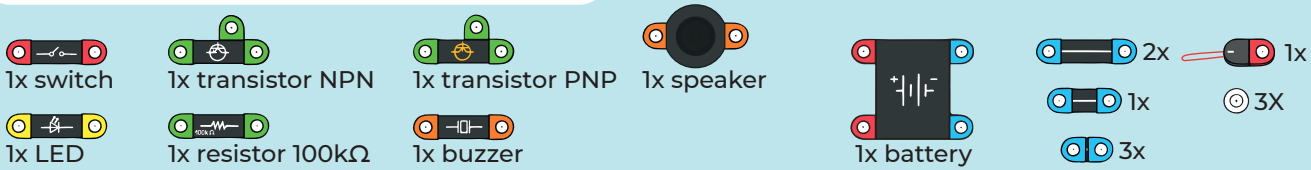
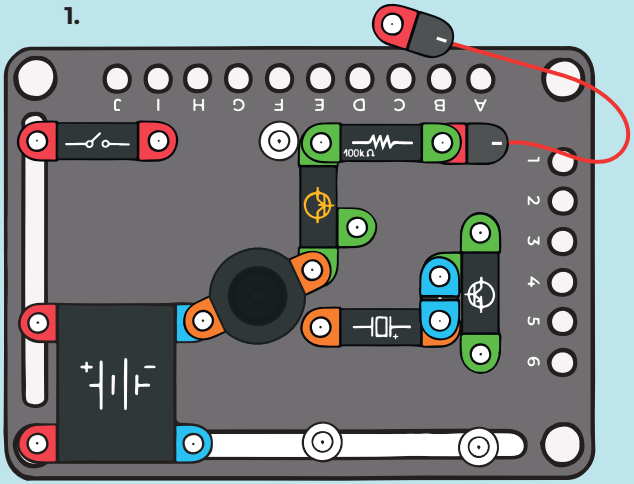
S10 MULTIPLE-TONE GENERATOR I.

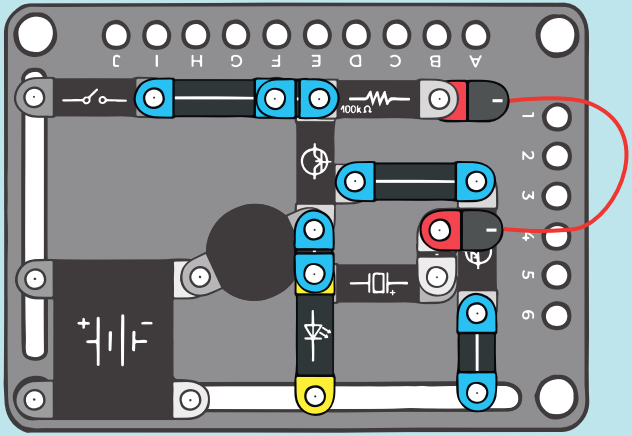


This build demonstrates a change in tone of a simple buzzer depending on the capacitor. We will use a buzzer as the first place for the capacitor. Its membrane acts as a capacitor and has its own capacitance. The capacitance is relatively small and, therefore, the tone of the buzzer is high. The oscillation is so fast that we do not see the LED flashing and perceive it as constantly lit up.

1.



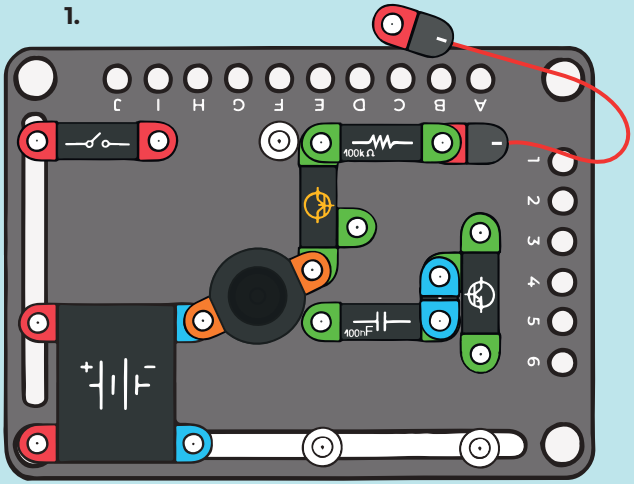
2.



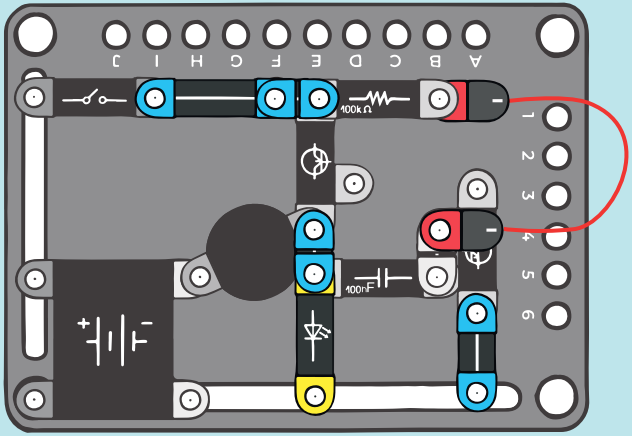
S20 MULTIPLE-TONE GENERATOR II.

We replace the buzzer with a capacitor with a capacitance of 100 nF. The capacitance is higher, and the tone pitch decreases. Again, the LED only appears to be constantly lit, but the brightness has changed. A good eye can already notice a hint of flicker – like rapid fluctuations in brightness.

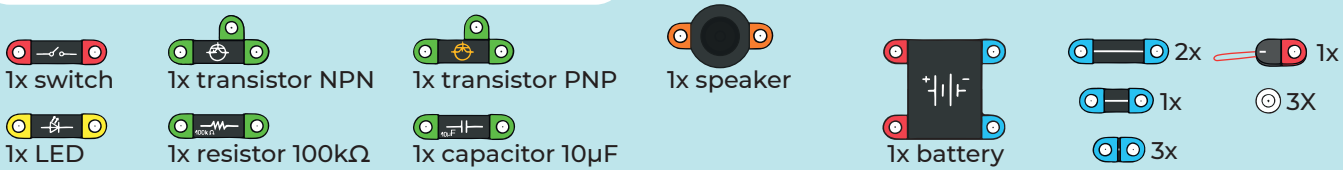
1.



2.

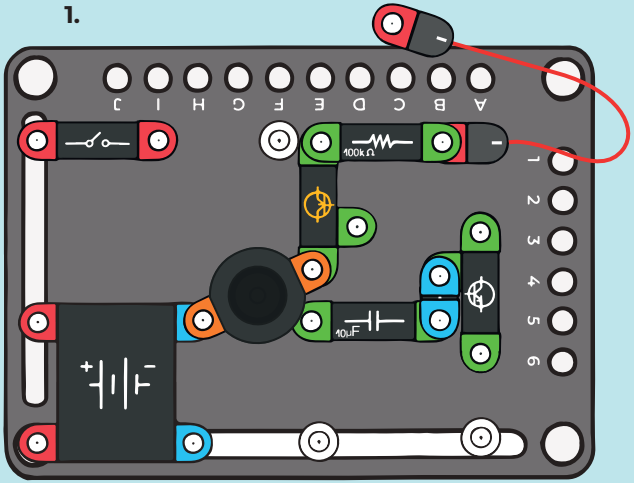


S30 MULTIPLE-TONE GENERATOR III.

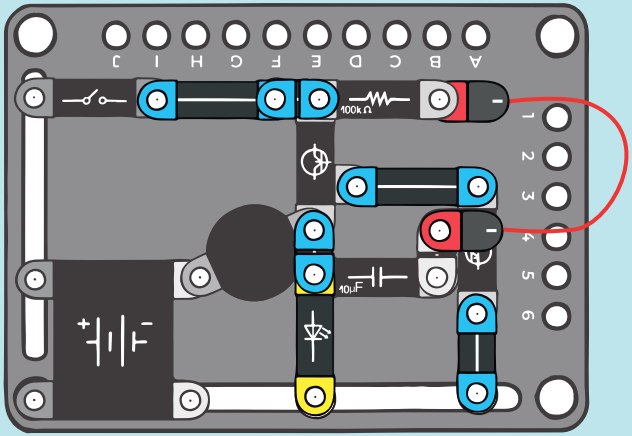


Replace the capacitor with a capacitance of 100 nF with a capacitor with a capacitance of 10 μF. This capacitance is many times higher, and the continuous tone falls apart into mere clicking. The LED flashes. The generator frequency has dropped below the limit that a person can audibly perceive as a continuous tone.

1.



2.



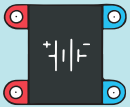
S40 ENGINE SOUND

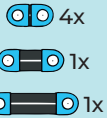
1x potentiometer

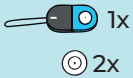
1x transistor NPN

1x transistor PNP

1x speaker

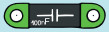

1x battery


4x
1x
1x


1x
2x

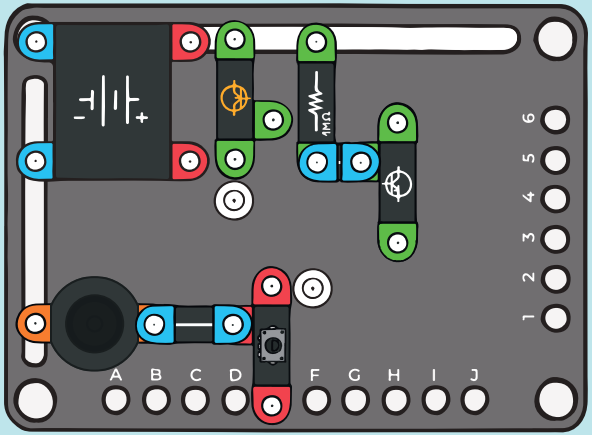
1x resistor 100Ω

1x resistor 1MΩ


1x capacitor 100nF

A sound generator can also be built using two amplifiers consisting of transistors of opposite conductivity. The circuit is simplified a bit, but the stability of the circuit is worse, which is reflected in a spontaneous change of tone. With its sound, this circuit resembles the operation of an internal combustion engine.

1.



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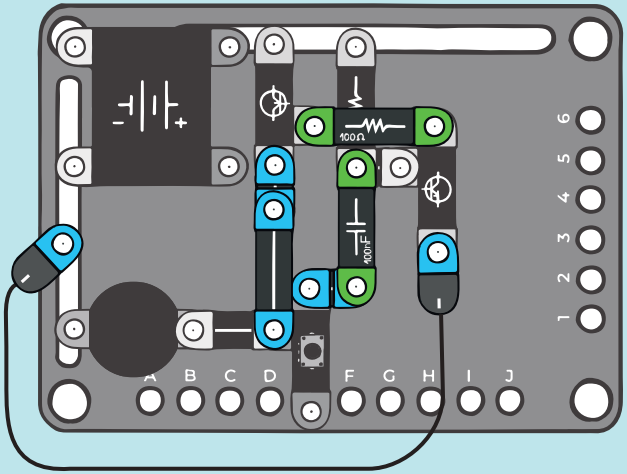
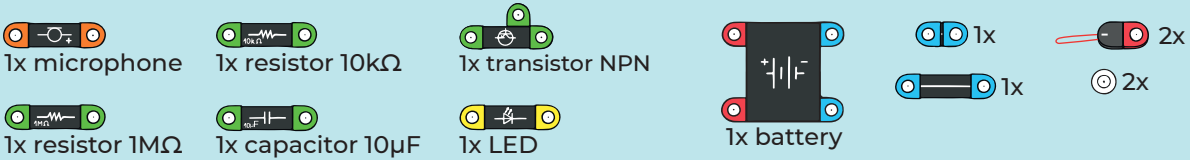
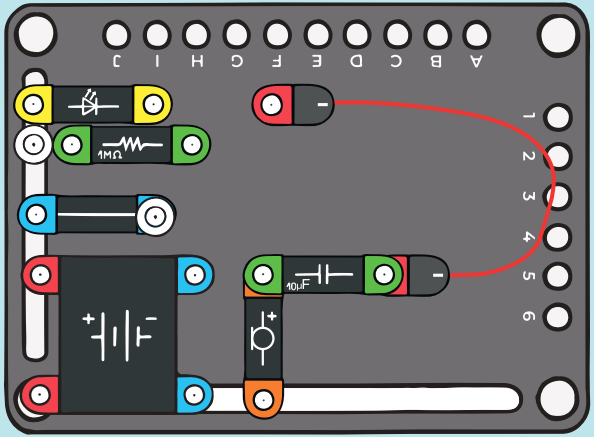


S50 VOICE-CONTROLLED LIGHT



By connecting a microphone and a transistor amplifier, you can control the LED brightness with sound. Unlike the L100 build, the microphone is connected in such a way that the supply current is separated from the current changes caused by the captured sound. The microphone is powered via a resistor. When sound is captured, this current changes, which causes a change in the loss of voltage at the resistor. The voltage change charges and discharges the capacitor, which generates a current, amplified by the transistor, that leads to a higher voltage for the LED as the transistor opens. The resistor supplying power to the microphone and the capacitor form a 'derivative circuit', which transmits only changes in the electric current, thus separating the change in electric current caused by sound and the current for supplying the microphone. The LED only lights up when the microphone registers sound.

1.



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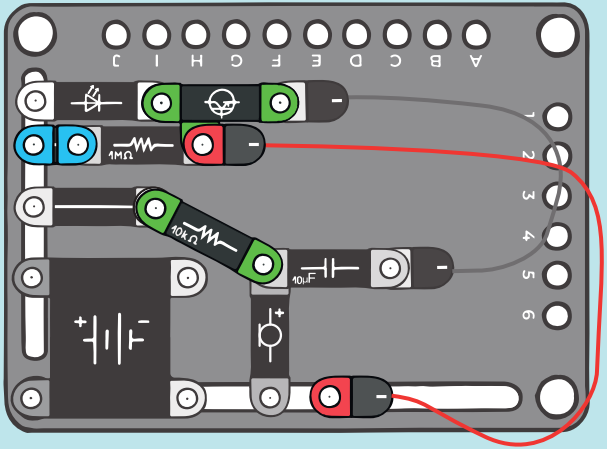
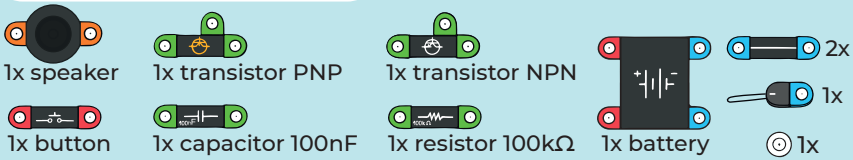
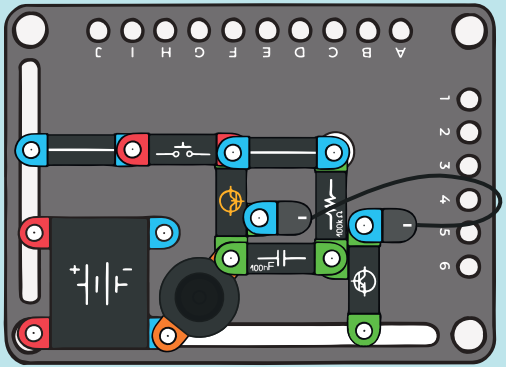


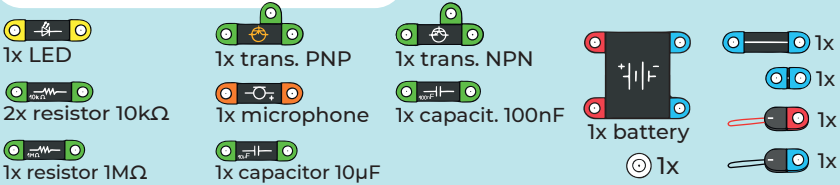
S60 MORSE CODE



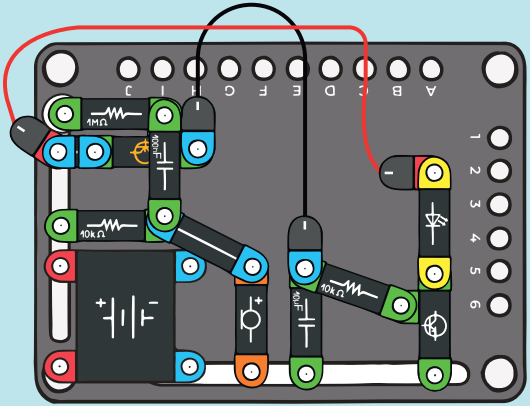
A simple buzzer with a button to practice the Morse code. This is a modified S40 circuit, where the selection of components achieves the characteristic tone used to receive Morse codes.



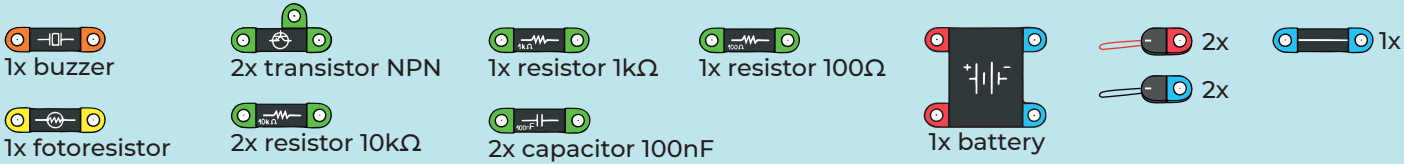
S70 APPLAUSE LED



This is a modification of the S50 manual. We charge the capacitor with an amplified current from the microphone. The capacitor slowly discharges into the base of the second transistor. It is actually a similar circuit as L530, only differently connected. The LED lights up quickly with a sound and then slowly goes out.

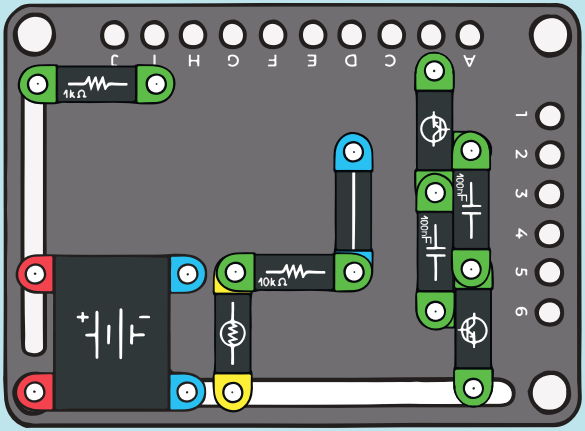


S80 BUZZING IN THE DARK

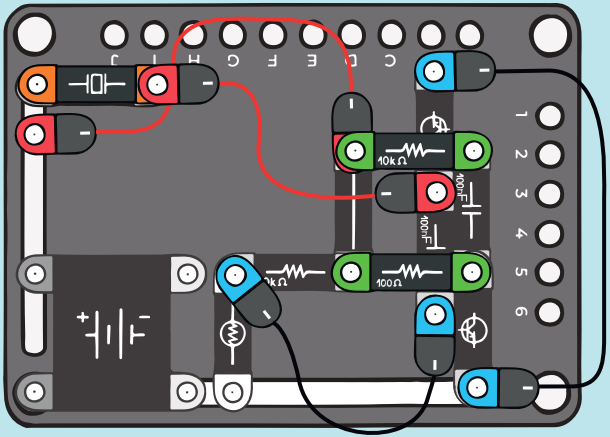


We can equip the astable flip-flop circuit not only with a photoresistor to change the pitch, as was the case in the L100 build, but with a suitable arrangement of components we can completely prevent the circuit from oscillating. If the photoresistor resistance falls below a certain limit due to illumination, the voltage at the transistor base will be so small that no current will flow to the transistor base. The transistor will be permanently closed, the circuit cannot oscillate further, and the tone will stop. In darkness, the resistance of the photoresistor increases, along with the voltage required for the current to flow to the base, and the circuit resumes the alternating opening of the transistors and thus oscillates. So the buzzer sounds again in the dark.

1.



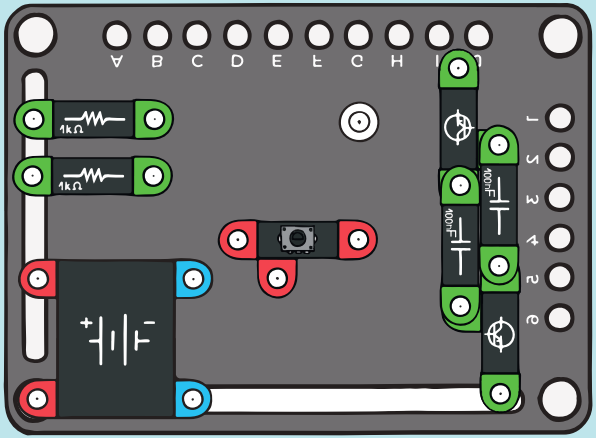
2.



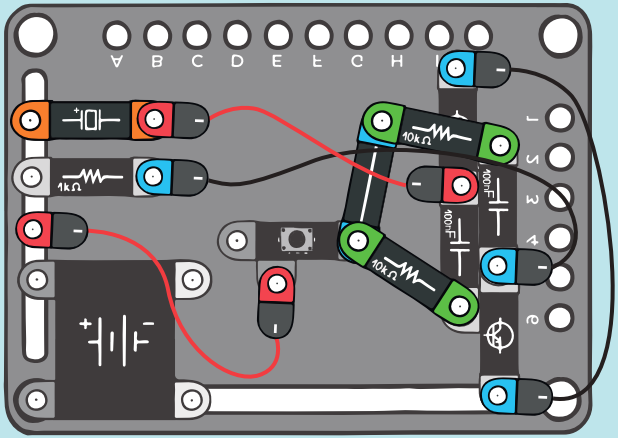
S90 ADJUSTABLE TONE GENERATOR

By suitably selecting components, we can force the L590 circuit to flip so rapidly that the change in electric current is able to cause the buzzer diaphragm to vibrate so fast that we hear a tone. In addition, we can use the potentiometer to influence the capacitor charging speed and thus change the pitch

1.



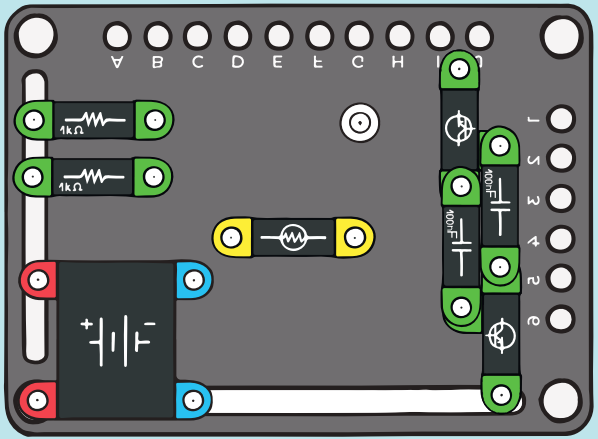
2.



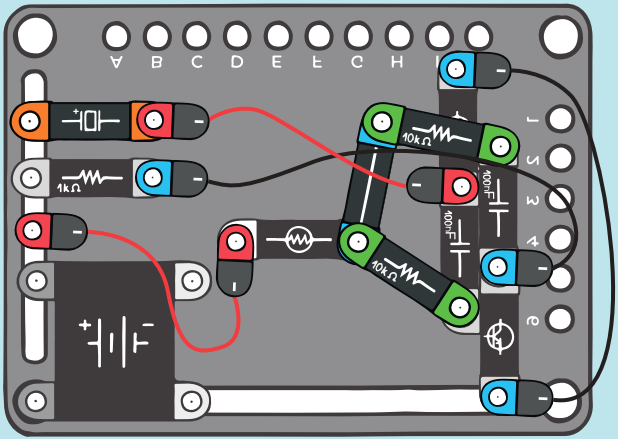
S100 PHOTOSENSITIVE ELECTRONIC ORGAN

You can connect a photoresistor instead of a potentiometer so the pitch will be directly proportional to the degree of illumination of the photoresistor.

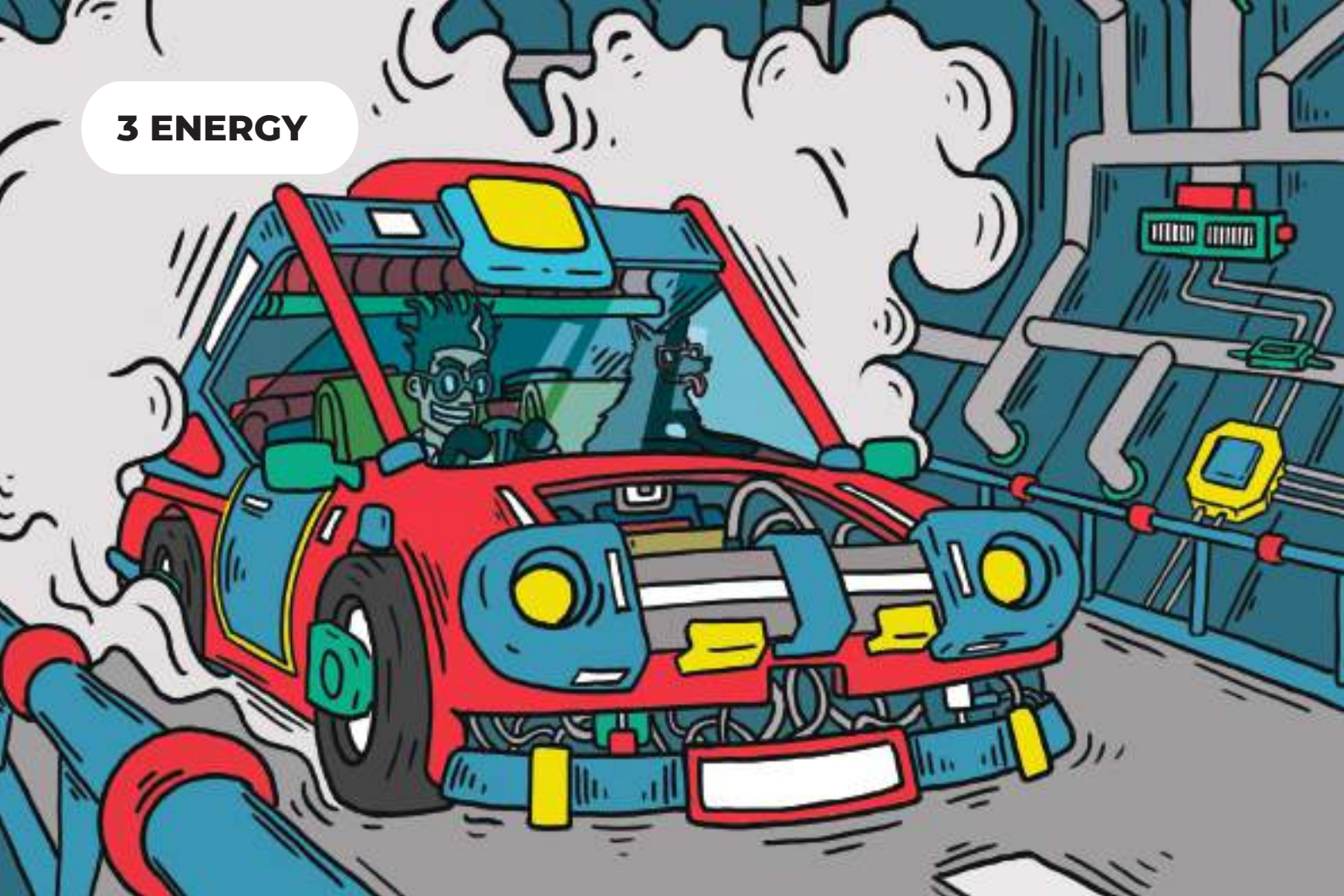
1.



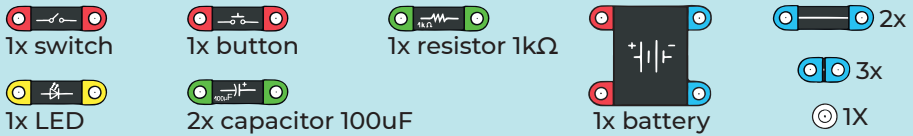
2.



3 ENERGY

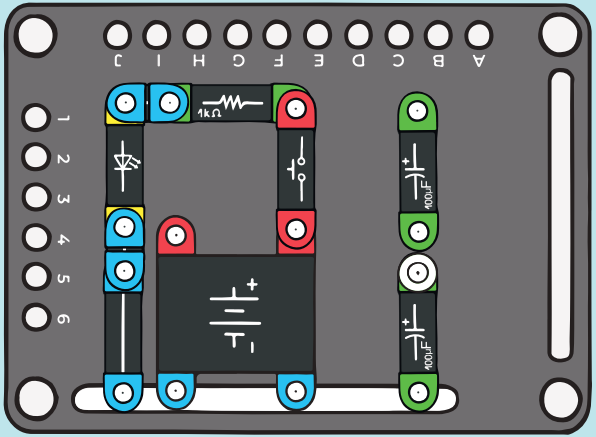


E10 CAPACITORS CONNECTED IN SERIES



This build makes it possible to supply power to the LED diode from one capacitor (with the switch closed) or from two capacitors connected in series (with the switch open). Because the total capacitance of capacitors connected in series decreases, after charging the capacitor(s), the LED will light longer when the switch is closed. If the switch is open, the LED light duration will be about a half (two identical capacitors in series have a total capacitance of one half).

1.



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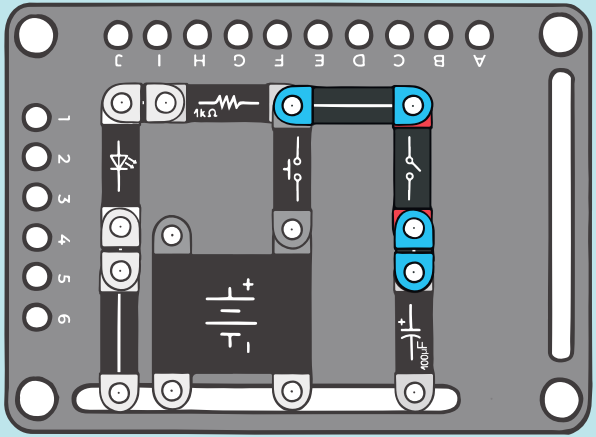
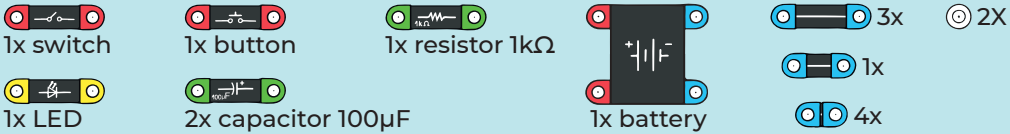
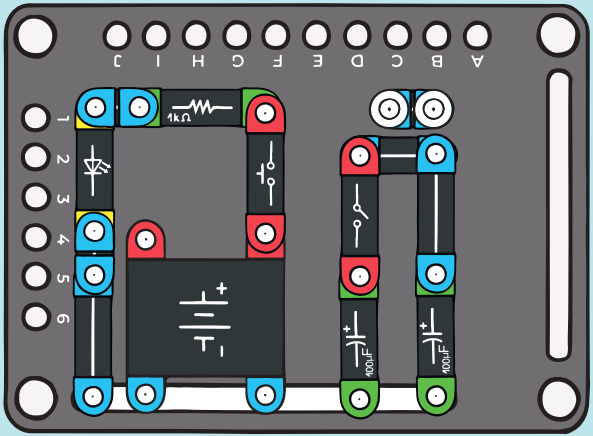


E20 CAPACITORS CONNECTED IN PARALLEL

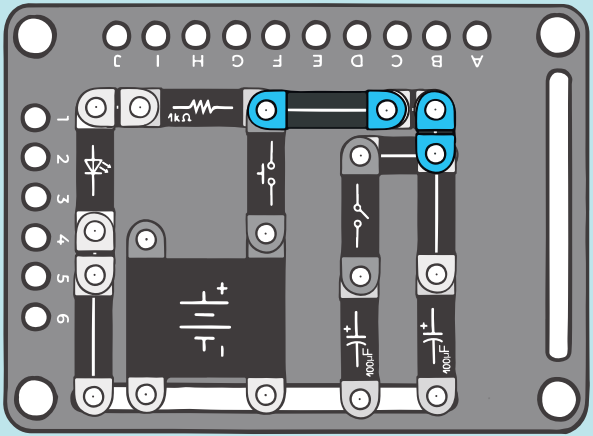


The build allows to supply power to the LED diode from two parallel capacitors (with the switch closed) or from one capacitor (with the switch open). In the parallel arrangement of the capacitors, their total capacitance is added up; therefore, once the capacitor(s) have been fully charged, the LED will light longer when the switch is closed. When the switch is closed, the LED light duration will be roughly doubled (two identical capacitors in parallel have twice the resulting capacitance).

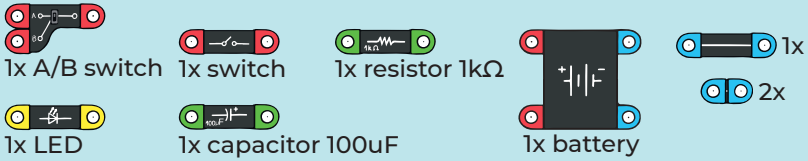
1.



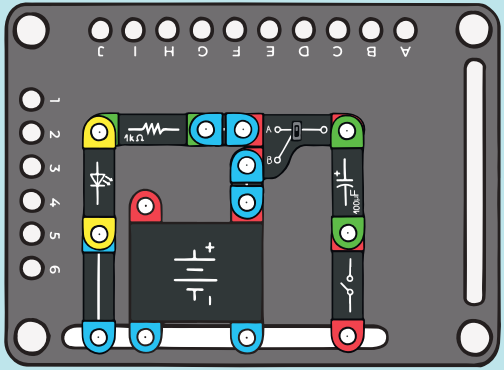
2.



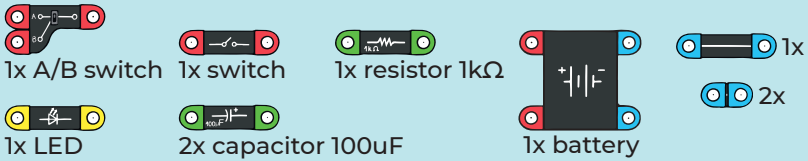
E30 YOUR OWN BATTERY I.



This circuit demonstrates the ability of the capacitor to accumulate an electric charge. By switching the capacitor to the battery, you will charge the capacitor and store electrical energy in it. When you switch it over to a LED, the energy in the capacitor is released in the form of an electric current that flows into the LED. The LED lights up. It is therefore powered from the capacitor. It is only possible to store and release energy when the switch is closed and, thus, the capacitor and LED circuit is closed.

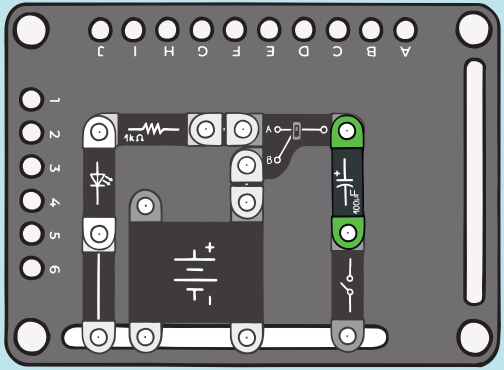


E40 YOUR OWN BATTERY II.

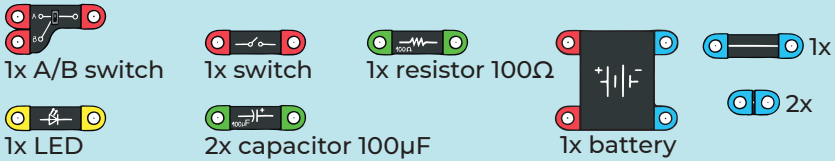


This build is identical to the previous version but contains two capacitors connected in parallel. The capacitor bank thus has a double capacitance. The LED will light up for a longer time.

Add a capacitor to the previous build

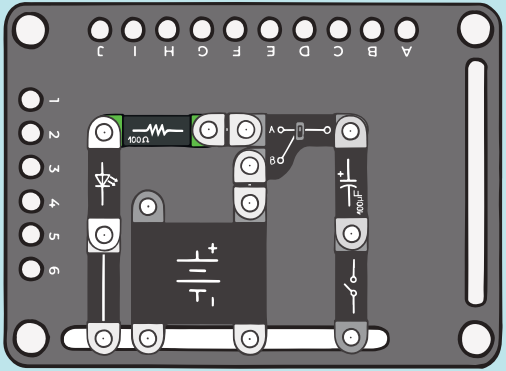


E50 YOUR OWN BATTERY III.

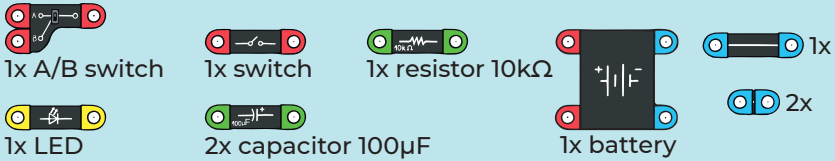


If you increase the current passing through the LED by reducing the value of the ballast resistor from 1 kΩ to 100 Ω, the current flowing through the LED diode will increase 10 times. The brightness will increase and the capacitor bank will be discharged earlier, so the LED will be on for a shorter time.

Adjust the previous build

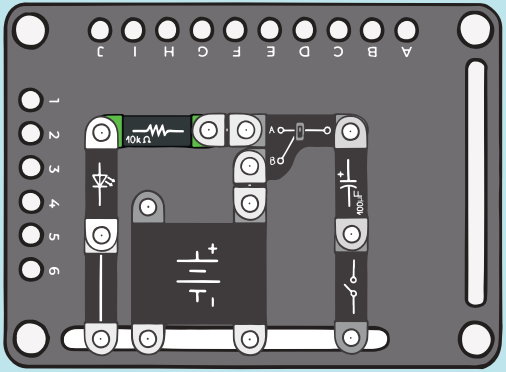


E60 YOUR OWN BATTERY IV.



Increasing the value of the ballast resistor to the LED will decrease the brightness and reduce the discharge current. The LED will last longer. As a result, you do not need to add more energy storage to extend the time provided by the capacitor, but you can start by reducing consumption.

Adjust the previous build

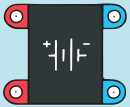


E70 CHARGING AND DISCHARGING THE CAPACITOR I.

1x button

1x resistor 100Ω

1x switch

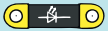

1x battery

2x

2x

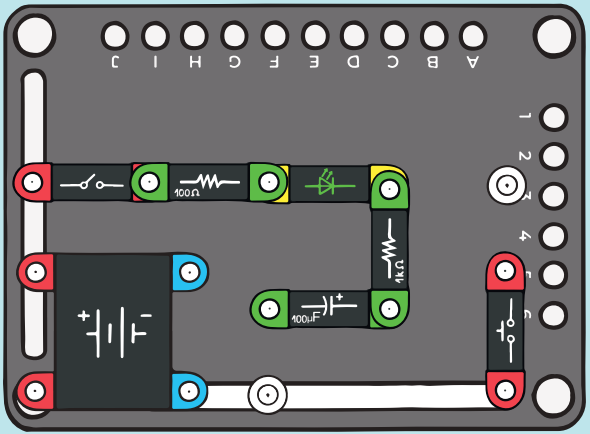
1x capacitor 100uF

1x resistor 1kΩ

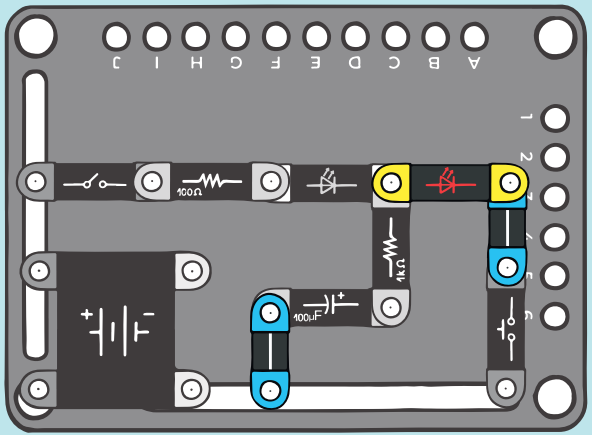

2x LED

Charging and discharging the capacitor is controlled by two buttons and indicated by two LEDs. A fully charged capacitor is indicated after pressing the button with the green LED flashing. Once the capacitor has fully been charged, no current flows into the capacitor (the green LED is off) because the voltage on the capacitor is the same as on the battery. The capacitor can be discharged by pressing the second button, which is indicated by the red LED. After the stored charge is depleted, no current flows through the discharge circuit with the red LED and the LED can no longer light up.

1.



2.

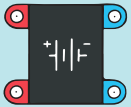


E80 CHARGING AND DISCHARGING THE CAPACITOR II.

1x button

1x resistor 100Ω

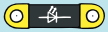
1x switch


1x battery

2x

2x capacitor 100μF

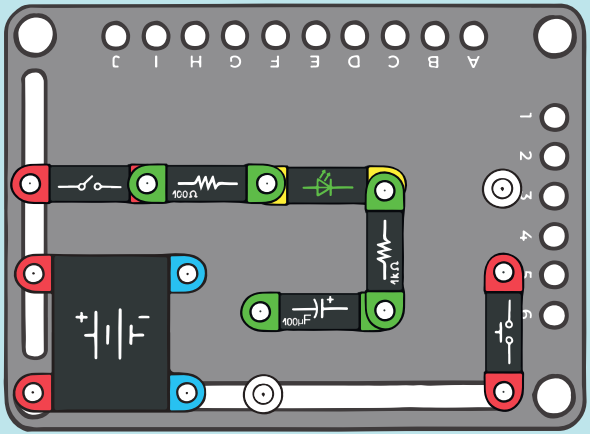
1x resistor 1kΩ


2x LED

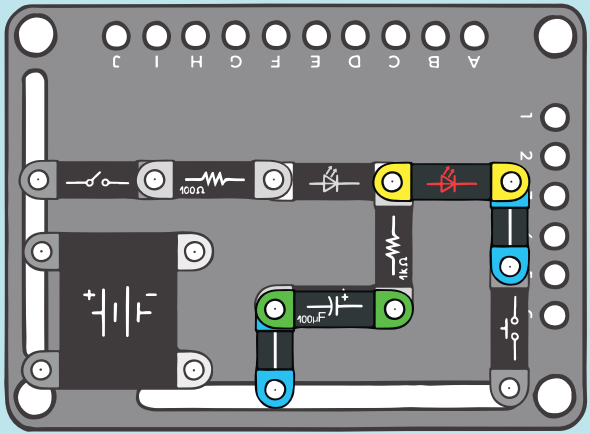
2x

By connecting the second capacitor in parallel, you will double the capacitance of the capacitor bank. Both LEDs will light up for about twice as long during charging and discharging. The function of the circuit is the same as for E80.

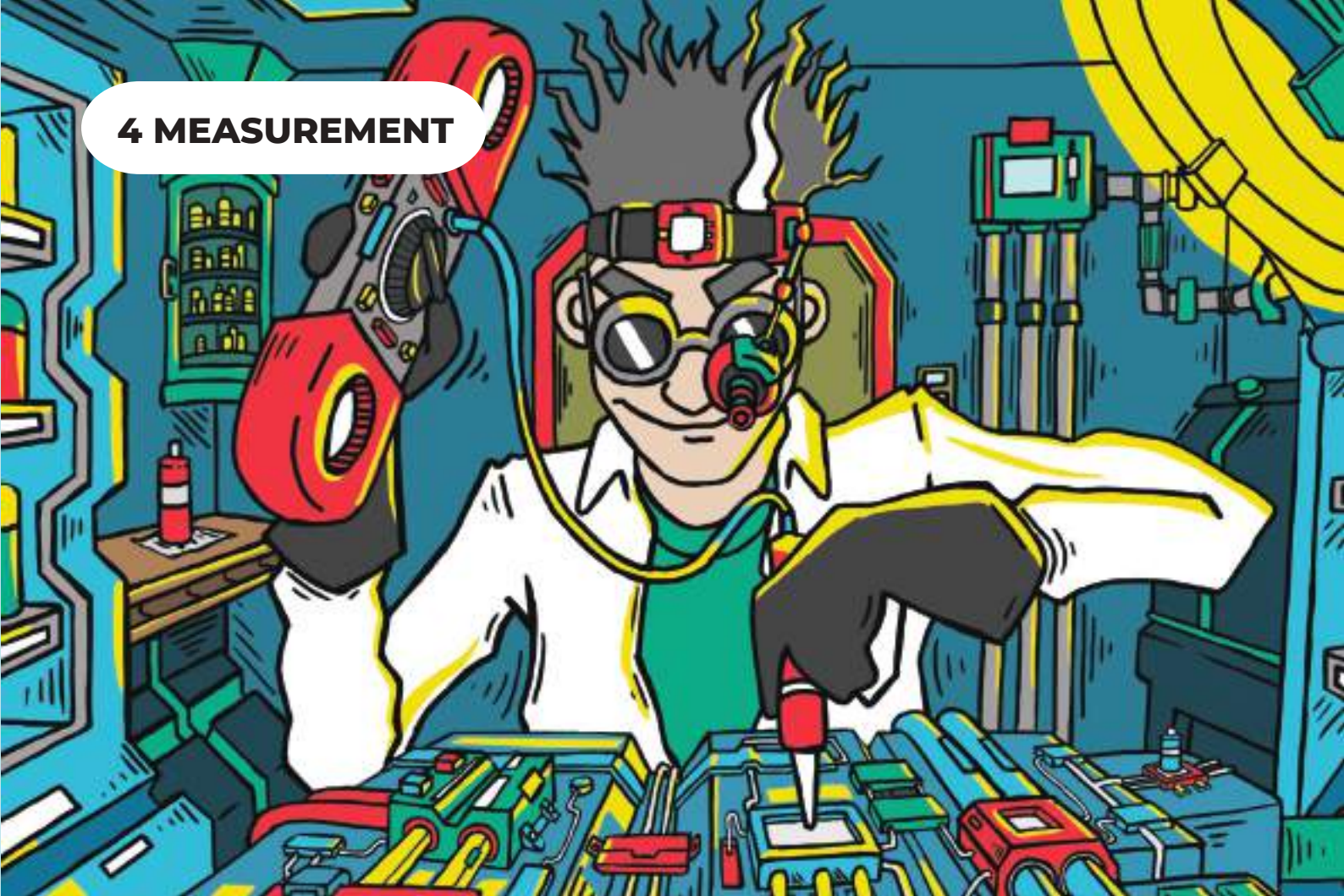
1.



2.



4 MEASUREMENT



M10 COMPRESSION METER

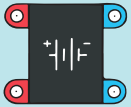
1x speaker

1x transistor NPN

1x transistor PNP

1x resistor 10kΩ

1x capacitor 100nF


1x battery

1x

1x

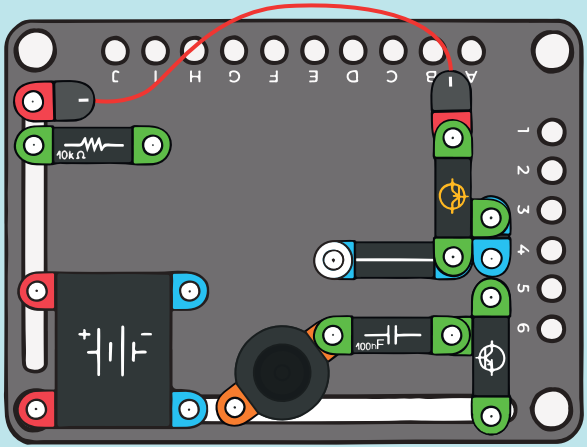
2x

2x

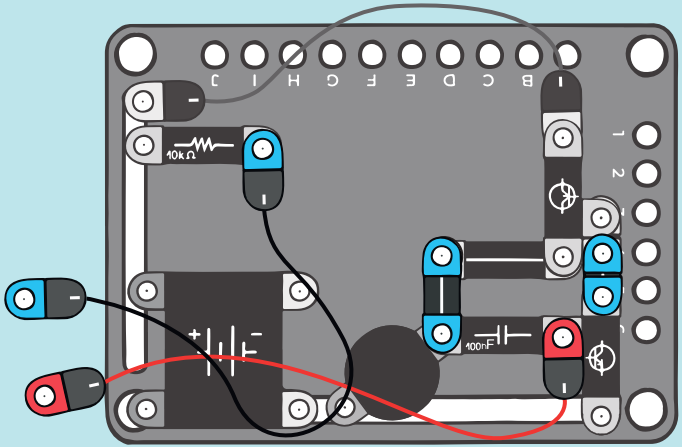
1x

1x

1.



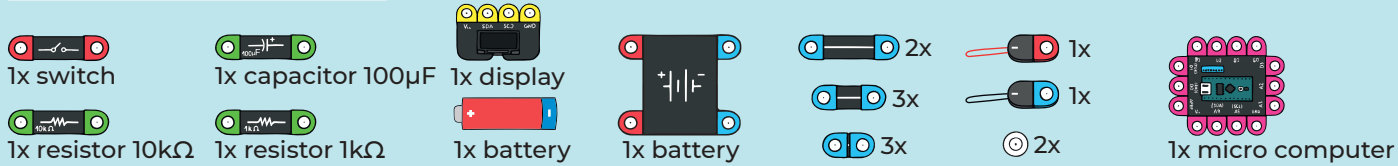
2.



As we know from the L240 build, our skin is conductive, especially when wet. If you replace the resistor in the simple buzzer described under S20 with conductors, then the resistance between the conductors will depend on the degree of compression between them. A fixed resistor is included in the circuit as a safety element so that, in the event of a short circuit of both conductors, the NPN transistor is not destroyed by too much current flowing to the base.

Warning: Never connect the red conductor directly to the positive terminal of the battery. There is a risk of the NPN transistor getting damaged!

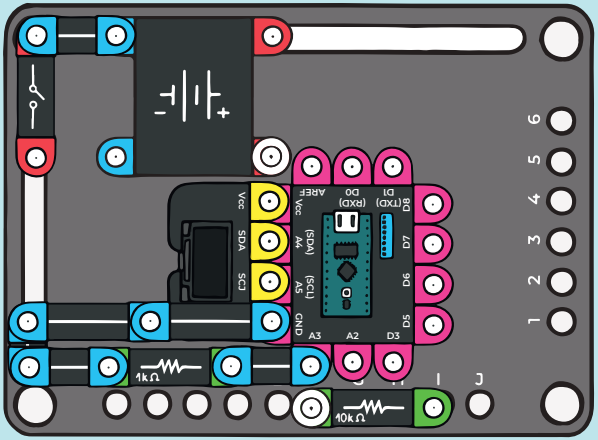
M20 VOLTAGE METER



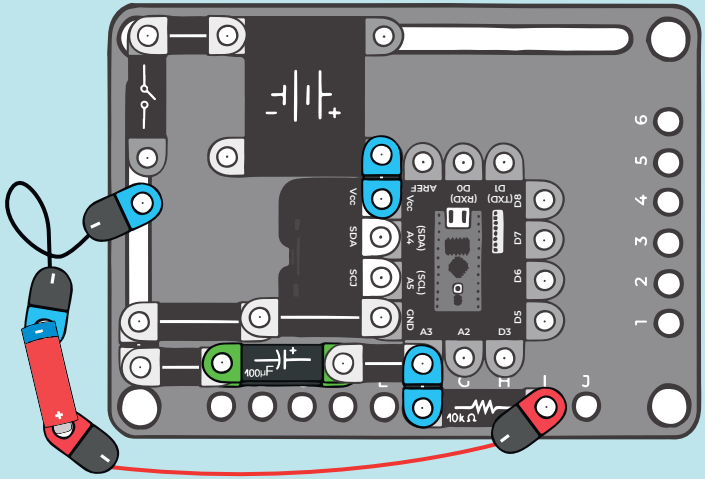
Each electrical device is powered by electrical energy, which can come from a battery or a power generator. In both cases, the source supplies an electric current of a certain voltage to the circuit. For batteries it is 1.5V, 9V or other voltage. As the battery discharges over time, its voltage also decreases. With this circuit, you can measure whether you can still use the battery or not. Attach the free terminals to the battery, with the red conductor placed on the positive contact and the black one on the negative contact.

Set the switches on the microcomputer to the ON position. In this build, it will only be Changeover Switch 6.
Tip: If you do not know where to set the changeover switches, see the Games section on Page 91 for more detailed pictures.

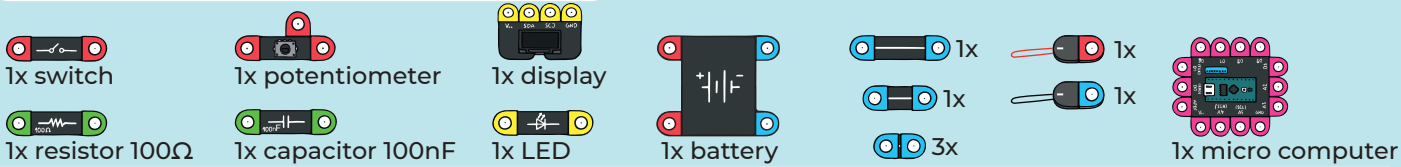
1.



2.



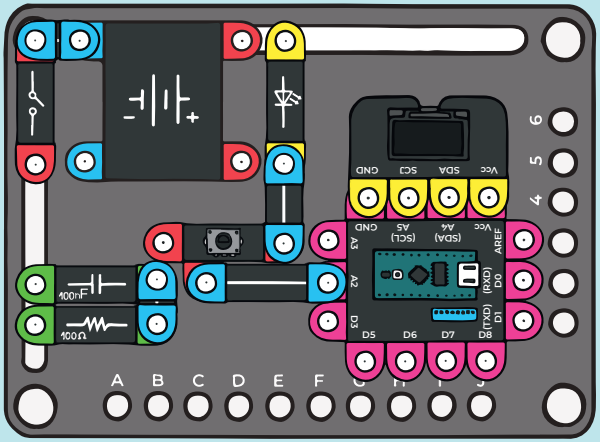
M30 LOW CURRENT MEASUREMENT



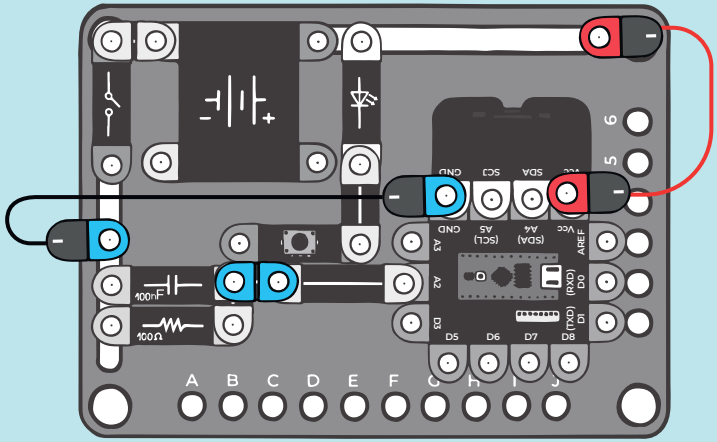
The flow of electric current through the circuit through the resistor causes the component to heat up, which represents an output power loss on the appliance. In order to determine the output power loss, it is first necessary to know the current flowing through the circuit, which is digitally measured as a voltage drop across a very small resistance. Common resistor values are less than 1Ω but are supplemented by signal amplifiers. Here we will include a 100Ω resistor in the circuit at which we will read the current being measured.

Set the changeover switches on the microcomputer to the **ON** position. In this build, set Changeover Switches **1** and **6.**

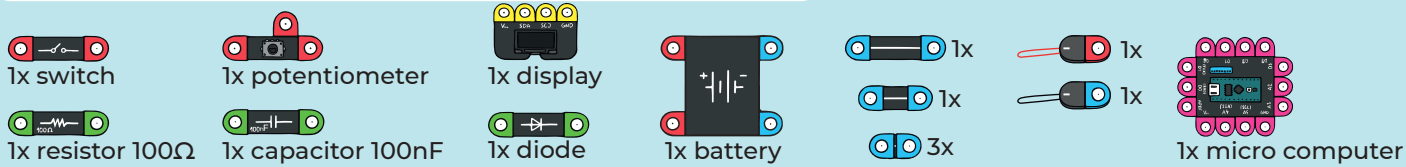
1.



2.



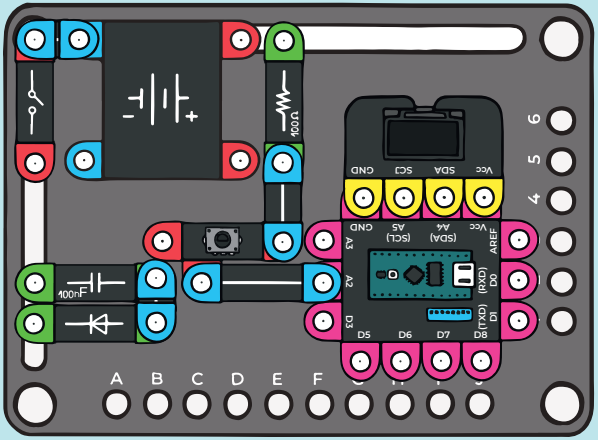
M40 DIODE FORWARD DIRECTION MEASUREMENT



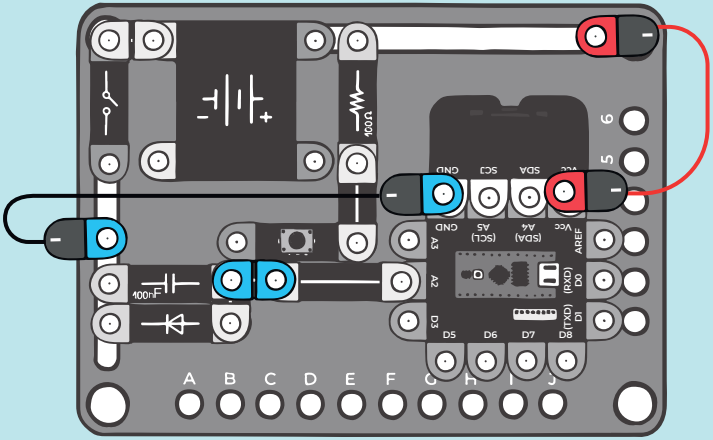
By connecting a diode to the circuit in the forward direction, you can determine its voltage drop and then also the output power loss during the passage of current. Conventional diodes tend to have a voltage drop between 0.2 and 1.5V. It depends on the production technology and also the purpose of use. The power diodes that you can find in electric locomotives can reach a pass voltage of just about 1.5V. On the contrary, common silicon or special diodes have a voltage mostly around 0.7V. Furthermore, the pass voltage depends on the magnitude of the current flowing through the diode. The higher the current, the higher the voltage drop across the diode. Test what voltage you can measure.

Set the changeover switches on the microcomputer to the **ON** position. For this circuit, set Changeover Switches **2** and **6**.

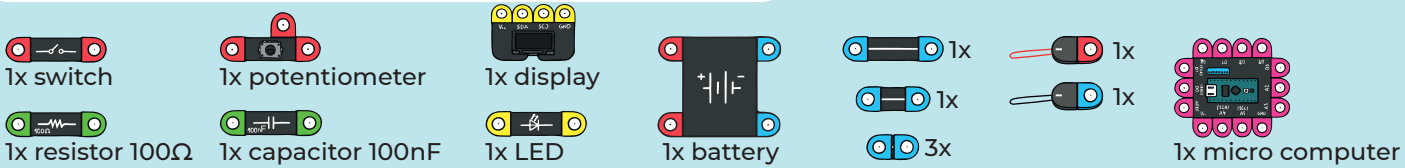
1.



2.



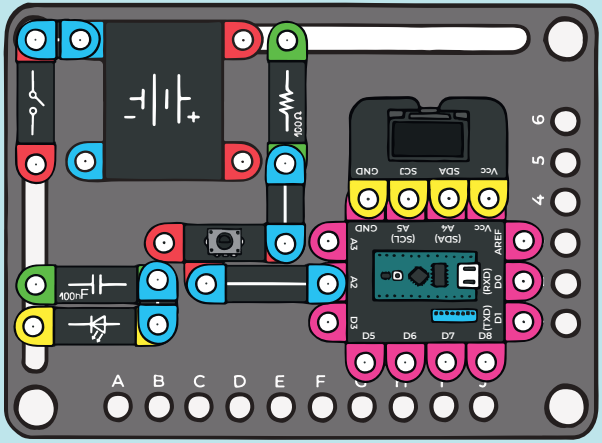
M50 LED FORWARD DIRECTION MEASUREMENT



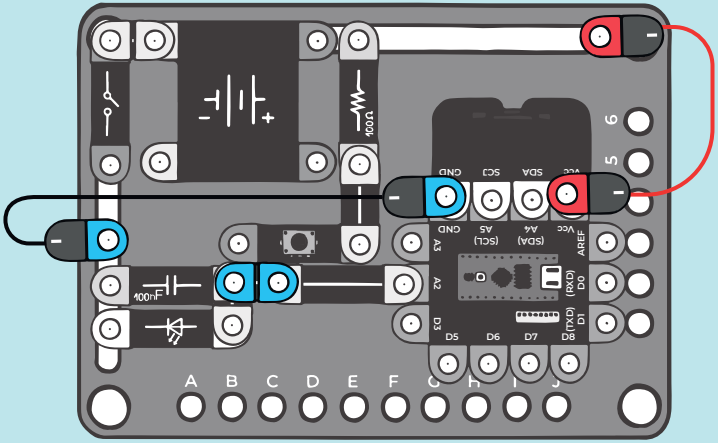
You can use the same circuit as in the previous build, just connect a light-emitting diode instead of a diode. Verify that different colors may have different voltages in the forward direction, depending on the technology that is used to manufacture them.

Set the changeover switches on the microcomputer to the **ON** position. In this build, set Changeover Switches **1**, **2** and **6**.

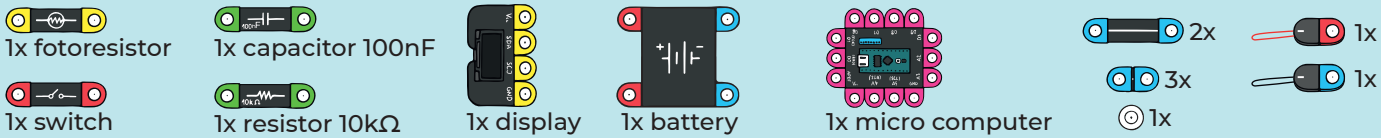
1.



2.



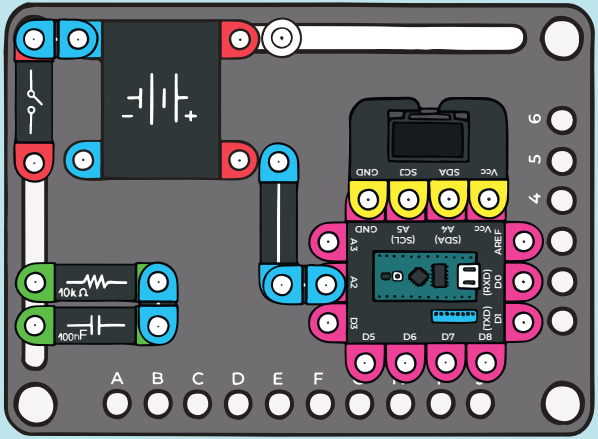
M60 LUMINANCE LEVEL MEASUREMENT



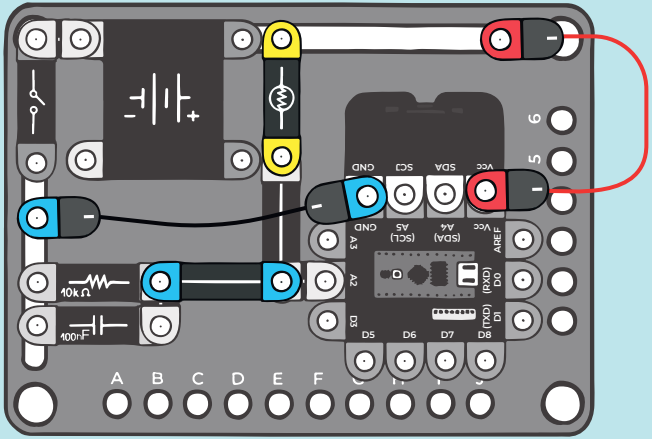
You can test the conversion of a non-electric quantity into its digital representation in this task, where you create a resistive voltage divider and connect a ballast resistor in one part and a photoresistor in the other as an element responding to the intensity of illumination. The higher the luminance intensity, the lower the resistance the resistor will have. See how the voltage on the resistive voltage divider will change when you cover the photoresistor with your finger or expose it to sunlight.

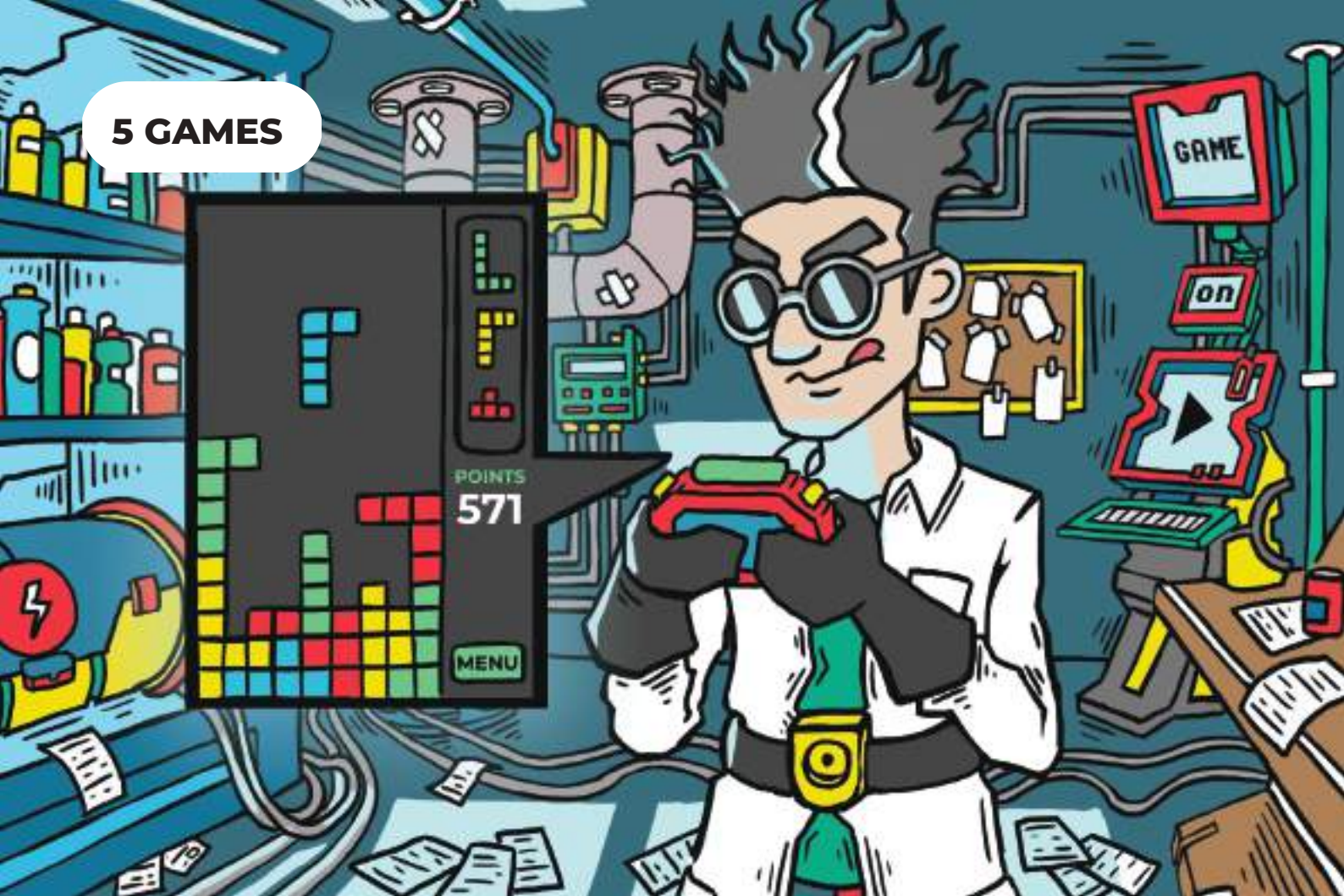
Set the changeover switches on the microcomputer to the **ON** position. In this circuit, set Changeover Switches **3** and **6**.

1.



2.




5 GAMES
POINTS
571
MENU
GAME
on

G10 FAST REFLEXES

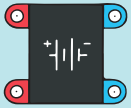
1x LED

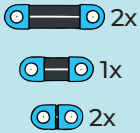
1x resistor 1kΩ

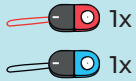
2x button

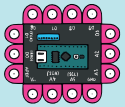
1x switch

1x display


1x battery

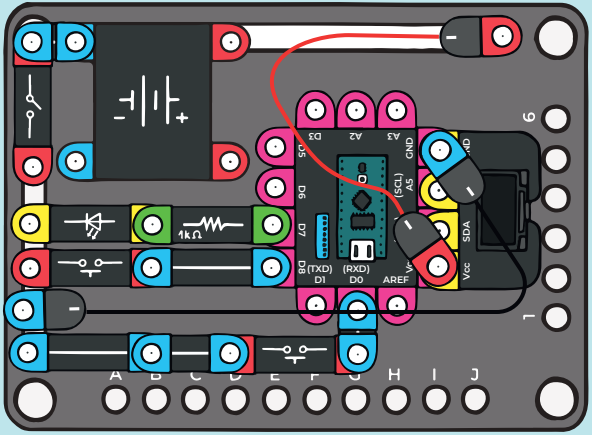

2x
1x
2x


1x
1x

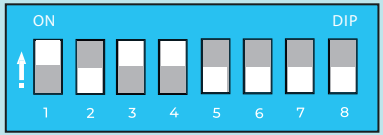

1x micro computer

A circuit for measuring how fast your reflexes are (reaction times to an optical stimulus). It is a fun and yet a practical build. Before assembling the circuit as shown in Figure 1, first adjust the position of the changeover switches as shown in Figure 2. Press the lower button to start the measurement. Then wait for the LED to light up and as soon as it happens, press the button under the LED as quickly as possible. Your reaction time will appear on the display. This way you can compete with friends or test your own reaction time according to the time of day.

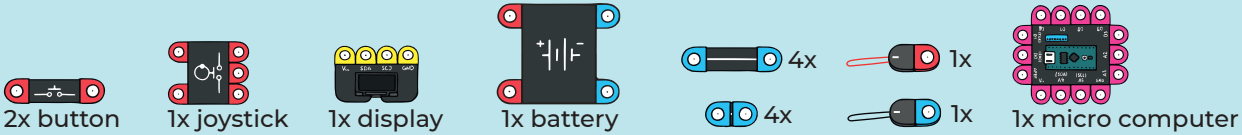
1.



2.

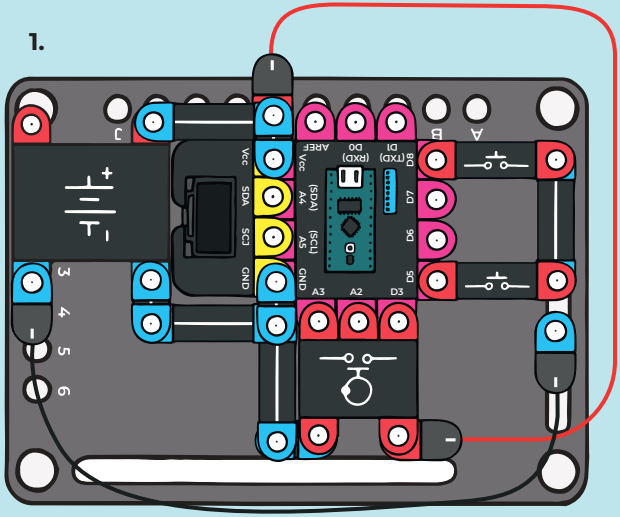


G20 PLATFORM GAME WITH BOFFIN

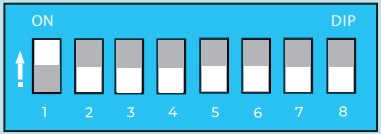


Make your own game console with a microcomputer, buttons and joystick. Before assembling the circuit as shown in Figure 1, first adjust the position of the changeover switches as shown in Figure 2. Then you can start playing and help the Boffin figure complete the mission. Do not disassemble the connected project as you will use it in other projects.

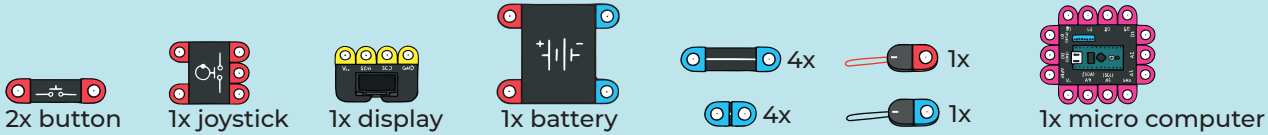
1.



2.

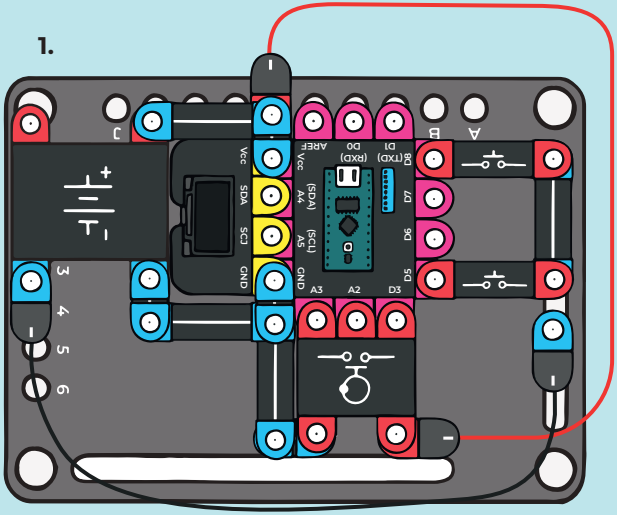


G30 PING PONG MULTIPLAYER

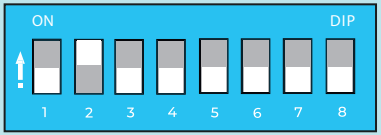


In the previous project, you learned how to build a game console using Boffin Magnetic. Now it is time to play a game against a friend. First, adjust the position of the changeover switches as shown in Figure 2. This will take you to a game called Ping Pong. This game is meant for two players. One of the players uses two buttons and the other one a joystick. To keep the game fair, we recommend swapping the controls after each game.

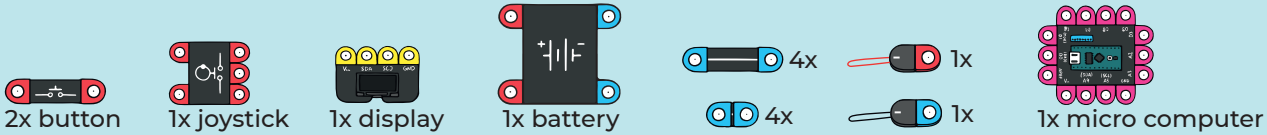
1.



2.

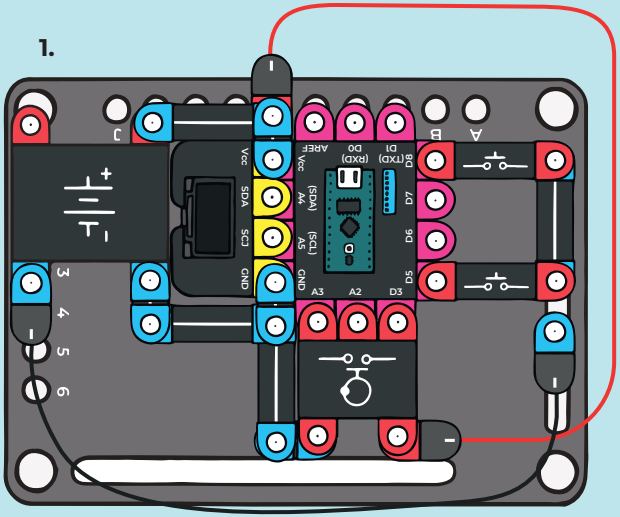


G40 TETRIS

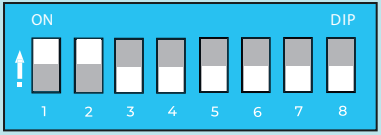


In previous projects, you learned how to assemble a game console using Boffin Magnetic. The connected circuit is the same as in the previous builds. Just change the position of the changeover switches as shown in Figure 2. At this point, you have entered the game of Tetris and your task is to reach the highest score. Can you beat Boffin himself?

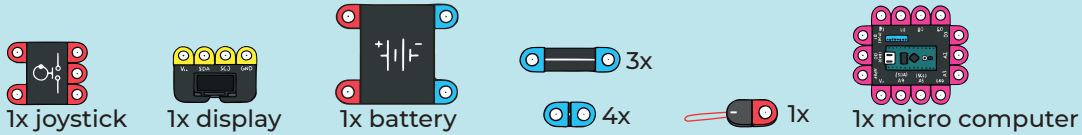
1.



2.

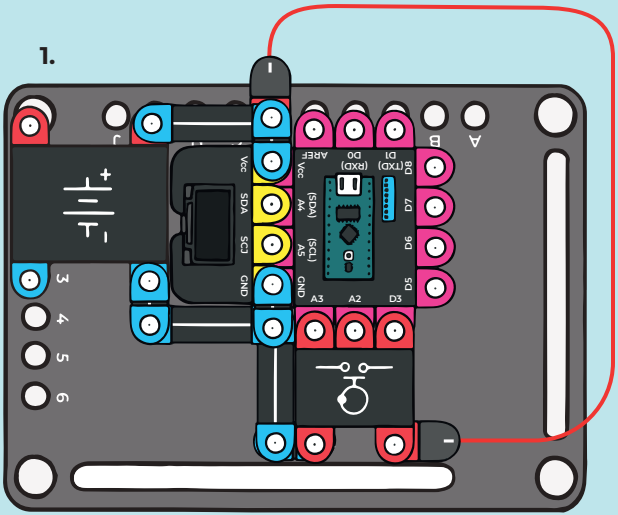


G50 ROXY CATCHES DICE

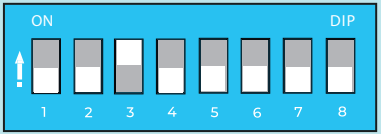


In previous projects, you learned how to build a game console using Boffin Magnetic. This build remains almost the same as in the previous projects, just remove the two buttons and leave the joystick. Then change the position of the changeover switches as shown in Figure 2. At this point, you get into a game where a dog named Roxy catches dice or hearts, but watch out for bombs that take your lives.

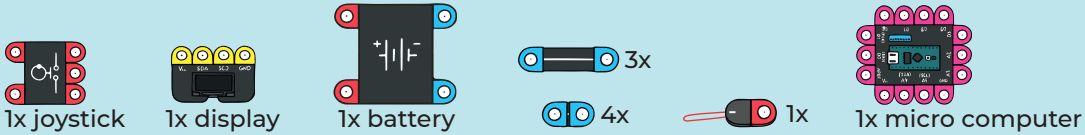
1.



2.

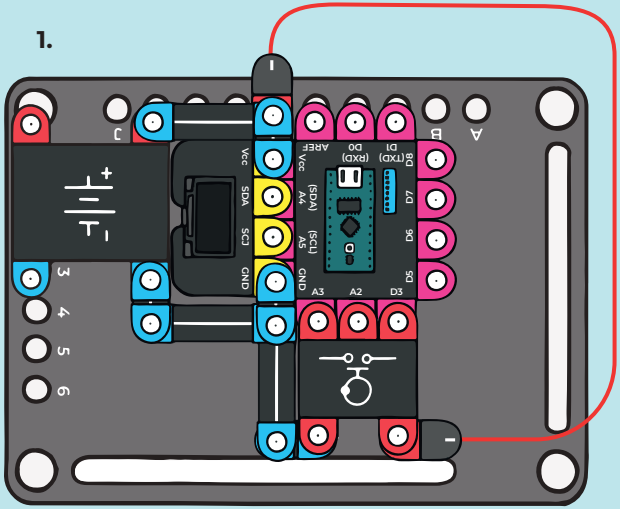


G60 PING PONG SINGLE PLAYER

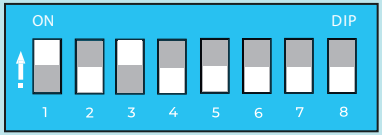


In the previous project, you learned how to build a game console with a joystick only. Because there is not always an opponent at hand, you can play against a micro computer that will be more than an equal opponent. Make sure to reset the changeover switches as shown in Figure 2.

1.



2.

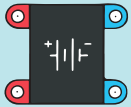


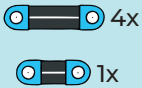
G70 SHOOTING DOWN THE DICE

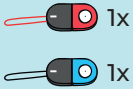
1x potentiometer

2x button

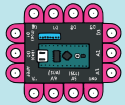
1x display


1x battery


4x 1x

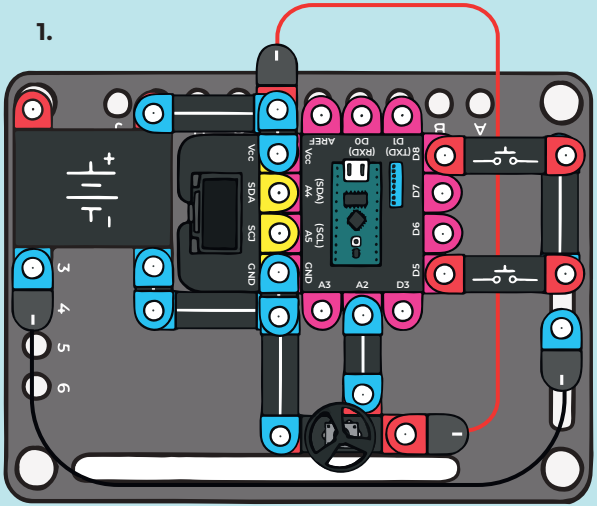

1x 1x

3x

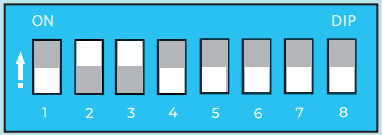

1x micro computer

In this project you will be able to build a console that you will use for racing games and shooters. We replaced the joystick with a potentiometer, which changes its internal resistance by turning and can thus be used for direct control. You can attach a steering wheel to the potentiometer which will give you a more realistic experience. Before assembling the circuit according to Figure 1, set the positions of the changeover switches according to Figure 2.

1.



2.

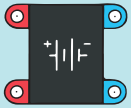


G80 SPACE SHOOTER

1x potentiometer

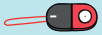
2x button

1x display


1x battery

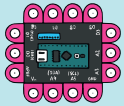
4x

1x


1x

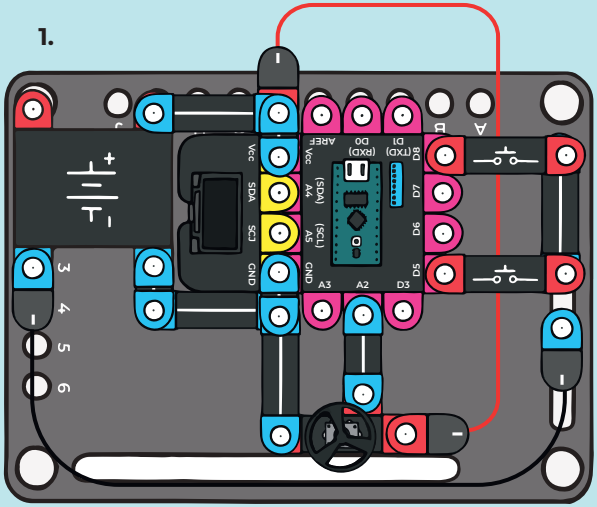
1x

3x

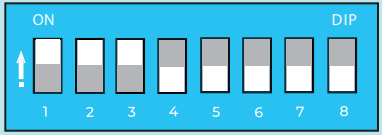

1x micro computer

In this project you will be able to build a console that you will use for racing games and shooters. The circuit remains the same as in the previous project. Just adjust the position of the changeover switches as shown in Figure 2. Now you can go on a space mission and save the whole world.

1.



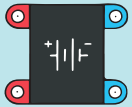
2.



G90 RACING GAME I.

1x potentiometer

1x display

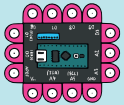

1x battery

3x

1x

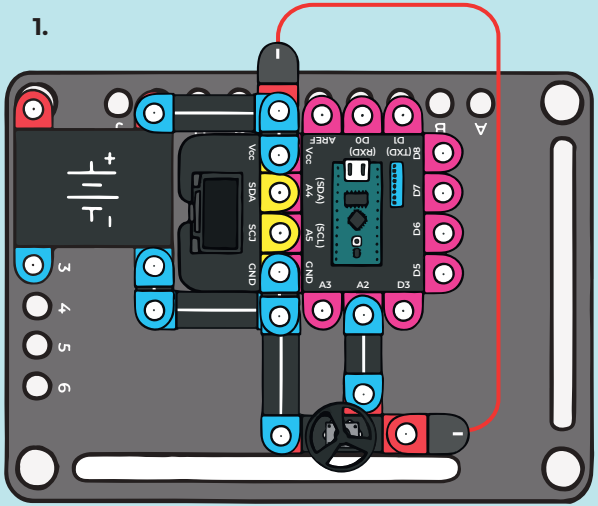
1x

3x

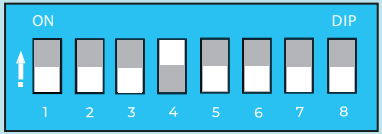

1x micro computer

Build a racing simulator. You can steer using a potentiometer (it changes its internal resistance by turning and can thus be used for direct control) on which you place a plastic steering wheel. Before assembling the circuit according to Figure 1, set the position of the changeover switches according to Figure 2. Now there is nothing stopping you from taking up on the role of a Formula 1 pilot.

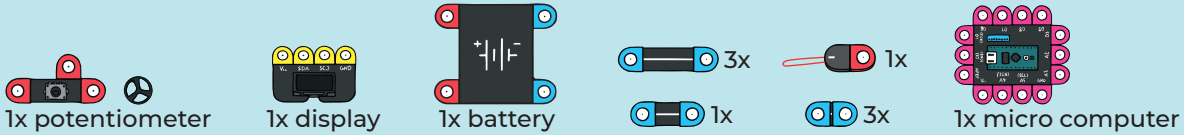
1.



2.

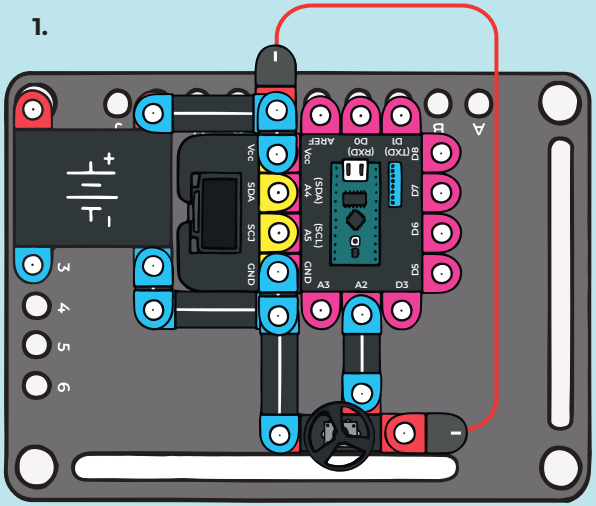


G100 RACING GAME II.

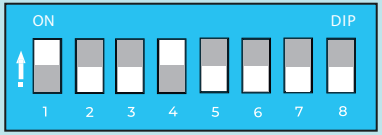


Build a racing simulator. You can steer using a potentiometer (it changes its internal resistance by turning and can thus be used for direct control) on which you place a plastic steering wheel. Before assembling the circuit according to Figure 1, set the position of the changeover switches according to Figure 2. This is an advanced level of the previous game.

1.



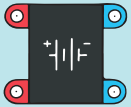
2.



G110 SNAKE

2x button

1x display

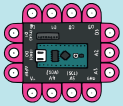

1x battery

2x

1x

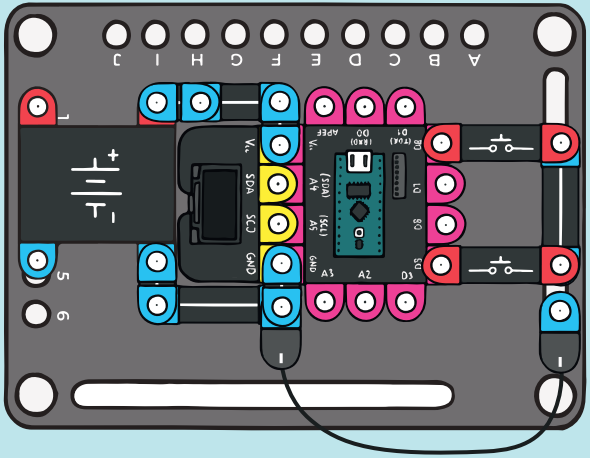
4x

1x

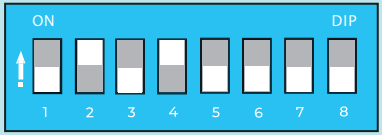

1x micro computer

Build a simple game console. You only have two buttons, but as usual, that is enough to control most funny games, such as the classic snake. Before assembling the circuit according to Figure 1, set the position of the changeover switches according to Figure 2. In this game you have only one task, and that is to achieve the highest possible score.

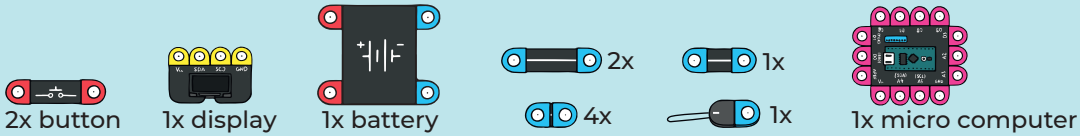
1.



2.

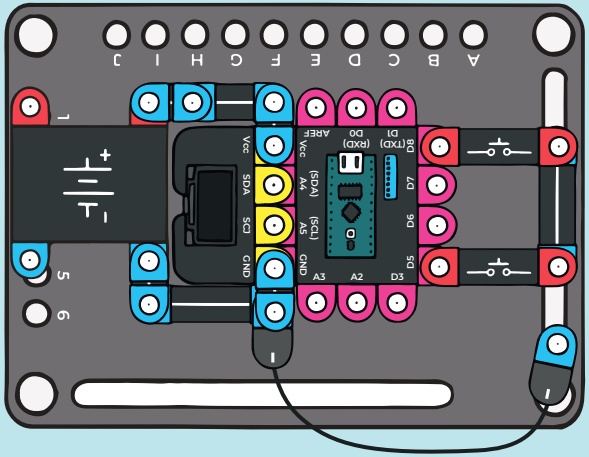


G120 JUMPING WITH BOFFIN

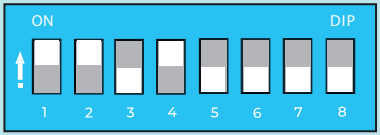


Build a simple game console. You only have two buttons, but as usual, that is enough to control most funny games. Before assembling the circuit according to Figure 1, set the position of the changeover switches according to Figure 2. This game has been personally prepared for you by the Boffin figure, and your task is to bring the figure to the end of a thorny path along which you will run, having to jump over specific obstacles. I wish you good luck.

1.



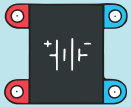
2.

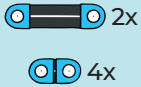


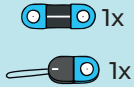
G130 LOGIC GAME WITH BOFFIN

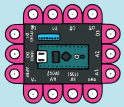
2x button

1x display


1x battery

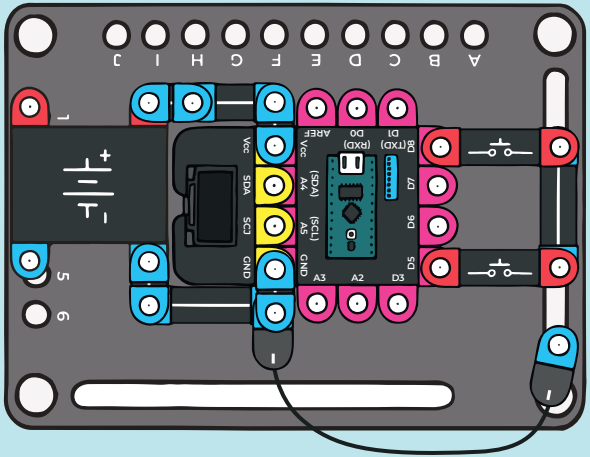

2x 4x


1x 1x

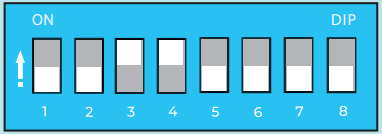

1x micro computer

Build a simple game console. You only have two buttons, but as usual, that is enough to control most funny games. Before assembling the circuit according to Figure 1, set the position of the changeover switches according to Figure 2. This game is mainly about your knowledge. Boffin will ask you tricky questions and it is up to you how fast you answer them and how far you progress in this game.

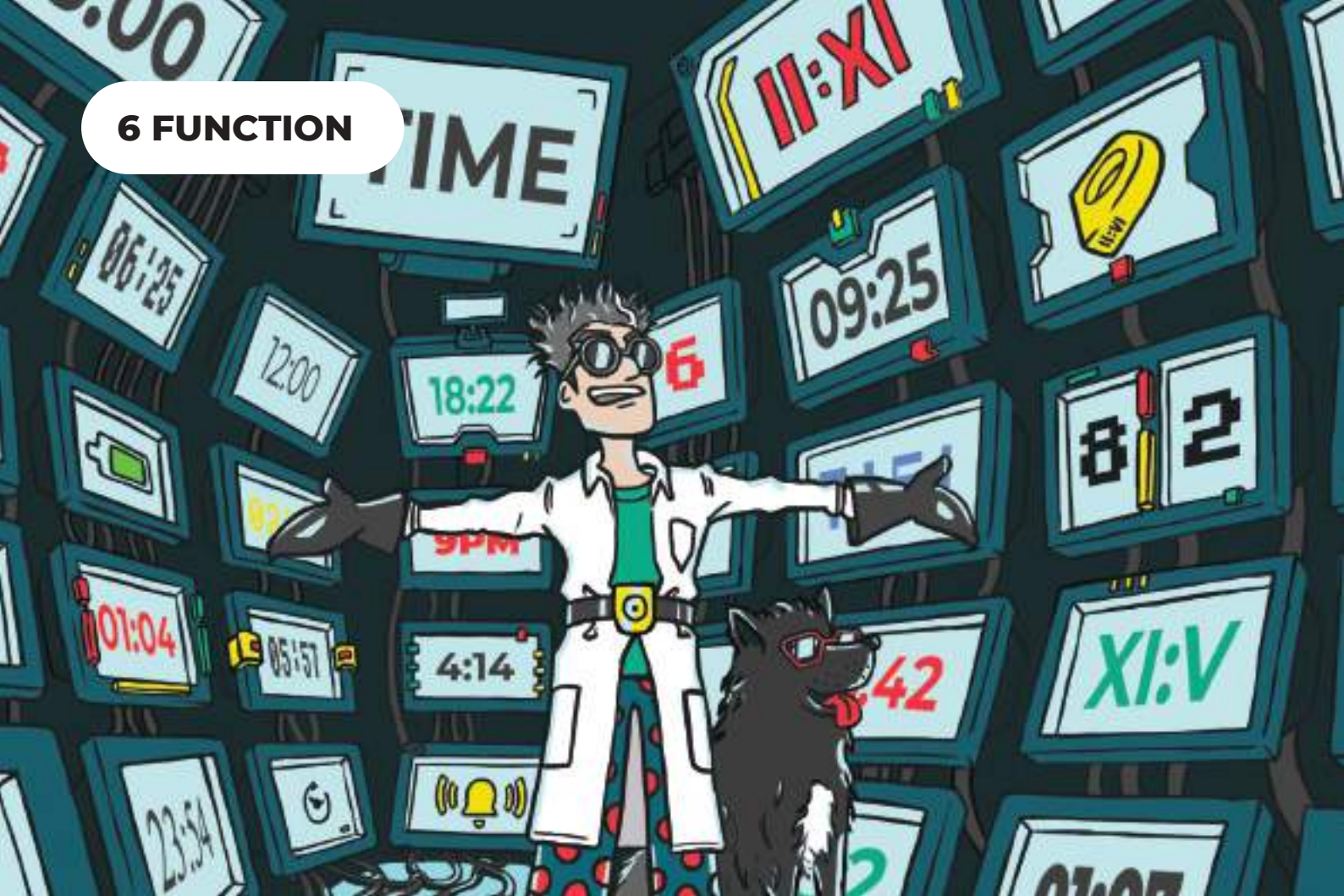
1.



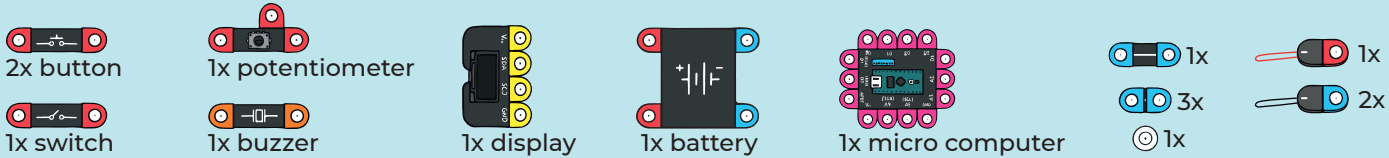
2.



6 FUNCTION

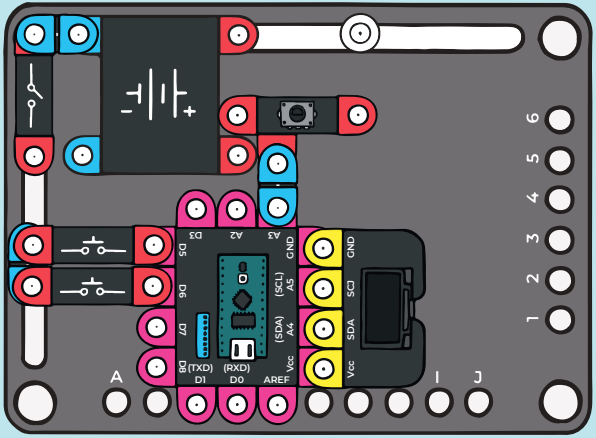

TIME
11:XI
06:25
09:25
12:00
18:22
6
8 2
9PM
01:04
05:57
4:14
42
XI:V
23:54

F10 KITCHEN TIMER

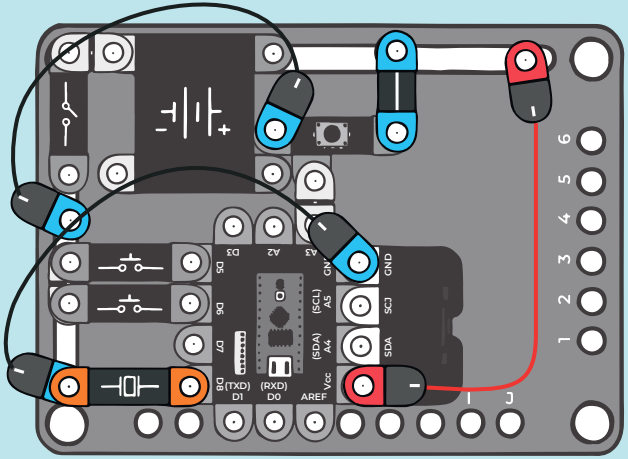


Make your mother or partner happy and put a kitchen timer in her kitchen so that she can bake something good for you. All you have to do is make the circuit using Figures 1 and 2 and then set the changeover switches to the correct position. In this case, set Changeover Switches **6** and **7** to the **ON** position (i.e. up).

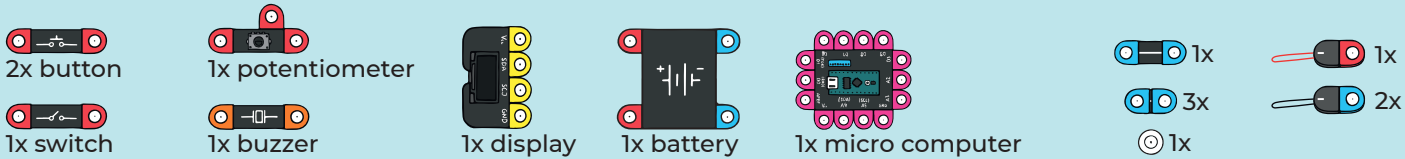
1.



2.

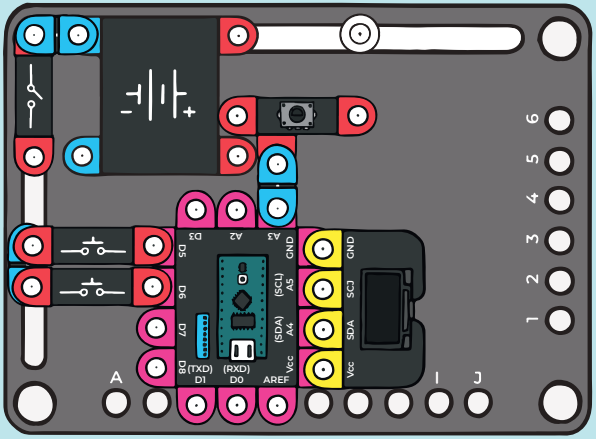


F20 CLOCK

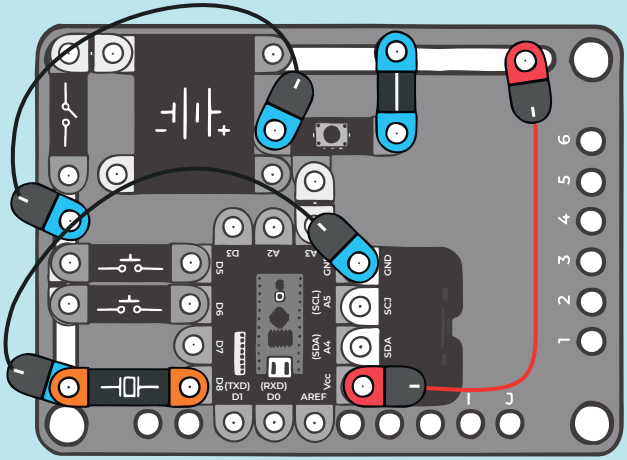


There are many things you can do with a microcomputer, but how about doing something to help you get up for school or work? Build a simple clock with an alarm function. As soon as you set the alarm, put it as far away from your bed as possible so that you can be sure that you will not destroy the connection in the morning and that you will get up. Set the changeover switches to the correct position, as you learned in the previous chapter.
In this case, set Changeover Switches **1**, **6** and **7** to the **ON** position.

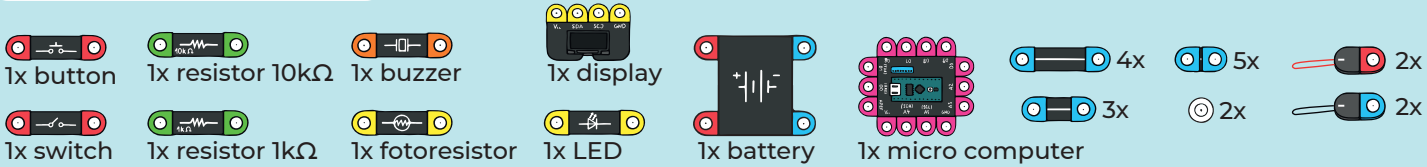
1.



2.

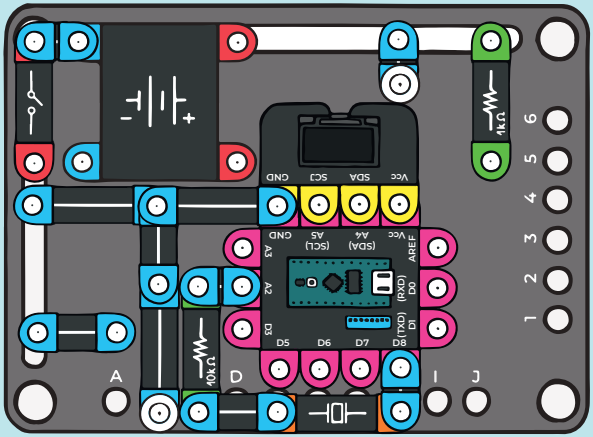


F30 PASS COUNTER

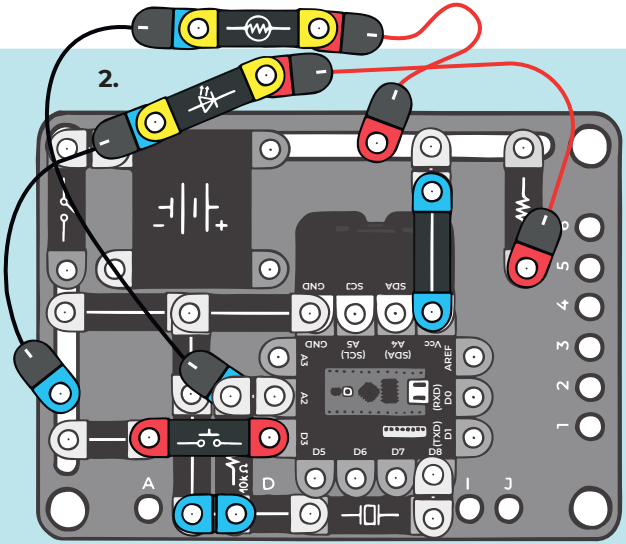


Assemble a pass counter using a LED and a photoresistor. The whole principle is simple – if an object or person gets between the diode and the photoresistor, the LED light does not shine on the photoresistor, which is interpreted as a circuit interruption. You can place this circuit, for example, on the door of a refrigerator and find out how many times a day it has opened. I believe that the number will surprise you. Set the changeover switches to the correct position as you learned in the previous chapter.
In this case, set Changeover Switches **2**, **6** and **7** to the **ON** position.

1.



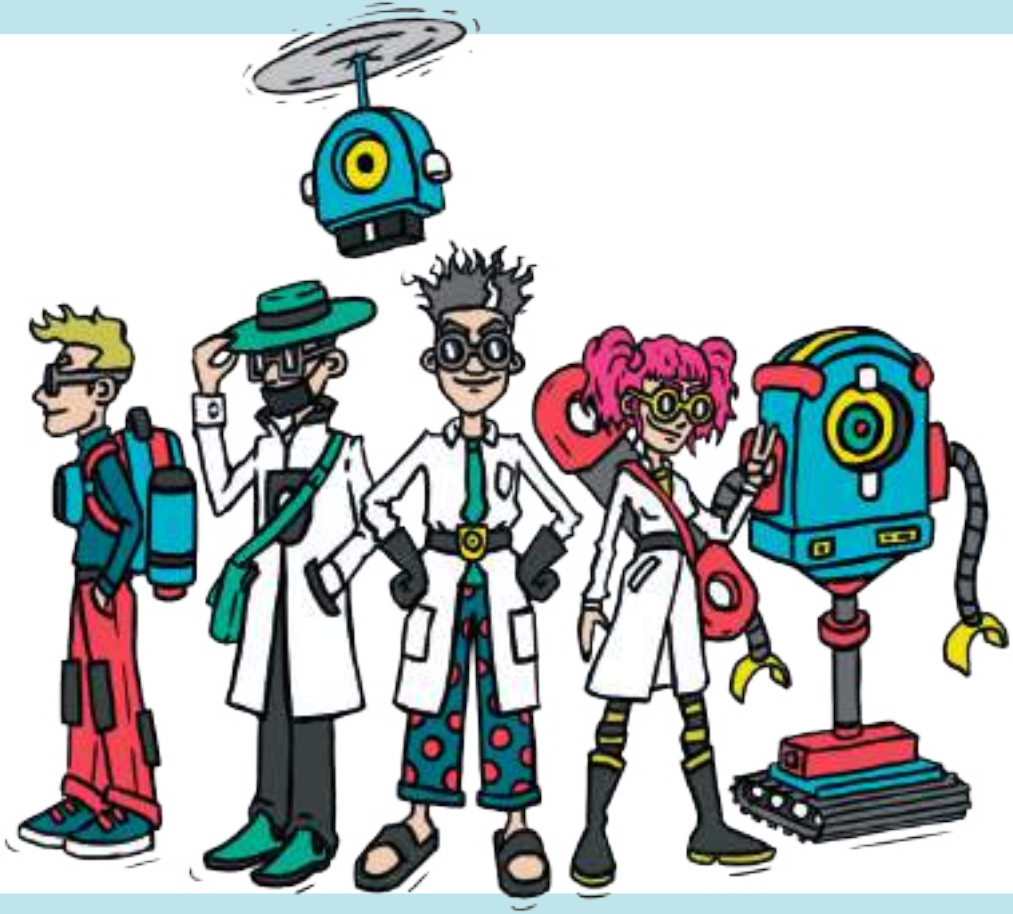
2.



You have made it!!

I hope you have had a great time. If you do not have enough yet (and I hope you don't), do not forget that you can find more projects on our website!

www.boffinmagnetic.com/community/projects



Did you know that Boffin magnetic has two other friends?

Their names are **3Dsimo** and **Noyce Joyce**.
Each of these friends has different super powers. Boffin Magnetic is a young genius. 3Dsimo is a handyman who repairs everything and substitutes an entire workshop. On the other hand, Noyce Joyce can turn any electronics into a kit that is either functional, beautiful or can even be worn.

3Dsimo web: www.3dsimo.com

Noyce Joyce web: www.noycejoyce.com

MORE BOFFIN
ELECTRONIC PARTS ON
BOFFINMAGNETIC.COM

It would not be Boffin Magnetic if he did not prepare a puzzle for you that will help you get a discount on all products from our e-shop.

In every household you have sockets that you use to power your computer, TV, refrigerator and many other appliances. Do not insert metal objects or fingers into these sockets as they have a high voltage. What phase voltage does your socket have at home?

There are multiple correct answers to this puzzle.

Just write the correct answer (number only) in the box in the basket under the name (discount code) in our e-shop and get a 25% discount on any product from our offer.

www.eshop.3dsimo.com

package contains **58 components**

Additional components can be purchased on:
www.boffinmagnetic.com

5x

connection 1

5x

connection 2

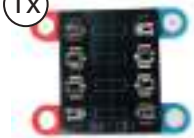
5x

connection 3

4x

connection 4

1x



battery 4xAAA

1x

joystick

1x

ON/OFF switch

1x

changeover switch

1x

potenciometer
50kΩ

2x

button

1x

microphone

1x

buzzer

1x

speaker

1x

reed switch

1x

OLED display

1x

fotoresistor

1x

lightbulb

1x

white LED diode

1x

green LED diode

1x

red LED diode

1x

resistor 100Ω

2x

resistor 1kΩ

2x

resistor 10kΩ

2x

resistor 100kΩ

1x

resistor 1MΩ

1x

PNP transistor

2x

NPN transistor

2x

polarized capacitor 100µF

1x

capacitor 10µF

2x

capacitor 100nF

1x

diode

1x

micro computer

2x

cable connection black

2x

cable connection red

1x

magnetic board