The Plate Shuttle

Assembly manual

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RIKEN

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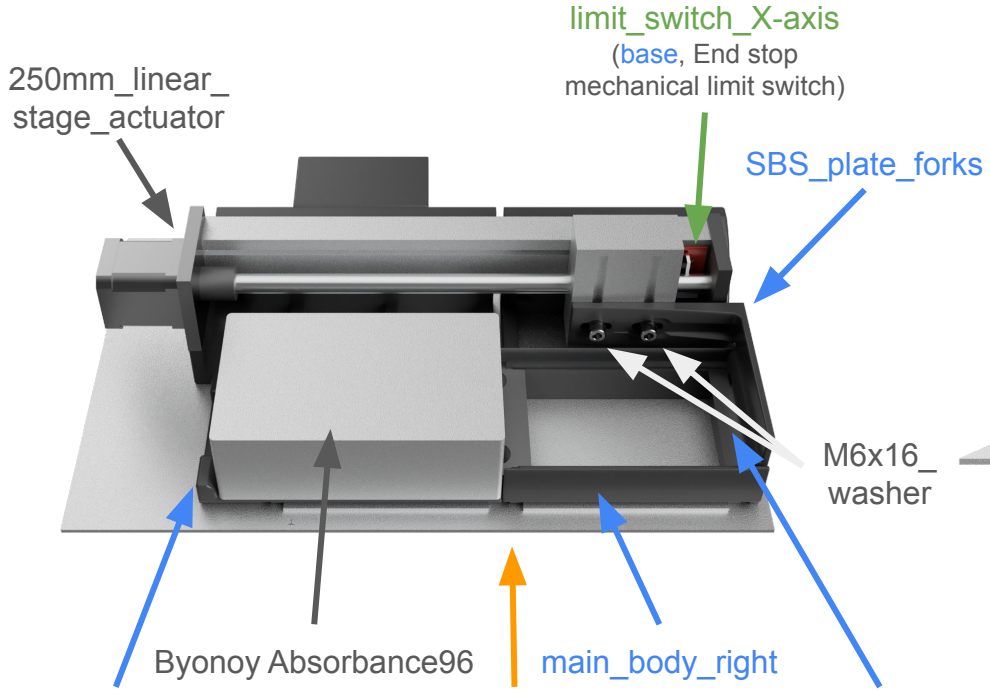
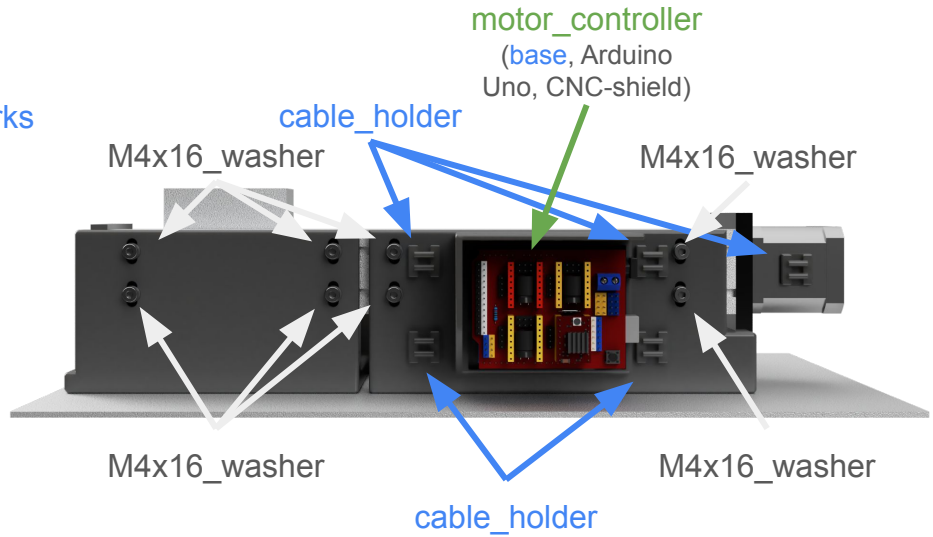
Summary

1. Preparation: 3D-Printed/other parts and tools
2. Mainbody assembly part.1
3. Actuator fine adjustment (can do it anytime)
4. Electronic parts quality check
    a. Installation grbl on an Arduino Uno
    b. Place a CNC Shield on the grbl installed Arduino Uno
    c. Stepping motor test
5. Electronic parts assembly and setting
    a. Electronic parts assembly
    b. grbl firmware parameter settings
6. Mainbody assembly part.2
    a. Set a byonoy on the body
    b. Adjustment height between a byonoy and a plate hold position
    c. Set the plate lift parts
    d. Set SBS plate cart on the actuator
    e. Fine adjustment
7. Test Running (🏗 Construction is progress)
    a. Test connection with Python script
    b. Adjustment location of pipette and byonoy insert position
    c. Test running
8. End

Parts name

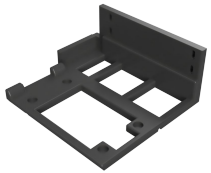


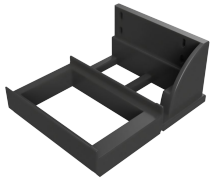


Black: Purchased parts
Blue: 3D-printed parts
Orange: Laser cutted parts
Green: Partial assembly

1. Preparation: 3D-Printed/other parts and tools

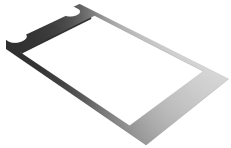
3D-printed parts

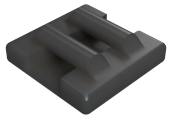

main_body_left (x1)


main_body_right (x1)

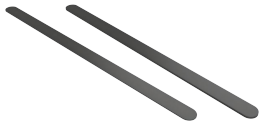

SBS_plate_forks (x1)

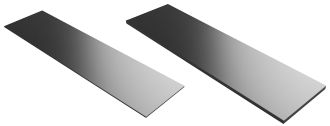

motor_controller_base (x1)


lubricating_sheet_for_SBS_plate_forks (x1)


cable_holder (x7)


limit_switch_X-axis_base (x1)


spacer_main_body_right_and_lubricating_sheet_for_SBS_plate_forks (0.5mm/1.0mm)


spacer_actuator_main_body (0.2mm/0.5mm)

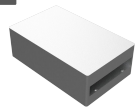

spacer_linear_stage_actuator-SBS_plate_forks (0.2mm/0.5mm)

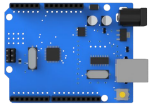
Laser cutted parts

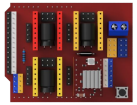

OT-2_base_for_assembly

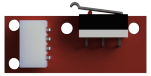
Purchased parts


250mm_linear_stage_actuator

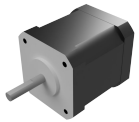

Byonoy Absorbance96

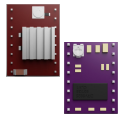

Arduino Uno


CNC shield

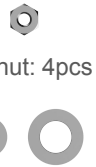

End stop mechanical limit switch


DC Power Supply (12-36V)


Nema-17 Stepping Motor

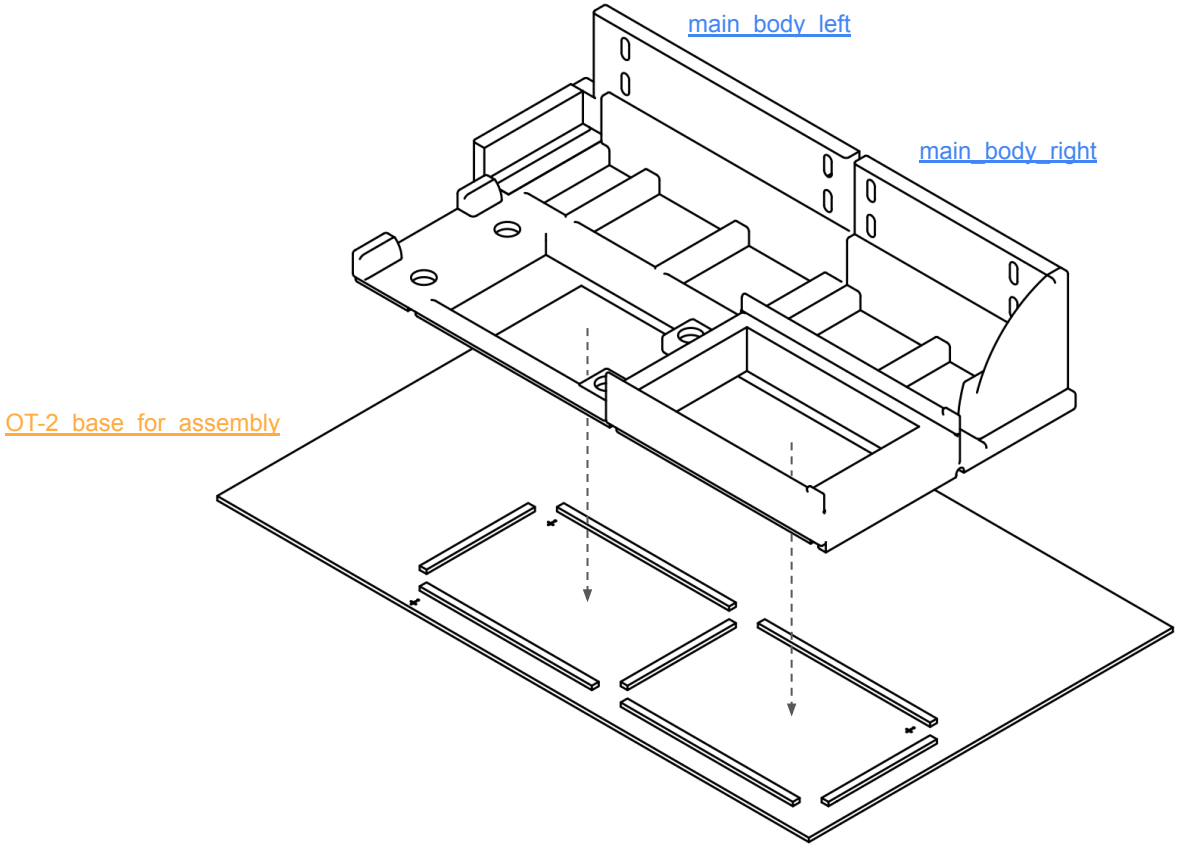

Stepping Motor Drivers (A4988 or DRV8825, etc.)


Screws
- M6 x 16mm: 2pcs
- M4 x 16mm: 8pcs
- M3 x 8mm: 4pcs

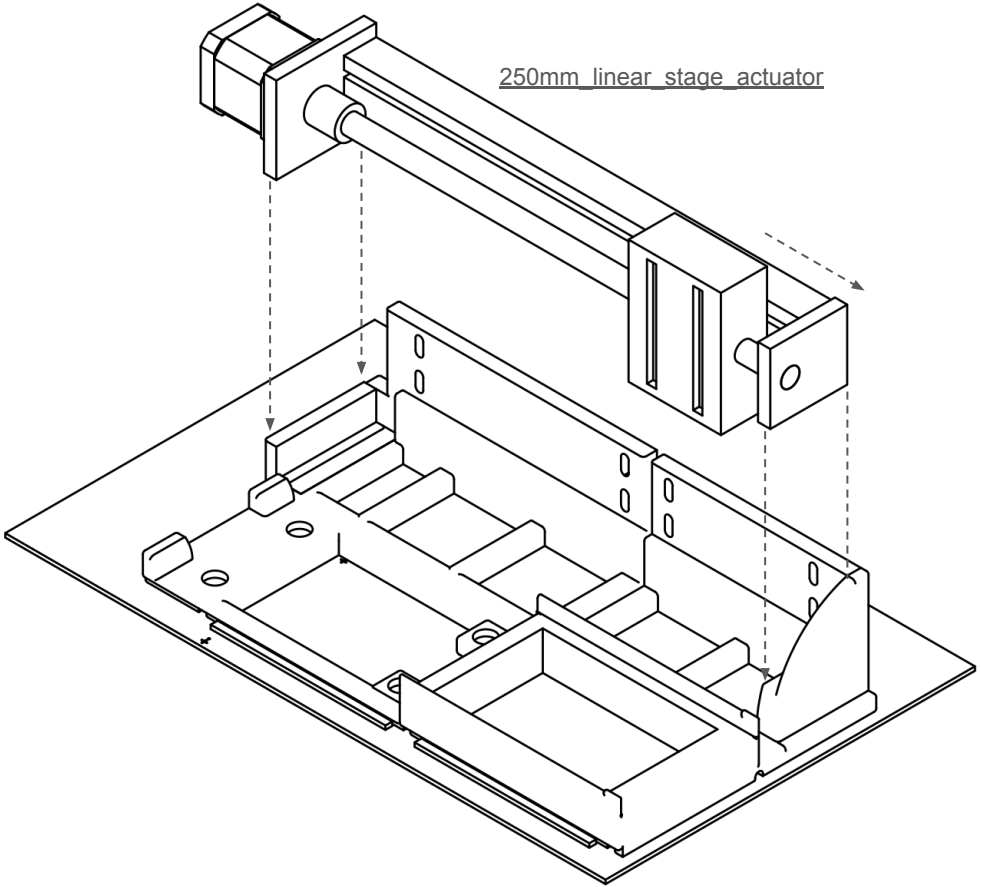

Washers
- M4: 8pcs
- M6: 2pcs

M3 nut: 4pcs

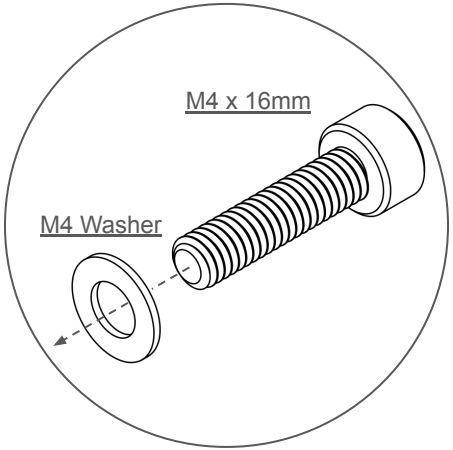
2. Main body assembly: No.1



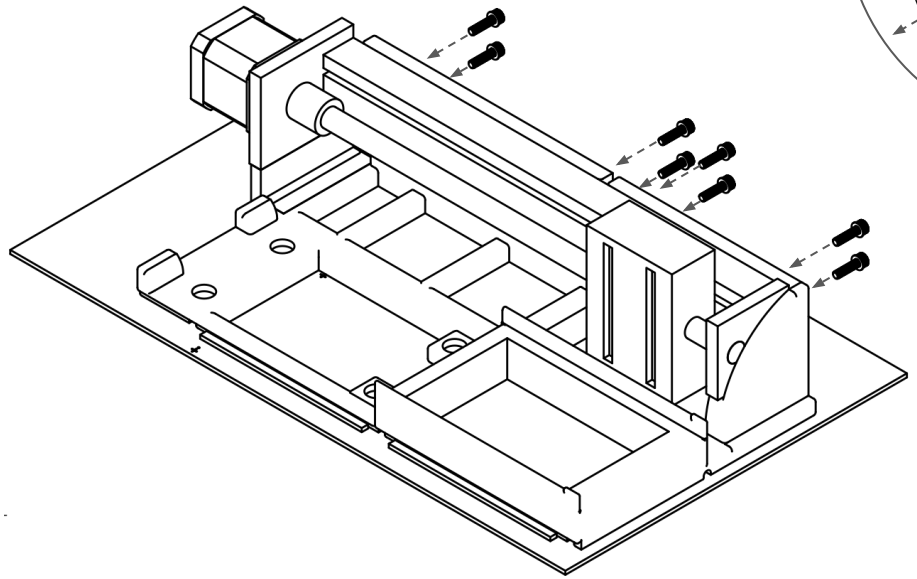
2. Main body assembly: No.1

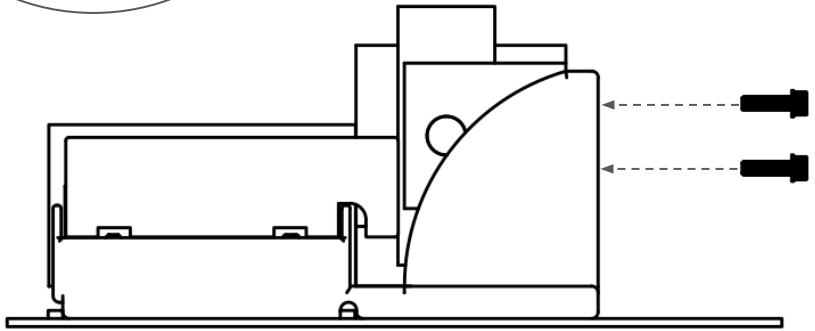


2. Main body assembly: No.1



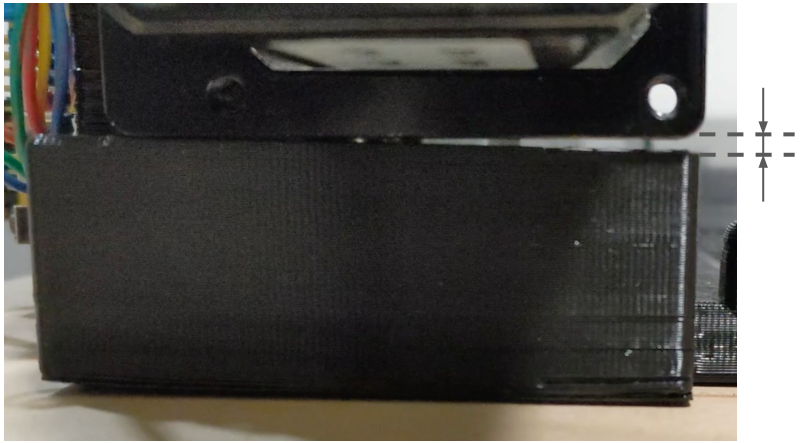
x 8





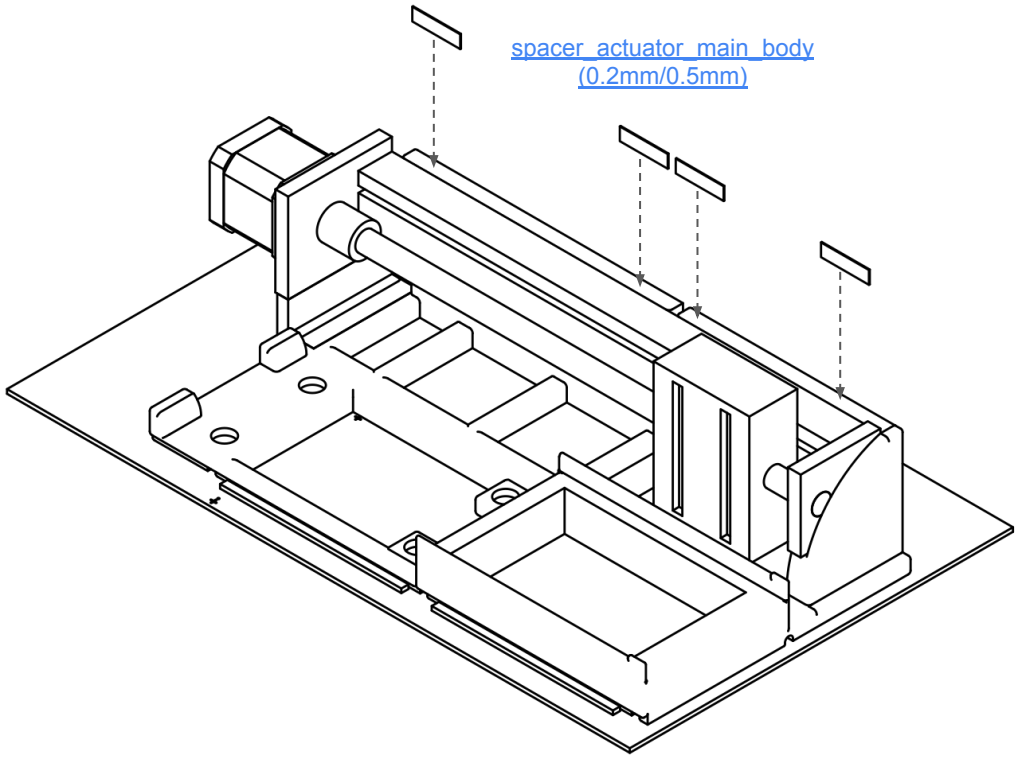
3. Actuator fine adjustment (can do it anytime)

Do NOT need Actuator
fine adjustment



Do Actuator
fine adjustment

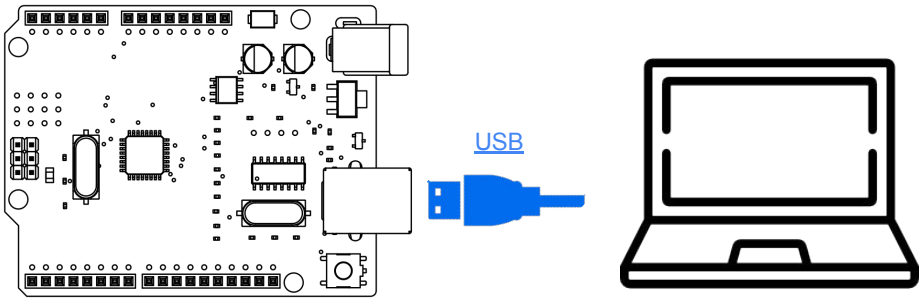
3. Actuator fine adjustment (can do it anytime)



4. Electronic parts quality check and initial settings

Electronic parts quality check

A. Connect an Arduino Uno and your computer (Windows, Mac or Linux).



Arduino Uno

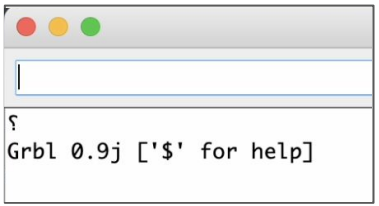
B. Install Arduino IDE (https://www.arduino.cc/) on your computer.

C. Install the grbl firmware (https://github.com/gnea/grbl) on your Arduino Uno according to the official installation manual (https://github.com/gnea/grbl/wiki/Compiling-Grbl).

D. Check grbl installation.

   a. Select: “Arduino IDE” → “Tools” → “Serial Plotter” .

   b. Check the screen shows the same display as the figure on right.



4. Electronic parts quality check and initial settings

Initial Settings

- Changed to using only a X-axis mechanical limit switch.
  - Edit “config.h” file and save.
    A “config.h” location is
    - Windows:
      “C:\Users\noguh\Documents\Arduino\libraries\grbl\config.h”
    - Mac:
      “/Users/{user name}/Documents/Arduino/libraries/grbl/config.h”

```
- #define HOMING_CYCLE_0 (1<<Z_AXIS)       // REQUIRED: First move Z to clear workspace.
- #define HOMING_CYCLE_1 ((1<<X_AXIS)|(1<<Y_AXIS))  // OPTIONAL: Then move X,Y at the same time.
+ #define HOMING_CYCLE_0 (1<<X_AXIS)       // REQUIRED: First move X to clear workspace.
+ //#define HOMING_CYCLE_1 ((1<<X_AXIS)|(1<<Y_AXIS))  // OPTIONAL: Then move X,Y at the same time.
```

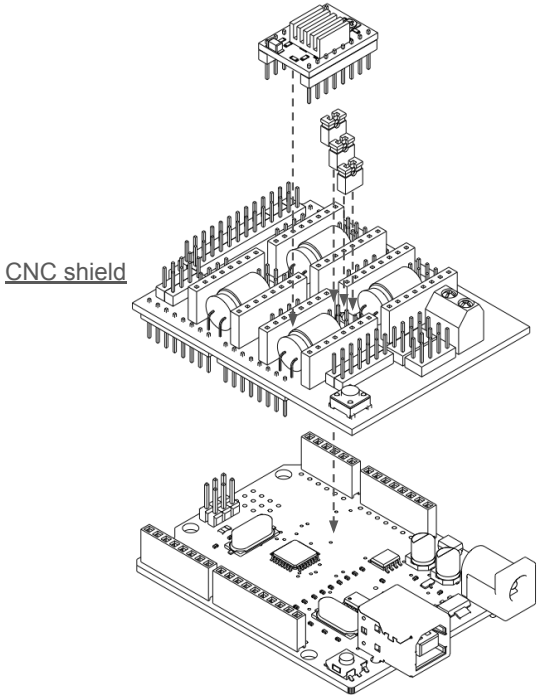
b. Re-write the grbl firmware.
   i. Select: “Arduino” → “File” → “Examples” → “grbl” → “grblUpload”
   ii. Select: “Upload”

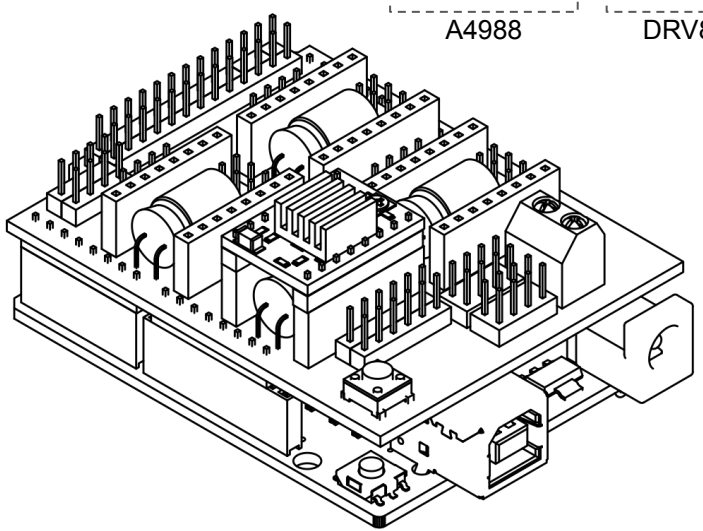
4. Electronic parts quality check and initial settings

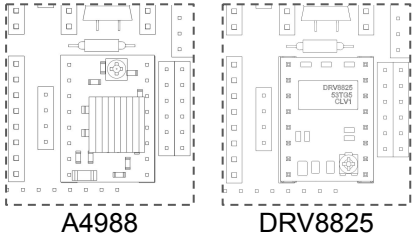
Electronic parts quality check No.2

A. Disconnect the Arduino Uno from your computer.

B. Place the CNC-shield on the Arduino Uno.



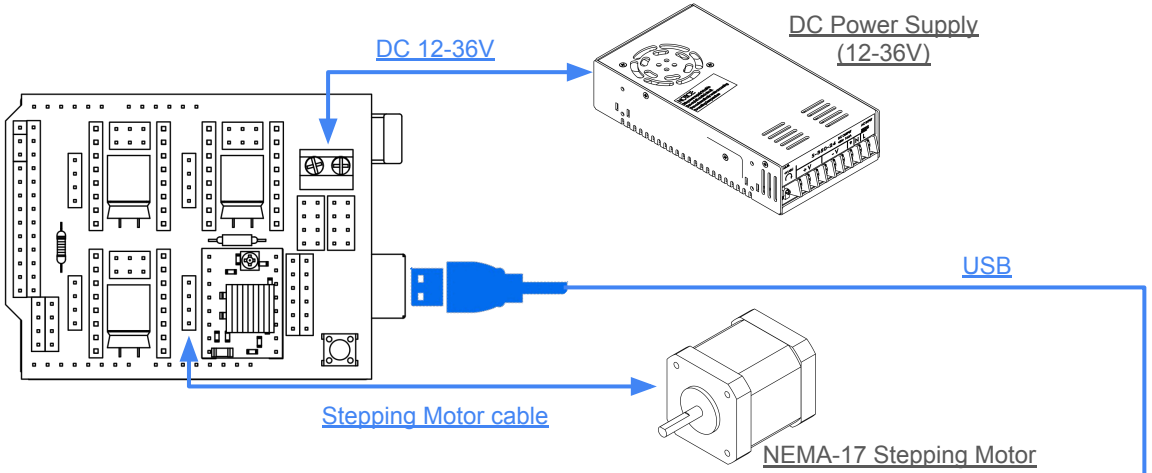




4. Electronic parts quality check and initial settings

Electronic parts quality check No.2

C. Connect DC Power Supply and NEMA-17 Stepping Motor.



D. Connect the Arduino/CNC-Shield and your computer.

4. Electronic parts quality check and initial settings

Electronic parts quality check No.2

E. Stepping motor running check.

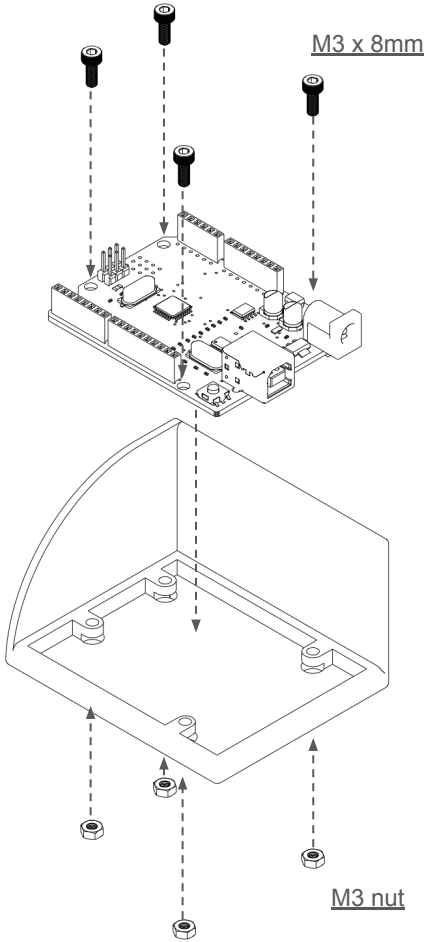
a. Select: “Arduino IDE” → “Tools” → “Serial Plotter” .

b. Type “x10” and ENTER.

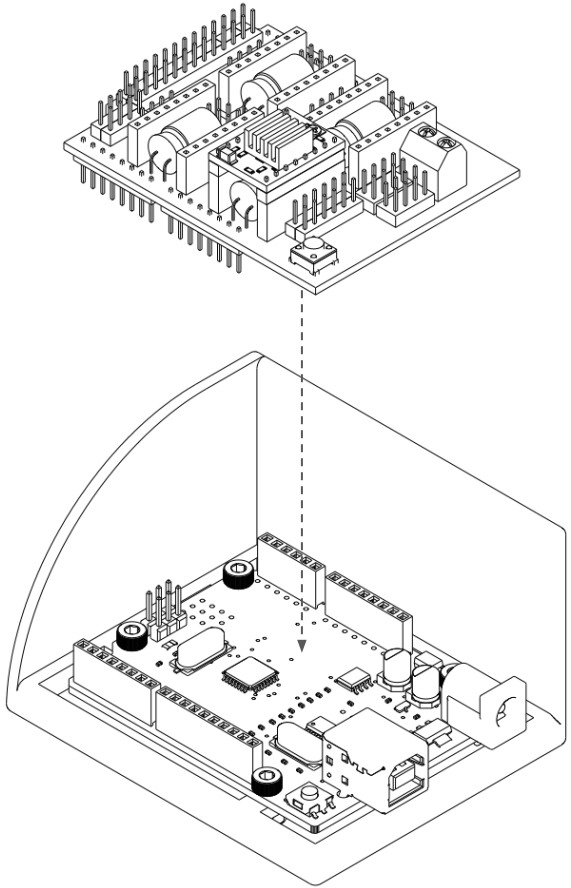
(it means “The stepping motor will run 10 mm.”)

c. If the motor is running, the check of the motor drive parts is complete.

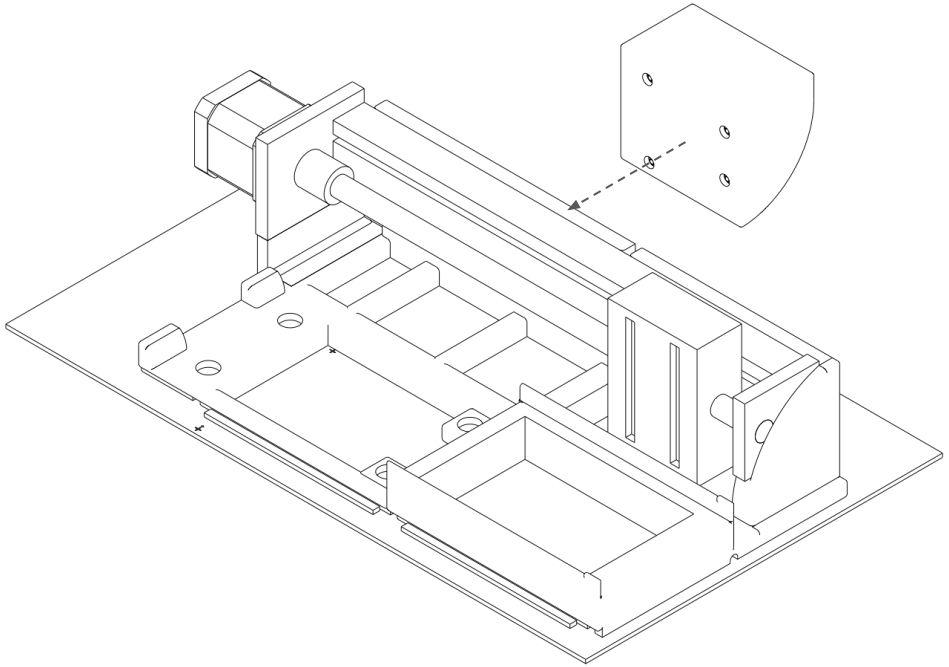
5. Electronic parts assembly and setting

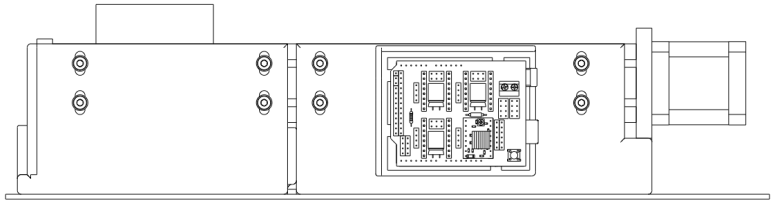


5. Electronic parts assembly and setting

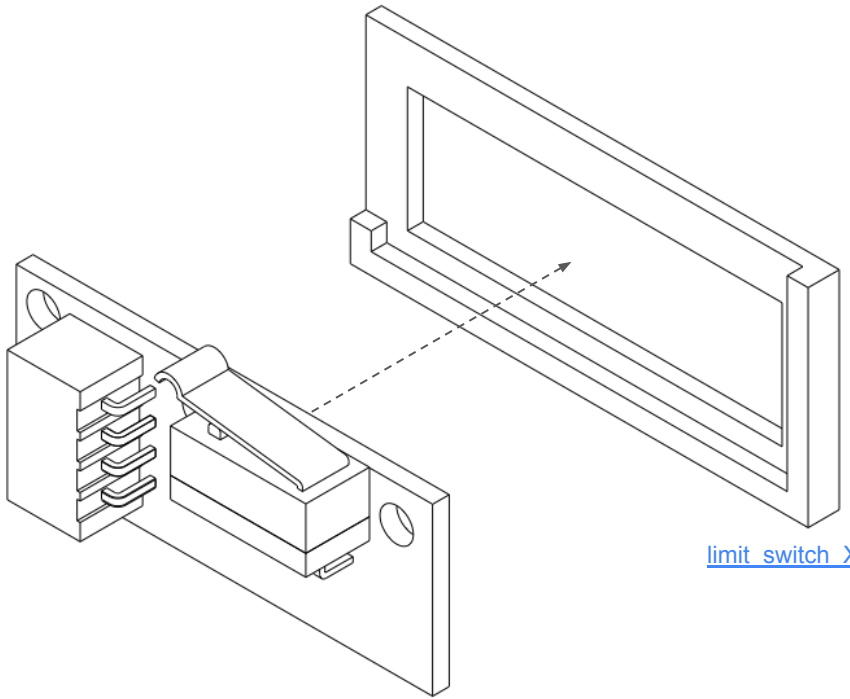


5. Electronic parts assembly and setting





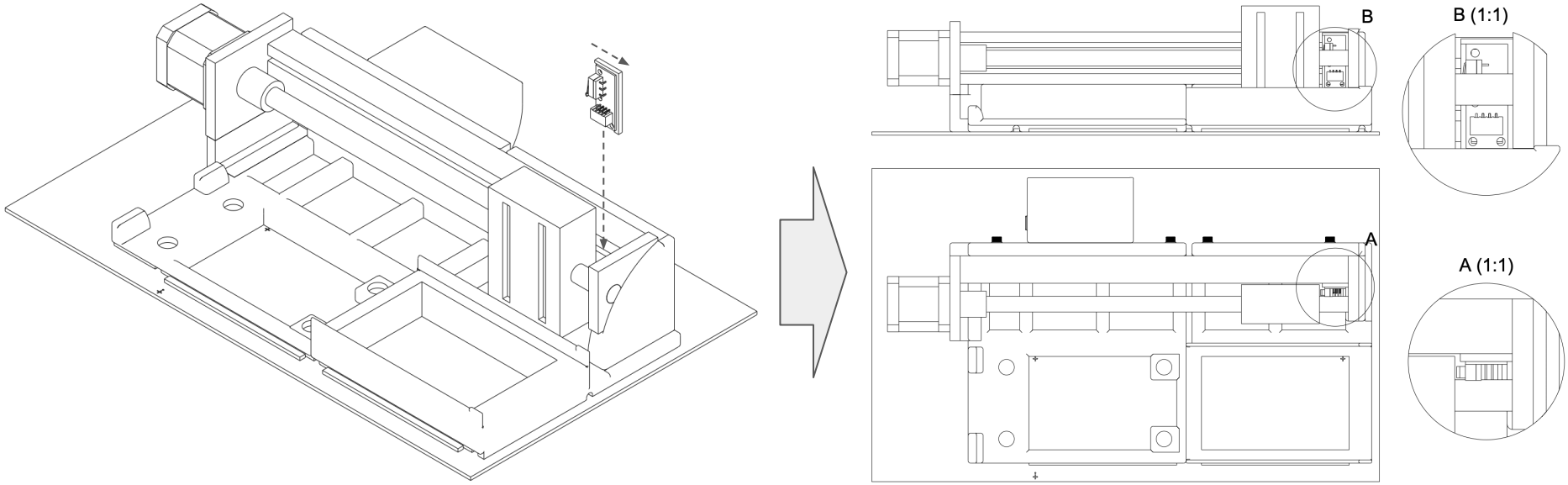
5. Electronic parts assembly and setting



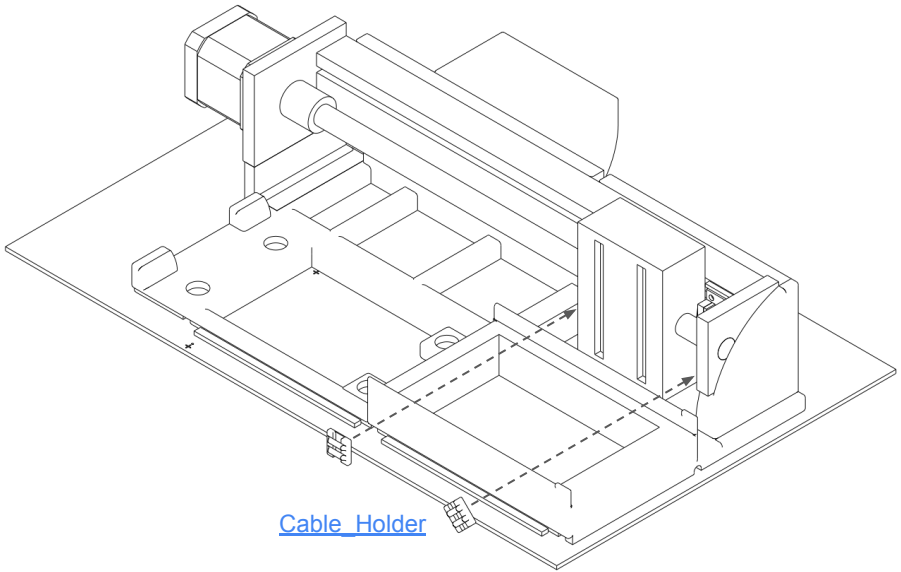
limit_switch_X-axis_base

End stop mechanical limit switch

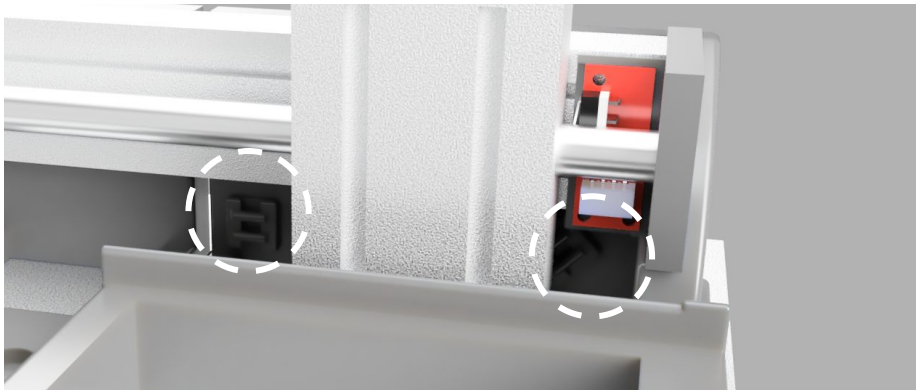
5. Electronic parts assembly and setting



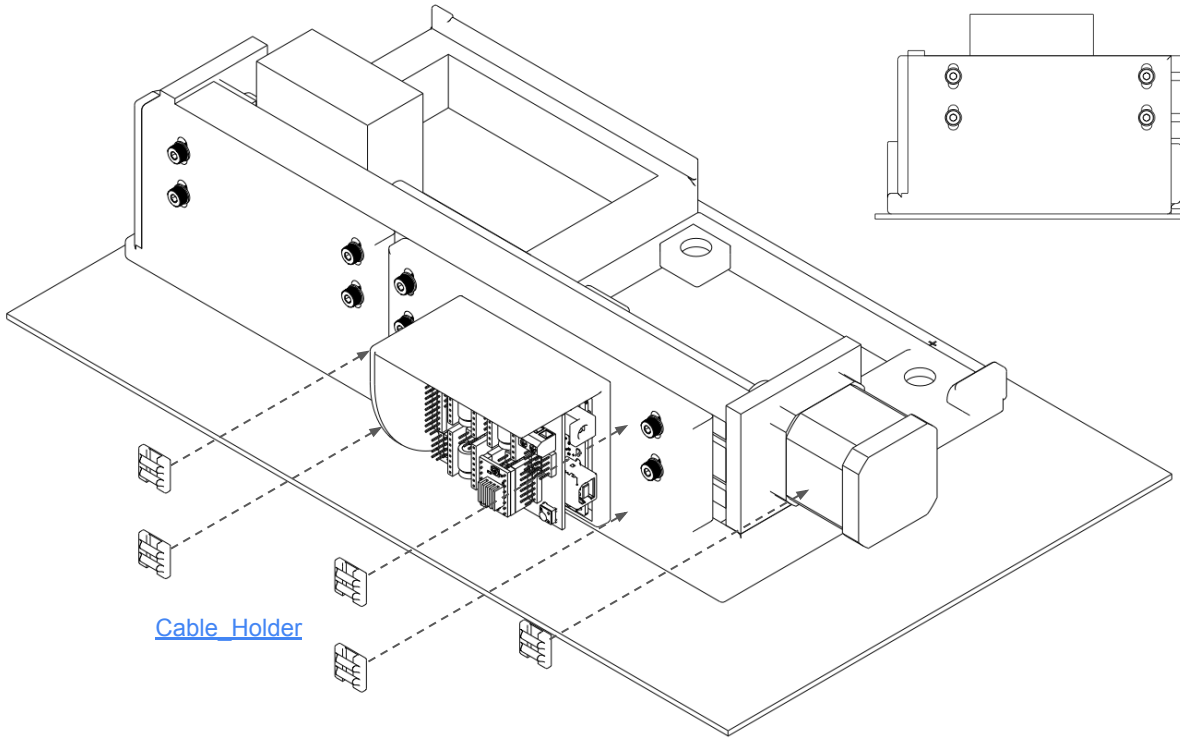
5. Electronic parts assembly and setting

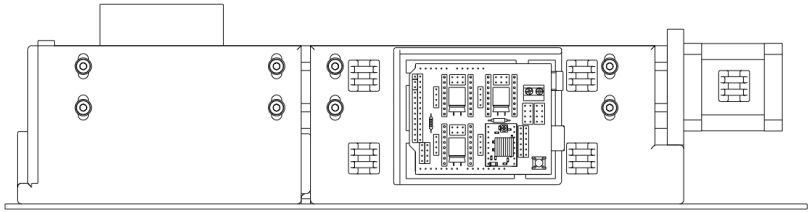


Cable_Holder

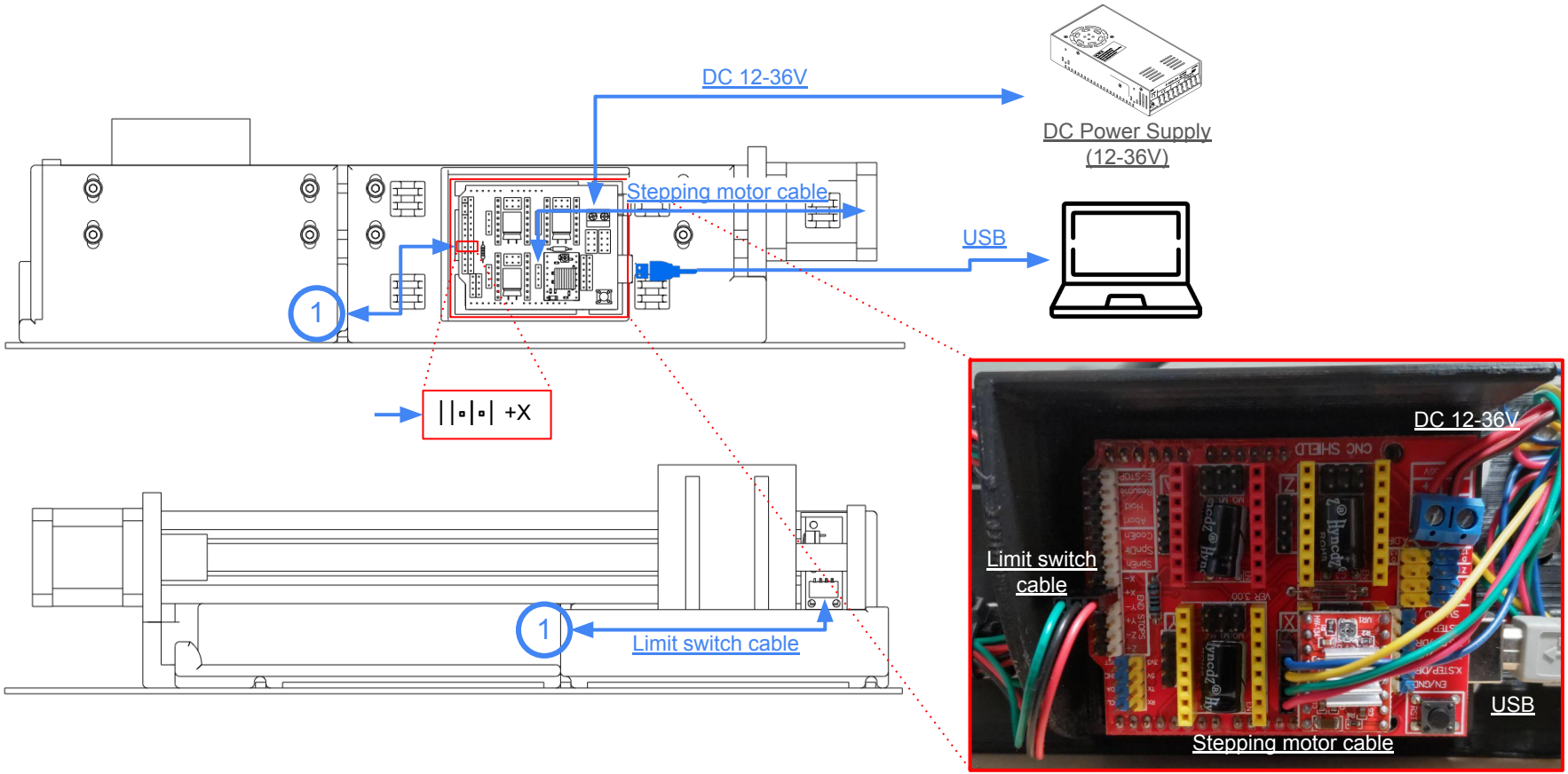


5. Electronic parts assembly and setting





5. Electronic parts assembly and setting



5. Electronic parts assembly and setting

A. Grbl firmware settings.

a. Select: “Arduino IDE” → “Tools” → “Serial Plotter” .

b. Type “$$” and ENTER.

(You can see the Grbl settings)

c. Change following parameters.

(ex., if you want to change $3 parameter to “1”, please type “$3 = 1” and hit ENTER.

If A4988

- $3=1 (dir port invert mask:00000001)
- …
- $20=0 (soft limits, bool)
- $21=0 (hard limits, bool)
- $22=1 (homing cycle, bool)
- …
- $100=800.000 (x, step/mm)
- …
- $110=2000.000 (x max rate, mm/min)
- …
- $120=50.000 (x accel, mm/sec^2)
- …
- $130=190.000 (x max travel, mm)

If DRV8825

- $3=1 (dir port invert mask:00000001)
- …
- $20=0 (soft limits, bool)
- $21=0 (hard limits, bool)
- $22=1 (homing cycle, bool)
- …
- $100=1600.000 (x, step/mm)
- …
- $110=1000.000 (x max rate, mm/min)
- …
- $120=50.000 (x accel, mm/sec^2)
- …
- $130=190.000 (x max travel, mm)

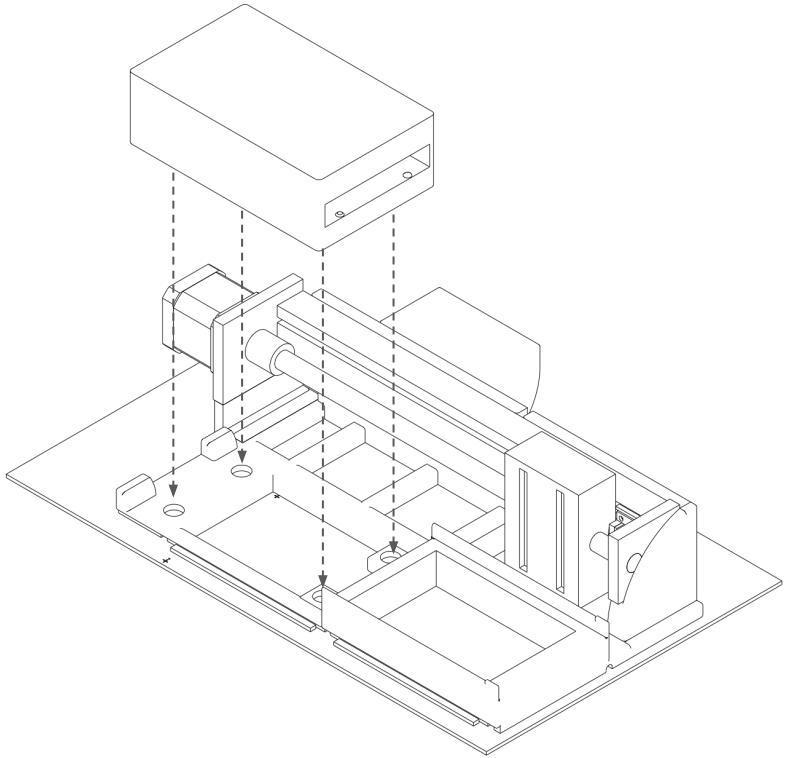
To change these value

$$\frac{\text{Num of steps per rev (steps)}}{\text{lead screw pitch (mm)}} \times \text{miro stepping}$$

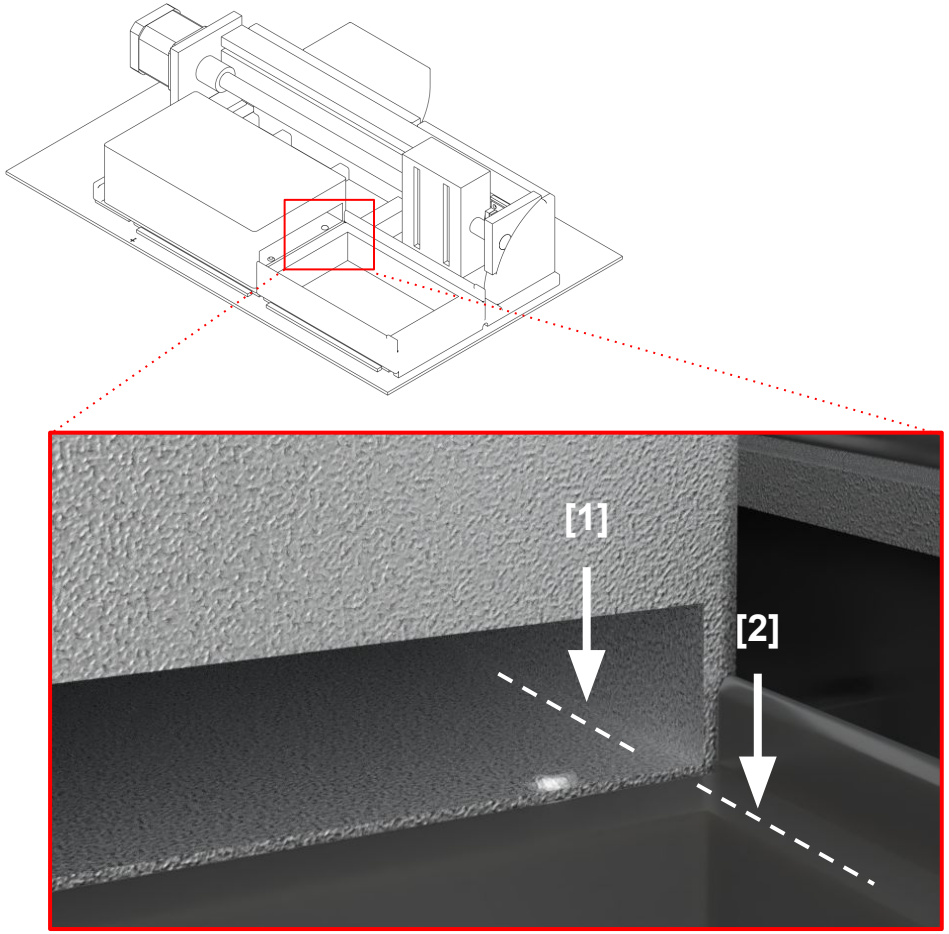
ex. $\frac{200}{4} \times 16 = 800$ (A4988)

ex. $\frac{200}{4} \times 32 = 1600$ (DRV8825)

6. Mainbody assembly No.2



6. Mainbody assembly No.2



Height:

- [1] = [2]:

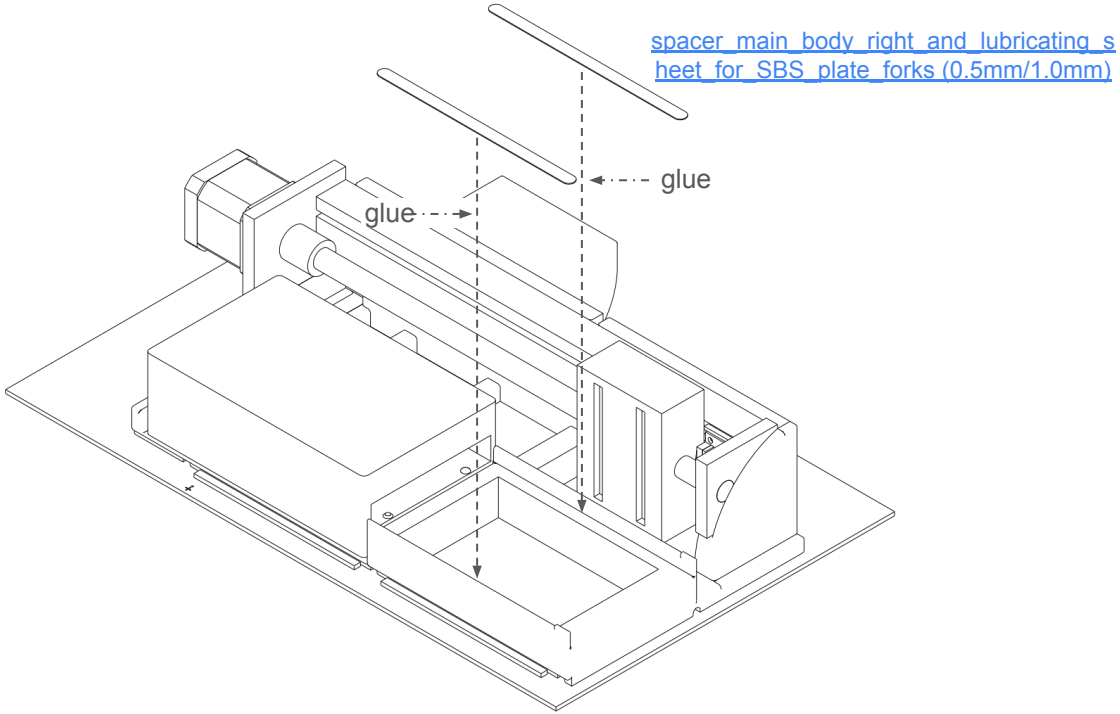
  Not Need Adjustment ✔

- [1] ≠ [2]:

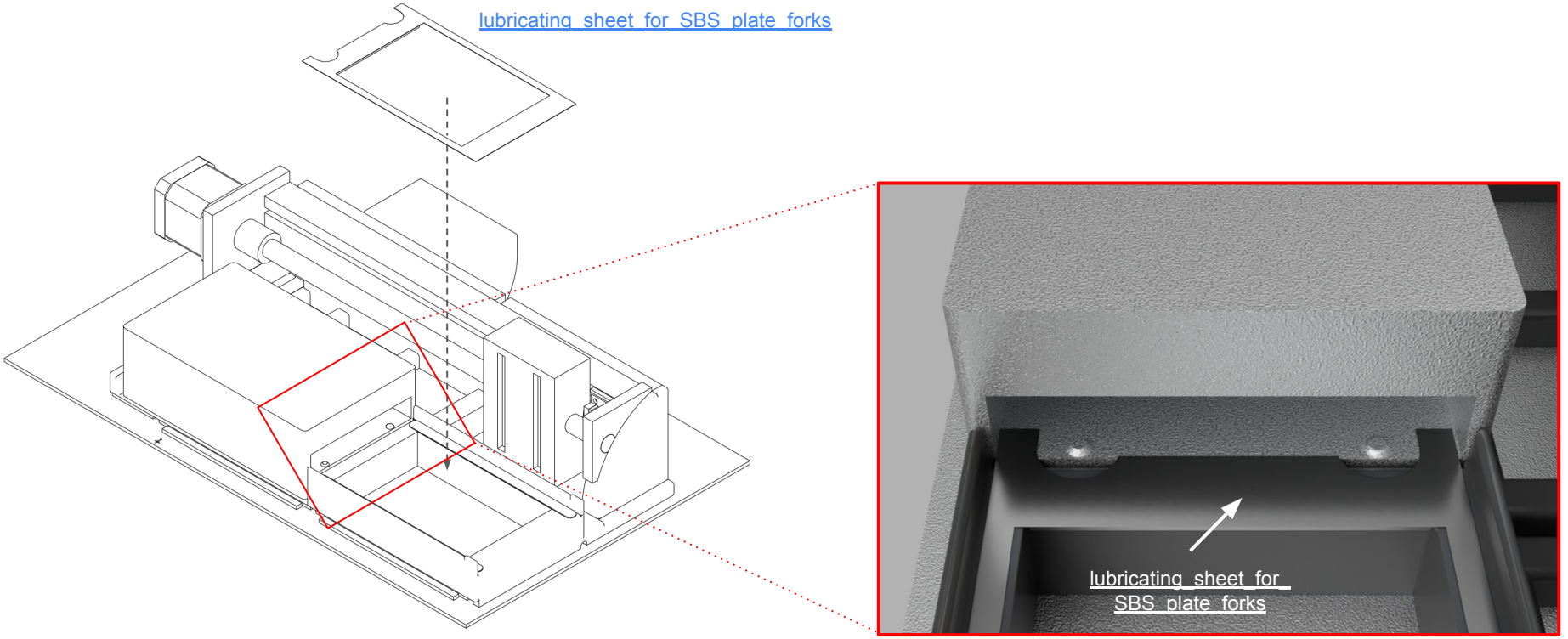
  Need Fine Adjustment 👎

6. Mainbody assembly No.2

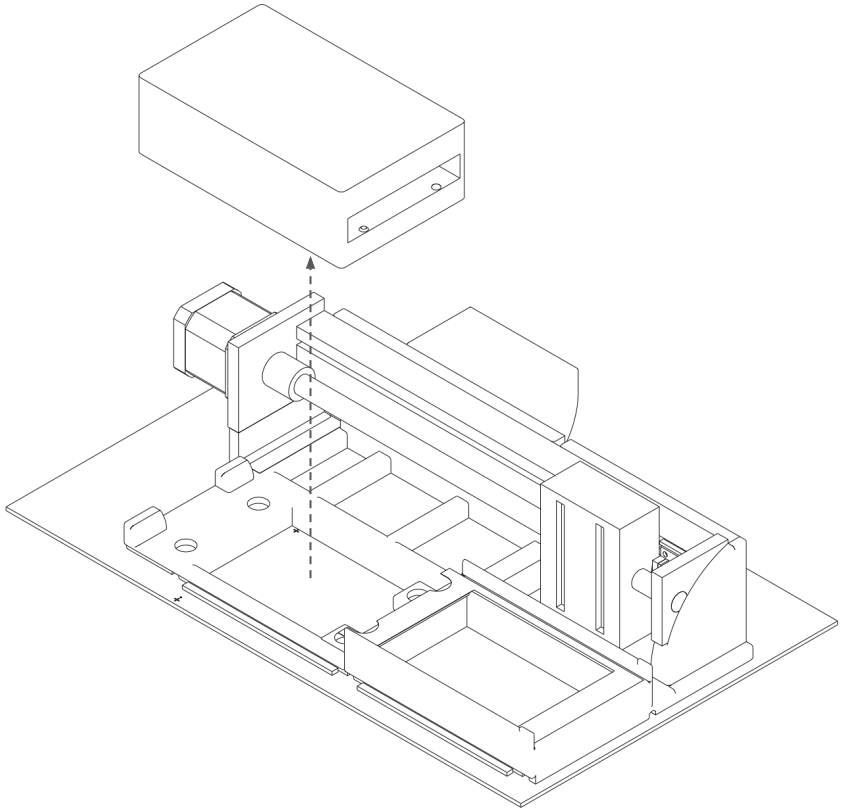
This fine-adjustment step between body and Byonoy is only for [1] ≠ [2] pattern on previous step.



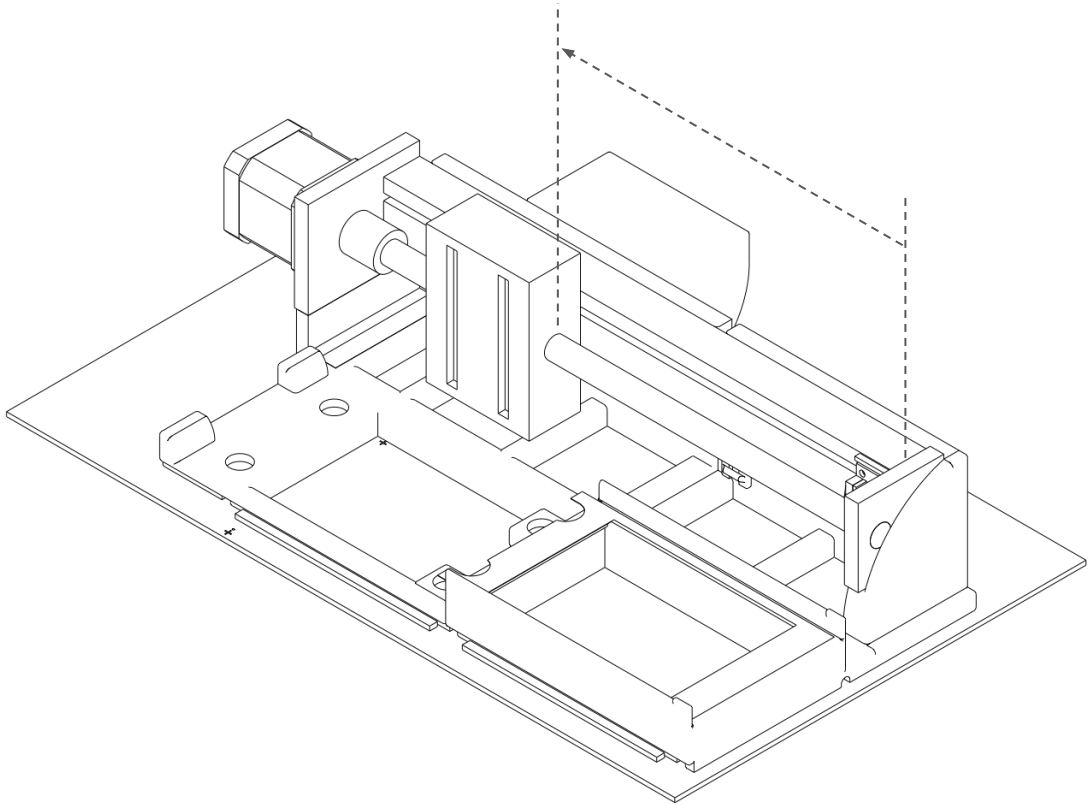
6. Mainbody assembly No.2



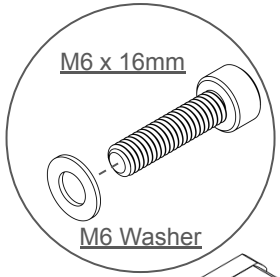
6. Mainbody assembly No.2



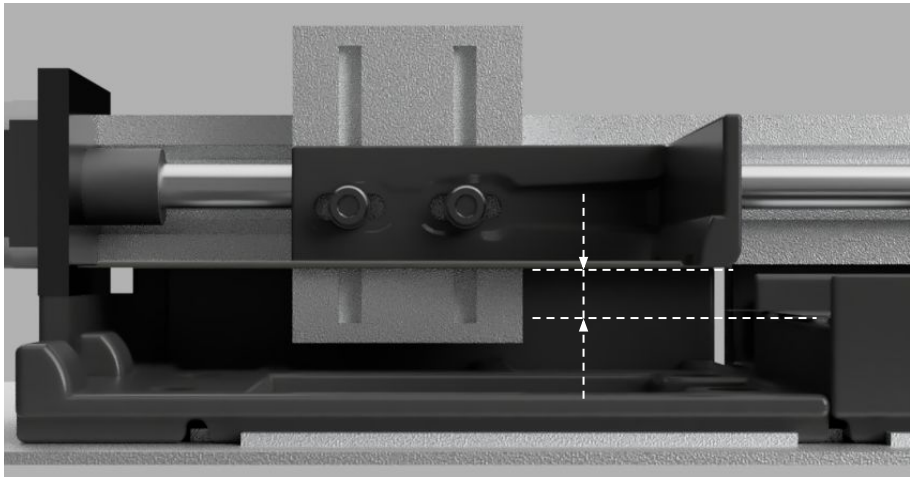
6. Mainbody assembly No.2

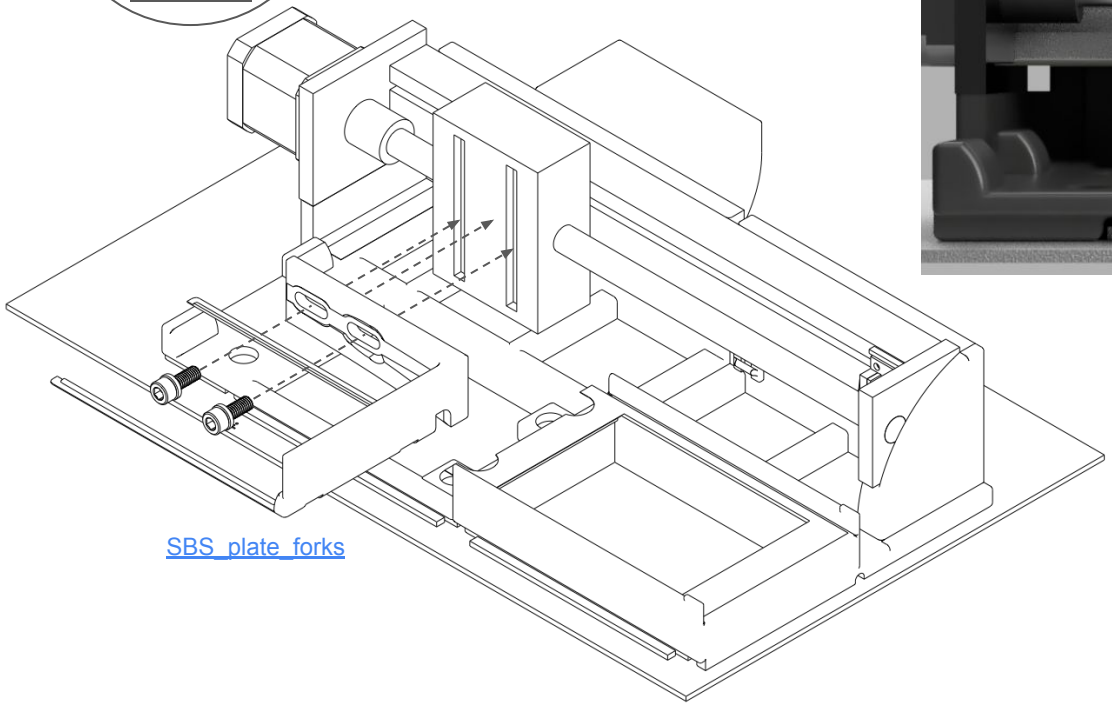


6. Mainbody assembly No.2



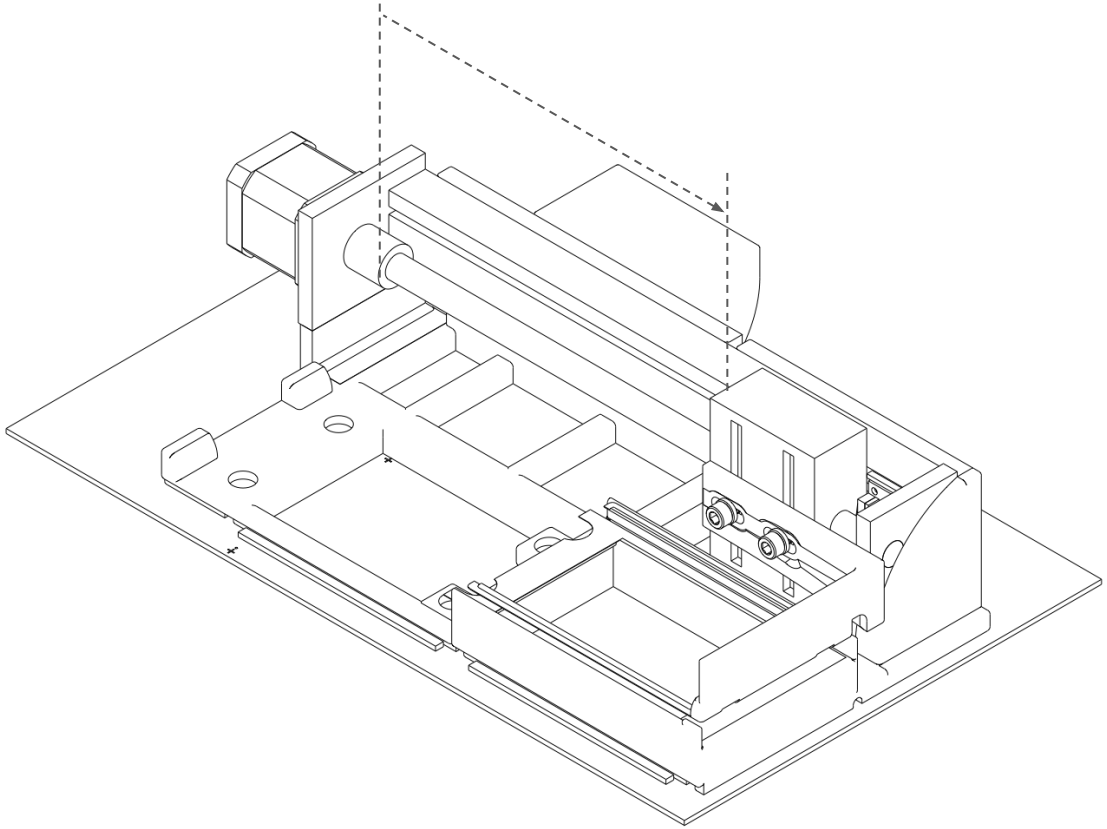
x 2



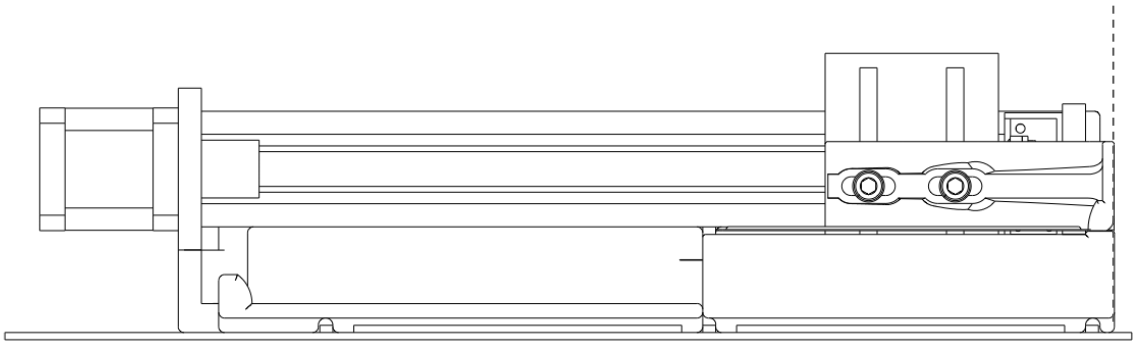


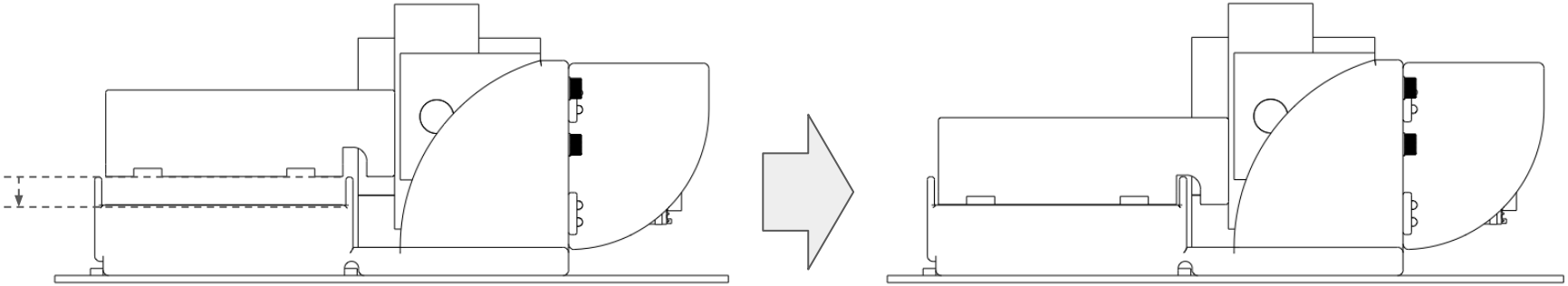
SBS_plate_forks

6. Mainbody assembly No.2



6. Mainbody assembly No.2

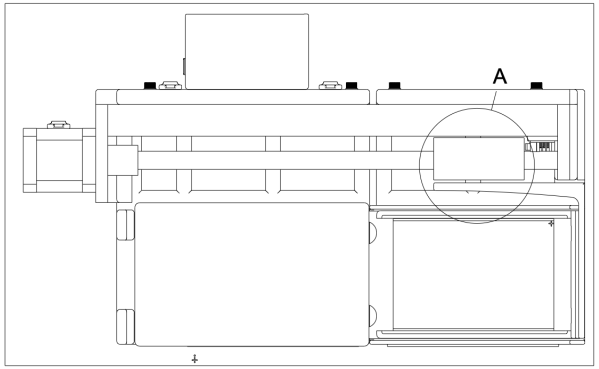


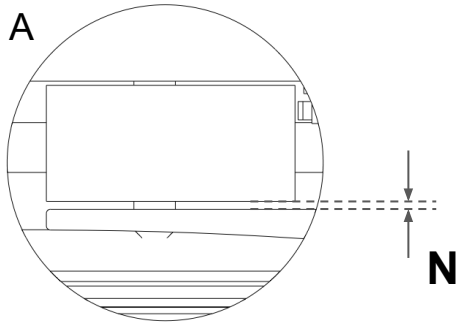


6. Mainbody assembly No.2

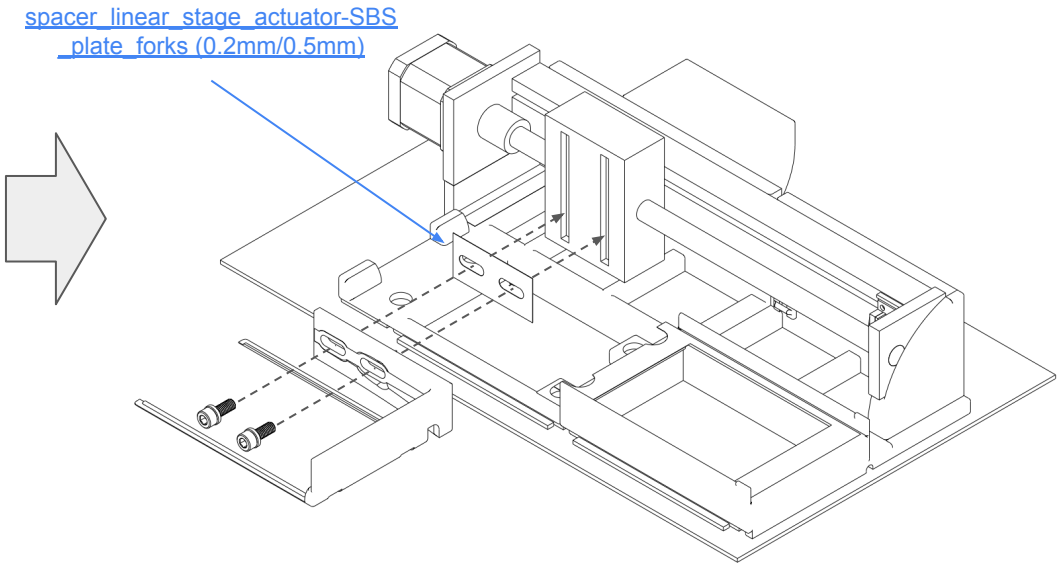
Fine tuning

If the SBS_plate_forks does not touch the main body.
→ Fine tuning with the spacer.





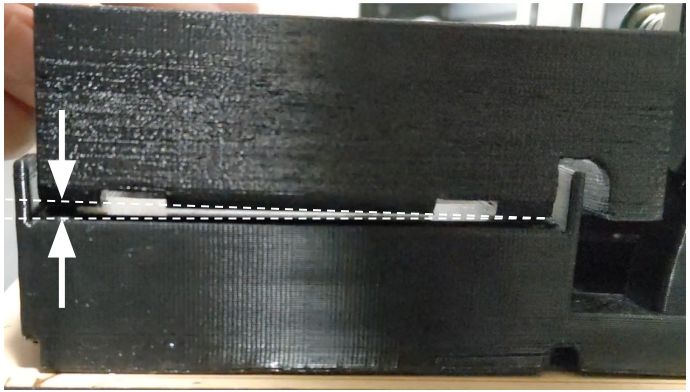
Not touched

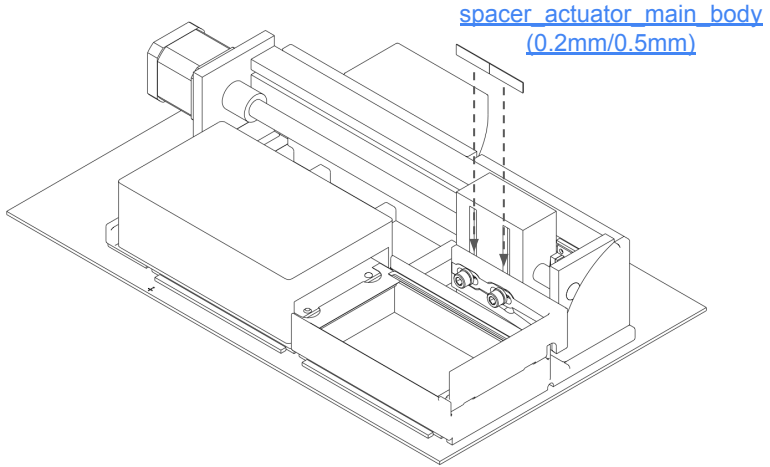


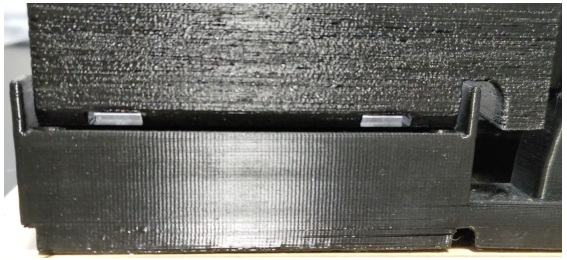
6. Mainbody assembly No.2

Fine tuning

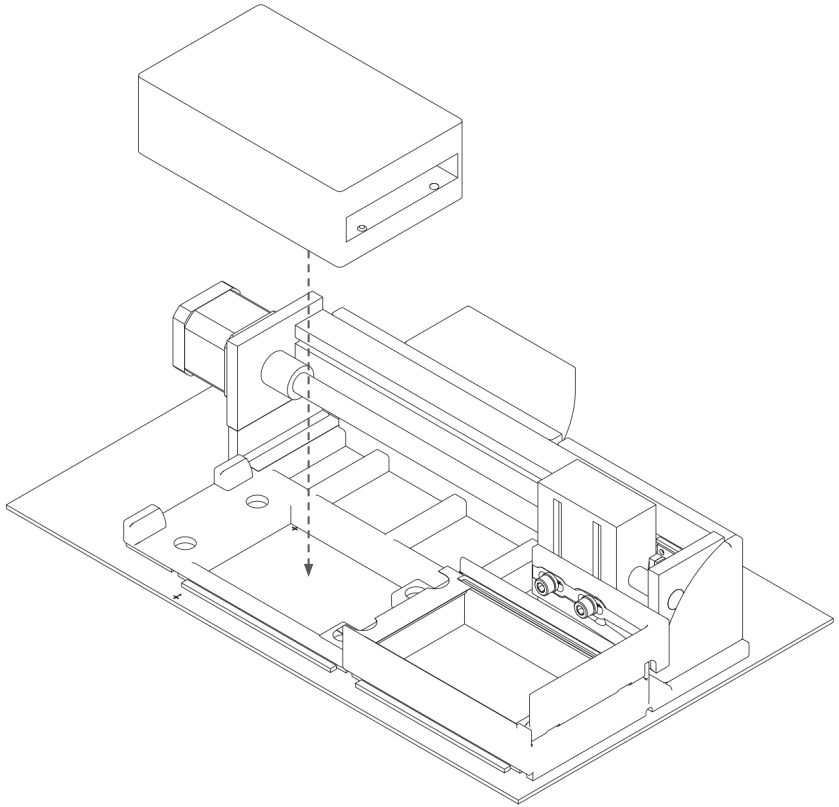
If the SBS_plate_forks is not level on the main_body_right.
→ Fine tuning with the spacer.

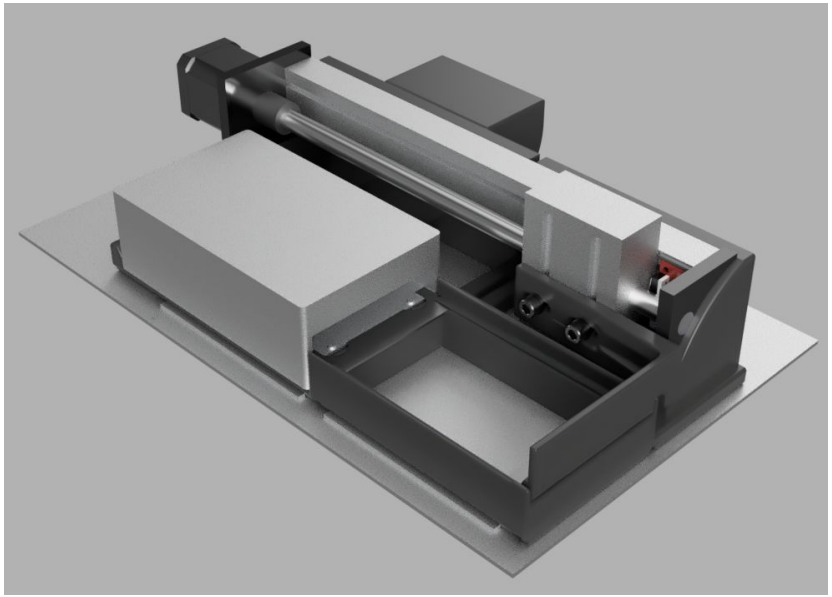






6. Mainbody assembly No.2





END