How To Build an Energy Efficient & Potentially Fuel-less Generator

For the Do-It-Yourself Engineering Enthusiast

DEDICATION

This Ebook is dedicated to the one race:

THE PEOPLE OF EARTH

For our creativity, innovation, diligence and resilience.

For our compassion and ability to love others.

For our future pioneering of possibilities.

For our good.

Edition 2020

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INTRODUCTION

High energy costs kill economies, and are like a tax on the populations as those increased costs are embedded in every product, service or human endeavor.[1] Given the current free energy culture's climate of competition and old paradigm struggle for money, power and control, we need to forgo the "religion of alternative energy" and look to physics and science for truth.[2]

The QEG (Quantum Energy Generator) is a type of 'green' energy technology that is being co-developed with engineers and builders all over the world. Due to its unique and little known property of using radiant, or quantum energy to electrify a steel core and produce power, the QEG has the potential to run an average sized home. Many individuals and groups are already building, and are in the perfect position for the final phase of co-development: self-running. Therefore, the time to start building is NOW!

Your generator at resonance has numerous applications that will work for you at an efficiency that rivals most generators on the market, while waiting for the final piece of self-running (motor spins rotor, generator powers motor).

FREQUENTLY ASKED QUESTIONS:

What is co-development? According to Adrien Payette and Claude Champagne: "Co-development is a development method for those who believe that learning from one another can help them to improve the way they do things. Individual and collective thought and reflection are reinforced and topics which the participants are currently finding problematic are shared and solutions reached. The benefits of co-development include:

•Learning through sharing experiences with others

•Develop active listening and feedback techniques and use of a 'manager-coach' posture

•Appreciate differences in style in a positive, supportive setting

•Put suggestions into practice immediately after each session, report back to the group

•Improve self-confidence

•Develop a network of cross-functional contacts

Why isn't this technology in mainstream? Is it a scam? The designers of these types of devices have more often than not been the recipients of discrediting tactics executed by big energy interests -- for over 130 years! Today on the internet one can find countless articles criticizing the technology, the designs and the designers from every imaginable angle. The disparaging and debunking comments are relentless, as has happened throughout the history of science any time there is something very threatening to the established ideas. We call these commenters 'trolls' and have no choice but to ignore them and continue on with the work.

It is unfortunate and painful to be living in a society that is so profoundly ensconced in one type of energy, conventional electricity, and that 'the powers-that-be' have ensured the ridiculous difficulties those who are trying to change the current energy paradigm have come up against.

What is radiant energy? Radiant energy is simply the forms of electromagnetic waves that collide in our electrosphere [ionosphere], waves of energy and radiation that we cannot see with our eyes that bounce off our atmosphere and linger near us, reaching as low as the lithosphere. Some waves are even absorbed into the rocks on the ground then released over time. This energy source is quite abundant because the sun keeps the ionosphere charged.

What's the benefit of using radiant energy over solar panels or wind turbines? Radiant energy harvests power from electromagnetic waves which are in abundance in the atmosphere at all times, day and night, and in all types of weather.

On the other hand, natural power sources such as those from the sun (solar power) or from the wind (wind energy) are dependent on sunshine and wind respectively, and can prove costly to maintain. These forms of energy are already being exploited by the big electric companies with intents of big profit and little to no thought of the best benefit to the consumer. One may argue that these forms of alternative energy sources are good for the environment but the higher truth is the energy companies want as much money as they can get from you. The 'best for the environment' argument is a smokescreen for greed, domination and control.

If radiant energy is common, why don't we use it? We use it indeed! Radiant energy is a wonderful source of power and we use it in our daily lives from listening to the radio to talking on our cellphones, and much more. It envelops the atmosphere from day to day, year to year, 24/7. So we do use it but here we are not talking about using it to directly power certain appliances, we intend to use this energy source to generate power to run our homes.

How can we use radiant energy to power our homes? In order to convert the energy into a usable form of electricity we will need a specific generator than can use this power. These are called radiant energy generators. These generators use three types of energy including radiant energy, and sort through the different waves of energy in the air, or more precisely the atmosphere, and convert that energy into electricity. Some waves of energy cannot be converted and this is why the generator sorts through the different frequencies that are compatible.

OPENSOURCING THE QEG PROJECT

The Quantum Energy Generator (QEG) is a potentially fuel-less generator prototype based on a public domain patented invention of Nikola Tesla. The additional type of energy that will be utilized by this generator in the near future is different than what a conventional generator uses. Once global co-development is complete and self-running achieved, the generator is designed to be highly efficient and power your home.

The plans for building a QEG were made available to the public (opensourced) in March of 2014 on the HopeGirl Blog, updated in March of 2015, and the Fix The World/QEG team has been in co-development with many other teams around the world. (You can find our full course on video and audio, as well as supporting documents at http://fixtheworldproject.org)

ABOUT PATENTS

The QEG is a modern day artistic improvement on Tesla's original engineering artwork, The Dynamo-Electric Machine, registered with the United States Patent Office #390414, and in the public domain.

The lifespan of design patents extend to 14 years, starting from the date of application rather than the date of approval. Patents protect the rights of the inventor, but at the same time the very purpose of issuing patents is to 'promote science and useful arts' wherein the inventor agrees to share the knowledge to the world after a period of exclusive right to commercially exploit the knowledge. Therefore, the inventor retains monopoly over the invention during the pendency of the patent. After expiry, the knowledge becomes public domain that anyone can access and use. The government makes public the description of the product, filed at the time of application. The inventor no longer has exclusive rights over the knowledge or invention, and anyone can access the patent office records and copy the invention.

The main content and claims of Tesla's patents were recorded back in the late 1800s, therefore all main claims and or any improvements to rise around the original patented idea are in public domain.

The QEG is to be considered an improvement to a prior granted art. Therefore, the QEG must not be considered of enough grounds to obtain the granting of a unique art as is the granting of a patent anywhere on planet earth.

Furthermore, an improvement based on newer advanced technology to run, operate, or control the prior granted art should be classified also as non-patentable intellectual art.

The QEG, its blueprints, and user manual in its original entirety are to be considered new means for operating the prior granted art and based on the research and development of James M. Robitaille, Advanced Engineering Artist, FTW Organization, whose purpose and intention is to freely disclose it, open-source it, and share it with the world as Nikola Tesla intended.

It is understood that by making the QEG, its blueprints and user manual in its original entirety public and available to all, it is an 'open sharing' of an improvement on a public prior granted art and will be used as proof of prior existence by its permanent timestamp and links in many public and social networks where it has been uploaded, becoming non-changeable.

The QEG, its blueprints and user manual in their original entirety are an improvement on a public prior granted art that has been given freely and without prejudice to the people of planet earth. It can be replicated and distributed for the use of the people.

QEG SYSTEM DESCRIPTION
16-Mar-2015

The Quantum Electric Generator system (QEG) is an adaptation of one of Nikola Tesla's many patented electrical generator / dynamo / alternator designs. The particular patent referenced is No. 511,916, titled simply "Electric Generator", and dated January 2, 1894 (see back of this manual). The adaptation is a conversion from a linear generating system with a reciprocating rod whose period is electrically regulated, to a rotary generating system. The reciprocating rod is replaced by a rotor whose motion is also electrically regulated, by means of tuned parametric resonance (parametric oscillation). The original intent of the patent (electrical regulation of the period (frequency) of a repetitive mechanical motion) is further expanded through subsequent utilization and application of mechanical self-resonance and radiant energy, in order to make the machine self-sustaining.

The QEG prototype is scaled to produce electrical power in the range of 10-15 kW (kilowatts) continuously, and can be set up to provide either 120 Volt or 230-240 Volt single phase output. We are also planning future designs to provide 3-phase power.

Service life of the device is limited only by certain replaceable components, such as bearings, v-belts, and capacitors. The basic machine should operate trouble-free (with minimal maintenance) for as long as any good quality electro-mechanical appliance, such as a quality washing machine or refrigerator. Heavy-duty mechanical components are used throughout for reliability.

The QEG is not a complicated device, as it is designed (like Tesla's other 'discoveries') to work in harmony with nature's laws, rather than the power wasting closed-system symmetric motor and generator designs used in today's mainstream industry.

An effective way to understand the operating principle of the QEG is to think of it as a self-powered toroidal transformer with high-voltage primary, and low voltage secondary. The primary high voltage is self-generated through mechanically pumped parametric resonance. The resonance occurs as a function of the spinning rotor modulating the reluctance/inductance in the primary tank circuit windings. This modulation initiates an oscillation which can develop up to 20,000 volts (20kV) in amplitude, with frequency determined by the tank capacitor value and inductance value in the primary windings. Power is then transferred to the secondary during the intervals where the rotor is between pole pieces (unaligned). The resultant power output is relatively high-voltage, low current AC (up to 5kV or more, at up to 2 Amps or more). In today's alternative energy terminology, it would be called a type of resonance machine.

The circuitry that develops high power in this device is based on an existing but under-utilized power oscillator configuration, however, the 'quantum' part of the design has to do with how the basic generator output is enhanced by the core mechanical resonance, and insertion of radiant energy to produce additional power. Conventional alternators (AC generators) consume much more input power than the output power they provide. For example, one brand of power take off (PTO) alternator uses 18,000 watts (24 horsepower) to develop 13,000 watts of output power. In the QEG, input power is used only to maintain resonance in the core, which uses a fraction of the output power (under 1000 watts to produce 10,000 watts), and once running, the QEG provides this power to its own 1 horsepower motor. This is known as over-unity, or COP over 1 (Coefficient of Performance). Once the machine is up and running at the resonant frequency, it powers itself (self-sustaining).

James Robitaille

25-Mar-15

THE LEGACY

A brief history of the reluctance generator

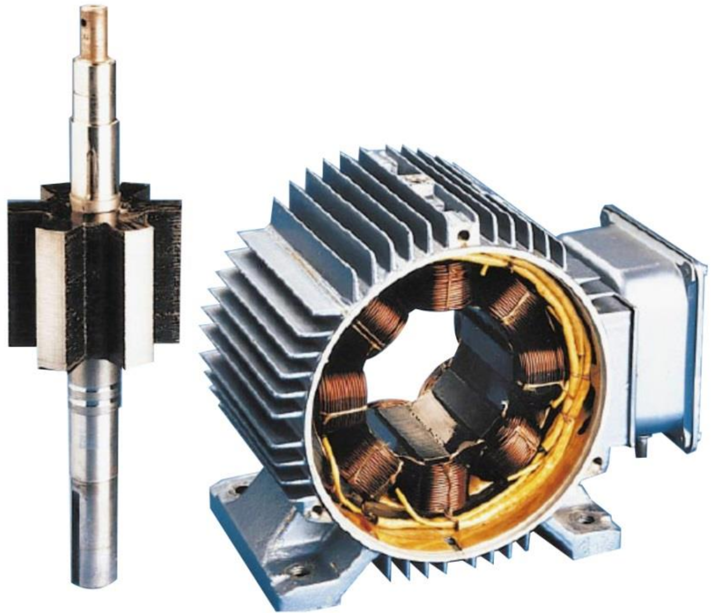
By Tivon A. Rivers, Engineer

The generator build in this course is of the 'reluctance' type, and can also be defined as a variant of the following: variable induction generator and flux alternator. To better understand why this class of generator is slated to still dominate the clean tech sector (in spite of new technologies), we must first recap the development of this technology.

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Electric motors produce either linear or rotary force (torque), and are found in the following applications: industrial fans, pumps, machine tools, household appliances, power tools, and disk drives. They can be powered by either direct current sources (i.e batteries, motor vehicles or rectifiers), or by alternating current sources (such as from the power grid, inverters or generators). General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pump applications with ratings approaching 100 megawatts. Electric motors are classified by electric power source type, internal construction, application, type of motion output, and so on.

Generators are motors operated in reverse, whereby it is an electrical machine that converts mechanical energy into electrical energy. Hence, to understand the origin of the reluctance generator, we must delve into the 125 year history of the reluctance motor and why this technology is anticipated to still dominate the renewable energy market in the 21st century.

In the 1880s, many inventors were trying to develop workable AC motors because of AC's advantages in long distance high voltage transmission. In 1888, Nikola Tesla presented his paper '*A New System for Alternating Current Motors and Transformers'* to the American Institute of Electrical Engineers (AIEE) and described three patented two-phase four-stator-pole motor types: one with a four-pole rotor forming a non-self-starting reluctance motor, another with a wound rotor forming a self-starting induction motor, and a third truly synchronous motor with separately excited DC supply to rotor winding.

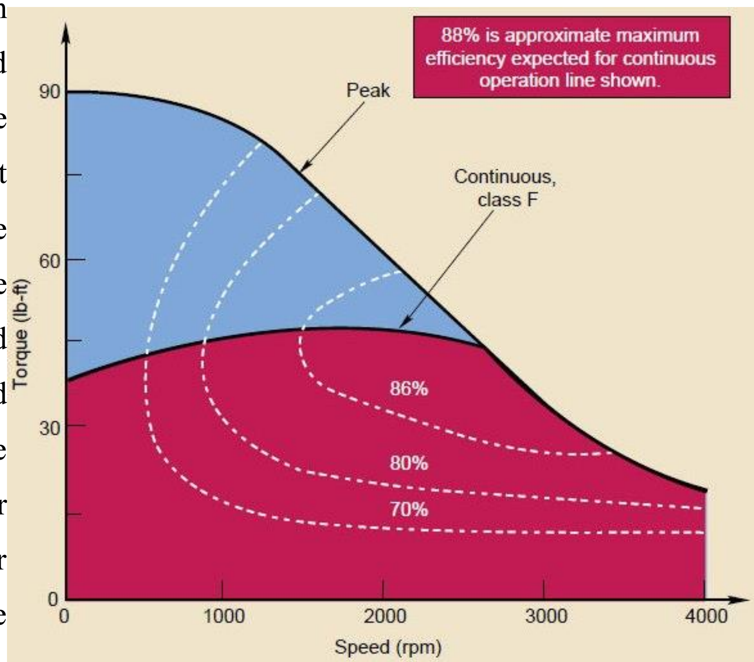


Switched reluctance motors have a rotor that has no magnets or windings. It is a salient piece of iron. The salient stator has a simple construction.

The design for the reluctance motor was first cited in patent 381,968 May 1, 1888 by the inventor Nikola Tesla. He conceived of an embodiment of a variable inductance motor with no magnets, and where the iron rotor contained no windings. The modern day Switched Reluctance Motor (SRM) remains true to Tesla's patent, as it contains no brushes or permanent magnets, and the rotor has no electric currents. Instead, torque comes from a slight misalignment of poles on the rotor with poles on the stator. The rotor aligns itself with the magnetic field of the stator, while the stator field stator windings are sequentially energized to rotate the stator field. The magnetic flux created by the field windings follows the path of least magnetic reluctance, meaning, the flux will flow through poles of the rotor that are closest to the energized poles of the stator, thereby magnetizing those poles of the rotor and creating torque. As the rotor turns, different windings will be energized, keeping the rotor turning.

Clean technology is a contemporary issue, and the international community has accepted the environmental dangers of false economies and the toxification of the environment. Renewable energy is one of the hot topics when it comes to a viable solution, and both wind and solar generation are but a few of the renewable energy power sources that help.

In recent decades, reluctance machines have become an important alternative in various applications in both the industrial and domestic markets. They have good mechanical reliability, high torque-volume ratio, high efficiency, plus low cost. Although the technology is less evangelized as a generator, there are a few studies of its application in the aeronautical industry and in wind based energy applications.



Although the synchronous and induction machines dominate the market of wind energy applications, the reluctance machines are the subject of current investigation and are a valid alternative for this field. Compared with the classical solutions of machines integrated in wind applications, its simplified construction associated with the inexistence of permanent magnets or conductors in the rotor results in lower manufacturing costs; in addition both the machine and the power converter are robust. The low inertia of the rotor also allows the machine to respond to rapid variations in the load. Associated with these characteristics, reluctance machines may now employ electronic control systems that enable rapid changes in machine function such that its performance is optimized (making them Switched Reluctance Machines or 'SRM'). The structure of reluctance technology is not as stiff as their synchronous counterparts, and due to its flexible control system; is capable of absorbing transient conditions, thus supplying more resilience to the mechanical system.

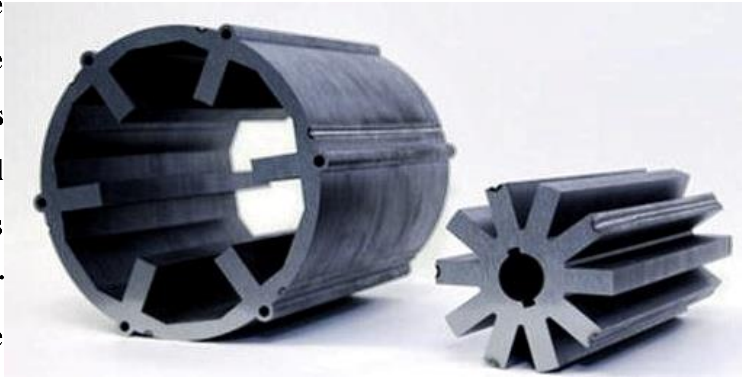
The machine has an inherent fault tolerance, especially when under an open-coil fault (in the windings) and in the power converter (external faults). Under normal operation, each phase of Switched Reluctance Generator (SRG) is electrically and magnetically independent from others.

Reluctance technology is generally felt to be louder than conventional machines, but this can be remediated with adequate mechanical design, which can do a lot to improve these figures.
In addition, all reluctance generators have the following advantages:

- simple construction, low manufacturing cost, low inertia,
- fault tolerance and the ability to operate in a high temperature environment
- present R&D for drives in power source applications that include hybrid electric vehicles, aerospace power systems and wind engines.

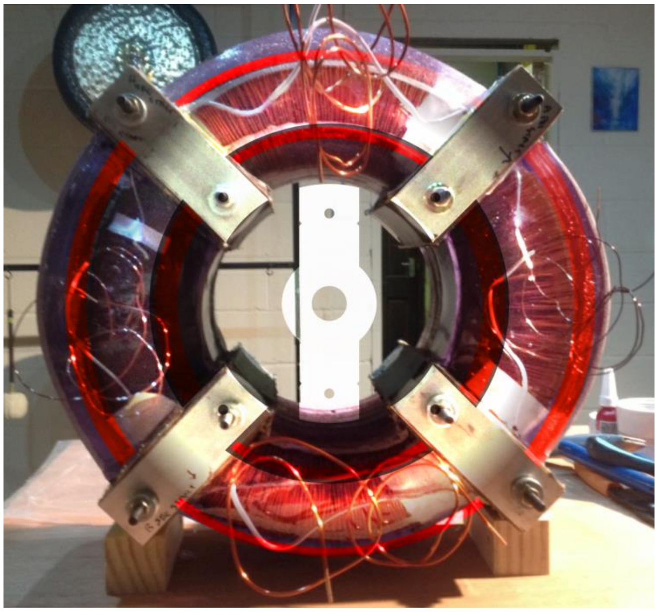
The aerospace and automotive applications are characterized by high-speed operation. Constant mechanical power is provided over a wide speed range, while the wind energy applications are characterized by low-speed and high-torque operation.

If 80% efficiency isn't enough, know that companies are embracing this technology to position themselves in the renewables sector. For example HEVT has developed their switched reluctance motor technologies and are poised to empower the next generation of electric motors, making performance leaps with unmatched reliability and reduced cost volatility due to the use of zero rare earth minerals. They emphasize environmental benefits of having technologies that do not require the use of neodymium magnets in their statement:



"To date, most motors are manufactured in China because rare earth mining and refining capacity is concentrated in China. Mining and refining rare earth metals is a process that causes air, land and water pollution because these metals are typically located in bands of ore that include radioactive thorium. Not only do our technologies enable electric motors free of rare earth metals – thereby reducing environmental and public health impact – but the manufacturing process is disruptively elegant – we can scale production of our motors quickly and globally, creating local jobs in the process. Finally, our motors are highly reliable and efficient, high-performing and less costly: we reduce the initial and lifetime

cost of ownership – a critical building block to enabling adoption of renewable energy, energy efficiency and sustainable transportation technologies in the U.S. and throughout the world." - HEVT

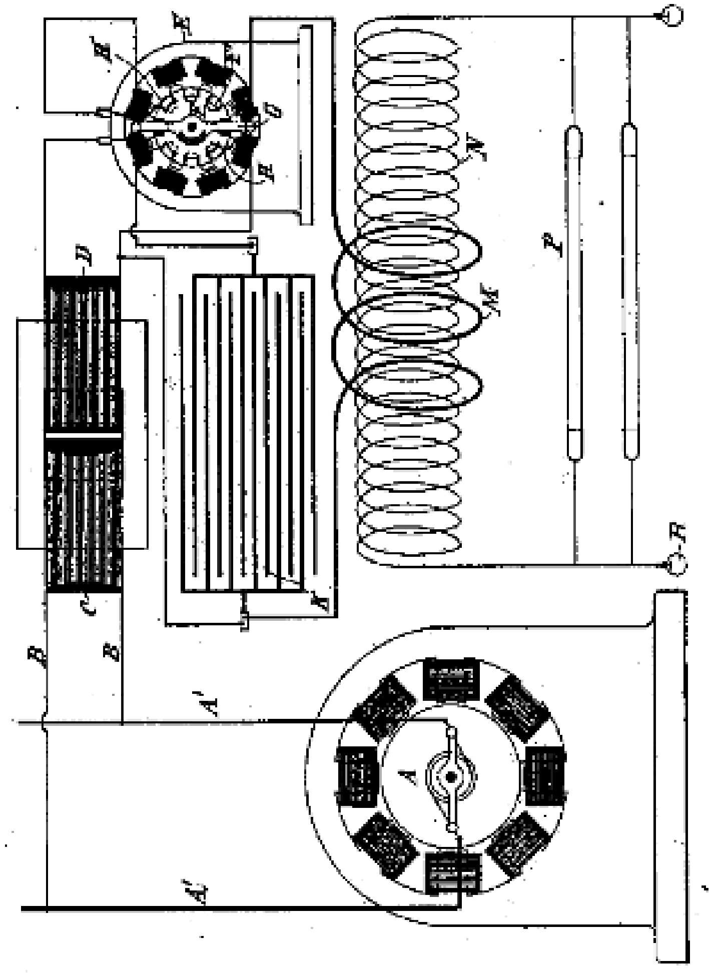


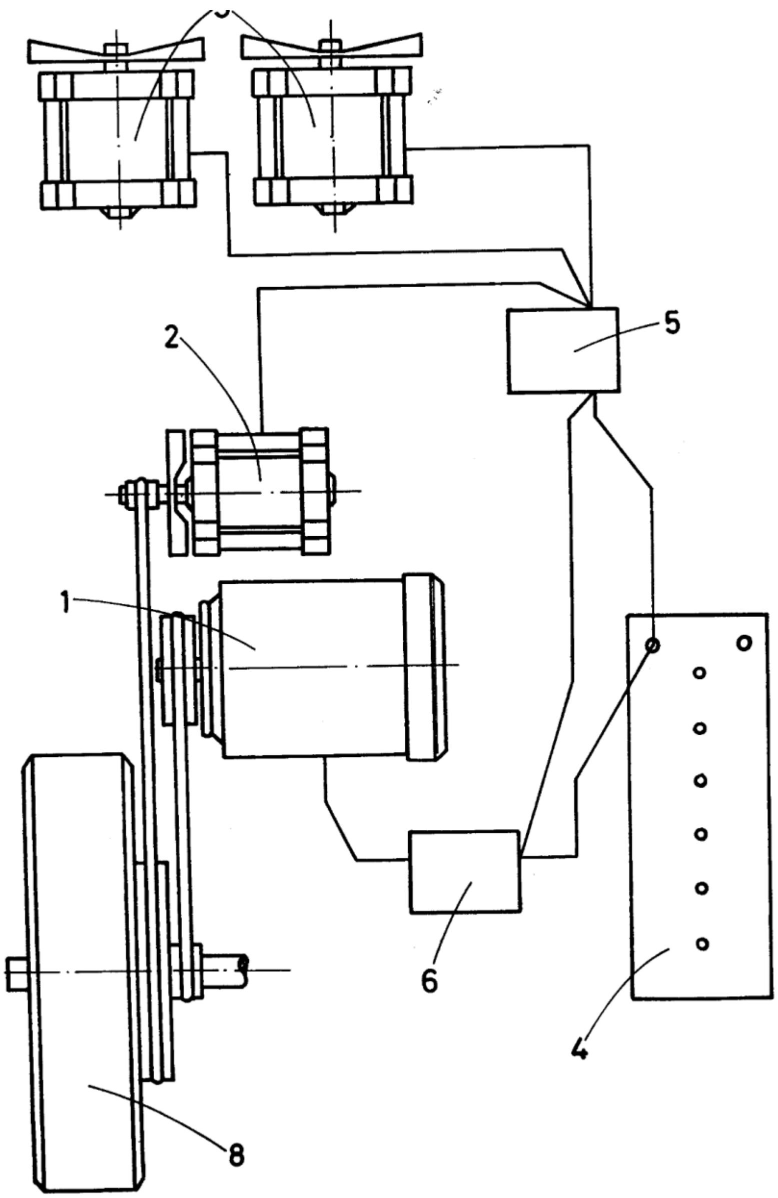
You'll learn how to build your own efficient reluctance generator.

Finally, by building the generator in this ebook you will be well positioned to participate in ongoing experiments in power regeneration research being undertaken worldwide. You will invariably test many configurations to get a better understanding of the methods other developers are using to recycle excess energy from the environment. There are generator builds that focus solely on the radiant techniques employed in countless Tesla patents, while others are using stored inertia in flywheels, gearing, and pendulums as an intermediary between the motor and generator as a means of an self-contained energy regeneration system (i.e. patents US 20080143302 A1 and ES2119690).

Please see APPENDIX for references and resource materials at the back of this ebook.

INSTRUCTIONAL VIDEOS OF CHAPTERS 1-10 CAN BE FOUND HERE

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When constructed properly, these modes are capable of accumulating their own operating energy in addition to generating a surplus which can be used in electrical networks using voltage converters as required. Just imagine. You have a motor turning a larger output generator, and the generator is producing enough energy to keep the motor running, as well as enough left over to power other loads (called 'Q-Mo-Gen'). All you need to get it going is a starter motor, temporarily, like on an automobile engine, and once the system is going, it stays going, made possible when coupling to an open system. There are at least 26 individual groups engaged in QmoGen projects, some of which have claimed success (www.qmogen.com).

Citing the patents above hopefully has placed you and yours firmly on the path to discovery. We ask that you document your work or publish a set of plans for a working system that people can replicate, optimize and propagate worldwide, creating clean energy systems, jobs, hope and social stability for all.

QEG101: Beginner's Build (All supporting documents in Appendix at back of ebook)

Building a quantum energy generator is not easy, as many already building one can attest. It requires a great time commitment, considerable planning, and possibly a few sacrifices (if you don't have necessary funds). Not only can parts be expensive in your country, they may be very difficult to find. The long-standing suppression of alternative/free energy research has created significant hardships for those interested in options to conventional energy. However, FTW and the QEG team have made a considerable impact in many parts of the world, and anticipate parts and opportunities to build will become increasingly accessible.

In the meantime, we are pleased to bring you information that you probably won't get anywhere else. The following short class descriptions are highlights taken from the 10-week online course. They will be presented as chapters in this ebook; Class 1 = Chapter 1, etc., and discussed in detail, including photos, diagrams and references.

The class labels below are hyperlinks that will take you to the individual class videos/pdfs if you need more instruction. You can also purchase the entire course HERE.

Short Class Descriptions

Class 1: Core & Insulation Choices

Discussion of insulation components used to insulate magnet wire from core steel; Sourcing, cost, specifications, and installation of core insulating materials; Pros & cons of building the QEG core vs. purchasing a fully processed unit; Answers to previously submitted e-mail questions from class members.

Class 2: Base, Resonance, Parts

Detailed discussion of parts needed for completion of QEG generator core; Presentation and description of core mechanical part drawings and specifications; Preliminary discussion of platform construction and options, with drawings; Explanation of power generation by means of parametric resonance; Answers to previously submitted email questions from class members.

Class 3: Core Assembly & Capacitors

Detailed discussion of parts needed for completion of QEG generator core; Presentation and description of core mechanical part drawings and specifications; Preliminary discussion of platform construction and options, with drawings; Explanation of power generation by means of parametric resonance; Answers to previously submitted email questions from class members.

Class 4: Core Mounting & Drive System

Excellent NEW end plates wiring diagram from Electronics Engineer Tivon Rivers provided; Description of mounting the completed core assembly onto the generator base; Presented specifications for drive system components, including pulleys, v-belts, drive motor, bridge rectifier, and variac, with drawings/photos; Discussed options for possible future use of solid-state SCR drive in place of variac with photos/specs; Discussed and provided complete, updated QEG Parts List.

Class 5: Initial Mech & Elec Setup

Presented options for wiring, terminal blocks, etc., with photos; Described recommended initial startup and testing procedure; discussed Hazards and Cautions involved with initial testing; Presented and reviewed Ivan Rivas' professional Cad drawing package; Answered in-class questions from students; Announced 'call for experiments' post on be-do website.

Class 6: Load Bank & Protection Gap

Provided schematic for recommended load bank; Provided corrected parallel wiring schematic; Discussed suggested components for building load bank (with photos); Explained requirements for load bank; Discussed necessity and concept of protection gap; Showed recommended components for protection gap (photos); Discussed location, mounting, wiring, and adjustment of protection gap (with photos).

Class 7: QEG Operational Description

Presented photos of 12-outlet strip and socket adapter (follow-up from last week's class); Provided detailed conceptual description of Parametric Oscillation/Resonance based on "QEG Mechanically Pumped Parametric Transformer" (included document); Described "sweet spot" testing (included test data); Discussed QEG RPM vs. Frequency vs. Power Output parameters; Explained concept and expected results from additional coils experiment on be-do website; Presented class assignment calling for most popular questions regarding QEG technology.

Class 8: Safety, Interactions & 3 Rs Pt 1

Explained safe operation and interactions to expect when testing the QEG; Discussed techniques for making safe measurements of voltage and current; Showed photos and explained operation of recommended test equipment; Discussed necessity and possible configuration of electronics applied to the QEG; Discussed interfacing the QEG to household mains/utility grid (w/reference documents); Showed construction of 7MHz resonant antenna system (for reference only); Provided documents and discussed targeted results of additional coils experiment; Answered previously submitted email questions.

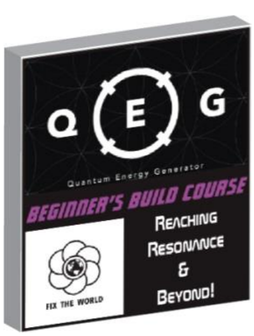
Class 9: 3 Rs Pt 2, Exciter Coil, Grounding

Parts 1 & 2: Described interaction of 2nd and 3rd resonance with 1st (parametric) resonance; Discussed exciter coil history, original construction, and experiments to date (with photos); Discussed exciter coil alternate constructions (with photos); Explained concept of radiant energy insertion (with drawings); Discussed antenna and grounding concept (with reference drawings); Answered weekly questions from students; Discussed concept of "RF Energy via Ionosphere" (provided document for study).

Class 10: 3 Rs Pt 3, Antenna, Radiant Energy

Part 1: Provided requested info on mica compression variable capacitors (with photos); Showed switch tap for suggested 12-outlet load bank (from last week); Continued discussion from last week on exciter coil history, original construction, and experiments to date (with photos); Continued discussion from last week on exciter coil alternate constructions (with photos); Continued discussing concept of radiant energy insertion (with drawings); Presented system overview of interaction of 3 resonances, and next steps; Provided link to Witts video showing exciter coil construction; Answered 3 questions from tonight's class.

Part 2: Presented several fun video clips of first-time resonances and filmed experiments over the last year.



ENTIRE QEG COURSE CAN BE FOUND [HERE]

INSTRUCTIONS FOR BUILDING A QEG
(All supporting documents in this ebook are compiled at the back)

Chapter 1: Core & Insulation Choices (Discussion)

We will begin by discussing whether you want to buy the fully processed generator core, or build from scratch. The core is basically the whole generator; all the power generation goes on in the core, the motor is just to spin the rotor and for some associated controls. The decision to buy or build depends on your contacts and how well you understand how a motor is built (laminated stator and rotor).

Stator and rotor as delivered

Mechanical Assembly: The Laminations

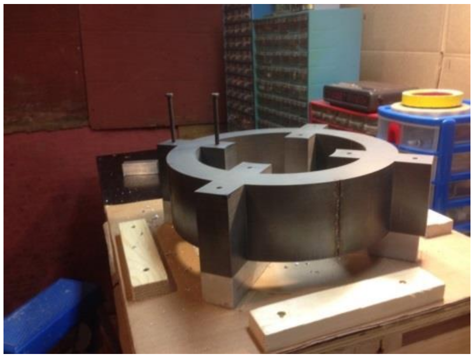
The QEG core is comprised of 140 laminations of 24 gauge steel, specifically M19 steel. The problem with this particular type of steel, however, is that it has been obsolete for over 30 years, and this would be very expensive to have custom-made. During the development process we realized there was no problem using any of the modern steel grades, and we chose M19 with the guidance and advice of a global supplier of electrical steel. They informed us that they had some spec sheets and data from the old M21 steel and said if we used M19 at 24 gauge (0.025”) per lamination it would behave like M21 (similar magnetic properties).

With the QEG, the permeability of the steel is NOT the most important factor, unlike other motor applications. The QEG is a type of toroidal transformer and can be described in a couple of ways. To compare with a conventional type motor or generator, the QEG is a variable reluctance generator. What that means is there are no windings or magnet wire on the rotor (the moving part), no commutator, no slip rings and no magnets. The rotor and the stator are both just stacks of laminations (the rotor has only 2 poles and the stator has 4), and there’s a plain shaft so the machine is mechanically quite simple (built similar to a switched reluctance motor or generator).

The QEG has the potential of up to 40kW which relates to how much high voltage you can generate. If you wanted to get 40kW out of a single machine, the high voltage level would have to be quite high – close to 20kV (20,000V) or higher. Operating in this range requires a carefully designed and assembled insulation system, which we have provided.

Most steel laminations are stamped, stacked and welded across the stack in 2 or 4 places, usually symmetrical, to hold the laminations together. You can also bolt the laminations together but be careful to make sure each lamination is exactly identical to the next one so that the holes will line up. The clearance between the rotor and stator will be somewhere between 7-10 thousandths of an inch. You can do it as close as 5 thousandths of an inch but you will have to watch the process of stacking the rotor and stator very closely.

We opted for having a welded stack, regardless of the controversy involving shorting out the laminations. The reason you have laminations in the first place is to stop the eddy currents. If you had a solid block of steel there would be so many eddy currents that all that block would do is heat up very fast and waste so much power you wouldn't get very much output. That's the reason for the laminations.



Welded lamination stack

In this application, the amount of short-circuiting you would cause by welding the stack is not as important as it would be in a conventional motor or generator. The actual source of power in the QEG core is electro-mechanical resonance; it's actually a big tank circuit. The rotor spinning in the core is changing the inductance of the windings as it rotates (inductance goes up and down). This creates an oscillation which builds upon itself. So it's not as critical to have or not have a weld on the stack as it would be for a motor or generator that's using magnets or electromagnets (there are no magnets in the QEG).

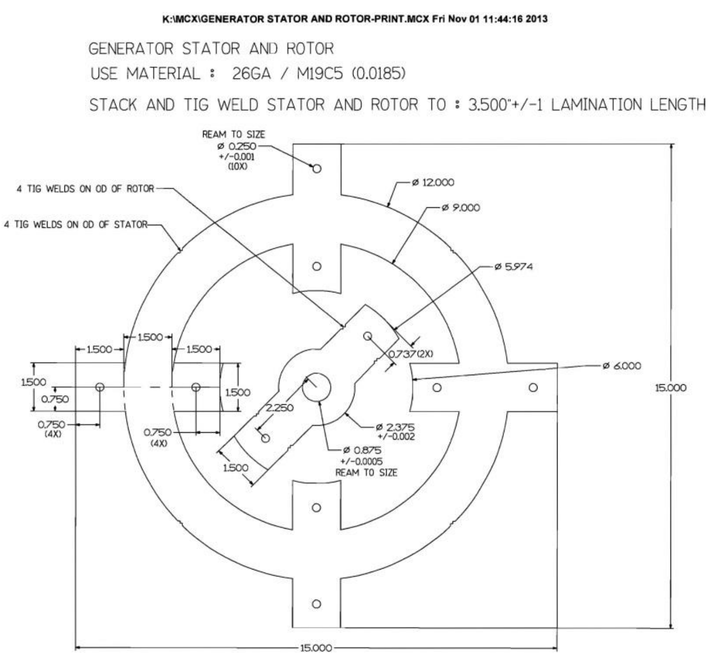
The weld holds the stack together for long-distance shipping. The assembly can also be bolted together so the laminations don't move around during shipping. Each lamination has C5 coating on it to insulate each lamination from the next lamination – this is critical – just like it would be in a standard motor or generator so that the laminations are not shorted out.

Building on the beach

These days you can also get the laminations bonded. Using adhesive, the lamination stack is put in a press and bonded together. With this technique you won't have any fasteners but you still have to have the mounting bolts so that you can mount the stator and rotor assembly to the end plates. You could use 1 or 2 bolts per pole (we used 2 so that the laminations wouldn't splay out).

If you're thinking about building the core and rotor assembly from scratch you would have control over the whole process. Of course there is a lot of infrastructure that would need to be in place for this; you would need a die designer, build the die, and buy the steel in substantial quantities to make it economical. So being a prototype, we went with a company that laser cuts custom parts which is very accurate – good for a prototype - but much more costly than stamping, which is good for mass manufacturing.

The two most important things to consider when building your own core: 1) the center bore has to be very accurate so that the rotor spins true (without rubbing on the stator), and 2) the mounting holes have to be accurate for the end panels and bearings.



Original core fabrication drawing

The 8 mounting holes (2 on each pole) are reamed instead of drilled, for part-to-part consistency. These are the holes you will use to mount the core to the end plates (and the end plates mount to the base).

The center hole where the shaft will go must of course be accurate as well. You can put a keyway in the shaft, knurl it, use a locking collar and/or use adhesive to mount the shaft to the rotor bore but you will have to make your decision before laminating, as additional features may be needed on the rotor profile. We used adhesive.

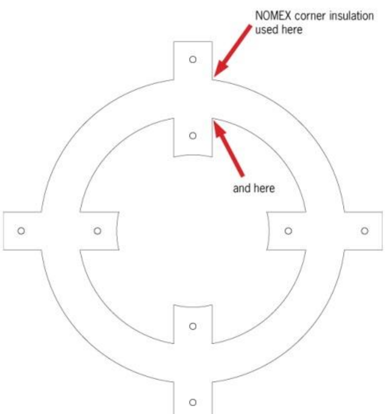
Insulation

We designed the insulation system around the criteria of being able to withstand 25,000 V.

If you're going to build your own core you will start with the bare steel stator and put the wire on it. So you will need an insulation system (to insulate the core from the magnet wire). We started with NEMA #6 mica plates (mica bonded with polyester) 30 thousandths of an inch thick.

We cut the plates by hand for our prototype and mounted them with contact cement:

The cut mica goes on in 2 pieces, one on each face (total 8 faces so 16 pieces altogether - half on the top and half on the bottom).



Nomex placement

In the photos above on the right you can also see 2 layers of mica tape wrapped (overlapped about 50%) around the stator. This tape has no adhesive but it's impregnated with mica and was one of Tesla's favorite things to use. Underneath the mica tape are 2 layers of mylar tape which go right on top of the steel (can also use kapton tape and other types that have very good cut-through resistance).

We used Teflon tubing to insulate the magnet wire at the beginning (the first turn) of each wind around the core to insulate the ends before building the coil, and then use again at the finish (you will drill holes through the end plates for the wires to come through).

There are 16 pieces of DuPont Nomex type 418 high voltage insulating paper in the corners between where the mica tape ends against the face of the pole, and the mica plates. So you have an interface between the mica tape that's wrapped around the circular part of the core and the mica plates that insulate the pole pieces – this area must be insulated to prevent the wire falling down to the bare steel during winding, which will cause a short-circuit.

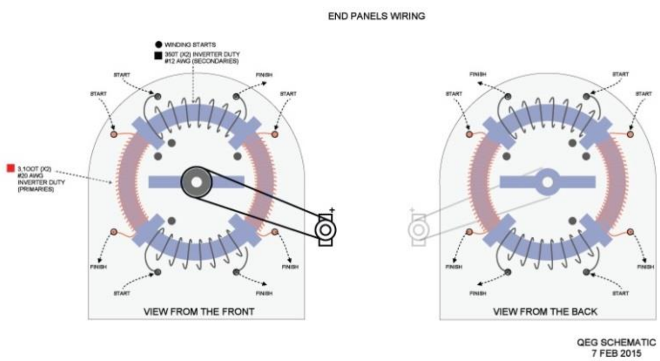
NOTE: So far, this discussion has been about what's inside the core. Of course there's the option of buying the complete assembly. The source that we use is [Torelco in the US], who will put the whole core together for you and ship anywhere in the world.

Wire Insulation

The wire insulation for this application is critical; it has to be the very best insulation you can get that's made for inverter applications, or Inverter Duty wire. The designation is HTAIHSD which indicates Inverter Duty. When the entire assembly is complete it has to be able to hold off up to 20,000 V, so you have to use the best stuff.

We used 'pulse shield' from REA which is rated for 200 degrees Celsius. It has heavy tough insulation specifically for high voltage transformers, motors and other devices that are driven with sharp steps in the pulses.

The two AWG gauges you need are 12 and 20 gauge. When the machine is finished you will have a low current/high voltage generator. When you apply electronics after the machine is built you can convert that high voltage to low voltage/high current.



Housing view winding direction

There are 2 primary windings and 2 secondary windings. (NOTE: In subsequent chapters, the terms primary and secondary will be defined for the QEG. Because the machine is not really a transformer, it is only for convenience that we use the terms primary and secondary at this point in the directions.) The (2) primary coils are located opposite each other and require 3100 turns of 20 gauge wire and must be wound in a specific direction (see diagram, or if you are purchasing a fully processed core, Torelco has the specifications).

The start windings on the primaries are connected together so that what you have is a 6100 turn inductor (between 20-26 Henries).

The 2 secondary coils are also opposite each other and require 350 turns of 12 gauge wire on each. Be sure to follow the "housing_view_winding_direction" drawing.

Vacuum Epoxy Impregnation

After consulting with some experts on building high voltage transformers, we determined vacuum epoxy impregnation is one of the best methods of insulation for high voltage windings. So we developed a mold system using a boot filled with epoxy that goes around each of the windings. The air is then sucked out so that the epoxy actually goes right into the windings.

NOTE: Although vacuum epoxy impregnation is the best insulation system, there are pros and cons using epoxy, e.g., if you encapsulate the whole core with epoxy it is difficult to experiment with it. You would have to break the epoxy off and possibly break the wire. At the time of this writing we are using a non-epoxied core and have not had any problems. We are using a protection gap (spark gap) on the outside of the primary that we developed which will be discussed in later chapters.

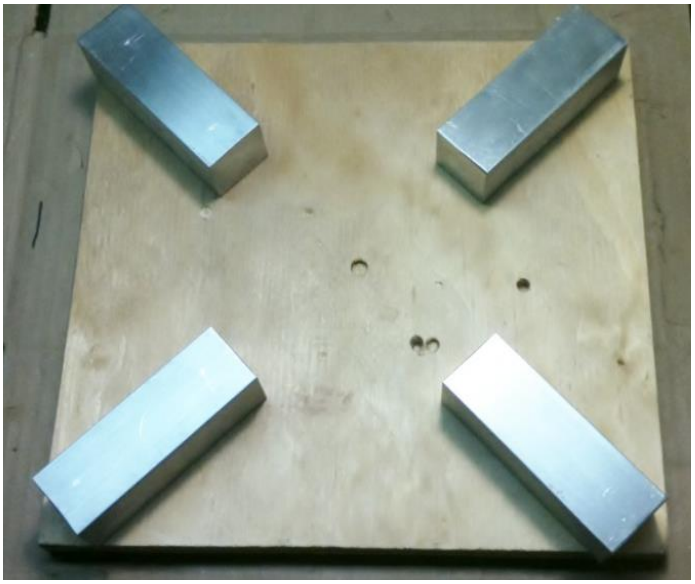
In summary, it's your decision if you want to build your own core or buy a fully processed one, depending on how deeply you want to get into it. Please see back of this ebook for a list of materials.

Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE CLASS 1 VIDEO/PDF PACKAGE

Chapter 2: Base, Resonance, Parts

Spacer Blocks



The spacers that we use are type 6061 aluminum. We've also used Accoya® wood impregnated with acetyl plastic. You could also use the same material as your end plates (clear polycarbonate, FR4 epoxy laminate, etc.). It's not critical for the spacers to be aluminum but you don't want to use steel because this would change the inductance of the core (would add some inductance). You want a non-magnetic material for the spacer blocks so that the inductance of the system is known.

Bearings

We decided to use the FC-7/8-RHP 4-bolt flange bearing made by RHP because it is heavy duty and very flat, even though the housing diameter is larger. The bearings can be placed on the inside or on the outside of the end plate. There is less of a 'moment arm' if the bearings are on the inside closer to the rotor surface, so you'll get less flexing. However, a 7/8 shaft of hardened steel isn't going to flex much at the RPM we're talking about – under 3000 RPM. Nonetheless, you want to build in the most rugged configuration where possible.

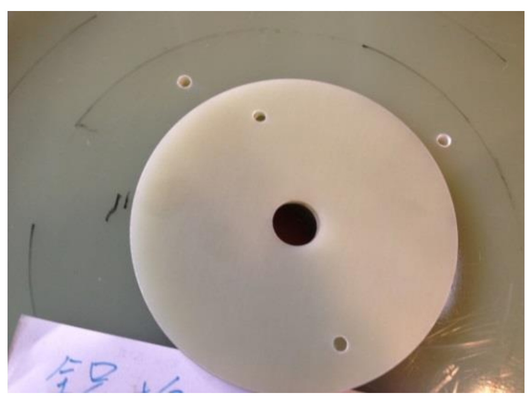
This bearing works better for mounting on the inside of the end plate because the location of the setscrews/grubscrews on the inner ring is very close to the mounting surface (low profile). This allows better access to get your extra-long allen wrench in-between the windings on the core and the inside endplate surface, in order to tighten the setscrews once the core is fully assembled.

Also, if you have the epoxied core, there's even less room in-between the end plate surface and the windings on the core, because the epoxy fills more of the space around the windings. It's best to have the bearing assembly be as flat as possible when on the inside. So far we have only been able to find this RHP 4-bolt flange bearing at 'Simply Bearings.com' in the UK.

End Plates

We used the FR4 material which is the same material used to make circuit boards (fiberglass impregnated epoxy). There are several grades of this laminated material that can be used. The FR4 is very strong and stable and one of the more expensive of the epoxy laminates. (Other less expensive grades of phenolic, or laminated sheet material, are provided at the end of this ebook). Cotton fiber/epoxy resin type (grade CE), or linen fiber/epoxy resin type (grade LE) can also be used. These both have good machineability, and good electrical properties. Both the CE and LE are cheaper than the FR4. These grades are not quite as strong as FR4, but are plenty strong enough for this application.

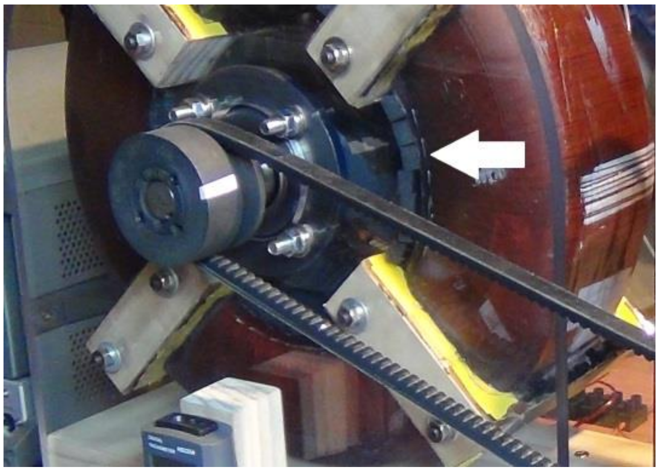
Shrouds



When the rotor is spinning in the bore it's a really good air beater. One of the techniques used to quiet this 'windage' noise in motors and generators is sealing the bore area to prevent turbulence.

The 2 shrouds (see photo on right) can be made of the same material (FR4 or one of the other phenolic materials, not pure wood), and is a 1/8" thick disk. These are bolted onto both side faces of the rotor (see the 2 mounting holes in photo. The 2 holes in the rotor are there just to mount the shrouds onto the sides). The outside diameter of the shrouds is just slightly smaller than the opening in the core, which is 6 inches. So you're actually preventing any new air from coming into the center bore while it's rotating, eliminating some of the turbulence and making the windage noise much quieter.

The windage noise problem is greater with the epoxy core because there's a smooth hard surface on the inside. You can put adhesive-backed foam right on the surface of the epoxy core on the inside of the bore, being careful that the foam is less than ¼ inch thick (this is the voltage breakdown specification: the winding surface has to be ¼ inch away from the actual surface of the rotor so you don't get arcing between the wire and the spinning rotor.)



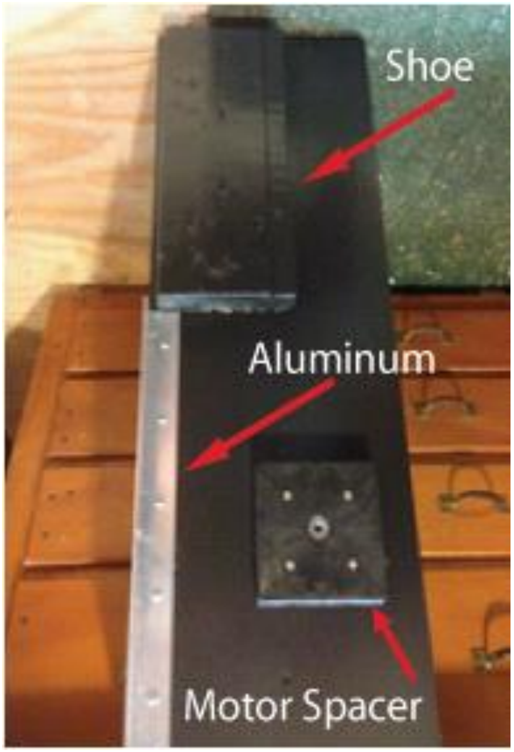
Foam on inner surface of the windings

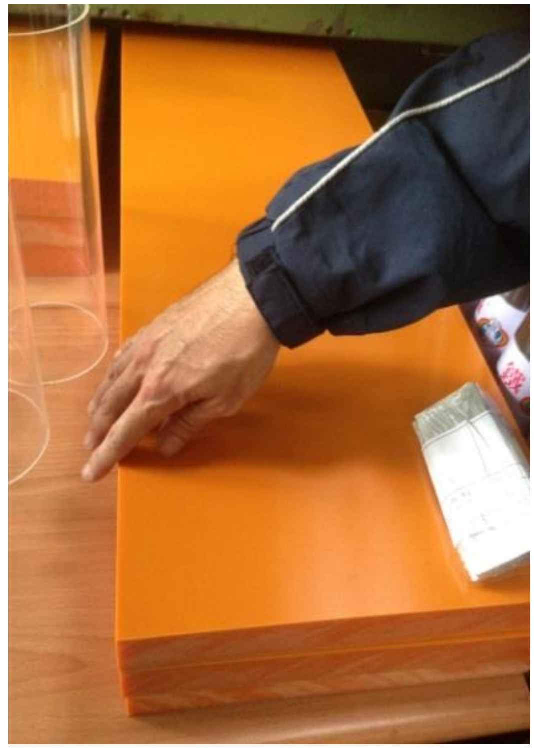
Even with the foam it's not as quiet as the cores without epoxy. This is because the foam may have a smooth surface. You will want to use foam with a rough surface as this creates an anechoic condition (e.g., egg crates placed in a room to cut down on the sound or echoes). Also, staggering 2 different thicknesses of foam will give you an uneven surface. The cores without epoxy just have tape wrapped around the outside to protect the outside surface of the windings, and the uneven winding pattern itself provides a rough uneven surface.

NOTE: The sound doesn't affect the operation of the machine but it's best practice to cut down on any additional noise. When you get to resonance, this creates a new sound and you don't want the machine to be any louder than it has to be. If you don't use the shrouds, there's a ticking noise that gets pretty loud. So…FOAM YOUR CORE!

The Base

On most of the machines we built, we used motors with a detachable base and bolted it right through the platform with carriage bolts (coming up from the bottom). On one machine we used a piece of 1/8" thick angle aluminum across the front of the platform and the c-face type motor (most are c-faced these days). So you have 4 mounting locations right on the front of the motor instead of using a detachable base on the bottom, but you can do it either way. The reason we





opted to mount to the angle aluminum is so that the belt tension can be easily adjusted without having to loosen and tighten 4 bolts; you can simply rock the motor back and forth pivoting on just one mounting bolt. We then built a simple sliding spacer to support the back of the motor.

The base doesn't have to be wood, just a dimensionally stable material. If you are using wood, the base plate itself is 2 pieces of ¾" thick plywood, bonded together (screwed and glued) with opposing grain directions. The dimensions should be 18" x 36," giving you plenty of room to do your wiring, attach terminal blocks, electrical boxes, variac, motor, etc.

The other main part of the platform is the mounting shoe. This is just a piece of wood, phenolic or laminate that goes in between the two end plates; the shoe bolts onto the platform, then the end plates bolt onto the sides of the shoe. The motor spacer is just to keep the motor shaft parallel with the base.

Capacitors

Before presenting the capacitor information we are going to describe how the machine actually works, how it generates power from resonance. This is what's unconventional and exciting about this generator. When you understand the way the generator creates power then you'll understand more about the capacitor situation.

<u>Parametric Resonance</u>

Using the term 'primary windings' is a bit of a misnomer; at first look the core appears to be a toroidal transformer, and it is partly - the way the energy transfers from the primary to the secondary is by conventional transformer action up to the point of the mechanical resonance of the steel and bringing in radiant energy. However, we're only going to talk about the first resonance at this point – how the machine actually generates power.

The input circuit (primary) is basically a tank circuit (a tuned inductor/capacitor circuit). Parametric resonance is a way to start and maintain an oscillation. You are changing one of the parameters of the circuit. The two primary coils (3100 turns each) are wired in series so you have a 6200 turn inductor that's built on a toroidal core.

If the two parameters (capacitance and inductance (primary windings) were fixed, you would have to add some kind of energy into the circuit to get it to start oscillating (resonating), and continue to add energy to maintain the oscillation. In this machine we start the resonance with mechanical motion, the actual spinning of the rotor. When the rotor is aligned with the stator poles the inductance is high, and when unaligned the inductance is low (almost a 50% change –

approximately 20 Henries aligned, to 10 Henries unaligned). When spinning, each time the rotor comes near one of the poles the inductance increases rapidly, then drops rapidly, etc. This is the principle by which it maintains resonance (oscillation): you're adding mechanical motion which causes the inductance to bounce up and down (varying the inductance parameter).

When the rotor starts spinning you are at very low voltage, but when you get near the resonance value the voltage increases rapidly. If you try to speed up the motor while it's in resonance it will speed up only slightly, and instead of the rotor going faster, you just produce more output power because you're going deeper into the resonance, i.e., the voltage wave form in the primary, or the amplitude, is increasing. As you add more mechanical energy with the motor you're pushing the resonance voltage higher and higher. This is very unique, like a phase-lock effect; you can increase the output voltage and current with a single knob just by changing the speed of the motor.

What happens next is a basic transformer action. As the rotor leaves alignment, the primary, or tank circuit energy begins to collapse. This is when it's operating as a standard transformer; when you're unaligned the energy transfers into the secondary. This is the part that gives you the reduced Lenz effect because it's not all magnetic flux transfer. On the primary side you're transferring the voltage and current which creates a magnetic field in the toroidal core, but the transfer is done when the primary power is at its lowest point rather than at the highest point (which is what you would want in a conventional motor and generator.) Once we have the circuit tuned, the power can be increased or reduced by simply adjusting the rotor speed.

The energy transfer is very efficient. Those familiar with standard generators or alternators will know that as you increase the load, the rotor tends to slow down due to the Lenz effect. With this generator, the primary power responds very readily to increases and decreases to the load in the secondary making this an incredibly efficient generator: the output power – voltage and current - is within 200 Watts of the input power. The mechanical motion of the rotor actually maintains the resonance. Creating primary power from a mechanically variable inductance is what makes this generator so unique.

Depending on the capacitor value, you can get it to resonate anywhere between about 60 and 300 Hz (output frequency).

When we reach the goal of self-looping and generating power the capacitor values will be known. Until then the best info we have from research and experimentation to date is that the final value will be between about 30 and 300nF (0.03 and 0.3uF), and may be just around 100nF (0.1uF). See fixtheworldproject.org for updates.

This system has extremely low Lenz effect. This is one of the things that many of the free energy experimenters are wrestling with (trying to figure out ways to limit the Lenz effect – see Bedini generators for more information on limiting the Lenz effect).

There are several ways to make a capacitor bank to cover all the frequencies you are experimenting with. (Please see Chapter 6 for further instructions on how to build a capacitor bank).

Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 2 VIDEO/PDF PACKAGE

Chapter 3: Core Assembly & Capacitors

Now that you have a finished wound core, it's time to:

- Install the shaft into the rotor
- insert the rotor assembly into the stator bore
- mount the endplates with bearings onto the core
- align the rotor in the stator bore

This will complete the core assembly, which will then be mounted onto the platform/base. The initial build of the generator was completed using preliminary hand drawings for the parts, and was hand assembled with some of the layout simply done by eye. We now have a complete package of new, professional CAD drawings available in the updated 'Anniversary Edition' open source QEG Build Manual, released March 25, 2015. The updated manual is available at the back of this book.

Shaft and rotor

Drawings are provided for the shaft in the CAD drawing package. The shaft length can be 11" (minimum), or 12" or more, depending on whether you mount your bearings on the inside or the outside of the end plates. We used Loctite 648 industrial adhesive (with activator) to mount the shaft to the rotor, which is effective for bonding close fitting metal parts. At this point you will install the shaft into the rotor, but first you must mark the shaft to indicate its final position with respect to the rotor stack. Make a mark 3” [76.2mm] in from the end that *does not* have the keyway, or if you purchased stock shafting with a full-length keyway, make the mark 3” in from either end. You can lay the shaft over the rotor to estimate this position and mark the shaft with a scratch awl or other sharp instrument. You could also temporarily insert the shaft into the rotor (no adhesive yet) until 3” of the plain (non-keyway) end is protruding, mark the shaft, and then remove it again. It is best to scratch the mark into the shaft rather than use a marker, because the adhesive may dissolve the marker ink during installation. The marked shaft is now ready to be inserted into the rotor stack with the 3 inch protruding end first.

Your rotor stack should have a very slight taper of the bore diameter from end-to-end (the shaft will be slightly easier to insert into one end vs. the other end). In the next step, install the shaft into the end where it slides in easier.

Next, you will need to apply adhesive to the rotor.

First, build up a ridge of adhesive around the lip of the rotor bore as shown in the photo. Apply the adhesive liberally near the lip so that it will run down along the inside wall of the rotor bore.

Next, spread a thin layer of adhesive around the shaft diameter in the 3-1/2” wide area that will end up inside the rotor (see photo). Apply the adhesive layer a bit heavier at the end that will be inserted first. You will need to act fast in the following step as the Loctite® 648 cyanoacrylate-based Bonding Compound cures in the absence of oxygen (anaerobic). Inserting the shaft will displace the oxygen in the bore and the adhesive will begin to harden.

Once shaft insertion begins, you will have about 60 seconds to get the shaft in place before the adhesive begins to harden. Insert the end with the mark at 3 inches first, and install the shaft through the rotor stack quickly with a pushing and twisting motion. Stop when you just see the reference mark on the shaft come through on the other end of the rotor bore.

Once the shaft has been installed, allow it to set for 5-6 minutes. Now you can wipe off the excess adhesive using an alcohol or acetone based solution. Your shaft / rotor assembly is now ready.

Rotor Shrouds (optional)

You may choose to add shrouds to the rotor to reduce the windage noise generated by the spinning rotor. They should be installed before installation of the rotor / shaft assembly into the rear bearing on the rear end plate. Drill a 7/8" center hole, and two ¼" mounting holes into the shroud disks (mounting holes are lined up with the holes in the rotor). Slide one disk onto the shaft on each side of the rotor. Bolt both shrouds to the rotor using two 4" or 4-1/4" long ¼ - 28 through-bolts and nuts. Insert bolts in opposite directions according to the drawing. These bolts should not be any longer than necessary or a rotor imbalance can occur.

If you're going to have the rotor professionally balanced, you should have the shrouds attached. The rotor should be balanced as a complete assembly. The balancing procedure involves removing small amounts of material from different areas on the rotor steel using a drill bit. We recommend that you ask the machine shop to be very careful not to delaminate (splay out) the laminations when balancing.

NOTE: It is highly recommended to get your shaft / rotor assembly balanced by a professional machine shop. This is not required for the machine to be operational, but is best practice for smoothest, quietest operation.

Mount End Plates onto the core

Your core may have a small amount of excess mica plate material protruding beyond the spacer block faces that bear against the end plates. This should be trimmed off. The mica plates' edges must be flush with the spacer blocks' surface, to prevent them moving when installing the end plates.

End Plate Layout

After end plates are cut and finished, place one on a flat work surface that will support up to 130 lbs. [about 60kg]. Place the core over the end plate, aligning the center bore of the core with the center hole in the end plate. When mounting the core on the endplates, it should be oriented with the pole pieces at 45° to the generator base for the lowest profile. Make sure the pole pieces are right to the edge of the radius at the top of the end plate.

We used an extra long drill bit to drill the 8 mounting holes. Repeat this process for the other end plate. Alternately, an 8 inch long ¼" dia. pin with a sharpened end could be used as a center punch to mark hole locations and drill the holes using a drill press, or the CAD drawings (back of this book) could be used to program a CNC milling machine if you have access to a machine shop.

If using the core as a template be sure to make assembly marks on the core and the end plate so that the final assembly will have all the parts in the same orientation and the mounting bolts will go through without binding. Be sure to mark the in-facing and out-facing sides of each panel. You can use calipers to measure from pole piece edge to end plate edge on both sides, to ensure the core is centered on the end plate.

Bearings

We recommend mounting the bearings to the inside of the front and rear end plates. Center each bearing on the 2.450" hole (or 2.875" hole, depending on which bearing housing is used) in the center of the plate. Drill the holes oversize for the mounting bolts. This is done to provide adjustability in the position of the shaft at final assembly. The bearings will have to be moved slightly to center the rotor in the bore of the generator. The gap between rotor and stator is very small (.010" or less) and the rotor will need to be positioned so it does not rub on the stator bore. Only tighten finger tight at this time.

Core Assembly

We opted to bring the leads from the coils out directly through holes drilled in the rear end plate. You may decide to bring the leads out a different way. Here are the steps for our method:

1) Lay the pre-drilled front end plate (the one *without* the holes for the coil wire leads) on top of 4 wood blocks, 1-1/2" thick x 3-1/2" wide x 6" long (North American standard 2x4, 6" long) arranged in a cross, and placed on a flat work surface that can support up to 130 lbs. [about 60kg]. Position the wood blocks under the end plate evenly without covering any of the pre-drilled holes.

2) With an assistant or two, place the fully processed core (about 90 lbs.) down onto the pre-drilled end plate with the wire leads facing up. Line up the center bore of the core with the center hole in the end plate, then line up the mounting holes. Make sure the wire leads are oriented according to the included "Housing_View_Winding_Direction" drawing. Use a couple of long ¼" rods or 2 of the long mounting bolts and push them through the stator, into 2 mounting holes on opposite sides of the end plate. In this way, line up all 8 mounting holes in the stator with all 8 mounting holes in the end plate, using the long rods or bolts.

3) Leaving the 2 rods (or bolts) in place momentarily to maintain alignment, insert the longer end of the rotor/shaft/shroud assembly through the stator bore and into the front pre-mounted bearing. Let the rotor assembly drop through the bearing gently to the bottom, then rotate it to align with 2 of the stator poles. Without moving the core, front end plate, or rotor, gently remove the 2 long alignment rods (or mounting bolts). Now take the *rear* end plate (with pre-mounted bearing) and fish the 8 lead wires through the pre-drilled holes, as you lower it over the end of the rotor shaft. Take care not to pinch, bunch up, or crush any of the wire leads as you lower it

into place.

4) Once the rear end plate is down in contact with the stator assembly, install the 4 *outer* mounting bolts, washers, and nuts, and tighten securely. The core assembly must now be placed upright to reach the 4 inner mounting bolts. With assistance, place the assembly upright onto the raised portion of the base (mounting shoe), and install the 4 inner mounting bolts. Tighten the bolts to approximately 7-8 ft. lbs.

Core Mounting

5) We used 5 lag bolts across the bottom of the end plates on each side to mount the assembly to the mounting shoe on the wood base/frame. Other methods could be employed for mounting the core assembly to the base, such as using angle aluminum rails across the bottom skirts of the end plates (see CAD drawing layouts).

Rotor Adjustment

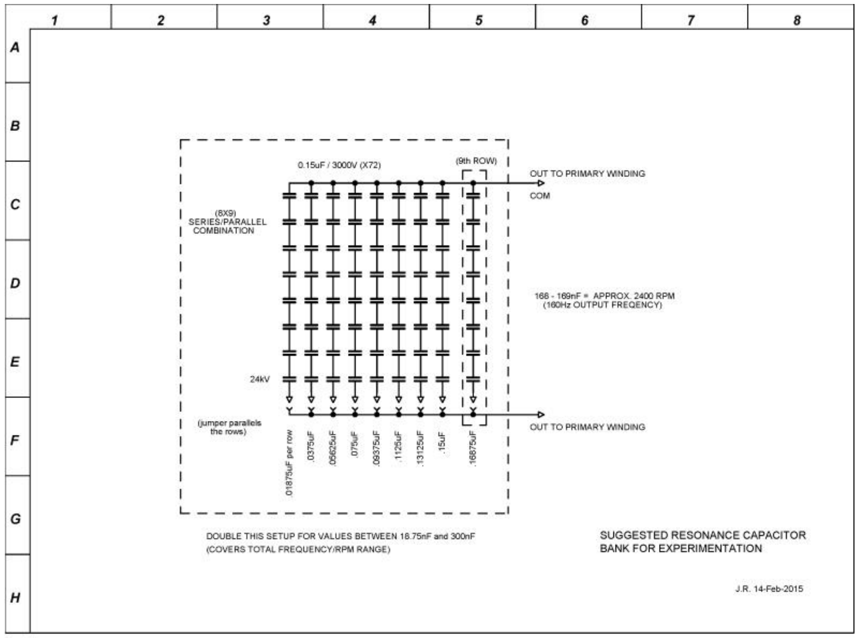
At this point the rotor position should be adjusted so that it spins freely inside the core without

rubbing. This is where you may need to adjust the bearing positions repeatedly until the rotor spins freely. (The gap between the rotor and stator is .010" or less, making this step a little delicate). However, once the rotor is tightened in position it doesn't tend to move. Place the 2-½" pulley on the generator shaft at this time; it can be used to turn the rotor by hand while adjusting its position.

Resonant (Tank) Capacitors

The primary tank circuit capacitors are a critical part of the system. The initial capacitor bank configuration on our prototype uses 72 tubular film type caps, 0.15uF [150nF] each (see parts list). Each cap is rated for 3000V. The bank is configured with 9 parallel rows of 8 series wired capacitors. Each series string can withstand up to 24,000 Volts, and total capacitance value is adjusted by making and breaking the connections that parallel the rows (see included schematic "initial resonance cap value.pdf", and cross-reference table "tank capacitor values.pdf").

The value of these capacitors will be adjusted to tune the frequency/RPM of the generator. Fine tuning (of small increments of capacitance value) can be accomplished by jumpering (or switching) single capacitors in or out *in series* with any of the 9 series strings of capacitors. This bank can be adjusted for values between about 0.019 and 0.169uF [19 and 169nF]. A value of about 0.169uF [169nF] will establish resonance near 2,400 RPM on the rotor shaft, which is in the ideal speed range for the machine's mechanical setup. The machine in the Witts 40kW demo video is running at about 2450 RPM. Below is the suggested way to build a capacitor bank for testing. Two such banks will allow experimentation at any frequency between 60 – 300Hz.



Please see APPENDIX for references and resource materials at the back of this ebook.

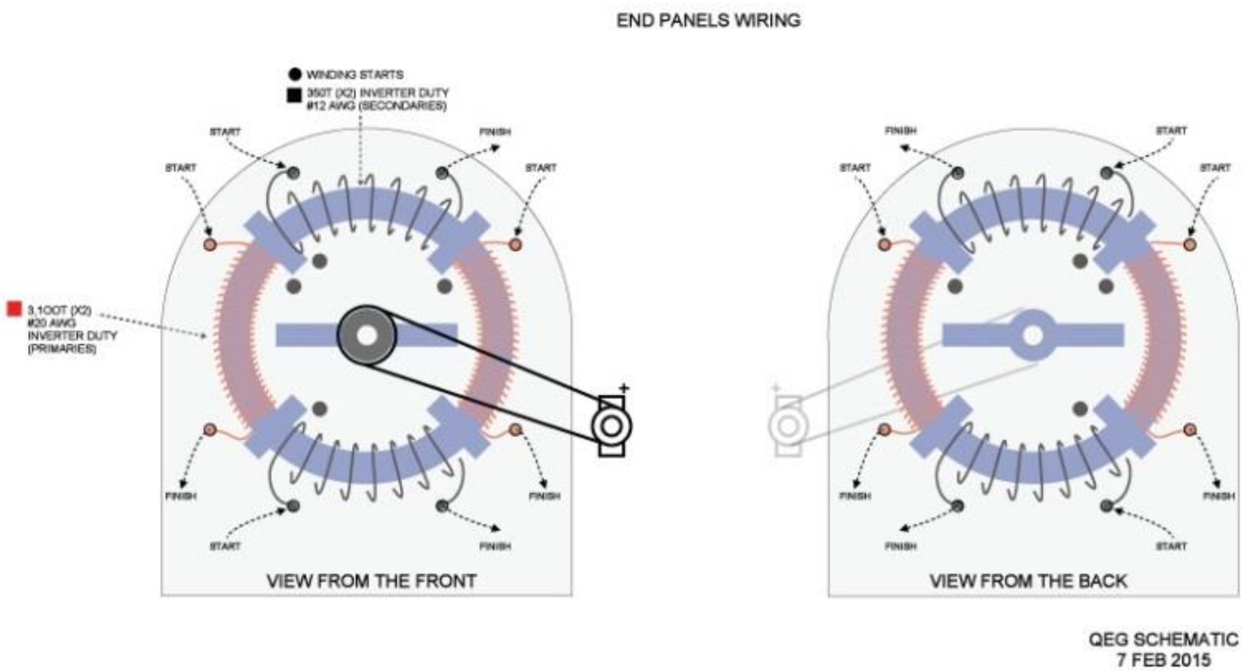
CLICK HERE FOR CLASS 3 VIDEO/PDF PACKAGE

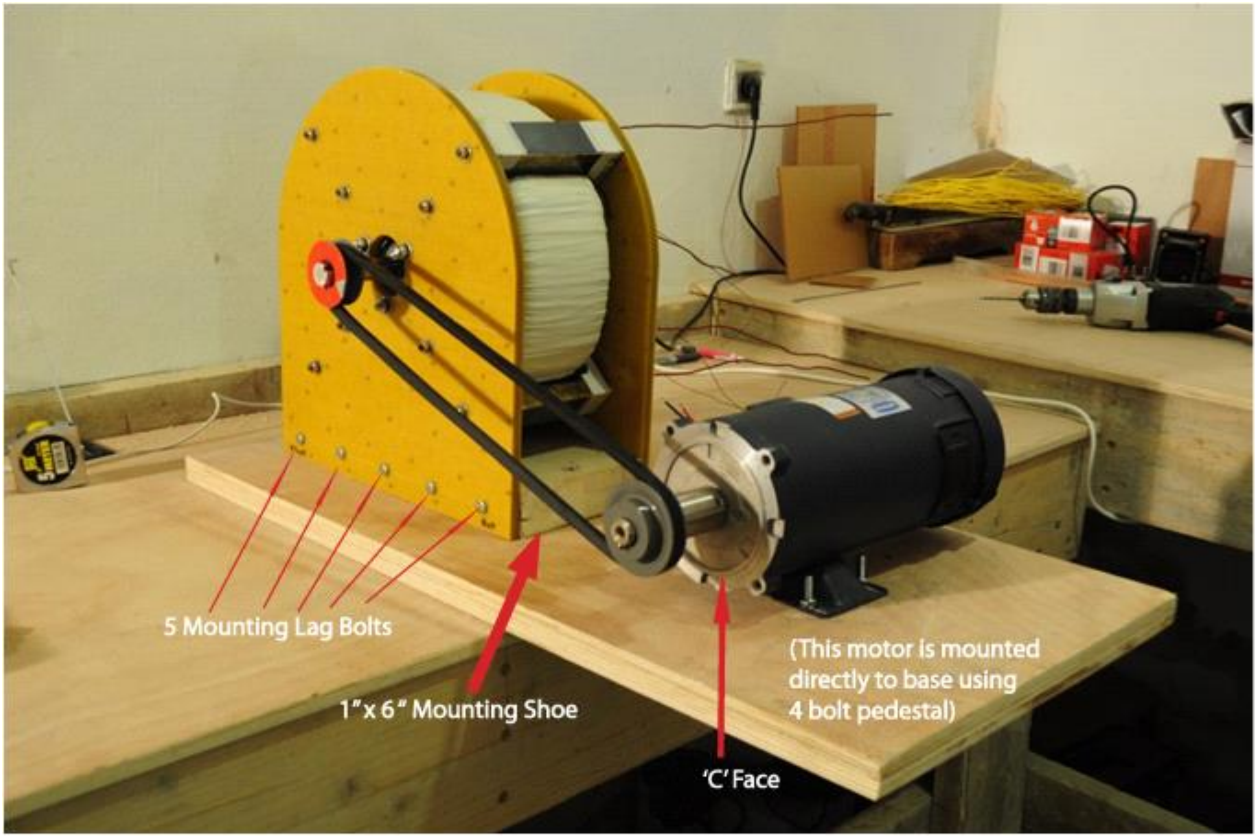
Chapter 4: Core Mounting & Drive System

So far we've gone through the building of the core assembly and here we'll talk about mounting it onto the base and continue on to describe the drive system (pulleys, belts, motor, variac).

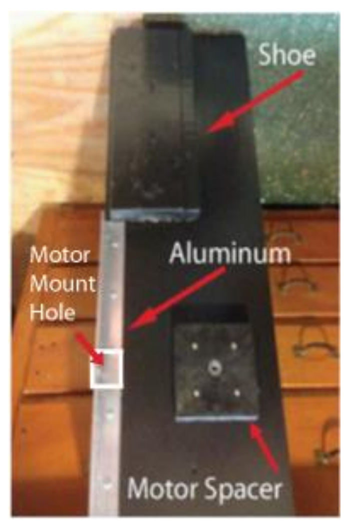
Below are transparent views of the core mounted in the endplates, showing the wiring configuration from the front (pulley side) and from the back (wiring side). The front plate is the one that *does not* have the wires coming through it. The 8-inch bolts used to mount the core to the end plates should be inserted through the rear endplate first (bolt heads on the side where the wires are coming out). With the nuts on the front (pulley) side, if you have to work on the rotor or bearings you can easily open the core assembly just by removing the rotor pulley and pulling off the front plate. No need to drive out the bolts or bother with taking the wires back out of the rear plate.

Winding/Wiring diagram:





The above photo shows the core assembly mounted onto the base (18" wide by 36" long). We used 2 pieces of ¾" plywood, screwed and glued together with opposing grain direction (top piece is oriented in the opposite grain direction from the bottom piece). This gives more strength and makes the finished assembly less likely to warp.



We used the 1-½ HP Leeson motor depicted in the photo above in the experimental stage. You will only need a 1 HP motor. The motor should be a 2500 RPM DC permanent magnet type, with either 90 Volt or 180 Volt armature (depending on your selected output voltage setup).

The mounting shoe is a 2" x 6-1/2" piece of wood, mounted onto the main base with large wood screws. You can either drive in the screws from the top, or through the underside, into the mounting shoe.

5) The photo at top shows the Morocco prototype with the motor mounted using the 4-bolt pedestal base. On the PA prototype, we opted to remove the 4-bolt base supplied with the motor,

and mounted it onto the aluminum angle on the front of the base instead. We used one bolt (on the ‘C’ face) so the motor could simply pivot to provide easy belt tension adjustability. The ¾” plywood spacer under the motor acts as a pedestal to keep the motor and shaft level.

Pulleys, Shaft and Belts

There are a couple of different ways to do the pulleys. The type of pulley most often used in Europe and the U.K. has a tapered bushing that fits into the v-belt pulley (the part that has the v-belt groove). This piece is made to fit on the shaft using 2 or 3 set screws (depending on the diameter of the bore) to tighten the pulley assembly onto the shaft. The bushed pulleys are 2-piece pulleys, and are a little more accurate than what are called ‘finished bore’ pulleys. So you would select the bushing depending on your selected shaft diameter (7/8” or 5/8” shaft). The outer diameter of the bushing will depend on what size pulley you use.

Most of the machines we’ve built had the standard 1-piece U.S. type finished bore pulleys. However, the ones with the bushing seem to run a little more accurate. The pulleys need to be best quality, balanced and true-running. It will make a difference if the diameter of the pulley isn’t consistent over the whole circumference; the belt will bounce, which will cause fluctuation of the generator’s output voltage in the final stages.

The AK 30 x 7/8” (or 5/8”) type finished bore pulleys have no bushing and are specified by the shaft diameter and outer diameter. These are used on the motor shaft and the smaller AK 25 pulley is used on the generator shaft.

The shaft we used is 7/8” diameter X 11” long, type C1045 TGP (turned ground polished) with standard 3/16” X 3/32” keyway

1.875” in from one end.

NOTE: You can put a keyway in the shaft, knurl it, use a locking collar and/or use adhesive to mount the shaft to the rotor bore. We used the Loctite 648 adhesive with excellent results on all machines except the Taiwan build. Mr. Li preferred knurling the shaft, and pressing it into the rotor bore.

V-Belts

The belts that work the best are the cogged belts (GoodYear 4L430 series – 43” long). When you get deeper into the operation of the machine and connect the exciter coil, you may need to move the motor closer to the generator. There are magnetic fields surrounding the motor and the generator, and you will position the exciter coil in between these fields halfway impinging on each other. To accomplish this you will need several different lengths of belts (41”, 42”, 43”, 44” and 45”).

The Motor

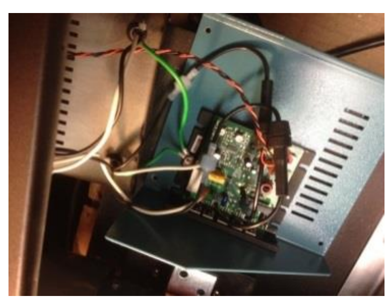
(The specs for Iron Horse brand motors that come from China can be found in the reference section.) This brand is the cheapest one we could find. It’s a little smaller and we like the metric frame. The only thing we noticed with these (that we didn’t notice in the Leeson and Baldor motors) is the presence of a hum. This could be taken care of with a filter capacitor on the output of the bridge rectifier, rated for at least 250V. If you’re using a 240V system it would then have to be a minimum 400V capacitor, and something like 30 microfarad would be sufficient. Most of these motors are supplied with both the (detachable) slotted pedestal bases and the ‘C’ face mounting, and come in all the standard shaft sizes. The Iron Horse brand is a good option for cost.

NOTE: For motor choices see references at back of this ebook. Our preference is the metric frame motors – better packaging (smaller).

The Variac

Before we understood the operation of the machine as well as we do now, it seemed we could build more cheaply using a solid state SCR drive rather than buying a variac (which is very expensive, especially in the US). However, we had to purchase a variac after all because when the solid-state drive is energized, there is a delay before output power is available. For self-sustaining, switching the motor over from mains power to generator power has to happen as quickly as possible so that the machine doesn't come out of resonance during the switchover.

Using the variac, output power is available instantly when you power it up (no delay). Once the machine is tuned up and you have enough power to run the motor from the generator, there may be enough inertia in the rotor to keep it spinning long enough to stay in resonance while switching over from mains power to generator power. So using an SCR drive is still a possible option on the finished generator. This is advantageous because it will make the machine cheaper, lighter, and less bulky.



The circuit board in the photo on the right (SCR drive) uses 5 SCRs and is light and easy to work with. We built the solid state drive into an enclosure with a rocker switch. This type of switch is the quickest way to switch the hot and neutral from the mains to the generator.

We also used 8 amp fuses on the armature and line connections (with either the variac or the SCR drive). The 240V, 1 HP motor is about 5 amps at full load. If you're going to use a 120 V system the motor will draw about 7 1/2 amps.

We used a Staco model (1520CT) variac. This is a voltage doubling type variac and can be used with either 120V or 240V input. Most others cannot be used for both voltages. The capacity of the variac should be minimum 9 Amps.

NOTE: Our recommendation at the time of this writing is to use a variac for development, until the maximum switchover delay time is known (please see fixtheworldproject.org for updates).

You can set up the system for 120V or 230/240V. A 120V system would have the secondary output from the generator wired in parallel for lowest voltage / highest current, and be used with a motor with 90V armature. You can set it up either way – 90V armature motor / parallel output for 120V system, or 180V armature motor / series output for 230/ 240V system.

Bridge Rectifier

The bridge rectifier should be rated 1,000V and 25 amps (you'll only see 10amps max through the bridge rectifier but a little headroom is always good). We specify the ones with quick connect terminals but you could use other types of terminals depending on how you're doing your wiring.

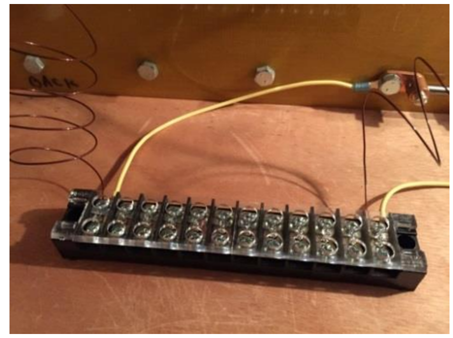
You'll want to mount the bridge rectifier to a heat sink surface (you could use the aluminum angle that the motor is mounted on, a separate piece of aluminum, or a commercial heat sink. We mounted it to the aluminum frame of the variac, where there is a good bit of surface area.

Self-Run Switch (Rocker Switch)

We used this 2-pole center off switch (not required to be center off, it could be on/on), with one direction connected to the mains and one direction connected to the generator, and the variac on the common terminals (see schematic). It should be rated 15 Amps, and at least

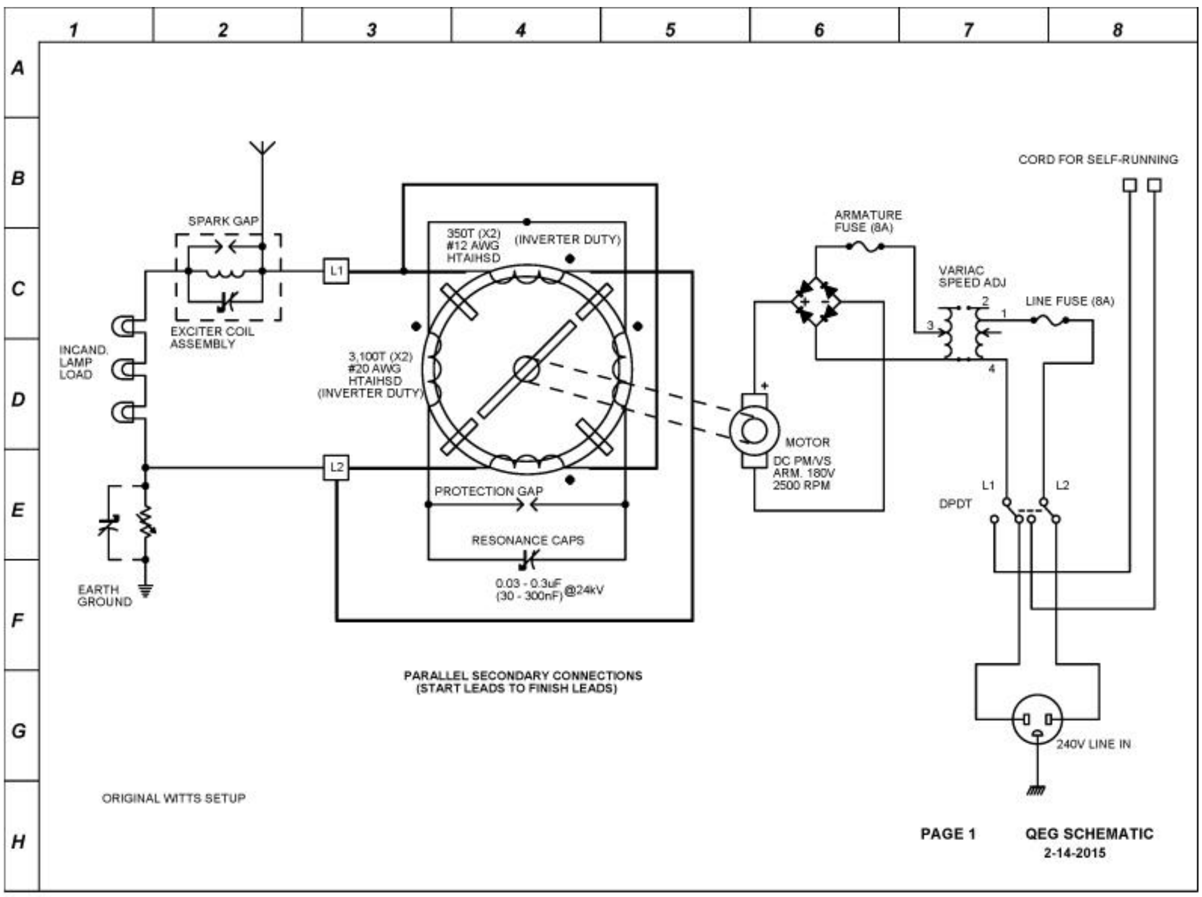
240V to cover the maximum system voltage.

Barrier Strip



We bought a 12 position barrier strip rated at 40 amps, to interface all the generator connections to the output, protection gap, load bank, and capacitor bank. There are 12 double-row terminals that will handle all 8 wire leads from the generator securely.

Optional (Parallel) Secondary Wiring Diagram



Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 4 VIDEO/PDF PACKAGE

Chapter 5: Initial Mechanical & Electrical Setup

Initial wiring

With all components mounted on the base, wiring can begin. Please follow the included schematic to make connections. We mounted a 12-position, 40 Amp rated barrier terminal strip on the base to support the external wiring connections (see photos).You could also use the euro style barrier terminal strips, which come in many different sizes and current ratings to make your connections. There should be plenty of lead wire length from the core windings protruding from the rear end plate. We will now discuss how to dress and terminate the high voltage primary and low voltage secondary leads.

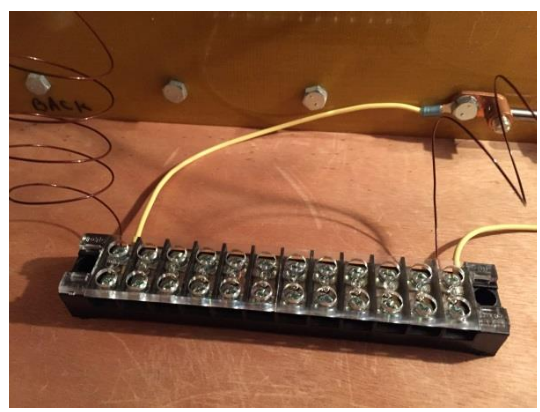
The #20 wire primary leads exiting the bottom of the end plate should connect to the capacitors and the protection gap at either end of the terminal strip. This is to assure clear distance from the secondary low voltage leads and adjacent connections. We opted to coil up any excess lead length, in place, rather than cut the leads shorter, as we may want to move connections around later.

We mounted a 2-position terminal strip at the top of the rear end plate radius, to connect the 2 primary START leads together. Again, this keeps the connection at the top, away from the lower voltage connections, and also provides a detachable termination for possible future experiments. The secondary leads are brought down to the base right in line with where they exit the end plate. They are then coiled near the bottom and connected to the terminal strip. This is where you will make your connections to the load bank, capacitor bank, exciter coil and ground. Test instruments can also be conveniently connected here.

NOTE: When designing your base to mount the generator assembly, be sure to leave space at the back of the generator to allow for wiring of leads, mounting of terminal strips, and installation of any additional capacitors or measuring equipment).

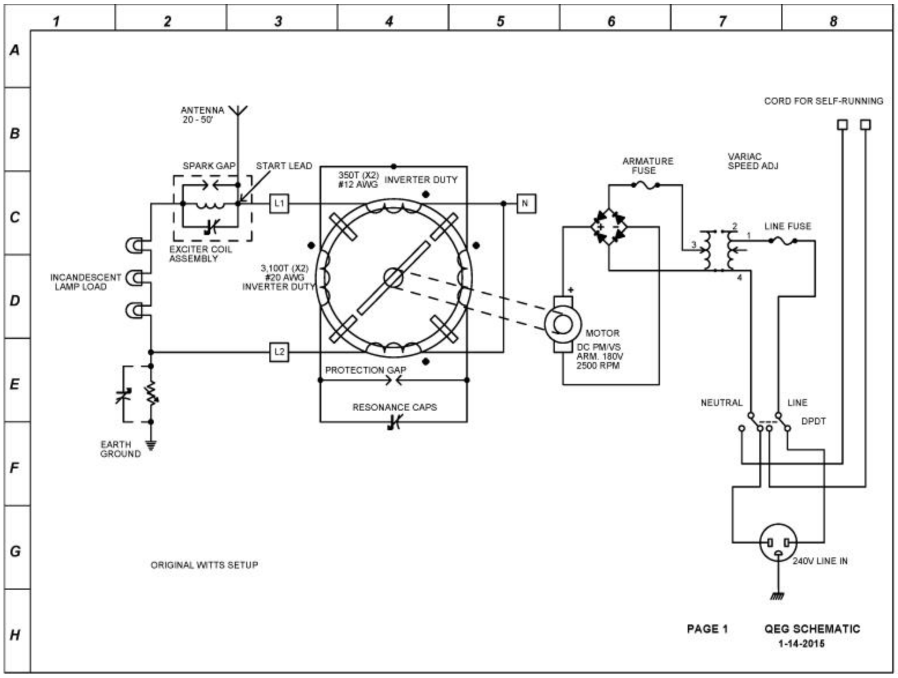
Terminal strip photos

The white plastic euro style terminal strips have the added feature of being able to cut them apart to make strips with as many positions as you need.

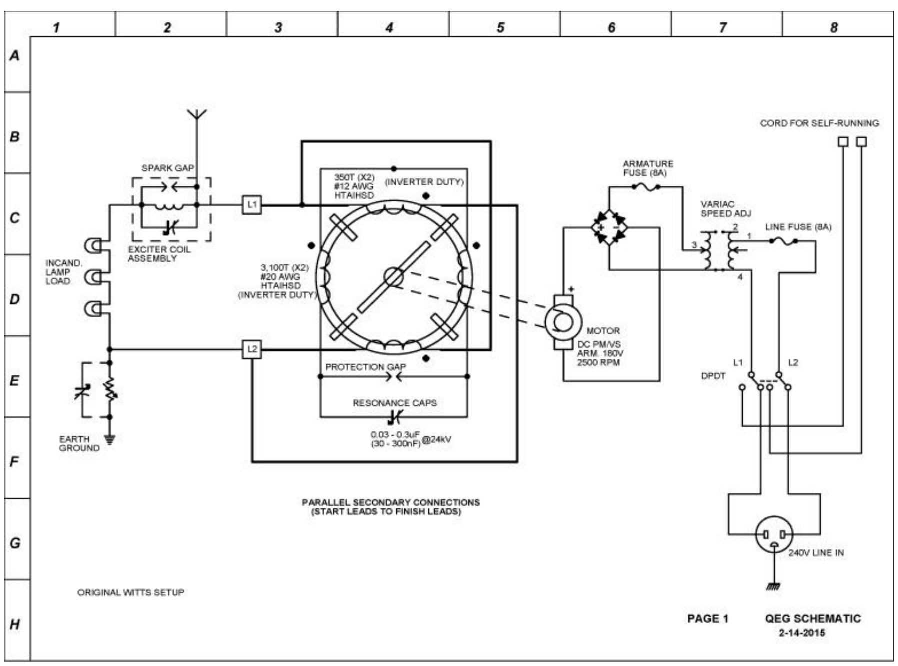


Winding configuration

You can configure the generator for either 120 Volt or 230/240 Volt. The first image on the next page is set up for 230/240 Volt line (see reference documents at back of book). The #12 gauge secondary windings are connected in series with each other, and with the load bank. This setup will give you the highest voltage output and lowest current.



The configuration below is arranged for 120 Volt line (see image below). Here the secondaries are connected in parallel (polarity-opposed) to each other. The start lead of one secondary winding connects to the end lead of the other. (Full-sized schematics at back of e-book.)



Setup Considerations

The variac we used can be wired for 120 or 240 volt input, and provides 0-280 volts output, at up to 9.5 Amps. This is a versatile variac and can be used with either a 120 or 240 volt system. The output of the variac is connected to a 1000 volt, 25 Amp full-wave bridge rectifier to power the variable speed DC drive motor. Optionally, a 30-50uF, 400-450 Volt filter capacitor can be added across the bridge rectifier to filter out any AC hum in the motor.

Starting with the wiring setup as shown in the schematic, prepare the series/parallel capacitor bank, but do not connect to primaries at this time. This will prevent resonance momentarily. Connect input power to the variac. We started with a full 240 volt series wired system, but parallel 120 volt wiring can also be used.

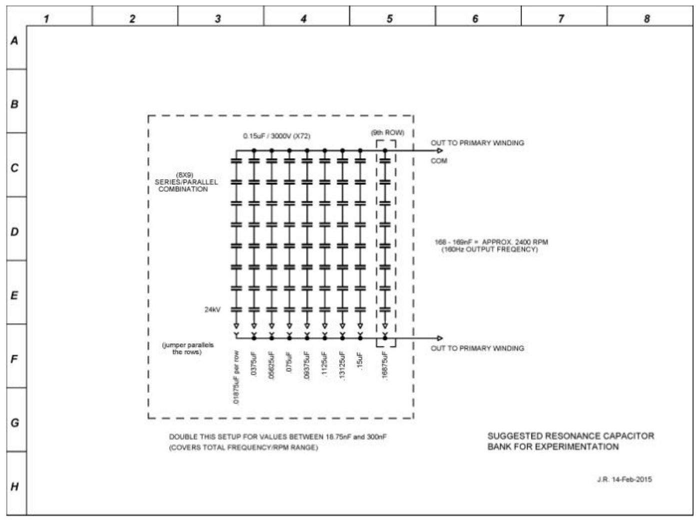
Test mechanical assembly by spinning up the motor/rotor/belt and observing operation. Adjust variac voltage from zero to about ¾ through its range. The active rpm range is under 3000 rpm, so we don't need to spin very fast. Assure there is no stack rub (rotor scrubbing on stator), or other mechanical issues that need to be corrected for smooth operation.

When proper mechanical operation is assured, connect the series/parallel capacitor bank. The recommended initial configuration of 72 (seventy-two) 0.15 uF (150nF), 3000 volt capacitors gives us .16875uF (168.75nF), that will withstand up to 24,000 volts. This initial value should be in the range to produce resonance at approx. 2400 RPM (about 160Hz). Be sure to apply a load on the output of the generator at all times! We recommend starting with the generator output wired in series, and four (4) 100 Watt/240 Volt incandescent lamps wired in parallel for initial load.

Approaching Resonance

If you are satisfied with the test run of your unit and the tank capacitor value, then it's time to establish resonance of your generator. Slowly increase the speed of the DC motor. As you approach the resonance point you will notice the rotor speed will overshoot slightly, then lock in to the RPM determined by the resonance capacitor value. At this point, phase lock is established.

Once into phase lock, trying to increase the rpm will not increase the rotor speed much, but will deepen the resonance, thus increasing power output. With a single control, the voltage and current (power) can be increased or decreased. (See reference material at end of ebook.)



NOTE: Safely discharge your capacitor bank after each use of the generator to avoid accidental electric shock in future use!

Load Bank

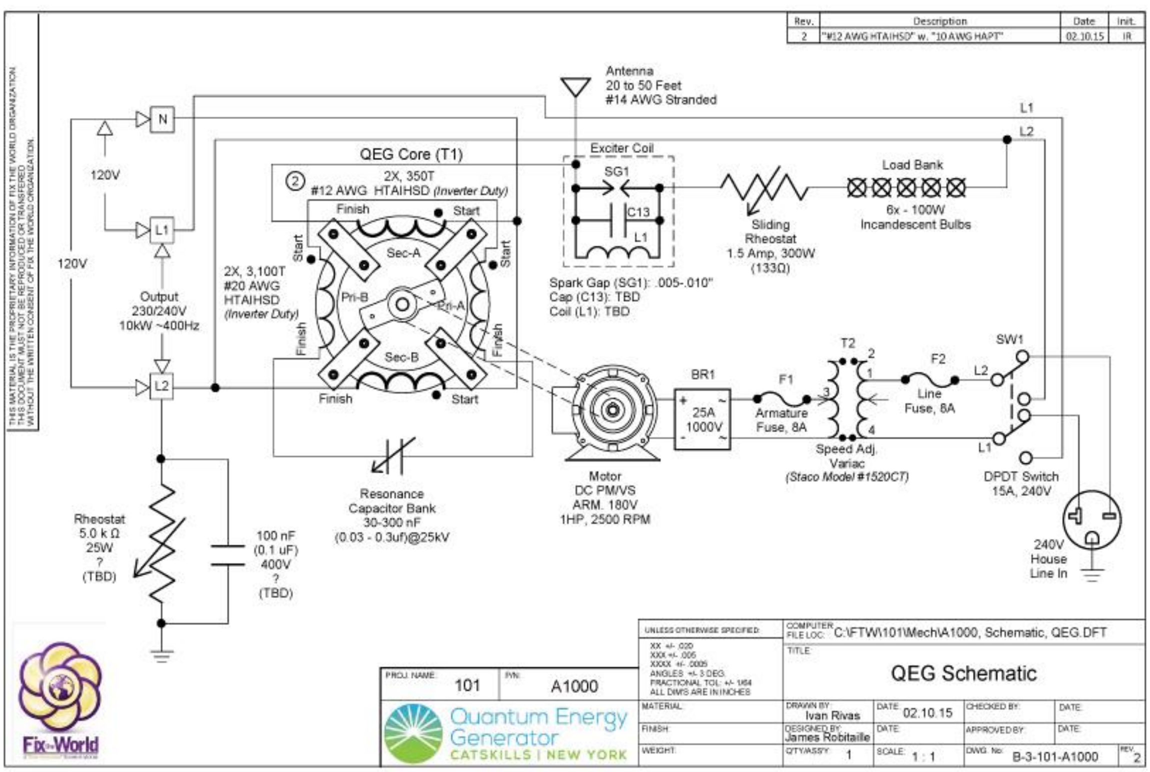
There are some safety concerns when running the generator that should be mentioned. When approaching resonance you want to approach gently as not to send too much surge current to the load. If the load bank is connected in-series, then you should expect higher terminal voltages to reflect the cumulative impedance of the load. You should have a method of re-arranging the load bank with little effort. Although this will save countless hours, it should not be at the expense of safety. We recommend varying the load while the machine is running using a power rheostat (i.e. 300W @ 1.5 amps).

Hazards and Dangers

Electrical / Mechanical devices are inherently dangerous. Both can cause serious injury, dismemberment and in some cases death. Due diligence has been applied to ensure that the generator instructions in this manual are complete and correct. All local and country-specific electrical and mechanical regulation code implications, by which such a device may be installed and operated, cannot possibly be known by us. Nor is it conceivable that any and all possible hazards and/or results of each procedure or method have been accounted for.

Therefore, the generator must either be directly installed or supervised by an experienced electrician or electrical technician/engineer, to ensure the installation is done safely and in accordance with local electrical code. However, the generator is installed the same way as any commercial generator and does not violate any electrical codes. Anyone engaged in this project must satisfy themselves that neither their safety, nor the safety of the end user, will be endangered over the course of the installation and operation of this efficient generator.

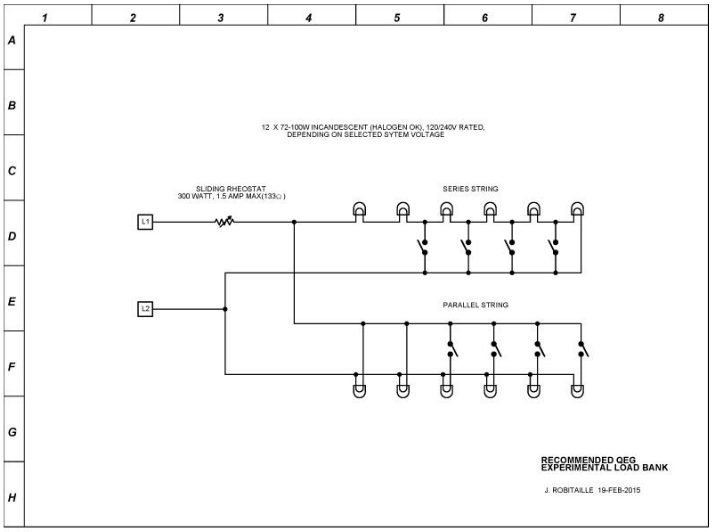
Like other renewable energy technologies, you may experiment with increasing the efficiency of your generator and integrate into wind and solar solutions to live off grid. You could then tell the utility company that you have moved to a renewable source of energy if they inquire.



Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 5 VIDEO/PDF PACKAGE

Chapter 6: Load Bank & Protection Gap



The load bank must be adjustable as you increase the power output. We recommend the load bank construction depicted in the photo (see actual size schematic at back of ebook).

This load bank can handle 1200W.

When you set up the load bank you'll want plenty of capacity. It's getting very difficult to find standard 100W light bulbs so you might only be able to get the 72W standard light bulbs that are now being sold. These are still purely resistive loads so they are okay to use.

As you're working with the generator there will be requirements for more and more load current. We recommend setting up so you can switch lamps in and out in series or in parallel.

In the load bank schematic, if you have 6 lamps in series you'll be able to handle a higher voltage output (up to about 1,440V). But you'll get to a point where that won't be enough load because the current is lowest with all 6 lamps connected in series (each lamp divides the current). Still, we recommend starting out with the series lamp string so that you can easily increase or decrease the load as you're developing the machine. There will always be a minimum of 2 lamps in circuit if you're using the highest wattage you can get (72-100W) so we didn't show switches on all lamps.

Using the series string, if you have all 6 sockets filled and all the shorting switches open, this would be the lightest load. To increase the load, you would switch (short-out) each of the lamps in sequence (starting with the last lamp in the string), so you would have increasingly more power going to the bulbs that are still in line. Maximum current would be with all 4 switches closed. Opening the switches (in sequence) will give you 3, 4, 5 and 6 lamps in series (opens up the series string).

When you get into the machine putting out higher output you'll want to switch to a parallel connection to be able to withstand more current. Depending on your budget, the parallel bulbs could just be unscrewed or disconnected (pull the bulb out) which will do the same thing as opening the switch, so you don't have to use the switches.

A single 100W light bulb @ 120 Volts draws close to 1 Amp, and using this parallel string you can handle up to about 6 Amps. This generator is a low current/high voltage generator and therefore will not put out much more than 4 amps -- but you'll have the high voltage on the output and this is how you'll still be able to get the power. (Voltage X Current = Watts is the same whether you have 10 Amps and 2,000 Volts, or 2 Amps and 10,000 Volts. You still have 20 kW in either case).

The load bank can also be built so that the series string can be converted to a parallel string. There are lots of options here.

The maximum power applied to the load bank during the developmental stage will be up to about 1,200 Watts. Once you get the generator output up to this point, you'll start testing using actual loads (once you get over about 1200W, and if your goal is self-running, you'll move away from the load bank and begin using real loads, such as the drive motor, for self-running).

If you're going to wire your generator output for 120V then the parallel connection would probably be used most of the time. If it's a series connection (230-240V system), then you would probably want to start with series light bulbs because of the higher voltage.

When you get to the point where you're tuning the exciter coil circuit, there's a requirement to be able to quickly increase the load as the energy is coming in from the environment. But switching in additional lamps while the generator is running will cause a step change in the current which will surge the generator.

The best way to increase the load while running is to use a sliding rheostat or a rotary rheostat. *This is most important for the development process while tuning.* When you get to the finish of your generator build, electronics will be used to regulate step changes in the load and prevent surging. We prefer a rheostat with a dial (rotary) because we can increment the load smoothly and avoid having a big step in it (surging) but we did use the sliding rheostat which we discuss below.

The sliding/rotary rheostat will be at the connection of the generator continually so you will always have it in line regardless of the load set up (series or parallel). The rheostat we used is pictured above left (the biggest one). This is a 300W power resistor that will handle up to 1.5 Amps. It's about 133 ohms and will handle up to about 200V. These are low torque; doesn't take much to move the slider.

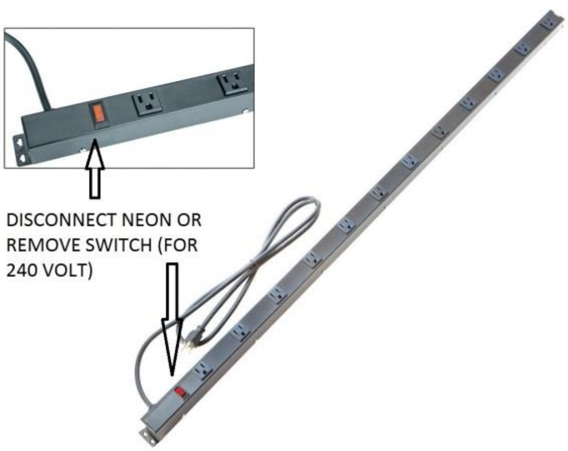
Depending on what country you're in, you'll use different lampholders on your load bank (reference different styles at back of this ebook).

The wiring can also be done several ways. We found that one of the best ways was to use the European style barrier strips (see chapter 5). These come in many different sizes and current ratings, so as your load bank gets bigger these are very handy in making all the connections.

You can construct this however you want. We used a 1"x 6" plank of wood and mounted the lampholders on it. You can also buy pre-made metal 15 amp, 12-outlet strips, and use lamp socket adapters and tap switches on each lamp. Series-parallel switches could also be mounted directly on the outlet strip for convenience.

We used standard light bulb sockets on a strip of wood with pull chains. We also recommend switches built onto the load bank.

You can experiment with both series and parallel configurations in your load bank. For the parallel connection, the phasing of the output coils (secondaries) is such that the start lead of one coil has to be connected to the finish lead of the other coil, and the finish of the first coil to the start of the second coil. These 2 outputs are then connected to the load bank.



The strip in the photo to the left is set up for 120 volts, so if you're going to use it on 240 volts it's a good idea to disconnect the neon lamp that's in the switch on the strip. We were using a 120V strip on 240 and it blew out that neon and burned the resistor so we are informing you.

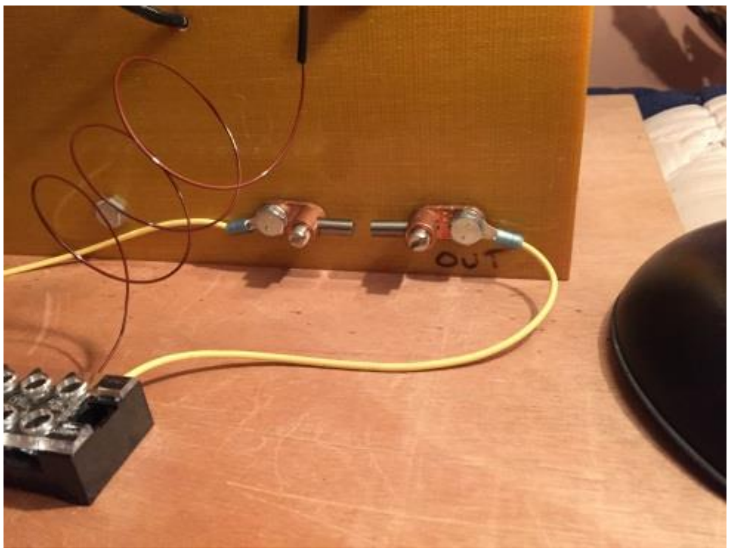
This strip is set up with all 12 sockets in parallel, and the switch controls all of them. So the whole strip is either off or on. We opened ours up, removed the switch, and left the first 6 outlets wired in parallel.

We then changed the wiring on the other 6 outlets so they would be in series. (You can reference the schematic for the load bank.) There is enough room in between the other outlets so that you could install a switch if you wanted to set it up like the schematic. Using these outlet strips is just a recommendation. You can do it however it works best for you. The strips are available at

Harbor Freight in the U.S., and are reasonably priced. You could buy two of them and make one all parallel and one all series. There are several ways to do this. We wanted to give you some options so you can visualize what it would look like.

The Protection Gap

The protection gap goes right across the connection to the capacitors for protection of the core. This is essentially 2 spark gap rods separated by about 4 mm initially. We adjusted the protection gap so that it sparks when the primary coil goes above about 12kV RMS. The opening can be adjusted to fire at any primary voltage level you wish to set as your maximum.



We've seen this spark gap fire on a number of occasions so it's a good fail-safe mechanism just in case you push the kVs a little too high – this spark gap protects the core (primary windings) from over voltage by providing a discharge path on the outside of the windings so that arcing cannot occur inside.

PLEASE NOTE: Notwithstanding the importance of a protection gap, there are some choices for your insulation system. However, regarding arcing within the core, the risks are more in how the machine is operated (operator error) than with the insulation system. Internal arcing can occur if the machine is operated in resonance with either no load, or too much load. These conditions cause the primary high voltage to rise above the rating of the wire insulation. As long as the machine is operated with a proper load, we have not seen any arcing in the core. The people building QEGs have found this to be very effective protection while testing and experimenting.

There are several ways to assemble your protection gap. Electrical one-hole mount lug terminals can be used to make a cheap and very easy spark gap. We recommend using these. The mounting hole is 9/32” and the hole in the barrel is also 9/32,” so you can put in a 1/4” steel rod and clamp it down with the screw. If you use 2 of these facing each other, you can mount them permanently to the core assembly, then connect your leads from the capacitors (see photo above). We bolted the protection gap lugs into the mounting shoe from the outside, using 2 of the 5 existing lag bolts through the end plate (see photo above). We used ring terminals under each of the lag bolts to wire into the terminal strip, where the primary leads connect to the capacitor bank. The spark gap will be across this connection all the time. When the generator’s all wired up, the output leads will also be connected to this terminal strip.

For the elements of the spark gap, you can use A2 type drill rod (the steel stock used to make drill bits) cut to length. You can also use ¼” soft steel rod (most hardware stores in the U.S. have a display with this type of rod). This protection gap won’t fire often so it really doesn’t have to be hardened steel, but when you assemble your exciter coil spark gap, you will need to use hardened steel or tungsten for the elements, to prevent erosion of the gap openings. You can grind the end of the drill rod into a point but you don’t have to. It will work flat but it’s easier to determine the 3KV per mm spacing measurement if they’re pointed.

The initial setup for adjusting the gap is about 4-6mm so if you go above 12,000 - 18,000 Volts it will fire. Eventually you’ll be going higher than that but this is a good starting point for resonance.

PLEASE NOTE: The very first time you go into resonance, the protection gap will probably fire off, regardless of the gap setting. This is due to voltage overshoot the first time the capacitors and primary coils are energized. Don’t be alarmed. This is normal and will only happen the first time. When you hear one or more loud cracks and see the sparks, just back off the RPM slightly, then dial it back up and it should go into resonance normally. If the gap fires the second time you go into resonance, open the gap slightly.

Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 6 VIDEO/PDF PACKAGE

Chapter 7: QEG Operational Description

This chapter will talk about how the machine actually works. We wanted to make sure that people understand as well as they can at this stage how this machine generates power, and what we'll be doing to get the second and third resonances working, in order for the machine to self-sustain and provide additional power to run your home and other electrical loads.

The Sweet Spot Test

There is a specific rpm and frequency (basic resonance level) where the generator will put out more power. This is what we've been calling the 'sweet spot' testing. You have to look for the RPM/frequency where you get the highest output power for the lowest input power from the mains (from the wall). It will be necessary to stop the machine, change capacitor value, then restart the machine at the new RPM/frequency. Each change in the capacitor value will change the RPM and frequency where the machine goes into resonance. Since each core has slightly different characteristics, you will need to experiment to find the best output condition.

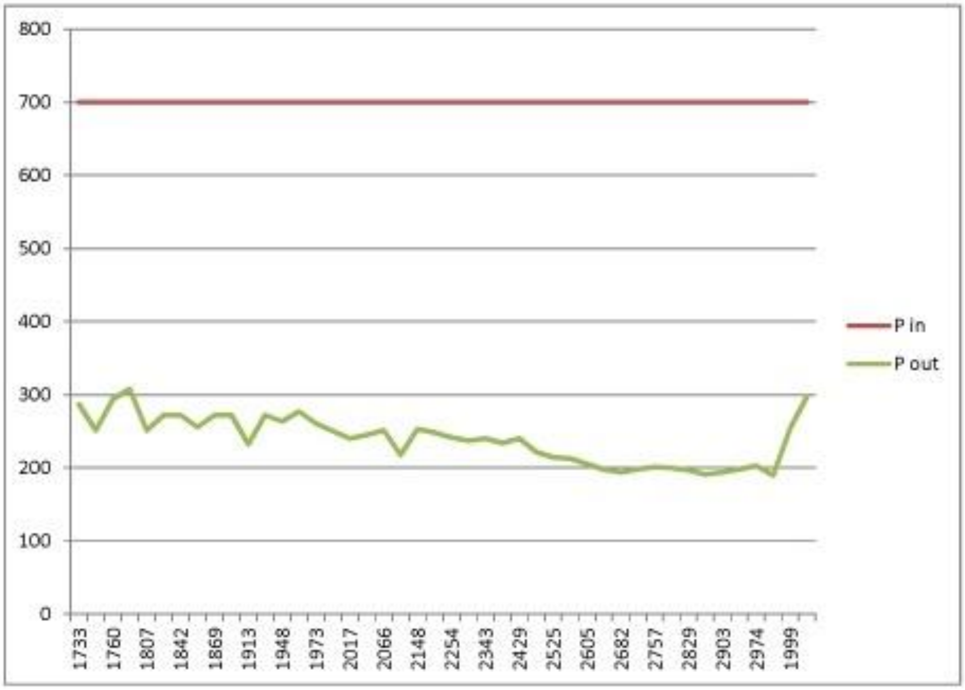
The following is what we did during the build in Morocco in April of 2014:

We purchased 50 microwave oven capacitors that were 5.0uF (microfarad) @ 450 volts. A Russian engineer that came to the build also brought us 6 military surplus capacitors that were 1.0uF @ 5,000 volts (5kV) each. We used these initially (167nF / 0.167uF total value wired in series), but we needed to be able to make small step changes in the capacitor value. We figured with the capacitors we had on hand, we could set up a test to increment the capacitor values (up or down) in steps of about 7nF (nanofarad). We decided to look for the sweet spot between about 1,700 and 3,000 RPM, because the overall mechanical design is smoothest and quietest in the range between 2,200–2,700 RPM, and the final operating RPM will most likely be in this range (the WITTS machine is running at 2,450 RPM in the '40kW Fuelless Generator' video).

See results of the 'Sweet Spot' test on the following page:

QEG SWEET SPOT TEST								
Test #	Image #	Power in W	RPM	Cap. nf	Vrms	Amp x0.1	freq	Pwr out
1	3277	700	1733	332.0	163	17.6	116	286.88
2	3278	700	1751	325.5	162	15.5	115	251.1
3	3279	700	1760	322.0	166	17.7	117	293.82
4	3280	700	1788	312.5	171	18	119	307.8
5	3281	700	1807	306.4	155	16.2	120	251.1
6	3282	700	1815	303.5	160	17	120	272
7	3283	700	1842	294.8	160	17	123	272
8	3284	700	1860	289.3	155	16.5	124	255.75
9	3285	700	1869	286.7	160	17	125	272
10	3286	700	1896	278.8	160	17	126	272
11	3287	700	1913	274.0	145	16	127	232
12	3288	700	1922	271.5	160	17	128	272
13	3289	700	1948	264.4	155	17	129	263.5
14	3290	700	1965	260.0	163	17	130	277.1
15	3291	700	1973	257.9	160	16.3	132	260.8
16	3292	700	2023	251.0	165	20	135	250.2
17	3294	700	2017	247.7	150	16	135	240
18	3295	700	2050	241.3	156	15.7	136	244.92
19	3296	700	2066	236.6	160	15.7	137	251.2
20	3297	700	2099	229.6	145	15	138	217.5
21	3298	700	2148	220.5	160	15.8	142	252.8
22	3300	700	2195	210.9	155	16	146	248
23	3303	700	2254	201.1	150	16.1	150	241.5
24	3304	700	2298	193.8	150	15.8	151	237
25	3305	700	2343	186.6	150	16	156	240
26	3306	700	2385	180.1	150	15.6	159	234
27	3307	700	2429	174.0	150	16	163	240
28	3308	700	2485	166.6	144	15.4	165	221.76
29	3309	700	2525	161.8	140	15.3	169	214.2
30	3310	700	2566	156.6	138	15.4	171	212.52
31	3311	700	2605	152.2	136	15.1	173	205.36
32	3312	700	2645	147.7	130	15.2	176	197.6
33	3313	700	2682	144.0	130	14.9	179	193.7
34	3314	700	2719	140.0	132	15	181	198
35	3316	700	2757	136.3	135	14.9	184	201.15
36	3317	700	2793	132.9	134	14.9	186	199.66
37	3318	700	2829	129.5	132	14.9	188	196.68
38	3319	700	2867	126.4	130	14.7	191	191.1
39	3320	700	2903	123.6	130	14.9	194	193.7
40	3321	700	2939	120.6	132	15	196	198
41	3322	700	2974	117.8	138	14.7	198	202.86
42	3324	700	3008	115.2	129	14.7	200	189.63
43	low check	700	1999	251.6	160	15.9	133	254.4
44	xtra lo check	700	1727	337.8	170	17.5	115	297.5

Power, speed curve



We took scope shots of each of the steps, and we used a plug–in appliance monitor (similar to the 'Kill-a-Watt®' line of products), to monitor the RMS wattage input.

We then ran the machine up into resonance and set the variac so the input power was right at 700 watts for each step. We tried to keep the input power very close to 700 watts for each change of capacitor value. The value of the resonance capacitors determine the frequency (and rpm) at which the LC tank circuit goes into resonance. Notwithstanding the action of the spinning rotor, the inductance in the 3100 turn coils is basically fixed, so the RPM you're going to run at in resonance is effectively determined by the capacitor value only. We did the first test with 332nF which resulted in 1,733 RPM/116Hz. We then went through many iterations with the capacitor values (in 7nF steps), up to 3,008 RPM/200Hz. The best output power was at the low end of the RPM range we selected, at TEST #4 (1,788 RPM, 119Hz, and capacitor value of 312.5nF). This confirms that the machine (at the basic resonance level) generally has more power output at lower RPM.

Note the RPM/frequency where you get the best power output from your machine. You will need to do the sweet spot test again after we get the second resonance, and again after the third. This is most likely what will determine the final RPM. There is a lot of stored energy in the core. Determine which frequency/RPM will put out the most power with the least input from the wall.

Capacitors

We chose to conduct our experiments with 3000 volt rated capacitors. The higher the voltage rating of each capacitor, the fewer you will need to meet the 24 kV voltage withstand requirement (12 units required @ 2,000 Volts each, but only 8 units @ 3,000 Volts). One of the concerns with the capacitors is cost. As the capacitance (nF/uF value) goes higher, so does the price. Above about 1.0uF (1000nF), the price begins to go up rapidly. Also, it becomes increasingly difficult to find capacitors with high voltage ratings as you go higher in capacitance value. Several QEG teams have used twelve 2.5uF/2,000 Volt snubber capacitors on their machines for first resonance… but these are expensive capacitors. Depending on your budget, it may be cheaper to use 3,000 Volt (or higher) rated units, with lower capacitance value. You'll need to use more units to get to the desired capacitance value, but it's still cheaper to go with more capacitors of smaller value (see Chapter 3 for detailed information on constructing a suitable capacitor bank).

Operation of the Machine

All 4 of the windings share the same toroidal core. Toroidal means ring or donut shaped, and also indicates that all the lines of force are contained within the core. This is a toroidal core with 4 pole pieces, making it quite unique. Another name for this generator could be variable reluctance generator or switched reluctance generator, since the primary high voltage is self-generated through mechanically pumped parametric resonance. The resonance occurs as a function of the spinning rotor modulating (switching/varying) the reluctance/inductance in the primary tank circuit windings. This modulation initiates an oscillation which can develop up to 20,000 volts (20kV) or more in amplitude, with frequency determined by the tank capacitor value and inductance value in the primary windings. Power is then transferred to the secondary during the intervals where the rotor is between pole pieces (unaligned). The resultant power output is relatively high-voltage, low current AC.

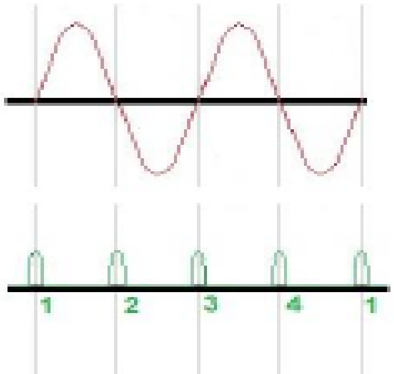
‘Parametric’ resonance is defined as an oscillation resulting from the changing or variation of one (or more) parameters of a tuned circuit (tank circuit). The parameter we’re varying is the inductance/reluctance in the primary windings. The primary oscillation happens on a toroidal core with other windings on it, so the other windings (secondaries), pick up the collapse of the field that is generated from the oscillation.

A conventional generator is based upon the windings having a constant fixed reluctance and inductance value. A wound rotor, with slip rings or a commutator rotates within a field produced by permanent magnets or electromagnets, and there is no tuned circuit (tank circuit).

In the QEG, the frequency in the primary is half the frequency in the secondary. The inductance (and reluctance) is modulated 4 times per revolution as the rotor spins past the stator poles. To calculate the output frequency from RPM, simply plug in the RPM value and divide that by 60. Take the result and multiply by 4. This will give you your output frequency, and the input frequency (primary frequency) is half of that.

$$E = \frac{d}{dt}(Li) = \underbrace{L\frac{di}{dt}}_{\text{Flux Coupling Term}} + \underbrace{i\frac{dL}{dt}}_{\text{Parametric Coupling Term}}$$

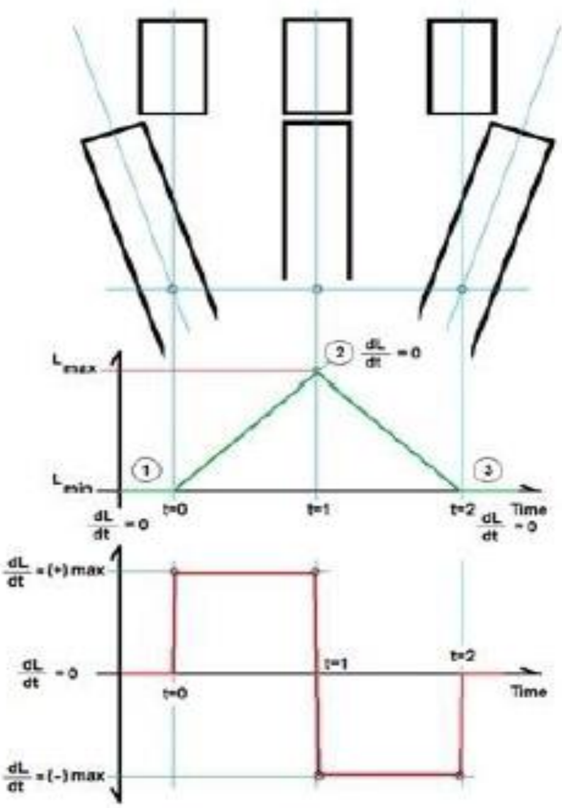
Parametric Energy Equation



Sine wave current
in parallel LC resonant circuit

Parametrically pumped inductance
pulses at current zero crossings

Fig. 1



Pole/Rotor alignment
progression

Corresponding change
in Inductance over time

Corresponding Rate of Change of
Inductance over time

Fig. 2

TANK CAPACITOR MIX AND MATCH

Discrete Value	Final Value			Total Value of (n) Parallel Rows (nF)				
2000V Rated	Series Multiplier	uF	nF	X8	X9	X10	X11	X12
0.1uF	X 12	0.008333	8.3	66.4	74.7	83	91.3	99.6
0.15uF	X 12	0.0125	12.5	100	112.5	125	137.5	150
0.2uF	X 12	0.016666	16.6	132.8	149.4	166	182.6	199.2
0.25uF	X 12	0.020833	20.83	166.64	187.47	208.3	229.13	249.96
0.3uF	X 12	0.025	25	200	225	250	275	300
0.35uF	X 12	0.029166	29.16	233.28	262.44	291.6	320.76	349.92
0.4uF	X 12	0.033333	33.3	266.4	299.7	333	366.3	399.6
0.45	X 12	0.0375	37.5	300	337.5	375	412.5	450
0.5uF	X 12	0.041666	41.6	332.8	374.4	416	457.6	499.2
0.55uF	X 12	0.045833	45.83	366.64	412.47	458.3	504.13	549.96
0.6uF	X 12	0.05	50	400	450	500	550	600
0.65uF	X 12	0.054166	54.16	433.28	487.44	541.6	595.76	649.92
0.7uF	X 12	0.058333	58.3	466.4	524.7	583	641.3	699.6
0.75uF	X 12	0.0625	62.5	500	562.5	625	687.5	750
0.8uF	X 12	0.066666	66.6	532.8	599.4	666	732.6	799.2
0.85uF	X 12	0.070833	70.83	566.64	637.47	708.3	779.13	849.96
0.9uF	X 12	0.075	75	600	675	750	825	900
0.95uF	X 12	0.079166	79.16	633.28	712.44	791.6	870.76	949.92
1.0uF	X 12	0.083333	83.3	666.4	749.7	833	916.3	999.6
1.2uF	X 12	0.1	100	800	900	1000	1100	1200
1.5uF	X 12	0.125	125	1000	1125	1250	1375	1500
2.0uF	X 12	0.166666	166	1328	1494	1660	1826	1992
2.2uF	X 12	0.183333	183.3	1466.4	1649.7	1833	2016.3	2199.6
2.5uF	X 12	0.208333	208.3	1666.4	1874.7	2083	2291.3	2499.6
3.0uF	X12	0.25	250	2000	2250	2500	2750	3000
3000V Rated				X8	X9	X10	X11	X12
0.1uF	X8	0.0125	12.5	100	112.5	125	137.5	150
0.15uF	X8	0.01875	18.75	150	168.75	187.5	206.25	225
0.2uF	X8	0.025	25	200	225	250	275	300
0.25uF	X8	0.03125	31.25	250	281.25	312.5	343.75	375
0.3uF	X8	0.0375	37.5	300	337.5	375	412.5	450
0.35uF	X8	0.04375	43.75	350	393.75	437.5	481.25	525
0.4uF	X8	0.05	50	400	450	500	550	600
0.45	X8	0.05625	56.25	450	506.25	562.5	618.75	675
0.5uF	X8	0.0625	62.5	500	562.5	625	687.5	750
0.55uF	X8	0.06875	68.75	550	618.75	687.5	756.25	825
0.6uF	X8	0.075	75	600	675	750	825	900
0.65uF	X8	0.08125	81.25	650	731.25	812.5	893.75	975
0.7uF	X8	0.0875	87.5	700	787.5	875	962.5	1050
0.75uF	X8	0.09375	93.75	750	843.75	937.5	1031.25	1125
0.8uF	X8	0.1	100	800	900	1000	1100	1200
0.85uF	X8	0.10625	106.25	850	956.25	1062.5	1168.75	1275
0.9uF	X8	0.1125	112.5	900	1012.5	1125	1237.5	1350
0.95uF	X8	0.11875	118.75	950	1068.75	1187.5	1306.25	1425
1.0uF	X8	0.125	125	1000	1125	1250	1375	1500
1.2uF	X8	0.15	150	1200	1350	1500	1650	1800
1.5uF	X8	0.1875	187.5	1500	1687.5	1875	2062.5	2250
2.0uF	X8	0.25	250	2000	2250	2500	2750	3000
2.2uF	X8	0.275	275	2200	2475	2750	3025	3300
2.5uF	X8	0.3125	312.5	2500	2812.5	3125	3437.5	3750
3.0uF	X8	0.375	375	3000	3375	3750	4125	4500

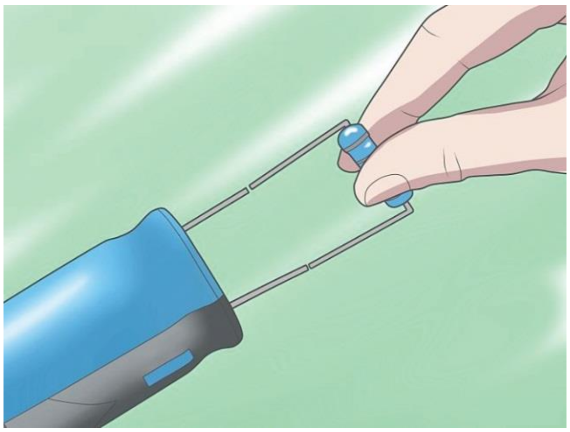
Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 7 VIDEO/PDF PACKAGE

Chapter 8: Safety, Interactions & 3 Rs Part 1

The cautions and safety information in Chapter 5 has mostly to do with installing the QEG when you get to that point. It talks about the need to have professional assistance/advice when installing, even though it's installed the same way as any conventional generator.

Another safety issue that can come up with the machine is the possibility of the resonance capacitors holding a charge after the machine has stopped. In the experiments we've done to date we've never had the resonance capacitors hold a charge, but just to make sure everyone is safe, we recommend that you at least try to discharge them after running live tests and before handling them or changing connections. Momentarily short out the two primary coil leads right at the connections to the capacitors, or directly across the capacitors. We recommend using a 5 to 10 Watt resistor (in the range of 100 to 1000 ohms) and momentarily connect it across the primary coil/capacitor leads.



In the discussion of the safe operation of the machine, there are some interactions you should be aware of, and there are quite a few variables. The generator will resonate at many different frequencies (anywhere between 50 and 500 nanofarads). You can put those values of capacitance in and get resonance at various rpms. The machine produces a little more power at the lower frequencies (between 1500 and 2000 rpm).

In Chapter 6, we talked about setting the opening of the spark gap to whatever maximum high voltage level you'll be running at for experiments. The level of primary high voltage generated depends on tank capacitor value, rotor rpm, and load value. Generally speaking, when you dial up the machine and start to get into resonance, the way it operates normally is thus: the rpm will overshoot slightly as you're spinning up the rotor and approaching the resonant frequency. When you get to the resonance point you can hear the rpm overshoot slightly, then the phase lock takes over and clamps the rpm right at the frequency determined by the particular combination of capacitors, rpm, and load value. If you try to increase the speed any further when it's in phase lock, the rpm doesn't increase much but the output power increases. As you add more mechanical energy to the machine the resonance deepens and you get more power output, and the primary high voltage increases in response to increases in the load.

There are some dependencies and interactions based on whether the generator is heavily loaded or lightly loaded. The most obvious is, as you approach resonance with too light a load, it will bounce in and out of resonance (speed up, slow down). As this is happening, the light bulbs will repeatedly go on very brightly, then go off and you'll hear the speed of the generator fluctuating (it will go into resonance, come out and go in again, etc.). Be careful if you see this happening, as you could blow out a light bulb, which could cause a no-load condition and firing of the protection gap. The solution is to add more load, which will stabilize the generator output (the minimum load we've been able to run is about 400 Watts). It will be very stable when you get a good minimum load at your selected resonant frequency (set by the capacitor value).

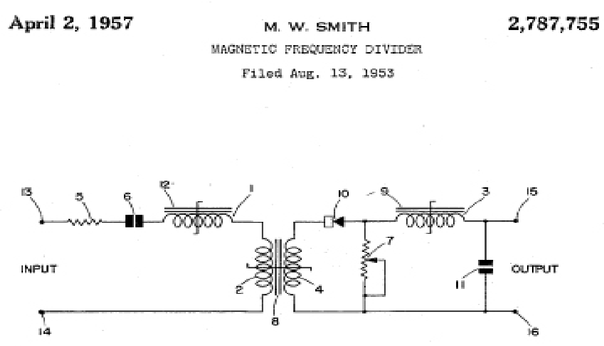
At this point in development the resonance has some dependency on how the output is wired, whether in series or parallel, and how much load (light bulbs) you're drawing from the machine. This will all affect the point at which the machine goes into resonance.

Although the tank circuit parameters set up the basic resonance point, the load setting also affects where it goes into resonance, but to a lesser extent than the capacitors. If the load is lighter it will go into resonance at a slightly higher rpm. When you have a heavy load it will go into resonance at a slightly lower rpm. It's not a big difference but you should always have the load set up and connected whenever you go into resonance.

We recommend that you start with between 400 and 600 Watts of light bulbs. Whether you use 120 Volt or 230/240 Volt bulbs depends on what secondary wiring you select (parallel or series, 120 or 230/240 Volt system). If using our suggested load bank, the sliding (or rotary) rheostat should always be in circuit, so the load value is continuously adjustable *within* the fixed value set by the light bulbs.

NOTE: The load setting and capacitor value are the factors that determine the RPM/frequency where the machine will go into resonance.

When you get to the final stage there will be some electronics used to stabilize the voltage at 120 or 230/240 Volts, and also to convert the output frequency. We want to keep the system as affordable as possible, so the ultimate goal is not necessarily to connect the generator to an inverter (to interface with the electric grid), although that is one final use. There are several techniques that many groups working on QEGs are ready to apply, that are targeted more toward a stand-alone, off-grid system that won't require you to buy an inverter in addition to the cost of the generator.



One of those circuits is a magnetic frequency divider (see photo). The photo is of a simple circuit (public domain patent). As of the writing of this ebook, we will need to build this and scale the components to be able to handle the voltage and current that's in the system. These are saturable reactors and a saturable transformer. The reactors will only operate through a certain range of magnetic flux. At the point they become saturated they will pass all the signal. If you divide by 8 you can input a frequency around 400 Hz and the output side will convert to 50 or 60 Hz, but it doesn't change the power. This circuit should be able to pass all the power that we're generating but it will modify the frequency and stabilize the voltage. This is just one possible solution for electronically conditioning the output when we get to that point.

MEASUREMENTS

Fluke 80K-40 kV Probe

When you want to safely measure the high voltage level, use a 1000:1 voltage probe (see tools-equipment list). Measure across the terminals where the resonance capacitors connect to the primary coil leads. This will give you the primary circuit voltage reading. To measure the voltage in the secondary, measure across the L1 and L2 outputs (see schematic). This probe will allow you to read up to

40,000 volts on your digital multimeter or oscilloscope. The probe we recommend has a dual banana plug for easy connection to your multimeter. If using the probe on a scope, you will need a banana plug-to-BNC adapter (tools-equipment list). Measure between the tip of the probe and the ground clip (the clip would go to one side of the capacitor bank and the tip to the other).

USE CAUTION!!! – HIGH VOLTAGE

Cen-Tech 98674 DMM

This is a unique digital multimeter from Cen-Tech that we found at Harbor Freight stores in the U.S. (only $60 USD)! In addition to the normal measurements of voltage, current, and capacitance, this meter also measures temperature, humidity, light intensity and sound intensity. In addition, if you have the rotary dial set to a position that's wrong for the leads, the banana sockets light up to indicate where you should connect the probes for the setting you have on the rotary dial (so you know where to plug in).

Input Power Monitor

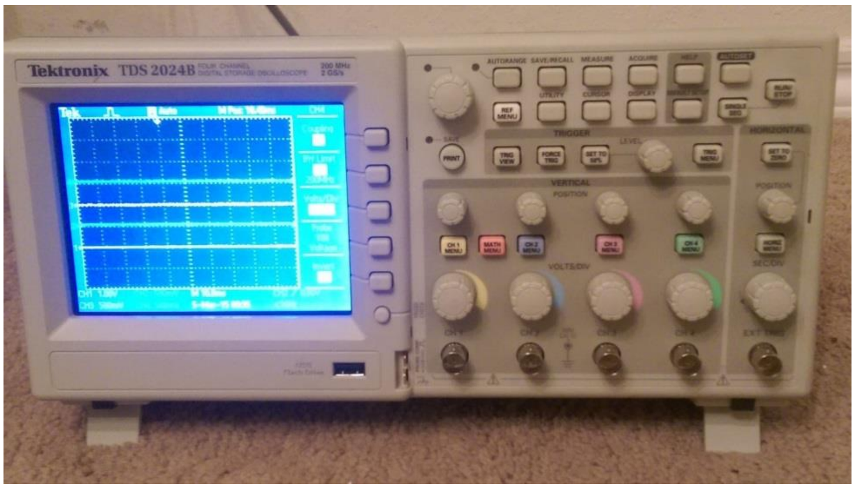
The power monitor we recommend (HQRP Model D02A) has universal input voltage (90 to 280 Volts) so it can be used anywhere in the world, and has many other useful functions. We have incorporated this meter into our QEG setup to monitor the input power (wattage) full-time. Install this at your power source, and then plug in your supply cord going to the QEG. All QEG power comes through the meter, so this will allow you to determine how much power you're drawing from the grid, and compare that with how much power you're generating.

Uni-T Model UT-612 LCR Meter

The LCR meter we use measures inductance, capacitance and resistance, and has adjustable test frequency for better measurement accuracy. Test frequencies of 100Hz, 120Hz, 1kHz, 10kHz and 100kHz can be set for inductance and capacitance readings. This is a useful feature for examining a component nearer to its actual operating frequency. This will be useful when we reach the point of tuning the exciter coil using low value mica and ceramic capacitors.

It's a good idea to have 2 LCR meters during the testing because there are a lot of factors involved when measuring inductance. It will be helpful to compare readings from one meter with readings from a second meter to verify a measured value. It can also make a difference how much contact the probe is making with the device under test. This meter comes with a test clip with wide conductors so you can get better contact to the component you're testing.

Most LCR meters a have maximum range of only 20 Henrys. We will be working with values up to 26 Henrys (measuring the primary inductance), so make sure *both* your meters have a range greater than 20 Henrys. Comparative readings are very helpful when working with inductors and low-value capacitors. In addition, this meter has an extremely accurate DC resistance function. This is also handy when working with inductors.



Oscilloscope

We used a Tektronix TDS 2024B, 200 MHz, 4 channel oscilloscope with FFT (fast Fourier transform) function. FFT allows you to use the scope as a spectrum analyzer. This will be handy for the second and third resonances, especially working with the exciter coil. The spectrum analyzer function isn't absolutely necessary, but is helpful for signal analysis.

This scope also performs math functions so you can plot voltage and current waveforms to calculate power, and observe wave forms when they're added or subtracted. This is a good feature-rich scope at a good price. Used, fully functional, calibrated units can also be found on e-bay.

NOTE: You do not need electronics to get to overunity with this machine. Electronics are only needed to regulate output voltage and frequency. We have several electronic solutions (inverter-like technology) to rectify the output (convert to DC), chop it up in the inverter and convert it back to AC. This is one way to get control of the amplitude and frequency of the output power.

NOTE: Regarding the grid-tie type of inverters that connect to your electrical mains; if you have momentary demand for more power than the generating system can provide, the inverter will automatically take some of the power you're demanding from the grid. Conversely, at the times when your demand is low you can actually feed power back to the grid (reduce your bill, or even get money back from the electric company)!

Another Interaction

If the secondary isn't loaded, the primary voltage will rise too high. **The power that you draw from the load is what regulates the primary high voltage.** So if there isn't any load on the generator there's a possibility of shorting out the core because the high voltage will rise uncontrolled. If you don't have a protection gap, it's possible the core could be damaged.

NOTE: Always have a load on the machine. We recommend starting with 400 Watts.

Please see APPENDIX for references and resource materials at the back of this ebook.

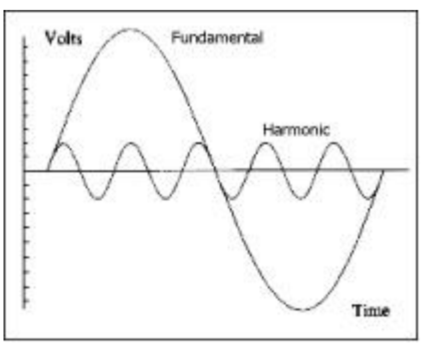
CLICK HERE FOR CLASS 8 VIDEO/PDF PACKAGE

Chapter 9: 3 Rs Pt 2, Exciter Coil, Grounding

We will have 3 resonances working together to amplify the generator's output voltage;

The first resonance is the parametric oscillation that's set up by the spinning rotor modulating the inductance (and reluctance) in the core. There is more than a 50% change in inductance between the aligned and unaligned positions. This constant changing of inductance as the rotor spins and speeds up (varying the inductance parameter), causes a small oscillation voltage to start, which quickly builds up in amplitude, until you have up to 20,000 Volts (20kV) in the primary coils. The rotor then locks in at the resonant frequency/RPM.

The second resonance is the core steel actually vibrating. From previous testing we know that the resonant frequency of the steel is around 1500 Hz. We have to get that number into a range where the generator can actually run. If we were to try to run the generator to produce a 1500Hz output that would be about 22,000 rpm, much faster than this machine can spin. In fact, the best speed range for the machine is under 3000 rpm. So the solution is to get the frequency of the steel to be around 400 Hz while the rotor is at 200 Hz or less. This can be done by resonating on a harmonic (photo), as we explain in the 'Next Steps' section (Chapter 10 of this e-book).



The third resonance is the exciter coil resonance, tuned (in the secondary circuit) to 1.3MHz, which conducts radiant energy into the core to condition and electrify the core steel.

There are some interactions, but the exciter coil resonance (3rd resonance) is not directly related to the mechanical resonance (2nd resonance), or to the parametric resonance (1st resonance), so the 3 resonances are isolated and *additive*.

Exciter Coil

The exciter coil is actually a 1.3 MHz tuned antenna, and the 20 to 50 foot external antenna wire is an extension of the exciter coil, used only to enhance the *amplitude* of the radiant signal coming in to the exciter coil. When the rotor aligns with a pair of stator poles, magnetic flux 'switches' across half of the stator core and a magnetic loop is created. As the rotor moves out of alignment, the reluctance between the rotor and core changes quickly and causes the circulating magnetic flux to break; this is where radiant energy is introduced into the circuit (Chapter 10).

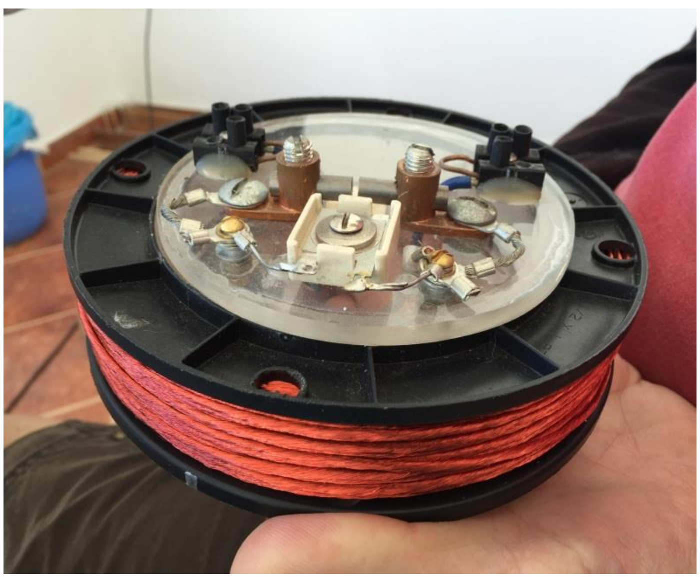
We were instructed by WITTS that the exciter coil could be wound using the same wire as used on the secondary windings, but they felt it was easier to bring in the energy using ‘multiple strand’ wire. We took that to mean we should use stranded/jacketed wire (instead of magnet wire), so we wound the first time using 100 turns of premium quality high-stranding (41/30), #12 jacketed wire. The first exciter coil was built as a single-layer helical (or solenoid) coil using this wire, but we found that tuning the circuit to 1.3 MHz proved difficult with the coil connected in-circuit, due to the presence of many harmonics making it difficult to tune to the fundamental frequency (1.3MHz).

When trying to condition the core with the exciter coil we should see a small spark across the exciter coil spark gap, but with the single-layer coil, there was not enough inductance to develop sufficient voltage to energize the spark gap. After further research we realized that the exciter coil cannot be constructed as a helical coil, rather, it should be wound using multiple layers, to yield the highest inductance.

During the time we were doing these experiments, an associate had taken a WITTS class (for their 3,000 Watt motor/generator project). That project uses an identical exciter coil, and we learned that what they meant by ‘multiple-strand’ was not standard stranded wire. They were talking about taking 4 or 5 strands of the #20 magnet wire used on the primaries, twisting it into a bundle with about the same overall diameter as a 12 gauge wire, and winding the exciter coil with that. In addition, our associate was given a link to a WITTS video, where the actual exciter coil is shown. Here is the link: https://www.youtube.com/watch?v=JgxL0V_NNcg

The exciter coil is a bit difficult to see in the video, but if you look carefully, stopping and starting the video, you can see it in-between the motor and the generator. It is indeed a flat, multi-layer loop type coil, about 1 inch thick, with about the same inside diameter as a CD (4.7"), and no coil form. Loop coils and loop antennas are traditionally used for radio direction-finding and for directional, rotatable amateur radio antennas (mostly for listening).

We realized that the multiple-strand wire WITTS mentioned is similar to Litz wire (multiple small strands of individually insulated magnet wire, soldered together at the ends, to form a single conductor). Litz wire is constructed to be impedance-controlled, and frequency specific, to minimize AC losses. With all the parameters considered, it seemed to be the best choice. We purchased some #14 Litz wire from an electronics surplus store, and that's what we're working with now. It's not the optimum strand size (165/36 - #14 AWG, 20-50kHz) for this frequency, but so far we have tried tuning the coil on the bench, and it tunes up much more easily (only 2 low amplitude harmonics, and the fundamental). The exact Litz wire for the application would be 1725/46. This is 1,725 individual strands of #46 magnet wire bundled together to form a #14 AWG single conductor, for use between 850kHz–1.4MHz. The insulation should be rated for minimum 3,000 Volts.



We will obtain 100 feet of the proper Litz wire, for continuing the experiment.

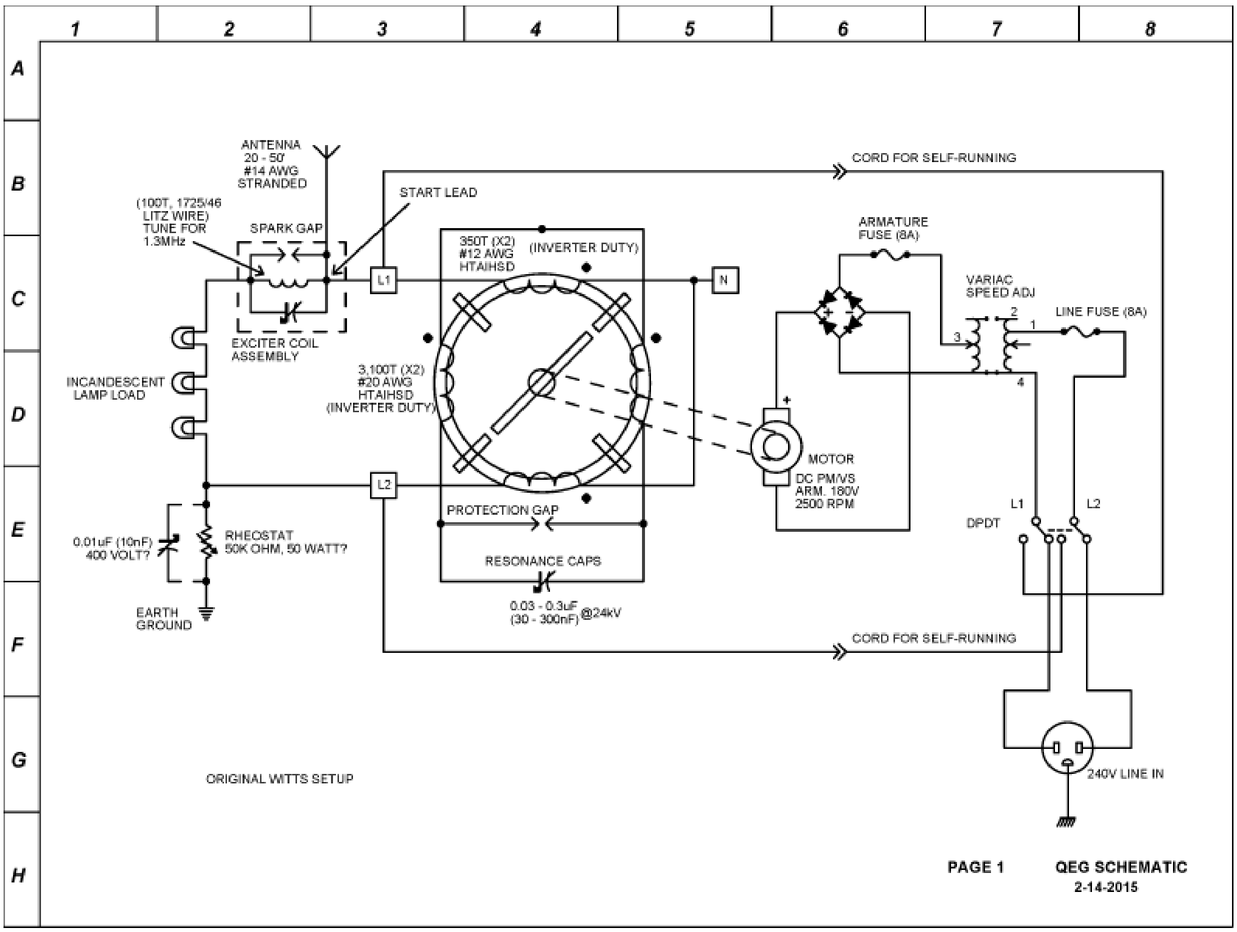
We are currently testing the exciter coil built as shown in the photo. As mentioned, we have done a rough tuning on this coil so far with good results. We cut off 1 inch from the top of the original exciter coil form (4.7 inch diameter Plexiglass/Perspex tubing), and glued on two flanges that were cut off an old wire reel. We then removed the cap (with terminals, variable capacitor, and spark gap) from the original helical coil, and attached it to the new coil form with hot melt glue.

The exciter coil must be physically placed in-between the motor and the generator during tuning, as it needs to take advantage of the circulating magnetic fields there, to assist with starting the

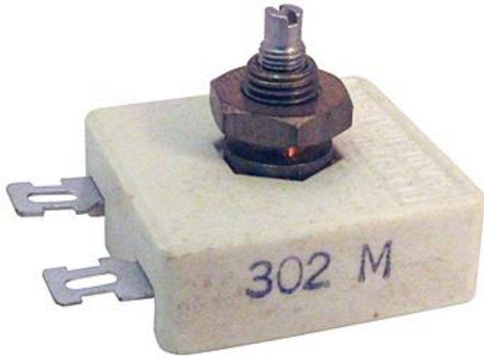
1.3MHz resonance. The motor position should be adjustable in order to optimize these magnetic fields impinging on the exciter coil windings (see “V-Belts” in Chapter 4).

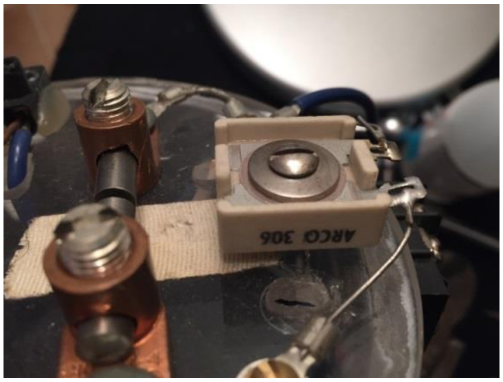
Exciter Coil Tuning

The exciter coil tuning procedure is thus: starting with the exciter coil wound with 100 turns of the above Litz wire, connect the START (inside) lead to the L1 terminal coming from the generator, along with the external antenna feedline. (See schematic here, and at back of book).



Then connect the FINISH (outside) lead from the coil to the *ungrounded* side of the load bank (L2 side is grounded). Your initial spark gap opening should be between 0.005” and 0.010”, and the initial value of the (fixed or variable) mica capacitor should be between about 30 and 50pF (picofarad). We recommend using a 1000 Volt rated, 15-125 pF variable mica compression capacitor here, such as Arco part number (CTM)-302M (see photos).





We made a 1-turn transmitting loop using a 2-foot long piece of #14 jacketed solid copper wire, with a 50Ω carbon composition resistor in series, to loosely couple the signal generator output into the coil. We taped the 1-turn loop flat up against the flange opposite the cover with the spark gap/capacitor/terminals. The transmitting loop does not make electrical connection to the coil, it's simply taped on to the flange in proximity to the coil windings.

Assure that the entire assembly is placed in-between the motor and generator, and set the signal generator output for sine wave, at about 2MHz initially. Set the signal output level to about half (about 10 Volts). Place your R.F. field strength meter somewhere within about a 1-foot radius of the exciter coil, and set it near maximum sensitivity. Making sure the load bank is connected, bring the generator into resonance. Now slowly sweep the frequency from 2MHz downward while looking for an indication on the field strength meter. Note the frequency at which you have the highest indication on the field strength meter (lower the sensitivity or move the meter further away if your reading is off the scale). The exciter coil's initial resonance will likely be below 1.3 MHz, so you'll have to remove turns until you get the highest field strength reading right at 1.3MHz. Adjust the variable capacitor to fine tune when you get close to 1.3MHz. There are several techniques for tuning an inductor, and it can be a bit tricky, but there are several websites where these techniques are explained in detail. If you need help with this step, you can Google "how to tune an inductor" for a better understanding.

Grounding

When trying to bring in the atmospheric energy, it's important to provide the opposite pole. This means we have to connect to a good ground (on the L2 side of the secondary). WITTS informed us that a variable resistor with a value between about 20k and 40k ohm should be placed in series with ground and the low side (L2) generator output, with a capacitor across it. They didn't provide the capacitor value, so it will have to be determined experimentally. We used a 0.01uF (10nF), 400 Volt film capacitor for the initial value. Also, a 15 Amp AC ammeter can be placed in line (in series) with the ground wire, to observe the atmospheric energy coming in. We used a 50k ohm, 50 Watt rheostat for the variable resistor, and drove an 8-foot copper clad ground rod into the earth about 30 feet from the generator for a solid ground reference.

We were instructed that as the generator is running, we should let the exciter coil spark gap discharge for 2-3 seconds at a time repeatedly while tuning, for the first couple of weeks of operation. As the energy is coming in (as observed on the ammeter in the ground line), the load should be momentarily increased using the 300 watt (sliding or rotary) rheostat on the load bank. This technique will help to bring the energy in faster.

At this point we need to develop the mechanical resonance (2nd resonance) before continuing with the exciter coil experiments. This is because we need to first increase the secondary voltage output, in order for the exciter coil to work properly (see Chapter 10 for details). We will continue with development of the exciter coil resonance after the current experiments, detailed in Chapter 10.

NOTE: Exciter coil is a little bit of a misnomer; it's actually an antenna to bring in the radiant energy from the atmosphere. This is not as difficult as one might think, since the machine creates its own radiant energy and the atmospheric energy will find it. This is how we connect to the radiant energy in the atmosphere needed to condition the core.

Please see APPENDIX for references and resource materials at the back of this ebook.

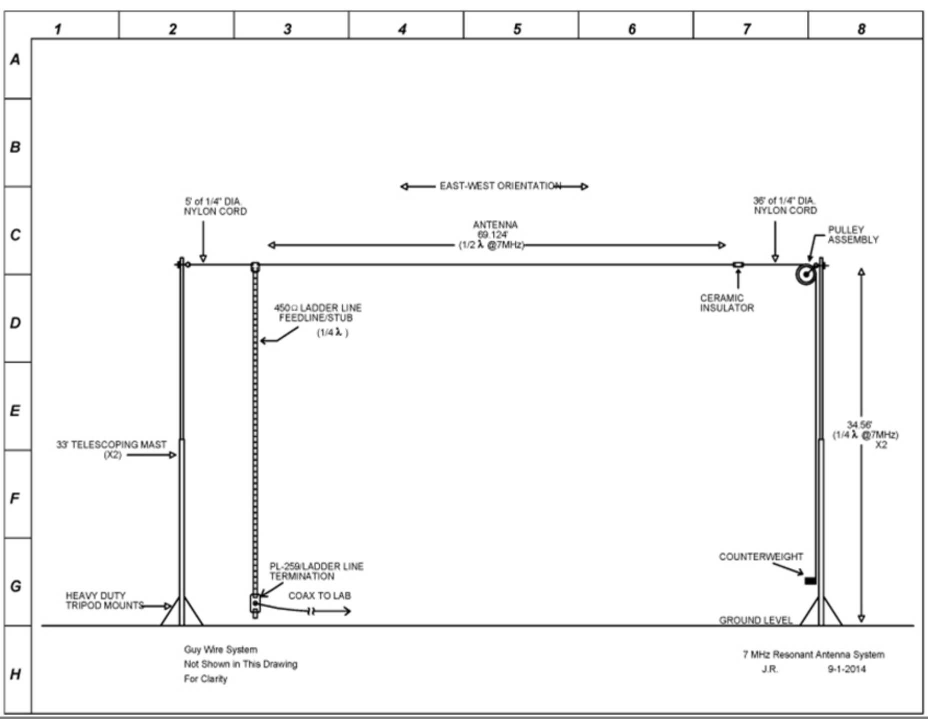
CLICK HERE FOR CLASS 9 VIDEO/PDF PACKAGE

Chapter 10: 3 Rs Pt 3, Antenna, Radiant Energy

History of Antenna Experiments

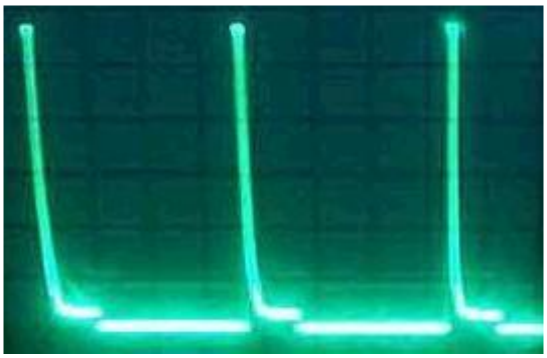
We were told by our teachers that an antenna can be connected to the exciter coil while tuning to assist in bringing in the radiant energy from the atmosphere. During our research for methods of obtaining this energy, we found a paper that discussed setting up a resonance between the ionosphere and an antenna on the surface of the Earth, where you could actually set up a resonant RF signal between your antenna and the ionosphere.

It seemed that in order to make this system work you would need to have a resonant antenna, the same style of antenna that's used by amateur radio operators. The antenna would have to be set up for the specific frequency you're going to be operating on; in this case 1.3 MHz. When you're tuning an air core inductor or coil, some amateur radio experience is handy. Also, using the spectrum analyzer function on your scope as discussed previously, you are able to see the signal strength as amplitude (peaks) on the scope. This shows the signal intensity at different frequency points across a range that you select. We determined the highest amplitude signals at our location, were around 7 MHz, and proceeded to construct a resonant antenna system with this information. However, after further research we discovered it doesn't have to be tuned or resonant. In fact, it's not as difficult to get this energy from the atmosphere as we first thought.



The reason you don't need a resonant antenna is because you're not trying to get a radio signal, you just need a conductor out in the atmosphere, and the higher you can get the antenna, the less time you'll spend getting the machine tuned, because you can pick up more of the radiant signal in the atmosphere just from the height. The antenna length should be anywhere from 20-50 ft., with a simple open wire feedline.

Radiant Energy



When the generator is in resonance and putting out power, the point where the high voltage is at maximum is during the interval where the rotor is aligned with the stator poles. There's no secondary output during this period. The power is transferred from the primary to the secondary when the rotor is unaligned (between stator poles).

When you're looking at the current in the secondary you can see many radiant spikes (any spikes that are narrower or shorter than 100 nanoseconds). If you look at the primary waveform on the scope it's very sharp and defined, and the same is true with the secondary *voltage* signal (well-defined), however, the *current* signal looks like a very noisy signal – this is not noise – these are radiant energy spikes. You will have these spikes in the whole system (the core and windings) when the system is operating; this is the machine creating (its own) radiant energy.

The document 'RF Energy via Ionosphere' attached to this e-book cites how it's possible to access electrical energy from the ionosphere using aerials to set up a resonance between a receiving antenna and the ionosphere. It is highly recommended that you read this document.

In deciding which (of the 2^{nd} or 3^{rd}) resonances to work on next, we started with the exciter coil resonance since it was shown (in the secondary circuit) as part of the original WITTS schematic. However, during development we determined that an increase in the generator's *voltage* output was needed first, in order for the exciter coil to work properly. This indicated that developing the mechanical resonance has to come first.

Next Steps

Please refer to the new build manual which can be downloaded free here:

https://hopegirl2012.files.wordpress.com/2015/03/qeg-build-manual-25-mar-15.pdf

We've successfully built 5 machines ourselves, and have confirmation of reaching (the first) resonance from at least 10 other builders around the world. At the present point in development, the machine will produce a maximum of about 800 Watts output, for input of about 1,000 Watts. So we're still 200 Watts away from unity (input and output at same level).

The machine was originally designed in the 1930's when modern electronics were not available, and electronics are not needed to generate output power well in excess of the input power used to run the motor and spin the rotor. Electronics are needed only for the frequency conversion (400Hz to 50/60Hz), and output voltage regulation (120/230-240 VAC). We have several different electronic (and some electromagnetic) solutions that can be applied once we reach that point in development, and of course we'll use the most efficient method.

When the machine is running and generating output, the primary voltage is produced by Parametric Oscillation (primary tank circuit reluctance/inductance modulated by the rotor motion). This is the source of power in the QEG, and power is transferred to the secondary windings at the zero crossing points, so there is no stall effect (very little back EMF/Lenz effect), and very little heating of the core/windings. These are some of the unique features of this generator.

2nd resonance: Core mechanical Resonance – Experiments

The second resonance is the mechanical resonance of the steel in the core. It is a piezoelectric effect vibration that creates voltage by creating a 'ringing' or vibrating motion in the steel. We will use this effect to produce a large amount of additional voltage in the core. The process of accumulating additional voltage through mechanical resonance is isolated from the basic resonance, but is also additive to it. The additional voltage that we create from the mechanical resonance will add to the output power of the generator, and also provide sufficient energy to properly drive the exciter coil circuit.

We made an announcement on the be-do website that entails adding a third coil set over the top of the secondary coils. This is how we propose to harness additional voltage from the core mechanical resonance. The experiment is detailed below.

Audio Amp Test

A 600 Watt automotive audio power amplifier was used (with 12VDC switching power supply) to drive the low impedance (approx. 1.5Ω) secondaries, wired in series. We used a 20MHz signal/function generator to drive the audio amp *with a 50% duty cycle square wave signal*, between about 47Hz and 2,000Hz (2KHz). We then connected the scope across the *primary* windings (also wired in series) and observed the core's response to the input signals. The output level from the signal generator was set to about 18V, just below clipping of the signal, and the rotor was held stationary, in alignment with 2 of the pole pieces (for maximum inductance) – See schematic at back of book:

The test was done with no load (resistance) across the primaries, in order that all aspects of the signal could be observed, including reflections and harmonics. The results provided several of the answers we've been looking for, both directly and by inference;

Mechanical Resonant Frequency of the Steel

As we swept through the frequency range, there was a very obvious fundamental resonance just around 1,500Hz (1.5KHz). The input voltage to the secondary windings at this frequency was amplified by more than a factor of 30 at the output! We tested 2 different cores (one with epoxy impregnation, one without), and the fundamental was between 1,560Hz and 1,630Hz, depending on the rotor position. We also have one class participant that tested an unmounted bare stator (before winding) that reported reading 1,135Hz simply by tapping the steel with a small hammer. This is also close enough to confirm the test results, since the rotor, windings, spacer blocks, and mounting surfaces were not involved in the bare stator test. Because of mechanical limits, a practical maximum RPM for this machine would only be slightly over 3,000 RPM (200Hz). So we can't actually spin the rotor fast enough to output 1,500Hz directly. That would require a speed of something like 22,500 RPM. So obviously we have to run on a harmonic of 1,500Hz.

Carefully dialing down the signal generator frequency from 1,500Hz, we observed several harmonics that still had plenty of amplitude to excite the steel core. The first appeared around 730Hz, then 406Hz, 201Hz, and around 122Hz. The 406Hz and 201Hz harmonics are right on the frequencies WITTS told us would produce the desired core steel resonance. It's important to note that the fundamental resonance appears on the scope as a huge single peak, the 1st harmonic as 2 peaks, the 2nd as 3 peaks and so on. Upon zooming out with the scope, we saw that the harmonics are actually the peaks of a 'ringing' waveform. This is a clear indication that the signal is reflecting (off the steel) at these harmonic frequencies, which is what we're after.

The next step is to focus on the harmonic with the most amplitude that is within the practical speed range of the generator. We are told by WITTS that this should be right around 400Hz, but for the generator to run at this frequency would require RPM to be around 6,000. This is too fast for the mechanical setup. Even 3,000 RPM is a bit high, although it could be used. We know that the WITTS generator we see in the "Self-Running 40kW Fuelless Generator" video is running at 2,450 RPM, which is right in the mechanical "sweet spot". With all these considerations in mind, it becomes clear that what we need to do is double the generator output frequency, but without doubling the rotor speed. That's where the following experiments come in.

Additional Coils Experiment

To those of you who have reached resonance (or are close), we propose to add feedback coils on top of both *secondary* coils, in an experiment to transfer energy back and forth between the primary and secondary windings. With reference to Tesla's work, we would expect to see several effects realized:

1. Since the energy stored in the resonant LC tank circuit is normally supplied to the output coils (and load) during the period when the rotor is between poles (primary voltage at zero crossing), we see a path where the addition of feedback coils will serve to transfer energy (real power) back to the primary during the output interval, effectively inducing a second voltage peak halfway between the normal primary voltage peaks (remember that the output frequency is 2X the resonant tank frequency). This second voltage peak would not be due to the (resonant)

modulation of the primary inductance, rather it would be real power, fed back during the secondary's output cycle. We think one likely result of this modification would be a doubling of the generator frequency, without the corresponding increase in rotor speed. With some fine tuning, this should allow excitation of the core steel at the harmonic residing near 400Hz, while still running at a practical RPM.

2. The additional small wire coils (probably 20 gauge) wound over the secondaries are fairly obvious in the Witts videos. With the resonant tank capacitor value based on rotor RPM (parametric pumping frequency), and the inductance value of the primary windings, this proposed modification will effectively lengthen the wire in the primary windings (feedback coils in series with primary). This could explain why the resonance capacitors in the WITTS video are apparently too few and too small to be the corresponding value for the running RPM (2,450 RPM, about 163Hz). It follows that the increase in wire length will increase inductance and therefore less capacitance would be required for the same RPM.

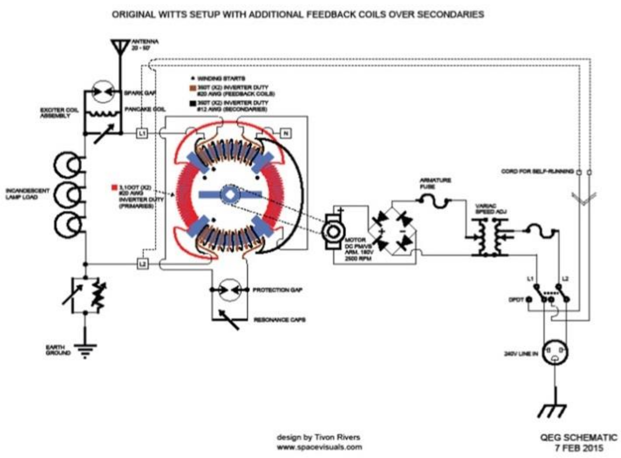
3. Other desirable effects will almost certainly be seen, but would be difficult to predict without actually performing the experiment. So here are the details of how to proceed.

Experiment Details: The experiment may be easier to do on a core without epoxy since there will be more room between the secondary coils and the endplates, although it can still be done on either style to prove the concept.

- Unmount the core and remove rotor. Support the core on a strong work surface with clear space around the existing secondary windings.

- If you have a core without epoxy, we would recommend wrapping 2 layers of mica tape or Kapton tape over the existing white fiberglass outer wrap for additional insulation, since the new coils will be carrying the primary high voltage. If you have an epoxied core, no additional insulation should be necessary, although it may be easier to wind the wire if a layer of fiberglass tape is installed just so the wire won't slide around on the smooth epoxy surface.

- Using the same 20 gauge (inverter duty) wire used to wind the primaries, begin winding against the same pole piece where the existing secondary winding starts, and wind in the



same direction as the secondary coils. Wind across the entire surface as evenly as possible, from pole piece to pole piece (cover entire secondary winding) - See attached schematic here, and at back of book.

The optimum number of turns will have to be determined experimentally. We will start with 350 turns per winding (same as secondary number of turns), but this could be reduced (or increased) depending on how much space you have. The turns count should be the same for both coils in any case, to keep the system balanced.

- Connecting the new coils to the existing primary windings will also have to be determined experimentally. There are several possible configurations depending on phasing, bucking and non-bucking etc. We will start by connecting according to the attached schematics, which place one end of each of the new windings in series with the capacitor connected ends of each of the existing primaries, then connecting the remaining ends (of the new windings) to the resonance capacitors (extend each existing primary coil). It's also possible that the existing midpoint connection on the primaries (the 2 START leads connected together) could be opened, and the new coils inserted in series at that point. If done this way, also connect the 2 start leads of the new coils together, with END leads to START leads of existing primaries. The proper connections will become evident after testing the possible combinations – See attached schematic at back of book.

Please see APPENDIX for references and resource materials at the back of this ebook.

CLICK HERE FOR CLASS 10 VIDEO/PDF PACKAGE

APPENDIX

PARTS LIST **(Updated 8-Feb-2015)**

NOTE: All dimensions provided in both Metric and Imperial values where possible

Part	**Type, Model # or MFG P/N**	**Quantity**
Generator Core		
Stator	140 Laminations 24 gauge (.025”) [0.64mm] type M19 Steel w/C5 coating, 3-1/2” stack, Welded, Bolted, or Bonded	(1) (See Drawing)
Rotor	(Cut at same time, from same lamination sheets as stator)	(1) (See Drawing)
Spacer Blocks 1-1/2” [38.1mm] x 1-1/2” [38.1mm] x 4-3/8” [111.125mm]	Aluminum 6061-T6, G10-FR4, Clear Polycarbonate, Accoya® Acetylated Wood	(8) (See Drawing)
8” [203.2mm] Bolts, ¼” [M6] Ø, ¼ -28 [M6x0.75] Thread, Grade 8 [Class 10.9]	Instock Fasteners P/N 1050095555	(8)
Nuts/Washers/Lockwashers	¼ -28 [M6x0.75] Grade 8 [Class 10.9] Hex Nuts/Flat Washers/Split Lockwashers	(8 pcs. each)
Shafting 7/8” [22.225mm] dia. x 11.0” [279.4mm] Long w/Standard 3/16” [4.7625mm] x 3/32” [2.38125mm] Keyway	Trukey P/N C1045 TGP (turned/ground/polished)	7/8” [22.225mm] dia. x 11” [279.4mm] or 12” [304.8mm] length
Bonding Compound for Shaft to Rotor	LOCTITE 648 Retaining Compound (Cat. No. 64836)	(1) (50ml Bottle)
Primer/Activator (use with bonding compound)	Loctite 7471 (Cat. No.142474)	(1) (150ml Aerosol)
Bearings	4-Bolt Flange Mount, 7/8” Bore, P/N FC7/8-RHP (preferred), or 3-Bolt Flange Mount, 7/8” Bore, P/N SBTRD205-14G	(2)
Bearing Bolts	5/16” [M8] x 1-3/4” [44.45mm] Carriage Bolts	(6)
Nuts/Washers/Lockwashers	5/16” [M8] Hex Nuts/Flat Washers/Split Lockwashers	(6 pcs. each)
Mica Tape 1.00” [25.4mm] x 50YD [45.72M]	MICA77956X1X50	(2) Rolls

Part	**Type, Model # or MFG P/N**	**Quantity**
Magnet Wire #12 gauge	Round Wire, Type HTAIHSD REA Pulse Shield® Inverter Duty (critical part!)	~620' [188.976M] (19.8 lbs./1000')
Magnet Wire #20 gauge	Round Wire, Type HTAIHSD, REA Pulse Shield® Inverter Duty (critical part!)	~5200' [1584.96M] (3.1 lbs. [1.406kg] /1000' [304.8M])
Mica Plate	NEMA 6 (36" [.9144M] x 36" [.9144M] x .030" [0.762mm])	(16) (See Drawing)
PTFE (Teflon) Sleeving (tubing) for #20 HTAIHSD Wire	Alpha Wire P/N TFT20011 (natural)	(4) pieces (18" [457.2mm] each)
PTFE (Teflon) Sleeving (tubing) for #12 HTAIHSD Wire	Alpha Wire P/N TFT20019 (black)	(4) pieces (18" [457.2mm] each)
Tape, White, 1" [25.4mm] Fiberglass, Hi-Temp (outer wrap)	Intertape P/N RG48	(2) Rolls
Tape, 1" [25.4mm] High Cut-Through Strength Mylar (Polyester), or Kapton	3M P/N 850 (Mylar, 1.9 mil), or Caplinq P/N PIT2A/25.4 (Kapton, 2 mil, tan color)	(2) Rolls
Nomex Corner Insulation	Torelco (custom made)	(16) pcs., (DuPont Type 418)
End Plates and Shrouds		
Reinforced Resin Laminated or Cast Sheet Material (for 2 end plates)	G10/FR4 (preferred), Phenolic types CE or LE, or transparent (clear) Polycarbonate	(1) sheet ½" [12.7mm] thick x 3' [.9144M] x 4' [1.292M] (makes 2 plates). (See Drawing)
Reinforced Resin Laminated or Cast Sheet Material (shrouds)	G10/FR4 (preferred), Phenolic types CE or LE, or transparent (clear) Polycarbonate	(2) 1/8" [3.175mm] thick x 5.875" [149.225mm] Ø, with 7/8" [22.225mm] Ø hole dead center (See Drawing)
Mounting Rail		
Angle aluminum	1 ½" [38.1mm] x 1 ½" [38.1mm] x 4' [1.2192M] Long. 1/8" [3.175mm] Thick	(1)
Wood or Laminate Parts for Platform (Base)		

Part	**Type, Model # or MFG P/N**	**Quantity**
Wood or Laminate Parts for Platform (Base)		
Generator Baseplate	18” [457.2mm] (W) x 36” [.9144M] (L) x 1.5” [38.1mm] (Thick)	(1) If using wood, make from 2 pcs. of ¾” [19.05mm] thick quality plywood. Bond (screw and glue) together with opposing grain direction
Core Mounting Shoe	6.5” [165.1mm] (W) x 15” [381mm] (L) x 1.5” [38.1mm] (Thick)	(1)
Lag Bolts (Generator Core to mounting shoe)	¼” [M6] x 2.5” [65mm]	(10)
Washers/Lockwashers	¼” [M6] Flat Washers/Split Lockwashers	(10 pcs each)
Drive System		
V-Belts and Pulleys		
V-Belt, Goodyear 4L430	GDYR_4L430 (cogged belt)	(1)
Pulley, 1 Groove, 3” [76.2mm] x 7/8” (or 5/8”) Bore, Type A (Motor)	AK30 x 7/8” Bore (bore size could also be 5/8” to match motor shaft)	(1)
Pulley, 1 Groove 2.50” [63.5mm] x 7/8” Bore, Type A (Generator)	AK25 x 7/8”	(1)
Drive Motor		
DC PM Variable Speed, 1.0 HP, 2500 RPM, 90V or 180V armature (depending on selected system voltage)	5/8” or 7/8” shaft, with sliding or slotted base. Leeson Model # 4D28FK5 (90V armature), #4D28FK6 (180V armature)	(1)
Motor Mounting Bolts	5/16” [M8] x 2-1/4” [60mm] Carriage Bolts	(4)
Nuts/Washers/Lockwashers	5/16” [M8] Hex Nuts/Flat Washers/Split Lockwashers	(4 pcs. each)
Variac, 120/240V Input, 0-280V Output, 9.5 Amps	STACO Type 1520	(1)

Part	**Type, Model # or MFG P/N**	**Quantity**
Switch, Start/Run	Carling # TIGM51-6S-BL-NBL (DPDT Center Off, 15 amp, 240V)	(1)
Capacitors		
Capacitor, Filter, optional anti-hum for drive motor (if needed)	W.W. Grainger #2MDZ6 (40uF, 440 VAC, quick-connect terminals	(1)
Capacitors, Resonant Tank 0.15uF [150nF], 3000 Volt, Tubular Axial Polypropylene	Cornell Dubilier #940C (preferred) High dV/dt for pulse applications	(72) 8 capacitors x 9 rows for initial value of 0.169uF [169nF] (see "Description of Components" section)

Suppliers and Parts/Service List

TORELCO – Toroidal winding service and complete core processing ready to ship
TESLA ENERGY SOLUTIONS – Kits with all parts to build a QEG (minus the core).
FASTENAL – Retaining (bonding) compound - Loctite 648 (bonds rotor to shaft) with Loctite 7471 activator (or equivalent)
EIS – Mica Tape, 20 gauge & 12 gauge Magnet Wire
MOUSER – Capacitors, Variac, Rectifiers, Start/Run Switch, Electronic Parts
MAUREY POWER TRANSMISSION – V Belt Pulleys
EMCO PLASTICS – End plates/shrouds
ASHEVILLE-SCHOONMAKER MICA – Mica plates
DISCOUNT STEEL – Aluminum Spacer Blocks
BRIGHTON BEST – 8 in. bolts
THE PLASTIC SHOP.CO.UK – Clear acrylic tube for exciter coil
BETECH.CO.UK - Variable speed DC Motor (1 HP)
THE BIG BEARING STORE – 7/8" Three Bolt Flange Bearing w/set screws
SIMPLY BEARINGS.CO.UK – 7/8" Four Bolt Flange Bearing w/set screws (preferred)

MAJOR GENERATOR COMPONENTS

- Stator
- Rotor
- Insulation Components
- Magnet Wire
- Resonant Tank Capacitors
- Bearings
- End Plates
- Pulleys/V-Belt
- Drive Motor
- Bridge Rectifier
- Variac
- Base/Frame and packaging

QEG SUGGESTED TOOLS & EQUIPMENT LIST (updated 18-Jan-2015)

(1) Tabletop Drill Press
(1) Cordless Drill
(1) Drill Bit Set (assorted sizes Metric/Imperial)
(2) Extra Long ¼" (.250") [6.35mm] Drill Bits (general purpose)
(1) Benchtop Grinder
(1) Medium Bench Vise
(1) Heat Gun
(1) Heat Shrink Tubing Set (assorted sizes)
(1) Good Quality 6" Dial or Digital Calipers
(1) Small Grease Gun w/Hi-Temp Grease
(1) Small, Good Quality ¼" & 3/8" Drive Metric & Imperial Socket set
(1) ¼" Drive Extension (6")
(1) Small Set ¼" Drive Imperial Allen Key Bits
(1) Small Set ¼" Drive Metric Allen Key Bits
(1) Good Quality General Purpose Terminal Crimping Tool
(1) Good Electronics Soldering Station w/Spare Tips, Electronic Solder (Rosin Core)
(1) Industrial Size Soldering Gun w/Spare Tips, 180 – 300 Watt
(1) Deburring Tool
(1) Hot Glue Gun w/Glue Sticks
(1) Small Bottle Acetone (or Alcohol)
(1) Hacksaw w/Blades (General Purpose)
(1) Good Quality Small Flush Cutters for Electronics Work
(1) Assorted Hand Tools (rubber mallet, hammer, needle nose pliers, screwdrivers, etc.)

QEG GENERAL WIRING ITEMS LIST

(1) Short Reel 15M (50 feet) 1.5mm 3-Conductor Cordage (Extension Cord Reel)
(1) Short Reel 15M (50 feet) 2.5mm 3-Conductor Cordage (Extension Cord Reel)
(Assortment) Ring & Spade Terminals
(1) 8 foot [2.44M] Copper or Copper Clad Grounding Rod w/Clamp
(1 Roll) Electrical Tape
(1) Small Fluorescent Tube (15 Watt)
(10) Standard Surface Mount Light Bulb Sockets
(6) 100 Watt, 240 Volt Incandescent Light Bulbs
(6) 100 Watt, 120 Volt Incandescent Light Bulbs

QEG NUTS AND BOLTS (HARDWARE) LIST

(4) M8 (5/16") x 60mm (2-1/4") Carriage Bolts (Motor Mounting)
(12 pcs. each) M8 (5/16") Hex Nuts, Flat Washers, Lockwashers
(8) M8 (5/16") x 40mm (1-1/2") Carriage Bolts (Bearing Mounting)
(8) M10 (3/8") x 40mm (1-1/2") Carriage Bolts (Alternate Bearing Mounting)
(8 pcs. each) M10 (3/8") Hex Nuts, Flat Washers, Lockwashers
(10) M6 (1/4") x 65mm (2-1/2") Lag Screws (Assembled Core to Mounting Shoe)
(10 pcs. each) M6 (1/4") Flat Washers, Lockwashers

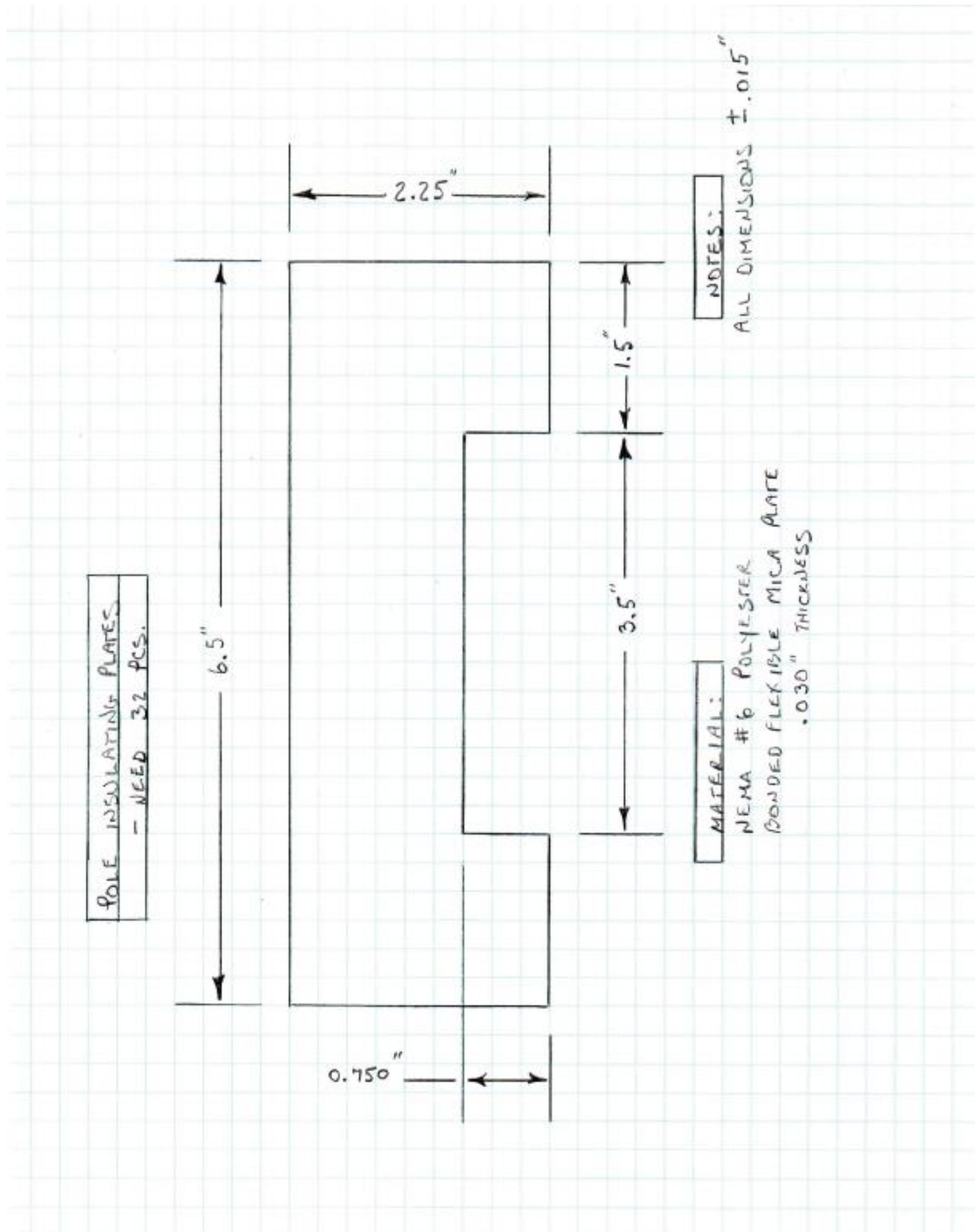
QEG INSTRUMENTATION (TEST EQUIPMENT) LIST

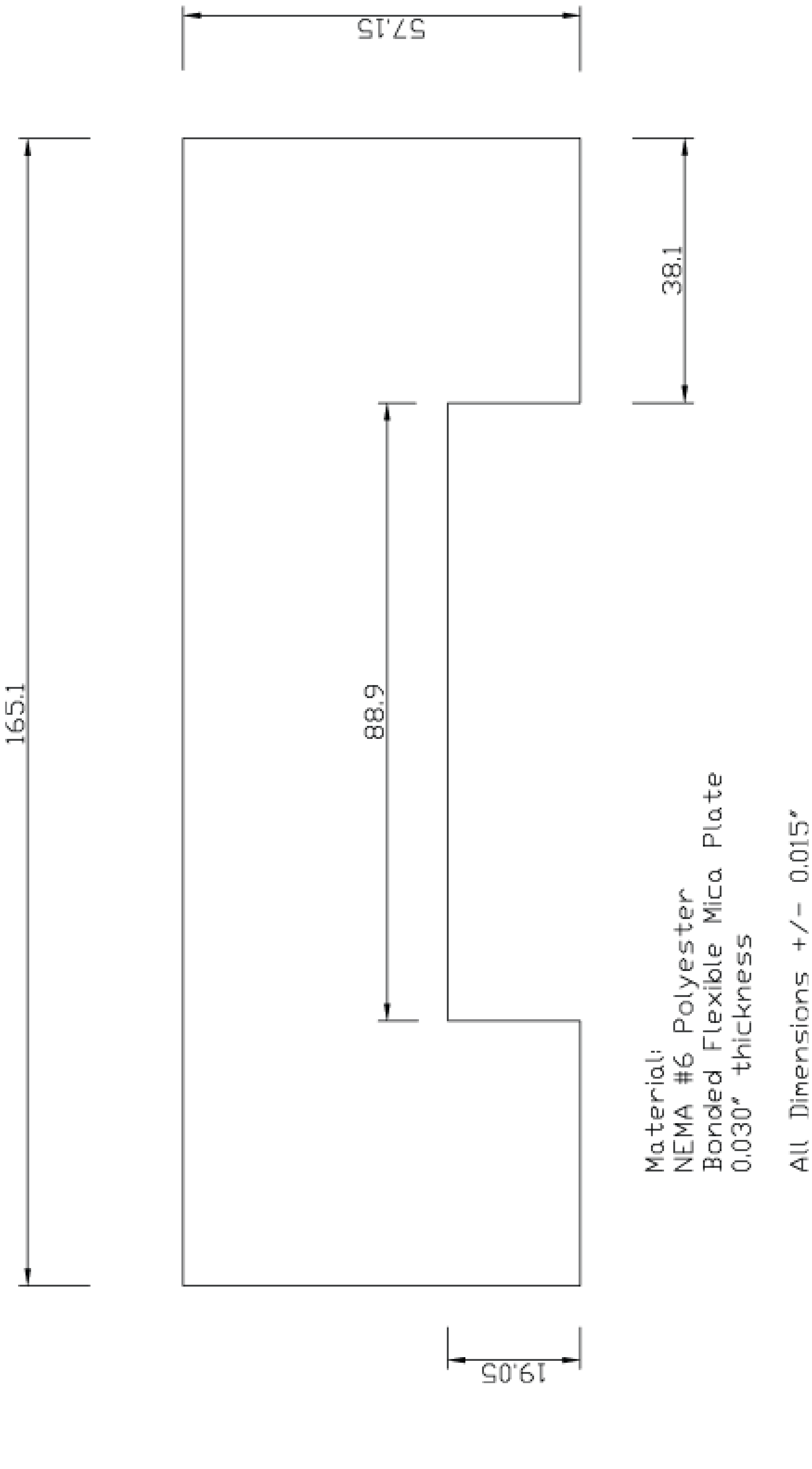
(1) Digital Storage Oscilloscope. Minimum 4-Channel, 100MHz, Example: Tektronix Model TDS2014 (100MHz), or TDS 2024B (200mHz)
(1) 1X Scope Probe
(2) 10X Scope Probes
(1) 100X Scope Probe
(1) 1000X (High Voltage) Probe for Scope/DMM, 40kV (example: Fluke Model 80K-40)
(1) Female Banana plug to BNC adapter (for above 1000X High Voltage Probe if needed for scope)
(1) Digital Signal/Function Generator w/output cable. (Minimum 5MHz. 20MHz would be better)
(2) Clamp-On Oscilloscope Current Probes, Minimum 0-40 Amp, AC/DC
(1) Clamp-On Digital Multimeter & Probes
(2) General Purpose DMMs & Probes (Capacitor function is helpful)
(1) Portable Relative RF Field Strength Meter w/antenna (Ideal Range: 500kHz – 200MHz or higher). Example: Coaxial Dynamics Model 7600 (1 MHz - 1GHz) or Model 7601 (1 MHz - 3 GHz)
(2) Good Quality LCR Meters (get 2 different brands. Inductance range must be over 20 Henries)
(1) Plug-In Power Usage Monitor/Wattmeter (Digital Multifunction Power Monitor. Buy for use in your specific Country).
(1) Portable Digital Laser Tachometer

CITATIONS:

1) Article Source: http://EzineArticles.com/?expert=Lance_Winslow

2) Article Source: http://EzineArticles.com/?expert=Tim_Jametson


POLE INSULATING PLATES
- NEED 32 PCS.
2.25"
6.5"
1.5"
3.5"
0.750"
NOTES:
ALL DIMENSIONS ±.015"
MATERIAL:
NEMA #6 POLYESTER
BONDED FLEXIBLE MICA PLATE
.030" THICKNESS


57.15
38.1
165.1
88.9
19.05
Material:
NEMA #6 Polyester
Bonded Flexible Mica Plate
0.030" thickness
All Dimensions +/- 0.015"

DuPont™
NOMEX®

NOMEX® TYPE 418 AND 419

TECHNICAL DATA SHEET

NOMEX® Type 418 is designed for high-voltage applications, including motor conductor and coil wrap, transformer ground and layer insulation. It is a calendered product with high inherent dielectric strength (30 to 40 kV/mm), which can be readily impregnated with varnishes where this is desirable. NOMEX® Type 418 is available in 5 thicknesses, from 0.08 to 0.36 mm (3 to 14 mil). This calendered blend of aramid and mica offers increased voltage endurance over NOMEX® Type 410 when subjected to corona attack.

NOMEX® Type 419 is the uncalendered precursor of NOMEX® Type 418, and is available in two thicknesses, 0.18 and 0.33 mm (7 and 13 mil). NOMEX® Type 419 is used in applications which take advantage of the lower density (0.5) which allows improved conformability and saturability.

Electrical properties

The typical electrical property values for NOMEX® Type 418 and NOMEX® Type 419 papers are shown in Table I. The AC Rapid Rise dielectric strength data of Table I, representing voltage stress levels, withstood 10 to 20 seconds at a frequency of 60 Hz. These values differ from long-term strength potential. DuPont recommends that continuous stresses in transformers not exceed 3.2 kV/mm (80 V/mil) to minimize the risk of partial discharges (corona). The Full Wave Impulse dielectric strength data of Table I were generated on flat sheets, such as in layer and barrier applications. The geometry of the system has an effect on the actual impulse strength values of the material.

The dielectric strength data are typical values and not recommended for design purposes. Design values can be supplied upon request.

Please note:

The properties in this data sheet are typical, or average values and should not be used as specification limits. Unless otherwise noted, all properties were measured in air under "standard" conditions (in equilibrium at 23°C, 50% relative humidity). Note that, like other products of papermaking technology, NOMEX® papers have somewhat different properties in the papermaking machine direction (MD) compared to the cross direction (XD). In some applications it may be necessary to orient the paper in the optimum direction to obtain its maximum potential performance.

Table I – **TYPICAL ELECTRICAL PROPERTIES**

Type		418					419	
Nominal thickness (mil)		3	5	8	10	14	7	13
(mm)		0.08	0.13	0.20	0.25	0.36	0.18	0.33
Dielectric Strength								
AC rapid rise[1]								
(V/mil)		770	890	1020	965	920	395	370
(kV/mm)		30.3	35.0	40.2	38.0	36.2	15.6	14.6
Full wave impulse[2]								
(V/mil)		1600	1600	1600	1700	1500	650	650
(kV/mm)		63	63	63	67	59	26	26
Dielectric constant[3]	50% RH	2.9	3.6	4.0	4.1	3,4	2.0	2.0
at 60 Hz	Dry[4]	2.3	2.5	2.5	2.5	2.1	1.4	1.5
Dissipation factor[3]	50% RH	130	120	140	140	150	140	130
at 60 Hz (x10^{-3})	Dry[4]	6	6	6	6	5	11	14
Volume resistivity[5]	50% RH	$(10)^{13}$	$(10)^{15}$	$(10)^{13}$	$(10)^{15}$	$(10)^{14}$	$(10)^{13}$	$(10)^{13}$
(ohm.cm)	Dry[4]	$(10)^{16}$	$(10)^{16}$	$(10)^{16}$	$(10)^{16}$	$(10)^{15}$	$(10)^{16}$	$(10)^{16}$
Surface resistivity[5]	50% RH	$(10)^{11}$	$(10)^{12}$	$(10)^{12}$	$(10)^{12}$	$(10)^{13}$	$(10)^{13}$	$(10)^{13}$
(ohm/square)	Dry[4]	$(10)^{14}$	$(10)^{15}$	$(10)^{15}$	$(10)^{15}$	$(10)^{15}$	$(10)^{15}$	$(10)^{15}$

[1] ASTM D-149 using 50mm (2 inches) electrodes, rapid rise; corresponds with IEC 243-1 subclause 9.1, except for electrodes set-up of 50mm (2 inches)

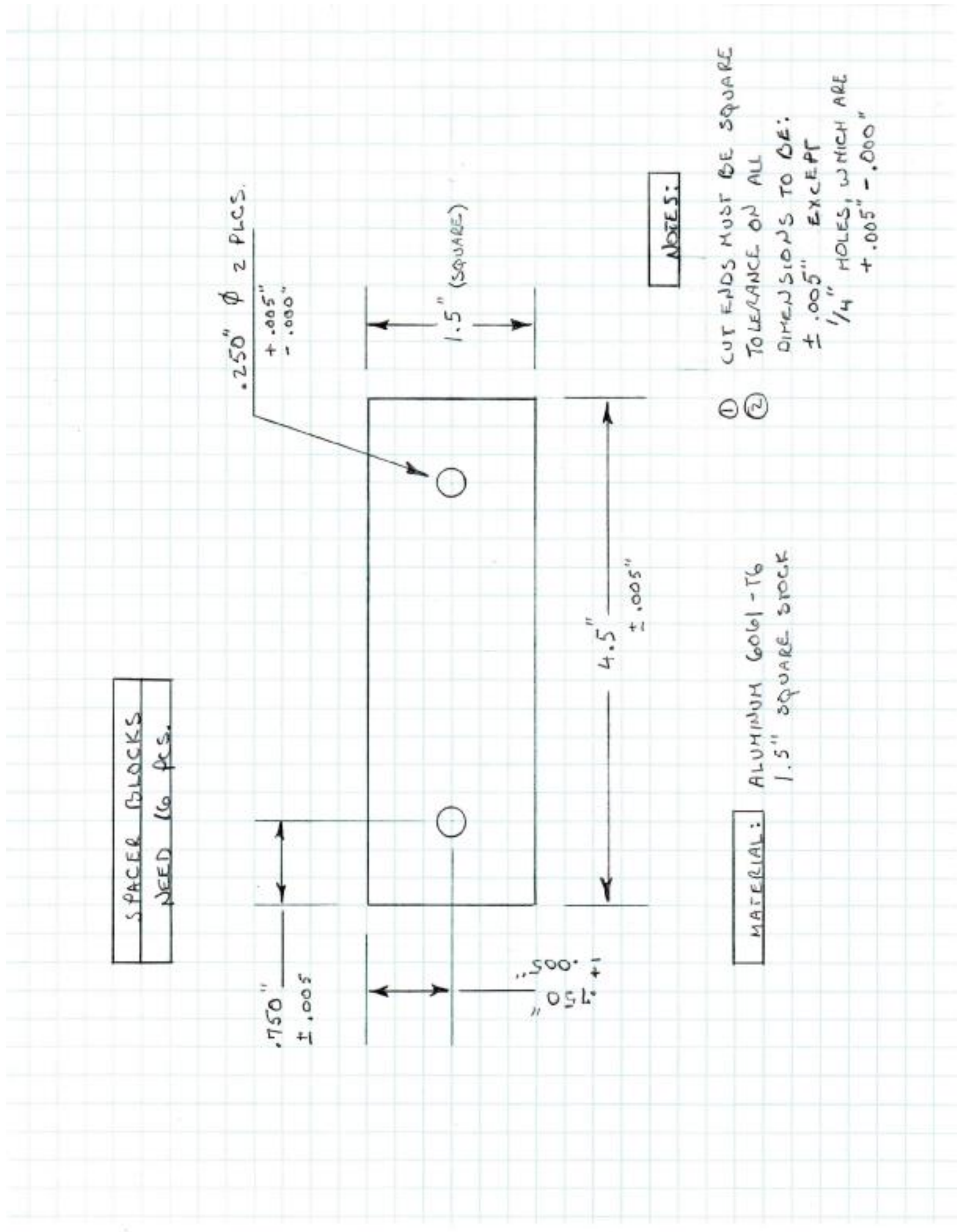
[2] ASTM D-3426

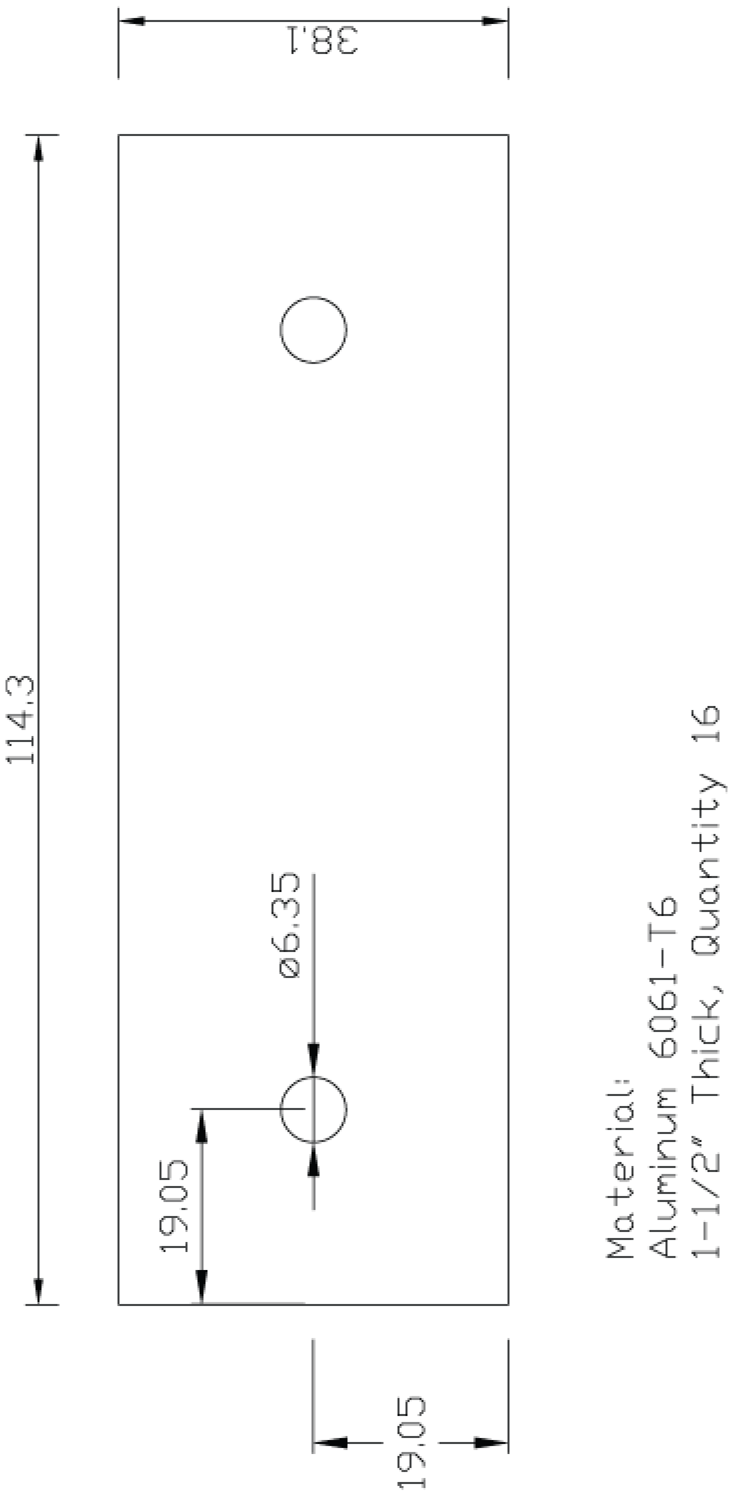
[3] ASTM D-150

[4] Values measured at 23°C after one hour drying at 120°C

[5] ASTM D-257

PERFORM WHEN THE HEAT'S ON


SPACER BLOCKS
NEED 16 PCS.
.250" Ø 2 PLCS.
+.005"
-.000"
1.5" (SQUARE)
NOTES:
① CUT ENDS MUST BE SQUARE
② TOLERANCE ON ALL DIMENSIONS TO BE:
±.005" EXCEPT
1/4" HOLES, WHICH ARE
+.005" -.000"
4.5"
±.005"
.750"
±.005
.750"
±.005"
MATERIAL:
ALUMINUM 6061-T6
1.5" SQUARE STOCK


38,1
114,3
ø6,35
19,05
19,05
Material:
Aluminum 6061-T6
1-1/2" Thick, Quantity 16

Keywords:

☐ In stock
☐ Lead free
☐ RoHS Compliant

Search Again

Product Index > Cables, Wires - Management > Solid Tubing, Sleeving > TFT20011 NA005

All prices are in US dollars.

Digi-Key Part Number	ATFT20011-100-ND
Quantity Available	Digi-Key Stock: 1 Can ship immediately
Manufacturer	Alpha Wire
Manufacturer Part Number	**TFT20011 NA005**
Description	TUBING PTFE .091" ID 100' CLR
Lead Free Status / RoHS Status	Lead free / RoHS Compliant

Price Break	Unit Price	Extended Price
1	196.58000	196.58
5	174.74000	873.70
10	152.89800	1,528.98
25	131.05520	3,276.38
50	122.31800	6,115.90
100	113.58100	11,358.10

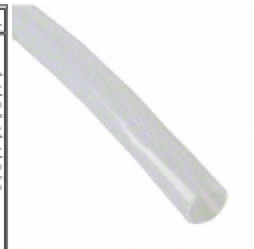


Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

Quantity | Item Number | Customer Reference

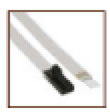
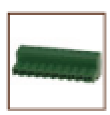
1 | ATFT20011-100-ND | | Add to Cart

When requested quantity exceeds displayed pricing table quantities, a lesser unit price may appear on your order.
You may submit a request for quotation on quantities which are greater than those displayed in the pricing table.

Datasheets	FIT Wire Management Catalog Part Number Ordering Guide TFT20011 Spec Sheet
Product Photos	TFT2000,1,2 NA005
Standard Package	1
Category	Cables, Wires - Management
Family	Solid Tubing, Sleeving
Series	FIT® TFT-200
Type	Smooth
Diameter - Inside	0.091" (2.31mm)
Diameter - Outside	0.113" (2.88mm)
Length	100' (30.5m)
Material	Polytetrafluoroethylene (PTFE)
Color	Natural
Online Catalog	TFT-200 Series
Other Names	ATFT20011-100 TFT-200-11-NA005 TFT20011NA005

Report an Error

Customers Who Purchased This Product are also Interested In:

- 
- A9CAG-0402F-ND
- TE Connectivity
- FLEX CABLE - AFG04G/AF04/AFE04T
- Unit Price 2.94000
- 
- 609-3893-ND
- FCI
- TERM BLOCK PLUG 10POS STR 5.08MM
- Unit Price 3.96000
- 

Keywords:

In stock

Lead free

RoHS Compliant

Search Again

Product Index > Cables, Wires - Management > Solid Tubing, Sleeving > TFT20019 NA005

All prices are in US dollars.

Digi-Key Part Number	ATFT20019-100-ND
Quantity Available	Digi-Key Stock: 33 Can ship immediately
Manufacturer	Alpha Wire
Manufacturer Part Number	TFT20019 NA005
Description	TUBING PTFE .036" ID 100' CLR
Lead Free Status / RoHS Status	Lead free / RoHS Compliant

Price Break	Unit Price	Extended Price
1	126.36000	126.36
5	112.32000	561.60
10	98.28000	982.80
25	84.24000	2,106.00
50	78.62400	3,931.20
100	73.00800	7,300.80

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

Quantity	Item Number	Customer Reference	
1	ATFT20019-100-ND		Add to Cart

When requested quantity exceeds displayed pricing table quantities, a lesser unit price may appear on your order. You may submit a request for quotation on quantities which are greater than those displayed in the pricing table.

Datasheets	FIT Wire Management Catalog FIT Family Brochure TFT-200-19 Specification Part Number Ordering Guide TFT20019 Spec Sheet
Product Photos	TFT2000,1,2 NA005
Standard Package	1
Category	Cables, Wires - Management
Family	Solid Tubing, Sleeving
Series	TFT-200
Type	Smooth
Diameter - Inside	0.036" (0.91mm)
Diameter - Outside	0.060" (1.52mm)
Length	100' (30.5m)
Material	Polytetrafluoroethylene (PTFE)
Color	Natural
Dynamic Catalog	TFT-200 Series
Other Names	ATFT20019-100 TFT-200-19-NA005 TFT20019NA005

Report an Error

IMPERIAL/METRIC CONVERSION TABLE

FRACTIONS	DECIMALS	MM	FRACTIONS	DECIMALS	MM	FRACTIONS	DECIMALS	MM
1/64	0.015625	0.3968	23/64	0.359375	9.1279	11/16	0.687500	17.46210
1/32	0.031250	0.7937	**3/8**	0.375000	9.5248	45/64	0.703125	17.85900
3/64	0.468750	1.1906	25/64	0.390625	9.9216	23/32	0.718750	18.25590
1/16	0.625000	1.5874	13/32	0.406250	10.3185	47/64	0.734375	18.65270
5/64	0.078125	1.9843	27/64	0.421875	10.7154	**3/4**	0.750000	19.04960
3/32	0.093750	2.3812	7/16	0.437500	11.1122	49/64	0.765625	19.44650
7/64	0.109375	2.7780	29/64	0.453125	11.5091	25/32	0.781250	19.84330
1/8	0.125	3.1749	15/32	0.468750	11.9060	51/64	0.796875	20.24020
9/64	0.140625	3.5718	31/64	0.484375	12.3029	13/16	0.812500	20.63710
5/32	0.156250	3.9686	**1/2**	0.500000	12.6997	53/64	0.828125	21.03390
11/64	0.171850	4.3655	33/64	0.515625	13.0966	27/32	0.843750	21.43080
3/16	0.187500	4.7624	17/32	0.531250	13.4934	55/64	0.859375	21.82770
13/64	0.203125	5.1592	35/64	0.546875	13.8903	**7/8**	0.875000	22.22450
7/32	0.218750	5.5561	9/16	0.562500	14.2872	57/64	0.890625	22.62140
15/64	0.234375	5.9530	37/64	0.578125	14.6841	29/32	0.906250	23.01830
1/4	0.250	6.3498	19/32	0.593750	15.0809	59/64	0.921875	23.41510
17/64	0.265625	6.7467	39/64	0.609375	15.4778	15/16	0.937500	23.81200
9/32	0.281250	7.1436	**5/8**	0.625000	15.8747	61/64	0.953125	24.2089
19/64	0.296875	7.5404	41/64	0.640625	16.27150	31/32	0.968750	24.60570
5/16	0.312500	7.9373	21/32	0.656250	16.66840	63/64	0.984375	25.00260
21/64	0.328125	8.3342	43/64	0.671875	17.06530	**1**	1.000000	25.40000
11/32	0.343750	8.7310						

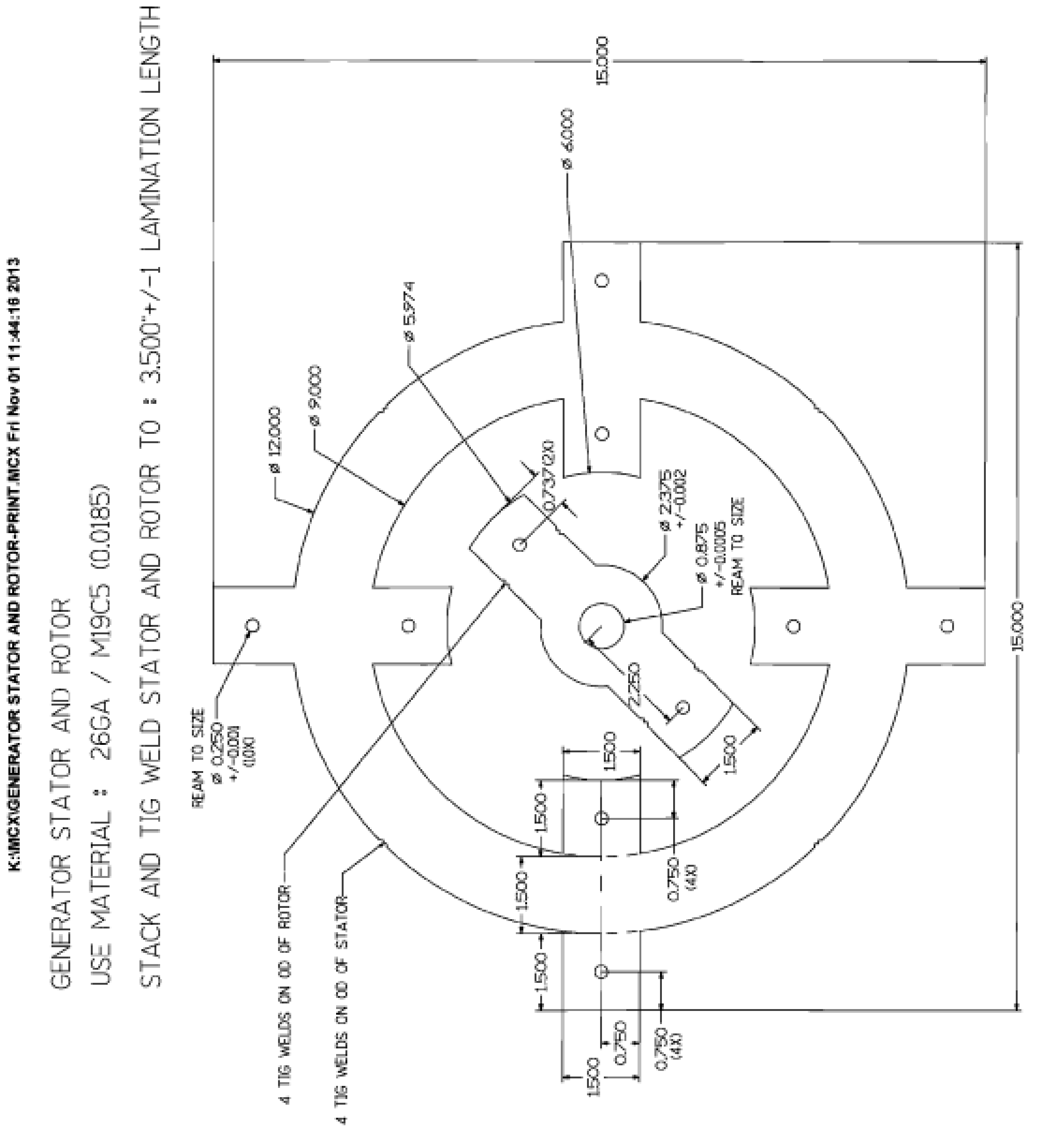
1" = 25.4 millimeters

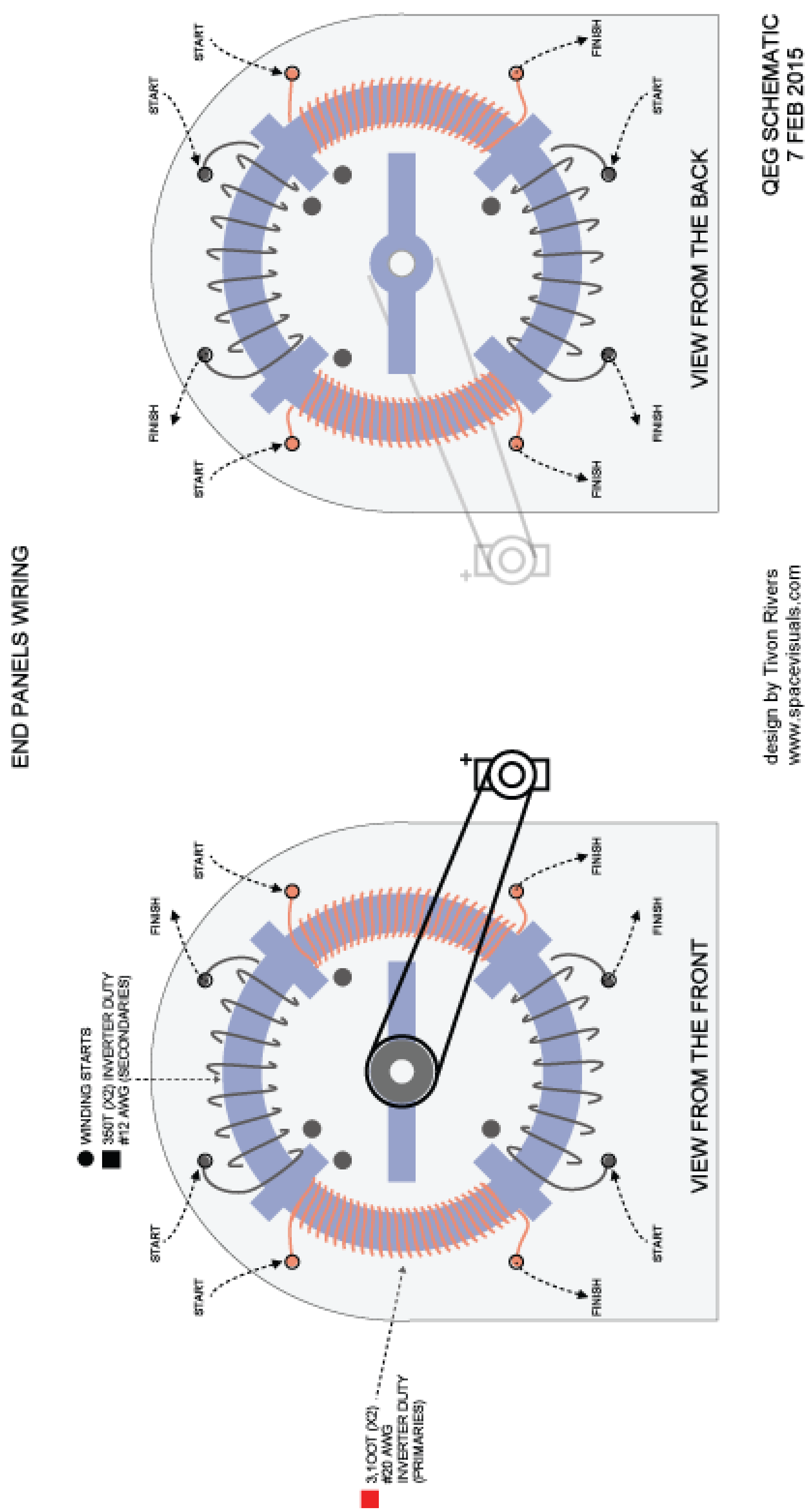
1 millimeter = 0.3937"

Stranded Wire Chart (AWG)

AWG	Stranding	Approx. O.D. Inches	Approx. O.D. mm	Circular Mil Area	Square Inches	Square mm	Weight Lbs/ 1000 Ft.	Weight KG/KM	D.C. Resistance ohms/ 1000 Ft.	D.C. Resistance ohms/ KM
36	7/44	.006	.1524	28.00	–	.0143	.085	,126	371.0	1217.18
34	7/42	.0075	.1905	43.75	–	.0223	.132	,196	237.0	777.55
32	7/40	.008	.2032	67.27	.0001	.0343	.203	.302	164.0	538.05
32	19/44	.009	.2286	76.00	.0001	.0388	.230	.342	136.4	447.50
30	7/38	,012	.3048	112.00	.0001	.0571	.339	.504	103.2	338.58
30	19/42	,012	.3048	118.75	.0001	.0606	.359	.534	87.3	286.4 1
28	7/36	.015	.3810	141.75	.0001	.0723	.529	.787	64.9	2 12.92
28	19/40	.016	.4064	182.59	.0001	.0931	.553	.823	56.7	186.02
27	7/35	.018	.4572	219.52	.0002	.1120	.664	.988	54.47	178.71
26	10/36	.021	.5334	250.00	.0002	.1275	.757	1.126	41.48	136.09
26	19/38	.020	.5080	304.00	.0002	.1550	.920	1.369	34.43	112.96
26	7/34	.019	.4826	277.83	.0002	.1417	.841	1.251	37.3	122.37
24	7/32	.024	.6096	448.00	.0004	.2285	1.356	2.018	23.3	76.44
24	10/34	.023	.5824	396.90	.0003	.2024	1.201	1.787	26.09	85.60
24	19/36	,024	.6096	475.00	.0004	.2423	1.430	2.128	21.08	69.16
24	41/40	.023	.5824	384.40	.0003	.1960	1.160	1.726	25.59	83.96
22	7/30	.030	.7620	700.00	.0006	.3570	2.120	3.155	14.74	48.36
22	19/34	.031	.7874	754.11	.0006	.3846	2.280	3.393	13.73	45.05
22	26/36	.030	.7620	650.00	.0005	.3315	1.970	2.932	15.94	52.30
20	10/30	.035	.8890	1000.00	.0008	.5100	3.025	4.502	10.32	33.86
20	19/32	.037	.9398	1216.00	.0010	.6202	3.680	5.476	8.63	28.31
20	26/34	.036	.9144	1031.94	.0008	.5263	3.120	4.643	10.05	32.97
20	41/36	.036	.9144	1025.00	.0008	.5228	3.100	4.613	10.02	32.87
18	7/26	.048	1.2192	1769.60	.0014	.9022	5.360	7.976	5.86	19.23
18	16/30	.047	1.1938	1600.00	.0013	.8160	4.840	7.202	6.48	21.26
18	19/30	.049	1.2446	1900.00	.0015	.9690	5.750	8.557	5.46	17.91
18	41/34	.047	1.1938	1627.29	.0013	.8299	4.920	7.321	6.37	20.90
18	65/36	.047	1.1938	1625.00	.0013	.8288	4.910	7.307	6.39	20.96
16	7/24	.060	1.5240	2828.00	.0022	1.4423	8.560	12.738	3.67	12.04
16	65/34	.059	1.4986	2579.85	.0020	1.3157	7.810	11.622	4.02	13.19
16	26/30	.059	1.4986	2600.00	.0021	1.3260	7.870	11.711	4.00	13.12
16	19/29	.058	1.4732	2426.30	.0019	1.2374	7.350	10.938	4.27	14.01
16	105/36	.059	1.4986	2625.00	.0021	1.3388	7.950	11.830	3.99	13.09
14	7/22	,073	1.8542	4480.00	.0035	2.2848	13.56	20.179	2.31	7.58
14	19/27	,073	1.8542	3830.40	.0030	1.9535	11.59	17.247	2.70	8.86
14	41/30	.073	1.8542	4100.00	.0032	2.0910	12.40	18.452	2.53	8.30
14	105/34	.073	1.8542	4167.50	.0033	2.1254	12.61	18.765	2.49	8.17
12	7/20	.096	2.4384	7 168.0	.0057	3.6557	21.69	32.277	1.45	4.76
12	19/25	.093	2.3698	6087.6	.0048	3.1047	18.43	27.426	1.70	5.58
12	65/30	,095	2.4130	6500.0	.0051	3.3150	19.66	29.256	1.75	5.74
12	165/34	.095	2.4130	6548.9	.0052	3.3399	19.82	29.494	1.58	5.18
10	37/26	.115	2.9210	9353.6	.0074	4.7703	28.31	42.128	1.11	3.64
10	49/27	.116	2.9464	9878.4	.0078	5.0380	29.89	44.479	1.09	3.58
10	105/30	.116	2.9464	10,530.0	.0083	5.3703	31.76	47.262	.98	3.22
8	49/25	.147	3.7338	15,699.6	.0124	8.0068	47.53	70.729	.67	2.20
8	133/29	.147	3.7338	16,984.1	.0134	8.6619	51.42	76.518	.61	2.00
8	655/36	.147	3.7338	16,625.0	.0131	8.4788	49.58	73.780	.62	2.03

(continued on following page)


K:\MCX\GENERATOR STATOR AND ROTOR-PRINT.MCX Fri Nov 01 11:44:16 2013
GENERATOR STATOR AND ROTOR
USE MATERIAL : 26GA / M19C5 (0.0185)
STACK AND TIG WELD STATOR AND ROTOR TO : 3.500"+/-1 LAMINATION LENGTH
15.000
15.000
ø 6.000
ø 5.974
ø 9.000
ø 12.000
0.737(2X)
ø 2.375 +/-0.002
ø 0.875 +/-0.0005 REAM TO SIZE
REAM TO SIZE ø 0.250 +/-0.001 (10X)
2.250
1.500
1.500
1.500
1.500
1.500
1.500
0.750 (4X)
0.750
0.750 (4X)
4 TIG WELDS ON OD OF ROTOR
4 TIG WELDS ON OD OF STATOR


END PANELS WIRING
WINDING STARTS
350T (X2) INVERTER DUTY
#12 AWG (SECONDARIES)
3,100T (X2)
#20 AWG
INVERTER DUTY
(PRIMARIES)
START
FINISH
VIEW FROM THE FRONT
VIEW FROM THE BACK
QEG SCHEMATIC
7 FEB 2015
design by Tivon Rivers
www.spacevisuals.com

LOCTITE

Technical Data Sheet

LOCTITE® 648™

(TDS for the new formulation of LOCTITE® 648™) August 2013

PRODUCT DESCRIPTION

LOCTITE® 648™ provides the following product characteristics:

Technology	Acrylic
Chemical Type	Urethane methacrylate
Appearance (uncured)	Green liquid[LMS]
Fluorescence	Positive under UV light[LMS]
Components	One component - requires no mixing
Viscosity	Low
Cure	Anaerobic
Secondary Cure	Activator
Application	Retaining
Strength	High

This Technical Data Sheet is valid for LOCTITE® 648™ manufactured from the dates outlined in the "Manufacturing Date Reference" section.

LOCTITE® 648™ is designed for the bonding of cylindrical fitting parts. The product cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration. Typical applications include holding gears and sprockets onto gearbox shafts and rotors on electric motor shafts. LOCTITE® 648™ provides robust curing performance. It not only works on active metals (e.g. mild steel) but also on passive substrates such as stainless steel and plated surfaces. The product offers high temperature performance and oil tolerance. It tolerates minor surface contaminations from various oils, such as cutting, lubrication, anti-corrosion and protection fluids.

TYPICAL PROPERTIES OF UNCURED MATERIAL

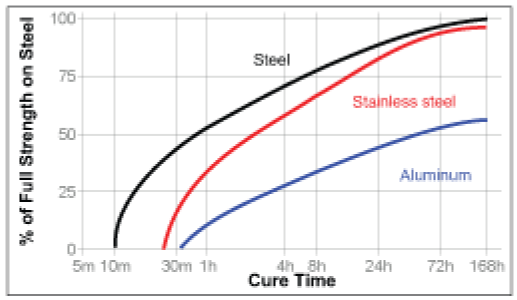
Specific Gravity @ 25 °C	1.1
Viscosity, Brookfield - RVT, 25 °C, mPa·s (cP): Spindle 2, speed 20 rpm,	400 to 600[LMS]
Viscosity, Cone & Plate, 25 °C, mPa·s (cP): Shear rate 129 s^{-1}	400 to 600

Flash Point - See MSDS

TYPICAL CURING PERFORMANCE

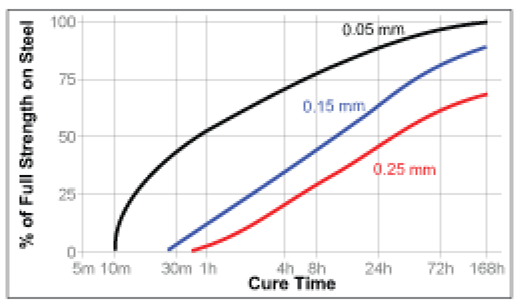
Cure Speed vs. Substrate

The rate of cure will depend on the substrate used. The graph below shows the shear strength developed with time on steel pins and collars compared to different materials and tested according to ISO 10123.



Cure Speed vs. Bond Gap

The rate of cure will depend on the bondline gap. The following graph shows shear strength developed with time on steel pins and collars at different controlled gaps and tested according to ISO 10123.



Henkel

Technical Data Sheet

LOCTITE

LOCTITE® 7471™

March 2011

PRODUCT DESCRIPTION

LOCTITE® 7471™ provides the following product characteristics:

Technology	Activator for LOCTITE® anaerobic adhesives and sealants
Chemical Type	Amine and Thiazole
Solvent	Acetone and Isopropanol
Appearance	Transparent, yellow to amber liquid LMS
Viscosity	Very low
Cure	Not applicable
Application	Cure acceleration of LOCTITE® anaerobic products

LOCTITE® 7471™ is used where increased cure speed of LOCTITE® anaerobic products is required. It is especially recommended for applications with passive metals or inert surfaces and with large bond gaps. LOCTITE® 7471™ is particularly recommended when prevailing temperature is low (<15 °C).

TYPICAL PROPERTIES

Specific Gravity @ 25 °C	0.79
Viscosity @ 20 °C, mPa·s (cP)	2
Drying Time @ 20 °C, seconds	30 to 70
On Part Life, days	≤7
Infrared Spectrum	To match standard LMS
Flash Point - See MSDS	

TYPICAL PERFORMANCE

Fixture time and cure speed achieved as a result of using LOCTITE® 7471™ depend on the adhesive used and the substrate bonded.

Fixture Time, ISO 4587, minutes:

Zinc dichromate using LOCTITE® 640™, two side activation	≤25

(Fixture time is defined as the time to develop a shear strength of 0.1 N/mm²)

TYPICAL PERFORMANCE OF CURED MATERIAL

Adhesive Properties

After 5 minutes @ 25 °C

Compressive Shear Strength, ISO 10123:

Steel pins and collars (degreased), using LOCTITE® 640™	* N/mm²	≥4.5 LMS
	* (psi)	(≥2,935)

* Applies to material made in N. America

Handling precautions

Activator must be handled in a manner applicable to highly flammable materials and in compliance with relevant local regulations.

The solvent can affect certain plastics or coatings. It is recommended to check all surfaces for compatibility before use.

GENERAL INFORMATION

This product is not recommended for use in pure oxygen and/or oxygen rich systems and should not be selected with a sealant for chlorine or other strong oxidizing materials.

For safe handling information on this product, consult the Material Safety Data Sheet (MSDS).

Under no circumstances should activator and adhesive be mixed directly as liquids.

Use only in a well ventilated area

Where aqueous washing systems are used to clean the surfaces before bonding, it is important to check for compatibility of the washing solution with the adhesive. In some cases these aqueous washes can affect the cure and performance of the adhesive.

Directions for use:

1. Spray or brush on the activator on both mating surfaces to be bonded. For small gaps, treatment of only one surface may be adequate. Contaminated surfaces may need repeated treatment or special degreasing prior to activation to remove any dissolvable contamination. Porous surfaces may need two treatments of activator.
2. Allow the solvent time to evaporate under good ventilation until the surfaces are completely dry.
3. After activation, parts should be bonded within 7 days. Contamination of the surface before bonding should be prevented.
4. Apply the Loctite Anaerobic product to one or both surfaces and assemble parts immediately.
5. Where possible, move surfaces in relation to each other for a few seconds on assembly to properly distribute the adhesive and for maximum activation..
6. Secure the assembly and await fixturing before any further handling..

Henkel

MC511AF is chosen over high temperature glass mat composites and high-performance glass-filled thermoplastics because of its excellent machineability, outstanding dimensional stability, superior creep resistance, and overall endurance over long periods of time in the application. In use, the product is often exposed to continuous temperatures as high as 155°C for up to a decade. And in short-term applications such as insulation in aerospace and defense systems, the material withstands temperatures in excess of 300°C. Halogen free to conform to European restrictions, MC511AF is specially formulated to meet exacting power generation standards requiring higher strength at elevated temperatures. The product is considered the standard material for use as Class F insulation in electrical power generation and transmission equipment.

MC511FR (NEMA FR-5) is a high strength medium weight glass epoxy composite that offers excellent physical, mechanical, and electrical properties at both room temperature and elevated temperatures. It is similar to MC511AF but also has a UL 94 flamability rating of V-1. The product retains at least 50 percent of its room-temperature flexural strength at 150°C (E-1/150, T-150).

MC511SN - StatNot™ is a composite consisting of woven glass and a static-dissipative epoxy resin system. It offers electrostatic dissipative properties (10^{6} to 10^{10} Ω/Sq). This material is used when static dissipation is required from surface to surface of the composite in the X, Y, and Z directions. The product can serve as corona discharge and static dissipative slot filler material in structural applications. Other applications include PCB test fixtures and tabletops used for testing and repair of military and civilian electronics.

NP130 (NEMA FR-4) consists of a woven glass fabric substrate combined with a halogenated epoxy resin system. It is produced to printed circuit board quality standards, is flame retardant and meets UL-94 flammability classification V-0. NP130 meets or exceeds the requirements of MIL-I-24768/27, Type GEE-F, and IPC 4101, sheet 21.

NP130HF (NEMA FR-4) is a glass fabric epoxy composite that is a lower resin content version of NP130. NP130HF is engineered to provide higher flexural strength, higher flexural modulus (stiffness), and resistance to warp and twist than other NEMA Grade FR-4 products. The product is also more dimensionally stable than some similar offerings. Users give the product high marks for its performance in applications such as printed circuit board testing. NP130HF meets or exceeds the requirements of MIL-I-24768/27, Type GEE-F.

NP500A (NEMA G-10) is a glass fabric combined with a halogen-free epoxy resin system. The product offers a combination of excellent electrical characteristics and superior physical properties. In addition, it is not flame retardant and meets NEMA G-10 requirements. NP500A is used for structural support and insulation properties. It is also suitable for pipe shoes and vacuum applications. NP500A complies with the requirements of MIL-I-24768/2, Type GEE, and IPC 4101, sheet 20.

NP500CR (NEMA G-10) is composed of a woven glass fabric combined with a halogen-free epoxy resin system. The product also offers superior physical properties and excellent electrical characteristics that are maintained in high-humidity conditions. In addition, it is not flame retardant and meets NEMA G-10 requirements. Designed to withstand absolute zero temperatures, the product is manufactured to the NIST G-10CR process specification for materials used in deep space and cryogenic applications. NP500CR complies with the requirements of MIL-I-24768/2, Type GEE.

NP510A (NEMA FR-4) combines a woven glass fabric and an epoxy resin laminate (T_g approximately 130°C) that contains bromine. The product provides consistent quality and good electrical properties under dry and humid conditions, as well as high flexural, impact, and bond strength at room temperatures. This product is suitable for a variety of structural, high humidity, and electrical insulation applications, which include terminal boards, lapping carriers, and disc and microelectronics polishing. NP510A complies with the requirements of MIL-I-24768/27, Type GEE-F.

NP511 (NEMA G-11) combines a woven glass fabric and a high temperature epoxy resin system (T_g over 180°C) that is non-brominated. The product provides consistent quality and good electrical properties under dry and humid conditions, as well as high flexural, impact, and bond strength at room and elevated temperatures. This product is suitable for a variety of structural, high humidity, and electrical insulation applications, which include cryogenic applications and many other applications for which very high or very low temperatures are part of the environmental requirement of the application. NP511 meets or exceeds the requirements of MIL-I-24768/3, Type GEB.

D256	Impact strength, izod (ft-lb/in. of notch)	0.30- 0.35	0.6- 1.05	0.28	0.28- 0.45	0.26	0.4-1.5	0.50
D785	Hardness, Rockwell E	70-95	82	82	75-88	94	92-104	76
				THERMAL				
C177	Thermal conductivity (104 cal - cm/sec- cm2- °C)	7.1	7.9	-	16.0	-	-	8.8
D696	Coefficient of thermal expansion (105 in./in.-°C)	3.95	3.56	4.40	2.60	2.80	1.80	3.60
D648	Deflection temperature (°F) At 264 psi	275-360	270-500	370	310-400	330-380	370-550	360-430
UL94	Flammability rating 1/8 inch	V-1	HB	-	V-0	V-0	V-0	HB
				ELECTRICAL				
D149	Dielectric strength (V/mil) short time, 1/8 in. thick	350	350-400	200	400	170	400	175
D150	Dielectric constant At 1kHz	5.2-5.3	5.2-5.4	-	4.9-6.5	11.7	4.4	7.8
D150	Dissipation factor At 1kHz	0.04- 0.05	0.04- 0.06	-	0.025- 0.10	0.15	0.03	0.12
D257	Volume resistivity (ohm-cm) At 73°F, 50% RH	1011- 1012	1011- 1012	1012	1011- 1013	1012	1012	1011
D495	Arc resistance(s)	100	50	-	184	181	181	-

Thermoset Plastic Laminate.

Thermoset Plastic Laminate is a uniformly dense and structurally strong material that will not soften appreciably under the reapplication of heat. It is an extremely durable plastic that is lightweight and moisture resistant. Industrial laminates are thermoset resin impregnated reinforcing materials (paper, cotton fabric, glass fabric, etc.) that are cured under heat and pressure to form solid shapes having high mechanical and electrical insulating properties. Laminates are available in sheet, rod, tube, and angle. Since laminates are comprised of a combination of materials, they are also referred to as composites.

Standard stock grades include:

G1O/FR4 Glass Reinforced Epoxy - natural (yellowish to light green) The most versatile all around laminate, this grade is a continuous glass woven fabric base impregnated with an epoxy resin binder. It has extremely high mechanical strength, good dielectric loss properties, and good electric strength properties, both wet and dry. Certifies to Mil-I-24768/27 GEE-F

G11/FRS Glass Reinforced Epoxy - natural (yellow green to amber) This grade is similar to G10/FR4, with the addition of a higher operating temperature and some improved mechanical strength at elevated temperatures. Certifies to Mil-I-24768/28 GEB -F

G5/G9 Class Reinforced Melamine - natural (grayish brown) This grade is composed of a continuous glass woven cloth base impregnated with a melamine resin binder. Melamines are the hardest of all laminates, exhibiting good dimensional stability and are resistance. It is also caustic resistant. Certifies to Mil-I-24768/1 CME

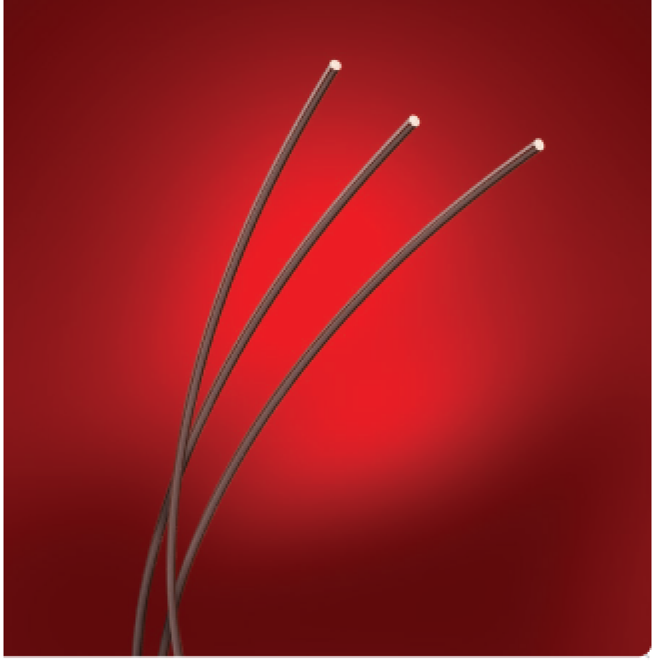
G7 Glass Reinforced Silicone - natural (cream to white) Composed of a continuous glass woven cloth base impregnated with a silicone resin binder,this grade has excellent heat and are resistance. It has extremely good dielectric loss properties under dry conditions and good electrical properties under humid conditions, although the percentage of change is high. Certifies to Mil-I-2476811 GSG

X/XX/XXX Paper Reinforced Phenolic - natural (tan) This grade is composed of a paper base impregnated with a phenolic resin binder. It has good electric strength properties with fair mechanical strength. Outstanding for use as template material and or backup material. Certifies to Mil-I-24768112 PBM,I11 PBG and /10 PBE

C/CE Cotton Fabric Reinforced Phenolic - natural (light tan to brown) This grade is composed of a continuous cotton woven cloth impregnated with a phenolic resin binder. This grade contains a medium weave canvas and is known primarily for it's mechanical properties. This grade is not recommended for primary insulation. Certifies to Mil- I-24768/14 FBG

Linen L/LE Cotton Fabric Reinforced Phenolic - natural (light tan to brown) This grade is composed of a continuous cotton woven cloth impregnated with a phenolic resin binder. This grade contains a fine weave linen and, like the canvas phenolic, is known for it's

Pulse Shield SD®



TAIHSD

Thermal Class: 200°C

Features and Benefits

- Resistant to voltage stresses generated by high frequency, rapid rise time, voltage spikes typically introduced by IGBT-type inverters. Motor life is increased significantly over standard MW-35C magnet wire under these voltage stresses and across a wide temperature range
- Improved insulation protection against transient spikes, high frequencies, elevated voltage levels, and short rise time pulses without increasing insulation thickness
- Excellent resistance to thermoplastic flow (cut-through), abrasion and heat shock
- Excellent resistance to heat and solvent shock conditions encountered in varnishing and encapsulating processes

General Information

References are provided for comparative purposes

Round

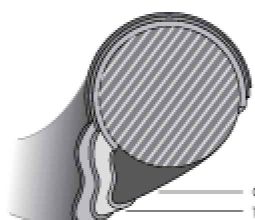
NEMA: MW 35-C
UL: File No. E37683

Availability

Round	single	heavy
copper		14-24 AWG
Rectangle		heavy
copper		
Min. Width		.081"
Max. Width		.750"
Min. Thickness		.030"
Max. Thickness		.292"

Typical Applications

High speed windings with difficult insertion and winding characteristics for inverter-driven motors, high frequency transformers, and high voltage motors



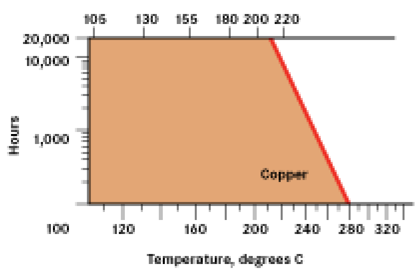
Rea

Typical Properties

This data is typical of 18 AWG copper, heavy build insulation only. It is not intended to be used to create specification limits.

Thermal

Thermal Endurance		
20,000 hr life	>200°C	
Thermoplastic Flow	minimum	typical
	300°C	350°C
Heat Shock (20%3x)		
1/2 hr at 220°C minimum no cracks		
Solderability		
not designed to be self-solderable		
Stress Relief temp		
160°C		



Mechanical

Mandrel Flexibility	minimum	typical
After Elongation	20% 3x OK	25% 3x OK
After Snap	min. 3x OK	3x OK
Unilateral Scrape		
Taken at 120° Increments		
Avg. of 3 tests	1150 gms	1300 gms
Dynamic C of F		
		0.06

Electrical

Pulse Endurance Test		
20,000 Hz, 2000 V, 0.025 microsecond rise time		
150°C, 50% Duty Cycle - Twisted pairs		
18 HTAIH Reference = 600 seconds		
18 HTAIHSD >80,000 seconds		
Pulse Endurance Index (PEI) >100		
Life of product/life of same size and build MW-35 (Reference)		
Dielectric Breakdown	minimum	typical
NEMA	5.7 kV	11.0 kV
@ RT @ 200°C		11.0 kV 7.0 kV
Corona Inception Voltage		
Typical		580V
High Voltage Continuity		
NEMA @ 1500 V DC:	5 faults/100 feet max	
typical @ 2000 V DC:	0-1 faults/100 feet max	

Chemical

Retained Dielectric
After 72 hrs exposure to R-22 + 300°C conditioning:
3.5 kV
R-22 Extractables
.08%
Resistance to Solvents Including
After 24 hrs @ RT: Pass
Xylene 50/50 Cellosolve/Xylene Perchloroethylene 1% NaOH 28% Sulfuric Acid Gasohol

U.S. Patent No. 6,056,995

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QEG
A Mechanically Pumped Parametric Transformer

Preliminary Conditional Reverse Engineering Analysis
Prior to Examination of an Operational Device:

In this device all coils share the same toroidal core; therefore, they form a toroidal transformer. The two series resonating coils form the primary, and the two output coils (tapped by the Neutral) form the secondary. The core has four equally spaced pole pieces. This allows the non-magnetized rotor to modulate the core reluctance thereby modulating the inductance of the resonating coils. This modulation can be considered to be a parametric coupling of mechanical energy of the rotor to electrical energy in the resonating coils.

The following equations govern this energy transfer relationship:

$$E = \frac{d}{dt}(Li) = \underbrace{L\frac{di}{dt}}_{\text{Flux Coupling Term}} + \underbrace{i\frac{dL}{dt}}_{\text{Parametric Coupling Term}}$$

Normal transformers are governed by the flux coupling term, and are based upon constant reluctance and inductance values with time variant current (and voltages). This device, on the other hand utilizes a parametrically varied reluctance and inductance in order to induce oscillating current and voltages. This operation is additionally governed by the parametric coupling term in the above equation. Parametric coupling of an oscillating circuit requires that the pumping frequency be twice the oscillating frequency. The reluctance is modulated four times per armature revolution occurring when the rotor and the pole pieces align. Since the oscillating (resonant) frequency should be one-half the pumping frequency we can determine the driving RPM in relation to the resonant frequency.

For example: assuming a driving speed of 1,800 RPM or 30 Revolutions per Second, a production of 30 x 4 = 120 pumps per second is realized. Given that resonant frequency is one-half of pump frequency, the resonant oscillations should occur at 120/2 = 60 cycles per second (or 60 Hertz). Similarly, a 1500 driving RPM infers a 50 Hz output. (Where 1500/60 = 25, 25 x 4 = 100, 100/2 = 50 Hz.)

Since we are told that the QEG is typically driven into resonance at approximately 1450 RPM, and that the resonant frequency is about 400 Hz, a disparity emerges. At 1450 RPM we would expect a resonant frequency of approximately 48.33 Hz to exist, however, apparently the Parallel LC Resonant Circuit is designed to resonate at something close to or slightly over 400 Hz. This implies that the QEG is actually being operated at something like the 9th Harmonic of the design frequency. Usually the most efficient coupling should occur at the design frequency. Operation in this manner necessitates a critical tuning procedure before effective phase lock occurs.

V 2.2

The design of this machine appears to achieve much of its efficiency from its ability to reduce back MMF to the rotor in comparison to what a traditional generator rotor experiences. The back MMF experienced by the rotor is proportional to the core magnetic field strength near the times of the pole/rotor alignment which is when parametric pumping occurs in this device. Since this occurs near the zero-crossing points when the magnetic field is in the process of reversing itself, little energy is needed to drive this device as compared to a traditional generator. When a near synchronization in time of the pole/rotor alignments occur with the zero crossing points of the resonating coil current sine wave, then this condition is met, so long as phase lock is maintained.

As the rotor approaches, aligns, and leaves a given pair of poles, a magnetic shunt is formed which alters the effective shape of the core as well as the magnetic path length. This produces the desired parametric change in both Reluctance and Inductance which is "parametric pumping". As these magnetic shunts form and subsequently disconnect, magnetic snap-back occurs as magnetic flux loops are broken and forced to reform within the cyclically altering core geometry. Interesting and novel energy effects are thought to exist when magnetic snap-back occurs.

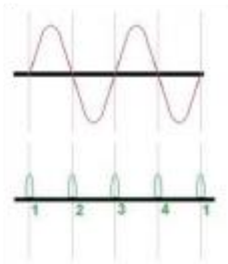
An examination of the parametric coupling term from the equation ($i\frac{dL}{dt}$) allows for a closer look at the parametric pumping and the reduced back MMF. The magnetic field strength (and Flux Density) corresponds to the sine wave current in the parallel LC resonant circuit. As the current becomes smaller, crosses zero, and then begins to reverse direction so does the magnetic field. In phase lock, this happens as the rotor approaches, aligns, and leaves each pair of poles, which is when parametric pumping and Inductance pulses occur. (See Fig. 1)

As the rotor passes each pole/rotor alignment, the rate of change in Inductance $\frac{dL}{dt}$ reaches a positive maximum as alignment begins, traverses its own zero-point as exact alignment occurs, and reaches a negative maximum as the rotor begins to misalign. Once the rotor is fully disengaged from the pole-pair the rate of change in Inductance returns to zero where $\frac{dL}{dt} = 0$ until the next pole/rotor alignment occurs. (See Fig. 2)

While the current (i) is relatively small during these events, it is exactly zero for only the briefest time at the exact moment of pole/rotor alignment. The rate of change in Inductance $\frac{dL}{dt}$ is significant (at a maximum) during the same period. All of this works together to allow the rotor to move past each pole-pair with minimal back-MMF while parametrically pumping energy into the system. When the rotor is between poles, the flux coupling term describes the operation of the QEG as a toroidal transformer; the energy stored in the resonant LC circuit supplies power to the output coils and load by transformer action.

These appear to be the primary factors involved from what we can determine, with the information we have so far, on this interesting power generation design. Critical comments from James Robitaille or other members of the QEG community are welcomed.

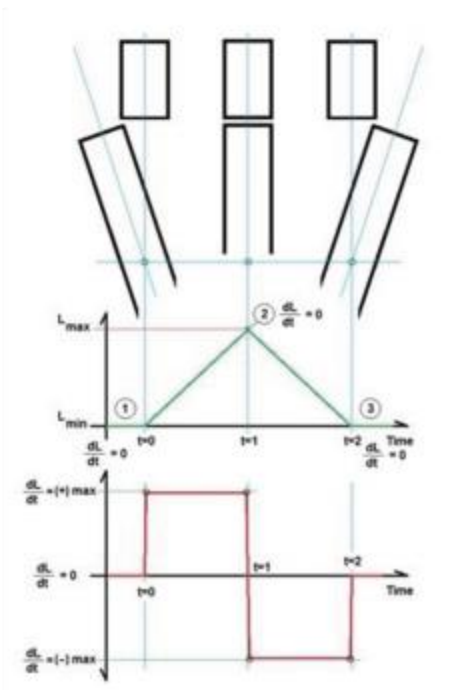
V 2.2



Sine wave current
in parallel LC resonant circuit

Parametrically pumped inductance
pulses at current zero crossings

Fig.1



Pole/Rotor alignment
progression

Corresponding change
in Inductance over time

Corresponding Rate of Change of
Inductance over time

Fig. 2

$$E = \frac{d}{dt}(Li) = \underbrace{L\frac{di}{dt}}_{\text{Flux Coupling Term}} + \underbrace{i\frac{dL}{dt}}_{\text{Parametric Coupling Term}}$$

Parametric Energy Equation

V 2.2

Other observations:

James Robitaille stated that the exciter is not necessary for the basic operation of the QEG; therefore, we omitted it from this analysis.

The resonant coil capacitor combination should have a spark-gap across it to limit the peak voltage to a safe value. In addition, if capacitor failures occur, high value voltage balancing resistors should be added across each capacitor.

It should be determined whether the specified electronic motor drive circuit will operate at 400 Hz since it is a SCR phase controlled device and may be sensitive to input frequency. If this is the case, a controller that rectifies the incoming line to DC and provides a pulse width modulated output should be used. Voltage feedback to this controller could be used to regulate the output voltage of the device.

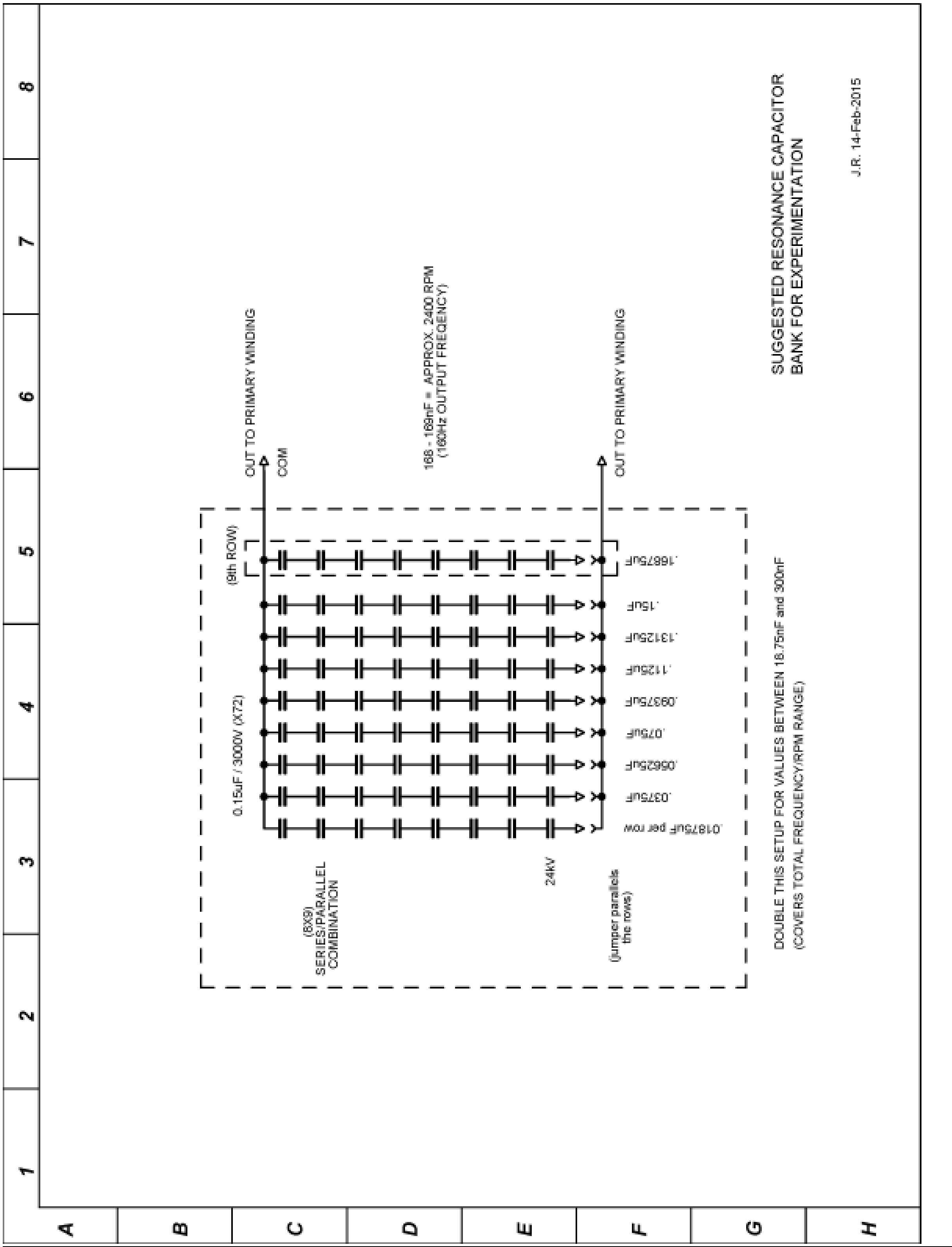
If the output of the QEG is rectified and filtered to DC, the ideal inverter to use to produce 60 Hz AC and possible co-generation to the power line is the type of inverter designed for solar photo-voltaic systems. They usually require from 250-600 volts DC and can easily self-adjust within that range.

A redrawn schematic needs to be provided to address the issue of the missing bridge rectifier and the inconsistent use of 240V power line and 120V Feedback simultaneously.

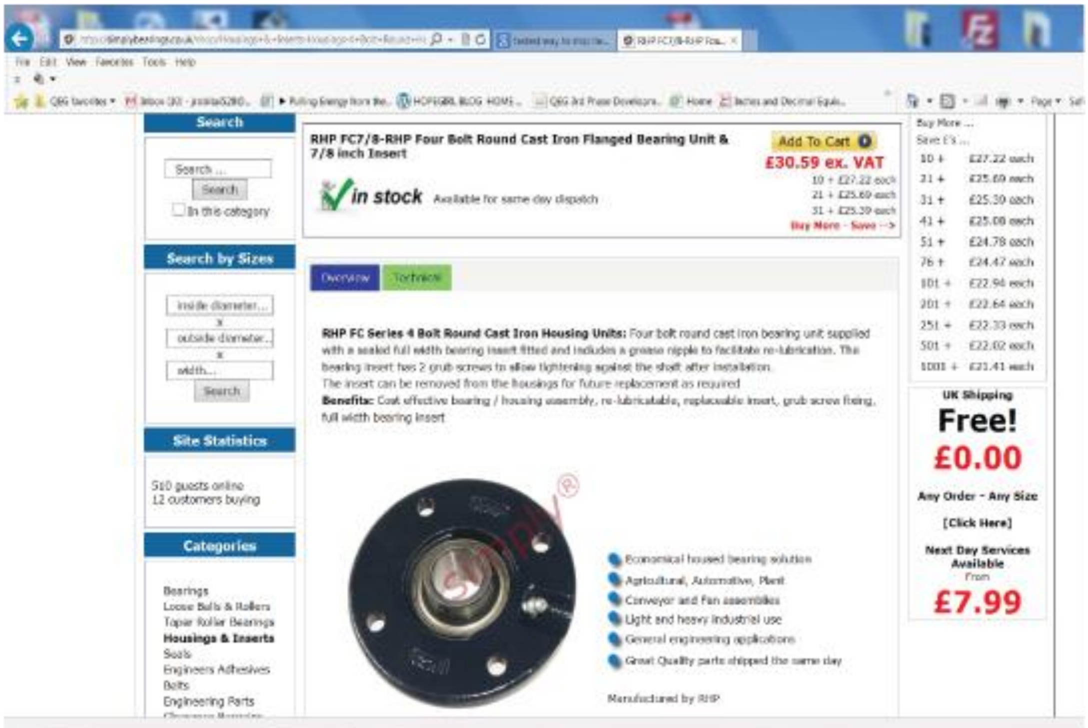
George Pidick, Engineering Consultant

Mark D Chase, Electrical Engineer, MSEE

April 8, 2014



SUGGESTED RESONANCE CAPACITOR
BANK FOR EXPERIMENTATION
J.R. 14-Feb-2015
OUT TO PRIMARY WINDING
COM
168 - 169nF = APPROX. 2400 RPM
(160Hz OUTPUT FREQENCY)
OUT TO PRIMARY WINDING
(9th ROW)
0.15uF / 3000V (X72)
.16875uF
.15uF
.13125uF
.1125uF
.09375uF
.075uF
.05625uF
.0375uF
.01875uF per row
(8X9)
SERIES/PARALLEL
COMBINATION
24kV
(jumper parallels
the rows)
DOUBLE THIS SETUP FOR VALUES BETWEEN 18.75nF and 300nF
(COVERS TOTAL FREQUENCY/RPM RANGE)
1
2
3
4
5
6
7
8
A
B
C
D
E
F
G
H


Search
Search by Sizes
Site Statistics
510 guests online
12 customers buying
Categories
Bearings
Loose Balls & Rollers
Taper Roller Bearings
Housings & Inserts
Seals
Engineers Adhesives
Belts
Engineering Parts
RHP FC7/8-RHP Four Bolt Round Cast Iron Flanged Bearing Unit & 7/8 inch Insert
Add To Cart
£30.59 ex. VAT
in stock
Available for same day dispatch
Buy More - Save -->
Overview
Technical
RHP FC Series 4 Bolt Round Cast Iron Housing Units: Four bolt round cast iron bearing unit supplied with a sealed full width bearing insert fitted and includes a grease nipple to facilitate re-lubrication. The bearing insert has 2 grub screws to allow tightening against the shaft after installation.
The insert can be removed from the housings for future replacement as required
Benefits: Cost effective bearing / housing assembly, re-lubricatable, replaceable insert, grub screw fixing, full width bearing insert
Economical housed bearing solution
Agricultural, Automotive, Plant
Conveyor and Fan assemblies
Light and heavy industrial use
General engineering applications
Great Quality parts shipped the same day
Manufactured by RHP
10 + £27.22 each
21 + £25.69 each
31 + £25.39 each
41 + £25.08 each
51 + £24.78 each
76 + £24.47 each
101 + £22.94 each
201 + £22.64 each
251 + £22.33 each
501 + £22.02 each
1001 + £21.41 each
UK Shipping
Free!
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Any Order - Any Size
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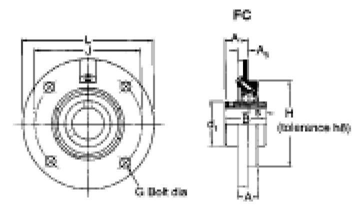
Next Day Services Available
From
£7.99

Self-Lube cast iron flange cartridge bearing units

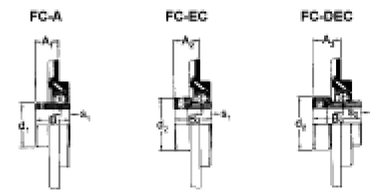
RHP *bearings*

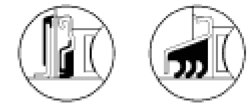
FC SERIES

For housing tolerances to suit spigot 'H' see page 23



Note Re-lubrication Hole – M6 x 0,8 Pitch





Bearing inserts with flinger seals shown on pages 91 and 92 can be fitted into these housings. The unit reference has the suffix 'FS', e.g. FC40FS.

Triple seal bearing inserts shown on pages 88 to 90 can be fitted into these housings. The unit reference has a prefix 'T', e.g. TFC40.

Shaft diameter mm	Shaft diameter inches	RHP designation				Basic bearing insert	Casting group	L	H	J	G	A	A1
mm	inches							mm inches					
20	 ¾	FC20 FC¾	FC20A FC¾A	FC20EC FC¾EC	FC20DEC FC¾DEC	1020	2	100,0 3·937	62,0 2·441	78,0 3·071	8 5/16	17,0 ·669	16,29 ·641
25	 ⅞ 15/16 1	FC25 FC⅞ FC15/16 FC1	FC25A FC1A	FC25EC FC⅞EC FC15/16EC FC1EC	FC25DEC FC⅞DEC FC15/16DEC FC1DEC	1025	3	115,0 4·528	70,0 2·756	90,0 3·543	8 5/16	19,0 ·748	17,34 ·683
30	 1⅛ 1 3/16 1¼	FC30 FC1⅛ FC1 3/16 FC1¼R	FC30A FC1¼AR	FC30EC FC1⅛EC FC1 3/16EC FC1¼ECR	FC30DEC FC1⅛DEC FC1 3/16DEC FC1¼DECR	1030	4	125,0 4·921	80,0 3·150	100,0 3·937	10 ⅜	20,5 ·807	20,22 ·796
35	 1¼ 1 ⅜ 1 7/16	FC35 FC1 ¼ FC1⅜ FC1 7/16	FC35A FC1¼A	FC35EC FC1¼EC FC1⅜EC FC1 7/16EC	FC35DEC FC1¼DEC FC1⅜ DEC FC1 7/16DEC	1035	5	135,0 5·315	90,0 3·543	110,0 4·331	10 ⅜	20,5 ·807	24,40 ·961
40	 1½	FC40 FC1½	FC40A FC1½A	FC40EC FC1½EC	FC40DEC FC1½DEC	1040	6	145,0 5·709	100,0 3·937	120,0 4·724	10 ⅜	23,0 ·906	29,18 1·149
45	 1⅝ 1 11/16 1¾	FC45 FC1⅝ FC1 11/16 FC1¾	FC45A FC1¾A	FC45EC FC1⅝EC FC1 11/16EC FC1¾EC	FC45DEC FC1⅝DEC FC1 11/16DEC FC1¾DEC	1045	7	155,0 6·102	105,0 4·134	130,0 5·118	12 ½	25,0 ·984	28,18 1·109
50	 1⅞ 1 15/16 2	FC50 FC1⅞ FC1 15/16 FC2R	FC50A	FC50EC FC1⅞EC FC1 15/16EC	FC50DEC FC1⅞DEC FC1 15/16DEC	1050	8	165,0 6·496	110,0 4·331	135,0 5·315	12 ½	25,0 ·984	31,52 1·241
55	 2 2⅛ 2 3/16	FC55 FC2 FC2⅛ FC2 3/16			FC55DEC FC2DEC FC2⅛DEC FC2 3/16DEC	1055	9	185,0 7·283	125,0 4·921	150,0 5·906	16 ⅝	27,5 1·083	33,30 1·311
60	 2¼ 2⅜ 2 7/16	FC60 FC2¼ FC2⅜ FC2 7/16			FC60DEC FC2¼DEC FC2⅜DEC FC2 7/16DEC	1060	10	195,0 7·677	135,0 5·315	160,0 6·299	16 ⅝	29,0 1·142	38,65 1·522

Please check availability

52

A2	A3	A4	B	B1	B2	B3	s	s1	s2	d1	d3	ISO load ratings dynamic C_r	static C_{or}	Rec. max. speed	Mass (approx.)
mm inches												newtons lbf	newtons lbf	rev/ min	kg lb
21,45 ·844	24,57 ·967	8,0 ·315	30,96 1·219	25,77 1·015	30,92 1·217	43,62 1·717	12,75 ·502	7,56 ·298	17,12 ·674	28,50 1·122	33,30 1·311	12800 2880	6580 1480	6700	0,7 1·5
20,86 ·821	24,41 ·961	9,0 ·354	34,11 1·343	27,35 1·077	30,92 1·217	44,40 1·748	14,32 ·564	7,56 ·298	17,49 ·689	34,01 1·339	38,10 1·500	14000 3150	7880 1770	6250	0,9 1·9
24,64 ·970	28,10 1·106	9,5 ·374	38,10 1·500	31,21 1·229	35,68 1·405	48,42 1·906	15,93 ·627	9,04 ·356	18,32 ·721	40,00 1·575	44,45 1·750	19500 4380	11300 2540	5300	1,1 2·5
28,33 1·115	31,29 1·232	10,0 ·394	42,88 1·688	34,90 1·374	38,88 1·531	51,18 2·015	17,53 ·690	9,55 ·376	18,89 ·744	46,69 1·838	55,58 2·188	25700 5780	15300 3440	4500	1,5 3·3
31,59 1·244	33,88 1·334	11,5 ·453	49,23 1·938	41,18 1·621	43,64 1·718	56,34 2·218	19,10 ·752	11,05 ·435	21,46 ·845	52,70 2·075	60,30 2·374	29100 6540	17900 4020	4000	1,8 3·9
30,59 1·204	32,88 1·294	12,0 ·472	49,23 1·938	41,18 1·621	43,64 1·718	56,34 2·218	19,10 ·752	11,05 ·435	21,46 ·845	57,30 2·256	63,50 2·500	32500 7310	20500 4610	3700	2,2 4·8
31,63 1·245	37,14 1·462	13,0 ·512	51,59 2·031	43,54 1·714	43,64 1·718	62,70 2·469	19,10 ·752	11,05 ·435	24,65 ·970	62,20 2·449	69,85 2·750	35000 7870	23200 5220	3400	2,8 6·2
- -	43,72 1·721	15,0 ·591	55,55 2·187	- -	- -	71,44 2·813	22,28 ·877	- -	27,82 1·095	68,81 2·709	76,20 3·000	43500 9780	29200 6560	3100	4,0 8·8
- -	45,89 1·807	16,0 ·630	65,07 2·562	- -	- -	77,82 3·064	25,45 1·002	- -	31,02 1·221	75,34 2·966	84,12 3·312	52500 11800	35900 8070	2800	4,7 10·4

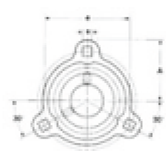
53

7/8" Three Bolt Flange Bearing SBTRD205-14G

SKU: SBTRD205-14G

High quality 7/8" three bolt flange bearing. The bearing has a narrow inner ring with two set screws for attaching to the shaft. Housing is cast iron with a grease zerk for re-lubing the bearing.

Basic Dimensions				
Shaft Size	Bolt Distance	Bolt Circle	Center to Edge	Overall Thickness
7/8"	2.60"	3.00"	1.88"	1.17"

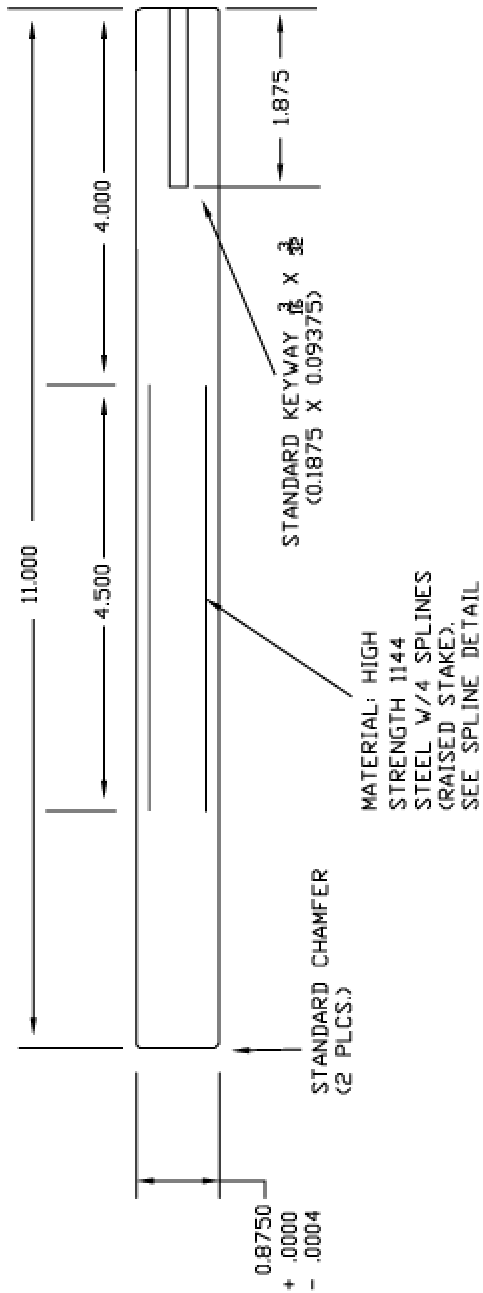


Click Above for Full Dimensions

Interchange

Peer: FHSF3X205-14G
AMI: BTM205-14
Browning: VF3S-114
Dodge: LF-SC-014
Fafnir: GSFD-7/8

PRICE: $13.65
Quantity: 1


11.000
4.000
4.500
1.875
STANDARD KEYWAY 3/16 X 3/32
(0.1875 X 0.09375)
MATERIAL: HIGH
STRENGTH 1144
STEEL W/4 SPLINES
(RAISED STAKE).
SEE SPLINE DETAIL
STANDARD CHAMFER
(2 PLCS.)
0.8750
+ .0000
- .0004

Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Type 940 round, axial leaded film capacitors have polypropylene film and dual metallized electrodes for both self healing properties and high peak current carrying capability (dV/dt). This series features low ESR characteristics, excellent high frequency and high voltage capabilities.

Highlights

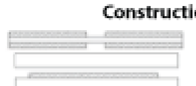
- High dV/dt
- High pulse current
- Low inductance
- Self healing

Specifications

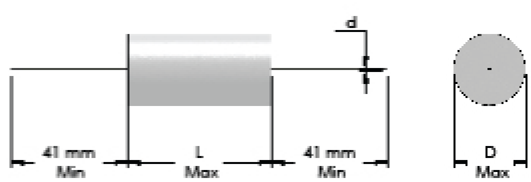
Capacitance Range	0.01 to 4.7 µF
Capacitance Tolerance	±10% Standard Tolerance
Rated Voltage	600 to 3000 Vdc (275 to 500 Vac, 60 Hz)
Operating Temperature Range with Ripple	–55 ºC to 105 ºC* *Full rated voltage at 85 ºC - derated linearly to 50% rated at 105 ºC
Maximum rms Current	Check tables for values
Insulation Resistance	> 100,000 MΩ x µF
Test Voltage between Terminals @ 25 ºC	160% rated DC voltage for 60 s
Test Voltage between Terminals & Case @ 25 ºC	3 kVac @ 50/60 Hz for 60 s
Life Test	2,000 h @ 85 ºC, 125% rated DC voltage
Life Expectancy	60,000 h @ rated Vdc, 70 ºC 30,000 h @ rated Vac, 70 ºC
RoHS Compliant	

Dimensions

Construction Diagram



Construction Details	
Case Material	UL510 Polyester Tape Wrap
Resin Material	UL94V-0 Epoxy Fill
Terminal Material	Tin Plated Copper



CDE Cornell Dubilier • 1605 E. Rodney French Blvd. • New Bedford, MA 02744 • Phone: (508)996-8561 • Fax: (508)996-3830

Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Part Numbering System

940	C	6	P	22	K	–F
Series	Termination Code	Voltage Code	Capacitance Decimal Point	Capacitance Significant figures in µF	Tolerance Code	RoHS Compliant Indicator
940	C =Tinned Copper Wire F = Insulated Stranded Wire H = Tinned Lugs	6 = 600 Vdc 8 = 800 Vdc 10 = 1000 Vdc 12 = 1200 Vdc 16 = 1600 Vdc 20 = 2000 Vdc 30 = 3000 Vdc	S = 0.0 P = 0. W = No decimal point		K = ±10%	

Ratings

NOTE: Other ratings, sizes and performance specifications are available. Contact us.

Cap. (µF)	Catalog Part Number	D mm	L mm	d mm	Typical ESR (mΩ)	Typical ESL (nH)	dV/dt V/µs	I peak (A)	I_{RMS} 70 °C 100 kHz (A)
				600 Vdc (275 Vac)					
.10	940C6P1K-F	9.0	34.0	0.8	28	19	196	20	2.5
.15	940C6P15K-F	10.5	34.0	0.8	13	20	196	29	4.0
.22	940C6P22K-F	11.5	34.0	0.8	12	20	196	43	4.4
.33	940C6P33K-F	13.5	34.0	0.8	9	21	196	65	5.6
.47	940C6P47K-F	15.5	34.0	1.0	7	22	196	92	6.9
.68	940C6P68K-F	18.0	34.0	1.0	6	23	196	134	8.1
1.00	940C6W1K-F	21.0	34.0	1.0	6	24	196	196	8.9
1.50	940C6W1P5K-F	25.0	34.0	1.2	5	26	196	295	10.9
2.00	940C6W2K-F	23.5	46.0	1.2	5	31	128	255	11.8
3.30	940C6W3P3K-F	27.0	54.0	1.2	4	36	105	346	15.3
4.70	940C6W4P7K-F	31.5	54.0	1.2	4	38	105	492	16.8
				850 Vdc (450 Vac)					
.15	940C8P15K-F	13.0	34.0	0.8	8	21	713	107	5.8
.22	940C8P22K-F	15.5	34.0	1.0	8	22	713	157	6.4
.33	940C8P33K-F	18.0	34.0	1.0	7	23	713	235	7.5
.47	940C8P47K-F	21.0	34.0	1.0	5	24	713	335	9.8
.68	940C8P68K-F	24.5	34.0	1.2	4	26	713	485	12.0
1.00	940C8W1K-F	22.5	46.0	1.2	5	30	400	400	11.5
1.50	940C8W1P5K-F	27.0	46.0	1.2	4	32	400	600	14.3
2.00	940C8W2K-F	30.5	46.0	1.2	3	34	400	800	17.9
2.20	940C8W2P2K-F	32.0	46.0	1.2	3	34	400	880	18.4
2.50	940C8W2P5K-F	34.0	46.0	1.2	3	35	400	1000	19.1
				1000 Vdc (500 Vac)					
.15	940C10P15K-F	15.0	34.0	1.0	7	22	856	128	6.7
.22	940C10P22K-F	17.5	34.0	1.0	7	23	856	188	7.4
.33	940C10P33K-F	20.5	34.0	1.0	6	24	856	283	8.8
.47	940C10P47K-F	24.0	34.0	1.2	5	26	856	402	10.6
.68	940C10P68K-F	28.0	34.0	1.2	5	27	856	582	11.7
1.00	940C10W1K-F	26.0	46.0	1.2	5	32	480	480	12.5
1.50	940C10W1P5K-F	31.0	46.0	1.2	4	34	480	720	15.6
2.00	940C10W2K-F	35.5	46.0	1.2	3	36	480	960	19.6

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Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Cap. (µF)	Catalog Part Number	D mm	L mm	d mm	Typical ESR (mΩ)	Typical ESL (nH)	dV/dt V/µs	I peak (A)	I_{rms} 70 °C 100 kHz (A)
				1200 Vdc (500 Vac)					
.10	940C12P1K-F	15.5	34.0	1.0	9	22	1142	114	6.1
.15	940C12P15K-F	18.5	34.0	1.0	7	23	1142	171	7.6
.22	940C12P22K-F	21.5	34.0	1.0	7	24	1142	251	8.4
.33	940C12P33K-F	20.0	46.0	1.0	7	29	640	211	9.0
.47	940C12P47K-F	23.0	46.0	1.2	7	30	640	301	9.8
.68	940C12P68K-F	27.0	46.0	1.2	6	32	640	435	11.7
1.00	940C12W1K-F	33.0	46.0	1.2	5	35	640	640	14.5
1.50	940C12W1P5K-F	35.0	54.0	1.2	4	39	502	754	17.9
				1600 Vdc (500 Vac)					
.10	940C16P1K-F	18.0	34.0	1.0	7	23	1427	143	7.5
.15	940C16P15K-F	21.5	34.0	1.0	5	24	1427	214	9.9
.22	940C16P22K-F	25.5	34.0	1.2	7	26	1427	314	9.3
.33	940C16P33K-F	23.5	46.0	1.2	7	31	800	264	10.0
.47	940C16P47K-F	27.5	46.0	1.2	6	32	800	376	11.8
.68	940C16P68K-F	32.5	46.0	1.2	6	35	800	544	13.1
1.00	940C16W1K-F	39.0	46.0	1.2	5	37	800	800	16.2
1.50	940C16W1P5K-F	42.0	54.0	1.2	4	42	628	942	20.1
				2000 Vdc (500 Vac)					
.022	940C20S22K-F	11.5	34.0	0.8	35	6	1712	38	2.6
.033	940C20S33K-F	13.5	34.0	0.8	20	21	1712	57	3.8
.047	940C20S47K-F	15.0	34.0	1.0	12	22	1712	80	5.2
.068	940C20S68K-F	17.5	34.0	1.0	8	23	1712	116	6.9
.100	940C20P1K-F	21.0	34.0	1.0	7	24	1712	171	8.3
.150	940C20P15K-F	19.5	46.0	1.0	7	29	960	144	8.9
.220	940C20P22K-F	22.0	46.0	1.0	8	30	960	211	9.0
.330	940C20P33K-F	27.0	46.0	1.2	8	32	960	317	10.1
.470	940C20P47K-F	32.0	46.0	1.2	6	34	960	451	13.0
.560	940C20P56K-F	31.0	54.0	1.2	7	37	754	422	12.6
.680	940C20P68K-F	34.0	54.0	1.2	6	39	754	513	14.3
1.00	940C20W1K-F	41.0	54.0	1.2	5	42	754	754	17.7
				3000 Vdc (500 Vac)					
.010	940C30S1K-F	11.5	34.0	0.8	60	20	2568	26	2.0
.015	940C30S15K-F	13.5	34.0	0.8	40	21	2568	39	2.7
.022	940C30S22K-F	15.5	34.0	1.0	25	22	2568	57	3.6
.033	940C30S33K-F	18.0	34.0	1.0	14	23	2568	85	5.3
.047	940C30S47K-F	16.5	46.0	1.0	14	28	1440	68	5.7
.068	940C30S68K-F	19.0	46.0	1.0	12	29	1440	98	6.7
.100	940C30P1K-F	22.5	46.0	1.2	10	30	1440	144	8.1
.150	940C30P15K-F	27.0	46.0	1.2	8	32	1440	216	10.1

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electrocube

HIGH VOLTAGE METALLIZED POLYESTER CAPACITOR 226 SERIES

The unique high performance and long life characteristics of polyester account for the varied applications of this miniature capacitor series.

These capacitors feature extended foil construction and standard tin coated copper-clad steel leads. Nickel, copper, dumet and other special leads are available.

Protective clear wrap is offered on all wrap and fill units. Please add .010" to maximum diameter dimension for protective clear wrap.

The potting material and endfills of Electrode's capacitors meet or exceed the flammability requirements of UL94VO.

RoHS

SPECIFICATIONS

Temperature: -55ºC to +85ºC at rated voltage.

Dielectric Strength: Will withstand 125% at voltage and 25ºC for a period not to exceed 1 minute; current limited to 5 mA.

Life Test: Will withstand rated voltage for 2000 hrs. at +40ºC with not more than 1 failure in 12 permitted.

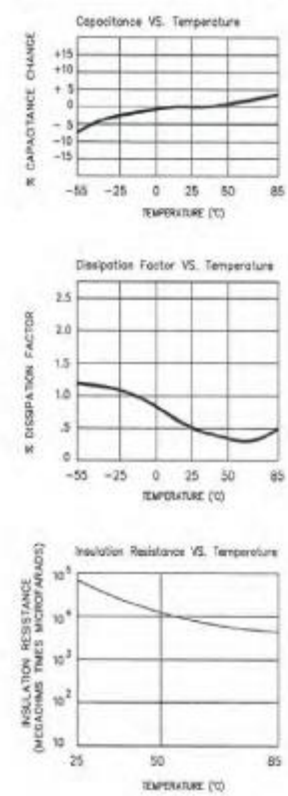
Dissipation factor: Shall not exceed 1.0% at 25ºC.

Acceptance Criteria: Measurement frequency for capacitance and dissipation factor shall be 1000Hz for values to 1 mfd; 120Hz. For values of 1 mfd and up.

Insulation Resistance: At 500V, units shall meet the minimum values below:

Temperature (ºC)	MEG x MFDS	MEG (NEED NOT EXCEED)
	2000V - UP	2000V - UP
25	40,000	80,000
85	4,000	8,000

TYPICAL DIELECTRIC CHARACTERIS CURVERS



NOTES:

For information regarding insulating sleeves, mountings, special terminals non-standard leads, circuit connections and other hardware, please consult factory.

For styles and ratings not shown, or for unusual requirements necessitated by special circuit applications (including higher IR or lower DF), consult the factory direct.

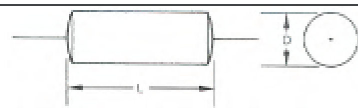
All Electrocube film capacitors have endfills and tape that Meet or exceed the flammability requirements of UL94VO.

Electrocube
Drawn: Tuyet

3366 Pomona Blvd. · Pomona, CA 91768 · TEL: (909) 595-4037 · FAX: (909) 595-0186
e-mail: esales@electrocube.com · Internet : www.electrocube.com ·(A: 03/08)

electrocube

HIGH VOLTAGE METALLIZED POLYESTER
226D SERIES



For max. D and L dimensions, allow +.062".

LEAD LENGTH:2.0" ±.50"

WRAP AND FILL
ROUND CONFIGURATION

	2000 VOLT DC				3000 VOLT DC				4000 VOLT DC			
MFD	PART NO.	DIMENSIONS D	DIMENSIONS L	LEADSIZE (AWG)	PART NO.	DIMENSIONS D	DIMENSIONS L	LEAD SIZE (AWG)	PART NO.	DIMENSIONS D	DIMENSIONS L	LEAD SIZE (AWG)
.0010	226D1J102*	.28	.69	24	226D1L102*	-	-	-	226D1M102*	-	-	-
.0012	226D1J122*	.31	.69	24	226D1L122*	-	-	-	226D1M122*	-	-	-
.0015	226D1J152*	.31	.69	24	226D1L152*	-	-	-	226D1M152*	-	-	-
.0018	226D1J182*	.31	.69	24	226D1L182*	-	-	-	226D1M182*	-	-	-
.0022	226D1J222*	.31	.69	24	226D1L222*	-	-	-	226D1M222*	-	-	-
.0027	226D1J272*	.31	.69	24	226D1L272*	-	-	-	226D1M272*	.25	1.25	22
.0033	226D1J332*	.31	.69	24	226D1L332*	-	-	-	226D1M332*	.27	1.25	22
.0039	226D1J392*	.31	.69	24	226D1L392*	-	-	-	226D1M392*	.28	1.25	22
.0047	226D1J472*	.31	.69	24	226D1L472*	-	-	-	226D1M472*	.31	1.25	22
.0056	226D1J562*	.31	.69	24	226D1L562*	-	-	-	226D1M562*	.33	1.25	22
.0068	226D1J682*	.25	.88	24	226D1L682*	.25	1.25	22	226D1M682*	.36	1.25	22
.0082	226D1J822*	.25	.88	24	226D1L822*	.27	1.25	22	226D1M822*	.38	1.25	22
.010	226D1J103*	.27	.88	22	226D1L103*	.30	1.25	22	226D1M103*	.41	1.25	22
.012	226D1J123*	.28	.88	22	226D1L123*	.31	1.25	22	226D1M123*	.45	1.25	22
.015	226D1J153*	.28	1.00	22	226D1L153*	.34	1.25	22	226D1M153*	.38	1.75	22
.018	226D1J183*	.29	1.00	22	226D1L183*	.38	1.25	22	226D1M183*	.41	1.75	22
.022	226D1J223*	.34	1.00	22	226D1L223*	.41	1.25	22	226D1M223*	.43	1.75	22
.027	226D1J273*	.37	1.00	22	226D1L273*	.42	1.75	22	226D1M273*	.48	1.75	20
.033	226D1J333*	.38	1.00	22	226D1L333*	.44	1.75	20	226D1M333*	.53	1.75	20
.039	226D1J393*	.39	1.00	22	226D1L393*	53	1.75	20	226D1M393*	.56	1.75	20
.047	226D1J473*	.34	1.25	22	226D1L473*	.68	1.75	20	226D1M473*	.52	2.25	20
.056	226D1J563*	.38	1.25	22	226D1L563*	.50	1.75	20	226D1M563*	.56	2.25	20
.068	226D1J683*	.39	1.25	22	226D1L683*	.45	2.25	20	226D1M683*	.61	2.25	20
.082	226D1J823*	.38	1.50	22	226D1L823*	.48	2.25	20	226D1M823*	.67	2.25	20
.10	226D1J104*	.41	1.50	22	226D1L104*	.53	2.25	20	226D1M104*	.73	2.25	20
.12	226D1J124*	.43	1.50	22	226D1L124*	.65	2.25	20	226D1M124*	.79	2.25	20
.15	226D1J154*	.47	1.50	20	226D1L154*	.72	2.25	20	226D1M154*	.83	2.25	18
.18	226D1J184*	.53	1.50	20	226D1L184*	.73	2.25	20	226D1M184*	.94	2.25	18
.22	226D1J224*	.53	1.75	20	226D1L224*	.81	2.25	20	226D1M224*	1.03	2.56	18
.27	226D1J274*	.56	1.75	20	226D1L274*	.83	2.56	18	226D1M274*	1.06	2.81	18
.33	226D1J334*	.63	1.75	20	226D1L334*	.92	2.56	18	226D1M334*	1.19	2.81	18
.39	226D1J394*	.67	1.75	20	226D1L394*	1.00	2.56	18				
.47	226D1J474*	.66	2.00	20	226D1L474*	1.08	2.81	18				
.56	226D1J564*	.71	2.00	20	226D1L564*	1.13	2.81	18				
.68	226D1J684*	.81	2.00	20								
.82	226D1J824*	.82	2.25	18								
1.0	226D1J105*	.88	2.25	18								
1.2	226D1J125*	.91	2.25	18								
1.5	226D1J155*	.94	2.75	18								
1.8	226D1J185*	.98	2.75	18								
2.0	226D1J205*	1.06	2.75	18								

*Add tolerance designator to complete part number: J= ±5%, K= ±10%, M= ±20

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Drawn: Tuyet

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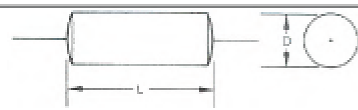
HIGH VOLTAGE METALLIZED POLYESTER

226D SERIES



For max. D and L dimensions, allow +.062".

LEAD LENGTH:2.0" ±.50"

WRAP AND FILL
ROUND CONFIGURATION

	5000 VOLT DC				6000 VOLT DC				8000 VOLT DC			
MFD	PART NO.	DIMENSIONS D	DIMENSIONS L	LEADSIZE (AWG)	PART NO.	DIMENSIONS D	DIMENSIONS L	LEAD SIZE (AWG)	PART NO.	DIMENSIONS D	DIMENSIONS L	LEAD SIZE (AWG)
.0010	226D1N102*	-	-	-	226D1P102*	-	-	-	226D1Y102*	.25	1.81	22
.0012	226D1N122*	-	-	-	226D1P122*	.25	1.31	22	226D1Y122*	.27	1.81	22
.0015	226D1N152*	-	-	-	226D1P152*	.27	1.31	22	226D1Y152*	.28	1.81	22
.0018	226D1N182*	-	-	-	226D1P182*	.30	1.31	22	226D1Y182*	.30	1.81	22
.0022	226D1N222*	.25	1.31	22	226D1P222*	.31	1.31	22	226D1Y222*	.33	1.81	22
.0027	226D1N272*	.28	1.31	22	226D1P272*	.34	1.31	22	226D1Y272*	.38	1.81	22
.0033	226D1N332*	.30	1.31	22	226D1P332*	.38	1.31	22	226D1Y332*	.39	1.81	22
.0039	226D1N392*	.31	1.31	22	226D1P392*	.41	1.31	22	226D1Y392*	.44	1.81	22
.0047	226D1N472*	.34	1.31	22	226D1P472*	.34	1.69	22	226D1Y472*	.47	1.81	20
.0056	226D1N562*	.38	1.31	22	226D1P562*	.38	1.69	22	226D1Y562*	.50	1.81	20
.0068	226D1N682*	.41	1.31	22	226D1P682*	.41	1.69	22	226D1Y682*	.55	1.81	20
.0082	226D1N822*	.34	1.69	22	226D1P822*	.44	1.69	22	226D1Y822*	.49	2.31	20
.010	226D1N103*	.38	1.69	22	226D1P103*	.49	1.69	20	226D1Y103*	.53	2.31	20
.012	226D1N123*	.41	1.69	22	226D1P123*	.53	1.69	20	226D1Y123*	.56	2.31	20
.015	226D1N153*	.44	1.69	22	226D1P153*	.58	1.69	20	226D1Y153*	.63	2.31	20
.018	226D1N183*	.50	1.69	22	226D1P183*	.53	2.06	20	226D1Y183*	.69	2.31	20
.022	226D1N223*	.53	1.69	22	226D1P223*	.59	2.06	20	226D1Y223*	.75	2.31	20
.027	226D1N273*	.58	1.69	20	226D1P273*	.64	2.06	20	226D1Y273*	.83	2.31	18
.033	226D1N333*	.53	2.06	20	226D1P333*	.70	2.06	20	226D1Y333*	.91	2.31	18
.039	226D1N393*	.59	2.06	20	226D1P393*	.80	2.06	20	226D1Y393*	.84	2.81	18
.047	226D1N473*	.63	2.06	20	226D1P473*	.83	2.06	18	226D1Y473*	.92	2.81	18
.056	226D1N563*	.69	2.06	20	226D1P563*	.91	2.06	18	226D1Y563*	1.00	2.81	18
.068	226D1N683*	.75	2.44	20	226D1P683*	.88	2.44	18	226D1Y683*	1.13	2.81	18
.082	226D1N823*	.73	2.44	20	226D1P823*	.95	2.44	18	226D1Y823*	1.25	2.81	18
.10	226D1N104*	.88	2.44	20	226D1P104*	1.06	2.44	18	226D1Y104*	1.38	2.81	18
.12	226D1N124*	.82	3.25	20								
.15	226D1N154*	.84	3.25	18								
.18	226D1N184*	.92	3.25	18								
.22	226D1N224*	1.03	3.25	18								
.27	226D1N274*	1.13	3.25	18								

*Add tolerance designator to complete part number: J= ±5%, K= ±10%, M= ±20

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Magnet Wire Dimension Chart

	Inches	Millimeters
Nominal Bare Wire Diameter	0.083000	2.1082
Nominal Coated Wire Diameter		

Cir Mils	6,888.802	Non-Standard IEC Metric Size	2.1082
Sq Mils	5,410.465	Approximate AWG	12
Sq MM	3.488838	Approximate SWG	14
Sq Cm	0.03488838	Standard BWG	14
Sq Inches	0.0054077097		

Wire Measurement System

○ AWG ○ SWG
○ METRIC ● BWG

14 BWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters
Nominal Bare Wire Diameter	0.080800	2.0523
Nominal Coated Wire Diameter	0.0838	2.1285

Cir Mils	6,528.452	Non-Standard IEC Metric Size	2.0523
Sq Mils	5,127.447	Standard AWG	12
Sq MM	3.306339	Approximate SWG	14
Sq Cm	0.03306339	Approximate BWG	14
Sq Inches	0.0051248352		

Wire Measurement System

● AWG ○ SWG
○ METRIC ○ BWG

12 AWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters
Nominal Bare Wire Diameter	0.080000	2.0320
Nominal Coated Wire Diameter	0.0836	2.1234

Cir Mils	6,399.816	Non-Standard IEC Metric Size	2.0320
Sq Mils	5,026.416	Approximate AWG	12
Sq MM	3.241191	Standard SWG	14
Sq Cm	0.03241191	Approximate BWG	14
Sq Inches	0.0050238557		

Wire Measurement System

○ AWG ● SWG
○ METRIC ○ BWG

14 SWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters
Nominal Bare Wire Diameter	0.078740	2.0000
Nominal Coated Wire Diameter	0.0817	2.0740

Cir Mils	6,199.810	Standard IEC Metric Size	2.0000
Sq Mils	4,869.330	Approximate AWG	12
Sq MM	3.139897	Approximate SWG	14
Sq Cm	0.03139897	Approximate BWG	15
Sq Inches	0.0048668505		

Wire Measurement System

○ AWG ○ SWG
● METRIC ○ BWG

2 MM

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

Magnet Wire Dimension Chart

	Inches	Millimeters	Wire Measurement System
Nominal Bare Wire Diameter	0.033900	0.8611	● AWG ○ SWG
Nominal Coated Wire Diameter	0.0354	0.8992	○ METRIC ○ BWG

Cir Mils	1,149.177	Standard IEC Metric Size	0.8611
Sq Mils	902.564	Standard AWG	19.5
Sq MM	0.582001	Approximate SWG	20
Sq Cm	0.00582001	Approximate BWG	22
Sq Inches	0.0009021039		

19.5 AWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters	Wire Measurement System
Nominal Bare Wire Diameter	0.033465	0.8500	○ AWG ○ SWG
Nominal Coated Wire Diameter	0.0358	0.9090	● METRIC ○ BWG

Cir Mils	1,119.841	Standard IEC Metric Size	0.8500
Sq Mils	879.523	Approximate AWG	20
Sq MM	0.567144	Approximate SWG	21
Sq Cm	0.00567144	Approximate BWG	21
Sq Inches	0.0008790749		

.85 MM

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters	Wire Measurement System
Nominal Bare Wire Diameter	0.032000	0.8128	● AWG ○ SWG
Nominal Coated Wire Diameter	0.0339	0.8611	○ METRIC ○ BWG

Cir Mils	1,023.971	Non-Standard IEC Metric Size	0.8128
Sq Mils	804.227	Standard AWG	20
Sq MM	0.518591	Approximate SWG	21
Sq Cm	0.00518591	Approximate BWG	21
Sq Inches	0.0008038169		

20 AWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

	Inches	Millimeters	Wire Measurement System
Nominal Bare Wire Diameter	0.032000	0.8128	○ AWG ● SWG
Nominal Coated Wire Diameter	0.0344	0.8738	○ METRIC ○ BWG

Cir Mils	1,023.971	Non-Standard IEC Metric Size	0.8128
Sq Mils	804.227	Approximate AWG	20
Sq MM	0.518591	Standard SWG	21
Sq Cm	0.00518591	Approximate BWG	21
Sq Inches	0.0008038169		

21 SWG

If no dimension is shown for coated wire, magnet wire is not normally available for this size or wire type.

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QEG MAGNET WIRE DATA -

PRIMARY WINDINGS - 3100T (X2)

STANDARD AWG SIZE	SQUARE MILLIMETER	NON-STARDARD IEC METRIC SIZE
#20	**0.518591**	0.8128

INSULATING FILM TYPE

HTAIHSD (200° C, POLYESTER POLYAMIDE/IMIDE, **INVERTER DUTY**, NEMA MW35-C

REQUIRED LENGTH/WEIGHT

1 FOOT/TURN (NOMINAL) = 6,200 FEET [1,889.76 M]
@ 3.217 POUNDS / 1,000 FEET = 6.200 X 3.217 = 19.95 POUNDS [9.05 kg]

RECOMMENDED PURCHASE:

21 POUNDS [9.53 kg]
or 6,300 FEET [1,920.24 M]

NOMINAL COATED WIRE DIAMETER

INCH	MILLIMETER
0.0339	0.8611

SECONDARY WINDINGS - 350T (X2)

STANDARD AWG SIZE	SQUARE MILLIMETER	NON-STARDARD IEC METRIC SIZE
#12	**3.306339**	2.0523

INSULATING FILM TYPE

HTAIHSD (200° C, POLYESTER POLYAMIDE/IMIDE, **INVERTER DUTY**, NEMA MW35-C

REQUIRED LENGTH/WEIGHT

1 FOOT/TURN (NOMINAL) = 700 FEET [213.36 M]
@ 20.13 POUNDS / 1,000 FEET = .700 X 20.13 = 14.1 POUNDS [6.4 kg]

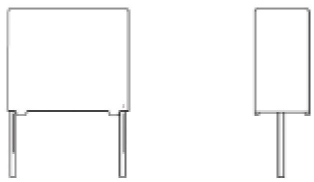
RECOMMENDED PURCHASE:

15 POUNDS [6.8 kg]
or 750 FEET [228.6 M]

NOMINAL COATED WIRE DIAMETER

INCH	MILLIMETER
0.0838	2.1285

AC and Pulse Metallized Polypropylene Film Capacitors MKP Radial Potted Type



FEATURES

- 5 mm to 52.5 mm lead pitch; 7.5 mm bent back pitch
- Low contact resistance
- Low loss dielectric
- Small dimensions for high density packaging
- Supplied loose in box and taped on reel or ammopack
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

APPLICATIONS

- Where steep pulses occur e.g. SMPS (switch mode power supplies)
- Electronic lighting e.g. ballast
- Motor control circuits
- High frequency and pulse operations
- Deflection circuits in TV-sets (S-correction)
- Loudspeaker crossover networks, storage, filter, timing and sample and hold circuits

QUICK REFERENCE DATA	
Capacitance range (E24 series)	0.00047 µF to 82 µF
Capacitance tolerance	± 5 %
Climatic testing class according to IEC 60068-1	55/110/56
Rated DC temperature	85 °C
Rated AC temperature	85 °C
Maximum application temperature	110 °C
Maximum operating temperature for limited time	125 °C
Reference specifications	IEC 60384-17
Dielectric	Polypropylene film
Electrodes	Metallized
Construction	Mono and internal serial construction
Encapsulation	Flame retardant plastic case and epoxy resin UL-class 94 V-0
Leads	Tinned wire
Marking	C-value; tolerance; rated voltage; manufacturer's type; code for dielectric material; manufacturer location; manufacturer's logo; year and week

Note

- For more detailed data and test requirements, contact dc-film@vishay.com

VOLTAGE RATINGS										
Rated DC voltage	160	250	400	630	850	1000	1250	1600	2000	2500
Rated AC voltage	110	160	200	220	300	350	450	550	700 (1)	900 (2)
Rated peak to peak voltage	310	450	560	620	850	1000	1250	1600	2000	2500

Notes

(1) Rated AC voltage is 600 V_{AC} for pitch ≥ 37.5 mm
(2) Rated AC voltage is 800 V_{AC} for pitch ≥ 37.5 mm

COMPOSITION OF CATALOG NUMBER

Multiplier (nF)	
0.01	1
0.1	2
1	3
10	4
100	5
1000	6

Example		
147	470 pF	0.00047 µF
210	1 nF	0.001 µF
310	10 nF	0.01 µF
410	100 nF	0.1 µF
510	1000 nF	1.0 µF
610	10 000 nF	10.0 µF

Capacitance Code (numerically)

Voltage (V_{DC})
016 = 160
025 = 250
040 = 400
063 = 630
085 = 850
100 = 1000
125 = 1250
160 = 1600
200 = 2000
250 = 2500

P_1 (mm)	Pitch Code
5	B
7.5	C
10	D
15	F
22.5	I
27.5	K
37.5	P
52.5	Y

Special Code for Terminal	
2	2 pins
4	4 pins P_2 = 10.2 mm
5	4 pins P_2 = 20.3 mm
(#)	Customized

1 2 3 4 5 6	7	8 9	10 11 12	13	14	15	16	17	18
M K P 3 8 5	1	4 7	2 5 0	J	F	P	2	T	0

Type

Tolerance	
J	± 5 %
A	Special tolerance

Special
0 = Standard
Other = Special

lt (mm)	Lead Length Code	Pitch (mm)
3.5 + 1.0/- 0.5	A	≤ 10
3.5 ± 0.3	P	≥ 15
5 ± 1	M	All
25 ± 2	I	All
0: Space holder		

Packing Code	Packing Style	Remark
B/T	Bulk/loose (1)	Excluding bent back
R	Tape and reel; (H: 16 mm; 500 mm)	For bent back only
Z	Tape and reel; (H: 16 mm; 356 mm)	For bent back only
H	Ammo (H: 16 mm)	For bent back only
W	Tape and reel (H: 18.5 mm; 500 mm)	Pitch 5 mm to 22.5 mm
G	Ammo (H: 18.5 mm)	Pitch ≤ 10 mm

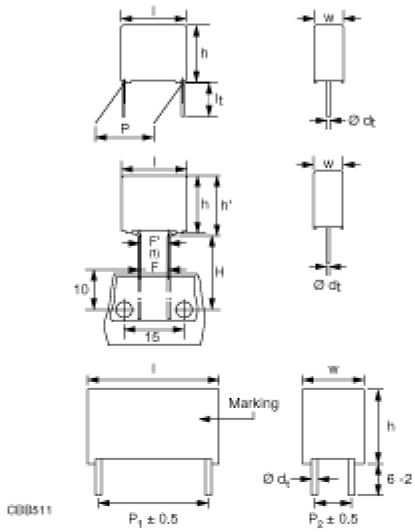
Notes

- For detailed tape specifications refer to packaging information www.vishay.com/doc?28139

(1) Packaging will be bulk for all capacitors with pitch ≤ 15 mm and such with long leads (> 5 mm).
Capacitors with short leads up to 5 mm and pitch > 15 mm will be in tray and asking code will be "T".

ELECTRICAL DATA (For Detailed Ratings go to www.vishay.com/doc?28182)	
U_{RDC} (V)	CAP. (µF)
160	0.011 min.
	82 max.
250	0.010 min.
	62 max.
400	0.0043 min.
	27 max.
630	0.0015 min.
	15 max.
850	0.001 min.
	10 max.
1000	0.00047 min.
	6.8 max.
1250	0.00047 min.
	5.1 max.
1600	0.00047 min.
	2.7 max.
2000	0.00047 min.
	1.6 max.
2500	0.00047 min.
	0.68 max.

DIMENSIONS in millimeters



Note

- | F-F' | < 0.3 mm
  F = 7.5 mm + 0.6 mm/- 0.1 mm
  Ø dt ± 10 % of standard diameter specified

VISHAY.
www.vishay.com

MKP386M Snubber
Vishay Roederstein

Metallized Polypropylene Film Capacitor Radial Snubber Type

FEATURES

- Reduce EMI by clamping voltage and current ringing
- High pulse strength (dV/dt up to 2500 V/μs)
- Low inductance construction (low ESL)
- Low ESR
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT HALOGEN FREE

APPLICATIONS

- Photovoltaic and wind inverters
- Motor drives
- Frequency converters
- Direct mount on IGBT modules

QUICK REFERENCE DATA	
Rated capacitance range	0.047 μF to 10 μF
Capacitance tolerance	± 5 %/± 10 %
Rated (DC) voltage, U_{NDC}	700 V, 850 V, 1000 V, 1250 V, 1600 V, 2000 V, 2500 V
Climatic testing class	55/105/56
Rated temperature	85 °C
Maximum permissible case temperature	105 °C
Rated (AC) voltage	420 V, 400 V to 450 V, 425 V to 500 V, 450 V to 550 V, 450 V to 600 V, 700 V, 800 V
Reference standards	IEC 60384-17
Dielectric	Polypropylene film
Electrodes	Metallized film
Construction	Series construction
Encapsulation	Flame retardant plastic case and epoxy resin sealed
Terminals	Tinned coated copper
Self inductance (L_S)	< 0.7 nH per mm of lead spacing
Withstanding DC voltage between terminals [(1)]	1.6 U_{RDC} for 60 s (maximum rise time 1000 V/s; cut off current 10 mA)
Test voltage between terminals and case	1.4 U_{RAC} + 2000 V_{DC} for 60 s
Insulation resistance	RC between leads, at 500 V after 1 min: > 100 GΩ for C ≤ 0.33 μF > 30 000 s for C > 0.33 μF
Performance grade	Grade 1 (long life)
Stability grade	Grade 2
Life time expectancy	Operation life > 300 000 h - failure rate < 5 FIT (40 °C and 0.5 x U_R)
Marking	C-value, tolerance code, rated voltage, manufacturer's emblem, code for dielectric material, manufacturer's type designation, year and week, manufacturer's location

Notes
- For more detailed data and test requirements contact dc-film@vishay.com
- For general information like characteristics and definitions used for film capacitors follow the link: www.vishay.com/doc?28147

[(1)] See document "Voltage Proof Test for Metalized Capacitors" (www.vishay.com/doc?28169)

DC VOLTAGE RATINGS							
U_{RDC}	700 V_{DC}	850 V_{DC}	1000 V_{DC}	1250 V_{DC}	1600 V_{DC}	2000 V_{DC}	2500 V_{DC}
U_{RAC}	420 V_{AC}	450 V_{AC}	500 V_{AC}	550 V_{AC}	600 V_{AC}	700 V_{AC}	800 V_{AC}

ELECTRICAL DATA AND ORDERING CODE

U_{RDC} (V)	CAP. (µF)	DIMENSION (mm) [4] W	H	L	dU/dt (V/µs)	I_{peak} (A)	I_{RMS} [2] (A)	ESR [3] (mΩ)	tan δ 1 kHz < (10^{-4})	tan δ 10 kHz < (10^{-4})	tan δ 100 kHz < (10^{-4})	ORDERING CODE [1]
	U_{RAC} = 550 V; U_{pp} = 1550 V											
	0.33	22.0	30.5	33.5	800	264	7.0	16.0	4.0	8.0	40	MKP386M433125J**
	0.39	22.0	30.5	33.5	800	312	7.0	14.0	4.0	8.0	40	MKP386M439125J**
	0.47	22.0	30.5	33.5	800	376	8.0	11.0	4.0	8.0	40	MKP386M447125J**
	0.56	22.0	30.5	33.5	800	448	8.5	10.0	4.0	8.0	40	MKP386M456125J**
	0.68	22.0	30.5	33.5	800	544	9.5	8.0	4.0	8.0	40	MKP386M468125J**
	0.82	22.0	38.0	44.0	375	308	9.0	13.0	5.0	15.0	60	MKP386M482125J**
	1.0	22.0	38.0	44.0	375	375	10.0	10.0	5.0	15.0	60	MKP386M510125J**
	1.2	22.0	38.0	44.0	375	450	11.0	9.0	5.0	15.0	-	MKP386M512125J**
	1.5	30.0	46.0	44.0	375	563	14.0	7.0	5.0	15.0	-	MKP386M515125J**
1250	1.8	30.0	46.0	44.0	375	675	15.0	6.0	5.0	15.0	-	MKP386M518125J**
	2.0	30.0	46.0	44.0	375	750	16.0	5.5	5.0	15.0	-	MKP386M520125J**
	2.2	30.0	46.0	44.0	375	825	18.0	4.5	5.0	15.0	-	MKP386M522125J**
	U_{RAC} = 450 V; U_{pp} = 1300 V											
	2.2	25.0	45.0	58.0	225	495	14.0	6.0	7.5	20	-	MKP386M522125Y**
	2.5	25.0	45.0	58.0	225	563	15.0	5.0	7.5	20	-	MKP386M525125Y**
	3.0	25.0	45.0	58.0	225	675	16.5	4.0	7.5	20	-	MKP386M530125Y**
	3.3	30.0	45.0	58.0	225	743	18.0	4.0	7.5	20	-	MKP386M533125Y**
	4.0	35.0	50.0	58.0	225	900	21.5	3.0	7.5	20	-	MKP386M540125Y**
	4.7	35.0	50.0	58.0	225	1058	23.5	2.5	7.5	20	-	MKP386M547125Y**
	5.0	35.0	50.0	58.0	225	1125	24.5	2.5	7.5	20	-	MKP386M550125Y**
	U_{RAC} = 600 V; U_{pp} = 1690 V											
	0.22	22.0	30.5	33.5	800	176	7.0	16.0	3.0	5.0	40	MKP386M422160J**
	0.27	22.0	30.5	33.5	800	216	7.0	15.0	3.0	5.0	40	MKP386M427160J**
	0.33	22.0	30.5	33.5	800	264	8.0	12.0	3.0	5.0	40	MKP386M433160J**
	0.39	22.0	30.5	33.5	800	312	8.5	10.0	3.0	5.0	40	MKP386M439160J**
	0.47	22.0	30.5	33.5	800	376	9.0	8.5	3.0	5.0	40	MKP386M447160J**
	0.56	22.0	38.0	44.0	375	210	9.0	14.0	4.0	10.0	60	MKP386M456160J**
	0.68	22.0	38.0	44.0	375	255	9.0	12.0	4.0	10.0	60	MKP386M468160J**
	0.82	22.0	38.0	44.0	375	308	10.0	10.0	4.0	10.0	60	MKP386M482160J**
1600	1.0	22.0	38.0	44.0	375	375	12.0	8.0	4.0	10.0	60	MKP386M510160J**
	1.3	30.0	46.0	44.0	375	488	16.0	6.0	4.0	10.0	-	MKP386M513160J**
	1.5	30.0	46.0	44.0	375	563	16.0	5.5	4.0	10.0	-	MKP386M515160J**
	1.8	30.0	46.0	44.0	375	675	18.0	4.5	4.0	10.0	-	MKP386M518160J**
	2.0	30.0	46.0	44.0	375	750	19.0	4.0	4.0	10.0	-	MKP386M520160K**
	U_{RAC} = 450 V; U_{pp} = 1300 V											
	1.5	25.0	45.0	58.0	360	540	18.0	3.5	5.0	15	-	MKP386M515160Y**
	2.0	30.0	45.0	58.0	360	720	22.0	2.5	5.0	15	-	MKP386M520160Y**
	2.2	35.0	50.0	58.0	360	792	25.0	2.5	5.0	15	-	MKP386M522160Y**
	2.5	35.0	50.0	58.0	360	900	26.5	2.0	5.0	15	-	MKP386M525160Y**
	U_{RAC} = 700 V; U_{pp} = 1980 V											
	0.047	22.0	30.5	33.5	2000	94	6.0	20.0	3.0	5.0	30	MKP386M347200J**
	0.068	22.0	30.5	33.5	2000	136	6.5	17.0	3.0	5.0	30	MKP386M368200J**
	0.10	22.0	30.5	33.5	2000	200	8.0	11.0	3.0	5.0	30	MKP386M410200J**
	0.12	22.0	30.5	33.5	2000	240	9.0	9.0	3.0	5.0	30	MKP386M412200J**
	0.15	22.0	30.5	33.5	2000	300	9.5	8.0	3.0	5.0	30	MKP386M415200J**
	0.22	22.0	38.0	44.0	850	187	10.0	10.0	4.0	10.0	50	MKP386M422200J**
	0.27	22.0	38.0	44.0	850	230	11.0	8.5	4.0	10.0	50	MKP386M427200J**
2000	0.33	22.0	38.0	44.0	850	281	12.0	7.0	4.0	10.0	50	MKP386M433200J**
	0.39	22.0	38.0	44.0	850	332	12.0	6.0	4.0	10.0	50	MKP386M439200J**
	0.47	30.0	46.0	44.0	850	400	16.0	5.0	4.0	10.0	50	MKP386M447200J**
	0.56	30.0	46.0	44.0	850	476	18.0	4.0	4.0	10.0	50	MKP386M456200J**
	0.68	30.0	46.0	44.0	850	578	20.0	3.5	4.0	10.0	50	MKP386M468200J**
	0.68	25.0	45.0	58.0	525	357	14.0	6.0	5.0	15.0	75	MKP386M468200Y**
	0.82	25.0	45.0	58.0	525	431	15.5	5.0	5.0	15.0	75	MKP386M482200Y**
	1.0	30.0	45.0	58.0	525	525	18.0	4.0	5.0	15.0	-	MKP386M510200Y**
	1.5	35.0	50.0	58.0	525	788	24.0	2.5	5.0	15.0	-	MKP386M515200Y**

ELECTRICAL DATA AND ORDERING CODE

U_{RDC} (V)	CAP. (µF)	DIMENSION (mm) [4]			dU/dt (V/µs)	I_{peak} (A)	I_{RMS} [2] (A)	ESR [3] (mΩ)	tan δ 1 kHz < (10^{-4})	tan δ 10 kHz < (10^{-4})	tan δ 100 kHz < (10^{-4})	ORDERING CODE [1]
		W	H	L								
	U_{RAC} = 800 V; U_{pp} = 2260 V											
2500	0.047	22.0	30.5	33.5	2500	118	6.0	20.0	3.0	5.0	30	MKP386M347250J**
	0.068	22.0	30.5	33.5	2500	170	7.0	14.0	3.0	5.0	30	MKP386M368250J**
	0.10	22.0	30.5	33.5	2500	250	8.5	10.0	3.0	5.0	30	MKP386M410250J**
	0.12	22.0	30.5	33.5	2500	300	9.5	8.0	3.0	5.0	30	MKP386M412250J**
	0.15	22.0	38.0	44.0	1000	150	9.5	12.5	4.0	10.0	50	MKP386M415250J**
	0.18	22.0	38.0	44.0	1000	180	10.0	11.0	4.0	10.0	50	MKP386M418250J**
	0.22	22.0	38.0	44.0	1000	220	11.0	8.5	4.0	10.0	50	MKP386M422250J**
	0.33	30.0	46.0	44.0	1000	330	15.0	6.0	4.0	10.0	50	MKP386M433250J**
	0.39	30.0	46.0	44.0	1000	390	16.0	5.0	4.0	10.0	50	MKP386M439250J**
	0.47	30.0	46.0	44.0	1000	470	18.0	4.0	4.0	10.0	50	MKP386M447250J**
	0.47	25.0	45.0	58.0	795	374	15.0	5.5	5.0	15.0	75	MKP386M447250Y**
	0.56	30.0	45.0	58.0	795	445	17.0	4.5	5.0	15.0	75	MKP386M456250Y**
	0.68	35.0	50.0	58.0	795	541	20.5	4.0	5.0	15.0	75	MKP386M468250Y**
	0.82	35.0	50.0	58.0	795	652	22.5	3.0	5.0	15.0	75	MKP386M482250Y**

Notes

[1] Change the symbol ** according special code for the terminals (see Packaging Information table)

[2] Maximum RMS current at 100 kHz, + 85 °C

[3] The ESR (Equivalent Series Resistance) typical values at 100 kHz

[4] Standard dimension

PACKAGING INFORMATION

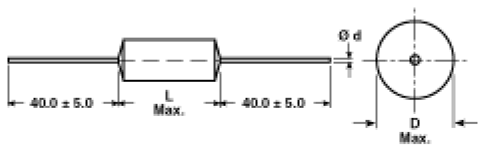
U_{RDC} (V)	CAP. (µF)	ORDERING CODE [1]	MASS (g)	TERMINAL AVAILABLE - SPQ (pcs)							
				T1	T2	T3	T4	T5	T6	T7	T8
700	0.47	MKP386M447070J**	41			48		48		55	
	0.68	MKP386M468070J**	39			48		48		55	
	1.0	MKP386M510070J**	38			48		48		55	
	1.5	MKP386M515070J**	35			48		48		55	
	2.0	MKP386M520070J**	59	42	42	36	42	36	42	36	42
	2.2	MKP386M522070J**	57	42	42	36	42	36	42	36	42
	3.0	MKP386M530070J**	91	63	63	54	63	60	63	60	63
	3.3	MKP386M533070J**	89	63	63	54	63	60	63	60	63
	4.0	MKP386M540070J**	86	63	63	54	63	60	63	60	63
	4.7	MKP386M547070J**	82	63	63	54	63	60	63	60	63
	5.0	MKP386M550070J**	80	63	63	54	63	60	63	60	63
850	0.47	MKP386M447085J**	40			48		48		55	
	0.68	MKP386M468085J**	39			48		48		55	
	0.82	MKP386M482085J**	38			48		48		55	
	1.0	MKP386M510085J**	36			48		48		55	
	1.5	MKP386M515085J**	60	42	42	36	42	36	42	36	42
	2.0	MKP386M520085J**	56	42	42	36	42	36	42	36	42
	2.2	MKP386M522085J**	55	42	42	36	42	36	42	36	42
	3.0	MKP386M530085J**	88	63	63	54	63	60	63	60	63
	3.3	MKP386M533085J**	86	63	63	54	63	60	63	60	63
	4.0	MKP386M540085J**	86	63	63	54	63	60	63	60	63
	4.7	MKP386M547085Y**	79	50	50	48	55	55	55	50	50
	5.0	MKP386M550085Y**	78	50	50	48	55	55	55	50	50
	6.0	MKP386M560085Y**	93	45	45	40	45	45	45	45	45
	7.0	MKP386M570085Y**	90	45	45	40	45	45	45	45	45
	8.0	MKP386M580085Y**	121	35	35	36	40	40	40	35	35
	10	MKP386M610085Y**	114	35	35	36	40	40	40	35	35

MKP 1845

Vishay Roederstein

Metallized Polypropylene Film Capacitor
Related Document: IEC 60384-16

Dimensions in millimeters



D	Ø d
≤ 7.0	0.7
< 16.0	0.8
≥ 16.0	1.0

MAIN APPLICATIONS
High voltage, high current and high pulse operations, deflection circuits in TV sets (S-correction and fly-back tuning). Protection circuits in SMPS's. Snubber and electronic ballast circuits. Input and output filtering in SPS designs, storage, timing and integrating circuits.

MARKING
Manufacturer's logo/type/C-value/rated voltage/tolerance/ date of manufacture

DIELECTRIC
Polypropylene film

ELECTRODES
Vacuum deposited aluminum

COATING
Metal-foil-wrapped, insulated, epoxy resin sealed, flame retardant

CONSTRUCTION
Extended double-sided metallized polyester film, internal series connection (630 to 2000 VDC), double-sided metallized polyester carrier film, (refer to general information)

LEADS
Tinned wire

IEC TEST CLASSIFICATION
55/100/56, according to IEC 60068

OPERATING TEMPERATURE RANGE
- 55 °C to + 100 °C

CAPACITANCE RANGE
1000 pF to 4.7 µF

FEATURES
Product is completely lead (Pb)-free.
Product is RoHS compliant.

CAPACITANCE TOLERANCES
± 20 % (M), ± 10 % (K), ± 5 % (J)

RATED VOLTAGES (U_R):
160 VDC, 250 VDC, 400 VDC, 630 VDC, 1000 VDC, 1600 VDC, 2000 VDC

PERMISSIBLE AC VOLTAGES (RMS) UP TO 60Hz
100 VAC, 160 VAC, 220 VAC, 400 VAC, 600 VAC, 650 VAC, 700 VAC

TEST VOLTAGE (ELECTRODE/ELECTRODE)
1.6 x U_R for 2 s

INSULATION RESISTANCE
Measured at 100 VDC after one minute
For C ≤ 0.33 µF:
100000 MΩ minimum value (150000 MΩ typical value)

TIME CONSTANT
Measured at 100 VDC after one minute
For C > 0.33 µF:
30000 s minimum value (50000 s typical value)

TEMPERATURE COEFFICIENT
- 250 x 10^{-6}/°C (typical value)

CAPACITANCE DRIFT
Up to + 40 °C, ± 0.5 % for a period of two years

DERATING FOR DC AND AC.CATEGORY VOLTAGE U_C
At + 85 °C: U_C = 1.0 U_R
At + 100 °C: U_C = 0.7 U_R

SELF INDUCTANCE
~ 12 nH measured with 6mm long leads

PULL TEST ON LEADS
≥ 20 N in direction of leads according to IEC 60068-2-21

BEND TEST ON LEADS
2 bends through 90 °C with half of the force used in pull test

RELIABILITY
Operational life > 300000 h
Failure rate < 10 FIT (40 °C and 0.5 x U_R)

For further details, please refer to the general information available at www.vishay.com/?26033.

MAXIMUM PULSE RISE TIME

CAPACITOR LENGTH (MM)	Maximum Pulse Rise Time d_V/d_t [V/µs]						
	160 VDC	250 VDC	400 VDC	630 VDC	1000 VDC	1600 VDC	2000 VDC
17	900	1140	1840	—	—	—	—
22	450	560	910	3430	—	—	—
29	260	320	520	2120	2800	3800	6200
34	202	240	400	1524	2000	2680	4200
44	140	170	280	980	1280	1690	2600

If the maximum pulse voltage is less than the rated voltage higher d_V/d_t values can be permitted.

Document Number: 26023
Revision: 07-Feb-06

For technical questions contact; dc-film@vishay.com

www.vishay.com
1

Metallized Polypropylene Film Capacitor
Related Document: IEC 60384-16

DISSIPATION FACTOR TAN δ

MEASURED AT	C ≤ 0.1 µF	0.1µF < C ≤ 1.0 µF	C > 1.0 µF
1 kHz	0.3×10^{-3}	0.3×10^{-3}	0.3×10^{-3}
10 kHz	0.4×10^{-3}	0.4×10^{-3}	-
100 kHz	1.5×10^{-3}	-	-
	Maximum values		

CAPACITANCE	CAPACITANCE CODE	VOLTAGE CODE 16 160 VDC/100 VAC		VOLTAGE CODE 25 250 VDC/160 VAC		VOLTAGE CODE 40 400 VDC/220 VAC		VOLTAGE CODE 63 630 VDC/250 VAC	
		D	L	D	L	D	L	D	L
1000 pF	- 210	-	-	-	-	-	-	-	-
1500 pF	- 215	-	-	-	-	-	-	-	-
2200 pF	- 222	-	-	-	-	-	-	-	-
3300 pF	- 233	-	-	-	-	-	-	-	-
4700 pF	- 247	-	-	-	-	-	-	-	-
6800 pF	- 268	-	-	-	-	-	-	-	-
0.01 µF	- 310	-	-	-	-	6.0	17.0	7.0	22.0
0.015 µF	- 315	-	-	-	-	6.5	17.0	8.0	22.0
0.022 µF	- 322	-	-	6.0	17.0	7.5	17.0	9.5	22.0
0.033 µF	- 333	6.0	17.0	7.0	17.0	7.0	22.0	9.0	29.0
0.047 µF	- 347	6.5	17.0	8.0	17.0	8.0	22.0	10.5	29.0
0.068 µF	- 368	7.5	17.0	7.0	22.0	9.0	22.0	12.5	29.0
0.1 µF	- 410	7.0	22.0	8.0	22.0	11.0	22.0	12.5	34.0
0.15 µF	- 415	8.0	22.0	9.5	22.0	10.0	29.0	15.0	34.0
0.22 µF	- 422	9.5	22.0	9.0	29.0	12.0	29.0	14.5	44.0
0.33 µF	- 433	9.0	29.0	10.5	29.0	13.5	29.0	17.5	44.0
0.47 µF	- 447	10.0	29.0	12.0	29.0	15.0	34.0	21.0	44.0
0.68 µF	- 468	12.0	29.0	13.0	34.0	17.5	34.0	25.0	44.0
1.0 µF	- 510	12.5	34.0	15.5	34.0	17.5	44.0	-	-
1.5 µF	- 515	15.5	34.0	15.5	44.0	21.5	44.0	-	-
2.2 µF	- 522	15.5	44.0	18.5	44.0	26.0	44.0	-	-
3.3 µF	- 533	18.5	44.0	22.5	44.0	-	-	-	-
4.7 µF	- 547	22.0	44.0		-	-	-	-	-

Further C-values on request.
pcm = L + 3.5.

RECOMMENDED PACKAGING

LETTER CODE	TYPE OF PACKAGING	REEL DIAMETER (mm)	ORDERING CODE EXAMPLES	
G	AMMO	-	MKP 1845-310-135-G	X
R	REEL	350	MKP 1845-310-135-R	X
-	BULK for L > 31.5 mm	-	MKP 1845-410-135	X

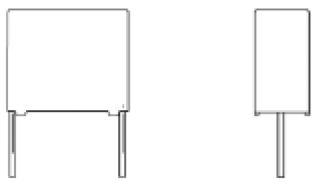
CAPACITANCE	CAPACITANCE CODE	VOLTAGE CODE 10 1000 VDC/600VAC		VOLTAGE CODE 13 1600 VDC/650 VAC		VOLTAGE CODE 20 2000 VDC/700 VAC	
		D	L	D	L	D	L
1000 pF	- 210	-	-	-	-	6.5	29.0
1500 pF	- 215	-	-	-	-	6.5	29.0
2200 pF	- 222	-	-	-	-	6.5	29.0
3300 pF	- 233	-	-	-	-	7.0	29.0
4700 pF	- 247	-	-	-	-	8.0	29.0
6800 pF	- 268	-	-	-	-	9.5	29.0
0.01 µF	- 310	6.5	29.0	8.0	29.0	11.0	29.0
0.015 µF	- 315	8.0	29.0	9.5	29.0	11.5	34.0
0.022 µF	- 322	9.0	29.0	11.0	29.0	13.0	34.0
0.033 µF	- 333	11.0	29.0	11.5	34.0	16.0	34.0
0.047 µF	- 347	11.0	34.0	13.5	34.0	15.0	44.0
0.068 µF	- 368	13.0	34.0	16.0	34.0	18.0	44.0
0.1 µF	- 410	15.5	34.0	15.0	44.0	21.0	44.0
0.15 µF	- 415	15.0	44.0	18.5	44.0	-	-
0.22 µF	- 422	18.0	44.0	22.0	44.0	-	-
0.33 µF	- 433	-	-	-	-	-	-
0.47 µF	- 447	-	-	-	-	-	-
0.68 µF	- 468	-	-	-	-	-	-
1.0 µF	- 510	-	-	-	-	-	-
1.5 µF	- 515	-	-	-	-	-	-
2.2 µF	- 522	-	-	-	-	-	-
3.3 µF	- 533	-	-	-	-	-	-
4.7 µF	- 547	-	-	-	-	-	-

Further C-values on request.
pcm = L + 3.5.

RECOMMENDED PACKAGING

LETTER CODE	TYPE OF PACKAGING	REEL DIAMETER (mm)	ORDERING CODE EXAMPLES	
G	AMMO	-	MKP 1845-310-135-G	X
R	REEL	350	MKP 1845-310-135-R	X
-	BULK for L > 31.5 mm	-	MKP 1845-410-135	X

AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type



FEATURES

- 7.5 mm to 37.5 mm lead pitch; 7.5 mm bent back pitch
- Low contact resistance
- Low loss dielectric
- Small dimensions for high density packaging
- Supplied loose in box and taped on reel or ammopack
- Mounting: Radial
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

e3 RoHS COMPLIANT

APPLICATIONS

- Where steep pulses occur e.g. SMPS (switch mode power supplies)
- Electronic lighting e.g. ballast
- Motor control circuits
- S-correction
- For flyback applications please use 1400 V series

QUICK REFERENCE DATA	
Capacitance range (E24 series)	0.00047 µF to 4.7 µF
Capacitance tolerance	± 5 %
Climatic testing class according to IEC 60068-1	55/110/56
Rated DC temperature	85 °C
Rated AC temperature	105 °C
Maximum application temperature	105 °C
Reference specifications	IEC 60384-17
Dielectric	Polypropylene film
Electrodes	Metallized
Construction	Mono and internal serial construction
Encapsulation	Flame retardant plastic case and epoxy resin UL-class 94 V-0
Leads	Tinned wire
Marking	C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer location; manufacturer's logo; year and week

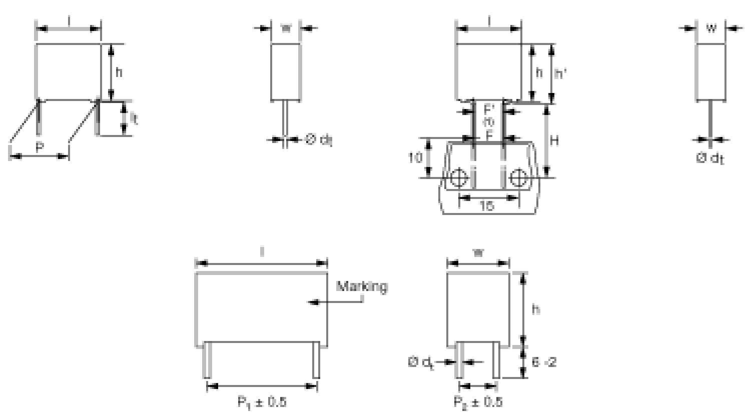
Note

- For more detailed data and test requirements, contact dc-film@vishay.com

VOLTAGE RATINGS								
Rated DC voltage	250	400	630	1000	1400	1600	2000	2500
Rated AC voltage	125	200	220	350	500	550	700	900
Rated peak to peak voltage	350	560	630	1000	1400	1600	2000	2500

ELECTRICAL DATA (For Detailed Ratings go to www.vishay.com/doc?28183)	
U_{RDC} (V)	CAP. (µF)
250	0.0068 min.
	2.7 max.
400	0.0047 min.
	1.5 max.
630	0.00047 min.
	4.7 max.
1000	0.0043 min.
	1.8 max.
1400	0.0022 min.
	0.68 max.
1600	0.0027 min.
	0.56 max.
2000	0.0010 min.
	0.56 max.
2500	0.0010 min.
	0.3 max.

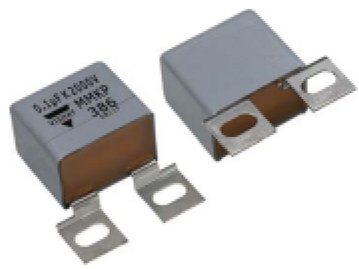
DIMENSIONS in millimeters



Note

(1) | F-F' | < 0.3 mm
F = 7.5 mm + 0.6 mm/- 0.1 mm
Ø dt ± 10 % of standard diameter specified

Double Metallized Polypropylene Film Capacitor Radial Snubber Type



FEATURES

- Low inductive construction
- Low loss dielectric
- Double sided metallized for high pulse ratings
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free e3 RoHS COMPLIANT

APPLICATIONS

Industrial motor control circuits, mounted directly on the IGBT or GTO.

QUICK REFERENCE DATA	
Capacitance range (E12 series)	0.1 µF to 4.7 µF
Capacitance tolerance	± 5 %; ± 10 %
Rated (DC) voltage	630 V, 850 V, 1000 V, 1250 V, 1400 V, 1600 V, 2000 V, 2500 V
Climatic testing class acc. to IEC 60068-1	50/085/56
Rated (DC) temperature	85 °C
Rated (AC) temperature	85 °C
Maximum application temperature	85 °C
Rated (AC) voltage	220 V, 300 V, 350 V, 425 V, 500 V, 550 V, 700 V, 900 V
Rated peak-to-peak voltage	630 V, 850 V, 1000 V, 1250 V, 1400 V, 1600 V, 2000 V, 2500 V
Reference standards	IEC 60384-17
Dielectric	Polypropylene film
Electrodes	Double metallized
Construction	Mono construction for 630 V version Internal serial construction from 850 V_{DC} on
Encapsulation	Flame retardant plastic case (UL-class 94 V-0) and epoxy resin
Tabs	Tinned coated copper
Performance grade	Grade 1 (long life)
Stability grade	Grade 2
Marking	C-value, tolerance; rated voltage; code for dielectrical material; code for factory of origin; manufacturer's type; manufacturer; year and week of manufacture

Note

- For more detailed data and test requirements contact dc-film@vishay.com

ELECTRICAL DATA AND ORDERING INFORMATION

U_{RDC} (V)	CAP. (µF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING TRAY PACKAGING C-TOL. = ± 10 %	SPQ
1400				DRAWING A	
	0.10	22.0 x 30.5 x 33.5	37	40104	56
	0.12		36	40124	
	0.15		35	40154	
				DRAWING B	
	0.18	22.0 x 38.0 x 44.0	61	40184	42
	0.22		59	40224	
	0.27		57	40274	
	0.33		56	40334	
	0.39	30.0 x 46.0 x 44.0	89	40394	36
	0.47		85	40474	
	0.56		82	40564	
	0.68		79	40684	
1600				DRAWING A	
	0.10	22.0 x 30.5 x 33.5	37	50104	56
	0.12		36	50124	
	0.15		35	40154	
				DRAWING B	
	0.18	22.0 x 38.0 x 44.0	61	50184	42
	0.22		59	50224	
	0.27		58	50274	
	0.33		57	50334	
	0.39	30.0 x 46.0 x 44.0	90	50394	36
	0.47		87	50474	
	0.56		84	50564	
2000				DRAWING A	
	0.10	22.0 x 30.5 x 33.5	36	60104	56
	0.12		35	60124	
				DRAWING B	
	0.15	22.0 x 38.0 x 44.0	61	60154	42
	0.18		59	60184	
	0.22		58	60224	
	0.27		57	60274	
	0.33	30.0 x 46.0 x 44.0	89	60334	36
	0.39		86	60394	
	0.47		84	60474	
2500				DRAWING B	
	0.10	22.0 x 38.0 x 44.0	60	70104	42
	0.12		59	70124	
	0.15		57	70154	
	0.18		55	70184	
	0.22	30.0 x 46.0 x 44.0	87	70224	36
	0.27		83	70274	

Note

- SPQ = Standard Packaging Quantity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DC Motors | Metric Frames | 1.00 HP |
Product Overview: VP3458-14
Catalog Number: VP3458-14
Description: 1HP/.75KW/3000RPM/TEFC/34-6243Z145
Ship Weight: 39 lbs.
List Price: $0 USD
Multiplier Symbol: K
* Click for Larger Image
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* The image shown is representative only. Actual product may differ in appearance from image shown.

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DC Motors | General Purpose | 1.00 HP |

Product Overview: CDP3460

Catalog Number:	CDP3460
Description:	1HP,2500RPM,DC,56C,3428P,TEFC,F1
Ship Weight:	37 lbs.
List Price:	$996 USD
Multiplier Symbol:	K

* Click for Larger Image

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FEATURES
- NEMA C-face with removable base
- Tach adaptable
- Class F insulation
- Double sealed ball bearings
- UL and CSA recognized
- 3300P motors are TENV,all others are TEFC
- No dual mounting base holes on 33P type

APPLICATIONS

Conveyors, mixers,packaging machinery and other applications requiring variable speed and constant torque.

* The image shown is representative only. Actual product may differ in appearance from image shown.

GOODYEAR Engineered Products — Fractional Horsepower Belt

SEE ALSO...
FHP Sheaves on pages 591-592.

Features:
- Precision-cut edge construction for precise fit
- Exclusive Plioflex® rubber compound for optimum performance
- Molded cogs for increased flexibility around smaller sheaves
- 2Ls and 3Ls are cut edge – non-cogged construction
- 4Ls and 5Ls are cut edge – molded cog construction or enveloped on HY-T PLUS equivalents
- Cooler running for longer life
- Low vibration for minimal noise
- Superior efficiency for improved performance

Applications:
- Light-duty machinery
- Home appliances
- Shop equipment
- Fans and blowers

2L Series

Cogged: No

Outside Length (in)	No. of Ribs: 1 Order No.	Mfr. No.	Net Price
12	MA100768640	2L120	$5.27
14	MA100768641	2L140	5.27
15	MA100768642	2L150	5.27
16	MA100768643	2L160	5.27
18	MA100768644	2L180	$5.27
19	MA100768645	2L190	5.27
20	MA100768646	2L200	5.27
22	MA100768647	2L220	5.27
24	MA100768648	2L240	$5.27
26	MA100768649	2L260	5.55
30	MA100768650	2L300	5.64
31	MA100768651	2L310	5.69
32	MA100768652	2L320	$5.79

3L Series

Cogged: No

12	MA100768654	3L120	$5.27
13	MA100768655	3L130	5.27
14	MA100768656	3L140	5.27
15	MA100768657	3L150	5.27
16	MA100768658	3L160	5.27
17	MA100768660	3L170	5.27
18	MA100768662	3L180	5.27
19	MA100768664	3L190	5.27
20	MA100768666	3L200	5.27
21	MA100768668	3L210	5.27
22	MA100768670	3L220	5.27
23	MA100768672	3L230	5.27
24	MA100768674	3L240	5.27
25	MA100768676	3L250	5.27
26	MA100768678	3L260	5.33
27	MA100768680	3L270	5.35
28	MA100768682	3L280	$5.45
29	MA100768684	3L290	5.55
30	MA100768686	3L300	5.64
31	MA100768688	3L310	5.69
32	MA100768690	3L320	5.79
33	MA100768692	3L330	5.84
34	MA100768694	3L340	5.92
35	MA100768696	3L350	6.07
36	MA100768698	3L360	6.16
37	MA100768700	3L370	6.31
38	MA100768702	3L380	6.38
39	MA100768704	3L390	6.51
40	MA100768706	3L400	6.61
41	MA100768708	3L410	7.18
42	MA100768710	3L420	6.86
43	MA100768712	3L430	6.93
44	MA100768714	3L440	$7.00
45	MA100768716	3L450	7.15
46	MA100768718	3L460	7.23
47	MA100768720	3L470	7.37
48	MA100768722	3L480	7.40
49	MA100768724	3L490	7.47
50	MA100768726	3L500	7.55
51	MA100768728	3L510	7.71
52	MA100768730	3L520	7.74
53	MA100768732	3L530	7.82
54	MA100768734	3L540	7.96
55	MA100768736	3L550	7.99
56	MA100768738	3L560	8.09
57	MA100768740	3L570	8.16
58	MA100768742	3L580	8.29
59	MA100768744	3L590	8.38
60	MA100768746	3L600	$8.38
61	MA100768748	3L610	8.51
62	MA100768749	3L620	8.60
63	MA100768750	3L630	8.70
64	MA100768751	3L640	8.75
65	MA100768752	3L650	8.98
66	MA100768753	3L660	8.98
67	MA100768754	3L670	9.10
69	MA100768755	3L690	9.29
73	MA100768756	3L730	9.69
74	MA100768757	3L740	9.81

4L Series

Cogged: Yes

15	MA100768759	4L150	$5.45
16	MA100768760	4L160	5.45
17	MA100768761	4L170	5.45
18	MA100768762	4L180	5.45
19	MA100768764	4L190	5.45
20	MA100768766	4L200	5.45
21	MA100768768	4L210	5.45
22	MA100768770	4L220	5.45
23	MA100768772	4L230	5.45
24	MA100768774	4L240	5.45
25	MA100768776	4L250	5.45
26	MA100768778	4L260	5.55
27	MA100768780	4L270	$5.64
28	MA100768782	4L280	5.72
29	MA100768784	4L290	5.80
30	MA100768786	4L300	5.91
31	MA100768788	4L310	6.36
32	MA100768790	4L320	6.07
33	MA100768792	4L330	6.16
34	MA100768794	4L340	6.31
35	MA100768796	4L350	6.39
36	MA100768798	4L360	6.46
37	MA100768800	4L370	6.53
38	MA100768802	4L380	6.68
39	MA100768804	4L390	$6.86
40	MA100768806	4L400	6.98
41	MA100768808	4L410	7.15
42	MA100768810	4L420	7.20
43	MA100768812	4L430	7.34
44	MA100768814	4L440	7.47
45	MA100768816	4L450	7.59
46	MA100768818	4L460	7.71
47	MA100768820	4L470	7.74
48	MA100768822	4L480	7.79
49	MA100768824	4L490	7.89
50	MA100768826	4L500	7.97
51	MA100768828	4L510	$8.01
52	MA100768830	4L520	8.16
53	MA100768832	4L530	8.21
54	MA100768834	4L540	8.33
55	MA100768836	4L550	8.36
56	MA100768838	4L560	8.46
57	MA100768840	4L570	8.55
58	MA100768842	4L580	8.61
59	MA100768844	4L590	8.71
60	MA100768846	4L600	8.85

5L Series

Cogged: Yes

23	MA100768852	5L230	$6.61
24	MA100768854	5L240	6.61
25	MA100768856	5L250	6.61
26	MA100768858	5L260	6.80
27	MA100768860	5L270	6.98
28	MA100768862	5L280	7.15
29	MA100768864	5L290	7.28
30	MA100768866	5L300	7.39
31	MA100768868	5L310	7.54
32	MA100768870	5L320	$7.72
33	MA100768872	5L330	7.89
34	MA100768874	5L340	8.01
35	MA100768876	5L350	8.16
36	MA100768878	5L360	8.38
37	MA100768880	5L370	8.43
38	MA100768882	5L380	8.60
39	MA100768884	5L390	8.85
40	MA100768886	5L400	9.20
41	MA100768888	5L410	$9.39
42	MA100768890	5L420	9.62
43	MA100768892	5L430	9.81
44	MA100768894	5L440	10.04
45	MA100768896	5L450	10.25
46	MA100768898	5L460	10.30
47	MA100768900	5L470	10.50
48	MA100768902	5L480	10.67
49	MA100768904	5L490	10.92
50	MA100768906	5L500	$11.09
51	MA100768908	5L510	11.24
52	MA100768910	5L520	11.41
53	MA100768912	5L530	11.57
54	MA100768914	5L540	11.74
55	MA100768916	5L550	11.86
56	MA100768918	5L560	11.96

IronHorse® Permanent-Magnet DC Motors (SCR Rated) Model Overview

MTPM-P10-1JK43

MTPM-P25-1JK44

MTPM-P33-1L18

MTPM-P75-1L18

MTPM-1P5-1M18

IronHorse motors are manufactured by leading motor suppliers with over 20 and 45 years experience delivering high-quality motors to the demanding U.S. market. Our suppliers test the motors during production and after final assembly. This is how we can stand behind our IronHorse motors with a **two-year warranty** (motors 1/3 hp and above only; motors 1/4 hp and less have a one-year warranty).

IronHorse DC motors are designed for use on unfiltered SCR (Thyristor) type and PWM (pulse width modulated) type DC adjustable speed drives, and on across-the-line DC controls.

The IronHorse line of DC motors features:

- Replacement brush sets
- Simple two-lead connection
- Class F insulation

Features for Small-Frame Motors 1/4 hp and Under

- Available models accommodate 12VDC, 24VDC, 90VDC (110VAC DC drive), and 180VDC (230VAC DC drive)
- Rated for SCR drives
- Rolled steel TENV housing
- IP40 environmental rating
- Class F insulation
- High energy ceramic magnets
- Double shielded ball bearings
- Dynamically balanced armature
- Reversible design
- 18-inch leads, or junction boxes with 8-inch leads
- Externally replaceable brushes
- Can be mounted in any orientation
- Not intended for DC power generation
- UL recognized (E365956), CSA certified (259724), RoHS

Features for Motors 1/3 hp and Above

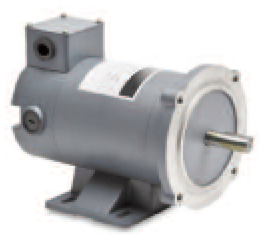
- Input power of 115 or 230 volts rectified AC can be used with an appropriate SCR drive
- Linear speed/torque characteristics over entire speed range
- High starting torque for heavy load applications
- Capable of dynamic braking for faster stops
- Available in TENV or TEFC housings, depending on model
- NEMA 56C flange mount
- Rolled steel shell frame / cast aluminum end bell
- Removable base (0.33–2 hp)
- STABLE motor slide bases for adjustable mounting of NEMA motors from 56–449T
- Space-saving design
- Large replaceable brushes for longer brush life
- Easy access to DC motor brushes (DC motors ship with one set of brushes installed and one set of spare brushes in the box)
- Large easy-to-wire junction box with rubber gasket
- Heavy duty oversized ball bearings
- High tensile strength steel shaft
- Large easy to read nameplate
- Electrically reversible
- Not intended for DC power generation
- Service Factor: 1.0
- Two year warranty
- $_C$CSA$_{US}$ certified (247070), CE, RoHS

Applications

- Conveyors
- Turntables
- Where adjustable speed and constant torque are required
- When dynamic braking and reversing capabilities are needed

IronHorse® DC Motors

56C Frame TEFC/TENV Motors – DC – 0.33 to 2 hp



Motor Specifications – DC 56C Frame Motors – 1800 RPM									
Part Number	**Price**	**HP**	**Base RPM**	**Armature Voltage**	**Housing**	**NEMA Frame**	**Service Factor**	**F.L. Amps**	**Weight (lb)**
MTPM-P33-1L18	$134.00	1/3	1800	90 VDC	TENV	56C flange mount	1.0	3.5	17.70
MTPM-P50-1L18	$171.00	1/2						5.2	20.74
MTPM-P75-1L18	$194.00	3/4			TEFC			7.8	25.30
MTPM-001-1L18	$217.00	1						10.4	28.36
MTPM-1P5-1L18	$234.00	1-1/2						15.4	34.97
MTPM-P33-1M18	$133.00	1/3		180 VDC	TENV			1.75	17.60
MTPM-P50-1M18	$170.00	1/2						2.6	20.74
MTPM-P75-1M18	$194.00	3/4			TEFC			3.9	25.58
MTPM-001-1M18	$217.00	1						5.2	28.32
MTPM-1P5-1M18	$234.00	1-1/2						7.7	35.70
MTPM-002-1M18	$372.00	2						9.8	61.95

Note: Please review the AutomationDirect Terms & Conditions for warranty and service on this product.

Performance Data – DC 56C Frame Motors – 1800 RPM																
Part Number	**HP**	**Armature Voltage**	**Torque (lb-ft)**	**Form Factor ***	**Ambient Temp.**	**Insulation Class**	**Ball Bearings**		**Mounting**	**Wire / Housing**	**Shaft**	**Constant Torque Speed Range**	**Overall Speed Range**	**Base / Type**	**Paint Color**	**Efficiency (%)**
			Full Load				**DE Bearing**	**ODE Bearing**								
MTPM-P33-1L18	1/3	90 VDC	0.97	1.35	40°C (104°F)	F	6203	6203	Top Mounted	Junction Box	Keyed	90-1800 RPM	0-2000 RPM	Rigid Removable	Gray	79
MTPM-P50-1L18	1/2		1.46													80
MTPM-P75-1L18	3/4		2.19													
MTPM-001-1L18	1		2.92													
MTPM-1P5-1L18	1-1/2		4.38													81
MTPM-P33-1M18	1/3	180 VDC	0.97													79
MTPM-P50-1M18	1/2		1.46													80
MTPM-P75-1M18	3/4		2.19													
MTPM-001-1M18	1		2.92													
MTPM-1P5-1M18	1-1/2		4.38													81
MTPM-002-1M18	2		5.84													85

**** See additional information in Form Factor Table.***

Form Factor

The voltage used to power a permanent magnet (PM) DC motor is not pure DC; it is derived by rectifying a supplied AC voltage. The resulting DC voltage has a ripple that is related to the frequency of the AC input.

Form factor is the ratio of I_{rms} to I_{dc}, and it indicates how close the driving voltage is to pure DC. The form factor for a DC battery is 1.0. The higher the form factor is above 1.0, the more it deviates from pure DC. The Form Factor Table shows examples of commonly used voltages.

Form factor should not exceed 1.35 for continuous operation. Half wave rectification is not recommended, as it drastically increases form factor.

Operating Ironhorse PMDC motors with DC voltages with form factors higher than 1.35 can result in premature brush failure and excessive motor heating.

Form Factor Table	
Form Factor	**DC Voltage Source**
1.0	Battery (pure DC)
1.05 *	Pulse width modulation (PWM)
1.35 **	Full wave rectification (single phase)
1.9 ***	Half wave rectification (single phase) **

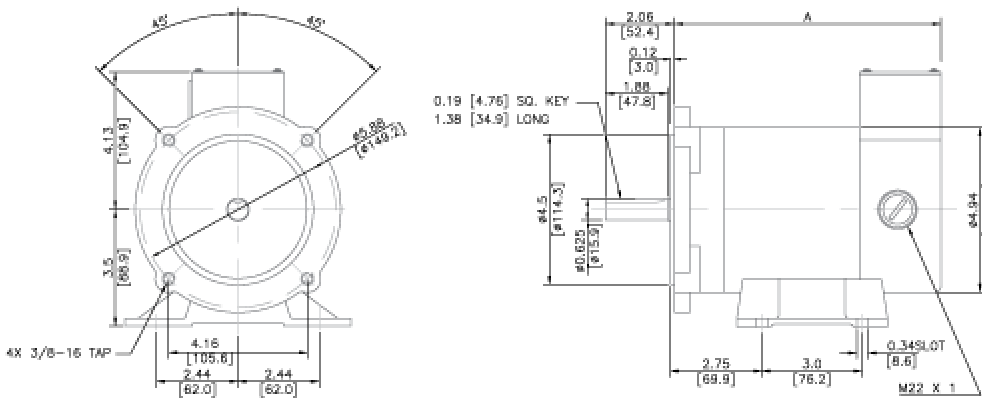
**** All DC-input IronHorse GSD series DC drives are 1.05. IronHorse AC-input GSD5 DC drive is 1.05.***

***** Single phase full wave rectification is the most common form of DC drive in 0.33–2 hp range. All IronHorse GSD series DC drives are 1.35 or better.***

****** Not Recommended.***

IronHorse® DC Motors

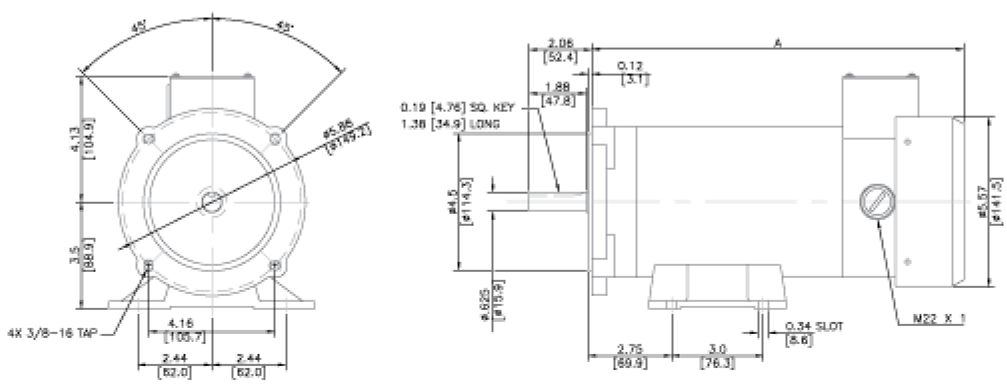
56C Frame TENV DC Motors – 0.33 to 0.5 hp – Dimensions



UNITS: INCHES [mm]

A = 8.0" [203.2] – 0.33 HP, 90VDC, 1800RPM
A = 8.0" [203.2] – 0.33 HP, 180VDC, 1800RPM
A = 8.88" [225.5] – 0.50 HP, 90VDC, 1800RPM
A = 8.88" [225.5] – 0.50 HP, 180VDC, 1800RPM

56C Frame TEFC DC Motors - 0.75 to 1.5 hp - Dimensions



A = 11.45" [290.8] – .75 HP, 90VDC, 1800RPM
A = 11.45" [290.8] – .75 HP, 180VDC, 1800RPM
A = 12.24" [311.0] – 1 HP, 90VDC, 1800RPM
A = 12.24" [311.0] – 1 HP, 180VDC, 1800RPM
A = 14.39" [365.5] – 1.5 HP, 90VDC, 1800RPM
A = 14.39" [365.5] – 1.5 HP, 180VDC, 1800RPM

UNITS: INCHES [mm]

DC Motors

NEMA Frame - SCR Rated

TEFC - SCR Rated 90 & 180 Volts
NEMA 56C - C Face With Removable Base

HP	Full Load RPM	NEMA Frame	Catalog Number	Stock	List Price	Model Number	App. Wgt. (lbs)	Arm. Volts DC	Control Volts AC Input	F. L. Amps DC	"C" Dim. (Inches)	♥Notes
1/4	1750	SS56C	098002.00	√	609	42D17FK2	19	90	115	2.5	10.81	S, US
	1750	SS56C	098003.00	√	609	42D17FK3	22	180	230	1.4	11.31	S, US
1/3	1750	SS56C	098004.00	√	646	42D17FK4	23	90	115	3.5	11.31	S, US
	1750	SS56C	098005.00	√	646	42D17FK5	23	180	230	1.7	11.31	S, US
	1140	S56C	109098.00	C/A	793	4D11FK5	32	90	115	3.5	12.81	S, US
1/2	2500	SS56C	098006.00	√	646	42D28FK1	22	90	115	5.0	10.81	S, US
	2500	SS56C	098007.00	√	646	42D28FK2	22	180	230	2.5	10.81	S, US
	1750	SS56C	098000.00	√	718	42D17FK1	26	90	115	5.0	11.81	S, US
	1750	S56C	108014.00	√	754	4D17FK1	29	90	115	5.0	12.82	S, US
	1750	SS56C	098008.00	√	718	42D17FK6	25	180	230	2.5	11.81	S, US
	1750	S56C	108015.00	√	754	4D17FK2	30	180	230	2.5	12.82	S, US
	1140	S56C	109099.00	√	832	4D11FK6	40	90	115	5.0	14.32	S, US
3/4	2500	SS56C	098009.00	√	773	42D28FK3	26	90	115	7.6	11.81	S, US
	2500	S56C	108016.00	√	814	4D28FK3	29	90	115	7.6	12.82	S, US
	2500	SS56C	098010.00	√	773	42D28FK4	25	180	230	3.8	11.81	S, US
	2500	S56C	108017.00	√	814	4D28FK4	29	180	230	3.8	12.82	S, US
	1750	SS56C	098032.00	√	873	42D17FK7	36	90	115	7.6	13.81	S, US
	1750	S56C	108018.00	√	918	4D17FK3	38	90	115	7.6	13.82	S, US
	1750	SS56C	098069.00	√	873	42D17FK11	36	180	230	3.8	13.81	S, US
	1750	S56C	108019.00	√	918	4D17FK4	35	180	230	3.8	13.82	S, US
	1140	S56C	109100.00	C/A	1124	4D11FK7	49	90	115	7.5	15.82	S, US
1	2500	S56C	108020.00	√	873	4D28FK5	34	90	115	10.0	13.32	S, US
	2500	S56C	108021.00	√	873	4D28FK6	38	180	230	5.0	13.82	S, US
	1750	S56C	108022.00	√	1068	4D17FK5	47	90	115	10.0	14.82	S, US
	1750	S56C	108023.00	√	1068	4D17FK6	39	180	230	5.0	14.81	S, US
	1140	145TC	128023.00	√	2129	C145D11FK1	82	90	115	11.0	18.84	S, US
11/2	2500	S56C	108265.00	√	1293	4D28FK11	43	180	230	7.5	15.32	S, US
	1750	S56C	108092.00	√	1334	4D17FK10	53	180	230	7.6	16.82	S, US
	1750	S56/145TC	108262.00	√	1334	4D17FK19	54	180	230	7.6	17.39	S, US, 55
	1750	145TC	128000.00	√	2026	C145D17FK2	70	180	230	7.5	18.34	S, US
2	2500	S56/145TC	108266.00	√	2026	4D28FK12	51	180	230	8.6	17.89	S, US, 55
	1750	145TC	128010.00	√	2418	C145D17FK3	83	180	230	9.5	19.34	S, US
	1750	182/145TC	128001.00	√	2418	C182D17FK3	84	180	230	9.5	19.34	S, US, 54
3	1750	182/145TC	108502.00	√	3368	182D17FK2	88	180	230	14.0	21.75	S, US, 54

If base is removed, do not reinstall bolts without using washers to compensate for thickness of base.

♥ Note listing on inside back flap

C/A - Check Availability

Specifications are subject to change without notice

View On-line Technical Information

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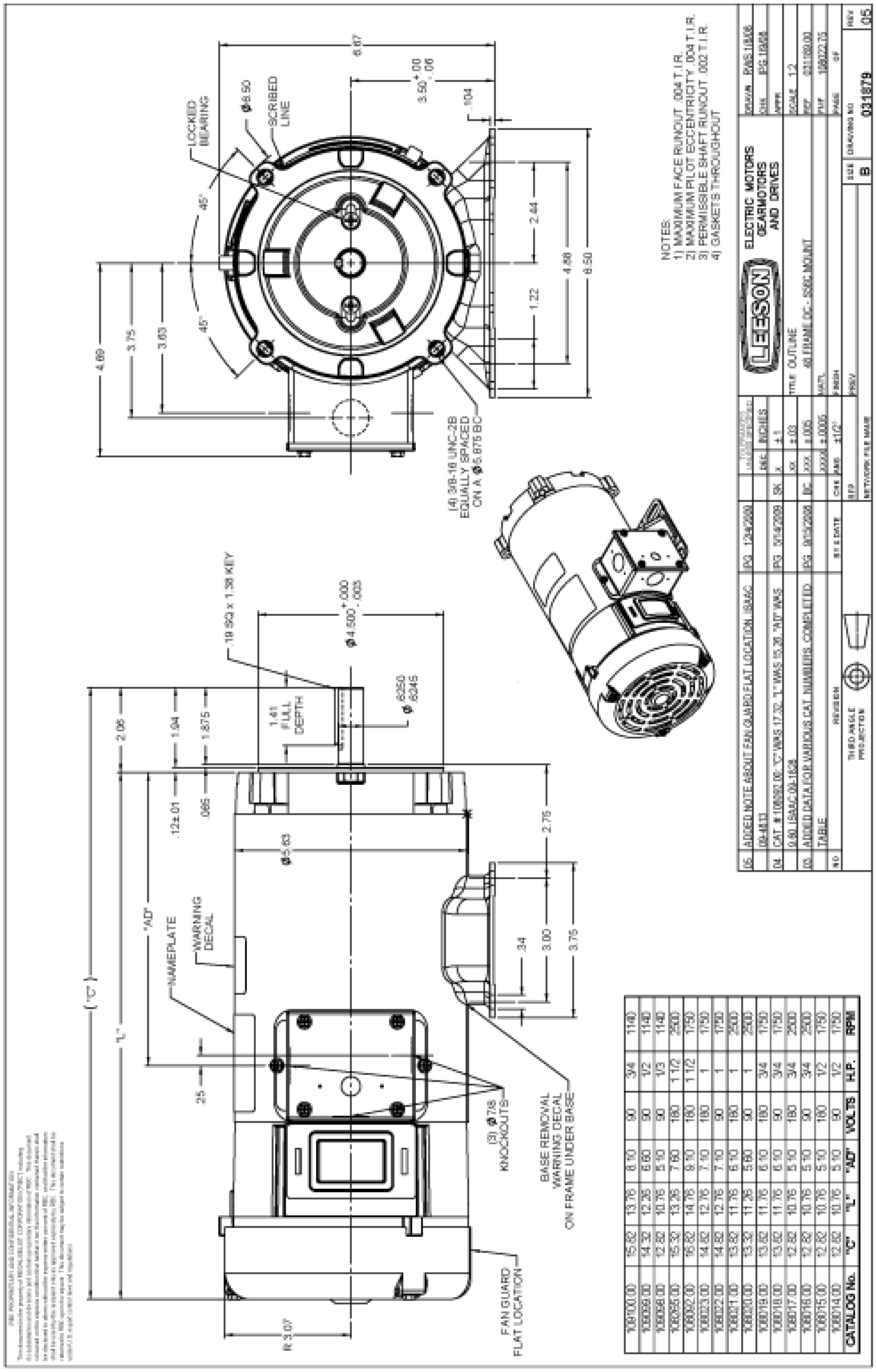

CATALOG No.	"C"	"L"	"AD"	VOLTS	H.P.	RPM
108100.00	15.82	13.76	8.10	90	3/4	1140
108099.00	14.32	12.26	6.60	90	1/2	1140
108098.00	12.82	10.76	5.10	90	1/3	1140
108085.00	15.32	13.26	7.60	180	1 1/2	2500
108092.00	16.82	14.76	8.10	180	1 1/2	1750
108023.00	14.82	12.76	7.10	180	1	1750
108022.00	14.82	12.76	7.10	90	1	1750
108021.00	13.82	11.76	6.10	180	1	2500
108020.00	13.32	11.26	5.60	90	1	2500
108019.00	13.82	11.76	6.10	180	3/4	1750
108018.00	13.82	11.76	6.10	90	3/4	1750
108017.00	12.82	10.76	5.10	180	3/4	2500
108016.00	12.82	10.76	5.10	90	3/4	2500
108015.00	12.82	10.76	5.10	180	1/2	1750
108014.00	12.82	10.76	5.10	90	1/2	1750

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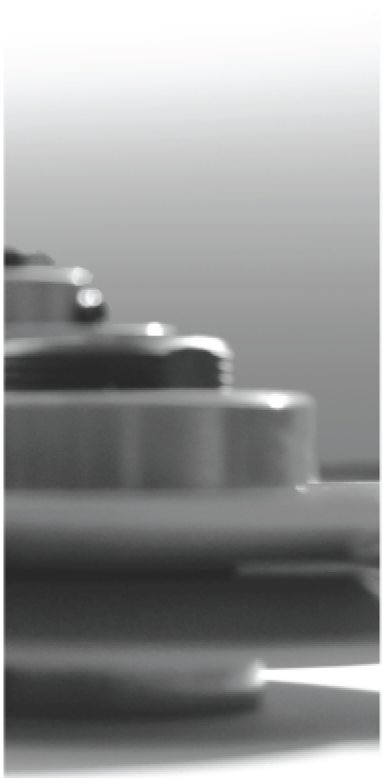

TABLE OF CONTENTS

BORE AND KEYWAY DIMENSIONS

USAS B 17.1 1967

Bush No	Bore	Bushing Keyway
1008	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
△	15/16	1/4x1/16
△	1	
1108	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
△	1-1/16	1/4x1/16
△	1-1/8	
1210	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
1215	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
1310	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	...	...
	...	...
	...	...
	...	...

Bush No	Bore	Bushing Keyway
1610	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
△	1-9/16	3/8x1/8
△	1-5/8	
1615	1-2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
△	1-9/16	3/8x1/8
△	1-5/8	
2012	1/2	1/8x1/16
	9/16	
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	
	7/8	
	15/16	1/4x1/8
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
	1-9/16	
	1-5/8	
	1-11/16	
	1-3/4	
	1-13/16	1/2x1/4
	1-7/8	
△	1-15/16	1/2x3-16
△	2	
	...	...

Bush No	Bore	Bushing Keyway
2517	1/2	1/8x1/16
	5/8	3/16x3/32
	11/16	
	3/4	
	13/16	1/4x1/8
	7/8	
	15/16	
	1	
	1-1/16	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
	1-9/16	
	1-5/8	
	1-11/16	
	1-3/4	
	1-13/16	1/2X1/4
	1-7/8	
	1-15/16	
	2	
	2-1/16	
	2-1/8	
	2-3/16	
	2-1/4	
△	2-5/16	5/8x3/16
△	2-3/8	
△	2-7/16	
△	2-1/2	
2525	3/4	3/16x3/32
	7/8	
	1	1/4x1/8
	1-1/8	
	1-3/16	
	1-1/4	
	1-3/8	5/16x5/32
	1-7/16	3/8x3/16
	1-1/2	
	1-5/8	
	1-11/16	
	1-3/4	
	1-13/16	1/2x1/4
	1-7/8	
	1-15/16	
	2	
	2-1/8	
	2-3/16	
	2-1/4	
△	2-5/16	5/8X3/16
△	2-3/8	
△	2-7/16	
△	2-1/2	
	...	...
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Bush No	Bore	Bushing Keyway
3020	7/8	3/16x3/32
	15/16	1/4x1/8
	1	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
	1-9/16	
	1-5/8	
	1-11/16	
	1-3/4	
	1-13/16	1/2x1/4
	1-7/8	
	1-15/16	
	2	
	2-1/16	
	2-1/8	
	2-3/16	
	2-1/4	
	2-5/16	5/8x5/16
	2-3/8	
	2-7/16	
	2-1/2	
	2-5/8	
	2-11/16	
	2-3/4	
△	2-13/16	3/4x1/4
△	2-7/8	
△	2-15/16	
△	3	
3030	15/16	1/4x1/8
	1	
	1-1/8	
	1-3/16	
	1-1/4	
	1-5/16	5/16x5/32
	1-3/8	
	1-7/16	3/8x3/16
	1-1/2	
	1-9/16	
	1-5/8	
	1-11/16	
	1-3/4	
	1-13/16	1/2x1/4
	1-7/8	
	1-15/16	
	2	
	2-1/16	
	2-1/8	
	2-3/16	
	2-1/4	
	2-5/16	5/8x5/16
	2-3/8	
	2-7/16	
	2-1/2	
	2-5/8	
	2-11/16	
	2-3/4	
△	2-7/8	3/4x1/4
△	2-15/16	
△	3	
	...	...

Bush No	Bore	Bushing Keyway
3535	1-3/16	1/4x1/8
	1-1/4	
	1-3/8	5/16x5/32
	1-7/16	3/8x3/16
	1-1/2	
	1-5/8	
	1-11/16	
	1-3/4	
	1-7/8	1/2x1/4
	1-15/16	
	2	
	2-1/8	
	2-3/16	
	2-1/4	
	2-5/16	5/8x5/16
	2-3/8	
	2-7/16	
	2-1/2	
	2-5/8	
	2-11/16	
	2-3/4	
	2-7/8	3/4x3/8
	2-15/16	
	3	
	3-1/8	
	3-3/16	
	3-1/4	
△	3-5/16	7/8x1/4
△	3-3/8	
△	3-7/16	
△	3-1/2	
4040	1-7/16	3/8x3/16
	1-1/2	
	1-5/8	
	1-11/16	
	1-3/4	
	1-7/8	1/2x1/4
	1-15/16	
	2	
	2-1/8	
	2-3/16	
	2-1/4	
	2-3/8	5/8x5/16
	2-7/16	
	2-1/2	
	2-5/8	
	2-11/16	
	2-3/4	
	2-7/8	3/4x3/8
	2-15/16	
	3	
	3-1/8	
	3-3/16	
	3-1/4	
	3-3/8	7/8x7/16
	3-7/16	
	3-1/2	
	3-5/8	
	3-11/16	
	3-3/4	
△	3/7/8	1x1/4
△	3-15/16	
△	4	

Bush No	Bore	Bushing Keyway
4545	1-15/16	1/2x1/4
	2	
	2-3/16	
	2 3/8	5/8x5/16
	2-7/16	
	2-5/8	
	2-3/4	
	2 7/8	3/4x3/8
	2-15/16	
	3-1/8	
	3-3/16	
	3-1/4	
	3-3/8	7/8x7/16
	3-7/16	
	3-1/2	
	3-5/8	
	3-3/4	
	3-7/8	1x1/2
	3-15/16	
	4	
	4-1/8	
	4-3/16	
	4-1/4	
△	4-3/8	1x1/4
△	4-7/16	
△	4-1/2	
5050	2-7/16	5/8x5/16
	2-15/16	3/4x3/8
	3-3/8	7/8x7/16
	3-7/16	
	3-5/8	
	3-7/8	1x1/2
	3-15/16	
	4	
	4-1/8	
	4-3/8	
	4-7/16	
	4-1/2	
△	4-7/8	1-1/4x7/16
△	4-15/16	
△	5	
	...	...
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△ = shallow keyseat

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LEESON

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BTL TAPER BUSHINGS

BORE & KEYWAY DIMENSIONS

DIN 6885
JIS B1301-1976
UNI 6604-1969
GB 1095-1979

BORE AND KEYWAY DIMENSIONS

Bush No	Bore	Bushing Keyway
1008	10	3x1.40
	11, 12	4x1.80
	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24	8x2.00
△	25	8x1.30
1180	10	3x1.40
	11, 12	4x1.80
	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25	8x3.30
△	28	8x2.00
1210	11, 12	4x1.80
	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32	10x3.30
1215	11, 12	4x1.80
	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32	10x3.30
1310	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35	10x3.30
1610	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40	12x3.30
△	42	12x2.20
1615	14, 16	5x2.30
	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40	12x3.30
△	42	12x2.20
2012	18, 19, 20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
2517	20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60	18x4.40
2525	20, 22	6x2.80
	24, 25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60	18x4.40
3020	25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60, 65	18x4.40
	70, 75	20x4.90
3030	25, 28, 30	8x3.30
	32, 35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60, 65	18x4.40
	70, 75	20x4.90
3535	35, 38	10x3.30
	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60, 65	18x4.40
	70, 75	20x4.90
	80, 85	22x5.40
	90	25x5.40
4040	40, 42	12x3.30
	45, 48, 50	14x3.80
	55	16x4.30
	60, 65	18x4.40
	70, 75	20x4.90
	80, 85	22x5.40
	90, 95	25x5.40
	100	28x6.40
4545	55	16x4.30
	60, 65	18x4.40
	70, 75	20x4.90
	80, 85	22x5.40
	90, 95	25x5.4
	100, 105, 110	28x6.40
5050	60, 65	18x4.40
	70, 75	20x4.90
	80, 85	22x5.40
	90, 95	25x5.40
	100, 105, 110	28x6.40
	115, 120, 125	32x7.40

△ = shallow keyseat

BUSHINGS

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TABLE OF CONTENTS

V-PULLEYS

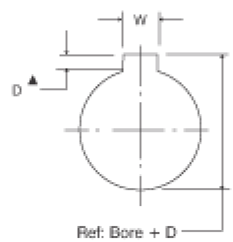
LEESON V-PULLEYS are available in two configurations:

• finished (fixed) bore

• taper bore for STL and QTL style.

AK & BK CAST IRON SHEAVES

- Manufactured in high quality grey cast iron
- Finished bore with H7 precision
- Keyway and set screws in accordance with USAS. B. 17.1-1967
- OEM surface treatment available: paint or black phosphate - contact LEESON
- Individually packaged



ISO STANDARD METHOD
FOR MEASURING KEYSEAT
DEPTH

▲ Depth measured at centerline.

Example: 5/8" Bore + 1/16" D dim. = .6875" Keyseat Depth

Reference:
1 inch=25.4 millimeters
1 millimeter=0.3937 inches.

STANDARD KEYSEATS

Stock Bores	Keyseat (WxD)	Stock Bores	Keyseat (WxD)
1/2	None	1	1/4x1/8
9/16	1/8x1/16	1 1/16	1/4x1/8
5/8	3/16x3/32	1 1/8	1/4x1/8
11/16	3/16x3/32	1 3/16	1/4x1/8
3/4	3/16x3/32	1 1/4	1/4x1/8
13/16	3/16x3/32	1 3/8	1/4x1/8
7/8	3/16x3/32	1 3/8	1/4x1/8
15/16	1/4x1 1/8	1 7/16	3/8x3/16

HOW TO ORDER

2 AK 26 X 1

- 1 — Bore
- 26 — Outside Diameter
- AK — Sheave Cross Section
- 2 — No. of Grooves

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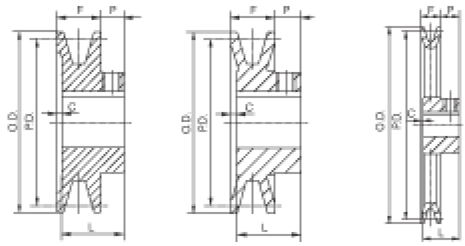
AK SHEAVES



TYPE 1 TYPE 2 TYPE 3

1 GROOVE • A or 3L-4L BELTS

Part Number	Diameter			Type	Dimensions				Stock Bores											Wgt. Lbs.
	O.D.	P.D. A	P.D. 3L		F	L	P	C	1/2	5/8	3/4	7/8	15/16	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	
AK17	1.75	1.50	1.16	1	21/32	15/16	7/16	5/32	●	●										0.2
AK20	2.00	1.80	1.46	1	21/32	15/16	7/16	5/32	●	●	●									0.3
AK21	2.10	1.90	1.56	1	21/32	15/16	7/16	5/32	●	●	●									0.4
AK22	2.20	2.00	1.66	1	21/32	15/16	7/16	5/32	●	●	●									0.5
AK23	2.30	2.10	1.76	1	21/32	15/16	7/16	5/32	●	●	●									0.5
AK25	2.50	2.30	1.96	2	21/32	15/16	7/16	5/32	●	●	●									0.6
AK26	2.60	2.40	2.06	2	21/32	15/16	7/16	5/32	●	●	●									0.6
AK27	2.70	2.50	2.16	2	21/32	15/16	7/16	5/32	●	●	●									0.6
AK28	2.80	2.60	2.26	2	21/32	15/16	7/16	5/32	●	●	●									0.7
AK30	3.05	2.80	2.46	2	21/32	15/16	7/16	5/32	●	●	●	●								0.7
AK32	3.25	3.00	2.66	2	21/32	15/16	7/16	5/32	●	●	●	●								0.8
AK34	3.45	3.20	2.86	2	21/32	15/16	7/16	5/32	●	●	●	●								0.9
AK39	3.75	3.50	3.16	2	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●						1.4
AK41	3.95	3.70	3.36	2	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●						1.5
AK44	4.25	4.00	3.66	2	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●					1.5
AK46	4.45	4.20	3.86	2	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●					1.6
AK49	4.75	4.50	4.16	2	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●					1.7
AK51	4.95	4.70	4.36	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●					1.7
AK54	5.25	5.00	4.66	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●	●				1.8
AK56	5.45	5.20	4.86	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●	●				1.9
AK59	5.75	5.50	5.16	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●	●				2.0
AK61	5.95	5.70	5.36	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●	●				2.1
AK64	6.25	5.00	5.66	3	3/4	1 5/32	15/32	1/16	●	●	●	●	●	●	●	●				2.2
AK66	6.45	6.20	5.86	3	3/4	1 5/32	15/32	1/16		●	●			●	●					2.3
AK69	6.75	6.50	6.16	3	3/4	1 15/32	23/32	—			●			●	●					3.5
AK71	6.95	6.70	6.36	3	3/4	1 15/32	23/32	—		●	●			●	●				●	3.8
AK74	7.25	7.00	6.66	3	3/4	1 15/32	23/32*	—	●	●	●		●	●	●	●	●		●	3.9
AK79	7.79	7.50	7.16	3	3/4	1 15/32	23/32	—			●			●	●				●	4.0
AK84	8.25	8.00	7.66	3	3/4	1 15/32	23/32*	—	●	●	●		●	●		●			●	4.2
AK89	8.75	8.50	8.16	3	3/4	1 15/32	23/32	—			●			●	●				●	4.3
AK94	9.25	9.00	8.66	3	3/4	1 15/32	23/32*	—	●	●	●		●	●		●	●		●	4.5
AK99	9.75	9.50	9.16	3	3/4	1 15/32	23/32	—			●			●					●	5.3
AK104	10.25	10.00	9.66	3	3/4	1 15/32	23/32*	—		●	●			●		●	●	●	●	5.7
AK109	10.75	10.50	10.16	3	3/4	1 15/32	23/32	—			●			●				●	●	5.8
AK114	11.25	11.00	10.66	3	3/4	1 15/32	23/32*	—			●			●		●			●	5.9
AK124	12.25	12.00	11.66	3	3/4	1 15/32	23/32*	—		●	●			●		●	●		●	6.5
AK134	13.25	13.00	12.66	3	3/4	1 15/32	23/32	—			●			●		●		●	●	7.5
AK144	14.25	14.00	13.66	3	3/4	1 15/32	23/32	—			●			●		●			●	8.5
AK154	15.25	15.00	14.66	3	3/4	1 15/32	23/32	—			●			●		●		●	●	9.8
AK184	18.25	18.00	17.66	3	3/4	1 15/32	23/32	—			●			●		●			●	12.1

*P=25/32 and C=1/16 for 1" Bore and smaller

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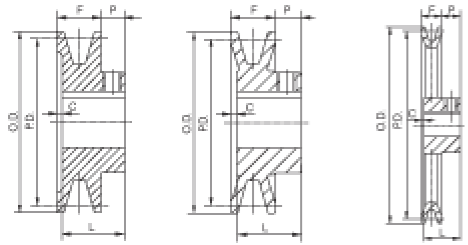
V PULLEYS

LEESON power plus

BK SHEAVES



TYPE 1 TYPE 2 TYPE 3

1 GROOVE • A, B, 4L & 5L BELTS

Part Number	Diameter			Type	Dimensions				Stock Bores											Wgt. Lbs.
	O.D.	P.D. A	P.D. B		F	L	P	C	1/2	5/8	3/4	7/8	15/16	1	1 1/8	13/16	1 1/4	1 3/8	17/16	
BK24	2.40	1.80	2.20	1	13/16	1 1/16	13/32	5/32	●	●	●									0.4
BK25	2.50	1.90	2.30	1	13/16	1 1/16	13/32	5/32	●	●	●	●								0.5
BK26	2.60	2.00	2.40	1	13/16	1 1/16	13/32	5/32	●	●	●	●								0.6
BK27	2.70	2.10	2.50	2	13/16	1 1/16	13/32	5/32	●	●	●	●								0.7
BK28	2.95	2.20	2.60	2	13/16	1 1/16	13/32	5/32	●	●	●	●								0.8
BK30	3.15	2.40	2.80	2	13/16	1 1/16	13/32	5/32	●	●	●	●								0.9
BK32	3.35	2.60	3.00	2	13/16	1 1/16	13/32	5/32	●	●	●	●								1.0
BK34	3.55	2.80	3.20	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					1.3
BK36	3.75	3.00	3.40	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					1.5
BK40	3.95	3.20	3.60	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					1.6
BK45	4.25	3.50	3.90	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					1.8
BK47	4.45	3.70	4.10	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					1.9
BK50	4.75	4.00	4.40	2	7/8	1 5/32	13/32	1/8	●	●	●	●	●	●	●					2.0
BK52	4.95	4.20	4.60	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					2.1
BK55	5.25	4.50	4.90	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●					2.2
BK57	5.45	4.70	5.10	2	7/8	1 5/32	13/32	1/8		●	●	●	●	●	●					2.3
BK60	5.75	5.00	5.40	2	7/8	1 5/32	13/32	1/8	●	●	●	●		●	●	●				2.4
BK62	5.95	5.20	5.60	2	7/8	1 5/32	13/32	1/8	●	●	●	●	●	●	●					2.5
BK65	6.25	5.50	5.90	2	7/8	1 5/32	13/32	1/8		●	●			●	●	●				2.7
BK67	6.45	5.70	6.10	2	7/8	1 5/32	13/32	1/8		●	●			●	●	●				2.8
BK70	6.75	6.00	6.40	3	7/8	1 15/32	21/32*	1/16		●	●		●	●	●				●	3.3
BK72	6.95	6.20	6.60	3	7/8	1 15/32	21/32	1/16			●			●	●			●		3.9
BK75	7.25	6.50	6.90	3	7/8	1 15/32	21/32	1/16			●			●	●	●		●		4.0
BK77	7.45	6.70	7.10	3	7/8	1 15/32	21/32	1/16			●			●	●			●		4.1
BK80	7.75	7.00	7.40	3	7/8	1 15/32	21/32	1/16		●	●	●		●	●		●	●	●	4.4
BK85	8.25	7.50	7.90	3	7/8	1 15/32	21/32	1/16			●			●	●			●	●	5.0
BK90	8.75	8.00	8.40	3	7/8	1 15/32	21/32	1/16			●	●	●	●	●	●		●	●	5.2
BK95	9.25	8.50	8.90	3	7/8	1 15/32	21/32	1/16			●			●	●			●	●	5.4
BK100	9.75	9.00	9.40	3	7/8	1 15/32	21/32	1/16			●	●	●	●	●	●	●	●	●	5.6
BK105	10.25	9.50	9.90	3	7/8	1 15/32	21/32	1/16						●				●	●	5.8
BK110	10.75	10.00	10.40	3	7/8	1 15/32	21/32	1/16			●			●	●	●		●	●	6.4
BK115	11.25	10.50	10.90	3	7/8	1 15/32	21/32	1/16						●				●	●	6.9
BK120	11.75	11.00	11.40	3	7/8	1 15/32	21/32	1/16			●			●		●		●	●	7.4
BK130	12.75	12.00	12.40	3	7/8	1 15/32	21/32	1/16			●			●	●	●			●	8.4
BK140	13.75	13.00	13.40	3	7/8	1 15/32	21/32	1/16			●			●		●			●	9.4
BK160	15.75	15.00	15.40	3	7/8	1 15/32	21/32	1/16						●	●	●	●		●	12.4
BK190	18.75	18.00	18.40	3	7/8	1 15/32	21/32	1/16								●	●		●	13.4

*P=13/32 and C=1/8 for 1" Bore and smaller

V PULLEYS

AK-H & BK-H CAST IRON SHEAVES

- The AK-H and BK-H series of taper sheaves are designed for "H" style STL bushings
- Precision installation
- Easy assembly disassembly
- Manufactured in high quality grey cast iron
- Surface treatment: painting or black phosphating.
- Individually packaged
- "H" style bushings are available for bore sizes from 3/8" to 1-1/2"

STL Taper bushings • See page 16

STOCK "H" BUSHINGS • STL

Stock Bores	Keyseats	Stock Bores	Keyseats
3/8	None	1	1/4x1/16
7/16	None	1 1/16	1/4x1/16
1/2	1/8x1/16	1 1/8	1/4x1/16
9/16	1/8x1/16	1 3/16	1/4x1/16
5/8	3/16x3/32	1 1/4	1/4x1/16
11/16	3/16x3/32	1 5/16	5/16x1/16
3/4	3/16x3/32	1 3/8	5/16x1/16
13/16	3/16x3/32	1 3/8	3/8x1/16
7/8	3/16x3/32	1 7/16	3/8x1/16
15/16	1/4x1/8	1 1/2	3/8x1/16

MILLIMETER BORES • STL

Stock Bores	Keyseats	Stock Bores	Keyseats
10	None	24	8x3.5
11	None	25	8x3.5
12	None	28	8x3.5
14	5x2.5	30	8x3.5
16	5x2.5	32	10x4
18	6x3	35	10x4
19	6x3	36	10x4
20	6x3	38	10x4
22	6x3		

HOW TO ORDER

2 AK 30 H

- H — Bushing
- 30 — Outside Diameter
- AK — Sheave Cross Section
- 2 — No. of Grooves

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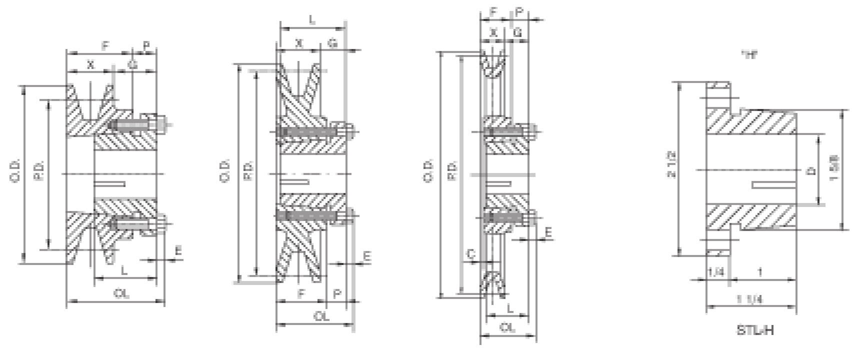
LEESON power plus

V-PULLEYS
TAPER BORE • AK-H

AK-H SHEAVES



TYPE 1 TYPE 2 TYPE 3

1 GROOVE • A or 3L-4L BELTS

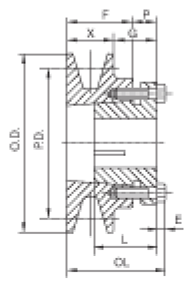
Part Number	Diameter			Type	Dimensions								Wgt. Less Bush
	O.D.	P.D. A	P.D. 3L		OL	F	L	P	C	X	G	E	
AK30H	3.05	2.80	2.46	1	1 13/16	3/4	1 1/4	7/8	—	1 3/16	7/16	3/16	1.1
AK32H	3.25	3.00	2.66	1	1 13/16	3/4	1 1/4	7/8	—	1 3/16	7/16	3/16	1.2
AK34H	3.45	3.20	2.86	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	1.0
AK39H	3.75	3.50	3.16	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	1.4
AK41H	3.95	3.70	3.36	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	1.6
AK44H	4.25	4.00	3.66	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	1.9
AK46H	4.45	4.20	3.86	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	1.9
AK49H	4.75	4.50	4.16	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.1
AK51H	4.95	4.70	4.36	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.3
AK54H	5.25	6.00	4.66	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.0
AK56H	5.45	5.20	4.86	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.3
AK59H	5.75	5.50	5.16	2	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.4
AK61H	5.95	5.70	5.36	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.5
AK64H	6.25	5.00	5.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.7
AK66H	6.45	6.20	5.86	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	2.8
AK69H	6.75	6.50	6.16	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	3.2
AK71H	6.95	6.70	6.36	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	3.1
AK74H	7.25	7.00	6.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	3.3
AK79H	7.75	7.50	7.16	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	3.5
AK84H	8.25	8.00	7.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	3.6
AK89H	8.75	8.50	8.16	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	4.0
AK94H	9.25	9.00	8.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	4.4
AK99H	9.75	9.50	9.16	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	4.7
AK104H	10.25	10.00	9.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	4.5
AK109H	10.75	10.50	10.16	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	5.1
AK114H	11.25	11.00	10.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	5.5
AK124H	12.25	12.00	11.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	6.1
AK134H	13.25	13.00	12.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	7.4
AK144H	14.25	14.00	13.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	7.8
AK154H	15.25	15.00	14.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	8.8
AK184H	18.25	18.00	17.66	3	1 1/2	3/4	1 1/4	9/16	—	7/8	7/16	3/16	11.3

FOR STL TAPER BUSHING - SEE PAGE 16

LEESON power+plus

V-PULLEYS
TAPER BORE • BK-H

BK-H SHEAVES



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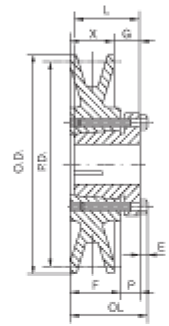

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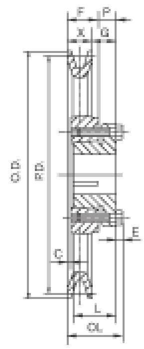
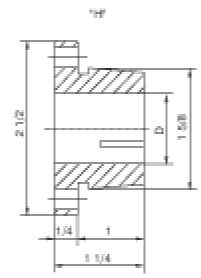


TYPE 3



STL-H

V PULLEYS

1 GROOVE • A, B, 4L & 5L BELTS

Part Number	Diameter O.D.	Diameter P.D. A	Diameter P.D. 3L	Type	Dimensions OL	F	L	P	C	X	G	E	Wgt. Less Bush
BK30H	3.15	2.40	2.80	1	1 15/16	7/8	1 1/4	7/8	—	15/16	7/16	3/16	1.2
BK32H	3.35	2.60	3.00	1	1 15/16	7/8	1 1/4	7/8	—	15/16	7/16	3/16	1.4
BK34H	3.55	2.80	3.20	1	1 15/16	7/8	1 1/4	7/8	—	15/16	7/16	3/16	1.6
BK36H	3.75	3.00	3.40	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	1.2
BK40H	3.95	3.20	3.60	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	1.4
BK45H	4.25	3.50	3.90	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	1.8
BK47H	4.45	3.70	4.10	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.2
BK50H	4.75	4.00	4.40	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.0
BK52H	4.95	4.20	4.60	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.1
BK55H	5.25	4.50	4.90	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.7
BK57H	5.45	4.70	5.10	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.7
BK60H	5.75	5.00	5.40	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.5
BK62H	5.95	5.20	5.60	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.6
BK65H	6.25	5.50	5.90	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.8
BK67H	6.45	5.70	6.10	2	1 1/2	7/8	1 1/4	7/16	—	7/8	7/16	3/16	2.9
BK70H	6.75	6.00	6.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	2.8
BK72H	6.95	6.20	6.60	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	3.1
BK75H	7.25	6.50	6.90	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	3.3
BK77H	7.45	6.70	7.10	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	3.8
BK80H	7.75	7.00	7.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	3.4
BK85H	8.25	7.50	7.90	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	3.8
BK90H	8.75	8.00	8.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	4.3
BK95H	9.25	8.50	8.90	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	5.0
BK100H	9.75	9.00	9.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	5.2
BK105H	10.25	9.50	9.90	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	5.5
BK110H	10.75	10.00	10.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	6.0
BK115H	11.25	10.50	10.90	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	6.4
BK120H	11.75	11.00	11.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	6.9
BK130H	12.75	12.00	12.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	6.9
BK140H	13.75	13.00	13.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	8.5
BK150H	14.75	14.00	14.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	9.5
BK160H	15.75	15.00	15.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	9.8
BK190H	18.75	18.00	18.40	3	1 9/16	7/8	1 1/4	1/2	1/16	7/8	7/16	3/16	12.8

FOR STL TAPER BUSHING - SEE PAGE 16

32

ENERGY PRODUCTS CO.

Variable Transformers
Series 1500 • 9.5 to 15.0 Amperes

1500 Series

The 1510/1520 Series Variable Transformers are highly reliable, dependable and accurate AC control devices. The 1510, 120 volt unit is rated at 15 amperes for constant current loads; while the 1520, 240 volt unit is rated at 9.5 amperes for constant current loads. Constant impedance ratings are listed in the specifications. They can be operated at frequencies between 50 and 2000 hertz with derating at higher than rated frequency.

Uncased models have the shaft extending from the base end. This shaft is fully adjustable and can be extended from either end for general utility mounting. Cased styles are available in either "C" style (featuring protective screening over the coil assembly only) or the "CT" style (which also includes a terminal box cover with knock-outs to accept conduit).

Motor driven units are available in single, two and three ganged assemblies; cased or uncased styles as identified by the prefix "M" in the type number. If a motor driven model is ordered, be sure to prefix the part number with the desired travel time from 0 to maximum of 5, 15, 30, or 60 seconds.

The synchronous motor is designed for operation on 120 volts, 50/60 hertz single phase lines and draws approximately 0.3 amperes.

Part Number: Manually Operated	Part Number: Motor Driven	Wiring	Input: Volts	Input: Hertz	Output: Volts	Constant Current Load: Max Amps	Constant Current Load: Max KVA	Constant Impedance Load: Max Amps	Constant Impedance Load: Max KVA	Shaft Rotation for Voltage Increase	Terminal Connections (for increasing voltage) as viewed from base end: Input	Jumper•	Output	Sche-matic (Pg 8 & 9)	Net Weight Lbs. Max.: Man-ual	Net Weight Lbs. Max.: Motor Driven
1510 1510C 1510CT	M1510+ M1510C+ M1510CT+	Single Phase	120	50/60	0-120	15	1.80	20	2.40	CW	2-4	—	4-3	14	15 3/4	26
										CCW	2-4	—	2-3			
					0-140	15	2.10	—	—	CW	1-4	—	4-3			
										CCW	5-2	—	2-3			
1510-2 1510C-2 1510CT-2	M1510-2+ M1510C-2+ M1510CT-2+	Single Phase Series	240	50/60	0-240	15	3.60	20	4.80	CW	2-2	4-4	3-3	14 & 4	35 1/4	45 1/2
										CCW	4-4	2-2	3-3			
					0-280	15	4.20	—	—	CW	1-1	4-4	3-3			
										CCW	5-5	2-2	3-3			
		Three Phase Open Delta	120++	50/60	0-120	15	3.12	20	4.15	CW	2-4-2	4-4	3-4-3	14 & 5		
										CCW	4-2-4	2-2	3-2-3			
					0-140	15	3.64	—	—	CW	1-4-1	4-4	3-4-3			
										CCW	5-2-5	2-2	3-2-3			
1510-3 1510C-3 1510CT-3	M1510-3+ M1510C-3+ M1510CT-3+	Three Phase Wye	240++	50/60	0-240	15	6.22	20	8.30	CW	2-2-2	4-4-4	3-3-3	14 & 6	55 1/2	65 3/4
										CCW	4-4-4	2-2-2	3-3-3			
				60	0-280	15	7.28	—	—	CW	1-1-1	4-4-4	3-3-3			
										CCW	5-5-5	2-2-2	3-3-3			
3PN1510B	—	Single Phase	120	50/60	0-140	15‡	2.10	—	—	CW	LINE CORD & RECEPTACLE			3	18	—
3PN1510BA 3PN1510BV	—	Single Phase	120	50/60	0-140	15‡	2.10	—	—	CW	LINE CORD & RECEPTACLE			9	18	—
1520 1520C 1520CT	M1520+ M1520C+ M1520CT+	Single Phase	240	50/60	0-240	9.5	2.28	12	2.88	CW	2-4	—	4-3	15	19 1/4	29 1/2
										CCW	2-4	—	2-3			
					0-280	9.5	2.66	—	—	CW	1-4	—	4-3			
										CCW	5-2	—	2-3			
			120	50/60	0-280	9.5#	1.14§	—	—	CW	7-4	—	4-3			
										CCW	6-2	—	2-3			
1520-2 1520C-2 1520CT-2	M1520-2+ M1520C-2+ M1520CT-2+	Single Phase Series	480	50/60	0-480	9.5	4.56	12	5.76	CW	2-2	4-4	3-3	15 & 4	42 1/4	52 1/2
										CCW	4-4	2-2	3-3			
					0-560	9.5	5.32	—	—	CW	1-1	4-4	3-3			
										CCW	5-5	2-2	3-3			
			240	50/60	0-560	9.5#	2.28§	—	—	CW	7-7	4-4	3-3			
										CCW	6-6	2-2	3-3			
		Three Phase Open Delta	240++	50/60	0-240	9.5	3.96	12	5.0	CW	2-4-2	4-4	3-4-3	15 & 5		
										CCW	4-2-4	2-2	3-2-3			
					0-280	9.5	4.61	—	—	CW	1-4-1	4-4	3-4-3			
										CCW	5-2-5	2-2	3-2-3			
			120++	50/60	0-280	9.5#	1.98§	—	—	CW	7-4-7	4-4	3-4-3			
										CCW	6-2-6	2-2	3-2-3			
1520-3 1520C-3 1520CT-3	M1520-3+ M1520C-3+ M1520CT-3+	Three Phase Wye	480++	50/60	0-480	9.5	7.90	12	10	CW	2-2-2	4-4-4	3-3-3	15 & 6	66	76 1/4
										CCW	4-4-4	2-2-2	3-3-3			
				60	0-560	9.5	9.21	—	—	CW	1-1-1	4-4-4	3-3-3			
										CCW	5-5-5	2-2-2	3-3-3			
			240++	60	0-560	9.5#	3.96§	—	—	CW	7-7-7	4-4-4	3-3-3			
										CCW	6-6-6	2-2-2	3-3-3			
3PN1520B	—	Single Phase	240	50/60	0-280	9.5‡	2.66	—	—	CW	LINE CORD & RECEPTACLE			3	22	—

"A" suffix includes Ammeter, "V" suffix includes Voltmeter

\+ Motor driven units use terminal connections for CCW increasing voltage, as viewed from the base end. See Fig 23 on page 9 for motor wiring.

• Jumper provided in the standard common position and should be moved or removed as required.

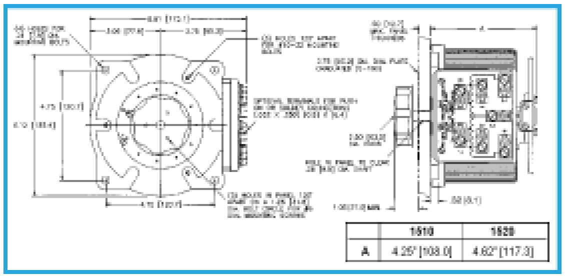
++ Line to line voltage

‡ Unit is fused for the constant current rating at the factory.

§ Maximum KVA at maximum output voltage and corresponding derated output current. Maximum KVA for lower voltages may be calculated from derating curve Figure B, page 6.

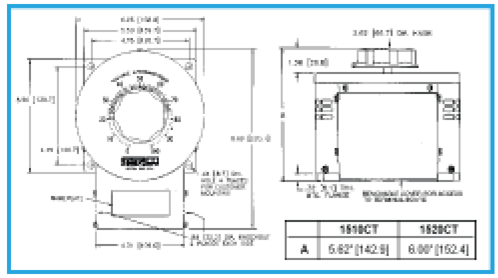
If ganged units are used in a system that ordinarily has a common neutral or ground between source and load, the neutral or ground must be connected to the common terminals of the variable transformer assembly. If the system has no neutral, the load must be balanced or the transformers will be damaged.

\# Maximum output current in output voltage range from 0 to 25% above line voltage. At higher output voltages, the output current must be reduced according to the derating curve, Figure B, page 6.



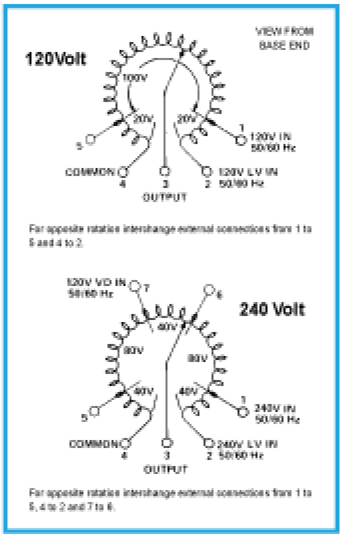
	1510	1520
A	4.25" [108.0]	4.62" [117.3]

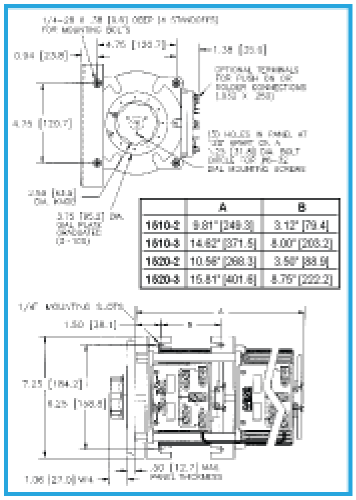
Manual Single, Uncased



	1510CT	1520CT
A	5.62" [142.9]	6.00" [152.4]

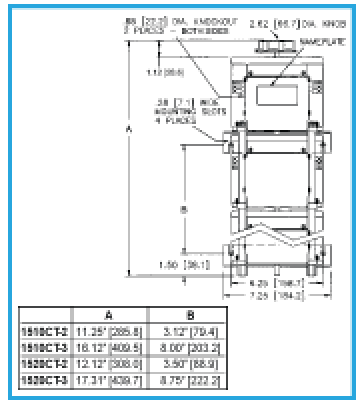
Manual Single, Cased





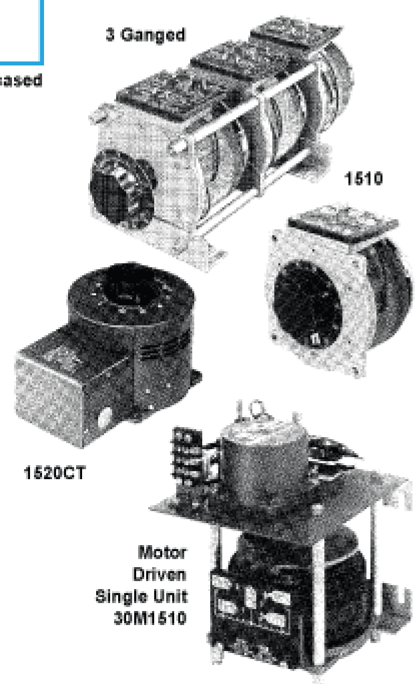
	A	B
1510-2	9.81" [249.3]	3.12" [79.4]
1510-3	14.62" [371.5]	8.00" [203.2]
1520-2	10.56" [268.3]	3.50" [88.9]
1520-3	15.81" [401.6]	8.75" [222.2]

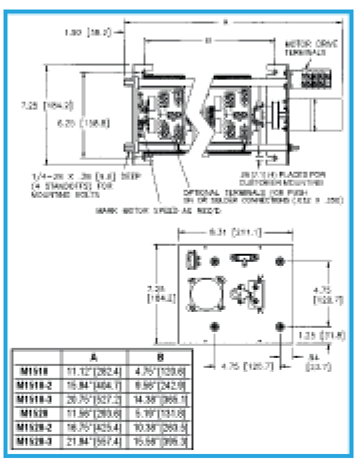
Manual Two- and Three-Ganged, Uncased



	A	B
1510CT-2	11.25" [285.8]	3.12" [79.4]
1510CT-3	16.12" [409.5]	8.00" [203.2]
1520CT-2	12.12" [308.0]	3.50" [88.9]
1520CT-3	17.31" [439.7]	8.75" [222.2]

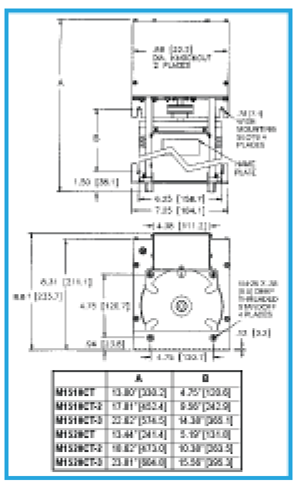
Manual Two- and Three-Ganged, Cased





	A	B
M1510	11.12" [282.4]	4.75" [120.6]
M1510-2	15.84" [404.7]	9.56" [242.9]
M1510-3	20.75" [527.2]	14.38" [365.1]
M1520	11.56" [293.6]	5.19" [131.8]
M1520-2	16.75" [425.4]	10.38" [263.5]
M1520-3	21.94" [557.4]	15.56" [395.3]

Motor-Driven Single, Two and Three-Ganged, Uncased



	A	B
M1510CT	13.00" [330.2]	4.75" [120.6]
M1510CT-2	17.81" [452.4]	9.56" [242.9]
M1510CT-3	22.62" [574.5]	14.38" [365.1]
M1520CT	13.44" [341.4]	5.19" [131.8]
M1520CT-2	18.62" [473.0]	10.38" [263.5]
M1520CT-3	23.81" [604.8]	15.56" [395.3]

Motor-Driven Single, Two and Three-Ganged, Cased

QEG Cautions-Hazards

Electrical / Mechanical devices are inherently dangerous. Electrical shock hazards can cause serious injury and in some cases death. Mechanical hazards can result in dismemberment and in some cases death.

Due diligence has been applied to ensure that the QEG instructions are complete and correct. All local and country-specific electrical and mechanical code implications, by which a QEG might be installed and operated, cannot possibly be known by us. Nor is it conceivable that any and all possible hazards and/or results of each procedure or method have been accounted for.

It is for these reasons that the QEG must be either directly installed or supervised by an experienced electrician or electrical technician/engineer, to ensure the installation is done safely and in accordance with local electrical code. However, the QEG is installed the same way as any commercial generator and does not violate any electrical codes. Anyone who uses the QEG installation instructions (including but not limited to any procedure or method of installation) must first satisfy themselves that neither their safety, nor the safety of the end user, will be endangered over the course of the installation and operation of the QEG.

It is imperative to understand you need PROFESSIONAL and EXPERT ADVICE to install a QEG.

HAZARDOUS VOLTAGES AND CURRENT LEVELS ARE PRESENT IN THE QEG CORE AND ASSOCIATED CIRCUITRY WHEN OPERATING! PLEASE USE CAUTION!

MAINTAIN SAFE DISTANCE, AND DO NOT TOUCH ANY CONNECTIONS TO THE CORE, OR MAKE ANY ELECTRICAL ADJUSTMENTS WHILE THE MACHINE IS RUNNING!

Always stop the machine when making connections or adjustments. The tank circuit capacitors do not normally hold a charge when the machine is stopped, but for added assurance, it is a good idea to try to discharge them before handling.

To Discharge Capacitors: PROVIDED THE MACHINE HAS STOPPED, momentarily short out the two primary coil leads (connected to the capacitor bank) with a 100 - 1000Ω, 5 – 10W resistor. If no resistor is on hand, simply lay a screwdriver across the coil leads momentarily.

Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Type 940 round, axial leaded film capacitors have polypropylene film and dual metallized electrodes for both self healing properties and high peak current carrying capability (dV/dt). This series features low ESR characteristics, excellent high frequency and high voltage capabilities.

Highlights

- High dV/dt
- High pulse current
- Low inductance
- Self healing

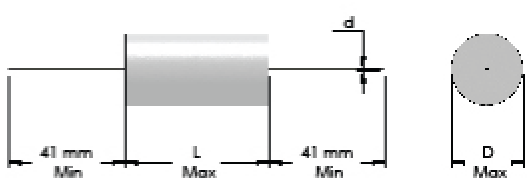
Specifications

Capacitance Range	0.01 to 4.7 µF
Capacitance Tolerance	±10% Standard Tolerance
Rated Voltage	600 to 3000 Vdc (275 to 500 Vac, 60 Hz)
Operating Temperature Range with Ripple	–55 ºC to 105 ºC* *Full rated voltage at 85 ºC - derated linearly to 50% rated at 105 ºC
Maximum rms Current	Check tables for values
Insulation Resistance	> 100,000 MΩ x µF
Test Voltage between Terminals @ 25 ºC	160% rated DC voltage for 60 s
Test Voltage between Terminals & Case @ 25 ºC	3 kVac @ 50/60 Hz for 60 s
Life Test	2,000 h @ 85 ºC, 125% rated DC voltage
Life Expectancy	60,000 h @ rated Vdc, 70 ºC 30,000 h @ rated Vac, 70 ºC
RoHS Compliant	

Dimensions

Construction Diagram

Construction Details	
Case Material	UL510 Polyester Tape Wrap
Resin Material	UL94V-0 Epoxy Fill
Terminal Material	Tin Plated Copper



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Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Part Numbering System

940	C	6	P	22	K	-F
Series	Termination Code	Voltage Code	Capacitance Decimal Point	Capacitance Significant figures in µF	Tolerance Code	RoHS Compliant Indicator
940	C = Tinned Copper Wire F = Insulated Stranded Wire H = Tinned Lugs	6 = 600 Vdc 8 = 800 Vdc 10 = 1000 Vdc 12 = 1200 Vdc 16 = 1600 Vdc 20 = 2000 Vdc 30 = 3000 Vdc	S = 0.0 P = 0. W = No decimal point		K = ±10%	

Ratings

NOTE: Other ratings, sizes and performance specifications are available. Contact us.

Cap. (µF)	Catalog Part Number	D mm	L mm	d mm	Typical ESR (mΩ)	Typical ESL (nH)	dV/dt V/µs	I peak (A)	I_{RMS} 70 °C 100 kHz (A)
				600 Vdc (275 Vac)					
.10	940C6P1K-F	9.0	34.0	0.8	28	19	196	20	2.5
.15	940C6P15K-F	10.5	34.0	0.8	13	20	196	29	4.0
.22	940C6P22K-F	11.5	34.0	0.8	12	20	196	43	4.4
.33	940C6P33K-F	13.5	34.0	0.8	9	21	196	65	5.6
.47	940C6P47K-F	15.5	34.0	1.0	7	22	196	92	6.9
.68	940C6P68K-F	18.0	34.0	1.0	6	23	196	134	8.1
1.00	940C6W1K-F	21.0	34.0	1.0	6	24	196	196	8.9
1.50	940C6W1P5K-F	25.0	34.0	1.2	5	26	196	295	10.9
2.00	940C6W2K-F	23.5	46.0	1.2	5	31	128	255	11.8
3.30	940C6W3P3K-F	27.0	54.0	1.2	4	36	105	346	15.3
4.70	940C6W4P7K-F	31.5	54.0	1.2	4	38	105	492	16.8
				850 Vdc (450 Vac)					
.15	940C8P15K-F	13.0	34.0	0.8	8	21	713	107	5.8
.22	940C8P22K-F	15.5	34.0	1.0	8	22	713	157	6.4
.33	940C8P33K-F	18.0	34.0	1.0	7	23	713	235	7.5
.47	940C8P47K-F	21.0	34.0	1.0	5	24	713	335	9.8
.68	940C8P68K-F	24.5	34.0	1.2	4	26	713	485	12.0
1.00	940C8W1K-F	22.5	46.0	1.2	5	30	400	400	11.5
1.50	940C8W1P5K-F	27.0	46.0	1.2	4	32	400	600	14.3
2.00	940C8W2K-F	30.5	46.0	1.2	3	34	400	800	17.9
2.20	940C8W2P2K-F	32.0	46.0	1.2	3	34	400	880	18.4
2.50	940C8W2P5K-F	34.0	46.0	1.2	3	35	400	1000	19.1
				1000 Vdc (500 Vac)					
.15	940C10P15K-F	15.0	34.0	1.0	7	22	856	128	6.7
.22	940C10P22K-F	17.5	34.0	1.0	7	23	856	188	7.4
.33	940C10P33K-F	20.5	34.0	1.0	6	24	856	283	8.8
.47	940C10P47K-F	24.0	34.0	1.2	5	26	856	402	10.6
.68	940C10P68K-F	28.0	34.0	1.2	5	27	856	582	11.7
1.00	940C10W1K-F	26.0	46.0	1.2	5	32	480	480	12.5
1.50	940C10W1P5K-F	31.0	46.0	1.2	4	34	480	720	15.6
2.00	940C10W2K-F	35.5	46.0	1.2	3	36	480	960	19.6

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Type 940C, Polypropylene Capacitors, for Pulse, Snubber

High dV/dt for Snubber Applications

Cap. (µF)	Catalog Part Number	D mm	L mm	d mm	Typical ESR (mΩ)	Typical ESL (nH)	dV/dt V/µs	I peak (A)	I_{rms} 70 °C 100 kHz (A)
				1200 Vdc (500 Vac)					
.10	940C12P1K-F	15.5	34.0	1.0	9	22	1142	114	6.1
.15	940C12P15K-F	18.5	34.0	1.0	7	23	1142	171	7.6
.22	940C12P22K-F	21.5	34.0	1.0	7	24	1142	251	8.4
.33	940C12P33K-F	20.0	46.0	1.0	7	29	640	211	9.0
.47	940C12P47K-F	23.0	46.0	1.2	7	30	640	301	9.8
.68	940C12P68K-F	27.0	46.0	1.2	6	32	640	435	11.7
1.00	940C12W1K-F	33.0	46.0	1.2	5	35	640	640	14.5
1.50	940C12W1P5K-F	35.0	54.0	1.2	4	39	502	754	17.9
				1600 Vdc (500 Vac)					
.10	940C16P1K-F	18.0	34.0	1.0	7	23	1427	143	7.5
.15	940C16P15K-F	21.5	34.0	1.0	5	24	1427	214	9.9
.22	940C16P22K-F	25.5	34.0	1.2	7	26	1427	314	9.3
.33	940C16P33K-F	23.5	46.0	1.2	7	31	800	264	10.0
.47	940C16P47K-F	27.5	46.0	1.2	6	32	800	376	11.8
.68	940C16P68K-F	32.5	46.0	1.2	6	35	800	544	13.1
1.00	940C16W1K-F	39.0	46.0	1.2	5	37	800	800	16.2
1.50	940C16W1P5K-F	42.0	54.0	1.2	4	42	628	942	20.1
				2000 Vdc (500 Vac)					
.022	940C20S22K-F	11.5	34.0	0.8	35	6	1712	38	2.6
.033	940C20S33K-F	13.5	34.0	0.8	20	21	1712	57	3.8
.047	940C20S47K-F	15.0	34.0	1.0	12	22	1712	80	5.2
.068	940C20S68K-F	17.5	34.0	1.0	8	23	1712	116	6.9
.100	940C20P1K-F	21.0	34.0	1.0	7	24	1712	171	8.3
.150	940C20P15K-F	19.5	46.0	1.0	7	29	960	144	8.9
.220	940C20P22K-F	22.0	46.0	1.0	8	30	960	211	9.0
.330	940C20P33K-F	27.0	46.0	1.2	8	32	960	317	10.1
.470	940C20P47K-F	32.0	46.0	1.2	6	34	960	451	13.0
.560	940C20P56K-F	31.0	54.0	1.2	7	37	754	422	12.6
.680	940C20P68K-F	34.0	54.0	1.2	6	39	754	513	14.3
1.00	940C20W1K-F	41.0	54.0	1.2	5	42	754	754	17.7
				3000 Vdc (500 Vac)					
.010	940C30S1K-F	11.5	34.0	0.8	60	20	2568	26	2.0
.015	940C30S15K-F	13.5	34.0	0.8	40	21	2568	39	2.7
.022	940C30S22K-F	15.5	34.0	1.0	25	22	2568	57	3.6
.033	940C30S33K-F	18.0	34.0	1.0	14	23	2568	85	5.3
.047	940C30S47K-F	16.5	46.0	1.0	14	28	1440	68	5.7
.068	940C30S68K-F	19.0	46.0	1.0	12	29	1440	98	6.7
.100	940C30P1K-F	22.5	46.0	1.2	10	30	1440	144	8.1
.150	940C30P15K-F	27.0	46.0	1.2	8	32	1440	216	10.1

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Your Source for Capacitor Solutions

Set-up and testing

***Wiring Notes:** The generator output can be wired in series (220, 230-240V), or parallel (110, 115, 120V). For the series connection shown on the schematic, the start leads from each coil are connected together. This connection provides the highest voltage output from the windings. If using a parallel connection for lower voltage/higher current, be careful to connect the four leads with polarity opposed (start lead of one coil connected to finish lead of other coil).

The variac we used can be wired for 120 or 240 volt input, and provides 0-280 volts output, at up to 9.5 amps. This is a versatile variac and can be used with either a 120 or 240 volt system. The output of the variac is connected to a 1000 volt, 25 Amp full-wave bridge rectifier to power the variable speed DC drive motor.

*Starting with the wiring setup as shown in the schematic, prepare the series/parallel capacitor bank, but do not connect to primaries at this time. This will prevent resonance momentarily. Connect input power to the variac. We started with a full 240 volt series wired system, but parallel 120 volt wiring can also be used.

Test mechanical assembly by spinning up the motor/rotor/belt and observing operation. Adjust variac voltage from zero to about ¾ through its range. The active rpm range is under 3000 rpm, so we don't need to spin very fast. Assure there is no stack rub (rotor scrubbing on stator), or other mechanical issues that need to be corrected for smooth operation.

*When proper mechanical operation is assured, connect the series/parallel capacitor bank. The recommended initial configuration of 72 (seventy-two) 0.15 uF (150nF), 3000 volt capacitors gives us .16875uF (168.75nF), that will withstand up to 24,000 volts. This initial value should be in the range to produce resonance at approx. 2400 RPM (about 160Hz). Be sure to apply a load on the output of the generator at all times. We recommend starting with the generator output wired in series, and four (4) 100 Watt/240 Volt incandescent lamps wired in parallel for initial load.

As the machine spins up to resonance, the sound will change, and the rotor speed will lock into the resonant frequency. At this point any further increase of the motor speed control will change the speed only slightly, but the additional mechanical power input will drive the core deeper into resonance, thereby increasing the power output. With a single control, the voltage and current (power) can be increased or decreased.

* *Denotes drawing included*

Angle
Channel
Beams
Flat Bar
Round Bar
Square Bar
Pipe
Square Tube
Rectangle Tube
Round Tube
Diamond Plate
Plate
Sheet
Expanded Sheet
Perforated Sheet
Bar Grating
Safety Grating
Specialty Metals
Metals Depot® Gear

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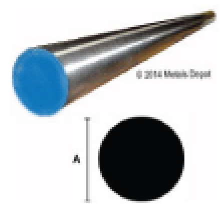
A2 Drill Rod

A2 Drill Rod, is an air hardening chromium alloy die steel that replaces O1 Drill Rod when safer hardening, less distortion and increased wear resistance are required. Characteristics of A2 Drill Rod include - good machinability, high compressive strength, very good non-deforming properties, deep hardening, and high dimensional stability after hardening and tempering. A2 Drill Rods are ground to a surface finish of better than 40 micro inches and are free from defects and decarburization. All Drill Rod grades are supplied in the annealed condition.



- Specifications: ASTM A681, QQ-T-570, AISI A2
- AKA: A-2 round, A-2 Drill Steel, Drill Rods
- Applications: dies, stamps, punches, taps, cams, machine parts, etc.
- Tolerances: Diameter = +/- .0005"
- How is it Measured? Diameter (A) X Length
- Available Stock Sizes: 36 inch lengths

Rockwell Hardness**	58-62C	**Corrosion Resistance**	Low
Machinability	Medium	**Depth of Hardening**	Deep
Weldability	Difficult	**Grindability**	Medium
Wear Resistance	High	**Distortion in Heat Treating**	Lowest
Overall Toughness	Medium	**Decarburization Resistance**	Medium
Strength	Medium	**Resistance to Heat Softening**	Medium

** Data provided for references only and is not warranted. ** Obtainable Hardness*

NEW Cut-to-Size Service **available on these items!** Call **1-859-745-2650** for details.

Stock Number	Product Type	Item Size & Description (Inches)	Click! Arrow to Select Size	Qty	Select / Price
05736	A-2 Drill Rod	1/8 Dia.	Select ...	1	Get Price
05758	A-2 Drill Rod	5/32 Dia.	Select ...	1	Get Price
05780	A-2 Drill Rod	3/16 Dia.	Select ...	1	Get Price
05805	A-2 Drill Rod	7/32 Dia.	Select ...	1	Get Price
05827	A-2 Drill Rod	1/4 Dia.	Select ...	1	Get Price
05849	A-2 Drill Rod	9/32 Dia.	Select ...	1	Get Price
05871	A-2 Drill Rod	5/16 Dia.	Select ...	1	Get Price
05893	A-2 Drill Rod	11/32 Dia.	Select ...	1	Get Price
05918	A-2 Drill Rod	3/8 Dia.	Select ...	1	Get Price
05962	A-2 Drill Rod	7/16 Dia.	Select ...	1	Get Price
06003	A-2 Drill Rod	1/2 Dia.	Select ...	1	Get Price
06025	A-2 Drill Rod	9/16 Dia.	Select ...	1	Get Price
06047	A-2 Drill Rod	5/8 Dia.	Select ...	1	Get Price
06058	A-2 Drill Rod	21/32 Dia.	Select ...	1	Get Price
06069	A-2 Drill Rod	11/16 Dia.	Select ...	1	Get Price
06091	A-2 Drill Rod	3/4 Dia.	Select ...	1	Get Price
06105	A-2 Drill Rod	13/16 Dia.	Select ...	1	Get Price
16116	A-2 Drill Rod	7/8 Dia.	Select ...	1	Get Price
06127	A-2 Drill Rod	15/16 Dia.	Select ...	1	Get Price
06138	A-2 Drill Rod	1 Dia.			

Home > Lighting > Lighting Components & Accessories > Lampholders

150 W n/a pin Urea, GLS Batten Holder, B22 Base, T2 Ceiling Ceiling Rose

RS Stock No. 776-8419
Brand Deta
Mfr. Part No. V1289A

DETA

£3.11
Price Each

Qty 1 - 9	Qty 10 - 49	Qty 50 +
£3.11	£2.95	£2.80

In stock for delivery next working day

Quantity 1 Add to Cart

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Technical Reference

RoHS Certificate of Compliance

Back Box Cross Reference Chart Data Sheet

Statement of conformity

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Essential extras

RS White uPVC Cable Self-Adhesive Trunking, W25 mm x D16mm
£26.86

Quick View

10m 2+E Core Unscreened 6242Y PVC Sheath Twin & Earth Electrical Wiring Cable, 1 mm² CSA
£6.91

Quick View

Product Details

Batten Lampholder

Part of the Deta Ceiling Accessories range. This is a Straight Batten Holder - home office skirt, with clear ceiling rose base. This Deta Batten Holdercomes with a 10 year warranty.

- T2 Rated Lampholder
- 3 terminal in ceiling rose

Deta Ceiling Accessories

Specifications

Find alternatives

To find a similar product, based on selected attributes, click the green button

Base	B22
Fixing Method	Ceiling
Lamp Size	T2
Length	75 mm
Material	Urea

http://uk.rs-online.com/web/p/lampholders/7768419/ 2/21/2015

Supported Lamp Type	GLS
Wattage	150 W
Width	89 mm
Wiring Points	4
Wiring Type	Ceiling Rose

Customer reviews

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Similar Products

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Alternative for 150 W n/a pin Urea, GLS Batten Holder, B22 Base, T2 Ceiling Ceiling Rose


Thermoplastic Lampholder
£5.08

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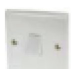
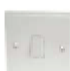
You may also like

Single gang BS 400W dimmer switch white
£10.35


20A Double Pole BS single switch white
£3.60


Single gang BS blank cover plate white
£0.53


Deta 13A 1 Gang Flush Mount Fused Spurs IP2X
£2.46


Single gang 2 way BS light switch white
£1.10


Deta White 2 Gang Urea Formaldehyde Switched Electrical Socket, BS 1363, 13A, IP2X
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Plastic, Batten Lampholder


Plastic Lampholder


White Straight Battenholder

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8827-CW1

UPC Code: 078477100318
Country of Origin: Please Contact Customer Service

Product Lists

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Quantity: 1

Lampholders

Brand Features

Leviton produces lamp holders for virtually every light source equipped with incandescent, fluorescent, or CFL lamps. Lamp-holders include incandescent medium base, and specialty sizes & fluorescent lamp holders, in addition to a large line of porcelain lamp holders including pulse-rated mogul-base products, and an extensive selection of devices for high-intensity lamps.

Where To Buy

Find a Store

enter your zip code

Market Channel

Item Description

660W/250V Medium Base One-Piece White Urea Outlet Box Mount Incandescent Lampholder, Pull Chain, Single Circuit, 2 Screws Top Wired - White

Technical Information Discussions

Technical Information

TOP

Electrical Specifications

Wiring Access: Top Wired
Max. Lamp Wattage: 660W
Voltage: 250 Volt

Material Specifications

Body Material: White Urea
Construction: One-Piece
Socket Shell Material: Aluminum
Color: White
Availability: Distribution

Mechanical Specifications

Lamp Socket Base: Medium
Operator Type: Pull Chain
Circuit: Single Circuit
Sequence: ON-OFF
Termination: 2 Terminal Screws
Mounting Type: Twist-lock
Fits Outlet Box Size: 3-1/4 or 4 Inch

Product Features

Lamp Socket Base: Medium
Construction: One-Piece
Operator Type: Pull Chain
Circuit: Single Circuit
Sequence: ON-OFF
Wiring Access: Top Wired
Max. Lamp Wattage: 660W
Voltage: 250 Volt
Termination: 2 Terminal Screws
Mounting Type: Twist-lock
Fits Outlet Box Size: 3-1/4 or 4 Inch
Standards and Certifications: UL/CSA
Warranty: 1 Year Limited
Availability: Distribution

Standards and Certifications

UL Listed: File E3810
CSA Certified: File LR-1563

Discussions

TOP

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19062

Lampholders

Item Description

Medium Base, One-Piece, Keyless, Incandescent, Unglazed Porcelain Lampholder, Pony Cleat, Single Circuit, Open Terminal, - White

Where To Buy

Find a Store

enter your zip code

Market Channel

UPC Code: 07847731815
Country of Origin: China

Product Lists

Add to Product List

View Product List

Quantity: 1

Technical Information Discussions

Technical Information

TOP

Electrical Specifications

Circuit: Single Circuit
Wattage Rating: 660W
Voltage: 250 Volt

Material Specifications

Color: White
Availability: Distribution

Mechanical Specifications

Access: Open Terminal

Product Features

Lamp Socket Base: Medium
Construction: One-Piece
Mounting Type: Pony Cleat
Circuit: Single Circuit
Access: Open Terminal
Termination: 2-Terminal Screws
Mounting Type: Surface Mtg
Screw Shell Material: Aluminum
Body Material: Unglazed Porcelain
Standards and Certifications: UL/CSA
Warranty: 1 Year Limited
Availability: Distribution

Standards and Certifications

UL Listed: File E3810
CSA Certified: File LR-1563

Discussions

TOP

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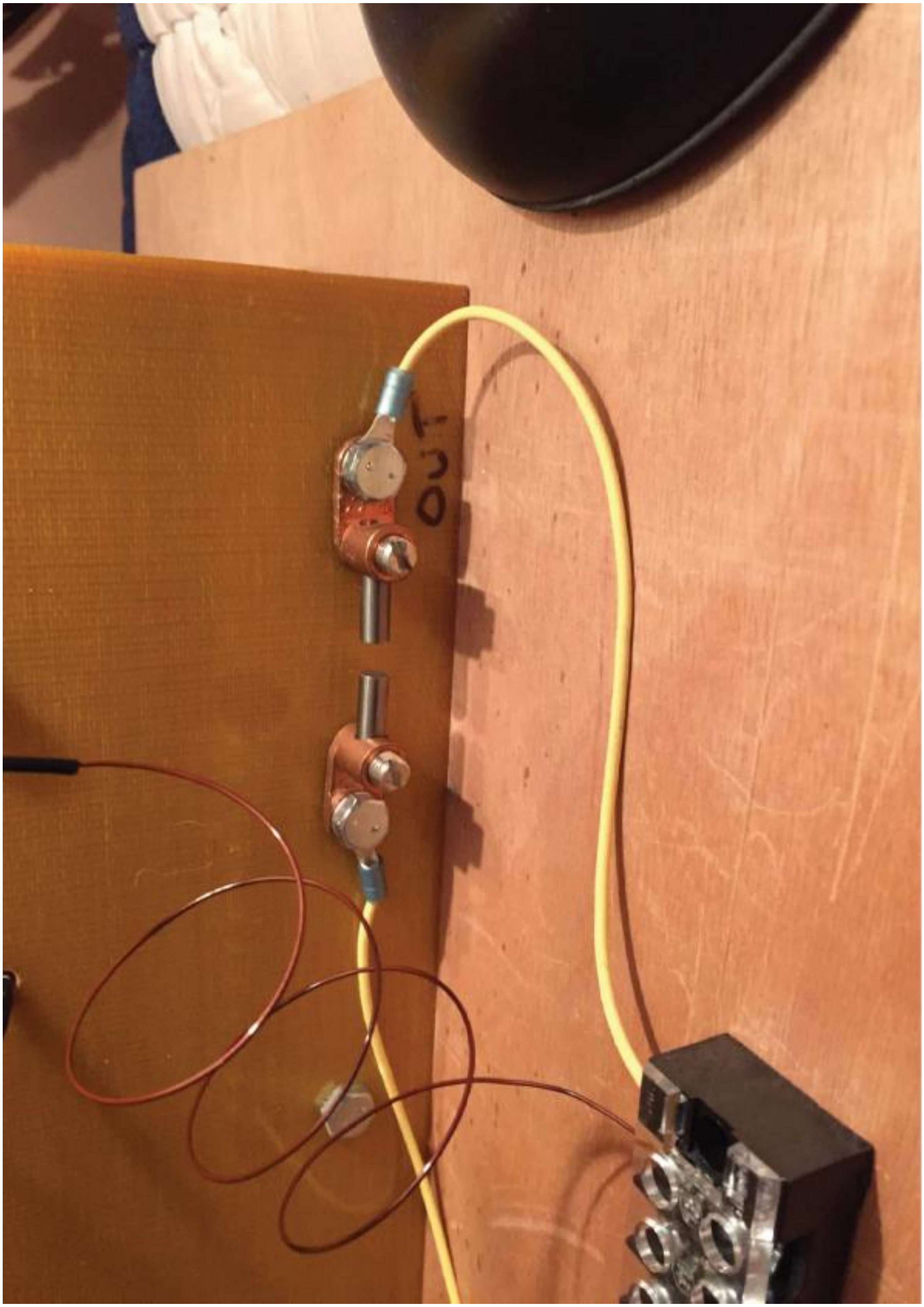
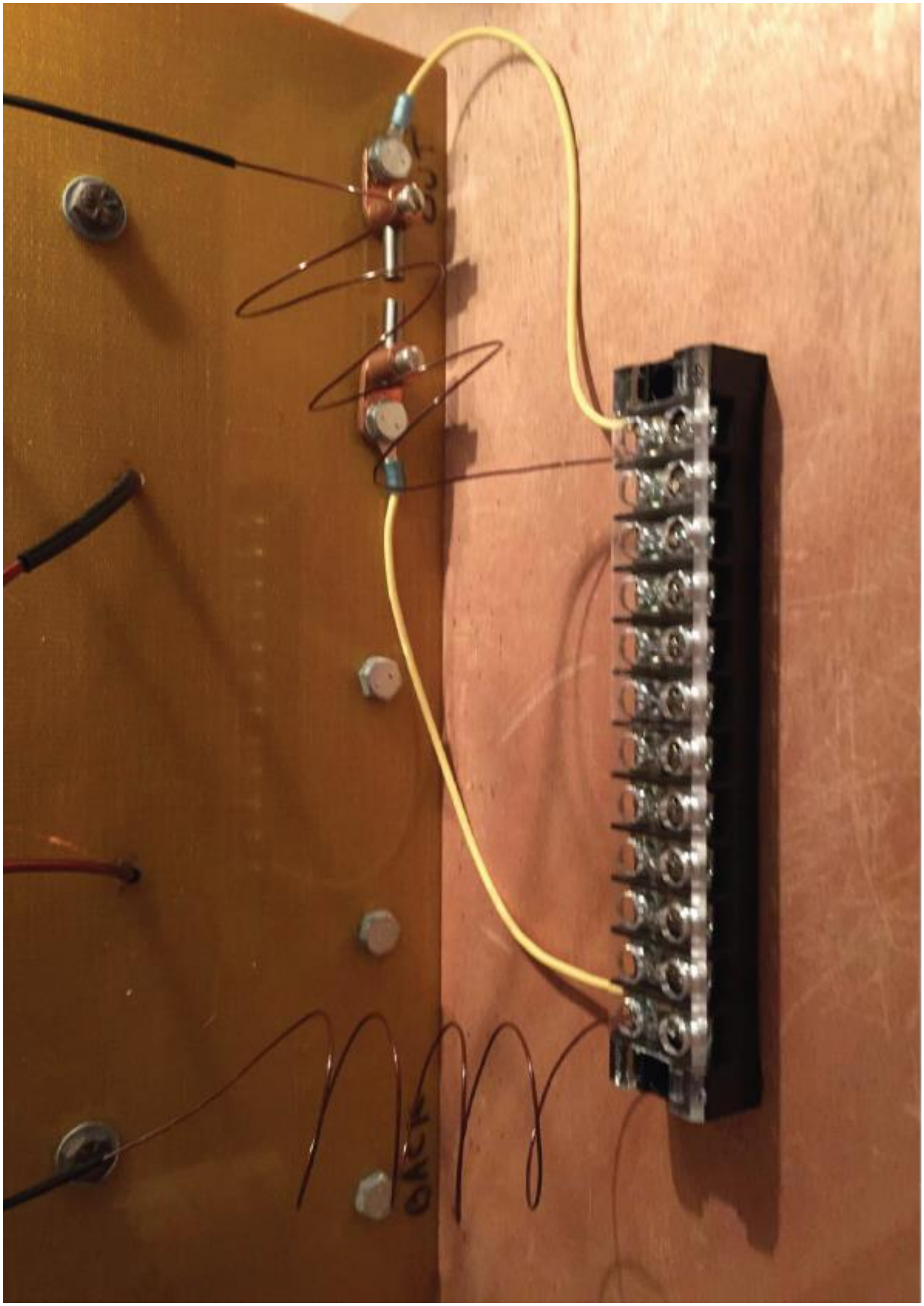
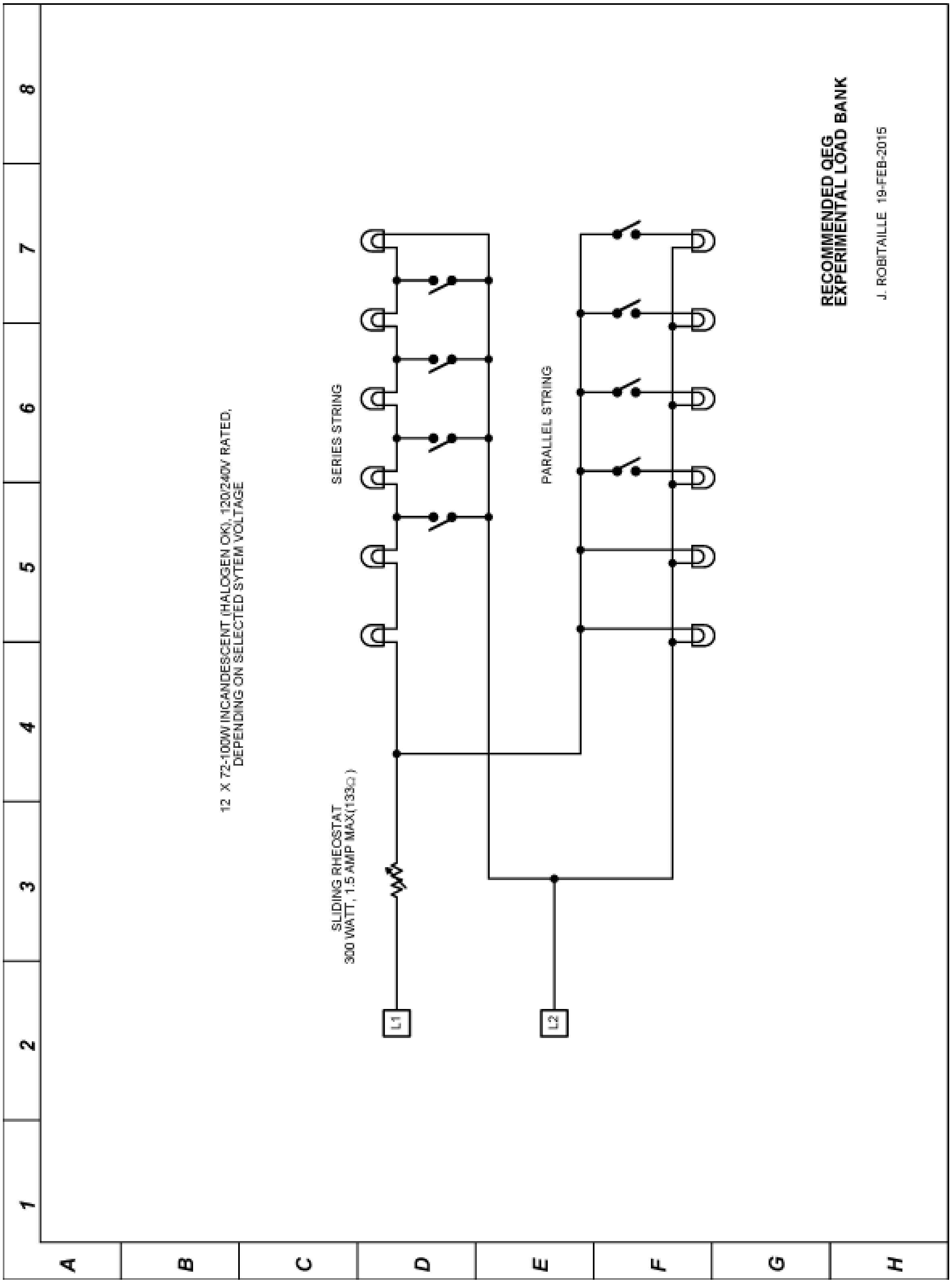

OUT




RECOMMENDED QEG
EXPERIMENTAL LOAD BANK
J. ROBITAILLE 19-FEB-2015
12 X 72-100W INCANDESCENT (HALOGEN OK), 120/240V RATED,
DEPENDING ON SELECTED SYTEM VOLTAGE
SERIES STRING
PARALLEL STRING
SLIDING RHEOSTAT
300 WATT, 1.5 AMP MAX(133Ω)
L1
L2
1
2
3
4
5
6
7
8
A
B
C
D
E
F
G
H

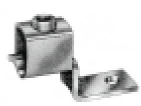

OFF
ON

MECHANICAL LUGS

Copper Mechanical Lugs

Type SLU - 1-Hole

Offset

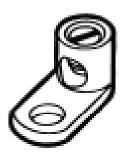


- Range taking.
- Made of electrolytic copper tubing and strip stock.
- 600V.
- For copper conductors.

ILSCO

PartNumber	Wire Size	Bolt Size	Size	Description
SLU-35	#6 - #14 AWG	#10	1"L x .32"W	Slotted Screw

Type L - Single Connector - 1-Hole Mount - Copper

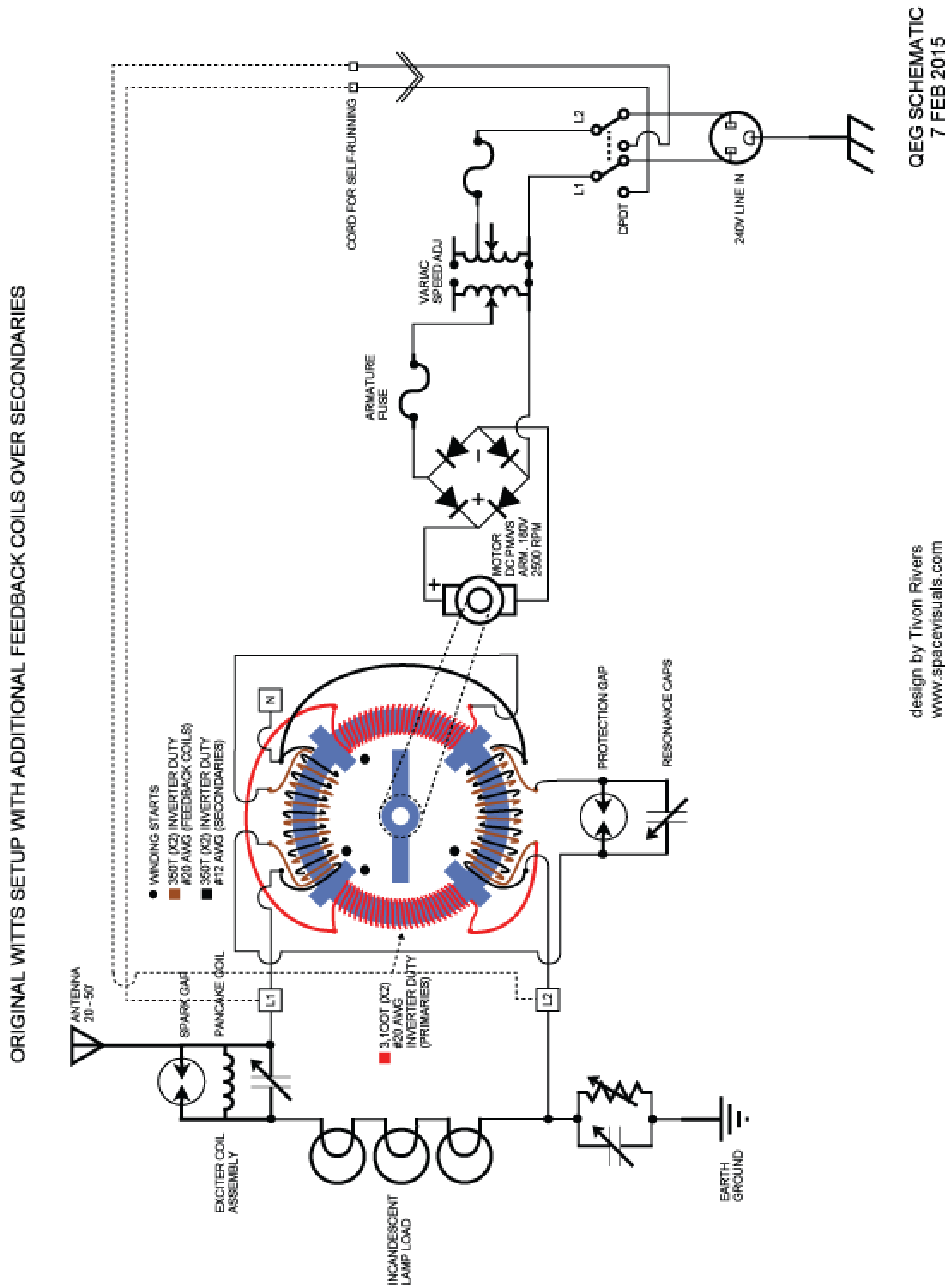


- Plated steel screws.
- Single-piece construction.
- For copper conductors.

Blackburn

PartNumber	Wire Size	Bolt Size	Size	Description
L35	#8 Str - #14 Sol AWG	13/64"	1-3/16"L x 3/8"W x 3/8"H	Slotted Screw
L70	#4 Str - #14 Sol AWG	9/32"	1-1/8"L x 17/32"W x 35/64"H	Slotted Screw
L125	#1/0 Str - #8 Sol AWG	21/64"	1-1/2"L x 47/64"W x 3/4"H	Socket Screw
L250	250 kcmil - #6 Str AWG	13/32"	1-61/64"L x 15/16"W x 1-1/16"H	Socket Screw

F


ORIGINAL WITTS SETUP WITH ADDITIONAL FEEDBACK COILS OVER SECONDARIES
ANTENNA 20 - 50'
SPARK GAP
PANCAKE COIL
EXCITER COIL ASSEMBLY
INCANDESCENT LAMP LOAD
EARTH GROUND
WINDING STARTS
350T (X2) INVERTER DUTY #20 AWG (FEEDBACK COILS)
350T (X2) INVERTER DUTY #12 AWG (SECONDARIES)
3,100T (X2) #20 AWG INVERTER DUTY (PRIMARIES)
L1
L2
N
PROTECTION GAP
RESONANCE CAPS
MOTOR DC PM/VS ARM. 180V 2500 RPM
ARMATURE FUSE
VARIAC SPEED ADJ
CORD FOR SELF-RUNNING
DPDT
240V LINE IN
QEG SCHEMATIC 7 FEB 2015
design by Tivon Rivers www.spacevisuals.com

QEG SWEET SPOT TEST								
Test #	Image #	Power in W	Speed	Cap nf	Vrms	Amp x001	freq	Pwr out
1	3277	690	1733	332.0	163	17.6	116	286.88
2	3278	700	1751	325.5	162	15.5	115	251.1
3	3279	710	1760	322.0	166	17.7	116	293.82
4	3280	700	1788	312.5	171	18	119	307.8
5	3281	705	1807	306.4	155	16.2	120	251.1
6	3282	705	1815	303.5	160	17	120	272
7	3283	703	1842	294.8	160	17	123	272
8	3284	700	1860	289.3	155	16.5	124	255.75
9	3285	705	1869	286.7	160	17	125	272
10	3286	700	1896	278.8	160	17	126	272
11	3287	700	1913	274.0	145	16	127	232
12	3288	700	1922	271.5	160	17	128	272
13	3289	700	1948	264.4	155	17	129	263.5
14	3290	710	1965	260.0	163	17	130	277.1
15	3291	695	1973	257.9	160	16.3	132	260.8
16	3292	900	2023	251.0	165	20	135	330
16.1	3293	700	2000	251.0	150	16	134	240
17	3294	705	2017	247.7	150	16	135	240
18	3295	700	2050	241.3	156	15.7	136	244.92
19	3296	705	2066	236.6	160	15.7	137	251.2
20	3297	695	2099	229.6	145	15	138	217.5
21	3298	700	2148	220.5	160	15.8	142	252.8
22	3300	710	2195	210.9	155	16	146	248
23	3303	703	2254	201.1	150	16.1	150	241.5
24	3304	705	2298	193.8	150	15.8	151	237
25	3305	695	2343	186.6	150	16	156	240
26	3306	703	2385	180.1	150	15.6	159	234
27	3307	700	2429	174.0	150	16	163	240
28	3308	700	2485	166.6	144	15.4	165	221.76
29	3309	700	2525	161.8	140	15.3	169	214.2
30	3310	700	2566	156.6	138	15.4	171	212.52
31	3311	700	2605	152.2	136	15.1	173	205.36
32	3312	700	2645	147.7	130	15.2	176	197.6
33	3313	695	2682	144.0	130	14.9	179	193.7
34	3314	700	2719	140.0	132	15	181	198
35	3316	705	2757	136.3	135	14.9	184	201.15
36	3317	700	2793	132.9	134	14.9	186	199.66
37	3318	703	2829	129.5	132	14.9	188	196.68
38	3319	710	2867	126.4	130	14.7	191	191.1
39	3320	705	2903	123.6	130	14.9	194	193.7
40	3321	707	2939	120.6	132	15	196	198
41	3322	700	2974	117.8	138	14.7	198	202.86
42	3324	700	3008	115.2	129	14.7	200	189.63
43	ow check	710	1999	251.6	160	15.9	133	254.4
44	3325	690	1727		170	17.5	115	297.5

TANK CAPACITOR MIX AND MATCH

Discrete Value	Final Value			Total Value of (n) Parallel Rows (nF)				
2000V Rated	Series Multiplier	uF	nF	X8	X9	X10	X11	X12
0.1uF	X 12	0.008333	8.3	66.4	74.7	83	91.3	99.6
0.15uF	X 12	0.0125	12.5	100	112.5	125	137.5	150
0.2uF	X 12	0.016666	16.6	132.8	149.4	166	182.6	199.2
0.25uF	X 12	0.020833	20.83	166.64	187.47	208.3	229.13	249.96
0.3uF	X 12	0.025	25	200	225	250	275	300
0.35uF	X 12	0.029166	29.16	233.28	262.44	291.6	320.76	349.92
0.4uF	X 12	0.033333	33.3	266.4	299.7	333	366.3	399.6
0.45	X 12	0.0375	37.5	300	337.5	375	412.5	450
0.5uF	X 12	0.041666	41.6	332.8	374.4	416	457.6	499.2
0.55uF	X 12	0.045833	45.83	366.64	412.47	458.3	504.13	549.96
0.6uF	X 12	0.05	50	400	450	500	550	600
0.65uF	X 12	0.054166	54.16	433.28	487.44	541.6	595.76	649.92
0.7uF	X 12	0.058333	58.3	466.4	524.7	583	641.3	699.6
0.75uF	X 12	0.0625	62.5	500	562.5	625	687.5	750
0.8uF	X 12	0.066666	66.6	532.8	599.4	666	732.6	799.2
0.85uF	X 12	0.070833	70.83	566.64	637.47	708.3	779.13	849.96
0.9uF	X 12	0.075	75	600	675	750	825	900
0.95uF	X 12	0.079166	79.16	633.28	712.44	791.6	870.76	949.92
1.0uF	X 12	0.083333	83.3	666.4	749.7	833	916.3	999.6
1.2uF	X 12	0.1	100	800	900	1000	1100	1200
1.5uF	X 12	0.125	125	1000	1125	1250	1375	1500
2.0uF	X 12	0.166666	166	1328	1494	1660	1826	1992
2.2uF	X 12	0.183333	183.3	1466.4	1649.7	1833	2016.3	2199.6
2.5uF	X 12	0.208333	208.3	1666.4	1874.7	2083	2291.3	2499.6
3.0uF	X12	0.25	250	2000	2250	2500	2750	3000
3000V Rated				X8	X9	X10	X11	X12
0.1uF	X8	0.0125	12.5	100	112.5	125	137.5	150
0.15uF	X8	0.01875	18.75	150	168.75	187.5	206.25	225
0.2uF	X8	0.025	25	200	225	250	275	300
0.25uF	X8	0.03125	31.25	250	281.25	312.5	343.75	375
0.3uF	X8	0.0375	37.5	300	337.5	375	412.5	450
0.35uF	X8	0.04375	43.75	350	393.75	437.5	481.25	525
0.4uF	X8	0.05	50	400	450	500	550	600
0.45	X8	0.05625	56.25	450	506.25	562.5	618.75	675
0.5uF	X8	0.0625	62.5	500	562.5	625	687.5	750
0.55uF	X8	0.06875	68.75	550	618.75	687.5	756.25	825
0.6uF	X8	0.075	75	600	675	750	825	900
0.65uF	X8	0.08125	81.25	650	731.25	812.5	893.75	975
0.7uF	X8	0.0875	87.5	700	787.5	875	962.5	1050
0.75uF	X8	0.09375	93.75	750	843.75	937.5	1031.25	1125
0.8uF	X8	0.1	100	800	900	1000	1100	1200
0.85uF	X8	0.10625	106.25	850	956.25	1062.5	1168.75	1275
0.9uF	X8	0.1125	112.5	900	1012.5	1125	1237.5	1350
0.95uF	X8	0.11875	118.75	950	1068.75	1187.5	1306.25	1425
1.0uF	X8	0.125	125	1000	1125	1250	1375	1500
1.2uF	X8	0.15	150	1200	1350	1500	1650	1800
1.5uF	X8	0.1875	187.5	1500	1687.5	1875	2062.5	2250
2.0uF	X8	0.25	250	2000	2250	2500	2750	3000
2.2uF	X8	0.275	275	2200	2475	2750	3025	3300
2.5uF	X8	0.3125	312.5	2500	2812.5	3125	3437.5	3750
3.0uF	X8	0.375	375	3000	3375	3750	4125	4500

TOUGH Series

Specification

Ver. 08

Model	TOUGH-3000	TOUGH-3300	TOUGH-4000	TOUGH-5000
Output Data (AC)				
Maximum AC Output	3000W	3300W	4000W	5000W*
Maximum AC Output Current	14.5 a.c.A	16.5 a.c.A	20 a.c.A	22 a.c.A
Nominal AC Voltage	220-240 a.c.V			
Grid AC Frequency	50/60Hz, auto-selection			
Power Factor	> 0.99 @ 20% load			
Reactive Power Factor	1 or adjustable from -0.9 to +0.9**			
Total Harmonic Distortion	< 3%			
AC connection / Grid forms	Single-Phase / TN-C, TN-S, TN-C-S			
Input Data (DC)				
Maximum DC Power	3200W	3600W	4300W	5300W
Maximum DC Input Current	16 d.c.A	2 x 10 d.c.A	2 x 13 d.c.A	2 x 15 d.c.A
Max. number of MPP Trackers (parallel / independent)	1	2		
Maximum DC Voltage	650 d.c.V			
MPP Tracking Voltage Range	150-500 d.c.V			
Peak Power Tracking Voltage Range	200-460 d.c.V			
Efficiency				
MPPT Efficiency	>99.9%			
Maximum Efficiency	96.5%	96.5%	96.7%	96.9%
Euro. Efficiency	95.8%	96.1%	96.3%	96.6%
Consumption: Operating (standby) / Night	<12W / <0.2W	<12.5W / <0.2W		
General Specification				
Dimensions (W x H x D) in mm	405 x 442 x 152	405 x 442 x 165		
Weight	18kg	25.8kg		
Cooling Concept	free convection			
Acoustic Noise Level	< 35dB(A)			
Maximum Operating Temperature Range without derating	-20 to +45 °C	-20 to +60 °C		-20 to +55 °C
Ambient Temperature Range	-25 to +60 °C			
Humidity	0 to 95%, non-condensing			
Protection Degree	IP65			
Topology	Transformerless			
Features				
DC Connection	MC4, Tyco			
DC Disconnect	yes			
AC Connection	AC connectors			
Display	LCD 16X2 screen			
Communication Interface	RS232, RS485；Bluetooth (Option)			
Safety	VDE-AR-N 4105；IEC 62109-1 / -2			
Warranty	5 years			

* For VDE-AR-N4105, the inverter is rated 4600 VA.

** Adjustable from 0.95 over-excited to 0.95 under-excited with VDE-AR-N 4105.

AUTOMATIC CO-GENERATION MANAGEMENT SYSTEM

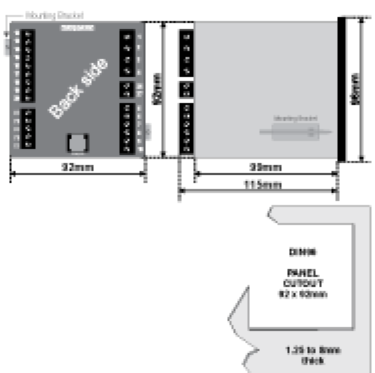
KSQ304E1

- All-in-one precision Frequency, Synchronising and Load Controller for single generator system
- Load control of generator parallelled to mains
- Fast precision "Spot-on" Synchronising of generator
- Frequency control
- Loading and offloading slope control, peak shaving, Fixed load export, load limiting control, breaker trip and automatic reset facility
- System status output

Specifications

System Voltage:	100-120, 200-240, 380-415, or 440-460VAC, 40-70Hz (Fuse 0,5A)	
Contact Rating:	AC: 100VA - 250V/2A max. DC: 50W - 100V/1A max.	
Adjustments:	Freq. difference	: + 0,1-2Hz
	Volt differential	: +/- 2-15%
	CB closing time	: 30-300mS
	Freq. reference	: 48-62Hz
	Pulse rate	: 10-60 pr min
	Pulse width	: 0,1 to 1,6sec
	Load trim	: 0-110% kW nom.
Analogue input:	0-10mADC = 0-110% kW	
Temperature:	-20 to +70ºC	
Weight:	0.7kgs	
Front protection:	IP54 (IP65 optional)	

Megacon is the inventor of the original, now industry standard "rotating" LED display, and a trendsetter in modern synchronisation control.



Description

The digitally controlled KSQ304E1 is an automatic one-generator co-generation or peak-shaving management system, which can be used with any make of GenSet starter together with Megacon's range of standard protective guards and controllers.

User settable limits on unit rear for frequency sync. difference, voltage differential, frequency reference, circuit breaker closing time, fuel regulator pulse width and pulse rate, load trim reference when paralleled to mains.

Note that the kW load signal input needs to be calibrated to be 0-110% of generator nominal load.

Applications

Synchronising modes
To adapt the functionality of KSQ304E1 to any specific application, the direction of approach to synchronising (LEAD, LAG or NEUTRAL) is factory set as required:

LEAD (incomer faster than bus), LAG (incomer slower than bus), NEUTRAL (bi-directional)

LEAD is the standard mode. The synchronising relay will then close when the frequency of the incomer is slightly HIGHER than the bus frequency. This avoids a non-stabilised incomer entering reverse power condition after synchronisation.

The rotary LED display indicates the incomer's speed relative to the bus, and is lit during frequency mode if the difference between the systems does not exceeds 5Hz.

During all modes the UP/DOWN arrows indicate the pulses from the raise/lower speed relays.

Speed control
The raise/lower relays pulse the fuel regulator or an interfacing MXR845 electronic potentiometer. Pulse width and rate can be adjusted to suit the dynamic response of any fuel regulator. The speed control has a P/I (proportional/integral) characteristic with a dynamically controlled dead zone.

System status:
KSQ304E1 is fitted with a system status relay. As standard the unit is powered from generator side (terminal 3 & 4), when power is ok and unit is working correctly the relay activates. It will release on alarm or when unit is not powered. Separate auxiliary supply is needed for continuously system status.

Normal operation	: Closed contact
Alarm condition/unpowered	: Open contact

Norway
Denmark
United Kingdom
megacon

www.megacon.com
ELECTRONIC CONTROL AND INSTRUMENTATION

Page: 1 of 2
REF: Datasheet.KSQ304E1 - REV: 1.01/02.2012

Application Note: Co-Generation

By Erik Mikkelsen, Product Manager Ms. Sc., SELCO A/S

Co-generation is becoming an increasingly important issue in the electricity market.

For some companies it is beneficial always to utilise a certain amount of their own power generating capacity and only import the excess power from the grid. This is also called "base-load". See fig. 1.

In case of limited grid capacity, companies sometimes have to pay a penalty fee when they exceed a certain agreed amount of power, and then it is beneficial to import only this amount of power from the grid, and produce the excess power with own power generating equipment. This is also called "peak-lopping" or "peak-shaving".

Another important factor is the increasing liberalisation of the electricity market in many countries. It is now more and more common to be permitted to operate in parallel with the grid, when proper generator control equipment is used. Also many countries now have a policy for exporting excess power to the grid.

SELCO has equipment for control, protection and monitoring generators operating in parallel with each other or with the grid.

The SELCO load sharers provide automatic load sharing for generators running in parallel. When applied with the SELCO B9300 Power Reference Unit, one or several generators in parallel operation with the grid can be controlled.

The SELCO T4900 VAr (Voltage Ampere reactive) Load Sharer provides automatic VAr load sharing for parallel running generators. The VAr Load Sharer can also be used for power factor control ("cos ϕ") on a generator in parallel operation with the grid.
The SELCO synchronizers perform automatic synchronisation of incoming generators.

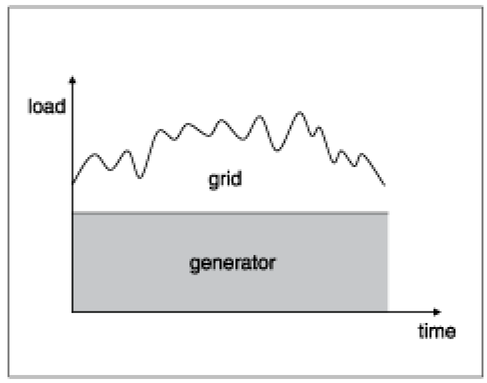


Fig. 1. Illustration of "base-load"

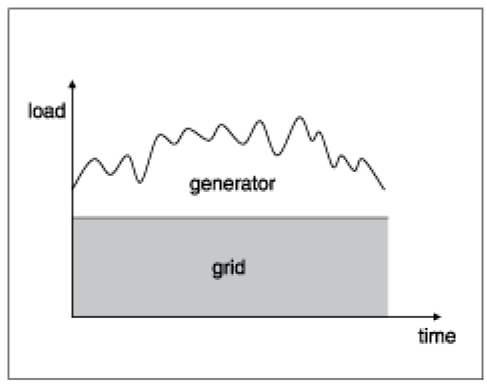


Fig. 2. Illustration of "peak-shaving"

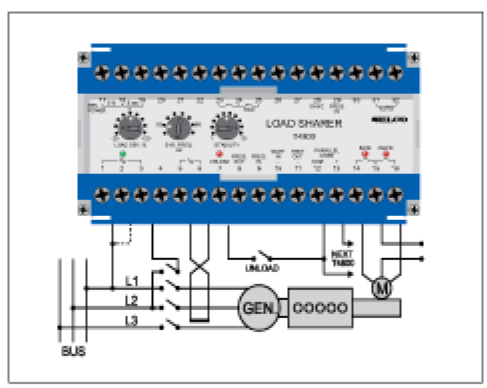
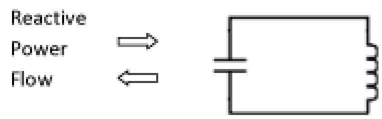


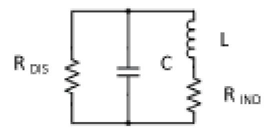
Fig. 3. The SELCO T4800 Load Sharer.

Dispelling Myths About Reactive Power in Resonant Circuits

Power flow into a resonant circuit appears to the energizing ***source*** to be reactive



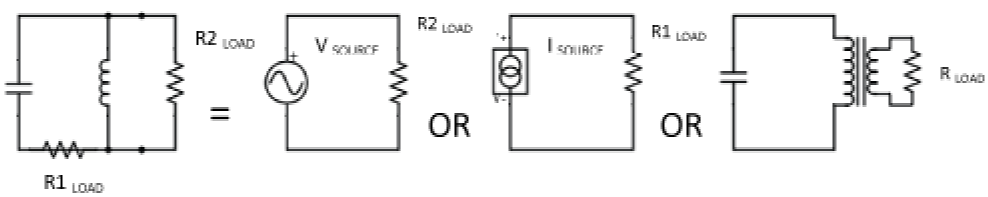
Assuming no dissipative losses, all power flow into the tank circuit can be returned to the source.
This does NOT mean that power taken out of a resonant tank is reactive. If this was not true, dissipative losses would not occur; therefore,



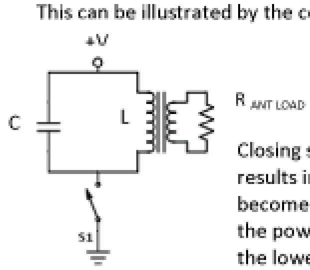
In the above circuit, real power is removed from the system by R_{DISP} and R_{IND}. Because of this fact, real power can be used by a resistive load connected in the following ways:

1.) Parallel to L & C, 2.) In Series with L & C, 3.) Inductively coupled to L

When this occurs, a partially resistive impedance presents itself to the driving source. Real power flows from the source to replenish the energy removed by the loads. This occurs in the QEG tank circuit below.



This means that oscillating reactive power does ***NOT*** need to be converted to real power before use.
This can be illustrated by the common RF Class C power output transmitter stage shown below

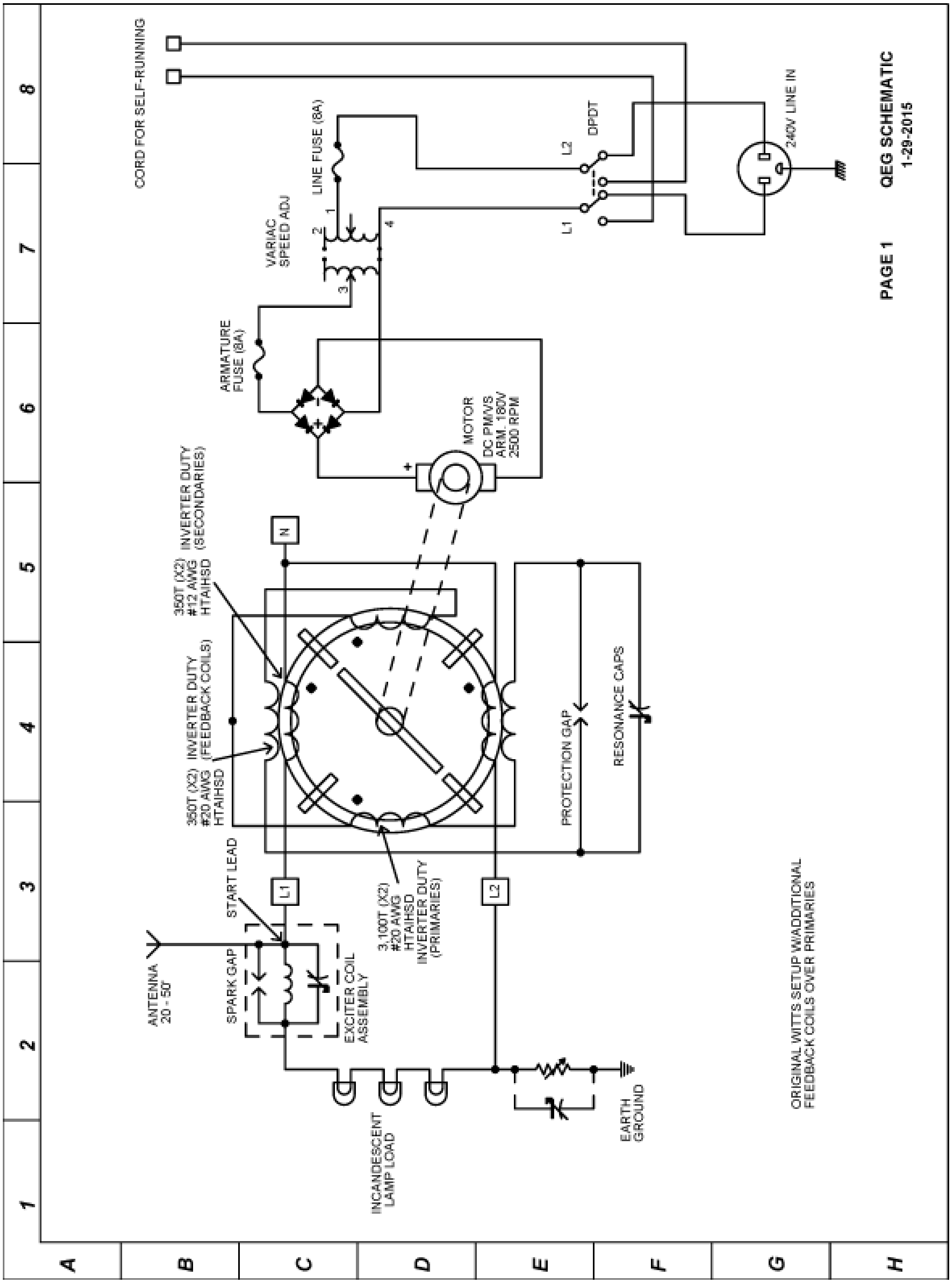


Closing switch S1 for a short time and repeated in sync with the resonant period, results in Capacitor C being charged to the DC power source voltage. This becomes an initial condition to the resonant tank. No additional load is placed on the power supply until power is consumed by the load or losses. This results in the lowering of capacitor voltage (Lower Q) and DC restoring power flow at switch closure. time.

The above effects occur because **only** the current or voltage is extracted in each case. If voltage is applied to a resistive load the current flow is determined by the resistor, not the source and is therefore in phase. If current is applied to a resistor the in phase voltage is generated by the resistor, not the source. The same is true for inductors and capacitors except that leading or lagging phase voltage or current results.

Rev. A

George Pidick
(Herm)
06/19/2014


CORD FOR SELF-RUNNING
LINE FUSE (8A)
VARIAC
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QEG SCHEMATIC
1-29-2015
PAGE 1
ARMATURE
FUSE (8A)
MOTOR
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350T (X2)
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HTAIHSD
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(FEEDBACK COILS)
350T (X2)
#20 AWG
HTAIHSD
PROTECTION GAP
RESONANCE CAPS
START LEAD
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L2
3,100T (X2)
#20 AWG
HTAIHSD
INVERTER DUTY
(PRIMARIES)
ANTENNA
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SPARK GAP
EXCITER COIL
ASSEMBLY
INCANDESCENT
LAMP LOAD
EARTH
GROUND
ORIGINAL WITTS SETUP W/ADDITIONAL
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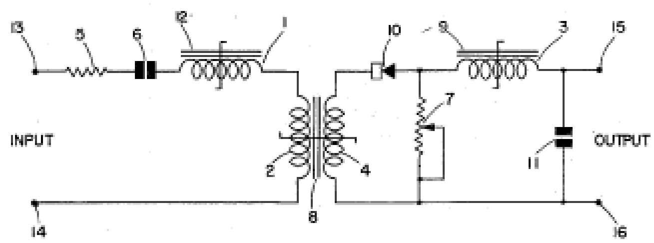
April 2, 1957 M. W. SMITH 2,787,755

MAGNETIC FREQUENCY DIVIDER

Filed Aug. 13, 1953



INVENTOR.

MILTON W. SMITH

BY William L. Lane

ATTORNEY

United States Patent Office

2,787,755

Patented Apr. 2, 1957

1

2,787,755

MAGNETIC FREQUENCY DIVIDER

Milton W. Smith, Palmdale, Calif., assignor to North American Aviation, Inc.

Application August 13, 1953, Serial No. 373,975

6 Claims. (Cl. 321—68)

This invention pertains to the production of uniformly spaced electrical pulses, and in particular to a magnetic device adapted to produce a relatively low frequency train of electrical pulses from a source of higher frequency electrical pulses.

In control devices of many types the problem often arises of dividing the frequency of an alternating current source to obtain either an alternating current signal of lower frequency or a train of pulses separated by a uniform time interval. To solve this problem it has been proposed to utilize a series of bistable multivibrators, or flip-flops, or to utilize a multivibrator to charge a condenser rapidly in steps. Both of these solutions have the disadvantage that the apparatus required includes vacuum tubes which have a definite short life, and, in addition, these devices require a relatively stable power source to assure accurate operation. This invention contemplates a frequency divider utilizing no vacuum tubes but only static elements such as resistors, condensers, and saturable reactors.

It is therefore an object of this invention to provide an improved frequency divider.

It is another object of this invention to provide a source of uniform interval pulses.

It is another object of this invention to provide a source of constant frequency electrical pulses.

It is another object of this invention to provide means for producing a train of constant frequency pulses of low frequency from a constant frequency, variable-voltage source of higher frequency pulses.

It is another object of this invention to provide a frequency divider whose output is stable despite changes in voltage and frequency of the input thereto.

Other objects of invention will become apparent from the following description taken in connection with the accompanying single figure which is a circuit diagram of the invention.

Referring to the drawing, the device is comprised of saturable reactor windings **1**, **2**, **3**, and **4** wound upon cores **12**, **8**, and **9**, as shown. Input to the device is through resistor **5** and capacitor **6**, while the output circuit includes potentiometer **7**, rectifier **10**, and capacitor **11**.

Typically, the input to the device is supplied to terminals **13** and **14** and may consist of 400 cycle alternating current supplied at 115 volts. Output from the device is taken from terminals **15** and **16**, and the desired output frequency may be of the order of 50 cycles in frequency. The relatively high frequency input is supplied through resistor **5** and capacitor **6** through saturable reactor winding **1** and saturable transformer winding **2**. Saturable reactor winding **1** is arranged to saturate core **12** at a voltage considerably lower than the voltage supplied to it each cycle of the input frequency. Thus, core **12** tends to be saturated and tends to be desaturated twice during each cycle of the supply frequency. The result is that there is supplied to winding **4** a train of pulses of approximately uniform energy level, that is, the product of the voltage appearing across winding **4** and the time duration of the pulse is approximately uniform despite variations in frequency at the input because of the presence of resistor **5**, capacitor **6**, and reactor winding **1** in the primary circuit of the saturable transformer.

Pulses from winding **4** are applied to saturable reactor winding **3** via potentiometer **7**, it being understood that with rectifier **10** in the circuit the pulses applied to winding **3** are unidirectional. Each of these pulses is of amplitude and time insufficient to saturate core **9** upon which winding **3** is wound. If it is desired to accomplish a division ratio of eight, potentiometer **7** should be set so that core **9** becomes saturated only after eight pulses from winding **4**. As soon as core **9** saturates, the impedance of winding **3** drops to zero and capacitor **11** becomes charged. As soon as capacitor **11** becomes charged it tends to discharge through potentiometer **7** and saturable reactor winding **3**. This discharge current accomplishes complete desaturation of core **9** and supplies an output pulse to terminals **15** and **16** at a frequency which is a submultiple of the frequency supplied to terminals **13** and **14**. There thus results an output train of pulses having a repetition rate which is a submultiple of the frequency supplied to terminals **13** and **14**. For any given set of circuit parameters the output frequency is a submultiple of the input frequency despite variations in the input frequency and voltage, because of the stabilizing influence of resistor **5**, capacitor **6**, and reactor winding **1**. By adjustment of the value of potentiometer **7** relative to the firing voltage of saturable reactor core **9** it is possible to achieve a division ratio substantially larger than eight, with good accuracy. The size of capacitor **11** must be chosen so that the discharge of this capacitor is always adequate to saturate core **9** in the opposite direction from which it is saturated by the unidirectional current from winding **4**.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. Means for generating a constant frequency train of electrical pulses comprising a saturable reactor, means for supplying constant frequency unidirectional electrical pulses to saturate said saturable reactor, which pulses are individually of insufficient energy to saturate said reactor, and a condenser connected to be charged through said saturable reactor only when said saturable reactor is saturated and to desaturate said reactor when said condenser is charged whereby the voltage across said reactor is caused to vary with constant frequency.

2. A device as recited in claim 1 in which said unidirectional pulse supplying means includes in series a tuned circuit and a saturable core transformer connected to said saturable reactor to thereby render the charging and discharging frequency of said condenser insensitive to minor frequency and voltage changes of said input pulses.

3. A frequency divider comprising an input circuit including in series a resistor, a capacitor, a saturable reactor and one winding of a saturable transformer, and an output circuit including a secondary winding on said saturable transformer, a second saturable reactor, means for supplying unidirectional pulses from said secondary winding to said saturable reactor, each said pulse being of insufficient energy to saturate said second saturable reactor, and a capacitor charged by firing of said saturable reactor whereby the charging and discharging frequency of said capacitor is a submultiple of the frequency of input to said input circuit.

4. A device as recited in claim 3 in which said unidirectional pulse means comprises a rectifier in circuit between said second saturable reactor and said transformer secondary, and a resistor connected at one terminal between said rectifier and said second saturable reactor and by the other terminal to the other terminal of said second saturable reactor.

5. A frequency divider comprising a saturable reactor, means for supplying saturating energy to said saturable reactor in predetermined steps, and capacitor means connected to be charged through said saturable reactor when it saturates and of sufficient size to desaturate said saturable reactor whereby the charged-discharge cycle of said

capacitor is a submultiple of the frequency of said unidirectional input pulses.

6. A device as recited in claim 5 and further comprising filter means including an additional saturable reactor for assuring that said unidirectional pulses are of substantially the same energy despite changes in voltage and frequency thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

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Litz Wire applications include Crystal Radio Coils and Loop Antennas also can be used for other purposes like Tesla Coils, Inductors, Tonearms and Transformer Windings.

I have a large supply and variety of Litz Wire for sale all sizes listed are in stock and ready to be sold. Unlike some Litz Wire Suppliers that sell one or two sizes I have purchased a variety of different sizes in the 20, 26, 28, 34, 36, 38, 40, 41, 44 and 46 AWG range. But no matter how many sizes I stock there will some I do not. However if your application calls 185/46 Litz Wire you can always go up or down a notch and use the 175/46 or 220/46 or if you need 165/46 then 175/46 may work in your application as well.

Litz wire is specified like this, the first number is number of strands, the number after the "/" is the AWG wire gauge size. So 175/46 for instance is 175 strands of number 46 AWG gauge wires. The approximate diameter in the chart is the over all diameter of the entire bundle of wires including the nylon or silk serving and is taken from a data sheet not actual measurement.

Each and every copper wire in all the Litz wire is Enameled coated. So each strand acts like an individual wire conductor.

Make sure you know what you are buying, there are no returns or refunds on wire sales, all sales are final. Items that are returned because they are un-deliverable, unclaimed, refused and wrong address etc. can be resent with the re-payment of shipping. For instance you order 10 foot 660/46 and the item is returned, I have no use and most likely will not get another order for just 10 foot. So your only recourse is have the item resent, no refunds will be given.

For volume users I have whole full spools of most sizes in stock that can be quoted based on the weight, most in stock full spools are from around 2 to 8 pounds.

If you need a special size of Litz Wire I can give a quote from the supplier. It usually takes around 4-6 weeks for a

0
5
10
15
AC
AMPERES

ELEKTRISOLA
Enamelled Copper Wire

Enamelled Wire
Litz Wire
Manufacturing Program
EFOLIT

Taped High Frequenzy Litz Wire EFOLIT

Triple reinforced insulated high frequency Litz Wire with self adhesive sPET and sPEN film material for diameters up to 5.0 mm.

VDE tested according to specification:

DIN EN 60950, Annex U

DIN EN 61558, Annex K

DIN EN 60601, Annex L

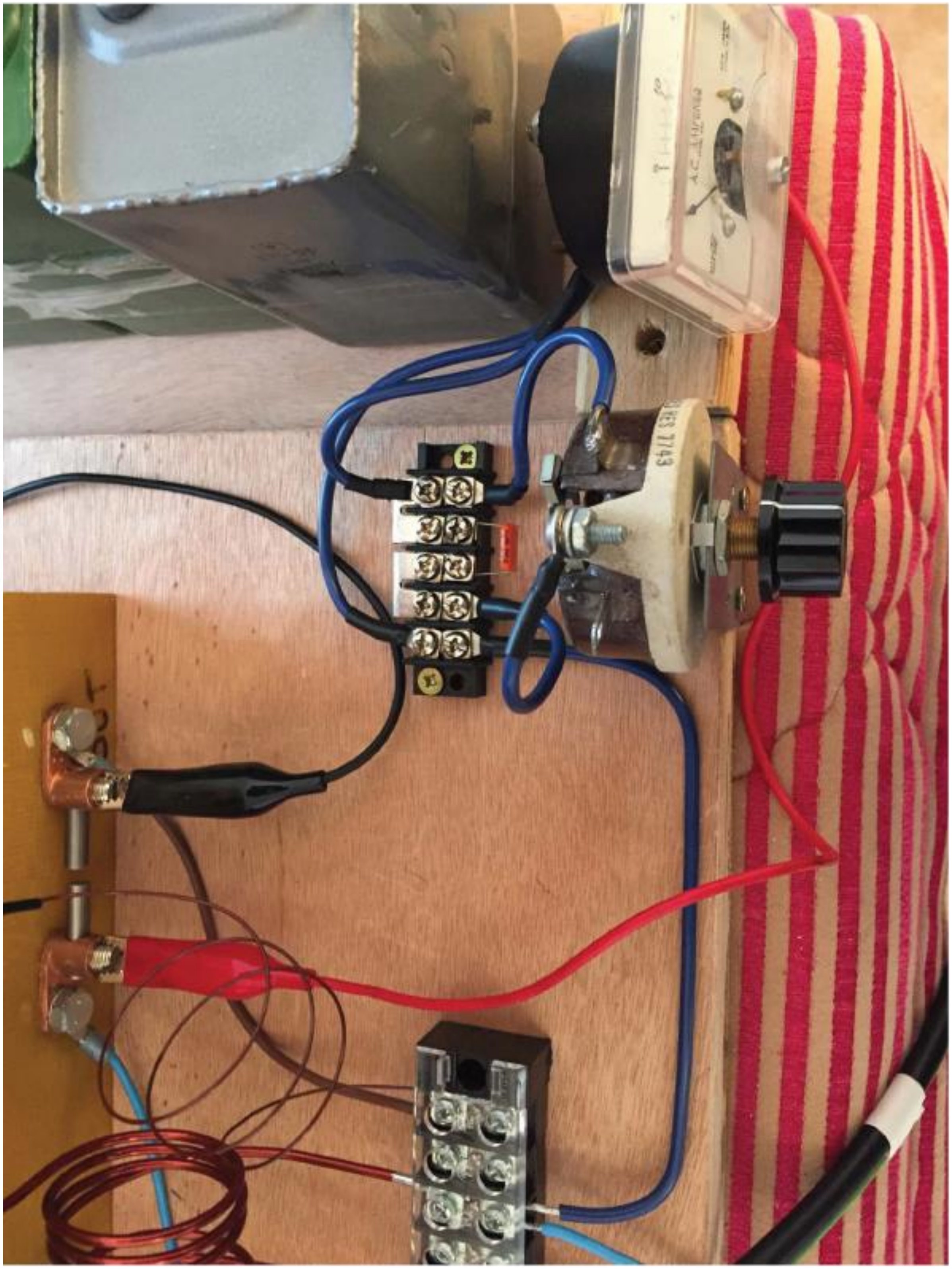
Features

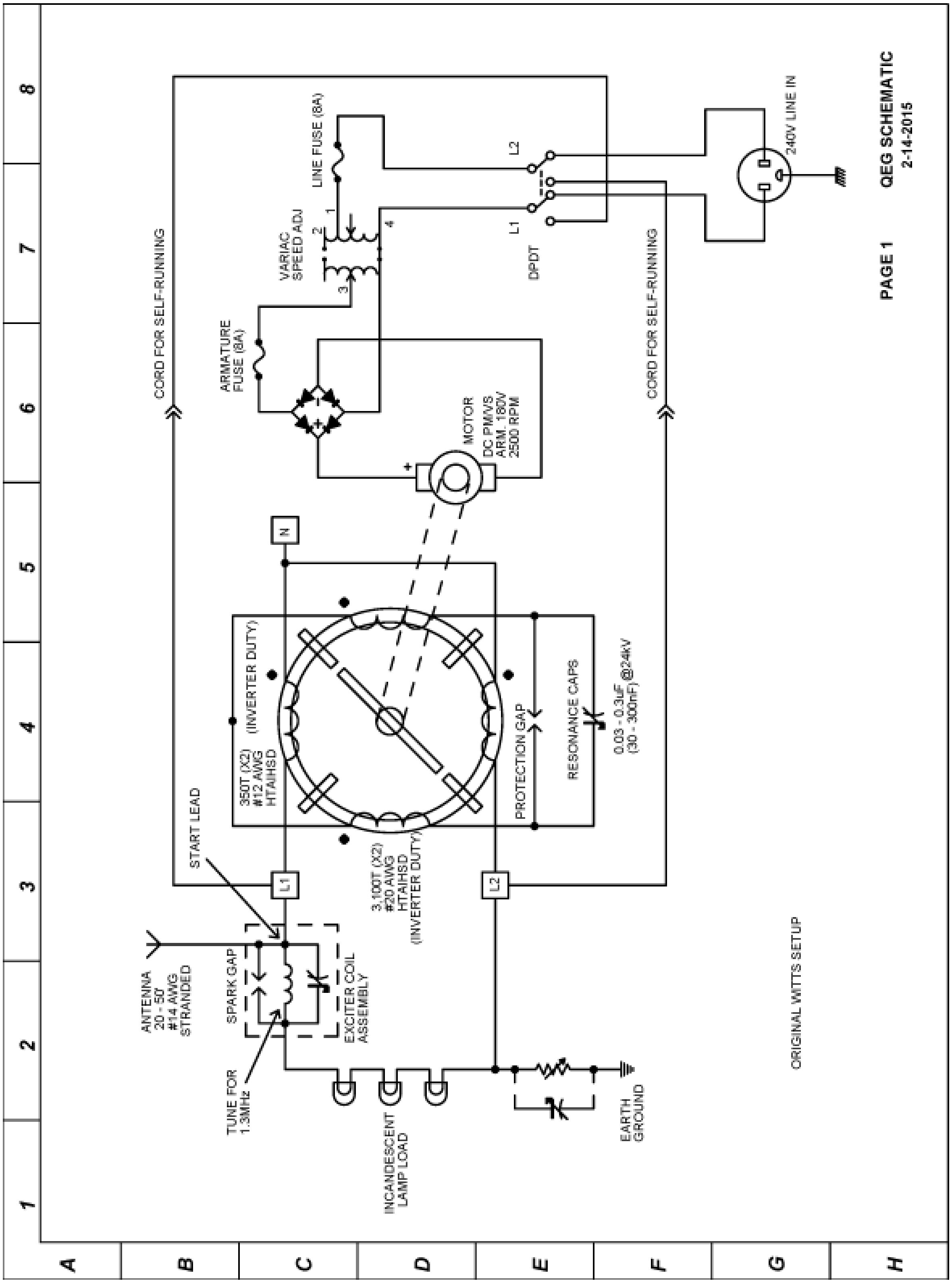
Constructions with self adhesive tapes allow very high break down voltages as well as high flexibility. Compliance with application specific demands for air and creepage distances is covered in perfect manner.

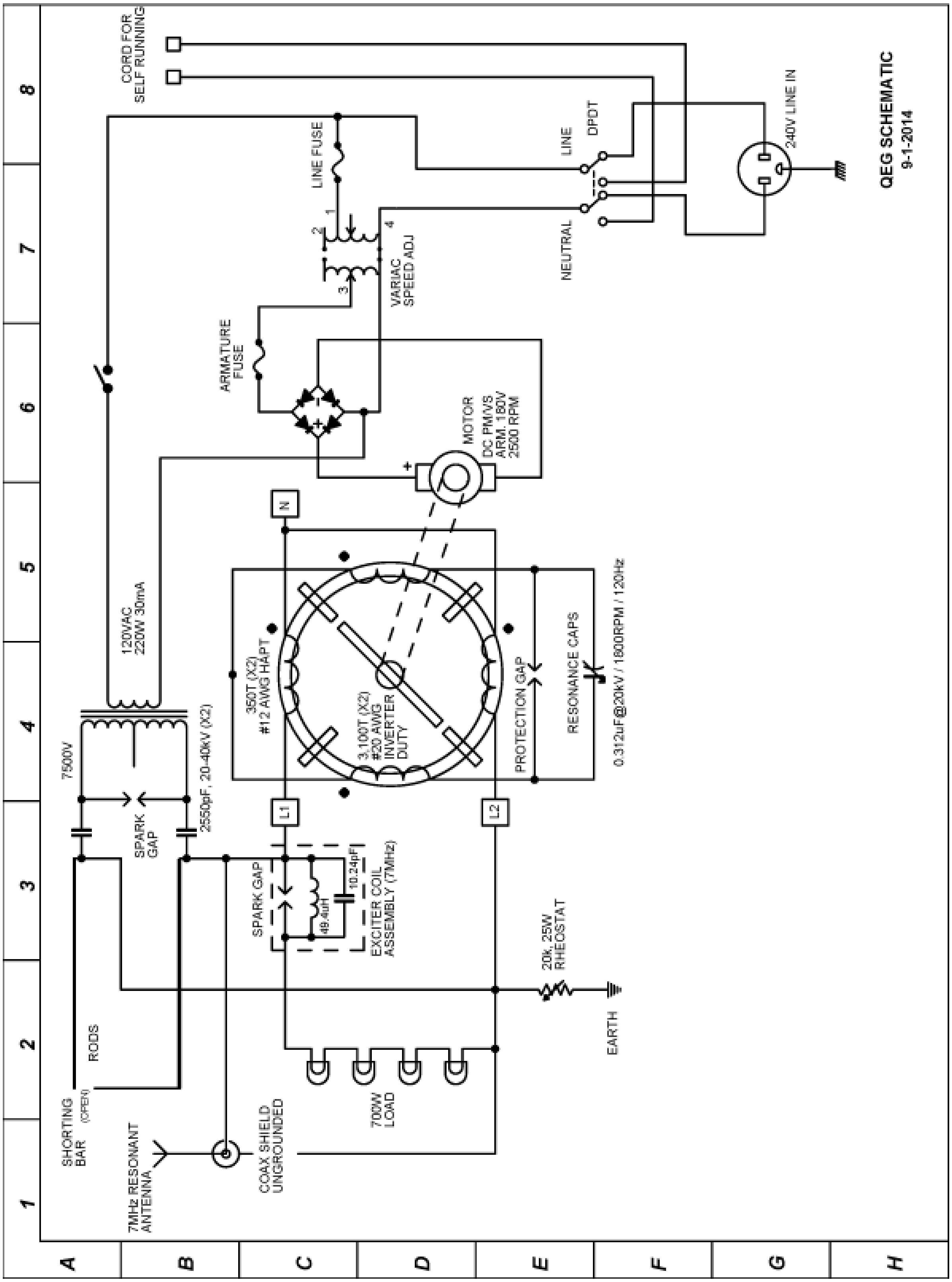
Dimensional range EFOLIT

Construction	
Diameter single conductor	0.030 - 0.300 mm 48 - 28 AWG
Total conductor cross section	0.100 - 10.600 mm²
Outer diameter Litz Wire (approx.)	0.500 - 5.000 mm 24 - 4 AWG
Tape insulation	3-layers

Operating range EFOLIT




QEG SCHEMATIC
2-14-2015
PAGE 1
ORIGINAL WITTS SETUP
CORD FOR SELF-RUNNING
CORD FOR SELF-RUNNING
LINE FUSE (8A)
VARIAC SPEED ADJ
ARMATURE FUSE (8A)
DPDT
L1
L2
240V LINE IN
MOTOR
DC PM/VS
ARM. 180V
2500 RPM
N
L1
L2
START LEAD
350T (X2)
#12 AWG
HTAIHSD
(INVERTER DUTY)
3,100T (X2)
#20 AWG
HTAIHSD
(INVERTER DUTY)
PROTECTION GAP
RESONANCE CAPS
0.03 - 0.3uF @24kV
(30 - 300nF)
ANTENNA
20 - 50'
#14 AWG
STRANDED
SPARK GAP
EXCITER COIL
ASSEMBLY
TUNE FOR
1.3MHz
INCANDESCENT
LAMP LOAD
EARTH
GROUND
1 2 3 4 5 6 7 8
A B C D E F G H


CORD FOR SELF RUNNING
LINE FUSE
LINE
DPDT
NEUTRAL
240V LINE IN
QEG SCHEMATIC
9-1-2014
VARIAC SPEED ADJ
ARMATURE FUSE
MOTOR
DC PM/VS
ARM. 180V
2500 RPM
120VAC
220W 30mA
7500V
2550pF, 20-40kV (X2)
SPARK GAP
N
L1
L2
350T (X2)
#12 AWG HAPT
3,100T (X2)
#20 AWG
INVERTER
DUTY
PROTECTION GAP
RESONANCE CAPS
0.312uF@20kV / 1800RPM / 120Hz
SPARK GAP
49.4uH
10.24pF
EXCITER COIL
ASSEMBLY (7MHz)
20k, 25W
RHEOSTAT
EARTH
SHORTING BAR (OPEN)
RODS
700W LOAD
7MHz RESONANT ANTENNA
COAX SHIELD UNGROUNDED
1 2 3 4 5 6 7 8
A B C D E F G H

RF Energy Concepts Sec. 101 Rev. August 21, 2007

Home Gravity Concepts Create Momentum
Light Speed vs Special Relativity Force Interactions **RF Energy Concept**

RF Energy via Ionosphere

< RF Energy Concept **<RF Energy_Iono. >** Demo.s RF Energy > RF Energy Links >

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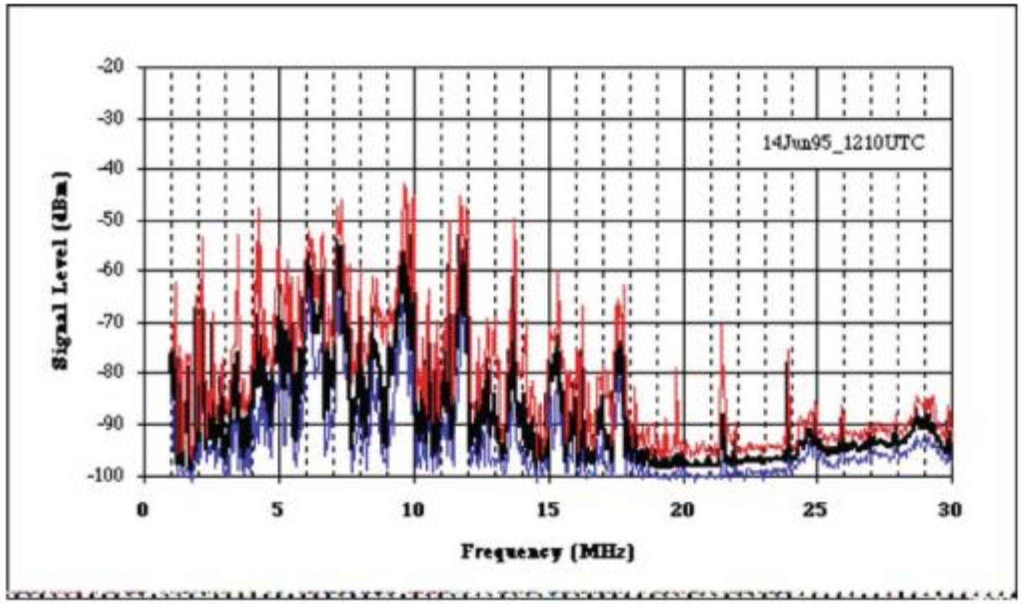

Image via NRL

Fig. A1 Natural RF Radiant Energy Spectra of Ionosphere

Radio Frequency Energy via Solar Ionospheric Resonance

Circa, Spring 1986 S. V. Byers

The Radio Frequency (RF) Energy is demonstrated when a resonant radio frequency energy flow is established between two reflectors, and the broadband RF energy of the ionosphere maintains the resonant radio energy at a frequency determined by the natural conditions of the ionosphere.

A specific application of the RF resonance phenomenon is the creation of a resonant RF energy flow between the reflecting ionosphere and a tuned, resonant, vertically reflecting antenna system for the extraction of useful energy. The ionosphere provides two of the main functions. It provides the upper reflector and furnishes its random broadband RF energy to the radio frequency [RF] energy resonance. The resonance may be initiated by transmitters or natural pulses of cosmic or atmospheric energy.

The frequency of the resonance is preferably determined by the dominant echo frequency of the Ionospheric layer, and the **matching** tuned resonant frequency of the antenna system. From ionosounding test data the most likely frequencies for RF resonance, will be from 4.5 to 7 megahertz. The spectrum analyzer graph of the natural Ionospheric RF energy, Fig. A1, displayed at the heading of this paper also demonstrates that the predominance of energy occurs in the same 4.5 to 7 MHz range.

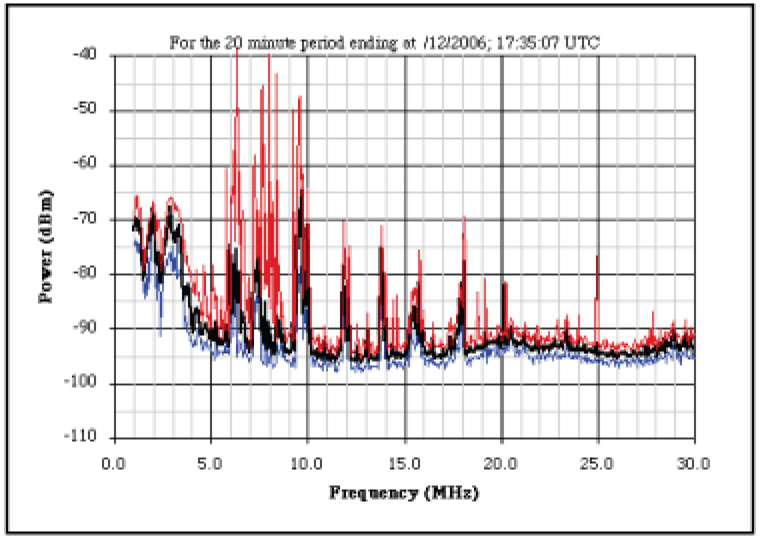

Fig. A1-a Natural RF Radiant Energy Spectra of Ionosphere For 20 minute period

The natural RF energy in the ionosphere pumps the resonance and no artificial energy is required to maintain the resonant energy flow. It is recognized that for every energy application system, a **source and sink** system must exist for the transformation of the potential energy into the desired form of useful work. A heat engine will not function unless there is a heat sink available. A hydro plant will not operate unless there is a lower level sink to accept the flow. For this RF Ionospheric system there must be a reflector, a receiving antenna and the **all important sink** (matched impedance resistive load). The reflection function would normally be shared between a ground plane and a tuned antenna.

The referenced work by others, shows that 50 kilowatts of electrical energy has been successfully extracted from the resonant flow with no apparent reduction of signal strength. The primary radiation causing ionization of the ionosphere is thought to be ultraviolet solar radiation. Yet the process does not need direct solar radiation to maintain the energy flow and has been shown to operate through the night. It is well known that the Ionospheric layers change in the night shadow. It is fortunate for this process that the ionosphere persists through the night.

Cosmic and terrestrial radiation may contribute energy to the ionization process. A geo perspective of the resonant energy available includes more than just a local vertically reflecting ionosphere and antenna system. The two conducting spheres, the earth-sphere and the ionosphere, must be involved, acting as a resonant waveguide with the atmosphere as an insulating medium. It is not yet known what factors may limit the usable energy available from this process, other than radio interference, aviation safety and public safety.

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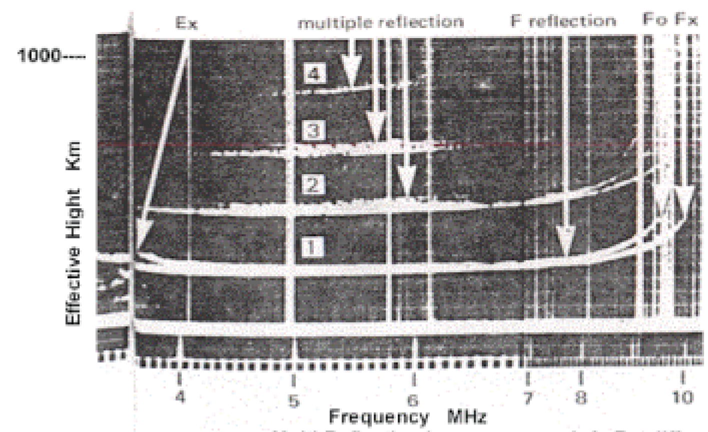
Sec. 101

RF Energy Resonance on Ionograms



Multi Reflection Ionogram; J. A. Ratcliffe

Figure A2

The first major demonstration of the RF energy process is the multiple ionosound reflections clearly seen on many ionograms. Figure A2 above presents an ionogram with four reflections at 5.5 megacycles. The multiple reflections are from the F layer. Other ionograms show multiple reflections from both the E and F layers. This ability of the ionosphere to reflect RF energy has long been used to establish **multiple skip** radio communication.

From the ionogram, it is seen that the effective height indicated is 250 km, is 155 miles, is 820 K feet. This is of course deduced from the timing of the echo and where the velocity is taken as 300,000 km/sec. The first echo must have taken 1.66 milli-seconds for a round trip. The three subsequent echoes would be the second, third and fourth multiples of the 1.66 ms time. The one directional trip timing would be 0.833 ms , corresponding to a height of 250 km. The number of wavelengths between reflectors is found to be 4,580 from the frequency of 5.5 megahertz for 0.833 ms.

It is not evident if the dominant 5.5 megahertz resonance frequency is determined by the conditions of the ionosphere or the antenna system. My limited search of ionograms reveal that a large percentage contain multiple reflections. It is assumed that a normal ionosounding installation would not be specifically designed with a highly resonant and reflective antenna system. Multiple reflections can interfere with the desired data. With a proper resonant reflecting antenna system, it is possible to establish continuous resonance and extract useful power from the ionosphere.

It seems logical to expect that any Earth--Ionosphere resonance will only occur at a frequency below the existing MUF (maximum usable frequency). Energy frequencies above the MUF pass through the Ionosphere and are lost to space. The frequencies below the MUF are trapped (reflected) within the space between the ionosphere and Earth and are known to propagate very long distances with multiple skips (echoes ?). These **multiple skips** are a close example of the continuous RF resonance that we wish to establish at one location. in order to obtain energy.

The following RF information is from an ARRL http://bplinterference.wikispaces.com/ web discussion concerning the argument that BPL (Broadband Power Line) internet transmission will degrade shortwave radio use.

Quote from A Good's works :

Q: Isn't long distance HF communications more an infrequent anomaly rather than a common occurrence?

Ans: HF propagation in an area varies on the time of day and on solar activity. It's usually possible to communicate on some HF band to various places in the world 24 hours a day. During the day, the D, E, and F layers form a thicker layer of ionization. This thicker layer absorbs lower frequencies (below 5 Mhz or so), and enables farther propagation of frequencies between 15 and 30 Mhz. At night, the D, E, and F layers combine. This causes the upper frequency limit (called Maximum Usable Frequency or MUF) to drop, usually to about 14 or 15

Mhz. During this time, frequencies below 5 Mhz will propagate better. This is why you can hear many AM broadcast radio stations at night, and most AM radio stations decrease their power at night to avoid interference

Q: Why doesn't my 802.11 WiFi or cellular phone radio signal travel around the world?

Ans: 802.11 WiFi uses 2.4 Ghz frequencies (2400 Mhz) which is considered microwave frequencies, cellular is 800 Mhz, and PCS is around 1.3 Ghz. These do not bounce off of the ionosphere, but travel right through it. The reflective characteristics of the ionosphere **diminish above about 30 Mhz**. Also, microwave frequencies are much more susceptible to absorption by precipitation and water vapor.

Unquote

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Sec. 101

Moray's RF Energy Experiments,   Review

The second major demonstration of this RF energy process is from the work of Dr. T Henry Moray. The book, The Sea of Energy 5th edition by Mr. John Moray, documents experiments where his father, Dr. Moray, obtained up to 50 KW from a simple long wire antenna and his still secret detecting equipment. He was able to power lights, heaters, and specially designed motors. The book gives more than enough documentation and description to **erase any doubts about its reality.**
The book was available from ,
Cosray Research Institute, 2505 South 4th East, Salt Lake City, Utah 84155.
This author has no association with Moray interests. This knowledge of their work has been taken solely from the book.

Dr. Moray first started experimenting with obtaining energy from an antenna in 1909 when work with crystal radios was popular. He was able to light a 16 candle power carbon arc light at half power with an antenna and ground. From antenna experience it is known that a one quarter wavelength horizontal antenna that is one sixth of a wavelength above a reflecting surface reflects its dominant energy in the vertical direction. Assuming a resonance at 5 mega hertz, the wavelength is about 200 ft. Therefore if Dr. Moray had used a 50 ft. horizontal wire about 33 ft. above the conductive water table he would have had all of the requirements to establish resonance with the ionosphere. The ground in the Salt Lake valley is highly salty, and conductive and therefore is a good reflector. Cosmic or atmospheric noise pulses have been seen by this author to establish echoes off of the ionosphere and may have initialized the resonance for Dr. Moray. Dr. Moray continued his dedicated research into the 1940's.

Even though he was able to extract 50 KW, [67hp] from his devices, he was not able to obtain a patent. The patent office reasoning for denying the patent, as stated by the book, was
"**No natural source of electric wave energy is known to the Examiner and proof of the existence of such a source is required**."

There is no indication in the book that Dr. Moray ever believed that his system was resonating with the ionosphere. He apparently believed that the energy was being taken from the cosmic background radiation and the disassociation of matter. The antenna systems revealed in the book show no evidence of being designed for a specific frequency or for vertical reception and reflection. The Moray book indicates their energy system consisted of two sections. The first section being an antenna, a resonant circuit, a ground, and a switch to the second section. The second section contained a rectifying detector, ion tubes and transformers forming sub-harmonic resonant circuits to transform the energy to a frequency and voltage compatible with the loads.

> **Quote:** From page 31 of his book, "When his device was set up, he could connect it to an antenna and a ground, and by PRIMING it first and then

TUNING it as he primed it, the device would draw electrical energy. This high frequency electric energy produced up to 250,000 volts and it lighted a brighter light than witnesses had ever before seen. Heavy loads could be connected to the device without dimming the lights that were already connected to it. This device worked many miles from any known source of electrical energy, such as transmission lines or radio. The device produced up to 50 kw of power and worked for long periods of time."
Unquote

PRIMING the device consisted of stroking the iron core in the resonant circuit with a strong magnet. The **stroking and TUNING** of the resonant circuit continued as long as **5 to 10 minutes**, "then" the switch was closed and the lights obtained power. When the antenna or ground wire was momentarily opened and closed the lights would go out and then return, **if the re-closure was soon enough**. If there was a delay before the re-closure, the lights **would not come back on without re-priming**.

It seems clear that the priming and tuning was establishing resonance with the ionosphere. The priming would furnish the energy for the first reflections, and the tuning was adjusting the antenna and tank circuit to a frequency compatible with the ionosphere and the reflective antenna/ground system.

The book places proprietary and technical importance on the detector, tubes and circuits used to capture the cosmic energy and reduce the frequency to a usable level. Yet, on page 48 is a paragraph that indicates the detector and complex sub-harmonic circuits are not necessary.

Quote: "Dr. Moray made one demonstration not mentioned above to a writer while he only was present. It consisted of lighting a 100 watt globe from CONNECTIONS WITH THE ANTENNA only. It was noted that while this light was burning the lights inside the trunk burned dimly and then assumed their usual brightness when the other lights were taken off. "
Unquote

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There is no clear reason why exotic proprietary detectors and ion tubes should be necessary to extract usable energy. A simple non-inductive load resistor matched to the antenna should produce heat. Moray's original antenna experiments which lit a 16 candle power carbon arc light did not use any proprietary equipment. Fluorescent lamps can be directly excited by these frequencies. Tube type diode rectification may be necessary at high power levels with this frequency range of 2 to 13 megahertz. Industrial induction heating uses these frequencies directly. Radio operators refer to the critical frequency of the ionosphere as the highest frequency that will vertically reflect from the ionosphere.

> Radio link operators report that,... as they increase their circuit frequency toward the maximum critical frequency, **exceedingly strong reception develops**. If the circuit frequency is increased further, the signal penetrates the ionosphere and communication is lost.

This suggests that maximum energy may be available just below the critical frequency. The reports from ham radio operators about the **large increase in signal strength** when nearing the critical frequency of the ionosphere, prompted this research of this RF energy process.

The works of Nikola Tesla with energy transmission via antennas may have been close to this process. It appears that his equipment was operating in the **kilohertz region**. This resonance appears mainly above two megahertz. Below two megahertz the absorption in the D layer normally inhibits reflection for the power levels used in radio.

Theory predicts the system should operate independently of the grounding wire and ground reflector. If two reflecting antennas were placed in orbit with an adequate portion of the ionosphere between them , a resonant flow should be possible. The following experiment by Dr. Moray shows that the system can operate without a grounding conductor.

Quote from page 187, circa 1943:

" He put it in the back of the automobile, with a bank of lights as the resistive load, and drove the car with his family from Salt Lake City to Ashton, Idaho, into Wyoming, back to Salt Lake City and to Denver, letting the device operate continually."

The fact that the unit operated and was later restarted in Denver is also significant. Denver is at 5000 ft altitude and does not have the reflective, salty and moist ground found in Salt Lake City. This seems to indicate that the process can be independent of ground conductors and the Salt Lake City ground reflection conditions. A single satellite with a gravity gradient tether antenna may also be able to use the process. Any planet or moon with an ionosphere should provide some form of RF resonant energy. Ionosounding from earth satellites is common and shows that the ionosphere will reflect upward. The topside ionogram records have not yet been searched for echoes or reflections.

Continued >> *Next Pg >*

Web page address URL http://home.netcom.com/~sbyers11/RFenergy_Iono.html

Web site by: sbyers11@ix.netcom.com

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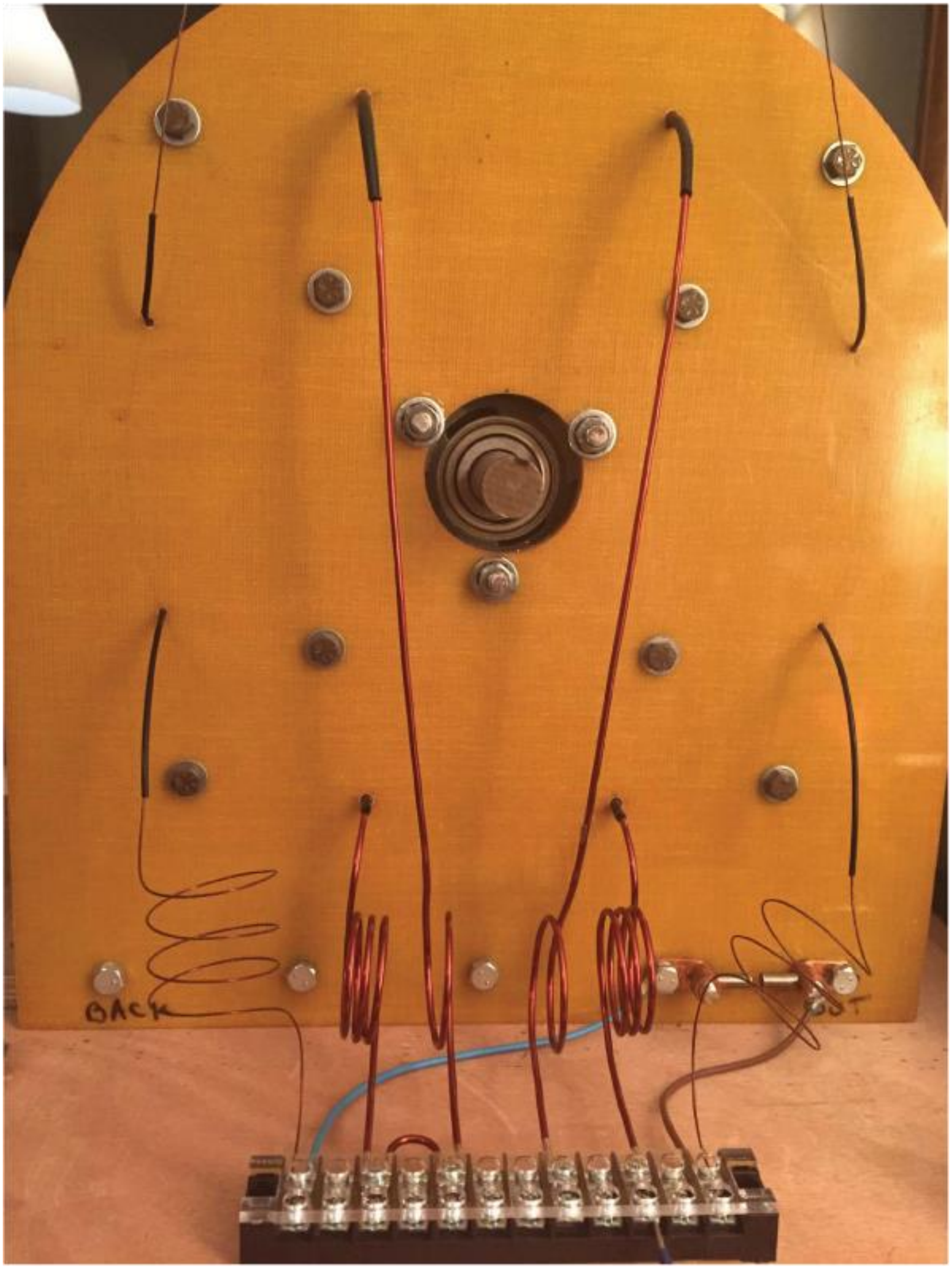
Sec. 101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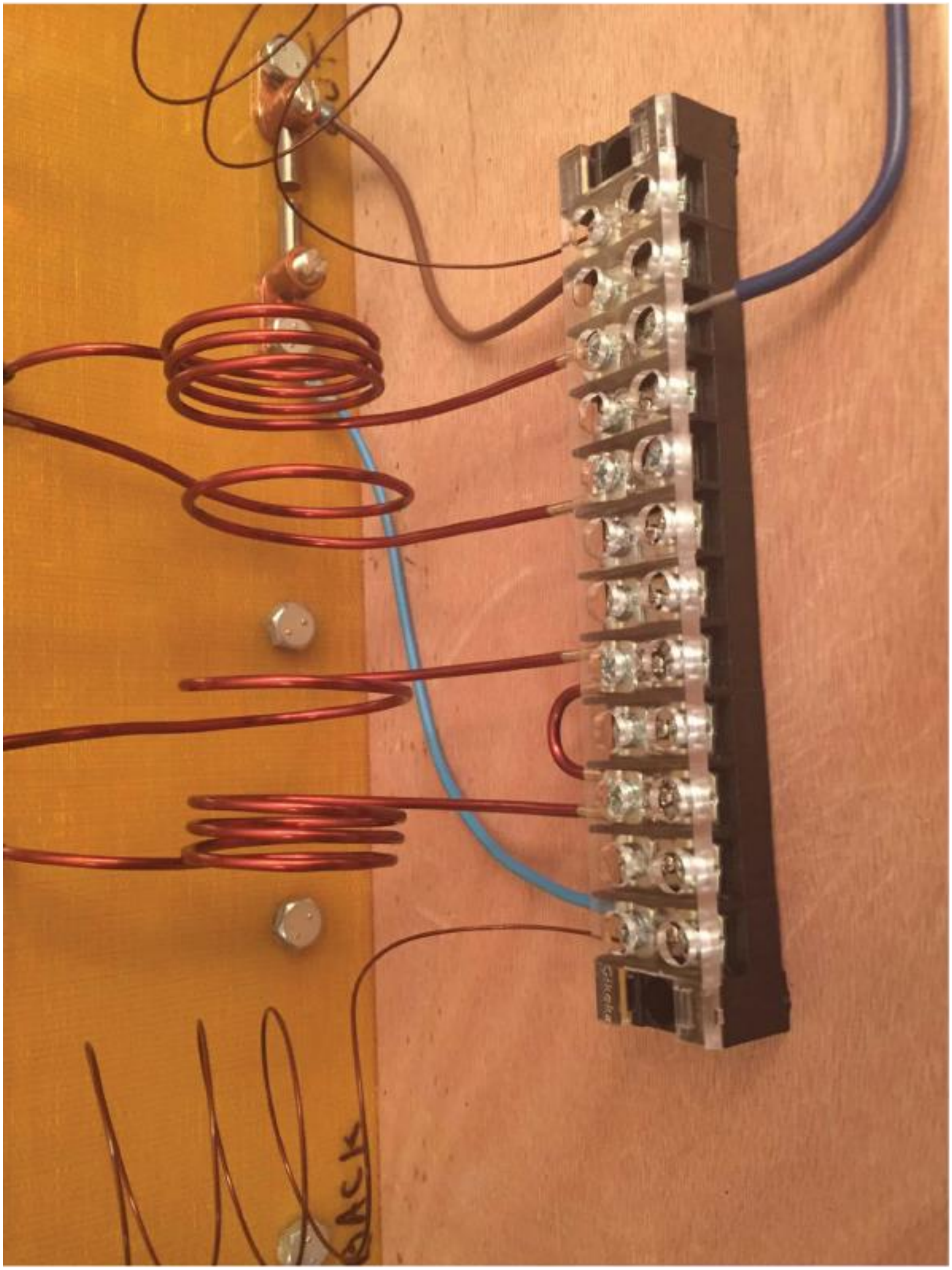

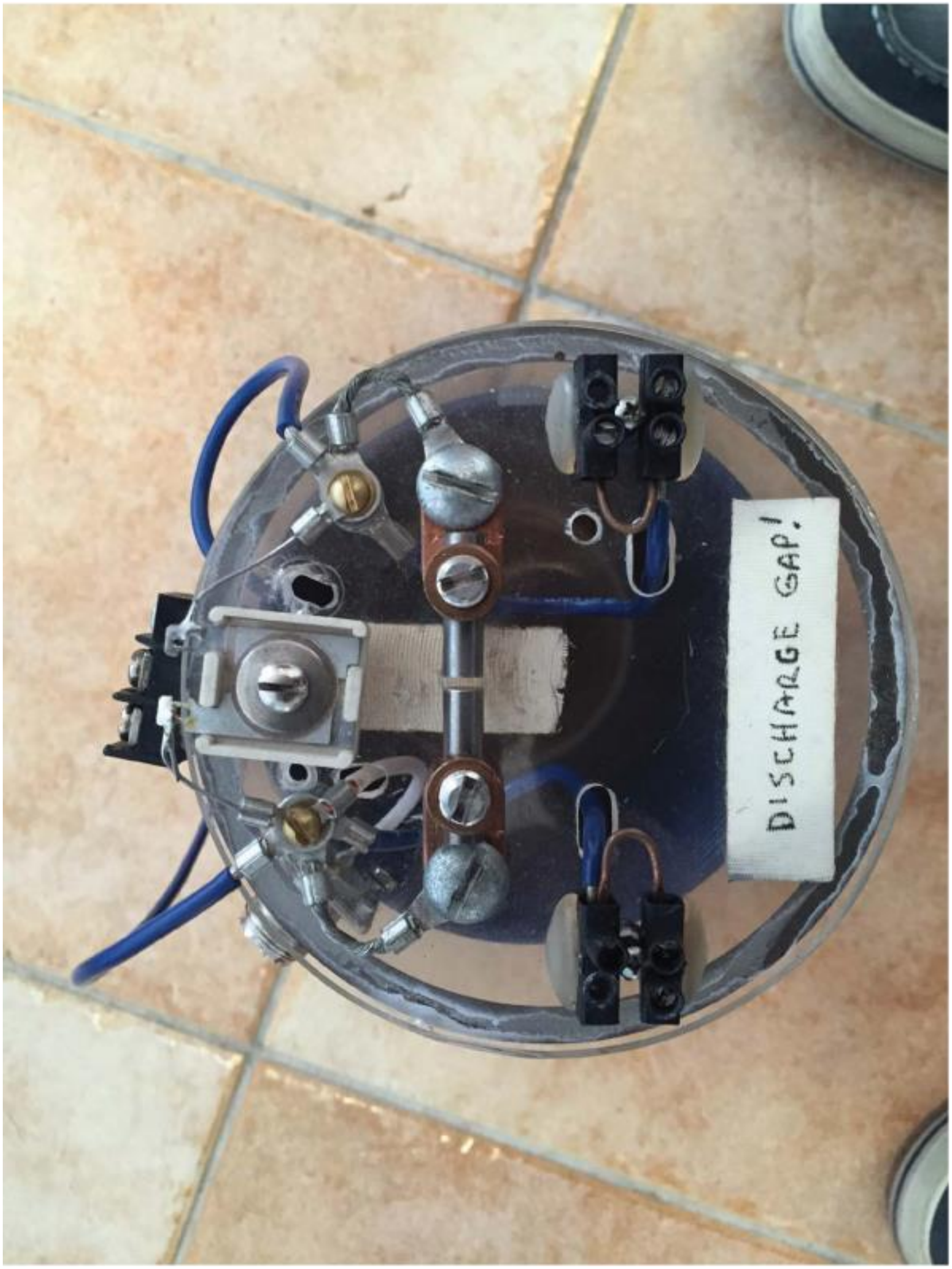
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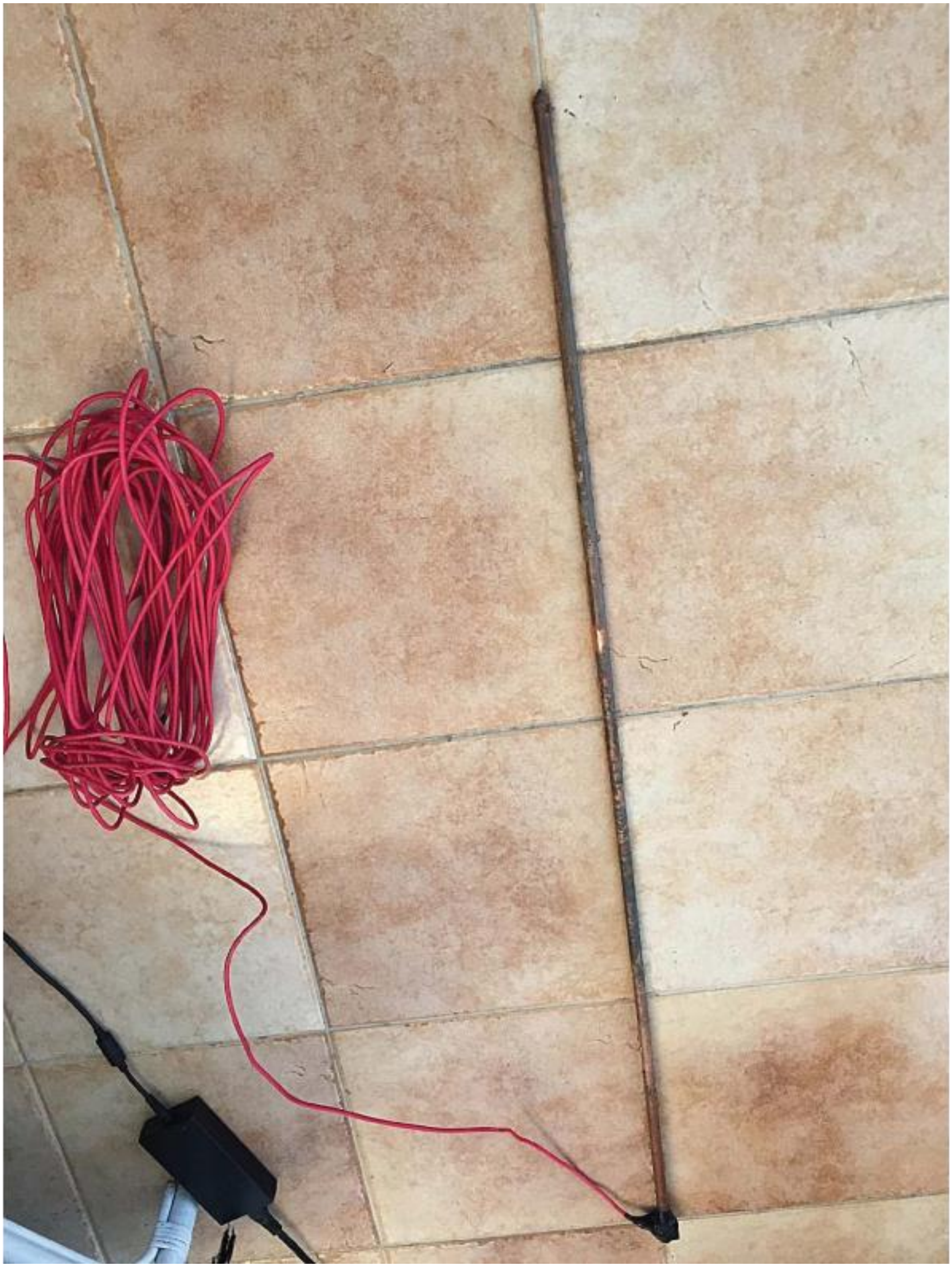

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Item # EZ TM-40, Telescoping Mast

Telescoping mast - 435'' (36'3")

Four galvanized pieces of tubing; bottom piece 2" OD- 18 gauge; 2nd piece 1-3/4" -18 gauge OD; third piece 1-1/2" OD- 18 gauge; fourth / top piece 1-1/4"- 16 gauge. Must be guyed or bracketed. Made in America.

Specifications · Note

Specifications

Extended Height	36 ft 3 in 435 in
Bottom Section OD	2.00 in
Top Section OD	1.25 in
Weight	42 lb
Shipping Length	123 Inches

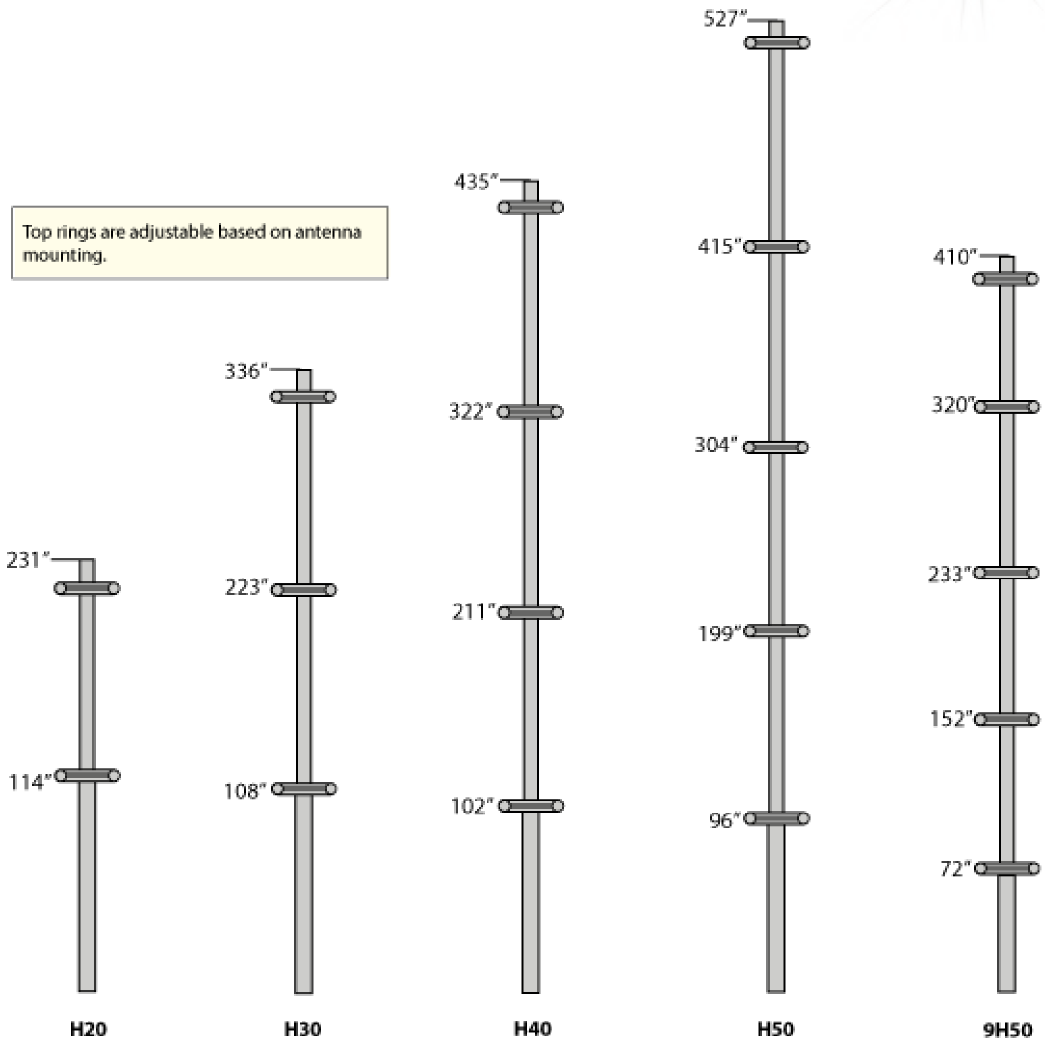
Note

TM Masting sizes - 1-3/4" OD - 16 gauge - 120" long ; 1-1/2" OD - 18 gauge - 118 " long ; 1-3/4" OD - 18 gauge - 112" long ; 2" OD - 18 gauge - 106" long ; 2-1/4" OD - 18 gauge - 100" long. Masting is overlapped for added strength & stability.

All Telescoping masting made in America & must ship by truck unless denoted UPS shippable.

TELESCOPING MASTS
H20|H30|H40|H50|9H50

NEW PRODUCT 9H50
UPS Shippable!



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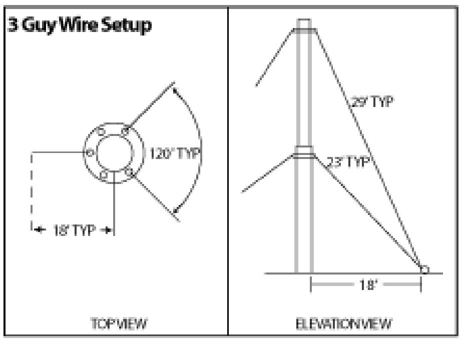
ROHN Products LLC 245

INSTALLATION GUIDELINES

All Telescoping Mast kits include guys, connection hardware, anchors and ground mount. Mast must be ordered separately.

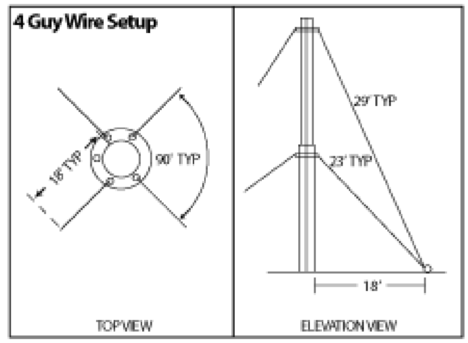
H20 GUY KIT



H203WAYGUY

Actual Wire Required - 200'

1	618	1000' - 6 Strand/18 GA Wire
3	GAS4303	1/2" x 30" Screw Anchor
12	61820GRPL	618/620 Gripple
1	GTMBL	Ground Mount

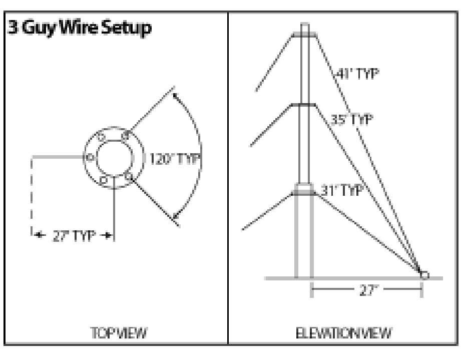


H204WAYGUY

Actual Wire Required - 250'

1	618	1000' - 6 Strand/18 GA Wire
4	GAS4303	1/2" x 30" Screw Anchor
16	61820GRPL	618/620 Gripple
1	GTMBL	Ground Mount

H30 GUY KIT



H303WAYGUY

Actual Wire Required - 350'

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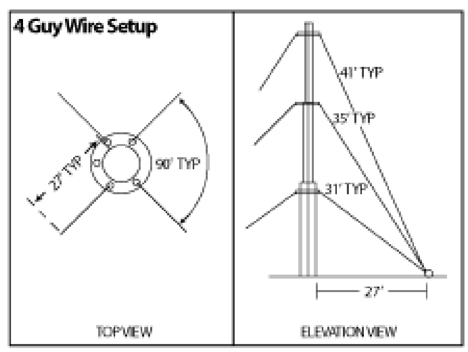
1	GTMBL	Ground Mount



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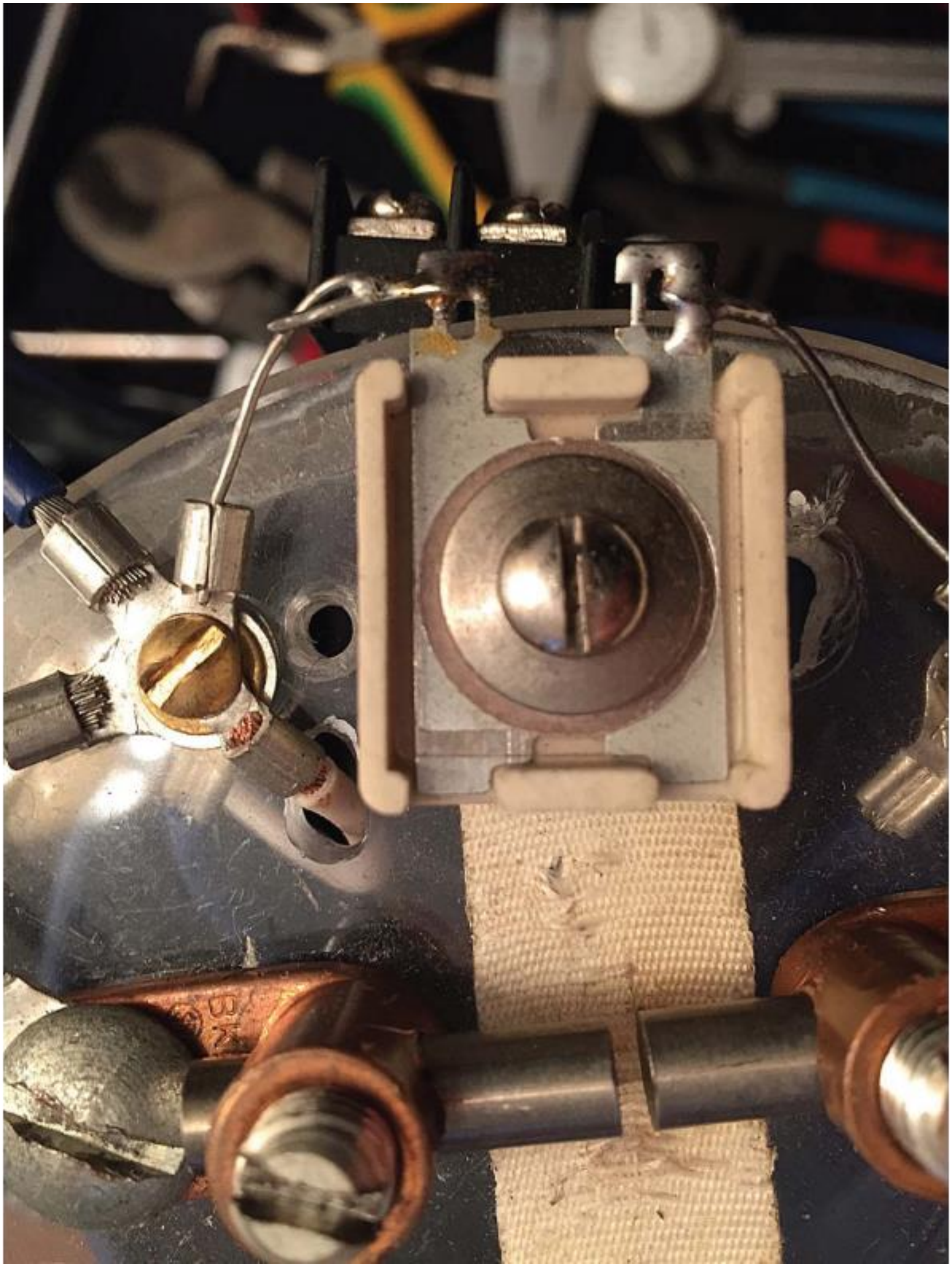
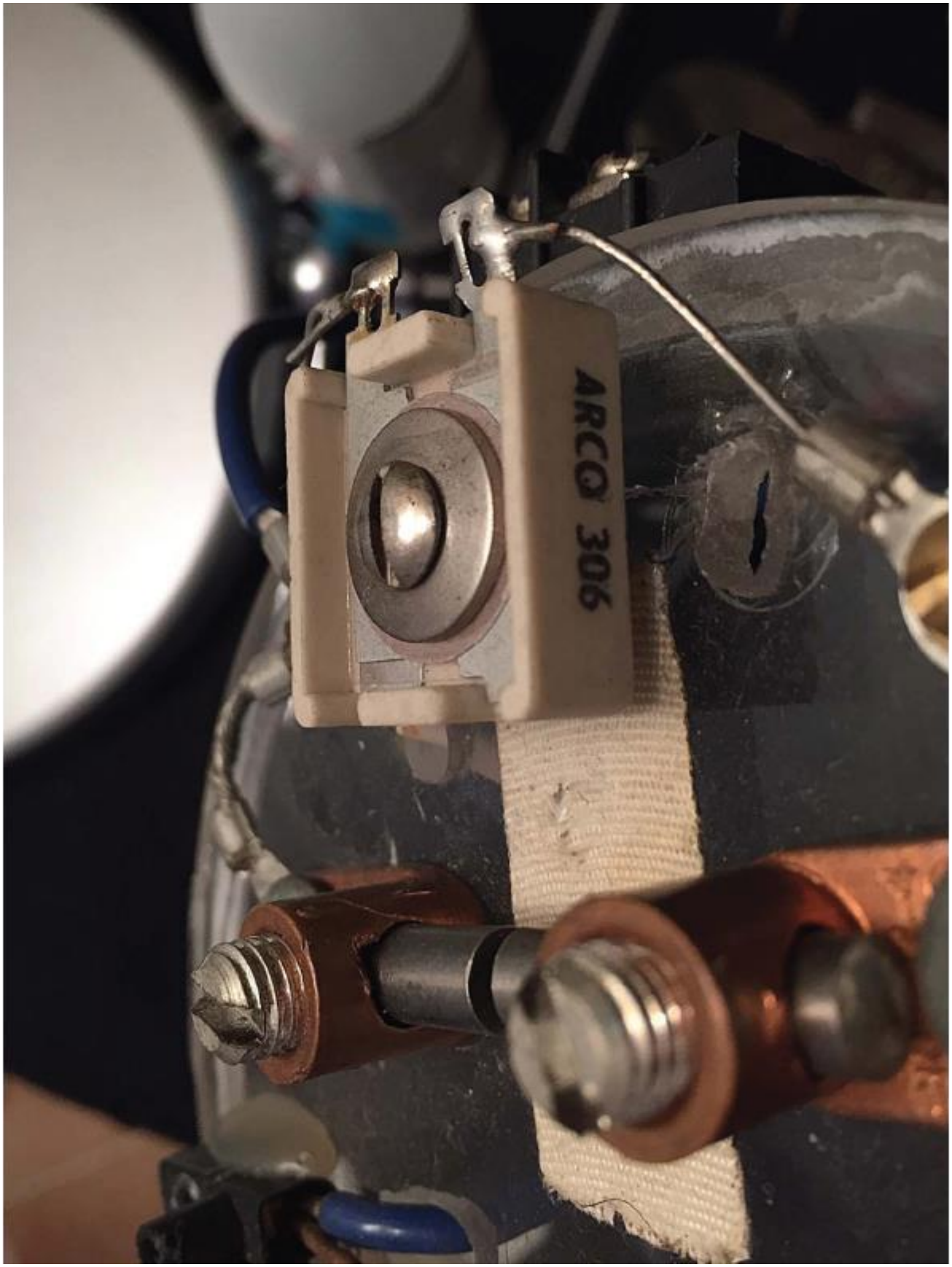
1	GTMBL	Ground Mount

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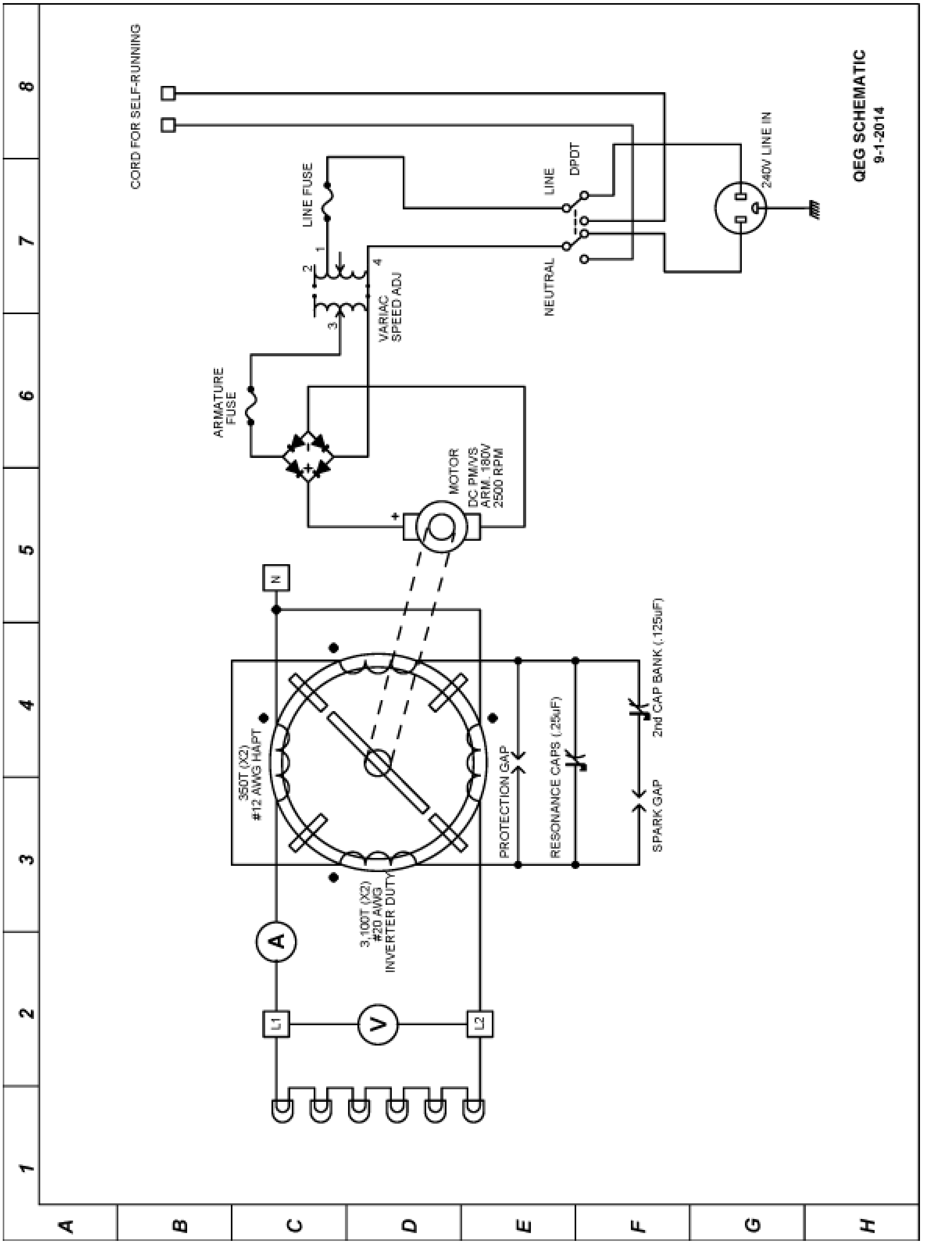
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NEUTRAL
240V LINE IN
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VARIAC
SPEED ADJ
ARMATURE
FUSE
MOTOR
DC PM/VS
ARM. 180V
2500 RPM
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#12 AWG HAPT
3,100T (X2)
#20 AWG
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RESONANCE CAPS (.25uF)
2nd CAP BANK (.125uF)
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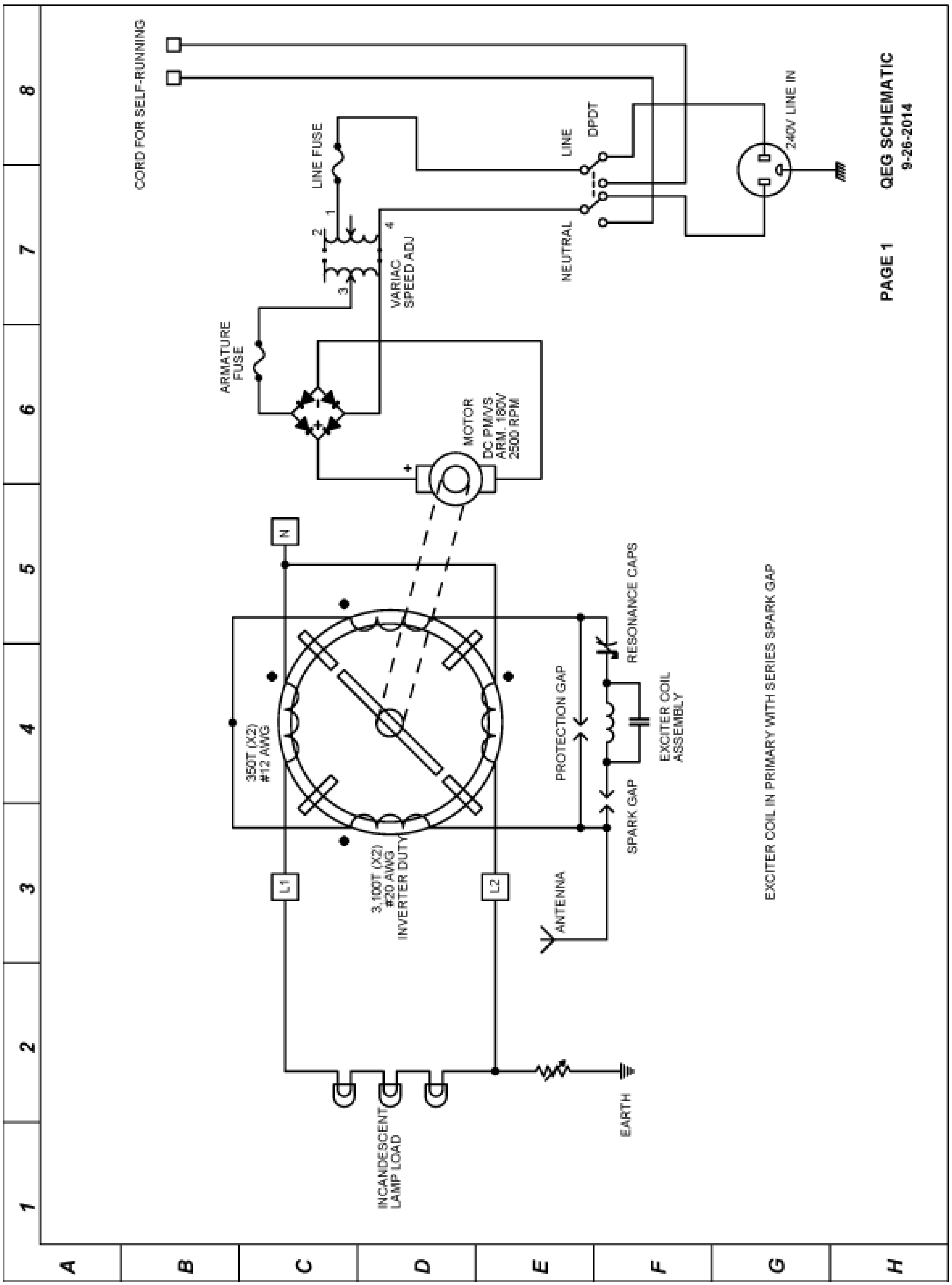
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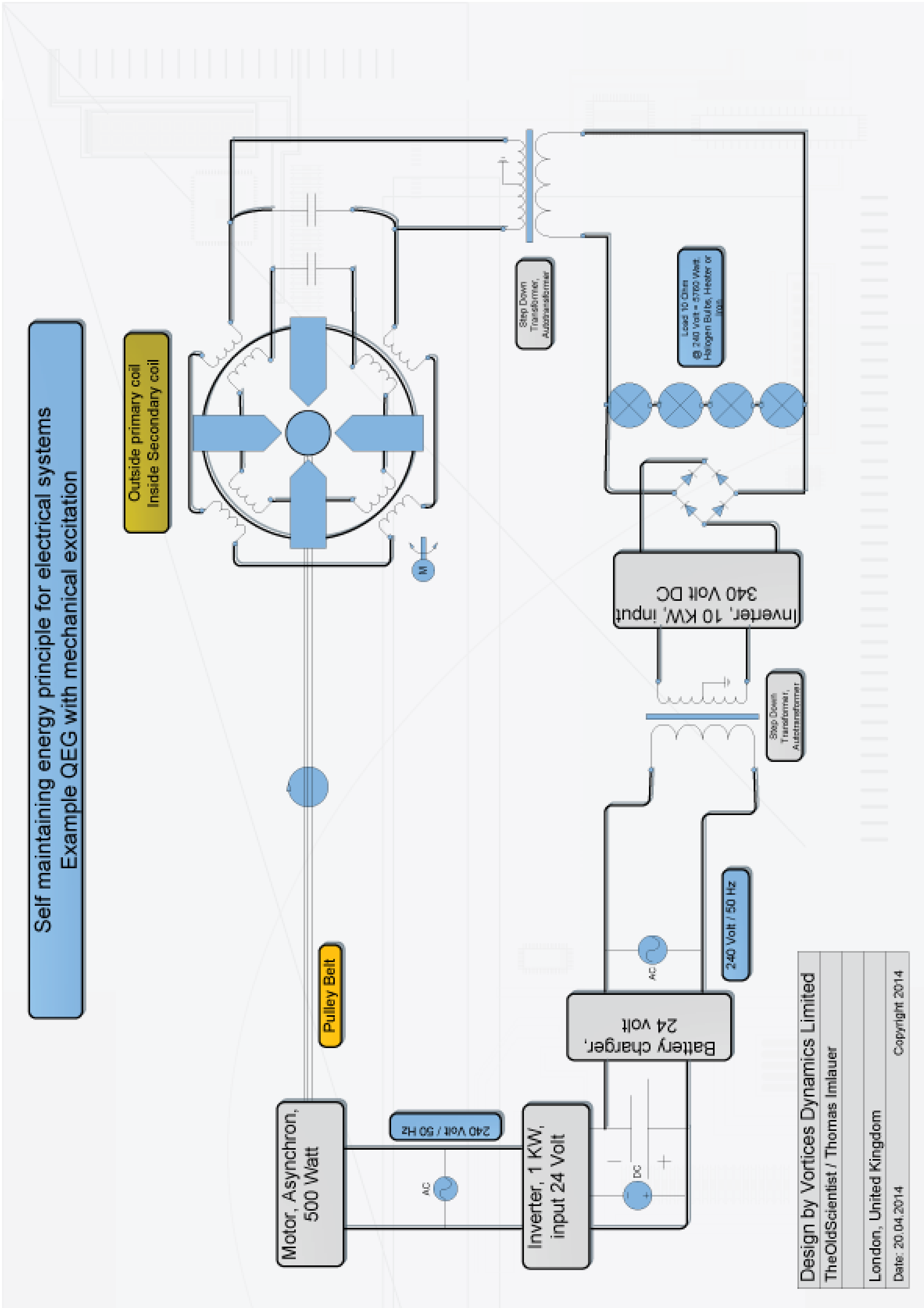

Self maintaining energy principle for electrical systems
Example QEG with mechanical excitation
Outside primary coil
Inside Secondary coil
Step Down Transformer, Autotransformer
Inverter, 10 KW, input 340 Volt DC
Step Down Transformer, Autotransformer
240 Volt / 50 Hz
Pulley Belt
Battery charger, 24 volt
Motor, Asynchron, 500 Watt
240 Volt / 50 Hz
Inverter, 1 KW, input 24 Volt
AC
DC
M
Design by Vortices Dynamics Limited
TheOldScientist / Thomas Imlauer
London, United Kingdom
Date: 20.04.2014
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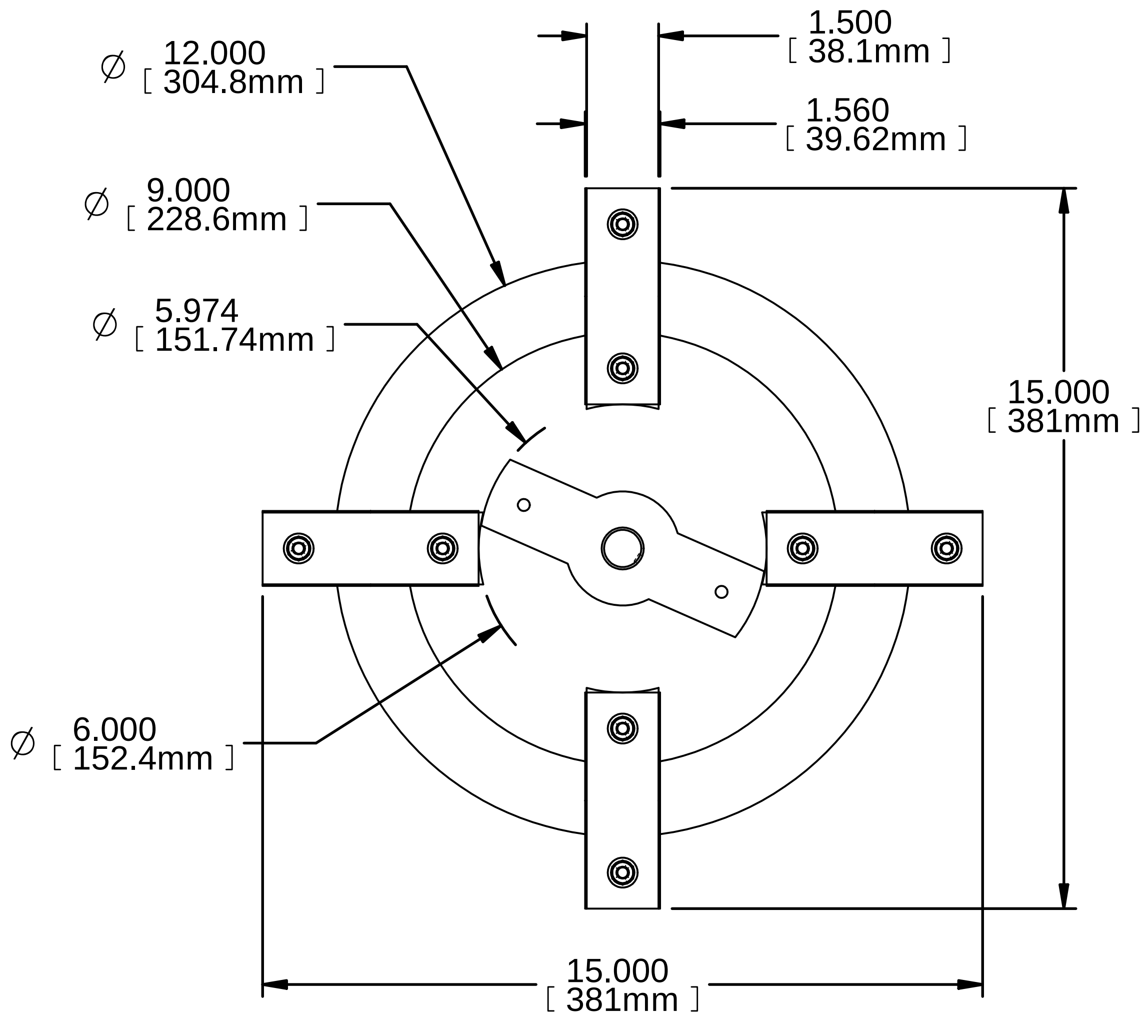
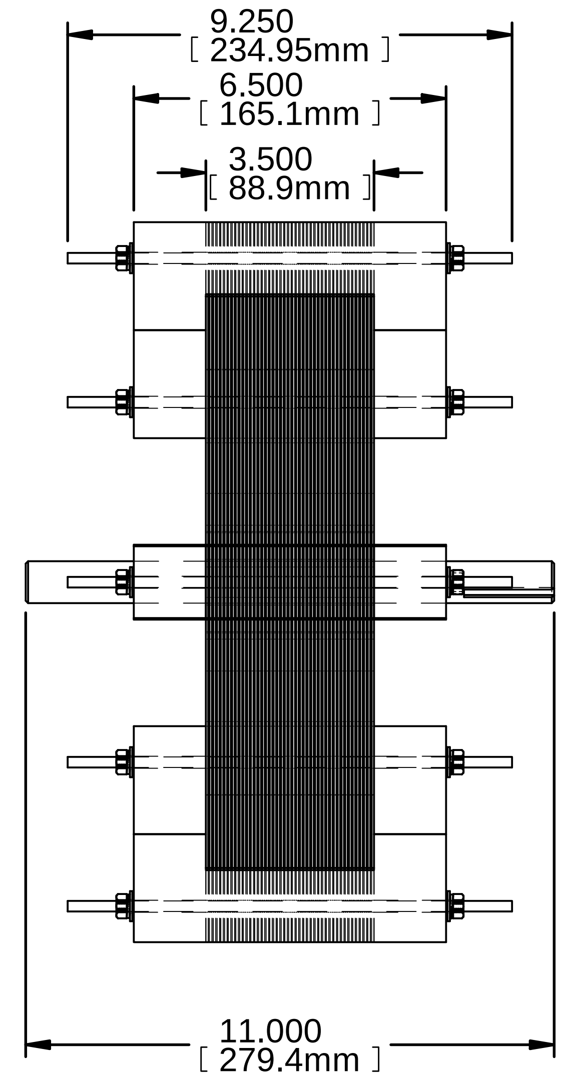
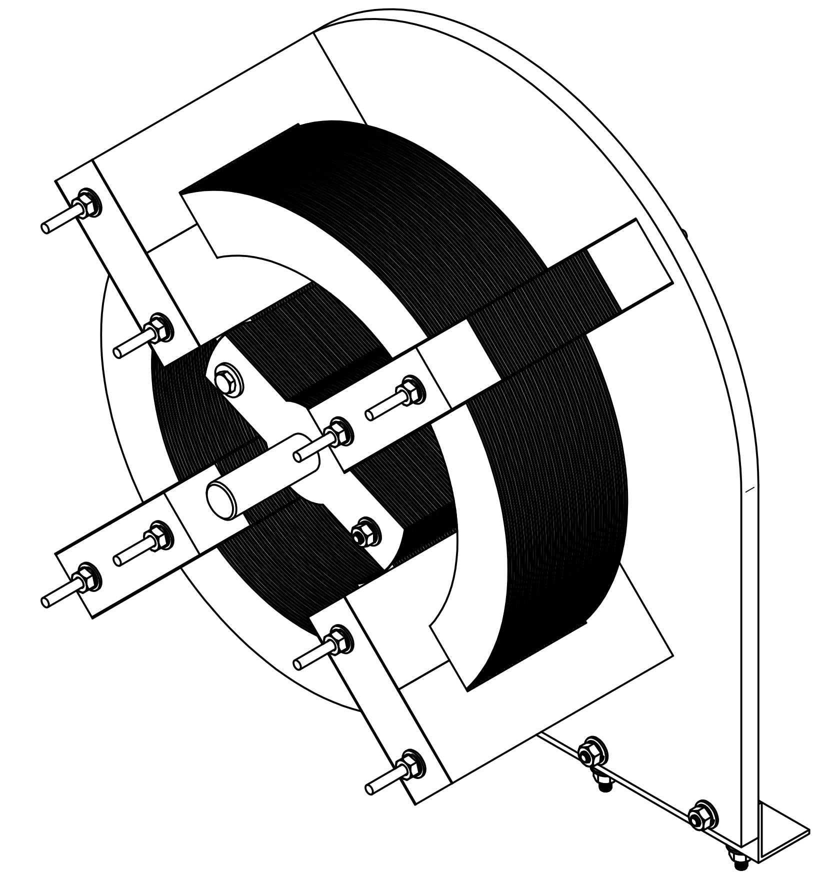
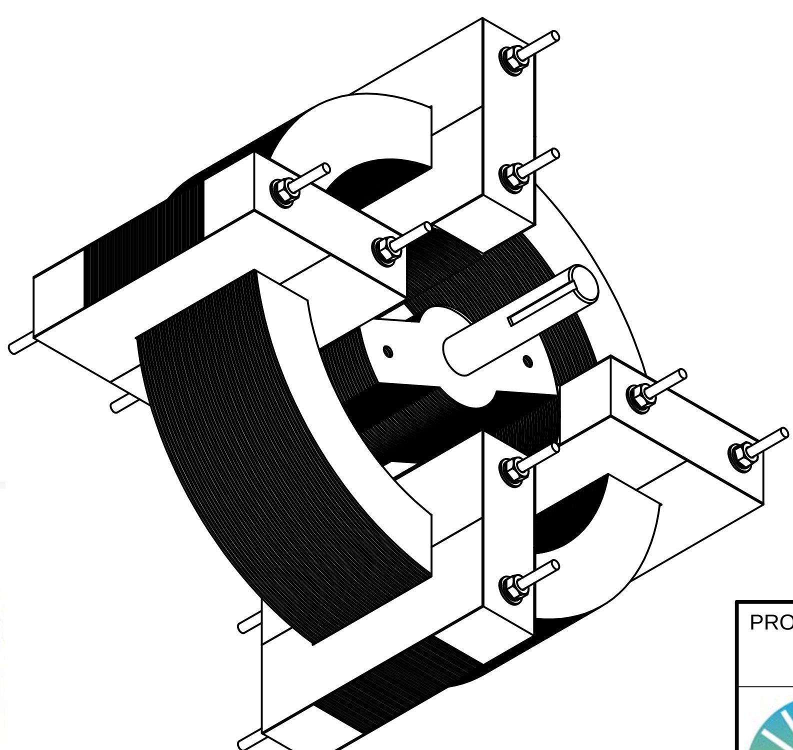
Rev.	Description	Date	Init.
1	Updated Consent Notice	03.24.15	IR









Page 1 of 2

PROJ. NAME: 101	P/N: A1000

Quantum Energy Generator
CATSKILLS | NEW YORK

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

MATERIAL:

FINISH:

WEIGHT:

COMPUTER FILE LOC: C:\FTW\101\Mech\A1000, Main, GA, pg1.DFT

TITLE:

10KW Quantum Energy Generator

DRAWN BY: Ivan Rivas	DATE: 03.24.15	CHECKED BY:	DATE:		
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:		
Q'TY/ASS'Y: 1	SCALE: 1 : 4	DWG. No: B-0-101-A1000	REV. 1		

Fix the World
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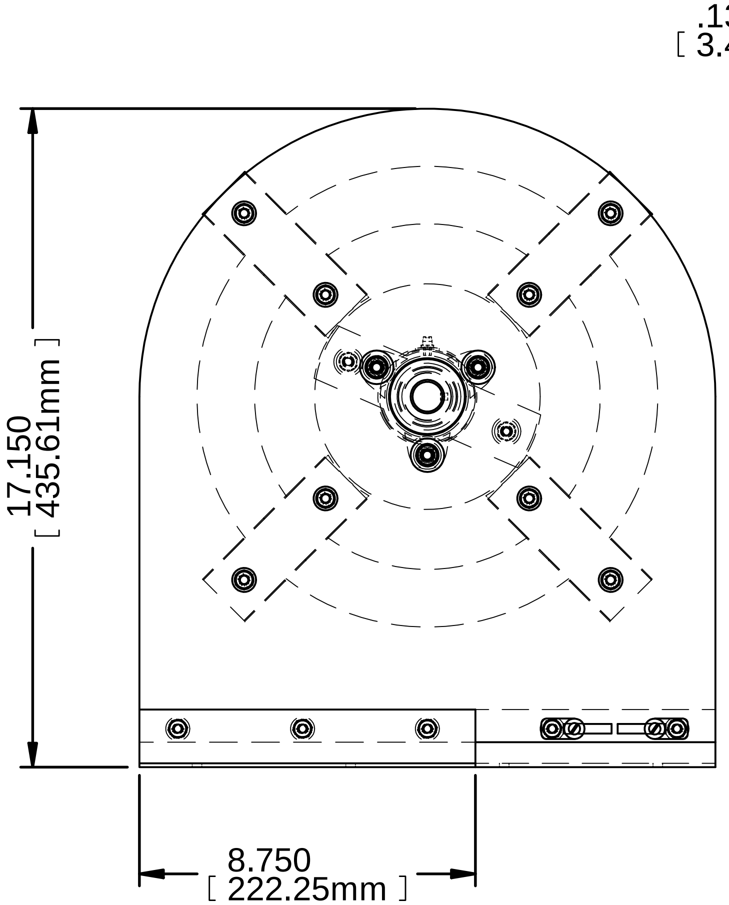
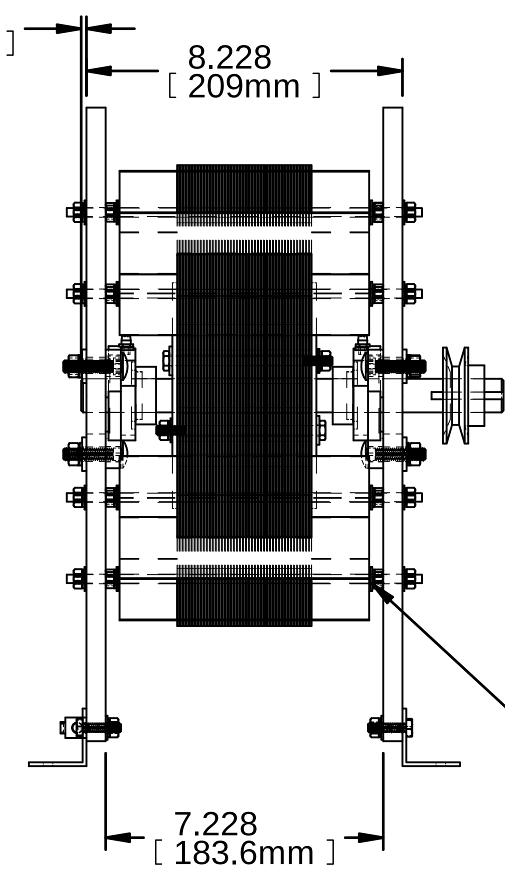
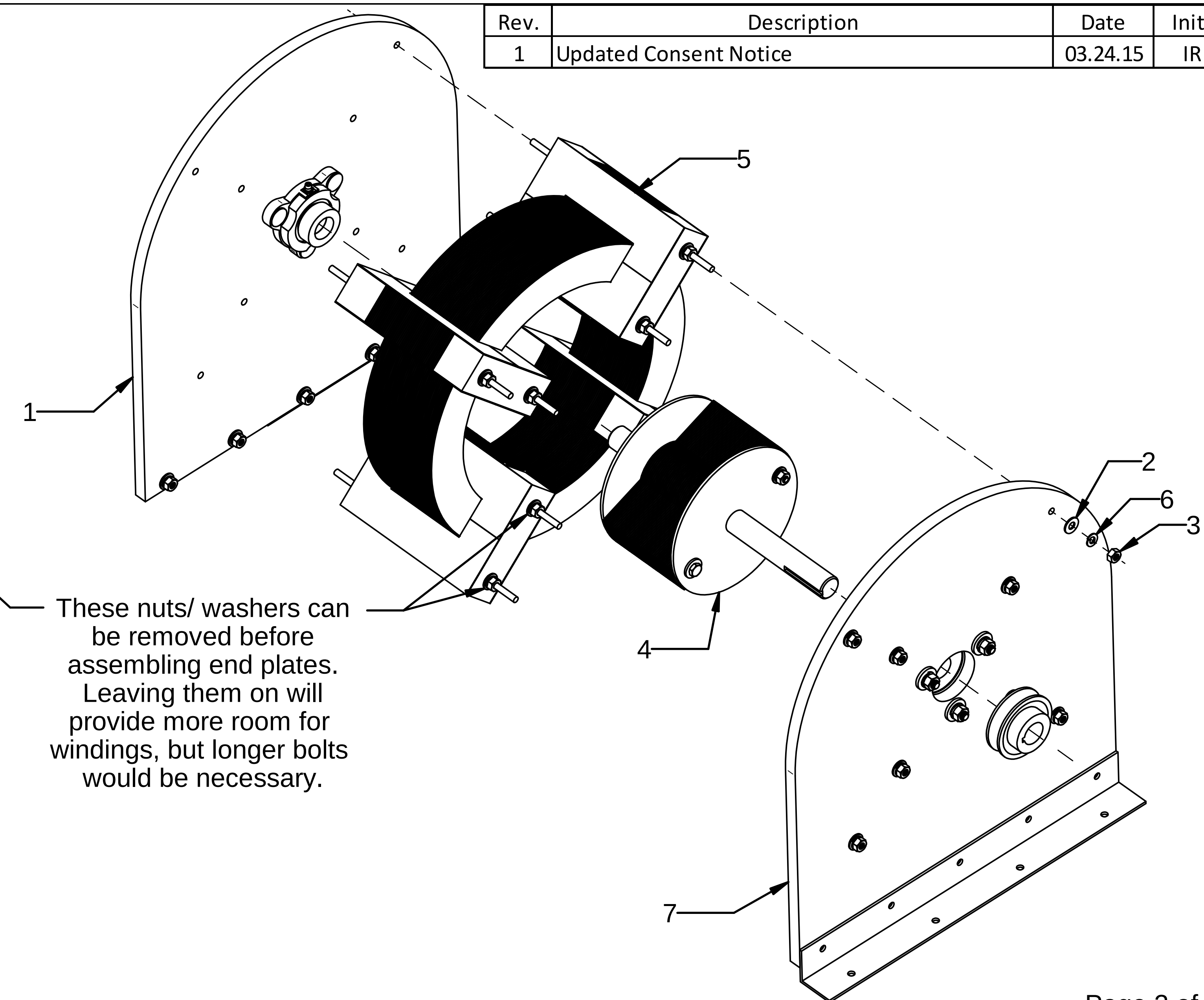
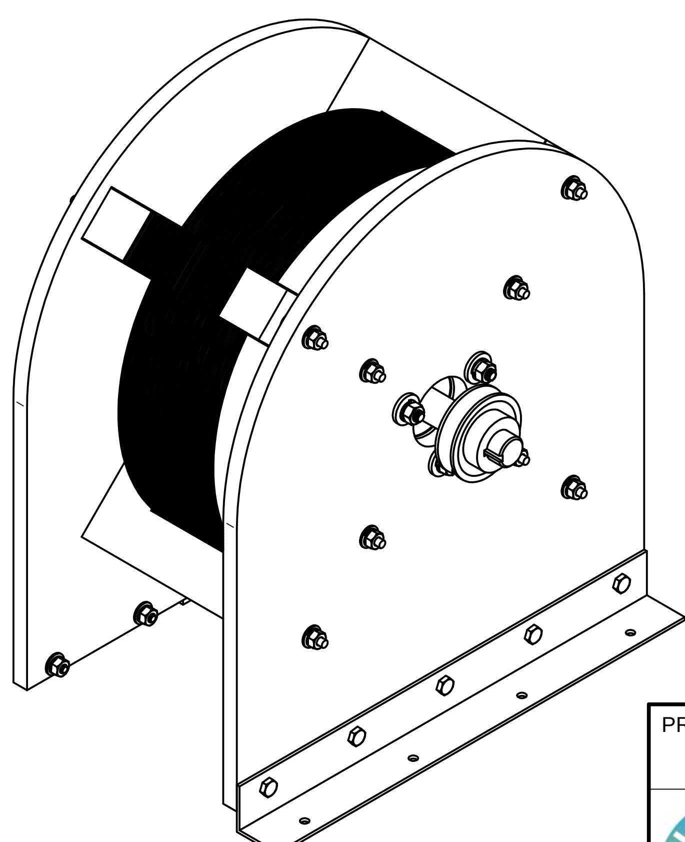
Rev.	Description	Date	Init.
1	Updated Consent Notice	03.24.15	IR





These nuts/ washers can be removed before assembling end plates. Leaving them on will provide more room for windings, but longer bolts would be necessary.





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6	P1015	16	Washer, Split, Lock, 1/4
5	A1008	1	Stator Assy
4	A1007	1	Rotor Assy
3	P1006	16	Nut, Hex, 1/4-20
2	P1005	16	Washer, Flat, #1/4
1	A1016	1	Plate, End, Gap Protection, Assy

Fix the World
A "New Paradigm" Business Model

PROJ. NAME: 101
P/N: A1000

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UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

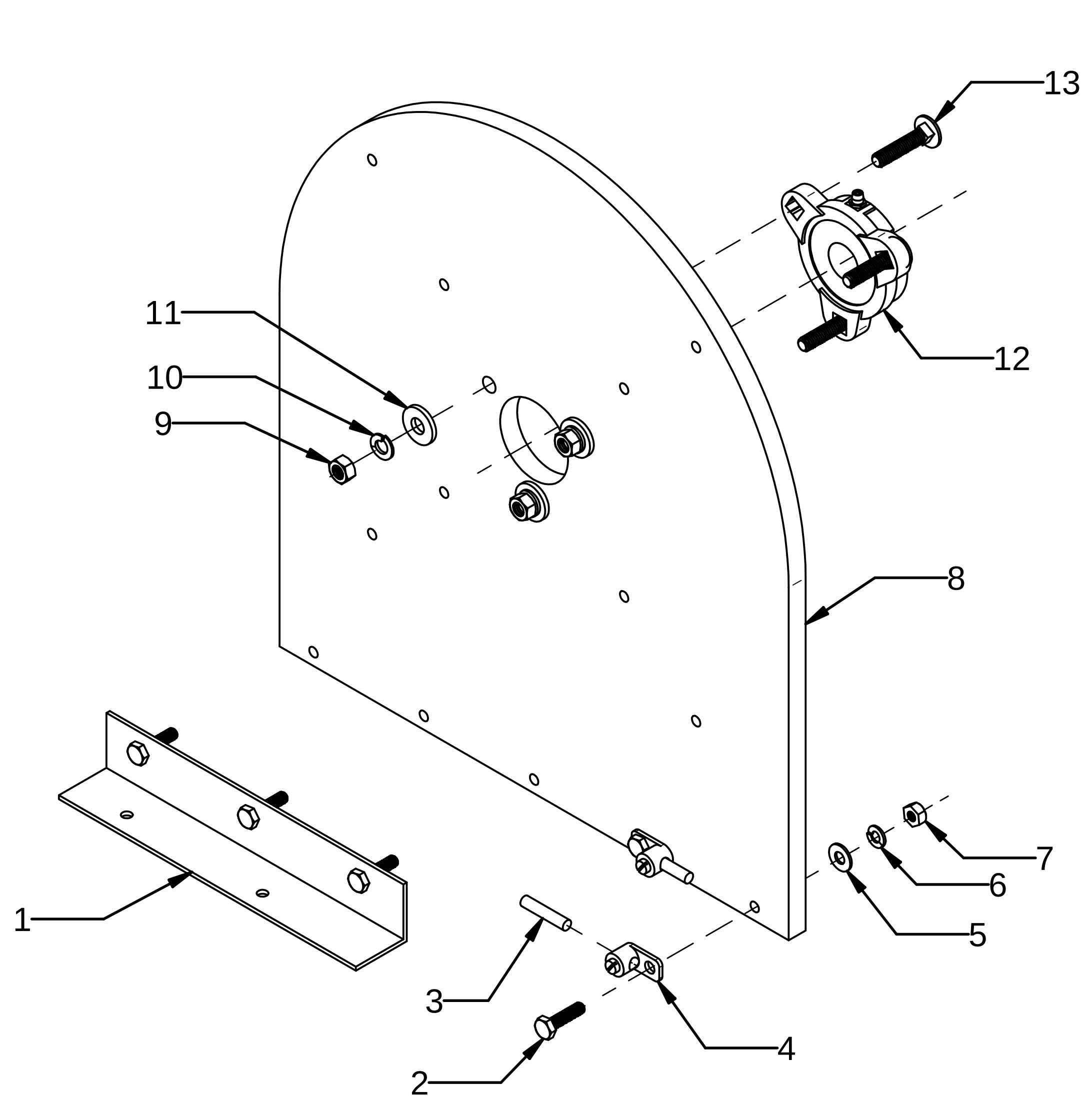
MATERIAL:
FINISH:
WEIGHT:

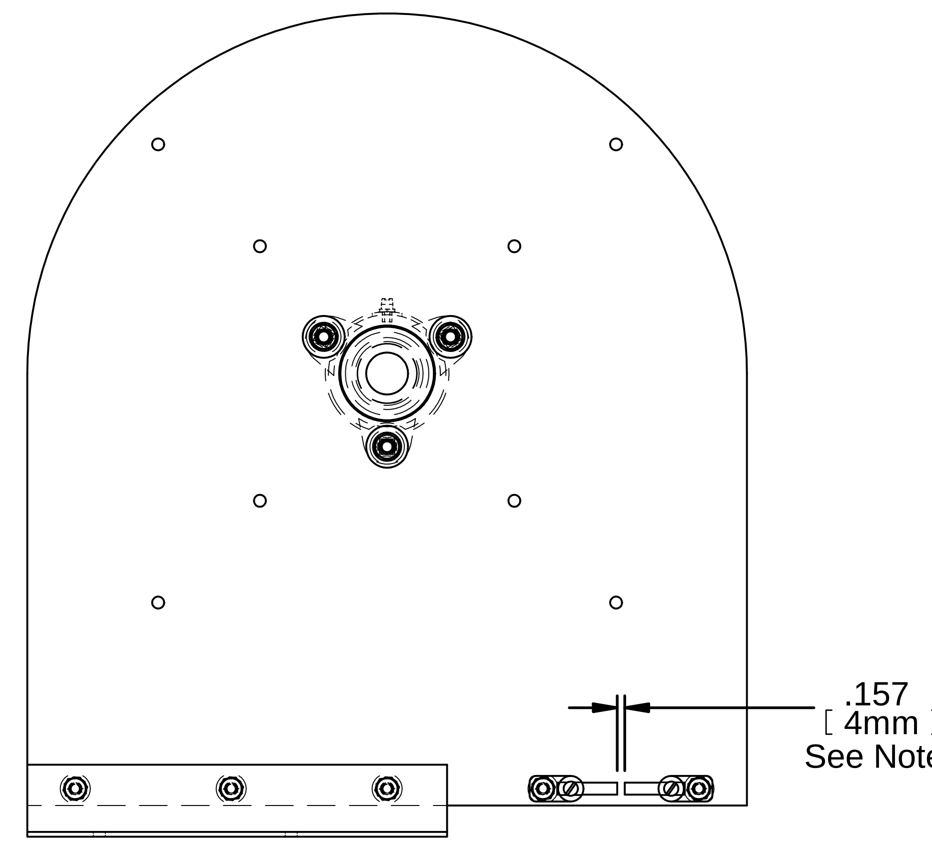
COMPUTER FILE LOC: C:\FTW\101\Mech\A1000, Main, GA, pg2.DFT

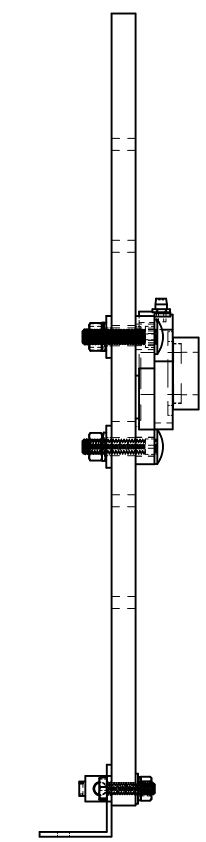
TITLE:
10KW Quantum Energy Generator

DRAWN BY: Ivan Rivas	DATE: 03.24.15	CHECKED BY:	DATE:
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
Q'TY/ASS'Y: 1	SCALE: 1 : 5	DWG. No: B-1-101-A1000	REV. 1

Rev.	Description	Date	Init.
1	Updated Consent Notice, and note	03.24.15	IR







#	P/N	Qty	Description
13	P1036	3	Bolt, Carriage, 3/8-16 x 1 1/2"
12	P1035	1	Flange, Bearing, 3 Bolt, SBTRD205-14G 7/8"
11	P1034	3	Washer, Flat, 3/8
10	P1033	3	Washer, Split, Lock, 3/8
9	P1032	3	Nut, Hex, 3/8-16
8	P1014	1	Plate, End
7	P1006	5	Nut, Hex, 1/4-20
6	P1015	5	Washer, Split, Lock, 1/4
5	P1005	5	Washer, Flat, 1/4
4	P1031	2	Connector, Copper, L70
3	P1030	2	Rod, Drill, A2, 1/4" Dia. x 1.25"
2	P1029	7	Screw, Hex, 1/4-20 x 1"
1	P1028	1	Bracket, Angle, L, 1.5" x 1.5" x 8.75"

Note

1. Protection Gap for Capacitor Bank; A2 rod offset gap should be between 4mm - 6mm for testing. (basically a spark gap across capacitor bank. Running the machine with no load or too much load can cause arcing and short circuit in the core. Set gap at 4mm initially, then adjust for desired firing voltage. Ex. 4mm = 12kV ... 6mm=18kV, etc. (Gap opening 3mm = 1kV, or 3mm per kV)

Fix the World
A "New Paradigm" Business Model

PROJ. NAME: 101
P/N: A1016

Quantum Energy Generator
CATSKILLS | NEW YORK

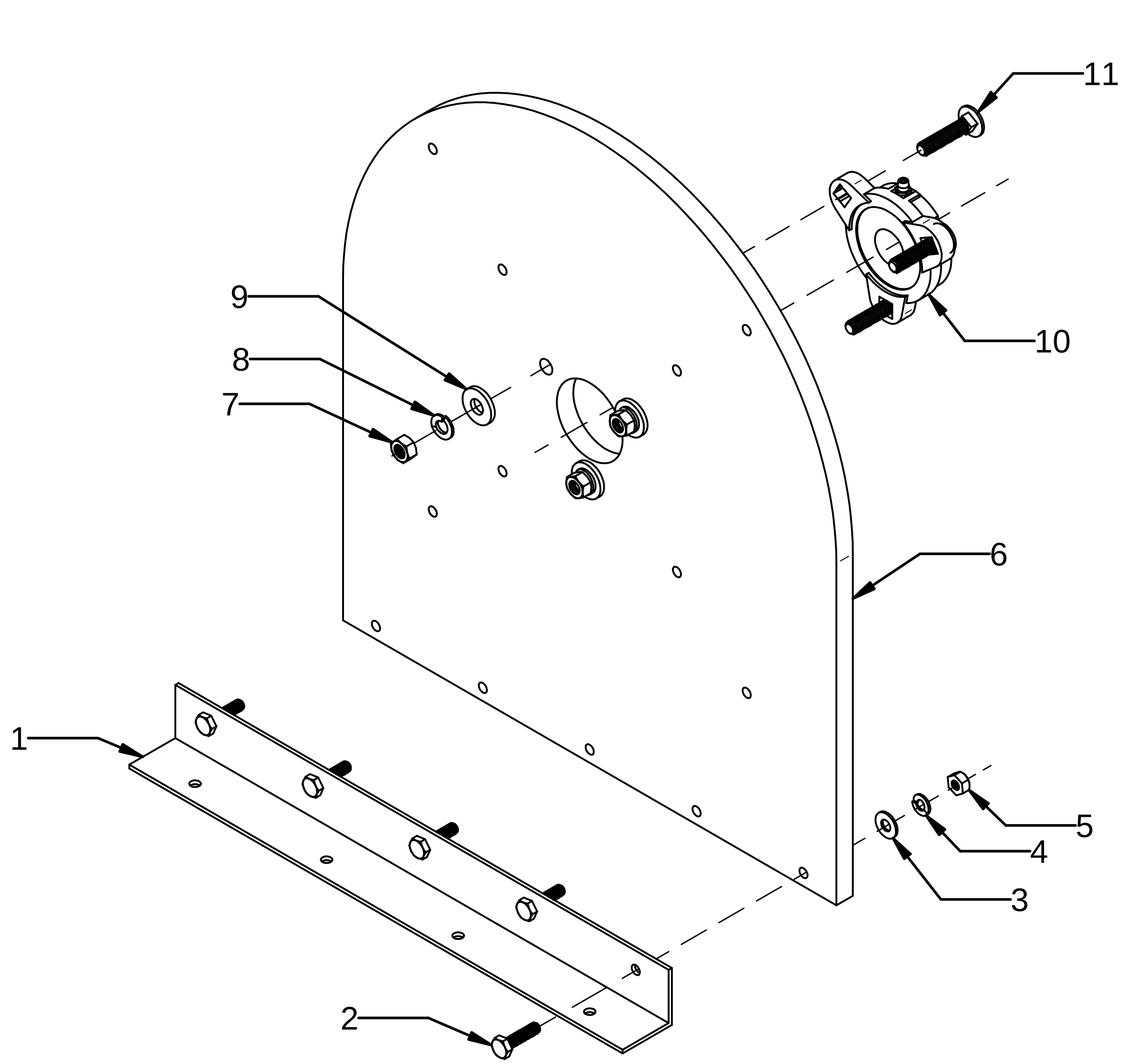
UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

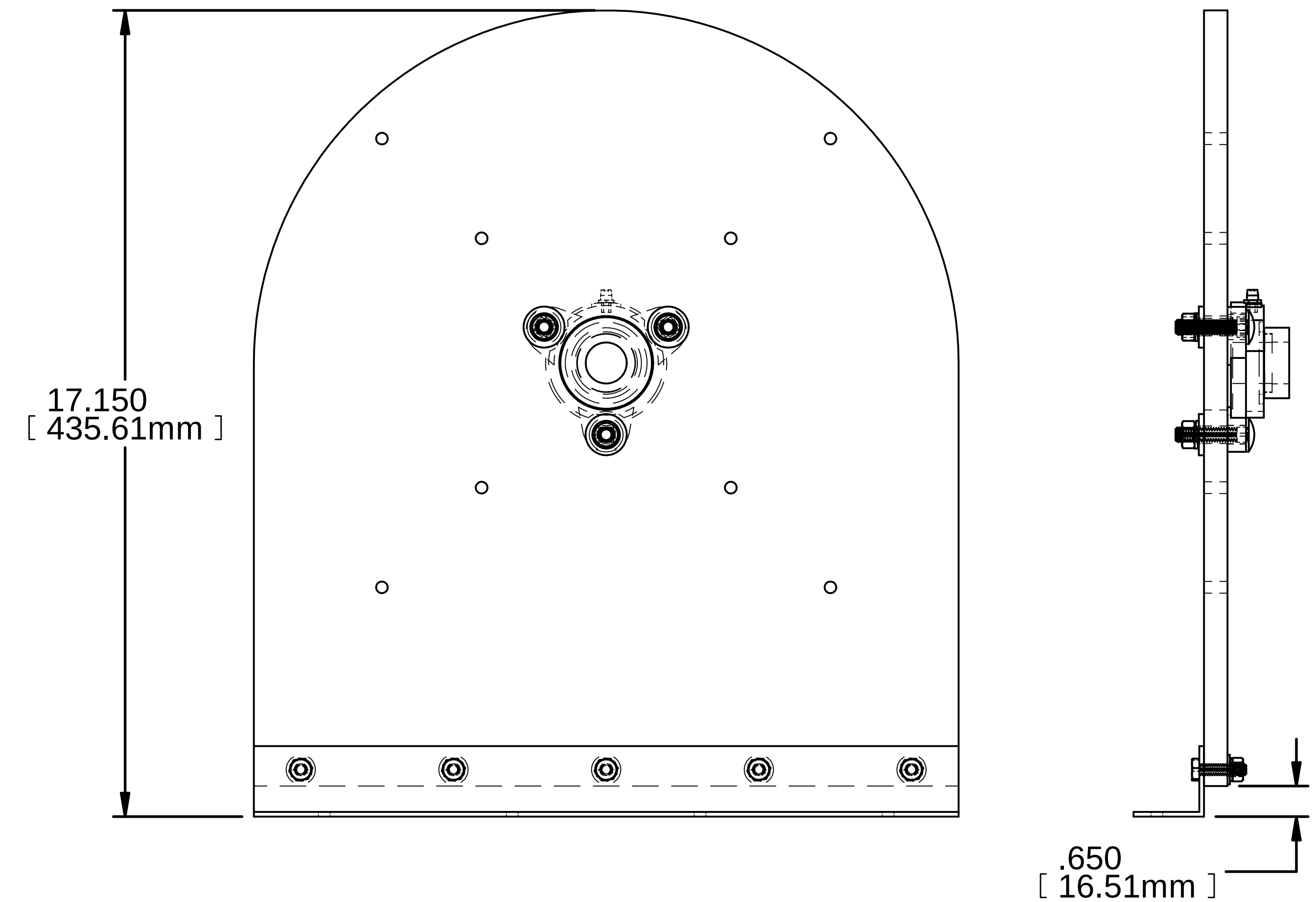
COMPUTER FILE LOC: C:\FTW\101\Mech\A1016, Plate, End, Gap protx.DFT

TITLE:
End Plate Assy, Protection Gap Side
10KW Quantum Energy Generator

MATERIAL:	DRAWN BY: Ivan Rivas	DATE: 03.24.15	CHECKED BY:	DATE:
FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 4	DWG. No: B-0-101-A1016	REV. 1

Rev.	Description	Date	Init.
1	Updated Consent Notice	03.24.15	IR





#	P/N	Qty	Description
11	P1036	3	Bolt, Carriage, 3/8-16 x 1 1/2"
10	P1035	1	Flange, Bearing, 3 Bolt, SBTRD205-14G 7/8"
9	P1034	3	Washer, Flat, 3/8
8	P1033	3	Washer, Split, Lock, 3/8
7	P1032	3	Nut, Hex, 3/8-16
6	P1014	1	Plate, End
5	P1006	5	Nut, Hex, 1/4-20
4	P1015	5	Washer, Split, Lock, 1/4
3	P1005	5	Washer, Flat, 1/4
2	P1029	5	Screw, Hex, 1/4-20 x 1"
1	P1028	1	Bracket, Angle, L, 1.5" x 1.5" x 15"

Fix the World
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PROJ. NAME: 101
P/N: A1037

Quantum Energy Generator
CATSKILLS | NEW YORK

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

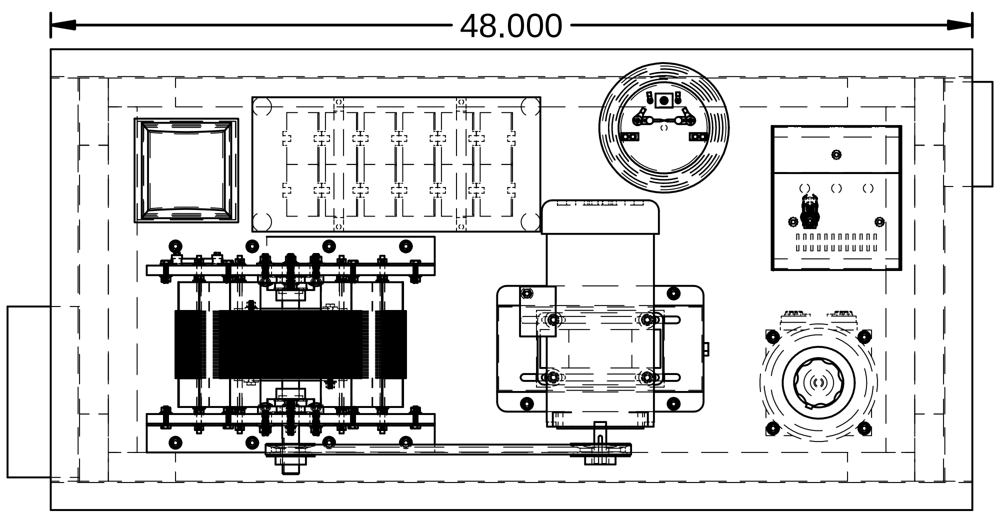
MATERIAL:
FINISH:
WEIGHT:

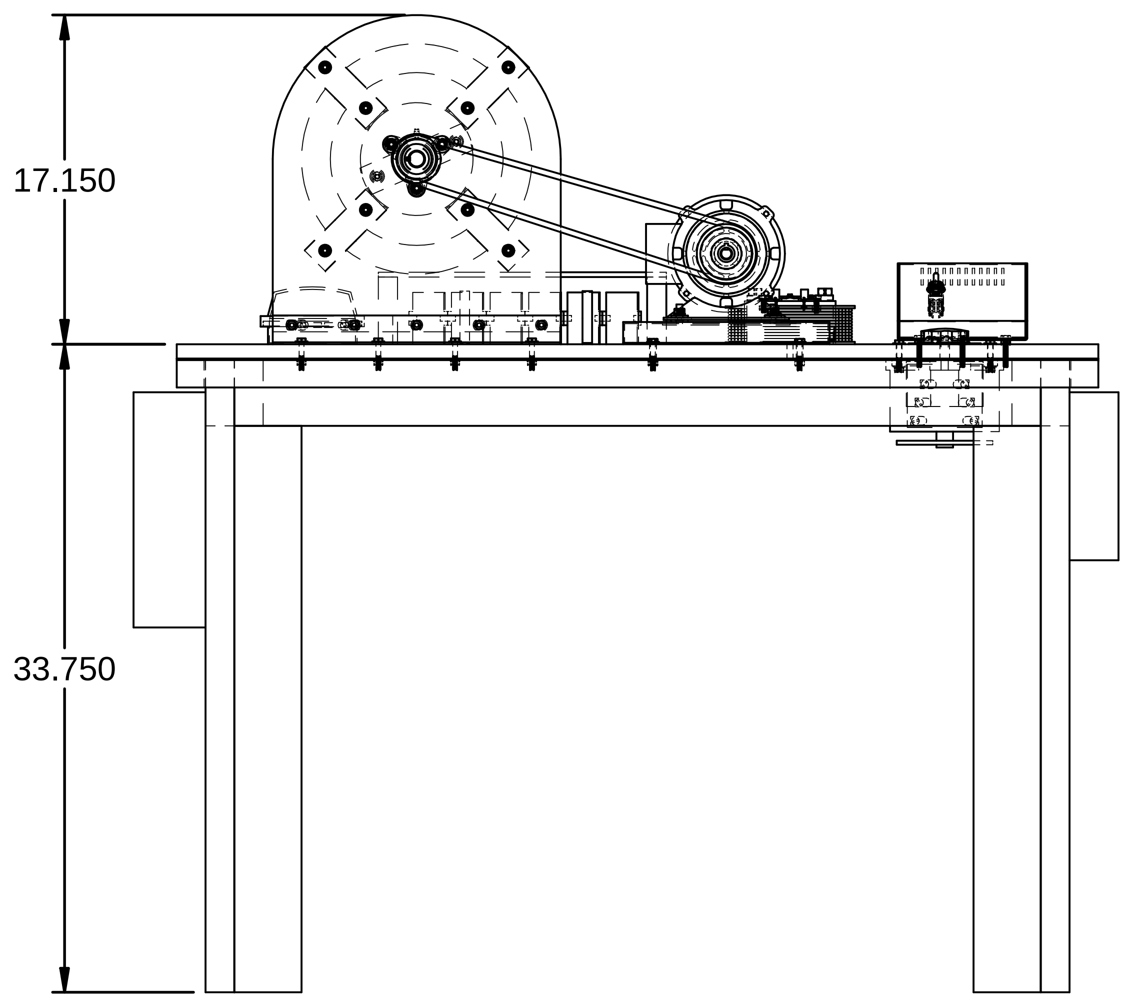
COMPUTER FILE LOC: C:\FTW\101\Mech\A1037, Plate, End, Pully side.DFT

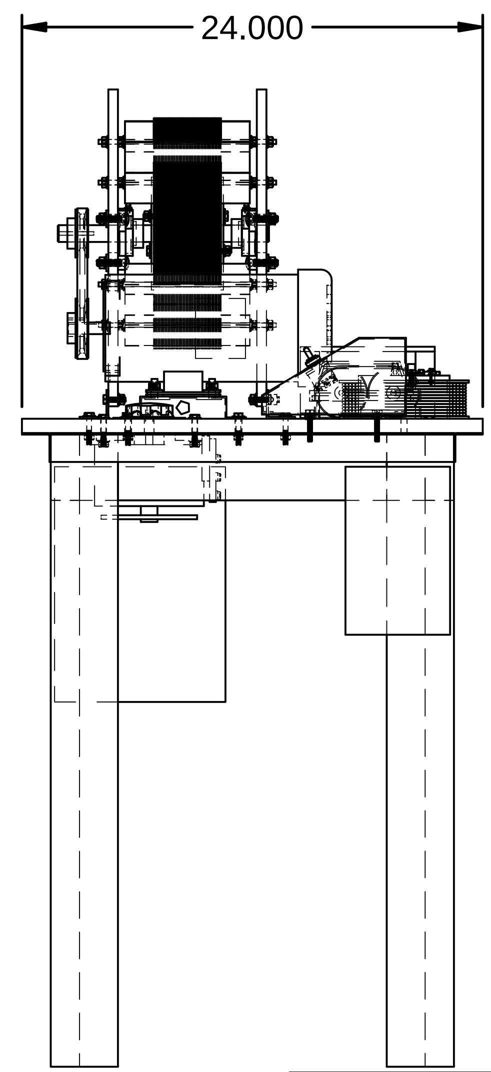
TITLE:
End Plate Assy, Pully Side
10KW Quantum Energy Generator

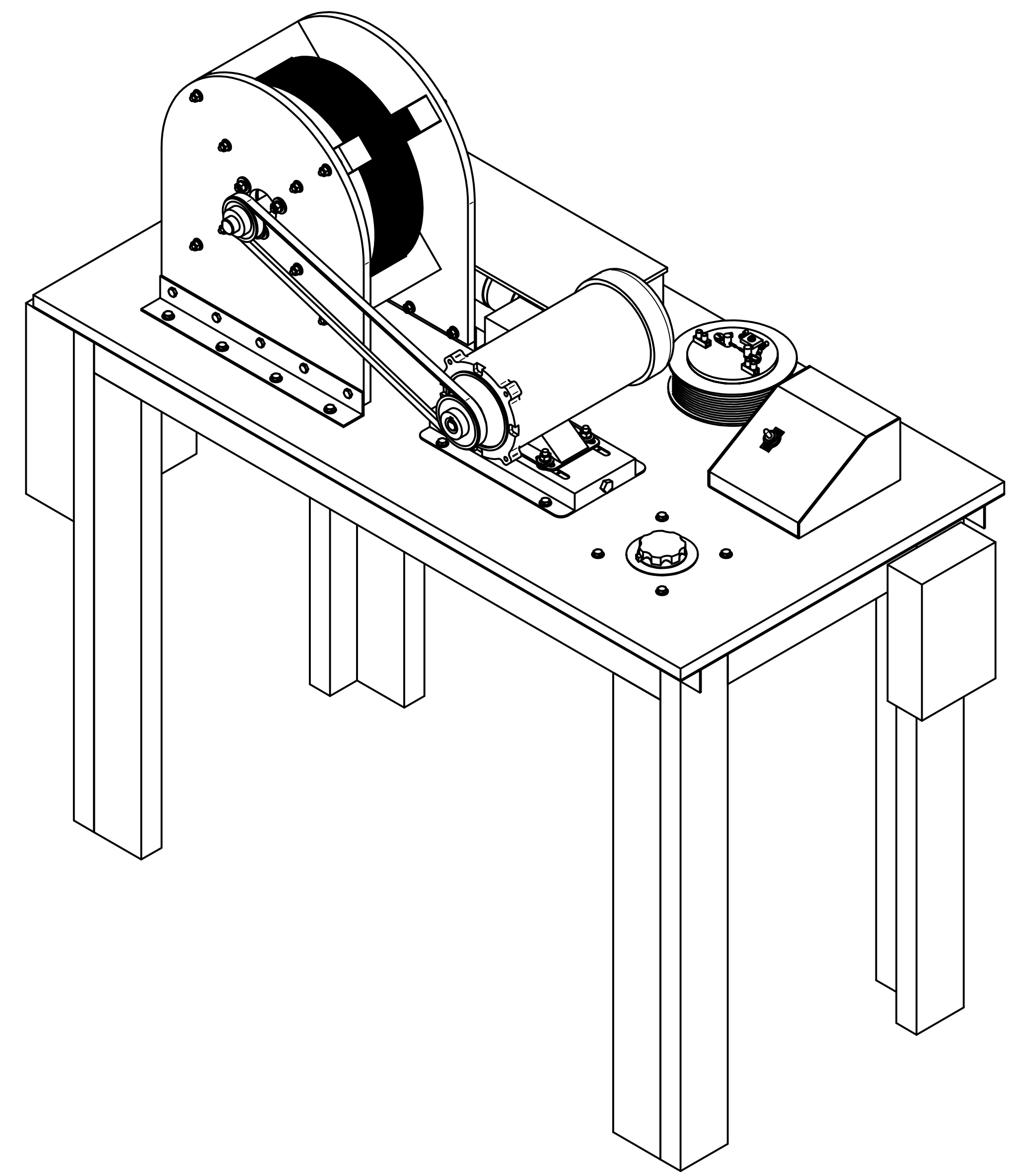
DRAWN BY: Ivan Rivas	DATE: 03.24.15	CHECKED BY:	DATE:		
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:		
Q'TY/ASS'Y: 1	SCALE: 1 : 4	DWG. No: B-0-101-A1037		REV.	1

Rev.	Description	Date	Init.
1	Updated Exciter Coil Design	03.25.15	IR









Fix the World
A "New Paradigm" Business Model

PROJ. NAME: 101
P/N: A1018

Quantum Energy Generator
CATSKILLS | NEW YORK

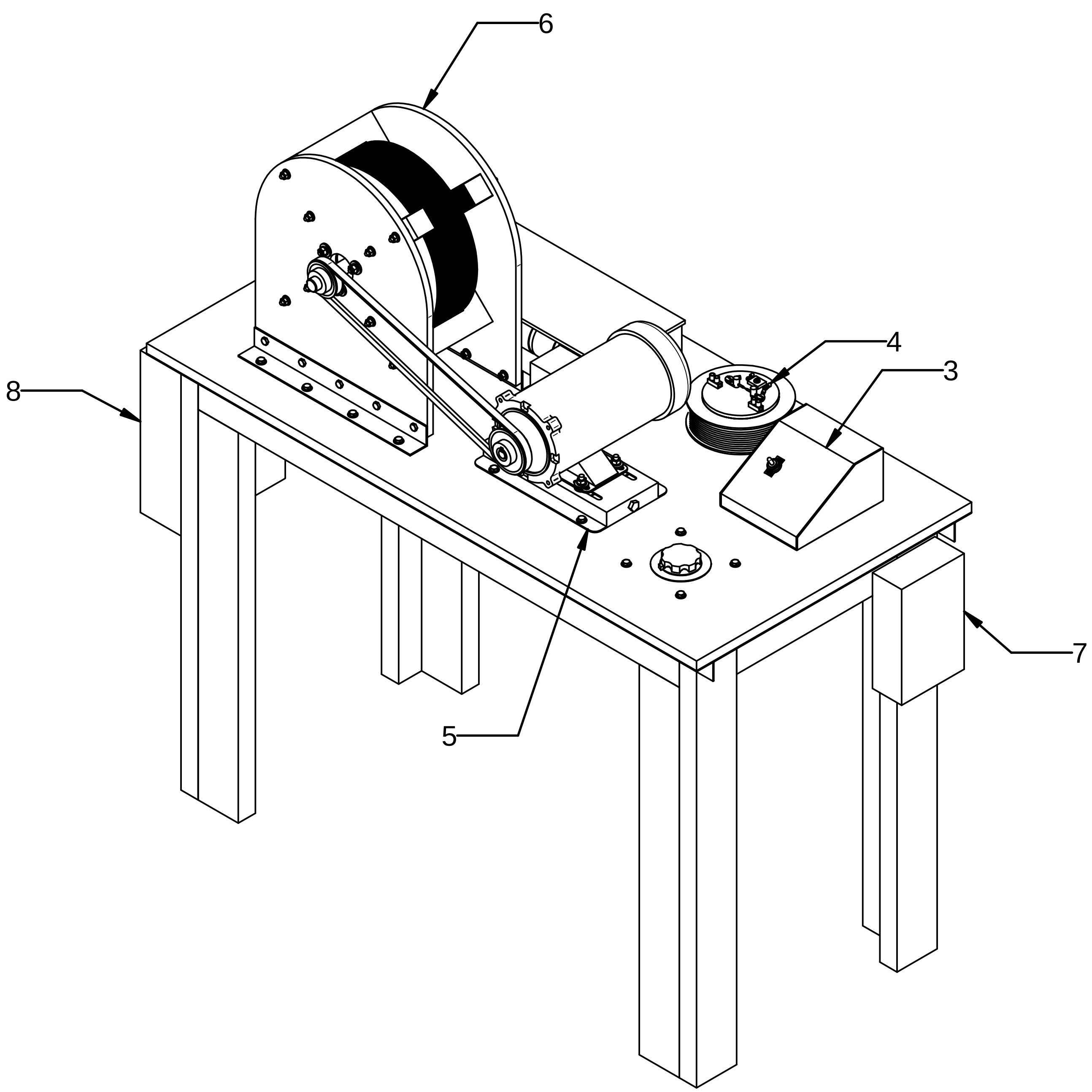
UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

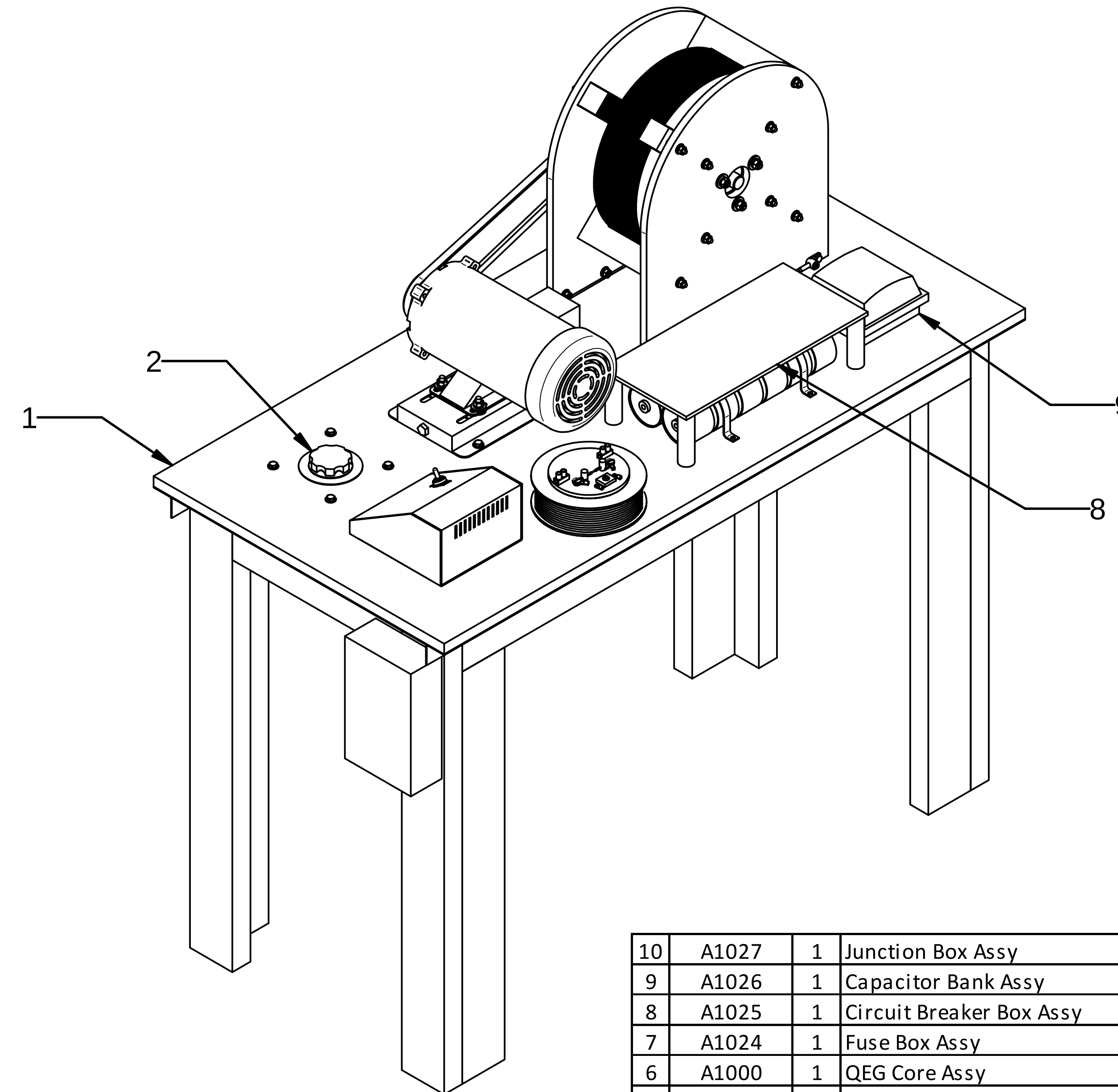
COMPUTER FILE LOC: C:\FTW\101\Mech\A1018, QEG, Fixture, pg1.DFT

TITLE: QEG Prototype Fixture

MATERIAL:	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 10	DWG. No: B-0-101-A1018	REV. 1

Rev.	Description	Date	Init.
1	Updated Exciter Coil Design	03.25.15	IR





#	P/N	Qty	Description
10	A1027	1	Junction Box Assy
9	A1026	1	Capacitor Bank Assy
8	A1025	1	Circuit Breaker Box Assy
7	A1024	1	Fuse Box Assy
6	A1000	1	QEG Core Assy
5	A1023	1	Motor Assy
4	A1022	1	Exciter Assy
3	A1021	1	Switch Box Assy
2	A1020	1	Variac Assy
1	A1019	1	Wood Bench Assy

Fix the World
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PROJ. NAME: 101
P/N: A1018

Quantum Energy Generator
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UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

MATERIAL:
FINISH:
WEIGHT:

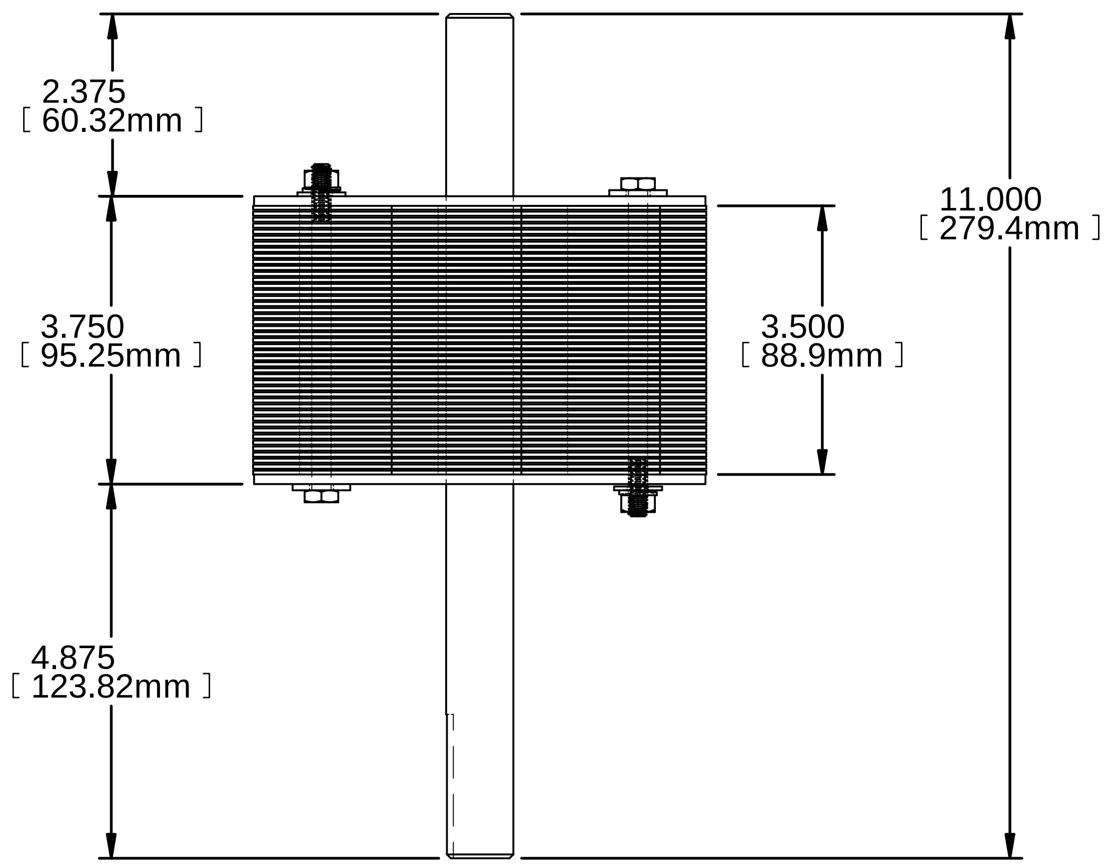
COMPUTER FILE LOC: C:\FTW\101\Mech\A1018, QEG, Fixture, pg2.DFT

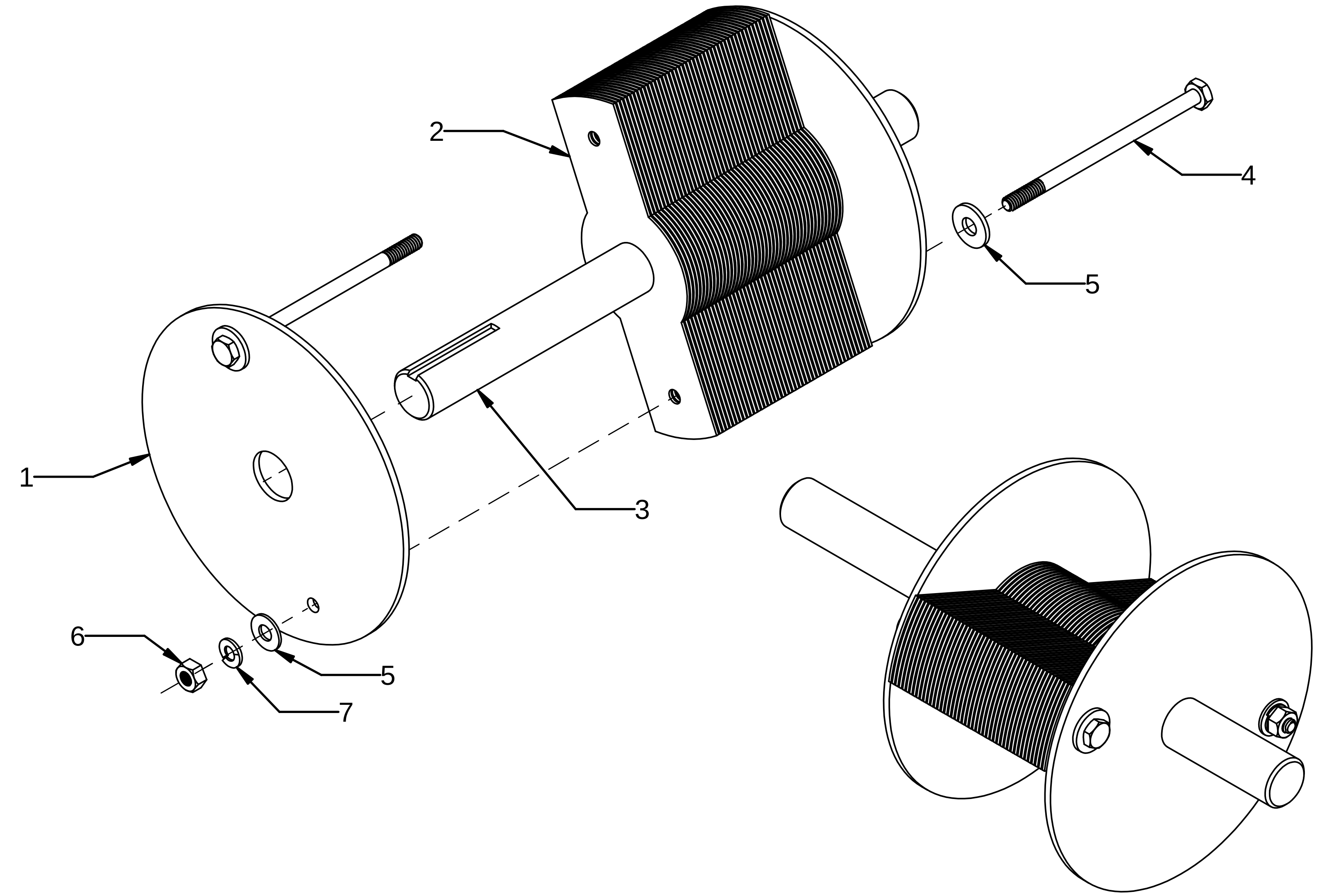
TITLE:

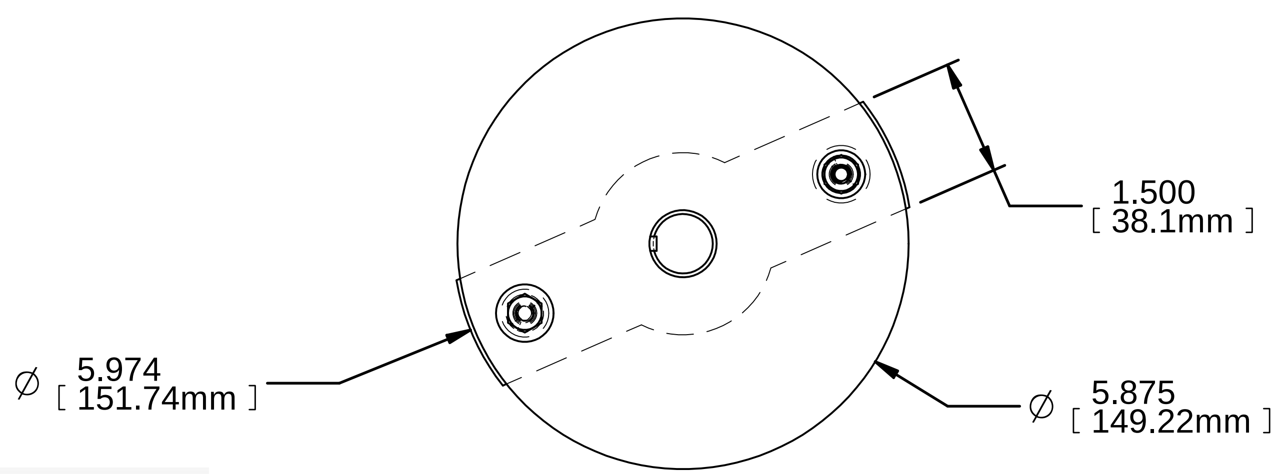
QEG Prototype Fixture

DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
Q'TY/ASS'Y: 1	SCALE: 1 : 10	DWG. No: B-1-101-A1018	REV. 1

Rev.	Description	Date	Init.
1	Updated consent Notice, Removed SS from Hardware	03.25.15	IR







#	P/N	Qty	Description
7	P1015	2	Washer, Split, Lock, 1/4
6	P1006	2	Nut, Hex, 1/4-20, Grade 8
5	P1005	4	Washer, Flat, #1/4
4	P1004	2	Bolt, Hex, 1/4-20 x 4-1/4, Grade 8
3	P1003	1	Shafting, 7/8" Dia x 11" Long, w/ standard 3/16" x 3/32" Keyway, C1045 TGP Trukey
2	P1002	140	Lamination, Rotor, 24 Gauge, M19 C5, Electrical Steel
1	P1001	2	Shroud, Mat.: (Fiberglass, Laminate, epoxy, Reinforced, 1/8" thk x 5.875" Diameter

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PROJ. NAME: 101
P/N: A1007

Quantum Energy Generator
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UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

MATERIAL:
FINISH:
WEIGHT:

COMPUTER FILE LOC: C:\FTW\101\Mech\A1007, Rotor, Main, GA.DFT

TITLE:
Rotor Assy
10KW Quantum Energy Generator

DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
Q'TY/ASS'Y: 1	SCALE: 1 : 2.5	DWG. No: B-0-101-A1007	REV. 1

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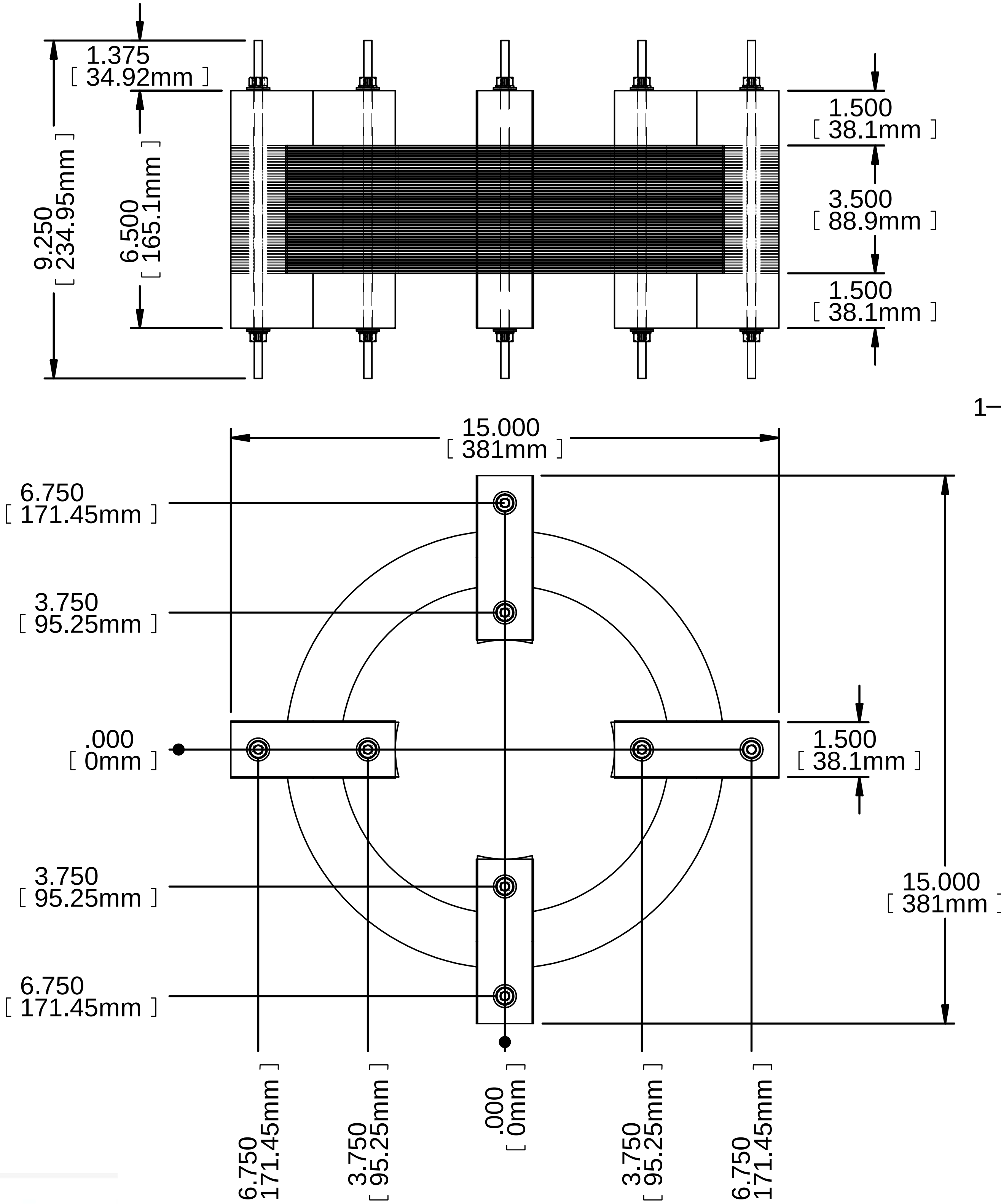
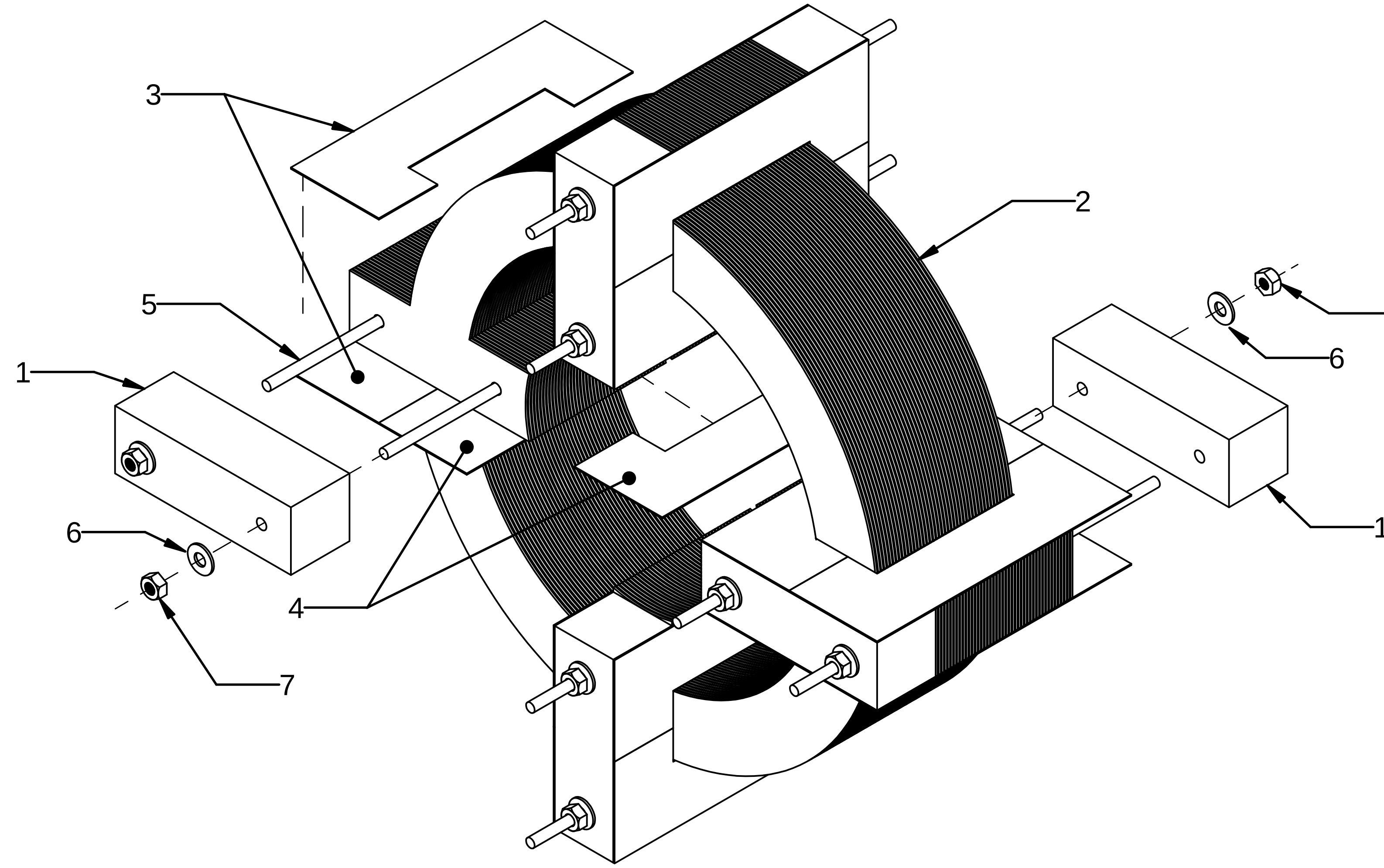
CONSENT OF THE FIX THE WORLD ORGANIZATION.

Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR





#	P/N	Qty	Description
7	P1006	16	Nut, Hex, 1/4-20, Grade 8
6	P1005	16	Washer, Flat, #1/4
5	P1013	8	Rod, 1/4-20 x 9.25in, Grade 8
4	P1012	8	Insulation, Corner, Nomex, Inner
3	P1011	8	Insulation, Corner, Nomex, Outer
2	P1010	140	Lamination, Stator, 24 Gauge, M19 C5, Electrical Steel
1	P1009	8	Spacer, block, 1-1/2" x 1-1/2" x 4-1/2", Aluminum, 6061-T6

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

COMPUTER FILE LOC: C:\FTW\101\Mech\A1008, Stator, Main, GA.DFT

TITLE: Stator Assy
10KW Quantum Energy Generator

PROJ. NAME: 101 | P/N: A1008

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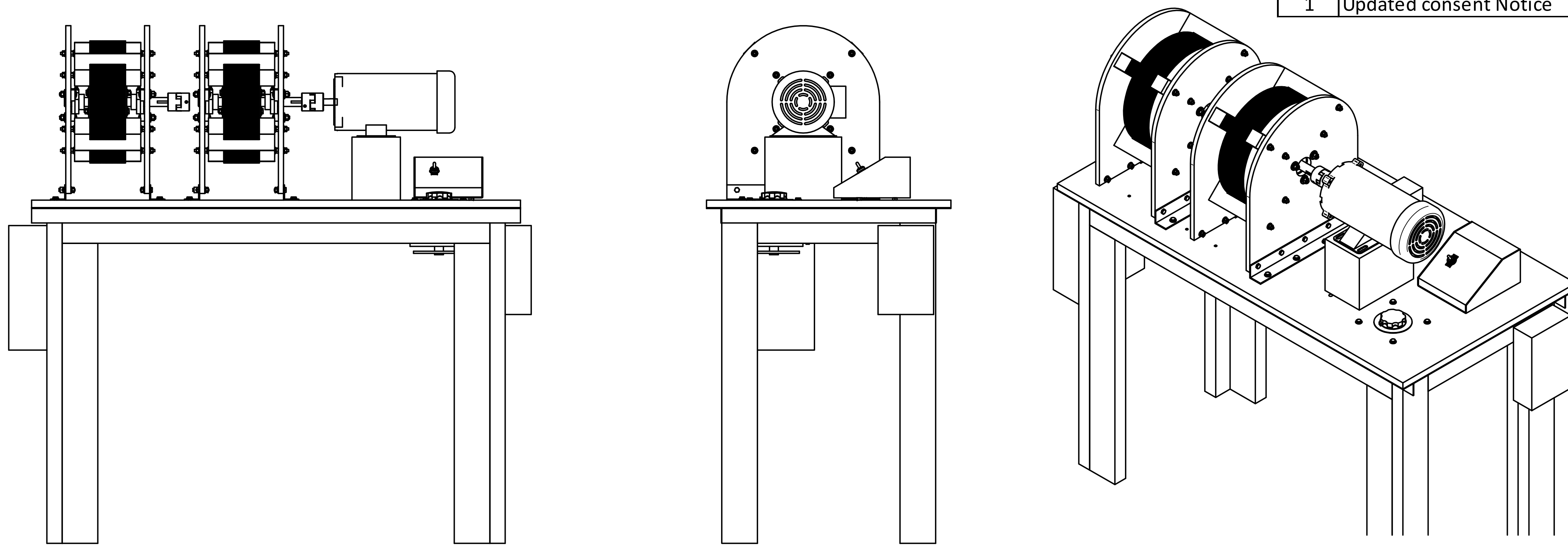
A "New Paradigm" Business Model

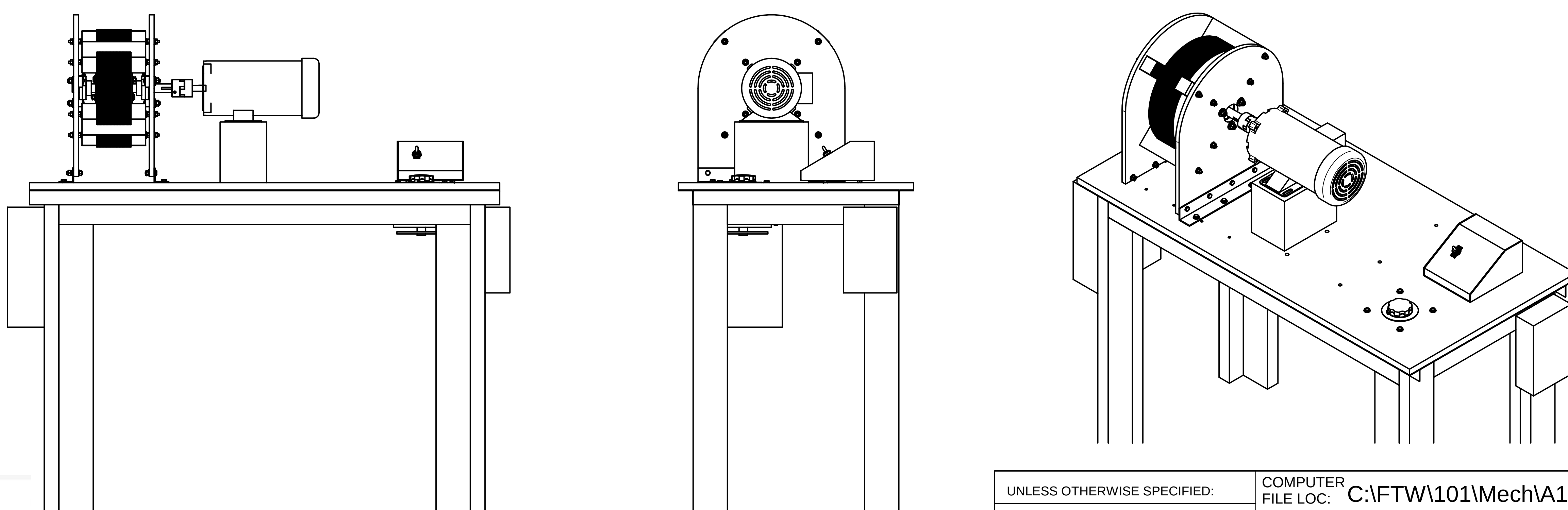
Quantum Energy Generator
CATSKILLS | NEW YORK

MATERIAL:	DRAWN BY: I. Rivas	DATE: 03.25.15	CHECKED BY:	DATE:	
FINISH:	DESIGNED BY:	DATE:	APPROVED BY:	DATE:	
WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 4	DWG. No: B-0-101-A1008	REV. 1	

Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR



Dual
QEG Core
Mount Option



Single
QEG Core
Mount Option

Fix the World
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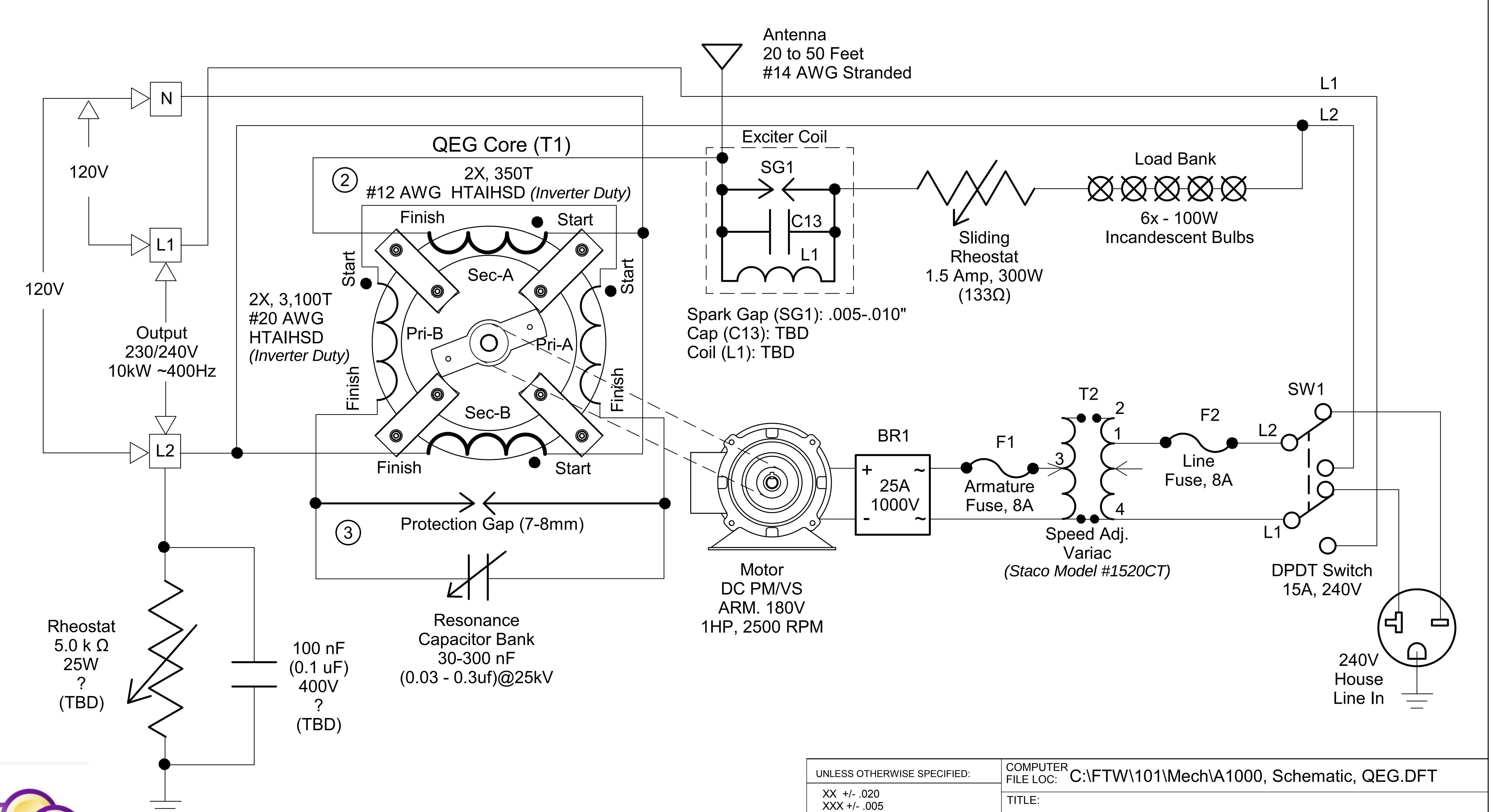
PROJ. NAME: 101	P/N: A1039	UNLESS OTHERWISE SPECIFIED: XX +/- .020 XXX +/- .005 XXXX +/- .0005 ANGLES +/- 3 DEG. FRACTIONAL TOL: +/- 1/64 ALL DIM'S ARE IN INCHES	COMPUTER FILE LOC: C:\FTW\101\Mech\A1039, QEG Mount Options.DFT TITLE: Single & Dual QEG Core Mount Options				
Quantum Energy Generator CATSKILLS | NEW YORK		MATERIAL:	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:	
		FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:	
		WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 10	DWG. No: B-0-101-A1039		REV. 1

Rev.	Description	Date	Init.
4	Updated consent Notice	03.25.15	IR



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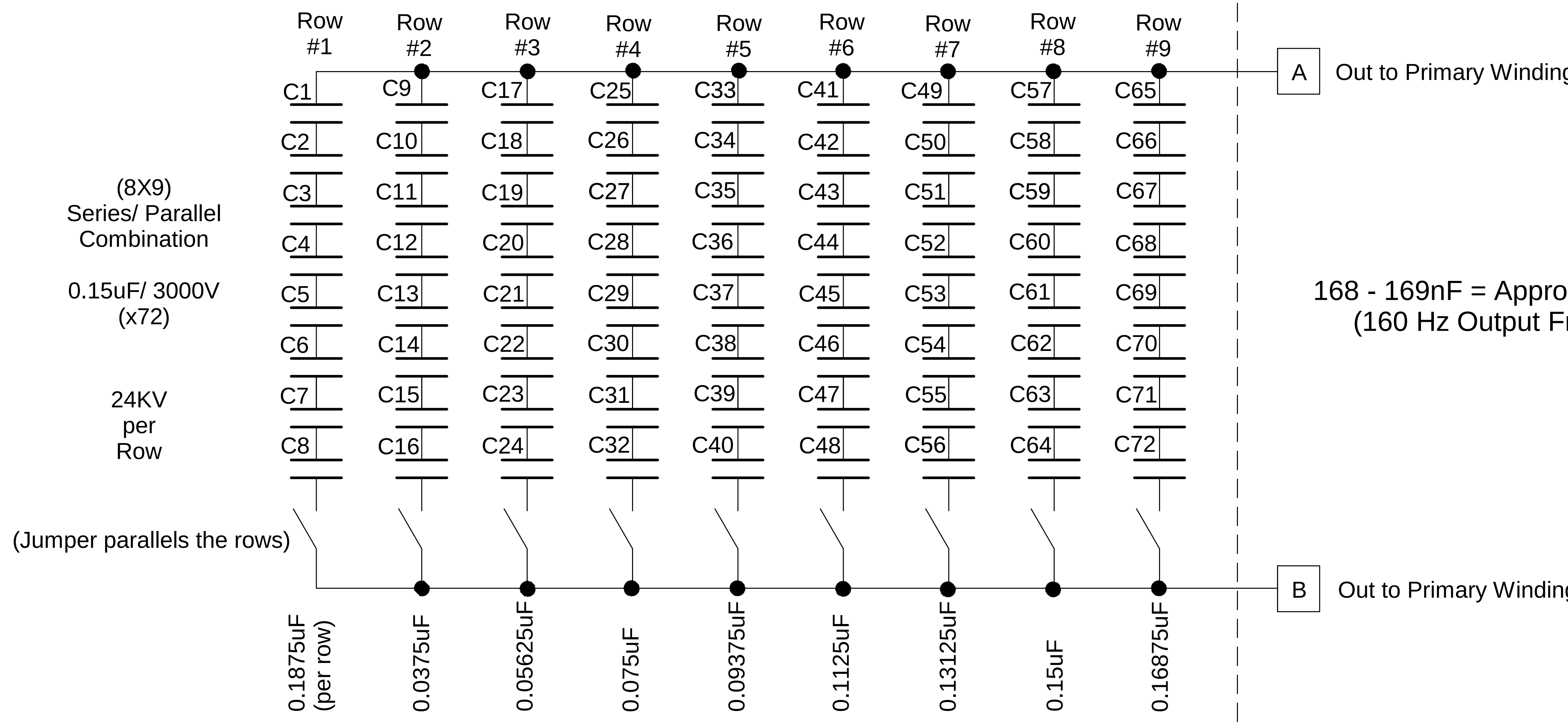
PROJ. NAME: 101	P/N: A1000	UNLESS OTHERWISE SPECIFIED: XX +/- .020; XXX +/- .005; XXXX +/- .0005; ANGLES +/- 3 DEG.; FRACTIONAL TOL: +/- 1/64; ALL DIM'S ARE IN INCHES	COMPUTER FILE LOC: C:\FTW\101\Mech\A1000, Schematic, QEG.DFT		
			TITLE: QEG Schematic		
Quantum Energy Generator CATSKILLS | NEW YORK		MATERIAL:	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY: / DATE:
		FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY: / DATE:
		WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 1	DWG. No: B-3-101-A1000 / REV. 4

Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR



168 - 169nF = Approx. 2400 RPM
(160 Hz Output Frequency)

Double this setup for values between 18.75nF and 300nF
(Covers Total frequency/RPM Range)

Fix the World
A "New Paradigm" Business Model

PROJ. NAME: 101
P/N: A1000

Quantum Energy Generator
CATSKILLS | NEW YORK

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

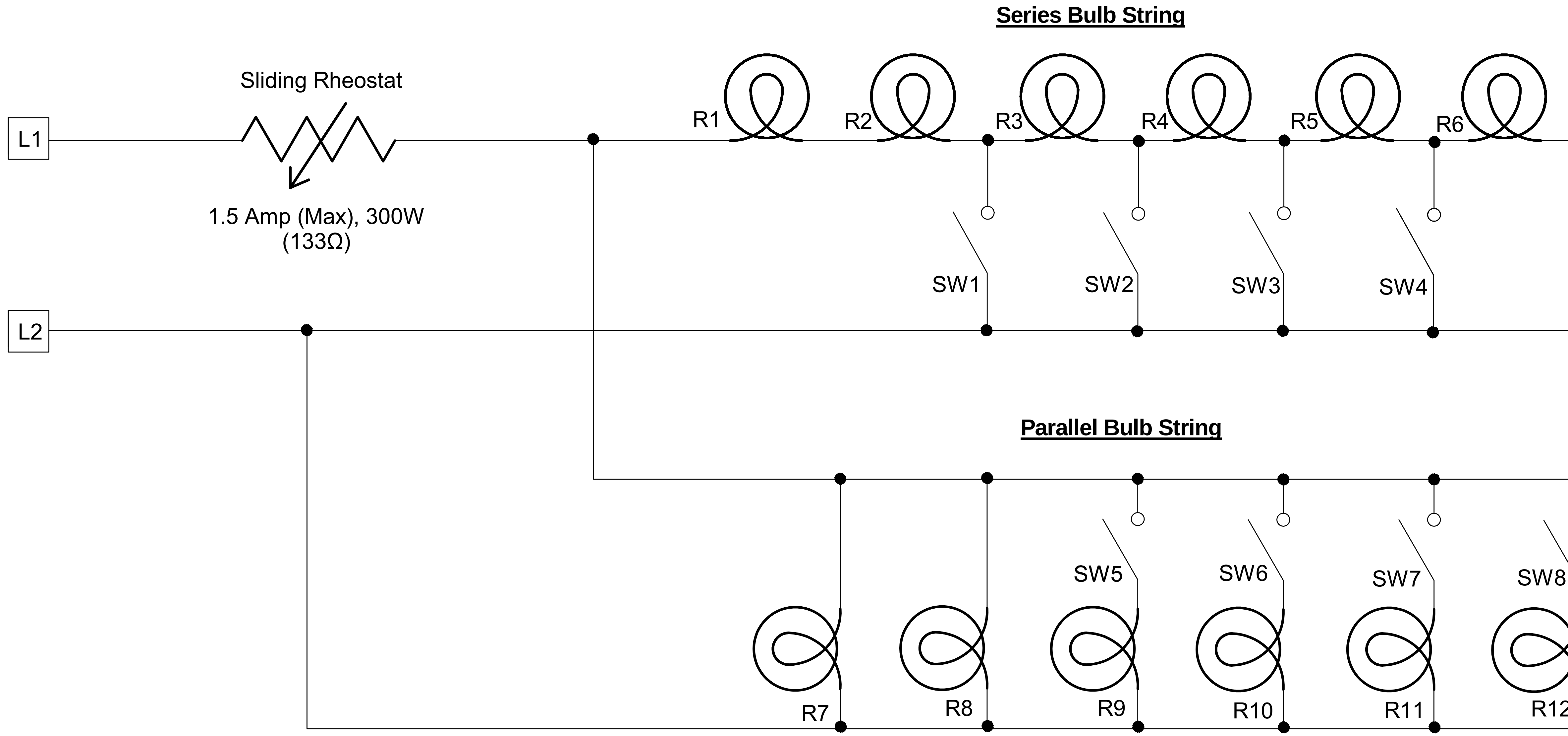
MATERIAL:
FINISH:
WEIGHT:

COMPUTER FILE LOC: C:\FTW\101\Mech\A1000, Capacitor Load Bank.DFT

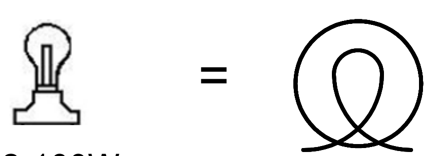
TITLE:
Resonance Capacitor Load Bank Suggested for Experimentation

DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
Q'TY/ASS'Y: 1	SCALE: 1 : 1	DWG. No: B-5-101-A1000	REV. 1

Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR



Notes:

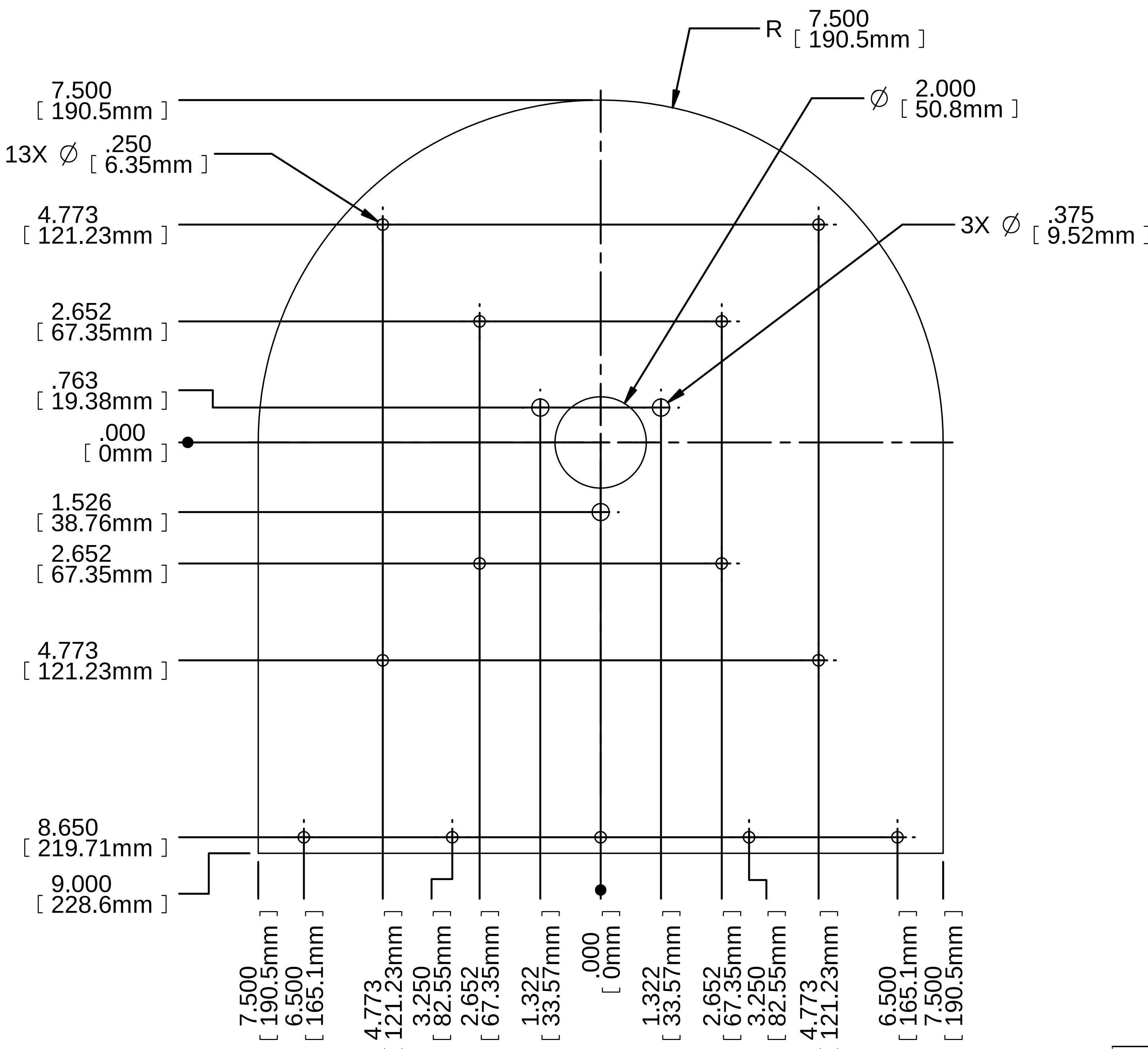
1. 12x 72-100W Incandescent Bulbs (Halogen Ok)
2. 120/240V Rated - depending on selected System voltage.
3. 

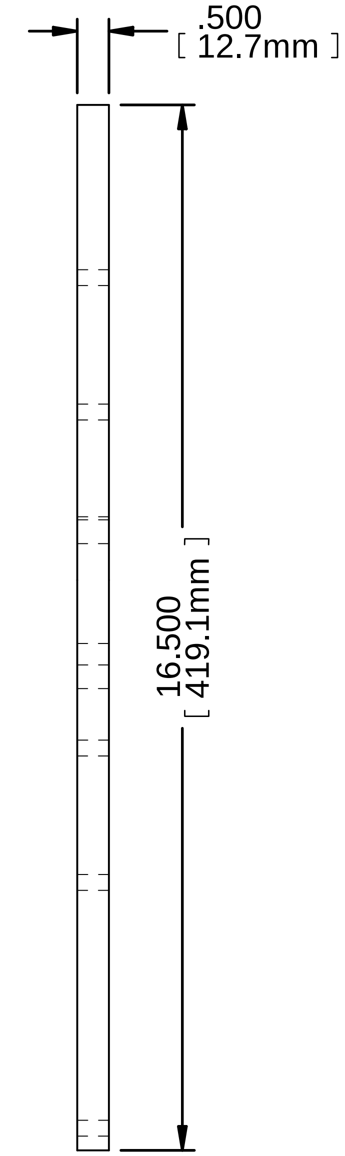
72-100W Bulb

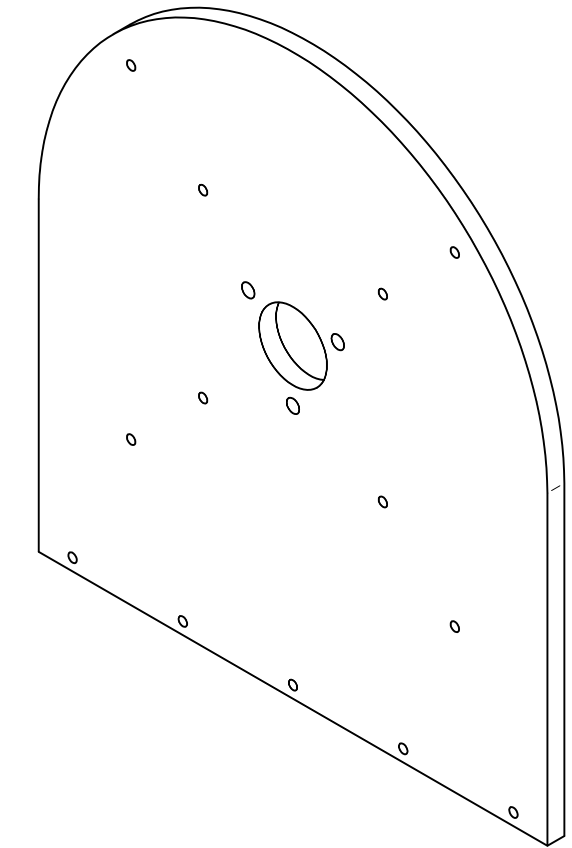
PROJ. NAME: 101	P/N: A1000	UNLESS OTHERWISE SPECIFIED: XX +/- .020 XXX +/- .005 XXXX +/- .0005 ANGLES +/- 3 DEG. FRACTIONAL TOL: +/- 1/64 ALL DIM'S ARE IN INCHES	COMPUTER FILE LOC: C:\FTW\101\Mech\A1000, Schematic, Load Bank.DFT				
			TITLE: Recommended QEG Experimental Load Bank				
Quantum Energy Generator CATSKILLS | NEW YORK		MATERIAL:	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:	
		FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:	
		WEIGHT:	Q'TY/ASS'Y: 1	SCALE: 1 : 1	DWG. No: B-5-101-A1000		REV. 1

Fix the World
A "New Paradigm" Business Model

Rev.	Description	Date	Init.
2	Updated consent Notice	03.25.15	IR







1 Notes:

1. Material: can use either G10/FR4 or Polycarbonate (Clear plastic).
2. Used with Flange, Bearing, 3 Bolt, SBTRD205-14G 7/8"

Fix the World — A "New Paradigm" Business Model

Quantum Energy Generator
CATSKILLS | NEW YORK

PROJ. NAME: 101	P/N: P1014

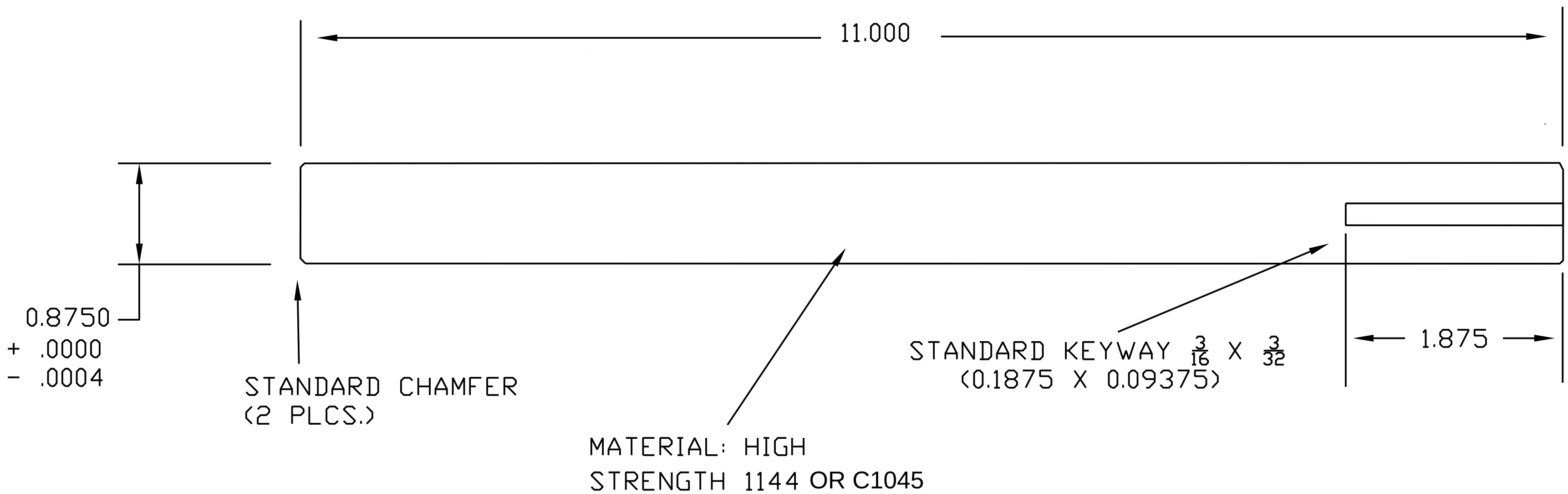
UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

COMPUTER FILE LOC: C:\FTW\101\Mech\P1014, Plate, End, 15x16.5.DFT

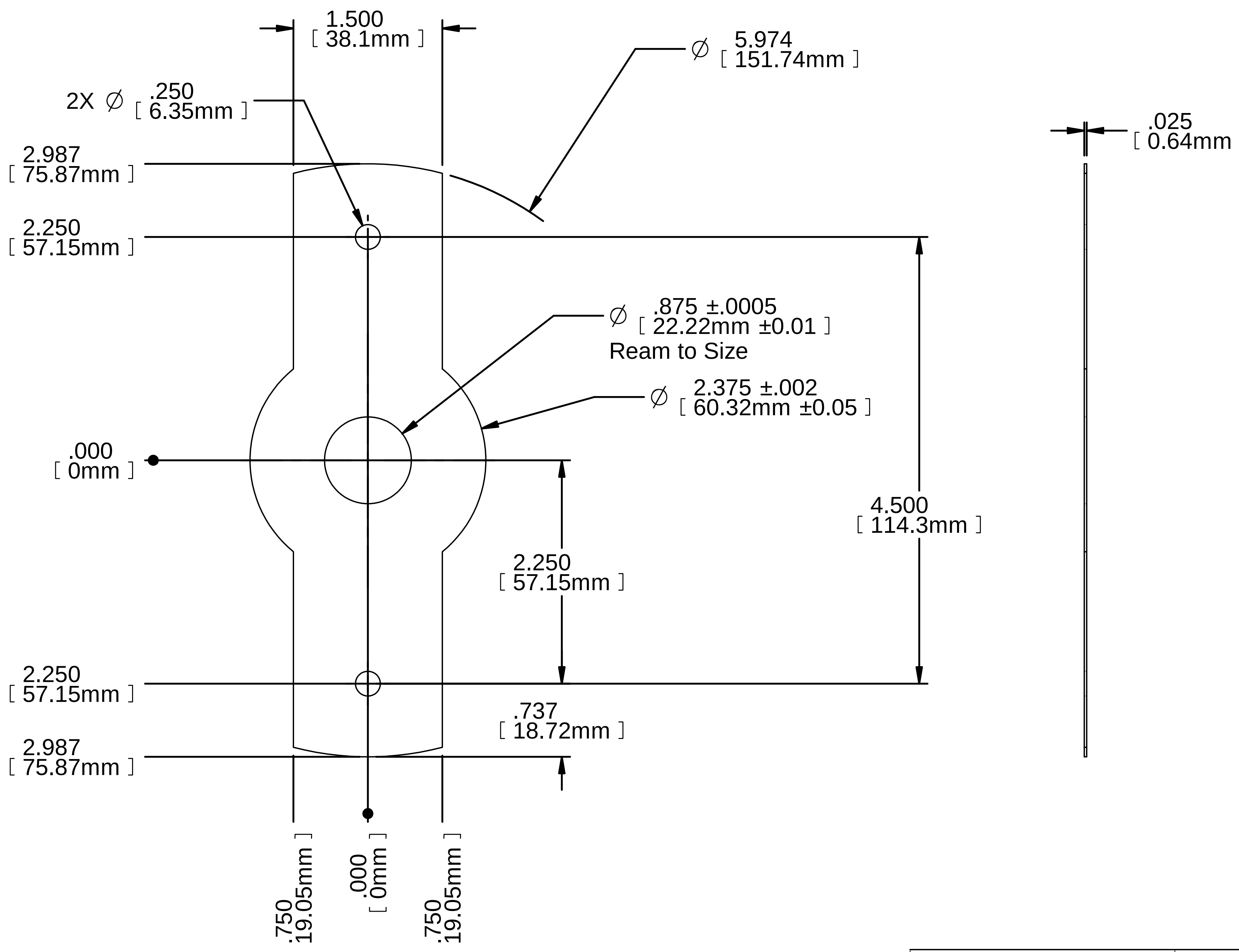
TITLE: Plate, End, 15in x 16.5in x 1/2in Fiberglass, Laminate, Epoxy, Reinforced

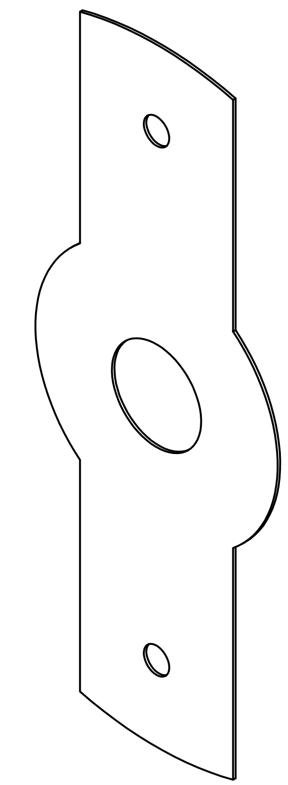
MATERIAL: See Note	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
WEIGHT:	Q'TY/ASS'Y: 2	SCALE: 1 : 3	DWG. No: B-0-101-P1014	REV. 2

SHAFT DETAIL



Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR





Note:

1. Stack and Tig Weld Rotor to a Length: 3.5" +/-.025

Fix the World
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PROJ. NAME: 101
P/N: P1002

Quantum Energy Generator
CATSKILLS | NEW YORK

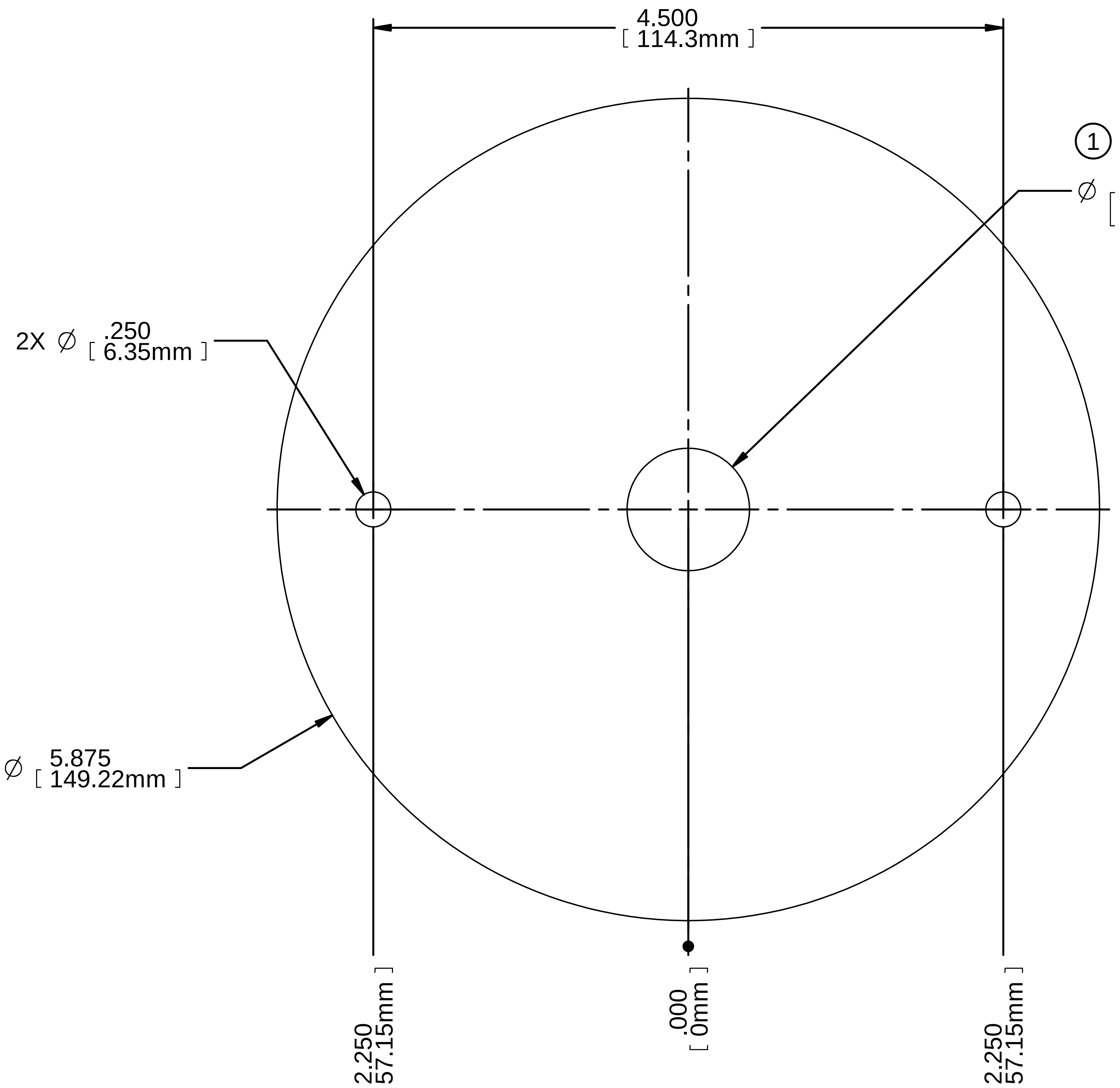
UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

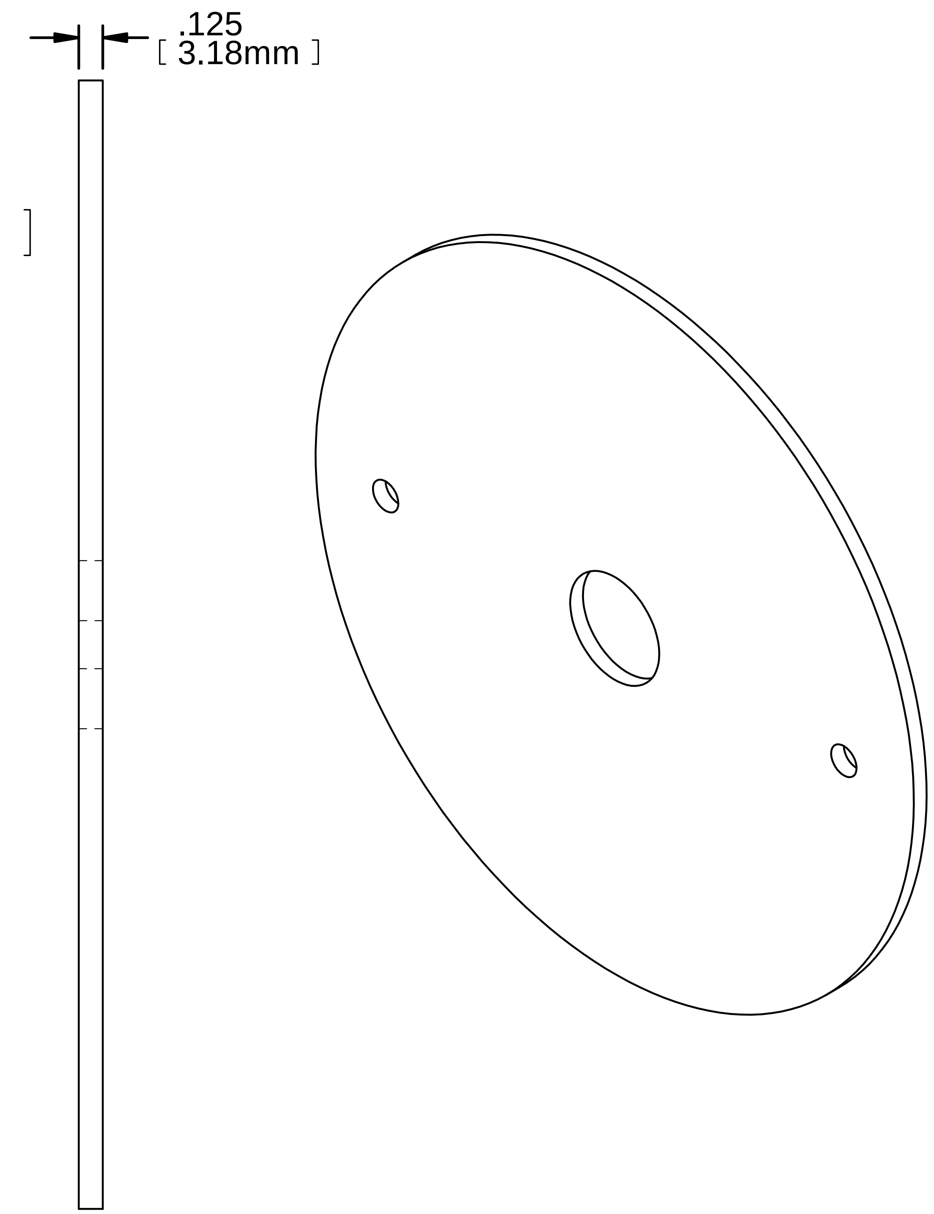
COMPUTER FILE LOC: C:\FTW\101\Mech\P1002, Rotor.DFT

TITLE:
Rotor
Generator Magnectic Core

MATERIAL: 24GA/ M19C5	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:	
FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:	
WEIGHT:	Q'TY/ASS'Y: 140	SCALE: 3 : 4	DWG. No: B-0-101-P1002	REV. 1	

Rev.	Description	Date	Init.
3	Updated consent Notice	03.25.15	IR





2 Note:

1. Material: can use either G10/FR4 or Polycarbonate (Clear plastic).

PROJ. NAME: 101	P/N: P1001	UNLESS OTHERWISE SPECIFIED: XX +/- .020, XXX +/- .005, XXXX +/- .0005, ANGLES +/- 3 DEG., FRACTIONAL TOL: +/- 1/64, ALL DIM'S ARE IN INCHES	COMPUTER FILE LOC: C:\FTW\101\Mech\P1001, Plate, Rotor.DFT			
			TITLE: Shroud, 1/8in Thk x 5.875in Dia. Fiberglass, Laminate, Epoxy, Reinforced			
Quantum Energy Generator CATSKILLS | NEW YORK		MATERIAL: See Note	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:
		FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:
		WEIGHT:	Q'TY/ASS'Y: 2	SCALE: 1 : 1	DWG. No: B-0-101-P1001	REV. 3

Fix the World
A "New Paradigm" Business Model

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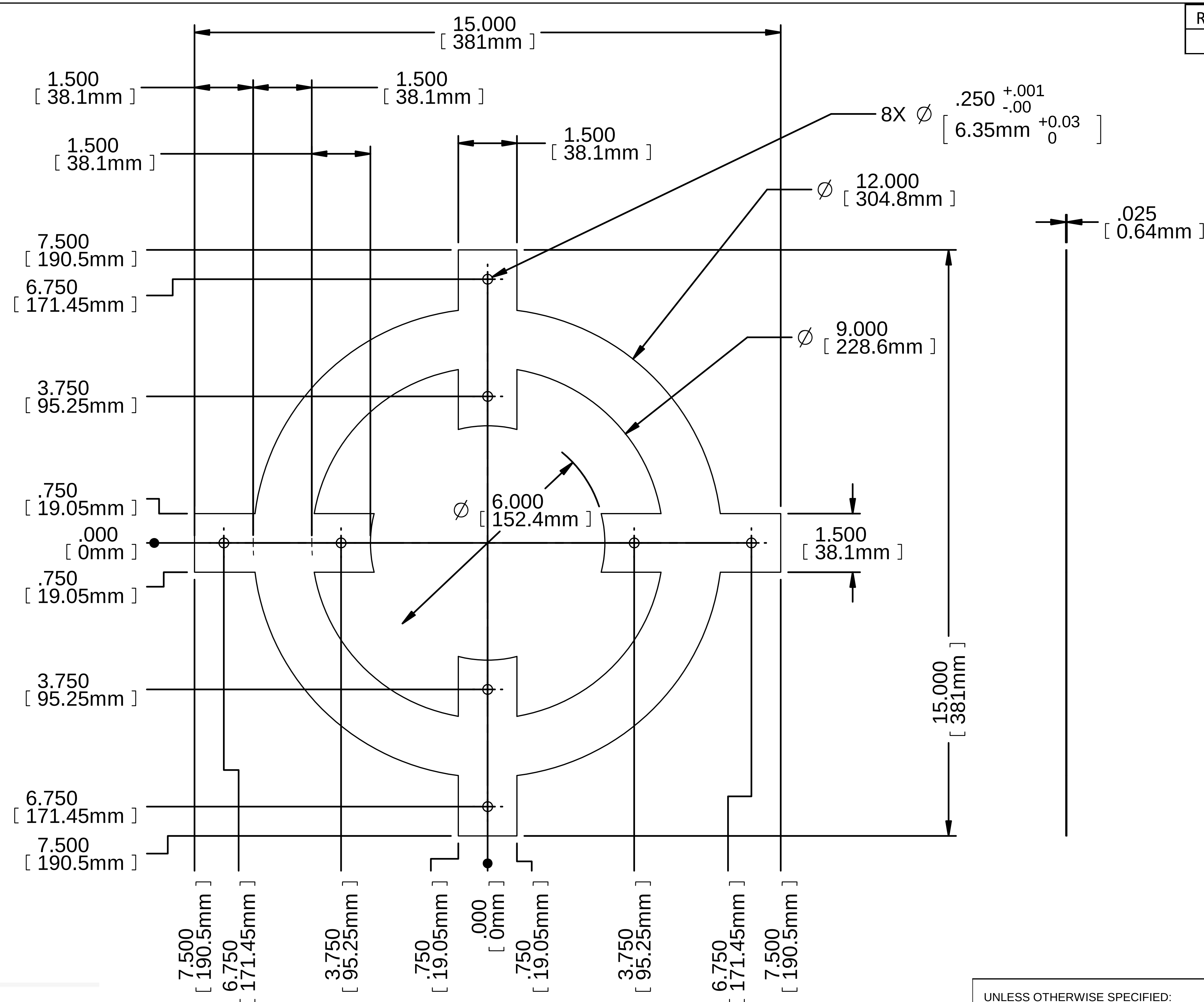
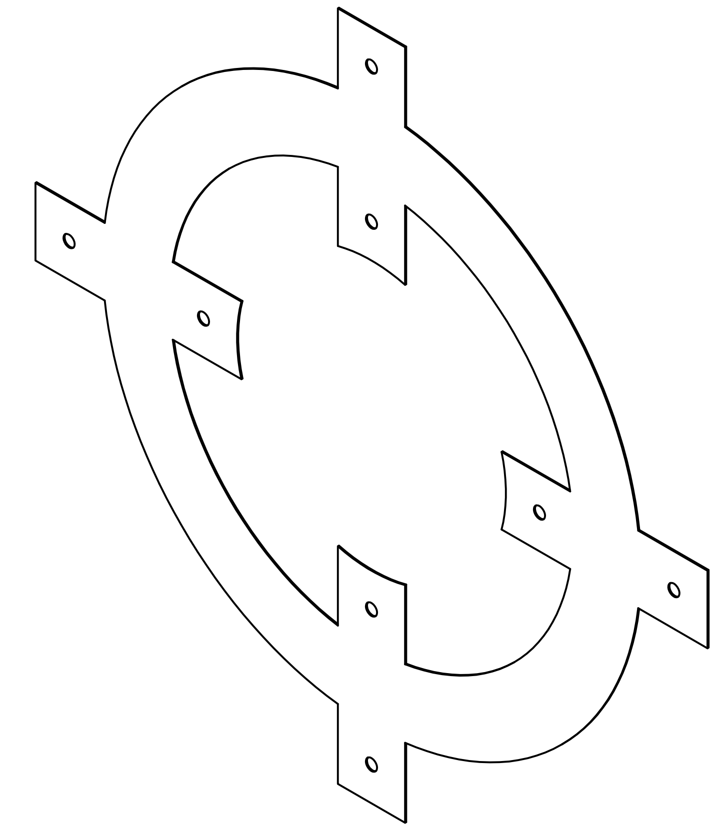
Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR





Note:

1. Stack and Tig Weld Stator to a Length: 3.5" +/-.025

Page 1 of 2

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

COMPUTER FILE LOC: C:\FTW\101\Mech\P1010, Stator, pg1.DFT

TITLE: Stator Generator Magnectic Core

PROJ. NAME: 101

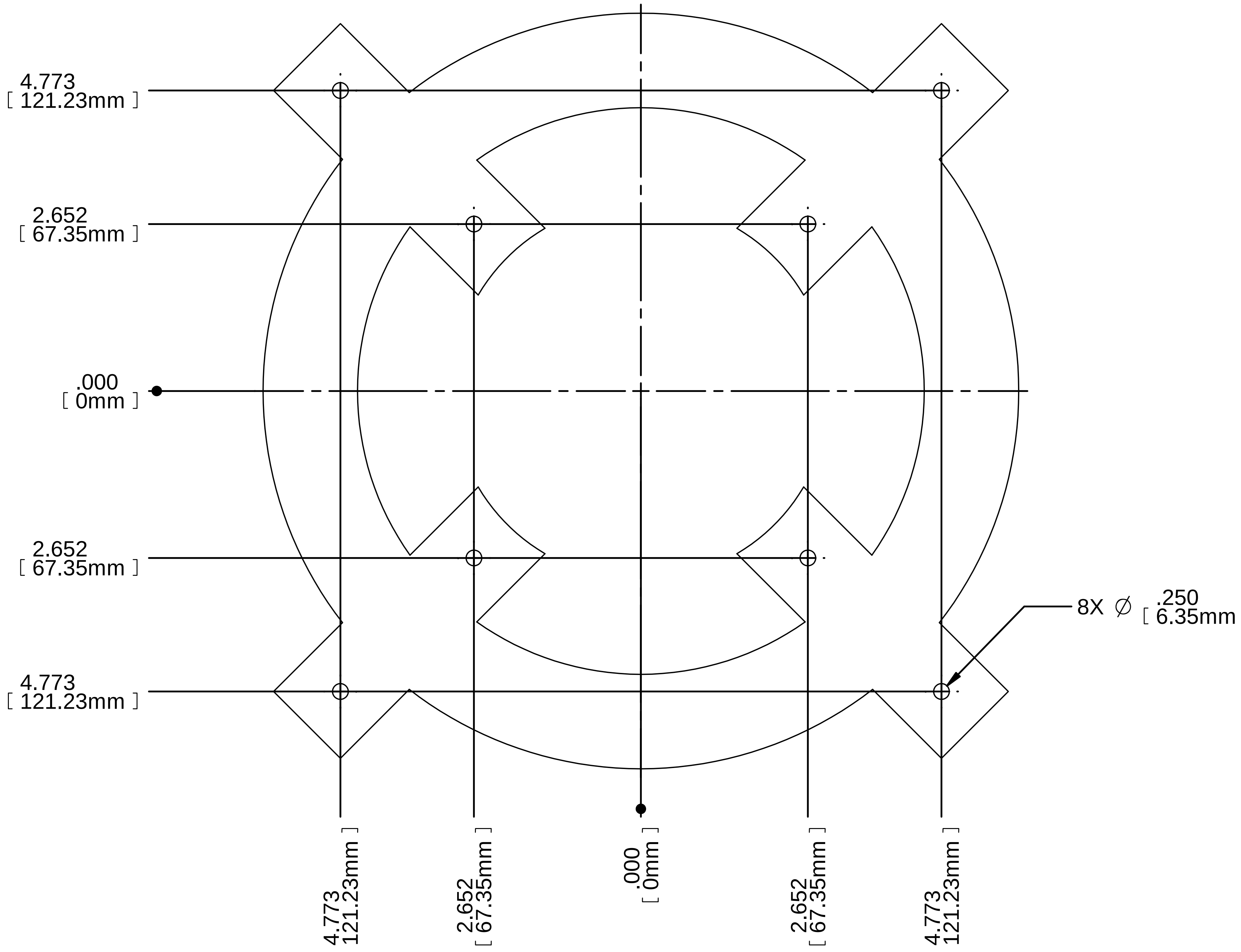
P/N: P1010

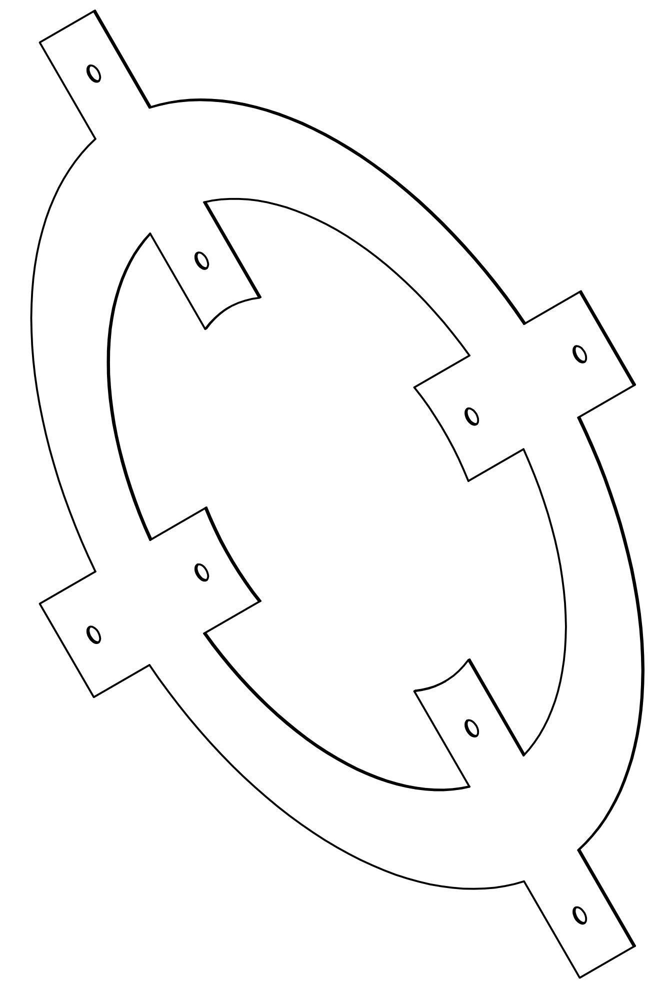
Quantum Energy Generator
CATSKILLS | NEW YORK

MATERIAL: 24GA/ M19C5	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:	DATE:	
FINISH:	DESIGNED BY: James Robitaille	DATE:	APPROVED BY:	DATE:	
WEIGHT:	Q'TY/ASS'Y: 140	SCALE: 1 : 3	DWG. No: B-0-101-P1010	REV. 1	

Fix the World
A "NEW PARADIGM" BUSINESS MODEL

Rev.	Description	Date	Init.
1	Updated consent Notice	03.25.15	IR





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Quantum Energy Generator
CATSKILLS | NEW YORK

PROJ. NAME:	101	P/N:	P1010

UNLESS OTHERWISE SPECIFIED:
XX +/- .020
XXX +/- .005
XXXX +/- .0005
ANGLES +/- 3 DEG.
FRACTIONAL TOL: +/- 1/64
ALL DIM'S ARE IN INCHES

COMPUTER FILE LOC: C:\FTW\101\Mech\P1010, Stator, pg2.DFT

TITLE: Stator at 45 Deg., Mount Position Generator Magnectic Core

MATERIAL:	24GA/ M19C5	DRAWN BY: Ivan Rivas	DATE: 03.25.15	CHECKED BY:		DATE:	
FINISH:		DESIGNED BY: James Robitaille	DATE:	APPROVED BY:		DATE:	
WEIGHT:		Q'TY/ASS'Y: 140	SCALE: 1 : 2	DWG. No: B-1-101-P1010		REV. 1	