# VERTEX CUSTOM HEATBED FOR DUMMIES

## INTRODUCTION

This is an instruction to assemble Marlarks heatbed. I am an electronics nitwit and with the help of Marlark I managed to get my heatbed working. If you are as well as me not sure about your capabilities and in doubt to buy this heatbed, this document may help you further.

There are two ways to use this heatbed.

1. It can be mounted on the original build platform. Then the total height of the platform package will become about 13 mm (platform, cork, heatbed, glass plate). In that case you have to realise that the bedclips can't be used anymore. Instead use bulldog clips or think about some other way to clamp the package together.

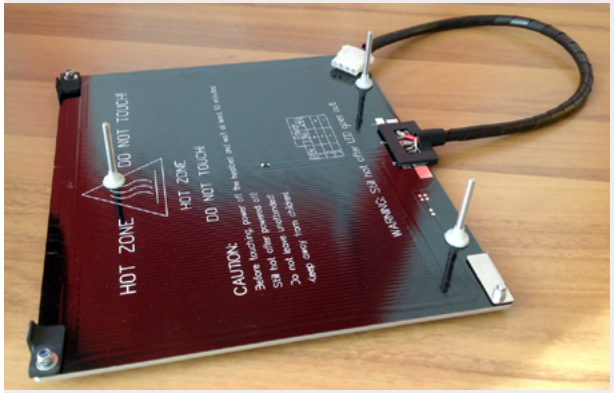
2. You can remove the Vertex build platform and use the heatbed itself as such. This comes with additional work because you have to glue bolts to the heatbed. The platform package will become about 7 mm (heatbed + glass plate).

I chose for option 2.
Assuming that you have ordered a heatbed already, you have to gather the other necessary parts.

## PREPARATION

<u>POWER SUPPLY</u>
First of all you have to think about the Power Supply Unit (PSU). The Vertex PSU can't manage this heatbed. You can add a second PSU especially for the heatbed or replace the Vertex PSU for a more powerful one. But a replacement has the advantage of not making the printer more heavy than it is already. You can buy a PSU that approximately has the same dimensions as the Vertex PSU, it's just a little bit larger.


*Out of the box, and yes, it measures 215 x 240 mm...*
*(photo: Marlark)*



*Heatbed as a build platform*


*Final result*

An additional PSU possibly can be mounted besides the Vertex PSU.
I chose for a replacement PSU and found one of the same brand Mean-Well. There are several PSU models that can be used but I took one that fits rather nice in size: MeanWell RSP-320-15 (320W, 15V, with internal fan) which measures 215 x 115 x 30 mm. (the Vertex PSU measures 199 x 98 x 38.) If you like this PSU, for instance you can order it here. But I think you can find your PSU on many other locations and in your own country.*
The heatbed itself can be connected on 12V or 24V, so I used the 12V connection. If you decide to take an additional PSU for the heatbed, you also can use a 24V PSU, but remember the Vertex itself works on 15V.

POWER EXPANDER

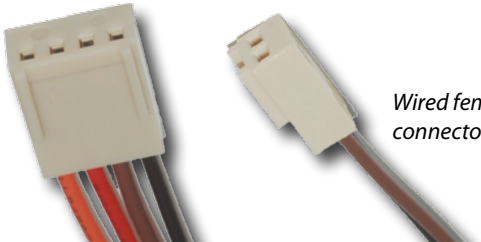
Between the PSU and the heatbed you have to install a Power Expander (PE). It's a little pre-made printboard (30 x 30 mm) on which you have to solder/connect the wires. You can order this PE from RepRap

THERMISTOR

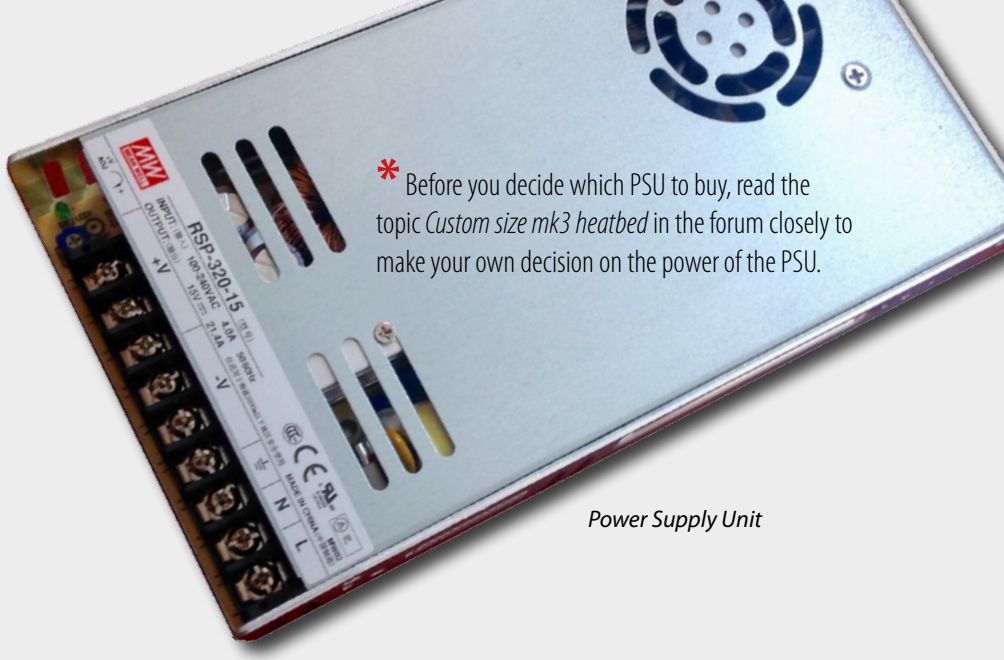
A very little flea-sized temperature sensor, you have to solder to the heatbed. Also it can be ordered from RepRap

WIRING

From PSU to PE and from PE to heatbed you need some thick wires. Have a look on the bottom of your Vertex to the wire between PSU and mainboard. That's about the wire you need (but use splitted wires). It's preferable to buy some colours to keep apart the + and –. Red is normally used for +, black for –.
For the other connections you can use the same thin kind of wiring as used for the fan's and motors. So about 1,20 meter thick red, 1,20 m thick black, 1 m thin x-colour, 1 m thin y-colour, has to be enough.
Nice would be to have some female connectors to connect the wires to the mainboard. You can buy these connectors pre-made with a short piece of wiring. You got to have one 4-pin and two 2-pin connectors (all female).

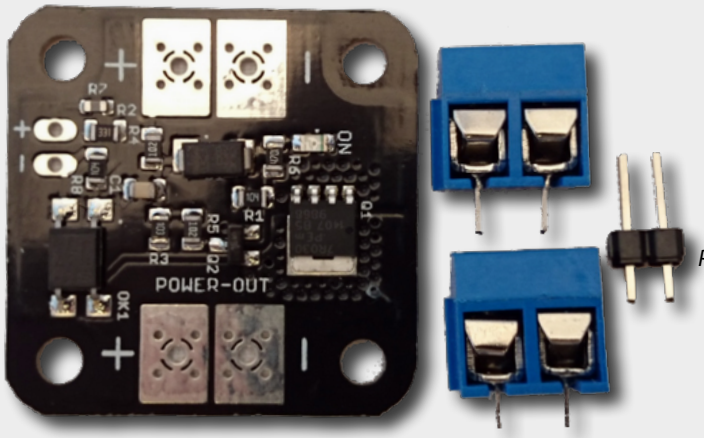


*Wired female 4-and 2-pin connectors*

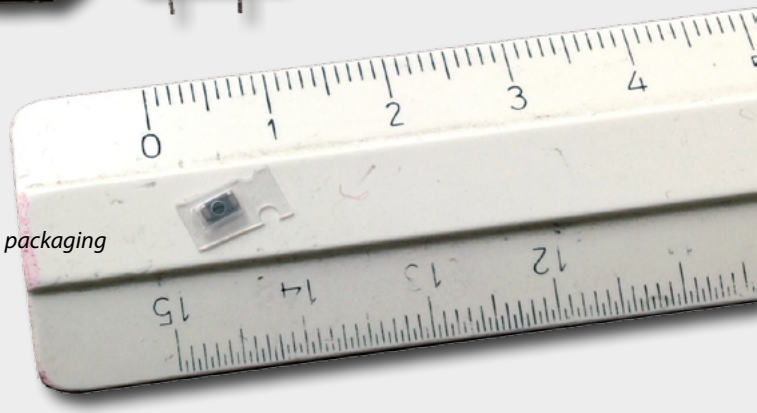



*Before you decide which PSU to buy, read the topic *Custom size mk3 heatbed* in the forum closely to make your own decision on the power of the PSU.

*Power Supply Unit*




*Power Expander with connectors*



*The thermistor in its packaging*

It's very useful to buy one (kind of) Molex connection (male & female) to put between the heatbed *in* the printer and the connections *beneath* the printer so you can easily remove your heatbed if you like.
To hold the heatbed cabling together, use a spiral wrapping band of about 8 mm diameter.

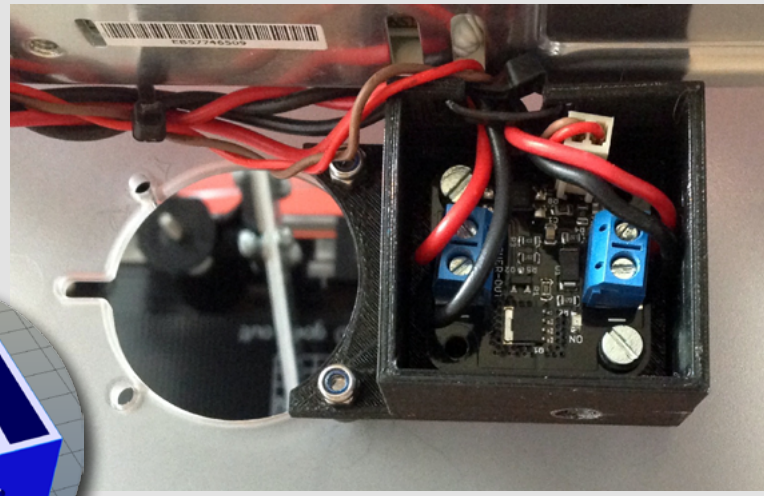
TOOLS & MISCELLANEOUS

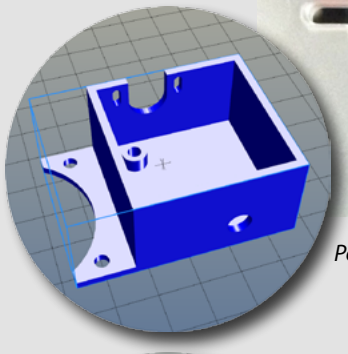
- Soldering iron with a fine point and of course solder (40/60 colophonium).
- Wire stripper.
- Small sized screw driver.
- Heat resistant 2-components glue like Pattex Super Mix Metal, resistant till 150 degrees, or something similar from Loctite.
- Some ironware, bolts and nuts.
- Some shrinking tube.

PARTS TO PRINT (IF YOU LIKE)

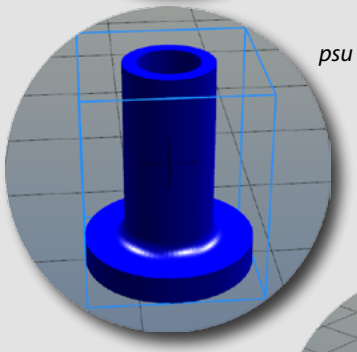
- We like printing :) and so, for example, you can print a small housing for the Power Expander in PLA. I mounted this thing against the underside and used 2 screw holes besides the bottom fan opening. (Placed the bottom fan elsewhere.) But there is plenty of other space for this PE. Print this beforehand!
  Download PE housing.
- Four spacers (PLA) for the PSU. Print these beforehand.
  Download PSU spacer.
- I made some bedclips (ABS) for the front side because I don't like bulldog clips.
  Download bedclips left and right.
- Also printed a connection (ABS) between wire and heatbed. You can try to print this without heatbed beforehand?
  Download heatbed connector.

*Kind of Molex connector*

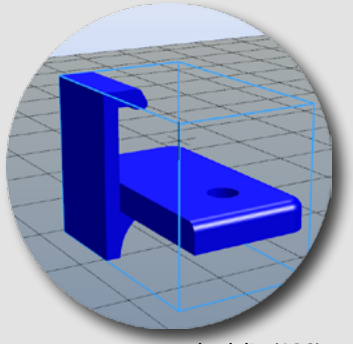




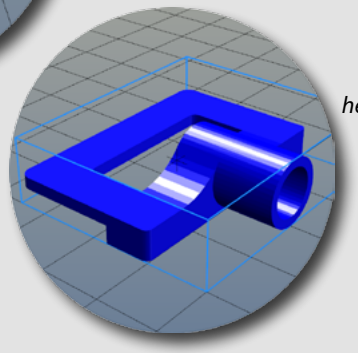
*Power Expander housing*



*psu spacer*



*bedclip (ABS)*



*heatbed connector (ABS)*

## ASSEMBLY

This instruction has as a starting point the replacement of the PSU and using the heatbed as a building platform.
If you're intention is to add a PSU and using the original building platform, you can use these instructions too but has to interpret it in your own way.

### POWER EXPANDER ASSEMBLY

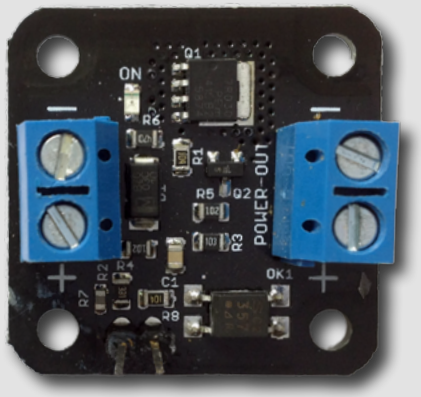
The Power Expander exists of 4 parts. The printboard, 2 screw-wire connectors and 1 male 2-pin connector. You have to solder those 3 connectors to the printboard yourselves. Push the 2 screw connectors through the little holes on the printboard (power in and power out) with the wire entrance on the outside and solder them on the back side.
Put the short ends of the pin connector in the 2 holes (signal in) and also solder them on the backside.

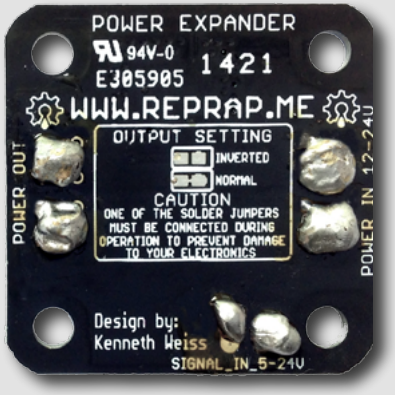
### APPLY THE THERMISTOR

This is a tricky job because the thermistor is a very tiny thing. I used a little piece of double-sided tape to stick it on the contacts in the middle of the heatbed before soldering.
Solder both ends of the thermistor in such a way they do not contact each other. It's useful in case you use the heatbed on the Vertex build platform, to ensure that thermistor and solder do not stick out more then 2 mm.

### MOUNTING THE (REPLACEMENT) PSU

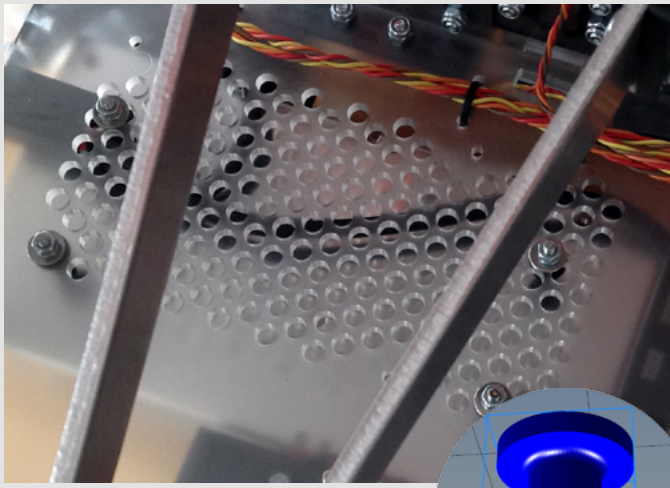
Turn your Vertex on one side (easiest is to remove one filament spool) and remove the original PSU.
Try your new PSU to see which position is best for you. Then make a simple paper mould of the size of your PSU and pierce with a ballpoint through the paper in the 4 screw holes of the PSU. Now you can lay this mould against the bottom to mark the holes. Maybe you can use some existing ventilation holes, but if not, make new holes. To make it easy, I glued M4 threaded rod in the PSU mounting holes and put the nuts inside the printer. But if you like, you can do it otherwise.
Earlier I made a switch and euro plug on my printer, so I had to use 15



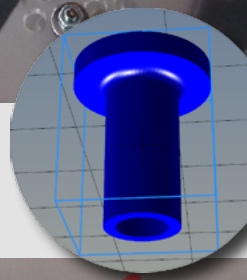




*Solder the connectors on the Power Expander*

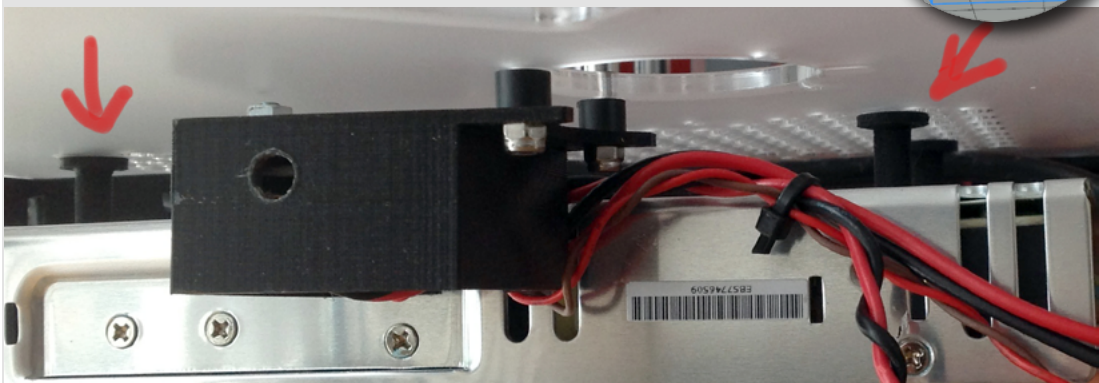

*Thermistor soldered in the middle of the heatbed*



*M4 Bolts and washer/ locking nuts to mount the PSU*



*Spacers between bottom and PSU*



mm self-made spacers between PSU and printer bottom to hold a certain distance for those additions. At the same time it makes some room for the wiring.

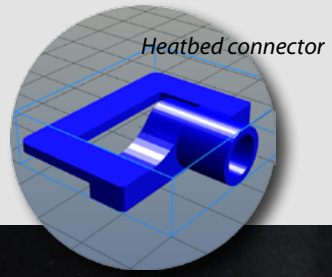
## SOLDERING THE WIRES TO THE HEATBED

Presuming you make a Molex connection (or something like this) on the inside of your printer right above the rectangular wire hole in the bottom. Cut about 45 cm red & black thick wire and two lengths of thin wire. Solder the wires to the heatbed according the picture. Don't forget to make a bridge between 2 and 3. Note that this is the 12V connection. If you are using an additional 24V PSU, see the scheme at the end of this document. Use the right colours (+ and –) for the thick wires. The thin wires are for the thermistor and can be switched, + and – doesn't matter for this.
If you like to use the ABS printed heatbed connector, you have to shove this part over the wires now.
On the other side of the 4 wires, mount the Molex connector, I used the female one. If you like to print the heatbed connector later on, you can decide not to make use of the Molex plastic housing on this moment. You can temporarily use only the metal connectors so the printed heatbed connector can be applied later on. In that case note that you isolate the metal connectors to prevent short-circuiting.

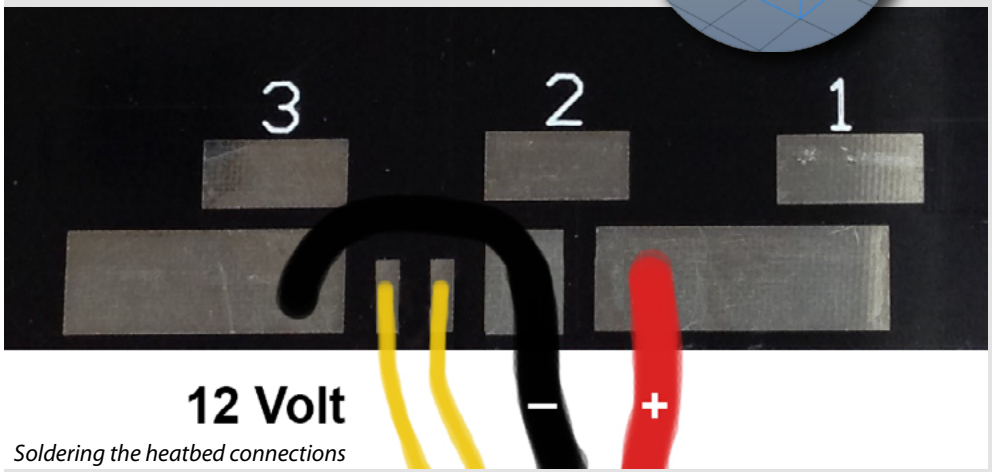
## SOLDERING AND MOUNTING THE OTHER WIRES

Take the 4-pin female wired connector and cut away the two wires in the middle, you don't need them. Look closely at your mainboard connector called 'bed heater'. Plug the 4-pin connector in and mark the colours of + and –. Now take the 2-pin female pin connector, connect it to the male pins (signal in) on the PE and mark the + and – colours also.
Now connect and solder the wiring of these pin connectors together considering the right colours for + and –. It would be nice to use some shrinking tube, but insulating tape also will do.
Connect both pin connectors to mainboard 'bed heater' and PE 'signal in'.
Now cut off about 40 cm thick red and black wire and take the other 2-pin female wired connector. Mount these 4 wire ends to the other Molex half (male). Note that the thick red (+) en black (–) corresponds with the other

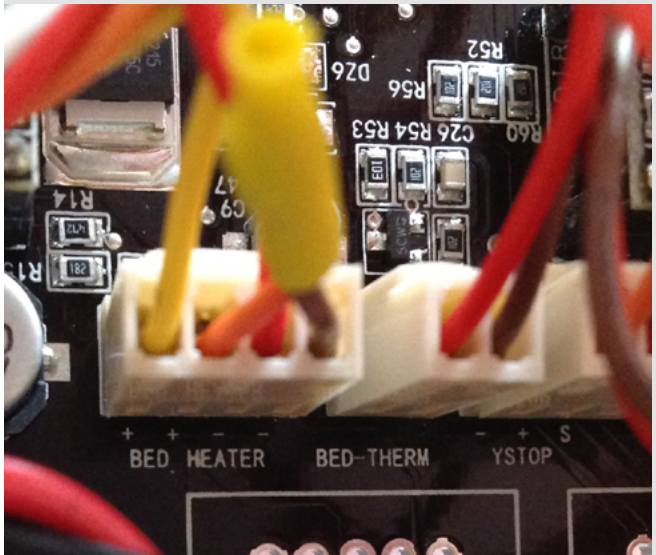
*Molex connection in rear-right corner*



*Heatbed connector*




*Soldering the heatbed connections*




*Bed heater connector uses only one plus and one minus! The other to wires can be cutted.*

*Bed therm connector has no plus or minus, so they can be mixed up. (But this applies only the thermistor connection!)*

*(Note that this colours do not match with the connection scheme on the next page. Use your own colours!)*

female side of the Molex connector you made before. The thin wires can be changed, there's no + and –. You can shove the plastic Molex housing over the metal connectors already.
Screw the other side of the thick red and black wires to the power out connector on the PE. Screw it tight but be aware that the little connector stays firmly soldered.
Connect the 2–pin female to the mainboard male connector called 'bed therm'.

Cut off 30 cm thick red and black wire and connect it (+ and – !) to the PSU. The other side goes to the PE power in connector.

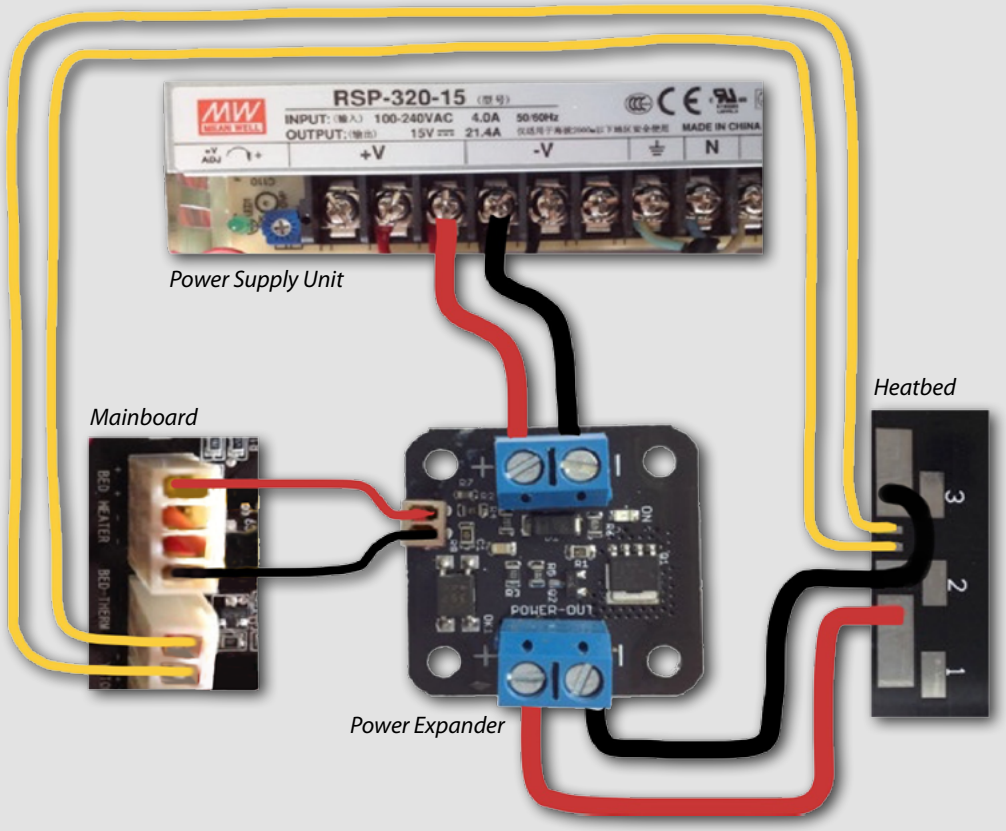
Connect the 2 Molex parts. With some effort you can push the Molex through the Vertex rectangular wire hole in the bottom.

TESTING THE HEATBED

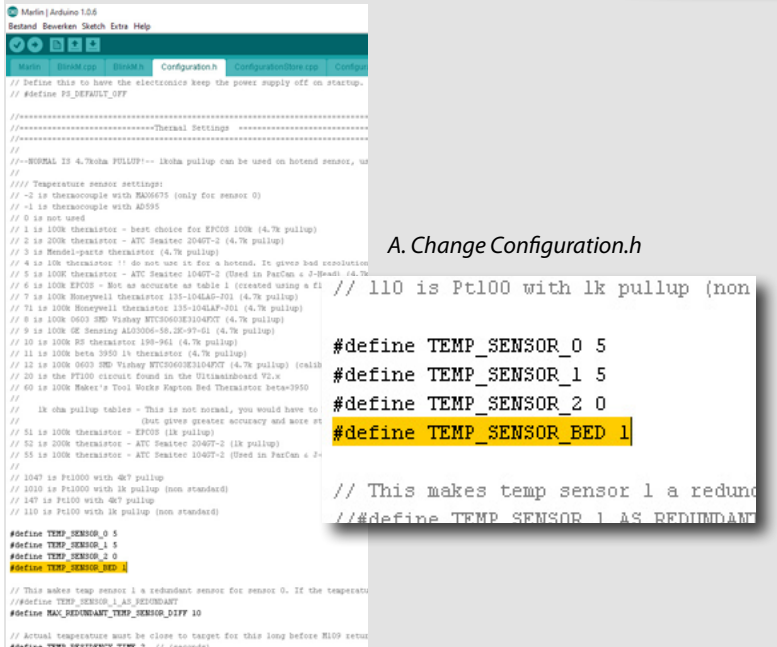
Before tidying up everything you'd better test the heatbed now. Before that you have to modify your settings:

- The Marlin firmware the 'Configuration.h' file has a line that need to be changed for the type of thermistor used. See picture A. Export the settings to your printer and reset the Eeprom settings on your printer. (see Velleman instructions.)
- The Start and End G–code in Cura has to have those lines, see picture B, next page.
- Set a bed temperature for PLA or/and ABS in your filament set tings.

If you turn on your printer you have to see the heatbed temp on your lcd–screen.
If you connect your computer with Vertex 3d printer Repetier-Host, under the tab Manual Control you'll see the bed temperature is added above the extruder(s). If you click on this icon and shove the temperature to, say 50 degrees, the bed has to warm up. The led on the Power Expander and the led on the mainboard's heated bed connection will burn both.




Connection scheme




A. Change Configuration.h

## TIDY UP THE HARDWARE

Knowing your heatbed is working fine you can assemble the housing of the PE and make the heatbed as your build platform.

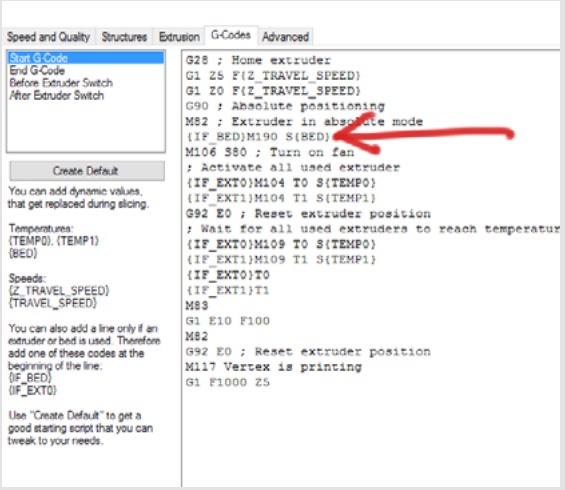
In case you use the heatbed on your existing Vertex platform, you have to put a layer of thermal insulator between it. For this you can use 2 mm cork. Given that the thermistor sticks out of the heatbed surface, you have to make a hole in the cork where the thermistor sticks out. If the thermistor sticks out more than this, you have to make a hole in the build platform. But ensure that the thermistor contacts do not touch the build platform, otherwise it won't work.

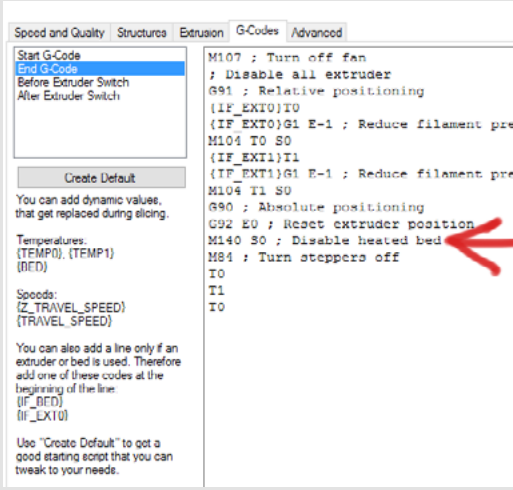
Put the printboard in the PE housing in such a way that the ON-led is showing through the hole in the side. Mount it with 2 short M3 bolts and ordinary nuts. The wires can be pushed through the cut-away and locked up with a tie-rip.
Mount the housing with 2 spacers against the bottom and beware the led-hole is in front of the printer, so you can easily check if your PE is doing well.

If you printed the heatbed connector (in ABS, otherwise it will melt) you can glue it around the soldered connections like the picture is showing. Use the heat resistant glue. After that you can attach the 8 mm spiral wrapping around the wiring and push the end in the heatbed connector.

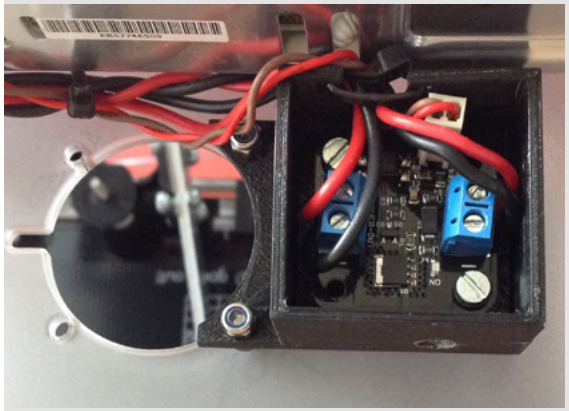
## THE HEATBED AS BUILDING PLATFORM

And now the somewhat difficult part: Making your heatbed suitable as a building platform.
Remove the existing platform from the printer and remove the bedclips. Put the bolts in again, but on the other side of the platform (not countersunk side). Attach the nuts with a (large) washer between and fasten the 3 bolts firmly. You have to find a way to position the bolts exactly in the middle of the holes as they are not countersunk anymore. Before going further convince yourself that the 3 bolts precisely fits in the bed arm supports! If not, try to center them again.
This positioning is important since the platform is the way to glue the

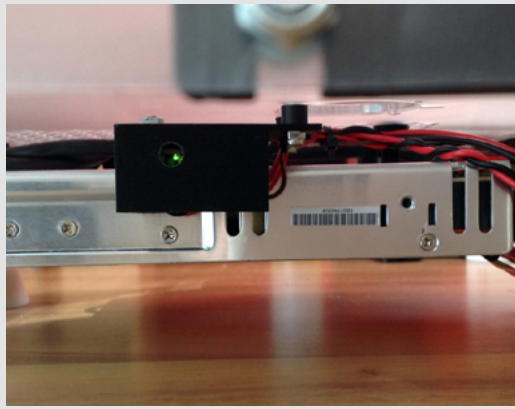



*B. Changing the start- and end-Gcode*



*Power Expander seen from under*

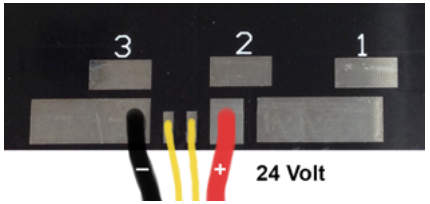


*Checking the led of the PE*

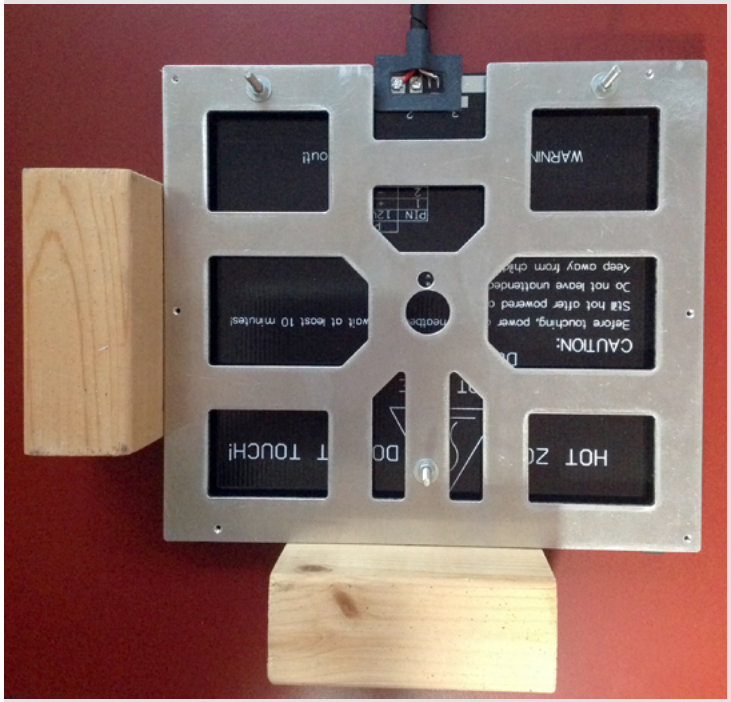
*Heatbed-wire connection*

bolts exactly perpendicular and on the right place on the heatbed.
Use some fine sanding paper to roughen the bolt-heads for better adhesion. Clean both heads and heatbed gluing places with acetone.
Lay the heatbed on a flat surface with the black side up. Put two nice rectangular pieces of wood (or something else) against two adjacent sides of the heatbed in such a way you have a kind of rip fence to place the platform against in order to glue the bolts directly on the right places. Follow the instructions of the glue you are using. You carefully can put some weight on the building platform while the glue hardens out.

After the glue is hardened out and the bolts are removed, you can consider to use the original bedclips on the rear side of the heatbed. This is recommended because on the rear side there's little height for another solution due to the printhead(s). This two clips don't have to swing so they can be screwed firmly against the heatbed. Therefore I drilled M3 holes in the four corners of the heatbed. Note that this corners are the only place to use because there is no electric wiring to hurt, but you have to mark the right spot precisely before drilling! After drilling the hole use a countersink drill to countersunk the M3 bolt.
One original bedclip can be mounted on the left rear corner, but in the right one, you have to drill another hole to mount it in the right corner. It's not easy to drill in the bedclip steel, but it is doable. Between bedclip and black side of the heatbed, use a nylon washer to prevent damage. The bedclip could be a fraction to wide for the glass plate (with Buildtak) but with a plier you can squeeze the bedclip sides a little bit together.
Given that the bedclips at the front side has to swing, I didn't use the original clips, but designed one left and one right sided in ABS. You can print them if you like. Use a washer and a spring washer to mount it.

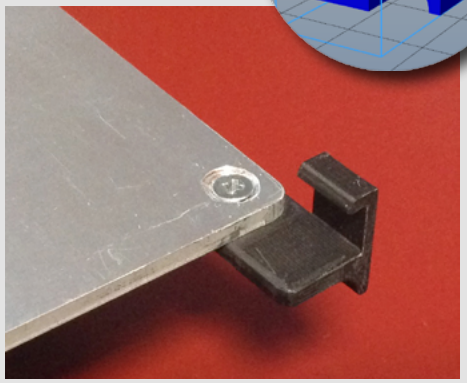


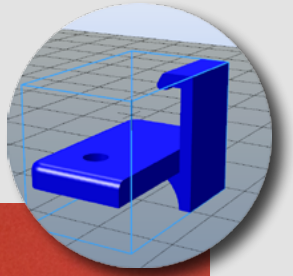

*If you are using an additional 24V PSU: Connect the wires like this*



*Using the Vertex build platform as a mould to glue the bolts on the heatbed*

*You have to drill an extra hole for the rear-right bedclip*





*Custom bedclip printed in ABS for heatbed plus Vertex glass plate with Buildtak*