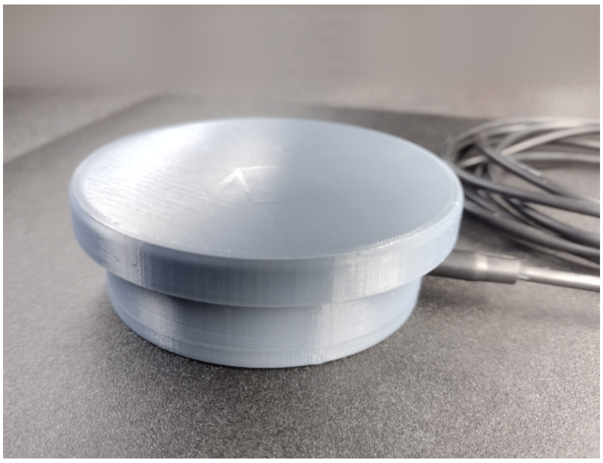
Push Button Switch

by 7B Industries

(page

Introduction

This is a 3D printed switch for many uses, including controlling a computer when used with a switch adapter and screen scanning software.



There are multiple modes for screen scanning software. In one mode, the screen scanner will move between user interface elements and allow the user to press the button to activate or select one. Onscreen keyboards can oftentimes be used in this way. In another mode, quadrants of the screen are scanned. A user waits until the scanner box reaches the desired part of the screen and then presses the button. The screen scanning software then narrows down its search that that part of the screen and the process begins again until the desired user interface element can be selected.

There are three main sections of this documentation: mechanical, electrical and final assembly. The mechanical documentation covers 3D printing all the parts, as well as sourcing and installing fasteners. The electrical section covers the custom circuit board and the components that go on it. The final assembly section explains how to fit all of the parts together into the completed switch. The electrical assembly and mechanical sections must be completed before the final assembly can be attempted.

In addition to these sections, there is a section on creating custom bases so that the switch can be adapted and mounted as needed.

If you have comments or questions while printing, assembling or using this switch, please feel free to join the switch forum topic (page or mailing list (page .

Construction Steps

The sections below provide the instructions for constructing the push button switch.

Bill of Materials

Obtaining the parts and tools in this BOM should provide everything needed to make and assemble the push button switch.

Parts

- 4 1/4 Inch Heavy Rubber Band (page 58)
- 1 Audio Jack (page 41)
- 20 m of Filament (page 47)
- 12 M2 Captive Nut (page 51)
- 1 M2 Washer (page 50)
- 3 M2x12mm Socket Head Screw (page 56)
- 1 M2x16 Socket Head Screw (page 49)
- 6 M2x6mm Socket Head Screw (page 54)
- 3 M2x8mm Socket Head Screw (page 55)
- 1 M3 Square Nut (page 52)
- 1 M3x6mm Socket Head Screw (page 57)
- 1 Microswitch (page 42)
- 1 Mono Audio Cable (page 43)
- 1 Printed Circuit Board (page 40)
- 20 mm of solder (page 45)

Tools

- 1 1.5mm Hex Wrench (page 53)
- 1 2.5mm Hex Wrench (page 59)
- 1 3D Printer (page 46)
- 1 Soldering Iron (page 44)
- 1 Tweezers (page 48)

Licenses

- Documentation: Attribution-ShareAlike 4.0 International (page
- Software: Apache License, Version 2.0 (page
- Hardware: CERN Open Hardware Licence Version 2 - Permissive (page

(page

Electrical

Bill of Materials

Below are the parts and tools that will be needed to complete this section.

Parts

- 1 Audio Jack (page 41)
- 1 Microswitch (page 42)
- 1 Mono Audio Cable (page 43)
- 1 Printed Circuit Board (page 40)
- 20 mm of solder (page 45)

Tools

- 1 Soldering Iron (page 44)

The Process

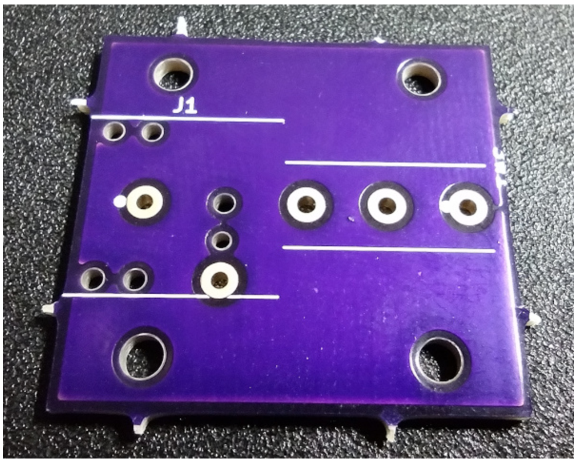
In order to complete the electical portion of the push button switch design, a PCB (Printed Circuit Board) must be made or ordered, the electrical components that go on the PCB must be obtained, and then the components must be soldered onto the PCB. The sections below explain each of these steps.

- PCB Manufacture (page 5)
- Order Components (page 8)
- Assemble (Solder) (page 9)

(page

PCB Manufacture

The Printed Circuit Board (page 40)(PCB) for the switch must be manufactured before the switch can be assembled and used in its default configuration. This is normally done by sending the manufacturing files to a vendor, such as OSHPark and then waiting for the finished boards to be shipped.



Sending Files to a Manufacturer

All of the files necessary to have the printed circuit board (PCB) manufactured are available as a zip file for download here (page . If a manufacturer such as OSHPark is being used, the KiCAD project file can be uploaded directly. That file can be downloaded here (page (right click and select `Save Link As`). Instructions on uploading files for every manufacturer is beyond the scope of this documentation, but OSHPark will be offered as an example. This is not a direct endorsement of OSHPark, although 7B Industries does use OSHPark to produce finished PCBs.

Step 1: Account Login

Navigate to oshpark.com (page and create an account (page or log in.

Step 2: Upload Files

The OSHPark landing page has an area where the KiCAD project file can be dragged and dropped. Alternatively, users can click the `BROWSE FOR FILES` button and upload the file through their web browser's file manager.

The file should upload, be processed, and then an `About your board` page will load. Initial information such as the cost of manufacturing should be displayed.

Step 3: Click Through the Board Confirmation Screens

The default settings should be fine for this design. Click the `Continue` button to advance past the `About your board` page.

The next page that will be loaded is called `Verify your design`. Scroll down through the images shown of the board just to make sure that nothing obvious is wrong. Once at the bottom of the page, click the `Order` button.

Step 4: Ordering

The rest of the process is typical of most online shopping carts. There is no need to add any of the optional services such as "2 oz copper" unless you want to. Check out, enter the shipping information, and pay.

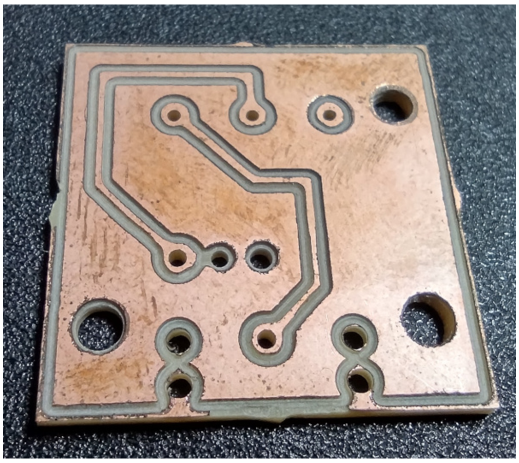
Step 5: Wait

When ordering PCBs from online manufacturers, it often takes weeks to receive the finished boards. It is also a good idea to check to see if there will be any import fees that are due. Selecting a manufacturer that is closer to your location may help avoid unnecessary import duties.

Isolation Routing (Optional Advanced DIY Manufacturing)

The PCB has been laid out in such a way that it is possible to use isolation routing on a CNC machine to manufacture it. That is how the initial prototypes are made by 7B Industries. This method should not be attempted unless the user is familiar with CNC machines. This method only provides a board with the proper traces, and does not include solder mask or silkscreen.

When isolation routing is attempted, use a v-shaped engraving bit set to the appropriate depth. The "appropriate depth" will vary based on the exact bit used and the copper thickness on the copper clad board, and may take some experimentation to determine. The traces have 0.508 mm of clearance around them, so by setting the proper depth of the bit and the width of the tool to 0.508 mm, it should be possible to route the board in a single pass. Experimentation is often needed to complete this process effectively though, and is attempted at your own risk.



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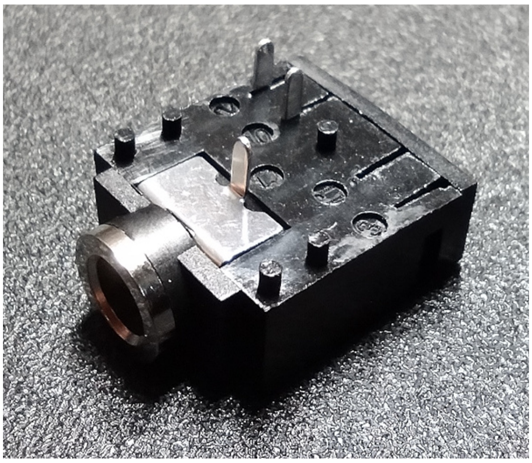
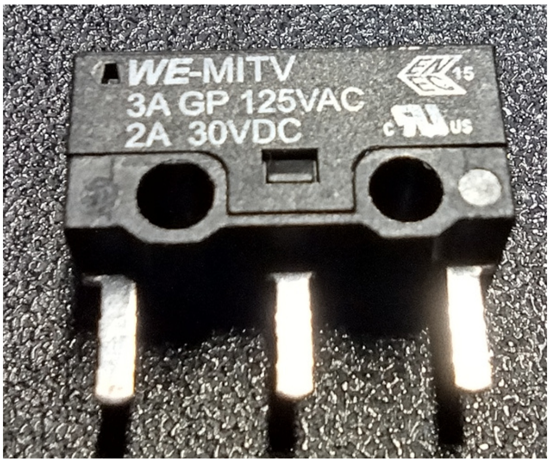
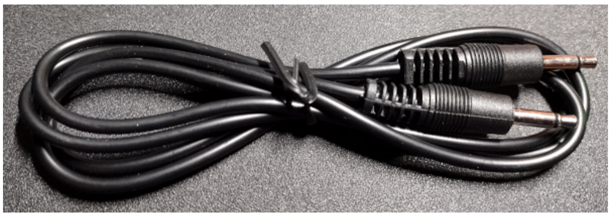
Order Components

There are two off-the-shelf components that must be ordered in order to assemble the circuit board. The first is an Audio Jack (page 41), and the second is a Microswitch (page 42). There is also a Mono Audio Cable (page 43)that will be needed later to connect the switch to a switch adapter.







Clicking on each of the components in the bill of materials (BOM) below will show suppliers they can be purchased from. If only a single board is being assembled, one of each part is all that is needed. The audio cable can be purchased in any length that is needed for the application. Cables of 0.9m to 1.2m are shown in the BOM as examples only.

Parts

- 1 Audio Jack (page 41)
- 1 Microswitch (page 42)
- 1 Mono Audio Cable (page 43)

(page

Assemble (Solder)

Bill of Materials

Parts

- 20 mm of solder (page 45)

Tools

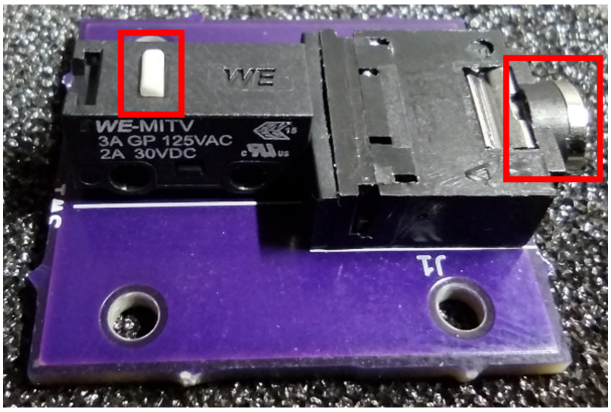
- 1 Soldering Iron (page 44)

Introduction

Once the PCB (printed circuit board) and electrical components have been obtained, the components can be soldered onto the board. Orientation of these components is important, and will be explained below.

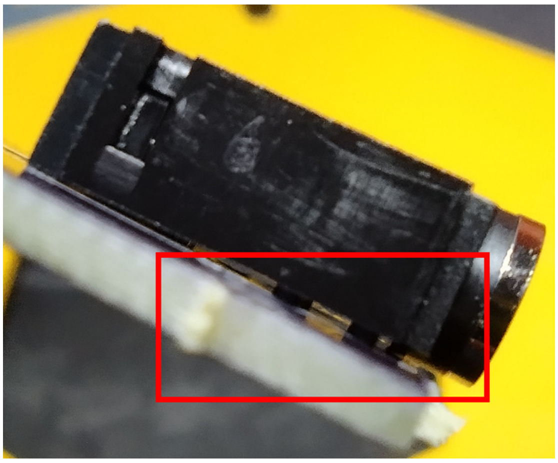
Step 1: Placing Parts

Arrange the components on the PCB in the orientation shown in the following image. Notice that the components are placed on the side of the PCB with the silkscreen (white lines and lettering). This will be considered the top side of the PCB from here out, and it is important to place the components on this side of the PCB.



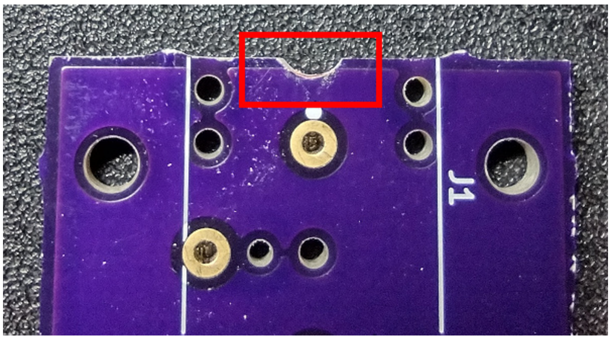
Notes on Audio Connector Placement

Notice that the barrel connector opening on the audio connector hangs over the edge of the board. The audio connector has pegs on the bottom that should fit closely into the non-plated through holes on the PCB. The audio connector should not fit correctly in any other orientation than that shown in the picture. The collar on the barrel of the connector should just slip past the edge of the PCB so that the connector's bottom is flush with the surface of the board. However, there is a minor design flaw with the current PCB that may cause the barrel of the audio connector to interfere with the edge of the board. This prevents the body of the audio connector from laying flush. If the audio connector looks like the following image, than the connector is interfering with the edge of the PCB.



It is best if the audio connector body is flush with the surface of the PCB so that the collar can take some of the pressure off of the solder joints when the user is plugging in an audio connector. However, the solder joints should be strong enough to hold the connector in place under normal use conditions.

If the audio connector's barrel is interfering and you want to prevent that, you can file a notch in the board directly below the barrel connector. The notch only needs to be 1 millimeter deep and 3 millimeters wide, so be careful not to make it excessively deep, or damage the solder mask, traces, or pads on the board.



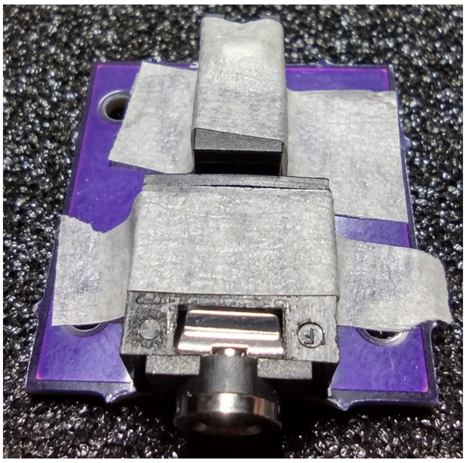
This design flaw will be fixed in later revisions.

Notes on Microswitch Placement

The plunger of the microswitch, which is the part that gets pressed so that the switch activates, must be oriented as shown in the image at the top of the documentation. The microswitch has two modes of operation. The first is normally open (NO), where the microswitch will not activate and let current flow until the plunger is pushed down. The second is normally closed (NC), where the microswitch will be activated (let current flow) until the plunger is pushed. The push button switch is designed to operate in the normally open configuration, and so the switch must be oriented as shown above so that the correct pins are connected. If the microswitch is turned 180 degrees, the switch will not operate properly. The incorrect orientation will also put the plunger in the wrong position to be depressed by the stem of the switch when the cap is pressed down.

Step 2: Secure the Components to the PCB

The components will likely fall out if the PCB is flipped for soldering without securing them first. This can be done using a piece of tape placed over the component (never between it and the circuit board) on the top side of the board. Masking tape is likely the best type of tape to use for this purpose. Try to get the components as square (aligned) with the edge of the PCB as possible when securing them.

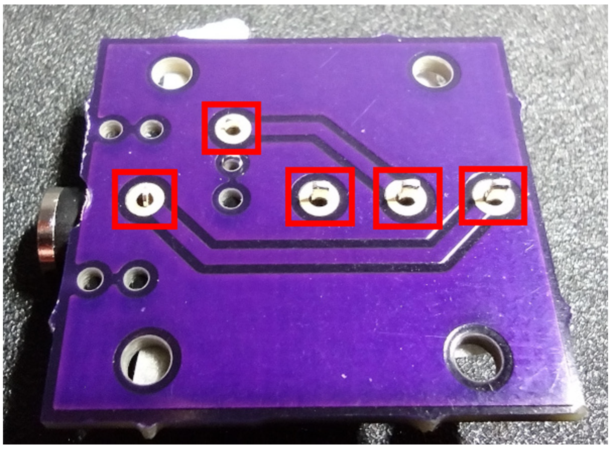


A small amount of hot glue can also be used to hold the components in place, but caution must be used to keep from overheating and melting the parts. It is also important not to use something permanent like super glue.

If many of these boards need to be assembled over time, it may be worth investing in a PCB assembly frame like this one (page or, better yet, building your own such as this 3D printed one (page or this aluminum extrusion unit (page .

Step 3: Flip the PCB and Solder

Once the components have been secured, it is time to flip the board over and use a pencil Soldering Iron (page 44)and solder (page 45)the terminals to the pads on the circuit board. The following image shows which pins need to be soldered.



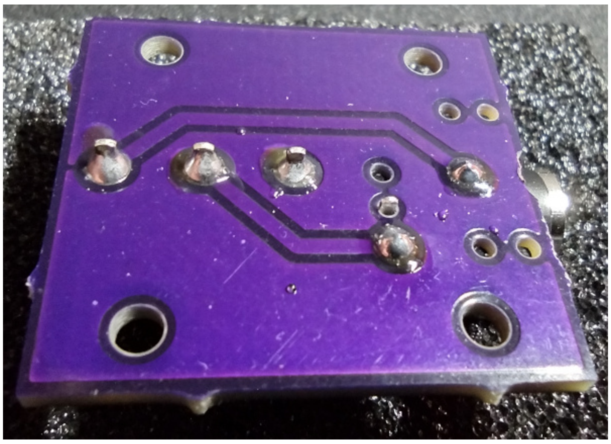
Be sure to create good solder joints (no cold solder joints) without an excess of solder. Once all pins have been soldered, the masking tape can be removed.

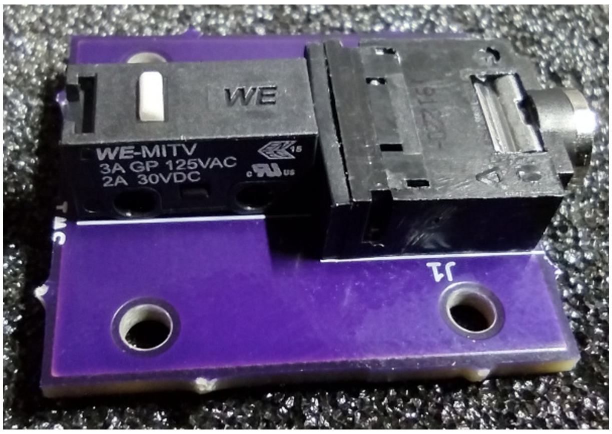
If you are new to soldering, there are guides to soldering that can be used as a reference. One example is Adafruit's guide on making good solder joints (page , which is part of a larger guide (page that covers everything a beginner needs to know about soldering.

Step 4: Inspect the Assembled Board

Once the board is soldered, the assembly is complete. Take a moment of inspect the solder joints for any problems, and look at the top side of the board to make sure that the plastic housings of components did not get melted at all and were not bumped out of position during soldering.

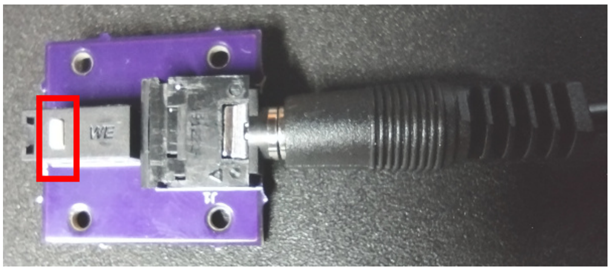
The finished board should look something like this.





Step 5: (Optional) Do Continuity Check

Once the circuit board is complete, and if you have a digital multimeter (DMM), a mono audio cable can be plugged into the PCB for testing.



The plunger is highlighted in the previous picture because it can be pressed to close the switch for the test once the DMM is connected.

A DMM can be connected to the two terminals shown below. One on the tip, and one on the sleeve.You are just checking continuity, so the polarity will not matter.

Set the DMM to the continuity check setting and then press the plunger on the microswitch, which is highlighted in the first image in this section. If the DMM shows continuity, the electrical assembly is working correctly.

(page

Mechanical

Bill of Materials

Below are all the parts and tools that are required to complete this section.

Parts

- 20 m of Filament (page 47)
- 12 M2 Captive Nut (page 51)
- 1 M2 Washer (page 50)
- 1 M2x16 Socket Head Screw (page 49)
- 1 M3 Square Nut (page 52)

Tools

- 1 1.5mm Hex Wrench (page 53)
- 1 3D Printer (page 46)
- 1 Tweezers (page 48)

The Process

In order to produce the mechanical portion of the push button switch, all plastic parts must be 3D printed, captive nuts must be added, and then the printed parts must be assembled in the order specified. The sections linked below walk through each of these steps.

- Print Parts (page 15)
- Clean Up Parts (page 18)
- Add Captive Nuts (page 20)

(page

Print Parts

Bill of Materials

Parts

- 20 m of Filament (page 47)

Tools

- 1 3D Printer (page 46)

Step 1: Download STL Files

A zip file of all STL files needed to print the switch are available here (page .

Once that file has been download and the STLs have been extracted, the parts can be printed. Depending on what type of printer you have, it may be possible to upload the STL files directly to the printer. On other printers it will be necessary to use slicing software such as Cura (page or PrusaSlicer (page to convert the STL files into GCode for the printer.

Step 2: Determine Print Settings

Almost any 3D Printer (page 46)can be used for printing these parts as long as the printer has a large enough print volume and can achieve the proper amount of detail. For reference, the prototypes were printed on a Prusa i3 Mk2 with a 0.4mm nozzle. Both PLA or PETG types of Filament (page 47)have been used to print these parts. PETG will produce more durable parts but is not required.

None of these parts should need supports, but it is usually a good idea to print them with a brim. Using a brim will help maintain flatness on the 3D printer bed during the print. The print settings that were used on the prototypes was a 0.2mm layer height, no support, 20% infill, and the brim was enabled. Some of the parts in the STL are not oriented for printing by default. All parts are designed so that the larger flat surface should be placed on the print bed, with no supports needed.

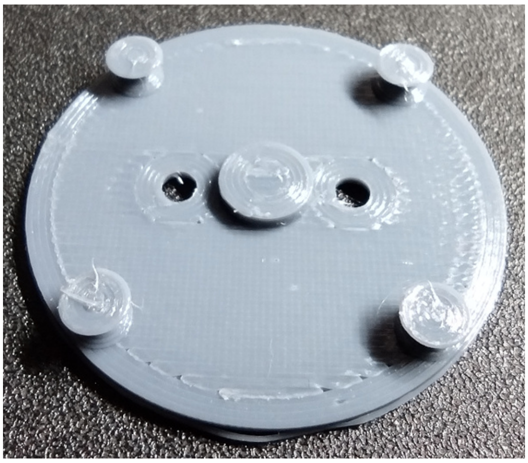
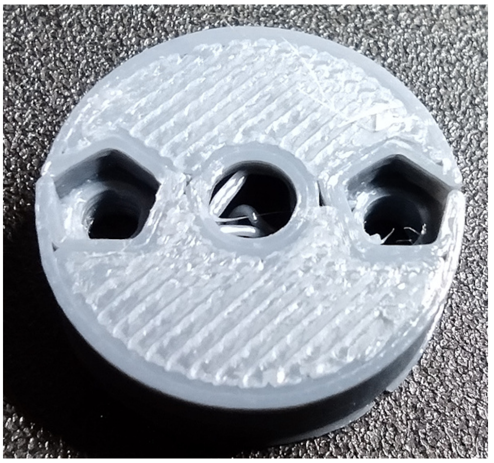
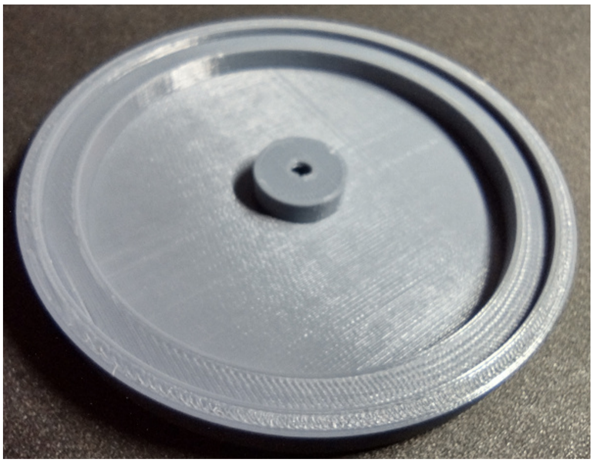
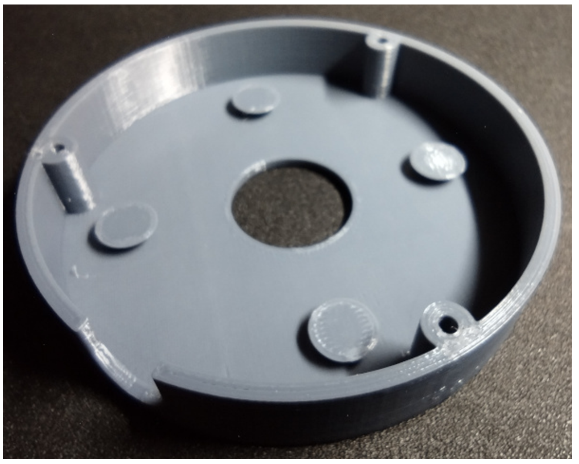
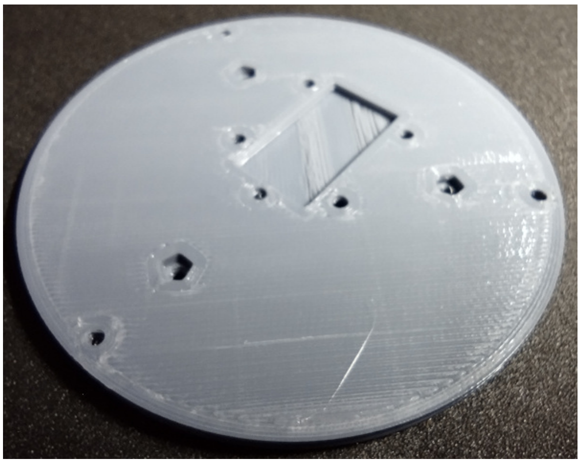
One other setting that is not required but that can help with durability is to increase the number of perimeters, if your software supports it. On the prototypes, the number of perimeters was increased from 2 to 4.

Step 3: Print Parts

The following is the list of parts that should be in the zip file.

- band_mounts.stl
- switch_stem.stl
- switch_cap.stl
- switch_body.stl
- switch_bottom.stl

These are standard STL files that should work with any 3D printer and/or slicing software. Follow the instructions for your 3D printer to print each of the parts. Here is a gallery of what each the files above should look like when printed.

Once all the parts have been printed, the next step is to clean up the parts (page 18).

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Clean Up Parts

Bill of Materials

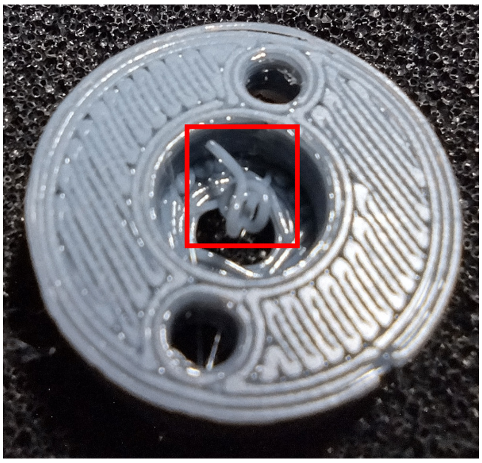
Tools

- 1 Tweezers (page 48)

The parts should almost be ready to assemble. However, there is often some extra plastic in the holes, nut traps, or counter-bore holes. These areas should be cleaned up before doing the assembly step.

Extra Plastic in Counter-Bore

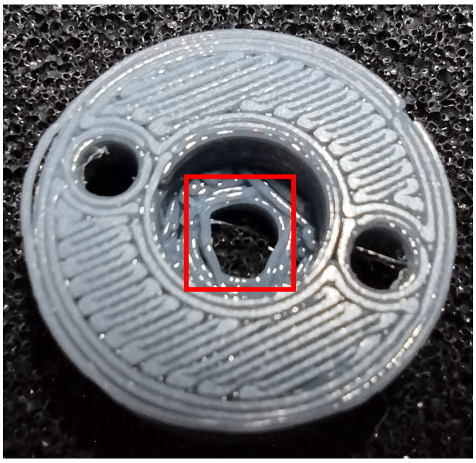
Below is an example of a counter bore hole with an extra plastic string in it. This extra plastic will keep the bolt from seating properly in the bottom of the hole and must be removed.



Most plastic strings are easy to remove with Tweezers (page 48). The string in the picture above can be removed by grabbing it with the tweezers and twisting.

Non-Round Hole

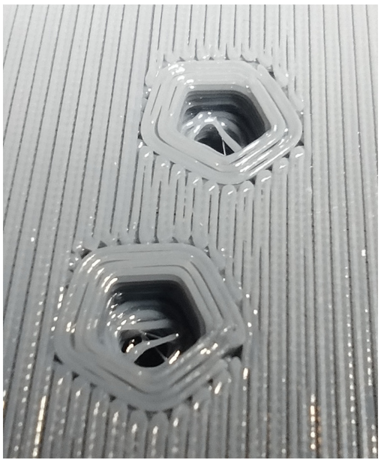
Sometimes plastic will ooze during a move of the print head when it should not, and can string across open areas. Most of the time there is no issue with the roundness of a hole, but sometimes the hole is bad enough that it will not let a bolt pass through.



In this case, a drill bit can be used to clean up the hole. Be careful not to force a drill bit through the hole that is too large, or the size tolerance of the hole may be altered too much. If using a power drill with the drill bit, be careful not to damage the hole by enlarging it or making it an oval shape.

Extra Plastic in Nut Trap

Captive nuts are used throughout this design instead of heatset inserts or simply threading into the plastic. This ensures a durable design without the complications that using heatset inserts can cause. Sometimes there is excess plastic inside the nut pockets which can prevent the nuts from pulling all the way down into the pocket. This should be cleaned out with tweezers.



Light Plastic Strings in Hole

There can sometimes be plastic strings in bolt holes. If the strings are small and light, there is a good chance that they will not cause problems. As long as you are able to insert the bolt into the hole, these can usually be left alone.

(page

Add Captive Nuts

This switch design uses captive nuts instead of threading screws directly into the plastic, or using heatset inserts. Threading screws directly into plastic, even if the plastic is tapped, makes for a weak connection because the plastic threads strip out easily. Heatset inserts create a very strong connection, but are hard to install squarely into a hole, and tend to cause distortion of the plastic around the insertion site, such as mounding.

The M2 nuts will be pulled down into their pockets in this step so that the assembly step can happen more smoothly later.

Bill of Materials

Parts

- 12 M2 Captive Nut (page 51)
- 1 M2 Washer (page 50)
- 1 M2x16 Socket Head Screw (page 49)
- 1 M3 Square Nut (page 52)

Tools

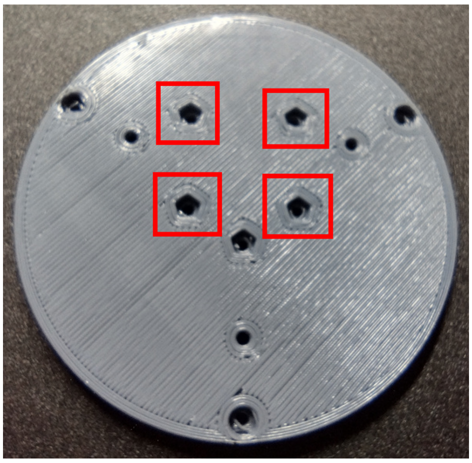
- 1 1.5mm Hex Wrench (page 53)

Step 1: Prepare the Puller Bolt

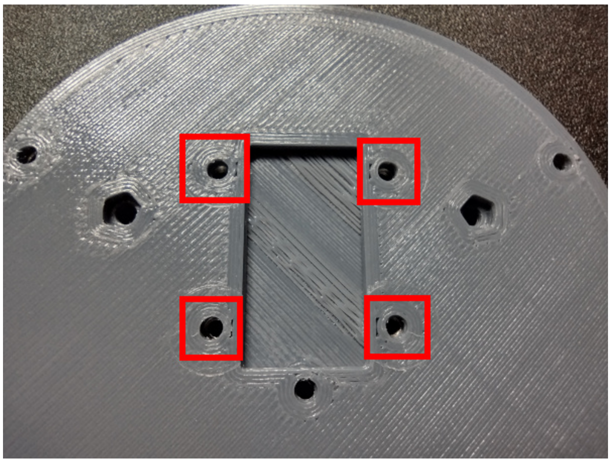
A longer M2 screw is used to pull the M2 nuts squarely into their pockets. An M2x16 Socket Head Screw (page 49)can be used as the puller, and should have an M2 Washer (page 50)placed on it so that the head does not indent the plastic under it while the nut is being pulled into position.

Step 2: Install the PCB Captive Nuts

There are 4 nuts that will be used to hold the PCB (printed circuit board) in place. The locations of these nut pockets are in the bottom side of the bottom part of the switch, and are shown in the following image.



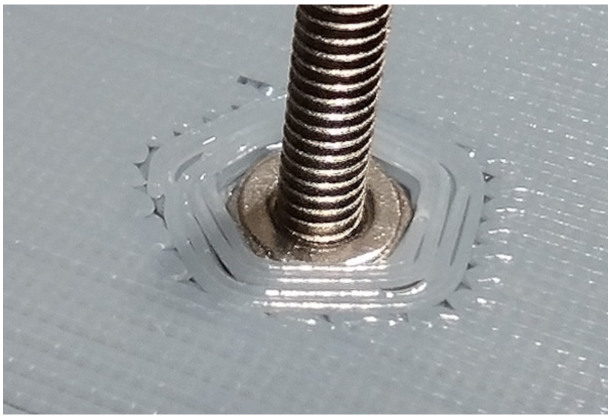
These are the same holes viewed from the top side.



Insert the nut puller screw through the top side of the bottom part, and thread an M2 Captive Nut (page 51)onto the end. Thread the nut on until it comes in contact with the pocket.

WARNING: Do not over-tighten the nuts in this step. Too much torque can cause the nuts to spin in their pockets, which will strip the plastic out so that the pocket will no longer hold the nut captive. Just make sure the top face of the nut is at, or a little below, the surface of the plastic.

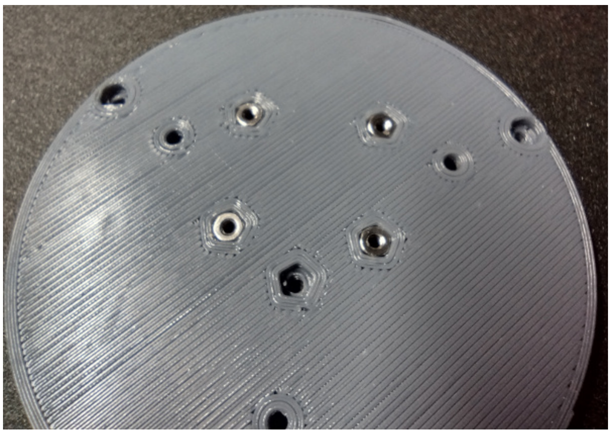
Now take the 1.5mm Hex Wrench (page 53)and tighten the puller screw until the captive nut is seated in the pocket. Make an effort to keep the points of the nut aligned with the points of the pocket. This often happens naturally as the screw is tightened. Continue tightening the screw until the nut has obviously bottomed-out in the pocket, or the nut is at or below the surface.



Once this first nut has been installed, remove the puller screw and seat the remaining three nuts in their respective pockets.

NOTE: If the M2 nut is too large for the pocket, there is not a good work around. The best options are to buy M2 nuts that are the proper size, or download the CAD model for the switch bottom and modify the captive nut pocket size.

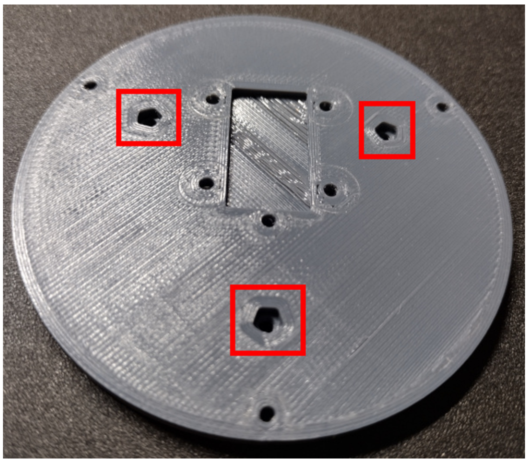
When all captive nuts are installed, the bottom should look something like this.



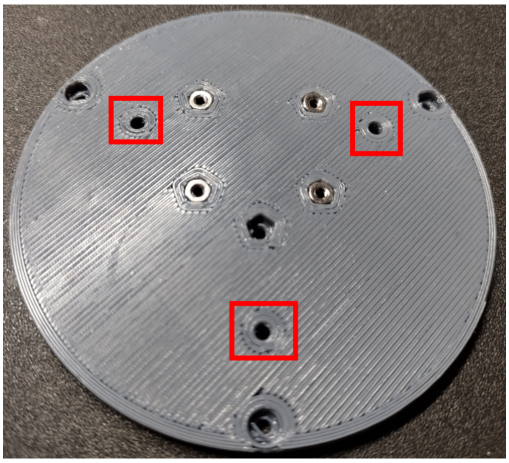
Step 3: Install the Mounting Base Captive Nuts

There are three holes in the switch bottom which will be used later to attach a mounting base. The intention is for these bases to be designed and printed for each use case. Examples might be a v-block base for mounting the switch to a metal tube, or a flat base with pockets where double stick tape can be applied.

The three mounting base captive nut pockets are highlighted below.

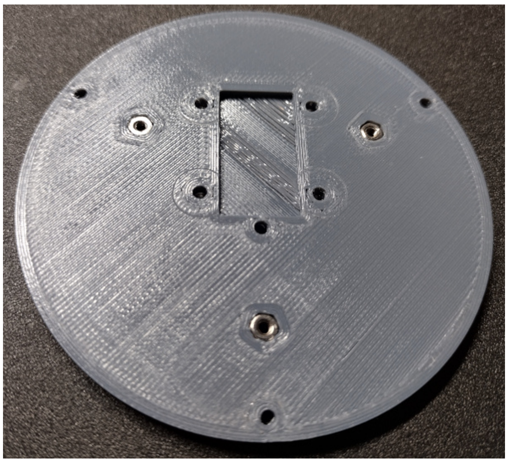


And here are the same hole locations when viewed from the bottom side.



WARNING (Again): Do not over-tighten the nuts in this step. Too much torque can cause the nuts to spin in their pockets, which will strip the plastic out so that the pocket will no longer hold the nut captive. Just make sure the top face of the nut is at, or a little below, the surface of the plastic.

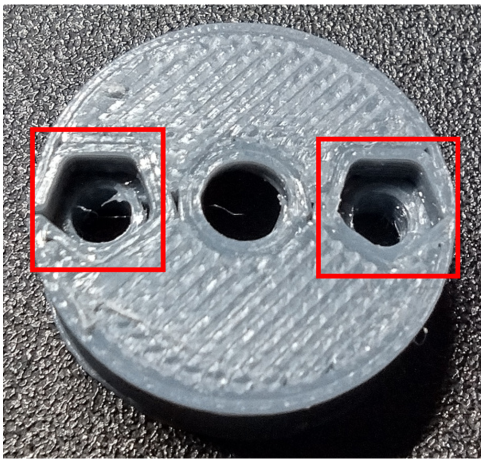
Repeat the same process with the puller screw that was used in Step 2, and pull each M2 Captive Nut (page 51)down into their pockets. When finished, the switch bottom should look like the following when viewed from the top side.



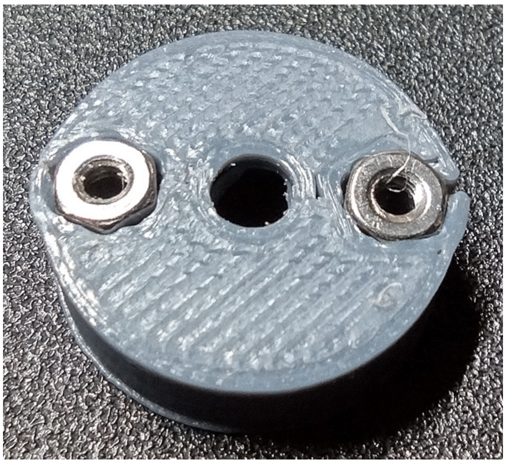
Installation of the captive nuts in the switch bottom is now complete.

Step 4: Install the Stem Mounting Nuts

There are two holes in the switch stem that hold the rubber band mounts in place. The locations of the nut traps for these holes is shown in the following picture.



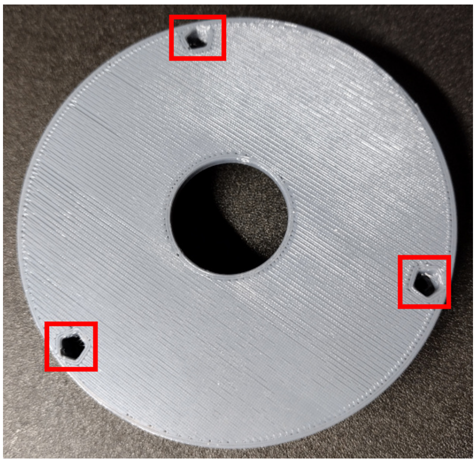
Install each M2 Captive Nut (page 51)as in steps 3 and 4, as always, being sure not to over-torque the nuts. When finished, the stem should look like the following.



Notice that there can be a little deformation at the edges of the stem from where the nuts are pressed in. This is acceptable as long as the deformation is around the outside edge, and not on the top or bottom surface of the stem. In the future the diameter of the switch stem may be increased to prevent this issue.

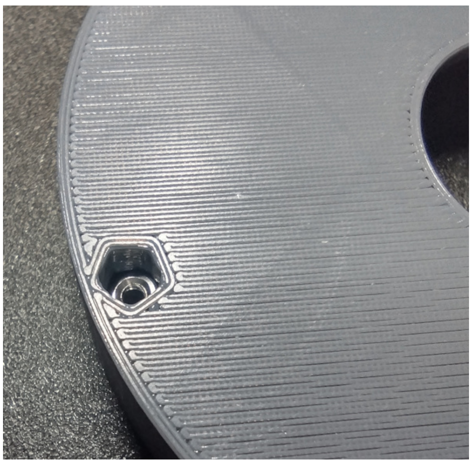
Step 5: Install Body Captive Nuts

There are three captive nuts that need to be installed in the switch body, and those will be used to attach the bottom during the final assembly process. The locations of each of the holes are highlighted in the following image.



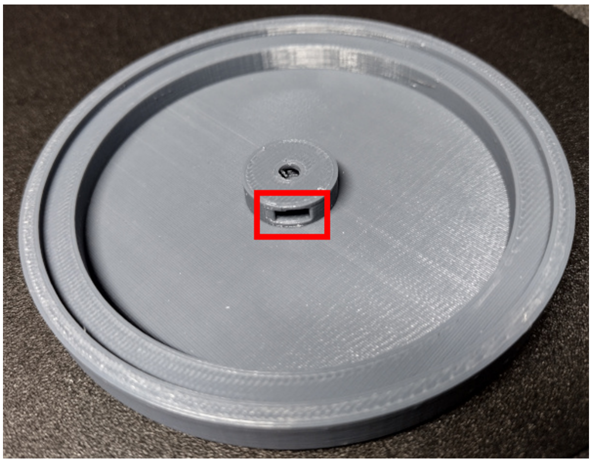
Pull an M2 Captive Nut (page 51)down into each of these pockets using the puller screw technique and the 1.5mm Hex Wrench (page 53)that has been used in other steps. These pockets are deeper than any of the others, and the nuts need to be pulled down to the bottom of each pocket to work correctly during final assembly.

The nut should measure about 4mm from its top to the top of the switch body. The following image shows how deep one of the nuts looks in the pocket.



Step 6: Install Square Captive Nut

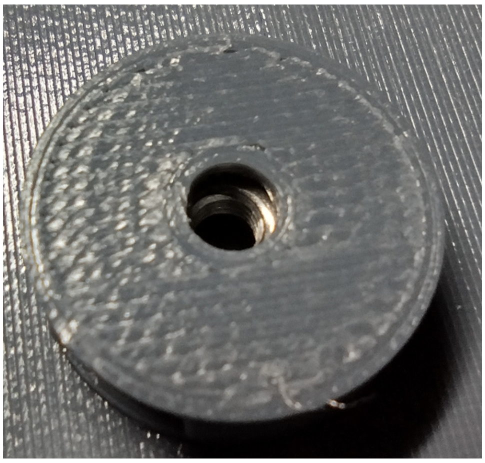
There is one last captive nut to install, and that is in the switch cap. The location is shown in the following image.

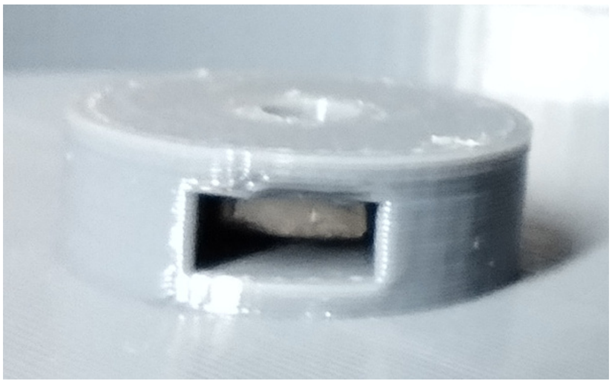


The M3 Square Nut (page 52)can be inserted into the pocket with fingers or tweezers. A set of curved tip tweezers makes insertion easier. Be sure to push the nut all the way down into the pocket so that the threaded hole in the center of the nut lines up with the hole in the switch cap. Pushing with a pair of tweezers or a small L-shaped hex wrench can help.

If the nut will not not seat all the way down into the pocket, there may be a bit of plastic in the pocket. The square nut can be removed with tweezers by placing the tips down in the center hole and pushing the nut towards the pocket opening. Then any extra plastic should be cleared from the pocket with tweezers.

The next images show the square nut properly installed in the switch cap.





After that square nut is installed, it is now possible to move on to the assembly step (page 27).

(page

Final Assembly

Bill of Materials

Parts

- 4 1/4 Inch Heavy Rubber Band (page 58)
- 3 M2x12mm Socket Head Screw (page 56)
- 6 M2x6mm Socket Head Screw (page 54)
- 3 M2x8mm Socket Head Screw (page 55)
- 1 M3x6mm Socket Head Screw (page 57)

Tools

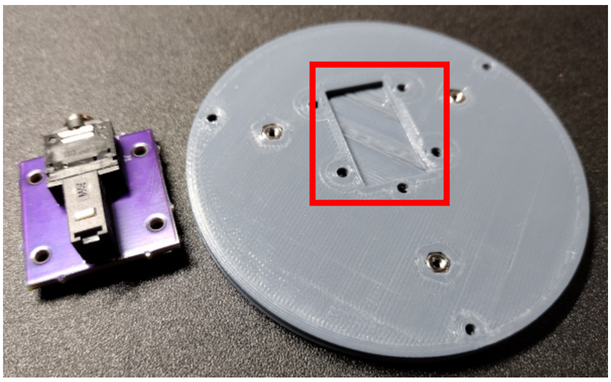
- 1 1.5mm Hex Wrench (page 53)
- 1 2.5mm Hex Wrench (page 59)

Introduction

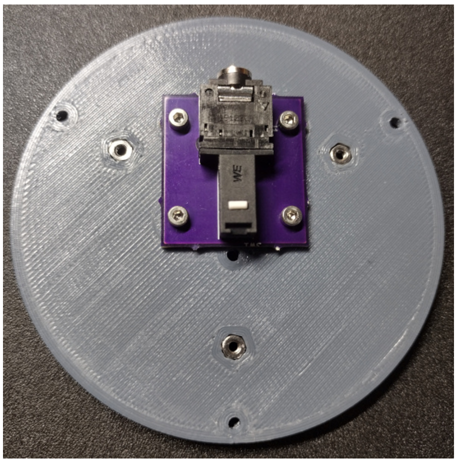
Assuming that all of the previous mechanical and electrical sections have been completed, it is now possible to assemble the switch for use. Please be aware that some of the parts interlock in a specific way, and so the order of the assembly steps matters.

Step 1: Attach the PCB Assembly to the Bottom

The finished circuit board is installed into the area of the switch bottom that has the relief pocket for the soldered pins. The relief pocket is highlighted in the following image.

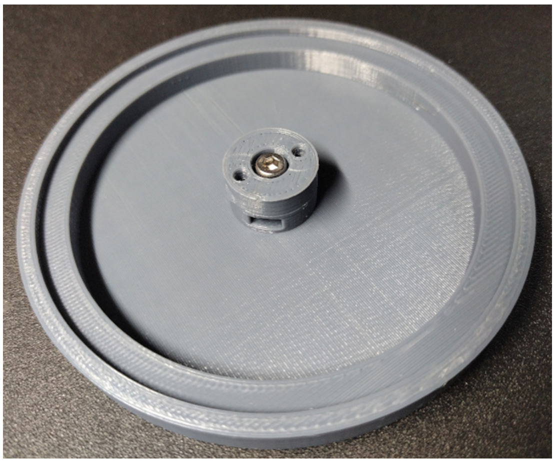


The assembled PCB (circuit board) should be placed so that the 4 mounting holes line up with the 4 holes near the corners of the relief pocket. The PCB should be oriented so that the plunger on the microswitch is near the center of the switch bottom, and the open part of the audio connector faces the outer edge. Then an M2x6mm Socket Head Screw (page 54)can be placed in each of the 4 holes and tightened with a 1.5mm Hex Wrench (page 53). The result should look like the following image.



Step 2: Attach the Stem to the Cap

Turn the switch cap over on the table so that the hole with the M3 captive nut is facing up. Place the stem on top of the cap so that the holes align and the counter-bore of the hole in the stem is facing up. An M3x6mm Socket Head Screw (page 57)can be inserted and tightened with a 2.5mm Hex Wrench (page 59)to secure the stem to the cap. When finished, the two parts should look like the following.



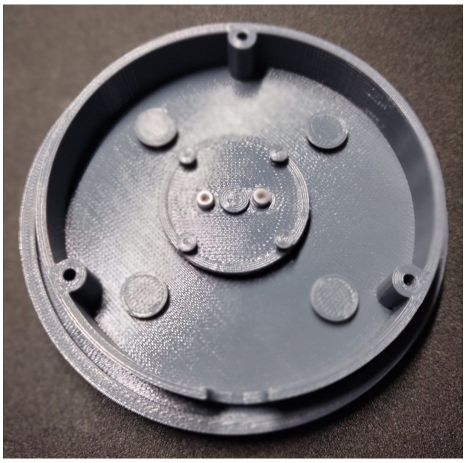
Step 3: Place the Body on the Cap

Lay the switch body upside down on top of the cap, centering the hole in the body with the stem on the cap. It does not have to be perfectly centered. That will be addressed in a future step. The stack should now look like the following.

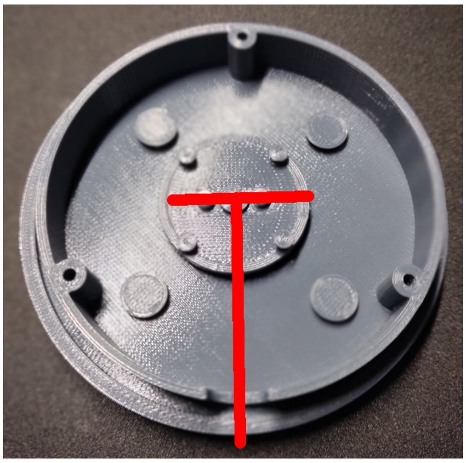
Step 4: Attach the Rubber Band Mounts

The rubber band mounts can now be attached to the stem. This part provides the attachment points for the rubber bands that will be used to suspend the cap for the user to press.

Lay the rubber band mounts on top of the stem, aligning the two holes with the holes in the stem. Place an M2x6mm Socket Head Screw (page 54)in each of the two holes and tighten with the 1.5mm Hex Wrench (page 53). The partial assembly should now look like the following.



Notice how the screw heads are aligned with the cutout in the body of the switch. This orientation will be important when the bottom is attached. The following image illustrates the proper alignment.



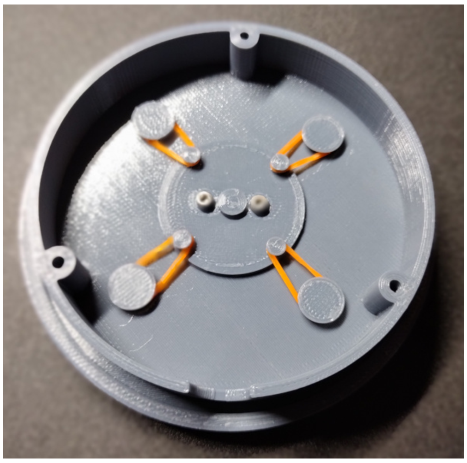
Step 5: Install the Rubber Bands

The rubber bands suspend the cap within the body of the switch, and stand in for something like a metal coil spring. A small size of rubber bands are used here, but there are other sizes of rubber bands or windings that may also work. This is just the configuration that has been found to work the best in testing.

WARNING: The rubber bands are typically used in dental applications and may contain latex. If you have a latex allergy, take the proper precautions such as wearing gloves. The rubber bands will be enclosed within the switch after it is fully assembled and should not come in contact with the user during normal operation. However, this inclusion of latex should always been noted.

Using a pair of tweezers, loop a 1/4 Inch Heavy Rubber Band (page 58)between one of the pegs on the rubber band mounts and the peg on the switch body. This can take some patience, but the pegs are tapered so that the rubber bands will not slip off during use. The first set of pegs with the (orange) rubber band on it should look like the following.

Install the rest of the rubber bands in a similar manner, and the end result should look like this.

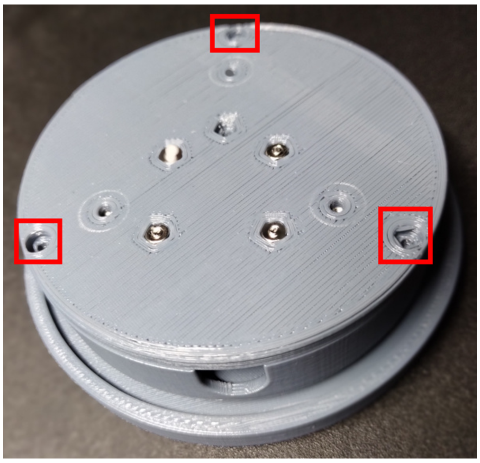


Make sure that the screw heads on the rubber band mounts are still oriented as in the image above with the red T. Sometimes that screw orientation can become rotated while working to slip the rubber bands over the pegs.

Step 6: Install the Bottom

The final assembly step before plugging in and testing the switch is to attach the switch bottom to the rest of the assembly.

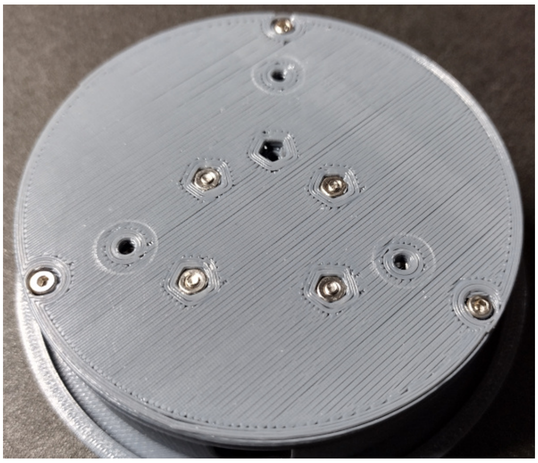
Lay the switch bottom on the rest of the assembly so that the audio connector lines up with the cutout in the body. If these are not aligned properly it will not be possible to plug the mono audio cable into the audio connector. The screw holes that are used to attach the bottom to the body are highlighted in the following image, which also shows the orientation of the captive nuts on the bottom in relation to the cutout in the body. Attaching the bottom this way will ensure the proper orientation as long as all other assembly steps have been done correctly.



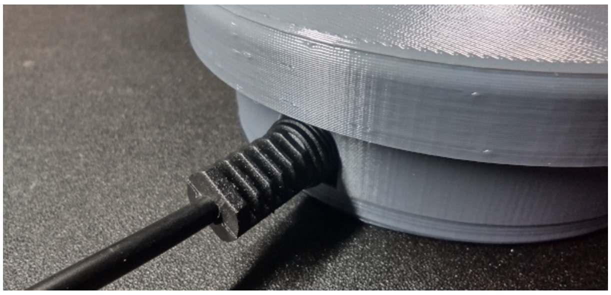
Place an M2x12mm Socket Head Screw (page 56)in each of the 3 holes highlighted above and tighten them with a 1.5mm Hex Wrench (page 53).

Note: If the head of the screw will not draw down into the counter-bore pocket, either the captive nuts have not been installed in the switch body, or they have not been drawn down far enough into their pockets. Please check the Captive Nut Installation (page 20) section to make sure they were installed properly.

The bottom of the assembly should now look like the following.



The assembly is now complete. A mono audio cable can be plugged into the audio connector on the PCB through the cutout in the body. The other end of the audio cable can then be plugged into a switch adapter for testing.



Once tested, the switch should be ready to use.

Step 7: Attaching a Base

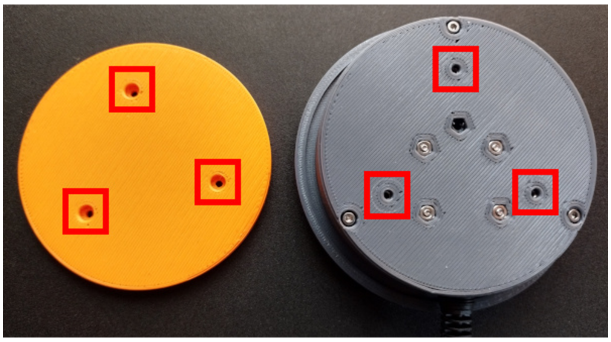
The switch will work fine as it is without a base, but there is no mechanism included for mounting the switch. Also, the screws that secure the PCB to the switch bottom can sometimes stick out just enough to scratch the surface of a desk. Rubber feed can be used on the bottom of the switch in place of a base, but in most cases some sort of base is helpful.

There are two sample bases included with this design, and it is hoped that the community will develop more over time. The switch is designed so that bases can be interchangeable and easy to swap. There are two sample bases included with this design, and those are in the STL zip file (page . The file names are below.

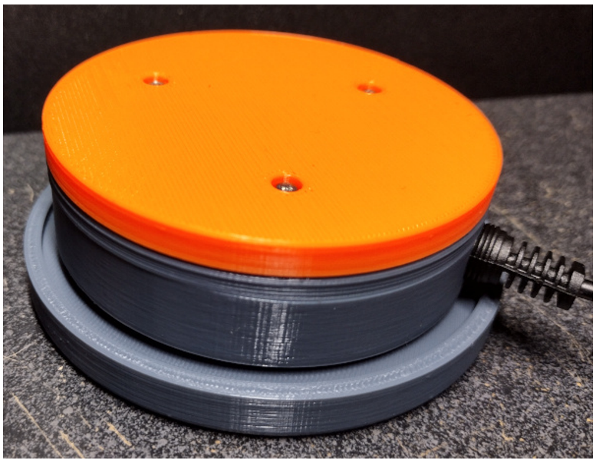
- sample_base_straight.stl

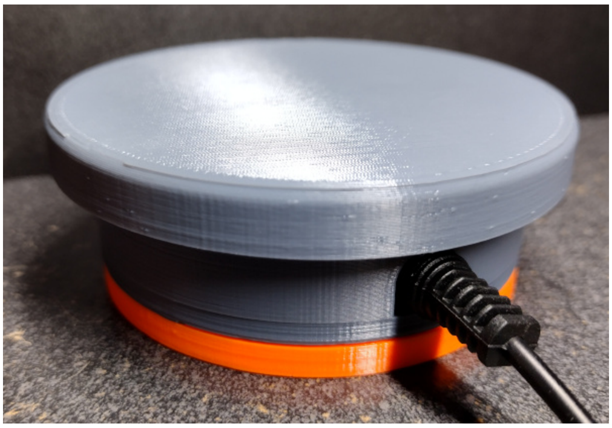
- sample_base_flange.stl

The "straight" base is meant for use on a desktop. It has a smooth bottom and no mounting holes other than the 3 used to attach it to the switch bottom. An M2x8mm Socket Head Screw (page 55)screw is used in each of the 3 holes, and are tightened with the 1.5mm Hex Wrench (page 53). The following image highlights the mounting holes in the switch bottom and the matching holes in the base.



The following images show the straight base (orange) attached to a switch.





If the screws to not tighten and pull the base up to the switch bottom, make sure that you installed the captive nuts properly in the switch bottom per the instructions in the Captive Nut Instructions (page 20).

The "flange" base has a lip that runs around the outside of the switch with holes all around it. The intention is for the flange to make it easier to mount the switch to a wheelchair or a bed.

It is easy to envision other designs as well, including a tube mount base. To aid in the creation of custom switch bases, a Custom Bases (page 34)section has been created in this documentation that provides some instruction.

(page

Custom Bases

Introduction

The push button switch is designed so that custom bases for different use cases can be created. It is hoped that the community will share these with each other through sites like Printables (page , Thingiverse (page and GitHub (page .

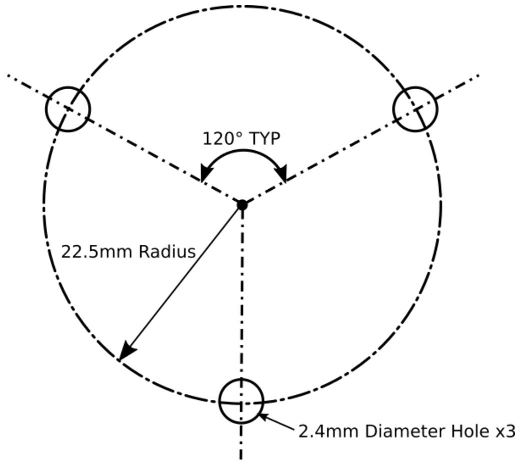
The instructions below are meant to help get someone started creating their own switch bases. A willingness to learn, as well as access to a 3D printer and CAD software such as FreeCAD (page , TinkerCAD (page or Fusion360 (page is all that is needed. If you have comments or questions, please feel free to join the switch forum topic (page or mailing list (page .

Base Dimensions

Bases can be designed in any way, but some sample dimensions are given for the straight base that is included with the design.

The straight base has the same diameter as the switch bottom, with no overhang. This means that the base is 75mm in diameter, or 37.5mm in radius. Other dimensions can be used if overhang is desired, which is the case with the flange base.

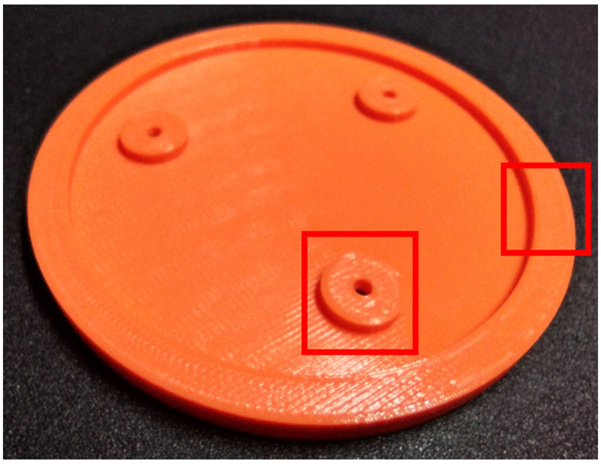
The bottom of the push button switch has 3 holes in a pattern, with captive nuts on the opposite side (assuming that they were installed by the builder). The following sketch shows how the holes are laid out in a base to match.



What this sketch means in words is that the hole pattern can be laid out in a polar (aka radial or circular) pattern every 120 degrees, with a pattern radius of 22.5mm. If the holes are laid out this way, they should mate properly to the switch bottom. If your base has an orientation to it, be sure that when installed the base and the cable cutout on the switch body will be aligned properly. If it does not fit your intention, you can shift the starting angle of the array by any value needed to make the base and the switch cable cutout align properly.

Relief Areas

Depending on the screws used, 3D printer accuracy, and amount of torque applied to the screws, they may protrude below the surface of the switch bottom slightly. It is best to provide some open area between the base and the switch bottom. The inside of the straight base is shown below as an example.



Notice that there is a lip around the outside of the base (highlighted on the right side), that has an outside diameter of 75mm and an inside diameter of 65mm. This lip is the full base thickness of 5mm. There are also 3 bosses (one of them is highlighted in the image) at each of the mounting hole locations. Each of these bosses is the full 5mm thick as well. This provides an open relief area under the switch, and also saves on print material and time.

Wrapping Up

If your base is a different thickness than 5mm, you will most likely need to use a different screw than the M2x8mm socket head screw that is specified in the assembly documentation. Don't be afraid to deviate and try different design options in order to best fulfill your needs. Also, please do not hesitate to share your base designs with the community so that everyone can gain benefit from your efforts.

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Printed Circuit Board

Manufactured circuit board that holds the electrical components for this switch.

Specifications

Attribute	Value
Substrate	FR4
Layers	2

Suppliers

Supplier	Part Number
OSHPark	N/A (page

(page

3.5mm Mono Jack HDR

Audio jack that accepts a cable that goes to the switch adapter.

Specifications

Attribute	Value
Standard	3.5mm, 1/8 in
Gender	Female
Number of Positions	2
Mounting Style	Chassis (Panel)
Orientation	Right Angle
Terminal Style	Solder Pin
Voltage Rating	250 V

Suppliers

Supplier	Part Number
Mouser	502-35RAPC2AHN2 (page
Digi-Key	35RAPC2AHN2-ND (page
Newark	35RAPC2AHN2 (page

(page

Microswitch SPDT

SPST switch with normally open and normally closed terminals and a pin plunger (no lever).

Specifications

Attribute	Value
Series	WS-MITV
Type	Micro Switch
Contact Form	SPDT
Actuator	Plunger
Current Rating	3A
Voltage Rating AC	125 VAC
Voltage Rating DC	30 VDC
Operating Force	150 grams
Termination Style	Solder Terminal
Mounting Style	PCB Mount

Suppliers

Supplier	Part Number
Mouser	710-463091370402 (page
Digi-Key	732-13715-ND (page
Newark	463091370402 (page

(page

Mono Audio Cable

Single channel audio cable that is connected to the audio connector on the PCB.

Specifications

Attribute	Value
Connector End A	3.5mm Mono Plug
Connector End B	3.5mm Mono Plug
Number of Conductors	1
Cable Length	3 ft (~0.9 m) but can be any length needed

Suppliers

Supplier	Part Number
Mouser	172-2137 (page
Newark	67C4144 (page

(page

Soldering Iron

Any pencil soldering iron should work as long as the wattage is not too high. A temperature controlled soldering iron would be best. There are TS style portable soldering irons that have the temperature control built in, and are very convenient to use.

Suppliers

Supplier	Part Number
Pine64	PINECIL-BB2 (page
SeeedStudio	110990479 (page
Amazon	TS100 (page

(page

Solder

Typical rosin core solder should work fine. A smaller diameter can make it easier to make cleaner and smaller solder joints. Do not use lead based solder.

Specifications

Attribute	Value
Type	44 rosin core
Diameter	0.8mm (0.031")
Standard	ANSI-J-STD-006 C

Suppliers

Supplier	Part Number
Mouser	533-24-6040-9709 (page
Newark	35M4362 (page

(page

3D Printer

Any FDM 3D printer should work, provided that it has a large enough build volume to print the switch cap, which is the largest part. Some 3D printers are listed in the Suppliers section for reference only. No specific 3D printer is required to complete this build.

Suppliers

Supplier	Part Number
PrusaResearch	i3 MK3S+ (page
LulzBot	TAZ SideKick 289 (page

(page

Filament

Other filament types may work, but PLA and PETG have been tested for this switch. PETG should yield better durability, but is not required. The diameter should not matter either, but all switch prototypes have been printed with 1.75mm diameter filament. The color of the filament does not matter.

Specifications

Attribute	Value
Type	PLA or PETG
Diameter	1.75mm
Color	Any

Suppliers

Supplier	Part Number
PrusaResearch	Prusament PETG Prusa Orange 1kg (page

(page

Tweezers

Any tweezers with a tip that is small enough to grab thin strands of plastic should work fine. For the prototypes sharp tweezers that are used to place tiny components on circuit boards worked fine. Tweeezers of this type are specified in the Suppliers section.

Suppliers

Supplier	Part Number
Mouser	119-18072USA (page
JamecoElectronics	253092 (page

(page

M2x16mm Socket Head Screw

A standard M2 socket head screw, 16 millimeters long, that is used to pull captive nuts down into their pockets. Button head and other screw head types will work in place of this screw.

Specifications

Attribute	Value
Size	M2
Style	Socket Head
Length	16mm

Suppliers

Supplier	Part Number
McMasterCarr	91290A047 (page
Amazon	OCH-945A89DC847200FF9FDAFE8A13F8271D (page

(page

M2 Flat Washer

A standard M2 flat washer. The outer diameter is not critical since the purpose of this washer is to spread the load out so that the head of the puller screw does not indent into the plastic.

Specifications

Attribute	Value
Size	M2
OuterDiameter	Any

Suppliers

Supplier	Part Number
McMasterCarr	91166A180 (page
Fastenal	MW6320000A20000 (page

(page

M2 Hex Nut

A standard M2 hex nut with a width (flat to flat) of 4 millimeters so that it will pull down into the captive nut pockets properly.

Specifications

Attribute	Value
Size	M2
Style	Hex Nut
Profile	Standard
Width	4mm

Suppliers

Supplier	Part Number
McMasterCarr	90591A265 (page
Amazon	a18082200ux0354 (page

(page

M3 Square Nut

A standard M3 square nut. The width across flats needs to be 5.4mm to 5.5mm so that it will fit properly in the nut trap.

Specifications

Attribute	Value
Size	M3
Style	Square Nut
Thickness	Standard (~2.4mm) or Thin (~1.8mm)
Width	5.4mm to 5.5mm

Suppliers

Supplier	Part Number
McMasterCarr	97259A101 (page
Amazon	a16033100ux0511 (page

(page

1.5mm Hex (aka Allen) Wrench

A 1.5mm hex wrench is the most likely size to work with the M2 screws. Whether the wrench is L-Key, T-handle or something else should not matter.

Suppliers

Supplier	Part Number
McMasterCarr	7289A11 (page
Amazon	JB1.5MM (page

(page

M2x6mm Socket Head Screw

A standard M2 socket head screw, 6 millimeters long.

Specifications

Attribute	Value
Size	M2
Style	Socket Head
Length	6mm
Material	Stainless steel (or others except for plastic/nylon)

Suppliers

Supplier	Part Number
McMasterCarr	91292A831 (page
Fastenal	MS2460006A20000 (page

(page

M2x8mm Socket Head Screw

A standard M2 socket head screw, 8 millimeters long.

Specifications

Attribute	Value
Size	M2
Style	Socket Head
Length	8mm
Material	Stainless steel (or others except for plastic/nylon)

Suppliers

Supplier	Part Number
McMasterCarr	91292A832 (page
Fastenal	MS2460008A20000 (page

(page

M2x12mm Socket Head Screw

A standard M2 socket head screw, 12 millimeters long.

Specifications

Attribute	Value
Size	M2
Style	Socket Head
Length	12mm
Material	Stainless steel (or others except for plastic/nylon)

Suppliers

Supplier	Part Number
McMasterCarr	91292A834 (page
Fastenal	MS2460012A20000 (page

(page

M3x6mm Socket Head Screw

A standard M3 socket head screw, 6 millimeters long.

Specifications

Attribute	Value
Size	M3
Style	Socket Head
Length	6mm
Material	Stainless steel (or others except for plastic/nylon)

Suppliers

Supplier	Part Number
McMasterCarr	91290A111 (page
Fastenal	MS2510006A40000 (page

(page

1/4 Inch Heavy Rubber Band

Commonly used as tensioner bands for dental braces, many different sizes of these rubber bands may work, but only the 1/4" size has been tested with the switch.

Specifications

Attribute	Value
Size	1/4 inch
Material	Rubber (some may contain latex)
Note	Use caution if you have a latex alergy

Suppliers

Supplier	Part Number
Amazon	N1445 (page

(page

2.5mm Hex (aka Allen) Wrench

A 2.5mm hex wrench is the most likely size to work with the M2 screws. Whether the wrench is L-Key, T-handle or something else should not matter.

Suppliers

Supplier	Part Number
McMasterCarr	7289A13 (page
Amazon	a21082400ux0277 (page