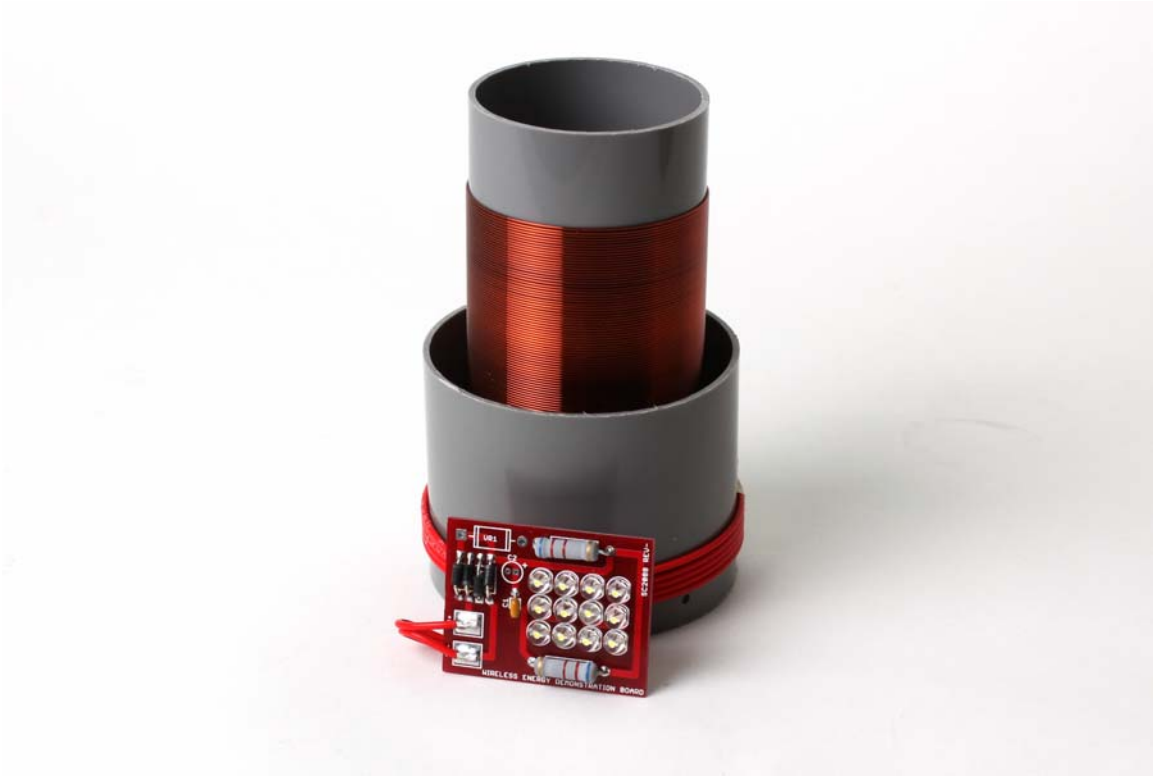
Wireless Energy Demonstration Kit



Instruction Manual

Eastern Voltage Research, LLC

AGE DISCLAIMER

THIS KIT IS AN ADVANCED, HIGH POWER SOLID STATE POWER DEVICE. IT IS INTENDED FOR USE FOR INDIVIDUALS OVER 18 YEARS OF AGE WITH THE PROPER KNOWLEDGE AND EXPERIENCE, AS WELL AS FAMILIARITY WITH LINE VOLTAGE POWER CIRCUITS.

BY BUILDING, USING, OR OPERATING THIS KIT, YOU ACKNOWLEDGE THAT YOU ARE OVER 18 YEARS OF AGE, AND THAT YOU HAVE THOROUGHLY READ THROUGH THE SAFETY INFORMATION PRESENTED IN THIS MANUAL.

THIS KIT SHALL NOT BE USED AT ANY TIME BY INDIVIDUALS UNDER 18 YEARS OF AGE.

SAFETY AND EQUIPMENT HAZARDS

PLEASE BE SURE TO READ AND UNDERSTAND ALL SAFETY AND EQUIPMENT RELATED HAZARDS AND WARNINGS BEFORE BUILDING AND OPERATING YOUR KIT.

THE PURPOSE OF THESE WARNINGS IS NOT TO SCARE YOU, BUT TO KEEP YOU WELL INFORMED TO WHAT HAZARDS MAY APPLY FOR YOUR PARTICULAR KIT.

VARIAC WARNING

DO NOT USE A VARIAC WITH THIS PRODUCT. THIS PRODUCT REQUIRES POWER THROUGH AN ISOLATED TRANSFORMER (SUCH AS THE ONES PROVIDED IN THE KITS). A VARIAC IS NOT ISOLATED AND USING A VARIAC WITH THIS PRODUCT WILL CAUSE A SHORT CIRCUIT TO OCCUR WHICH WILL RESULT IN PERMANENT DAMAGE TO THE CIRCUITS.

ELECTRICAL HAZARD

This circuit utilizes dangerous line voltages up to 115VAC. Failure to handle this circuit in a safe manner may result in serious injury or death!

POWER SEMICONDUCTOR HAZARD

This is a solid state power device. Components may fail explosively at any time and eject high velocity projectiles.
EYE PROTECTION IS REQUIRED AT ALL TIMES!

ELECTROMAGNETIC FIELD HAZARD

This device when connected to a resonator will produce strong electric and magnetic fields. Exposure to this field should be limited.
DO NOT USE THIS KIT IF YOU HAVE AN IMPLANTED BIOMEDICAL DEVICE!

FIRE HAZARD

Due to high power dissipations of the various semiconductors devices attached to the heatsink, the heatsink may become extremely hot, especially during periods of continuous operation. Please ensure the heatsink is not installed on or near any flammable material and that a cooling fan is ALWAYS used during operation.

SAFETY GUIDELINES FOR LINE POWERED EQUIPMENT

The electronic kit you purchased utilizes line voltages (115VAC) and also contains circuitry that produces output voltages in excess of 400VDC. Normally, consumer electronics equipment are safely enclosed to prevent accidental contact. However, the kit you have purchased does not come with an enclosure, and must be handled and operated with this in mind. Voltages exceeding 35V pose a safety hazard and depending on overall conditions and your general state of health, voltage and current levels have the ability to serious harm or even kill.

The following guidelines are to protect you from potentially lethal electrical shock hazards as well as the equipment from accidental damage.

It is also important to note that the danger isn't limited to only your body providing a conductive path, namely your heart. Any involuntary muscle contractions caused by an electrical shock, while perhaps harmless in themselves, may cause the person to be injured by falling, hitting a body part on something sharp, etc….

The purpose of these set of guidelines is not to frighten you, but rather make you aware of the appropriate precautions needed to safely build and operate this electronics kit.

- Perhaps, the number one rule – Don't work alone! If something does happen, it is extremely important to have someone nearby to render assistance or to call for help.
- When working on energized equipment (namely those that are line powered), always keep one hand in your pocket. This ensures there is not a complete

electrical path through your heart providing you accidentally make contact with live voltage.

- Wear footwear with non-conductive (rubber) soles. Do NOT work on line powered or high voltage equipment in barefeet.
- Always wear eye protection. Power semiconductor devices, and capacitors do have the potential to explode unexpectedly and project sharp fragments across the room.
- Always work in a clean, open area. Avoid working in cluttered spaces, especially if there are grounded objects nearby that could complete a circuit path in the event you make accidental contact with live voltage.
- Avoid wearing any kind of jewelry or other articles that could accidentally contact circuitry.
- Never operate your PC boards on top of conductive tables, or other conductive objects. PC boards should ALWAYS be supported by the provided stand-offs or placed on top of a non-conductive tabletop or other material.
- ALWAYS allow proper time for any large electrolytic or other high voltage capacitors to discharge after removing power prior to working or touching any circuit. ALWAYS use a multimeter to measure the voltage across large capacitors after power is disconnect to ensure the voltage has properly bled off.
- Use an isolation transformer if there is any chance of contacting line powered circuitry. A Variac is NOT an isolation transformer!
- Finally, if your kit involves a Tesla Coil – NEVER touch or attempt to draw an arc with an object from the output of a Tesla Coil. The output of a Tesla Coil poses not only an electrical hazard, but also a burn hazard. The output from even the smallest solid state Tesla Coil can cause serious burns. Always operate the Tesla Coil at a safe distance.

SAFETY GUIDELINES - SEMICONDUCTOR POWER DEVICES

- Always wear eye protection. Power semiconductor devices, and capacitors do have the potential to explode unexpectedly and project sharp fragments across the room.
- Power semiconductors may be extremely hot. NEVER touch any semiconductors during operation or after use. Always allow proper time for components to cool down prior to handling them.

SAFETY GUIDELINES – HIGH TEMPERATURE COMPONENTS

- Power semiconductors may be extremely hot. NEVER touch any semiconductors during operation or after use. Always allow proper time for components to cool down prior to handling them.
- The extruded aluminum heatsink will be extremely hot during and after use until it cools down to ambient temperature. NEVER place the heatsink on any material that is flammable such as wood, plastic, or paper. It is preferable to place the extruded aluminum heatsink onto a metal plate.
- NEVER operate the device without the use of a cooling fan. If you are using an extruded aluminum heatsink, be sure to blow fan parallel to the cooling fins of the heatsink to maximize the cooling effects of the fan. Always allow the cooling fan to continue running, even after power is removed, until the heatsink and board components are properly "cooled" down.

SAFETY GUIDELINES – ELECTROMAGNETIC FIELD OUTPUT

DO NOT USE THIS KIT if you have an implanted biomedical device such as a pacemaker!

- Electromagnetic fields are produced when the Tesla coil is operating. Ensure that you and others are always at least five feet away from the devices during operation (small kits), and farther away with some of the larger kits such as the miniBrute Tesla Coil kit.
- Avoid contact with metallic objects. This is mostly important for the smaller CW based Tesla coils such as the SSTC 1.0 or Class-E Audio Modulated Tesla Coil. What happens is that the electromagnetic fields cause charge to build up on your person and any contact with something metallic will initiate a potential RF burn to occur. The burns are on the magnitude of an electrostatic shock – they are rarely harmful, but they can surprise you and give you a small instant of localized pain – again similar in receiving a electrostatic shock. Maintaining at least five feet away from the Tesla coil will prevent his from occurring.
- DO NOT use this kit if you have an implanted biomedical device.

Introduction to the Wireless Energy Demonstration Kit

Thank you for purchasing the Wireless Energy Demonstration Kit. This kit is perfect to demonstrate the principle of wireless energy transfer and is designed to be used in conjunction with our Class-E Audio Modulated Tesla Coil kits.

Notice to Beginners: If you are a first time kit builder, you may find this instruction manual easier to understand than expected. Each component in this kit has an individual check box, while a detailed description of each component is provided as well. If you follow each step in the instruction manual in order, and practice good soldering and kit building skills, the kit is next to fail-safe.

Please read this manual in its entirety before building, testing, or operating your kit!

Circuit Description

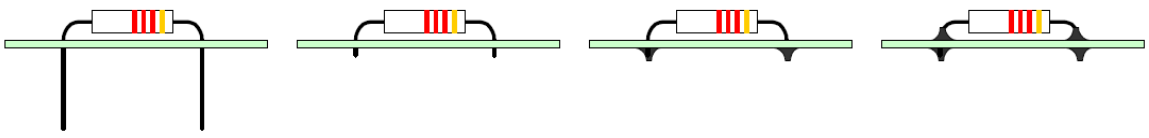
The Wireless Energy Demonstration Kit features a tuned Tesla Resonator and a ultra high speed rectification circuit which converts the 4MHz energy from the Class-E Audio Modulator into voltage and current which is used to illuminate twelve (12) ultra-bright white LEDs. Firstly, a Tesla Resonator consisting of primary coil, L101 and secondary coil, L102, which is tuned precisely at 4MHz, is brought into close proximity (within 3 feet) of the Tesla Resonator from the Class-E Audio Modulator Kit. The electromagnetic field radiated by the Class-E Audio Modulator is then coupled into this second Tesla Resonator where it is rectified by ultra high speed schottky diodes, CR1, CR2, CR3, and CR4, and then filtered by capacitor, C1. The voltage developed across C1 is then used to provide power to two strings of six (6) ultra-bright white LEDs. R1 and R2 serve as current limiting resistors for each LED string and VR1 is a voltage suppressor to protect the schottky diodes, CR1, CR2, CR3, and CR4, from over-voltage.

Kit Building Tips

A good soldering technique is key! Let your soldering iron tip gently heat both the wires and pads simultaneously. Apply solder to the wire and the pad when the pad is hot enough to melt the solder. The finished joint should appear like a small shiny drop of water on paper, somewhat soaked in. If the pads have not heated up sufficiently, melted solder (heated only by the soldering iron itself) will form a cold solder joint and will not conduct properly. These cold joints appear as dull beads of solder, and can be easily fixed by applying additional heat to the pad and wire. All components, unless otherwise noted, should be mounted on the top side of the board. This is the side with the silkscreen printing.

When installing components, the component is placed flat to the board and the leads are bent on the backside of the board to prevent the part from falling out before soldering. The part is then soldered securely to the board, and the remaining lead length is clipped off. It is also extremely important to place the components as close to the board as possible. This is necessary for proper operation over the wide frequency range of the various kits we provide. Also be sure that component lead lengths are always as short as possible. This will avoid adding any stray capacitances or inductances that can be detrimental to circuit operation.

An alternative approach (which is actually the one I use) is to install the component into the board and then apply a piece of masking tape on the topside to the hold the component in place temporarily. The leads on the backside of the board are then trimmed leaving about 0.10” lead protruding through the backside of the board, and then soldered from the backside. You can then remove the masking tape, and finally apply a small amount of solder on the top to complete the joint on both sides. This is shown in the figure below.



Wireless Energy Demonstration Kit Parts List

RESISTORS

❒	2	6.2k ohm Resistor, 2W (blue-red-red), R1,R2

CAPACITORS

❒	1	1uF Ceramic Capacitor (marked M39014/02-1407 or BC105), C1

DIODES

❒	12	LED, White, D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12
❒	4	STPS1150 Diode (marked STPS1150), CR1,CR2,CR3,CR4
❒	1	1.5KE150CA Transient Voltage Suppressor (marked 1.5KE150CA), VR1

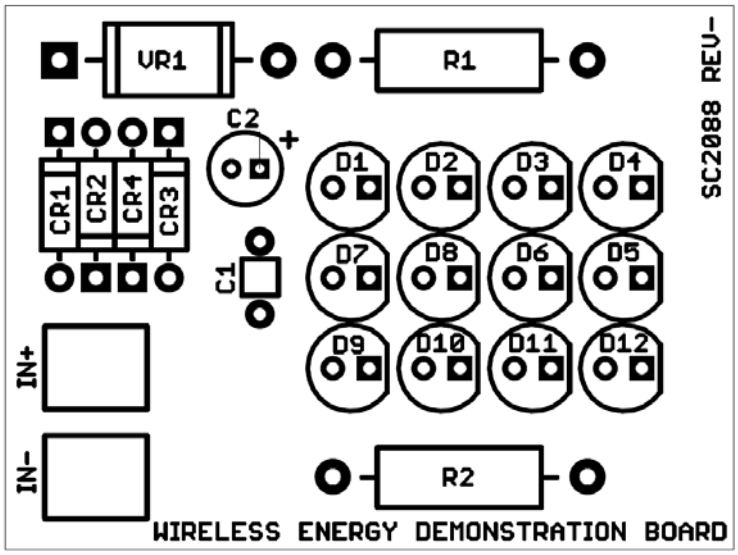
MISCELLANEOUS

❒	1	Primary Coil Form, 3.1” DIA
❒	1	Secondary Coil Form, 2” DIA
❒	1	Centering Ring, 3.1” to 2”
❒	1	Magnet Wire, 22 AWG, 1/4LB Spool
❒	1	Primary Wire, 20-22AWG, 5 Foot Length
❒	1	Ground Wire, Black
❒	1	PCB Board, Flyback Driver 2.0
❒	1	Schematic, Flyback Driver 2.0

REQUIRED, NOT SUPPLIED

❒	A/R	Two-Part Five Minute Epoxy
❒	A/R	Masking Tape and/or Electrical Tape

Wireless Energy Board - Component Layout Diagram



KIT Building Instructions

Now we will begin building the kit. There are just a few more important things to know before we install the first components.

For each component, the word "install" always means the following:

1. Pick the correct value to start with.
2. Insert the component into the correct printed circuit board (PCB) location.
3. Orient the component correctly – especially when there is a right and a wrong way to solder it in. (i.e. Electrolytic capacitors, diodes, ICs, transistors, etc…)
4. Solder all connections unless directed otherwise. Ensure enough heat is used to allow solder to flow for clean, shiny, and completed connections.

Also, please be sure to take us seriously when we say that good soldering is the key to the proper operation of your circuit!

- Use a 25W soldering pencil with a clean, sharp tip. DO NOT USE a high power soldering gun such as those trigger activated units.
- Use only rosin core solder intended for electronics use
- Ensure your work area is clean, and has plenty of bright lighting
- Build your kit in stages, taking breaks to check your work. Be sure to clean the board periodically with a brush or compressed air to remove any excess wire cuttings, etc…

Okay, so lets begin!

❒ 1. Install R1, 6.2k ohm, 2W resistor (blue-red-red)

❒ 2. Install R2, 6.2k ohm, 2W resistor (blue-red-red)

❒ 3. Install CR1, STPS1150 diode. The cathode band on the diode must match that shown on the silkscreen.

❒ 4. Install CR2, STPS1150 diode. The cathode band on the diode must match that shown on the silkscreen.

❒ 5. Install CR3, STPS1150 diode. The cathode band on the diode must match that shown on the silkscreen.

❒ 6. Install CR4, STPS1150 diode. The cathode band on the diode must match that shown on the silkscreen.

❒ 7. Install C1, 1uF capacitor (marking M39014/02/1407 or BC105)

❒ 8. Install D1, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 9. Install D2, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 10. Install D3, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 11. Install D4, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 12. Install D5, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 13. Install D6, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 14. Install D7, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 15. Install D8, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 16. Install D9, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

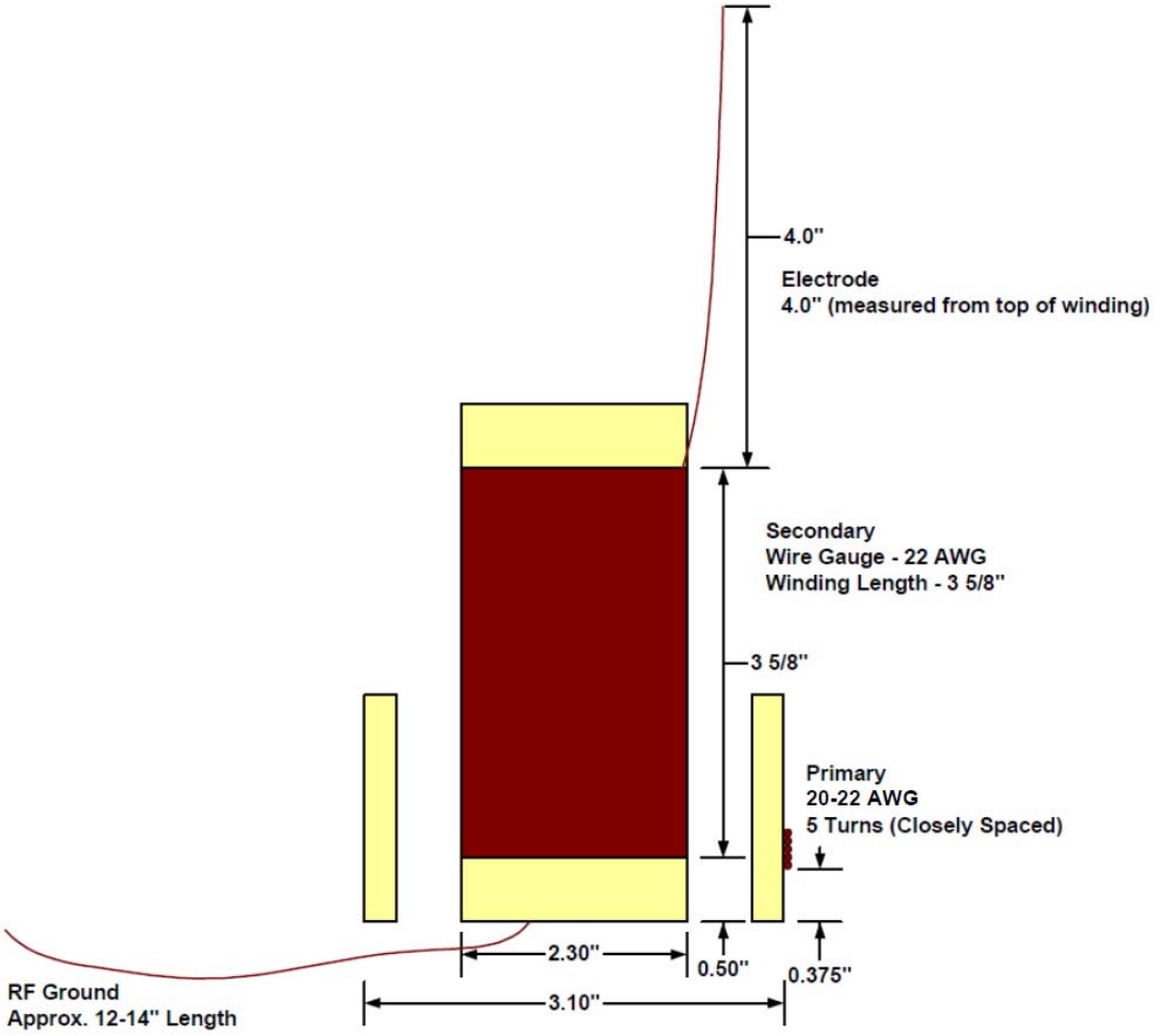
❒ 17. Install D10, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 18. Install D11, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 19. Install D12, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.

❒ 20. Now the fun part – winding the secondary coil. Using the figure below, wind the secondary coil using the included 2.2" secondary coilform and 22 AWG spool of wire. First place the spool of wire on a stationary rod so that it can spin freely. Next, either manually holding the secondary in your hand, or using a winding jig (built by user) wind a few extra turns at the base of the secondary and use masking or electrical tape to hold in place. **Be sure to leave about 14" of 22 AWG at the bottom of the secondary as this will be used to connect the**

secondary RF ground to the included ground wire and PCB board. Begin winding the secondary at the locations shown in the figure below. Continue winding the secondary, ensuring each wind is neat and tightly together with adjacent windings, for the entire length as indicated in the figure below. Adding masking tape every inch or so will ensure the windings don't unwind and also allows you to take rests if needed. Once you are completed, tape off the end of the winding, and finally add a few extra turns. Do not coat the secondary coil at this time. You will first need to tune the coil for proper operation and may need to adjust the number of turns.

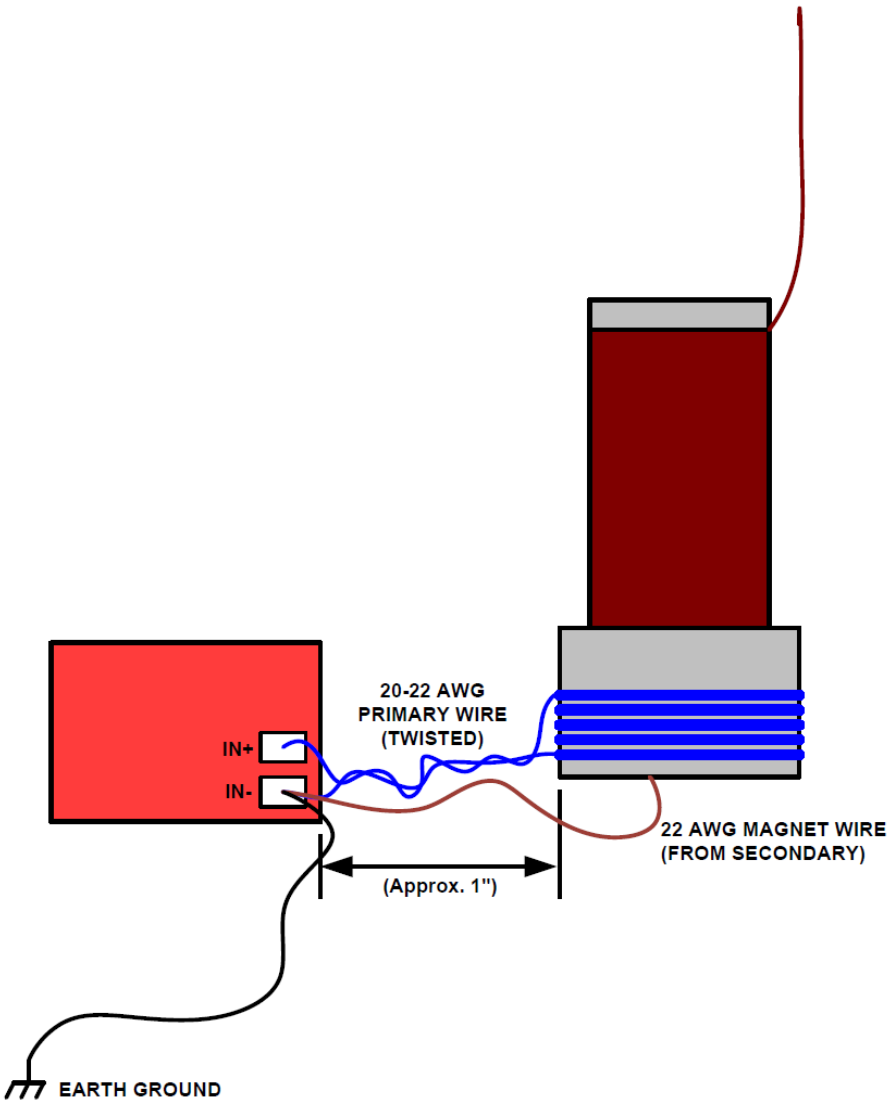


❒ 21. Form the top wire of the secondary into a discharge electrode as shown in the figure above. For initial tuning, is extremely important that the wirelength is precisely the length as shown in the figure above.

❒ 22. Using the included 3.1" DIA primary coilform and 20-22 AWG wire, wind the primary coil as shown in the figure above. It is especially important to ensure the proper dimensioning of the primary coil as this is crucial to the operation and tuning of the Class-E Tesla coil. The primary coil can then be secured in place using masking or electrical tape (not supplied), or two-part epoxy (not supplied).

DO NOT connect the primary coil to the PCB board at this time.

❒ 23. Using five-minute epoxy (not supplied) or similar adhesive, attach the primary coil to the secondary coil using the included plywood centering ring.



❒ 24. Using the diagram above, attach the two ends of the primary to the PCB board as shown. Polarity is not important. Twist the primary wires together and ensure the distance between the PCB board and primary coil is 1 inch or less. This 1 inch number is merely for aesthetic reasons – to keep everything short and neat looking.

❒ 25. Attach the included black ground wire to the IN- terminal of the PCB board. This wire will be attached to EARTH ground for the safety reasons.

Congratulations! You have just completed your Wireless Energy Demonstration kit. Please take a few moments to look over the board and ensure that all the components are installed properly with the correct orientation. Since some of the parts may be unfamiliar to you, you may want to be extra sure that they have been inserted correctly. After you are sure that everything seems to be properly installed, move on to the set-up and testing section.

Set-up and Testing

Okay, so lets begin!

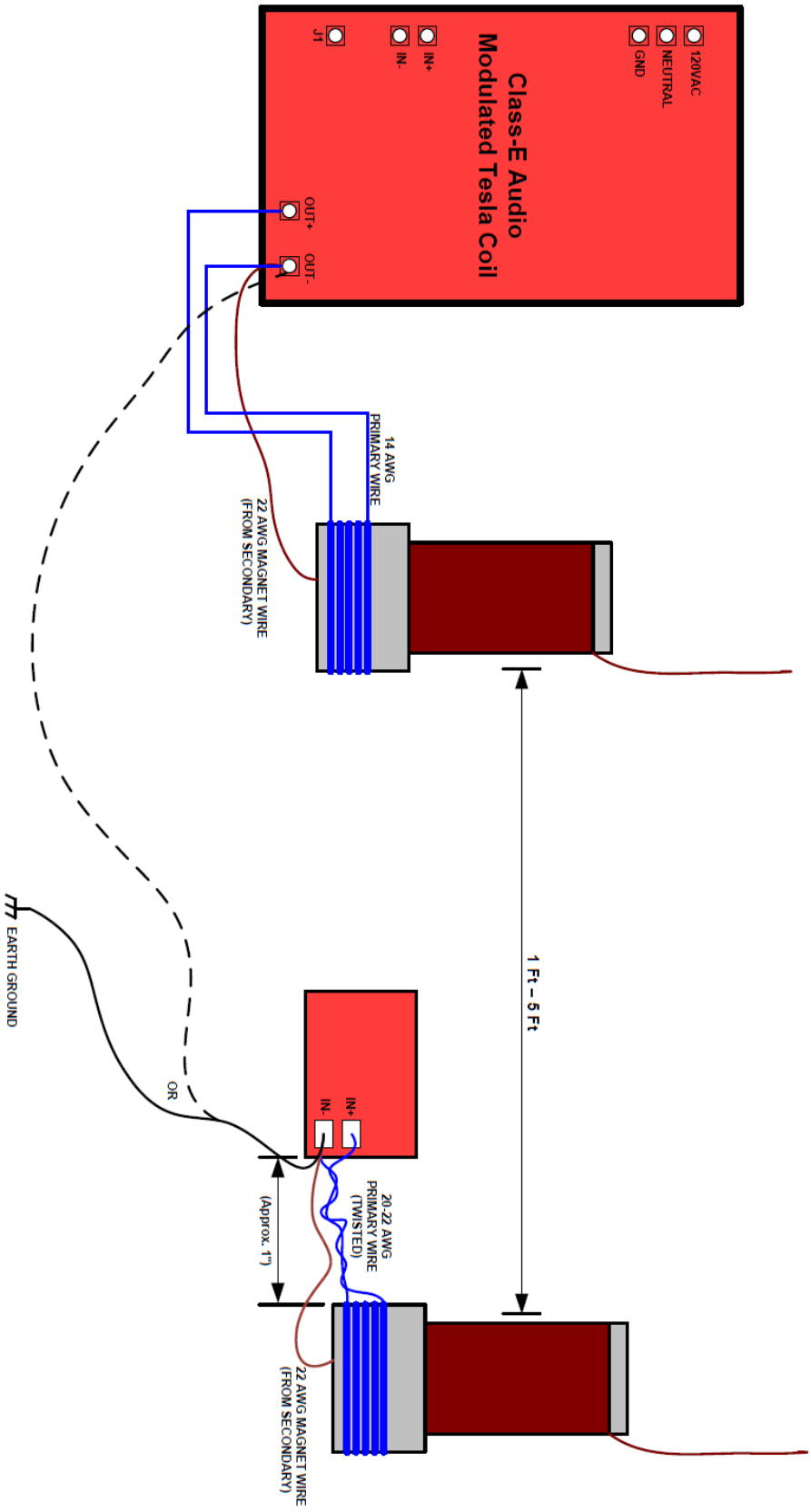
RECOMMENDED TEST EQUIPMENT, NOT SUPPLIED

❒ None required

Please be sure to wear safety glasses when testing and operating the Wireless Energy Demonstration Kit

❒ 1. Attach the black ground wire to any EARTH ground that is readily available as shown in the figure below. This can be the GND terminal on the Class-E PCB board, installed conductive plumbing pipe in your home / office, or even directly to a large piece of metallic furniture such as a desk, table, or even tool chest.

The reason for this connection is two-fold. Firstly, it ensures that the wireless demonstration kit PCB board is not floating electrically. High voltage will be developed on this kit during operation and for safety reasons, it is important to keep the primary coil and PCB board at a low potential for safe handling. Secondly, it ensures that any coronal discharge will form at only the top of the secondary coil. If the secondary was not floating, or grounded in a different location that at the bottom, the voltage peak on the secondary coil may occur in a different location then the top and cause high voltage to damage the secondary winding.


Class-E Audio
Modulated Tesla Coil
J1
IN-
IN+
GND
NEUTRAL
120VAC
OUT-
OUT+
14 AWG
PRIMARY WIRE
22 AWG MAGNET WIRE
(FROM SECONDARY)
1 Ft – 5 Ft
EARTH GROUND
OR
IN
IN+
(Approx. 1")
20-22 AWG
PRIMARY WIRE
(TWISTED)
22 AWG MAGNET WIRE
(FROM SECONDARY)

❒ 3. If your wireless coil is connected as shown above, then you are ready for test. Begin by placing your wireless demonstration coil approx. 3 feet from your Class-E resonator coil. Apply power to the Class-E Resonator coil and your wireless demonstration coil should begin to illuminate.

❒ 4. Move your wireless demonstration coil to different locations, closer and farther, and see how the LEDs get brighter and dimmer. When moving the wire demonstration coil, be sure to grasp the coil by the primary coil form. Do not touch any portion of the secondary coil.

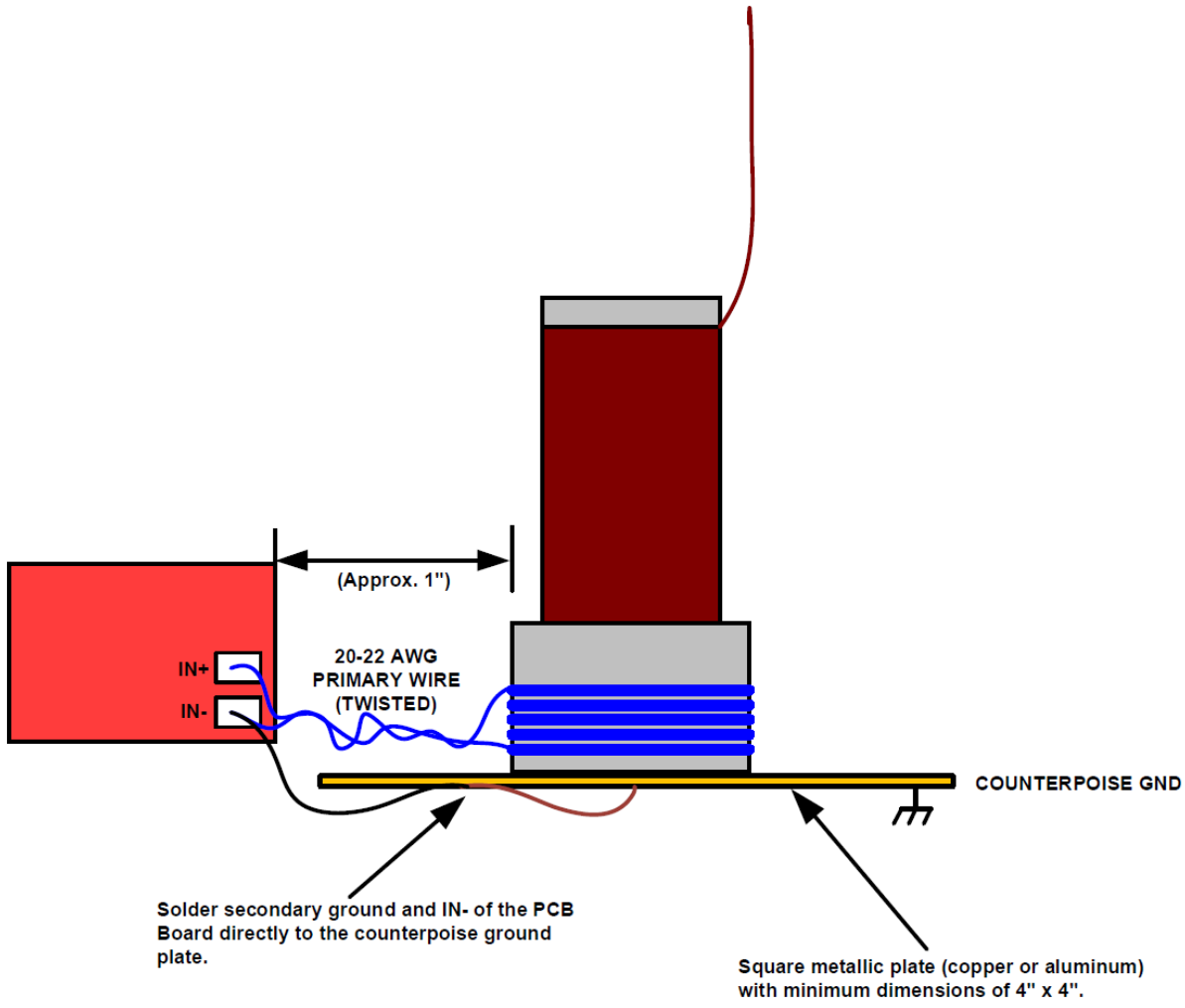
NEVER touch the secondary coil of the wireless demonstration unit while your Class-E Audio Modulator is operating. If you have to move the wireless demonstration unit, grasp it by the base of the primary coil form. Otherwise, you may receive a small burn from the high voltage present on the secondary coil.

To increase the longevity of your kit, we recommend not positioning the wireless demonstration kit closer than 1 ft. to the Class-E Tesla Resonator. Doing so may couple excessive energy into the wireless demonstration PCB board and overvoltage some of the devices on the board.

Congratulations! Your Wireless Energy Demonstration Kit is now completed and operational.

Counterpoise Ground Arrangement

If you wish to operate this unit without the connecting ground wire, you may wish to employ a counterpoise type grounding arrangement as shown in the figure below. We recommend a small metallic plate (copper or aluminum is ideal) with minimum dimensions of 4” x 4”.



Troubleshooting

PROBLEM: LEDs do not illuminate
SOLUTION: Ensure the wireless demonstration unit is wired to the exact dimensions as specified in the figures above and that the diodes and LEDs are installed with the correct polarity on the PCB board.

Conclusion

We sincerely hope that you have enjoyed the construction of this Eastern Voltage Research Kit. As always, we have tried to write this instruction manual in the easiest, most "user friendly" format that is possible. As our customers, we value your opinions, comments, and additions that you would like to see in future publications. Please submit comments or ideas to:

Eastern Voltage Research, LLC

Technical Support
support@easternvoltageresearch.com

Thanks again from the people here at Eastern Voltage Research.

Terms and Conditions of Sale

Before opening or assembling your kit, please read and review the latest Terms and Conditions of Sale on our website at the following link:

http://www.easternvoltageresearch.com/terms.html