BOFFIN I 500 Electronic kit

500 PROJECTS

75 PARTS

8+

Overview: Amendments of the new EN 62115: 2020/A11:2020 concerning batteries and LEDs

Batteries

Small batteries

Batteries that fit wholly within the small parts cylinder (as specified in §8.2 of EN 71- 1:2014+A1:2018) shall not be removable without the aid of a tool.

For parts of electric toys containing batteries, where the part fits wholly within the small parts cylinder (as specified in 8.2 of EN 71-1:2014+A1:2018), batteries shall not be accessible withoutthe aid of a tool.

Other batteries

Batteries shall not be removable without the aid of a tool unless the security of the battery compartment cover is adequate.

Compliance is checked by inspection and by the following test. An attempt is made to gain access to the battery compartment by manual means. It shall not be possible to open the cover unless at least two independent movements have to be applied simultaneously.

The electric toy is placed on a horizontal steel surface. A cylindrical metallic mass of 1 kg, having a diameter of 80 mm, is dropped from a height of 100 mm so that its flat face falls onto the electric toy. The test is carried out once with the cylindrical metallic mass striking the electric toy in the most unfavourable place. The battery compartment shall not become open.

▸ So all batteries need a battery cover in future, which complies with the specifications above.

Batteries supplied with the toy

Primary batteries supplied with electric toys shall comply with the relevant parts of the IEC 60086 series.

▸ A Pass Test Report is needed.

Secondary batteries supplied with electric toys shall comply with IEC 62133.

▸ A Pass Test Report is needed.

Battery compartment fasteners

If srews or similar fasteners are used to secure a door or cover providing access to the battery compartment, the srew or similar fastener shall be captive to ensure that they remain with the door, cover or equipment.

Compliance is checked by inspection and by the following test after the battery door or cover is opened. A force of 20N is applied to the srew or similar fastener without jerks for a duration of 10s in any direction.

The srew or similar fastener shall not become seperated from the door, cover or equipment.

Light-emitting diodes

The emission from electric toys incorporating LEDs shall not exceed the following limits:

− 0,01 Wm-2 when assessed at 10 mm from the LED front for accessible emissions with wavelengths of < 315 nm;

− 0,01 Wsr-1 or 0,25 Wm-2 when assessed at 200 mm, for accessible emissions with wavelengths of 315 nm ≤ λ < 400 nm;

− 0,04 Wsr-1 or the AEL specified in Tables E.2 or E.3 assessed at 200 mm for accessible emissions with wavelengths of 400 nm ≤ λ < 780 nm;

− 0,64 Wsr-1 or 16 Wm-2 when assessed at 200 mm for accessible emissions with wavelengths of 780 mm ≤ λ < 1 000 nm;

− 0,32 Wsr-1 or 8 Wm-2 when assessed at 200 mm for accessible emissions with wavelengths of 1 000 nm ≤ λ < 3 000 nm.

LED data sheets

As the technical data sheet is essential for compliance with this standard, it shall be developed following the measurement criteria of condition A or condition B of CIE 127. The technical data sheet shall indicate that it has been created using the CIE 127 measurement methods and as a minimum include:

− the luminous intensity in candela or radiant intensity in Watts per steradian as a function of forward current,
− the angle,
− the peak wavelength,
− the spectral emission bandwidth,
− the date of issue and the revision number.

▸ So all LEDs need a LED data sheet in future, which includes the specifications above.

Table of Contents

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

⚡ **WARNING: SHOCK HAZARD** - Never connect Boffin to the electrical outlets in your home in any way!

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

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

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.**

ConQuest entertainment a.s. is not responsible for parts damaged due to incorrect wiring.

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

⚠ Batteries:

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

Review of How To Use It

(See p.3 of the Projects 1-101 manual for more details.)

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

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

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

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

Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.
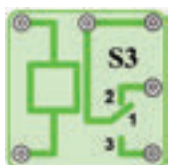
Some circuits use the red and black jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated.

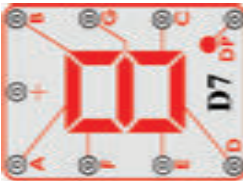**Note:** While building the projects, be careful not to accidentally make a direct connection across the battery holder (a "short circuit"), as this may damage and/or quickly drain the batteries.

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

Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free +420 284 000 111 or e-mail us at: info@toy.cz. Customer Service • Hloubětínská 11 • Praha 9, 198 00

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

You may order additional / replacement parts at our website: www.toy.cz

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

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

(Part designs are subject to change without notice).

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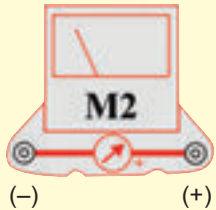
FM Module:

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

See project #307 for example of proper connections.

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

Meter:

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

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

Recording IC Module:

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

See project #308 for example of proper connections.

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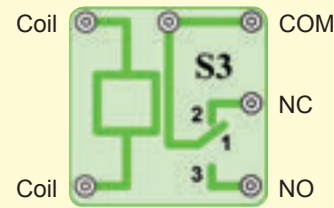
Relay:

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

See project #341 for example of proper connections.

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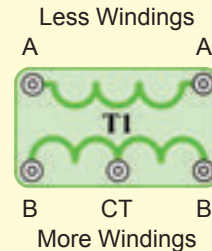
Transformer:

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

See project #347 for example of proper connections.

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

Diode:

Anode - (+)
Cathode - (−)

MORE About Your Boffin Parts (continued)

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

SCR:
A - Anode
K - Cathode
G - Gate

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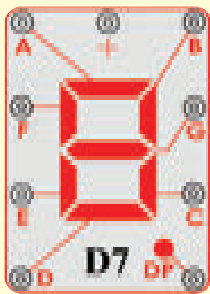
7-segment Display:
(+) - power from batteries
A - Segment A
B - Segment B
C - Segment C
D - Segment D
E - Segment E
F - Segment F
G - Segment G
DP - Decimal Point

See project #337 for example of proper connections.

## MORE Advanced Troubleshooting (Adult supervision recommended)

ConQuest Entartainment a.s. is not responsible for parts damaged due to incorrect wiring.

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

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

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

22. **Meter (M2):** Build the mini-circuit shown here and set the meter switch to LOW (or 10mA), the meter (M2) should deflect full scale. Then, replace the 10kΩ resistor (R4) with the 2.5V lamp (L1), and set the meter switch to HIGH (or 1A). The meter should deflect to 1 or higher.
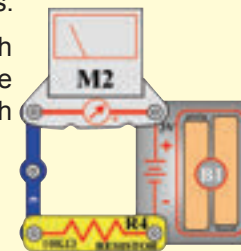
23. **Recording IC (U6):** Build project #308. Make an 8 second recording, then listen to the three prerecorded songs.

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

25. **Transformer (T1):**   Build the mini-circuit shown here. Pressing the press switch (S2) flashes the green LED (D2). Connect the jumper wire to the CT point. Pressing the press switch flashes the green LED.
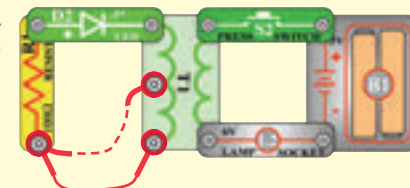
26. **Diode (D3):** Build the mini-circuit shown here, the red LED (D1) should light. Reverse the direction of the diode, the LED should not light now.
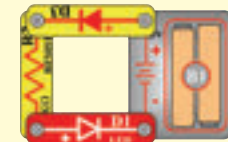
27. **SCR (Q3):** Build the mini-circuit shown here. Turn on the slide switch (S1) and the motor (M1) should not spin. Press the press switch (S2), the motor should start spinning. Now turn the slide switch off and on, the motor should not spin.
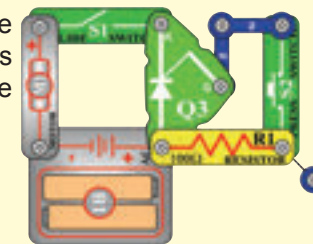
28. **7-Segment Display (D7):** Build project #337. All segments light, displaying the number 8.

MORE DO's and DON'Ts of Building Circuits

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

Here are some important guidelines:

ALWAYS use eye protection when experimenting on your own.

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

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

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

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

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

ALWAYS check your wiring before turning on a circuit.

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

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

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

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

NEVER leave a circuit unattended when it is turned on.

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

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

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

Warning to Boffin II Auto owners: Do not connect your parts to the Rover body except when using our approved circuits, the Rover body has a higher voltage which could damage your parts.
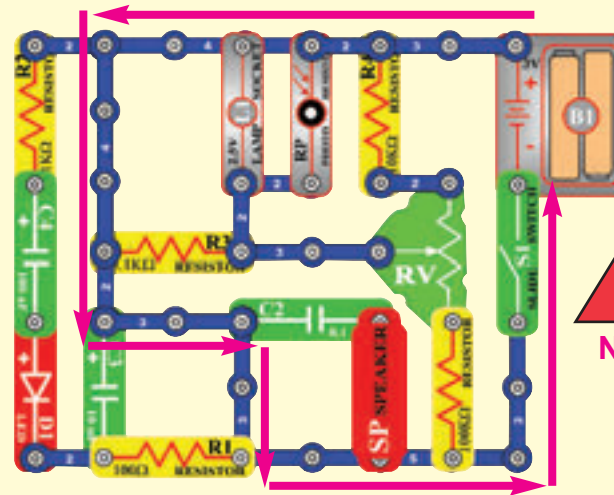
Examples of SHORT CIRCUITS - NEVER DO THESE!!!

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

NEVER DO!

NEVER DO!
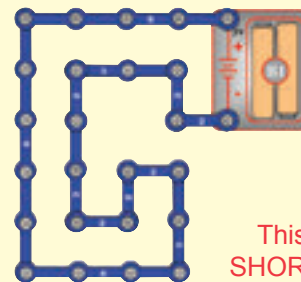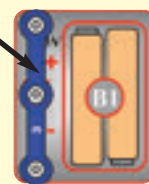
This is also a SHORT CIRCUIT.

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

NEVER DO!

NEVER DO!

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

ConQuest entertainment a.s. provides a circuit designer so that you can make your own Boffin drawings. This Microsoft® Word document can be downloaded from **www.snapcircuits.net/SnapDesigner.doc** or through the **www.toy.cz** web site.

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

Project Listings

Project Listings

Project #306

AM Radio

OBJECTIVE: To build a one-IC AM radio.

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

Project #307
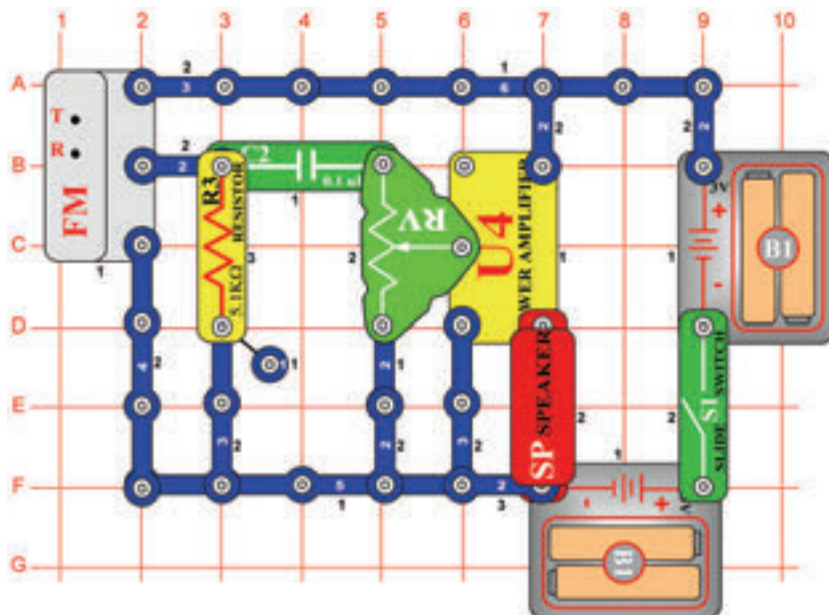
Adjustable Volume FM Radio

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

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

Project #308
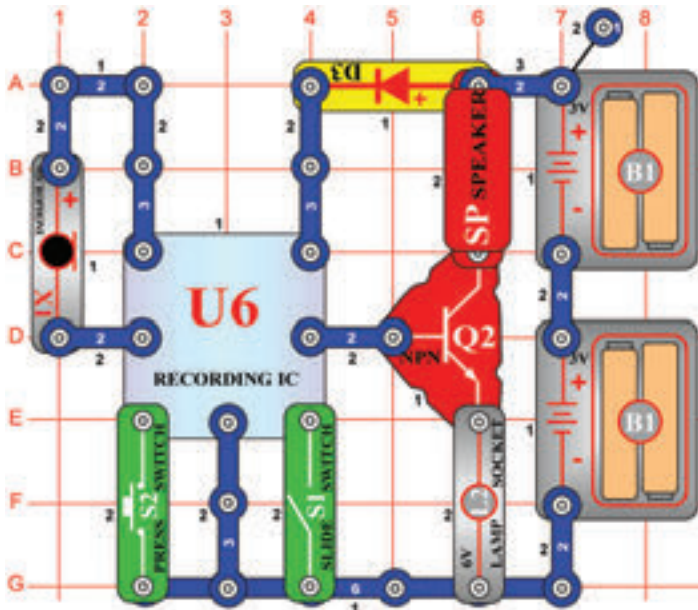
Playback & Record

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

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

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

Project #309

Playing Music

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

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

Project #310

Light-Controlled Music

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

Use the circuit in project #308. Replace the press switch (S2) with the phototransistor (Q4), then turn on the slide switch (S1). Turn the music on and off by waving your hand over phototransistor.

Project #311

Touch-Controlled Music

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

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

Project #312
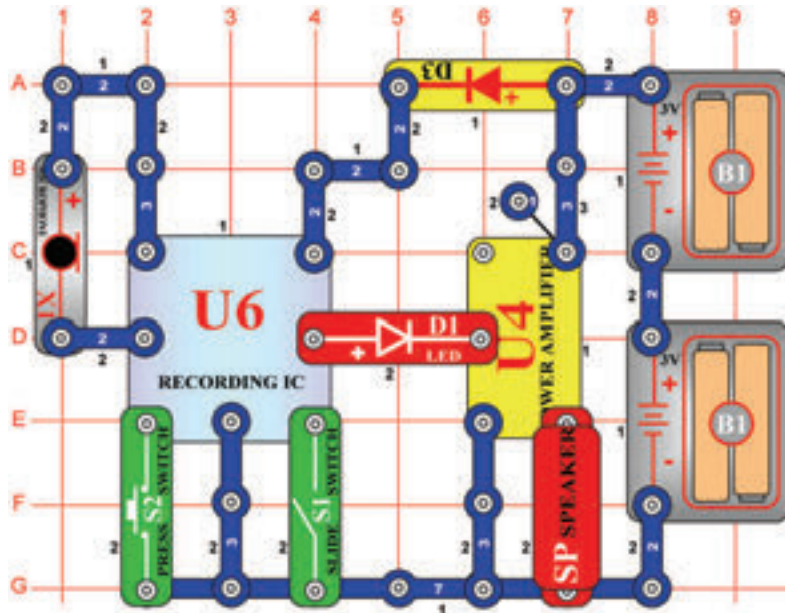
Power Amplified Playing Music

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 #308.

Turn on the switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone up to 8 seconds, and then turn open 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 switch (S2) before the song is over, music will stop. You may press the press switch several times to play all three songs.

Project #313

Power Playback & Record

OBJECTIVE: To amplify the output of the recording IC.

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

Project #314

Power Light-Controlled Music

OBJECTIVE: Show variations of project #312.

Use the circuit in project #312. Replace the press switch (S2) with the phototransistor (Q4), then turn on the switch (S1). Turn the music on and off by waving your hand over phototransistor.

Project #315

Power Touch-Controlled Music

OBJECTIVE: Show variations of project #312.

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

Project #316
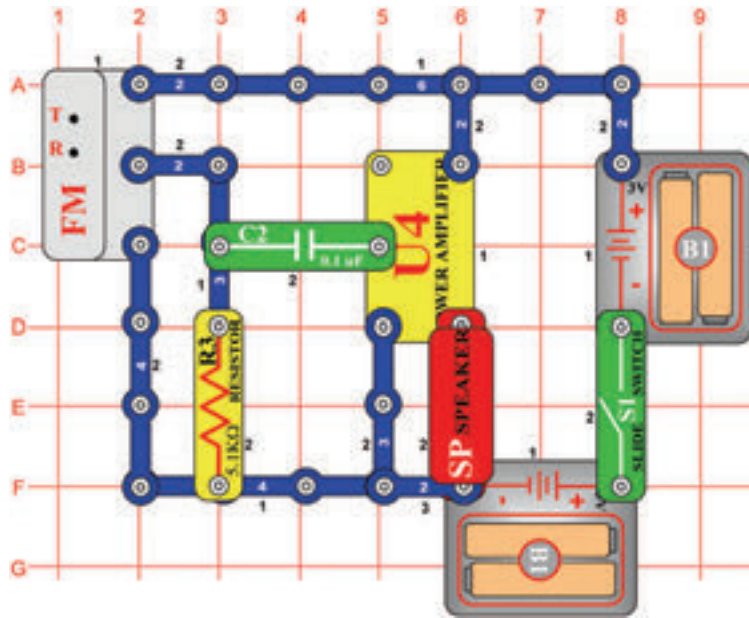
FM Radio

OBJECTIVE: *To build a working FM radio.*

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

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

Project #317
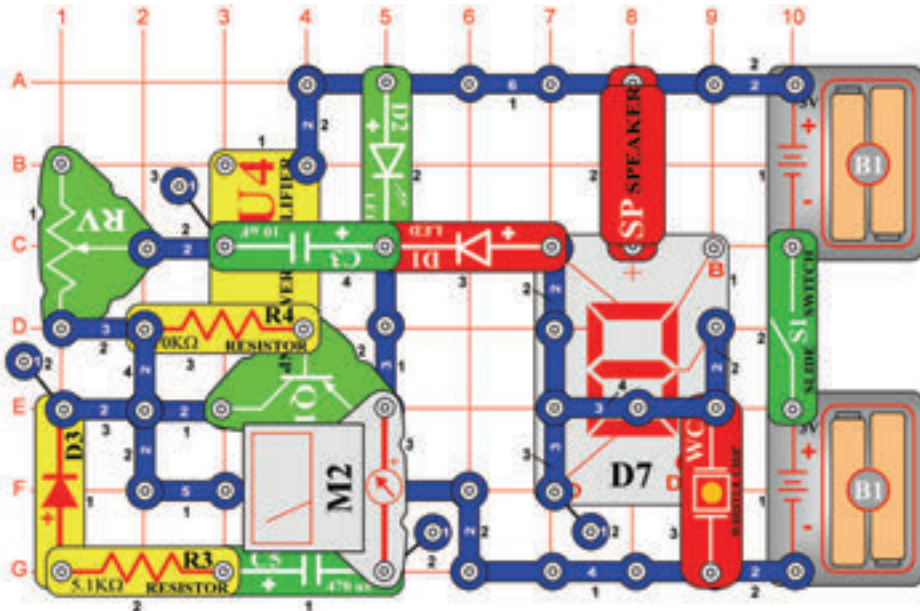
Mega Circuit

OBJECTIVE: *To build a complex circuit.*

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 #318
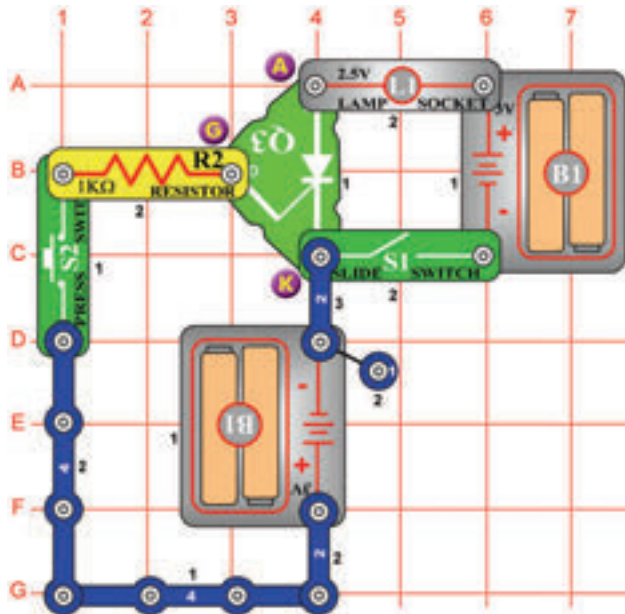
SCR 2.5V Bulb

OBJECTIVE: To learn the principle of an SCR.

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

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

Project #319
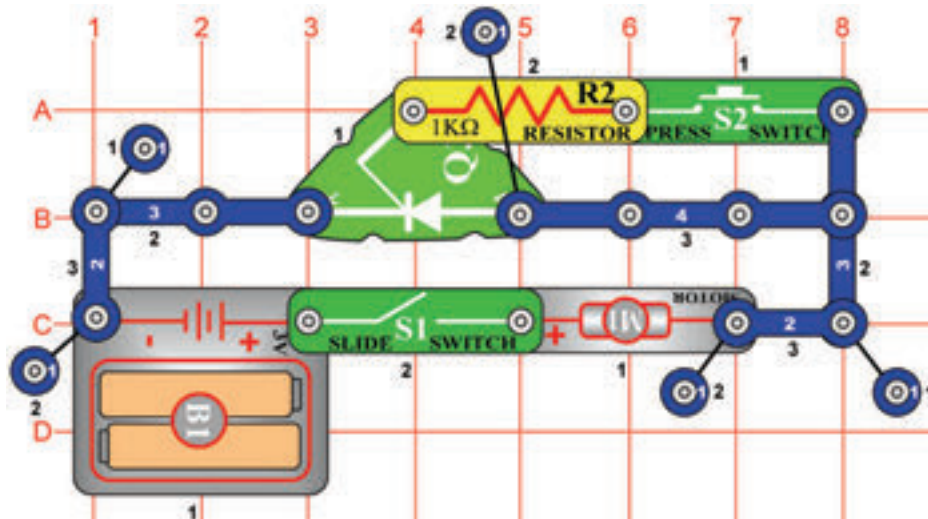
SCR & Motor

OBJECTIVE: To activate a motor using an SCR.

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

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

Project #320

Music Alarm

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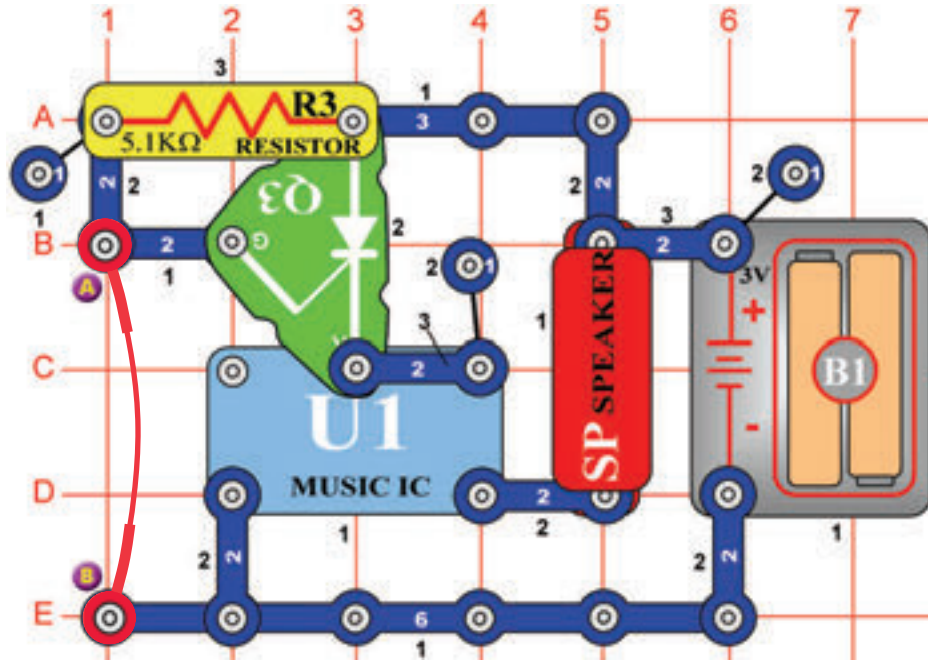
The alarm circuit activates when you remove the jumper wire from points A & B. The jumper wire shorts the SCR's (Q3) gate to ground and the SCR does not conduct. Removing the jumper wire places a voltage on the gate and the SCR conducts. This connects the battery to the music IC (U1) and music is played.

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

Project #321

Light-Music Alarm

OBJECTIVE: To build a light-music alarm.

Use the circuit in project #320. Replace the resistor R3 with the phototransistor (Q4) and remove the jumper wire. Cover the phototransistor with your hand. Now slowly remove your hand. When enough light hits the resistor, the music plays.

Project #322

Light-controlled SCR

OBJECTIVE: To build a circuit that activates a bulb and motor with the amount of light present.
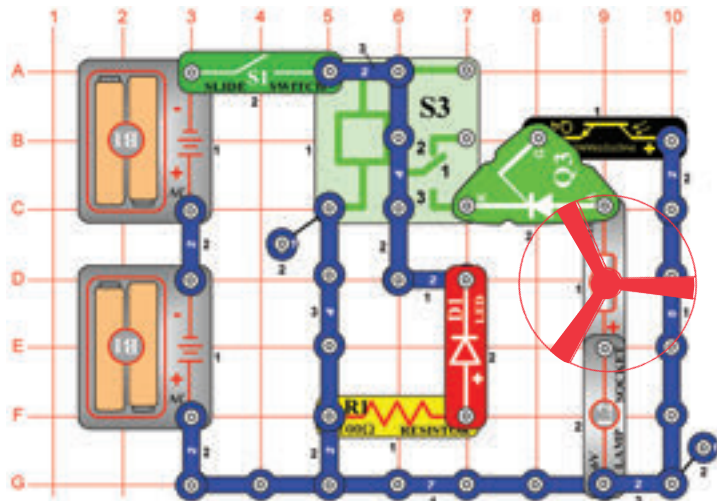
Cover the phototransistor (Q4) with your finger. Turn on the switch (S1), and only the LED (D1) lights. The relay (S3) connects the motor (M1) and the bulb (L2) to the batteries, but the motor and bulb are powerless until a voltage is applied to the SCR's gate.

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

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

-13-

Project #323
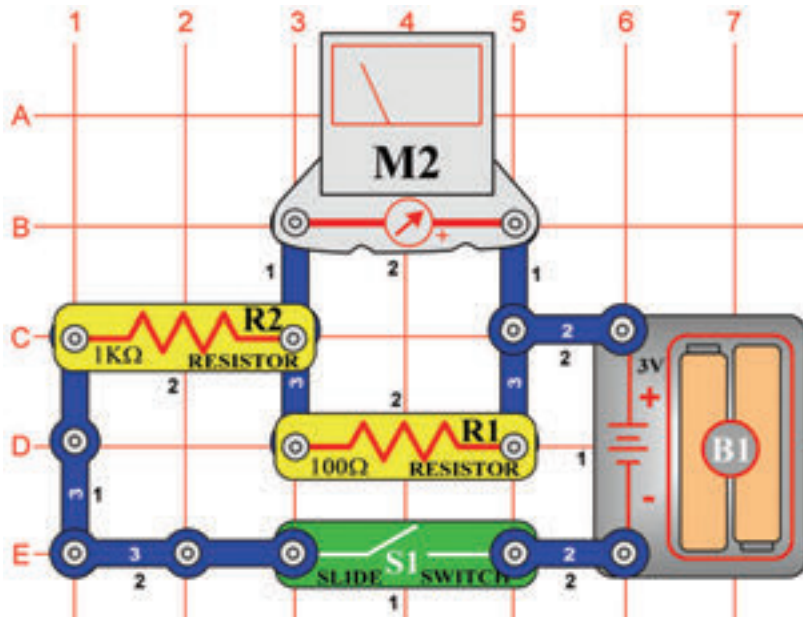
3mA Meter

OBJECTIVE: *To build a 3mA meter circuit.*

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

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

Project #324
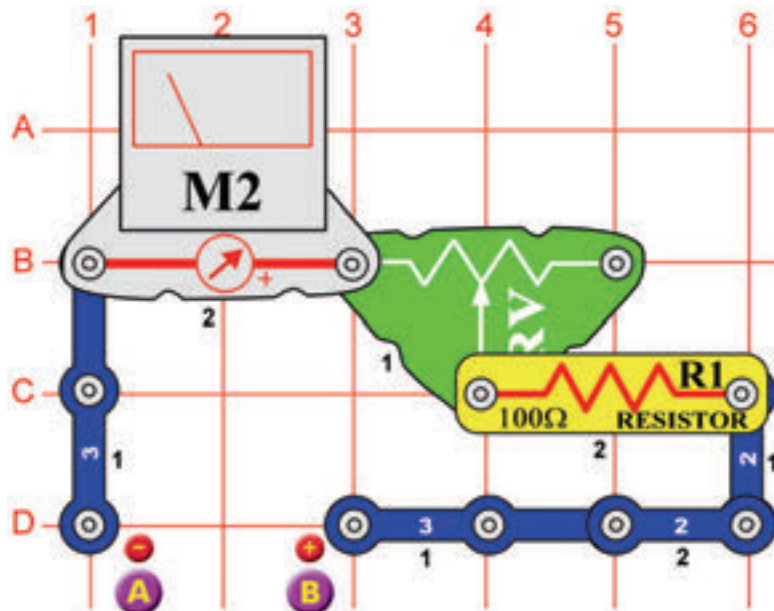
0-3V Voltmeter

OBJECTIVE: *To build a voltmeter.*

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

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

Project #325

Function of Adjustable Resistor
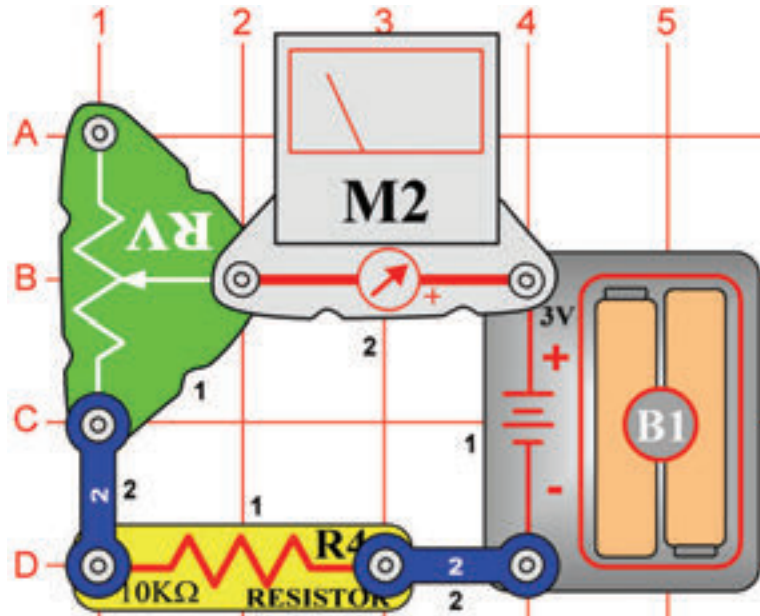
OBJECTIVE: To understand the function of the adjustable resistor.

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

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

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

Project #326

Function of phototransistor
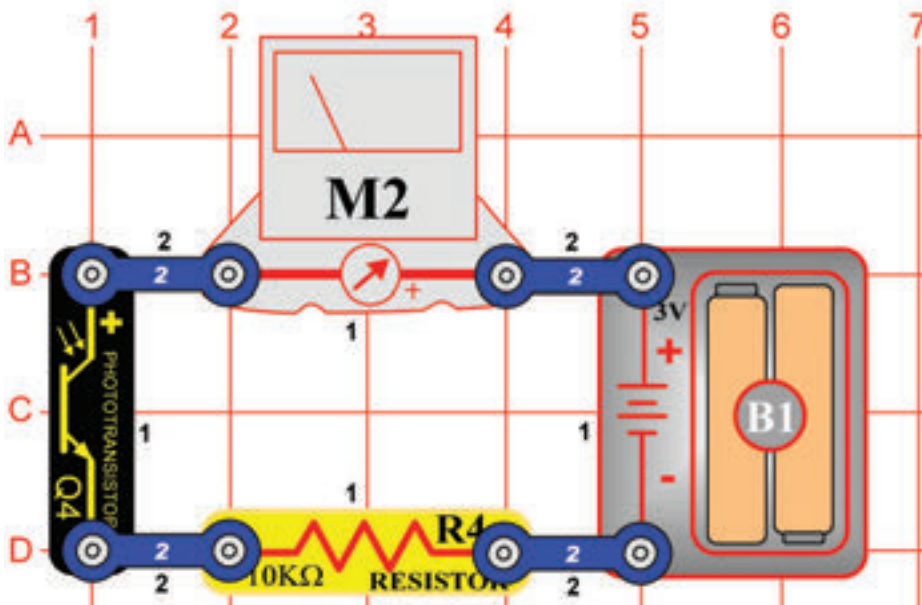
OBJECTIVE: To understand the function of the phototransistor.

Build the circuit shown. Set the meter (M2) to the LOW (or 10mA) scale. The phototransistor (Q4) 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 phototransistor is changing according to the amount of light in the room.

Project #327
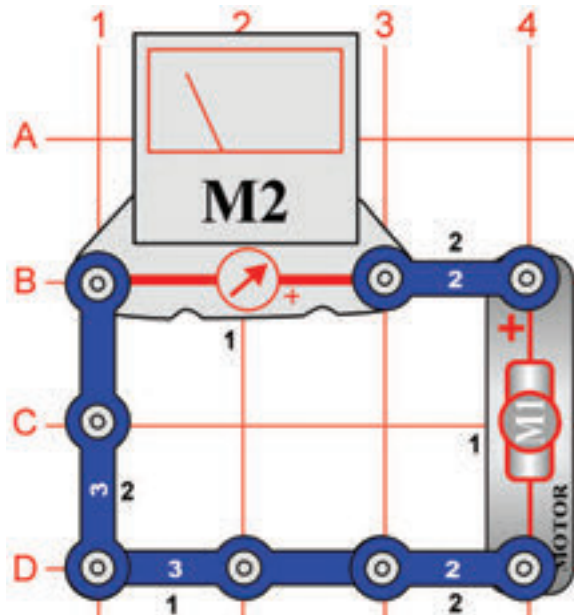
Meter Deflect by Motor

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

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

Project #328
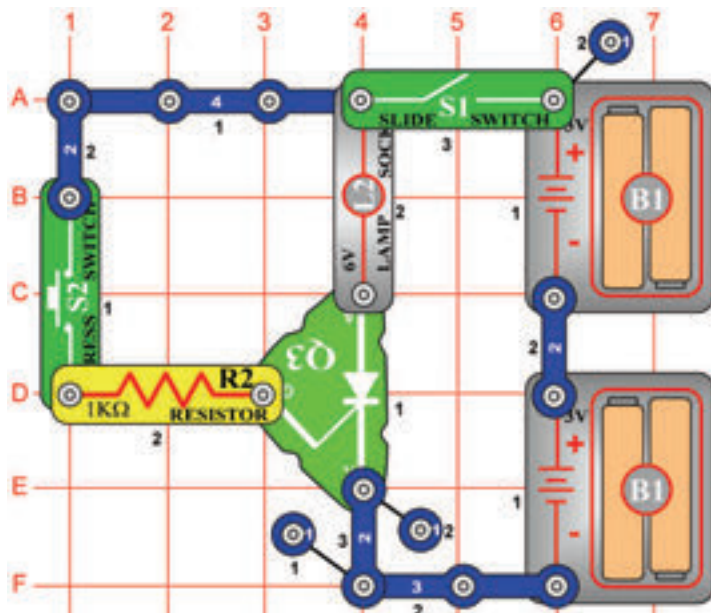
SCR 6V Bulb

OBJECTIVE: To learn the principle of an SCR.

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

Project #329
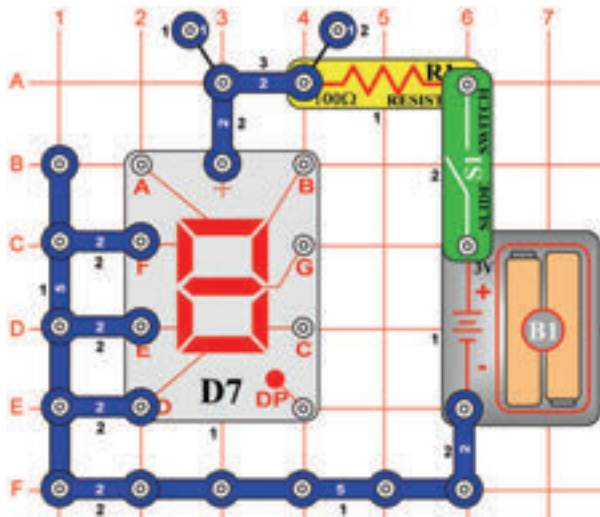
Principle of Segment LED

OBJECTIVE: To demonstrate how a seven segment LED works.

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

Project #330
Display #1

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

Connect B & C to the negative of the battery.

Project #331
Display #2

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

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

Project #332
Display #3

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

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

Project #333
Display #4

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

Connect B, C, F, & G to the negative of the battery.
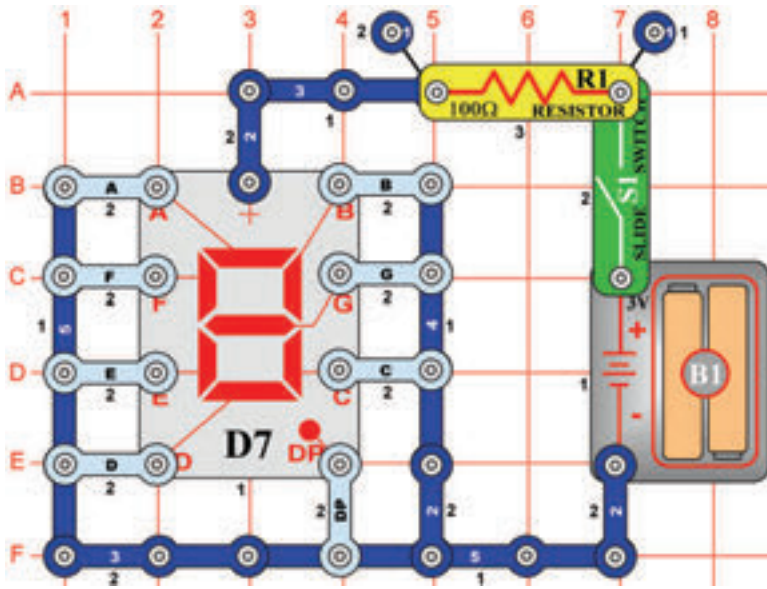
Project #334
Display #5

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

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

Project #335
Display #6

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

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

Project #336
Display #7

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

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

Project #337
Display #8

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

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

Project #338
Display #9

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

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

Project #339
Display #0

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

Connect A, B, C, D, E, & F to the negative of the battery.
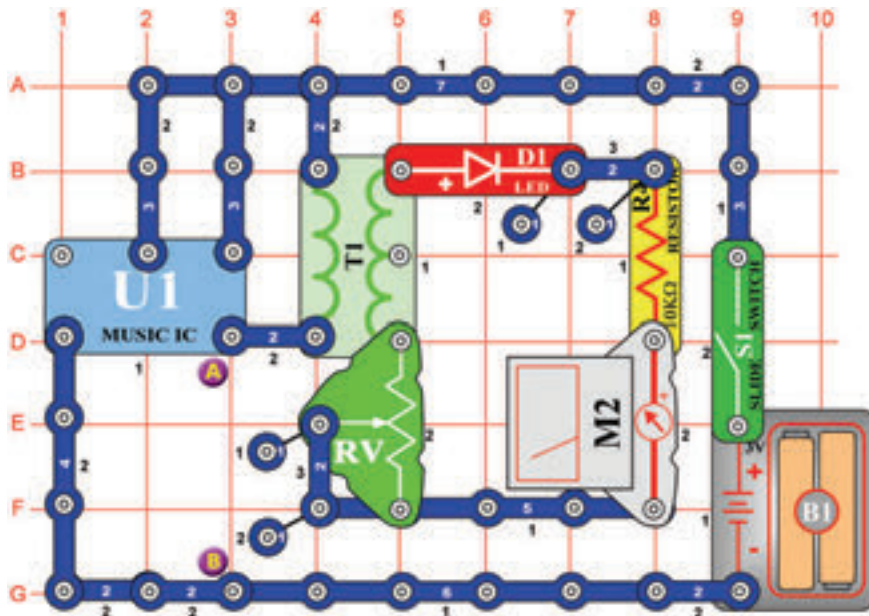
Project #340
Music Meter

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

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

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

Project #341
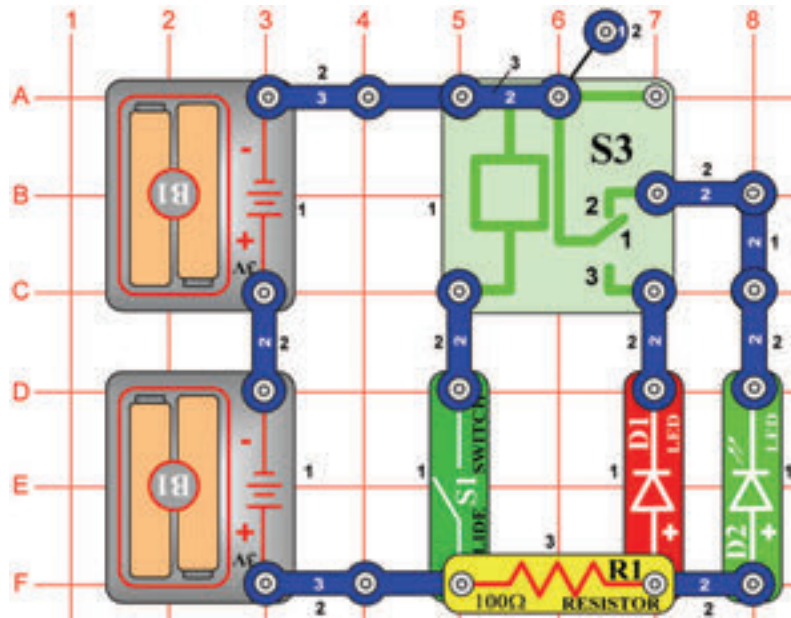
LED & Relay

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

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

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

Project #342
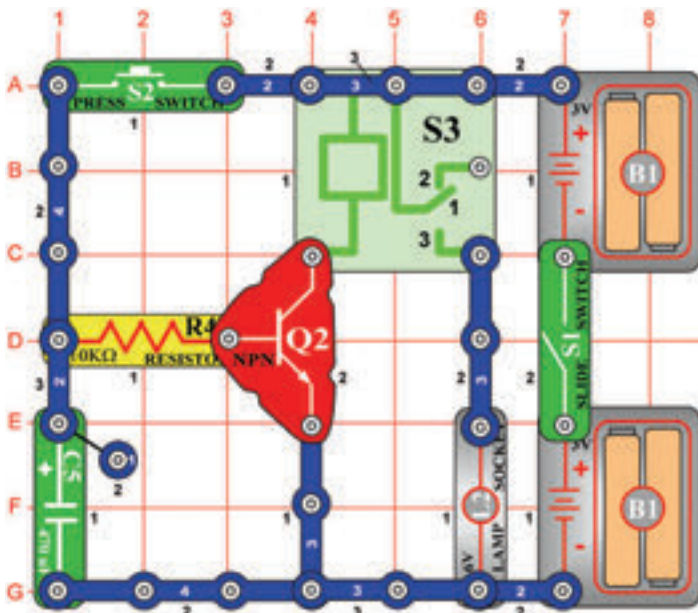
Manual 7 Second Timer

OBJECTIVE: To build a manual timer using a relay.

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

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

Change the value of the capacitor and see what happens.

Project #343
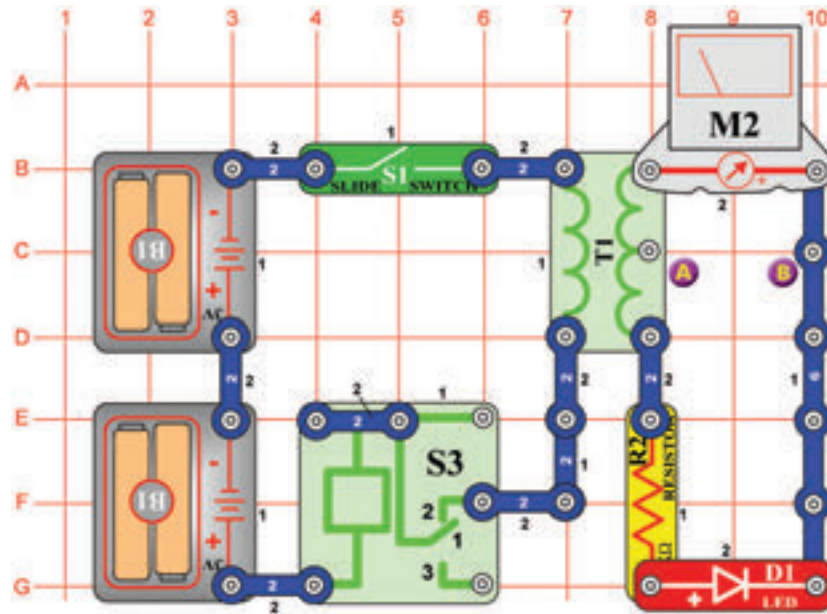
Half Wave Rectifier Circuit

OBJECTIVE: To build a half wave rectifier circuit.

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

Project #344

Half Wave Rectifier Circuit (II)

OBJECTIVE: Measure the voltage using the center-tap.

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

Project #345

LED vs. Diode

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

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

Project #346

Current & Resistance

OBJECTIVE: See how resistance affects current.

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

Project #347
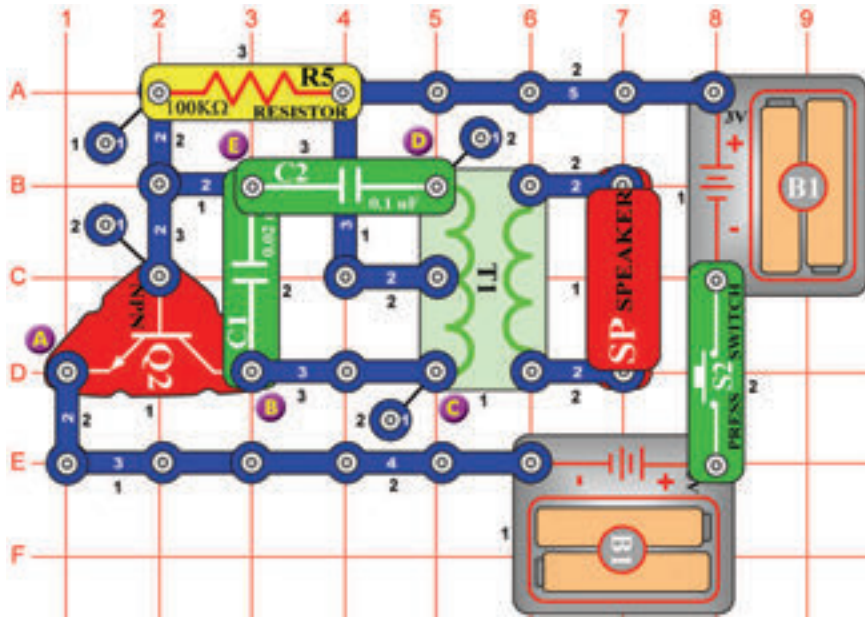
OBJECTIVE: *Making telegraph sounds.*

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

Project #348
Mosquito Sound

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

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

Project #349
Mosquito Sound (II)

OBJECTIVE: *Show variations of project #347.*

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

Project #350
Mosquito Sound (III)

OBJECTIVE: *Show variations of project #347.*

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

Project #351
Touch-Control Mosquito Sound

OBJECTIVE: *To use the phototransistor to adjust the oscillator sound.*

Use the circuit in project #347. Replace the 100kΩ resistor (R5) with the phototransistor (Q4). Wave your hand over the resistor and the sound changes.

Project #352
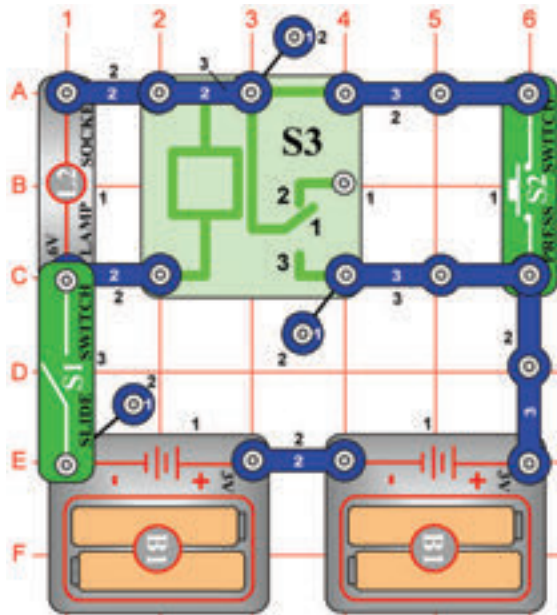
Bulb & Relay

OBJECTIVE: Light a bulb using a relay.

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

Project #353
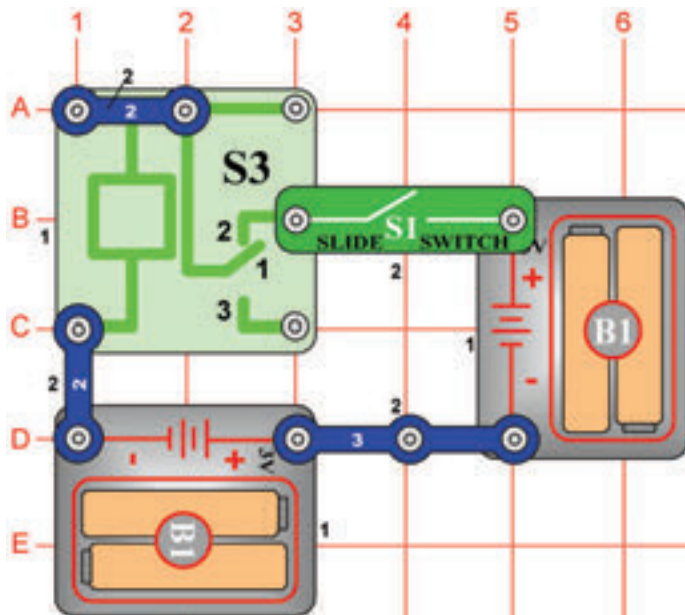
Relay Buzzer

OBJECTIVE: To make a relay buzzer.

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

Project #354
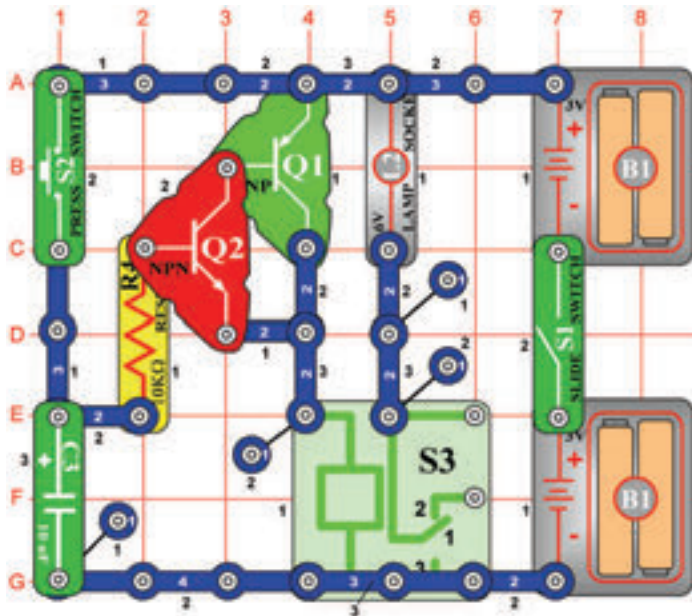
Transistor Timer

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

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

Project #355
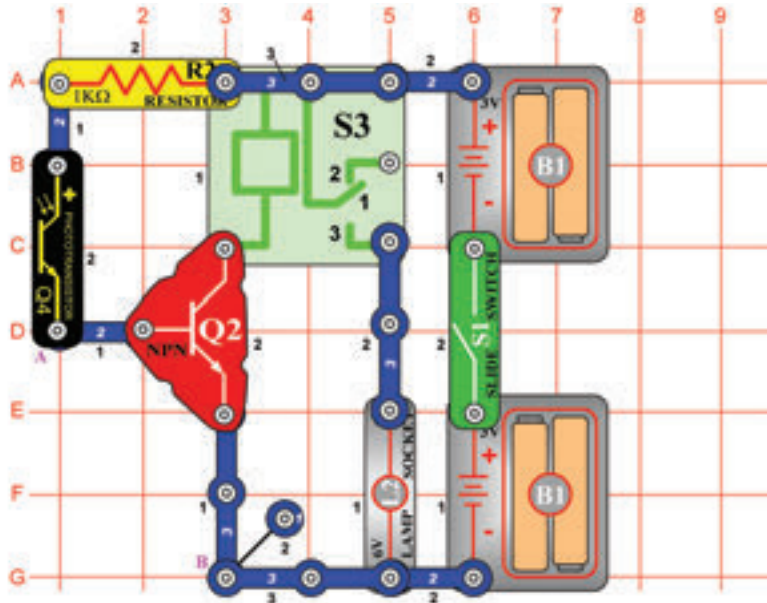
Light-controlled Relay

OBJECTIVE: To use a phototransistor to control a relay.

Under normal light, the resistance of the phototransistor (Q4) is low, allowing a voltage at the base of the transistor (Q2). This turns the transistor on, connecting the relay (S3) across the batteries, and the bulb (L2) lights. If the light decreases, the resistance increases and the voltage to Q2 drops. If the voltage at Q2 decreases enough, the transistor turns off.

Turn on the slide switch (S1) and the bulb lights. Now as you block the light from the phototransistor, the bulb turns off.

Project #356

Bulb Alert Relay

OBJECTIVE: Make a warning system that lights the bulb.

Replace the phototransistor (Q4) with a 10kΩ resistor (R4). Connect the wire to points A & B. As long as the wire is connected, the transistor (Q2) is off and the relay (S3) and bulb (L2) are not powered. Disconnect the wire. The relay contacts will switch and the bulb will light.

Project #357
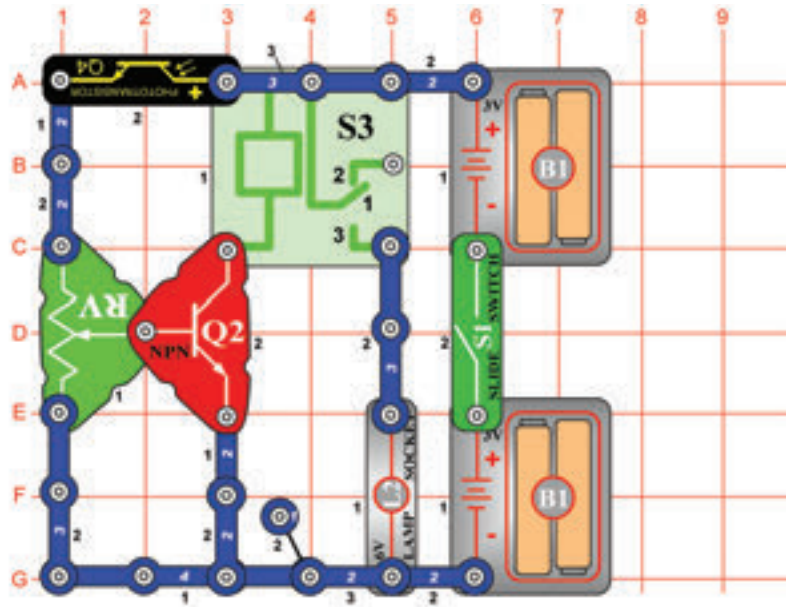
Adjustable Light Control

OBJECTIVE: Build an adjustable light-controlled relay.

You can set the amount of light it takes to keep the bulb (L2) on by adjusting the adjustable resistor (RV). Set the adjustable resistor to the top position and turn on the switch. The bulb lights. Cover the phototransistor (Q4) and the bulb turns off. Set the adjustable resistor to different positions and then cover the phototransistor. Note that only the top half of the adjustable resistor affects the circuit. If you position it below the middle, the bulb stays off.

Project #358
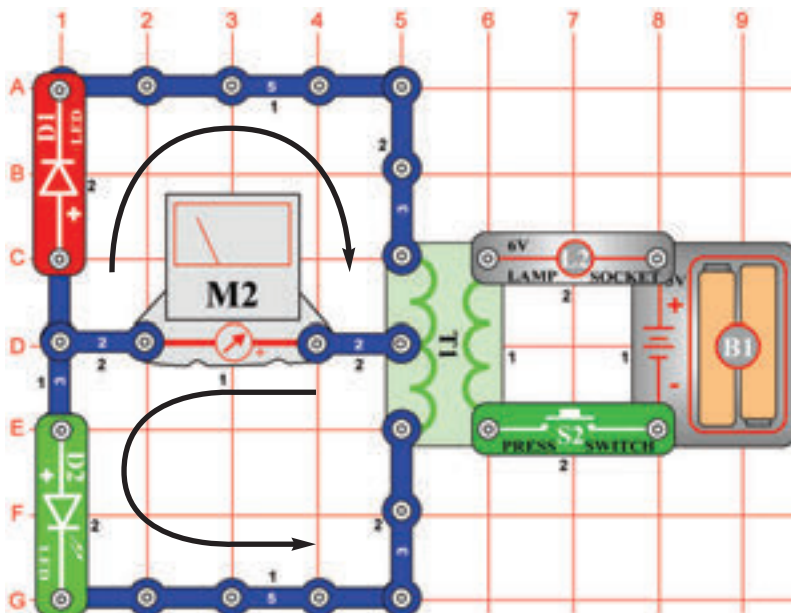
Meter Deflection

OBJECTIVE: To demonstrate the properties of a transformer.

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

Project #359

AC to DC Current

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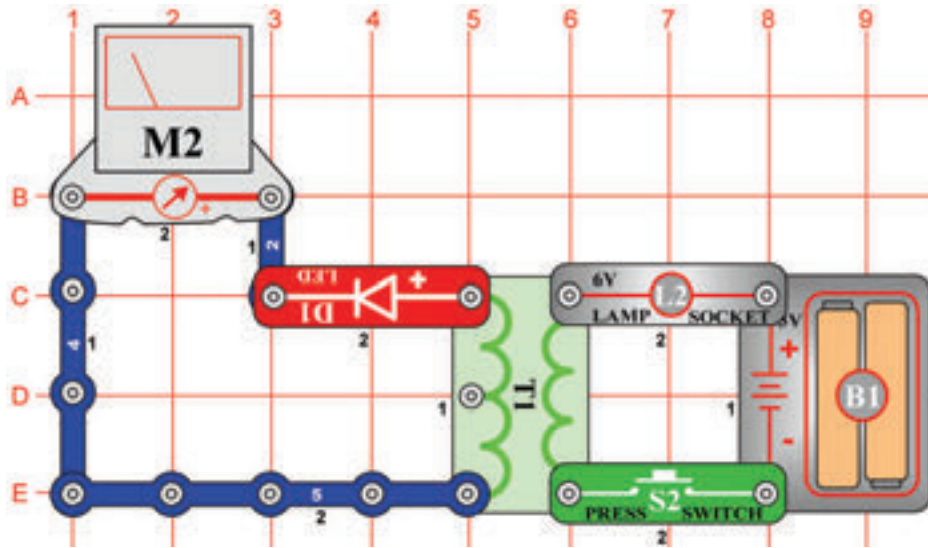
Set the meter (M2) to the LOW (or 10mA) scale. Pressing and releasing the press switch (S2) continuously generates an AC (changing) current. The LED (D1) is used to convert the AC (changing) current to DC (unchanging) current because it only allows the current to flow in one direction. The LED should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

Project #360

Current Meter

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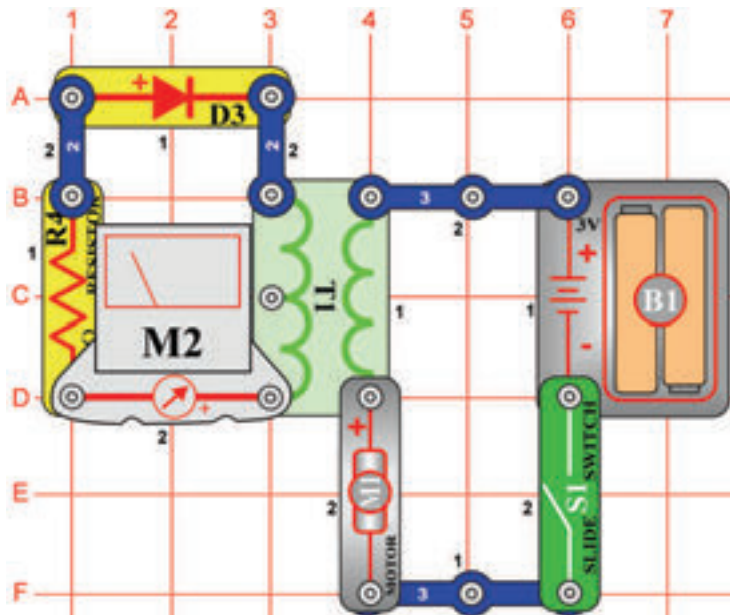
Set the meter (M2) to the LOW (or 10mA) setting. By placing the meter, diode (D3) and current limiting resistor (R4) on the transformer (T1), you can measure the current. Turn on the slide slide switch (S1) and the motor (M1) starts spinning. The current on the right side of the transformer creates a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

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

Project #361
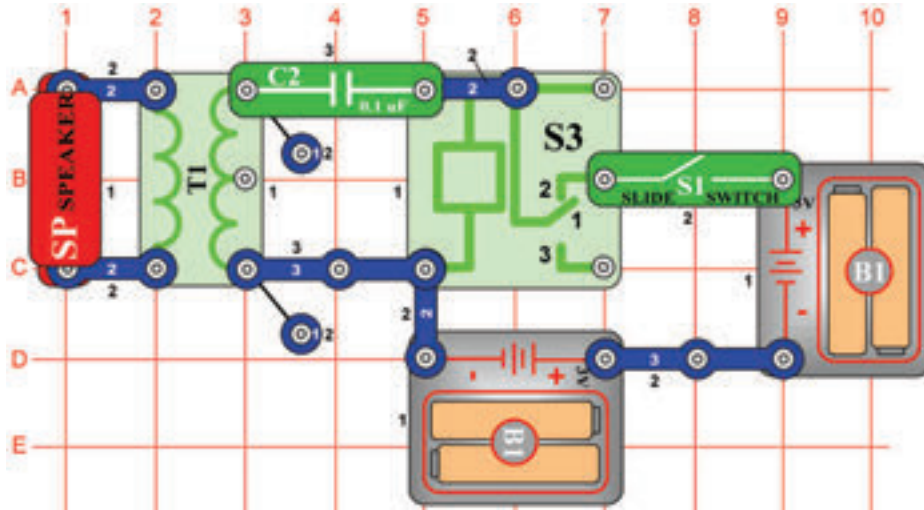
Buzzer, Relay, & Transformer

OBJECTIVE: *To use a transformer for a louder buzzer.*

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

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

Project #362
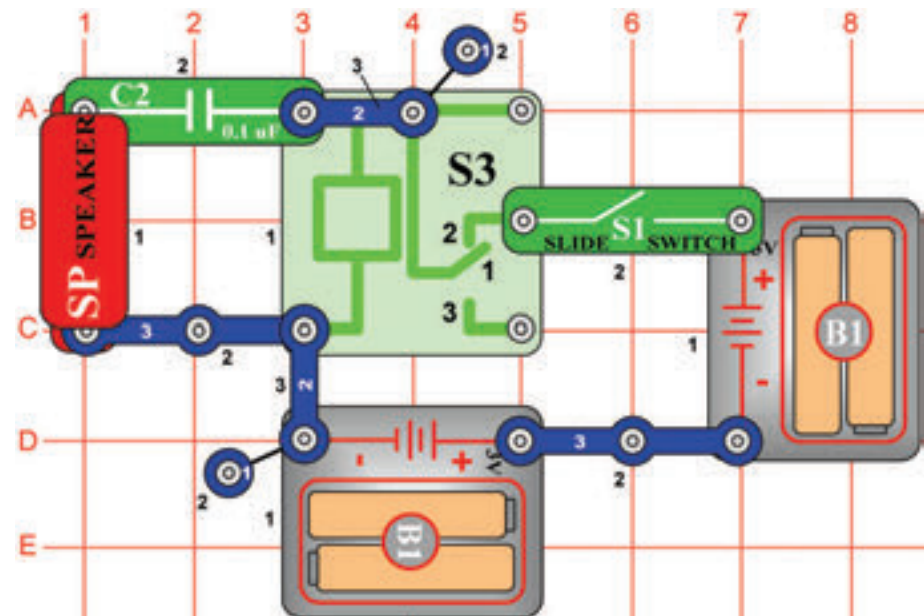
Buzzer & Relay

OBJECTIVE: *Make a relay buzzer with speaker.*

A speaker (SP) and capacitor (C2) are placed across the coil of the relay (S3). When the slide switch (S1) is turned on, the relay's contacts open and close as in project #353. As the capacitor (C2) charges and discharges, the speaker generates a buzzing sound.
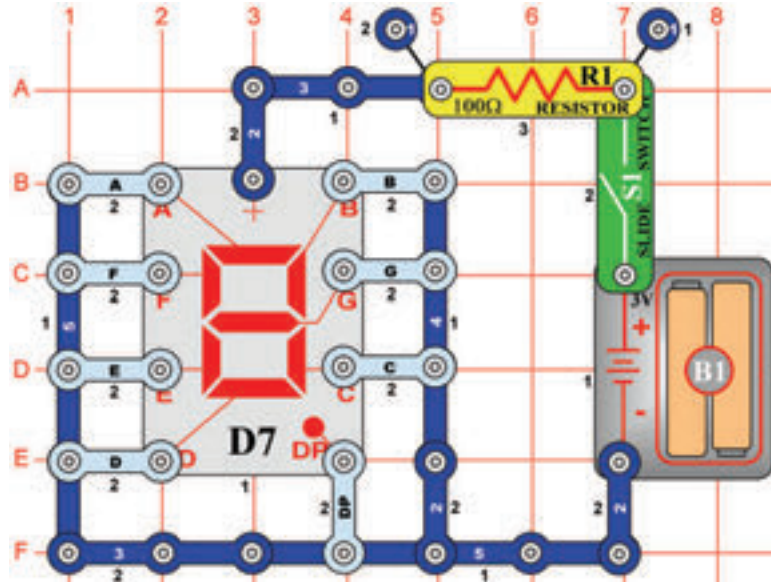
□ Project #363
Display Capital Letter "F"

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

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

□ Project #364
Display Capital Letter "H"

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

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

□ Project #365
Display Capital Letter "P"

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

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

□ Project #366
Display Capital Letter "S"

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

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

□ Project #367
Display Capital Letter "U"

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

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

□ Project #368
Display Capital Letter "C"

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

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

□ Project #369
Display Capital Letter "E"

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

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

□ Project #370
Display "."

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

Connect DP to the negative of the battery.
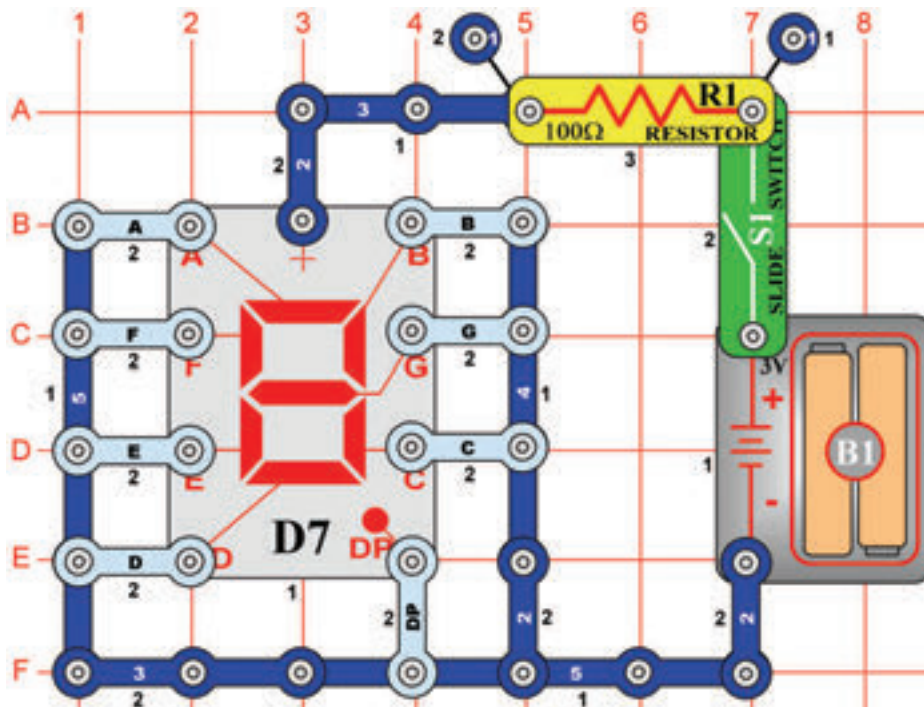
Project #371
Display Letter "b"

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

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

Project #372
Display Letter "c"

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

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

Project #373
Display Letter "d"

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

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

Project #374
Display Letter "e"

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

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

Project #375
Display Letter "h"

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

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

Project #376
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.

Project #377
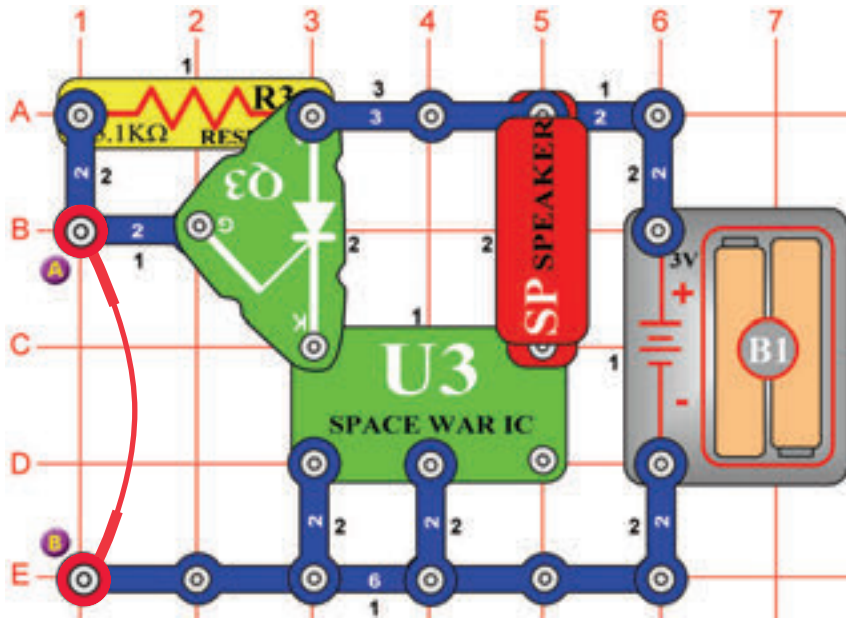
Space War Alarm by SCR

OBJECTIVE: To build an alarm circuit.

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

Project #378

Light Space War Alarm

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #377. Replace the resistor (R3) with the phototransistor (Q4) and remove the jumper wire. Cover the phototransistor with your hand. Now slowly remove your hand. The music plays when enough light hits the resistor.

Project #379
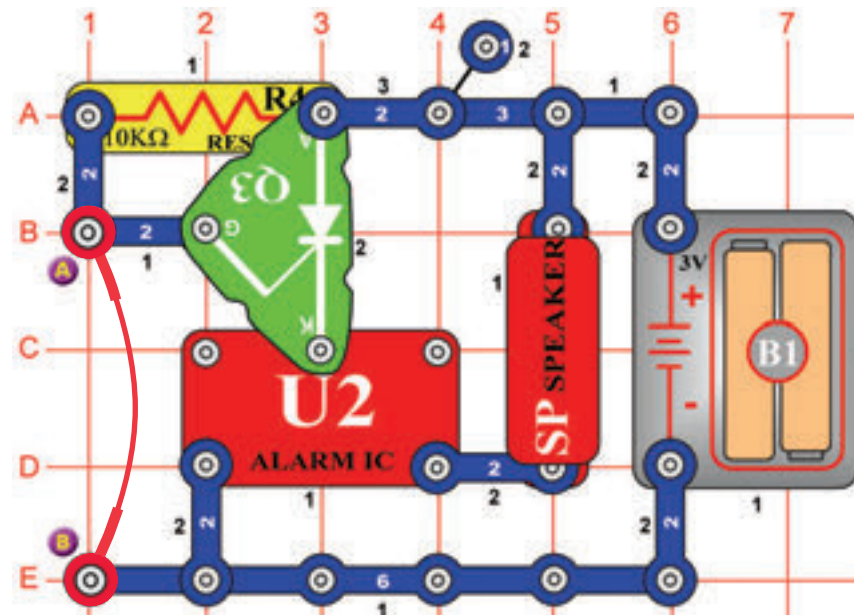
Alarm by SCR

OBJECTIVE: To build an alarm circuit.

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

Project #380

Light & Alarm IC

OBJECTIVE: To build an alarm circuit.

Use the circuit in project #379. Replace the 10kΩ resistor (R4) with the phototransistor (Q4) and remove the jumper wire. When enough light strikes the phototransistor, the Alarm IC (U2) plays. Cover the phototransistor with your hand. Now slowly remove it, when enough light hits the resistor, the IC plays.

Project #381
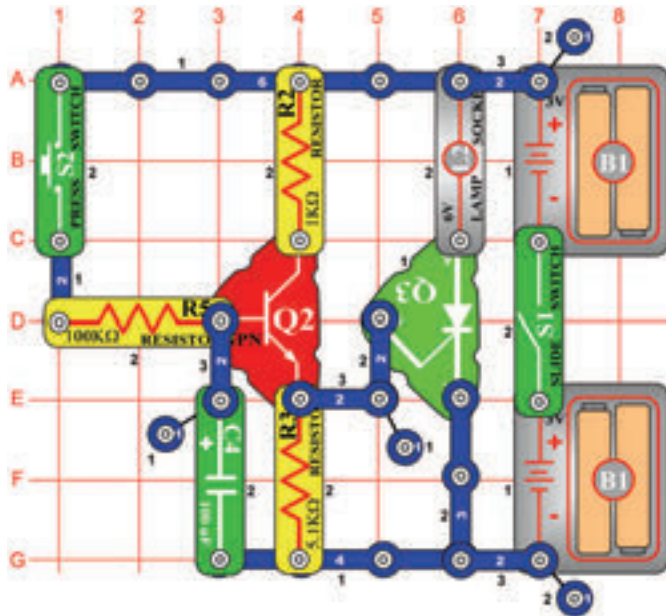
Delay Light

OBJECTIVE: To construct a time delay circuit.

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

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

Project #382
Delay Fan

OBJECTIVE: To construct a time delay fan.

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

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

Project #383
Delay Fan (II)

OBJECTIVE: To construct another type of time delay fan.

Use the circuit in project #382. Replace the 100μF capacitor (C4) with the 470μF capacitor (C5). Turn on slide switch (S1) and press switch (S2). See how long it takes until the motor (M1) spins.

Project #384

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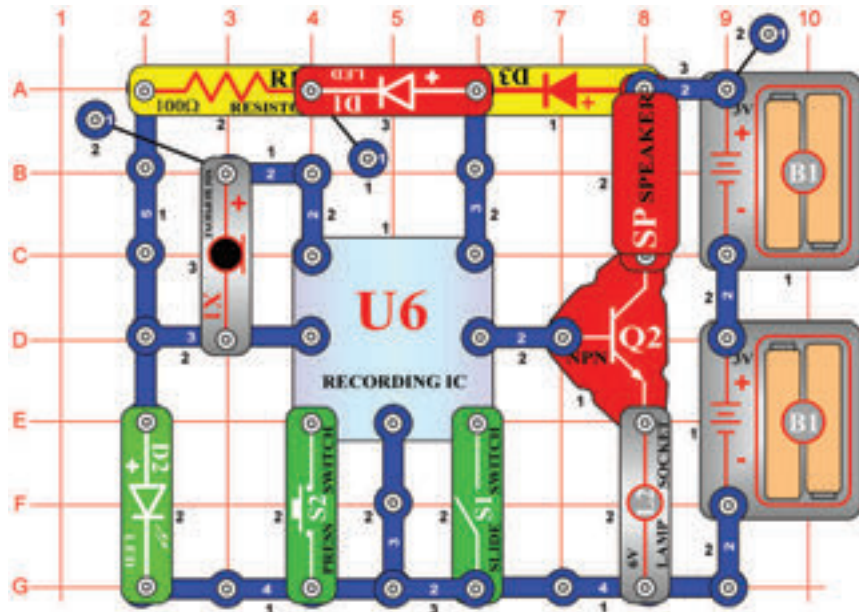
OBJECTIVE: *To build a circuit that lights an LED to indicate the recording mode.*

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

Project #385

Playback & Record with Meter
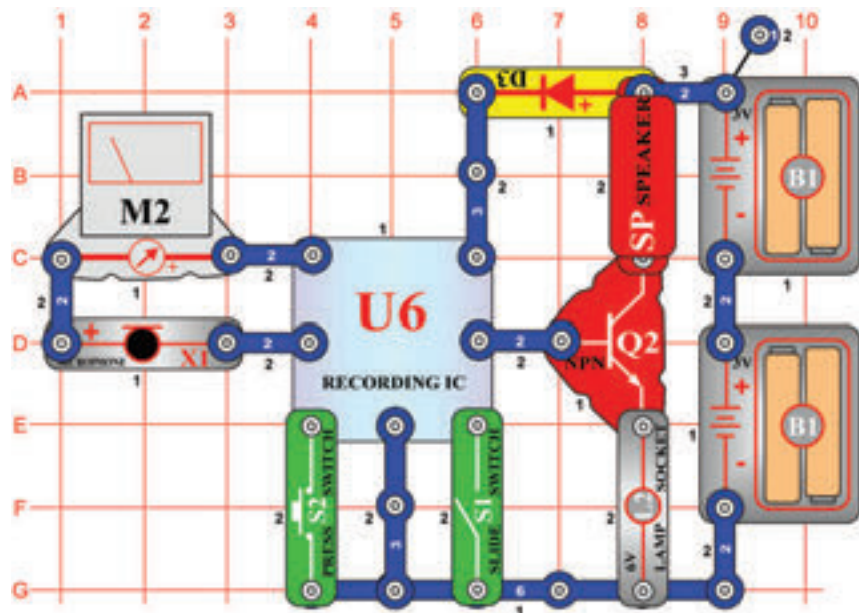
OBJECTIVE: *To add a volt meter to the playback and record circuit.*

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

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

Project #386
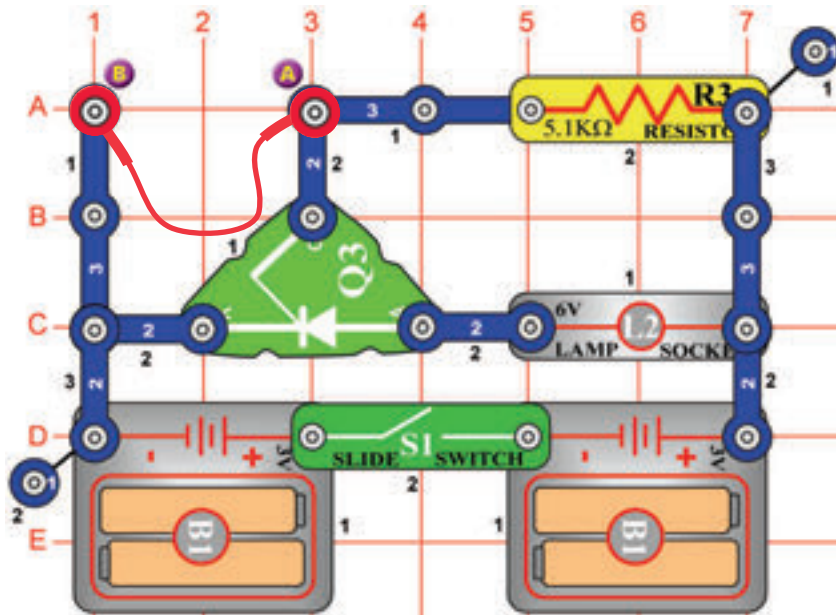
Alarm Light

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

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

Project #387
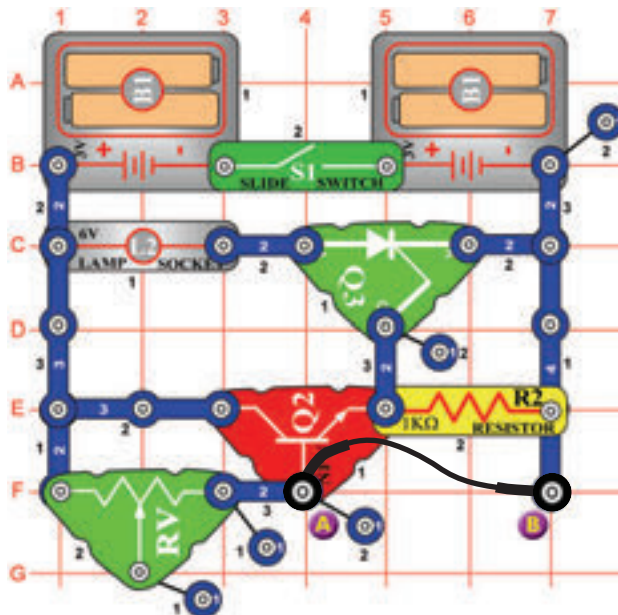
Alarm Light (II)

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

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

Project #388

Night Police Car

OBJECTIVE: To build a night-sensitive police car sound.
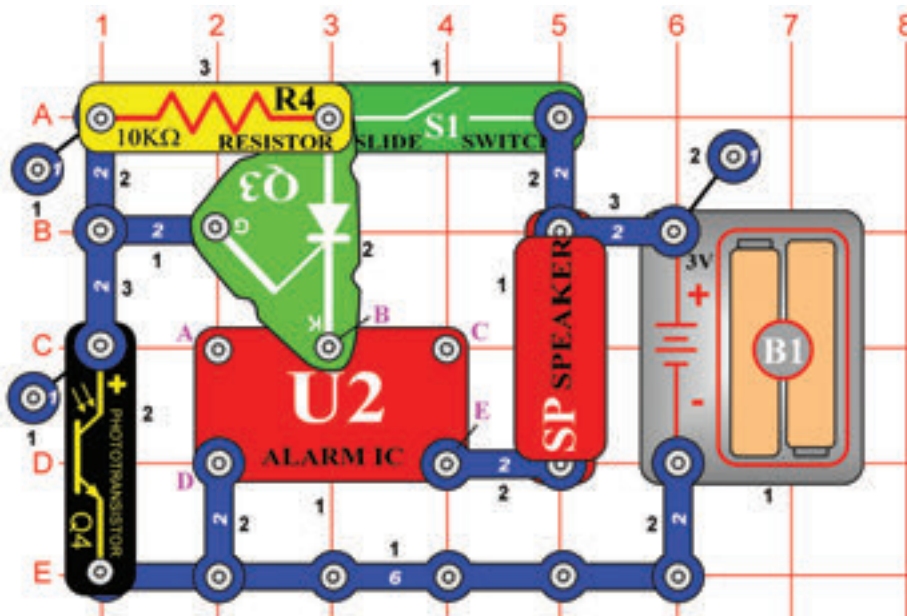
As the phototransistor (Q4) is exposed to light, its resistance is very low, thereby connecting the gate of the SCR (Q3) to ground. This prevents the SCR from conducting, connecting the alarm IC (U2) to the batteries. The alarm IC remains off until the light is blocked, triggering the SCR. If the light in the room is not bright, the IC may turn on.

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

Project #389
Night Machine Gun

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

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

Project #390
Night Fire Engine

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

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

Project #391
Night Ambulance

OBJECTIVE: To build a night-sensitive ambulance sound.

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

Project #392

Daytime Light Police Car
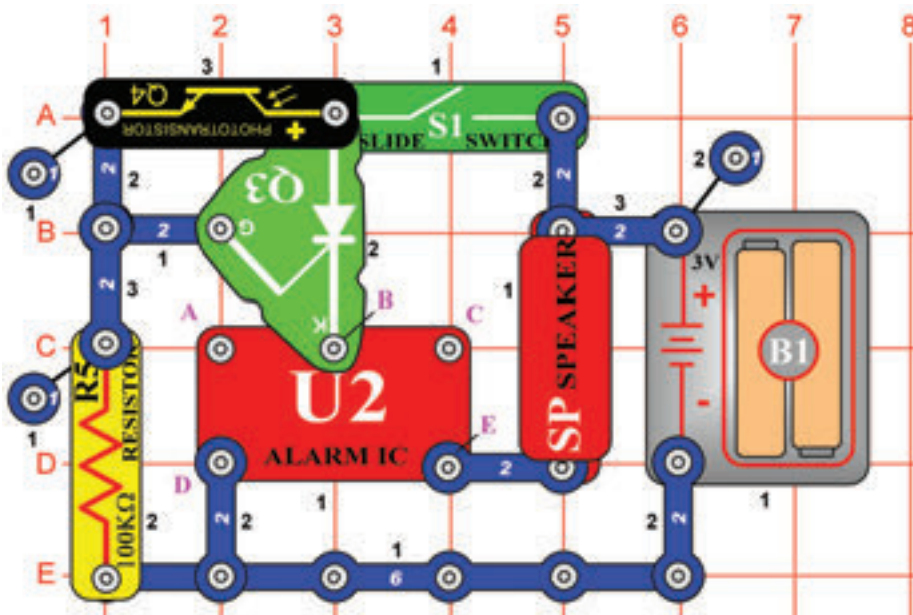
OBJECTIVE: To build a light-sensitive police car sound.

As long as the phototransistor (Q4) is exposed to light, the alarm IC (U2) outputs a signal to the speaker (SP). Block the light with your hand and the sound will stop.

Project #393
Daytime Light Machine Gun

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

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

Project #394
Daytime Light Fire Engine

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

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

Project #395
Daytime Light Ambulance

OBJECTIVE: To build a light-sensitive ambulance sound.

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

Project #396
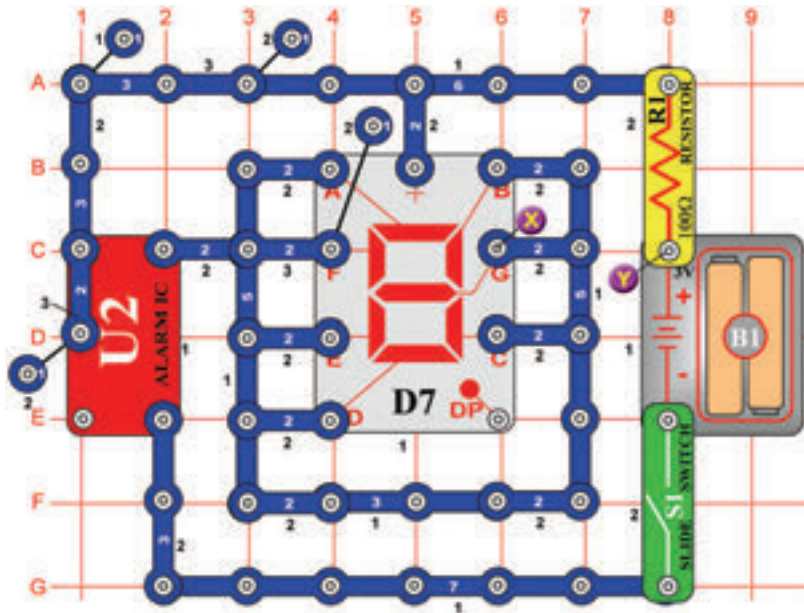
Flashing 8

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

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

Project #397

Flashing 8 with Sound

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

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

Project #398
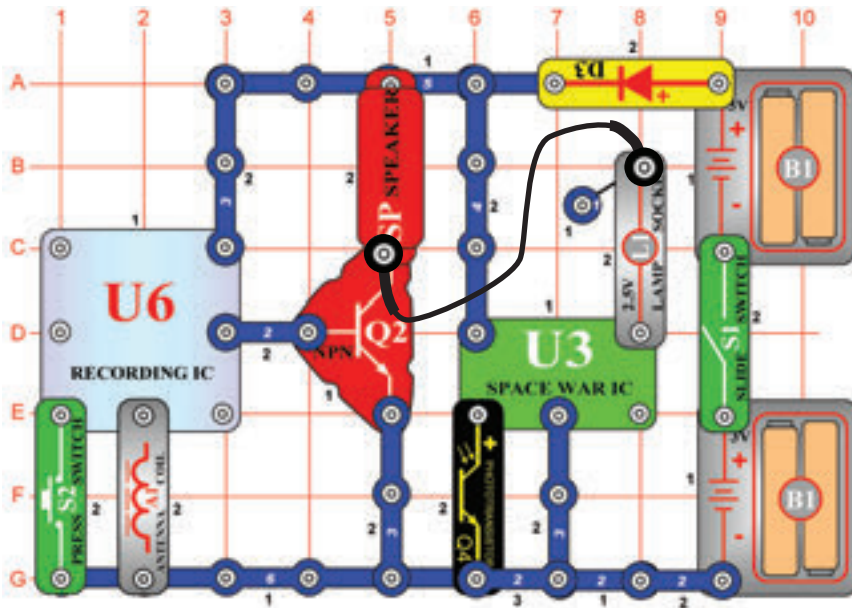
Musical Space War

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

Turn on the slide switch (S1) and you hear space war sounds as the lamp (L1) flashes. If you wave your hand over the phototransistor (Q4), the sound changes. If you keep the phototransistor covered, then the sound will stop.

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

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

Project #399
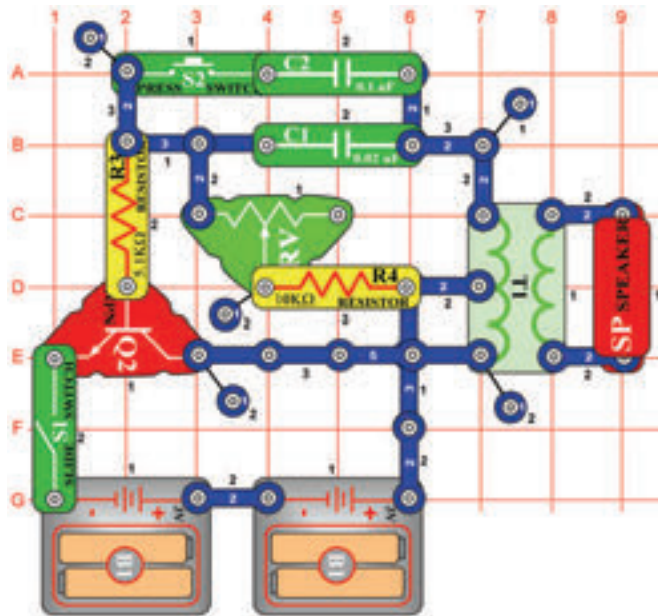
Electronic Noisemaker

OBJECTIVE: To make different tones with an oscillator.

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

Project #400

Electronic Noisemaker (II)

OBJECTIVE: To show a variation of project #399.

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

Project #401
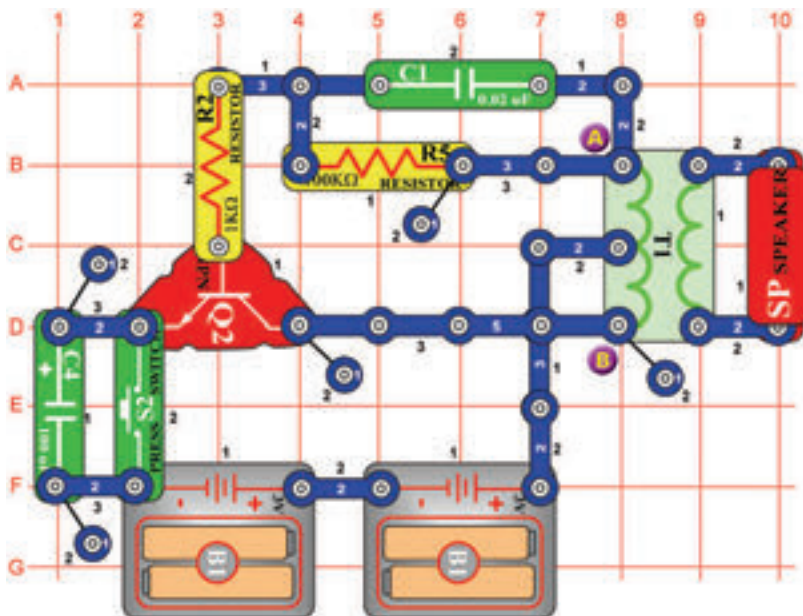
Bee

OBJECTIVE: To make different sounds with an oscillator.

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

Project #402

Bee (II)

OBJECTIVE: Show a variation of project #401.

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

Project #403

Bee (III)

OBJECTIVE: Show a variation of project #401.

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

Project #404

Oscillator Sound

OBJECTIVE: Build an oscillator circuit.

Turn on the slide switch (S1) and the LED (D1) lights as the speaker (SP) emits a tone. The circuit oscillates and generates an AC voltage across the speaker through the transformer (T1).
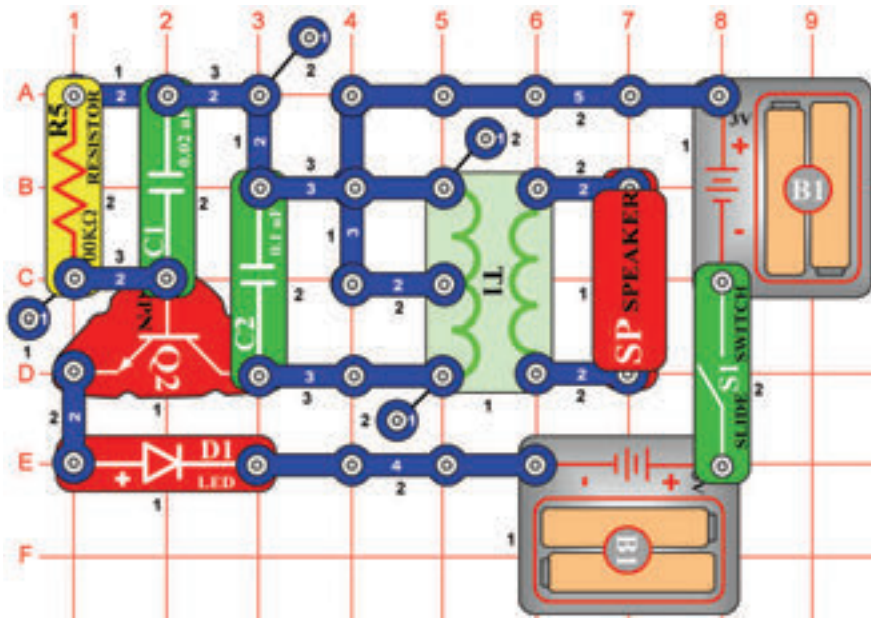
Project #405

Oscillator Sound (II)

OBJECTIVE: Show variations of project #404.

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

Project #406

Oscillator Sound (III)

OBJECTIVE: Show variations of project #404.

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

Project #407

Oscillator Sound (IV)

OBJECTIVE: Show variations of project #404.

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

Project #408

Oscillator Sound (V)

OBJECTIVE: Show variations of project #404.

Use the circuit in project #404. Replace the 100kΩ resistor (R5) with the phototransistor (Q4). Wave your hand over the phototransistor. Now, as the resistance changes, so does the oscillator frequency.

Project #409
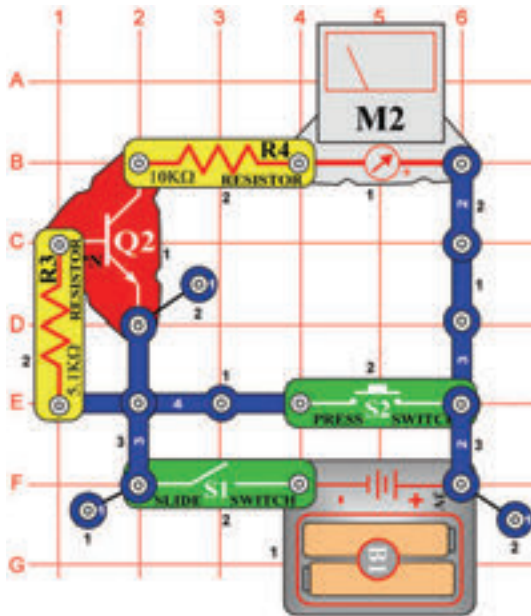
Transistor Tester

OBJECTIVE: To build a circuit that checks the transistor.

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

Project #410
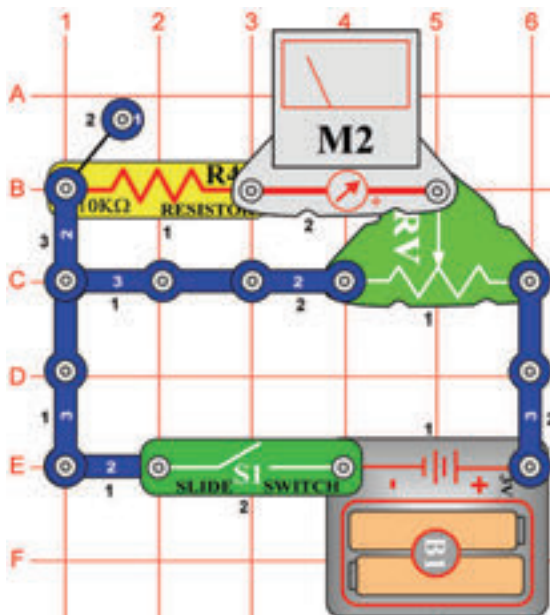
Adjustable Voltage Divider

OBJECTIVE: To make an adjustable current path.

Set the meter (M2) to the LOW (or 10mA) setting. This circuit is a simple voltage divider. When the adjustable resistor (RV) is set to the far right, the voltage across the resistors (R4) and (RV) are equal. Adjust resistor (RV) to the left, the meter deflects less, as the voltage decreases.
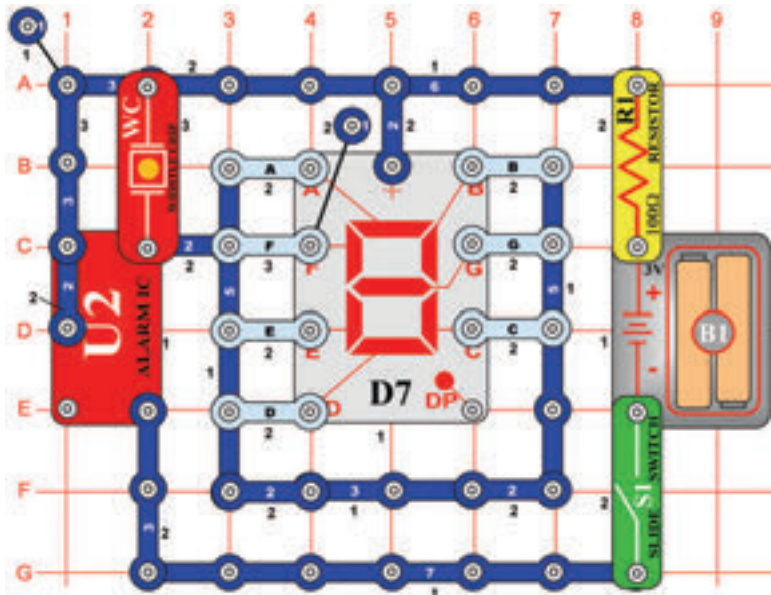
Project #411
Automatic Display Capital Letter "C"

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

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

Project #412
Automatic Display Capital Letter "E"

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

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

Project #413
Automatic Display Capital Letter "F"

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

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

Project #414
Automatic Display Capital Letter "H"

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

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

Project #415
Automatic Display Capital Letter "P"

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

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

Project #416
Automatic Display Capital Letter "S"

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

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

Project #417
Automatic Display Capital Letter "U"

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

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

Project #418
Automatic Display Capital Letter "L"

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

Use the circuit from project #411. Connect D, E, & F to the circuit. Turn on the switch (S1), the display flashes and the whistle chip (WC) buzzes on and off.
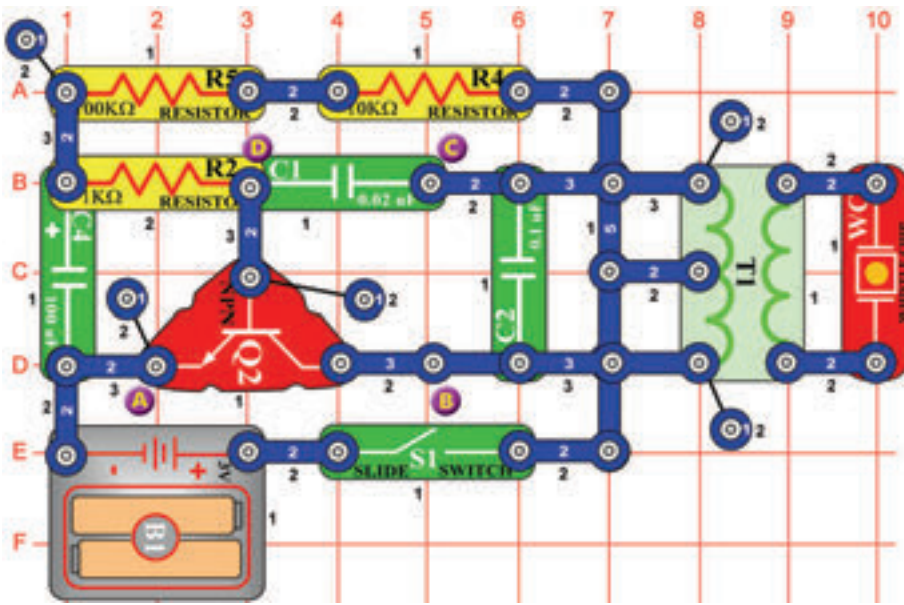
Project #419
Whistle Chip Sounds

OBJECTIVE: *To make sounds from the whistle chip.*

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

Project #420
Whistle Chip Sounds (II)

OBJECTIVE: *Show variations of project #419.*

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

Project #421
Whistle Chip Sounds (III)

OBJECTIVE: *Show variations of project #419.*

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

Project #422
Whistle Chip Sounds (IV)

OBJECTIVE: *Show variations of project #419.*

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

Project #423
Whistle Chip Sounds (V)

OBJECTIVE: *Show variations of project #419.*

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

Project #424
Whistle Chip Sounds (VI)

OBJECTIVE: *Show variations of project #419.*

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

Project #425
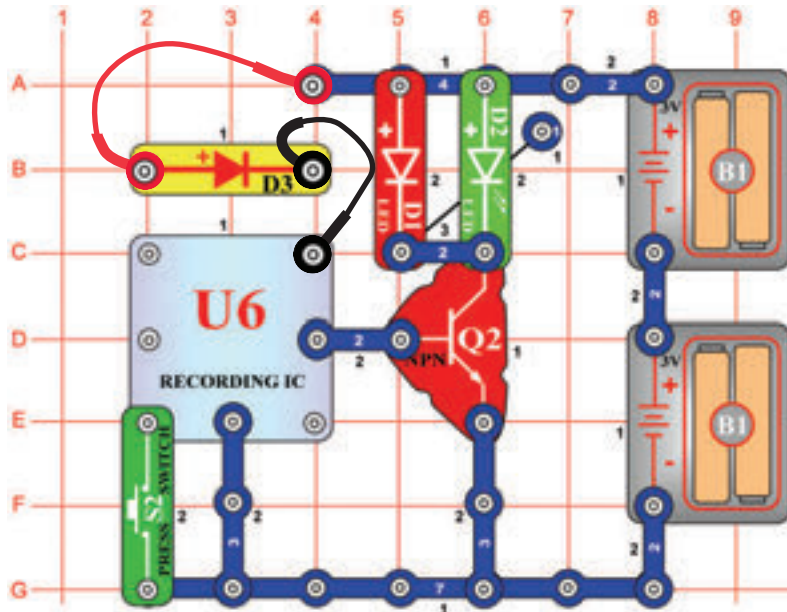
LED Music

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

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

Project #426
Light-controlled LED Time Delay

OBJECTIVE: Show variations of project #425.

Use the circuit in project #425. Replace the press switch (S2) with the phototransistor (Q4). Turn the LED's on and off by waving your hand over the phototransistor.

Project #427
Touch-controlled LED Time Delay

OBJECTIVE: Show variations of project #425.

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

Project #428
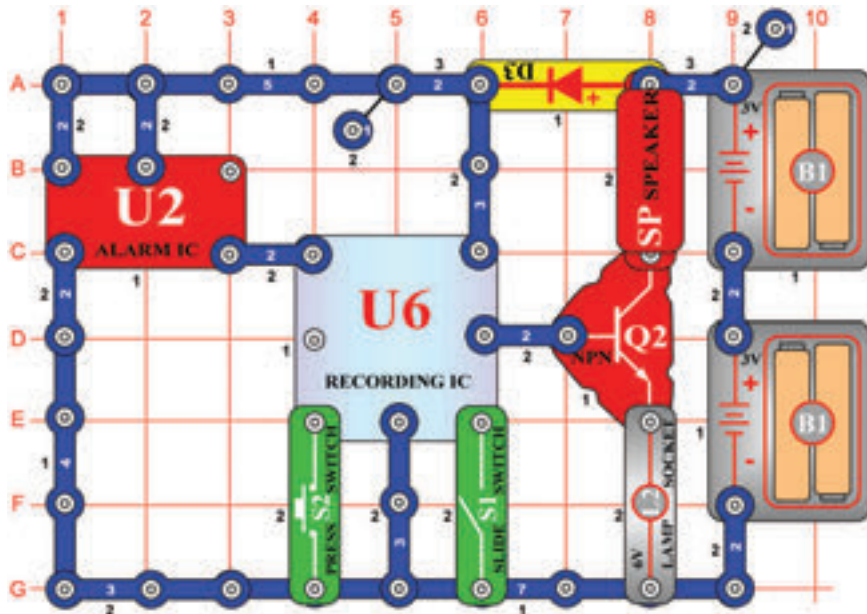
Alarm Recorder

OBJECTIVE: *To record the sound from the alarm IC.*

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

Project #429

Alarm Recorder (II)

OBJECTIVE: *Record the sound from the alarm IC.*

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

Project #430

Machine Gun Recorder

OBJECTIVE: *To record the sound of a machine gun.*

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

Project #431
Time Delay
1-7 Seconds

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

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

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

Turn on the switch (S1), the red LED (D1) lights. Now press and release the switch (S2), the bulb lights and the motor spins.
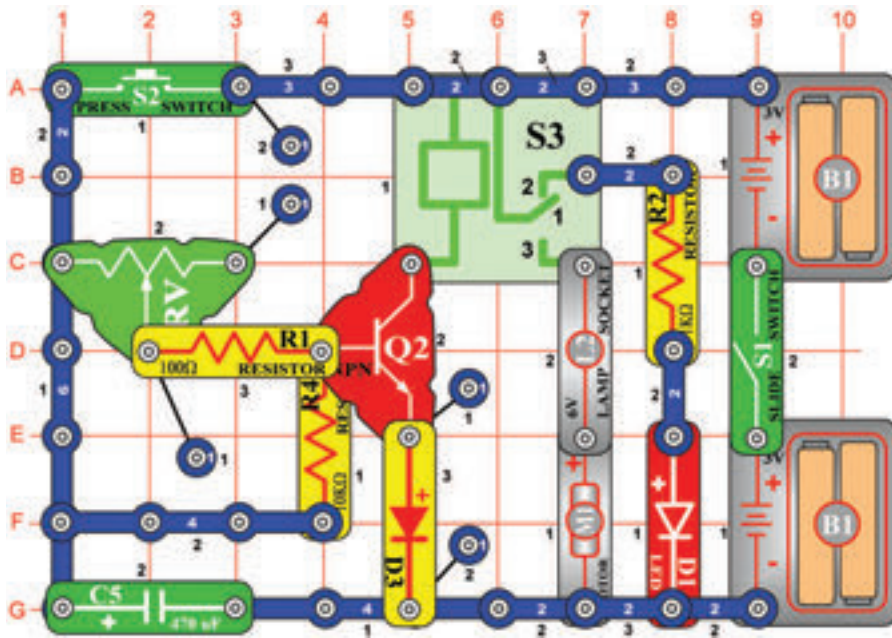
Project #432
Time Delay

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

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

⚠ **WARNING:** Moving parts. Do not touch the fan or motor during operation.
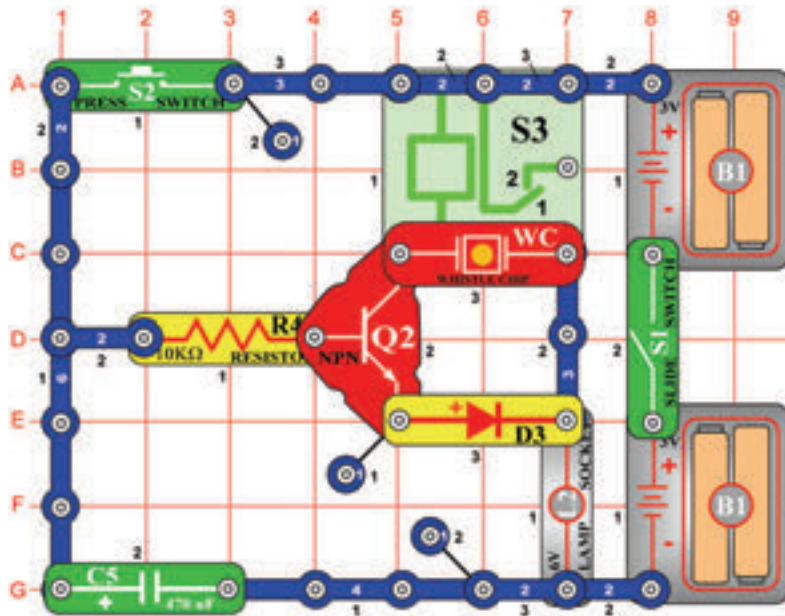
Project #433

Manual 7 Second Timer (II)

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

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

Project #434
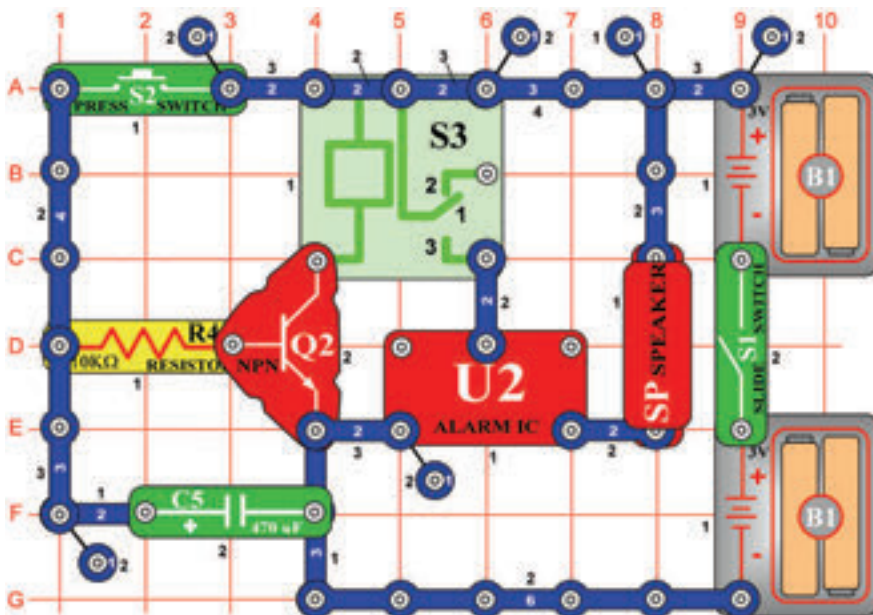
15 Second Alarm

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

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

Turn on the slide switch (S1) and then press the switch (S2). The transistor turns on, the capacitor (C5) charges up, and the alarm sounds. Release the press switch (S2). As the capacitor discharges, it keeps the transistor on. The transistor will turn off when the capacitor is almost discharged, about 15 seconds. The relay contacts will switch and the alarm will turn off.
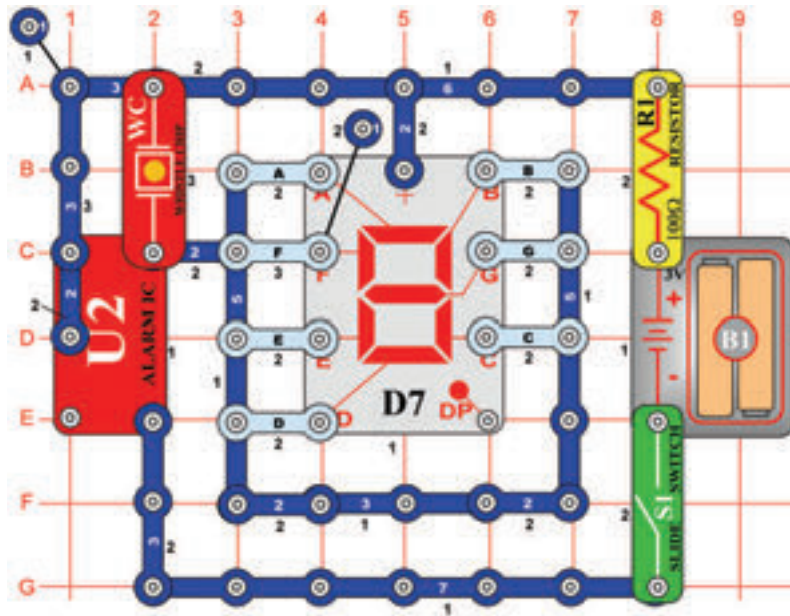
Project #435

Flashing "1 & 2"

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

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

Project #436

Flashing "3 & 4"

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

Use the circuit in project #435. Connect A, B, G, C, & D to the circuit. Turn on the slide switch (S1) and the number "3" should be flashing. Now, connect C, B, G & F to flash the number "4".

Project #437

Flashing "5 & 6"

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

Use the circuit in project #435. Connect A, F, G, C & D to the circuit. Turn on the slide switch (S1) and the number "5" should be flashing. Now, connect A, C, D, E, F & G to flash the number "6".

Project #438

Flashing "7 & 8"

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

Use the circuit in project #435. Connect A, B, & C to the circuit. Turn on the slide switch (S1) and the number "7" should be flashing. Now, connect A, B, C, D, E, F & G to flash the number "8".

Project #439

Flashing "9 & 0"

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

Use the circuit in project #435. Connect A, B, C, D, F, & G to the circuit. Turn on the switch (S1) and the number "9" should be flashing. Now, connect A, B, C, D, E, & F to flash the number "0".

Project #440

Flashing "b & c"

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

Use the circuit in project #435. Connect C, D, E, F & G to the circuit. Turn on the slide switch (S1) and the letter "b" should be flashing. Now, connect A, F & G to flash the letter "c".

Project #441

Flashing "d & e"

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

Use the circuit in project #435. Connect B, C, D, E, & G to the circuit. Turn on the slide switch (S1) and the letter "d" should be flashing. Now, connect A, B, D, E, F & G to flash the letter "e".

Project #442

Flashing "h & o"

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

Use the circuit in project #435. Connect C, E, F, & G to the circuit. Turn on the slide switch (S1) and the letter "h" should be flashing. Now, connect C, D, E, & G to flash the letter "o".

Project #443

Flashing "A & J"

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

Use the circuit in project #435. Connect A, B, C, E, F, & G to the circuit. Turn on the slide switch (S1) and the capital letter "A" should be flashing. Now, connect B, C, & D to flash the capital letter "J".

Project #444

Alarm Timer

OBJECTIVE: To connect the alarm IC to a timer circuit.
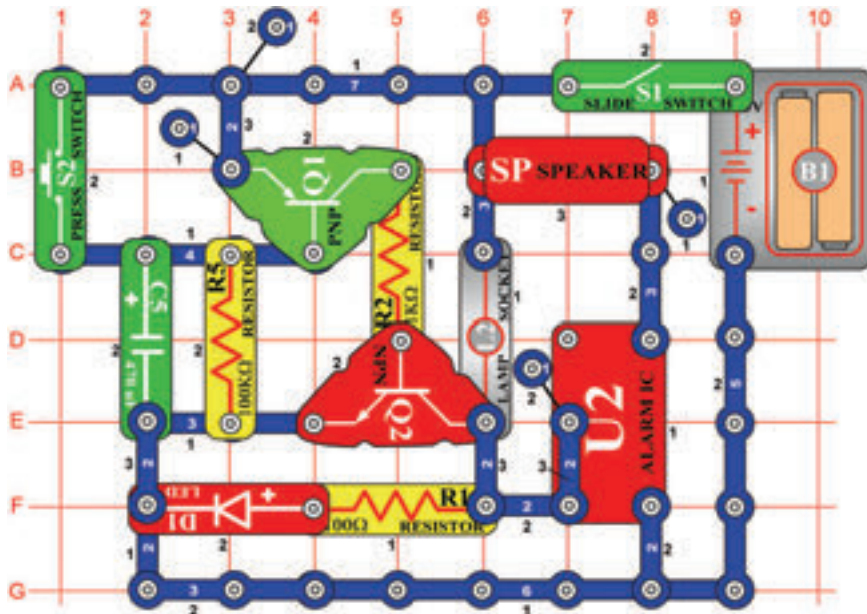
Turn on the slide switch (S1) and the alarm may sound and slowly drift away as the lamp (L2) brightens. Press the press switch (S2) and the alarm sounds at full volume as the LED (D1) lights. Capacitor C5 is also charged. Release the press switch; the alarm IC (U2) still sounds because the voltage from the discharging C5 keeps Q1 and Q2 off. As the capacitor's voltage drops, the LED will turn off and the sound will slowly stop.

Replace resistor R5 and capacitor C5 with different values and see how it affects the circuit.

Project #445
Alarm Timer (II)

OBJECTIVE: To change the time by switching the resistor and capacitor.
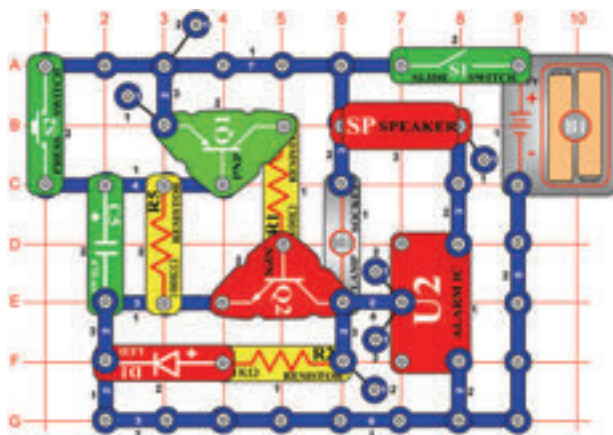
Build this circuit using the following combinations for R5 and C5:

R5 & C3, R4 & C4, and R4 & C5.

Project #446
Alarm Timer (III)

OBJECTIVE: To modify project #285 for a different sound.
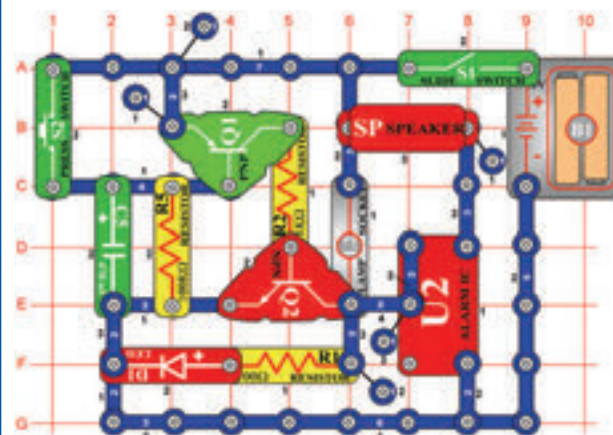
Replace the 1-snap wire from the middle snap on U2 with a 2-snap and connect it to grid location D7 & E7. The circuit now produces a different sound. Change R5 and C5 with the following combinations for R5 and C5:

R5 & C3, R4 & C4, and R4 & C5.
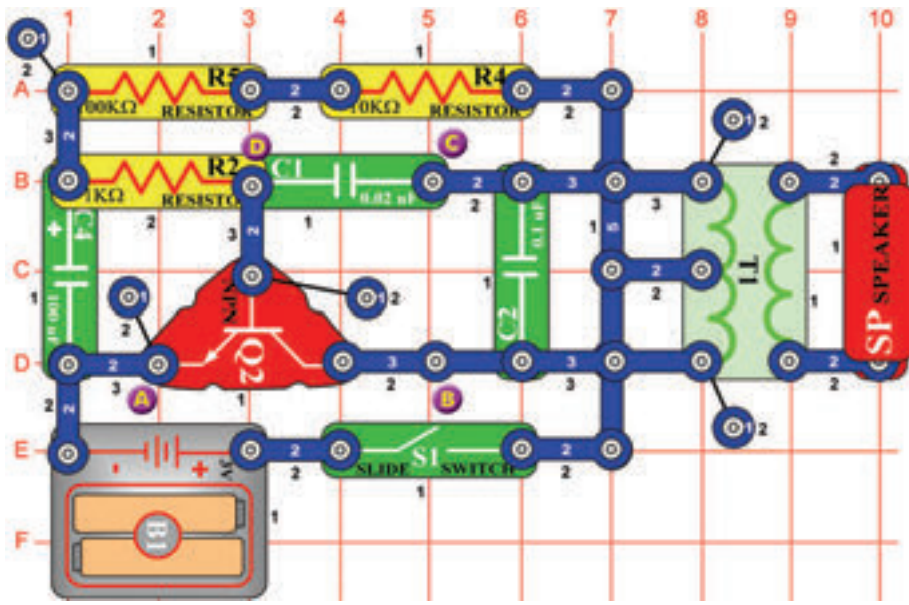
Project #447
Bird Sounds

OBJECTIVE: *To create bird sounds.*

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

Project #448
Bird Sounds (II)

OBJECTIVE: *To create bird sounds.*

Use the circuit in project #447. Replace the 100µF (C4) capacitor with the 10µF capacitor (C3), the tone should sound like a buzzer. Now use the 470µF capacitor (C5) and hear how the tone gets longer between chirps.

Project #449
Bird Sounds (III)

OBJECTIVE: *To create bird sounds.*

Use the circuit in project #447. Using the jumper wires, connect the whistle chip (WC) across points A & B and the sound changes.

Project #450
Bird Sounds (IV)

OBJECTIVE: *To create bird sounds.*

Use the circuit in project #447. Connect the whistle chip (WC) across points B & C.

Project #451
Bird Sounds (V)

OBJECTIVE: *To create bird sounds.*

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

Project #452
Touch-Control Bird Sound

OBJECTIVE: *Show variations of project #447.*

Use the circuit in project #447. Replace the 100kΩ resistor (R5) with the phototransistor (Q4). Wave your hand over the resistor and the sound changes. With the phototransistor installed, redo projects #448 - 451.

Project #453
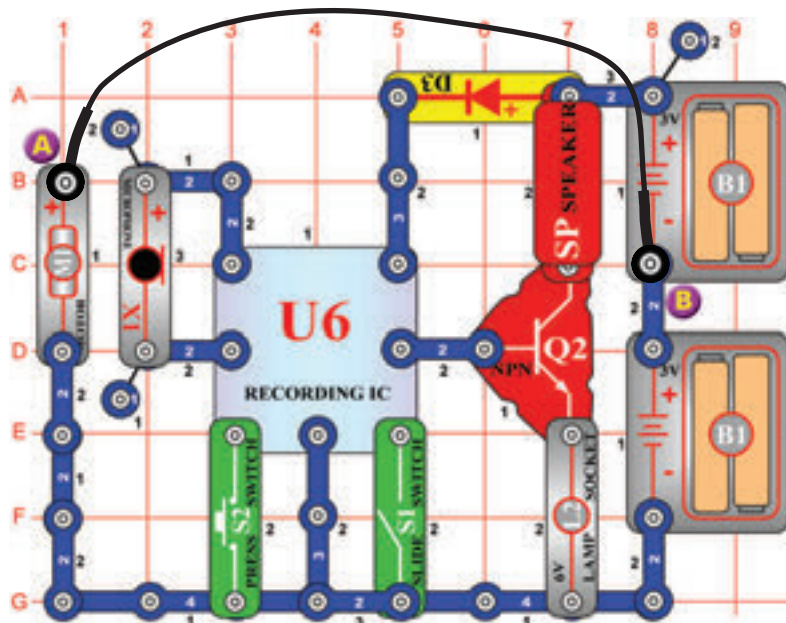
Motor Sound Recording

OBJECTIVE: Build a circuit that records the sound of the motor spinning.

Placing the motor (M1) (with the fan attached) next to the microphone (X1) enables you to record the sound as it spins. Turn off and then turn on the switch (S1). After the two beeps, turn off the slide switch (S1) again. Remove the jumper wire connected across points A & B and press the press switch (S2) to hear the recording. The lamp (L2) is used to limit the current and will not light.

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

Project #454
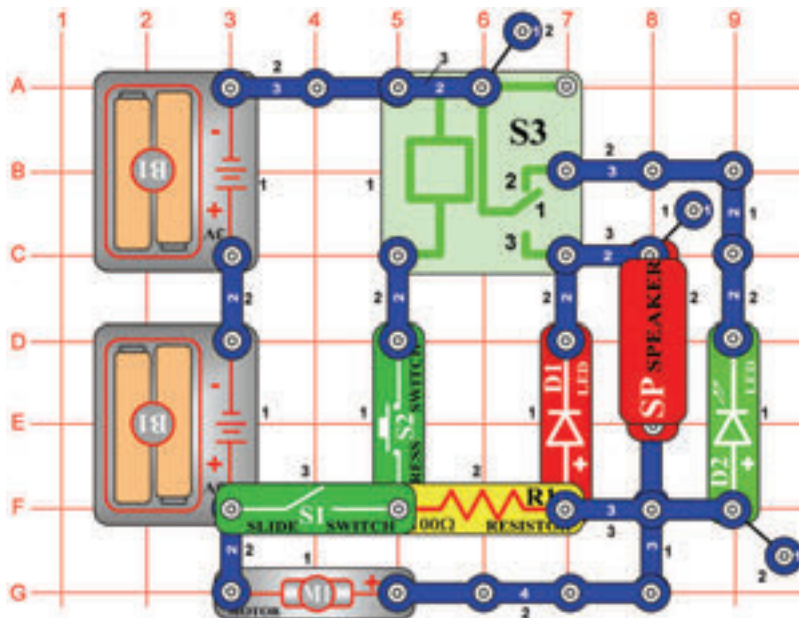
Motor Sound Indicator

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

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

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

Project #455
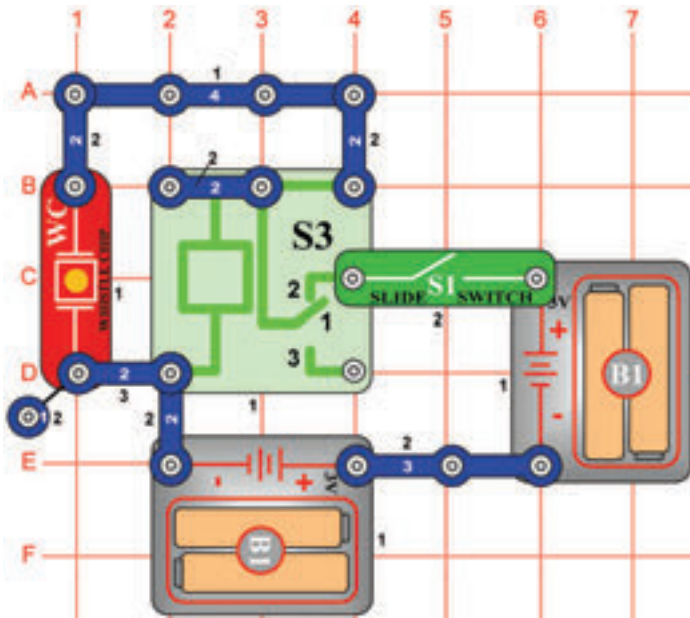
Relay & Buzzer

OBJECTIVE: Use the whistle chip and relay to make sound.

Turn on the slide switch (S1) and the relay (S3) opens and closes continuously. This creates an AC voltage across the whistle chip (WC), causing it to vibrate and sound.

Project #456

Relay & Speaker

OBJECTIVE: Use the speaker and relay to make sound.

Use the circuit from project #455. Replace the whistle chip (WC) with the speaker (SP). Turn on the slide switch (S1) and now you generate a louder sound using the speaker.

Project #457

Relay & Lamp

OBJECTIVE: Light the bulb using the relay.

Use the circuit from project #455. Replace the whistle chip (WC) with the 6V lamp (L2). Turn on the slide switch (S1) and the lamp lights.

Project #458
Electronic Cat

OBJECTIVE: To create the sound of a cat.

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

Project #459
Electronic Cat (II)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Connect the whistle chip (WC) across points A & B. Press and release the the switch (S2). You hear sound from the whistle chip and speaker (SP). Adjust the resistor (RV) and hear the different sounds.

Project #460
Electronic Cat (III)

OBJECTIVE: Show variations of project #458.
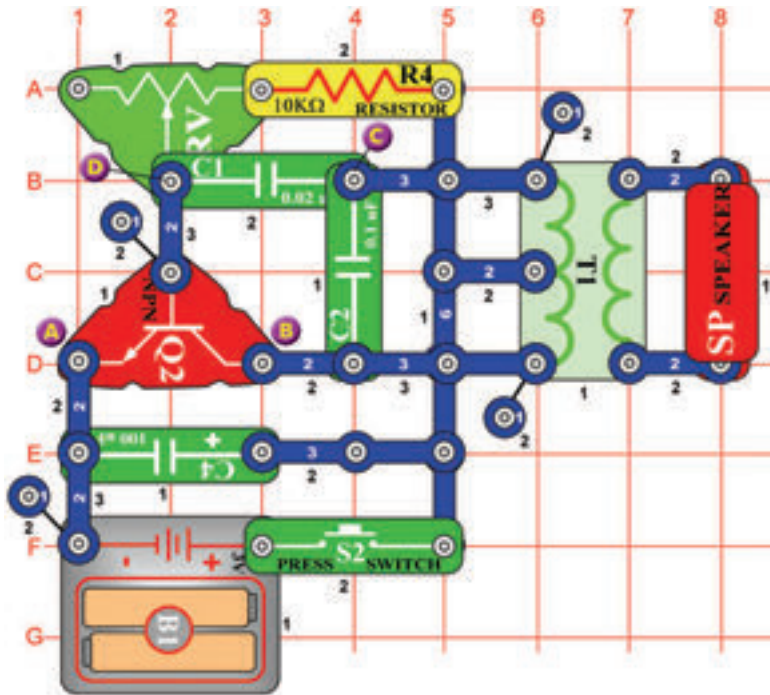
Use the circuit in project #458. Using the jumper wires, connect the whistle chip (WC) across points B & C. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #461
Electronic Cat (IV)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Connect the whistle chip (WC) across points C & D. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #462
Buzzer Cat

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Remove the speaker (SP) and connect the whistle chip (WC) across points A & B. Press and release the press switch (S2) to hear the sounds.

Project #463
Buzzer Cat (II)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Remove the speaker (SP) and, using the jumper wires, connect the whistle chip (WC) across points B & C. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #464
Buzzer Cat (III)

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Remove the speaker (SP) and connect the whistle chip (WC) across points C & D. Press and release the switch (S2). Adjust the resistor (RV) and hear the different sounds.

Project #465
Lazy Cat

OBJECTIVE: Show variations of project #458.

Use the circuit in project #458. Replace the 100µF capacitor (C4) with 470µF (C5). Repeat projects #459-464 and hear 7 different sounds.

Project #466
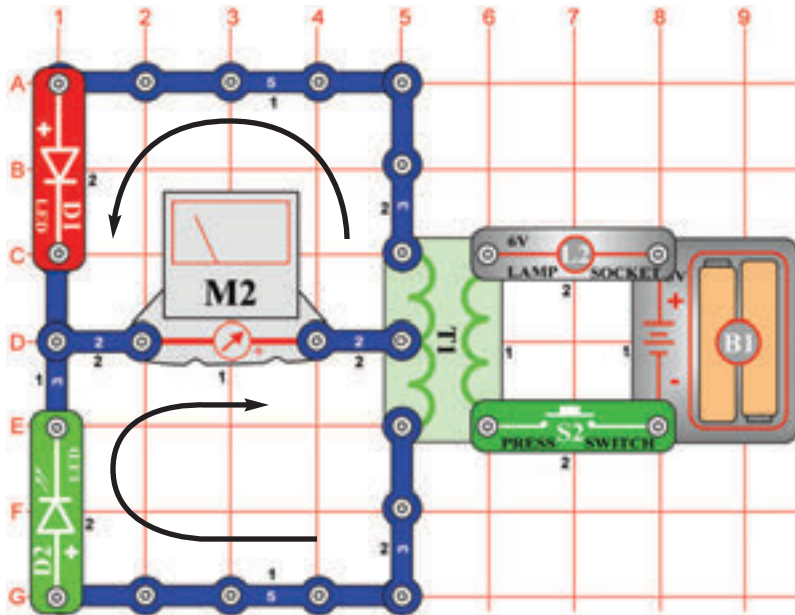
Meter Deflection (II)

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

Compare this circuit to project #358, which has the LED (D1 & D2) positions reversed. This changes the direction that current can flow. Set the meter (M2) to the LOW (or 10mA) scale. Press the press switch (S2) and now the meter deflects to the left.
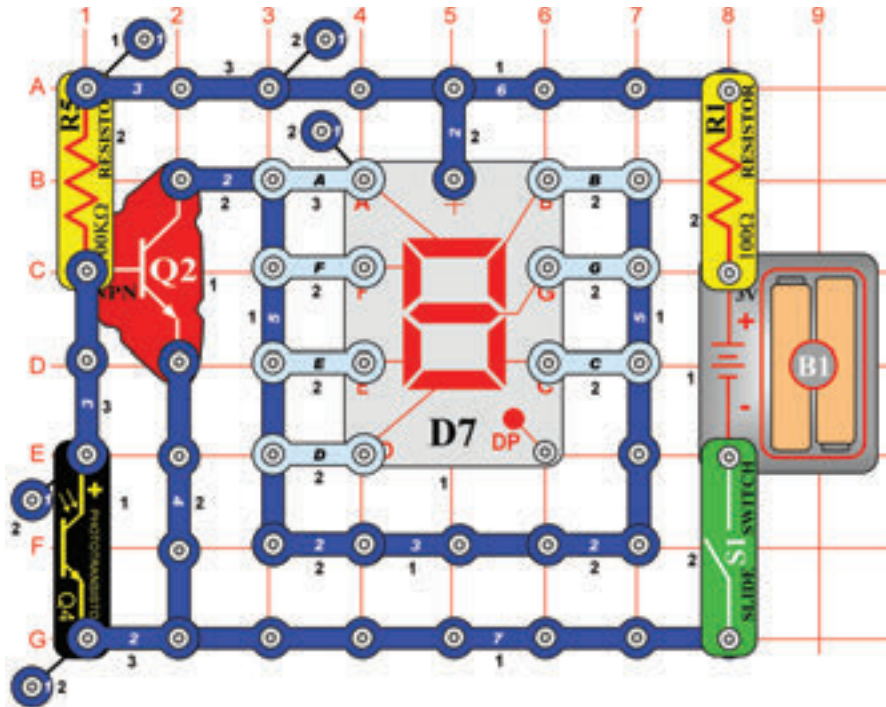
Project #467
Automatic Display #1

OBJECTIVE: Construct a light-controlled display.

Connect segments B & C to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 1 lights.

Project #468
Automatic Display #2

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

Use the circuit from project #467. Connect A, B, G, E, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 2 lights.

Project #469
Automatic Display #3

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

Use the circuit from project #467. Connect A, B, G, C, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 3 lights.

Project #470
Automatic Display #4

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

Use the circuit from project #467. Connect B, G, C, & F to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 4 lights.

Project #471
Automatic Display #5

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

Use the circuit from project #467. Connect A, C, F, G, & D to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 5 lights.

Project #472
Automatic Display #6

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

Use the circuit from project #467. Connect A, C, D, E, F, & G to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 6 lights.

Project #473
Automatic Display #7

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

Use the circuit from project #467. Connect A, B, & C to the circuit. Turn on the switch (S1), the display should be off.   Place your hand over the phototransistor (Q4), now the number 7 lights.

Project #474
Automatic Display #8

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

Use the circuit from project #467. Connect A, B, C, D, E, F & G to the circuit. Turn on the switch (S1), the display should be off. Place your hand over the phototransistor (Q4), now the number 8 lights.

Project #475
Automatic Display #9

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

Use the circuit from project #467. Connect A, B, D, F, G, & C to the circuit. Turn on the switch (S1), the display should be off.   Place your hand over the phototransistor (Q4), now the number 9 lights.
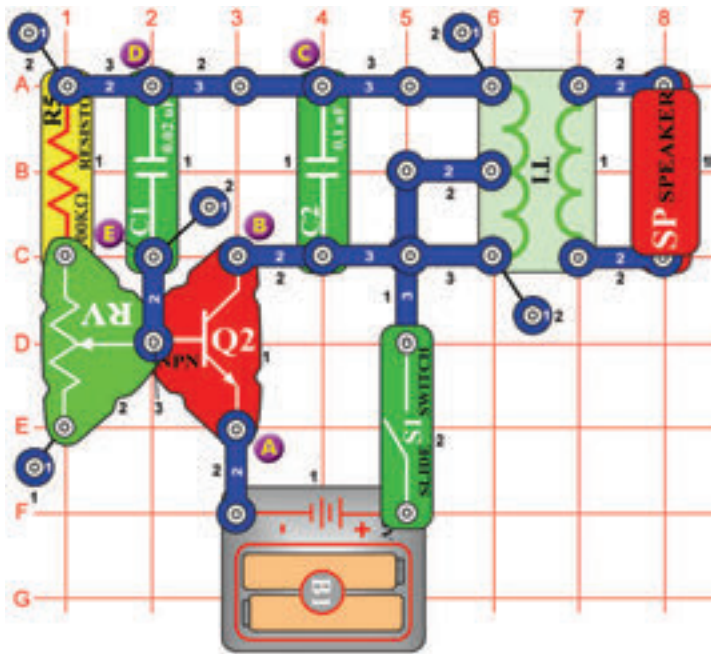
Project #476
Automatic Display #0

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

Use the circuit from project #467. Connect A, B, C, D, E & F to the circuit. Turn on the switch (S1), the display should be off.   Place your hand over the phototransistor (Q4), now the number 0 lights.

Project #477
Variable Oscillator

OBJECTIVE: To change the tone using the adjustable resistor.

Set the adjustable resistor (RV) to the bottom position. Turn on the slide switch (S1) and you should hear sound from the speaker (SP).   Adjust the resistor to hear the different sounds.

Project #478
Variable Oscillator (II)

OBJECTIVE: To change the tone using the adjustable resistor.

Use the circuit in project #477. Connect the whistle chip (WC) across points A & B and adjust the resistor (RV). You should hear a higher tone. This is generated by the whistle chip (WC).

Project #479
Variable Oscillator (III)

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Connect the whistle chip (WC) across points B & C and adjust the resistor (RV).

Project #480
Variable Oscillator (IV)

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Connect the whistle chip (WC) across points D & E and adjust the resistor (RV).

Project #481
Photo Variable Resistor

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Replace the 100kΩ resistor (R5) with the phototransistor (Q4). Wave your hand over the resistor and the sound changes. Adjust the resistor (RV) to make more sounds.

Project #482
Variable Whistle Chip Oscillator

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477, remove the speaker (SP). Make three more sounds by placing the whistle chip (WC) across points, A & B, B & C, and D & E.

Project #483
Slow Adjusting Tone

OBJECTIVE: Show variations of project #477.

Use the circuit in project #477. Place the 10μF capacitor (C3) (+ towards the top) directly over the .02μF capacitor (C1). A tone is generated once or twice per second, depending on the resistor setting.
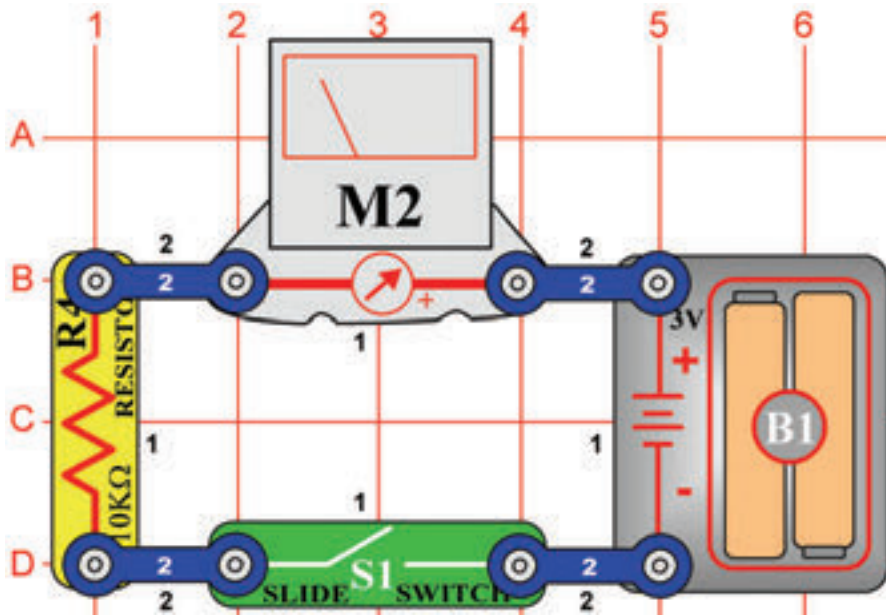
Project #484
Slow Adjusting Tone (II)

OBJECTIVE: Show a variation of project #483.

Use the circuit in project #483. Replace the 10μF capacitor (C3) with the 100μF capacitor (C4) and the tone is much slower. To make it even slower, replace the 100μF capacitor (C4) with the 470μF capacitor (C5).
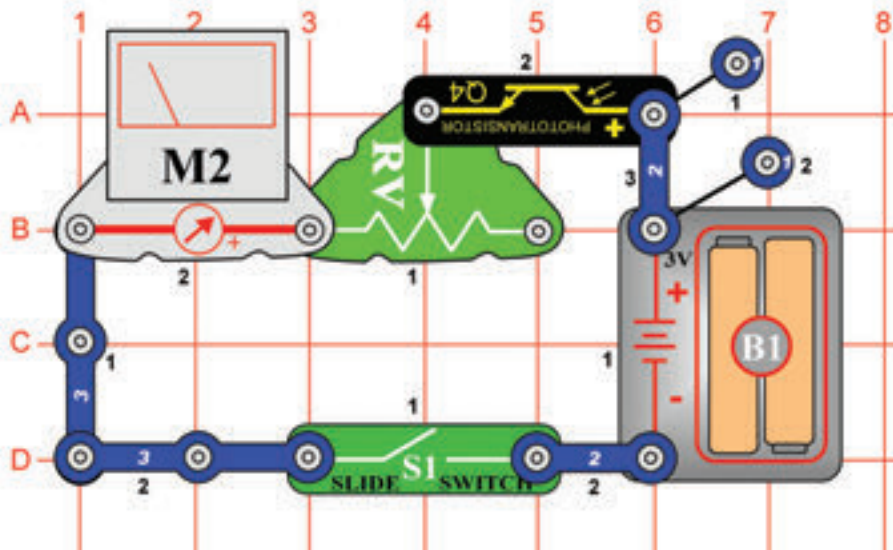
Project #485

Fixed-Current Path

OBJECTIVE: To make a fixed-current path.

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

Project #486

Simple Illumination Meter

OBJECTIVE: To make a simple light meter.

Set the meter (M2) to the LOW (or 10mA) setting. Using only a few parts, you can make a simple light meter. The amount of light changes the resistance of the phototransistor (Q4), 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 phototransistor (Q4) and the meter deflects to the left, almost to zero. Move the adjustable resistor to the far right and see how less sensitive the circuit is to light now.

Project #487
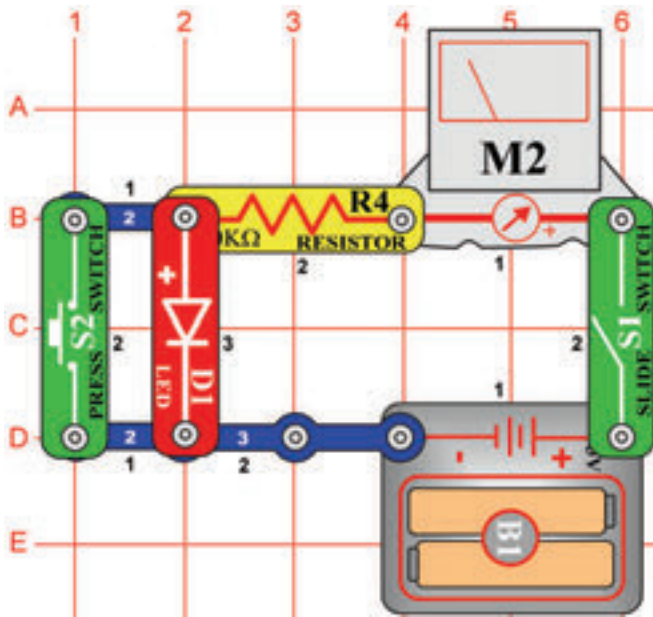
LED Voltage Drop

OBJECTIVE: To measure the voltage drop across diodes.

Set the meter (M2) to the LOW (or 10mA) setting. Turn on the slide switch (S1) and the LED (D1) lights as the meter deflects to the middle of the scale. The sum of the voltage drop across each components equals the battery voltage. Bypass the LED by pressing the switch (S2). The voltage across the 10kΩ resistor increases, as shown by the meter deflecting more to the right. Replace the red LED with the green LED (D2) and then the diode (D3), to see the different voltage drops.

Project #488

Open/Closed Door Indicator
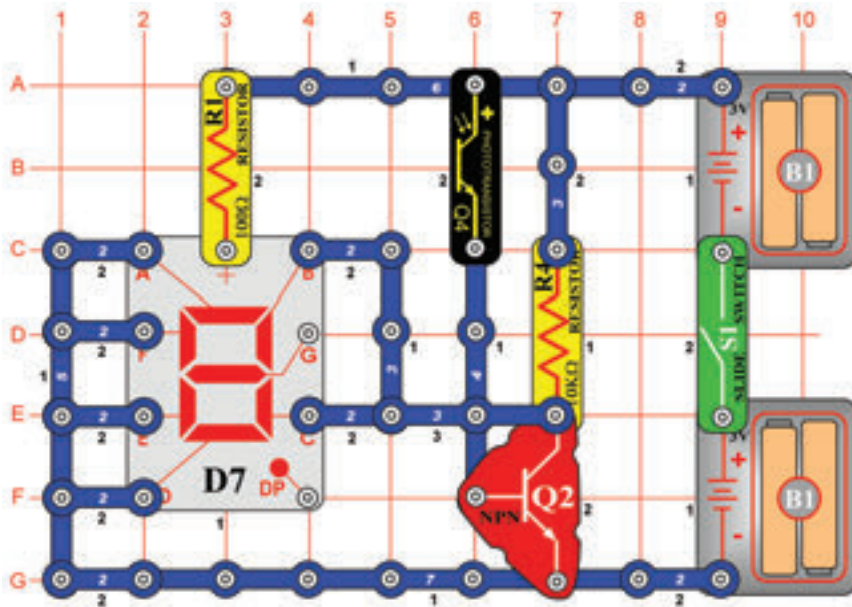
OBJECTIVE: To make a circuit that indicates whether a door is open or closed.

Using the phototransistor (Q4) 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 phototransistor turns the transistor (Q2) on or off, depending on the amount of light in the room. When the transistor is on (light present), segments B & C connect to the (–) side of the batteries and letter "O" lights. When the room is dark, the transistor is off and the letter "C" lights. Segments B & C are connected to the transistor.

Turn the slide switch (S1) on and the letter "O" should light. Cover the phototransistor, simulating closing the door, and the letter "C" lights.
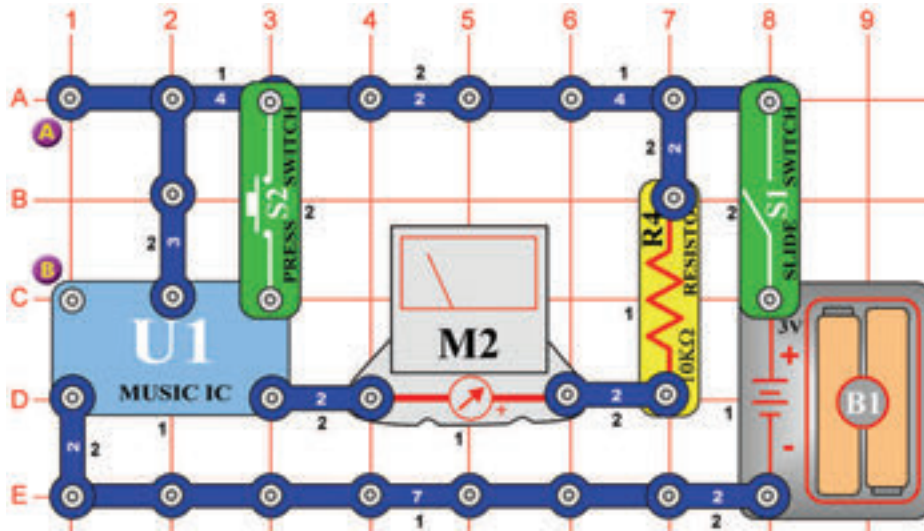
Project #489

Hand-control Meter

OBJECTIVE: To understand music deflection.

Set the meter (M2) to the LOW (or 10mA) setting. Instead of driving a speaker (SP) with the music IC (U1), you can see it by using the meter. Turn on the slide switch (S1) and the meter deflects according to the rhythm of music. After the music stops, hold down the press switch (S2) to make it continue.

☐ Project #490
Light-control Meter

OBJECTIVE: To control the circuit using light.

Use the circuit in project #489. Replace the press switch (S2) with the phototransistor (Q4). The music IC (U1) outputs a signal, as long as a light is present on the phototransistor. The phototransistor is like a short, connecting the pin to the battery. When the song repeats, cover the phototransistor with your hand, the resistance goes up, and the music stops.

☐ Project #491
Electric-control Meter

OBJECTIVE: To start the circuit using an electric motor.

Use the circuit in project #489. Place the motor (M1) across points A & B. Turn on the slide switch (S1) and the meter (M2) deflects and swings according to the rhythm of music. When deflection stops, rotate motor to start the music again. The voltage generated by the motor triggers the IC again.

☐ Project #492
Sound-control Meter

OBJECTIVE: To start the circuit by using a speaker.

Use the circuit in project #489. Place the speaker (SP) 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 speaker, the music plays again. The clapping sound vibrates the plates in the whistle chip, creating the voltage needed to trigger the IC.

Project #493
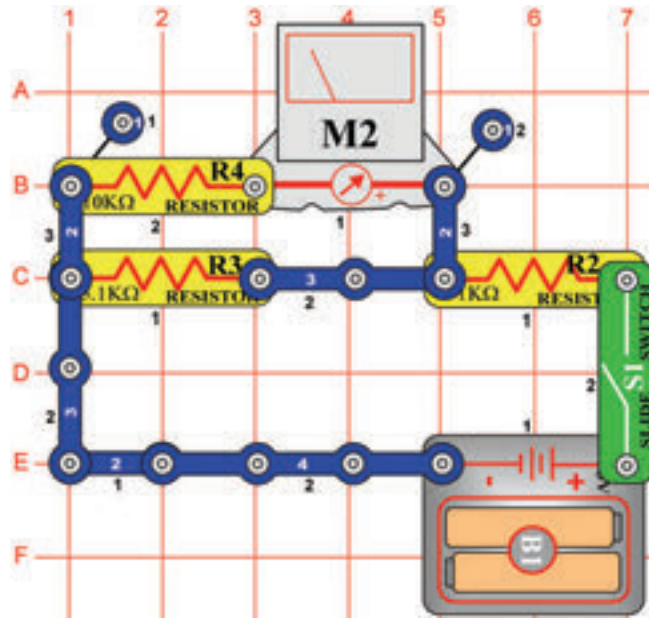
Fixed-Voltage Divider

OBJECTIVE: To make a simple voltage divider.

Set the meter (M2) to the LOW (or 10mA) scale. This circuit is a simple voltage divider with parallel load resistors. The voltage across resistors R3 & R4 is the same. The current through both paths are different, due to the resistor values. Since resistor (R3) (5.1kΩ) is half the value of resistor (R4) (10kΩ), twice the current flows through R3.

The lights in a house are an example of this type of circuit. All are connected to the same voltage, but the current is dependent on the wattage of the bulb.
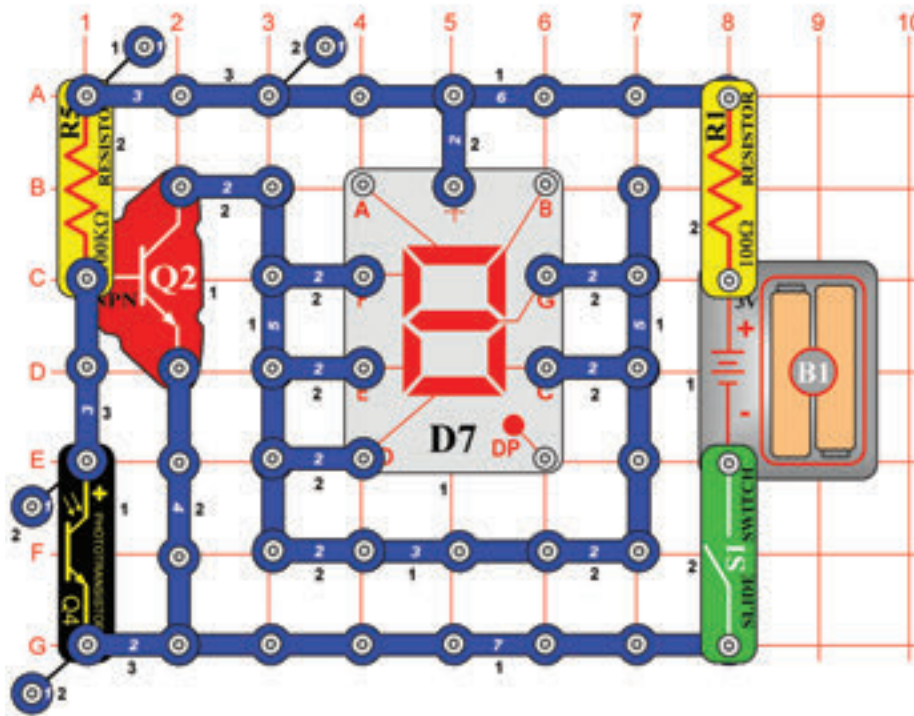
Project #494
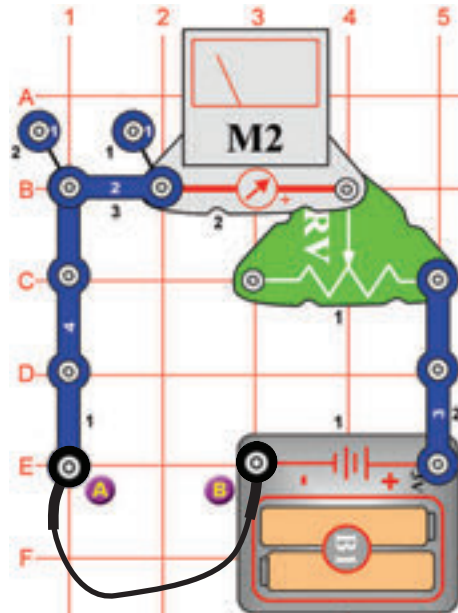
Resistor Measurement

OBJECTIVE: To make a resistor checker.

Set the meter (M2) to the LOW (or 10mA) setting. Connect the jumper wire to points A & B. Adjust the adjustable resistor (RV) so the meter deflects to 10. The resistance between points A & B is zero. Remove the jumper wire and put the 100Ω resistor (R1) across points A & B. The meter deflects to the 10, indicating a low resistance. Now replace resistor (R1) with the other resistors. The meter will display different readings for each resistor.

Project #495
Automatic Display Letter "b"

OBJECTIVE: To construct a light-controlled display for lower case letters.

Connect C, D, E, F & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the phototransistor (Q4), now the letter "b" lights.

Project #496
Automatic Display Letter "c"

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

Use the circuit from project #495. Connect E, D, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the phototransistor (Q4), now the letter "c" lights.

Project #497
Automatic Display Letter "d"

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

Use the circuit from project #495. Connect B, C, D, E, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the phototransistor (Q4), now the letter "d" lights.

Project #498
Automatic Display Letter "e"

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

Use the circuit from project #495. Connect A, B, D, E, F, & G to the circuit. Turn on the slide switch (S1) and the display should be off. Place your hand over the phototransistor (Q4), now the letter "e" lights.

Project #499
Automatic Display Letter "h"

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

Use the circuit from project #495. Connect F, E, C, & G to the circuit. Turn on the slide switch (S1) the display should be off. Place your hand over the phototransistor (Q4), now the letter "h" lights.

Project #500
Automatic Display Letter "o"

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

Use the circuit from project #495. Connect C, D, E, and G to the circuit. Turn on the slide switch (S1) the display should be off. Place your hand over the phototransistor (Q4), now the letter "o" lights.
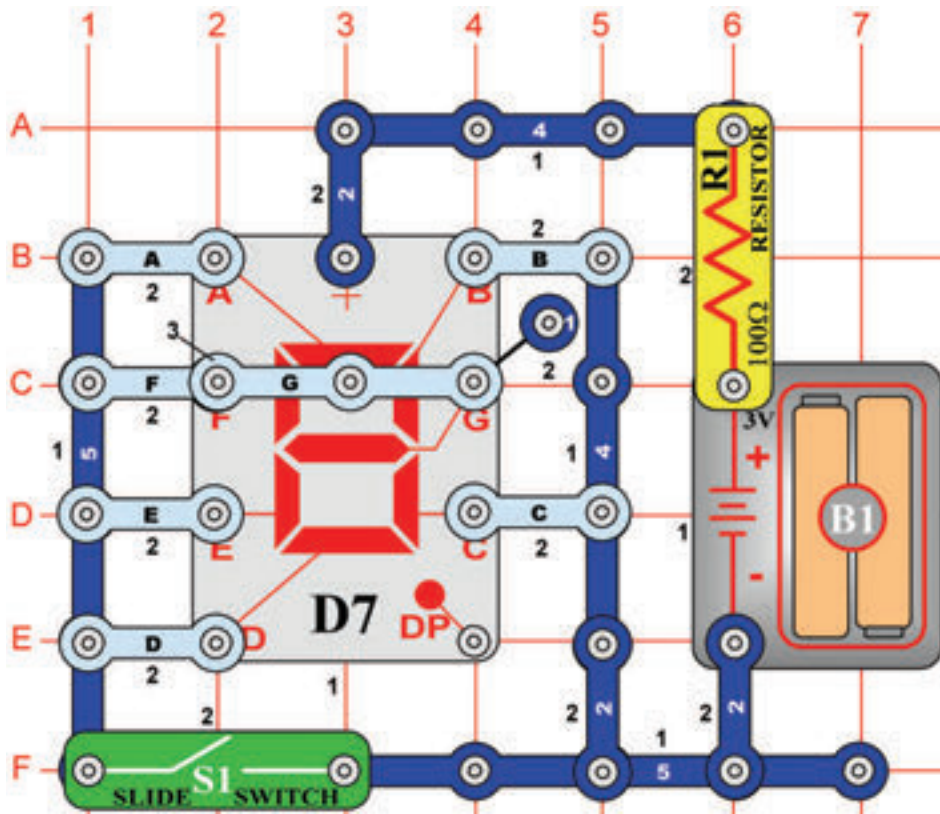
Project #501
Hand-Control Display 1 & 4

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

Connect segments B, C, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 4.

Project #502
Hand-Control Display 1 & 0

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

Connect segments A, B, C, D, E, & F as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 0.

Project #503
Hand-Control Display 1 & 7

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

Connect segments A, B, & C as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 7.

Project #504
## Hand-Control Display 1 & 8

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

Connect segments A, B, C, D, E, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 8.

Project #505
Hand-Control Display 1 & 9

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

Connect segments A, B, C, D, F, & G as shown in the diagram. Turn the slide switch (S1) off and on, the display changes from numbers 1 to 9.

Project #506
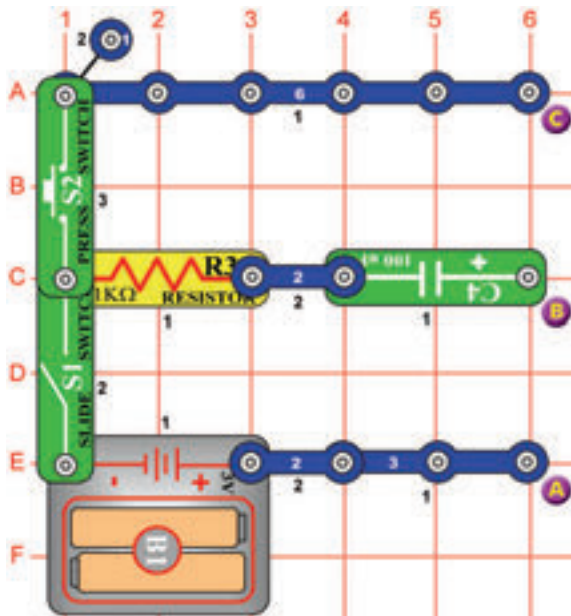
Monitor Capacitor Charging & Discharging

*OBJECTIVE: View charging and discharging a capacitor.*

Using the meter (M2), we can monitor the charging and discharging of a capacitor. First turn off the switch (S1).

Charging: Connect the meter (M2) to points A & B (positive pole downward). Turn on the switch (S1). The 100μF capacitor (C4) charges and the meter deflects, slowly returning to zero.

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

Project #507
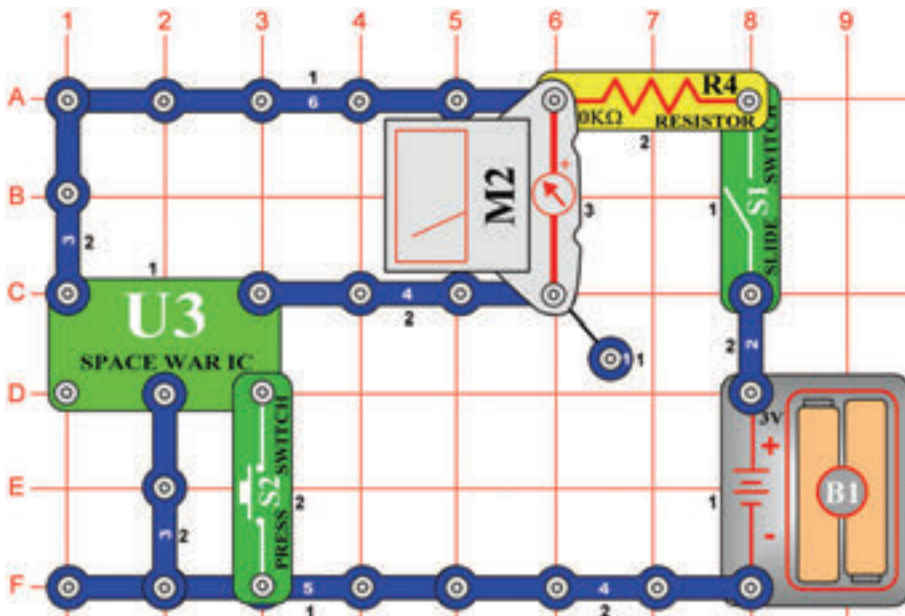
Hand-Control Space Meter

*OBJECTIVE: Using the meter with the space war IC.*

Set the meter (M2) to the LOW (or 10mA) setting. This is another circuit using the meter to monitor the output of an IC.
Turn on the switch (S1). Press switch (S2) to start the circuit. As the space war IC (U3) outputs a signal, the meter will deflect. When the circuit stops, start it again by pressing switch (S2).

Project #508

Rhythm Swinging Meter
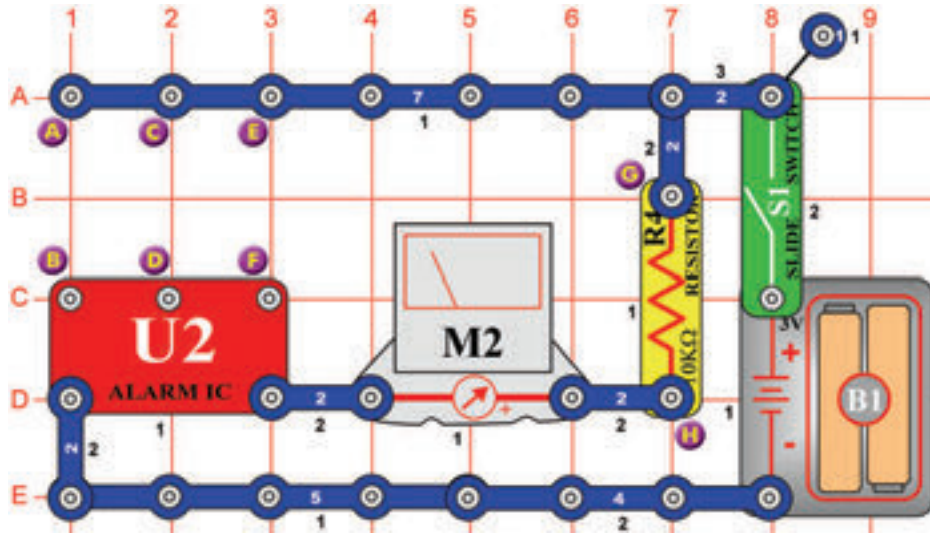
OBJECTIVE: Use the meter with the alarm IC.

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

Project #509

Police Car Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Use the circuit in project #508. Connect the whistle chip (WC) to points G & H. Connect a 3-wire snap to the terminals C & D and turn on the switch (S1).

Project #510

Fire Engine Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Connect 3-wire snaps to terminals C & D and A & B. Connect the whistle chip (WC) across points G & H. You should hear a fire engine sound generated by the alarm IC (U2).

Project #511

Ambulance Sound with Whistle Chip

OBJECTIVE:
Show variations of project #508.

Connect a 3-wire snap to terminals C & D. Connect the whistle chip (WC) across points G & H. Connect a jumper wire to terminals B & H. You should hear an ambulance sound generated by the alarm IC (U2).

All kits and manuals are available at

www.boffin.cz/en

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