Axial-Gap Brushless DC Motor

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Abstract

This project group developed a low-cost, brushless DC motor testing platform. The design consists of parts that allow for testing different parameters on the testing base to generate a knowledge base of electric motor variations. From this knowledge base, calculations for designing an electric motor to meet a set of specifications can then be determined.

Acknowledgements

We want to acknowledge everyone who helped us with our project. We would like to thank our advisor, Dr. Donald Pratt, for guidance throughout the entire length of the project and John Meyer for training on equipment and for use of the shop. We also want to thank our families for their support as we completed our project. A special thanks to the Collaboratory for Strategic Partnerships and Applied Research for its continued support and interest in pursuing this project further.

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1. Introduction

1.1 Description

Many projects at Messiah College utilize electric motors. The electric tricycle project, solar commuter vehicle projects, and other projects of the Collaboratory for Strategic Partnerships and Applied Research incorporate conventional electric motors into their designs. Replacing these motors with brushless DC motors would have numerous advantages, including improving efficiency and reducing maintenance.

For each motor application, motor specifications can change, specifically torque and RPM required. Initially our project group wanted to build an in-hub brushless DC motor for the electric wheelchair but didn't know what physical motor parameters to use in order to meet the required specifications. Our project aim became to establish and quantify the relationships between the physical motor parameters and the output specifications of the motor.

This project required that the team learn the basic principles of motor design, which enabled us to develop an initial design for a preliminary prototype. This prototype was designed in SolidWorks, with care taken to accommodate both variation of key motor design parameters and attachment to a dynamometer to facilitate data acquisition. The building phase required team members to learn the use of various pieces of shop equipment, including especially the CNC milling machine, to create precisely-dimensioned parts for construction. Testing would then need done on the preliminary prototype by measuring the motor performance variables of speed, torque, and efficiency while varying motor parameters such as size of air gap, voltage, number of magnets and stators, radial positions of magnets and stators, and stator circuit configuration.

1.2 Literature Review

A great deal of research was conducted to establish the state-of-the-art of brushless motor design and application. We found that many electric motors used on bicycles and motorcycles were standard brushed DC motors utilizing gear reduction systems and chains to supply power to the vehicle wheel. Part of the purpose of our project was to eliminate this need for reduction gears. Most of these motors were also radial-gap based, a standard configuration for most electric motors. Most axial gap motors are used for specific and specialized tasks where space is limited, such as in VCRs or computer hard drives. Because of how specific some of these tasks are, we found only a few motors with enough power suitable for our application.

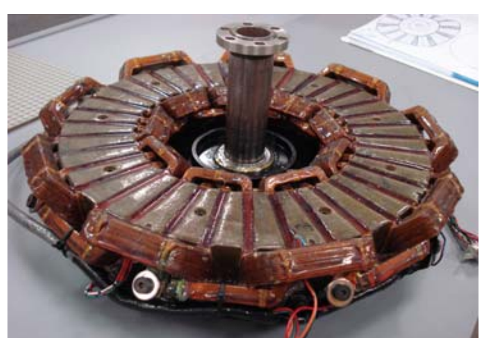

Fig. 1.2.1 NGM Motor Stators

New Generation Motors Corporation is a company that specializes in electric motor design. One of their products is an axial-gap design pancake motor, specifically for use in solar cars and other research and experimental vehicles. The motor is capable of variable voltage and current inputs and has ample power output. These features would be very beneficial for use in a motorcycle with its slim, in-hub design. The Genesis Solar Racing Team previously purchased one of these motors back in the mid-1990s for use in their solar car. The total purchase price for the motor and controller in 1996 came to $12,000. For our project, we did not have the budget to purchase such a motor.

Fig. 1.2.2 Bionx Power Assist

Another product we looked into was an electronic assist for bicycles. The Bionx system uses a brushless DC motor to power a bicycle. The motor is attached directly to the hub of the wheel, eliminating the need for any reduction system. The user of this system can pedal the bicycle as usual and use the system as needed or rely fully on the motor for forward propulsion. This system is brushless, and takes advantage of this by allowing battery regeneration during braking and pedaling when the system is not in use. There are four variations of the product: there are two motors, one at 250 watts and one at 350 watts, and two battery systems, one using NiMH and the other Li-Ion. This sounded very good for what we were hoping to achieve, but there were some downsides to using such a system. First, the motor comes preinstalled in the wheel, meaning that you need to purchase the whole wheel with the motor on it. Second, the cheapest Binox system is around $1100, still higher than our project budget.

Fig. 1.2.3 Golden Motors In-Hub Bike Motor

We then saw another product that was very similar to the Bionx system but for a much cheaper price. Again, it was an in-hub on-the-wheel brushless DC 500 watt motor. This was specifically designed for a bicycle tire and ran off lead acid batteries. This motor seemed perfect for our purposes, especially since the price was around $266 for the whole system. This motor and controller seemed ideal for our tasks, but there were other considerations that we needed to take into account. The company that produces this motor is based in China, meaning that if we were to need replacement parts (if there are replacement parts available) it would take at least three weeks to get them. Another reason is that the motor is installed on the wheel, much like the Bionx system. This does not allow for easy removal or replacement if the motor is somehow damaged.

All of the existing motors that we researched lacked a vital aspect of our project: scalability. Each motor was made for a specific task, whether that was racing or for use on a bicycle. We wanted to develop scalability factors so that a motor could be made for smaller tasks, such as the electric wheelchair, and for more powerful and robust tasks, such as on an electric motorcycle.

1.3 Solution

There have been other approaches to what we were planning on achieving with this project. The electric wheelchair of the Collaboratory's Disability Resources group has used a radial brushed scooter motor. However, because the motor spins at speeds higher than are required for the job, a chain and sprocket reduction system is required. This has caused torque imbalances, power losses due to friction, and the eventual burning out of the motors due to stresses that they were not originally designed to handle.

There are other motors for sale that integrate a hub motor inside a bicycle wheel, such as the Bionx and Golden Motors systems; however the motor is not separate from the wheel. We are designing a motor that can mount to the wheel and is still separate from the wheel. There are reduction gear designs for electric motorcycles that use standard radial designs. This design will allow for the motor to fit inside the wheel, eliminating the need for reduction drives and allowing for direct speed control.

The current designs are also fairly expensive since they are not widely used and are only needed for specialized tasks, like the New Generation motor. This motor is design specifically for solar cars. Since there are not that many solar cars out on the road today, the price for one of these motors is quite high. One of our goals is to create a motor that is just as reliable and powerful but less expensive than commercially available motors.

Our solution to this problem was to create a motor testing station "from scratch" with which we would be able to adjust parameters and test different variables. This means we would build everything from the ground up, winding the stators ourselves, milling out the rotors, and developing a testing station that would allow for easy modification of the parameters. This station is to test the various parameters so that motors can be designed and built for a specific task.

2. Design Process

Our design was conceived with two main considerations in mind. First, in order to allow torque and speed testing of our motor, our design had to provide for an interface with the available dynamometer. Second, since our prototype was to be a dedicated testing platform, the design had to accommodate easy adjustment of key testing parameters.

Our team recognized that the essential components required for the construction of a brushless DC motor are permanent magnets, stator coils, a rotor, shaft, Hall Effect sensors, and mounts. Together, permanent magnets and stators compose the heart of the motor. They are the elements whose interaction generates rotation. Hall Effect sensors are necessary to provide the motor with an interface with its electronic controller. Rotation is conducted to a rotor, and from the rotor to a shaft. Mounts are required to keep the stators in place, to allow the rotor and shaft to rotate freely, and to support the Hall Effect sensors.

In general, materials for our design were chosen based on their cost, workability, and availability.

2.1 Stators

A stator is simply an electromagnet. We decided to use 6 stators in our design—this number made our system easily adaptable for use with a three-phase power input. Threaded, low-carbon steel bolt was chosen as the core material for each stator. This material was readily available, ferromagnetic, and easy to mount and adjust with the aid of steel nuts and washers. Each core was wound with 20 gauge copper magnet wire. Copper wire was chosen for its low resistance, and the specific gauge of wire used was decided upon by using an Excel spreadsheet designed by the team. Spreadsheet calculations took into account such factors as heat generated, allowable maximum current, and physical size of a coil wound with particular gauges of wire. See appendix for more details on this spreadsheet. Once wound, coil leads were equipped with “quick connects” to allow easy manipulation of circuit connections.

2.2 Permanent Magnets

Design considerations for permanent magnets included strength and temperature resistance. Both samarium-cobalt and neodymium magnets were considered. In the end, the team decided upon using neodymium magnets. Although samarium-cobalt magnets were found to have ample strength for our design and very good temperature resistance, their excessive cost diminished their viability. Neodymium magnets, however, were had both sufficient strength and temperature resistance at a reasonable cost. We settled upon using 3/4” diameter disk-shaped magnets, covered in an epoxy coating. These were quite strong for their small size, suitably dimensioned for our application, and had a degree of protection from the elements due to their coating.

2.3 Rotor

The rotor was to be one of the moving parts of our design, and as such required special consideration. A material of relatively low density was desirable for minimizing rotational inertia. Safety considerations dictated that the material used should be shatterproof or at least shatter-resistant, as the rotor would be rotating at high speeds. Stator-magnet alignment was another concern; this necessitated use of material that would retain its shape and dimensions when rotated at high speeds. With all these constraints in mind, the team chose to use Lexan® polycarbonate material for rotor construction, which met all of the requirements nicely. A disk of this material was equipped with eight radial slots at regular angular intervals. The slots were to be part of a system for allowing attachment and easy radial adjustment of permanent magnets. Each permanent magnet was press-fit into a central hole on a small Lexan® square. Two smaller holes, diagonally opposite each other, were punched into each square, allowing affixation to one of the rotor's radial slots via small bolts and nuts.

2.4 Shaft

The shaft in our design was to both receive torque from the rotor and transmit it to the dynamometer. It was important that the material used be strong, stiff, and somewhat accommodating of both disassembly and axial adjustment at the rotor-shaft interface. To suit these purposes, our team selected generic 3/4" diameter threaded steel rod, secured to the rotor and bearings using compatible nuts and washers. We found this setup to be marginally operational, but problematic for a few reasons. First, rotation of the shaft led to loosening of the nuts and washers that held the shaft assembly in place. Second, the shaft, being generic in quality, was not sufficiently true (straight) for our design; this was a problem, because it caused additional friction and excessive vibration during operation. These problems were surmounted by redesign. We replaced the threaded rod, nuts, and washers with specialized steel shaft material and locking shaft collars. The shaft collars remained tight during operation and the shaft itself was true enough to greatly lessen the friction and vibration problems.

2.5 Mounts

Four separate mounts were required to support the various active components in our design. The first of these was the stator mount. This part was required to hold the stators in place and to keep them in alignment. Medium-density fiberboard (MDF) was chosen as a base material due to its flatness and relatively low cost. Six radial slots were cut into the stator mount in order to accommodate radial adjustment of the stators.

A mount was also required to hold the Hall Effect sensors in place. To avoid magnetic interference between the Hall Effect sensors and the permanent magnets, and to conserve space in our design, this was made of a fairly thin, aluminum sheet. The mount was slotted to allow adjustment of the sensors' radial positions, and had a drilled lip on the bottom allowing it to be bolted down in place.

Two foundational mounts were required to hold our design together and to allow the shaft-rotor assembly to rotate freely. These had to be strong and very stiff in order to retain precise alignment of the assembly; thus, we chose 3/16" thick steel plate as a construction material. Each mount was shaped like an "L," the bottom portion drilled for bolting to a flat surface, and the upright portion containing a press-fit ball bearing. A two-piece mount was used to aid in the assembly and dissassembly of the motor. Finally, one of the mounts was designed to receive the stator mount.

2.6 Hall Effect Sensors

Brushless DC motors, lacking an internal switching mechanism, require external electronic controllers to alter the currents through their stators. Our design was no different, and thus it required a controller interface. Our team used Hall Effect sensors to establish this. Three of these were mounted in close proximity to the rotating permanent magnets of our motor in order to provide electronic feedback to the external circuit controller.

3. Implementation

3.1 Construction

3.1.1 Stators

Stators were constructed by wrapping magnet wire around steel bolts (Fig 3.1.1). This was done with the aid of a rig consisting of an electric drill, a small trash can, a brass rod, duct tape, and a pedometer (Fig 3.1.2). The brass rod was placed through the center of the wire spool and then mounted on the top of the trash can with the aid of duct tape; this allowed the wire spool to spin freely. The pedometer was disassembled and rewired to make it count each time its internal circuit was closed. A small piece of metal was affixed to the outside of the electric drill's chuck to provide electrical contact between the pedometer wires after each revolution. A bolt was placed in the chuck of the electric drill, and with the wire from the spool held taut by hand, the wire was coiled around the bolt. Each stator was wound 750 times with 20 gauge magnetic wire.

Fig. 3.1.1 Wound

Fig. 3.1.2 Electromagnet Winder

This setup worked well for prototype stators, although there were some limitations. Winding speed was limited to fairly low RPM due to limitations of the pedometer. Also the wire did not overlap perfectly resulting in more air space than may be considered ideal.

3.1.2 Stator Base

Two stator bases, a six-slot (Fig 3.1.3) and an eight-slot (Fig 3.1.4), were constructed of medium-density fiberboard (MDF). This material was chosen for its strength, flatness, and workability. Suitably dimensioned pieces were cut from a large sheet of MDF and then milled on the CNC machine with the appropriate number of slots and mounting holes.

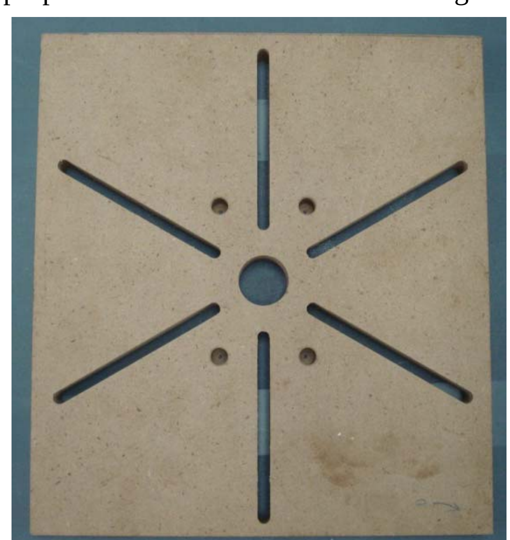

Fig. 3.1.3 6-Slot Stator Base

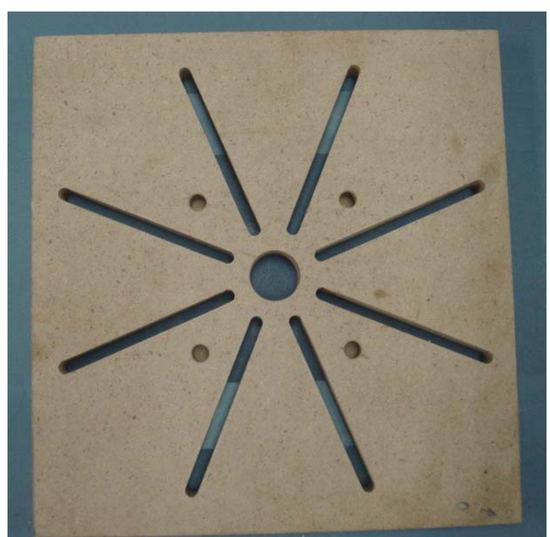

Fig. 3.1.4 8-Slot Stator Base

3.1.3 Base Plates

Two base plate supports (Fig 3.1.5) were required for supporting the shaft and stator base. These were made by cutting 6 inch wide steel plate to length and then using the CNC milling machine to cut the necessary holes. After milling, each plate was welded to another piece of steel so as to produce an “L” shaped support. Unfortunately, welding resulted in slight distortion of one of the supports, and the angle produced was somewhat less than 90 degrees. This was overcome by placing a large piece of steel in the well of the “L” and pressing down on it with the arbor press. The support was brought to almost perfect perpendicularity after a few used of the press. Once the supports were finished, a roller bearing was press fit into each using the arbor press.

Fig. 3.1.5 Base Plates

3.1.4 Shaft

Initially, we used a ¾” threaded rod for the shaft of our motor. This was secured to the rotor and the bearings of the assembly using nuts and washers. However, this setup became problematic when the motor was run. First, the nuts came loose and began to unscrew. This was temporarily solved using thread lock. Additionally, the shaft we used was not precision-machined, and was not perfectly straight; this introduced severe vibrations into the system when the motor was run at speed. For these reasons, we decided to replace the threaded rod with precision-machined steel shaft material, and the nuts and washers with locking collars. A keyway was cut into the shaft using the vertical milling machine to secure the rotor to the shaft. This redesigned shaft produced substantially less vibration and also allowed for easier assembly and disassembly of the prototype.

3.1.5 Rotor

Fig. 3.1.6 Rotor Plate

Rotors were built with Lexan polycarbonate material. A piece of Lexan was cut to the appropriate square size and screwed to a piece of scrap backing material to avoid cutting through the piece and into the CNC machine. It was then placed on the CNC milling machine and slots and a central hole were cut into it. The center was found, and a circle inscribed into the Lexan to allow a rough cut to be done on the vertical band saw. The circularity of the rotor was brought to precision by mounting the rotor on a lathe and making a series of small circumferential cuts. Our initial prototype used a six-slot rotor (Fig 3.1.6) which allowed for the mounting of six permanent magnets. However, after attempting to run the motor with this configuration, it became clear that a six-magnet, six-stator setup was unstable; the motor had a tendency to self-reverse the direction of rotation and if slowed down enough, would lock up due to the alignment of all magnets and stators. This was remedied by building another rotor with eight slots (Fig 3.1.7). This offset the magnet-stator alignment which improved stability and performance.

Fig. 3.1.7 Rotor Plate in CNC

3.1.6 Magnet Holders

Permanent magnets were mounted to the rotor using Lexan polycarbonate holders (Fig 3.1.8). Each of these was a 1" x 1" square with a large ¾" diameter center punched hole to accommodate a press-fit round magnet. Two 1/8" diameter holes were punched in opposite corners of each for mounting screws. To reduce the deformation during construction of these holders the holes were punched out of a 1" x 10" sheet of Lexan first and then the individual 1" x 1" squares were cut to shape last.

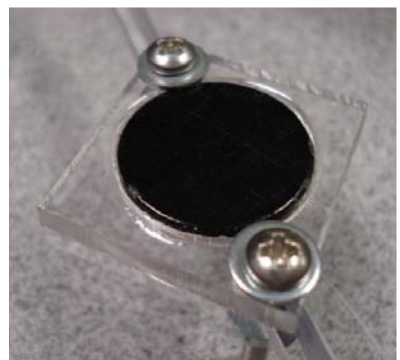

Fig. 3.1.8 Magnet Holder

3.1.7 Hall Effect Sensors and Mount

Each Hall Effect sensor had extension wires soldered to its leads and was then hot-glued to the end of a small screw (Fig 3.1.9). The screws were then affixed to the aluminum mounting plate with nuts and washers (Fig 3.1.10). The mounting plate was constructed of 1/16" aluminum. First the sheet was cut to size and the mounting holes were punched. Next the base was bent using a break. Finally the slots were milled on the CNC machine.

Fig. 3.1.9 Hall Effect Sensor

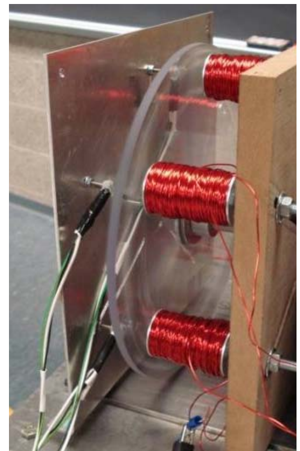

Fig. 3.1.10 Sensor Mount

3.1.8 Prototype Assembly

To assemble the motor components, first we mounted the stators to the base in the selected position. The magnets were also set to the proper radial distance based on the stator location. Next the stator base was bolted to the base plate. It was essential that none of the stator bolts were allowed to touch the base so that no unintentional grounding occurred. The rotor and two collars were fitted loosely to the shaft insuring that the rotor key was in place. The shaft was slid through the base containing the stators. Next the other base plate was slide into place along with the Hall Effect sensor mounting plate. Both base plates were bolted securely to the dynamometer mounting plate. The gap was selected and set by tightening the two shaft collars. Two more shaft collars were fit to the outside of both bearings. The final step was to make the connection to the dynamometer. We found that due to the tight clearance the easiest way to do this was to unbolt the four dynamometer mounting bolts (keeping the motor assembly in tact) and make the connection with the rubber bushing making sure that the key is in place. Finally we secured the dynamometer mounting plate back in place.

3.2 Operation

Our team succeeded in constructing a functional, parameter-variable, brushless DC motor. Operation of our first prototype was promising, yet unsatisfactory. The motor functioned properly, but design issues dictated that it could not run for sustained periods, and problems with vibration prevented achievement of significant speed. After debugging and redesign of a few problematic components, the motor's reliability and operating speed were greatly improved, yet the torque developed was still insufficient to overcome the rotational resistance of the dynamometer. For this reason, the team was not able to perform as much torque and speed testing as has been originally planned.

However, some important observations were made with what was available. First, the motor operated very smoothly and consistently at 12 volts. This was the target operational voltage around which we had originally designed the motor, and the same voltage produced by the lead-acid batteries on both the electric wheelchair and the electric motorcycle. The prototype was also able to sustain a peak current of 25 amperes for short periods of time.

The operating speed of our motor was calculable from the period of the current pulses entering the stators. Calculations revealed that our motor reached 1250 rotations per minute when run at its top speed. The lowest speed attained was around 600 rotations per minute, and this limit we ascribed to constraints imposed by the electronic controller.

High operating temperatures were not a problematic issue for our prototype. The maximum operating temperature we measured during testing was approximately 60ºC. This was well below the 80ºC maximum imposed by our project goal.

4. Schedule

Our original schedule had us building our testing station in January and February, leaving time in March to accomplish testing. Our group did not follow through on this plan because we did not anticipate the amount of time required to become trained on shop equipment. This was difficult because we had to coordinate our schedules with each other and with John Meyer while the shop was open during the week. Once our group was trained on the equipment, we could work on making the parts and pieces for the test bed. [See appendix for Gantt Chart]

5. Budgeting Materials

Steel plate (6"x3/16"x 24") (*Mount Base Plates*)	$50.00
Aluminum Plate (1/16"x10"x10.5") (*Hall Effect Sensor Mounting Plate*)	7.00
Bearings (3/4"id) x2	18.00
Threaded Rod	6.27
Shaft Material (3/4" x 10")	4.75
Shaft Collars (x4)	4.00
Washers (3/4" id, 1 ¼" od) x2	.58
Large Nuts (x6)	2.28
Washers (1/4" id) x20	2.60
25pk small washers	0.90
25pk small nuts	1.57
Small bolt and nut 2pk (x5)	4.90
Magnetic Wire, 20 gauge (10 lbs, appx. 3300 ft)	84.73
Magnets (x10)	14.30
Pedometer	5.00
Medium Density Fiberboard (*Stator Bases*)	4.30
Lexan (10"x20"x1/4") (*Rotors*)	12.80
Lexan (1/8"x1"x8") (*Magnet Holders*)	.50
Hall Effect Sensors (x7)	14.00
Misc Hardware	10.00
Total Cost	$248.48

6. Conclusions

We can conclude that our current design of 8 permanent neodymium magnets with 6 stator coils of 750 turns of 20 AWG wire and using 3-phase power could generate 1,250 RPMs. This design did not produce enough torque, at least enough to turn the low-horsepower dynamometer. From our research, we feel that using more stators (a number that works with 3-phase) that have a lesser amount of turns (250 instead of 750 to reduce reluctance of the coils) would work better than our attempt.

We have also learned the importance of overestimating the time required for project completion, mainly for learning to use the equipment in the shop. This process takes a lot of coordination with the shop technician and our schedules in order to be trained on equipment before being able to mill out parts or pieces for the project. Getting the design completed during this training period also helps for efficient use of time.

7. Recommendations for Future Work

By the conclusion of this project, we were not able to accomplish every goal we had initially established. Accordingly, we have three areas to suggest for future work: additional testing, variations of different parameters, and the development of scalability equations.

7.1 Additional Testing

As we were unable to complete significant testing on our prototype, we would first recommend that more testing be done. This could be accomplished by either modifying our current prototype to enable it to produce greater torque, or by testing using another dynamometer with less resistance to rotation. Once testing can be performed, data can be collected, and the effects of varying different motor parameters can be investigated.

7.2 Variation of Different Parameters

Our prototype makes provision for varying a number of motor parameters, but there are many more that can and should be examined. Specifically, the shape of the stators is a parameter of interest, as it has great bearing on the compactness of the motor. Others parameters that would make for useful study are the size, shape, number, and configuration of the permanent magnets used, the circuit configuration of the stators, etc. Thorough examination of the effects of varying these things will be immensely helpful when the time comes to implement a motor in a practical application.

7.3 Development of Scalability Equations

Ideally, scalability equations for creating motors for specific tasks should also be developed. Once an optimal design has been achieved through parameter testing, equations should be drawn up to make it scalable. They should allow for use in applications with different size, torque, and speed requirements.

I. & II. References and Bibliography

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ID	Task Name	Duration	Start	Finish	Date Completed
1	Research	72 days?	Mon 9/10/07	Fri 12/14/07	NA
5	Proposal Draft	9 days?	Mon 9/17/07	Thu 9/27/07	Thu 9/27/07
2	Characterize Motor	6 days?	Thu 9/20/07	Thu 9/27/07	Wed 10/3/07
4	Project Proposal	2 days?	Fri 9/28/07	Mon 10/1/07	Mon 10/1/07
39	Receive Training in Welding	60 days?	Tue 10/2/07	Thu 12/20/07	Fri 3/21/08
40	Receive Training in CNC Machine	60 days?	Tue 10/2/07	Thu 12/20/07	Wed 3/19/08
6	Fall Break	2 days?	Thu 10/11/07	Sun 10/14/07	NA
3	Have Specs to Controller Team	10 days?	Mon 10/15/07	Fri 10/26/07	Fri 10/26/07
41	Logbooks Due	1 day?	Mon 10/15/07	Mon 10/15/07	Mon 10/15/07
12	**Preliminary Motor Design**	**33 days?**	**Fri 10/19/07**	**Fri 11/30/07**	**NA**
13	**Magnet Design**	**5 days?**	**Fri 10/19/07**	**Thu 10/25/07**	**NA**
14	Know number	5 days?	Fri 10/19/07	Thu 10/25/07	Sun 10/21/07
15	Know type	5 days?	Fri 10/19/07	Thu 10/25/07	Sun 10/21/07
16	Know strength	5 days?	Fri 10/19/07	Thu 10/25/07	Sun 10/21/07
17	**Coil Design**	**6 days?**	**Fri 10/26/07**	**Thu 11/1/07**	**NA**
18	Core Material	6 days?	Fri 10/26/07	Thu 11/1/07	Fri 12/21/07
19	Wire Gauge	6 days?	Fri 10/26/07	Thu 11/1/07	Wed 10/31/07
20	Wire Length	6 days?	Fri 10/26/07	Thu 11/1/07	Wed 10/31/07
21	Resistance	6 days?	Fri 10/26/07	Thu 11/1/07	Wed 10/31/07
22	Number of turns	6 days?	Fri 10/26/07	Thu 11/1/07	Wed 10/31/07
23	Wiring Scheme	6 days?	Fri 10/26/07	Thu 11/1/07	Sun 11/11/07
24	Current through each	6 days?	Fri 10/26/07	Thu 11/1/07	Wed 10/31/07
25	Manufacturing Plan	6 days?	Fri 10/26/07	Thu 11/1/07	Sun 11/11/07
26	**Stator Design**	**5 days?**	**Fri 11/2/07**	**Thu 11/8/07**	**NA**
27	Know Dimensions	5 days?	Fri 11/2/07	Thu 11/8/07	Fri 11/16/07
28	Mounting of Magnets	5 days?	Fri 11/2/07	Thu 11/8/07	Wed 10/31/07
29	Manufacturing Plan	5 days?	Fri 11/2/07	Thu 11/8/07	Wed 10/31/07
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33	**Bearings**	**4 days?**	**Fri 11/16/07**	**Wed 11/21/07**	**NA**
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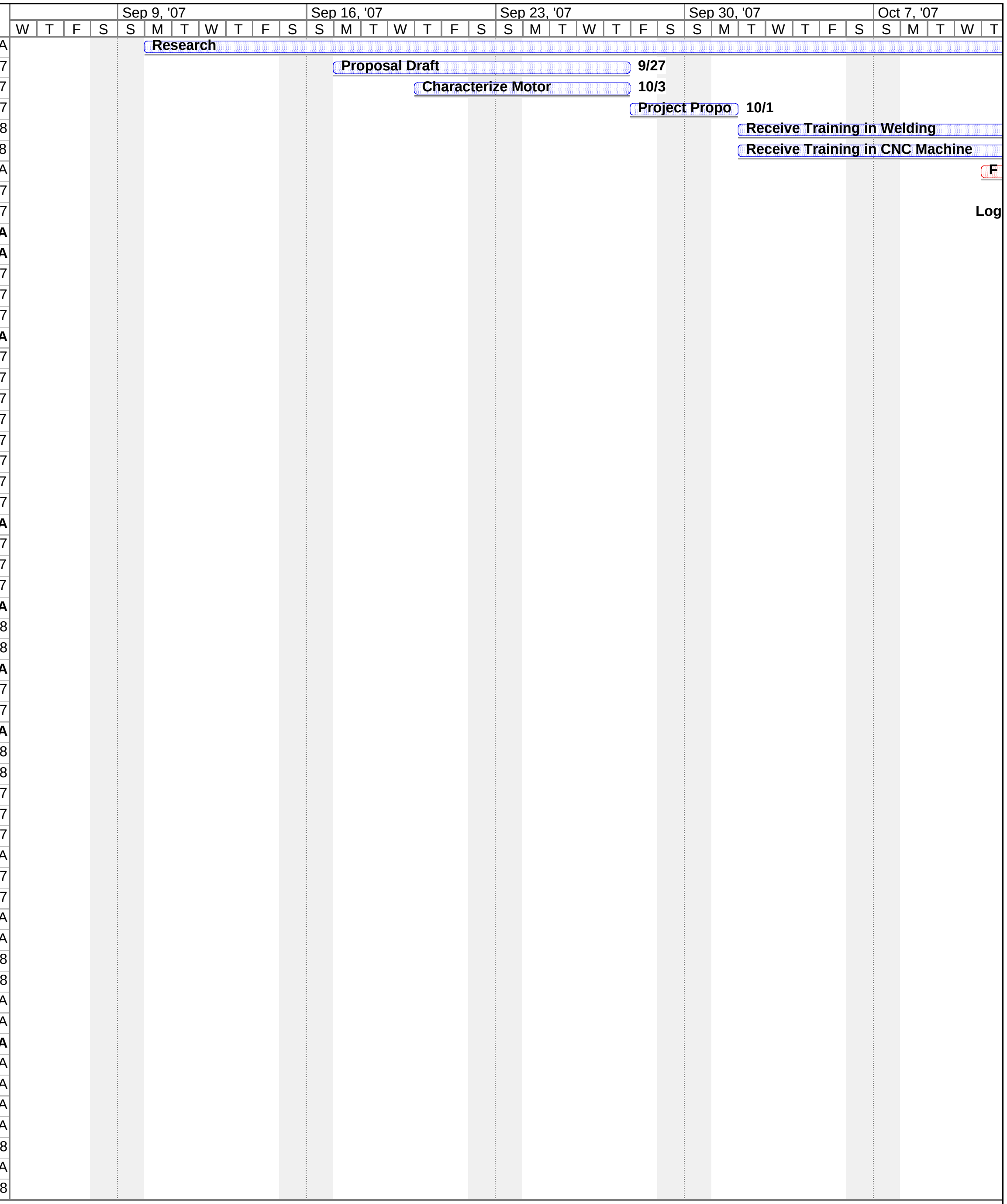
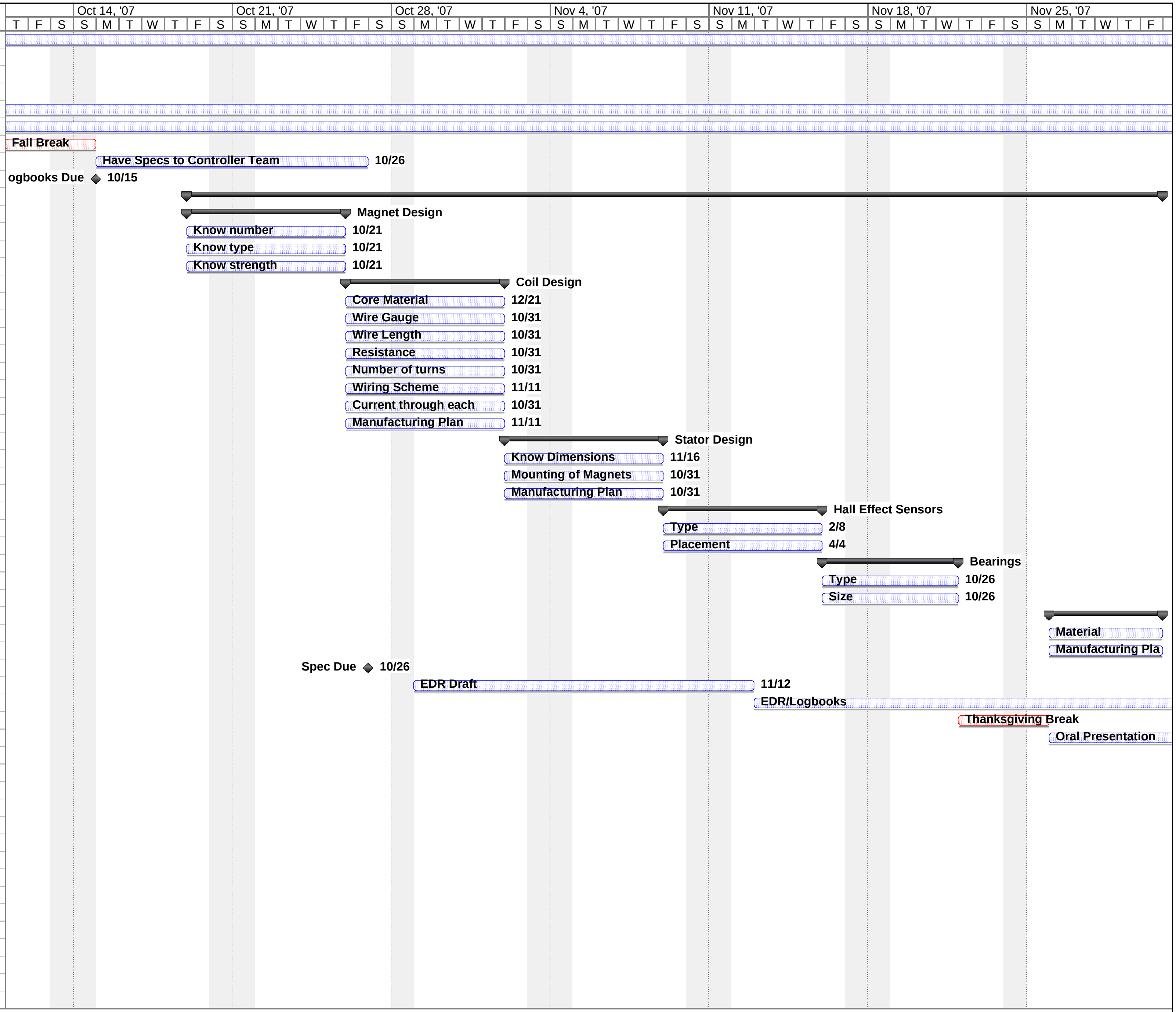
8	Fall Finals	4 days?	Mon 12/17/07	Thu 12/20/07	NA
9	Christmas Break	13 days?	Fri 12/21/07	Tue 1/8/08	NA
47	Build Preliminary Motor	11 days?	Wed 1/9/08	Wed 1/23/08	Fri 4/18/08
48	Test Preliminary Motor	6 days?	Wed 1/23/08	Wed 1/30/08	Thu 5/1/08
10	J Term Break	2 days?	Thu 1/31/08	Sun 2/3/08	NA
49	Develop Scalable Equation	11 days?	Mon 2/4/08	Mon 2/18/08	NA
52	**Trike Prototype Motor**	**22 days?**	**Mon 2/18/08**	**Tue 3/18/08**	**NA**
53	Decide parameters to use	3 days?	Mon 2/18/08	Wed 2/20/08	NA
54	Order materials	11 days?	Wed 2/20/08	Wed 3/5/08	NA
55	Build	6 days?	Wed 3/5/08	Wed 3/12/08	NA
56	Test	5 days?	Wed 3/12/08	Tue 3/18/08	NA
50	Final Presentation	40 days?	Mon 2/25/08	Fri 4/18/08	Fri 5/2/08
11	Spring Break	5 days?	Tue 3/18/08	Mon 3/24/08	NA
51	Final Project Report	25 days?	Tue 3/25/08	Mon 4/28/08	Fri 5/9/08



ID	Task Name
1	Research
5	Proposal Draft
2	Characterize Motor
4	Project Proposal
39	Receive Training in Welding
40	Receive Training in CNC Machine
6	Fall Break
3	Have Specs to Controller Team
41	Logbooks Due
12	**Preliminary Motor Design**
13	**Magnet Design**
14	Know number
15	Know type
16	Know strength
17	**Coil Design**
18	Core Material
19	Wire Gauge
20	Wire Length
21	Resistance
22	Number of turns
23	Wiring Scheme
24	Current through each
25	Manufacturing Plan
26	**Stator Design**
27	Know Dimensions
28	Mounting of Magnets
29	Manufacturing Plan
36	**Hall Effect Sensors**
37	Type
38	Placement
33	**Bearings**
34	Type
35	Size
30	**Mount**
31	Material
32	Manufacturing Plan
42	Spec Due
43	EDR Draft
44	EDR/Logbooks
7	Thanksgiving Break
45	Oral Presentation
46	Order Preliminary Supplies
8	Fall Finals
9	Christmas Break
47	Build Preliminary Motor
48	Test Preliminary Motor
10	J Term Break
49	Develop Scalable Equation
52	**Trike Prototype Motor**
53	Decide parameters to use
54	Order materials
55	Build
56	Test
50	Final Presentation
11	Spring Break
51	Final Project Report



ID	Task Name	Dec 2, '07 – Dec 9, '07 – Dec 16, '07 – Dec 23, '07 – Dec 30, '07 – Jan 6, '08 – Jan 13, '08 – Jan
1	Research	search NA
5	Proposal Draft	
2	Characterize Motor	
4	Project Proposal	
39	Receive Training in Welding	ceive Training in Welding 3/21
40	Receive Training in CNC Machine	ceive Training in CNC Machine 3/19
6	Fall Break	
3	Have Specs to Controller Team	
41	Logbooks Due	
12	**Preliminary Motor Design**	**Preliminary Motor Design**
13	**Magnet Design**	
14	Know number	
15	Know type	
16	Know strength	
17	**Coil Design**	
18	Core Material	
19	Wire Gauge	
20	Wire Length	
21	Resistance	
22	Number of turns	
23	Wiring Scheme	
24	Current through each	
25	Manufacturing Plan	
26	**Stator Design**	
27	Know Dimensions	
28	Mounting of Magnets	
29	Manufacturing Plan	
36	**Hall Effect Sensors**	
37	Type	
38	Placement	
33	**Bearings**	
34	Type	
35	Size	
30	**Mount**	**Mount**
31	Material	1/25
32	Manufacturing Plan	1/25
42	Spec Due	
43	EDR Draft	
44	EDR/Logbooks	12/11
7	Thanksgiving Break	
45	Oral Presentation	12/14
46	Order Preliminary Supplies	Order Preliminary Supplies 12/21
8	Fall Finals	Fall Finals
9	Christmas Break	Christmas Break
47	Build Preliminary Motor	Build Preliminary Motor
48	Test Preliminary Motor	
10	J Term Break	
49	Develop Scalable Equation	
52	**Trike Prototype Motor**	
53	Decide parameters to use	
54	Order materials	
55	Build	
56	Test	
50	Final Presentation	
11	Spring Break	
51	Final Project Report	

20, '08 | Jan 27, '08 | Feb 3, '08 | Feb 10, '08 | Feb 17, '08 | Feb 24, '08 | Mar 2, '08 | Mar 9, '08

ID	Task Name	
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40	Receive Training in CNC Machine	
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41	Logbooks Due	
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17	**Coil Design**	
18	Core Material	
19	Wire Gauge	
20	Wire Length	
21	Resistance	
22	Number of turns	
23	Wiring Scheme	
24	Current through each	
25	Manufacturing Plan	
26	**Stator Design**	
27	Know Dimensions	
28	Mounting of Magnets	
29	Manufacturing Plan	
36	**Hall Effect Sensors**	
37	Type	
38	Placement	
33	**Bearings**	
34	Type	
35	Size	
30	**Mount**	
31	Material	
32	Manufacturing Plan	
42	Spec Due	
43	EDR Draft	
44	EDR/Logbooks	
7	Thanksgiving Break	
45	Oral Presentation	
46	Order Preliminary Supplies	
8	Fall Finals	
9	Christmas Break	
47	Build Preliminary Motor	4/18
48	Test Preliminary Motor	Test Preliminary Motor 5/1
10	J Term Break	J Term Break
49	Develop Scalable Equation	Develop Scalable Equation NA
52	**Trike Prototype Motor**	
53	Decide parameters to use	Decide pa NA
54	Order materials	Order materials NA
55	Build	Build
56	Test	
50	Final Presentation	Final Presentation
11	Spring Break	
51	Final Project Report	

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53	Decide parameters to use
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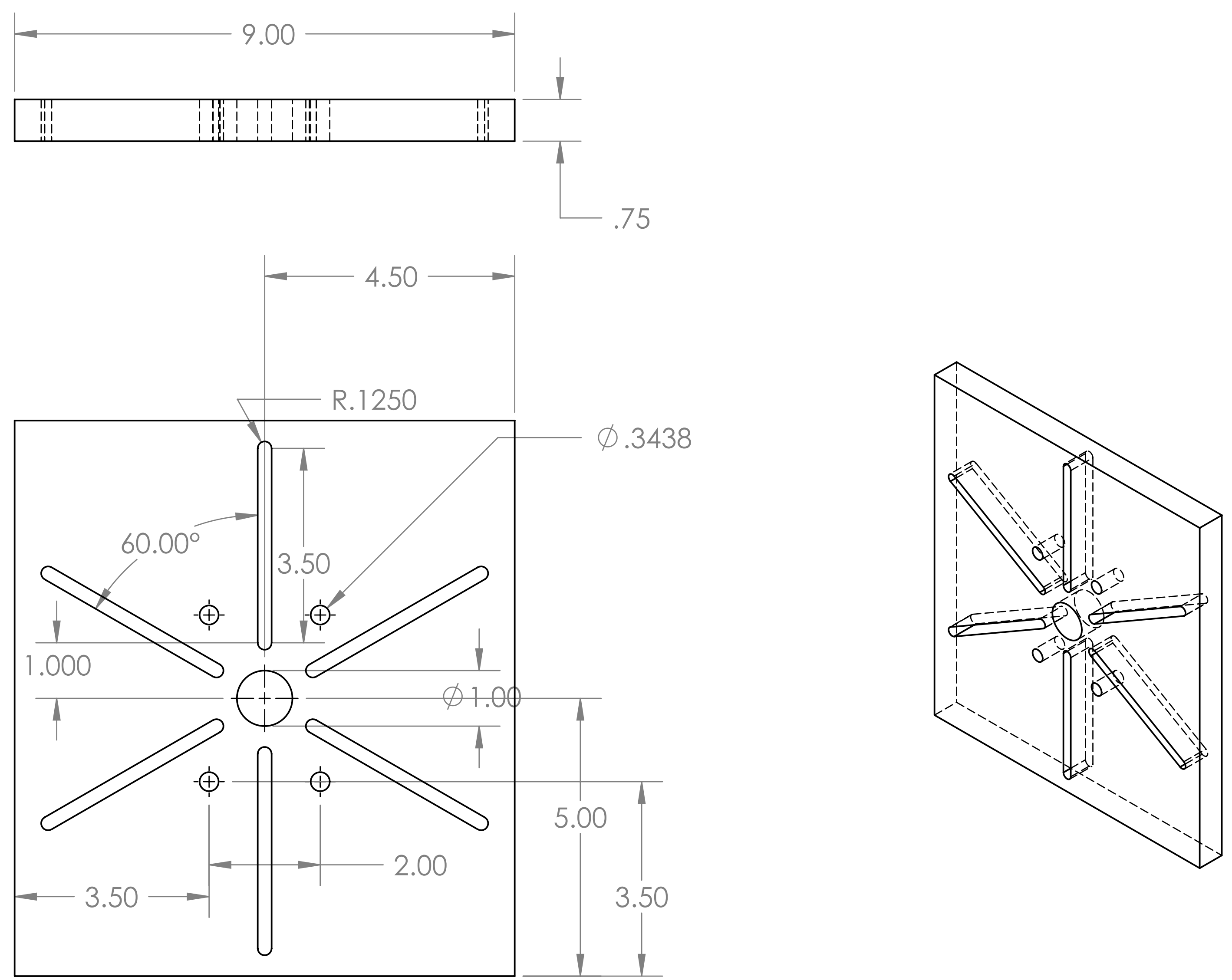
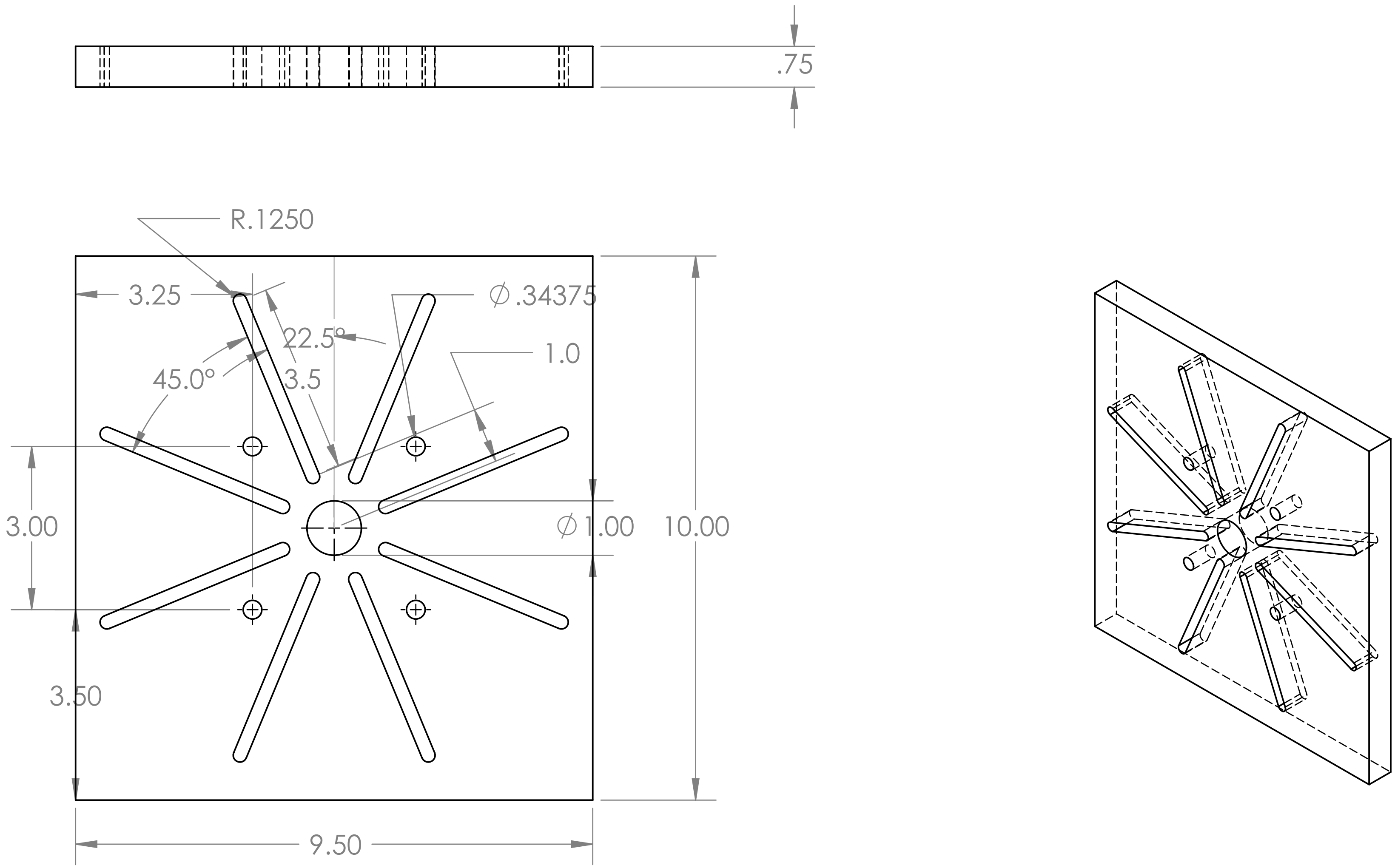
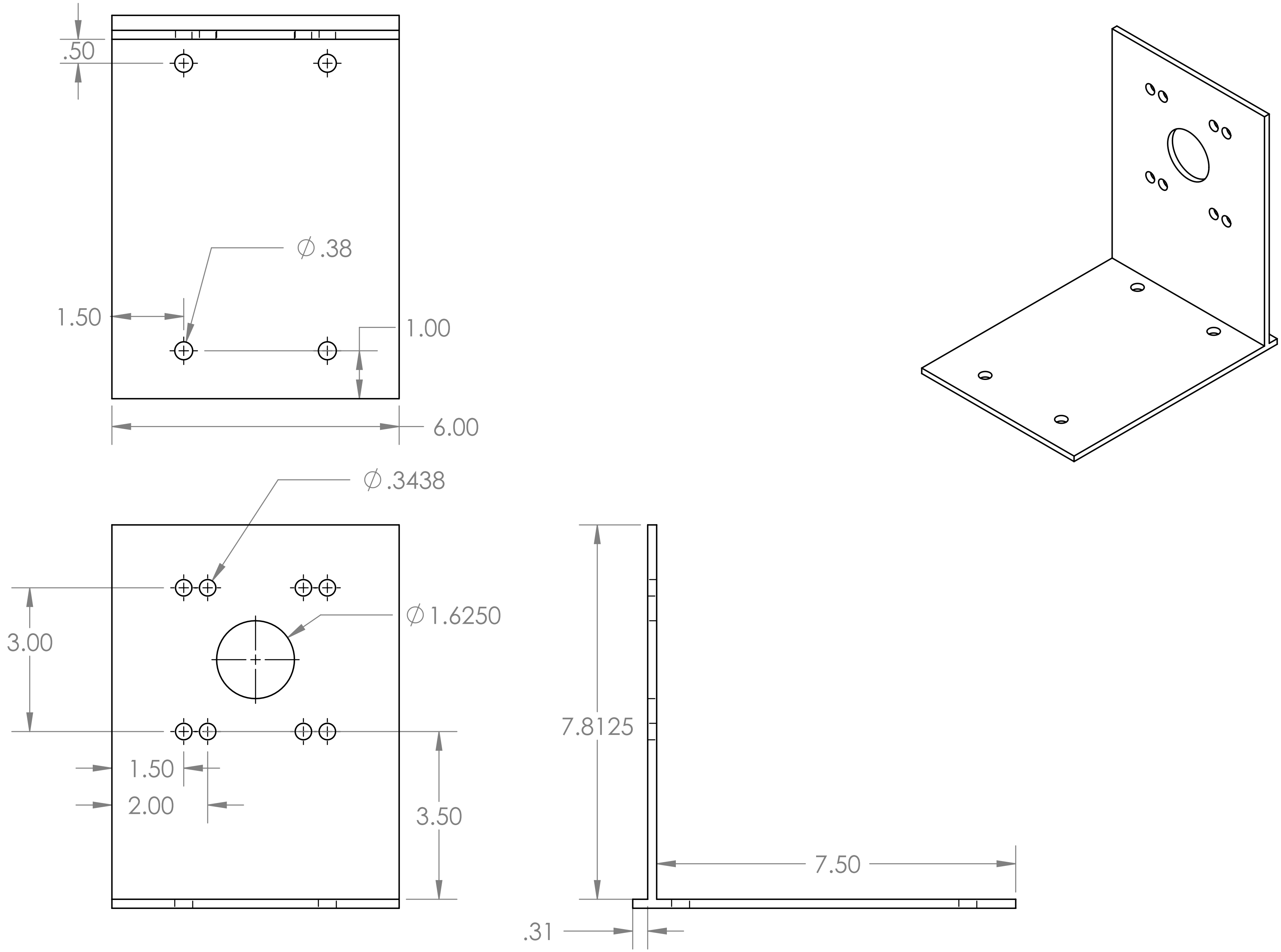
56	Test
50	Final Presentation
11	Spring Break
51	Final Project Report



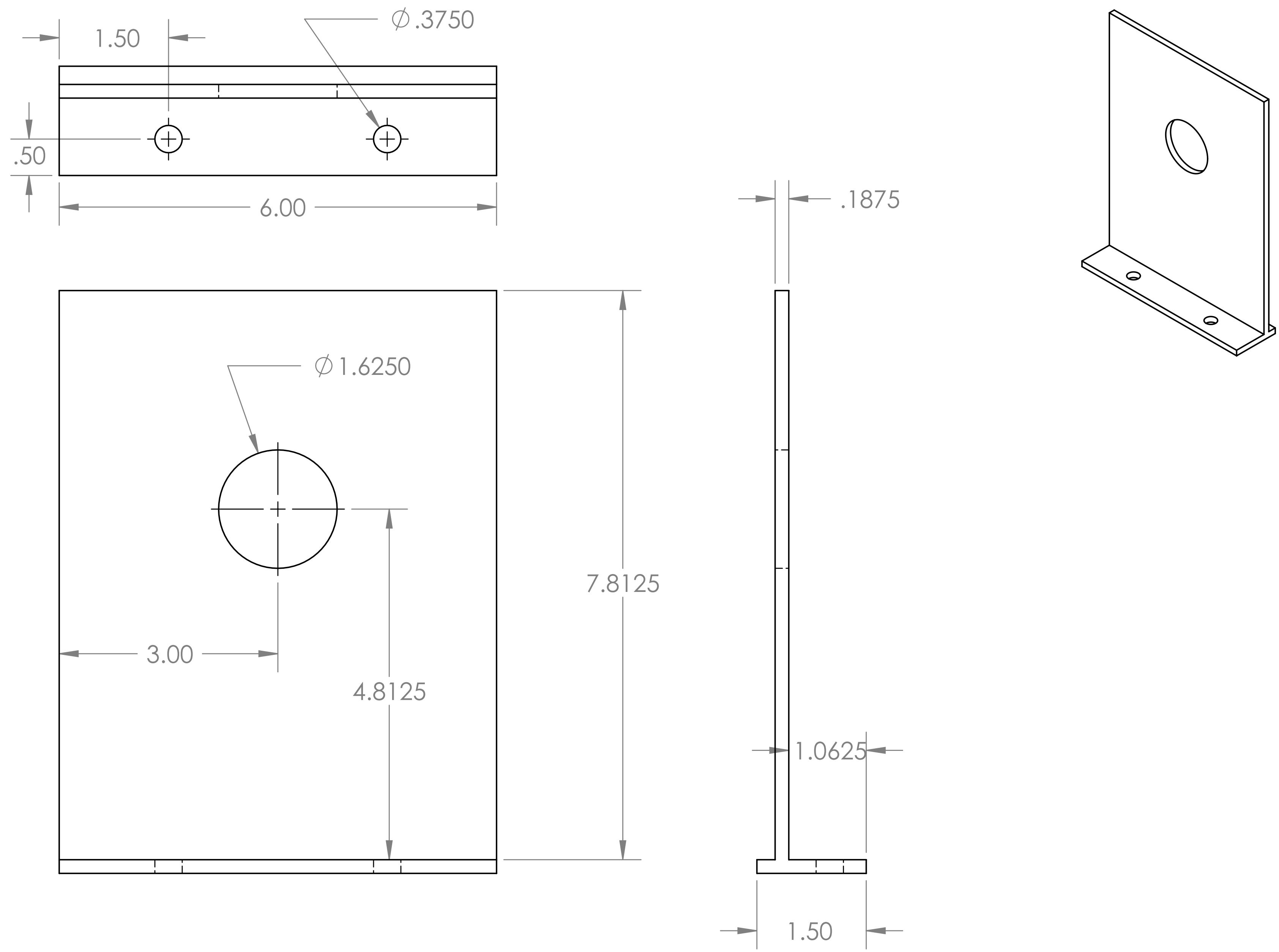
TITLE:	COMMENTS:	MATERIAL:
6-Slot Stator Base Plate		3/4" MDF



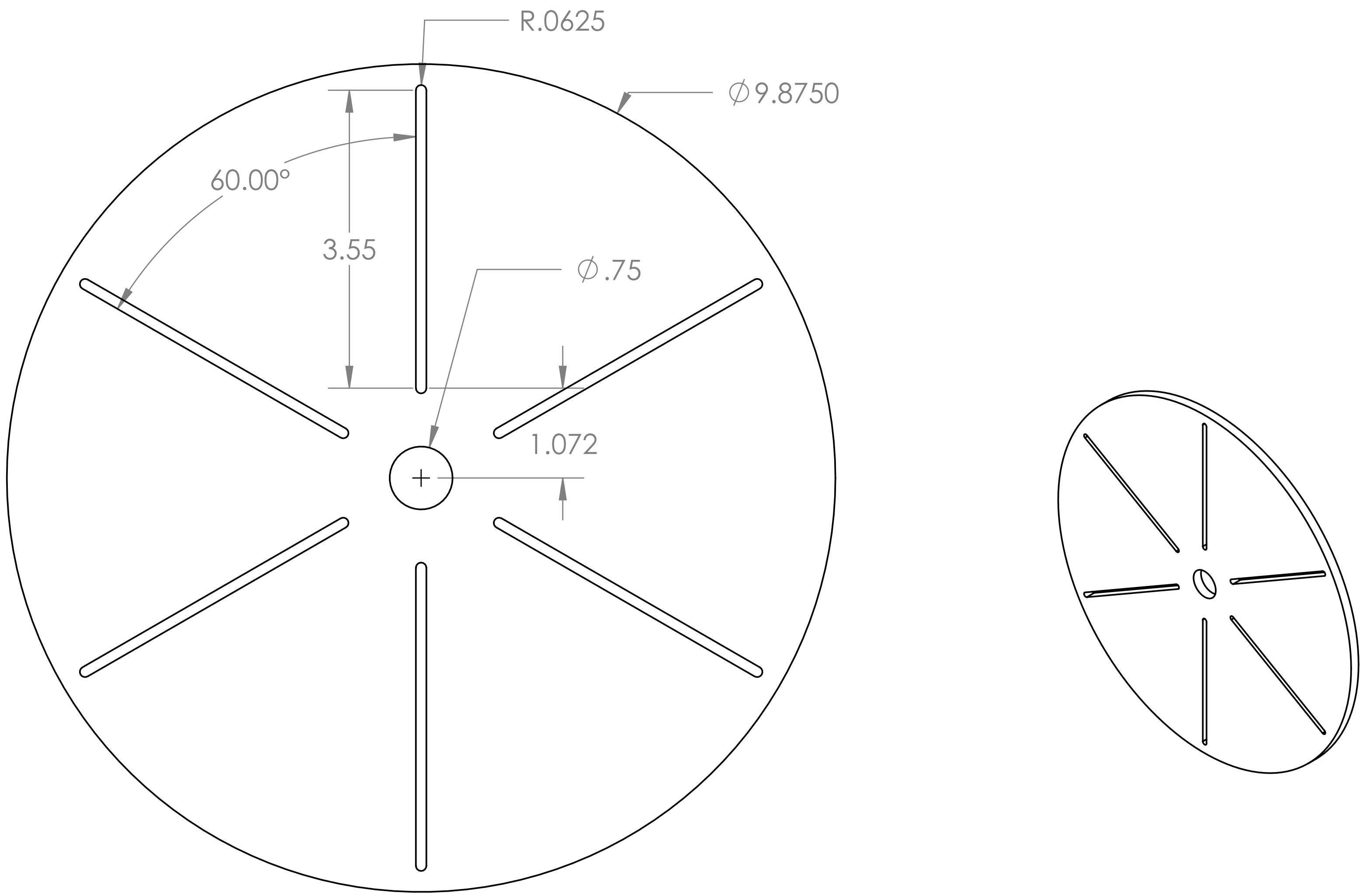
TITLE:	COMMENTS:	MATERIAL:
8-Slot Stator Base		3/4" MDF



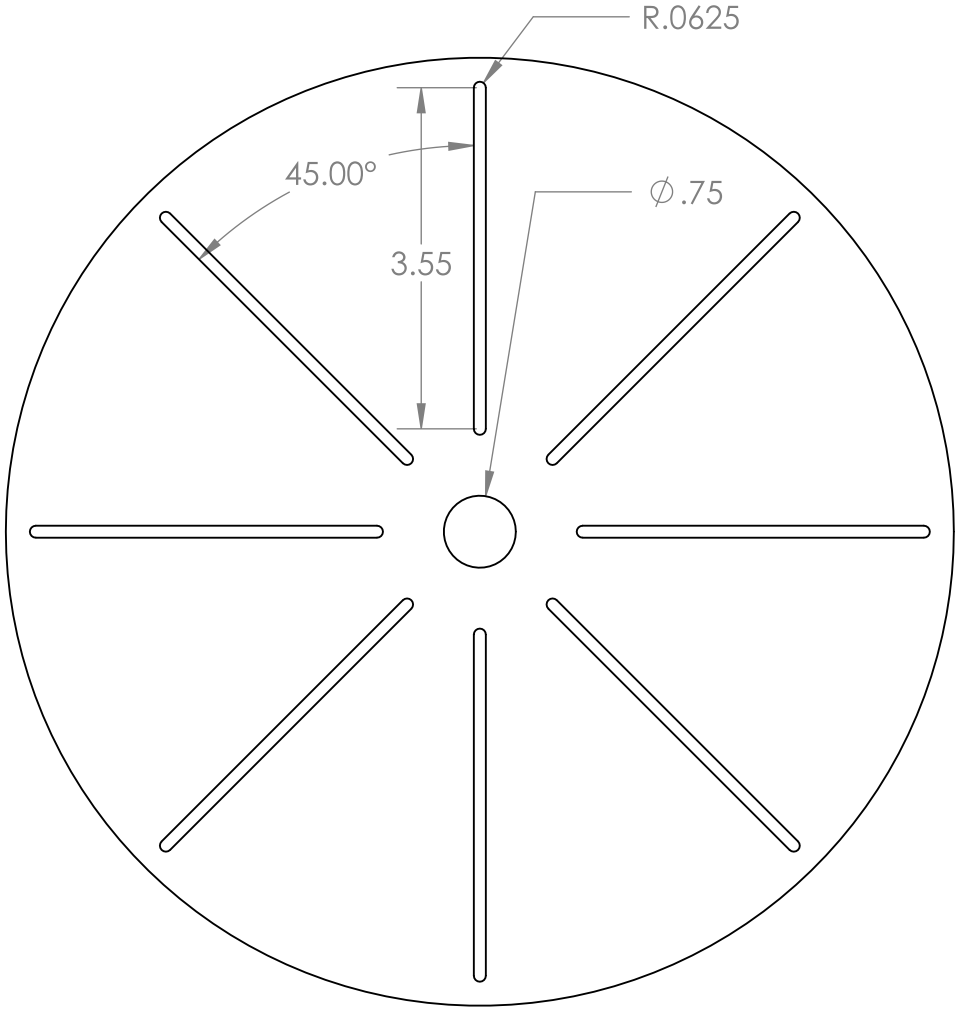
TITLE:	COMMENTS:	MATERIAL:
Base Plate 2	Weld Last	3/16" Steel

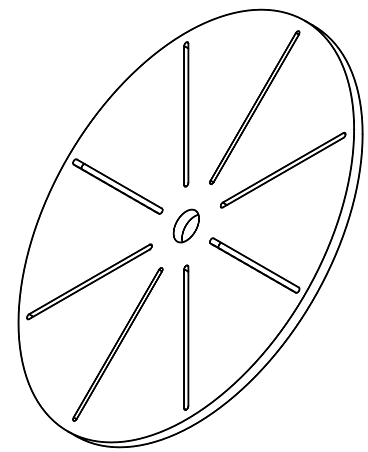


TITLE:	COMMENTS:	MATERIAL:
Base Plate 2	1st: Drill/mill holes in small plate 2nd: Weld plates together 3rd: CNC bearing hole	3/16" Steel

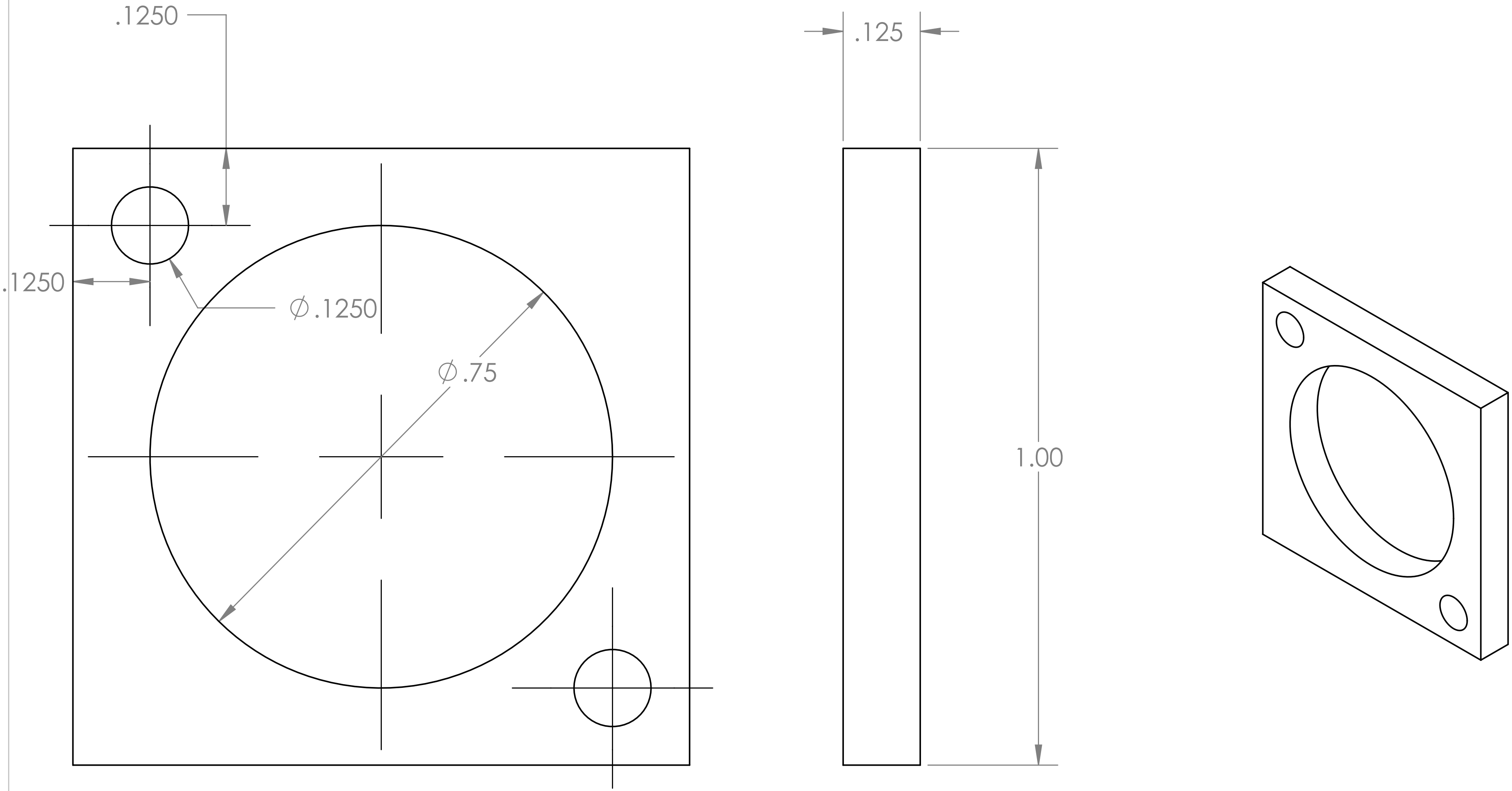


TITLE:	COMMENTS:	MATERIAL:
6-Slot Rotor	Outside Diameter has to be slightly less than 10" for dyno clearance.	1/4" Lexan

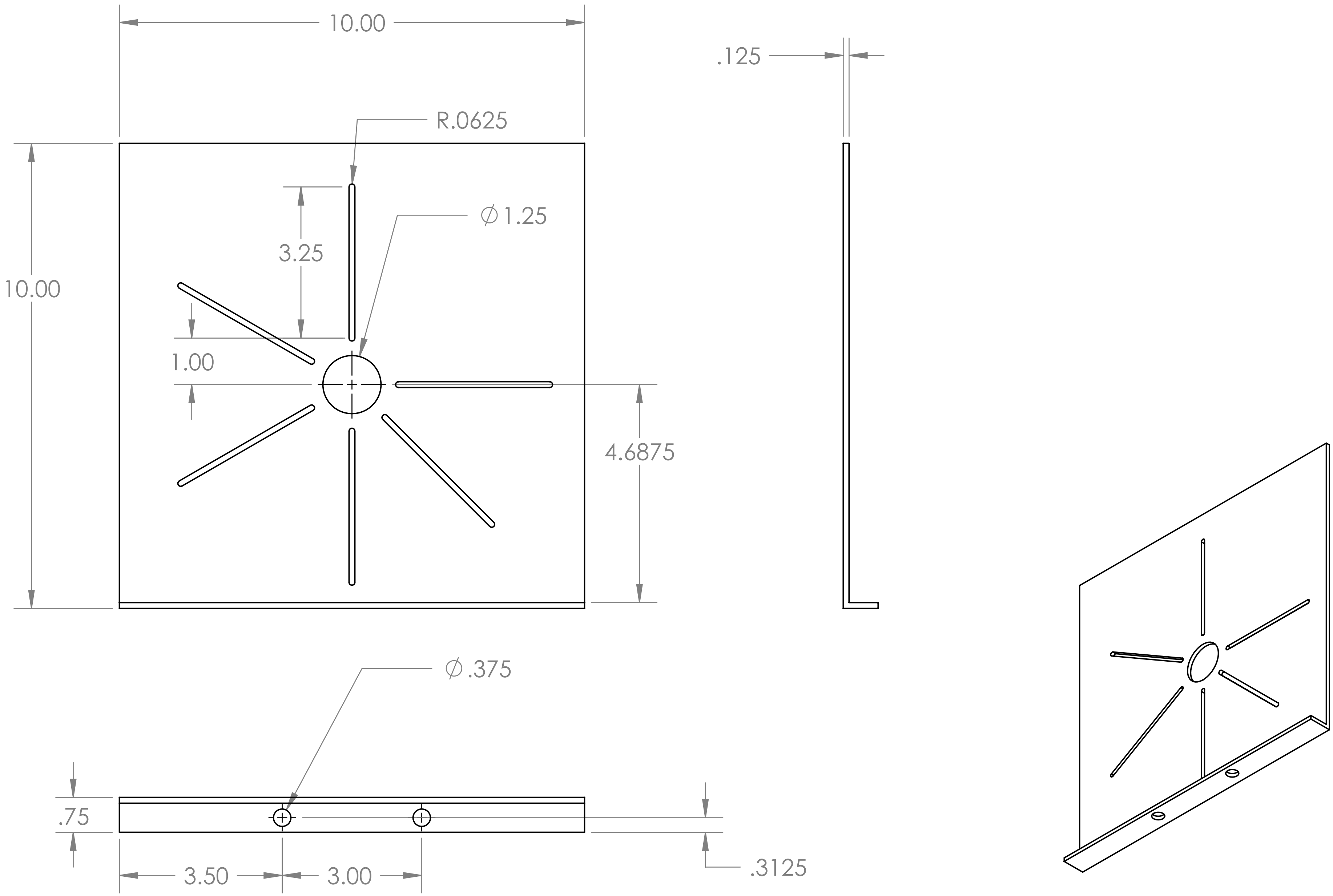




TITLE:	COMMENTS:	MATERIAL:
8-Slot Rotor	Outside Diameter has to be slightly less than 10" for dyno clearance.	1/4" Lexan

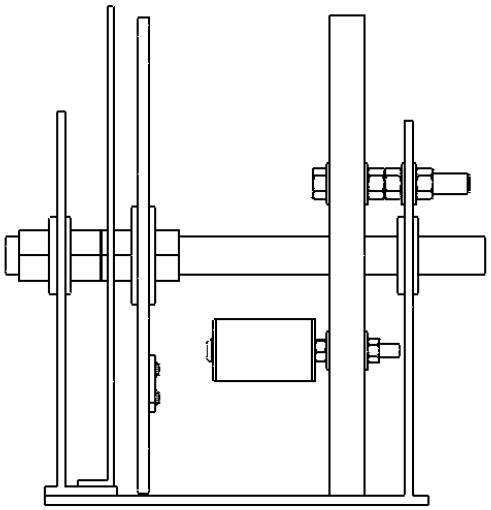


TITLE:	COMMENTS:	MATERIAL:
Magnet Holder	To avoid distorsion, punch out holes in strip of Lexan and cut to square shape last. Punch large holes first.	1/8" Lexan

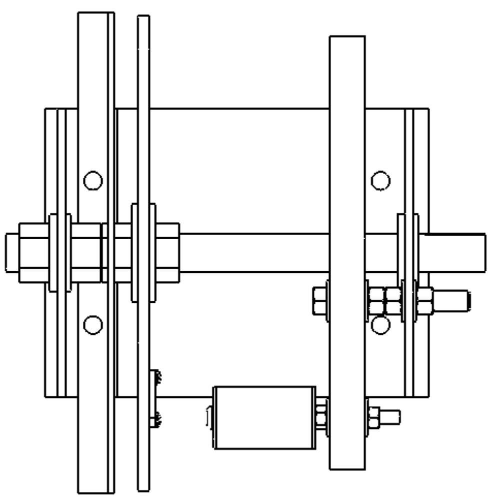


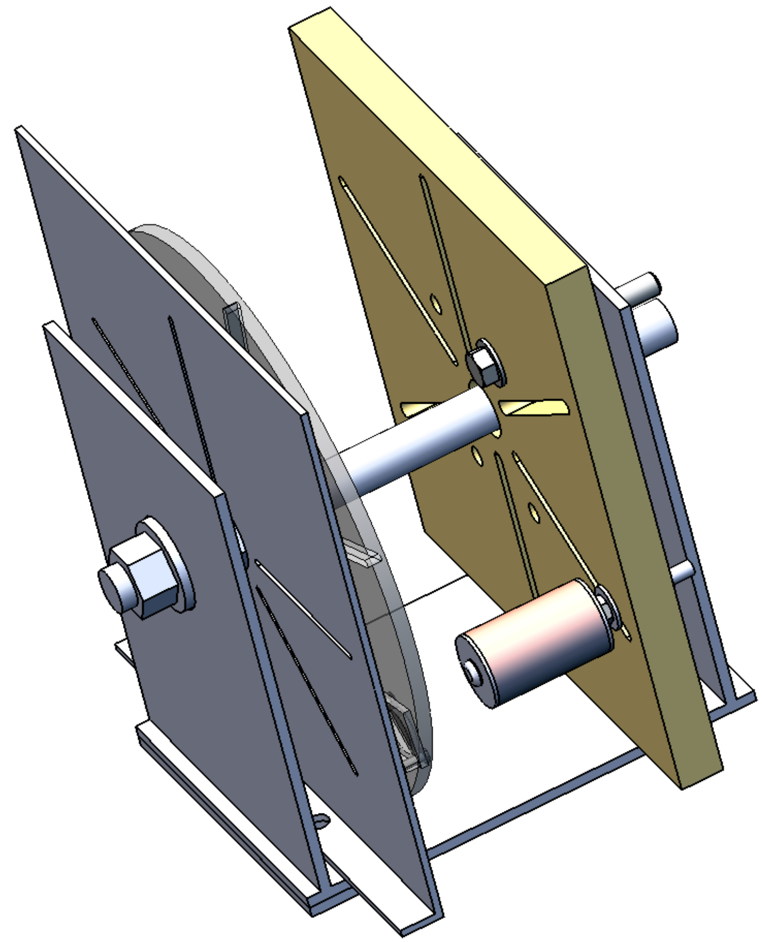
TITLE:	COMMENTS:	MATERIAL:
Hall Effect Sensor Plate	Aluminum was used for non-magnetic properties. 2 sets of slots, one for Stators at 45 degrees, one for 60 degrees. Bend then CNC.	1/16" Alum

Side



Top





TITLE:	COMMENTS:	MATERIAL:
Prototype Assembly	Only one stator and magnet shown	

Stator Diameter	0.25	in	0.00635	m
Stator Length	2	in	0.0508	m
Cross Section Area (Stator Core)	3.16692E-05	in^2	0.000323	m^2
Gap Length	0.003	m		
Wire Gauge	20	AWG		
Resistance of Wire	10.15	Ohms/1000 ft	(304.8 m)	
Wire Diameter	0.0008128	m		
Battery Voltage	12	V		
Permeability of Free Space	1.25664E-06	H/m		
Number of turns per layer	62.50	#		
*Green Cells are variables that can be changed				
*Blue cells are Calculations and Constants				
**See reference table of gauges and enter in resistance and wire diameter				
	0.00071537			

Layer #	Turn #	Diameter of Coil (m)	Length per Layer	Total Length (meters)	Total Length (feet)	Total Resistance (Ohms)	Current	Flux
Layer 1	62.50	0.00635	1.246819584	1.246819584	4.090615434	0.041519747	289.0191045	2.396E-04
Layer 2	125.00	0.0079756	1.566005398	2.812824982	9.22842842	0.093668548	128.1113052	2.124E-04
Layer 3	187.50	0.0096012	1.885191212	4.698016194	15.41343896	0.156446405	76.70358401	1.908E-04
Layer 4	250.00	0.0112268	2.204377025	6.902393219	22.64564704	0.229853318	52.20720819	1.731E-04
Layer 5	312.50	0.0128524	2.523562839	9.425956058	30.92505268	0.313889285	38.23004028	1.585E-04
Layer 6	375.00	0.014478	2.842748652	12.26870471	40.25165587	0.408554307	29.37186022	1.461E-04
Layer 7	437.50	0.0161036	3.161934466	15.43063918	50.62545662	0.513848385	23.35319203	1.355E-04
Layer 8	500.00	0.0177292	3.48112028	18.91175946	62.04645491	0.629771517	19.05452957	1.264E-04
Layer 9	562.50	0.0193548	3.800306093	22.71206555	74.51465075	0.756323705	15.86622225	1.184E-04
Layer 10	625.00	0.0209804	4.119491907	26.83155746	88.03004415	0.893504948	13.43025579	1.114E-04
Layer 11	687.50	0.022606	4.43867772	31.27023518	102.5926351	1.041315246	11.52388774	1.051E-04
Layer 12	750.00	0.0242316	4.757863534	36.02809871	118.2024236	1.199754599	10.00204542	9.951E-05
Layer 13	812.50	0.0258572	5.077049348	41.10514806	134.8594096	1.368823008	8.766655682	9.449E-05
Layer 14	875.00	0.0274828	5.396235161	46.50138322	152.5635932	1.548520471	7.74933249	8.995E-05
Layer 15	937.50	0.0291084	5.715420975	52.21680419	171.3149744	1.73884699	6.90112475	8.583E-05
Layer 16	1000.00	0.030734	6.034606788	58.25141098	191.1135531	1.939802564	6.186196587	8.206E-05
Layer 17	1062.50	0.0323596	6.353792602	64.60520358	211.9593293	2.151387193	5.577796521	7.862E-05
Layer 18	1125.00	0.0339852	6.672978416	71.278182	233.8523032	2.373600877	5.055609861	7.545E-05
Layer 19	1187.50	0.0356108	6.992164229	78.27034623	256.7924745	2.606443616	4.603974521	7.253E-05
Layer 20	1250.00	0.0372364	7.311350043	85.58169627	280.7798434	2.849915411	4.21065129	6.982E-05
Layer 21	1312.50	0.038862	7.630535856	93.21223213	305.8144099	3.10401626	3.86595913	6.731E-05
Layer 22	1375.00	0.0404876	7.94972167	101.1619538	331.8961739	3.368746165	3.562156189	6.497E-05
Layer 23	1437.50	0.0421132	8.268907484	109.4308613	359.0251354	3.644105125	3.292989524	6.279E-05
Layer 24	1500.00	0.0437388	8.588093297	118.0189546	387.2012946	3.93009314	3.053362751	6.076E-05
Layer 25	1562.50	0.0453644	8.907279111	126.9262337	416.4246512	4.22671021	2.839087471	5.885E-05
Layer 26	1625.00	0.04699	9.226464925	136.1526986	446.6952054	4.533956335	2.646695097	5.705E-05
Layer 27	1687.50	0.0486156	9.545650738	145.6983494	478.0129572	4.851831516	2.473292809	5.537E-05
Layer 28	1750.00	0.0502412	9.864836552	155.5631859	510.3779065	5.180335751	2.316452172	5.378E-05
Layer 29	1812.50	0.0518668	10.18402237	165.7472083	543.7900534	5.519469042	2.174122168	5.227E-05
Layer 30	1875.00	0.0534924	10.50320818	176.2504164	578.2493978	5.869231388	2.044560728	5.085E-05
Layer 31	1937.50	0.055118	10.82239399	187.0728104	613.7559398	6.229622789	1.926280355	4.951E-05
Layer 32	2000.00	0.0567436	11.14157981	198.2143902	650.3096793	6.600643245	1.818004633	4.823E-05
Layer 33	2062.50	0.0583692	11.46076562	209.6751559	687.9106164	6.982292756	1.71863318	4.702E-05
Layer 34	2125.00	0.0599948	11.77995143	221.4551073	726.558751	7.374571323	1.627213227	4.587E-05
Layer 35	2187.50	0.0616204	12.09913725	233.5542445	766.2540832	7.777478944	1.542916424	4.477E-05
Layer 36	2250.00	0.063246	12.41832306	245.9725676	806.9966129	8.191015621	1.465019792	4.373E-05
Layer 37	2312.50	0.0648716	12.73750887	258.7100765	848.7863402	8.615181353	1.392890005	4.273E-05
Layer 38	2375.00	0.0664972	13.05669469	271.7667712	891.623265	9.04997614	1.325970347	4.178E-05
Layer 39	2437.50	0.0681228	13.3758805	285.1426517	935.5073874	9.495399982	1.263769828	4.086E-05
Layer 40	2500.00	0.0697484	13.69506631	298.837718	980.4387073	9.951452879	1.205854074	3.999E-05
Layer 41	2562.50	0.071374	14.01425213	312.8519701	1026.417225	10.41813483	1.151837656	3.915E-05
Layer 42	2625.00	0.0729996	14.33343794	327.1854081	1073.44294	10.89544584	1.101377601	3.835E-05
Layer 43	2687.50	0.0746252	14.65262376	341.8380318	1121.515852	11.3833859	1.054167899	3.758E-05
Layer 44	2750.00	0.0762508	14.97180957	356.8098414	1170.635963	11.88195502	1.009934811	3.684E-05
Layer 45	2812.50	0.0778764	15.29099538	372.1008368	1220.80327	12.39115319	0.968432866	3.613E-05

Layer 46	2875.00	0.079502	15.6101812	387.711018	1272.017775	12.91098042	0.929441422	3.545E-05
Layer 47	2937.50	0.0811276	15.92936701	403.640385	1324.279478	13.4414367	0.892761709	3.479E-05
Layer 48	3000.00	0.0827532	16.24855282	419.8889378	1377.588379	13.98252204	0.858214274	3.415E-05
Layer 49	3062.50	0.0843788	16.56773864	436.4566764	1431.944476	14.53423644	0.825636768	3.354E-05
Layer 50	3125.00	0.0860044	16.88692445	453.3436009	1487.347772	15.09657989	0.794882026	3.295E-05
Layer 51	3187.50	0.08763	17.20611026	470.5497112	1543.798265	15.66955239	0.765816387	3.238E-05
Layer 52	3250.00	0.0892556	17.52529608	488.0750072	1601.295955	16.25315395	0.738318239	3.183E-05
Layer 53	3312.50	0.0908812	17.84448189	505.9194891	1659.840844	16.84738456	0.712276731	3.130E-05
Layer 54	3375.00	0.0925068	18.16366771	524.0831568	1719.432929	17.45224423	0.687590653	3.078E-05
Layer 55	3437.50	0.0941324	18.48285352	542.5660103	1780.072212	18.06773296	0.664167443	3.029E-05
Layer 56	3500.00	0.095758	18.80203933	561.3680497	1841.758693	18.69385074	0.641922318	2.980E-05
Layer 57	3562.50	0.0973836	19.12122515	580.4892748	1904.492371	19.33059757	0.620777498	2.934E-05
Layer 58	3625.00	0.0990092	19.44041096	599.9296858	1968.273247	19.97797346	0.600661525	2.888E-05
Layer 59	3687.50	0.1006348	19.75959677	619.6892826	2033.101321	20.63597841	0.581508653	2.845E-05
Layer 60	3750.00	0.1022604	20.07878259	639.7680651	2098.976592	21.30461241	0.563258311	2.802E-05
Layer 61	3812.50	0.103886	20.3979684	660.1660335	2165.89906	21.98387546	0.545854621	2.761E-05
Layer 62	3875.00	0.1055116	20.71715421	680.8831878	2233.868726	22.67376757	0.529245965	2.721E-05
Layer 63	3937.50	0.1071372	21.03634003	701.9195278	2302.88559	23.37428874	0.513384605	2.682E-05
Layer 64	4000.00	0.1087628	21.35552584	723.2750536	2372.949651	24.08543896	0.498226336	2.644E-05
Layer 65	4062.50	0.1103884	21.67471166	744.9497653	2444.06091	24.80721823	0.483730174	2.607E-05
Layer 66	4125.00	0.112014	21.99389747	766.9436628	2516.219366	25.53962656	0.469858084	2.571E-05
Layer 67	4187.50	0.1136396	22.31308328	789.256746	2589.42502	26.28266395	0.456574723	2.536E-05
Layer 68	4250.00	0.1152652	22.6322691	811.8890151	2663.677871	27.03633039	0.443847217	2.502E-05
Layer 69	4312.50	0.1168908	22.95145491	834.84047	2738.97792	27.80062589	0.431644958	2.469E-05
Layer 70	4375.00	0.1185164	23.27064072	858.1111108	2815.325167	28.57555044	0.419939417	2.437E-05
Layer 71	4437.50	0.120142	23.58982654	881.7009373	2892.719611	29.36110405	0.408703977	2.406E-05
Layer 72	4500.00	0.1217676	23.90901235	905.6099497	2971.161252	30.15728671	0.397913782	2.375E-05
Layer 73	4562.50	0.1233932	24.22819816	929.8381478	3050.650091	30.96409843	0.387545597	2.346E-05
Layer 74	4625.00	0.1250188	24.54738398	954.3855318	3131.186128	31.7815392	0.377577685	2.317E-05
Layer 75	4687.50	0.1266444	24.86656979	979.2521016	3212.769362	32.60960903	0.367989693	2.288E-05
Layer 76	4750.00	0.12827	25.1857556	1004.437857	3295.399794	33.44830791	0.358762543	2.261E-05
Layer 77	4812.50	0.1298956	25.50494142	1029.942799	3379.077423	34.29763585	0.349878343	2.234E-05
Layer 78	4875.00	0.1315212	25.82412723	1055.766926	3463.80225	35.15759284	0.341320296	2.207E-05
Layer 79	4937.50	0.1331468	26.14331305	1081.910239	3549.574275	36.02817889	0.333072622	2.182E-05
Layer 80	5000.00	0.1347724	26.46249886	1108.372738	3636.393497	36.90939399	0.325120483	2.156E-05
Layer 81	5062.50	0.136398	26.78168467	1135.154422	3724.259916	37.80123815	0.317449919	2.132E-05
Layer 82	5125.00	0.1380236	27.10087049	1162.255293	3813.173533	38.70371136	0.310047786	2.108E-05
Layer 83	5187.50	0.1396492	27.4200563	1189.675349	3903.134348	39.61681363	0.302901695	2.084E-05
Layer 84	5250.00	0.1412748	27.73924211	1217.414591	3994.14236	40.54054495	0.295999968	2.061E-05
Layer 85	5312.50	0.1429004	28.05842793	1245.473019	4086.19757	41.47490533	0.289331583	2.039E-05
Layer 86	5375.00	0.144526	28.37761374	1273.850633	4179.299977	42.41989477	0.282886133	2.017E-05
Layer 87	5437.50	0.1461516	28.69679955	1302.547433	4273.449582	43.37551326	0.276653787	1.996E-05
Layer 88	5500.00	0.1477772	29.01598537	1331.563418	4368.646384	44.3417608	0.270625248	1.974E-05
Layer 89	5562.50	0.1494028	29.33517118	1360.898589	4464.890384	45.3186374	0.264791721	1.954E-05
Layer 90	5625.00	0.1510284	29.654357	1390.552946	4562.181582	46.30614305	0.259144882	1.934E-05
Layer 91	5687.50	0.152654	29.97354281	1420.526489	4660.519977	47.30427776	0.253676846	1.914E-05

Layer 92	5750.00	0.1542796	30.29272862	1450.819218	4759.905569	48.31304153	0.24838014	1.895E-05
Layer 93	5812.50	0.1559052	30.61191444	1481.431132	4860.338359	49.33243435	0.243247676	1.876E-05
Layer 94	5875.00	0.1575308	30.93110025	1512.362232	4961.818347	50.36245622	0.238272731	1.857E-05
Layer 95	5937.50	0.1591564	31.25028606	1543.612518	5064.345532	51.40310715	0.233448923	1.839E-05
Layer 96	6000.00	0.160782	31.56947188	1575.18199	5167.919915	52.45438714	0.228770188	1.821E-05
Layer 97	6062.50	0.1624076	31.88865769	1607.070648	5272.541496	53.51629618	0.224230764	1.803E-05
Layer 98	6125.00	0.1640332	32.2078435	1639.278491	5378.210273	54.58883428	0.219825174	1.786E-05
Layer 99	6187.50	0.1656588	32.52702932	1671.805521	5484.926249	55.67200143	0.215548205	1.769E-05
Layer 100	6250.00	0.1672844	32.84621513	1704.651736	5592.689422	56.76579763	0.211394898	1.753E-05
Layer 101	6312.50	0.16891	33.16540094	1737.817137	5701.499792	57.87022289	0.207360528	1.736E-05
Layer 102	6375.00	0.1705356	33.48458676	1771.301723	5811.357361	58.98527721	0.203440597	1.720E-05
Layer 103	6437.50	0.1721612	33.80377257	1805.105496	5922.262126	60.11096058	0.199630814	1.705E-05
Layer 104	6500.00	0.1737868	34.12295839	1839.228454	6034.214089	61.24727301	0.19592709	1.689E-05
Layer 105	6562.50	0.1754124	34.4421442	1873.670599	6147.21325	62.39421449	0.192325524	1.674E-05
Layer 106	6625.00	0.177038	34.76133001	1908.431929	6261.259608	63.55178503	0.188822391	1.659E-05
Layer 107	6687.50	0.1786636	35.08051583	1943.512444	6376.353164	64.71998462	0.185414136	1.645E-05
Layer 108	6750.00	0.1802892	35.39970164	1978.912146	6492.493918	65.89881326	0.182097361	1.631E-05
Layer 109	6812.50	0.1819148	35.71888745	2014.631034	6609.681869	67.08827097	0.178868822	1.616E-05
Layer 110	6875.00	0.1835404	36.03807327	2050.669107	6727.917017	68.28835772	0.175725415	1.603E-05
Layer 111	6937.50	0.185166	36.35725908	2087.026366	6847.199363	69.49907354	0.172664172	1.589E-05
Layer 112	7000.00	0.1867916	36.67644489	2123.702811	6967.528907	70.7204184	0.169682254	1.576E-05
Layer 113	7062.50	0.1884172	36.99563071	2160.698442	7088.905648	71.95239233	0.166776943	1.563E-05
Layer 114	7125.00	0.1900428	37.31481652	2198.013258	7211.329587	73.19499531	0.163945635	1.550E-05
Layer 115	7187.50	0.1916684	37.63400234	2235.64726	7334.800723	74.44822734	0.161185839	1.537E-05
Layer 116	7250.00	0.193294	37.95318815	2273.600449	7459.319057	75.71208843	0.158495166	1.524E-05
Layer 117	7312.50	0.1949196	38.27237396	2311.872822	7584.884588	76.98657857	0.155871325	1.512E-05
Layer 118	7375.00	0.1965452	38.59155978	2350.464382	7711.497317	78.27169777	0.153312121	1.500E-05
Layer 119	7437.50	0.1981708	38.91074559	2389.375128	7839.157244	79.56744602	0.150815448	1.488E-05
Layer 120	7500.00	0.1997964	39.2299314	2428.605059	7967.864368	80.87382333	0.148379284	1.476E-05
Layer 121	7562.50	0.201422	39.54911722	2468.154176	8097.618689	82.1908297	0.14600169	1.465E-05
Layer 122	7625.00	0.2030476	39.86830303	2508.02248	8228.420208	83.51846511	0.143680801	1.453E-05
Layer 123	7687.50	0.2046732	40.18748884	2548.209968	8360.268925	84.85672959	0.14141483	1.442E-05
Layer 124	7750.00	0.2062988	40.50667466	2588.716643	8493.164839	86.20562312	0.139202056	1.431E-05
Layer 125	7812.50	0.2079244	40.82586047	2629.542503	8627.107951	87.5651457	0.137040827	1.420E-05
Layer 126	7875.00	0.20955	41.14504628	2670.68755	8762.09826	88.93529734	0.134929554	1.410E-05
Layer 127	7937.50	0.2111756	41.4642321	2712.151782	8898.135767	90.31607804	0.132866708	1.399E-05
Layer 128	8000.00	0.2128012	41.78341791	2753.9352	9035.220472	91.70748779	0.13085082	1.389E-05
Layer 129	8062.50	0.2144268	42.10260373	2796.037804	9173.352374	93.10952659	0.128880475	1.378E-05
Layer 130	8125.00	0.2160524	42.42178954	2838.459593	9312.531473	94.52219445	0.12695431	1.368E-05
Layer 131	8187.50	0.217678	42.74097535	2881.200568	9452.75777	95.94549137	0.125071015	1.358E-05
Layer 132	8250.00	0.2193036	43.06016117	2924.26073	9594.031265	97.37941734	0.123229326	1.349E-05
Layer 133	8312.50	0.2209292	43.37934698	2967.640077	9736.351957	98.82397237	0.121428027	1.339E-05
Layer 134	8375.00	0.2225548	43.69853279	3011.338609	9879.719847	100.2791564	0.119665945	1.329E-05
Layer 135	8437.50	0.2241804	44.01771861	3055.356328	10024.13493	101.7449696	0.117941949	1.320E-05
Layer 136	8500.00	0.225806	44.33690442	3099.693232	10169.59722	103.2214118	0.116254949	1.311E-05
Layer 137	8562.50	0.2274316	44.65609023	3144.349323	10316.1067	104.708483	0.114603895	1.302E-05

Layer 138	8625.00	0.2290572	44.97527605	3189.324599	10463.66338	106.2061833	0.112987772	1.293E-05
Layer 139	8687.50	0.2306828	45.29446186	3234.619061	10612.26726	107.7145127	0.111405601	1.284E-05
Layer 140	8750.00	0.2323084	45.61364768	3280.232708	10761.91833	109.2334711	0.109856438	1.275E-05
Layer 141	8812.50	0.233934	45.93283349	3326.165542	10912.61661	110.7630586	0.10833937	1.267E-05
Layer 142	8875.00	0.2355596	46.2520193	3372.417561	11064.36208	112.3032751	0.106853518	1.258E-05
Layer 143	8937.50	0.2371852	46.57120512	3418.988766	11217.15474	113.8541207	0.10539803	1.250E-05
Layer 144	9000.00	0.2388108	46.89039093	3465.879157	11370.99461	115.4155953	0.103972084	1.241E-05
Layer 145	9062.50	0.2404364	47.20957674	3513.088734	11525.88167	116.987699	0.102574887	1.233E-05
Layer 146	9125.00	0.242062	47.52876256	3560.617496	11681.81593	118.5704317	0.10120567	1.225E-05
Layer 147	9187.50	0.2436876	47.84794837	3608.465445	11838.79739	120.1637935	0.099863691	1.217E-05
Layer 148	9250.00	0.2453132	48.16713418	3656.632579	11996.82605	121.7677844	0.098548233	1.209E-05
Layer 149	9312.50	0.2469388	48.48632	3705.118899	12155.9019	123.3824043	0.097258601	1.201E-05
Layer 150	9375.00	0.2485644	48.80550581	3753.924405	12316.02495	125.0076532	0.095994123	1.194E-05
Layer 151	9437.50	0.25019	49.12469163	3803.049096	12477.1952	126.6435313	0.094754149	1.186E-05
Layer 152	9500.00	0.2518156	49.44387744	3852.492974	12639.41264	128.2900383	0.09353805	1.179E-05
Layer 153	9562.50	0.2534412	49.76306325	3902.256037	12802.67729	129.9471745	0.092345217	1.171E-05
Layer 154	9625.00	0.2550668	50.08224907	3952.338286	12966.98913	131.6149396	0.09117506	1.164E-05
Layer 155	9687.50	0.2566924	50.40143488	4002.739721	13132.34817	133.2933339	0.090027008	1.157E-05
Layer 156	9750.00	0.258318	50.72062069	4053.460342	13298.7544	134.9823572	0.088900507	1.150E-05
Layer 157	9812.50	0.2599436	51.03980651	4104.500148	13466.20784	136.6820095	0.087795022	1.143E-05
Layer 158	9875.00	0.2615692	51.35899232	4155.85914	13634.70847	138.3922909	0.086710032	1.136E-05
Layer 159	9937.50	0.2631948	51.67817813	4207.537319	13804.25629	140.1132014	0.085645035	1.129E-05
Layer 160	10000.00	0.2648204	51.99736395	4259.534683	13974.85132	141.8447409	0.084599541	1.122E-05
Layer 161	10062.50	0.266446	52.31654976	4311.851232	14146.49354	143.5869095	0.083573078	1.116E-05
Layer 162	10125.00	0.2680716	52.63573557	4364.486968	14319.18297	145.3397071	0.082565186	1.109E-05
Layer 163	10187.50	0.2696972	52.95492139	4417.441889	14492.91958	147.1031338	0.081575421	1.102E-05
Layer 164	10250.00	0.2713228	53.2741072	4470.715996	14667.7034	148.8771895	0.080603349	1.096E-05
Layer 165	10312.50	0.2729484	53.59329302	4524.309289	14843.53441	150.6618743	0.079648551	1.090E-05
Layer 166	10375.00	0.274574	53.91247883	4578.221768	15020.41263	152.4571882	0.078710621	1.083E-05
Layer 167	10437.50	0.2761996	54.23166464	4632.453433	15198.33803	154.2631311	0.077789164	1.077E-05
Layer 168	10500.00	0.2778252	54.55085046	4687.004283	15377.31064	156.079703	0.076883796	1.071E-05
Layer 169	10562.50	0.2794508	54.87003627	4741.87432	15557.33045	157.906904	0.075994144	1.065E-05
Layer 170	10625.00	0.2810764	55.18922208	4797.063542	15738.39745	159.7447341	0.075119847	1.059E-05
Layer 171	10687.50	0.282702	55.5084079	4852.57195	15920.51165	161.5931932	0.074260554	1.053E-05
Layer 172	10750.00	0.2843276	55.82759371	4908.399543	16103.67304	163.4522814	0.073415922	1.047E-05
Layer 173	10812.50	0.2859532	56.14677952	4964.546323	16287.88164	165.3219986	0.072585621	1.041E-05
Layer 174	10875.00	0.2875788	56.46596534	5021.012288	16473.13743	167.2023449	0.071769328	1.035E-05
Layer 175	10937.50	0.2892044	56.78515115	5077.797439	16659.44042	169.0933202	0.07096673	1.030E-05
Layer 176	11000.00	0.29083	57.10433697	5134.901776	16846.7906	170.9949246	0.070177521	1.024E-05
Layer 177	11062.50	0.2924556	57.42352278	5192.325299	17035.18799	172.9071581	0.069401407	1.018E-05
Layer 178	11125.00	0.2940812	57.74270859	5250.068008	17224.63257	174.8300206	0.068638098	1.013E-05
Layer 179	11187.50	0.2957068	58.06189441	5308.129902	17415.12435	176.7635122	0.067887314	1.008E-05
Layer 180	11250.00	0.2973324	58.38108022	5366.510982	17606.66333	178.7076328	0.067148783	1.002E-05
Layer 181	11312.50	0.298958	58.70026603	5425.211248	17799.2495	180.6623825	0.066422239	9.968E-06
Layer 182	11375.00	0.3005836	59.01945185	5484.2307	17992.88287	182.6277612	0.065707425	9.915E-06
Layer 183	11437.50	0.3022092	59.33863766	5543.569338	18187.56344	184.603769	0.06500409	9.863E-06

Layer 184	11500.00	0.3038348	59.65782347	5603.227161	18383.29121	186.5904058	0.064311988	9.811E-06
Layer 185	11562.50	0.3054604	59.97700929	5663.204171	18580.06618	188.5876717	0.063630883	9.760E-06
Layer 186	11625.00	0.307086	60.2961951	5723.500366	18777.88834	190.5955666	0.062960541	9.709E-06
Layer 187	11687.50	0.3087116	60.61538091	5784.115747	18976.7577	192.6140906	0.062300738	9.659E-06
Layer 188	11750.00	0.3103372	60.93456673	5845.050313	19176.67426	194.6432437	0.061651254	9.610E-06
Layer 189	11812.50	0.3119628	61.25375254	5906.304066	19377.63801	196.6830258	0.061011874	9.561E-06
Layer 190	11875.00	0.3135884	61.57293836	5967.877004	19579.64896	198.733437	0.060382391	9.512E-06
Layer 191	11937.50	0.315214	61.89212417	6029.769128	19782.70711	200.7944772	0.0597626	9.464E-06
Layer 192	12000.00	0.3168396	62.21130998	6091.980438	19986.81246	202.8661465	0.059152304	9.416E-06
Layer 193	12062.50	0.3184652	62.5304958	6154.510934	20191.96501	204.9484448	0.05855131	9.369E-06
Layer 194	12125.00	0.3200908	62.84968161	6217.360616	20398.16475	207.0413722	0.05795943	9.322E-06
Layer 195	12187.50	0.3217164	63.16886742	6280.529483	20605.41169	209.1449287	0.057376481	9.276E-06
Layer 196	12250.00	0.323342	63.48805324	6344.017537	20813.70583	211.2591142	0.056802283	9.231E-06
Layer 197	12312.50	0.3249676	63.80723905	6407.824776	21023.04716	213.3839287	0.056236663	9.185E-06
Layer 198	12375.00	0.3265932	64.12642486	6471.9512	21233.4357	215.5193723	0.055679449	9.140E-06
Layer 199	12437.50	0.3282188	64.44561068	6536.396811	21444.87143	217.665445	0.055130478	9.096E-06
Layer 200	12500.00	0.3298444	64.76479649	6601.161608	21657.35436	219.8221467	0.054589586	9.052E-06
Layer 201	12562.50	0.33147	65.08398231	6666.24559	21870.88448	221.9894775	0.054056616	9.008E-06
Layer 202	12625.00	0.3330956	65.40316812	6731.648758	22085.4618	224.1674373	0.053531414	8.965E-06
Layer 203	12687.50	0.3347212	65.72235393	6797.371112	22301.08633	226.3560262	0.05301383	8.923E-06
Layer 204	12750.00	0.3363468	66.04153975	6863.412652	22517.75804	228.5552441	0.052503718	8.880E-06
Layer 205	12812.50	0.3379724	66.36072556	6929.773377	22735.47696	230.7650911	0.052000933	8.838E-06
Layer 206	12875.00	0.339598	66.67991137	6996.453289	22954.24307	232.9855672	0.051505336	8.797E-06
Layer 207	12937.50	0.3412236	66.99909719	7063.452386	23174.05638	235.2166723	0.051016792	8.756E-06
Layer 208	13000.00	0.3428492	67.318283	7130.770669	23394.91689	237.4584065	0.050535166	8.715E-06
Layer 209	13062.50	0.3444748	67.63746881	7198.408138	23616.8246	239.7107697	0.050060329	8.675E-06
Layer 210	13125.00	0.3461004	67.95665463	7266.364792	23839.7795	241.9737619	0.049592154	8.635E-06
Layer 211	13187.50	0.347726	68.27584044	7334.640633	24063.7816	244.2473833	0.049130516	8.595E-06
Layer 212	13250.00	0.3493516	68.59502625	7403.235659	24288.8309	246.5316337	0.048675295	8.556E-06
Layer 213	13312.50	0.3509772	68.91421207	7472.149871	24514.9274	248.8265131	0.048226372	8.517E-06
Layer 214	13375.00	0.3526028	69.23339788	7541.383269	24742.07109	251.1320216	0.047783632	8.478E-06
Layer 215	13437.50	0.3542284	69.5525837	7610.935853	24970.26198	253.4481591	0.047346961	8.440E-06
Layer 216	13500.00	0.355854	69.87176951	7680.807622	25199.50007	255.7749257	0.046916249	8.402E-06
Layer 217	13562.50	0.3574796	70.19095532	7750.998577	25429.78536	258.1123214	0.046491388	8.364E-06
Layer 218	13625.00	0.3591052	70.51014114	7821.508719	25661.11784	260.4603461	0.046072272	8.327E-06
Layer 219	13687.50	0.3607308	70.82932695	7892.338046	25893.49752	262.8189999	0.045658799	8.290E-06
Layer 220	13750.00	0.3623564	71.14851276	7963.486558	26126.9244	265.1882827	0.045250868	8.254E-06
Layer 221	13812.50	0.363982	71.46769858	8034.954257	26361.39848	267.5681946	0.04484838	8.218E-06
Layer 222	13875.00	0.3656076	71.78688439	8106.741141	26596.91975	269.9587355	0.044451238	8.182E-06
Layer 223	13937.50	0.3672332	72.1060702	8178.847211	26833.48823	272.3599055	0.044059349	8.146E-06
Layer 224	14000.00	0.3688588	72.42525602	8251.272467	27071.1039	274.7717045	0.043672619	8.111E-06
Layer 225	14062.50	0.3704844	72.74444183	8324.016909	27309.76676	277.1941326	0.04329096	8.076E-06
Layer 226	14125.00	0.37211	73.06362765	8397.080537	27549.47683	279.6271898	0.042914282	8.041E-06
Layer 227	14187.50	0.3737356	73.38281346	8470.46335	27790.23409	282.070876	0.042542499	8.007E-06
Layer 228	14250.00	0.3753612	73.70199927	8544.16535	28032.03855	284.5251913	0.042175527	7.973E-06
Layer 229	14312.50	0.3769868	74.02118509	8618.186535	28274.89021	286.9901356	0.041813284	7.939E-06

Layer 230	14375.00	0.3786124	74.3403709	8692.526906	28518.78906	289.465709	0.041455688	7.905E-06
Layer 231	14437.50	0.380238	74.65955671	8767.186462	28763.73511	291.9519114	0.041102659	7.872E-06
Layer 232	14500.00	0.3818636	74.97874253	8842.165205	29009.72836	294.4487429	0.040754122	7.839E-06
Layer 233	14562.50	0.3834892	75.29792834	8917.463133	29256.76881	296.9562034	0.040409999	7.806E-06
Layer 234	14625.00	0.3851148	75.61711415	8993.080247	29504.85645	299.474293	0.040070217	7.774E-06
Layer 235	14687.50	0.3867404	75.93629997	9069.016547	29753.9913	302.0030117	0.039734703	7.742E-06
Layer 236	14750.00	0.388366	76.25548578	9145.272033	30004.17334	304.5423594	0.039403386	7.710E-06
Layer 237	14812.50	0.3899916	76.5746716	9221.846705	30255.40257	307.0923361	0.039076195	7.678E-06
Layer 238	14875.00	0.3916172	76.89385741	9298.740562	30507.67901	309.6529419	0.038753063	7.647E-06
Layer 239	14937.50	0.3932428	77.21304322	9375.953605	30761.00264	312.2241768	0.038433923	7.616E-06
Layer 240	15000.00	0.3948684	77.53222904	9453.485834	31015.37347	314.8060407	0.038118709	7.585E-06
Layer 241	15062.50	0.396494	77.85141485	9531.337249	31270.7915	317.3985337	0.037807358	7.554E-06
Layer 242	15125.00	0.3981196	78.17060066	9609.50785	31527.25673	320.0016558	0.037499806	7.524E-06
Layer 243	15187.50	0.3997452	78.48978648	9687.997636	31784.76915	322.6154069	0.037195992	7.494E-06
Layer 244	15250.00	0.4013708	78.80897229	9766.806609	32043.32877	325.239787	0.036895855	7.464E-06
Layer 245	15312.50	0.4029964	79.1281581	9845.934767	32302.93559	327.8747962	0.036599337	7.434E-06
Layer 246	15375.00	0.404622	79.44734392	9925.382111	32563.5896	330.5204345	0.036306379	7.405E-06
Layer 247	15437.50	0.4062476	79.76652973	10005.14864	32825.29082	333.1767018	0.036016924	7.376E-06
Layer 248	15500.00	0.4078732	80.08571554	10085.23436	33088.03923	335.8435981	0.035730918	7.347E-06
Layer 249	15562.50	0.4094988	80.40490136	10165.63926	33351.83483	338.5211236	0.035448305	7.318E-06
Layer 250	15625.00	0.4111244	80.72408717	10246.36334	33616.67764	341.209278	0.035169032	7.290E-06
Layer 251	15687.50	0.41275	81.04327299	10327.40662	33882.56764	343.9080616	0.034893047	7.261E-06
Layer 252	15750.00	0.4143756	81.3624588	10408.76908	34149.50484	346.6174742	0.034620297	7.233E-06
Layer 253	15812.50	0.4160012	81.68164461	10490.45072	34417.48924	349.3375158	0.034350734	7.205E-06
Layer 254	15875.00	0.4176268	82.00083043	10572.45155	34686.52084	352.0681865	0.034084307	7.178E-06
Layer 255	15937.50	0.4192524	82.32001624	10654.77157	34956.59963	354.8094863	0.033820967	7.150E-06
Layer 256	16000.00	0.420878	82.63920205	10737.41077	35227.72562	357.5614151	0.033560668	7.123E-06
Layer 257	16062.50	0.4225036	82.95838787	10820.36916	35499.89881	360.3239729	0.033303363	7.096E-06
Layer 258	16125.00	0.4241292	83.27757368	10903.64673	35773.1192	363.0971598	0.033049005	7.069E-06
Layer 259	16187.50	0.4257548	83.59675949	10987.24349	36047.38678	365.8809758	0.032797551	7.043E-06
Layer 260	16250.00	0.4273804	83.91594531	11071.15944	36322.70156	368.6754209	0.032548956	7.016E-06
Layer 261	16312.50	0.429006	84.23513112	11155.39457	36599.06354	371.4804949	0.032303177	6.990E-06
Layer 262	16375.00	0.4306316	84.55431694	11239.94888	36876.47272	374.2961981	0.032060171	6.964E-06
Layer 263	16437.50	0.4322572	84.87350275	11324.82239	37154.92909	377.1225303	0.031819897	6.938E-06
Layer 264	16500.00	0.4338828	85.19268856	11410.01508	37434.43266	379.9594915	0.031582314	6.913E-06
Layer 265	16562.50	0.4355084	85.51187438	11495.52695	37714.98343	382.8070818	0.031347382	6.887E-06
Layer 266	16625.00	0.437134	85.83106019	11581.35801	37996.5814	385.6653012	0.031115063	6.862E-06
Layer 267	16687.50	0.4387596	86.150246	11667.50826	38279.22656	388.5341496	0.030885316	6.837E-06
Layer 268	16750.00	0.4403852	86.46943182	11753.97769	38562.91892	391.4136271	0.030658105	6.812E-06
Layer 269	16812.50	0.4420108	86.78861763	11840.76631	38847.65848	394.3037336	0.030433392	6.787E-06
Layer 270	16875.00	0.4436364	87.10780344	11927.87411	39133.44524	397.2044692	0.03021114	6.763E-06
Layer 271	16937.50	0.445262	87.42698926	12015.3011	39420.27919	400.1158338	0.029991315	6.739E-06
Layer 272	17000.00	0.4468876	87.74617507	12103.04727	39708.16035	403.0378275	0.02977388	6.714E-06
Layer 273	17062.50	0.4485132	88.06536088	12191.11263	39997.08869	405.9704502	0.029558802	6.690E-06
Layer 274	17125.00	0.4501388	88.3845467	12279.49718	40287.06424	408.913702	0.029346045	6.667E-06
Layer 275	17187.50	0.4517644	88.70373251	12368.20091	40578.08699	411.8675829	0.029135578	6.643E-06

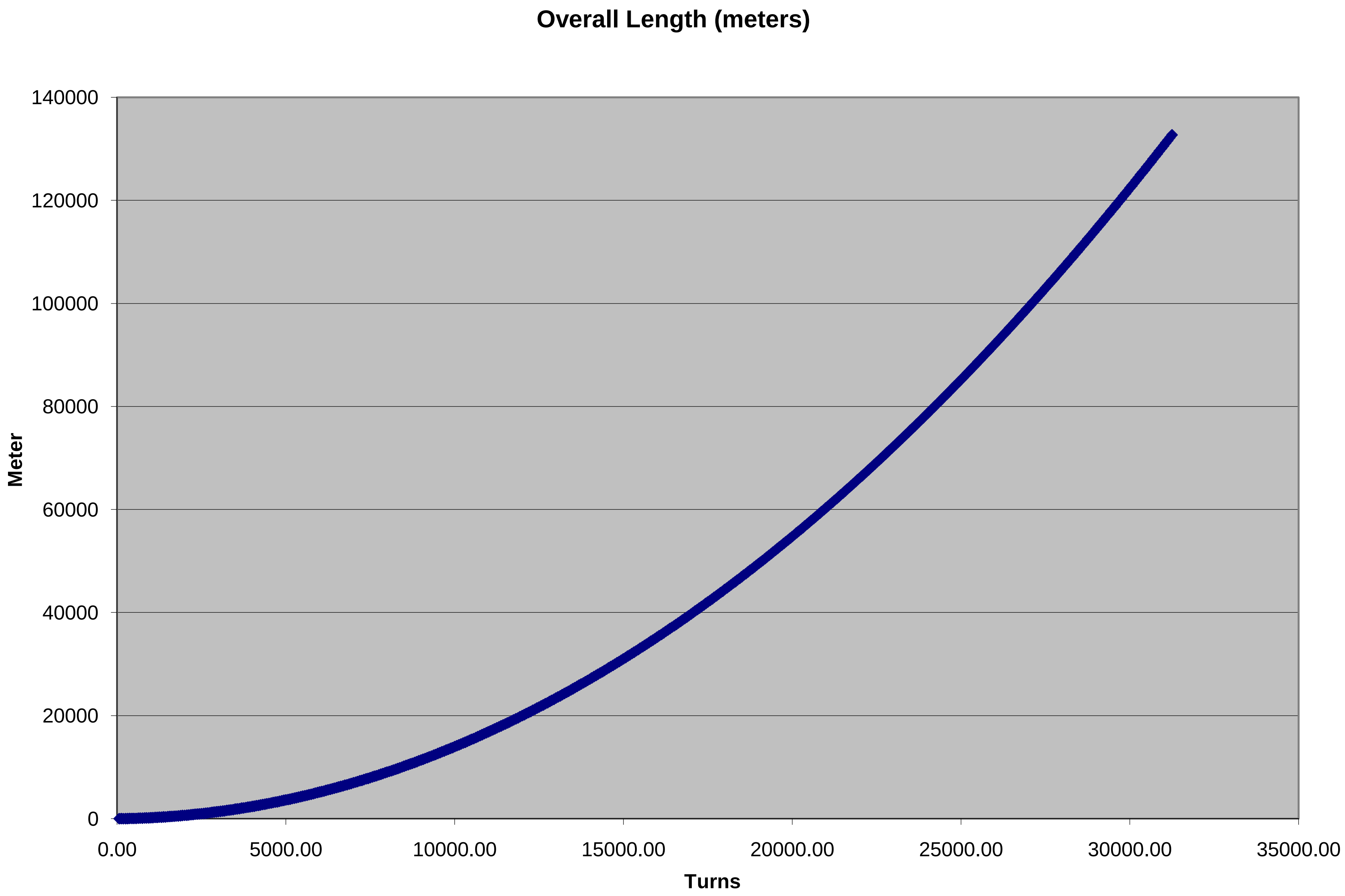
Layer 276	17250.00	0.45339	89.02291833	12457.22383	40870.15693	414.8320928	0.028927367	6.619E-06
Layer 277	17312.50	0.4550156	89.34210414	12546.56594	41163.27407	417.8072318	0.028721379	6.596E-06
Layer 278	17375.00	0.4566412	89.66128995	12636.22723	41457.4384	420.7929998	0.028517585	6.573E-06
Layer 279	17437.50	0.4582668	89.98047577	12726.2077	41752.64994	423.7893969	0.028315951	6.550E-06
Layer 280	17500.00	0.4598924	90.29966158	12816.50736	42048.90867	426.796423	0.028116449	6.527E-06
Layer 281	17562.50	0.461518	90.61884739	12907.12621	42346.2146	429.8140782	0.027919048	6.504E-06
Layer 282	17625.00	0.4631436	90.93803321	12998.06424	42644.56773	432.8423624	0.027723719	6.482E-06
Layer 283	17687.50	0.4647692	91.25721902	13089.32146	42943.96805	435.8812757	0.027530432	6.460E-06
Layer 284	17750.00	0.4663948	91.57640483	13180.89787	43244.41558	438.9308181	0.02733916	6.437E-06
Layer 285	17812.50	0.4680204	91.89559065	13272.79346	43545.9103	441.9909895	0.027149875	6.415E-06
Layer 286	17875.00	0.469646	92.21477646	13365.00823	43848.45221	445.06179	0.026962548	6.393E-06
Layer 287	17937.50	0.4712716	92.53396228	13457.5422	44152.04133	448.1432195	0.026777154	6.372E-06
Layer 288	18000.00	0.4728972	92.85314809	13550.39534	44456.67764	451.2352781	0.026593665	6.350E-06
Layer 289	18062.50	0.4745228	93.1723339	13643.56768	44762.36115	454.3379657	0.026412056	6.329E-06
Layer 290	18125.00	0.4761484	93.49151972	13737.0592	45069.09186	457.4512824	0.026232302	6.307E-06
Layer 291	18187.50	0.477774	93.81070553	13830.8699	45376.86976	460.5752281	0.026054376	6.286E-06
Layer 292	18250.00	0.4793996	94.12989134	13924.9998	45685.69487	463.7098029	0.025878254	6.265E-06
Layer 293	18312.50	0.4810252	94.44907716	14019.44887	45995.56717	466.8550067	0.025703912	6.244E-06
Layer 294	18375.00	0.4826508	94.76826297	14114.21714	46306.48667	470.0108397	0.025531326	6.223E-06
Layer 295	18437.50	0.4842764	95.08744878	14209.30458	46618.45336	473.1773016	0.025360473	6.203E-06
Layer 296	18500.00	0.485902	95.4066346	14304.71122	46931.46725	476.3543926	0.025191329	6.182E-06
Layer 297	18562.50	0.4875276	95.72582041	14400.43704	47245.52834	479.5421127	0.025023871	6.162E-06
Layer 298	18625.00	0.4891532	96.04500622	14496.48205	47560.63663	482.7404618	0.024858078	6.142E-06
Layer 299	18687.50	0.4907788	96.36419204	14592.84624	47876.79212	485.94944	0.024693927	6.122E-06
Layer 300	18750.00	0.4924044	96.68337785	14689.52962	48193.9948	489.1690472	0.024531397	6.102E-06
Layer 301	18812.50	0.49403	97.00256367	14786.53218	48512.24468	492.3992835	0.024370466	6.082E-06
Layer 302	18875.00	0.4956556	97.32174948	14883.85393	48831.54176	495.6401489	0.024211114	6.062E-06
Layer 303	18937.50	0.4972812	97.64093529	14981.49486	49151.88604	498.8916433	0.024053319	6.043E-06
Layer 304	19000.00	0.4989068	97.96012111	15079.45499	49473.27751	502.1537667	0.023897063	6.023E-06
Layer 305	19062.50	0.5005324	98.27930692	15177.73429	49795.71618	505.4265192	0.023742324	6.004E-06
Layer 306	19125.00	0.502158	98.59849273	15276.33278	50119.20205	508.7099008	0.023589083	5.985E-06
Layer 307	19187.50	0.5037836	98.91767855	15375.25046	50443.73512	512.0039114	0.023437321	5.966E-06
Layer 308	19250.00	0.5054092	99.23686436	15474.48733	50769.31538	515.3085511	0.023287019	5.947E-06
Layer 309	19312.50	0.5070348	99.55605017	15574.04338	51095.94284	518.6238198	0.023138158	5.928E-06
Layer 310	19375.00	0.5086604	99.87523599	15673.91861	51423.6175	521.9497176	0.02299072	5.909E-06
Layer 311	19437.50	0.510286	100.1944218	15774.11304	51752.33936	525.2862445	0.022844687	5.890E-06
Layer 312	19500.00	0.5119116	100.5136076	15874.62664	52082.10841	528.6334004	0.022700041	5.872E-06
Layer 313	19562.50	0.5135372	100.8327934	15975.45944	52412.92466	531.9911853	0.022556765	5.854E-06
Layer 314	19625.00	0.5151628	101.1519792	16076.61142	52744.78811	535.3595993	0.02241484	5.835E-06
Layer 315	19687.50	0.5167884	101.4711651	16178.08258	53077.69876	538.7386424	0.022274251	5.817E-06
Layer 316	19750.00	0.518414	101.7903509	16279.87293	53411.6566	542.1283145	0.022134981	5.799E-06
Layer 317	19812.50	0.5200396	102.1095367	16381.98247	53746.66164	545.5286157	0.021997013	5.781E-06
Layer 318	19875.00	0.5216652	102.4287225	16484.41119	54082.71388	548.9395459	0.021860331	5.764E-06
Layer 319	19937.50	0.5232908	102.7479083	16587.1591	54419.81332	552.3611052	0.021724919	5.746E-06
Layer 320	20000.00	0.5249164	103.0670941	16690.22619	54757.95995	555.7932935	0.021590761	5.728E-06
Layer 321	20062.50	0.526542	103.3862799	16793.61247	55097.15378	559.2361109	0.021457842	5.711E-06

Layer 322	20125.00	0.5281676	103.7054658	16897.31794	55437.39481	562.6895574	0.021326147	5.693E-06
Layer 323	20187.50	0.5297932	104.0246516	17001.34259	55778.68304	566.1536329	0.02119566	5.676E-06
Layer 324	20250.00	0.5314188	104.3438374	17105.68643	56121.01846	569.6283374	0.021066368	5.659E-06
Layer 325	20312.50	0.5330444	104.6630232	17210.34945	56464.40109	573.113671	0.020938255	5.642E-06
Layer 326	20375.00	0.53467	104.982209	17315.33166	56808.83091	576.6096337	0.020811307	5.625E-06
Layer 327	20437.50	0.5362956	105.3013948	17420.63306	57154.30792	580.1162254	0.02068551	5.608E-06
Layer 328	20500.00	0.5379212	105.6205806	17526.25364	57500.83214	583.6334462	0.02056085	5.591E-06
Layer 329	20562.50	0.5395468	105.9397664	17632.1934	57848.40355	587.161296	0.020437314	5.575E-06
Layer 330	20625.00	0.5411724	106.2589523	17738.45235	58197.02216	590.6997749	0.020314888	5.558E-06
Layer 331	20687.50	0.542798	106.5781381	17845.03049	58546.68797	594.2488829	0.020193559	5.542E-06
Layer 332	20750.00	0.5444236	106.8973239	17951.92782	58897.40097	597.8086199	0.020073314	5.525E-06
Layer 333	20812.50	0.5460492	107.2165097	18059.14433	59249.16117	601.3789859	0.019954139	5.509E-06
Layer 334	20875.00	0.5476748	107.5356955	18166.68002	59601.96857	604.959981	0.019836023	5.493E-06
Layer 335	20937.50	0.5493004	107.8548813	18274.5349	59955.82317	608.5516052	0.019718952	5.477E-06
Layer 336	21000.00	0.550926	108.1740671	18382.70897	60310.72497	612.1538584	0.019602915	5.461E-06
Layer 337	21062.50	0.5525516	108.493253	18491.20222	60666.67396	615.7667407	0.019487899	5.445E-06
Layer 338	21125.00	0.5541772	108.8124388	18600.01466	61023.67015	619.390252	0.019373892	5.429E-06
Layer 339	21187.50	0.5558028	109.1316246	18709.14629	61381.71354	623.0243924	0.019260883	5.414E-06
Layer 340	21250.00	0.5574284	109.4508104	18818.5971	61740.80412	626.6691618	0.01914886	5.398E-06
Layer 341	21312.50	0.559054	109.7699962	18928.36709	62100.94191	630.3245603	0.019037811	5.382E-06
Layer 342	21375.00	0.5606796	110.089182	19038.45627	62462.12689	633.9905879	0.018927726	5.367E-06
Layer 343	21437.50	0.5623052	110.4083678	19148.86464	62824.35906	637.6672445	0.018818592	5.352E-06
Layer 344	21500.00	0.5639308	110.7275537	19259.5922	63187.63844	641.3545302	0.0187104	5.336E-06
Layer 345	21562.50	0.5655564	111.0467395	19370.63894	63551.96501	645.0524449	0.018603139	5.321E-06
Layer 346	21625.00	0.567182	111.3659253	19482.00486	63917.33878	648.7609887	0.018496797	5.306E-06
Layer 347	21687.50	0.5688076	111.6851111	19593.68997	64283.75975	652.4801615	0.018391364	5.291E-06
Layer 348	21750.00	0.5704332	112.0042969	19705.69427	64651.22792	656.2099634	0.01828683	5.276E-06
Layer 349	21812.50	0.5720588	112.3234827	19818.01775	65019.74328	659.9503943	0.018183185	5.261E-06
Layer 350	21875.00	0.5736844	112.6426685	19930.66042	65389.30584	663.7014543	0.018080418	5.247E-06
Layer 351	21937.50	0.57531	112.9618543	20043.62227	65759.9156	667.4631433	0.017978521	5.232E-06
Layer 352	22000.00	0.5769356	113.2810402	20156.90331	66131.57256	671.2354614	0.017877482	5.217E-06
Layer 353	22062.50	0.5785612	113.600226	20270.50354	66504.27671	675.0184086	0.017777293	5.203E-06
Layer 354	22125.00	0.5801868	113.9194118	20384.42295	66878.02806	678.8119848	0.017677944	5.188E-06
Layer 355	22187.50	0.5818124	114.2385976	20498.66155	67252.82661	682.6161901	0.017579425	5.174E-06
Layer 356	22250.00	0.583438	114.5577834	20613.21933	67628.67235	686.4310244	0.017481727	5.160E-06
Layer 357	22312.50	0.5850636	114.8769692	20728.0963	68005.5653	690.2564878	0.017384842	5.146E-06
Layer 358	22375.00	0.5866892	115.196155	20843.29246	68383.50544	694.0925802	0.01728876	5.132E-06
Layer 359	22437.50	0.5883148	115.5153409	20958.8078	68762.49278	697.9393017	0.017193472	5.118E-06
Layer 360	22500.00	0.5899404	115.8345267	21074.64233	69142.52731	701.7966522	0.01709897	5.104E-06
Layer 361	22562.50	0.591566	116.1537125	21190.79604	69523.60905	705.6646318	0.017005245	5.090E-06
Layer 362	22625.00	0.5931916	116.4728983	21307.26894	69905.73798	709.5432405	0.016912289	5.076E-06
Layer 363	22687.50	0.5948172	116.7920841	21424.06102	70288.91411	713.4324782	0.016820092	5.062E-06
Layer 364	22750.00	0.5964428	117.1112699	21541.17229	70673.13744	717.332345	0.016728648	5.049E-06
Layer 365	22812.50	0.5980684	117.4304557	21658.60275	71058.40796	721.2428408	0.016637947	5.035E-06
Layer 366	22875.00	0.599694	117.7496416	21776.35239	71444.72568	725.1639657	0.016547982	5.021E-06
Layer 367	22937.50	0.6013196	118.0688274	21894.42121	71832.0906	729.0957196	0.016458744	5.008E-06

Layer 368	23000.00	0.6029452	118.3880132	22012.80923	72220.50272	733.0381026	0.016370227	4.995E-06
Layer 369	23062.50	0.6045708	118.707199	22131.51643	72609.96203	736.9911146	0.016282422	4.981E-06
Layer 370	23125.00	0.6061964	119.0263848	22250.54281	73000.46854	740.9547557	0.016195321	4.968E-06
Layer 371	23187.50	0.607822	119.3455706	22369.88838	73392.02225	744.9290259	0.016108917	4.955E-06
Layer 372	23250.00	0.6094476	119.6647564	22489.55314	73784.62316	748.9139251	0.016023203	4.942E-06
Layer 373	23312.50	0.6110732	119.9839422	22609.53708	74178.27126	752.9094533	0.015938172	4.929E-06
Layer 374	23375.00	0.6126988	120.3031281	22729.84021	74572.96657	756.9156106	0.015853815	4.916E-06
Layer 375	23437.50	0.6143244	120.6223139	22850.46252	74968.70907	760.932397	0.015770126	4.903E-06
Layer 376	23500.00	0.61595	120.9414997	22971.40402	75365.49876	764.9598124	0.015687099	4.890E-06
Layer 377	23562.50	0.6175756	121.2606855	23092.66471	75763.33566	768.9978569	0.015604725	4.878E-06
Layer 378	23625.00	0.6192012	121.5798713	23214.24458	76162.21975	773.0465305	0.015522998	4.865E-06
Layer 379	23687.50	0.6208268	121.8990571	23336.14364	76562.15104	777.105833	0.015441912	4.852E-06
Layer 380	23750.00	0.6224524	122.2182429	23458.36188	76963.12953	781.1757647	0.01536146	4.840E-06
Layer 381	23812.50	0.624078	122.5374288	23580.89931	77365.15521	785.2563254	0.015281634	4.827E-06
Layer 382	23875.00	0.6257036	122.8566146	23703.75592	77768.22809	789.3475152	0.01520243	4.815E-06
Layer 383	23937.50	0.6273292	123.1758004	23826.93172	78172.34817	793.449334	0.015123839	4.802E-06
Layer 384	24000.00	0.6289548	123.4949862	23950.42671	78577.51545	797.5617818	0.015045856	4.790E-06
Layer 385	24062.50	0.6305804	123.814172	24074.24088	78983.72993	801.6848588	0.014968475	4.778E-06
Layer 386	24125.00	0.632206	124.1333578	24198.37424	79390.9916	805.8185647	0.01489169	4.766E-06
Layer 387	24187.50	0.6338316	124.4525436	24322.82678	79799.30047	809.9628998	0.014815493	4.754E-06
Layer 388	24250.00	0.6354572	124.7717294	24447.59851	80208.65654	814.1178639	0.01473988	4.742E-06
Layer 389	24312.50	0.6370828	125.0909153	24572.68943	80619.0598	818.283457	0.014664845	4.730E-06
Layer 390	24375.00	0.6387084	125.4101011	24698.09953	81030.51027	822.4596792	0.014590381	4.718E-06
Layer 391	24437.50	0.640334	125.7292869	24823.82882	81443.00793	826.6465304	0.014516483	4.706E-06
Layer 392	24500.00	0.6419596	126.0484727	24949.87729	81856.55278	830.8440108	0.014443144	4.694E-06
Layer 393	24562.50	0.6435852	126.3676585	25076.24495	82271.14484	835.0521201	0.01437036	4.682E-06
Layer 394	24625.00	0.6452108	126.6868443	25202.93179	82686.78409	839.2708585	0.014298125	4.671E-06
Layer 395	24687.50	0.6468364	127.0060301	25329.93782	83103.47054	843.500226	0.014226434	4.659E-06
Layer 396	24750.00	0.648462	127.325216	25457.26304	83521.20419	847.7402225	0.01415528	4.648E-06
Layer 397	24812.50	0.6500876	127.6444018	25584.90744	83939.98504	851.9908481	0.014084658	4.636E-06
Layer 398	24875.00	0.6517132	127.9635876	25712.87103	84359.81308	856.2521028	0.014014564	4.625E-06
Layer 399	24937.50	0.6533388	128.2827734	25841.1538	84780.68832	860.5239865	0.013944992	4.613E-06
Layer 400	25000.00	0.6549644	128.6019592	25969.75576	85202.61076	864.8064992	0.013875936	4.602E-06
Layer 401	25062.50	0.65659	128.921145	26098.6769	85625.5804	869.099641	0.013807393	4.591E-06
Layer 402	25125.00	0.6582156	129.2403308	26227.91724	86049.59723	873.4034119	0.013739356	4.579E-06
Layer 403	25187.50	0.6598412	129.5595167	26357.47675	86474.66126	877.7178118	0.01367182	4.568E-06
Layer 404	25250.00	0.6614668	129.8787025	26487.35545	86900.77249	882.0428408	0.013604781	4.557E-06
Layer 405	25312.50	0.6630924	130.1978883	26617.55334	87327.93091	886.3784988	0.013538235	4.546E-06
Layer 406	25375.00	0.664718	130.5170741	26748.07042	87756.13654	890.7247859	0.013472175	4.535E-06
Layer 407	25437.50	0.6663436	130.8362599	26878.90668	88185.38936	895.081702	0.013406597	4.524E-06
Layer 408	25500.00	0.6679692	131.1554457	27010.06212	88615.68938	899.4492472	0.013341498	4.513E-06
Layer 409	25562.50	0.6695948	131.4746315	27141.53675	89047.03659	903.8274214	0.013276871	4.502E-06
Layer 410	25625.00	0.6712204	131.7938173	27273.33057	89479.43101	908.2162247	0.013212713	4.491E-06
Layer 411	25687.50	0.672846	132.1130032	27405.44357	89912.87262	912.6156571	0.013149018	4.481E-06
Layer 412	25750.00	0.6744716	132.432189	27537.87576	90347.36143	917.0257185	0.013085783	4.470E-06
Layer 413	25812.50	0.6760972	132.7513748	27670.62714	90782.89744	921.446409	0.013023004	4.459E-06

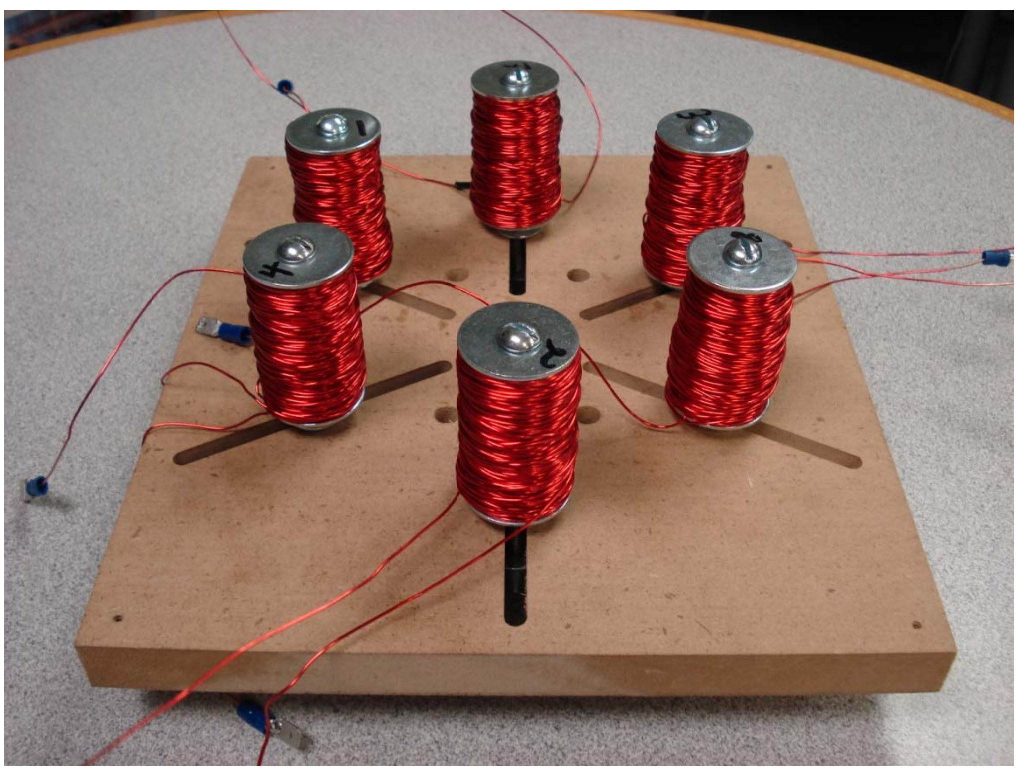
Layer 414	25875.00	0.6777228	133.0705606	27803.6977	91219.48064	925.8777285	0.012960675	4.449E-06
Layer 415	25937.50	0.6793484	133.3897464	27937.08745	91657.11104	930.3196771	0.012898792	4.438E-06
Layer 416	26000.00	0.680974	133.7089322	28070.79638	92095.78864	934.7722547	0.012837351	4.428E-06
Layer 417	26062.50	0.6825996	134.028118	28204.8245	92535.51344	939.2354614	0.012776349	4.417E-06
Layer 418	26125.00	0.6842252	134.3473039	28339.1718	92976.28543	943.7092971	0.01271578	4.407E-06
Layer 419	26187.50	0.6858508	134.6664897	28473.83829	93418.10462	948.1937619	0.012655641	4.396E-06
Layer 420	26250.00	0.6874764	134.9856755	28608.82396	93860.97101	952.6888558	0.012595928	4.386E-06
Layer 421	26312.50	0.689102	135.3048613	28744.12883	94304.8846	957.1945787	0.012536636	4.376E-06
Layer 422	26375.00	0.6907276	135.6240471	28879.75287	94749.84538	961.7109306	0.012477762	4.366E-06
Layer 423	26437.50	0.6923532	135.9432329	29015.69611	95195.85337	966.2379117	0.012419302	4.356E-06
Layer 424	26500.00	0.6939788	136.2624187	29151.95852	95642.90855	970.7755217	0.012361251	4.345E-06
Layer 425	26562.50	0.6956044	136.5816046	29288.54013	96091.01092	975.3237609	0.012303607	4.335E-06
Layer 426	26625.00	0.69723	136.9007904	29425.44092	96540.1605	979.882629	0.012246365	4.325E-06
Layer 427	26687.50	0.6988556	137.2199762	29562.6609	96990.35727	984.4521263	0.012189521	4.315E-06
Layer 428	26750.00	0.7004812	137.539162	29700.20006	97441.60124	989.0322526	0.012133072	4.305E-06
Layer 429	26812.50	0.7021068	137.8583478	29838.05841	97893.89241	993.6230079	0.012077015	4.296E-06
Layer 430	26875.00	0.7037324	138.1775336	29976.23594	98347.23077	998.2243923	0.012021345	4.286E-06
Layer 431	26937.50	0.705358	138.4967194	30114.73266	98801.61633	1002.836406	0.011966059	4.276E-06
Layer 432	27000.00	0.7069836	138.8159052	30253.54856	99257.04909	1007.459048	0.011911154	4.266E-06
Layer 433	27062.50	0.7086092	139.1350911	30392.68365	99713.52905	1012.09232	0.011856626	4.257E-06
Layer 434	27125.00	0.7102348	139.4542769	30532.13793	100171.0562	1016.73622	0.011802471	4.247E-06
Layer 435	27187.50	0.7118604	139.7734627	30671.91139	100629.6306	1021.39075	0.011748687	4.237E-06
Layer 436	27250.00	0.713486	140.0926485	30812.00404	101089.2521	1026.055909	0.011695269	4.228E-06
Layer 437	27312.50	0.7151116	140.4118343	30952.41588	101549.9209	1030.731697	0.011642215	4.218E-06
Layer 438	27375.00	0.7167372	140.7310201	31093.1469	102011.6368	1035.418114	0.011589521	4.209E-06
Layer 439	27437.50	0.7183628	141.0502059	31234.1971	102474.3999	1040.115159	0.011537184	4.199E-06
Layer 440	27500.00	0.7199884	141.3693918	31375.5665	102938.2103	1044.822834	0.011485201	4.190E-06
Layer 441	27562.50	0.721614	141.6885776	31517.25507	103403.0678	1049.541138	0.011433568	4.180E-06
Layer 442	27625.00	0.7232396	142.0077634	31659.26284	103868.9726	1054.270071	0.011382283	4.171E-06
Layer 443	27687.50	0.7248652	142.3269492	31801.58979	104335.9245	1059.009634	0.011331342	4.162E-06
Layer 444	27750.00	0.7264908	142.646135	31944.23592	104803.9236	1063.759825	0.011280742	4.153E-06
Layer 445	27812.50	0.7281164	142.9653208	32087.20124	105272.97	1068.520645	0.01123048	4.143E-06
Layer 446	27875.00	0.729742	143.2845066	32230.48575	105743.0635	1073.292094	0.011180554	4.134E-06
Layer 447	27937.50	0.7313676	143.6036925	32374.08944	106214.2042	1078.074173	0.01113096	4.125E-06
Layer 448	28000.00	0.7329932	143.9228783	32518.01232	106686.3921	1082.86688	0.011081695	4.116E-06
Layer 449	28062.50	0.7346188	144.2420641	32662.25438	107159.6272	1087.670216	0.011032756	4.107E-06
Layer 450	28125.00	0.7362444	144.5612499	32806.81563	107633.9096	1092.484182	0.010984141	4.098E-06
Layer 451	28187.50	0.73787	144.8804357	32951.69607	108109.2391	1097.308777	0.010935846	4.089E-06
Layer 452	28250.00	0.7394956	145.1996215	33096.89569	108585.6158	1102.144	0.010887869	4.080E-06
Layer 453	28312.50	0.7411212	145.5188073	33242.4145	109063.0397	1106.989853	0.010840208	4.071E-06
Layer 454	28375.00	0.7427468	145.8379931	33388.25249	109541.5108	1111.846335	0.010792858	4.063E-06
Layer 455	28437.50	0.7443724	146.157179	33534.40967	110021.0291	1116.713445	0.010745818	4.054E-06
Layer 456	28500.00	0.745998	146.4763648	33680.88603	110501.5946	1121.591185	0.010699086	4.045E-06
Layer 457	28562.50	0.7476236	146.7955506	33827.68158	110983.2073	1126.479554	0.010652657	4.036E-06
Layer 458	28625.00	0.7492492	147.1147364	33974.79632	111465.8672	1131.378552	0.01060653	4.028E-06
Layer 459	28687.50	0.7508748	147.4339222	34122.23024	111949.5743	1136.288179	0.010560701	4.019E-06

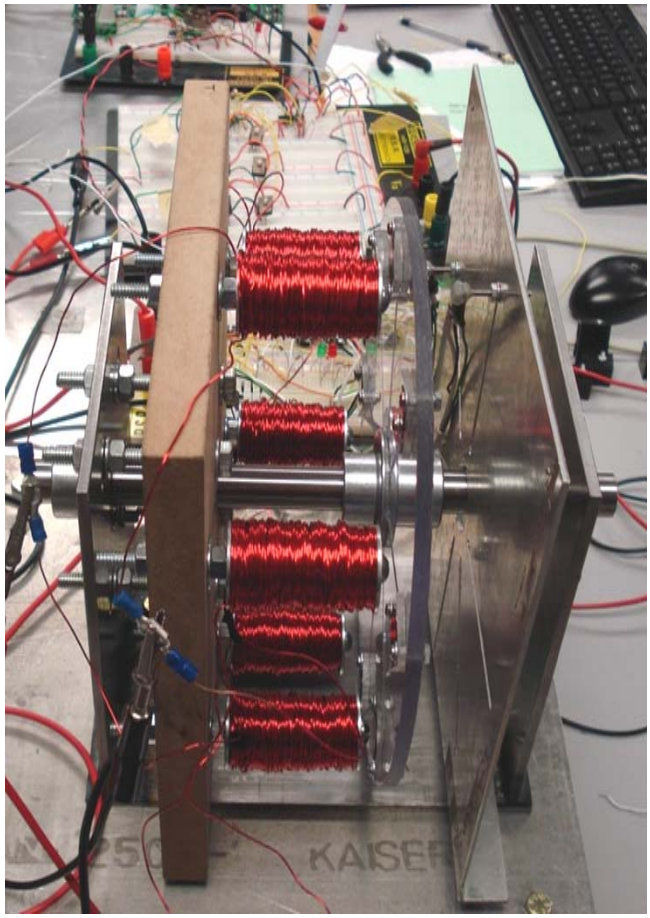
Layer 460	28750.00	0.7525004	147.753108	34269.98335	112434.3286	1141.208435	0.010515169	4.010E-06
Layer 461	28812.50	0.754126	148.0722938	34418.05564	112920.1301	1146.13932	0.010469931	4.002E-06
Layer 462	28875.00	0.7557516	148.3914797	34566.44712	113406.9788	1151.080834	0.010424985	3.993E-06
Layer 463	28937.50	0.7573772	148.7106655	34715.15779	113894.8746	1156.032978	0.010380327	3.985E-06
Layer 464	29000.00	0.7590028	149.0298513	34864.18764	114383.8177	1160.99575	0.010335955	3.976E-06
Layer 465	29062.50	0.7606284	149.3490371	35013.53668	114873.808	1165.969151	0.010291867	3.968E-06
Layer 466	29125.00	0.762254	149.6682229	35163.2049	115364.8455	1170.953182	0.010248061	3.959E-06
Layer 467	29187.50	0.7638796	149.9874087	35313.19231	115856.9302	1175.947841	0.010204534	3.951E-06
Layer 468	29250.00	0.7655052	150.3065945	35463.4989	116350.062	1180.95313	0.010161284	3.943E-06
Layer 469	29312.50	0.7671308	150.6257804	35614.12468	116844.2411	1185.969047	0.010118308	3.934E-06
Layer 470	29375.00	0.7687564	150.9449662	35765.06965	117339.4674	1190.995594	0.010075604	3.926E-06
Layer 471	29437.50	0.770382	151.264152	35916.3338	117835.7408	1196.032769	0.01003317	3.918E-06
Layer 472	29500.00	0.7720076	151.5833378	36067.91714	118333.0615	1201.080574	0.009991003	3.910E-06
Layer 473	29562.50	0.7736332	151.9025236	36219.81966	118831.4293	1206.139008	0.009949102	3.902E-06
Layer 474	29625.00	0.7752588	152.2217094	36372.04137	119330.8444	1211.208071	0.009907464	3.894E-06
Layer 475	29687.50	0.7768844	152.5408952	36524.58227	119831.3067	1216.287763	0.009866086	3.885E-06
Layer 476	29750.00	0.77851	152.860081	36677.44235	120332.8161	1221.378084	0.009824968	3.877E-06
Layer 477	29812.50	0.7801356	153.1792669	36830.62162	120835.3728	1226.479034	0.009784105	3.869E-06
Layer 478	29875.00	0.7817612	153.4984527	36984.12007	121338.9766	1231.590613	0.009743497	3.861E-06
Layer 479	29937.50	0.7833868	153.8176385	37137.93771	121843.6277	1236.712821	0.009703142	3.853E-06
Layer 480	30000.00	0.7850124	154.1368243	37292.07453	122349.3259	1241.845658	0.009663037	3.846E-06
Layer 481	30062.50	0.786638	154.4560101	37446.53054	122856.0713	1246.989124	0.009623179	3.838E-06
Layer 482	30125.00	0.7882636	154.7751959	37601.30574	123363.864	1252.143219	0.009583568	3.830E-06
Layer 483	30187.50	0.7898892	155.0943817	37756.40012	123872.7038	1257.307944	0.009544201	3.822E-06
Layer 484	30250.00	0.7915148	155.4135676	37911.81369	124382.5908	1262.483297	0.009505076	3.814E-06
Layer 485	30312.50	0.7931404	155.7327534	38067.54644	124893.5251	1267.669279	0.009466191	3.806E-06
Layer 486	30375.00	0.794766	156.0519392	38223.59838	125405.5065	1272.865891	0.009427545	3.799E-06
Layer 487	30437.50	0.7963916	156.371125	38379.96951	125918.5351	1278.073131	0.009389134	3.791E-06
Layer 488	30500.00	0.7980172	156.6903108	38536.65982	126432.6109	1283.291001	0.009350958	3.783E-06
Layer 489	30562.50	0.7996428	157.0094966	38693.66931	126947.734	1288.5195	0.009313014	3.776E-06
Layer 490	30625.00	0.8012684	157.3286824	38850.998	127463.9042	1293.758627	0.0092753	3.768E-06
Layer 491	30687.50	0.802894	157.6478683	39008.64586	127981.1216	1299.008384	0.009237816	3.761E-06
Layer 492	30750.00	0.8045196	157.9670541	39166.61292	128499.3862	1304.26877	0.009200558	3.753E-06
Layer 493	30812.50	0.8061452	158.2862399	39324.89916	129018.698	1309.539785	0.009163525	3.746E-06
Layer 494	30875.00	0.8077708	158.6054257	39483.50458	129539.057	1314.821429	0.009126715	3.738E-06
Layer 495	30937.50	0.8093964	158.9246115	39642.42919	130060.4632	1320.113702	0.009090126	3.731E-06
Layer 496	31000.00	0.811022	159.2437973	39801.67299	130582.9166	1325.416604	0.009053757	3.723E-06
Layer 497	31062.50	0.8126476	159.5629831	39961.23598	131106.4172	1330.730135	0.009017606	3.716E-06
Layer 498	31125.00	0.8142732	159.8821689	40121.11814	131630.965	1336.054295	0.008981671	3.708E-06
Layer 499	31187.50	0.8158988	160.2013548	40281.3195	132156.56	1341.389084	0.00894595	3.701E-06
Layer 500	31250.00	0.8175244	160.5205406	40441.84004	132683.2022	1346.734503	0.008910442	3.694E-06

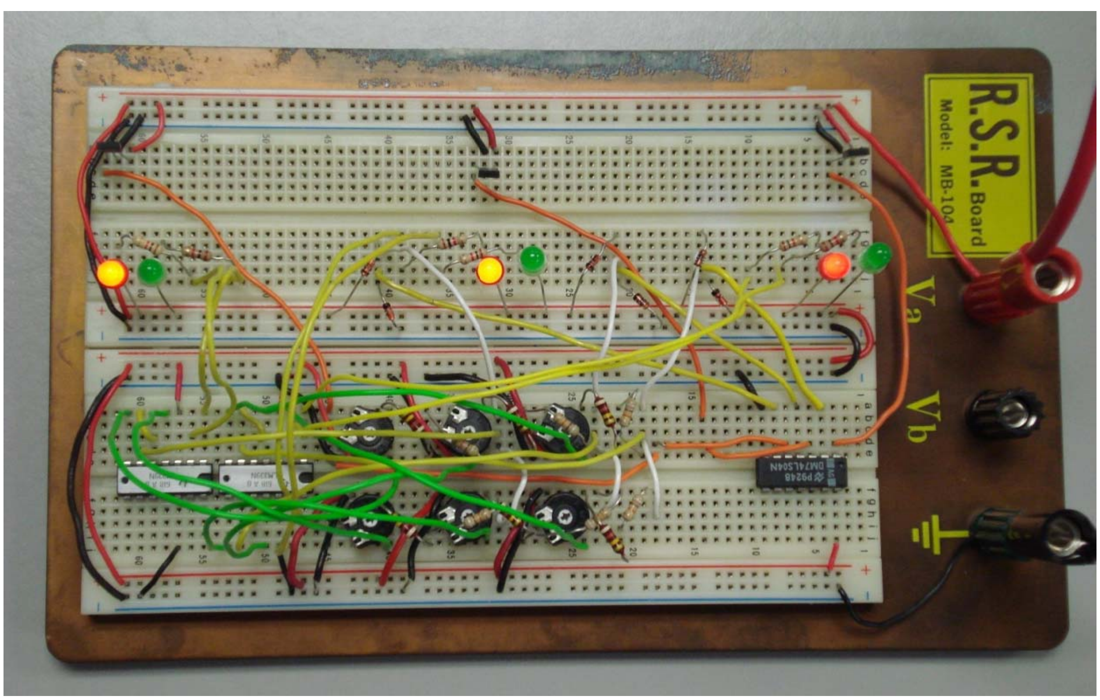

Overall Length (meters)
140000
120000
100000
80000
60000
40000
20000
0
Meter
0.00
5000.00
10000.00
15000.00
20000.00
25000.00
30000.00
35000.00
Turns

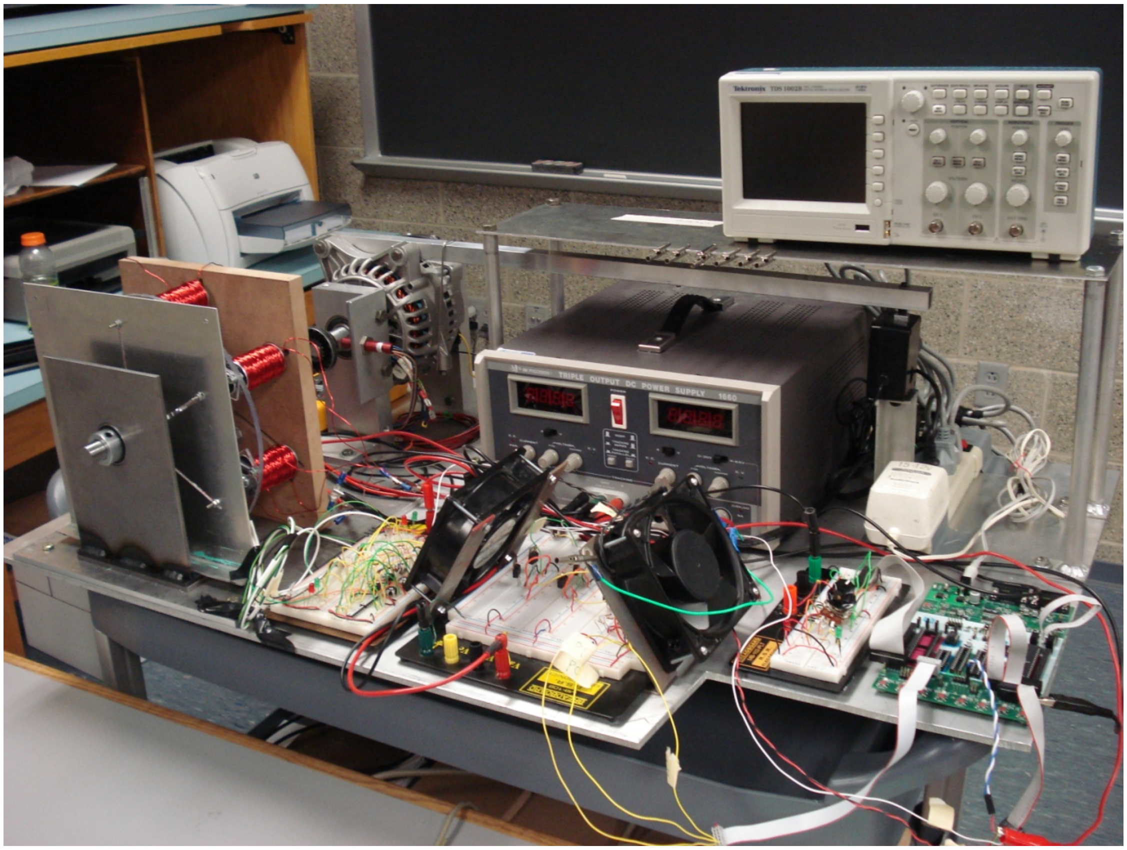
AWG Gauge	Dia Inches	Dia mm	Dia m	Ohms / 1000 ft (304.8 m)	Ohms / km	Max Amps (Power Transmission)	Max Amp (Chassis Wiring)
OOOO	0.46	11.684	0.011684	0.049	0.16072	302	380
OOO	0.4096	10.40384	0.01040384	0.0618	0.202704	239	328
OO	0.3648	9.26592	0.00926592	0.0779	0.255512	190	283
O	0.3249	8.25246	0.00825246	0.0983	0.322424	150	245
1	0.2893	7.34822	0.00734822	0.1239	0.406392	119	211
2	0.2576	6.54304	0.00654304	0.1563	0.512664	94	181
3	0.2294	5.82676	0.00582676	0.197	0.64616	75	158
4	0.2043	5.18922	0.00518922	0.2485	0.81508	60	135
5	0.1819	4.62026	0.00462026	0.3133	1.027624	47	118
6	0.162	4.1148	0.0041148	0.3951	1.295928	37	101
7	0.1443	3.66522	0.00366522	0.4982	1.634096	30	89
8	0.1285	3.2639	0.0032639	0.6282	2.060496	24	73
9	0.1144	2.90576	0.00290576	0.7921	2.598088	19	64
10	0.1019	2.58826	0.00258826	0.9989	3.276392	15	55
11	0.0907	2.30378	0.00230378	1.26	4.1328	12	47
12	0.0808	2.05232	0.00205232	1.588	5.20864	9.3	41
13	0.072	1.8288	0.0018288	2.003	6.56984	7.4	35
14	0.0641	1.62814	0.00162814	2.525	8.282	5.9	32
15	0.0571	1.45034	0.00145034	3.184	10.44352	4.7	28
16	0.0508	1.29032	0.00129032	4.016	13.17248	3.7	22
17	0.0453	1.15062	0.00115062	5.064	16.60992	2.9	19
18	0.0403	1.02362	0.00102362	6.385	20.9428	2.3	16
19	0.0359	0.91186	0.00091186	8.051	26.40728	1.8	14
20	0.032	0.8128	0.0008128	10.15	33.292	1.5	11
21	0.0285	0.7239	0.0007239	12.8	41.984	1.2	9
22	0.0254	0.64516	0.00064516	16.14	52.9392	0.92	7
23	0.0226	0.57404	0.00057404	20.36	66.7808	0.729	4.7
24	0.0201	0.51054	0.00051054	25.67	84.19706	0.577	3.5
25	0.0179	0.45466	0.00045466	32.37	106.1736	0.457	2.7
26	0.0159	0.40386	0.00040386	40.81	133.8568	0.361	2.2
27	0.0142	0.36068	0.00036068	51.47	168.8216	0.288	1.7
28	0.0126	0.32004	0.00032004	64.9	212.872	0.226	1.4
29	0.0113	0.28702	0.00028702	81.83	268.4024	0.182	1.2
30	0.01	0.254	0.000254	103.2	338.496	0.142	0.86
31	0.0089	0.22606	0.00022606	130.1	426.72	0.113	0.7
32	0.008	0.2032	0.0002032	164.1	538.248	0.091	0.53
33	0.0071	0.18034	0.00018034	206.9	678.632	0.072	0.51
34	0.0063	0.16002	0.00016002	260.9	855.752	0.056	0.43
35	0.0056	0.14224	0.00014224	329	1079.12	0.044	0.33
36	0.005	0.127	0.000127	414.8	1360	0.035	0.27
37	0.0045	0.1143	0.0001143	523.1	1715	0.0289	0.17
38	0.004	0.1016	0.0001016	659.6	2163	0.0228	0.13
39	0.0035	0.0889	0.0000889	831.8	2728	0.0175	0.11
40	0.0031	0.07874	0.00007874	1049	3440	0.0137	0.09

III.4. Final Testing Station Pictures




KAISER


R.S.R. Board
Model: MB-104
Va
Vb


Tektronix
TRIPLE OUTPUT DC POWER SUPPLY 1660