Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

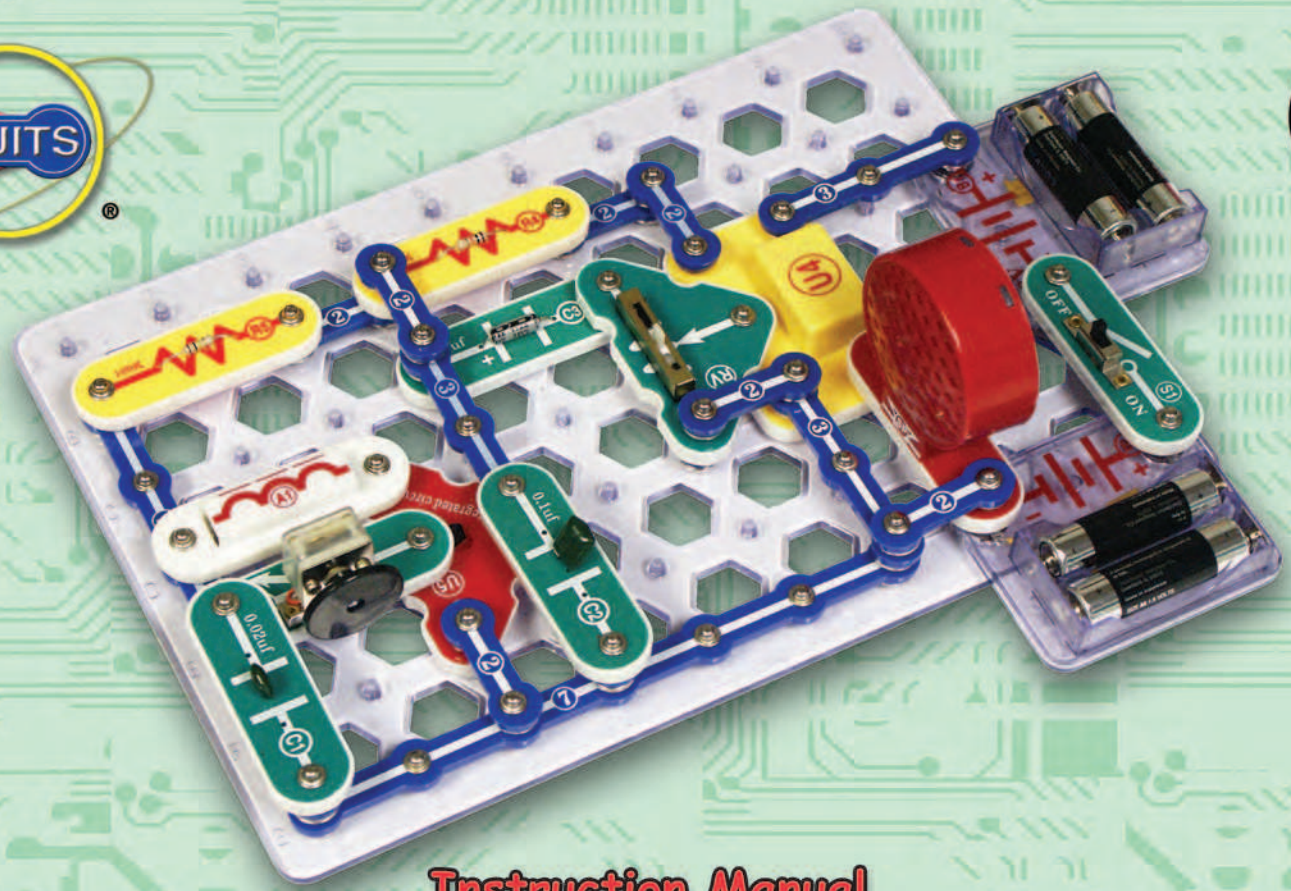
Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

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.

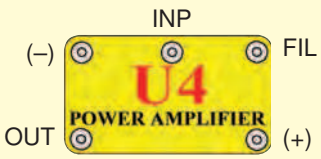
The **microphone (X1)** is actually a resistor that changes in value when changes in air pressure (sounds) apply pressure to its surface. Its resistance typically varies from around 1KΩ in silence to around 10KΩ when you blow on it.

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:

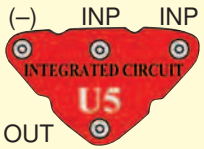


Power Amplifier IC:

(+) - 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.

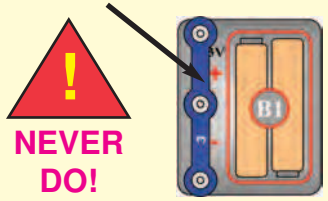
Note: If you have the more advanced Models SC-500 or SC-750, there are additional guidelines in your other project manual(s).

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.

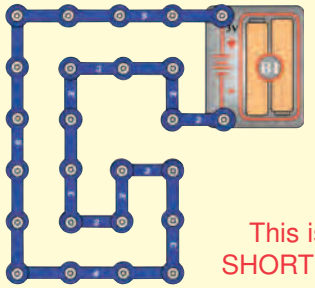
Warning to Snap Rover owners: Do not connect your parts to the Rover body except when using our approved circuits, the Rover body has a higher voltage which could damage your parts.

Examples of SHORT CIRCUITS - NEVER DO THESE!!!

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



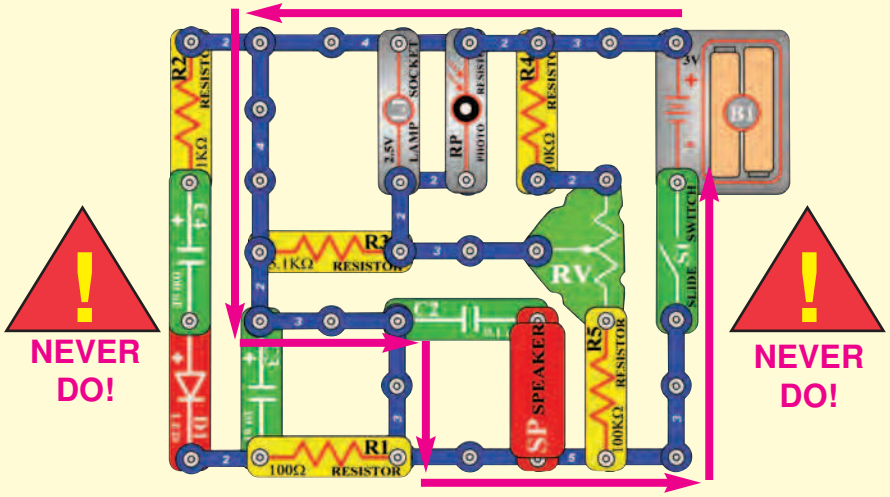
NEVER DO!



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)

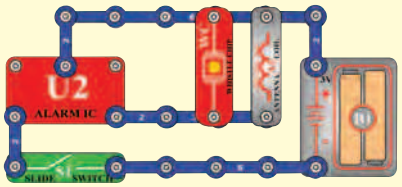
Elenco® is not responsible for parts damaged due to incorrect wiring.

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

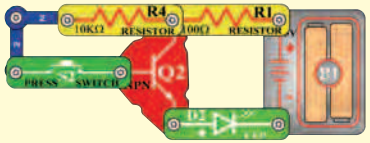
1. - 9. Refer to project manual 1 (projects 1-101) for testing steps 1-9, then continue below. Test both lamps (L1, L2) and battery holders in test step 1, all blue snap wires in step 3, and both LEDs (D1, D2) in step 5.

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.

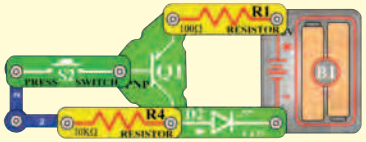
11. **Antenna (A1):** Build the mini-circuit shown here, you should hear sound.



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.

ELENCO®

150 Carpenter Avenue
Wheeling, IL 60090 U.S.A.
Phone: (847) 541-3800
Fax: (847) 520-0085
e-mail: help@elenco.com
Web site: www.elenco.com

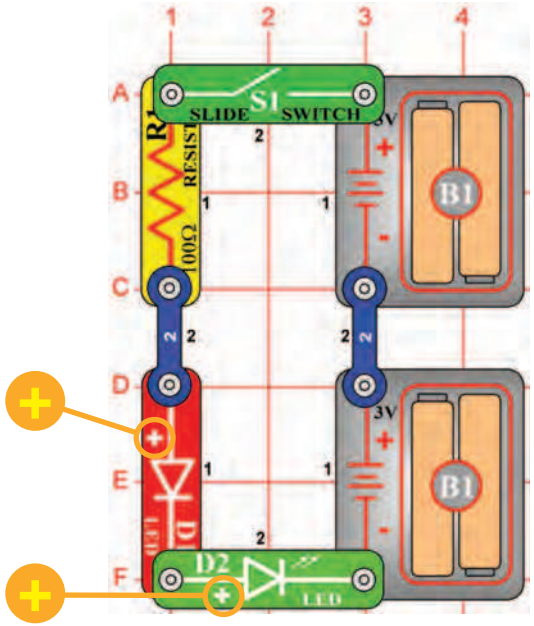
You may order additional / replacement parts at: www.snapcircuits.net

Project Listings

Project Listings

Project #102

Batteries in Series



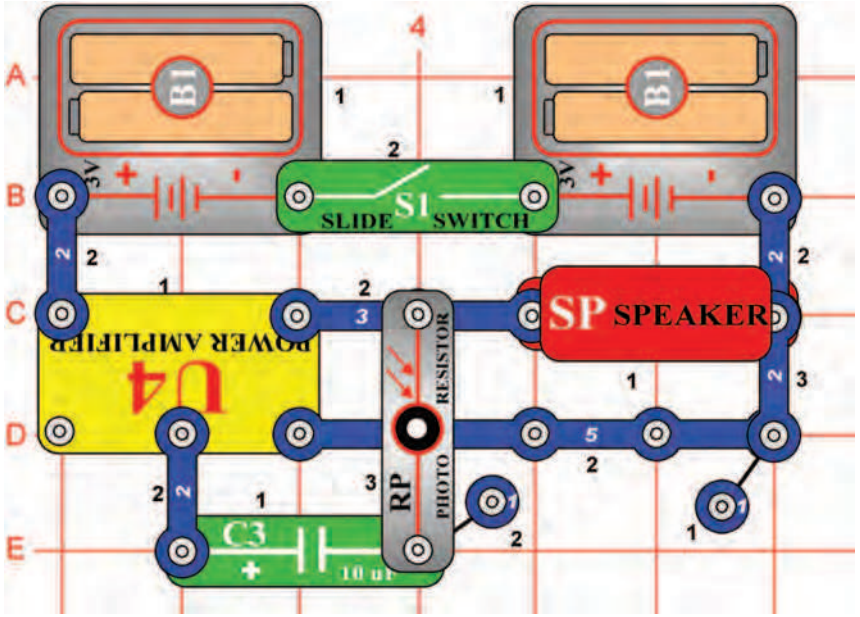
OBJECTIVE: To show the increase in voltage when batteries are connected in series.

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

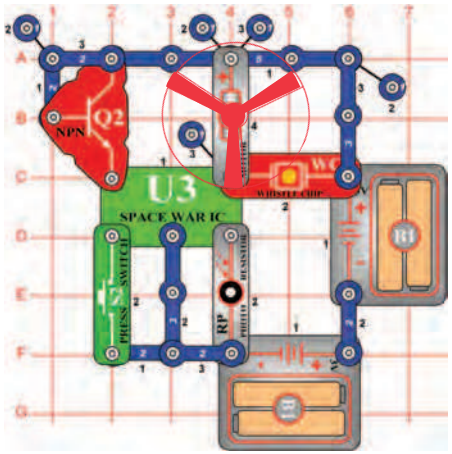


OBJECTIVE: To make fun sounds using light.

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

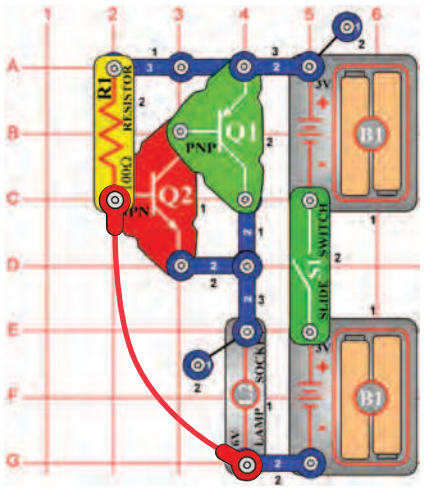


OBJECTIVE: To build a fan with sound that is activated by light.

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.

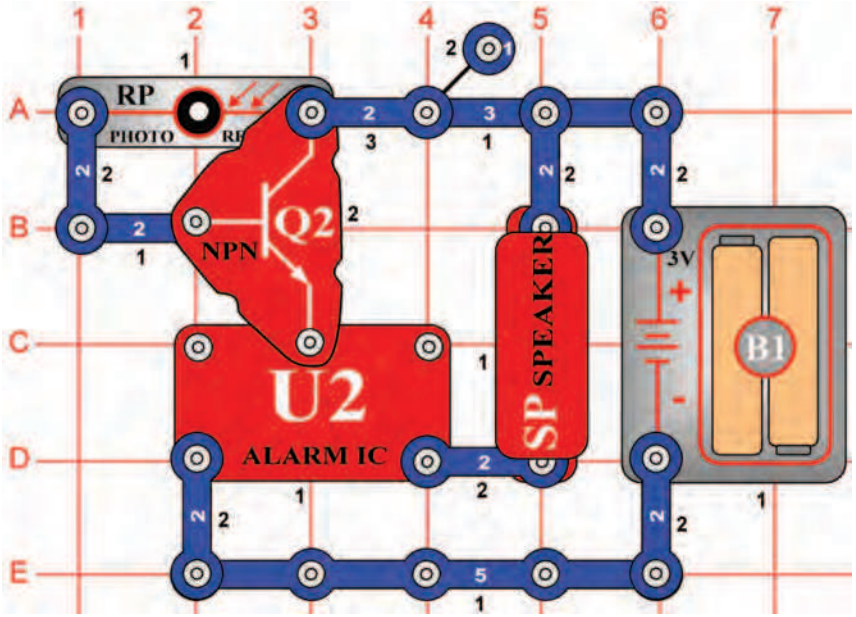
Project #105
Two-Transistor Light Alarm



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.

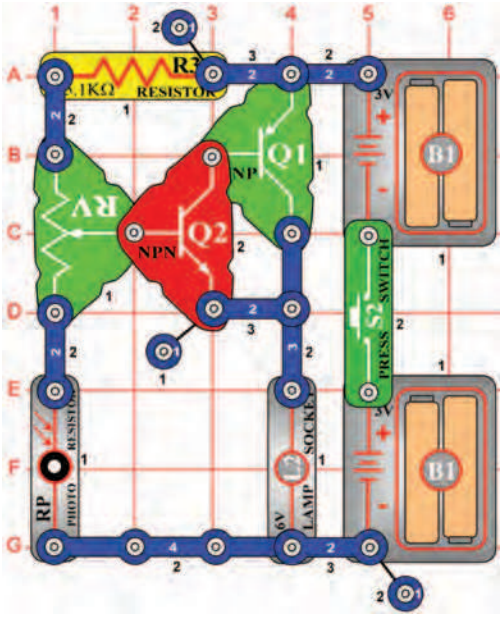
The alarm will sound, as long as light is present. Slowly cover the photoresistor (RP), and the volume goes down. If you turn off the lights, the alarm will stop. The amount of light changes the resistance of the photoresistor (less light means more resistance). The photoresistor and transistor (Q2)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

Visit www.snapcircuits.net or page 74 to learn about Snap Circuits® upgrade kits, which have more parts and circuits.

Project #107

Automatic Street Lamp



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

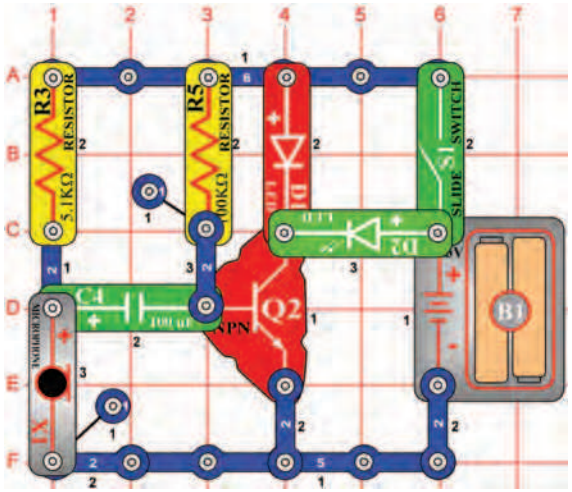
Press the press switch (S2) on and set the adjustable resistor (RV) so the lamp (L2) just lights. Slowly cover the photoresistor (RP) and the lamp brightens. If you place more light at the photoresistor the light dims.

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.

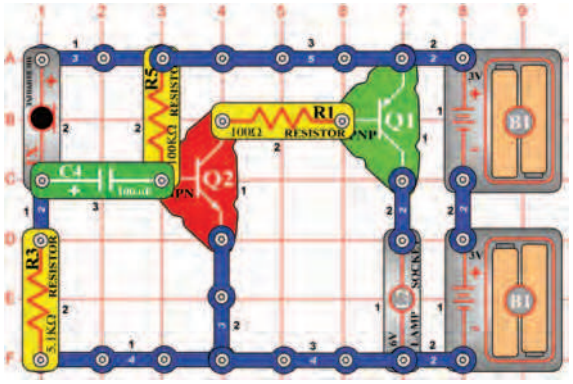


Turn the slide switch (S1) on. There will be only a weak light emitting from the green LED (D2). By blowing on the mic (X1) or putting it near a radio or TV set, the green LED will emit light, and its brightness changes as the loudness changes.

Project #109

Blowing Off the Electric Light

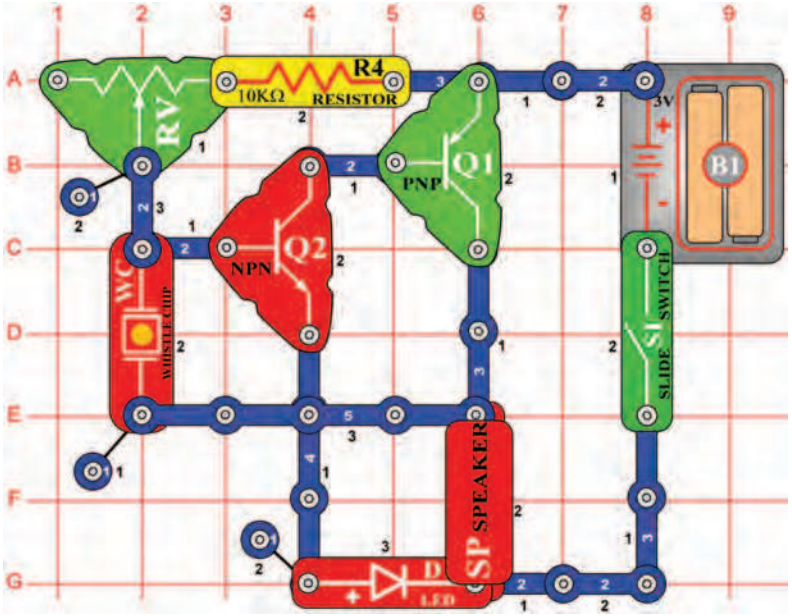
OBJECTIVE: To show how light is stimulated by sound.



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

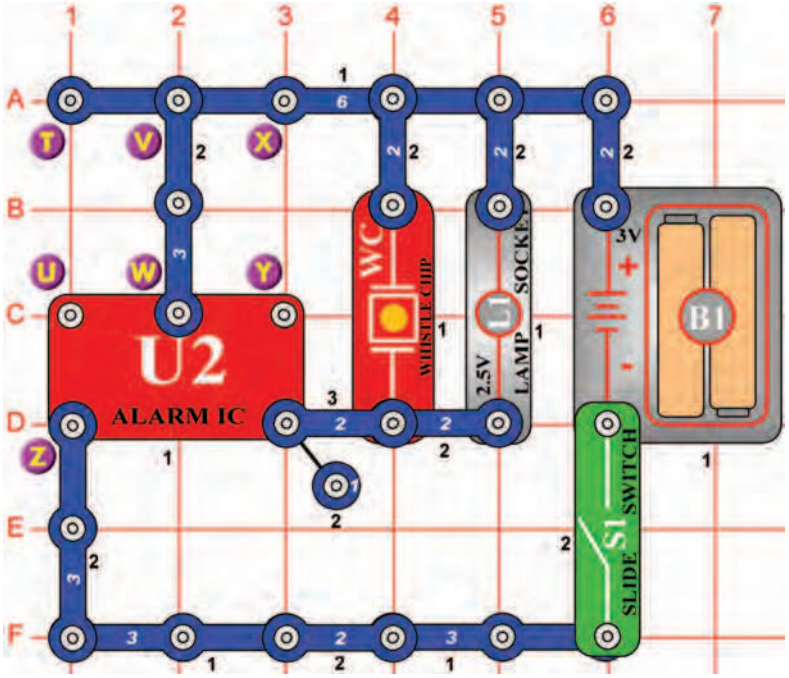
OBJECTIVE: To show how capacitors in parallel change the frequency of an oscillator.

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

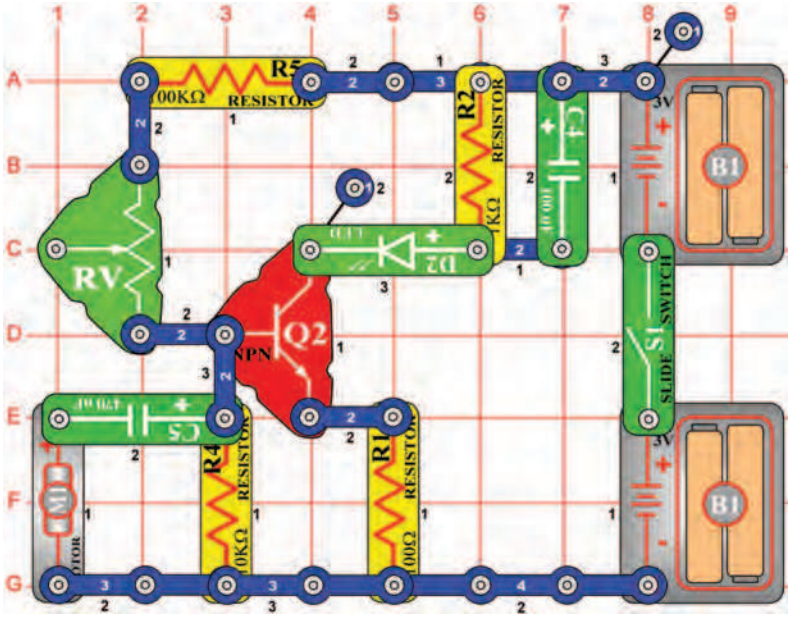
More Light & Sounds (IV)

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



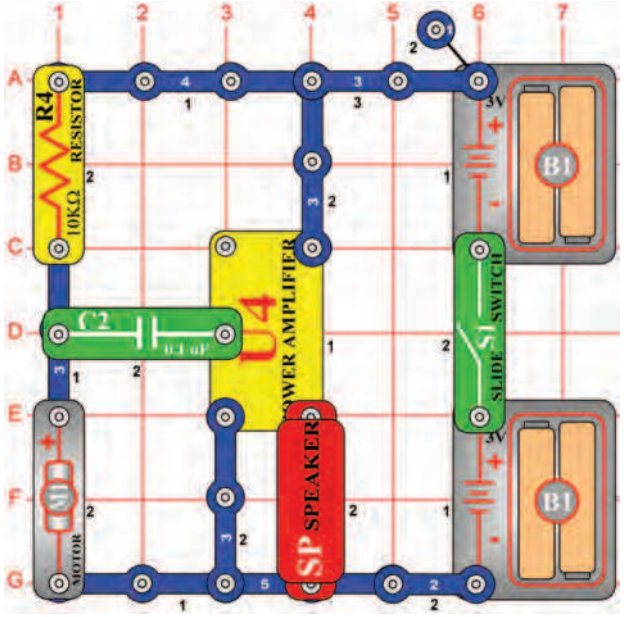
OBJECTIVE: To show how to make electricity in one direction.

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



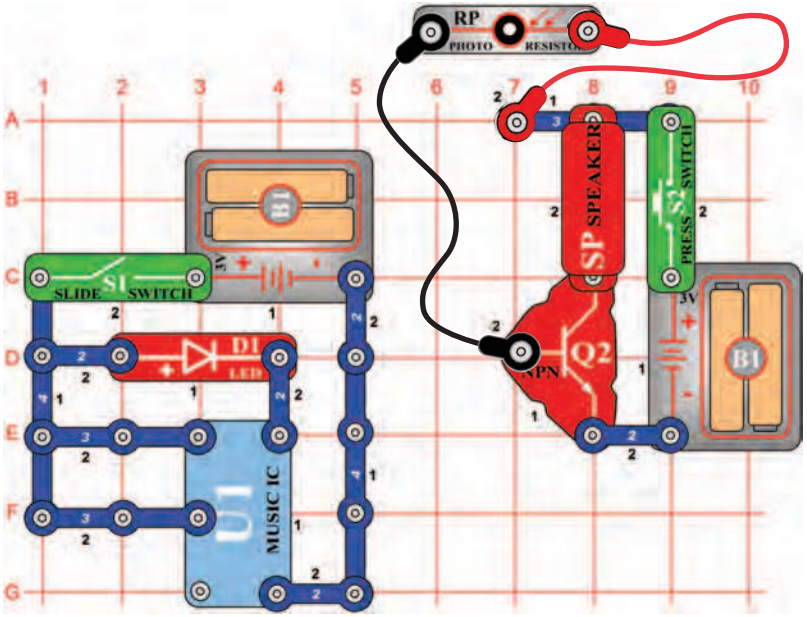
OBJECTIVE: To show how a generator works.

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



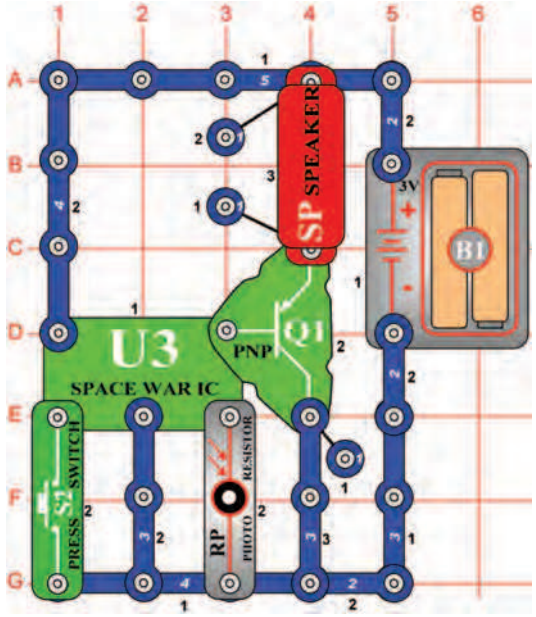
Optical Transmitter & Receiver

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.

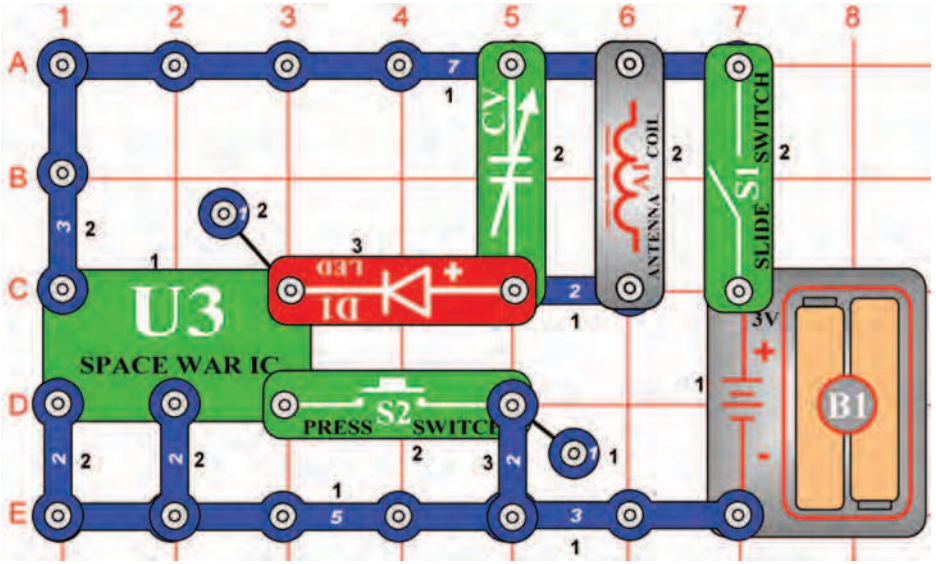
The space war IC (U3) will play a sound continuously. Block the light to the photoresistor (RP) with your hand. The sound will stop. Remove your hand and a different sound is played. Wave your hand over the photoresistor to hear all the different sounds.

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.



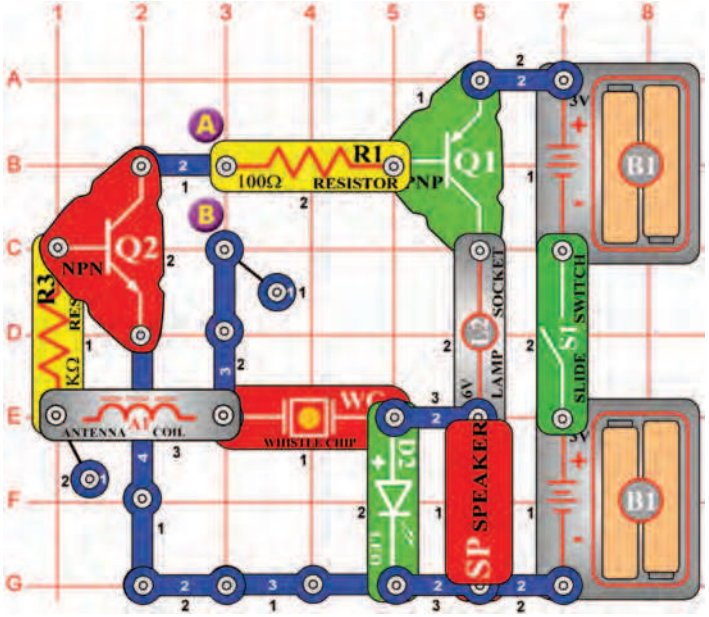
Place the circuit next to an AM radio. Tune the radio so no stations are heard and turn on the slide switch (S1). You should hear the space war sounds on the radio. The red LED (D1) should also be lit. Adjust the variable capacitor (CV) for the loudest signal. Push the press switch (S2) to change the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



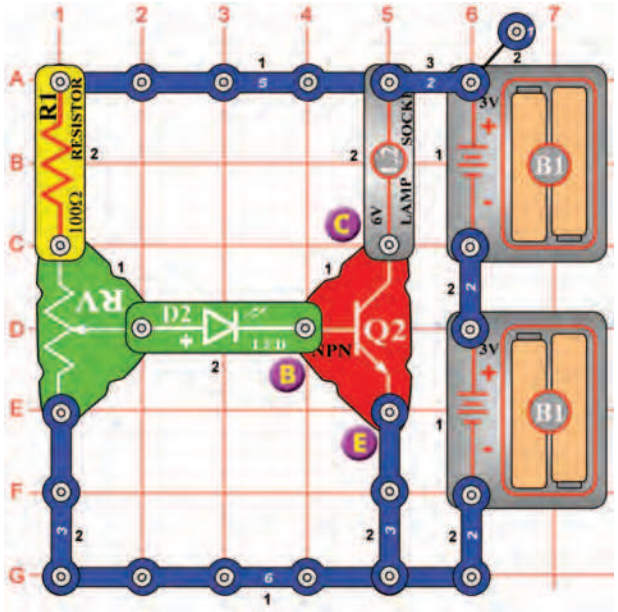
Turn on the slide switch (S1) and place your finger across points A & B. The speaker (SP) will output a tone and the LED (D2) will flash at the same frequency. Your finger acts as a conductor connecting points A & B. When a person is lying, one thing the body starts to do is sweat. The sweat makes the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

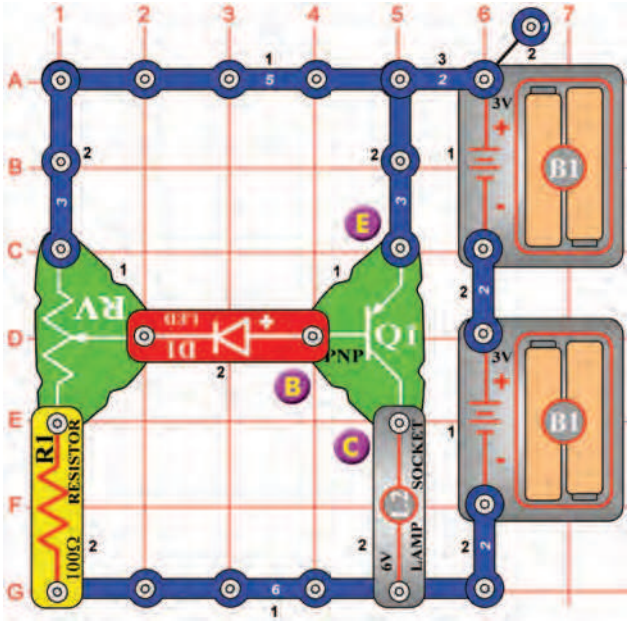


There are three connection points on an NPN transistor (Q2), called base (marked B), emitter (marked E), and collector (marked C). When a small electric current flows from the base to the emitter, a larger (*amplified*) current will flow from the collector to the emitter. Build the circuit and slowly 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

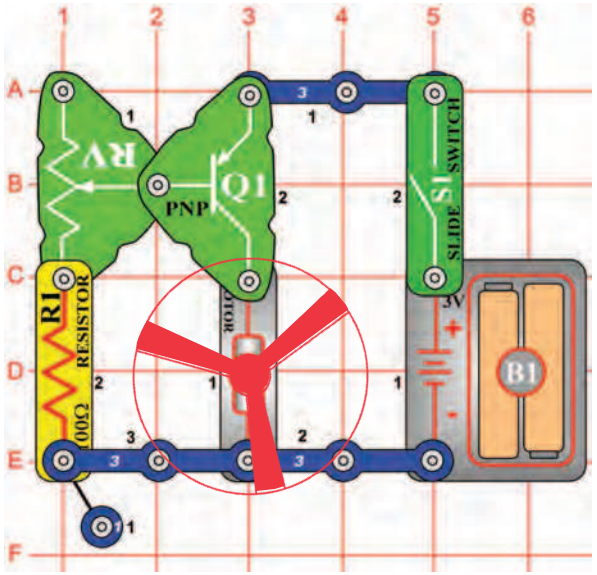
PNP Amplifier

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.

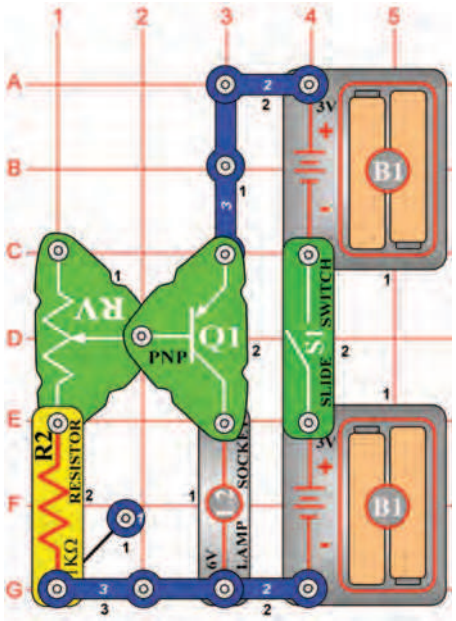
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

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.

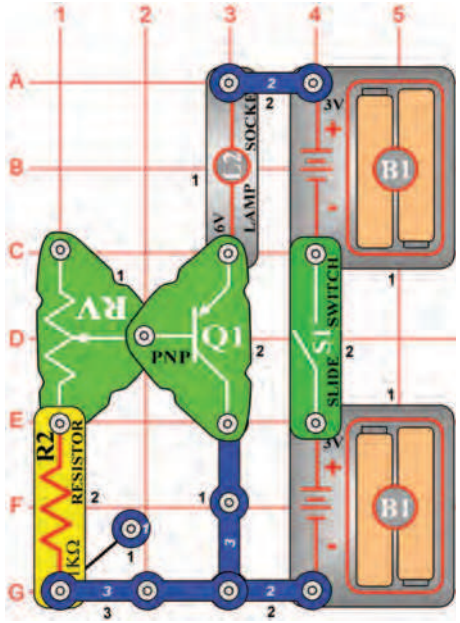
Project #128 PNP Collector



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.

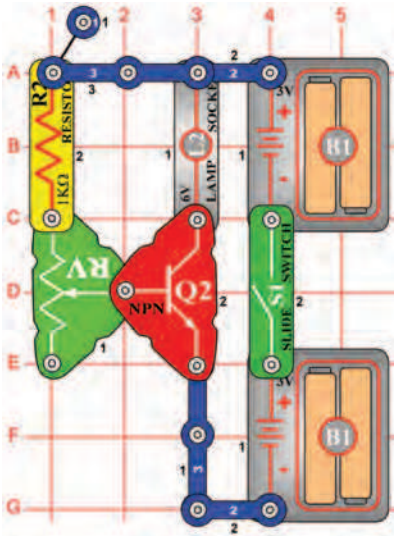
Project #129 PNP Emitter



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.

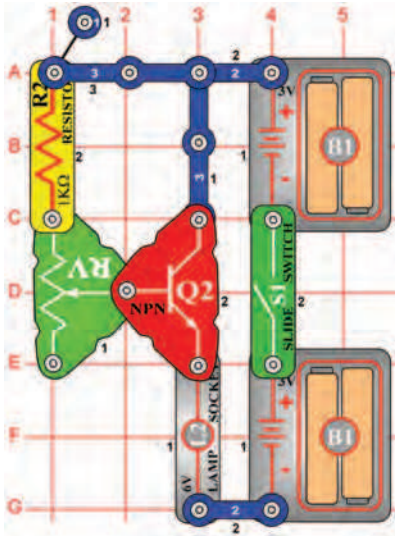
Project #130
NPN Collector



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).

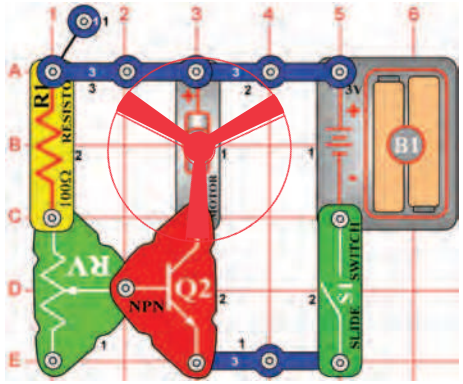
Project #131
NPN Emitter



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



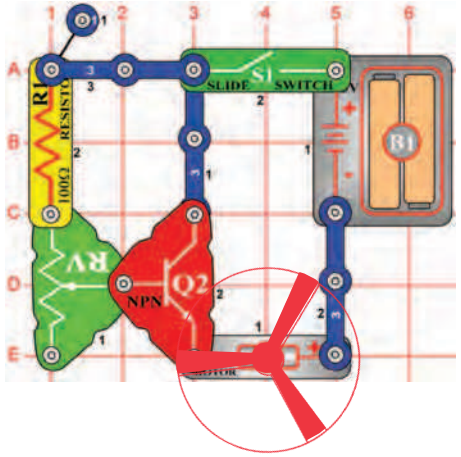
OBJECTIVE: To compare transistor circuits.

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



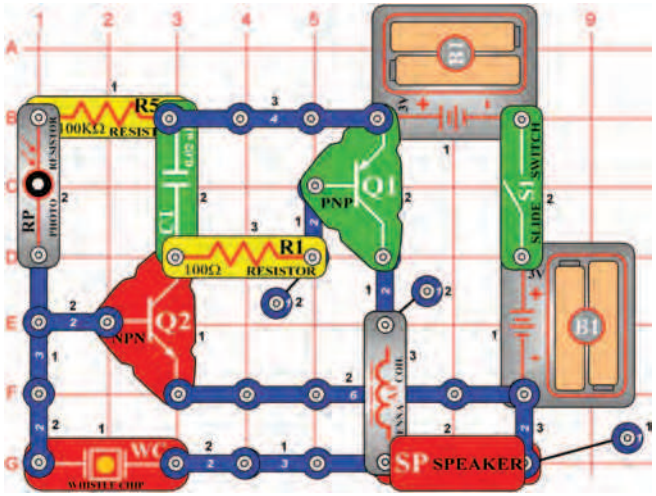
OBJECTIVE: To compare transistor circuits.

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

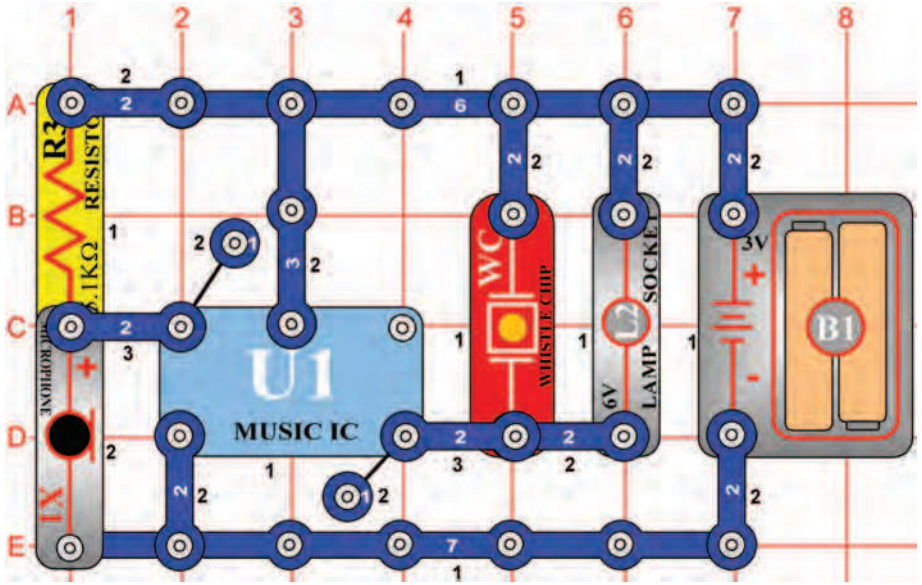
Mosquito

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

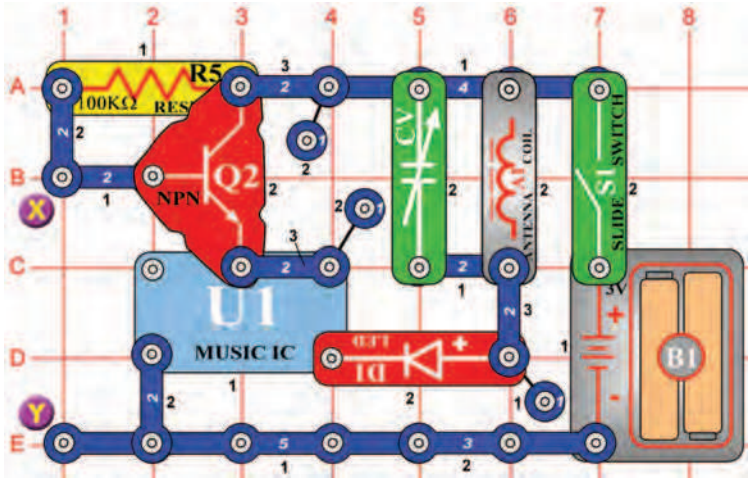
Musical Motion Detector

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

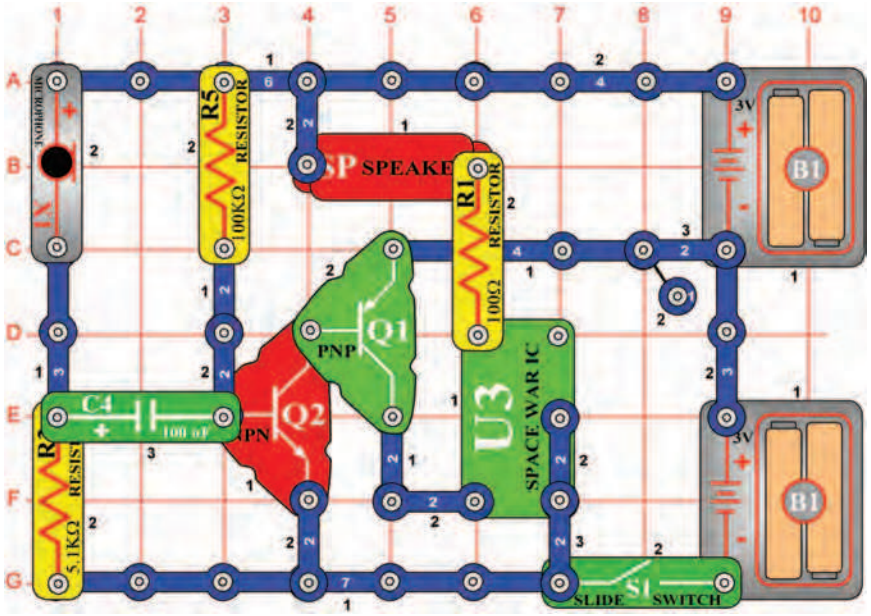
OBJECTIVE: To build a light-controlled radio transmitter.

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



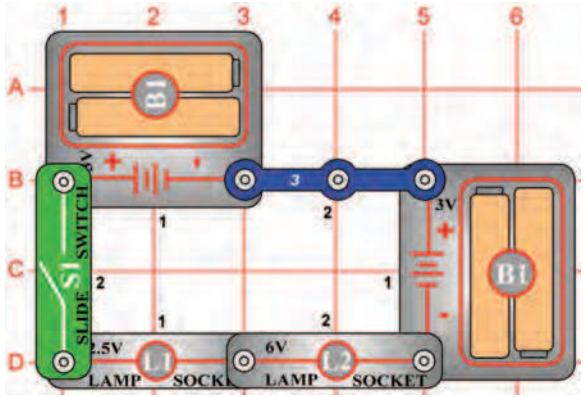
OBJECTIVE: To turn off a circuit by blowing on it.

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.

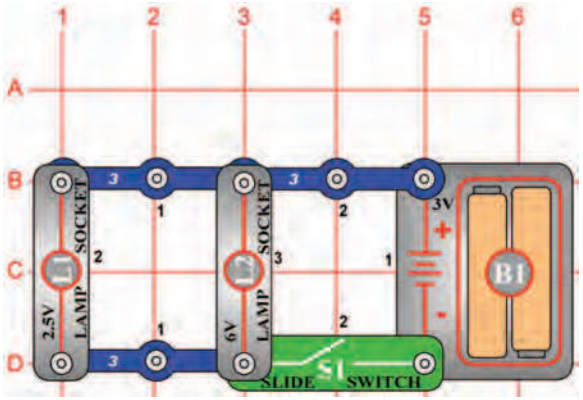


Turn on the slide switch (S1) and both lamps (L1 & L2) will light. If one of the bulbs is broken then neither will be on, because the lamps are in series. An example of this is the strings of small Christmas lights; if one bulb is damaged then the entire string does not work.

Project #153

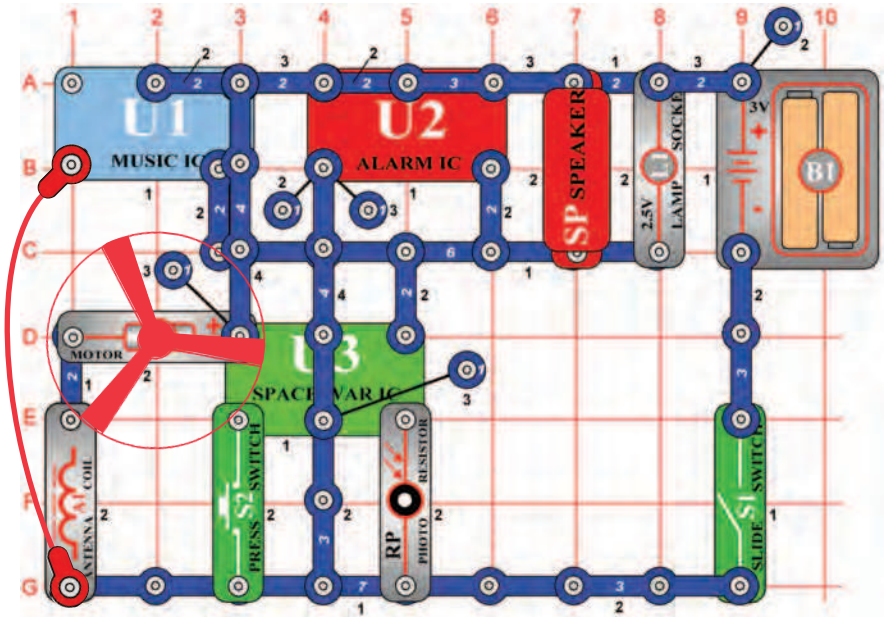
Parallel Lamps

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!

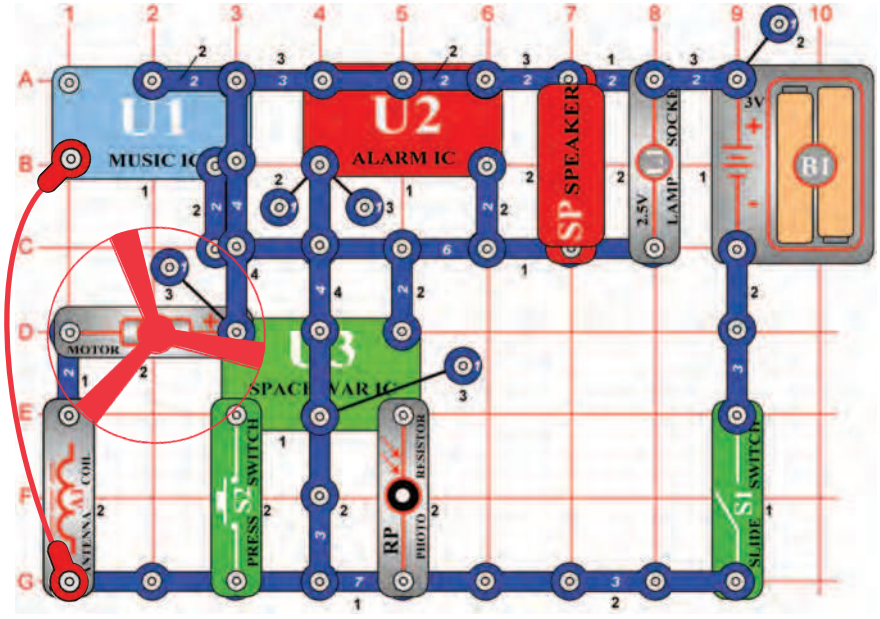
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ 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.

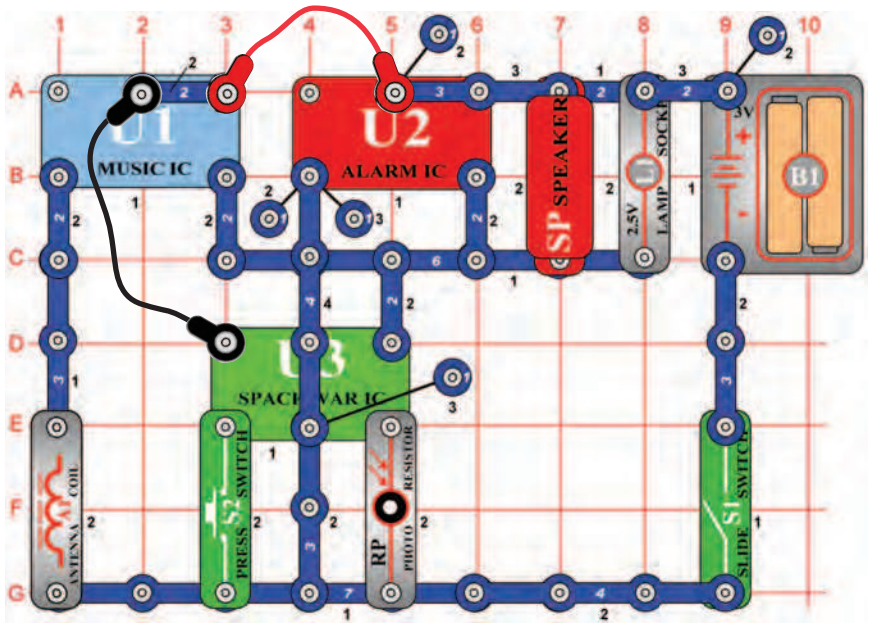
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.

☐ 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!

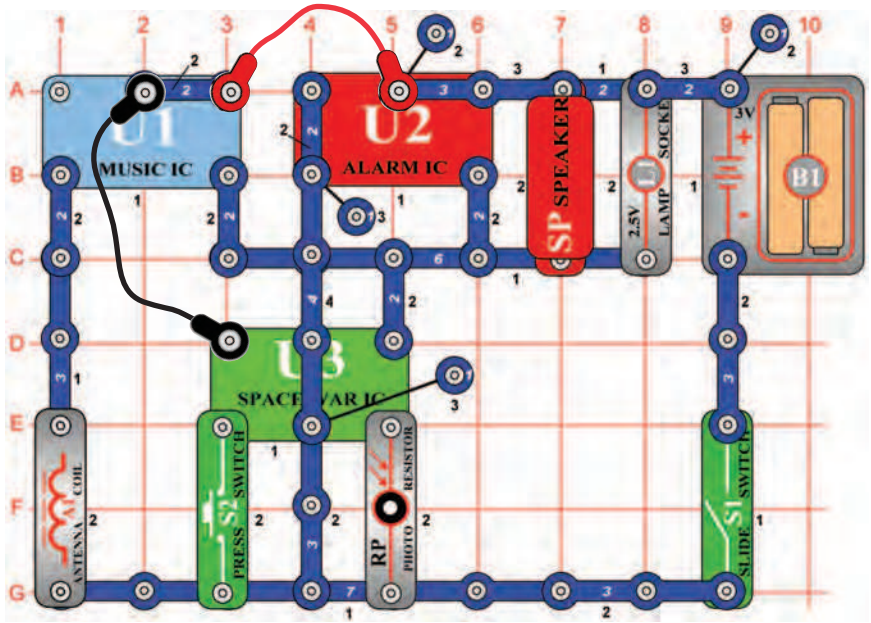
Do you know why the antenna (A1) is used in this circuit? It is being used as just a 3-snap wire, because it acts like an ordinary wire in low frequency circuits such as this. Without it, you don't have enough parts to build this complex circuit.

☐ 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).