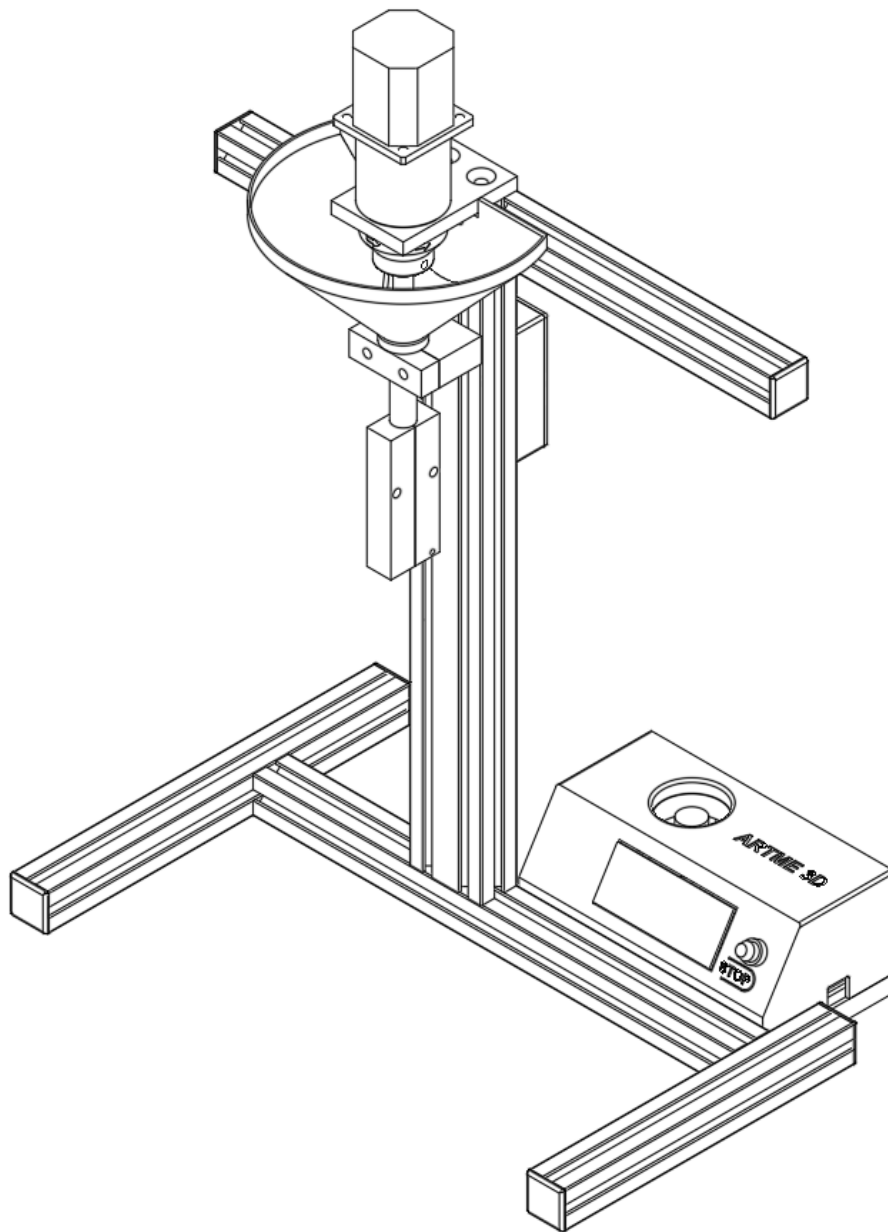


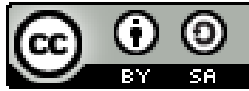
Assembly instructions

02 Electronics

Original Desktop Filament Extruder MK1 by ARTME 3D

Version 30.05.2022





Die Aufbauanleitung des Original-Desktop-Filament-Extruder MK1 von ARTME 3D ist ein Open-Source-Projekt, das unter einer CC BY-SA-Lizenz verwendet wird:

Sie dürfen:

- Alle Inhalte verwenden, verändern und weitergeben.

Unter der folgenden Bedingung:

- Nennen Sie meinen Namen: David Thönnies von ARTME 3D
- Verlinke mein Projekt: www.artme-3d.de
- Geben Sie an, was geändert wurde
- Veröffentlichen Sie unter der gleichen Lizenz

Mehr Details zur Lizenz siehe <https://creativecommons.org/licenses/by-sa/4.0/>

Additional tools required for this assembly section:

Phillips screwdriver PH1
slotted screwdriver 2,5mm
Side cutter
Wire stripper
Knife
Marking pen
Folding rule

Packages overview:

Package 0: Delivered carton
Package 1: Screws (SC)
Package 2: Spare Parts (SP)
Package 3: Custom Metal Parts (CM)
Package 4: Extruder Barrel (EB)
Package 5: Electronics (EL)
Package 6: Tools (TO)

ATTENTION:

Please be extremely careful when handling electronic components:

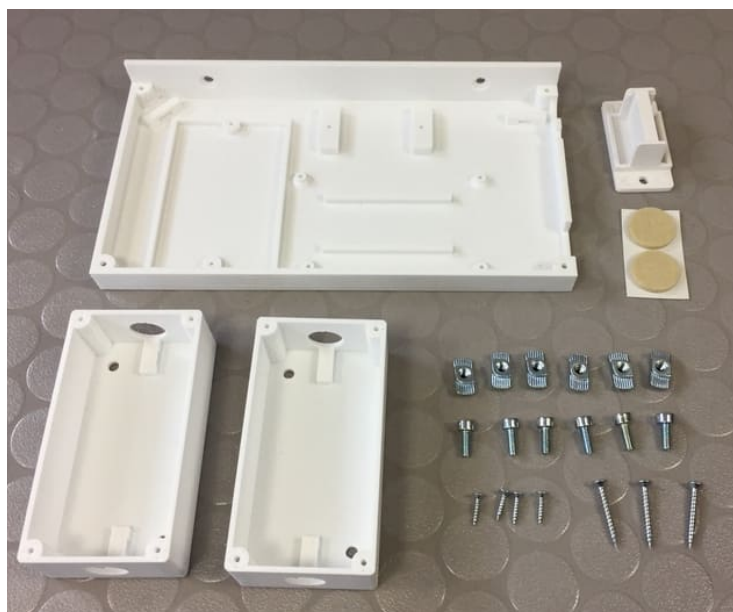
- **Avoid electrostatic charge! (Touch grounded metal parts, such as a radiator, to discharge before handling electronic components).**
- **Do not bend printed circuit boards!**
- **Never pull or plug plugs or components during operation!**
- **Handle electronics only when switched off!**
- **Always pay attention to the correct polarity of the connections!**
- **If these rules are not observed, the electronics may be damaged or destroyed. ARTME 3D is not liable for these damages.**

Step 1:

3D printing: 1x control housing bottom (EL15), 2x connection housing body (EL18), 1x holder clamp (EL17) (IN04)

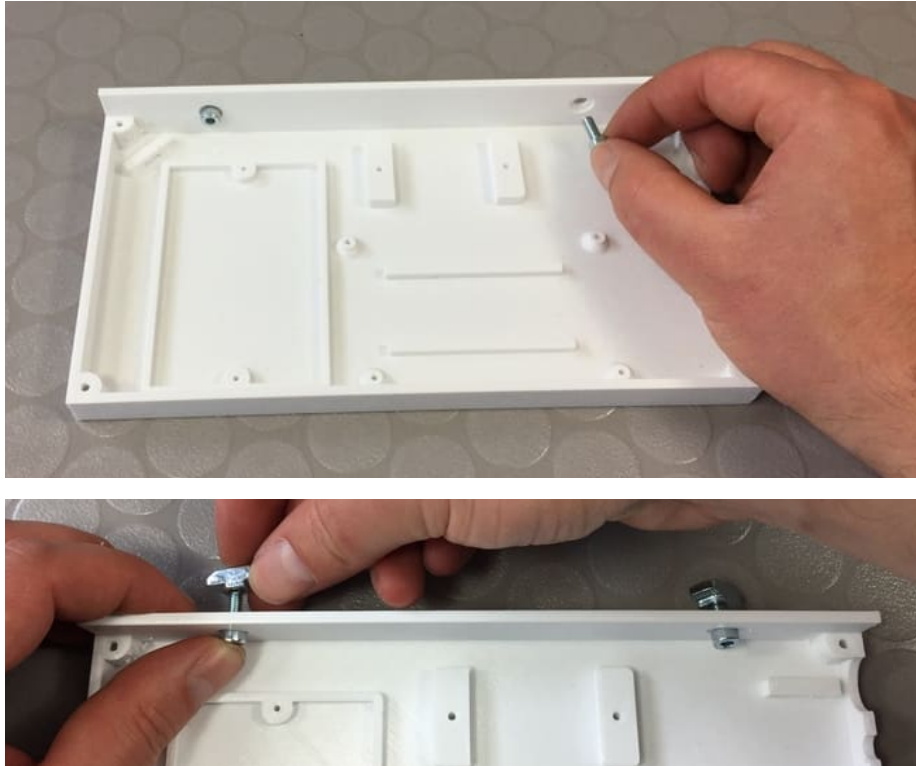
Remove from package 1: 6x hammer nut M4 (SC16), 2x cheese head screw M4x10 (SC05), 4 x wood screw 2,5x12 (SC01), 3x wood screw 3x25 (SC02)

Remove from package 2: 2x felt gliders (SP05)



Step 2:

Insert the cap screws into the holes provided for this purpose in the control unit housing base. Screw the hammer nuts onto the thread.



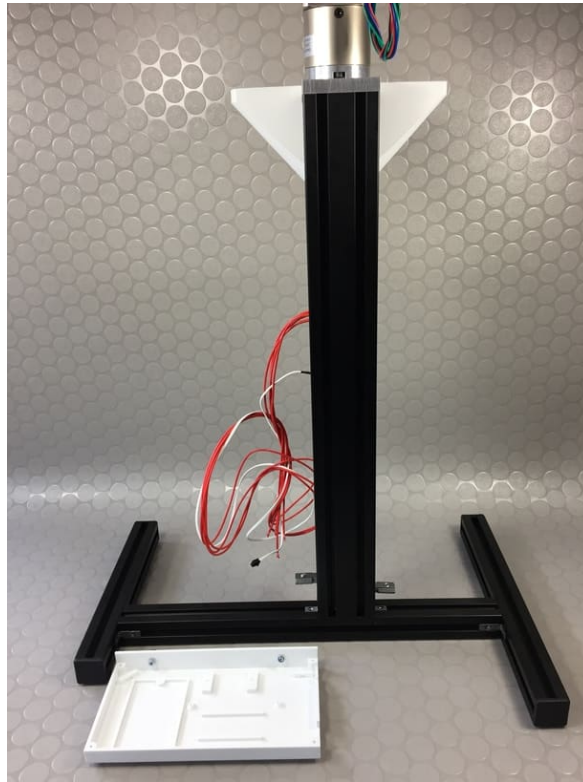
Step 3:

Turn the control housing bottom around and glue the felt glides.



Step 4:

Turn the extruder unit over so that you are looking at the aluminum frame from behind. Alignment of the control housing base see picture.



Step 5:

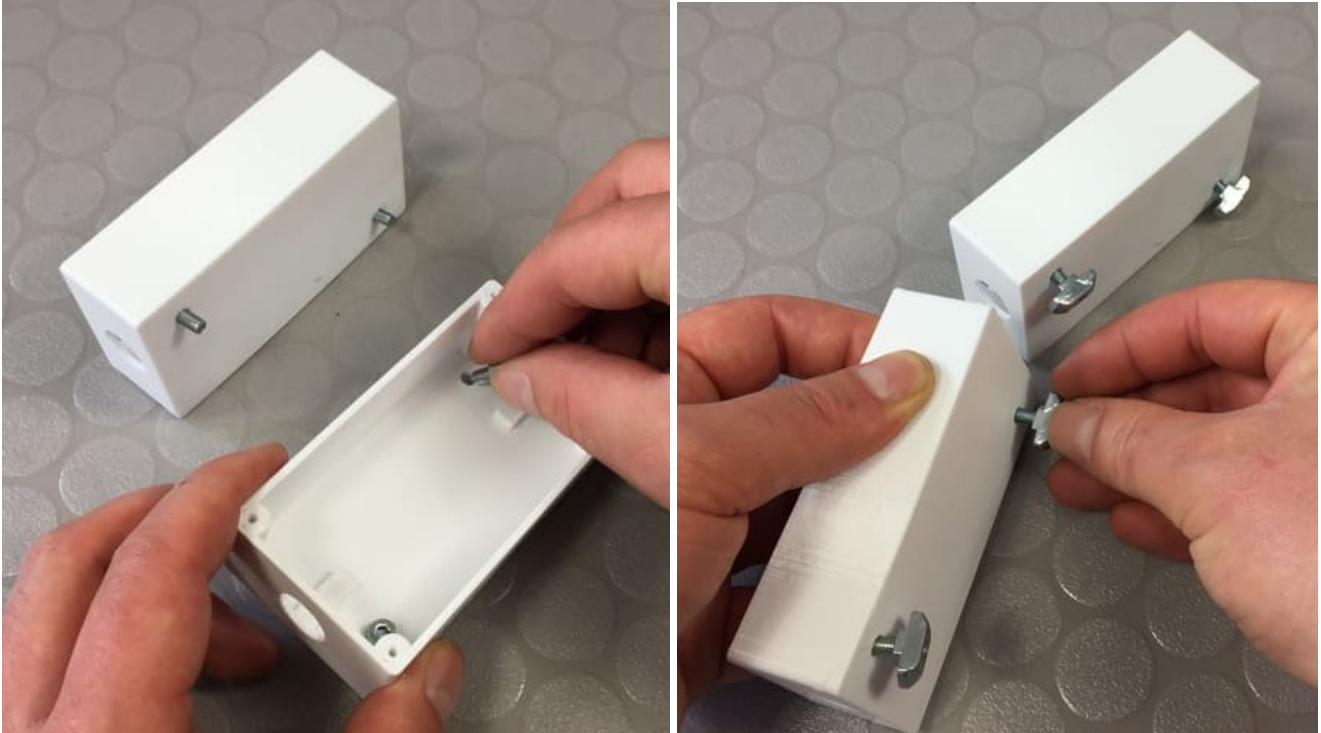
Remove from package 6: Allen wrench 3mm (TO07).

Insert the hammer nuts into the groove of the aluminum profile and turn tightly. Again, make sure that the hammer nuts twist inside the groove. Do not overtighten the screws or the 3D printed part may break.



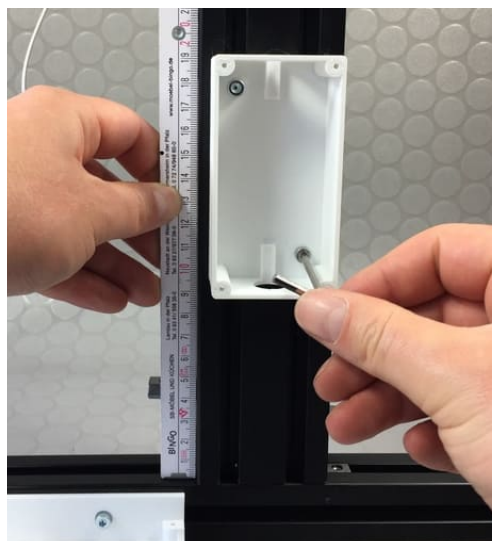
Step 6:

Insert the cap screws into the holes provided in the two connection housings. Screw the hammer nuts onto the thread.



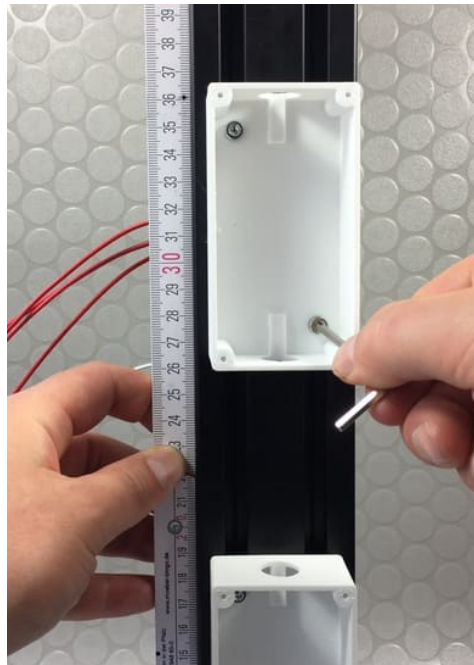
Step 7:

Place the first connection housing on the aluminum profile 30x60x500 mm and insert the hammer nuts into the grooves. The distance between the upper edge of the housing and the lower edge of the aluminum profile is 190 mm. Then tighten the cylinder screws. Again, make sure that the hammer nuts twist inside the groove. Do not turn the screws too tightly, otherwise the 3D printing part may break.



Step 8:

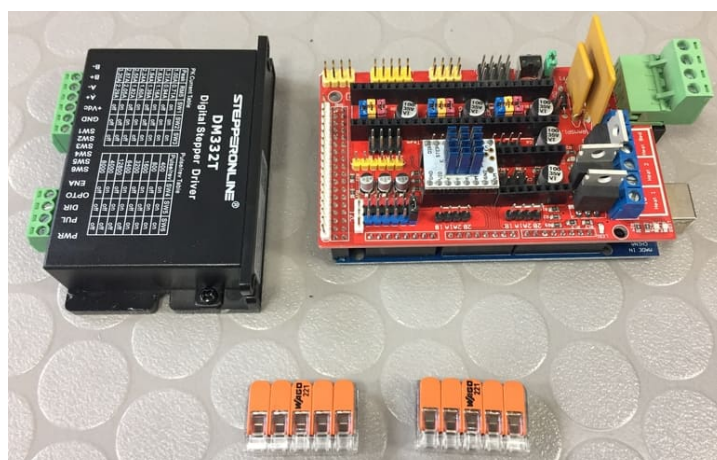
Place the second connection housing on the aluminum profile 30x60x500 mm and insert the hammer nuts into the grooves. The distance between the upper edge of the housing and the lower edge of the aluminum profile is 360 mm. Then tighten the cylinder screws. Again, make sure that the hammer nuts twist inside the groove. Do not turn the screws too tightly, otherwise the 3D printing part may break.



Step 9:

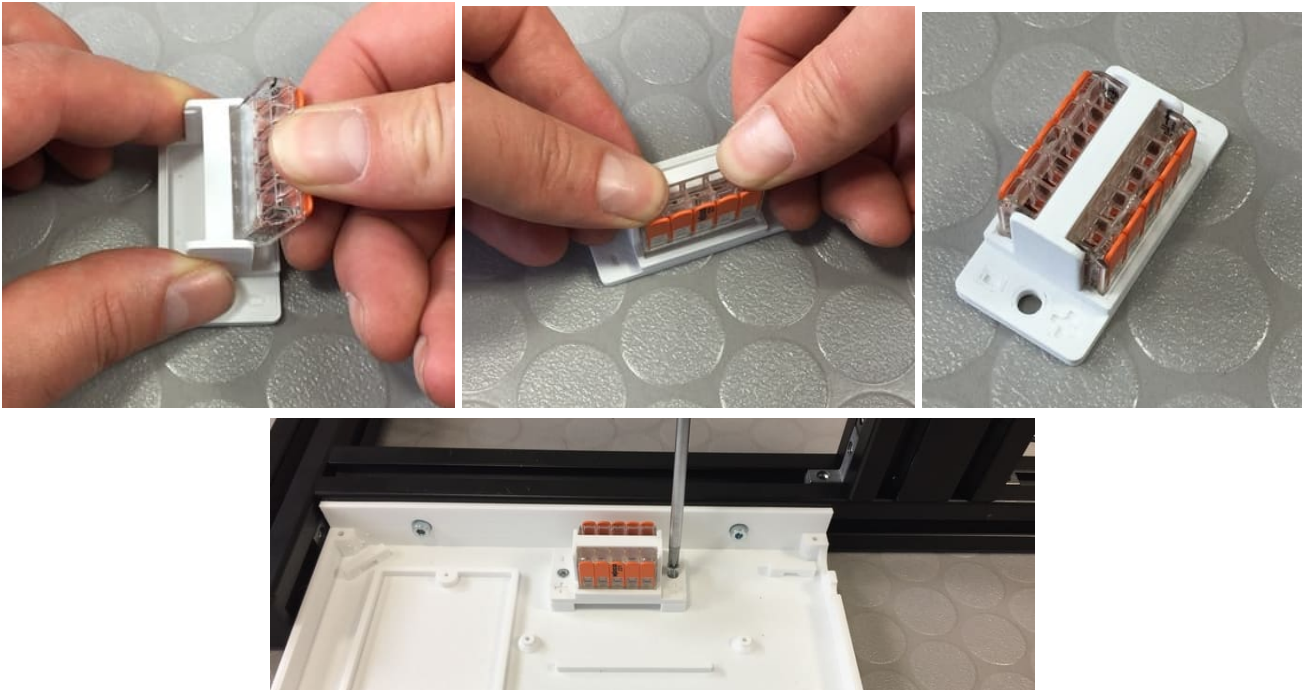
Remove from package 0: 1x stepper motor driver DM332T (MO03)

Remove from package 5:
1x Arduino (EL01 (with attached Ramps Board (EL02) and Stepper Motor Driver (EL04)),
Stepper Motor Driver (EL(If you purchased the kit from ARTME 3D, this unit is pre-assembled and tested.
2x wago terminal 221-415 5pin



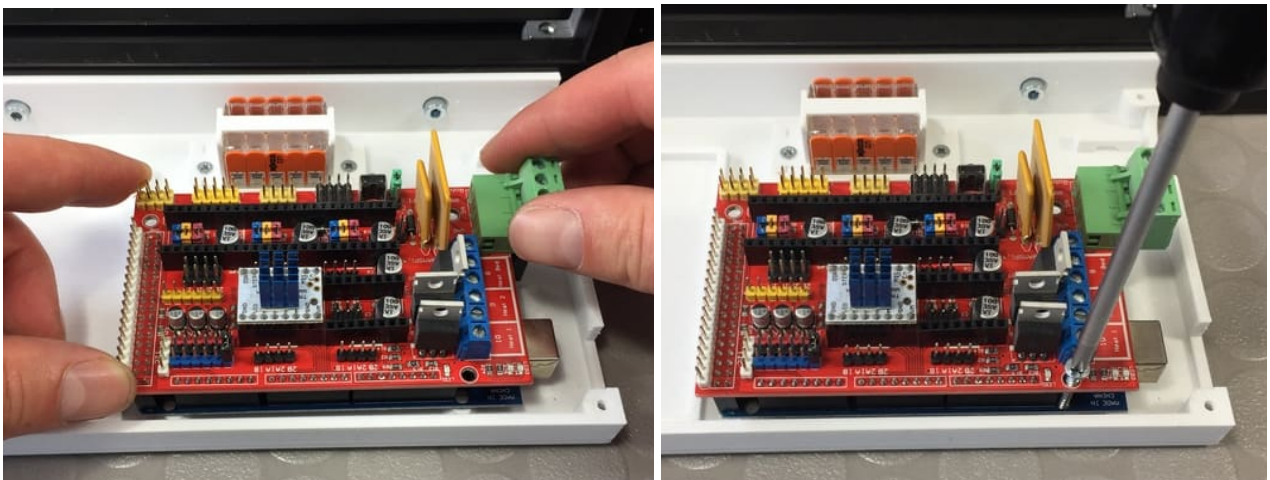
Step 10:

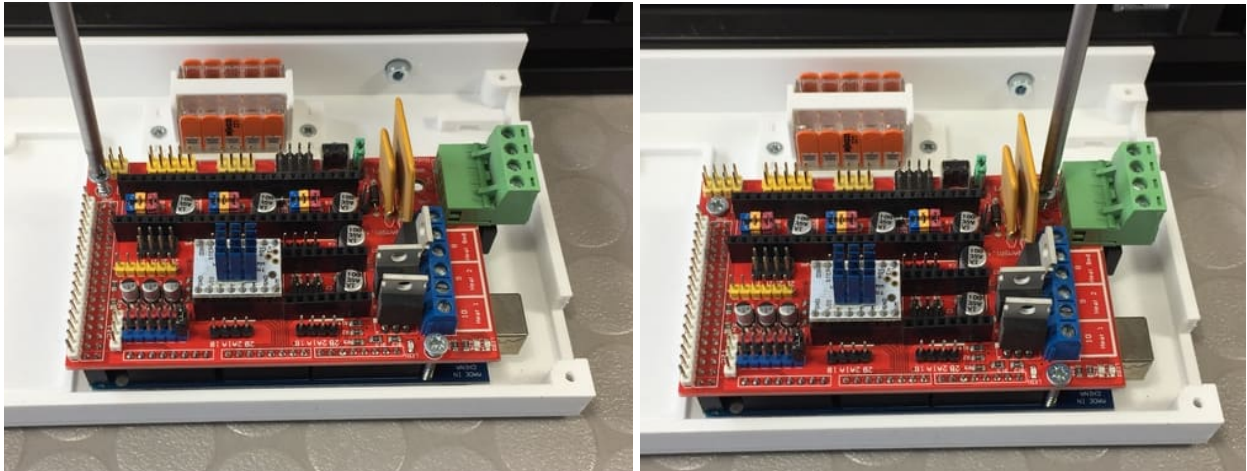
Insert the wago clamps into the clamp holder. Align them as shown in the picture and press them sideways into the holder. Then press the clamps all the way down. Then screw the clamp holder tightly into the floor of the control unit housing using two wood screws at the point provided for this purpose. The "+" sign on the holder points towards you. The "-" sign points away from you. Alignment See picture.



Step 11:

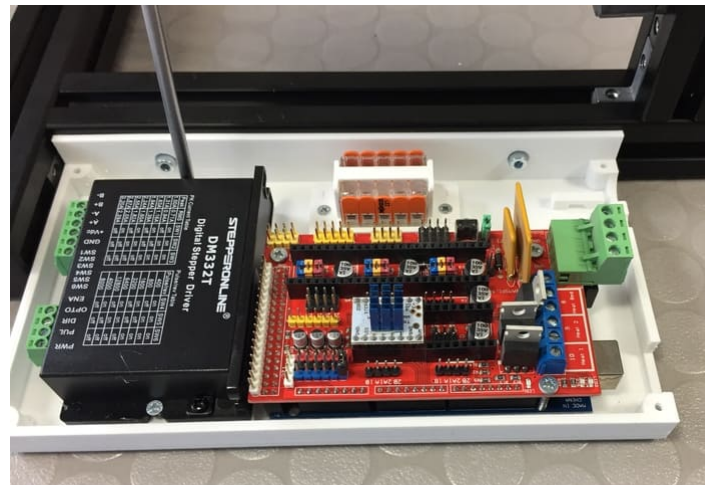
Screw the Arduino with the attached Ramps boards firmly in place. Alignment See picture. The wood screw 3x25 is inserted in three places and screwed in only so far that the board is touched but not bent.





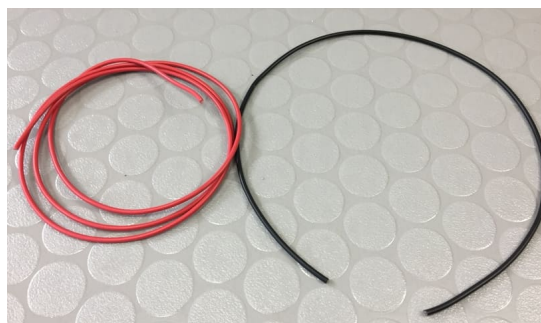
Step 12:

Position the stepper motor driver DM332T at the designated place and fix it with two wood screws 2,5x12. Set the dip switches on the side as shown in the picture. Alignment see picture. The setting means: 3200 steps per revolution and 1.9 A maximum phase current. In a few cases (depending on the material) it may be necessary to increase the motor current a little later. But this is also possible with closed housing.



Step 13:

Remove from package 5: Red wire (EL11), Black wire (EL12)



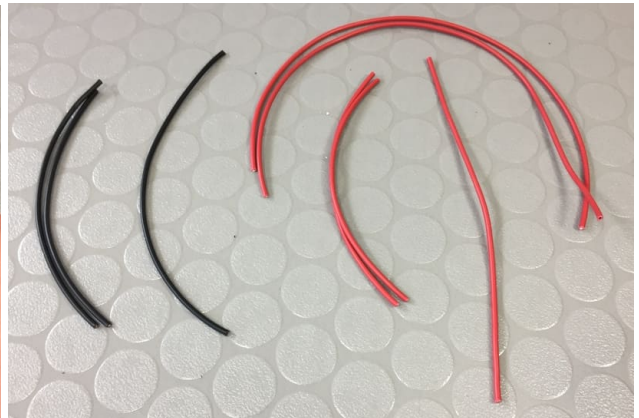
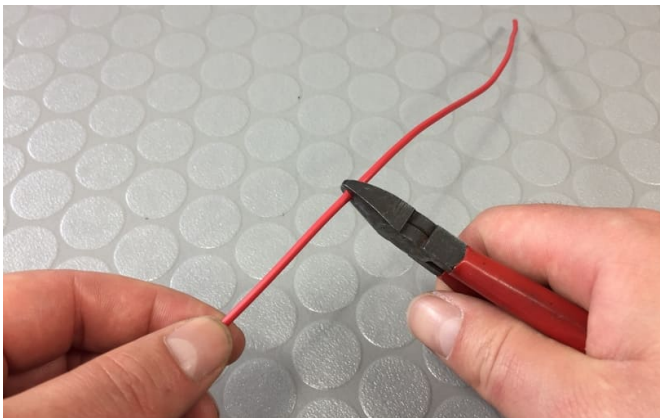
Step 14:

Tool: Side cutter

Measure and cut the leads into the following pieces:

Red wire: 1x 180mm, 2x 140mm, 2x 320mm

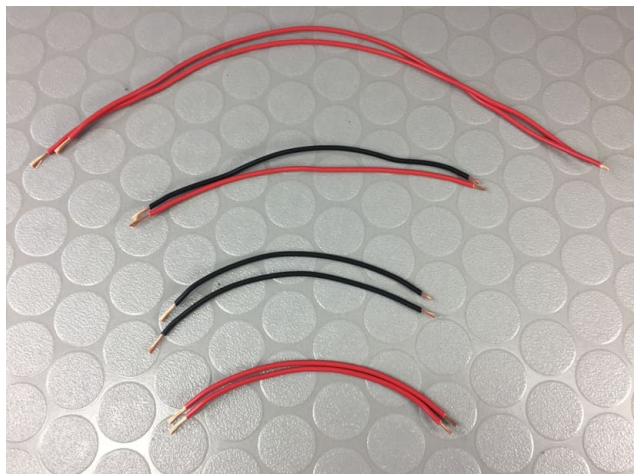
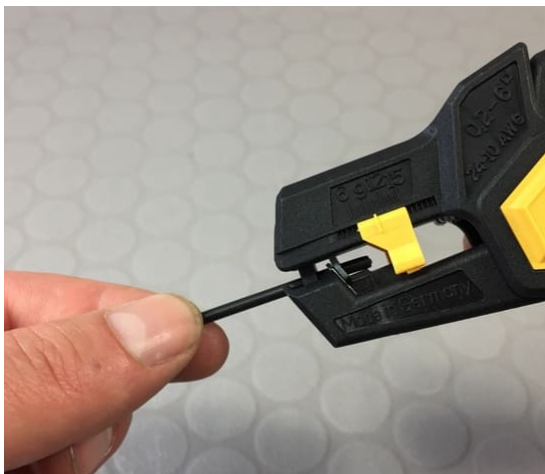
Black wire: 1x 180mm, 2x 140mm



Step 15:

Tool: Stripper

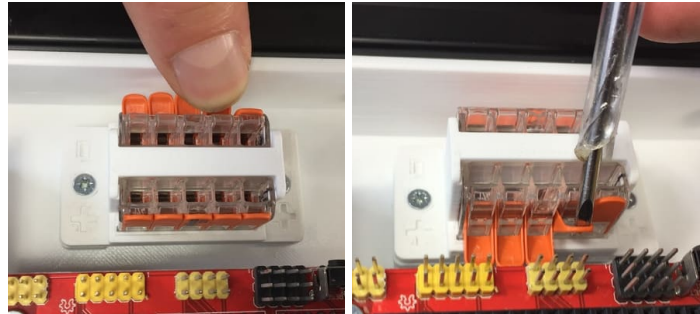
Each piece of wire is stripped 5mm long at one end and 11mm long at the other.



Step 16:

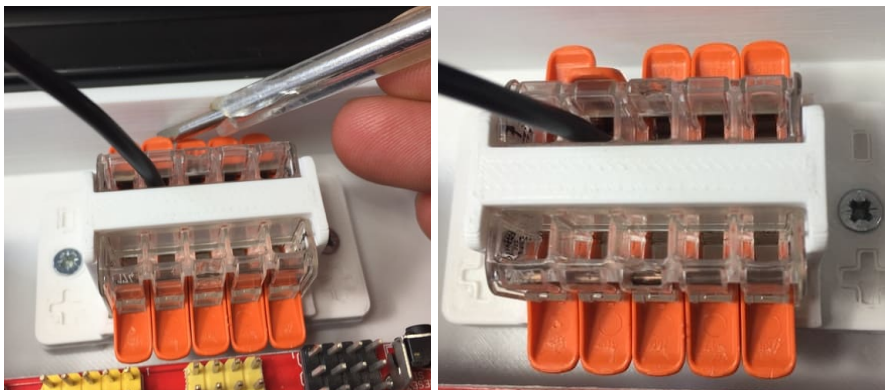
Tool: Screwdriver slot 2.5mm

The orange small clamp levers on the wago clamp are opened. The clamp directly next to the Ramps Board can be opened with a tool such as a small screwdriver, as there is not enough room for your fingers.



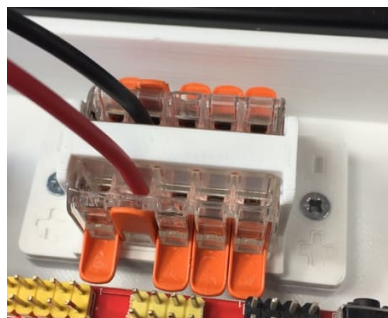
Step 17:

Insert the black 180 mm long wire with the 11mm stripping into the second terminal of the upper wago terminal (marked with "-"). See picture. Close the small orange clamp lever with the screwdriver as an aid.



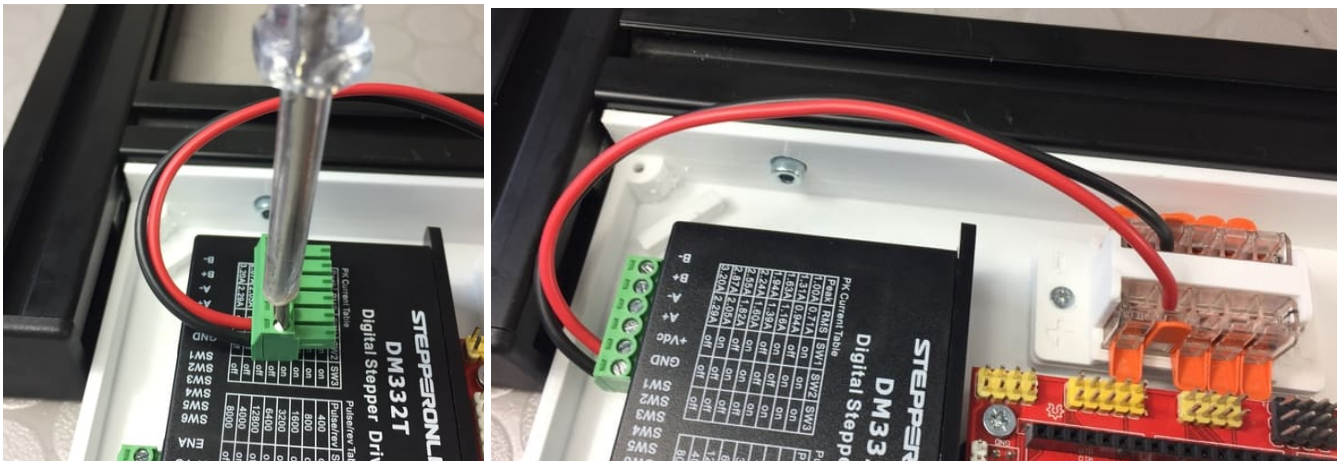
Step 18:

Insert the red 180 mm long wire with the 11mm insulation stripping into the second terminal of the lower wagon terminal (marked with "+"). See picture. Close the small orange clamping lever with the screwdriver as an aid.



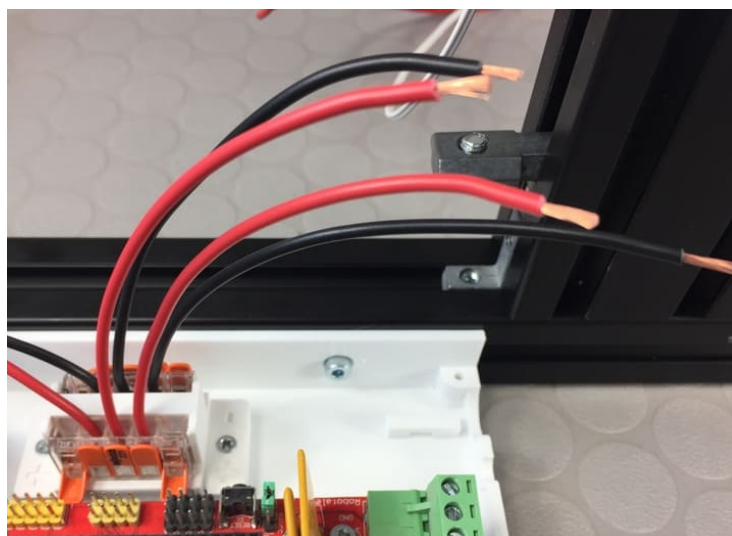
Step 19:

The two lines are now connected to the stepper motor driver. To do this, you can pull out the green row of terminals to be able to better insert the lines into the terminals. The terminals may have to be turned up a little first before you can insert the cable correctly. The black line is inserted into the 1st terminal (GND) and screwed tight. The red wire is inserted into the second terminal (+Vdc) and screwed tight. Make sure that all strands of the stripped wire meet in the terminal. You can twist the strands a little with your fingers beforehand. Make sure that the cable is correctly seated in the clamp. Do not pinch the insulation, only the strands. Pull lightly on the wire to check that it is tight. Then you can plug the green terminal row back into the stepper motor driver.



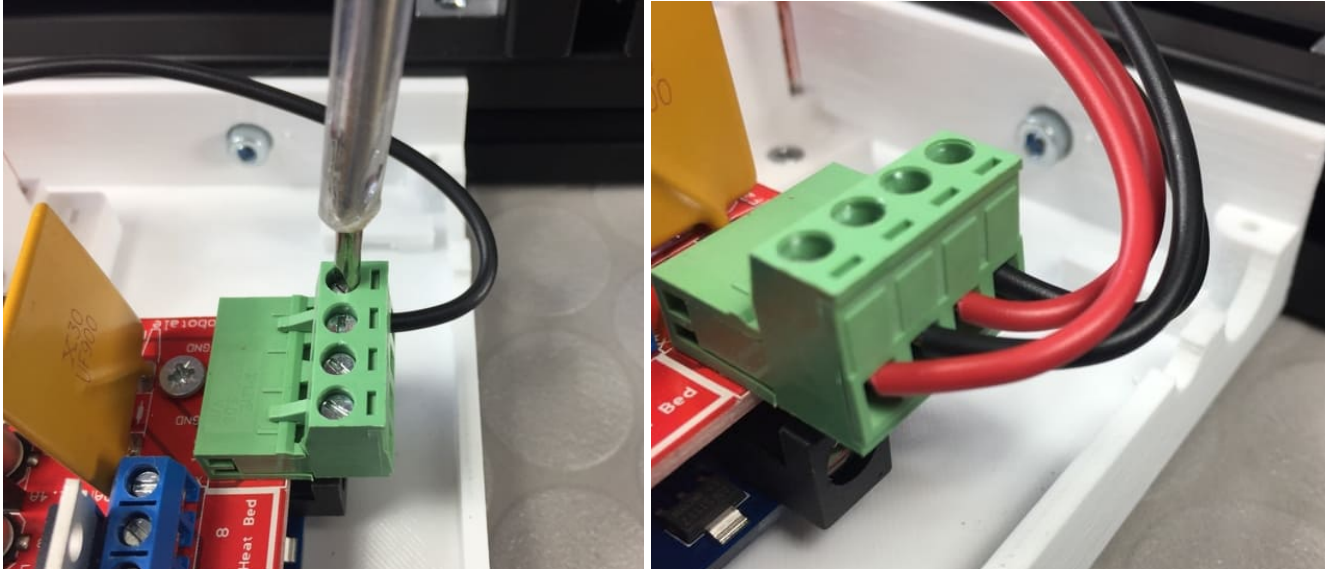
Step 20:

Now the 140mm long wires are clamped into the wagon clamp. The red wires with the 11mm insulation are inserted into the lower wagon terminal marked "+". The black wires with the 11mm stripping are plugged into the upper wagon clamp marked with "-". The small orange clamping lever is closed accordingly.



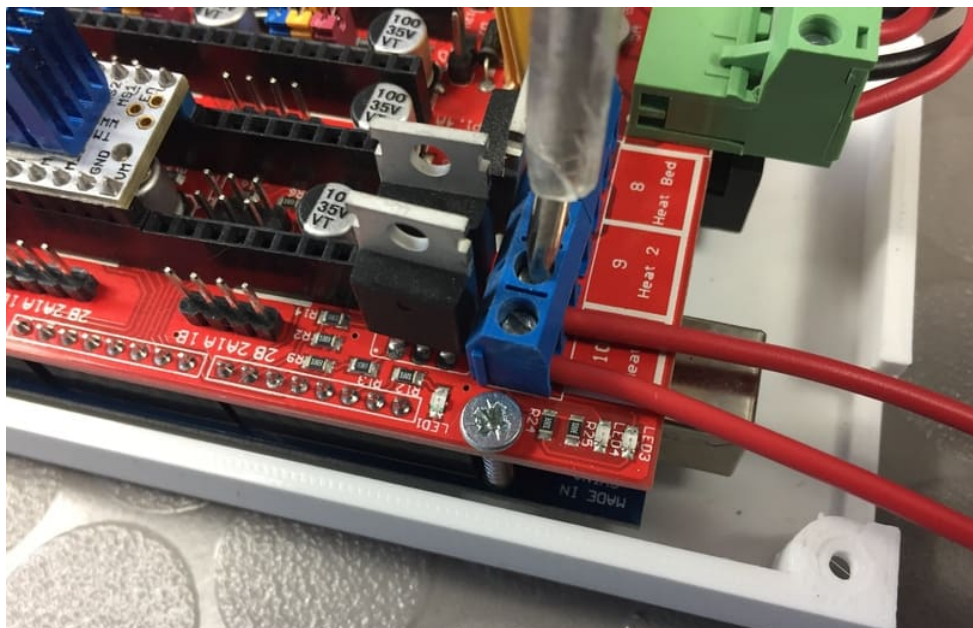
Step 21:

The other end is connected to the green terminal strip on the Ramps Board. To do this, first open the terminals a little with the screwdriver, then insert the cable and close them again. Attention the order of the wires is very important. A wrong order can lead to damage of the electronics. Sequence See picture.



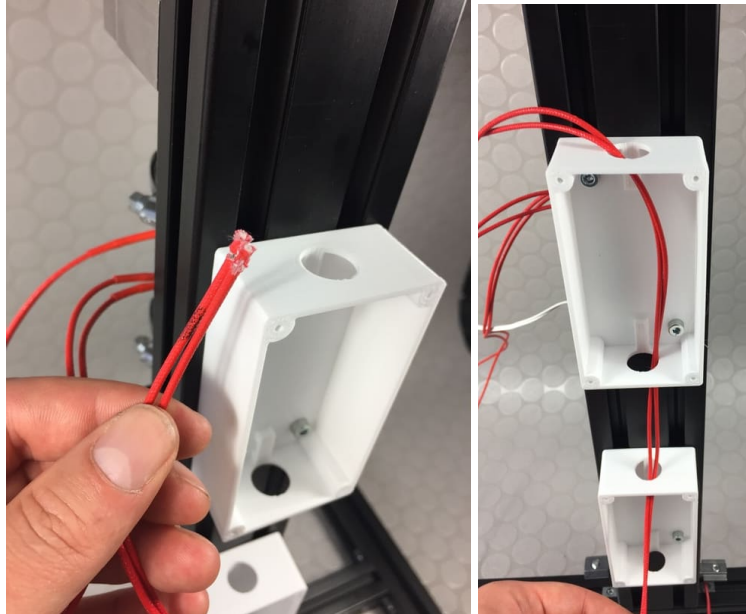
Step 22:

The two red 320mm long wires are screwed to the D10 terminal on the Ramps Board with the 5mm insulation stripped. Again, twist the strands with your fingers beforehand.



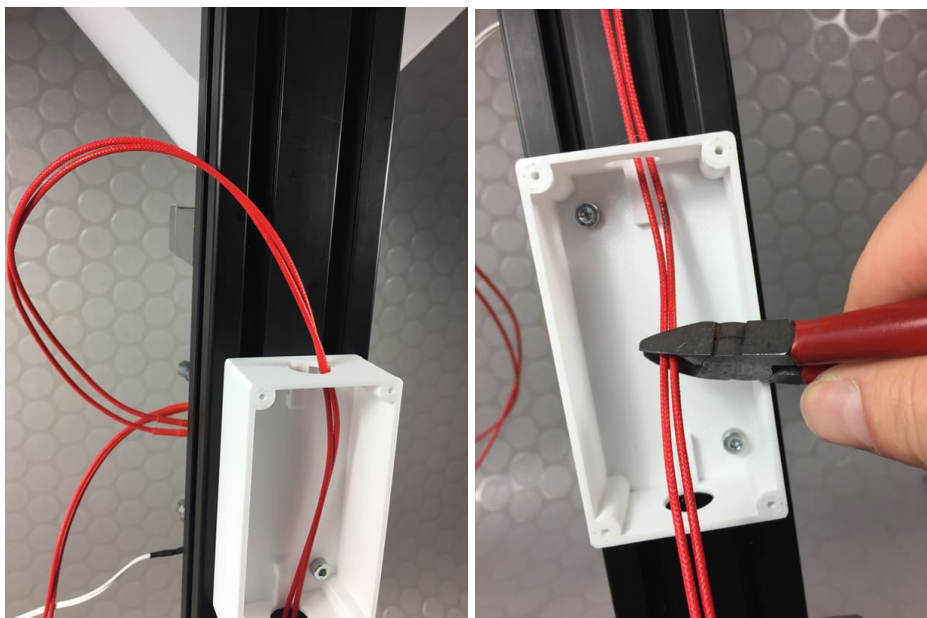
Step 23:

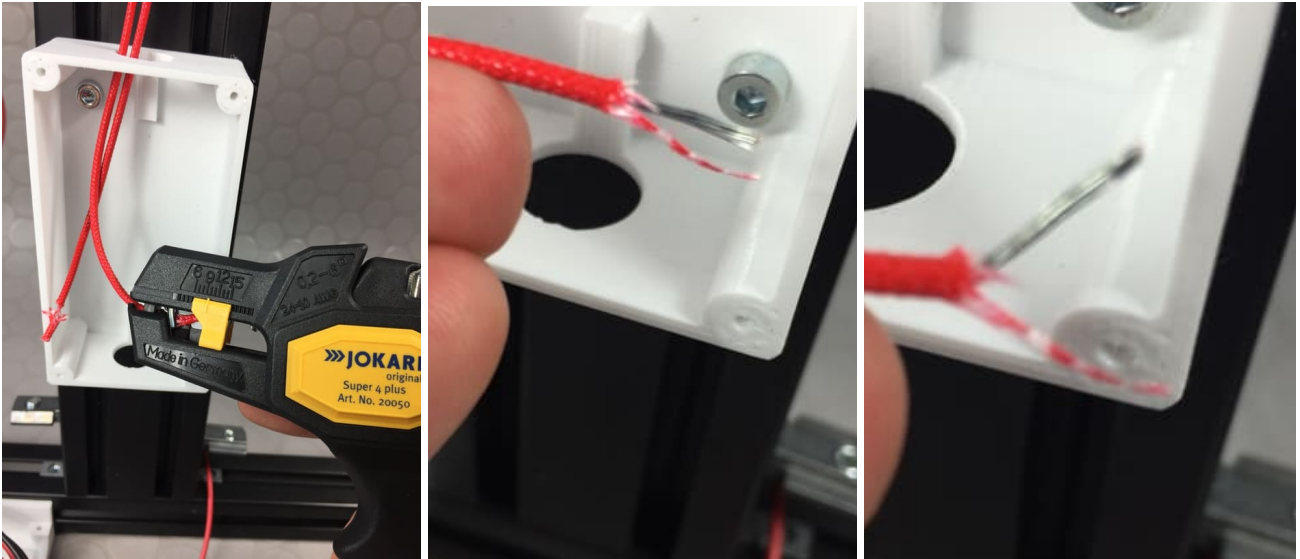
In the following, the heating cartridges, which are installed in the heating elements on the extruder tube, are connected. To do this, take the lines of only ONE heating cartridge in your hand and lead them through the upper connection housing to the lower connection housing.



Step 24:

Make sure that a round bend remains at the top of the line. Then cut the two wires with a side cutter. Then strip the insulation from the leads 11mm. This silicone wire is quite difficult to strip. If you use wire strippers, you will be left with thin "strands" of insulation. Bend the strands of the line to the side, then these "threads" can be seen better and can be cut off.





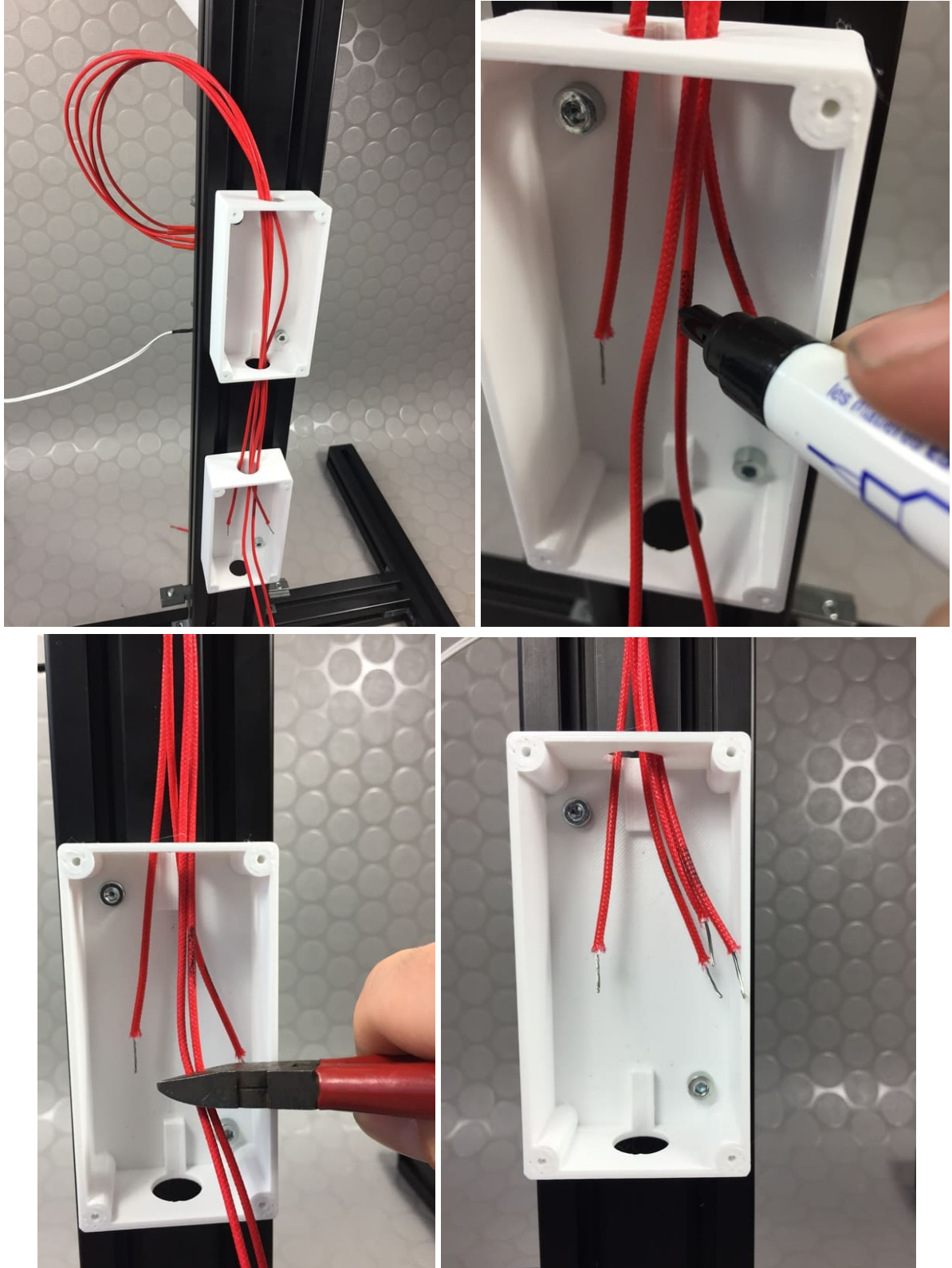
Step 25:

twist the strands with your fingers and mark one of the two wires with a marking pen or similar.



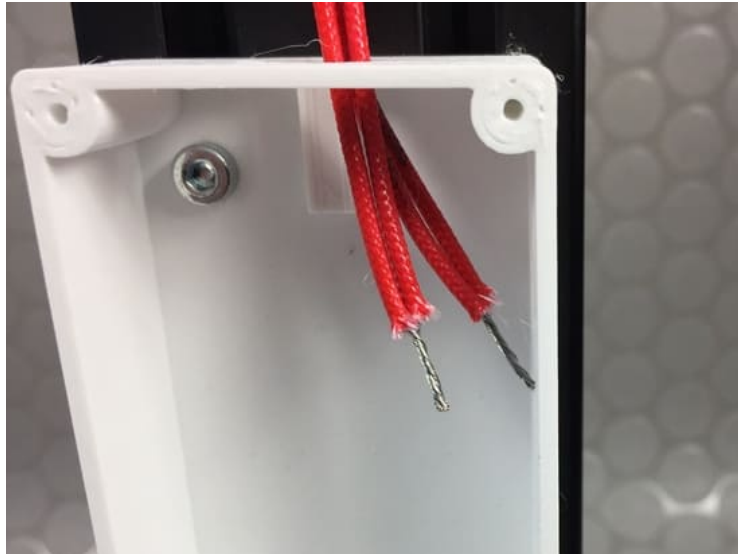
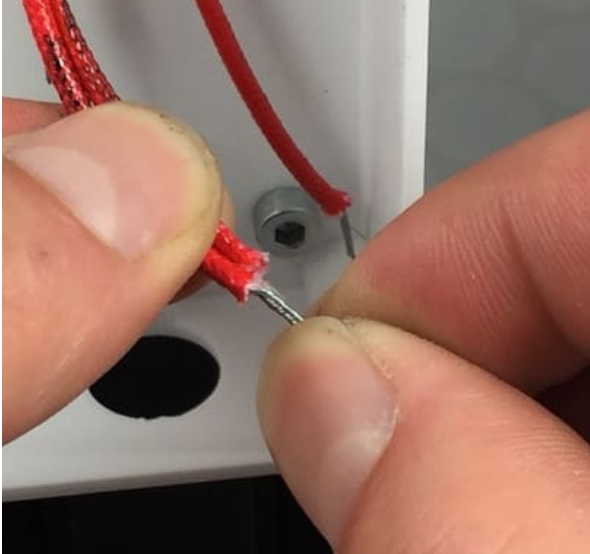
Step 26:

Feed the two leads of the other cartridge heater through the upper connector housing into the lower connector housing. MARK one of the two leads of this cartridge heater again with a marking pen, cut the leads and also insulate them 11mm.



Step 27:

The two lines which have been marked are twisted with the fingers. Then the two lines without marking are twisted with the fingers.



Step 28:

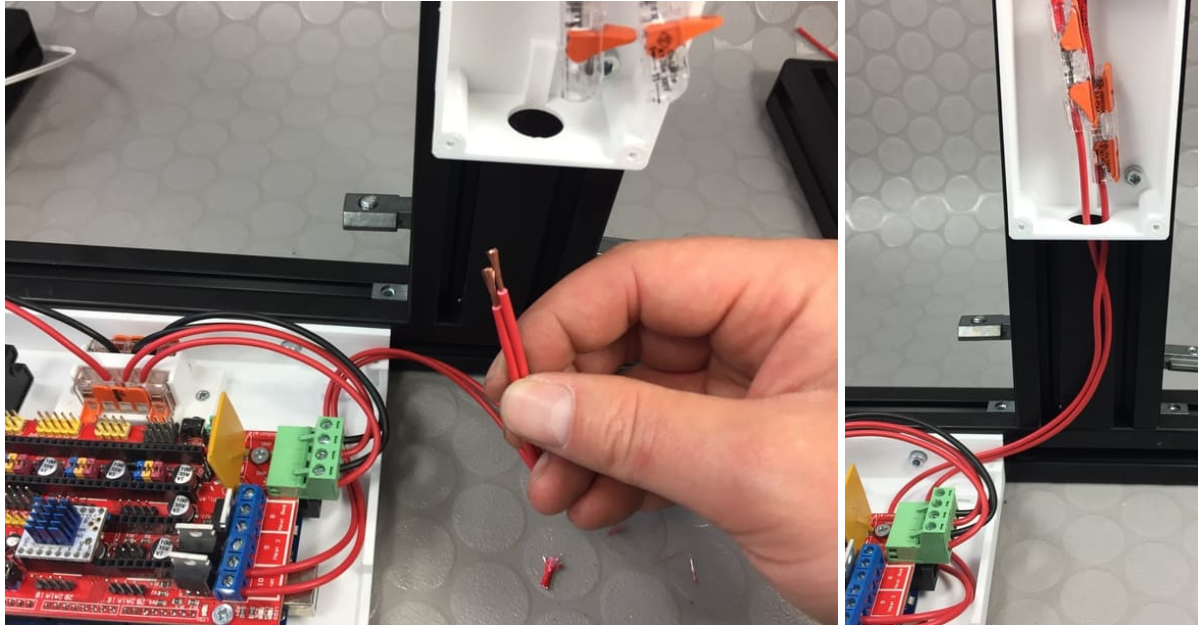
Remove from package 5: 2x Wago terminal 221-2411 1pin (EL08).

Open the orange levers of the terminals and insert a twisted pair of wires into each terminal and close the lever.



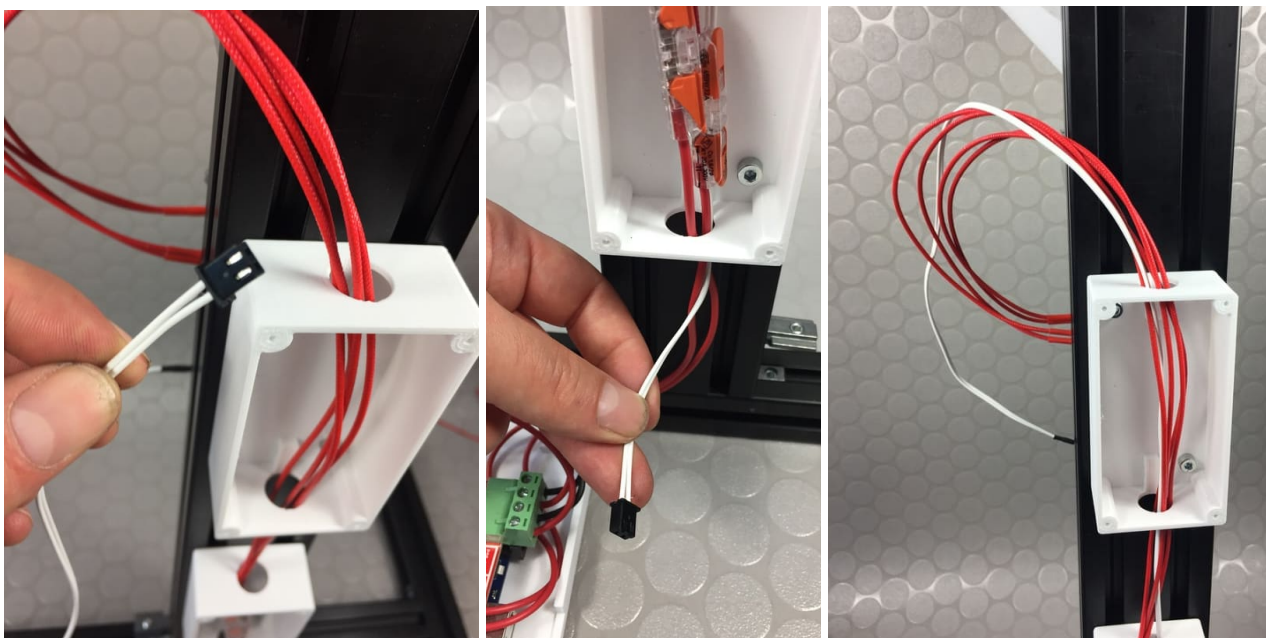
Step 29:

Lead the two 320mm long red wires, which were connected to the ramps, in a bend out of the control housing. Then lead the wires into the lower connection housing and connect them to the Wago terminals of the cartridge heater wires. The polarity does not matter.



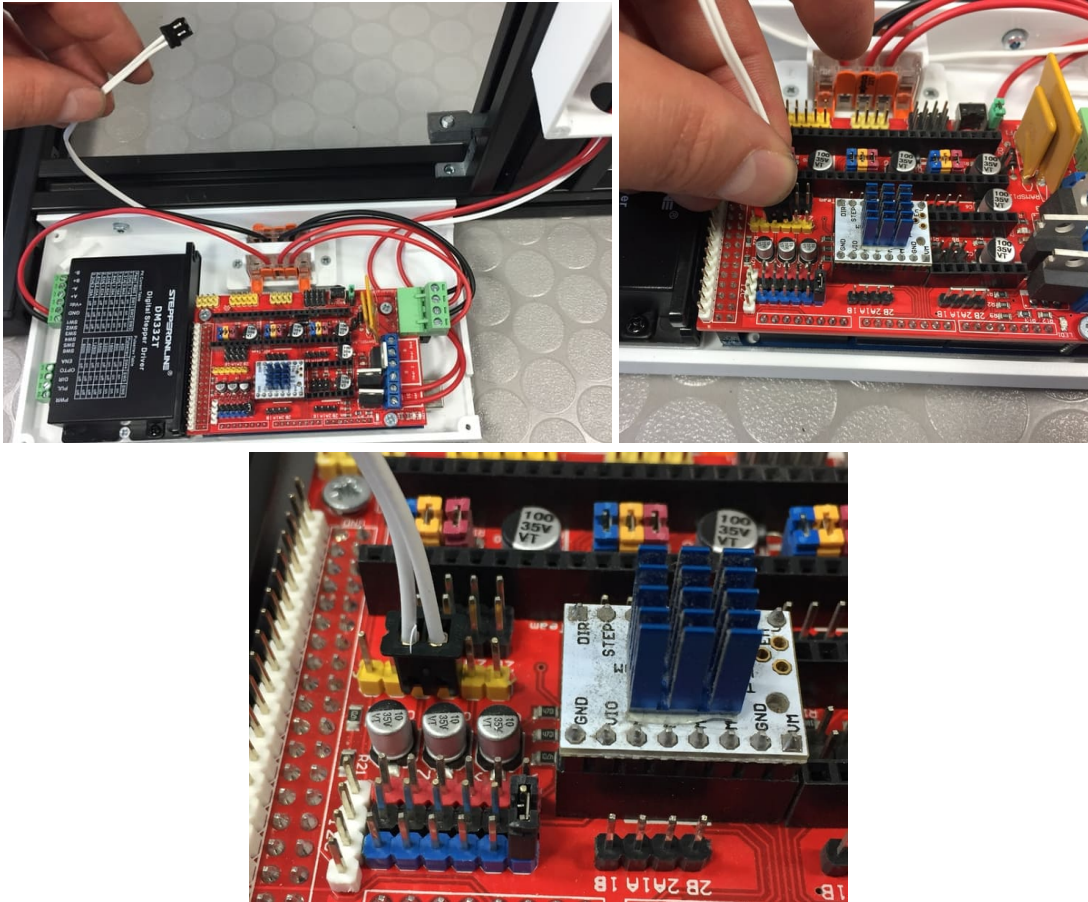
Step 30:

The connection line of the thermistor, which is installed in the heating element, is led through both connection housings. Make sure that it follows the curve of the two cartridge heater leads at the top.



Step 31:

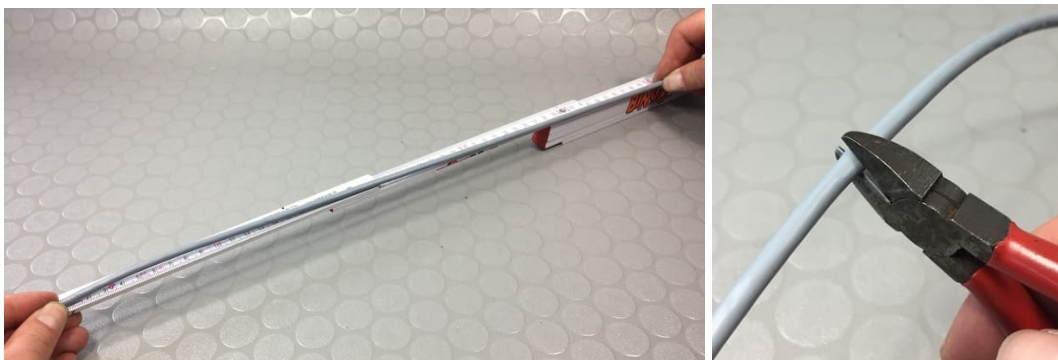
Guide the end with the plug into the control housing. See picture for cable path. Plug it into the slot shown in the picture. There are 6 pins in a row. Plug into the middle two pins. The polarity does not matter. More information about the pin assignment can be found in the electronic diagram in the documentation.

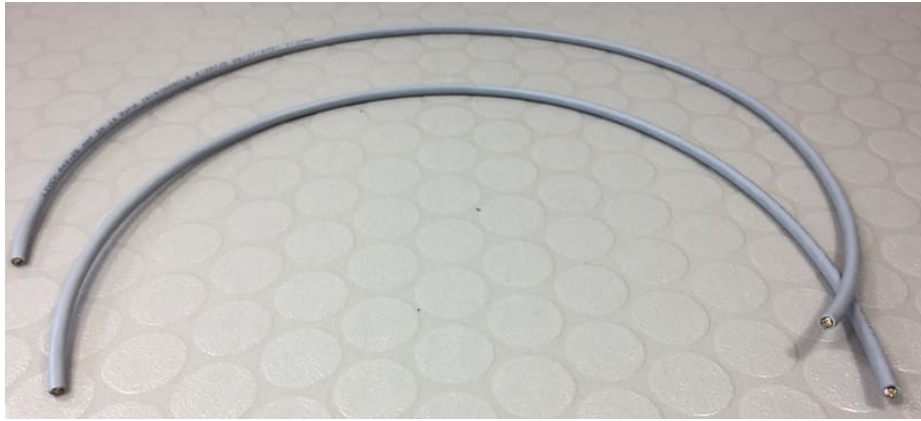


Step 32:

Remove from package 5: Control cable LiYCY 4x0.25

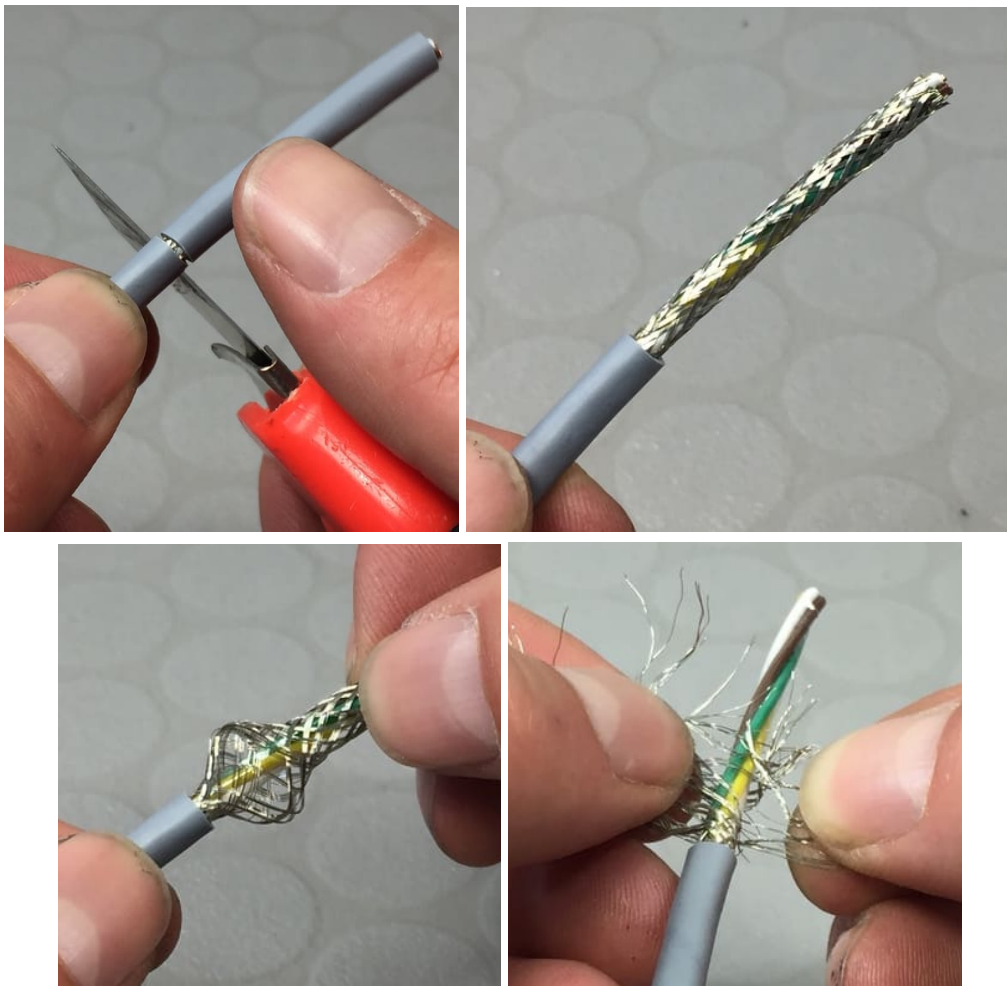
Measure a 500mm long piece and cut the control cable. This creates two pieces, each 500 and 600mm long.

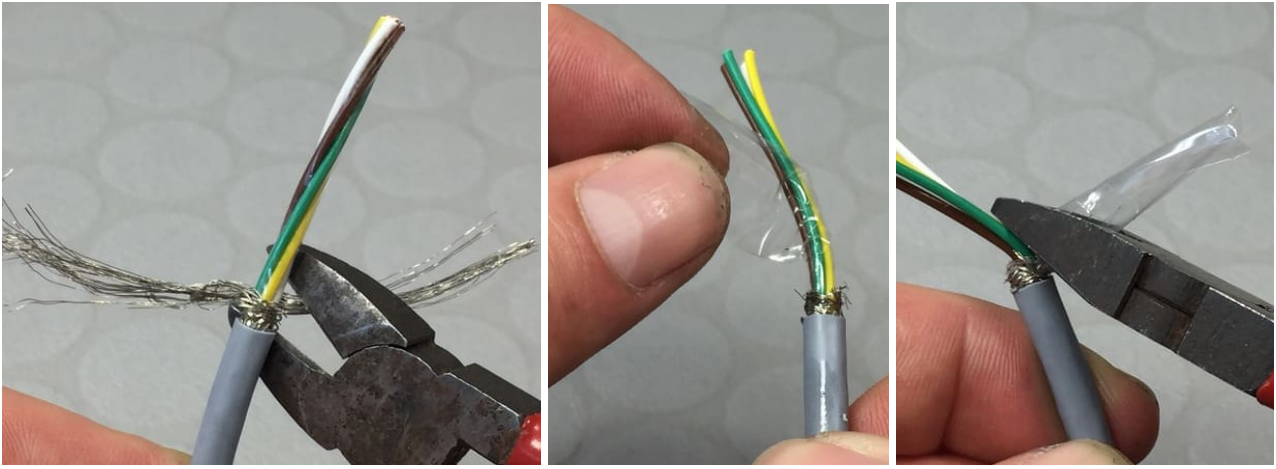




Step 33:

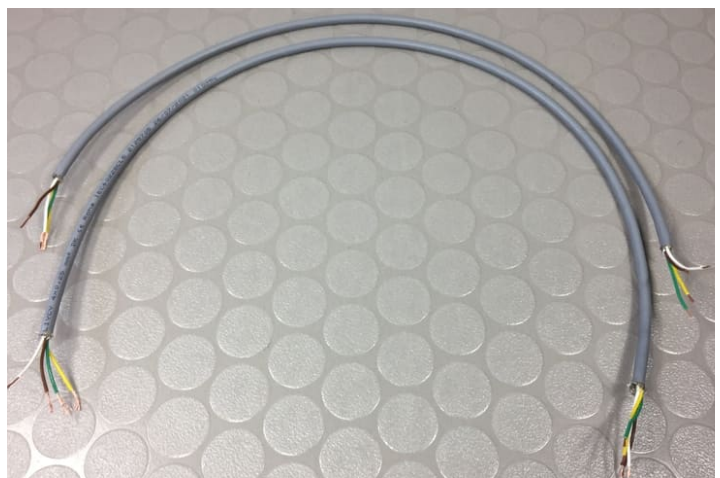
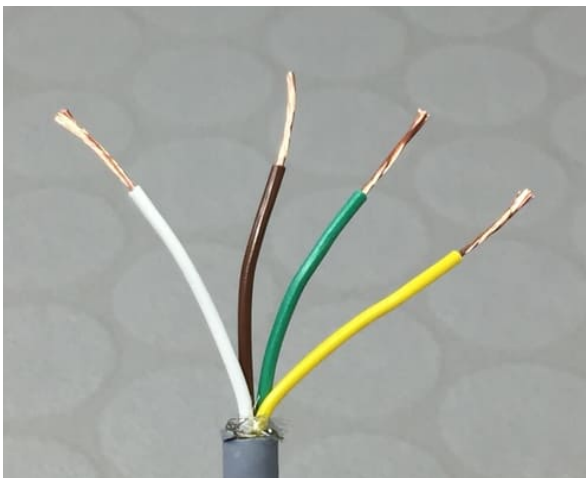
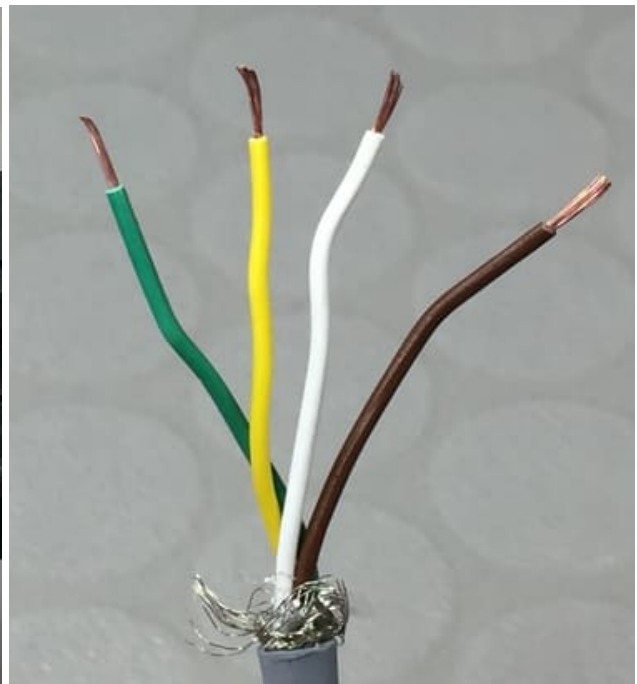
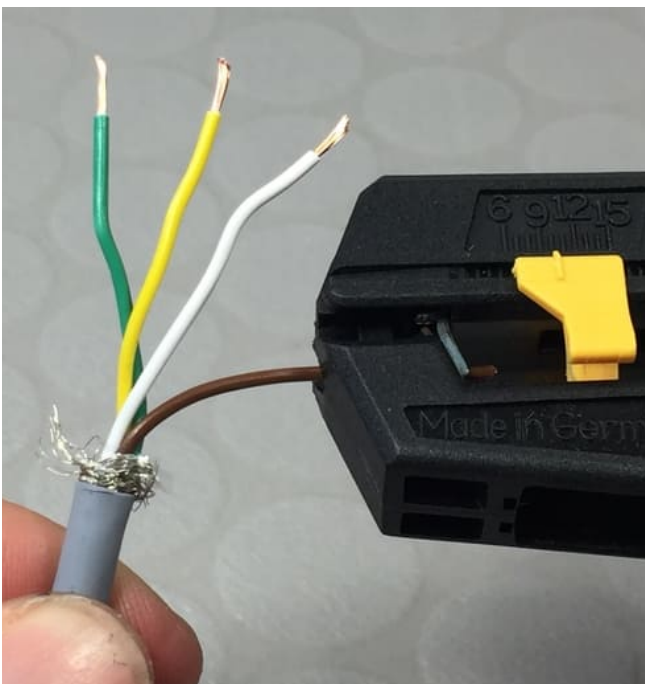
The two control cables are stripped at all ends to a length of approx. 35mm. To do this, first cut the sheath with a knife all around and pull it off. Then a metal braiding can be seen (shielding). This braiding is removed. To do this, you can push it together a little with your fingers. This loosens it up a bit. Then you can pull it apart with your fingers and cut it off. Then the wrapped plastic foil is removed. Now the individual cores are exposed. Insulate all ends of the two control wires like this.





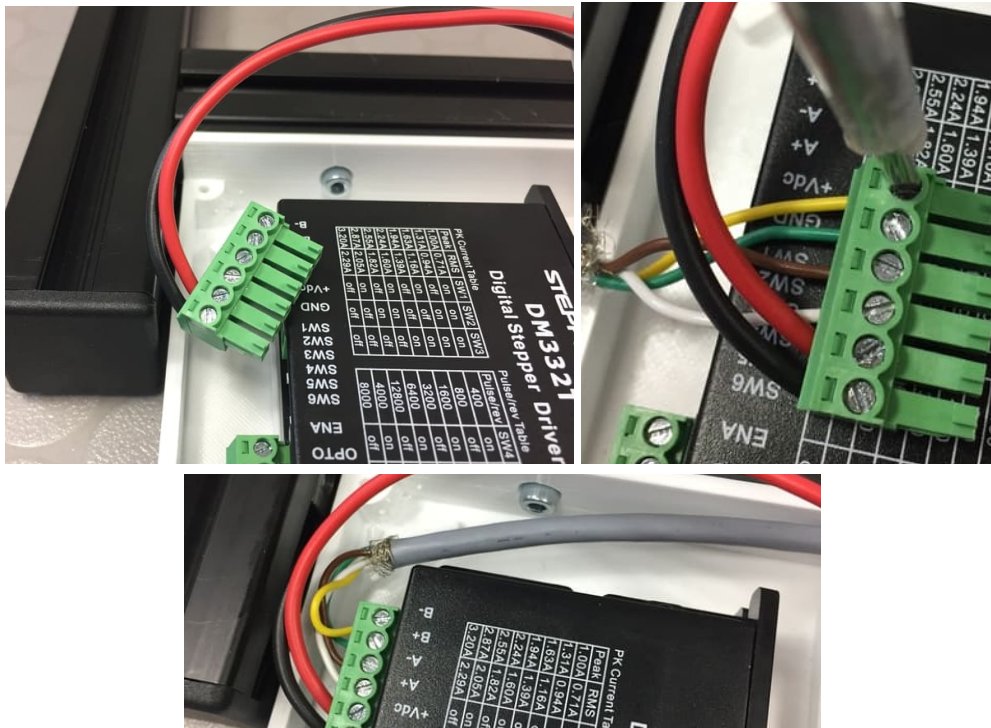
Step 34:

At one end of the 500mm long control line, strip 5mm of insulation from each individual wire. At the other end of this control line, strip 11mm of insulation from each individual wire. The same is done on the 600mm long control cable.



Step 35:

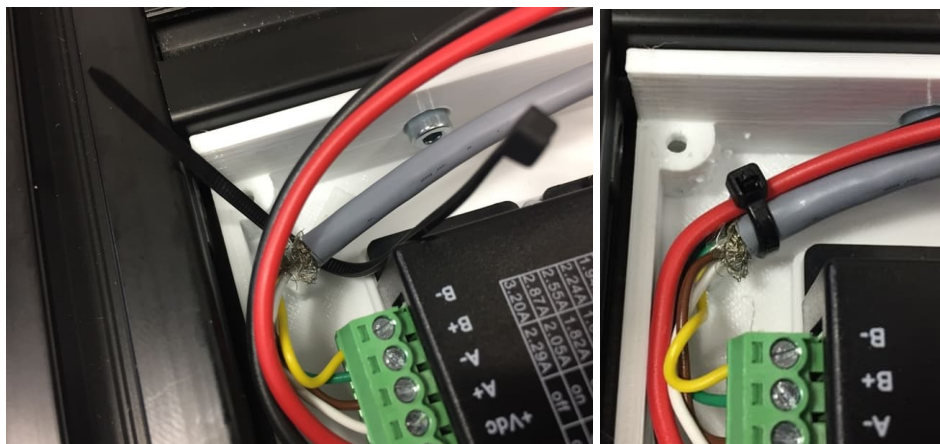
Disconnect the green terminal on the stepper motor driver once again. Take the 600mm long control cable with the side of the 5mm long stripped wires to hand. Connect them as shown. It is essential to follow the color sequence. For more details on the pin assignment, refer to the electronics diagram in the documentation. Then the green terminal can be plugged back into the stepper motor driver.



Step 36:

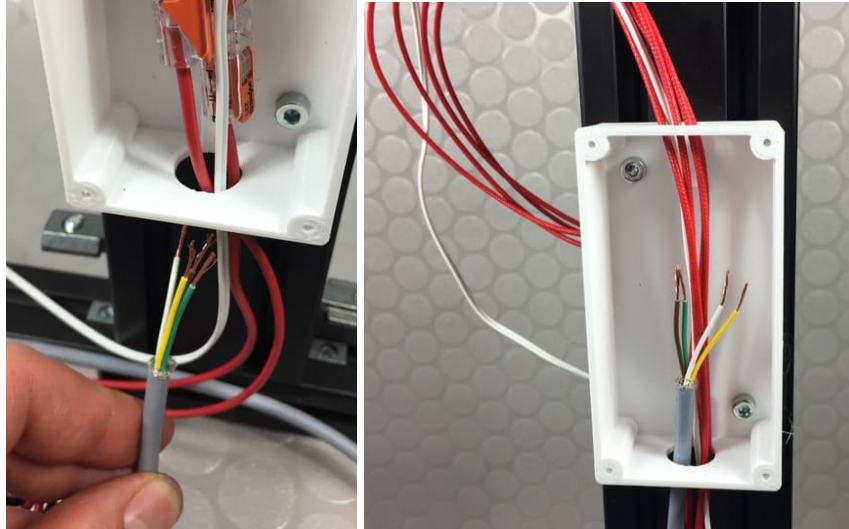
Remove from package 2: 1x cable tie (SP12).

Guide the cable tie through the eyelet provided for this purpose under the cables, see illustration. Tighten the cable tie and cut off the protruding end.



Step 37:

Lead the control line through the control housing, through the lower connection housing and into the upper connection housing.

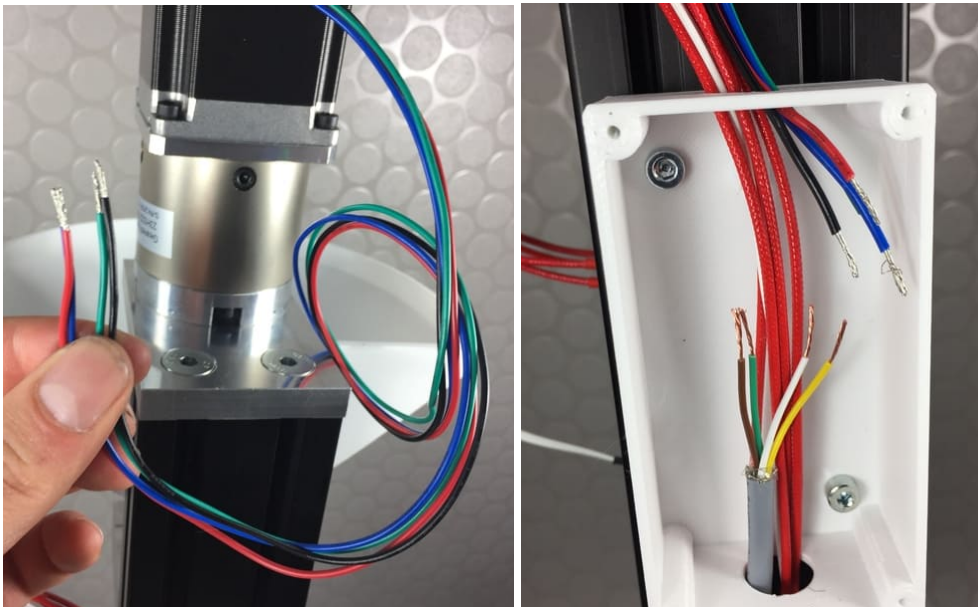


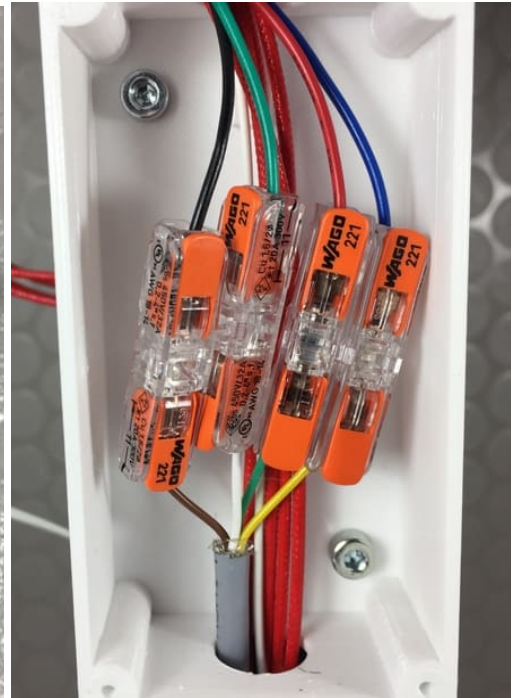
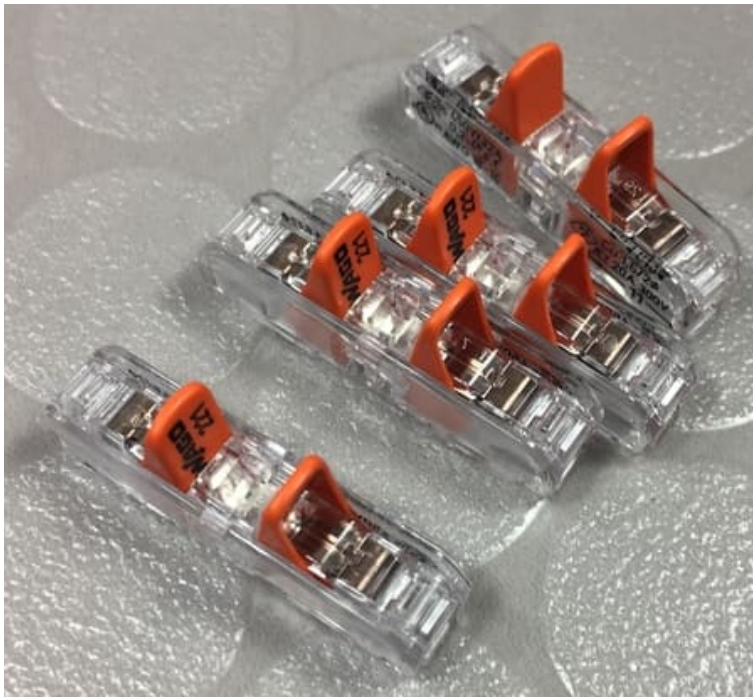
Step 38:

The connecting cable of the stepper motor of the extruder unit is connected to the control cable. Use the Wago terminals again for this purpose. Connect:

- Black lead from stepper motor with brown control lead
- Green line from stepper motor with white control line
- Red line from stepper motor with green control line
- Blue line from stepper motor with yellow control line

For more details on line colors, refer to the electronics diagram in the documentation.



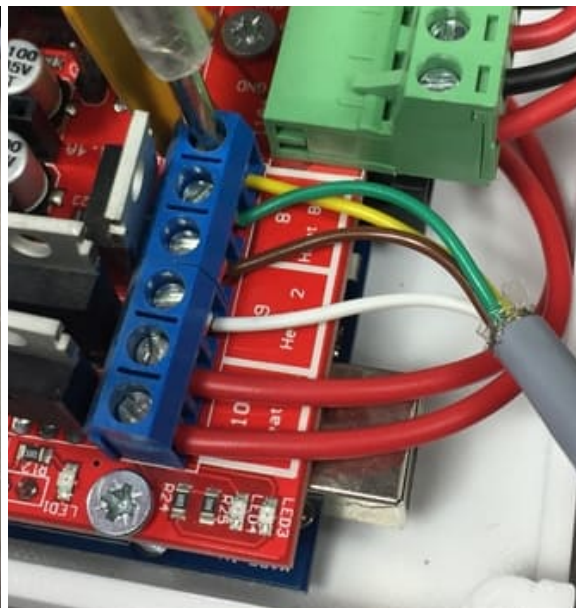
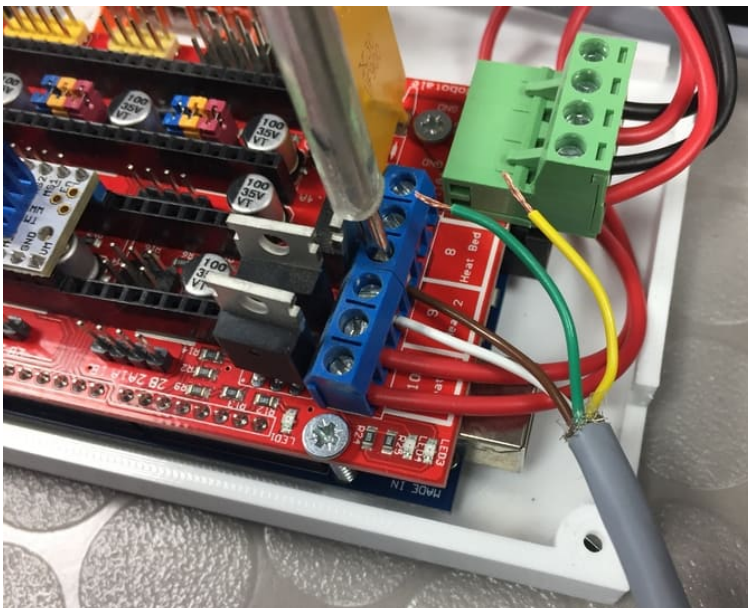


Step 39:

Take the 500mm long control cable with the side of the 5mm long stripped wires to hand. Connect it to the Ramps Board as shown. It is essential to follow the color sequence:

- Connection D9 left: white
- Connection D9 right: brown
- Connection D8 left: green
- Connector D8 right: yellow

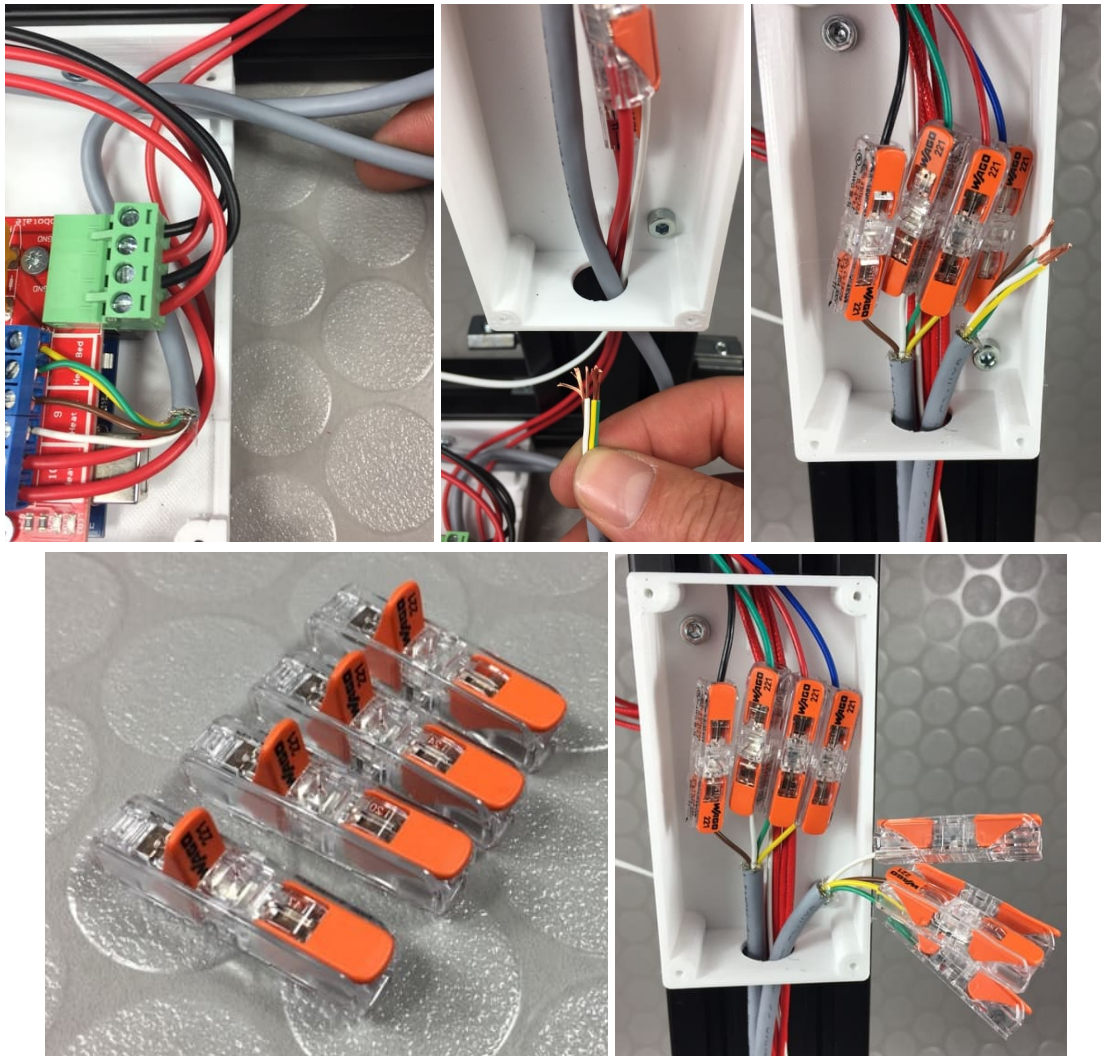
For more details on the pin assignment, please refer to the electronic diagram in the documentation.



Step 40:

Remove from package 5: 4x Wago terminal 221-2411 1pol

Then lead the control line in a bend out of the control housing and lead it through the lower connection housing into the upper connection housing. Then clamp one Wago terminal each onto the wires of the control line.



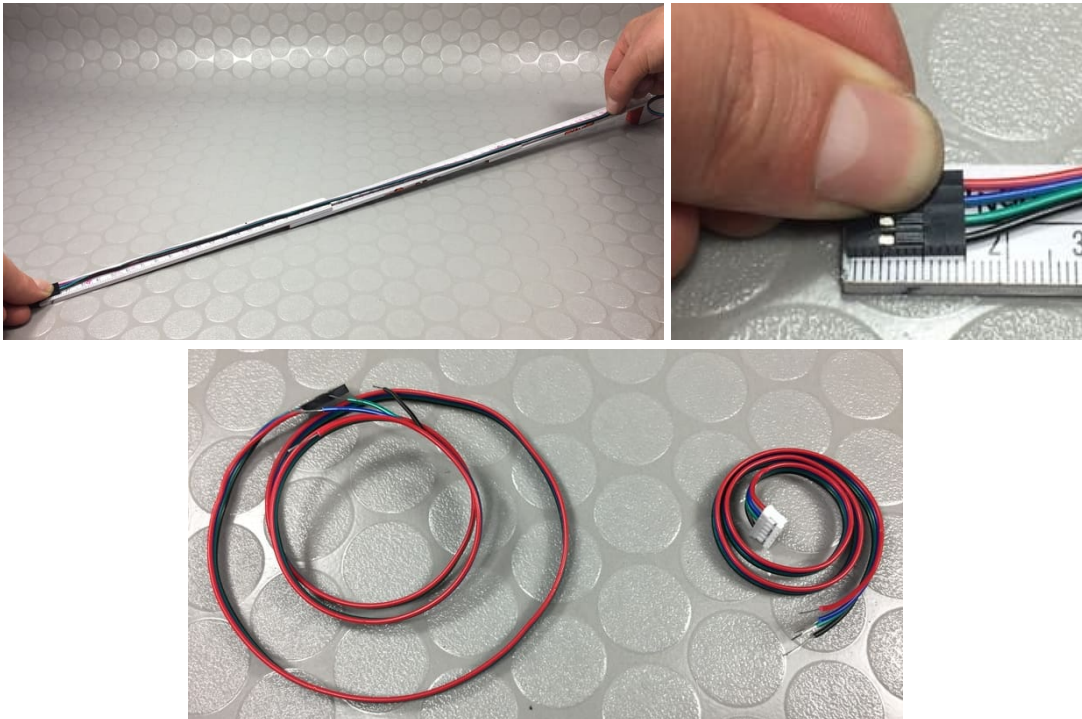
Step 41:

Remove from package 0: 1x connection cable of Nema 17 stepper motors (MO02)



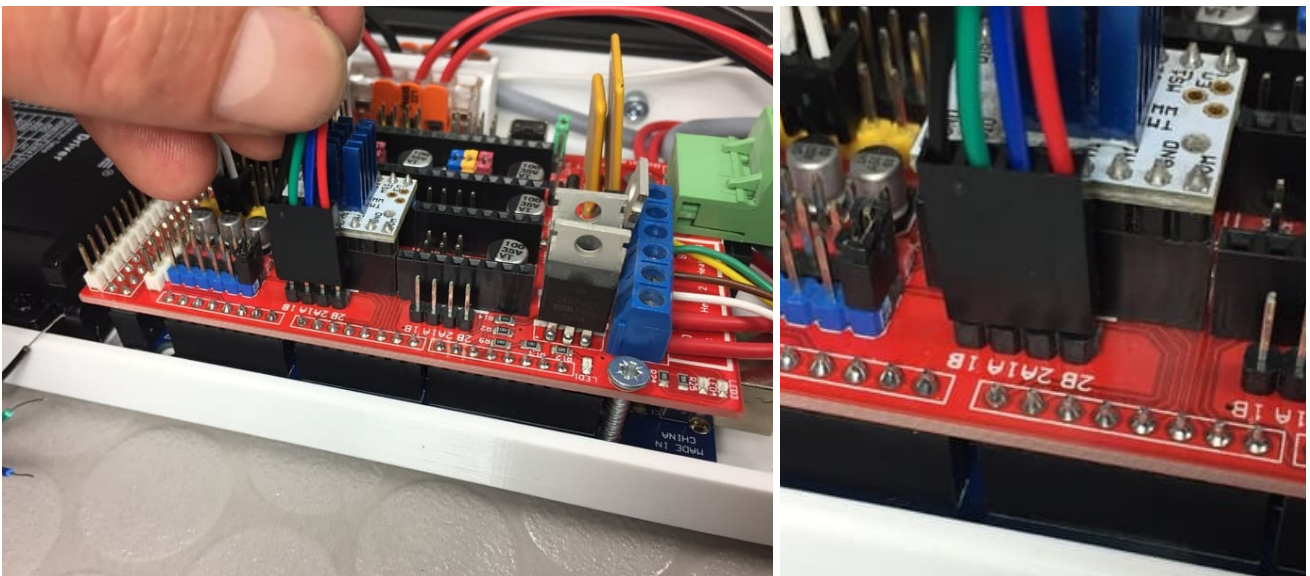
Step 42:

Remove the cable tie that holds the rolled cable together and unroll the cable. Measure 530mm from the end of the cable with the black, flat connector and cut the cable. This way you will have two wires. One with black plug, one with white plug. Take the cut end of both cables and pull the individual wires apart. Then insulate the wires 11mm each.



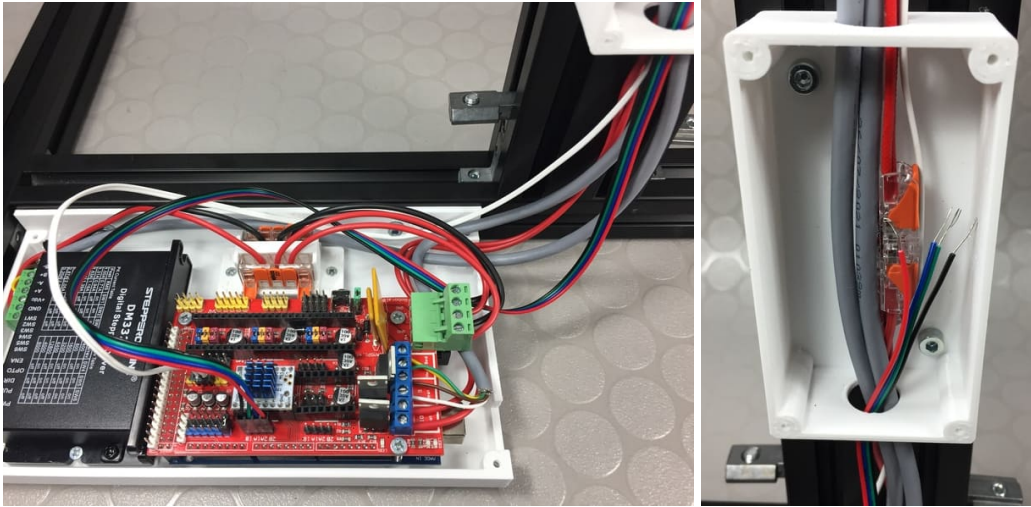
Step 43:

Take the cable with the black, flat plug to hand. Plug it onto the Ramps Board as shown. The red lead points to the right.



Step 44:

Lead the cable in an arc through the control housing, up to the lower connection housing.



Step 45:

Remove from package 0: 1x connection cable of Nema 17 stepper motors (MO02)



Step 46:

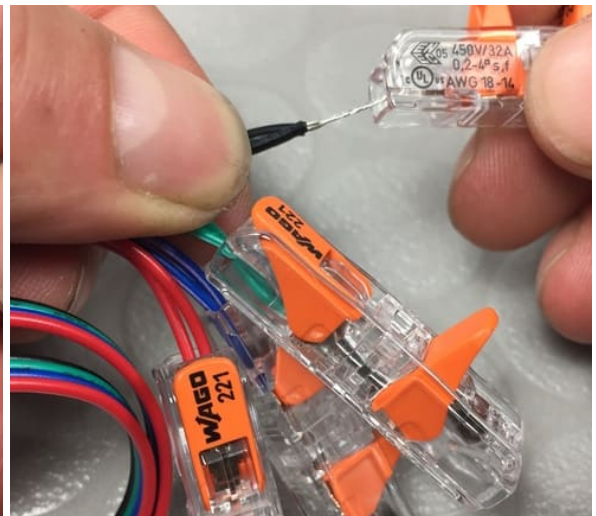
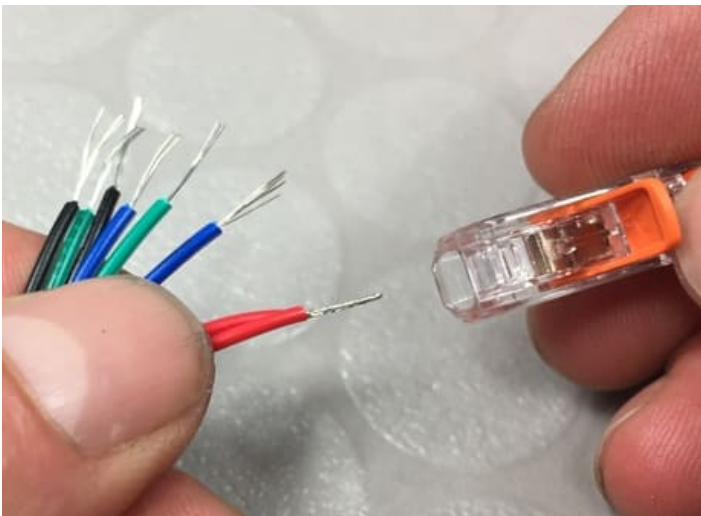
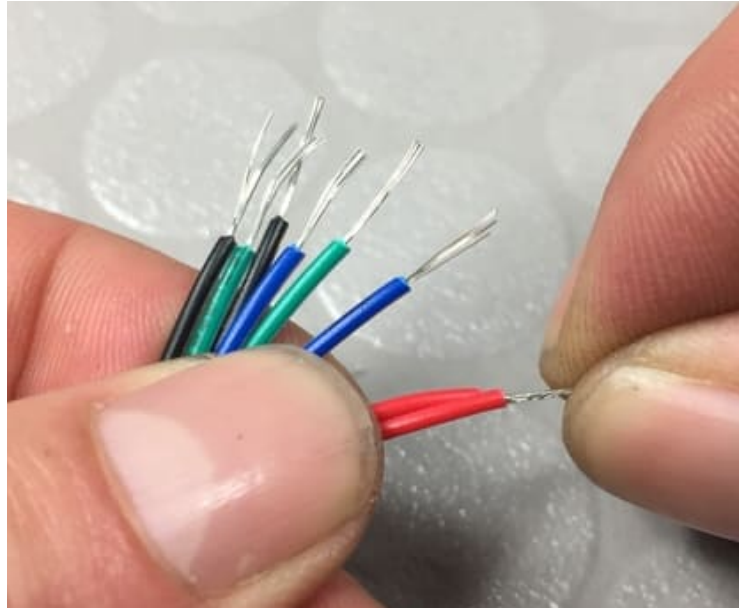
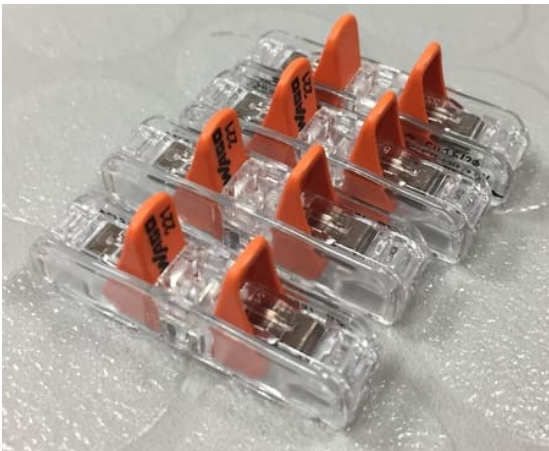
Remove the cable tie that holds the rolled cable together and unroll the cable. Measure 580mm from the end of the cable with the **white** plug and cut the cable. The end of the cable with the black plug is no longer needed. Take the cut end of the cable with the white plug and pull the individual wires apart. Then strip 11mm of insulation from each of the wires.



Step 47:

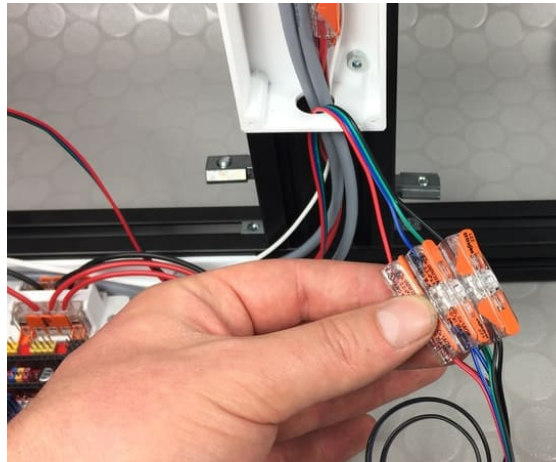
Take out of package 5: 4x Wago terminal 221-2411 1pol

Take the two wires with the white connector. One wire is 580mm long, the other approx. 340mm. Take the ends with the stripped wires in your hand and lay the colored wires of both cables on top of each other so that you can twist two wires of the same color together, see picture. When you have twisted two wires of the same color, clamp the strands into a Wago clamp. To do this, open and close the small orange levers on the clamp. Then continue with the next pair of wires of the same color until all four pairs of wires are connected.



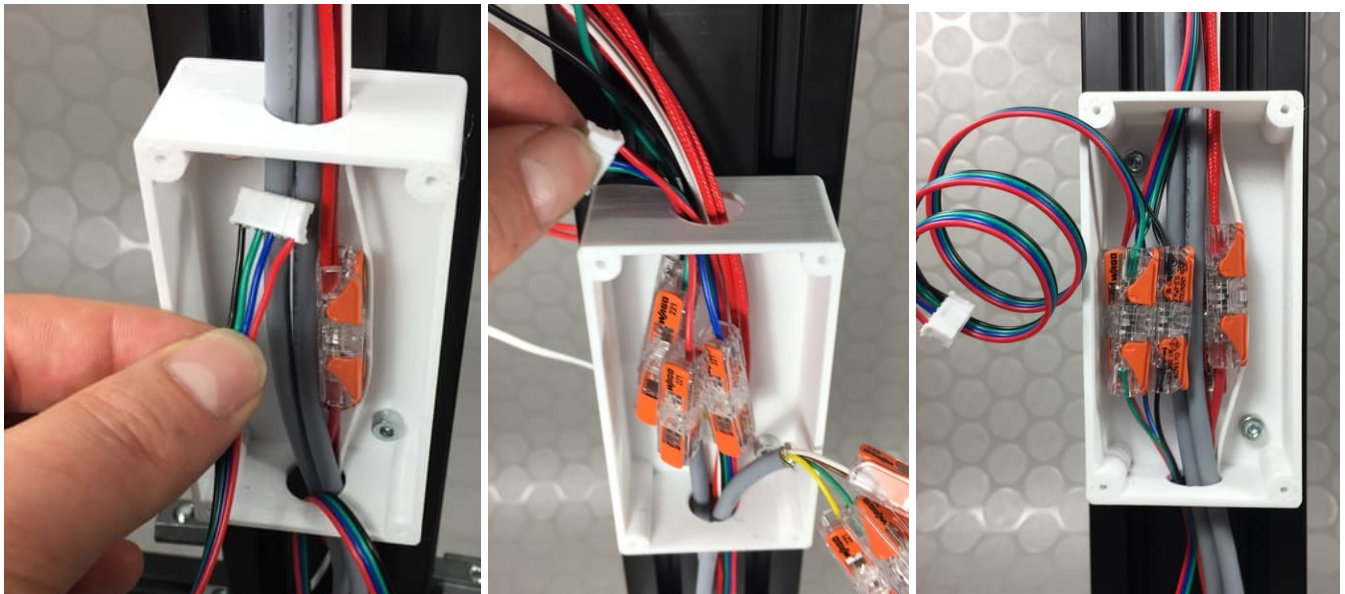
Step 48:

Connect the Wago terminals to the open wire in the lower connection housing. Connect the same color with each other.



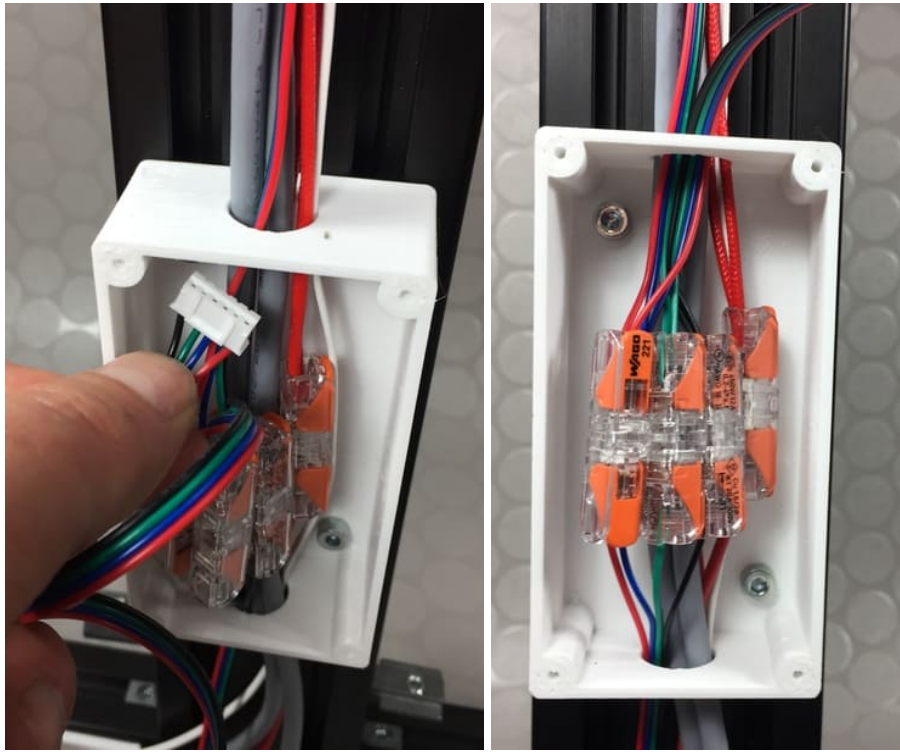
Step 49:

The 580 mm long cable with the white plug is now led through the openings of the lower and upper connection housing all the way to the top. Pull the cable out until the Wago terminals in the lower connection housing stand upright.



Step 50:

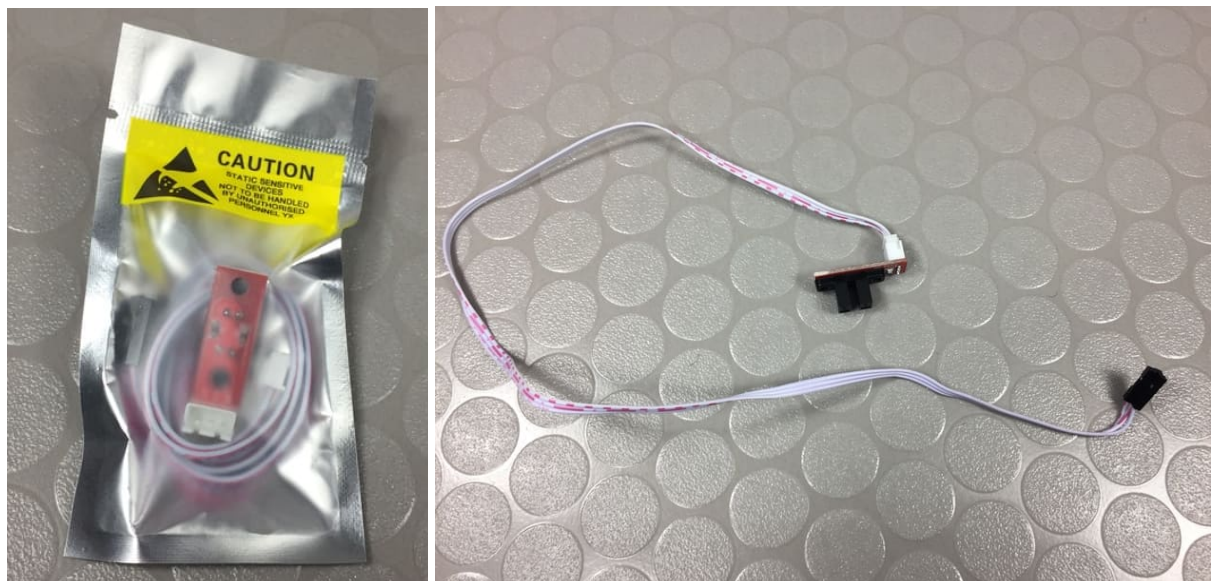
The 340 mm long cable with the white plug is now fed through the openings of the lower connection housing. Pull the cable out completely.



Step 51:

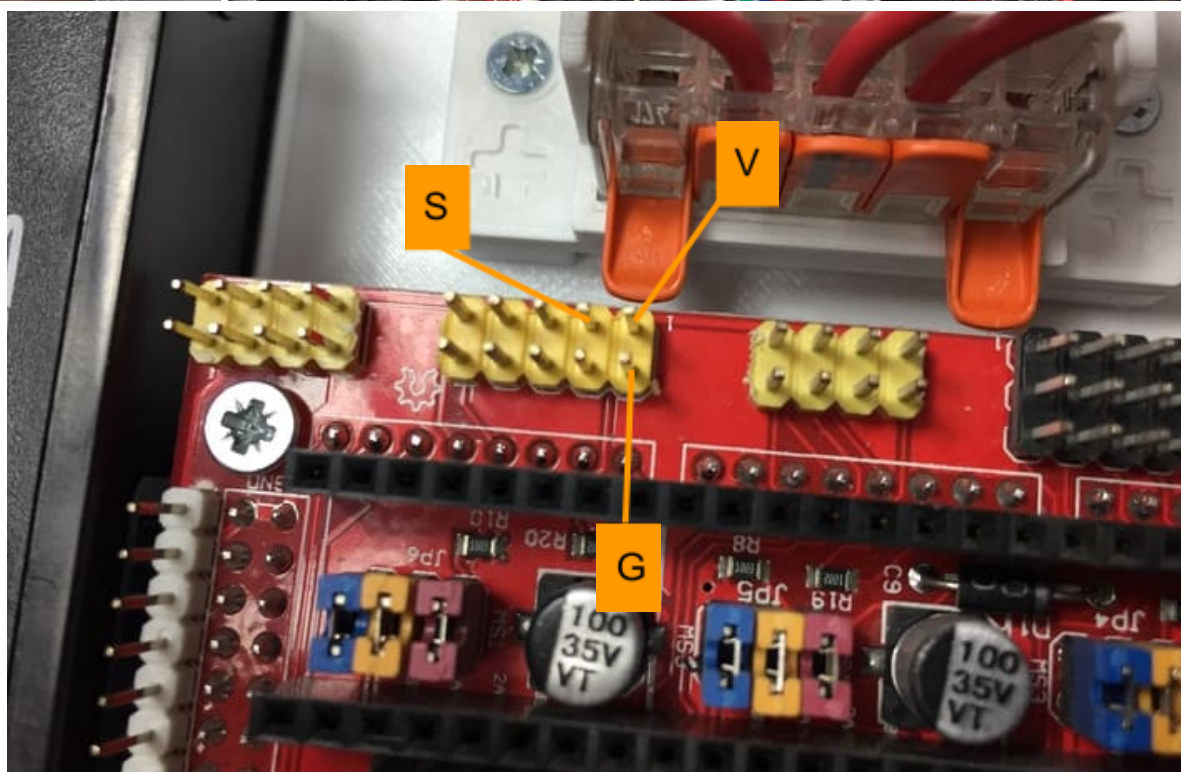
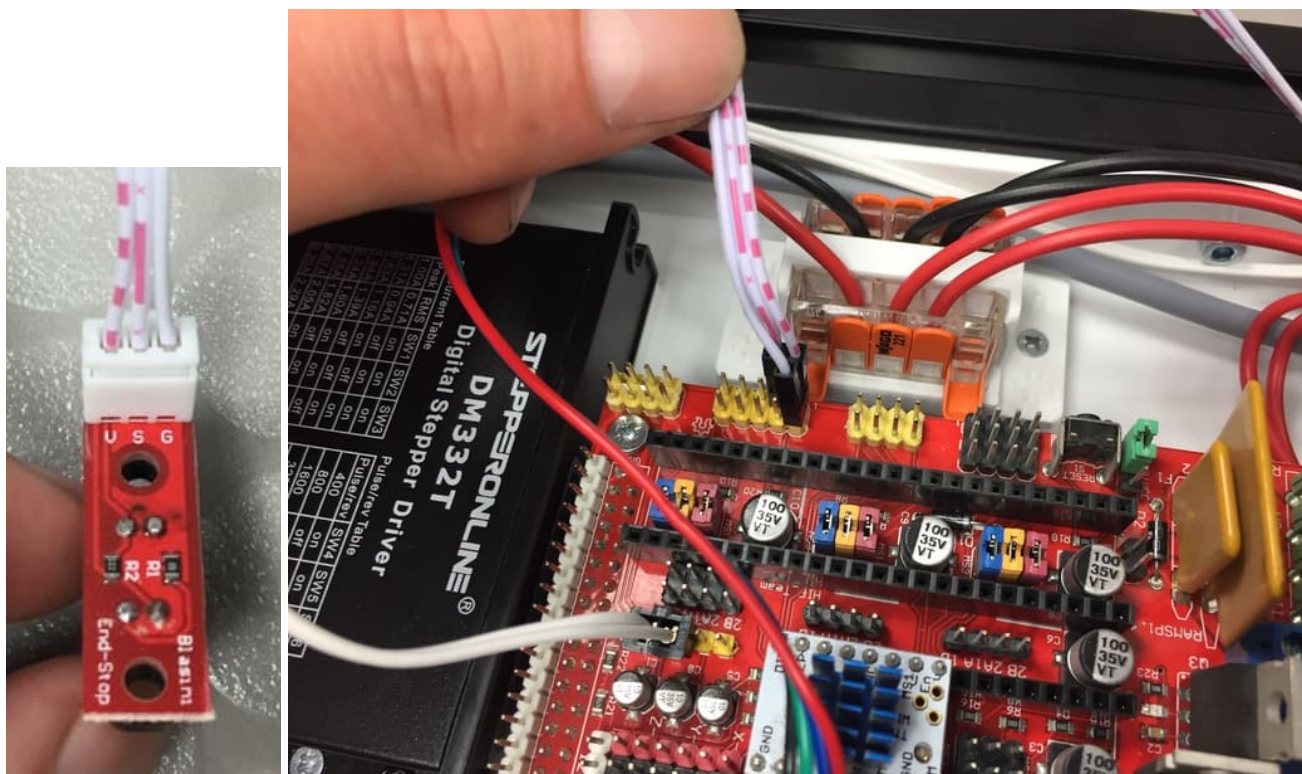
Remove from package 5: 1x Optical sensor with cable (EL05).

Plug the connection cable to the sensor. The connector is coded by pins so that it can only be plugged in one orientation.



Step 52:

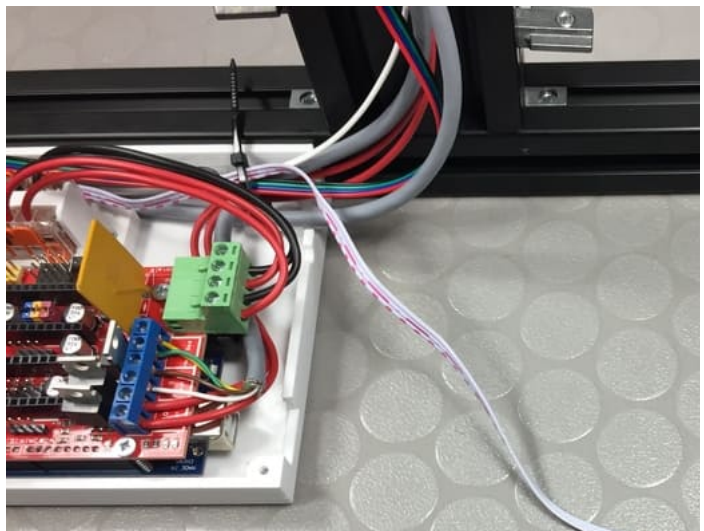
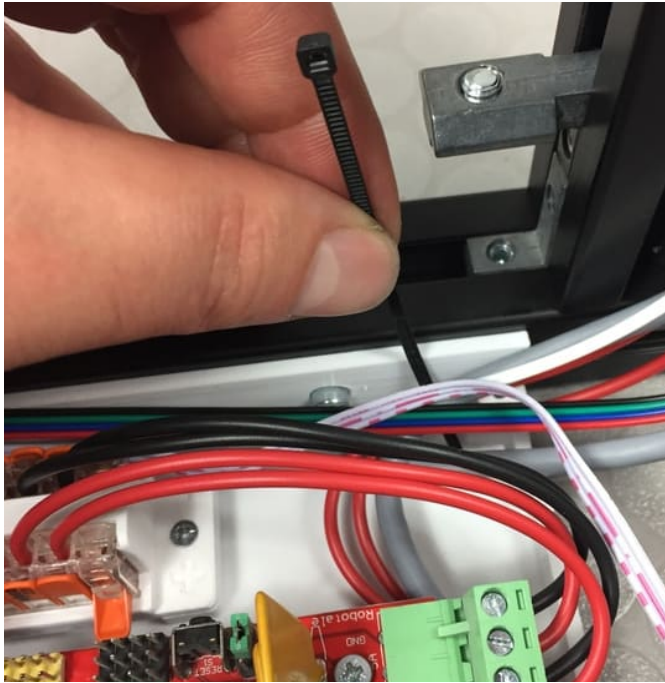
Make a note of which letter belongs to which line. The lines can be distinguished by dots and dashes. The other end with the black plugs is now plugged onto the Ramps Board. See the picture for the orientation of the individual connectors. More information about the pin assignment can be found in the electronic diagram in the documentation.



Step 53:

Remove from package 2: 1x cable tie (SP12).

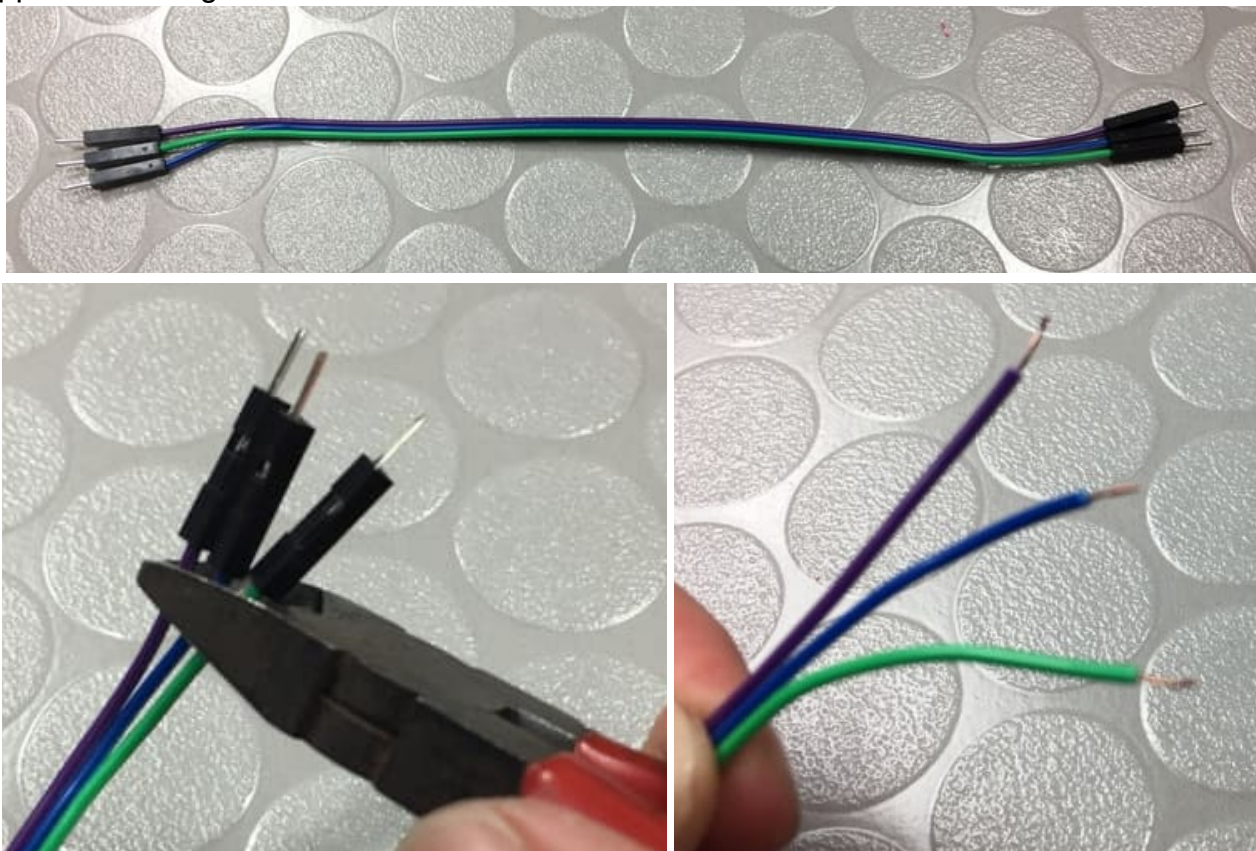
The cable of the sensor is led out to the side of the control unit housing. Guide a cable tie through the eyelet provided for this purpose under the cables on the right edge of the control unit housing, see figure. Do not tighten the cable tie yet.



Step 54:

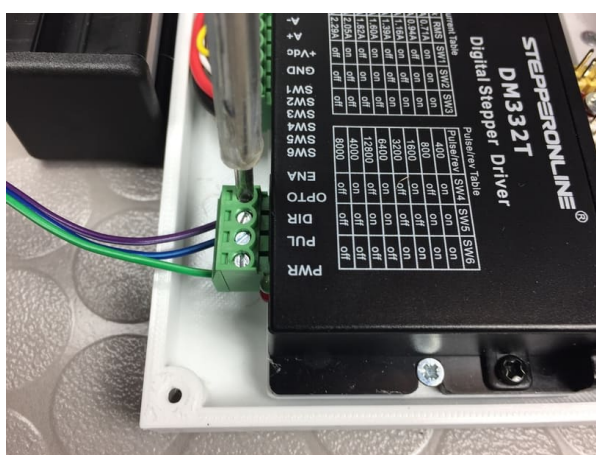
Remove from package 5: 3x Dupont connecting cable (EL10).

The connectors on one side of the 3 wires are cut off. The individual wires are pulled apart and stripped 5mm long.



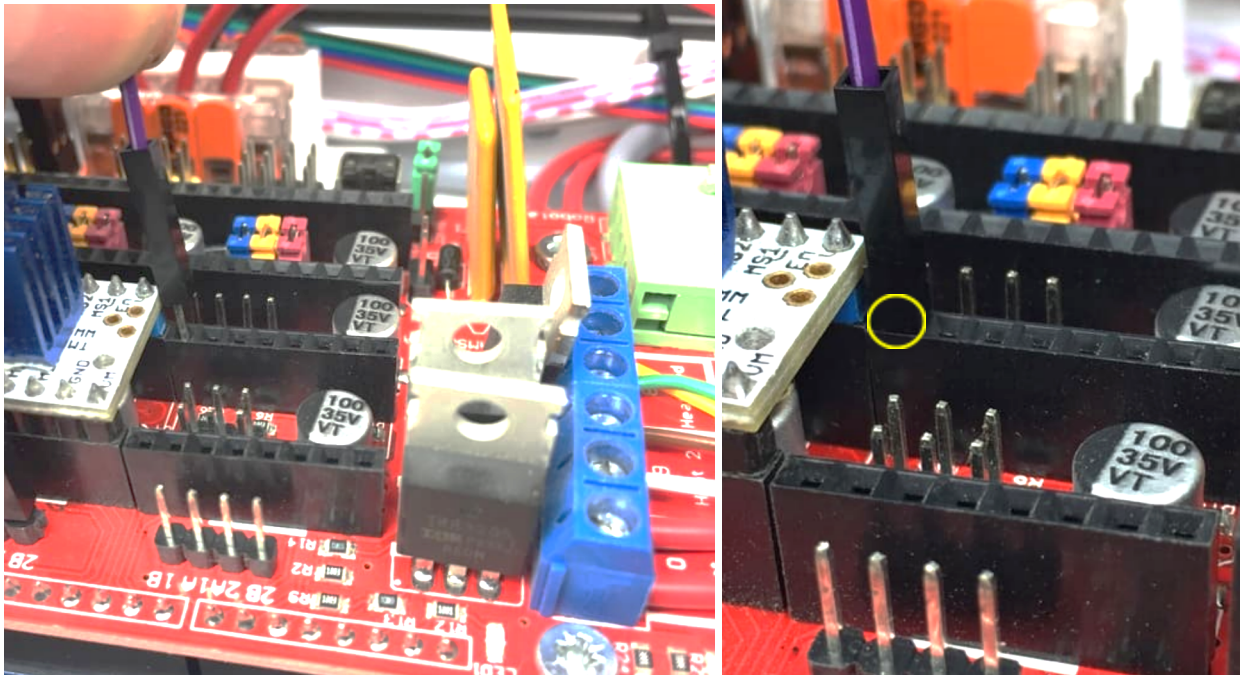
Step 55:

The strands of the stripped wires are twisted and connected to the stepper motor driver. The wire color can be different, which is not important. Connect one wire at "ENA", one at "OPTO" and one at "PUL". The connection of "DIR" remains free. If you should use another stepper motor driver than the Dm332T, this connection is different.



Step 56:

The line, which you have connected at "ENA", has a plug at the other end, which is now connected to the Ramps Board. On the connector strip shown, the cable is plugged into the first slot on the far left, see picture. It is recommended to secure the connector with a drop of glue. (On the plastic parts). You can find more details about the pin assignment in the electronic plan in the documentation.



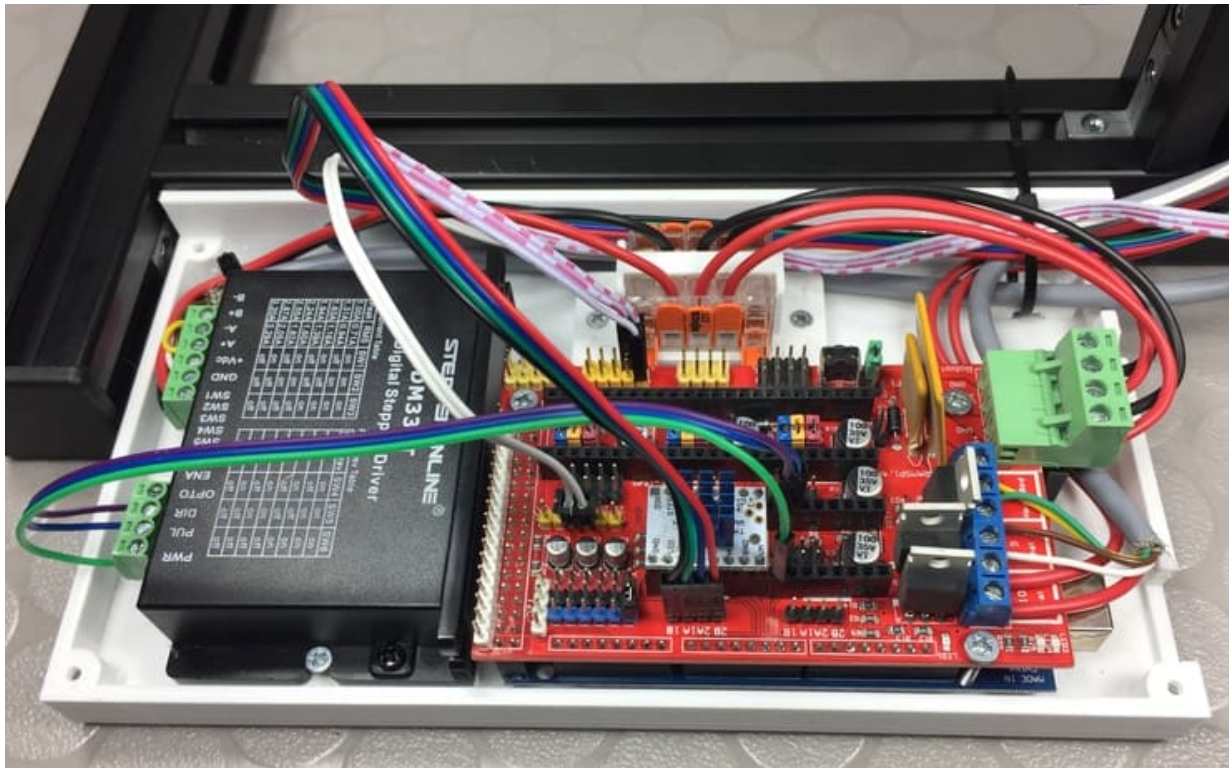
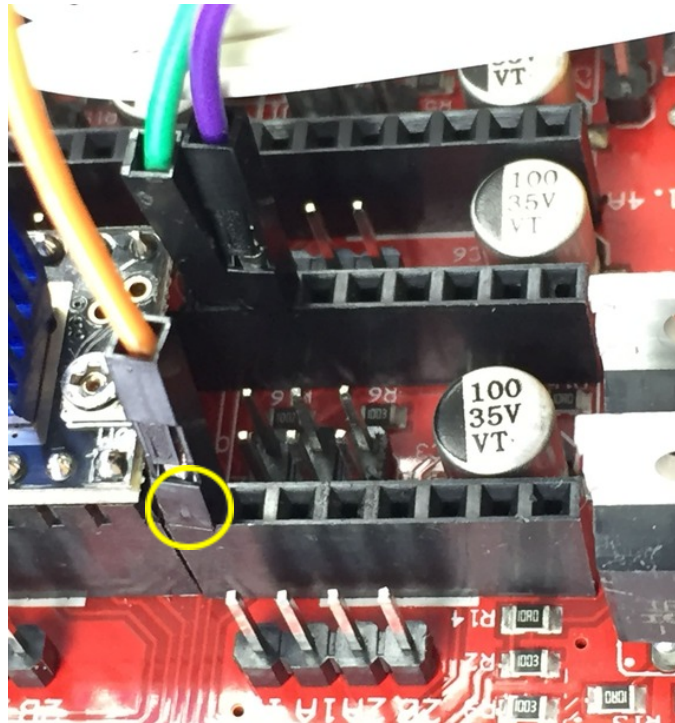
Step 57:

Now the line, which you have connected at "OPTO", is plugged. On the connector strip shown, the line is plugged into the second from the left, see picture. It is recommended to secure the plug with a drop of glue. (On the plastic parts). For more details on the pin assignment, refer to the electronics diagram in the documentation.



Step 58:

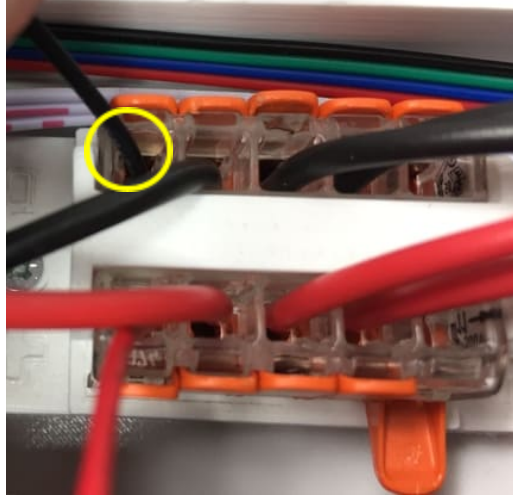
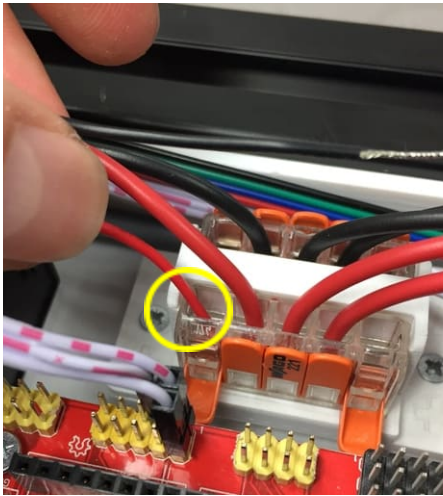
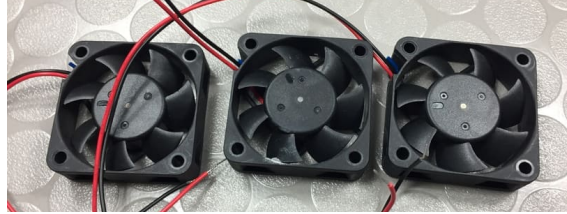
The line that you have connected at "PUL" has a plug at the other end, which is now connected to the Ramps Board. On the connector strip shown, the cable is plugged into the first slot on the far left, see picture. It is recommended to secure the connector with a drop of glue. (On the plastic parts). You can find more details about the pin assignment in the electronic plan in the documentation.



Step 59:

Remove from package 5: 3x fans 50x50x15 (EL13)

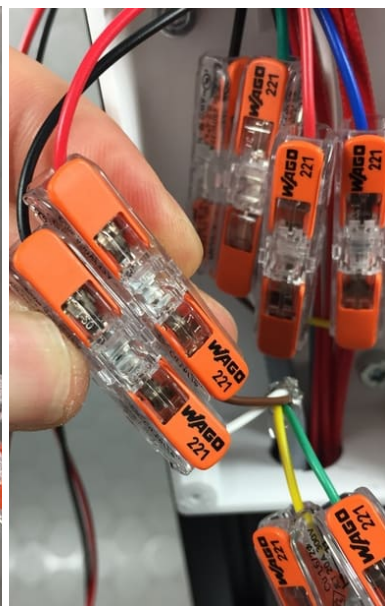
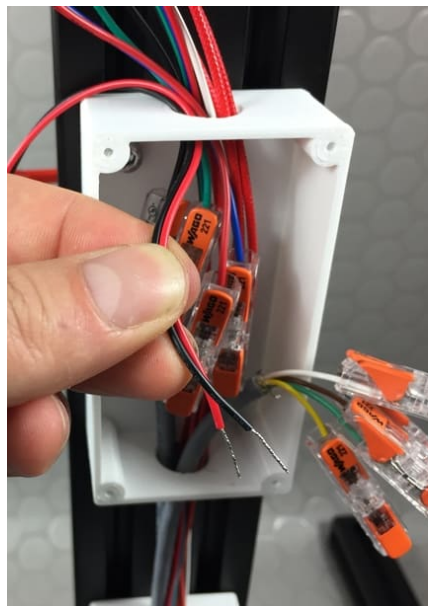
One of the fans is connected to the Wago terminal in the control box. See picture.



Step 60:

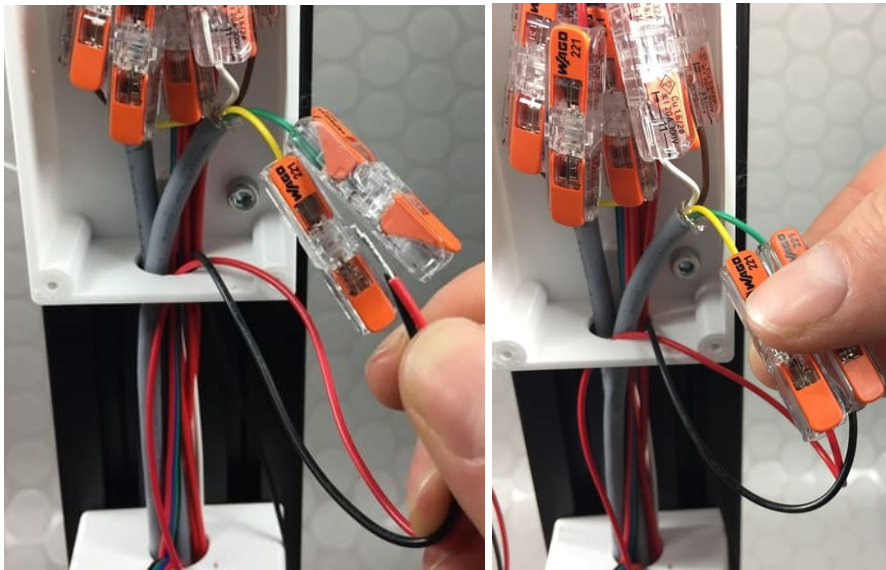
The second fan is led into the upper connection housing from above. The cables are connected to the prepared Wago terminals:

- Red wire from fan to brown control wire.
- Black wire from fan to white control wire.



Step 61:

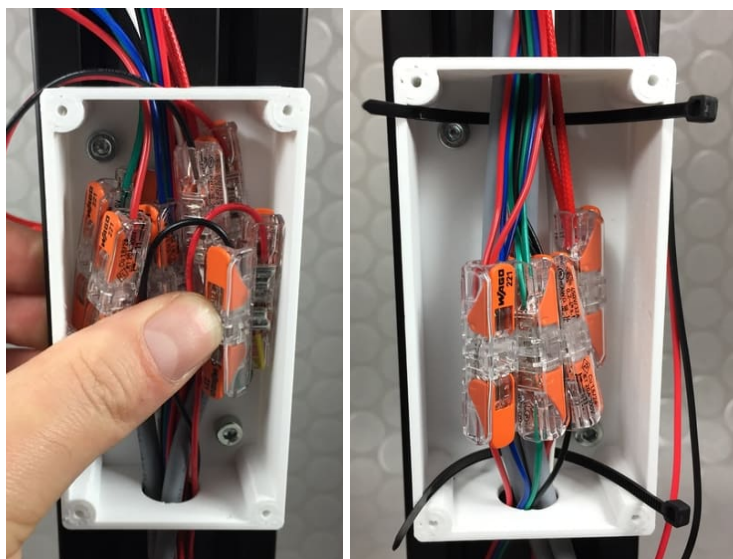
- The third fan is led from below into the upper connection housing. The wires are connected to the prepared Wago terminals:
- Red wire from the fan to the yellow control wire.
- Black wire from the fan to the green control wire.

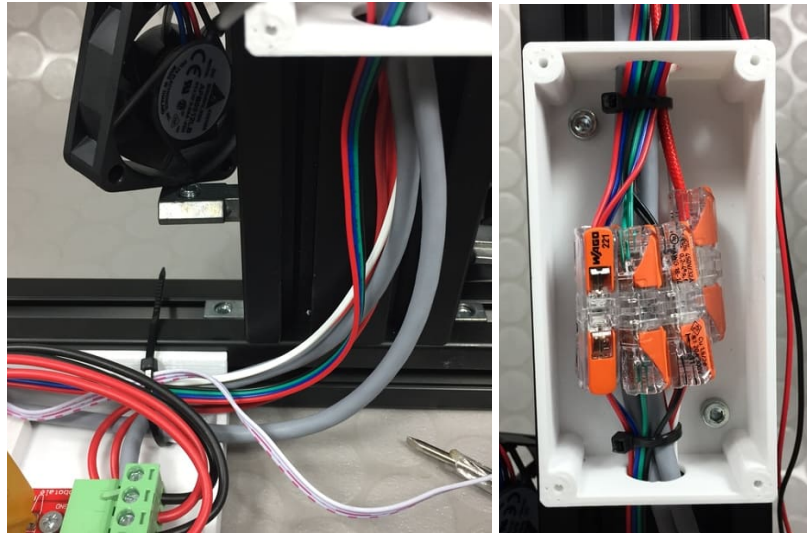


Step 62:

Take out of package 2: 4x cable ties (SP11).

Arrange the Wago terminals in the upper and lower connection housing. Then insert one cable tie into each of the eyelets provided under the leads. See picture. Then arrange the cables. Make sure that the leads from the cartridge heaters and the thermistor run in an arc above the upper connector housing. The leads under the lower connection housing should also be in a neat arc. Then tighten the cable ties and cut off the protruding end. This is done in both connection housings.





Step 63:

3D print: 2x connection housing cover (EL19)

Remove from package 1: 8x wood screw 2.5x12 (SC01)

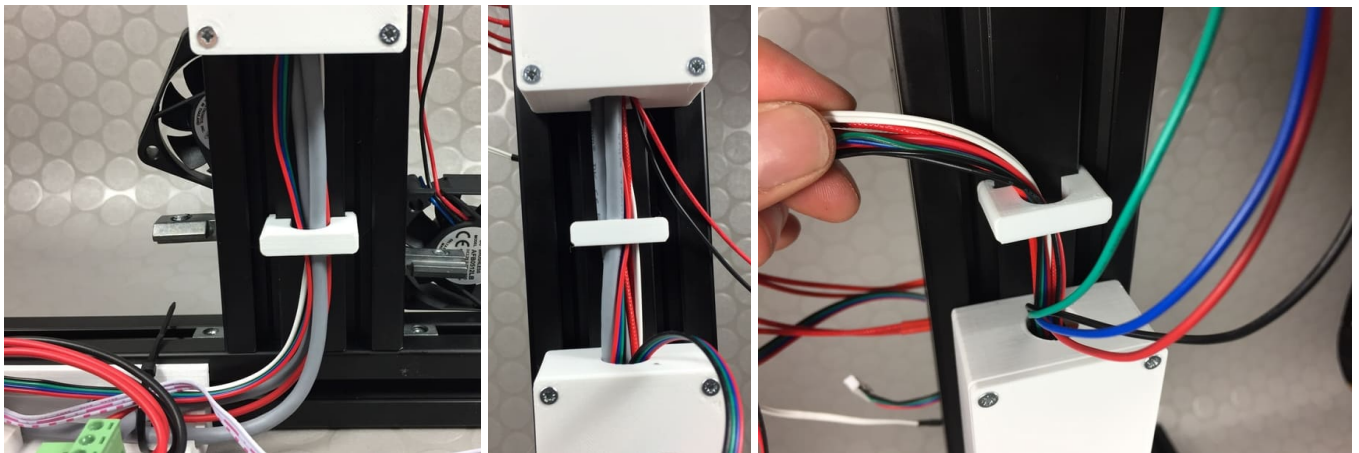
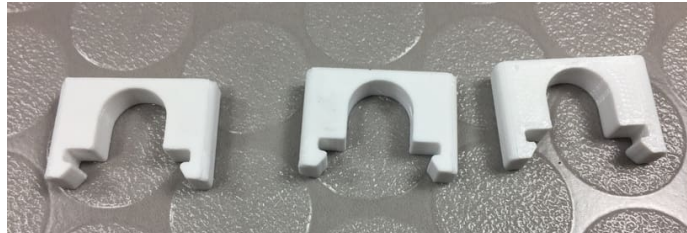
Hold the lids on the two connection housings and screw them tight with the wood screws in the holes provided.



Step 64:

3D Printing: 3x Profile Clamp (EL21)

You can attach the profile clamps to the aluminum profile at three positions. See picture. With the clamp above the upper connection housing, the connection cable of the stepper motor is not fixed with the clamp.



Step 65:

Take the power supply (not included) to hand. I strongly recommend using a closed table power supply (12Vdc, 12.5A) as they are the safest to use. Make sure that the power plug is not connected to the power supply when you perform the following steps.



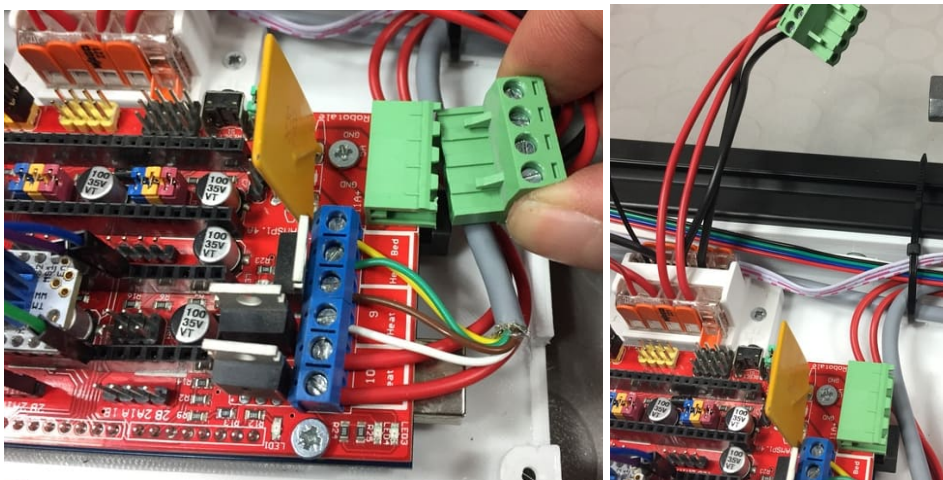
Step 66:

With the table power supplies in the power class above 5A (amps), the plugs used on the 12V connection are often not suitable for this high current. Especially at 10 to 12A the plug can get hot and be a fire hazard. Therefore, cut off the plug. Expose the wires and insulate them again 11mm long. Make sure that the copper strands are not damaged when stripping.



Step 67:

The green terminal on the Ramps Board is disconnected and bent to the side.

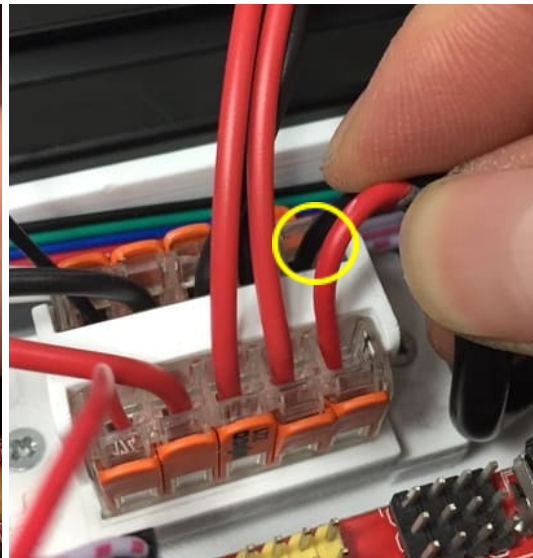
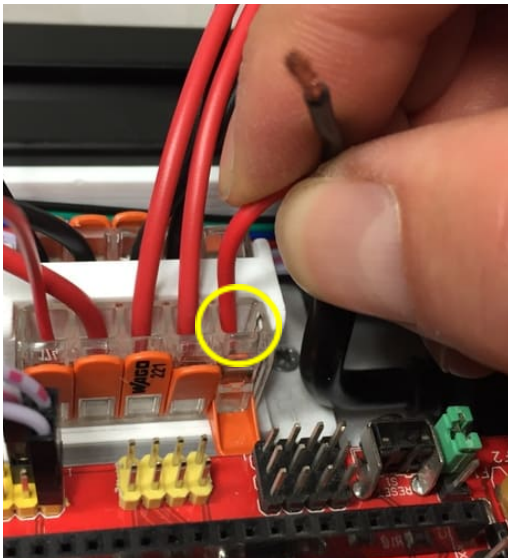
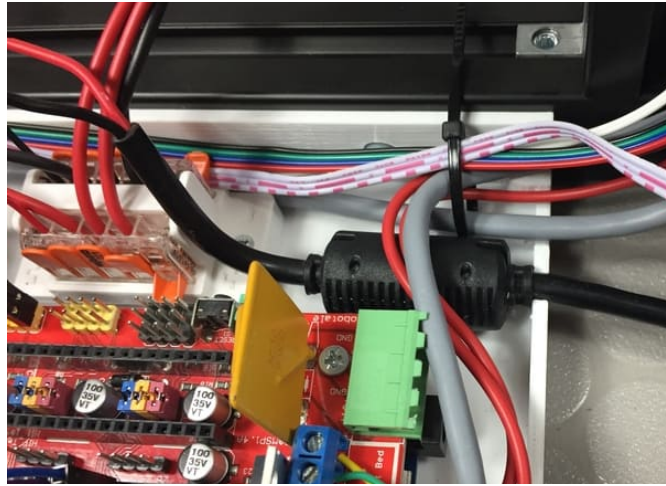


Step 68:

This type of closed table power supply often has an interference suppression filter on the connection cable. This is placed in the control housing and serves as strain relief. To do this, lift the cables that are connected to the Ramps Board and pass the connection cable from the power supply unit with the interference suppression filter under these cables, see picture on the next page.

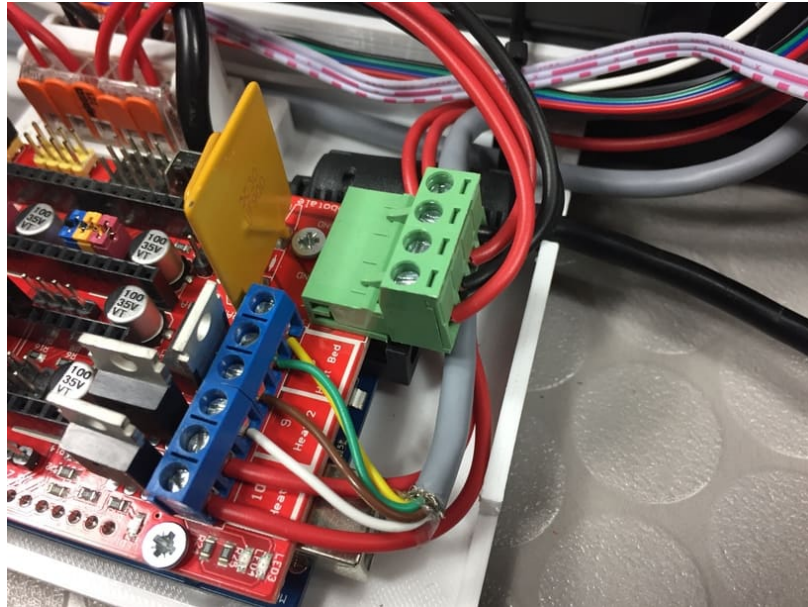
The 12V line of the power supply is connected to the Wago terminal. Attention: Please pay attention to the polarity! Clamp the positive pole (+) of the power supply to the Wago terminal with the red wires and the "+" marking.

Connect the negative pole (-) of the power supply unit to the Wago terminal with the red lines and the "+" marking. Connect the negative (-) pole of the power supply to the Wago terminal with the black wires and the "-" marking. Often the wires of the power supply have the same colors (red for + and black for -) but it is not guaranteed. Reverse polarity can damage the components. If in doubt, measure with a meter (multimeter) to determine the correct polarity.



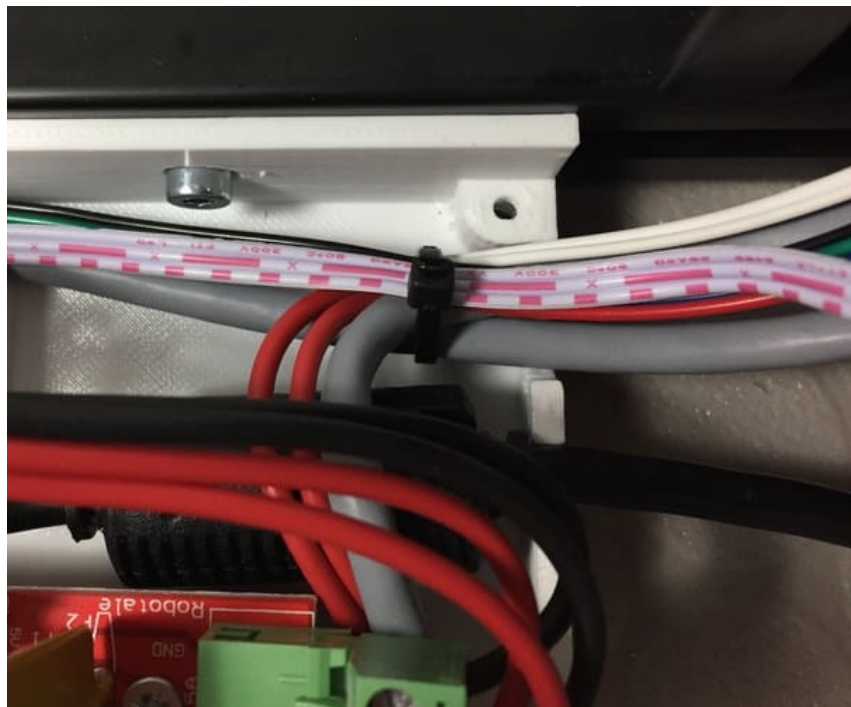
Step 69:

The green terminal on the Ramps Board is reconnected.



Step 70:

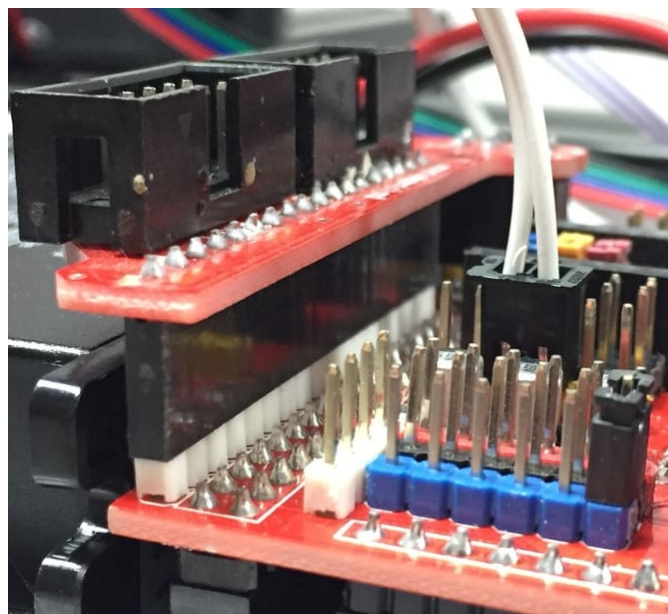
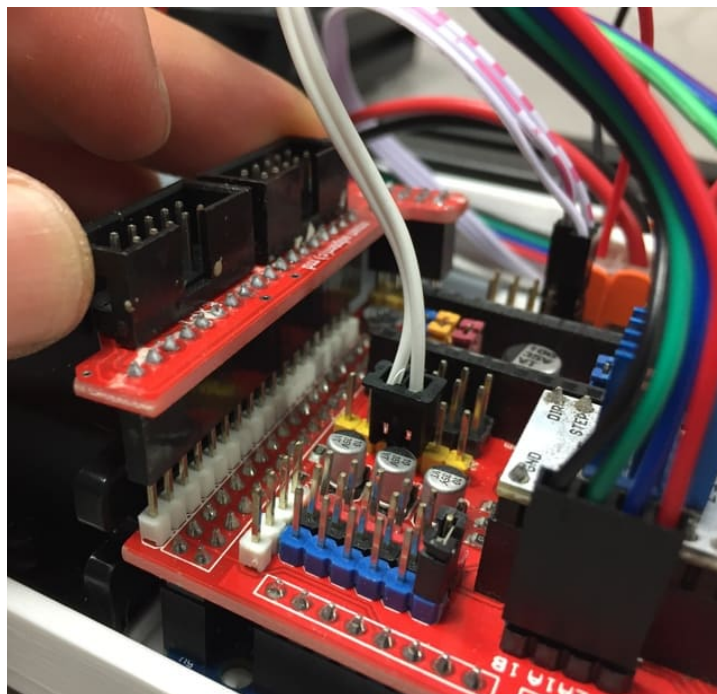
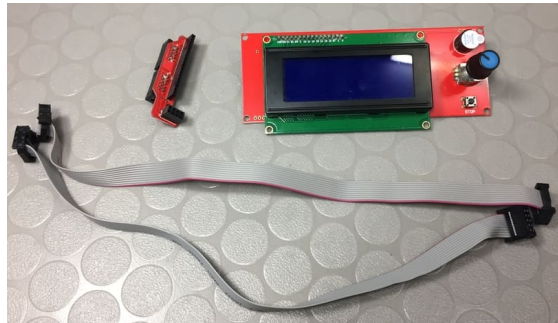
Organize the wires that everything is neatly laid. Then tighten the cable tie and cut off the protruding piece.



Step 71:

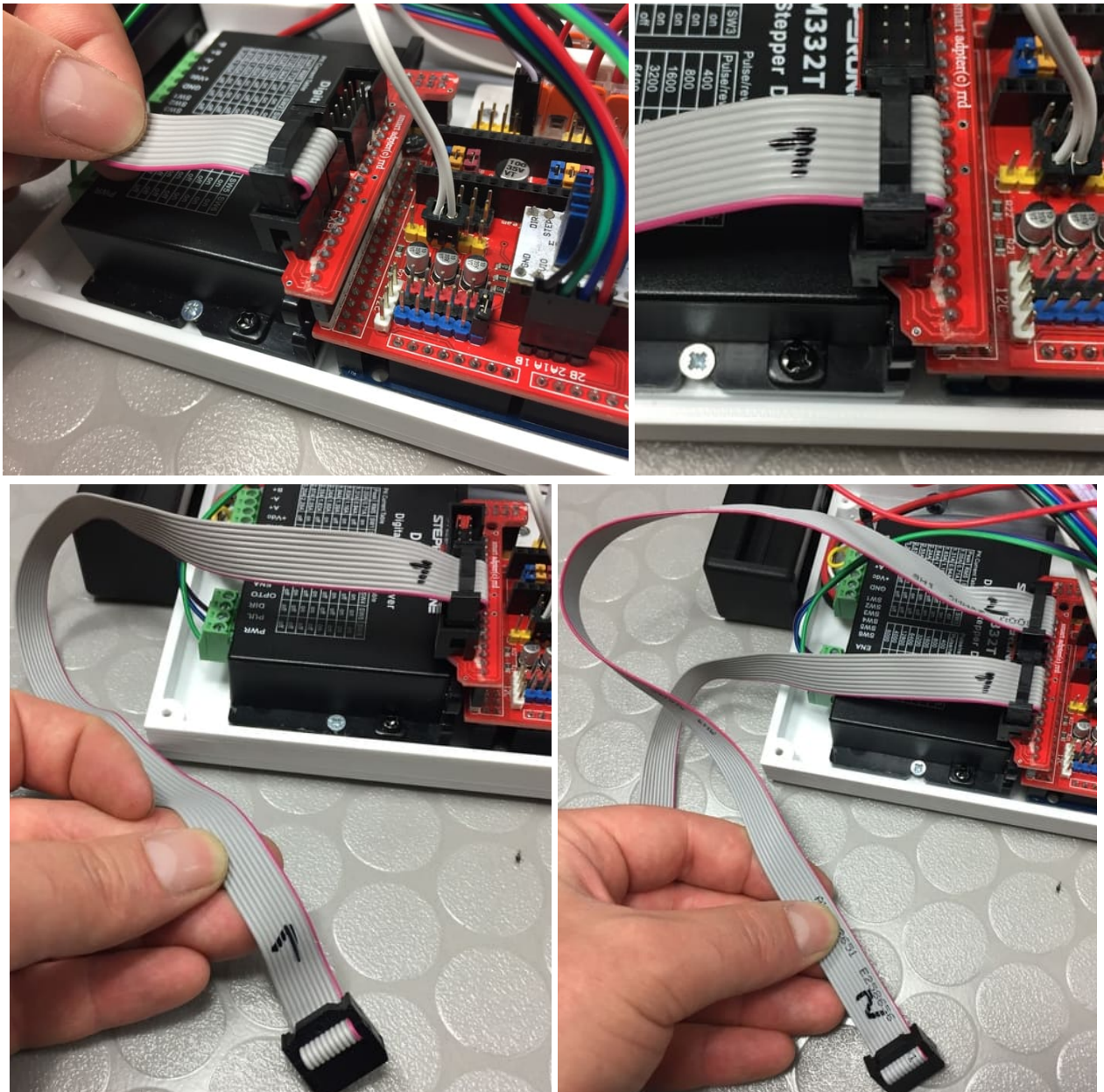
Take from package 5: 1x 2 LCD cable with adapter (EL06), 1x LCD 2004 display (EL14)

The LCD adapter is plugged onto the Ramps Board. See picture. Make sure that the adapter hits all pins and no pin is bent.



Step 72:

The connector on the LCD cables are coded by plastic pins so that it can only be plugged in one orientation. If the connector does not plug in as shown, use the other end of the cable. Plug the first cable into the position shown and label it with the number 1 using a marking pen. Label both ends of the cable with the same number. Then plug the second cable into the position shown and label it with the number 2 using a marking pen. Label both ends of the cable with the same number.

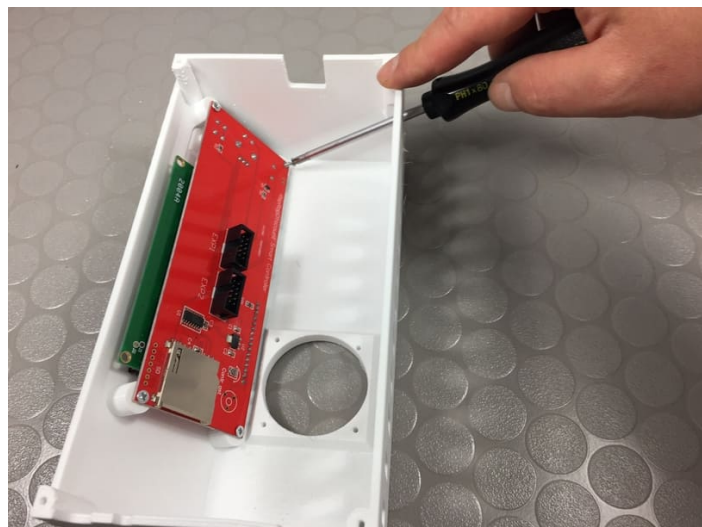


Step 73:

3D print: 1x control unit housing cover (EL16)

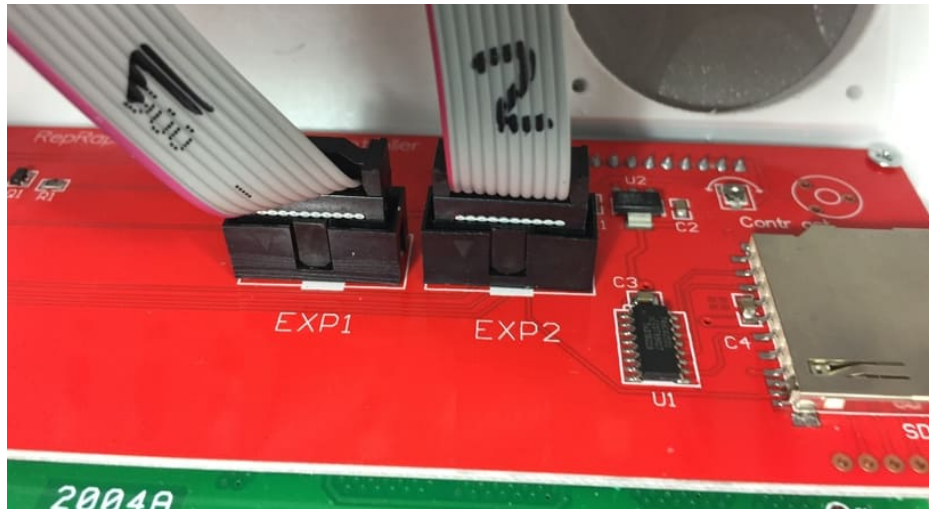
Remove from package 1: 8x wood screw 2,5x12 (SC01), 4x wood screw 3x25 (EL02)

Remove the rotary knob on the LCD display. Turn the control housing cover upside down and position the LCD display as shown. Place it in the opening provided. Screw it in place with 4 wood screws 2.5x12 in the holes provided.



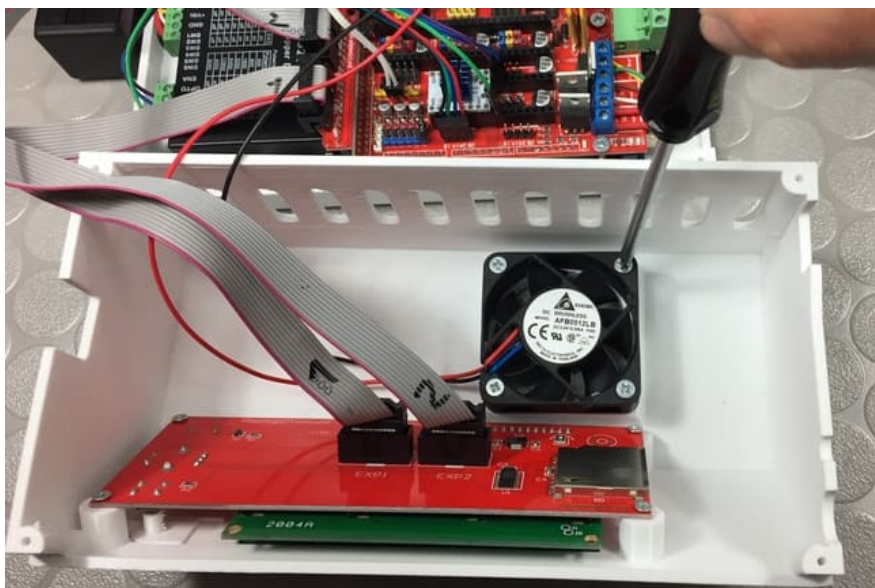
Step 74:

The LCD cables are connected to the LCD display, see picture. The sockets on the LCD display are numbered. The LCD cables are labeled accordingly. There are sometimes deviations in the labeling of the sockets on the display. If the sockets are not labeled with 1 and 2 but with 2 and 3. Then connect the LCD cable with the number 1 to the socket on the display with the number 2. And the LCD cable with the number 2 to the socket on the display with the number 3.



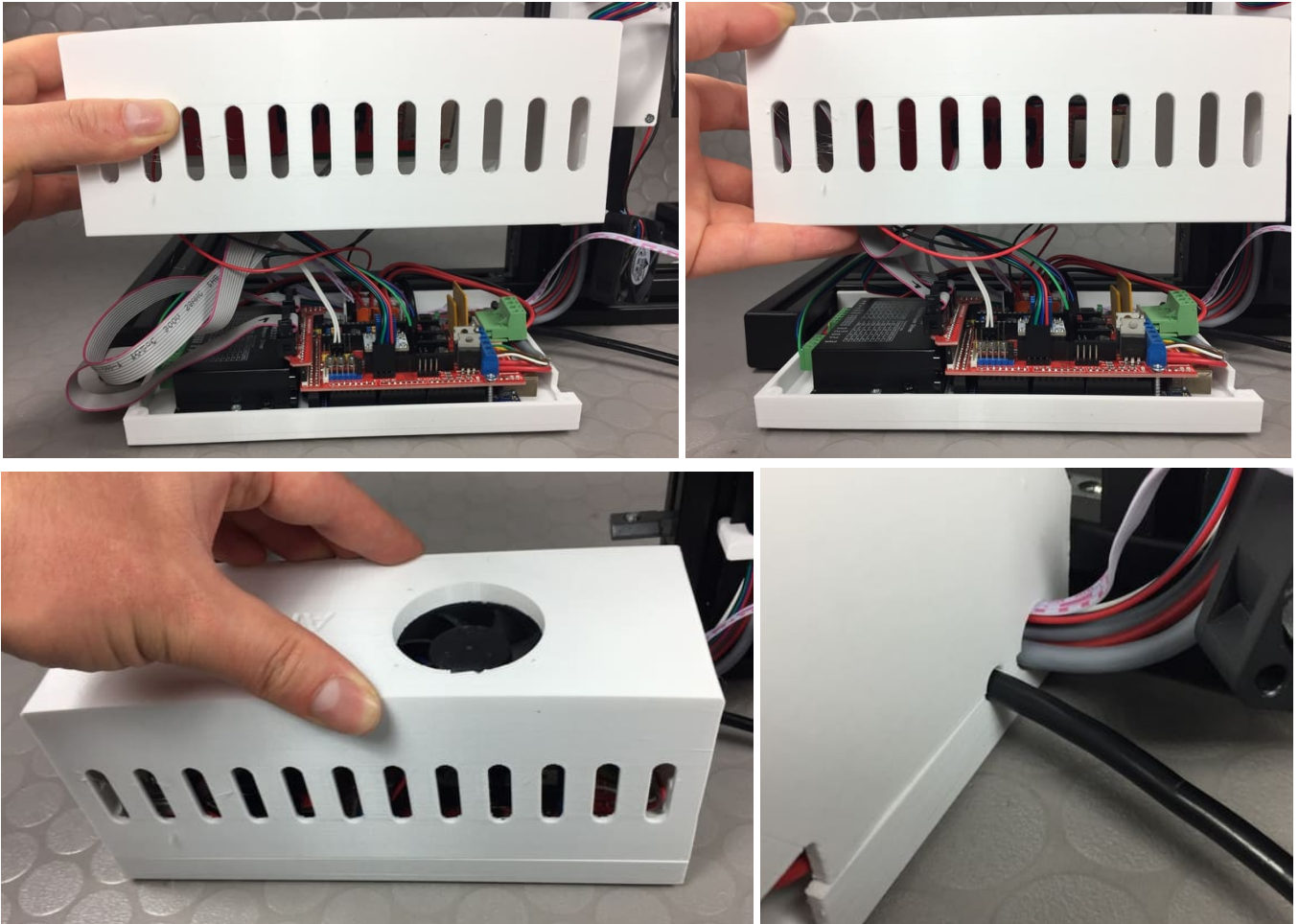
Step 75:

The fan, which is connected to the wago terminal in the control box, is screwed into the lid with four 3x25mm wood screws.



Step 76:

The lid is now mounted. To do this, turn it the right way around again and hold it over the controller. The LCD cables are pushed into the lid by hand and then the lid is set down. Make sure that no cables protrude from the edge. Make sure that on the right side the wires that come out are in the holes provided, see picture. It may be necessary to apply a little pressure so that the cables give way on the inside.

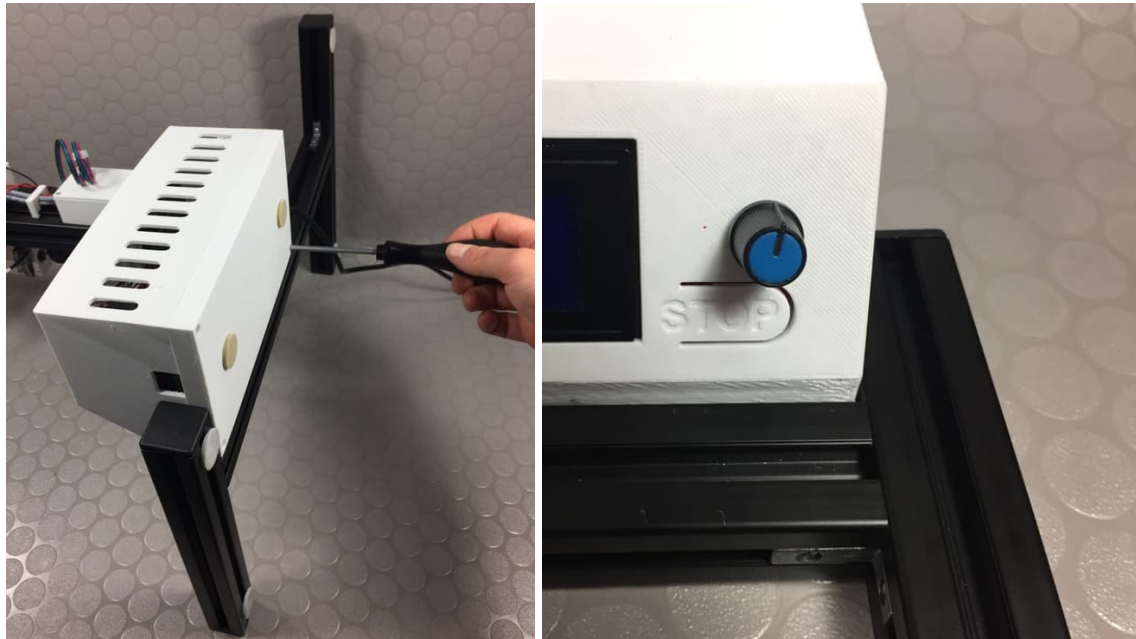


Step 77:

Remove from package 1: 4x wood screw 2.5x12 (SC01).

When the lid fits snugly, tilt the complete extruder forward. If necessary, place something underneath so that the entire weight of the extruder does not rest on the hopper. Now you can

screw the 4 wood screws from below into the holes provided. now the lid is fixed. Then straighten the extruder again and put the knob from the display back on.



Done:

Now continue with assembly instructions "03-Insulation build up".

