

# STENSBORG

## User Guide

### Epson ET-M1120 retrofit

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# STENSBORG

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## Mechanical modifications

### Tools required:

- 3.5mm drill
- Phillips screwdriver size 1
- Phillips screwdriver size 2
- 2.5mm umbraco or whatever fits your bolts
- Flat screwdriver or similar for prying parts apart
- Small pair of tweezers
- Pliers
- Knife

### Bill of materials:

#### Store bought parts:

- 5x M3 nuts
- 2x M3x10-12mm bolt
- 2x M3x25-30mm bolt
- 1x M3x20+mm bolt
- 2x Washer M3, OD min. Ø9+
- 2x Washer M3, OD min. Ø7mm
- 1x Washer M10 OD: 20mm
- 1x Metal rod Ø3x50mm
- 15x M3x9mm self-threading screws (long screws from Epson printer)

#### 3D printed parts

#### Feeding mechanism:

- ConnectorPlateLeft
- ConnectorPlateRight
- BracketLeftFM
- BracketRightFM

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- Gear
- GearWithSleeves
- 2x Spacers. Can be substituted with store bought spacers ID: Ø3, length: 15mm

Barrel

- 2x Arm
- BracketLeftBarrel
- ButtonMount

Button mount

- Top
- Bottom

Feeding tray

- 2x SupportLegFT

Landing platform

- Platform
- 2x SupportLegLP
- Extension

Miscellaneous

- 2x HoldingPegL30V60

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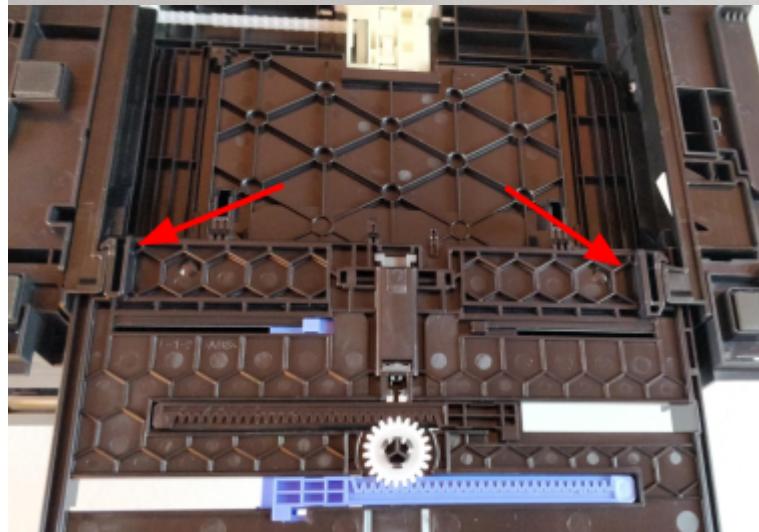
## Disassembling the printer

*It is recommended to use an unused printer as any residual ink or resin carries the risk of leakage when turning the printer upside down and handling it roughly. Save the screws from the covers as these will be used to install the mechanical modifications*

After unpacking and removing all the blue pieces of tape holding the loose parts together removing the back side.



Turn the printer upside down and remove the paper tray by releasing the indicated snap-fits and pulling the tray out.



Removing the loose top cover. It is snapped in place around the hinges and can be lifted upwards when closed.



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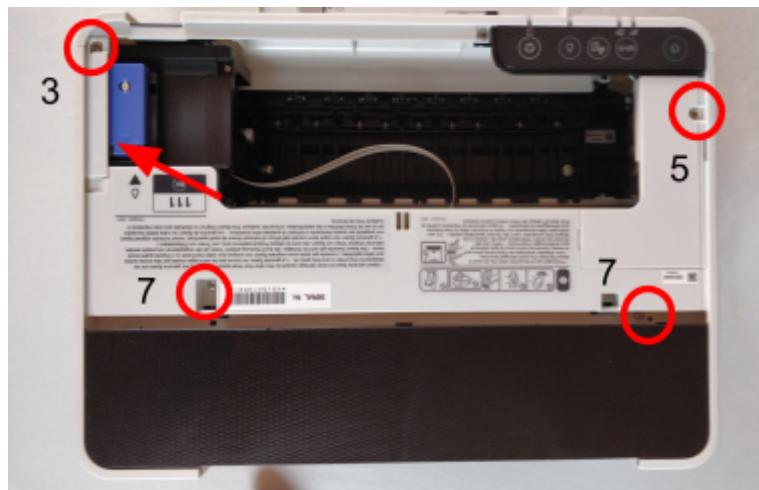
Remove screw (1), locking the small cover in place, and slide this backwards. It might be tight and inserting a flat screwdriver or similar near the screw and prying the cover backwards is helpful.



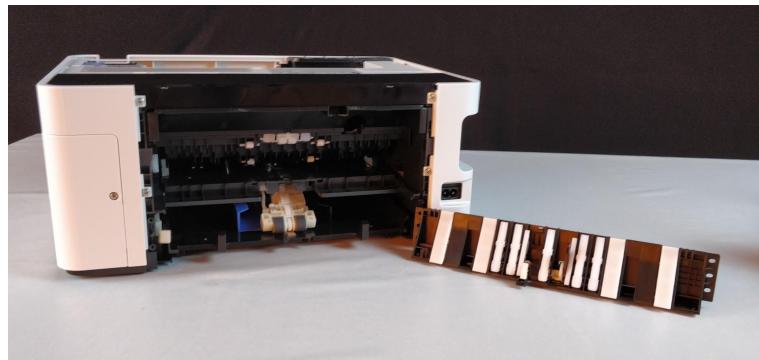
Remove screw (2) locking the tank in place and remove it.



Remove the screws (3), note the previous images. By lifting up the lip indicated by the arrow the left panel can be slid backwards.

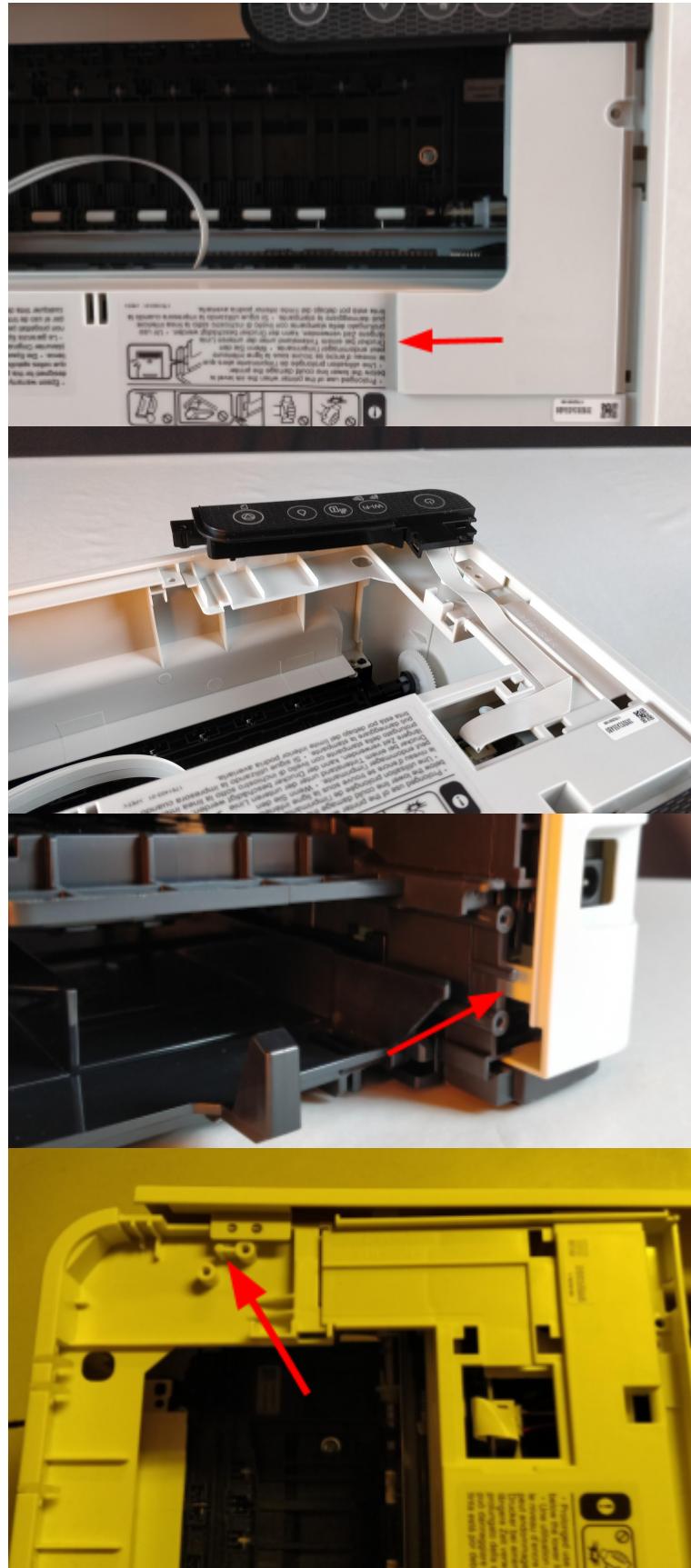


Remove the screws (4) and the bottom piece should come off easily by turning it out from behind the right panel.



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Remove the screw (5) to unlock the small cover on the top. Lift up the edge by the arrow and slide the cover in the shown direction.

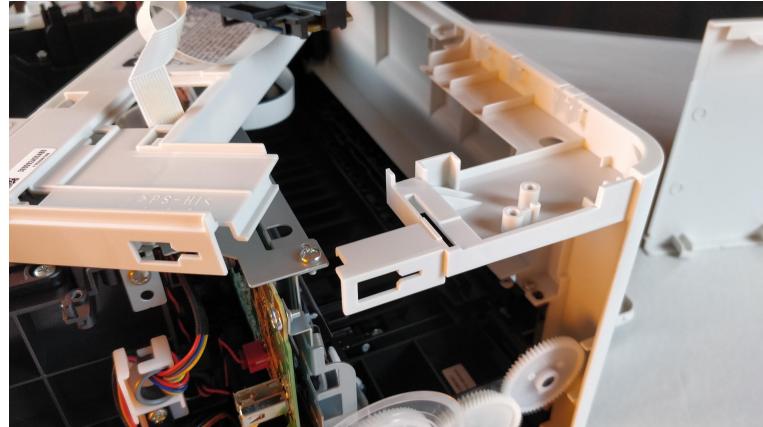


Remove the two screws locking the buttons in place and slide the module out. The ribbon cable is glued down and should be peeled off carefully.

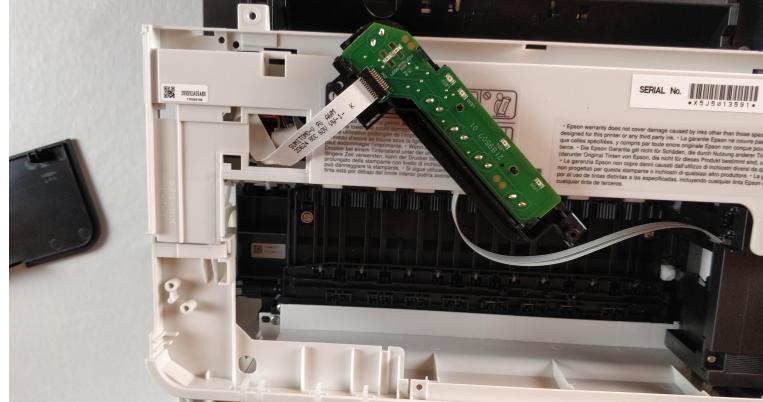
Remove the screws (6) to fully unlock the right panel. This is held in place by a snap connection as shown along with a small pin at the top underneath the previous cover. While prying off the snap connection, the panel can be slid backwards. Now the black panel on the top should also come right off.

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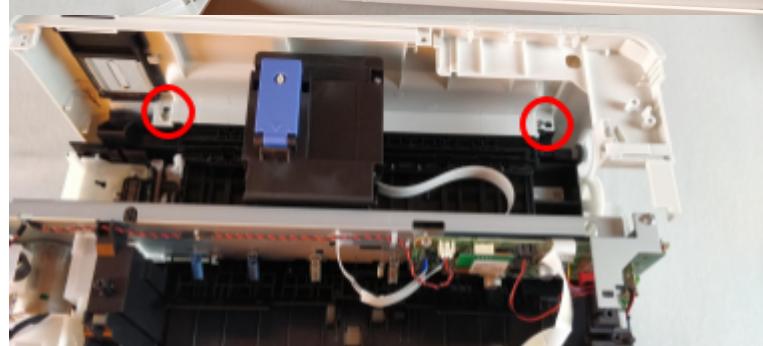
Now remove screws (7) and remove the white top panel. Lift it upwards and turn it forwards to get the lip out of the slot.



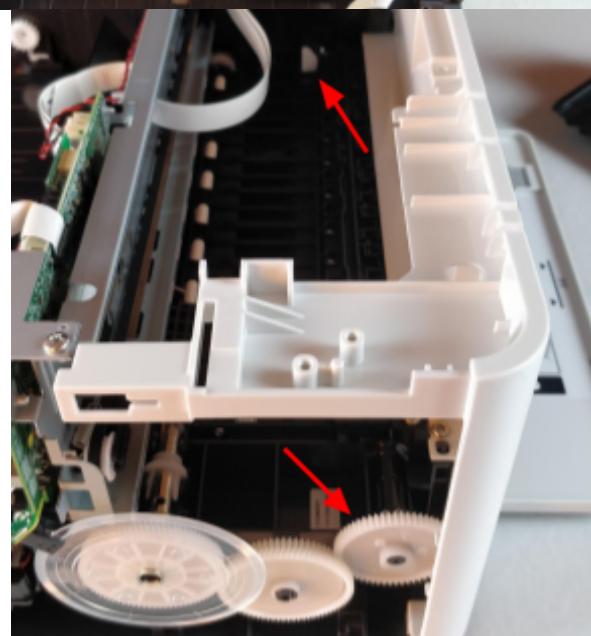
Carefully pull out the ribbon cable from the button module and feed it back through the hole in the white top panel.



Move the print head to the middle of the printer and remove the exposed screws. The front panel can now be removed easily by lifting it up slightly and moving it forwards.



If the print head is locked in place, push it back as far as it goes (it should collide with a white carrier and push the carrier back). Now manually rotate the indicated gear to lower the locking mechanism (top arrow).



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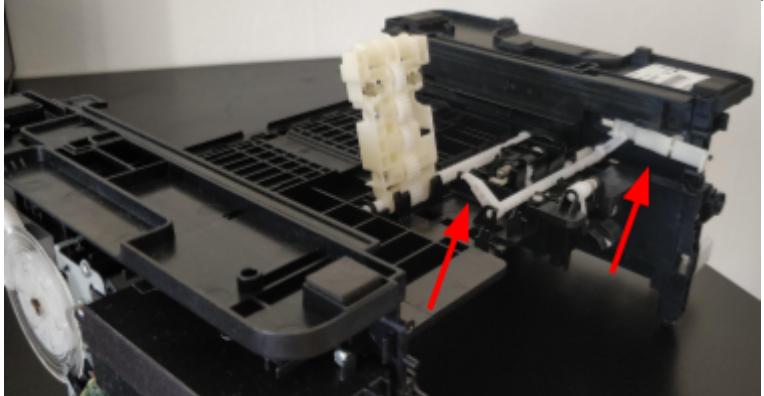
Remove the four screws and the oddly shaped cover.



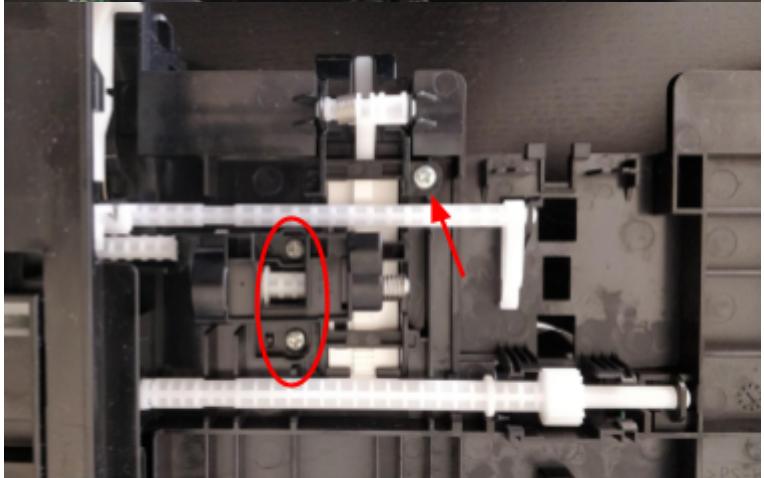
Turn the printer upside down and pull out the landing tray. Release the snap fits with a small screwdriver.



Move the indicated bar to the right as far back as possible and lift up the gear train to remove it. Turn the hook backwards and pull out the bar.

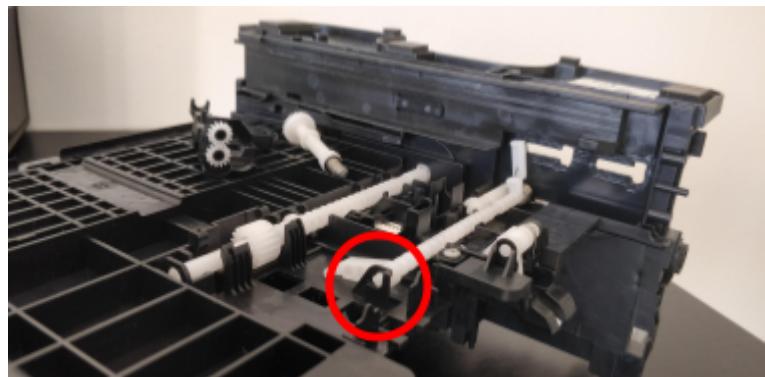


Remove the screws in the circle and along with the cover and gears hidden underneath. Be careful, as two gears are loosely mounted underneath the cover.

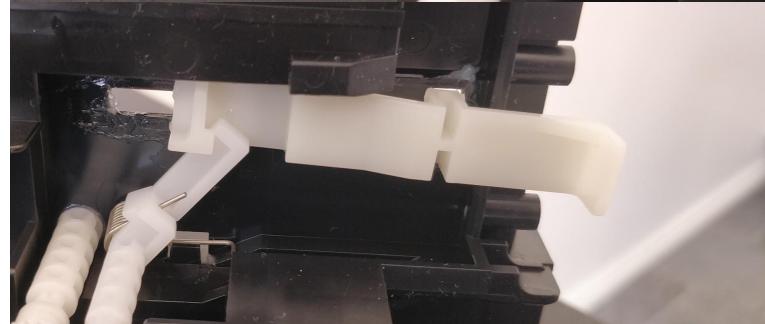
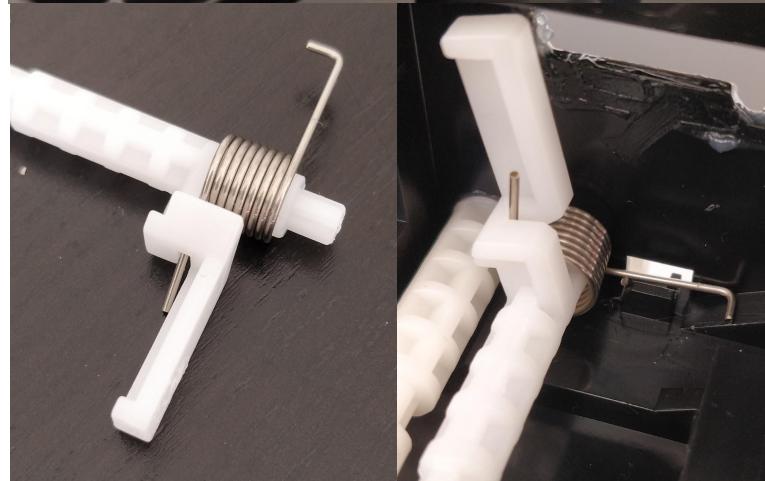


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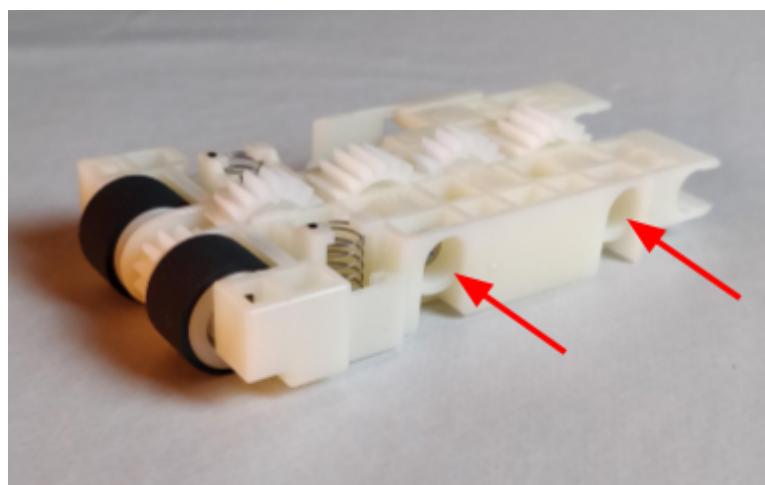
The bar with the hook can be removed by gently bending it and pulling it out of the socket to the left.



Remove the final screw indicated by an arrow in the previous image and pull out the last part. Reinsert the bar with the hook and the sliding bar to the right. Notice the orientation of the spring and make sure the 90 degree bend is located behind the notch. When inserting the sliding bar, make sure the connection between this and the hook bar is as shown. Check that it acts as intended when pulling it back and forth.

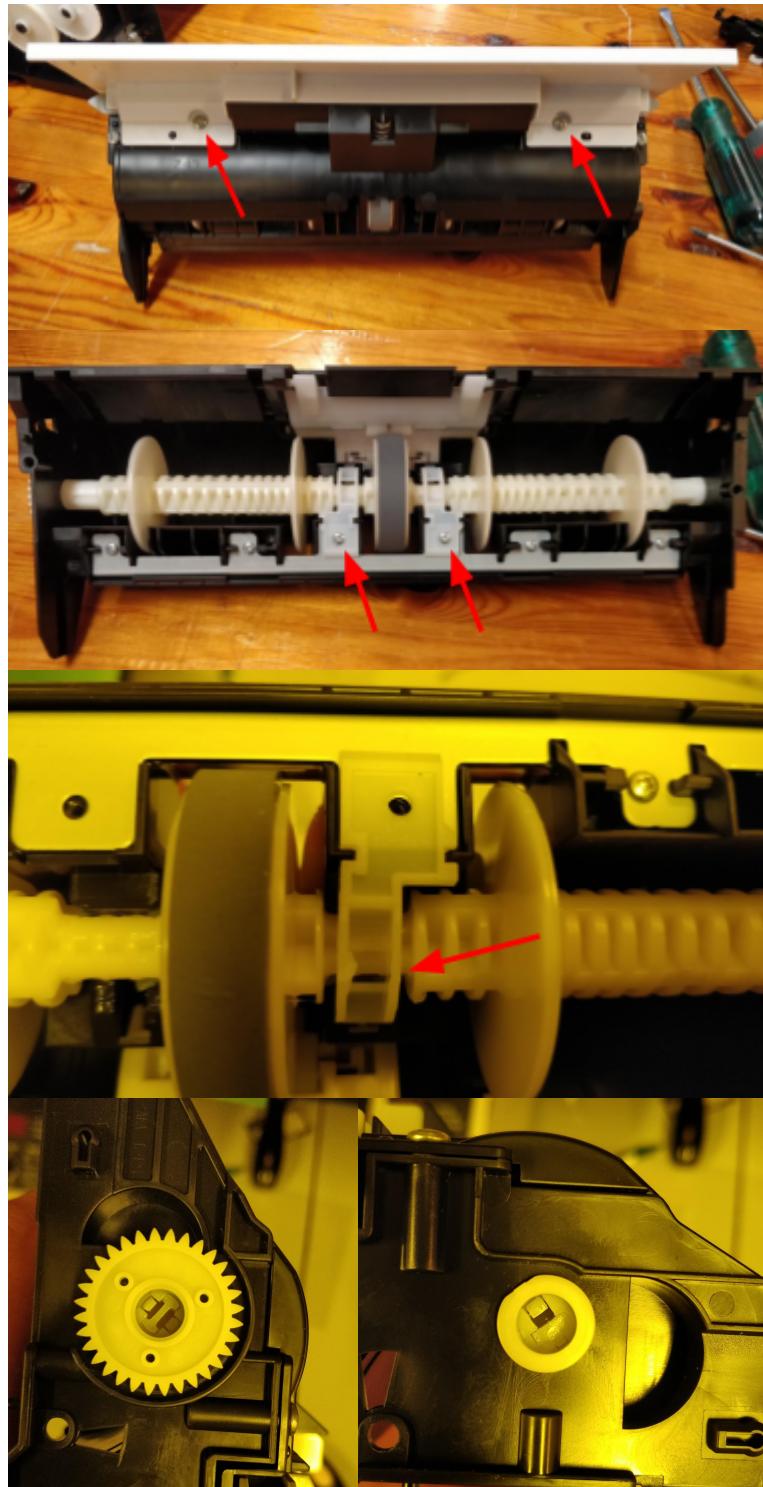


The rubber sleeves on the gear train will be reused on another part. Remove the two screws and carefully pull the gear train assembly apart. Remove and set aside the rubber sleeves, reassemble the gear train and put it back in the printer. Make sure the hook goes into its slot on the gear train.



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The back panel contains an axle with a wheel and a rubber sleeve which will be reused. Remove the two screws to loosen the cover. Turn it over and remove the next two screws

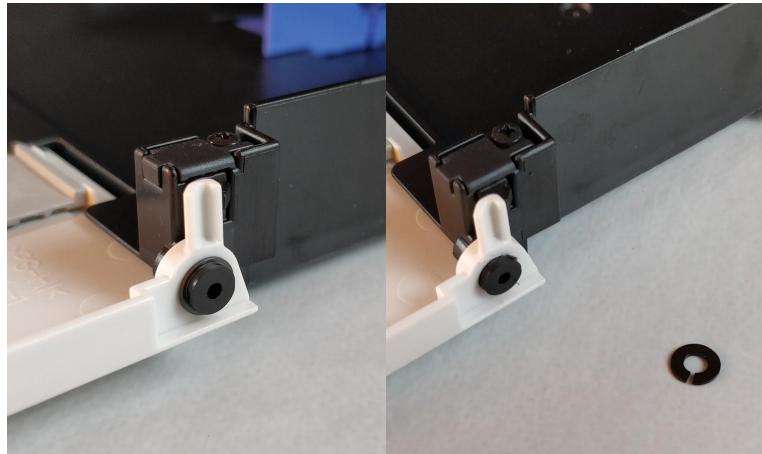


Remove the two plastic bearings. They can be removed by inserting a flat screwdriver or similar into the indicated slot and bending away the snap fit.

Finally the two end pieces are pulled off. The snap fits should be soft enough that releasing them won't be necessary. Otherwise they can be released with a set of tweezers.

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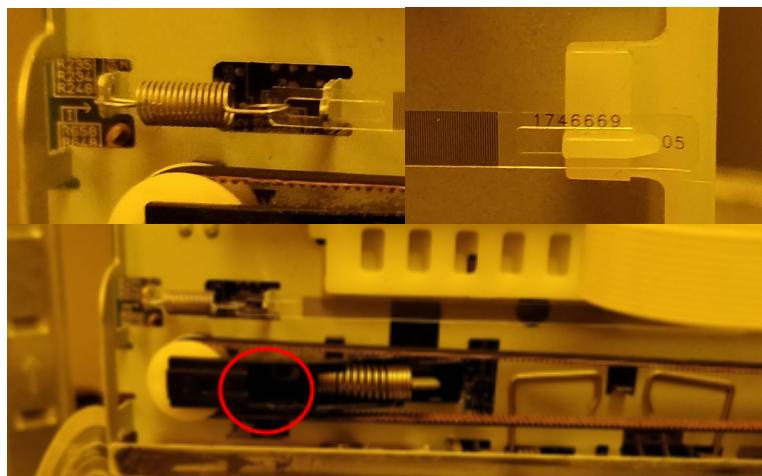
The paper tray will be reused to align the substrate. Remove the white cover by pulling off the locking ring. The easiest way to do this is by inserting a small pair of tweezers into the opening of the ring to expand it and pulling it off with a pair of pliers. Pry one end of the white panel of the hinge and pull it off the other. Set the tray aside.



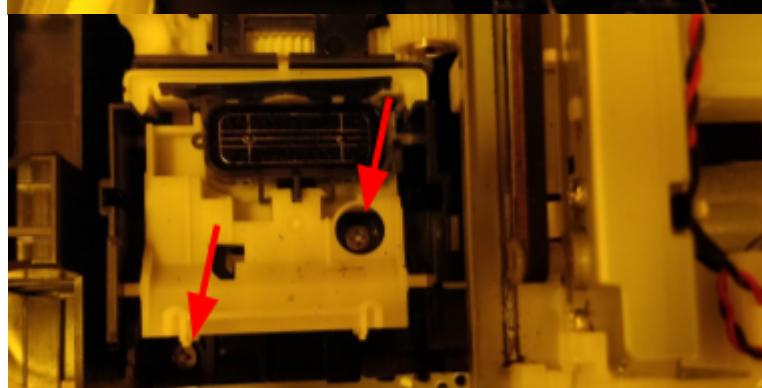
Remove the plastic strip with the bar code by gently pulling it off the hook to the right.

It can now be pried off to the left including the small spring.

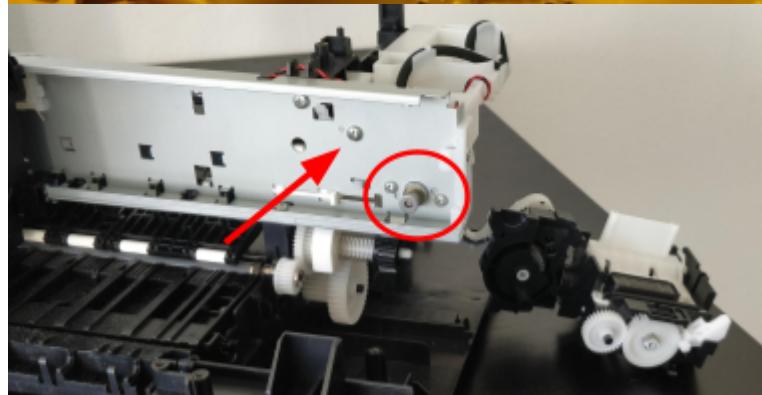
Contract the spring to loosen the timing belt and pull this off. This is easiest done by inserting a screwdriver into the small hole on the black part and pushing back.



Move the print head away from the resting area and remove the two screws. The subassembly can then carefully be pulled out.



Remove the three screws and pull out the motor (if careful, this can hang in the wires) and the square plastic part. The small black gear can also come off now.



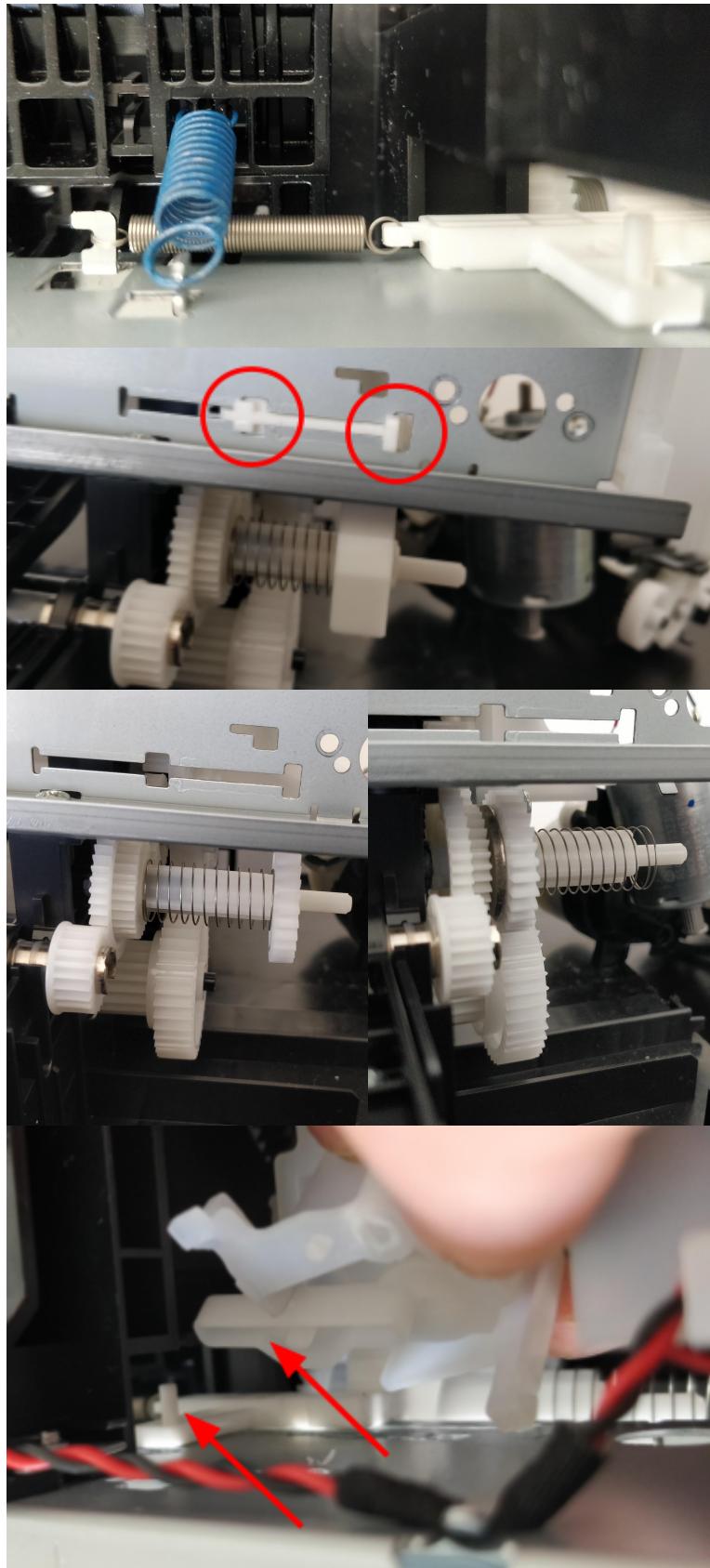
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Now remove the small spring on the back (not the blue one) to loosen the sliding mechanism.

The sliding mechanism comes off pushing the two tabs through the holes as shown.

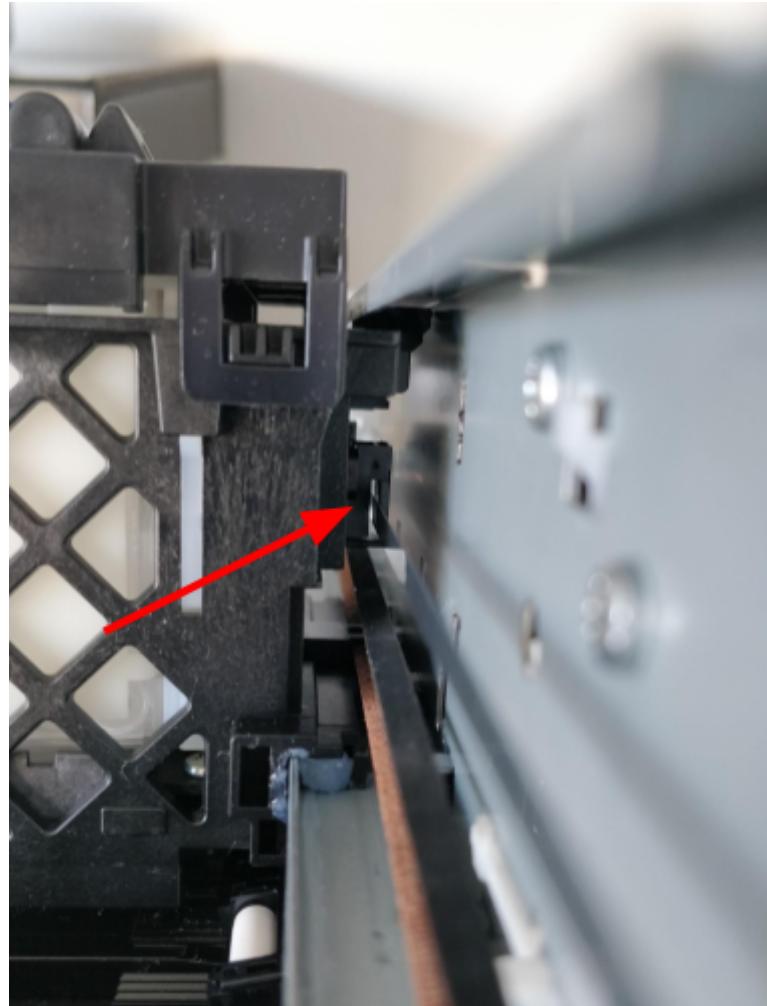
Next, the spring and gear is removed and the M10 washer is attached as shown in the before/after images. Hereafter the sliding mechanism can be put back in place along with the small spring on the back.

Now the square plastic part can be screwed back in place. Notice how the pin on the sliding part is inserted into the slot. Check that the sliding mechanism can lock halfway down the track and is released by moving it to the very end of the track.



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Hereafter, the motor can be put back on followed by the small black gear and the cleaning subassembly. Check the connection between the gears by manually rotating the large gear in the opposite end of the printer. The timing belt and the plastic strip with the bar code can then be put back on. Make sure to wipe off the bar code beforehand. When inserting the barcode and the timing belt make sure they are not twisted and that the barcode runs through the little slot in the sensor.

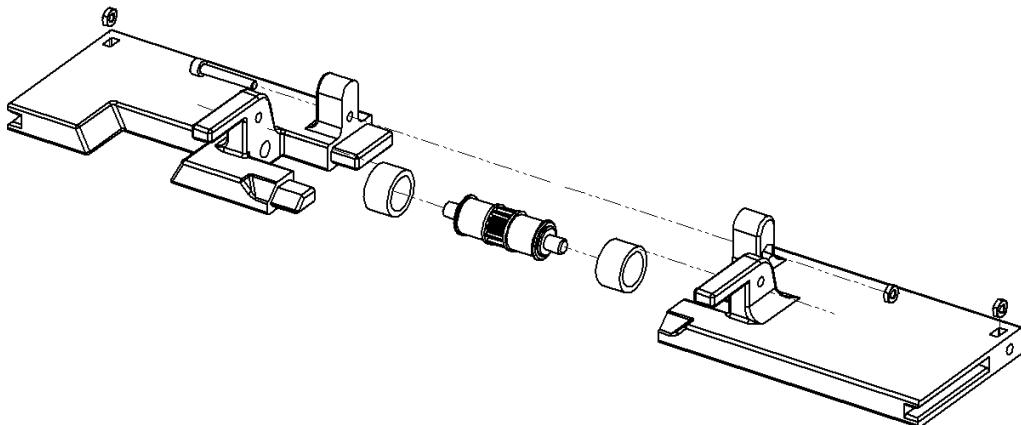


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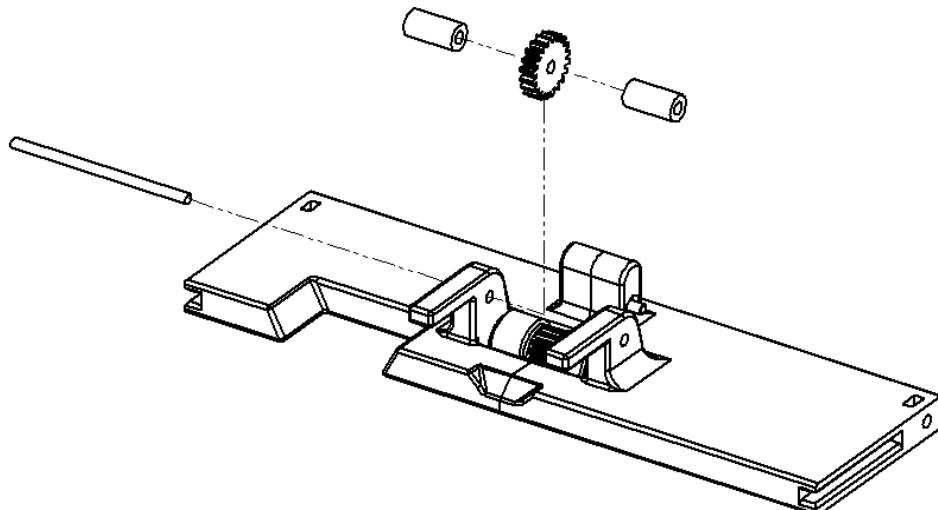
## Installing the new parts

### Feeding mechanism

Push the two small M3 nuts into the indicated slots. They should fit in snugly but can be heated slightly if necessary. The rubber sleeves are mounted on the GearWithSleeves. The two ConnectorPlates are pushed together around the GearWithSleeves and an M3x20+mm bolt and an M3 nut locks them together. Once again the nut can be heated slightly if necessary

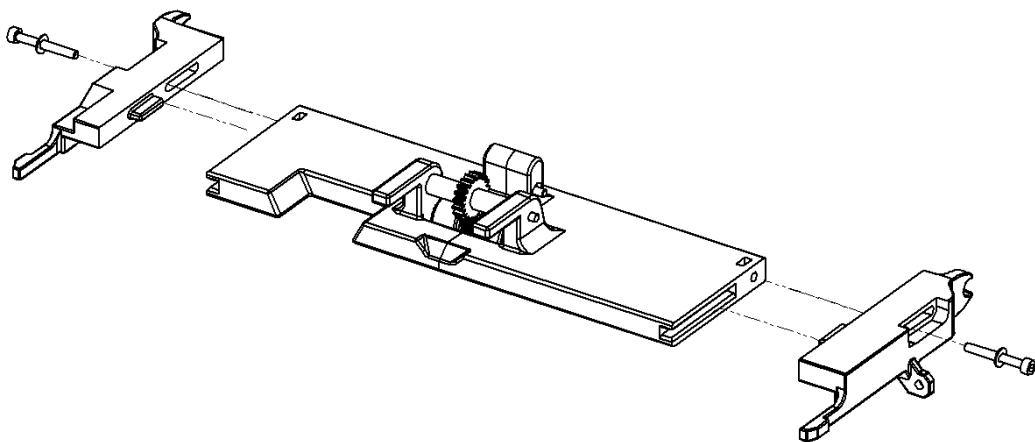


The Spacers and Gear are now attached in place using the Axle. The Axle should fit snugly into the ConnectorPlates but the Gear should spin freely. The axle can be heated slightly if necessary, but be careful not to overheat it as it risks being too loose in the ConnectorPlates.

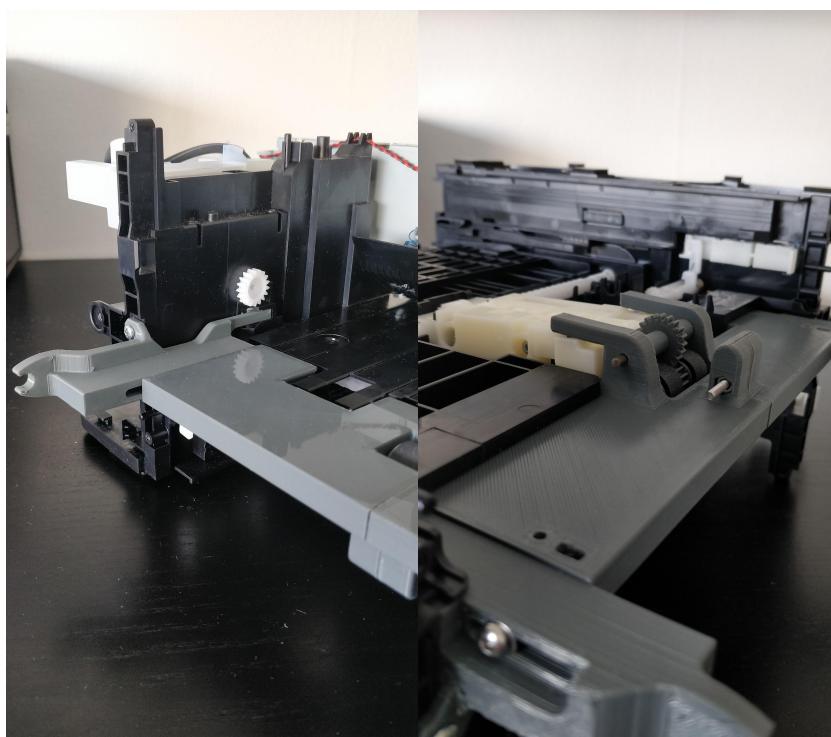


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Lastly the Brackets are attached to the main assembly using two M3x20 bolts and the two M3 OD 7mm washers. Make sure not to over tighten the bolts as the ConnectorPlates need to be able to slide back and forth.



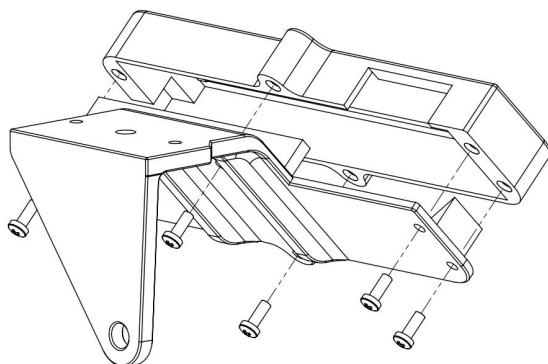
The entire assembly is pushed into place using the snap-fit on each side and secure with two of the screws from the epson printer. Make sure the white gear train is locked in place under the ConnectorPlate. Tighten the two bolts on the side while holding the subassembly dead against the printer. Manually check that the gears run smoothly. The alignment tray is connected to the "C" clamps.



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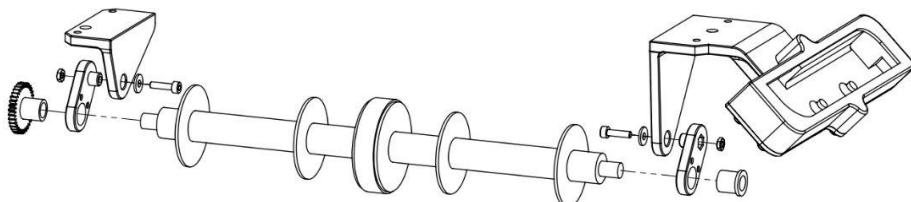
## Button mount

The button mount is assembled around the button module using 5 of the long self threading screws from the epson printer. It is then mounted on top of the right brackets using 2 of the long self threading screws from the epson printer . The internal geometry supports the button module at specific areas without applying pressure to the PCB itself.

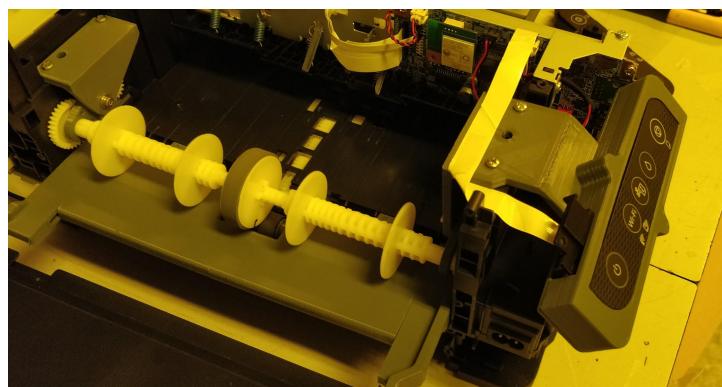


## Barrel

The barrel is assembled as shown in the exploded view. Insert the 2 M3 nuts into the small arms and screw these onto the brackets using washers. The barrel is then attached to the brackets using the two original end pieces.



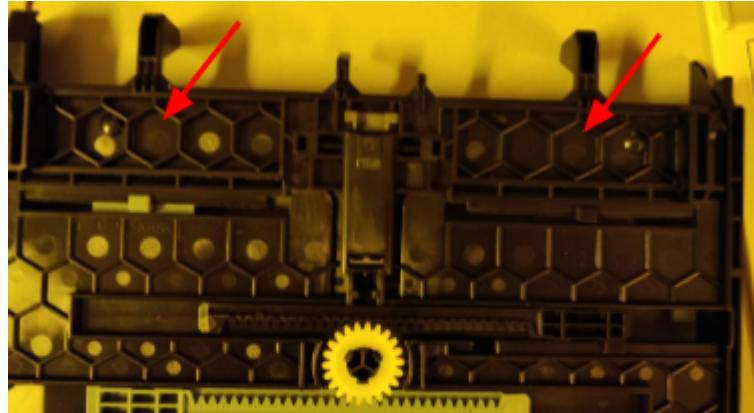
The entire subassembly is then screwed into premade holes using 4 of the long self-threading screws which was originally used for the printer. Check that the barrel easily moves up and down. Reinsert the ribbon cable back into the button module making sure that the text on the cable is on the same side as the PCD of the button module. The small pin will need to be removed to make room for the button mount. Optionally the ribbon cable can be glued down onto the bracket similarly to how Epson did it.



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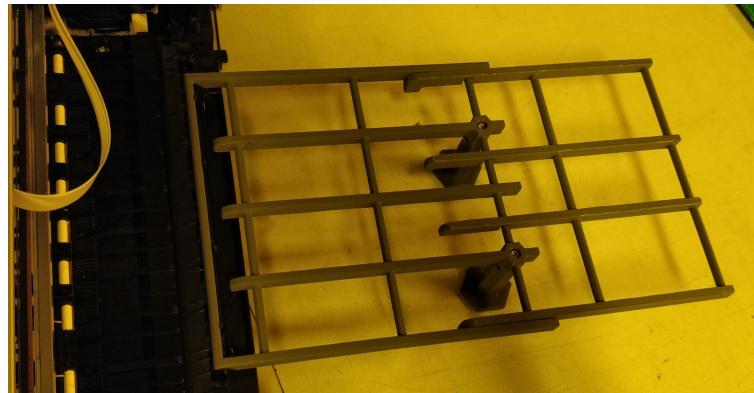
## Feeding tray

Drill Ø3.5mm holes in the center of the indicated hexagons. The 2 long support legs are pushed into the hexagons and secured with 2 long self threading screws from the epson printer.



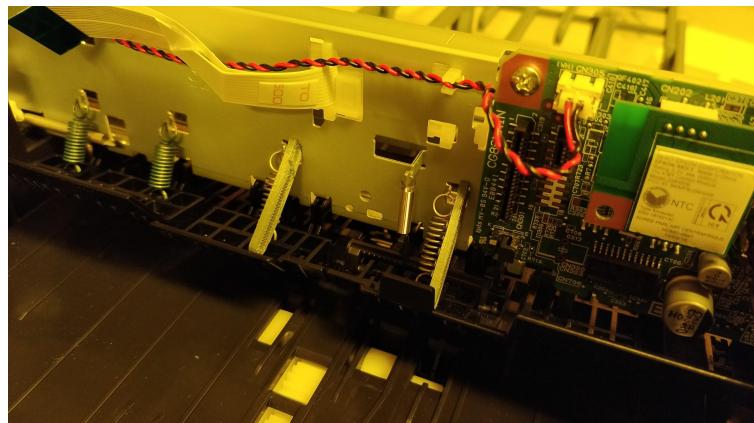
## Landing tray

The support legs for the landing tray are attached similarly to the legs for the feeding tray. The extension is attached to the main landing tray by pivoting around the transverse rod and bending the two prongs slightly to let the snap-fit underneath the main platform.



## Pegs

Two small pegs are inserted into the two slots shown in the image. They serve to raise the feet slightly to prevent excessive force onto the substrate. The raised area has a width of approximately 8 cm. The change is not required, but if the pegs are installed it is important to acknowledge that the media detector is moved slightly. To prevent printing outside the substrate an **offset from the top side of minimum 23mm** is required. This is set under “Image placement settings” in the software.

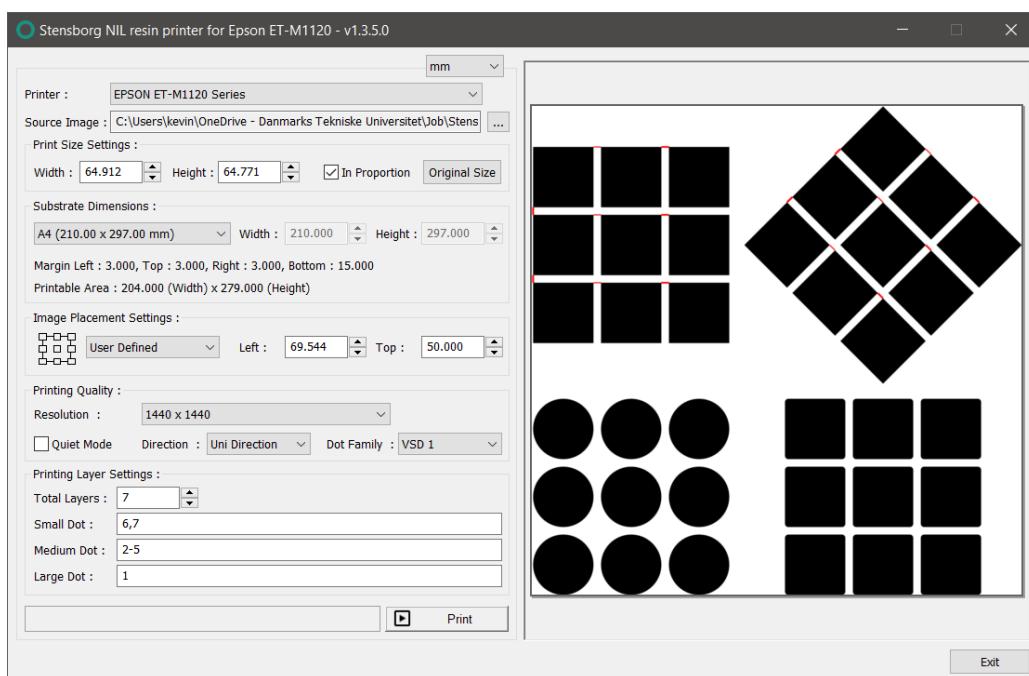


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Some of the covers can be put back on if desired, but requires several new screws as the original screw has been reused. However, keeping the printer naked is advised to access the mechanical parts and ease maintenance (and it looks cool). It is highly advised to cover up the transparent parts on the print head, as stray light can cure the resin thereby clogging up the nozzles.

## Software

To use the modified printer run the program “Stensborg NIL resin printer.exe” and allow it through any security messages that might pop up.



**Printer** displays all available printers. Make sure the Epson ET-M1120 is connected either through wifi or USB as the original instruction explains.

**Source image** determines the pattern to be printed. The program accepts images with the following file extension: “.bmp”, “.gif”, “.png”, “.tiff”, “.tif”, “.jpeg” and “.jpg”. A preview of the image can be seen to the right. The printer will then eject resin on all black (RGB: 0,0,0) pixels. Other colors will be ignored by the software.

**Print Size Settings** scales the width and height of the image. To lock in the proportion check the box to the right. The button “Original Size” resets the image to the original size.

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**Substrate Dimensions** defines the size of the substrate inserted into the printer. Preset sizes are available through the drop down menu as well as a user defined option which unlocks the boxes “Width” and “Height”. When using a carrier sheet, it’s size is written here instead. Read further down for a more in depth explanation. Due to the firmware of the printer margins are implemented and shown below along with the remaining printable area.

**Image Placement Settings** determine the location of the print job on the substrate. Preset locations are available through the drop down menu as well as a user defined option which unlocks the boxes “Left” and “Top” which are simply the distance from the top left corner of the substrate to the top left corner of the chosen print job. The small illustration to the left can be used to quickly select a preset.

**Printing Quality** contains:

- Various resolutions in dpi (drops per inch), which is used for the entire print job.
- “Quiet Mode” which slows down the printer to lower the noise generated. No advantage has been found using this mode.
- Direction which determines if the print head should only deposit resin when moving in one direction or both directions. It is recommended to use “Uni” as the droplets should be positioned more correctly by putting all mechanical slack to the same side.
- When starting a job the printer required a dot family to determine the available drop sizes. The dot family cannot change once the print job has started, but the drop sizes can be varied with each layer. It was found that VSD1 is most reliable when using the small drop sizes.

**Printing Layer Settings** determine the number of layers to be deposited as well as size of the drops for each layer. The layers are written in the respective box, either individually separated by a comma (i.e. 1,2,3,4,5), or with a dashed line (i.e. 1-5) which selects the layers in the interval. Layer 1 refers to the first layer deposited, 2 the second layer etc. All layers must be allocated before a print can begin. It is a combination of these drop sizes, with a predetermined resolution, that determines the final layer height. See the table with layer heights on the next page.

## Printer specifications

Max print size	204x279mm <i>80mm width with raised clamping wheels</i>
Min print size	n/a
Max substrate size	210x297mm (A4)
Min substrate size	105x148mm (A6)
Max substrate/carrier thickness until physical collision with print head	Polycarbonate: 900µm Glass: 725µm
Min substrate thickness	n/a <i>Unlimited if a carrier is used</i>
Max coating thickness	195µm <i>Resin runs very easily at this thickness</i>
Min coating thickness	1.5µm <i>Surfaces with nice quality requires around 20 µm</i>
Substrate material tested	Polycarbonate Glass primed with P94
Resin tested	X30L, density: 1.1-1.2 g/cm³, viscosity: 19cP

## Layer heights

The layer heights presented below are generated from a single test, so some uncertainty is likely to be present. For VSD1 only.

Resolution	Small [µm]	Medium [µm]	Large [µm]
360x360	1.5319	2.2282	4.0385
720x360	2.7852	4.1778	7.5201
720x720	5.4311	8.4949	14.3438
1440x720	10.4445	16.9897	28.9661
1440x1440	20.8890	34.1188	59.0463

## Using the printer

### Flushing the printer

Flushing the printer should be done every time the resin is being exchanged for another type of resin. The majority of the resin can be removed by inserting a syringe with a needle tip into the carriage through the ink deposit valve (under the grey lid) and extracting the resin. It might be necessary to tilt the printer to reach the resin. With the majority of the resin removed, injecting isopropanol into the printhead and removing it with the syringe will help remove the final resin. To fully flush the printer, inject a bit of isopropanol and run a few nozzle cleaning cycles through Windows' printer settings.

It is recommended to flush the printer if it is not being used for a longer period of time to prevent the resin curing in the nozzles.

Should the nozzles get clogged with cured resin, it is likely that a new print head is required.



### Nozzle check

At times it is necessary to run a nozzle check to see if some of the nozzles are clogged and if so running a cleaning cycle. This is done through Window's own software. Search for "Printers and Scanners", find and click on the connected "EPSON ET-M1120 Series"-printer. Click manage and select printing preferences. Under the "Maintenance"-tab nozzle check can be found.

When running the nozzle check it is important to keep in mind the mechanical modification which has moved the media detector. Lift the barrel and start the nozzle check. Manually push in an A4-sized sheet when the print head stands still while the feed is running at a constant pace (a few seconds after initiating the nozzle check). The nozzle check pattern should be printed. If any lines are interrupted, proceed to clean the nozzles as prompted by Window's software.

## Using a carrier plate

When inkjetting on a small or very flexible substrate, it is advised to use a large carrier plate, i.e. 180µm clear PVC, with a generous offset from the top using the "Image Placement Settings". **At least 23mm due to the mechanical**

**modifications.** In this case the size of the carrier plate is chosen/written in the "Substrate Dimensions" in the software and the substrate is glued onto the substrate using scotch tape on the corners or similar. The image placement must be altered accordingly. This is easiest done by printing directly onto the carrier with a thin layer of resin and marking the printed area on the backside with a permanent marker. The resin can then be washed off with a bit of isopropanol. The substrate is located in such a way that the pattern fits inside it.



## Starting a print job

When starting the first print job of the day it is advised to run a nozzle check and a nozzle cleaning routine if necessary. For small or very flexible substrates a carrier plate is required. Details for both can be seen further down.

1. Start by selecting a printer and source image in the software. Check that the Print Size Settings are correct. They should be fine if the loaded pattern is made with correct dimensions.
2. Next, select the substrate dimensions. If a carrier plate is being used, its dimensions are selected instead.
3. For the most part the image placement settings will be horizontally centered (easiest to align with the substrate). Select "Top center" to get the left distance. Next select "User defined" and change the top distance. It should be at least 23mm due to the mechanical modifications.

4. In the Printing quality start by selecting a resolution. The higher the resolution the more droplets are ejected for a given area. Next, determine if quiet mode is desired, the direction which the print head is ejecting resin and the dot family.
5. In the Printing Layer Settings start by determining the total number of layers. Then, write which layers should have which drop size based on the table on the previous page. This determines the final layer thickness. For print jobs which require various drop sizes, it is recommended to start with the largest drop sizes to properly wet the entire surface.
6. **Before hitting print** clean the substrate with isopropanol and a silicone lint roller. For printing on polycarbonate 2 routines with a corona discharge machine is advised to encourage adhering. For printing on glass a primer is required. Make sure the substrate is properly aligned on the carrier plate and held in place with some low tack tape. It is important that the tape lies flat on the carrier plate to prevent collision with the printhead, which could spread the resin to undesired areas. Make sure the carrier plate is aligned in the tray and the two aligning pieces are pushed together (without squeezing the carrier). The carrier plate should be under the barrel and the edge should be above the middle of the exposed gears.

## Cleaning nozzle head

To remove resin and clean the nozzle head the following approach is recommended:

1. Remove bulk from reservoir  
A syringe with a tubing that would fit the ink-deposition opening on the printer is required.  
Tilt the printer so it lays on its side (or even tilt it more), while using the syringe as a suction tool to extract the excess resin.
2. Purge with solvents  
At the back of the printer there is an absorbent cartridge where the ink for cleaning would go - exchange that with a small container (like a glass beaker) to keep track of what is going through the printhead.  
Place solvent in the ink chamber and then run a cleaning/purge operation on the inkjet printer several times using the windows software.
3. If you want to use a different solvent after - repeat from step 1.  
Depending on the solvents and material solubilities - one could use the 1st solvent to get rid of the ink, and the 2nd solvent to get rid of the 1st solvent, where the 2nd one would be something like IPA.
4. Remove the bulk of the solvent and put in the new resin.

## General advice when using the epson printer

1. Use an unused printer. Residual ink might impose problems to the resin.
2. When cleaning the nozzle head it is advised not to use aggressive solvents such as hexanone, as it might damage the print head. Tested solvents include:
  - a. Isopropylalcohol
  - b. 4-methyl-2-pentanol
3. Cover up all sides of the print head to prevent stray light entering and curing the resin.
4. Store the printer in a dark place or a room shielded against UV light to prevent stray light curing the residual resin in the nozzle.
5. The printer should not be stored in a very dirty area, as many dust particles can clog the nozzles.
6. Store the printer the right side up when the reservoir is full of resin. Otherwise it might risk leaking.
7. Keep in mind that the ink normally used in the printer has a viscosity of approximately 5 cP whereas the tested resin has a viscosity of 19 cP. Using resin with lower viscosity than the tested ones, might allow smaller droplets to form whereas using resin with higher viscosity might prevent smaller droplets to be formed.