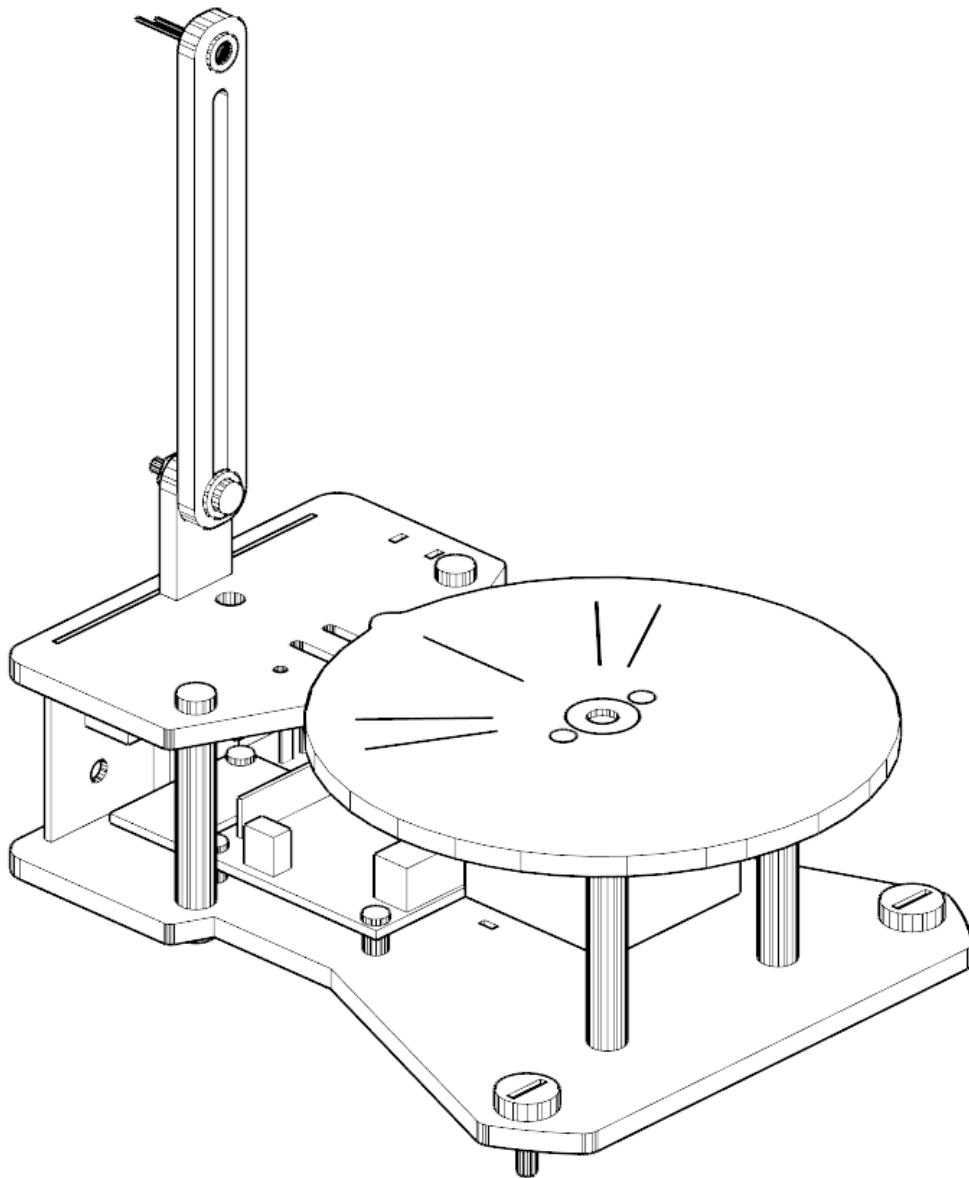


**TriAngles™ 3D Circumference Scanner**  
**Turn Table Assembly Instructions V2**



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TriAngles 3D Scanner Turn Table Version 2 PUBLICATION

TriAngles 3D Scanner Turn Table Version 2 DESIGN

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**DO NOT LOOK INTO LASER BEAM**

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## Table of Contents

### Overview

<b>1. Introduction</b>	<b>4</b>
<b>2. Tools</b>	<b>5</b>
<b>3. Parts List</b>	<b>5</b>
<b>4. General Guidelines</b>	<b>6</b>

### Electrical Assembly

<b>5. Electrical Overview</b>	<b>7</b>
<b>6. Control Panel</b>	<b>7</b>
<b>7. Power Jack</b>	<b>9</b>
<b>8. Stepper motor</b>	<b>9</b>

### Mechanical Assembly

<b>9. Populate Control Panel</b>	<b>10</b>
<b>10. Stepper Motor Hub</b>	<b>11</b>
<b>11. Populate Base Plate</b>	<b>12</b>
<b>12. Mount Control Panel</b>	<b>16</b>
<b>13. Mount Support Plate</b>	<b>17</b>
<b>14. Functions test</b>	<b>21</b>

## 1. Introduction

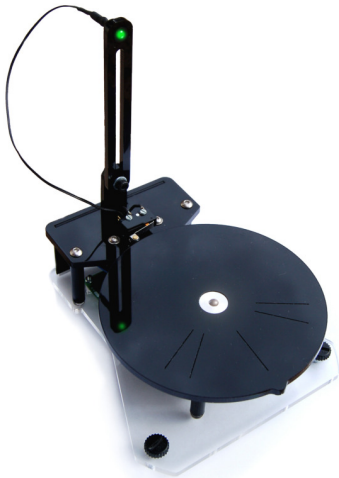
The Scan Turn Table was developed in order to turn an object around in a controlled and consistent fashion during scanning. More precisely, the turn table disc must rotate at a very smooth and consistent speed with minimal wobble. This is important as inconsistent speeds will warp the resulting scan. The unit employs a high quality microstepper driver in order to attain the highest possible turning accuracy.

The Turn Table includes an indicator LED. The LED functions to indicate to the user when the Turn Table disc has completed a full 360 degree rotation. It does this by switching OFF at 0 degrees and switching back ON exactly after the disc has rotated 360 degrees. The LED is controlled via the motor driver. The driver counts the amount of steps incremented after the LED switches OFF. When the amount of steps is equivalent to a full turn it switches the LED back ON.

In addition to the stand alone mode, as described above, the turn table now also includes USB interface support. It is now possible to accurately control each motor step directly from a PC. This added control reduces processing overhead while allowing more accurate scanning.

The Turn Table disc has 5 radial engraved stripes on its surface which serve to align projectors/lasers and camera. The middle line represents the camera position facing the turntable. The 4 other lines are the projector/laser angle positions.

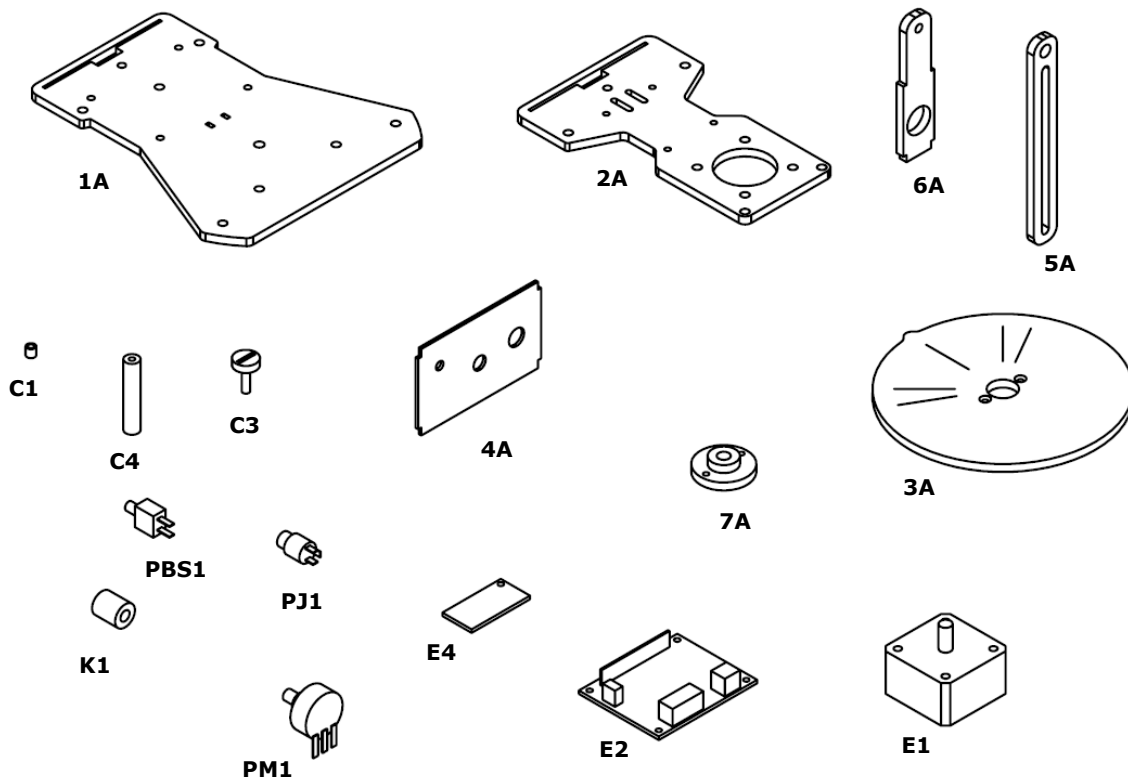
The table was designed for small lightweight objects. However due to the design simplicity it should not be much of a problem to build a larger or a smaller scaled Turn Table to better suit specific scanning needs.



## 2. Tools

1. Screw Driver (flat)
2. Screw Driver (Philips)
3. Small Pliers
4. Glue (contact or super glue)
5. Multimeter (Ohmmeter)
6. Soldering iron with solder
7. Hot air gun for shrink wraps

## 3. Parts List



**Notes: Not all parts drawn. Drawings may differ from actual parts**

**Parts List**

<b>Qty.</b>	<b>Part</b>	<b>Name</b>	<b>Size</b>	<b>Where Used</b>	<b>Remarks</b>
<b>1</b>	<b>1A</b>	<b>Base Plate</b>		<b>Frame</b>	
<b>1</b>	<b>2A</b>	<b>Support Plate</b>		<b>Frame</b>	
<b>1</b>	<b>3A</b>	<b>Disc</b>		<b>Stepper Motor</b>	
<b>1</b>	<b>4A</b>	<b>Control Panel</b>		<b>Frame</b>	
<b>1</b>	<b>5A</b>	<b>LED Bracket</b>		<b>Frame</b>	
<b>1</b>	<b>6A</b>	<b>Bracket Plate</b>		<b>Frame</b>	
<b>1</b>	<b>7A</b>	<b>Hub</b>		<b>Stepper Motor</b>	
<b>1</b>	<b>E1</b>	<b>Stepper Motor</b>		<b>Support Plate</b>	
<b>1</b>	<b>E2</b>	<b>Micro Stepper Motor Driver</b>		<b>Base Plate</b>	
<b>1</b>	<b>E4</b>	<b>USB Circuit</b>		<b>Base Plate</b>	
1	O1	Calibrator			Not used during assembly
8	F1	Bolt	M4x12	Frame	
1	F2	Bolt	6-32 1/2	Led Stand	
1	F3	Nut	6-32	Led Stand	
2	F4	Washer	6-32	Led Stand	
2	F5	Bolt	4-40 1 1/4	Stepper Motor	May differ depending on supplied motor
5	F6	Bolt	4-40 3/4	PCB	
7	F7	Nut	4-40	Stepper / PCB	
7	F8	Washer	4-40	Stepper / PCB	
2	F12	FHMS Flat head Machine Screws		Disk	
3	F13	Nut	M4	Frame	
<b>5</b>	<b>C1</b>	<b>Stand Off</b>	<b>5x5</b>	<b>PCB's</b>	
<b>4</b>	<b>C2</b>	<b>Threaded Spacer (Stand Off)</b>	<b>40x8xM4</b>	<b>Frame</b>	
<b>3</b>	<b>C3</b>	<b>Knurled Adjustment Screw</b>		<b>Frame</b>	
<b>2</b>	<b>C4</b>	<b>Tyrap</b>		<b>Base Plate</b>	
<b>1</b>	<b>PJ1</b>	<b>Power Jack</b>		<b>Control Panel</b>	
<b>1</b>	<b>PM1</b>	<b>Potentiometer</b>		<b>Control Panel</b>	
<b>1</b>	<b>LH1</b>	<b>LED Holder</b>		<b>Led Stand</b>	
<b>1</b>	<b>LED1</b>	<b>LED (green)</b>		<b>Led Stand</b>	
<b>1</b>	<b>PBS1</b>	<b>Push Button Switch</b>		<b>Control Panel</b>	
<b>1</b>	<b>K1</b>	<b>Knob</b>		<b>Potentiometer</b>	

**Note: Only bold listed parts drawn**

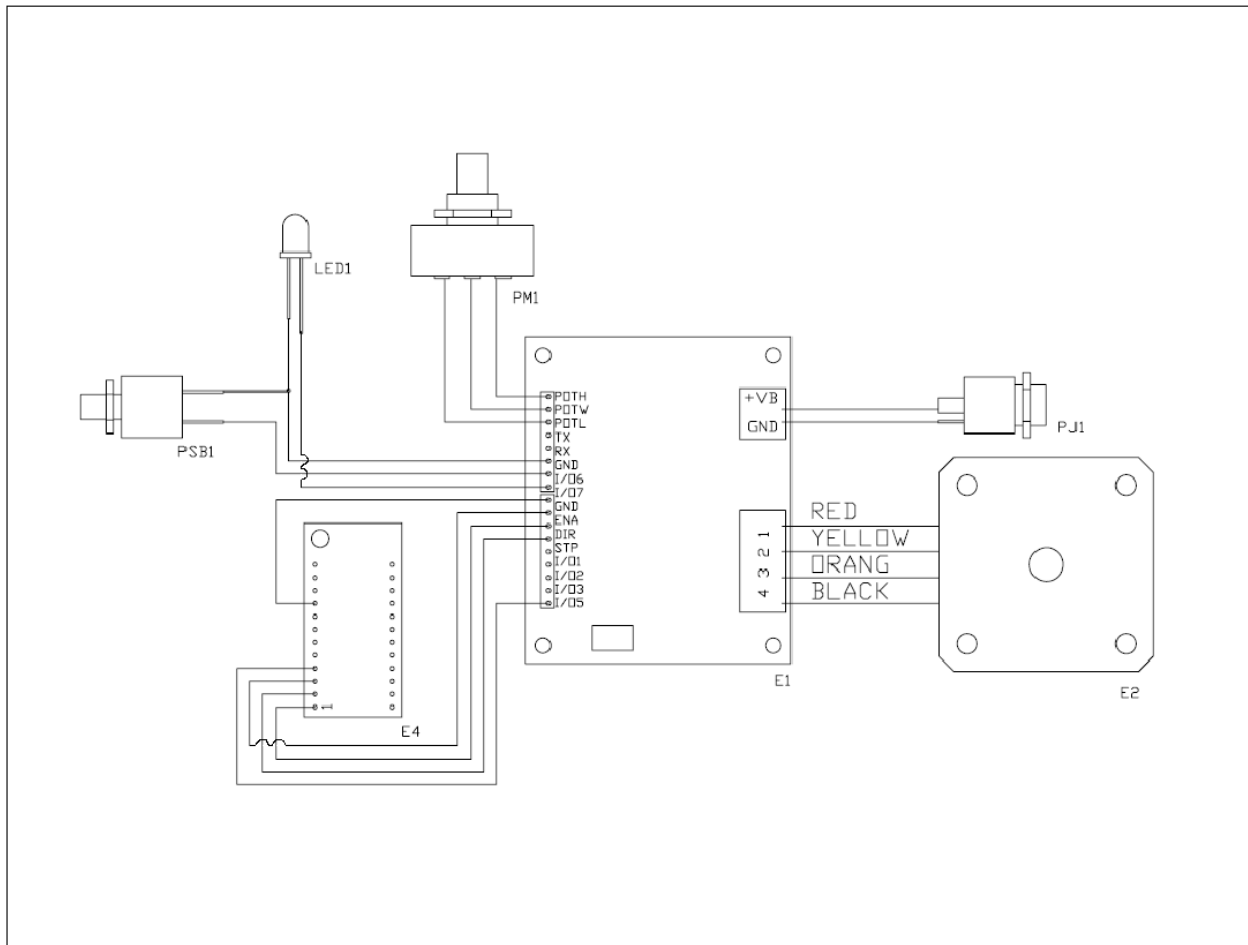
## 4. General Guidelines

6 main aspects should be observed during assembly:

1. The panel material is supplied with a protective layer. This should be removed only when necessary. The base material is not scratch-resistant.
2. Caution should be taken when handling the micro stepping motor driver. The driver is electro-static sensitive. The acrylic panels are an ideal material to induce static electricity, which can damage the driver in case a discharge occurs.
3. The micro stepping motor should never be disconnected from the driver while it is running. This will permanently damage the driver.
4. Before assembly it is advised to first read through the instructions carefully as well as lay out all major parts in position.
5. The control panel may be a bit sticky due to the manufacturing process used. Panels should be cleaned with citrus.
6. Always make sure that copper wire cuttings do not fall onto the electrical boards (PCB). This may lead to short circuits and permanent damage.

## Electrical Assembly

### 5. Electrical Overview



**Note: Some parts may already have been preassembled**

### 6. Control panel

#### Prepare

1. Take the MTA connector with 6 wires attached to it. The wires should be colored: white – yellow – blue – black – white and red. The red cable should be about 3 times longer than the other cables.
2. Strip all wires 3[mm].
3. Apply solder to all 6 wire ends.

#### Solder Potentiometer

1. Cut 3 pieces of shrink sleeve of 10[mm] each

2. Place a piece of shrink sleeve on the 1<sup>st</sup> 3 wires. The wires should be colored: white – yellow and blue
3. Take the Potentiometer (PM1) and place it in front of you with the shaft facing away from you and with the terminal pins facing you.
4. Solder the blue wire to the left terminal pin of the Potentiometer (PM1).
5. Solder the yellow wire to the middle terminal pin of the Potentiometer (PM1).
6. Solder the white wire to the right terminal pin of the Potentiometer (PM1).
7. Slide the 3 shrink sleeves over the terminals.
8. Shrink the 3 shrink sleeves using a hot air gun.

### Solder Push Switch

1. Take the long piece of black wire, the wire should be approximately 260[mm].
2. Strip both ends of the black wire 3[mm].
3. Apply solder to both the wire ends.
4. Cut 2 pieces of shrink sleeve of 10[mm].
5. Find the black wire of the MTA connector.
6. Place both black wires together with the stripped ends facing the same way.
7. Place 1 (one) piece of shrink sleeve over both wires at the same time such that they are held together by the shrink sleeve.
8. Place a piece of shrink sleeve on the unused white wire.
9. Take the Push Button Switch (PBS1) and place it on a work surface.
10. Solder both black wires to one terminal pin of the Push Button Switch (PBS1).
11. Solder the white wire to the remaining terminal pin of the Push Button Switch (PBS1).
12. Slide the 2 shrink sleeves over the terminals.
13. Shrink the 2 shrink sleeves with a hot air gun.

### Solder LED

1. Cut 2 pieces of shrink sleeve 15[mm].
2. Slide a piece of shrink sleeve over the red wire coming from the MTA connector.
3. Slide a piece of shrink sleeve over the black wire coming from the Push Button Switch (PBS1).
4. Take the LED (LED1) and place it on a work surface.
5. Cut the **long** connection pin of the LED (LED1) to a length of 7[mm] and solder the red wire to this pin. Led's will only work if the polarity is correct, therefore it is important to solder the wire to the correct pin.
6. Cut the other connection pin of LED (LED1) to a length of 7[mm] and solder the black wire to this pin.
7. Slide the 2 shrink sleeves over the connections.
8. Shrink the 2 shrink sleeves with a hot air gun.

### Finish

1. Place the assembled Control panel parts in a save place for temporary storage



## 7. Power Jack

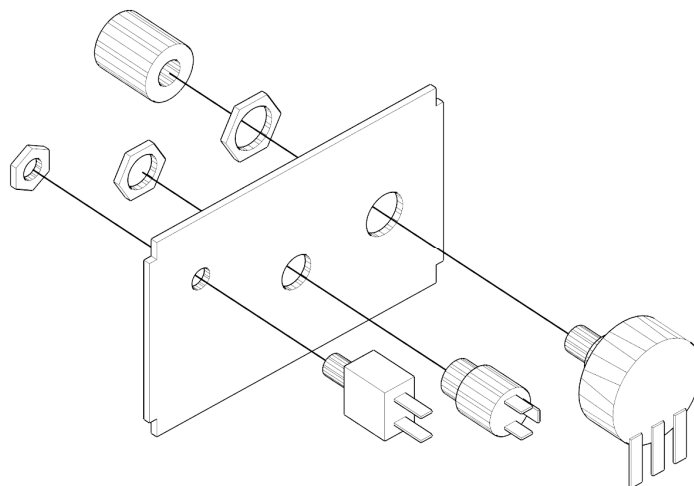
1. Take the short piece of black wire, the wire should be approximately 100[mm].
2. Take a piece of red wire, the wire should be approximately 100[mm].
3. Strip both ends of both wires 3[mm].
4. Apply solder to both stripped ends of both wires.
5. Cut 2 pieces of shrink sleeve 15[mm].
6. Slide a piece of shrink sleeve on the black wire.
7. Slide a piece of shrink sleeve on the red wire.
8. Take the Power Jack (PJ1).
9. Solder the red wire to the terminal pin of the Power Jack (PM1) that is connected to the center pin of the jack. Verify with an ohm meter that the terminal is indeed connected to the center pin. **Incorrect connection can damage the driver board!**
10. Solder the black wire to the terminal pin of the Power Jack (PM1) connected to the outer connection of the jack.
11. The 3<sup>rd</sup> ground connector is not used.
12. Slide the 2 shrink sleeves over the terminals.
13. Shrink the 2 shrink sleeves with a hot air gun.
14. Place the assembled Power Jack in a save place for temporary storage.

## 8. Stepper motor

1. Strip all 4 wires of the stepper motor 3[mm]. Note: the wire lengths may be excessive depending on the motor supplied. If so, cut the wires to a shorter length to accommodate easy connection to the driver board.
2. Apply solder to the stripped ends of the wires.
3. Place the Stepper Motor in a save place for temporary storage.

## Mechanical Assembly

### 9. Populate Control Panel



**Control Panel Components**

#### Prepare

1. Take the Control Panel (4A).
2. Remove the protective layers.
3. Place the Control Panel (4A) such that the larger hole on the side is on the right side while the center hole is slightly lower.
4. Take the previously stored Control Panel Parts.

#### Potentiometer

1. Place the Potentiometer in the right hole of the Control Panel (4A) with the terminals low and fasten the nut. It might be necessary to cut off a pin on the side of the Potentiometer.
2. Bend the 3 terminals of the potentiometer 90° outwards. This is needed to create space for the Base Plate (1A).
3. Place the Knob (K1) over the Potentiometer shaft and fasten it. Note: Depending on the supplied potentiometer it may be required to cut its shaft to accommodate the knob.

#### Push Switch

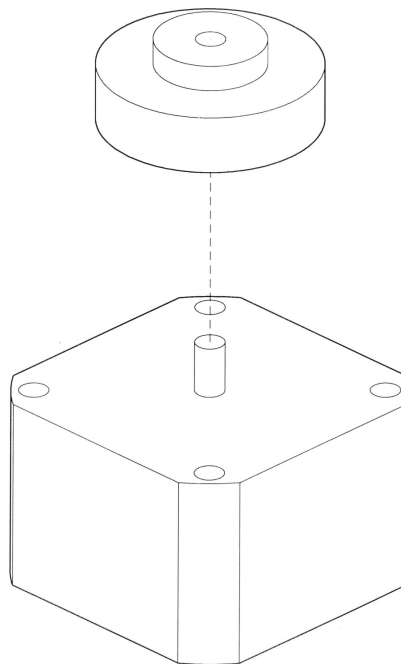
1. Place the Push switch in the left hole of the Control Panel and fasten the nut

#### Power Jack

1. Place the Power Jack in the center hole of the control panel and fasten the nut
2. Place the assembled control panel in a safe place for temporary storage.

## 10. Stepper Motor Hub

1. Take the Stepper Motor and the HUB (7A). **The hub may have already been placed and fixed over the motor shaft by the product distributor. If this is the case do not remove the hub. Please proceed to the next section.**
2. Clean the stepper motor shaft of burrs or debris. If the stepper motor has 2 shafts the larger 5[mm] shaft should be used.
3. Clean the Hub (7A) of burrs or debris.
4. Firmly push the Hub (7A) over the shaft in a controlled fashion. Ensure that the Hub (7a) does not slant over the shaft.
5. Ensure that the Hub does not slip over the shaft and turns without obstructions.

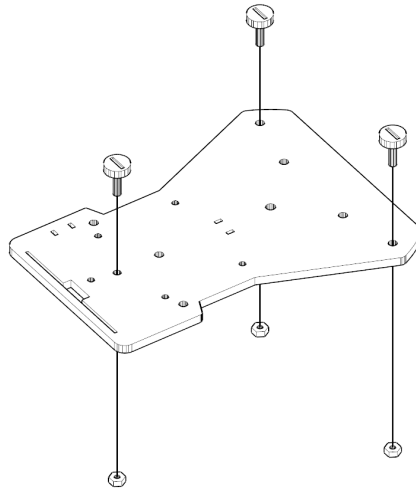


**Note:** Supplied motor may have different dimensions and/or fastening points.

## 11. Populate Base Plate

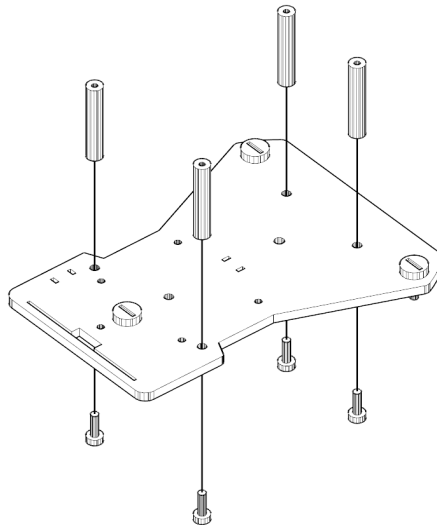
### Mount Pegs

1. Take the Base Plate (1A).
2. Remove the protective layers.



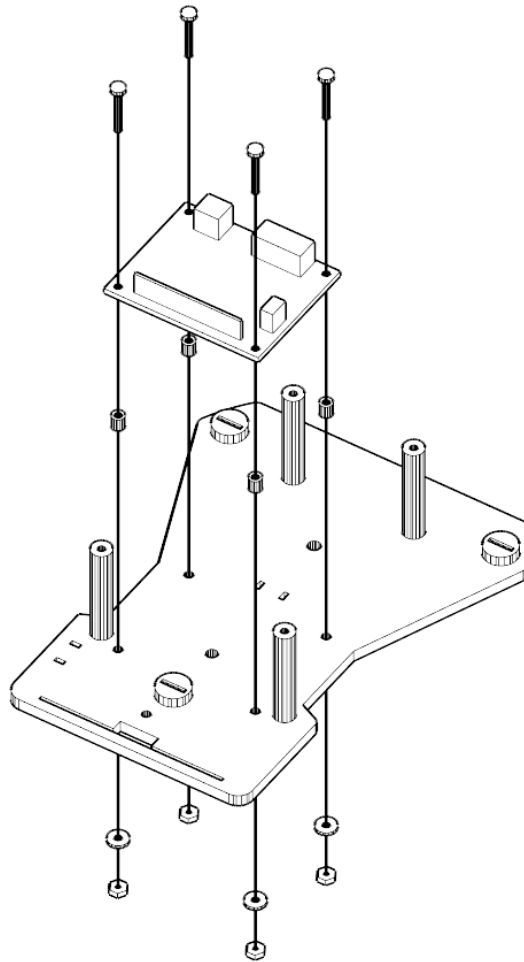
3. Take the 3 Knurled Adjustment Screws (C3).
4. Take 3 nuts (F13).
5. Place the 3 Knurled Adjustment Screws (C3) in the holes in the base plate and fasten them using the Nuts (F13).

### Mount Standoffs



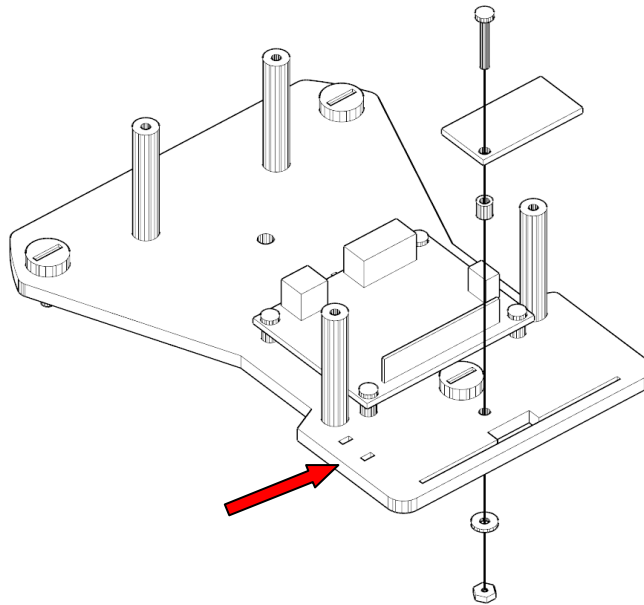
1. Take 4 Standoffs (C2).
2. Take 4 Bolts (F1).
3. Mount the 4 Standoffs (C2) on the Base Plate.

## Mount Micro Stepper Circuit



1. Take 4 Standoffs (C1).
2. Take 4 Bolts (F6).
3. Take 4 Washers (F8).
4. Take 4 Nuts (F7).
5. Take the Micro Stepper Motor Driver (E2).
6. Mount the Micro Stepper Motor Driver (E2) on the Base Plate. To minimize possible static discharge, hold the Micro Stepper Motor Driver at its sides.

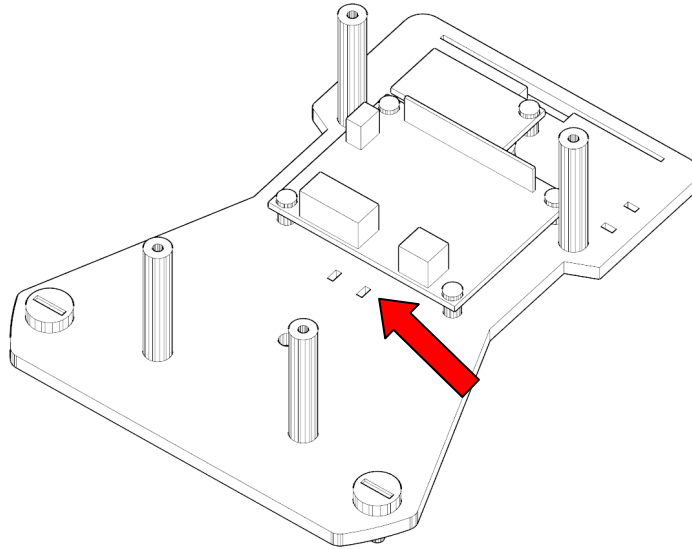
## Mount and Connect USB Circuit



**Note: Arrow indicates zip tie location**

1. Take 1 Standoff (C1).
2. Take 1 Bolt (F6).
3. Take 1 Washer (F8).
4. Take 1 Nut (F7).
5. Take 1 Zip tie (C4).
6. Take the previously stored USB circuit.
7. Take the cable with two 9 pin MTA connectors
8. Feed a Zip tie (C4) through the holes on the side of the Base Plate shown by the arrow.
9. Mount the USB circuit on the Base Plate with the **chip facing down** and the connection pins facing up.
10. Fasten the USB circuit cable firmly with the Zip Tie (C4).
11. Cut the excess length of the Zip tie (C4).
12. Connect the first MTA connector to the Micro Stepper Motor Driver so that the green wire is connected to pin I/O5 of J4 and the Black cable is connected to pin GND of J4.
13. Carefully, not to damage the USB circuit, connect the second MTA connector to the USB circuit so that the green wire is connected to pin 4 of the USB circuit and the Black wire is connected to pin 9 of the USB circuit. Support the USB circuit by hand if needed.

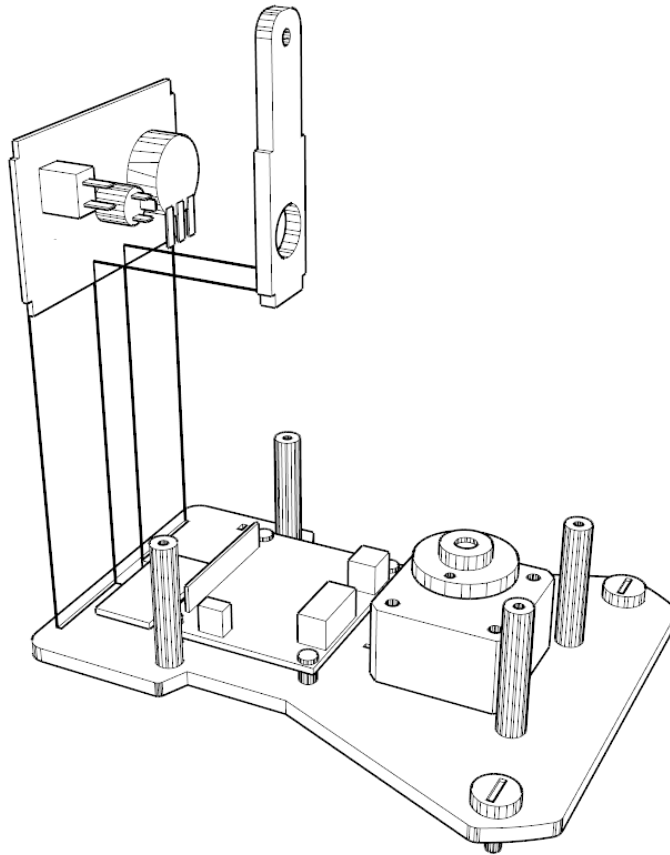
## Install Stepper Motor



**Note: Arrow indicates zip tie location**

1. Take the Stepper Motor.
2. Take 1 Zip tie (C4).
3. Feed the Zip tie (C4) through the holes in the middle of the Base Plate as shown by the arrow.
4. Connect the red Stepper Motor wire to the Micro Stepper Motor Driver terminal 1 of J3.
5. Connect the yellow Stepper Motor wire to the Micro Stepper Motor Driver terminal 2 of J3.
6. Connect the orange Stepper Motor wire to the Micro Stepper Motor Driver terminal 3 of J3.
7. Connect the black Stepper Motor wire to the Micro Stepper Motor Driver terminal 4 of J3.
8. **Loosely** fasten the Stepper Motor wires with the Zip tie (C4). Do not tighten yet. The Motor still needs to be fastened to the top plate in the following sections.

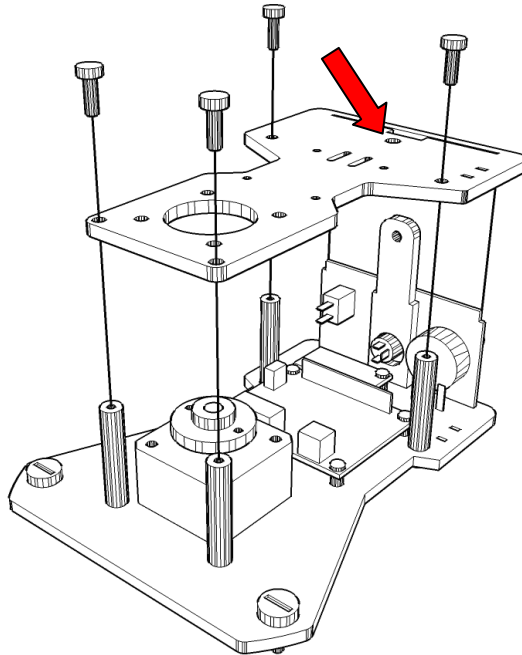
## 12. Mount Control Panel



1. Take the Bracket Plate (6A).
  2. Remove the protective layers.
  3. Take the previously stored Control Panel.
  4. Feed the cables of the Power Jack through the large hole of the Bracket Plate (6A).
  5. Place the Control Panel and the Bracket Plate (6A) in the Base Plate.
  6. Connect the MTA connector to the Micro Stepper Motor Driver so that the white wire to the Potentiometer is connected to pin POTH of J4 and the red wire is connected to I/O7 of J4.
  7. Connect the black wire of the Power Jack to the Micro Stepper Motor Driver GND terminal of J2.
  8. Connect the red wire of the Power Jack to the Micro Stepper Motor Driver +VB terminal of J2.
- Verify all mechanical connections have been made properly. Correct if needed
  - Verify all electrical connections are made properly. Correct if needed
  - **Verify that no debris has fallen on any of the PCB's. Clean if needed.**

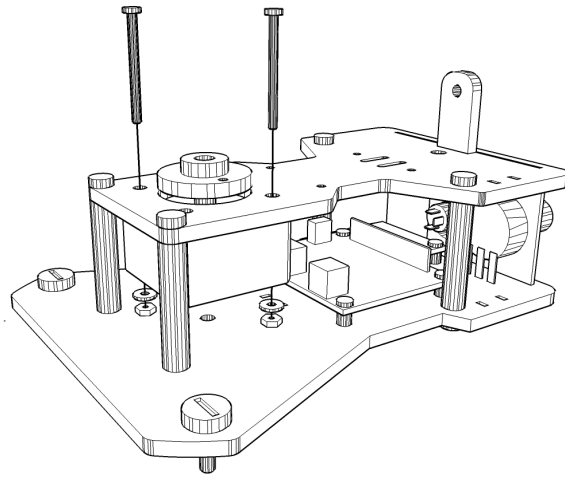


### 13. Mount Support Plate



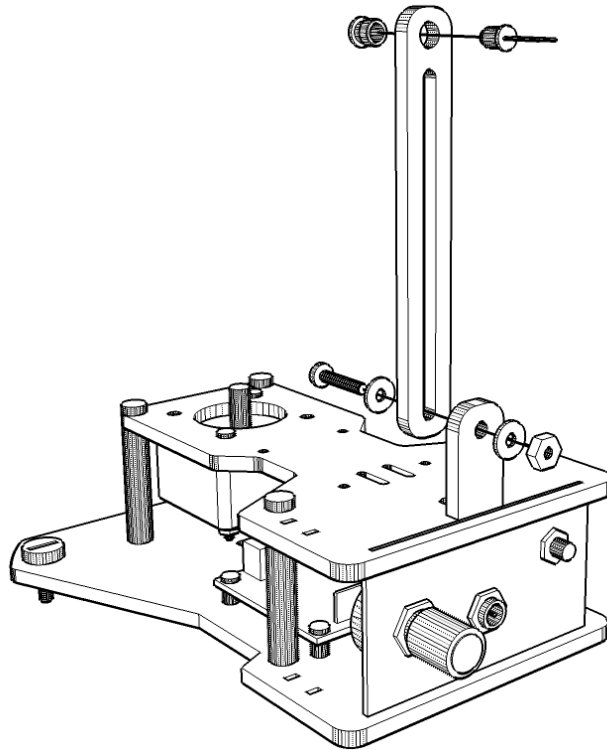
1. Take the Support Plate (2A).
2. Take 4 Bolts (F1).
3. Remove the protective layers of the Support Plate (2A).
4. Carefully feed the LED through the 6[mm] round hole next to the groove in the Support Plate (2A) as show by the arrow.
5. Mount the Support Plate (2A) to the assembled Base Plate.

## Mount Stepper Motor



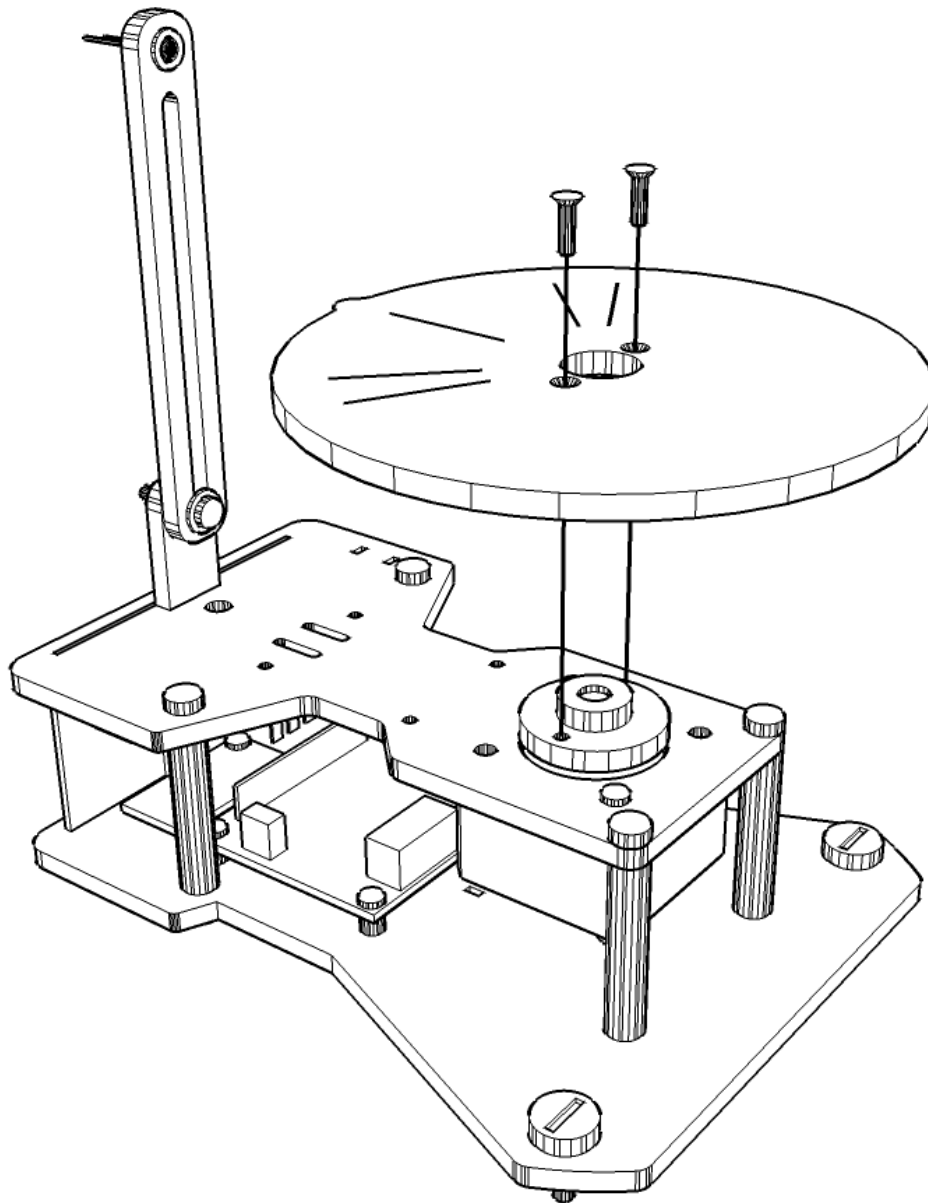
1. Take 2 Bolts (F5).
2. Take 2 Washers (F8).
3. Take 2 Nuts (F7).
4. Mount the stepper to the Support Plate. Make sure the Hub is centered in the hole. and can turn freely. For some motors different bolt holes need to be used.
5. Tighten the Zip tie around the Stepper Motor wires.
6. Cut of the excess length of the Zip tie.

## Led Stand



1. Take the LED Bracket (5A).
2. Take 1 bolt (F2).
3. Take 2 Washers(F4).
4. Take 1 Nut(F3).
5. Take the LED Holder (LH1).
6. Remove the protective layers of the LED Bracket (5A).
7. Mount the LED Bracket (5A) as shown in the picture.
8. Mount the LED Holder (LH1) and the LED as shown in the picture. In case the fitting of the LED holder is loose then carefully apply a small amount of super glue. Be careful as excessive glue will lead to frost like layer over the glued area.

## Attach Disk



1. Take Disk (3A).
2. Take 2 FHMS Flat head Machine Screws (F12).
3. Remove the protective layers of the Disk (3A).
4. Mount the Disk (3A) as shown in the picture.
5. Verify the Disk turns true and can rotate freely and without a wobble. Wobbling will decrease the scan accuracy and should therefore be minimized. **Do not over fasten the screws.**

## 14 Functions Test

### Prepare

1. Take the AC Wall Adapter.
2. Carefully insert the power connector in the Power Jack of the Control Panel. Do not force the plug in.
3. Insert the AC Wall Adapter into a power outlet.

### Stand alone

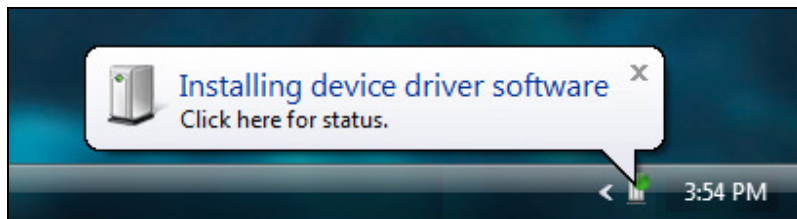
1. Carefully push the Push Button Switch on the Control Panel.
2. Verify that the LED lights up for a few seconds.
3. Verify that the Stepper Motor turns CCW when looked at from the top.
4. Verify that the Stepper Motor speed changes when changing the Potentiometer position on the Control Panel.
5. Wait until the motor stops turning.
6. Disconnect the AC Wall Adapter.
7. Investigate, correct and retest if errors are found.

### Setting Rotation Speed and Direction

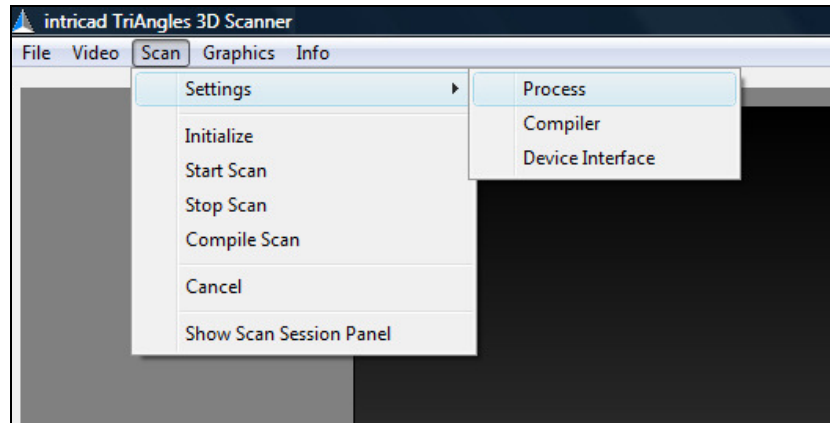
1. The rotation speed should be set to allow a full turn to take about 45. This is time between the LED going OFF after the push button is pressed and ON again after a full turn. Set this using the Potentiometer.
2. The turning direction of the motor must be CCW when looked at from the top. In case the disc rotates CW then reverse one of the wire pairs of the stepper motor.

### PC control

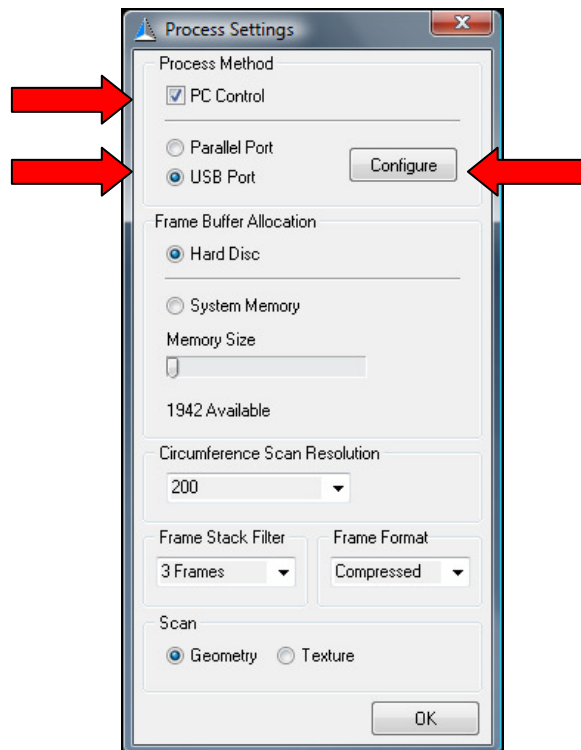
1. Connect the USB cable to the USB port of a PC with intricad TriAngles software installed.
2. Wait until the USB device has been recognized by the PC is ready for use. **The required driver will install automatically. No .NET frameworks or additional drivers are required.**

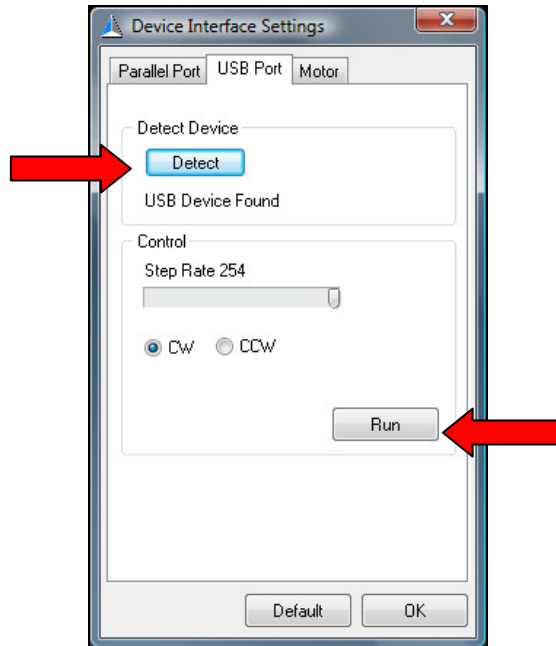


3. Open intricad TriAngles 3D Scanner V2.
4. Browse to Scan, Settings, Process

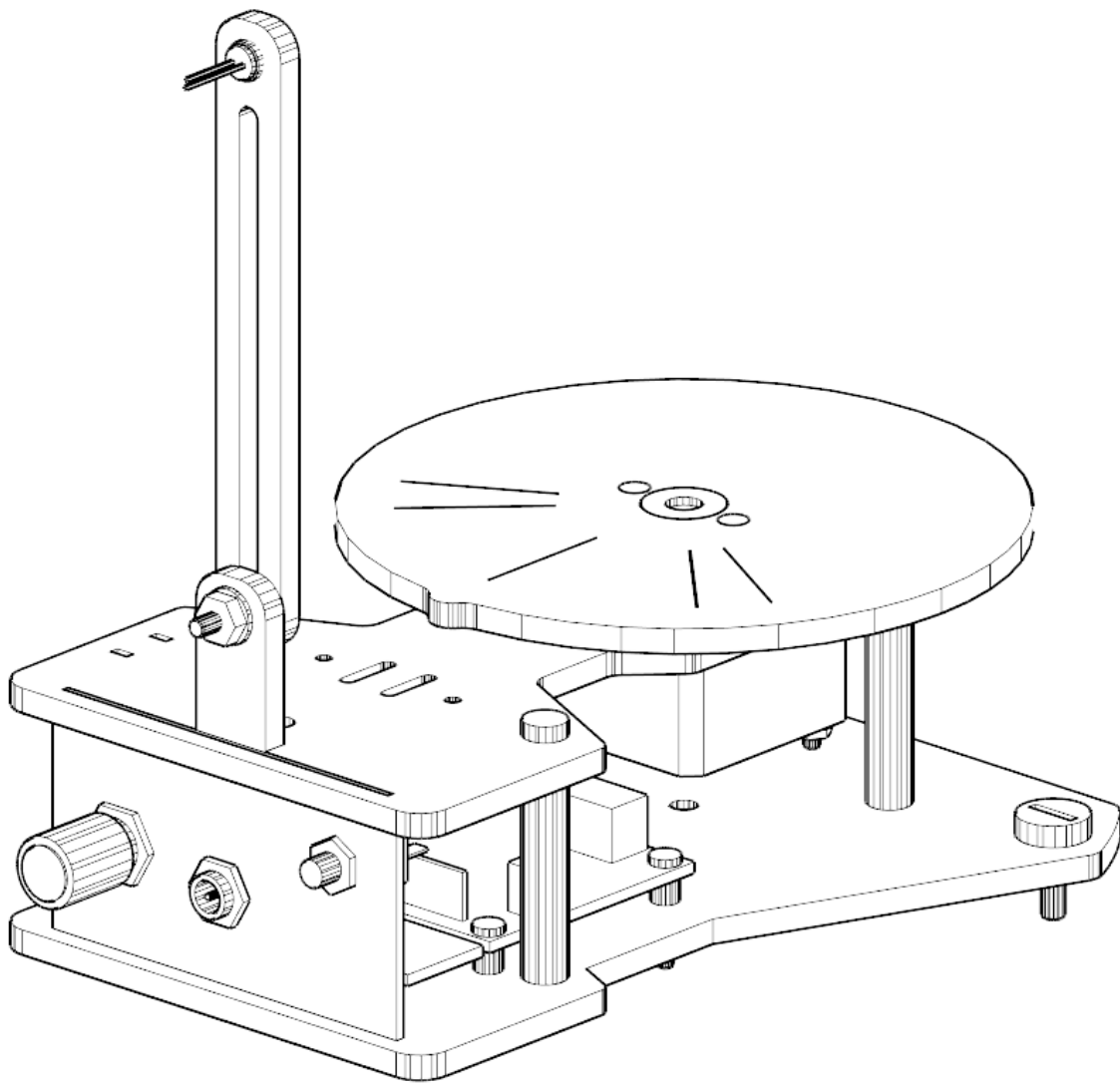


5. Make sure PC Control is selected (requires product activation).
6. Make Sure USB Port is selected.
7. Click Configure.
8. Browse to tab USB port.





9. Click Detect
10. Verify the text changes from "Status" to "USB Device Found". Do NOT connect the AC Wall Adapter yet! The USB circuit is Stand Alone Mode and will run on USB power. Investigate, correct and retest if errors are found.
11. Connect the AC Wall Adapter.
12. Slide the slider until the value reads between 240 and 250. By using the up and down buttons it is possible to change 1 step at a time.
13. Make sure CW is selected.
14. Click Run.
15. Verify the Stepper Motor turns CW. *Note: It is normal that the Stepper Motor makes short stops while rotating.*
16. Click CCW.  
Verify the Stepper Motor turns CCW.
17. Change the slider value to a higher value.
18. Verify that the Stepper Motor speed increases, setting the value too high might cause the Stepper Motor to stop rotating or make random moves. Lower the setting if this happens.
19. Change the slider value to a lower value.
20. Verify that the Stepper Motor speed decreases.
21. Click stop.
22. Close intricad TriAngles software.
23. Disconnect the AC Wall Adapter.
24. Disconnect the USB Cable.
25. Investigate, correct and retest if errors are found.
26. Your scan table is now ready to be used!



**Completed Turn Table**