HYREL LLC

Advanced Printing Techniques: Mastering Multi-Head Printing

Mastering Multi-Head Printing

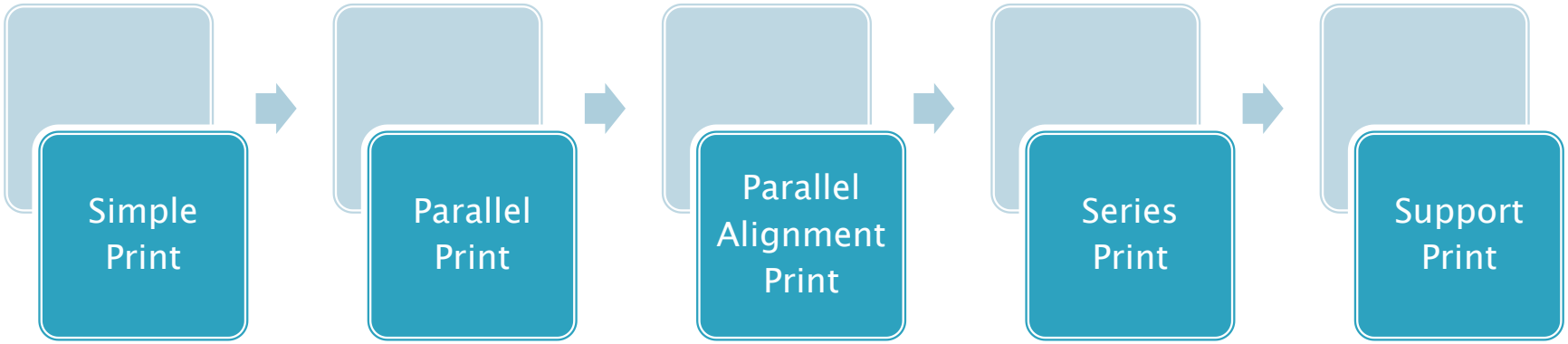
- In order to do proper multi-head printing, the user must follow this training from the beginning to the end.

- WARNING: Any deviation from this guide for first-timers will result in failed prints.

Roadmap

- Simple Print (Terra firma)
- Aligning Print Heads (Z-Alignment)
- Parallel Print, Performance Verification
- Parallel Print Alignment Marks
- Calibrate Offsets (X & Y Alignment)
- Series Print
- Support Print

Roadmap


Simple Print
Parallel Print
Parallel Alignment Print
Series Print
Support Print

Simple Print – Overview

- Purpose: Make sure the printer is in tram and the printer is working properly.
- This establishes a solid foundation for the rest of the steps toward advanced printing / fabrication.
- We accomplish this by demonstrating we can print a simple, single color/material part without issues

Simple Print – 1-By-1

- Check Tram
- Install Head “Master” in slot 2
- Set Head of single extruder to bed
- Start with a *.gcode file you’ve printed, it must not be larger than 2” in the X-Axis
  - NOTE: The shorter / smaller the print, the better
- Print

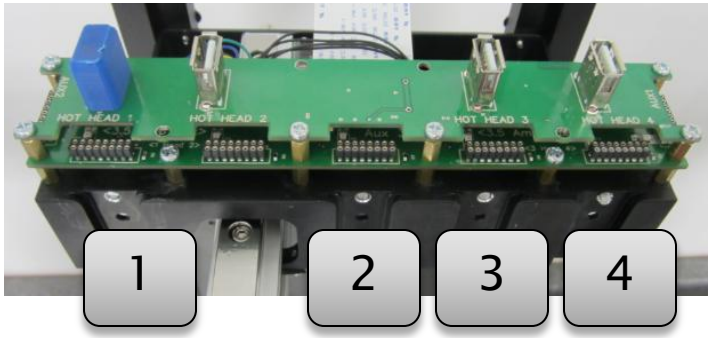
- If *.gcode does not finish correctly, work backwards
  → Re-slice .stl file – If this works, continue from top
  → Adjust Slic3r settings / Recipes – Then re-slice, and continue from top
  → Re-orient/rotate/scale .stl file – Then adjust, re-slice, continue from top
  → Heal .stl file – Then Re-orient, adjust, re-slice, continue from top
  → Re-design model – Then heal, re-orient, adjust, re-slice, continue from top
- If *.gcode finishes correctly, remove the print from the build platform & move forward to next step.

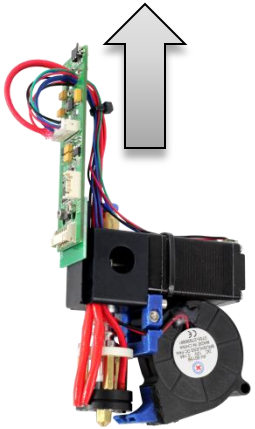
Simple Print

Install Head “Master” in slot 2

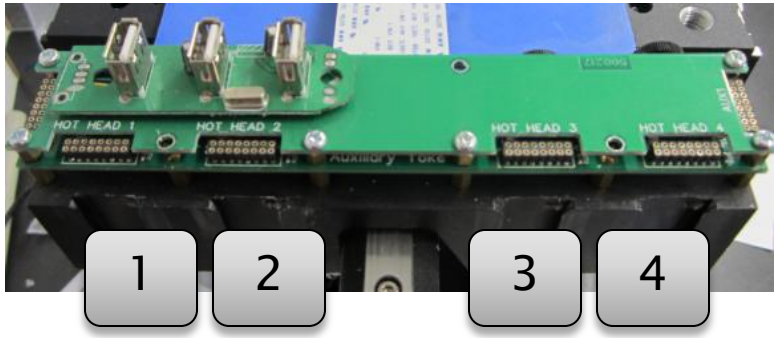
Physical Head Slot

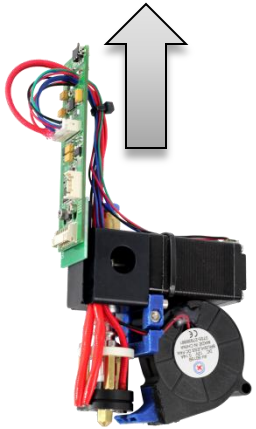
1x3 Yoke





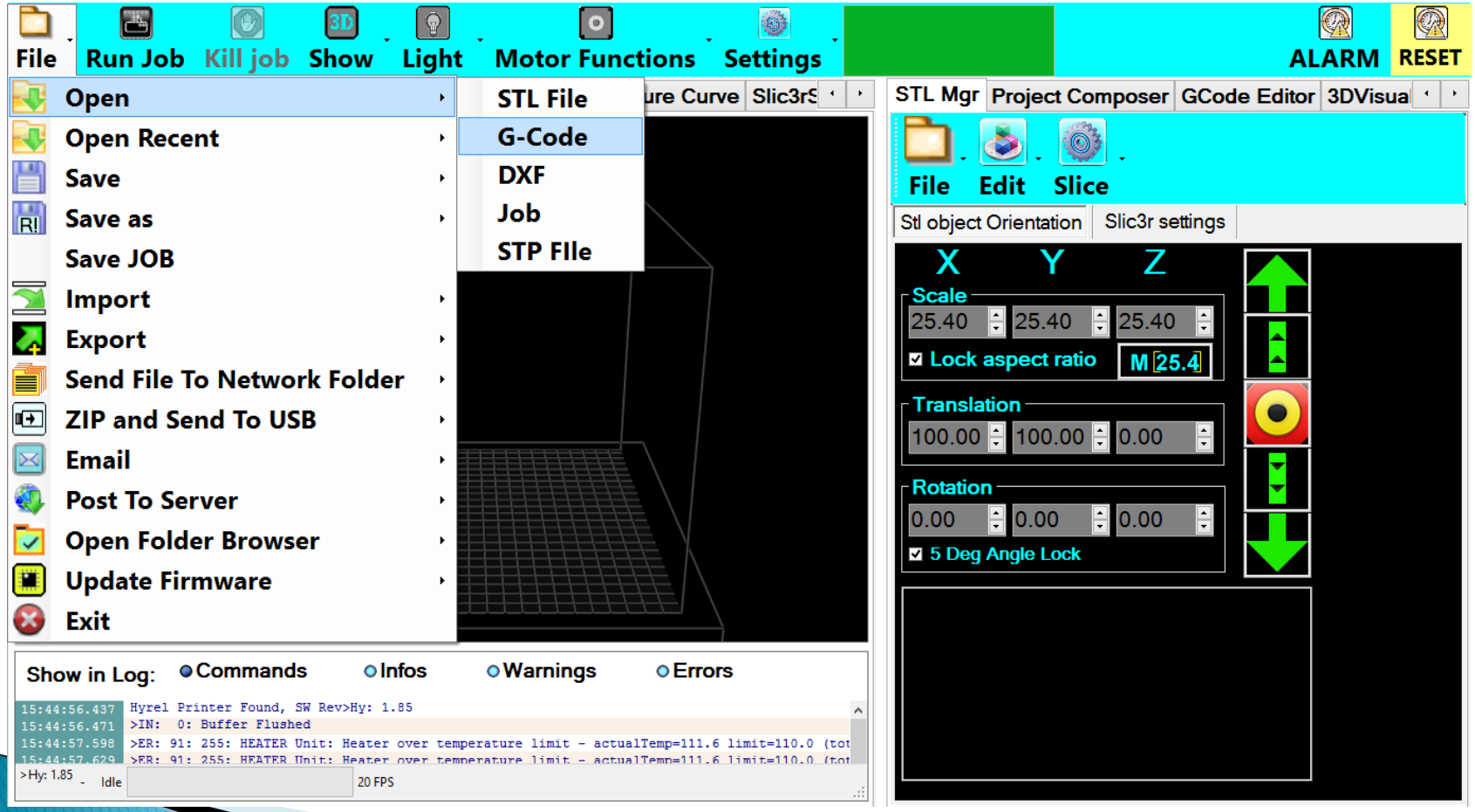
2x2 Yoke





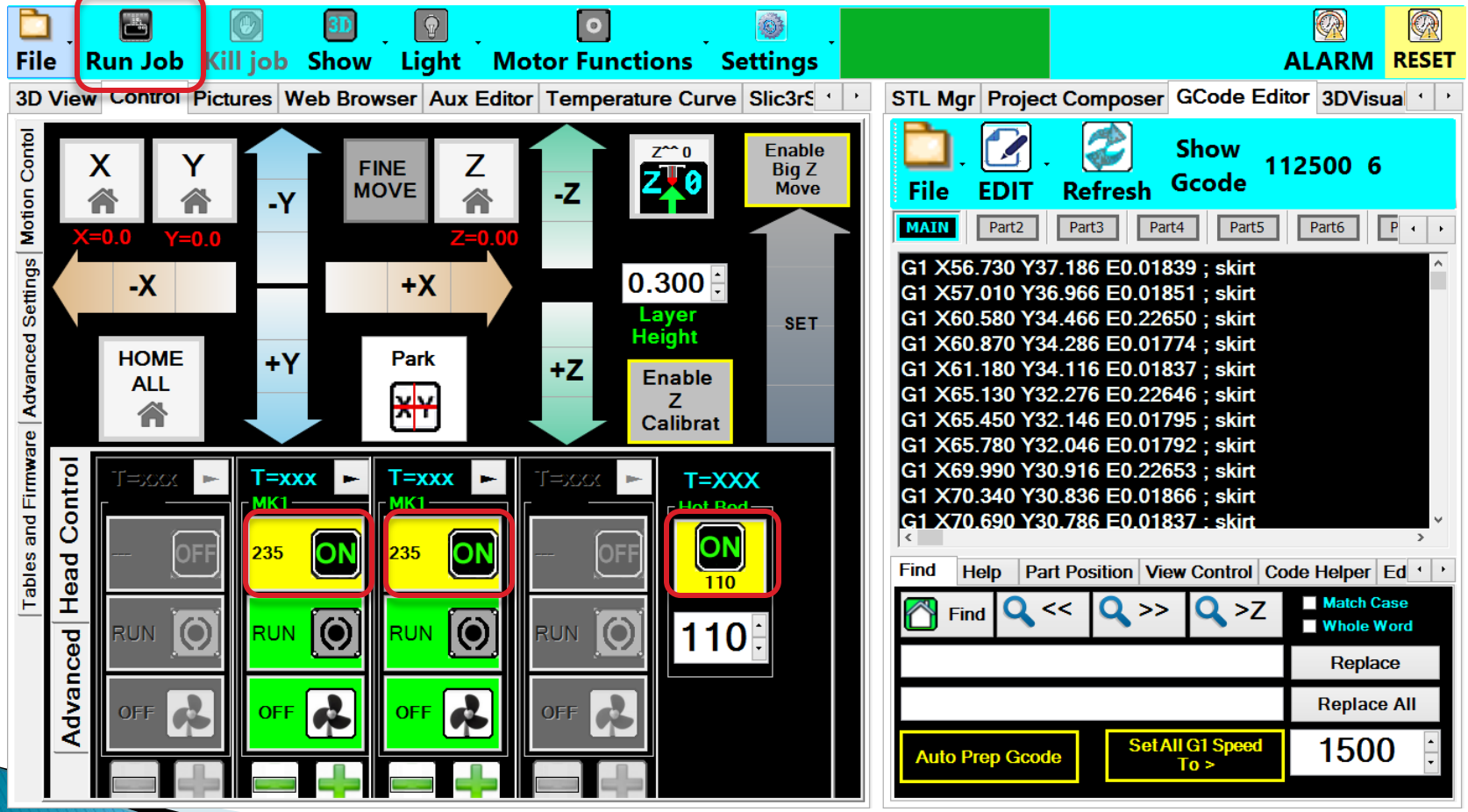
Simple Print

Load G-Code



Simple Print

Turn on the Heat, & when ready, Print



Aligning Print Heads – Overview

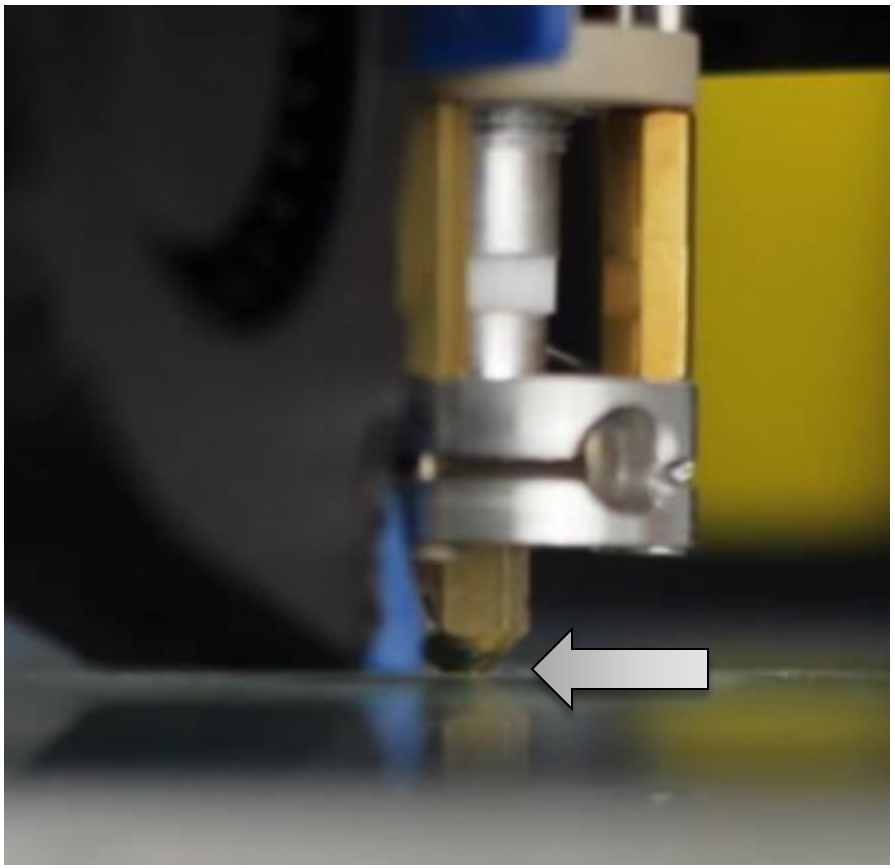
- Purpose: Certify each print head is level to each other in the Z-Axis.
- In order to setup perfect extruder head parallel prints, we need to confirm the exact position of the nozzles relative to each other in the Z-Axis are set to the bed.
- We accomplish this by designating the left-most extruder head as the “Master”, and all heads to the right as the “Clones”, then physically setting all nozzle heights to the height of the “Master”

Aligning Print Heads – 1-By-1

- With the Head “Master” in slot 2
- Set Head “Master” to the bed
- Loosen the PCA screws on “Clone”
- Install Head “Clone” in slot 3, do not tighten the Set-screws
- Gently press down on the extruder body of the “Clone” extruder until the nozzle touches the bed
- Tighten the Set-screw
- Set the Spacer Board
- Tighten the PCA screws on “Clone”

Aligning Print Heads

Set Head “Master” to the Bed

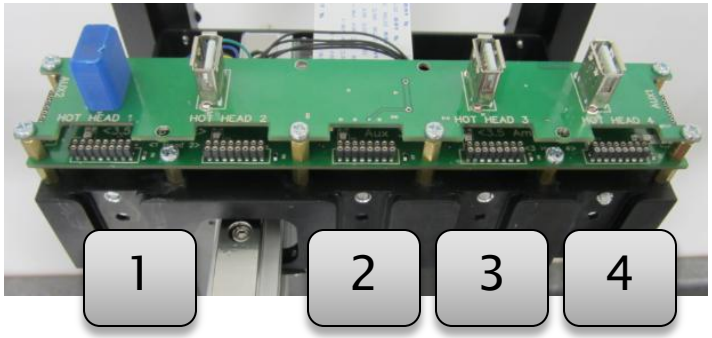


Aligning Print Heads

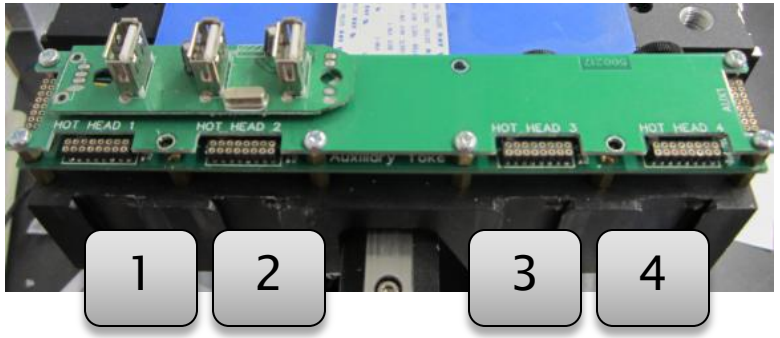
“Clone” Extruder installation into slot 3

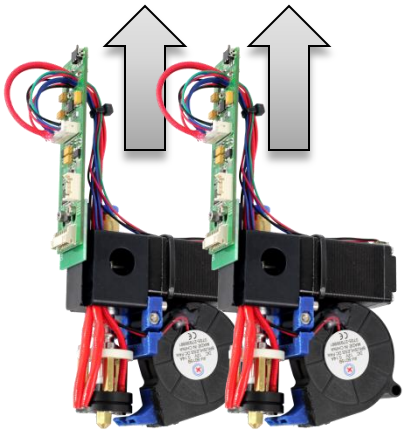
Physical Head Slot

1x3 Yoke

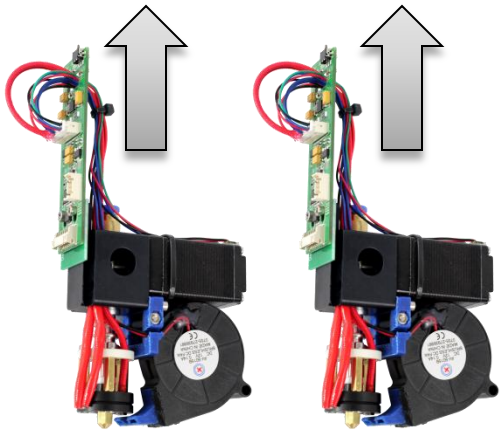


2x2 Yoke





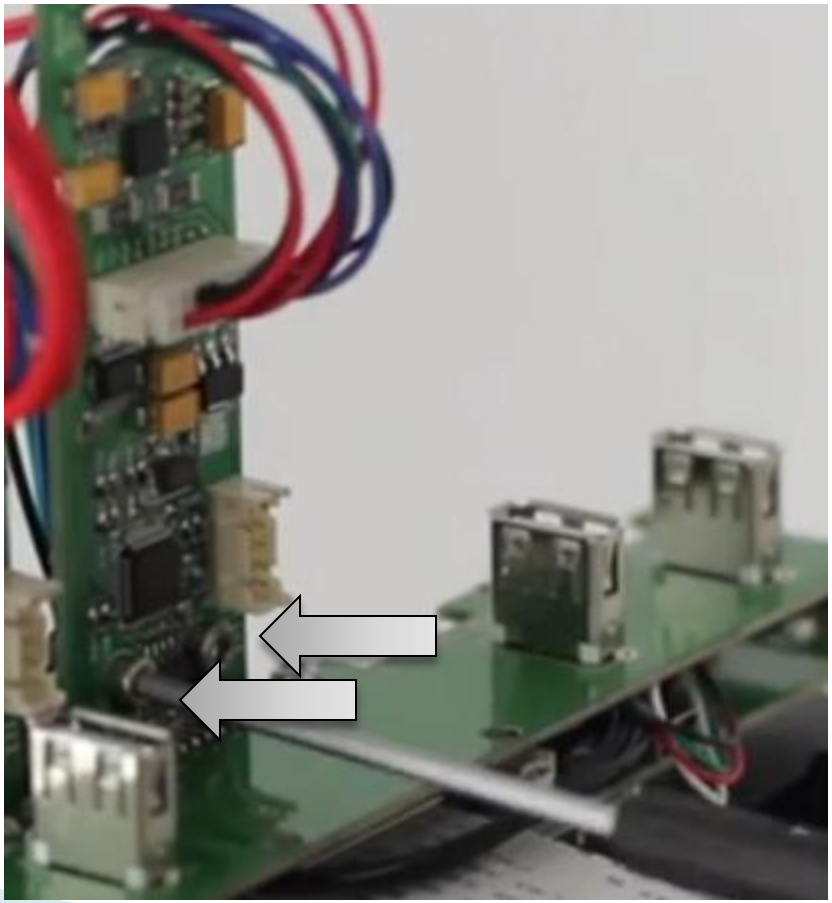
Master Clone



Master Clone

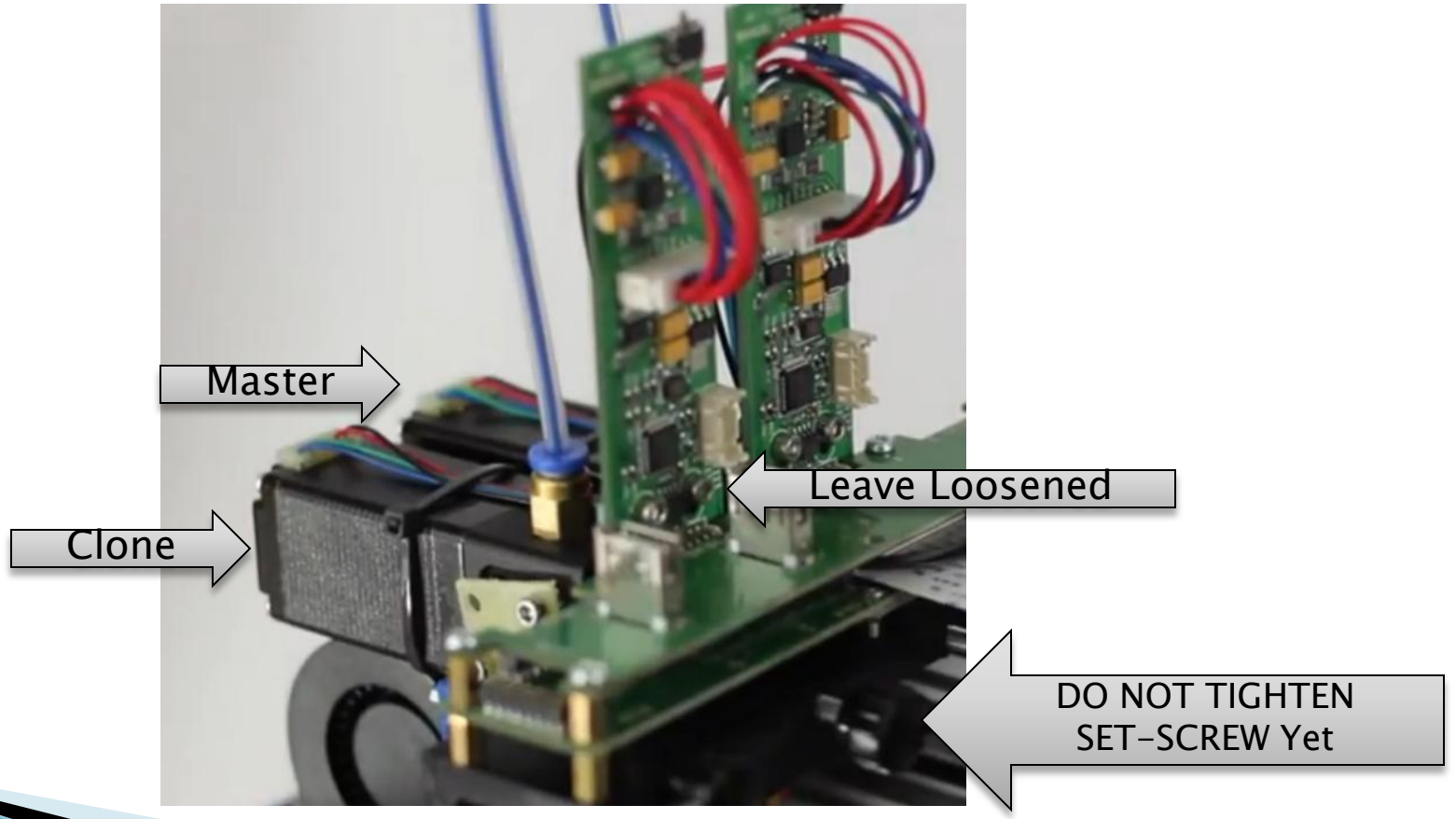
Aligning Print Heads

Loosen the PCA screws on “Clone”



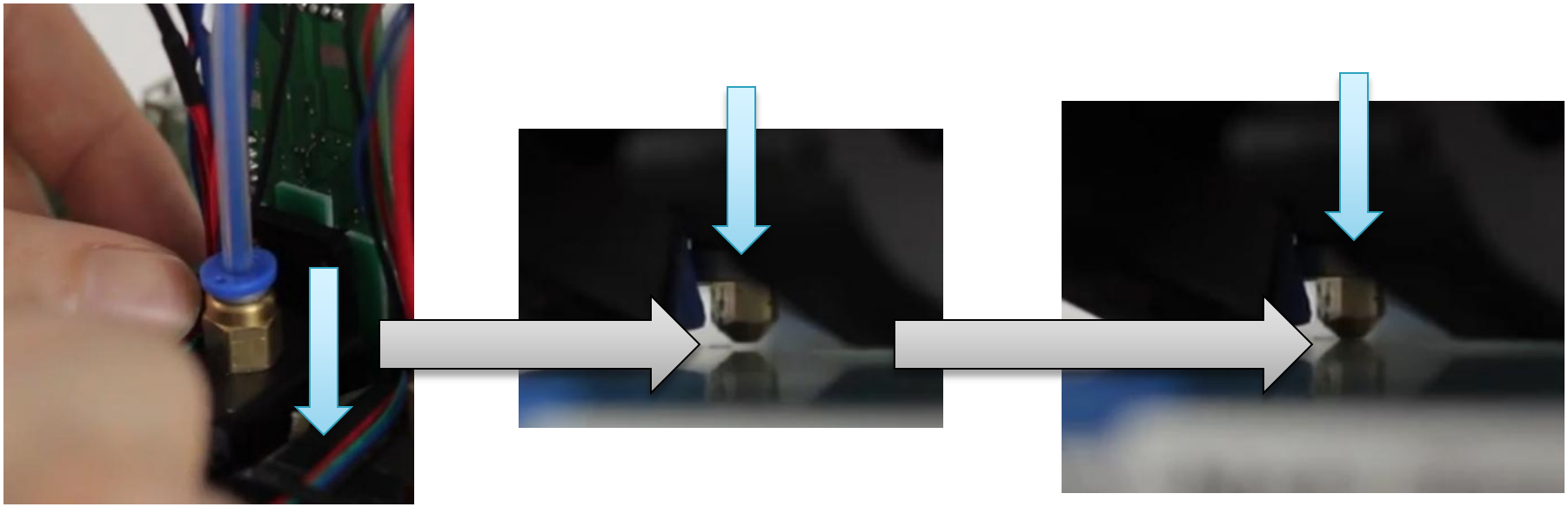
Aligning Print Heads

Install Head “Clone” in right-hand slot



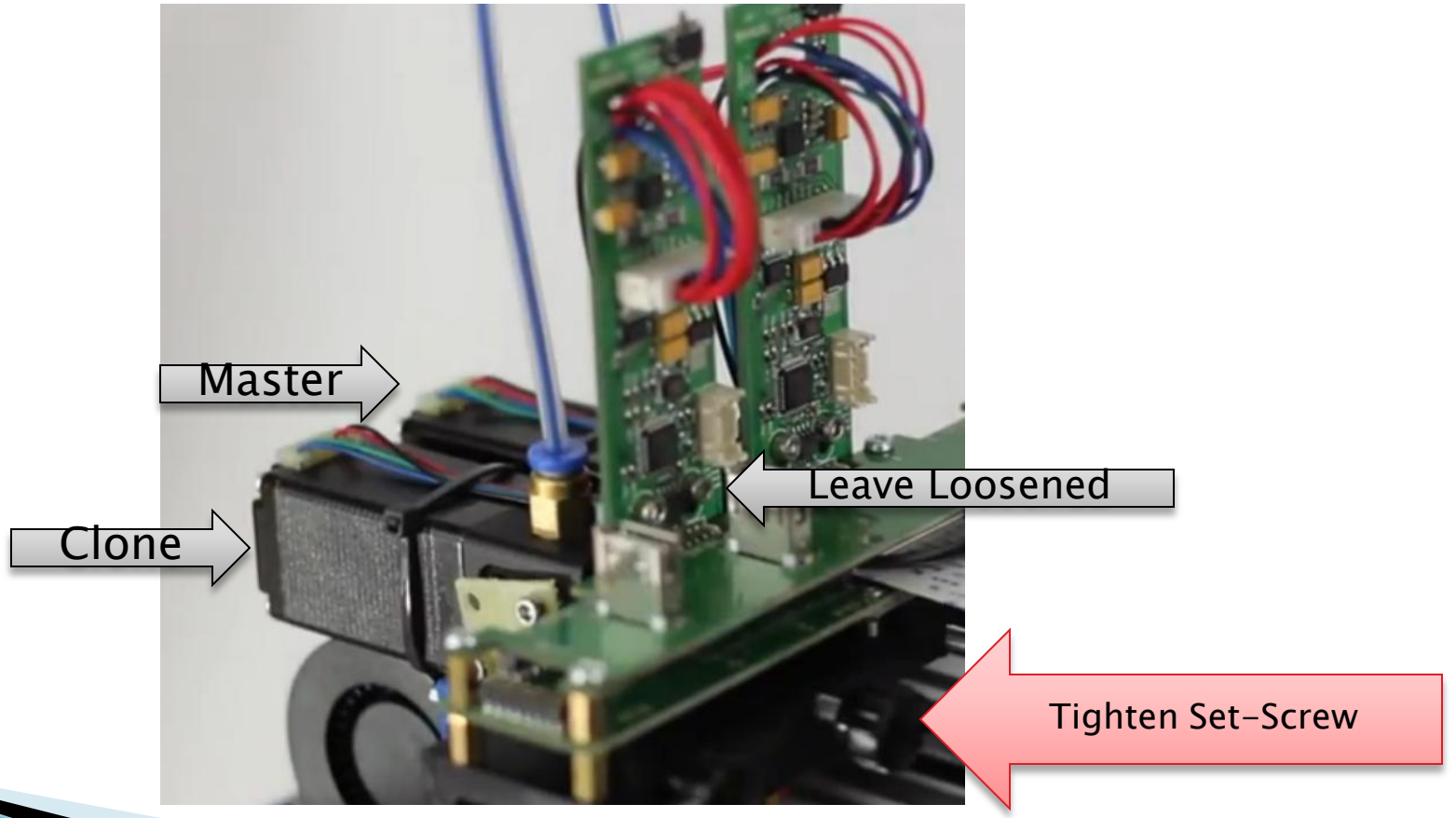
Aligning Print Heads

Gently press down on the extruder body of the “Clone” extruder until the nozzle touches the bed



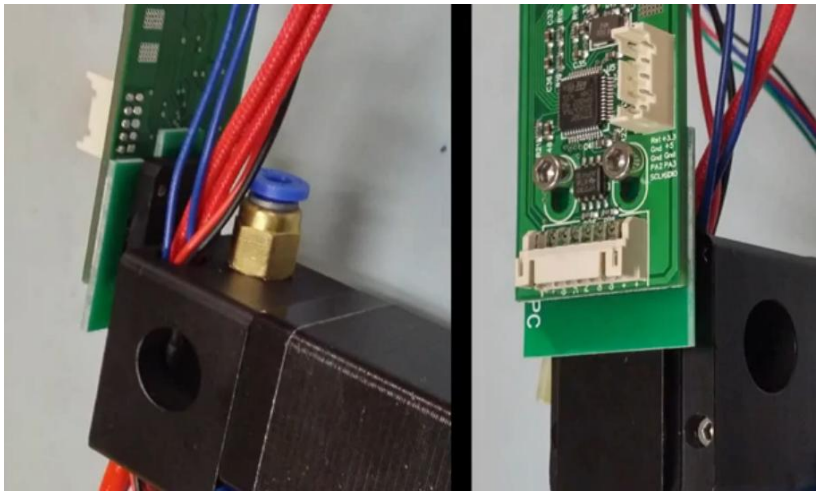
Aligning Print Heads

Tighten the Set-screw



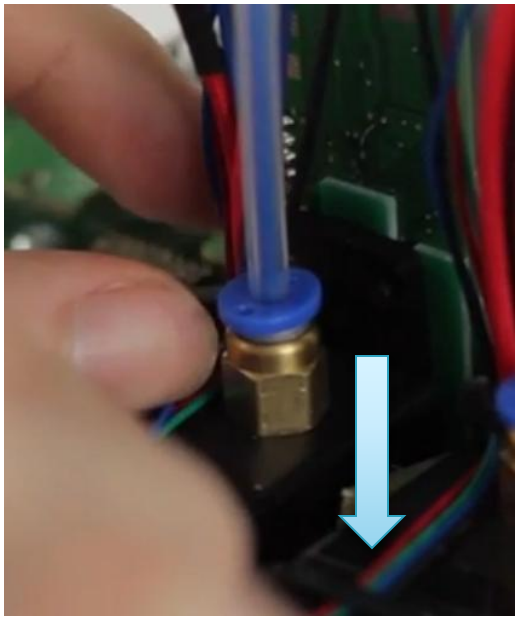
Aligning Print Heads

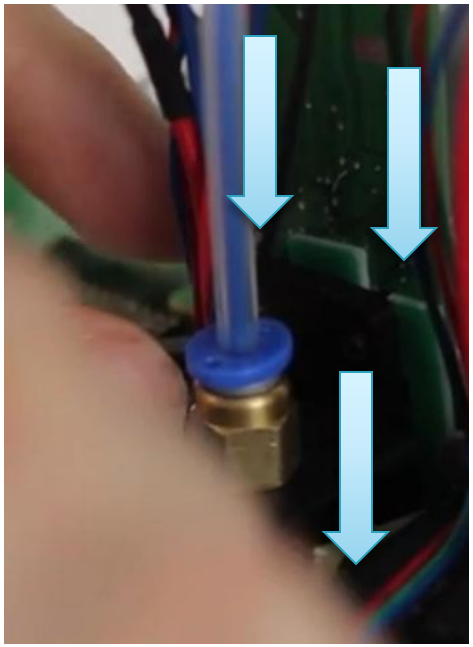
Set the Spacer Board (1 of 2)



Aligning Print Heads

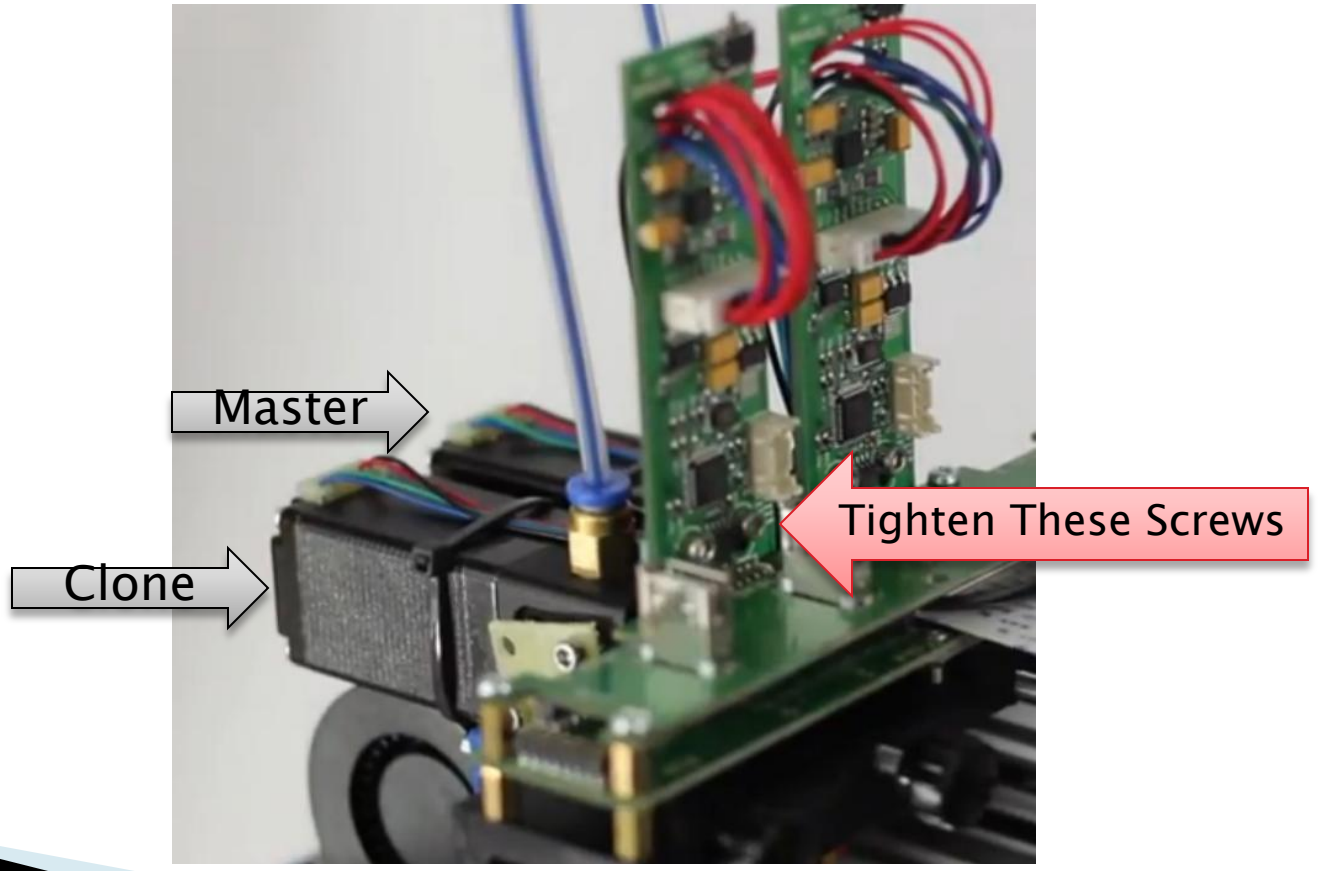
Set the Spacer Board (2 of 2)





Aligning Print Heads

Tighten the PCA screws on “Clone”



Parallel Print – Overview

- Purpose: Print multiple copies of a single part with multiple extruder heads.

- Doubling, Tripling, or even Quadrupling the printing ability of the HYREL machine will increase the user's production of usable parts within the same time it takes to print a single part.

Parallel Print – 1-By-1

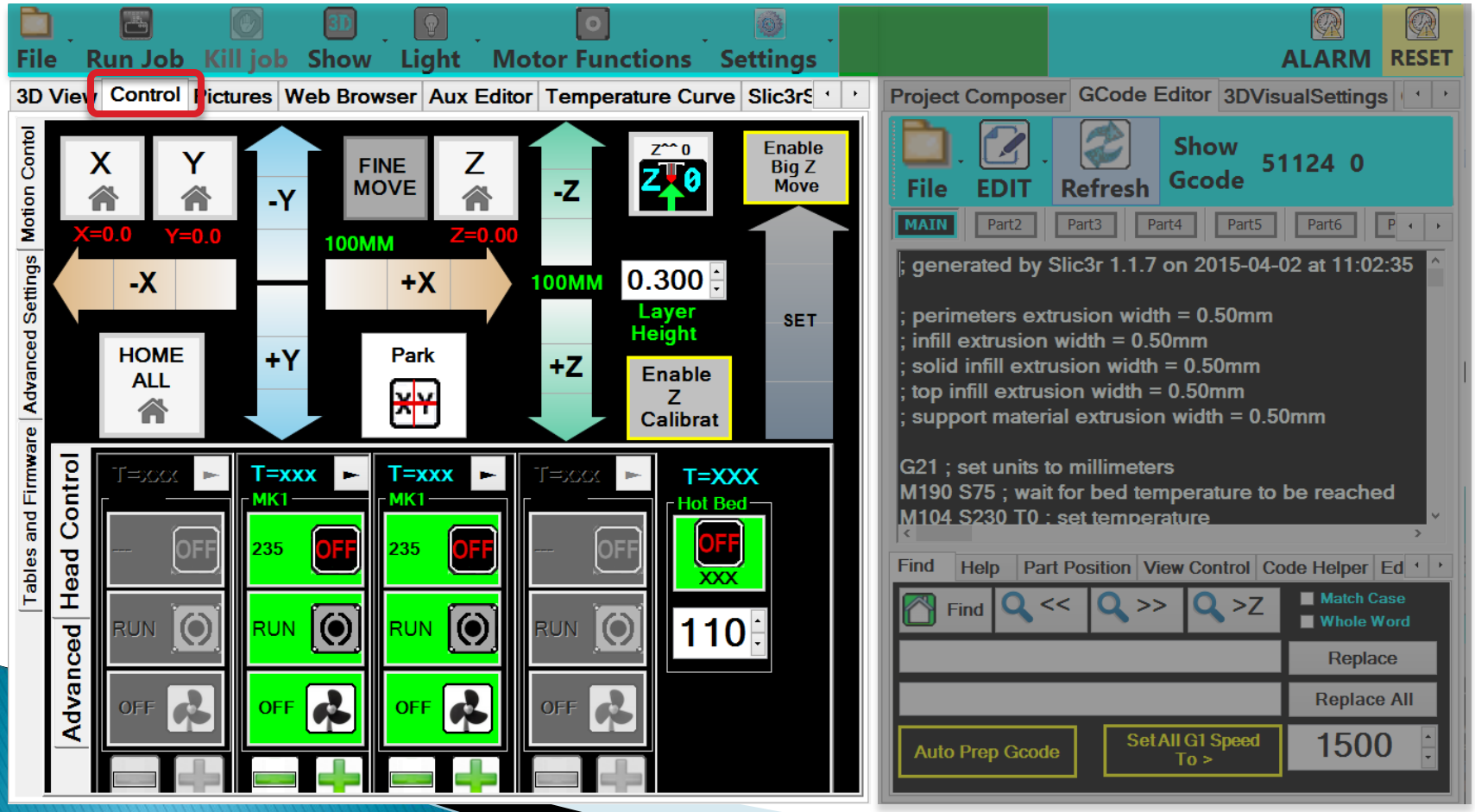
- Align Heads ← **Manditory**
- Check Tram
- Use same *.gcode file as the Simple Print
  - NOTE: The shorter / smaller the print, the better
- In the “Clone” extruder settings, set to “Head Alias 12”.
- Print

- If *.gcode does not finish correctly, more than likely, the heads are out of alignment. Re-align the heads, and retry.
- If *.gcode finishes correctly, remove the prints from the build platform & move forward to next step.

Parallel Print

Set Extruder 2 to “Clone” Extruder 1

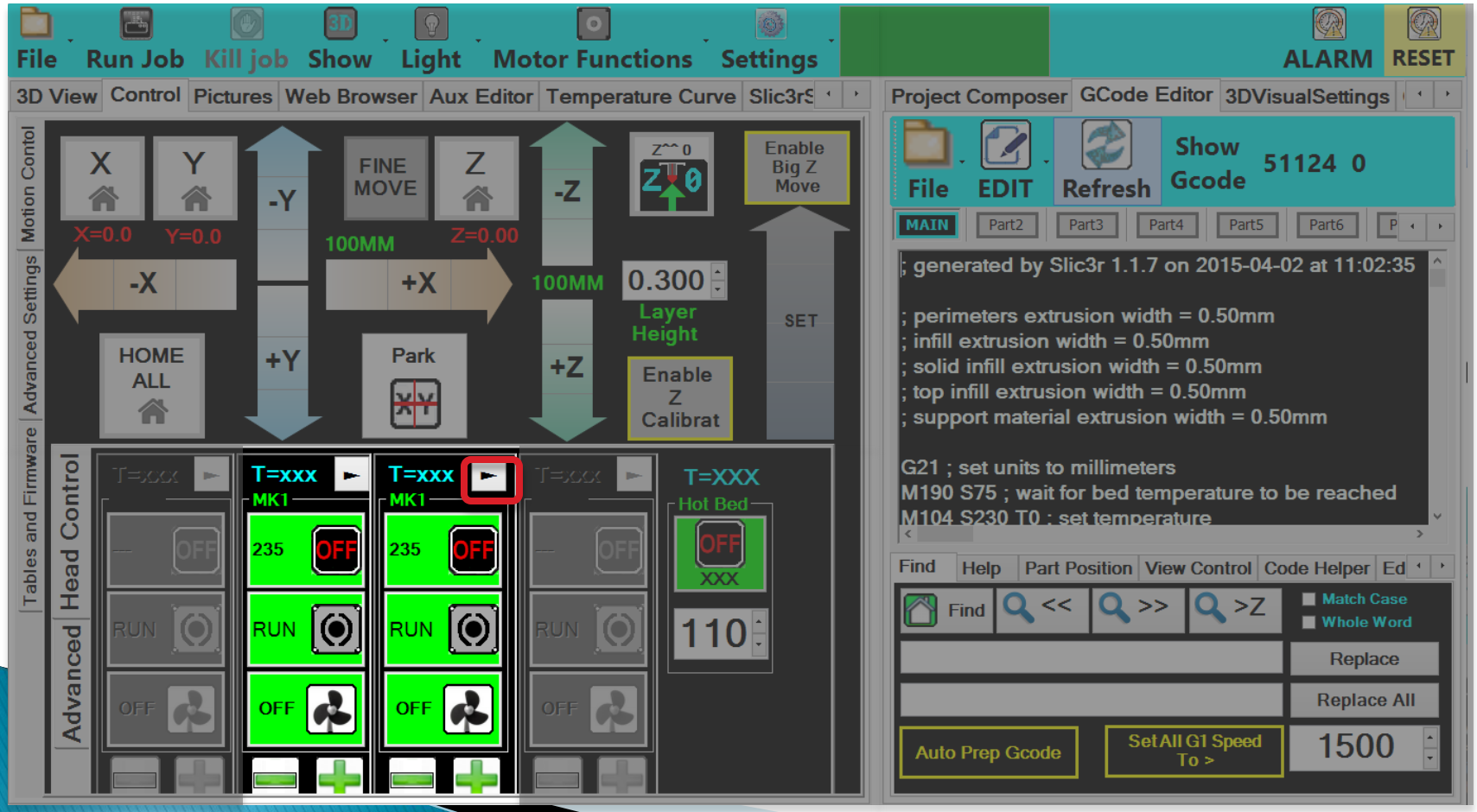
→ Go to the “Control” tab



Parallel Print

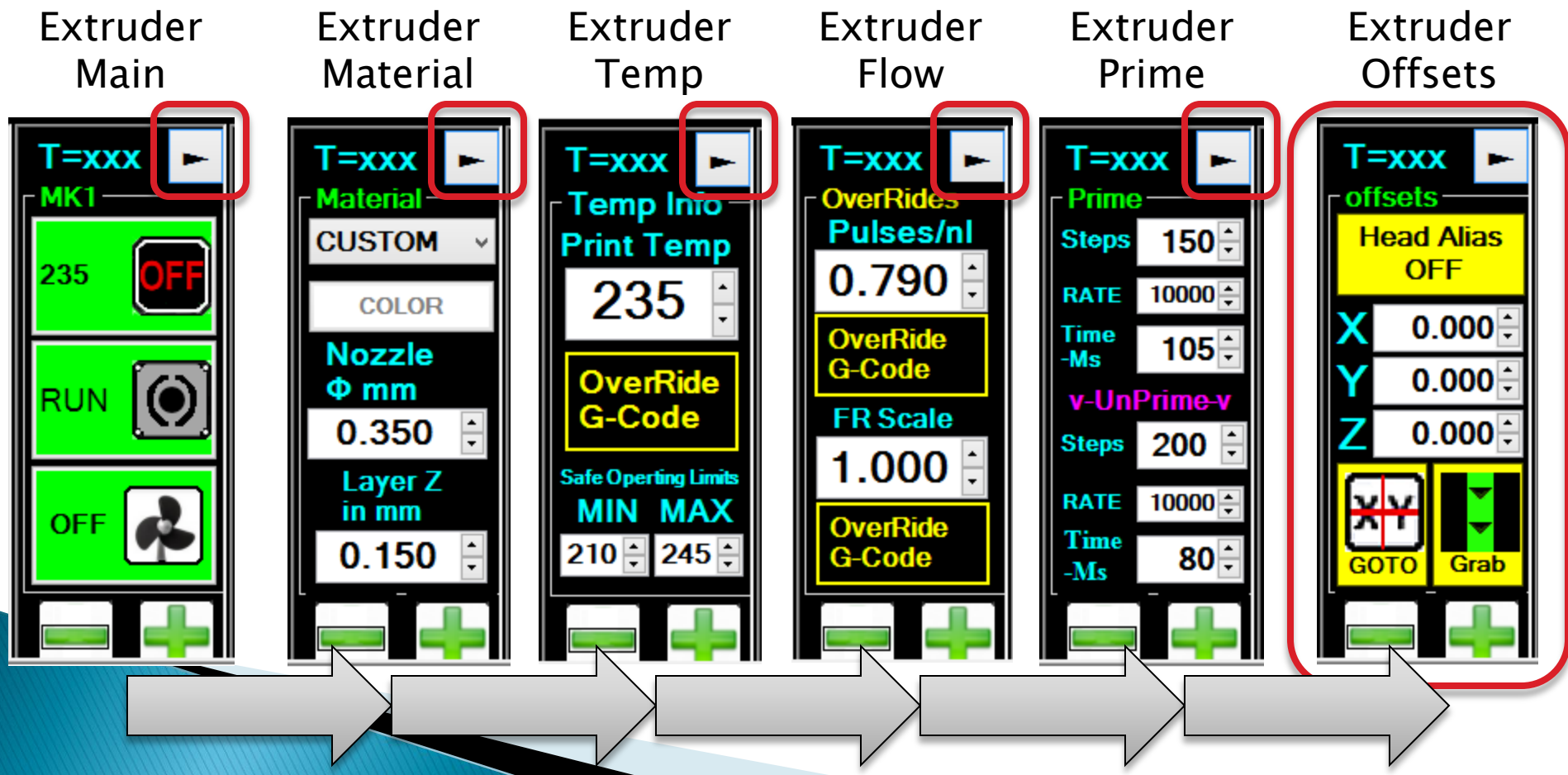
Set Extruder 2 to “Clone” Extruder 1

→ Click the ► button to get to the “offsets”



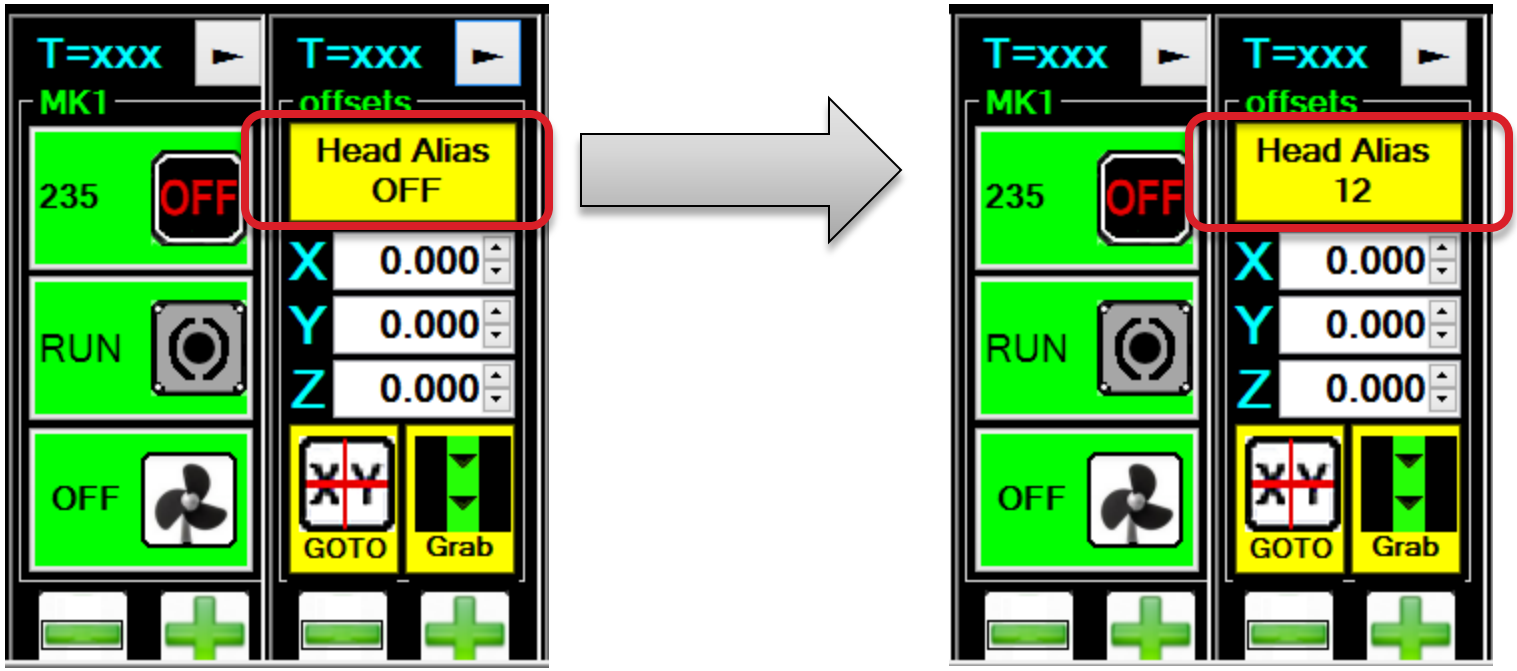
Parallel Print

Click the ► button to get to the “offsets”



Parallel Print

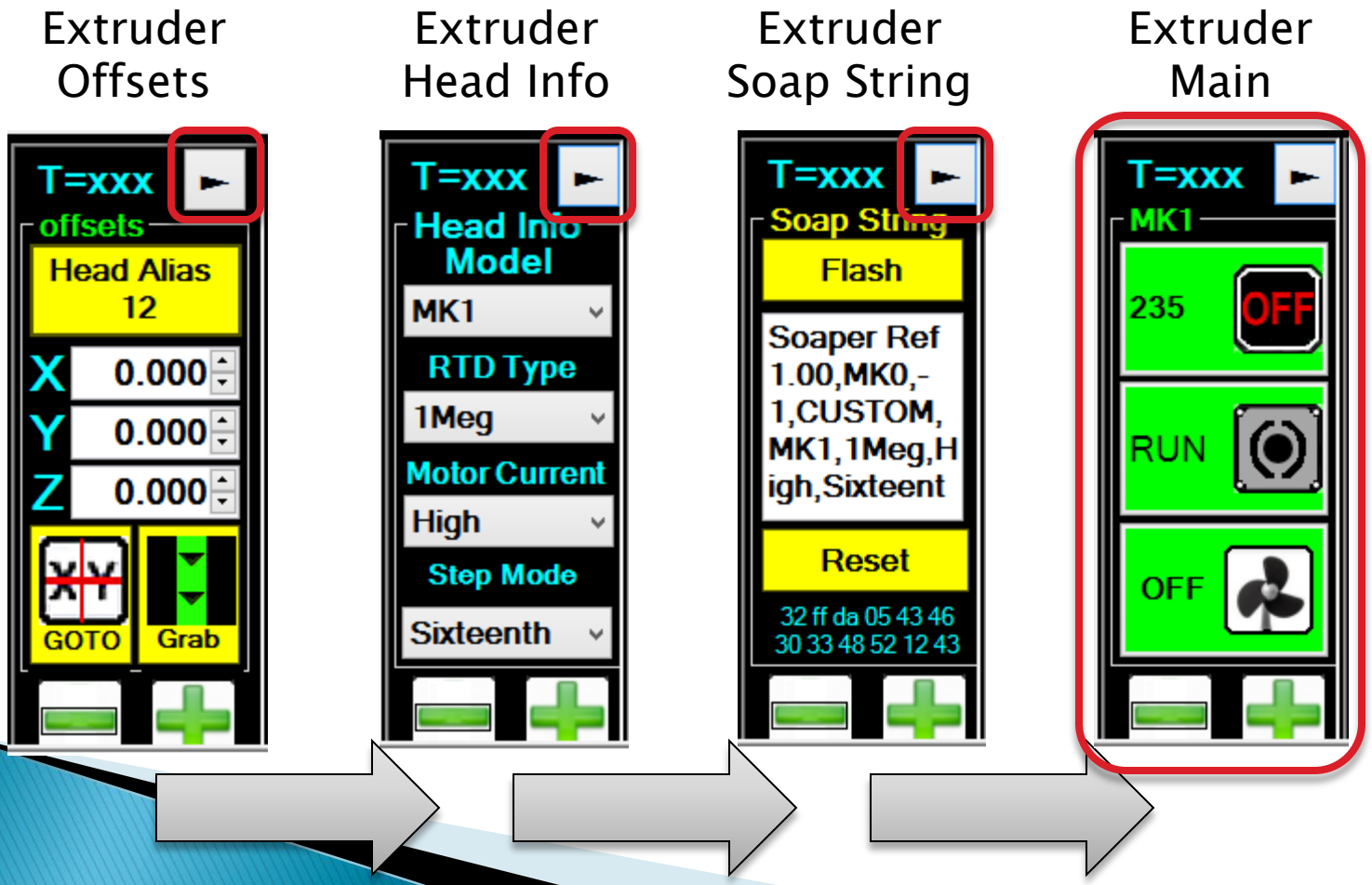
In the extruder “offsets” settings,
Click to set to “Head Alias 12”.
This “clones” Extruder 1.



WARNING: Cloning the head(s) is not persistent and will not save when you close Repetrel and/or shut down the machine.

Parallel Print

Click the ► button to return to the “Extruder Main” Sub-menu.



Parallel Print Alignment Marks Overview

- Purpose: To create calibration prints for the extruder heads for series and multiple head printing

- In order to setup perfect extruder head offsets in the X & Y Axises, we need to specify the exact position of the nozzles relative to each other. Therefore, we use this parallel print to setup for Calibrating the Offsets in the X & Y Axises.

- We accomplish this by printing the “Parallel Print Alignment Marks” first.

Parallel Print Alignment Marks 1-By-1

- Remove all prints from the build surface
- Load “Parallel Print Alignment” G-code
- Print “Parallel Print Alignment” G-code
- When complete, DO NOT REMOVE PRINTS FROM THE BUILD PLATFORM

Calibrate Offsets – Overview

- Purpose: To get and set the X & Y Axis offsets for all extruder heads.

- In order to setup perfect X & Y Axis, we will use the camera's red crosshairs to align, assign, and save the offsets to each extruder head.

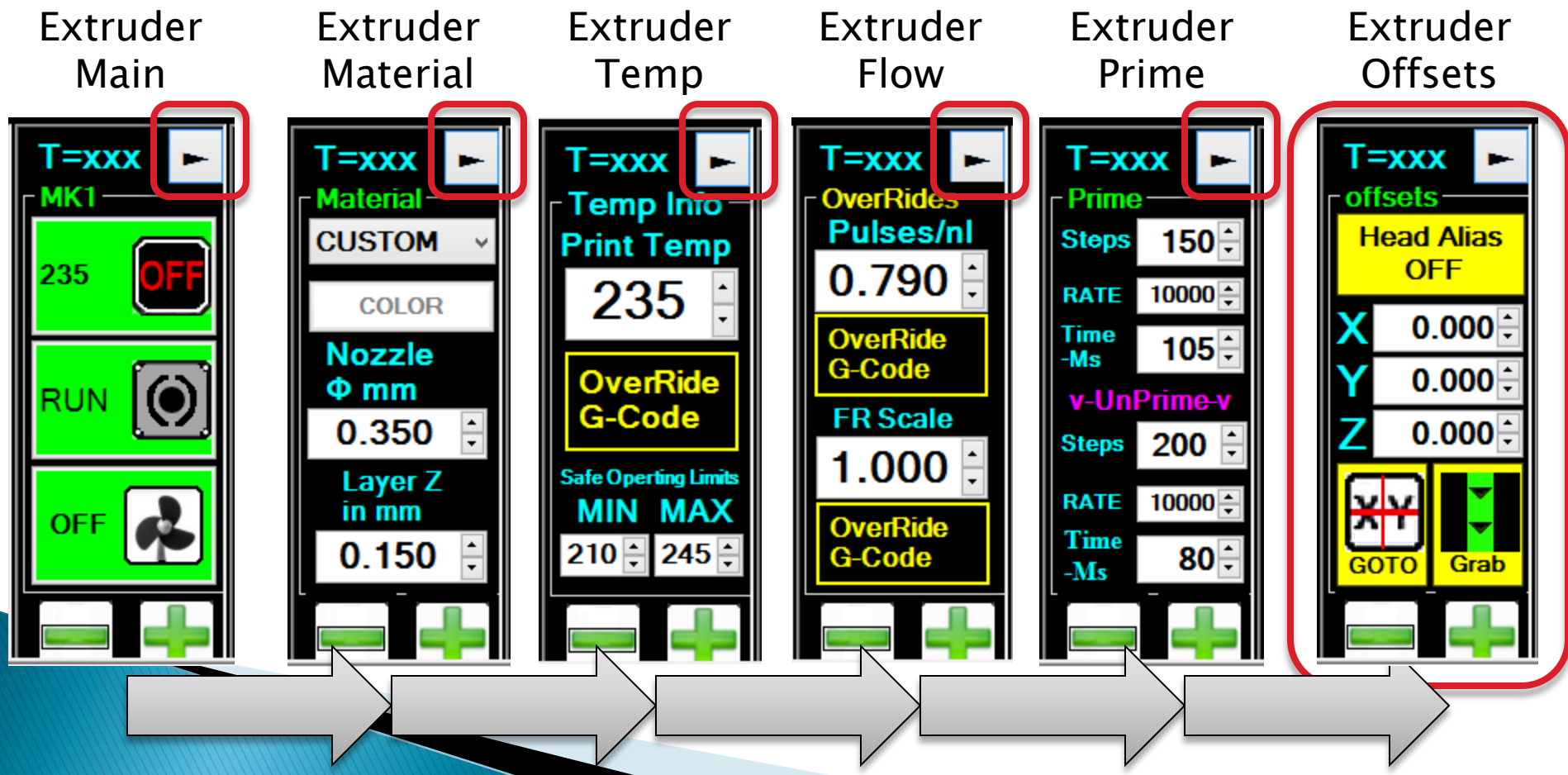
- We accomplish this using the following steps:

Calibrate Offsets – 1-By-1

- With the Parallel Print Alignment prints on the build platform:
- Use Yoke Camera to determine the origin with the left-most extruder's print
  - The camera's red crosshairs need to be aligned to the Printed "+" of the what the left-most extruder printed with the Parallel Print Alignment print
  - Use the "Fine Move" button to fine-tune the position of the camera's red crosshairs with the Printed "+" of the corresponding extruder head
  - Click on the red X & Y Axis read-outs in the Manual Control sub-menu
- Then use Yoke Camera to determine the offset for the extruders to the right of the left-most head
  - The camera's red crosshairs need to be aligned to the Printed "+" of that extruder's Parallel Print Alignment print
  - Use the "Fine Move" button to fine-tune the position of the camera's red crosshairs with the Printed "+" of the corresponding extruder head
  - Use the Extruder Controls to "grab" the offsets for the Heads automatically
- Flash the Heads

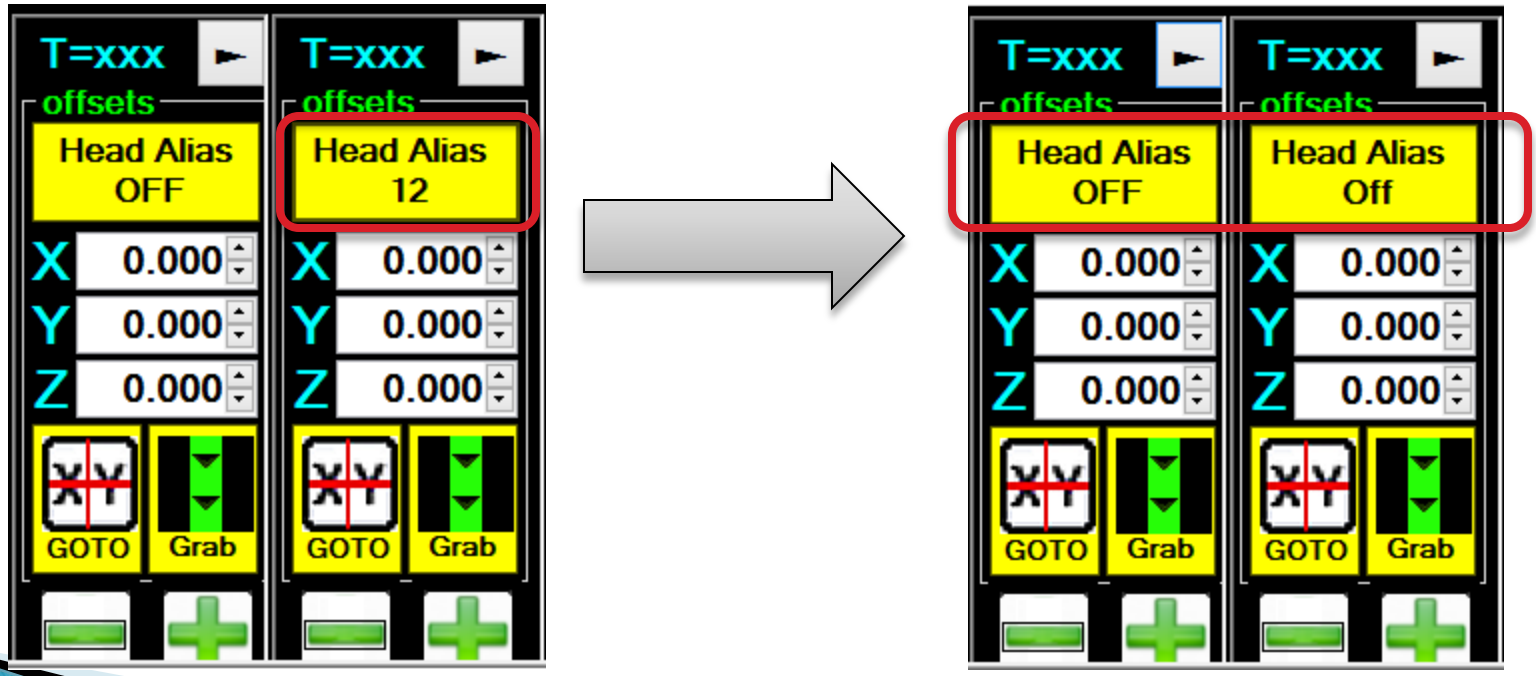
Calibrate Offsets

Click the ► button to get to the “offsets”



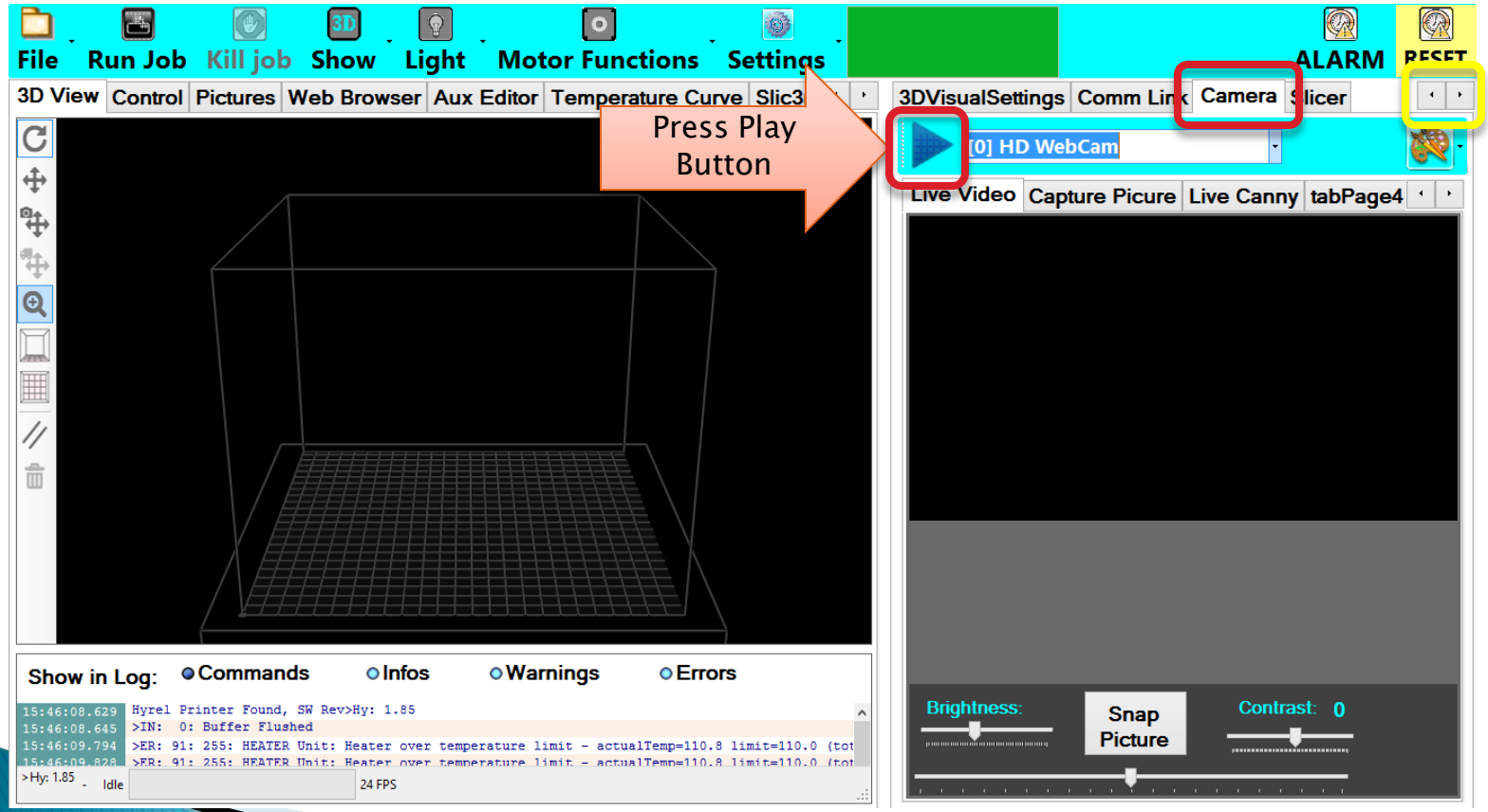
Calibrate Offsets

In the “offsets” extruder settings, Make sure all extruders are set to “Head Alias OFF”.



Calibrate Offsets

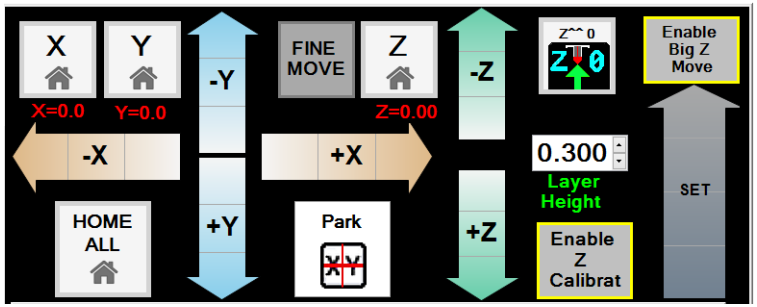
Open the “Camera” tab
→ Start yoke camera



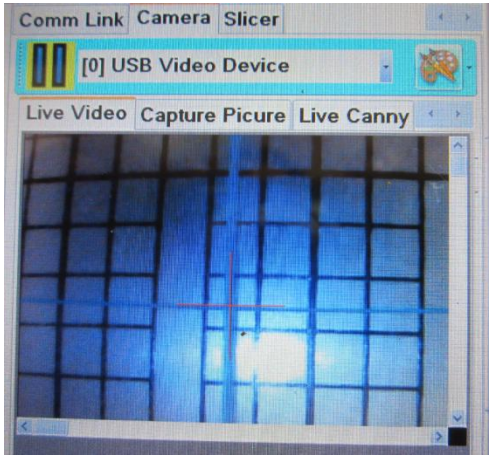
Use these arrows to navigate to the “Camera” tab

Calibrate Offsets

Starting with the Left-most print:
Use the manual controls to align yoke camera's red crosshairs with the printed "+"

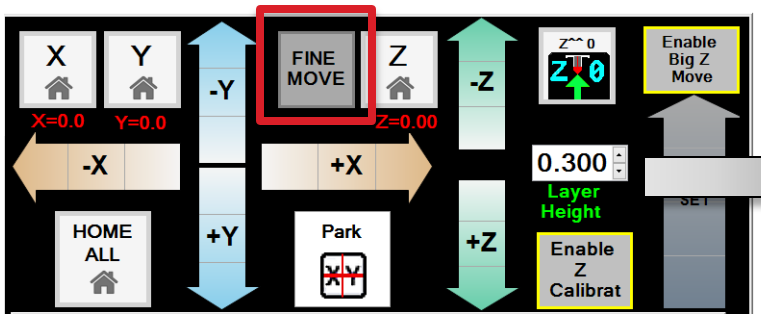


Manual Controls, Regular Moves

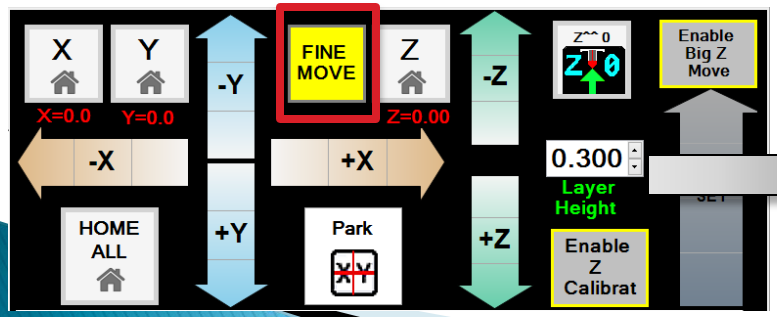


Calibrate Offsets

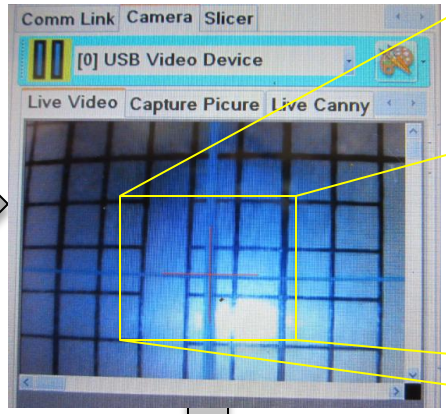
Use the “Fine Move” button to change the manual controls to move in tight steps

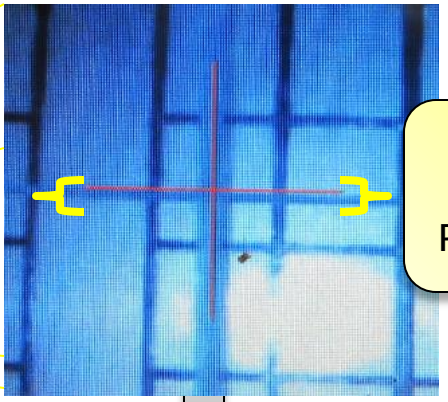


Manual Controls, Regular Moves

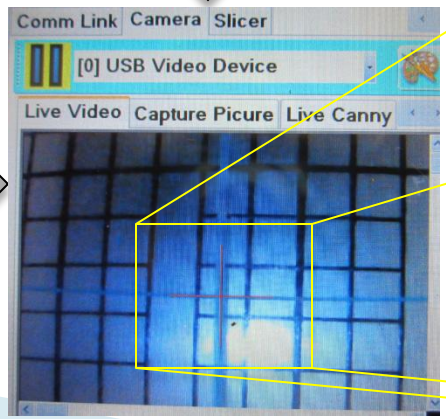


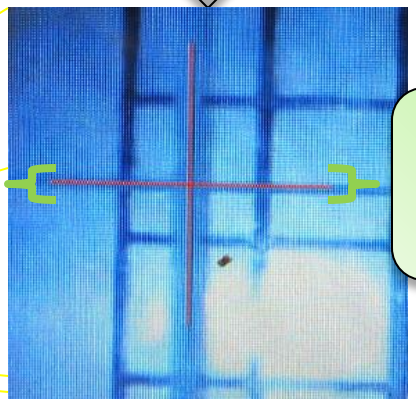
Manual Controls, Fine Moves





Not Quite Perfect



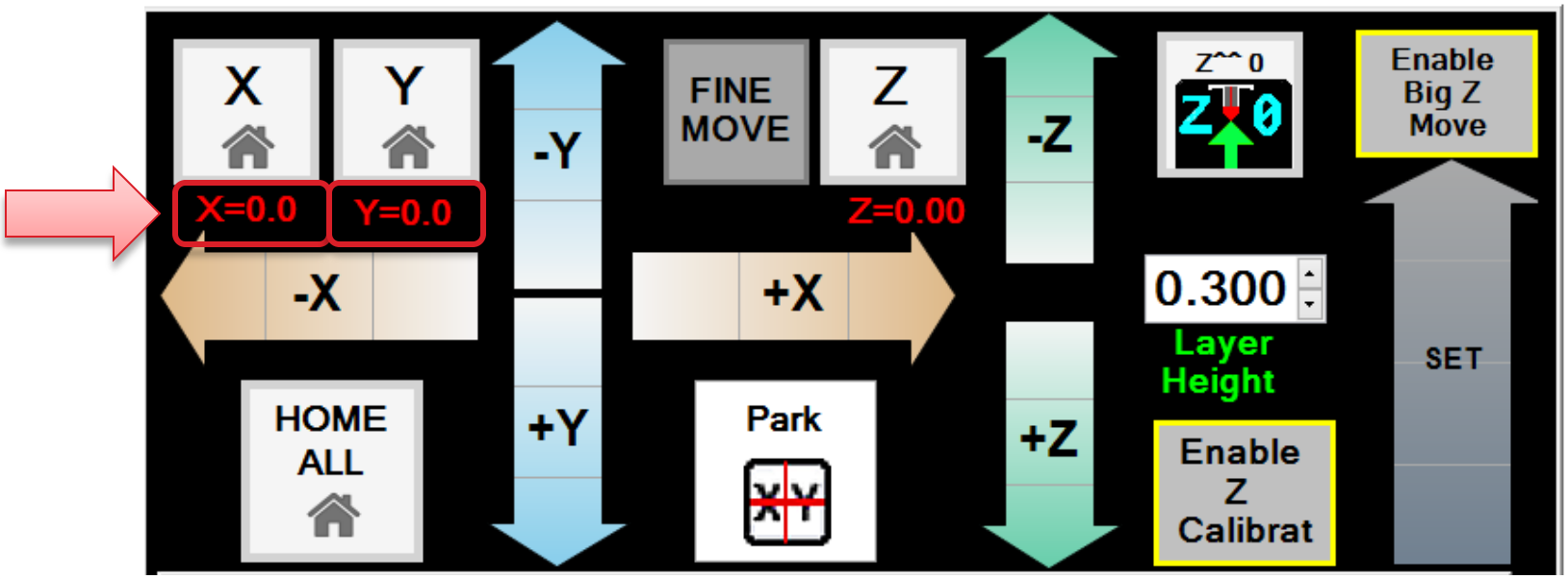


Perfect

Calibrate Offsets

The Left-most extruder is the origin, therefore, Click on the red X & Y coordinates in the Manual Controls to “zero” the X & Y Axis

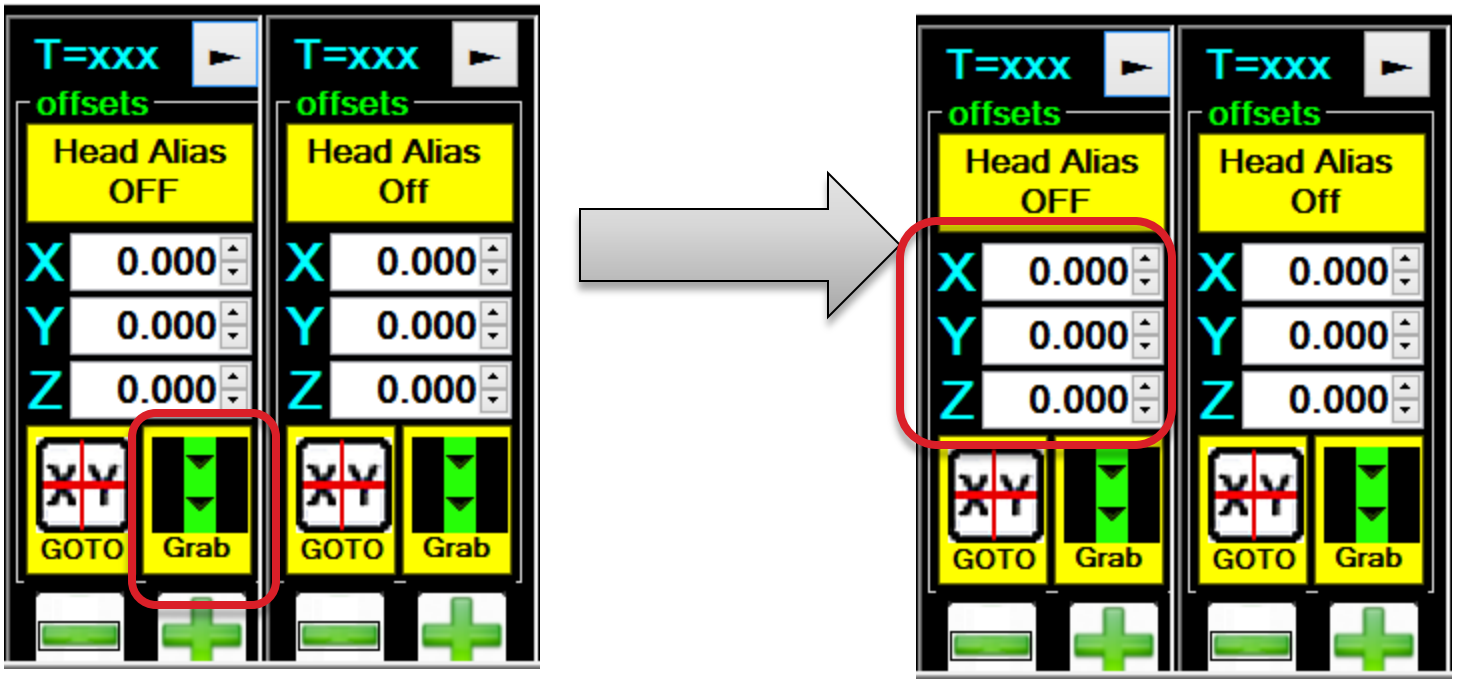
Manual Controls, Regular Moves



This sets the reference points.
The movements from this position to the next are relative to these reference points

Calibrate Offsets

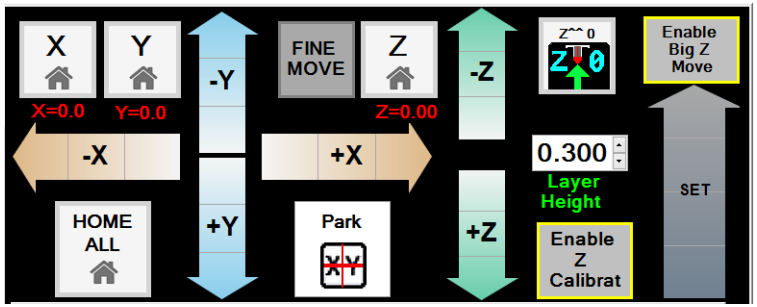
Use the Extruder Controls to “grab” the offsets for the Heads automatically for the Left-most Extruder



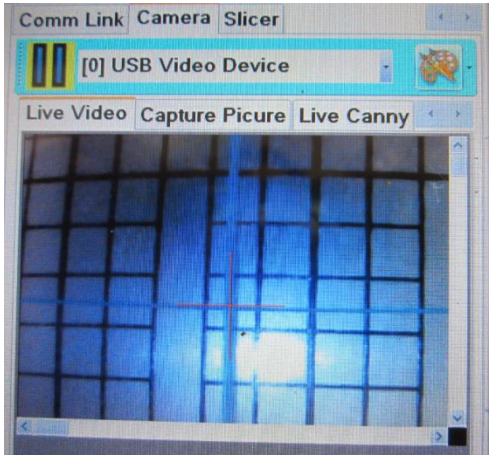
*We always grab the origin points – just in case the left-most extruder head had offsets, other than 0,0

Calibrate Offsets

Next, use the manual controls to align yoke camera's red crosshairs with the printed "+" of the next right-side print.

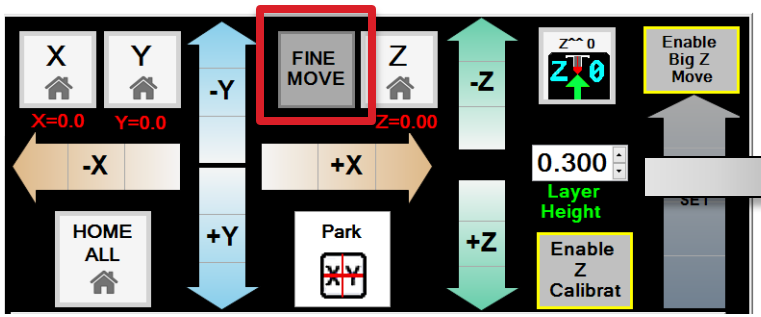


Manual Controls, Regular Moves

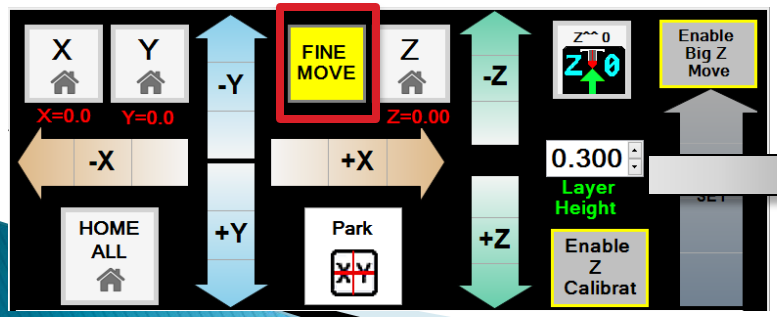


Calibrate Offsets

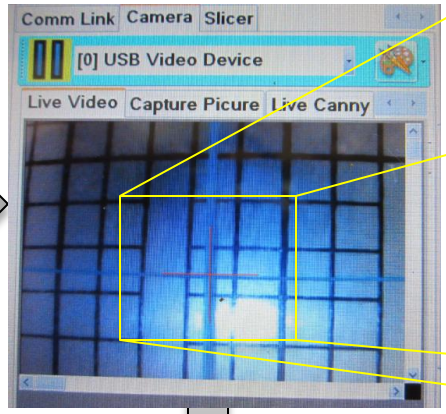
Use the “Fine Move” button to change the manual controls to move in tight steps

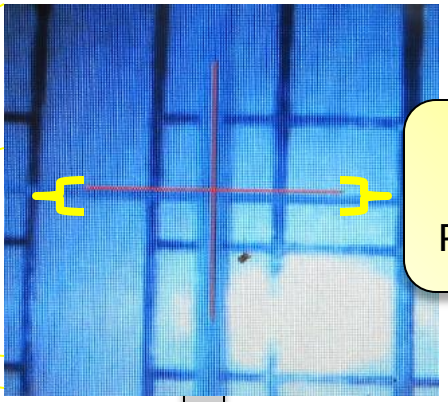


Manual Controls, Regular Moves

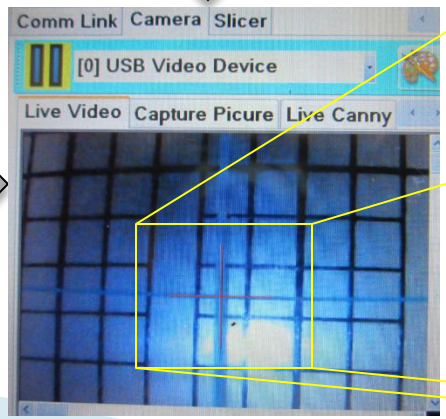


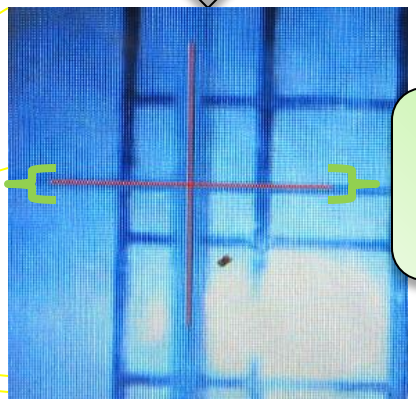
Manual Controls, Fine Moves





Not Quite Perfect

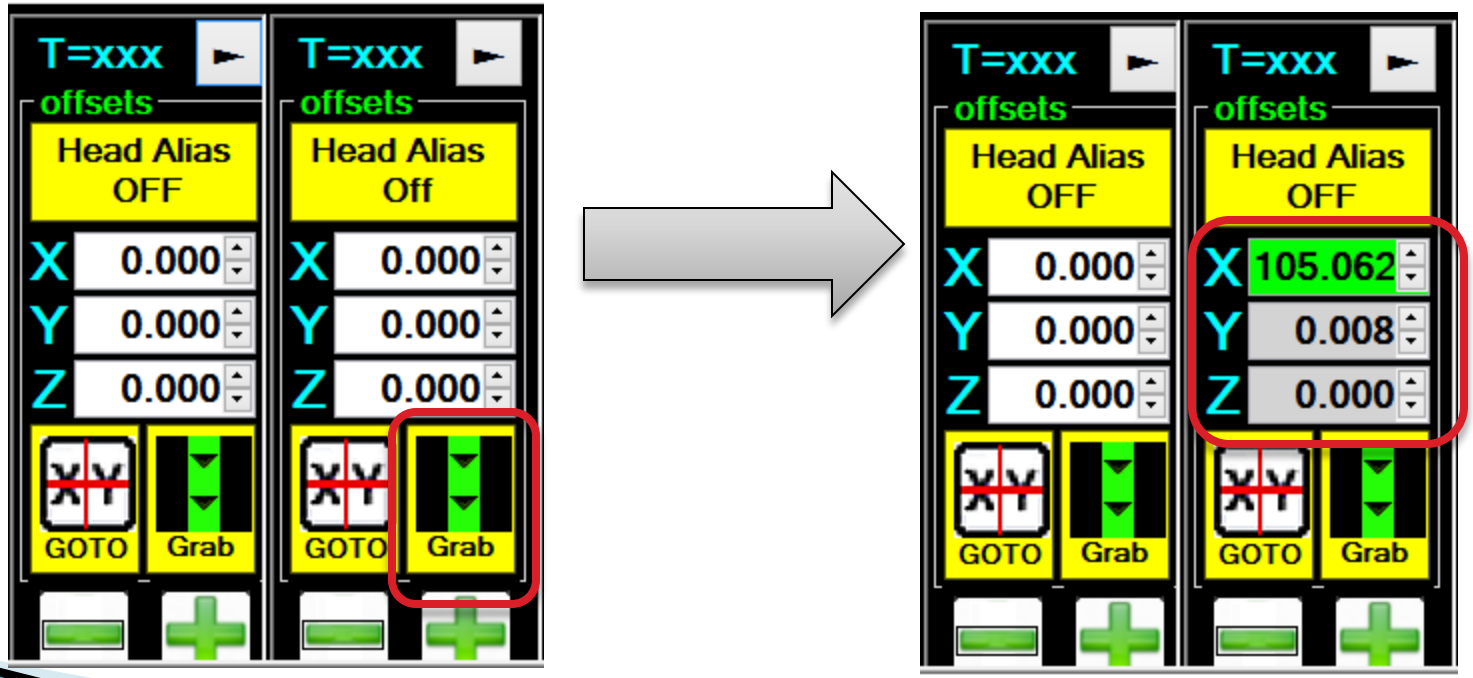




Perfect

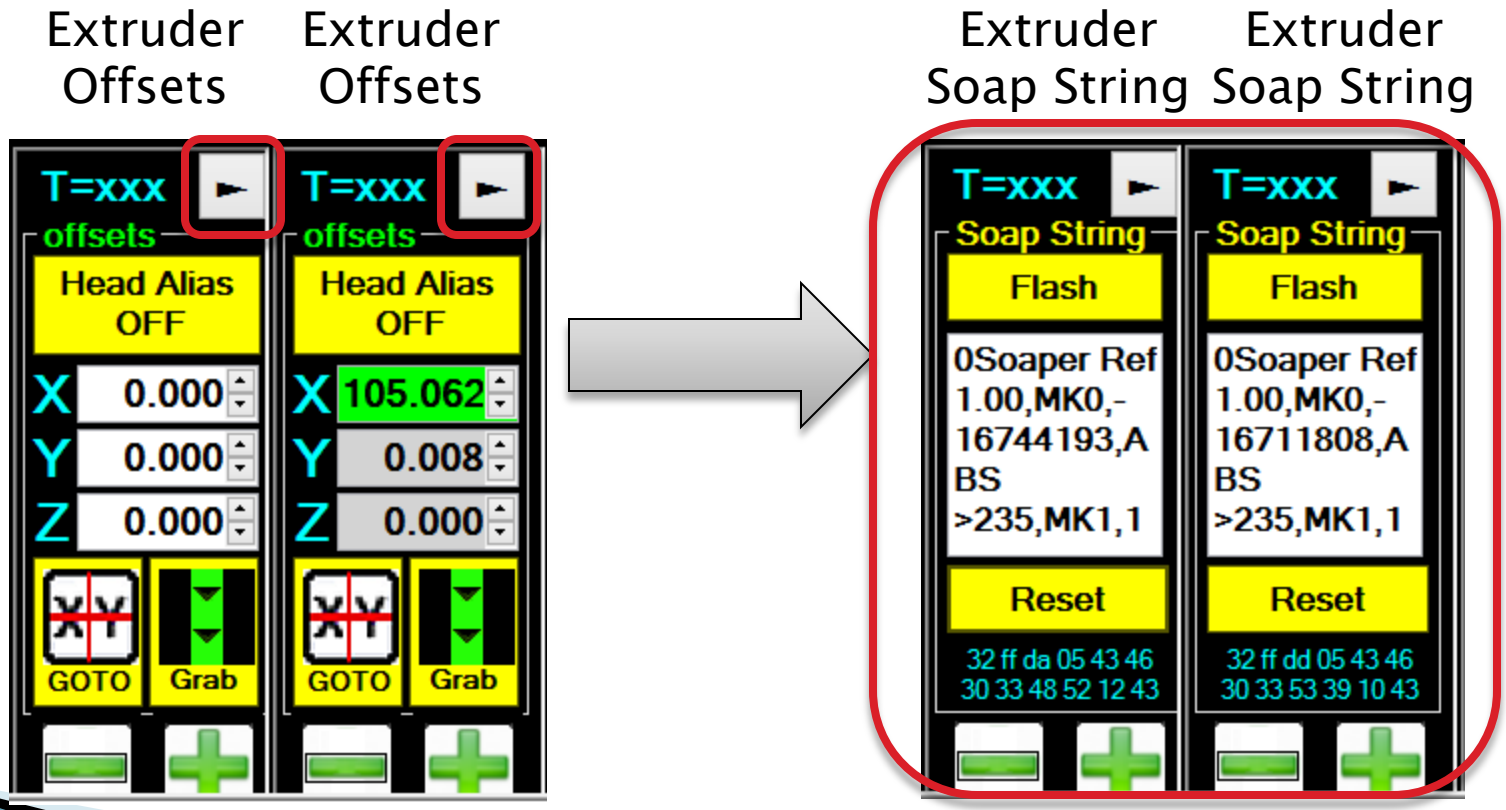
Calibrate Offsets

Use the Extruder Controls to “grab” the offsets for the Heads automatically
For the next, right-side extruder



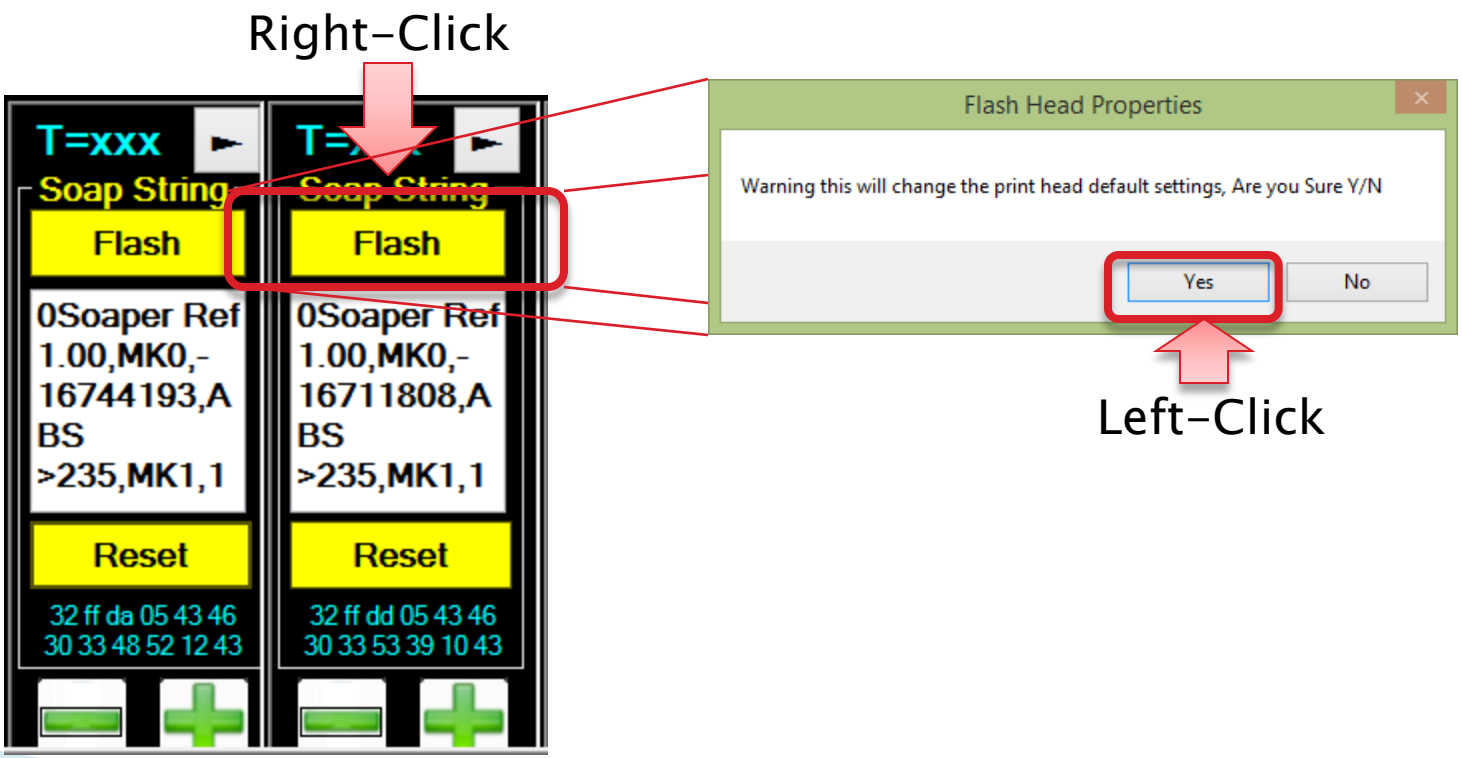
Calibrate Offsets

Click the ► button until the “Soap String” is seen for both extruders.



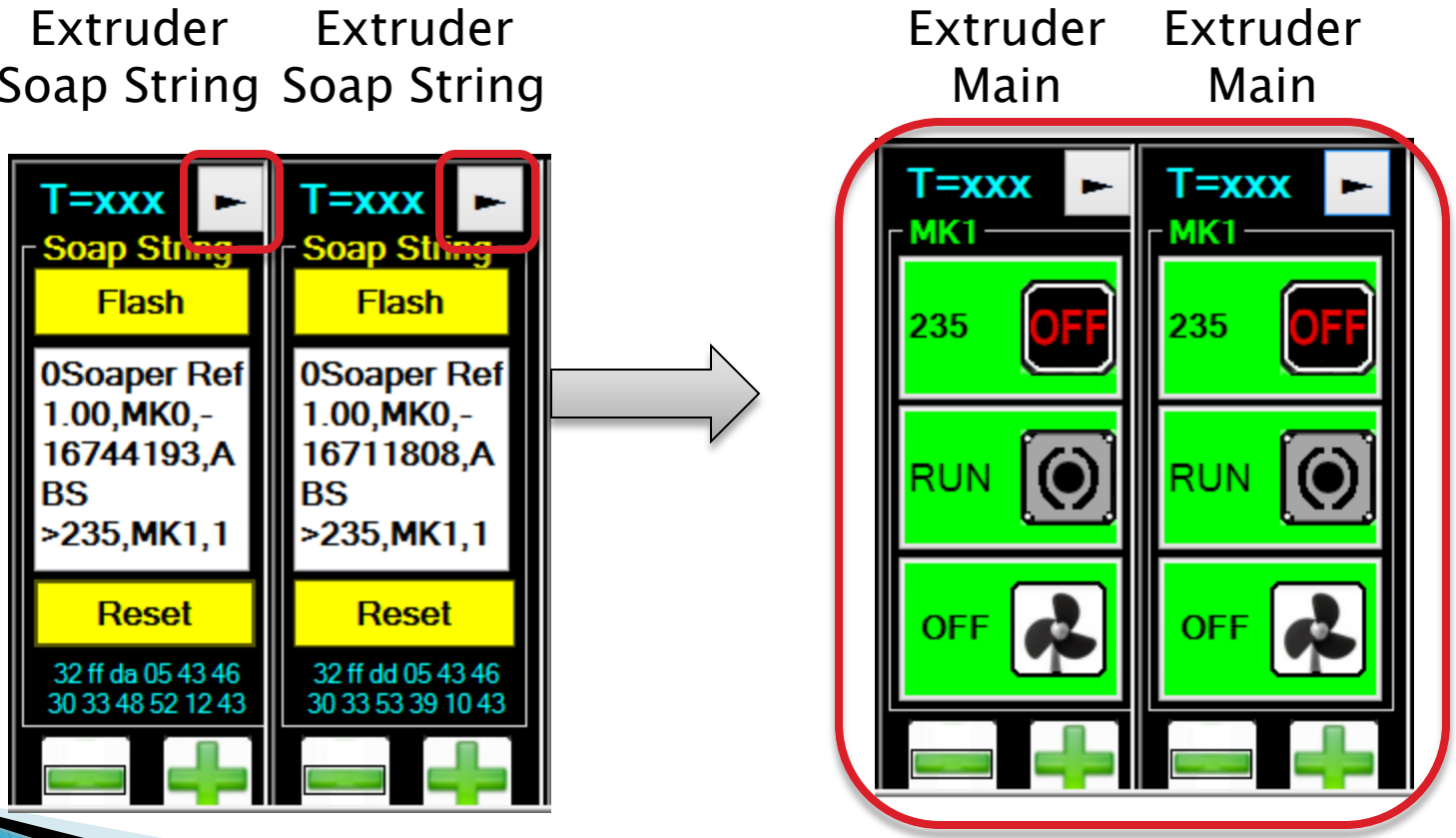
Calibrate Offsets

In the “Soap String” submenu,
Flash (Program) the head.
Do this for both heads.



Calibrate Offsets

Click the ► button to return to the main Extruder controls



Series Print – Overview

- Purpose: To change material color / type layer by layer
- When the user wants to change the material color / type per layer on the same print, these are the instructions to follow. This validates that the user has their HYREL setup for success for the subsequent Multi-Head prints (support prints, et al.)
- In order to properly do this, the user must specify when the extruder change will occur after a layer change (Z-Axis move) has occurred. This process is currently a manual edit in the g-code.

Series Print – 1-By-1

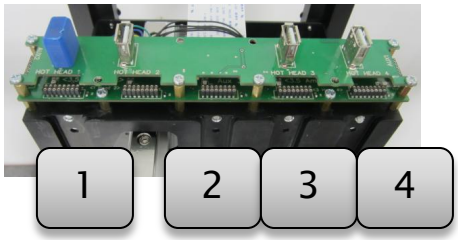
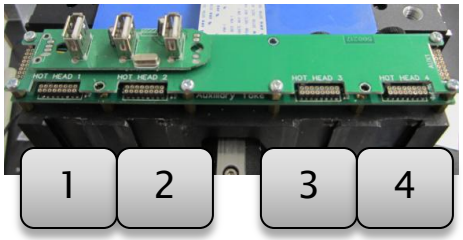
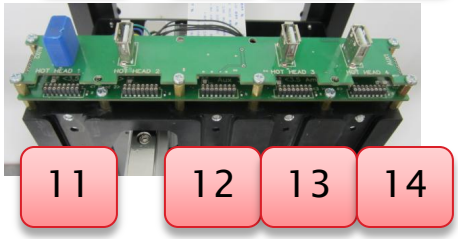
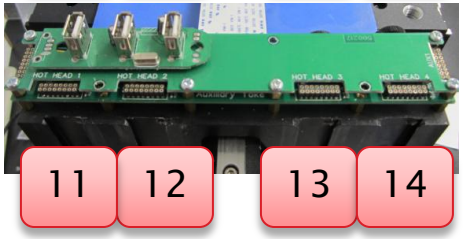
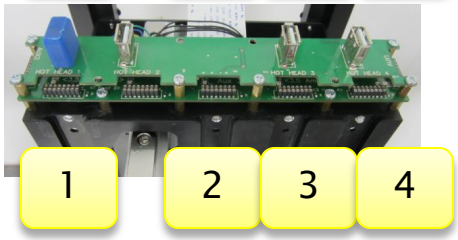
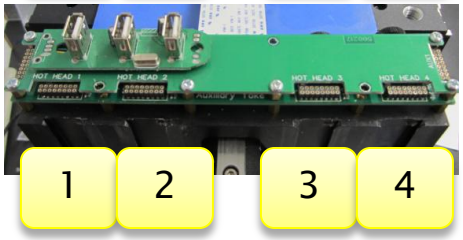
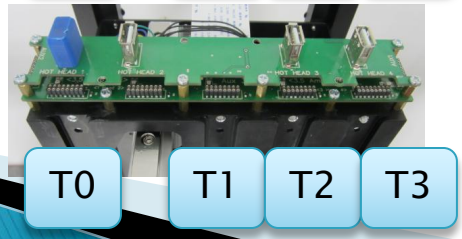
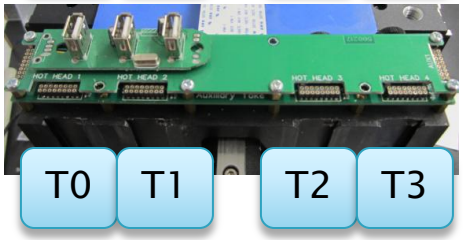
- Calibrate Offsets (X & Y Alignment) ← **Manditory**
- Manual setup of G-Code
- Remove all prints from the build surface.
- Check Tram
- Print “Series Test” print ***FIRST***

- IF each layer is not aligned, re-calibrate offsets & re-print

- IF each layer is aligned, continue to Support Print

Series Print

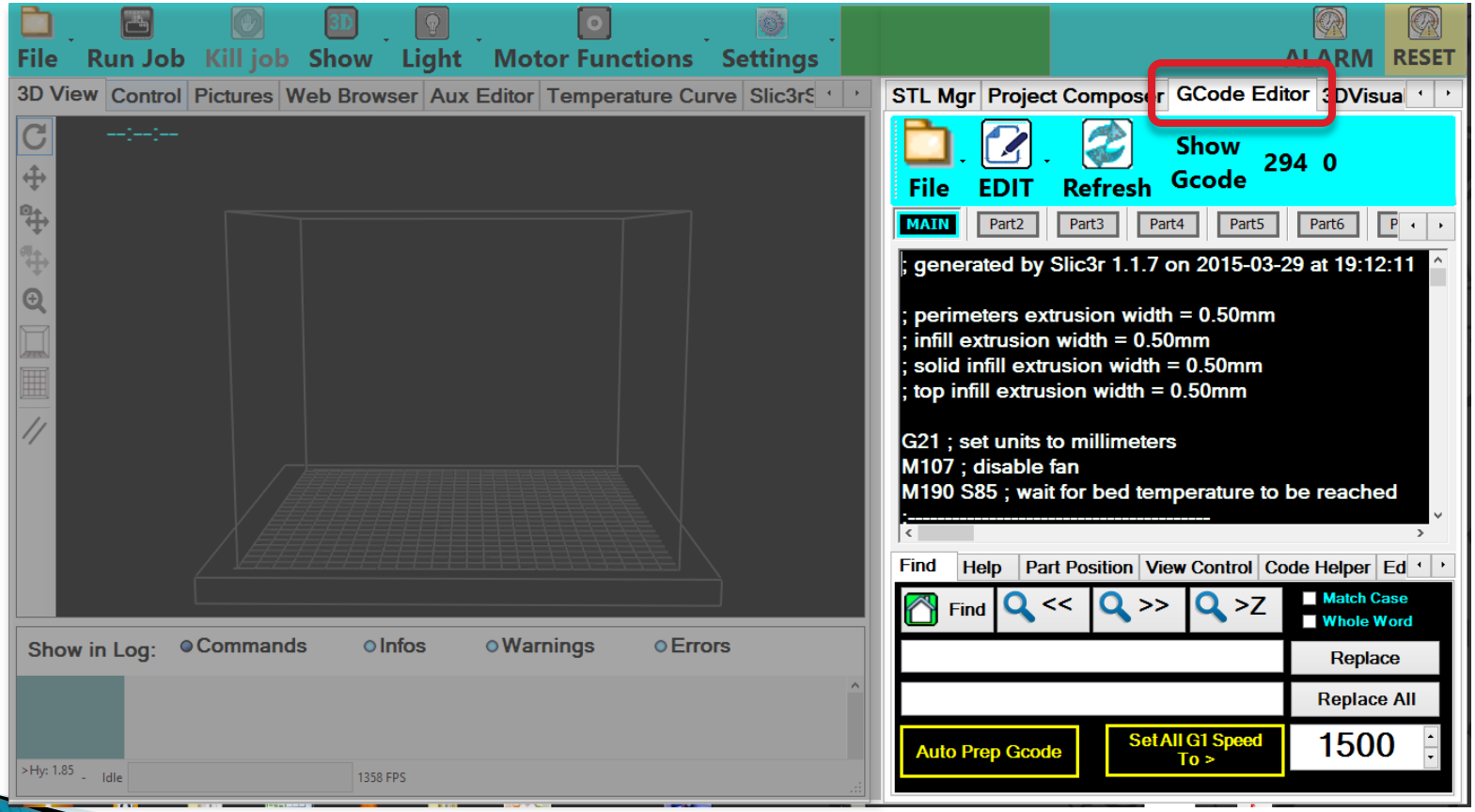
Cheat Sheet:
Extruder Positioning to G-Code Link-up

	1x3 Yoke	2x2 Yoke
Physical Head Slot		
Repetrel Extruder Designation		
Slic3r Extruder Designation		
G-Code* Designation		

*Generated By Slic3r

Series Print

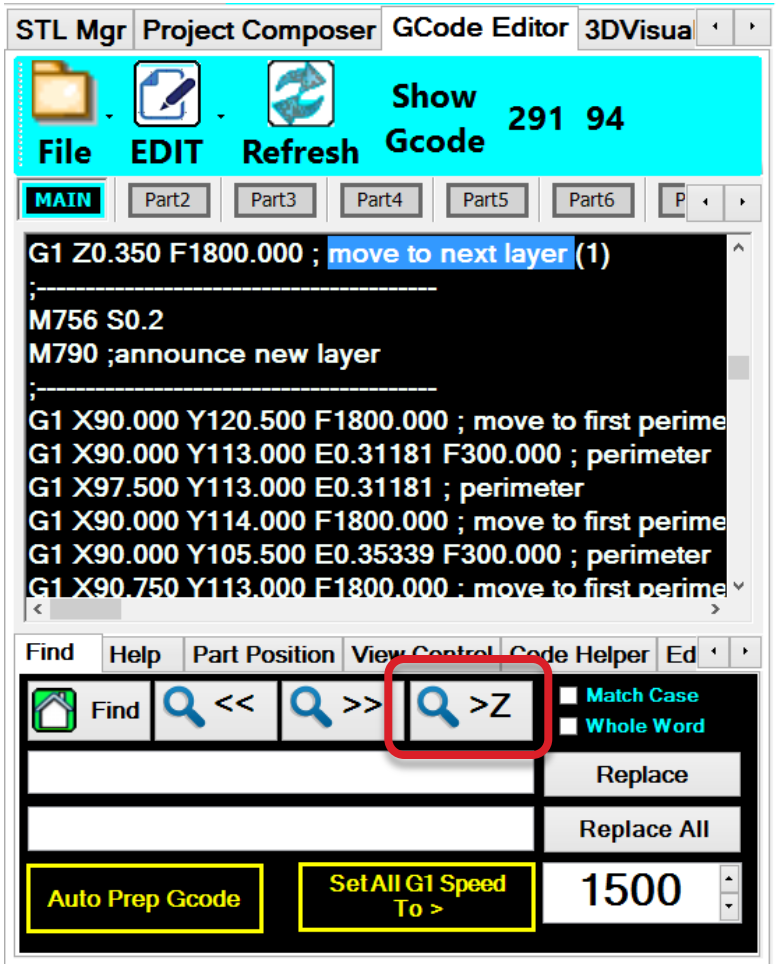
Manual setup of G-Code in Repetrel
→ Select “Gcode Editor” tab



Series Print

Manual setup of G-Code in Repetrel

→Select “>Z” button twice
to skip to second Z-layer



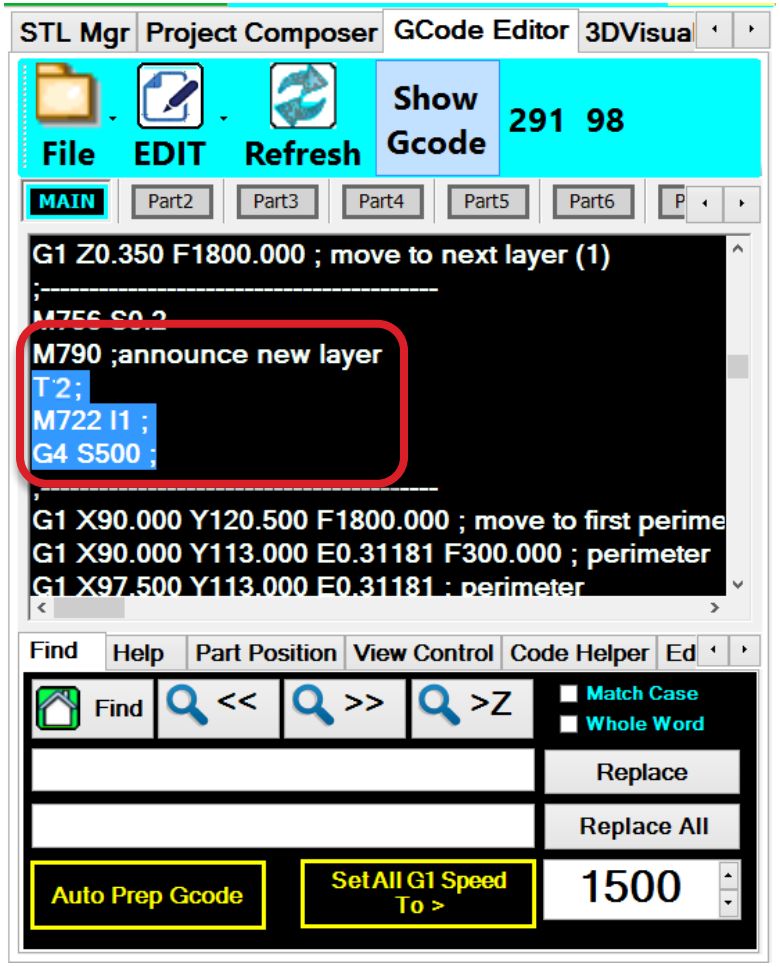
Series Print

Manual setup of G-Code in Repetrel

→Manually type in the following
after “M790 ;announce new layer”:

T2 ;
M722 I1 ;
G4 S500 ;

Decoded:
T2 = Change to 2nd extruder (slot 3)
M722 I1 = Prime the 2nd extruder ASAP
G4 S500 = Pause for 500ms



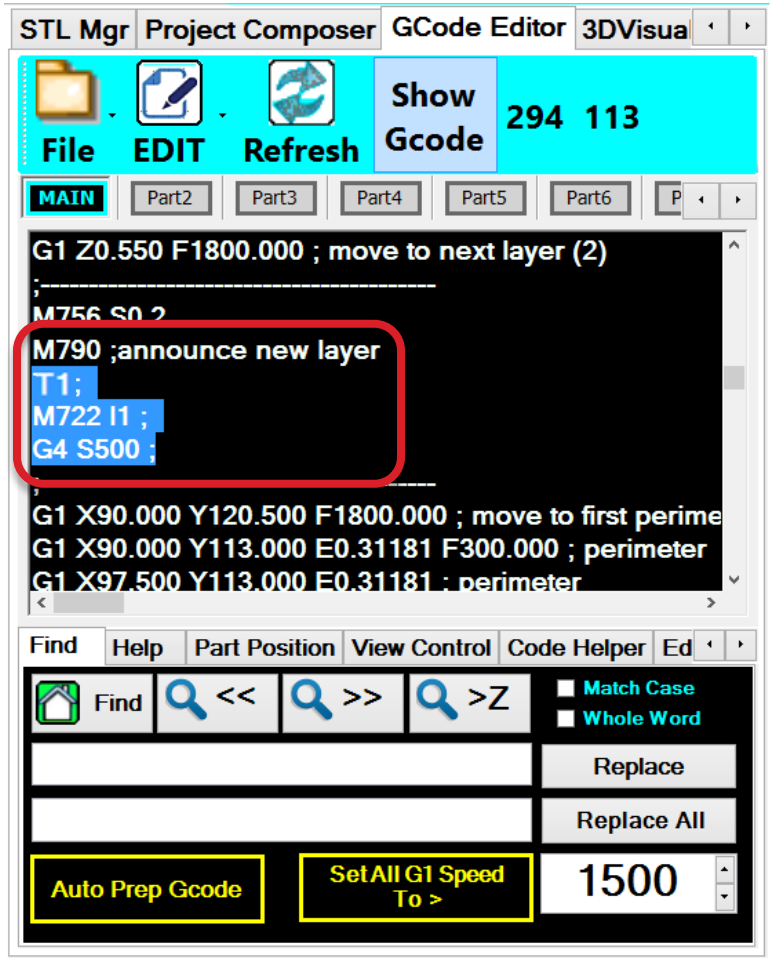
Series Print

Manual setup of G-Code in Repetrel

→Press the “>Z” button
to go to the next layer
→Manually type in the following
after “M790 ;announce new layer”:

T1 ;
M722 I1 ;
G4 S500 ;

Decoded:
T1 = Change to 1st extruder (slot 2)
M722 I1 = Prime the 1st extruder ASAP
G4 S500 = Pause for 500ms

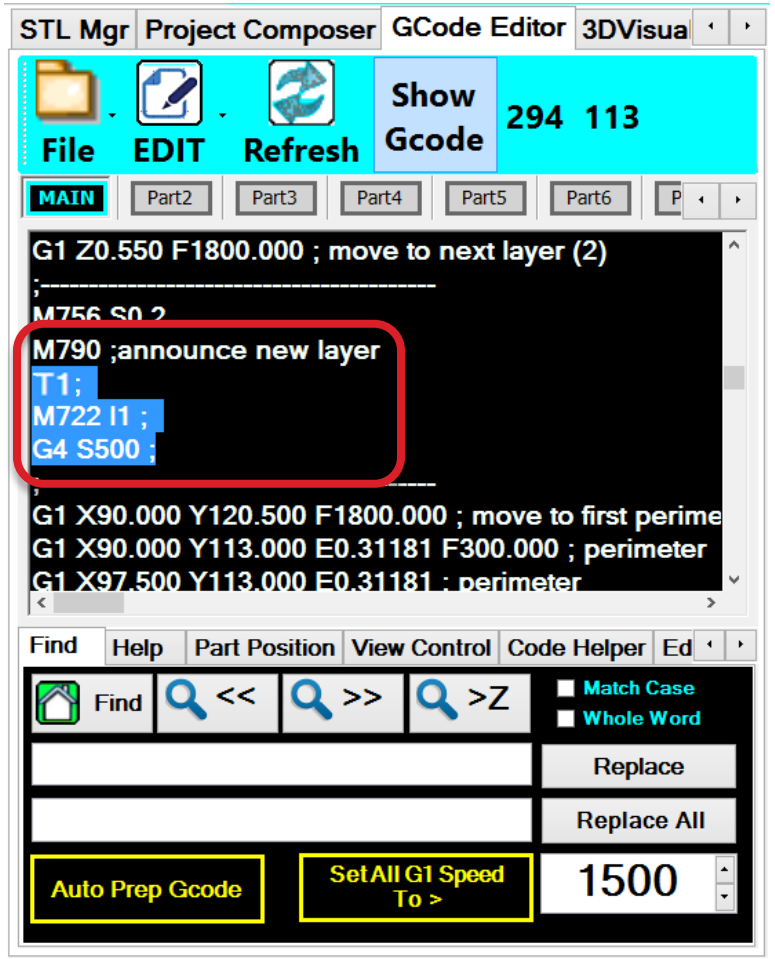


Series Print

Manual setup of G-Code in Repetrel

Continue the previous processes until satisfied

NOTE: The user can also select which layers will have a tool change.



Support Print – Overview

- Purpose: To print objects with two or more heads, one of which is the user's support material.

- At this point, the user should now be able to make the models with the heads installed. They will need to be setup properly in the Slic3r recipes to produce the desired results.

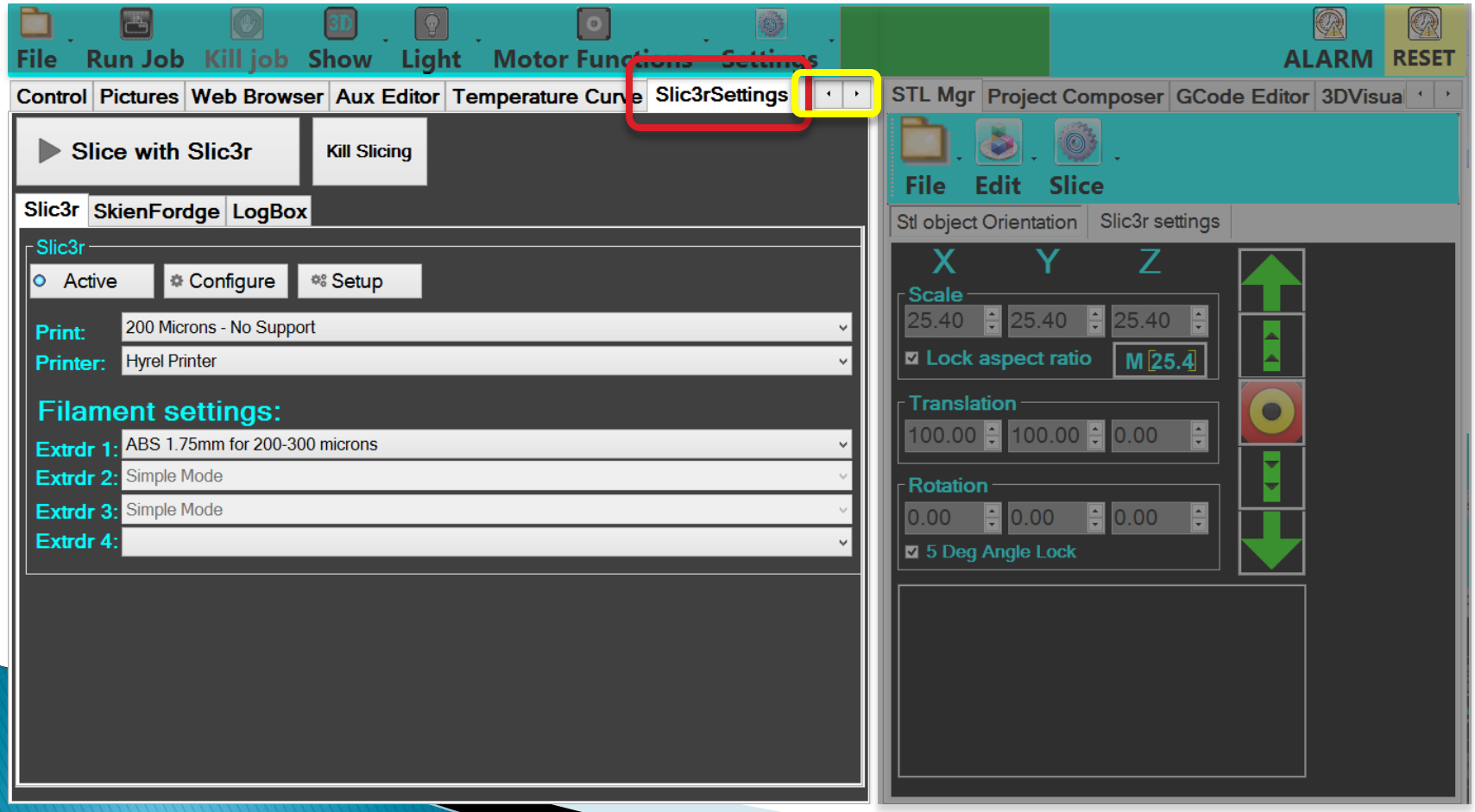
Support Print – 1-By-1

- At this point, the user should now be able to make the models with the heads installed. They will need to be called out in the Slic3r recipes in order to work properly.

- Remove all prints from the build surface.
- Check Tram
- Load your *.stl file
- Orient, Rotate, Scale
- Setup Slic3r recipes
- Slice
- Print

Support Print

Printing Support with a Different Head
Slic3r Recipe Setup: Select “Slic3rSettings” tab (Use arrow keys to navigate)

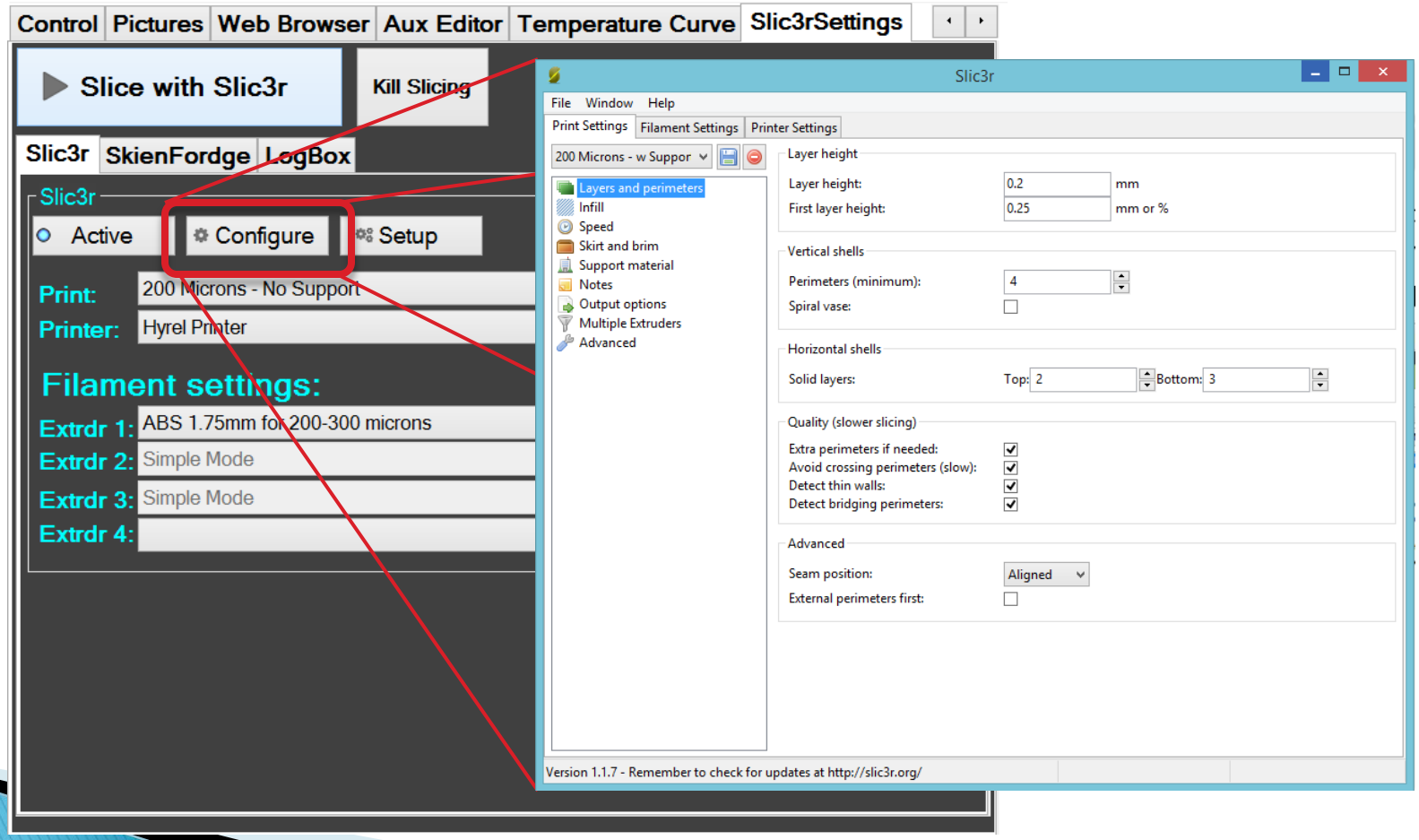


Support Print

Printing Support with a Different Head

Slic3r Recipe Setup: Click on the “Configure” button

<In 5-6 seconds> The Slic3r Configuration Pop-up window will load



Support Print

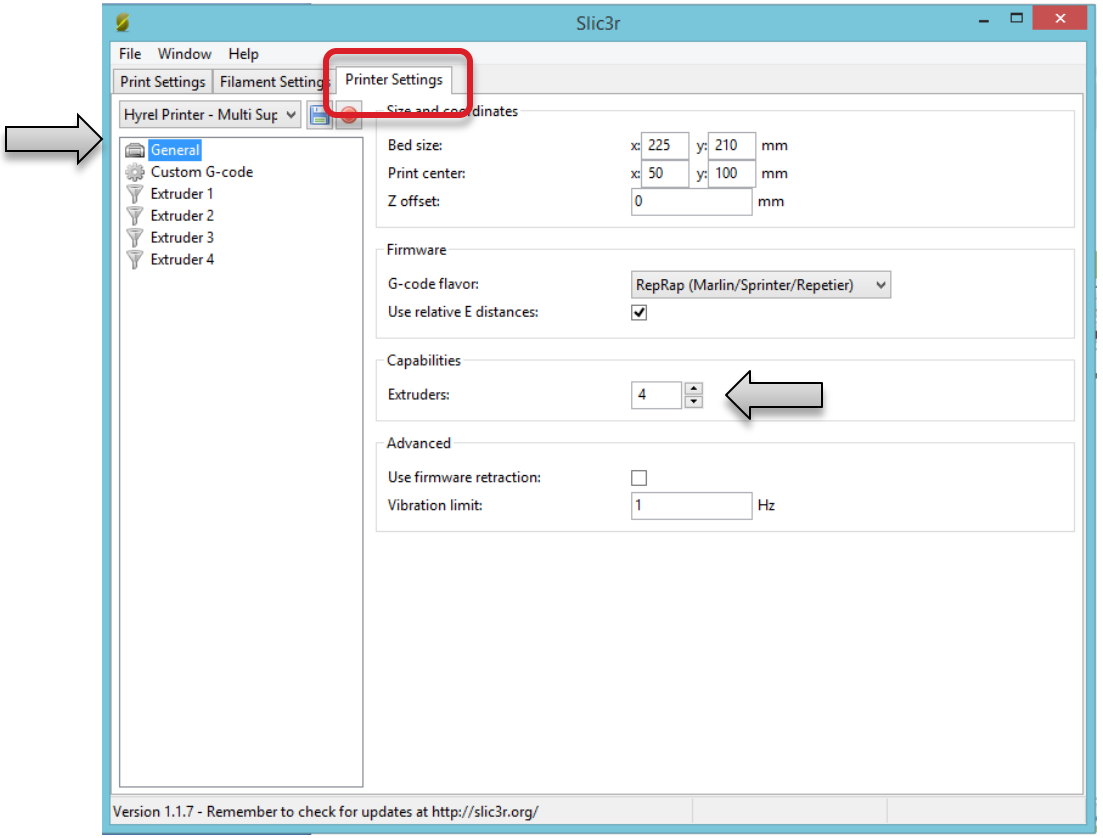
Printing Support with a Different Head
Slic3r Recipe Setup:

Select “Printer Settings” tab:

Select “General”

‘Capabilities’ Section
➔ “Extruders” = 4

Four extruders will appear in the sub-menu



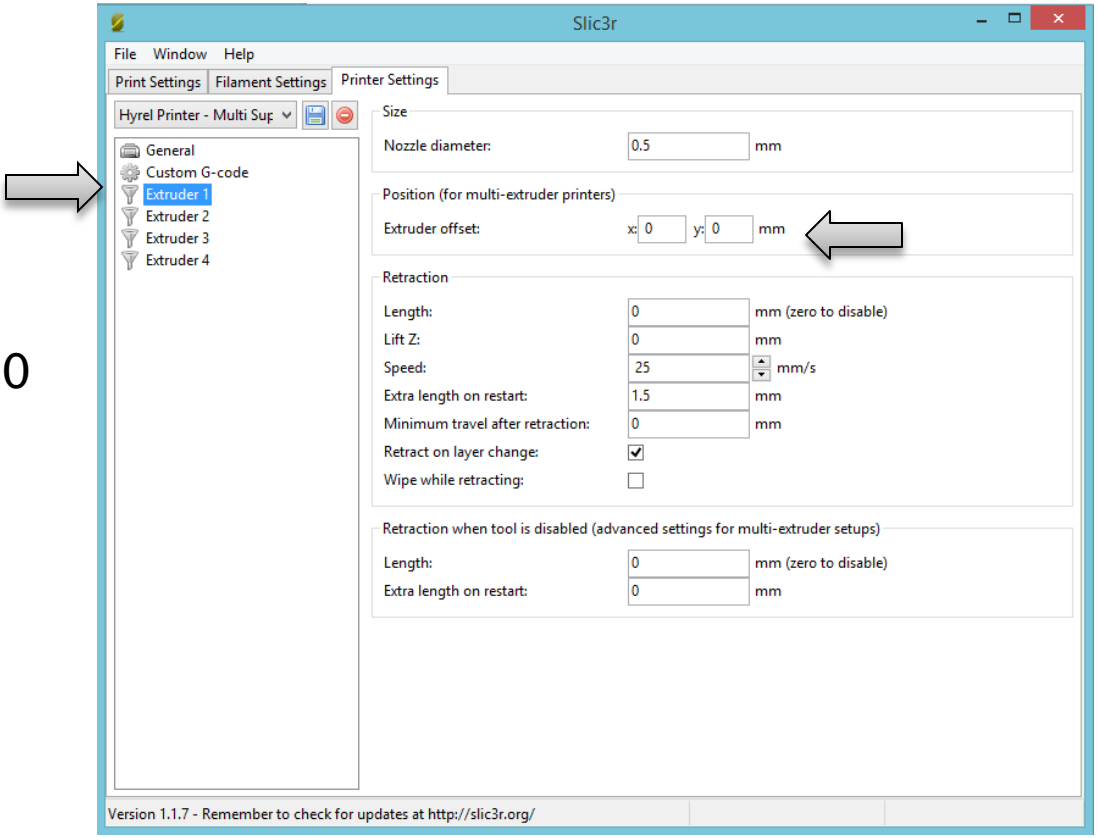
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Select “Extruder 1”

‘Position’ Section
➔ “Extruder offset” = x 0, y 0



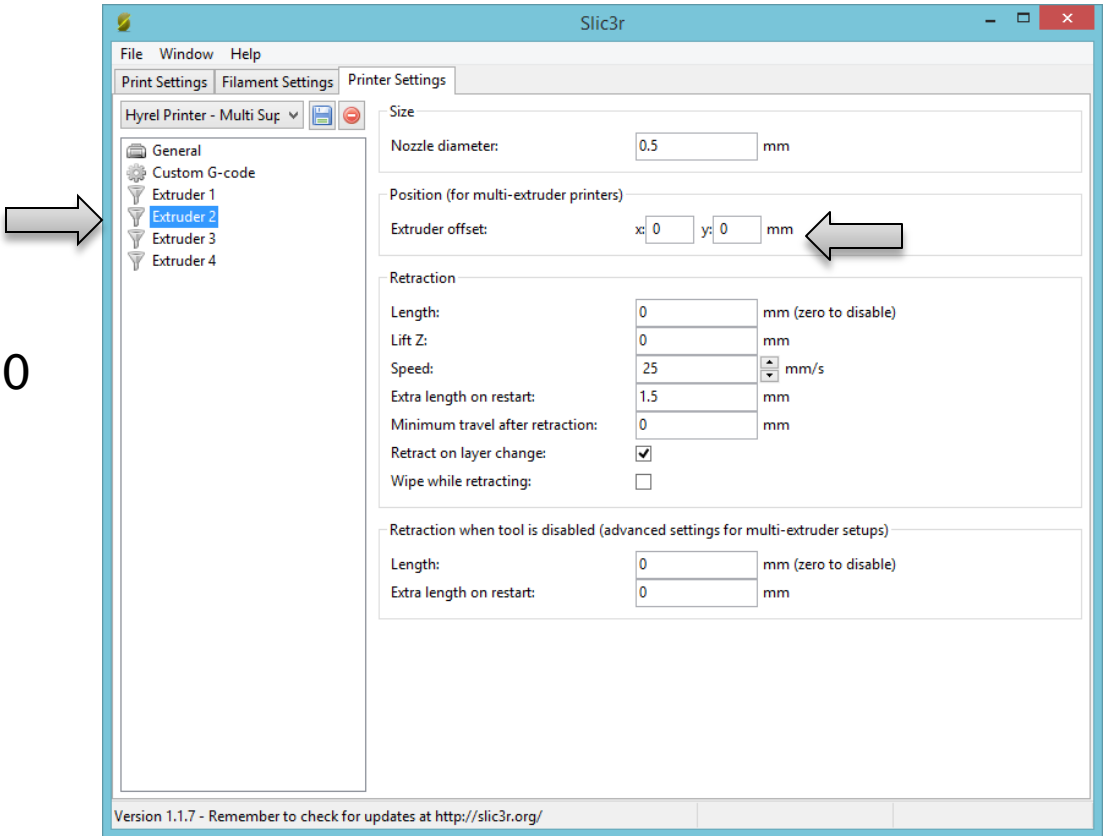
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Select “Extruder 2”

‘Position’ Section
➔ “Extruder offset” = x 0, y 0



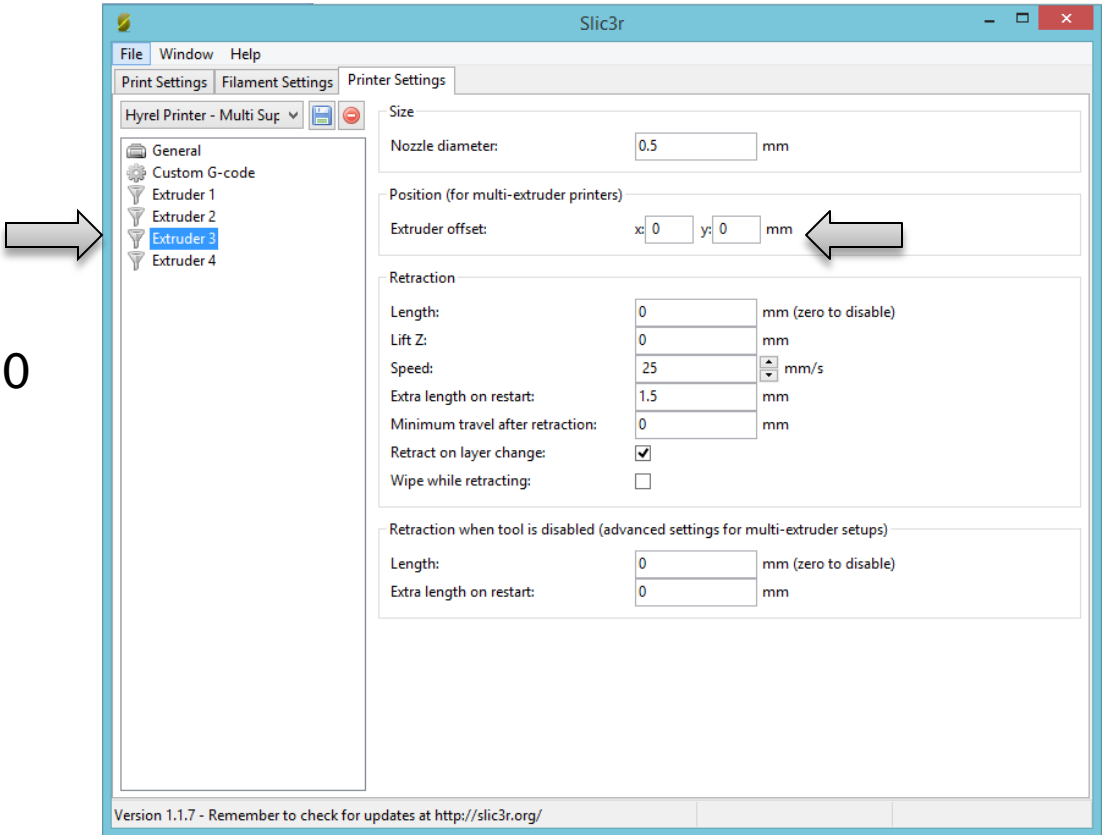
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Select “Extruder 3”

‘Position’ Section
➔ “Extruder offset” = x 0, y 0



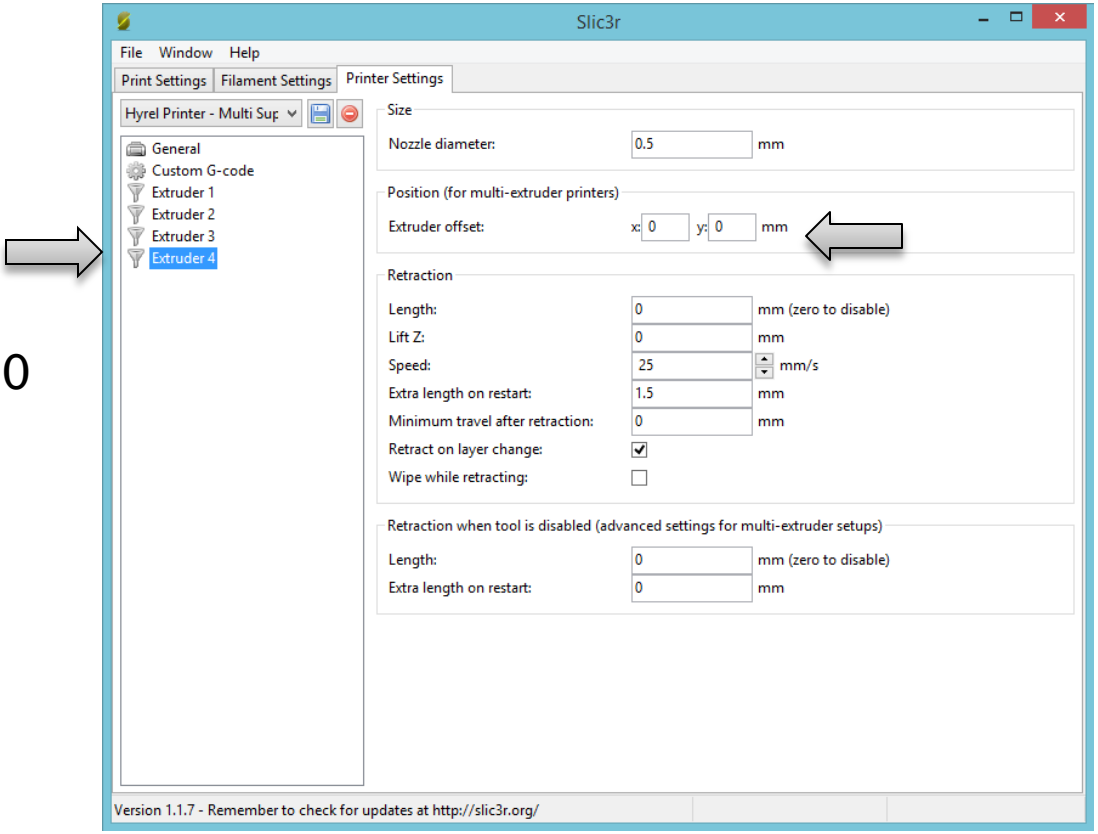
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Select “Extruder 4”

‘Position’ Section
➔ “Extruder offset” = x 0, y 0



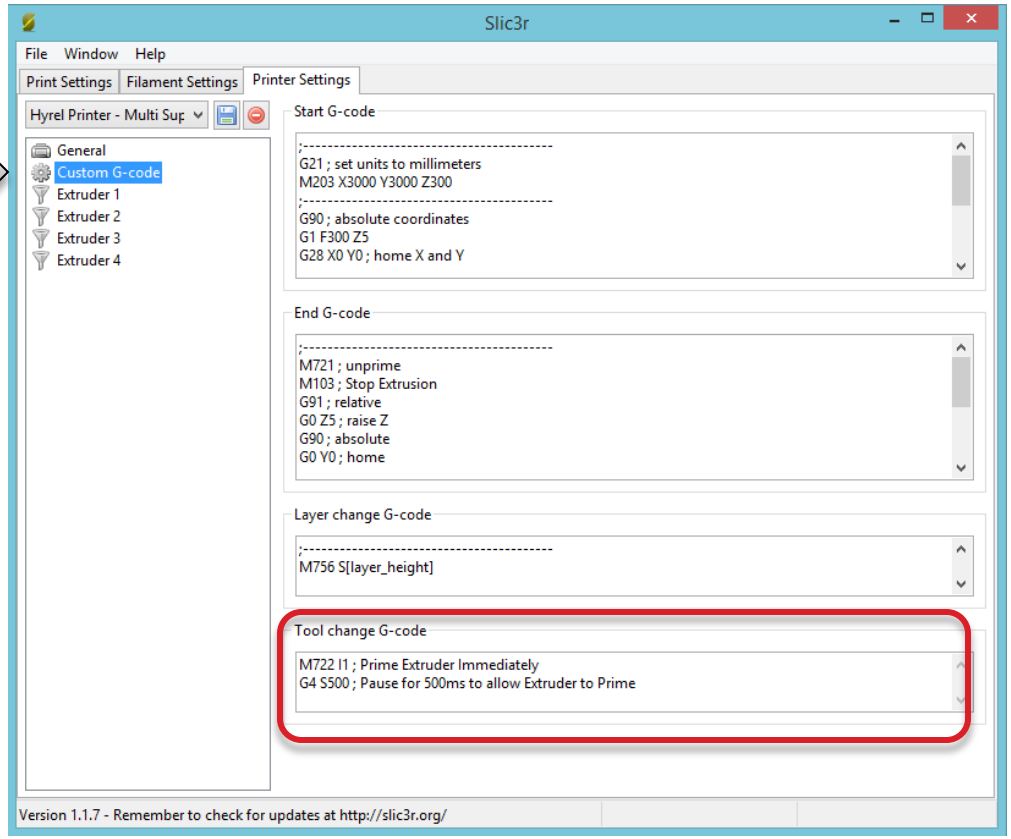
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Select “Custom G-code”

‘Tool change G-code’ Section
→Add the following G-Code:
M722 I1 ; Prime Extruder
G4 S500 ; Pause for Prime



Support Print

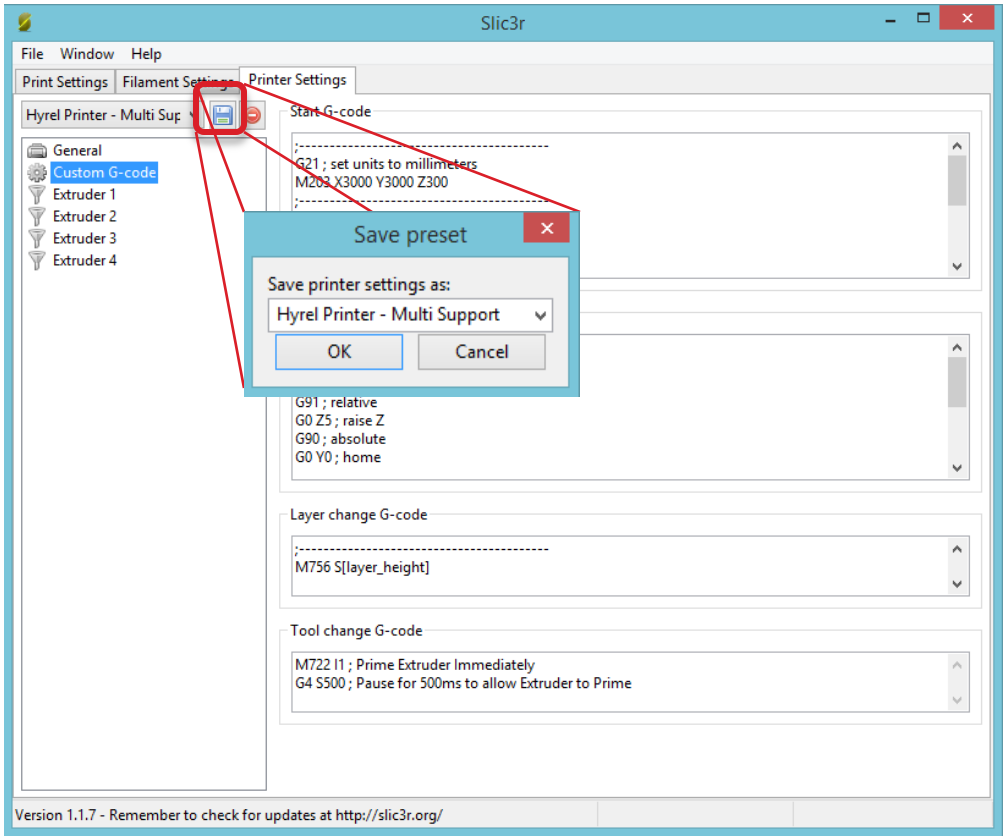
Printing Support with a Different Head
Slic3r Recipe Setup:

“Printer Settings” tab:

Click the Save button

In the pop-up window,
name your Slic3r preset / recipe

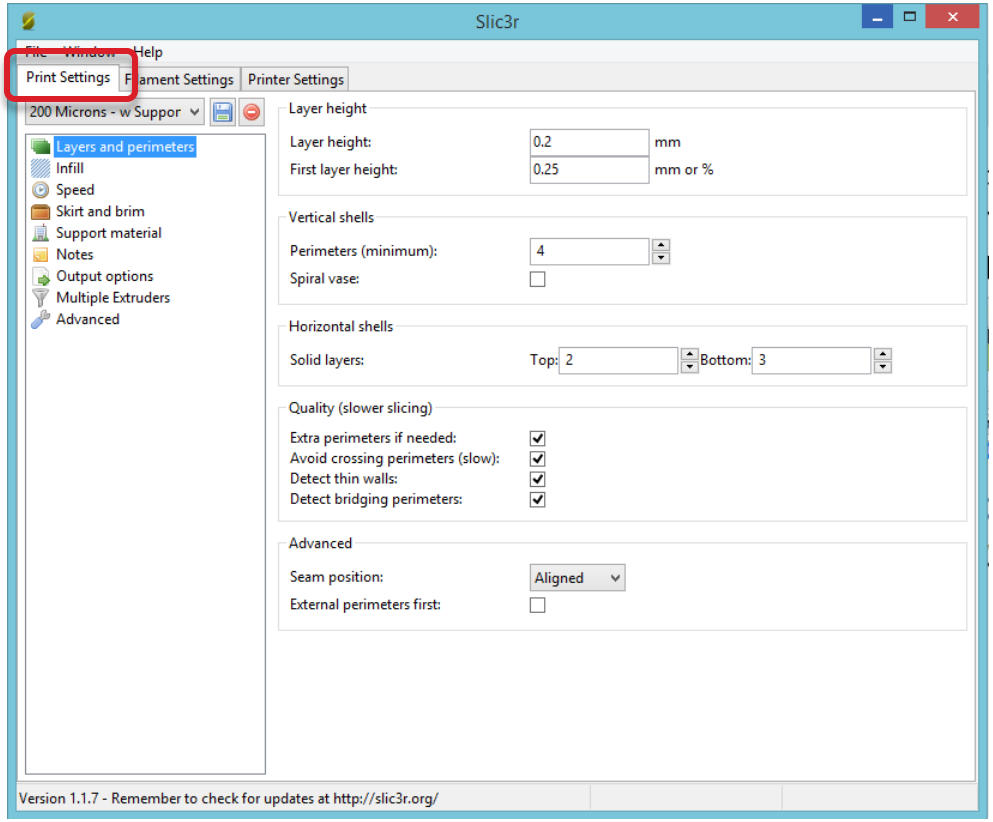
Click OK



Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

Select the “Print Settings” tab:

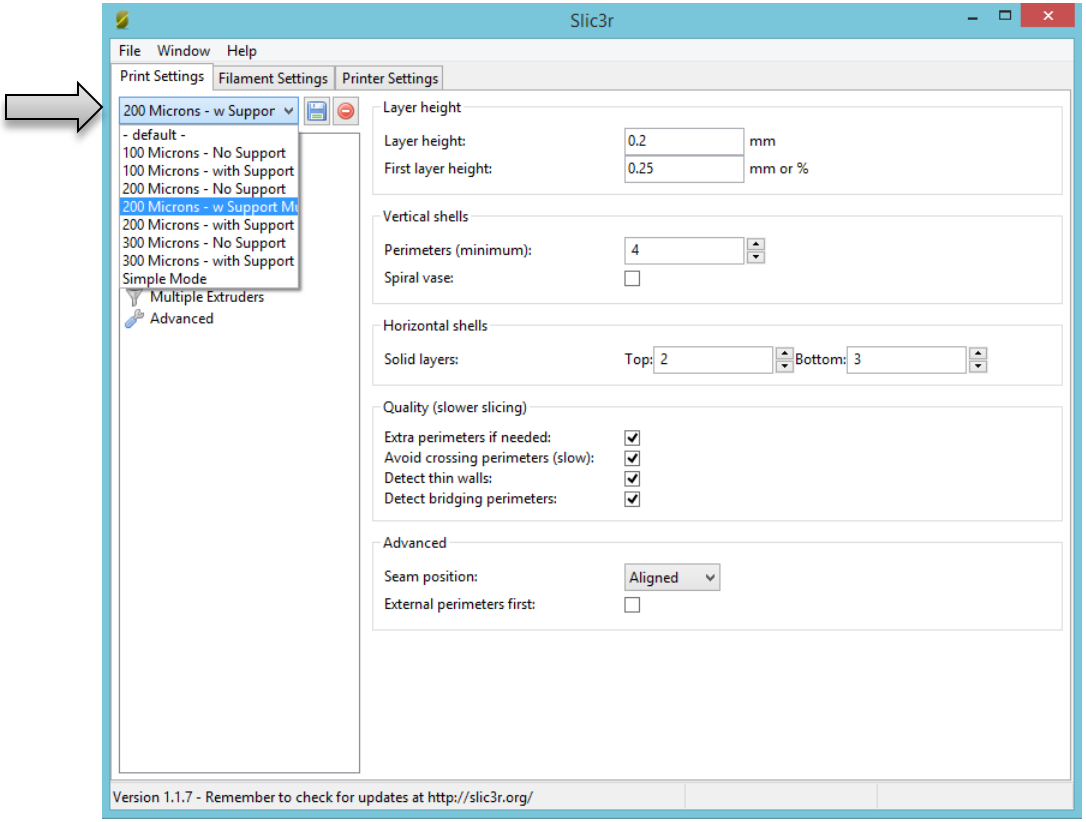


Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Print Settings” tab:

Select which Pre-setup Recipe to start with



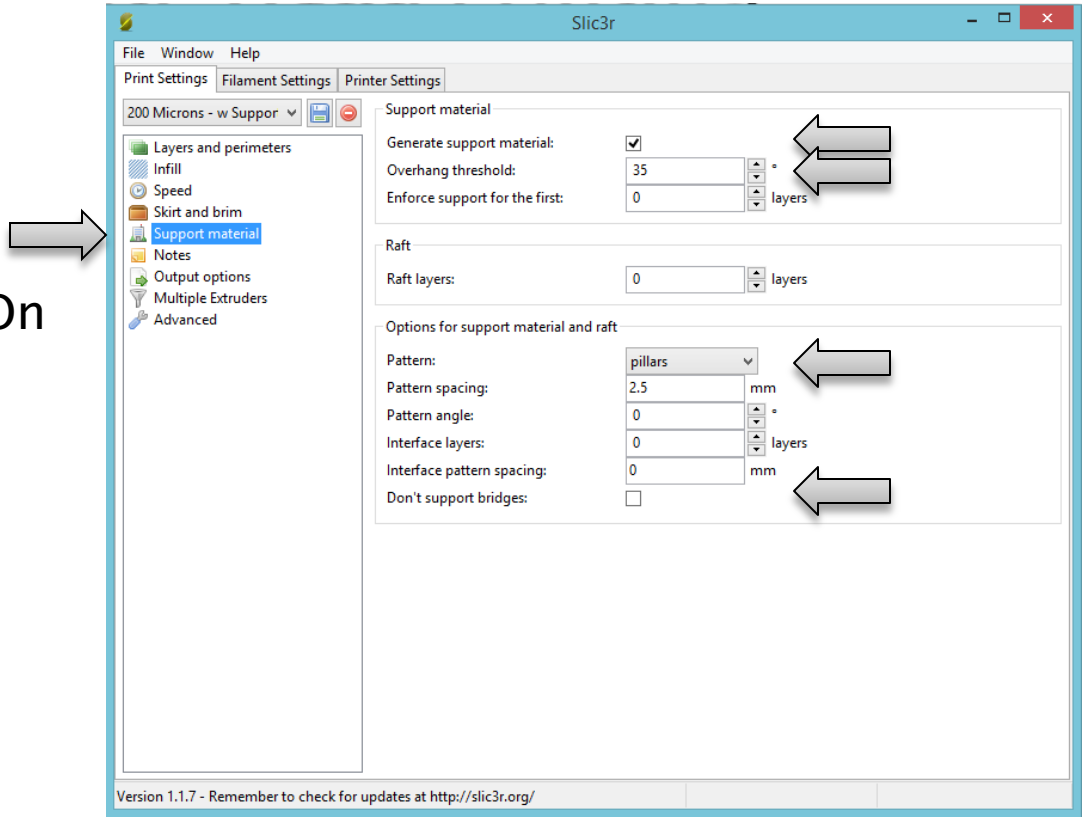
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Print Settings” tab:

Select “Support material”

“Generate support material” – On
“Overhang threshold” – >35
“Pattern” – ‘pillars’
“Don’t support bridges – Off



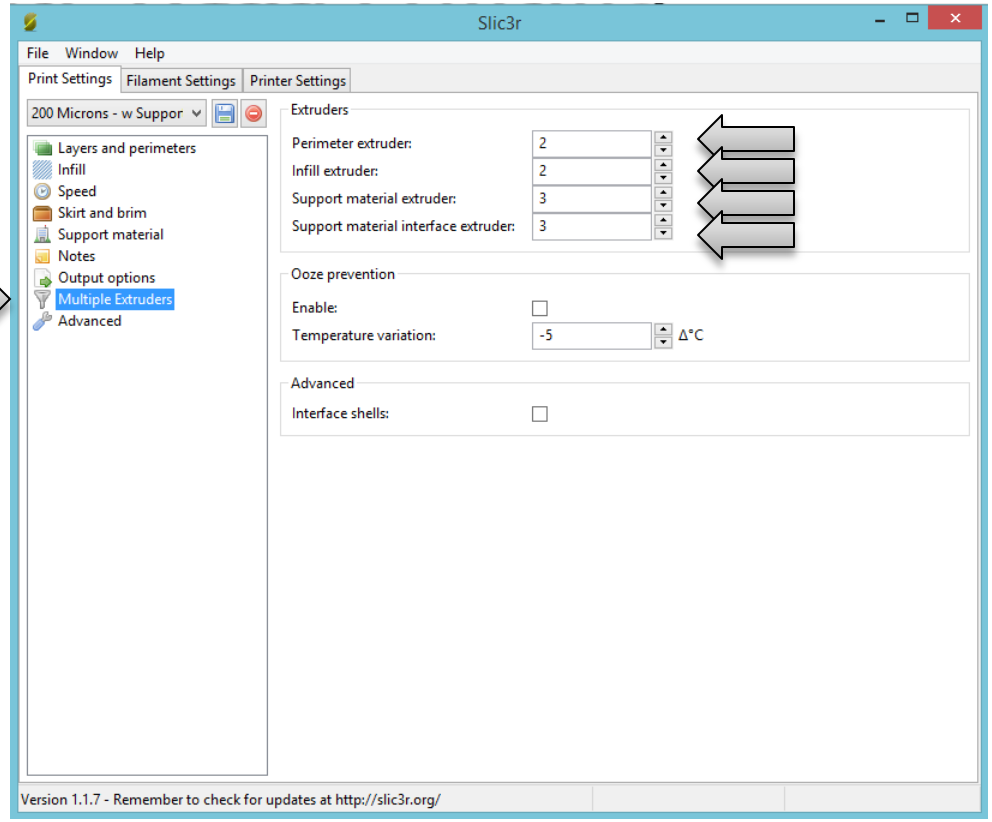
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup:

“Print Settings” tab:

Select “Multiple Extruders”

“Perimeter extruder” – 2
“Infill extruder” – 2
“Support material extruder” – 3
“Support material
interface extruder” – >3



Support Print

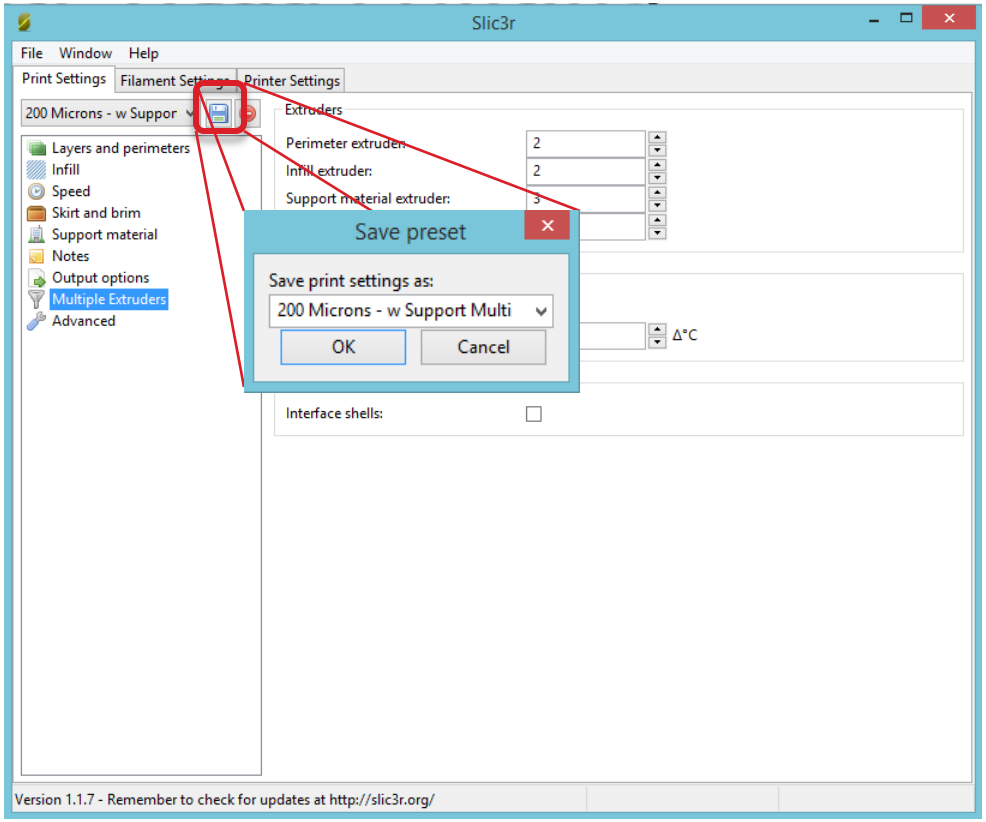
Printing Support with a Different Head
Slic3r Recipe Setup:

“Print Settings” tab:

Click the Save button

In the pop-up window,
name your Slic3r preset / recipe

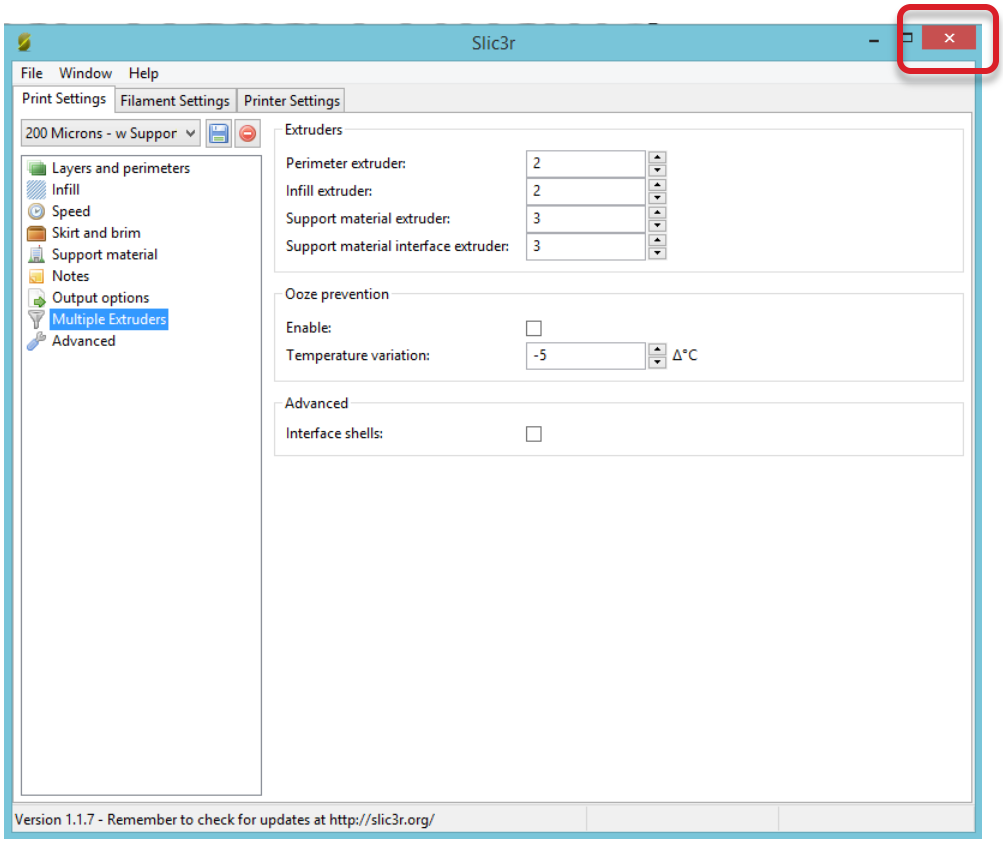
Click OK



Support Print

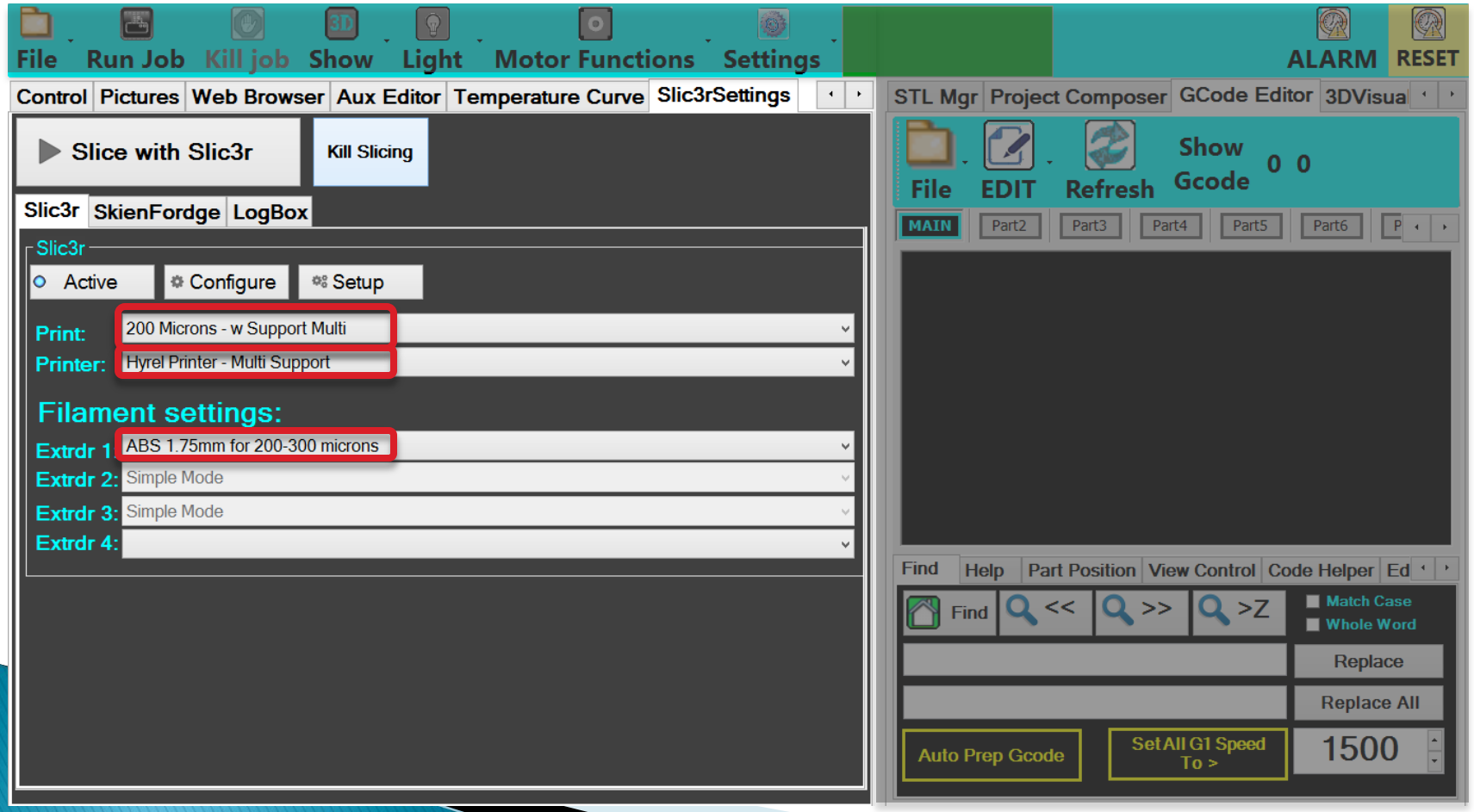
Printing Support with a Different Head
Slic3r Recipe Setup:

Close the Slic3r Configuration



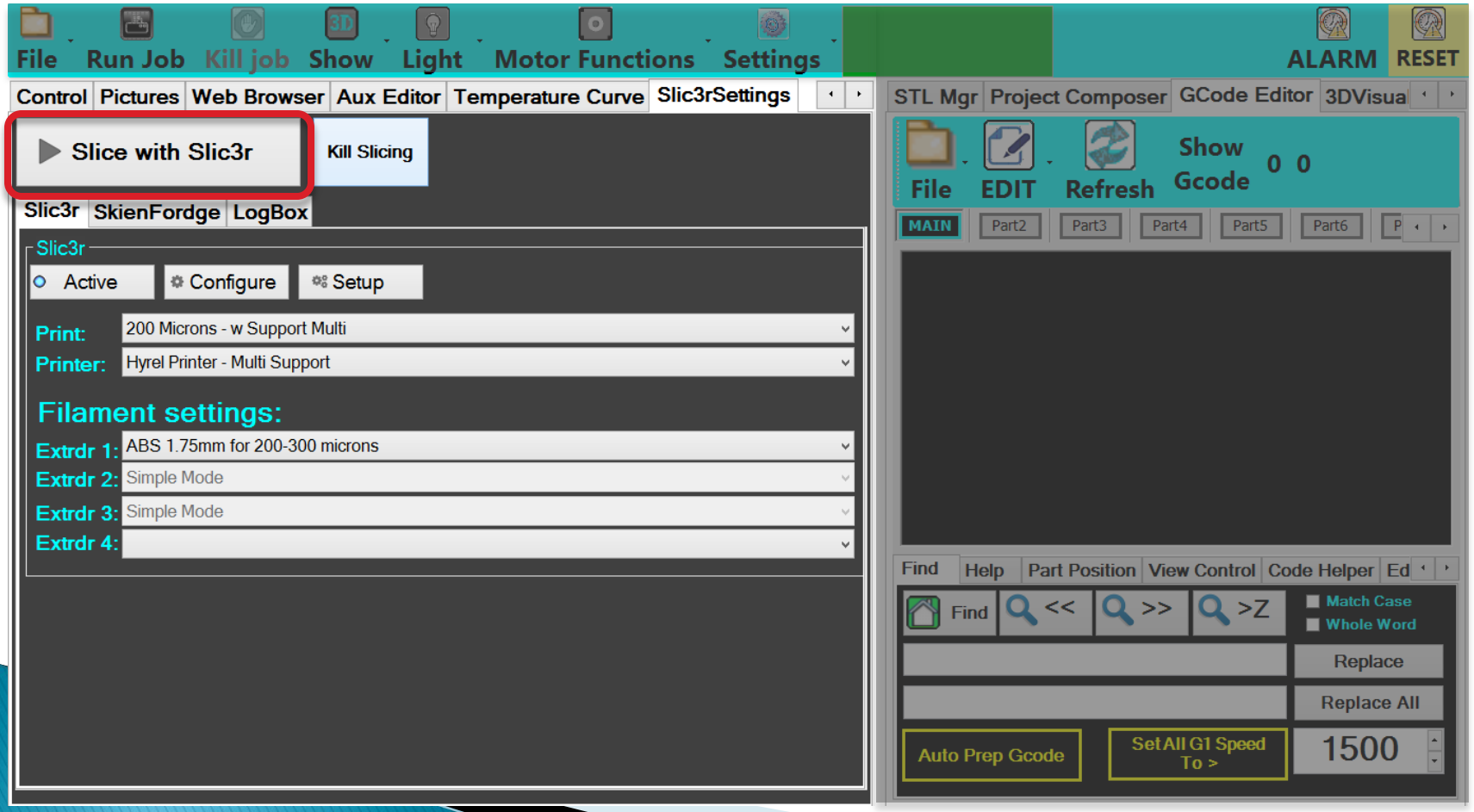
Support Print

Printing Support with a Different Head
Slic3r Recipe Setup: Select your Print, Printer, and Extrdr Recipes



Support Print

Printing Support with a Different Head
Click the “Slice with Slic3r” button to generate G-Code



Support Print

- At this point, the user should now be able to make the models with the heads installed. They will need to be called out in the Slic3r recipes in order to work properly.

- ~~Remove all prints from the build surface.~~
- ~~Turn on the Heat~~
- ~~Check Tram~~
- ~~Load your *.stl file~~
- ~~Orient, Rotate, Scale~~
- ~~Setup Slic3r recipes~~
- ~~Slice~~
- Print

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