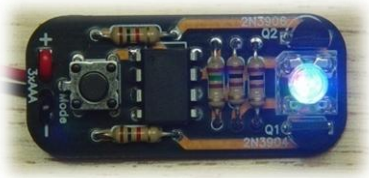
Lux Spectralis



*A Deluxe LED Blinky That **You** Can Build!*

Assembly Instructions

Contents

Thank you!

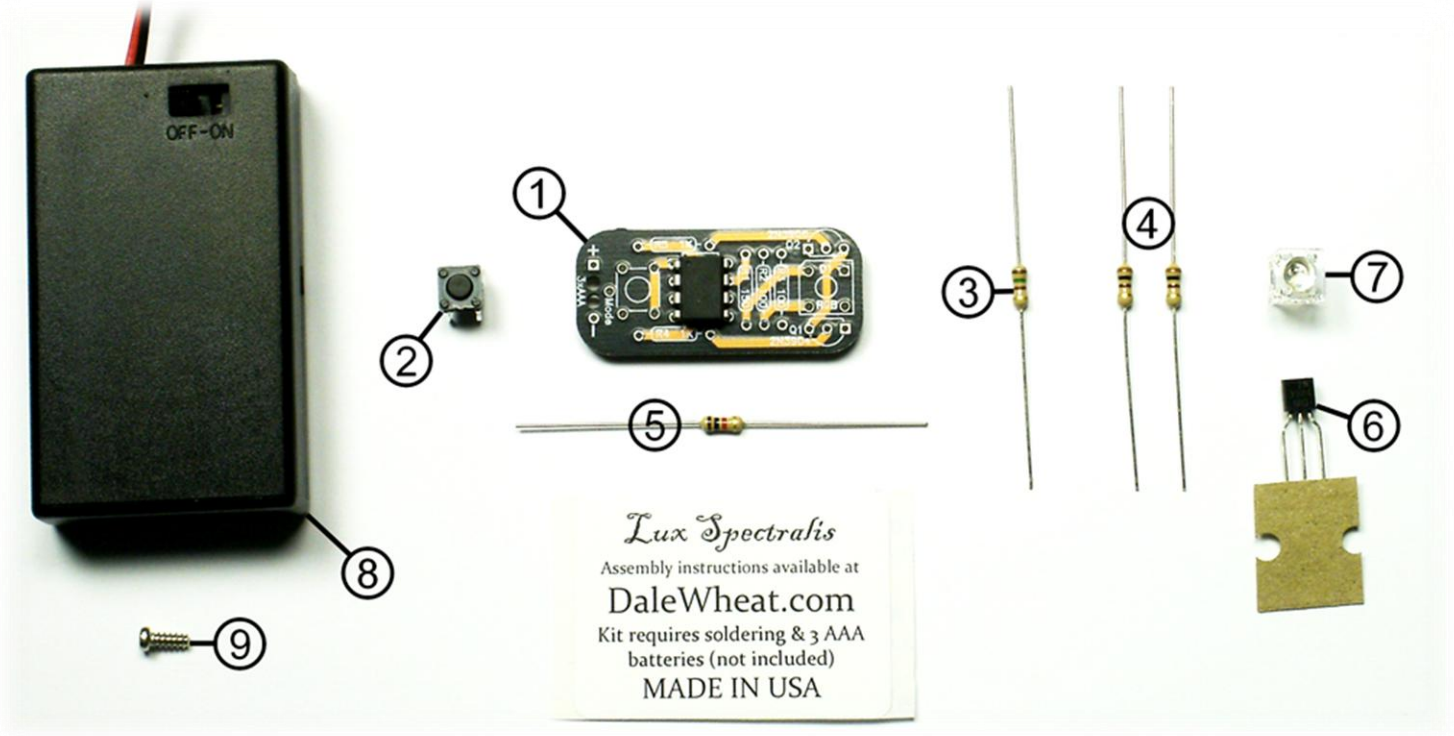
Thank you for bothering to at least look at these instructions. Building the Lux Spectralis kit should be easy and fun. You should be able to complete the assembly in under an hour. If you experience any problems while building the kit, please do not hesitate to contact me. I want everyone to enjoy this kit as much as I do.

Dale Wheat
4 March 2009
DaleWheat.com/luxspectralis

14 March 2010: Version 1.1, omit R5 and Q2

Step 1: Parts check

Make sure you have all the parts that are supposed to come with the Lux Spectralis kit.



Item #	Quantity	Reference designator	Description
①	1		Printed circuit board (PCB) with computer chip
②	1	Mode	Push button switch, 4 or 5 legs
③	1	R1	Resistor, 150 Ω, ¼ Watt (brown green brown)
④	2	R2, R3	Resistors, 100 Ω, ¼ Watt (brown black brown)
⑤	1	R4	Resistor, 1K Ω, ¼ Watt (brown black red)
⑥	1	Q1	NPN Transistor, 2N3904 or PN2222A
⑦	1	D1	Red, green & blue LED
⑧	1		3 × AAA Battery holder
⑨	1		Teensy weensy screw for battery holder cover

Important Notes:

- R5 (1K) and Q2 (2N3906) are not included with the kit. They are not required and you do not need them to build the Lux Spectralis kit. It works just fine without them.
- You may receive a pushbutton that has either 4 or 5 legs. Either one will work.

Step 2: Tool check

Collect the required tools and supplies to assemble the Lux Spectralis kit:

Soldering Iron

You need a relatively small soldering iron to properly assemble the Lux Spectralis kit. Anything with a "pistol grip" is probably too large. Try to use something in the 15-30 Watt range. You can use a higher powered soldering iron if it has a temperature control built in.

I use a Weller WES50 50 Watt soldering iron that has been discontinued and replaced with the WES51. They cost about US$100 and I've been using it for years. There are many quality soldering irons out there for less and you can often find good deals online or in the surplus chain. There are also many brands and models that cost quite a bit more. Like any tools, many people hold wide and varying opinions based on experience, hearsay and the phase of the moon.

A Little Bit of Solder

I really can't advise you on solder at this point. All of the components in the Lux Spectralis kit are "RoHS" compliant, meaning that they contain either absolutely none or only microscopic amounts of toxic substances, such as lead, mercury, cadmium and other nasty stuff. You can use solder that contains lead, and it will work just fine, but bear in mind that lead is not something you want in your garden. Do not eat your Lux Spectralis. If swallowed, do not induce vomiting.

On the other hand, the lead in solder is there for a reason. There are long-term reliability issues associated with using "lead-free" soldering processes. You decide which is more important.

Side Cutters

You could *almost* use scissors to trim the leads during the assembly of the Lux Spectralis kit, but you will find that the right tool for the job is a pair of "side cutters" or "flush cutters". They allow you to get the cutting parts right up against edge of the solder joint and cut the majority of the excess lead off cleanly and safely. You really should wear safety glasses when soldering and especially when cutting leads. They have a bad habit of jumping up and flying this way and that.

3 AAA Batteries

While we're hugging the trees and doing cartwheels though the springtime meadow, let's have a little chat about batteries. Sure, you can slide three alkaline cells into your shiny new Lux Spectralis and what's the harm? It's a very energy-efficient device. However, eventually it will deplete the electrochemical potential of the cells and then they will most likely become filler for yet another land fill.

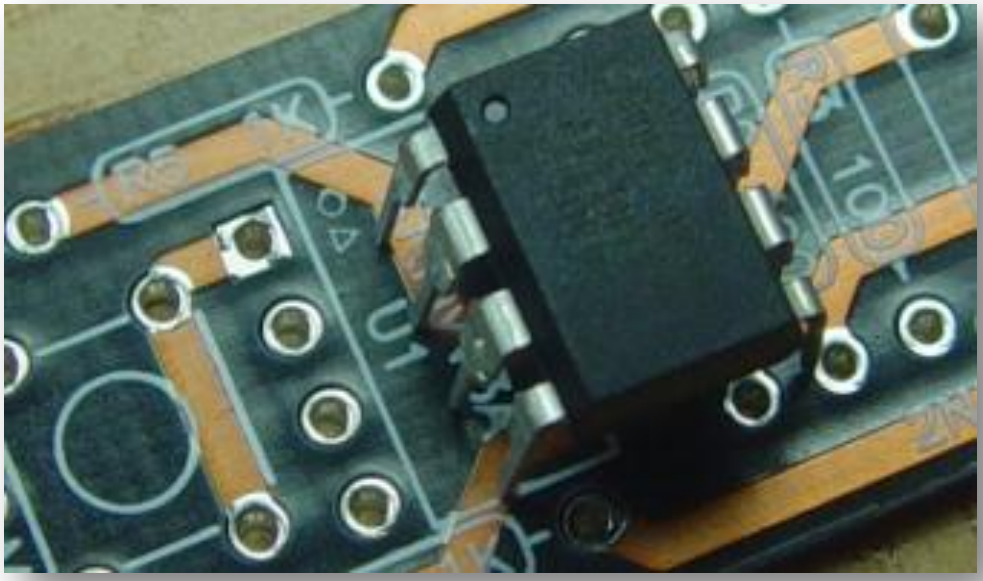
That's why I *strongly* suggest using some form of rechargeable cell. Since cadmium is on the RoHS hit list, and will one day be difficult or impossible to obtain, today's recommendation is Nickel-Metal Hydride (NiMH) or Lithium Polymer (LiPoly or LiPo) cells.

The battery holder supplied with the Lux Spectralis kit holds three AAA cells. The best fit right now is a set of three AAA NiMH cells and a solar powered charger. A single LiPoly cell will also power the Lux Spectralis quite well. You are of course free to use whatever power supply you like with this kit. The only limitation is that you *cannot exceed 5.0 volts*, as this is the limit of the operational range of the computer chip on board.

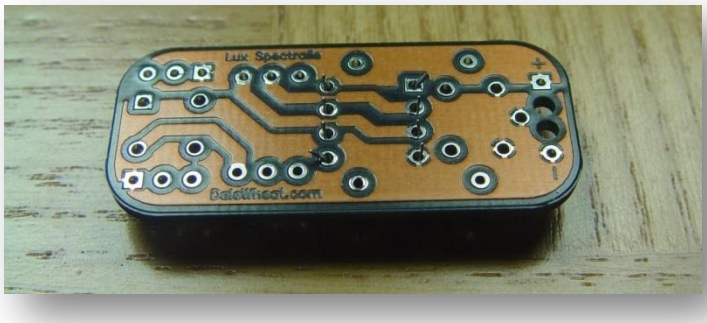
Step 3: Install the computer chip

The computer chip is the "main brain" of the Lux Spectralis and controls everything once the power is turned on. If you bought the complete Lux Spectralis kit or just the chip with the board, then the chip should already be inserted into the PCB in the correct orientation. I have to tell you that it just won't work at all if it is plugged in backwards or from the wrong side.

If for whatever reason the chip and the PCB come as two separate items, you will need to align the chip in the correct way when installing it into the PCB. There's a small round dot next to one corner of the chip as well as a small triangle printed or etched on top. Those are your two clues as to the proper orientation.



Make sure all eight (8) pins of the computer chip are inserted into their holes by looking at the back side of the PCB and counting how many little legs are poking through. A couple of them may be bent outwards to hold the chip in place during shipment. If all of the legs don't make it though the PCB, remove the chip and carefully examine all the pins. Be careful if you have to bend the legs back into the right position as they are sort of fragile and will just break off if you bend them back and forth more than a couple of times.



I'd suggest soldering a pair of opposite corner pins first and then double-checking that the body of the computer chip is still laying flat against the PCB. If so, go ahead and solder the rest of the pins to the PCB.

Hint: Use the tip of the soldering iron to heat the junction between the lead and the pad on the PCB. Then apply a small amount of solder to the joint. The solder should flow around the lead and into the hole, filling it up. This takes practice.

Step 4: Install the resistors

First find all the resistors and identify them according to value. They have colored bands that indicate their value in a secret code that I will reveal to you in Appendix B, if you aren't already familiar.

Reference Designator	Value	Digits	Band Colors	Photo
R1 Green stripe	150 Ω	1, 5, 1	Brown, Green, Brown	
R2, R3	100 Ω	1, 0, 1	Brown, Black, Brown	
R4 Red stripe	1K Ω	1, 0, 2	Brown, Black, Red	

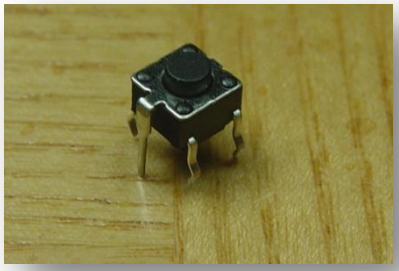
Hint: R1 has a green stripe. R4 has a red stripe. That should narrow it down for you.

Install R1, R2 and R3 first. Bend their leads so that they will line up with the holes. Find their marked spots on the PCB and thread the leads through the holes so that the bodies of the resistors lay flat against the PCB. Now bend the leads that are sticking through the board outward a little so that they don't just fall back out again when you flip the board over to solder them.

Note: The resistors are not polarized so they can be installed either way and they will still work just fine.

Flip the board over and solder the leads to the board. After the leads have cooled, clip the excess leads off as close to the board as you can without cutting into the actual solder joint.

Now install R4.



Look carefully: This is a five-legged button. You might get a four-legged button. Either one works great.

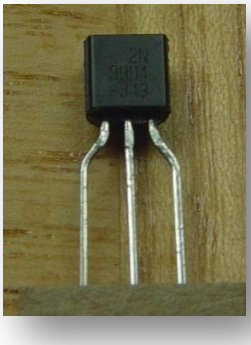
Step 5: Install the push button

Find the push button and then find the spot on the PCB where it belongs. Line up all four (or five) legs of the switch with the holes in the PCB. Press the button down until it snaps into place. The legs of the switch are bent a little so that they hold on to the PCB once the switch has been inserted. Make sure that the body of the switch is laying flat on the PCB, then flip the board over and solder the four (or five) leads to the PCB. After the solder joints cool, trim the excess leads. Don't cut into the actual solder joint.

Step 6: Install the LED

Find the big, clear LED and make sure its four legs are straight. If they are bent a little, try to gently line them back up again. Now look at the outline of the LED on the PCB and find the corner with the diagonal flat on it. This matches the angled corner on the body of the LED and lets you know which direction to align the LED when you insert it into the PCB. Like the computer chip, it will only work right if it is installed the right way.

When you install the LED, it will not go all the way flush with the PCB. This is because of little flares on the legs of the LED that keep it a uniform height above the plane of the PCB. While holding the LED in place, flip the board over and solder the leads to the PCB. Trim the excess leads that are poking out. Do not cut into the solder joint itself.



Step 7: Install the transistor

Find Q1. It has the part number "2N3904" or "PN2222A" printed on it in eensy weensy letters. Q1 comes on a piece of cut cardboard tape. Don't try to peel the tape off the leads; just cut them off (at the edge of the tape) with your cutters. You don't want random adhesive molecules cluttering up your solder joints. Leave enough of the leads so that they can be inserted all the way through the PCB.

Q1 is polarized and must be installed in the correct orientation. Look at the part outline printed on the PCB and find the flat side of the transistor with the part number. Use that to guide your placement of the part on the board.

Inserted Q1 into the PCB and spread the leads out a little to keep it in place. Now turn the PCB over and solder the leads to the PCB. Once the solder joints cool, clip the excess leads. Do not cut into the solder connection itself.

Step 8: Install the battery holder

Find the 3×AAA battery holder. It has two wires coming out of it; a red one and a black one. The red one is positive [+] and the black one is negative [-]. Now look at the end of the PCB where it is marked "3×AAA" and locate the two center holes between the square and the round pads, which are marked "+" and "-", respectively. The two inside holes are strain reliefs for the battery wire.

Thread the red wire from the bottom though the hole next to the square pad marked "+". Pull about one inch of wire through the strain relief hole. Now poke it down through the square hole, leaving a loop of wire sticking up in the air. Flip the board over and solder the end of the wire to the square pad.

Now do the same thing with the black wire and the round pad, remembering to leave about a one inch loop of wire. This keeps the insulation on the wire from deforming when you solder the wire to the board.

After you've soldered both battery wires to the board, clip off any extra leads that are sticking out the back, being careful not to cut into the actual solder joint. Now slowly pull the extra slack in the loop back out through the strain relief holes. Now the battery wires won't break off as easily from being bent back and forth.

Step 9: Install the batteries

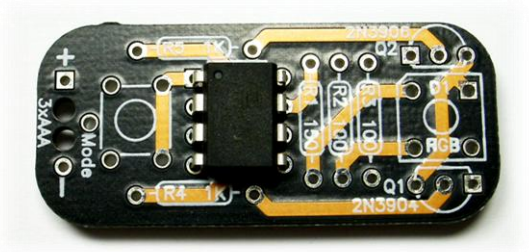
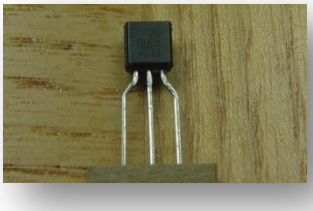
Slide the cover off the battery holder and install the batteries according to the markings inside the battery holder. I recommend using rechargeable batteries if at all possible. Now replace the cover on the battery holder. If you want, you can install that teeny tiny screw in the back of the battery holder to keep the cover on.

Step 10: Power on!

Now comes the moment of truth. Slide the power switch on. If all went well you should see the LED light up white. Press the button to try out all of the different modes.

When you are done, remember to turn off the power switch to save the batteries.

Appendix A: Detailed description of kit contents

Item #	Quantity	Reference designator	Description	Photo
①	1		Printed circuit board (PCB) with computer chip	
②	1	Mode	Push button switch. Might have 4 legs, might have 5 legs, either one works perfectly.	
③	1	R1 Green stripe	Resistor, 150 ohms, ¼ Watt (brown green brown)	
④	2	R2, R3	Resistors, 100 ohms, ¼ Watt (brown black brown)	
⑤	1	R4 Red stripe	Resistors, 1K ohms, ¼ Watt (brown black red)	
⑥	1	Q1	NPN Transistor, 2N3904 or PN2222A	

⑦	1	D1	Red+Green+Blue LED	
⑧	1		3 × AAA Battery holder	
⑨	1		Teensy weensy screw for battery holder cover	

Table 1. This is what you get in the kit. Check to make sure you have everything!

Important Notes:

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- You may receive a pushbutton that has either 4 or 5 legs. Either one will work.

Appendix B: How to Read Resistor Color Codes

For those of you that would like to learn how to read resistor color codes, or if you just want a brief review, read on. This is just a quick introduction and I don't plan on telling you every single thing there is to know; just enough to spot the right parts for building this kit.

The first band is the first digit of the value. The second band is the second digit of the value. The third digit is the value multiplier. The fourth band is the tolerance of the value. For single digit values, like the first two bands, the color codes mean this:

Value	Band Color
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

The third band uses the same colors are the first two bands but instead of representing a single digit, it represents the number of zeros on the end of the value.

The fourth band is a special one and lets you know how close the marked value is to the actual value of the resistor. It's not a problem if they are not exactly the right value; within 5% is good enough. All of the resistors used in the Lux Spectralis kit have a tolerance of 5% of their nominal value and have a gold band. A silver band means a 10% tolerance.

For example, R1 is a 100 ohm resistor. It has a brown band, a black band, another brown band and then a gold band. This means the value is a "1" then a "0" then (and here's the only tricky part) a total of "1" more zero(s) to finish spelling out its value: 100 ohms, give or take 5%.

Also note that "1K" is an abbreviation for "1,000". It comes from the Greek prefix "kilo", which you remember from that pesky Metric System that just won't seem to go away; i.e., "kilometer" or "kilogram".