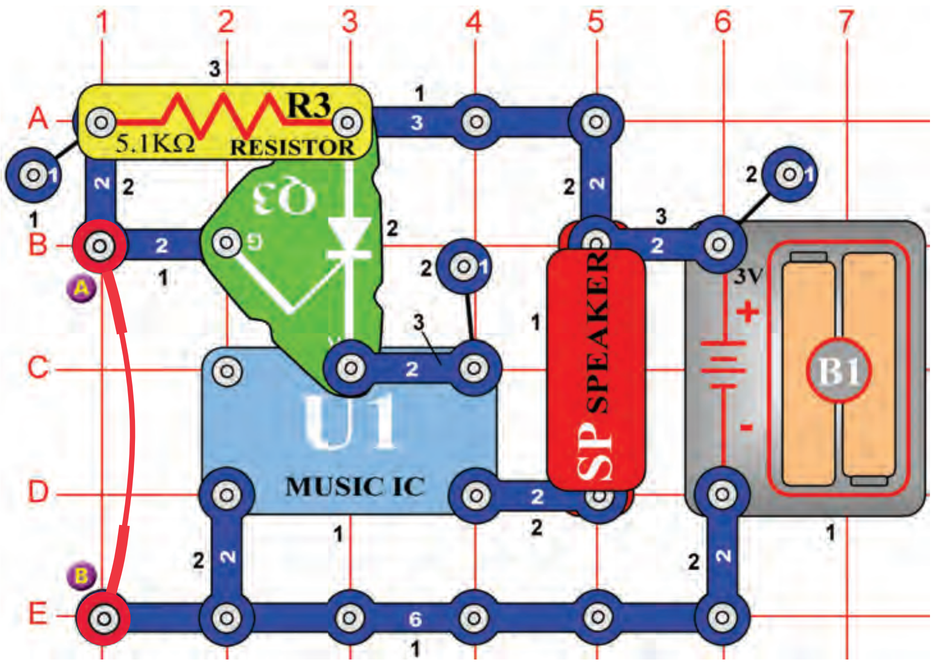


Place the fan onto the motor (M1). In this circuit, the gate is connected to the battery (B1) through the 1KΩ resistor (R2). When the slide switch (S1) is turned on, it triggers the gate, the SCR (Q3) conducts, and the motor spins. The motor continues to spin until the switch is turned off.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #320 Music Alarm

OBJECTIVE: To build a music alarm.



The alarm circuit activates when you remove the jumper wire from points A & B. The jumper wire shorts the SCR's (Q3) gate to ground and the SCR does not conduct. Removing the jumper wire places a voltage on the gate and the SCR conducts. This connects the battery to the music IC (U1) and music is played.

Construct the circuit and you should hear no music. Now remove the jumper wire and the music starts playing.

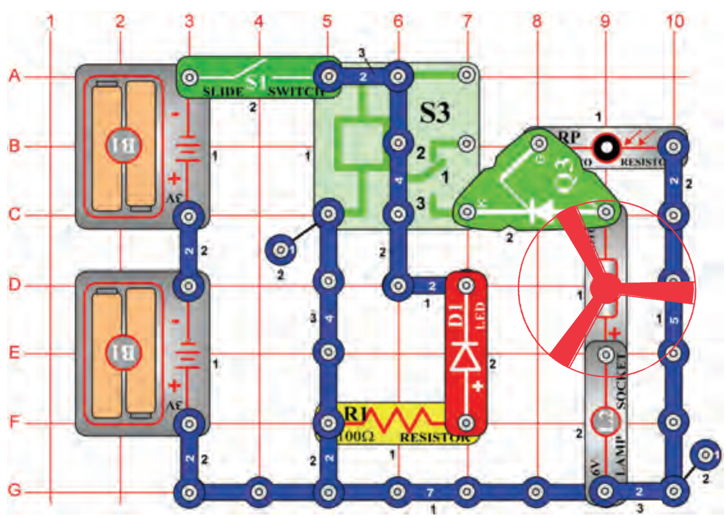
Project #321 Light-Music Alarm

OBJECTIVE: To build a light-music alarm.

Use the circuit in project #320. Replace the resistor R3 with the photoresistor (RP) and remove the jumper wire. Cover the photoresistor with your hand. Now slowly remove your hand. When enough light hits the resistor, the music plays.

Project #322 Light-controlled SCR

OBJECTIVE: To build a circuit that activates a bulb and motor with the amount of light present.

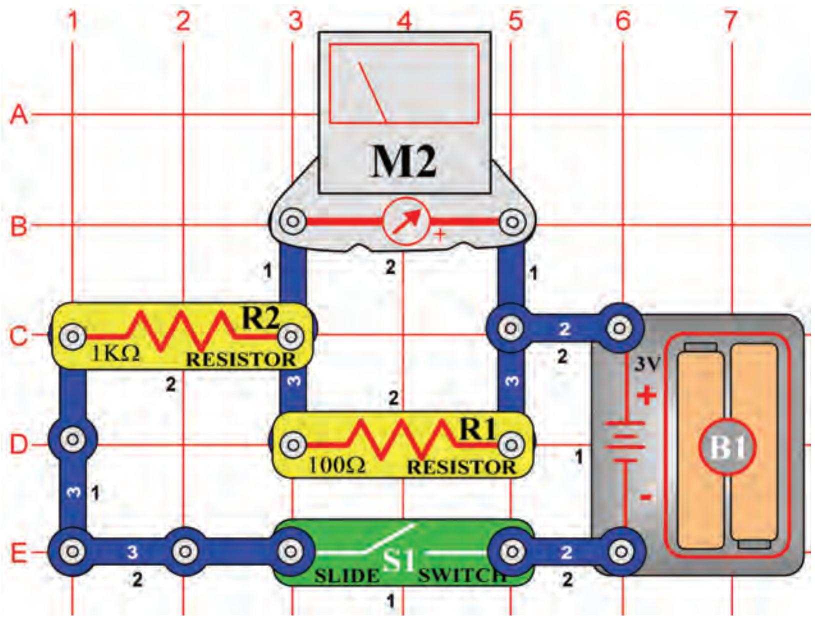


Cover the photoresistor (RP) with your finger. Turn on the switch (S1), and only the LED (D1) lights. The relay (S3) connects the motor (M1) and the bulb (L2) to the batteries, but the motor and bulb are powerless until a voltage is applied to the SCR's gate.

Remove your finger, as light hits the photoresistor, its resistance decreases and a voltage appears on the gate of the SCR (Q3). The SCR conducts and the motor and bulb work now.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ Project #323 — 3mA Meter

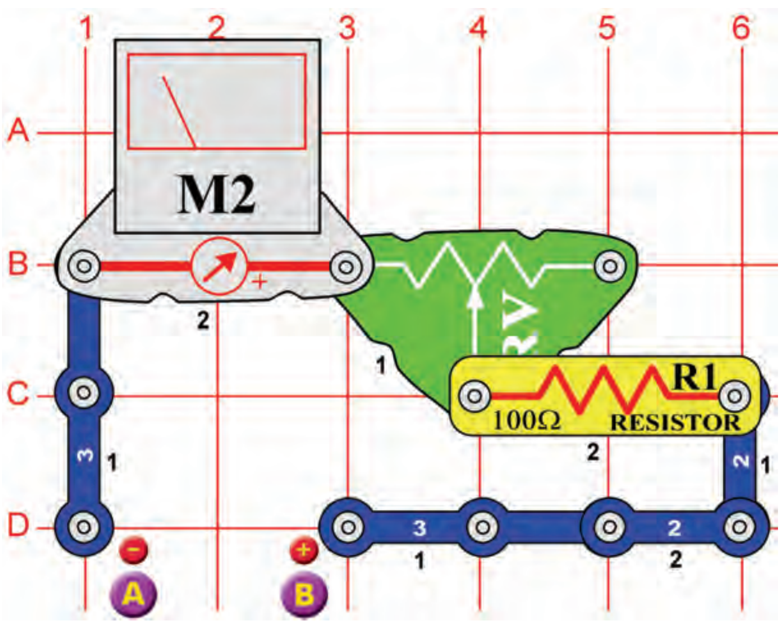


OBJECTIVE: To build a 3mA meter circuit.

Set the meter (M2) to the LOW (or 10mA) scale. Inside the meter, there is a fixed magnet and a moveable coil around it. As current flows through the coil, it creates a magnetic field. The interaction of the two magnetic fields cause the coil (connected to the pointer) to move (deflect). By itself, the meter can measure 300μA. To increase its range, resistors are connected in parallel or in series to the meter.

Build the circuit shown. Placing the 100Ω resistor (R1) in parallel with the meter increases the range by 10 times to 3mA. More current flows through the resistor than the meter. The lower the resistor value, the wider the range of the meter.

☐ Project #324 — 0-3V Voltmeter

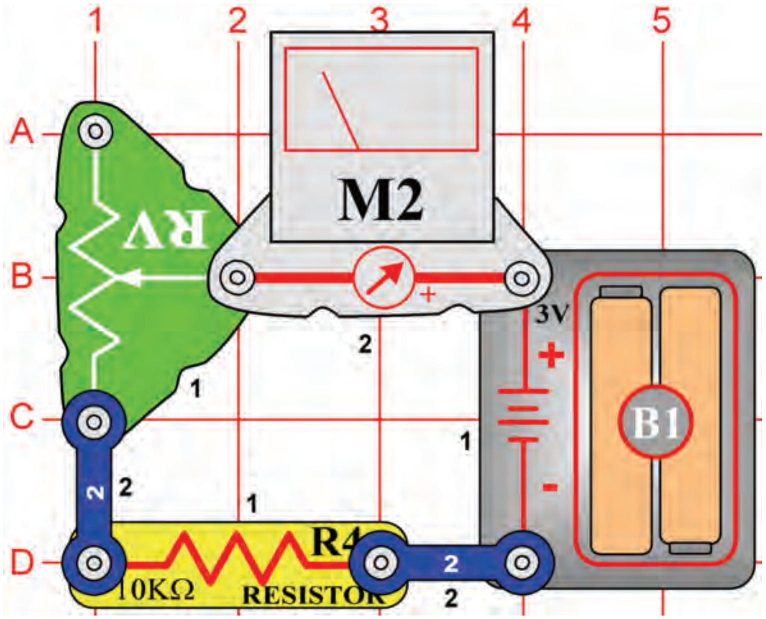


OBJECTIVE: To build a voltmeter.

Build this 0-3V voltmeter circuit. Set the meter (M2) to the LOW (or 10mA) setting. Using new batteries, place the battery holder between points A & B. Adjust the adjustable resistor (RV) so the meter deflects full scale.

Now you can check your other “AA” batteries by inserting them into the battery holder.

Project #325



Function of Adjustable Resistor

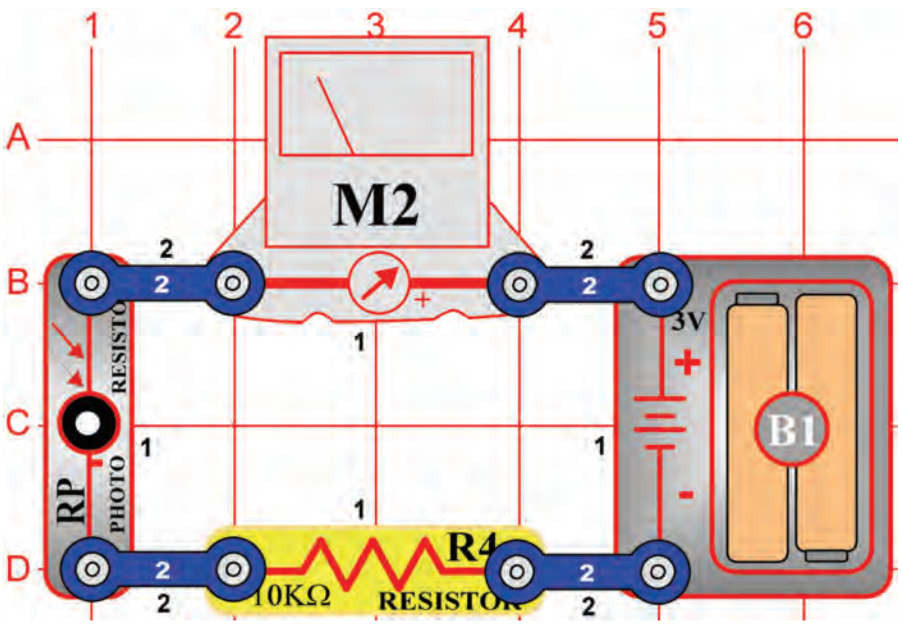
OBJECTIVE: To understand the function of the adjustable resistor.

An adjustable resistor is a normal resistor with an additional arm contact. The arm moves along the resistive material and taps off the desired resistance.

The slider on the adjustable resistor moves the arm contact and sets the resistance between the bottom (point C1) pin and the center pin (point B2). The remaining resistance is between the center and top pin. For example, when the slider is all the way down, there is minimal resistance between the bottom and center pins (usually 0Ω) and maximum resistance between the center and top pins. The resistance between the top (point A1) and bottom (point A3) pins will always be the total resistance, (50kΩ for your part).

Set the meter (M2) to the LOW (or 10mA) scale. Adjust the adjustable resistor (RV) for maximum resistance by setting the slider to the top. The meter only deflects part of the way. As you move the slider down, decreasing the resistance, the meter deflects more.

Project #326



Function of photoresistor

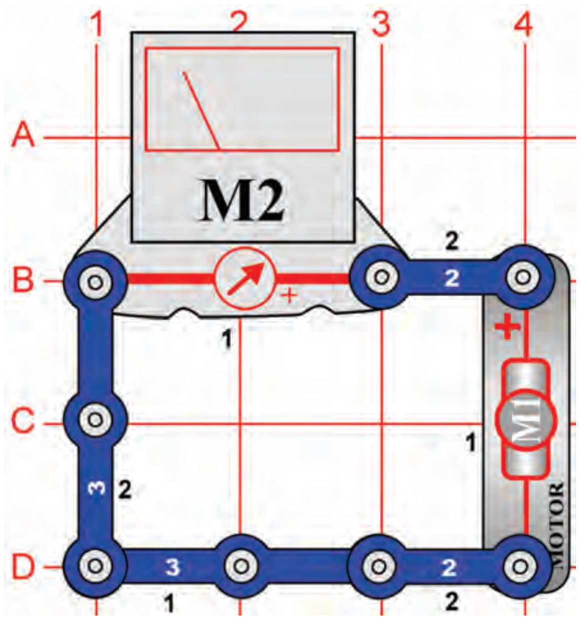
OBJECTIVE: To understand the function of the photoresistor.

Build the circuit shown. Set the meter (M2) to the LOW (or 10mA) scale. The photoresistor (RP) is a light-sensitive resistor. Its value changes from nearly infinite in total darkness to about 1,000Ω when a bright light shines on it.

The meter reading changes as the resistance changes in the circuit. When the lights are on, the meter points to a higher number on the scale. When the lights are OFF, the pointer will point to a lower number on the scale. This means that the resistance of the photoresistor is changing according to the amount of light in the room.

☐ Project #327

Meter Deflect by Motor

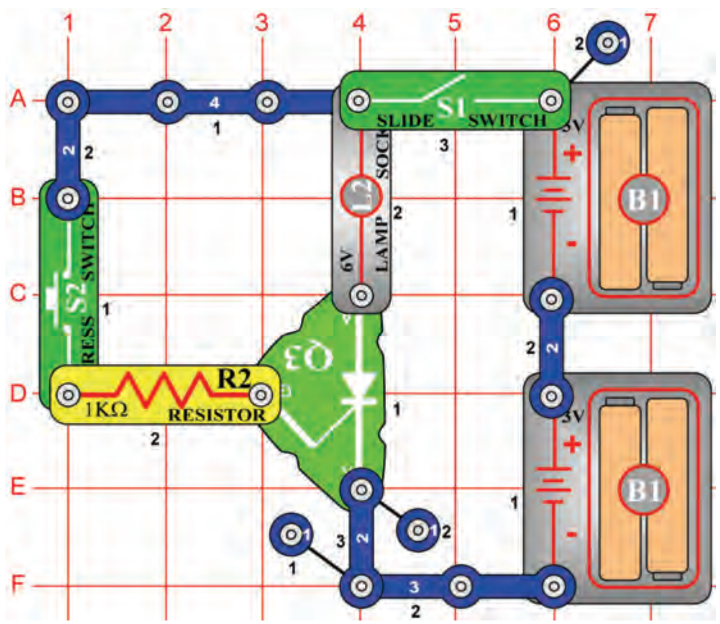


OBJECTIVE: To change the direction of current flow using a motor.

Set the meter (M2) to the LOW (or 10mA) setting. A motor generates a current when it rotates. The rotation of the motor determines the direction current flows. Quickly spin the motor (M1) clockwise with your hand; the meter deflects to the right. Now spin the motor counterclockwise, and the meter deflects to the left.

☐ Project #328

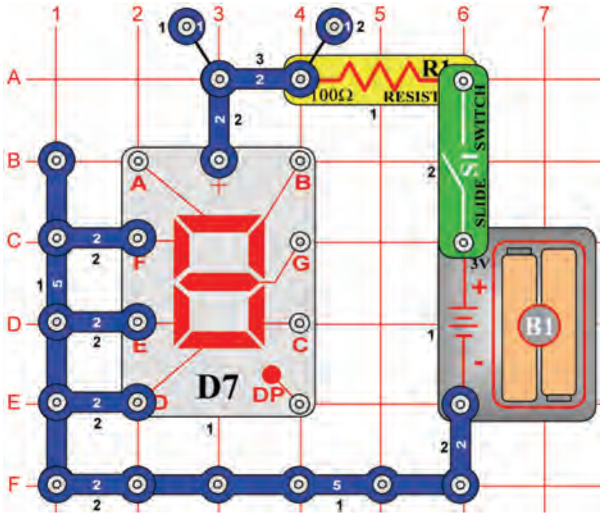
SCR 6V Bulb



OBJECTIVE: To learn the principle of an SCR.

In this circuit, the 6-volt bulb (L2) will not light until the SCR (Q3) is triggered. Turn on the slide switch (S1) and the bulb will not light. Now press the press switch (S2) to light the bulb. The bulb will stay lit until the slide switch is turned off. To protect the SCR, a current limiting 1kΩ resistor (R2) is placed in series with the gate.

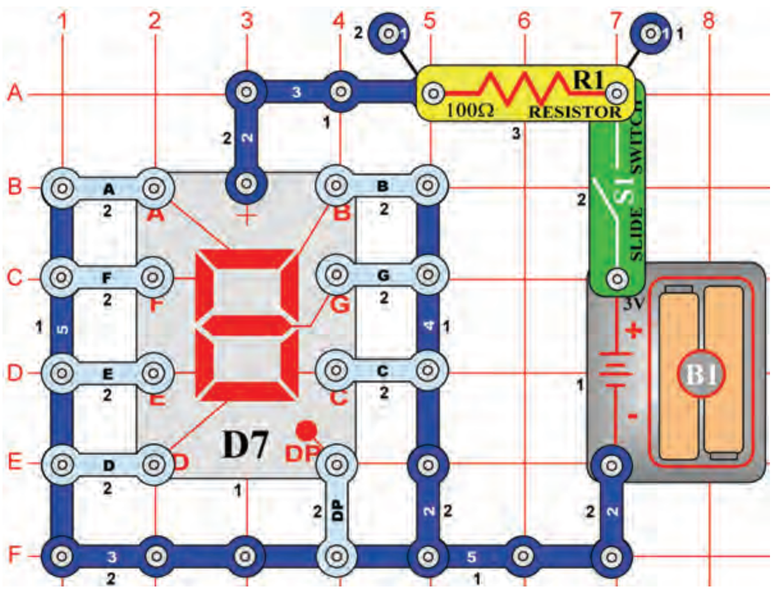
Project #329



Principle of Segment LED

OBJECTIVE: To demonstrate how a seven segment LED works.

The display (D7) is made up of seven segments. Each segment contains an LED connected to an input snap. When the snap is connected to the negative of the battery the segment lights. For example, connect the circuit as shown and the letter "L" lights.



Project #330

Display #1

OBJECTIVE: To configure the seven segment to display the number 1.

Connect B & C to the negative of the battery.

Project #331

Display #2

OBJECTIVE: To configure the seven segment to display the number 2.

Connect A, B, G, E, & D to the negative of the battery.

Project #332

Display #3

OBJECTIVE: To configure the seven segment to display the number 3.

Connect A, B, G, C, & D to the negative of the battery.

Project #333

Display #4

OBJECTIVE: To configure the seven segment to display the number 4.

Connect B, C, F, & G to the negative of the battery.

Project #334

Display #5

OBJECTIVE: To configure the seven segment to display the number 5.

Connect A, F, G, C, & D to the negative of the battery.

Project #335

Display #6

OBJECTIVE: To configure the seven segment to display the number 6.

Connect A, C, D, E, F, & G to the negative of the battery.

Project #336

Display #7

OBJECTIVE: To configure the seven segment to display the number 7.

Connect A, B, & C to the negative of the battery.

Project #337

Display #8

OBJECTIVE: To configure the seven segment to display the number 8.

Connect A, B, C, D, E, F & G to the negative of the battery.

Project #338

Display #9

OBJECTIVE: To configure the seven segment to display the number 9.

Connect A, B, C, D, F, & G to the negative of the battery.

Project #339

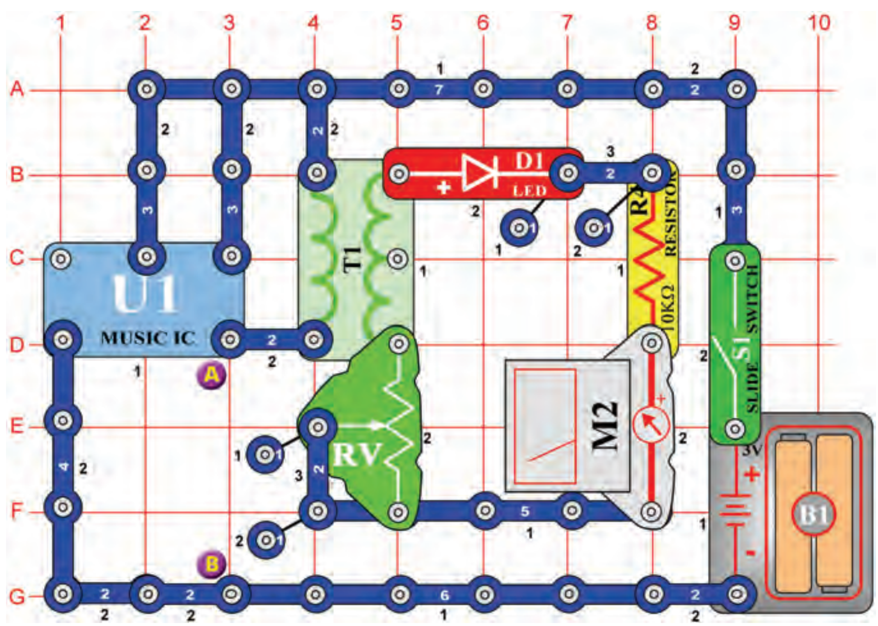
Display #0

OBJECTIVE: To configure the seven segment to display the number 0.

Connect A, B, C, D, E, & F to the negative of the battery.

Project #340 Music Meter

OBJECTIVE: See and hear the output of the music IC.



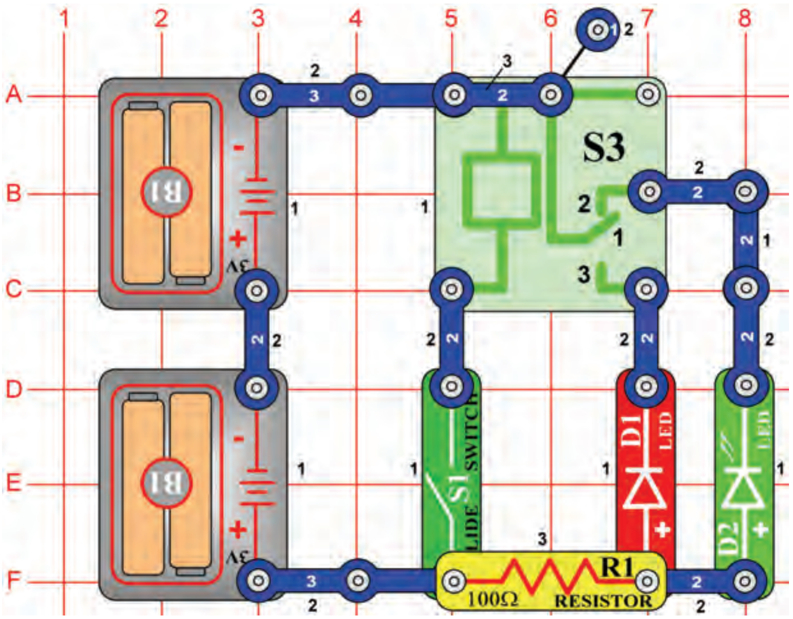
Set the meter (M2) to the LOW (or 10mA) setting. In this circuit, the output of the music IC (U1) is applied to the less windings side of the transformer (T1), which lights the LED (D1) and deflects the meter.

Place the adjustable resistor (RV) to the bottom position and turn on the switch (S1). Adjust the adjustable resistor upwards. This increases the voltage across the LED and meter. The LED brightens and the meter deflects more towards 10. Place the speaker (SP) across points A & B and use a jumper wire to complete the connection. Now you can hear and see the output of the music IC.

Project #341

LED & Relay

OBJECTIVE: Turn on and off LED's using a relay.



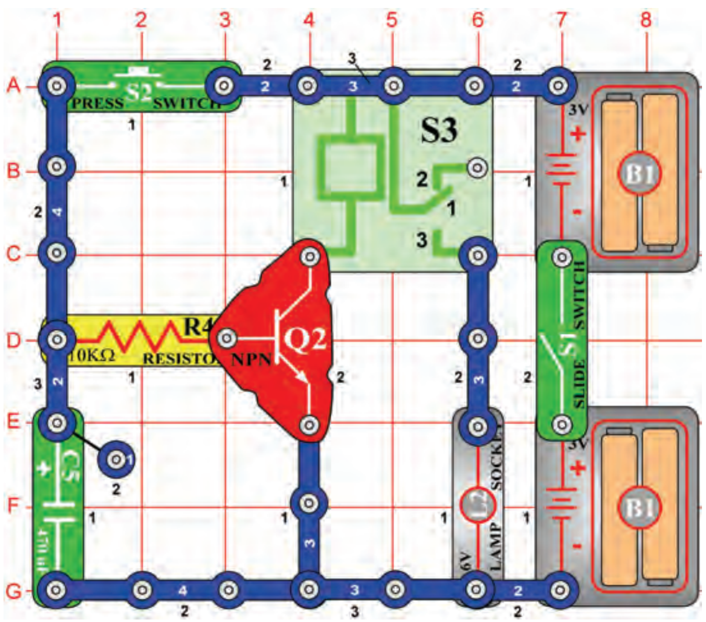
A relay is an electronic switch with contacts that are opened or closed using voltage. It contains a coil that generates a magnetic field when a current flows through it. The magnetic field attracts an iron armature which switches the contacts. Contact #2 is normally closed, connecting the green LED (D2) and the resistor across the batteries.

With the slide slide switch (S1) turned off, the green LED should light. Now turn on the switch, contact #1 on the relay (S3) will switch to contact #3, lighting the red LED (D1).

Project #342

Manual 7 Second Timer

OBJECTIVE: To build a manual timer using a relay.

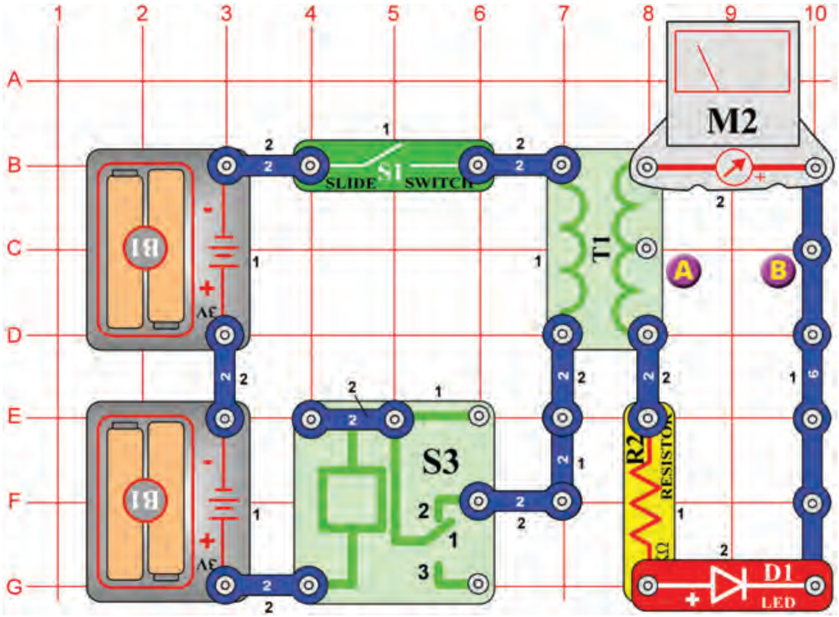


The transistor (Q2) acts as a switch, connecting the relay (S3) to the batteries. As long as there is positive voltage on the transistor's base, the bulb (L2) will light.

Turn on the slide switch (S1) and hold down the press switch (S2). The transistor turns on, capacitor C5 charges up, and the bulb lights. When the press switch is released, the capacitor discharges through the base, keeping the transistor on. The transistor will turn off when the capacitor is almost discharged, about 7 seconds. The relay contacts will switch and the bulb will turn off.

Change the value of the capacitor and see what happens.

Project #343



Half Wave Rectifier Circuit

OBJECTIVE: To build a half wave rectifier circuit.

A rectifier changes an AC voltage into a DC voltage. A diode (D1) is used because it allows current to flow in only one direction, for one polarity of applied voltage. As the contacts open and close, it generates an AC voltage across the transformer (T1). We can measure the DC current from the transformer's output using a resistor (R2), a diode (D1), and a meter (M2). Set the meter to the LOW (or 10mA) scale. Turn on the slide switch (S1), the LED lights as the meter points past the 5 scale.

Project #344

Half Wave Rectifier Circuit (II)

OBJECTIVE: Measure the voltage using the center-tap.

Use the circuit in project #343. Now see what happens if you connect to the center-tap on the side with more windings. Place the meter (M2) across points A & B, then turn on the switch (S1). The needle should deflect less, about half as much as project #343. As you use less windings, the output decreases.

Project #345

LED vs. Diode

OBJECTIVE: To see the voltage difference between an LED and diode.

Use the circuit in project #343. Replace the LED (D1) with the diode (D3) and turn on the switch (S1). The needle deflects higher, because the voltage drop across the diode is less than the voltage drop across the LED.

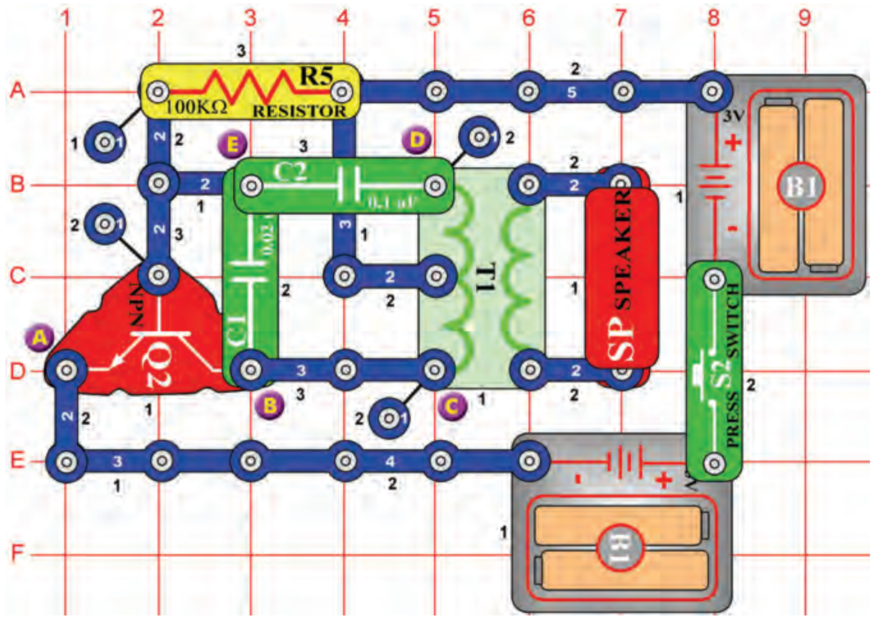
Project #346

Current & Resistance

OBJECTIVE: See how resistance affects current.

Change the 1kΩ (R2) resistor to a 5.1kΩ (R3) and turn on the switch (S1). You will see that increasing the resistance decreases the current through the meter (M2).

Project #347 Telegraph



OBJECTIVE: Making telegraph sounds.

Press the press switch (S2) down. The circuit oscillates and the AC voltage generated from the transformer (T1) drives the speaker (SP). To make a telegraph sound, depress the switch for long and short periods.

Project #348 Mosquito Sound

OBJECTIVE: Use the whistle chip to make a mosquito sound.

Use the circuit in project #347. Remove the speaker (SP). Connect the whistle chip (WC) across points C & D to make a mosquito sound.

Project #349 Mosquito Sound (II)

OBJECTIVE: Show variations of project #347.

Use the circuit in project #347. Connect the whistle chip (WC) across points B & E.

Project #350 Mosquito Sound (III)

OBJECTIVE: Show variations of project #347.

Use the circuit in project #347. Connect the whistle chip (WC) across points E & D (place it beneath capacitor (C2) or use the jumper wires).

Project #351 Touch-Control Mosquito Sound

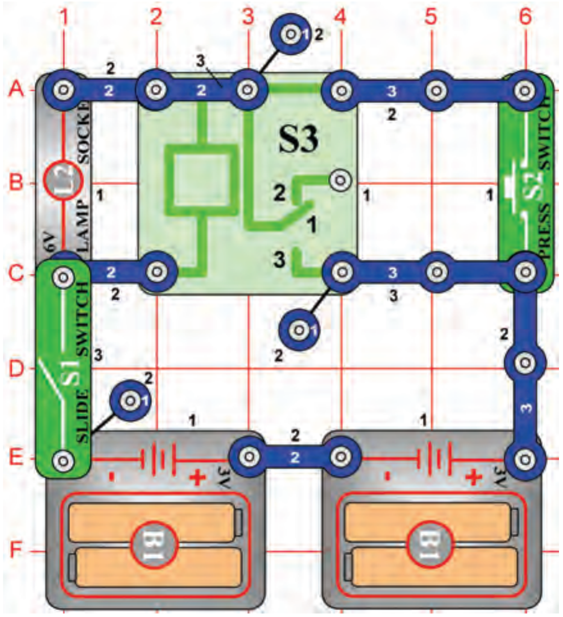
OBJECTIVE: To use the photoresistor to adjust the oscillator sound.

Use the circuit in project #347. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the resistor and the sound changes.

To learn more about how circuits work, visit www.snapcircuits.net or page 62 to find out about our Student Guides.

☐ Project #352 Bulb & Relay

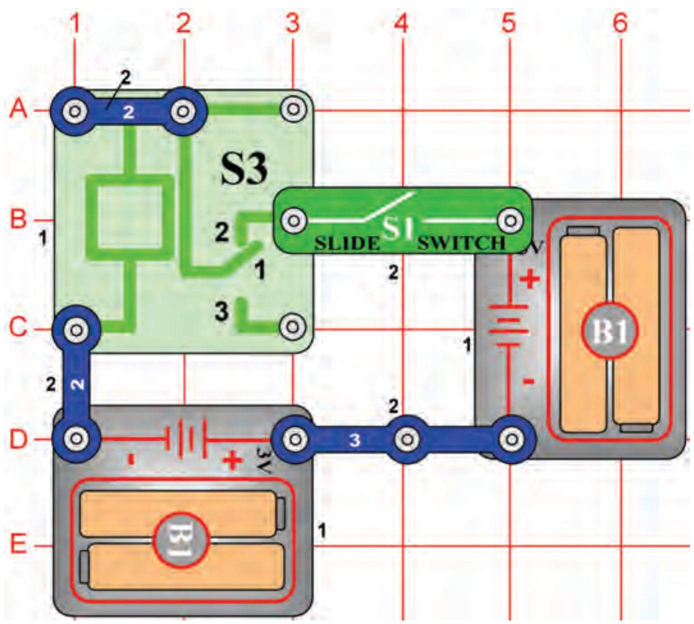
OBJECTIVE: Light a bulb using a relay.



Turn off the slide switch (S1). If you press switch (S2), the lamp (L2) will not light. Turn on the slide switch and press the press switch again; the lamp lights and stays on until the slide switch is turned off. This circuit remembers that the press switch was pressed. Turn the slide switch off and back on again. The lamp will be off until the press switch is pressed, then the lamp will stay on. Computers use memory circuits to remember states like on and off.

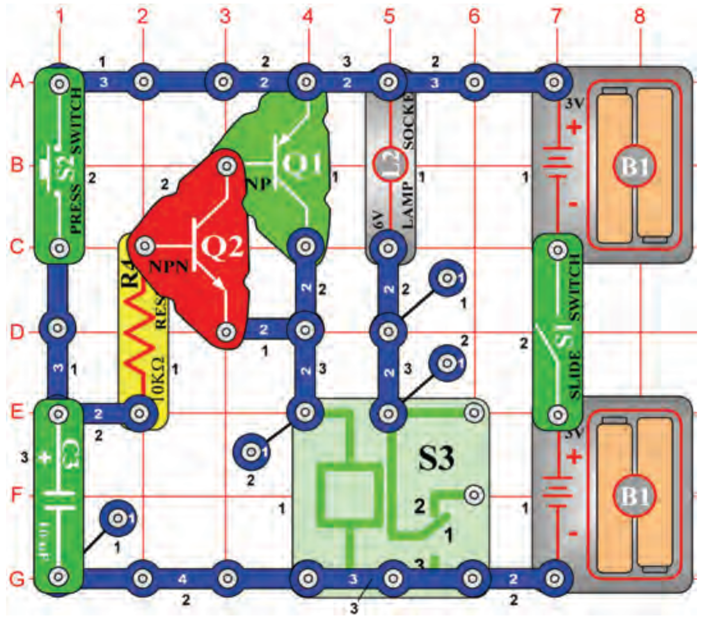
☐ Project #353 Relay Buzzer

OBJECTIVE: To make a relay buzzer.



When you turn on the switch (S1), you should hear a buzzing sound from the relay (S3). The sound is caused by the relay's contacts opening and closing at a fast rate.

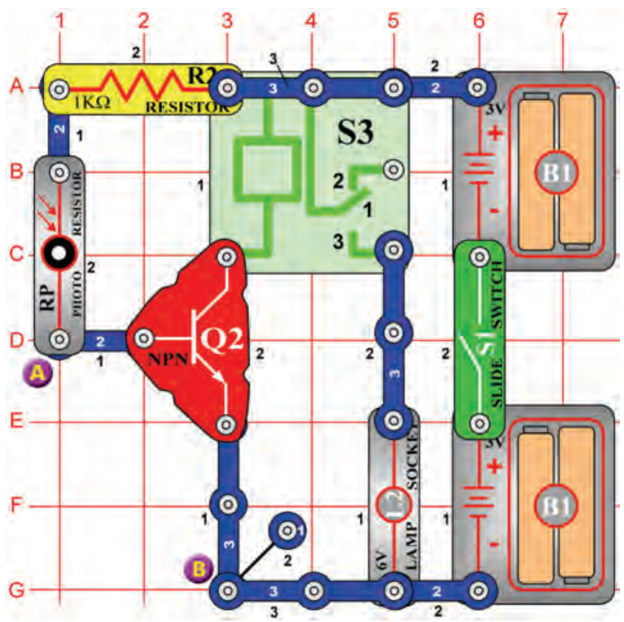
Project #354 Transistor Timer



OBJECTIVE: To build a manual timer using a transistor in place of the relay.

This circuit is similar to project #342 except now two transistors are used. Turn on the slide switch (S1) and hold down the press switch (S2). The transistors (Q1 & Q2) turn on, the capacitor (C3) charges up, and the bulb (L2) lights. When the press switch (S2) is released, the capacitor discharges through the base, keeping the transistors on. The transistors will turn off when the capacitor is almost discharged (about 1 minute). The relay (S3) contacts will switch and the bulb will turn off.

Project #355 Light-controlled Relay



OBJECTIVE: To use a photoresistor to control a relay.

Under normal light, the resistance of the photoresistor (RP) is low, allowing a voltage at the base of the transistor (Q2). This turns the transistor on, connecting the relay (S3) across the batteries, and the bulb (L2) lights. If the light decreases, the resistance increases and the voltage to Q2 drops. If the voltage at Q2 decreases enough, the transistor turns off.
Turn on the slide switch (S1) and the bulb lights. Now as you block the light from the photoresistor, the bulb turns off.

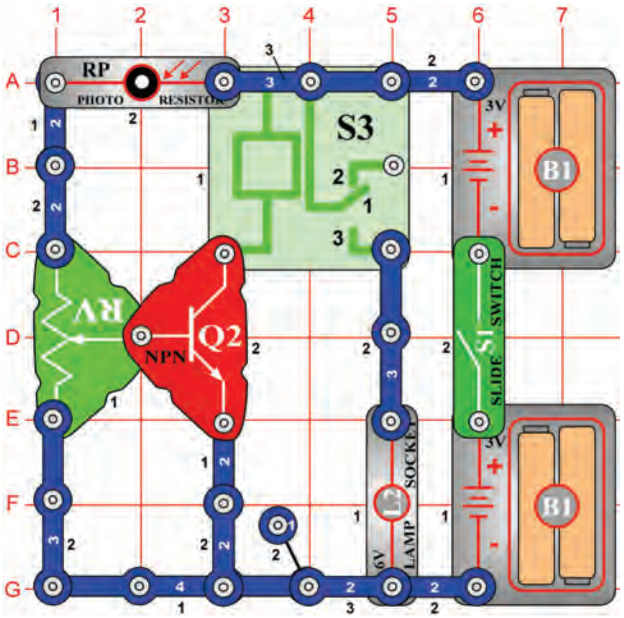
Project #356 Bulb Alert Relay

OBJECTIVE: Make a warning system that lights the bulb.

Replace the photoresistor (RP) with a 10kΩ resistor (R4). Connect the wire to points A & B. As long as the wire is connected, the transistor (Q2) is off and the relay (S3) and bulb (L2) are not powered. Disconnect the wire. The relay contacts will switch and the bulb will light.

Project #357

Adjustable Light Control

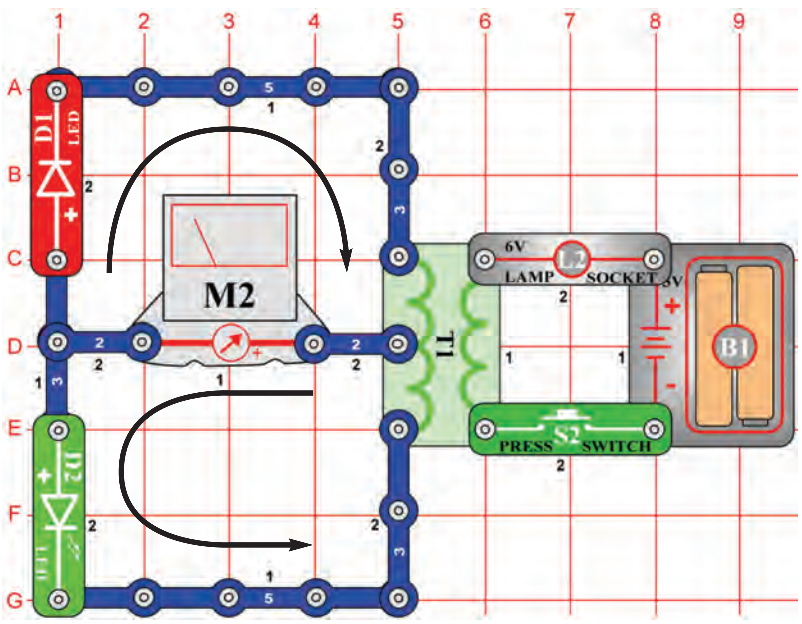


OBJECTIVE: Build an adjustable light-controlled relay.

You can set the amount of light it takes to keep the bulb (L2) on by adjusting the adjustable resistor (RV). Set the adjustable resistor to the top position and turn on the switch. The bulb lights. Cover the photoresistor (RP) and the bulb turns off. Set the adjustable resistor to different positions and then cover the photoresistor. Note that only the top half of the adjustable resistor affects the circuit. If you position it below the middle, the bulb stays off.

Project #358

Meter Deflection

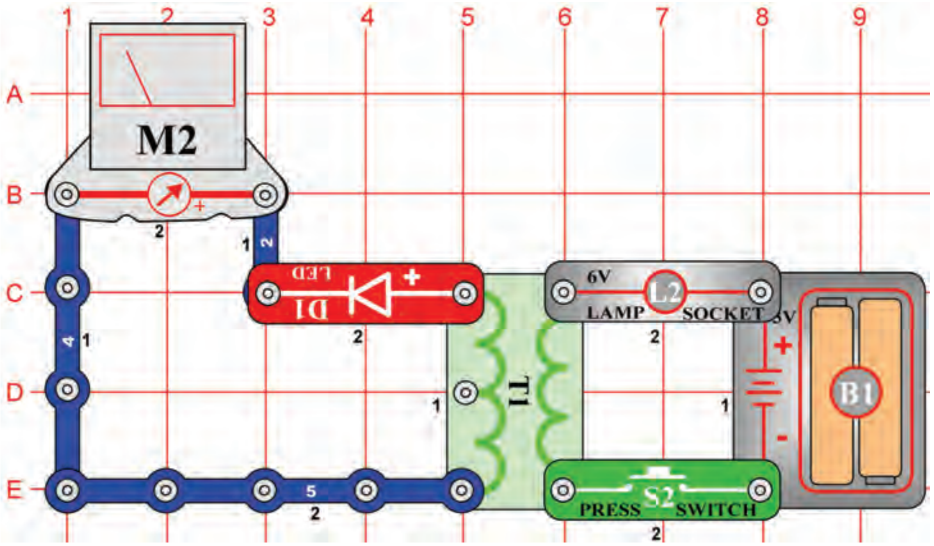


OBJECTIVE: To demonstrate the properties of a transformer.

Set the meter (M2) to the LOW (or 10mA) scale. Pressing the press switch (S2) generates a current on the left side of the transformer (T1). The current lights the LED's (D1 & D2) and deflects the meter. There are two current paths as shown by the arrows. Placing the meter in both current paths always measures each current. The top current is produced when the press switch is pressed and the bottom current is produced when the press switch is released.

Project #359 AC to DC Current

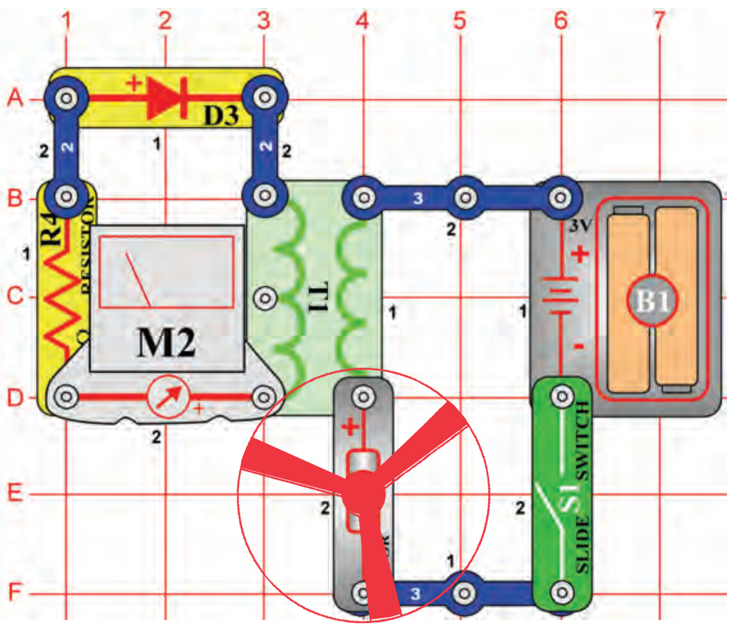
OBJECTIVE: To convert an AC current to DC using an LED.



Set the meter (M2) to the LOW (or 10mA) scale. Pressing and releasing the press switch (S2) continuously generates an AC (changing) current. The LED (D1) is used to convert the AC (changing) current to DC (unchanging) current because it only allows the current to flow in one direction. The LED should light as the meter deflects to the right only. Without the LED, the meter would deflect in both directions.

Project #360 Current Meter

OBJECTIVE: To measure the current through a transformer.

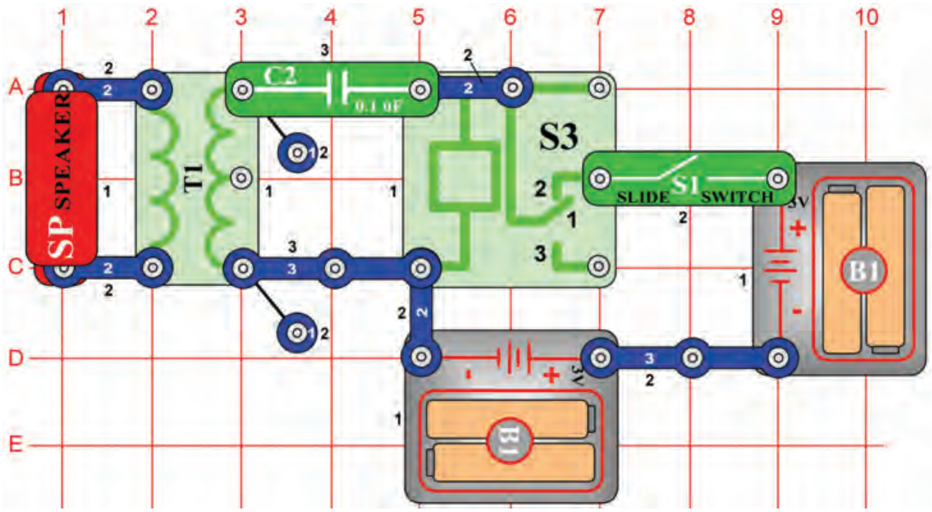


Set the meter (M2) to the LOW (or 10mA) setting. By placing the meter, diode (D3) and current limiting resistor (R4) on the transformer (T1), you can measure the current. Turn on the slide slide switch (S1) and the motor (M1) starts spinning. The current on the right side of the transformer creates a current on the left side using magnetism.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #361

Buzzer, Relay, & Transformer



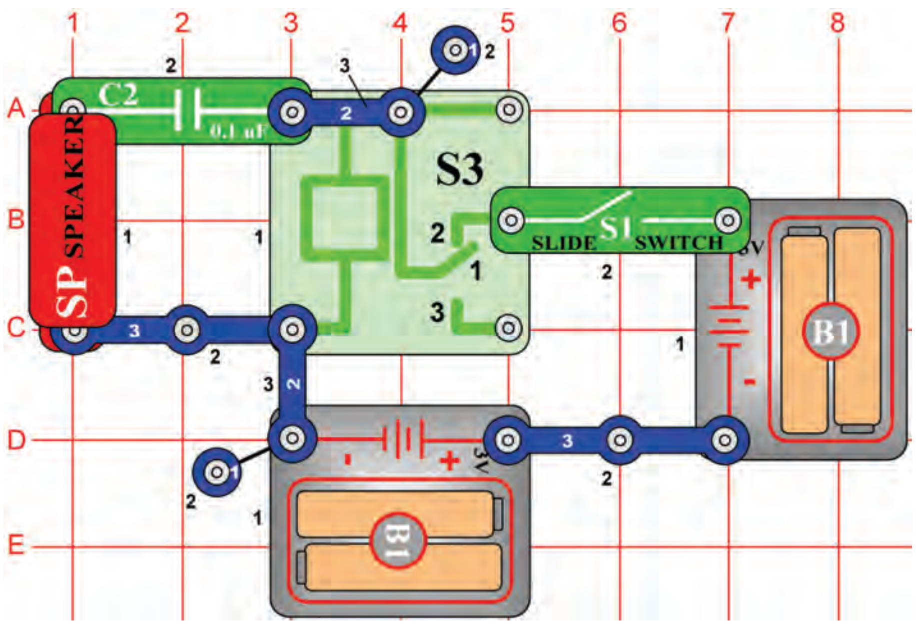
OBJECTIVE: To use a transformer for a louder buzzer.

Turn on the switch (S1). The speaker (SP) generates a buzzer sound. As in project #353, the relay (S3) is rapidly switched on and off. This causes an AC voltage on the left side of the transformer (T1). The voltage is stepped-down and applied to the speaker, generating the sound.

To make the sound a little louder, replace the $0.1\mu F$ capacitor (C2) with a 3-snap wire.

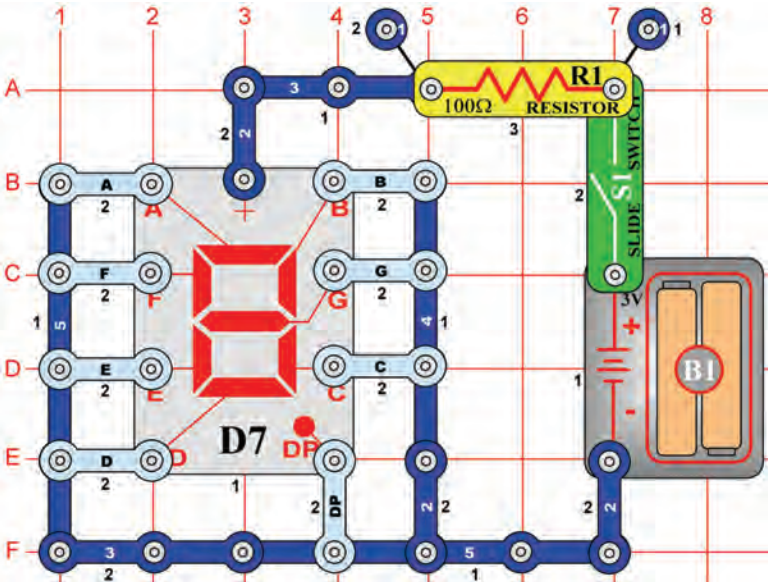
Project #362

Buzzer & Relay



OBJECTIVE: Make a relay buzzer with speaker.

A speaker (SP) and capacitor (C2) are placed across the coil of the relay (S3). When the slide switch (S1) is turned on, the relay's contacts open and close as in project #353. As the capacitor (C2) charges and discharges, the speaker generates a buzzing sound.



☐ Project #363

Display Capital Letter “F”

OBJECTIVE: To configure the seven segment to display the capital letter “F”.

Connect A, E, F, & G to the negative of the battery.

☐ Project #364

Display Capital Letter “H”

OBJECTIVE: To configure the seven segment to display the capital letter “H”.

Connect B, C, E, F, & G to the negative of the battery.

☐ Project #365

Display Capital Letter “P”

OBJECTIVE: To configure the seven segment to display the capital letter “P”.

Connect A, B, E, F, & G to the negative of the battery.

☐ Project #366

Display Capital Letter “S”

OBJECTIVE: To configure the seven segment to display the capital letter “S”.

Connect A, F, G, C, & D to the negative of the battery.

☐ Project #367

Display Capital Letter “U”

OBJECTIVE: To configure the seven segment to display the capital letter “U”.

Connect B, C, D, E, & F to the negative of the battery.

☐ Project #368

Display Capital Letter “C”

OBJECTIVE: To configure the seven segment to display the capital letter “C”.

Connect A, D, E, & F to the negative of the battery.

☐ Project #369

Display Capital Letter “E”

OBJECTIVE: To configure the seven segment to display the capital letter “E”.

Connect A, D, E, F, & G to the negative of the battery.

☐ Project #370

Display “.”

OBJECTIVE: To configure the seven segment to display the decimal (DP).

Connect DP to the negative of the battery.

Project #371 Display Letter "b"

OBJECTIVE: To configure the seven segment to display the letter "b".

Connect C, D, E, F, & G to the negative of the battery.

Project #372 Display Letter "c"

OBJECTIVE: To configure the seven segment to display the letter "c".

Connect A, F, & G to the negative of the battery.

Project #373 Display Letter "d"

OBJECTIVE: To configure the seven segment to display the letter "d".

Connect B, C, D, E, & G to the negative of the battery.

Project #374 Display Letter "e"

OBJECTIVE: To configure the seven segment to display the letter "e".

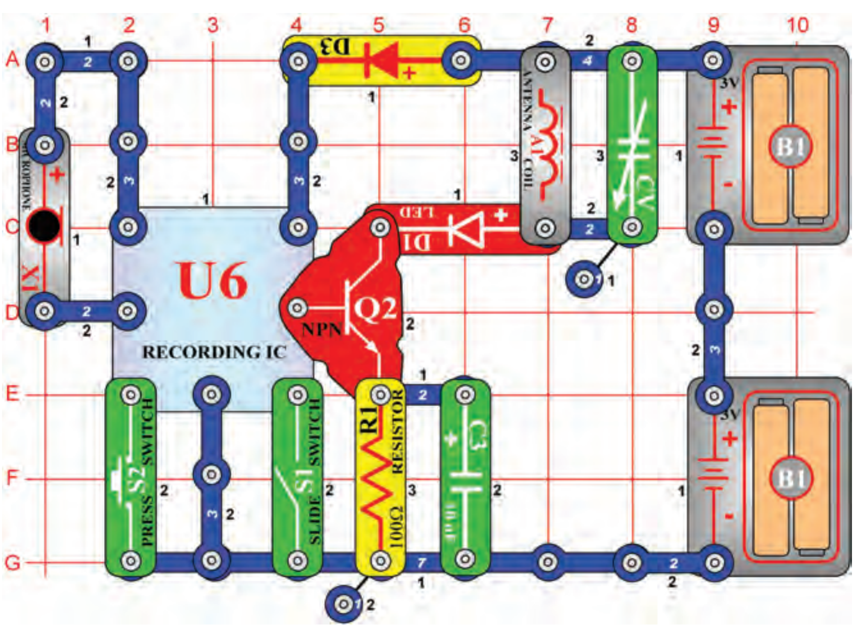
Connect A, B, D, E, F, & G to the negative of the battery.

Project #375 Display Letter "h"

OBJECTIVE: To configure the seven segment to display the letter "h".

Connect F, E, G, & C to the negative of the battery.

Project #376 Recorded Voice Transmitter



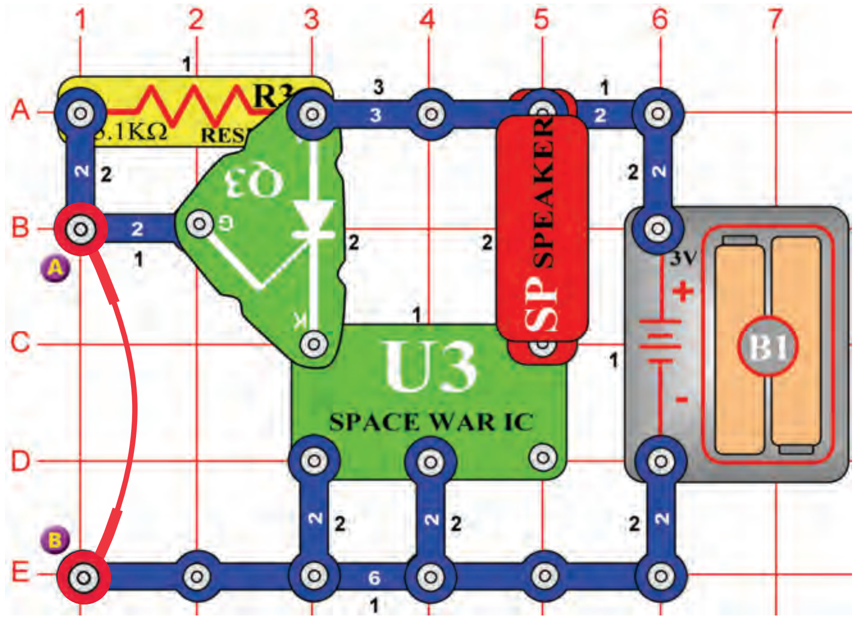
OBJECTIVE: To hear your voice on the radio.

You need an AM radio for this project. Build the circuit shown and place it next to your AM radio. Tune the radio frequency to where no other station is transmitting. Push the press switch (S2); the red LED (D1) should light for a while, indicating that music is being transmitted to your radio. Tune the adjustable capacitor (CV) and the radio volume control until the music sounds best on the radio. Wait until the music stops.

Turn on the slide switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone (X1) up to 8 seconds, and then turn off the slide switch (it also beeps after the 8 seconds expires).

Press the press switch (S2) for playback. It plays the recording you made followed by one of three songs. If you press the press switch before the song is over, music will stop. You may press the press switch several times to play all three songs.

Project #377



Space War Alarm by SCR

OBJECTIVE: To build an alarm circuit.

The circuit uses the space war IC (U3) and works the same way as project #320. Remove the jumper wire and a space war sound plays.

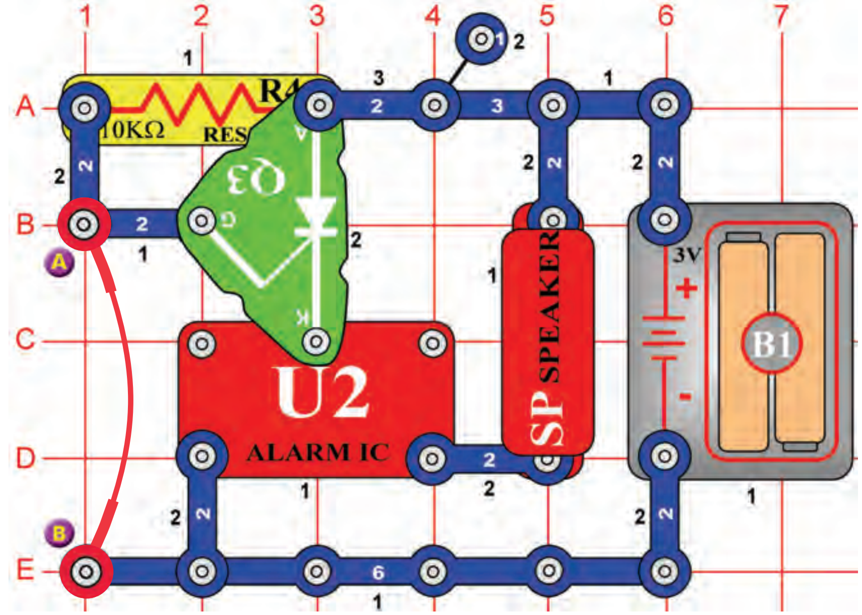
Project #378

Light Space War Alarm

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #377. Replace the resistor (R3) with the photoresistor (RP) and remove the jumper wire. Cover the photoresistor with your hand. Now slowly remove your hand. The music plays when enough light hits the resistor.

Project #379



Alarm by SCR

OBJECTIVE: To build an alarm circuit.

The circuit uses the alarm IC (U2) and works the same way as project #377. Remove the jumper wire and an alarm IC sounds.

Project #380

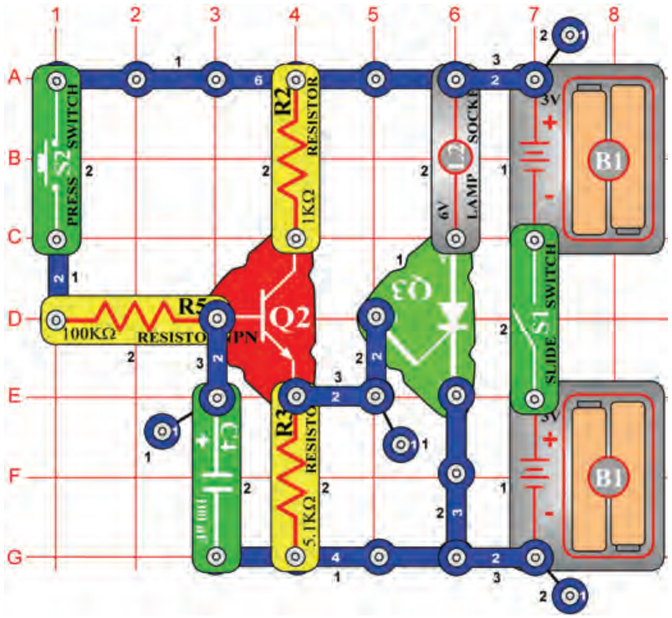
Light & Alarm IC

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #379. Replace the 10kΩ resistor (R4) with the photoresistor (RP) and remove the jumper wire. When enough light strikes the photoresistor, the Alarm IC (U2) plays. Cover the photoresistor with your hand. Now slowly remove it, when enough light hits the resistor, the IC plays.

Project #381 Delay Light

OBJECTIVE: To construct a time delay circuit.



Turn on the slide switch (S1) and the bulb (L2) does not light. Press switch (S2) and slowly the bulb lights.

When the press switch is pressed, current flows to the base of the transistor (Q2) and charges the 100μF capacitor (C4). When the capacitor charges up to more than 1 volt, the transistor (Q2) turns on and triggers the SCR (Q3). The bulb will stay lit until the slide switch is turned off. The values R5 and C4 determine the time it takes until the transistor turns on. The larger the capacitor value, the more time it takes to turn on.

Project #382 Delay Fan

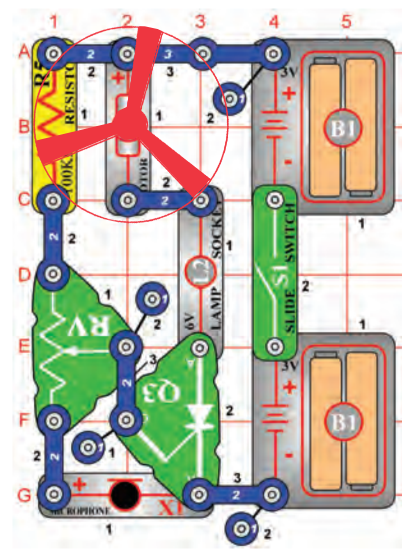
OBJECTIVE: To construct a time delay fan.

Use the circuit in project #381. Replace the lamp (L2) with the motor (M1) and fan, then replace the 3-snap (base grid locations E6-G6) with the lamp (L2). Turn on slide switch (S1) and press down the press switch (S2) to start the motor.

Now replace the 100μF capacitor (C4) with the 470μF capacitor (C5). Turn on slide switch (S1) and press switch (S2). See how long it takes until the motor (M1) spins.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #383 Sound Activated Fan



OBJECTIVE: To build a sound activated fan.

Build the circuit as shown. Place the fan on the motor (M1). Set the lever on the adjustable resistor (RV) toward towards the 100kΩ resistor (R5). Clap to start the motor.

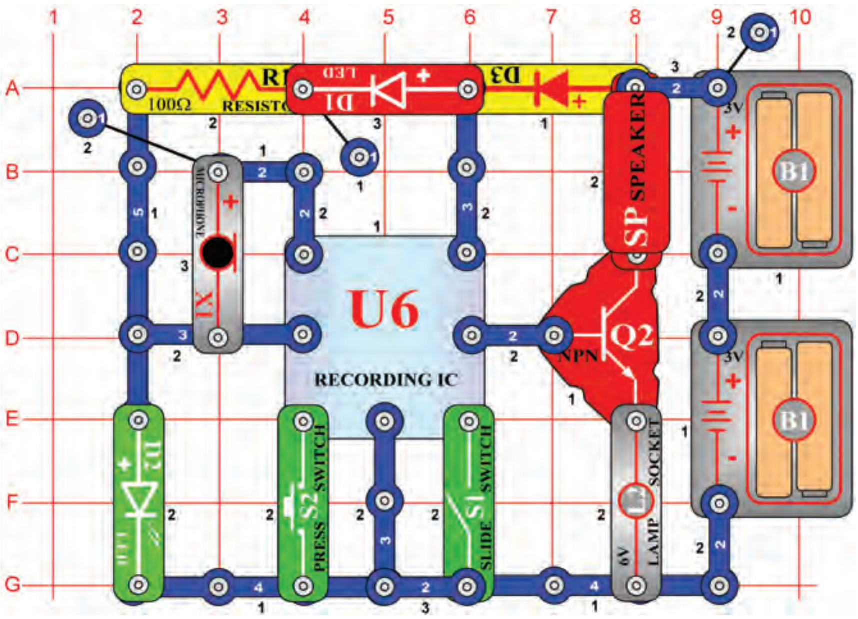
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

To learn more about how circuits work, visit www.snapcircuits.net or page 62 to find out about our Student Guides.

☐ Project #384

Recording LED Indicator

OBJECTIVE: To build a circuit that lights an LED to indicate the recording mode.

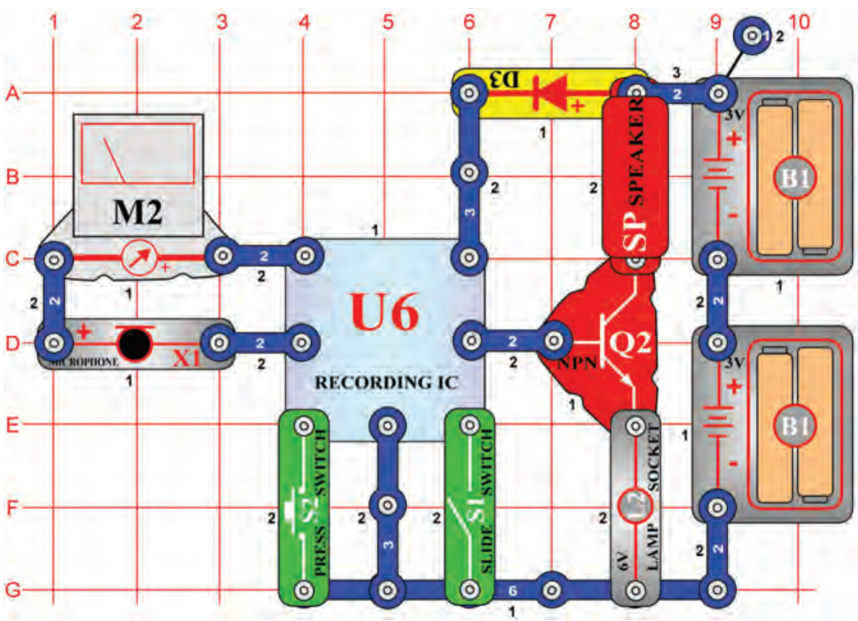


The circuit uses sound (beep) and light (LED) to indicate that you are recording. Build the circuit; the red (D1) and green (D2) LED's should light. Now turn on the slide switch (S1). You hear one beep and the green LED turns off. Speak into the microphone (X1) to record a message. When you turn off the slide switch, or the circuit beeps twice (indicating the recording is finished), the green LED turns on again. Make sure that the slide switch is turned off. Press the press switch to hear your recording followed by a song. The lamp (L2) is used to limit current and will not light.

☐ Project #385

Playback & Record with Meter

OBJECTIVE: To add a volt meter to the playback and record circuit.

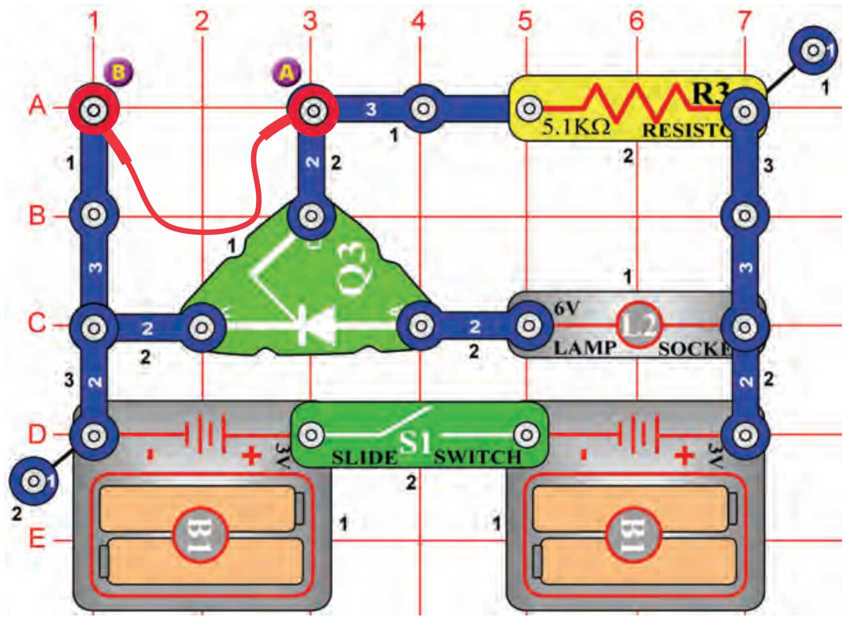


When recording, if the input signal into the microphone (X1) is too high, distortion can occur. To monitor the level, a meter (M2) is placed in series with the microphone.

Set the meter to the LOW (or 10mA) scale. Turn on the slide switch (S1) and the meter defects to the right. As you speak into the microphone, the meter indicates the change in current. Turn the switch off and then on to record again, but this time speak louder. You will find that the louder you speak, the more the meter deflects. The lamp (L2) is used to limit current and will not light.

Project #386 — Alarm Light

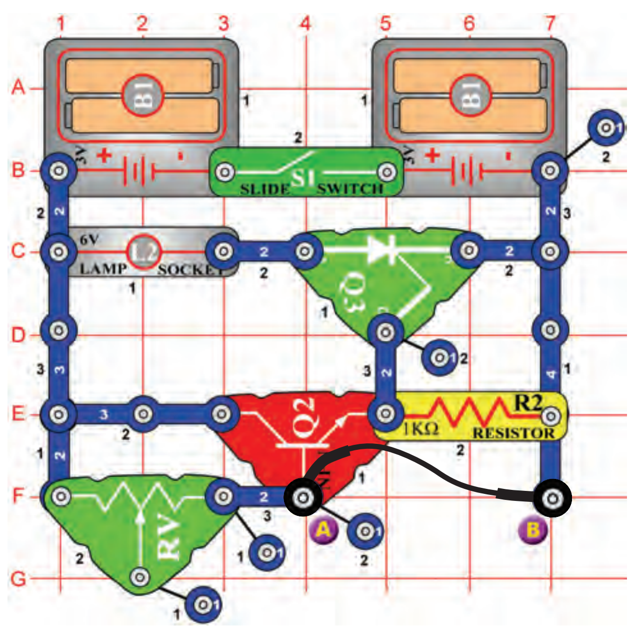
OBJECTIVE: To light a bulb to indicate an open circuit.



This is another example of a alarm that activates when the circuit is broken. Connect the jumper wire across points A & B and then turn on the slide switch (S1). The lamp (L2) will not light until the jumper wire is disconnected. Then the lamp will not turn off. Turn off the switch to turn the lamp off again. This circuit remembers if there was a break in the connection.

Project #387 — Alarm Light (II)

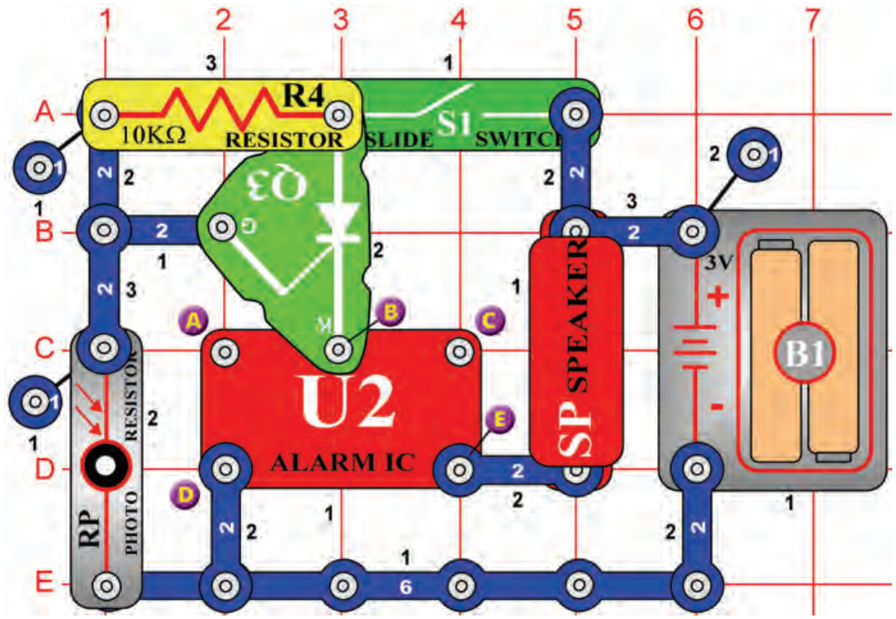
OBJECTIVE: To light a bulb to indicate an open circuit.



This project is similar to project #386, but uses a transistor (Q2). The lamp (L2) will not light until the jumper wire is disconnected. The jumper wire grounds the base of the transistor, keeping it off. Remove the jumper and the voltage on the base rises; turning the transistor and SCR (Q3) on, and lighting the lamp. Note, the adjustable resistor (RV) is used as a fixed value. Once the SCR is triggered, it will light the lamp even if the jumper wire is replaced. Turn the slide switch (S1) off to turn off the lamp.

Project #388 Night Police Car

OBJECTIVE: To build a night-sensitive police car sound.



As the photoresistor (RP) is exposed to light, its resistance is very low, thereby connecting the gate of the SCR (Q3) to ground. This prevents the SCR from conducting, connecting the alarm IC (U2) to the batteries. The alarm IC remains off until the light is blocked, triggering the SCR. If the light in the room is not bright, the IC may turn on.

Wave your hands over the photoresistor. Block the light with your hand and the speaker (SP) sounds.

Project #389 Night Machine Gun

OBJECTIVE: To build a night-sensitive machine gun sound.

Use the circuit from project #388. Connect the jumper wire to points B & C for a machine gun sound.

Project #390 Night Fire Engine

OBJECTIVE: To build a night-sensitive fire engine sound.

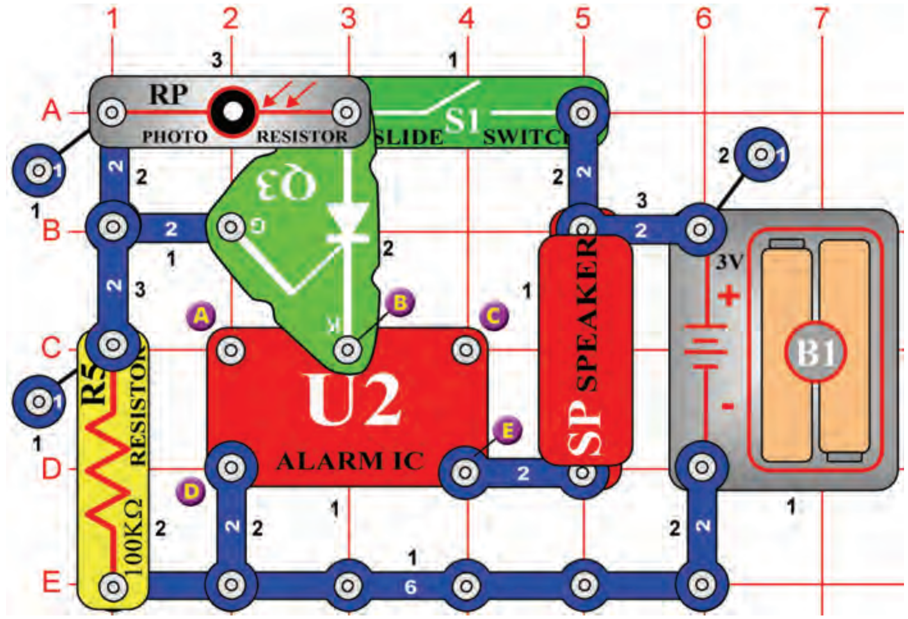
Use the circuit from project #388. Connect the jumper wire to points A & B for a fire engine sound.

Project #391 Night Ambulance

OBJECTIVE: To build a night-sensitive ambulance sound.

Use the circuit from project #388. Connect the jumper wire to points A & D for an ambulance sound.

☐ # Project #392



Daytime Light Police Car

OBJECTIVE: To build a light-sensitive police car sound.

As long as the photoresistor (RP) is exposed to light, the alarm IC (U2) outputs a signal to the speaker (SP). Block the light with your hand and the sound will stop.

☐ # Project #393

Daytime Light Machine Gun

OBJECTIVE: To build a light-sensitive machine gun sound.

Use the circuit from project #392. Connect the jumper wire to points B & C. The sound of a machine gun will be heard when the room is not dark.

☐ # Project #394

Daytime Light Fire Engine

OBJECTIVE: To build a light-sensitive fire engine sound.

Use the circuit from project #392. Connect the jumper wire to points A & B for a fire engine sound, when room is not dark.

☐ # Project #395

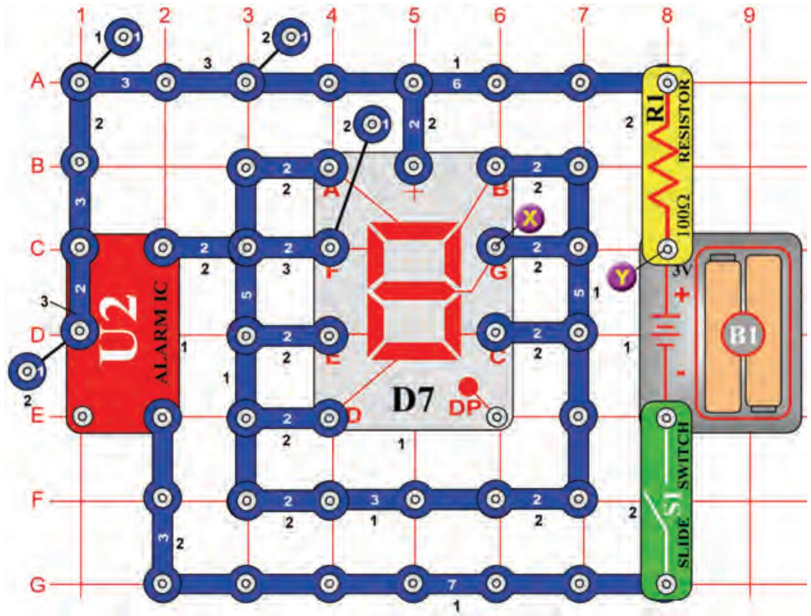
Daytime Light Ambulance

OBJECTIVE: To build a light-sensitive ambulance sound.

Use the circuit from project #392. Connect the jumper wire to points A & D for an ambulance sound.

Project #396 — Flashing 8

OBJECTIVE: Use the Alarm IC as a switch to flash the number "8".



Turn on the slide switch (S1) and the number 8 starts flashing. The segments are powered by connecting them to the IC's (U2) output.

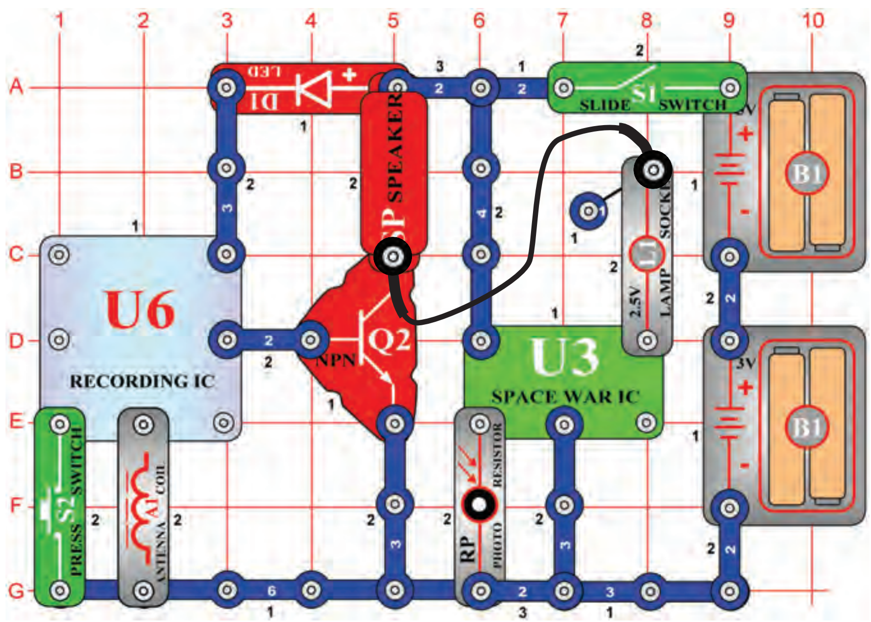
Project #397 — Flashing 8 with Sound

OBJECTIVE: To build a circuit so you can hear and see the 8 flash.

Use the circuit in project #396. Connect the speaker (SP) across points X & Y to see and hear the IC's (U2) output.

Project #398 — Musical Space War

OBJECTIVE: To combine the sound effects of the recorder and space war integrated circuits.

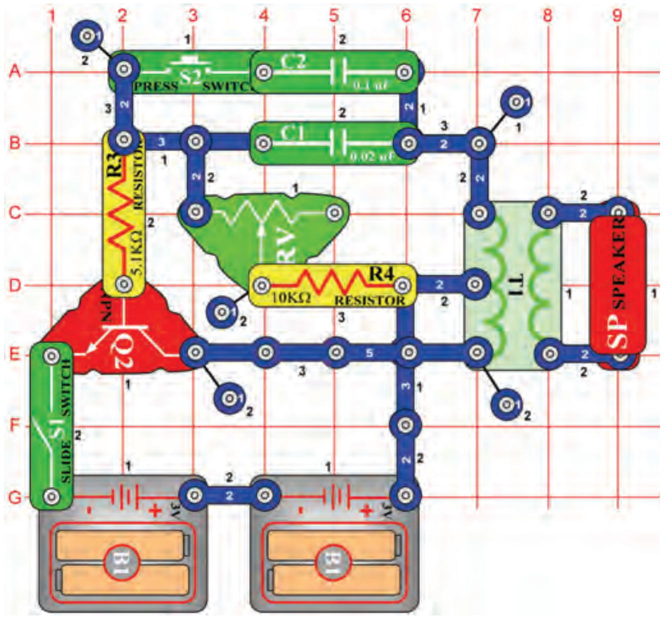


Turn on the slide switch (S1) and you hear space war sounds as the lamp (L1) flashes. If you wave your hand over the photoresistor (RP), the sound changes. If you keep the photoresistor covered, then the sound will stop.

Press the press switch (S2) and you will hear music in addition to any space war sounds that are playing. Press the press switch again to change the music. You will also hear any recording you had made previously with other projects.

Replace the lamp with the 100Ω resistor (R1) to reduce the loudness.

Project #399 Electronic Noisemaker



OBJECTIVE: To make different tones with an oscillator.

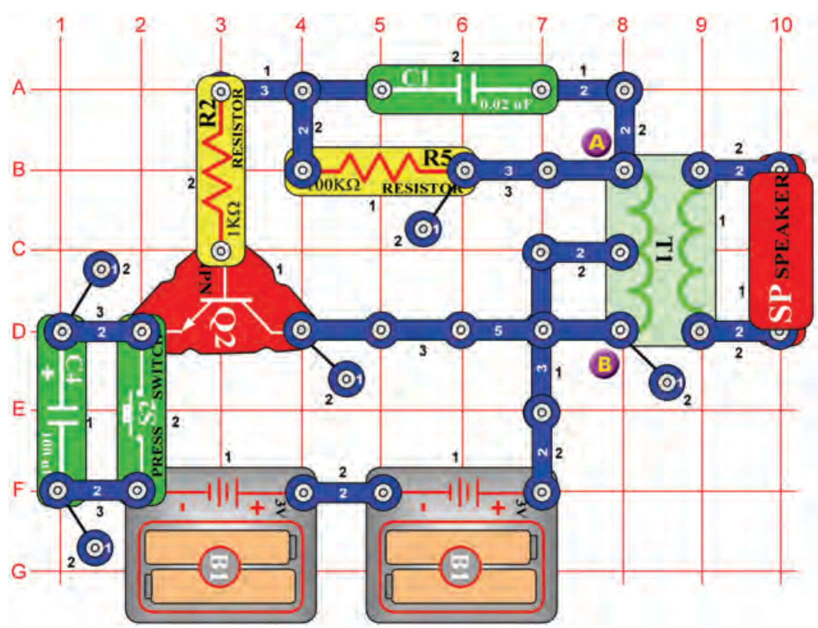
Build the circuit and turn on the slide switch (S1), you hear a high-frequency tone. Press the press switch (S2) and move the adjustable resistor (RV) control around to change to frequency of the tone. Replace the 0.1μF capacitor (C2) with the 10μF capacitor (C3, "+" on the right) to lower the frequency of the tone.

Project #400 Electronic Noisemaker (II)

OBJECTIVE: To show a variation of project #399.

You can also change the frequency by changing the resistance in the oscillator. Replace the 10KΩ resistor (R4) with the 100KΩ resistor (R5), this can be done with either the 0.1μF (C2) or 10μF (C3) capacitors in the circuit.

Project #401 Bee



OBJECTIVE: To make different sounds with an oscillator.

Build the circuit and press the press switch (S2) a few times, you hear cute sounds like a bumble bee. Replace the 0.02μF capacitor (C1) with 0.1μF capacitor (C2) or 10μF capacitor (C3, "+" on the right) to change the sound.

Project #402 Bee (II)

OBJECTIVE: Show a variation of project #401.

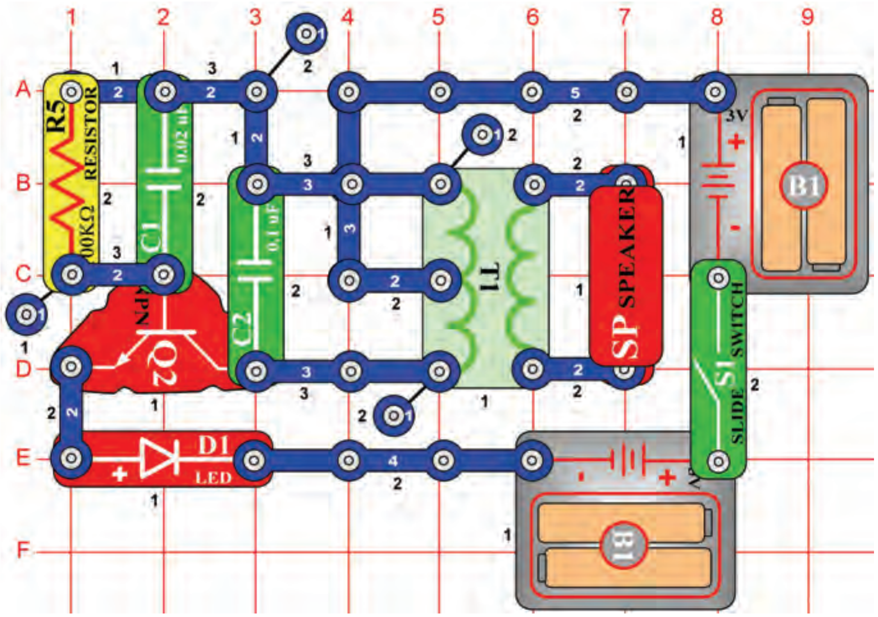
Place the 0.02μF capacitor (C1) back in the circuit. Remove the speaker (S1) from the circuit and place the whistle chip (WC) across the transformer (T1) at points labeled A & B on the circuit layout. Listen to the sounds as you press the press switch (S2). Replace the 0.02μF capacitor (C1) with 0.1μF capacitor (C2) or 10μF capacitor (C3, "+" on the right) to change the sound.

Project #403 Bee (III)

OBJECTIVE: Show a variation of project #401.

Replace the 100μF capacitor (C4) with the 10μF capacitor (C3) or the 470μF capacitor (C5) to change the duration of the sound. Use either the speaker circuit in project #401 or the whistle chip circuit in project #402.

Project #404 Oscillator Sound



OBJECTIVE: Build an oscillator circuit.

Turn on the slide switch (S1) and the LED (D1) lights as the speaker (SP) emits a tone. The circuit oscillates and generates an AC voltage across the speaker through the transformer (T1).

Project #405 Oscillator Sound (II)

OBJECTIVE: Show variations of project #404.

Use the circuit in project #404. In this circuit, you will change the tone by adding more capacitance. Place the whistle chip (WC) on top of capacitor (C1). Turn on the slide switch (S1) and you now hear a lower tone. Adding the more capacitance lowers the oscillating frequency.

Project #406 Oscillator Sound (III)

OBJECTIVE: Show variations of project #404.

Use the circuit in project #404. Place the whistle chip (WC) in parallel with the capacitor (C2) by placing it on the left side of the transformer (T1). Turn on the slide switch (S1) and you now hear a lower tone.

Project #407 Oscillator Sound (IV)

OBJECTIVE: Show variations of project #404.

Use the circuit in project #404. Using a 1-snap, place the 10μF capacitor (C3) on top of the 100kΩ resistor (R5), with the "+" side on point A1. Turn on the slide switch (S1) and you should hear a much lower sound then the previous projects.

Project #408 Oscillator Sound (V)

OBJECTIVE: Show variations of project #404.

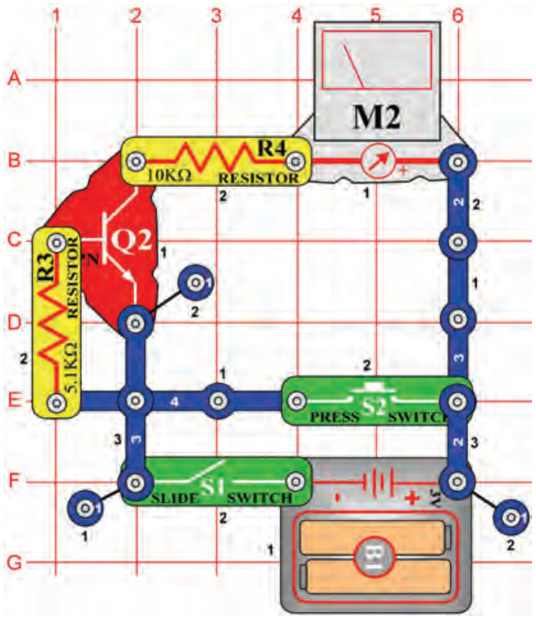
Use the circuit in project #404. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the photoresistor. Now, as the resistance changes, so does the oscillator frequency.

☐

Project #409

Transistor Tester

OBJECTIVE: To build a circuit that checks the transistor.



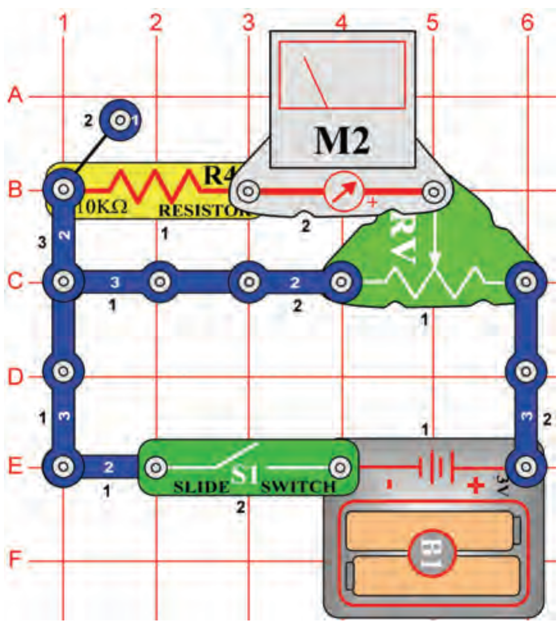
Set the meter (M2) to the LOW (or 10mA) setting. Turn on the switch (S1), the meter does not move. Press the switch (S2), the meter deflects and points to 10. This indicates the transistor (Q2) is GOOD. The meter would only deflect a little or not at all for a BAD transistor.

☐

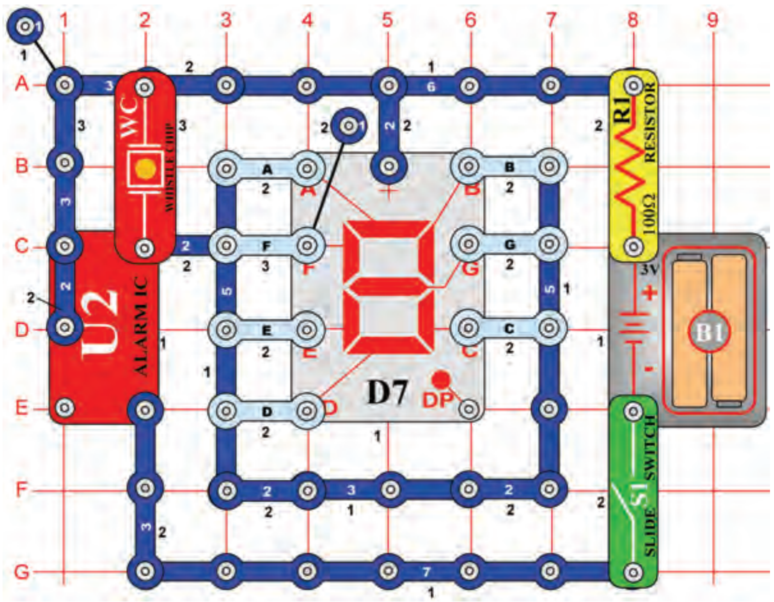
Project #410

Adjustable Voltage Divider

OBJECTIVE: To make an adjustable current path.



Set the meter (M2) to the LOW (or 10mA) setting. This circuit is a simple voltage divider. When the adjustable resistor (RV) is set to the far right, the voltage across the resistors (R4) and (RV) are equal. Adjust resistor (RV) to the left, the meter deflects less, as the voltage decreases.



Project #411

Automatic Display Capital Letter “C”

OBJECTIVE: To construct a flashing display for the capital letter C.

Connect segments A, D, E & F to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #412

Automatic Display Capital Letter “E”

OBJECTIVE: To construct a flashing display for the capital letter E.

Use the circuit from project #411. Connect A, D, E, F, & G to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #413

Automatic Display Capital Letter “F”

OBJECTIVE: To construct a flashing display for the capital letter F.

Use the circuit from project #411. Connect A, E, F, & G to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #414

Automatic Display Capital Letter “H”

OBJECTIVE: To construct a flashing display for the capital letter H.

Use the circuit from project #411. Connect B, C, E , F, & G to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #415

Automatic Display Capital Letter “P”

OBJECTIVE: To construct a flashing display for the capital letter P.

Use the circuit from project #411. Connect A, B, E, F, & G to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #416

Automatic Display Capital Letter “S”

OBJECTIVE: To construct a flashing display for the capital letter S.

Use the circuit from project #411. Connect A, F, G, C, & D to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #417

Automatic Display Capital Letter “U”

OBJECTIVE: To construct a flashing display for the capital letter U.

Use the circuit from project #411. Connect B, C, D, E, & F to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

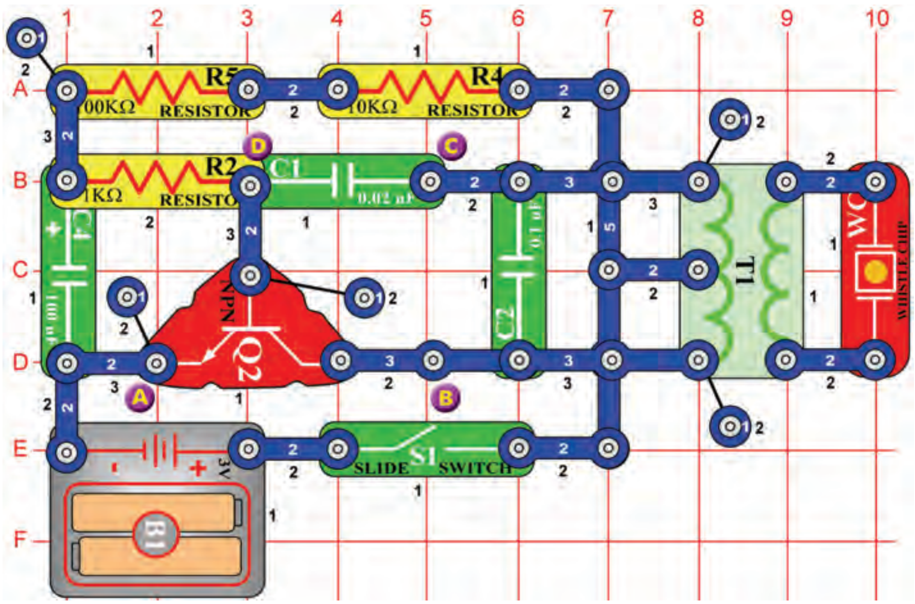
Project #418

Automatic Display Capital Letter “L”

OBJECTIVE: To construct a flashing display for the capital letter L.

Use the circuit from project #411. Connect D, E, & F to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

To learn more about how circuits work, visit www.snapcircuits.net or page 62 to find out about our Student Guides.



Project #419
Whistle Chip Sounds

OBJECTIVE: To make sounds from the whistle chip.

Turn on the switch (S1). As the circuit oscillates, the plate in the whistle chip vibrates and generates sound.

Project #420
Whistle Chip Sounds (II)

OBJECTIVE: Show variations of project #419.

Connect the whistle chip (WC) across points B & C.

Project #421
Whistle Chip Sounds (III)

OBJECTIVE: Show variations of project #419.

Use the circuit in project #419. Connect the whistle chip (WC) across points C & D. You should hear a faster sound.

Project #422
Whistle Chip Sounds (IV)

OBJECTIVE: Show variations of project #419.

Use the circuit in project #419, but replace the 100μF capacitor (C4) with the 10μF capacitor (C3).

Project #423
Whistle Chip Sounds (V)

OBJECTIVE: Show variations of project #419.

Use the circuit in project #419, but replace the 100μF capacitor (C4) with the 470μF capacitor (C5).

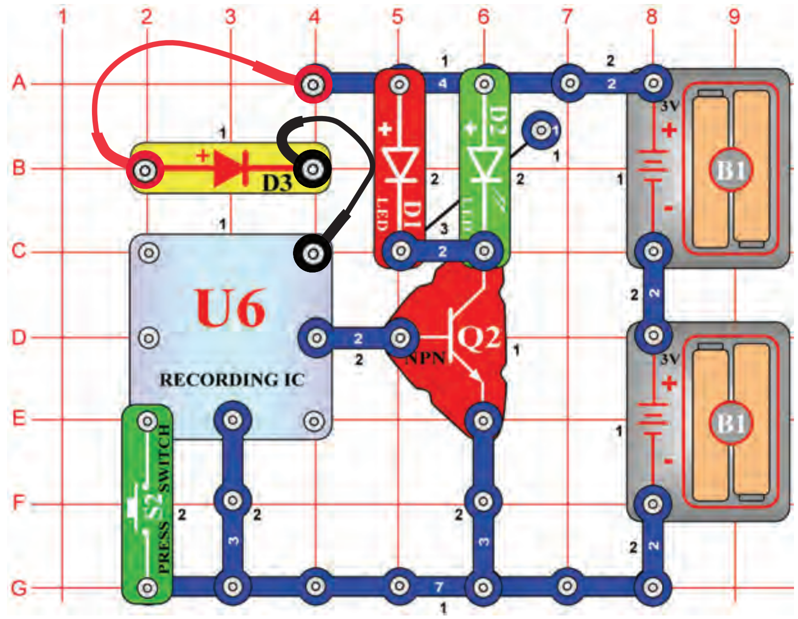
Project #424
Whistle Chip Sounds (VI)

OBJECTIVE: Show variations of project #419.

Use the circuit in project #419, but replace the 100μF capacitor (C4) with the 10μF capacitor (C3) and connect the whistle chip across points B & C. You can also connect the whistle chip across points C & D.

Project #425 LED Music

OBJECTIVE: To light the LED's using the recording IC.



The recording IC (U6) lights the LED's (D1 & D2) instead of driving the speaker (SP). Press the press switch (S2) once. The LED's light and then turn off after a while. Press the press switch again and see how long the second song plays. When the second song stops, press the press switch (S2) again to play the third song.

Project #426 Light-controlled LED Time Delay

OBJECTIVE: Show variations of project #425.

Use the circuit in project #425. Replace the press switch (S2) with the photoresistor (RP). Turn the LED's on and off by waving your hand over the photoresistor.

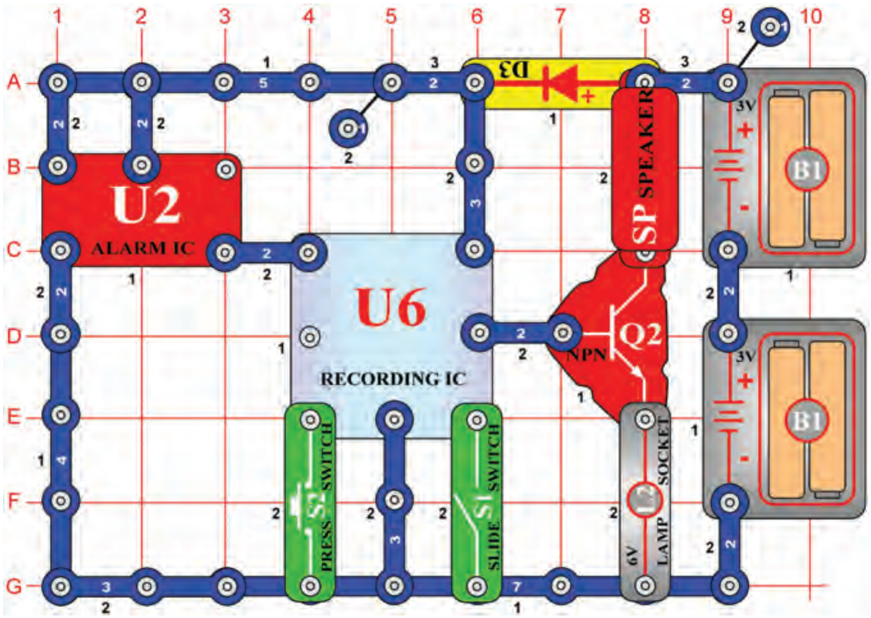
Project #427 Touch-controlled LED Time Delay

OBJECTIVE: Show variations of project #425.

Use the circuit in project #425. Replace the press switch (S2) with the PNP transistor (Q1, arrow on U6 and a 1-snap on point F1). Turn the LED's on and off by touching grid points F1 & G2 at the same time. You may need to wet your fingers.

Project #428 — Alarm Recorder

OBJECTIVE: To record the sound from the alarm IC.



The circuit records the sound from the alarm IC (U2) into the recording IC (U6). Turn on the switch (S1). The first beep indicates that the IC has begun recording. When you hear two beeps, the recording has stopped. Turn off the slide switch (S1) and press the switch (S2). You will hear the recording of the alarm IC before each song is played. The lamp (L2) is used to limit current and will not light.

Project #429

Alarm Recorder (II)

OBJECTIVE: Record the sound from the alarm IC.

Use the circuit in project #428. Remove the 2-snap from A1 to B1. Turn on the switch (S1). The first beep indicates that the IC (U6) has begun recording. When you hear two beeps, turn off the switch (S1), press the switch (S2), and the new recording plays.

Project #430

Machine Gun Recorder

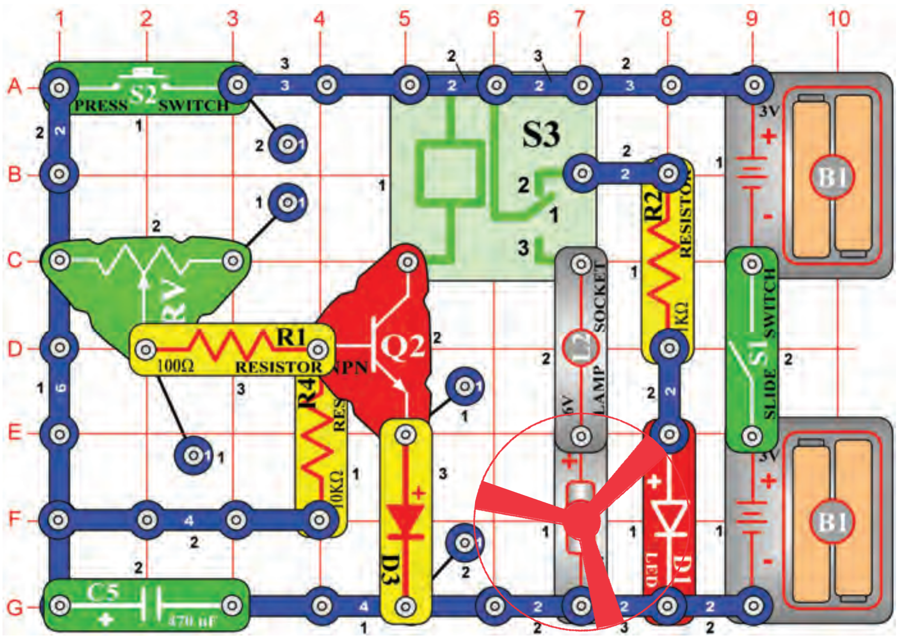
OBJECTIVE: To record the sound of a machine gun.

Use the circuit in project #428. Move the 2-snap from A1 - B1 to 3A - 3B. Turn on the switch (S1). The first beep indicates that the IC (U6) has begun recording. When you hear two beeps, turn off the switch (S1), press the switch (S2), and the machine gun sound plays.

Project #431

Time Delay 1-7 Seconds

***OBJECTIVE:** To build a time delay circuit.*



The length of time the motor (M1) runs depends on the position of the adjustable resistor (RV). When the press switch (S2) is pressed, the 470µF capacitor (C5) charges. As the press switch is released, C5 discharges through the resistors R4 and RV, turning the transistor (Q2) on. Transistor Q2 connects the relay (S3) to the batteries, the contacts switch, and the motor (M1) spins. As the voltage decreases, Q2 will turn off and the motor will stop spinning.

Setting RV to the right (large resistance) sets a long discharge time. To the left, a short discharge time.

Turn on the switch (S1), the red LED (D1) lights. Now press and release the switch (S2), the bulb lights and the motor spins.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

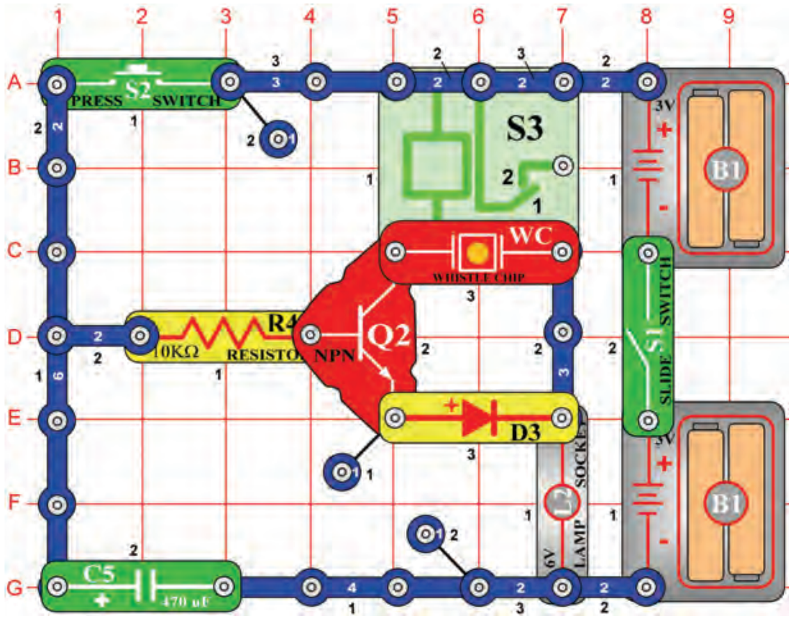
Project #432

Time Delay

***OBJECTIVE:** To see how the capacitor value affects the time.*

Use the circuit in project #431. Replace the 470µF capacitor (C5) with the 100µF capacitor (C4). Set the adjustable resistor (RV) to the far right, turn on the switch (S1), then press and release the switch (S2). The motor (M1) spins and bulb (L2) lights for about 3 seconds. Adjust the adjustable resistor to the left for a much shorter time.

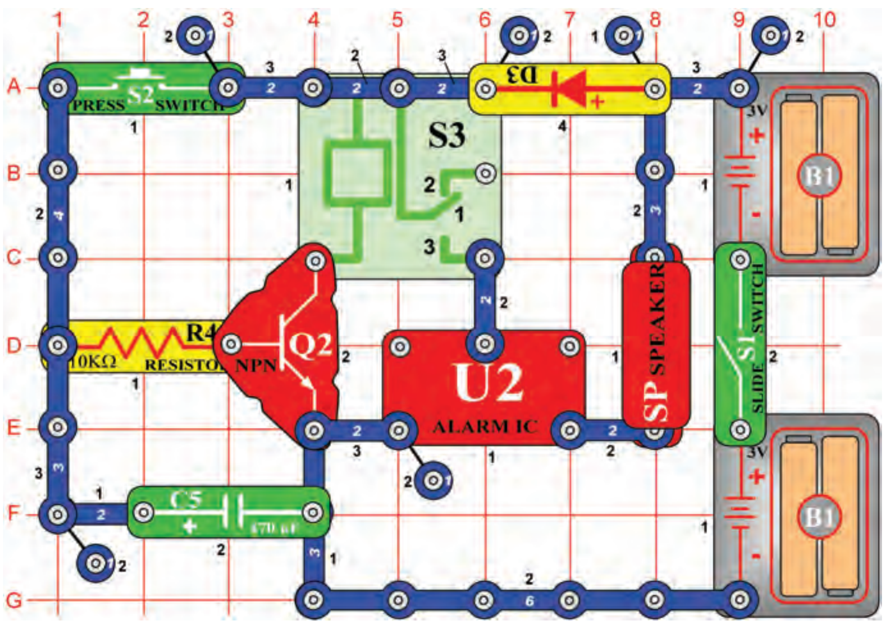
Project #433 Manual 7 Second Timer (II)



OBJECTIVE: To build a manual timer using a relay and whistle chip.

This circuit is similar to project #431 except now the whistle chip (WC) will also make sound.

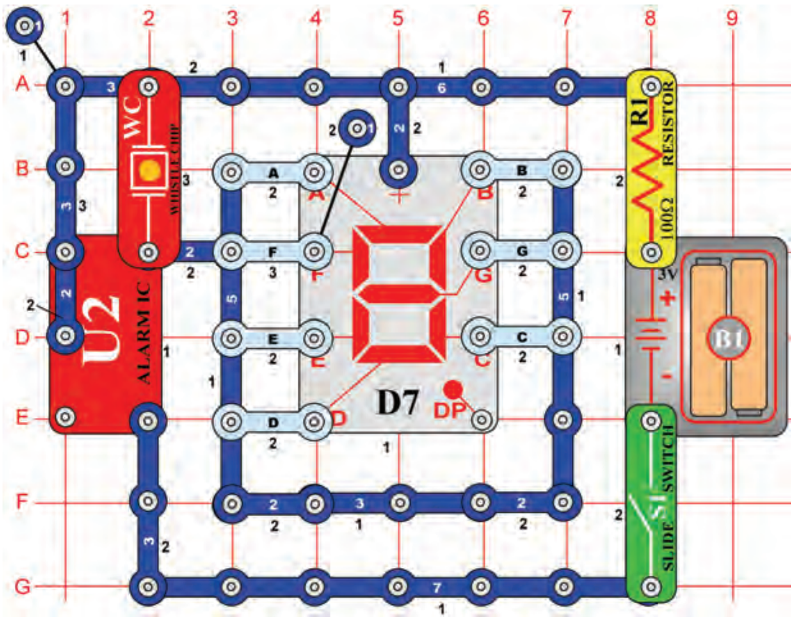
Project #434 15 Second Alarm



OBJECTIVE: To build a circuit that sounds the speaker for 15 seconds.

As in project #431, the transistor (Q2) acts as a switch, connecting the relay (S3) and the alarm IC (U2) to the batteries. As long as there is a voltage on the transistor's base, the alarm IC sounds.

Turn on the slide switch (S1) and then press the switch (S2). The transistor turns on, the capacitor (C5) charges up, and the alarm sounds. Release the press switch (S2). As the capacitor discharges, it keeps the transistor on. The transistor will turn off when the capacitor is almost discharged, about 15 seconds. The relay contacts will switch and the alarm will turn off.



Project #435

Flashing "1 & 2"

OBJECTIVE: Use the Alarm IC as a switch to flash the numbers "1 & 2".

Connect segments B & C to the circuit. Turn on the slide switch (S1) and the number "1" should be flashing. Now, connect A, B, G, E, & D to flash the number "2".

Project #436

Flashing "3 & 4"

OBJECTIVE: Use the Alarm IC as a switch to flash the numbers "3 & 4".

Use the circuit in project #435. Connect A, B, G, C, & D to the circuit. Turn on the slide switch (S1) and the number "3" should be flashing. Now, connect C, B, G & F to flash the number "4".

Project #437

Flashing "5 & 6"

OBJECTIVE: Use the Alarm IC as a switch to flash the numbers "5 & 6".

Use the circuit in project #435. Connect A, F, G, C & D to the circuit. Turn on the slide switch (S1) and the number "5" should be flashing. Now, connect A, C, D, E, F & G to flash the number "6".

Project #438

Flashing "7 & 8"

OBJECTIVE: Use the Alarm IC as a switch to flash the numbers "7 & 8".

Use the circuit in project #435. Connect A, B, & C to the circuit. Turn on the slide switch (S1) and the number "7" should be flashing. Now, connect A, B, C, D, E, F & G to flash the number "8".

Project #439

Flashing "9 & 0"

OBJECTIVE: Use the Alarm IC as a switch to flash the numbers "9 & 0".

Use the circuit in project #435. Connect A, B, C, D, F, & G to the circuit. Turn on the switch (S1) and the number "9" should be flashing. Now, connect A, B, C, D, E, & F to flash the number "0".

Project #440

Flashing "b & c"

OBJECTIVE: Use the Alarm IC as a switch to flash the letters "b & c".

Use the circuit in project #435. Connect C, D, E, F & G to the circuit. Turn on the slide switch (S1) and the letter "b" should be flashing. Now, connect A, F & G to flash the letter "c".

Project #441

Flashing "d & e"

OBJECTIVE: Use the Alarm IC as a switch to flash the letters "d & e".

Use the circuit in project #435. Connect B, C, D, E, & G to the circuit. Turn on the slide switch (S1) and the letter "d" should be flashing. Now, connect A, B, D, E, F & G to flash the letter "e".

Project #442

Flashing "h & o"

OBJECTIVE: Use the Alarm IC as a switch to flash the letters "h & o".

Use the circuit in project #435. Connect C, E, F, & G to the circuit. Turn on the slide switch (S1) and the letter "h" should be flashing. Now, connect C, D, E, & G to flash the letter "o".

Project #443

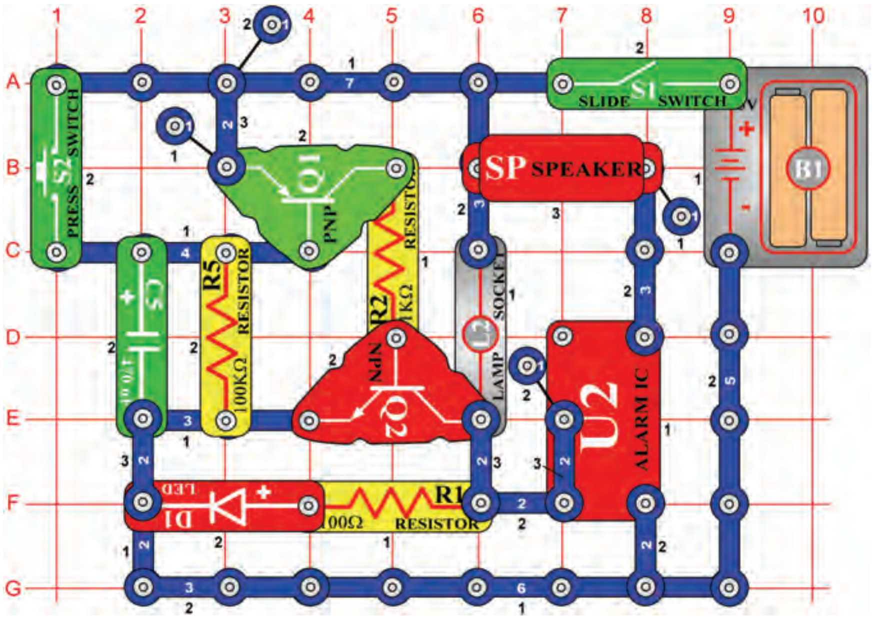
Flashing "A & J"

OBJECTIVE: Use the Alarm IC as a switch to flash the letters "A & J".

Use the circuit in project #435. Connect A, B, C, E, F, & G to the circuit. Turn on the slide switch (S1) and the capital letter "A" should be flashing. Now, connect B, C, & D to flash the capital letter "J".

Project #444 Alarm Timer

OBJECTIVE: To connect the alarm IC to a timer circuit.

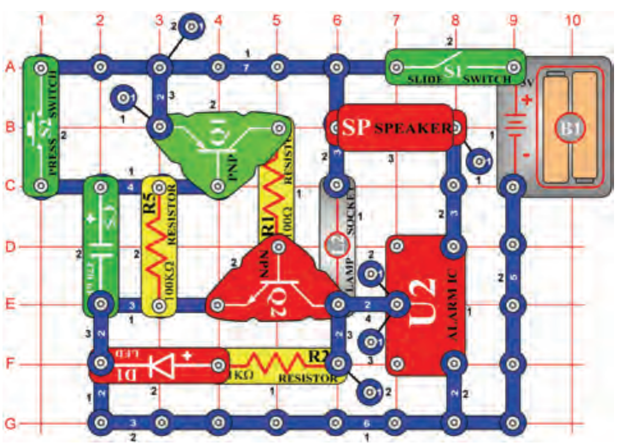


Turn on the slide switch (S1) and the alarm may sound and slowly drift away as the lamp (L2) brightens. Press the press switch (S2) and the alarm sounds at full volume as the LED (D1) lights. Capacitor C5 is also charged. Release the press switch; the alarm IC (U2) still sounds because the voltage from the discharging C5 keeps Q1 and Q2 off. As the capacitor's voltage drops, the LED will turn off and the sound will slowly stop.

Replace resistor R5 and capacitor C5 with different values and see how it affects the circuit.

Project #445 Alarm Timer (II)

OBJECTIVE: To change the time by switching the resistor and capacitor.

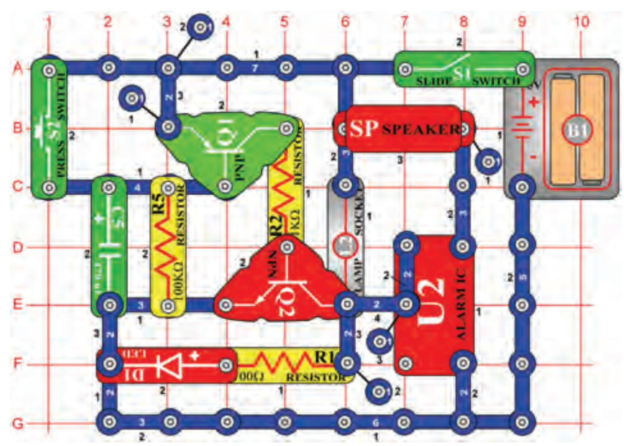


Build this circuit using the following combinations for R5 and C5:

R5 & C3, R4 & C4, and R4 & C5.

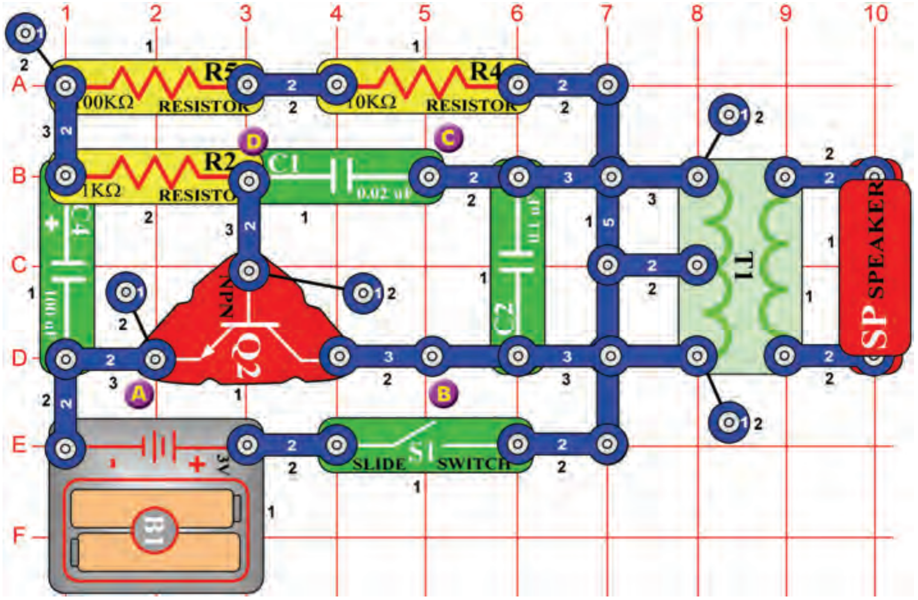
Project #446 Alarm Timer (III)

OBJECTIVE: To modify project #285 for a different sound.



Replace the 1-snap wire from the middle snap on U2 with a 2-snap and connect it to grid location D7 & E7. The circuit now produces a different sound. Change R5 and C5 with the following combinations for R5 and C5:

R5 & C3, R4 & C4, and R4 & C5.



Project #447

Bird Sounds

OBJECTIVE: To create bird sounds.

Turn on the switch (S1). The circuit makes a bird sound.

Project #448

Bird Sounds (II)

OBJECTIVE: To create bird sounds.

Use the circuit in project #447. Replace the 100μF (C4) capacitor with the 10μF capacitor (C3), the tone should sound like a buzzer. Now use the 470μF capacitor (C5) and hear how the tone gets longer between chirps.

Project #449

Bird Sounds (III)

OBJECTIVE: To create bird sounds.

Use the circuit in project #447. Using the jumper wires, connect the whistle chip (WC) across points A & B and the sound changes.

Project #450

Bird Sounds (IV)

OBJECTIVE: To create bird sounds.

Use the circuit in project #447. Connect the whistle chip (WC) across points B & C.

Project #451

Bird Sounds (V)

OBJECTIVE: To create bird sounds.

Using the jumper wires, connect the whistle chip (WC) across points C & D.

Project #452

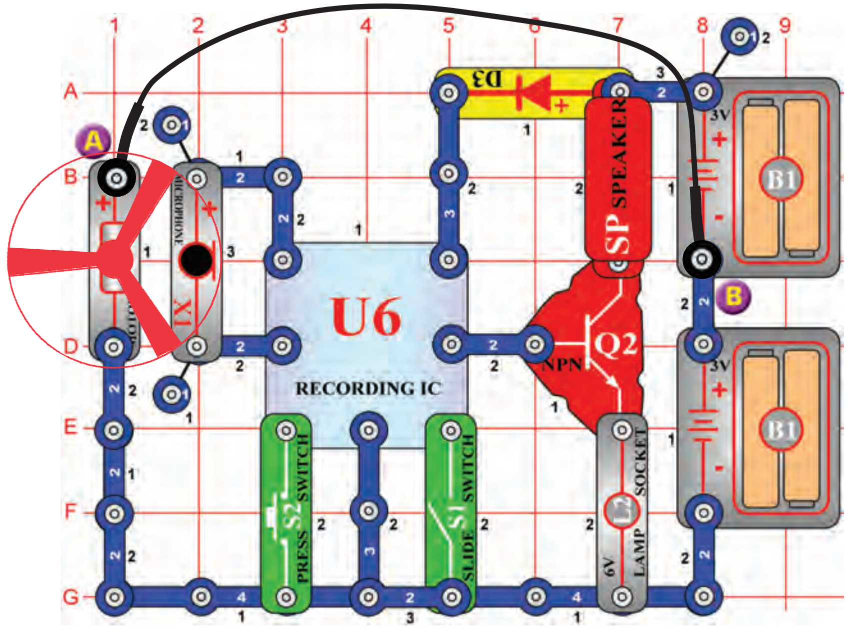
Touch-Control Bird Sound

OBJECTIVE: Show variations of project #447.

Use the circuit in project #447. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the resistor and the sound changes. With the photoresistor installed, redo projects #448 - 451.

Project #453 — Motor Sound Recording

OBJECTIVE: Build a circuit that records the sound of the motor spinning.

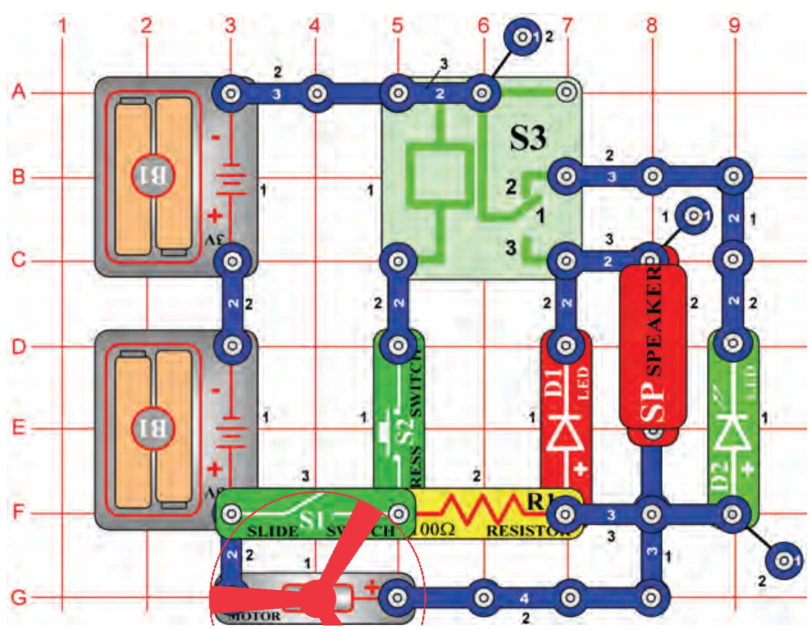


Placing the motor (M1) (with the fan attached) next to the microphone (X1) enables you to record the sound as it spins. Turn off and then turn on the switch (S1). After the two beeps, turn off the slide switch (S1) again. Remove the jumper wire connected across points A & B and press the press switch (S2) to hear the recording. The lamp (L2) is used to limit the current and will not light.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #454 — Motor Sound Indicator

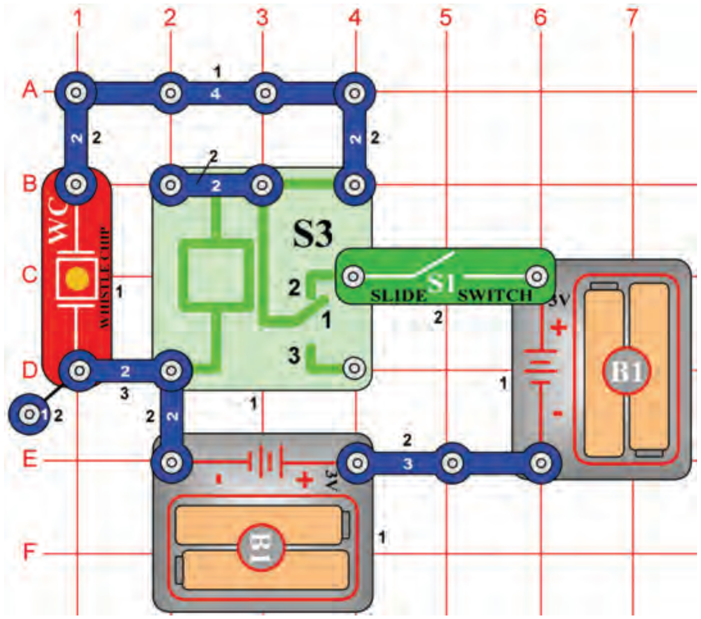
OBJECTIVE: To build a circuit that generates sound as a motor is spinning.



Turn off the switch (S1). There is no power; the LED's and motor are off. Now turn on the switch (S1). Only the green LED (D2) lights, indicating power to the circuit. Press the switch (S2). The motor spins, the red LED (D1) lights, and you hear the motor sound from the speaker (SP).

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

Project #455 Relay & Buzzer



OBJECTIVE: Use the whistle chip and relay to make sound.

Turn on the slide switch (S1) and the relay (S3) opens and closes continuously. This creates an AC voltage across the whistle chip (WC), causing it to vibrate and sound.

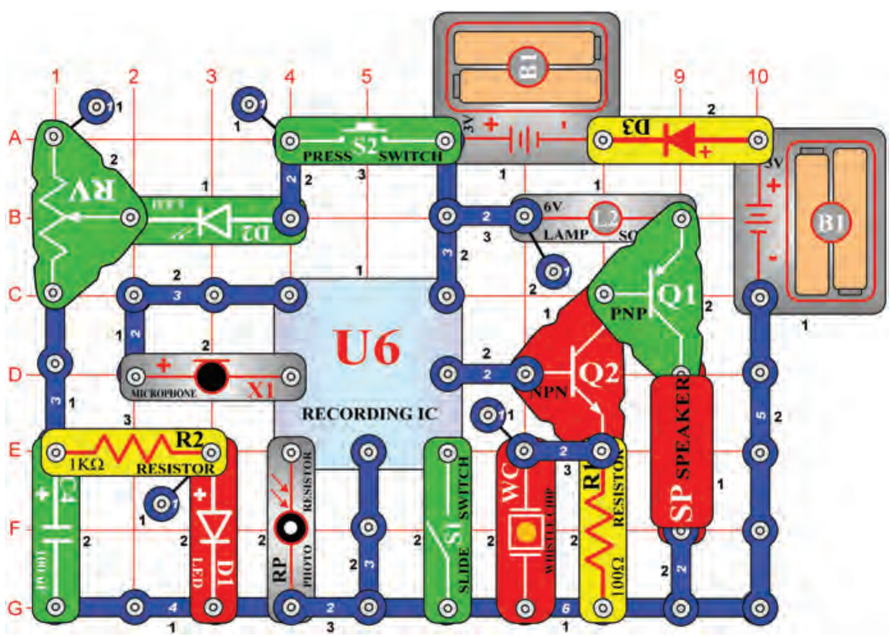
Project #456 Relay & Speaker

OBJECTIVE: Use the speaker and relay to make sound.

Use the circuit from project #455. Replace the whistle chip (WC) with the speaker (SP). Turn on the slide switch (S1) and now you generate a louder sound using the speaker.

Next, replace the whistle chip (WC) with the 6V lamp (L2). Turn on the slide switch (S1) and the lamp lights.

Project #457 Electronic Playground

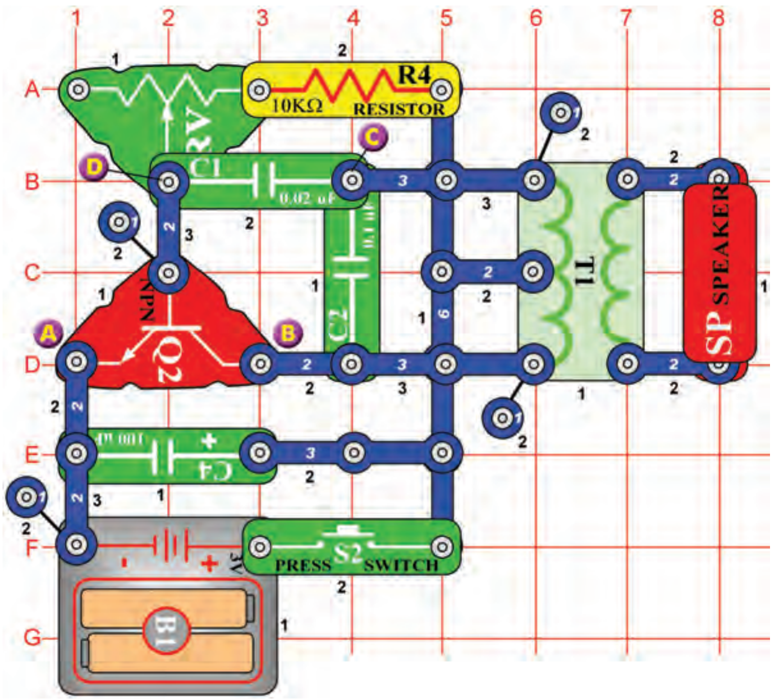


OBJECTIVE: To see how much fun electronics can be.

Uncover the photoresistor (RP) to play a recorded message followed by music, cover it to stop the music.

Turn on the slide switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone (X1) up to 5 seconds, and then turn off the slide switch (it also beeps after the 5 seconds expires).

Set the lever on the adjustable resistor (RV) down (towards the microphone). Push and release the press switch (S2); the green LED (D2) flashes once while the red LED (D1) stays on longer. The LEDs will be brighter if your batteries are new.



Project #458
Electronic Cat

OBJECTIVE: To create the sound of a cat.

Set the adjustable resistor (RV) to the far left. Press and release the switch (S2). You should hear the sound of a cat from the speaker (SP). Now adjust the resistor and hear the different sounds.

Project #459
Electronic Cat (II)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Connect the whistle chip (WC) across points A & B. Press and release the the switch (S2). You hear sound from the whistle chip and speaker (SP). Adjust the resistor (RV) and hear the different sounds.

Project #460
Electronic Cat (III)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Using the jumper wires, connect the whistle chip (WC) across points B & C. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #461
Electronic Cat (IV)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Connect the whistle chip (WC) across points C & D. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #462
Buzzer Cat

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Remove the speaker (SP) and connect the whistle chip (WC) across points A & B. Press and release the press switch (S2) to hear the sounds.

Project #463
Buzzer Cat (II)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Remove the speaker (SP) and, using the jumper wires, connect the whistle chip (WC) across points B & C. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #464
Buzzer Cat (III)

OBJECTIVE: Show variations of project #458.

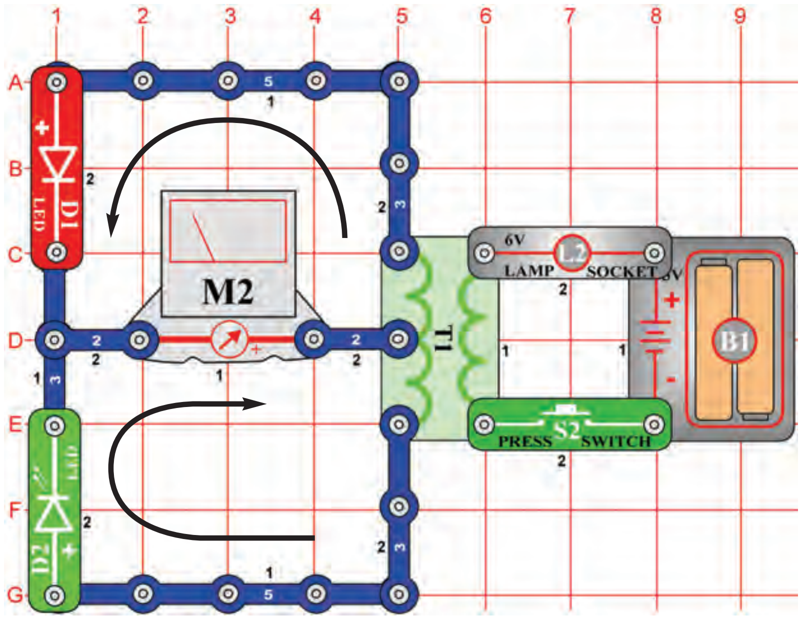
Use the circuit in project #458. Remove the speaker (SP) and connect the whistle chip (WC) across points C & D. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #465
Lazy Cat

OBJECTIVE: Show variations of project #458.

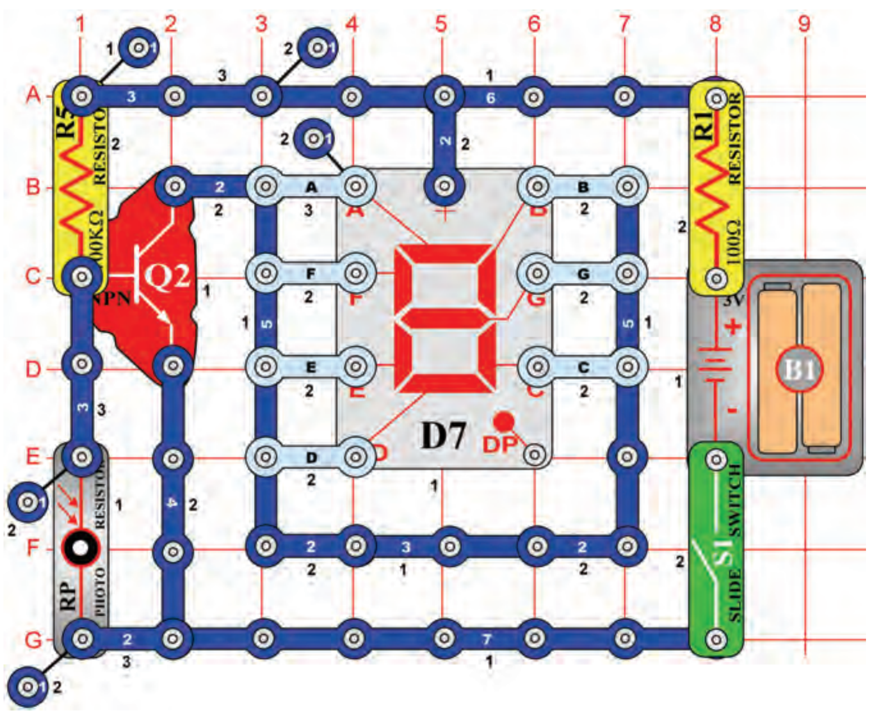
Use the circuit in project #458. Replace the 100μF capacitor (C4) with 470μF (C5). Repeat projects #459-464 and hear 7 different sounds.

Project #466 Meter Deflection (II)



OBJECTIVE: To build change the direction in which current flows.

Compare this circuit to project #358, which has the LED (D1 & D2) positions reversed. This changes the direction that current can flow. Set the meter (M2) to the LOW (or 10mA) scale. Press the press switch (S2) and now the meter deflects to the left.



Project #467 Automatic Display #1

OBJECTIVE: Construct a light-controlled display.

Connect segments B & C to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 1 lights.

Project #468 Automatic Display #2

OBJECTIVE: Light the number 2 using a light-controlled display.

Use the circuit from project #467. Connect A, B, G, E, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 2 lights.

Project #469
Automatic Display #3

OBJECTIVE: Light the number 3 using a light-controlled display.

Use the circuit from project #467. Connect A, B, G, C, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 3 lights.

Project #470
Automatic Display #4

OBJECTIVE: Light the number 4 using a light-controlled display.

Use the circuit from project #467. Connect B, G, C, & F to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 4 lights.

Project #471
Automatic Display #5

OBJECTIVE: Light the number 5 using a light-controlled display.

Use the circuit from project #467. Connect A, C, F, G, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 5 lights.

Project #472
Automatic Display #6

OBJECTIVE: Light the number 6 using a light-controlled display.

Use the circuit from project #467. Connect A, C, D, E, F, & G to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 6 lights.

Project #473
Automatic Display #7

OBJECTIVE: Light the number 7 using a light-controlled display.

Use the circuit from project #467. Connect A, B, & C to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 7 lights.

Project #474
Automatic Display #8

OBJECTIVE: Light the number 8 using a light-controlled display.

Use the circuit from project #467. Connect A, B, C, D, E, F & G to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 8 lights.

Project #475
Automatic Display #9

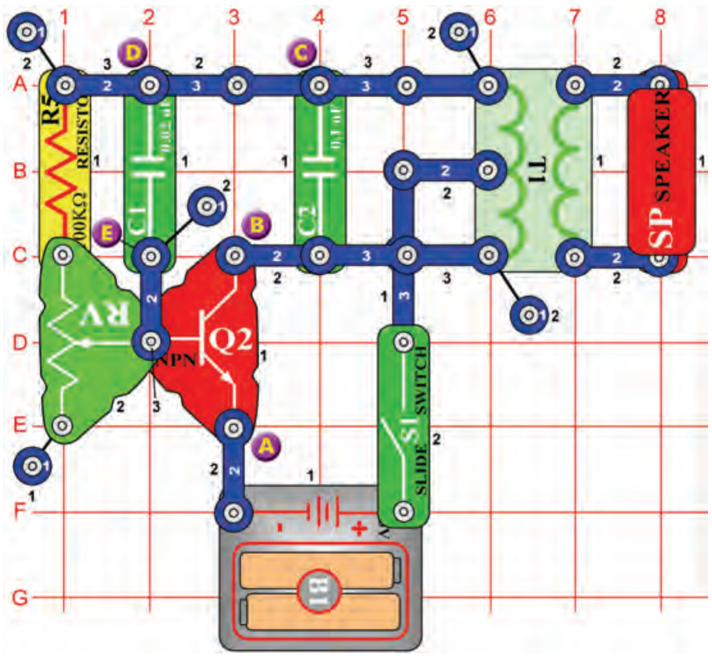
OBJECTIVE: Light the number 9 using a light-controlled display.

Use the circuit from project #467. Connect A, B, D, F, G, & C to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 9 lights.

Project #476
Automatic Display #0

OBJECTIVE: Light the number 0 using a light-controlled display.

Use the circuit from project #467. Connect A, B, C, D, E & F to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 0 lights.



Project #477
Variable Oscillator

OBJECTIVE: To change the tone using the adjustable resistor.

Set the adjustable resistor (RV) to the bottom position. Turn on the slide switch (S1) and you should hear sound from the speaker (SP). Adjust the resistor to hear the different sounds.

Project #478
Variable Oscillator (II)

OBJECTIVE: To change the tone using the adjustable resistor.

Use the circuit in project #477. Connect the whistle chip (WC) across points A & B and adjust the resistor (RV). You should hear a higher tone. This is generated by the whistle chip (WC).

Project #479
Variable Oscillator (III)

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Connect the whistle chip (WC) across points B & C and adjust the resistor (RV).

Project #480
Variable Oscillator (IV)

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Connect the whistle chip (WC) across points D & E and adjust the resistor (RV).

Project #481
Photo Variable Resistor

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the resistor and the sound changes. Adjust the resistor (RV) to make more sounds.

Project #482
Variable Whistle Chip Oscillator

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477, remove the speaker (SP). Make three more sounds by placing the whistle chip (WC) across points, A & B, B & C, and D & E.

Project #483
Slow Adjusting Tone

OBJECTIVE: Show variations of project #477.

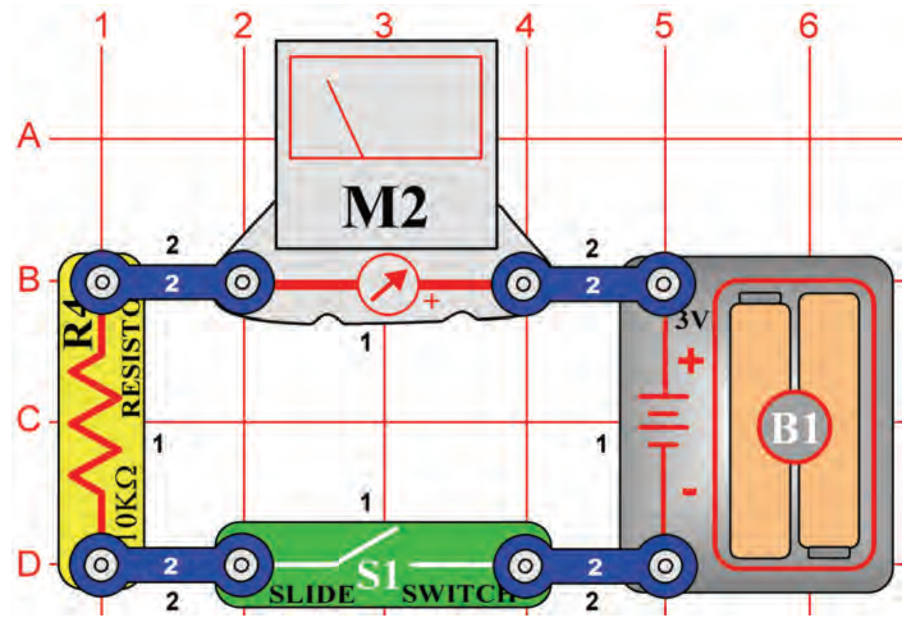
Use the circuit in project #477. Place the 10μF capacitor (C3) (+ towards the top) directly over the .02μF capacitor (C1). A tone is generated once or twice per second, depending on the resistor setting.

Project #484
Slow Adjusting Tone (II)

OBJECTIVE: Show a variation of project #483.

Use the circuit in project #483. Replace the 10μF capacitor (C3) with the 100μF capacitor (C4) and the tone is much slower. To make it even slower, replace the 100μF capacitor (C4) with the 470μF capacitor (C5).

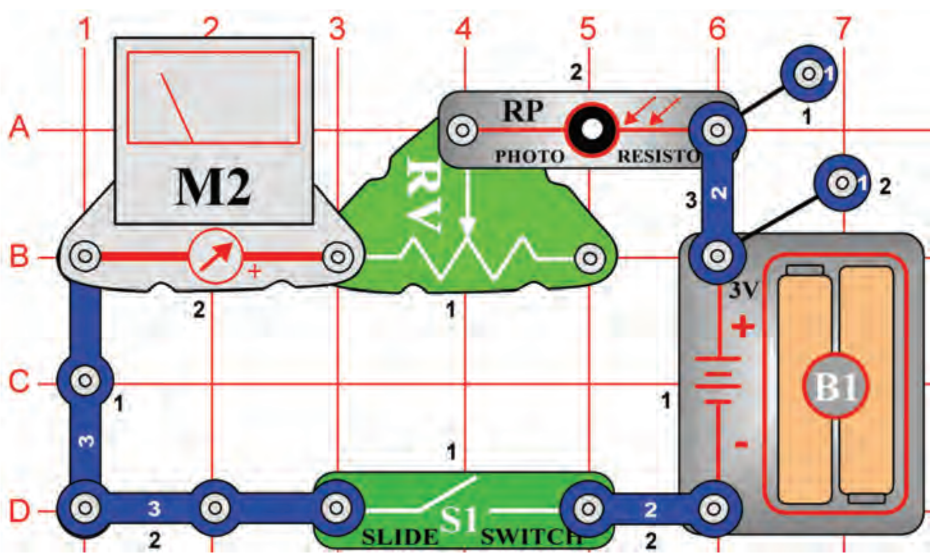
Project #485 Fixed-Current Path



OBJECTIVE: To make a fixed-current path.

Set the meter (M2) to the LOW (or 10mA) setting. The meter indicates the amount of current in the circuit. Turn on the switch (S1), the needle deflects indicating the amount of current. The 10kΩ resistor limits the current, otherwise the meter could be damaged.

Project #486 Simple Illumination Meter



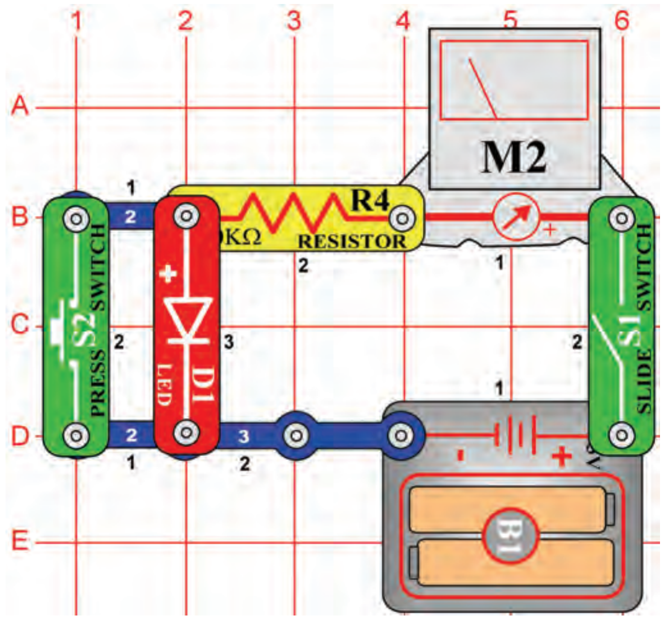
OBJECTIVE: To make a simple light meter.

Set the meter (M2) to the LOW (or 10mA) setting. Using only a few parts, you can make a simple light meter. The amount of light changes the resistance of the photoresistor (RP), which affects the current though the meter. As light increases, the resistance drops and the meter deflects to the right. Decreasing the light, the meter deflects to the left, indicating less current.

Set the adjustable resistor (RV) to the far left and turn on the slide switch (S1). The circuit is now very sensitive to light. Wave your hand over the photoresistor (RP) and the meter deflects to the left, almost to zero. Move the adjustable resistor to the far right and see how less sensitive the circuit is to light now.

☐ Project #487 LED Voltage Drop

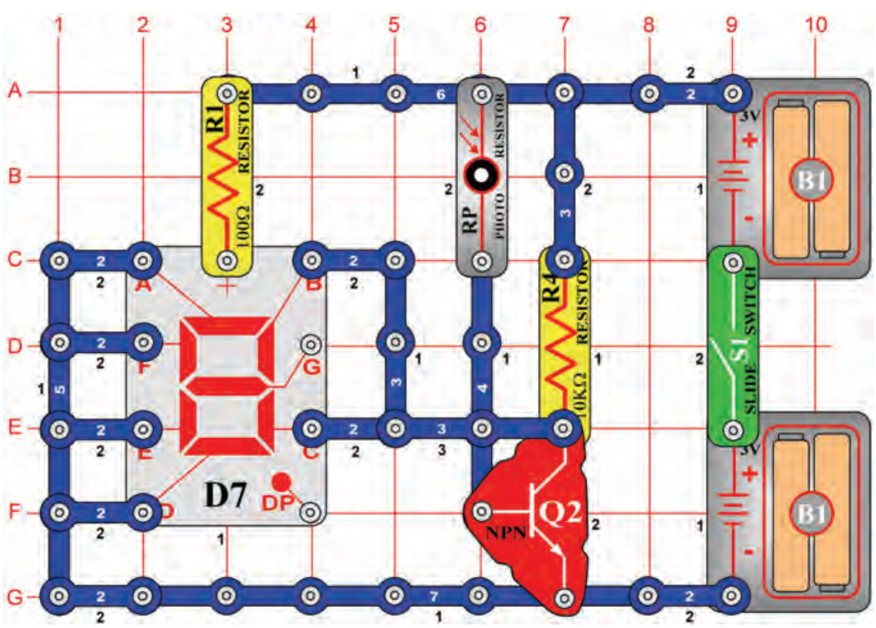
OBJECTIVE: To measure the voltage drop across diodes.



Set the meter (M2) to the LOW (or 10mA) setting. Turn on the slide switch (S1) and the LED (D1) lights as the meter deflects to the middle of the scale. The sum of the voltage drop across each components equals the battery voltage. Bypass the LED by pressing the switch (S2). The voltage across the 10kΩ resistor increases, as shown by the meter deflecting more to the right. Replace the red LED with the green LED (D2) and then the diode (D3), to see the different voltage drops.

☐ Project #488 Open/Closed Door Indicator

OBJECTIVE: To make a circuit that indicates whether a door is open or closed.



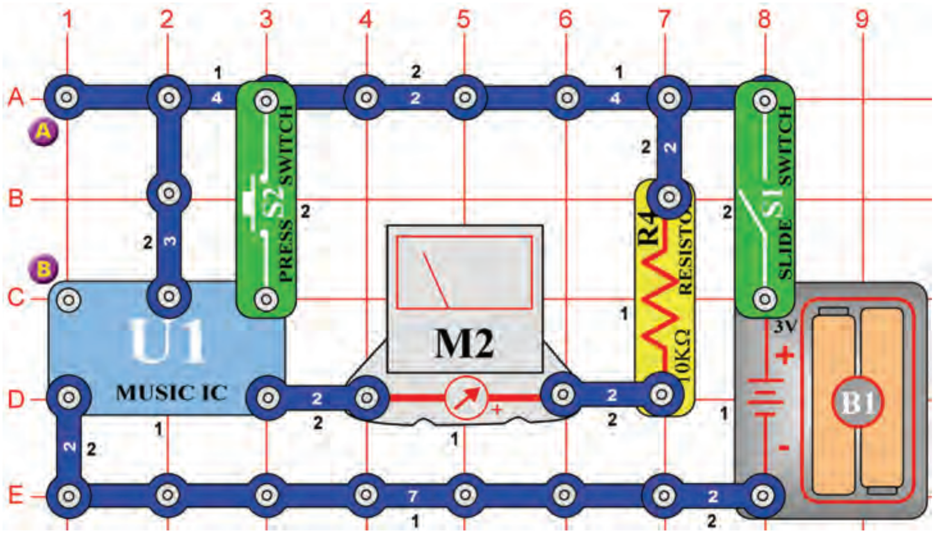
Using the photoresistor (RP) you can build a circuit that indicates if a door is open or closed. When the door is open and light is present, the letter “O” lights. When the door is closed and the room is dark, the letter C lights.

The photoresistor turns the transistor (Q2) on or off, depending on the amount of light in the room. When the transistor is on (light present), segments B & C connect to the (–) side of the batteries and letter “O” lights. When the room is dark, the transistor is off and the letter “C” lights. Segments B & C are connected to the transistor.

Turn the slide switch (S1) on and the letter “O” should light. Cover the photoresistor, simulating closing the door, and the letter “C” lights.

Project #489 Hand-control Meter

OBJECTIVE: To understand music deflection.



Set the meter (M2) to the LOW (or 10mA) setting. Instead of driving a speaker (SP) with the music IC (U1), you can see it by using the meter. Turn on the slide switch (S1) and the meter deflects according to the rhythm of music. After the music stops, hold down the press switch (S2) to make it continue.

Project #490 Light-control Meter

OBJECTIVE: To control the circuit using light.

Use the circuit in project #489. Replace the press switch (S2) with the photoresistor (RP). The music IC (U1) outputs a signal, as long as a light is present on the photoresistor. The photoresistor is like a short, connecting the pin to the battery. When the song repeats, cover the photoresistor with your hand, the resistance goes up, and the music stops.

Project #491 Electric-control Meter

OBJECTIVE: To start the circuit using an electric motor.

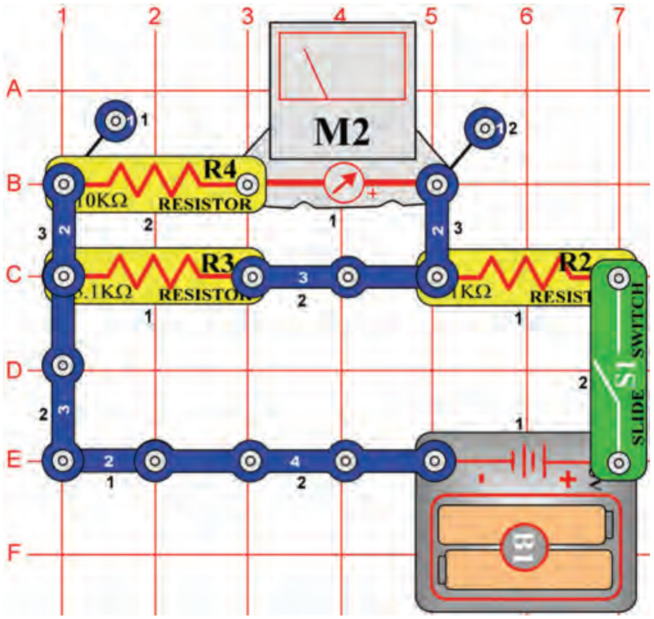
Use the circuit in project #489. Place the motor (M1) across points A & B. Turn on the slide switch (S1) and the meter (M2) deflects and swings according to the rhythm of music. When deflection stops, rotate motor to start the music again. The voltage generated by the motor triggers the IC again.

Project #492 Sound-control Meter

OBJECTIVE: To start the circuit by using the whistle chip.

Use the circuit in project #489. Place the whistle chip (WC) across points A & B. Turn on the slide switch (S1) and the meter (M2) deflects and swings according to the rhythm of music. When deflection stops, clap your hands next to the whistle chip, the music plays again. The clapping sound vibrates the plates in the whistle chip, creating the voltage needed to trigger the IC.

Project #493 Fixed-Voltage Divider

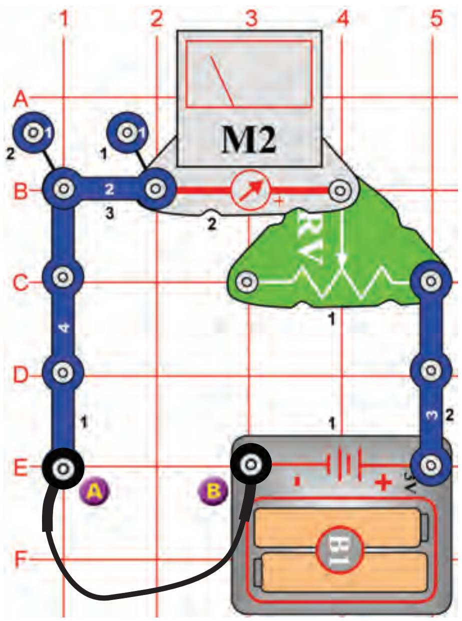


OBJECTIVE: To make a simple voltage divider.

Set the meter (M2) to the LOW (or 10mA) scale. This circuit is a simple voltage divider with parallel load resistors. The voltage across resistors R3 & R4 is the same. The current through both paths are different, due to the resistor values. Since resistor (R3) (5.1kΩ) is half the value of resistor (R4) (10kΩ), twice the current flows through R3.

The lights in a house are an example of this type of circuit. All are connected to the same voltage, but the current is dependent on the wattage of the bulb.

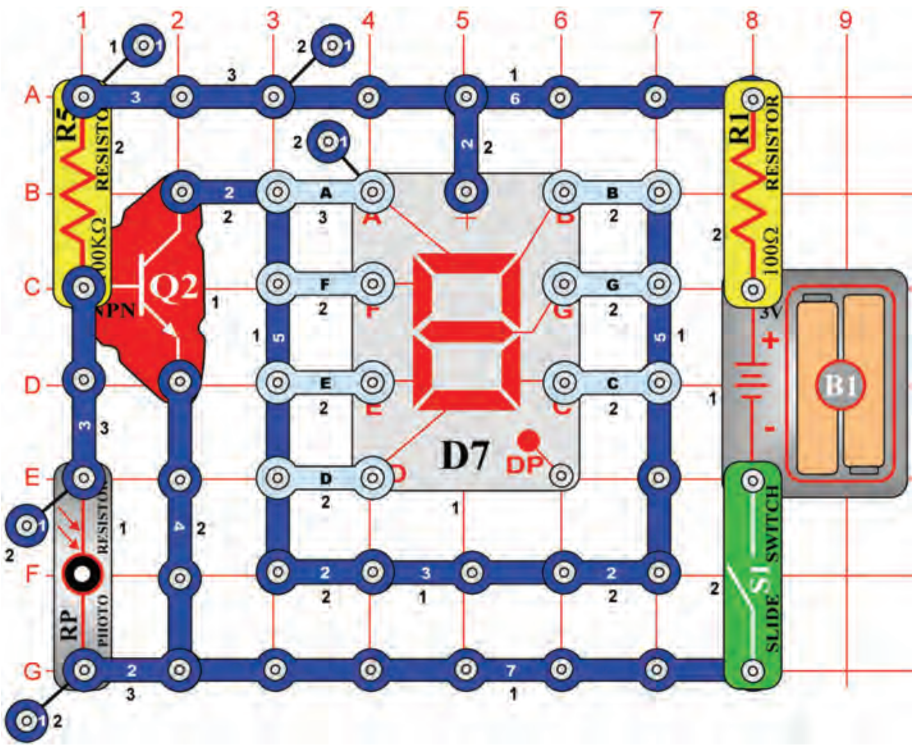
Project #494 Resistor Measurement



OBJECTIVE: To make a resistor checker.

Set the meter (M2) to the LOW (or 10mA) setting. Connect the jumper wire to points A & B. Adjust the adjustable resistor (RV) so the meter deflects to 10. The resistance between points A & B is zero. Remove the jumper wire and put the 100Ω resistor (R1) across points A & B. The meter deflects to the 10, indicating a low resistance. Now replace resistor (R1) with the other resistors. The meter will display different readings for each resistor.

To learn more about how circuits work, visit www.snapcircuits.net or page 62 to find out about our Student Guides.



Project #495

Automatic Display Letter “b”

OBJECTIVE: To construct a light-controlled display for lower case letters.

Connect C, D, E, F & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the photoresistor (RP), now the letter “b” lights.

Project #496

Automatic Display Letter “c”

OBJECTIVE: To light the letter “c” using a light-controlled display.

Use the circuit from project #495. Connect E, D, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the photoresistor (RP), now the letter “c” lights.

Project #497

Automatic Display Letter “d”

OBJECTIVE: To light the letter “d” using a light-controlled display.

Use the circuit from project #495. Connect B, C, D, E, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the photoresistor (RP), now the letter “d” lights.

Project #498

Automatic Display Letter “e”

OBJECTIVE: To light the letter “e” using a light-controlled display.

Use the circuit from project #495. Connect A, B, D, E, F, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the photoresistor (RP), now the letter “e” lights.

Project #499

Automatic Display Letter “h”

OBJECTIVE: To light the letter “h” using a light-controlled display.

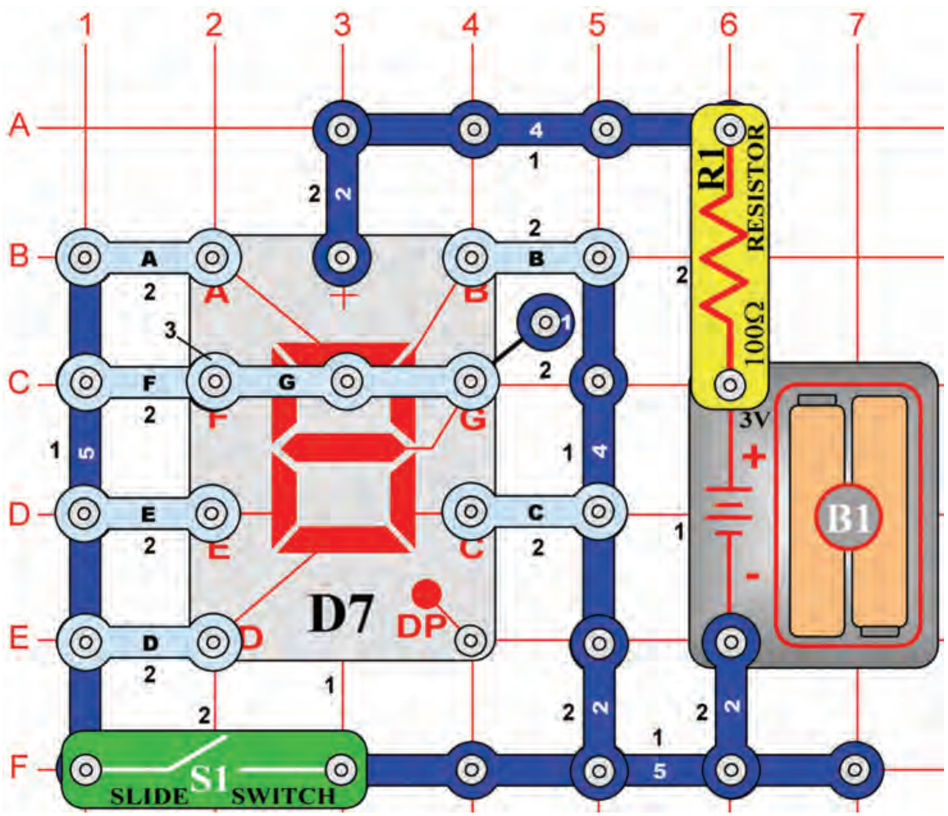
Use the circuit from project #495. Connect F, E, C, & G to the circuit. Turn on the slide switch (S1) the display should be off. Place your hand over the photoresistor (RP), now the letter “h” lights.

Project #500

Automatic Display Letter “o”

OBJECTIVE: To light the letter “o” using a light controlled display.

Use the circuit from project #495. Connect C, D, E, and G to the circuit. Turn on the slide switch (S1) the display should be off. Place your hand over the photoresistor (RP), now the letter “o” lights.



Project #501

Hand-Control Display 1 & 4

OBJECTIVE: Display numbers 1 or 4 using the slide switch.

Connect segments B, C, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 4.

Project #502

Hand-Control Display 1 & 0

OBJECTIVE: Display numbers 1 or 0 using the slide switch.

Connect segments A, B, C, D, E, & F as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 0.

Project #503

Hand-Control Display 1 & 7

OBJECTIVE: Display numbers 1 or 7 using the slide switch.

Connect segments A, B, & C as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 7.

Project #504

Hand-Control Display 1 & 8

OBJECTIVE: Display numbers 1 or 8 using the slide switch.

Connect segments A, B, C, D, E, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 8.

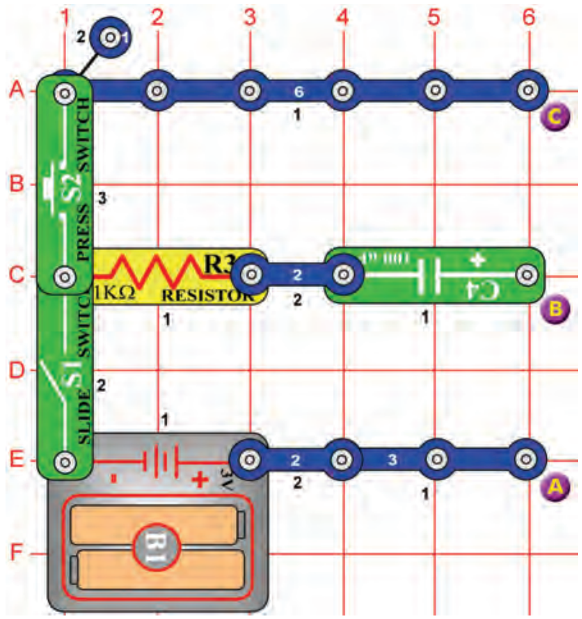
Project #505

Hand-Control Display 1 & 9

OBJECTIVE: Display numbers 1 or 9 using the slide switch.

Connect segments A, B, C, D, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 9.

☐ # Project #506



Monitor Capacitor Charging & Discharging

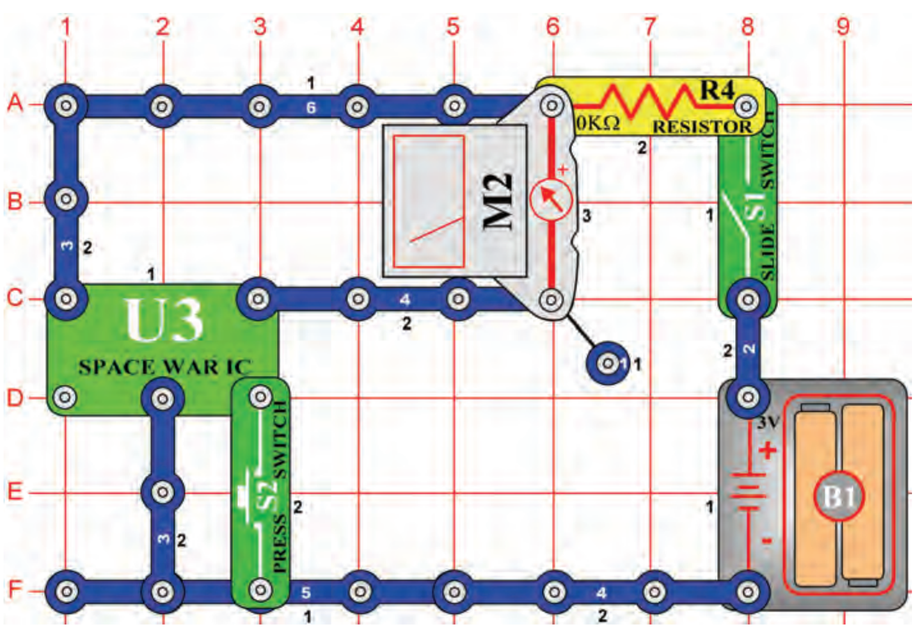
OBJECTIVE: View charging and discharging a capacitor.

Using the meter (M2), we can monitor the charging and discharging of a capacitor. First turn off the switch (S1).

Charging: Connect the meter (M2) to points A & B (positive pole downward). Turn on the switch (S1). The 100μF capacitor (C4) charges and the meter deflects, slowly returning to zero.

Discharging: Connect the meter to points B & C (positive pole downward). Press the switch (S2). The capacitor discharges and the meter deflects, slowly returning to zero.

☐ # Project #507



Hand-Control Space Meter

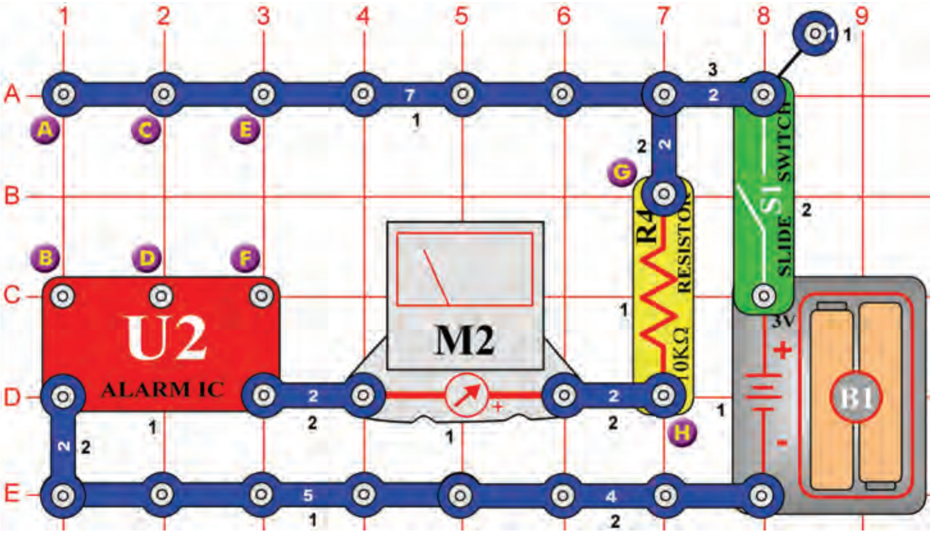
OBJECTIVE: Using the meter with the space war IC.

Set the meter (M2) to the LOW (or 10mA) setting. This is another circuit using the meter to monitor the output of an IC.
Turn on the switch (S1). Press switch (S2) to start the circuit. As the space war IC (U3) outputs a signal, the meter will deflect. When the circuit stops, start it again by pressing switch (S2).

☐ # Project #508

Rhythm Swinging Meter

OBJECTIVE: Use the meter with the alarm IC.



Set the meter (M2) to the LOW (or 10mA) setting. Connect 3-snap wires to terminals E & F, and C & D. Turn on the slide switch (S1) and the meter swings rhythmically.

☐ # Project #509

Police Car Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Use the circuit in project #508. Connect the whistle chip (WC) to points G & H. Connect a 3-wire snap to the terminals C & D and turn on the switch (S1).

☐ # Project #510

Fire Engine Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Connect 3-wire snaps to terminals C & D and A & B. Connect the whistle chip (WC) across points G & H. You should hear a fire engine sound generated by the alarm IC (U2).

☐ # Project #511

Ambulance Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Connect a 3-wire snap to terminals C & D. Connect the whistle chip (WC) across points G & H. Connect a jumper wire to terminals B & H. You should hear an ambulance sound generated by the alarm IC (U2).

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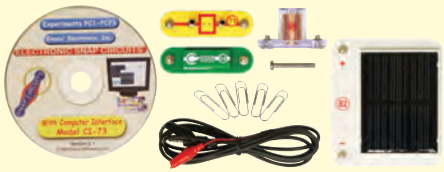

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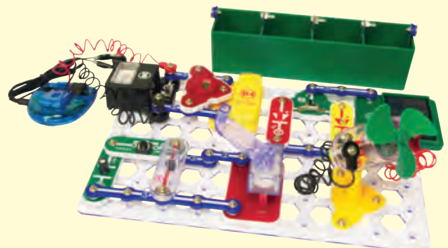

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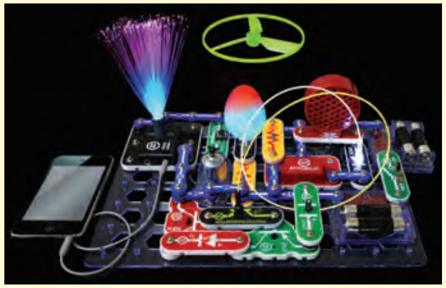

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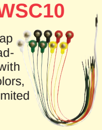
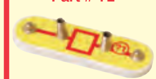


Two-spring Socket

Part # ?1



Three-spring Socket

Part # ?Q

Eight-Pin IC Socket

Part # ?U8

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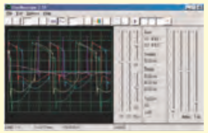

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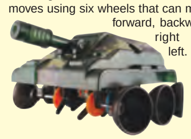

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