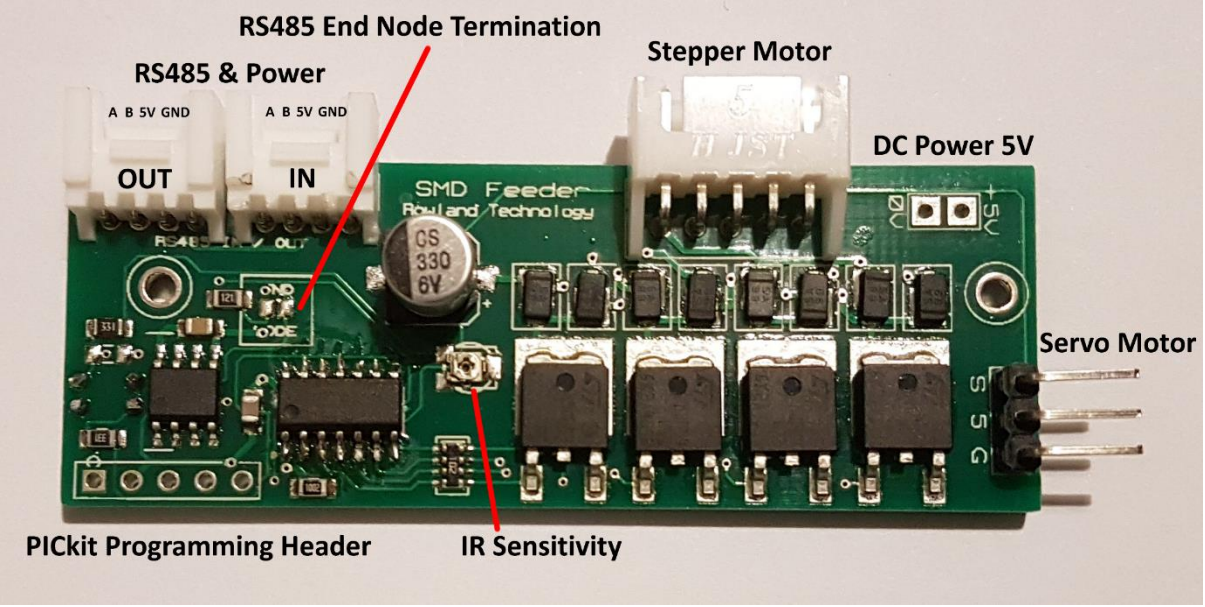
Pick and Place Component Feeder

A 3D printed pick and place component feeder with intelligent IR based automatic movement or RS485 controlled manual movement.

Features the following:

- RS485 control allowing up to 256 feeders to be linked together and independently controlled from the same RS485 host
- Infra-Red reflective beam for automatic pickup sensing
- User set parameters allowing for a wide range of operation modes
- Stable and repetitive operation
- Metal spike to move the component tape without risk of wear
- Quick release mounting onto 5mm threaded rod or 5mm bolts (not supplied)

Control PCB Layout



Grove Cable RS485 Connections

Using a standard Grove cable to connect the RS485 the connections are in the following order.

Yellow – A
White – B
Red – 5V
Black - GND

Powering

The feeder requires a 5V DC power supply to operate, this can be wired into one of the feeder PCBs or can be supplied via one of the RS485 data cables.

The RS485 data cables are standard 4-way Grove cables that can be purchased from a number of vendors.

Command Interface

The RS485 interface is designed to be as simple as possible with three commands, each beginning with a ':' character and ending with a '\n' character. The RS485 baud rate is set at 9600 bps. A standard USB to RS485 adapter can be used to drive the RS485 interface from a computer. The address byte has the default value of 1 but can be altered by using the Parameter write command with the Index 0.

Move Command

The Move command consists of sending four bytes via the RS485 interface.

':', Address, 'A', '\n'

This will perform the feed operation of moving the component tape and peeling back the component film.

Parameter Write Command

The Parameter Write command consists of sending six bytes via the RS485 interface.

':', Address, 'B', Index, Data, '\n'

This will write to the on-board memory to configure the operation of the feeder.

Index - specifies the memory location

Data - specified the value to write

See the table below for details.

Stepper Move Command

The Stepper Move command consists of sending four bytes via the RS485 interface.

':', Address, 'C', '\n'

This helps to simplify fitting a new component reel by moving the film stepper motor by 1mm. The stepper motor cannot be turned by hand so the move command allows for any slack to be removed from the film before starting any feed operations.

Here is a table of indexes that can be used with the Parameter Write Command.

Index	Description	Default	Scale/Range
0	RS485 Address	1	0-255
1	Min Film Speed	255	1-255
2	Max Film Speed	100	1-255
3	Servo Speed	4	1-255
4	Servo Pull Position	200	128-255
5	Servo Push Position	20	0-128
6	IR Sensor Enable	1	0-1
7	Sensor Threshold	3	1-10
8	Sensor Delay	15	100ms
9	Hole Pitch	4	1mm
10	Film Back Off	2	1mm
11	Feeder Cycles	1	1-255
12	Stepper Revolutions	0	0-255
13	Beep Enabled	1	0-1
14	IR Sensor Filter Enable	1	0-1

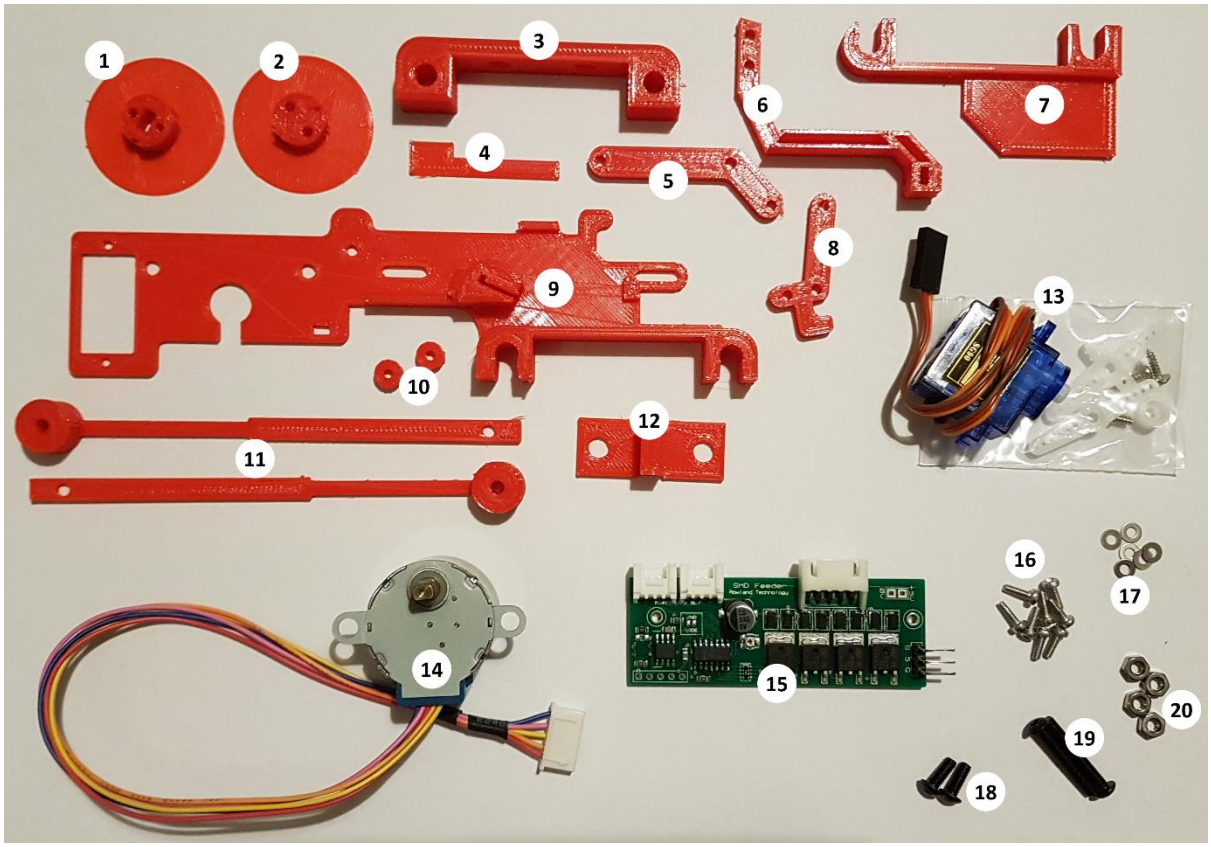
Stepper Motor Film Removal Information

The stepper motor allows a precise amount of film to be removed from the component tape. As the amount of film on the bobbin increases the stepper motor has to travel less for the same amount of film removal. This is automatically calculated for you as the feeder performs its movements. When changing the component reel it is necessary to reset the internal rev counter prior to taking up the slack or performing feed operations. The counter can be reset in two ways.

1. Place your finger near the IR sensor to trigger the feed operation, keep your finger in place until the feed operation is complete and the feeder will beep a second time to indicate the counter has been reset.
2. Use the RS485 parameter write command to reset the counter, Index = 12, Data = 0.

Parts List

1. Film Bobbin – Motor Side
2. Film Bobbin – Screw Side
3. Mount
4. Spring – 3 different sizes supplied with the kit
5. Control Arm
6. Push Arm
7. Sub Frame
8. Pivot Arm
9. Main Frame
10. PCB Spacer x 2
11. Reel Holder x 2
12. Reel Mount
13. Servo Motor and Accessories
14. Stepper Motor
15. Control PCB
16. M2 Bolts 8mm x 7
17. M2 Bolt 10mm x 2
18. M2 Washers x 8
19. M2 Nuts x 9
20. M3 Bolts 16mm x 2
21. M3 Bolts 20 - 30mm x 2
22. M3 Nuts x 4
23. Modelling Wire 100mm x 1
24. 14mm Tack x 1



Build Instructions

The feeder is supplied in pre-built or kit form. The kit must be assembled following the instructions below. The kit is simple to assemble but take care when assembling to ensure you end up with a fully functional and reliable feeder.

You will need

To assemble the kit you will need the following tools.

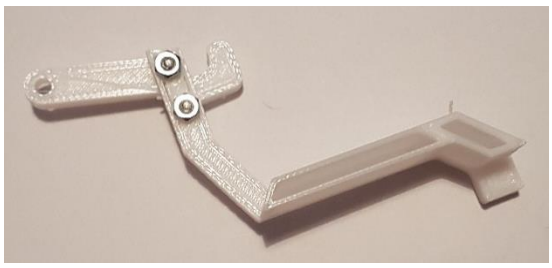
- Plyers
- Thread Lock – Blue Recommended
- Small Phillips (Posi Drive) Screwdriver

The Mechanism
Step 1

Parts: Push Arm, Pivot Arm, 2 x M2 8mm Bolt, 2 x M2 Nut

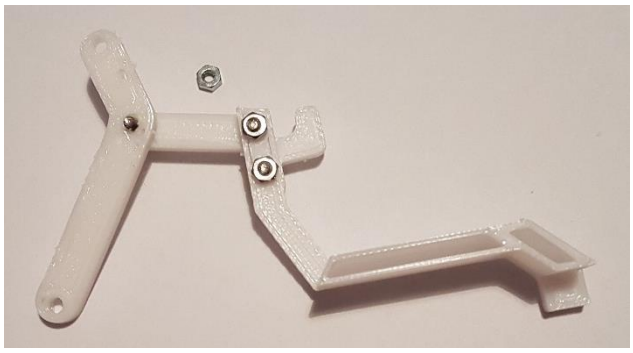
Note the orientation of the bolts through the Pivot Arm.

Connect the arms together and tighten.



Step 2

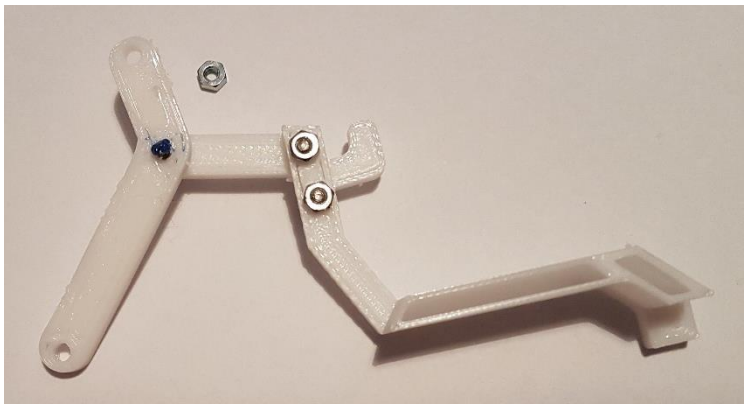
Parts: Control Arm, M2 8mm Bolt, M2 Nut, M2 Washer x 3



Note the orientation of the bolts through the Control Arm and Pivot Arm.

Add washers to each face of the plastic.

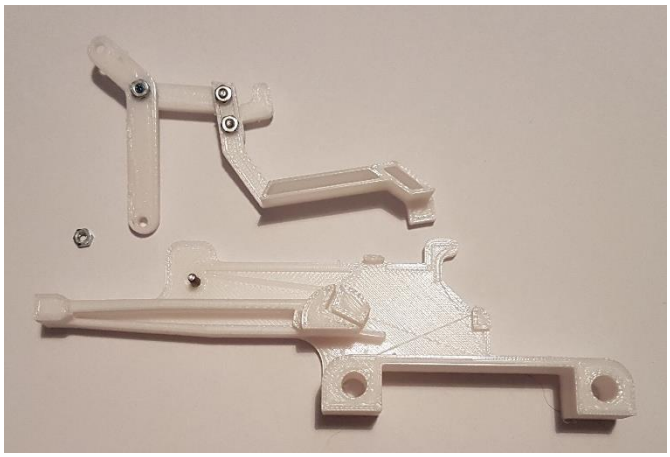
Apply Blue Threadlock to the bolt where the nut will sit and add the nut.



This joint should be reasonably stiff. It needs to be allowed to move but not too freely.

Step 3

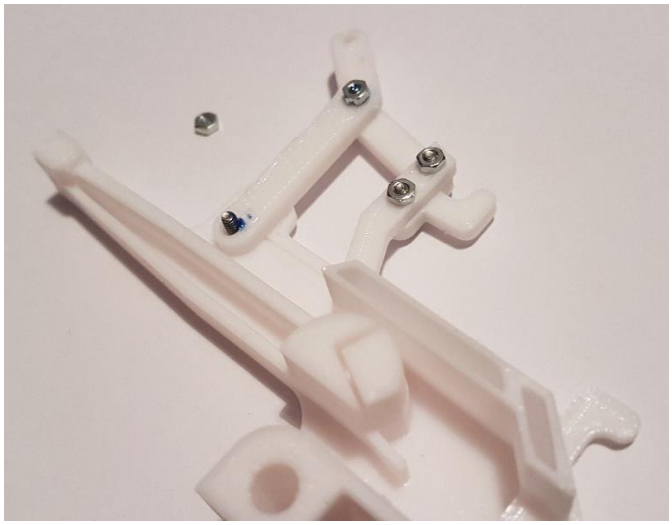
Parts: Frame, M2 8mm Bolt, M2 Nut, M2 Washer x 3



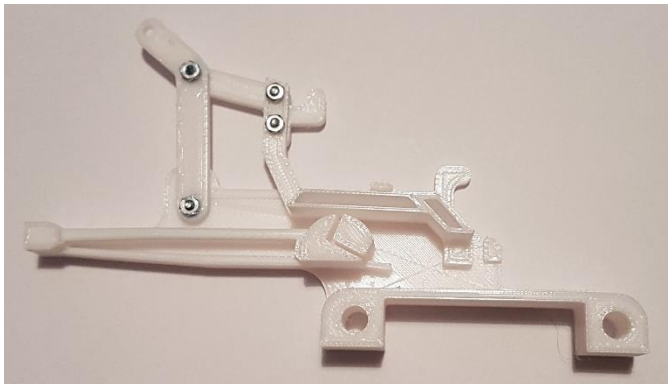
Note the orientation of the bolts through the Frame and Control Arm.

Add washers to each face of the plastic.

Apply Blue Threadlock to the bolt where the nut will sit and add the nut.

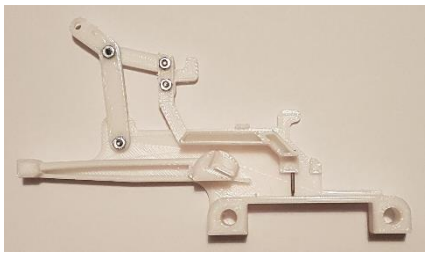


This joint should be reasonably loose. It needs to be free to move but not loose enough to twist.



Step 4
Parts: Push Pin

Insert Push Pin all the way down into hole in Push Arm



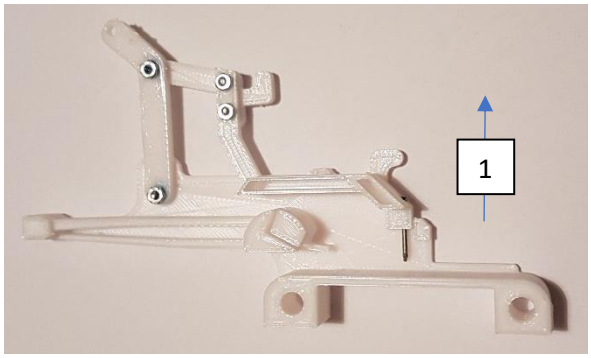
Place a M2 nut into the slot in the push arm and insert a M2 8mm bolt to hold the push pin firmly in place. Do not over tighten.

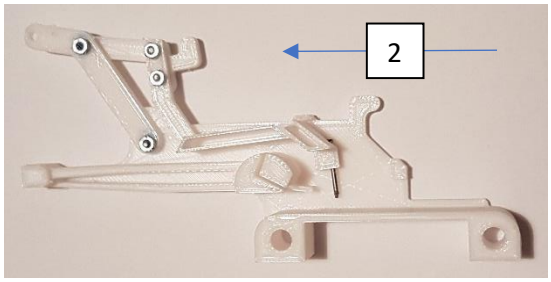
Before you continue test the mechanism to make sure it operates correctly.

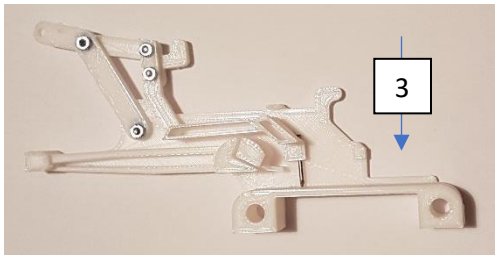
The mechanism must move following the four numbered steps below in order.

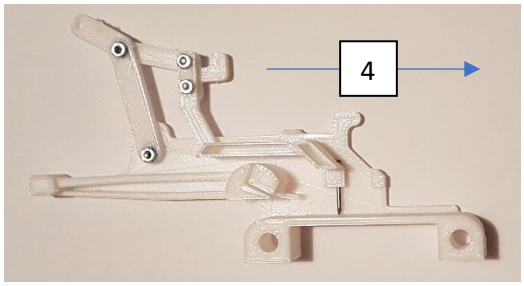
Steps 1 and 2 occur with the control arm moving away from the pickup plate.

Steps 3 and 4 occur with the control arm moving towards the pickup plate.









If the order is not quite right and repeatable then try tightening the Control Arm / Pivot Arm bolt.

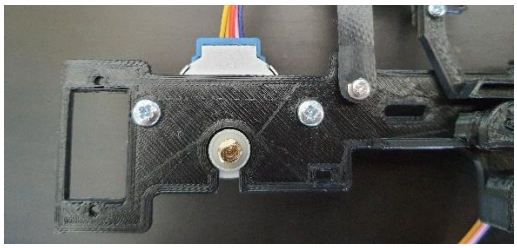
If the mechanism is hard to move then ensure the Frame / Control Arm bolt is loose and try slightly loosening the Control Arm / Pivot Arm bolt.

If the mechanism is unstable and the Control Arm wobbles then try slightly tightening the Frame / Control Arm bolt.

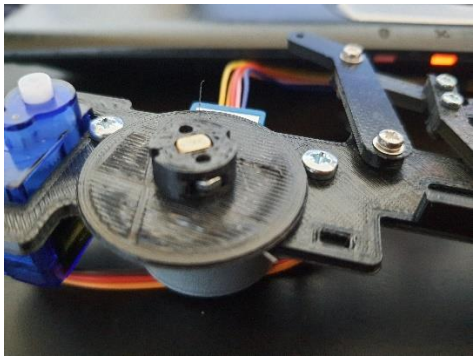
Ensure that no nuts come loose when operating the mechanism, If they do then you may need more thread lock on the bolts or allow the thread lock some time to dry.

The Motors

Connect the stepper motor to the frame using the two M3 16mm bolts and two M3 nuts.

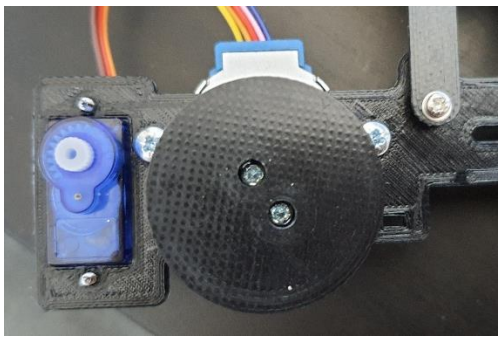


Push the bobbin onto the stepper motor using a flat surface being careful not to apply too much pressure and damage the bobbin.

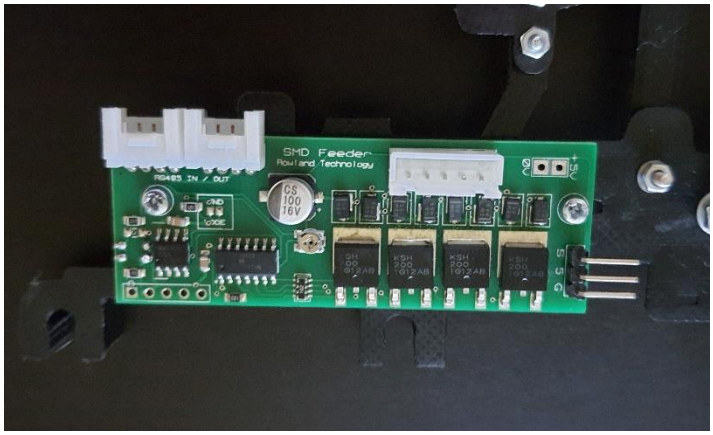


Insert the M2 nuts into the slots in the bobbin and insert two M2 10mm bolts into the other side of the bobbin. Place the two halves of the bobbin together and loosely tighten the bolts to hold the two halves together.

Attach the servo motor to the frame with the motor shaft towards the top of the frame using the screws supplied in the servo motor kit.



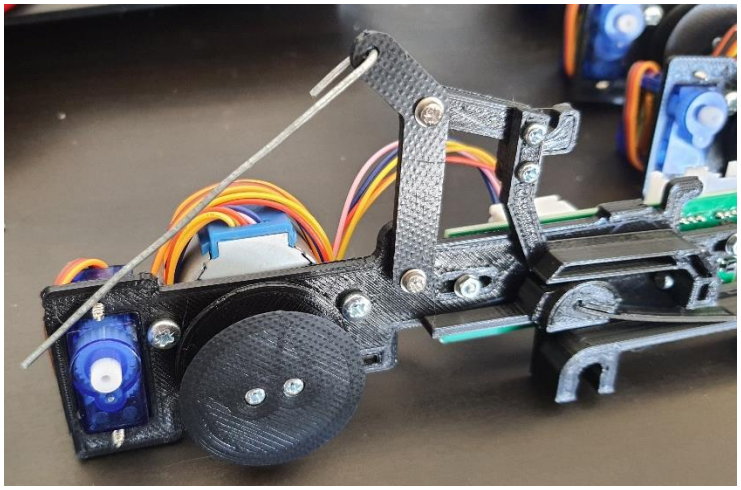
Add the PCB to the back of the frame using 2 x M2 8mm bolts, 2 x M2 Washers, 2 x 3D printed spacers and 2 x M2 nuts. The order should be Bolt, PCB, Spacer, Frame, Washer, Nut. Don't overtighten the nuts.



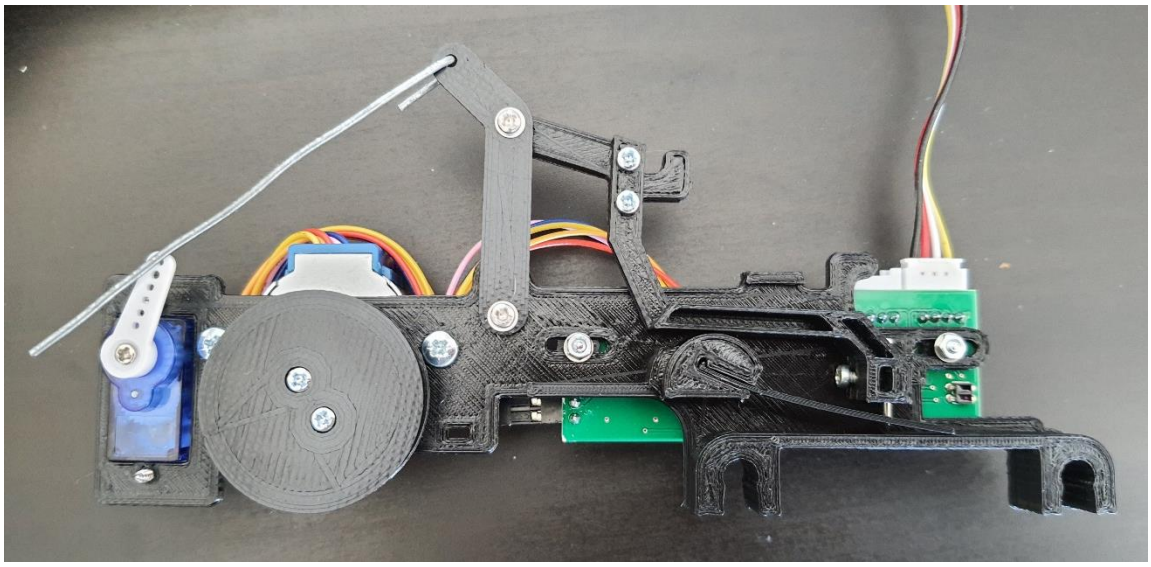
Connect the stepper and servo wires onto the PCB, double check the orientation of the servo motor connector, the pin marked G is the Brown wire on the motor. You can wrap the wires around the stepper to help keep them out of the way. You can also tie band the wires to the frame if needed to keep them tidy.

Open up one of the holes in the short servo arm using a 1mm drill bit or small screwdriver to allow the modelling wire to pass through the hole. Recommend using the 2nd hole from the end as shown.

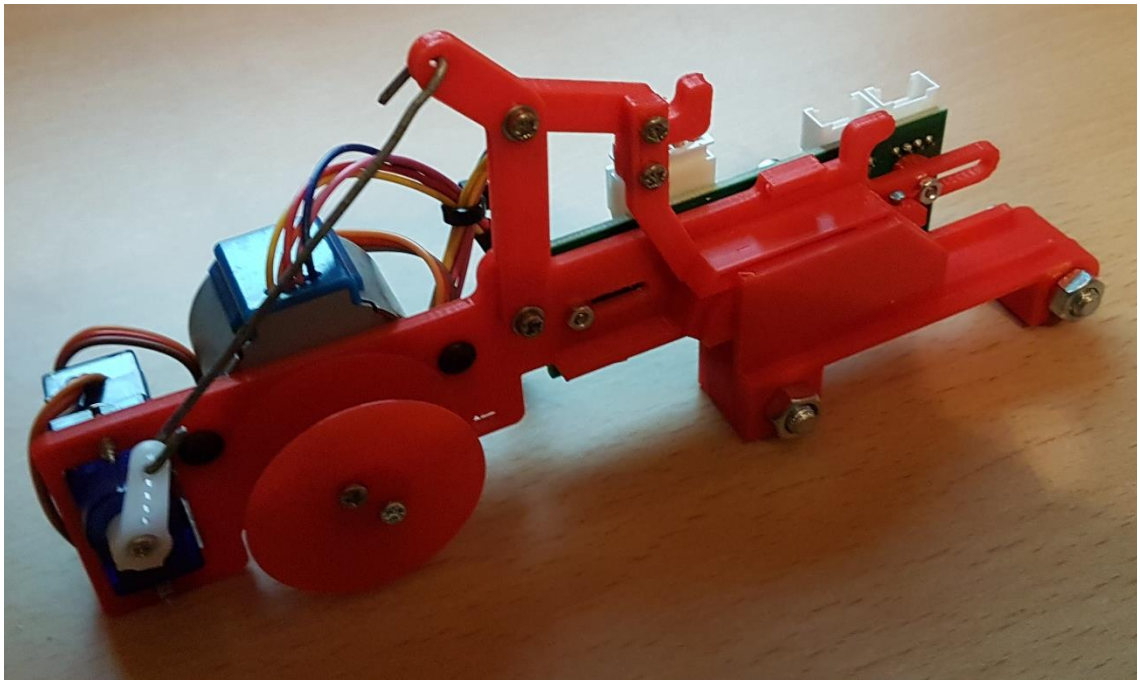
Put the wire through the hole in the control arm and using plyers loosely bend the wire to hold it in place on the arm.



Power up the circuit board by connecting 5V and Ground either to the DC power holes on the PCB or via the RS485 connection. Place a finger in front of the IR sensor to trigger the movement. Once the motors have moved you can power down again. The servo motor is now in the correct position to fit the servo horn and screw into place.



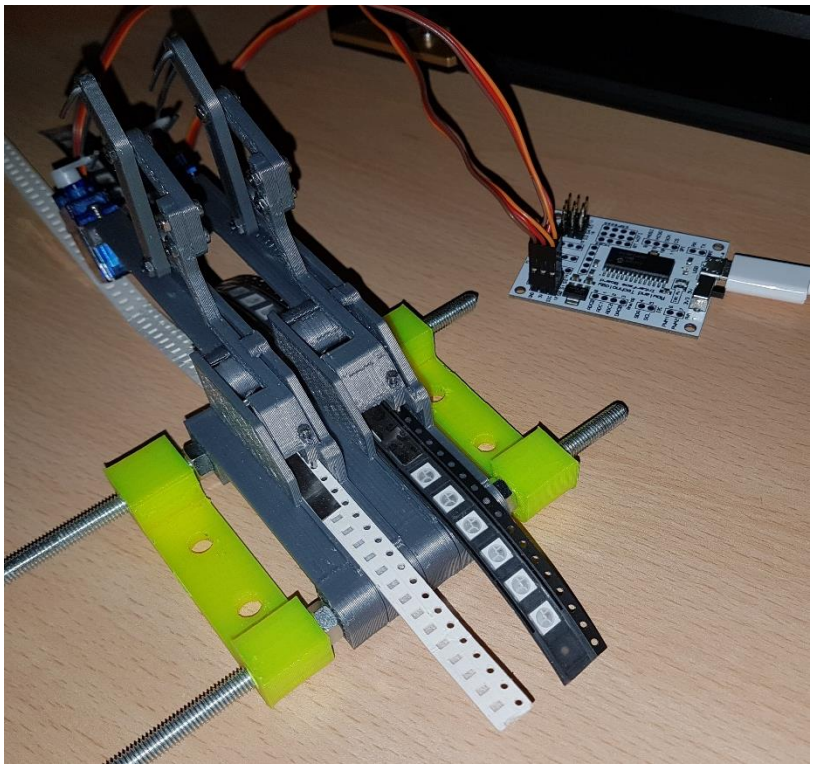
Taking care that the control arm is at the far end of movement carefully bend the wire using plyers to go through the hole in the servo motor horn.



Mounting

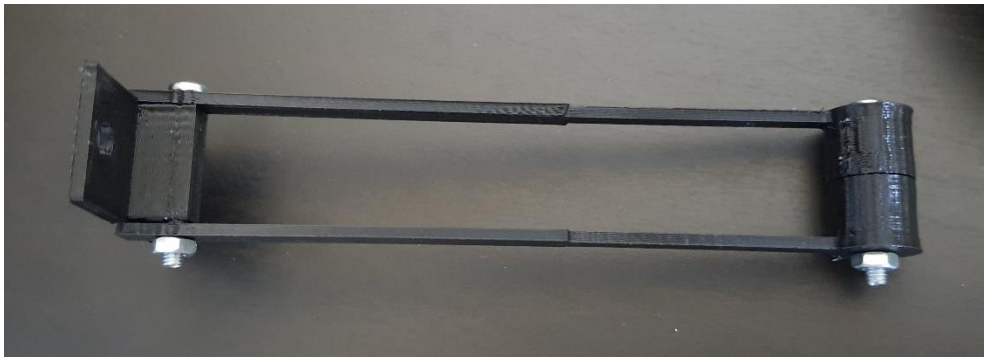
The component feeder comes with a single mounting part that can be screwed or bolted down directly to the PnP table or can be fitted onto a standard aluminium extrusion. Two M5 bolts (not supplied) can be used to connect the feeder to the mount.

For multiple feeders two mounting parts can be used to hold 5mm threaded rod (not supplied). The feeders can then clip onto place on the rod and be secured using M5 washers and nuts.



The reel holder

The reel holder requires 2 x M3 bolts sized 20mm to 30mm depending on the size of your feeder kit and 2 x M3 nuts. Simply connect the four parts together using the nuts and bolts.

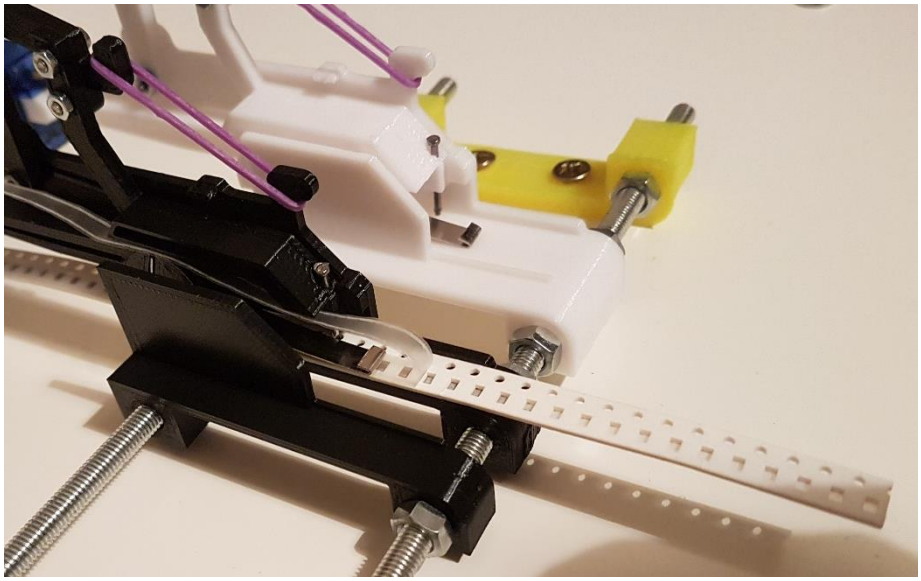


New reels can be added and removed by unbolting the top bolt and gently bending apart the two arms.

Adding SMD Component Tape

Pull back the control arm using the servo motor and feed a length of tape through the feeder.

A new feeder will have some waste parts as you need a length of the film. You can always attach a scrap of spare film with tape to help reduce wastage.



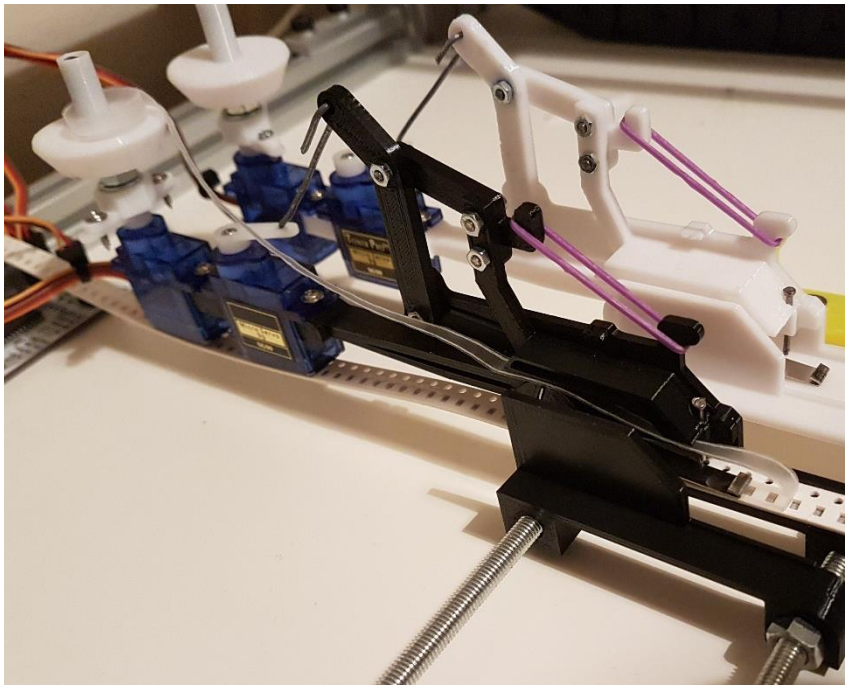
Peel back the film and loosen the Frame Clamp from the Frame.

Fold the Frame Clamp out of the way

Feed the film back above the Spring Steel but below the Push Arm.

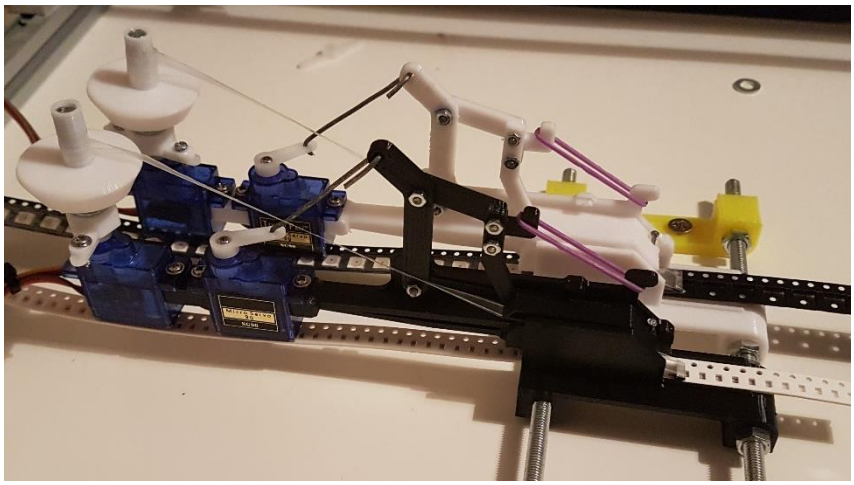
Tape the end of the film onto the Film Bobbin.

The film should wrap around the bobbin anti-clockwise when viewed from the top of the bobbin.



Put the control arm back into the forward position to clamp the tape in place.

Wind the bobbin anti-clockwise until the film is fully pulled back to the Spring Steel.



To check the bobbin tension wind a bit more anti-clockwise so that the film is under tension and then let go of the bobbin. It should spin back to release the tension. If the tension remains on the film then it may be worth slightly bending out the Spring Steel tensioner.

If the bobbin turns with very little force then it may be worth slightly bending in the Spring Steel tensioner.

Be careful when adjusting the tension of the bobbin a little goes a long way. To adjust simply pull the bobbin off the motor shaft, remove the Spring Steel pieces and gently bend them slightly by hand.

Different types of SMD component tape may require different bobbin tensions. A nut with Threadlock added to the end of the Bobbin shaft can be useful to adjust the tension on the film without having to remove and adjust the Spring Steel inside the Bobbin.

Add the rubber band as shown to enhance the Pull power of the feeder.