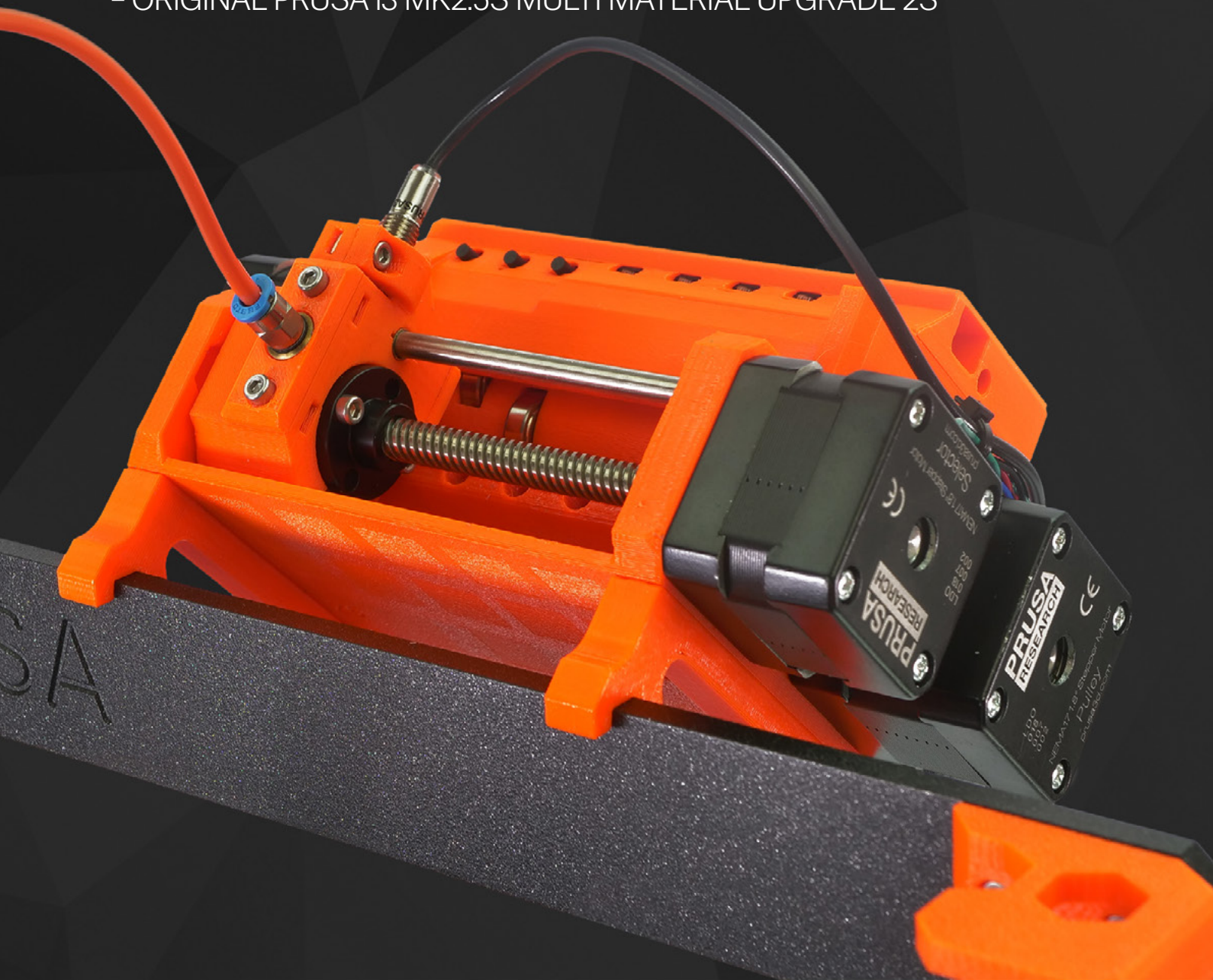# 3D PRINTING HANDBOOK

USER MANUAL FOR 3D PRINTERS:
– ORIGINAL PRUSA i3 MK3S MULTI MATERIAL UPGRADE 2S
– ORIGINAL PRUSA i3 MK2.5S MULTI MATERIAL UPGRADE 2S

PRUSA RESEARCH
by JOSEF PRUSA

ENG

(i) **Please always refer to http://www.prusa3d.com/drivers/**
for an updated version of this 3D printing handbook (PDF download).

Translated versions of the handbook are available at:

Czech: www.prusa3d.cz/ovladace/
French: www.prusa3d.fr/drivers/
German: www.prusa3d.de/treiber/
Polish: pl.prusa3d.com/sterowniki/
Italian: www.prusa3d.it/driver/
Spanish: www.prusa3d.es/drivers-y-manuales/

Assembly manual is available at http://manual.prusa3d.com

Multi Material Upgrade 2S (MMU2S) is compatible only with Original Prusa i3 MK3S / MK2.5S.

This handbook is based on the MMU2S firmware version 1.0.6 and MK3S/MK2.5S firmware version 3.8.0. Using other (older) firmware versions may lead to incorrect results. Please, update your MMU2S unit regularly.

USEFUL LINKS

- Official website: www.prusa3d.com
- Newest drivers: www.prusa3d.com/drivers
- Knowledge base: help.prusa3d.com
- E-shop: shop.prusa3d.com
- PrusaSlicer @ GitHub: www.github.com/prusa3d
- MMU2S Objects: www.prusa3d.com/printable-3d-models/

Symbols used in this handbook:

(i) Important notice, tip, hint or information that helps you print with ease.

⚠ Read carefully! This part of the text has the greatest importance - either for user safety or for proper printer service.

About the author

Josef Prusa (born Feb 23rd, 1990) became interested in the 3D printing phenomenon before joining Prague's University of Economics in 2009. At first, 3D printing was a hobby, a new technology open to changes and improvements. This hobby soon became a passion and Josef grew into one of the leading developers of Adrien Bowyer's international, open-source, RepRap project. Today, you can see the Prusa design in different versions all around the world. It is one of the most popular printers, and thanks to Josef Prusa's machines, the knowledge of the 3D printing technology significantly increased among the public.

Jo's work on self-replicating printers (you can print the other printer parts with your printer) is still ongoing. Currently, the Original Prusa i3 MK3S is on the market - the third and latest iteration of the original 3D printer. It is constantly updated with the latest innovations, such as the brand new Multi-Material Upgrade 2S, which you have just purchased.

Josef Prusa also organizes workshops for the public, participates in professional conferences dedicated to the popularization of 3D printing. For example, Josef lectured at the TEDx conference in Prague and Vienna, at World Maker Faire in New York, Maker Faire in Rome and at the Open Hardware Summit hosted by MIT. In addition, Josef teaches Arduino at Charles University and was a lecturer at the Academy of Arts in Prague.

In his own words, he imagines that 3D printers will be available in every home in the not-too-distant future. "If anything is needed, you can simply print it. In this field, you just push the boundaries every day... We're glad you're part of it with us!"

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1 About the product

Multi Material Upgrade 2S (MMU2S) is the latest revision of the Multi Material Upgrade 2.0, originally released in 2018. Our unique multi-material printing solution is now compatible with the Original Prusa i3 MK2.5S and MK3S 3D printers. Actually, MMU2 and MMU2S units are almost the same, but the printer extruder is equipped with a new filament sensor mechanism, which improves the reliability of the MMU2S unit. Thanks to the new type and placement of the filament sensor, the MMU2S unit now receives feedback from the printer, that the filament is loaded into Bondtech gears, making the complicated filament length calibration obsolete. The MMU2S allows to load up five filaments simultaneously, which enables the users to print even more complex and more colorful objects.

To unlock the maximum potential of your printer with the MMU2S, use our latest PrusaSlicer slicing software. Offering a multitude of unique features, PrusaSlicer is the go-to solution for single and multi-material printing. The latest version introduces options such as **Wipe to infill** or **Wipe object** and helps you save time and filament by utilizing various smart routines. See the picture below to learn the official names for each MMU2S part. We will be referring to these names in our guide.
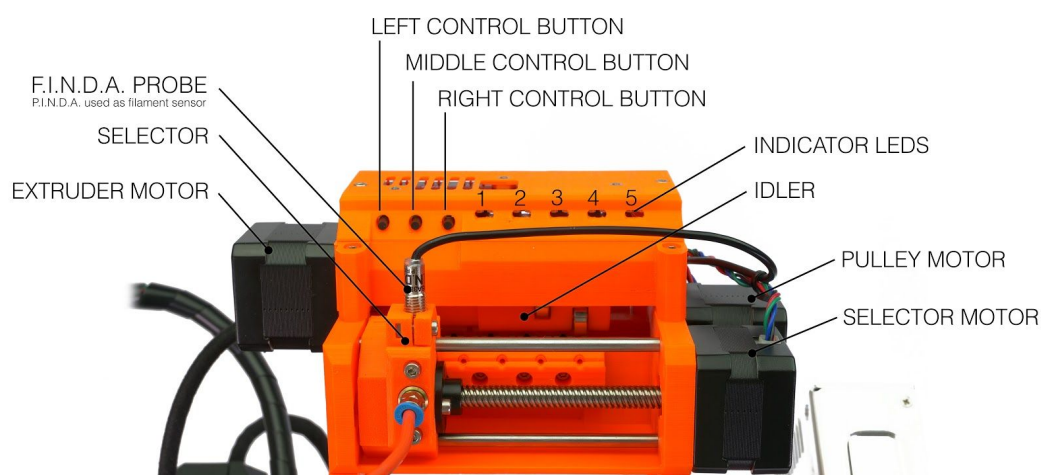
Pict. 1 - The Multi Material Upgrade 2S
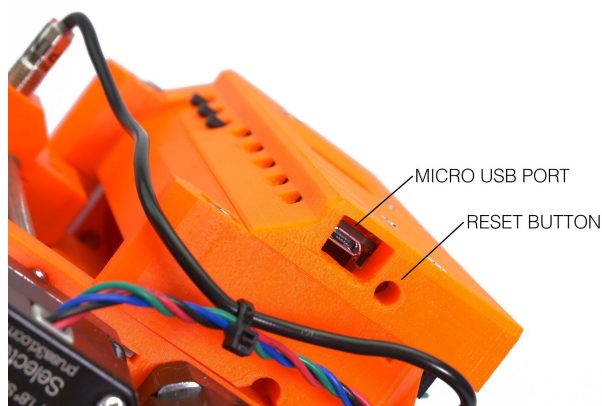
Pict. 2 - Location of the Reset button and of the micro USB port

2 Quick-start instructions

We get it. You just assembled the MMU2S according to Assembly Guide, connected it to your printer and now you are eager to start printing. :) But give us just a second! There's a couple of important steps you need to take before you can print your first multi-material G-Code. Please note that these instructions are just a quick overview for users who already have experience with 3D printing. We highly recommend reading the full instructions.

1. **Download and install Drivers & Apps from www.prusa3d.com/drivers, update printer firmware with PrusaSlicer.**
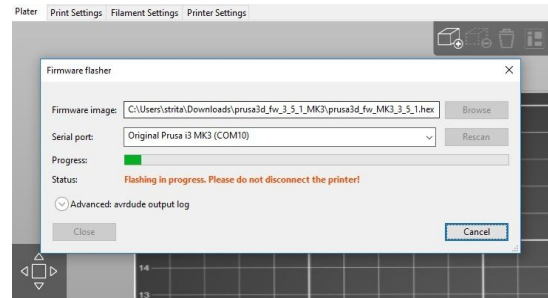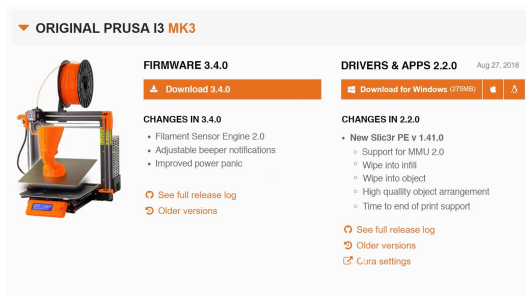
2. **Place filament spool holders next to the printer, the filament buffer behind the printer and pull filament strings through the filament buffer in designed order.**
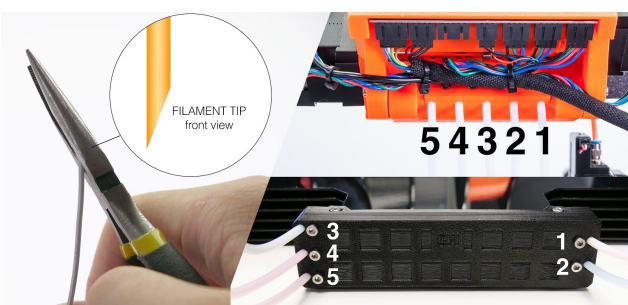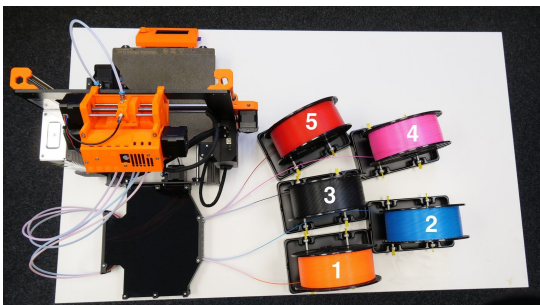
3. **Run Z-axis, IR filament sensor and First Layer calibrations.**
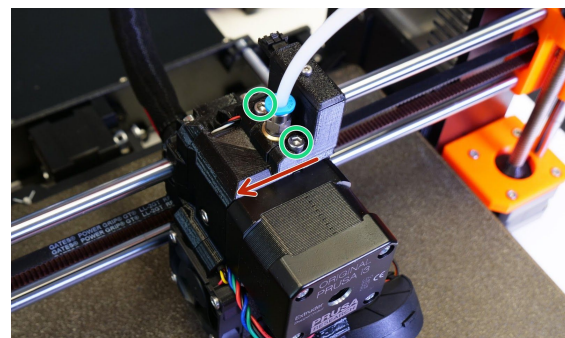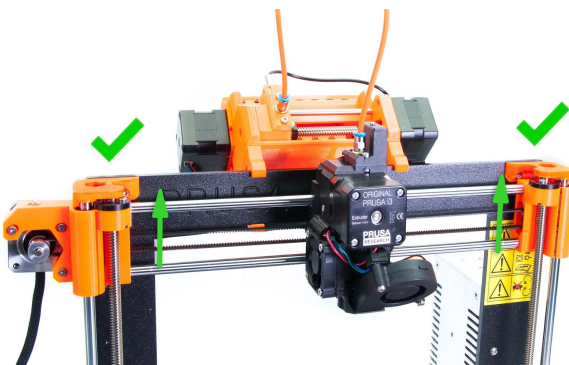
4. **Print your first test object!**

3 Placement and setup

During filament changes, all of the filament is unloaded from the orange/white PTFE tube in the front. Our new solution for dealing with retracted filament is a device called filament buffer. The filament string creates a loop inside in order to prevent tangling. The setup requires a space of at least 70 × 100 cm.
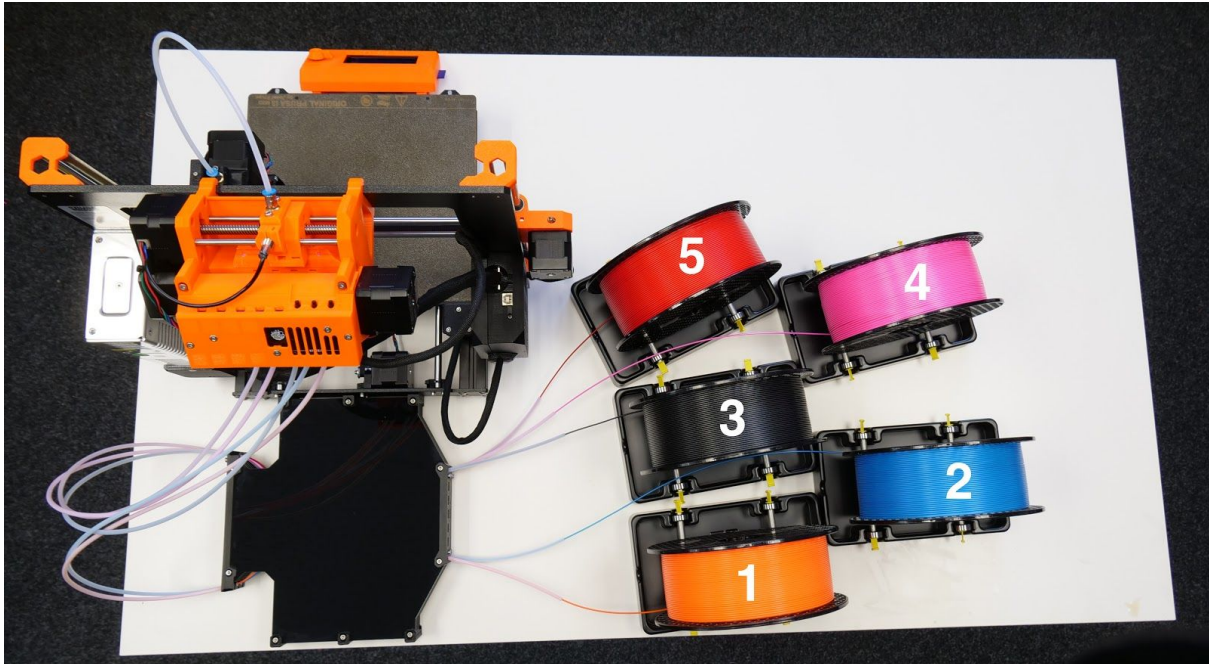
Pict. 3 - Filament buffer and spool holders setup

Basic steps for the arrangement of spool holders and the filament buffer:

1. Place the filament buffer behind the printer and attach it to the frame using the built-in clips. Pay attention to the **correct orientation** of the filament buffer.
2. Attach PTFE tubes leading from the MMU2S unit in the designated order and secure them with screws. See Pict. 4.
3. Place the spool holders into two lines. The first line of spool holders should be at least 20 cm from the filament buffer. Three spools are in the front line and two spools between them in the rear line. Make sure, that the short PTFE tubes on the other side of the buffer are pointing toward the spool holders (see picture above for reference)
4. Insert all filament strings through the filament buffer in the correct order (Pict. 5). **Avoid crossing the filament strings in the buffer**. The string must go directly through opposing holes on the same level (Pict. 5).
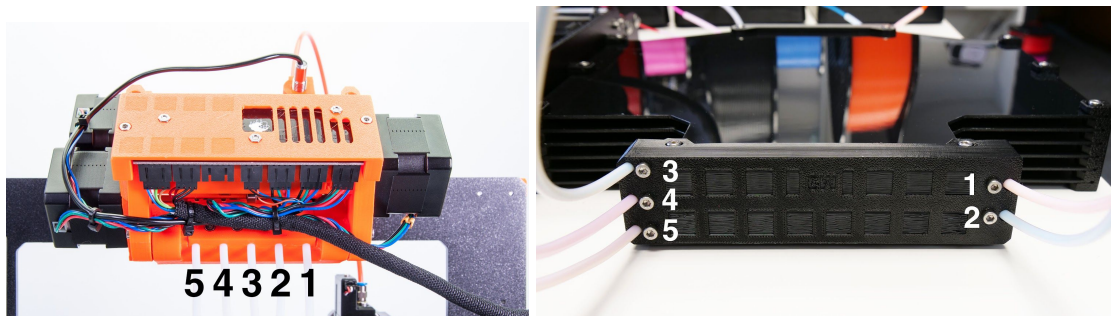
Pict. 4 - Order of PTFE tubes plugged to the buffer
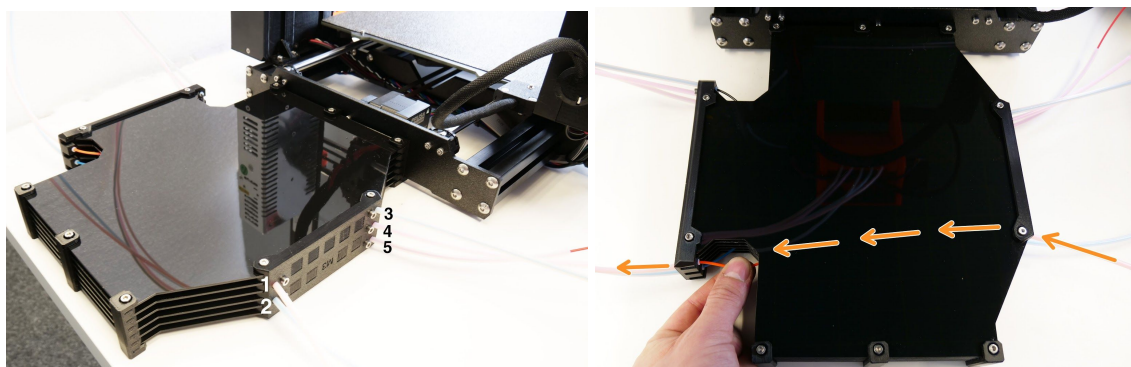
Pict. 5 - Loading filament into the buffer

The placement described above is ideal as initial setup and it is designed to save as much space as possible. Alternatively, you can place the filament buffer and spool holders behind the printer in line. There are other possible setups that you can try, so feel free to experiment. But remember, that **excessive bending of PTFE tubes causes high resistance when loading filaments**, which may result in various issues during printing.

4 Flashing the firmware

Before you start using the MMU2S, the **printer's firmware needs to be updated,** otherwise, the printer won't communicate with the new unit. The MMU2S motherboard can be also updated with new firmware, which comes as a separate file. Please keep in mind that there are slightly different flashing procedures for each board and that firmware files for the printer and the MMU2S can be released independently. Drivers, apps and firmware files can be downloaded from www.prusa3d.com/drivers.

⚠️ **WARNING: Do not disconnect the printer during the flashing process!**
MAKE SURE YOU HAVE THE CORRECT FIRMWARE FILE FOR THE DEVICE YOU WANT TO UPDATE

4.1 Flashing firmware on Windows

1. Go to www.prusa3d.com/drivers and download the correct firmware for your printer and/or MMU2S unit. Please note that there is a different firmware for each of our printers and also a different type of firmware for the MMU2S.
2. Download the latest **Drivers & Apps package** from the same page and install it. Make sure that **PrusaSlicer and Drivers are selected** in the installation wizard.
3. Turn on the printer and wait for the initialization to complete.
4. Connect your printer to your PC using a USB cable. The type of USB cable and the port depending on which type of firmware you want to flash.
   a. **TO FLASH PRINTER FIRMWARE:** Use the standard procedure - connect the **printer mainboard (RAMBo)** to your PC using a square-shaped **USB-B 2.0** cable.
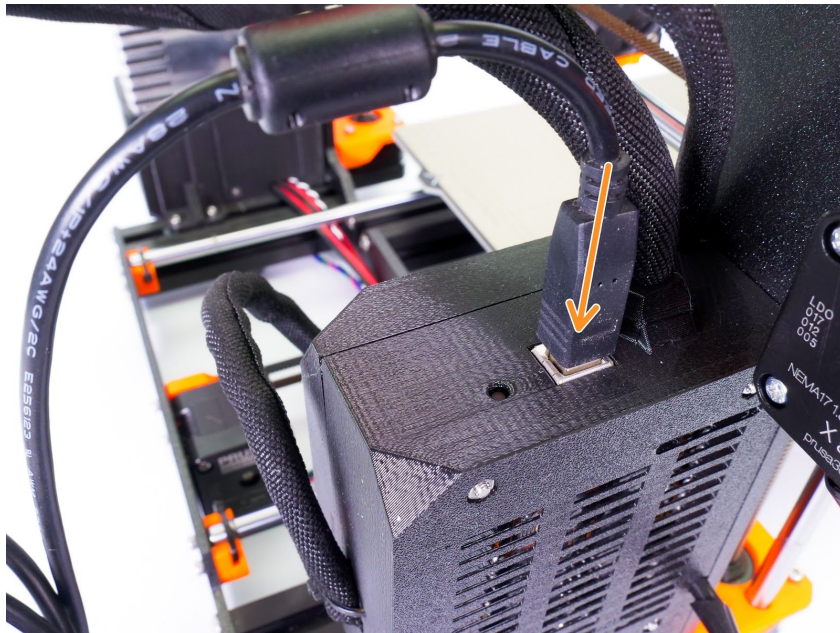
Pict. 6 - Connection of printer mainboard (RAMBo)

   b. **TO FLASH MMU2S UNIT FIRMWARE:** Use a **micro USB cable** to connect the **MMU2S unit** to your PC.
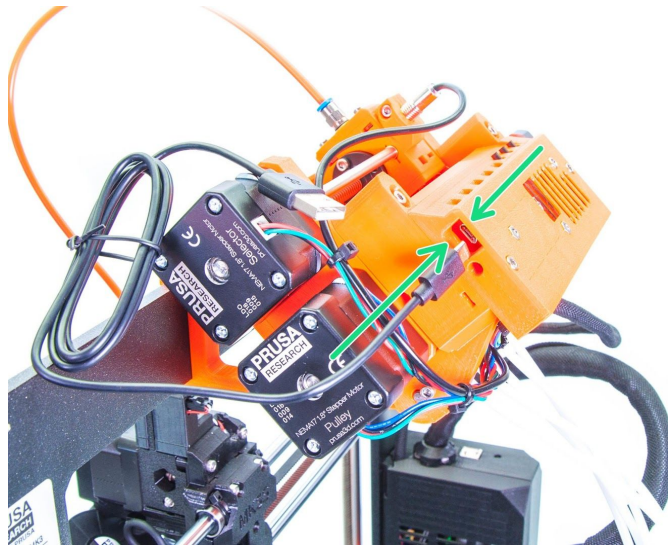
Pict. 7 - Connection of MMU2S unit

5. Start PrusaSlicer and select Configuration -> Flash Printer Firmware.
6. A new window will appear. Your printer should be detected in the 'Serial Port' box.
7. Click Browse to select the downloaded firmware file.
8. Press Flash! and wait for the process to finish.
9. Once the flashing process is finished, you can disconnect the printer from your PC.
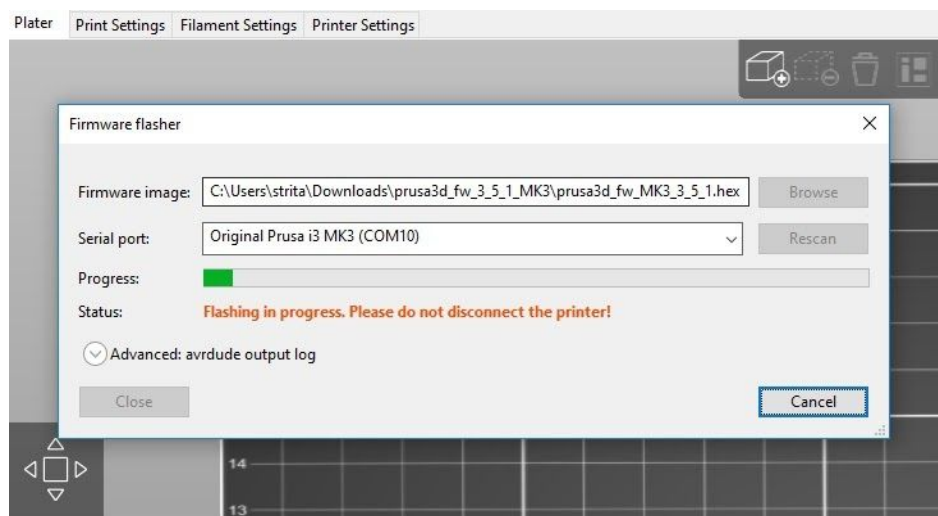
Pict. 8 - Flashing new firmware

(i) If the MMU2S unit is not recognized in the Device Manager, it's possible that your antivirus software has prevented the drivers from installing. Try installing them manually from the destination directory - it's **C:\Program Files\Prusa3D\Rambo** by default. Also, you can try a different USB port or a micro USB cable.

To flash the firmware on MacOS or Linux, please download the latest version of PrusaSlicer for your system, then download the firmware files and follow the procedure described above. Downloading and installing USB drivers is not necessary.

The firmware for our lineup of printers is updated regularly. To ensure the best possible experience when working with the printer and the MMU2S, it is necessary to always use the latest firmware.

5 Initialization procedure

MMU2S unit is turned on simultaneously with the printer. After that, the homing procedure of the idler body (extruder stepper) is started. Homing of the selector is started only when the selector needs to move, not directly after being turned on. It means, that the initialization is successful even in case the printer is turned on with a string of filament loaded in the nozzle (which blocks the selector from moving).

During homing procedures, a repeated clicking can be heard. Don´t worry about it, it's a part of the procedure.

6 Loading/Unloading/Selecting/Ejecting filament

It's essential that you cut the end of the filament as shown in the picture. The sharp tip ensures proper insertion of the filament into the MMU2S unit. Also, try to straighten the filament string with your fingers and make it as straight as possible.

You don't need to preheat the nozzle as filament loading pushes the filament only to the MMU2S unit. Insertion of the filament to the extruder is done automatically during print.
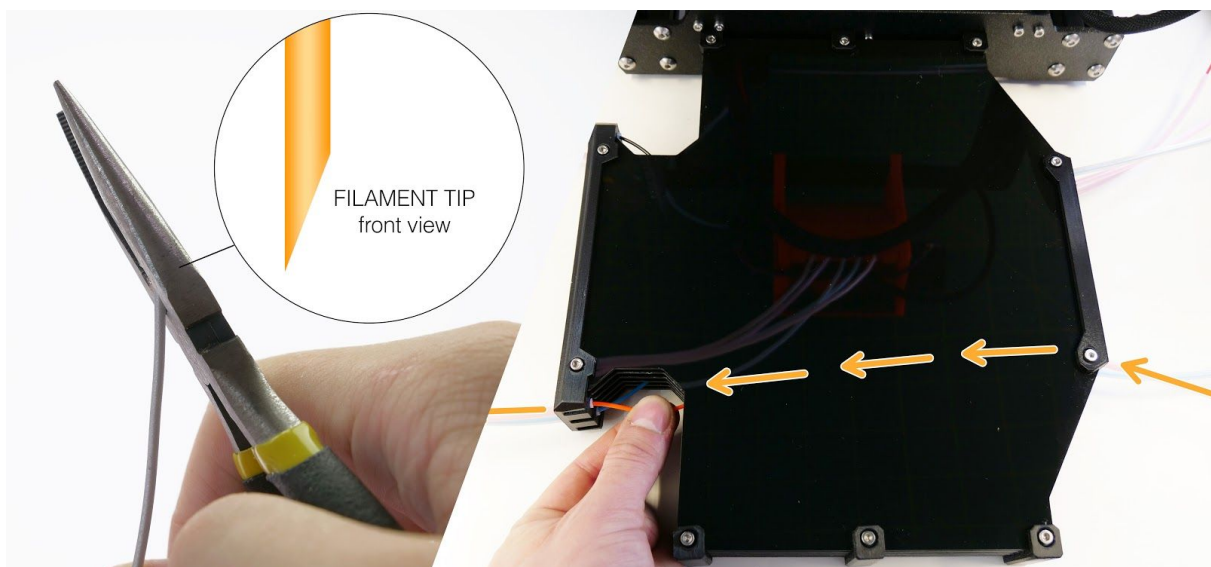
Pict. 9 - Loading the filament

6.1 Loading all five filaments at once

1. Go to **LCD Menu - Load filament - Load All.**
2. The selector will move to the first position, the first LED will start blinking red.
3. Push the filament to the first PTFE tube until it's caught by the drive gear.
4. The filament will be pushed until it's detected by the FINDA, then it will be retracted from the selector, ready to be extruded when needed.
5. The LED indicator will turn green, signaling successful filament load, the selector will move to the 2nd position.
6. Repeat the process for the remaining 4 filaments.

6.2 Loading one of the filaments using the LCD Menu

1. Go to **LCD Menu - Load filament - Load filament 1/2/3/4/5.**
2. The selector will move to the first position, the corresponding LED will start blinking red.
3. Insert the filament into the correct PTFE tube and push it until it's caught by the drive gear.
4. The filament will be pushed until it's detected by the FINDA, then it will be retracted from the selector, ready to be extruded when needed.
5. The LED will turn green.

6.3 Loading one of the filaments using the MMU control buttons

1. Using the left and right control buttons, move the selector to the position corresponding with the filament number you'd like to load.
2. Insert the filament inside the white PTFE tube and continue pushing it until it's not possible to push it any further.
3. **Press and hold the middle control button for a few seconds**.
4. The corresponding LED indicator will start **blinking red**.
5. Push the filament a little bit further into the white PTFE tube until it's caught by the extruder.
6. The LED indicator should turn green after a short while, signaling successful filament load.

To **unload** filament simply pull the filament string from the white PTFE tube manually.
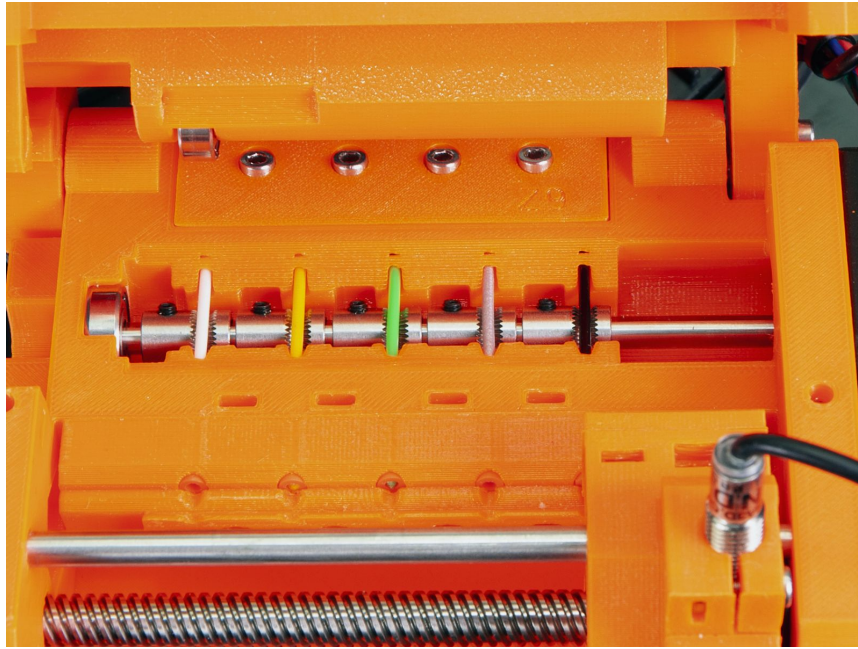
Pict. 10 - Inside of the MMU2S unit with properly loaded filament

If you want to verify the proper load of all five filaments before print, select **LCD Menu - Load filament - Load all.** The MMU2S unit should quickly try loading and unloading all 5 filaments one after another without any user interaction. After the last position, the LCD Menu should quickly try loading and unloading all 5 filaments one after another without any user interaction. Green LED should signal the success of load after each position.

6.4 Ejecting filament

Found in **LCD Menu - Eject Filament - Eject Filament 1/2/3/4/5.** It's advised to run this procedure after you use up filament scraps through the automatic depletion function (**LCD Menu - Settings - SpoolJoin [on/off]** - 10.2 SpoolJoin). It allows you to remove the last remaining piece of filament from the loading tubes after a filament spool is completely used up.

Ejecting during the print:
1. **Pause print** via the **LCD menu**.
2. Select the **Eject filament** option and choose which filament you want to remove.
3. Then, the selector moves to the side and the filament string is ejected forward (through the MMU2S unit).
4. Remove the rest of filament string and press the knob.
5. Select the **Load filament** option and insert a new filament string as usual.
6. **Resume the print process**.
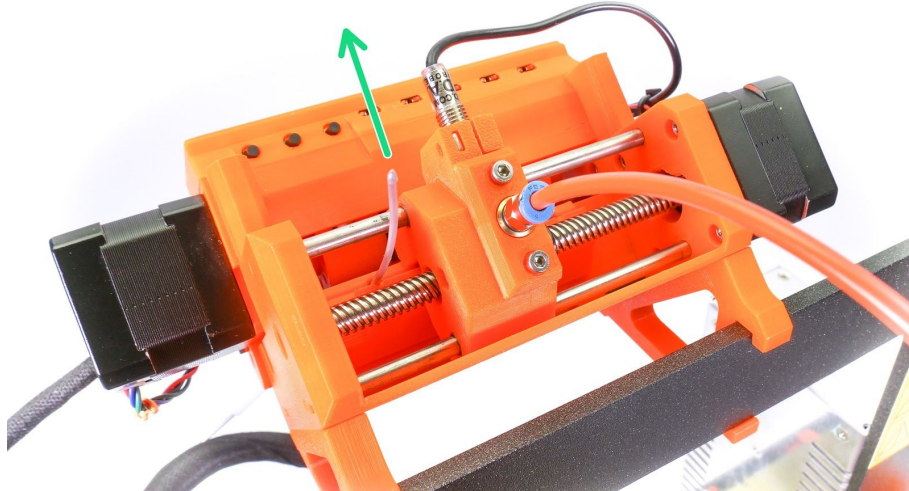
Pict. 11 - Ejected filament string is ready to be removed

⚠ Please note that the ends of the filament string must be straight in order to perform the ejecting process correctly.

If the next filament slot is empty (filament string is not inside the MMU2S), the printer will ask you to insert filament. This is indicated by a red LED light above the empty filament slot. Press the middle button on the unit and the filament will be loaded. If the operation is successful, the LED changes to red-green flashing. Continue the print by pressing the right MMU2S button.

⚠ Please note that the nozzle has to be preheated in order to perform a filament ejection procedure, because the filament may still be in loaded in the printer's extruder.

6.5 Load to the nozzle

It is possible to load the filament not only to the MMU2S unit but also all the way to the printer's nozzle. This is useful when printing older MK3/MK2.5 G-codes on a printer with the MMU2S unit attached. So if you have an existing G-code for single-material printing, you don't have to re-slice it using the MMU2S Single Mode profile. Just select option Load to the nozzle, select type of material, wait for the nozzle to preheat and select which filament you want to load. Then simply print the single-material sliced G-code.

6.6 Unload filament

If the filament is loaded to the nozzle you can unload filament using this function. If the nozzle is not preheated, the preheat menu will automatically appear. Select the filament type, wait until the nozzle is preheated and confirm the unload by pressing the LCD knob.

6.7 F.I.N.D.A explained

F.I.N.D.A is an older design P.I.N.D.A probe repurposed as a filament sensor. When the filament is pushed through the selector, it raises a stainless steel ball. Its movement is detected by the F.I.N.D.A. There is a small red LED light on the back of the probe. As soon as the filament is detected, the light turns off.

When the filament is removed, the stainless steel ball falls back down. Please note that the ball is pulled down by gravity, which means the filament sensor won't work if you for whatever reason turn the MMU2S unit upside down.
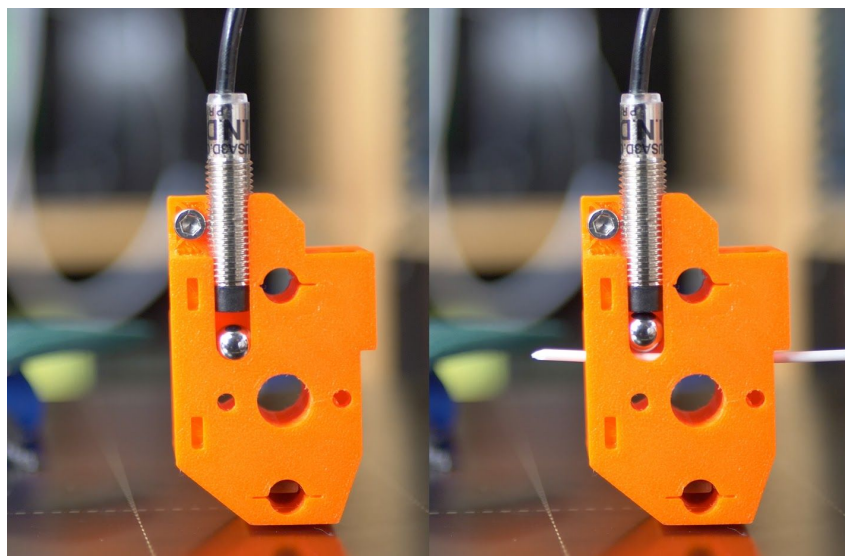
Pict.12 - F.I.N.D.A.

7 Calibration

⚠️ Since the assembly of the MMU2S requires the printer's extruder to be disassembled in the process, it's very likely that your printer's Z-axis is now shifted. It's essential to **re-calibrate the Z-axis** and run the **First Layer Calibration** routine before you start printing!

7.1 IR filament sensor calibration

The IR filament sensor on the extruder body detects if the filament has entered the Bondtech drive gears. This is **key information** for the control unit and the **print won't continue without the filament successfully detected** during each filament change. The calibration of the IR sensor is based on the correct position of the chimney with the sensor (IR sensor holder) on the extruder. Calibration is purely mechanical.

1. Before you start, make sure that the **filament is not loaded**!
2. Unscrew the Festo fitting on the extruder.

3. Open the **LCD menu - Support - Sensor info** and focus on **IR value**.
4. Loosen both M3 screws on the chimney (green marks).
5. Move the chimney as far left as possible (red arrow) and make sure, that the **IR value is "0".**
6. Tighten the M3 screws on the chimney.
7. Prepare the smaller 1.5 mm Allen key which was included in the kit.
8. **Insert the Allen key instead of the filament** and push until you force the Bondtech gears apart
   a. This requires a bit of force and you definitely won't be able to do it with a piece of filament. You can loosen the idler a bit if it's too hard.
9. **If IR sensor value is "1", the calibration is done. If not, continue with the next step.**
10. Pull out the Allen key from the extruder.
11. Loosen the M3 screws on the chimney and move chimney a little bit to the right side. Make sure, that **IR value is still "0"** and continue with step 6.
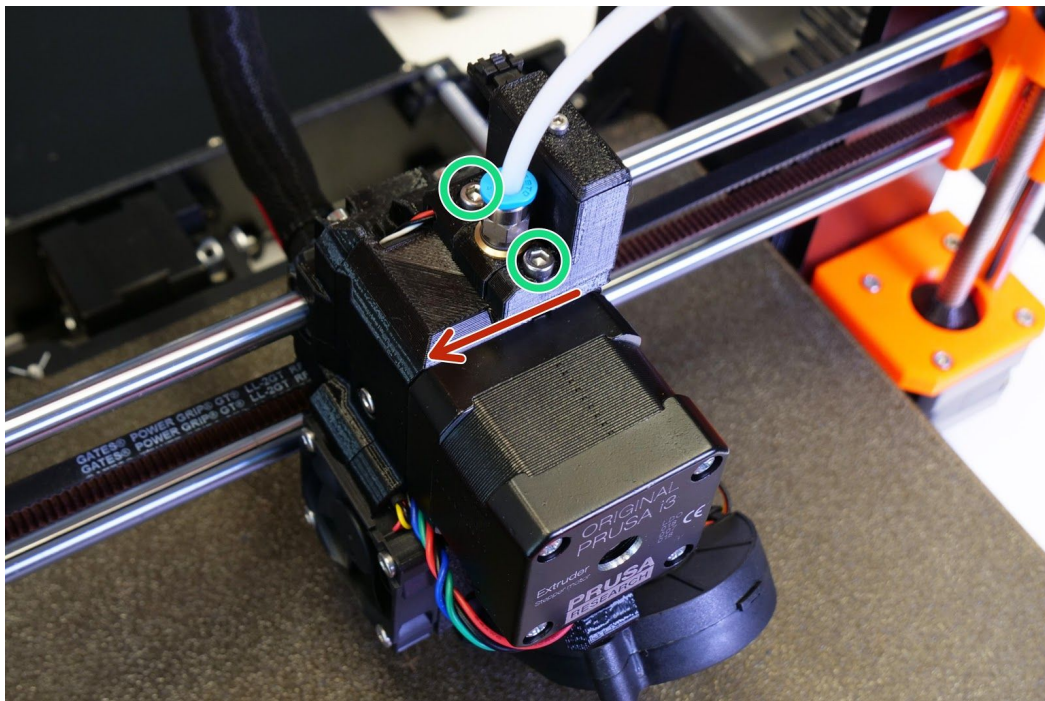
Pict.13 - IR filament sensor calibration

7.2 Calibrate the Z-axis

In your printer's LCD menu, go to **Menu - Calibration - Calibrate Z** and let the printer run the calibration procedure. The procedure consists of raising and lowering the Z-Axis and measuring 9 points on the print bed.
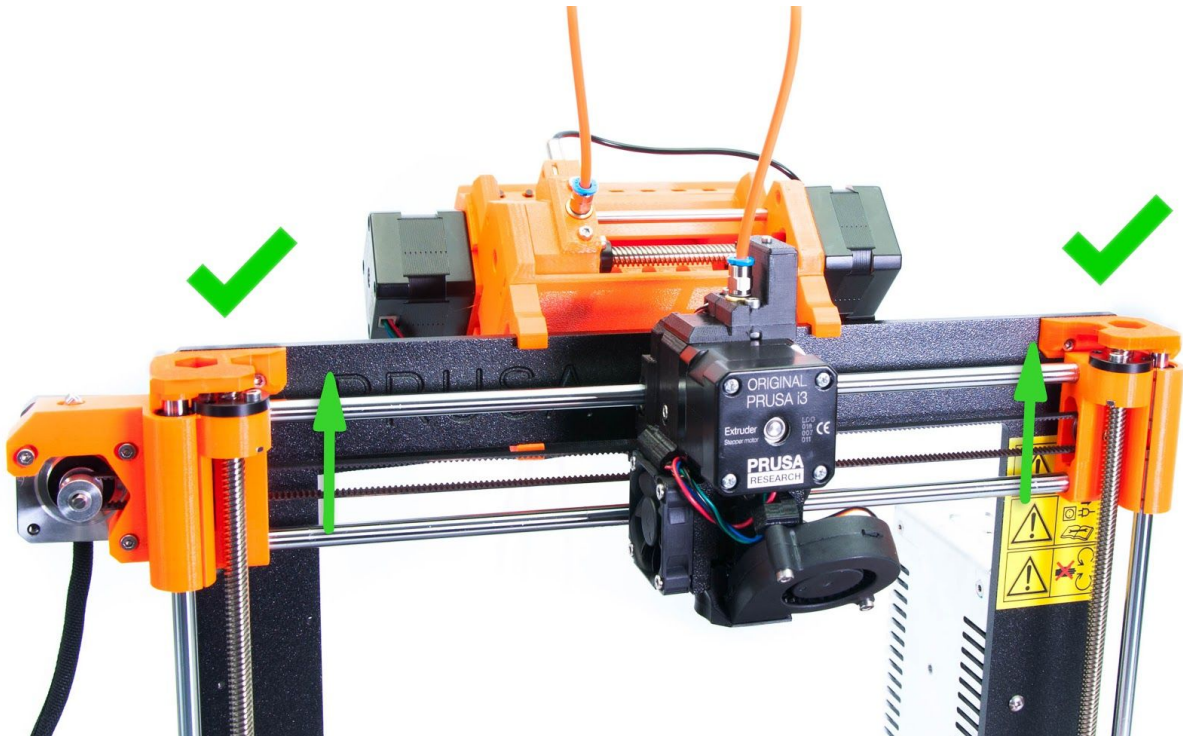
Pict. 14 - Z calibration

Alternatively, you can run a "manual" Z-axis calibration. After you power on the printer, press and hold the knob for 2 seconds. A new menu will be displayed, showing the letter 'Z' and a number representing the current height of the Z-axis. Rotate the knob clockwise until **both ends of the Z-axis hit the top part of the frame**.

Once the Z-axis is calibrated, you can proceed with the First Layer Calibration.

7.3 First Layer Calibration

1. Load a **PLA filament** into at least one MMU2S slot.
2. Check if your printer's print surface is completely clean. Please refer to your model's handbook to learn more about surface maintenance.
3. On your printer, go to **LCD Menu - Calibration - First Layer Cal.**
4. The printer will warm up and ask you which filament should be used. Use the on-screen menu to choose the desired PLA filament for the test.
5. The printer will probe the bed and start printing a zig-zag pattern on the print surface. The nozzle must not by any means touch the printing surface.
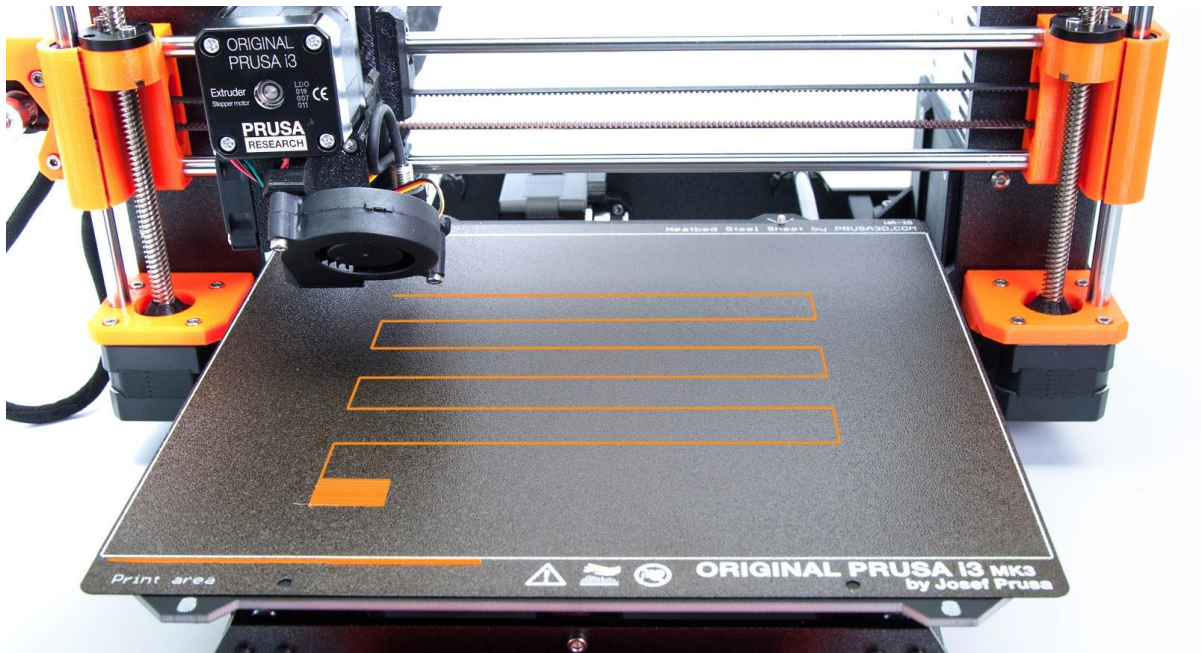
```
Adjusting Z:
        -0.640 mm
```
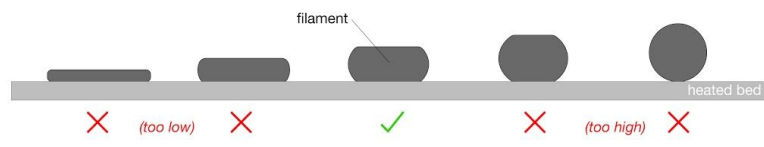

Pict. 15 - How to tune the nozzle height in real time during the test print. Note: -0.640 mm is only for illustration. **Your setting will be different!**

Observe the line which is being extruded on the print surface. A new menu will automatically show up, with an option to tune the nozzle height in real-time by turning the knob. The aim is to adjust the nozzle height until the extruded plastic sticks nicely to the bed and you can see that it is being slightly squished. The value should not exceed -2.000 mm. **If you have to adjust it more (e.g. -2.500), move the P.I.N.D.A probe slightly higher. Please refer to our knowledge base in case the P.I.N.D.A probe needs to be realigned.**
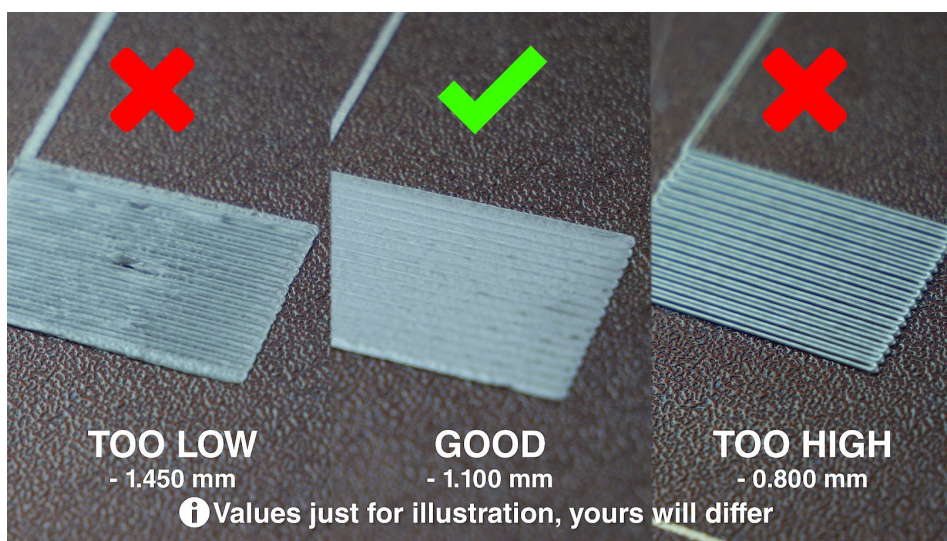
Pict. 16 - The properly-tuned first layer

If your printer was working without any issues before adding the MMU2S unit, these two calibrations should be everything you need to start printing. In case you still have trouble calibrating the first layer height, please refer to the printer's handbook or our knowledge base at help.prusa3d.com.

7.4 Individual filament calibration

Information for advanced MMU2 users, who already performed filament length calibration before: although you can enter the service menu and run Individual filament calibration procedure, there is no reason to do it anymore. The length of the filament is automatically controlled thanks to the new IR filament sensor.

The only reason to run the calibration is in case you have changed the length of the front PTFE tube between the extruder and the MMU2S unit. With the calibration, the filament loading will be faster. In that case, please refer to this manual: https://manual.prusa3d.com/Guide/Service+menu+-+Individual+Filament+Calibration/842

8 First Print

First Print checklist:

✔ MMU2S Unit attached
✔ New printer firmware flashed
✔ Spool holders and the filament buffer are correctly placed
✔ Filaments loaded
✔ Performed IR filament sensor, Z-Axis, and First Layer calibrations

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For your first print, **we recommend using one of our G-codes.**

If you have installed the **latest driver package** with the MMUS2 option selected, you can use the '3D Objects' shortcut on your desktop that will take you to a folder containing MMU2S objects and G-codes.

Place the desired G-code(s) on your printer's SD card, insert it into your printer's SD card slot and select the object to print in **LCD Menu - Print from SD Card.** Wait for the printer to start the process.

> ⚠️ **Do not leave your printer unattended during the first print.** Watch the process closely and in case of any kind of trouble, use the Menu - Stop print function to cancel the process immediately.

9 Printing in Multi Material Mode

With the MMU2S unit mounted, you can print in two different modes: **Multi-material mode and Single mode** (which works as a regular 3D printer). To print in Multi-material mode, at least two filaments have to be loaded. Both modes have the same set of features like the standard MK2.5S/MK3S, such as variable layer height and many others.

You can download multi-material G-codes ready for printing from our website. To generate your own multi-material G-Codes, you should use our slicer software - PrusaSlicer. You can always get the latest stable version in our Drivers & Apps package at prusa3d.com/drivers/.

> ⚠️ Do not forget to enable print profiles for MMU2S in PrusaSlicer using the **Configuration -> Configuration Wizard** menu to choose the Original Prusa i3 MK3S MMU2S or Original Prusa i3 MK2.5S MMU2S profile.

9.1 Importing objects into PrusaSlicer - STL, 3MF, AMF

Objects ready for multi-material printing come in three file formats
1. **.3MF/.AMF** - a preferred format which includes all of the parts in a single file
2. **.STL** - several separate files, each file for a different part of the object

3MF files are automatically loaded with all the parts already aligned. To load a multi-part model saved as multiple STLs simply drag and drop all of the files inside PrusaSlicer's window and confirm multi-part object auto-detection.
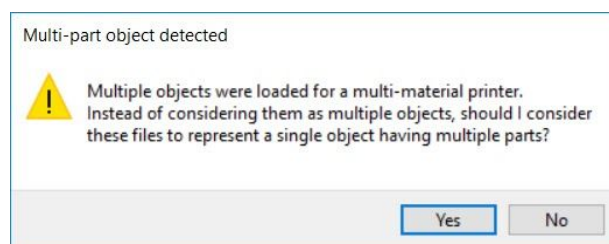
Pict. 17 - Loading a multi-part object
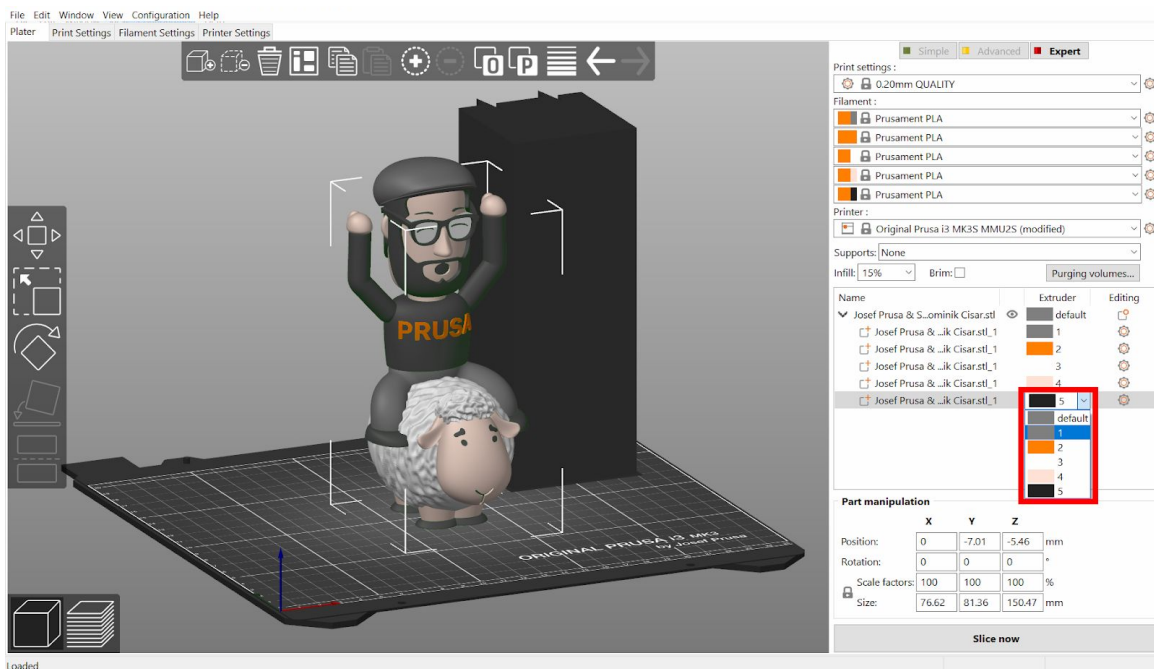
Pict. 18 - Multi-part object correctly imported to PrusaSlicer

9.2 Setting up colors

1. Select a part of the object in the list.
2. In the Extruder column, choose the corresponding extruder (=filament).
3. Assign an extruder to each part of the object. Assigning the same extruder to two parts will result in those parts being printed in the same color.
4. Use the Filament menu on the top right side of the PrusaSlicer window to change colors for each part of the object by left-clicking the small box next to the filament's name. Try to match these colors to the colors of your filaments to get a better idea of how your 3D object will look once it's printed. Keep in mind the order of filaments!
5. Slice the object as usual. Once you are happy with the result, export the G-code.
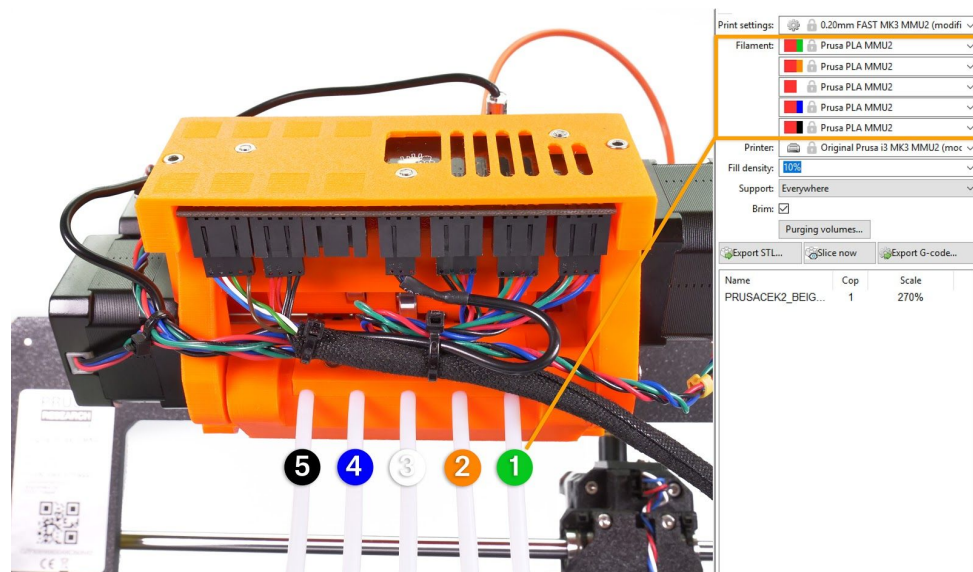
Pict. 19 - Assigning colors in PrusaSlicer and the corresponding PTFE tubes

> **If your object has a solid-green color in PrusaSlicer, it means it's selected. Click anywhere in the PrusaSlicer 3D view to deselect the object.**

9.3 Slicing a multi-material object

You can use the standard procedure to slice a multi-material object. Press the Slice now button and wait until the process finishes.

9.4 Smart wipe tower

The smart wipe tower ensures sharp color transitions and stable filament flow after a color change while aiming to waste as little filament as possible. There is always only one wipe tower no matter how many objects are being printed at once. The size of the wipe tower is independent of the size of the object being printed. Printing multiple copies at once or printing big objects, therefore, improves the overall efficiency of the filament use.

9.4.1 Wipe tower placement

As soon as you select Original Prusa i3 MK2.5S / MK3S MMU2S in the Printer selection box, the smart wipe tower will appear in the 3D preview. The preview shows its maximum footprint, because the size may decrease after slicing, based on the number of color changes in each layer. The size will decrease from the edge with the polyline.

You can change the placement of the wipe tower by dragging it with left mouse button. Make sure the wipe tower doesn't intersect any of the objects. To shorten the travel moves between the object and the wipe tower, place it in the near proximity of the object.
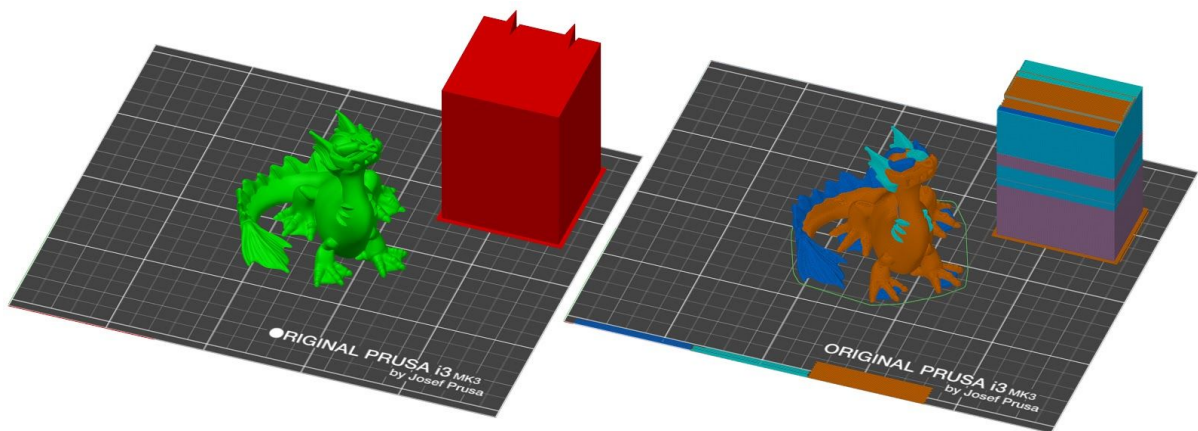
Pict. 20 - Smart wipe tower preview and real size after slicing

9.4.2 Purging volumes

In the panel on the right side, you'll find a **Purging volumes** button. Purging volumes...
In the **Simplified settings,** you can simply set how much filament will be purged when filament is being unloaded or loaded. This lets you optimize the amount of wasted filament

by, for example, decreasing the amount to purge when loading **black** filament. On the other hand, you can increase the value when transitioning to very **light** colors, to ensure they are not contaminated by previous colors.

Pict. 21 - Right sheep has contaminated white color due to insufficient purging

By default, 70mm^3 is used for both loading and unloading. When using water-soluble supports we suggest using at least 100mm^3.
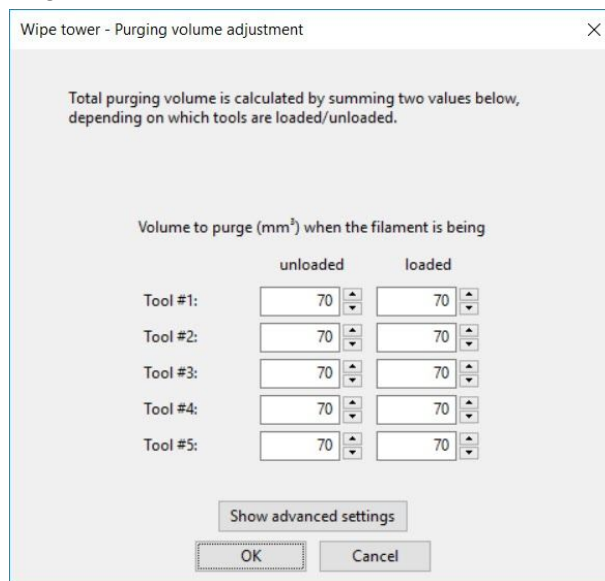
Pict. 22 - Simplified settings of purging volumes

In the table below you can see suggested values for some of the commonly used colors/filaments.

Color	Unloaded	Loaded
Black	100	60
White	70	100
Yellow	80	80

Silver	70	70
High gloss filaments	90	70
PVA/BVOH	120	100

The **Advanced settings** let you set the purging values for each combination of filaments in a matrix view. E.g. purge more when transitioning from black to white (e.g. 100mm^3), but purge less when transitioning from white to black (e.g. 60mm^3).
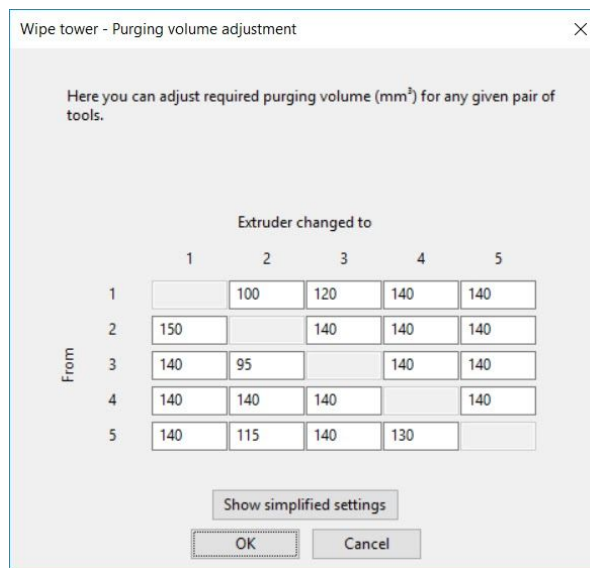
Pict. 23 - Advanced settings, a purging volumes matrix

9.5 Wipe to infill

Since the inside of the model isn't visible, it can be used to wipe the nozzle during the color transition. The wipe tower cannot be eliminated completely, because some models do not have enough infill, but wipe to infill can **greatly reduce the amount of wasted material**. To enable this feature, right-click on a model in the 3D view and choose **Wipe options**. Then in the right panel tick **Wipe into this object's infill**. Please note that dark filament purged into infill may be visible through light-colored walls. To avoid this issue, we suggest increasing the number of perimeters.
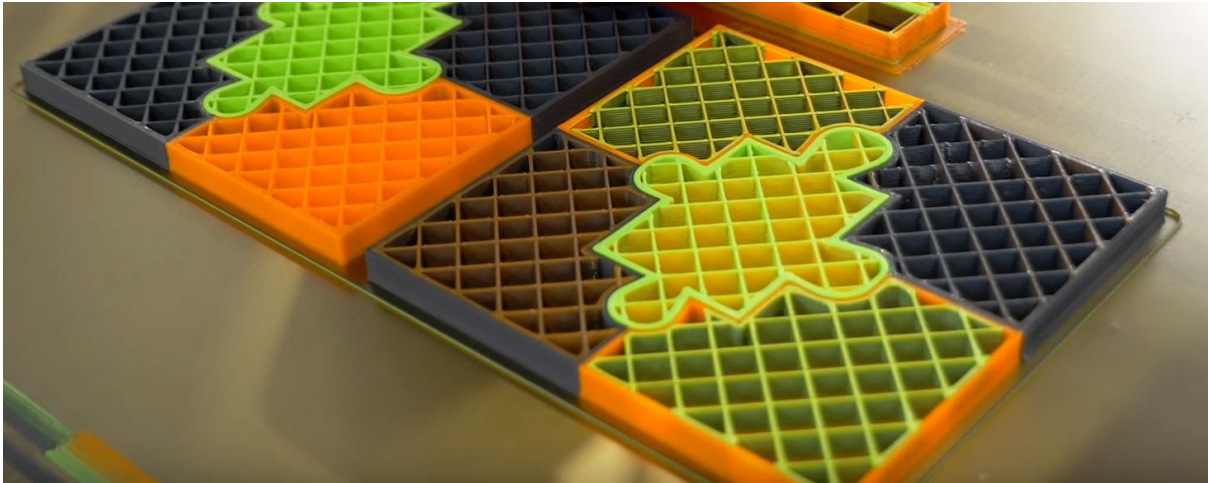
Pict. 24 - Wipe to infill
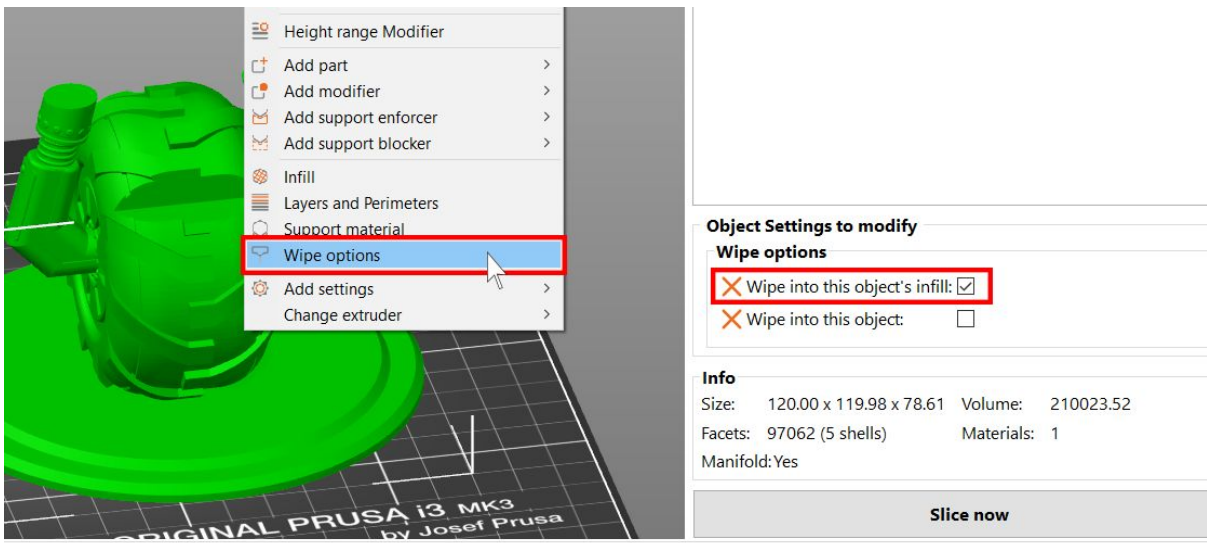
Pict. 25 - Wipe to infill settings in PrusaSlicer

9.6 Wipe object

To further decrease the amount of material used for the smart wipe tower, you can choose to wipe residual filament into an object. The so-called 'wipe object' will be used during the color transition to wipe the nozzle. As a result, the colors of the object will be mixed - this is handy in case you don't care about the surface color (e.g. mechanical parts). To turn a regular object into a wipe object, open it in PrusaSlicer, right-click on a model in the 3D view and choose **Wipe options**. Then in the right panel tick **Wipe into this object**.
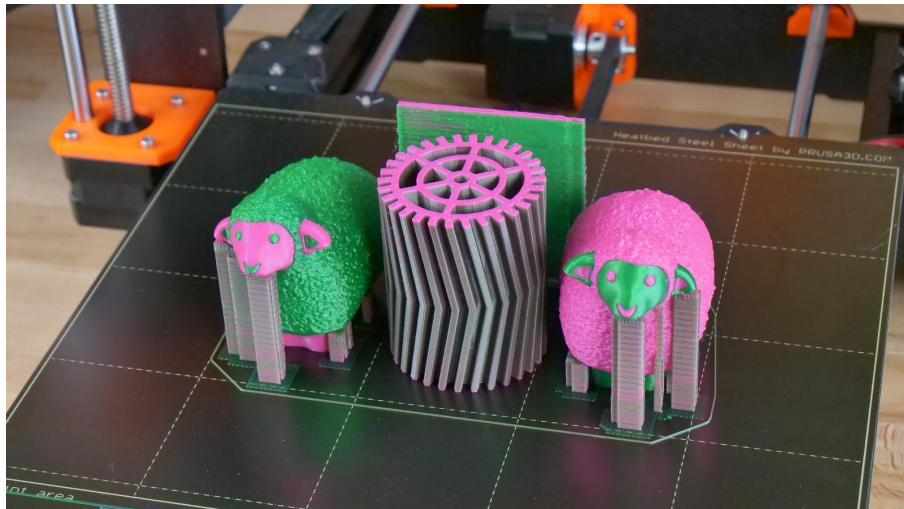
Pict. 26 - Wipe object

Wipe object taller than the multi-colored object
- The wipe object will be finished with the last filament used during the multi-colored print.

Multi-colored object taller than the wipe object
- After the wipe object is finished printing, wiping will move to the smart wipe tower

9.7 Supported Materials

MMU2S supports the most common materials (such as PLA, PETG, and ABS) along with soluble materials (BVOH) from the start. In addition, we're working on expanding the range of supported materials (Flex and PVA+ coming soon). Support for additional materials is delivered through software updates.

(i) Please, keep in mind that mixing different types of materials is not recommended due to different temperatures for bed and nozzle.

Check our website and blog regularly to get the latest news about supported materials.

9.8 Soluble Supports

We strongly suggest using Verbatim BVOH support material. The second best option is Prima Select PVA, both available in our e-shop. Unfortunately, the quality of different PVA brands can vary greatly and we cannot guarantee good results when working with soluble materials from other brands.

9.8.1 Soluble support interface only

Water-soluble filament us usually fairly expensive. In order to greatly reduce the amount of water-soluble filament needed, you can choose to print a soluble support interface only. With this option turned on, only the last few layers in contact with the model with being printed using a soluble filament. This feature is enabled in PrusaSlicer by selecting the "Soluble interface" **Print settings**.
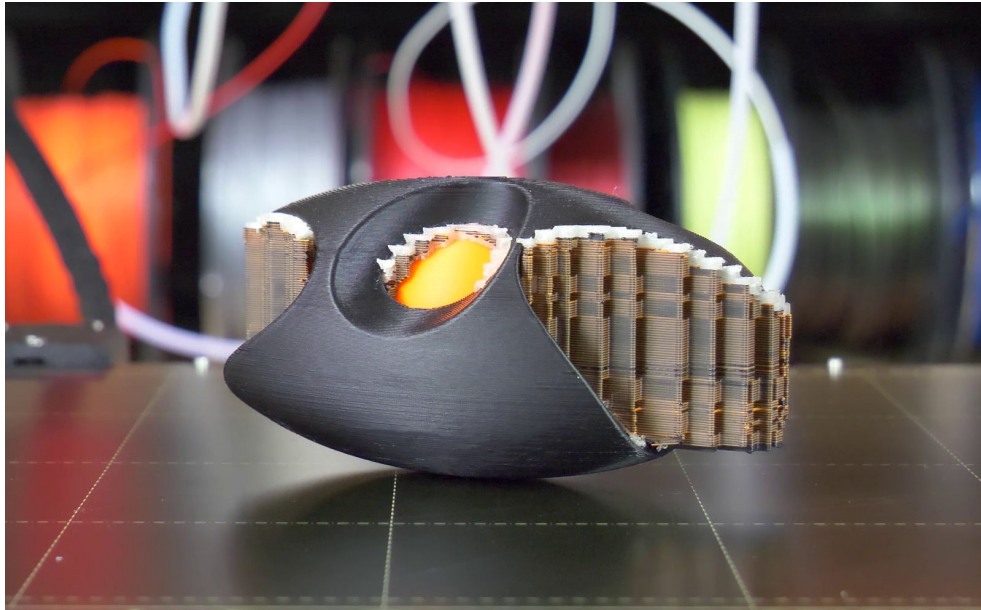
Pict. 27 - Water-soluble support interface

9.8.2 Completely soluble supports

When removing soluble supports, try to break away as much material as possible while the object is still dry. Then continue peeling the material under running warm water. The last bits can be removed by letting the print soak in warm water. Water-soluble filaments must be **always** stored in dry conditions. Soluble supports printing is enabled by selecting the "Soluble full" Print settings in PrusaSlicer.
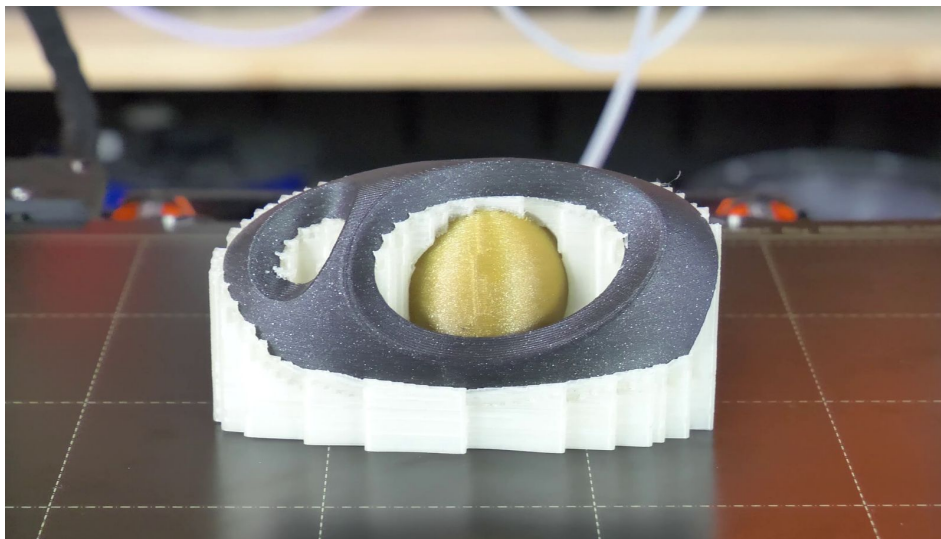
Pict. 28 - Water-soluble supports

9.9 Power panic support

In case of a power surge, the printer will save the current G-code instructions/position. After the power is restored, the printer preheat and if necessary the printer and MMU2S rehomes and continue printing.

10 Printing in Single Mode

Even with the MMU2S unit mounted, you can still use the printer for single-color printing, also known as 'Single Mode'. The best option is to have 5 of your favorite filaments loaded, so once you start printing, you can choose which filament to use via an on-screen menu.

To prepare a Single Mode G-code, follow these steps:

1. Open PrusaSlicer and choose 'Original Prusa i3 MK3S MMU2S Single' or 'Original Prusa i3 MK2.5S MMU2S Single' in the Printer menu on the right side of the window.
2. Import object(s) and slice them as usual.
3. Once you are happy with the results, export the G-code.
4. Place the G-code on an SD card and insert it into your printer.
5. Go to **LCD Menu - Print from SD card** and select the desired object.
6. The printer will ask you which filament (extruder) you wish to use. Select the desired filament spool in the on-screen menu and confirm it by pressing the knob.
7. The printer will load the selected filament and proceed with single-color printing.

Multi-material G-codes cannot be printed in single color mode. The object has to be sliced again and re-exported as a Single Mode G-code.

10.1 Colorprint

Color change in PrusaSlicer
1. Switch to the layer preview using the button in the lower-left corner
2. Using the slider on the right side, select a layer where the color change should occur
3. Click on the **orange plus icon**
4. A preview is instantly displayed. You can remove the color change by clicking on the grey cross button that is now displayed instead of the orange plus button
5. Export the G-code and you're ready to print!
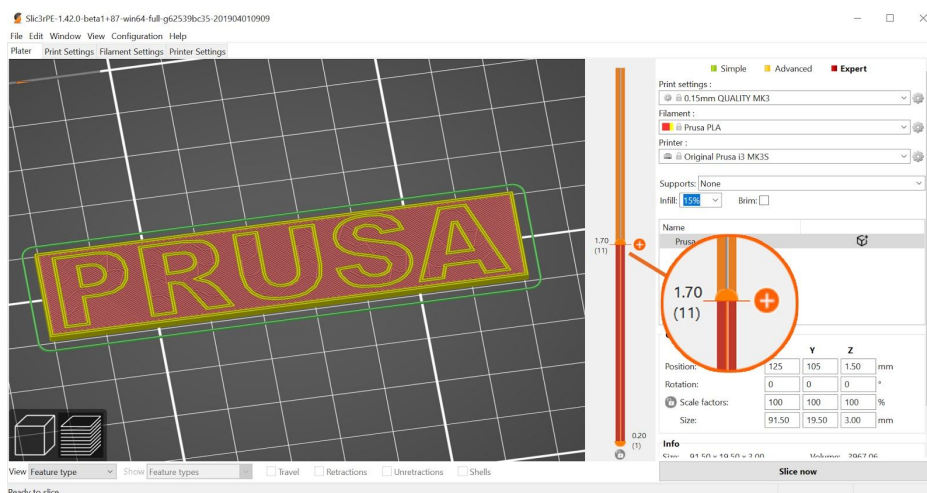
Pict. 29 - Setting up color change in PrusaSlicer

Colorprint has the 2 different modes with the MMU2S.

Add color change (M600)
You can create a manual color change, where you'll physically unload and load a filament. This way you can create prints with more than 5 colors. For example, once they're printed, filament 1 used for shoes of a figure can be swapped to a different color and used for a different part of the model later on.

Change extruder
Changing the extruder is parallel to standard one color per layer colorprint. You'll be limited to only one color per layer, but the change will happen automatically. A minimal wipe tower will be printed to clean the nozzle of residue pigment.

Color change using the ColorPrint web app
The web version of Colorprint tool is compatible with the **MMU2S Single Mode.**

1. Import an object into PrusaSlicer and choose 'Original Prusa i3 MK3/MK2.5 MMU2S Single' in the 'Printer' menu on the right side of the window.
2. Slice an object and export the resulting G-code from PrusaSlicer as usual.
3. Upload the G-code to the ColorPrint web app.
    https://www.prusaprinters.org/color-print/
4. Click the **Add color change** button.
5. Set the layer height at which the color change should happen.
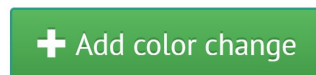
6. Continue adding as many color changes as you like.
7. Download the G-code, upload it to SD card and you're ready to print.
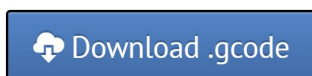
8. During the print, the printer will automatically pause the print and prompt you to change/select the filament.

10.2 SpoolJoin

When printing in Single mode with filament sensor turned on, the SpoolJoin function can be switched on in **LCD Menu - Settings - SpoolJoin [on/off]**. This function enables automatic switching of filament spools in case one of the filaments runs out. This is especially useful when you want to get rid of filament scraps that are still on spools without the need to pay close attention to the printer during the printing process.

The SpoolJoin function cycles through all filament slots in a loop, so e.g. if you run out of filament in slot 1, the printer will automatically move to slot 2. In the meantime, you can replace the spool of filament in slot 1, so once the printer reaches slot 5, it will go back to slot 1 and continue printing.

11 Handling

11.1 Mounting/Unmounting the MMU2S unit

Follow these steps:
1. Unscrew the Festo coupling from the extruder body.
2. Unplug the two connectors from the MMU2S board that transfer power and data from the EINSY board.
   a. Use an Allen key to push on the connector release.
3. Tilt the MMU2S unit forward to unclip it from the frame.
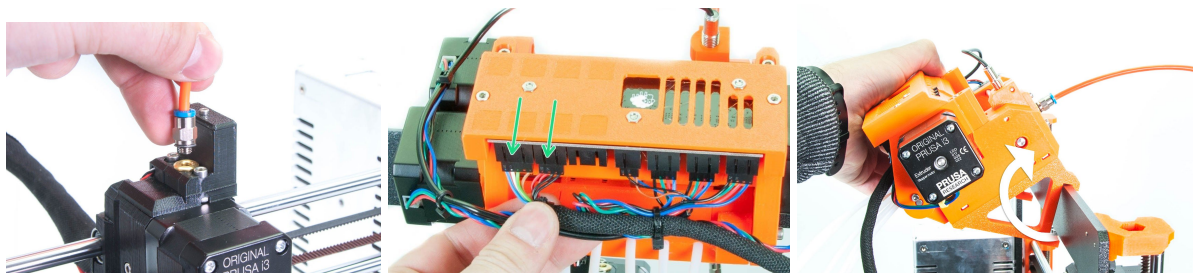
Pict. 30 - Unmounting the MMU2S unit in three steps

If you wish to print without the MMU2S unit installed, there are two possible options:

1. **The easiest way** is to use the printer as it is. So leave the extruder in MMU2S version. In that configuration, the filament IR sensor detects the absence of filament when it is almost under the Bondtech gears. This means less reliability of the filament unload. But in most cases, the unload will be successful. If the filament gets stuck under the Bontech gears, just use another piece of filament to go through.

2. **The more reliable** and also more difficult is to rebuild the extruder to original MKS3 version. See the MK3S assembly manual, how to do that. We recommend this solution only if you are planning to unmount the MMU2S permanently.

11.2 Transporting the printer

To transport the printer with the MMU2S unit attached, please follow these instructions:

1. Unload all filaments completely - see chapter 6 Loading and Unloading filaments.
2. Take all back PTFE tubes and push them through one of the hexagonal openings at the top of the printer.
3. Use the middle part of the frame to lift the printer with one hand.

12 Menu structure

- ❏ Info screen
- ❏ Live adjust Z (during the printing process only)
- ❏ Tune (during the printing process only)
    - ❏ Speed
    - ❏ Nozzle
    - ❏ Bed
    - ❏ Fan speed
    - ❏ Flow
    - ❏ Change filament
    - ❏ Mode
- ❏ Pause print (during the printing process only)
- ❏ Stop print (during the printing process only)
- ❏ Preheat
    - ❏ PLA - 215/60
    - ❏ PET - 230/85
    - ❏ ABS - 255/100
    - ❏ HIPS - 220/100
    - ❏ PP - 254/100
    - ❏ FLEX - 230/50
    - ❏ Cooldown
- ❏ Print from SD / No SD card
- ❏ Load filament
    - ❏ Load All (only when MMU2S is connected)
    - ❏ Load filament 1 (only when MMU2S is connected)
    - ❏ Load filament 2 (only when MMU2S is connected)
    - ❏ Load filament 3 (only when MMU2S is connected)
    - ❏ Load filament 4 (only when MMU2S is connected)
    - ❏ Load filament 5 (only when MMU2S is connected)
- ❏ Load to nozzle (only when MMU2S is connected)
    - ❏ Load filament 1
    - ❏ Load filament 2
    - ❏ Load filament 3
    - ❏ Load filament 4
    - ❏ Load filament 5
- ❏ Unload filament
- ❏ Eject filament (only when MMU2S is connected)
    - ❏ Eject filament 1
    - ❏ Eject filament 2
    - ❏ Eject filament 3
    - ❏ Eject filament 4
    - ❏ Eject filament 5
- ❏ Settings
    - ❏ Temperature
        - ❏ Nozzle
        - ❏ Bed
        - ❏ Fan speed
    - ❏ Move axis
        - ❏ Move X

- ❏ Move Y
- ❏ Move Z
- ❏ Extruder
- ❏ Disable steppers
- ❏ Filament sensor - On / Off
- ❏ F. autoload - On / Off (only when MMU2S is not connected)
- ❏ SpoolJoin - On / Off (only when MMU2S is connected and filament sensor is turned on)
- ❏ Fans check - On / Off
- ❏ Mode - Normal / Stealth
- ❏ Crash detection - On / Off
- ❏ Lin. correction
- ❏ Temperature calibration - On / Off
- ❏ RPi port - On / Off
- ❏ Live adjust Z
- ❏ Select language
- ❏ SD card - Normal / FlashAir
- ❏ Sort - Time / Alphabet / None
- ❏ Sound - mute / loud / once / silent
- ❏ Calibration
  - ❏ Wizard
  - ❏ First layer calibration
  - ❏ Auto home
  - ❏ Selftest
  - ❏ Calibrate XYZ
  - ❏ Calibrate Z
  - ❏ Mesh Bed Leveling
  - ❏ Bed level correction
  - ❏ PID Calibration
  - ❏ Reset XYZ calibration
  - ❏ Temperature Calibration
- ❏ Statistics
- ❏ Fail stats
- ❏ Fail stats MMU (only when MMU2S is connected)
- ❏ Support
  - ❏ Firmware version (printer)
  - ❏ MMU connection status and firmware version
  - ❏ XYZ calibration detail
  - ❏ Extruder info
  - ❏ Sensor info
  - ❏ Belt status
  - ❏ Temperatures
  - ❏ Voltages

13 Troubleshooting

In case you encounter any problems with the MMU2S unit, first make sure that you have the unit properly assembled and positioned as described in the assembly instructions and this manual.

> ⚠️ **Please pay attention to every step of the assembly manual and this handbook. Most issues are usually caused by skipping certain chapters or by not following the instructions.**

Here are the most common problems and their causes, plus suggested solutions:

1. **Incorrect setup of the spool holders and buffer**
   To learn how to place everything correctly, please see chapter 3 Placement and setup in this guide.

2. **Incorrect alignment of pulleys**
   Inaccurate alignment of the pulleys results in loading/unloading problems and excessive filament grinding by the pulleys and the accumulation of filament dust. The pulleys must be perfectly aligned with the filament holes. To learn how to align pulleys, please see the assembly manual at manual.prusa3d.com.
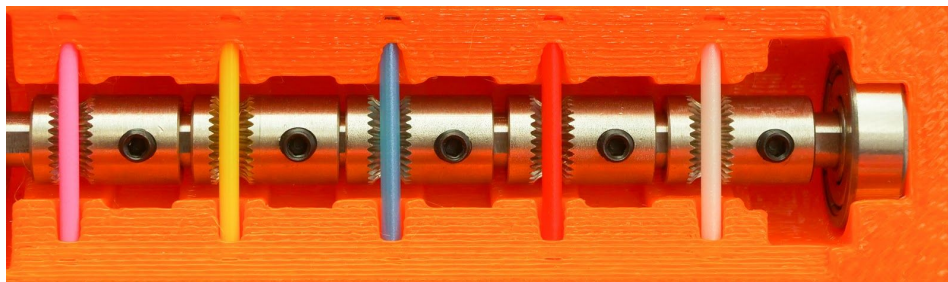
Pict. 31 - Pulley alignment

3. **Excessive tightening of the idler screws**
   Tighten the two idler screws with springs, so the heads of the screws are approximately 0.1mm to 0.4mm under the body level of the MMU2S in the initial state.
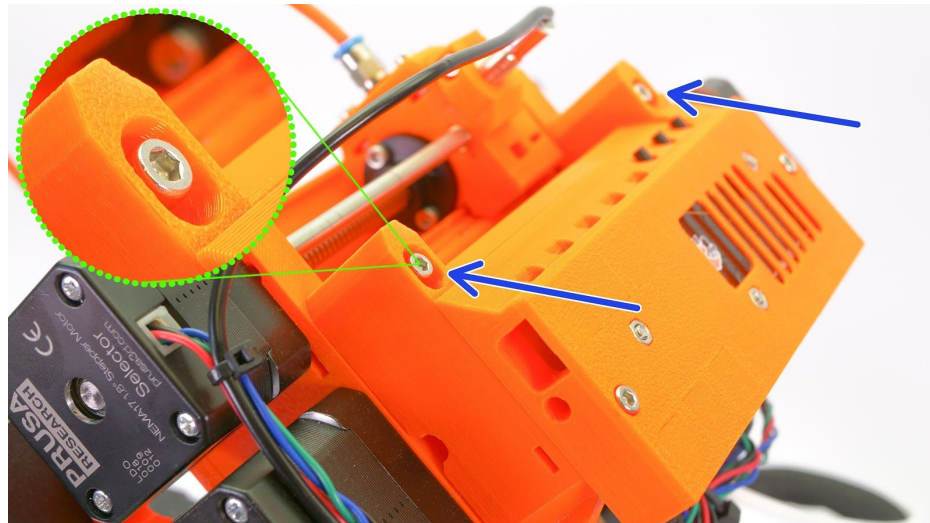
Pict. 32 - Tighten idler springs

4. Incorrectly placed short PTFE tubes

It's possible that you have inserted the short PTFE tubes incorrectly during the assembly. Doing this will cause a problem with filament jams due to retraction. The thicker end of the filament will always get stuck on the sharp edge of the PTFE tube. Check their correct orientation - **the countersink ends of the tubes must be facing out of the unit!**
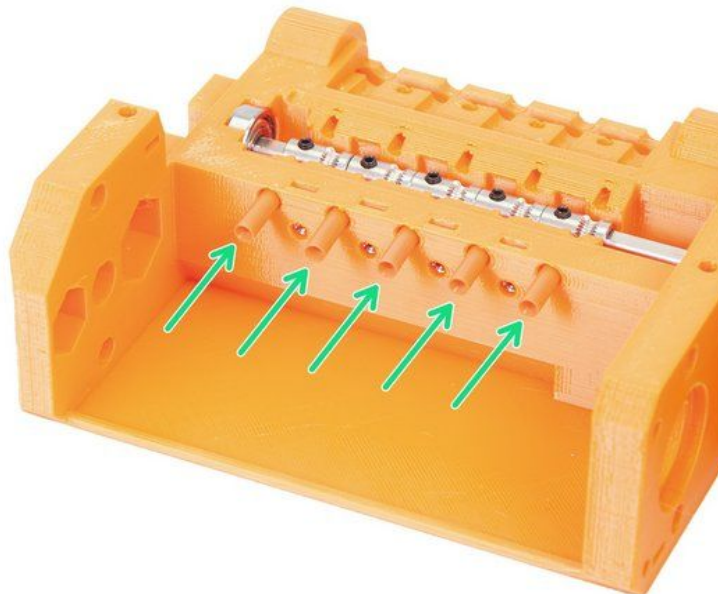
Pict. 33 - Correctly placed PTFE tubes

5. Insufficiently tightened the screw on the extruder Bondtech gear

A loose screw in the Bondtech gear on the extruder motor shaft can cause several problems like issues with loading/unloading of filament or missing layers.

How to check it:

1. Loosen the two screws which hold the extruder-idler (door) and remove them.
2. Try to push the Bondtech gear on the motor shaft by an Allen key. If it moves, continue with the next step. If it doesn't move, it means that the screw is properly tightened and you can close and secure the extruder-idler again.
3. Unscrew the Festo fitting on the extruder.
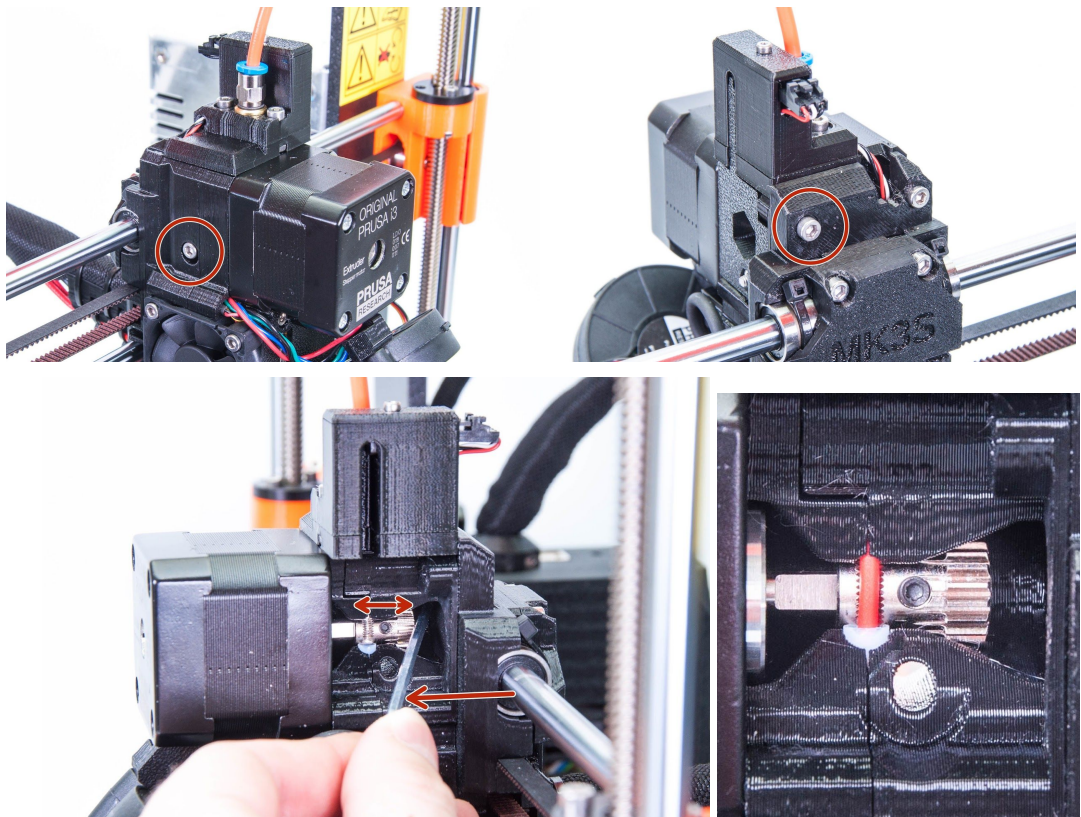4. Insert a string of filament into the extruder. Align the Bondtech gear precisely (as you can see on picture 34).
5. The screw in the Bondtech gear has to be tightened directly against the flat part of the shaft - this stops the gear from inadvertent rotation.
6. Screw the extruder-idler and Festo fitting back.

Pict. 34 - How to open idler doors and how to spot a loose Bondtech gear

13.1 MMU load failed - Blinking red LED

If you see the error message "MMU load failed" on the printer's LCD display, it indicates that the filament went through the MMU2S unit (FINDA sensor is triggered - value is 1), but the filament did not reach extruder Bondtech gears. First LED indicates that the loading of the first filament failed, second LED -> second filament and so on.
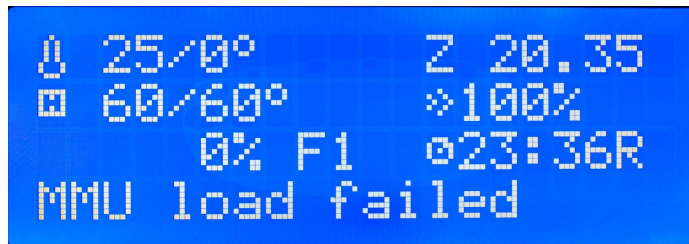
Pict. 35 - LCD notification: the printer is paused because of an unsuccessful filament load

Cause	Solution
Filament is blocked somewhere between the MMU2S unit and the spool.	Check, that the filament can move freely and can be loaded to the unit. **Resume print***.
PTFE tube is clogged - in most cases, it's because of filament strings or filament ball ends. To learn how to prevent this situation, see the chapter 13.9 Different filament tip shapes after the unload.	Unscrew the Festo fitting on the MMU2S unit and also on the extruder side. The filament string will probably stick out of MMU2S unit. Make sure, that the filament can go freely through the tube and that the tube is clean inside. Pull approximately 20 cm of filament out of the unit and cut this end - the gears have most likely damaged this part of the string, so it's better to remove it. Mount everything back and **resume print***.
IR sensor is not working properly or the sensor cable is broken / damaged.	Perform the calibration of the IR filament sensor. See chapter 7.1 IR filament sensor calibration Check that the sensor is working properly. Open LCD menu - Support - Sensor info and you will see the IR value. If the filament is not loaded, you should see value "0". Otherwise, when the filament is loaded, you should see value "1".

*How to resume print after repair?

Option 1:
Select on **LCD menu - Resume print**. The printer will automatically preheat the nozzle, try to load filament and if it's successful, it will continue printing.

Option 2:
Press the middle button on MMU2S unit. The unit will repeat the last unsuccessful operation. If the repair was successful, the LED will flash red and green. If it wasn't, you will see the red LED still on and you will have to try to resolve the issue again. Once you're ready, press the middle button again.

Press the right MMU2S button to resume print. The printer will automatically preheat nozzle and continue printing.

13.2 MMU needs user attention - Blinking red LED

This is related to the situation when the printer isn't printing and the following messages are displayed on the screen: "MMU needs user attention.", "Press the knob to resume nozzle temperature.".
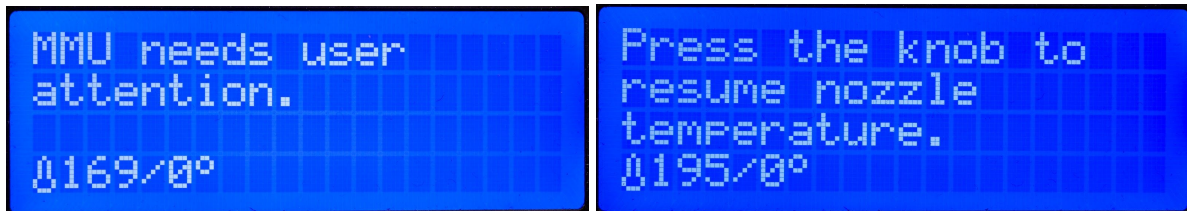
Pict. 36 - LCD notes, while the printer is paused because of unsuccessful operation

The extruder stops at the back left corner and seemingly nothing is happening for several minutes. See if one of the MMU LEDs is blinking red. Blinking red light signalizes that the filament got stuck during loading/unloading.

- **Slow flashing** - fault during filament **load**
- **Rapid flashing** - fault during filament **unload**

The print will remain paused until the problem is resolved.

How to solve a problem related to filament **unload - rapid flashing:**
1. Remove the orange/white PTFE tube by unscrewing the silver fittings from MMU2S body.
2. Check whether there's a filament string stuck in the MMU2S's selector.
3. Pull the filament out from the orange/white PTFE tube.
   a. If you're unable to remove the filament from the tube, proceed to the other end of the tube.
   b. Release the Festo fitting on the extruder and if needed open the extruder idler
   c. Then pull the filament out from the extruder body.
4. Pull out the filament (approximately 10 cm) from the MMU2S unit to the front. Cut the filament and leave about 1 cm sticking out. Create a sharp tip.
5. The **middle button** will be used now. Press it once and wait for the printer to finish the auto-check procedure.
6. If the procedure **finishes correctly**, the LED above affected filament will turn to **red-green flashing**, if the **procedure fails** it will remain **red**.
7. Finally, screw the Festo fitting back in and press the right button to continue the print.

How to solve a problem related to filament **load - slow flashing:**
> **You need to get access to the tip of the problematic filament.**

1. Roll with filament spool until the end of the filament reach end PTFE tube between MMU2S unit and filament buffer.
2. Catch the end of the filament, cut approximately 10 cm of the filament and create a sharp tip.
3. Insert the filament back into the white PTFE tube.
4. Press the **middle button** to start the loading sequence.
5. Push the filament until it's caught by the drive gear.
6. If the LED switches to **red-green flashing**, press the **right button** to continue the print.
7. If the LED turns red, repeat the process.

13.3 All five LEDs blinking red

All five simultaneously red-blinking LEDs indicate that there is a string of filament loaded through the selector, while the selector needs to move to the side. Moving the selector would cause the filament to break - this means the filament must be unloaded at first. This case occurs usually when the printer is turned off during the printing so the filament is not unloaded properly.

1. Using the Allen key, press the reset button on the right side of MMU2S unit.
2. Wait until the first LED turns green.
3. Select on LCD menu option Unload filament.
4. Select the type of filament and wait for preheat.
5. Filament will be automatically unloaded.

13.4 All five LEDs blinking red and green

MMU2S unit can now deal with a state in which the Trinamic drivers were not able to provide enough power for steppers. A possible cause can be a broken MMU2S power supply wiring, connectors etc. Please check that all connectors are properly plugged into the MMU2S board and make sure that the cables are in good condition. Also, make sure that the screws on the Einsy terminal box for the power cables are properly tightened. If this state is detected, the MMU2S unit rehomes and automatically continues printing. If the problem occurs three times in a row, the MMU2S unit stops printing and starts flashing continuously with red and green LEDs. Printing can be restored by restarting MMU2S unit using the button on the right side of MMU2S unit.

13.5 Selector not moving

If the selector is not moving smoothly or if it cannot reach a certain position, the cause is usually one of the following issues:

The selector motor isn't working - first, try powering the printer off and moving the selector by hand. If that didn't help or you were unable to move the selector, release the three screws holding the selector motor in place, pull the motor out. Then push the smooth rods out with an Allen key. You can now easily remove the selector. Clean the stuck filament and release three screws holding the selector motor in place, pull the motor out and try pressing the left

and right control buttons. See if the motor's shaft rotates. If not, the motor may be defective, or it is plugged in incorrectly.

The selector blade is loose - if you haven't secured the blade properly during assembly, it may fall out of the socket and block the movement of the selector. Release the three screws holding the selector motor in place and pull the motor out. Then pull both smooth rods out. Place the blade back in place and tighten it properly. Then reassemble the unit back to the original state.

Filament is bent and stuck in the selector - release the three screws holding the selector motor and pull the motor out. Then pull both smooth rods out (use the Allen key) and remove the selector's head. Remove the broken filament string from the selector and reassemble the unit.

## 13.6 Loud clicking and idler unable to move freely

(i) Clicking during the initialization sequence (homing) after switching on is a common part of the initialization process. This is not a problem and is unrelated to this case.

If the printer makes a loud clicking noise as the selector changes positions, and you see that the idler was unable to rotate into the correct position, it's a different case. See the following points for more information:

1. The idler springs are excessively tightened. Try loosening the screws at the edges of the MMU2S unit as shown below. The correct tightening of the springs is 0.1 mm to 0.4 mm (max. 0.8 mm) below the body level of the MMU2S unit - see Pict. 36.

   (i) How to verify the correct tightening of the springs? **Load all five filaments into the MMU2S unit.** Move the selector up to the right position and back again using the right and left buttons on the MMU2S unit. If you still hear a clicking noise, loosen the screws even more and check again.

2. If the idler is still getting stuck, turn the printer off and open the MMU2S completely, then make sure that the idler is moving freely.

3. Check that the idler is tightened against the flat part of the motor shaft by two M3x10 screws and does not slip when the motor rotates.
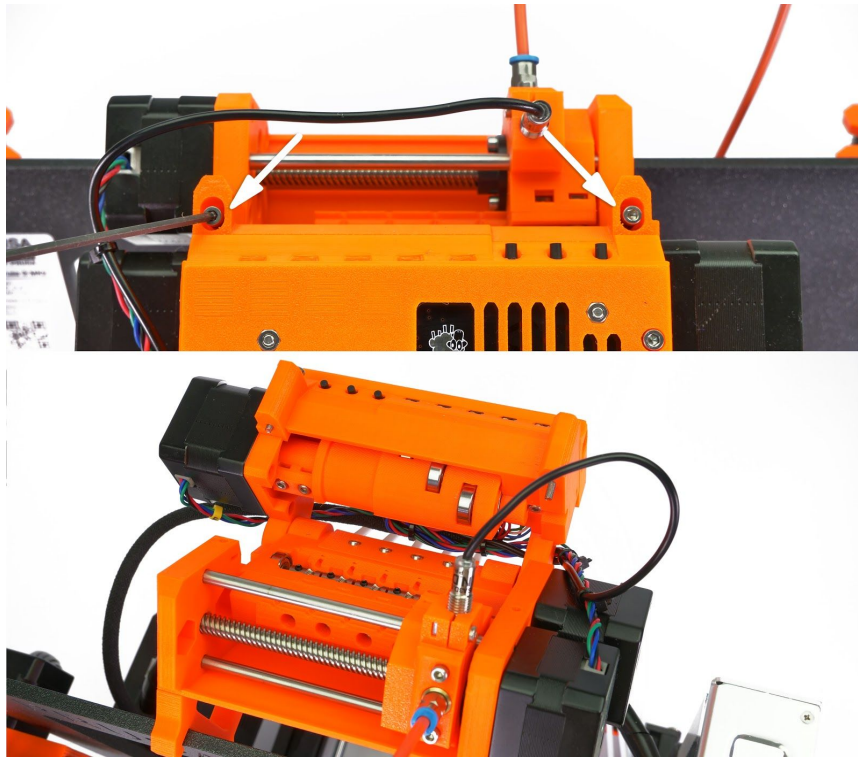
Pict. 37 - Idler opening

13.7 Filament not extruded during the print (missing layers)

If the extruder keeps moving across the heatbed (following the instructions from a G-code), but the filament is not extruded at all.

Solution 1: The hotend in the extruder might be jammed, please head to the MK3S 3D Printing Handbook - chapter 12.4 Clogged / jammed extruder

Solution 2: Filament IR sensor triggered (IR value is "1"), but the filament didn't reach Bondtech gears. It happens if the filament sensor is not calibrated properly. Please calibrate filament sensor as described in section 7.1 IR filament sensor calibration.

13.8 Filament cannot go through the selector

Selector jam may be caused by:

1. **The hole inside the selector is blocked by filament tips or strings.**

   Solution:
   a) Move the selector with the right button on the MMU2S unit to far right (service position).
   b) Unscrew the Festo fitting from the MMU2S unit.
   c) Use a 1.5mm Allen key to push the jammed pieces of the filament out of the selector.
   d) Clean the hole with compressed air and try inserting the filament again.

2. **Incorrect alignment of the F.I.N.D.A. sensor. The sensor is too low and blocks the filament.**
How to align the F.I.N.D.A. sensor correctly? Please see the assembly manual at manual.prusa3d.com.

13.9 Different filament tip shapes after the unload

Filament string ends, depending on the material type or manufacturer, can look different after the unload procedure. They can have a thick end, ball end, string end etc. See picture 38. If you want to get rid of these issues, you need to adjust the print temperature, which in most cases will solve the problem. If the problem persists, try to adjust the settings in PrusaSlicer to increase the value of "Number of cooling moves" to 2 or 3.
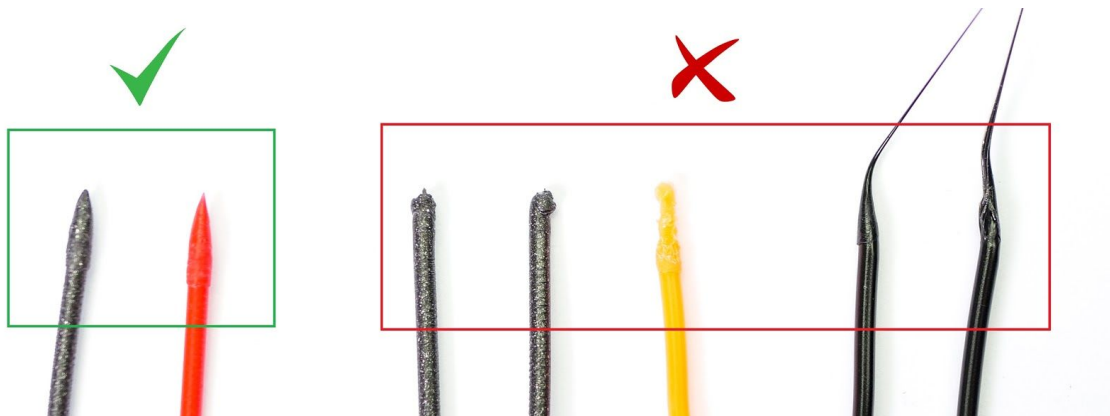
Pict. 38 - Filament tips after unload
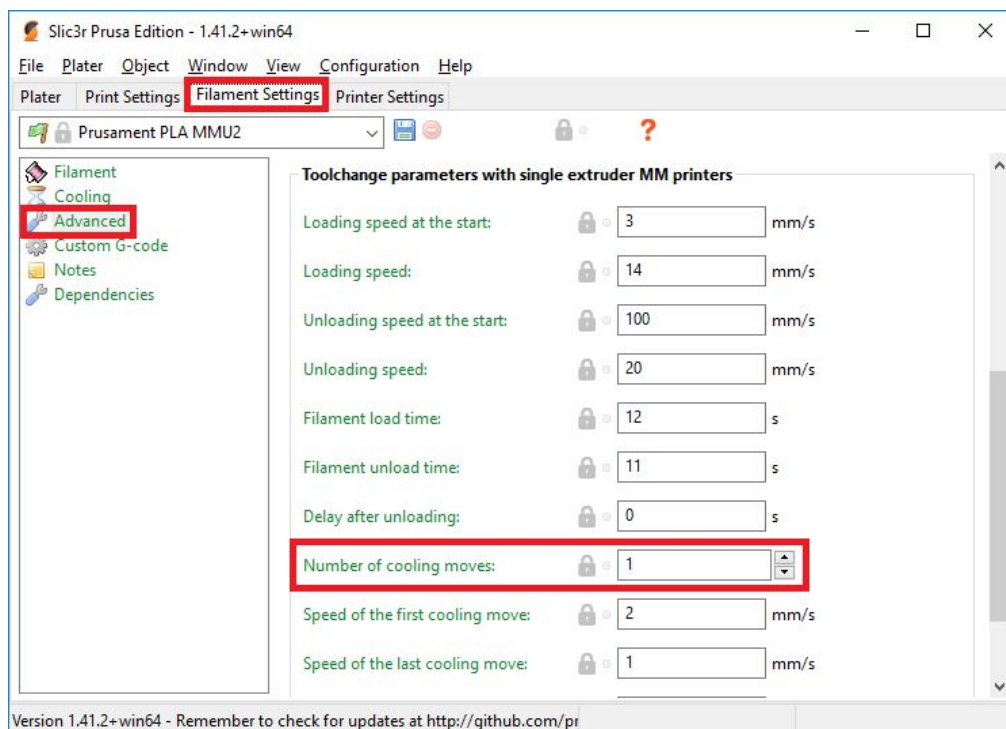
Pict. 39 - Number of cooling moves setting

13.10 F.I.N.D.A. does not detect the absence of the filament

F.I.N.D.A. sensor is located on the top of the selector. Please check out the picture 1.

During the printing process, the filament can be pulled completely out of the MMU2S unit (away from the pulleys), so during the next filament load, the gears are unable to grab the filament string.
This happens when the sensor (FINDA) does not detect the end of the filament and the unit is still trying to unload the filament, so it moves the string too far.

This problem is caused by improper detection of a filament string in the selector. It's very likely that there are filament pieces under the F.I.N.D.A. sensor, so the metal ball can't move freely.

Solution:
1. Unscrew the Festo fitting on the MMU2S side.
2. Use compressed air to blow out the filament dust in the area under F.I.N.D.A. sensor.
3. Check the correct functioning of F.I.N.D.A. sensor - open **LCD menu - Support - Sensor info**. If there is no filament below the sensor, the F.I.N.D.A. will show value "0". Insert a piece of filament from the front through the selector and the value must change to "1".

13.11 Pulleys covered with filament dust

Dirty pulleys cause the filament to slip, resulting in problems with insertion and ejection of the filament. The best practice is to clean the pulleys with an acupuncture needle, mini-brush or a similar tool.

When the filament is grinded away by the pulleys excessively, it can be caused by:
1. Lack of idler pressure - Tighten spring bolts, so they are about 0.1 - 0.4 mm (max 0.8 mm) below the MMU2S body level.

2. Excessive bending of PTFE tubes causes excessive resistance when moving the filament.

Check whether the idler springs are correctly tightened.
If the idler springs are overtightened, it may cause the idler motor to skip and then the correct filament is not pushed against the selector position. Insufficient tightening causes clogging of the pulleys. The screw head should be tightened just enough, so it's position is about **0.1 mm to 0.4 mm below the body level** of the MMU2S unit.

13.12 Can not update the MMU2S firmware

1. Make sure, that you have the last version of PrusaSlicer.
   https://www.prusa3d.com/drivers/
2. Make sure you have a MMU2S board connected to your computer and not a printer board. There are two different boards. For a detailed procedure, see the chapter 4 Flashing the firmware.
3. Check the device manager and see whether the unit has been correctly recognized and has a COM port assigned. If the driver has not been automatically installed during the Drivers & Apps package installation, install the driver manually from C:\Program Files\Prusa3D\Rambo (default path).
4. Make sure your microUSB cable is working and it is not damaged.

13.13 Crash detection

When the printer encounters a crash during printing (nozzle hits the printed object), the printer will pause the print and ask the user to confirm whether it's safe to continue printing. If the user chooses no, the print is completely stopped. The filament will remain loaded in the extruder. To unload the filament from the extruder, preheat the nozzle first and then select Unload filament in the printer's LCD menu.

13.14 MMU2S factory reset

MMU2S unit can be reset into default factory values. The factory reset procedure will primarily delete the filament length calibration values. This can be done in the service menu.

⚠ Firmware version will not be changed by factory reset.

How to enter the service menu:
1. Turn the printer on and wait for the initialization sequence to begin.
2. Press and hold the middle button on the MMU2S, and press the printer restart button at the same time. Wait until LED 1 (green and red) and LED 5 (red) light up.
3. Using the left/right button select LED 2 (red LED is on).
4. Press the middle button (this will unlock the EEPROM erase function). There is no visual indication.
5. Using the left/right button select LED 3 (red LED is on).
6. Press the middle button (this will erase the EEPROM).
7. Wait until the board erases its memory and restarts itself. All LEDs will flash once, then the first LED will turn green. The board is now erased and ready.

Print and share!

Do not forget to tag your prints with #mmu2s while sharing so we can find, pin and showcase them with our

Pinterest

http://www.prusa3d.com/original-prusa-i3-prints/

Happy Printing :)