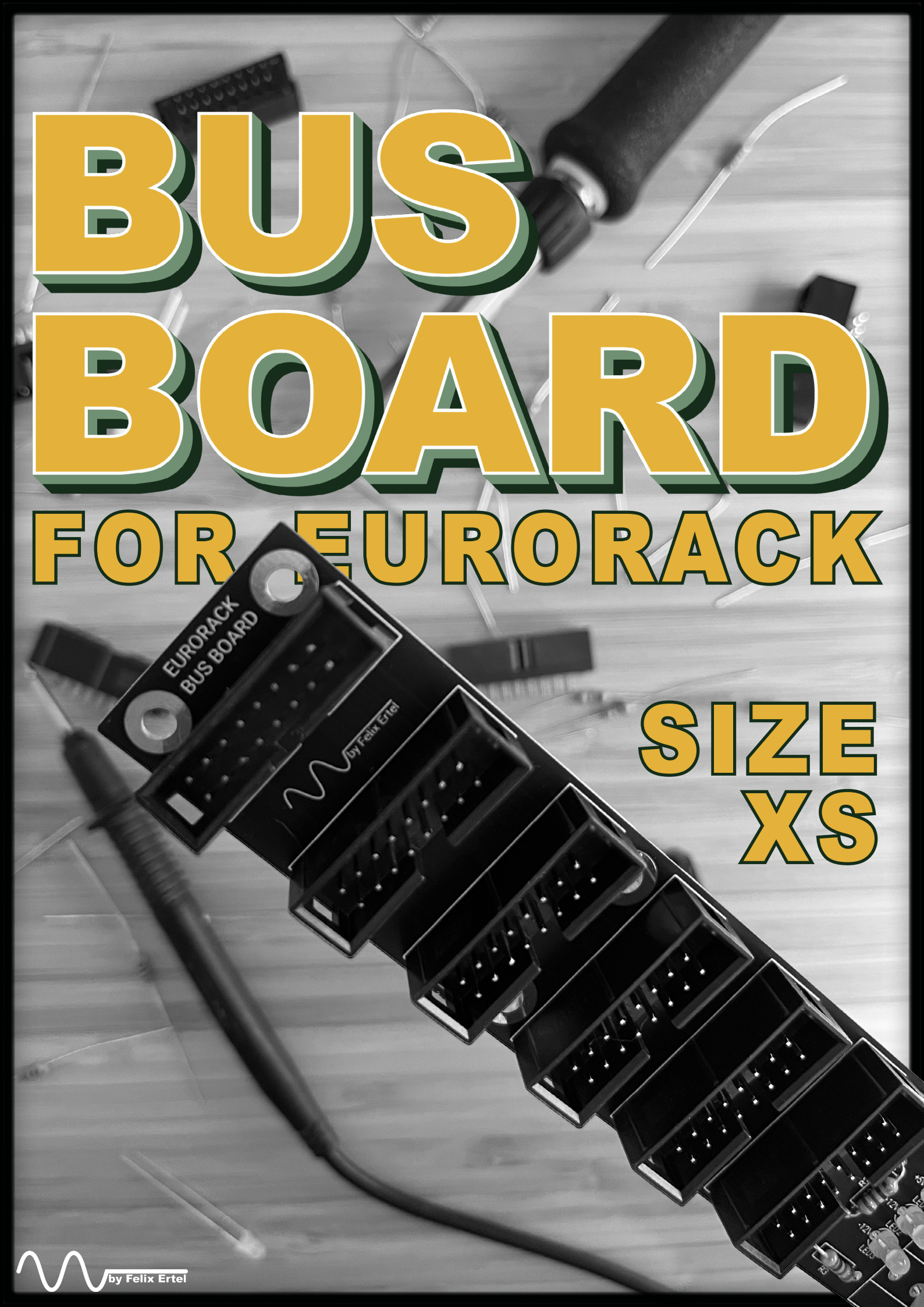
BUS BOARD FOR EURORACK



SIZE XS

by Felix Ertel

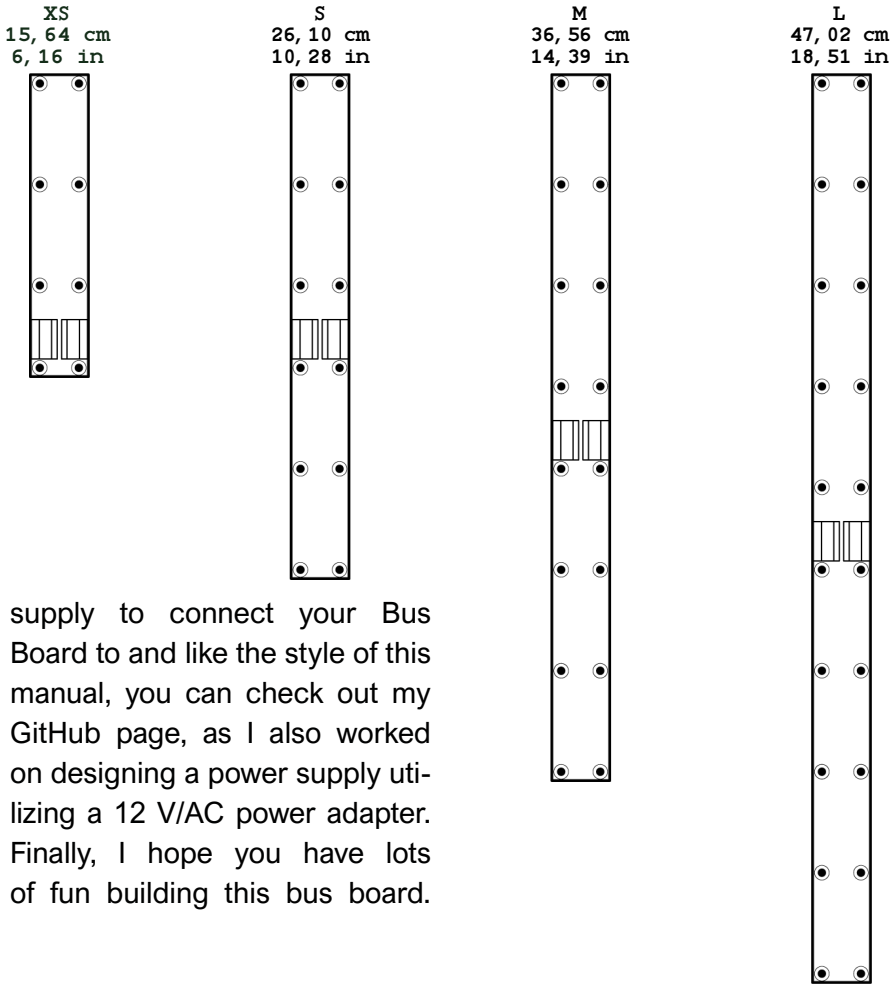
INTRODUCTION

This is the DIY manual for my open source project, “Bus Board for Eurorack”. The Bus Board can supply Eurorack modules with three distinct voltage levels, 5 Volt, 12 Volt, and -12 Volt. Being available in four sizes, you’re almost guaranteed to find the one that fits your Eurorack case perfectly.This particular manual is intended for the size XS, but others are obtainable on my GitHub page for the remaining ones.

This manual contains the Bus Board’s specifications, PCB layout, schematic, the Bill of Materials, and detailed building instructions. All other necessary files are available on my GitHub page.

If this is your first DIY Eurorack project, don’t worry. This manual will explain everything you need to know to build your own Bus Board successfully.

If you also require a power supply to connect your Bus Board to and like the style of this manual, you can check out my GitHub page, as I also worked on designing a power supply utilizing a 12 V/AC power adapter. Finally, I hope you have lots of fun building this bus board.



SPECIFICATIONS

current rating and dimensions

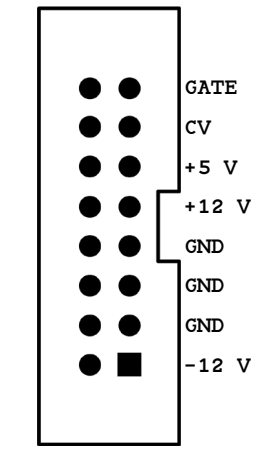
The Bus Board can supply three distinct voltage levels of 5 Volt, 12 Volt, and -12 Volt at up to about 2 Ampere, respectively. To provide your modules with electricity, it offers six 2x8 Pin Header connectors that follow the Eurorack power pinout standard, as shown in the graphic on the right.

You can find all this on a PCB with a length of 15,64 cm and a width of only 3,00 cm.

LED power indicator

Additionally, the Bus Board features three indicator LEDs that light up when voltage is applied at the Bus Board’s input, letting you know that your modules receive power.

If the LEDs are too bright for your liking, you can switch out the resistors R1, R2, and R3 for ones with higher resistances, as these essentially control the brightness of the LEDs.



2x8 Pin Header connector pinout

input/output section

The Bus Board's input and output section features two sets of four soldering pads. One of these sets is meant to be used as the input for the Bus Board and has to be connected to a power supply offering a 5 Volt, 12 Volt, -12 Volt, and 0 Volt/Ground connection.

You can use the remaining set of soldering pads to chain multiple Bus Boards together while only needing one power supply. For this, connect the remaining four soldering pads of one Bus Board to the corresponding pads on a second Board. It does not matter which set of soldering pads you use as the input and which you use to chain multiple Bus Boards together. Both sides are identical.

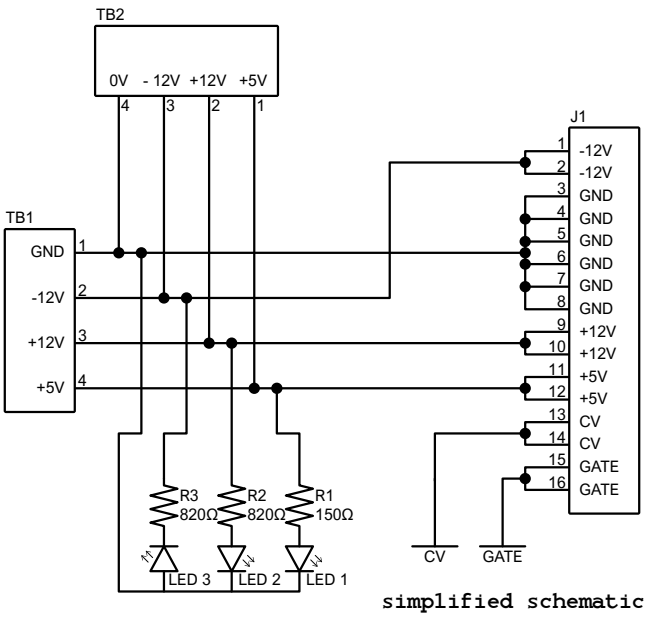
You have two options for connecting cables to the input and output section. You can either solder wires directly to the soldering pads or use a suitable terminal block and connect wires to it instead.

mounting holes

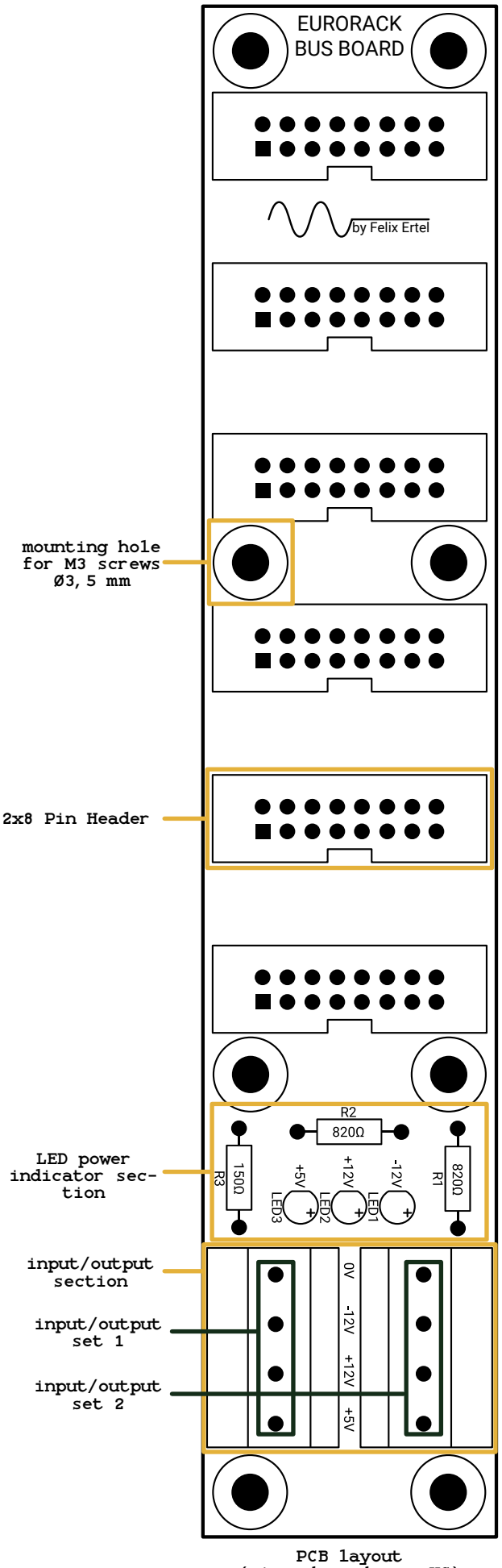
Additionally, the Bus Board offers eight mounting holes intended for use with M3 screws (the same size used to mount Eurorack modules). Using these in conjunction with M3 standoffs, you can easily secure the Bus Board to the bottom of your Eurorack case — this process will be explained in greater detail in the building instructions later in the manual.

schematic*1

Beneath, you can see the schematic diagram for the Bus Board. In reality, you obviously have more than one 2x8 Pin Header (J1). I chose to omit the remaining ones in the schematic to simplify it.



simplified schematic



PCB layout
(size shown here: XS)

*1 If you aren't familiar with reading electrical schematics, don't worry. For simply building the Bus Board, it's not all too important to be able to read them. Understanding some basics, however, can be quite helpful. So I'd recommend you watch the following YouTube video to learn about them: https://www.youtube.com/watch?v=9cps7Q_IrX0&ab_channel=Make%3A

BILL OF MATERIALS

The Bill of Materials shows you all the components you need to build a Bus Board. The category and part name help you roughly identify what component you need. The Part specification gives you more detailed information about it. You must buy components that satisfy all the given specifications unless stated otherwise. The description gives you some more information that may be useful to you when selecting your parts. The Quantity provides the number of components you need to buy. Finally, the last column shows whether a part is optional or strictly necessary to complete building the Bus Board (Y: necessary; N: optional).

Most of these components should be readily available online and relatively easy to find.

category	part name	part specification	description	quantity	needed
PCB	bus board PCB	please refer to the “ordering a PCB” part of this manual	/	1	Y
Resistor	R1	150 Ω; 1/4 W; THT	choose a higher value resistor if the corresponding LED is too bright	1	Y
Resistor	R2, R3	820 Ω; 1/4 W; THT*[3]	choose a higher value resistor if the corresponding LED is too bright	2	Y
LED*[4]	LED1, LED2, LED3	Ø3 mm; forward voltage: 3,5 V; forward current: 20 mA; THT	choose whatever color you like	3	Y
Connector	J1, ...	2x8 Pin Shrouded Header	these are the ones your modules plug into	6	Y
Terminal Block	TB1, TB2	4 Pins; pitch (Pin spacing): 5 mm	instead of using terminal blocks, you may solder wires to the solder pads directly	2	N
Hardware	wire	24 - 15 AWG stranded wire	for connecting the bus board to a power supply	/	Y
Hardware	screws	M3 screws	for mounting the PCB to the bottom of a case	8	N
Hardware	standoffs	M3 standoffs	for mounting the PCB to the bottom of a case	8	N
Hardware	inserts	self-tapping M3 threaded inserts	can be used to secure standoffs to a wooden case	8	N

*[3] Through-hole-technology (THT): components with leads meant to be inserted into drilled holes in the PCB to be soldered

*[4] You can also use LEDs with different forward voltage and forward current values. In that case, however, you might have to use resistors with different values. To calculate the correct resistance for your particular case, you may use an online calculator like this: https://ledcalculator.net/

ordering a PCB

Ordering a PCB online might seem daunting at first, but it's not too complicated.

First, you need to download the Gerber file for your chosen size from my GitHub page. Then you have to choose a PCB house that you'd like to manufacture your PCB. Since every PCB house has a slightly different process for ordering a PCB, I will only give detailed information on the PCB house I chose, which is JLCPCB. Luckily they have a straightforward article on their website explaining how to order from them. You can find this article here: https://support.jlcpcb.com/article/21-how-do-i-place-an-order.

This leaves the question of what options to choose for your PCB when ordering. Here are the options I'd recommend to you.

option	choice
Base Material	FR-4
Layers	2
Dimensions	filled out automatically when inserting Gerber
PCB Qty	choose the amount of PCBs you want
Product Type	Industrial/Consumer electronics
Different Design	1
Delivery Format	Single PCB
PCB Thickness	1,6
PCB Color	choose whatever you like

option	choice
Silkscreen	white or black depending on the PCB color
Silkscreen Technology	Ink-jet/Screen Printing Silkscreen
Surface Finish	HASL(with lead) or LeadFree HASL-RoHS
Outer Copper Weight	1 oz
Gold Fingers	No
Confirm Production File	No
Flying Probe Test	Fully Test
Castellated Holes	No
Remove Order Number	choose whatever option you like

tools

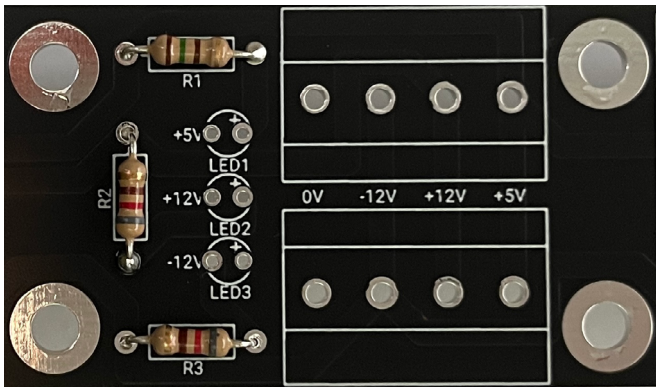
Building the Bus Board also requires some tools. While some are essential, others are simply nice to have, and you can certainly finish the build successfully without them.

tool name	description	needed
Soldering Iron and Solder	/	Y
Side Cutter	small ones designed with electronic work in mind function exceptionally well, but normal ones would suffice, too	Y
Wire Stripper	you can use a knife instead, being careful not to injure yourself	N
Multimeter	to test the finished Bus Board	N
Painters Tape	can help you hold components in place while soldering	N
Isopropyl Alcohol	to clean the PCB after assembly	N

BUILDING INSTRUCTIONS

This part of the manual gives you a step-by-step guide you can follow to build your Bus Board once you have sourced all the necessary components and tools. It includes pictures as well as written explanations for every step. For some stages of the build, there are multiple options on how to proceed — choose the one you like best.

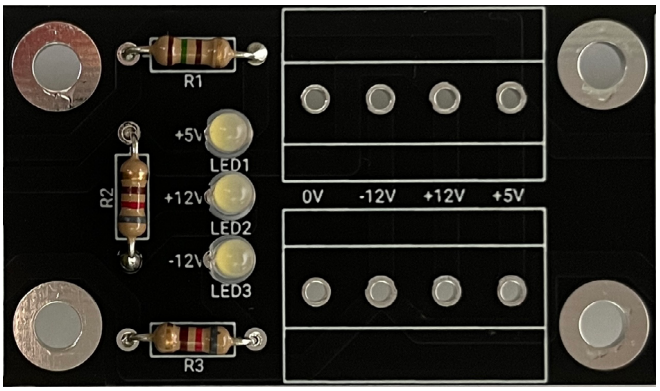
Building the Bus Board requires you to solder. If this is your first time soldering, I'd recommend you watch the following YouTube video to understand how to do so: https://www.youtube.com/watch?v=Qps9woUGkvI&ab_channel=oneTesla.



resistors

To start, place the PCB on top of some spacers (You can use two empty boxes, wire coils, or whatever you have lying around). Next, you can start populating the PCB by bending the resistor leads and placing them in their correct positions. The PCB shows the component's value and name to identify where it goes quickly.

After inserting all resistors, turn around the PCB, solder all resistors in place, and cut off the excess leads.



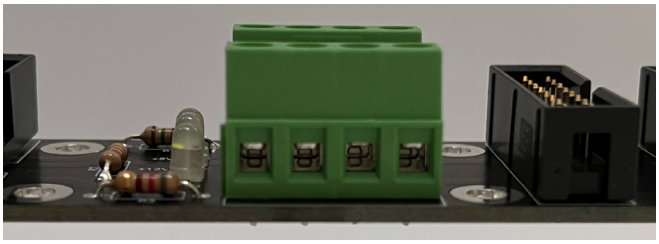
LEDs

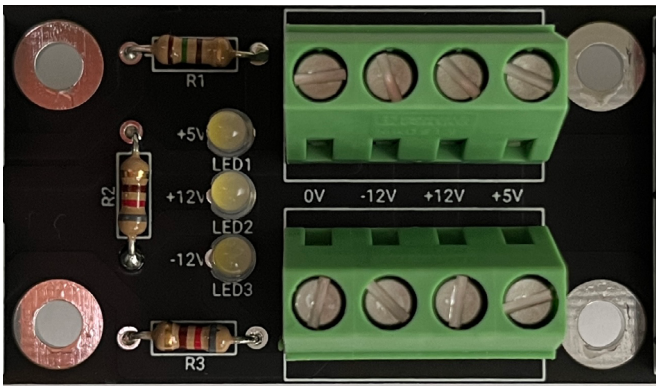
Next, you can turn the PCB to the front again and place the LEDs in their respective places. Since LEDs are a type of diode, orientation matters. Your LEDs each have one long and one short lead. The longer lead marks the positive side of the LED. Place this lead in the hole with a "+" above it. The short lead goes into the hole next to it. Now, turn the PCB around again, solder the LEDs into place, and clip the excess leads.

2x8 pin header connectors

Now you can start soldering the 2x8 pin header connectors to the Bus Board. The cutout on the connector should align with the cutout shown on the PCB. For soldering, you can hold the connectors in place using tape and solder two pins on opposite sites. Then check if the connector sits flush against the PCB. If it does not, reheat the joints and press the connector flush using your other hand. Be careful not to touch the pins you are heating up, so you don't burn yourself. Then solder the rest of the pins.

Your Bus Board should now look like this. Except yours is a smaller size.





connecting wires

As stated earlier, in this manual, you have two options for attaching wires to this bus board — soldering directly to the soldering pads or using terminal blocks. Both options work perfectly fine. If you decide to use terminal blocks, you should install them at this point. Place them on the PCB with the openings for the wires pointing outward from the PCB and solder them in place. You can also use tape to secure them while soldering, as you did with the connectors.

You may only install one terminal block if you don't plan on chaining multiple Bus Boards together.

In case you want to solder wires directly to the soldering pads, you might want to install the Bus Board to your Eurorack case first to measure the required length of the wire better.

mounting

In the following, I'll explain how to use M3 threaded inserts, standoffs, and screws to mount the Bus Board to your case. If you haven't bought these items, you can skip this part and mount the Bus Board differently.

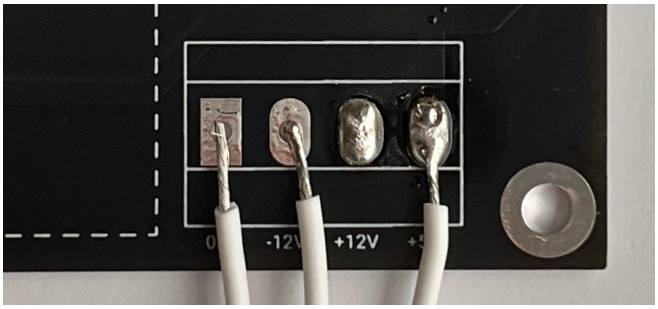
First, you should lay out where you want the Bus Board to go inside your case. Then you can mark the center of all the mounting holes.

Next, you should drill holes for your threaded inserts where you put your markings. Make sure to select the correct size drill bit and only drill as deep as the inserts are tall.

Now you can install the threaded inserts.

After that, screw in your standoffs.

You can now place your Bus Board on the standoffs and secure it using screws.



You might notice that these soldering pads look different than the ones in the other pictures. That´s because the PCB in the previous pictures is not the final version. When you order yours with the files provided on GitHub, your soldering pads will be as big as the ones shown in the picture.

connecting wires

You can skip this part if you use terminal blocks to connect your wires.

When soldering wires directly to the soldering pads on the PCB, you want to ensure the wire you are attaching isn't too short so you don't have to desolder it again. Now that your Bus Board is installed in your case, you can easily measure how long your wire has to be to reach from your power supply to it.

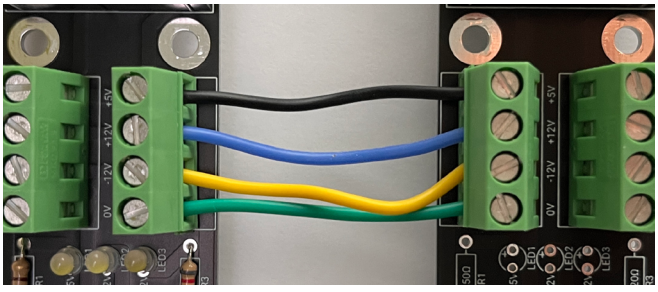
After cutting your wires to length, remove about half a centimeter of insulation from one end and twist the wires together.

Now find a way to hold this end of the wire in place, heat it with your soldering iron and apply solder to it, evenly coating the wire. This is called tinning the wire.

After this, heat the soldering pad you want to solder the wire to and apply a generous amount of solder so it makes a dome shape. Let it cool down for a bit.

Finally, place your tinned wire on top of the solder you just added to the desired pad and apply heat with your soldering iron. Once the solder is melted and the wire sits in place, remove the soldering iron and wait until the solder cools down.

If you feel comfortable doing so, you can do all of this inside your case. Otherwise, remove the Bus Board PCB from your case and attach the wires outside of it.



chaining bus boards together

To chain your bus boards together, connect multiple units as shown.

CONGRATULATIONS!

You just finished building your own Bus Board! Now it's time to test if everything is working. Just connect a power supply and some modules and see if it all runs fine. If you didn't make any mistakes, there shouldn't be any problems. In case something is not working, check if all the solder joints look good and all cables are connected correctly. If you still have issues, try troubleshooting using a multimeter, and definitely feel free to contact me — I'll try my best to help you out.

If everything works fine, you can clean the underside of the PCB with isopropyl alcohol to get rid of the leftover flux. Other than that, there is nothing more to do. Just enjoy your new equipment and take a bit of pride in having built it yourself ;)

ABOUT ME

My name is Felix Ertel, and I'm a student living in Germany.

While I have certainly done a fair bit of research and testing before writing this manual, I'm by no means an expert in electronics. If you find anything in this document that is wrong or could be improved upon, feel free to contact me. I'm eager to improve my knowledge and the work I share with you.

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