

# D3D Pro 3D Printer Assembly Instructions

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# 1. Assemble 12.7mm x 450mm Rebar Stake

## 1.1. Tools

| Name             | Description        | Notes   |
|------------------|--------------------|---|
| Circular Saw     | Circular Saw       |   |
| Cutoff Wheel     | Metal Cutoff Wheel | Make sure that the cutoff wheel that you purchase is compatible with your cutting tool! |
| Vise             | Metal Jaw Vise     |   |
| Measuring Tape   | Measuring Tape     |   |
| Permanent Marker | Permanent Marker   |   |

## 1.2. Materials

| Quantity | ID                       | Name                     | Description                            | Notes |
|----------|--------------------------|--------------------------|--|-------|
| 1 part   | rebar-stake-stock-length | Rebar Stake Stock Length | 12.7mm Rebar Stake Stock Length v1.0.0 |       |

## 1.3. Precautions

- **Circular Saw:** A Circular Saw can cause permanent injury or death! Follow all manufacturer recommended safety precautions!

## 1.4. Procedure

### 1.4.1. Cut 12.7mm x 450mm Rebar Stake to Length

#### Instructions

1. While following the **Circular Saw** manufacturer's instructions, install the **Cutoff Wheel** into the **Circular Saw**.
2. Affix the **Rebar Stake Stock Length** into the **Vise**, leaving enough **Rebar Stake Stock Length** sticking out to make the cut.
3. Mark the 250mm length on the **Rebar Stake Stock Length** using the **Measuring Tape** and **Permanent Marker**. Make sure that there is enough space marked for the width of the **Cutoff Wheel**!
4. Using the **Circular Saw**, make the cut on the **Rebar Stake Stock Length** where previously marked.

5. Repeat the above steps for all of the needed lengths of **12.7mm x 450mm Rebar Stake**.

## 2. Assemble Universal Frame Top

### 2.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 5mm Allen Wrench | 5mm Allen Wrench |       |
| Hobby Knife      | Hobby Knife      |       |

### 2.2. Materials

| Quantity   | ID                     | Name                      | Description   | Notes |
|------------|------------------------|---------------------------|---|-------|
| 4 part(s)  | rebar-stake            | Rebar Stake               | 12.7mm x 450mm<br>Rebar Stake v1.0.0                |       |
| 12 part(s) | m6-20mm-screw          | M6 x 20mm Screw           | M6 x 20mm Socket<br>Head Cap Screw<br>v1.0.0        |       |
| 12 part(s) | m6-thin-nut            | M6 Thin Nut               | M6 Thin Nut v1.0.0                                  |       |
| 2 part(s)  | corner-connector-left  | Left Corner<br>Connector  | Universal Frame<br>Corner Connector<br>Left v1.0.0  |       |
| 2 part(s)  | corner-connector-right | Right Corner<br>Connector | Universal Frame<br>Corner Connector<br>Right v1.0.0 |       |

### 2.3. Procedure

#### 2.3.1. Clean 3D Printed Parts

##### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the **Left Corner Connector** part(s) and **Right Corner Connector** part(s).

#### 2.3.2. Prepare Left Corner Connector part(s) and Right Corner Connector part(s) for Rebar Stake part(s)

##### Instructions

1. Insert an **M6 Thin Nut** into the slot of the **Left Corner Connector** so that the hole of the **M6 Thin Nut** aligns with the hole in the **Left Corner Connector**.
2. While holding the **M6 Thin Nut** in place with a finger, insert an **M6 x 20mm Screw** into the hole of the **Left Corner Connector**.
3. Using the **5mm Allen Wrench**, screw in the **M6 x 20mm Screw** enough to hold the **M6 x 20mm Screw** and **M6 Thin Nut** in place. Leave room for the **Rebar Stake** to be inserted later.

4. Repeat the above steps for each of the three slots on the **Left Corner Connector**.
5. Repeat each of the above steps for the **Left Corner Connector** part(s), and **Right Corner Connector** part(s).

### 2.3.3. Assemble Universal Frame Top

#### Instructions

1. Insert one **Rebar Stake** into a slot on a **Left Corner Connector**.
2. Press the **Rebar Stake** down hard into the slot so that the part(s) are flush with the bottom of the slot. This step is important to ensure squareness in the frame.
3. Using the **5mm Allen Wrench**, screw down the **M6 x 20mm Screw** in against the **Rebar Stake** until it is tight. If the plastic of the **Left Corner Connector** begins to strain or crack, unscrew the **M6 x 20mm Screw** slightly to reduce the pressure.
4. Insert the other end of the **Rebar Stake** into a **Right Corner Connector** and repeat the above steps to press and tighten down the **Right Corner Connector**.
5. Repeat the above steps so that there are two completed **Rebar Stake** part(s) with **Left Corner Connector** part(s) and **Right Corner Connector** part(s) on the ends.
6. Insert two **Rebar Stake** part(s) into the completed **Rebar Stake** part(s) from the previous step so that a square is formed.
7. Press the square together hard to seat the **Left Corner Connector** part(s) and **Right Corner Connector** part(s) onto the **Rebar Stake** part(s).
8. Tighten the four loose **M6 x 20mm Screw** part(s) down onto the **Rebar Stake** part(s) to complete the **Universal Frame Top**. As above, if the plastic of the **Left Corner Connector** part(s) or **Right Corner Connector** part(s) begins to strain or crack, unscrew the **M6 x 20mm Screw** slightly to reduce the pressure.

## 3. Assemble Universal Frame Base

### 3.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 5mm Allen Wrench | 5mm Allen Wrench |       |
| Hobby Knife      | Hobby Knife      |       |

### 3.2. Materials

| Quantity   | ID               | Name             | Description                                   | Notes |
|------------|------------------|------------------|---|-------|
| 4 part(s)  | rebar-stake      | Rebar Stake      | 12.7mm x 450mm<br>Rebar Stake v1.0.0          |       |
| 12 part(s) | m6-20mm-screw    | M6 x 20mm Screw  | M6 x 20mm Socket<br>Head Cap Screw<br>v1.0.0  |       |
| 12 part(s) | m6-thin-nut      | M6 Thin Nut      | M6 Thin Nut v1.0.0                            |       |
| 4 part(s)  | corner-connector | Corner Connector | Universal Frame<br>Corner Connector<br>v1.0.0 |       |

## 3.3. Procedure

### 3.3.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the **Corner Connector** part(s).

### 3.3.2. Prepare Corner Connector part(s) for Rebar Stake part(s)

#### Instructions

1. Insert an **M6 Thin Nut** into the slot of the **Corner Connector** so that the hole of the **M6 Thin Nut** aligns with the hole in the **Corner Connector**.
2. While holding the **M6 Thin Nut** in place with a finger, insert an **M6 x 20mm Screw** into the hole of the **Corner Connector**.
3. Using the **5mm Allen Wrench**, screw in the **M6 x 20mm Screw** enough to hold the **M6 x 20mm Screw** and **M6 Thin Nut** in place. Leave room for the **Rebar Stake** to be inserted later.
4. Repeat the above steps for each of the three slots on the **Corner Connector**.
5. Repeat each of the above steps for the **Corner Connector** part(s).

### 3.3.3. Assemble Universal Frame Base

#### Instructions

1. Insert one **Rebar Stake** into a slot on the **Corner Connector**.
2. Press the **Rebar Stake** down hard into the slot so that the part(s) are flush with the bottom of the slot. This step is important to ensure squareness in the frame.
3. Using the **5mm Allen Wrench**, screw down the **M6 x 20mm Screw** in against the **Rebar Stake** until it is tight. If the plastic of the **Corner Connector** begins to strain or crack, unscrew the **M6 x 20mm Screw** slightly to reduce the pressure.
4. Insert the other end of the **Rebar Stake** into another **Corner Connector** and repeat the above steps to press and tighten down the **Corner Connector**.
5. Repeat the above steps so that there are two completed **Rebar Stake** part(s) with **Corner Connector** part(s) on the ends.
6. Insert two **Rebar Stake** part(s) into the completed **Rebar Stake** part(s) from the previous step so that a square is formed.
7. Press the square together hard to seat the **Corner Connector** part(s) onto the **Rebar Stake** part(s).
8. Tighten the four loose **M6 x 20mm Screw** part(s) down onto the **Rebar Stake** part(s) to complete the **Universal Frame Base Base**. As above, if the plastic of the **Corner Connector** part(s) begins to strain or crack, unscrew the **M6 x 20mm Screw** slightly to reduce the pressure.

## 4. Assemble Universal Frame Module

### 4.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 5mm Allen Wrench | 5mm Allen Wrench |       |

## 4.2. Materials

| Quantity  | ID                   | Name                 | Description                          | Notes |
|-----------|----------------------|----------------------|--------------------------------------|-------|
| 4 part(s) | rebar-stake          | Rebar Stake          | 12.7mm x 450mm<br>Rebar Stake v1.0.0 |       |
| 1 module  | universal-frame-base | Universal Frame Base | Universal Frame Base v1.0.0          |       |
| 1 module  | universal-frame-top  | Universal Frame Top  | Universal Frame Top v1.0.0           |       |

## 4.3. Procedure

### 4.3.1. Assemble Universal Frame Module

#### Instructions

1. Orient the **Universal Frame Top** so that the open slots point upward.
2. Insert the four **Rebar Stake** part(s) into the slots of the **Universal Frame Top**.
3. Firmly press each **Rebar Stake** part(s) into the **Universal Frame Top** so that they are flush with the bottom of the slots in the **Universal Frame Top**.
4. Tighten down all of the remaining fasteners on the **Universal Frame Top** to secure the **Rebar Stake** part(s) in place. If the plastic of the **Universal Frame Top** begins to strain or crack, unscrew the fastener slightly to reduce the pressure.
5. Orient the **Universal Frame Base** so that the open slots point upward.
6. Insert the four **Rebar Stake** part(s) that are connected to the **Universal Frame Top** into the slots of the **Universal Frame Base**.
7. Firmly press the **Universal Frame Top** down onto the **Universal Frame Base** so that the **Rebar Stake** part(s) are properly seated.
8. Tighten down all of the remaining fasteners on the **Universal Frame Base** to secure the **Rebar Stake** part(s) in place. If the plastic of the **Universal Frame Base** begins to strain or crack, unscrew the fastener slightly to reduce the pressure.
9. The **Universal Frame Module** is complete.

## 5. Assemble Fast Heated Bed Top Plate

### 5.1. Tools

| Name             | Description               | Notes |
|------------------|---------------------------|-------|
| Plate Jig        | Fast Heated Bed Plate Jig |       |
| Permanent Marker | Permanent Marker          |       |
| Vise Grip Pliers | Vise Grip Pliers          |       |
| Welder           | Welder                    |       |
| Welding Brush    | Wire Welding Brush        |       |

## 5.2. Materials

| Quantity  | ID            | Name            | Description                               | Notes |
|-----------|---------------|-----------------|---|-------|
| 1 part    | steel-sheet   | Steel Sheet     | 16 Gauge 300mm x 300mm Steel Sheet v1.0.0 |       |
| 4 part(s) | m6-25mm-screw | M6 x 25mm Screw | M6 x 25mm Socket Head Cap Screw v1.0.0    |       |

## 5.3. Precautions

- **Welder:** DO NOT ATTEMPT TO WELD WITHOUT PROPER PERSONAL PROTECTIVE EQUIPMENT AND PROPER TRAINING. If necessary, have this part fabricated by someone who can safely perform the work.
- **Welder:** Welding is an operation that can be harmful or FATAL if done improperly. Follow all instructions and precautions included with the Welder and use common sense!

## 5.4. Procedure

### 5.4.1. Prepare the Steel Sheet for Welding

#### Instructions

1. Use the **Welding Brush** on the **Steel Sheet** to scrape off any surface impurities near the corners where the welds will occur.
2. Align the **Plate Jig** to one of the corners of the **Steel Sheet**.
3. In each of the holes on the **Plate Jig**, mark a circle the size of the hole using the **Permanent Marker**.

### 5.4.2. Weld the M6 x 25mm Screw part(s) to the Steel Sheet

#### Instructions

1. Using **Vise Grip Pliers**, secure a **M6 x 25mm Screw** over one of the **Plate Jig** circles drawn previously.
2. While wearing proper safety equipment, spot weld the **M6 x 25mm Screw** to the **Steel Sheet** using the **Welder**.
3. Repeat the above steps for the remaining **Plate Jig** marks until there are a total of four **M6 x 25mm Screw** part(s) in the locations indicated by the **Plate Jig**.
4. Clean off the welding marks on both sides of the **Steel Sheet** using the **Welding Brush**.

## 6. Assemble Carbon Fiber Blanket Sleeve

### 6.1. Tools

| Name           | Description    | Notes   |
|----------------|----------------|---|
| Sewing Machine | Sewing Machine | Optionally, use a needle and thread to hand sew components. |
| Scissors       | Scissors       |   |

## 6.2. Materials

| Quantity  | ID                         | Name                 | Description                              | Notes |
|-----------|----------------------------|----------------------|--|-------|
| 1 part(s) | carbon-fiber-blanket-stock | Carbon Fiber Blanket | Carbon Fiber Blanket (Stock Size) v1.0.0 |       |
| 1 part(s) | sewing-thread              | Sewing Thread        | Sewing Thread v1.0.0                     |       |

## 6.3. Procedure

### 6.3.1. Assemble Carbon Fiber Blanket Sleeve Parts

#### Instructions

1. Using the **Scissors**, cut four rectangles of **Carbon Fiber Blanket** to size (80mm x 300mm).
2. Set up the **Sewing Machine** and **Sewing Thread** by following the manufacturer's instructions for the **Sewing Machine**.
3. Overlap/fold one rectangle of **Carbon Fiber Blanket** so that it forms a 40mm x 300mm rectangle.
4. Using the **Sewing Machine**, sew the 300mm long edges of the rectangle together. It should form a 300mm long sleeve.
5. Repeat the previous two steps for all of the remaining **Carbon Fiber Blanket** rectangles.
6. Take one of the **Carbon Fiber Blanket Sleeve** parts and use **Scissors** to cut "X" shapes near the ends of the sleeve. The center of the "X" cuts should be approx. 20mm from each edge.
7. Repeat the above step for all of the remaining **Carbon Fiber Blanket Sleeve** parts.
8. The **Carbon Fiber Blanket Sleeve** parts are complete.

## 7. Assemble Fast Heated Bed Halogen Lightbulb Assembly

### 7.1. Tools

| Name           | Description               | Notes |
|----------------|---------------------------|-------|
| Soldering Iron | Soldering Iron            |       |
| Helping Hands  | Helping Hands Clamp Stand |       |
| Paper Towels   | Paper Towels              |       |

## 7.2. Materials

| Quantity  | ID                       | Name                     | Description                               | Notes |
|-----------|--------------------------|--------------------------|---|-------|
| 3 part(s) | halogen-lightbulb        | Halogen Lightbulb        | R7S 118mm Halogen Lightbulb v1.0.0        |       |
| 3 part(s) | halogen-lightbulb-holder | Halogen Lightbulb Holder | R7S 118mm Halogen Lightbulb Holder v1.0.0 |       |

| Quantity         | ID                | Name              | Description                                   | Notes |
|------------------|-------------------|-------------------|---|-------|
| 2 application(s) | electrical-solder | Electrical Solder | Rosin Core Lead Free Electrical Solder v1.0.0 |       |

## 7.3. Precautions

- **Fast Heated Bed Halogen Lightbulb Assembly:** Make sure to not touch the Halogen Lightbulb in the assembly with bare hands or they will be damaged!
- **Soldering Iron:** A Soldering Iron gets very very hot and can burn you! Follow all of the manufacturer recommended safety precautions when using a Soldering Iron!
- **Halogen Lightbulb:** If oils or other debris do get on the R7S 118mm Halogen Lightbulb it can be cleaned with rubbing alcohol and a clean paper towel.
- **Halogen Lightbulb:** R7S 118mm Halogen Lightbulb requires special handling. The oils on human skin can shorten the lifetime of a R7S 118mm Halogen Lightbulb if they get on the glass of the bulb. Always use something other than your hands to handle a R7S 118mm Halogen Lightbulb.
- **Electrical Solder:** Rosin Core Lead Free Electrical Solder can contain toxic chemicals! Always work in a well ventiated area and use personal protection equipment!

## 7.4. Procedure

### 7.4.1. Assemble Fast Heated Bed Halogen Lightbulb Assembly

#### Instructions

1. Preheat the **Soldering Iron** to the operating temperature recommended by the **Electrical Solder** packaging.
2. Position the wires of two **Halogen Lightbulb Holder** part(s) in the **Helping Hands** so that the exposed ends of the wires are touching.
3. Hold the hot end of the **Soldering Iron** against the exposed wires in the **Helping Hands** for a few seconds to heat the wires.
4. Apply **Electrical Solder** to the contact point between the hot end of the **Soldering Iron** and the exposed wires until enough has been added to fuse the wires and make a good electrical connection.
5. Remove the hot end of the **Soldering Iron** from the wires.
6. Wait for the wires to cool and then remove them from the **Helping Hands**.
7. Take the other wire of one of the previously soldered **Halogen Lightbulb Holder** part(s) and position it in the **Helping Hands**.
8. Position one of the wires of the remaining **Halogen Lightbulb Holder** part(s) in the unused side of the **Helping Hands**.
9. Hold the hot end of the **Soldering Iron** against the exposed wires in the **Helping Hands** for a few seconds to heat the wires.
10. Apply **Electrical Solder** to the contact point between the hot end of the **Soldering Iron** and the exposed wires until enough has been added to fuse the wires and make a good electrical connection.
11. Remove the hot end of the **Soldering Iron** from the wires.
12. Wait for the wires to cool and then remove them from the **Helping Hands**.
13. Using **Paper Towels**, remove a **Halogen Lightbulb** part(s) from its packaging material and insert it into one of the **Halogen Lightbulb Holder** part(s). Be careful to not touch the **Halogen Lightbulb** with your hands (see precautions).
14. Repeat the above step for each of the other **Halogen Lightbulb Holder** part(s)\*.
15. The **Fast Heated Bed Halogen Lightbulb Assembly** is now complete.

# 8. Assemble 0.5 Inch Trade Size 250mm Long Metal Conduit

## 8.1. Tools

| Name             | Description        | Notes   |
|------------------|--------------------|---|
| Circular Saw     | Circular Saw       |   |
| Cutoff Wheel     | Metal Cutoff Wheel | Make sure that the cutoff wheel that you purchase is compatible with your cutting tool! |
| Vise             | Metal Jaw Vise     |   |
| Measuring Tape   | Measuring Tape     |   |
| Permanent Marker | Permanent Marker   |   |

## 8.2. Materials

| Quantity | ID                   | Name                       | Description   | Notes |
|----------|----------------------|----------------------------|---|-------|
| 1 part   | conduit-stock-length | Stock Length Metal Conduit | 0.5 Inch Trade Size Stock Length Metal Conduit v1.0.0 |       |

## 8.3. Precautions

- **Circular Saw:** A Circular Saw can cause permanent injury or death! Follow all manufacturer recommended safety precautions!

## 8.4. Procedure

### 8.4.1. Cut 0.5 Inch Trade Size 250mm Long Metal Conduit to Length

#### Instructions

1. While following the **Circular Saw** manufacturer's instructions, install the **Cutoff Wheel** into the **Circular Saw**.
2. Affix the **Stock Length Metal Conduit** into the **Vise**, leaving enough **Stock Length Metal Conduit** sticking out to make the cut.
3. Mark the 250mm length on the **Stock Length Metal Conduit** using the **Measuring Tape** and **Permanent Marker**. Make sure that there is enough space marked for the width of the cutting blade!
4. Using the **Circular Saw**, make the cut on the **Stock Length Metal Conduit** where previously marked.
5. Repeat the above steps for all of the needed lengths of **0.5 Inch Trade Size 250mm Long Metal Conduit**.

# 9. Assemble Fast Heated Bed Bottom Plate

## 9.1. Tools

| Name             | Description               | Notes |
|------------------|---------------------------|-------|
| Plate Jig        | Fast Heated Bed Plate Jig |       |
| Permanent Marker | Permanent Marker          |       |
| Drill Press      | Drill Press               |       |
| 7mm Drill Bit    | 7mm Sheet Metal Drill Bit |       |
| Metal File       | Metal File                |       |

## 9.2. Materials

| Quantity | ID          | Name        | Description                               | Notes |
|----------|-------------|-------------|---|-------|
| 1 part   | steel-sheet | Steel Sheet | 16 Gauge 300mm x 300mm Steel Sheet v1.0.0 |       |

## 9.3. Precautions

- **Drill Press:** Drill presses can cause permanent injury or possibly death! Do not wear loose fitting clothing, put your hair up, and wear proper PPE including (but not limited to) safety glasses when operating the machine.

## 9.4. Procedure

### 9.4.1. Drill the Fast Heated Bed Bottom Plate

#### Instructions

1. Align the **Plate Jig** to one of the corners of the **Steel Sheet**.
2. In each of the holes on the **Plate Jig**, mark a circle the size of the hole using the **Permanent Marker**.
3. Insert the **7mm Drill Bit** into the chuck of the **Drill Press** and secure it tightly per the manufacturer's instructions.
4. Turn on the drill press and drill holes through each of the marks made on the **Steel Sheet** in the earlier steps.
5. Using the **Metal File**, file down any metal burrs created by the **Drill Press** on the **Steel Sheet**.

## 10. Assemble Fast Heated Bed Module

### 10.1. Tools

| Name              | Description       | Notes |
|-------------------|-------------------|-------|
| Slip Joint Pliers | Slip Joint Pliers |       |
| 5mm Allen Wrench  | 5mm Allen Wrench  |       |

## 10.2. Materials

| Quantity  | ID                 | Name                         | Description   | Notes |
|-----------|--------------------|------------------------------|---|-------|
| 2 part(s) | 8mm-rod            | 8mm Rod                      | 8mm x 600mm Smooth Rod v1.0.0                       |       |
| 2 part(s) | autoparallel       | Autoparallel                 | Autoparallel Part v1.0.0                            |       |
| 1 part    | bottom-plate       | Fast Heated Bed Bottom Plate | Fast Heated Bed Bottom Plate v1.0.0                 |       |
| 2 part(s) | clamp              | Fast Heated Bed Clamp        | Fast Heated Bed Clamp v1.0.0                        |       |
| 4 part(s) | conduit            | Metal Conduit                | 0.5 Inch Trade Size 250mm Long Metal Conduit v1.0.0 |       |
| 2 part(s) | corner-brace       | Corner Brace                 | 2 inch x 5/8 Inch Corner Brace (Four Holes) v1.0.0  |       |
| 1 part    | lightbulb-assembly | Halogen Lightbulb Assembly   | Fast Heated Bed Halogen Lightbulb Assembly v1.0.0   |       |
| 4 part(s) | m6-20mm-screw      | M6 x 20mm Screw              | M6 x 20mm Socket Head Cap Screw v1.0.0              |       |
| 8 part(s) | m6-nut             | M6 Nut                       | M6 Nut v1.0.0                                       |       |
| 1 part    | pei-sheet          | PEI Sheet                    | 300mm x 300mm PEI Sheet v1.0.0                      |       |
| 4 part(s) | sleeve             | Carbon Fiber Blanket Sleeve  | Carbon Fiber Blanket Sleeve v1.0.0                  |       |
| 1 part    | thermistor         | Thermistor                   | NTC 100K ohm B3950 Thermistor Cartridge v1.0.0      |       |
| 1 part    | top-plate          | Fast Heated Bed Top Plate    | Fast Heated Bed Top Plate v1.0.0                    |       |

## 10.3. Precautions

- **Halogen Lightbulb Assembly:** Make sure to not touch the Halogen Lightbulb in the assembly with bare hands or they will be damaged!

## 10.4. Procedure

### 10.4.1. Assemble Fast Heated Bed Module

#### Instructions

# 11. Assemble Universal Axis Motor Side Module

## 11.1. Tools

| Name               | Description        | Notes |
|--------------------|--------------------|-------|
| 1.5mm Allen Wrench | 1.5mm Allen Wrench |       |
| 2.5mm Allen Wrench | 2.5mm Allen Wrench |       |
| 3mm Allen Wrench   | 3mm Allen Wrench   |       |
| Hobby Knife        | Hobby Knife        |       |

## 11.2. Materials

| Quantity  | ID                        | Name                      | Description                                    | Notes |
|-----------|---------------------------|---------------------------|--|-------|
| 1 part    | universal-axis-motor-side | Universal Axis Motor Side | Universal Axis Motor Side Part v1.0.0          |       |
| 6 part(s) | m6-10mm-grub-screw        | M6 x 10mm Grub Screw      | M6 x 10mm Grub Screw v1.0.0                    |       |
| 1 part    | stepper-motor             | Nema 17 Stepper Motor     | Nema 17 0.5Nm Stepper Motor v1.0.0             |       |
| 1 part    | pulley                    | GT2 20 Tooth Pulley       | GT2 6mm Wide x 5mm Bore 20 Tooth Pulley v1.0.0 |       |
| 3 part(s) | m3-25mm-screw             | M3 x 25mm Screw           | M3 x 25mm Socket Head Cap Screw v1.0.0         |       |
| 2 part(s) | m6-nut                    | M6 Nut                    | M6 Nut v1.0.0                                  |       |

## 11.3. Precautions

- **Universal Axis Motor Side:** The Universal Axis Motor Side Part is made of plastic and can be damaged if too much force is applied! Be careful when screwing in fasteners.

## 11.4. Procedure

### 11.4.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the **Universal Axis Motor Side** part.

### 11.4.2. Assemble the Universal Axis Motor Side Module

#### Instructions

1. Using the **1.5mm Allen Wrench**, loosen the screw on the **GT2 20 Tooth Pulley** and then slide the **GT2 20 Tooth Pulley** onto the shaft of the **Nema 17 Stepper Motor** with the thicker end of the **GT2 20 Tooth Pulley** going on first.
2. Gently tighten down the screw on the **GT2 20 Tooth Pulley** so it stays in place on the **Nema 17 Stepper Motor** shaft.
3. Insert the shaft of the **Nema 17 Stepper Motor** into the center hole of the **Universal Axis Motor Side** until the face of the **Nema 17 Stepper Motor** is flush with the face of the **Universal Axis Motor Side**.
4. Look through the slot on the side of the **Universal Axis Motor Side** to see if the teeth of the **GT2 20 Tooth Pulley** align with the slot. Repeat the above steps to make adjustments to the position of the **GT2 20 Tooth Pulley** until it is properly aligned with the slot.
5. Once the **GT2 20 Tooth Pulley** is aligned with the slot, remove the **Nema 17 Stepper Motor** from the **Universal Axis Motor Side**.
6. Firmly tighten down the screw on the **GT2 20 Tooth Pulley**.
7. Insert two **M6 Nut** part(s) into the nut catchers on the face of the **Universal Axis Motor Side**.
8. Insert the shaft of the **Nema 17 Stepper Motor** into the center hole of the **Universal Axis Motor Side** and over the top of the **M6 Nut** part(s).
9. Turn the **Nema 17 Stepper Motor** in the hole of the **Universal Axis Motor Side** until the mounting holes in the face of the **Nema 17 Stepper Motor** align with the holes in the **Universal Axis Motor Side**.
10. While holding the current **Universal Axis Motor Side Module** in one hand, turn the **Universal Axis Motor Side Module** over so that the other side of the **Universal Axis Motor Side** part is accessible.
11. Insert three **M3 x 25mm Screw** part(s) into the holes that are aligned with the mounting holes on the **Nema 17 Stepper Motor**.
12. Tighten down the **M3 x 25mm Screw** part(s) using a **2.5mm Allen Wrench**. The **M6 Nut** part(s) should now be secure between the **Nema 17 Stepper Motor** and **Universal Axis Motor Side**.
13. Flip the **Universal Axis Motor Side Module** back over so that the **Nema 17 Stepper Motor** is on top.
14. Gently screw six **M6 x 10mm Grub Screw** part(s) into the holes on the **Universal Axis Motor Side** that run along the sides of the **Nema 17 Stepper Motor**. Only screw the **M6 x 10mm Grub Screw** part(s) in enough to hold them in place as other parts will be inserted into the holes below in a future step.
15. The **Universal Axis Motor Side Module** is now complete.

## 12. Assemble Universal Axis Idler Side Module

### 12.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 3mm Allen Wrench | 3mm Allen Wrench |       |
| 5mm Allen Wrench | 5mm Allen Wrench |       |
| Hobby Knife      | Hobby Knife      |       |

### 12.2. Materials

| Quantity  | ID                        | Name                      | Description                           | Notes |
|-----------|---------------------------|---------------------------|---------------------------------------|-------|
| 1 part    | universal-axis-idler-side | Universal Axis Idler Side | Universal Axis Idler Side Part v1.0.0 |       |
| 1 part(s) | m6-nut                    | M6 Nut                    | M6 Nut v1.0.0                         |       |

| Quantity  | ID                 | Name                 | Description                            | Notes |
|-----------|--------------------|----------------------|--|-------|
| 2 part(s) | m6-10mm-grub-screw | M6 x 10mm Grub Screw | M6 x 10mm Grub Screw v1.0.0            |       |
| 2 part(s) | flanged-bearing    | Flanged Bearing      | M6 x 12mm x 4mm Flanged Bearing v1.0.0 |       |
| 1 part    | m6-20mm-screw      | M6 x 20mm Screw      | M6 x 20mm Socket Head Cap Screw v1.0.0 |       |

## 12.3. Precautions

- **Universal Axis Idler Side:** The Universal Axis Idler Side Part is made of plastic and can be damaged if too much force is applied! Be careful when screwing in fasteners.

## 12.4. Procedure

### 12.4.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the **Universal Axis Idler Side** part.

### 12.4.2. Assemble Universal Axis Idler Side Module

#### Instructions

1. Take the two **Flanged Bearing** part(s) and orient them so that they are touching with the flanges on opposite sides.
2. Insert the **Flanged Bearing** part(s) into the slot of the **Universal Axis Idler Side** until they align with the hole in the center of the **Universal Axis Idler Side**.
3. Insert the **M6 Nut** into the nut holder above the hole that is aligned with the **Flanged Bearing** part(s).
4. Insert the **M6 x 20mm Screw** through the other side of the hole that aligns with the **Flanged Bearing** part(s).
5. Use the **5mm Allen Wrench** to gently tighten the **M6 x 20mm Screw**.
6. Using the **3mm Allen Wrench**, screw two **M6 x 10mm Grub Screw** into the holes on the face of the **Universal Axis Idler Side**. Only screw the **M6 x 10mm Grub Screw** part(s) in enough to hold them in place as other parts will be inserted into the holes below in a future step.
7. The **Universal Axis Idler Side Module** is now complete.

## 13. Assemble Universal X Axis Module

### 13.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 3mm Allen Wrench | 3mm Allen Wrench |       |
| 5mm Allen Wrench | 5mm Allen Wrench |       |

| Name           | Description            | Notes |
|----------------|------------------------|-------|
| Hobby Knife    | Hobby Knife            |       |
| 8mm Smooth Rod | 8mm x 600mm Smooth Rod |       |
| Scissors       | Scissors               |       |

## 13.2. Materials

| Quantity    | ID                                 | Name                           | Description                             | Notes |
|-------------|------------------------------------|--------------------------------|---|-------|
| 1 module    | universal-axis-idler-side-assembly | Universal Axis Idler Side      | Universal Axis Idler Side Module v1.0.0 |       |
| 1 module    | universal-axis-motor-side-assembly | Universal Axis Motor Side      | Universal Axis Motor Side Module v1.0.0 |       |
| 1 part      | carriage-side                      | Universal Axis X Carriage Side | Universal Axis X Carriage v1.0.0        |       |
| 1 part      | carriage-closure                   | Carriage Closure               | Universal Axis Carriage Closure v1.0.0  |       |
| 1 part      | belt-peg                           | Belt Peg                       | Universal Axis Belt Peg v1.0.0          |       |
| 1 part      | belt-pinch                         | Belt Pinch                     | Universal Axis Belt Pinch v1.0.0        |       |
| 2 part(s)   | m6-20mm-screw                      | M6 x 20mm Screw                | M6 x 20mm Socket Head Cap Screw v1.0.0  |       |
| 1 part(s)   | m6-nut                             | M6 Nut                         | M6 Nut v1.0.0                           |       |
| 1 part(s)   | m6-10mm-grub-screw                 | M6 x 10mm Grub Screw           | M6 x 10mm Grub Screw v1.0.0             |       |
| 1 part(s)   | gt2-belt                           | GT2 Belt                       | GT2 6mm Wide x 1500mm Long Belt v1.0.0  |       |
| 4 part(s)   | linear-bearing                     | Linear Bearing                 | LM8UU Linear Bearing v1.0.0             |       |
| 1 as needed | painters-tape                      | Painters Tape                  | Painters Tape v1.0.0                    |       |
| 2 part(s)   | 8mm-rod                            | 8mm Smooth Rod                 | 8mm x 600mm Smooth Rod v1.0.0           |       |

## 13.3. Procedure

### 13.3.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the 3D printed components.

### 13.3.2. Assemble Universal Axis X Carriage Side

#### Instructions

1. Slide two **Linear Bearing** part(s) onto the **8mm Smooth Rod**.
2. Use the **Painters Tape** to evenly cover the **Linear Bearing** part(s) with around five layers of **Painters Tape**. Do this by applying the tape to both **Linear Bearing** part(s) and then rotating the part(s) on the **8mm Smooth Rod** until enough **Painters Tape** is applied.
3. Remove the **Linear Bearing** part(s) from the **8mm Smooth Rod**.
4. Remove some **Painters Tape** from the **Linear Bearing** part(s) using **Scissors** until the part(s) can fit into the holes of the **Universal Axis X Carriage Side**.
5. Test the fit of the **Linear Bearing** part(s) by covering the open end of the **Universal Axis X Carriage Side** with the **Carriage Closure** and then shaking the part. If the **Linear Bearing** part(s) move around inside of the **Carriage Closure** then the fit is too loose and more **Painters Tape** must be added to the **Linear Bearing** part(s).
6. Repeat the above step until the **Linear Bearing** part(s) fit into the **Universal Axis X Carriage Side** without moving during the shake test.
7. Repeat all of the above steps for the other two **Linear Bearing** part(s).
8. Orient the **Carriage Closure** over the opening of the **Universal Axis X Carriage Side** so that the three mounting holes on the **Carriage Closure** line up with the mounting holes on the **Universal Axis X Carriage Side**. The flat side of the **Carriage Closure** should be facing away from the **Universal Axis X Carriage Side** and the side with the indents for the **Linear Bearing** part(s) should be facing toward the opening of the **Universal Axis X Carriage Side**.
9. Fix the **Carriage Closure** in place by using a **5mm Allen Wrench** to screw a **M6 x 20mm Screw** into the center hole of the **Carriage Closure**.

### 13.3.3. Assemble Universal X Axis Module

#### Instructions

1. Orient the **Universal Axis Motor Side** such that the section of the stepper motor that hangs off of the **Universal Axis Motor Side** is pointing left.
2. Insert two **8mm Smooth Rod** part(s) into the right side of the **Universal Axis Motor Side** until the part(s) are flush with the left face of the plastic part.
3. Tighten down all six **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Motor Side**. This should fix the **8mm Smooth Rod** part(s) in place.
4. Slide the **Universal Axis X Carriage Side** onto the **8mm Smooth Rod** part(s) with the **Carriage Closure** facing the **Universal Axis Motor Side**.
5. Slide the **Universal Axis Idler Side** onto the **8mm Smooth Rod** part(s) such that the larger opening on the **Universal Axis Idler Side** faces the **Universal Axis X Carriage Side**.
6. Gently tighten down the **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Idler Side** to hold the **Universal Axis Idler Side** in place. The final position of the **Universal Axis Idler Side** will be adjusted in a later step.
7. Take the **GT2 Belt** and make a loop on one end with the teeth of the belt locking into one another.
8. Insert the loop into the side of the **Belt Peg** and use a **3mm Allen Wrench** to screw a **M6 x 10mm Grub Screw** part(s) into the loop.
9. Thread the other end of the **GT2 Belt** through one of the openings on the **Universal Axis X Carriage Side** that is closer to the **Universal Axis Idler Side**.
10. Thread the end of the **GT2 Belt** through the **Universal Axis Motor Side**, around the pulley, and back through the **module**.
11. Thread the end of the **GT2 Belt** through the open slot in the **Universal Axis X Carriage Side**.
12. Thread the end of the **GT2 Belt** through the **Universal Axis Idler Side**, around the bearings, and back through the **module**.

13. Thread the end of the **GT2 Belt** back through the first slot of the **Universal Axis X Carriage Side**. Make sure that the **GT2 Belt** goes around the **Belt Peg** part in such a way that the part is positioned on the inside of the **GT2 Belt**.
14. Find the section of **GT2 Belt** that overlaps itself. This section will be coming out of the first slot of the **Universal Axis X Carriage Side**.
15. Take a **Belt Pinch** part and, while pulling the **GT2 Belt** tight by hand, slide the part over both sections of **GT2 Belt**.
16. Place a **M6 Nut** in the nut catcher of the **Belt Pinch**.
17. Push a **M6 x 20mm Screw** through the other side of the **Belt Pinch**. The part(s) may need to be wiggled while being pushed in.
18. Gently tighten down the **M6 x 20mm Screw** through the **M6 Nut** with a **5mm Allen Wrench**. The final belt tension will be adjusted in a later step.
19. The **Universal X Axis Module** is complete.

## 14. Assemble Universal Y1 Axis Module

### 14.1. Tools

| Name             | Description            | Notes |
|------------------|------------------------|-------|
| 3mm Allen Wrench | 3mm Allen Wrench       |       |
| 5mm Allen Wrench | 5mm Allen Wrench       |       |
| Hobby Knife      | Hobby Knife            |       |
| 8mm Smooth Rod   | 8mm x 600mm Smooth Rod |       |
| Scissors         | Scissors               |       |

### 14.2. Materials

| Quantity  | ID                                 | Name                            | Description                             | Notes |
|-----------|------------------------------------|---------------------------------|---|-------|
| 1 module  | universal-axis-idler-side-assembly | Universal Axis Idler Side       | Universal Axis Idler Side Module v1.0.0 |       |
| 1 module  | universal-axis-motor-side-assembly | Universal Axis Motor Side       | Universal Axis Motor Side Module v1.0.0 |       |
| 1 part    | carriage-side                      | Universal Axis Y1 Carriage Side | Universal Axis Y1 Carriage v1.0.0       |       |
| 1 part    | carriage-closure                   | Carriage Closure                | Universal Axis Carriage Closure v1.0.0  |       |
| 1 part    | belt-peg                           | Belt Peg                        | Universal Axis Belt Peg v1.0.0          |       |
| 1 part    | belt-pinch                         | Belt Pinch                      | Universal Axis Belt Pinch v1.0.0        |       |
| 2 part(s) | m6-20mm-screw                      | M6 x 20mm Screw                 | M6 x 20mm Socket Head Cap Screw v1.0.0  |       |

| Quantity    | ID                 | Name                 | Description                            | Notes |
|-------------|--------------------|----------------------|--|-------|
| 1 part(s)   | m6-nut             | M6 Nut               | M6 Nut v1.0.0                          |       |
| 1 part(s)   | m6-10mm-grub-screw | M6 x 10mm Grub Screw | M6 x 10mm Grub Screw v1.0.0            |       |
| 1 part(s)   | gt2-belt           | GT2 Belt             | GT2 6mm Wide x 1500mm Long Belt v1.0.0 |       |
| 4 part(s)   | linear-bearing     | Linear Bearing       | LM8UU Linear Bearing v1.0.0            |       |
| 1 as needed | painters-tape      | Painters Tape        | Painters Tape v1.0.0                   |       |
| 2 part(s)   | 8mm-rod            | 8mm Smooth Rod       | 8mm x 600mm Smooth Rod v1.0.0          |       |

## 14.3. Procedure

### 14.3.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the 3D printed components.

### 14.3.2. Assemble Universal Axis Y1 Carriage Side

#### Instructions

1. Slide two **Linear Bearing** part(s) onto the **8mm Smooth Rod**.
2. Use the **Painters Tape** to evenly cover the **Linear Bearing** part(s) with around five layers of **Painters Tape**. Do this by applying the tape to both **Linear Bearing** part(s) and then rotating the part(s) on the **8mm Smooth Rod** until enough **Painters Tape** is applied.
3. Remove the **Linear Bearing** part(s) from the **8mm Smooth Rod**.
4. Remove some **Painters Tape** from the **Linear Bearing** part(s) using **Scissors** until the part(s) can fit into the holes of the **Universal Axis Y1 Carriage Side**.
5. Test the fit of the **Linear Bearing** part(s) by covering the open end of the **Universal Axis Y1 Carriage Side** with the **Carriage Closure** and then shaking the part. If the **Linear Bearing** part(s) move around inside of the **Carriage Closure** then the fit is too loose and more **Painters Tape** must be added to the **Linear Bearing** part(s).
6. Repeat the above step until the **Linear Bearing** part(s) fit into the **Universal Axis Y1 Carriage Side** without moving during the shake test.
7. Repeat all of the above steps for the other two **Linear Bearing** part(s).
8. Orient the **Carriage Closure** over the opening of the **Universal Axis Y1 Carriage Side** so that the three mounting holes on the **Carriage Closure** line up with the mounting holes on the **Universal Axis Y1 Carriage Side**. The flat side of the **Carriage Closure** should be facing away from the **Universal Axis Y1 Carriage Side** and the side with the indents for the **Linear Bearing** part(s) should be facing toward the opening of the **Universal Axis Y1 Carriage Side**.
9. Fix the **Carriage Closure** in place by using a **5mm Allen Wrench** to screw a **M6 x 20mm Screw** into the center hole of the **Carriage Closure**.

### 14.3.3. Assemble Universal Y1 Axis Module

#### Instructions

1. Orient the **Universal Axis Motor Side** such that the section of the stepper motor that hangs off of the **Universal Axis Motor Side** is pointing left.
2. Insert two **8mm Smooth Rod** part(s) into the right side of the **Universal Axis Motor Side** until the part(s) are flush with the left face of the plastic part.
3. Tighten down all six **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Motor Side**. This should fix the **8mm Smooth Rod** part(s) in place.
4. Slide the **Universal Axis Y1 Carriage Side** onto the **8mm Smooth Rod** part(s) with the **Carriage Closure** facing away from the **Universal Axis Motor Side**.
5. Slide the **Universal Axis Idler Side** onto the **8mm Smooth Rod** part(s) such that the larger opening on the **Universal Axis Idler Side** faces the **Universal Axis Y1 Carriage Side**.
6. Gently tighten down the **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Idler Side** to hold the **Universal Axis Idler Side** in place. The final position of the **Universal Axis Idler Side** will be adjusted in a later step.
7. Take the **GT2 Belt** and make a loop on one end with the teeth of the belt locking into one another.
8. Insert the loop into the side of the **Belt Peg** and use a **3mm Allen Wrench** to screw a **M6 x 10mm Grub Screw** part(s) into the loop.
9. Thread the other end of the **GT2 Belt** through one of the openings on the **Universal Axis Y1 Carriage Side** that is closer to the **Universal Axis Idler Side**.
10. Thread the end of the **GT2 Belt** through the **Universal Axis Motor Side**, around the pulley, and back through the **module**.
11. Thread the end of the **GT2 Belt** through the open slot in the **Universal Axis Y1 Carriage Side**.
12. Thread the end of the **GT2 Belt** through the **Universal Axis Idler Side**, around the bearings, and back through the **module**.
13. Thread the end of the **GT2 Belt** back through the first slot of the **Universal Axis Y1 Carriage Side**. Make sure that the **GT2 Belt** goes around the **Belt Peg** part in such a way that the part is positioned on the inside of the **GT2 Belt**.
14. Find the section of **GT2 Belt** that overlaps itself. This section will be coming out of the first slot of the **Universal Axis Y1 Carriage Side**.
15. Take a **Belt Pinch** part and, while pulling the **GT2 Belt** tight by hand, slide the part over both sections of **GT2 Belt**.
16. Place a **M6 Nut** in the nut catcher of the **Belt Pinch**.
17. Push a **M6 x 20mm Screw** through the other side of the **Belt Pinch**. The part(s) may need to be wiggled while being pushed in.
18. Gently tighten down the **M6 x 20mm Screw** through the **M6 Nut** with a **5mm Allen Wrench**. The final belt tension will be adjusted in a later step.
19. The **Universal Y1 Axis Module** is complete.

## 15. Assemble Universal Y2 Axis Module

### 15.1. Tools

| Name             | Description      | Notes |
|------------------|------------------|-------|
| 3mm Allen Wrench | 3mm Allen Wrench |       |
| 5mm Allen Wrench | 5mm Allen Wrench |       |
| Hobby Knife      | Hobby Knife      |       |

| Name           | Description            | Notes |
|----------------|------------------------|-------|
| 8mm Smooth Rod | 8mm x 600mm Smooth Rod |       |
| Scissors       | Scissors               |       |

## 15.2. Materials

| Quantity    | ID                                 | Name                            | Description                             | Notes |
|-------------|------------------------------------|---------------------------------|---|-------|
| 1 module    | universal-axis-idler-side-assembly | Universal Axis Idler Side       | Universal Axis Idler Side Module v1.0.0 |       |
| 1 module    | universal-axis-motor-side-assembly | Universal Axis Motor Side       | Universal Axis Motor Side Module v1.0.0 |       |
| 1 part      | carriage-side                      | Universal Axis Y2 Carriage Side | Universal Axis Y2 Carriage v1.0.0       |       |
| 1 part      | carriage-closure                   | Carriage Closure                | Universal Axis Carriage Closure v1.0.0  |       |
| 1 part      | belt-peg                           | Belt Peg                        | Universal Axis Belt Peg v1.0.0          |       |
| 1 part      | belt-pinch                         | Belt Pinch                      | Universal Axis Belt Pinch v1.0.0        |       |
| 2 part(s)   | m6-20mm-screw                      | M6 x 20mm Screw                 | M6 x 20mm Socket Head Cap Screw v1.0.0  |       |
| 1 part(s)   | m6-nut                             | M6 Nut                          | M6 Nut v1.0.0                           |       |
| 1 part(s)   | m6-10mm-grub-screw                 | M6 x 10mm Grub Screw            | M6 x 10mm Grub Screw v1.0.0             |       |
| 1 part(s)   | gt2-belt                           | GT2 Belt                        | GT2 6mm Wide x 1500mm Long Belt v1.0.0  |       |
| 4 part(s)   | linear-bearing                     | Linear Bearing                  | LM8UU Linear Bearing v1.0.0             |       |
| 1 as needed | painters-tape                      | Painters Tape                   | Painters Tape v1.0.0                    |       |
| 2 part(s)   | 8mm-rod                            | 8mm Smooth Rod                  | 8mm x 600mm Smooth Rod v1.0.0           |       |

## 15.3. Procedure

### 15.3.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the 3D printed components.

### 15.3.2. Assemble Universal Axis Y2 Carriage Side

#### Instructions

1. Slide two **Linear Bearing** part(s) onto the **8mm Smooth Rod**.
2. Use the **Painters Tape** to evenly cover the **Linear Bearing** part(s) with around five layers of **Painters Tape**. Do this by applying the tape to both **Linear Bearing** part(s) and then rotating the part(s) on the **8mm Smooth Rod** until enough **Painters Tape** is applied.
3. Remove the **Linear Bearing** part(s) from the **8mm Smooth Rod**.
4. Remove some **Painters Tape** from the **Linear Bearing** part(s) using **Scissors** until the part(s) can fit into the holes of the **Universal Axis Y2 Carriage Side**.
5. Test the fit of the **Linear Bearing** part(s) by covering the open end of the **Universal Axis Y2 Carriage Side** with the **Carriage Closure** and then shaking the part. If the **Linear Bearing** part(s) move around inside of the **Carriage Closure** then the fit is too loose and more **Painters Tape** must be added to the **Linear Bearing** part(s).
6. Repeat the above step until the **Linear Bearing** part(s) fit into the **Universal Axis Y2 Carriage Side** without moving during the shake test.
7. Repeat all of the above steps for the other two **Linear Bearing** part(s).
8. Orient the **Carriage Closure** over the opening of the **Universal Axis Y2 Carriage Side** so that the three mounting holes on the **Carriage Closure** line up with the mounting holes on the **Universal Axis Y2 Carriage Side**. The flat side of the **Carriage Closure** should be facing away from the **Universal Axis Y2 Carriage Side** and the side with the indents for the **Linear Bearing** part(s) should be facing toward the opening of the **Universal Axis Y2 Carriage Side**.
9. Fix the **Carriage Closure** in place by using a **5mm Allen Wrench** to screw a **M6 x 20mm Screw** into the center hole of the **Carriage Closure**.

### 15.3.3. Assemble Universal Y2 Axis Module

#### Instructions

1. Orient the **Universal Axis Motor Side** such that the section of the stepper motor that hangs off of the **Universal Axis Motor Side** is pointing left.
2. Insert two **8mm Smooth Rod** part(s) into the right side of the **Universal Axis Motor Side** until the part(s) are flush with the left face of the plastic part.
3. Tighten down all six **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Motor Side**. This should fix the **8mm Smooth Rod** part(s) in place.
4. Slide the **Universal Axis Y2 Carriage Side** onto the **8mm Smooth Rod** part(s) with the **Carriage Closure** facing away from the **Universal Axis Motor Side**.
5. Slide the **Universal Axis Idler Side** onto the **8mm Smooth Rod** part(s) such that the larger opening on the **Universal Axis Idler Side** faces the **Universal Axis Y2 Carriage Side**.
6. Gently tighten down the **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Idler Side** to hold the **Universal Axis Idler Side** in place. The final position of the **Universal Axis Idler Side** will be adjusted in a later step.
7. Take the **GT2 Belt** and make a loop on one end with the teeth of the belt locking into one another.
8. Insert the loop into the side of the **Belt Peg** and use a **3mm Allen Wrench** to screw a **M6 x 10mm Grub Screw** part(s) into the loop.
9. Thread the other end of the **GT2 Belt** through one of the openings on the **Universal Axis Y2 Carriage Side** that is closer to the **Universal Axis Idler Side**.
10. Thread the end of the **GT2 Belt** through the **Universal Axis Motor Side**, around the pulley, and back through the **module**.
11. Thread the end of the **GT2 Belt** through the open slot in the **Universal Axis Y2 Carriage Side**.
12. Thread the end of the **GT2 Belt** through the **Universal Axis Idler Side**, around the bearings, and back through the **module**.

13. Thread the end of the **GT2 Belt** back through the first slot of the **Universal Axis Y2 Carriage Side**. Make sure that the **GT2 Belt** goes around the **Belt Peg** part in such a way that the part is positioned on the inside of the **GT2 Belt**.
14. Find the section of **GT2 Belt** that overlaps itself. This section will be coming out of the first slot of the **Universal Axis Y2 Carriage Side**.
15. Take a **Belt Pinch** part and, while pulling the **GT2 Belt** tight by hand, slide the part over both sections of **GT2 Belt**.
16. Place a **M6 Nut** in the nut catcher of the **Belt Pinch**.
17. Push a **M6 x 20mm Screw** through the other side of the **Belt Pinch**. The part(s) may need to be wiggled while being pushed in.
18. Gently tighten down the **M6 x 20mm Screw** through the **M6 Nut** with a **5mm Allen Wrench**. The final belt tension will be adjusted in a later step.
19. The **Universal Y2 Axis Module** is complete.

## 16. Assemble Universal Z Axis Module

### 16.1. Tools

| Name             | Description            | Notes |
|------------------|------------------------|-------|
| 3mm Allen Wrench | 3mm Allen Wrench       |       |
| 5mm Allen Wrench | 5mm Allen Wrench       |       |
| Hobby Knife      | Hobby Knife            |       |
| 8mm Smooth Rod   | 8mm x 600mm Smooth Rod |       |
| Scissors         | Scissors               |       |

### 16.2. Materials

| Quantity  | ID                                 | Name                           | Description                             | Notes |
|-----------|------------------------------------|--------------------------------|---|-------|
| 1 module  | universal-axis-idler-side-assembly | Universal Axis Idler Side      | Universal Axis Idler Side Module v1.0.0 |       |
| 1 module  | universal-axis-motor-side-assembly | Universal Axis Motor Side      | Universal Axis Motor Side Module v1.0.0 |       |
| 1 part    | carriage-side                      | Universal Axis Z Carriage Side | Universal Axis Z Carriage v1.0.0        |       |
| 1 part    | carriage-closure                   | Carriage Closure               | Universal Axis Carriage Closure v1.0.0  |       |
| 1 part    | belt-peg                           | Belt Peg                       | Universal Axis Belt Peg v1.0.0          |       |
| 1 part    | belt-pinch                         | Belt Pinch                     | Universal Axis Belt Pinch v1.0.0        |       |
| 2 part(s) | m6-20mm-screw                      | M6 x 20mm Screw                | M6 x 20mm Socket Head Cap Screw v1.0.0  |       |

| Quantity    | ID                 | Name                 | Description                            | Notes |
|-------------|--------------------|----------------------|--|-------|
| 1 part(s)   | m6-nut             | M6 Nut               | M6 Nut v1.0.0                          |       |
| 1 part(s)   | m6-10mm-grub-screw | M6 x 10mm Grub Screw | M6 x 10mm Grub Screw v1.0.0            |       |
| 1 part(s)   | gt2-belt           | GT2 Belt             | GT2 6mm Wide x 1500mm Long Belt v1.0.0 |       |
| 4 part(s)   | linear-bearing     | Linear Bearing       | LM8UU Linear Bearing v1.0.0            |       |
| 1 as needed | painters-tape      | Painters Tape        | Painters Tape v1.0.0                   |       |
| 2 part(s)   | 8mm-rod            | 8mm Smooth Rod       | 8mm x 600mm Smooth Rod v1.0.0          |       |

## 16.3. Precautions

- **Universal Axis Z Carriage Side:** The Universal Axis Z Carriage is made of plastic and can be damaged if too much force is applied! Be careful when screwing in fasteners.

## 16.4. Procedure

### 16.4.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the 3D printed components.

### 16.4.2. Assemble Universal Axis Z Carriage Side

#### Instructions

1. Slide two **Linear Bearing** part(s) onto the **8mm Smooth Rod**.
2. Use the **Painters Tape** to evenly cover the **Linear Bearing** part(s) with around five layers of **Painters Tape**. Do this by applying the tape to both **Linear Bearing** part(s) and then rotating the part(s) on the **8mm Smooth Rod** until enough **Painters Tape** is applied.
3. Remove the **Linear Bearing** part(s) from the **8mm Smooth Rod**.
4. Remove some **Painters Tape** from the **Linear Bearing** part(s) using **Scissors** until the part(s) can fit into the holes of the **Universal Axis Z Carriage Side**.
5. Test the fit of the **Linear Bearing** part(s) by covering the open end of the **Universal Axis Z Carriage Side** with the **Carriage Closure** and then shaking the part. If the **Linear Bearing** part(s) move around inside of the **Carriage Closure** then the fit is too loose and more **Painters Tape** must be added to the **Linear Bearing** part(s).
6. Repeat the above step until the **Linear Bearing** part(s) fit into the **Universal Axis Z Carriage Side** without moving during the shake test.
7. Repeat all of the above steps for the other two **Linear Bearing** part(s).
8. Orient the **Carriage Closure** over the opening of the **Universal Axis Z Carriage Side** so that the three mounting holes on the **Carriage Closure** line up with the mounting holes on the **Universal Axis Z Carriage Side**. The flat side of the **Carriage Closure** should be facing away from the **Universal Axis Z Carriage Side** and the side with the indents for the **Linear Bearing** part(s) should be facing toward the opening of the **Universal Axis Z Carriage Side**.

9. Fix the **Carriage Closure** in place by using a **5mm Allen Wrench** to screw a **M6 x 20mm Screw** into the center hole of the **Carriage Closure**.

### 16.4.3. Assemble Universal Z Axis Module

#### Instructions

1. Orient the **Universal Axis Motor Side** such that the section of the stepper motor that hangs off of the **Universal Axis Motor Side** is pointing left.
2. Insert two **8mm Smooth Rod** part(s) into the right side of the **Universal Axis Motor Side** until the part(s) are flush with the left face of the plastic part.
3. Tighten down all six **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Motor Side**. This should fix the **8mm Smooth Rod** part(s) in place.
4. Slide the **Universal Axis Z Carriage Side** onto the **8mm Smooth Rod** part(s) with the **Carriage Closure** facing the **Universal Axis Motor Side**.
5. Slide the **Universal Axis Idler Side** onto the **8mm Smooth Rod** part(s) such that the larger opening on the **Universal Axis Idler Side** faces the **Universal Axis Z Carriage Side**.
6. Gently tighten down the **M6 x 10mm Grub Screw** part(s) on the **Universal Axis Idler Side** to hold the **Universal Axis Idler Side** in place. The final position of the **Universal Axis Idler Side** will be adjusted in a later step.
7. Take the **GT2 Belt** and make a loop on one end with the teeth of the belt locking into one another.
8. Insert the loop into the side of the **Belt Peg** and use a **3mm Allen Wrench** to screw a **M6 x 10mm Grub Screw** part(s) into the loop.
9. Thread the other end of the **GT2 Belt** through one of the openings on the **Universal Axis Z Carriage Side** that is closer to the **Universal Axis Idler Side**.
10. Thread the end of the **GT2 Belt** through the **Universal Axis Motor Side**, around the pulley, and back through the **module**.
11. Thread the end of the **GT2 Belt** through the open slot in the **Universal Axis Z Carriage Side**.
12. Thread the end of the **GT2 Belt** through the **Universal Axis Idler Side**, around the bearings, and back through the **module**.
13. Thread the end of the **GT2 Belt** back through the first slot of the **Universal Axis Z Carriage Side**. Make sure that the **GT2 Belt** goes around the **Belt Peg** part in such a way that the part is positioned on the inside of the **GT2 Belt**.
14. Find the section of **GT2 Belt** that overlaps itself. This section will be coming out of the first slot of the **Universal Axis Z Carriage Side**.
15. Take a **Belt Pinch** part and, while pulling the **GT2 Belt** tight by hand, slide the part over both sections of **GT2 Belt**.
16. Place a **M6 Nut** in the nut catcher of the **Belt Pinch**.
17. Push a **M6 x 20mm Screw** through the other side of the **Belt Pinch**. The part(s) may need to be wiggled while being pushed in.
18. Gently tighten down the **M6 x 20mm Screw** through the **M6 Nut** with a **5mm Allen Wrench**. The final belt tension will be adjusted in a later step.
19. The **Universal Z Axis Module** is complete.

## 17. Assemble Hot End Assembly

### 17.1. Tools

| Name               | Description        | Notes |
|--------------------|--------------------|-------|
| 1.5mm Allen Wrench | 1.5mm Allen Wrench |       |

| Name               | Description                        | Notes  |
|--------------------|------------------------------------|--|
| 24v Power Supply   | 24V Industrial Power Supply Module |  |
| 2mm Allen Wrench   | 2mm Allen Wrench                   |  |
| 7mm Socket Wrench  | 7mm Socket Wrench                  |  |
| Needle Nose Pliers | Needle Nose Pliers                 |  |
| Slip Joint Pliers  | Slip Joint Pliers                  |  |
| Metal Jaw Vise     | Metal Jaw Vise                     | The jaws of the vise must be metal for heat resistance.  |
| Vise Grip Pliers   | Vise Grip Pliers                   | (Optional alternative to the Metal Jaw Vise) The jaws of the vise grips must be metal for heat resistance. |

## 17.2. Materials

| Quantity  | ID                        | Name                                     | Description   | Notes |
|-----------|---------------------------|--|---|-------|
| 1 part    | heat-break                | Heat Break                               | 1.75mm Heat Break v1.0.0                                      |       |
| 1 part    | heater-cartridge          | Heater Cartridge                         | 24V 70W 6mm Diameter Ceramic Heater Cartridge v1.0.0          |       |
| 1 part    | heatsink-block            | Heatsink Block                           | Universal Gearless Extruder Heatsink Block v1.0.0             |       |
| 2 parts   | m3-10mm-screw             | M3 x 10mm Cap Screw                      | M3 x 10mm Cap Screw v1.0.0                                    |       |
| 1 part    | m3-4mm-grub-screw         | M3 x 4mm Grub Screw                      | M3 x 4mm Grub Screw v1.0.0                                    |       |
| 1 part    | m6-thin-nut               | M6 Thin Nut                              | M6 Thin Nut v1.0.0  |       |
| 1 part    | nozzle                    | Volcano Nozzle                           | 1.75mm Volcano Style Filament Extrusion Nozzle (0.4mm) v1.0.0 |       |
| 2 drop(s) | thermal-paste             | Thermal Paste                            | Thermal Paste v1.0.0  |       |
| 1 part    | thermistor                | Thermistor Cartridge                     | NTC 100K ohm B3950 Thermistor Cartridge v1.0.0                |       |
| 1 part    | volcano-heater-block      | Volcano Style Heater Block               | Volcano Style Heater Block v1.0.0                             |       |
| 1 part    | volcano-heater-block-sock | Volcano Style Heater Block Silicone Sock | Volcano Style Heater Block Sock v1.0.0                        |       |

## 17.3. Precautions

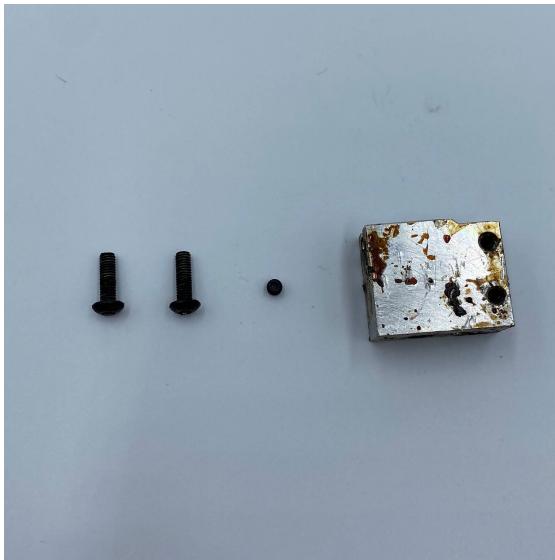
- **Heater Cartridge:** The 24V 70W 6mm Diameter Ceramic Heater Cartridge gets very hot when powered! Use caution when handling.

## 17.4. Procedure

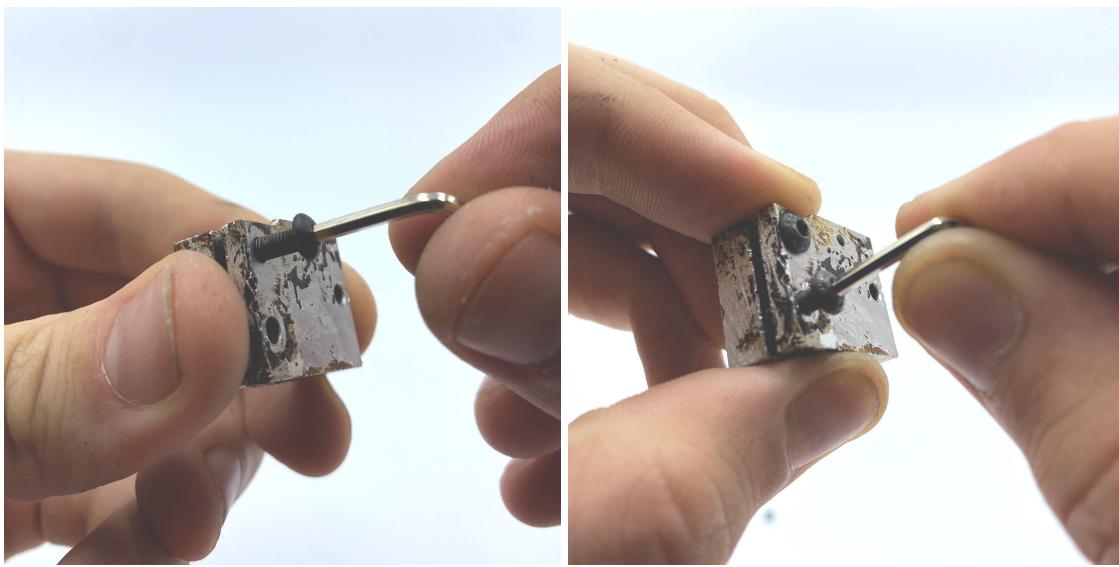
### 17.4.1. Assemble the Volcano Style Heater Block

#### Instructions

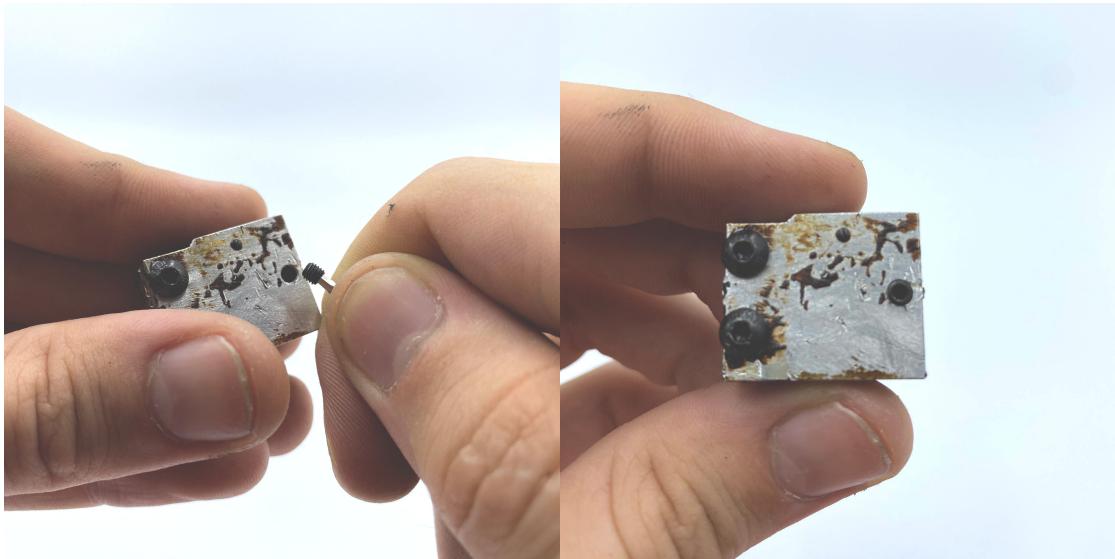
1. Unpack required parts from bag.



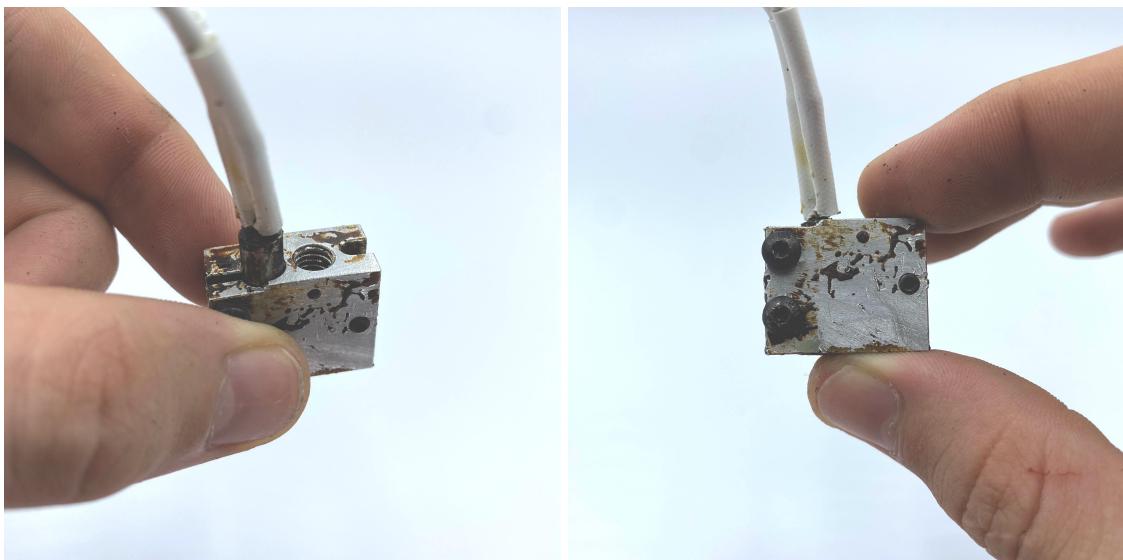
2. Using the **2mm Allen Wrench**, lightly screw the **M3 x 10mm Cap Screw** parts into the two threaded holes on the side of the **Volcano Style Heater Block**.



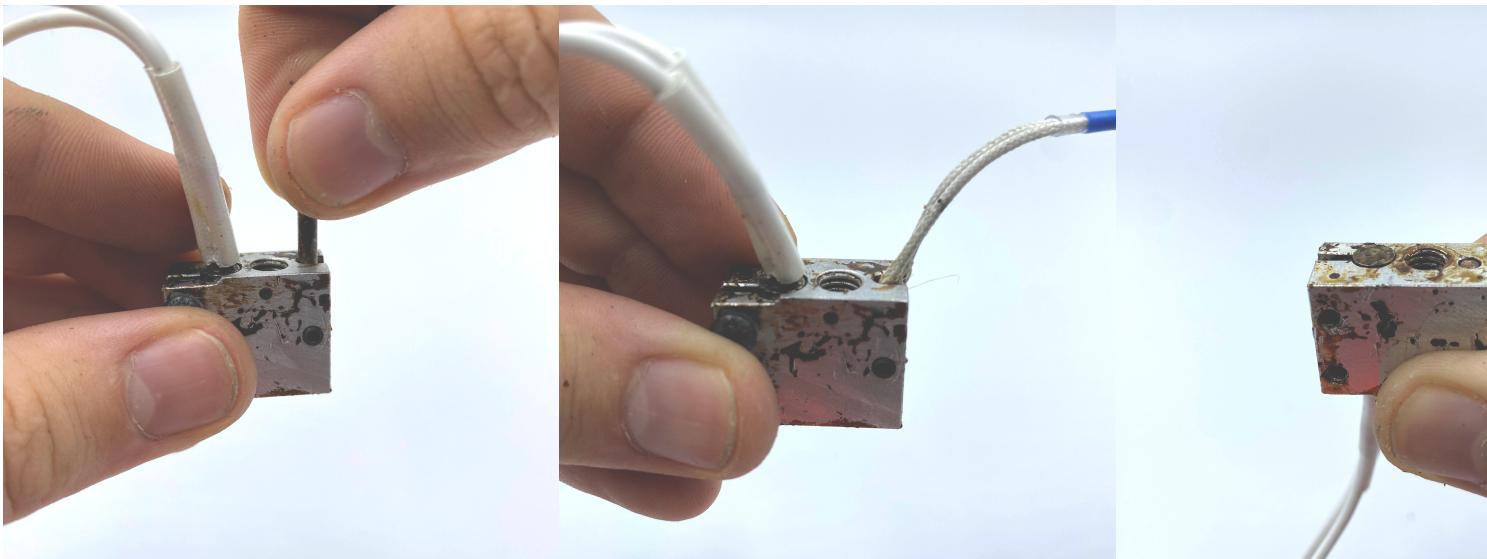
3. Using the **1.5mm Allen Wrench**, lightly screw the **M3 x 4mm Grub Screw** into the single threaded hole on the side of the **Volcano Style Heater Block**. Be sure to leave enough room for the **Thermistor Cartridge** to be inserted later.



4. Insert the **Heater Cartridge** into the non-threaded hole in the **Volcano Style Heater Block** with the wires coming out of the end with an indent. Make sure the **Heater Cartridge** does not extend past the bottom of the **Volcano Style Heater Block**.



5. Insert the **Thermistor Cartridge** into the smaller hole on the **Volcano Style Heater Block** with the wires coming out of the same side as the previous step. Make sure the **Thermistor Cartridge** does not extend past the bottom of the **Volcano Style Heater Block**.



6. Screw down the **M3 x 4mm Grub Screw** part lightly using a **1.5mm Allen Wrench** to fasten the **Thermistor Cartridge**, but very lightly as the part can go right through the **Thermistor Cartridge**.
7. Screw down the **M3 x 10mm Cap Screw** parts using a **2mm Allen Wrench**, so that the **Volcano Style Heater Block** is secured. Do this evenly by screwing down one **M3 x 10mm Cap Screw** then the other and alternating four times.
8. Using a **7mm Socket Wrench**, screw the **Volcano Nozzle** into the end of the **Volcano Style Heater Block** that does not have wires, until there is 1/2 of a thread (approximately 1mm) exposed.
9. Screw the short end of the **Heat Break** into the other side of the **Volcano Style Heater Block** until it bottoms out against the **Volcano Nozzle**.

#### 17.4.2. Hot Tighten the Volcano Nozzle and Heat Break

##### Instructions

1. Gently secure the **Volcano Style Heater Block** in the **Metal Jaw Vise**, leaving enough clearance to tighten down the **Volcano Nozzle**.
2. Attach the **Heater Cartridge** wires onto the output of the **24v Power Supply** and power on the **24v Power Supply**.
3. Wait two minutes for the **Volcano Style Heater Block** to get hot.
4. Using **Needle Nose Pliers**, hold the **Heat Break** in place while tightening down the **Volcano Nozzle** using the **7mm Socket Wrench**. Make sure that the **Volcano Nozzle** bottoms out against the **Heat Break**, not against the **Volcano Style Heater Block** - the goal is to close the filament flow gap between the **Volcano Nozzle** and **Heat Break**.
5. Once tightened, turn off the **24v Power Supply**.
6. Disconnect the **Heater Cartridge** from the **24v Power Supply**.

#### 17.4.3. Attach the Heatsink Block

##### Instructions

1. Wait at least five minutes for the **Volcano Style Heater Block** to cool down to a temperature that is safe to touch.
2. Reposition the **Volcano Style Heater Block** in the **Metal Jaw Vise** so that the long end of the **Heat Break** is accessible to tools.
3. Screw the **M6 Thin Nut** onto the **Heat Break** until the **M6 Thin Nut** is near the gap on the **Heat Break**.
4. Apply one drop(s) of **Thermal Paste** to the threads of the **Heat Break** and spread the **Thermal Paste** evenly

across the threads.

5. Bend the **Heater Cartridge** wires out of the way so you can screw on the heat sink. Hold the bottom of the **Heater Cartridge** wire with **Needle Nose Pliers** so that when the wires are bent down they won't break from the **Heater Cartridge**.
6. Screw the **Heatsink Block** onto the **Heat Break** so that the **Heat Break** sticks out 2mm above the **Heatsink Block**.
7. Line up the wider sides of the **Heatsink Block** and the **Volcano Style Heater Block**.
8. Tighten the **M6 Thin Nut** against the **Heatsink Block** using **Slip Joint Pliers**.
9. Remove the **Hot End Assembly** from the **Metal Jaw Vise**.
10. Place the **Volcano Style Heater Block Silicone Sock** onto the **Volcano Style Heater Block**.
11. The **Hot End Assembly** is complete.

## 18. Assemble Universal Gearless Extruder Module

### 18.1. Tools

| Name               | Description                | Notes |
|--------------------|----------------------------|-------|
| 1.75mm Filament    | 1.75mm 3D Printer Filament |       |
| 1.5mm Allen Wrench | 1.5mm Allen Wrench         |       |
| 2.5mm Allen Wrench | 2.5mm Allen Wrench         |       |
| 5mm Allen Wrench   | 5mm Allen Wrench           |       |
| Hobby Knife        | Hobby Knife                |       |

### 18.2. Materials

| Quantity | ID                                   | Name                    | Description  | Notes           |
|----------|--------------------------------------|-------------------------|--|-----------------|
| 1 part   | 40mm-fan                             | 40mm Fan                | 24v 40mm x 40mm x 10mm Fan v1.0.0  |                 |
| 1 part   | 40mm-heatsink                        | 40mm Heatsink Fins      | Mk7/Mk8 40mm Heatsink v1.0.0   |                 |
| 1 part   | 608-bearing                          | 608 ZZ Bearing          | 608 ZZ Bearing v1.0.0  |                 |
| 1 part   | active-cooling-height-sensor-plotter | Secondary Extruder Part | Universal Gearless Extruder Active Cooling Height Sensor Plotter Part v1.0.0 | 3D Printed Part |
| 1 part   | blower-fan                           | Blower Fan              | 24V 5015 Blower Fan v1.0.0   |                 |
| 1 part   | extruder-gear                        | Filament Drive Gear     | Mk7 Extruder Drive Gear v1.0.0   |                 |

| Quantity  | ID                  | Name                           | Description   | Notes           |
|-----------|---------------------|--------------------------------|---|-----------------|
| 1 part    | extruder-spring     | Extruder Spring                | 10mm Outer<br>Diameter 35mm Long<br>1.2mm Thick<br>Compression Spring<br>v1.0.0 |                 |
| 1 part    | height-sensor       | Height Sensor                  | LJ18A3-8-Z-BY-5V<br>Proximity Switch<br>v1.0.0                                  |                 |
| 1 part    | hot-end-assembly    | Hot End Assembly               | Hot End Assembly<br>v1.0.0  |                 |
| 4 part(s) | m3-20mm-screw       | M3 x 20mm Screw                | M3 x 20mm Socket<br>Head Cap Screw<br>v1.0.0                                    |                 |
| 2 part(s) | m3-30mm-screw       | M3 x 30mm Screw                | M3 x 30mm Socket<br>Head Cap Screw<br>v1.0.0                                    |                 |
| 4 part(s) | m3-8mm-screw        | M3 x 8mm Screw                 | M3 x 8mm Socket<br>Head Cap Screw<br>v1.0.0                                     |                 |
| 1 part(s) | m6-25mm-screw       | M6 x 25mm Screw                | M6 x 25mm Socket<br>Head Cap Screw<br>v1.0.0                                    |                 |
| 1 part    | m6-nut              | M6 Nut                         | M6 Nut v1.0.0   |                 |
| 1 part    | motor-mount         | Motor Mount                    | Universal Gearless<br>Extruder Motor Mount<br>Part v1.0.0                       | 3D Printed Part |
| 1 part    | split-wire-loom     | 2 Meter Split Wire<br>Loom     | 1/2 Inch Flame<br>Retardant Split Wire<br>Loom v1.0.0                           |                 |
| 1 part    | spring-tensioner    | Spring Tensioner Arm           | Universal Gearless<br>Extruder Spring<br>Tensioner Arm v1.0.0                   | 3D printed part |
| 1 part    | stepper-motor       | Nema 17 Stepper<br>Motor       | Nema 17 0.5Nm<br>Stepper Motor v1.0.0   |                 |
| 1 part    | stepper-motor-cable | 2 Meter Stepper<br>Motor Cable | Stepper Motor Wire 4<br>Pin Dupont to 6 Pin<br>XH2.54 v1.0.0                    |                 |
| 2 drop(s) | thermal-paste       | Thermal Paste                  | Thermal Paste v1.0.0  |                 |
| 1 part    | zip-tie-small       | Small Zip Tie                  | 4 Inch Zip Tie v1.0.0   |                 |

## 18.3. Procedure

### 18.3.1. Assemble the Motor Mount

#### Instructions

1. Clean off any extra plastic on the **Motor Mount** using a **Hobby Knife**.
2. Insert the **M6 Nut** into the slot in the middle of the **Motor Mount**.
3. Insert the **Nema 17 Stepper Motor** into the **Motor Mount** with the mounting holes lined up.
4. In the top right corner, use the **2.5mm Allen Wrench** to screw an **M3 x 8mm Screw** through the **Motor Mount** and into the mounting hole on the **Nema 17 Stepper Motor**.

### 18.3.2. Add the Secondary Extruder Part

#### Instructions

1. Clean off any extra plastic on the **Secondary Extruder Part** using a **Hobby Knife**.
2. Line up the **Secondary Extruder Part** with the mounting holes on the left side of the **Motor Mount**.
3. Using the **2.5mm Allen Wrench**, screw an **M3 x 8mm Screw** into the furthest back mounting hole.
4. Insert the open end of the **Blower Fan** into the fan duct on the **Secondary Extruder Part**.
5. Using the **2.5mm Allen Wrench**, screw two **M3 x 20mm Screw** part(s) into the mounting holes of the **Blower Fan** to mount it to the **Secondary Extruder Part**.
6. Use the **2.5mm Allen Wrench** to screw **M3 x 8mm Screw** part(s) into the remaining open mounting holes in the **Secondary Extruder Part**.

### 18.3.3. Install Hot End Assembly

#### Instructions

1. Apply one drop(s) of **Thermal Paste** to the flat area between the mounting holes on the **40mm Heatsink Fins**.
2. Place two **M3 x 30mm Screw** part(s) into the mounting holes of the **40mm Heatsink Fins** with the threads of the **M3 x 30mm Screw** part(s) sticking out of the flat side of the **40mm Heatsink Fins**.
3. Orient the **Hot End Assembly** with the longer side on the right.
4. Insert the **M3 x 30mm Screw** part(s) through the mounting holes of the **Hot End Assembly**. This should squish the **Thermal Paste** between the **Hot End Assembly** and the **40mm Heatsink Fins**.
5. Position the **Hot End Assembly** mounting holes against the bottom mounting holes of the **Nema 17 Stepper Motor** in the **Motor Mount**.
6. Lightly screw down the **M3 x 30mm Screw** part(s) using the **2.5mm Allen Wrench** to hold the **Hot End Assembly** against the **Nema 17 Stepper Motor** in the **Motor Mount**, but not too hard as the position of the **Hot End Assembly** will be adjusted later.

### 18.3.4. Install and adjust Filament Drive Gear / Adjust Hot End Assembly

#### Instructions

1. Put the **Filament Drive Gear** on the shaft of the **Nema 17 Stepper Motor** in the **Motor Mount**. Do not tighten it down yet.
2. Insert the **1.75mm Filament** into the top of the **Hot End Assembly** and align the **Filament Drive Gear** teeth with the **1.75mm Filament**.
3. Tighten down the screw on the **Filament Drive Gear** using the **1.5mm Allen Wrench**.
4. Using the **1.75mm Filament** as a guide, tighten down the **M3 x 30mm Screw** part(s) on the **Hot End Assembly** using a **2.5mm Allen Wrench**. Make sure that the **1.75mm Filament** is coming *straight* out of the top of the **Hot End Assembly** before tightening.

### 18.3.5. Install Spring Tensioner Arm

#### Instructions

1. Clean off any extra plastic on the **Spring Tensioner Arm** using a **Hobby Knife**.
2. Press the **608 ZZ Bearing** onto the peg on the **Spring Tensioner Arm**.
3. With the arm of the **Spring Tensioner Arm** pointing right, screw the **Spring Tensioner Arm** onto the top left mounting hole on the front of the **Motor Mount** using a **M3 x 20mm Screw** and a **2.5mm Allen Wrench**.
4. Insert the **Extruder Spring** between the arm of the **Spring Tensioner Arm** and the mounting slot on the **Motor Mount**.

### 18.3.6. Install Height Sensor

#### Instructions

1. Insert the **Height Sensor** into the slot on the left side of the **Secondary Extruder Part**.
2. Adjust the height of the **Height Sensor** so the bottom is 2mm above the bottom of the **Secondary Extruder Part**.
3. Using the **5mm Allen Wrench**, screw the **M6 x 25mm Screw** into the hole at the back of the slot. Tighten the **M6 x 25mm Screw** only enough to hold the **Secondary Extruder Part** in place and not damage it.

### 18.3.7. Install 40mm Fan

#### Instructions

1. Orient the **40mm Fan** over the **40mm Heatsink Fins** so that the fan will blow air toward the **40mm Heatsink Fins**.
2. Place the **40mm Fan** directly over the front of the **40mm Heatsink Fins** and screw it into place using two **M3 x 20mm Screw** part(s) and the **2.5mm Allen Wrench** in the bottom mounting holes of the **40mm Fan**. The screws will be held in the **40mm Heatsink Fins**.

### 18.3.8. Cables Management

#### Instructions

1. Connect the **2 Meter Stepper Motor Cable** to the **Nema 17 Stepper Motor** in the **Motor Mount**. There should only be one cable orientation that fits in the **Nema 17 Stepper Motor**.
2. Bundle the **Universal Gearless Extruder Module** wires such that when looking at the front of the Universal Gearless Extruder Module, the wires are sent to the right hand side.
3. Use a **Small Zip Tie** to hold the wires together.
4. Take all 15 **Universal Gearless Extruder Module** wires and pull them through the **2 Meter Split Wire Loom**.

## 19. Assemble Universal Controller Assembly

### 19.1. Tools

| Name                         | Description                  | Notes |
|------------------------------|------------------------------|-------|
| 3mm Flat Head Screwdriver    | 3mm Flat Head Screwdriver    |       |
| Phillips Head #2 Screwdriver | #2 Phillips Head Screwdriver |       |
| Hobby Knife                  | Hobby Knife                  |       |
| Scissors                     | Scissors                     |       |
| Helping Hands                | Helping Hands Clamp Stand    |       |

| Name                       | Description                     | Notes |
|----------------------------|---------------------------------|-------|
| Soldering Iron             | Soldering Iron                  |       |
| Ferrule Crimper            | Wire Ferrule Crimper            |       |
| MicroSD to SD Card Adapter | MicroSD Card to SD Card Adapter |       |
| PC                         | Personal Computer (PC)          |       |

## 19.2. Materials

| Quantity       | ID                         | Name  | Description  | Notes |
|----------------|----------------------------|---|--|-------|
| 1 part         | ramps-board                | RAMPS 1.4 Board                               | RAMPS 1.4 Board v1.0.0                               |       |
| 1 as needed    | electrical-tape            | Electrical Tape                               | Electrical Tape v1.0.0                               |       |
| 1 part         | 16gb-microsd-card          | 16GB MicroSD Card                             | 16GB MicroSD Card v1.0.0                             |       |
| 1 part         | 24v-power-supply           | 24v Power Supply Module                       | 24V Industrial Power Supply Module v1.0.0            |       |
| 1 part         | arduino-mega-2560          | Arduino Mega 2560                             | Arduino Mega 2560 v1.0.0                             |       |
| 1 part         | electrical-cord            | Three Prong Electrical Cord                   | Electrical Cord (NEMA 5-15P) v1.0.0                  |       |
| 1 part         | electrical-plug            | Two Prong Electrical Plug                     | Electrical Plug (NEMA 1-15) v1.0.0                   |       |
| 1 applications | electrical-solder          | Electrical Solder                             | Rosin Core Lead Free Electrical Solder v1.0.0        |       |
| 20 part        | ferrule                    | Ferrule                                       | Wire Ferrule v1.0.0                                  |       |
| 1 part         | gfci                       | GFCI  | Ground Fault Connection Interrupter (GFCI) v1.0.0    |       |
| 1 part         | heat-shrink-tubing         | Heat Shrink Tubing                            | Heat Shrink Tubing v1.0.0                            |       |
| 1 part         | lever-wire-nut             | Lever Wire Nut                                | 2 Connection Lever Wire Nut v1.0.0                   |       |
| 1 part         | microsd-to-sd-card-adapter | MicroSD to SD Card Adapter                    | MicroSD Card to SD Card Adapter v1.0.0               |       |
| 1 part         | raspberry-pi               | Raspberry Pi Computer                         | Raspberry Pi Model 4B v1.0.0                         |       |
| 1 part         | reprap-controller          | RepRap Discount Full Graphic Smart Controller | RepRap Discount Full Graphic Smart Controller v1.0.0 |       |

| Quantity   | ID                                    | Name                                  | Description                                     | Notes |
|------------|---------------------------------------|---------------------------------------|---|-------|
| 1 part     | solid-state-relay                     | Solid State Relay (SSR)               | 40A Solid State Relay (SSR-40DA) v1.0.0         |       |
| 1 part     | split-wire-loom                       | Split Wire Loom                       | 1/2 Inch Flame Retardant Split Wire Loom v1.0.0 |       |
| 1 part     | case                                  | Universal Controller Case             | Universal Controller Case v1.0.0                |       |
| 20 part(s) | zip-tie-large                         | Large Zip Tie                         | 8 Inch Zip Tie v1.0.0                           |       |
| 20 part(s) | zip-tie-small                         | Small Zip Tie                         | 4 Inch Zip Tie v1.0.0                           |       |
| 5 part(s)  | a4988-stepper-motor-driver            | A4988 Stepper Motor Driver            | A4988 Stepper Motor Driver v1.0.0               |       |
| 15 part(s) | jumper                                | Jumper Cap                            | 2.54mm Jumper Cap v1.0.0                        |       |
| 2 part(s)  | 10-pin-idc-connector                  | 10 Pin IDC Conector                   | 10 Pin IDC Connector Cable v1.0.0               |       |
| 1 part     | ramps-1_4-smart-adapter               | RAMPS 1.4 Smart Adapter               | RAMPS 1.4 Smart Adapter v1.0.0                  |       |
| 1 image    | marlin-firmware                       | Marlin Firmware                       | Marlin Firmware v1.0.0                          |       |
| 1 image    | octoprint-raspberry-pi-software-image | Octoprint Raspberry Pi Software Image | Octoprint Raspberry Pi Software Image v1.0.0    |       |

## 19.3. Precautions

- **Soldering Iron:** A Soldering Iron gets very very hot and can burn you! Follow all of the manufacturer recommended safety precautions when using a Soldering Iron!
- **Electrical Solder:** Rosin Core Lead Free Electrical Solder can contain toxic chemicals! Always work in a well ventiated area and use personal protection equipment!

## 19.4. Procedure

### 19.4.1. Clean 3D Printed Parts

#### Instructions

1. Use the **Hobby Knife** to clean any extra plastic off of the 3D printed components.

## 20. Assemble D3D Pro 3D Printer

### 20.1. Materials

| Quantity | ID                          | Name                        | Description                               | Notes |
|----------|-----------------------------|-----------------------------|---|-------|
| 1 module | universal-controller        | Universal Controller        | Universal Controller Assembly v1.0.0      |       |
| 1 module | universal-gearless-extruder | Universal Gearless Extruder | Universal Gearless Extruder Module v1.0.0 |       |
| 2 module | universal-axis-z            | Universal Z Axis            | Universal Z Axis Module v1.0.0            |       |
| 1 module | universal-axis-y2           | Universal Y2 Axis           | Universal Y2 Axis Module v1.0.0           |       |
| 1 module | universal-axis-y1           | Universal Y1 Axis           | Universal Y1 Axis Module v1.0.0           |       |
| 1 module | universal-axis-x            | Universal X Axis            | Universal X Axis Module v1.0.0            |       |
| 1 module | fast-heated-bed             | Fast Heated Bed             | Fast Heated Bed Module v1.0.0             |       |
| 1 module | universal-frame             | Universal Frame             | Universal Frame Module v1.0.0             |       |

## 20.2. Procedure

### 20.2.1. Throw Universal Gearless Extruder out the window

#### Instructions

1. Hello World!