D3D Pro 3D Printer Assembly Instructions

Table of Contents

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 permenent 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 Rebar Stake v1.0.0	
12 part(s)	m6-20mm-screw	M6 x 20mm Screw	M6 x 20mm Socket Head Cap Screw 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 Connector	Universal Frame Corner Connector Left v1.0.0	
2 part(s)	corner-connector-right	Right Corner Connector	Universal Frame Corner Connector 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 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 Rebar Stake v1.0.0	
12 part(s)	m6-20mm-screw	M6 x 20mm Screw	M6 x 20mm Socket Head Cap Screw 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 Corner Connector 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 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 ventialted 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 permenent 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 Universal Axis Motor Side Module

10.1. 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	

Name	Description	Notes
Hobby Knife	Hobby Knife	

10.2. 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	

10.3. 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.

10.4. Procedure

10.4.1. Clean 3D Printed Parts

Instructions

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

10.4.2. 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.

11. Assemble Universal Axis Idler Side Module

11.1. Tools

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

11.2. 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	
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	

11.3. 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.

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 Idler Side** part.

11.4.2. 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.

12. Assemble Universal X Axis Module

12.1. 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	

12.2. 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	

Quantity	ID	Name	Description	Notes
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	

12.3. Procedure

12.3.1. Clean 3D Printed Parts

Instructions

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

12.3.2. 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**.

12.3.3. 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.

13. Assemble Universal Y1 Axis Module

13.1. 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	

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 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	
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	

Quantity	ID	Name	Description	Notes
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 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**.

13.3.3. 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.

14. Assemble Universal Y2 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	

Quantity	ID	Name	Description	Notes
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	

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 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**.

14.3.3. 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.

15. Assemble Universal Z Axis Module

15.1. 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	

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 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	
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	

Quantity	ID	Name	Description	Notes
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. 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.

15.4. Procedure

15.4.1. Clean 3D Printed Parts

Instructions

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

15.4.2. 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**.

15.4.3. 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.

16. Assemble Hot End Assembly

16.1. Tools

Name	Description	Notes
1.5mm Allen Wrench	1.5mm Allen Wrench	
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	

Name	Description	Notes
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.

16.2. 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	

16.3. Precautions

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

16.4. Procedure

16.4.1. Assemble the Volcano Style Heater Block

Instructions

1. Unpack required parts from bag.

   [IMG 3425]

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**.

   [IMG 3428] [IMG 3429]

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.

   [IMG 3430] [IMG 3431]

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**.

   [IMG 3432] [IMG 3433]

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**.

   [IMG 3434] [IMG 3435] [IMG 3436]

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**.

   [IMG 3438]

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.

   [IMG 3439]

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.

   [IMG 3440]

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**.

   [IMG 3441] [IMG 3442]

16.4.2. 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**.

[IMG 3444]

2. Attach the **Heater Cartridge** wires onto the output of the **24v Power Supply** and power on the **24v Power Supply**.

[IMG 3445] [IMG 3446] [IMG 3447] [IMG 3448] [IMG 3449] [IMG 3450] [IMG 3452]

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**.

[IMG 3453] [IMG 3454] [IMG 3455]

5. Once tightened, turn off the **24v Power Supply**.
6. Disconnect the **Heater Cartridge** from the **24v Power Supply**.

16.4.3. 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.

[IMG 3457]

3. Screw the **M6 Thin Nut** onto the **Heat Break** until the **M6 Thin Nut** is near the gap on the **Heat Break**.

[IMG 3458] [IMG 3459]

4. Apply one drop(s) of **Thermal Paste** to the threads of the **Heat Break** and spread the **Thermal Paste** evenly across the threads.

[IMG 3460]

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**.

[IMG 3461]

6. Screw the **Heatsink Block** onto the **Heat Break** so that the **Heat Break** sticks out 2mm above the **Heatsink Block**.

[IMG 3462]

7. Line up the wider sides of the **Heatsink Block** and the **Volcano Style Heater Block**.

[IMG 3463]

8. Tighten the **M6 Thin Nut** against the **Heatsink Block** using **Slip Joint Pliers**.

[IMG 3464]

9. Remove the **Hot End Assembly** from the **Metal Jaw Vise**.

   [IMG 3465]

10. Place the **Volcano Style Heater Block Silicone Sock** onto the **Volcano Style Heater Block**.

    [IMG 3466]

11. The **Hot End Assembly** is complete.

17. Assemble Universal Gearless Extruder Module

17.1. 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	

17.2. 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	
1 part	extruder-spring	Extruder Spring	10mm Outer Diameter 35mm Long 1.2mm Thick Compression Spring v1.0.0	

Quantity	ID	Name	Description	Notes
1 part	height-sensor	Height Sensor	LJ18A3-8-Z-BY-5V Proximity Switch v1.0.0	
1 part	hot-end-assembly	Hot End Assembly	Hot End Assembly v1.0.0	
4 part(s)	m3-20mm-screw	M3 x 20mm Screw	M3 x 20mm Socket Head Cap Screw v1.0.0	
2 part(s)	m3-30mm-screw	M3 x 30mm Screw	M3 x 30mm Socket Head Cap Screw v1.0.0	
4 part(s)	m3-8mm-screw	M3 x 8mm Screw	M3 x 8mm Socket Head Cap Screw v1.0.0	
1 part(s)	m6-25mm-screw	M6 x 25mm Screw	M6 x 25mm Socket Head Cap Screw v1.0.0	
1 part	m6-nut	M6 Nut	M6 Nut v1.0.0	
1 part	motor-mount	Motor Mount	Universal Gearless Extruder Motor Mount Part v1.0.0	3D Printed Part
1 part	split-wire-loom	2 Meter Split Wire Loom	1/2 Inch Flame Retardant Split Wire Loom v1.0.0	
1 part	spring-tensioner	Spring Tensioner Arm	Universal Gearless Extruder Spring Tensioner Arm v1.0.0	3D printed part
1 part	stepper-motor	Nema 17 Stepper Motor	Nema 17 0.5Nm Stepper Motor v1.0.0	
1 part	stepper-motor-cable	2 Meter Stepper Motor Cable	Stepper Motor Wire 4 Pin Dupont to 6 Pin 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	

17.3. Procedure

17.3.1. 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**.

   [IMG 3503]

3. Insert the **Nema 17 Stepper Motor** into the **Motor Mount** with the mounting holes on both parts lined up.

   [IMG 3504] [IMG 3505]

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**.

   [IMG 3506] [IMG 3507] [IMG 3508]

17.3.2. 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 remaing open mounting holes in the **Secondary Extruder Part**.

17.3.3. 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.

17.3.4. 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.

17.3.5. 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**.

17.3.6. 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.

17.3.7. 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**.

17.3.8. 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**.

18. Assemble Universal Controller Assembly

18.1. Tools

Name	Description	Notes
3mm Flat Head Screwdriver	3mm Flat Head Screwdriver	
Phillips Head #2 Screwdriver	#2 Phillips Head Screwdriver	

Name	Description	Notes
Hobby Knife	Hobby Knife	
Scissors	Scissors	
Helping Hands	Helping Hands Clamp Stand	
Soldering Iron	Soldering Iron	
Ferrule Crimper	Wire Ferrule Crimper	
MicroSD to SD Card Adapter	MicroSD Card to SD Card Adapter	
PC	Personal Computer (PC)	

18.2. 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	

Quantity	ID	Name	Description	Notes
1 part	reprap-controller	RepRap Discount Full Graphic Smart Controller	RepRap Discount Full Graphic Smart Controller v1.0.0	
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	

18.3. 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 ventialted area and use personal protection equipment!

18.4. Procedure

18.4.1. Clean 3D Printed Parts

Instructions

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

19. Assemble D3D Pro 3D Printer

19.1. 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	

19.2. Procedure

19.2.1. Throw Universal Gearless Extruder out the window

Instructions

1. Hello World!