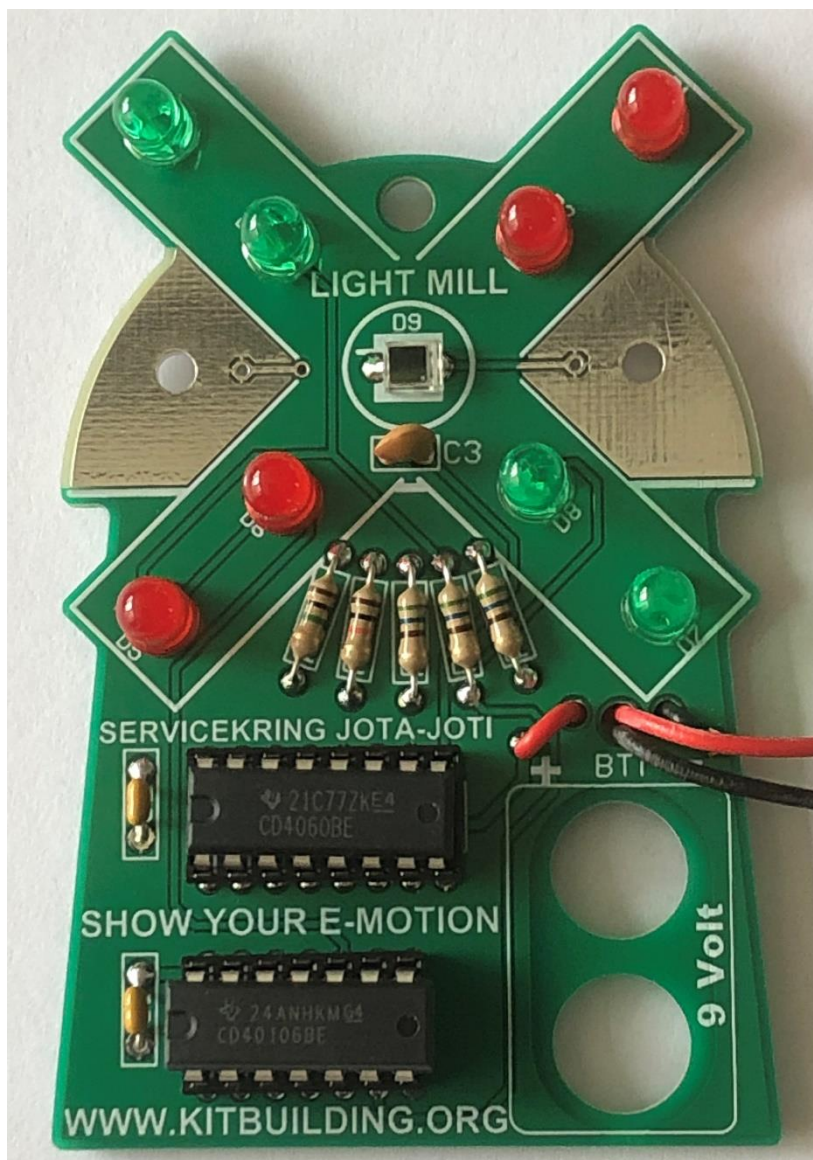


Light Mill 2022



Manual Light Mill kit.

A project of the Service Kring JOTA-JOTI.

**Do you like the Light Mill, do you have great ideas ?
Tell us, please see how on the last page .**

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Remark:

To the instructors: we want to advise you to read this entire document beforehand carefully. It is sufficient to print only pages 6 and 7 for the purpose of building it.

TIP: To build one kit yourself before the JOTA-JOTI is besides fun also educational.

Note: The used IC's are sensitive for static electricity so please install them as last items.

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Introduction:

The Light Mill 2022 is a kit that we have re-released. The circuit and the parts used are the same, only the color of the board has changed. Like all our kits this kit is also intended to be soldered together by children (under supervision) and to introduce them to electronics in this way. You can make the Light Mill spin faster by shining a light or a remote control on the photodiode D9 or grabbing the two silver surfaces.

The idea:

The Light Mill is inspired by the so-called Light Mill. This is a physical demonstration model in which a mill is mounted in a glass ball. This mill is equipped with blades that are black on 1 side and silver on the other side. If light falls on this mill it will turn, with more light this light mill will turn faster.

More information about this can be found on Wikipedia:

https://nl.wikipedia.org/wiki/Radiometer_van_Crookes

Game ideas:

Once soldered together, the print can be provided with a string and worn by the campfire but much more is possible with it:

- With a number of Light Mill's, for example, a route through the forest can also be plotted.
- By grabbing the silver-colored surfaces, you can vary the speed. But you can also "work" with, for example, two scouts. Each grabs a plane bite between thumb-index finger. With the remaining hand they can grab an object, if the object is electrically conductive the mill will turn faster.
- Instead of objects in the above, you could also take a pile of wires with uninsulated ends. These wires are in a tangle. If the scouts grab the right ends (which belong together) then the mill will turn faster. The electronic equivalent of "pulling string".
- There are holes in the contact surfaces, here a wire can be attached. You can attach these wires to a piece of paper with (for example a paper clip). Then you can make a track / maze with a soft pencil, if the paper clips are connected to each other via a line, the mill will turn faster.
- You can also use it to make your own electro game. Then use aluminum foil. Use separate surfaces with the wrong answers, planes that are connected to the other paper clip belong to the correct answers.

Have fun building and using the Light Mill!

If you have another nice idea, we would love to hear from you!

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Contents of the Package:

The table below can be used to check the contents of the kit. Solder and a 9 volt battery must be taken care of themselves.

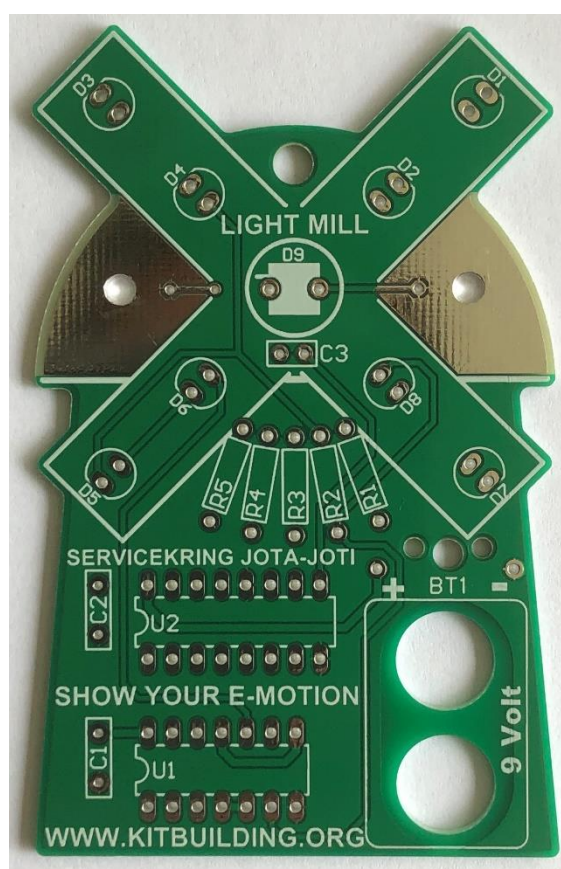
Component	Value	Qty	Pos. on board	Remarks
Resistor	560 Ω	3	R1, R2, R3	green, blue, brown, gold
Resistor	10 K Ω	1	R4	brown, black, orange, gold
Resistor	1 M Ω	1	R5	brown, black, green, gold
Capacitor	100 nF	2	C1, C2	yellow, inscription 104, pitch 5 mm
Capacitor	390 pF	1	C3	yellow, inscription 391, 2.5 mm pitch
LED	rood, 5mm	4	D1, D2, D5, D6	observe polarity
LED	groen, 5 mm	4	D3, D4, D7, D8	observe polarity
Fotodiode	BPW34	1	D9	
IC socket	14 pins	1	U1	watch direction
IC socket	16 pins	1	U2	watch direction
IC	40106	1	U1	watch direction
IC	4060	1	U2	watch direction
Batteryclip	9 Volt	1	BT1	see pictures
Board		1		



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Component numbering and component values:

Print Imprint	Component	Print Imprint	Component
R1	560 Ω	D1	LED Red
R2	560 Ω	D2	LED Red
R3	560 Ω	D3	LED green
R4	10 K Ω	D4	LED green
R5	1 M Ω	D5	LED Red
		D6	LED Red
C1	100 nF	D7	LED green
C2	100 nF	D8	LED green
C3	390 pF	D9	BPW34 photodiode
U1	IC socket 14 pins	BT1	Batteryclip 9V
U2	IC socket 16 pins		
U1	40106		
U2	4060		



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Building description of the Light Mill:

It is easiest to mount the parts from low to high. All resistors are mounted lying down, bend both wires at an angle of 90 degrees taking into account the distance between the holes on the PCB. Insert the resistance through the PCB and gently bend the wires on the bottom of the pcb slightly apart. The pcb can now be turned over to solder without the resistance falling out. After soldering, cut off the legs just above the soldering, do this also for all other components with longer legs.

Tip 1: The dots at the beginning of the line can be colored to indicate which parts have already been assembled.

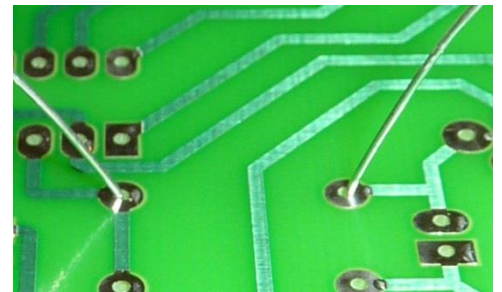
Tip 2: When in doubt about the assembly of a component, look at the photo of the built-up pcb, once soldered incorrectly, repair can be difficult.

Assembly sequence:

Mount the following resistors successively:

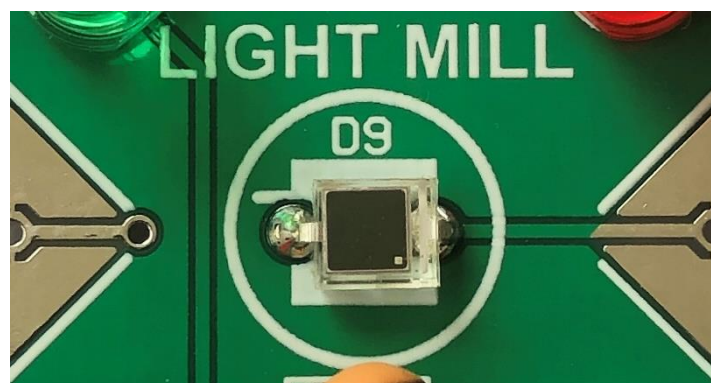
- R1, R2, R3: 560 Ω (green, blue, brown, gold)
- R4: 10 K Ω (brown, black, orange, gold)
- R5: 1 M Ω (brown, black, green, gold)

(The photo used is from a different print but shows what the intention is.)



- Mount photodiode D1.

Unlike some other diode applications, it does not matter how it is mounted in this circuit. If you want to do it according to the book, the print shows that the tiny tab on the left as can be seen in the photo, the dot comes at the bottom right.



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Mount the following capacitors successively:

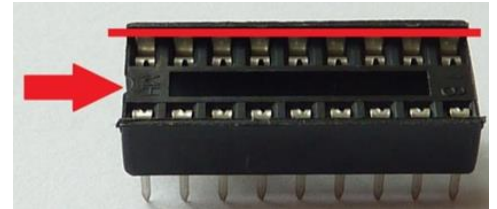
- C1, C2: 100 nF (yellow, pitch 5 mm, inscription 104)
- C3: 390 pF (yellow, pitch 2.5 mm, inscription 391)

Mount both IC feet:

- U1: 14 tripe (note direction)
- U2: 16 tripe (note direction)

Make sure they are well flat against the print.

NOTE: in one of the end sides of the IC feet there is a notch, this must match the drawing on the print. Make sure that all pins stick through the pcb well before soldering, at the top all connections must be flat and on the same line.



Mount the LEDs:

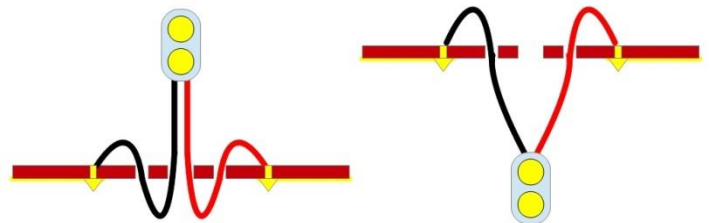
- D1, D2, D5, D6: LED red, 5 mm
- D3, D4, D7, D8: LED green, 5 mm

NOTE: The LEDs have a short and a long leg. The long legs are closest to the middle, on the side of the inscription D1 to D8 comes the shortest leg. Of course you can also change the colors from place to place, but if the LEDs are mounted incorrectly, they will not work!

TIP1: First solder them with one leg so that you can straighten them neatly and then solder the rest.

1. Mount the batteryclip.

Feed the wires from below through the pcb and then put them from above through the holes to solder them. After soldering, the wires can be pulled tight. As can be seen in the picture, this can be done in two ways depending on the side where you want the connection. As usual, red is + and black is -.



Place both ICs in the feet:

- U1: 40106, 14 pin (note direction)
- U2: 4060, 16 pin (note direction)

NOTE: in one of the end sides of the IC there is a notch (slot), this must correspond to the drawing on the print and the notch in the previously mounted IC feet.

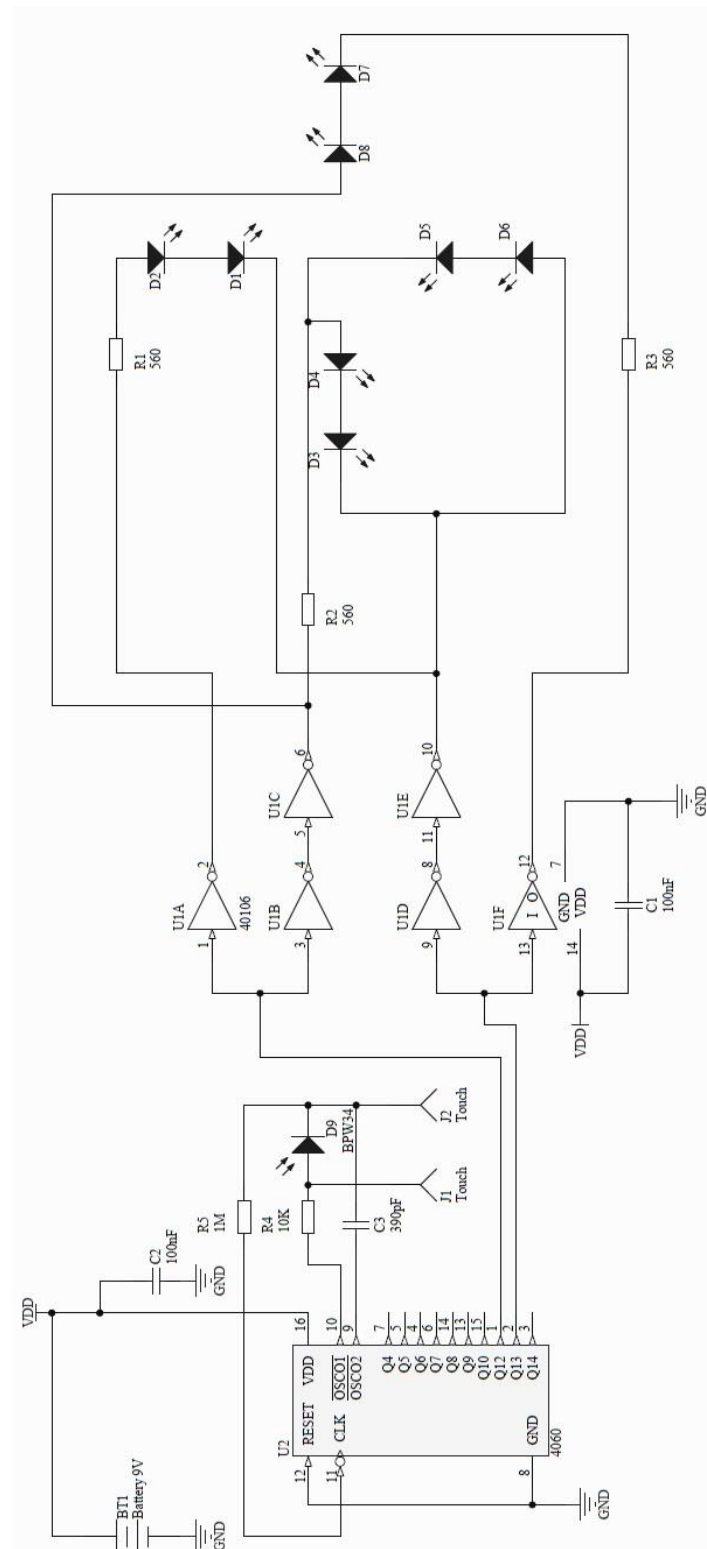
The ICs are sensitive to static electricity!

1. Plug in the battery and the Light Mill can be tested!

If you have done everything right, you can now see the blades of the mill turning. You can make them spin faster by shining a light or a remote control on the photodiode D9 or grabbing the two silver surfaces. By inserting the battery through the holes and then connecting it, you can leave the mill upright.

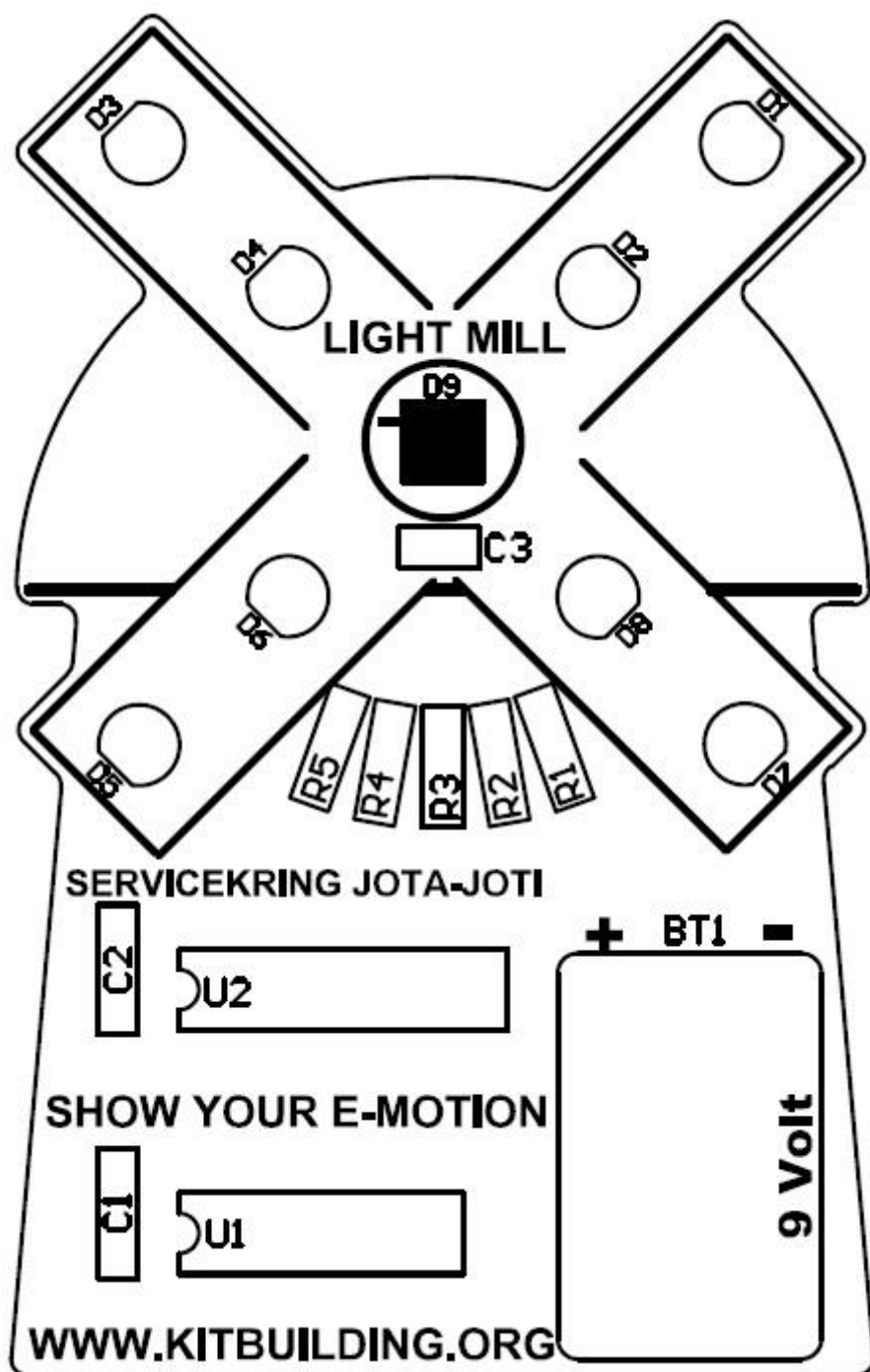
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Schematic:



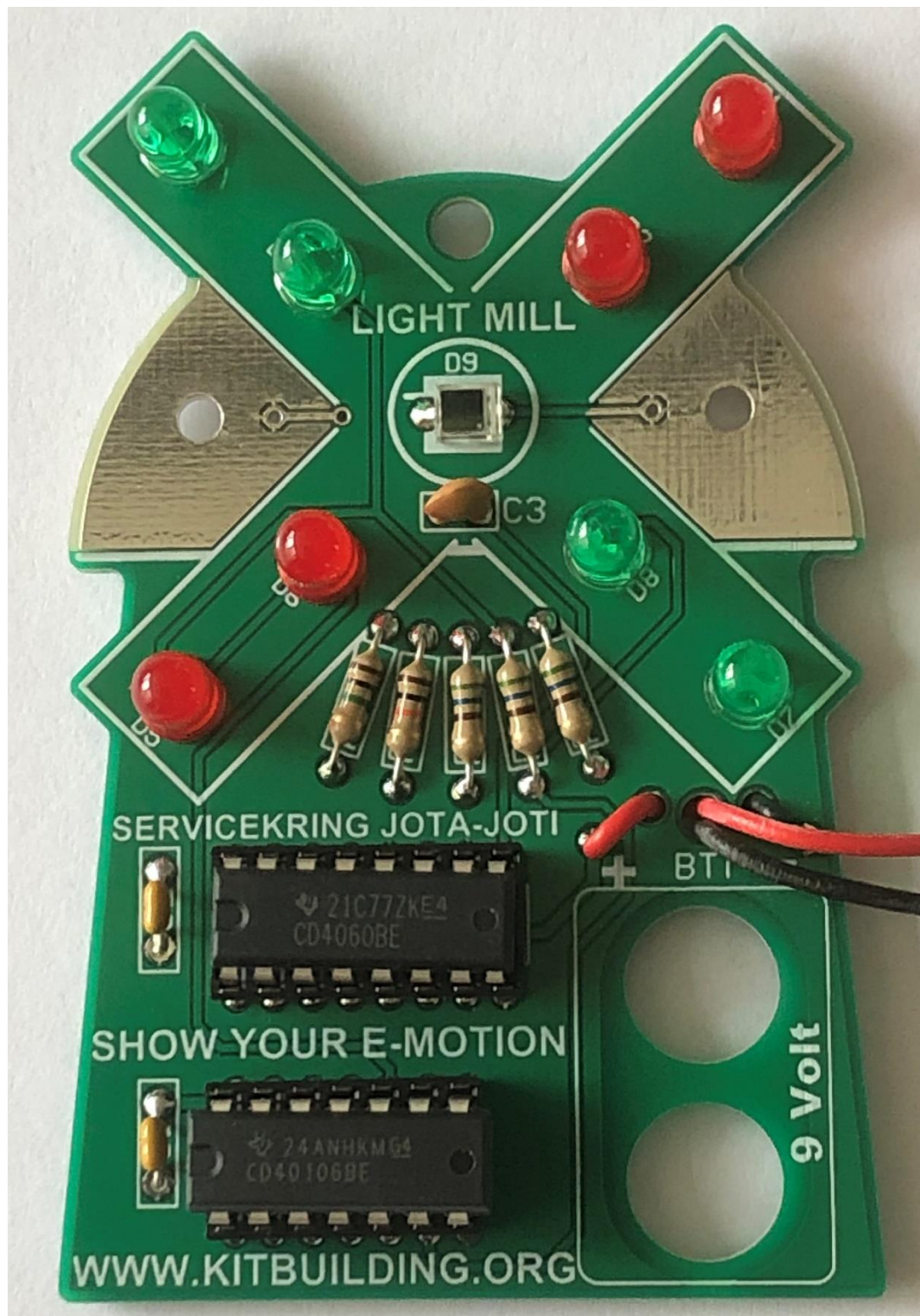
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Component arrangement:



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Fully build board:



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Soldering with children:

There are a number of pitfalls conceivable when soldering with children, by avoiding these the chance increases that the project will be successfully completed.

We regularly come across the following things:

- Making the solder connection takes (much) too long, normally a solder connection is made in about 3 seconds. Preheat for about 1.5 seconds (with a little solder at the tip for good heat conduction), add solder, remove solder and soldering iron. Children do not yet have this dexterity and the materials are heated for too long and therefore too hot with the risk that they will be irreparably damaged.
- Children often have the tendency to put solder on the soldering iron and then "stick" it on the pcb the flux is already burned and a bad soldering is then the result. In an attempt to get it right, the soldering place is then heated for an extra long time with a chance of defects of components, etc.
- Temperature-controlled soldering irons are set to too high a temperature, for lead-containing solder, about 320 °C is an excellent temperature for soldering.
- Non-temperature controlled soldering irons often have too high a power, the pin temperature can rise to 450 – 500 °C. A bolt with a power of about 15 – 20 W is the most suitable.
- The guidance has not read the manual in advance and does not know exactly what needs to be done.
- There is too little guidance compared to the number of participants. Especially the youngest children need a lot of guidance. A guideline is to assume 1 companion on 1 beaver, in cubs / gnomes 1 supervisor per soldering station (2 scout members per soldering station). At Scouts and parent 1 supervisor on 4 members. As the members are more experienced, this can of course be adjusted.
- It is advisable, in addition to the solder guidance, to have one supervisor who checks the prints and (if applicable) places the ICs etc. In the quiet moments, it can therefore focus on prints that do not work immediately.

Feedback:

Do you have any comments or would you like to give feedback about the Light Mill?

Do you have any comments or questions about the Jota-JOTI Service Circle?

Please contact us via the contact form on the site www.kitbuilding.org.

On behalf of the Service Kring JOTA-JOTI we wish everyone a lot of buildingfun but especially a lot of gamefun with the Light Mill!

Service Kring JOTA-JOTI

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