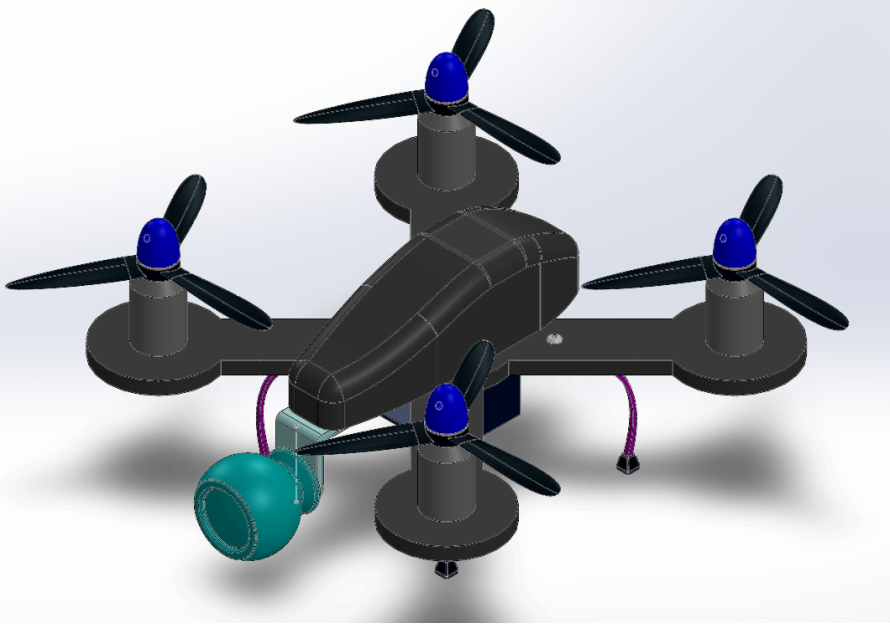
ENG 4 Project- Drone Quadcopter



Gupta, Shivam

Hodgson, Robert

Pham, Dahlia

Yang, Muqing

Zarate-Sanchez, Luis

Section: A01

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29 November 2016

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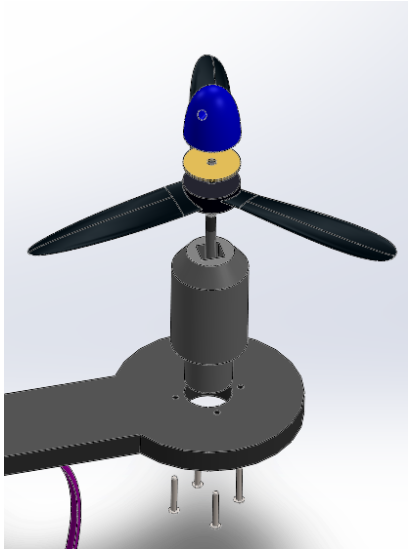
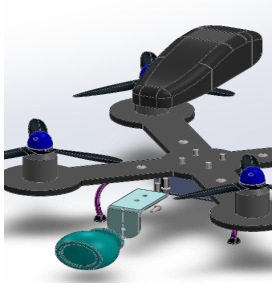


Quadcopter drones are multirotor flying machines that use two identical pairs of propellers to generate lift. For the sake of efficiency, our drone model was mainly broken down into five main components: the propellers, the box containing all of the hardware (such as a microcontroller, batteries, etc.), the legs/stand of the drone, the drone's frame, and the drone's motors. Dahlia Pham worked on the three-blade propellers, Luis Zarate-Sanchez worked on the box and camera, Robert Hodgson worked on the legs and controller, Muqing Yang worked on the frame as well as washers, and Shivam Gupta worked on the motors.

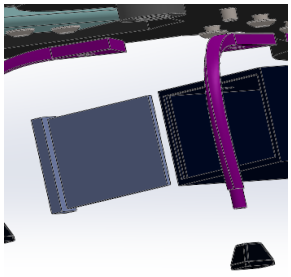
One motor is placed at each of the four large holes at the end of the main frame using concentric mates between the cylindrical wall of the motor and the large hole, and mating the bottom surfaces together. The motor is kept from freely rotating by aligning the smaller holes with concentric mates and inserting SBHCSCREW 0.06-80x0.4375-HX-N screws pointing upward into the motor’s threaded holes so they become fixed in place. At the top of the motor sticks out a cylindrical extension on which the center of the propeller, the washer and the nut are aligned with concentric mates and layered on top of each other with coincident mates.

The drone’s main box is placed on top of the project frame by coincidentally mating its bottom surface with the frame’s top surface. The four small holes located

near the center of the box are aligned with the holes nearest to the center of the frame with concentric mates. The smaller container box also possesses the set of four holes located at its top surface, and they must also be mated concentrically with each of the holes near the center of the frame. The smaller box's top surface is coincidentally mated to the bottom face of the project frame. To keep the main box, the frame, and the container box in place, we inserted a set of four SBHCSCREW 0.112- 48x0.5625-HX-N screws pointing upward into the main box's threaded holes. The landing legs of the drone include the curved legs and rubber feet to increase grip on the ground. These legs are attached approximately one quarter of the way from the center to the end of the frame. The drone's main box also contains two small holes toward the front to be concentrically mated with the two holes on the top feature of the camera stand. The bottom plane of the box is mated with the top surface of the stand. To keep these two pieces together, a pair of SBHCSCREW 0.112-48x0.4375-HX-N screws pointing up into the box's threaded holes. Similarily, The camera's only planar surface is mated coincidentally with the stand's front surface and their holes are aligned with concentric mates. A smaller SBHCSCREW 0.112-48x0.3125-HX-N screw is inserted through these two holes pointing forward into the thread inside the camera's hole.

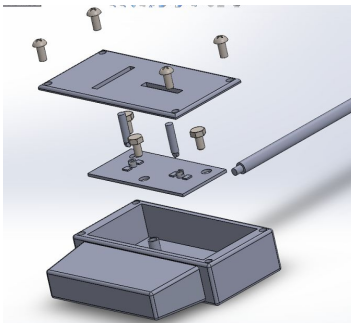


The rubber foot has a cylindrical end at the bottom to be concentrically mated with the hole in the rubber foot. The bottom surface of the leg is coincidentally mated with the bottom of the

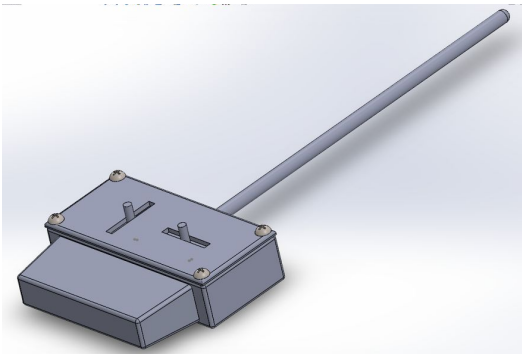


hole. The top face of the leg has a hole to be aligned with a hole in the frame (approximately one quarter of the way from the center to an end of the frame). The legs should be extended pointing directly away from the center of the frame. The top surface of the legs must be mated coincidentally to the bottom face of the frame and a set of four SBHCSCREW 0.112- 48x0.375-HX-N screws pointing down into the thread of the legs to keep them in place.

Controller Assembly:



The controller itself is an assembly. Comprised of the controller shell, antenna, control chip, front plate, and toggle switch, the parts themselves may be basic in design, but in assembly it is quite complicated. Each part was created by either Robert Hodgson or Dahlia Pham. A large amount of mates, including both coincident and concentric mates, were used to put the assembly together. The toolbox add in was also used to screw the assembly together. Some components of the controller are more simple than their real life counterparts, but this was a creative decision we made as the quadcopter was the focus of the project.



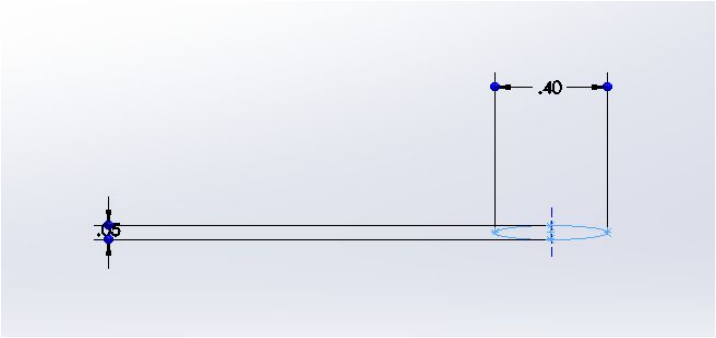
Each feature has its own unique properties, challenges and improvements. Here we will break down the drone model into its component parts including how the feature was created, assembled, and troubleshoot its capabilities.

Propeller by Dahlia Pham

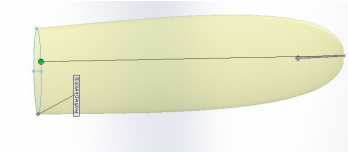
Drones are typically classified as rotorcraft because of the the four sets of motors and two pairs of propellers that are responsible for its flight capabilities. Propellers were made for the drone as the rotational motion generated by the angular blades allow the drone to be lifted off air/ take off in flight. Because this drone should theoretically be specialized for slow flight (as it has a camera and whatnot), we designed more of a circular set of rotor blades for the propeller as opposed to thinner ones and used a three-blade design to maximize this.

Procedure:

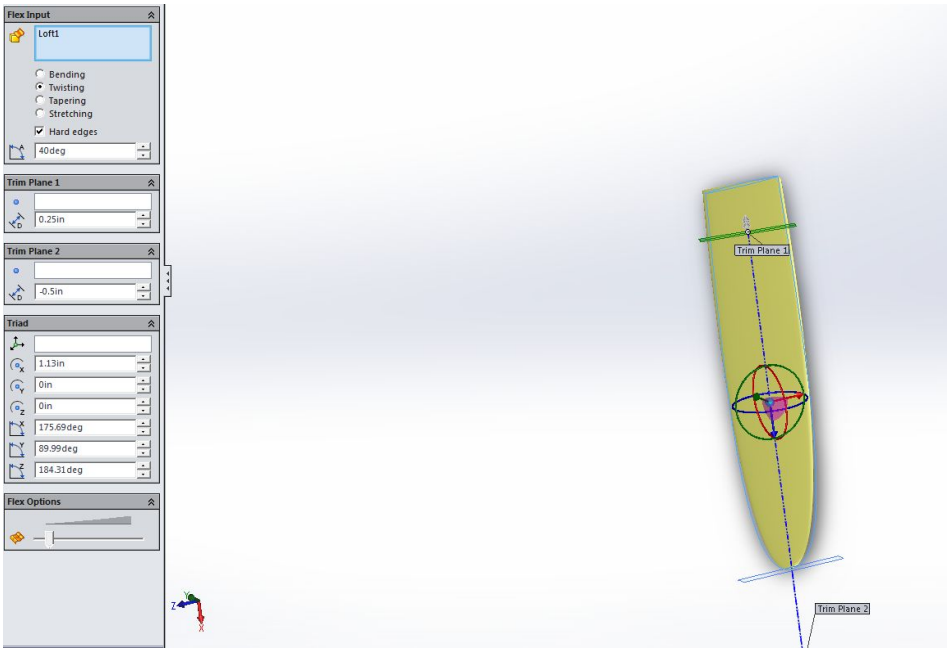
Step 1: An ellipse was made on the front plane with length of 0.4 inches and a width of 0.05 inches on any plane, (where the width determines the thickness of the propeller.) Then, using reference geometry, another plane (must be same plane as used before) was created on another front plane 2 inches away. This would determine the length of the propeller blade.



Step 2: On this new front plane, a point at the origin was sketched. Using the loft tool, a loft was created between the features of the two planes, forming a 3D shape.



Step 3: Flex was then used to bend the created loft at 40 degrees. This would form curvature along the blades, familiar in industrial drone propellers. Trim Plane 1 should read a depth of 0.25 inches while Trim Plane 2 should read -0.5 inches.

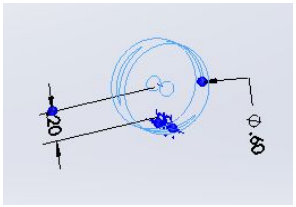


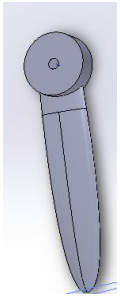
Step 4: Afterward, a circle of diameter 0.6 inches was created on the end of the propeller blade made at the origin on the original front plane. This was extruded to a

height of 0.1 inches and a hole of radius 0.1 inches was made through this extruded base. This is where the motor's screw would go through so that the propeller can be rotated at a controlled rpm.

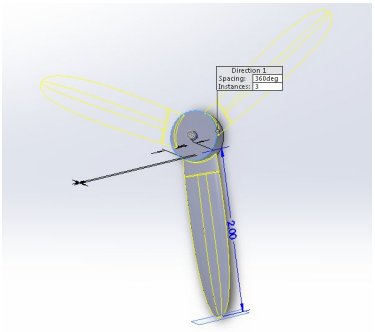
The circular element isolated

The circular element on that end of the propeller

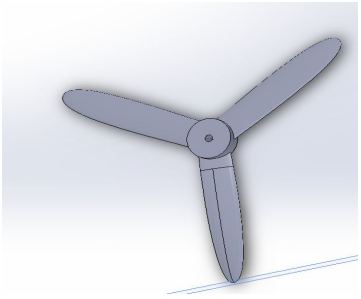




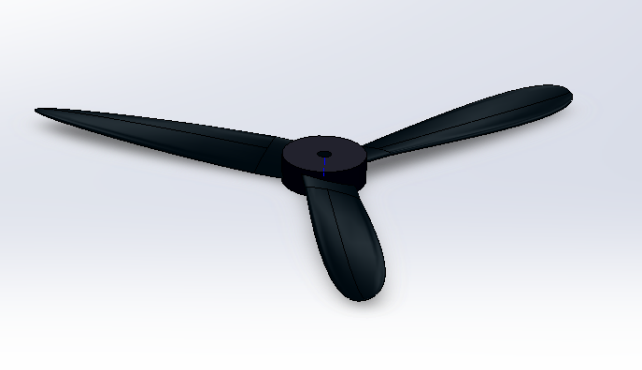
Step 5: Selecting the rotor blade, a circular pattern was made so that there could be three blades around the circular component of the propeller. When doing the circular pattern select Edge 1 (the circular edge) as the reference, and Loft 1 as features to pattern. Select equal spacing, input three faces.



Step 6: You should end up with the following product:



Aesthetics: To give it that more sleek look, the propeller's color was changed from the bland gray default to black. Here was the finished product:



Challenges:

There was another way to make the propeller which involved similar steps from before (starting with an elliptical base, creating a reference plane 2 inches away, using spline to model the basic shape of the propeller, and using loft to select the two open loops to create a solid form that would be used for flex), however we ran into difficulties in being able to select two open loops as a guiding curve for lofting due to the customized shape and after trying multiple times, we were unable to do it in Solidworks 2015. Thus, we ended up doing the method described. It was also hard at first to think of a way to make the propeller in Solidworks, but after trying a few methods this one worked the best. At one point I even tried drawing a pattern, extruding it to produce a thin fan; however I felt as if the method I used provided the best propeller.

Improvements:

If the method above was to be used, there would be more control over the rotor blade's shape and would have been more advanced than just resolving to use primitive shapes (the ellipses) to form the loft.

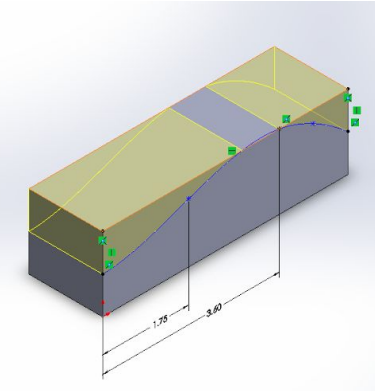
Drone Box - by Luis Zarate-Sanchez

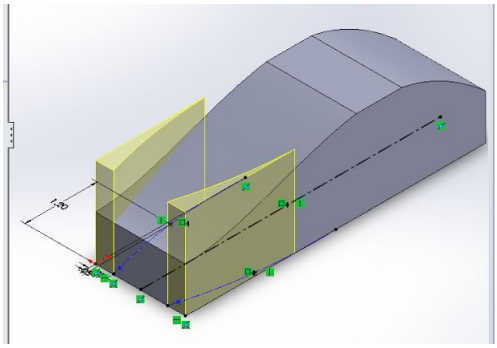
The box was made for the drone so it can hold batteries and all the circuitry inside and helps protect all these sensitive parts from particles in the wind, such as rust and humidity. The curved design of this drone box allows for decreased air resistance when flying at high speeds. It took several steps to create this protective case:

Procedure:

Step 1: Sketch a rectangle on the top plane, 5.000 in by 1.500 in, and extrude up by 1.500 in.

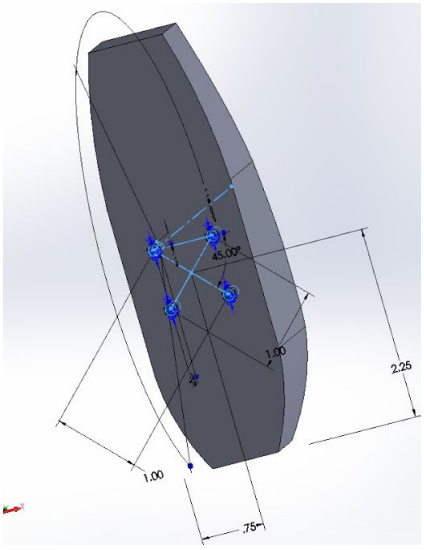
Step 2: Sketch a spline on a face parallel to the right plane. Draw vertical lines from each endpoint so that they are at least as long as the remaining height of the box and connect the lines with another line. Make this sketch your profile for an extruded cut and cut through the whole box.



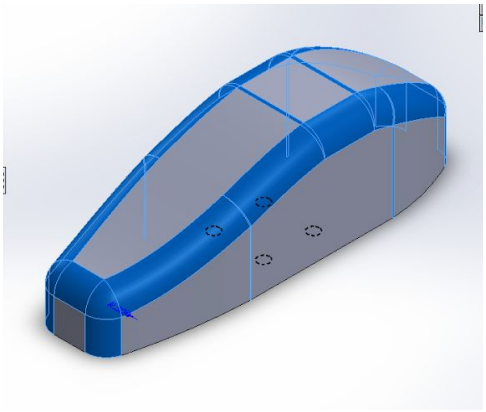


Step 3: Sketch two splines at the bottom face so that they make the base have a curved shape along the long side, while still leaving some straight sections. Connect the splines by creating lines that run along the

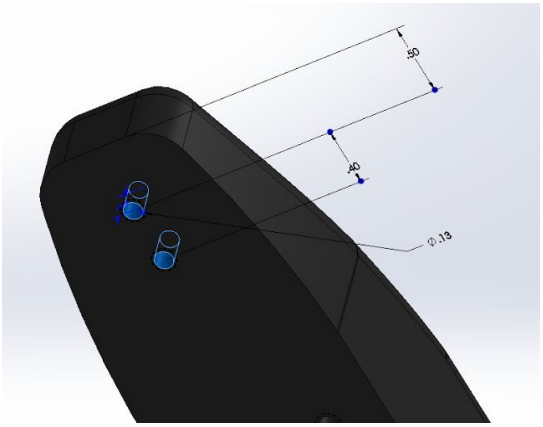
remaining corners of the rectangle. Mirror these entities and select the correct contours to make an extruded cut through the whole part.



Step 4: Create four equal-sized holes on the bottom face, equally distanced to create a square with their center points. Make sure the holes are positioned so that they are symmetric along the middle of the box . Add a cosmetic machine thread around the hole.



Step 5: Fillet every edge in the box (excluding every edge of the bottom face) with a .300 radius to add the last portion of curvature.



Step 6: Add two additional holes in the bottom face, aligned symmetrically down the middle of the box. Use holes with the same size and same cosmetic thread as the holes in Step 4.

Final Step: Add color to distinguish it in the assembly model.

Challenges:

One challenge of designing the drone box was figuring out its dimensions so that its material did not interfere with the rotation of the propellers. Another challenging aspect of designing this box was creating a curvature that not only had aerodynamic properties but also looked aesthetically pleasing.

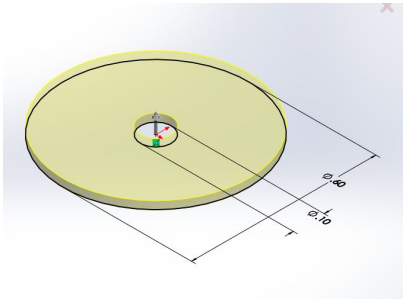
Improvements:

A possible improvement to the drone box could be to add a spoiler in the back to increase the lift on the drone and limit the energy required to fly. However, adding this feature creates another challenge, since it creates a problem in weight distribution and has the potential to interfere with the propellers' rotation.

Washer by Muqing Yang

The purpose of washer is to make the propeller rotate with least amount of friction between the motor and nut. It will ensure the propellers rotate faster, which mean the drone can travel further.

Procedure:
Step: Sketch two circles with diameter of 0.6 and 0.1 in in about the origin on the top place, and then extrude the bounded area by 0.1 in

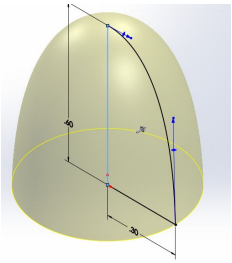


Improvement:
Due to the simplicity of the structure, no improvements were needed.

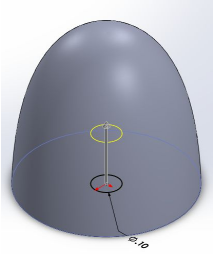
Challenge:
There was no real challenge in making the washer.

Nut by Muqing Yang

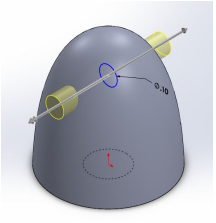
The purpose of the nut is to keep the propeller in place.



Procedure:
<u>Step 1:</u> Create two lines perpendicular to each other on the front plane, 0.3 in and 0.6 in.
<u>Step 2:</u> Create spline with length of 0.74 in between two line
<u>Step 3:</u> Revolve the profile around the 0.6 in line to make a nut shape



Step 4: Create a circle shape with diameter of 0.1 in about the center of the circle at the bottom of the nut, and then use extrude cut to cut it 0.2 in. At last, insert cosmetic thread



Step 5: Create a circle with diameter on the front plane, and the use extrude cut feature to cut both in both direction so it can make a hole all the way through the nut

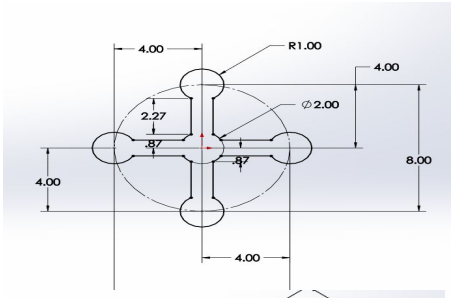
Challenge:
The most difficult challenge is finding the right arc so the shape of the nut can be aesthetically pleasing. Another challenging part is dimensioning the spline.

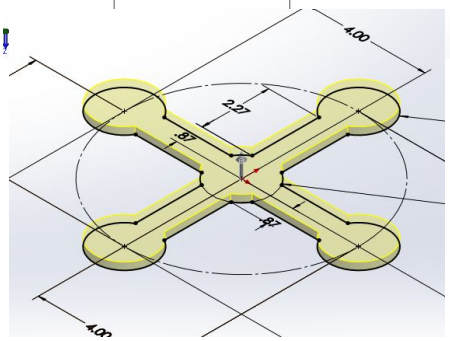
Improvement:
There is not much major to improve. I want add pattern to it so it can look better

Project Frame by Muqing Yang

The frame is created as the center of the assembly. It is where most of the parts attached to. It consists all the holes with thread for screws.

Procedure:



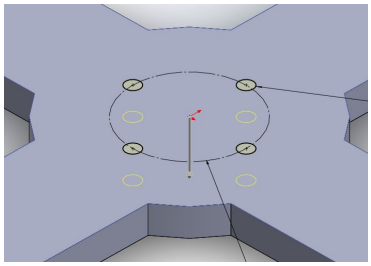


Step 1: Create a circle with the diameter of 8 in about the origin for construction, and then create fours circles with the diameter of 2 in around the 8 in circles evenly.

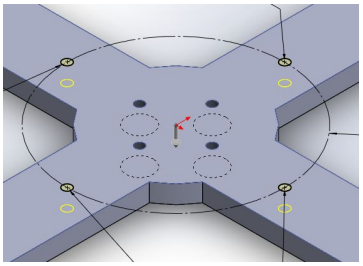
Step 2: Create a circle with diameter of 2 about the origin and use lines to connect the circle to other four circles.

Step 3: Trim every extra lines

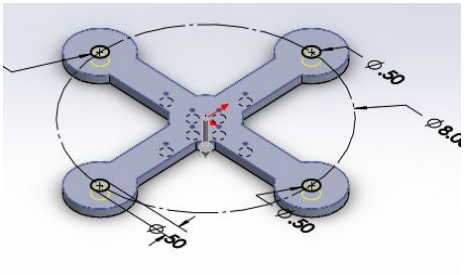
Step 4: Extrude the shape 0.25 in



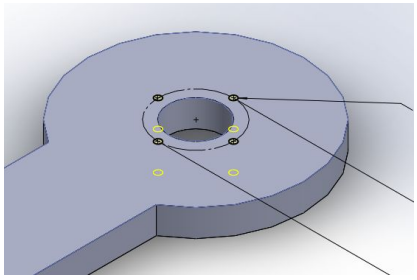
Step 5: Create a construction circle with diameter of 1 in about the origin, and then create 4 circles with diameter of ⅛ in with diameter center intersect the construction circle. Lastly, use extruded cut feature to cut all the way through



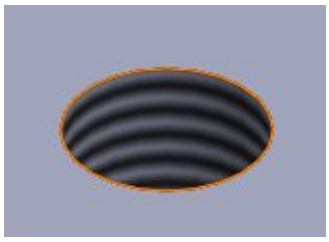
Step 6: Repeat similar process as step 5, but use a construction circle with diameter of 3 in and create four circles with ⅛ in along the construction circle



Step 7: Same process as the step 5, instead, use a construction circle with diameter of 8 in and create four circles with diameter of ½ in



Step 8: Create a construction circle with diameter of 0.7 in about the center of the four circles created from step 1, and then create four circles with diameter of 1/16 in evenly around the construction circle, and last use extrude cut with condition, “all the way through”



Step 9: Insert cosmetic thread to all the holes except for the holes with diameter of 1/2 in

Challenge:

One challenge of creating the frame is to think about a way to assemble everything into the frame without interfering with each other. Another challenge is that I need to change the feature of the frame if someone else changes their parts, even slightly. The working drawing is also difficult to create working drawing for the frame because the frame has many dimension and some parts are too small to show clearly in the working drawing, so I need to use detail view function to show them

Improvement:

I wish I can make the frame look more pleasing, such as the shape and way to arrange all the features.

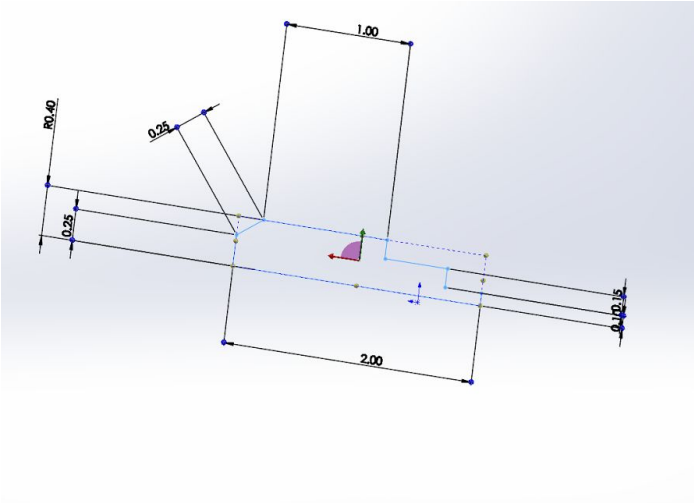
Drone Motor by Shivam Gupta

Motors are the rotary tools that convert electric energy to mechanical energy, usually set at a specific rpm to rotate the propeller blades.

Motor Casing

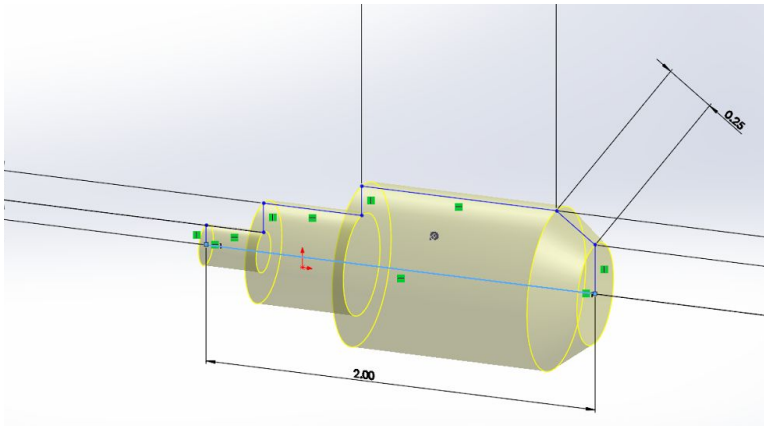
It the casing of the Motor and contains the rotor and the coil of the motor. It is or the part that is used to connect the propellers with the drone frame.

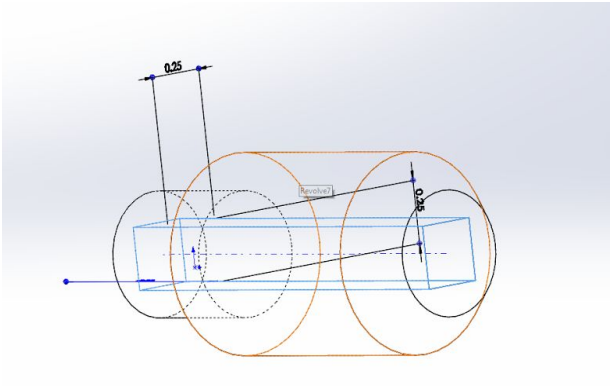
Procedure -



Step 1 - Create a basic sketch and define all the dimensions of the casing**.** Will we use the 2” line as the axis to get the basic structure of the casing.

Step 2 - Select the revolve command, and select the sketch we made in the step 1. Then we select the axis to around which we want to revolve it. In this it the 2” line or the axis 1. We enter the revolve, now we have a basic casing for the motor.





Step 3 - Next we will use the Extrude-Cut Command to create space for the Rotor and the Coil. To get the space, we first sketch a .25' X .25" square with the center being the axis we used for revolve. Then we use the Extrude-cut command to define the cut in the casing. This step makes the casing complete.

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Challenges

There were no significant challenges in creating this part.

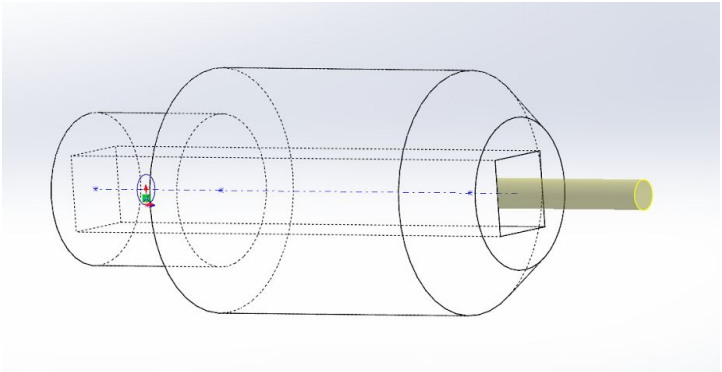
Improvement

The design can be made more aerodynamic by adding more fillets and chamfers.

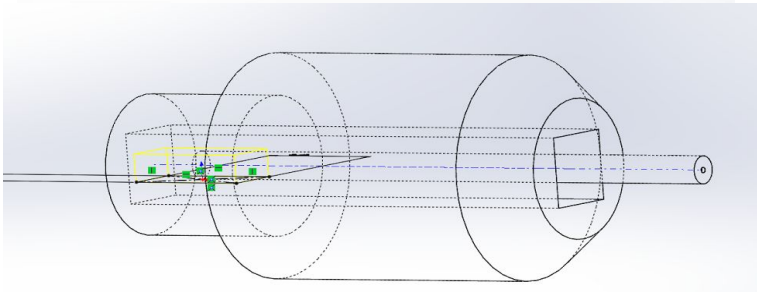
Rotor

The rotor is the part that will directly rotate the propeller.

Procedure



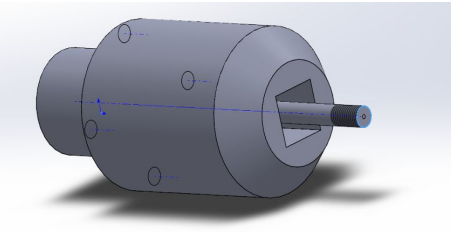
Step 1 - Create a Sketch of a circle with a set dimension. Now use the extrude Command to create the cylindrical part of the rotor.We have to set the dimension of the Rotor carefully so we can get the least amount of friction, and get the highest rpm achievable.



Step 2 - Now we need to add the Rectangular part of the Rotor that is going to Rotate between the Coils.First we sketch the

rectangular area at the end of the cylinder. Then we can use the extrude to extend the rectangular area. This area will give us the the rectangular part of the rotor that will spin in between the coil.

Step 3 - Finally we can add the cosmetic thread to the cylindrical part of the rotor. So, we can attach it to the propeller with ease. This fix should be tight as it will get the maximum rotation from the propellers.



Challenges

The main challenge with creating the rotor was selecting the position of the cylindrical and the rectangular part and attaching them together. And also setting the dimensions of the rotor, and the rectangular spinner of the rotor so that we can get the least friction possible.

Improvements

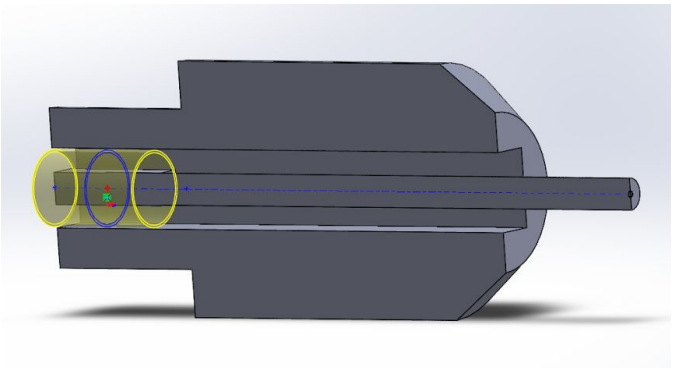
The part can be made better by using ferrous material to get the maximum rotation with any friction.

Coil

It is the part of the motor that is going to conduct the current and make the rotor rotate.

Procedure -

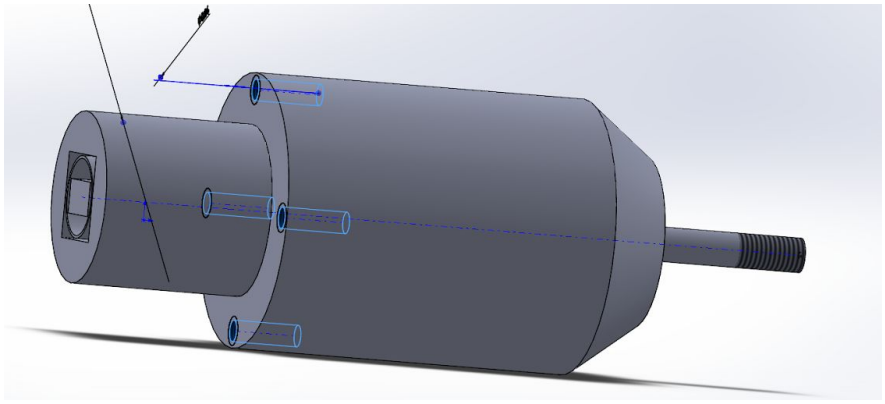
Step 1 - We can create the coil by making a sketch of the cylinder and using the Extrude command.



Challenges -
There were no challenges in creating this part.

Improvements -
We cannot improve this part.

Holes -
Now we need to make holes to attach the motor to the frame using the cosmetic thread.
Procedure- Step 1- We draw four Circle at the base of the motor.
Step 2 - We use the Extrude cut function.



Step 3 - We add the cosmetic thread to the holes to attach them to the frame.

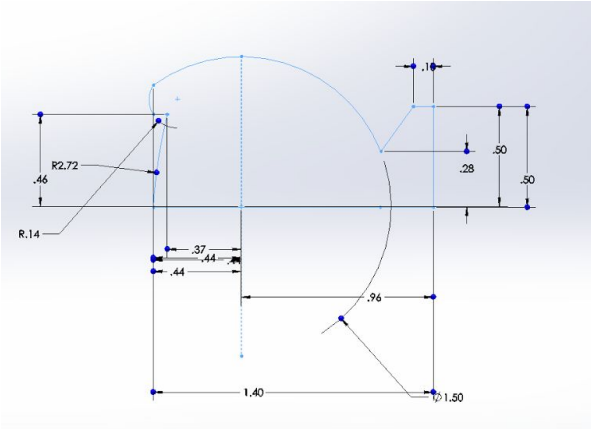
Challenges - There were no challenges in creating the holes.

Improvements - This part was maximized for its purpose, so there are no improvements needed.

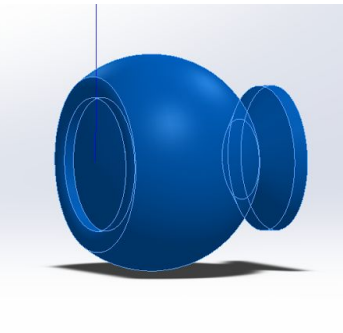
Drone Camera by Luis Zarate-Sanchez

The camera held by the drone allows the pilot to experience the drone's flight in first person to optimize control. The camera's spherical shape allows it to reduce drag while flying and allows for weight stability.

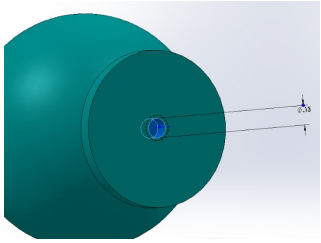
Procedure



Step 1: Create this profile composed of multiple circular arcs and a few line segments.



Step 2: Rotate this profile about the horizontal axis to create the (almost) spherical shape of the camera.



Step 3: In the back of the camera, on the flat side, create a hole with diameter of 1/8 in (same as all holes on the box), .1in deep. Add cosmetic thread. Add color to camera to distinguish it in the assembly model.

Step 4: Fillet the edges (except for the edges bordering the lens).

Challenges

The only challenging part to making the camera was creating a profile that included a curve that resembled a reasonable camera that was neither too big but large enough to demonstrate high-resolution video.

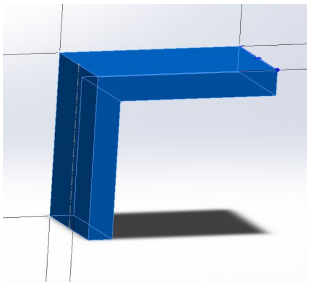
Improvements

An improvement that we could have made was to create a camera that had moving parts (expanding and contracting lens). However with the time limited and the main focus on the drone parts, making a very detailed camera was not possible.

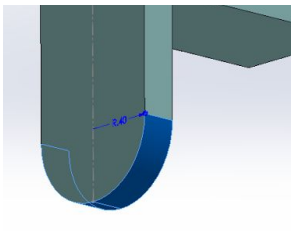
Camera Stand by Luis Zarate-Sanchez

The Camera Stand only served one purpose: to hold the camera while being attached to the drone box.

Procedure

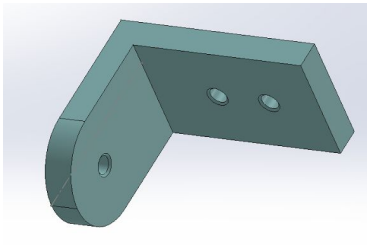


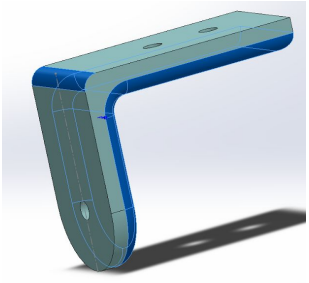
Step 1: Draw an L-shape as the profile on the right plane. Extrude the profile.



Step 2: Fillet the bottom side to make a semi-circular shape.

Step 3: Add two holes on the top (for the main box), and one on the front face (for the camera). Add cosmetic thread.





Step 4: Fillet most edges with .1 in fillet radius. Add color.

Challenges

No challenge except for making sure the stand did not interfere with the frame.

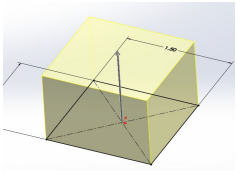
Improvements

Make it a multiple-piece stand so the camera can look around and not just straight forward. The problems again were the time limit and the focus on the main drone parts

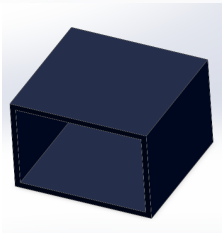
Container Box - By Muqing Yang and Dahlia Pham

The box is attached to the bottom of the drone. Its purposes is extra storage for little things, such as battery, gifts, and tiny tools.

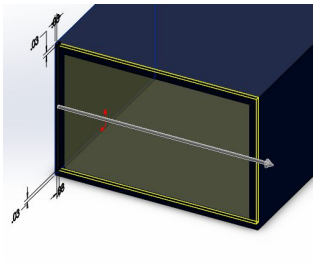
Procedure:



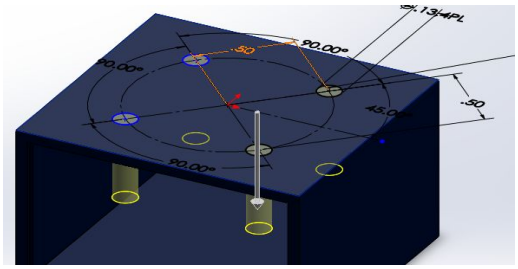
Step 1: Create a rectangle, 1.4 in by 1.5 in, and then extruded it 1 in



Step 2: Use Shell feature with thickness of 0.06 in



Step 3:Create a rectangle at the left side of the shelled box, and then use extrude cut with blind distance of 1.475 in



Step 4: Create four circles with diameter ⅛ in on top of the box around a construction purpose circle with diameter of 1 in, and then use extruded cut and insert cosmetic thread

Challenge:

The biggest challenge on creating the part is to create the four holes on top of the box because it required exact position of the holes, so it can insert to the frame correctly.

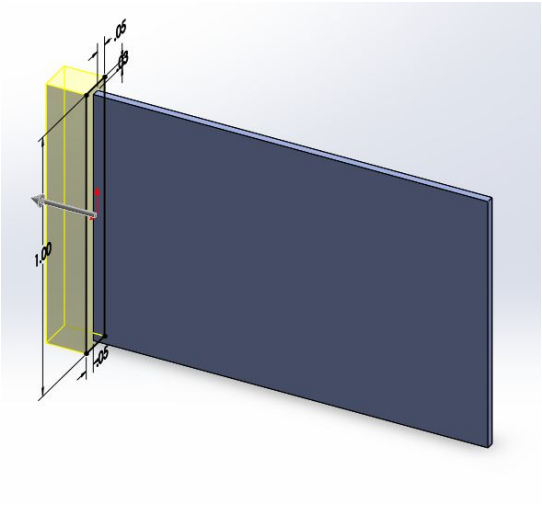
Improvement:

I want to add more feature to the box so it can have more purpose other than storage. I can also think a way that box can be detach from the frame if needed.

Container Box Door by Muqing Yang

This is created to as door for the container box, so thing can be keep save in the box during flight.

Procedure:



Step 1: Create a rectangle, 1.48 by 9.5 in, on the front plane, and then extruded it 0.03 in

Step 2: create another rectangle, 1 by 0.1 in at the left side of the rectangle created from step 1, and then extruded it 0.15 in

Challenge:

I did not experience difficulty.

Improvement:

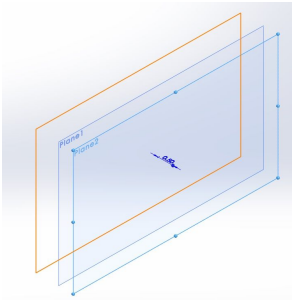
There is no major improvement.

Landing Leg by Robert Hodgson

The landing legs are attached to the bottom of the frame. The purpose of the landing leg is to help prevent damage to the copter from the landing as well as provide a controlled landing rather than a controlled crash.

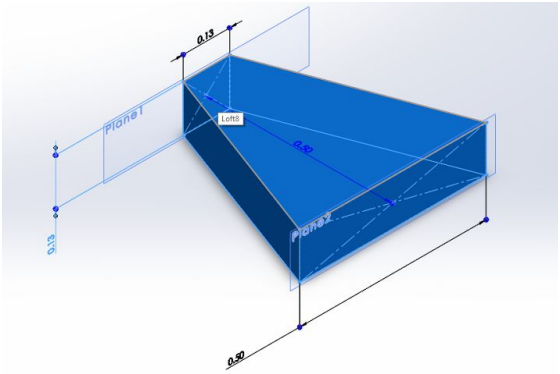
Procedure:

Step 1: Using reference geometry, create a reference plane .77 inches away from the front plane, which we will refer to as plane 1. Then, create another reference plane ahead of the first reference plane by half an inch, which we will refer to as plane 2.



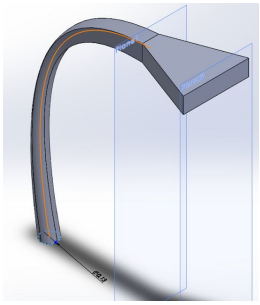
Step 2: On the origin, create a circle with a diameter of .13 inches on the top plane.

Step 3: Now in plane 1, we create a rectangle. It will be , assuming (z,y), .13 inches by .13 inches. The bottom edge of this rectangle should be 1.57 inches above the origin.



Step 4: In plane 2, create a rectangle with the dimensions of .5x.13, assuming (z,y). Their centers should share the same z and y coordinate.

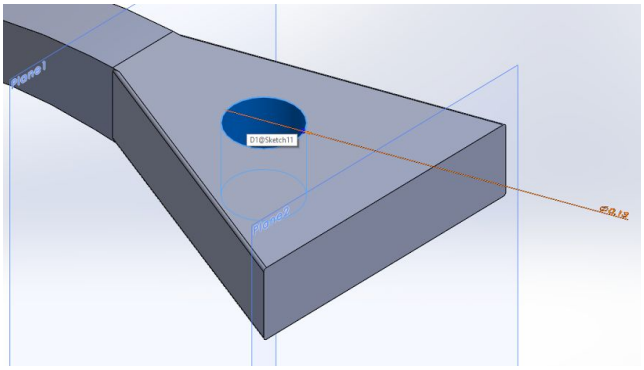
Step 5: On the features toolbar, select the loft tool and click the top edge of the rectangle from plane 1 and the top edge of the rectangle



from plane 2. This should create a solid mesh between the two planes in the shape of a trapezoid.

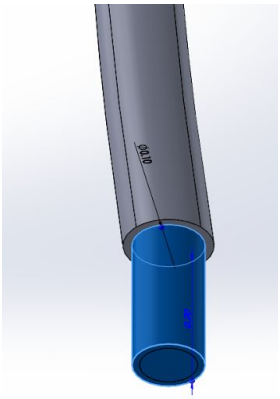
Step 6: Select the front plane from the property tree. On the toolbar, select the spline tool. Draw a curved path from the center of the circle on the top plane to the center of the rectangle on plane 1. From there, select the loft tool from the features tab and select as the faces the circle and the rectangle from plane 1. Select the spline as the guided path.

Step 7: On the (x,z) plane atop the lofted trapezoidal prism, sketch a line from the midpoint of the top edge of rectangle plane 1 to the midpoint of the top edge of rectangle plane 2. Next, draw a circle on the midpoint of this line with a diameter of .125 inches. Finally, select the extrude cut tool and click on the edge of the recently sketched circle. Change the option from blind to through all.



Step 8: On the features tab, click on the fillet tool. Now select all of the outer edges from the loft. Fillet to .01 inches.

Step 9: Using a bottom view, look at the circle from the origin. Sketch another circle here with a diameter of .1 inch. Next extrude boss the circle down the y-axis .2 inches. Insert an annotation for a cosmetic thread and then the landing leg is complete.



Challenge:

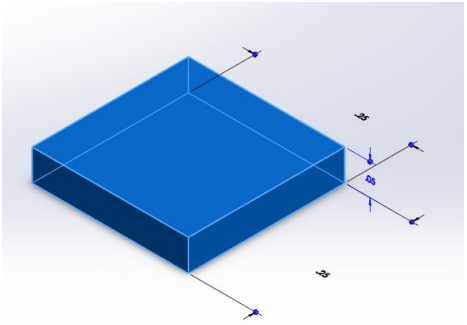
The primary challenge in designing this model was deciding how to create a curved loft which would move from circle shape to square shape. After that was completed, much of the challenge was gone.

Improvement:

A way to improve this model would be to design with an idea of the processes going in rather than improvising much of the processes. Also, could have made the legs a tad larger to help with the sturdiness of the legs, as the size ratio of the legs to the quadcopter could have been better.

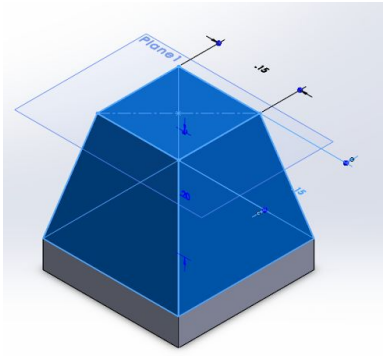
Rubber Foot by Robert Hodgson

This would screw onto the bottom of the landing leg. The purpose is to further buffer the landing and increase the security of the landing by adding for surface area to the feet of the craft.



Procedure:

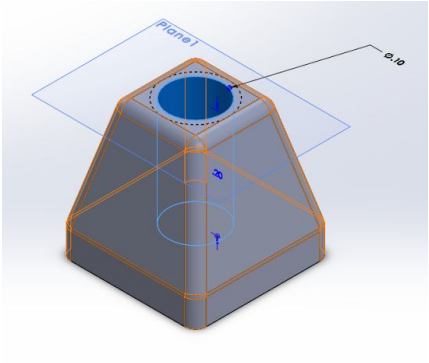
Step 1: Click on the extrude boss tool from the features tab. Begin sketching on the top plane. Sketch a square that is a ¼ inch by a ¼ inch. Extrude the sketch .05 inch.



Step 2: Create a reference plane, referred to as plane 1, .2 inch above the top of the current model.

Step 3: Sketch a square on plane 1 with the dimensions of .15x.15. Now loft the top face of the extruded boss to the face on plane 1.

Step 4: Next fillet all sides, except for the bottom most edges to a radius of .02 inches.



Step 5: Click on the face that is on plane 1. Select the extrude cut tool from the features tab. Now, draw a circle with a radius of .1 inch. Make the blind depth of the extrude cut .2 inches. Insert the annotation of a cosmetic thread and the model is finished.

Challenges:

No significant hurdles took place here.

Improvements:

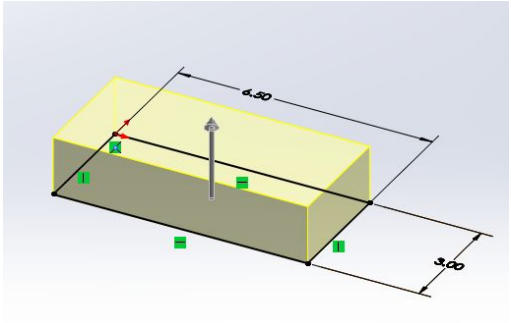
One improvement that could be made is adding some sort of indent to the bottom of the foot so that it may help with the landing even more so.

Controller Shell by Robert Hodgson

The purpose of the controller shell is to have something to hold in your hands as well sa house the components for controlling the direction of the craft.

Note for the figures: The structure was built before the instructions were written, and it is hard to remove the extruded cuts/ linear patterns from the CAD model so they will be included the figures accompanying the sets before the holes themselves are actually made.

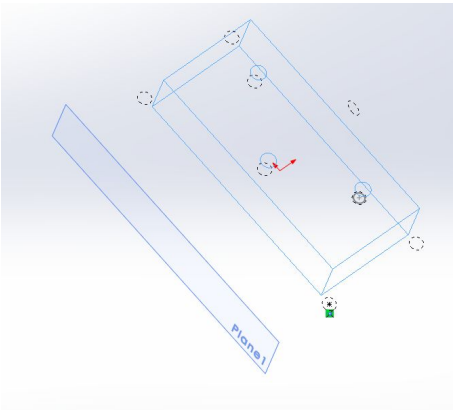
Procedure:



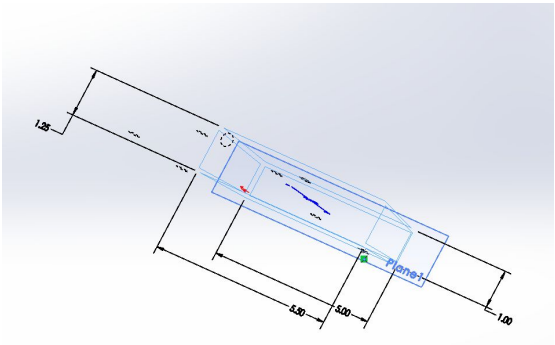
Step 1: Using the extrude boss feature, click on the top frame and begin to sketch a rectangle

with a length of 6.5 inches and a width of 3 units. After making that, set the depth of the solid model to 1.5 inches.

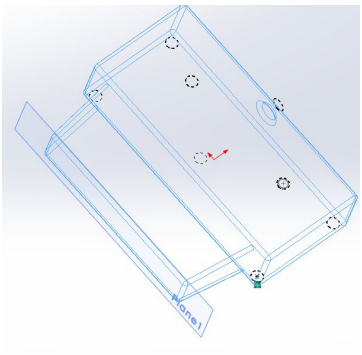
Step 2: Create a reference plane with reference to the front plane. Make this plane, which will be referred to as plane 1, 2 inches away from the closest length side face of the box just created.



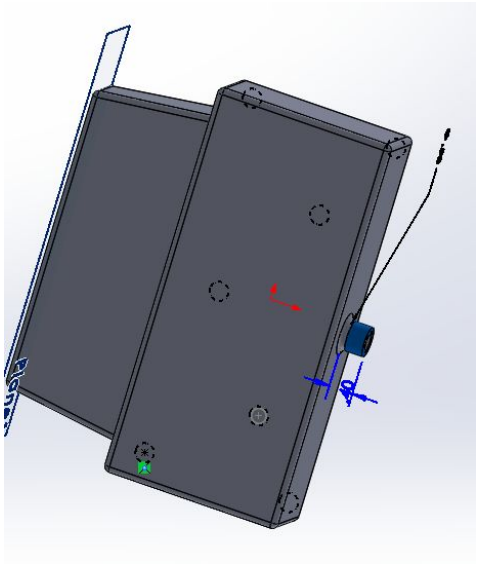
Step 3: Now, using the sketch tool in the sketch tab, begin to draw rectangles on plane 1 and on the length side face of the box. Make the length side face rectangle larger than the rectangle drawn on plane 1. The first rectangle should be 5.5 inches long and 1.25 inches wide. The center of the rectangle should also be the center of the face. The second rectangle should have a length of 5 inches and a width of 1 inch. The center of this rectangle should share the same z,y coordinates as the first rectangle.



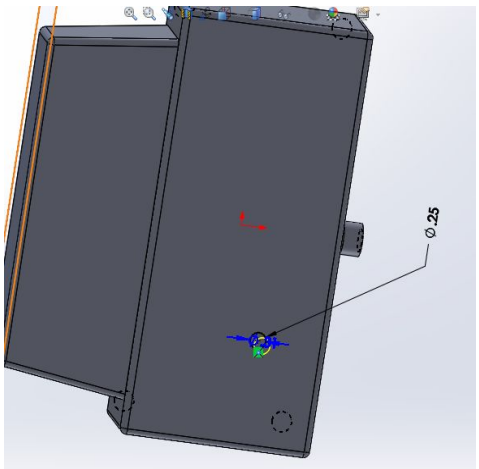
Using the loft tool from the features tab, click on the upper edges of each of these rectangles to create a loft between them.



Step 4: To create the component where the antenna will connect to the shell, click on the edge of the box opposite of the one worked on in step 3. Using the extrude boss tool, sketch a circle on this face that shares the same center point as the face itself with a diameter of .5 inches. Now, adjust the depth of this newly made cylinder to have a height of .4 inches.



Step 5: With the face of the cylinder that is furthest from the center selected, click the extrude cut. Sketch a circle with a diameter of a ¼ inch. Now, make a blind cut with a depth of .3 inches. Insert an annotation for a cosmetic thread with the edge of this cut selected.

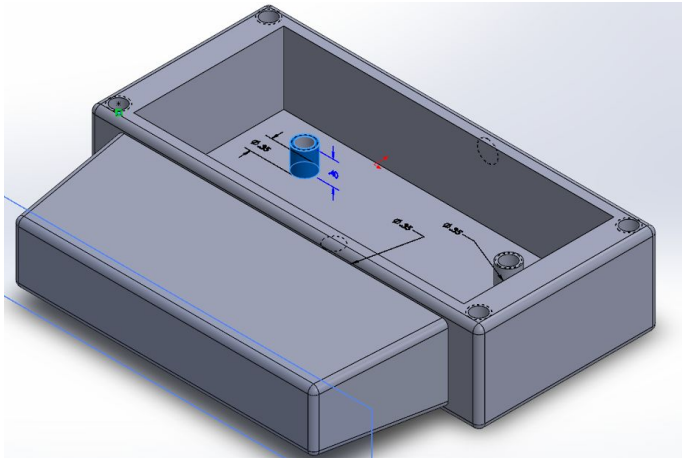


Step 6: Using the fillet tool, click on all edges of the controller shell except for those on the rectangle from the edge of the box. Make the radius .1 inches.

Step 7: On the top most face of our original box, begin to create the holes that will be used to keep the face

of the controller on. From the top view, sketch a circle on the right top corner of the face. Give it a diameter of a ¼ inch. Extrude cut this circle with a blind cut to a depth of .4 inches. Now using the linear pattern tool, create a pattern along the z-axis with another extrude cut 2.5 inches away from the original. Use the linear pattern tool again to mirror these cuts to the other side of the face. Make the next 2 extrude cuts 6 inches away in the x-axis direction. Insert a cosmetic thread to each of the extrusions complete this step.

Step 8: Using the extrude cut tool with the same face selected as in step 7, draw a rectangle that shares the same center point as the box. Make the rectangle 5.5 inches long and 2.5 inches wide and give the cut a depth of 1.2 inches.



Step 9: Using the extrude boss, create three cylinders that come from the floor of the sunken face to .4 inches up. Make the diameter of these faces .35 inches.

Step 10: Extrude cut a hole with a diameter of an ¼ inch into each top face of the cylinder posts. Give these holes a depth of .4 inches. Insert a cosmetic thread for each of these extruded cuts.

Challenges:

There were many hurdles in designing this model. Most of these were in regards to the shape and how much function would be given to the controller. The controller currently

controls direction. The shape had significant hurdles as it was tough to pin down which tool was best to use throughout the modeling process.

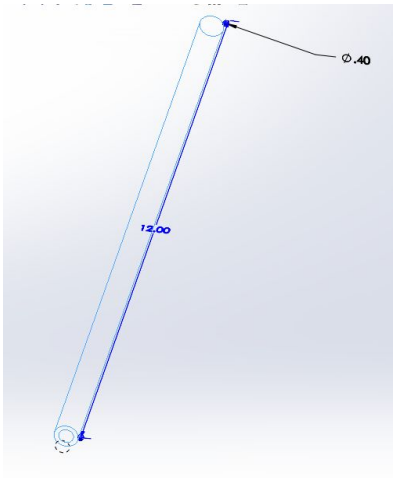
Improvements:

It could have been more aesthetically pleasing. With more time and heavy planning it could also have had more function, but then it would consist of so many parts that it could constitute as its own project at that point.

Antenna for Controller by Dahlia Pham

The function of the antenna is to transfer the signals back and forth between the quadcopter and the user.

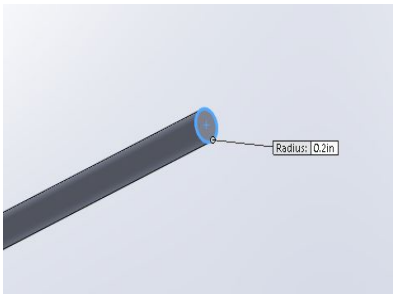
Procedure:



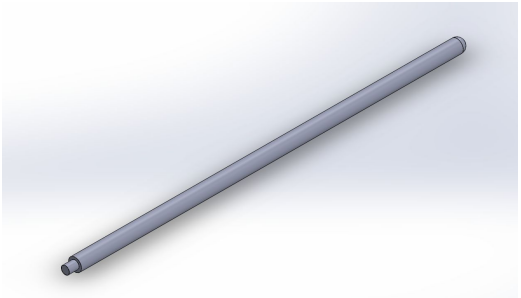
Step 1: Using the extrude boss tool, create a circle on the front plane with a diameter of .4 inches. Now make the height of this cylinder shape 12 inches.

Step 2: At the circular face away from the origin, use the extrude boss tool again and sketch a circle with a ¼ inch diameter. Allow for the height of this new smaller cylinder to be .3 inches. Insert a cosmetic thread for this cylinder.

Step 3: Fillet the edge of the original cylinder closest to the origin. GIve the fillet a radius of .2 inches



Step 4: After filleting, you should obtain the following structure for the antennae.



Challenges:

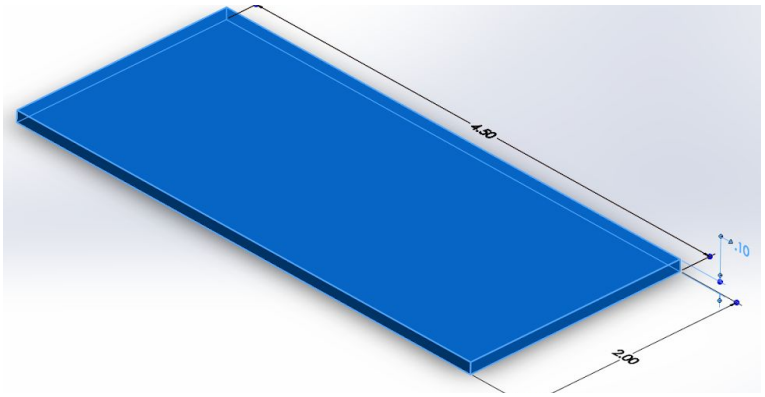
This structure was pretty simplistic, made primarily of primitive shapes and basic construction operations so there was no challenge.

Improvements:

With more time and energy devoted to the controller itself, the antenna could have been given much higher detail and perhaps an ability to shrink inward or expand outward from the controller. Due to constraints in detail, as this is a quadcopter project, it was given minimal detail.

Control Chip by Robert Hodgson

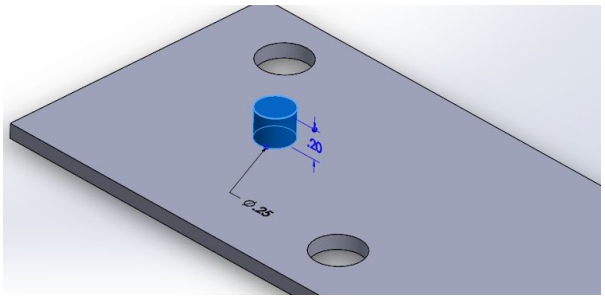
This control chip is a rudimentary model of a control chip used in a controller. It's function would be to dissect all the information relayed from the antenna, as well as tell the antenna to give direction.



Procedure:

Step 1: Start by using the extrude boss tool and selecting the top plane. Sketch a rectangle with a 4.5 inch length and a 2 inch width. Give it a height of .1 inches.

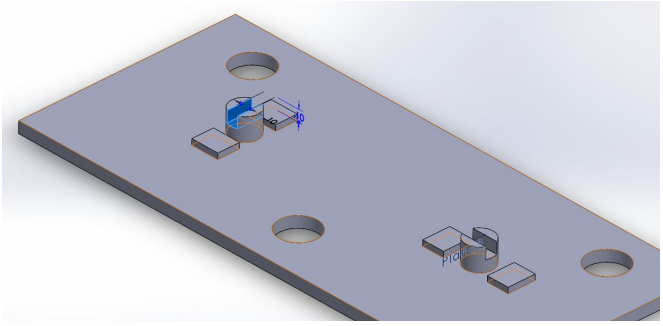
Step 2: Using measurements from the controller shell, create the holes the same distance from each other as your three posts were in the sunken face of the controller. Give each circle a diameter of .35 inches and a depth .1 inch



Step 3: Using the extrude boss tool, create a cylinder on the top face of the control chip. The center should be at the same z value as the origin and should be 1.125 inches toward the center from the edge along the z-axis. Set the height to .2 inches. Now mirror along the right plane.

Step 4: Sketch a rectangle on top of each cylinder have one be vertical and one be horizontal on the z,x plane. Make sure that the length has it move over the cylinders face entirely, but have its width be .1 inch. Next, using the extrude cut tool, cut the face of the rectangle blind down .1 inch.

Step 5: On the face of the control chip, below vertical facing cut, sketch a rectangle with the dimensions .2x.2. Extrude boss this shape to a height of .05 inches. Then create a reference plane that is perpendicular the vertical cut.



Mirror the box along this reference plane. Repeat this step for the horizontal facing cut with two exceptions. Sketch the rectangle right of the cylinder and make the dimensions .25 inches length and .2 inches width.

Challenges:

The challenge that this particular model proposed was how much detail to give it. Being CAD novices, it was within our best interest to use minimal detail, using the cylinder posts at where the toggle sticks connect, and the rectangular blocks mimicking the place where sensors would be.

Improvement:

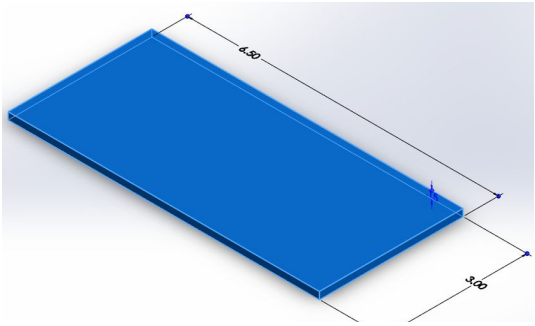
Once again, with more skill, time, and this time knowledge of circuitry, this could be an a quite detailed component.

Front Plate by Robert Hodgson

This is used to cover the control chip inside the controller shell.

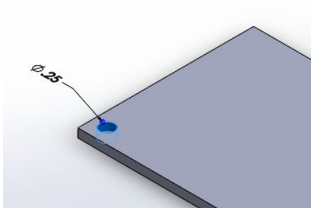
Procedure:

Step 1: Using the extrude boss tool, select the top plane to sketch on. Sketch a rectangle with a length

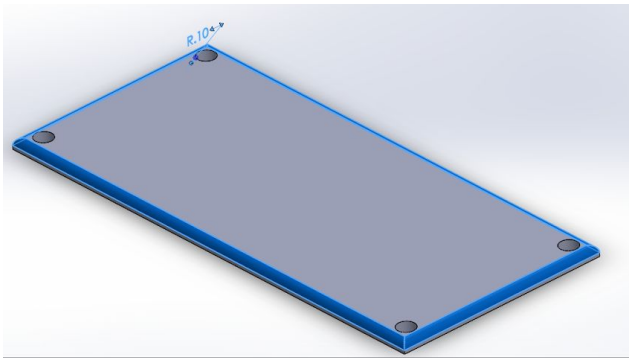


of 6.5 inches and a width of 3 inches. Give the box a height of .15 inches.

Step 2: Using measurements, sketch a circle on the top face of the box where if the plate was set upon the controller shell, the holes would line up. Give the circle a diameter of .25 inches and extrude cut it through all.

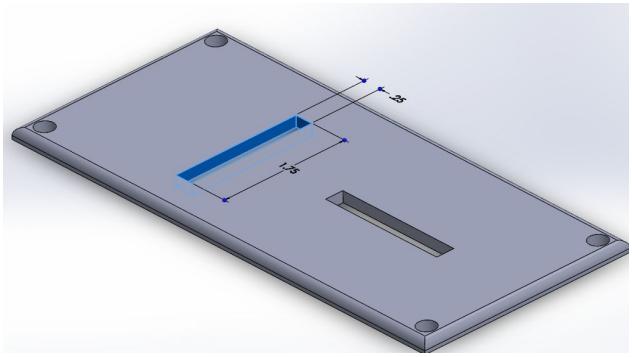


Step 3: Using a linear pattern, select the recently extruded cut and use the z-axis as the guide. Put the second extruded cut 2.5 inches away. Then mirror this across the right plane.



Step 4: Using the fillet tool from the features tab, fillet the top faces edges with a radius of .1 inch.

Step 5: Next sketch two rectangles for where the toggle switches will be placed inside the controller shell. Give these rectangles a length of 1.75 inch and a width .25 inch. Extrude cut these rectangles through all.



Challenges:

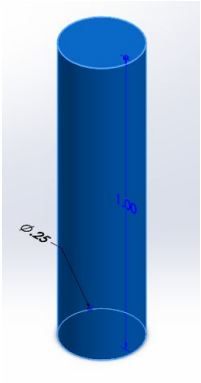
The biggest challenge in this was identifying where the holes and toggle switches were in relation to the plate. Using the measurements to identify this was hard, but not impossible.

Improvement:

Of course, there could always be more detail, and the front plate is no exception. With more skill I imagine there would be more ease in doing that.

Toggle Switch by Robert Hodgson

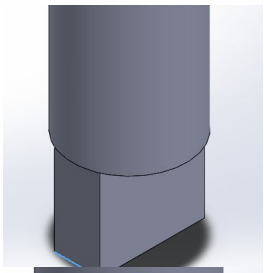
The toggle switches are the switches that attach to the control chip to designate direction. Once again, this is a very rudimentary model.



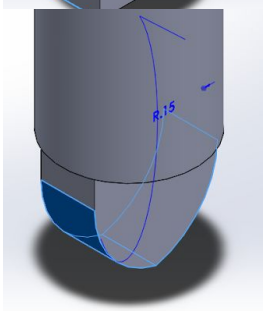
Procedure:

Step 1: On the top plane, extrude boss a sketched circle with a diameter of an ¼ inch and a height of 1 inch.

Step 2: With the bottom of the cylinder selected, click on the extrude boss tool. Sketch a rectangle on the bottom of the circle that was a width of .1 inches. Make it long enough for each of the four vertices to touch the circumference of the circular face. Extrude this feature .2 inches.



Step 3: Using the fillet tool, select the .1 inch edges on the very bottom of the model. Fillet these to a radius of .15 inches.

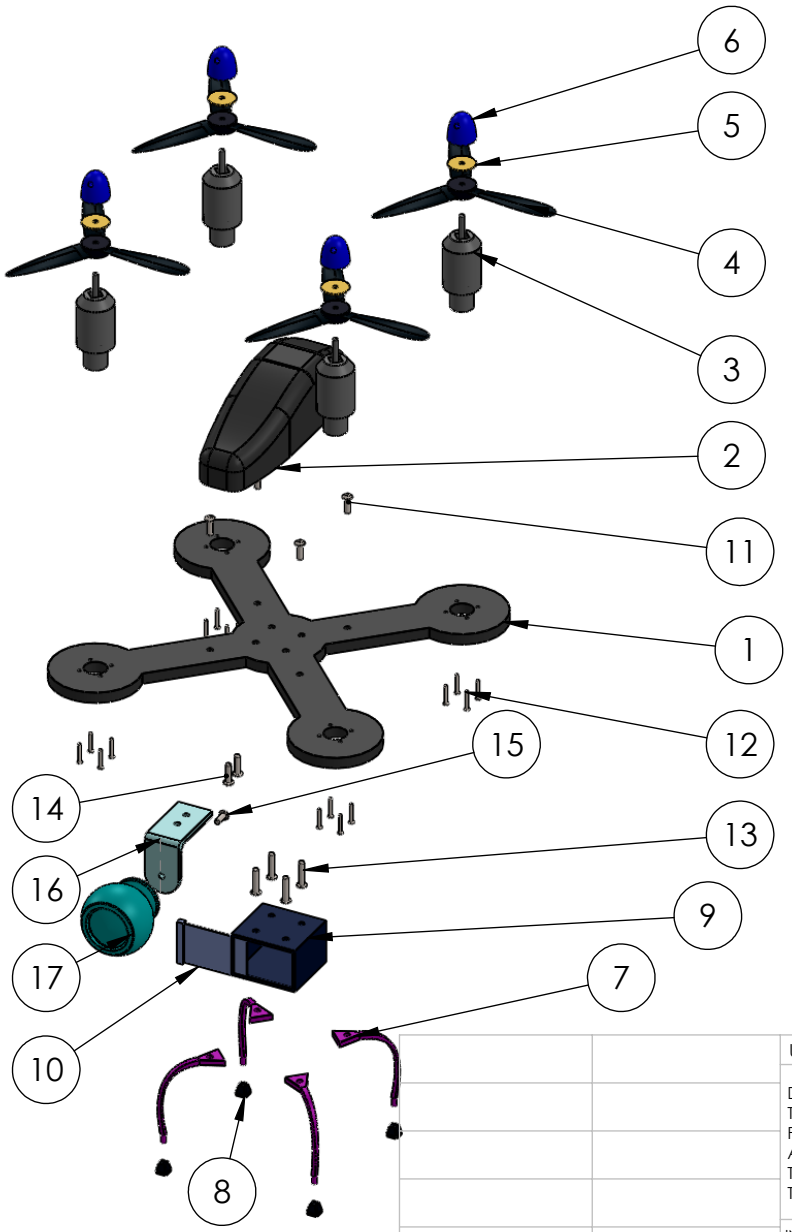


Challenges:

There were no significant hurdles in the design process.

Improvement:

The addition of a hole so it could be screwed into the control chip would be a way to improve the mesh.



ITEM NO.	PART NUMBER	QTY.
1	Project_Frame	1
2	Drone Box	1
3	drone motor	4
4	Propeller Part	4
5	Washer	4
6	Test part	4
7	LandingLeg	4
8	RubberFoot	4
9	Box assembly	1
10	Box 2 part2	1
11	SBHCSCREW 0.112-48x0.375-HX-N	4
12	SBHCSCREW 0.06-80x0.4375-HX-N	16
13	SBHCSCREW 0.112-48x0.5625-HX-N	4
14	SBHCSCREW 0.112-48x0.4375-HX-N	2
15	SBHCSCREW 0.112-48x0.3125-HX-N	1
16	Cam Stand	1
17	Drone Cam	1

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

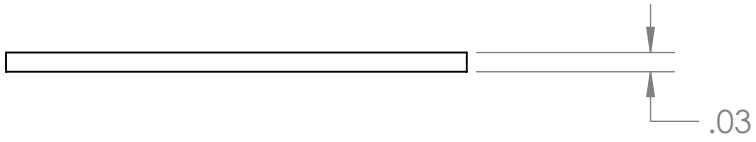
	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

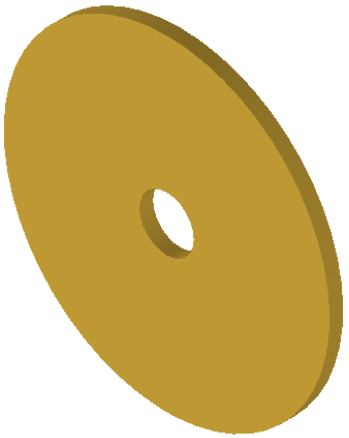
COMMENTS:

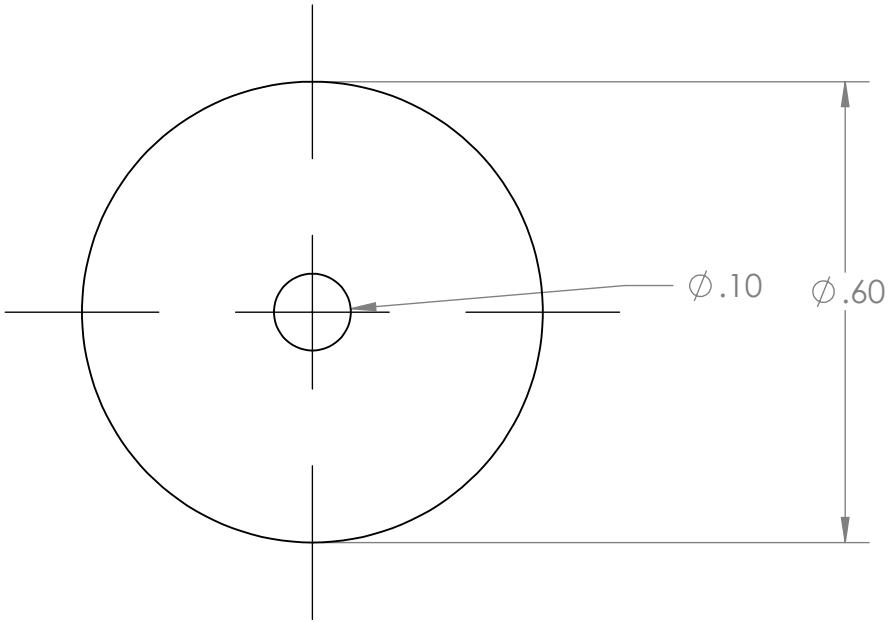
TITLE:

SIZE	DWG. NO.	REV
A	Assembly	

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 6







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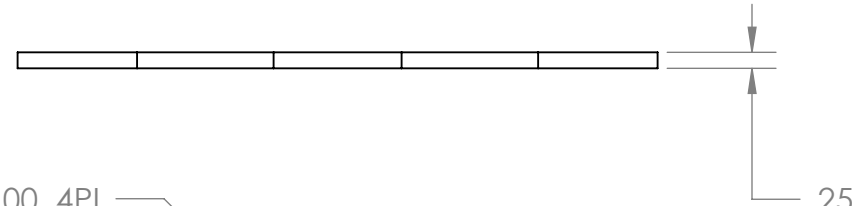
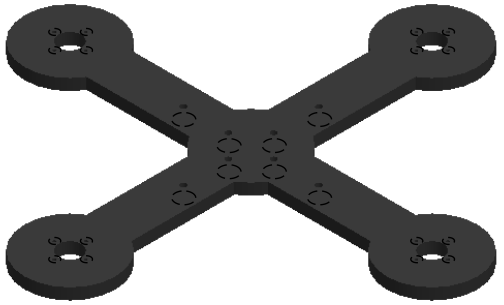
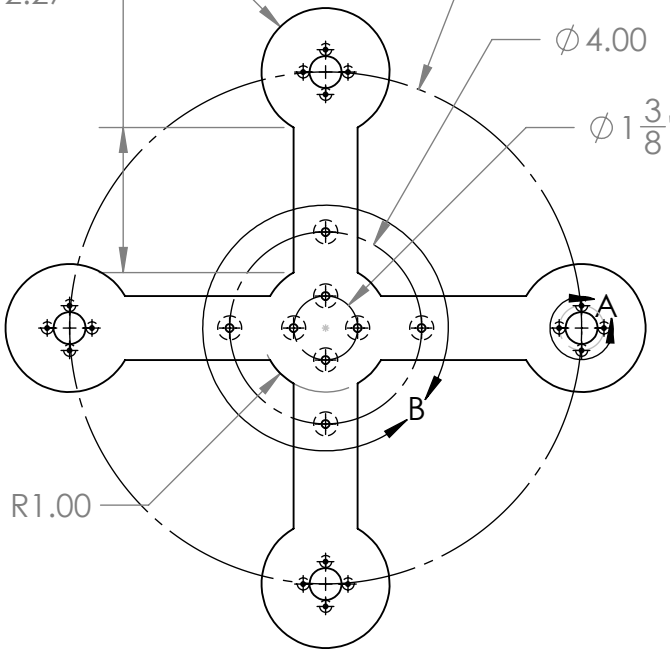
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

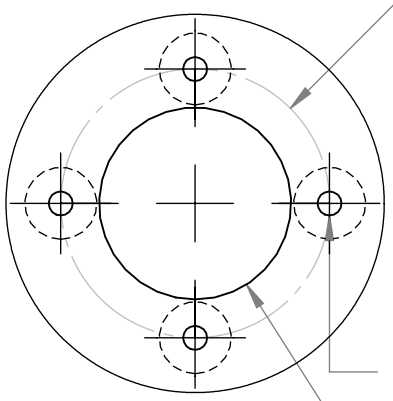
TITLE:

SIZE	DWG. NO.	REV
A	Washer	
SCALE: 1:4	WEIGHT:	SHEET 2 OF 6

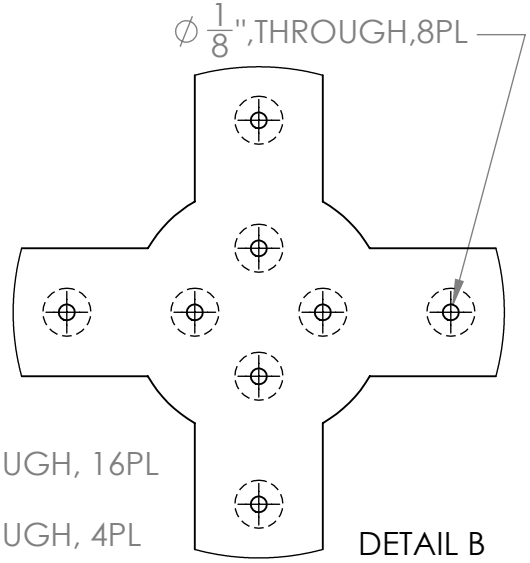








DETAIL A
SCALE 2 : 1



DETAIL B
SCALE 2 : 3

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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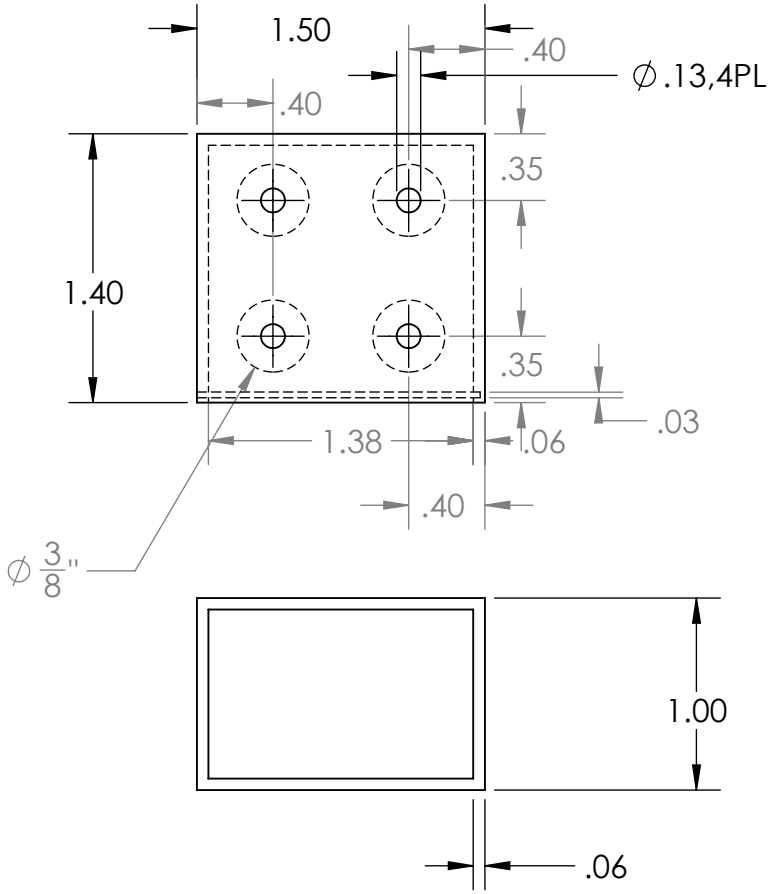
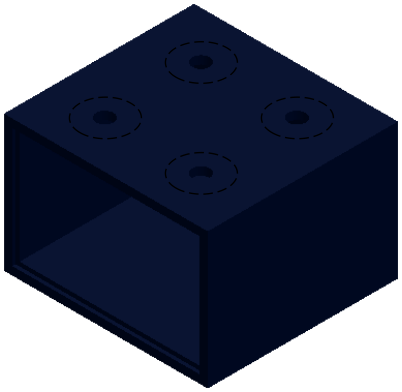
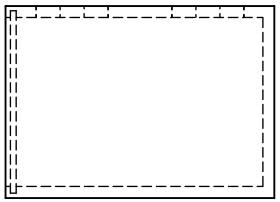
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	Frame	
SCALE: 1:4	WEIGHT:	SHEET 3 OF 6







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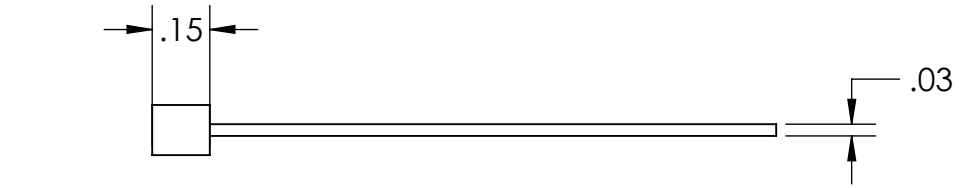
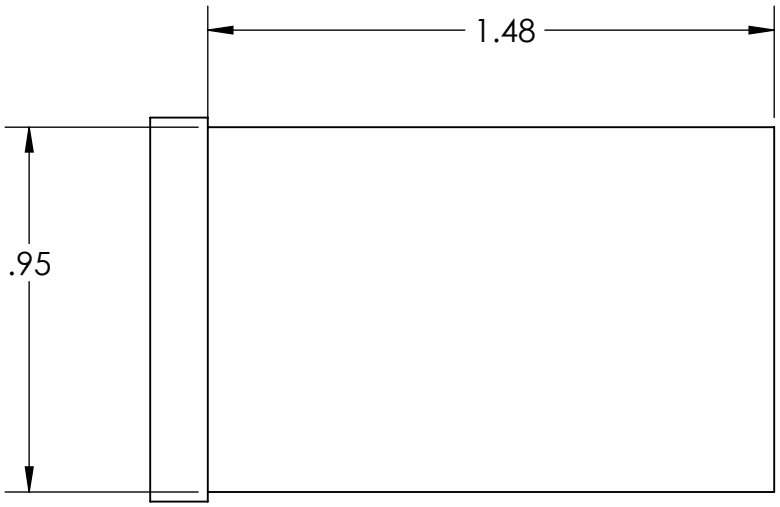
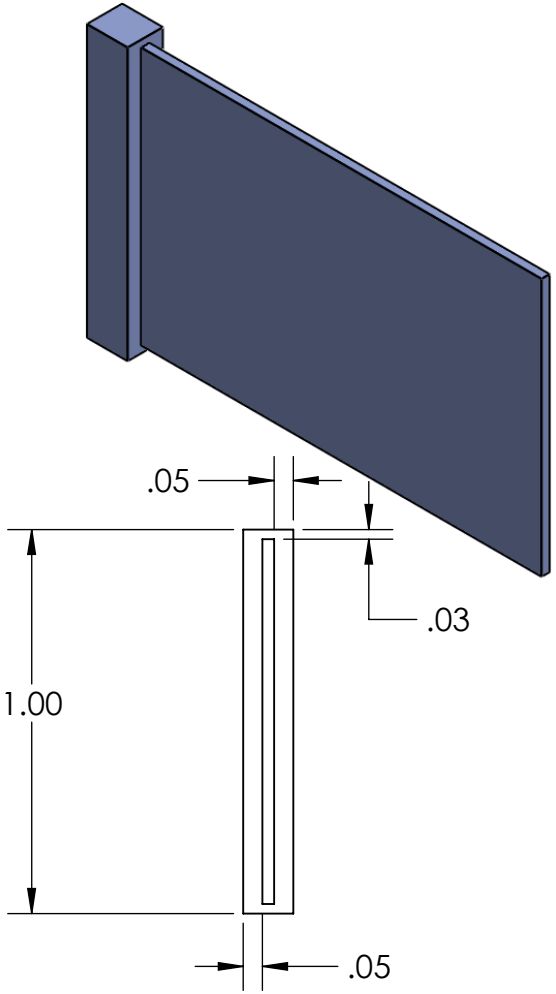
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	Box	
SCALE: 1:4	WEIGHT:	SHEET 4 OF 6







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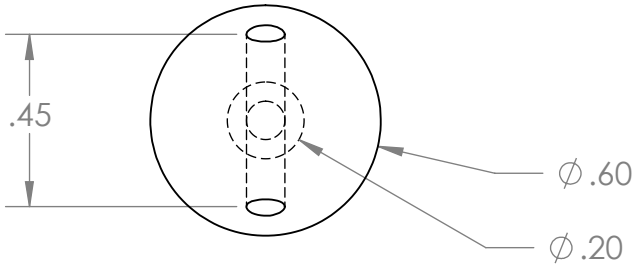
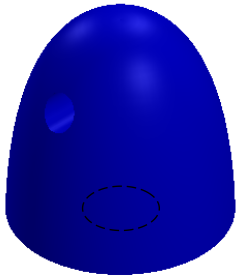
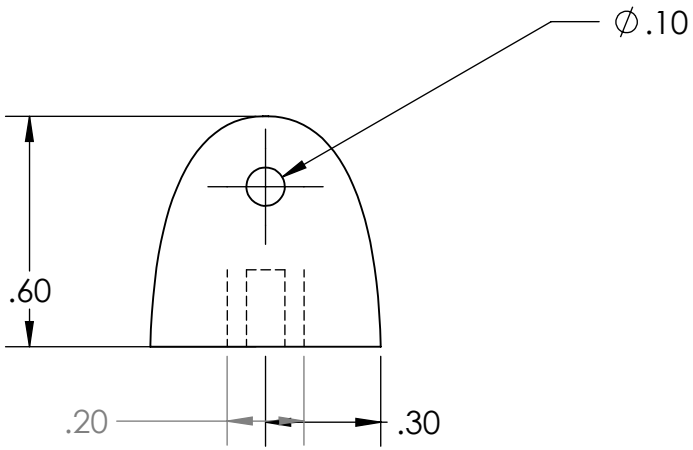
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

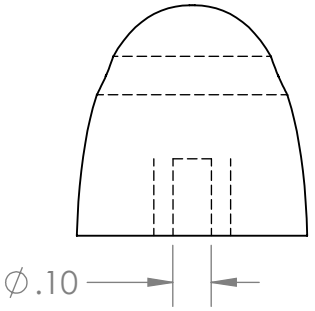
TITLE:

SIZE	DWG. NO.	REV
A	Box Door	
SCALE: 1:4	WEIGHT:	SHEET 5 OF 6









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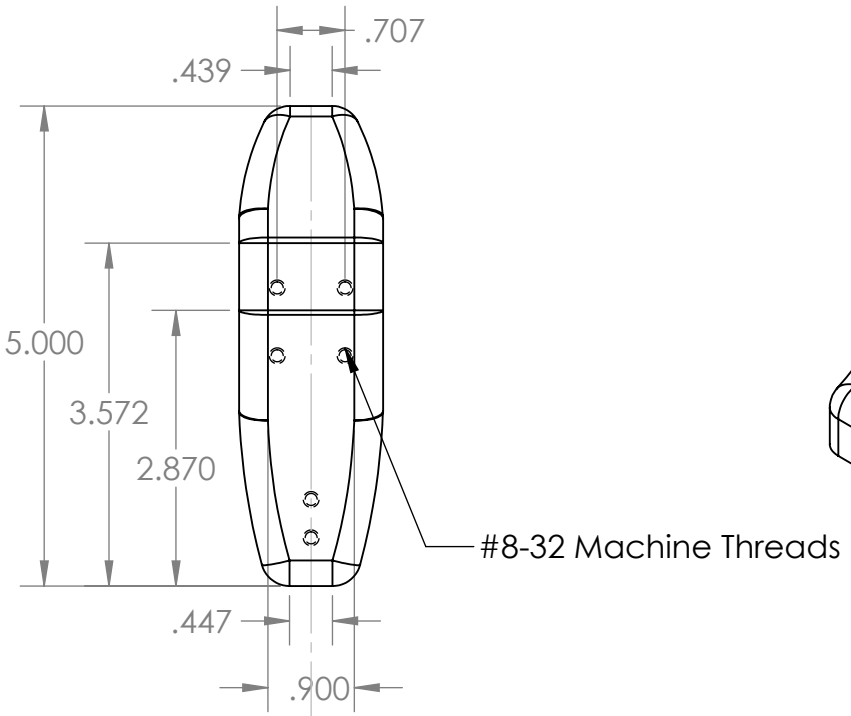
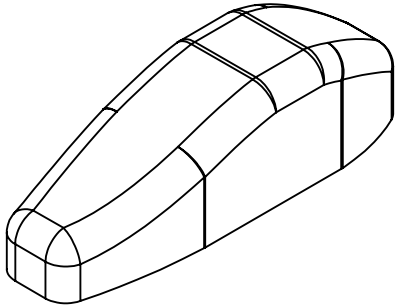
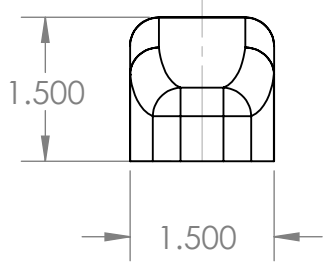
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

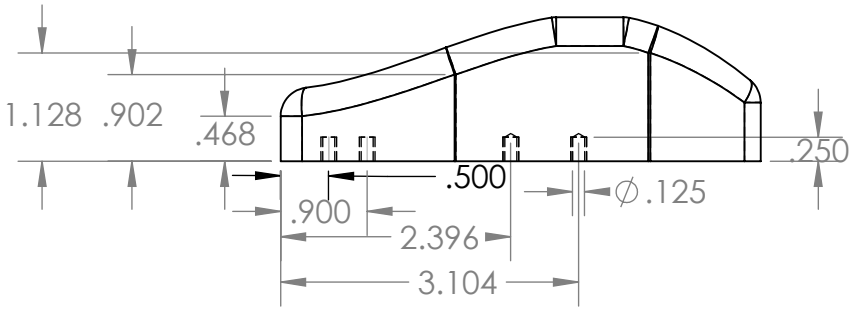
TITLE: Nut

SIZE	DWG. NO.	REV
A	Nut	
SCALE: 1:4	WEIGHT:	SHEET 6 OF 6







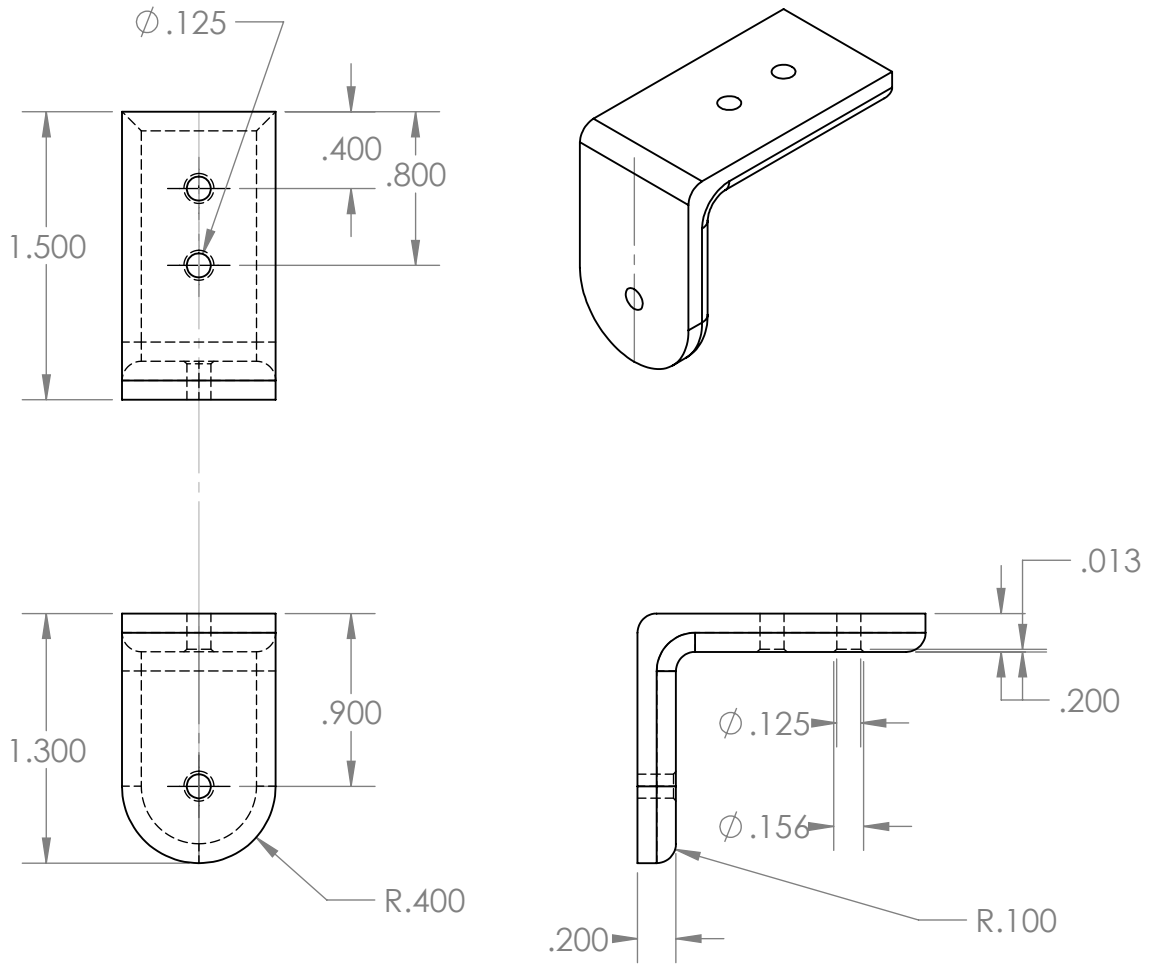


		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±.001 in	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL PLASTIC	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Drone Box

SIZE	DWG. NO.	REV
A	Drone Box	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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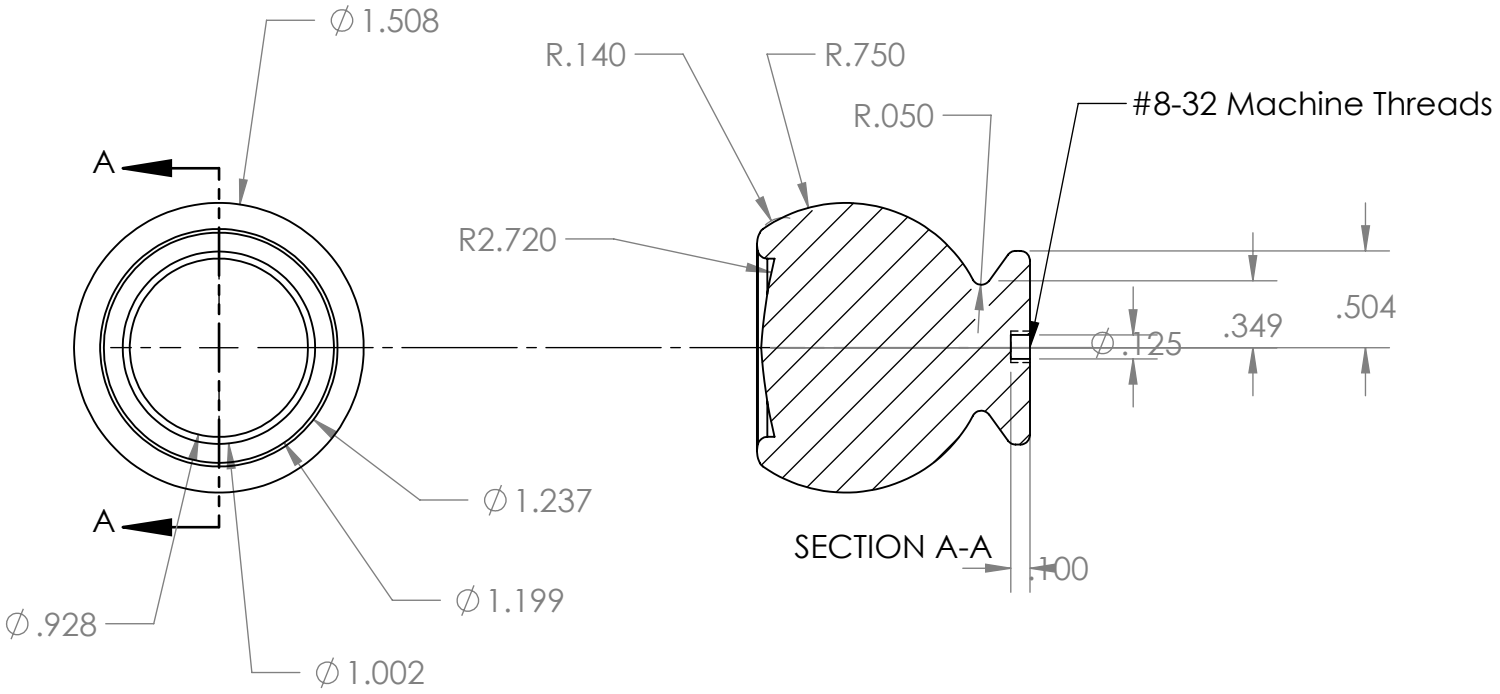
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: Aluminum	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Camera Stand

SIZE	DWG. NO.	REV
A	Cam Stand	
SCALE: 1:1	WEIGHT:	SHEET 1 OF 1



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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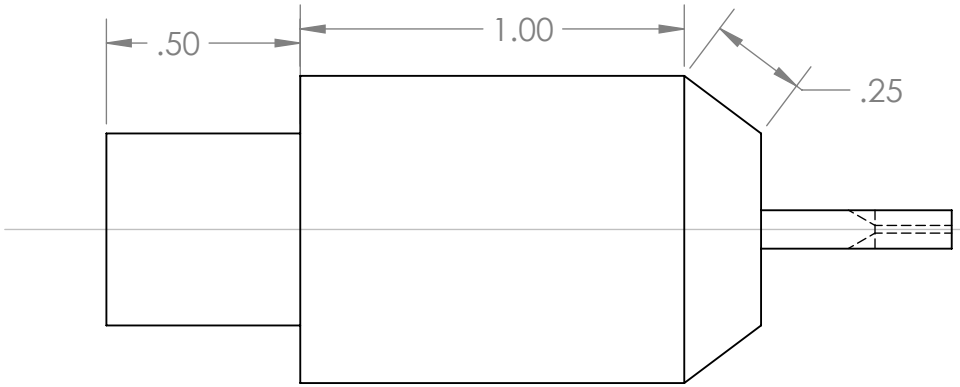
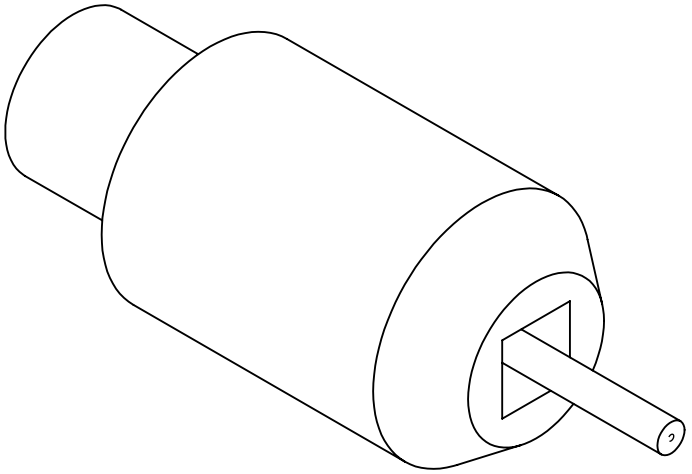
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL Glass and Plastic	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

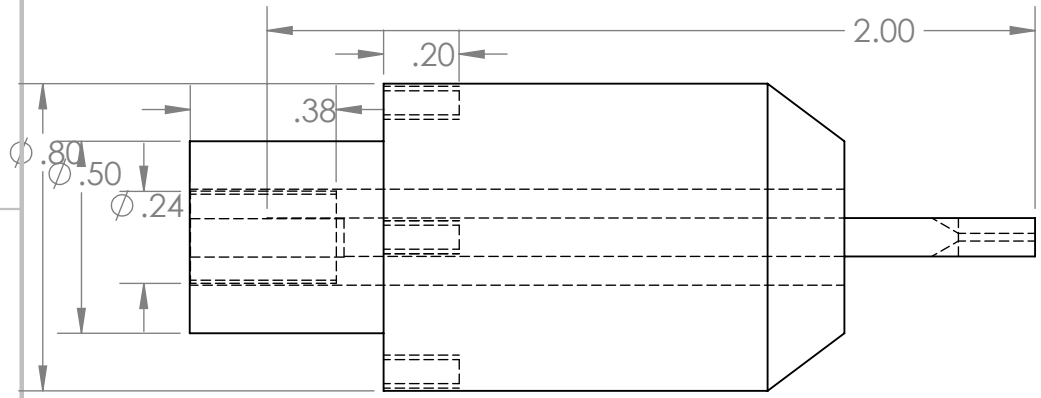
TITLE:

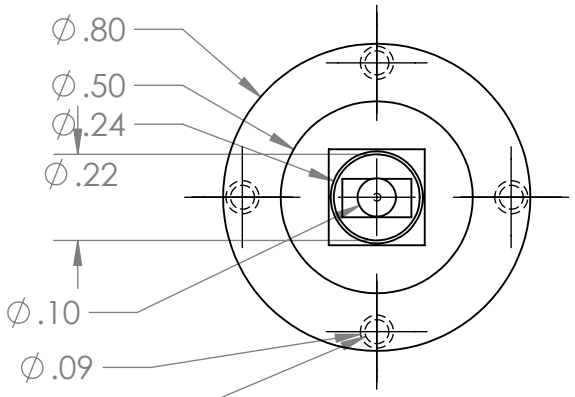
Drone Camera

SIZE	DWG. NO.	REV
A	Drone Cam	
SCALE: 1:1	WEIGHT:	SHEET 1 OF 1





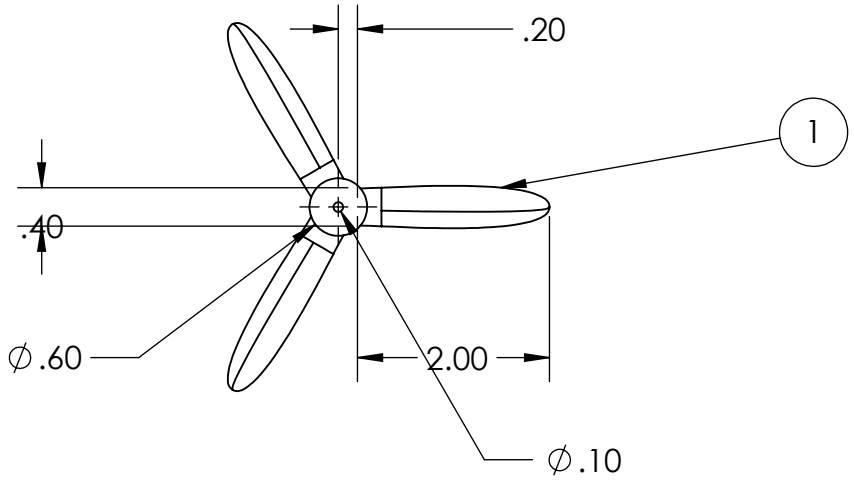


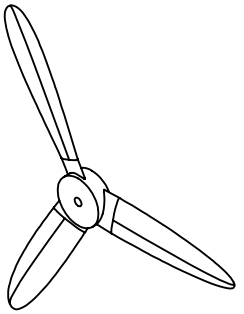


		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	Drone Motor	
SCALE: 2:1	WEIGHT:	SHEET 1 OF 1





1 Created From Loft And Flex

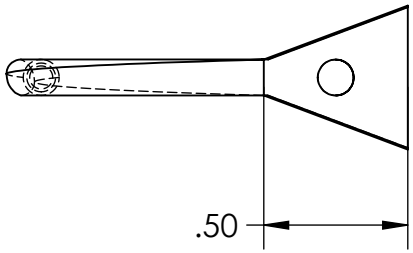
-Loft: Reverse Tangent Direction:4
-Flex: 40 degree

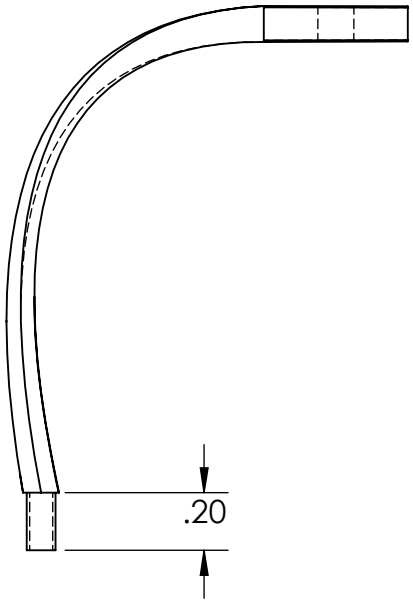
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

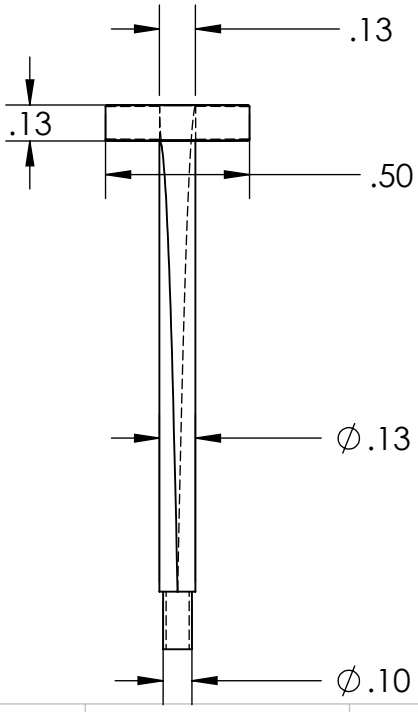
TITLE:

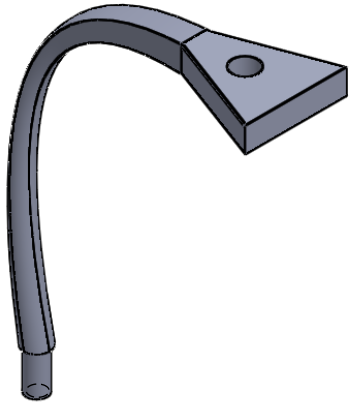
Propeller

SIZE	DWG. NO.	REV
A	Propeller Part	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1





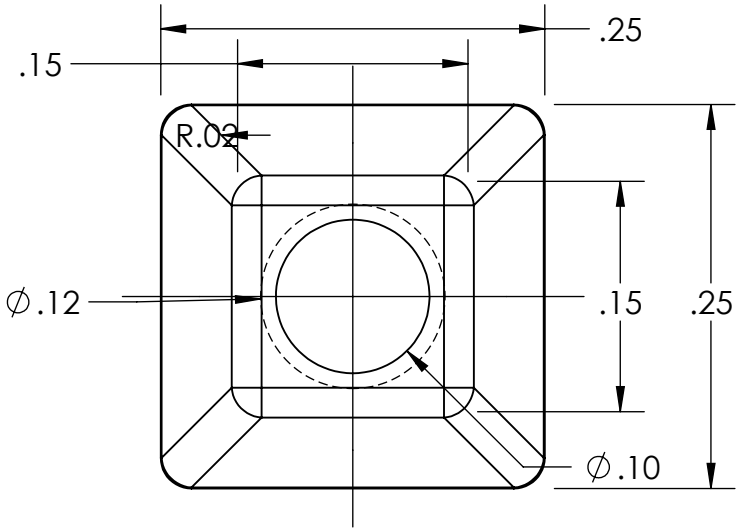


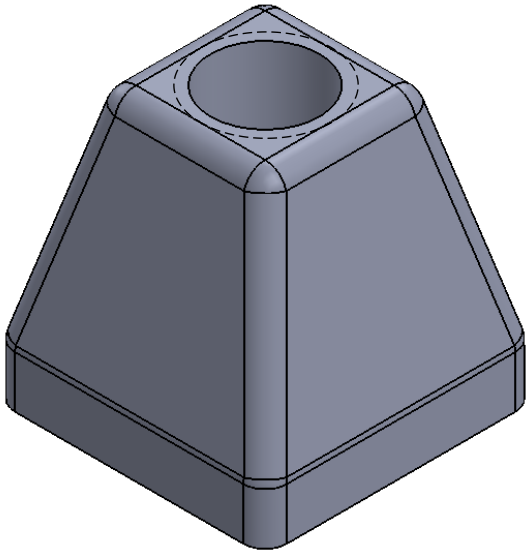


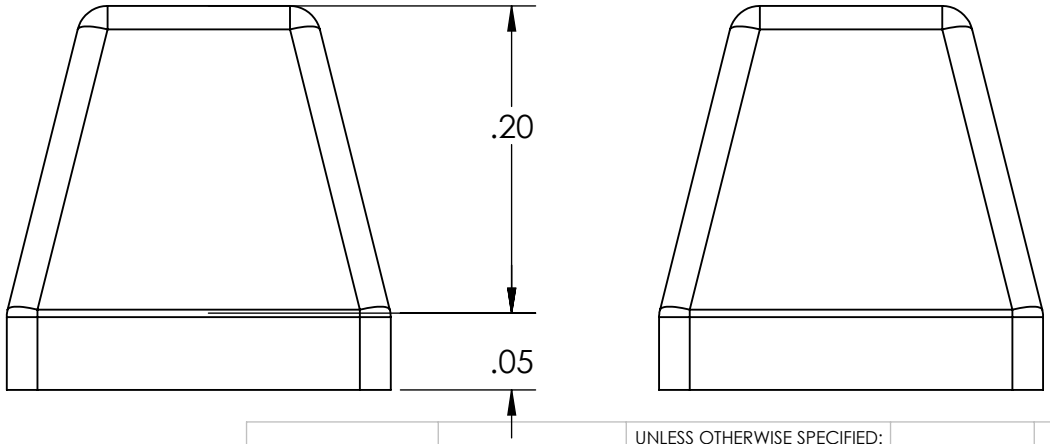
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	LandingLeg	
SCALE: 1:1	WEIGHT:	SHEET 1 OF 1







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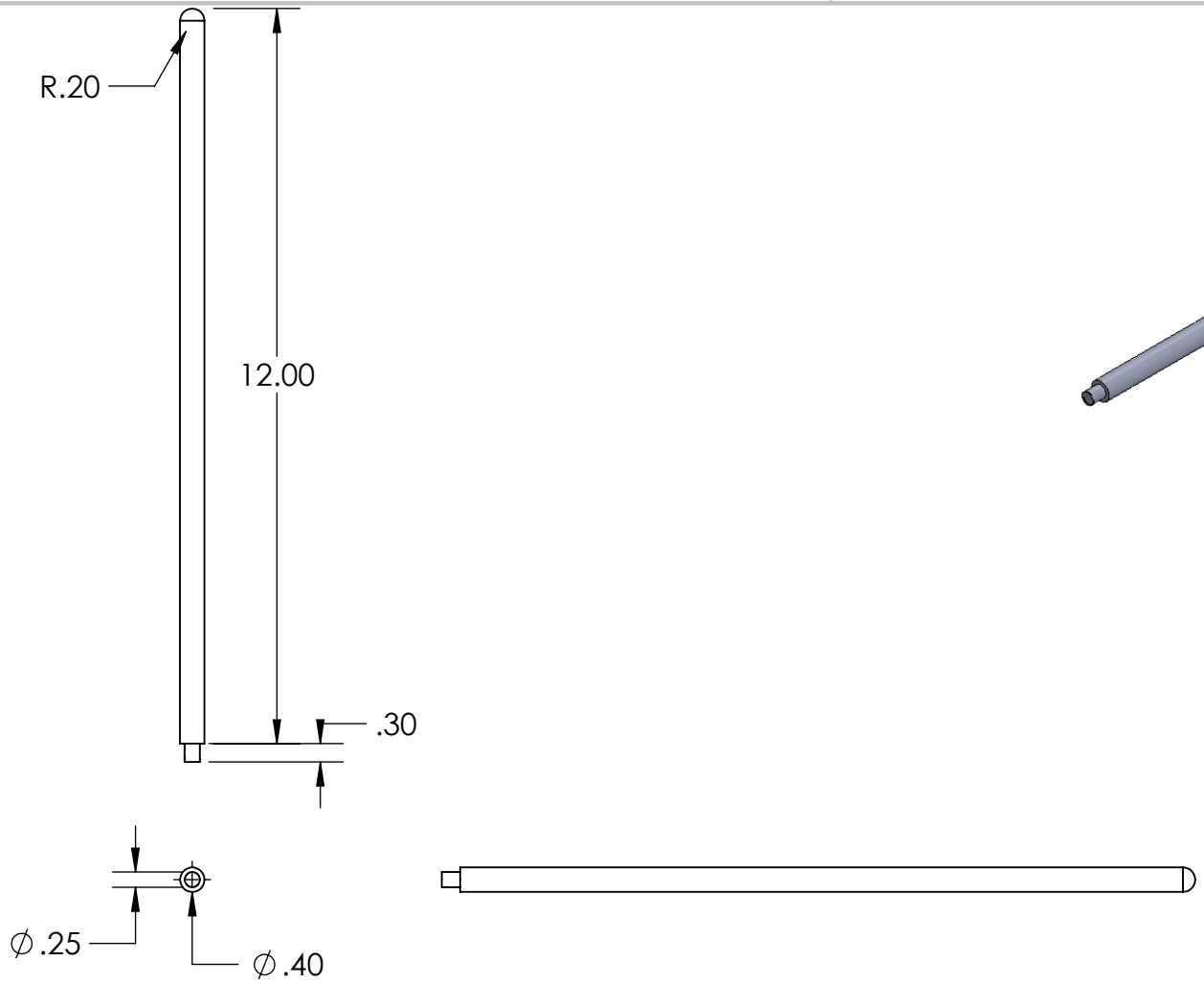
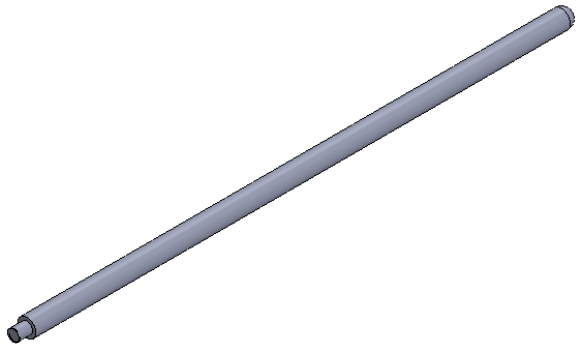
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE A | DWG. NO. RubberFoot | REV

SCALE: 8:1 | WEIGHT: | SHEET 1 OF 1

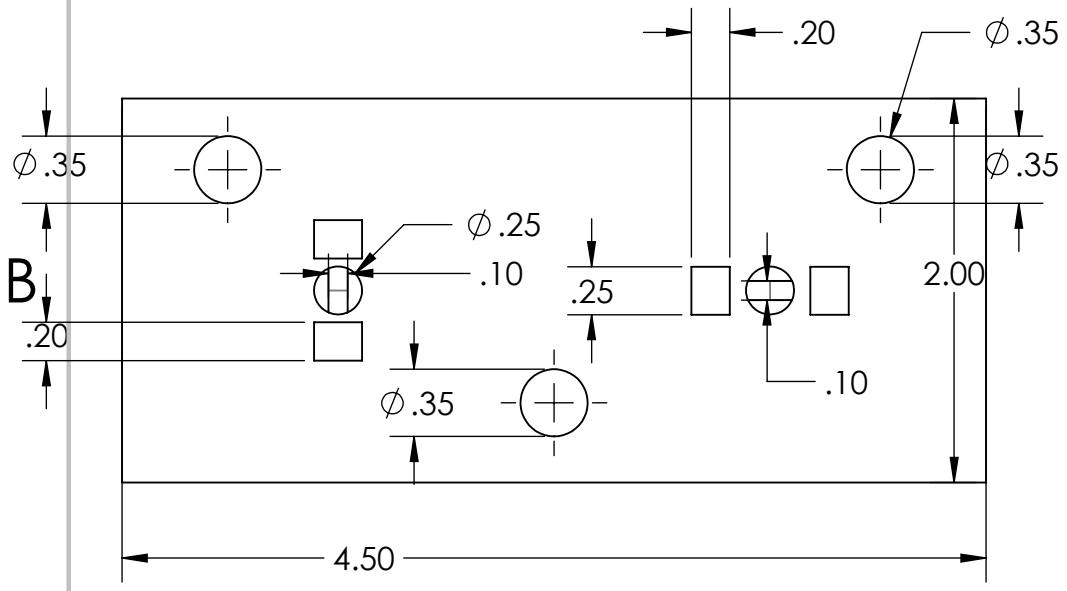


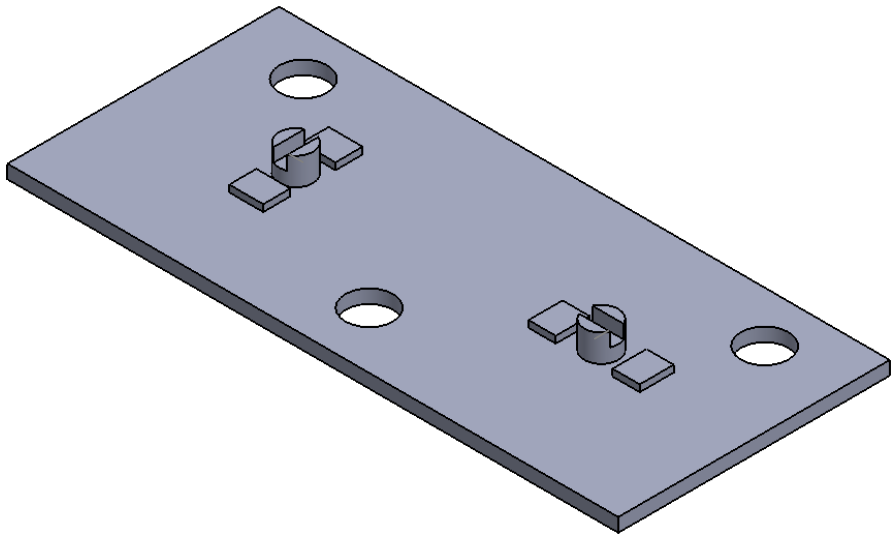


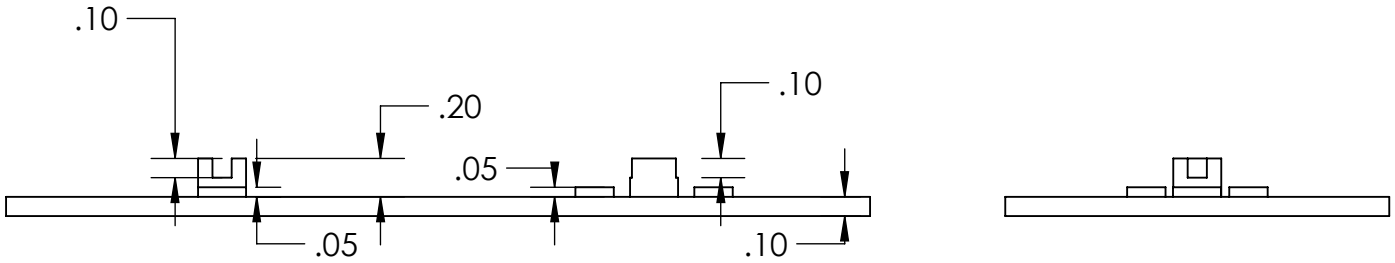
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	Antenna	
SCALE: 1:4	WEIGHT:	SHEET 1 OF 1



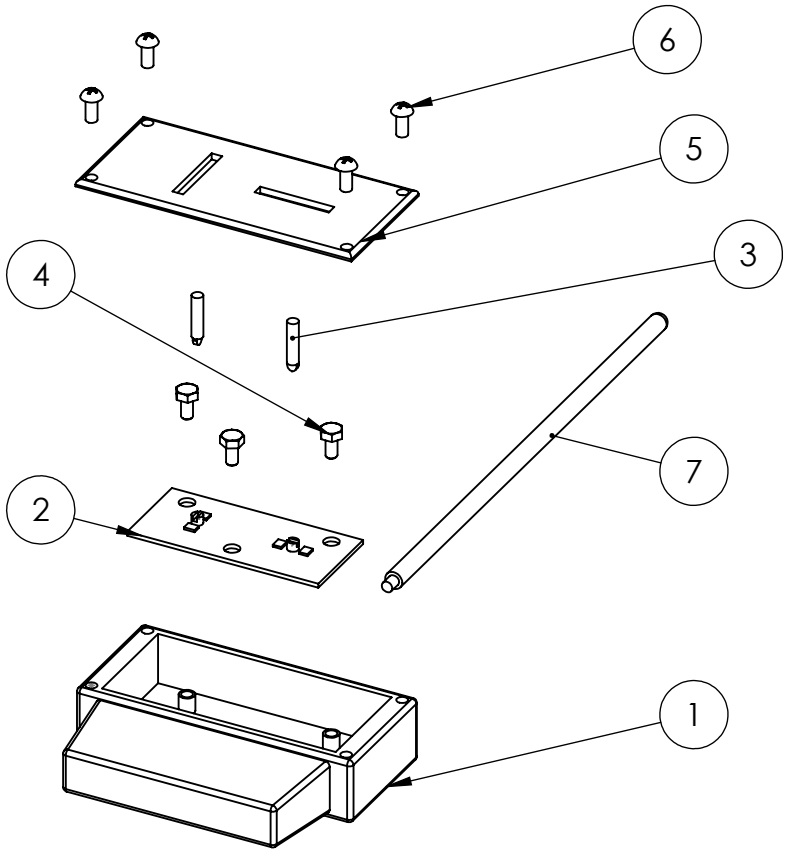




		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

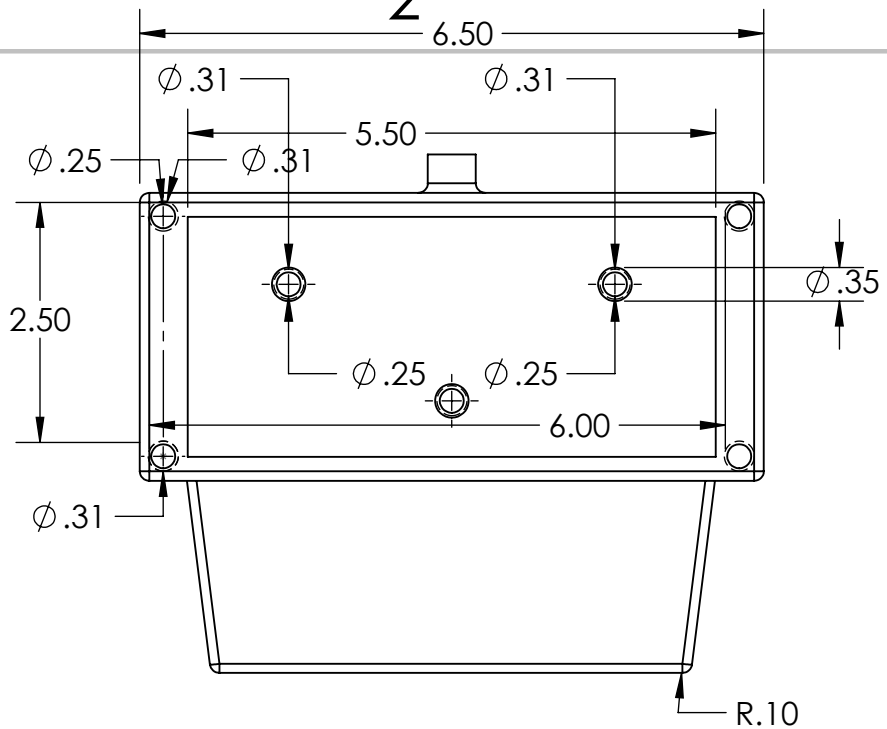
TITLE:

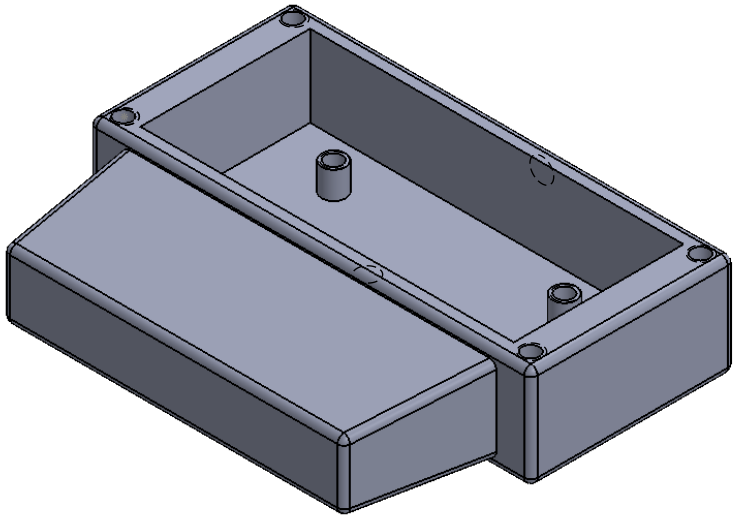
SIZE	DWG. NO.	REV
A	ControlChip	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1

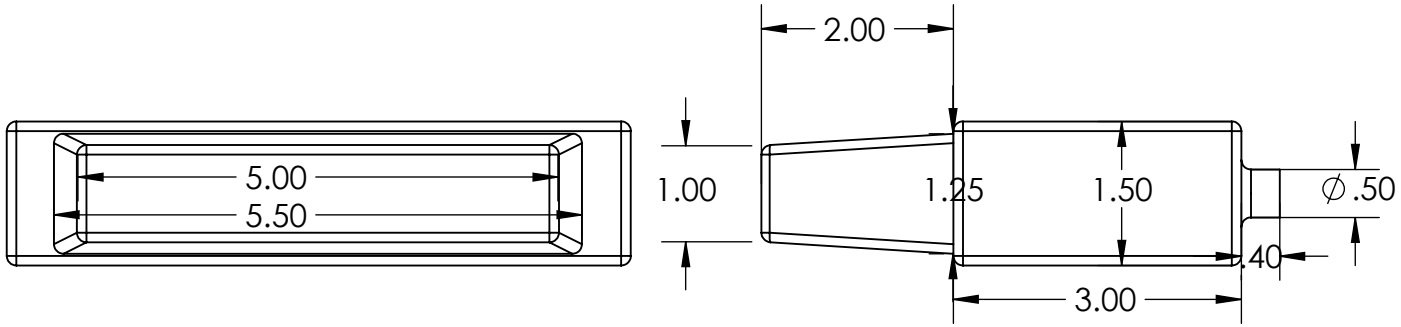


ITEM NO.	PART NUMBER	QTY.
1	ControllerShellv2	1
2	ControlChip	1
3	ToggleSwitch	2
4	HBOLT 0.2500-20x0.5x0.5-N	3
5	FacePlate	1
6	round head screw_ai	4
7	Antenna	1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN			TITLE:
			CHECKED			
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL	COMMENTS:			SIZE: A
NEXT ASSY	USED ON	FINISH				DWG. NO.: Controller Drawings
APPLICATION		DO NOT SCALE DRAWING				REV
						SCALE: 1:12 WEIGHT: SHEET 1 OF 1







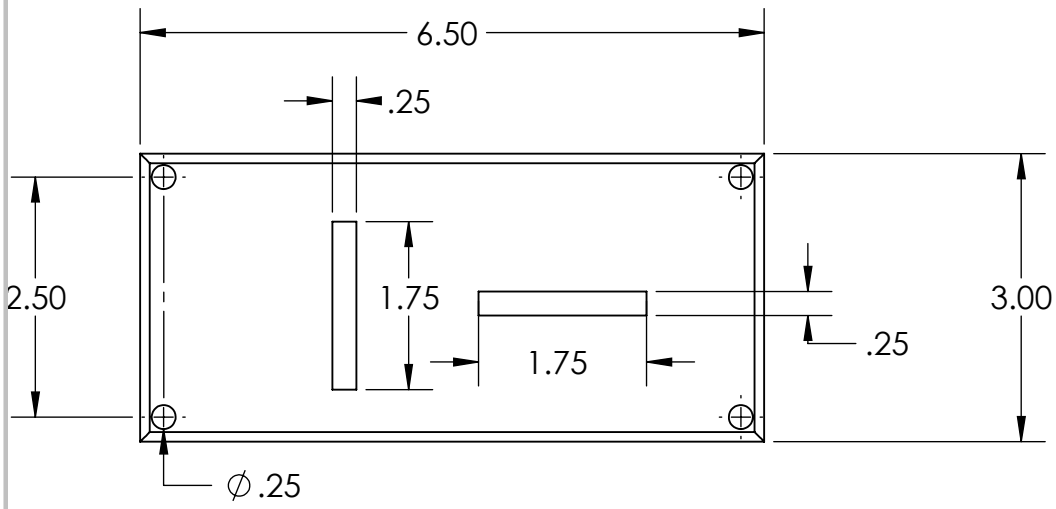
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

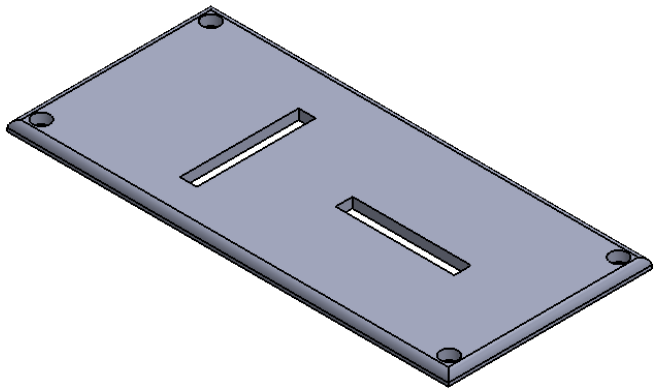
TITLE:

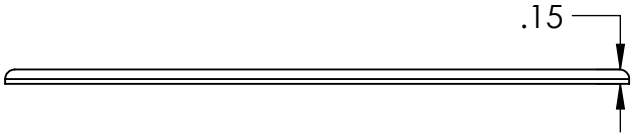
SIZE | DWG. NO. | REV

A | ControllerShellv2

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1



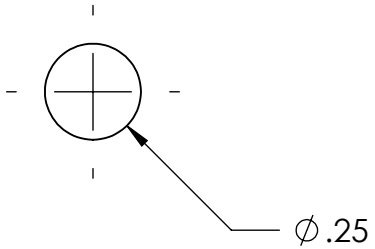


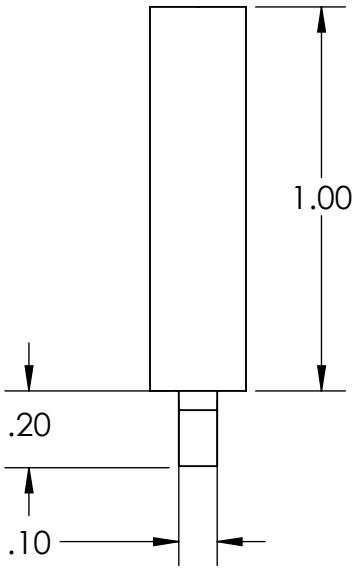


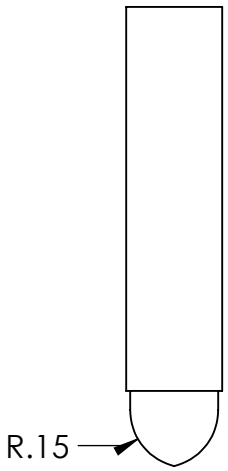
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	FacePlate	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1







		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

SIZE	DWG. NO.	REV
A	ToggleSwitch (1)	
SCALE: 2:1	WEIGHT:	SHEET 1 OF 1