BEGINNER

ADVANCED

EXPERT

PROJECTS

1 LIGHT

2 SOUND

3 ENERGY

4 MEASUREMENT

5 GAMES

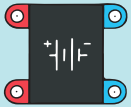
6 FUNCTIONS

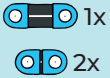

1 LIGHT

L10 LIGHTBULB WITH SWITCH


1x bulb

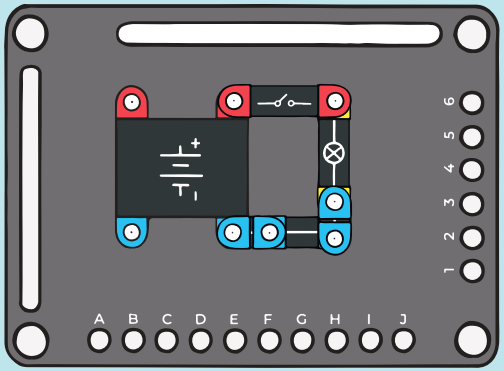

1x switch


1x battery


1x

2x

A basic build that demonstrates how the electronic circuit in principle works. The switch acts as a circuit breaker, the bulb generates light and the jumpers close the circuit so that electric current can flow through it. The battery is an integral part of the circuit and serves as a source of energy for the light bulb.

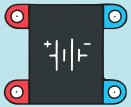


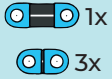
L20 LED WITH SWITCH


1x LED


1x resistor 1kΩ

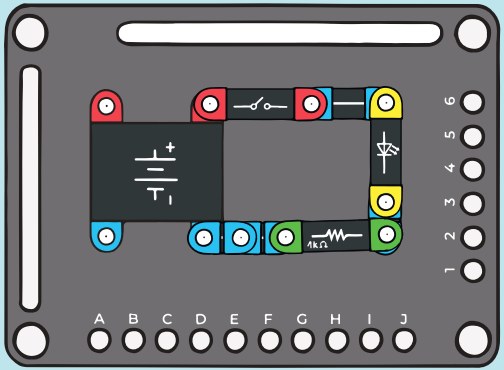

1x switch


1x battery


1x

3x

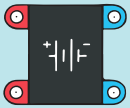
A basic build with an LED as a light source. LEDs are not adjusted to the soupply voltage of a battery, therefore is necessary to add a serial resistor to the build. That will lower the curent flow in the circuit. Othewise the LED would be destroyed.

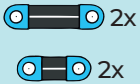


L30 SWITCH VS. BUTTON

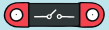

2x LED


1x button


1x battery

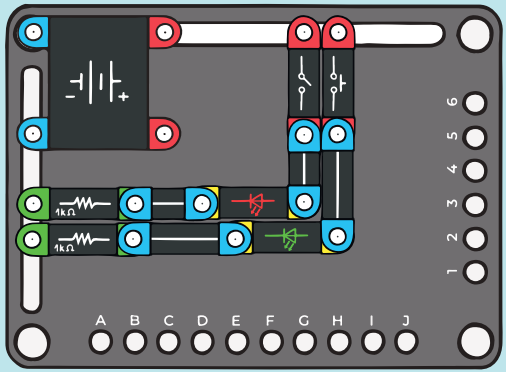

2x

2x

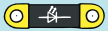

1x switch

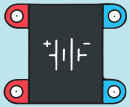

2x resistor 1kΩ

The basic components in the circuit include switches and buttons that control the current flow. The switch has two stable positions (OFF and ON) and the current flows only in the ON position. The current flows through the button only when it is pressed.



L40 SERIAL CONNECTION OF LEDS


3x LED


1x battery

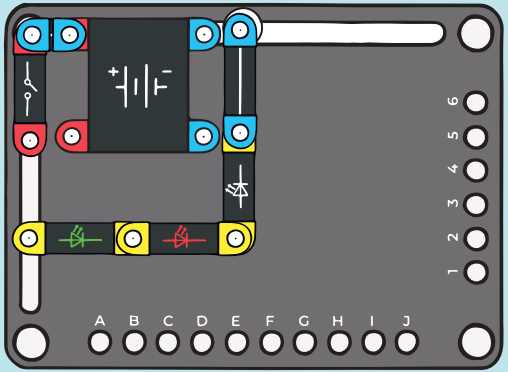

1x


1x

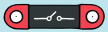

1X


1x switch

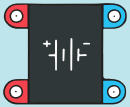
The objective is to test that by connecting 3 LEDs in series, none of them will light up because the voltage drop across each of the diodes is in total greater than the supply voltage of the batteries, which is 6V. Here you do not need to worry about destroying the LEDs without adding a resistor since almost no current will flow through them.

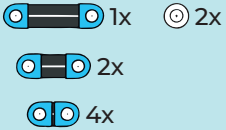


L50 SWITCHING WITH BUTTON I.

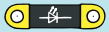

1x switch


1x button


1x battery

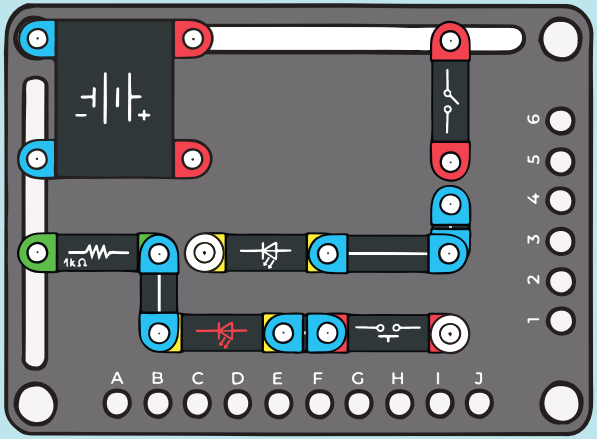

1x 2x 2x 4x


1x resistor 1kΩ


2x LED

In this circuit, a red and a white LED are connected in parallel with a common resistor. When the switch is closed, the white LED lights up. If you press the button, you connect the red LED to the white LED in parallel. Since the white LED needs a higher voltage than the red one to light up, connecting the red LED to the white LED will lower the voltage. The white LED goes out and the red LED lights up. The button visually acts as a changeover switch in this case even though it does not have a changeover contact.

1.



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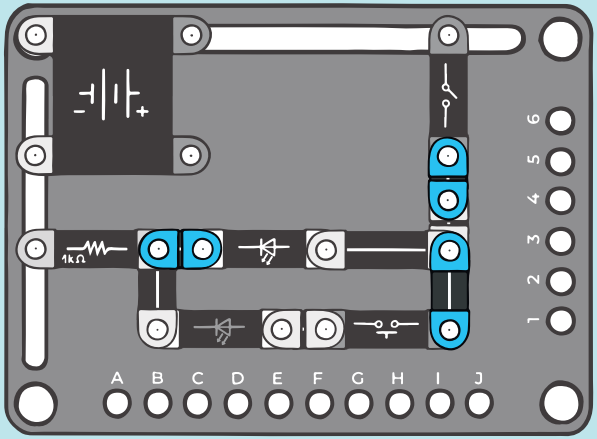
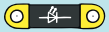
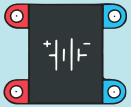


L60 LED LIGHTS UP IN ONE DIRECTION


1x LED


1x resistor 1kΩ

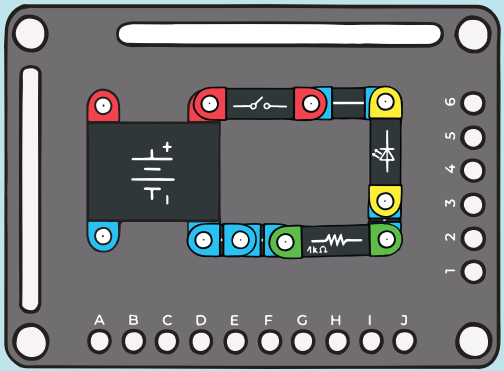

1x battery


1x


3x


1x switch

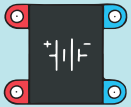
A LED is a semiconductor device (made up of two transitions called P and N) that conducts an electric current in only one forward direction (from the cathode (N) to the anode (P)). For this reason, the LED can only light up if connected in the forward direction, which is not the case in this circuit as the LED is connected in the reverse direction.



L70 HIGH LUMINOSITY WITH 100Ω RESISTANCE


1x LED


1x resistor 100Ω


1x battery

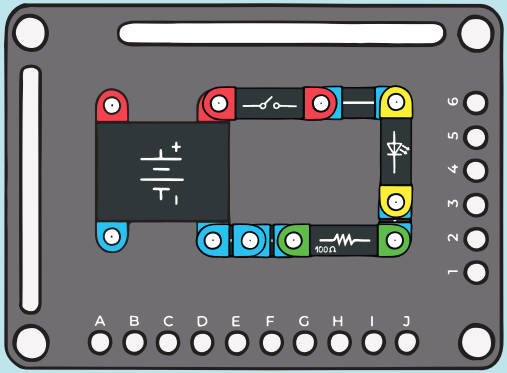

1x


3x


1x switch

The LED light intensity is determined by the amount of current flowing through the circuit. A resistor included in the circuit blocks the current from flowing, and this allows you to adjust its magnitude. The smaller the resistance you insert into the circuit, the greater the current that will flow through the circuit and the brighter the LED light will be.

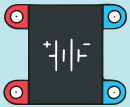
Warning: Never replace the ballast resistor for the LED with a plain conductive trace piece, otherwise you will destroy the LED.



L80 HIGH LUMINOSITY WITH RESISTOR CONNECTED IN PARALLEL


1x LED

2x resistor 1kΩ


1x battery

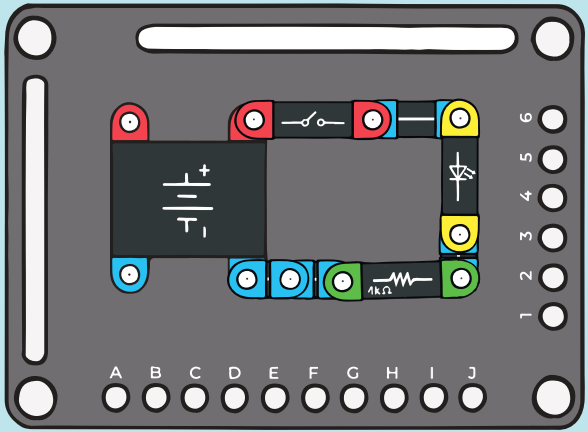

1x


3x

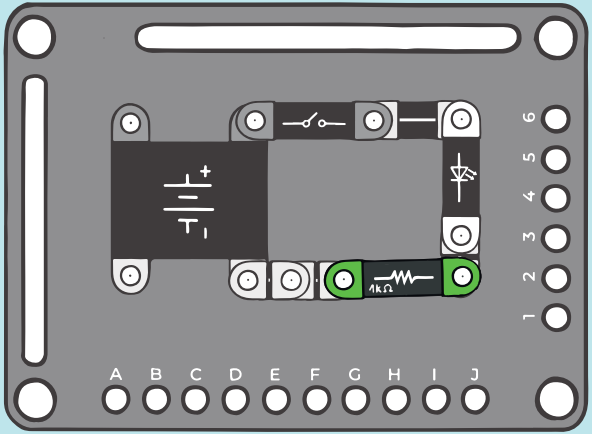

1x switch

You can find the resistor as a component in the package in several values, and it is possible to connect them in parallel (next to one another) or in series (in a row). When resistors are connected in parallel, the total resistance value decreases. This is used in cases where we do not have the required value or it is not produced. In the case of two identical resistors, the resistance is halved, thus increasing the LED light brightness.

1.



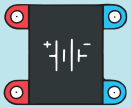
2.



L90 CONTROLLING BY PHOTORESISTOR


1x LED


1x fotoresistor

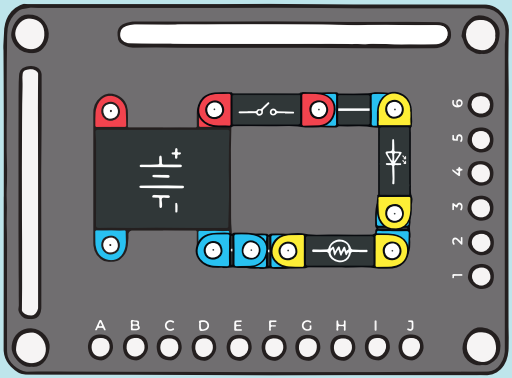

1x battery


1x


3x


1x switch

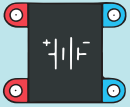
There are electronic components that respond to light. One of them is a photoresistor – its resistance changes with the intensity of incoming light. When you cover the photoresistor with your finger, its resistance increases.This reduces the current flowing through the circuit, which in turn decreases in the LED light intensity.



L100 CONTROLLING BY MICROPHONE


1x LED


1x microphone

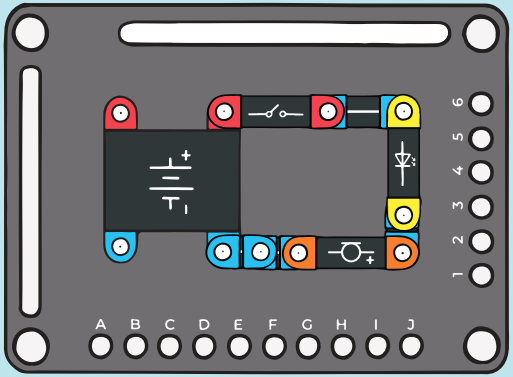

1x battery


1x


3x

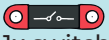

1x switch

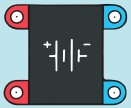
A microphone is a component that converts sound into an electrical signal. As a rule, the sound is converted into a diaphragm vibration, which is further evaluated as a change in resistance or capacitance.
In the presented circuit, the microphone changes the current using the LED, whose light brightness reacts to the sound interacting with the microphone diaphragm.

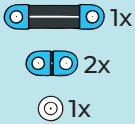


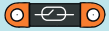
L110 BULB CONTROLLED BY A MAGNET


1x bulb

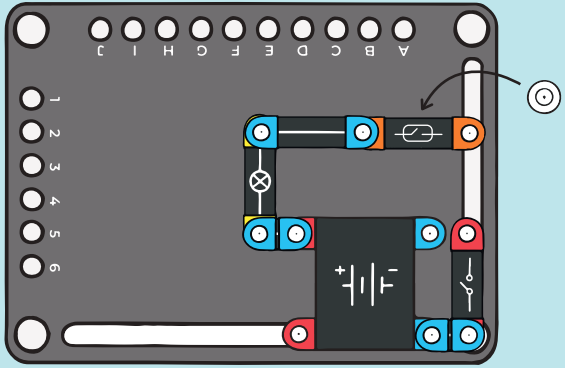

1x switch


1x battery


1x
2x
1x


1x reed switch

The electrical switch does not need to be just a manually operated component. A magnetic reed switch can sever as an alternative. It consists of two thin flexible steel contacts, usually in a glass flask. When the magnet approaches, the two contacts are magnetized and connect. This closes the electrical circuit and turns on the light bulb. After the magnet is moved away, the contacts open by their own elasticity. This interrupts the flow of electricity and the light goes out.

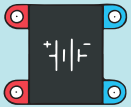


L120 LED CONTROLLED BY A MAGNET


1x LED


1x resistor 1kΩ

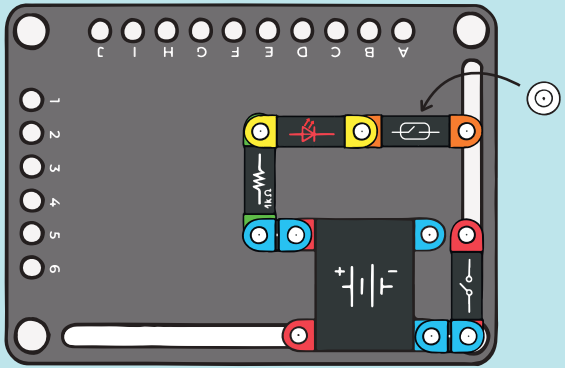

1x switch


1x battery


2x
1x


1x reed switch

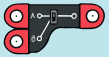
The magnetic reed switch can be used to directly switch a wide range of appliances. However, it is not suitable for large appliances with high current consumption as the contacts may slowly get burned or lose flexibility due to overheating. Although our small bulb represents a marginal load even for a small reed contact, it is always advantageous to minimize the current through the reed contact. Instead of a light bulb, we use a LED diode since it needs rather low current flow values to function.

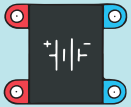


L130 SWITCHING LEDS


2x LED


1x resistor 1kΩ


1x A/B switch


1x battery

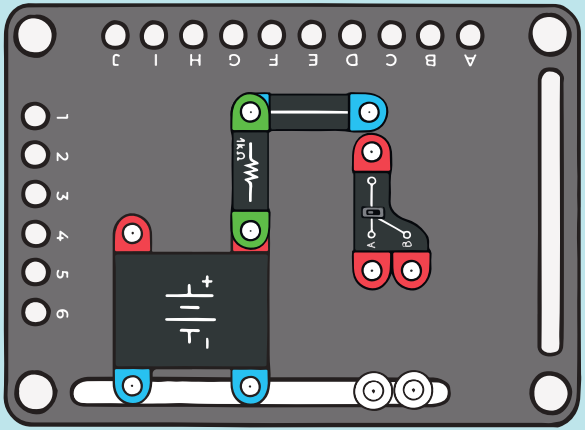

1x


1x


2x

The changeover switch is a variant of the on-off switch that has both positions of the switching contact available. When the changeover switch is operated, the contact interrupts the current flow in one part of the circuit and, at the same time, closes another part of the circuit. The LED therefore lights up alternately, depending on the position of the changeover switch. However, only one LED is active at any point of time.

1.



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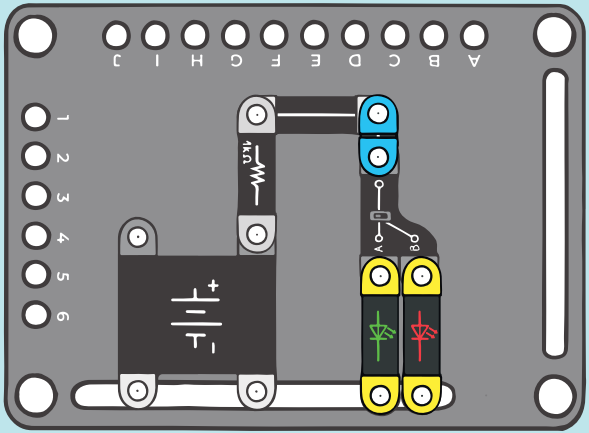
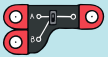


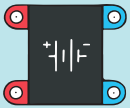
L140 CHANGING THE CURRENT BY LED


1x LED


1x resistor 1kΩ


1x A/B switch


1x resistor 10kΩ


1x battery

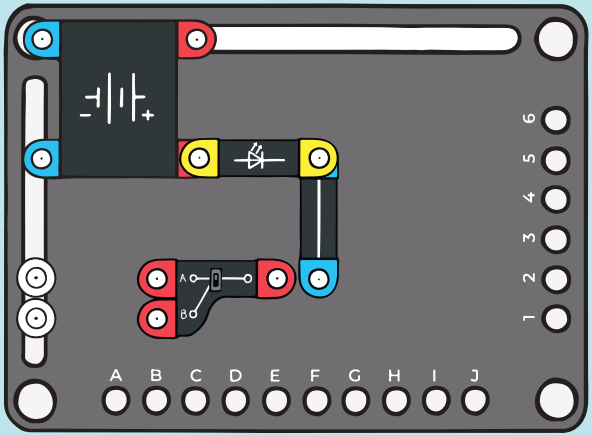

1x


1x

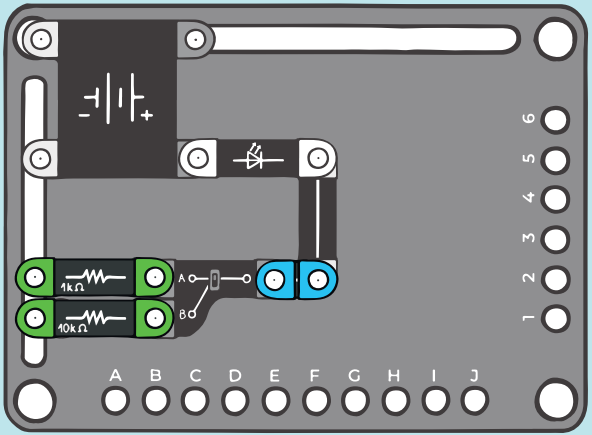

2x

We do not have to change the LED light brightness by means of altering the current flowing through it by physically changing a component. We can use a changeover switch to change the ballast resistance for the LED. We have a choice of two values of the current that can flow through the LED, i.e. 2 variants of brightness.

1.



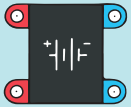
2.



L150 CONNECTING A LIGHT BULB AND LED IN SERIES


1x LED


1x bulb


1x battery

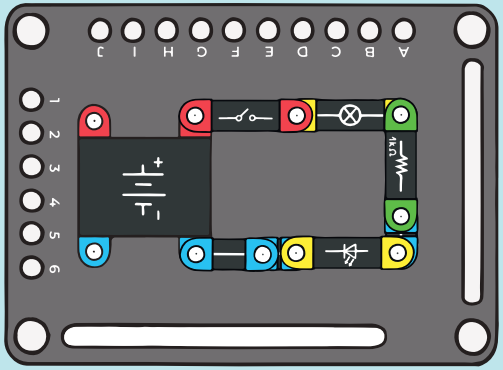

1x

2x


1x switch


1x resistor 1kΩ

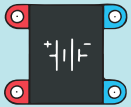
Connecting multiple appliances in a row. The same current flows through both appliances, but the battery voltage is divided between the two appliances. In our circuit, it is reflected in a low brightness of the bulb. In practice, a connection in series is used for the same appliances with the same consumption. One big disadvantage of connecting appliances in series is that the failure of any component will open the circuit, which you can simulate by unscrewing the bulb - the LED goes out.



L160 CONNECTING A LIGHT BULB AND LED IN PARALLEL


1x LED


1x bulb


1x battery


1x

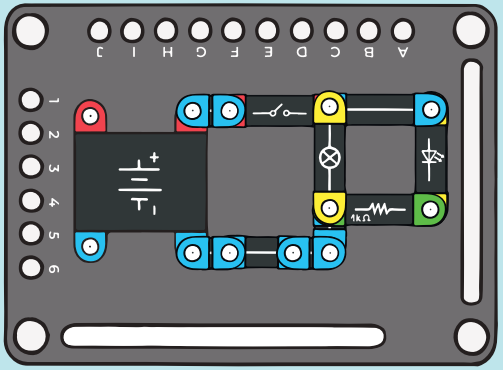
1x


4x

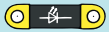

1x switch


1x resistor 1kΩ

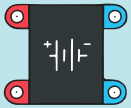
Connecting multiple appliances side by side. The total current drawn from the source is a sum of the partial currents taken. The voltage on both appliances is the same. If one appliance is disconnected from the circuit, it will not affect the rest, only the value of the current flowing through the circuit will decrease. Electricity is distributed to appliances exclusively in this way.



L170 LED BYPASS


1x LED

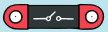

1x button


1x battery


2x

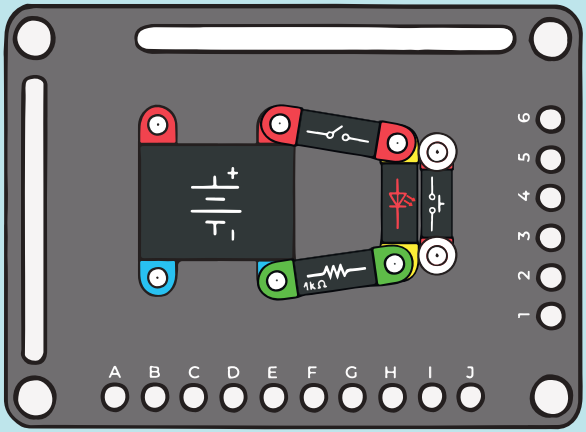

2x


1x resistor 1kΩ

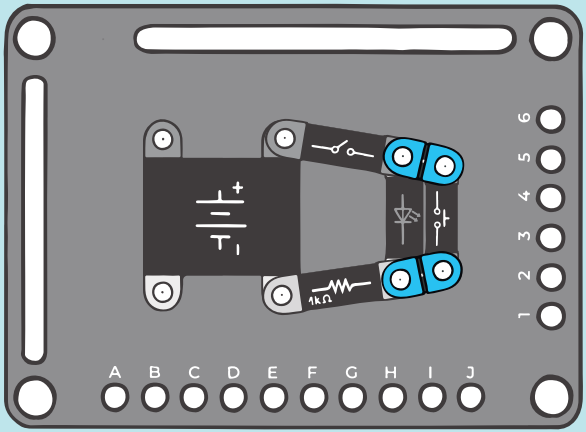

1x switch

A button connected in parallel to the LED. When the button is not pressed, i.e. it is open, the LED light is on. If you press the button, you short-circuit the LED diode and it goes out. It stays off as long as the button is pressed and lights up again when the button is released. The ballast resistor not only protects the LED from excessive current, but also ensures that the button does not short-circuit the battery directly. The resistor thus limits the short-circuit current and protects the battery as well as the button from excessive current.

1.



2.



L180 POLARITY INDICATOR

2x LED

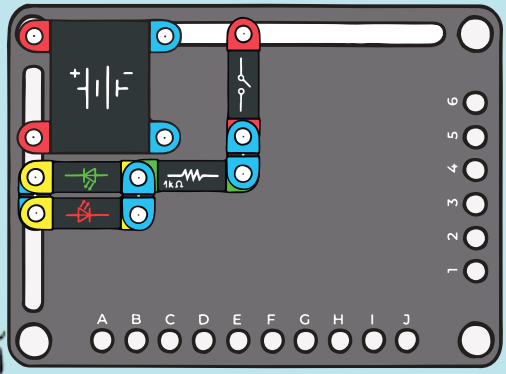
1x resistor 1kΩ

1x battery

3x

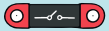
1x switch

Two anti-parallel LEDs indicate the polarity of the power supply. The LEDs light up alternately depending on the battery orientation.Try connecting the battery the other way – you will see that the second LED lights up.

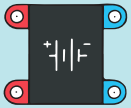


L190 HOW A SEMICONDUCTOR DIODE WORKS IN THE FORWARD DIRECTION


1x bulb


1x switch

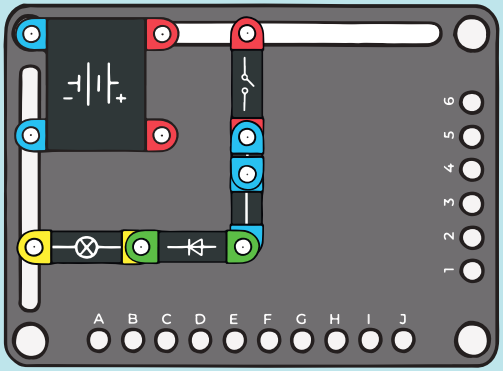

1x diode


1x battery


1x

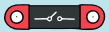

1x

Insert a semiconductor diode into the basic circuit with a switch and a light bulb. The bulb only lights up when the switch is closed and the diode is oriented in the forward direction.

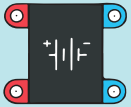


L200 HOW A SEMICONDUCTOR DIODE WORKS IN THE REVERSE DIRECTION


1x bulb


1x switch

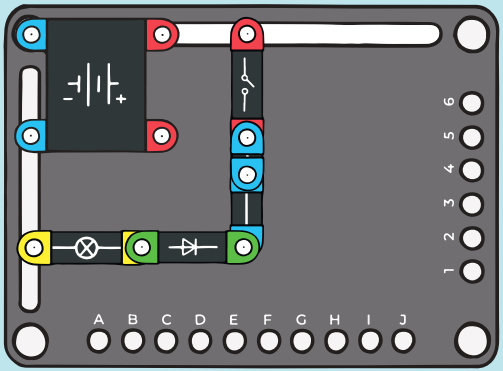

1x diode


1x battery

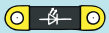

1x


1x

If the diode is oriented in the reverse direction, no electric current can flow through the circuit and the bulb cannot light up even when the switch is closed.

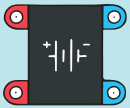


L210 CHANGING BRIGHTNESS SMOOTHLY I.


2x LED


1x potentiometer


1x resistor 1kΩ


1x battery

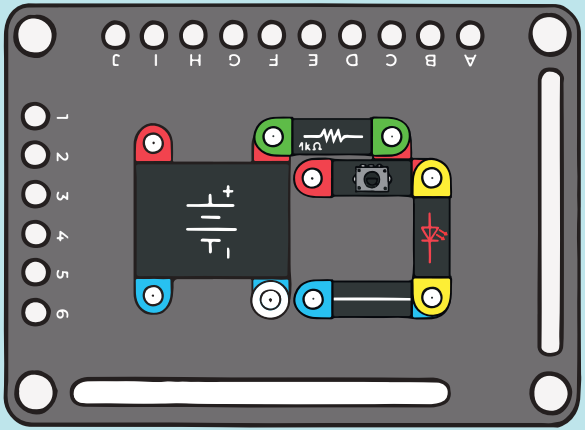

1x


1x

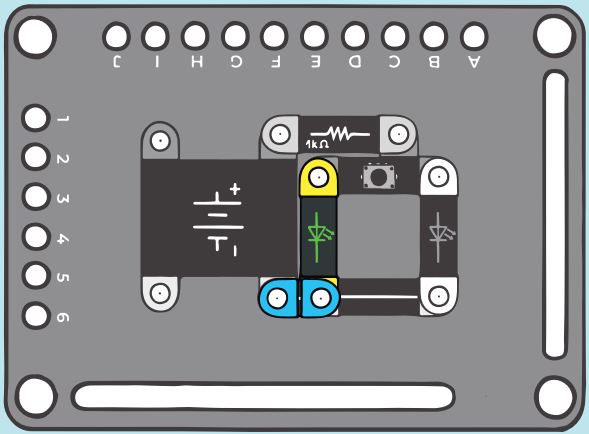

1x

If you want to change the LED current continuously and without step changes, you can use a variable resistor, also called a potentiometer, for which the resistance corresponds to the angle of rotation of the small shaft. Structurally, it is a fixed resistor that has an exposed resistance layer, along which the collector travels; by turning the slider you select how much of the resistance path will be included in the circuit. When being turned, it moves away from one end (the resistance of this end increases). Due to the shaft rotation, the brightness „spills“ from one LED to the other as the resistance decreases on one side and increases on the other.

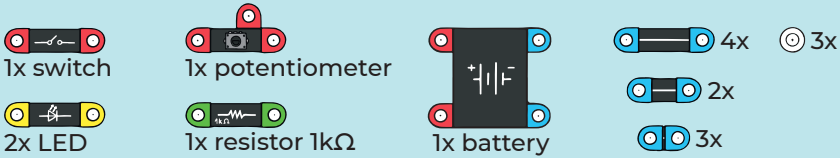
1.



2.

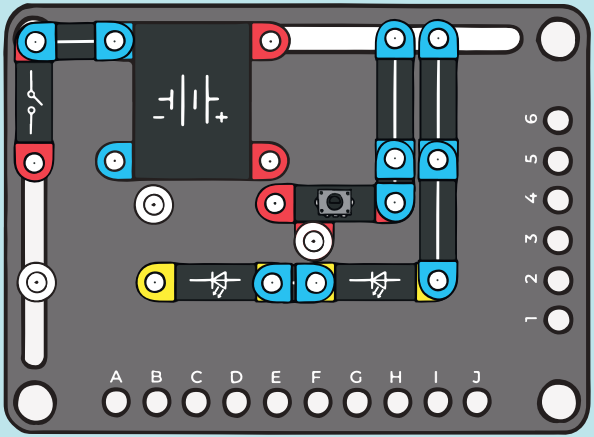


L220 SMOOTH BRIGHTNESS CHANGE II.

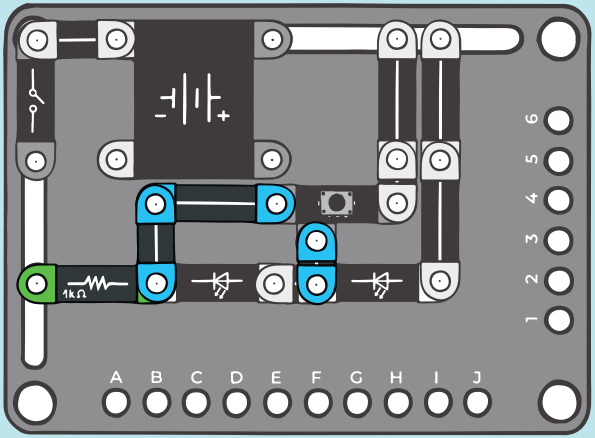


Two LEDs in series with a potentiometer connected in parallel. Use the slider to set the voltage between the LEDs. The build behaves visually as L210, but now you do not control the current through the LEDs but, instead, control the current flow indirectly - by changing the voltage on the LEDs.

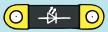
1.



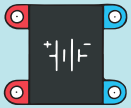
2.



L230 CONDUCTIVITY DETECTOR I.


1x LED


1x resistor 1kΩ

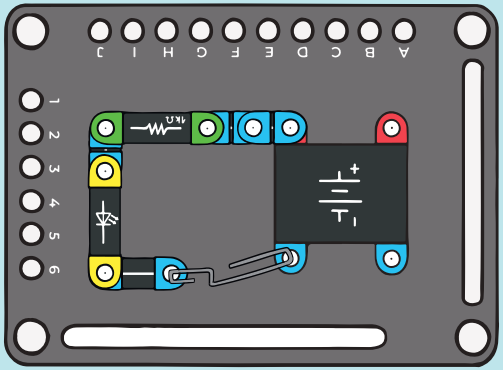

1x battery


1x

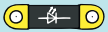

3x


1x paper clip

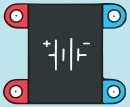
Connect the circuit as shown on the right so that you can test how different objects conduct or do not conduct electricity. For example, you can try to find a metal paper clip or teaspoon and place it on the contacts. If the object is conductive, the circuit will be closed and the LED will light up. In this case, the object has a similar function like a switch.



L240 HUMAN BODY CONDUCTIVITY DETECTOR


1x LED

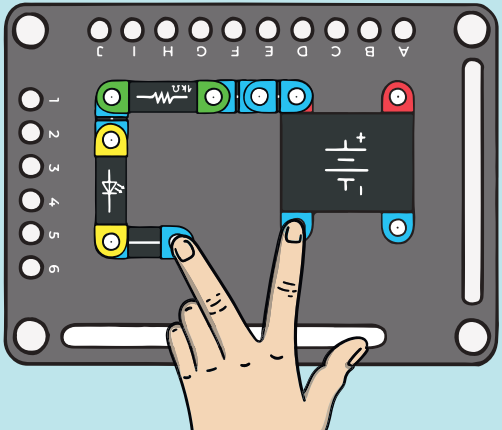

1x resistor 1kΩ


1x battery

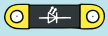

1x


3x

You can use a simple electrical circuit to test the conductivity of your body. The human body is made up mostly of water; however, the human skin is dry and poses high resistance to electrical current. The resistance of the skin decreases when the skin is moist. A moist skin has such a low resistance that enough current flows through the circuit for the LED to give a dim light (this can be best demonstrated with the white LED).

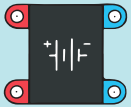


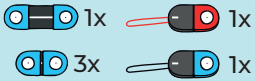
L250 CONDUCTIVITY DETECTOR II.


1x LED


1x resistor 1kΩ


banana

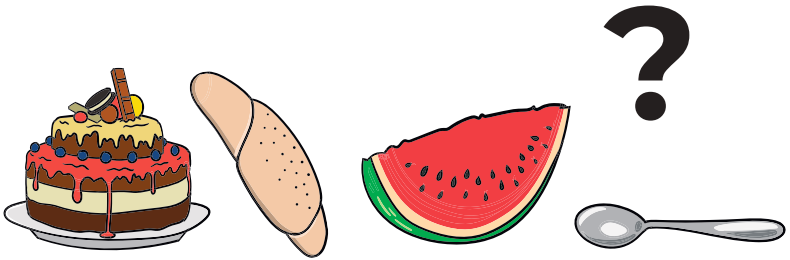

1x battery



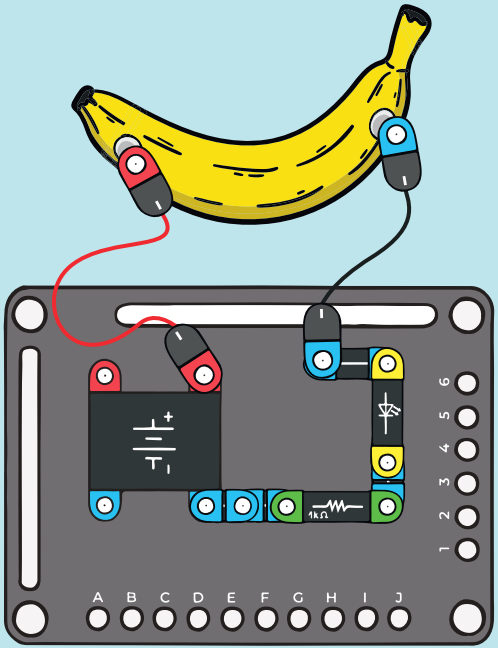
In addition to the human body, which has a high water content, you can test the conductivity of other water-containing things, such as various fruits and vegetables.

Warning: Never test the conductivity of an electrical network where a person could be injured!

Guess what has the highest conductivity?



(Hint: You can eat almost anything with it - except maybe a bread roll.)

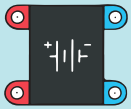


L260 WATER DETECTOR

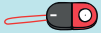

1x LED


1x resistor 1kΩ


cup


1x battery


1x


1x

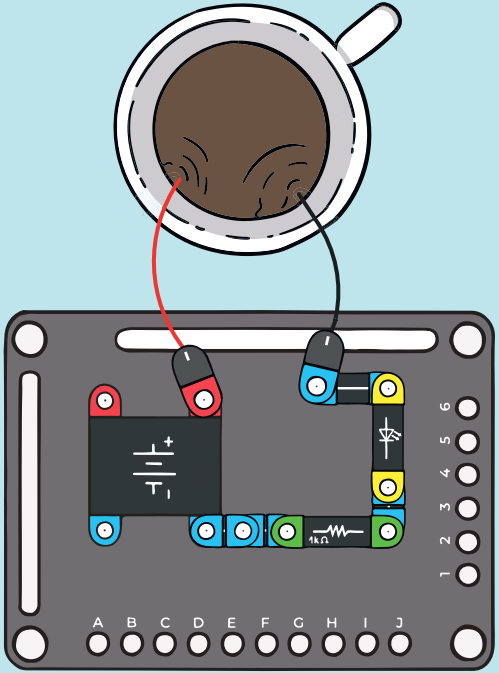

3x


1x

Test that pure water, tea, or any other liquid is conductive enough to light up the LED in the circuit. Take conductive parts with magnets and connect them to kitchen utensils – you can test the conductivity of water.

Tip: Try testing other household items that conduct electricity, such as a banana, bread roll, etc.

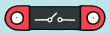
Warning: Never test the conductivity of the mains as you could get injured!

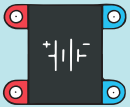


270 LIGHT ALARM


1x transistor NPN


1x LED


1x switch


1x battery


1x

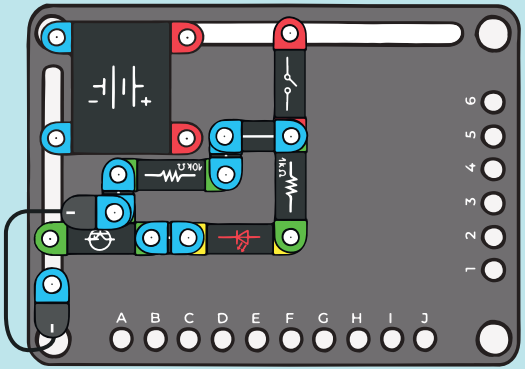

1x


3x


1x resistor 1kΩ


1x resistor 10kΩ

At rest, the base of the transistor is short-circuited by a conductor to ground. No current flows into the base and the transistor is closed. The LED is off. If the conductor is broken, the transistor opens because a current already flows into the base and the LED lights up.

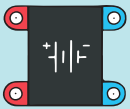


L280 INTENSIVE LIGHT ALARM


1x transistor NPN


1x LED


1x switch


1x battery


1x

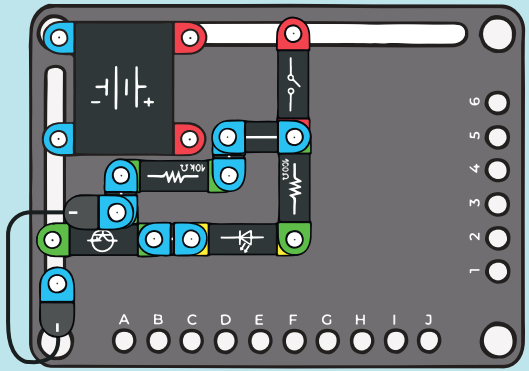

1x


3x


1x resistor 100Ω


1x resistor 10kΩ

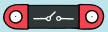
By replacing the LED with a white LED with a different resistance, you will obtain an intensive light alarm.

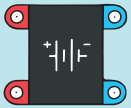


L290 NPN AMPLIFIER WITH LED


1x LED


1x potentiometer


1x switch


1x battery


1x


2x


1x


3x

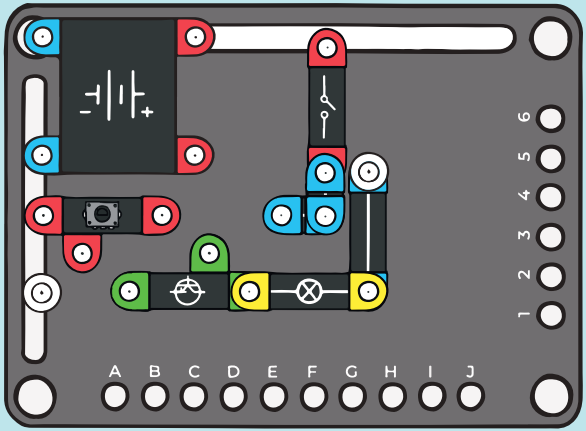

1x bulb


1x transistor NPN

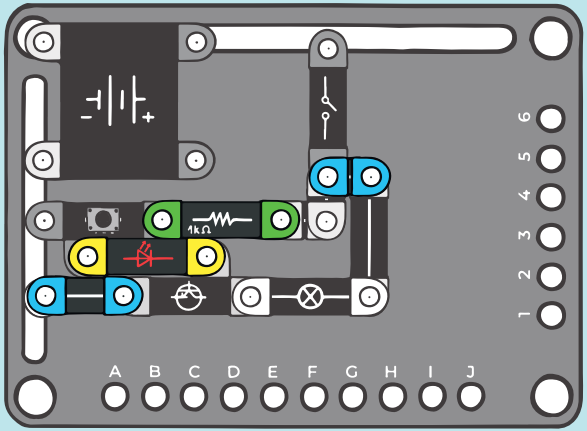

1x resistor 1kΩ

The circuit demonstrates the ability of a transistor to amplify an electric current. Use a potentiometer to control the current flowing through a LED diode to the transistor base. A low current that is barely sufficient to turn on the LED will cause the transistor to open and cause a high current to flow through the bulb as the partial opening of the transistor will increase the voltage on the bulb. This build is called a common emitter circuit because the emitter of the transistor is connected to a common power supply.

1.



2.

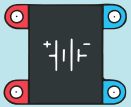


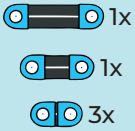
L300 NPN AMPLIFIER WITH LED IN REVERSE DIRECTION

1x LED


1x transistor NPN


1x potentiometer


1x battery


1x
1x
3x


2x

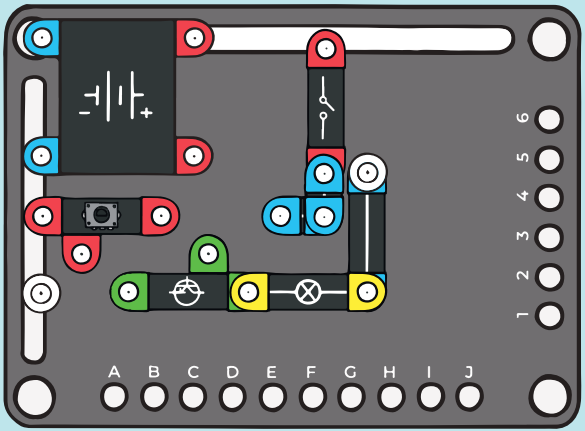

1x bulb


1x switch

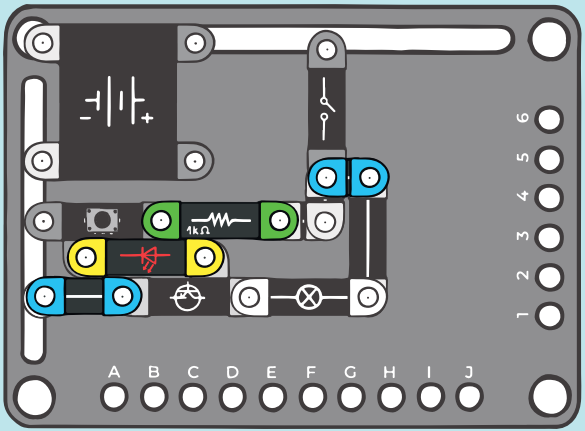

1x resistor 1kΩ

This build uses the same circuit as the previous one, just with the LED connected in the reverse direction. Therefore, no current flows into the transistor base and the bulb does not give light.

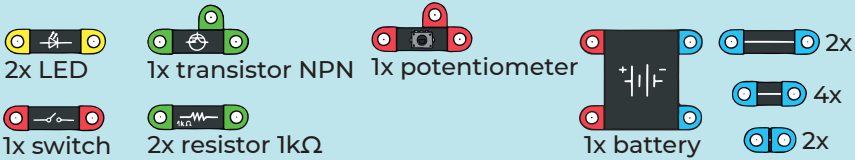
1.



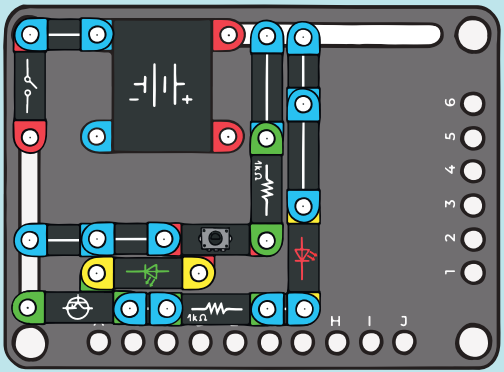
2.



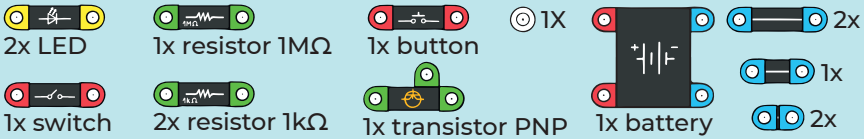
L310 AMPLIFIER WITH LED



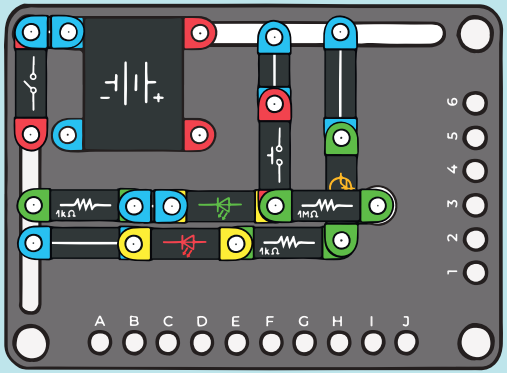
The circuit demonstrates the ability of a transistor to amplify an electric current. Use a potentiometer to control the current flowing through a LED diode to the transistor base. A low current that is barely sufficient to turn on the LED will cause the transistor to open to the extent that the voltage on the LED will be enough to light it up.



L320 SWITCHING WITH BUTTON II.

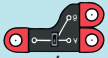


To switch between the red and the white LEDs, we used significantly different properties of both LEDs (different lighting voltages). However, if you want to switch similar or the same LEDs, you need to choose a different solution. You can use a PNP transistor. In this case, it acts as a switch that opens (and thus the corresponding LED goes out) if you press the button. At the same time, the button switches the second LED on, and it should light up when the button is pressed.

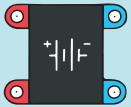


L330 ADJUSTABLE POWER SWITCH


1x potentiometer


1x A/B switch


1x switch


1x battery

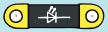

4x


3x

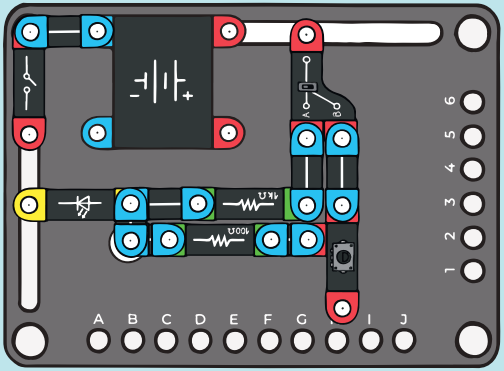

1x


1x resistor 1kΩ

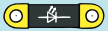

1x resistor 100Ω


1x LED

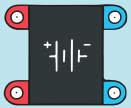
By combining a switch and a potentiometer, you can build a circuit where the switch can be used to select a constant brightness, or continuous LED brightness control with a potentiometer.



L340 SAFETY BUTTON


1x LED

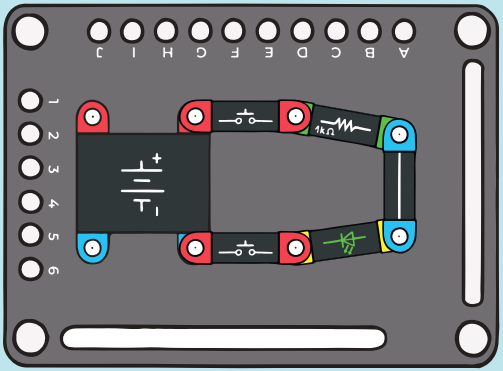

1x resistor 1kΩ


1x battery


1x


2x button

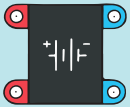
Two buttons connected in series close the circuit only if both buttons are pressed. The circuit closure is indicated by the LED. In practice, this connection is used as a safety element for dangerous machines (e.g. when material needs to be loaded manually under a press) where the operator must press two buttons with both hands to activate the machine. This ensures that both hands are out of the dangerous parts of the machine, which prevents injuries.



L350 CARBON BUTTON


1x LED


1x transistor NPN


1x battery


1x


2x


1x


1x

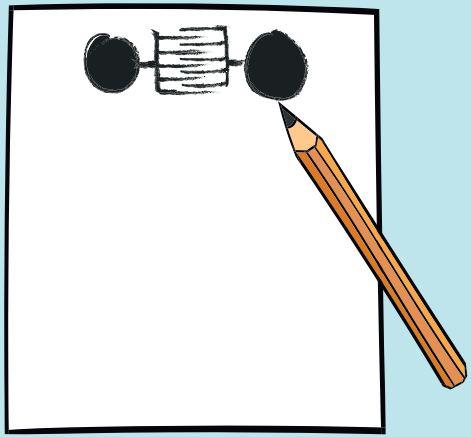

2x resistor 1kΩ


1x switch

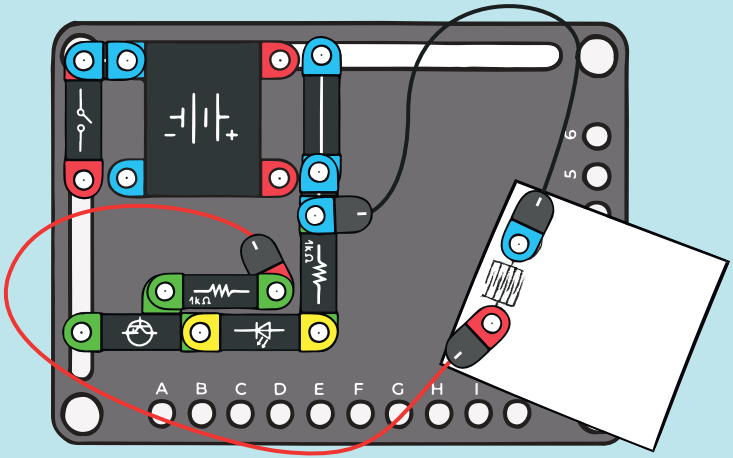

paper and pencil

You can create a button using a graphite painting - a set of two separate conductive parts that you connect with the touch of a finger. As in the case of the carbon potentiometer, the current flow through the button is very small, so it is advisable to amplify it with a transistor. This graphic representation of the button is actually used in practice. For example, calculators or remote controls have the same pattern etched on a printed circuit board, and the conductive traces are connected by a graphite layer on the underside of a rubber button. It is a very simple and working solution that does not require separate buttons as additional components.

1.



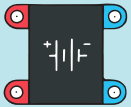
2.



L360 CARBON POTENTIOMETER

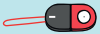

1x LED


1x transistor NPN


1x battery

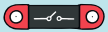

1x


2x


1x


1x

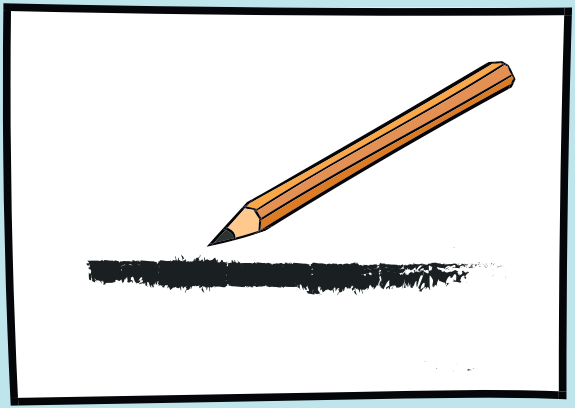

2x resistor 1kΩ


1x switch

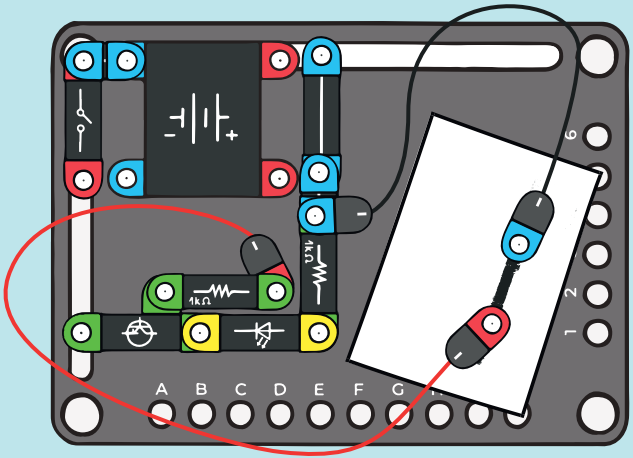

paper and pencil

The material from which the resistance layer of the potentiometer is made is graphite. It is the same material that forms the ordinary pencil lead. If you draw a thick line on paper with a pencil, a resistance path is created that you can then connect to the conductors in the circuit. The longer the line, the higher the resistance at its ends. The thicker the line, the less resistance there is. Since the resistance value may be too high to turn on the LED directly, we will use a transistor in connection with a common emitter, where we will use the voltage gain to light up the LED. If you fasten one conductive component firmly to one edge of the line and move the other, you will get a variable resistance, i.e. a potentiometer.

1.



2.

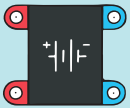


L370 CE PNP AMPLIFIER WITH A LED AND BULB


1x LED


1x switch


1x resistor 1kΩ


1x battery


1x


3x


1x

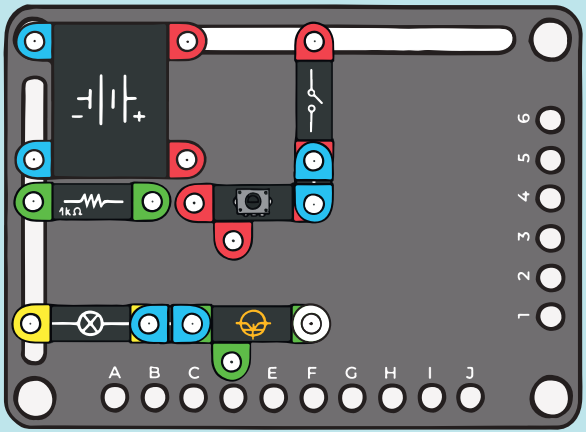

1x bulb


1x transistor PNP

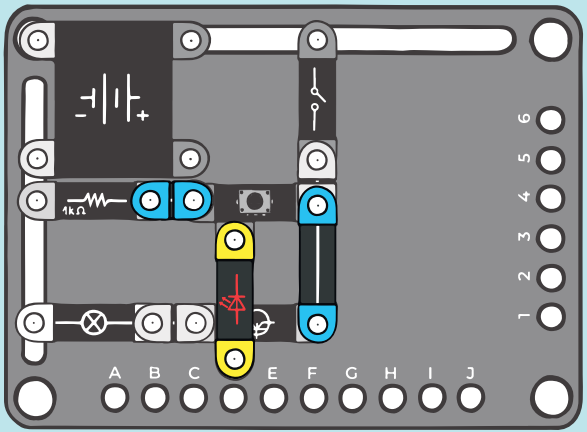

1x potentiometer

Functionally, it is the same circuit as the NPN amplifier with LED (page 40), just with a transistor of opposite conductivity. The base current flows in the opposite direction; therefore, it is necessary to modify the base circuit accordingly.

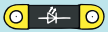
1.



2.

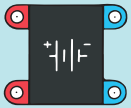


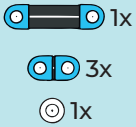
L380 PNP AMPLIFIER WITH LED IN REVERSE DIRECTION


1x LED


1x transistor PNP


1x potentiometer


1x battery


1x
3x
1x

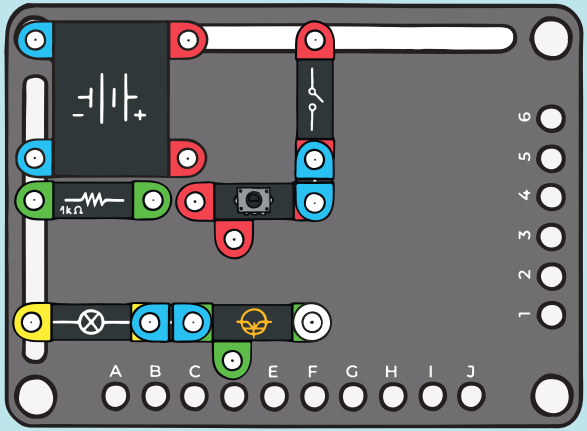

1x bulb


1x switch

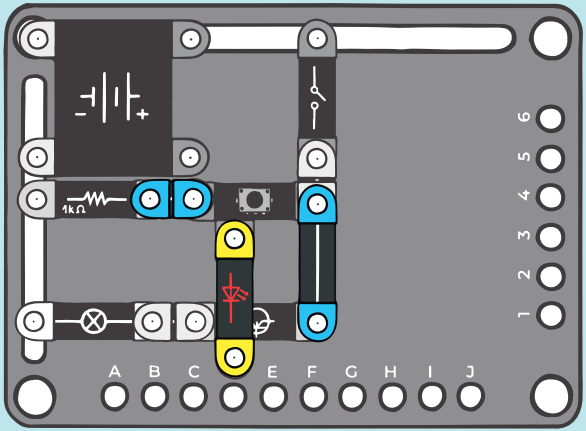

1x resistor 1kΩ

Use a potentiometer to control the current flowing through a LED diode to the transistor base. However, the LED is in the reverse direction, and so no current flows through the base and there is nothing to amplify. The bulb cannot light up because the transistor is closed.

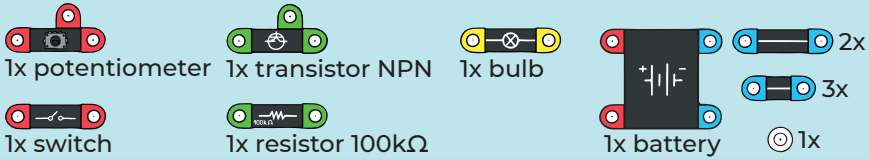
1.



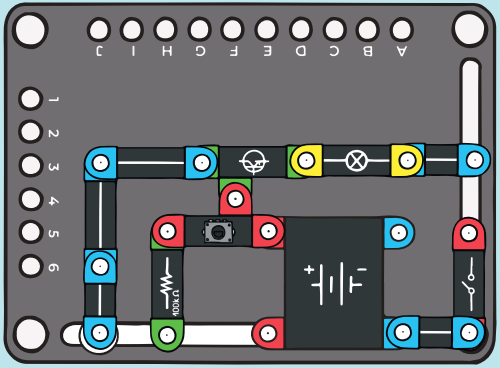
2.



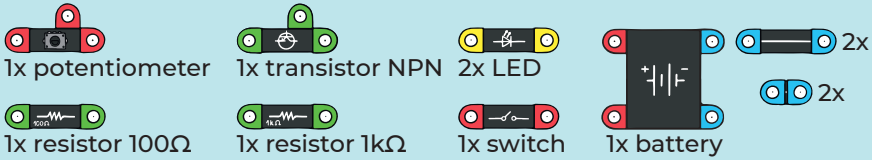
L390 EMITTER FOLLOWER WITH NPN



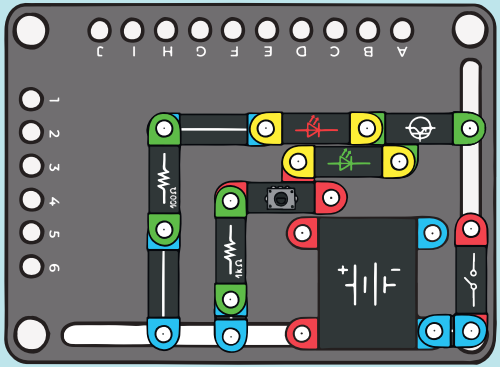
This build basically replicates the connection of the potentiometer slider directly to the bulb against the ground. However, too much current would flow through the potentiometer and destroy it. Therefore, we use a component called 'emitter follower' (connected with a common collector). It copies the voltage at the potentiometer output, but the transistor takes over the actual current load. Only a very small current flows through the potentiometer without the risk of damaging it.



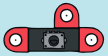
L400 CE AMPLIFIER WITH NPN AND LEDS



The circuit demonstrates the ability of a transistor to amplify an electric current. Use a potentiometer to control the current flowing through a LED diode to the transistor base. A low current that is barely sufficient to turn on the LED will cause the transistor to open to the extent that the voltage on the LED is sufficient to light it up.

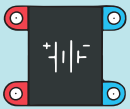


L410 CE AMPLIFIER WITH PNP AND BULB


1x potentiometer


1x transistor PNP


1x bulb

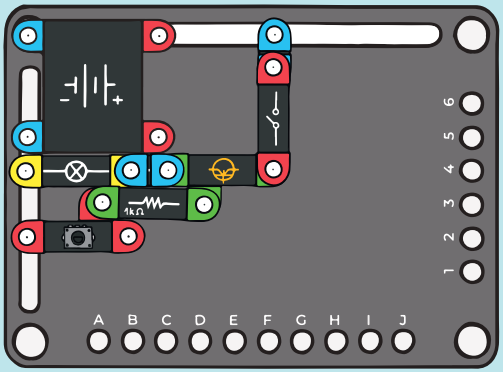


2x
1x battery


1x switch


1x resistor 1kΩ

By changing the low current to the transistor base, you can control the high current flowing through the bulb since opening and closing the transistor causes the voltage on the bulb to change. We use a PNP transistor in this case.

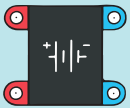


L420 EMITTER FOLLOWER WITH PNP


1x potentiometer

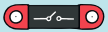

1x transistor PNP


1x bulb



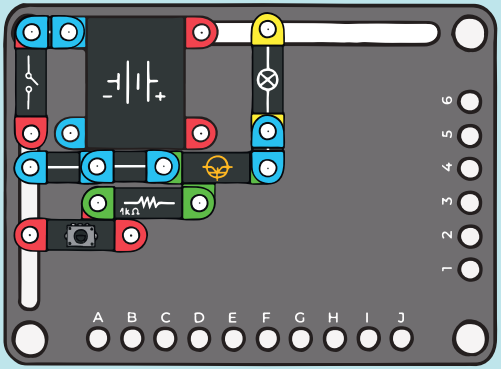
2x

2x
1x battery

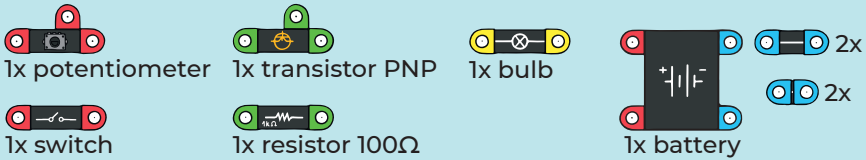

1x switch


1x resistor 1kΩ

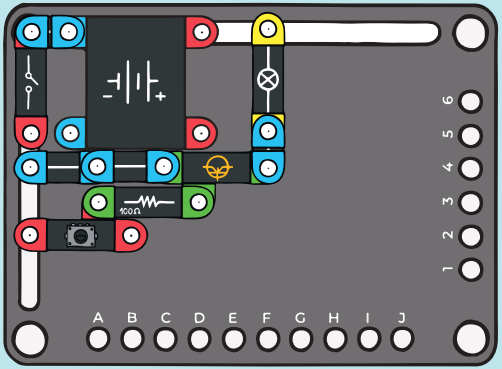
Functionally, it is the same circuit as the emitter follower with NPN, just with a transistor of opposite conductivity. The base current flows in the opposite direction; therefore, it is necessary to modify the base circuit accordingly.



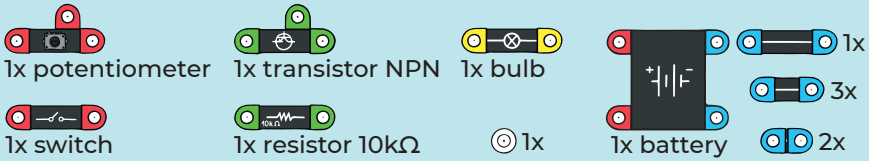
L430 RAISING CURRENT BY BASE WITH CC AMPLIFIER WITH PNP



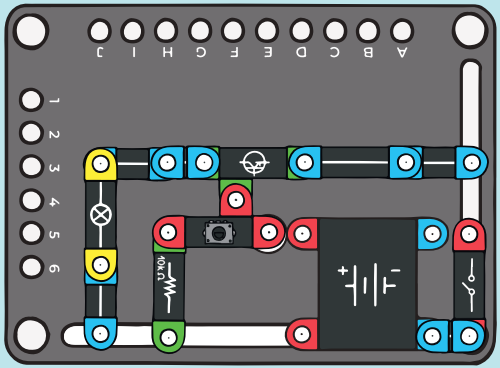
Changing the base resistor to a low value of 100 Ω will increase the current flowing to the transistor base, but the bulb brightness remains almost constant. This is because the voltage on the bulb still corresponds to that on the potentiometer slider although the circuit would be able to supply more current. However, since the load is still just one bulb, the amount of current consumed does not increase, so changing the resistor has virtually no effect.



L440 CE AMPLIFIER WITH NPN AND BULB

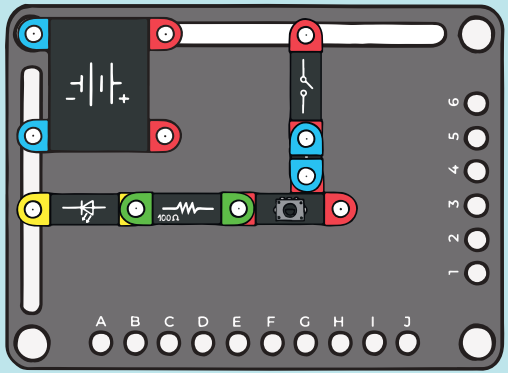


By changing the low current to the transistor base, you can control the high current flowing through the bulb since opening and closing the transistor causes the voltage on the bulb to change. We use an NPN transistor in this case.

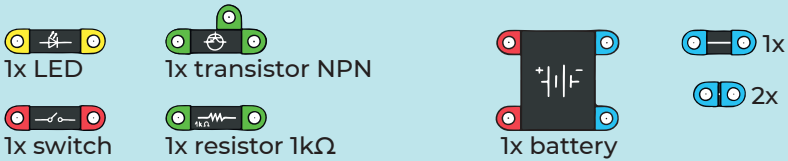


L450 BRIGHTNESS CONTROL

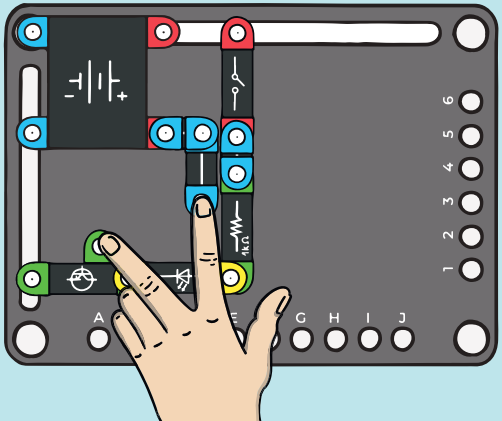
With the potentiometer you can directly control the current flowing through the LED diode and thus change its brightness. A small resistor in series serves as a current limiter when the potentiometer is set to the extreme position where it has zero resistance.



L460 TWO-FINGER TOUCH LAMP



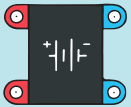
In addition to the graphite potentiometer, you can use your own fingers to turn on the transistor. Just touch the base terminal with one finger and the power supply contact with the other finger. For NPN it is the positive contact of the power supply, for PNP it is the negative contact. A very low current flows through the hand, which is then amplified by the transistor to a value that is enough to light up the LED diode.



L470 CONTROLLING NPN TRANSISTOR BY LIGHT I.


1x bulb


1x transistor NPN


1x battery


1x


1x


1x fotoresistor

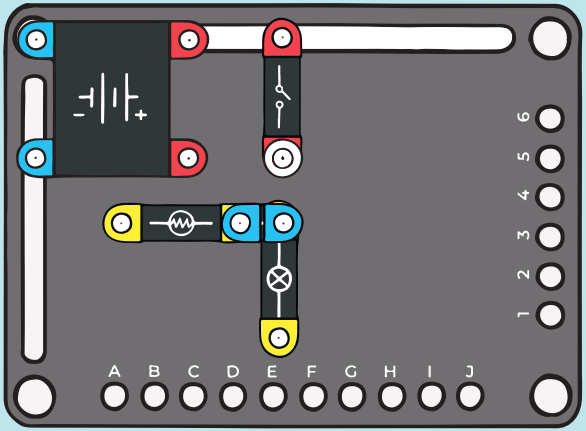

1x switch


2x

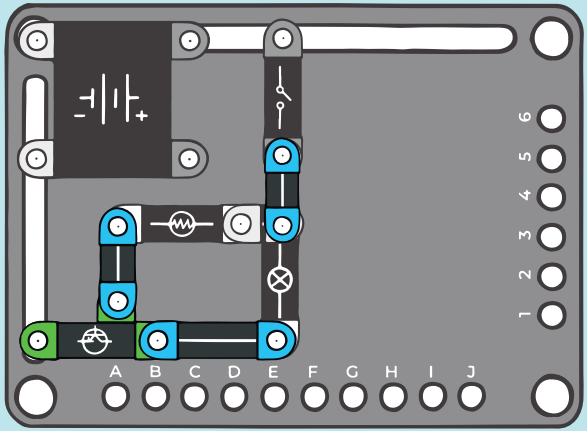

1x

The more the photoresistor is illuminated, the more light the bulb emits since the transistor opens. The build is functionally the same as L90 however, a direct series combination of a photoresistor and bulb would have such a high resistance that the bulb would not light up on battery power, so we will use the transistor as a voltage amplifier for the bulb.

1.



2.

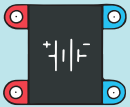


L480 CONTROLLING NPN TRANSISTOR BY LIGHT II.


1x bulb


1x transistor NPN


1x switch


1x battery


2x


2x

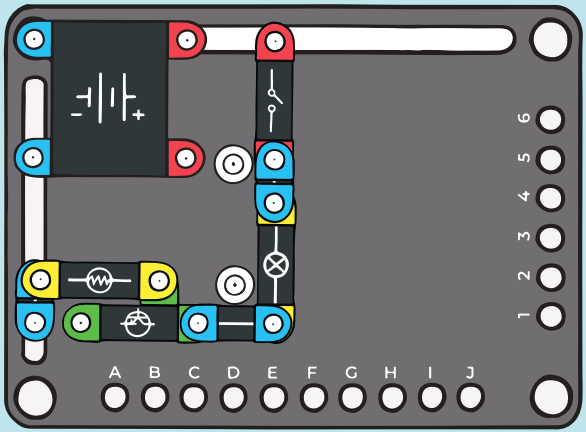

4x


1x fotoresistor

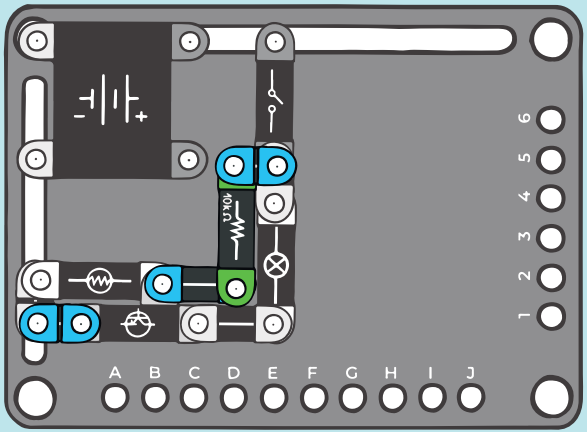
1x resistor 10kΩ

The photoresistor together with the resistor form a voltage divider, the output voltage of which depends inversely on the degree of illumination. The less the photoresistor is illuminated, the more the transistor opens, the voltage on the bulb and the current through the bulb increase until the bulb lights up. When illuminated, the current to the transistor base drops and the bulb goes out as the transistor closes.

1.



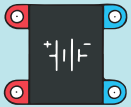
2.



L490 CONTROLLING PNP TRANSISTOR BY LIGHT I.


1x bulb


1x transistor PNP


1x battery

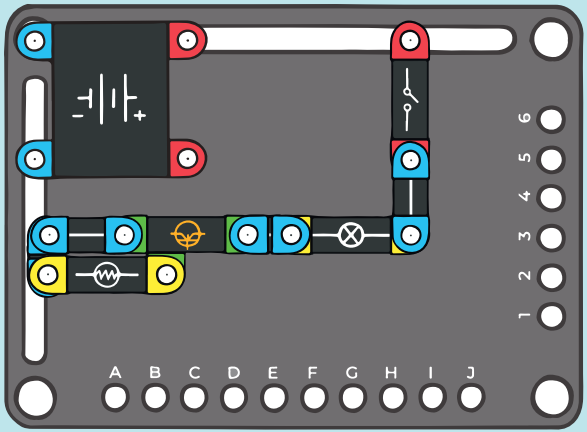

2x


2x


1x fotoresistor


1x switch

Functionally, this is the same build as L470, but with a transistor of opposite conductivity.
The direction of the base current is opposite, so it is necessary to modify the base circuit. The bulb is connected in the emitter circuit (see L440), so the bulb reacts with lower brightness because the voltage on the bulb is low as it copies the voltage on the photoresistor.

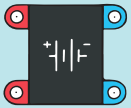


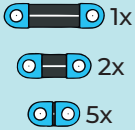
L500 CONTROLLING PNP TRANSISTOR BY LIGHT II.


1x bulb


1x transistor PNP


1x resistor 1kΩ

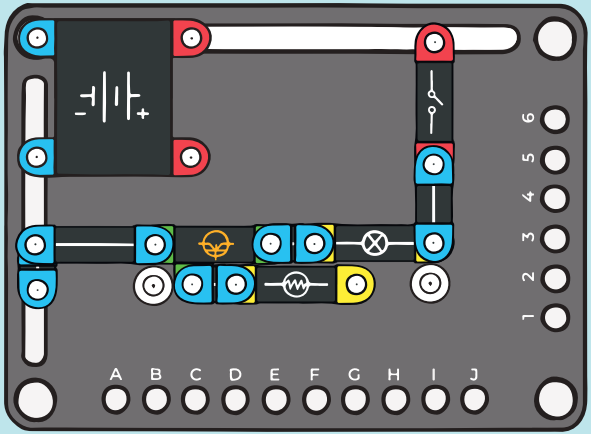

1x battery


1x
2x
5x

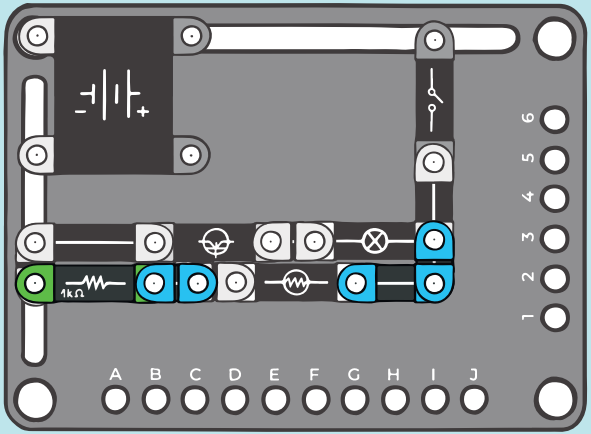

2x

Functionally, this is the same build as L480 but with a transistor of opposite conductivity.
The direction of the base current is opposite, so it is necessary to modify the base circuit. The bulb lights up again when the photoresistor is darkened, but because it is again connected in the emitter circuit, the voltage on the bulb is low and the bulb responds with lower brightness.

1.



2.

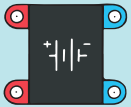


L510 STANDARD TRANSISTOR CIRCUIT


1x potentiometer

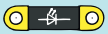

1x transistor NPN


2x resistor 1kΩ


1x battery


1x


2x


1x LED


1x switch

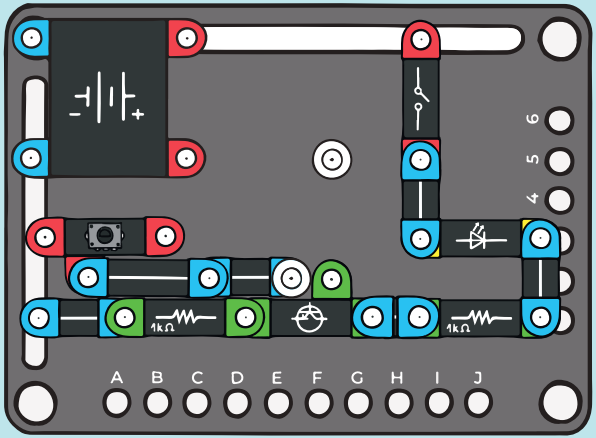

1x resistor 10kΩ


5x

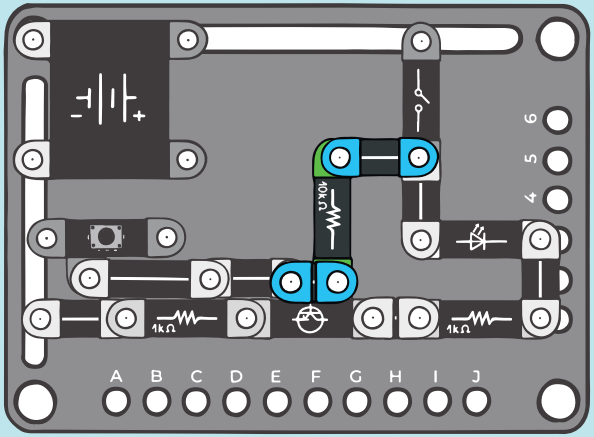

2x

We use a potentiometer to control the current flowing to the base, which changes the current flowing through the collector and, thus, also changes the LED brightness because the voltage on the LED changes. The resistance in the transistor emitter introduces a weak feedback, thus limiting the range of brightness control options.

1.



2.

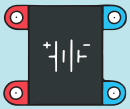


L520 FLASHING LIGHT BULB


1x bulb


1x transistor NPN


1x transistor PNP


1x battery


1x


1x


1x


3x

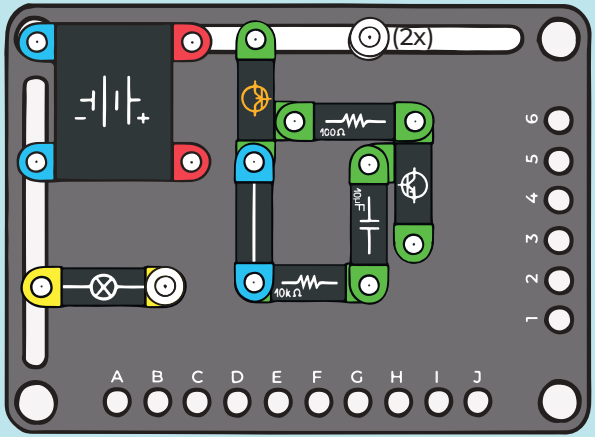

1x resistor 1MΩ


1x resistor 100Ω

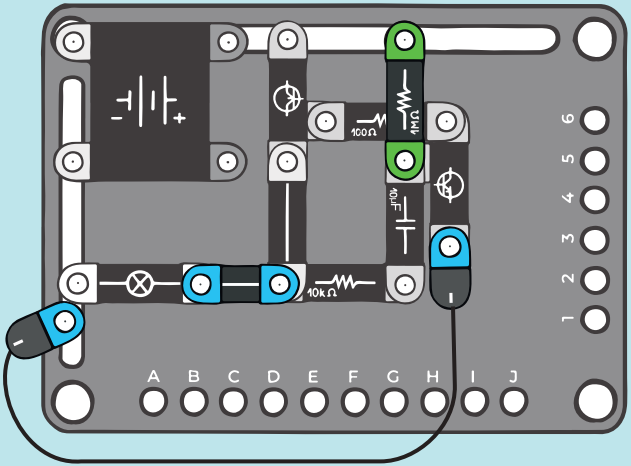

1x capacitor 10µF

An astable flip-flop can also be built using two amplifiers consisting of transistors of opposite conductivity. The build is simplified a bit, but the stability of the circuit is worse. The bulb is switched directly by the amplifier with a PNP transistor, so the bulb flashes with high brightness. The blinking is short with long pauses, so it may take a while for the bulb to light up for the first time after you connect the battery.

1.

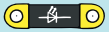


2.



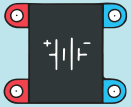
L530 NIGHT LIGHT AUTOMATIC SWITCH-OFF I.


1x transistor NPN


1x LED


1x resistor 1kΩ


1x button

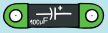

1x battery


2x


3x


1x


5x

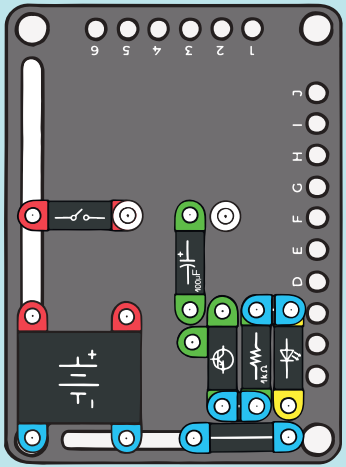

1x capacitor 100uF


1x switch

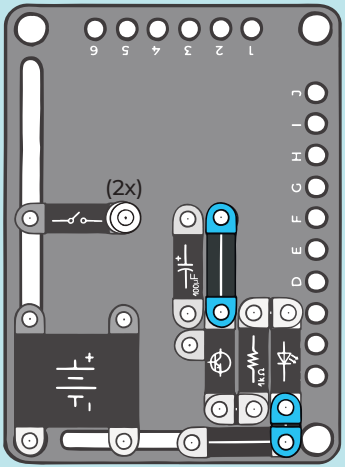

1x resistor 100kΩ

When the switch is turned in the ON position, the capacitor starts charging. As the capacitor charges, the current flowing through it decreases. This also closes the transistor and the LED slowly dims until it goes out. Press the button to discharge the capacitor and the LED will light up again and slowly dim until the capacitor is fully charged again.

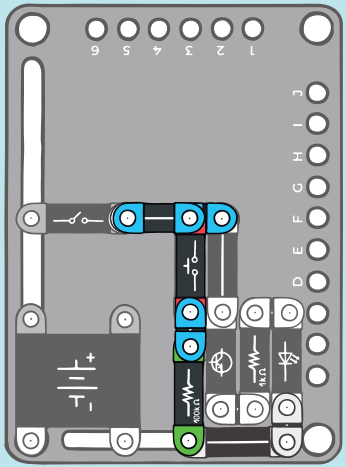
1.



2.



3.



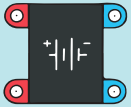
L540 NIGHT LIGHT AUTOMATIC SWITCH-OFF II.


1x transistor NPN


1x LED


1x resistor 1kΩ


1x button

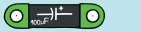

1x battery


2x


4x


1x


5x

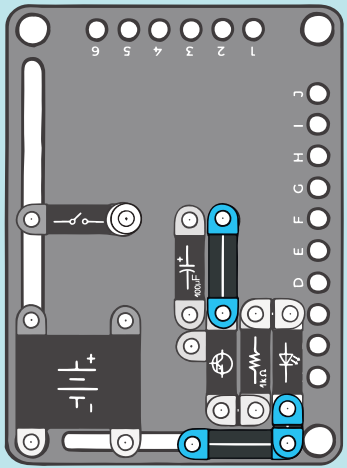

2x capacitor 100uF


1x switch

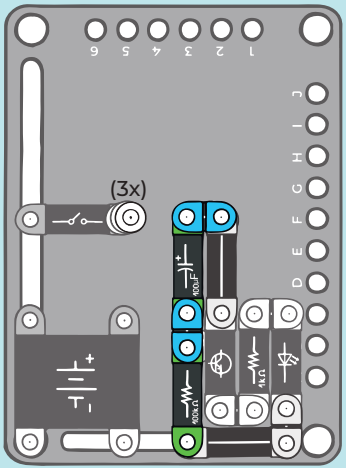

1x resistor 100kΩ

The light dimming time can be extended by adding another capacitor in parallel with the previous one. The parallel arrangement of the capacitors adds up their capacitances, so it will take longer for the capacitor to charge and for the LED to go out.

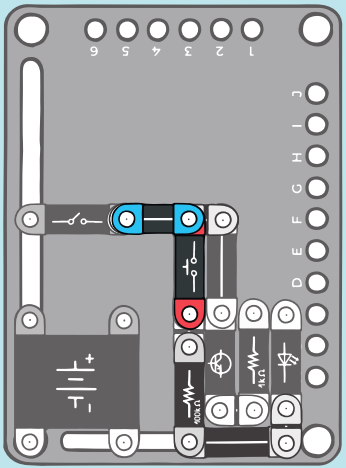
1. step 2 of L530



2.



3.



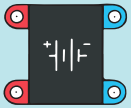
L550 NIGHT LIGHT AUTOMATIC SWITCH-OFF III.


1x transistor NPN


1x LED


1x resistor 1kΩ


1x button

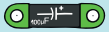

1x battery


2x


4x


1x


5x

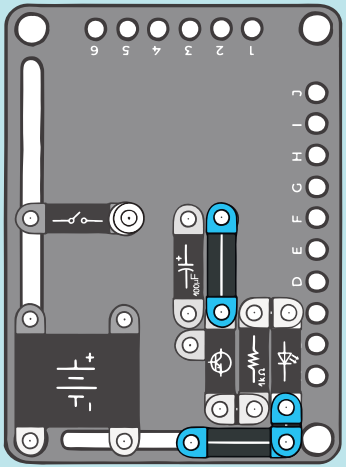

2x capacitor 100uF


1x switch

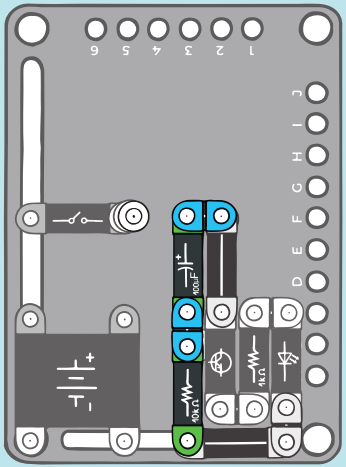

1x resistor 10kΩ

You can also shorten the lighting time. You can use a capacitor with a smaller capacitance, but a more practical variant is to replace the resistor between the transistor base and the ground with a smaller one. This will increase the charging current of the capacitor, and the capacitor will charge faster. The current flowing to the transistor base will then stop sooner – the transistor will close and the LED go out.

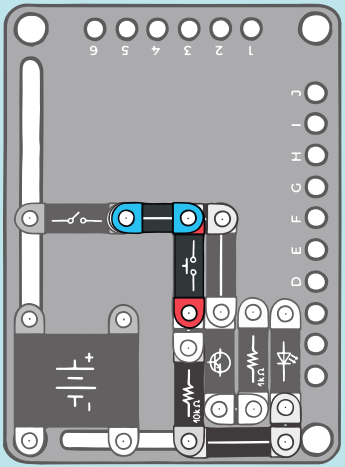
1. step 2 of L530



2.



3.

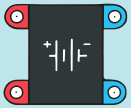


L560 SCHMITT CIRCUIT

1x switch


1x potentiometer


2x transistor NPN


1x battery


1x


4x


1x LED


2x resistor 1kΩ

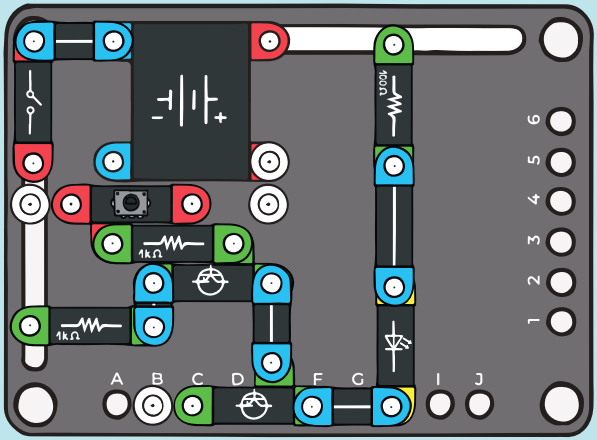

1x resistor 100Ω


5x

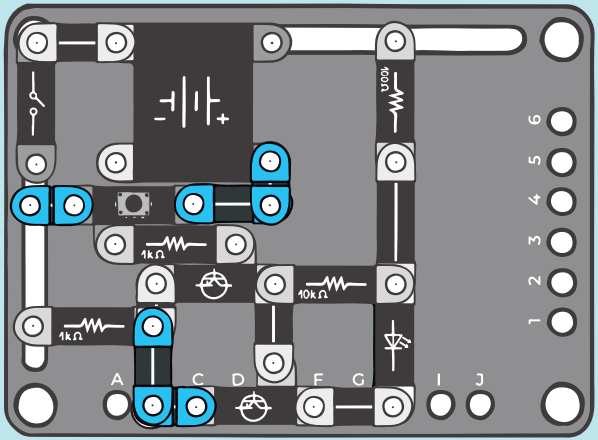

4x

A special type of two-stage amplifier. Unlike simple amplifiers that allowed the LED brightness to be adjusted continuously using the potentiometer, here the brightness changes in steps. By turning the potentiometer, you can only turn the LED on or off. The continuous change of voltage at the input of the circuit is thus converted to a simple on or off of the electric current, which is indicated by the LED. The reason is the introduction of feedback, which allows only one transistor to be opened and prevents a gradual change of state by preventing the change „until the last minute“ (the circuit does not respond to the rotation of the potentiometer by gradually changing the brightness of the LED). If the coupling can no longer prevent the flipping, it at least speeds up the flipping so that the change of state is essentially instantaneous.
The circuit is used as a signal shaper or as a detector of a certain voltage limit.

1.



2.



L570 NIGHT LIGHT AUTOMATIC SWITCH-OFF IV.

1x bulb

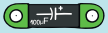

1x transistor PNP

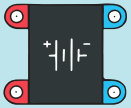

2x transistor NPN

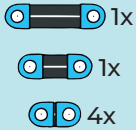

1x button

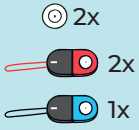

2x resistor 10kΩ


1x resistor 100Ω


1x capacitor 100uF

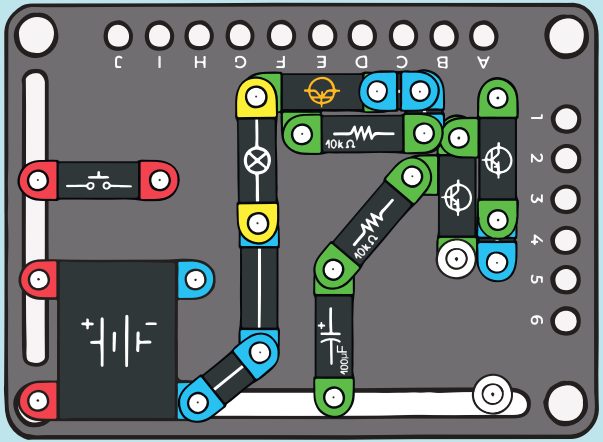

1x battery


1x
1x
4x

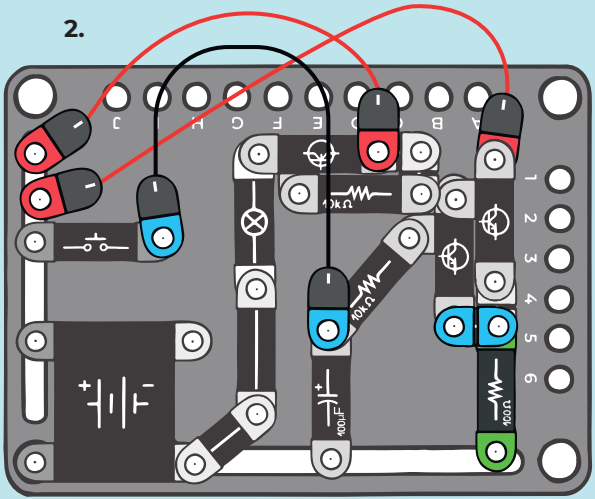

2x
2x
1x

With the Schmitt circuit, you can improve the familiar switching off of the night light, which has the disadvantage that switch-off is not abrupt – the brightness slowly fades. The Schmitt circuit solves this with its step change, causing the light bulb to be either fully lit up or go out. Due to the connection method, the capacitor charging function is reversed.
In the original instructions, the light went out when the capacitor was fully charged, and we then discharged it by pressing the button. Now, you can charge the capacitor by pressing the button and then let it gradually discharge. You can also improve the circuit with a transistor amplifier with a PNP transistor, which amplifies the output of the Schmitt circuit so much that we can use a light bulb instead of a LED diode.

1.



2.

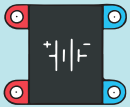


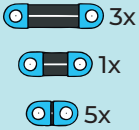
L580 NIGHT LIGHT AUTOMATIC SWITCH-OFF V.

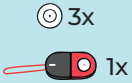

1x bulb


1x transistor PNP

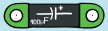

1x transistor NPN


1x battery





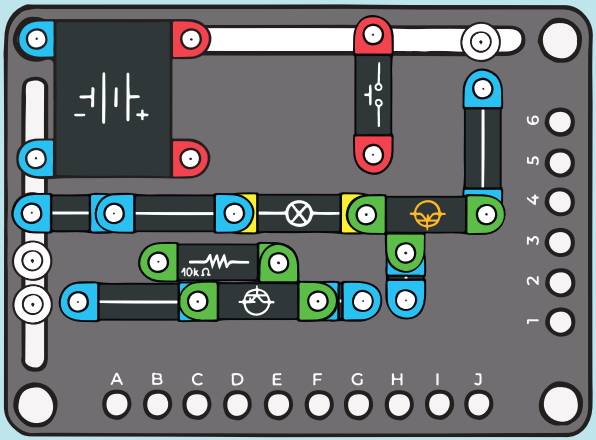

1x button


1x capacitor 100uF

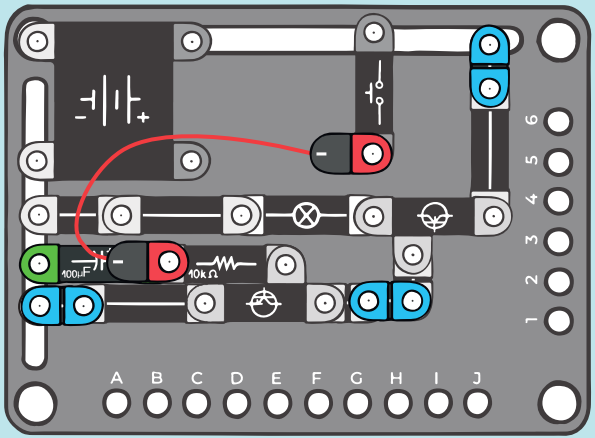

1x resistor 10kΩ

A simplified version without the Schmitt circuit. The circuit works similarly to L570 however, in the absence of a Schmitt circuit, it causes an undesirably slow dimming of the light.

1.

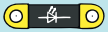


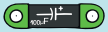
2.



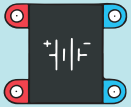
L590 RAIL CROSSING


2x transistor NPN


2x LED


2x capacitor 100uF


2x resistor 10kΩ


1x battery


2x

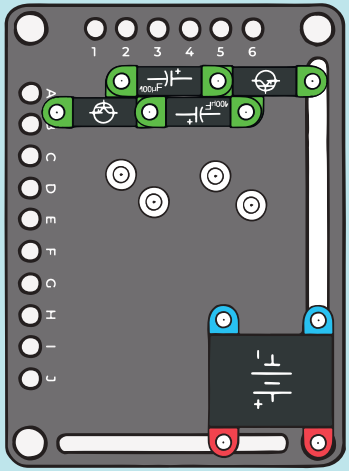

2x


4x

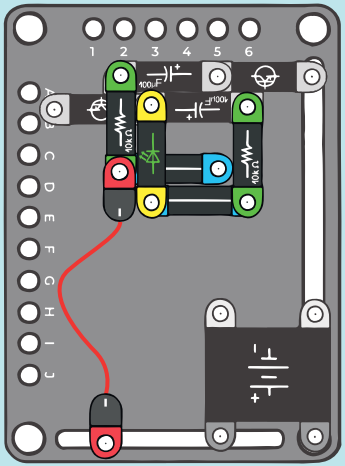

1x

If you connect two separate transistor amplifiers in series and connect the output again to the input, we get an astable flip-flop. This circuit has no stable state and constantly flips. Similar to L530 the transistor opening time is determined by the charging of the capacitor, with the difference being that the capacitor does not remain charged but begins to discharge again. The result is a constant alternating opening of both transistors, which is signaled by the alternating light of both LEDs. By choosing suitable sizes of resistors and capacitors, you can achieve the illusion of rail crossing signaling.

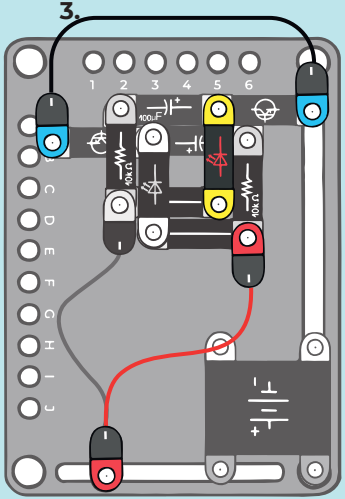
1.



2.



3.



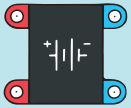
L600 TWILIGHT SWITCH


1x potentiometer


1x bulb


1x transistor PNP


2x transistor NPN


1x battery


1x


3x


4x


2x


2x

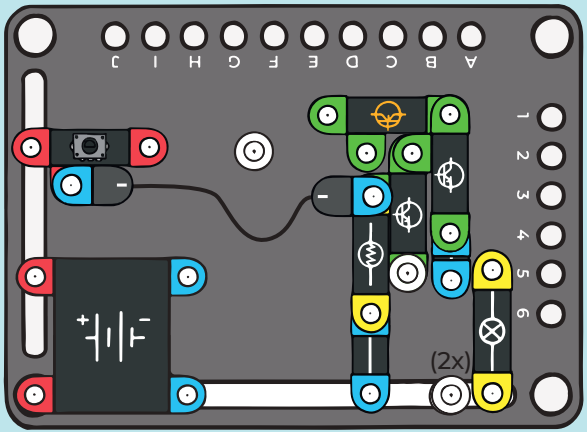

1x resistor 100Ω


1x fotoresistor

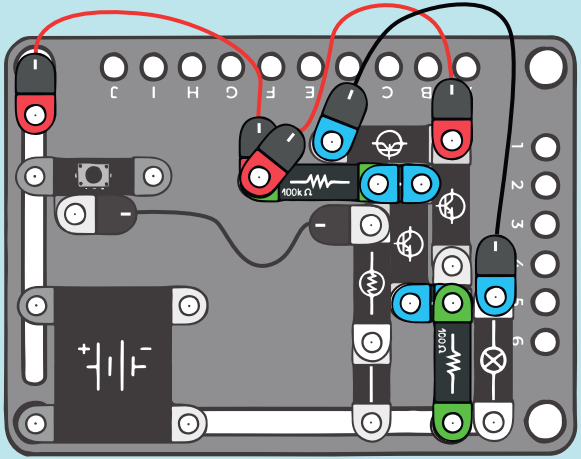

1x resistor 100kΩ

You can also use the Schmitt circuit to detect darkness. A voltage divider of the resistor and the photoresistor evaluates the Schmitt circuit, which turns on the bulb through the PNP transistor. If the photoresistor is well lit, the bulb will not light up. If it is shaded, the bulb lights up in full brightness thanks to the Schmitt circuit, and its brightness does not depend on the level of illumination as is the case in the following builds: L480 and L500. The level of shading when the bulb is to light up can be set with a potentiometer.

1.



2.




2 SOUND
test
SOUND
ON