Brick 'R' knowledge

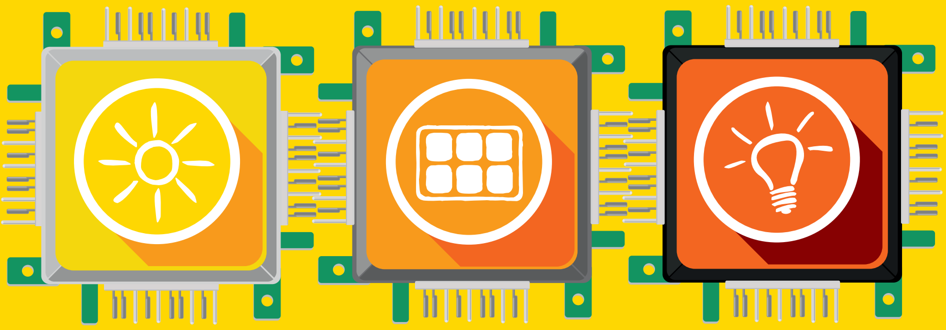
Solar Set

Solar experimental kit

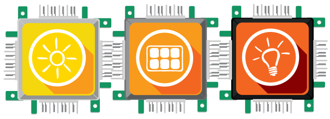
Promote creativity - strengthen development

Solar Experimentierkasten

Kreativität fördern - Entwicklung stärken



Solar Set



2. Safety information

Note: Never connect the bricks directly to the mains power supply (115V/230V). There might be danger to life.

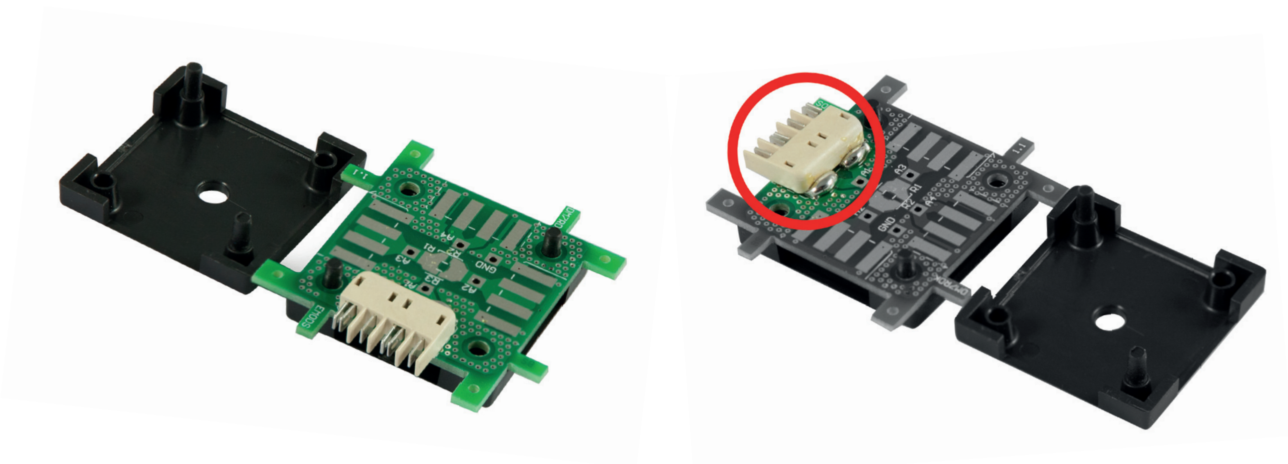
Please only use the included power supply-bricks. The voltage of our power-supply modules is 9V, which is not a health hazard. Please also ensure, that no openly wires are in contact with the mains power outlets. Otherwise there might be a danger of hazardous electric shocks. Never look straight into LEDs, since this may damage your eye retina

Please connect the included polarized capacitors (tantalum/electrolytic) only with the positive side to the plus side of the power supply. If those polarized capacitors are connected not correctly, they can be destroyed and even explode!

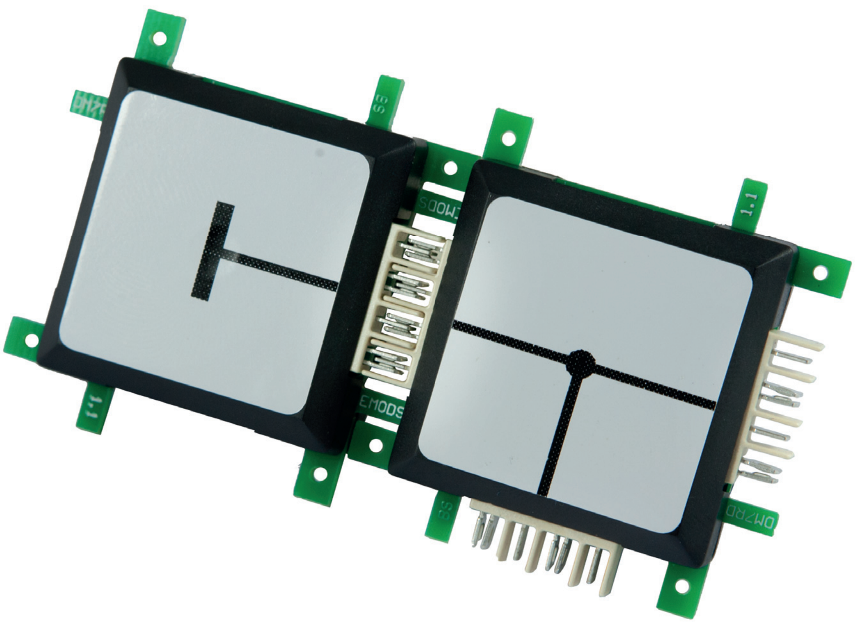
Please remove the power supply brick everytime you finished expimenting, to avoid the risk af an electric fire.

4.5 Ground and brick

One of the most important brick is the so called ground brick. The ground brick has one connector with for contacts. Usually the middle two contacts are used for signal or power connection. But the outer contacts are intended for the so call ground level. Which means technically a level of 0V. The ground brick connects the both inner contacts with the outer contacts. Therefore is possible to allow for a current return flow towards the 0V of a power supply invisible to the schematic symbols outside. The power supply of course must also be connected at one pole (usually the minus pole) to the ground using the ground brick. There is a power brick with an internal ground connection already done and visible in the symbol, and also a battery brick, where both poles are open, and can be connected with a ground brick to the ground level.

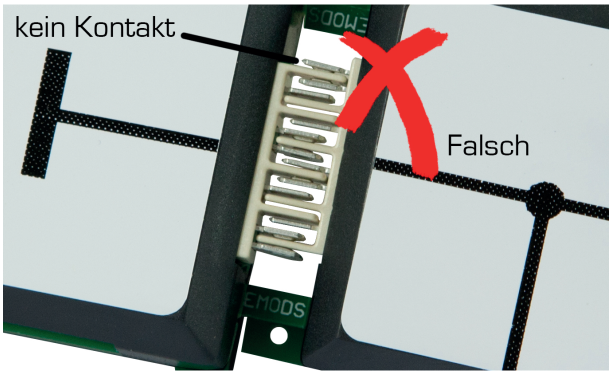


Please connect the bricks correctly, otherwise the connection will have an open or short circuit.



Here is an example of a correctly plugged connection. The connection consists of small contacts, that stuck mechanically and transmit the electrical energy.

The image below shows a incorrect connection. As you can see, the metal contacts are interrupted by the plastic pins. This allows no current flow.



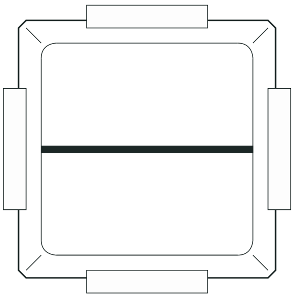
Caution: It is important to check the correct connection of the bricks. If they are not connected correctly this can lead to a short circuit or a malfunction of the circuit. If the connection is not working correctly, the current takes the lowest resistance way back to the power source, which might result in a short circuit, because the only resistance that has to be overcome, is the internal resistance of the voltage source.

Important: Always check the correct position of the contacts!

3. Bricks (components) of the advanced set

The bricks are compact modules for the electronic world. They are a perfect solution for young scientists to get used to the world of electronics. The sets contains standard components like connectors, power supplies as well as active and passive bricks. The following list gives an overview with the entities of the most common properties and the abbreviations.

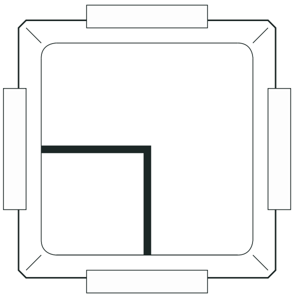
Value	Entity	Symbol/abbreviation
Current	Ampere	A
Voltage	Volt	V
power	Watt	W
Resistance	Ohm	Ω
Capacitance value (Capacitor)	Farad	F
Inductance value (Coil)	Henry	H
Frequency	Hertz	Hz
Prefix for $x10^{3}$	Kilo	k
Prefix for $x10^{6}$	Mega	M
Prefix for $x10^{9}$	Giga	G
Prefix for $x10^{12}$	Tera	T
Prefix for $x10^{-3}$	Milli	m
Prefix for $x10^{-6}$	Micro	µ
Prefix for $x10^{-9}$	Nano	n
Prefix for $x10^{-12}$	Pico	p
Prefix for $x10^{-15}$	Femto	f



ALL-BRICK-0004

WIRE STRAIGHT CONNECTOR BRICK

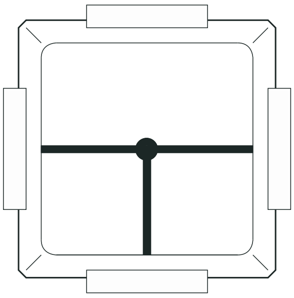
The straight connector brick connects two opposite bricks.



ALL-BRICK-0005

CORNER BRICK CONNECTOR

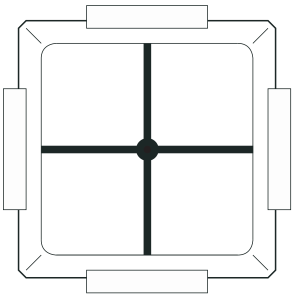
You can connect your circuits with the corner brick across the corner.



ALL-BRICK-0006

WIRE T-PART BRICK

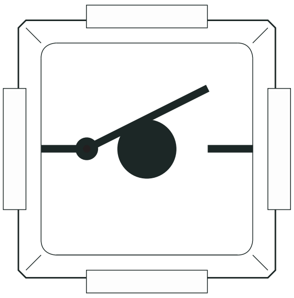
With the T-crossing brick you can connect your circuit's components like a "T".



ALL-BRICK-0007

WIRE CROSSING BRICK

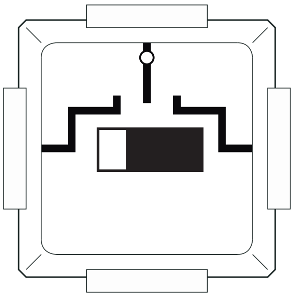
The crossing brick connects all four directions with each other.



ALL-BRICK-0017

BUTTON

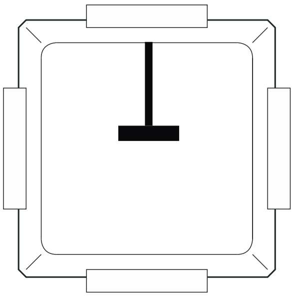
A button is a electromechanical element which connects when pressed.



ALL-BRICK-0018

SWITCH

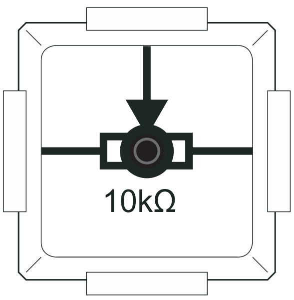
Our switch includes three different states: In the middle state, all contacts are separated. In the left state, there is a connection between the middle and the left. And in the right state there is a connection between right and middle. A maximum of 6A is possible.



ALL-BRICK-0003

WIRE GROUND

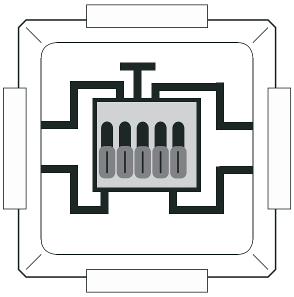
Ground is responsible for leading and returning voltage. Put the ground brick on the end of each circuit in order to close it. It connects the middle circuit with the two external ground lines.



ALL-BRICK-0027

POTENTIOMETER 10KOHM

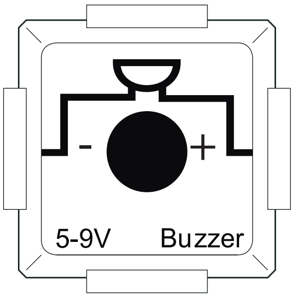
The potentiometer is a changeable resistor. There are three connections. The tapper can be changed mechanically and delivers a resistor size between the smallest and biggest value at the third clip. The potentiometer also has a maximum performance of 1/8 Watts if you connect the tapper with the voltage source and one of the other connectors.



ALL-BRICK-0370

5-POLE CLIP

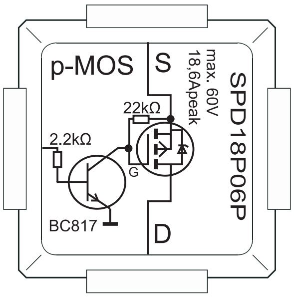
Both of the middle contacts of the plugs are connected to the contacts of the clip. Additionally, there is one clip for the ground.



ALL-BRICK-0152

BUZZER

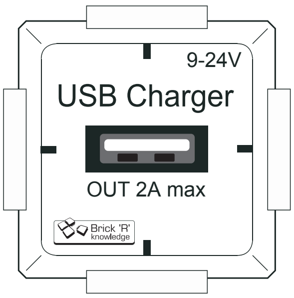
You probably know the buzzer as an electrical sounder. It is an acoustic sensor and when connecting it to your circuit it will make a loud noise.



ALL-BRICK-0625

Transistor p-MOS

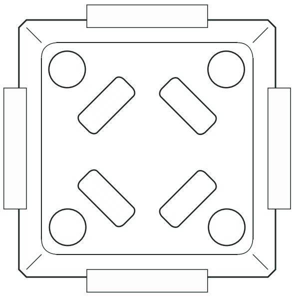
The p-MOS transistor with ballast transistor BC 817 may transistor through the ballast control using a 0.5V PWM (pulse width modulation) or ON / OFF signal that can be controlled directly with a motion detector. The performance of the p-MOS transistor: maximum 60V 18A. Can be operated within the Brick System with maximum 12A (contacts max. 6A per contact). Attention small cooling surface, protects the brick against thermal overload.



ALL-BRICK-0390

USB CHARGING BRICK

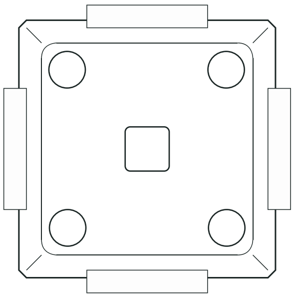
The USB charging brick can be injected with 9-24V voltage and outputs constant 5V at the USB port.



ALL-BRICK-0305

HIGHPOWER LED

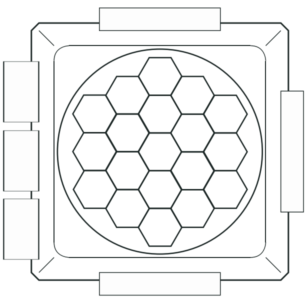
LED BRICK with 4 highpower LEDs



ALL-BRICK-0275

RGB LED

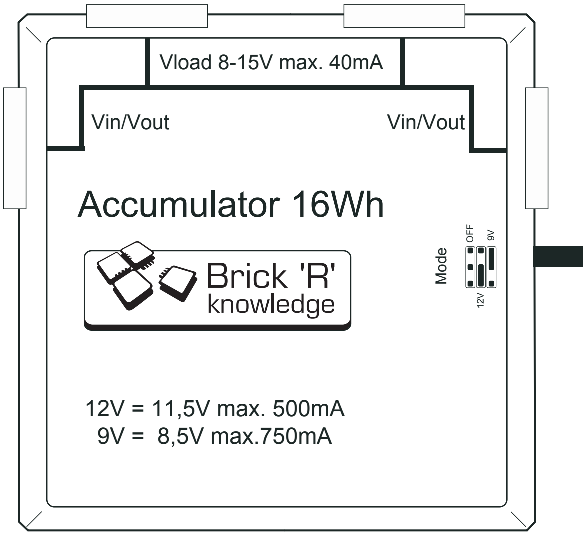
LED RGB colors are switched via three potentiometers.



ALL-BRICK-0372

PIR MOTION DETECTOR

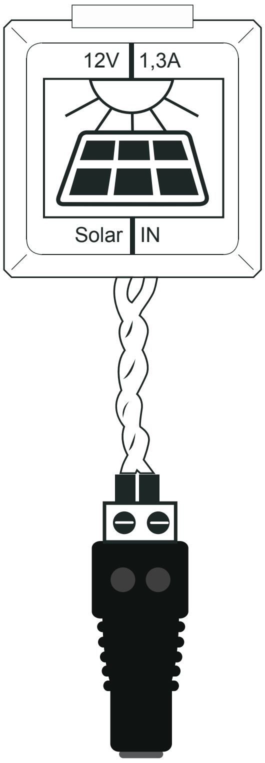
Due to its passive infrared technology (PIR), the motion detector brick offers a reliable movement detection providing an extremely high interference resistance and can be integrated easily into light switching.



ALL-BRICK-0282

ACCUMULATOR

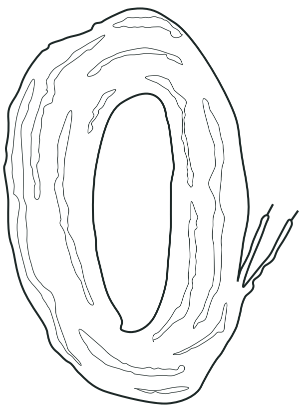
Adjustable to 9V or 12V. 12V max. 500mA. 9V max. 750mA. Short-circuit proof; with integrated charging electronics based on microcontroller.



ALL-BRICK-0485

Solar Brick

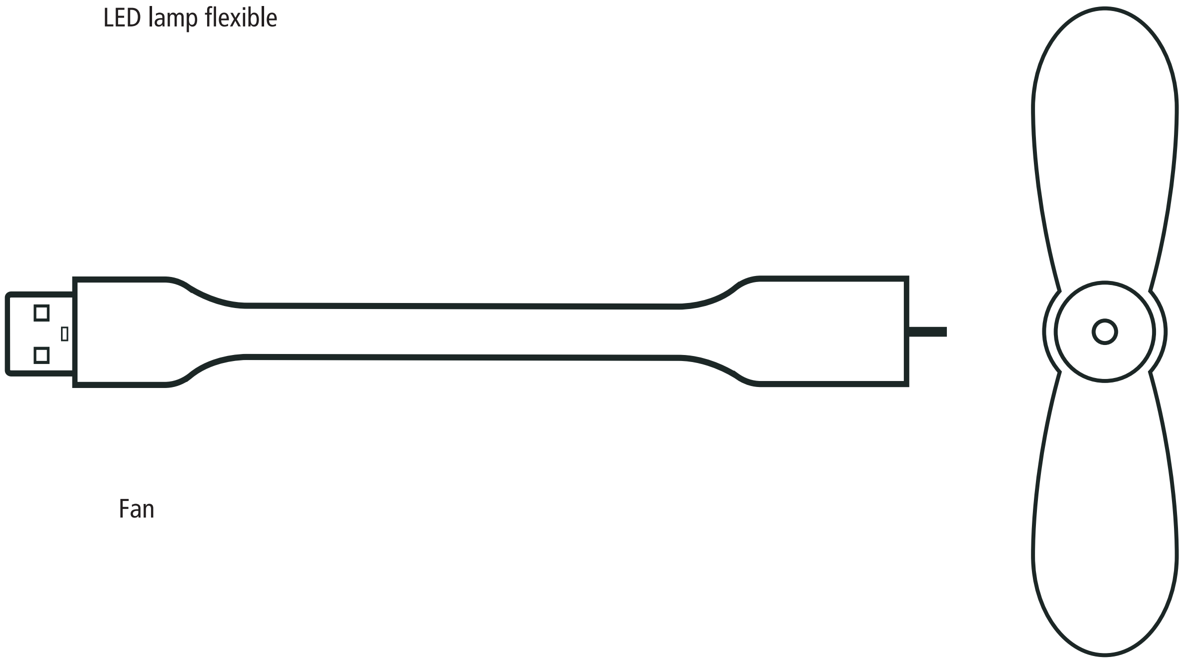
The Solar Brick has a small voltage regulator installed. This converts the input voltage into 12V constant output voltage.



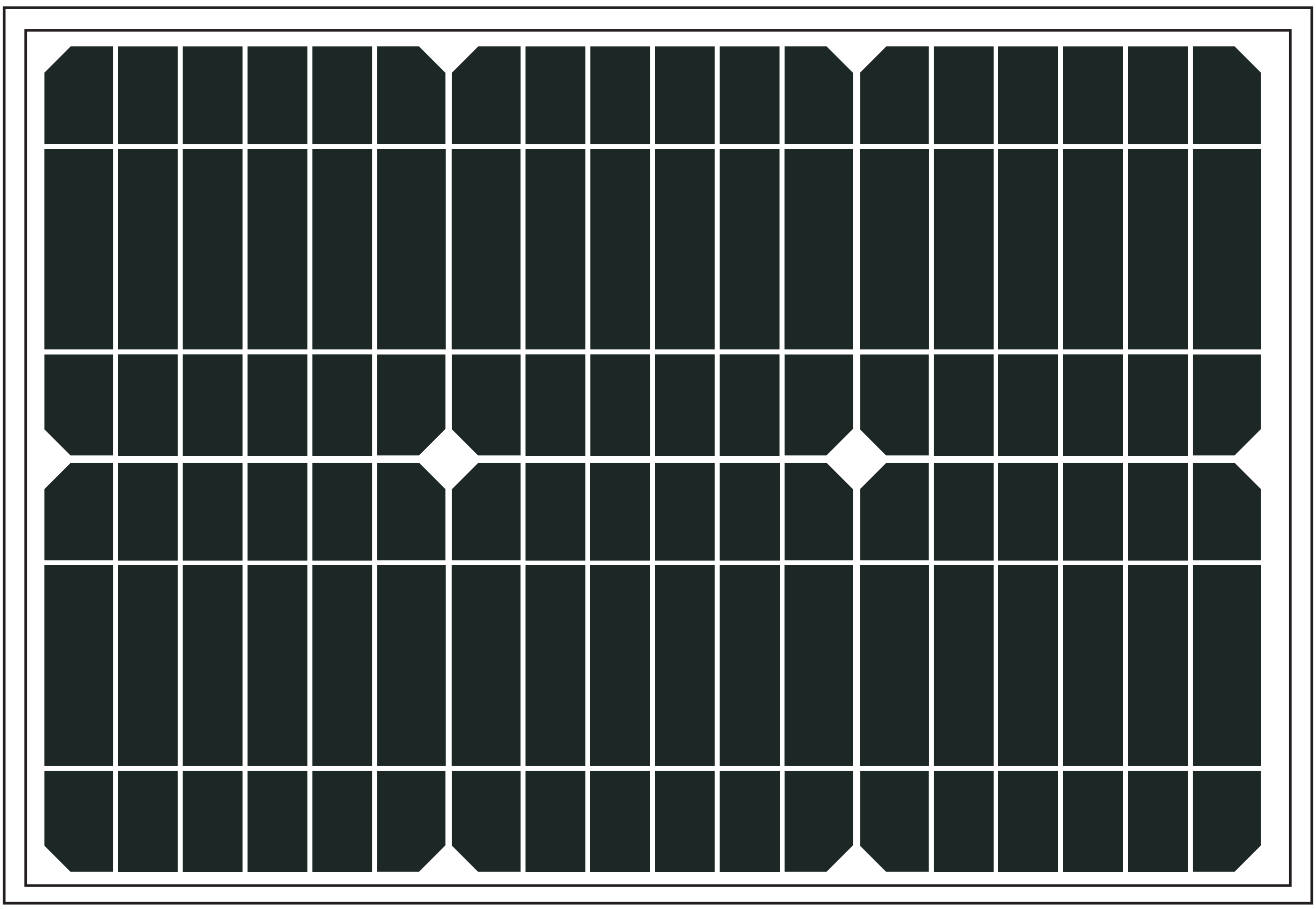
2-WIRE CABLE

This is 10 meters of bell wire.

LED lamp flexible



Fan



Solar panel

4. Photovoltaic system

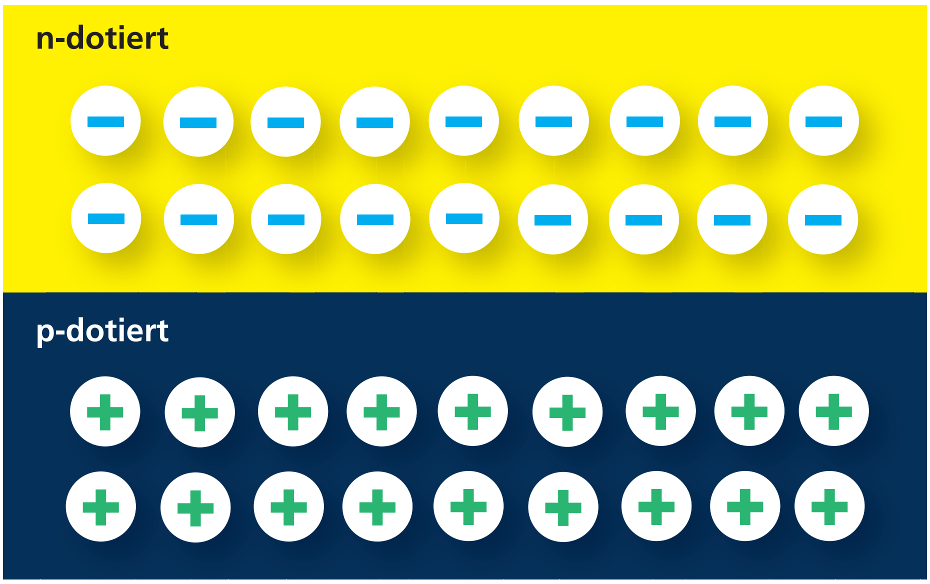
4.1. What does a solar module consist of?

A solar module consists of several solar cells that directly convert the light of the sun into electrical energy.
The solar cells are connected in series circuits. The series circuits are realized by soldering connectors to the bricks solar module. There are rigid and flexible modules. Flexible modules are based on organic materials. The structure of a rigid solar module is as follows: It consists of solar cells based on silicon that are mounted on an aluminum frame and covered by a glass plate. The glass plate saves the solar cells from hail, for example. Several solar modules result in a photovoltaic system and all solar modules of a photovoltaic system are called solar generators. There are on-grid and off-grid photovoltaic systems. Off-grid means independent of main power supply. This could be a satellite run by solar energy, for example.
On-grid means that the generated power is fed into the power supply. This is realized with the help of an inverter. The inverter needs power to synchronize with the power grid. The generated power needs to have the same voltage and and phase as the power grid.

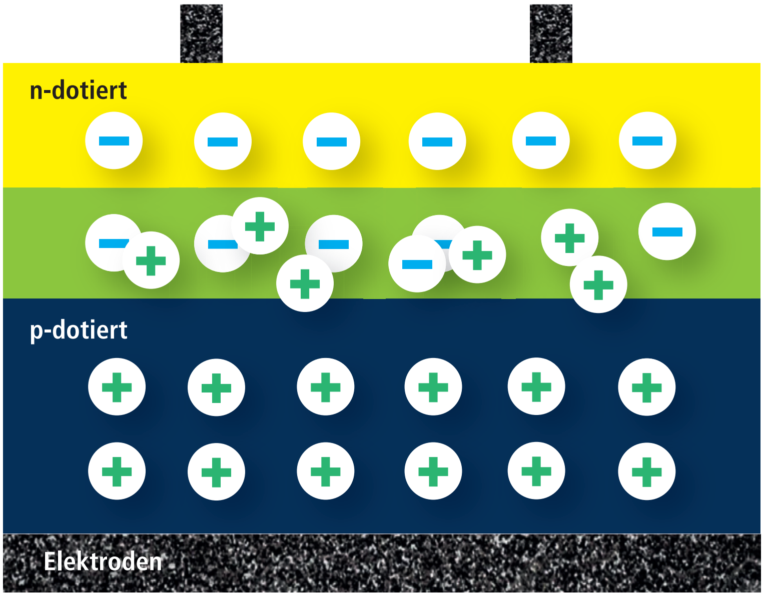
Inside the solar cell

Solar cells are electronical components with which solar energy can be transformed directly into electrical power.
Most solar cells consist of silicon. Silicon is a semiconductor that is gained from ordinary sand. In contrast to an isolator, a semiconductor is a material that consists under normal conditions (room temperature) of several free electrons. That is why in a semiconductor there can always flow a little current – which is not possible in an isolator. This fact also explains the name SEMIconductor. However, the current is far less than in an electrical conductor (wire, for example). Using technical tricks, engineers can specifically increase the semiconductor's conductivity.

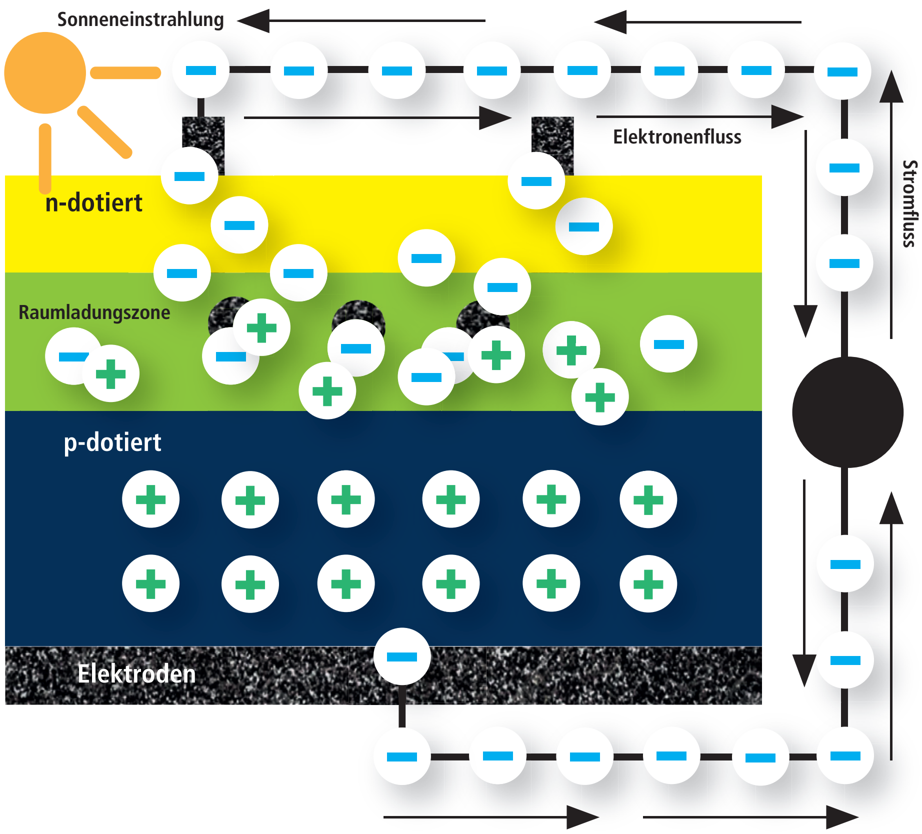
Chemical elements are built into the silicon crystal which leads to the fact that there are more free electrons: This surplus of electrons is also called "n type" (negatively conducting). Or chemical elements are introduced that cause a shortage of electrons in the silicon: This shortage leads to several spaces not being occupied. In this case we speak of holes. As well as the electrons, these holes are moving freely. The surplus of holes is called "p type" (positively conducting).



When producing a solar cell, above the layer with a shortage of electrons there will be a layer with a surplus of electrons in the silicon crystal. This leads to the free electrons occupying the holes in a narrow transition layer (plus and minus attract and make contact as with magnets). A thin layer called "space-charge region" will develop that does not include neither free electrons nor free holes but that is virtually an insulating layer. When we put a connector to the n layer and to the p layer and link it there won't happen anything as the layers are isolated from each other.



Now the sun will come into play. Sunrays, as we see them, consist of components that are called photons – a fact, that the famous Albert Einstein discovered. The sunrays encounter the solar cells' surface and penetrate the thin n layer until they reach the transition layer where they can force out the electrons that are bound in the holes. It is similar to playing with marbles when you try to remove a marble with your own one. Via the attached electrodes, the free electrons will flow back to the free holes which leads to a flow of current outside the solar cell. This current is the solar power we aimed for. With it, you can drive motors, light lamps or charge accumulators.



Types of solar cells

There is a further difference of silicon solar cells: The crystal structure is important as well! Our solar module consists of monocrystalline cells. They are developed out of wafers that are monocrystalline silicon discs. The word "mono" refers to the discs indicating the same crystal orientation and therefore looking "monochromatic". There are also polycrystalline cells that are more common as they are less expensive. They don't have the same crystal orientation everywhere which is why they look patterned. Amorphous cells have a very low efficiency but they are suitable for calculators or watches as they offer advantages when there is little light.

Electrical characteristic

It is important to know, how powerful, sophisticated and durable a solar module is. In order to know this there are the so called electrical characteristics that classify a module. When you turn the Brick'R'knowledge solar module around you will find some of those dates.

Pm = 15W = Maximal realizable power among standardized conditions.
Vmp = 18V = Voltage in operating point with maximal power.
Imp = 0,822 A = Voltage in optimum operating point
Voc = 21,6V = Open-circuit voltage.
Isc = 0,916A = Short circuit current.

Electrical characteristics depend on the wiring of solar cells. Hight efficiency is enabled by wiring similar solar cells. The best rated output is indicated in Wp (Watt peak). Our solar module hast a rated output of 15W, however, this is possible only under laboratory conditions (STC: standard test conditions). The STC are also indicated on the Brick'R'knowledge module. Under STC light irradiation is 1000W/m, cell temperature is 25°C, irradiation angle is 90° and the light spectrum AM 1,5. AM means Air mass and is the measure for the length of the way that the light of a celestial body (the sun, for example) covers through atmosphere until earth. The efficiency is the relation between the electrical power generated by the solar cell and the power of the occurring sun light.

$$\eta = \frac{P\ elektrical}{P\ light}$$

When we have an electrical power of 300W and the occurring sun light hat 1500W, then we will have the following calculation:

$$\frac{300W}{1500W} = 20\%$$

This module has an efficiency of 20%

$$1\mathrm{W} = 1\frac{kg \cdot m^2}{s^3}$$

Watt is the unit of power. Power is defined as energy turnover per time span. The unit Watt is named after James Watt who is famous for his improvement of efficiency regarding steam engines. A high efficiency is always preferable as it leads to a higher yield of electrical power although the light conditions and the surface of the solar cells are even.

Degradation and Recycling

Degradation is the age-related change of the parameter of semiconductor devices. Regarding solar cells, the degradation is the decrease of efficiency over time, like e.g. the lost of 11% after 25 years. The radiation in outer space is higher, the degradation faster. In most cases the efficiency reduces even earlier, e.g. due to dirty glasses. But even 95% of a solar module can be recycled. At a temperature of about 600°C, plastics existing inside the module get burned. Only glas, metal, filler materials and the solar cells remain. Glas- and matal remains get passed on to recycling companies. The surfaces of the solar cells get etched off to gain new silicon and new solar cells can be produced.
The recycling process wastes less energy than the production of a new solar cell.

4.2 What is an accumulator?

An important storage

An accumulator is a storage for electrical energy that is rechargeable und that can emit energy. An accumulator consists of several secondary cells. Cells that cannot or only up to a certain point be recharged are called primary cells.You will have an accumulator by interconnecting secondary cells either in a series connection (this will increase electrical power) or in a parallel circuit (this will increase the capacity). Both circuits will increase the total energy content – which is defined as being the product of voltage and capacity. In conclusion: By interconnecting several secondary cells you will receive an accumulator with more total energy content.

Sample calculation

The total energy content is indicated as watt-hours, the battery brick has 16 watt-hours. Here is a sample calculation: There are two smaller batteries in our brick battery. Each of it has a voltage of 3.8V and a capacity of 2300mAh (miliampere hours), that is 2.3Ah. This means, the battery can submit 3.8V including a current of 2.3A for one hour until it is empty.

$$3{,}8V \times 2{,}3A = 8{,}7W$$

As there are 2 batteries interconnected you need to double the result which will eventually lead to 17.4 watt-hours. The battery brick's sticker has 16 watt-hours as a parameter. This difference – between reality and our calculation – exists because there are several other components inside the brick, for example, the microcontroller that also consumes power.

A further calculation model:

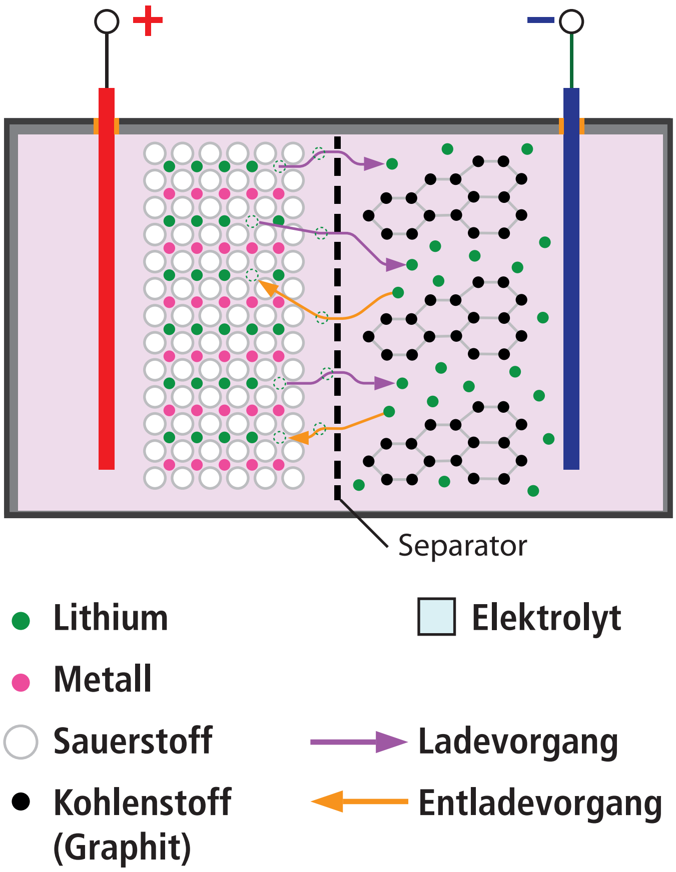
$$Current\ x\ capacity = energy\ content$$

If you discharge the accumulator with a current flow of 111mA and a nominal voltage of 9V, it corresponds to a power consumption of about 1W per hour, namely: $0{,}111A \times 9V = 1W$

As the accumulator has a power of 16Wh und the power consumption is 1W, the brick accumulator could operate the Highpower LED brick for 16 hours until it is empty.

It's all about chemistry

What happens when we charge an accumulator? In a nutshell: Electrical energy is transformed into chemical energy. When you connect an electrical consumer (like a LED or a motor) to the accumulator, chemical energy will be converted into electrical energy again.
When charging an accumulator, current flows through it and this leads to a chemical reaction inside the battery where positive and negative electrodes chemically change. Once the accumulator is fully charged we can extract the added current. Again, this will lead to a chemical reaction, however, in reverse order. Current can be extracted from the accumulator as long as there is a chemical reaction possible.



Different types of accumulators

Although there are different kinds of accumulators, their basic structure does not differ much from each other.
An accumulator includes two electrodes that are located in a special electrolyte. The electrolyte is either a liquid solution, a gel or a solid. You use different chemical substances for electrodes and the electrolyte. There are lead accumulators, nickel cadmium accumulators, nickel metal hydride accumulators and lithium ion accumulators. The battery brick is one of the latter where the positive electrode consists of lithium metal oxide and the negative electrode consists of graphite.
While discharging the positive electrode receives lithium ions that the negative electrode emitted. The positive electrode consists of a very light material to be able to receive the lithium ions.
A lithium ion accumulator has a very low self-discharge, namely, below 2% per months. The accumulator needs to be stored in an adequate way: when it is too hot, the accumulator will not last sufficiently. Lithium ions are used for laptops and e-cars.

Important terms

With regard to accumulators, there are three important terms that we would like to mention: nominal voltage, efficiency voltage and energy density. But what exactly do they mean?

The nominal voltage of an electrical consumer or a voltage source (the power grid, for example) is the voltage's value in normal operation. The European nominal voltage is 230V. The nominal voltage of a lithium ion battery is between 3.2 and 3.8V per cell.
The term "efficiency voltage" describes the relation between the amount of energy that is emitted during the accumulator's discharging process (called useful energy) and the amount of energy that is added during the charging process. Lithium ion batteries have one of the best efficiency voltages: about 90%. This means, there is a power loss of only 10%.efficienta

Energy density is the amount of energy with regard to height. For example, you can see how much energy can be accumulated in a cubic meter of space. A lithium ion battery has an energy density of 120-210Wh/kg (watt-hours per kilogram). Compared to a lead accumulator that has an energy density of about 30 watt-hours/kg, this is relatively high.

The accumulator brick

Now we have a closer look at the features, which the battery brick provides. There is one interesting advantage: by using the "jumper" (the little black connector), we can set the battery brick at 9V or 12V. When the battery brick is connected to the solar module it should always be set to 12V. Usually, the brick system is designed for 9V, however, the bricks included in the set withstand 12V.
There are two brick voltage regulators (ALL-BRICK-0300 and ALL-BRICK-0299) at Brick'R'knowledge that make it possible to get exactly 9V out of the solar module. But let's return to the battery brick: It has a input voltage of 8-15V and an input current of max. 400mA. The output voltage can be set to 8.5V or 11.5V because, as we have learned, this battery does not have a 100% efficiency. At 11.5V output voltage the output current is at 500mA, at 8.5V it is 750mA. You might have noticed that the LED blinking varies when connecting the battery. The LED's different colors tell you what the battery is doing. Here you can read about the meaning of the different colors.

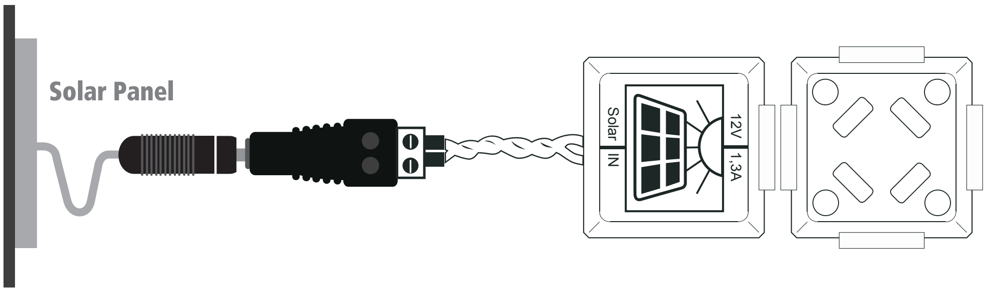
○ The LED does not lighten up: inactive, standby or discharged
●● The LED is green: active, discharging modus
●●● The LED is green/orange: active, discharging modus, almost discharged
●●● The LED is orange: active, discharging modus, discharged, shortly before switching off
● The LED blinks red: Error (overload, short circuit, discharged, overvoltage)
● The LED lightens in orange: charging modus
● The LED lightens in green/almost orange: idle modus, switching off in 0.5 to 3 minutes

5. LED lights up

5.1 LED light

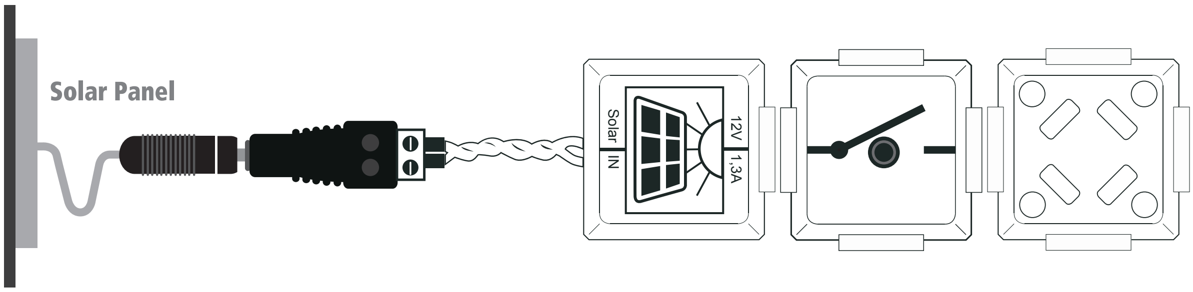
The first circuit includes a power supply and a LED. The power supply is our solar panel that is connected with the solar brick. The power supply could also be e.g. a battery or a power supply. The LED ist a modern form of a light bulb. It only has around 1/100 of the energy consumption compared to a light bulb because there is no wire that has to glow. A recombination process of the electrons in the p-dotted semiconductor sets the light free. LEDs also warum up during this process but a lot less than light bulbs. The highpower LED cunsumes 1W.

Attention: The bricks have to be connected in the right way. If the LED does not light up, please check the connection of the bricks again.



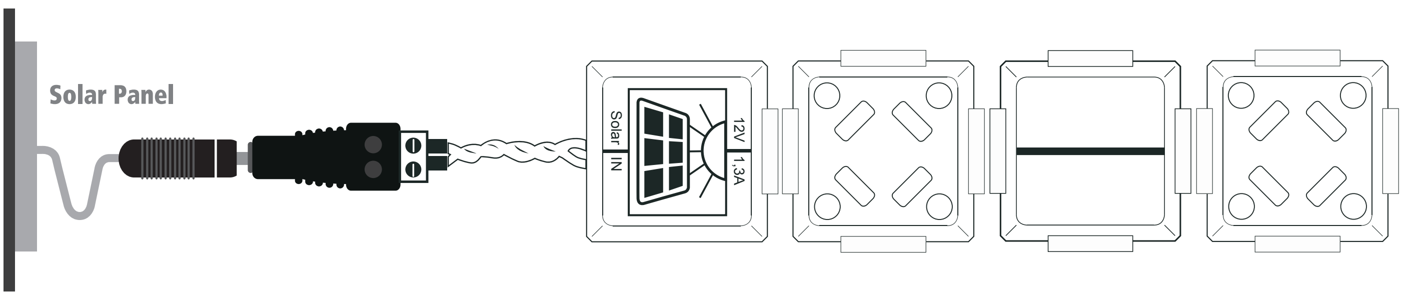
5.2 LED with push button

Now we´re going to add a push button to the curcuit. It works like that: Only if the push button is pressed, the circuit is closed. The push button is one of the easiest elemts of an electric circuit.



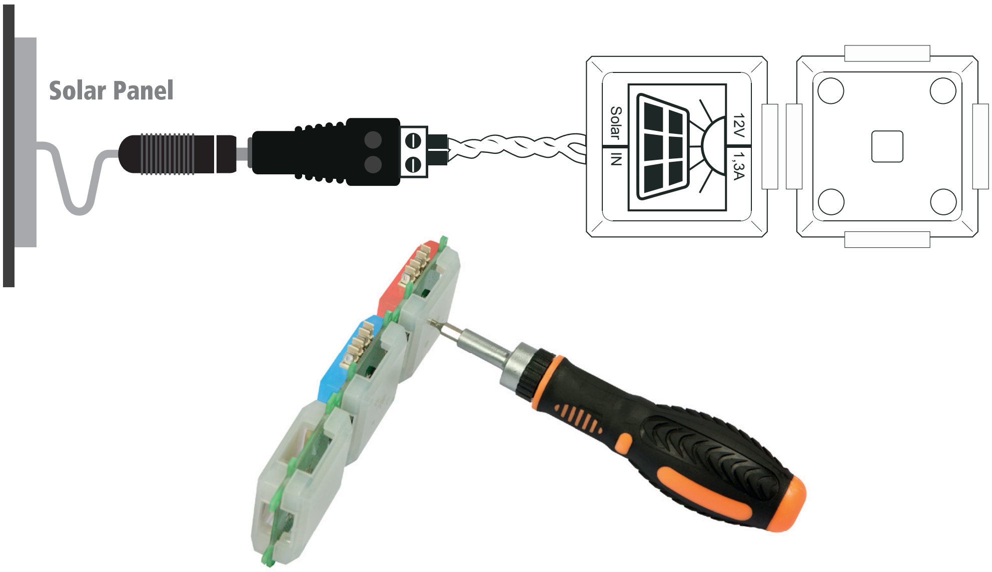
5.3 Two LEDs

It´s getting brighter: We´re going to add another highpower LED. We can extand the circuit by also adding a straight wire brick. This brick is a normal wire and forwards the power.



5.4 RGB LED

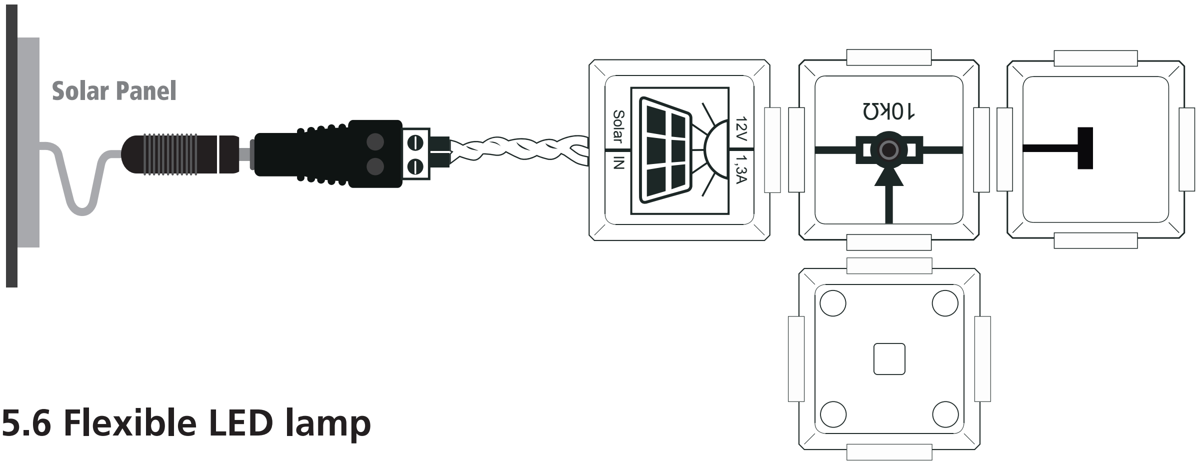
The RGB LED is a special LED. You can adjust the color in the back of the brick by three potentiometers. For doing that you can use a small screw driver.



5.5 RGB LED with p-MOS

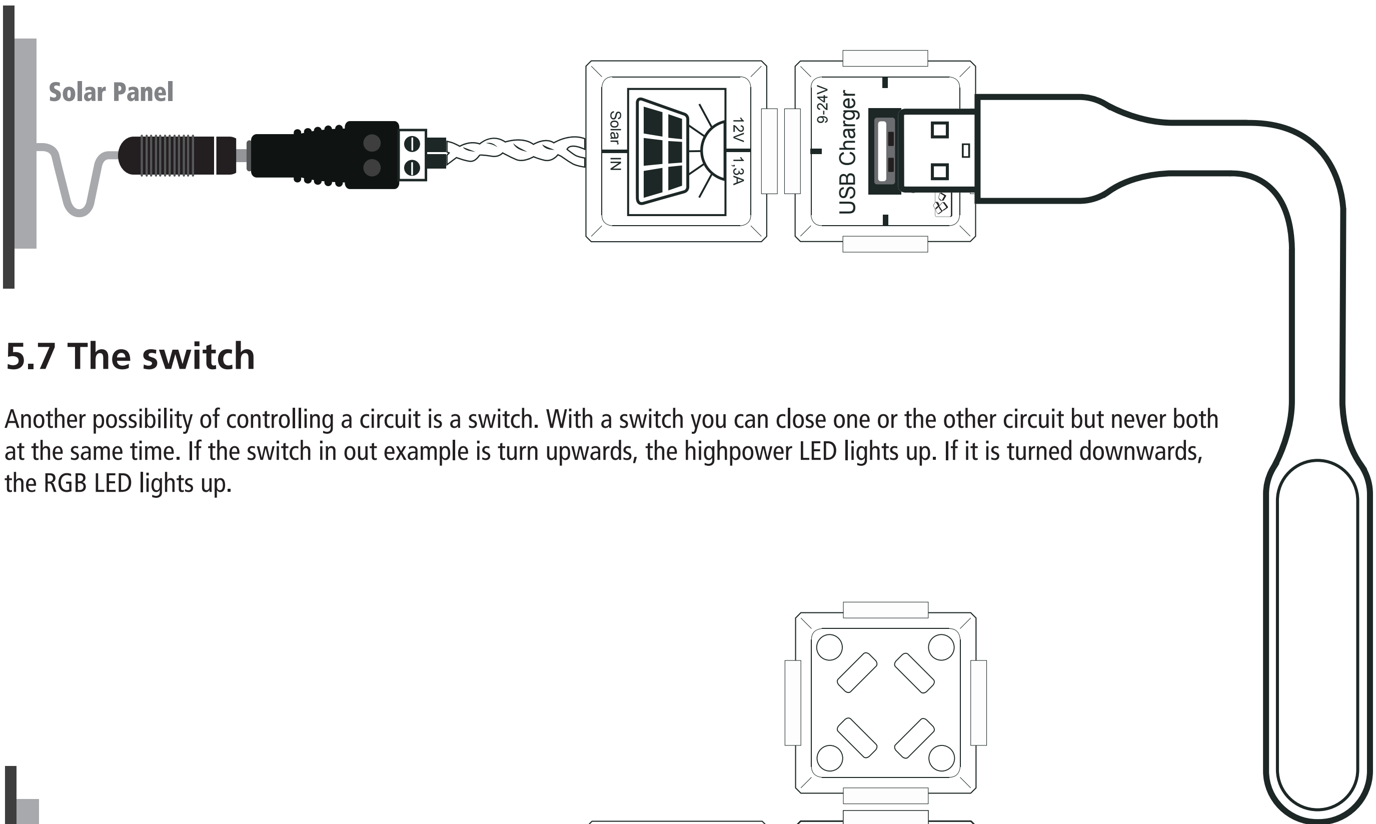
In this circuit we´re using a potentiometer for the first time, it is a manually changeable resistor. The electrical resistor reduces the current flow. This property is very important for electrical circuits. With a resistor you can manipulate or set a specific voltage. isolators and superconductors are extreme expamples of resistors. An isolator ideally has a infinitely large resistance, a superconductor no resistance. Resistance is indicated in Ohm (Ω). If a circuit wouldn´t hae any resistance, the current flow would be infinitely large, which is not possible. Every circuit (also a short circuit, when the cathode and anode are directly connected) has at least an internal resistance to pass. The properties voltage (U), current (I) and resistance (R) are directly connected. Remember: voltage (U) is the product of current (I) and resistance (R). U=R*I. For expamle: If you want to have a current of 0,9A, the resistance is 10Ω and the voltage 9V. In our example circuit, the resistance is a lot higher, which means that by having the same voltage, the current is a lot smaller.

In this experiment, as mentioned before, we don´t use a normal resistor, but a potentiometer. It works as a voltage divider, that´s why all three contact have to be connected in the right way as seen in the graphics. It is very important that the sliding contact (that´s the side with the arrow) is never connected with the cathode (minus) of the power supply and with the ground brick because of the possibility of a short circuit. In this example only the LED bricks should be connected with the sliding contact. This way the supply voltage can be divided from 0 to 12 Volt. If the knob of the potentiometer is turned fully to the left, the supply voltage is 12V, therefore the LED turns as bright as possible. By turning the know fully to the right, the LED goes out, now the supply voltage is 0V. If you turn the know exactly to the middle, you can reach 6V and so on. This way, you can change the intensitiy of the LED stepless.



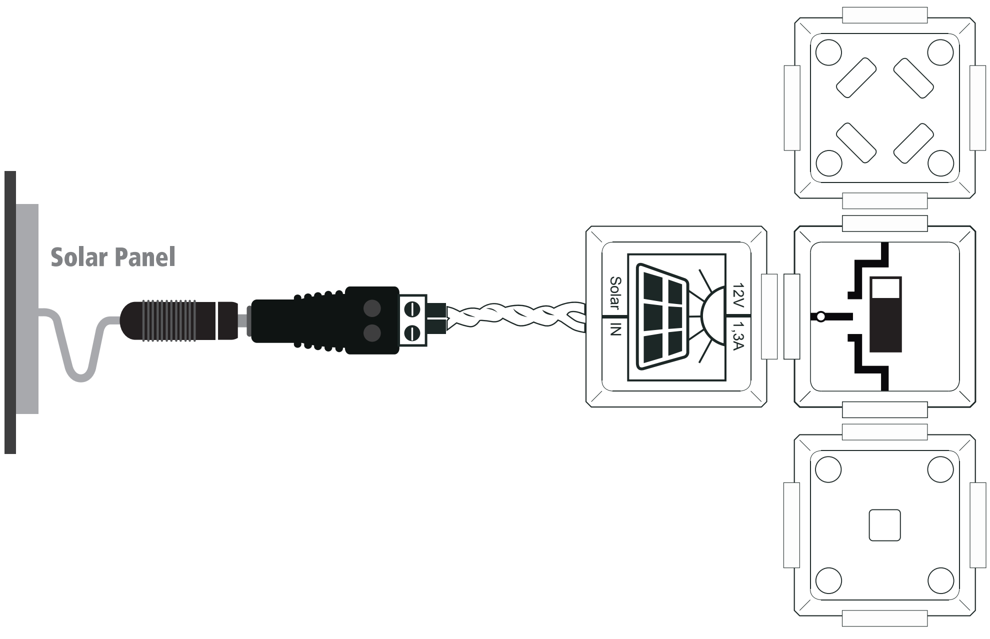
5.6 Flexible LED lamp

If you want to illuminate a piece of jewellery or a small statue from above, the highpower LED is of course not very useful. That´s why we´re going to use the flexible LED lamp now. For this experiment we also need another brick: the USB charging brick. It has a supply voltage of 9-24V and provides a constant voltage of 5V at the USB port. This is possible because of an integrated voltage regulator. Now you can plug in the flexible LED lamp and bend it the way you want.



5.7 The switch

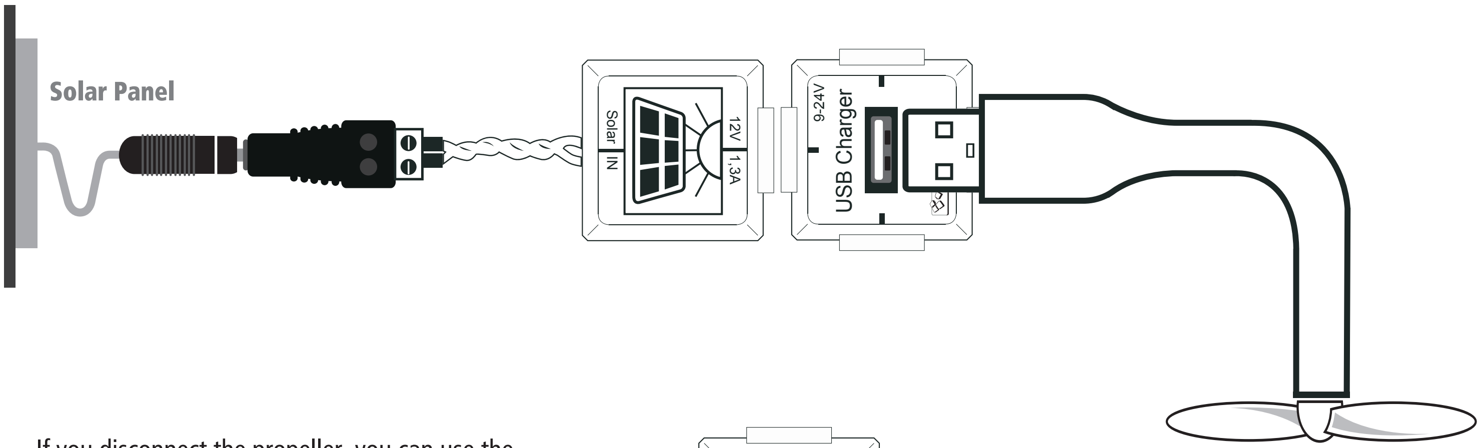
Another possibility of controlling a circuit is a switch. With a switch you can close one or the other circuit but never both at the same time. If the switch in out example is turn upwards, the highpower LED lights up. If it is turned downwards, the RGB LED lights up.



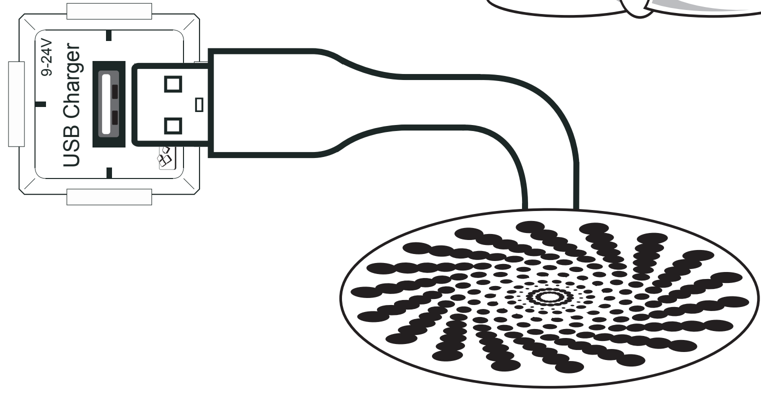
6. Let´s have fun

6.1 The fan

The fan can be connected to the USB brick in the same way as the flexible LED lamp. The propeller is spinning around constantly.

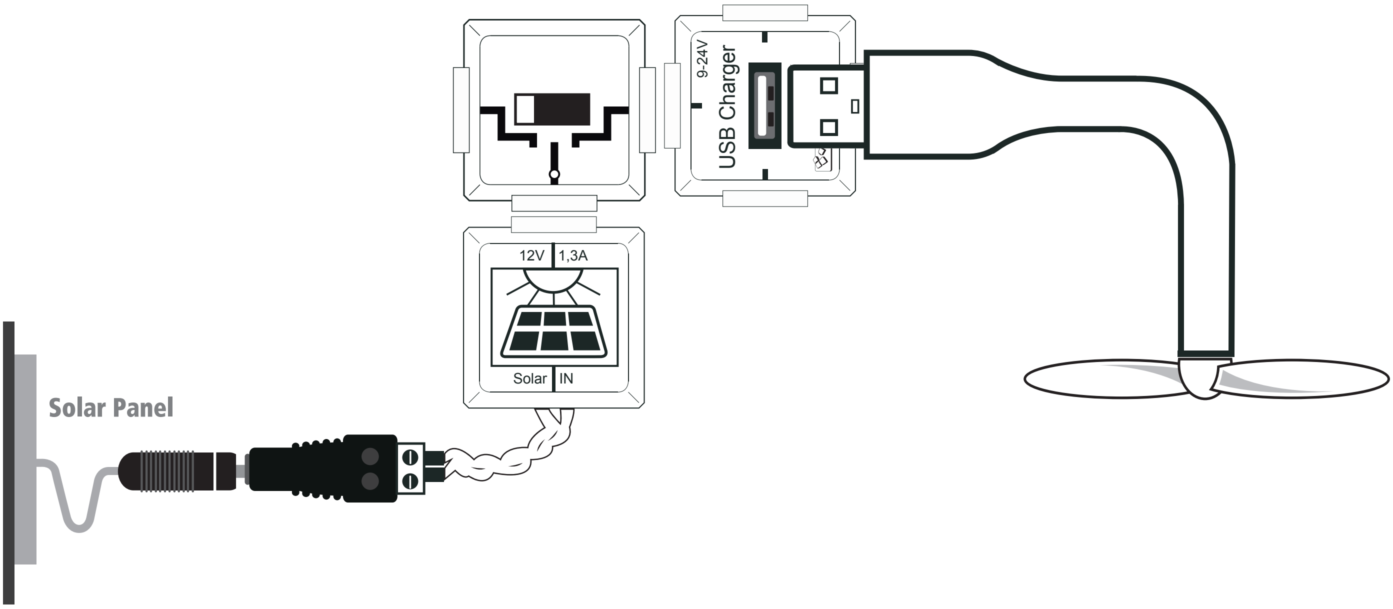


If you disconnect the propeller, you can use the motor also for other things. We created a hypnosis wheel for example, built with a piece of cardboard and a pen.



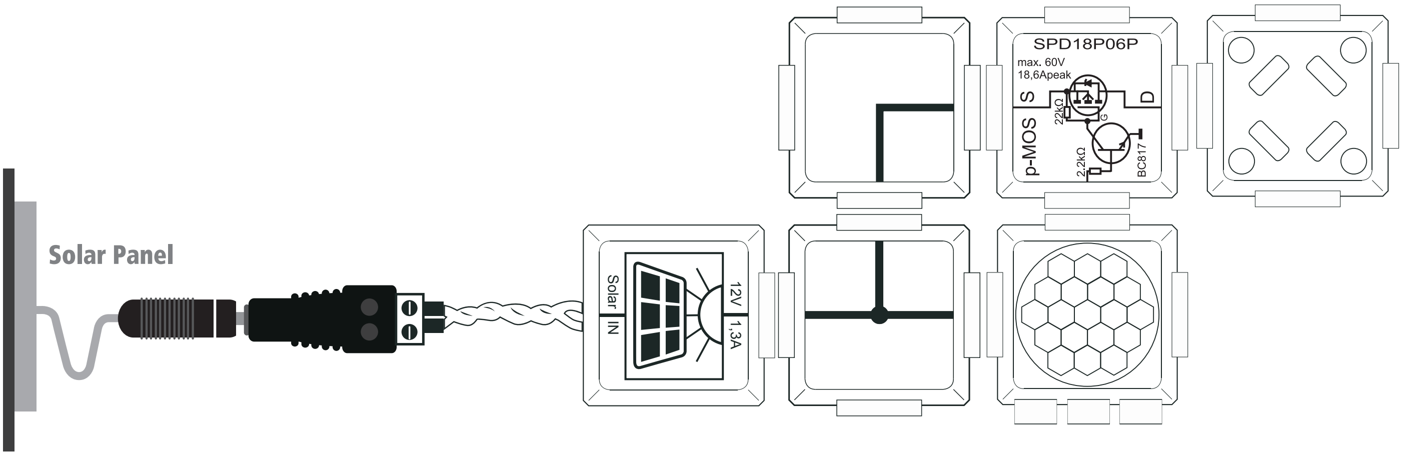
6.2 Fan with switch

In practice, it´s not very useful if the fan is always on. Just connect the switch and the problem is solved.



6.3 The motion detector

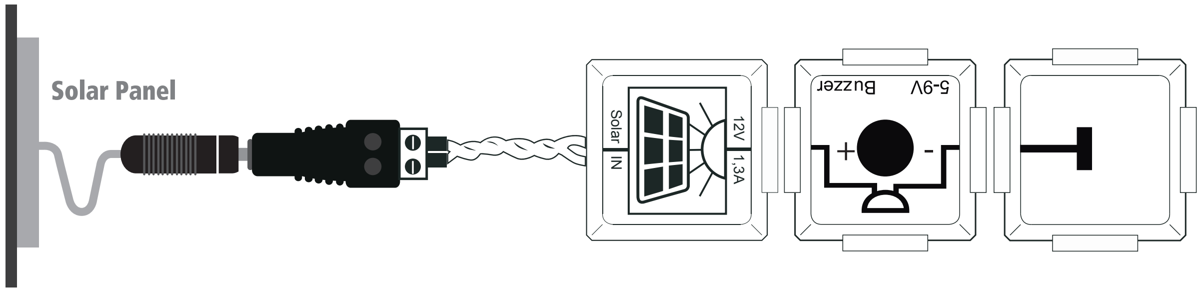
Now we´re going to light up a lamp magically by motion. For this we need a new brick: the motion detector. It has three knobs on the side: sensitivity, duration and light. If you turn the knob of sensitivity clockwise, the motion detector is the most sensitive. The next knob (time) changes the amount of time that the motion detector is active. Counterclockwise the duration gets smaller. The last knob defines if the motion detector should only work if it´s dark (counterclockwise) or if it should also be active in the day (clockwise). The signal that the motion detector provides is quite small, that´s why we need the p-MOS transistor is need in order to enhance the signal intensity. The transistor has to be connected correctly as seen in the graphics.

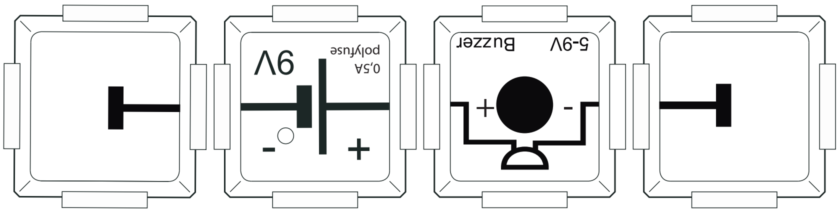


7. It is going to be loud!

7.1 Buzzer

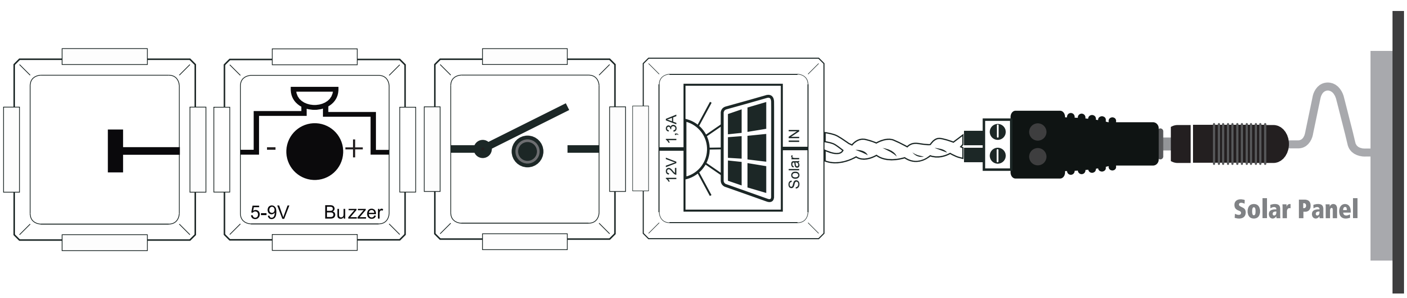
Here you can see an example for an electric circuit including a ground brick. The first image shows the final circuit, the second shows the ground line's way through the bricks. The ground bricks close the electric circuit even if they seem to go into void on the left and/or right of the middle bricks.
The ground bricks ensures the connection between the ends.
Keep in mind: The ground symbol saves time when drawing a circuit in a professional technical environment and lead to a better overview in complex circuit diagrams. In the image below, we used an example with a 9V battery brick instead of a solar brick and solar panel. Here you can see that the ground bricks build the ends of the circuit on the right and on the left.





7.2 Morse circuit

A buzzer is an acoustic signal generator with a low bandwidth that is different from a loud speaker. We use an operating voltage of 12V with which the buzzer, if correctly polarized, can become very loud. The image below shows the correct order of the bricks. When the switch is closed we will hear a very loud beep which is why this circuit can be well used for Morse code. Sequences of short or long sounds and stops transfer numbers or letters. The most popular signal is "SOS" ("...---...": Three times short, three times long, three times short) which means "Save our Souls" and which is seafaring uses to indicate an emergency signal.
The Morse alphabet was invented by Samuel Morse in the early 19th century and at that time made it possible to transfer information over long distances via radio – telegraphing was born. As it is very easy to code the Morse alphabet can also be transferred via short lighting signals with headlights. Nowadays, Morse code is a very popular operating mode among radio amateurs. Via one of the SDR stations under http:/www.websdr.org you can listen via web within the shortwave range (for example: University of Twente).

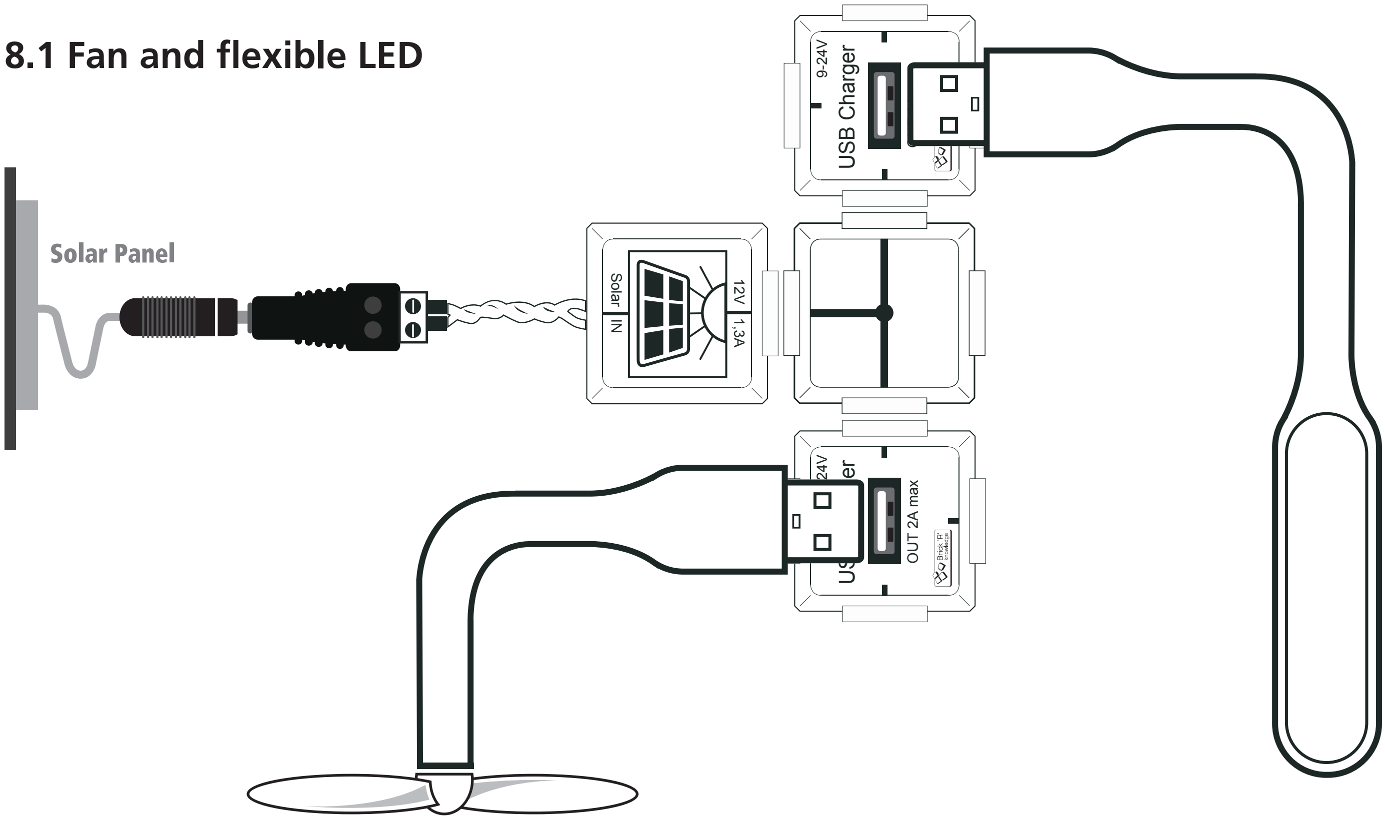


Zeichen - Morsecode

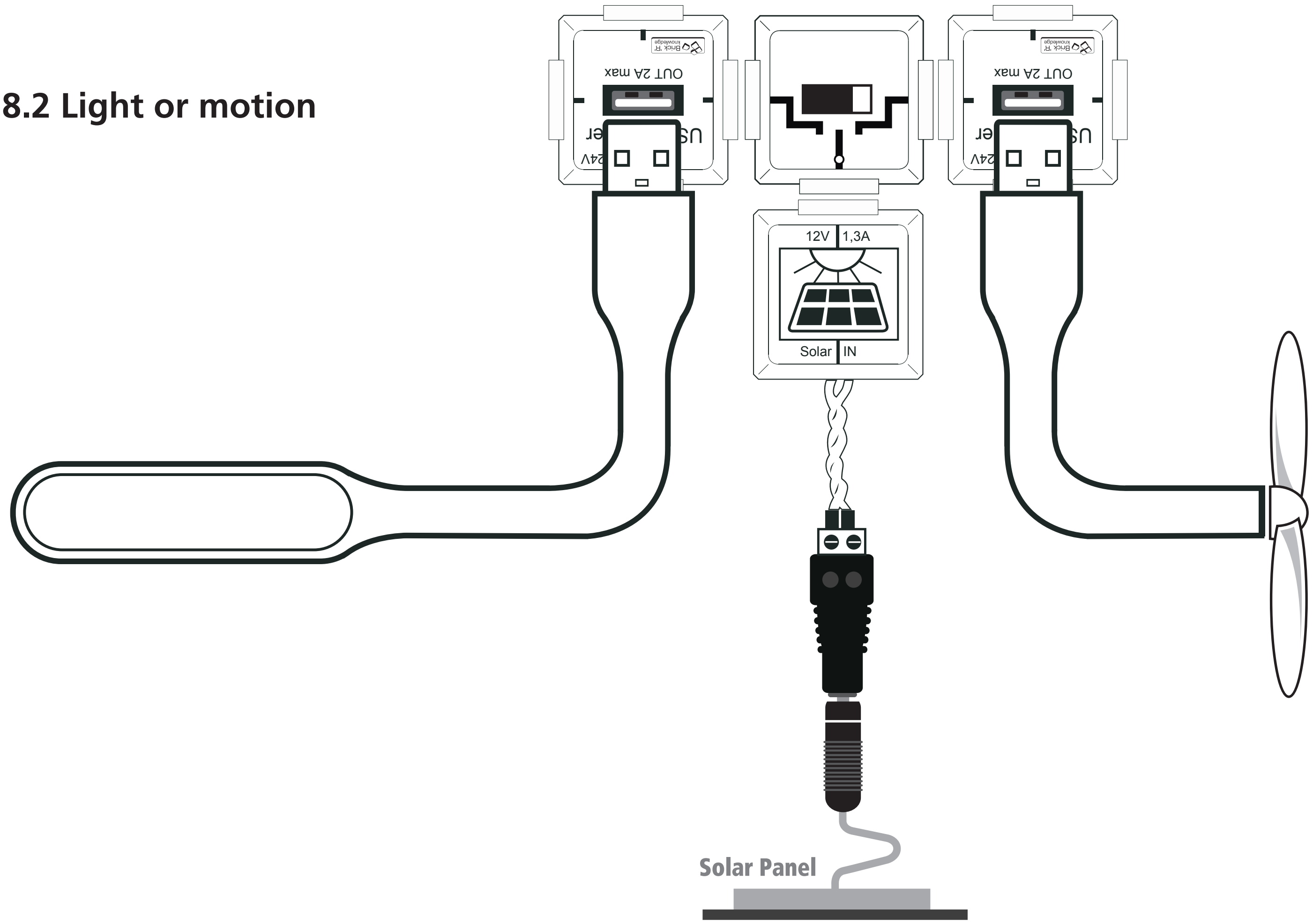
A	·—	S	···	.	·—·—·—
B	—···	T	—	,	——··——
C	—·—·	U	··—	?	··——··
D	—··	V	···—	"	·————·
E	·	W	·——	!	—·—·——
F	··—·	X	—··—	/	—··—·
G	——·	Y	—·——	(	—·——·
H	····	Z	——··	)	—·——·—
I	··	0	—————	&	·—···
J	·———	1	·————	:	———···
K	—·—	2	··———	;	—·—·—·
L	·—··	3	···——	=	—···—
M	——	4	····—	+	·—·—·
N	—·	5	·····	-	—····—
O	———	6	—····	_	··——·—
P	·——·	7	——···	"	·—··—·
Q	——·—	8	———··	$	···—··—
R	·—·	9	————·	@	·——·—·

8. A colorful mix

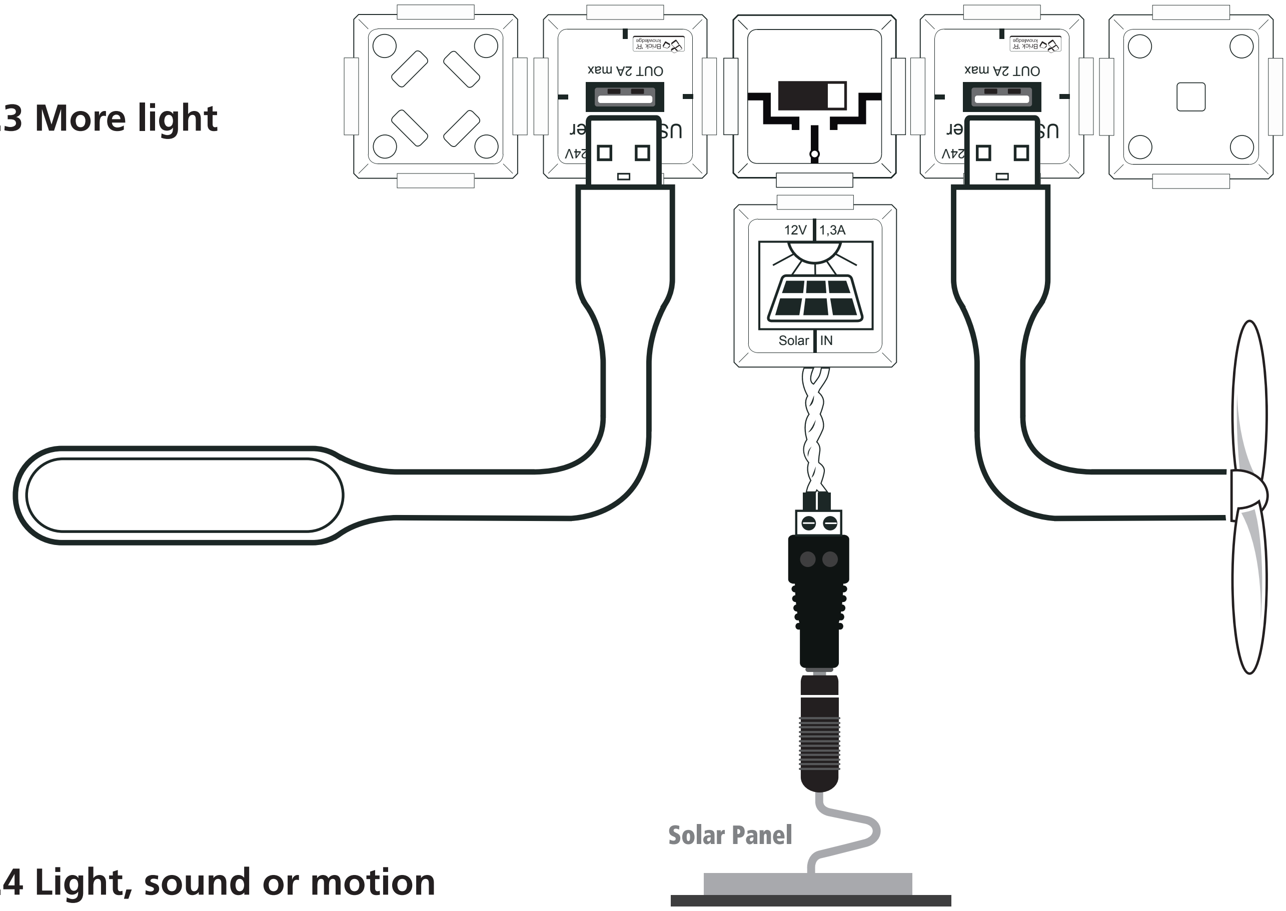
8.1 Fan and flexible LED



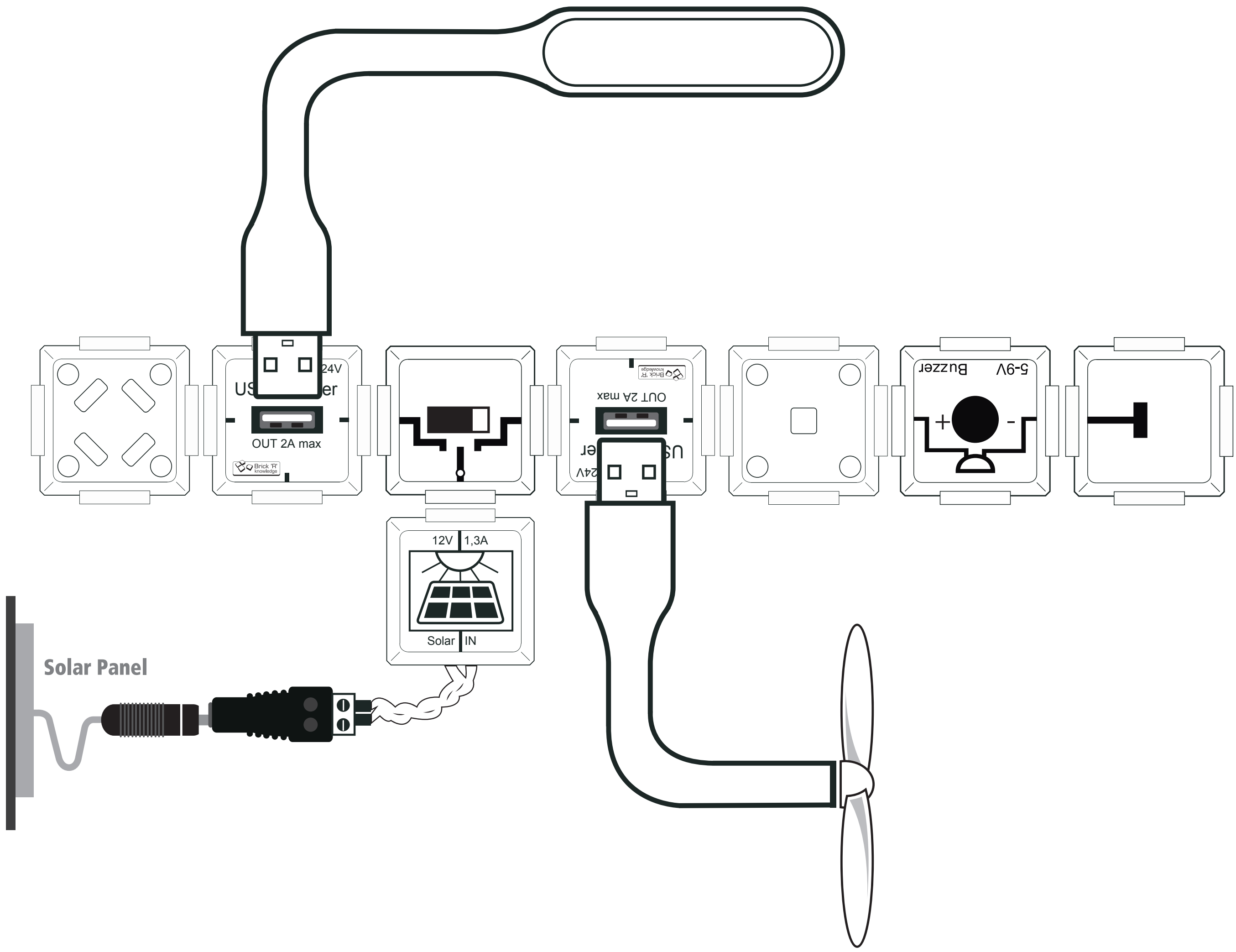
8.2 Light or motion



8.3 More light



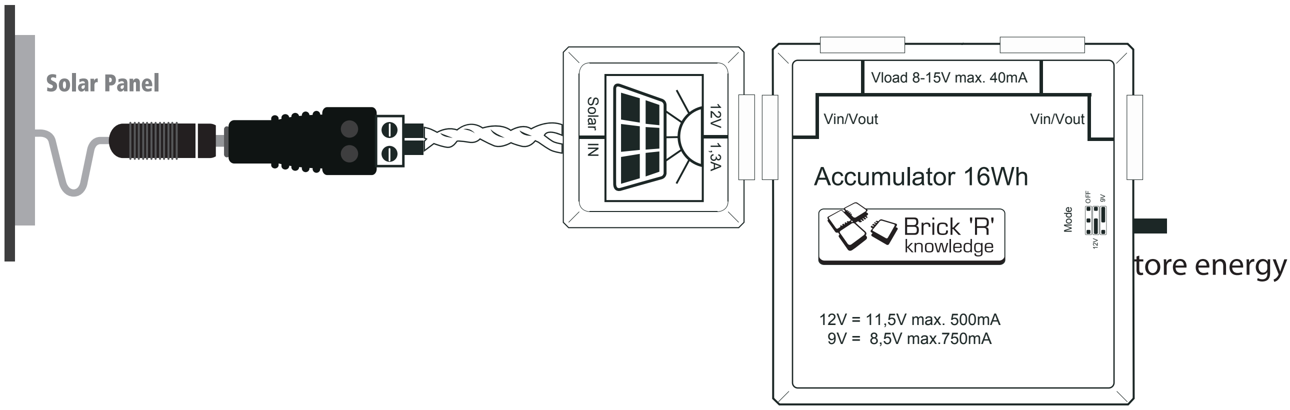
8.4 Light, sound or motion



9. How to store energy

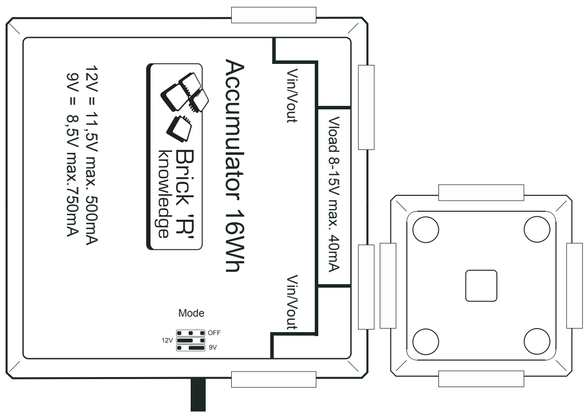
9.1 Charging the accumulator

Now we´re going to charge the accumulator with the help of the solar brick. You can easily connect those two bricks and the solar panel until the accumulator is fully charged. While the accumulator is connected with the solar panel, the jumper has to be set to 12V always!



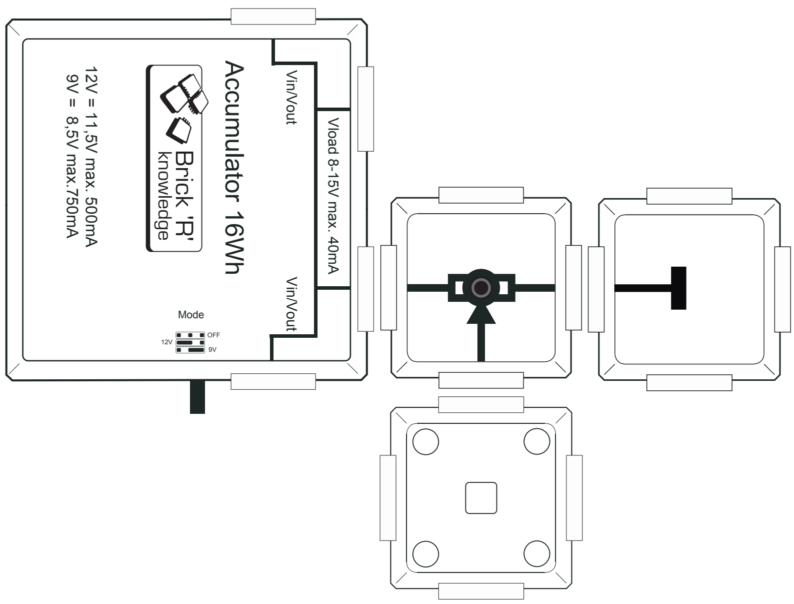
9.2 Accumulator and LED

The easiest way of creating a flashlight is by connecting the highpower LED brick to the charged accumulator. Because in this expample the accumulator is not used with the solar panel, you can set the jumper to 9V.



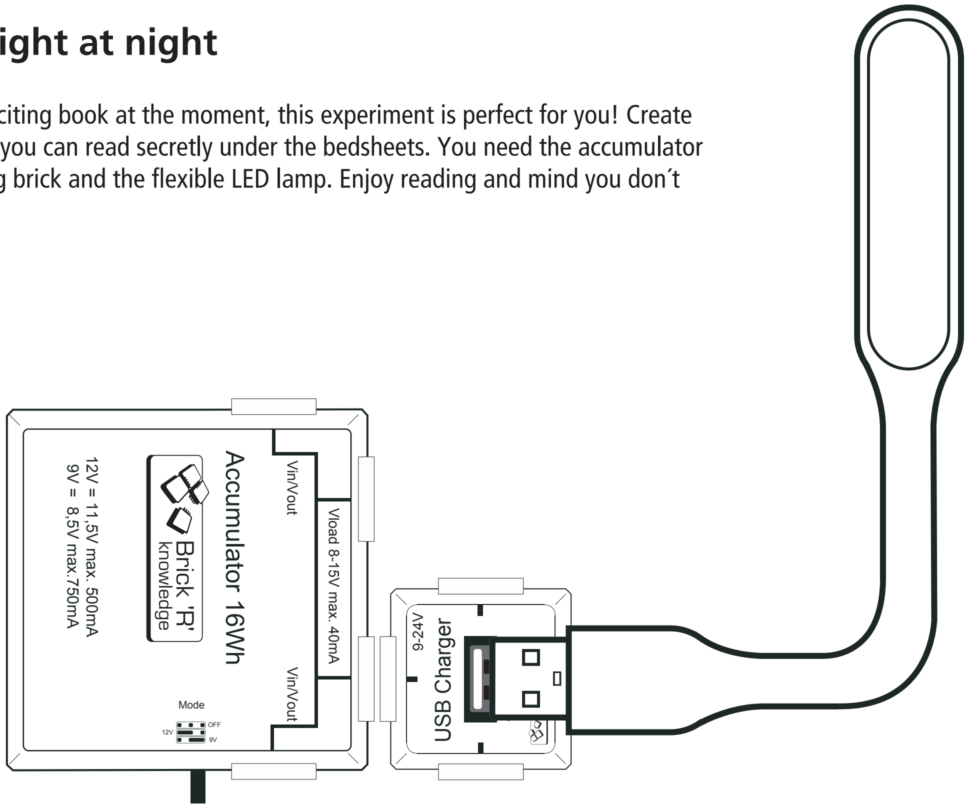
9.3 Changing the brightness

If you want to change the brightness of your flashlight, e.g. in order to see better when it´s dark, you can connect the potentiometer. This way the flashlight can adapt to the brightness by turning the knob.



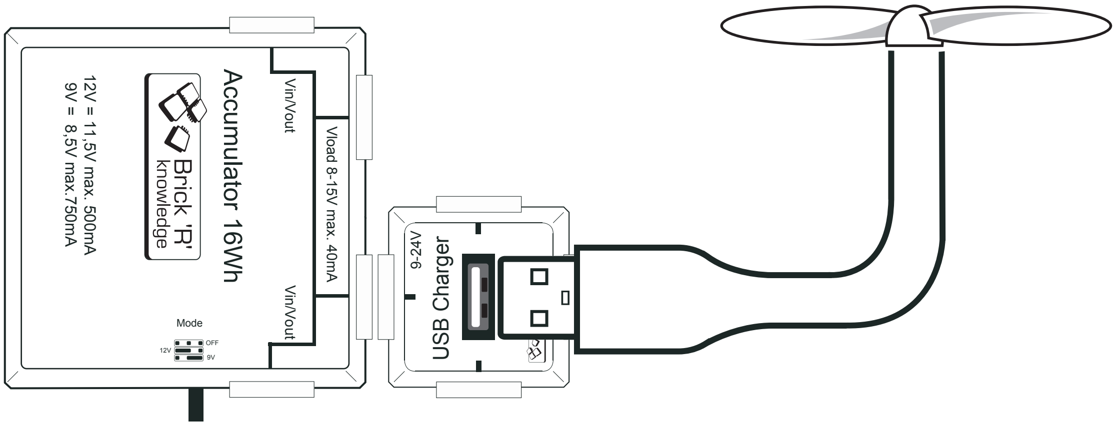
9.4 Reading light at night

If you´re reading an exciting book at the moment, this experiment is perfect for you! Create a reading light so that you can read secretly under the bedsheets. You need the accumulator brick, the USB charging brick and the flexible LED lamp. Enjoy reading and mind you don´t get caught!



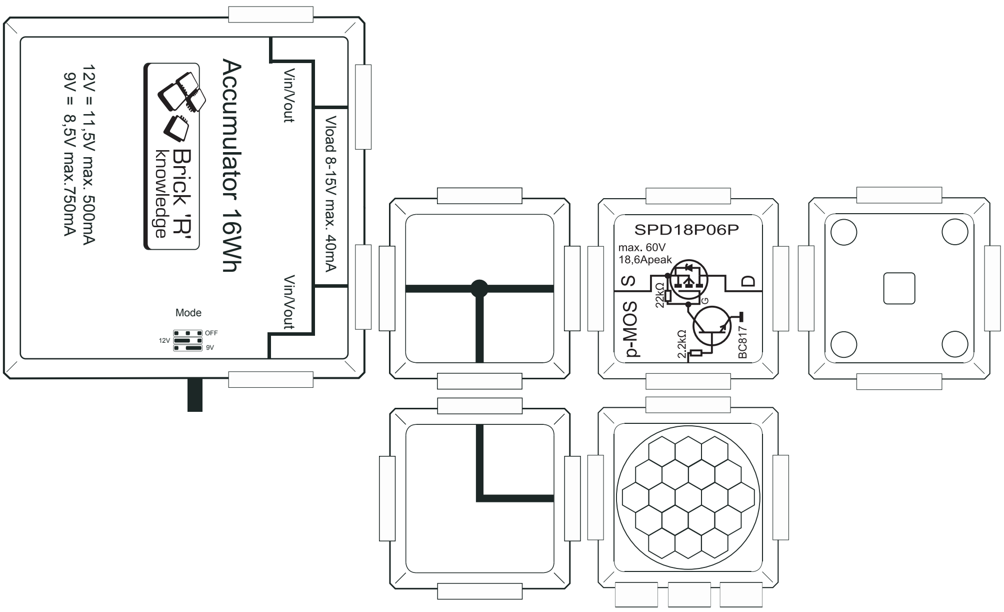
9.5 Portable fan

Do you know the struggle: It´s hot outside and you would give away everything to have your own fan in the rucksack. With the solar set you don´t have that problem anymore! Just connect the accumulator with the USB charging brick and plug in the fan. You can even bend the fan a little bit, so that it´s even more practical to carry. Attention: All of your friends will try to borrow your portable fan for a few minutes...



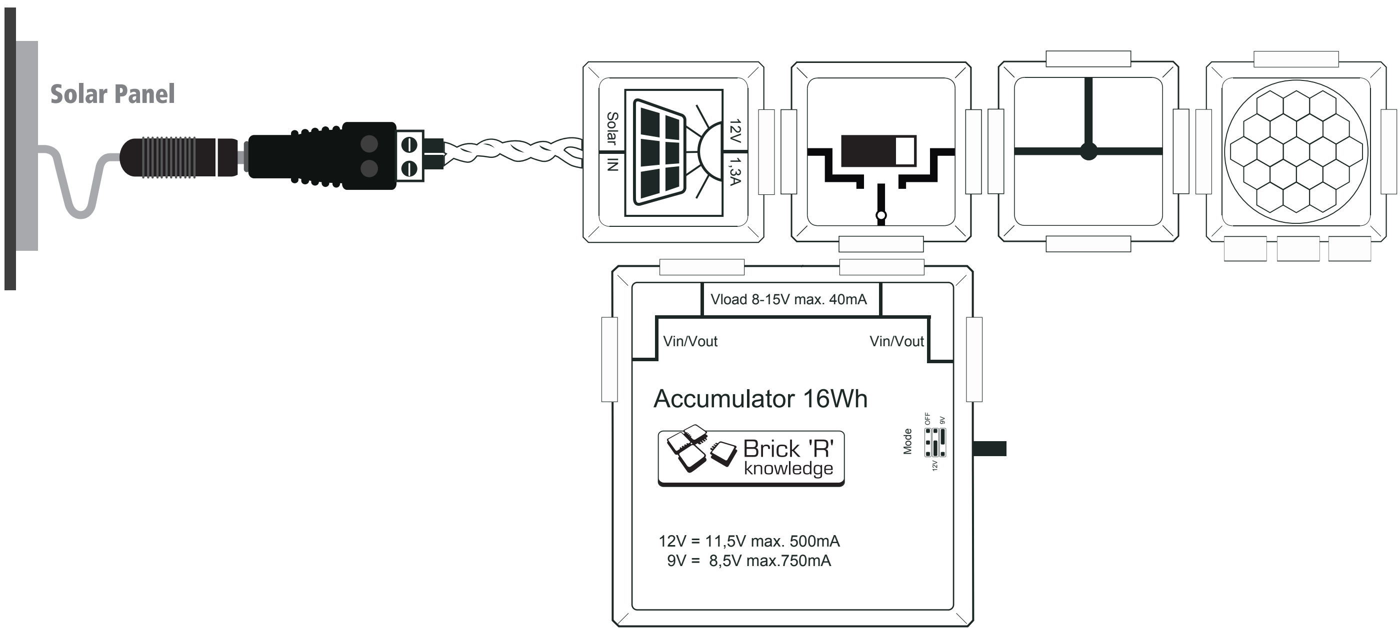
9.6 Nightlight with motion detector

You´re already lying in your bed but now you realize that you forgot something? From now on you don´t have to walk through your room in darkness. When you pass this circuit the motion detector gets active and you have a nightlight. For this experiment you need the accumulator, the corner brick, the T-part brick, the p-MOS transistor, the motion detector and the Highpower LED.



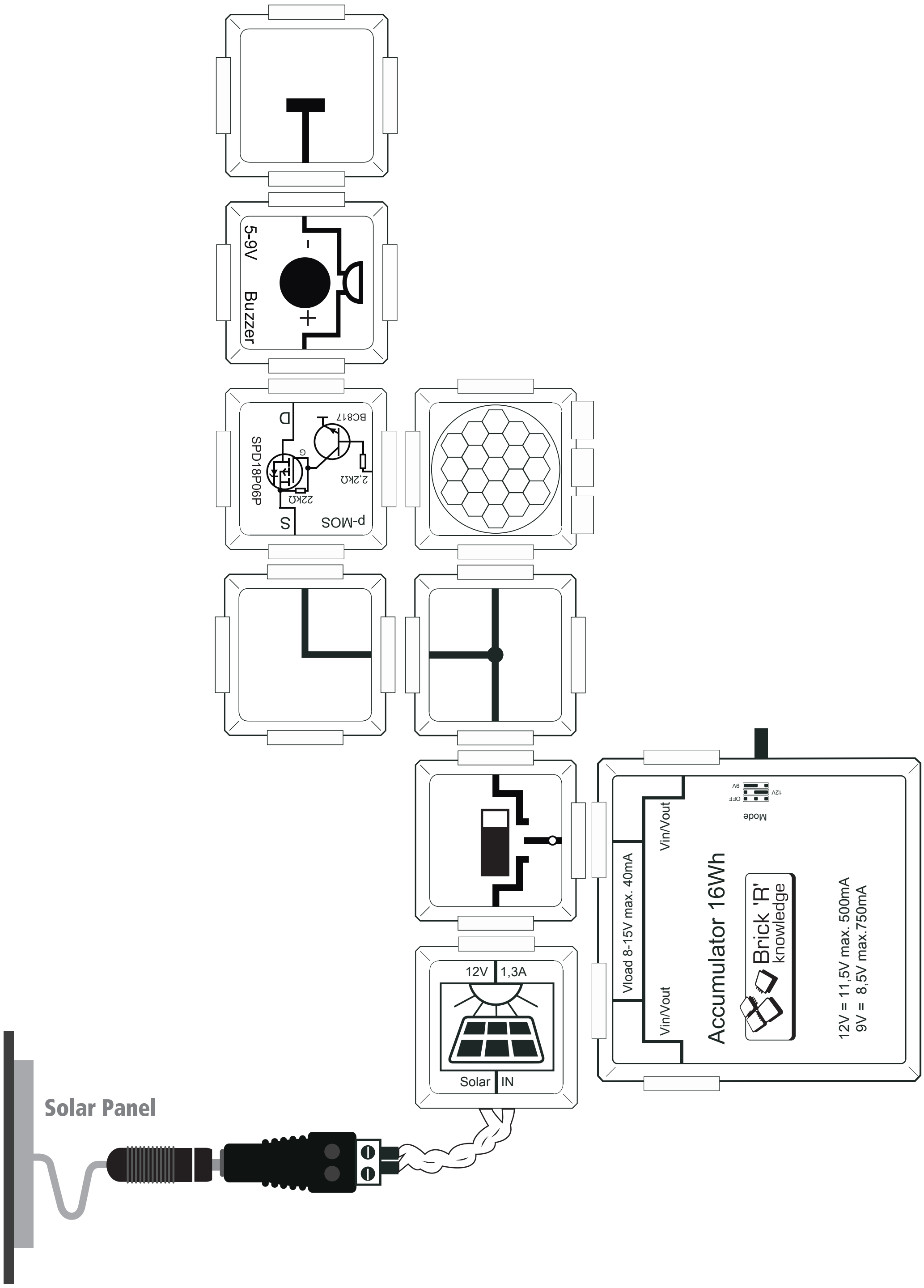
9.7 Charge by day - light at night

Build yourself a lamp that gets charged at daytime and lights up in the nightime. For this experiment you need the accumulator, the solar panel, the solar brick, the switch, the corner brick and the T-part brick, the p-MOS transistor, the motion detector and the Highpower LED. Now you have an effecient power supply that saves energy. At daytime you turn the switch to the left to chage the accumulator with solar energy, at nighttime you turn the switch to the right, your night light is now working.



9.8 Charge at daytime - alarm system at night

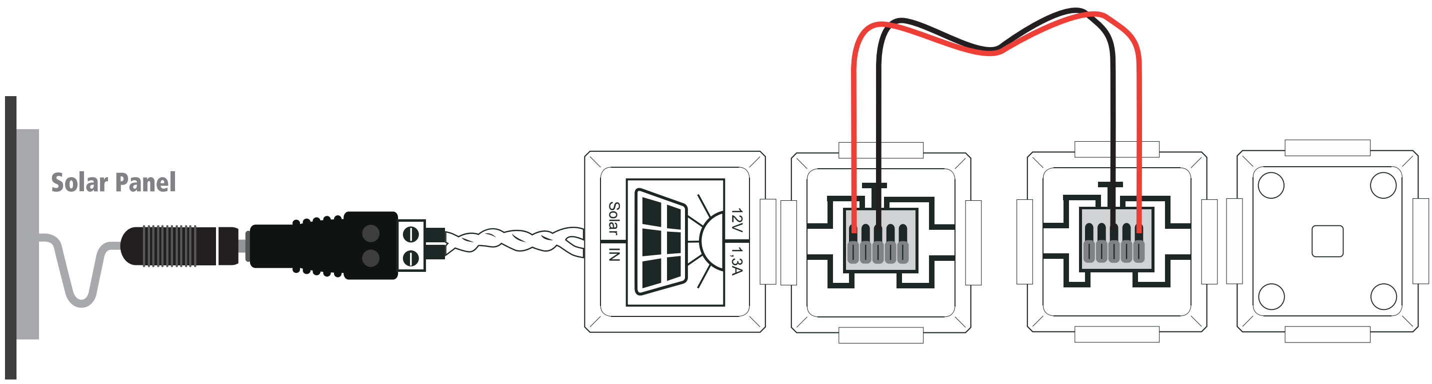
Do you want to protect your precious things from theft? It´s easy to build your own alarm system that rings loudly when someone enters your room. The principle is the same as in the experiment mentioned before: If the switch is turned left, the accumulator is charging, if you turn the switch to the right, the alarm system is active.



10. 10m forward

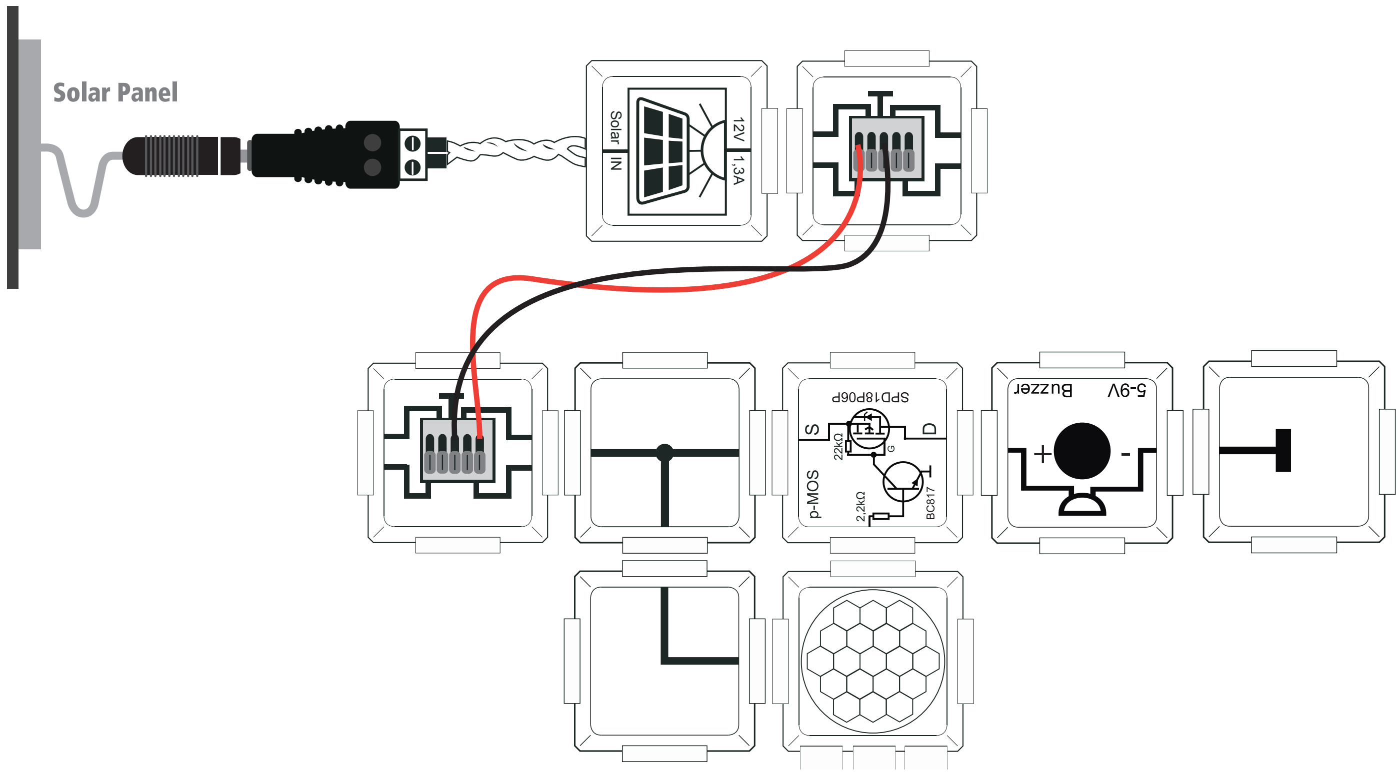
10.1 Extension with clamps

Even the coolest circuit is worthless if it has to be installed too far away from the solar panel. To fix this problem, we will use another brick: the 5-pol clamps. And this is how it works: You take one side of the two-wire cable and seperate the two wires a for around 1-5cm. The 5-pole clamp has 5 contact. If you push the clamp down, an inner connection gets seperated, if you let go, the connection is active again. If the wire is connected with one of the contacts inside the clamp it provides a current flow. Now: Take the black end of the wire, push down the clamp and plug the wire into the contact in the middle (It´s marked with the ground symbol). When you let go you can pull the wire a little bit in order to be sure that everything is connected firmly. If you want to coonect the solar brick now with the clamps, just do the same thing with the red end of the wire and use one of the left contacts. This means: The side with which you connect the wire decides which brick connector recieves the signal. Now we also need the second 5-pole clamp: black end of the two-wire cable to the middle ground contact, red cable end two one of the outer contacts.



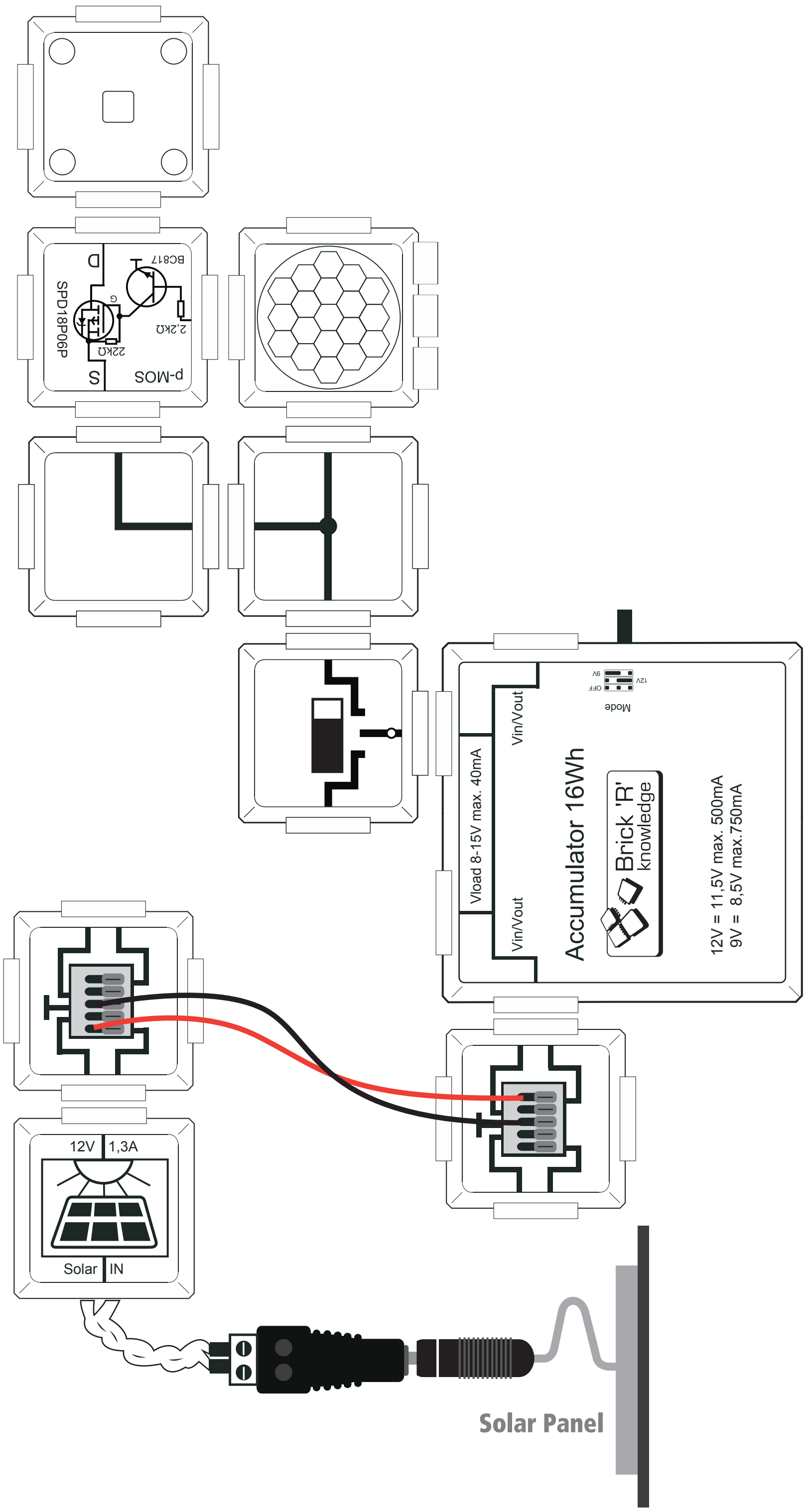
10.2 Extended alarm system

Now we can try to make the alarm system work even if it´s 10 metres away from the solar panel. Now you can also protect locations or things that are located in the shadow or in a dark room.



10.3 Extended: Charge at daytime - light at night

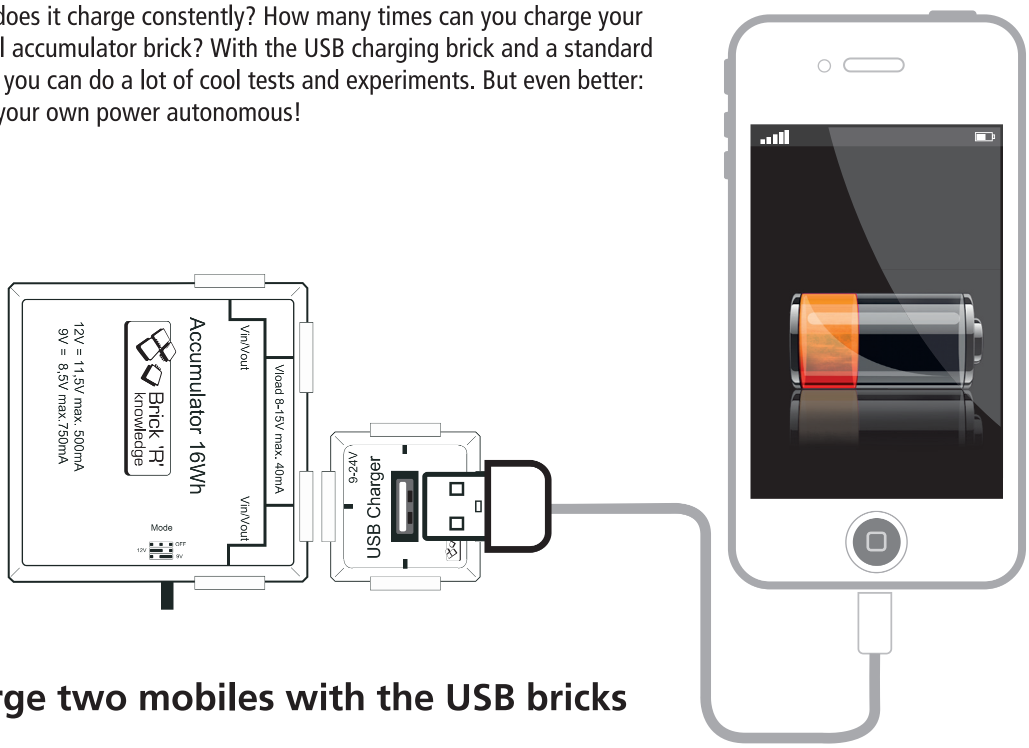
Of course you can also realize the circuit from the example 9.7 with the 5-pole clamps and the two-wire cable. Just try out different versions and experiments!



11. How much energy does a smartphone consume?

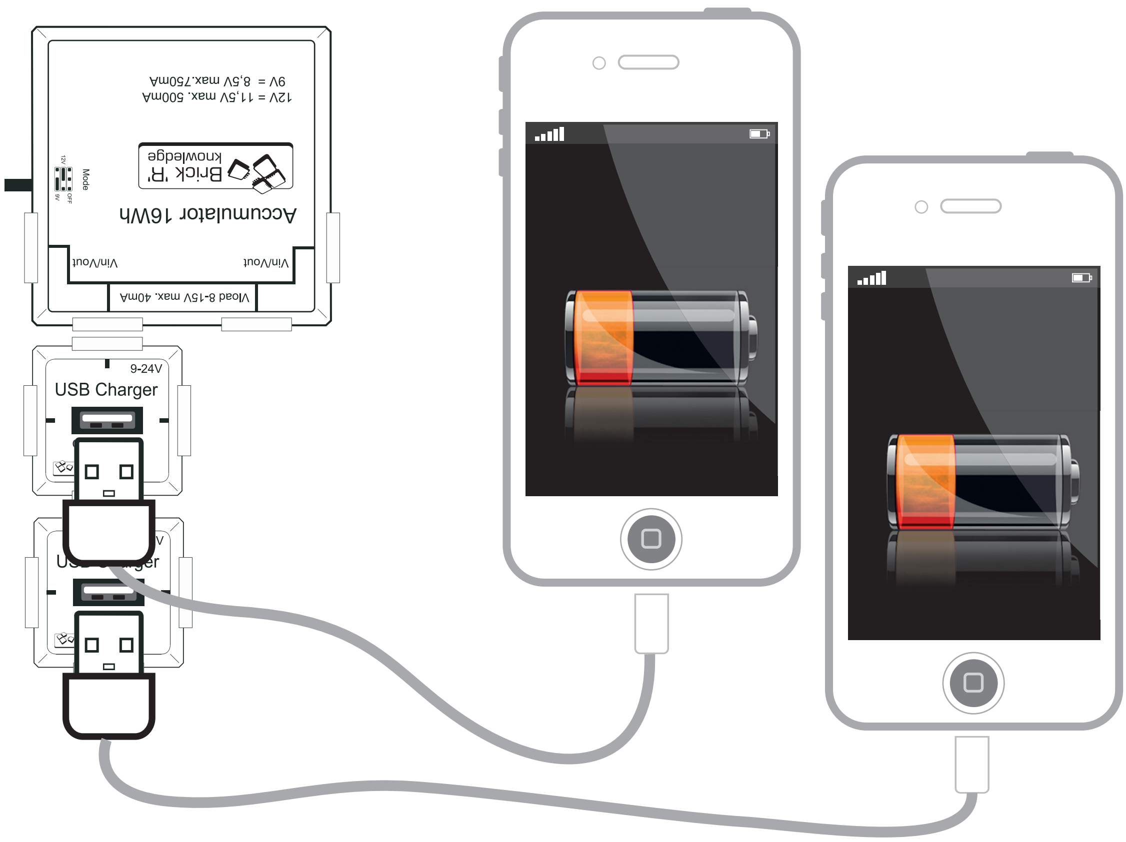
11.1 Charge your mobile with the USB brick

How much time does your smartphone need to charge fully? How much percent does it charge after 5 minutes? Or after 10 minutes? Is it charging slower after a specific time or does it charge constently? How many times can you charge your phone with a full accumulator brick? With the USB charging brick and a standard micro USB cable you can do a lot of cool tests and experiments. But even better: Your producing your own power autonomous!



11.2 Charge two mobiles with the USB bricks

You can also try the experiment with two smartphones. Which brand needs more power and which less? Try it out with your friends and family!



12. The journey goes on

12.1 Measuring and understanding

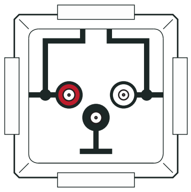
All of the experiments with the Solar Set showed you how to use the solar energy in everyday life. Solar energy is an important alternative to nuclear energy and coal-fired power plants in order to have a secure and eco-friendly power supply for the future. We learned how to convert solar energy into electrical energy, how to light up LEDs, how to make fans work and how to store energy in order to operate devices even if the sun doesn´t shine.

But what excactly happens in all our experiments? With the extension set of measurement bricks, you can measure all of the different currents and voltages of the circuits. You will also learn how to determine the key metrics of a solar cell and the accumulator brick. You can also measure the difference of the current provided by the solar panel at daytime when the sun shines bright or at the evening when it´s cloudy.

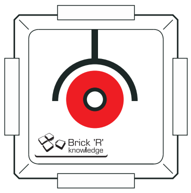
What you need:

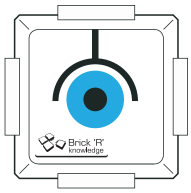
1. The Brick'R'knowledge Measuring Adapter Set (ALL-BRICK-0463) that consists of:

- A measuring adapter 3x2mm socket

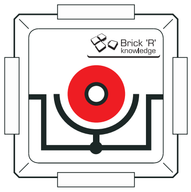


- Two measuring adapter 4mm Endpoint (red and blue)

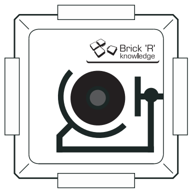




- A measuring adapter 4mm inline red



- A measuring adapter4mm closed end GND black



The set enables you to determine current, voltage and other measurement values with standard measurement easily.

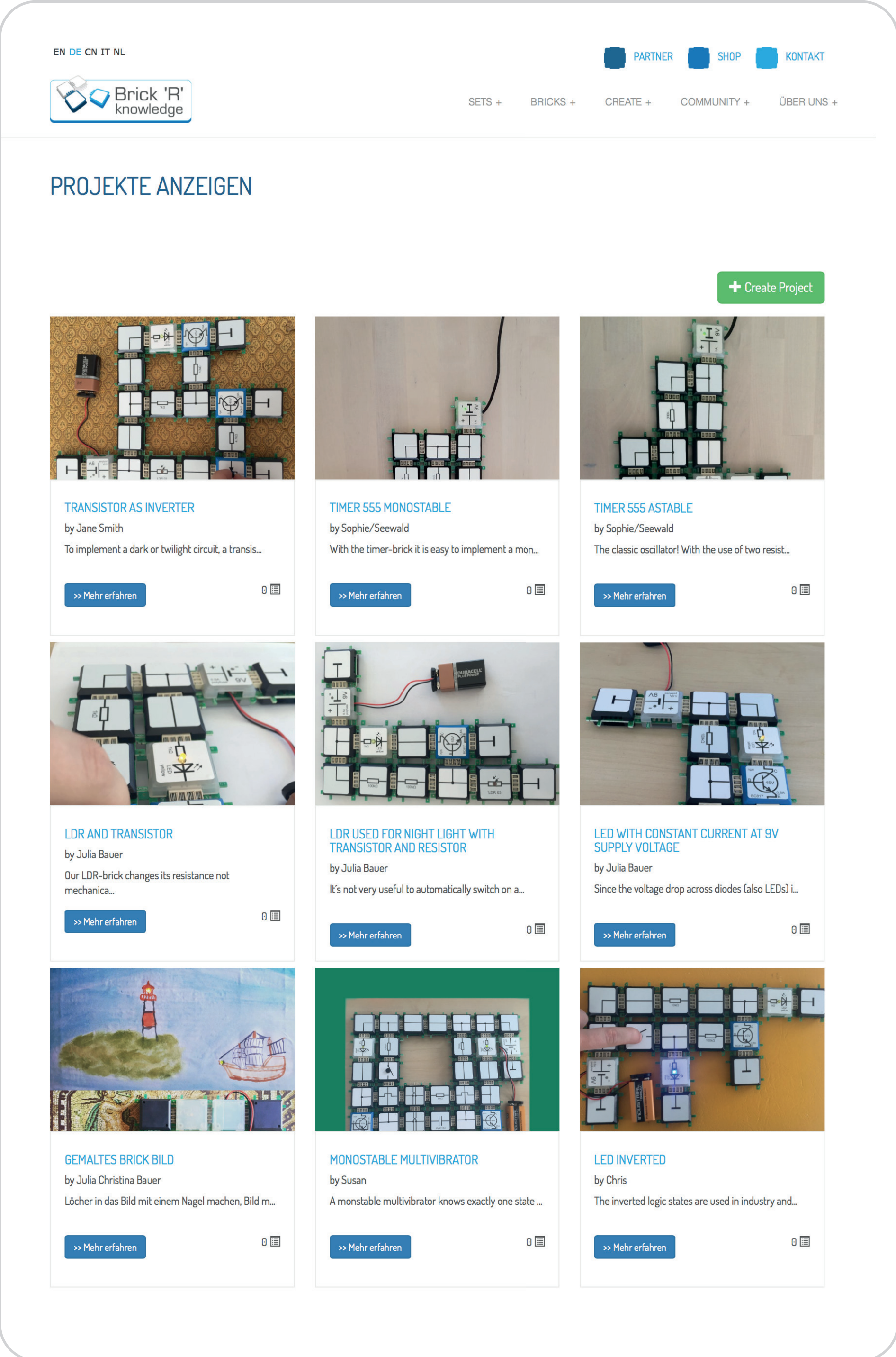
2. A digital multimeter (ask your friend, parents or teachers if you can borrow one from them). You can also fiend cost-effective devices and instructions on how to use them on the internet. You can also visit one of our workshops about multimeters in our Maker Space in Berlin. Find more information here: www.maker-store.de/shop

12.2 Brick Community

The brick universe is expanding: You can find more ideas, experiments and bricks at fairs, on our website, on youtoube or social media networks. Boost your creativity!

More projects

By clicking on "Create" you can try out experiments from other users or show your own cool circuits.

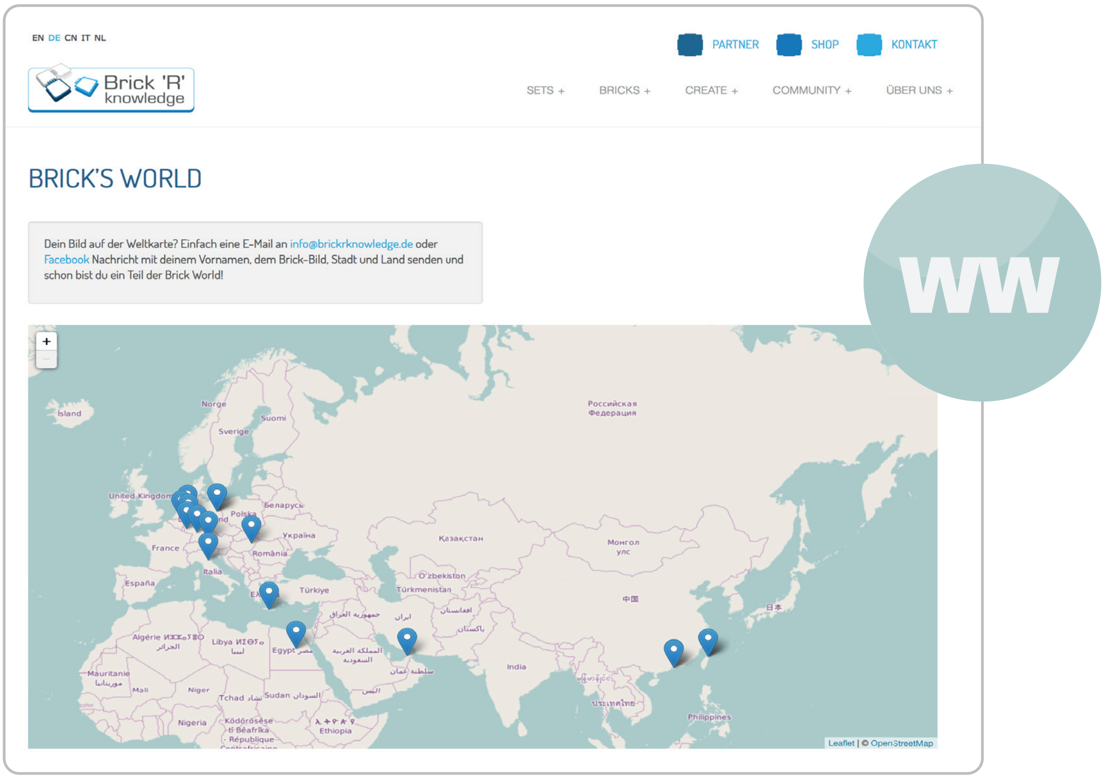


Social Media

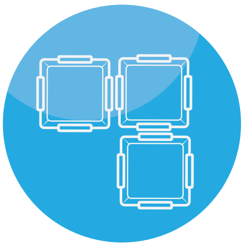
By clicking on "Community" you can find all of our social media networks. Stay up-to-date!

Worldwide

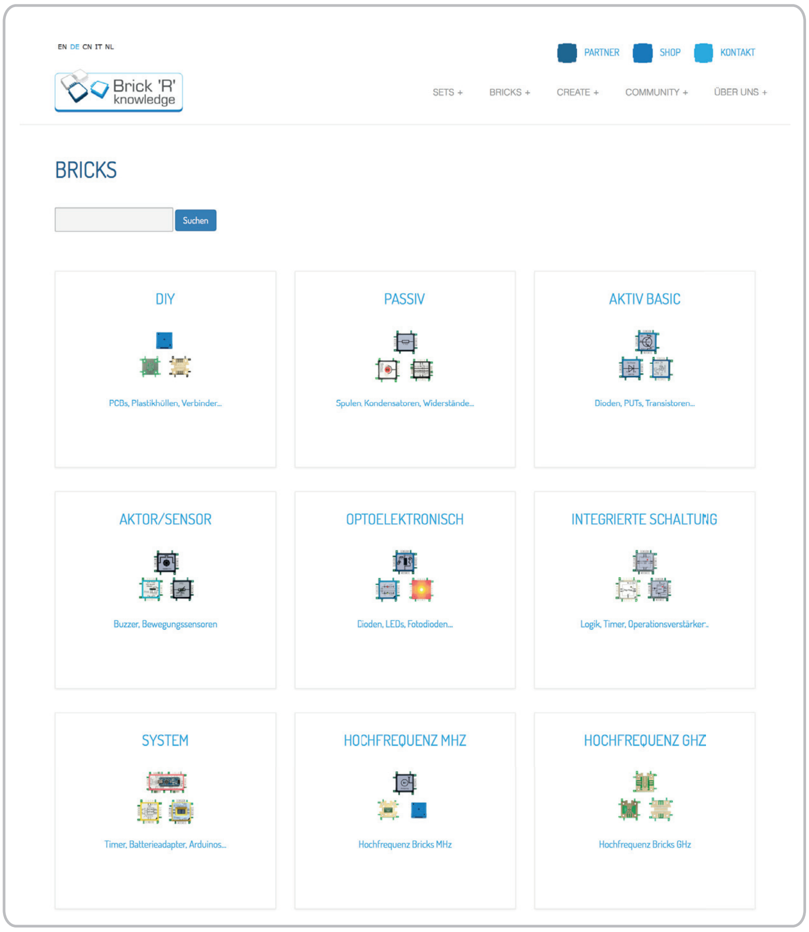
At "Community" you can also find out where our bricks were already. Do you have a nice picture of bricks in your town? Just send it to us and soon you will finde it on our website!



Even more bricks!



By clicking on "Bricks" you can find all of the available bricks with information and ideas for experiments.



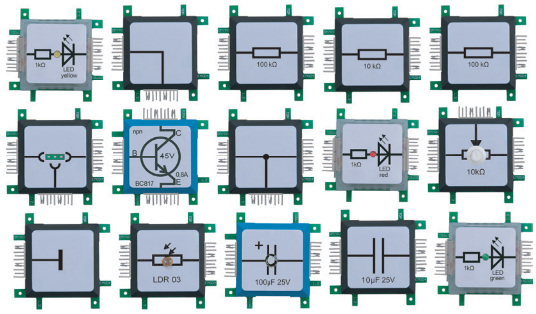
Brick Blog

Each week we post a new blog post. You can read about our experiences at fairs, new circuits, funny stories and information of the world of electronics.

13. Brick Sets im Überblick

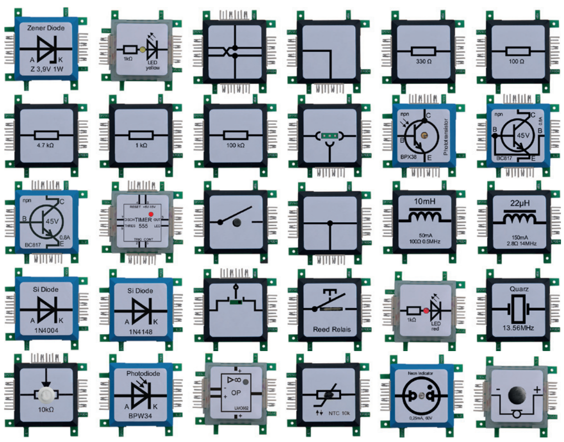
Basic Set ALL-BRICK-0374 enthält 19 Bricks

The basic set contains 19 selected bricks to offer a fast and easy start into the world of Brick `R` knowledge as well as the possibility to create numerous circuits. The basic set is a perfect support for kids gaining their rst experiences with electronic and technical experiments.



Advanced Set ALL-BRICK-0223 enthält 111 Bricks

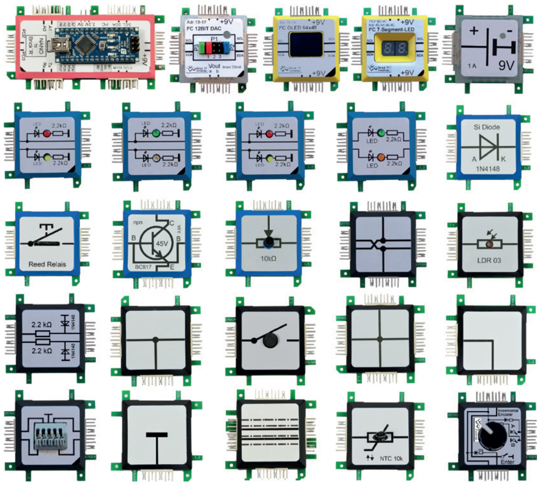
Our Advanced Set contains 111 components that allow you to build more complicated and complex solutions. Thanks to the educational system, knowledge can be gathered, so that not only you but also our next generation can prot from it. You can build individual circuits by plugging different bricks together. Simple as well as complex electronic and technological topics can be experienced in a totally new way. Due to the open-source factor, you can create your own bricks and develop your own solutions.
Brick'R'knowledge isn't all about basic electronic engineering, also RF experiments can be realized, which makes it a unique system worldwide.



Arduino coding Set

ALL-BRICK-0414

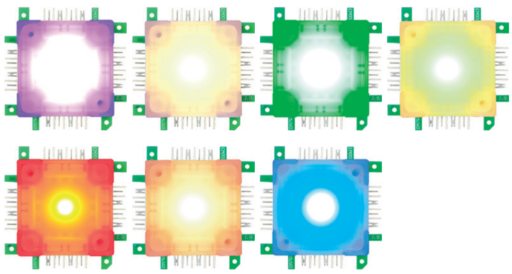
Get in touch with digital electronics and start understanding programming with the Arduino® Nano, which is included in the kit. It is our rst kit with digital components, such as 7-segment displays, OLED display, D/A converter or I2C Bricks, complementary to all analog bricks. To get you started with the popular microcontroller, we support you with various programming examples.



7 Color Light Set

ALL-BRICK-0398

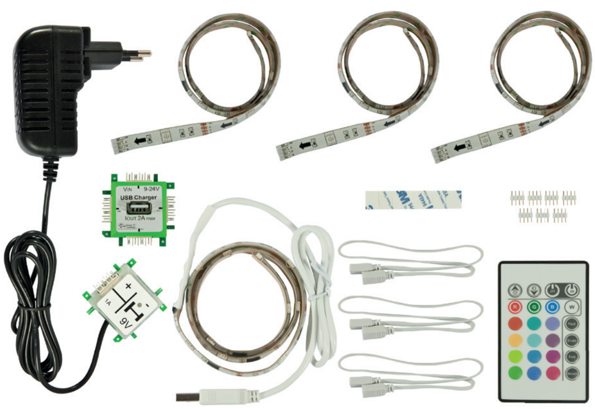
The 7 Color Light Set contains 28 LED bricks in 7 different colors to create stunning light effects in a horizontal and vertical architecture. The red, yellow, blue, orange, violet, green and warm white 1 watt LEDs are perfect for individual lighting characters or as a mobile lighting solution.



RGB Color Light Set

ALL-BRICK-0619

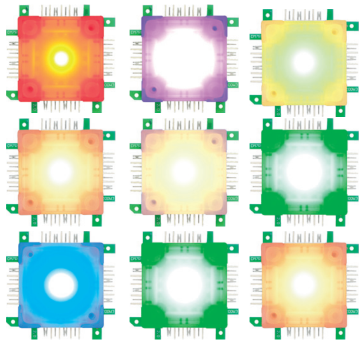
Create your light show! The RGB Color Light Set comes with four exible LED strips containing 36 LEDs in total that can be controlled with the included infrared remote control. You can glue, cut and connect the LED strips however you want. The infrared remote control has 16 different color keys and 4 light programs.



Programmable LED Set

ALL-BRICK-0483

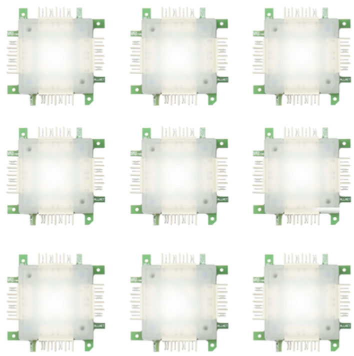
The kit contains 49 programmable and controllable RGB LED bricks, each with two or three connectors and a conjunction-brick for Arduino management and power supply. Furthermore, the Brick'R'knowledge Programmable LED Set includes an Arduino adapter brick and an Arduino Nano. With this kit you can realize colorful LED animations and other individual ideas. And the best thing about it: by performing different projects, you can easily learn the programming of microcontrollers.



Highpower LED Set

ALL-BRICK-0399

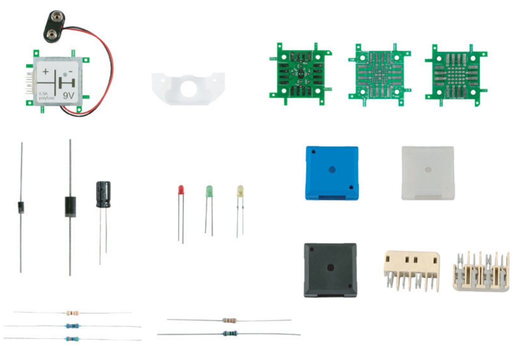
Powered by 1 Watts, each of the 50 High Power LED bricks contained in the kit irradiate the whole surrounding area in bright white. Build individual solutions in every imaginable architecture and invent Brick nightlights, Brick table lamps or any other creative illuminant. The power supply with 12V 8A supports the intensive luminosity to offer a stylish and cozy atmosphere. The High Power LED Set 50 allows you to deal with modern light design and simultaneously learn about electronics.



DIY Set

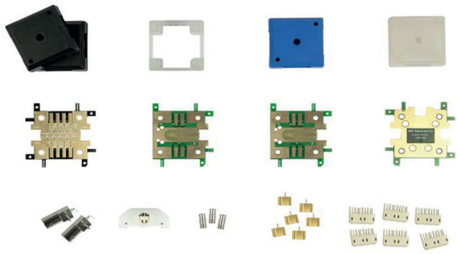
ALL-BRICK-0397

The DIY set goes even a step further. The included components offer a much more detailed insight into the brick architecture and allow even the production of individual bricks. The DIY set offers an enormous exibility for the maker generation or for people creating individual bricks.



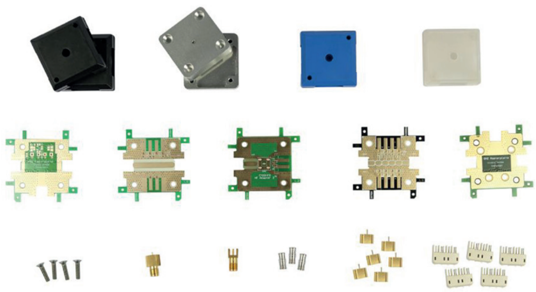
MHz DIY Set ALL-BRICK-0457

Individual challenging projects within the MHz frequency range can be created with the MHz DIY set. Three different grid and experimentation boards, BNC sockets, P-SMP plugs and suitable connectors make the kit perfect for any high frequency experiment. The kit contains hermaphrodite connectors and a soldering jig for SMD plugs to develop your own bricks or other components for the Brick system.



GHz DIY Set ALL-BRICK-0458

Realize advanced and complicated experiments in the high frequency range up to GHz frequencies. In addition, the kit offers four different PCBs, P-SMP, SMA sockets, P-SMP connectors and brick-specic hermaphrodite connectors. The GHz DIY Set is perfect for HAM radio operators and fans of measuring.



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