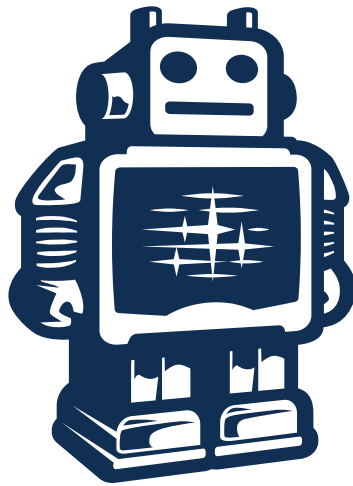


Ultimaker²



Ultimaker

Standard Operating Procedure

based on Ultimaker User Manual v2.1

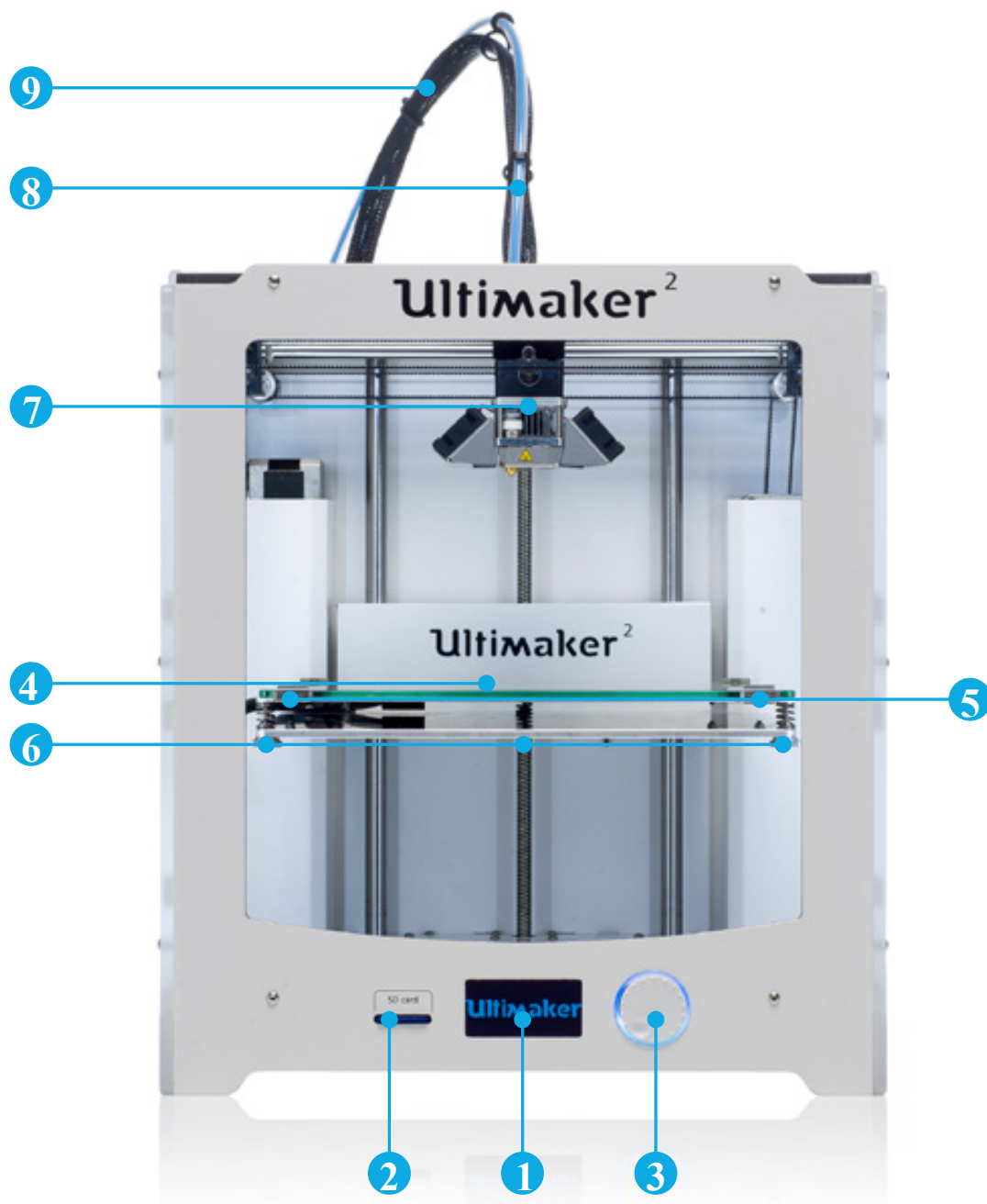
June 2018

www.ultimaker.com

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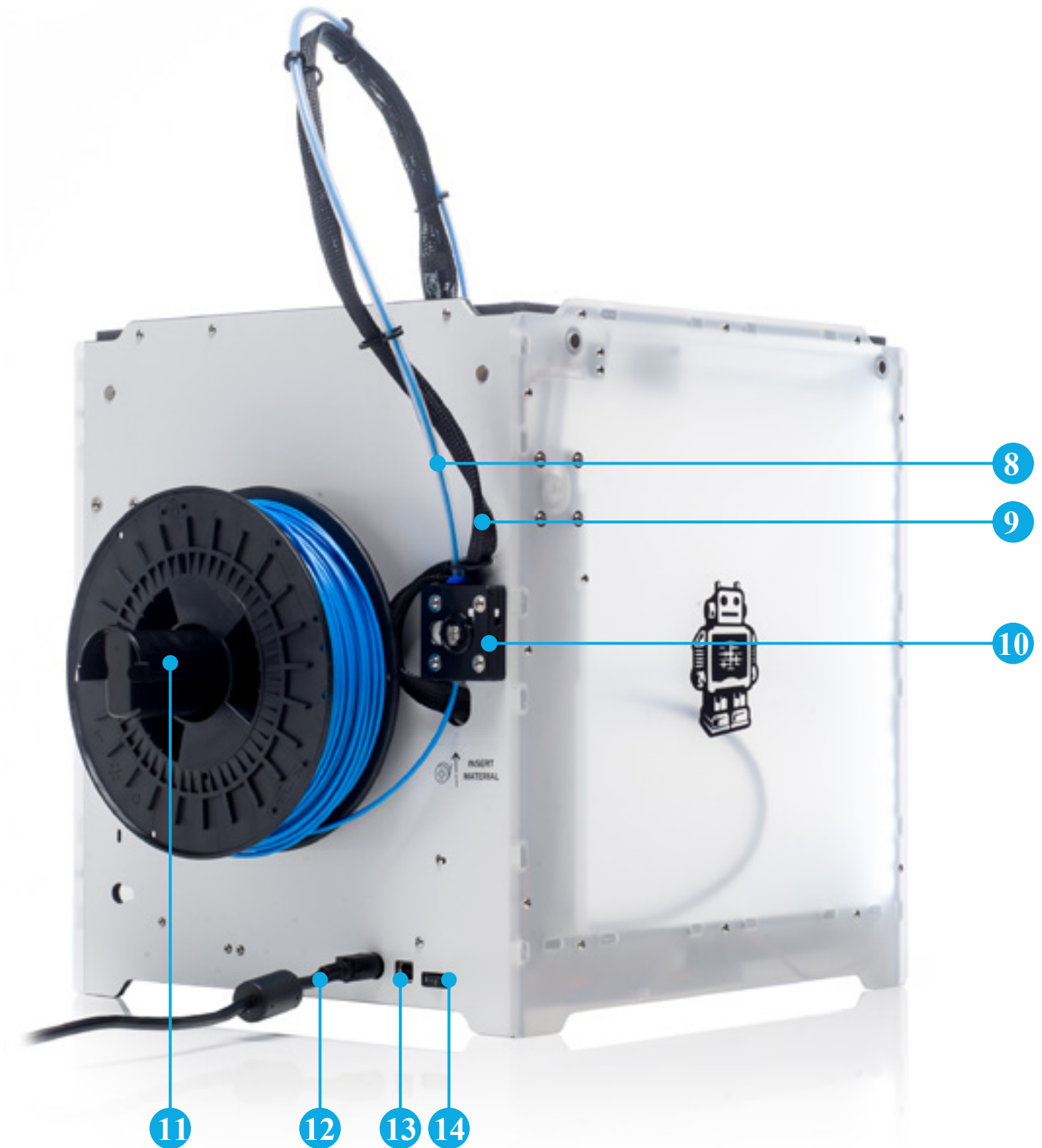
ULTIMAKER 2

The Ultimaker 2 is a 3D printer. It comes equipped with a heated build platform and can print at a resolution of up to 20 microns. It supports both PLA and ABS and can print at a speed of 300 mm/s. You might be familiar with other types of Ultimakers or 3D printers. It is however essential that you read this manual carefully in order to make the most out of your Ultimaker 2.



- | | | | | | |
|---|---------------------------------|---|--------------------|---|------------------|
| 1 | Display | 4 | Build plate | 7 | Print head |
| 2 | SD card slot Push/rotate button | 5 | Build plate clamps | 8 | Bowden tube |
| 3 | Rotate button | 6 | Build plate screws | 9 | Print head cable |

ULTIMAKER 2 AT A GLANCE



10 Feeder
11 Spool holder
12 Power socket

13 USB socket
14 Power switch

SPECIFICATIONS

Printing

Print technology	Fused Filament Fabrication
Build volume	223 mm / 223 mm / 205 mm
Layer resolution	Fast: 200 micron (0.2 mm) Normal: 100 micron (0. mm)1 High: 60 micron (0. Ulti: mm)06 40
Positioning precision	12.5 micron / 12.5micron(0.5 micron)04
Filament diameter	2.85 mm
Nozzle diameter	0 mm.4
Print speed	30 mm/s - 300 mm/s
Travel speed	30 mm/s - 350 mm/s

Software Supplied

software File types	Cura - Official Ultimaker Software
Supported OS	STL / OBJ / DAE / AMF Windows / Mac / Linux

Electrical

AC Input	100 - 240 V Approx. 1.4 AMPS 50 60- Hz W221 att max.
Connectivity	Stand-alone SD card printing

Physical dimensions

Desktop space	357 mm / 342 mm / 388 mm
Shipping dimensions	400 mm / 400 mm / 550 mm
Weight	11.2 kg
Shipping weight	18.0 kg

Temperature

Ambient operation temperature	15 - 32 °C
Storage temperature	0 - 32 °C
Nozzle operation temperature	180 - 260 °C
Heated bed operation temperature	50 - 100 °C

Sound

Average operational noise	49 dBA
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CAUTION: The Ultimaker 2 generates high temperatures and has hot moving parts that can cause injury. Never reach inside of the Ultimaker 2 while it is in operation. Always control the Ultimaker 2 with the button at the front or with the power switch at the back. Allow the Ultimaker 2 to cool down for 5 minutes before reaching inside.

CAUTION: When opening the Ultimaker 2 for service, ensure that the power supply is turned off and the power cable is disconnected from the wall socket.

CAUTION: Only use the power supply that came with your Ultimaker 2.

POWER SUPPLY

To operate ensure that the power supply will be connected. Before connecting it, make sure the power switch is in the “off” position.

1. Connect the power cable to the power brick.
2. Plug the power cable in the wall socket and connect the other side to the Ultimaker 2. The flat side of this cable needs to point upwards.
3. When ready to use, turn the Ultimaker on by putting the power switch in the “on” position.



CONTROL

The display at the front side of the Ultimaker 2 shows all the necessary information for setting up and using your Ultimaker 2. You can navigate through menus by rotating and/or pushing the button at the right side of the display. Rotating allows you to select or control an action; by pushing you can confirm an action. When pushing the button you will hear a “beeping” sound to confirm the action. A blinking button means the Ultimaker 2 is waiting for user input.



START A PRINT

Place your print files (*.gcode) on the SD card. Select one of the files and press the button to start.

After a print file has been chosen the Ultimaker 2 will prepare itself by homing the print head and build plate and heating up the build plate and nozzle. Please note that this can take up to 5 minutes.

While printing, the display will show the progress of the print and the remaining time for completion. When the print has finished, wait for the build plate to cool down and grab the print from the build plate.

NOTE: For good platform adhesion it is recommended to apply a thin layer of glue to the glass plate. Therefore you can use the glue stick delivered with the Ultimaker 2.

CAUTION: Don't touch the print head/nozzle while it is heating, printing or cooling down. Temperatures can reach up to 260°C.

If you want to switch between different (colors of) materials you first need to unload the filament that is already in the Ultimaker 2, after which you can insert the new filament.

REMOVE OLD FILAMENT

Removing the filament can simply be done by following the steps below.

1. Access the material change menu on your Ultimaker 2 by going to “Material” > “Change”.
2. Wait a minute while the print head is heating up. By heating it up we ensure that the filament is being melted before retracting it from the nozzle.
3. When the nozzle is hot, the Ultimaker 2 will automatically start turning the feeder wheel, through which the filament will be rewind completely. If the filament doesn’t come out of the feeder completely you can simply pull it out by hand.

Note: Make sure the feeder is free of any small pieces of filament before inserting new material. You can remove small pieces of filament with tweezers. For easier access you can loosen the bowden tube at the top of the feeder by removing the clamp clip, pressing down the tube coupling collet and pulling out the bowden tube.

LOAD NEW FILAMENT

After removing the filament you can start loading the new filament in the same way as done during the first setup of your Ultimaker 2. Make sure the old spool with filament is removed from the spool holder and the new one is placed.

1. Take the end of the filament, insert it into the bottom of the feeder and push it until the filament is being grabbed by the knurled wheel. This may require some force. Once the knurled wheel has grabbed the filament, it will slowly move it further into the bowden tube.
2. Wait till the filament reaches the first black bowden tube clip and then press the button to continue. The Ultimaker 2 will automatically load the filament through the bowden tube, into the print head.

Now you just have to wait until the filament is coming out of the nozzle. You may notice a ticking sound at the feeder; this is nothing to worry about. If necessary you can manually push the filament in order to get it through the nozzle with a bit more force.



BED LEVELING

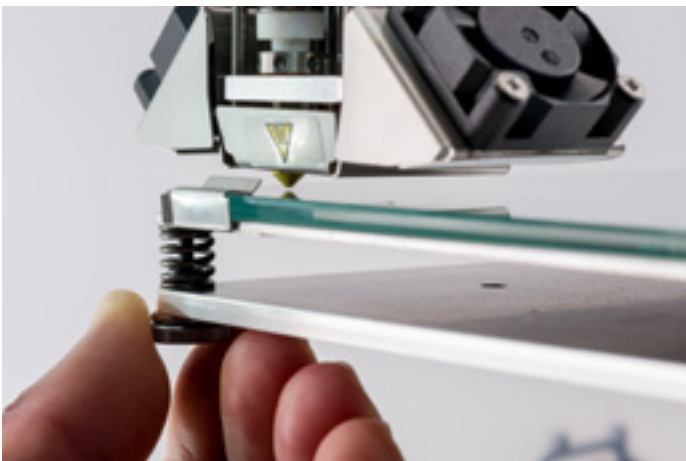
The first layer of a print is very important. Therefore regular bed leveling is advised. Always re-level the build plate when you notice that the plastic is not equally placed on the glass plate. After transportation of your Ultimaker 2 it is also advised to re-level the build plate to ensure your 3D prints stuck well to the build plate.

BED LEVELING PROCEDURE

The basic steps for bed leveling are described below.

1. Go to “Maintenance” > “Build plate” to start the bed leveling process on your Ultimaker 2.
2. Wait for the Ultimaker 2 to do its homing procedure and continue when the print head is in the center at the back of the build plate.
3. The first calibration step is to roughly level the build plate by rotating the button at the front of your Ultimaker 2 until there is approximately 1 mm distance between the nozzle and build plate. The measurement here is not critical, just make sure that the nozzle is close to the build plate without touching it.
4. Next, the same adjustment will be done on the front left and right side, but this time by turning the build plate screws. If you turn them to the left the build plate will get closer to the nozzle.
5. The last step will be fine-tuning of the build plate with the “calibration card”. If necessary further adjustment can be done by turning the build plate screws. Place the calibration card in between the nozzle and build plate on all 3 points and adjust the build plate screws until you feel slight friction when moving the card.

NOTE: Don't push on the build plate while fine-tuning with the calibration card; this will lead to inaccuracies.



For the Ultimaker 2, we recommend our free Cura software to prepare your 3D print files. Cura quickly and accurately converts 3D models into 3D print files within seconds, showing you a preview of the print so you can be sure everything is as you would like it to be.

INSTALLATION

The Cura software can be found at www.ultimaker.com/software. After downloading, open the installer and run the installation wizard to complete the installation. When opening Cura for the first time, you will be asked to select your 3D printer; select the Ultimaker 2. No other configuration is required and you can directly start using Cura.

USING CURA

The basic process of converting a 3D model to a print file in Cura is described below.

1. Load a 3D model (STL, OBJ, DAE or AMF file) into Cura via the “Load” button.
2. Choose your desired settings and wait for Cura to slice the model.
3. When Cura has converted the file you can save the print file (GCode) via the “Save” button. If the SD card has been inserted it will directly save the file to the SD card.
4. Remove the SD card from your computer - make sure to safely remove it - and insert it in your Ultimaker 2 to start printing.

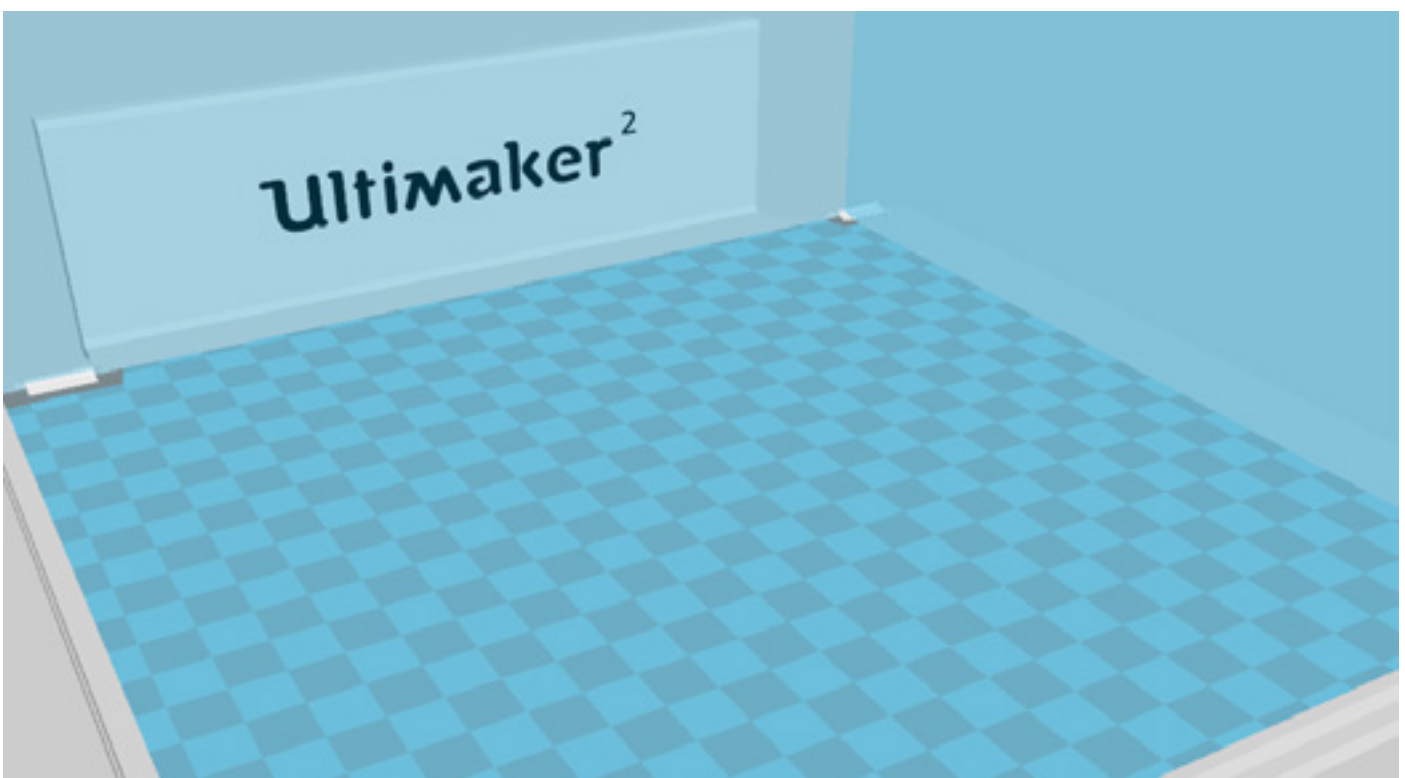
When using Cura for the first time you will see the “Quickprint” profiles. This is perfect for beginners, but when you’re a more experienced user and want to have more control over the print settings you can also switch to the “Advanced” mode. For more information on using Cura you can visit the Cura support pages: www.ultimaker.com/support/software

UPDATING FIRMWARE

Regularly a new Cura version is released, including a new firmware version as well. Make sure to install the latest version of Cura and firmware once available in order to stay up to date. The latest version of Cura can always be found at www.ultimaker.com/software.

In order to install the latest firmware on your Ultimaker 2, please take the following steps:

1. Connect the Ultimaker 2 to your computer with the USB cable.
2. Attach the power supply and turn the Ultimaker 2 on.
3. Start Cura and go to “Machine” > “Install default firmware” (make sure the Ultimaker 2 is selected in the “Machine” menu). Cura will now automatically upload the latest firmware to your Ultimaker 2.



USING GLUE

Although the heat of heated bed already takes care of the adhesion of your print to the glass plate, this is not always enough. For even better adhesion it is in some cases desired to also use glue on the glass plate.

WHEN TO USE GLUE?

The use of glue usually depends on the material you're using and the size and shape of the model.

For ABS and CPE we recommend to always use glue, because these materials have more “warping”. This means that the plastic will curl up. Warping basically happens because of the properties of the plastic. Plastics have the tendency to shrink when cooling down fast (some plastics more than others), which could eventually lead to your print curling up (at the corners). Since ABS and CPE have a relatively big shrinkage you will need glue to prevent it from warping.

PLA on the other hand, has a much lower shrinkage and thus less warping. Because of this it's often possible to print PLA directly on the glass plate, without glue. In this case you need to make sure that the glass plate is completely free from dust and oil though, because plastic won't stick well to a greasy surface. There are however situations in which glue on the glass plate is desired. If you want to print a model that has a big footprint, or with very thin parts at the bottom it's advised to use glue to prevent it from getting loose.

HOW TO USE?

The glue stick that was delivered with your Ultimaker 2 can be used for the glass plate. Therefore simply put a thin, even layer of glue on the glass plate. It's only necessary to apply glue to the print area.

TIP: To better distribute the glue over the platform you can use a damp cloth. This way a very thin layer of glue will be left on the glass plate.



When turning on your Ultimaker 2, you will always see the Ultimaker logo first after which you will go to the main menu. The main menu offers three options: PRINT, MATERIAL and MAINTENANCE.

PRINT

The “Print” menu simply allows you to select one of the print files from the SD card and will automatically start the print after that.

MATERIAL

In the “Material” menu you can either change the filament on your Ultimaker 2 or change the settings of material profiles. When selecting “Change” the Ultimaker 2 will start the procedure as described in chapter 3. In the “Settings” menu you can select material profiles and change their settings in the “Customize” menu.

MAINTENANCE

The “Maintenance” menu offers various options. By selecting “Build plate” you will be guided through the bed leveling steps. In the “Advanced” menu several options can be selected in order to manually do certain actions or change machine settings. Below a short overview of all these options is shown.

- LED settings Change the settings of the LED lights in your Ultimaker 2 Set
- Heatup nozzle custom temperature to manually heat up the nozzle
- Heatup buildplate Set a custom temperature to manually heat up the heated bed
- Home head Homes the head in the left back corner of the Ultimaker 2
- Lower buildplate Moves the build plate to the bottom of the Ultimaker 2
- Raise buildplate Moves the build plate to the top of the Ultimaker 2
- Insert material Heats up the nozzle after which you can insert filament
- Move material Heats up the nozzle after which you can use the scroll wheel to forward the material Set the
- Set fan speed speed of the two fans at the sides of the print head
- Retraction settings Customize the settings for retraction
- Version Shows the current firmware version on the Ultimaker 2
- Runtime stats Shows for how much time the Ultimaker 2 has been on and printing
- Factory reset A complete reset of your Ultimaker 2 through which you can completely recalibrate it

FINE-TUNING

The Ultimaker 2 also offers you the possibility to fine-tune settings during the printing process. This allows you to get full control over the printing process and helps you achieving the best print results. You can do this by accessing the “Tune” menu during printing. The Tune menu basically shows you the same settings as in the Advanced menu, which means that you can change settings like for example the temperature and speed of printing. Furthermore, it is possible to select “Pause”, after which you can change the filament in the middle of a print and resume again.



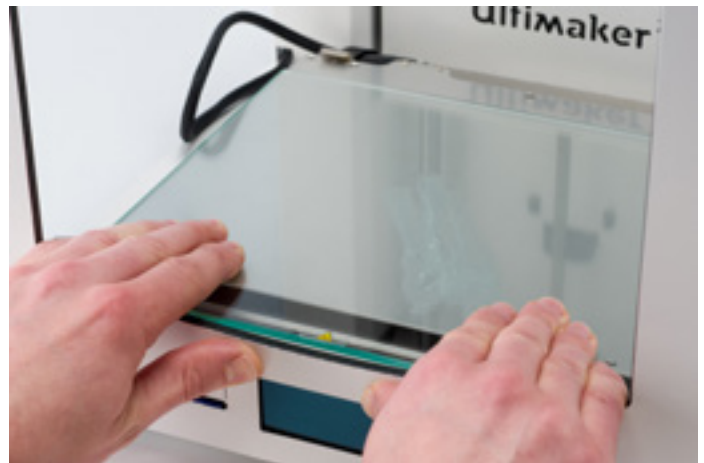
CLEANING THE GLASS PLATE

After a lot of printing, there sometimes can be too much excess glue stuck to the glass plate. This can cause an uneven print surface and it is therefore recommended to clean the glass plate once in a while. When doing this, always make sure that the Ultimaker 2 is turned off and build plate has cooled down.

1. Before taking out the glass plate, first manually move the build plate to the bottom of the Ultimaker 2. This way damage on the print head or Z trapezoidal leadscrew is prevented.
2. Open up the build plate clamps at the front side by using a hex wrench.
3. Slide the glass plate to the front of the build plate until you can take it out of the Ultimaker 2.
4. For cleaning it is advised to use some warm water and to brush off any excess glue. If necessary you can also use some soap to clean it.
5. The glass plate can simply be place back by sliding it onto the build plate until it snaps into the build plate clamps at the back of the build plate. Close the build plate clamps at the front side by hand in order to secure it.

CAUTION: The glass plate is positioned on an electrical heating area, so make sure it is completely dry before placing it back.

NOTE: In order to be sure about a successful next print we recommend to re-level the build plate after having repositioned the glass plate.



THE FEEDER & LUBRICATING THE AXES

Using the feeder in the right way and keeping it clean is important for a good extrusion. Tips on maintaining the feeder are described below.

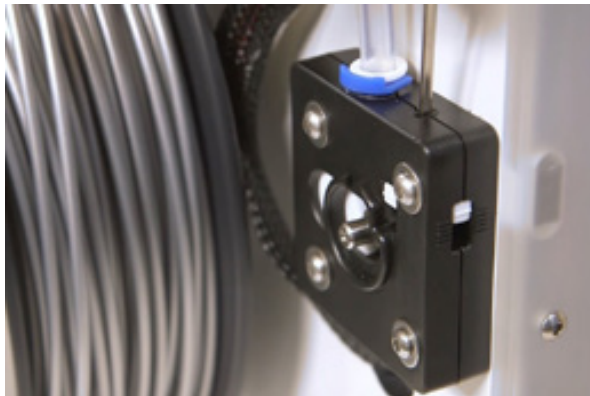
FEEDER TENSION

In order to guide the filament properly through the feeder into the bowden tube and print head, it's important that the tension on the feeder is set correctly. If the tension is too high, it means that the knurled wheel of the feeder will dig into the filament, through which it flattens or - even worse - completely gets stuck. This is what we call grinding.

To prevent grinding of the filament it is therefore important to set the tension on the feeder as loose as possible, meaning that the white insert clip should be completely at the top. You can achieve this by inserting one of the hex wrenches in the hole on top of the feeder and turning it clockwise.

CLEANING THE FEEDER

After a lot of printing, the knurled wheel in the material feeder can accumulate small plastic particles. You can clean this by blowing air on the knurled wheel or using a simple brush. It is also recommended to clean the feeder when you notice grinding of the filament.



To maintain your Ultimaker 2 correctly and keep it running smoothly it is recommended to lubricate the axes once in a while.

X AND Y AXES

When you notice small ridges on the surfaces of your 3D printed objects or feel that the X and Y axes are dry it is advised to put a single drop of sewing machine oil onto the X and Y axes. This will help your Ultimaker 2 running smoothly. Sewing machine oil is not included in the Ultimaker 2 package, but we highly recommend to only use this for lubricating the X and Y axes.

Z TRAPEZOIDAL LEADSCREW

Once every half year the Z trapezoidal leadscrew has to be lubricated with Magnalube. This is the green grease that was delivered with your Ultimaker 2. Make sure to spread 10 drops of grease over the entire threaded rod. With your next print the Ultimaker 2 will lubricate the axis itself by moving up and down.

NOTE: Magnalube should be applied to the Z trapezoidal leadscrew only; make sure to not put it on any of the other axes.



ATOMIC METHOD

After a longer time of using your Ultimaker 2 you might notice some signs of “under extrusion”. This means that your Ultimaker 2 can’t extrude enough plastic and is usually shown by very thin or missing layers in a print. In most cases, it is caused by some dirt or carbonized material in the nozzle or another hot end part through which a (partial) blockage is created. When under extrusion appears it is recommended to use the Atomic Method in order to clean the nozzle and other hot end parts. Below, the process of this simple though very effective method is described.

NOTE: It is also advised to use the Atomic Method when switching from a material that needs a higher printing temperature to one that uses a lower printing temperature in order to make sure any residue from the previous filament is removed.

REMOVE THE FILAMENT

- Go to MATERIAL > CHANGE in order to remove the filament and instead of inserting new material, select CANCEL
- Keep the print head in the corner

REMOVE THE BOWDEN TUBE

- Remove the (blue or red) clamp clip
- Press down the tube coupling collet and pull the bowden tube out of the print head



HEAT UP AND PREPARATION

- Go to MAINTENANCE > ADVANCED > Heatup nozzle and set the temperature to 260 degrees
- Cut off approximately 20 cm of filament with a straight cut and try to straighten the filament as much as possible
- When the temperature is reached, insert the straightened piece of filament manually all the way down to the nozzle
- Push it slightly until either the new filament comes out of the nozzle or until the filament can’t be pushed any further



REMOVE THE NEW FILAMENT

- Lower the temperature to 90 degrees (for PLA) or 110 degrees (for ABS)
- Once the temperature has been reached, pull the filament out with a quick, firm pull
- Check the color and shape of the tip of the filament; the goal is to have a clean, cone-shaped tip
- Repeat step 3 and 4 until the filament comes out without any residue and has a cone-like shape



RE-ASSEMBLY

- Insert the bowden tube through the tube coupling collet all the way down into the PTFE coupler
- Place the clamp clip around the tube coupling collet so that it secures the bowden tube



Below a short overview of the most common issues is shown. And the next page will show an overview of possible errors on the Ultimaker 2. For more instructions please take a look at the Ultimaker website: www.ultimaker.com/support

EXTRUSION PROBLEMS

Extrusion problems can occur in different ways and can have several reasons. The nozzle could simply be completely block, through which no material is coming out of the nozzle at all. But it could also mean that the Ultimaker 2 just doesn't extrude enough plastic, leading to very thin or missing layers in a print. This is what is called "under extrusion".

In most cases, extrusion problems are caused by some dirt or carbonized material in the nozzle or another hot end part through which a (partial) blockage is created. In order to get rid of this there are a few things that can be done:

- Check if the filament has not grinded in the feeder. If it did, remove it from the machine first.
- Make sure the tension on the feeder is as loose as possible (white insert clip at the top).
- Try to manually extrude some material by using the 'Move material' option in the Advanced menu. You can put some extra force on it by manually pushing the material at the feeder while doing this.
- Use the Atomic Method to remove any dirt or carbonized material from the hot end.

After having used the Ultimaker 2 for a longer time already it could also mean that the PTFE coupler has deformed, causing friction to the filament. This consumable item has the tendency to wear over time due to the heat and pressure from the hot end. If none of the above described options works, it is advised to take a closer look at the PTFE coupler. A deformed PTFE coupler can be recognized by a (small) brim on the inside at the bottom. Instructions for this can be found on the website.

CAN'T CONNECT TO CURA

If Cura doesn't recognize your Ultimaker 2 when you want to upload firmware, there is a problem with the connection due to software or hardware failure. The following checks are advised in this case:

- Make sure everything is connected properly (power supply and USB cable) and that the Ultimaker 2 is turned on when uploading firmware. If possible, you can also try another USB cable.
- Check if the latest version of Cura is installed on your computer.
- Try connecting on a different computer, preferably with a different Operation System.

PRINT NOT STICKING TO BUILD PLATE

When you're experiencing difficulties with prints sticking to the build plate, there could be a few things going on. It could either mean that the first layer just doesn't stick well enough or that the prints gets loose due to "warping" of the plastic. Warping basically happens because of the properties of the plastic. Plastics have the tendency to shrink when cooling down fast (some plastics more than others), which could eventually lead to your print curling up (at the corners). You will especially notice this behaviour when printing ABS, which has a relatively big shrinkage.

In order to decrease the amount of warping and have a good first layer you can do the following:

- Check if the heated bed is set to the correct temperature (60°C for PLA and 90°C for ABS).
- In order to have a nice first layer, make sure that the build plate is properly leveled.
- For good adhesion you will either need a completely clean glass plate (e.g. no oil on it) or a thin layer of glue applied to the glass plate.
- A nice feature in Cura to help preventing warping is called "Brim". It will place a single layer thick flat area around your object, thus creating a bigger adhesion surface.

ERROR MESSAGES

ERROR - STOPPED TEMP SENSOR	This refers to a problem with the PT100 B sensor, which is the sensor that measures the temperature of the nozzle. It means that the sensor registers incorrect values and due to safety reasons it will prevent the nozzle from heating up. The most likely reason for this is connection problem, which could either happen due to a bad connection at the main board or damage of the sensor itself.
ERROR - STOPPED TEMP SENSOR BED	This error refers to a problem with the sensor of the heated bed. It means that the sensor registers incorrect values and due to safety reasons it will prevent the heated bed from heating up. The most likely reason for this is connection problem, which could happen due to a bad connection on the heated bed or main board, or damage of the sensor itself.
ERROR - HEATER ERROR	The heater error can appear when the sensor doesn't register a steady (increase in) temperature. This could mean that the heater cartridge is not connected properly and to prevent overheating of the nozzle it will therefore turn the heater cartridge off.
Z-SWITCH BROKEN or Z-SWITCH STUCK	If you get one of these errors it means that there is a problem with the Z limit switch. It either tells you that the Z limit switch can't be pressed or that something is preventing the lever of the switch from switching back.
X OR Y SWITCH BROKEN	This error occurs when either the X or Y limit switch is not activated while the print head is homing.

In case you run into any difficulties with your Ultimaker 2 or need advice on using your Ultimaker 2, then please take a look at the Ultimaker website: www.ultimaker.com/support

The website contains a wealth of (troubleshooting) information and is a great source for quickly trying to solve issues on your own and getting more experienced with 3D printing. We also have a very active online community with experienced users who are willing to share tips and solutions and can help you getting the best out of your Ultimaker 2 as well.

If you ever need personal help resolving an issue with your Ultimaker 2 you can also get in touch with one of our local support partners. On the website you can find all the contact details.

SAFETY AND COMPLIANCE

ELECTROMAGNETIC COMPATIBILITY (EMC)

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

The Ultimaker 2 can in very rare cases temporarily lose display function caused by ESD. Display function can be fully restored by turning the machine off and then on again.

The EMC test report of the Ultimaker 2 is available on request at info@ultimaker.com.

ELECTRICAL SAFETY

The Ultimaker 2 operates on 24 volts (Extra-low-voltage) and is therefore outside the scope of the low-voltage directive. The power supply meets all CE mark regulations and is protected against short-circuit, overload, over voltage and over temperature. For more information concerning electrical safety aspects we refer you to the Mean Well EC-Conformity Declaration for the GS220AX power adapters.

Only use the Ultimaker 2 with power supplies and cables supplied by Ultimaker B.V..

CAUTION: Always unplug the printer before doing maintenance or modifications.

MECHANICAL SAFETY

The Ultimaker 2 contains many moving parts, but the stepper motors do not have enough power to cause serious injuries and moving gears have been covered. Still, it is advised to only reach in the machine when it is turned off.

CAUTION: Always unplug the printer before doing maintenance or modifications.

RISK OF BURNS

There is a potential risk of burns, as the print head can reach temperatures of up to 260°C and the heated bed of up to 120°C. The nozzle of the print head is mostly surrounded by an aluminum cover to prevent contact, but still we advise against reaching in the machine when the print head and/or heated bed are hot.

CAUTION: Always let the printer cool down for at least 30 minutes before doing maintenance or modifications.

HEALTH

The Ultimaker 2 is designed to print with PLA and ABS filaments. The use of other materials is at your own risk.

When printing ABS, small concentrations of Styrene vapor can be released. This can (in some cases) cause headaches, fatigue, dizziness, confusion, drowsiness, malaise, difficulty in concentrating, and a feeling of intoxication. Therefore good ventilation is required, and long term exposure should be avoided. It is advisable to use a fume hood (with active carbon filtering for ductless extraction). Fume extraction is mandatory for use in offices, classrooms and alike.

Printing pure PLA is considered safe, although good ventilation is still advised for possible unknown vapors released from coloring dyes in colored PLA.

CAUTION: Only use your printer in a well-ventilated area.

GENERAL SAFETY INFORMATION

The Ultimaker 2 is not intended for use by persons (including children) with reduced physical and/or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning the use of the appliance by a person responsible for their safety.

Children should be under constant supervision when using the printer.

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide.

The conditions or methods used for assembling, handling, storage, use or disposal of the device are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, injuries, damage, or expense arising out of or in any way connected with the assembly, handling, storage, use or disposal of the product.

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