

E3D-v6 on Ultimaker 2

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The Ultimaker 2 Extrusion Upgrade Kit is no longer available from E3D-Online, but this guide will continue to be available for our existing users.

This page provides a full guide to installing the E3D Ultimaker 2 Upgrade Kit (<http://e3d-online.com/Ultimaker-Extrusion-Upgrade-Kit>), including the E3D (<http://e3d-online.com/>) Titan Extruder (<http://e3d-online.com/Titan-Extruder>) and V6 HotEnd (<http://e3d-online.com/E3D-v6>) into your Ultimaker 2 Series (<https://ultimaker.com/en/products/ultimaker-2-plus>) 3D printer.

This upgrade kit is compatible with:

- Ultimaker 2/ Ultimaker 2 Extended
- Ultimaker 2+/ Ultimaker 2 Extended+

This article is a companion to this **Video Guide** by Thomas Sanladerer (<https://youtu.be/aLLci32tHA4>) showing the E3D Ultimaker Upgrade process. It is recommended to follow this page and his guide in tandem. Read the Preparation section before beginning the installation process.

The printed components used for this upgrade can be found on **Thingiverse** (<http://www.thingiverse.com/thing:1934309>).

Ensure your printer is switched off, disconnected from the power supply and cooled down before handling.

This guide is based on work originally written by Steve Wood of Gyrobot, many thanks for his contribution.



Ultimaker 2 with E3D Upgrade Kit.

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Requirements

Upgrade Kit Contents

- E3D Titan Extruder (<http://e3d-online.com/Titan-Extruder>) Kit
 - 3mm Groove Mount Bowden Adaptor
 - PTFE Bowden Tubing
 - NEMA 17 Stepper Motor with Cable
- E3D V6 HotEnd (<http://e3d-online.com/E3D-v6>)
3mm Bowden - 24V, 30W, PT100
 - Wiring Loom and Braided Sleeve
 - V6 Nozzle Fun Pack
 - V6 Silicone Sock
- Printed Parts (<http://www.thingiverse.com/thing:1934309>)
 - Four Layer Adaptor Body
 - 2x Fan Duct
 - Bowden Depressor Tool
- Fixings
 - 12 x M3 Nut
 - 16 x M3 Washer
- E3D Edge (<http://e3d-online.com/Edge>) Sample Filament
- Allen Keys



Tools Required

- Pliers or 7mm Hex Wrench
- Small Phillips-Head Screwdriver
- Allen Keys (Included)

Preparation

1. Begin by removing the filament from the printer in the normal manner used for Changing Filament (<https://ultimaker.com/en/resources/16955-changing-filament>) but do not insert a new spool, simply continue through the process pressing OK at each stage.
2. Wait for the HotEnd to cool back down, you can check this by going to **MAINTENANCE > ADVANCED > Heatup nozzle**. If the second temperature (eg. 27C/0C) is not already at 0C, rotate the dial to set this, wait for the first temperature to reach room temperature (eg. 27C/0C).
3. Factory reset your printer by scrolling to **MAINTENANCE > ADVANCED > Factory Reset** and press **YES**. When the setup wizard loads, do not run through it, instead switch the printer off.



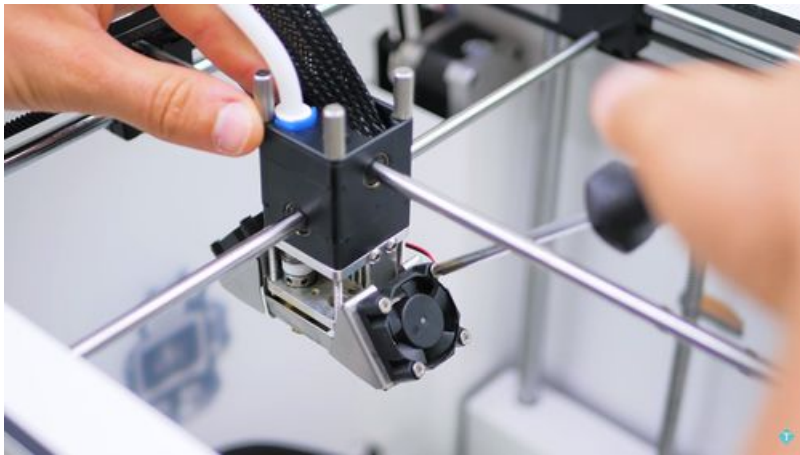
4. Disconnect the power supply.

Installation

Printhead

Ultimaker Printhead Dissassembly

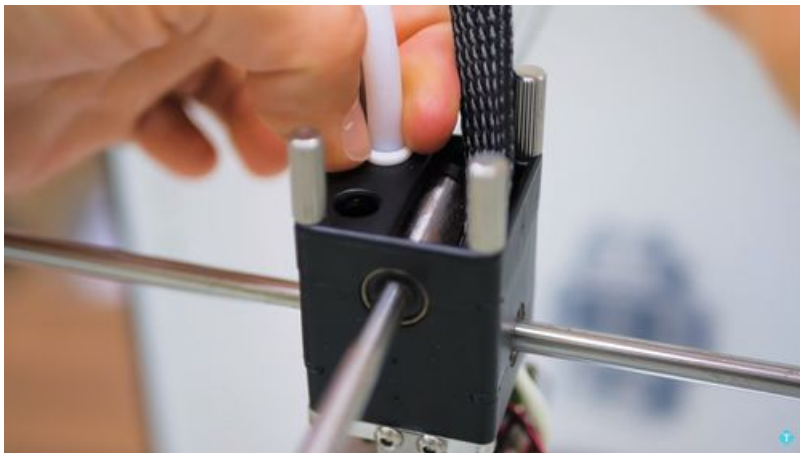
1. Lower the bed by pressing down on it gently until it reaches the bottom.
2. Unscrew both of the part cooling fans from the Ultimaker head. Save the screws as we will use them later.



3. Remove the Bowden clip from the Bowden collet.



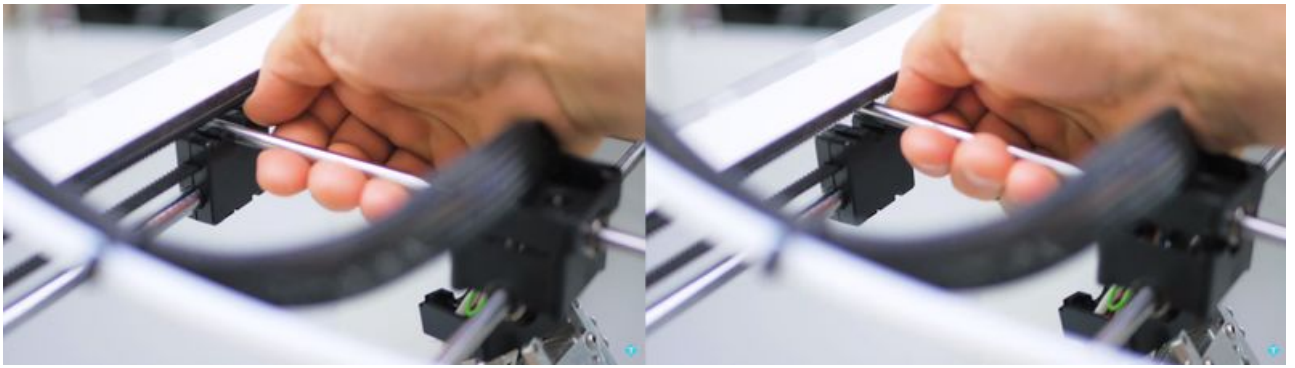
4. Press down on the Bowden collet with your fingernails or the Bowden removal tool, then pull upwards on the tube, it should slide out.



5. Unscrew the four long thumbscrews holding the Ultimaker printhead together, keep these as we will use them later.



6. Carefully remove the rail from its bracket on the left side by pulling up on it using the bracket for leverage.



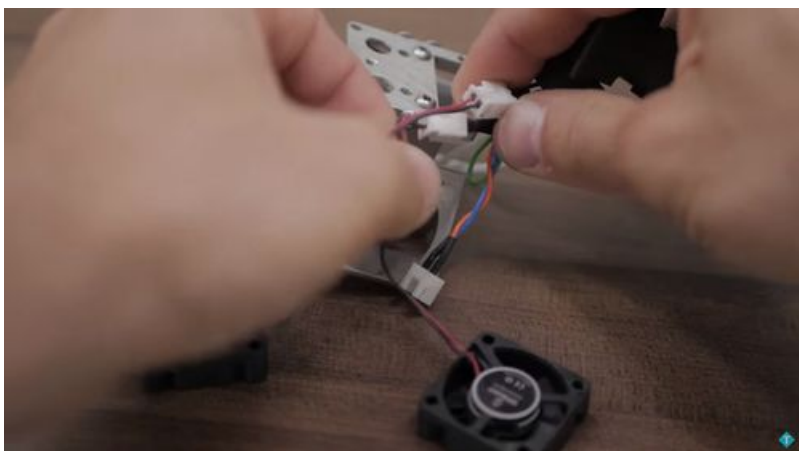
7. The lower and upper sections of the Ultimaker printhead should now be free from the assembly.



8. Gently lift the rail and slide out the middle section from its bearings. The head assembly should now be free from the rails. If wires remain tangled, one side of the other rail may need to be unclipped from its bracket in a similar manner to free them.

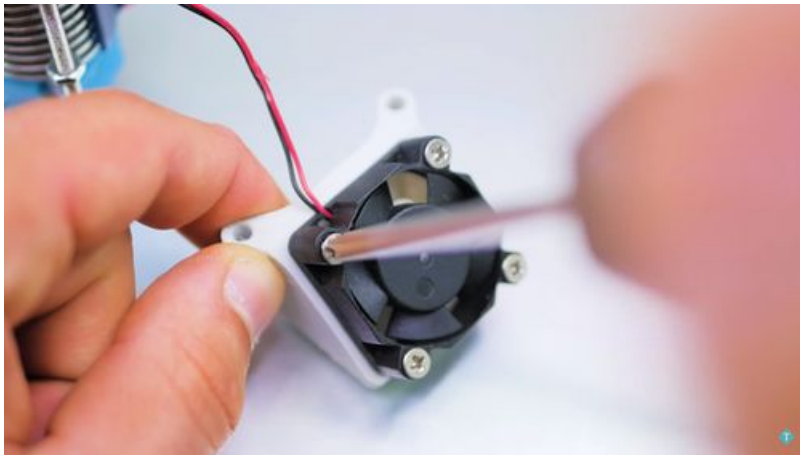


9. Detach all of the connectors from the Ultimaker head, keep the two 30x30mm part cooling fans as we will use them in the next section.



E3D Printhead Assembly

1. Take the two 30x30mm part cooling fans we saved from the Original Ultimaker Printhead. Screw these into the two printed fan ducts with the label on the inside and the wiring exiting from the tallest side of the duct as shown.



2. Carefully turn the printer onto its right side.
3. Slot the first section of the new printhead into the lower bearing as shown.



4. Pass the cables for the two part-cooling fans and the heatsink fan through the wiring hole in the first section of the printhead. Hold these in place for the next few steps.



5. Pass the wires through the second section (light grey) of the printhead as shown then slot it over the bearing. Pass the wires through the third (dark grey) section as shown.



6. Gently lift the upper rail and slot the third section into the upper bearing as shown. Slot the rail back into its bracket when complete.



7. Pass the wires through the top (black) section and slot it over the upper bearing.



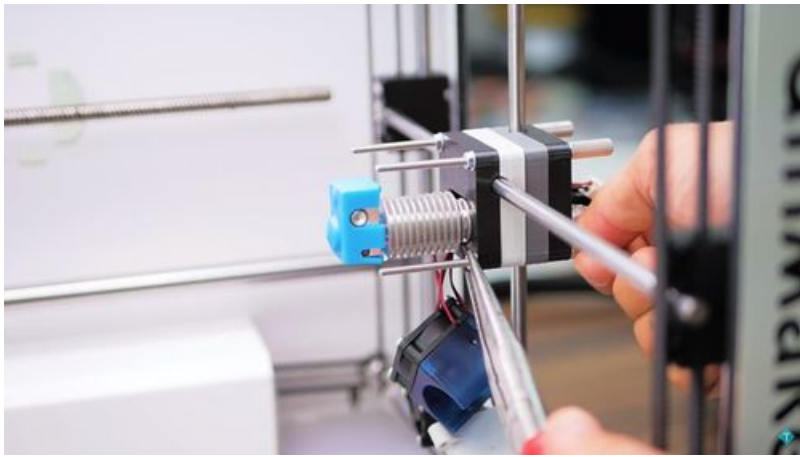
8. Slot the four long thumb screws from the original Ultimaker printhead through the four holes in the new printhead with washers between the screws and printed parts as shown.



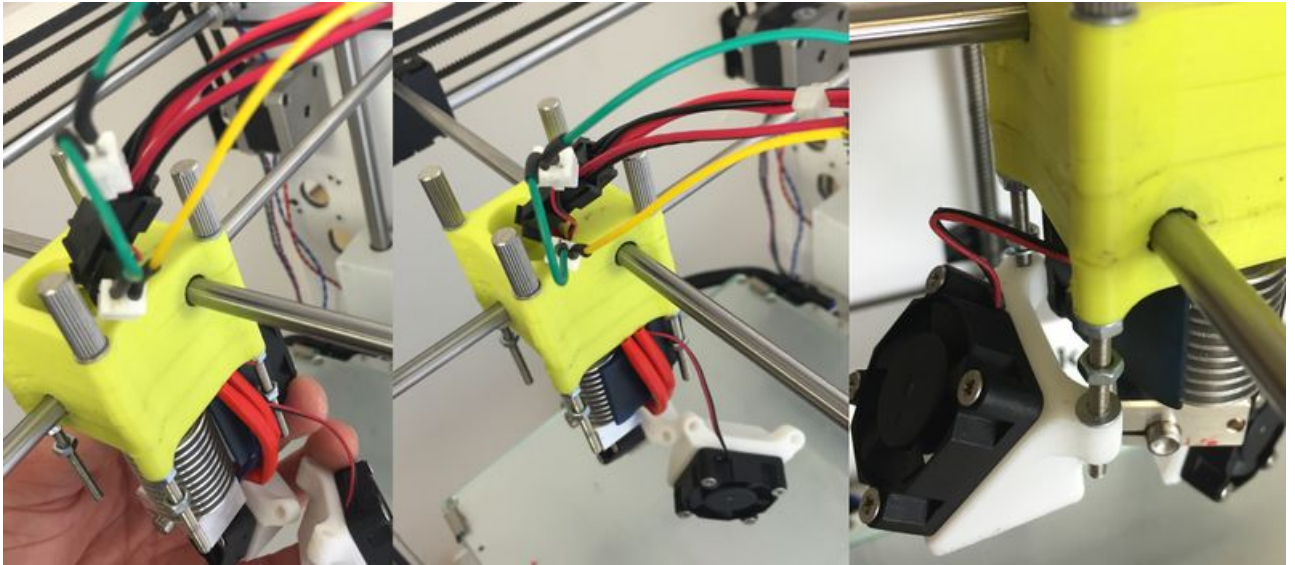
9. Connect the wiring loom to the cables from the printhead. Each connector should only go in one way.



10. Add a washer then nut to the other side of the bolts and tighten with pliers or a hex wrench.



11. Add another nut to each bolt then slot the heatsink fan onto the back of the heatsink with the **cutout side of the fan bracket facing towards the top**. The bottom flat surface of the fan bracket should align with the bottom of the heatsink. The wires should be routed around the sides of the bracket as shown below (viewed from the top right), running through the fan bracket cutout channel when installed.



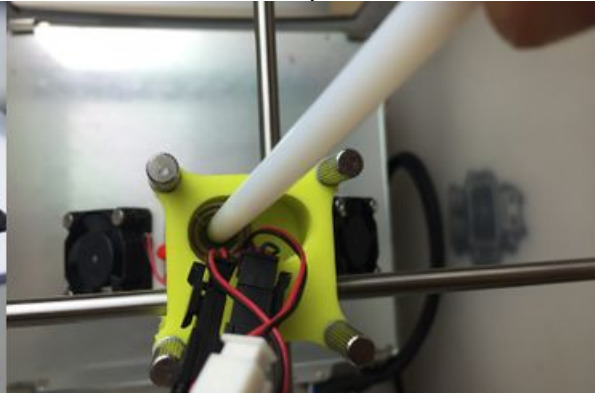
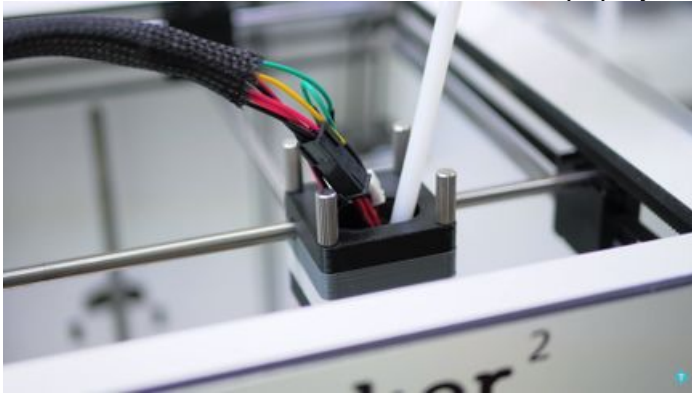
12. Add a washer to each bolt then slot the part cooling fan assemblies onto the bolts as shown, onto the left and right sides.



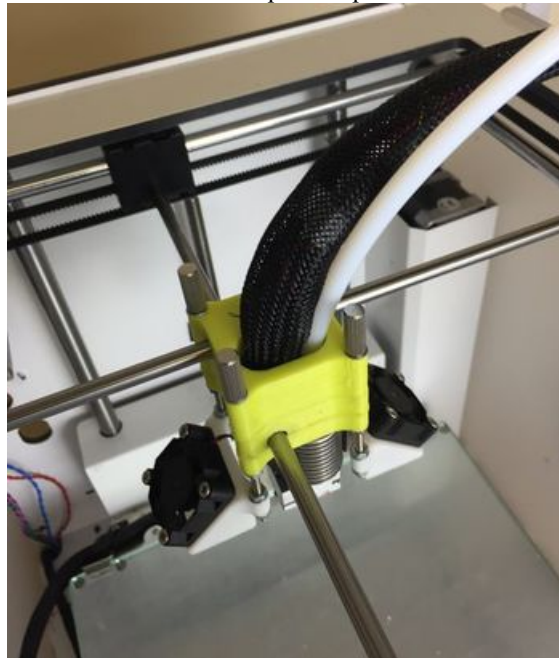
13. Add a final washer and nut to secure the part cooling fan assemblies and tighten. Ensure they do not go below the level of the nozzle to avoid fouling during printing.



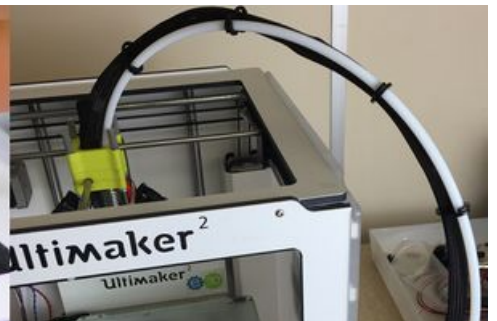
14. Insert the new Bowden tube into its collet as shown. When properly seated it should not be able to be pulled out.



15. Slide the braided sleeve down over the connectors and into the top of the printhead.



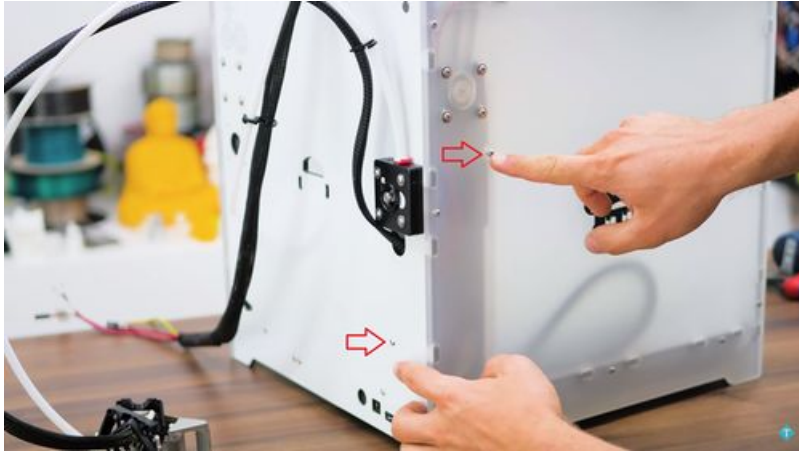
16. Remove the Bowden clips from the original Ultimaker wiring loom and attach them to the braided sleeve and Bowden tube of the new loom as shown.



Extruder

Ultimaker Extruder Disassembly

1. Remove the two screws shown below from the back of the Ultimaker.



2. It should now be possible to remove the motor cover.



3. Remove the Bowden clip from the original Ultimaker extruder using your fingernail or a screwdriver.



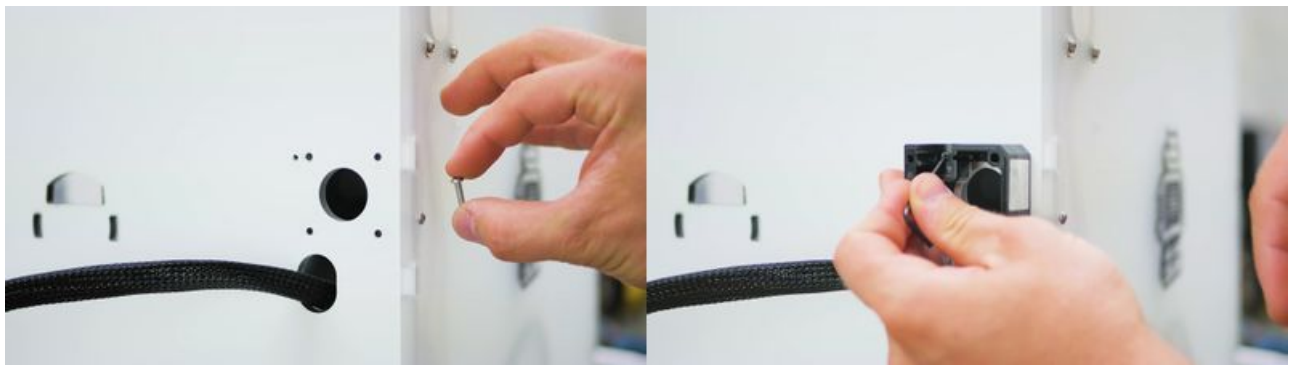
4. Hold the motor in place from the front and remove the four screws in the extruder shown below. The motor and extruder should now become free. Rest the motor at the bottom of the Ultimaker for now.



E3D Titan Installation

For more information on the E3D Titan installation process, please visit the E3D Titan Wiki Page (http://wiki.e3d-online.com/wiki/Titan_Assembly).

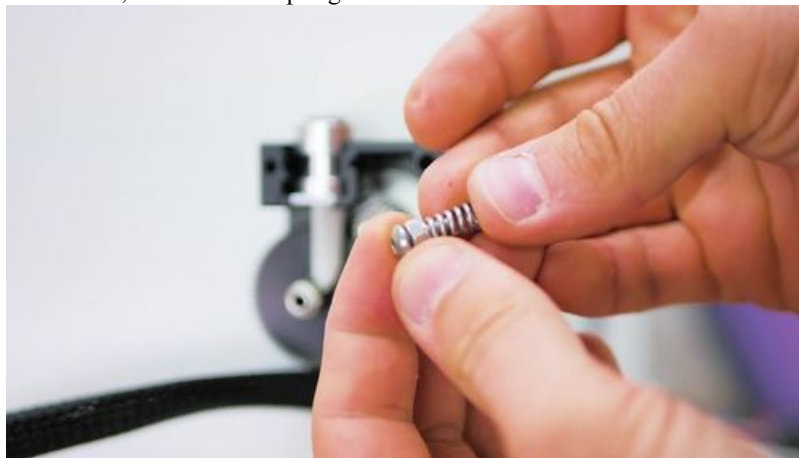
1. Pass the M3x12mm screw through the hole in the curved groove of the Titan. Hold the supplied stepper motor in place where the original one was mounted with the connector side facing downwards towards the bottom of the printer. Secure the Titan and motor by passing the screw through the Ultimaker body as shown and tightening it into the motor.



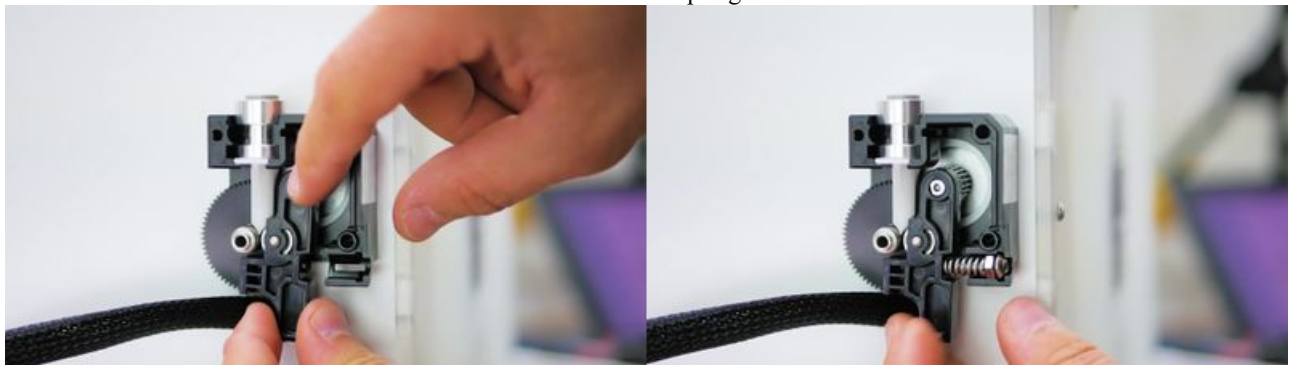
2. Mount the gear (with the longer shaft facing outwards), Bowden adaptor (with the grey collet on the top side) and filament guide into the Titan body as shown.



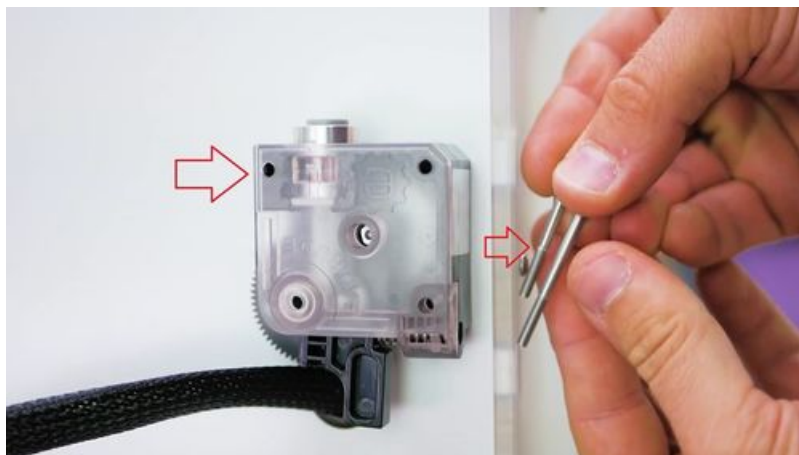
3. Screw the idler nut onto the idler screw, then slide the spring onto the screw.



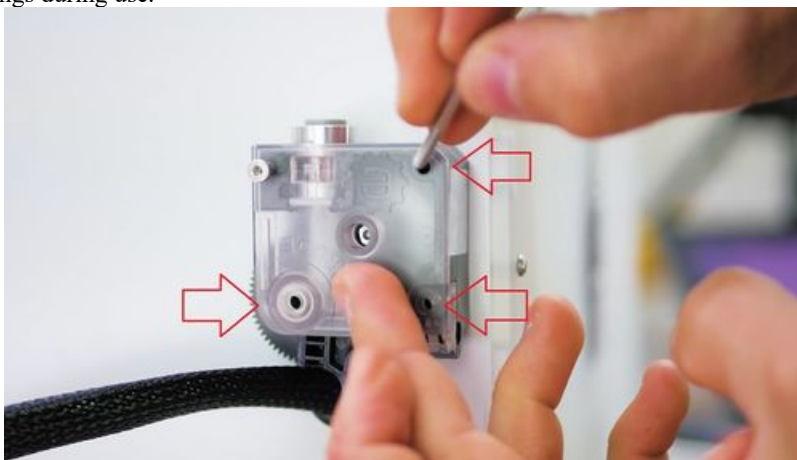
4. Slide the idler lever onto the motor shaft then seat the idler screw and spring as shown.



5. Slot the Titan lid onto the body assembly, this may require the body to be rotated to line up the motor shaft with its hole. The black gears shaft may also need to be pushed slightly to slot in. Screw the shorter M3x25mm screw into the top left corner hole in the Titan.



6. Screw the longer M3x35mm screws into the other three holes. Make sure not to over-tighten the screw passing through the gear as this could damage the bearings during use.



7. Slide the Bowden tube into the Bowden adaptor, when secure it should not be able to be pulled out.



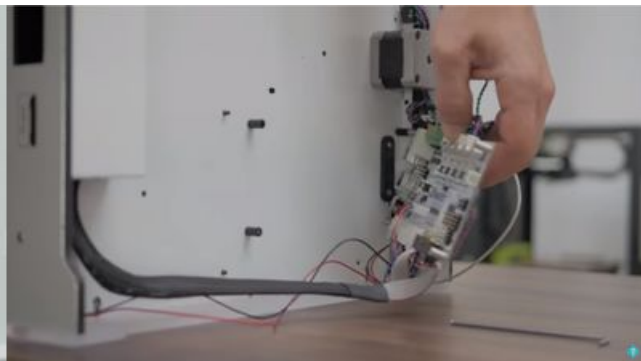
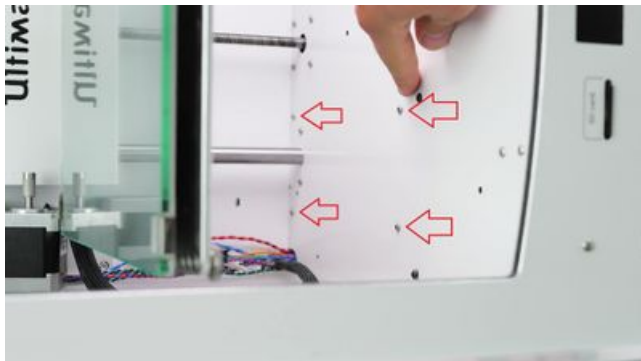
Electronics

Accessing the Control Board

1. Push the bed up to the top of the Ultimaker by pressing on it gently from below.
2. Carefully turn the Ultimaker onto its left side remembering that the old motor is still free to slide.
3. Remove the two screws pictured below being careful not to lose their corresponding nuts. This should allow the electronics cover to be removed.

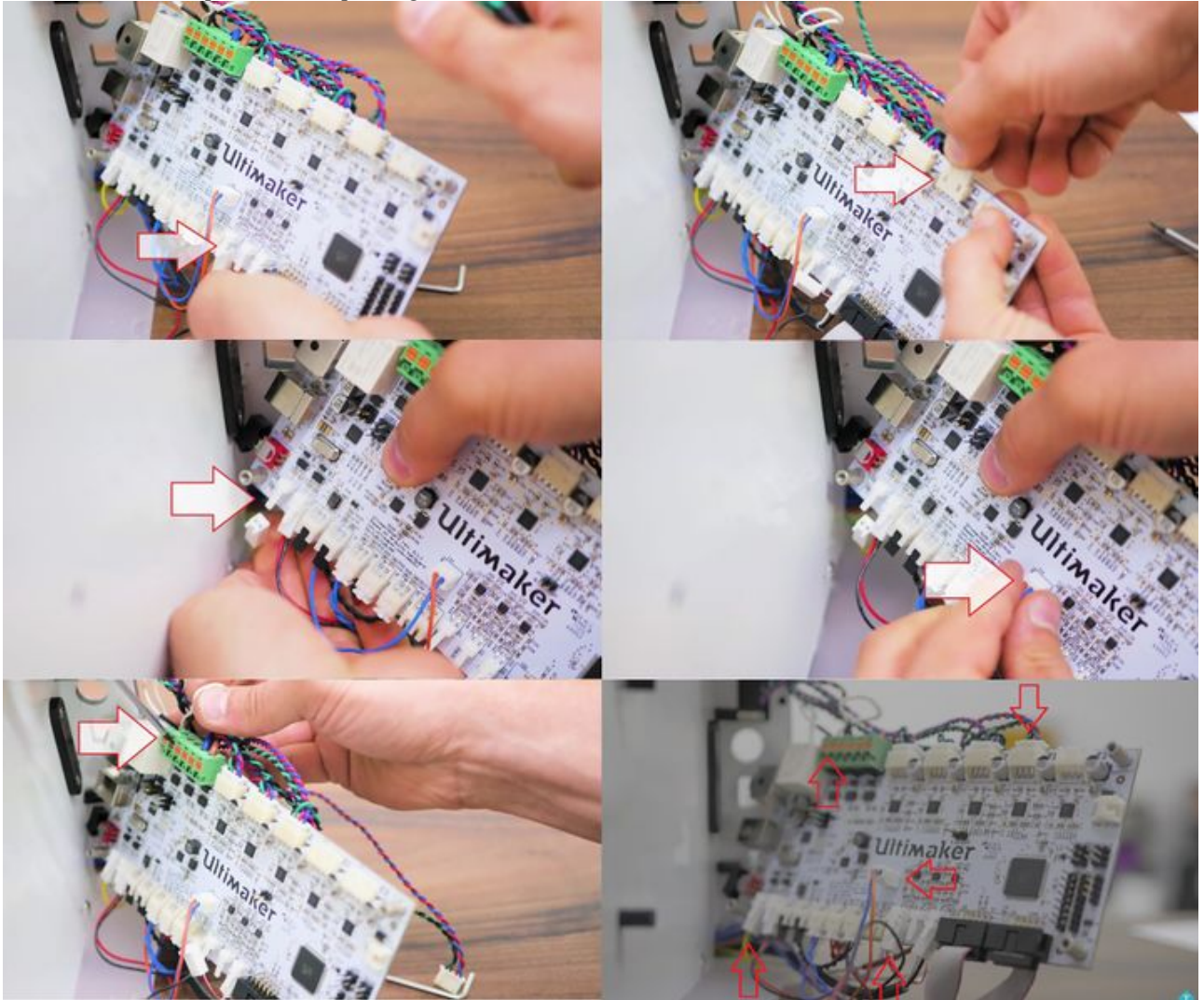


4. Remove the four screws shown below holding on the control board. Be careful not to lose the standoffs between the screws and the board.



Wiring

1. Once the electronics board is free from the frame we can begin removing the wiring of the original head. We wish to remove the wires from the pins labelled : *TMPI*, *E1*, *Fan PWM*, *5V*. Using a flathead screwdriver, press down on the orange tabs for the two wires labelled HTR1 and pull the corresponding wires out. These connectors are shown below.



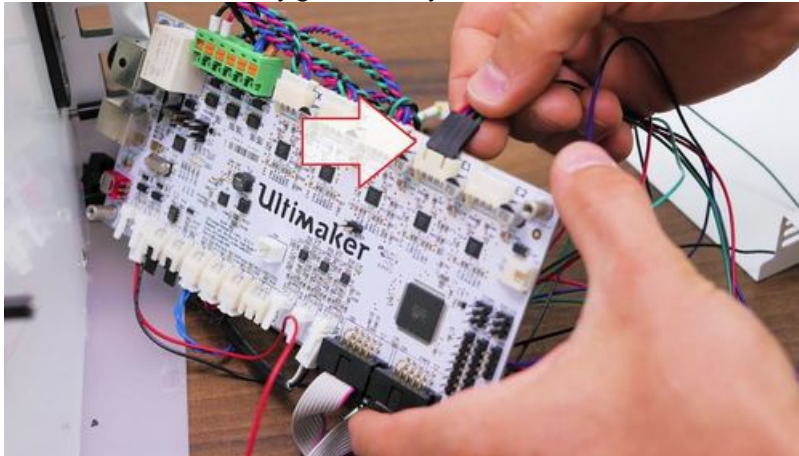
2. Remove the old wiring loom by feeding the loose wires through the hole in the base of the printer. These can then be pulled out through the hole below the extruder.
3. Insert the new wiring loom though, through the hole beneath the extruder then through the hole in the base of the printer. Tuck the the loom behind the Titan underneath the idler lever.



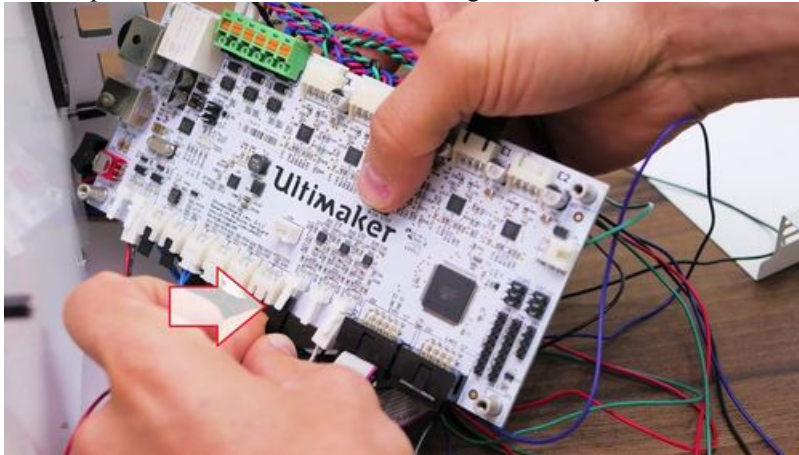
4. Plug in the extruder motor cable and run its wire through the hole in the base of the printer.



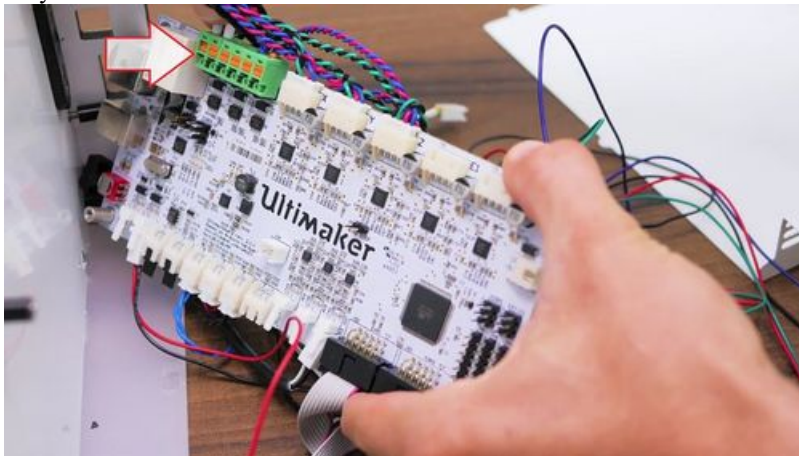
5. Insert the extruder motor cable into E1, this should only go in one way.



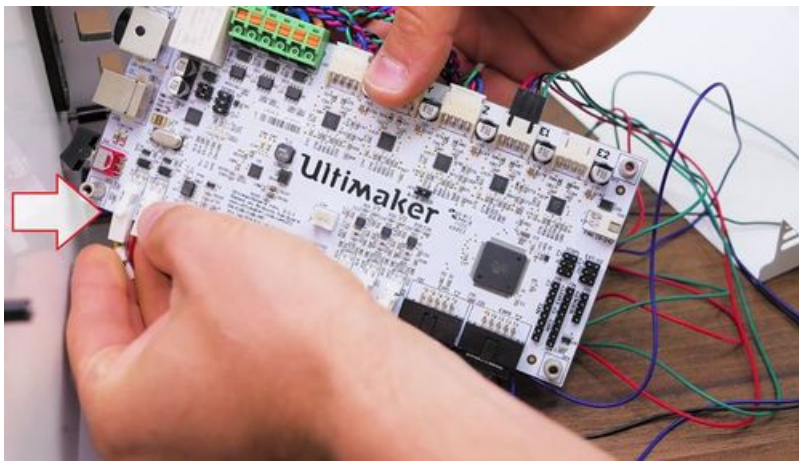
6. Insert the wire labelled 'Hotend Temp' into the 'TEMP1' socket. This can go either way around.



7. Insert the wires labelled 'Heater' into the two sockets with the label 'HEATER1', when secure these should not be able to be pulled out. The wires can go either way around.



8. Inset the wire labelled 'Part Cooling Fan' into the 'FAN PWM' socket, this should only go in one way around.



9. Insert the wire labelled 'Heatsink Fan' into the '24V' pins shown below by the heater cables. This should go with the black negative wire on the outside of the board.



Finishing Up

1. Run the four electronics board screws through their holes and place the four standoffs onto them on the other side. Place the electronics board above them being careful not to trap any wires and screw the in the four screws to secure the board.



2. Run the two electronics cover screws through their holes. Position the electronics cover into place by aligning its tabs into the sides of the printer, be careful not to trap any loose wires, the wires shown below should run through the small cutout in the cover. Place the bolts onto the screws and tighten to secure the cover.



3. Replace the motor cover again being sure not to trap any wires and screw its two screws in from the back of the printer to secure it.

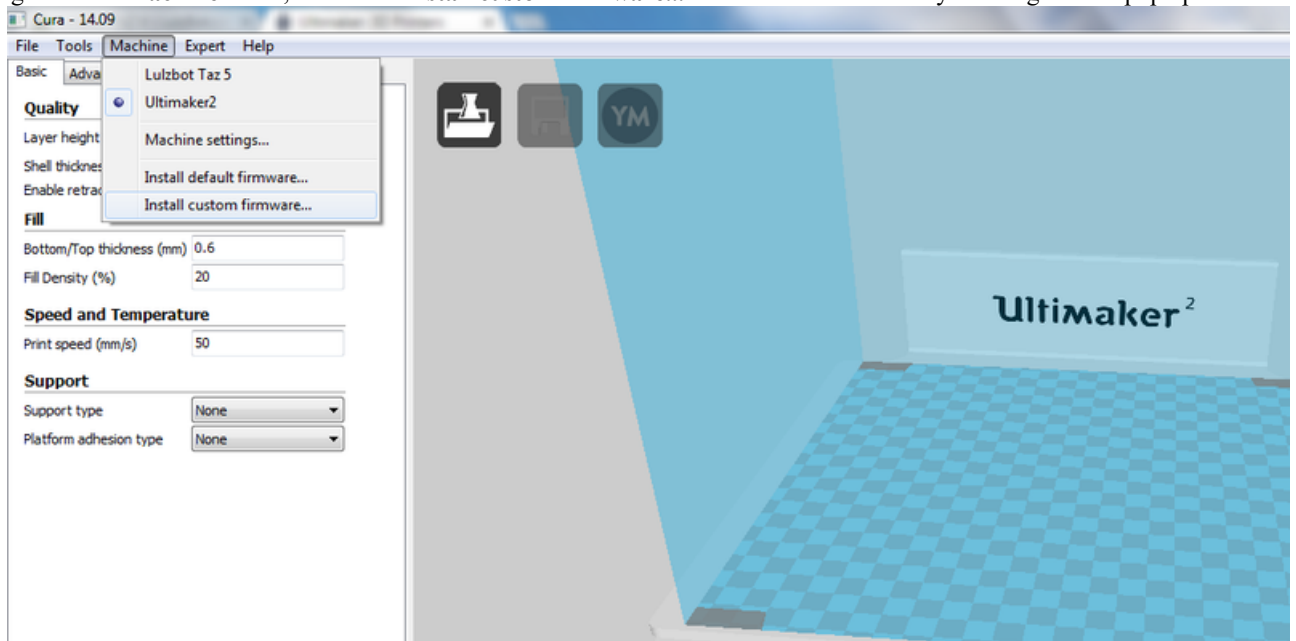


This completes the physical part of the installation.

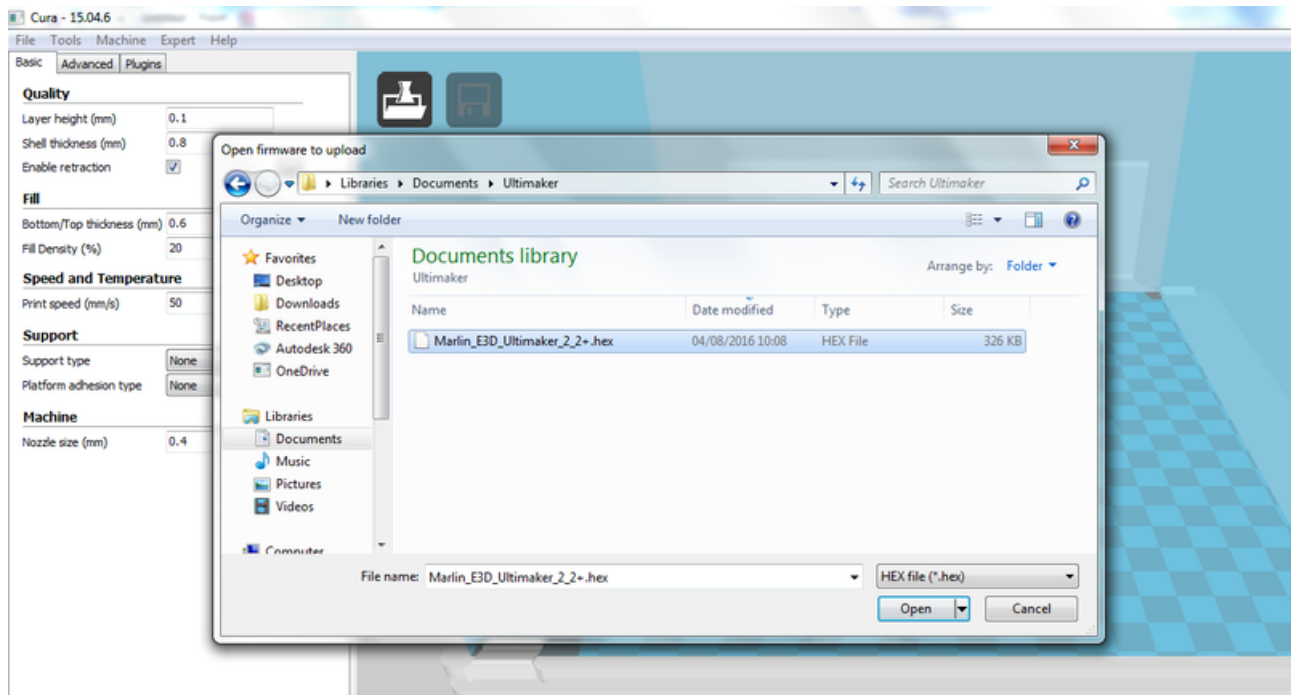
Firmware, Nozzles and Printing Settings

You must update the Ultimaker firmware for the upgrade to function correctly. To update the firmware, **Cura Version 15** or earlier is required. This can be downloaded here (<https://ultimaker.com/en/products/cura-software/list>). You can also use the Arduino IDE if you feel more confident in using this method.

1. Begin by downloading the appropriate E3D Ultimaker 2 Series Upgrade Kit Firmware for your printer.
 1. Download the E3D Ultimaker 2/2+ Firmware (<https://github.com/e3donline/E3DUltimaker>) by clicking on the green **Clone or download** button, and then **Download as Zip**.
 2. Once downloaded, extract the files named **Ultimaker2_E3DV6.hex** and **E3DV6 EEPROM default.gcode**.
2. Switch on your Ultimaker and plug it into your computer, if you have not already done so, factory reset the printer by following the factory reset steps in the Preparation section. do not run through the startup wizard just yet.
3. Load up **Cura 15 or earlier** as you normally would for printing on the Ultimaker. Make sure you have the correct printer selected by going to the **Machine** menu and selecting your printer. If it is not present, got to **Machine > Add new machine...** and run through the steps selecting your printer from the list.
4. Navigate to the **Machine** menu, then click **Install custom firmware....** Click OK to dismiss any warnings which pop up.



5. Navigate to and open the firmware hex file downloaded from the above link.



- When the firmware update is complete the printer should restart. Run through the startup wizard steps on the printer to calibrate your printer to the new head.
- DO NOT FORGET THIS STEP!** Copy the .gcode file onto an SD card and run it as you would any other print. The default values for the EEPROM settings will be modified to comply with the E3DV6.

Firmware Changes

If you want to further customise your firmware the following is a run-down of the exact changes made to the firmware to produce the hex file used above. If you have followed the above steps using the .hex file you do can ignore this section. The edits required to the Ultimaker 2 firmware after updating to the E3D HotEnd and Extruder combo are outlined here. If you have downloaded the modified firmware directly, you do not require to do this step. These are taken directly from the original guide by Steve Wood, which can be found here (http://wiki.e3d-online.com/wiki/E3D-v6_on_Ultimaker_2).

These updates are built upon a download from the official firmware (<https://github.com/Ultimaker/Ultimaker2Marlin>) taken on 29th January 2016.

There are 3 options for uploading the necessary firmware changes into your Ultimaker 2:

- You can upload custom firmware via the Cura slicing software, if this is your preferred option then you can download a previously compiled custom firmware (https://github.com/e3donline/E3DUltimaker/blob/master/Marlin_E3D_Ultimaker_2.hex) for this.
- Here are the modified Marlin source files. (<https://github.com/e3donline/E3DUltimaker>) for compiling yourself using the Arduino software. This is the preferred option as it enables you to upload the latest version of the firmware relevant to your machine.
- If you are running your own modified firmware and want to know what lines to change in the "configuration.h" file then here are the edits:

```
// increase the maximum temperature for the E3D V6 HotEnd
#define HEATER_0_MAXTEMP 400
```

```
// PID values for Ultimaker2 with E3D HotEnd
#define DEFAULT_Kp 36.59
#define DEFAULT_Ki 3.65
#define DEFAULT_Kd 91.72
```

```
// travel extents have reduced slightly for E3D HotEnd
#define X_MAX_POS 215 // For E3D HotEnd
#define Y_MAX_POS 210 // For E3D HotEnd
```

```
#define INVERT_E0_DIR true // for direct drive extruder v9 set to true, for geared extruder set to false
```

```
// default steps per unit for Ultimaker2 and E3D Extruder
#define DEFAULT_AXIS_STEPS_PER_UNIT {80.0,80.0,200,837} //837 to be changed to 418.5 for if a 200 steps/mm motor is used
#define DEFAULT_MAX_FEEDRATE {300, 300, 40, 20} // (mm/sec)
#define DEFAULT_MAX_ACCELERATION {9000,9000,100,3000} // X, Y, Z, E maximum start speed for accelerated moves. E default values are good for skei
```

The Bowden retraction settings should be changed if the filament change function is to work properly after the upgrade. These settings are found in the "UltiLCD2_menu_material.h" file. Here are the variables that need to be changed and their new value:

```
#define FILAMENT_REVERSAL_LENGTH      (FILAMENT_BOWDEN_LENGTH + 150)

#define FILAMENT_REVERSAL_SPEED      75

#define FILAMENT_INSERT_FAST_SPEED    75 // Speed during the forward length
```

A Warning : The later Ultimaker 2 firmware (after v14.09) has a temperature safety feature built in, which has been notoriously sensitive. It seems like it is overly sensitive and an E3D HotEnd doesn't conform to its expected heat up and cool down cycles. The result is a common "ERROR - STOPPED Heater error" on the display panel and a failed print. The part cooling fans can often trigger this error as the air blown to cool the print can also end up cooling the heater block due to certain print geometry. Although the silicone sock provided in the kit should reduce this, it is still a recurring issue.



The fabled "ERROR - STOPPED Heater error".

If you repeatedly encounter this issue, check the position of your part cooling fan ducts. They should be as low as possible without touching the bed when the nozzle does. Also, adding a silicone sock can greatly reduce this error. Otherwise, the following lines in the "configuration.h" file control the parameters of this "safety feature".

```
#define MAX_HEATING_TEMPERATURE_INCREASE 0.1 //[E3D] original value 10
#define MAX_HEATING_CHECK_MILLIS (90000) //[E3D] original value(30 * 1000)
```

If you want to disable this feature like it was back in v14.09 then you can comment out the following lines in the "temperature.cpp" file at your own risk:

```
// Commented out for UM2 because too sensitive for E3D HotEnd
// disable_heater();
// Stop(STOP_REASON_HEATER_ERROR);
```

This concludes the upgrade process, you should now have a fully working E3D HotEnd on your Ultimaker 2 series printer!

Changing nozzles

Your Ultimaker upgrade kit also includes a range of nozzles. These can all be swapped with the 0.4mm nozzle which we provide already installed on with the kit. However, this nozzle has been **hot tightened**, as should every nozzle used on your upgraded Ultimaker. This is to ensure perfect contact between the nozzle and the heatbreak. To swap nozzle, follow these simple steps (http://wiki.e3d-online.com/wiki/E3D-v6_Documentation#Swapping):

1. Remove the blue silicone sock from your **cold** hotend
2. Heatup your nozzle to around 270-280°C
3. Hold the block in place with a spanner of the correct size and, using the 7mm spanner provided in the nozzle tin, gently unscrew the nozzle. **TAKE GREAT CARE AS YOUR NOZZLE IS VERY HOT! DO NOT TOUCH WITH YOUR BARE HANDS!**
4. Once you have untightened the nozzle, let the hotend cool down
5. When the nozzle is cold, finish unscrewing the nozzle, and replace it with the nozzle of your choice and tighten lightly
6. Heatup your nozzle to around 270-285°C again
7. Hold the block in place with a spanner of the correct size and, using the 7mm spanner provided in the nozzle tin, gently tighten the nozzle.
8. let the nozzle cool down and replace the sock

Remember to change your slicer settings accordingly

E3D Edge Filament

The upgrade kit is supplied with a sample of E3D's Edge filament. In order to print with this material on the Ultimaker, a profile must be set up. This can be done in two ways:

Download the E3D Edge Ultimaker Profile and place this onto an SD card. Insert this into your Ultimaker then navigate to **MATERIAL > SETTINGS > Import from SD** on the interface. EDGE should now be present in the list.

If you would prefer, you can create a custom material profile directly on the printer instead by following the instructions in the next section.

Recommended Cura Settings

This upgrade kit now allows you to print with a much wider range of materials. However, different extrusion systems require different settings, so the standard Ultimaker settings might not prove satisfactory and we really recommend the creation of new slicing configurations. In Cura 2.1.3, these can be found in the "Advanced" section. Here are our recommended settings for the most common materials used (0.4mm diameter standard nozzle):

Quality

- Layer Height: 0.25mm
- Initial Layer Height: 0.3mm
- Line Width: 0.48

Shell

- Wall thickness: 1.2
- Top/Bottom Thickness: 0.75
- Horizontal Expansion: 0

Infill

- Infill Density: 25%
- Infil Pattern: Grid
- Disable Infill Before Walls

Material

- Enable Retraction
- Retraction Minimum Travel: 1.5mm

Speed

- Print Speed: 50mm/s
- Infill Speed: 40mm/s
- Wall Speed: 25mm/s
- Outer Wall Speed: 15mm/s
- Inner Wall speed: 20mm/s
- Travel Speed: 120mm/s
- Initial Layer Speed: 15mm/s
- Number of Slower Layers: 2

Travel

- Disable Combing

Cooling

- Enable Cooling Fans

Recommended Material Settings

On your Ultimaker, go to **MATERIAL > SETTINGS > Customize** and input the following settings depending on the material you are planning on using. Then select **Store as preset > New preset**. Note this will be called something like 'CUSTOM1' rather than 'EDGE'.

E3D's Edge

- Temperature: 230-240°C
- Heated buildplate: 80°C
- Diameter: 2.85mm
- Fan: 100%
- Flow %: 100%

- Retraction Distance: 2.00mm for 3mm filament, 25mm/s

Standard materials also have slightly different optimal values with your E3D V6 hotend and Titan Extruder:

PLA

- Temperature: 210-220°C
- Heated buildplate: 60°C
- Diameter: 2.85mm
- Fan: 100%
- Flow %: 100%
- Retraction Distance: 2.00mm for 3mm filament, 25mm/s

ABS

- Temperature: 240-250°C
- Heated buildplate: 100-110°C
- Diameter: 2.85mm
- Fan: 100%
- Flow %: 100%
- Retraction Distance: 2.00mm for 3mm filament, 25mm/s

Reverting back to stock configuration

If for any reason you are unsatisfied with the result of this upgrade, or wish to return your Ultimaker to its default configuration, simply follow the steps in this wiki in reverse order (once you have turned off your machine), install the appropriate default ultimaker firmware for your machine version and perform a factory reset upon powering it up again. This kit will not in any way stop you from reversing the process. Make sure that, if you intend to carry out this reverse modification, you keep all the components which you have removed from your Ultimaker, and store them in a safe place.

FAQ

What can I print with my E3D upgrade?	Any 3D printing filaments you can find! Up to hotend temperatures of 400°C
What does E3D mean for my Ultimaker?	E3D's modular extrusion system has every sized nozzle you could ever want, in a variety of materials, so you can print super-abrasive filaments such as carbon fibre or Glow PLA, by simply swapping your nozzle for a hardened steel version. You'll also start off with an awesome selection of 6 brass nozzles to get you started on printing with big, fat layers, or very fine detail.
What's the little YELLOW printed part?	It's for pushing down the connector that holds your filament guide tubing at each end (Bowden tube release tool).
All the wires look the same?	They should all arrive labelled at the lower end of the cables. If any labels have come loose, just watch the video guide or read the wiki to see where everything goes.
My hotend doesn't hit the endstop on the X and/or Y axis?	Check the wiki, you have probably mounted the carriage backwards or on the wrong side. No modifications are required to your endstops when assembled correctly.
I am experiencing some under-extrusion.	Check that you have uploaded the correct version of the firmware to your Ultimaker and that you have run the SD configuration file. Check that your filament flow is at or near 100%. Also, check your idler tension, we recommend making it tighter than looser as the Titan can easily cope with the extra grip, and is less likely to skip on retraction.
I am experiencing some over-extrusion.	Check that your filament flow is at or near 100%. Check your idler tension. We recommend making it tighter rather than looser as the Titan can easily cope with the extra grip, and is less likely to skip on retraction. Also, as above, check that the right filament diameter has been used, especially when using Simplify3D, where the default filament diameter is 1.75mm.
My first layer is not sticking to the bed.	Run the calibration procedure on the Ultimaker, and coat your bed with a light layer of UHU stick if you are using anything other than PLA. Also, run the bed hot to the material specifications.
How do I change my filament diameter in Cura 2.X?	You cannot, Ultimaker have "greyed it out". You can still see it in the settings, but unfortunately, in this latest version, you cannot change it. We recommend using an old version of Cura (15.X), which allows you to change the filament diameter in the advanced settings, or to use another slicer. We particularly recommend Simplify3D, which already has an Ultimaker 2/2+/2Extended/2+Extended profile. If you still want to use Cura 2.X, you still can, make sure, as mentioned above, to select the right filament diameter as you insert your filament, by creating a custom profile.
Does the filament change function still function on my upgraded Ultimaker 2/2+/2Extended/2+Extended ?	Yes it does.
Does my upgraded Ultimaker work with flexibles?	Yes it does. However the less soft flexibles are much easier to get running. We still recommend running the printing speed at 50% or lower of what you normally would.

Comparison Table

PRINTER AND PRINTING PROPERTIES	UM2	UM2+	E3D EDITION
Printhead	Fixed 0.4mm nozzle	Swappable nozzle	E3D v6 ecosystem
Build volume	223 x 223 x 205mm	223 x 223 x 205mm	218 x 215 x ~205mm (~305mm for Extended)
Filament Diameter	2.85mm	2.85mm	2.85mm
Printhead travel speed	30 to 300mm/s	30 to 300mm/s	30 to 300mm/s
X, Y, Z Resolution	12.5, 12.5, 5 micron	12.5, 12.5, 5 micron	12.5, 12.5, 5 micron
Material Capability	PLA, ABS, CPE, CPE+, PC, Nylon, TPU95A* 0.25, 0.4, 0.6, 0.8mm	PLA, ABS, CPE, CPE+, PC, Nylon, TPU95A* 0.25, 0.4, 0.6, 0.8mm	Pretty much any filament apart from the softest flexibles
Nozzle Diameters	0.25	0.25	0.25
			0.3
			0.35
	0.4	0.4	0.4
			0.5
	0.6	0.6	0.6
	0.8	0.8	0.8
Nozzle Materials	Brass	Brass	Brass, Hardened Steel, Stainless Steel
Nozzle temperature	180°C to 260°C	180°C to 260°C	Up to 380°C
Nozzle heatup time	~1 minute	~1 minute	~1 minute
Extruder	UM+ Standard Extruder	UM+ Standard Extruder	E3D Titan Extruder

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