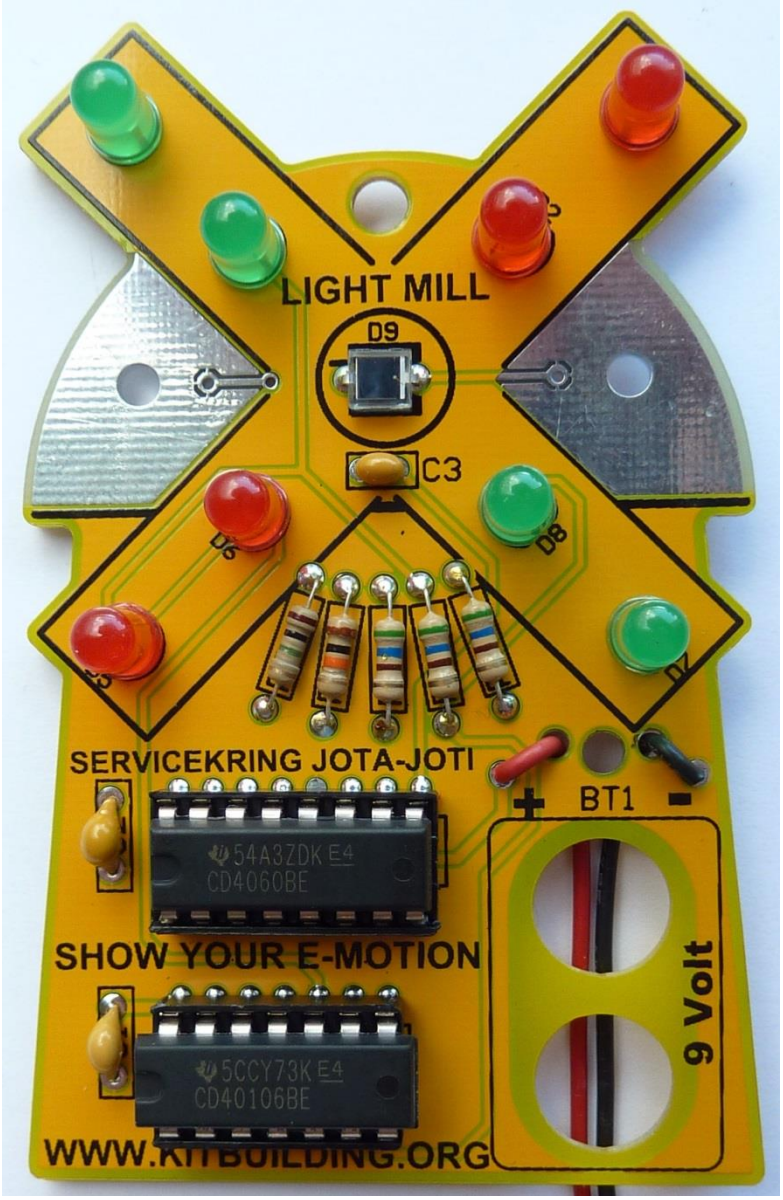
Light Mill 2016

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

Again the Service Kring JOTA -JOTI managed to create a fun and educational construction project for 2016 which we have named de “Light Mill” . As in previous years this kit is intended for use by children (under supervision) to be soldered together and in this way the children can experience the technical world of electronics. The speed of the rotation can be varied by shinning with a light ore IR remote control on the photo diode, ore by touching, and holding the 2 silverish pads near the photodiode.

The idea:

The Light Mill is inspired by the so-called Light Mill. This is a physics demonstration model where in a glass sphere a mill is mounted. This mill is provided with blades which are on 1 side silver and black on the other side. When light shins, it is running this mill, with more light, this light mill run faster. More information can for example be found on Wikipedia:
www.nl.wikipedia.org/wiki/Radiometer_van_Crookes

Once assembled the kit can hang on a piece of rope around the neck, when you sit down by a nice campfire. But there are more options:

- With a larger number of Light Mills you can mark a route in the woods to follow.
- With holding on to the silverfish contact spots the rotation speed can be altered. But this can also be done with 2 scouts, each holding one contact point of the Light Mill, and with the other hand they both hold on to an item to test, if it is conductive or not.
- Instead of any items, you can make a clew of several wires, (with un-isolated ends), and then the scouts need to find 2 ends which are connected. The electrical equivalent of "pulling rope".
- The contact spots have also a small hole. You can attach 2 wire to it with paperclips. Place the paperclips on a piece of paper, and now the drawing can begin, a black pencil works the best.. Draw a track, maze, line-art image, and when the paperclips are connected, the the rotation speed of the mill will rise.
- You can also make your own electro board game. Use silver foil. Use unconnected spaces for wrong answers, and connected spaces for the good answers.

Have fun with the construction and use of the Light Mill!
Do you have more ideas?, tell us at info@kitbuilding.org

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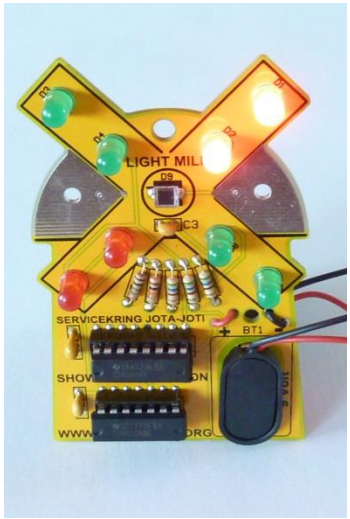
Contents of the Package

The table below can be used to check the contents of the kit . Soldering tin, headphones and a 9 volt battery must be added by yourselves.

Component	Value	Qty	Pos. on board	Remarks
Resistor	560 Ω	3	R1, R2, R3	green, blue, brown, gold
Resistor	10 KΩ	1	R4	brown, black, orange, gold
Resistor	1 MΩ	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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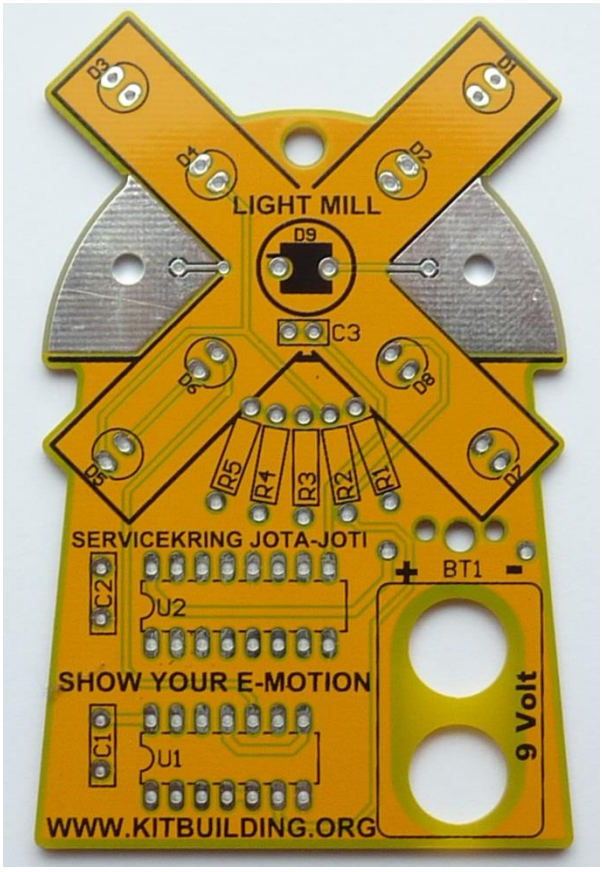
Component Numbering and Component Values

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 KΩ	D4	LED green
R5	1 MΩ	D5	LED Red
		D6	LED Red
C1	100 nF	D7	LED green
C2	100 nF	D8	LED green
			BPW34
C3	390 pF	D9	photodiode
U1	IC socket 14 pins	BT1	Batteryclip 9V
U2	IC socket 16 pins		
U1	40106		
U2	4060		



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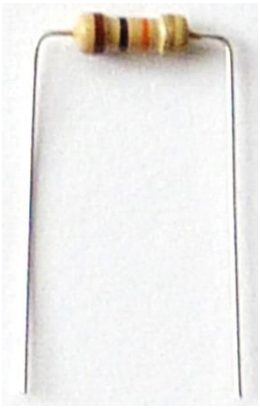
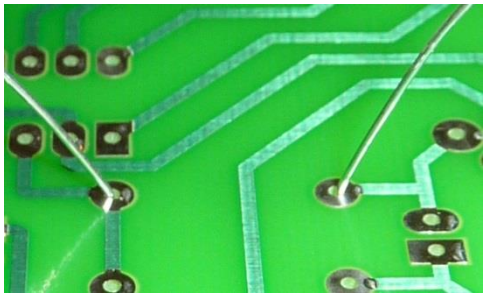
Building Description of the Light Mill:



It is easiest to assemble the components from the bottom upwards. All resistors and diode D2 should be mounted flat against the PCB. For this purpose bend both wires at an angle of 90 degrees, taking into account the distance between the holes on the PCB. Insert the resistor through the board holes and bend the wires on the copper side of the PCB gently slightly outwards. The PCB can now be turned upside down for soldering without the resistor or diode falling out. After soldering, cut off the excess wire just above the soldering joint and do the same for all other components with longer wires such as capacitors and LEDs.

Tip 1: Check or colour the dots at the beginning of the line to indicate which components are already mounted.
Tip 2: When in doubt about the Mounting of a component look at the picture of the finished print, once soldered incorrectly a repair can be tricky

Assembly sequence:



Successively assemble the following Resistors:

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

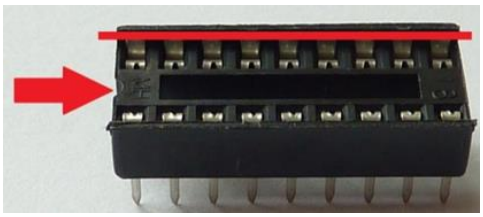
(Photo is from another board, just to show how to)

- Mount Photodiode D9.

Note: Unlike other diode applications, in this circuit it does not matter in which direction the diode is mounted. Do you want to do it “by the book” then the board shows a tiny small tab on the left side of the image, like the photo of the board shows

Successively assemble the following Capacitors:

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



Mount both IC-sockets:

- U1: 14 pins (watch direction)
- U2: 16 pins (watch direction)

Please make sure the feet is tight to the board
NOTE: In one of the ends of the IC sockets is a notch, this should match the drawing on the board. Make sure all pins are properly inserted in the board, before you start soldering, at the top all the connections have to be flat and aligned.

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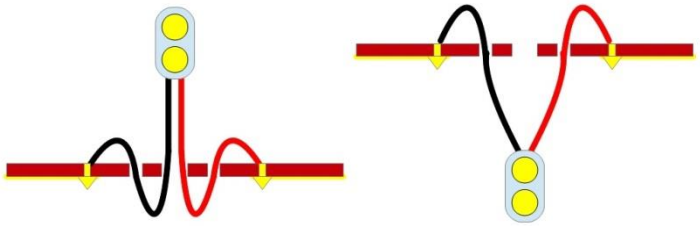
Mount de LED's:

- 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 the closest to the middle, on the side of the D1 t / m D8 inscription is the shortest leg. If they are mounted opposite the will not work!

TIP 1: Solder them first with one leg fixed so you can put them neatly and then solder the rest.

- Mount the batteryclip.

Feel the wires from underneath the board and put them on top through the holes to solder them. After the soldering, the wires may be pulled tight. As seen in the picture this in two ways depending on the side where you want the connection to end up



Place both IC's in the sockets:

- U1: 40106, 14 pins (Watch direction)
- U2: 4060, 16 pins (Watch direction)

NOTE: In one of the ends of the IC is a notch (groove), it must match the drawing on the board and the notch in the previously installed IC sockets. **The IC is sensitive to static electricity!**

- Connect the battery and the Light Mill can be tested!

If you've done everything you see now the blades of the windmill turning. They can run faster by shining a light or a remote control on the photodiode D9 or touch/hold the two silver patches. Placing the Battery connectors through the holes and then connect, you can leave the mill upright.

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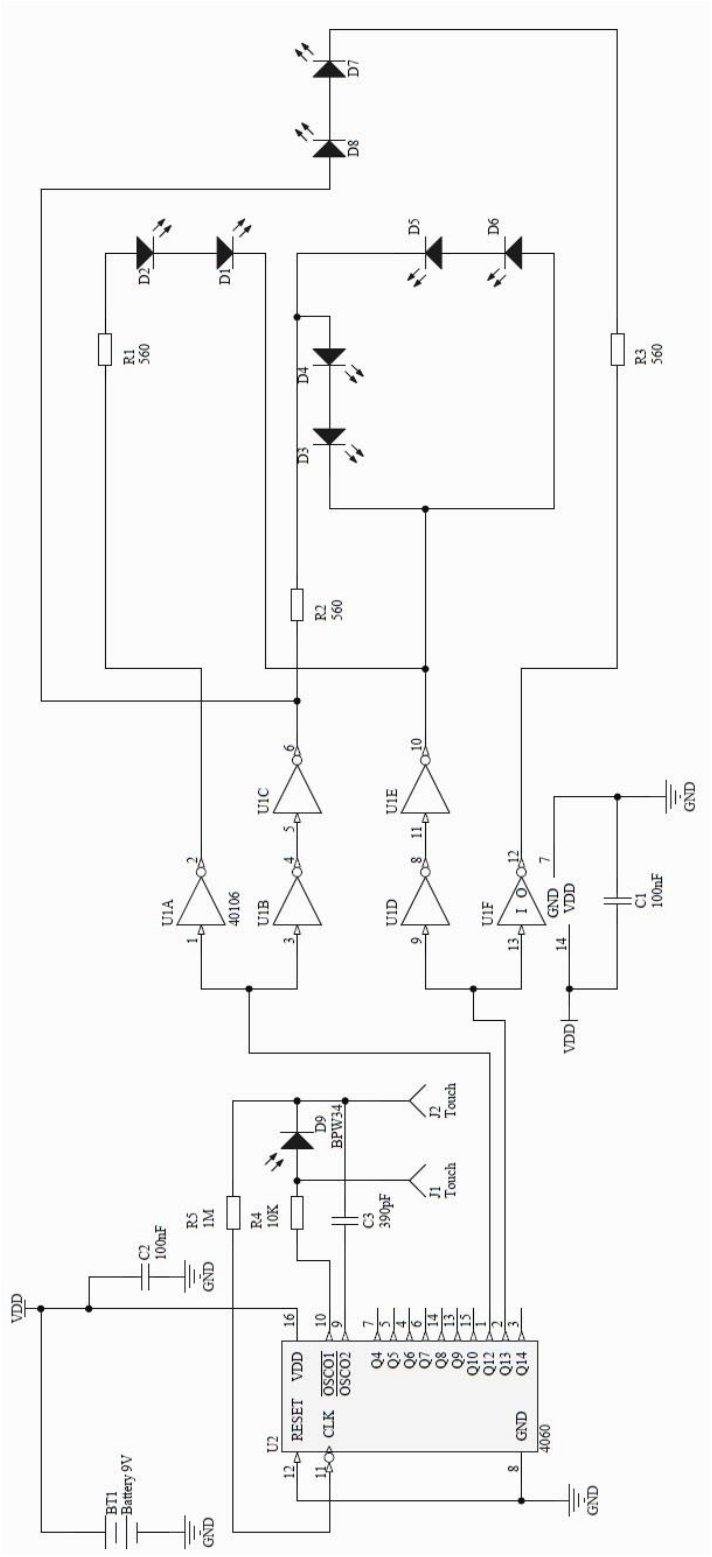
Schematic:



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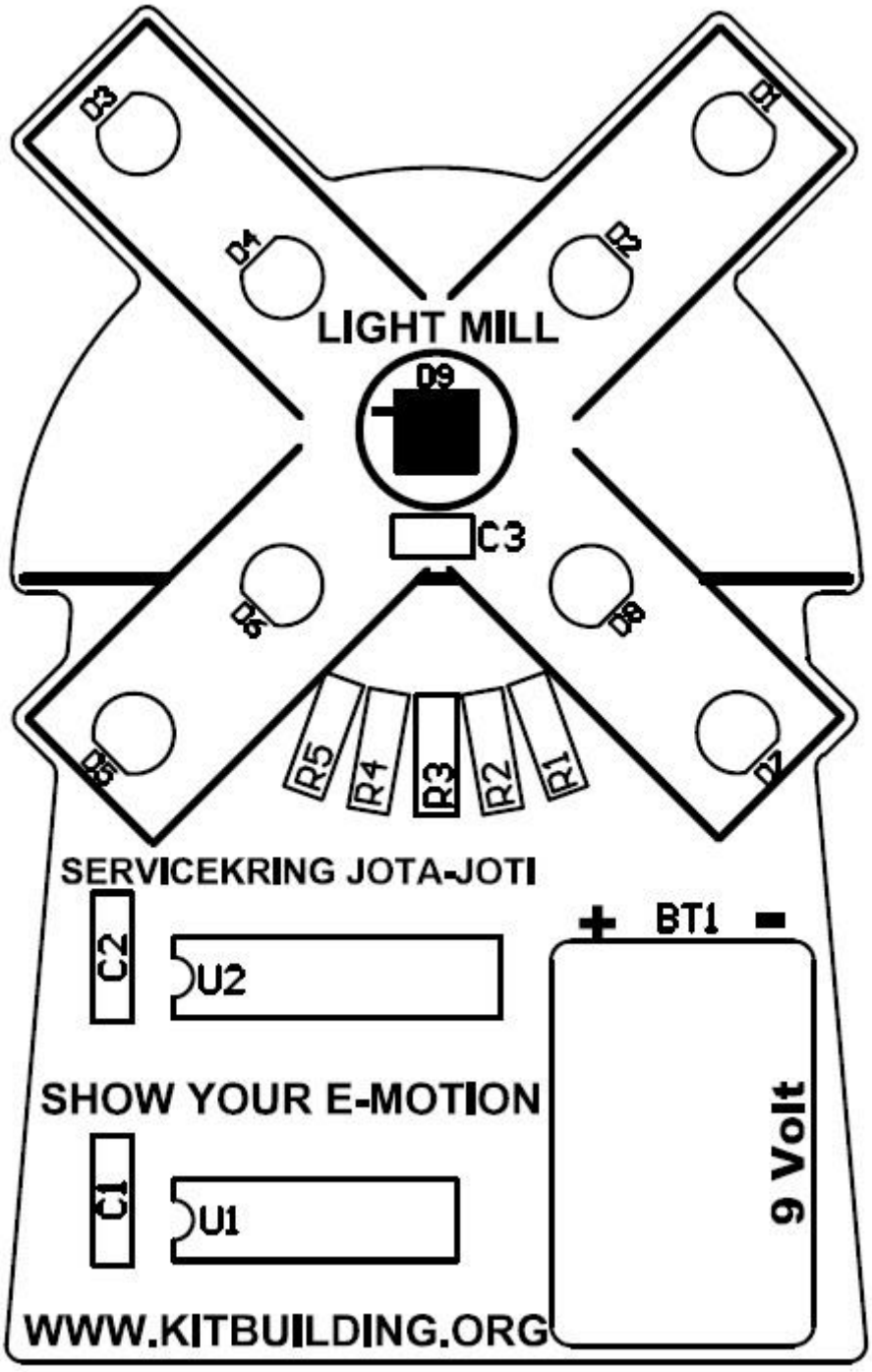
Component setup:



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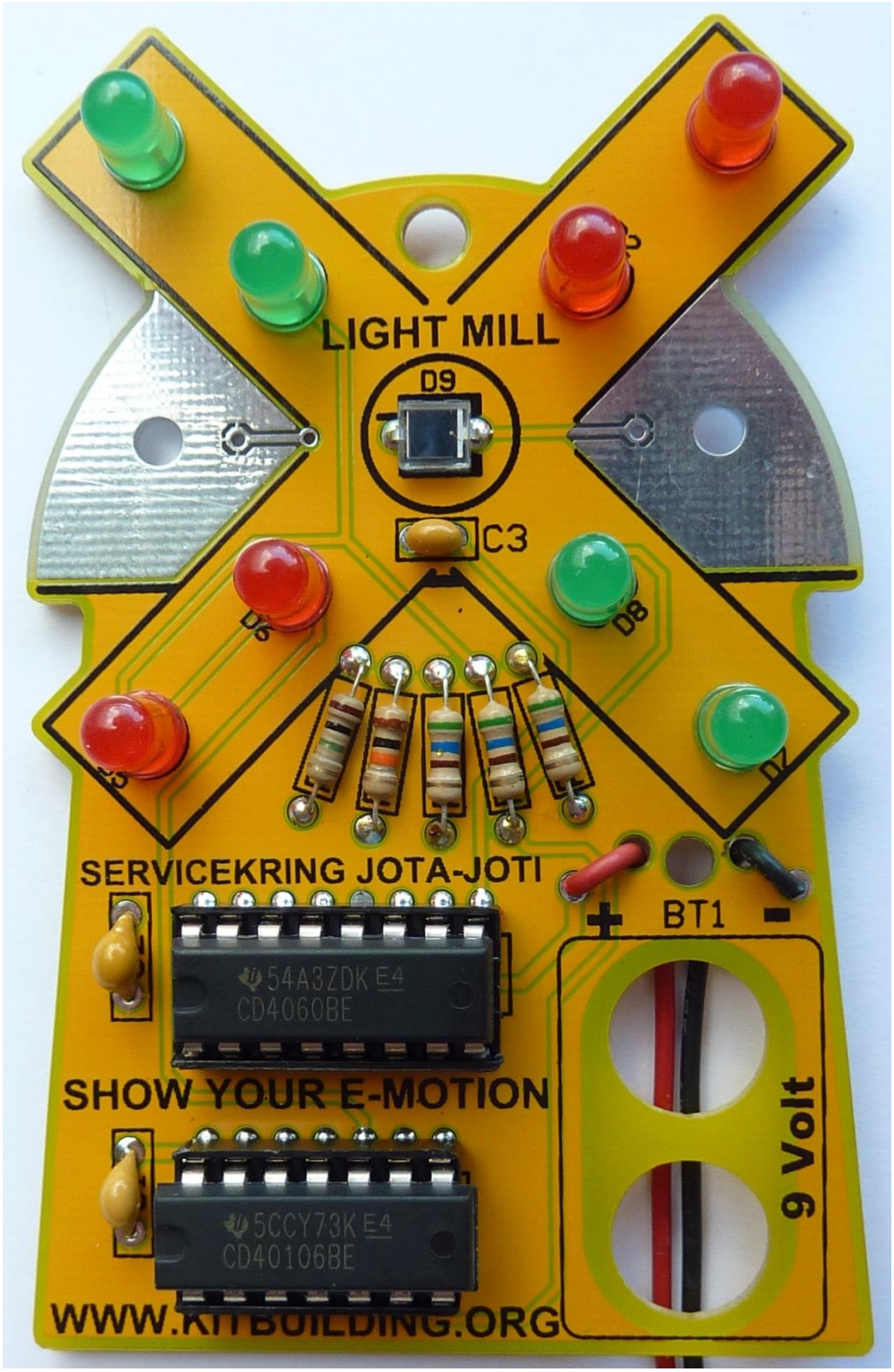
Fully build board:



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Soldering with children:

There are at soldering with children some pitfalls imaginable, by avoiding this, it is likely that the new little project is successfully completed.

The following items we see in the field:
• The making of the soldered connection takes (much) too long, A good soldered connection is made in about 3 seconds. Approximately 1.5 seconds for pre-heat (with a little solder to the tip for good heat conduction), attach solder, solder and remove the soldering iron. Children do not have this skill yet and the materials are heated for too long and thus too hot.
• Children often tend to put solder on the soldering iron and then "stick" the solder on the board, the flux is already burning and poor soldering is the result. In an attempt to get it right, the solder connection heats up too long, causing component failures ed.
• Temperature-controlled soldering irons are set at too high a temperature, for leaded solder around 320 ° C is a good temperature for soldering.
• NON-controlled soldering irons often have to high power, and the pin temperature can reach 450-500 ° C. A iron with a power of about 15 to 20 W is for this purpose the most suitable.
• The assistant has previously not read the manual and do not know exactly what to do.
• There is too little guidance in relation to the number of participants. Certainly the youngest children, many need much guidance. A directive is to go aim for one attendant on one beaver, with cubs / gnomes one supervisor per soldering (2 scout members per soldering station). With older Scouts go for one supervisor on four members. As the members are more experienced this can be adjusted of course.
• It is advisable to have besides the solder guidance, one supervisor who controls the PCB with components build on it and (if applicable) places the IC's ect. This trouble-shooter can also look at mail functional PCB that do not work right away.
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Feedback:

Do you have comments or would like to give you feedback about the Light Mill?
Do you have comments or questions about the Service Kring JOTA-JOTI?
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 fun building but also enjoy the Light Mill