

Henri Rantanen

LiveLight Module Assembly Guide

Device version 5

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1 Introduction

This document contains the guidelines to assemble a LiveLight USB Interface module.

Please note that if you decide to follow this guide, you do this at your own risk. Information should be updated and the voltage levels are safe but a wrong connection can still result in a short circuit and, thus, a fire, so check your connections with a multimeter before powering up the device.

2 Required Tools

You will need basic electronics tools during this build. Almost all of the parts are surface mounted so good pair of tweezers comes in handy. ESD-protection is highly recommended as the parts are sensitive to electrostatic discharges.

- ✓ Soldering iron and thin solder wire
- ✓ Multimeter
- ✓ Tweezers
- ✓ ESD-protection
- ✓ Components and a circuit board
- ✓ AVR ISP programmer and a computer (Windows 7 and AVRISP MKII recommended)

3 Required Components

You will need the components listed below to complete the build. Please note that items here are for reference and will make a reference model device but you can build your device with slightly different parts with a same layout of course.

Components like resistors, mosfets and LEDs can be changed up. Firmware has been programmed to work with ATmega32 but it can be ported for different chips with a same layout with relative ease.

3.1 Bill of Materials

Here are listed the parts for the USB Interface and the rest of the system.

Controller

Quantity	References	Value	Type	Stock code	
2	R1, R58	150Ω 1206	1206	Farnell - 1577409	
29	R2-R30	10KΩ 1206	1206	Farnell - 1577395	
27	R31-R57	1MΩ 1206	1206	Farnell - 1577398	
2	C1, C2	18pF 0603 Ceramic	0603	Farnell - 1828908	
2	C3, C6	68pF 1206 Ceramic	1206	Farnell - 1800828	
2	C4, C5	10uF W Tantalum	Case W	Farnell - 1658764	1
2	C7, C8	3.3pF 1206 Ceramic	1206	Farnell - 1650901	
2	C9, C10	470uF Electrolytic	Through Hole	Farnell - 8126461	1
1	U1	ATMEGA32-16AU	TQFP44	Farnell - 9171274	2
1	U3	FT232RL	SSOP28	Farnell - 1146032	2
27	Q1-Q27	IRLML2502TR MOSFET	MICRO3	Farnell - 1463264	2
1	AVR ISP	2x3 Header	Through Hole	Farnell - 1096984	1
9	J2-J10	Mini-USB B Connector	SMD	Farnell - 1753806	1
1	POWER	DC Connector	Through Hole	Farnell - 1737246	1
1	RXLED	Green 1206 LED	1206	Farnell - 1466000	2
1	TXLED	Red 1206 LED	1206	Farnell - 1465997	2
1	USB	USB B Connector	Through Hole	Farnell - 1753809	
1	X1	Crystal 14,7456MHz	Through Hole	Farnell - 1538745	
1	CASE	Hammond 1591AFLBK	Err... black?	Farnell - 3848589	

Accessories

Quantity	References	Value	Type	Stock code	
1	PSU	12V 4,5A / 230V 50Hz	Power Supply	ELFA - 6979851	1
3 m	LED STRIP	RGB LED-Strip	14,4W/m	Leditalo - 100321	2
1	USB	USB A-B Cable	1,3 m	DealExtreme - 28864	
9	OUTPUT	MiniUSB B cable	0,7 m	DealExtreme - 48933	

- 1) Parts marked with one have specific polarity, solder them the right way.
- 2) Parts marked with two are also ESD-sensitive, wear protection

4 Assembly

Start by laying out your parts on the table and check with the list above whether there are any missing parts. Use a plate or a small box to hold your parts as they are very small and get lost very easily.

Before opening any ESD-bags, make sure your ESD-protection is in use. Defects in the components caused by electrostatic discharges usually come into play long after you have successfully built and tested your module to be working, thus dramatically shortening the lifespan of the unit.

On the next page are the layout images of the circuit board you can use as an aid during the assembly process. It is recommended to follow the workflow described on the chapter 4.2.

4.1 Images



Figure 1 Parts

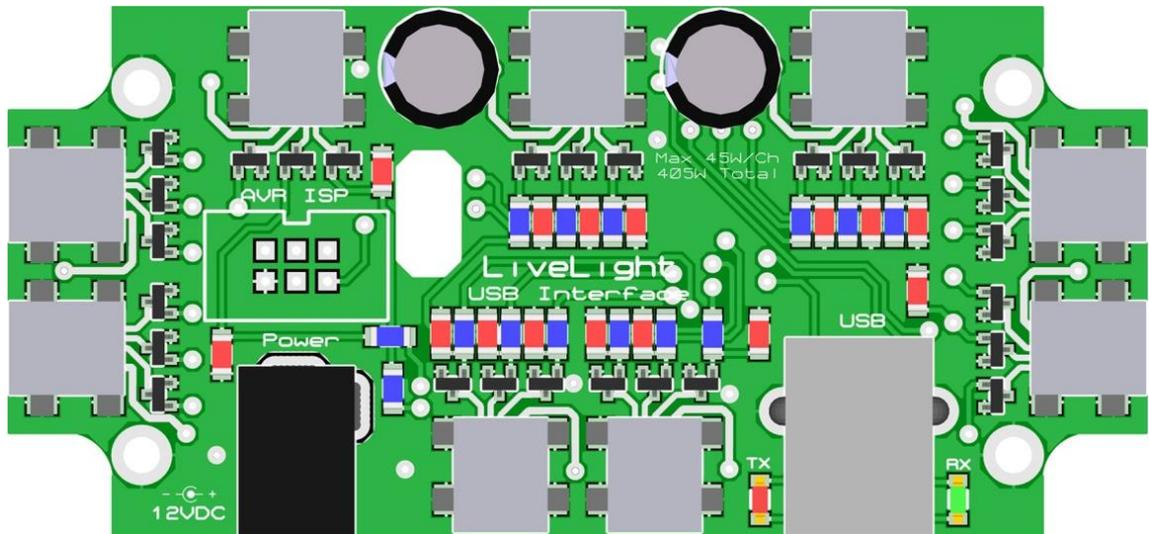


Figure 2 Component placement of the top layer

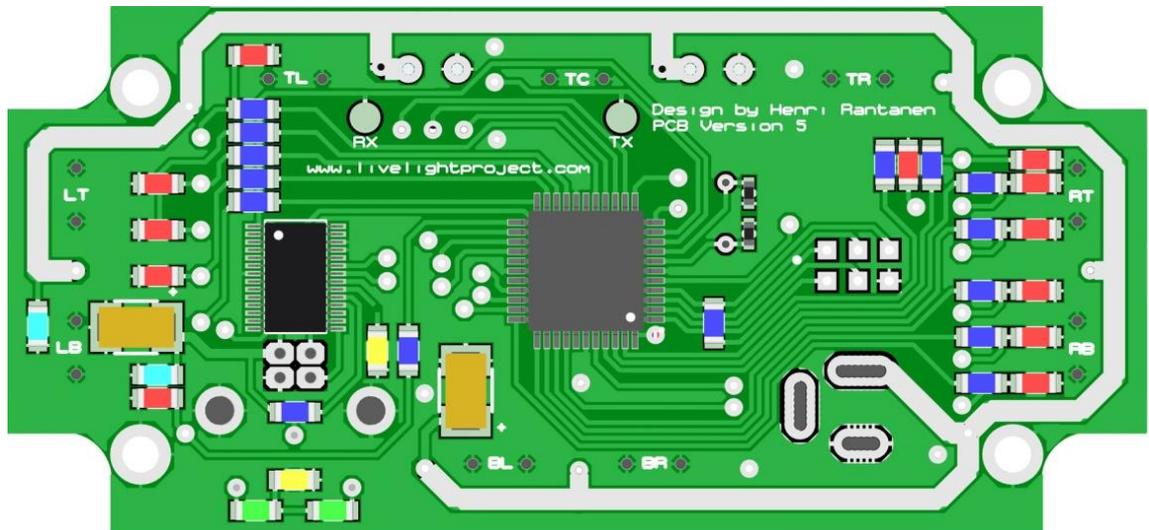


Figure 3 Component placement of the bottom layer

4.2 Workflow

Solder all resistors [R1 - R58]

Pre-solder one pad on the circuit board. Then position the resistor on the footprint using tweezers while heating up the solder on the other end. When the joint is solidified, solder the other end. Check with a multimeter.

Solder all ceramic capacitors [C1, C2, C3, C6, C7 and C8]

Same process applies on the ceramic capacitors. Be extra careful with 0603 packaged C1 and C2 cause of their size, they are lost very easily.

Solder all LEDs [TXLED and RXLED]

Solder both signal LEDs to their correct places. Be careful not to heat the component too much, as it will damage the part. Notice that LED is a diode and needs to be connected the right way. Negative pins go towards the middle of the circuit board.

Solder Crystal

Solder in the crystal oscillator. Polarity does not matter but leave some space between the circuit board and the crystal so the crystal's metal casing will not short the pads underneath.

Note that crystal oscillator is made of glass-like quartz, it might get broken if dropped.

Solder all mini USB connectors [J2 - J10]

Pre-solder pads on the board. Align the mini USB connector to the holes in the board and the pad and squeeze it down with your thumb. Heat one of the pads so the pin of the component will spring into place. When done to all five pins, solder the casing to the circuit board securing the connector in place.

For the last step it is recommended to use hotter setting on your iron as the joint can be made faster and plastics wont melt inside the connector.

Solder all transistors [Q1 - Q27]

Solder all mosfets to the circuit board. Check the leads of the USB-connectors for short circuits with a multimeter.

Note that after this step your board becomes ESD-sensitive so wear protection.

Solder all semiconductors

Pre-solder two pins at opposite corners of the IC footprint. Carefully place the chip on the board using tweezers. Check the orientation of the chip from the little white dot on the circuit board. Heat up the pad and tack the IC in place, reposition if needed.

After you are happy with the alignment of the chip, solder all of the other pins. Be careful not to use too much solder.

When ready, check for shorts between pins using multimeter's resistance function. Beeper function passes some current through the circuit and might damage the chip.

Solder all electrolytics [C4, C5, C9 and C10]

Solder in all electrolytic capacitors. Check their polarity from their casing or a datasheet and be sure to connect them correctly. Otherwise you could end up with aluminium foil everywhere, nasty smells and the tantalum capacitors tend to spit fire when connected to negative polarity.

Solder the tantalum caps using as smallest heat possible.

Note that tantalum capacitors usually have the stripe marking their polarity on the positive end instead of negative! Refer to your components datasheet for the info.

Solder everything else

Solder what is left on the table, connectors etc. It is recommended to start with the one with the lowest profile.

Check with a multimeter

Check your circuit for shorts using a multimeter. Best places to start would be in the USB voltage and 12V voltage inputs with a multimeter's beeper function on the negative probe grounded on the case of some connector. There could be a short beep while the electrolytic capacitors charge up from the multimeter but it should stop after few seconds.

If this check is passed, your device should be safe to plug in to the power supply and your computer.

Note that power supply's polarity is correct, positive on the center of the connector!

5 Burning in the Firmware

Before you can use the device you have just built, you need to tell it what to do by installing firmware into the AVR chip onboard. This is done by using in-system programmer and a PC.

1. Connect the USB cable to the LiveLight USB Interface and computer
2. Open AVR studio or AtmelStudio and click on “device programming” from the tools dropdown menu
3. Select programmer from the menu, set the device to “ATmega32” and click apply
4. Check whether the connection is working by clicking “read device signature”
5. Download the source code and firmware from the website and search for the HEX-file in the debug folder.
6. Go to “Memories” tab on the AtmelStudio and program the hex file to the Flash memory.
7. Program the fuse-bits under “Fuses” tab. Values should be HIGH 0xD9 and LOW 0xEE. This will disable JTAG and set the clock source to use the crystal.

Note: Make sure your fuse-bits are correct before clicking Program, otherwise you might end up bricking your 10€ chip!

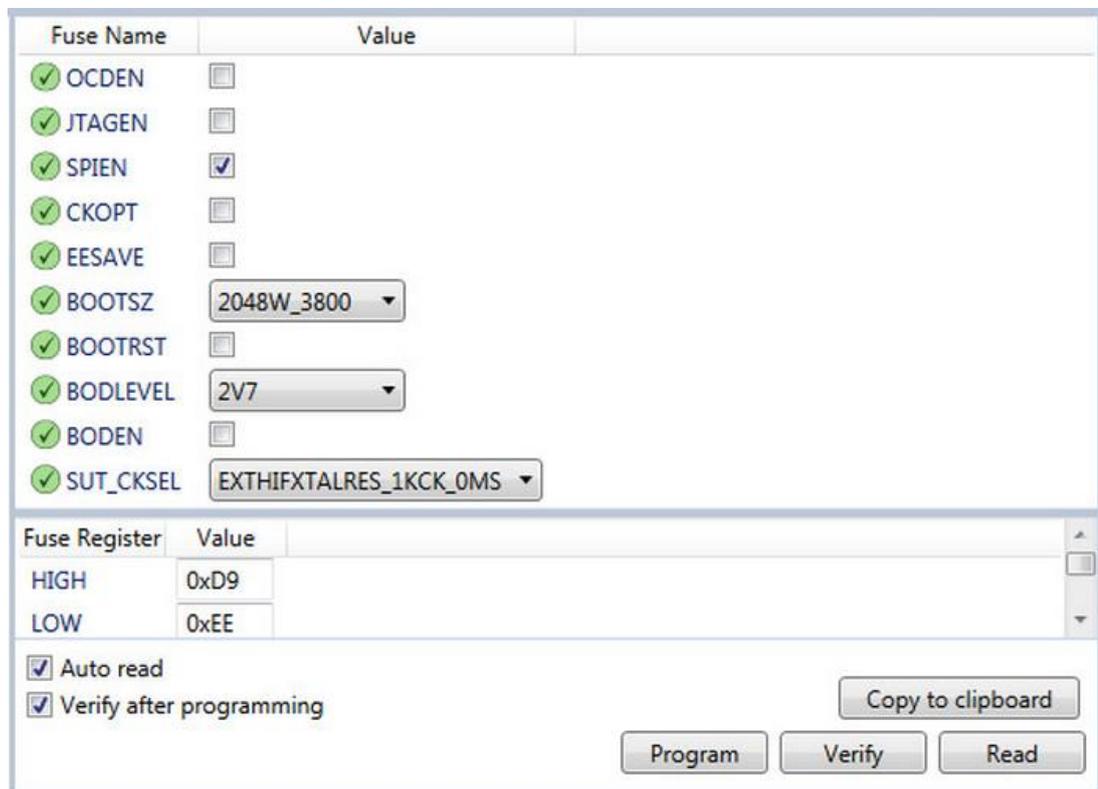


Figure 4 Correct Fuse-bit settings

5.1 Setting Up the FTDI Chip

You can add a professional touch to your device by configuring the FTDI chip on board with FTDI's program called "FT Prog". Product description and manufacturers name can be programmed to the chip for the operating system to recognise:



Setup is pretty strait forward, open the software and name your device under "USB String descriptors" as shown in the picture below. Make your changes and press the little button with the lightning icon to save your settings to the FTDI chip's memory

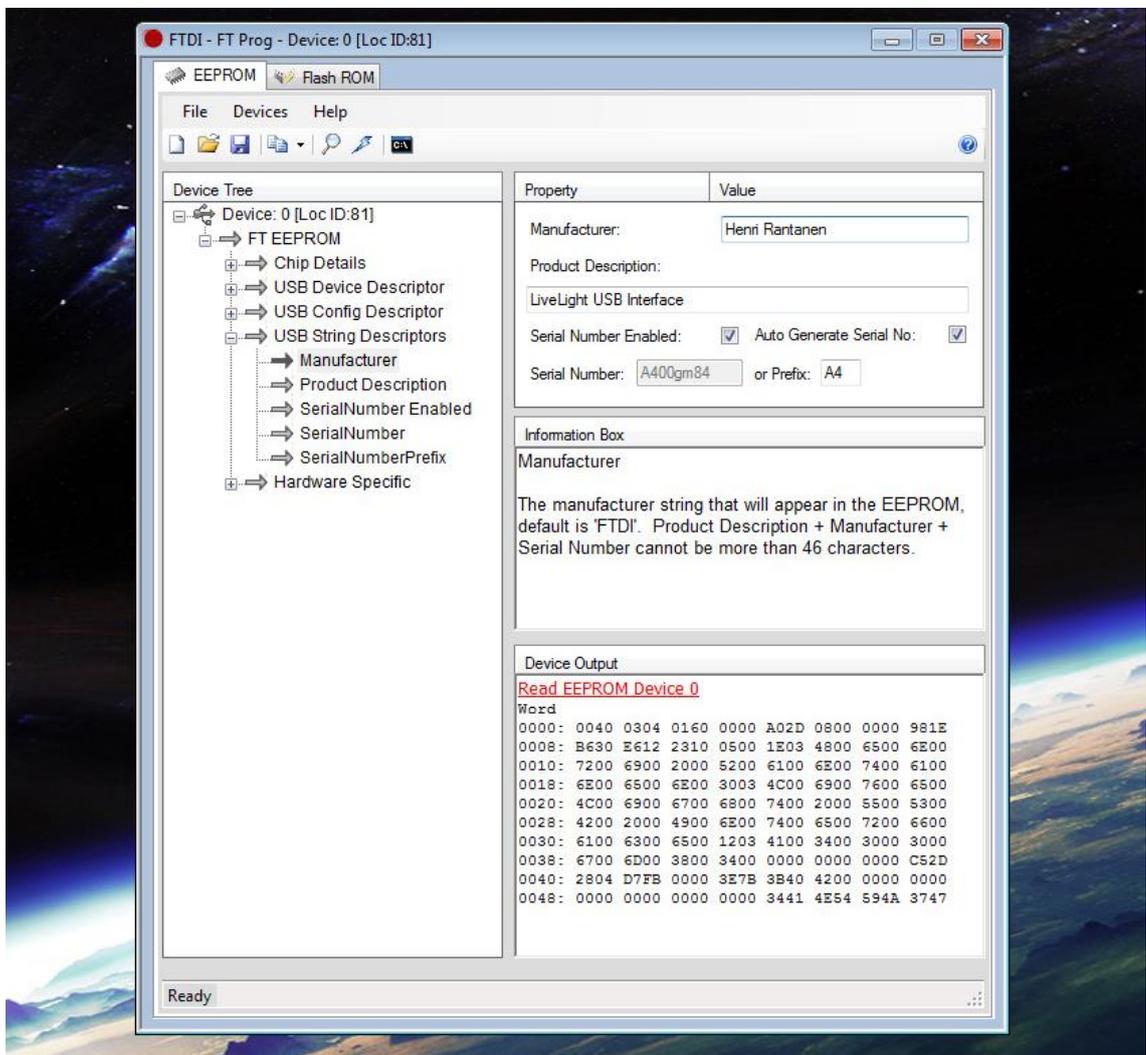


Figure 5 FT Prog with my settings on it

6 Debugging

Most of the problems are caused by bad solder joint or short circuit somewhere on the board, most likely under your USB connectors or the chips. Check your board with multimeter.

6.1 I Programmed the Wrong Fuse-Bits!

If you have set wrong clock settings or disabled the SPI connection, there is not much to do except replace the chip with new one and try again, this time being more careful.

6.2 I Accidentally Put the Power on Backwards!

Negative input voltage destroys practically every active component on the board so double check your positive lead is in the center of your power connection before plugging it in.

If you have already destroyed your device, you will probably need to replace all mosfets Q1-Q27 and probably some electrolytic capacitors with new ones and check the board for other damage.

Integrated circuits and LEDs are powered from the USB and are probably OK if your power supply is not referenced to your computers ground.

6.3 I got an error while trying to program the chip!

Check that you have the right chip selected. Try lowering your interface speed from the "interface settings" tab, 64kHz should be sure to work.