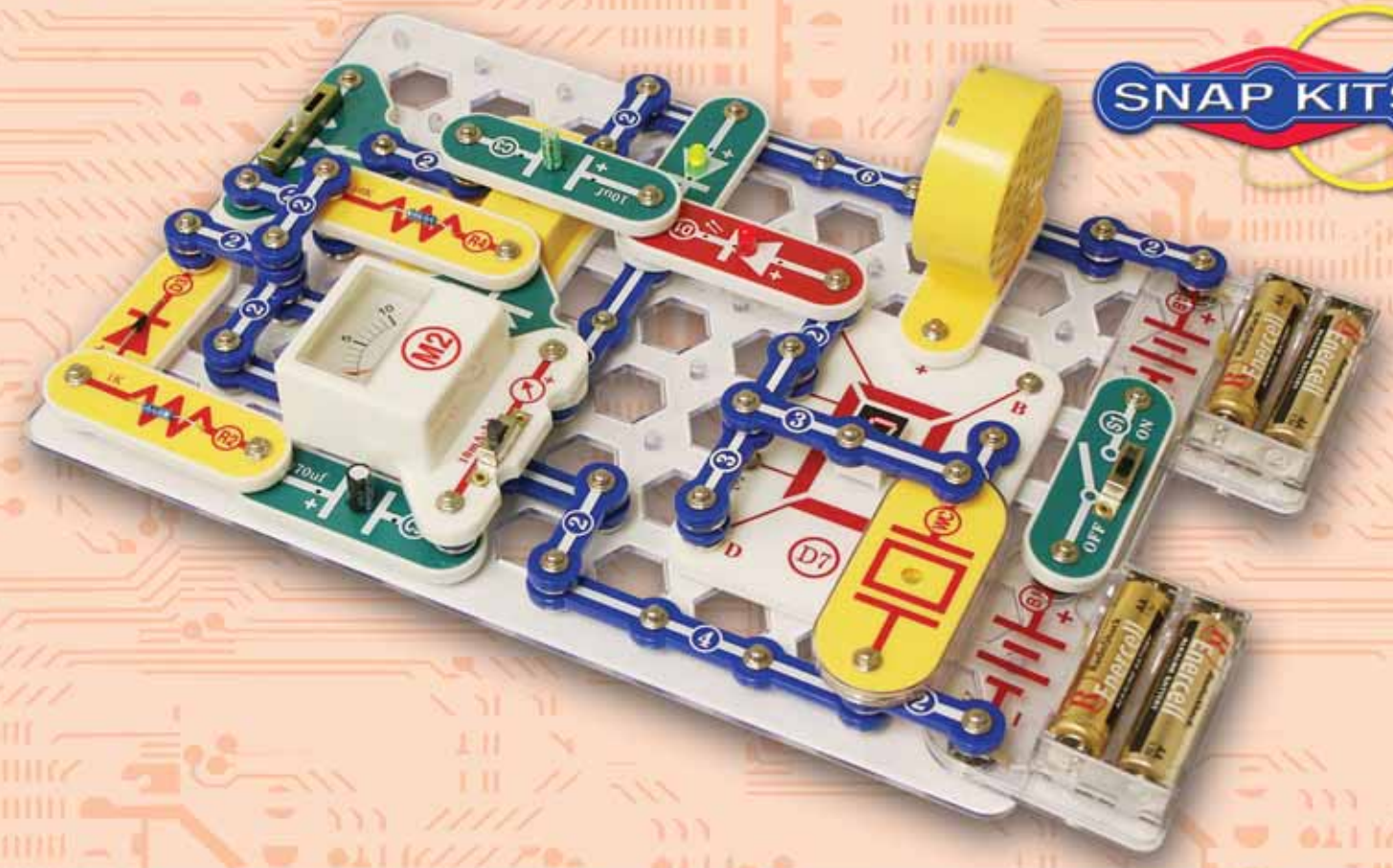
ELECTRONIC SNAP KITS™

Electronics 303



Instruction Manual

Catalog # 28-288 REV-A Revised 2005 753298

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WARNING: SHOCK HAZARD - Never connect Snap Kits™ parts to the electrical outlets in your home in any way!

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. **Sometimes the light bulbs come loose, tighten them as needed. Use care since glass bulbs can shatter.**
4. **Be sure that all connections are securely snapped.**
5. **Try replacing the batteries.**
6. **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.**

Radio Shack 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 6 to determine which ones need replacing.

WARNING: Always check your wiring before turning on a circuit. Never touch the motor when it is spinning at high speed. Never leave a circuit unattended while the batteries are installed. Never connect additional batteries or any other power sources to your circuits.

BATTERIES:

Use only 1.5V AA alkaline type (not included). Insert batteries with correct polarity. Non-rechargeable batteries should not be recharged. Rechargable 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. 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.

How To Use It

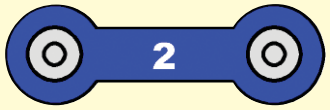
The Radio Shack Snap Kits™ has 752 projects. They are simple to build and understand.

Snap Kits™ uses building blocks with snaps to build the different electrical and electronic circuits in the projects. Each block has a function: there are switch blocks, lamp blocks, battery blocks, different length wire blocks, etc. 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 numbers, identifying the blocks that you will use and snap together to form a circuit.

For Example:

This is the switch block which is green and has the marking (S1) on it as shown in the drawings. Please note that the drawing doesn't reflect the real switch block exactly (it is missing the ON and OFF markings), but gives you the general idea of which part is being used in the circuit.

This is a wire block which is blue and comes in different wire lengths.
They have the number (2), (3), (4), (5), (6), or (7) on them depending on the length of the wire connection required.



There is also a 1-snap wire that is used as a spacer or for interconnection between different layers.

To build each circuit, you have a power source block number (B1) that needs two (2) "AA" batteries (not included with Snap Kits™).

A large clear plastic base grid is included with this kit to help keep the circuit block together. You will see evenly spaced posts that the different blocks snap into. You do not need this base to build your circuits, but it does help in keeping your circuit together neatly. The base has rows labeled A-G and columns labeled 1-10.

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.

The 6V bulb comes packaged separate from its socket. Install the bulb in the lamp socket (L2) whenever that part is used.

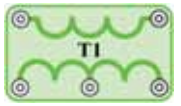
Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.

Note: While building the projects, be careful not to accidentally make a direct connection across the battery holder (a "short circuit"), as this will 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.

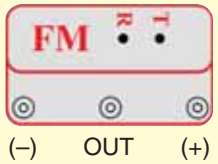
Important: If any parts are missing or damaged in shipping, **DO NOT RETURN TO RADIO SHACK**. Call toll-free 1-800-THE-SHACK.

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
☐ 3 (12 total)	(2)	2-Snap Wire		6SC02	☐ 1	(T1)	Transformer		6SCT1
☐ 1 (2 total)	(5)	5-Snap Wire		6SC05	☐ 1	(U4)	Power Amplifier Integrated Circuit		6SCU4
☐ 1	(D3)	Diode 1N4001		6SCD3	☐ 1	(U6)	Recording Integrated Circuit		6SCU6
☐ 1	(D7)	7-Segment LED Display		6SCD7	☐ 1	(WC)	Whistle Chip		6SCWC
☐ 1	(FM)	FM Module		6SCFM	☐ 1	(X1)	Microphone		6SCX1
☐ 1	(M2)	Analog Meter		6SCM2	☐ 2 (4 total)	(?1)	Two-Spring Socket		6SC?1
☐ 1 ☐ 1	(L1)	2.5V Lamp Socket 3.2V Bulb (3.2V, 0.2A) (R. S. p/n 272-1132)		6SCL1 6SCL1B	☐ 1 (2 total)	(?Q)	Three-Spring Socket		6SC?Q
☐ 1	(Q3)	SCR		6SCQ3	☐ 1	(?U8)	Eight-Pin Socket		6SC?U8
☐ 1	(S3)	Relay		6SCS3	☐ 1		Jumper Wire (Black)		6SCJ1
☐ 1	(S4)	Vibration Switch		6SCS4	☐ 1		Jumper Wire (Red)		6SCJ2

About Your Snap Kits™ Parts (Part designs are subject to change without notice).

Note: The rest of your parts are described in your other project manual.

The **FM module (FM)** contains an integrated FM radio circuit. Refer to the figure below for the pin-out description:

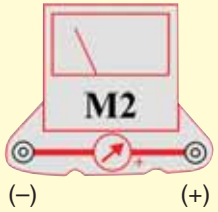


FM Module:

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

See project #440 for example of proper connections.

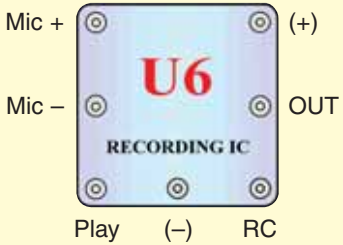
The **meter (M2)** The meter is a very important indicating and measuring device. You'll use it to measure the amount of current or voltage depending on the circuit configuration. The meter has a switch to change between scales, indicated as LOW and HIGH (or 10mA and 1A). Notice the meter has a "+" sign,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



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 eight seconds long. There are also three pre-recorded songs. Refer to the figure below for the pin-out descriptions:

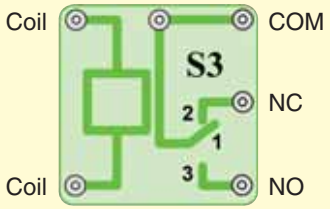


Recording IC Module:

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

See project #377 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).

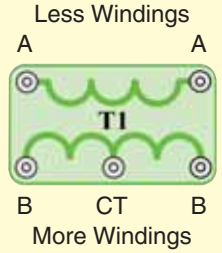


Relay:

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. The secondary has more windings than the primary.



Transformer:

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

See project #305 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 - (–)

About Your Snap Kits™ Parts (continued) (Part designs are subject to change without notice).

The **red and black jumper wires** make flexible connections for times when using the snap wires would be difficult. They also are used to make connections off the base grid (like the projects using water).

A light bulb, such as in the **2.5V lamp (L1)**, contains a special wire that glows bright when a large electric current passes through it. Voltages above the bulb's rating can burn out the wire.

The **whistle chip (WC)** contains two thin plates. When an electrical signal is applied across them they will stretch slightly in an effort to separate (like two magnets opposing each other), when the signal is removed they come back together. If the electrical signal applied across them is changing quickly, then the plates will vibrate. These vibrations create variations in air pressure that your ears feel just like sound from a speaker.

When shaken, the **vibration switch (S4)** contains two separate contacts; and a spring is connected to one of them. A vibration causes the spring to move, briefly connecting the two contacts.

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.

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

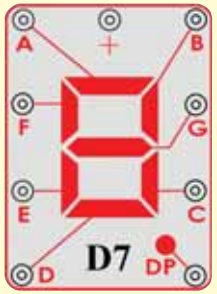
See project #304 for example of connections.

SCR (Q3) - An SCR is a three pin (anode, cathode and gate) controlled silicon 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 LEDs 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 #385 for example of proper connections.

The **eight-pin socket (?U8)** is described on page 9.

Advanced Troubleshooting (Adult supervision recommended)

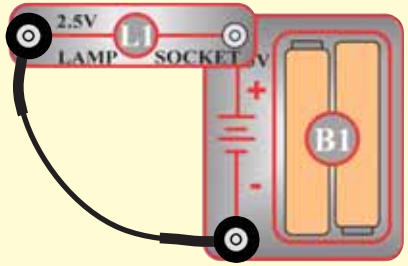
Radio Shack is not responsible for parts damaged due to incorrect wiring.

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

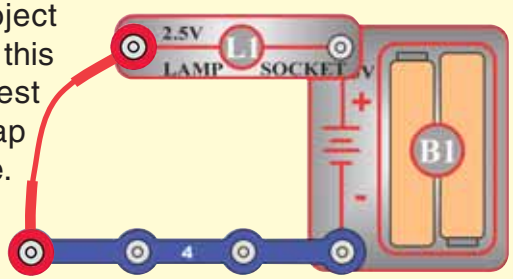
1-16. Refer to your other project manual (Experiments 1-303) for testing steps 1-16, except:

A. Test the **2.5V lamp (L1)** in the same manner as the 6V lamp (L2).

B. **Jumper wires:** Use this mini-circuit to test the black and red jumper wires, the lamp should light.



C. It is easier to test the snap wires by using the jumper wires, instead of the test circuit shown in your other project manual. So use this mini-circuit to test each of the snap wires, one at a time. The lamp should light.



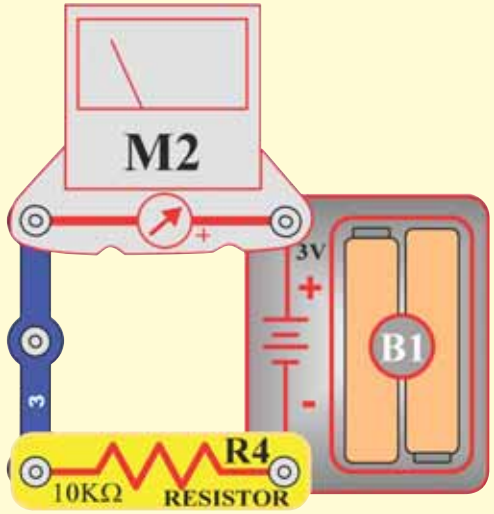
17. **Whistle chip (WC):** Build project #568 and if there is light on, the photoresistor (RP) then you will hear sound from the whistle chip.

18. **Power Amp IC (U4):** Build project #670, the sound from the speaker (SP) should be loud.

19. **Microphone (X1):** Build project #637, blowing into the microphone should turn off the lamp (L2).

20. **FM Module (FM):** Build project #418, you should hear FM radio stations.

21. **Meter (M2):** Build the mini-circuit shown here and set to 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.

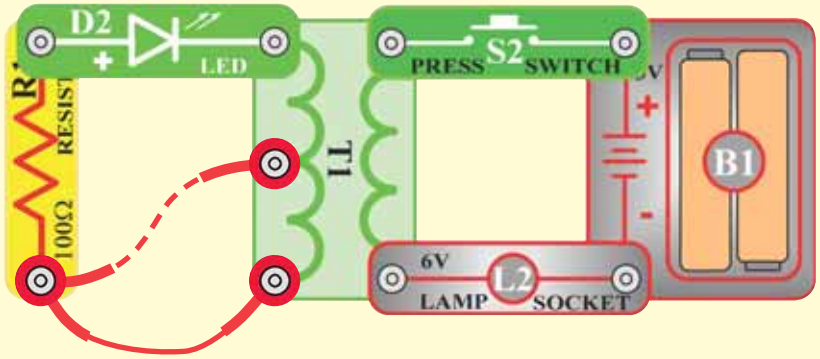


22. **Recording IC (U6):** Build project #432. Make an 8 second recording, then listen to the three prerecorded songs.

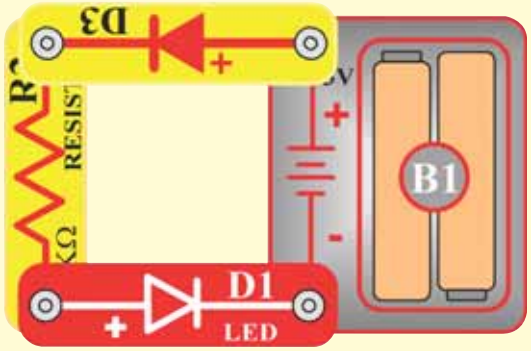
23. **Relay (S3):** Build project #477. Turn on the slide switch (S1) and you should hear a buzzing sound from the relay.

Advanced Troubleshooting (continued) (Adult supervision recommended)

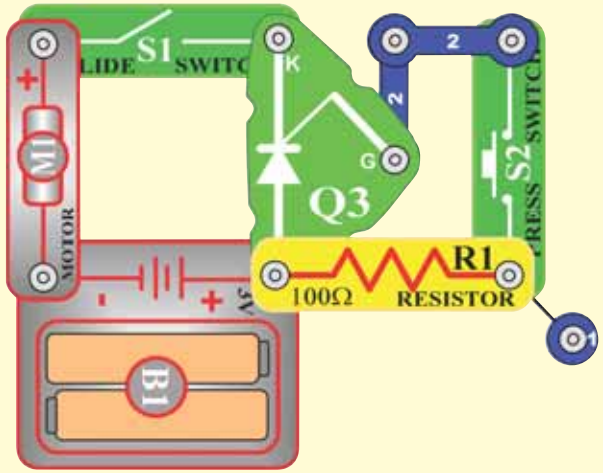
24. **Transformer (T1):** Build the mini-circuit shown here. Pressing the press switch (S2) make the LED (D2) flash. Connect the jumper wire to the CT point. Pressing the press switch makes the LED flash.



25. **Diode (D3):** Build the mini-circuit shown here, the LED (D1) should light. Reverse the direction of D3, the LED should not light now. **Note:** The resistor used in this circuit is the 1KΩ (R2).

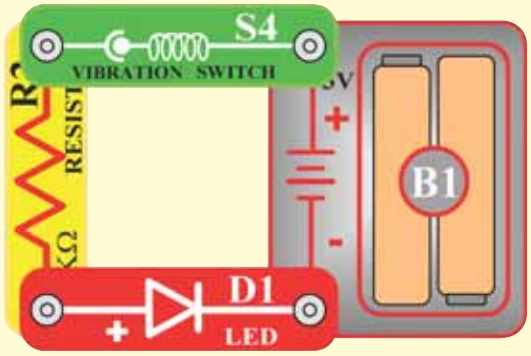


26. **SCR (Q3):** Build the mini-circuit shown here. Turn on the slide switch (S1) and the motor (M1) should not spin. Press the press switch (S2), the motor should start spinning. Now turn the slide switch off and on, the motor should not spin.



27. **7-Segment Display (D7):** Build project #461. All segments light, displaying the number 8.

28. **Vibration Switch (S4):** Build the mini-circuit shown here and shake the base grid. The LED (D1) should go on and off as you shake. **Note:** The resistor used in this circuit is the 1KΩ (R2).



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. **Radio Shack 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, photo resistor, 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 variable 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.

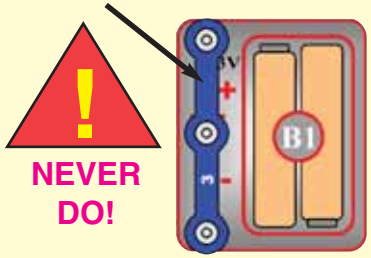
NEVER leave a circuit unattended when it is turned on.

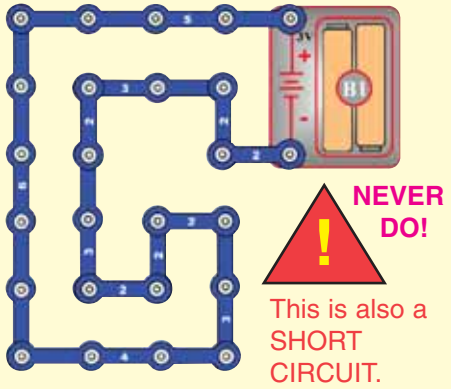
NEVER touch the motor when it is spinning at high speed.

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.

Examples of SHORT CIRCUITS - NEVER DO THESE!!!

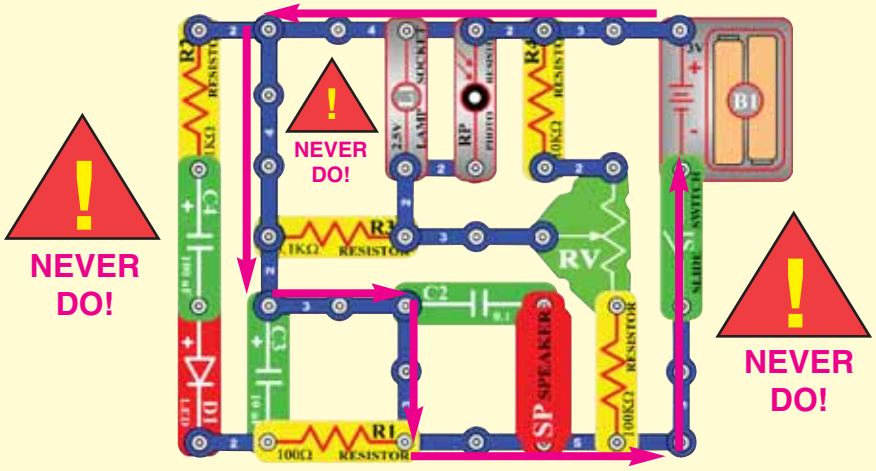
Placing a 3-snap wire directly across the batteries is a SHORT CIRCUIT.





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.



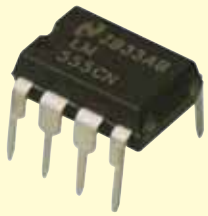
WARNING: SHOCK HAZARD - Never connect Snap Kits™ to the electrical outlets in your home in any way!

About the EIGHT-PIN SOCKET (?U8)

The eight-pin socket module (?U8) has an empty socket, and won't do anything by itself. It is not used in any of the experiments. It was included to make it easy to connect other electronic components to your Snap Kits™. It should only be used by advanced users who are creating their own circuits.

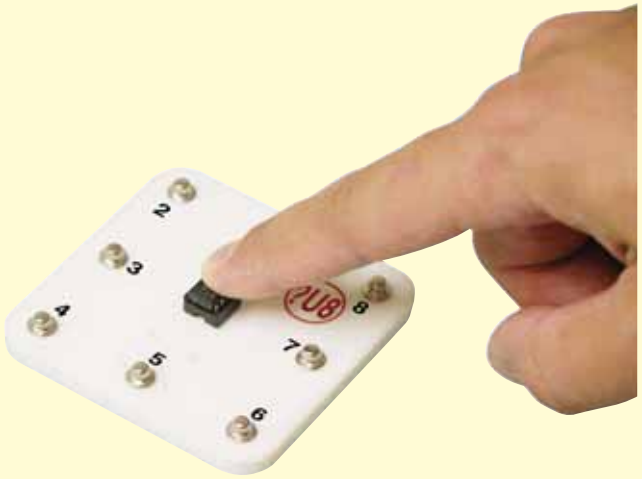
Many customers like to create their own circuits and asked us to include some actual Integrated Circuits (IC's) with Snap Kits™ (parts U1-U6 are modules containing ICs and other components). We could have done that, but there are many IC's available for a diverse range of uses. You could try to use your own IC's, but they are difficult to connect since normal IC's come with short wires on them instead of snaps. So we created a socket that lets you insert any 8-pin IC you want (IC's with more than 8 pins cannot be used).

There are many different 8-pin IC's that can be used, such as an NE555 timer, LM358 op amp, LM386 audio amplifier, LM311 comparator, and several types of voltage regulators. You can find these parts and others at Radio Shack.



Typical 8-pin IC

The eight-pin socket (?U8) makes it easy to connect your own 8-pin IC's to circuits by plugging them into the socket. Be careful not to bend the pins, straighten them with pliers if they get bent.



You can design your own circuits or substitute new parts into the projects in the manuals. Be sure to connect your parts correctly or you may damage them. Never exceed the voltage ratings of any parts. RADIO SHACK IS NOT RESPONSIBLE FOR ANY PARTS DAMAGED BY IMPROPER CIRCUIT DESIGN OR WIRING. **The 8-pin socket is intended for advanced users only.**

The two-spring socket (?1) and three-spring socket (?Q) are described on pages 10-11 of your other instruction manual.

Project Listings

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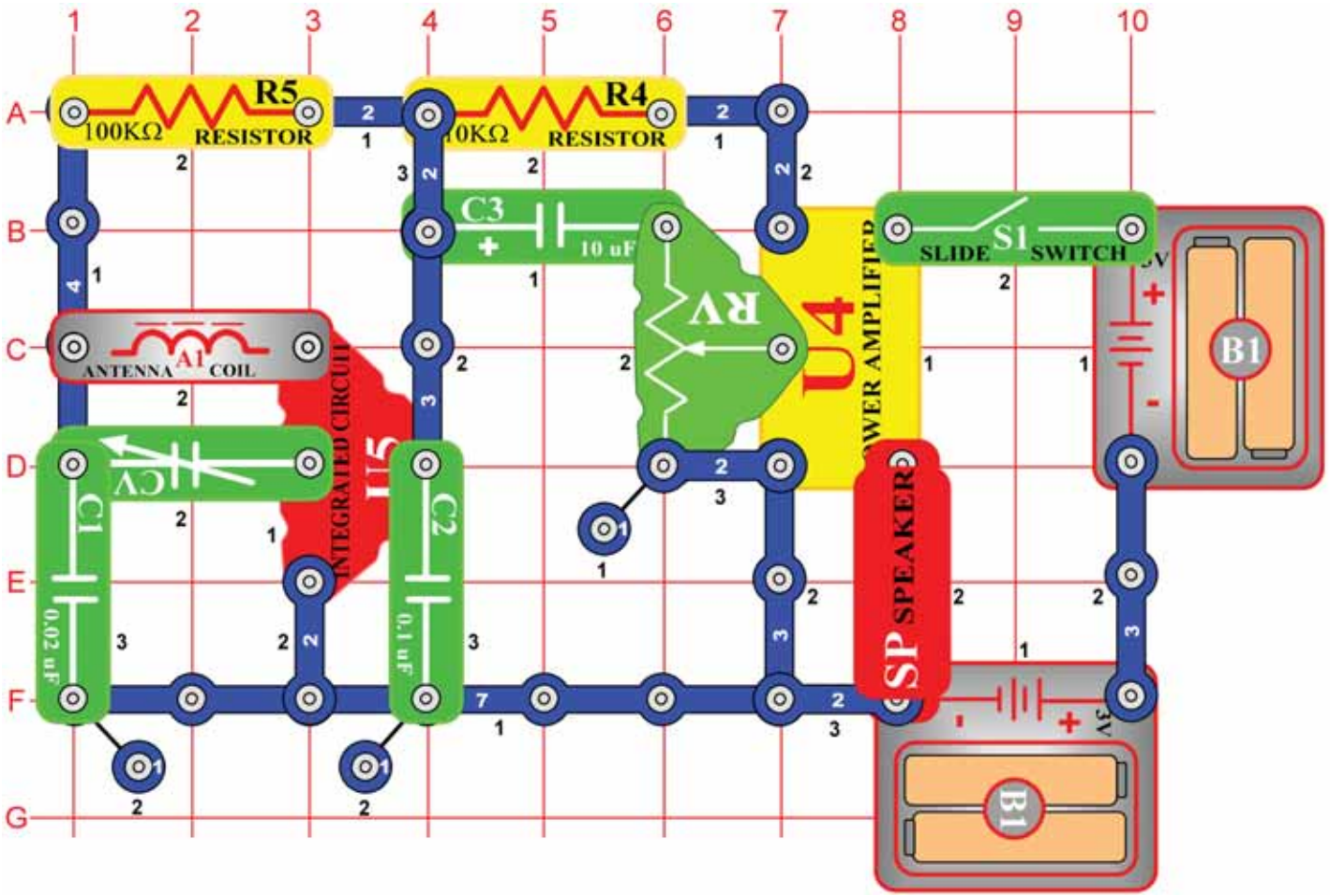
Project #304
AM Radio

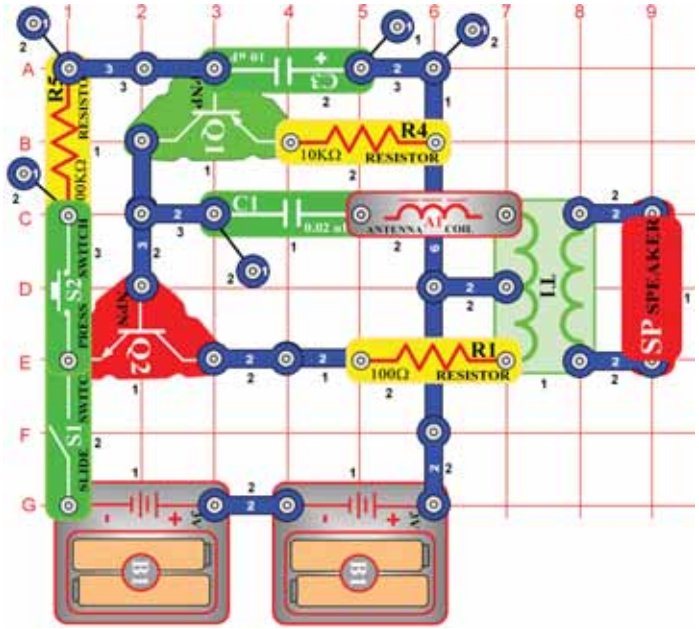
OBJECTIVE: To make a complete working AM radio.



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 (U4) drives the speaker (SP) to complete the AM radio project.

Project #305

Siren

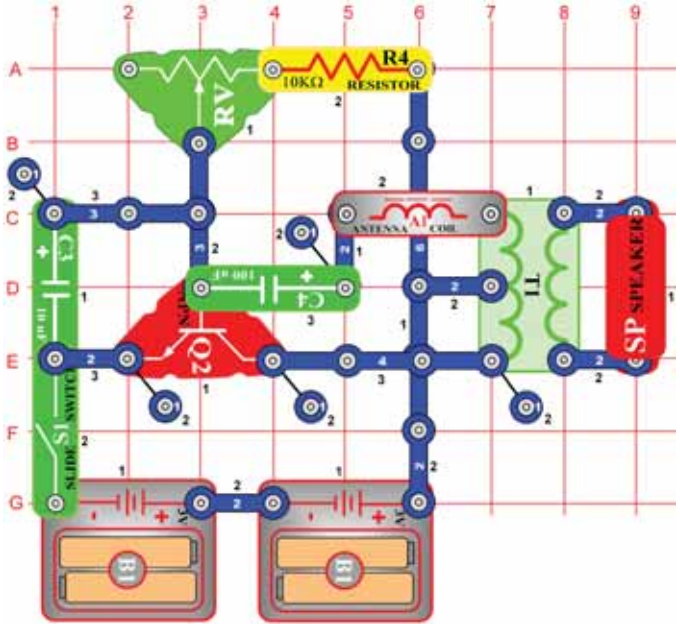


OBJECTIVE: To make a siren that slowly starts up and fades away.

Turn on the slide switch (S1), and then press the press switch (S2) for a few seconds and release. A siren starts up and then slowly fades away as capacitor C3 discharges.

Project #306

Electronic Rain

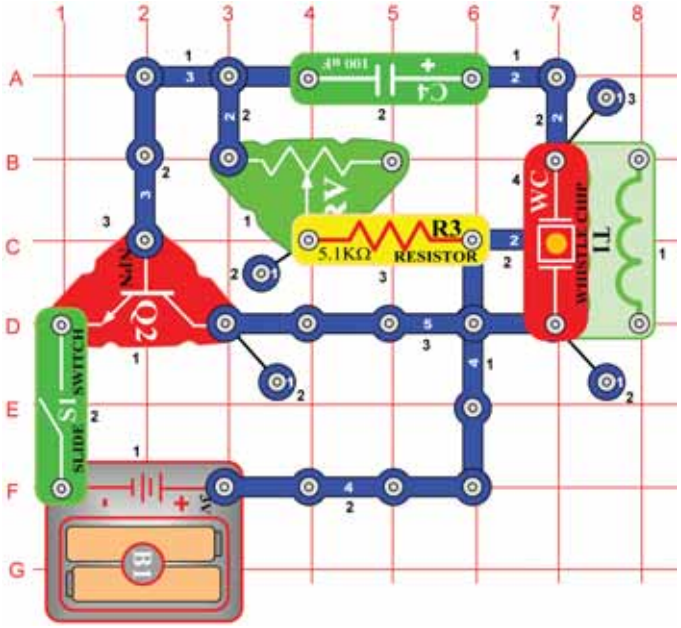


OBJECTIVE: To make a low-frequency oscillator.

Build the circuit and turn on the slide switch (S1), you hear a sound like raindrops. The adjustable resistor (RV) controls the rain. Turn it to the left to make a drizzle and turn to the right to make the rain come pouring down.

You can replace the 10KΩ resistor (R4) with the 1KΩ (R2) or 5.1KΩ (R3) resistors to speed up the rain.

Project #307

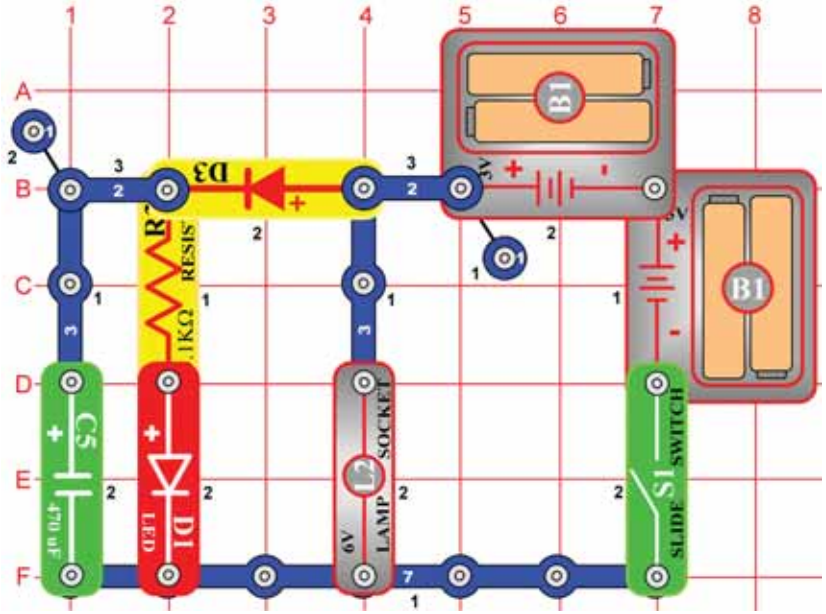


Leaky Faucet

OBJECTIVE: To make a low-frequency oscillator.

Build the circuit and set the adjustable resistor (RV) control all the way to the right. Turn on the slide switch (S1) and you hear a sound like a faucet dripping. You can speed up the dripping by moving the adjustable resistor control around.

Project #308



Diode

OBJECTIVE: To show how a diode works.

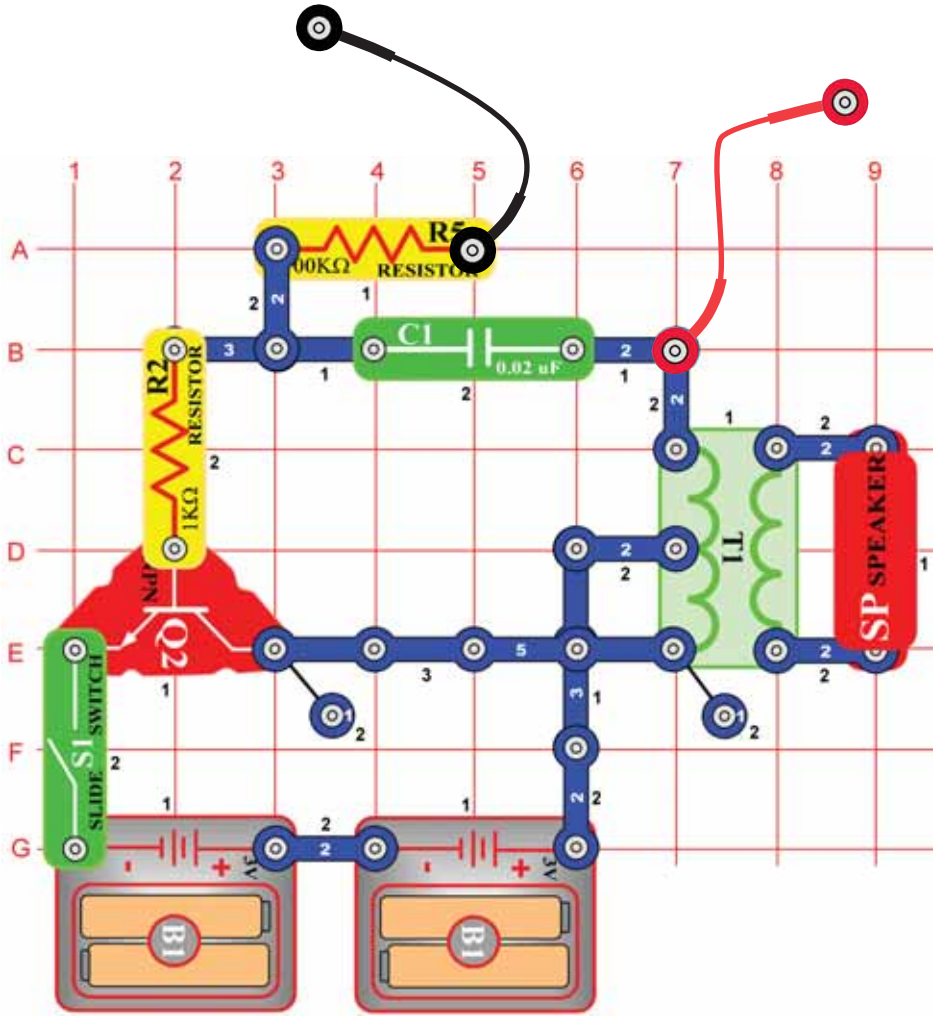
Turn on the slide switch (S1), the lamp (L2) will be bright and the LED (D1) will be lit. The diode (D3) allows the batteries (B1) to charge up capacitor C5 and light the LED.

Turn off the switch, the lamp will go dark immediately but the LED will stay lit for a few seconds as capacitor C5 discharges through it. The diode isolates the capacitor from the lamp; if you replace the diode with a 3-snap wire then the lamp will drain the capacitor almost instantly.

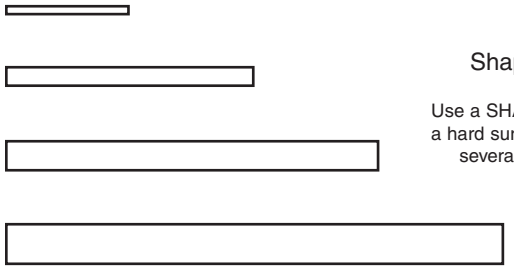
Project #309

Drawing Resistors

OBJECTIVE: To make your own resistors.



You need some more parts to do this experiment, so you're going to draw them. Take a pencil (No. 2 lead is best but other types will also work), **SHARPEN IT**, and fill in the 4 rectangles you see below. You will get better results if you **place a hard, flat surface between this page and the rest of this booklet** while you are drawing. **Press hard** (but don't rip the paper) and **fill in each several times** to be sure you have a **thick, even layer of pencil** lead and try to avoid going out of the boundaries.



Shapes to be drawn.

Use a SHARP No. 2 pencil, draw on a hard surface, press hard and fill in several times for best results.

Actually, your pencils aren't made out of lead anymore (although we still call them "lead pencils"). The "lead" in your pencils is really a form of carbon, the same material that resistors are made of. So the drawings you just made should act just like the resistors in Snap Kits™.

Build the circuit shown, it is the same basic oscillator circuit you have been using. Touch the the loose ends of the jumper wires to opposite ends of the rectangles you drew; you should hear a sound like an alarm. **Note:** You may get better electrical contact between the wires and the drawings if you wet the metal with a few drops of water or saliva.

Making the drawn resistors longer should increase the resistance while making them wider should reduce the resistance. So all 4 rectangles should produce the same sound, though you will see variations due to how thick and evenly you filled in the rectangles, and exactly where you touch the wires. If your 4 shapes don't sound similar then try improving your drawings.

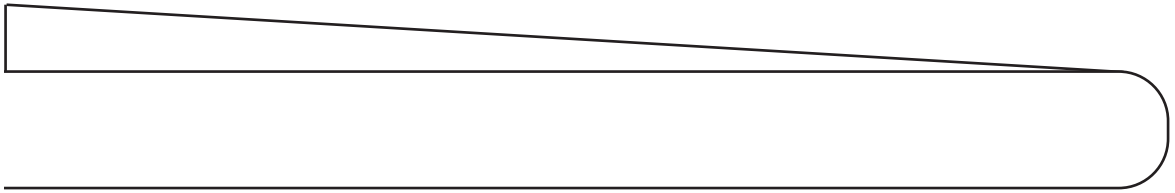
Be sure to wash your hands after this project.

Project #310 Electronic Kazoo

Use the same circuit as project #309, but draw a new shape. A Kazoo is a musical instrument that is like a one-note flute, and you change the pitch (frequency) of the sound by moving a plunger up and down inside a tube.

As before, take a pencil (No. 2 lead is best but other types will also work), **SHARPEN IT** again, and fill in the shape you see below. For best results, **SHARPEN IT again**, **place a hard flat surface between this page and the rest of this booklet** while you are drawing. **Press hard** (but don't rip the paper). **Fill in each several times** to be sure you have a **thick, even layer of pencil** lead, and try to avoid going out of the boundaries. **Where the shape is just a line, draw a thick line and go over it several times.** The black ink in this manual is an insulator just like paper, so you have to write over it with your pencil.

Take one loose wire and touch it to the widest part of this shape, at the upper left. Take the other loose wire and touch it just to the right of the first wire. You should hear a high-pitch sound. How do you think the sound will change as you slide the second wire to the right? Do it, slowly sliding all the way around to the end. The sound changes from high frequency to low frequency, just like a kazoo. **Note:** You may get better electrical contact between the wires and the drawings if you wet the wires with a few drops of water or saliva.



Shape to be drawn.

Use a SHARP No. 2 pencil, draw on a hard surface, press hard and fill in several times for best results.

Project #311 Electronic Kazoo (II)

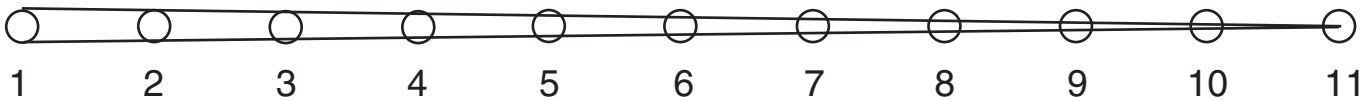
Use the same circuit as project #309, but fill in the new shape shown here.

Take one loose jumper wire and touch it to the left circle. Take the other loose wire and touch it to each of the other circles. The various circles produce different pitches in the sound, like notes. Since the circles are like keys on a piano, you now have an electronic keyboard! See what kind of music you can play with it. **Note:** You may get better electrical contact between the wires and the drawings if you wet the wires with a few drops of water or saliva.

Now take one loose wire and touch it to the right circle (#11). Take the other wire and touch it to the circles next to the numbers shown below, in order:

7 - 5 - 1 - 5 - 7 - 7 - 7
5 - 5 - 5
7 - 7 - 7
7 - 5 - 1 - 5 - 7 - 7 - 7 - 7 - 5 - 5 - 7 - 5 - 1

Do you recognize this nursery rhyme? It is "Mary Had a Little Lamb". By now you see that you can draw any shape you like and make electronic sounds with it. Experiment on your own as much as you like. Be sure to wash your hands after this test.



Shape to be drawn.

Use a SHARP No. 2 pencil, draw on a hard surface, press hard and fill in several times for best results.

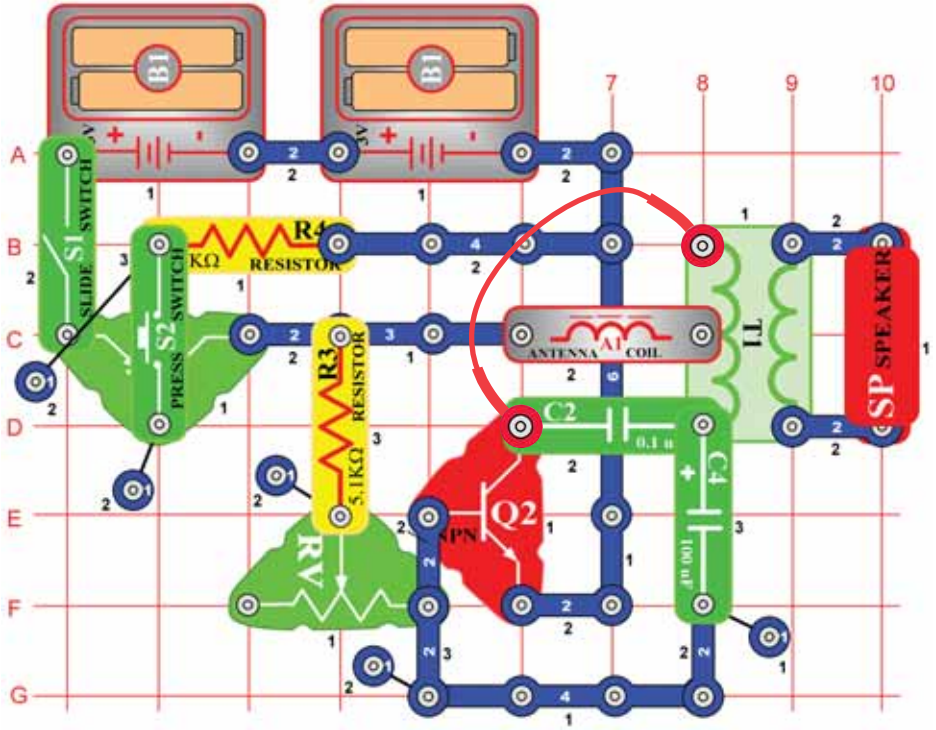
Project #312
Water Resistor

OBJECTIVE: To use water as a resistor.

Use the same circuit as project #309. Take the two loose jumper wires and touch them with your fingers. You should hear a low-frequency sound. Now place the loose jumpers in a cup of water without them touching each other. The sound will have a much higher frequency because drinking water has lower resistance than your body. You can change the sound by adding or removing water from the cup. If you add salt to the water then you will notice the frequency increase, because dissolving salt lowers the resistance of the water.

You can also make a water kazoo. Pour a small amount of water on a table or the floor and spread it with your finger into a long line. Place one of the jumper wires at one end and slide the other along the water. You should get an effect just like the kazoo you drew with the pencil, though the frequency will probably be different.

Project #313
Two-Transistor Oscillator

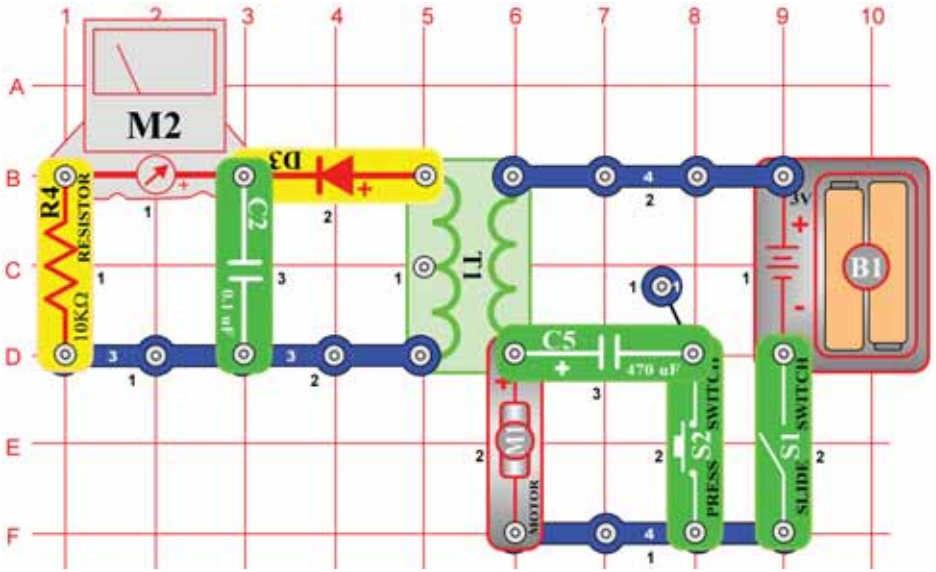


OBJECTIVE: To make an adjustable low-frequency oscillator.

Build the circuit, turn on the slide switch (S1), and then press the press switch (S2). Move the control lever of the adjustable resistor (RV) to change the tone.

Project #314

Motor Rectifier



OBJECTIVE: To show how what a rectifier does.

Set the meter (M2) to the LOW (or 10mA) scale. Place the fan on the motor (M1) and turn on the slide switch (S1). The meter measures the current on the other side of the transformer (T1).

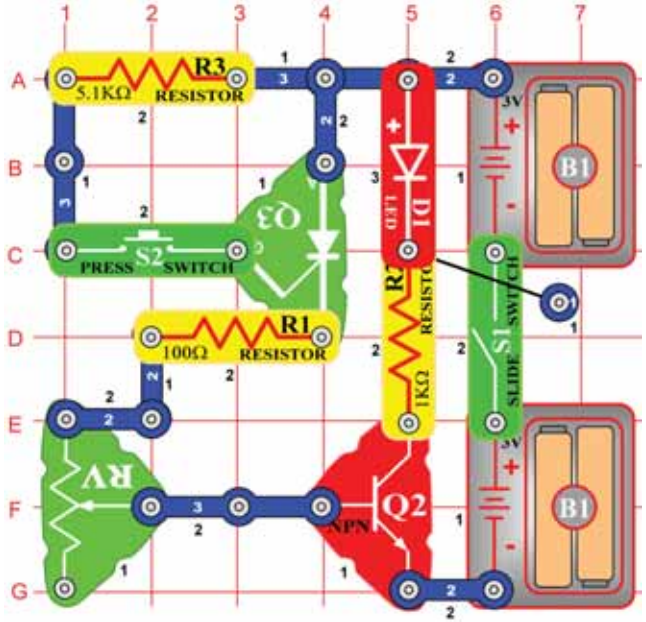
As the DC voltage from the battery (B1) spins the motor, the motor creates an AC ripple in the voltage. This ripple passes through the transformer using magnetism. The diode (D3) and 0.1µF capacitor (C2) "rectify" the AC ripple into the DC current that the meter measures.

Holding down the press switch (S2) connects the 470µF capacitor (C5) across the motor. This filters out the AC ripple, so the current through the meter is greatly reduced, but the motor speed is not affected.

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

Project #315

SCR Shutdown



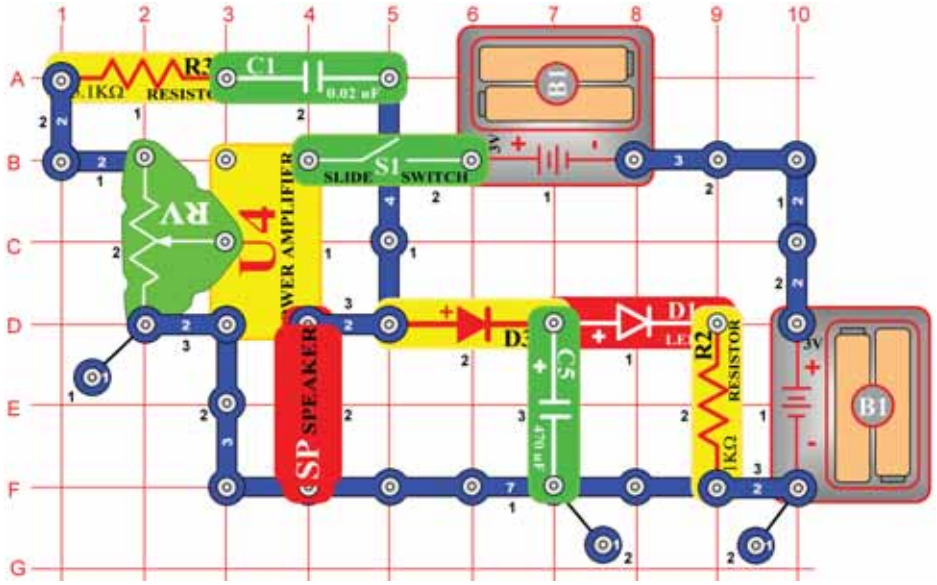
OBJECTIVE: To show how an SCR works.

In this circuit the press switch (S2) controls an SCR (Q3), which controls a transistor (Q2), which controls an LED (D1). Set the adjustable resistor (RV) control lever to the top (toward the press switch).

Turn on the slide switch (S1); nothing happens. Press and release the press switch; the SCR, transistor, and LED turn on and stay on. Now move the adjustable resistor control down until the LED turns off. Press and release the press switch again, this time the LED comes on but goes off after you release the switch.

If the current through an SCR (anode-to-cathode) is above a threshold level, then the SCR stays on. In this circuit you can set the adjustable resistor so that the SCR (and the LED it controls) just barely stays on or shuts off.

Project #316



Rectifier

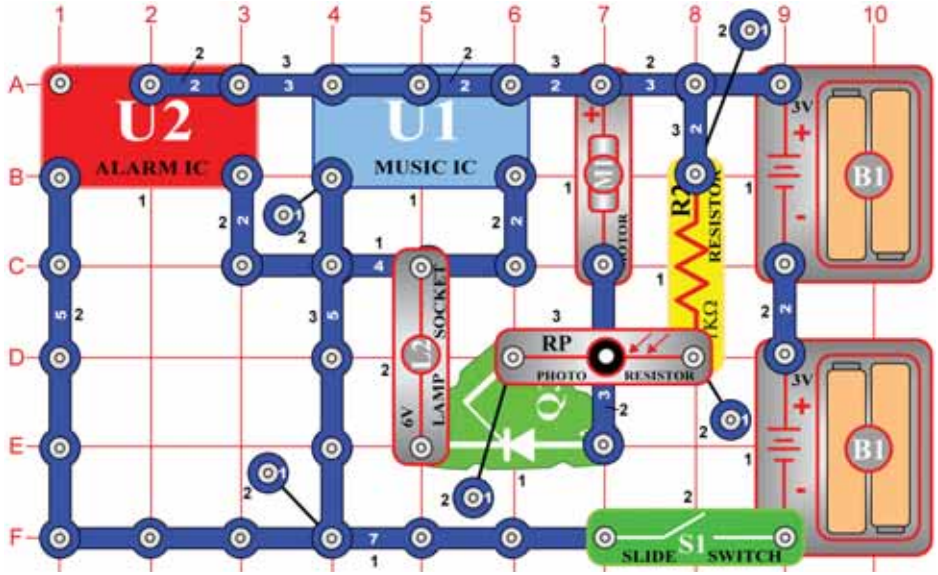
OBJECTIVE: To build a rectifier.

Turn on the slide switch (S1) and set the adjustable resistor (RV) for mid-range for the best sound. The LED (D1) will also be lit.

The signal from the power amplifier (U4) to the speaker (SP) is a changing (AC) voltage, not the constant (DC) voltage needed to light the LED. The diode (D3) and capacitor (C5) are a rectifier, which converts the AC voltage into a DC voltage.

The diode allows the capacitor to charge up when the power amp voltage is high, but also prevents the capacitor from discharging when the power amplifier voltage is low. If you replace the diode with a 3-snap or remove the capacitor from the circuit, the LED will not light.

Project #317



SCR Motor Control

OBJECTIVE: To show how an SCR is used.

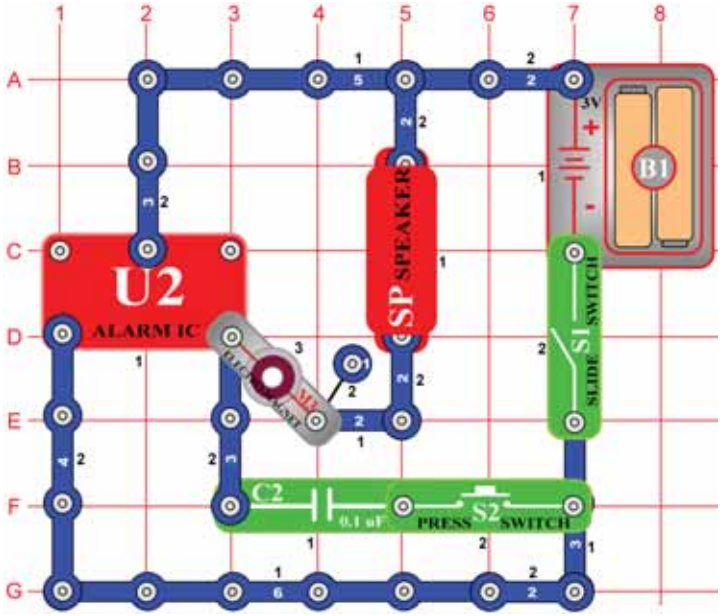
SCR's are often used to control the speed of a motor. The voltage to the gate would be a stream of pulses, and the pulses are made wider to increase the motor speed.

Place the fan on the motor (M1) and turn on the slide switch (S1). The motor spins and the lamp (L2) lights. Wave your hand over the photoresistor (RP) to control how much light shines on it, this will adjust the speed of the motor. By moving your hand in a repetitive motion, you should be able spin the motor at a slow and steady speed.

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

Project #318

Machine Siren



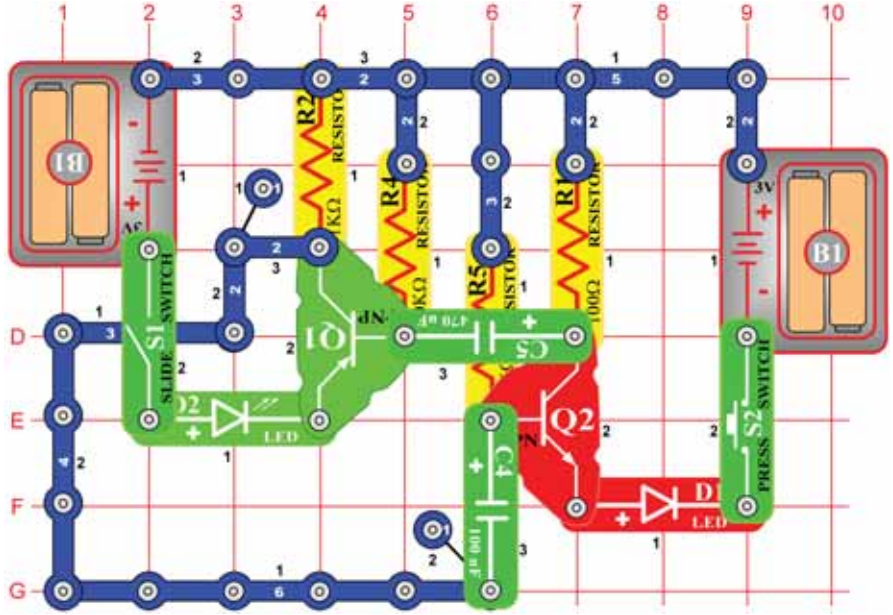
OBJECTIVE: To see how the electromagnet can change the sound from the alarm IC.

Turn on the slide switch (S1), you hear a strange sound from the speaker (SP). Push the press switch (S2) and the sound changes to a high-pitch siren.

The alarm IC (U2) produces a smooth siren sound, but the electromagnet (M3) distorts the siren into the strange sound you hear. Adding the 0.1μF capacitor (C2) counters the electromagnet effects and restores the siren.

Project #319

Flashing Mirror Circuit

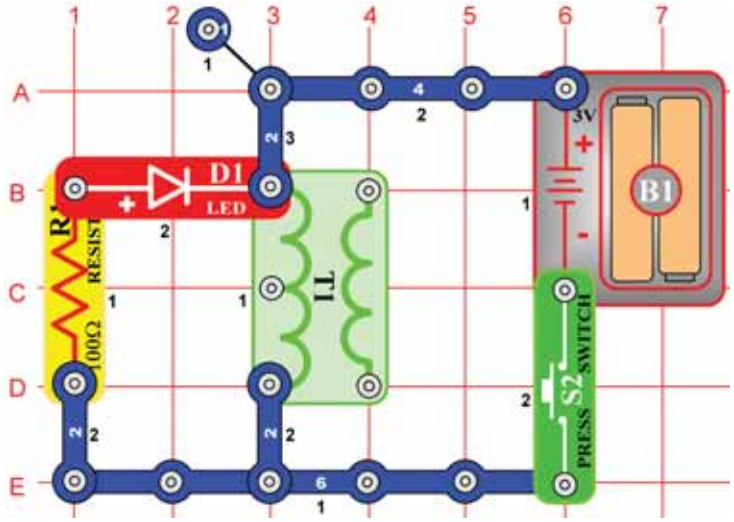


OBJECTIVE: To build a mirror view of a circuit.

Using the PNP transistor (Q1) and NPN transistor (Q2), you can combine two sub-circuits that look the same, but are exactly the opposite.

If you turn on the slide switch (S1) only, the green LED (L2) will be dim. If you press the press switch (S2) only, the red LED (D1) will be dim. But if you turn on the slide switch AND press the press switch, both LED's will flash every few seconds.

Project #320



Transformer Storing Energy

OBJECTIVE: To show that the transformer stores electrical energy.

Hold down the press switch (S2) and then watch the LED (D1) as you release the switch. The LED lights briefly but only after the batteries (B1) are disconnected from the circuit.

This circuit is similar to the Antenna Storing Energy project, and shows how the coils in the transformer (T1) also store energy in magnetic fields. When the switch is released, this energy creates a brief current through the LED.

Project #321

Relay Storing Energy

OBJECTIVE: To show that the relay coil stores energy.

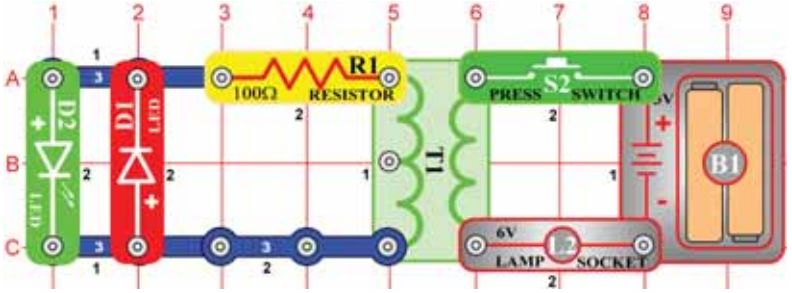
Modify project #320 by replacing the transformer (T1) with the relay (S3), position it with the 3-snap sides to top and right.

Hold down the press switch (S2) and then watch the LED (D1) as you release the switch. The LED lights briefly but only after the batteries (B1) are disconnected from the circuit.

The relay has a coil similar to the one in the transformer, and stores energy in the same way.

Project #322 Transformer Lights

OBJECTIVE: To show how the transformer works.



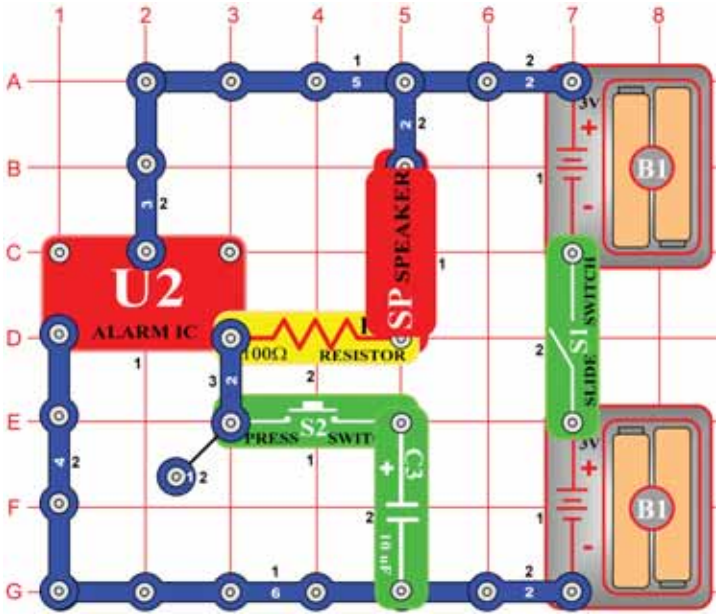
Watch the LED's (D1 & D2) as you press and release the press switch (S2). The red LED (D1) lights briefly just as you press the switch and the green LED (D2) lights briefly just after you release it, but neither lights while you hold the switch down. Why?

When you press the switch, a surge of current from the battery (B1) charges a magnetic field in the transformer (T1), which stays constant as the switch is held down. Charging the magnetic field induces an opposing current on the other side of the transformer, which lights the red LED until the magnetic fields stabilize.

When you release the switch (removing the current from the battery), the magnetic field discharges. Initially the transformer tries to maintain the magnetic field by inducing a current on the other side, which lights the green LED until the resistor (R1) absorbs the remaining energy.

Note that this project is different from the Antenna Storing Energy project because there is a magnetic connection across the transformer, not an electrical connection.

Project #323



Alarm Filter

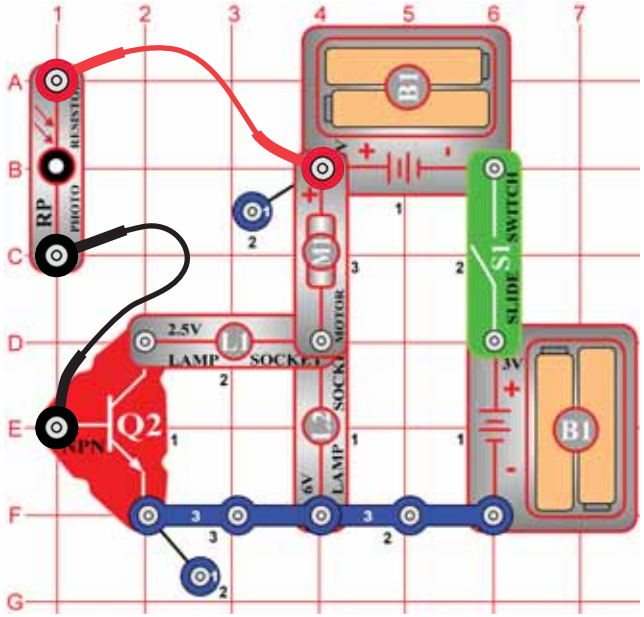
OBJECTIVE: To show how capacitors can change electrical signals.

Turn on the slide switch (S1) and press the press switch (S2) to change the sound. Do you know how?

The press switch adds the 10μF capacitor (C3) to the circuit. This part can store some of the electricity moving through the speaker (SP) and 100Ω resistor (R1) for a short period, changing the tone of the sound. You can test the effect by replacing C3 with your other capacitors.

You can change the alarm sound by placing a 2-snap (with a 1-snap) from base grid point C2 to point C1.

Project #324



Back EMF (II)

OBJECTIVE: To demonstrate how the motor draws more current to exert greater force when spinning slowly.

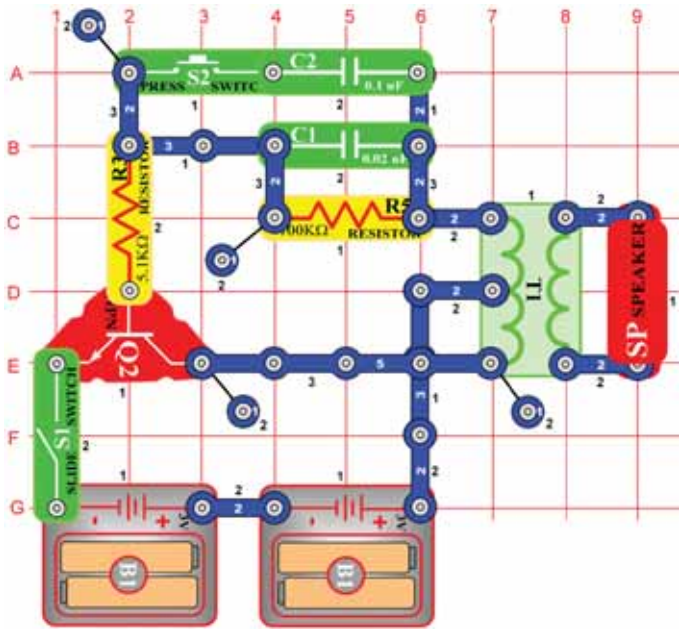
Place the fan on the motor (M1). Connect the photoresistor (RP) with the jumper wires as shown, and hold it next to the 6V lamp (L2) so the light shines on it.

Turn on the slide switch (S1) and watch how the 6V lamp is bright at first, but gets dim as the motor speeds up. By moving the photoresistor (RP) next to or away from the 6V lamp, you should be able to change the motor speed. To slow the motor down even more, cover the photoresistor.

When the photoresistor is held next to the 6V lamp, transistor Q2 (with lamp L1) will try to keep the motor at a constant speed.

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

Project #325



Electronic Sound

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) to lower the frequency by increasing the capacitance in the oscillator. Replace the 0.1μF capacitor (C2) with the 10μF capacitor (C3, "+" on the right) to further lower the frequency of the tone.

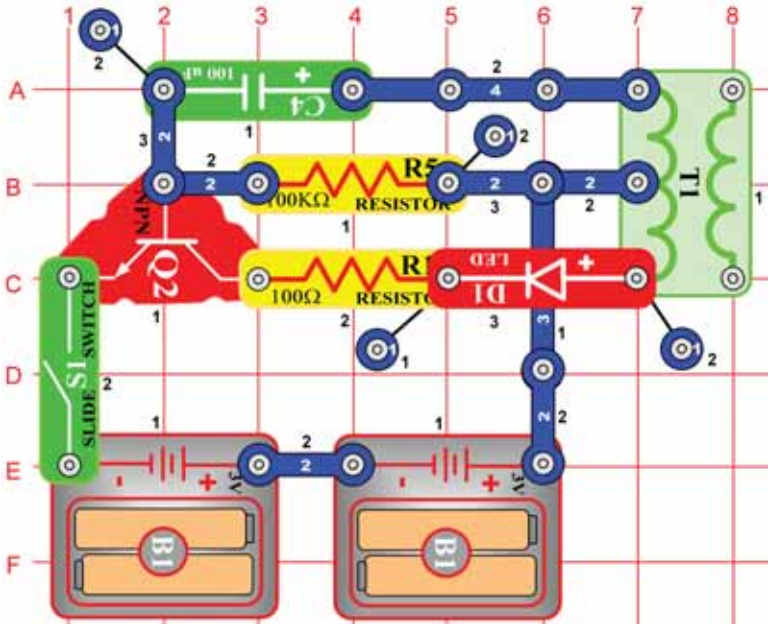
Project #326

Electronic Sound (II)

OBJECTIVE: To make different tones with an oscillator.

You can also change the frequency by changing the resistance in the oscillator. Replace the 100KΩ resistor (R5) with the 10KΩ resistor (R4), place the 0.1μF capacitor (C2) back in the circuit as before.

Project #327

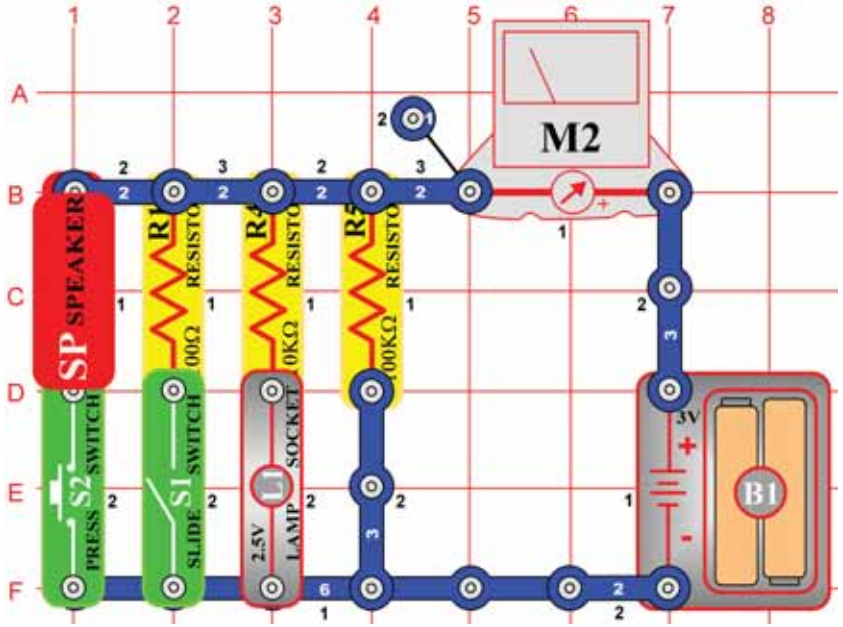


Lighthouse

OBJECTIVE: To make a blinking light.

Build the circuit and turn on the slide switch (S1), the LED (D1) flashes about once a second.

Project #328



Meter Ranges

OBJECTIVE: To show the difference between the low and high current meter ranges.

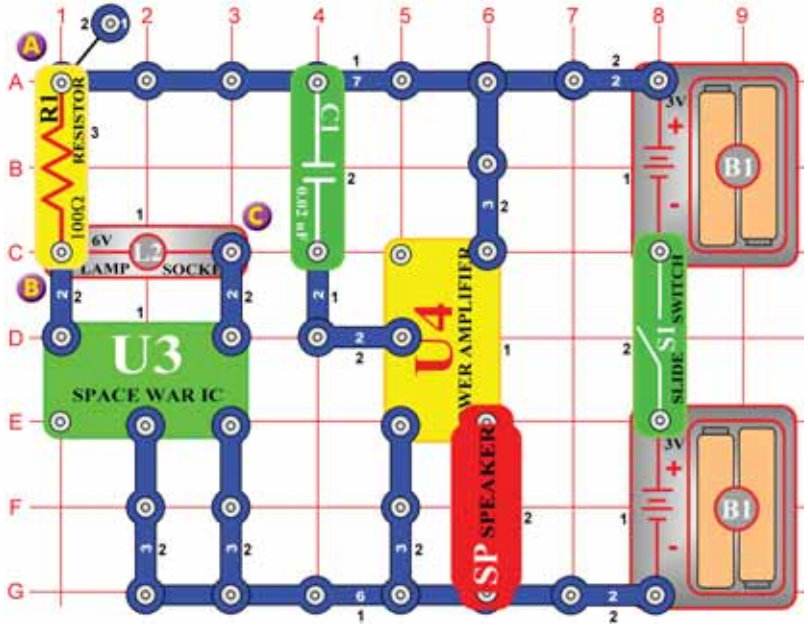
Use the LOW (or 10mA) setting on the meter (M2), turn off the slide switch (S1), and unscrew the 2.5V bulb (L1). The meter should measure about 2, since the 100KΩ resistor (R5) keeps the current low. Results will vary depending on how good your batteries are.

Screw in the 2.5V bulb to add the 10KΩ resistor (R4) to the circuit, now the meter reading will be about 10.

Now turn on the slide switch (S1) to add the 100Ω resistor (R1) to the circuit, the meter reading should be off the scale to the right. Change the meter to the HIGH (1A) setting, it should read just above zero.

Now press the press switch (S2) to add the speaker (SP) to the circuit. The meter reading will be about 5, since the speaker has only about 8Ω resistance.

Project #329



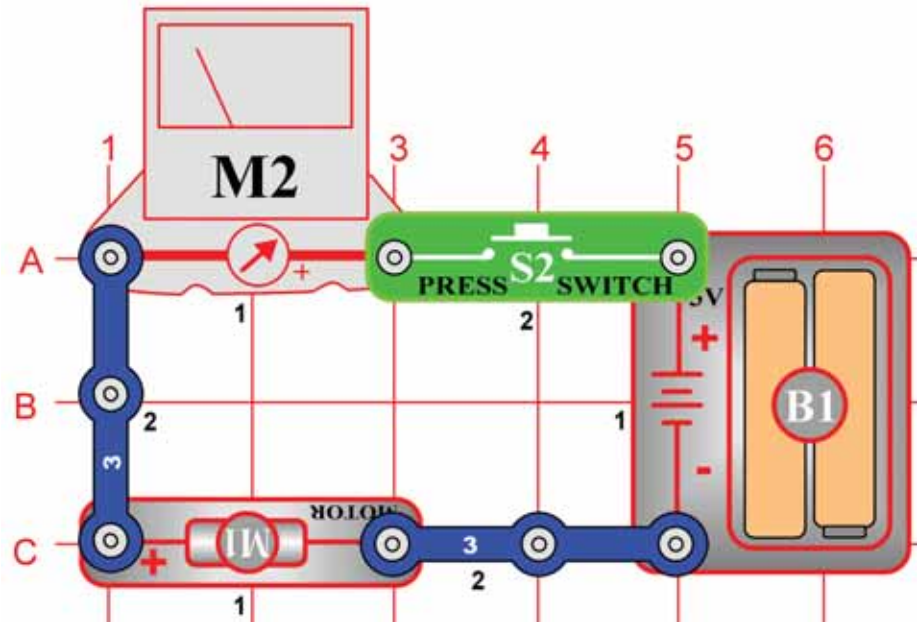
Loud Sounds

OBJECTIVE: To create a sound circuit.

Turn the slide switch (S1) on and you should hear a tone from the speaker (SP). Connect the jumper wire from A to B, the lamp (L2) lights and the tone changes. Move the jumper wire from B to C to hear an assortment of sounds.

Project #330

Motor Current



OBJECTIVE: To measure the motor current.

Use the HIGH (or 1A) setting on the meter (M2) and place the fan on the motor (M1). Press the press switch (S2), the meter will measure a very high current because it takes a lot of power to spin the fan.

Remove the fan and press the switch again. The meter reading will be lower since

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

Project #331

2.5V Lamp Current

OBJECTIVE: To measure the 2.5V lamp current.

Use the circuit from project #330, but replace the motor with the 2.5V lamp (L1). Measure the current using the HIGH (or 1A) setting on the meter (M2).

Project #332

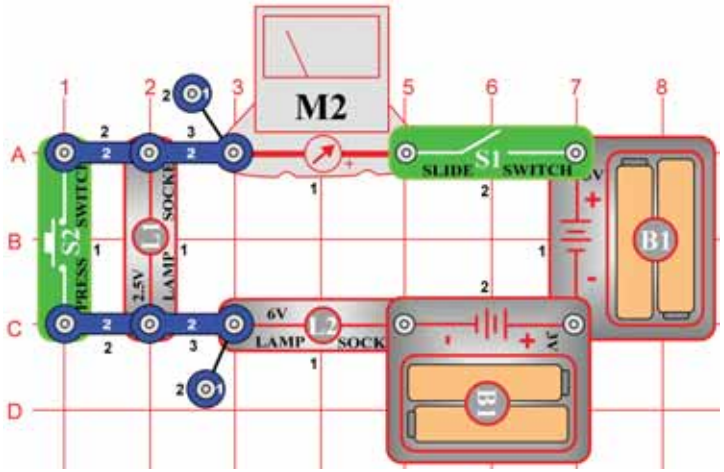
6V Lamp Current

OBJECTIVE: To measure the 6V lamp current.

Use the circuit from project #330 but replace the motor (M1) with the 6V lamp (L2). Measure the current using the HIGH (or 1A) setting on the meter (M2). Compare the lamp brightness and meter reading to that for the 2.5V lamp (L1).

Project #333

Combined Lamp Circuits



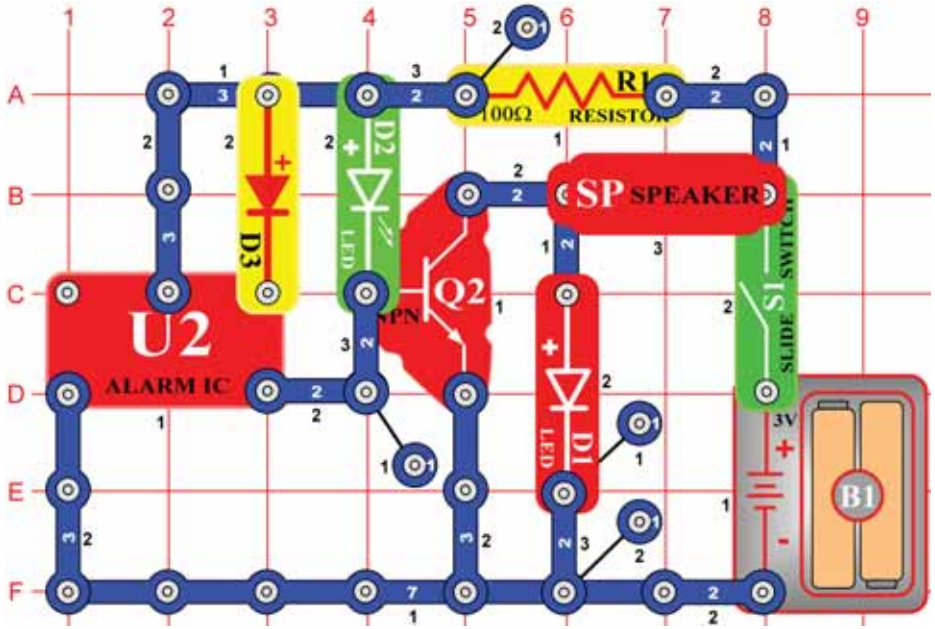
OBJECTIVE: To measure current through the lamps.

Use the HIGH (or 1A) setting on the meter (M2) and turn on the slide switch (S1). Both lamps are on and the meter measures the current.

Now turn on the press switch (S2) to bypass the 2.5V lamp (L1). The 6V lamp (L2) is brighter now, and the meter measures a higher current.

Project #334

U2 with Transistor Amplifier



OBJECTIVE: To combine U2 with an amplifier.

Turn the slide switch (S1) on and the LED's (D1 & D2) flash as the speaker (SP) sounds. The output pulses from U2 turns transistor Q2 on and off rapidly. As the transistor turns on, the speaker shorts to ground and a current flows through it. The current flow through the speaker causes it to produce a sound. The LED's show the pulsing signal from U2 that is turning Q2 on and off.

Project #335

U2 with Transistor Amplifier (II)

OBJECTIVE: To combine U2 with an amplifier.

Using project #334, remove the diode (D3) to create a different sound.

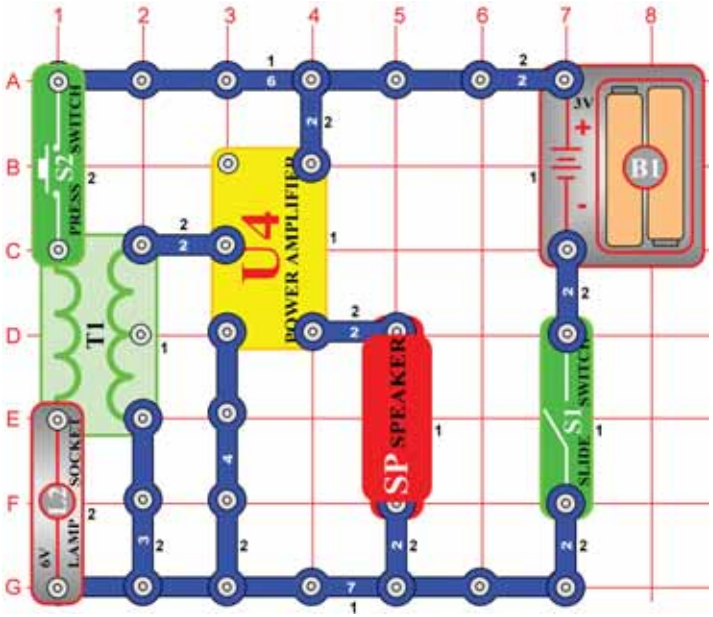
Project #336

U1 with Transistor Amplifier

OBJECTIVE: To replace U2 with the music integrated circuit (U1).

Using the project #334, replace U2 with U1. The circuit will now play music.

Project #337



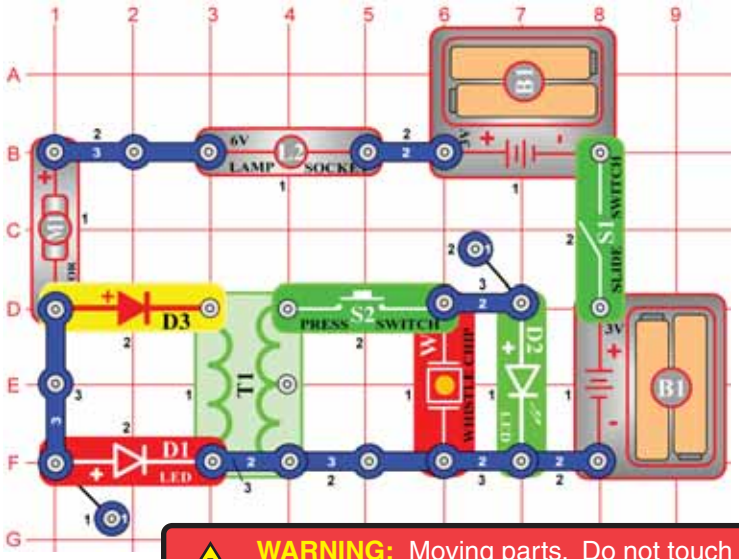
Motor Sound Using Transformer

OBJECTIVE: To create a sound circuit.

Turn the slide switch (S1) on and then rapidly turn on and off the press switch (S2). This causes a magnetic field to expand and collapse in the transformer (T1). The small voltage generated is then amplified by the power amplifier IC (U4) and the speaker (SP) sounds. Replace switch S2 with the motor (M1, leave the fan off) and you can hear how fast the motor spins. To hear the sound better, connect the speaker to the circuit using the red and black jumper wires (instead of the 2-snaps) and hold it next to your ear.

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

Project #338



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

Motor Sound with LED

OBJECTIVE: To create a sound circuit.

In this project, you will drive the whistle chip (WC) and LED's using the motor (M1) and transformer (T1). Turn the slide switch (S1) on. The motor begins spinning and the red LED (D1) lights. Now press the press switch (S2), the voltage generated from the transformer is now across the whistle chip and green LED (D2). The whistle chip sounds as the green LED lights.

Project #339

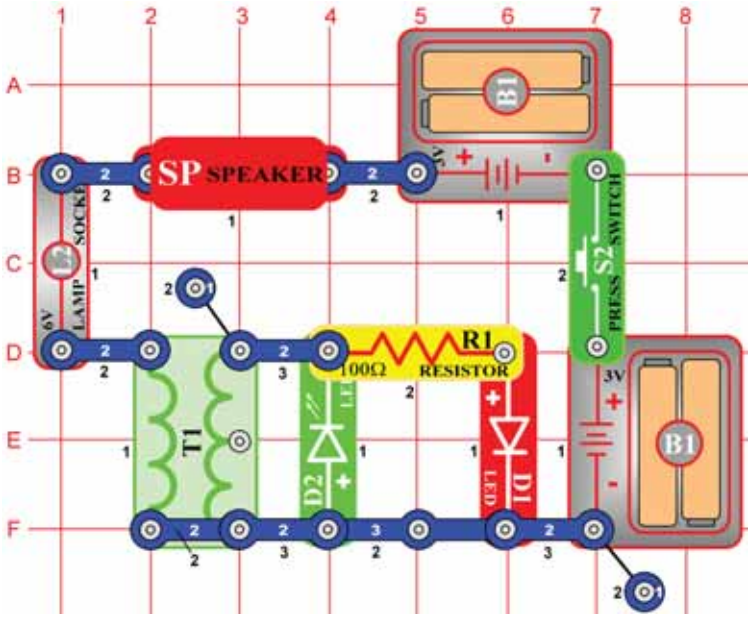
Motor Sound with LED (II)

OBJECTIVE: To create a sound circuit.

Modify project #338 by replacing the 6V lamp (L2) with the speaker (SP). Now the speaker will also output sound.

Project #340

AC & DC Current



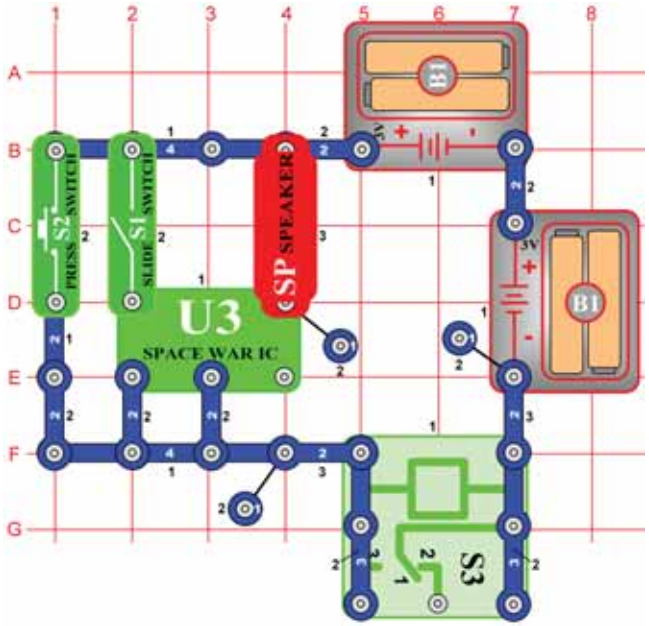
OBJECTIVE: Using AC & DC current.

This circuit creates an AC & DC current. Press the press switch (S2) a few times and the LED's flash back and forth. Turning the switch on and off causes the magnetic field in the transformer (T1) to expand (green LED D2 lights) and collapse (red LED D1 lights) and current flows in two directions. Hold the switch down and the green LED flashes once. Replace the 6V lamp (L2) with the motor (M1). Press the press switch, the red LED flickers and the speaker sounds, due to the small current change from the motor spinning.

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

Project #341

Noisemaker



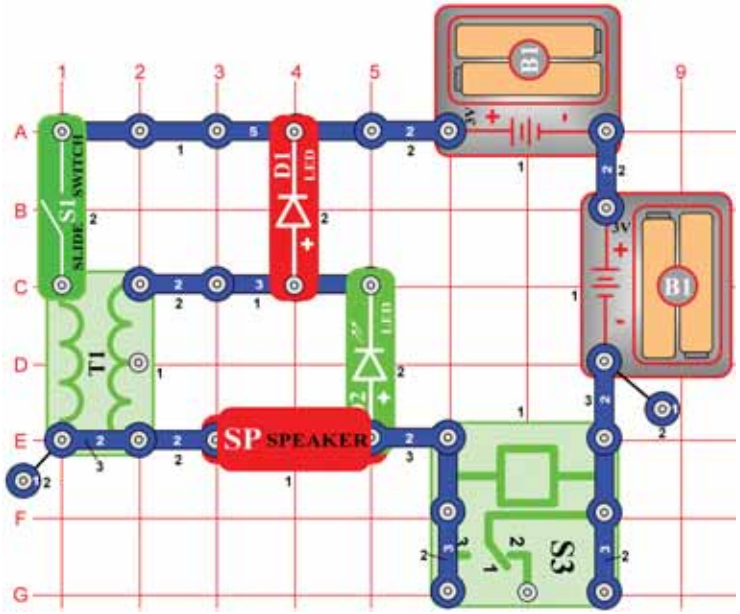
OBJECTIVE: To create a sound circuit.

Turn on the slide switch (S1) and the relay (S3) generates a buzzing noise. Increase the voltage across the relay by pressing the press switch (S2). The tone is higher because the relay's contacts are opening and closing faster.

Project #342

AC Voltage

OBJECTIVE: To using AC voltage.

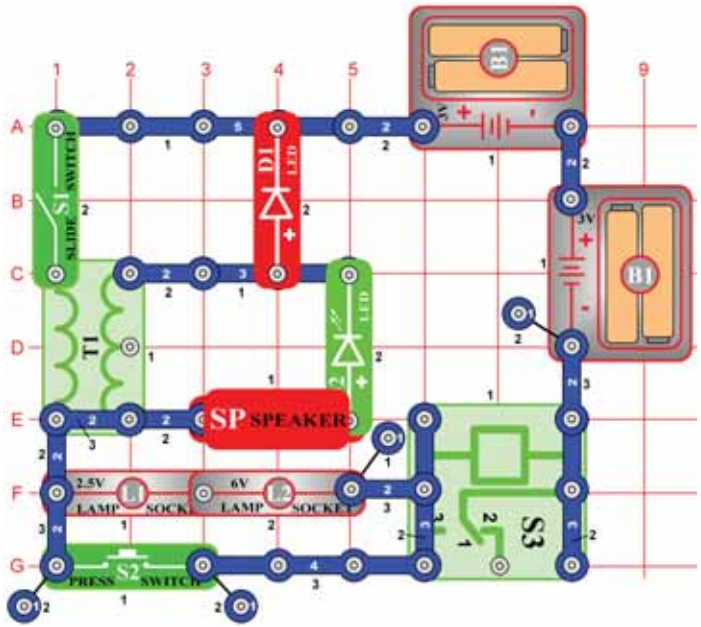


Turn the slide switch (S1) on. The LED's (D1 & D2) flash so fast that they appear to be on, and the speaker (SP) sounds. As in other projects, the relay's (S3) contacts open and close rapidly. This causes the magnetic field in the transformer (T1) to expand and collapse, creating an AC voltage lighting the LED's.

Project #343

AC Voltage (II)

OBJECTIVE: To using AC voltage.

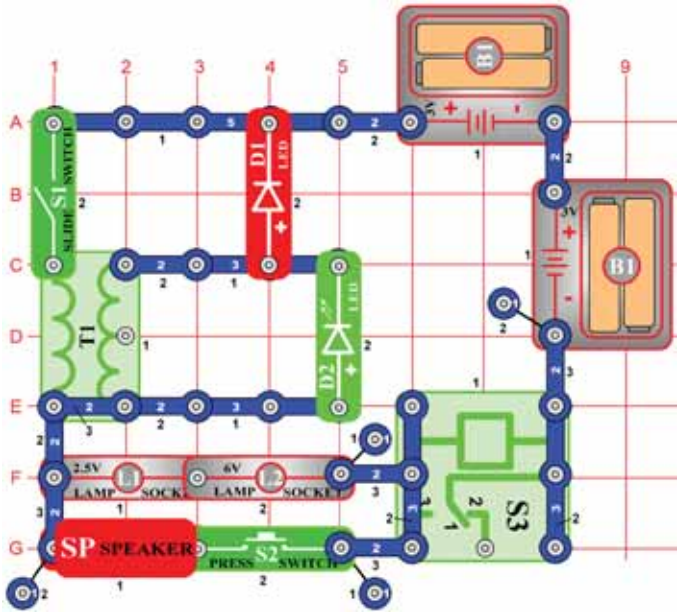


You can modify project #342 by adding the press switch (S2) and two lamps (L1 & L2). When the slide switch (S1) is turned on, the relay (S3) sounds and the lamps (L1 & L2) and LED's (D1 & D2) flash. Pressing the press switch shorts the lamps and speaker (SP).

Project #344

AC Voltage (III)

OBJECTIVE: Using AC voltage.

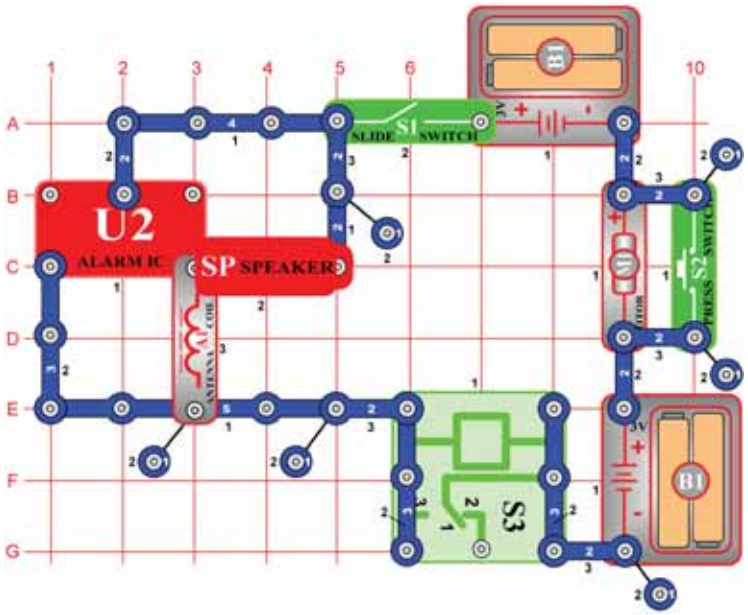


This project is similar to project #342. When the slide switch (S1) is turned on, the relay (S3) sounds and the lamps (L1 & L2) and LED's (D1 & D2) flash. Now when the press switch (S2) is pressed, the speaker (SP) also sounds.

Project #345

Noisemaker (II)

OBJECTIVE: To create a sound circuit.



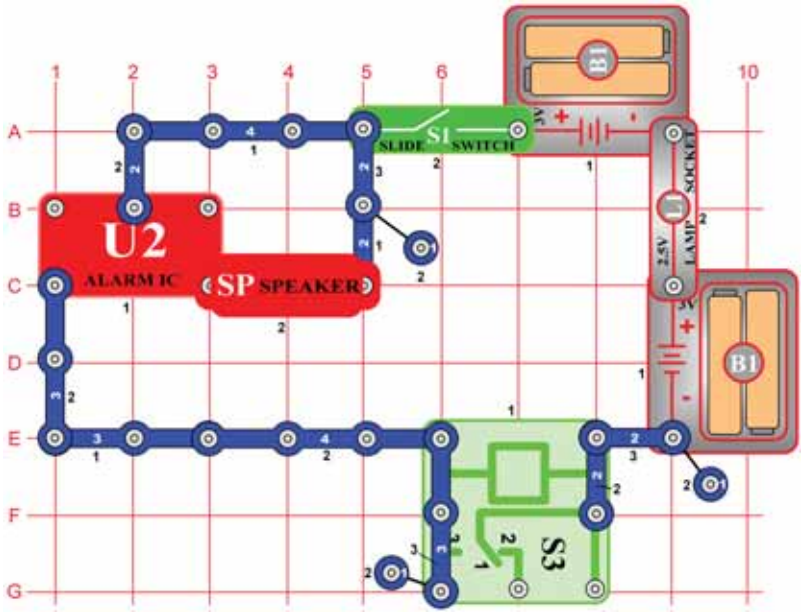
Turn on the slide switch (S1) and the relay (S3) generates a buzzing noise. Increase the voltage across the relay by pressing the press switch (S2). The tone changes because the relay's contacts are opening and closing faster.

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

WARNING: Do not lean over the motor.

Project #346

Noisemaker (III)

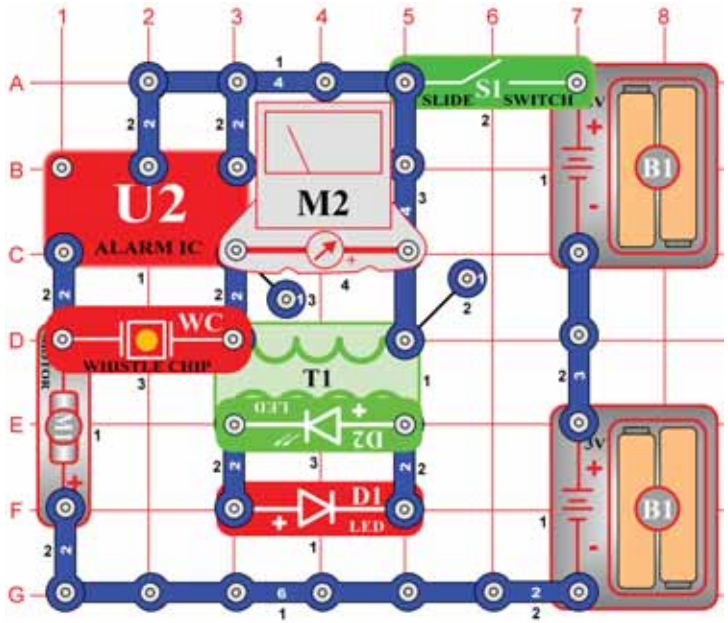


OBJECTIVE: To create a sound circuit.

Turn the slide switch (S1) on and the speaker (SP) sounds as if a motor is spinning and an alarm is running. The relay's (S3) contacts rapidly open and close the battery connection to the circuit causing the alarm IC (U2) sound to be different.

Project #347

Pulsing Motor

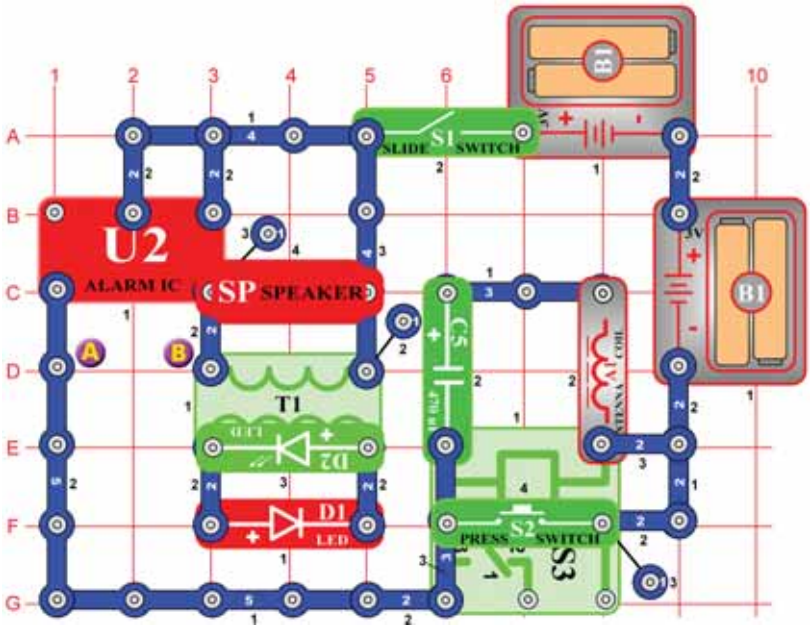


OBJECTIVE: To create a pulsing motor circuit.

Set the meter (M2) to the LOW (or 10mA) scale. Turn on the slide switch (S1) and now you have a pulsing motor and LED circuit. Replace the meter with the 470μF capacitor (C5, "+" at grid location C5) to change the rate the LED's (D1 & D2) flash.

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

☐ Project #348



Noisemaker (IV)

OBJECTIVE: To create a sound circuit.

In this project, you'll see and hear the output of the alarm IC (U2). Turn on the slide switch (S1), the LED's (D1 & D2) flash, and the speaker (SP) sounds as the relay (S3) chatters. Now press the press switch (S2) and see what happens when you remove the relay from the circuit.

☐ Project #349

Noisemaker (V)

OBJECTIVE: To create a sound circuit.

Modify the sound of project #348 by adding capacitor C4 across points A & B ("+" of C4 on right).

☐ Project #350

Noisemaker (VI)

OBJECTIVE: To create a sound circuit.

Modify project #349 by replacing the capacitor C4 with the motor (M1, position it with the "+" on the left and don't place the fan on it). Turn on the slide switch (S1), the LED's flash, and the speaker (SP) sounds as the relay (S3) chatters. Now press the press switch (S2) removing the relay from the circuit, providing a constant connection to the battery (B1). The motor speeds up and the sound from the speaker is not distorted.

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

☐ Project #351

Noisemaker (VII)

OBJECTIVE: To create a sound circuit.

Modify project #350 replacing the speaker (SP) with the whistle chip (WC) and placing the fan onto the motor (M1). Turn on the slide switch (S1) and the fan spins, lights flash, and the relay (S3) chatters. Now try to launch the fan by pressing the press switch (S2) down for about five seconds and releasing it.

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

WARNING: Do not lean over the motor.

☐ Project #352

Noisemaker (VIII)

OBJECTIVE: To create a sound circuit.

Modify project #351 by removing the motor (M1). Turn on the slide switch (S1) and press the press switch (S2) to hear the new sound.

☐ Project #353

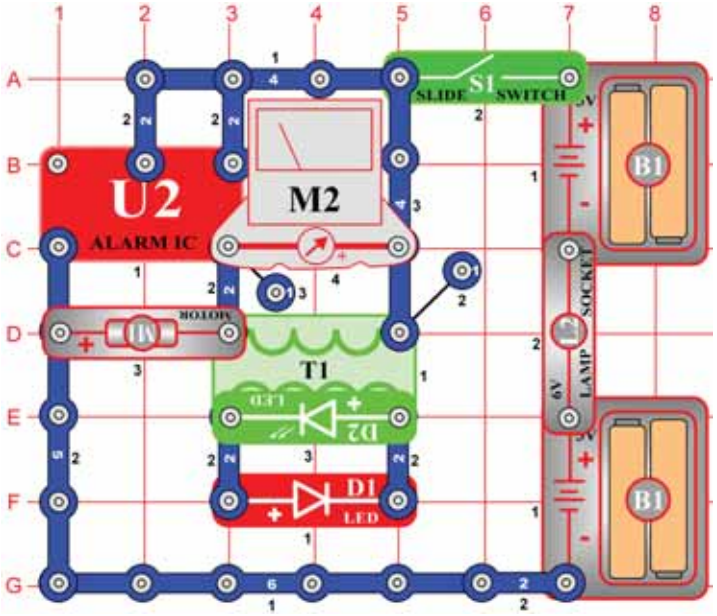
Noisemaker (IX)

OBJECTIVE: To create a sound circuit.

Modify the sound of project #352 by replacing the whistle chip (WC) with the meter (M2, "+" towards right), use the LOW (or 10mA) meter setting. Turn on the slide switch (S1) and as the LED's flash the meter deflects.

Project #354

Alarm Power



OBJECTIVE: To create a sound circuit.

In this project, the alarm IC (U2) powers the motor (M1), meter (M2) and LED's (D1 & D2). Set the meter to the LOW (or 10mA) setting and turn on the slide switch (S1). The circuit pulses the meter, motor, and LED's.

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

Project #355

Alarm Power (II)

OBJECTIVE: To create a sound circuit.

Remove the motor (M1) from the circuit and now the circuit pulses around 1Hz.

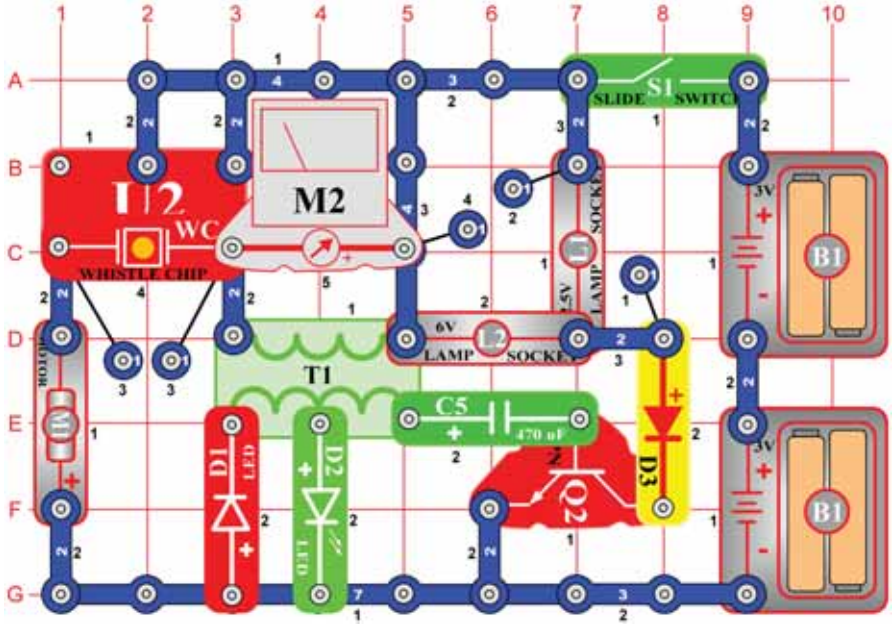
Project #356

Night Sounds

OBJECTIVE: To hear the sounds of the night.

Simulate the sound of a forest at night by replacing the motor (M1) in project #354 with the whistle chip (WC).

Project #357



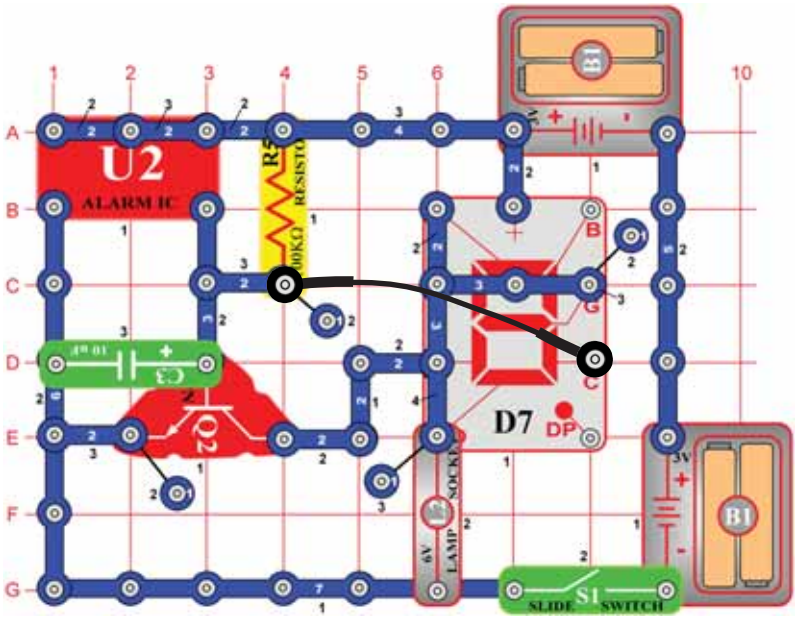
Mega Pulser & Flasher

OBJECTIVE: To power other devices using the alarm IC.

In this circuit, you will power many devices using the alarm IC (U2). Set the meter (M2) to LOW (or 10mA) and turn on the switch (S1). The LED's (D1 & D2) and lamps (L1 & L2) flash, the meter deflects, the whistle chip (WC) sounds, and the motor (M1) spins.

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

Project #358



"E" & "S" Blinker

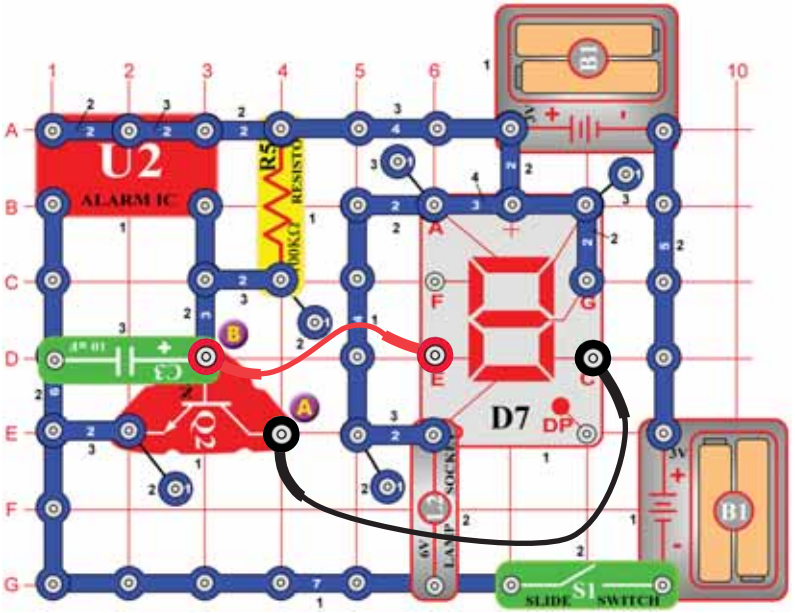
OBJECTIVE: To use the alarm IC to flash between "E" and "S".

This circuit alternately displays letters "E" and "S" by switching segments "E" and "C" on and off. Segments A, D, F, and G are connected to ground so they are always lit. Segment "C" is connected to the base of Q2 and output of U2. The segment "E" is connected to the collector of Q2. When the output of U2 is low, segment "C" is on and "E" is off. When the U2's output is high, the transistor (Q2) turns on and segment "C" turns off. When the transistor connects the "E" segment to ground the segment lights, displaying the letter "S".

Project #359

“2” & “3” Blinker

OBJECTIVE: To use the alarm IC to flash between “2” and “3”.

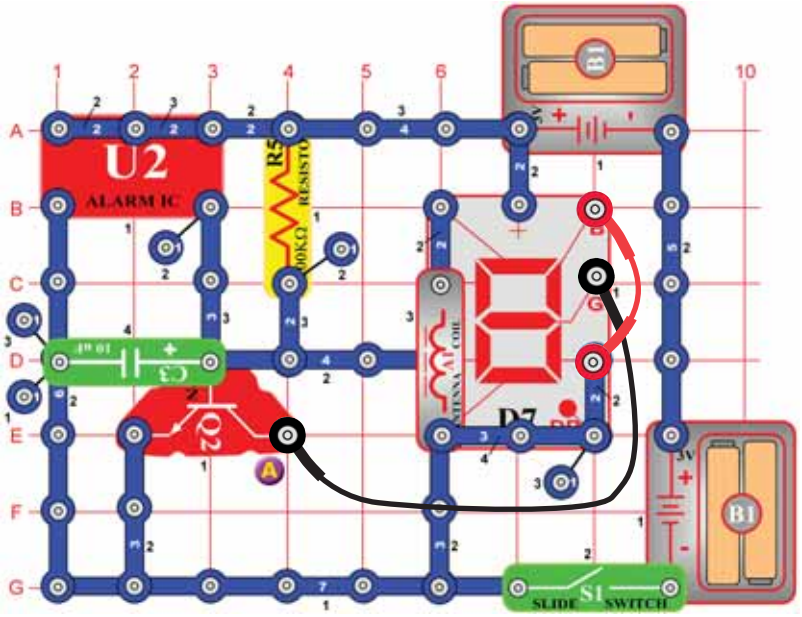


The circuit switches between numbers “2” and “3” on the display.
Place jumpers from point A to segment C and point B to segment E.

Project #360

“9” & “0” Blinker

OBJECTIVE: To use the alarm IC to flash between “9” and “0”.

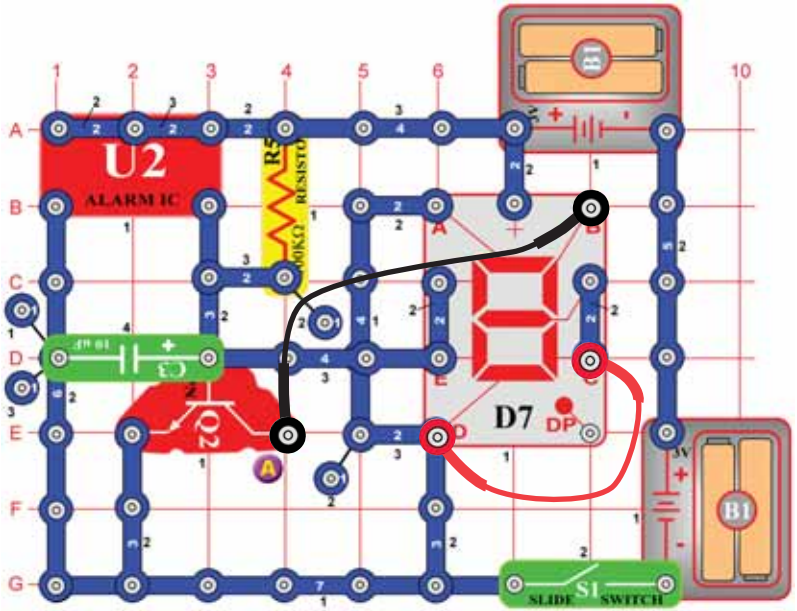


The circuit switches between numbers “9” and “0” on the display.
Place a jumper from point A to segment G and point B to segment E.

Project #361

"3" & "6" Blinker

OBJECTIVE: To use the alarm IC to flash between "3" and "6".

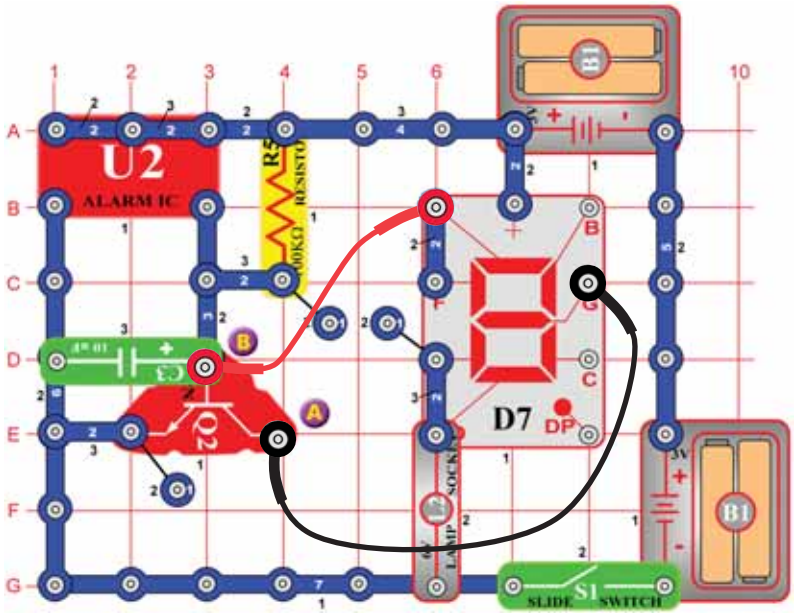


The circuit switches between numbers "3" and "6" on the display. Place a jumper from segment C to segment D and from point A to segment B.

Project #362

"c" & "C" Blinker

OBJECTIVE: To use the alarm IC to flash between "c" and "C".

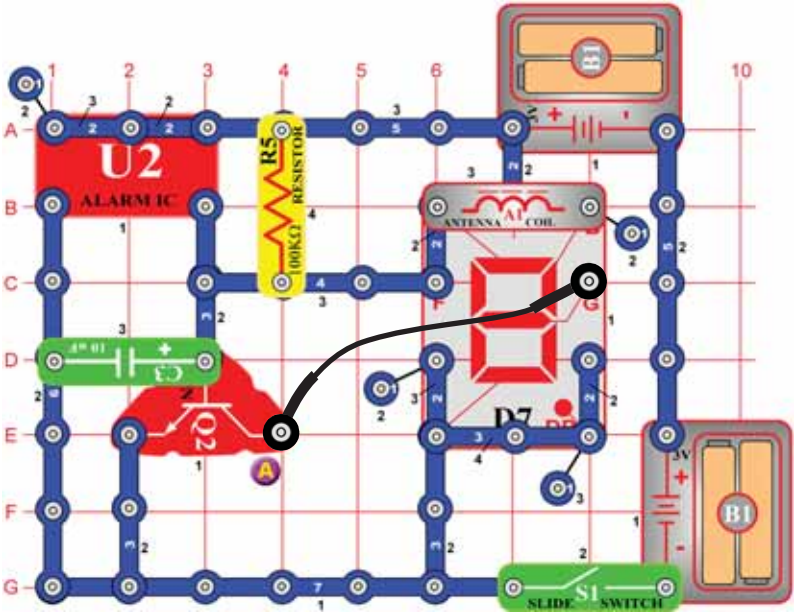


The circuit switches between letters "c" and "C" on the display. Place a jumper from point A to segment G and point B to segment A.

Project #363

“O” & “o” Blinker

OBJECTIVE: To use the alarm IC to flash between “O” and “o”.

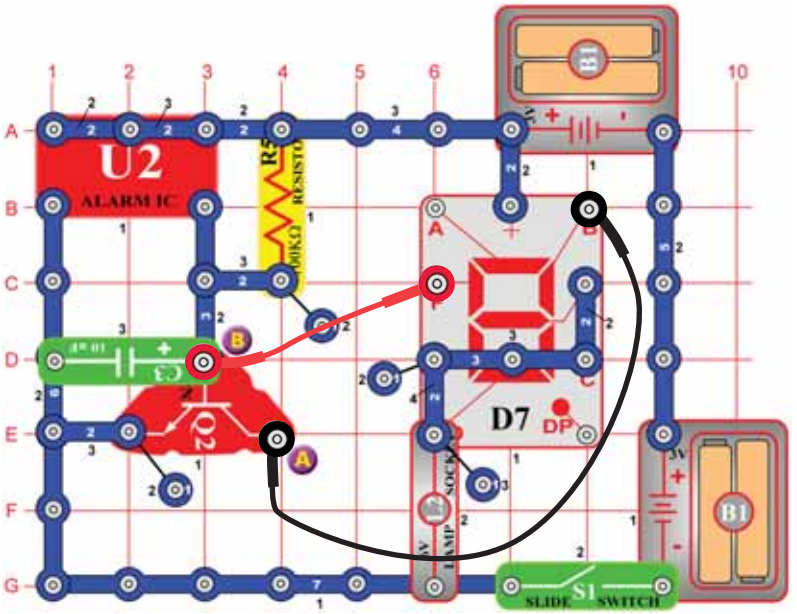


The circuit switches between upper case “O” and lower case “o”. Place a jumper from point A to segment G. The DP segment will also light.

Project #364

“b” & “d” Blinker

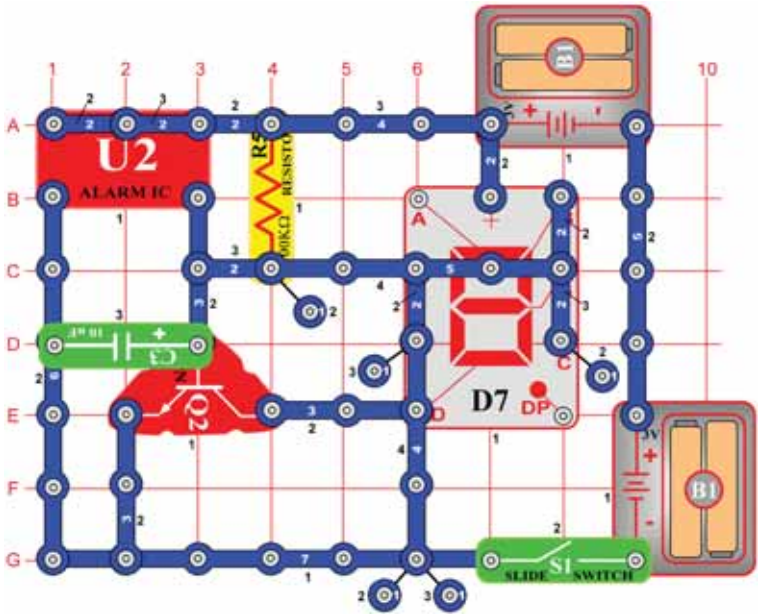
OBJECTIVE: To use the alarm IC to flash between “b” and “d”.



The circuit switches between letters “b” and “d” on the display. Place a jumper from point A to segment B and point B to segment F.

Project #365

"H" & "L" Blinker

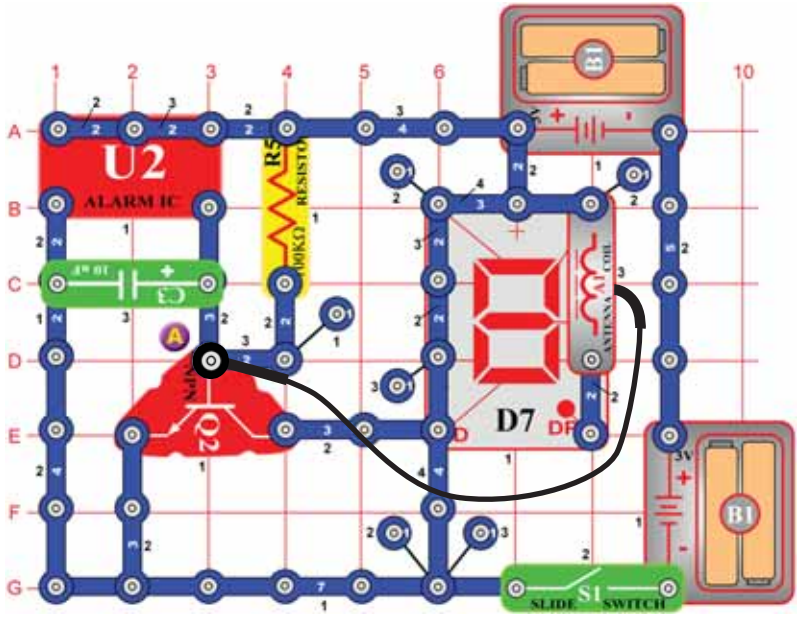


OBJECTIVE: To use the alarm IC to flash between "H" and "L".

The circuit switches between letters "H" and "L" on the display.

Project #366

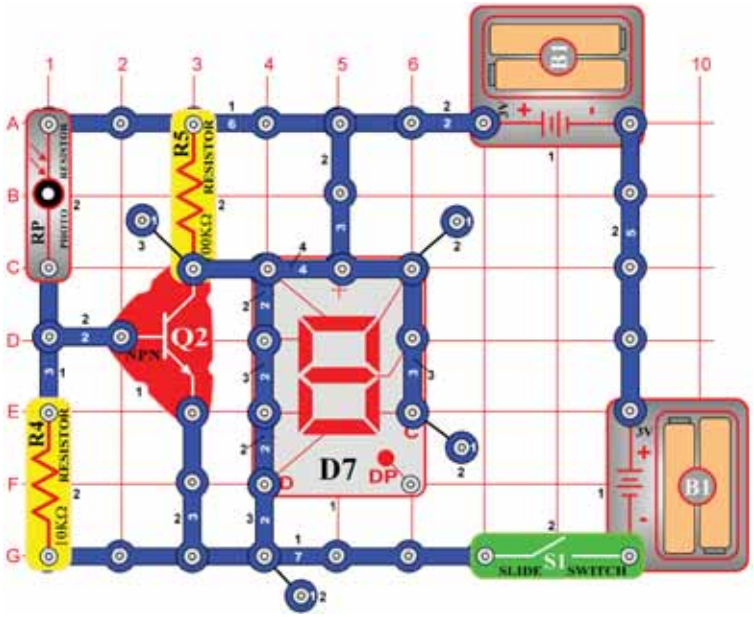
"A" & "O" Blinker



OBJECTIVE: To use the alarm IC to flash between "A" and "O".

The circuit switches between letters "A" and "O" on the display. Place a jumper from point A to segment G. The DP segment will also light.

Project #367

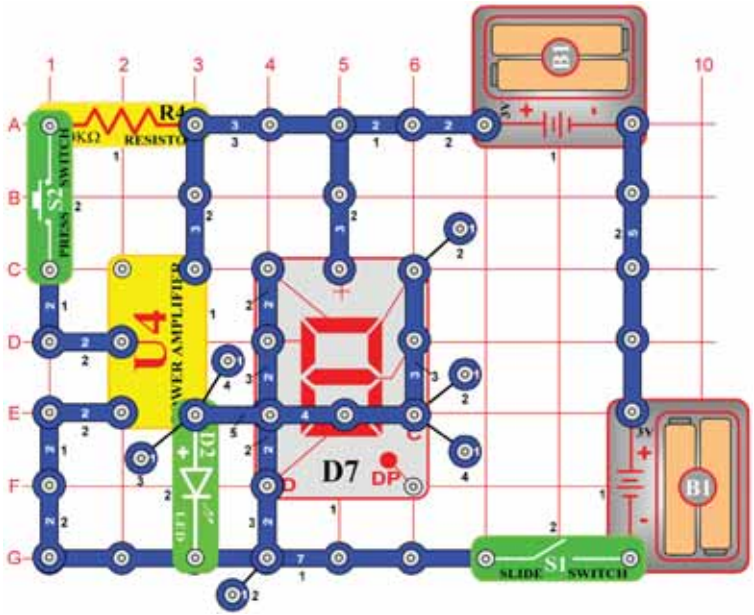


Open & Closed Indicator

OBJECTIVE: To construct a circuit that indicates if a door is open or closed using light.

Switching from letters "O" to "C" requires turning off segments B and C. Turn on the switch (S1), the display lights an "O" indicating an open door. Cover the photoresistor (RP) with your hand (closed door) and the letter "C" lights. The photoresistor turns Q2 on and off depending on the amount of light. When Q2 is on (light on RP) the voltage at the collector is low, lighting segments B and C. Covering the RP turns Q2 off and the collector voltage is high now. Segments B and C turn off and the letter "C" lights.

Project #368



Open & Closed Indicator (II)

OBJECTIVE: To construct a circuit that indicates if a switch is open or closed using U4.

As in project #367, the display will light an "O" or "C" indicating if the switch (S2) is on or off. Turn on the switch (S1), the LED (D2) and letter "O" lights. With no input to U4 the LED lights and the voltage decreases enough so segments B and C light. Press switch S2, the LED turns off and the letter "C" lights. The voltage at U4's output increased enough turning the segments off.

Project #369

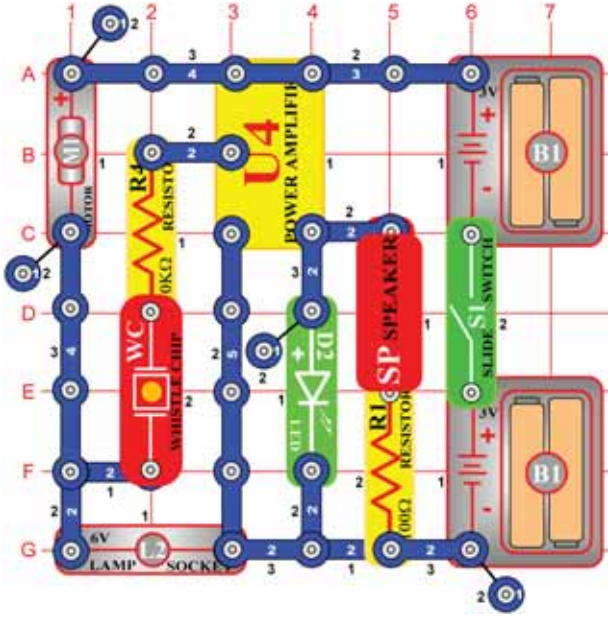
Vibration Indicator

OBJECTIVE: To construct a circuit that indicates vibration.

Modify project #368 by replacing the press switch (S2) with the whistle chip (WC). As you tap the whistle chip, U4's output voltage changes, lighting the LED (D2) and changing the display from "C" to "O".

Project #370

Vibration Sounder



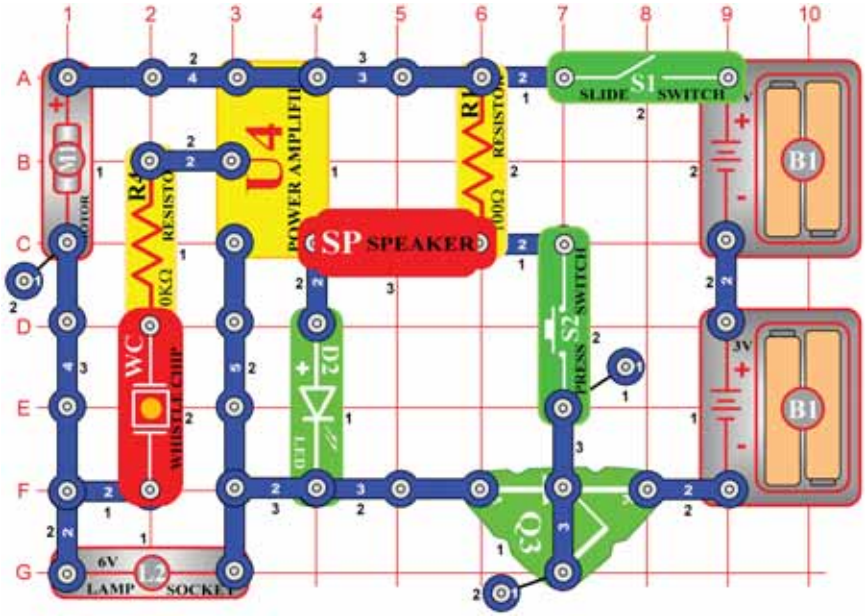
OBJECTIVE: To construct a circuit that indicates vibration.

As the motor (M1) spins, it generates an AC voltage amplified by U4. The output from U4 lights the LED (D2) and makes noise from the speaker (SP). With the fan not installed, turn on the slide switch (S1) and you hear the high tone of the spinning motor. Now, install the fan and hear the difference.

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

Project #371

SCR Noise Circuit

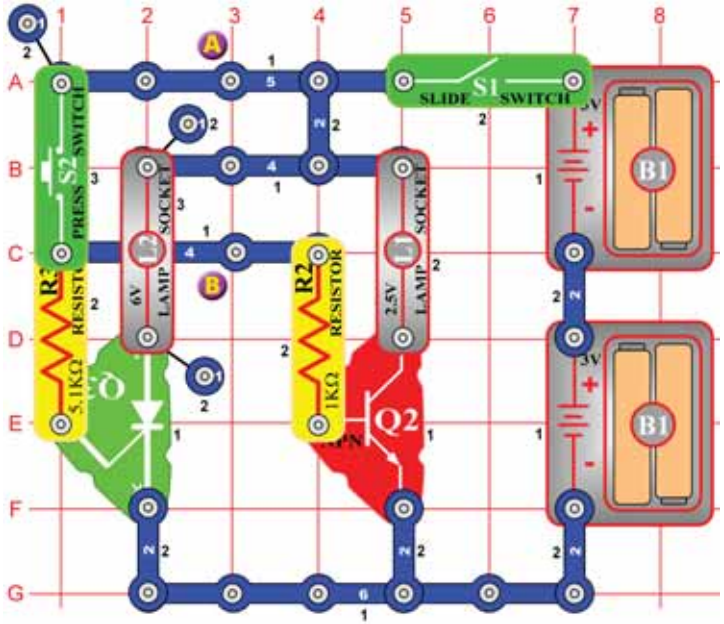


OBJECTIVE: To use the SCR to start a circuit.

Turn on the slide switch (S1) and nothing happens. The SCR (Q3) connects the circuit to the batteries (B1) and, until the SCR's gate goes high, the circuit is off. Press the press switch (S2) and the motor (M1) spins and the LED (D2) and lamp (L2) light. Increase the sound from the speaker (SP) by pressing S2.

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

Project #372

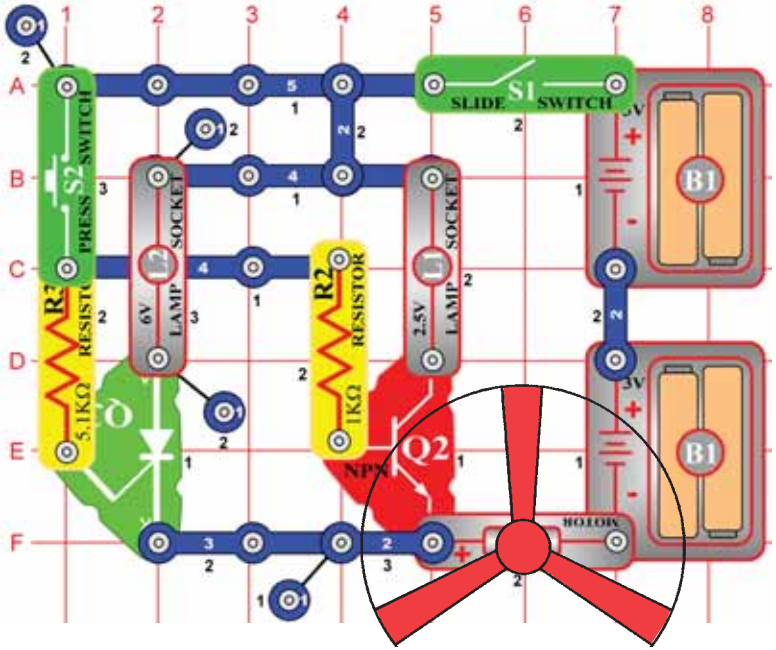


SCR & Transistor Switch

OBJECTIVE: Control lamps L1 and L2 with an SCR and transistor.

Turn the slide switch (S1) on and then press the press switch (S2), both lamps (L1 & L2) light, but only L2 stays on when S2 is released. To stay on, the transistor (Q2) requires a continuous voltage, but the SCR only needs a pulse. Add the 470μF capacitor (C5) across points A & B (make sure the "+" is connected to point A). The capacitor charges up when S2 is pressed. Now as S2 is released, L1 slowly turns off now. As the capacitor discharges, it keeps the transistor on longer.

Project #373



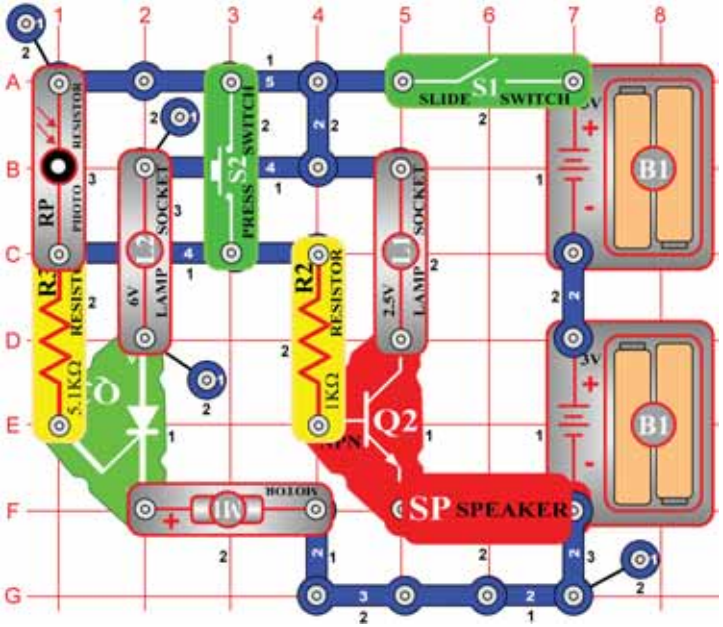
Two-speed Motor

OBJECTIVE: Increase the speed of a motor using an SCR and transistor.

Turning the slide switch (S1) on triggers the SCR (Q3) and the motor (M1) starts spinning. To increase the motor's speed, press down the press switch (S2). This turns on the transistor (Q2) increasing the voltage across the motor.

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

Project #374



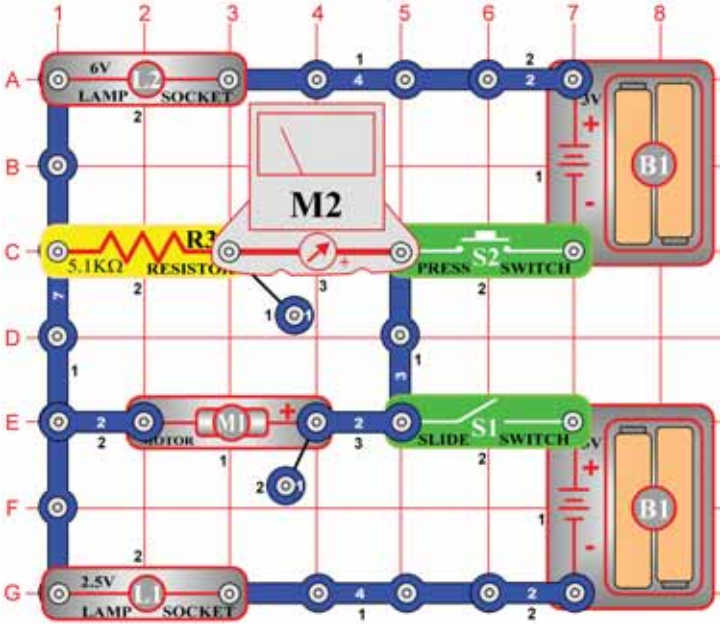
Two-speed Motor (II)

OBJECTIVE: To decrease the speed of a motor using an SCR and transistor.

Instead of increasing the motor's speed as in project #373, pressing the press switch (S2) decreases the speed. In this circuit, the transistor (Q2) is in parallel with the SCR (Q3). Pressing S2 turns on Q2 and the voltage across the motor (M1) decreases.

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

Project #375



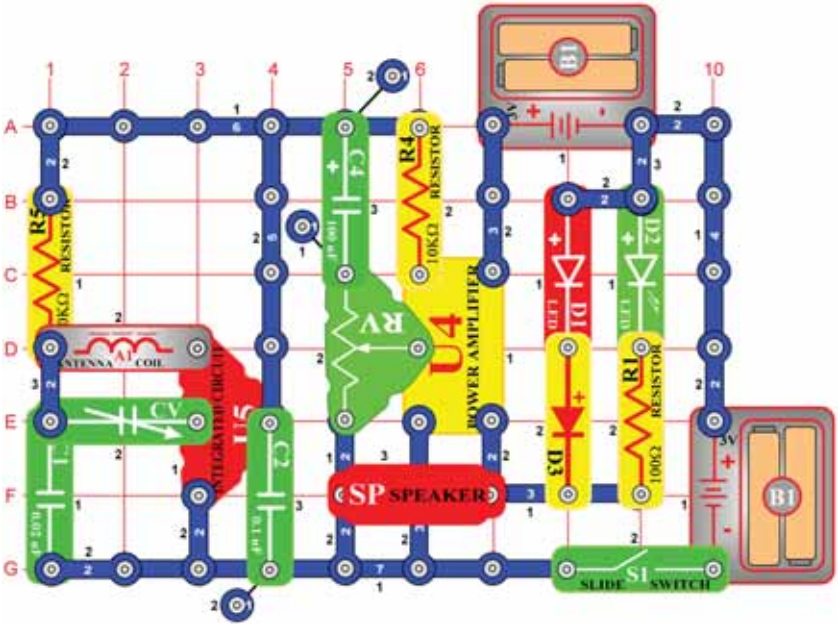
Current Flow

OBJECTIVE: To show the effects of current flow.

Set the meter (M2) to the LOW (or 10mA) position. Turning on the slide switch (S1) connects the motor (M1), meter and 2.5V lamp (L1) to the lower battery (B1) pack. The motor rotates clockwise and the meter deflects right. Now turn off the slide switch and press the press switch (S2). Now, current from the upper battery causes the motor to rotate in the opposite direction. If you place the batteries in series by turning on the slide switch and then pressing the press switch, only the lamps (L1 & L2) light.

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

Project #376

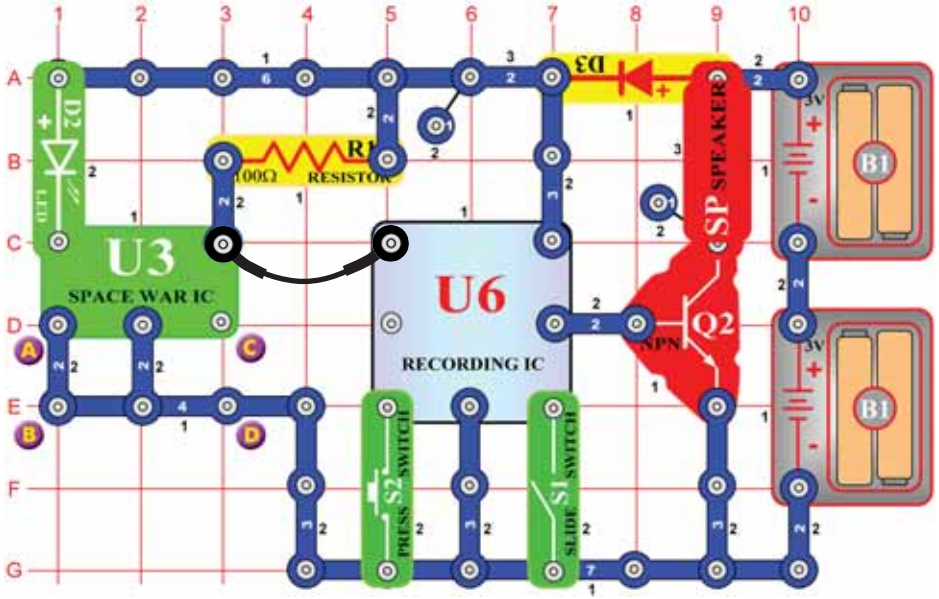


AM Radio with Power LED's

OBJECTIVE: To build an AM radio with LED's.

Set the adjustable resistor (RV) to the middle position and turn the slide switch (S1) on. Tune the radio by adjusting the variable capacitor (CV). The LED's (D1 & D2) flicker as the sound is heard.

Project #377



Space War IC Recording

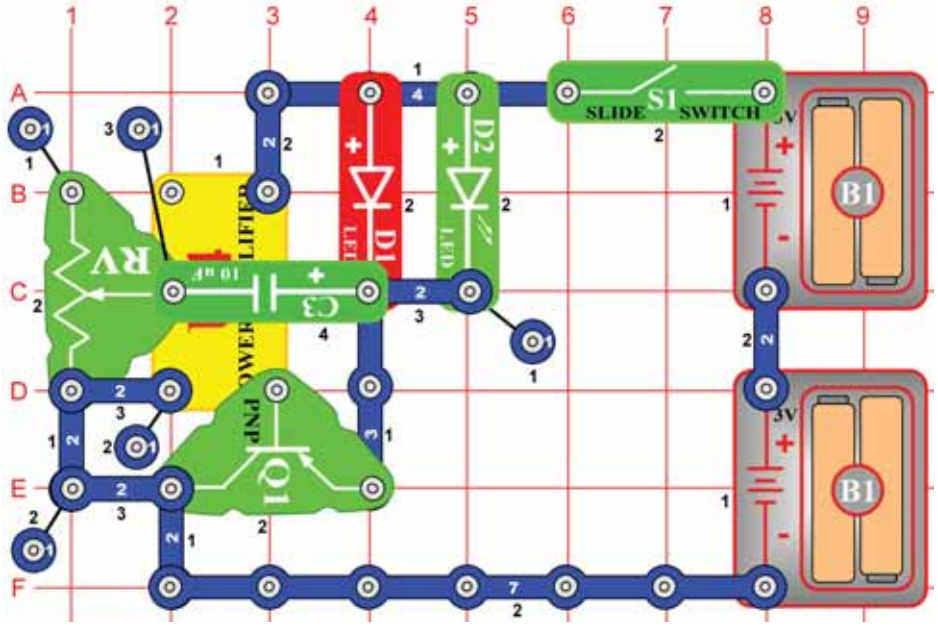
OBJECTIVE: To record the sounds from the space war IC.

The circuit records the sounds from the space war IC (U3) into the recording IC (U6). Turn on the slide switch (S1) and the first beep indicates that the IC has begun recording. When you hear two beeps, the recording has stopped. Turn off the slide switch and press the press switch (S2). You will hear the recording of the space war IC before each song is played.

Place the 2-snap from points A & B onto C & D. Now record a different sound from U3.

Project #378

LED Flasher

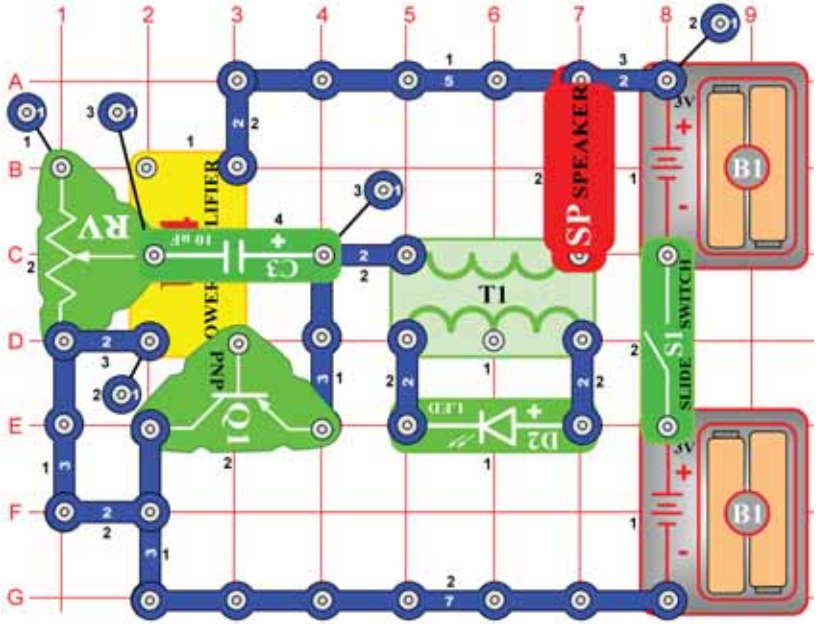


OBJECTIVE: To construct an LED flasher.

Set the adjustable resistor (RV) to the top position and then turn on the slide switch (S1). The LED's (D1 & D2) flash at a rate of once per second. As you adjust RV's knob down, the LEDs flash faster. When RV is at the bottom the LED's turn off.

Project #379

LED Flasher with Sound



OBJECTIVE: To construct an LED flasher with sound.

You can modify project #378 by adding a transformer (T1) to drive a speaker (SP). Set the adjustable resistor (RV) to the top position and turn on the slide switch (S1). The speaker sounds as the LED (D2) flashes at a rate of once per second. Increase the rate by moving RV's knob down.

Project #380

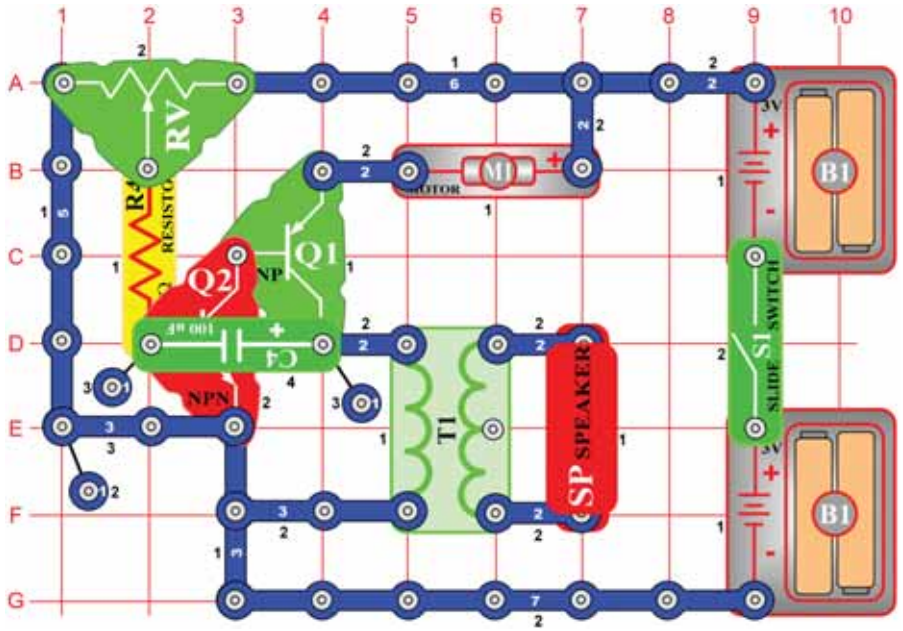
LED Flasher with Sound (II)

OBJECTIVE: To construct an LED flasher with sound.

Modify the frequency by replacing the 10μF capacitor (C3) with the 0.1μF capacitor (C2).

Project #381

Stepper Motor



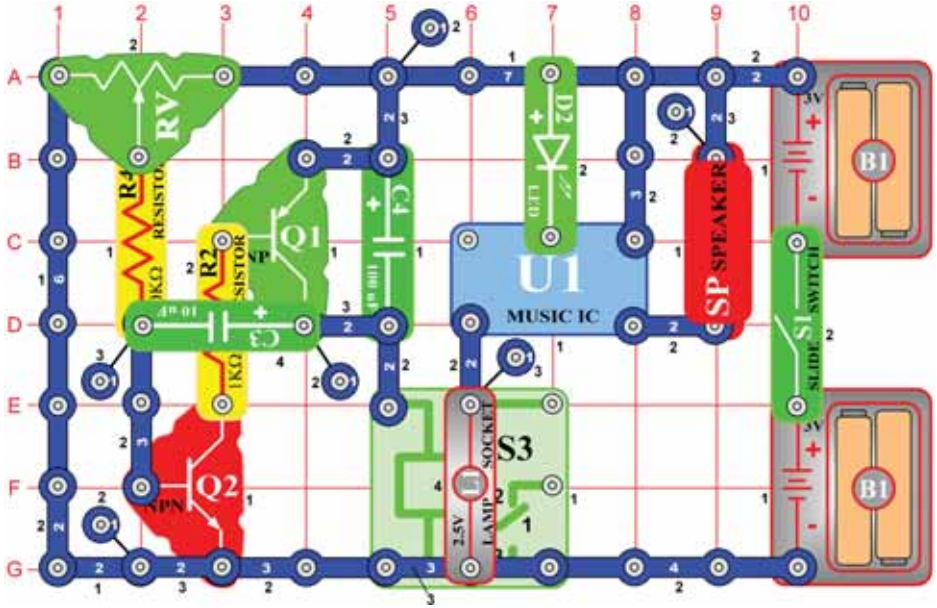
OBJECTIVE: To build a variable stepper motor.

Adjust the adjustable resistor (RV) to the middle position and turn on the slide switch (S1). As the circuit oscillates, the motor (M1) moves a short distance as the speaker (SP) sounds. Adjust the adjustable resistor to different positions seeing how it affects the motor and speaker.

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

Project #382

Crazy Music IC

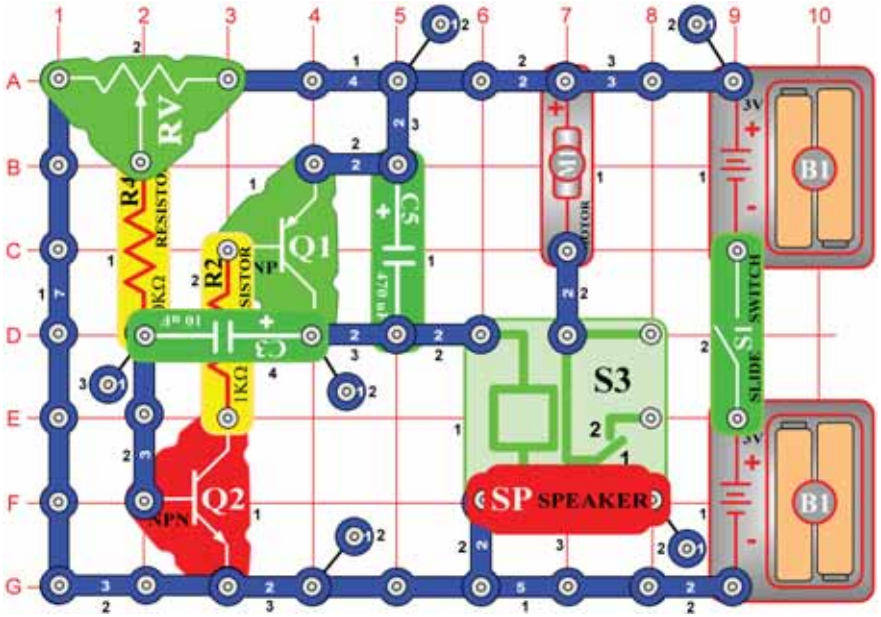


OBJECTIVE: To change the sound of the music IC.

Set the adjustable resistor (RV) to the far left position and turn on the slide switch (S1). The relay's (S3) contacts open and close shorting U1 to ground, causing the sound level to change.

Project #383

Stepper Motor w/ Sound



OBJECTIVE: To add sound to a stepper motor circuit.

Set the adjustable resistor (RV) to the middle position. Turn the slide switch (S1) on and the motor (M1) pulses on and off as the speaker (SP) sounds. As the circuit oscillates, the relay's (S3) contacts open and close shorting the motor and speaker to ground. See how much you can adjust the adjustable resistor before the motor turns off or continuously spins.

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

Project #384

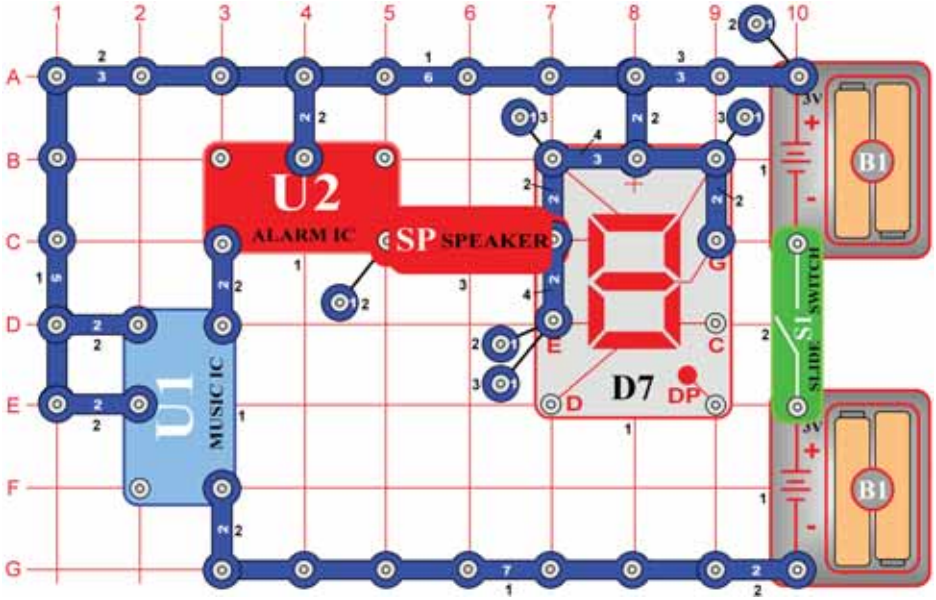
Stepper Motor w/ Light

OBJECTIVE: To add light to a stepper motor circuit.

Modify project #383 by removing the speaker (SP) and replacing it with the lamp (L1). Now when you turn the slide switch (S1) on, the lamp lights as the motor (M1) spins.

Project #385

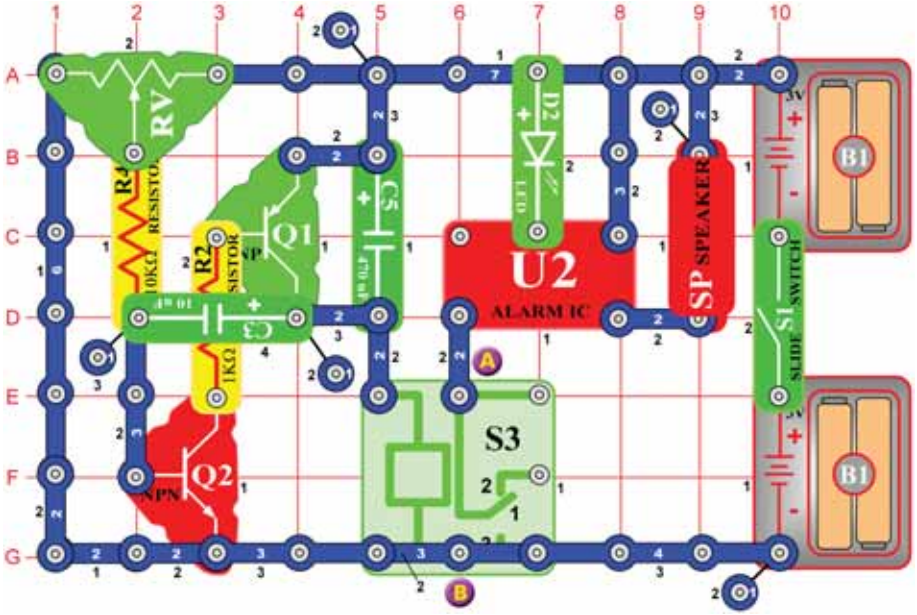
Police Siren with Display



OBJECTIVE: To display the letter "P" as the alarm IC sounds.

Turn the slide switch (S1) on and the speaker (SP) sounds as the letter "P" lights. You also hear the music IC (U1) playing. The alarm IC (U2) plays as long as the music IC is on since U2 is connected to U1's output. After 20 seconds, the circuit turns off for 5 seconds and then starts again.

Project #386



Oscillator Alarm

OBJECTIVE: To control the alarm IC with an oscillator circuit.

Set the adjustable resistor (RV) to the far left and turn the slide switch (S1) on. The speaker (SP) sounds only once. Slowly move the adjustable resistor to the right, the speaker momentarily sounds. As you move the adjustable resistor to the right, the alarm is on continuously. The adjustable resistor controls the frequency of the oscillator circuit (C3, C5, Q1, Q2) by adjusting the voltage at Q2's base. The relay (S3) switches the alarm IC (U2) on and off.

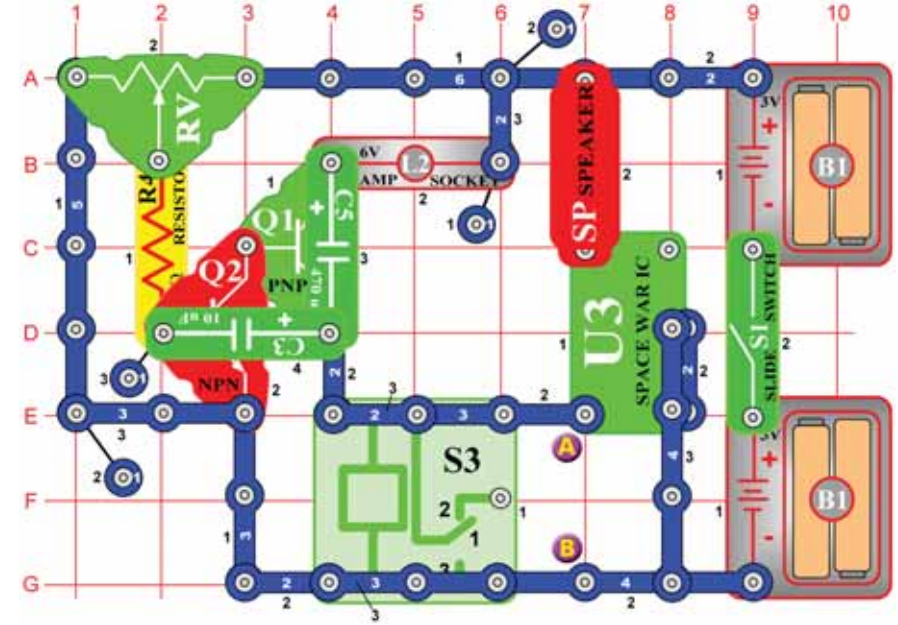
Project #387

Oscillator Alarm (II)

OBJECTIVE: To control the alarm IC with an oscillator circuit.

Using a single snap, connect the red LED (D1) across points A & B ("+" side on point A). Turn the slide switch (S1) on and the circuit has a different sound now.

Project #388



Tapping U3

OBJECTIVE: To control the space war IC with an oscillator circuit.

Set the adjustable resistor (RV) to the middle position and turn the slide switch (S1) on. This is another example using the oscillator that switches the power on and off creating sound. Alter the sound by adjusting the adjustable resistor.

Project #389

Tapping U3 (II)

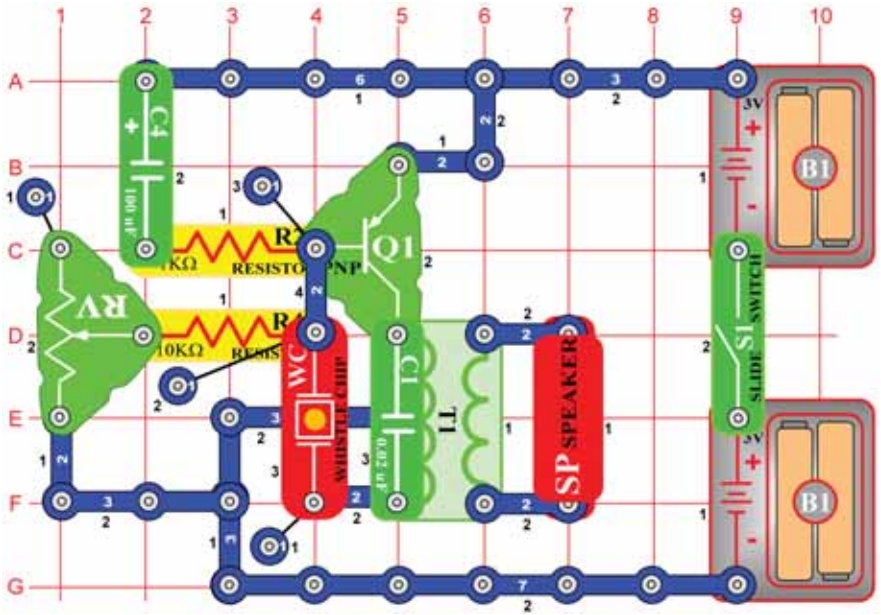
OBJECTIVE: To control the space war IC with an oscillator circuit.

Connect the motor (M1, "+" side up) across points A & B. Set the adjustable resistor (RV) to the middle position and turn the slide switch (S1) on. Now you hear random noise and static from the speaker (SP). The motor causes the random static and noise from the speaker.

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

Project #390

Adjustable Beeper

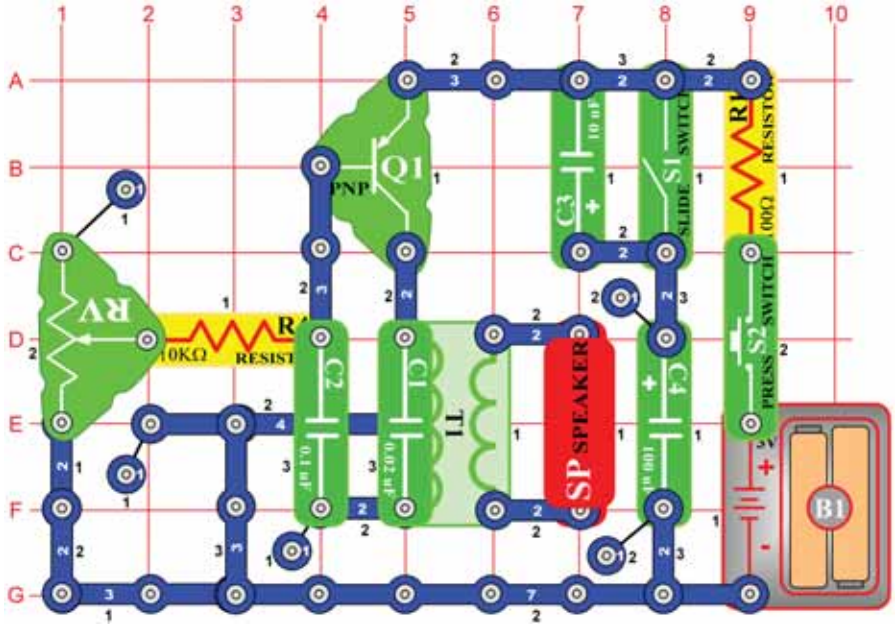


OBJECTIVE: To build a simple oscillator that beeps.

Turn the slide switch (S1) on and this simple oscillator circuit outputs a beep from the speaker (SP). Change the frequency by adjusting the adjustable resistor (RV).

Project #391

Electronic Cat



OBJECTIVE: To create the sound of a cat's meow.

Turn off the slide switch (S1) and then press and release the press switch (S2). You hear a "cat's meow" from the speaker (SP). Now turn the slide switch on and the sound is lower and lasts longer. Adjust the adjustable resistor (RV) while the sound is fading away.

Project #392

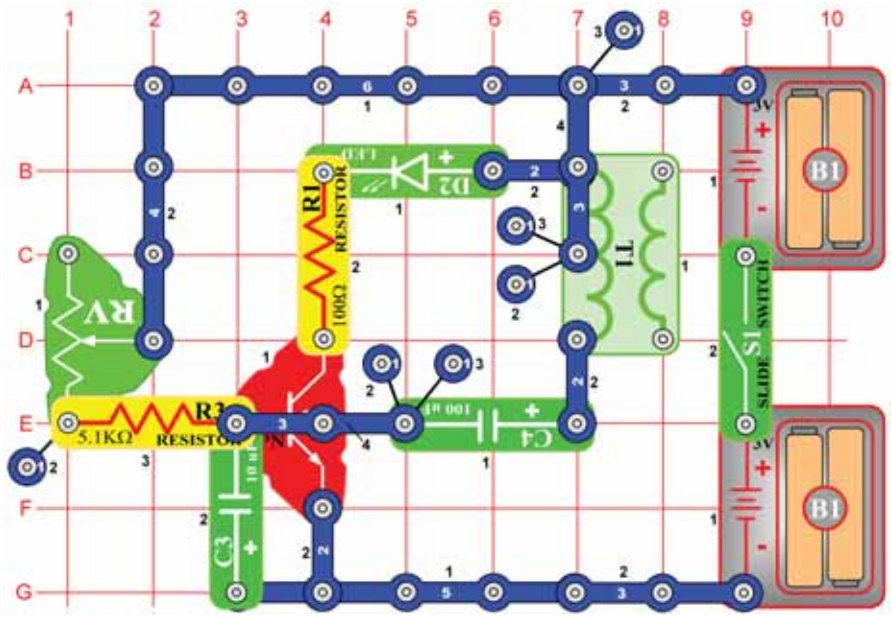
Electronic Cat (II)

OBJECTIVE: To add the photoresistor to project #391.

Replace the 10KΩ resistor (R4) with the photoresistor (RP). Wave your hand over photoresistor as you press down on the press switch (S2).

Project #393

Strobe Light

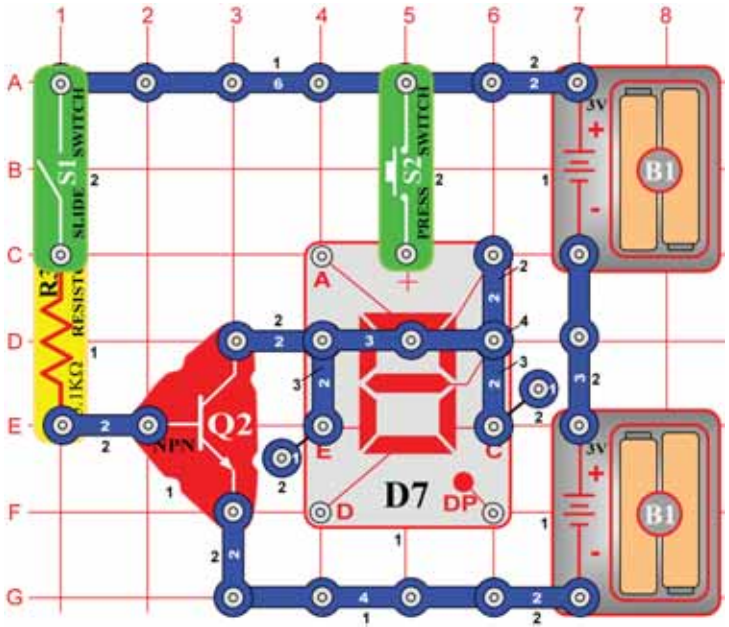


OBJECTIVE: To construct an LED strobe light.

This is an example of how a large strobe light works. Turn the slide switch (S1) on and the LED (D2) flashes at a certain frequency. Adjust the frequency by adjusting the adjustable resistor (RV). Now add sound by replacing the 100Ω resistor (R1) with the speaker (SP). Each time the LED lights, the speaker sounds.

Project #394

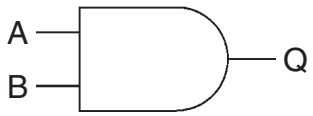
AND Gate



OBJECTIVE: To demonstrate the operations of the AND gate.

In digital electronics, there are two states, 0 and 1. The **AND gate** performs a logical "and" operation on two inputs, A & B. If A **AND** B are both 1, then Q should be 1. The logic table below shows the state of "Q" with different inputs and the symbol for it in circuit diagrams.

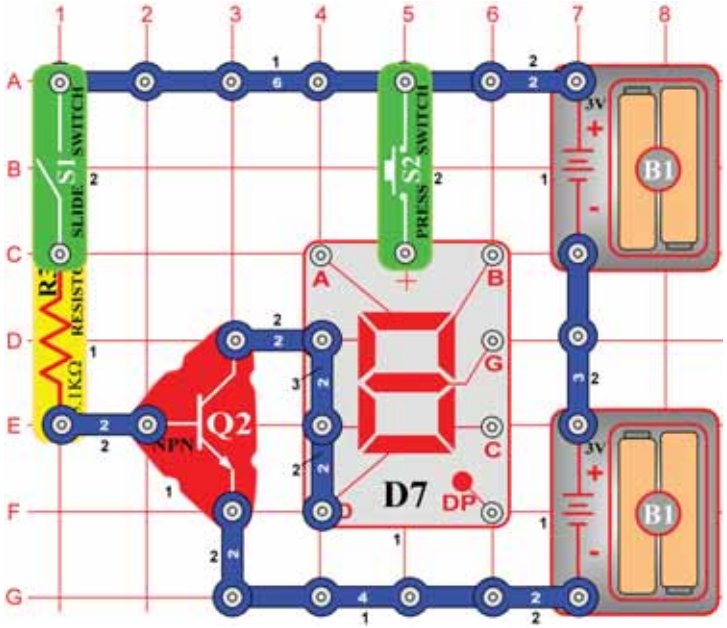
A	B	Q	D7
0	0	0	–
1	0	0	–
0	1	0	–
1	1	1	"H"



AND Gate

Turn the slide switch (S1) on and the display does not light. Turn the slide switch off and then press the press switch (S2) and still the display does not light. Turn the slide switch on and press the press switch down. Now, the LED and the letter "H" light.

Project #395

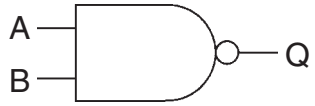


NAND Gate

OBJECTIVE: To demonstrate the operations of the NAND gate.

The NAND gate works the opposite of the AND as shown in the logic chart.

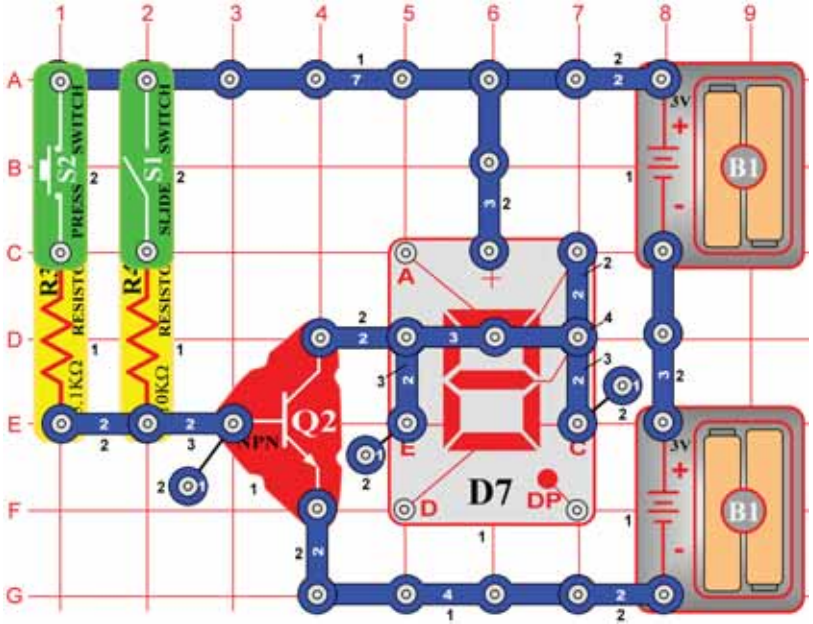
A	B	Q	D7
0	0	1	–
1	0	1	–
0	1	1	–
1	1	0	"L"



NAND Gate

Using the chart set the switches to the different states. When you have a logic "0" the display lights the letter "L".

Project #396

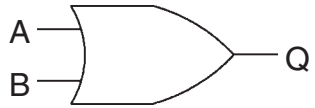


OR Gate

OBJECTIVE: To demonstrate the operations of the OR gate.

The basic idea of an OR gate is: If A OR B is 1 (or both are 1), then Q is 1.

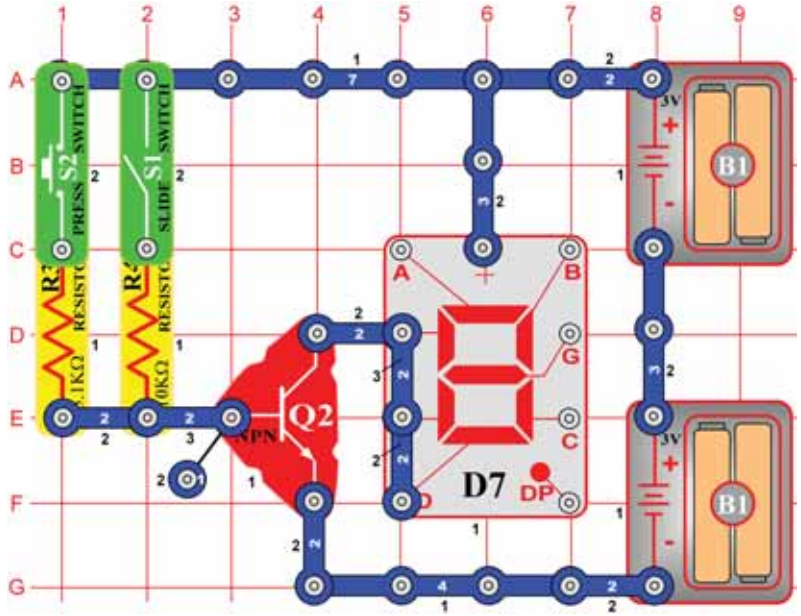
A	B	Q	D7
0	0	0	–
1	0	1	"H"
0	1	1	"H"
1	1	1	"H"



OR Gate

Using the chart set the switches to the different states. Only when you a have logic "0" the display does not light the "H".

Project #397

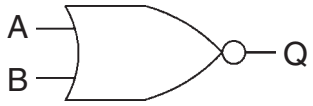


NOR Gate

OBJECTIVE: To demonstrate the operations of the NOR gate.

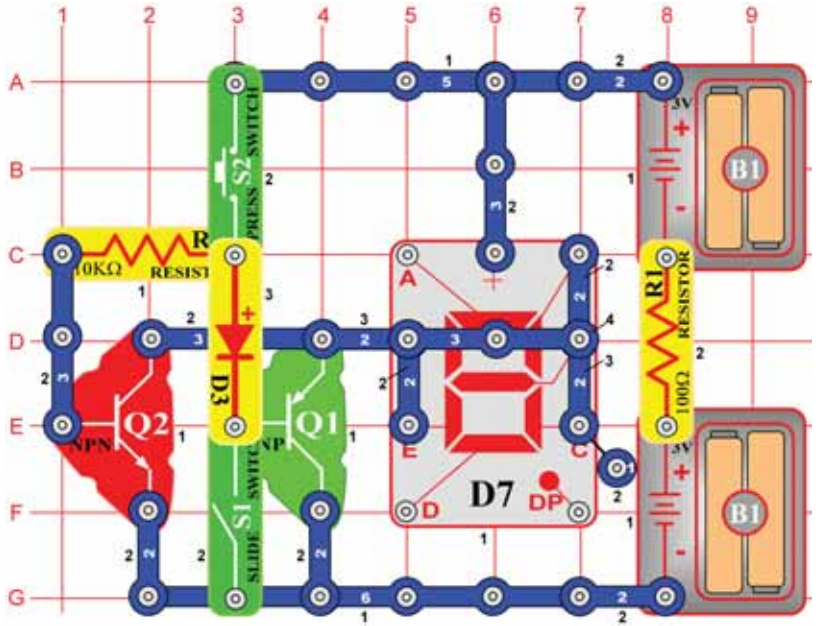
The NOR gate works the opposite of the OR. Using the chart set the switches to the different states. The display lights the letter "L" when either switch is turned on.

A	B	Q	D7
0	0	1	–
1	0	0	"L"
0	1	0	"L"
1	1	0	"L"



NOR Gate

Project #398

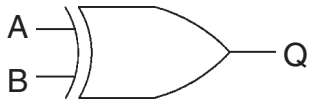


XOR Gate

OBJECTIVE: To demonstrate the operations of the "exclusive or" XOR gate.

In an XOR gate the output "Q" is only high when inputs "A" or "B" is set high (1).
Using the chart set the switches to the different states. The display lights the letter "H" only when either switch is turned on.

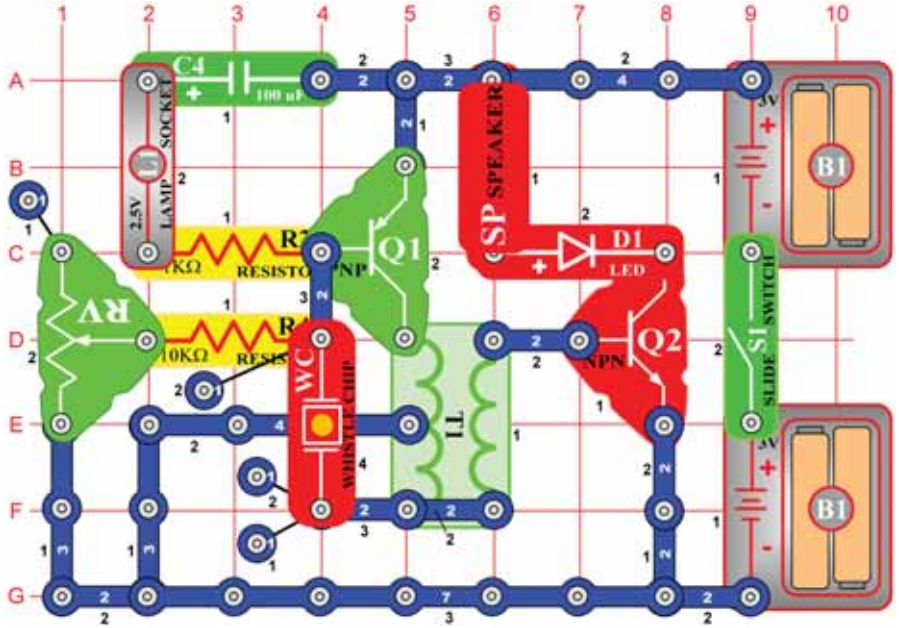
A	B	Q	D7
0	0	0	–
1	0	1	"H"
0	1	1	"H"
1	1	0	–



XOR Gate

Project #399

High Pitch Oscillator



OBJECTIVE: To build a high pitch oscillator.

Set the adjustable resistor (RV) to the top position and then turn the slide switch (S1) on. You hear a high pitch sound and the LED (D1) flashes at the same rate. Change the oscillator frequency by adjusting the adjustable resistor.

Project #400

Low Pitch Oscillator

OBJECTIVE: To modify project #399.

Replace the whistle chip (WC) with the 0.1μF capacitor (C2). Turn the slide switch (S1) on and now the circuit oscillates at a lower frequency.

Project #401

Low Pitch Oscillator (II)

OBJECTIVE: To modify project #399.

Replace the 0.1μF capacitor (C2) with the 10μF capacitor (C3) placing the + sign towards the top. Turn the slide switch (S1) on, now the circuit oscillates at a lower frequency.

Project #402

Low Pitch Oscillator (III)

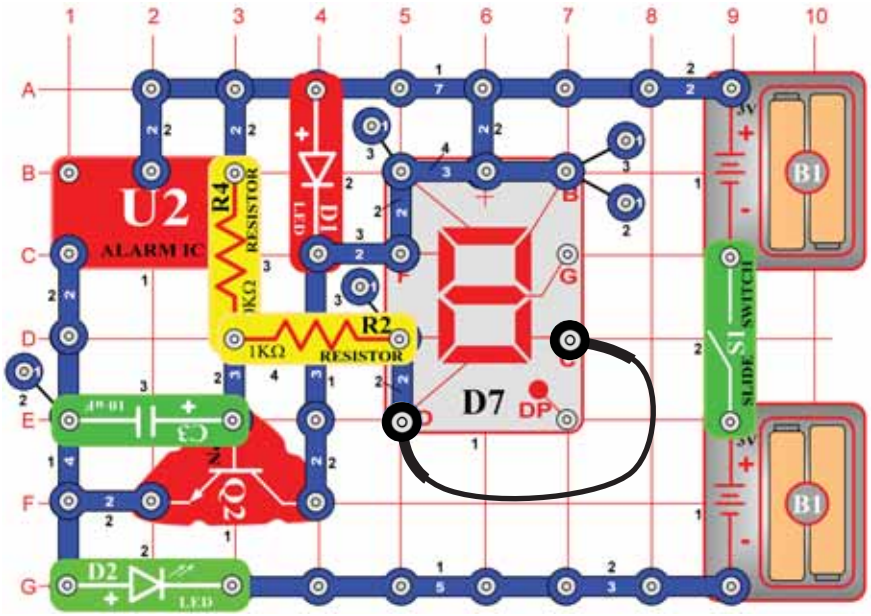
OBJECTIVE: To modify project #399.

Replace the 10μF capacitor (C3) with the 470μF capacitor (C5) placing the + sign towards top. Turn the slide switch (S1) on and the circuit oscillates at a lower frequency now.

Project #403

Segment Jumper

OBJECTIVE: To use the alarm IC with the 7-segment display.

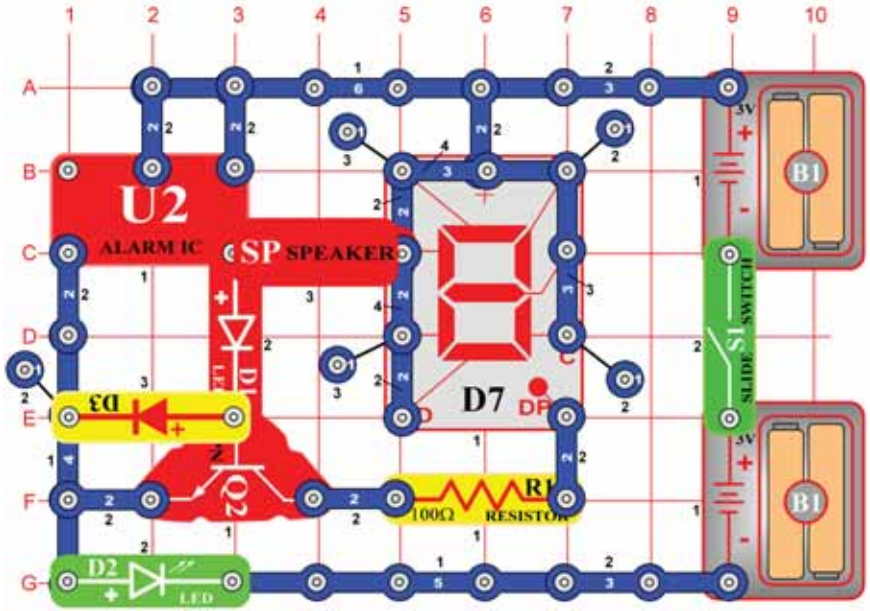


Turn the slide switch (S1) on, segments A, B, and F light and then segments C, D, and E. The two groups of segments are connected to different voltages. As the voltage changes from high to low, the segments toggle back and forth.

Project #404

DP & Zero Flasher

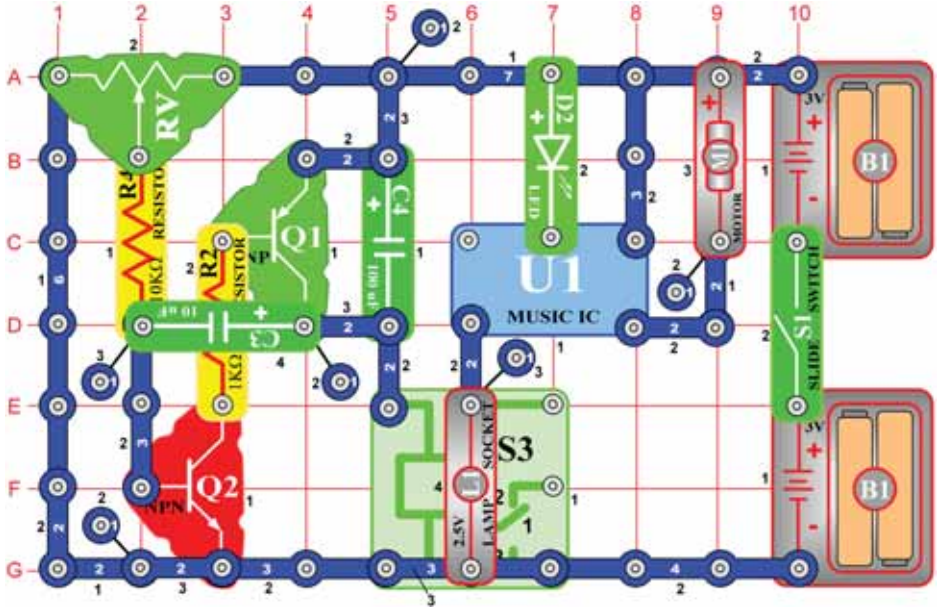
OBJECTIVE: To use the alarm IC with the 7-segment display.



As in project #403, we use the alarm IC (U2) to flash segments and LED's. Turn the slide switch (S1) on and the number "0" and green LED (D2) flash as the speaker (SP) sounds. When they turn off, the DP segment lights.

Project #405

Stepper Motor with Lamp & LED



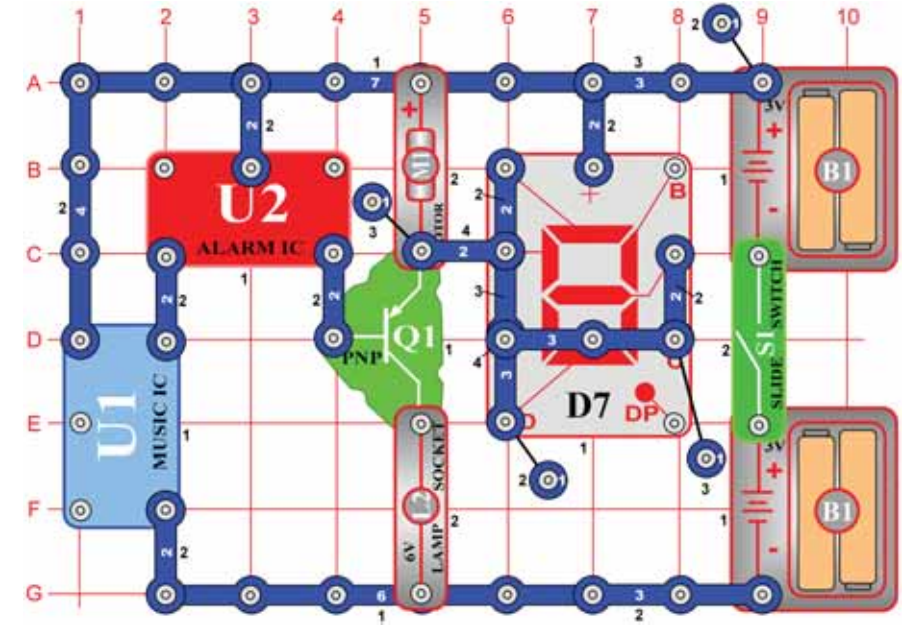
OBJECTIVE: To add an LED to a stepper motor circuit.

The circuit works the same as project #384 except now the green LED (D2) lights when the motor (M1) and lamp (L1) are off. Set the adjustable resistor (RV) to the middle position. Turn the slide switch (S1) on, the motor spins, the bulb lights, and then turn off as the green LED lights. Even though the motor is connected to the LED, it will not spin because the series resistor limits the current.

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

Project #406

IC Start & Stop



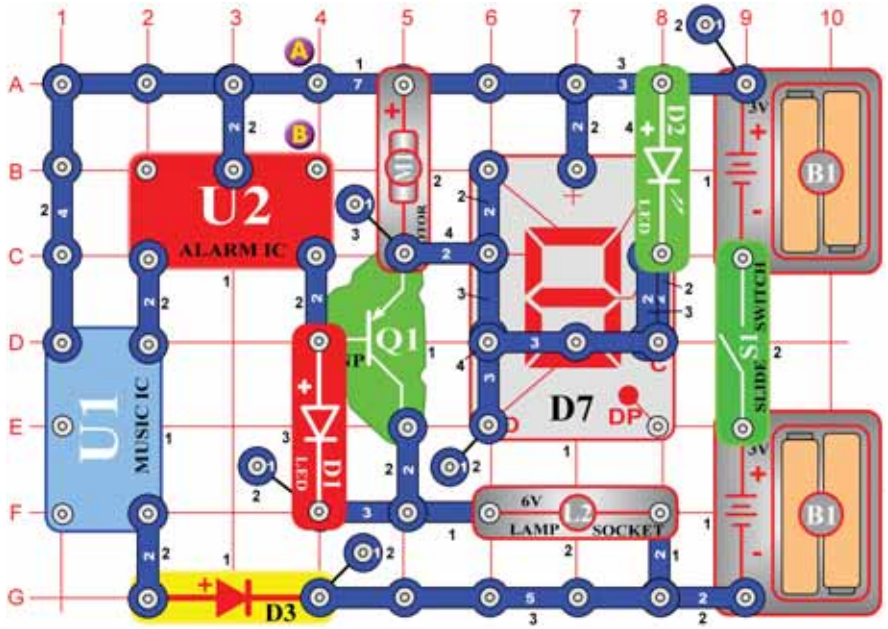
OBJECTIVE: To drive the motor and display with two IC modules.

Turn the slide switch (S1) on. As the output from the IC (U2) drives the transistor (Q1), the motor (M1) spins and the display (D7) lights the letter “S” and then turns off.

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

Project #407

IC Motor Speed



OBJECTIVE: To modify project #406 so the motor slows down.

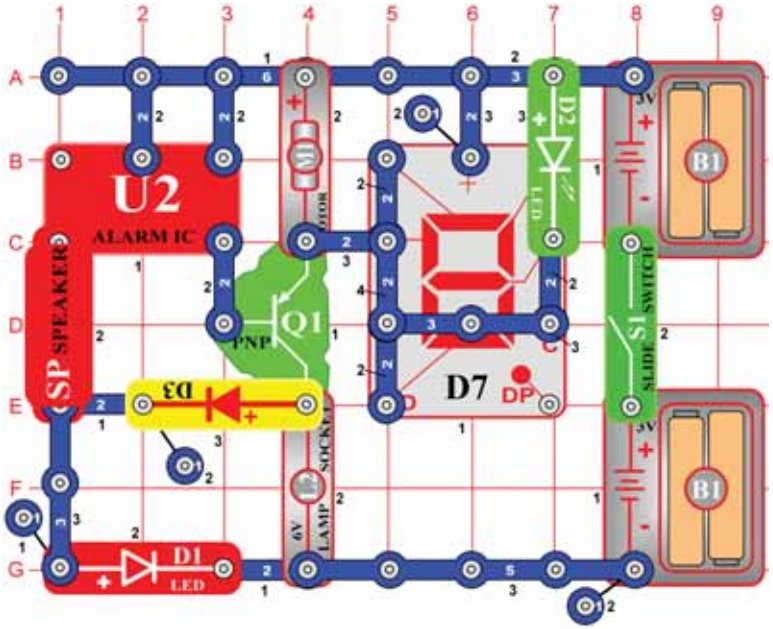
Turn the slide switch (S1) on. As the output from the IC (U2) drives the transistor (Q1), the motor (M1) spins and the display (D7) lights the letter "S". Instead of turning off as in project #406, the motor slows down and the red LED (D1) lights.

Modify the circuit by placing a jumper wire across points A & B. Now the circuit pulses and then runs continuously for a short time.

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

Project #408

Sound & Light Flasher

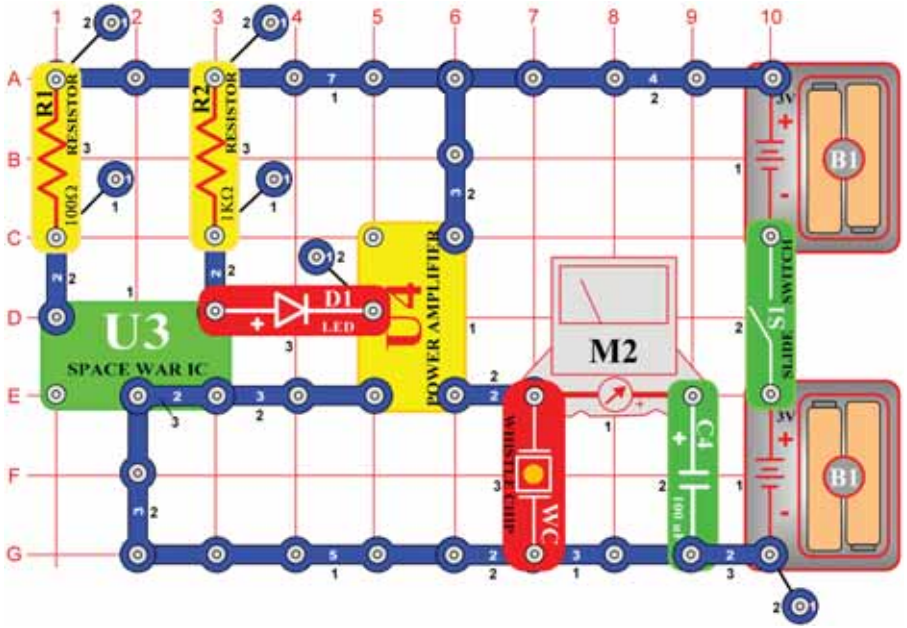


OBJECTIVE: To use the alarm IC to drive the motor, speaker, LED and bulb.

Turn the slide switch (S1) on and the speaker (SP) outputs the sounds from the alarm IC (U2). The IC also drives the transistor (Q1) causing the motor (M1) to spin and lights to flash.

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

Project #409

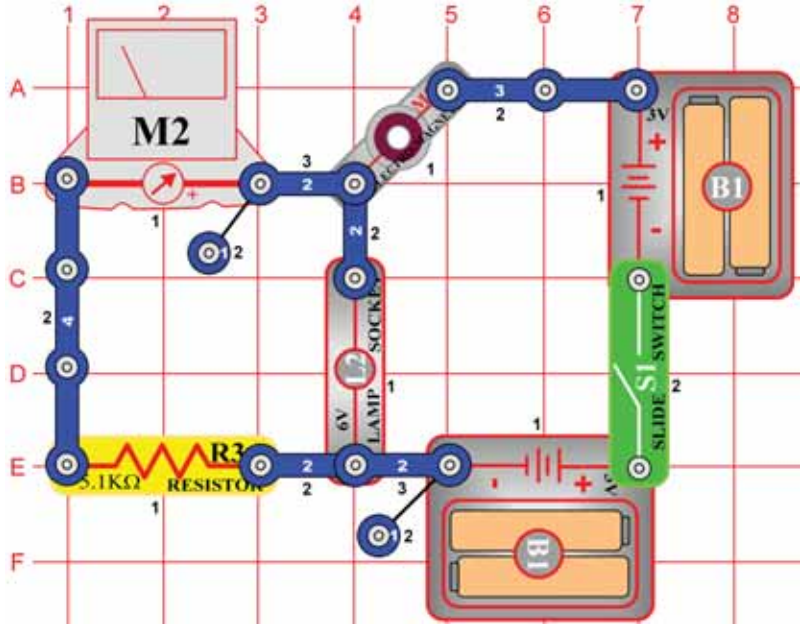


Swinging Meter with Sound

OBJECTIVE: To see and hear the output from the Space War IC.

Set the meter (M2) to the LOW (or 10mA) scale. In this project, you will see and hear the output from the space war IC (U3). The power amplifier IC (U4) amplifies the signal from U3 in order to drive the whistle chip (WC) and meter. Turn on the slide switch (S1). The meter deflects back and forth, as the LED (D1) flashes and the whistle chip sounds. Replace the whistle chip with the speaker (SP) for a louder sound. Note that the meter will not deflect now. Almost all the signal is across the speaker due to its low resistance.

Project #410

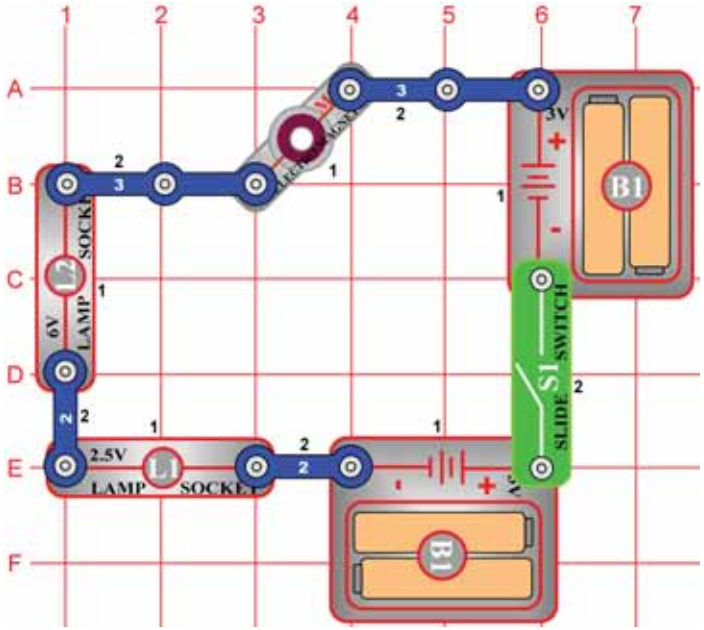


Electromagnet Delayer (II)

OBJECTIVE: To learn about the electromagnet.

Use the LOW (or 10mA) setting on the meter (M2) and turn on the slide switch (S1). The meter shows how the current slowly rises. After a delay of about 2 seconds, the lamp (L2) will light but be dim.

Project #411



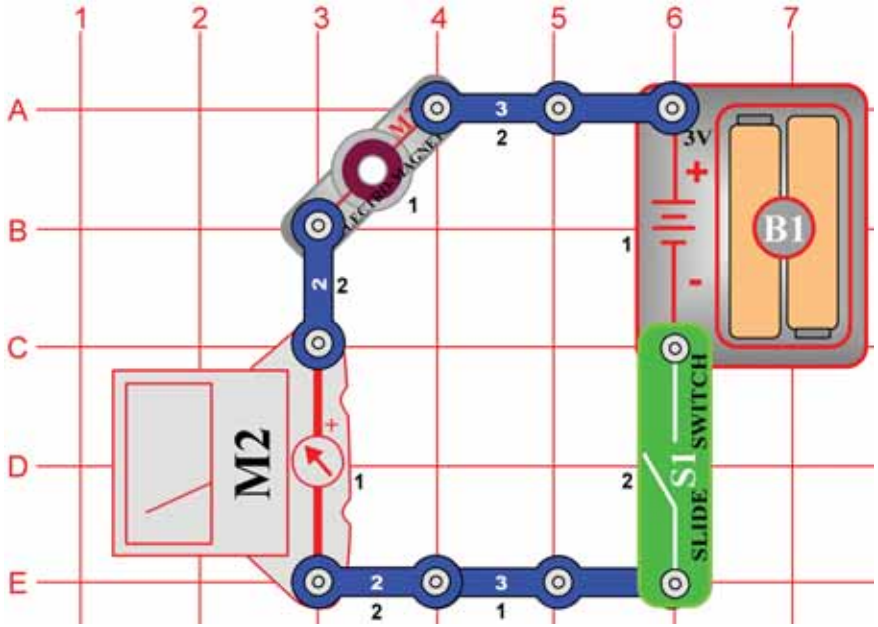
Two-Lamp Electromagnet Delayer

OBJECTIVE: To learn about the electromagnet.

Build the circuit and turn it on. First the 2.5V lamp (L1) turns on, and then the 6V lamp (L2) turns on. Both may be dim, replace your batteries if they do not light at all.

The electromagnet (M3) stores energy, and the batteries must fill it up before the lamps become bright. The smaller lamp turns on sooner because it needs less current to light.

Project #412

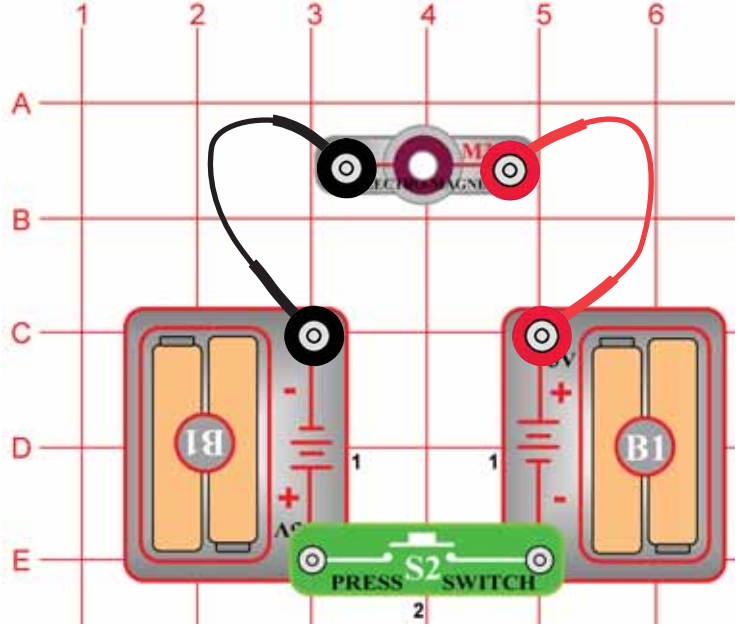


Electromagnet Current

OBJECTIVE: To measure the electromagnet current.

Use the HIGH (or 1A) setting on the meter (M2) to measure the electromagnet (M3) current. Compare the meter reading to that for the motor and lamp current in projects #330-332. Insert the iron core rod into the electromagnet and see if it changes the meter reading.

Project #413 Electromagnetism (II)



OBJECTIVE: To learn how electricity and magnetism are related.

Put the iron core rod into the electromagnet (M3). Press the press switch (S2) and place the electromagnet (M3) near some iron objects like a refrigerator or a hammer, it will be attracted to them. You can use it to pick up iron objects, such as nails.

Electricity and magnetism are closely related, and an electric current flowing in a coil of wire has a magnetic field just like a normal magnet. Placing an iron rod through the coil magnifies this magnetic field. Notice that when the electromagnet is attracted to an iron object, its attraction is strongest at the ends of the iron core rod. If you remove the iron core rod from the electromagnet then its magnetic properties are greatly reduced - try this.

If you place the electromagnet upside down under a large object like a table, you can suspend it there. Be careful though, since it will fall when you release the switch.

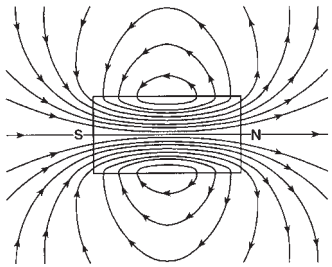
You can use this circuit to see which things are made of iron. Other metals like copper or aluminum will not be attracted to the electromagnet.

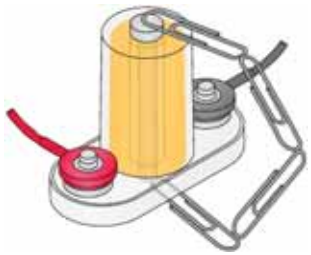
Project #414 Electromagnetism & Paper Clips

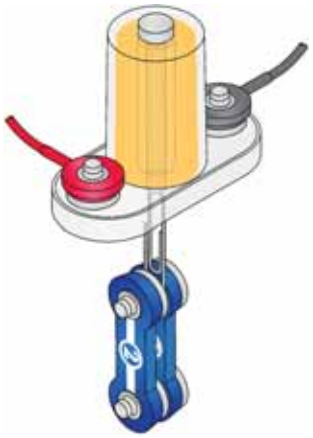
OBJECTIVE: To learn how electricity and magnetism are related.

Use the circuit from project #413, with the iron core rod in the electromagnet (M3). Snap two 2-snaps around a paper clip as shown. Press the press switch (S2) and use the electromagnet to pick up the paper clip and 2-snaps, they will be attracted to both ends of the iron core rod.

The magnetic field created by the electromagnet occurs in a loop, and is strongest in the iron core rod in the middle. You can see this loop with some paper clips:



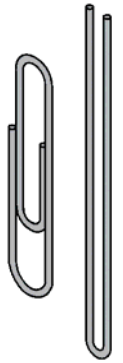




An electric current flowing in a coil of wire has a magnetic field, which tries to suck iron objects into its center. You can see this using the circuit from project #413.

Lay the electromagnet on its side with the iron core rod sticking out about half way, and press the press switch. The iron rod gets sucked into the center.

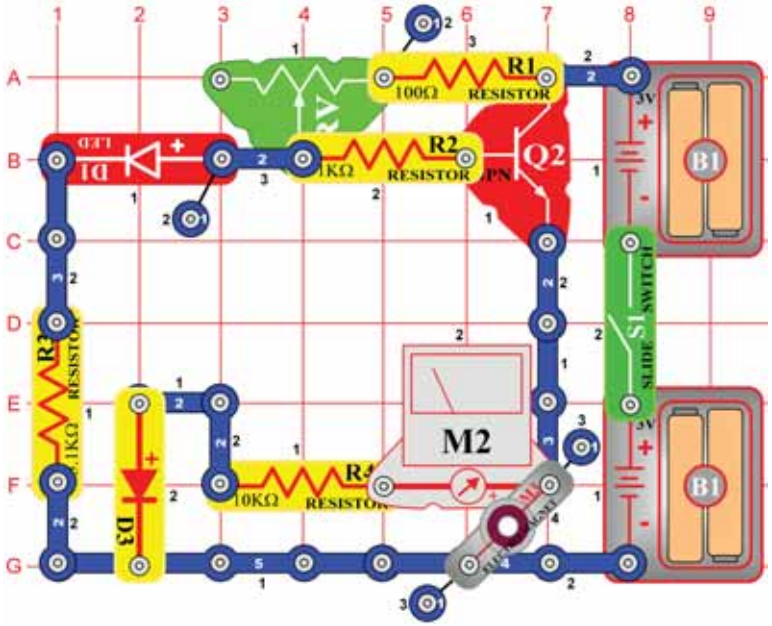
A lighter iron object will show this better. Take a paper clip and straighten it out, then bend it in half.



Place the bent paper clip next to the electromagnet and press the press switch to see it get sucked in. Gently pull it out to feel how much suction the electromagnet has.

Try sucking up other thin iron objects, like nails.

Project #415



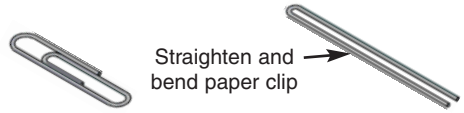
Adjustable Paper Clip Suspension

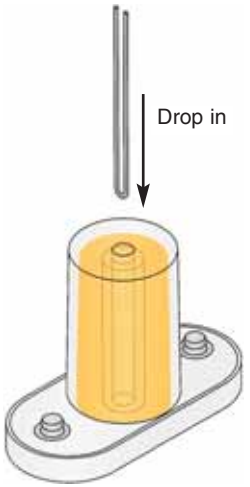
OBJECTIVE: To show how electricity can lift things using magnetism.

Use the LOW (or 10mA) setting on the meter (M2). Take a paper clip and straighten it out, bend it in half, and drop it into the electromagnet (M3) center. Turn on the slide switch (S1) and set the adjustable resistor (RV) control lever all the way to the right. The paper clip gets sucked into the center of the electromagnet and stays suspended there.

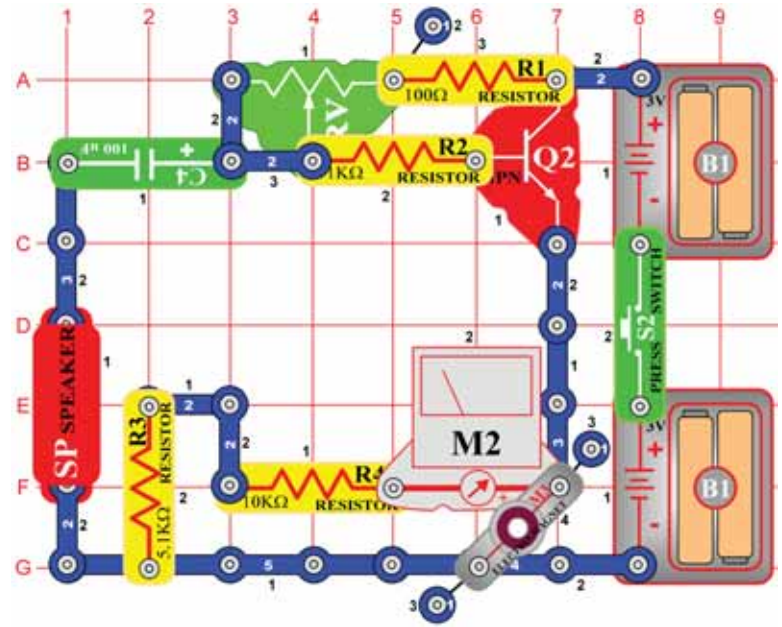
Now very slowly move the adjustable resistor lever to the left, and watch the paper clip and the meter reading. The paper clip slowly gets lower, as the meter shows the current dropping. When the current is at zero, the paper clip is resting on the table.

Add two more 1-snaps under the electromagnet to make it higher, and try this again. Or try using a different iron object in place of the paper clip.





Project #416

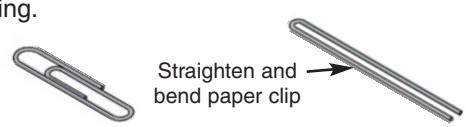


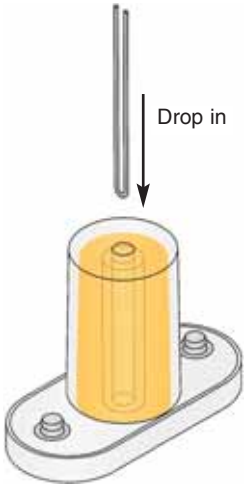
Adjustable Paper Clip w/ Delay

OBJECTIVE: To show how electricity can lift things using magnetism.

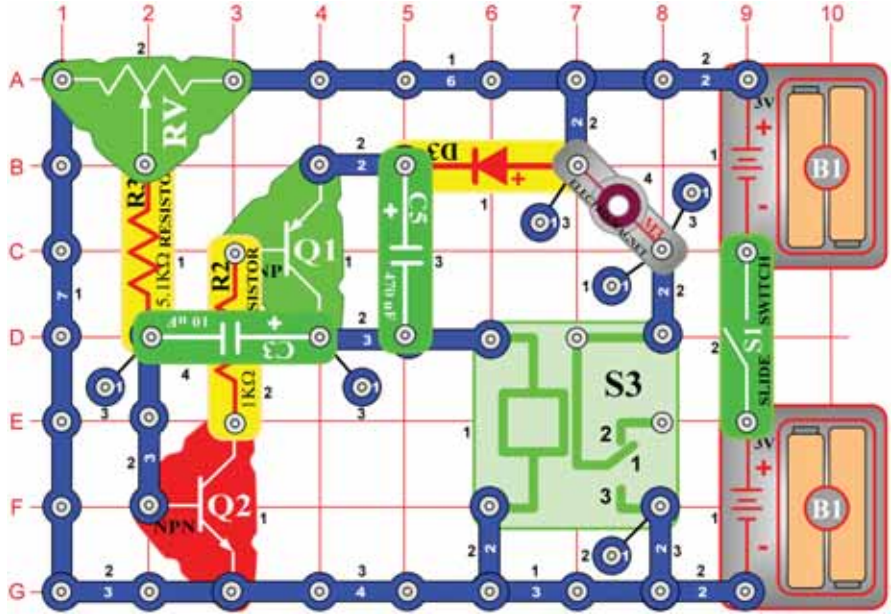
Use the LOW (or 10mA) setting on the meter (M2). Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Press the press switch (S2) and set the adjustable resistor (RV) control lever all the way to the right. The paper clip gets sucked into the center of the electromagnet and stays suspended there.

Now quickly slide the adjustable resistor lever all the way to the left, and watch the paper clip and the meter reading. The paper clip slowly gets lower, as the meter shows the current dropping. This circuit is similar to project #415, but the capacitor delays the effect of changing the adjustable resistor setting.





Project #417

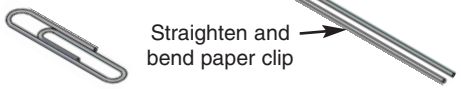


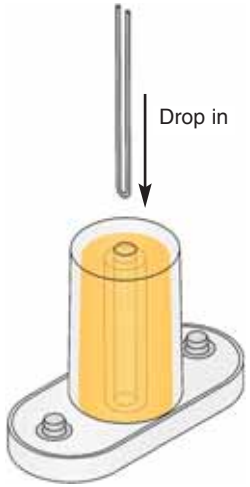
Paper Clip Oscillator

OBJECTIVE: To show how electricity can lift things using magnetism.

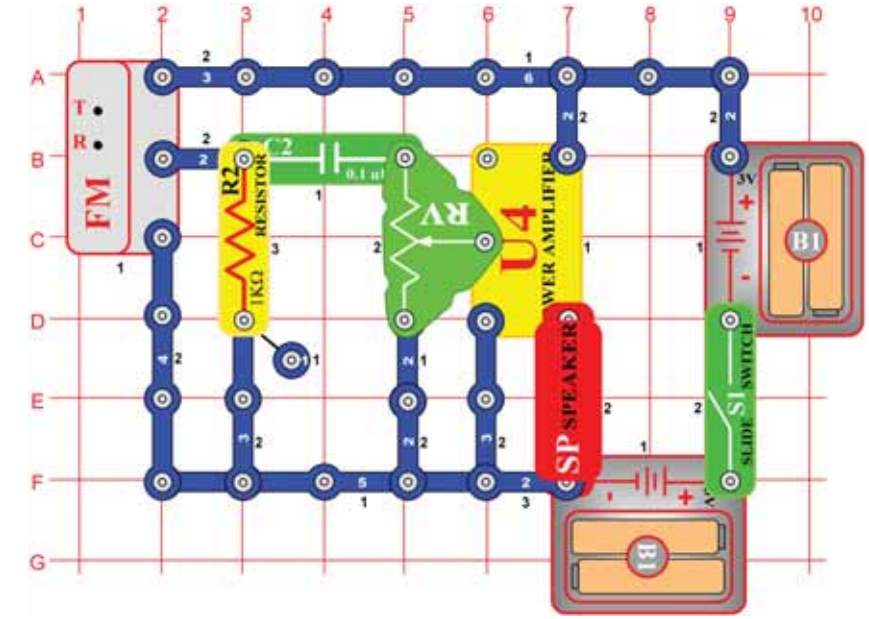
Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Turn on the slide switch (S1), and set the adjustable resistor (RV) control lever to the right. The paper clip gets sucked into the center of the electromagnet and stays suspended there. Move the adjustable resistor lever to the left, and the paper clip falls.

Now for the fun part: Slowly slide the adjustable resistor lever until you find a spot where the paper clip is bouncing up and down. There will be a clicking sound from the relay.





Project #418

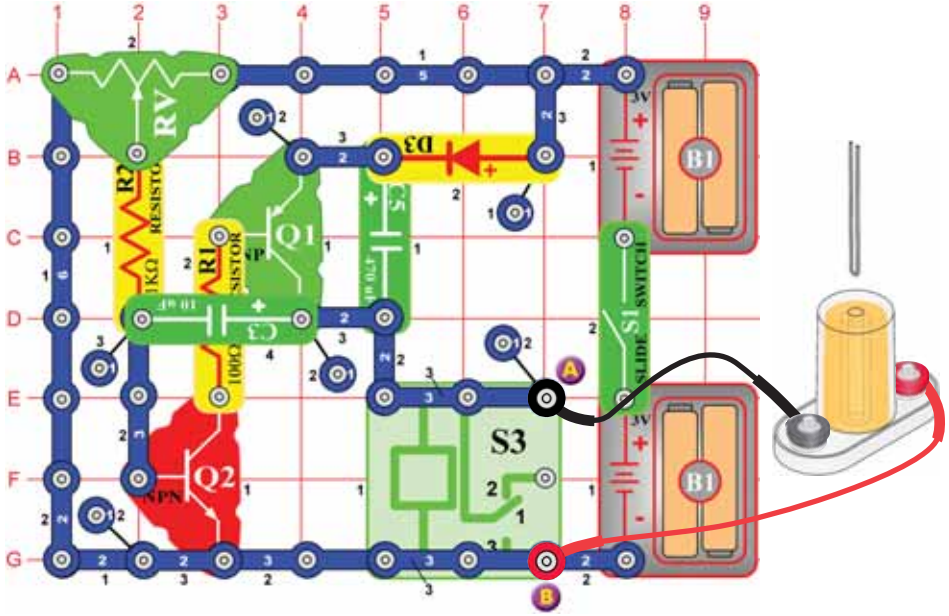


Adjustable Volume FM Radio

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 amp. 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 to start at 88MHz again.

Project #419



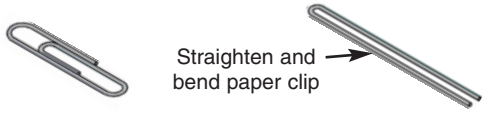
High Frequency Vibrator

OBJECTIVE: To show how electricity can lift things using magnetism.

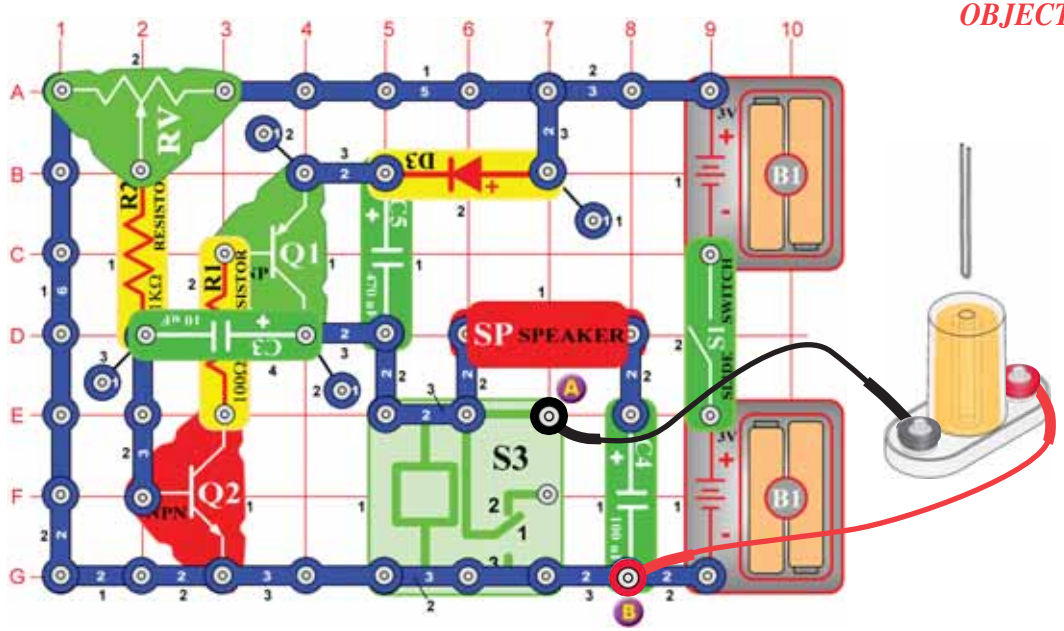
Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Connect the electromagnet to points A & B with the jumper wires and hold it about 1 inch above the table. Slide the adjustable resistor (RV) control lever around slowly, you will hear a clicking sound from the relay (S3).

Adjust the electromagnet height and resistor control lever until the paper clip vibrates up and down on the table. It will vibrate at a fast rate but will not move very high. Usually this works best with the electromagnet about one inch above the table and the resistor control about mid-way to the right side, but your results may vary. See how high you can make the paper clip bounce.

Adjust the electromagnet height and resistor control lever to change the height and frequency of the vibration.



Project #420



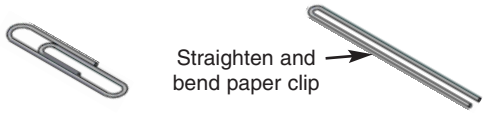
High Frequency Vibrator (II)

OBJECTIVE: To show how electricity can lift things using magnetism.

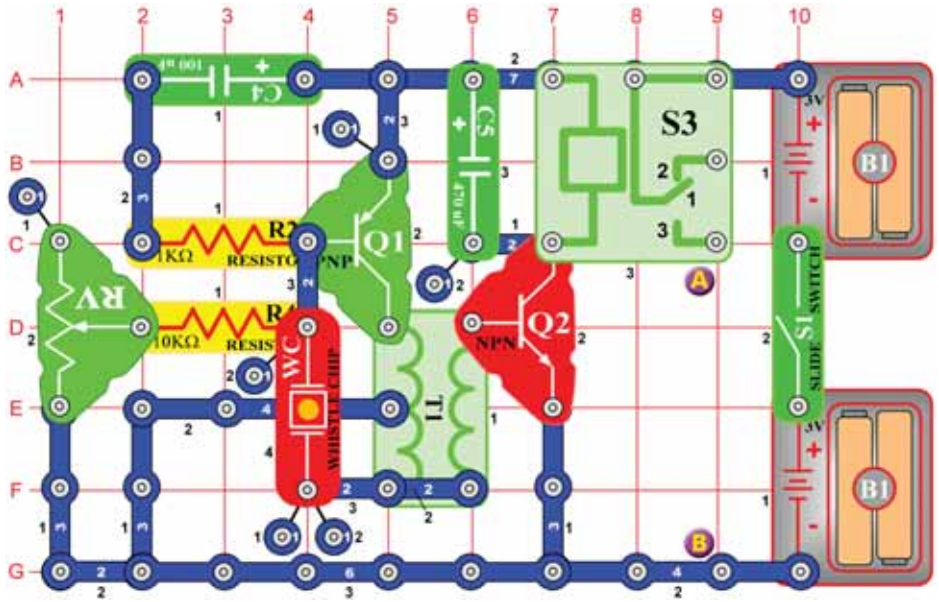
Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Connect the electromagnet to points A & B with the jumper wires and hold it about 1 inch above the table. Slide the adjustable resistor (RV) control lever around slowly, you will hear a clicking sound from the relay (S3) and speaker (SP).

Adjust the electromagnet height and resistor control lever until the paper clip vibrates up and down on the table. It will vibrate at a fast rate but will not move very high. Usually this works best with the electromagnet about one inch above the table and the resistor control about mid-way to the right side, but your results may vary. See how high you can make the paper clip bounce.

Adjust the electromagnet height and resistor control lever to change the height and frequency of the vibration.



Project #421



Relay-Whistle Vibrator

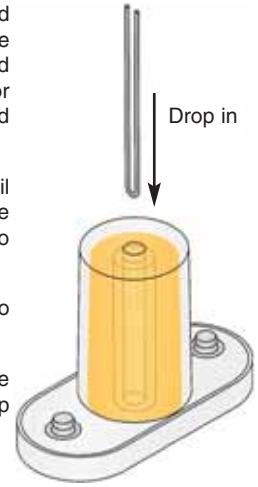
OBJECTIVE: To show how electricity can lift things using magnetism.

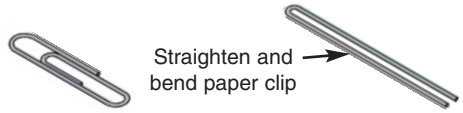
Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Connect the electromagnet to points A & B with the jumper wires and hold it about 1 inch above the table. Slide the adjustable resistor (RV) control lever around slowly, you will hear a clicking sound from the relay (S3) and buzzing from the whistle chip (WC).

Adjust the electromagnet height and resistor control lever until the paper clip vibrates up and down on the table. The vibration pattern may seem complex because it is due to two sources: the whistle chip and the relay.

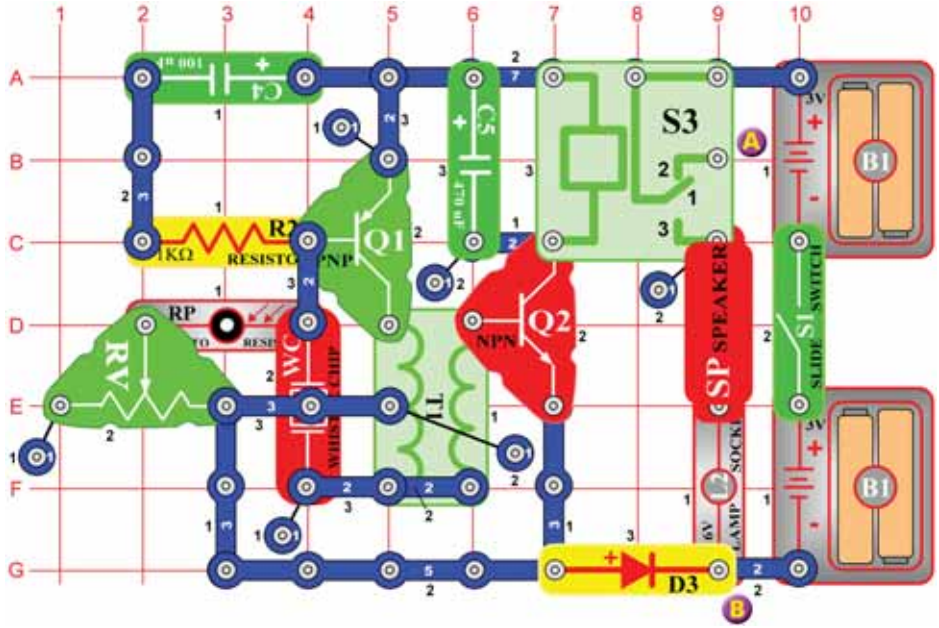
Adjust the electromagnet height and resistor control lever to change the height and frequency of the vibration.

You can also replace the 10KΩ resistor (R4) with the photoresistor (RP). Waving your hand over it will start or stop the vibration.





Project #422



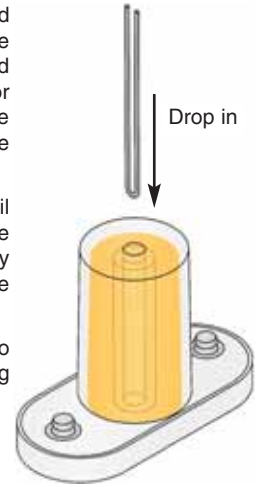
Relay-Whistle Photo Vibrator

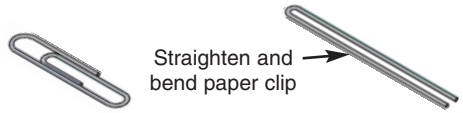
OBJECTIVE: To show how electricity can lift things using magnetism.

Take a paper clip and straighten it out, bend it in half, and place it into the electromagnet (M3) center. Connect the electromagnet to points A & B with the jumper wires and hold it about 1 inch above the table. Slide the adjustable resistor (RV) control lever around slowly without covering the photoresistor (RP), you will hear a clicking sound from the relay (S3) and buzzing from the whistle chip (WC).

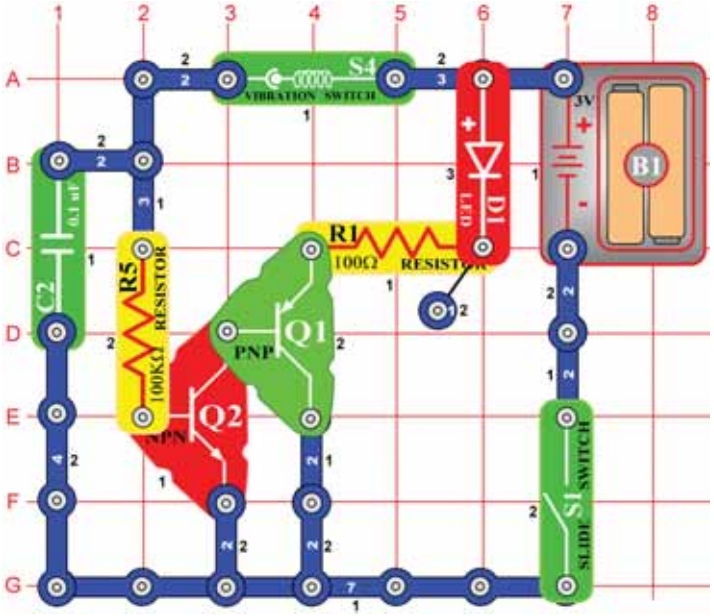
Adjust the electromagnet height and resistor control lever until the paper clip vibrates up and down on the table. Then wave your hand over the photoresistor. The vibration pattern may seem complex because it is due to three sources: the whistle chip, the relay, and the photoresistor.

Adjust the electromagnet height and resistor control lever to change the height and frequency of the vibration. Covering the photoresistor stops the vibration.





Project #423



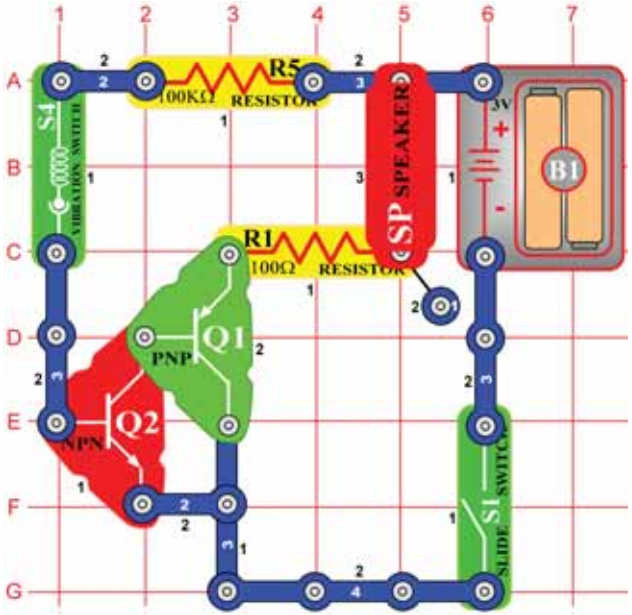
Vibration LED

OBJECTIVE: Introduction to the vibration switch.

The vibration switch (S4) contains two separate contacts; a spring is connected to one of the contacts. A vibration causes the spring to move briefly shorting the two contacts. This simple circuit demonstrates how the vibration switch works. Build the circuit and the LED (D1) does not light. Tap the vibration switch or table and the LED lights for every tap.

The 100KΩ resistor (R5) limits the current to protect the vibration switch while the transistors allow the vibration switch to control a large current.

Project #424



Vibration Speaker

OBJECTIVE: To create sound with a tap of your finger.

Build the circuit and turn on the slide switch (S1). When you tap on the vibration switch (S4), the speaker (SP) sounds. Listen closely because the sound may not be very loud.

Project #425

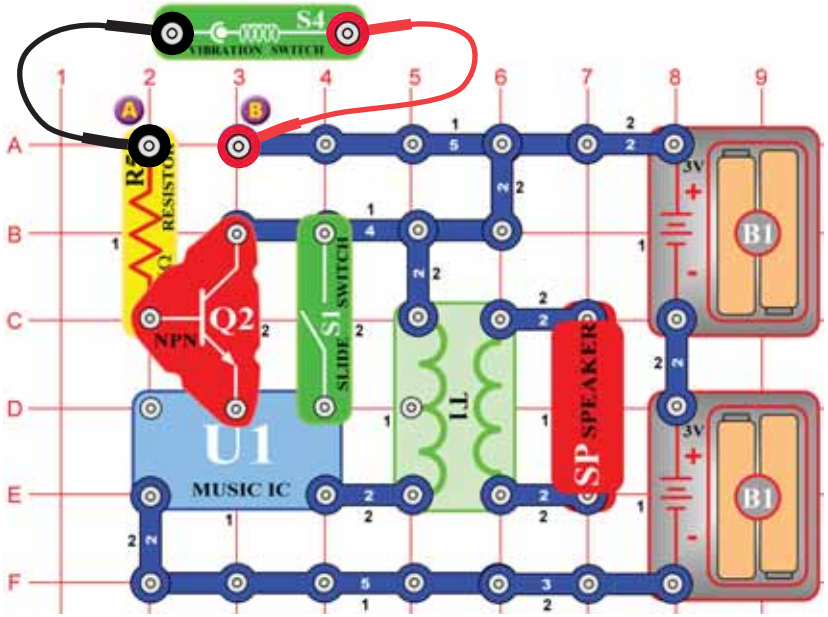
Measure the Vibration as You Tap the Switch

OBJECTIVE: To use the meter with the vibration switch.

Modify project 424 by replacing the speaker (SP) with the meter (M2). Place it with the + side towards R5 and use the LOW (or 10mA) setting. Tap the vibration switch (S4) and the meter deflects to the right. Tap harder on the switch; the switch closes longer and the meter deflect more to the right.

Project #426

Shaky Birthday Song

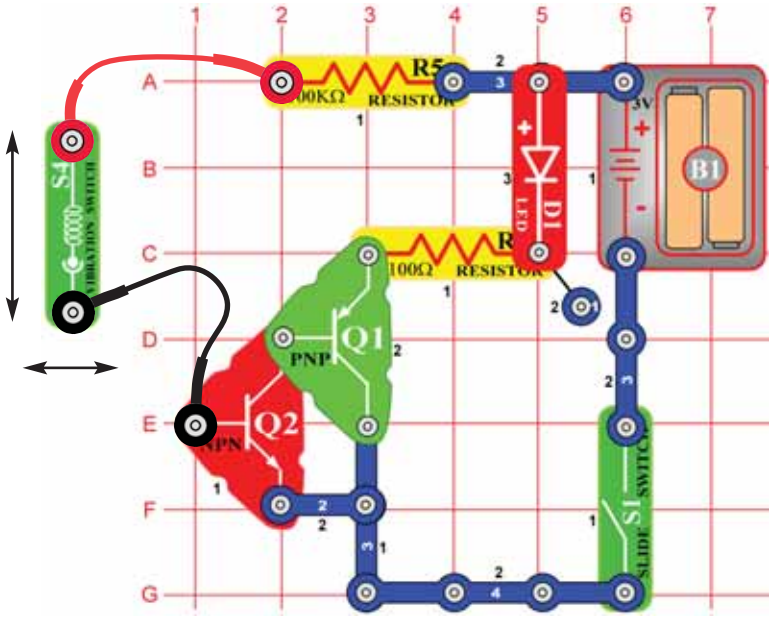


OBJECTIVE: To turn the music IC on and off using the vibration switch.

Connect the vibration switch (S4) to the circuit using the red and black jumpers. Hold the vibration switch steady in your hand and the music should not play. Now move your hand, the music should briefly play. If you continuously shake the switch, the music keeps playing. Turn the slide switch (S1) on and the music plays. Change the sound by shaking the vibration switch.

Project #427

Vibration Detector



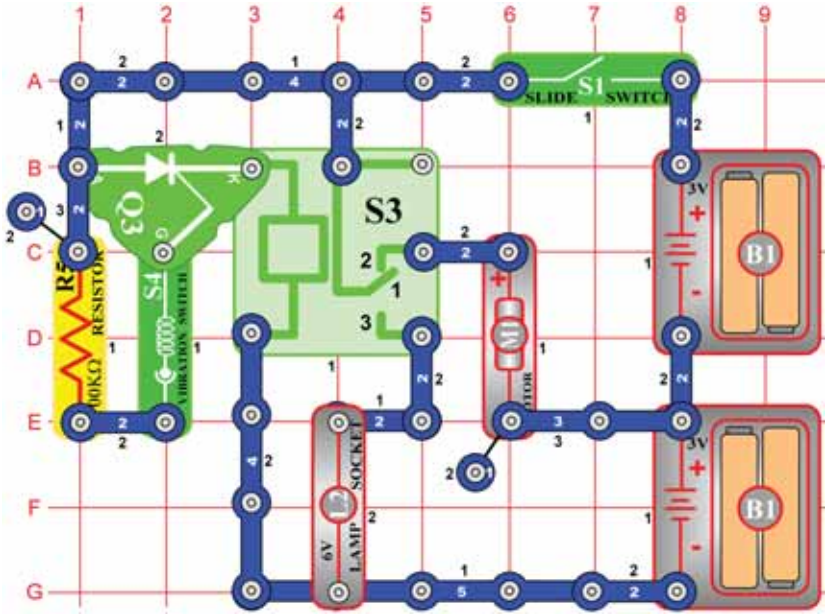
OBJECTIVE: To show the effects of horizontal and vertical direction.

Connect the vibration switch (S4) to the circuit using the black and red jumper wires. Place the switch horizontally on the table. Rapidly move the switch from left to right and notice that the LED (D1) does not light. There is not enough force to expand the internal spring to turn on the switch. Now move the switch up and down and see that the LED easily lights. It requires less force to move the spring back and forth.

You can replace the LED (D1) with the meter (M2), place it with the "+" side towards R5 and use the LOW (or 10mA) setting. The meter deflects more when you move the vibration switch up and down.

Project #428

Out of Balance



OBJECTIVE: To build an out of balance turn off circuit.

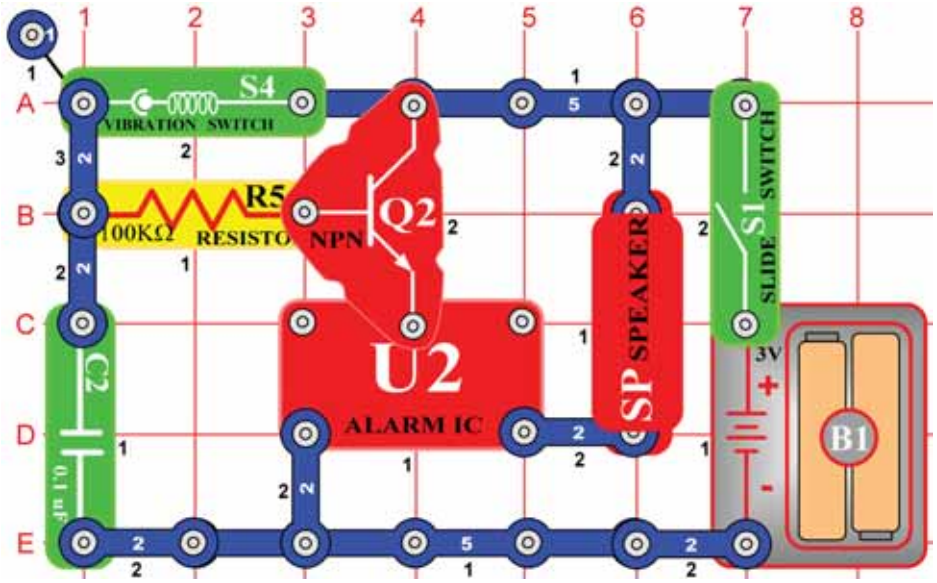
The vibration switch (S4) triggers the SCR (Q3) connecting the relay's (S3) coil to the battery (B1). The relay's contacts switch, turning the motor (M1) off, and lighting the lamp (L2). The lamp will stay lit until the slide switch (S1) is turned off.

Turn the slide switch on; the motor starts to spin. If the motor generates enough vibration, the switch will trigger the SCR, turning off the motor and lighting the lamp. If the motor keeps spinning, tap on the table to trigger the vibration switch.

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

Project #429

Vibration Alarm

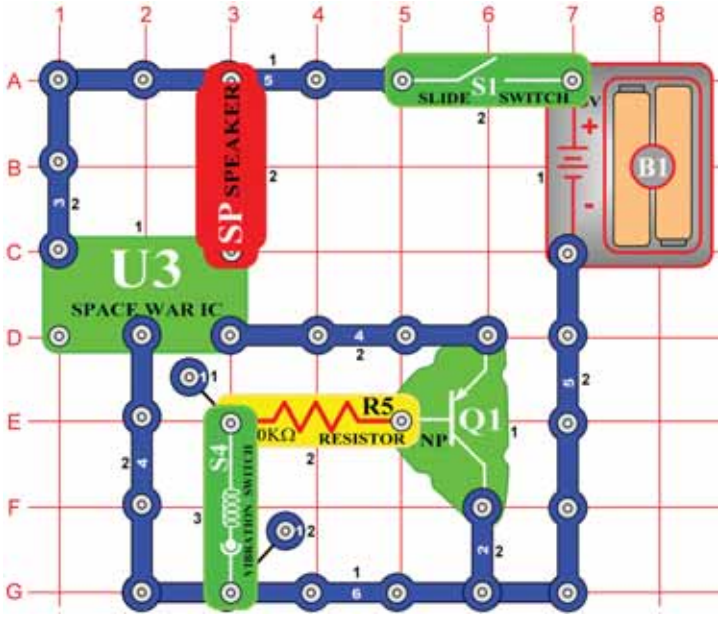


OBJECTIVE: To sound an alarm when something is shaken.

Turn on the slide switch (S1) and shake the circuit or bang on the table; an alarm will sound. Try banging on the table in a regular pattern, and see if you can make the alarm sound continuously.

Project #430

Vibration Space War



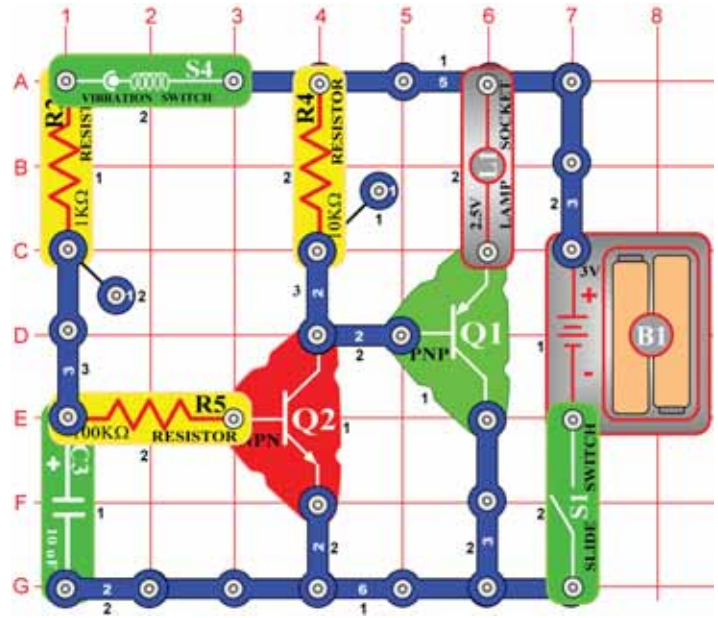
OBJECTIVE: To make sounds when something is shaken.

Turn on the slide switch (S1) and shake the circuit or bang on the table, you will hear different sounds. Try banging on the table in a regular pattern, and see if you can make the sounds continuous.

When the vibration switch (S4) is shaken, the circuit plays out one of eight sounds.

Project #431

Vibration Light

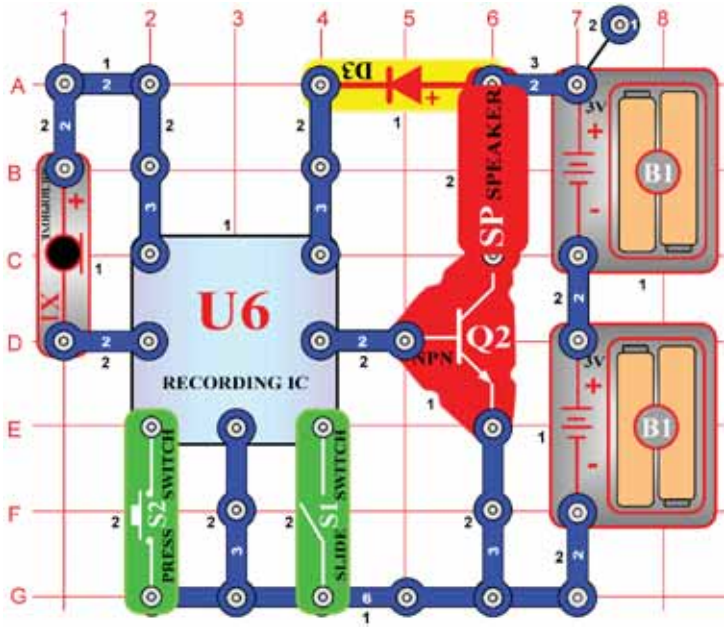


OBJECTIVE: To build a lamp that stays on for a while.

Turn on the slide switch (S1) and shake the base grid or bang on the table. The lamp (L1) turns on when there is vibration, and stays on for a few seconds.

Project #432

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 8 seconds, and then turn off the 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 #433

Playing Music

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

Use the circuit in project #432. 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 #434

Light-controlled Music

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

Use the circuit in project #432. 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.

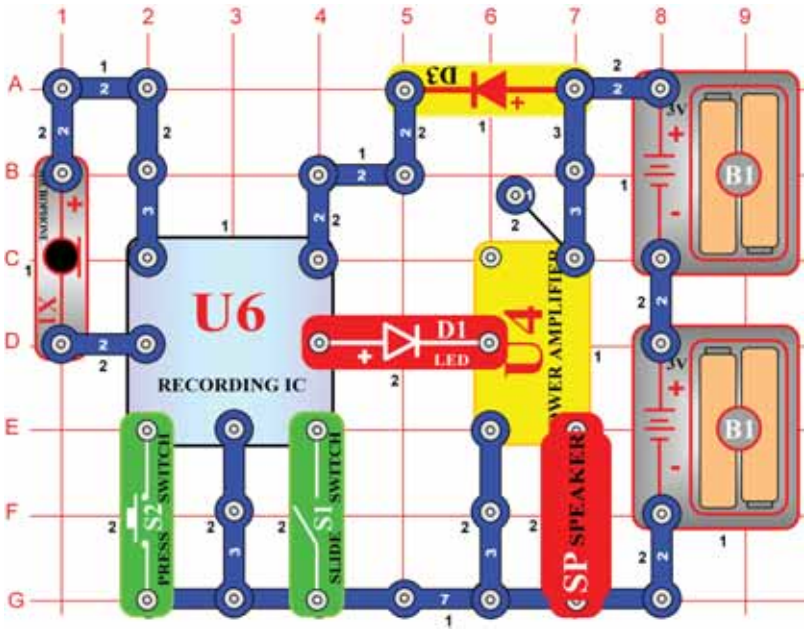
Project #435

Touch-controlled Music

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

Use the circuit in project #432. 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 #436



Power Amplified Playing Music

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 #432.

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 on 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 #437

Power Playback & Record

OBJECTIVE: To amplify the output of the recording IC.

Use the circuit in project #436. 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 #438

Power Light-controlled Music

OBJECTIVE: Show variations of project #437.

Use the circuit in project #436. 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 #439

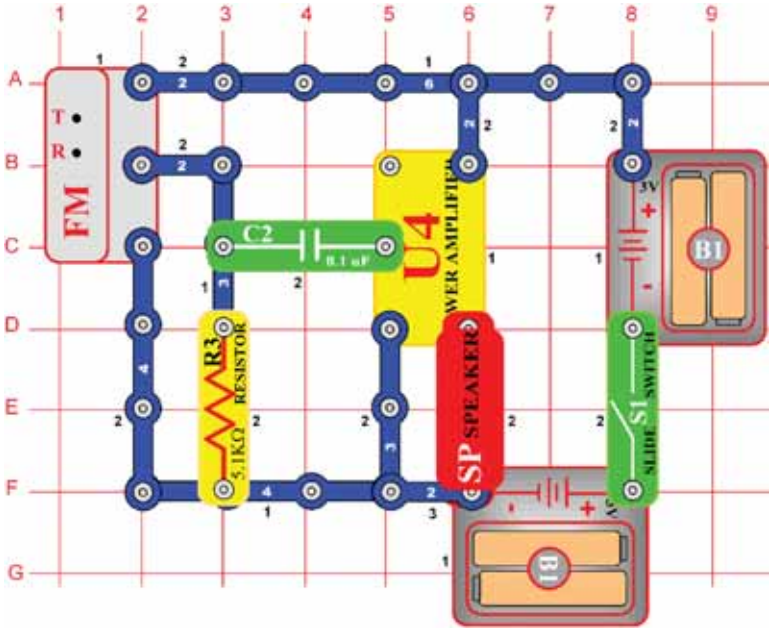
Power Touch-controlled Music

OBJECTIVE: Show variations of project #437.

Use the circuit in project #436. 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 #440

FM Radio



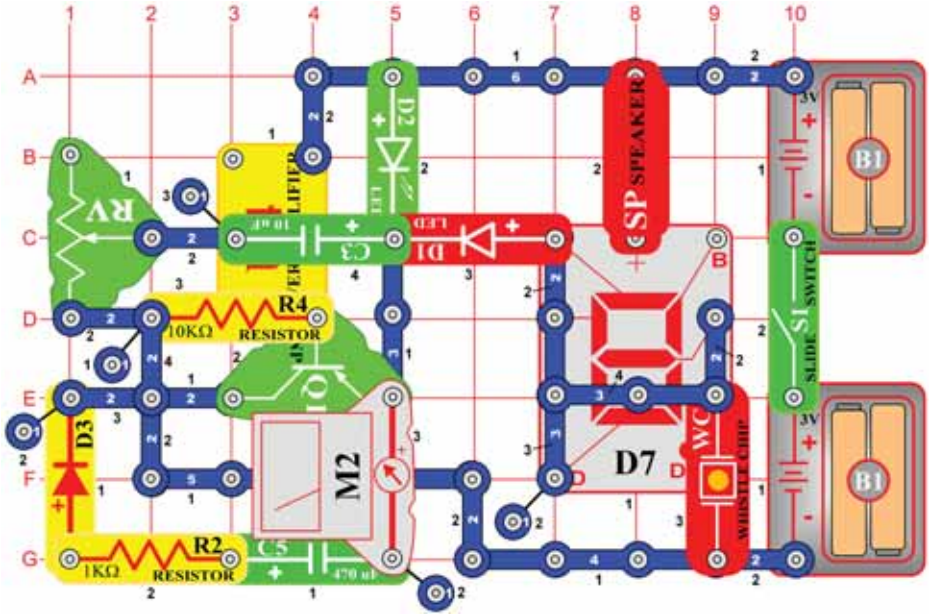
OBJECTIVE: To build a working FM radio.

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 (SP). 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 #441

Mega Circuit

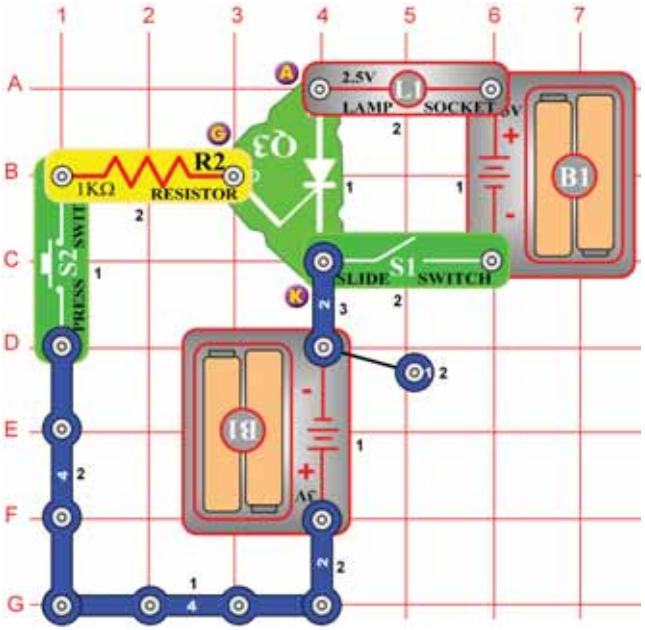


OBJECTIVE: To build a complex circuit.

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).

Project #442

SCR 2.5V Bulb



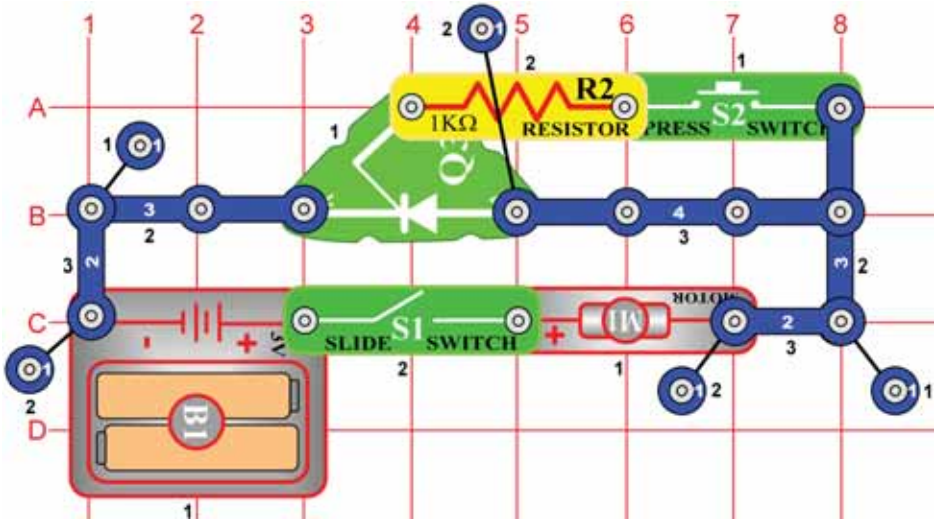
OBJECTIVE: To learn the principle of an SCR.

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 (L1), the other is used to trigger the SCR.

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

Project #443

SCR & Motor



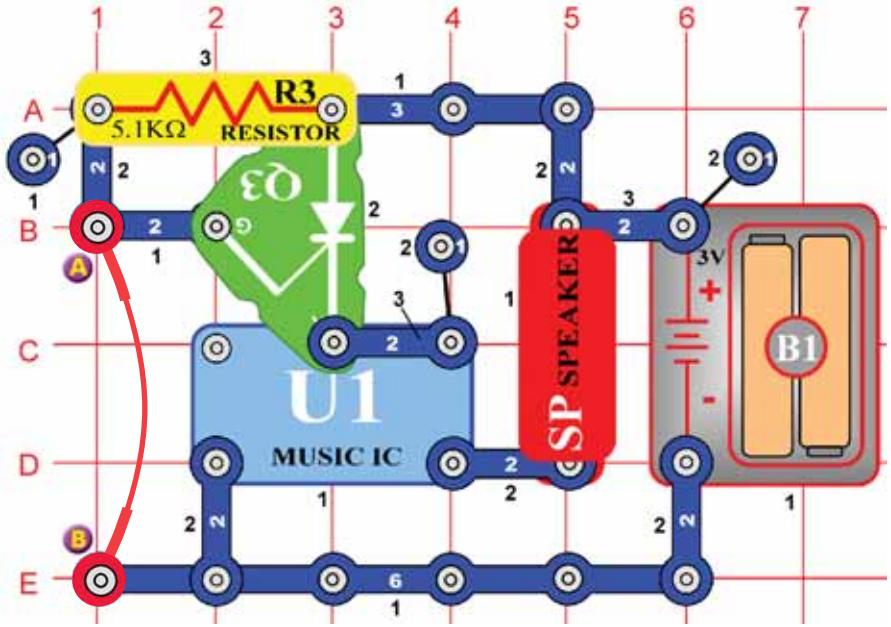
OBJECTIVE: To activate a motor using an SCR.

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.

Project #444

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 (B1) 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 #445

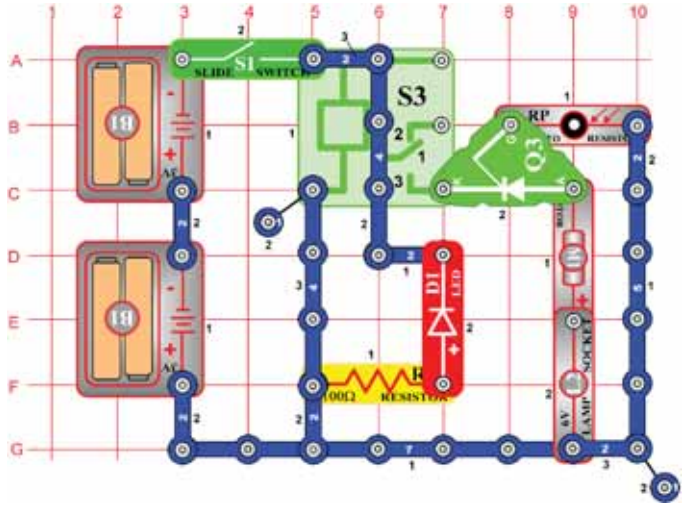
Light-Music Alarm

OBJECTIVE: To build a light-music alarm.

Use the circuit in project #444. Replace the 5.1KΩ 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 #446

Light-controlled SCR



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

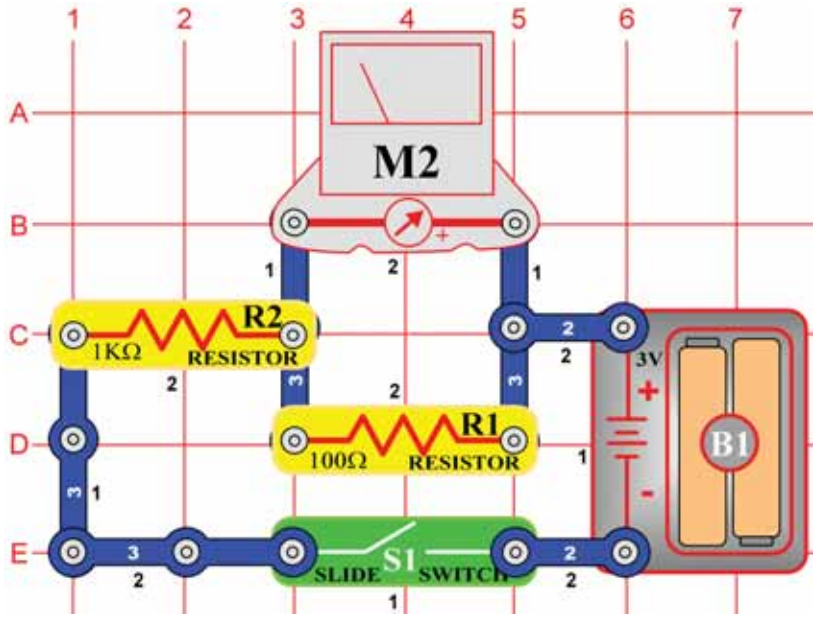
Cover the photoresistor (RP) with your finger. Turn on the slide switch (S1), and only the LED (D1) lights. The relay (S3) connects the motor (M1) and the lamp (L2) to the batteries (B1), but the motor and lamp are powerless until a voltage is applied to the SCR's gate.

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 lamp work now.

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

Project #447

3mA Meter



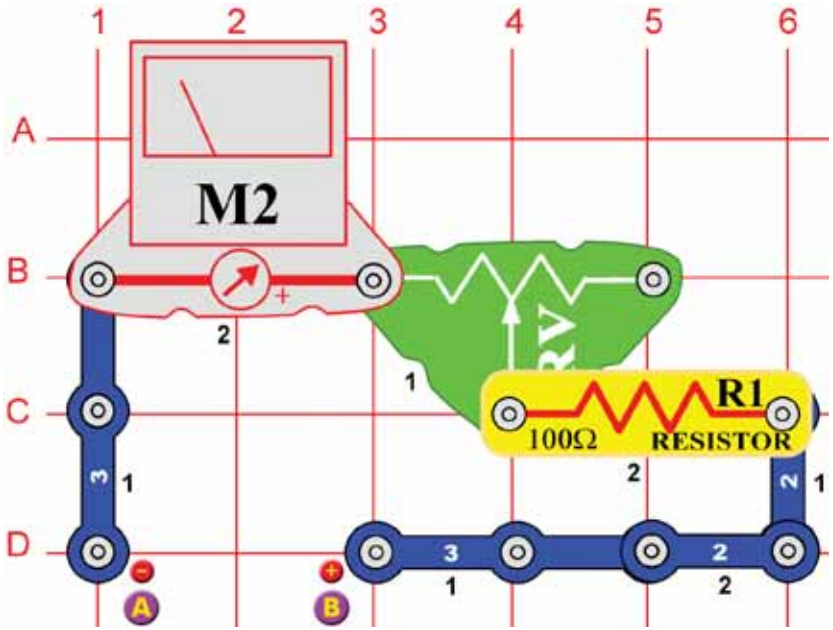
OBJECTIVE: To build a 3mA meter circuit.

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 #448

0-3V Voltmeter

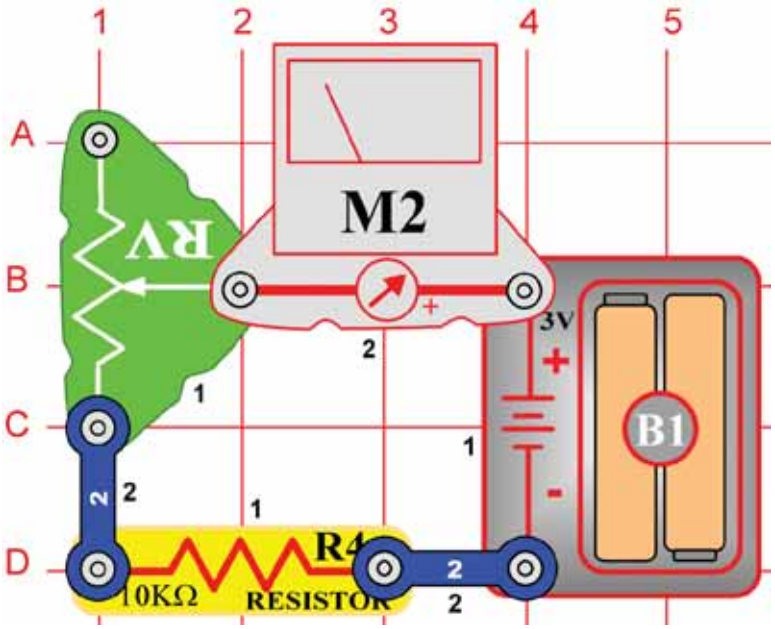


OBJECTIVE: To build a voltmeter.

Build this 0-3V voltmeter circuit. Set the meter (M2) to the LOW (or 10mA) scale. Using new batteries, place the battery holder (B1) 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 #449



Function of Variable Resistor

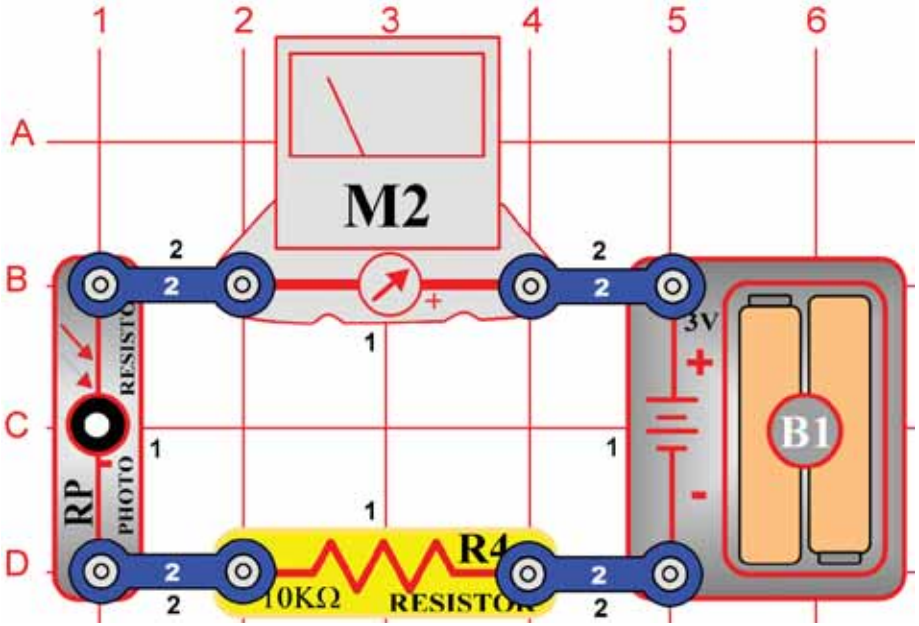
OBJECTIVE: To understand the function of the adjustable resistor.

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 #450



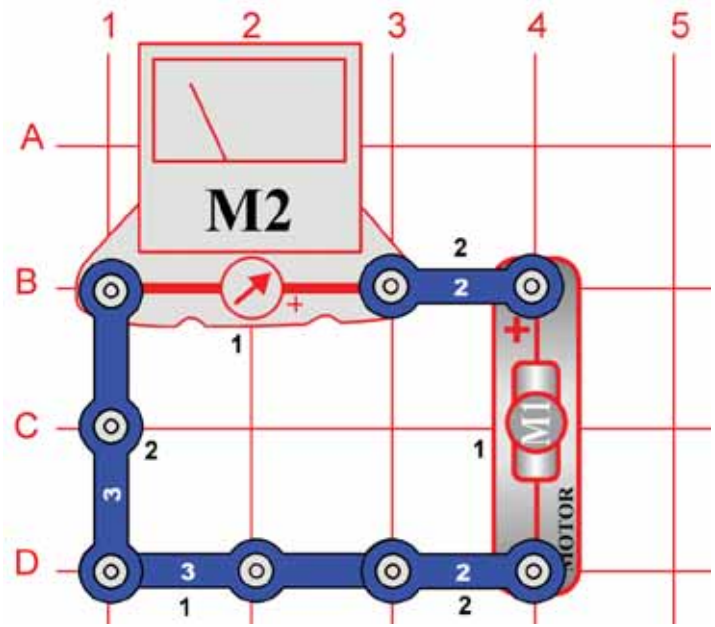
Function of Photoresistor

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 #451

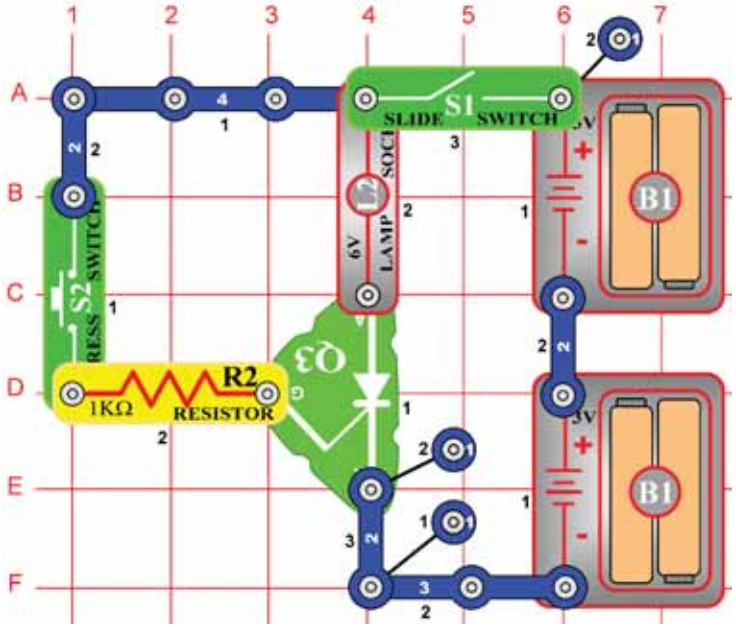


Meter Deflect by Motor

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

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

Project #452

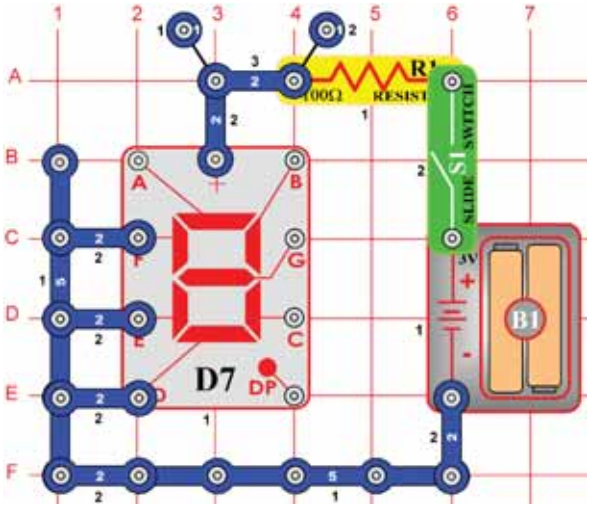


SCR 6V Bulb

OBJECTIVE: To learn the principle of an SCR.

In this circuit, the 6-volt lamp (L2) will not light until the SCR (Q3) is triggered. Turn on the slide switch (S1) and the lamp will not light. Now press the press switch (S2) to light the lamp. The lamp 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.

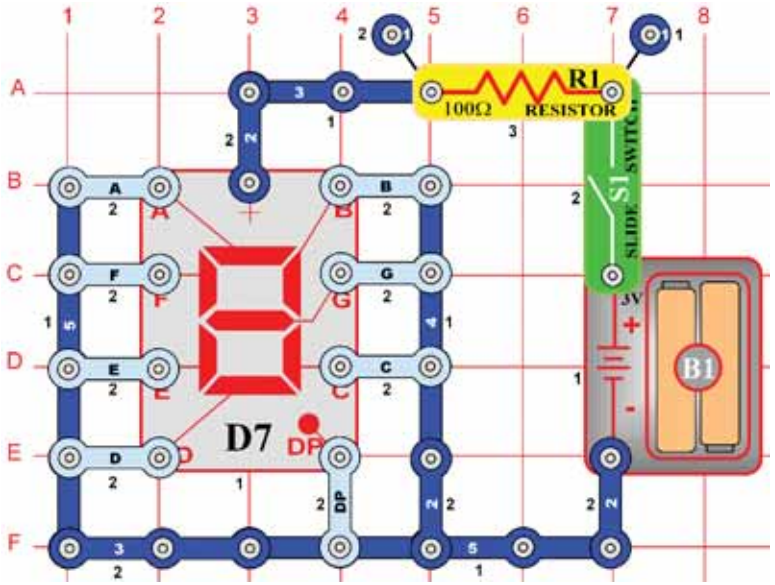
Project #453



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 (B1) the segment lights. For example, connect the circuit as shown and the letter "L" lights.



Project #454

Display #1

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

Connect B & C to the negative of the battery (B1).

Project #455

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 (B1).

Project #456

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 (B1).

Project #457

Display #4

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

Connect B, C, F, & G to the negative of the battery (B1).

Project #458
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 (B1).

Project #459
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 (B1).

Project #460
Display #7

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

Connect A, B, & C to the negative of the battery (B1).

Project #461
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 (B1).

Project #462
Display #9

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

Connect A, B, C, F, & G to the negative of the battery (B1).

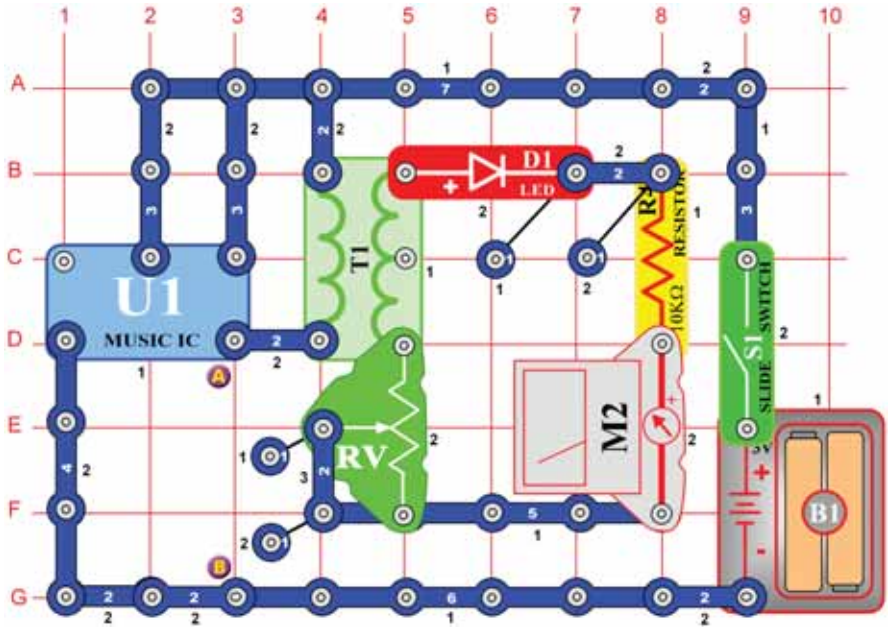
Project #463
Display #0

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

Connect A, B, C, D, E, & F to the negative of the battery (B1).

Project #464
Music Meter

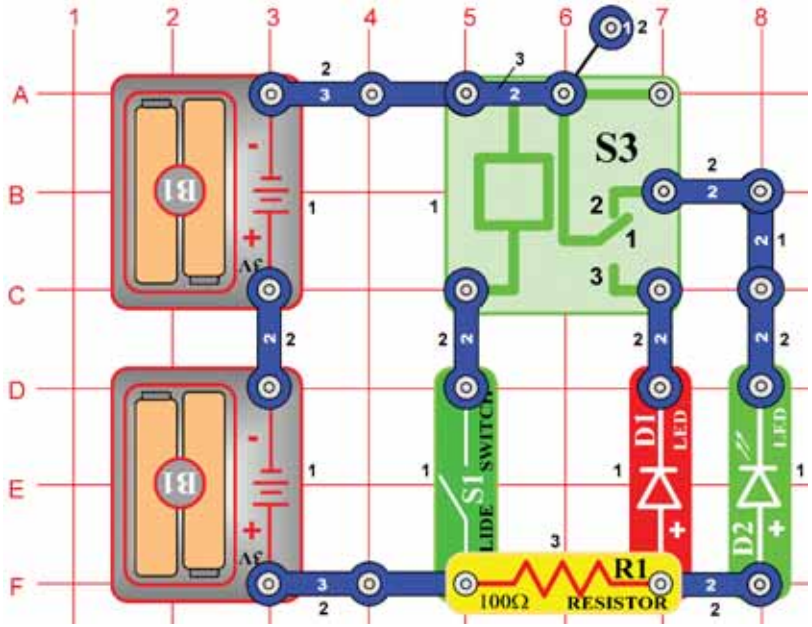
OBJECTIVE: See and hear the output of the music IC.



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 (M2).

Set the meter to the LOW (or 10mA) scale. Place the adjustable resistor (RV) to the bottom position and turn on the slide 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 #465



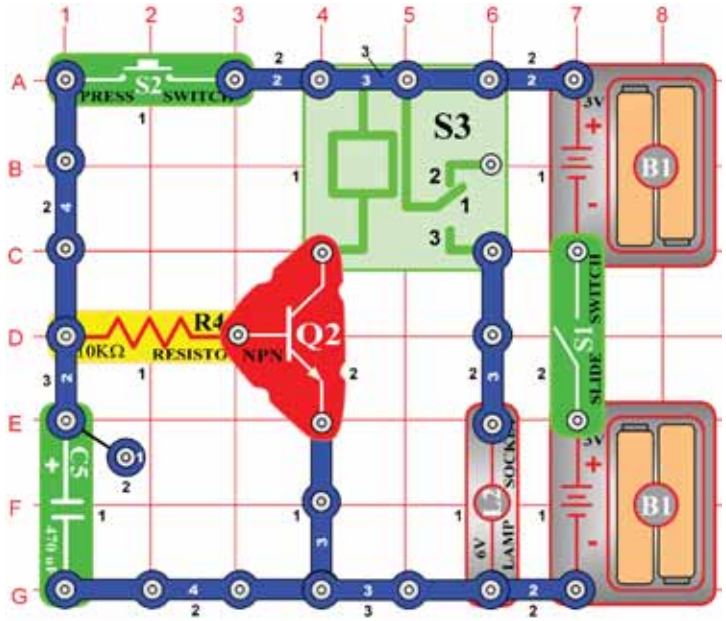
LED & Relay

OBJECTIVE: Turn on and off LEDs 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 (B1).

With the 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 #466



Manual
7 Second Timer

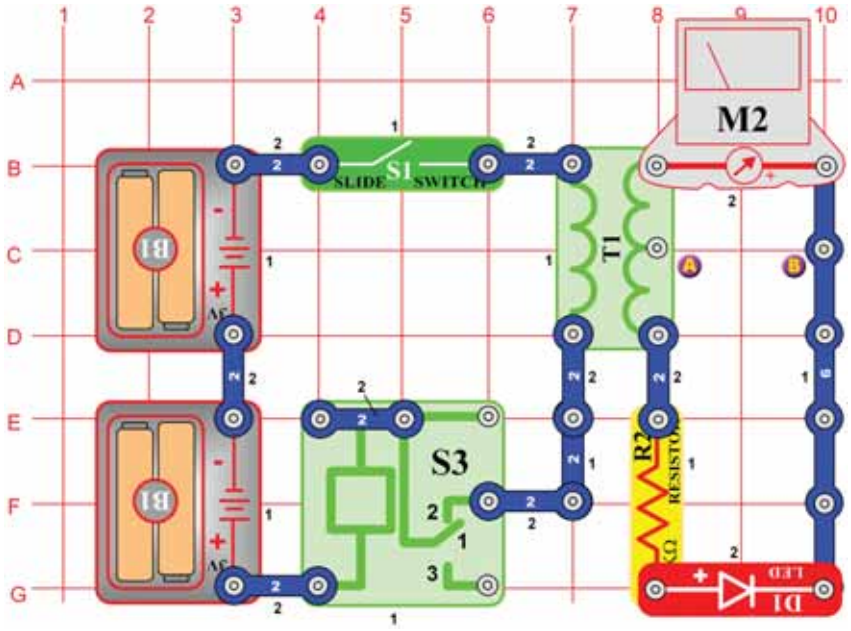
OBJECTIVE: To build a manual timer using a relay.

The transistor (Q2) acts as a switch, connecting the relay (S3) to the batteries (B1). As long as there is positive voltage on the transistor's base, the lamp (L2) will light.

Turn on the slide switch (S1) and hold down the press switch (S2). The transistor turns on, the 470μF capacitor (C5) charges up, and the lamp 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 lamp will turn off.

Change the value of the capacitor and see what happens.

Project #467



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 #468

Half Wave Rectifier Circuit (II)

OBJECTIVE: Measure the voltage using the center-tap.

Use the circuit in project #467. 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 slide switch (S1). The needle should deflect less, about half as much as project #467. As you use less windings, the output decreases.

Project #469

LED vs. Diode

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

Use the circuit in project #467. Replace the LED (D1) with the diode (D3) and turn on the slide switch (S1). The needle deflects higher, because the voltage drop across the diode is less than the voltage drop across the LED.

Project #470

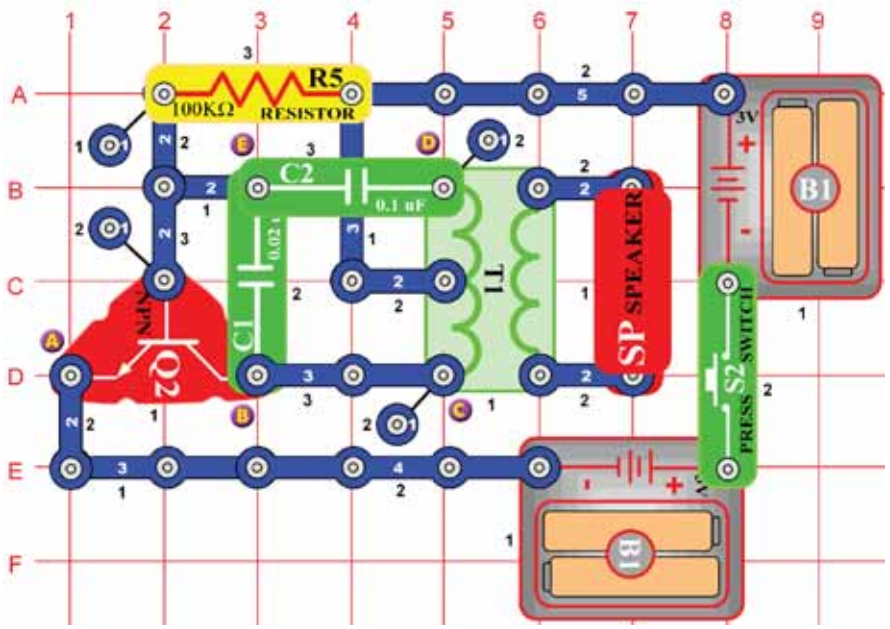
Current & Resistance

OBJECTIVE: See how resistance affects current.

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

Project #471

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 #472

Mosquito Sound

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

Use the circuit in project #471. Remove the speaker (SP). Connect the whistle chip (WC) across points C & D to make a mosquito sound.

Project #473

Mosquito Sound (II)

OBJECTIVE: Show variations of project #471.

Use the circuit in project #471. Connect the whistle chip (WC) across points B & E.

Project #474

Mosquito Sound (III)

OBJECTIVE: Show variations of project #471.

Use the circuit in project #471. Connect the whistle chip (WC) across points E & D (place it beneath capacitor (C2) or use the jumper wires).

Project #475

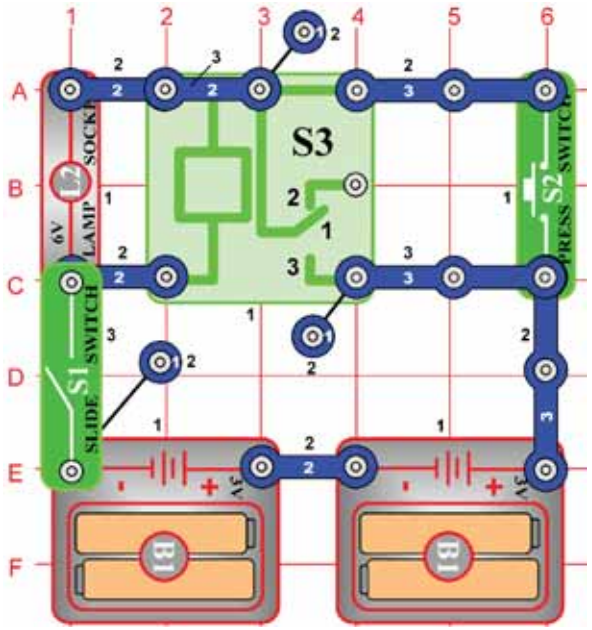
Touch-control Mosquito Sound

OBJECTIVE: To use the photo resistor to adjust the oscillator sound.

Use the circuit in project #471. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the resistor and the sound changes.

Project #476

Bulb & Relay

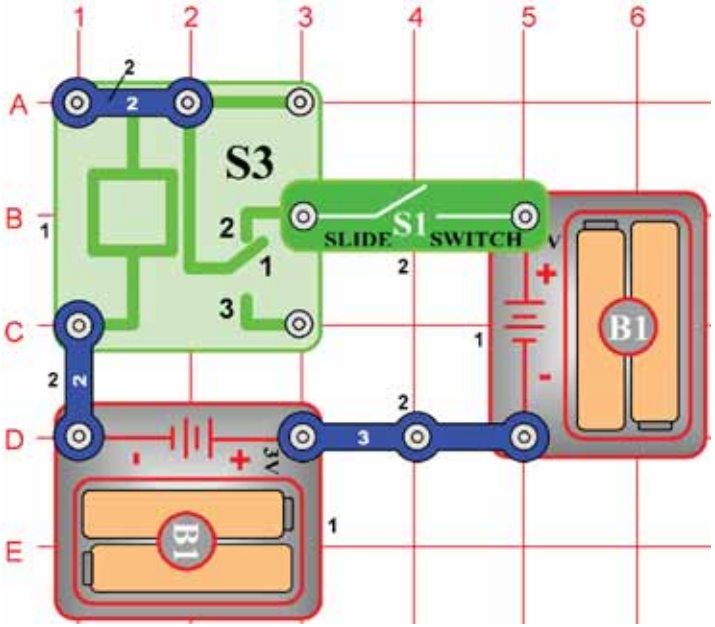


OBJECTIVE: Light a bulb using a relay.

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 #477

Relay Buzzer

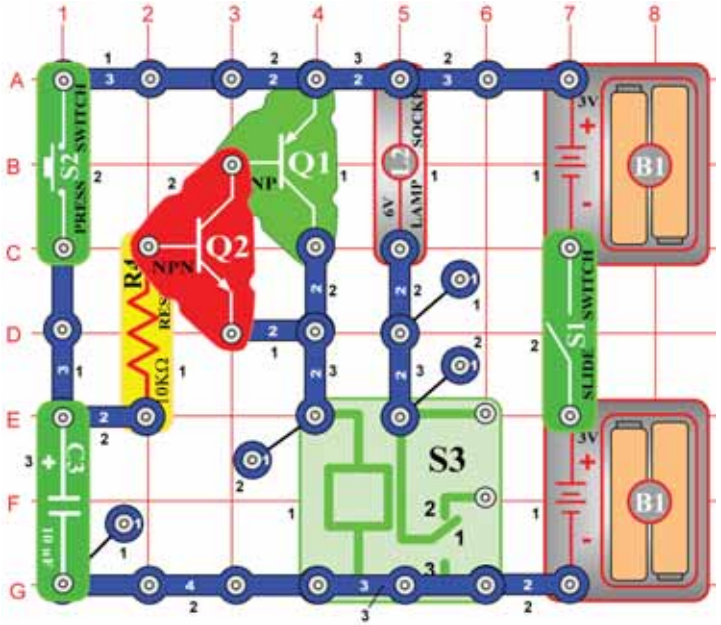


OBJECTIVE: To make a relay buzzer.

When you turn on the slide 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 #478

Transistor Timer

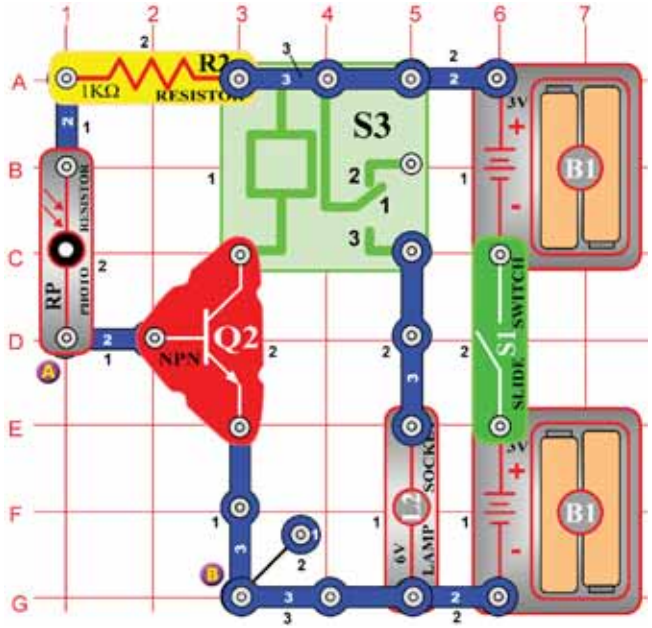


OBJECTIVE: To build a manual timer using a transistor in place of the relay.

This circuit is similar to project #476 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 lamp (L2) lights. When the press switch 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 lamp will turn off.

Project #479

Light-controlled Relay



OBJECTIVE: To use a photo resistor 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 lamp (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 lamp lights. Now as you block the light from the photoresistor, the lamp turns off.

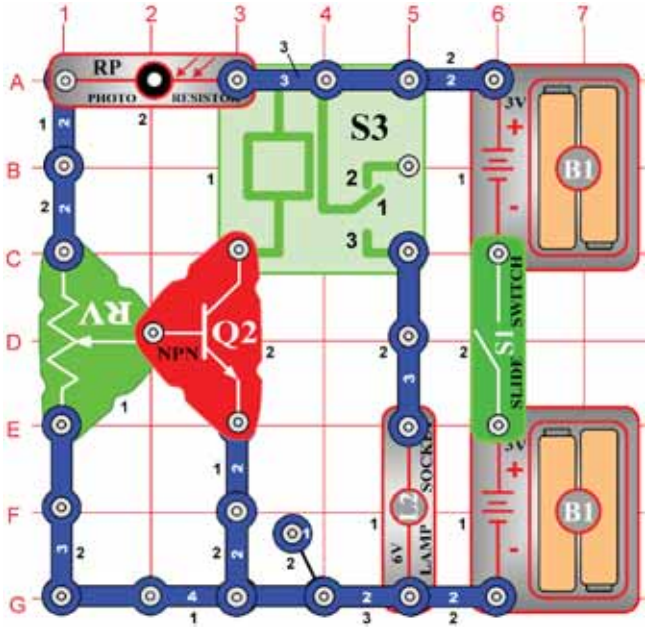
Project #480

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 lamp (L2) are not powered. Disconnect the wire. The relay contacts will switch and the lamp will light.

Project #481

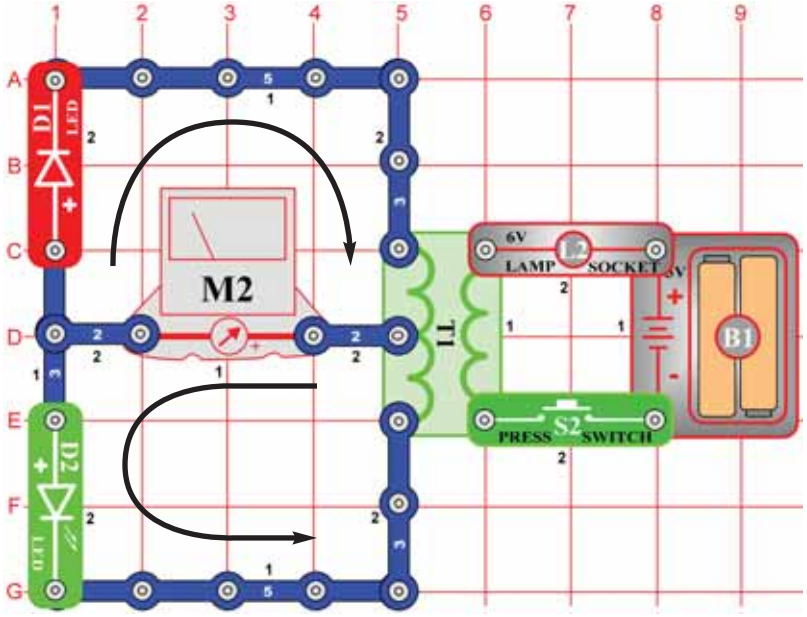


Adjustable Light Control

OBJECTIVE: Build an adjustable light-controlled relay.

You can set the amount of light it takes to keep the lamp (L2) on by adjusting the adjustable resistor (RV). Set the adjustable resistor to the top position and turn on the slide switch (S1). The lamp lights. Cover the photoresistor (RP) and the lamp 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 lamp stays off.

Project #482



Meter Deflection

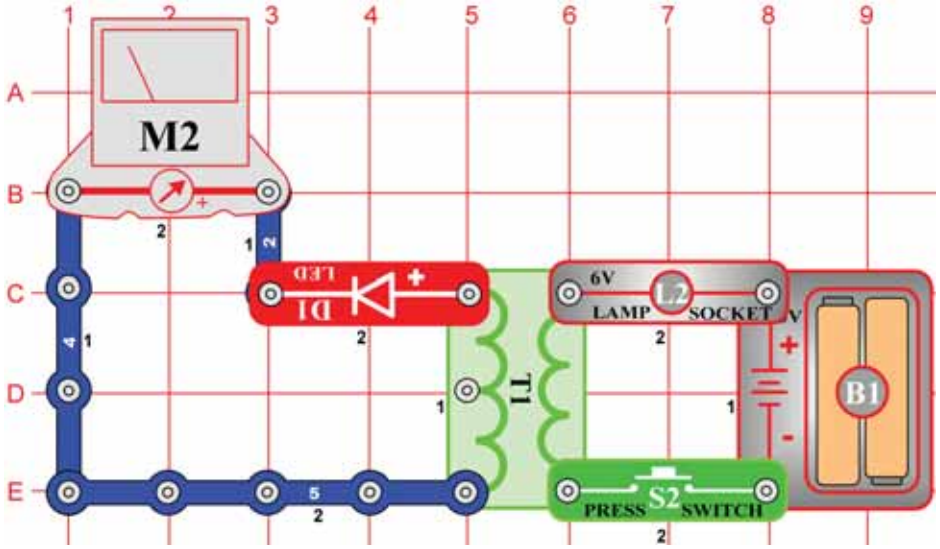
OBJECTIVE: To demonstrate the properties of a transformer.

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 #483

AC to DC Current

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

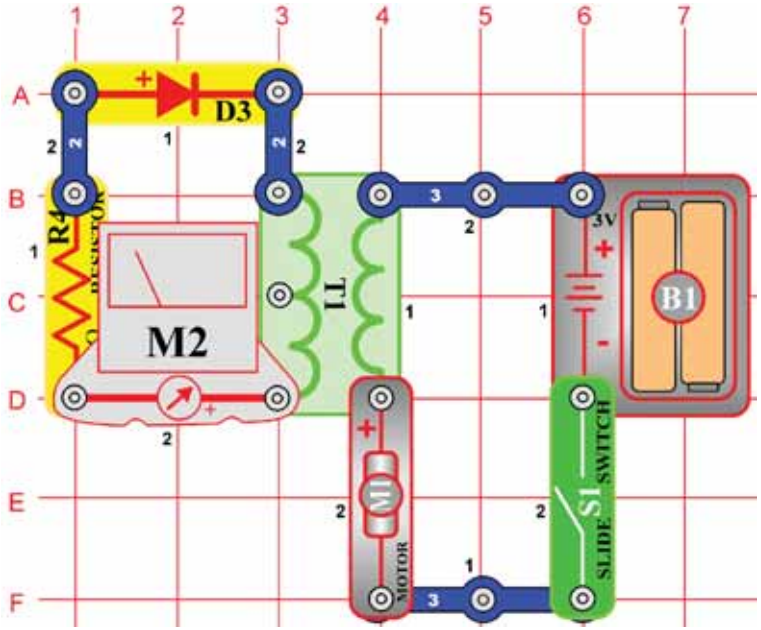


Set the meter (M2) to the LOW (or 10mA) scale. Pressing and releasing the press switch (S2) continuously generates an AC (changing) current. The LED (D1) is used to convert the AC (changing) current to DC (unchanging) current because it only allows the current to flow in one direction. The LED should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

Project #484

Current Meter

OBJECTIVE: To measure the current through a transformer.

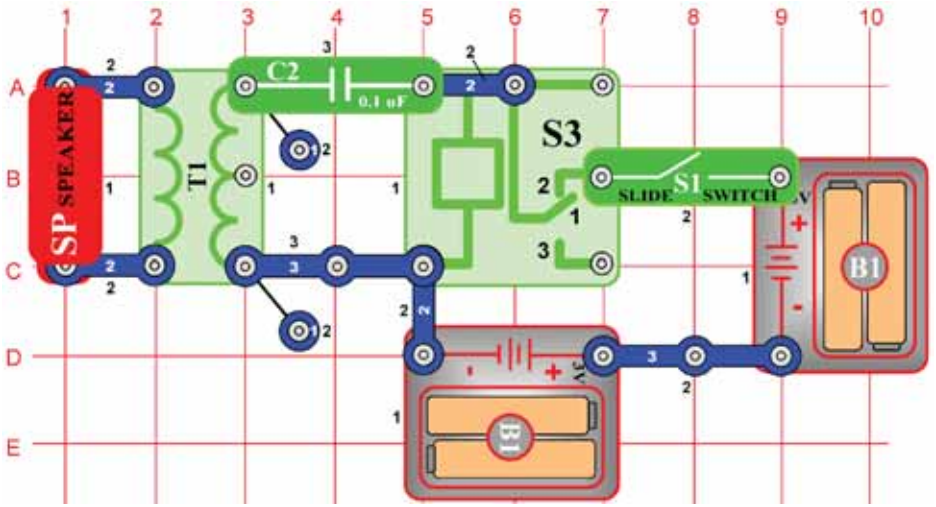


Set the meter (M2) to the LOW (or 10mA) scale. By placing the meter, diode (D3) and current limiting resistor (R4) on the transformer (T1), you can measure the current. Turn on the slide switch (S1) and the motor (M1) starts spinning. The current on the right side of the transformer creates a current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

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

Project #485

Buzzer, Relay, & Transformer



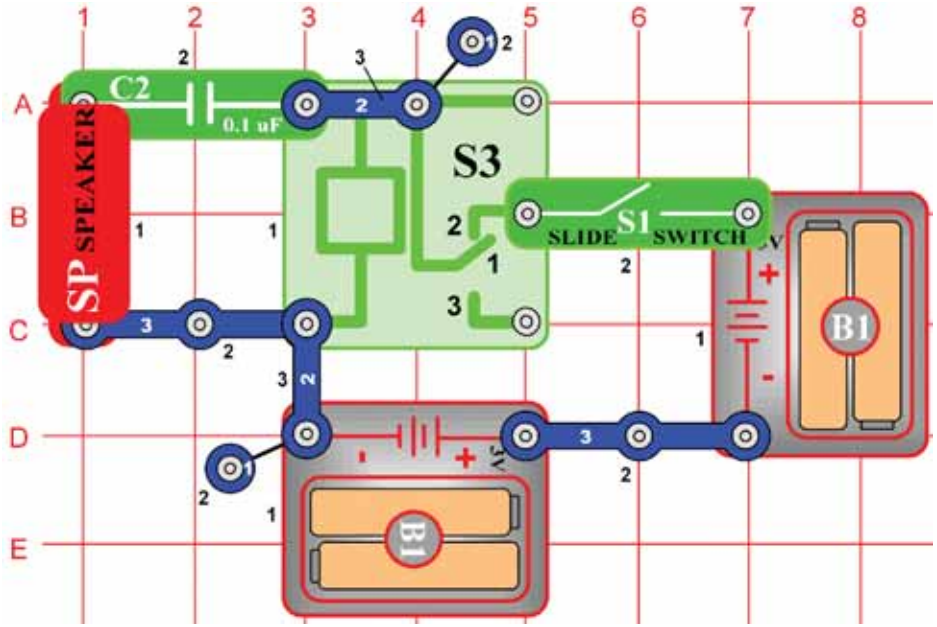
OBJECTIVE: To use a transformer for a louder buzzer.

Turn on the slide switch (S1). The speaker (SP) generates a buzzer sound. As in project #477, 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 0.1μF capacitor (C2) with a 3-snap wire.

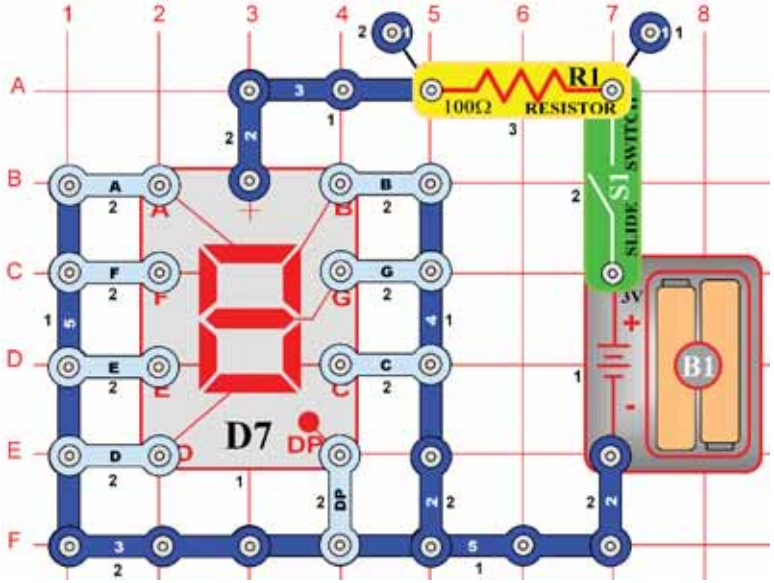
Project #486

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 #477. As the 0.1μF capacitor (C2) charges and discharges, the speaker generates a buzzing sound.



☐ Project #487

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 (B1).

☐ Project #488

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 (B1).

☐ Project #489

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 (B1).

☐ Project #490

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 (B1).

☐ Project #491

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 (B1).

☐ Project #492

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 (B1).

☐ Project #493

Display Capital Letter "E"

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

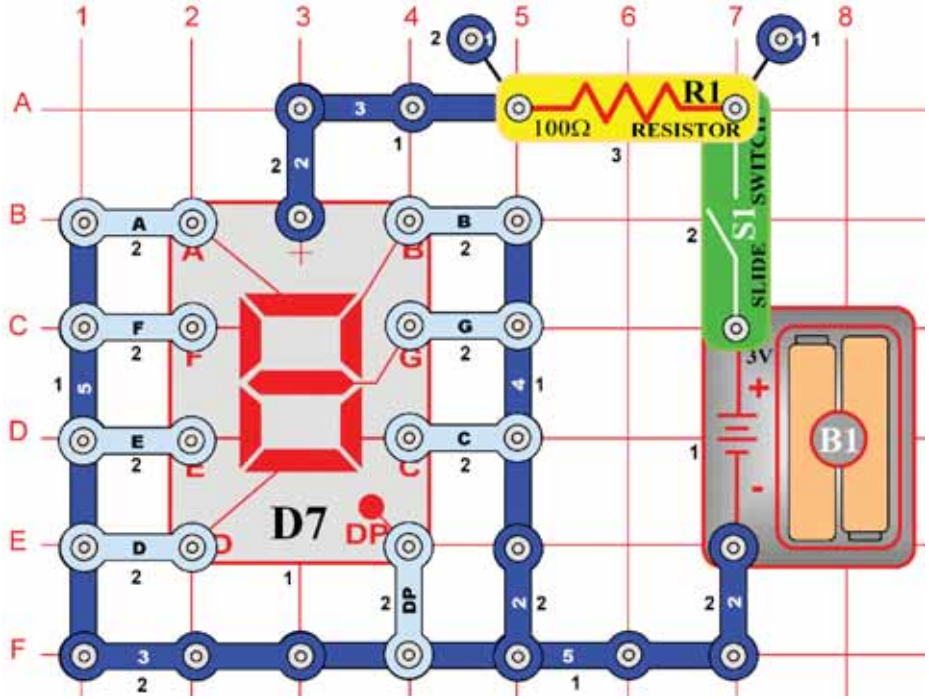
Connect A, D, E, F, & G to the negative of the battery (B1).

☐ Project #494

Display "."

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

Connect DP to the negative of the battery (B1).



☐ Project #495

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 (B1).

☐ Project #496

Display Letter "c"

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

Connect A, F, & G to the negative of the battery (B1).

☐ Project #497

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 (B1).

☐ Project #498

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 (B1).

☐ Project #499

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 (B1).

☐ Project #500

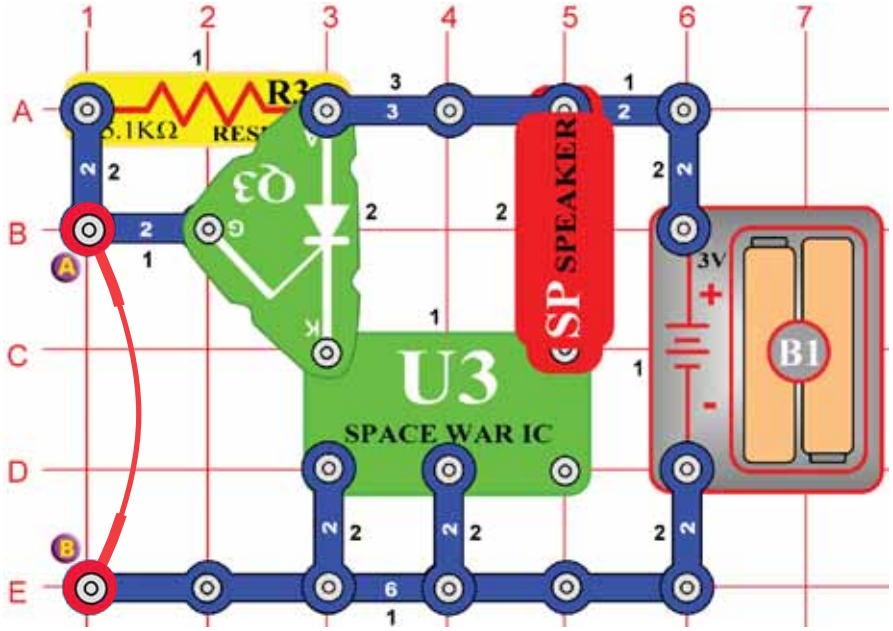
Display Letter "o"

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

Connect C, D, E, & G to the negative of the battery (B1).

Project #501

Alarm by SCR



OBJECTIVE: To build an alarm circuit.

The circuit uses the space war IC (U3) and works the same way as project #444. Remove the jumper wire and a space war sound plays.

Project #502

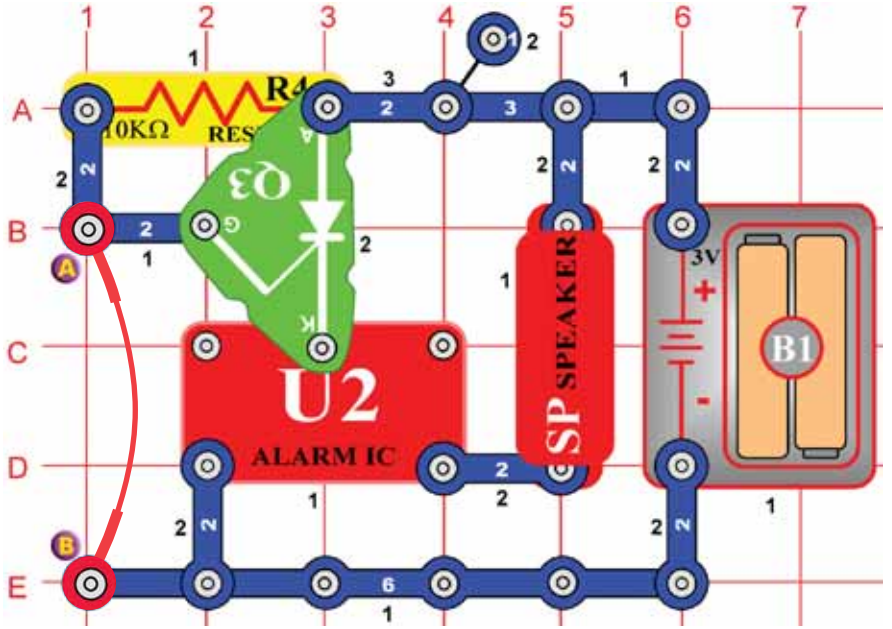
Light Space War Alarm

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #501. 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 photoresistor.

Project #503

Alarm by SCR



OBJECTIVE: To build an alarm circuit.

The circuit uses the alarm IC (U2) and works the same way as project #501. Remove the jumper wire and an alarm IC sounds.

Project #504

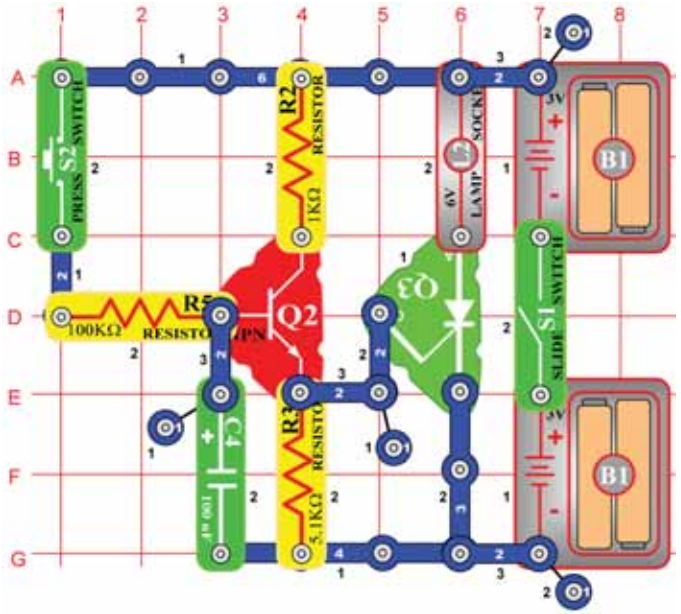
Light & Alarm IC

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #503. 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 photoresistor, the IC plays.

Project #505

Delay Light



OBJECTIVE: To construct a time delay circuit.

Turn on the slide switch (S1) and the lamp (L2) does not light. Press the press switch (S2) and slowly the lamp 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 turns on and triggers the SCR (Q3). The lamp will stay lit until the slide switch is turned off. The values of 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 #506

Delay Fan

OBJECTIVE: To construct a time delay fan.

Use the circuit in project #505. Replace the lamp (L2) with the motor (M1) and fan. Turn on slide switch (S1) and press down the press switch (S2) to start the motor.

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

Project #507

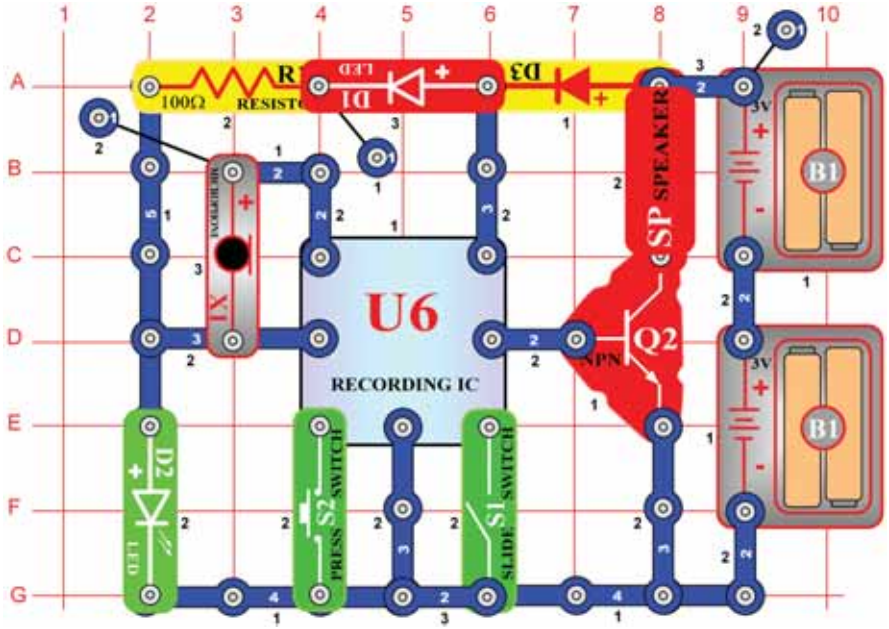
Delay Fan (II)

OBJECTIVE: To construct another type of time delay fan.

Use the circuit in project #506. Replace the 100μF capacitor (C4) with the 470μF capacitor (C5). Turn on the slide switch (S1) and press the 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.

Project #508

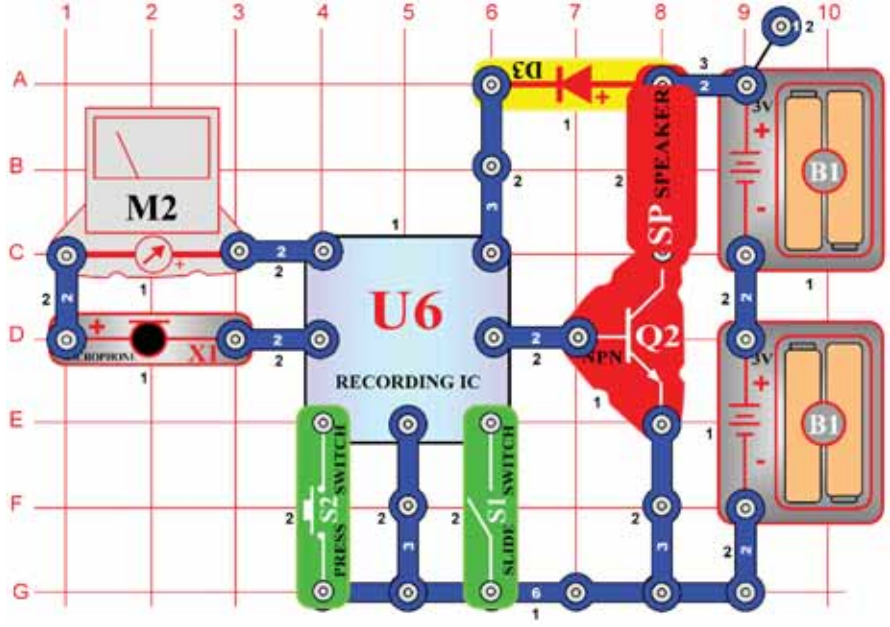


Recording LED Indicator

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.

Project #509



Playback & Record with Meter

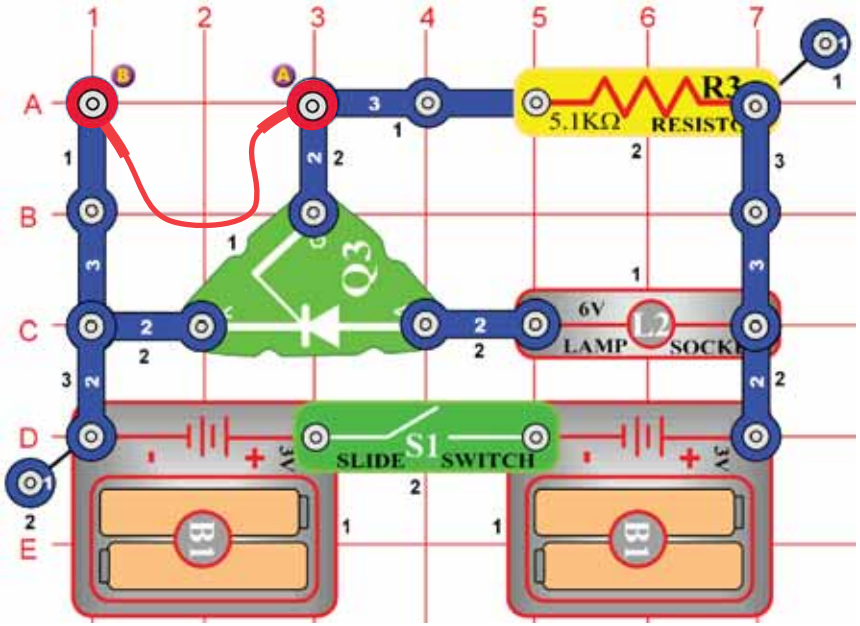
OBJECTIVE: To add a meter to the playback and record circuit.

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.

Project #510

Alarm Light

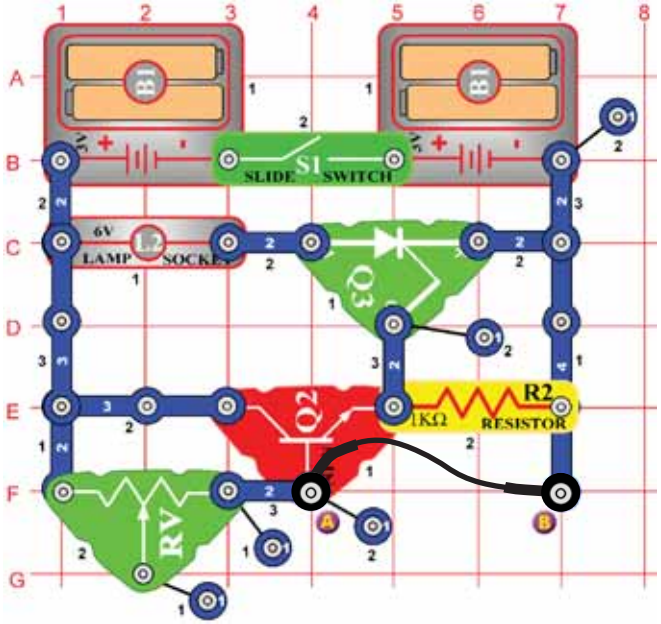


OBJECTIVE: To light a bulb to indicate an open circuit.

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 #511

Alarm Light (II)

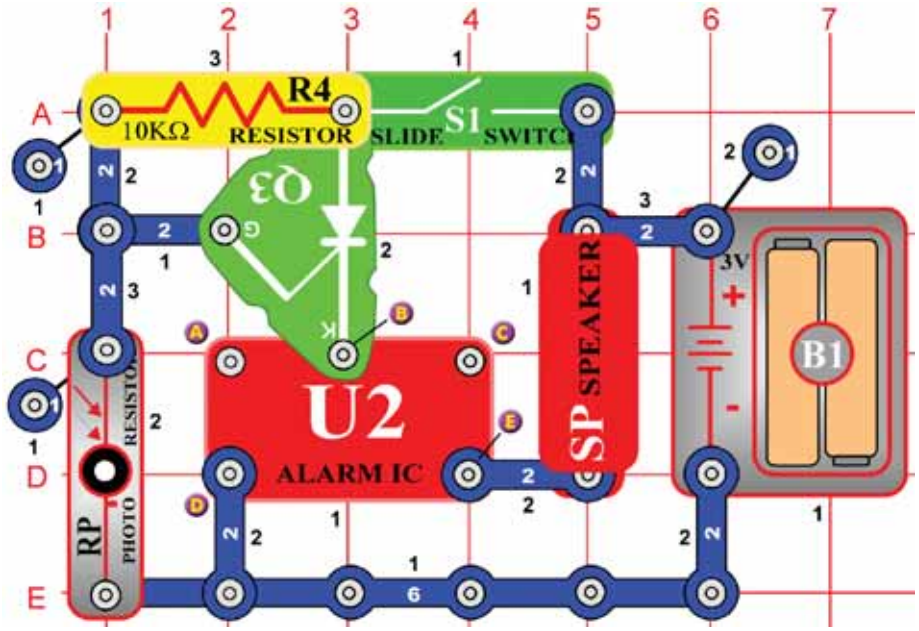


OBJECTIVE: To light a bulb to indicate an open circuit.

This project is similar to project #510, 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 #512

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 (B1). 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 #513

Night Machine Gun

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

Use the circuit from project #512. Connect the jumper wire to points B & C for a machine gun sound.

Project #514

Night Fire Engine

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

Use the circuit from project #512. Connect the jumper wire to points A & B for a fire engine sound.

Project #515

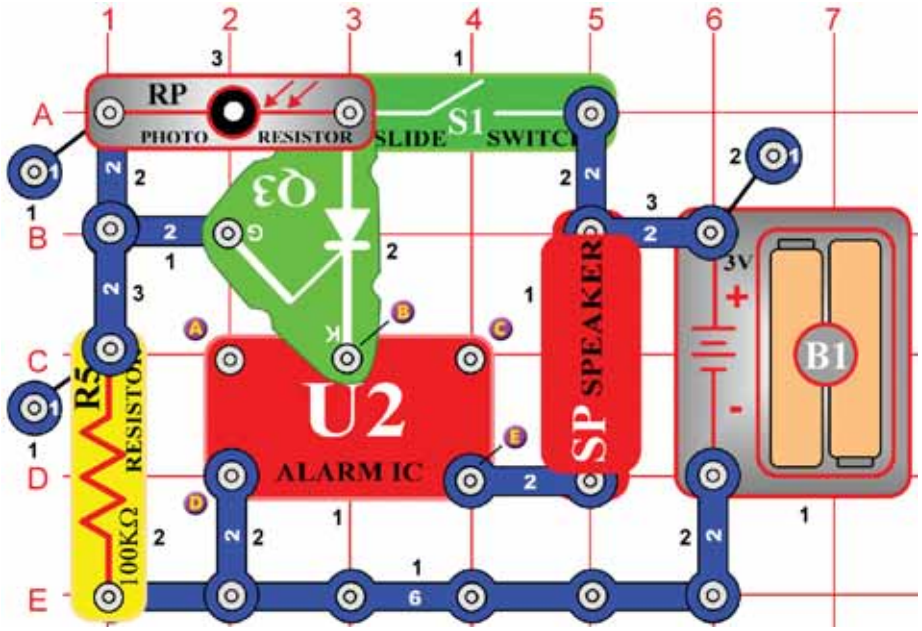
Night Ambulance

OBJECTIVE: To build a night-sensitive ambulance sound.

Use the circuit from project #512. Connect the jumper wire to points A & D for an ambulance sound.

Project #516

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 #517

Daytime Light Machine Gun

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

Use the circuit from project #516. Connect the jumper wire to points B & C. The sound of a machine gun will be heard, when the room is not dark.

Project #518

Daytime Light Fire Engine

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

Use the circuit from project #516. Connect the jumper wire to points A & B for a fire engine sound, when the room is not dark.

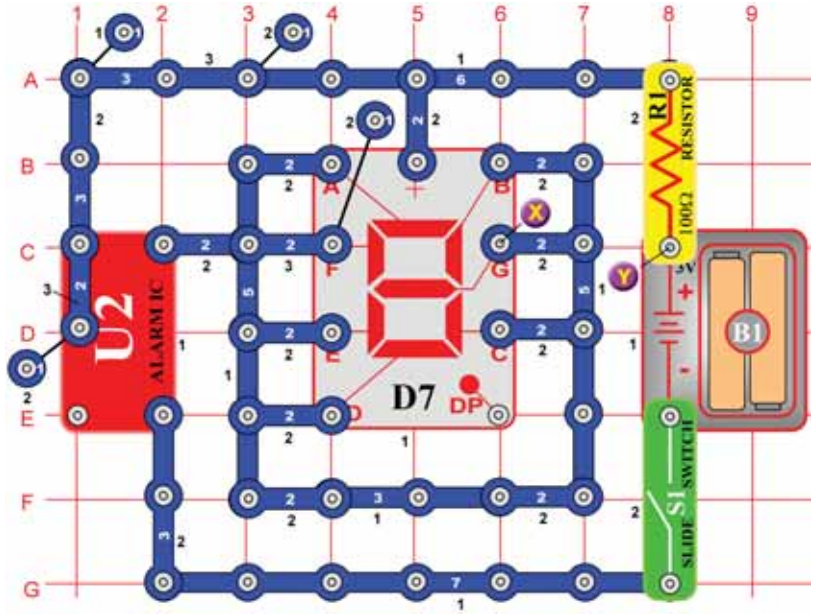
Project #519

Daytime Light Ambulance

OBJECTIVE: To build a light-sensitive ambulance sound.

Use the circuit from project #516. Connect the jumper wire to points A & D for an ambulance sound.

Project #520



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.

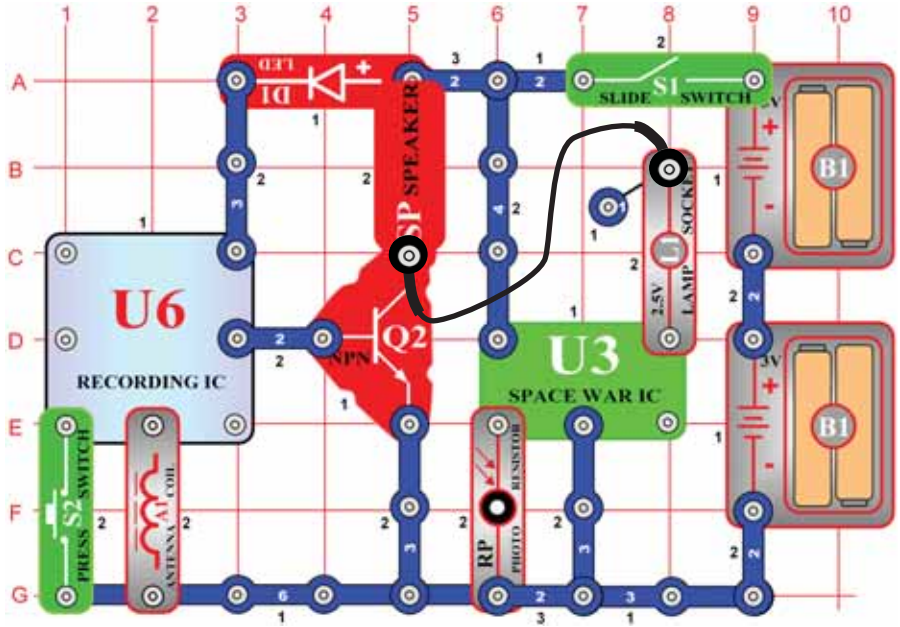
Project #521

Flashing 8 with Sound

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

Use the circuit in project 520. Connect the speaker (SP) across points X & Y to see and hear the IC's (U2) output.

Project #522



Musical Space War

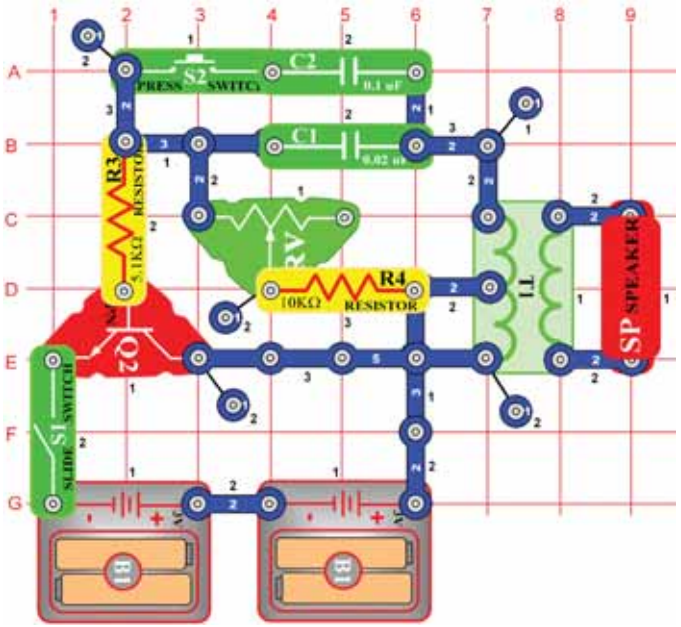
OBJECTIVE: To combine the sound effects of the recorder and space war integrated circuits.

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 the previous project.

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

Project #523



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 right) to lower the frequency of the tone.

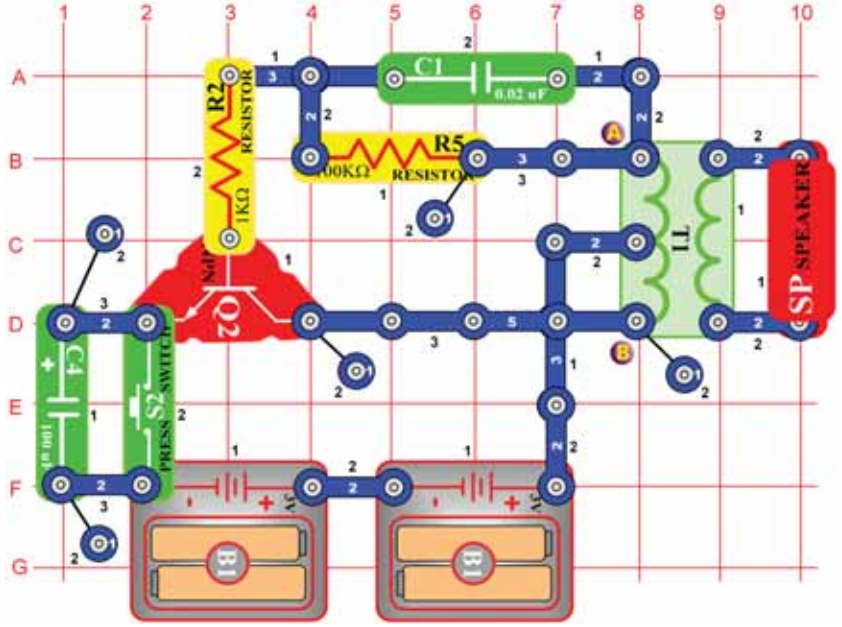
Project #524

Electronic Noisemaker (II)

OBJECTIVE: To show a variation of project #523.

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 #525



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) to change the sound.

Project #526

Bee (II)

OBJECTIVE: Show a variation of project #525.

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 right) to change the sound.

Project #527

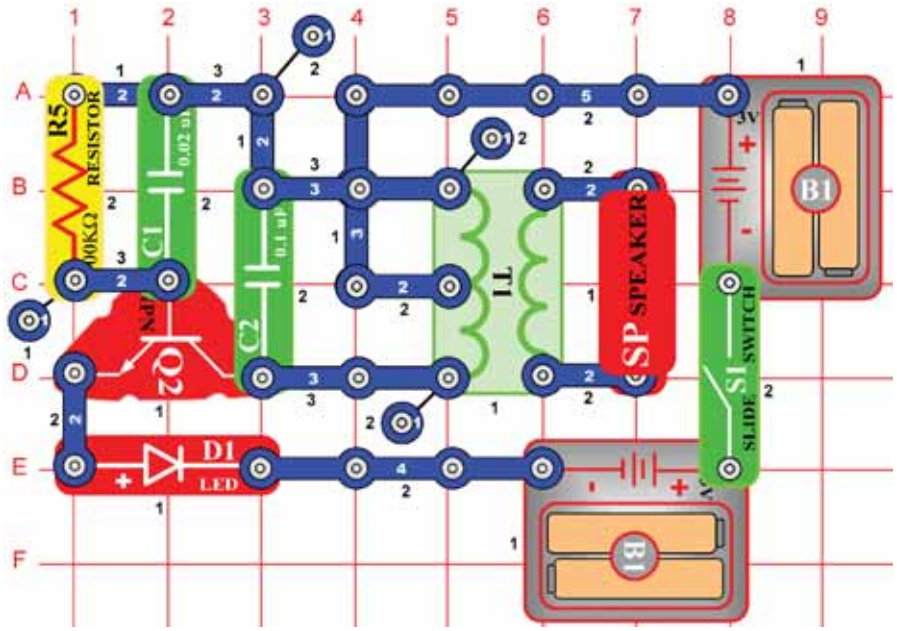
Bee (III)

OBJECTIVE: Show a variation of project #525.

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 #525 or the whistle chip circuit in project #526.

Project #528

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 #529

Oscillator Sound (II)

OBJECTIVE: Show variations of project #528.

Use the circuit in project #528. 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 #530

Oscillator Sound (III)

OBJECTIVE: Show variations of project #528.

Use the circuit in project #528. Place the whistle chip (WC) in parallel with the 0.1µF 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 #531

Oscillator Sound (IV)

OBJECTIVE: Show variations of project #528.

Use the circuit in project #528. 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 #532

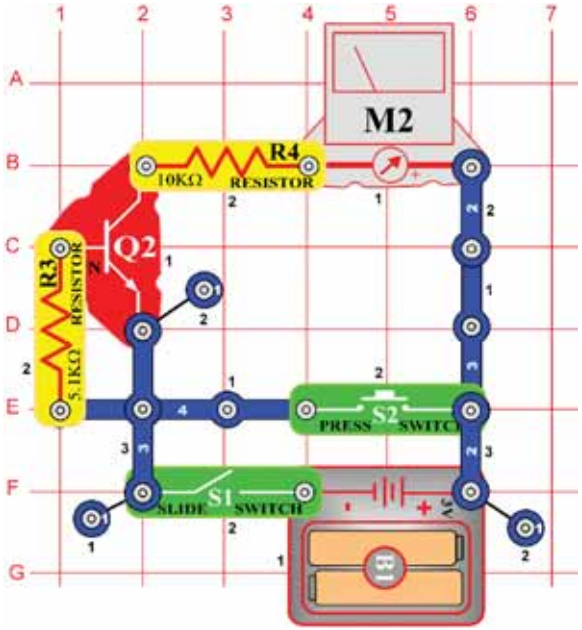
Oscillator Sound (V)

OBJECTIVE: Show variations of project #528.

Use the circuit in project #528. 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 #533

Transistor Tester

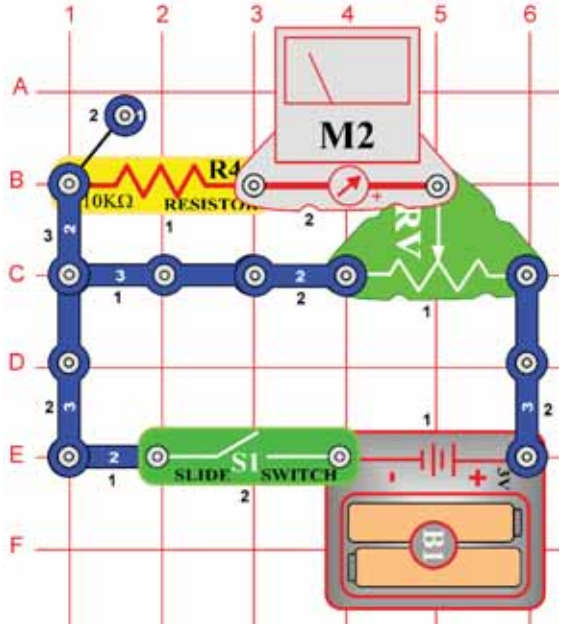


OBJECTIVE: To build a circuit that checks the transistor.

Set the meter (M2) to the LOW (or 10mA) scale. Turn on the slide switch (S1), the meter does not move. Press the press 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.

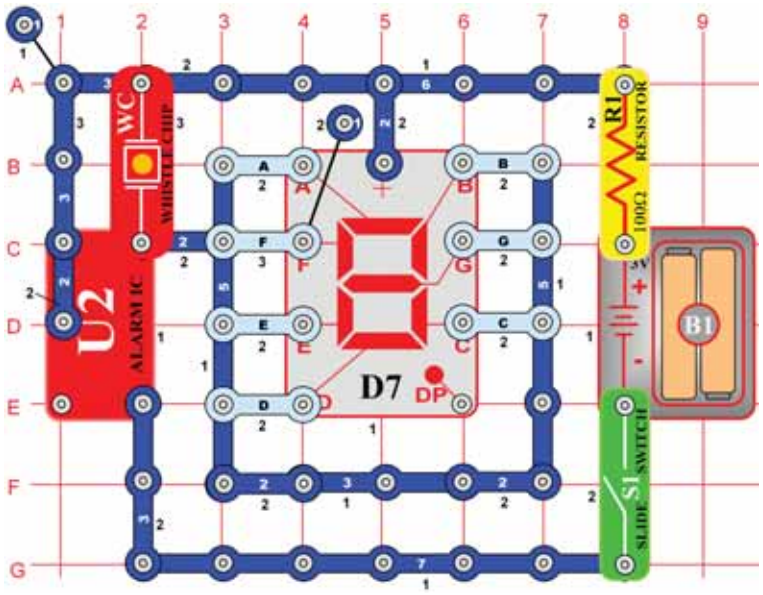
Project #534

Adjustable Voltage Divider



OBJECTIVE: To make an adjustable current path.

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. Set the meter (M2) to the LOW (or 10mA) scale. Adjust the adjustable resistor to the left, the meter deflects less, as the voltage decreases.



Project #535

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 slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #536

Automatic Display Capital Letter "E"

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

Use the circuit from project #535. Connect A, D, E, F, & G to the circuit. Turn on the slide switch (S1), the display (D7) flashes and the whistle chip (WC) buzzes on and off.

Project #537

Automatic Display Capital Letter "F"

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

Use the circuit from project #535. Connect A, E, F, & G to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #538

Automatic Display Capital Letter "H"

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

Use the circuit from project #535. Connect B, C, E , F, & G to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #539

Automatic Display Capital Letter "P"

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

Use the circuit from project #535. Connect A, B, E, F, & G to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #540

Automatic Display Capital Letter "S"

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

Use the circuit from project #535. Connect A, F, G, C, & D to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #541

Automatic Display Capital Letter "U"

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

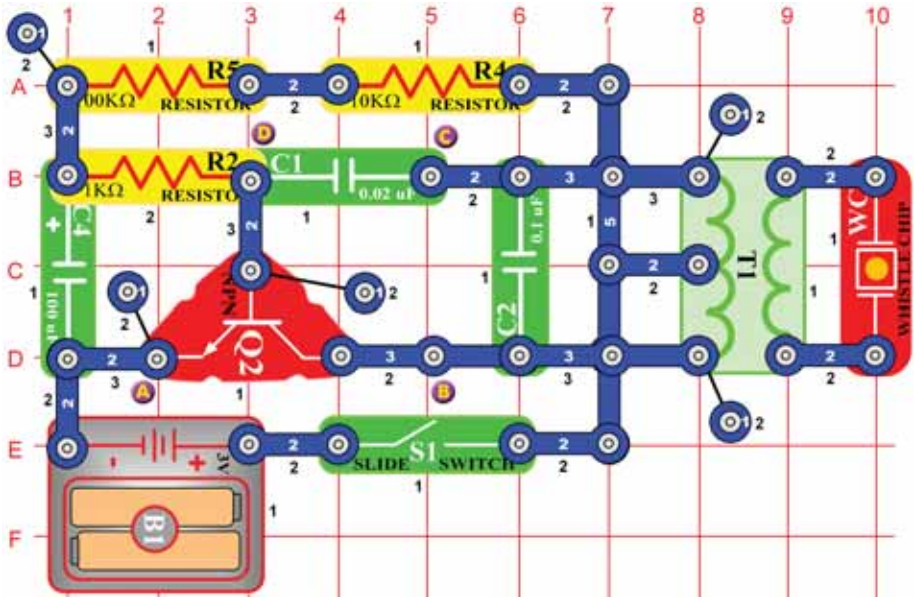
Use the circuit from project #535. Connect B, C, D, E, & F to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.

Project #542

Automatic Display Capital Letter "L"

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

Use the circuit from project #535. Connect D, E, & F to the circuit. Turn on the slide switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.



☐ Project #543
Whistle Chip Sounds

OBJECTIVE: To make sounds from the whistle chip.

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

☐ Project #544
Whistle Chip Sounds (II)

OBJECTIVE: Show variations of project #543.

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

☐ Project #545
Whistle Chip Sounds (III)

OBJECTIVE: Show variations of project #543.

Use the circuit in project #543. Connect the whistle chip (WC) across points C & D. You should hear a faster sound.

☐ Project #546
Whistle Chip Sounds (IV)

OBJECTIVE: Show variations of project #543.

Use the circuit in project #543, but replace the 100µF capacitor (C4) with the 10µF capacitor (C3).

☐ Project #547
Whistle Chip Sounds (V)

OBJECTIVE: Show variations of project #543.

Use the circuit in project #543, but replace the 100µF capacitor (C4) with the 470µF capacitor (C5).

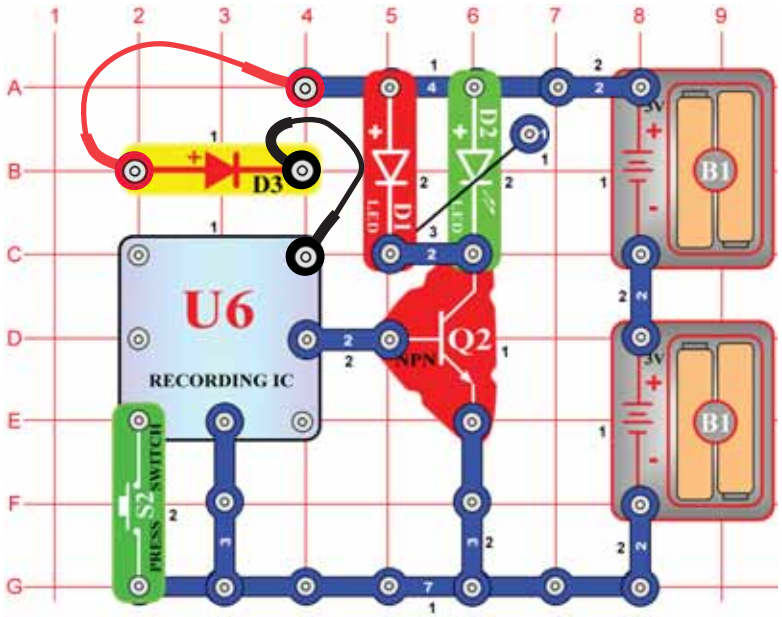
☐ Project #548
Whistle Chip Sounds (VI)

OBJECTIVE: Show variations of project #543.

Use the circuit in project #543, 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 #549

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 again to play the third song.

Project #550

Light-controlled LED Time Delay

OBJECTIVE: Show variations of project #549.

Use the circuit in project #549. Replace the press switch (S2) with the photoresistor (RP). Turn the LED's on and off by waving your hand over the photoresistor.

Project #551

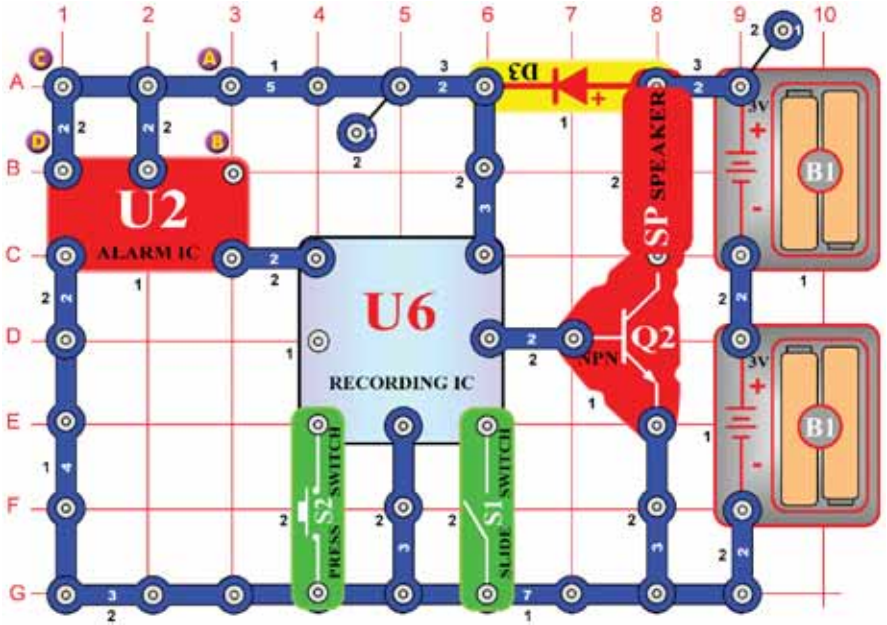
Touch-controlled LED Time Delay

OBJECTIVE: Show variations of project #549.

Use the circuit in project #549. 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 #552

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 slide 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 and press the press switch (S2). You will hear the recording of the alarm IC before each song is played.

Project #553

Alarm Recorder (II)

OBJECTIVE: Record the sound from the alarm IC.

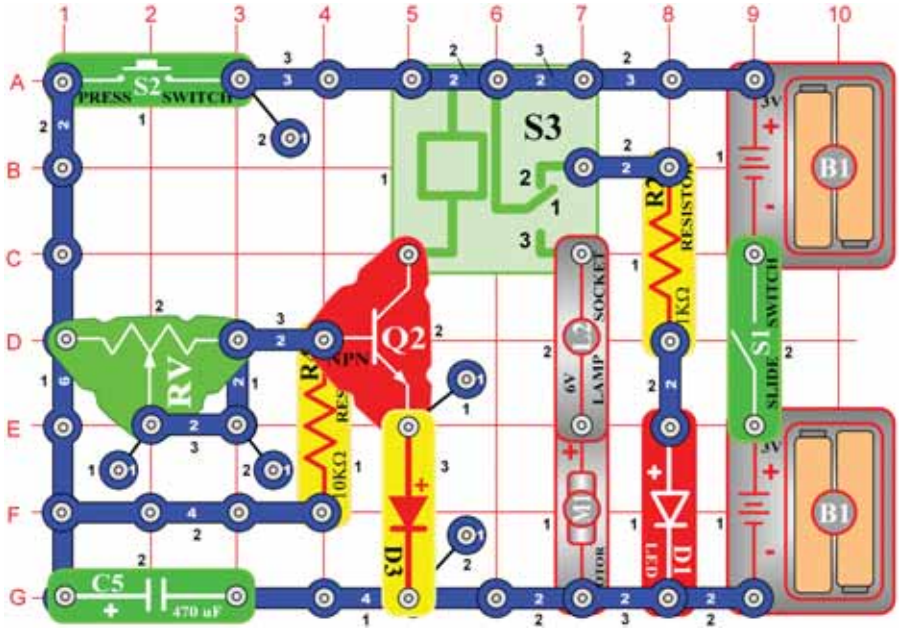
Use the circuit in project #552. Remove the 2-snap from A1 to B1. Turn on the slide switch (S1). The first beep indicates that the IC (U6) has begun recording. When you hear two beeps, turn off the slide switch, press the press switch (S2), and the new recording plays.

Project #554

Machine Gun Recorder

OBJECTIVE: To record the sound of a machine gun.

Use the circuit in project #552. Move the 2-snap from A1 - B1 to 3A - 3B. Turn on the slide switch (S1). The first beep indicates that the IC (U6) has begun recording. When you hear two beeps, turn off the slide switch, press the press switch (S2), and the machine gun sound plays.



Project #555
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 (B1), 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 slide switch (S1), the red LED (D1) lights. Now press and release the press switch, the lamp (L2) lights and the motor spins.

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

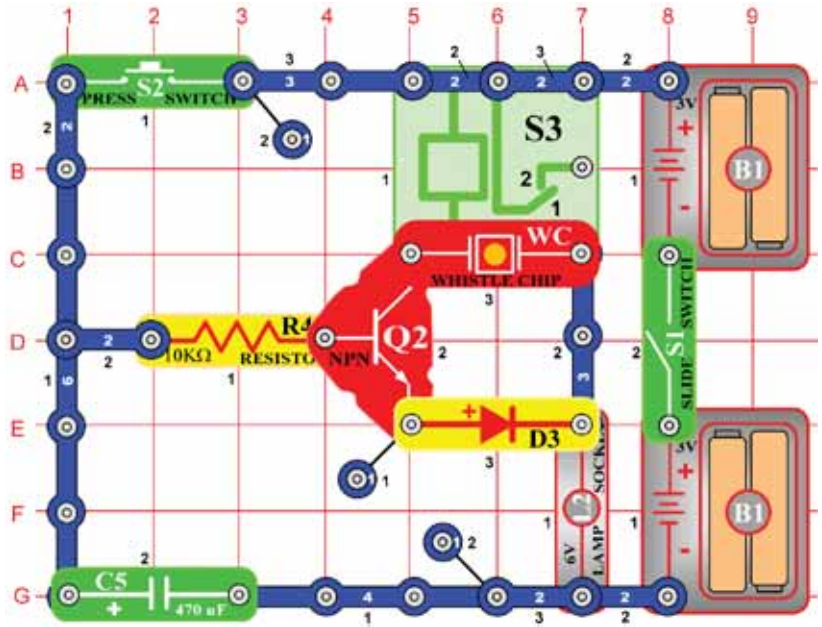
Project #556
Time Delay

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

Use the circuit in project #555. Replace the 470μF capacitor (C5) with the 100μF capacitor (C4). Set the adjustable resistor (RV) to the far right, turn on the slide switch (S1), then press and release the press switch (S2). The motor (M1) spins and lamp (L2) lights for about 3 seconds. Adjust the adjustable resistor to the left for a much shorter time.

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

Project #557



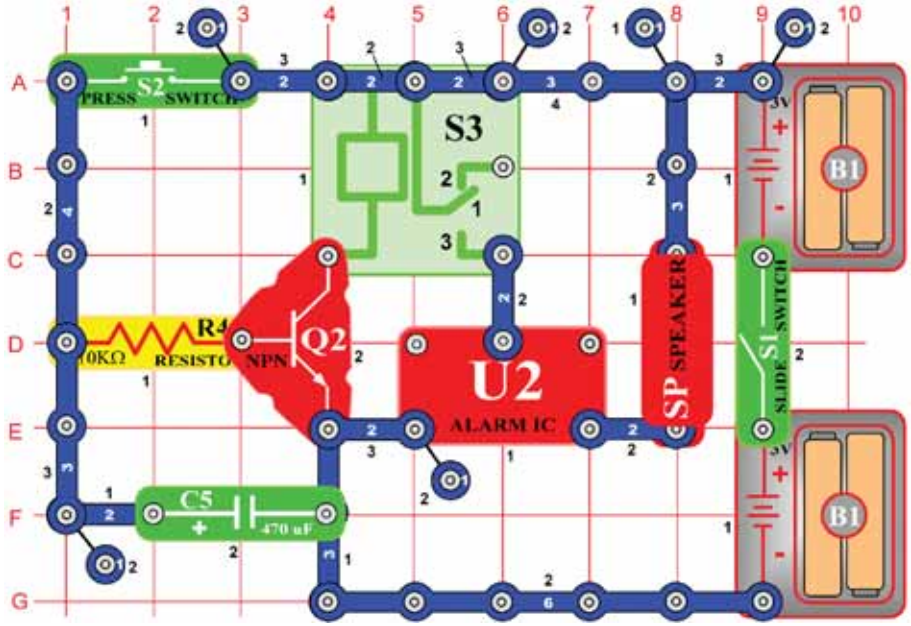
Manual 7 Second Timer (II)

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

This circuit is similar to project #555 except now the whistle chip (WC) will also make sound.

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

Project #558



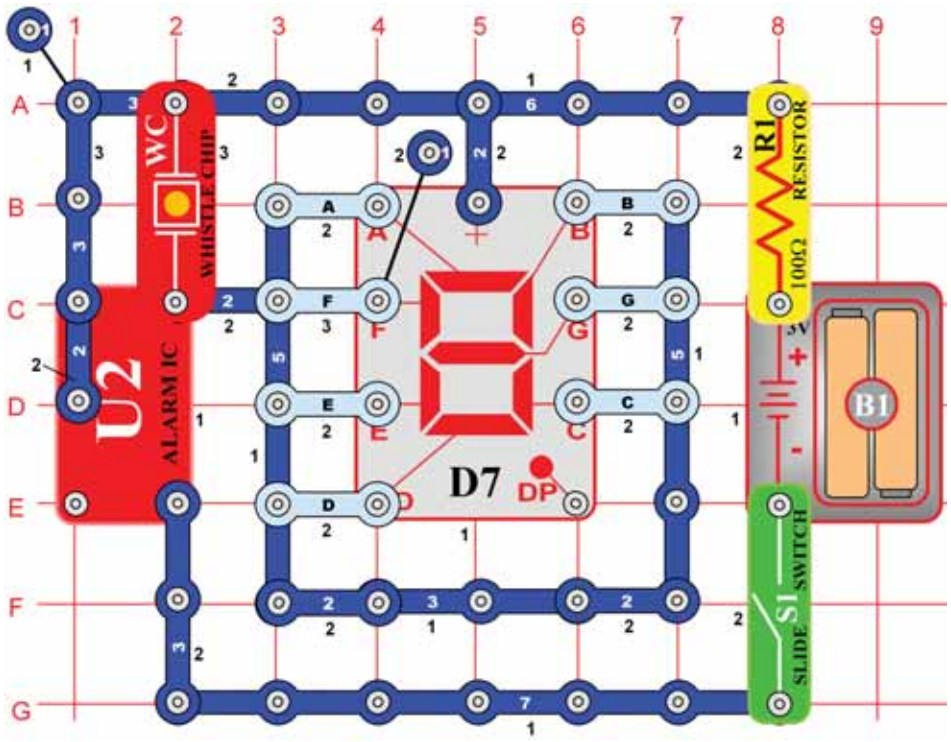
15 Second Alarm

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

As in project #555, the transistor (Q2) acts as a switch, connecting the relay (S3) and the alarm IC (U2) to the batteries (B1). 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 press switch (S2). The transistor turns on, the capacitor (C5) charges up, and the alarm sounds. Release the press switch. 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.

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



Project #559

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 #560

Flashing "3 & 4"

OBJECTIVE: Use the alarm IC as a switch to flash the numbers "3 & 4".

Use the circuit in project #559. 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 #561

Flashing "5 & 6"

OBJECTIVE: Use the alarm IC as a switch to flash the numbers "5 & 6".

Use the circuit in project #559. 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 #562

Flashing "7 & 8"

OBJECTIVE: Use the alarm IC as a switch to flash the numbers "7 & 8".

Use the circuit in project #559. 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 #563

Flashing "9 & 0"

OBJECTIVE: Use the alarm IC as a switch to flash the numbers "9 & 0".

Use the circuit in project #559. Connect A, B, C, D, F, & G to the circuit. Turn on the slide switch (S1) and the number "9" should be flashing. Now, connect A, B, C, D, E, & F to flash the number "0".

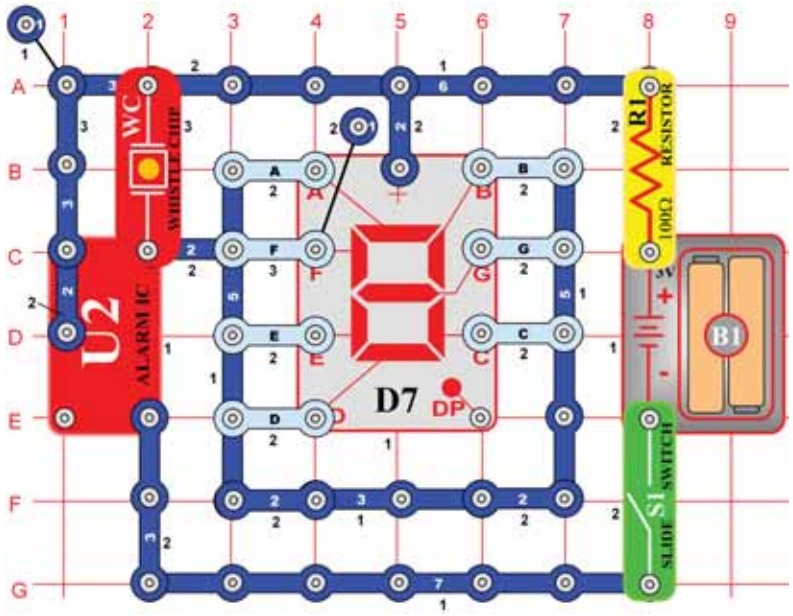
Project #564

Flashing "A & J"

OBJECTIVE: Use the alarm IC as a switch to flash the letters "A & J".

Use the circuit in project #559. 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 #565



Flashing "b & c"

OBJECTIVE: Use the alarm IC as a switch to flash the letters "b & c".

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 #566

Flashing "d & e"

OBJECTIVE: Use the alarm IC as a switch to flash the letters "d & e".

Use the circuit in project #565. 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".

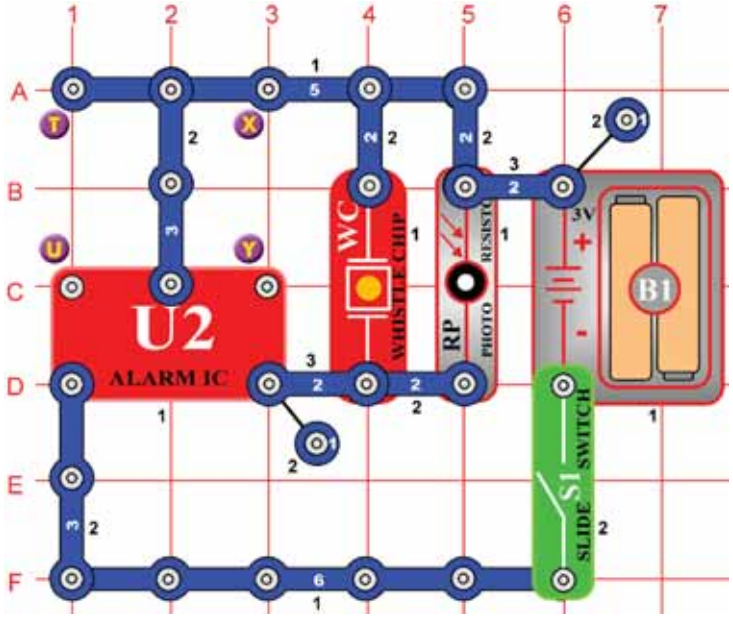
Project #567

Flashing "h & o"

OBJECTIVE: Use the alarm IC as a switch to flash the letters "h & o".

Use the circuit in project #565. 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 #568



Light-controlled Sounds

OBJECTIVE: To give a more dramatic demonstration of using the photosensitive resistance.

Build the circuit shown on the left.

Turn on the slide switch (S1), a police siren is heard. The loudness of the sound depends on how much light reaches the photoresistor (RP), try partially shielding it or placing near a very bright light, and compare the sound.

Project #569

Light-controlled Sounds (II)

OBJECTIVE: To show a variation of the circuit in project #568.

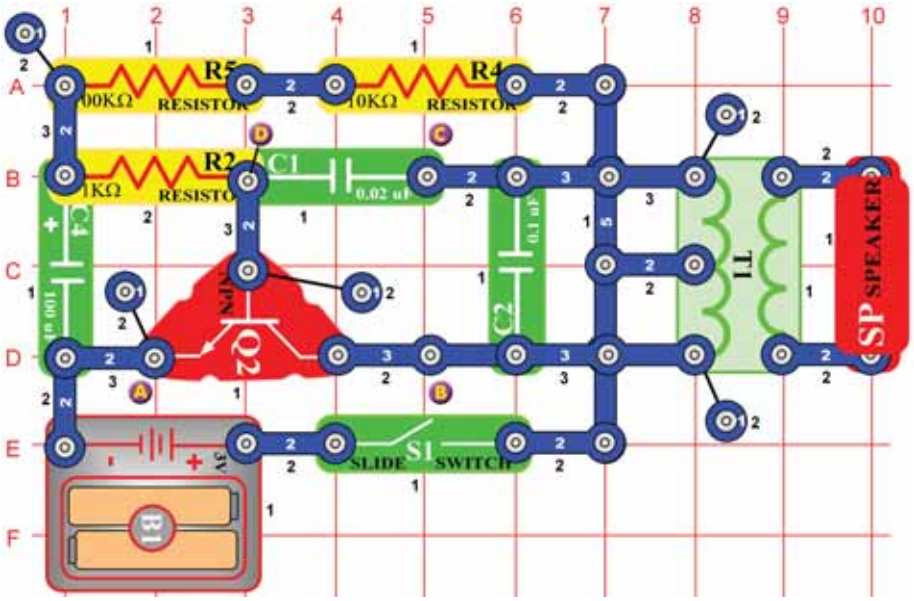
Modify the last circuit by connecting points X & Y. The circuit works the same way but now it sounds like a machine gun.

Project #570

Light-controlled Sounds (III)

OBJECTIVE: To show a variation of the circuit in project #568.

Now remove the connection between X & Y and then make a connection between T & U. The circuit works the same way but now it sounds like a fire engine.



Project #571
Bird Sounds

OBJECTIVE: To create bird sounds.

Turn on the slide switch (S1). The circuit makes a bird sound.

Project #572
Bird Sounds (II)

OBJECTIVE: To create bird sounds.

Use the circuit in project #571. 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 #573
Bird Sounds (III)

OBJECTIVE: To create bird sounds.

Use the circuit in project #571. Using the jumper wires, connect the whistle chip (WC) across points A & B and the sound changes.

Project #574
Bird Sounds (IV)

OBJECTIVE: To create bird sounds.

Use the circuit in project #571. Connect the whistle chip (WC) across points B & C.

Project #575
Bird Sounds (V)

OBJECTIVE: To create bird sounds.

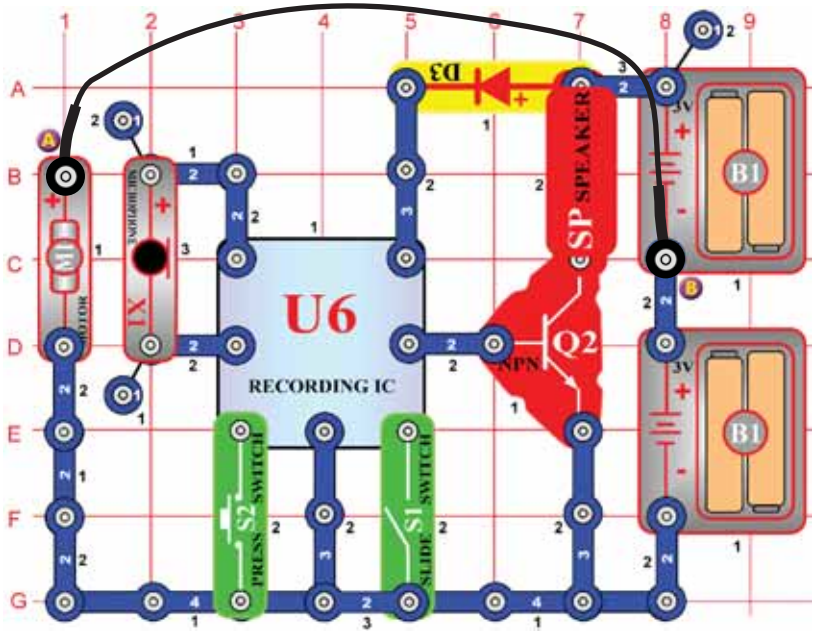
Using the jumper wires, connect the whistle chip (WC) across points C & D.

Project #576
Touch-control Bird Sound

OBJECTIVE: Show variations of project #571.

Use the circuit in project #571. 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 #571 - 575.

Project #577



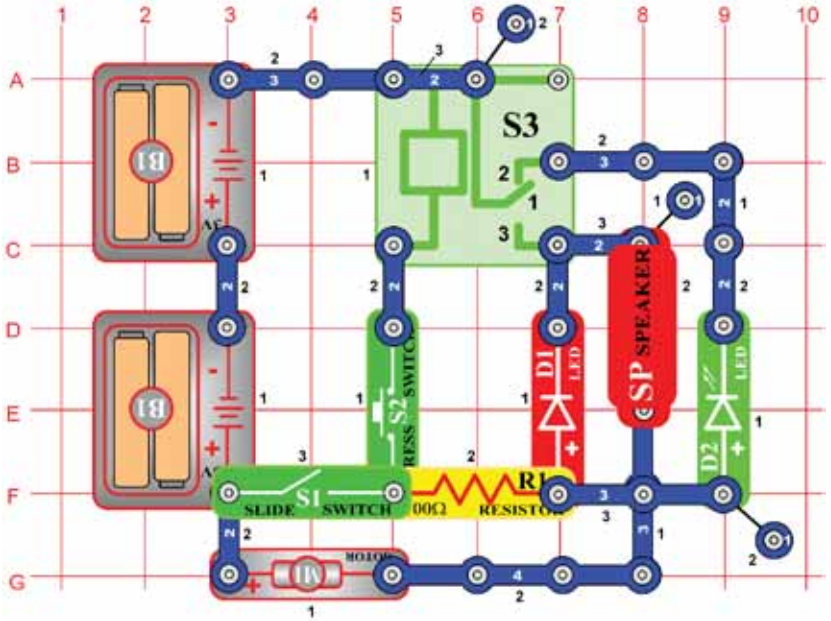
Motor Sound Recording

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 slide switch (S1). After the two beeps, turn off the slide switch again. Remove the jumper wire and press the press switch (S2) to hear the recording.

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

Project #578



Motor Sound Indicator

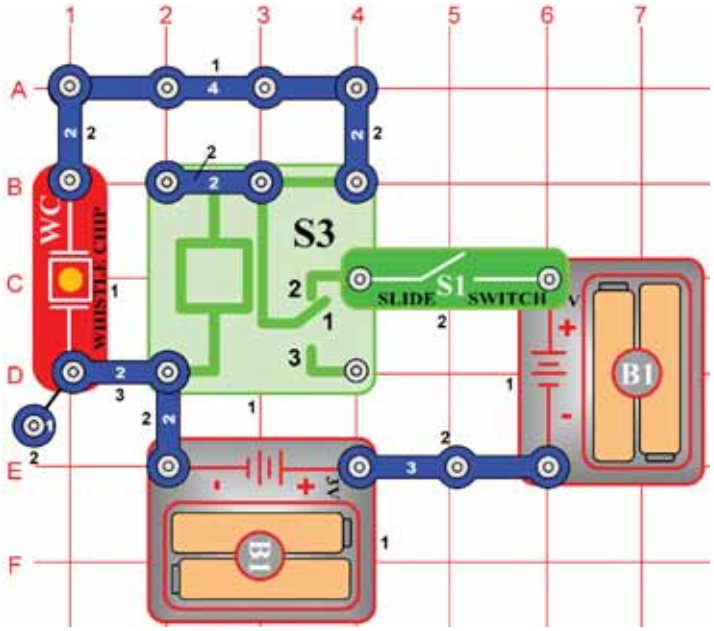
OBJECTIVE: To build a circuit that generates sound as a motor is spinning.

Turn off the slide switch (S1). There is no power; the LED's and motor are off. Now turn on the slide switch. Only the green LED (D2) lights, indicating power to the circuit. Press the press switch (S2). The motor spins, the red LED (D1) lights, and you hear the motor sound from the speaker.

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

Project #579

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 #580

Relay & Speaker

OBJECTIVE: Use the speaker and relay to make sound.

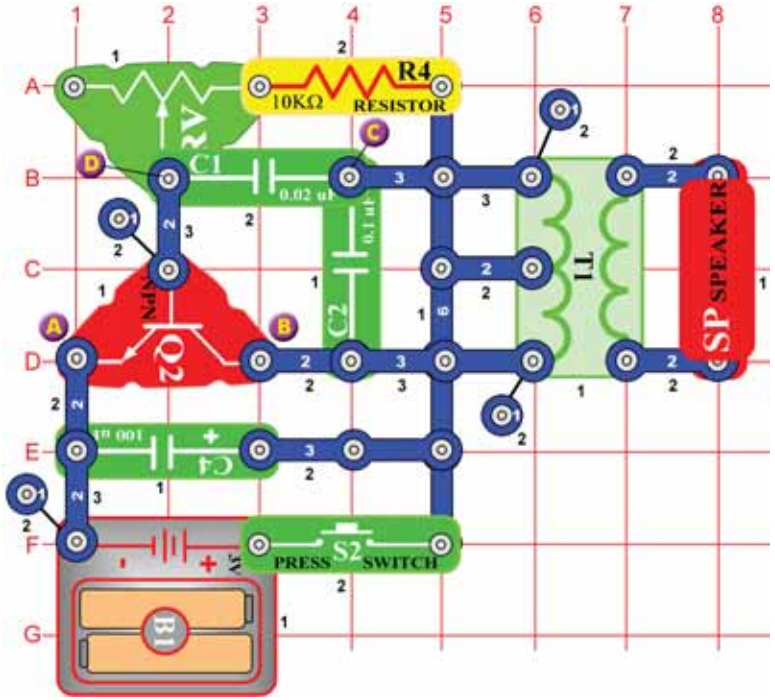
Use the circuit from project #579. Replace the whistle chip (WC) with the speaker (SP). Turn on the slide switch (S1) and now you generate a louder sound using the speaker.

Project #581

Relay & Lamp

OBJECTIVE: Light the bulb using the relay.

Use the circuit from project #579. Replace the whistle chip (WC) with the 6V lamp (L2). Turn on the slide switch (S1) and the lamp lights.



☐ Project #582
Electronic Cat

OBJECTIVE: To create the sound of a cat.

Set the adjustable resistor (RV) to the far left. Press and release the press switch (S2). You should hear the sound of a cat from the speaker (SP). Now adjust the resistor and hear the different sounds.

☐ Project #583
Electronic Cat (II)

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Connect the whistle chip (WC) across points A & B. Press and release the the press switch (S2). You hear sound from the whistle chip and speaker (SP). Adjust the resistor (RV) and hear the different sounds.

☐ Project #584
Electronic Cat (III)

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Using the jumper wires, connect the whistle chip (WC) across points B & C. Press and release the press switch (S2). Adjust the adjustable resistor (RV) and hear the different sounds.

☐ Project #585
Electronic Cat (IV)

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Connect the whistle chip (WC) across points C & D. Press and release the press switch (S2). Adjust the adjustable resistor (RV) and hear the different sounds.

☐ Project #586
Buzzer Cat

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. 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 #587
Buzzer Cat (II)

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Remove the speaker (SP) and connect the whistle chip (WC) across points B & C using the jumper wires. Press and release the press switch (S2). Adjust the adjustable resistor (RV) and hear the different sounds.

☐ Project #588
Buzzer Cat (III)

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Remove the speaker (SP) and connect the whistle chip (WC) across points C & D. Press and release the press switch (S2). Adjust the adjustable resistor (RV) and hear the different sounds.

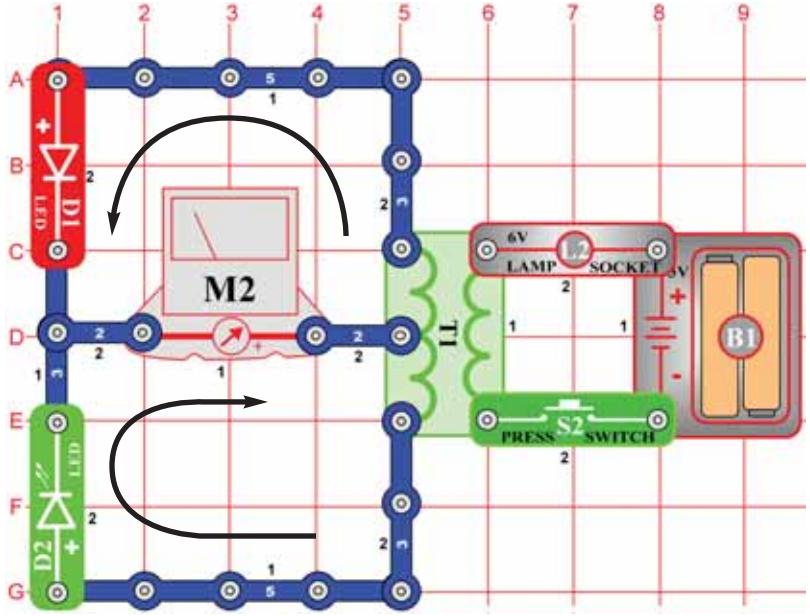
☐ Project #589
Lazy Cat

OBJECTIVE: Show variations of project #582.

Use the circuit in project #582. Replace the 100μF capacitor (C4) with 470μF (C5). Repeat projects #582-588 and hear 7 different sounds.

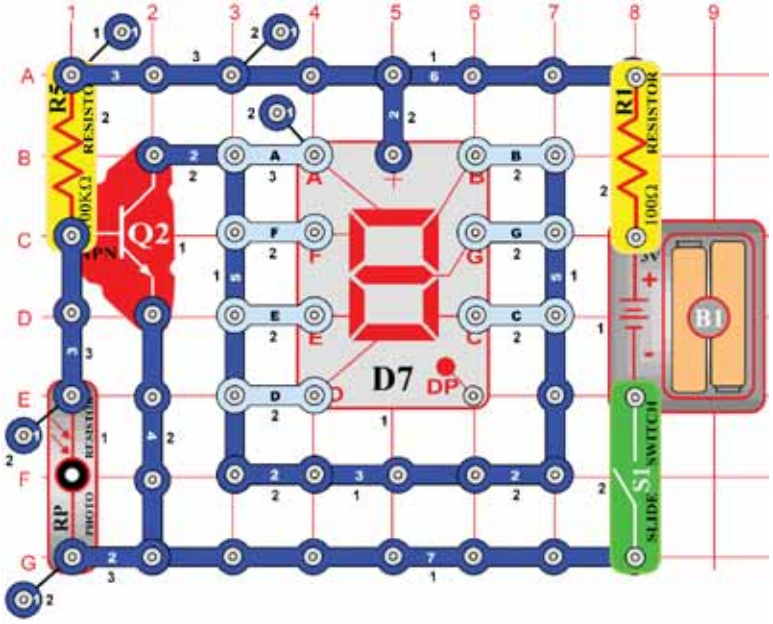
Project #590

Meter Deflection (II)



OBJECTIVE: To build change the direction in which current flows.

Compare this circuit to project #482, 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 #591

Automatic Display #1

OBJECTIVE: Construct a light-controlled display.

Connect segments B & C to the circuit. Turn on the slide switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 1 lights.

Project #592

Automatic Display #2

OBJECTIVE: Light the number 2 using a light-controlled display.

Use the circuit from project #591. Connect A, B, G, E, & D to the circuit. Turn on the slide switch (S1), the display should be off. Place your hand over the photoresistor (RP), now the number 2 lights.

Project #593

Automatic Display #3

OBJECTIVE: Light the number 3 using a light-controlled display.

Use the circuit from project #591. Connect A, B, G, C, & D to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 3 lights.

Project #594

Automatic Display #4

OBJECTIVE: Light the number 4 using a light-controlled display.

Use the circuit from project #591. Connect B, G, C, & F to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 4 lights.

Project #595

Automatic Display #5

OBJECTIVE: Light the number 5 using a light-controlled display.

Use the circuit from project #591. Connect A, C, F, G, & D to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 5 lights.

Project #596

Automatic Display #6

OBJECTIVE: Light the number 6 using a light-controlled display.

Use the circuit from project #591. Connect A, C, D, E, F, & G to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 6 lights.

Project #597

Automatic Display #7

OBJECTIVE: Light the number 7 using a light-controlled display.

Use the circuit from project #591. Connect A, B, & C to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 7 lights.

Project #598

Automatic Display #8

OBJECTIVE: Light the number 8 using a light-controlled display.

Use the circuit from project #591. Connect A, B, C, D, E, F & G to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 8 lights.

Project #599

Automatic Display #9

OBJECTIVE: Light the number 9 using a light-controlled display.

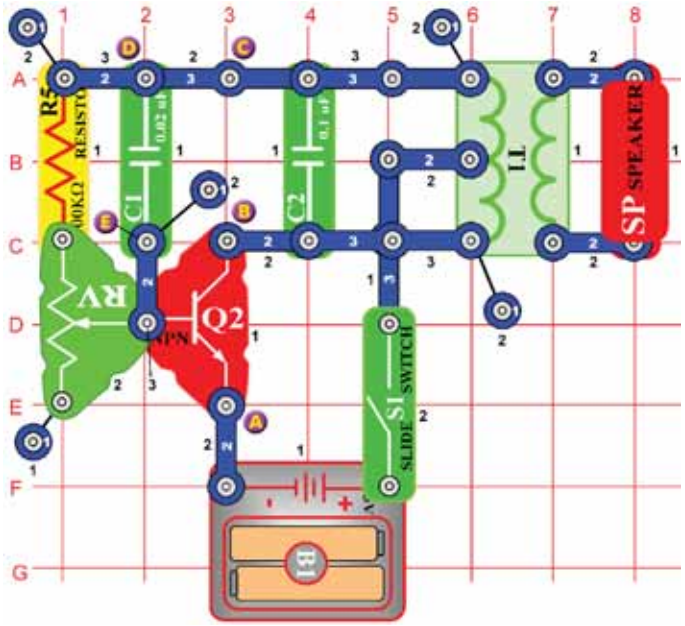
Use the circuit from project #591. Connect A, B, F, G, & C to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 9 lights.

Project #600

Automatic Display #0

OBJECTIVE: Light the number 0 using a light-controlled display.

Use the circuit from project #591. Connect A, B, C, D, E & F to the circuit. Turn on the slide switch (S1), the display (D7) should be off. Place your hand over the photoresistor (RP), now the number 0 lights.



☐ Project #601
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 adjustable resistor to hear the different sounds.

☐ Project #602
Variable Oscillator (II)

OBJECTIVE: To change the tone using the adjustable resistor.

Use the circuit in project #601. Connect the whistle chip (WC) across points A & B and adjust the adjustable resistor (RV). You should hear a higher tone. This is generated by the whistle chip (WC).

☐ Project #603
Variable Oscillator (III)

OBJECTIVE: Show variations of project #601.

Use the circuit in project #601. Connect the whistle chip (WC) across points B & C and adjust the adjustable resistor (RV).

☐ Project #604
Variable Oscillator (IV)

OBJECTIVE: Show variations of project #601.

Use the circuit in project #601. Connect the whistle chip (WC) across points D & E and adjust the adjustable resistor (RV).

☐ Project #605
Photo Variable Resistor

OBJECTIVE: Show variations of project #601.

Use the circuit in project #601. Replace the 100kΩ resistor (R5) with the photoresistor (RP). Wave your hand over the photoresistor and the sound changes. Adjust the adjustable resistor (RV) to make more sounds.

☐ Project #606
Photo Variable Whistle Chip Oscillator

OBJECTIVE: Show variations of project #601.

Use the circuit in project #601, remove the speaker (SP). Make three more sounds by placing the whistle chip (WC) across points, A & B, B & C, and D & E.

☐ Project #607
Slow Adjusting Tone

OBJECTIVE: Show variations of project #601.

Use the circuit in project #601. 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.

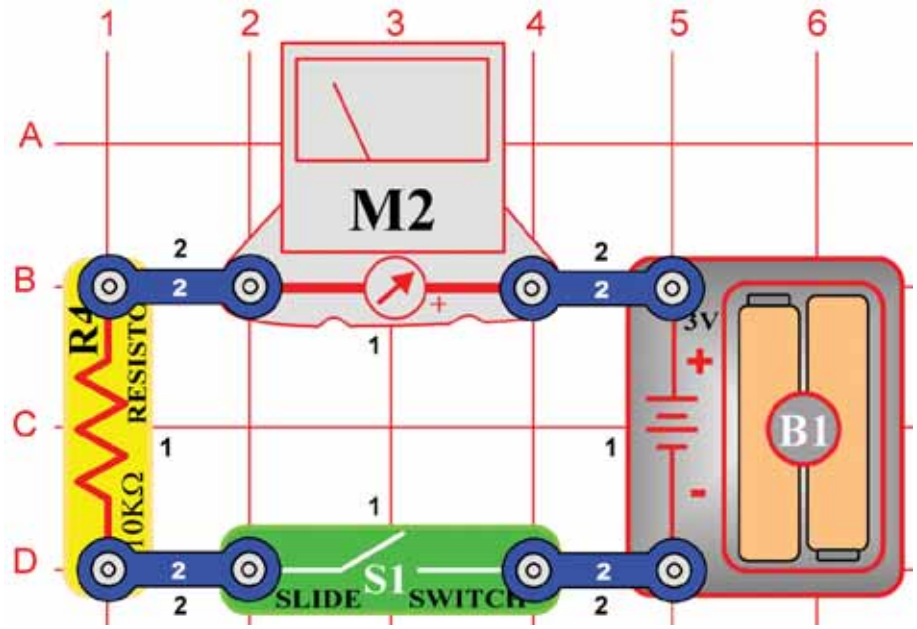
☐ Project #608
Slow Adjusting Tone (II)

OBJECTIVE: Show a variation of project #607.

Use the circuit in project #607. 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 #609

Fixed Current Path

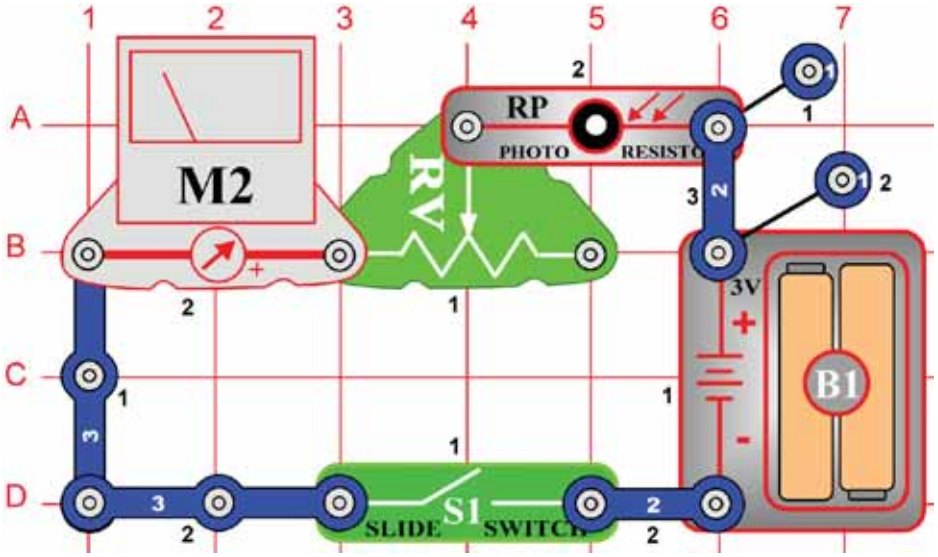


OBJECTIVE: To make a fixed current path.

Set the meter (M2) to the LOW (or 10mA) scale. The meter indicates the amount of current in the circuit. Turn on the slide switch (S1), the needle deflects indicating the amount of current. The 10kΩ resistor (R4) limits the current, otherwise the meter could be damaged.

Project #610

Simple Illumination Meter



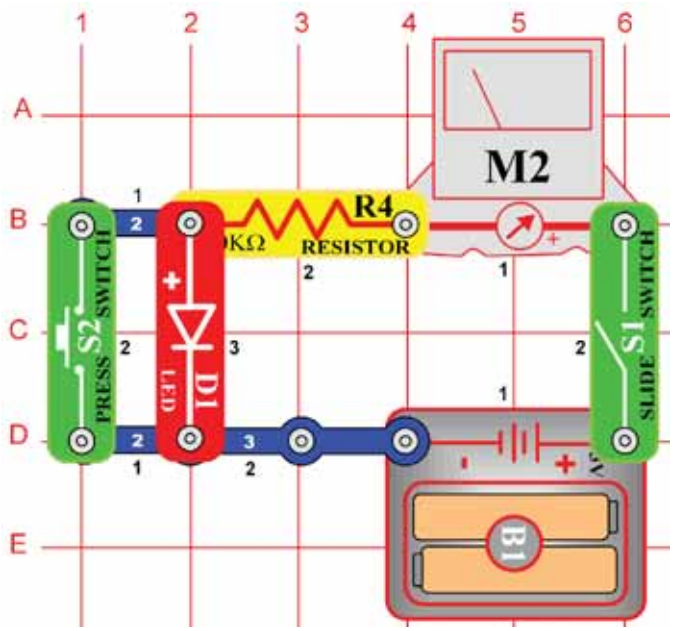
OBJECTIVE: To make a simple light meter.

Set the meter (M2) to the LOW (or 10mA) scale. 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 #611

LED Voltage Drop

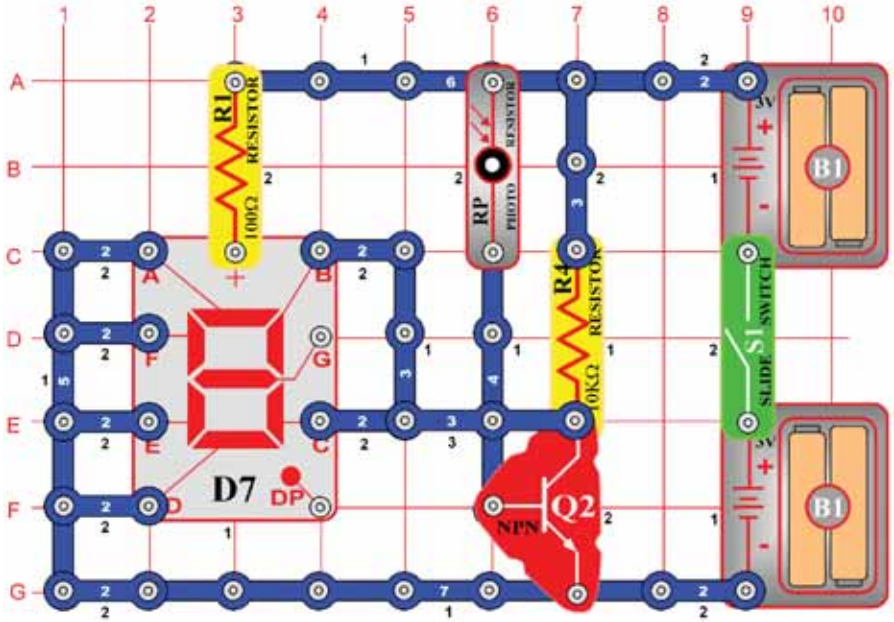


OBJECTIVE: To measure the voltage drop across diodes.

Set the meter (M2) to the LOW (or 10mA) scale. 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 (R4) 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 #612

Open/Closed Door Indicator



OBJECTIVE: To make a circuit that indicates whether a door is open or closed.

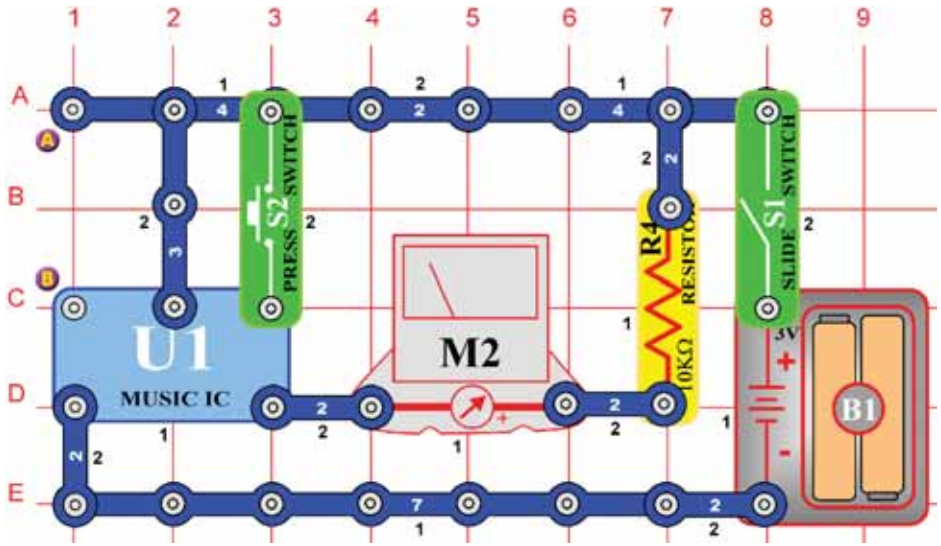
Using the photoresistor (RP) you can build a circuit that indicates if a door is open or closed. When the door is open and light is present, the letter "O" lights. When the door is closed and the room is dark, the letter C lights.

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 (B1) 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 #613

Hand-control Meter



OBJECTIVE: To understand music deflection.

Set the meter (M2) to the LOW (or 10mA) scale. 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 #614

Light-control Meter

OBJECTIVE: To control the circuit using light.

Use the circuit in project #613. 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 #615

Electric-control Meter

OBJECTIVE: To start the circuit using an electric motor.

Use the circuit in project #613. 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 #616

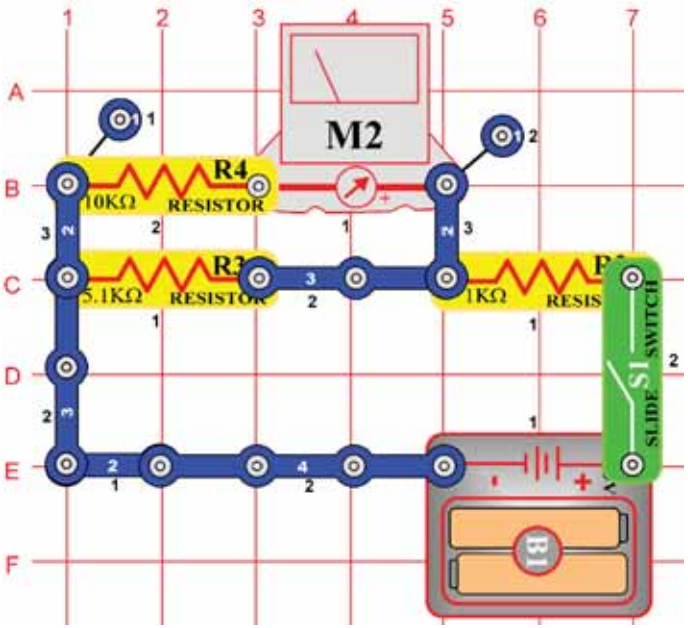
Sound-control Meter

OBJECTIVE: To start the circuit by using a speaker.

Use the circuit in project #613. 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 (WC), the music plays again. The clapping sound vibrates the plates in the whistle chip, creating the voltage needed to trigger the IC (U1).

Project #617

Fixed-Voltage Divider



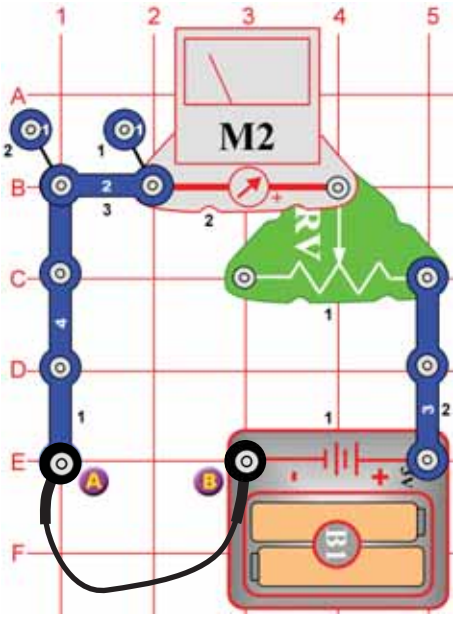
OBJECTIVE: To make a simple voltage divider.

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.

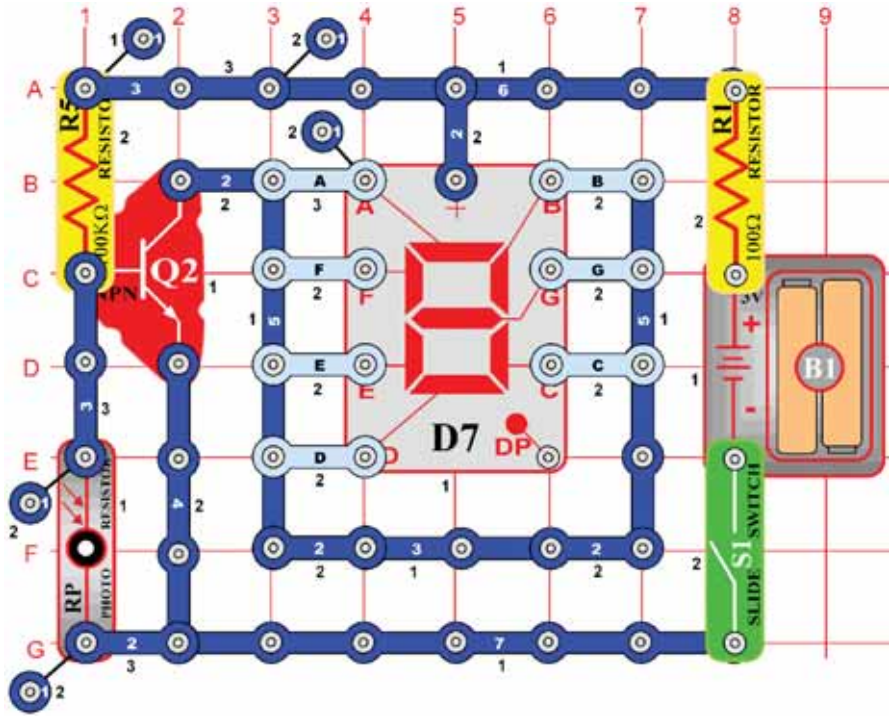
Project #618

Resistor Measurement



OBJECTIVE: To make a resistor checker.

Set the meter (M2) to the LOW (or 10mA) scale. 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.



Project #619

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 (D7) should be off. Place your hand over the photoresistor (RP), now the letter "b" lights.

Project #620

Automatic Display Letter "c"

OBJECTIVE: To light the letter "c" using a light-controlled display.

Use the circuit from project #619. Connect E, D, & G to the circuit. Turn on the slide switch (S1) and the display (D7) should be off. Place your hand over the photoresistor (RP), now the letter "c" lights.

Project #621

Automatic Display Letter "d"

OBJECTIVE: To light the letter "d" using a light-controlled display.

Use the circuit from project #619. Connect B, C, D, E, & G to the circuit. Turn on the slide switch (S1) and the display s(D7) hould be off. Place your hand over the photoresistor (RP), now the letter "d" lights.

Project #622

Automatic Display Letter "e"

OBJECTIVE: To light the letter "e" using a light-controlled display.

Use the circuit from project #619. Connect A, B, D, E, F, & G to the circuit. Turn on the slide switch (S1) and the display (D7) should be off. Place your hand over the photoresistor (RP), now the letter "e" lights.

Project #623

Automatic Display Letter "h"

OBJECTIVE: To light the letter "h" using a light-controlled display.

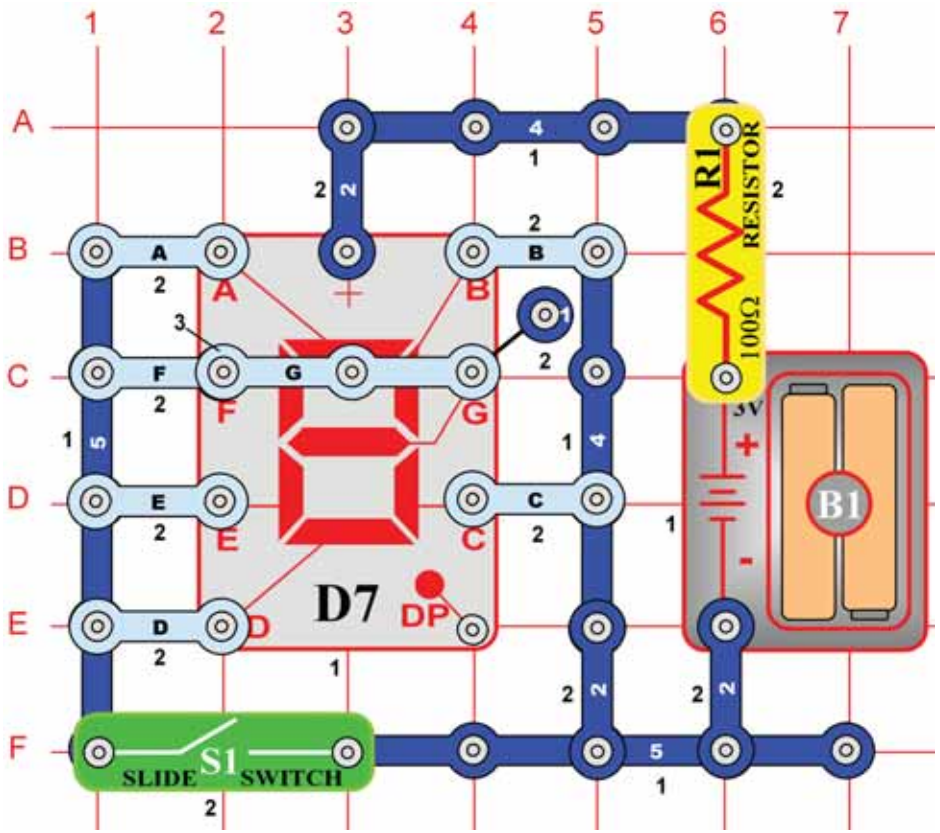
Use the circuit from project #619. Connect F, E, C, & G to the circuit. Turn on the slide switch (S1) the display (D7) should be off. Place your hand over the photoresistor (RP), now the letter "h" lights.

Project #624

Automatic Display Letter "o"

OBJECTIVE: To light the letter "o" using a light controlled display.

Use the circuit from project #619. Connect C, D, E, and G to the circuit. Turn on the slide switch (S1) the display (D7) should be off. Place your hand over the photoresistor (RP), now the letter "o" lights.



☐ Project #625

Hand-control Display "1 & 4"

OBJECTIVE: Display numbers 1 or 4 using the slide switch.

Using the diagram shown, connect 2-snap wires to segments B, C, F, & G. Turn the slide switch (S1) off and on, the display (D7) changes from numbers 1 to 4.

☐ Project #626

Hand-control Display "1 & 0"

OBJECTIVE: Display numbers 1 or 0 using the slide switch.

Using the diagram shown, connect 2-snap wires to segments A, B, C, D, E, & F. Turn the slide switch (S1) off and on, the display (D7) changes from numbers 1 to 0.

☐ Project #627

Hand-control Display "1 & 7"

OBJECTIVE: Display numbers 1 or 7 using the slide switch.

Using the diagram shown, connect 2-snap wires to segments A, B, & C. Turn the slide switch (S1) off and on, the display (D7) changes from numbers 1 to 7.

☐ Project #628

Hand-control Display "1 & 8"

OBJECTIVE: Display numbers 1 or 8 using the slide switch.

Using the diagram shown, connect 2-snap wires to segments A, B, C, D, E, F, & G. Turn the slide switch (S1) off and on, the display (D7) changes from numbers 1 to 8.

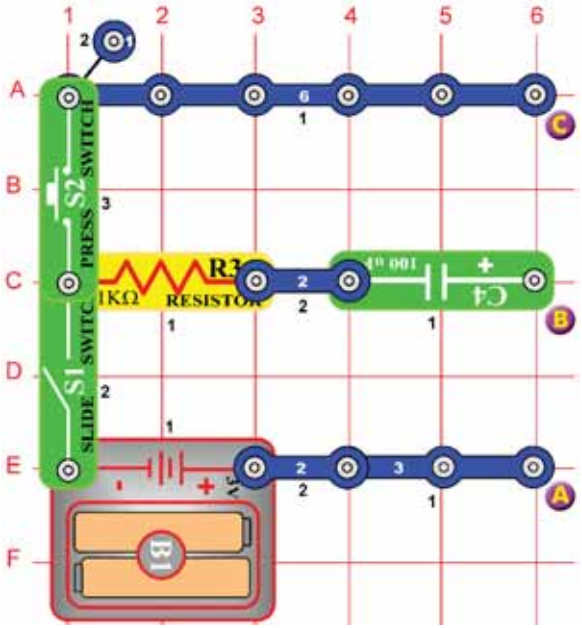
☐ Project #629

Hand-control Display "1 & 9"

OBJECTIVE: Display numbers 1 or 9 using the slide switch.

Using the diagram shown, connect 2-snap wires to segments A, B, C, D, F, & G. Turn the slide switch (S1) off and on, the display (D7) changes from numbers 1 to 9.

Project #630



Monitor Capacitor Charging & Discharging

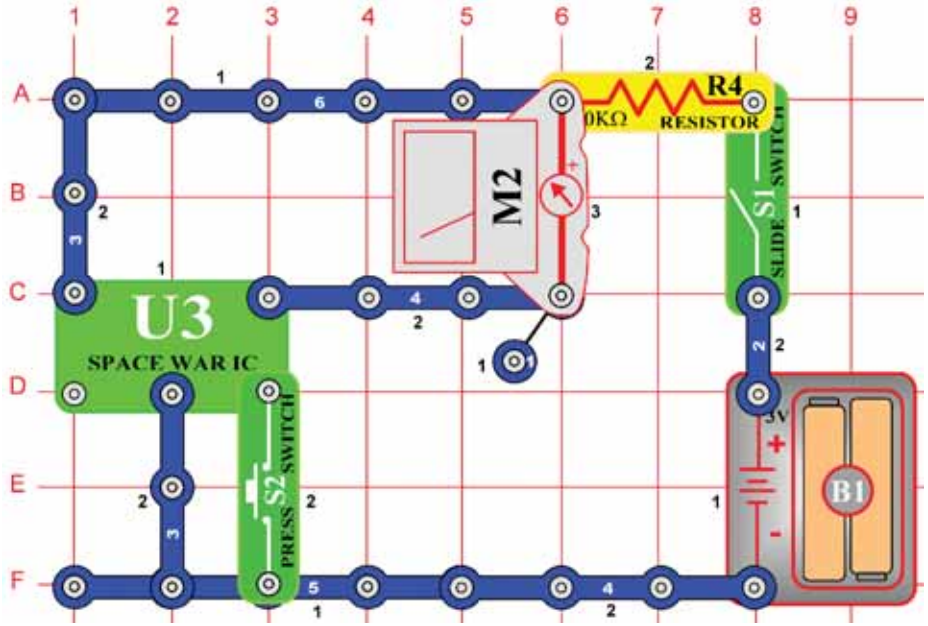
OBJECTIVE: View charging and discharging a capacitor.

Set the meter (M2) to the LOW (or 10mA) scale. Using the meter (M2), we can monitor the charging and discharging of a capacitor. First, turn off the slide switch (S1).

Charging: Connect the meter (M2) to points A & B (positive "+" downward). Turn on the slide switch. The 100μF capacitor (C4) charges and the meter deflects, slowly returning to zero.

Discharging: Connect the meter to points B & C (positive "+" downward). Press the press switch (S2). The capacitor discharges and the meter deflects, slowly returning to zero.

Project #631



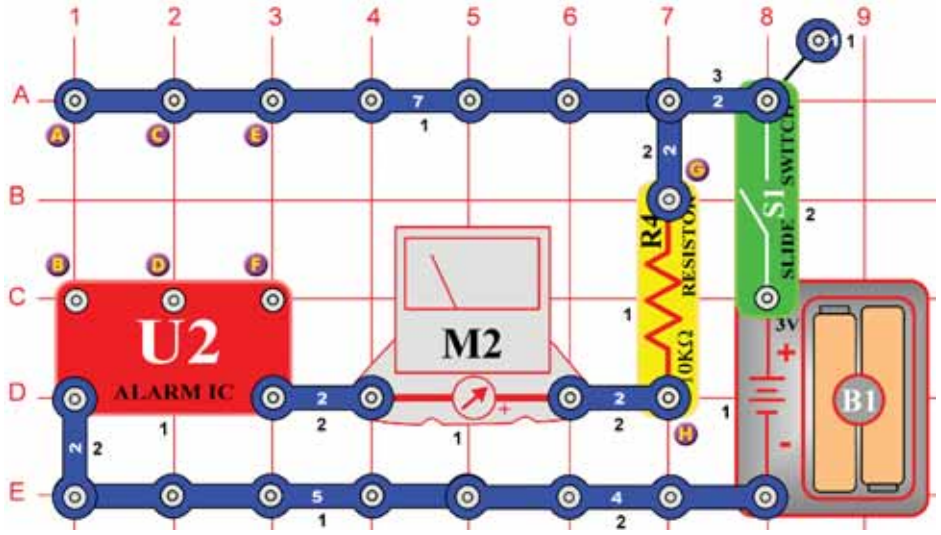
Hand-Control Space Meter

OBJECTIVE: Using the meter with the space war IC.

Set the meter (M2) to the LOW (or 10mA) scale. This is another circuit using the meter to monitor the output of an IC.
Turn on the slide switch (S1). Press the 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 the press switch.

Project #632

Rhythm Swinging Meter



OBJECTIVE: Use the meter with the alarm IC.

Set the meter (M2) to the LOW (or 10mA) scale. Connect 3-snap wires to terminals E & F, and C & D. Turn on the slide switch (S1) and the meter swings rhythmically.

Project #633

Police Car Sound with Whistle Chip

OBJECTIVE:
Show variations of project #632.

Use the circuit in project #632. Connect the whistle chip (WC) to points G & H. Connect a 3-wire snap to the terminals C & D and turn on the slide switch (S1).

Project #634

Fire Engine Sound with Whistle Chip

OBJECTIVE:
Show variations of project #632.

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 #635

Ambulance Sound with Whistle Chip

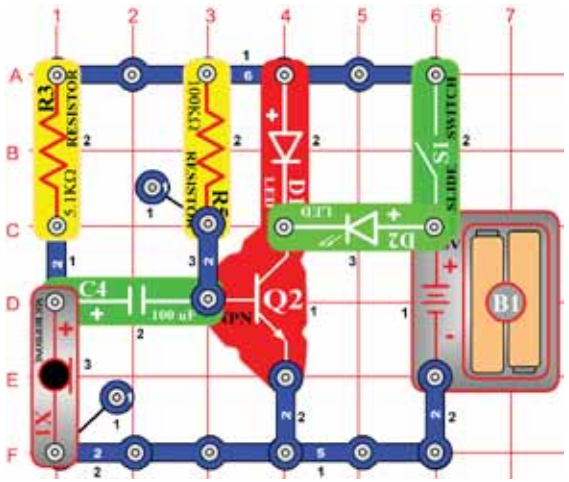
OBJECTIVE:
Show variations of project #632.

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).

Project #636

Voice-controlled Rays of Light

OBJECTIVE: To show how light is stimulated by sound.

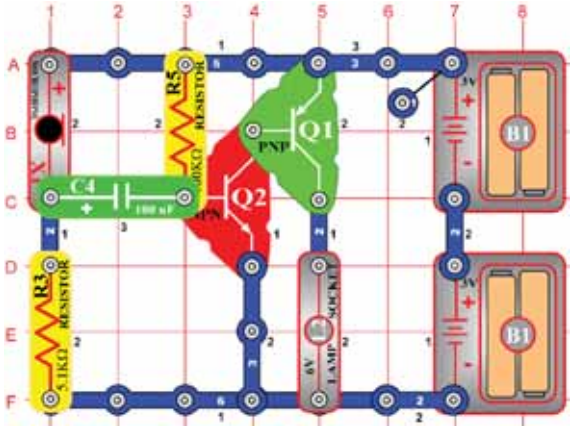


Turn the slide switch (S1) on. There will be only a weak light emitting from the green LED (D2). By blowing on the mic (X1) or putting it near a radio or TV set, the green LED will emit light, and its brightness changes as the loudness changes.

Project #637

Blowing Off the Electric Light

OBJECTIVE: To show how light is stimulated by sound.

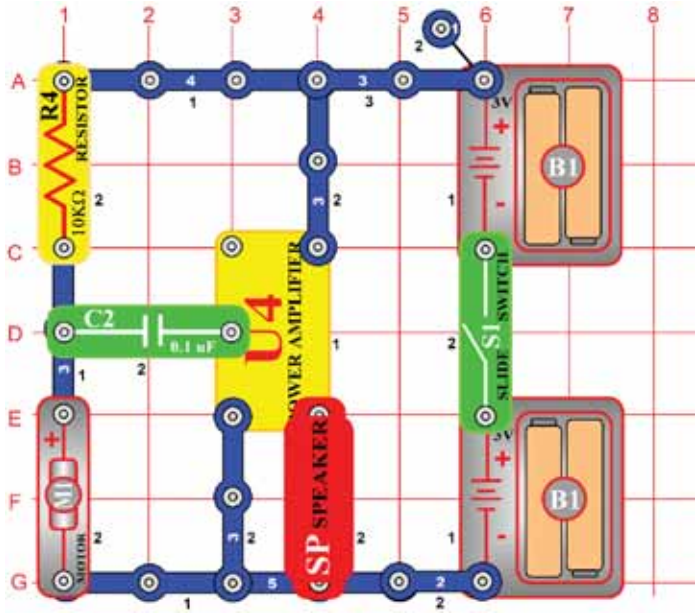


Install the parts. The lamp (L2) will be on. It will be off as long as you blow on the mic (X1). Speaking loud into the mic will change the brightness of the lamp.

Project #638

Old-Style Typewriter

OBJECTIVE: To show how a generator works.



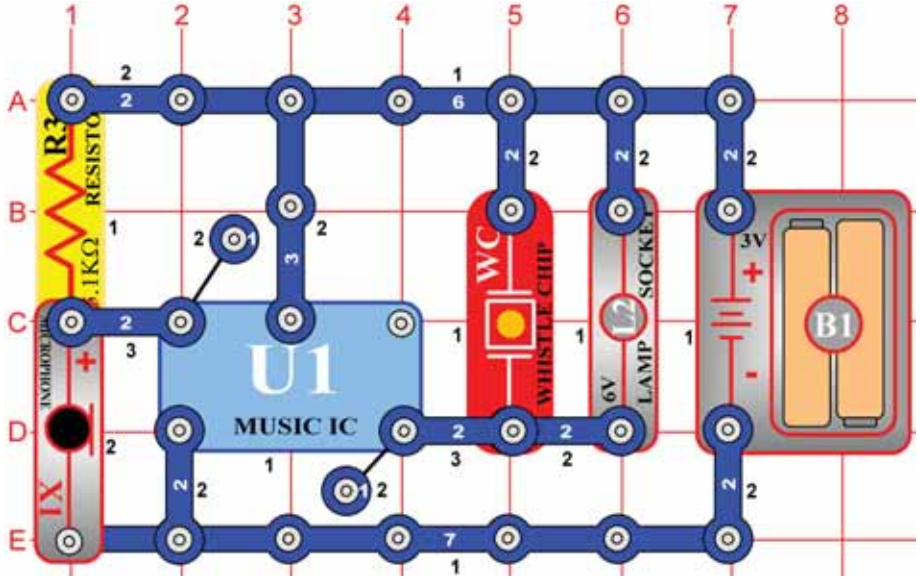
Turn on the slide switch (S1), nothing will happen. Turn the motor (M1) slowly with your fingers (don't use the fan blade), you will hear a clicking that sounds like an old-time manual typewriter keystrokes. Spin the motor faster and the clicking speeds up accordingly.

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 #639

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 #640

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 #641

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 #642

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 press switch to activate the music, just like the doorbell on your house.

☐ Project #643

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 #644

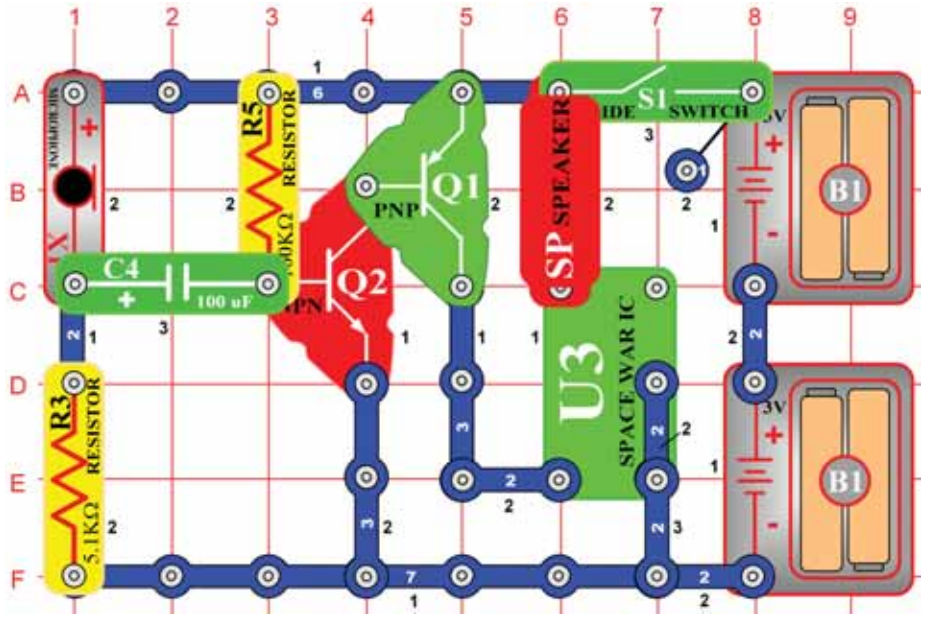
Musical Motion Detector

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 #645

Blow Off a Space War

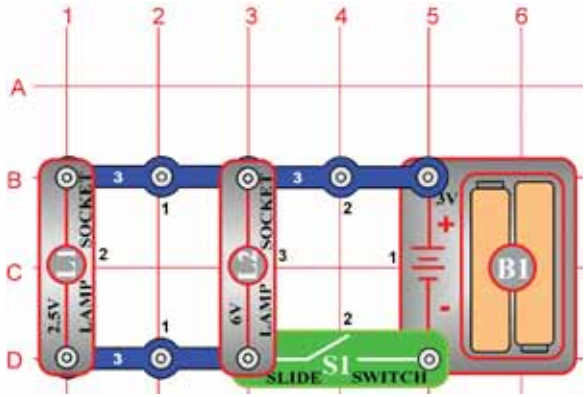


OBJECTIVE: To turn off a circuit by blowing on it.

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 #646

Parallel Lamps

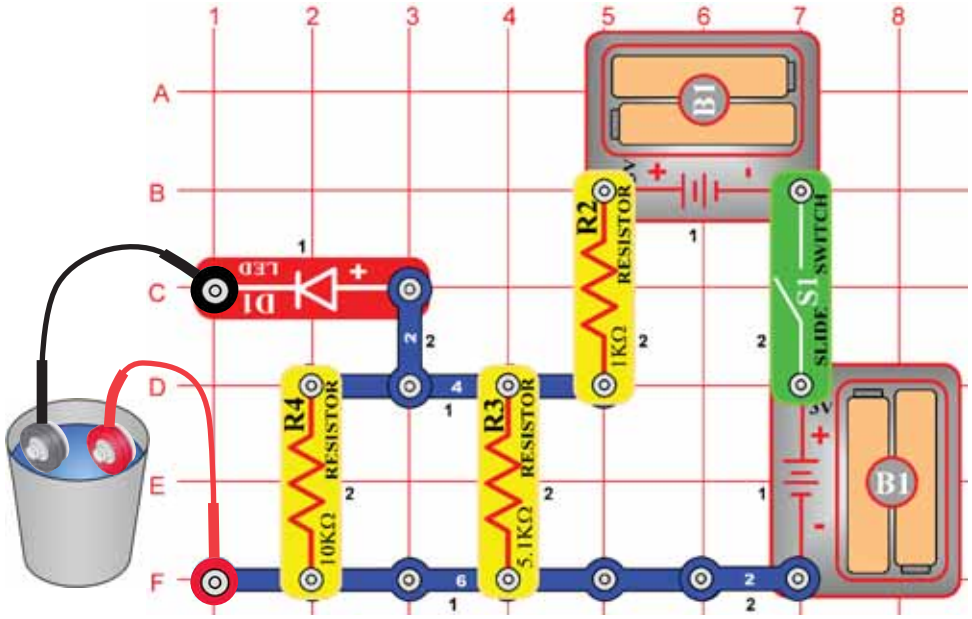


OBJECTIVE: To compare types of circuits.

Turn on the slide switch (S1) and both lamps (L1 & L2) will light. If one of the bulbs are 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 #647

Water Detector



OBJECTIVE: To show how water conducts electricity.

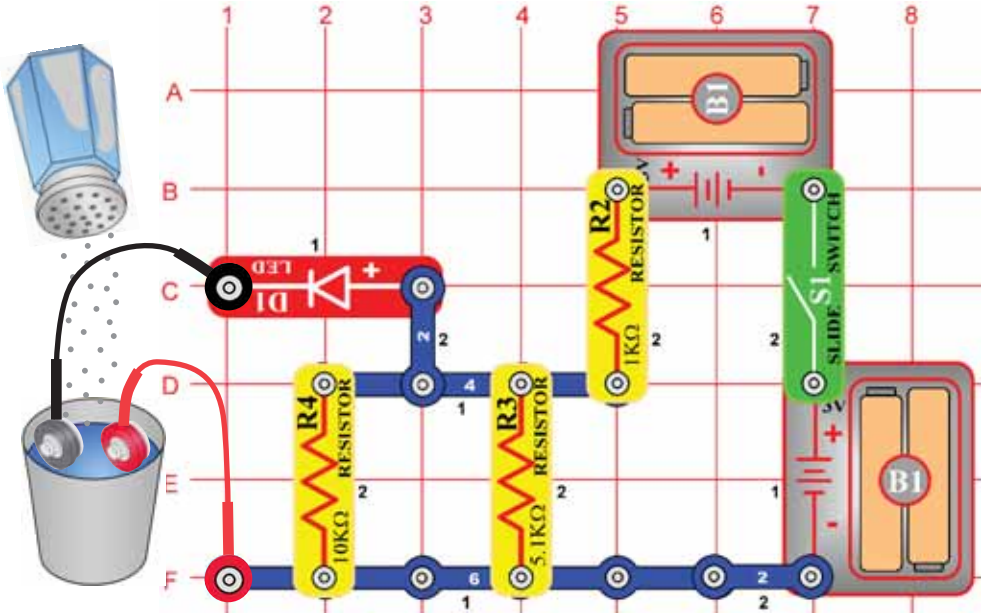
Build the circuit at left and connect the two jumpers to it, but leave the loose ends of the jumpers lying on the table initially. Turn on the slide switch (S1) - the LED (D1) will be dark because the air separating the jumpers has very high resistance. Touch the loose jumper ends to each other and the 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 #648

Saltwater Detector

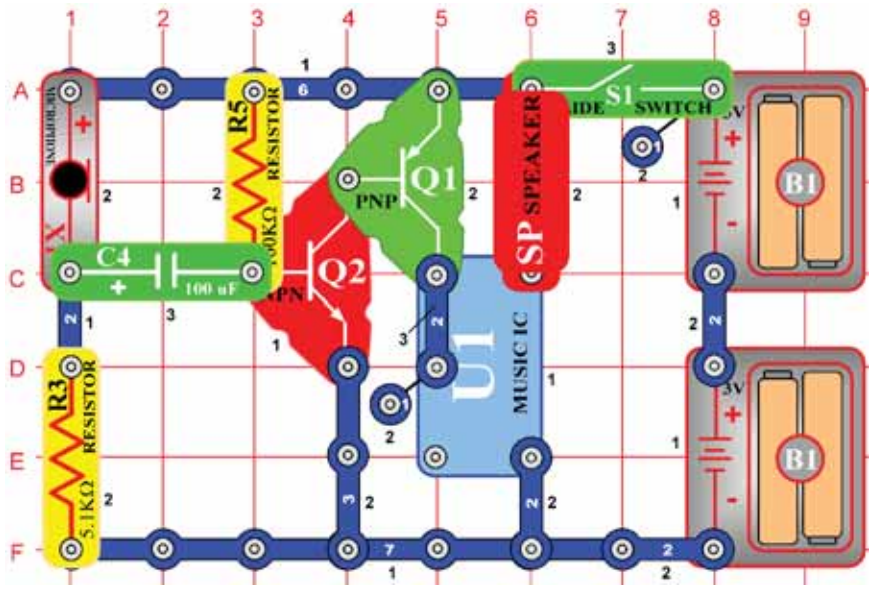


OBJECTIVE: To show how adding salt to water changes water's electrical characteristics.

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 #649 Blow Off a Doorbell



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

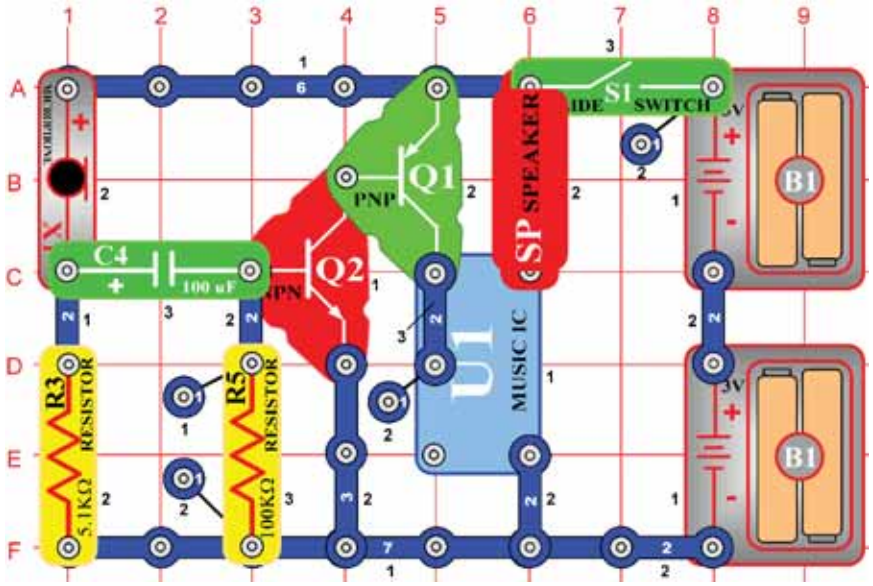
Build the circuit and turn it on, music plays. Since it is loud and annoying, try to shut it off by blowing into the microphone (X1). Blowing hard into the microphone stops the music, and then it starts again.

☐ Project #650 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 lamp briefly.

☐ Project #651 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.

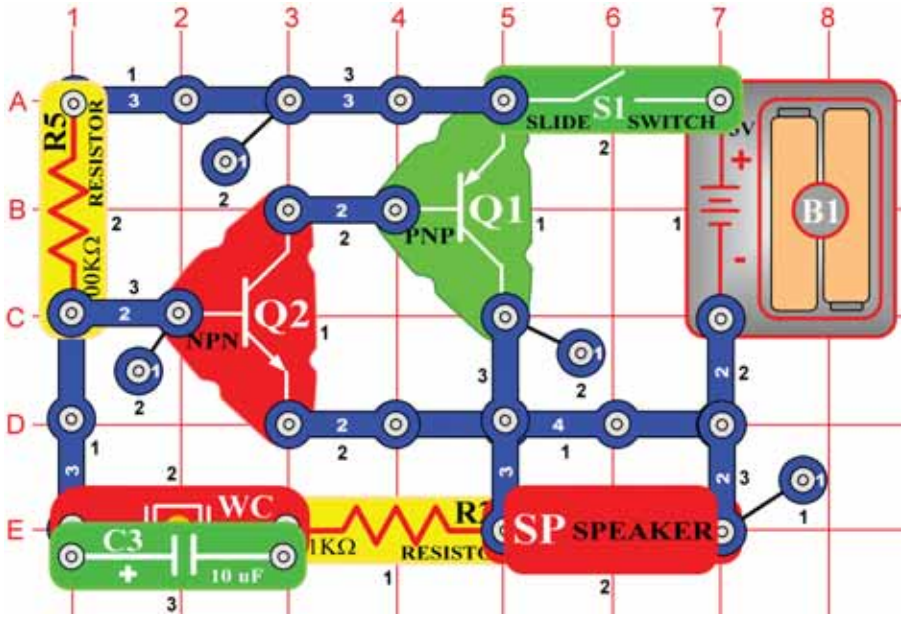
☐ Project #652 Blow On a Candle

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

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

Project #653

Tone Generator (V)

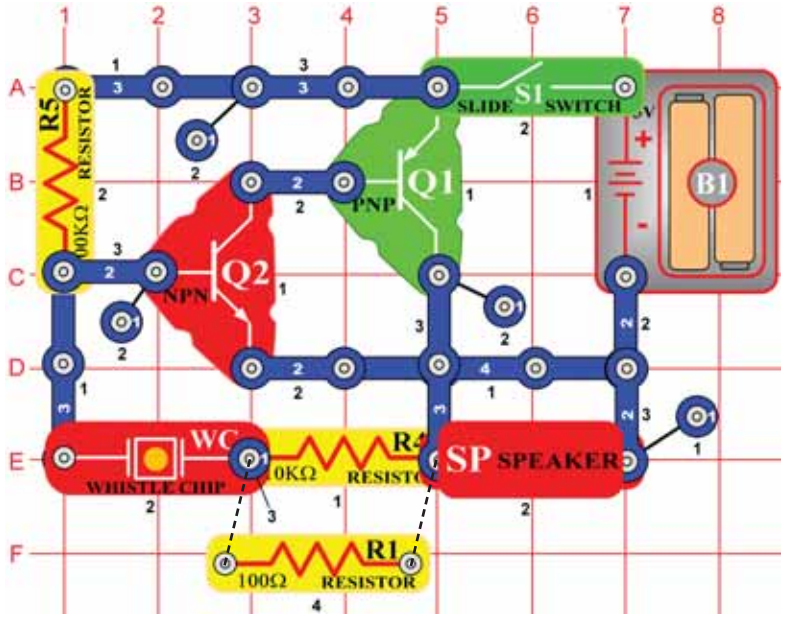


OBJECTIVE: To lower the frequency of a tone by increasing circuit capacitance.

Build the circuit, turn it on, and you hear the circuit click about once a second.

Project #654

Tone Generator (VI)



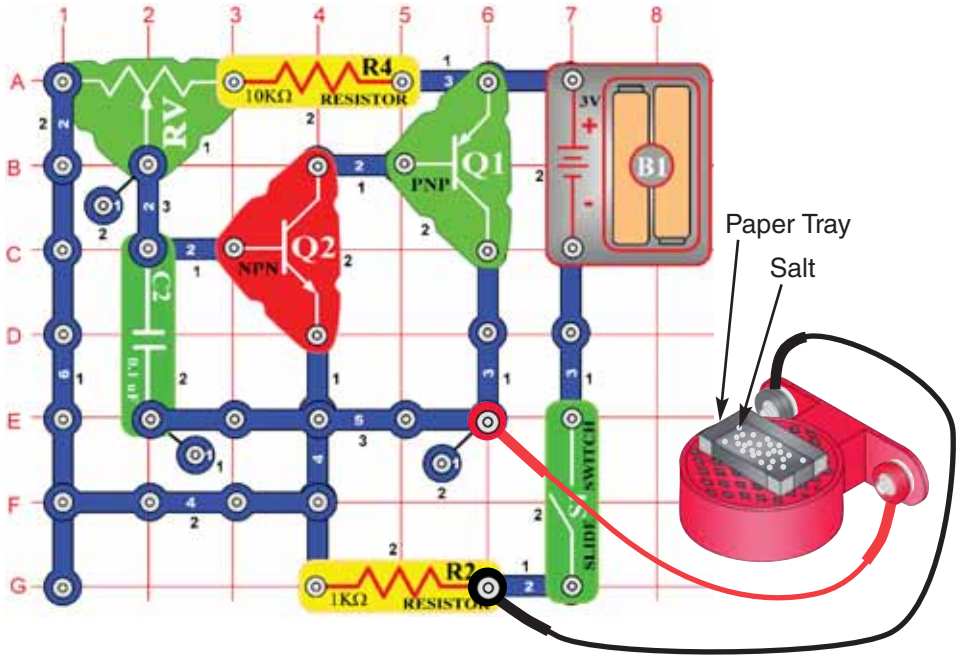
OBJECTIVE: To raise the frequency of a tone by decreasing circuit resistance.

Build the circuit. As the name suggests, this circuit is similar to that in project #653. Turn it on, you hear a very high frequency sound due to lower resistance.

Project #655

Sound Wave Magic

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

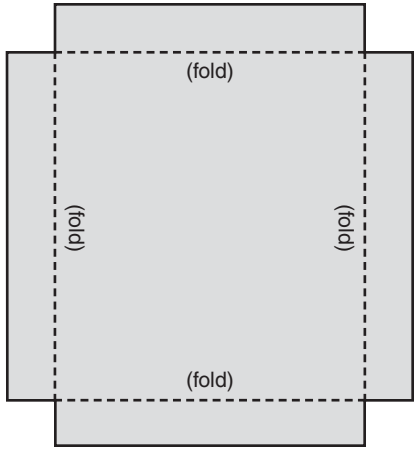


Build the circuit shown on the left and connect the speaker (SP) using the two (2) jumper wires. Then, lay the speaker on a flat hard surface.

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.

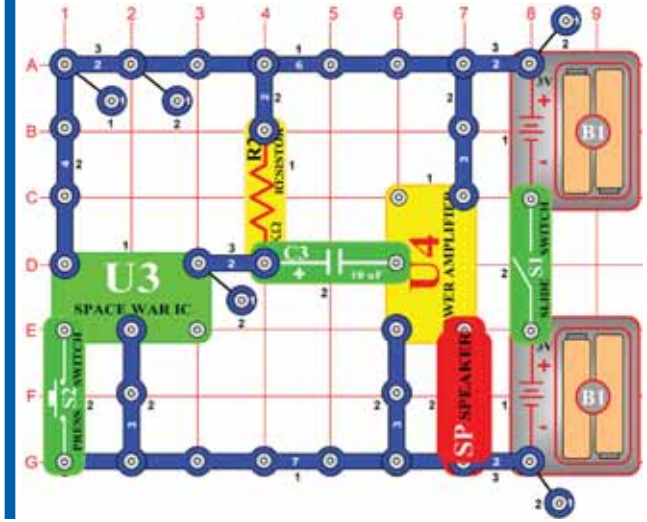
Sound Magic: Turn on the slide switch (S1). Adjust the adjustable resistor (RV) for different pitches and watch the salt particles. Particles that bounce high are directly over the vibrating paper and ones that do not move are in the nodes where the paper is not vibrating. Eventually, all the salt will 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



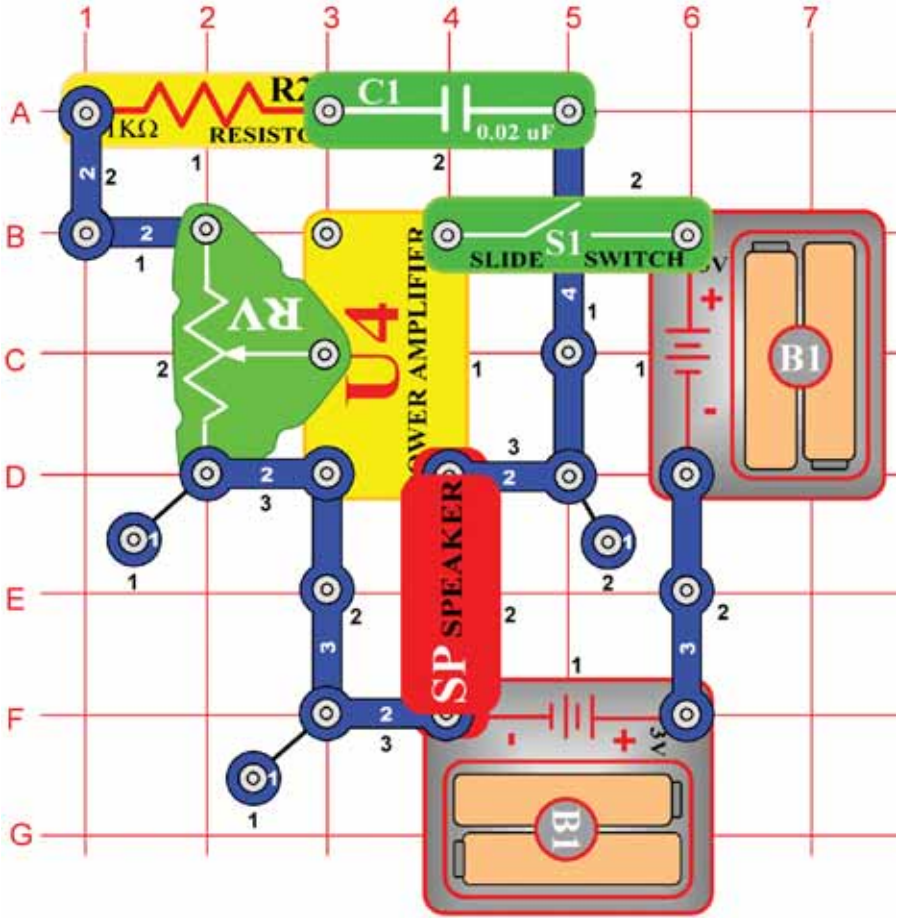
Project #656

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 integrated circuit (U3) is amplified by the power amplifier integrated circuit (U4). Nearly all toys that make sound use a power amplifier of some sort.



Project #657
Trombone

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

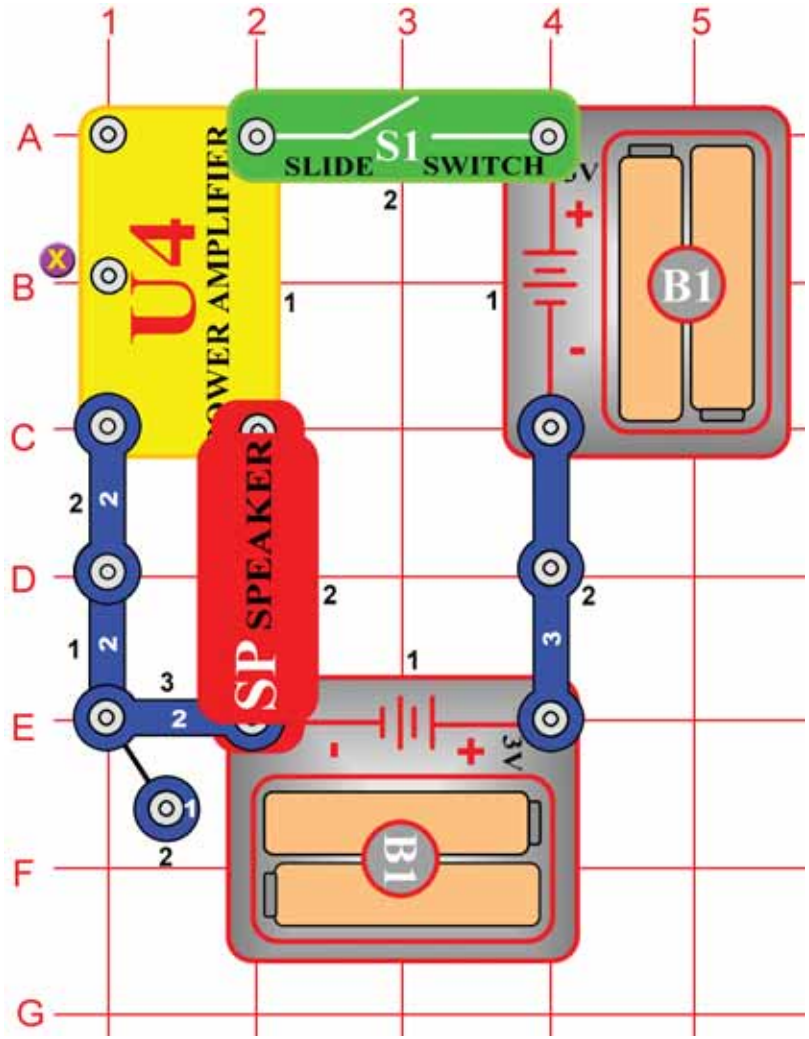
When you turn on the slide switch (S1) the trombone should start playing. To change the pitch of the note, simply slide the adjustable resistor control (RV) back and forth. By turning the slide switch on and off and moving the slider, you will be able to play a song much like a trombone player makes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

Project #658
Race Car Engine

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

Use the circuit from project #657 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 1KΩ 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 control (RV) 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 #659
Power Amplifier

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

When you turn on the slide switch (S1), the power amplifier (U4) should not oscillate. You should be able to touch point X with your finger and hear static. If you do not hear anything, then try touching point X with one of the snaps on any part. 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 #660
Feedback Kazoo

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

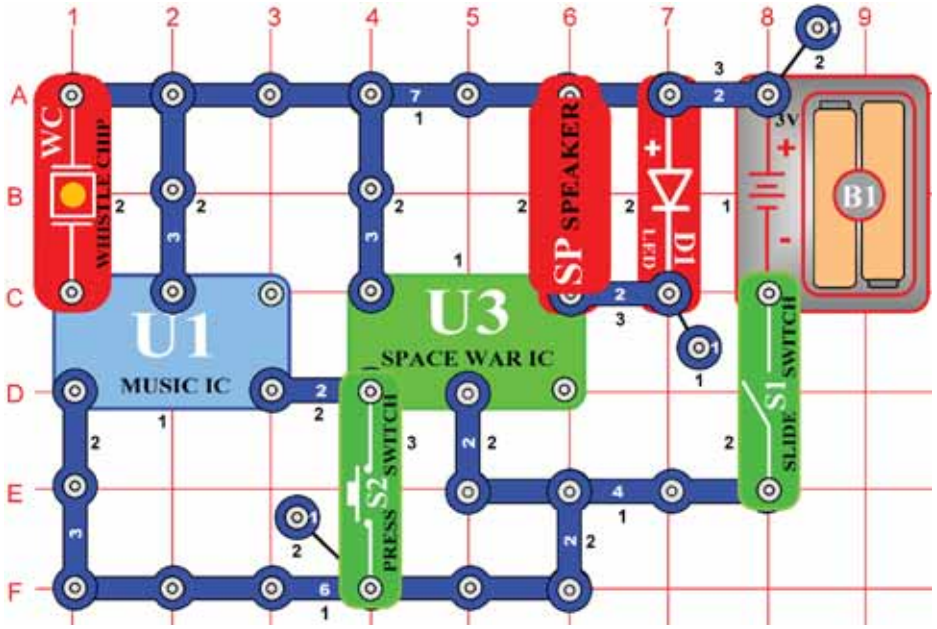
Use the circuit from project #659 shown on the left.

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 feed back 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 #661

Vibration or Sound Indicator

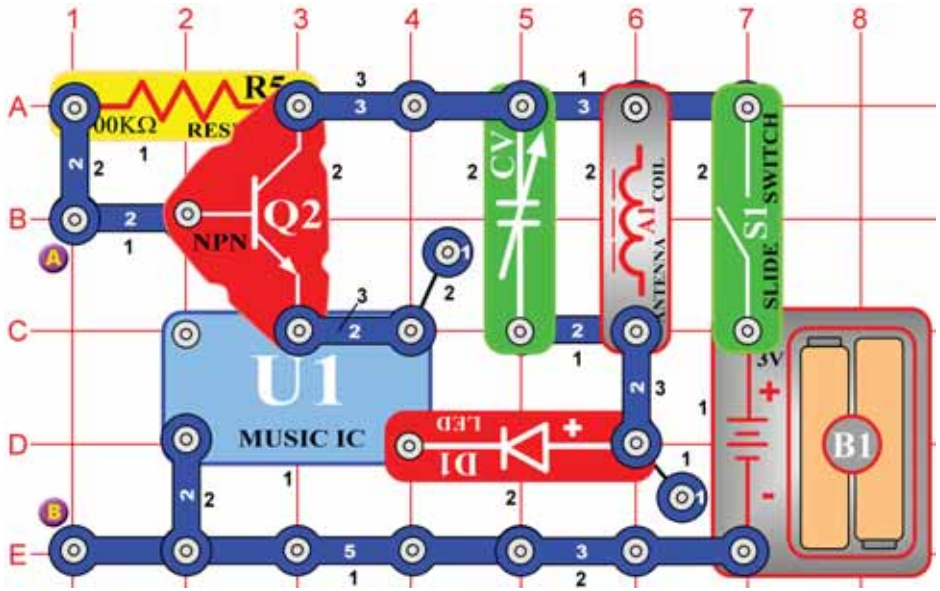


OBJECTIVE: To build a circuit that is activated by vibration or sound.

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 #662

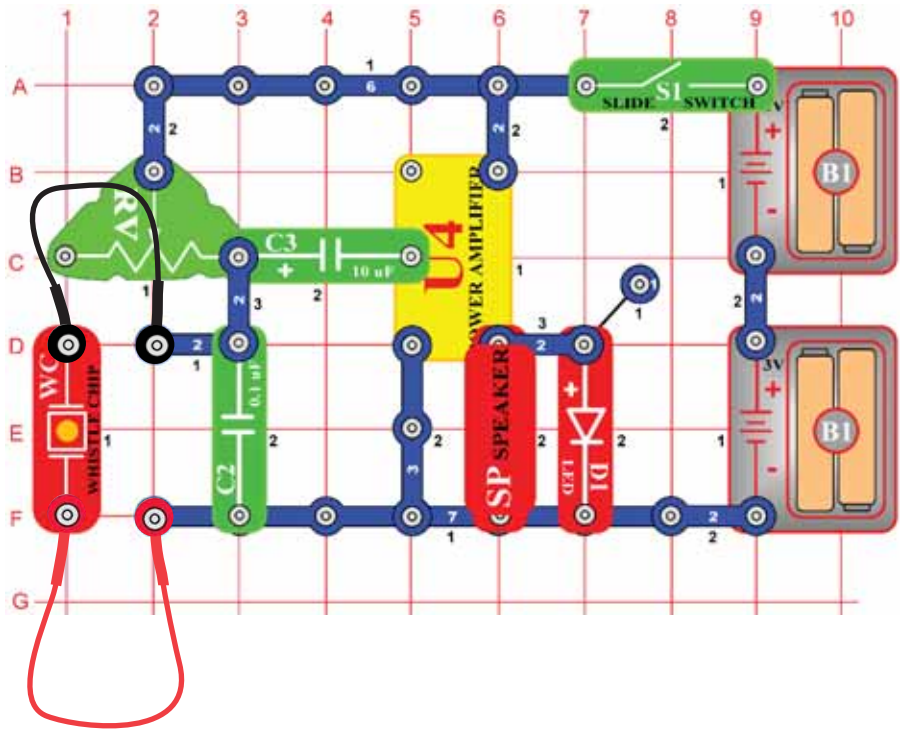
Radio Music Burglar Alarm



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. Turn on the slide switch (S1). You should hear the song play. The red LED (D1) should also be lit. Adjust the adjustable capacitor (CV) for the loudest signal.

Connect a jumper wire across points A & B and the music stops. The transistor acts like a switch connecting power to the music IC. Positive voltage on the base closes 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 #663
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 (U4), which drives the speaker and LED.

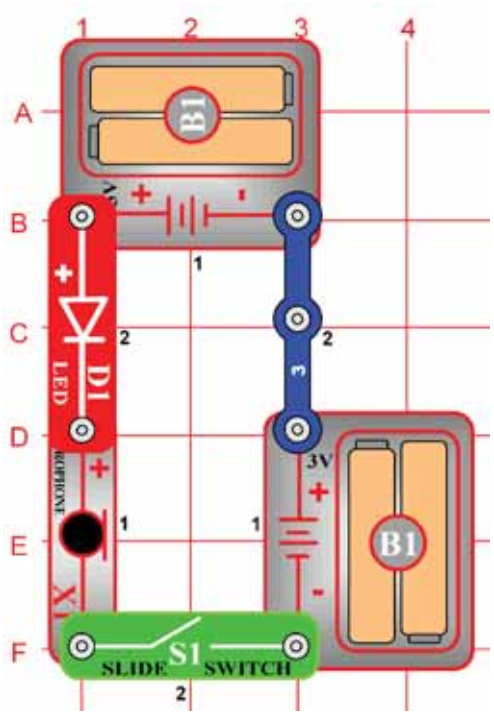
Place a small object in the center of the whistle chip. When you remove the object, the speaker and LED are activated. In alarm systems, a siren would sound to indicate the object has been removed.

Project #664
Power Microphone

OBJECTIVE: To build a power microphone.

Use the circuit from project #663.

Replace the whistle chip (WC) with the microphone (X1), and hold it away from the speaker (SP). Adjust the control of the adjustable resistor (RV) to the far left. Turn the slide switch (S1) on 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 (U4) and your voice is heard on the speaker.



☐ Project #665

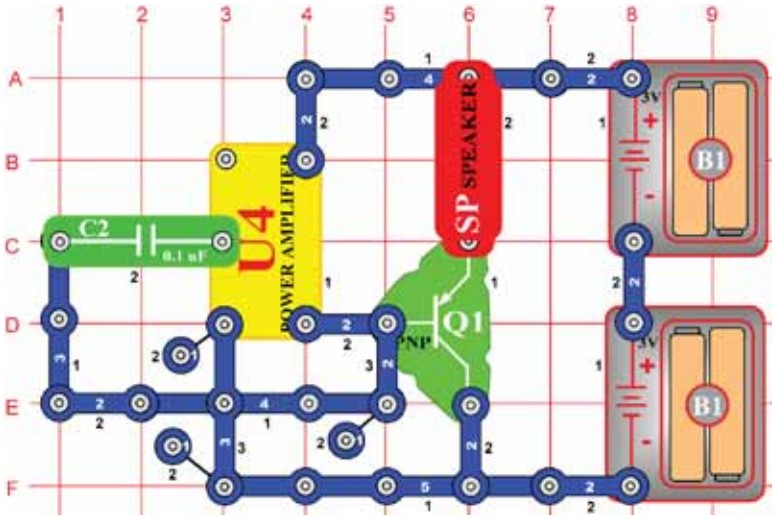
Microphone Control

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 #666



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 #667

Quick Flicking LED

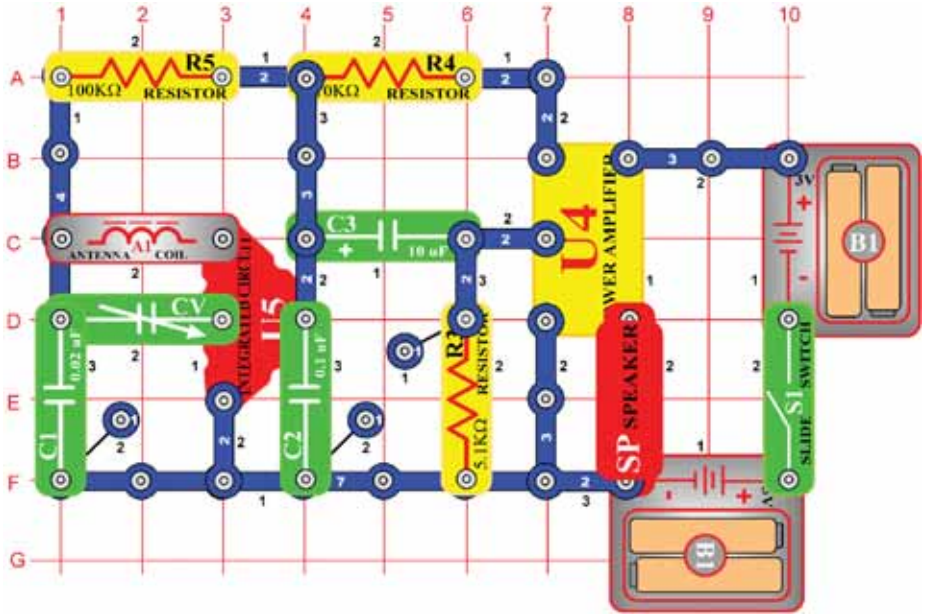
OBJECTIVE: To build a flicking LED circuit.

Use the circuit from project #666. 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 #668

AM Radio (II)

OBJECTIVE: To build a complete, working AM radio.

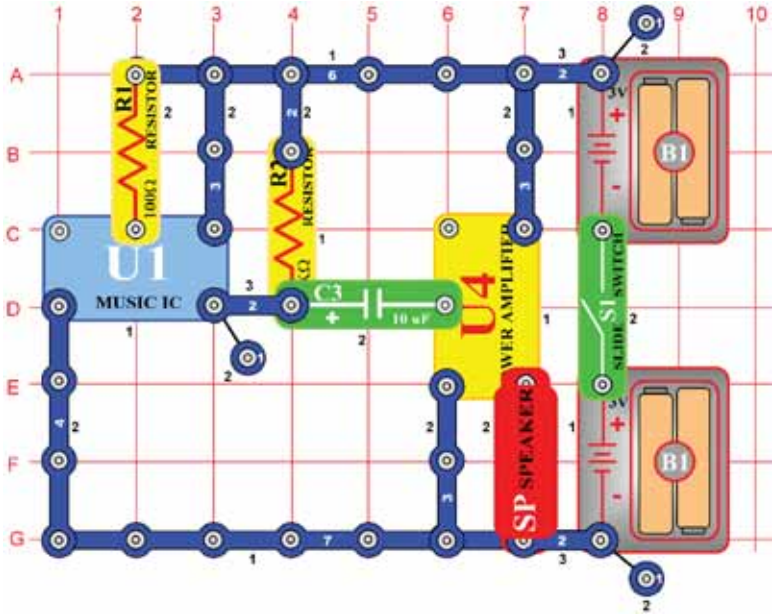


When you turn on the slide switch (S1), the integrated circuit (U5) should detect and amplify the AM radio waves. The signal is then amplified using the power amplifier (U4), which drives the speaker (SP). Tune the variable capacitor (CV) to the desired station.

Project #669

Music Amplifier

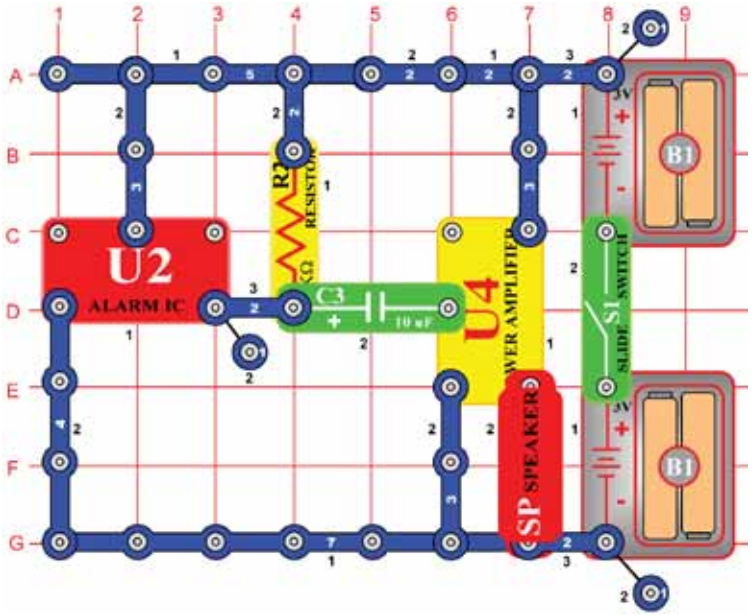
OBJECTIVE: To amplify sounds from the music integrated circuit.



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

Project #670

Police Siren Amplifier

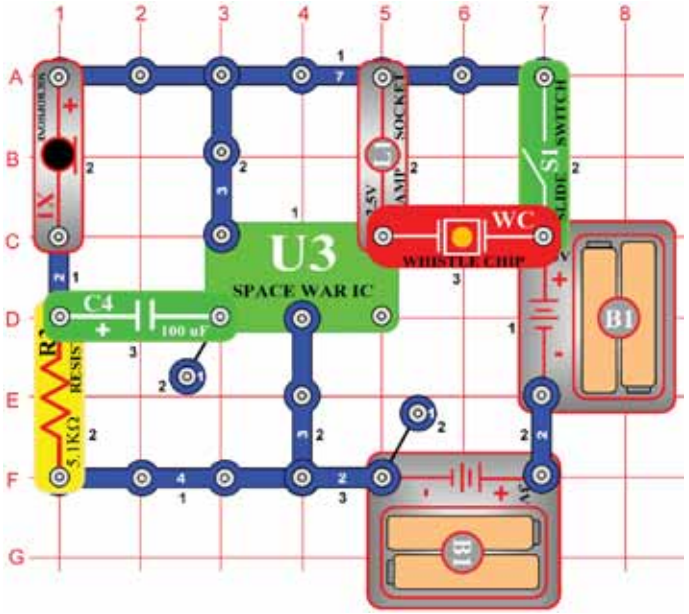


OBJECTIVE: To amplify sounds from the music integrated circuit.

Build the circuit and turn on the slide switch (S1). You will hear a very loud siren, since the sound from the alarm integrated circuit (U2) is amplified by the power amplifier integrated circuit (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 #671

Blowing Space War Sounds

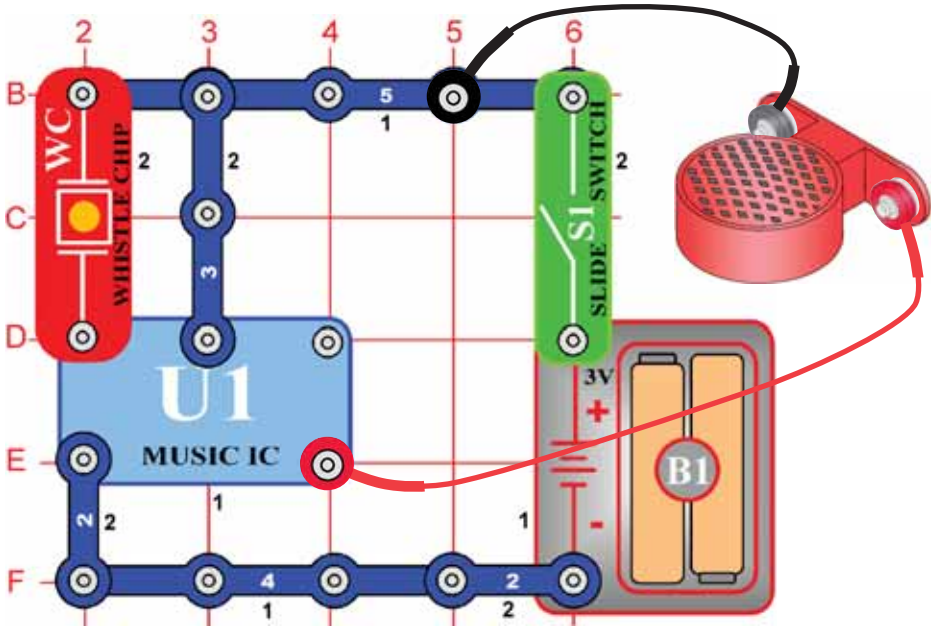


OBJECTIVE: To change space war sounds by blowing.

Turn on the slide switch (S1) and you will hear explosion sounds and the lamp (L1) is on or flashing. Blow into the microphone (X1) and you can change the sound pattern.

Project #672

Sound Activated Switch



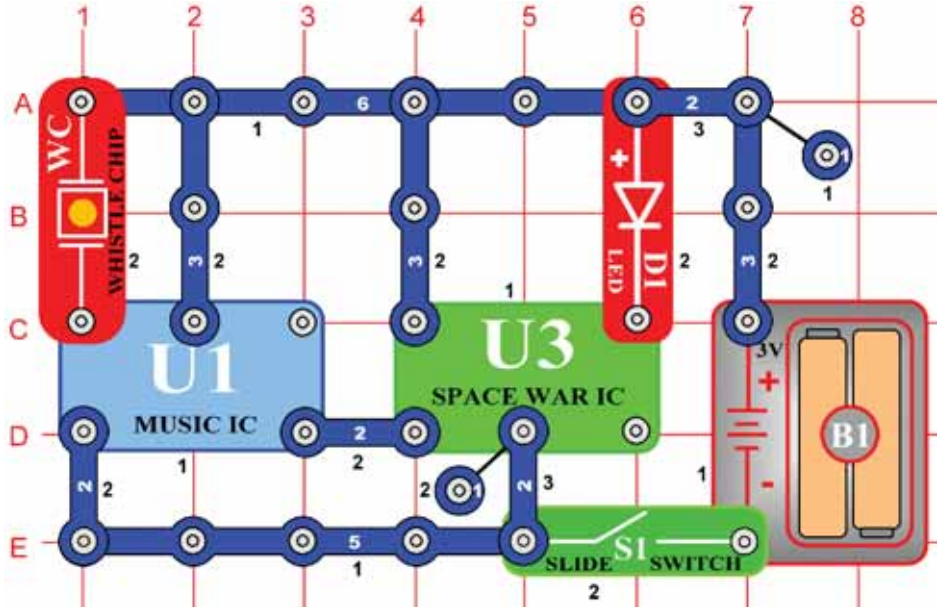
OBJECTIVE: To show how sound can turn "ON" an electronic device.

Build the circuit shown. When you turn on the slide switch (S1), the music will play for a short time, and then stop. After the music has stopped, clap your hands close to the whistle chip (WC) or tap the base with your finger. The music should play again for a short time, then stop. Blow on the whistle chip and the music should play.

You could connect the speaker (SP) using snap wires instead of the jumper wires, but then the speaker may create enough sound vibrations to re-activate the whistle chip.

Project #673

Voice Light Diode



OBJECTIVE: To build a circuit that uses your voice to control a light emitting diode.

Build the circuit shown on the left and turn on the slide switch (S1). The LED (D1) may be on for a while and then turn off. Clap or talk loud and the LED will light again and keep flickering for a little while.

Project #674

Voice Control

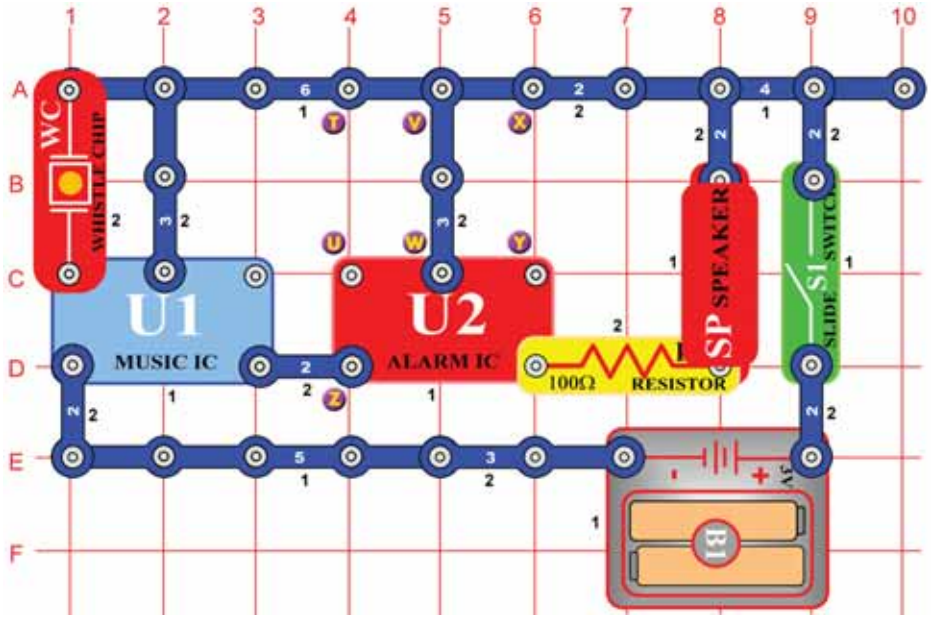
OBJECTIVE: To use your voice to control sounds.

The preceding circuit probably did not seem too exciting; so replace the LED (D1) with the speaker (SP). You hear a range of exciting sounds. Clap or talk loud and the sounds will resume.

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

Project #675

Clap Sounds



OBJECTIVE: To build a police siren and other sounds that are controlled by clapping your hands.

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

Turn on the slide switch (S1) and a police siren is heard and then stops, clap your hands and it will play again. Note, however, that music can be heard faintly in the background of the siren. If clapping does not trigger the sound, tap the whistle chip (WC) with your finger.

Project #676

More Clap Sounds

OBJECTIVE: To show how ICs can do many jobs.

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

Project #677

More Clap Sounds (II)

OBJECTIVE: To show how ICs can do many jobs.

Now remove the connection between X & Y and then make a connection between T & U. The circuit works the same way but now it sounds like a fire engine.

Project #678

More Clap Sounds (III)

OBJECTIVE: To show how ICs can do many jobs.

Now remove the connection between T & U and then make a connection between U & Z. The circuit works the same way but now it sounds like an ambulance.

Project #679

More Clap Sounds (IV)

OBJECTIVE: To show how ICs can do many jobs.

Now remove the connections between U & Z and between V & W, then make a connection between T & U. The circuit works the same way but now it sounds like a familiar song but with static.

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• Includes spring-coil connectors and breadboard for quick no-solder hookups.
• Documentation was written by best-selling author and science writer Forrest M. Mims III.
• Requires “9V” and 6 “AA” batteries, not included.

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