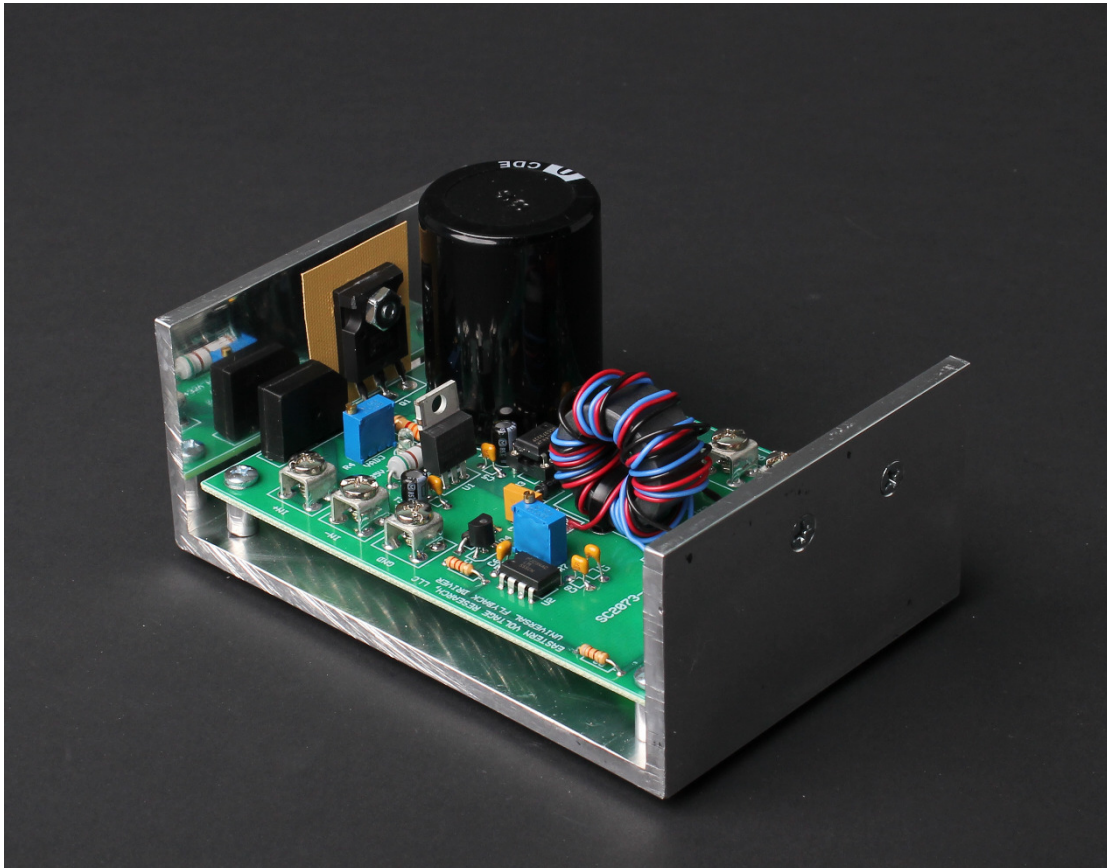


Universal Flyback Driver



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

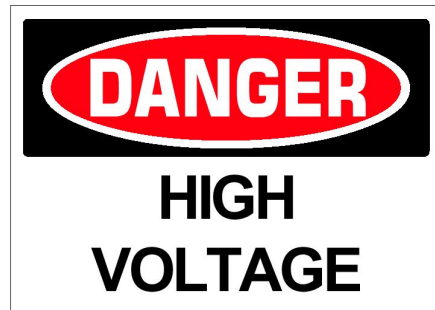
PLEASE BE SURE TO READ AND UNDERSTAND ALL SAFETY AND EQUIPMENT RELATED HAZARDS AND WARNINGS BEFORE BUILDING AND OPERATING YOUR KIT.

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 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 this from occurring.
- DO NOT use this kit if you have an implanted biomedical device.

Introduction to the Universal Flyback Driver

Thank you for purchasing the Universal Flyback Driver. The Universal Flyback Driver is a high power drive circuit which can be used with virtually all open-core type flyback transformers to generate high voltage arcs. With onboard controls to vary both output frequency and voltage, it's an extremely flexible design which can be used to drive almost any open-core flyback transformer.

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 Universal Flyback Driver is an open-loop half-bridge switching power supply. It is called "open loop" as the output voltage is not regulated. Both control and half-bridge power are first rectified and filtered through BR1 and C3 respectively to produce approximately 25-35VDC. Linear regulator, U1 (LM7812) provides the +12VDC control voltage. Transistor, Q1 (N-Channel MOSFET) is utilized as the voltage control device, and with potentiometer R4, the user can vary the output voltage of the flyback driver. The oscillator of the flyback driver utilizes a 555 Timer IC running in astable mode (continuous operation) and has a variable frequency between approximately 5kHz and 120kHz which is controlled via potentiometer, R7. The unique configuration of this 555 Timer circuit provides a nearly 50% duty cycle regardless of the frequency setting. Finally, the 555 Timer output is fed into a high current gate driver, U3, which drives the half-bridge switching transistors (200V N-Channel MOSFETs), Q2 and Q3, whose output is connected directly to the flyback transformer's primary winding. Gate transformer, T2, provided electrical isolation between the control circuit and the half-bridge switching circuit.

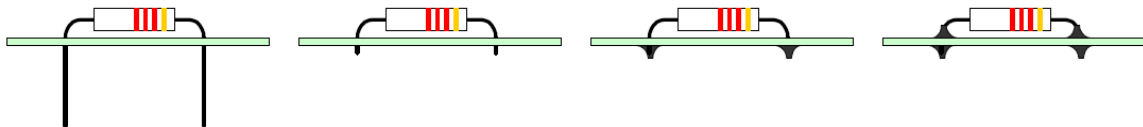
This circuit can also be used to drive a solid state Tesla Coil (SSTC) resonator in open-loop mode. Open loop means that the user sets the output frequency, so it wouldn't be a self-tuning SSTC – it would have to be manually tuned via R7 so that the 555 Timer output frequency matches the resonant frequency of the resonator.

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 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.



Universal Flyback Driver Parts List**RESISTORS**

- 2 62 ohm Resistor, 2W (blue-red-black), R1,R10
- 1 3.3k Resistor, 1/2W (orange-orange-red), R2
- 1 10 ohm Resistor (brown-black-black), R5
- 2 5.1 ohm Resistor, 2W (green-brown-gold),R8,R9
- 1 1k ohm Resistor (brown-black-red), R3
- 1 2.2k Resistor (red-red-red), R6
- 2 100k Potentiometer, R4,R7

CAPACITORS

- 4 0.1uF Ceramic Capacitor, C2,C5,C6,C10
- 2 10uF Electrolytic Capacitor, C1,C4
- 1 10uF Tantalum Capacitor, C9
- 1 15000uF 50V Electrolytic Capacitor, C3
- 1 2200pF Ceramic Capacitor, C7
- 1 0.01uF Ceramic Capacitor (marked M39014/01-1455 or BC103), C8
- 1 1uF Ceramic Capacitor (marked M39014/02-1407 or BC105), C13
- 2 0.68uF 250V Polypropylene Capacitor, C11,C12

DIODES

- 1 Bridge Rectifier (marked KBL01 or KBL02), BR1
- 2 LED, Blue, D1,D2
- 2 1N4002 Diode (marked 1N4002), CR1,CR2
- 2 1N5819 Diode (marked 1N5819), CR3,CR4

SEMICONDUCTORS

- 2 IRFP260 MOSFET, Q2,Q3
- 1 IRFP3306 or IRFP260 MOSFET, Q1
- 1 2N3904 Transistor, Q4

INTEGRATED CIRCUITS (ICs)

- 1 15V Regulator (marked LM7815), U1
- 1 555 Timer (marked 555), U2
- 1 Non-Inverting Gate Driver (marked UCC37322), U3

MISCELLANEOUS

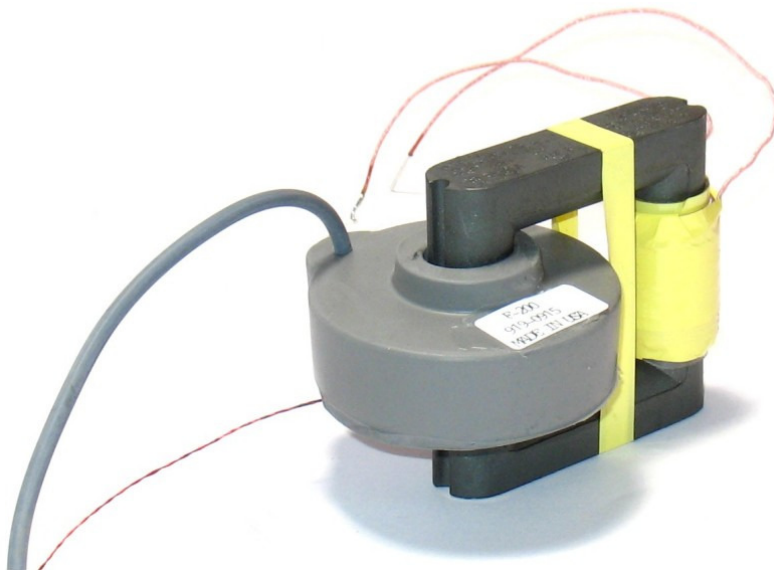
- 1 8DIP IC Socket
- 5 Screw Terminals
- 1 Power Transformer
- 1 Ferrite Toroid
- 1 Extruded U-Channel Heatsink
- 1 TO-220 Heatsink
- 1 Misc. Hardware
- 1 AC Power Cord

RECOMMENDED, NOT SUPPLIED

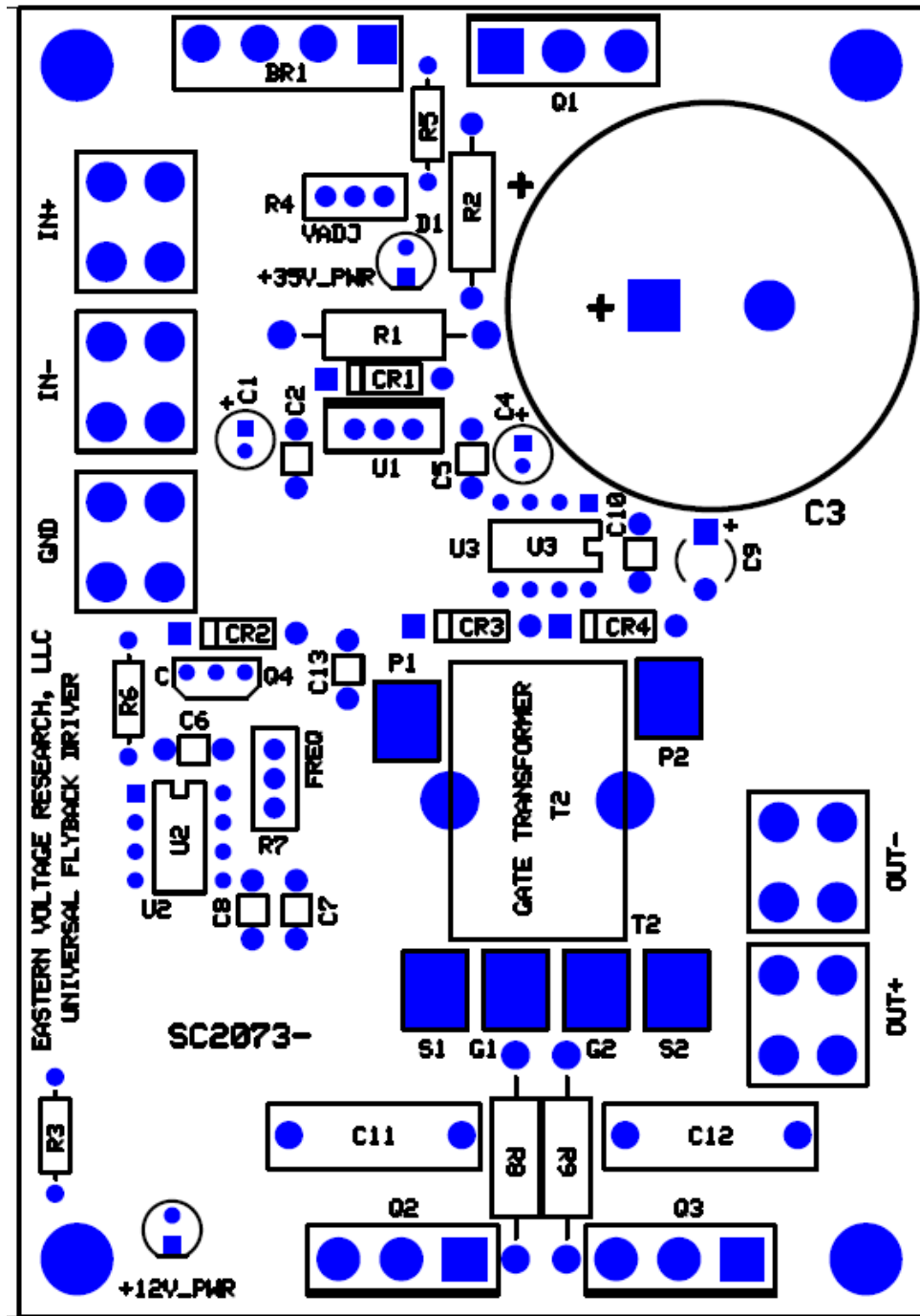
- 1 Enclosure for Universal Flyback Transformer board

REQUIRED, NOT SUPPLIED

- 1 Flyback Transformer (open core, old style preferred)
- A/R Electrical Tape or Wire Nuts



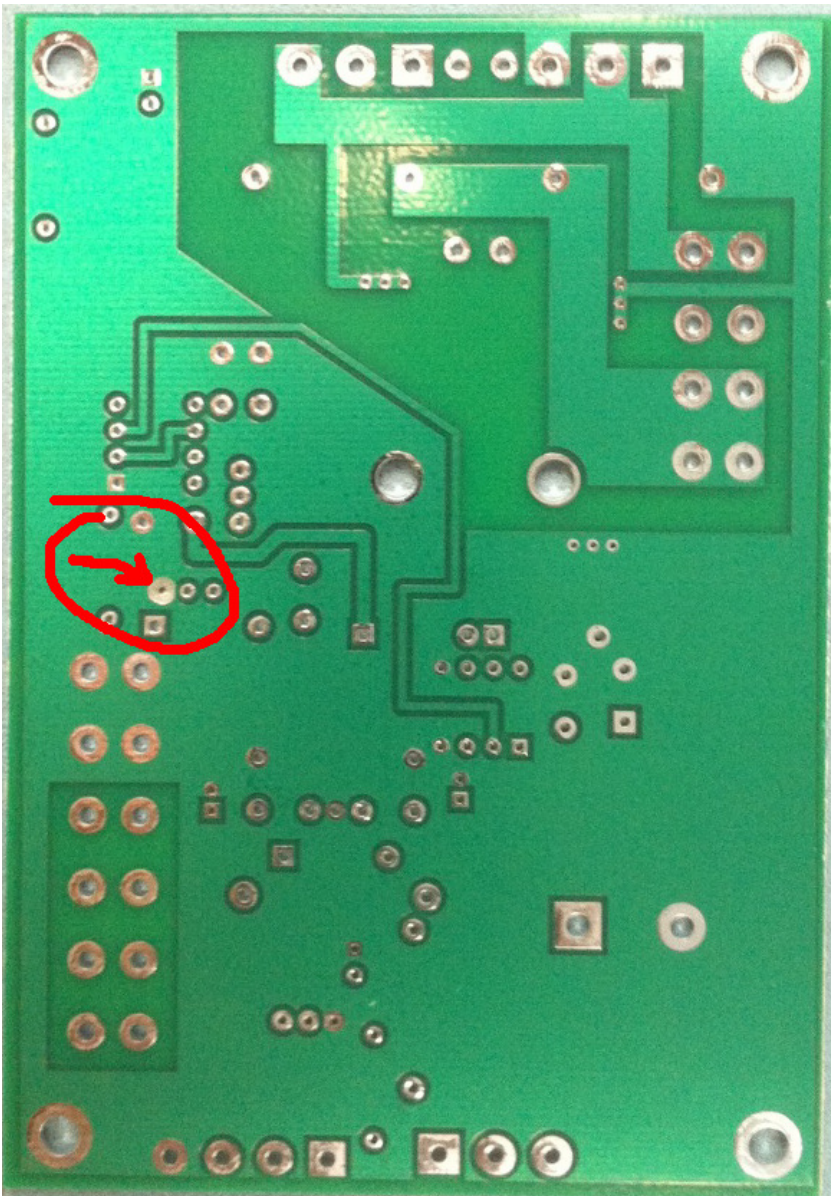
Universal Flyback Driver Component Layout Diagram



Special Rework for REV - Boards

There is a special rework required for REV- Universal Flyback Driver boards. Most of these boards have already been reworked, but in some cases, they may have been shipped out without the rework.

Before working on the board, ensure that the via (marked with a red arrow) has been drilled out slightly to isolate the via (top side of board) from the GND plane on the bottom side of board. This can be done by hand by simply placing a small drillbit on the via and turning a few times (is is shown below)



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 and R10, 62 ohm, 2W resistors (blue-red-black). These resistors will be installed in a stacked configuration in the R1 location on the PC board. These resistors will get hot so be sure to space them slightly above the board. They should be installed as shown below:



- 2. Install R2, 3.3k, 1/2W ohm resistor (orange-orange-red)
- 3. Install R3, 1k resistor (brown-black-red)
- 4. Install R5, 10 ohm resistor (brown-black-black)

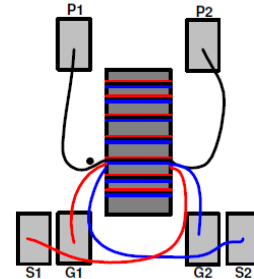
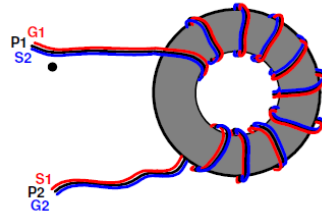
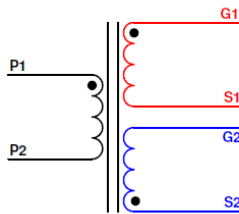
- 5. Install R6, 2.2k resistor (red-red-red)
- 6. Install R8, 5.1 ohm, 2W resistor (green-brown-gold)
- 7. Install R9, 5.1 ohm, 2W resistor (green-brown-gold)
- 8. Install CR1, 1N4002 diode. The cathode band on the diode must match that shown on the silkscreen.
- 9. Install CR2, 1N4002 diode. The cathode band on the diode must match that shown on the silkscreen.
- 10. Install CR3, 1N5819 diode. The cathode band on the diode must match that shown on the silkscreen.
- 11. Install CR4, 1N5819 diode. The cathode band on the diode must match that shown on the silkscreen.
- 12. Install C2, 0.1uF capacitor (marking BC104)
- 13. Install C5, 0.1uF capacitor (marking BC104)
- 14. Install C6, 0.1uF capacitor (marking BC104)
- 15. Install C10, 0.1uF capacitor (marking BC104)
- 16. Install C7, 2200pF capacitor (marking BC222)
- 17. Install C8, 0.01uF capacitor (marking BC103 or M39014/01-1455)
- 18. Install C13, 1uF capacitor (marking M39014/02/1407 or BC105)
- 19. Install C1, 10uF, 50V electrolytic capacitor. C3 has “polarity.” Polarity means the capacitor must be inserted a certain way. You may notice that one side of the capacitor, there is a black stripe with minus signs. This is the negative end. Looking at the PCB silkscreen, you will notice the positive side marked. Install this capacitor into the board ensuring the positive side of the capacitor installs in the hole that is marked positive on the PCB layout.
- 20. Install C4, 10uF, 50V electrolytic capacitor. Install this capacitor into the board ensuring the positive side of the capacitor installs in the hole that is marked positive on the PCB layout.

- 21. Install C9, 10uF, 35V tantalum capacitor (marking 10635). Install this capacitor into the board ensuring the positive side of the capacitor installs in the hole that is marked positive on the PCB layout.
- 22. Install C11, 0.68uF, 250V polypropylene capacitor.
- 23. Install C12, 0.68uF, 250V polypropylene capacitor.
- 24. Install D1, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.
- 25. Install D2, LED. The short lead of the diode is the cathode and will install into the square pad on the PCB board.
- 26. Install an 8-pin DIP socket into the U3 location. Note that one end of the DIP socket is marked by a notch; this end **MUST** be oriented as shown on the PCB layout.
- 27. Install U3, UCC37322 Gate Driver IC into the 8-pin DIP socket that was installed in the previous step. Note that one end of the IC is marked by a dot, notch, or band; this end **MUST** be oriented as shown on the PCB layout.
- 28. Install U2, 555 Timer. The 555 Timer IC may be soldered directly to the PCB without worry, but you may use an 8-pin DIP socket (your own) if you prefer. Use the same care in soldering such a socket and inserting the IC as you would in direct soldering of the chip. Note that one end of the IC is marked by a dot, notch, or band; this end **MUST** be oriented as shown on the PCB layout.
- 29. Install Q4, 2N3904 transistor. This transistor needs to be orientated properly. Please insert Q4 into the board with the flat edge of the transistor orientated according to the silkscreen layout drawing.
- 30. Install the five (5) screw terminals.
- 31. Install R4, 100k potentiometer
- 32. Install R7, 100k potentiometer
- 33. Build and install T2, gate transformer, as shown in the instructions below. Visibly check to ensure the windings of the transformer connect to the board as shown below. Failure to connect the windings properly will result in failure of the MOSFET switching devices, Q2 and Q3.

1. Begin by grouping all three (3) windings together.



2. Tie a knot in one end and secure to a bench / vise, etc... and then twist all windings together. This can be done by hand, or by using a cordless drill. If using a cordless drill, simply insert the ends of the three (3) windings into the drill chuck and then operate the drill to twist the windings.



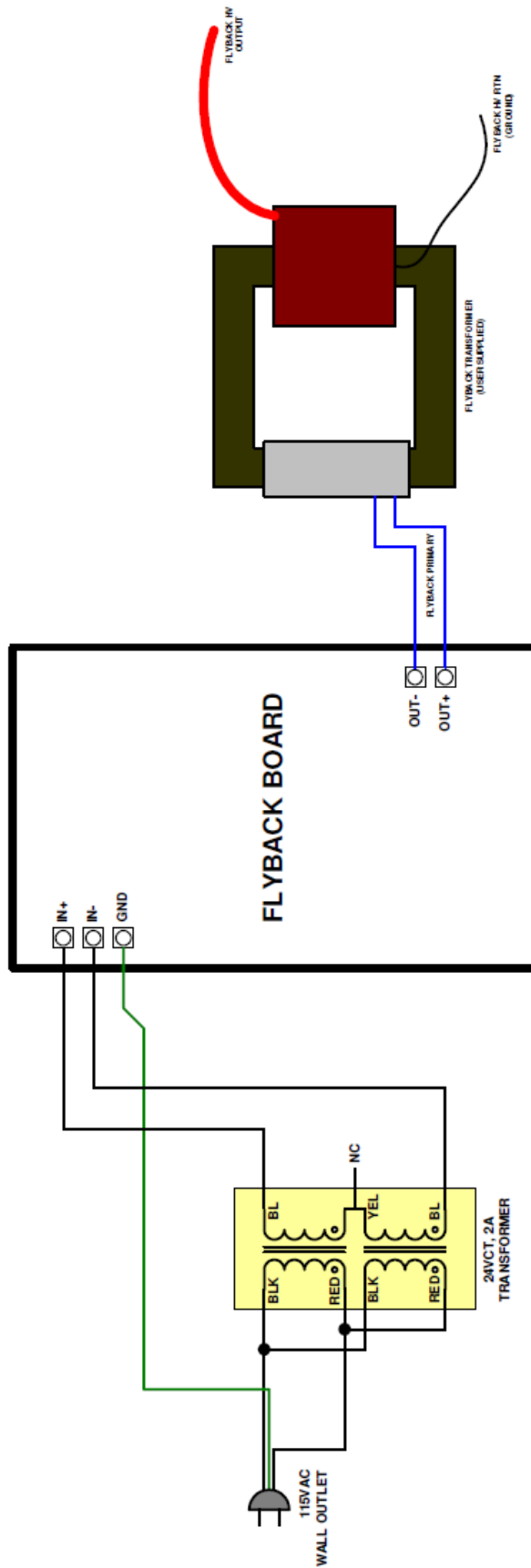
3. Winding the transformer with 12 Turns. Ensure the windings are tight against the core and evenly spaced around the entire core.

4. Attach the transformer to the board as shown in the schematic and illustration above. Note the dots showing the proper phasing of the windings and should match that to the schematic. It is important to keep the lengths of the windings as short as possible when connecting to the board lands.

- 34. Install U1, LM7815 regulator. This component needs to be orientated correctly. The metallized heatsink of U1 should be facing the top of the board towards BR1. Attach the included TO-220 heatsink to the top of this component using the 6-32 hardware supplied.
- 35. Install C3, 15000uF, 50V electrolytic capacitor. C3 has “polarity.” Polarity means the capacitor must be inserted a certain way. You may notice that one side of the capacitor, there is a black stripe with minus signs. This is the negative end. Looking at the PCB silkscreen, you will notice the positive side marked. Install this capacitor into the board ensuring the positive side of the capacitor installs in the hole that is marked positive on the PCB layout.
- 36. Attach the four (4) threaded stand-offs to the base of the heatsink. The PCB board will sit on top of these stand-offs.
- 37. Using the included 6-32 hardware, attach the PCB board to the four (4) threaded stand-offs. The board should be oriented so that the two (2) component mounting holes in the heatsink align with the component locations BR1, Q1, Q2, and Q3 on the PCB.
- 38. Install BR1, bridge rectifier. The notched end of BR1 is the positive pin and must be installed in the square pad in the PCB board.

- ❑ 39. Attach the self-adhesive thermal insulator to the heatsink in the position where Q1 will be mounted. Ensure that the thermal insulator is positioned so that the entire component fits on it. (No overlapping)
- ❑ 40. Attach the self-adhesive thermal insulator to the heatsink in the position where Q2 will be mounted. Ensure that the thermal insulator is positioned so that the entire component fits on it. (No overlapping)
- ❑ 41. Attach the self-adhesive thermal insulator to the heatsink in the position where Q3 will be mounted. Ensure that the thermal insulator is positioned so that the entire component fits on it. (No overlapping)
- ❑ 42. Install Q1, IRFP3306 or IRFP260 MOSFET. With the PCB board mounted to the heatsink, first insert Q1 into the board. Do NOT solder Q1 at this time. The metallized back of Q1 will be the side that attaches to the heatsink. Using the included hardware, attach Q1 to the heatsink (ensure the thermal insulator is also in place). Once Q1 is attached to the heatsink, solder it to the board. This ensures that the fit and alignment of Q1 will match the heatsink mounting hole.
- ❑ 43. Install Q2, IRFP260 MOSFET. With the PCB board mounted to the heatsink, first insert Q2 into the board. Do NOT solder Q2 at this time. The metallized back of Q2 will be the side that attaches to the heatsink. Using the included hardware, attach Q2 to the heatsink (ensure the thermal insulator is also in place). Once Q2 is attached to the heatsink, solder it to the board. This ensures that the fit and alignment of Q2 will match the heatsink mounting hole.
- ❑ 44. Install Q3, IRFP260 MOSFET. With the PCB board mounted to the heatsink, first insert Q3 into the board. Do NOT solder Q3 at this time. The metallized back of Q3 will be the side that attaches to the heatsink. Using the included hardware, attach Q3 to the heatsink (ensure the thermal insulator is also in place). Once Q3 is attached to the heatsink, solder it to the board. This ensures that the fit and alignment of Q3 will match the heatsink mounting hole.
- ❑ 45. Install T1, power transformer (and power cord) as shown in the diagram below. It is very important to attach the ground wire of the AC cord to the GND terminal on the PCB board. Use electrical tape or wirenuts (not supplied) to secure and insulate the connections between the power transformer and AC cord.

DO NOT connect the flyback transformer to the PCB board at this time.



Congratulations! You have just completed your Universal Flyback Driver 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

- 1 Analog or Digital Multimeter



Please be sure to wear safety glasses when testing and operating the Universal Flyback Transformer Driver!

- 1. After putting on your safety glasses, plug in the 120VAC power cord. Note that the flyback transformer should NOT be installed at this time. Using a multimeter, verify that the following voltages are correct. If they are not, then there is a problem with your circuit that needs to be diagnosed and corrected.

Check	Component	Measuring Point	Voltage
<input type="checkbox"/>	BR1	Pin 1 (Positive)	30V +/- 2V
<input type="checkbox"/>	U1	Pin 1 (Input)	17V to 26V
<input type="checkbox"/>	U1	Pin 3 (Output)	15V \pm 0.5V
<input type="checkbox"/>	U3	Pin 1 (Vcc)	15V \pm 0.5V
<input type="checkbox"/>	U3	Pin 8 (Vcc)	15V \pm 0.5V
<input type="checkbox"/>	U2	Pin 4 (Reset)	15V \pm 0.5V
<input type="checkbox"/>	U2	Pin 8 (Vcc)	15V \pm 0.5V

Note: All voltages should be measured with respect to the GND screw terminal.

- 2. Verify that both LEDs, D1 and D2, are illuminated. If they are not, and the voltages above are correct, they may be installed backwards.

- 3. Potentiometer R4 controls the output voltage of Q1 which is the DC bus voltage used to provide power to the half-bridge. Using a multimeter, measure the voltage across Q1-Source to GND and verify that you can adjust this voltage from TBD to TBD volts by adjusting R4. For typical operation, the voltage will be set to its maximum (Q1 saturated and acting as a short). At this time, set the voltage for maximum output voltage. It should be equal to the voltage measured at BR1, Pin 1 in step 1 above.
- 4. Unplug the 120VAC power cord. Due to the capacitor storage on the board, it may take about 10 seconds for the power to bleed off. Wait until the LEDs completely turn off before proceeding to the next step.
- 5. Install the primary wires of the flyback transformer to the screw terminals labeled OUT+ and OUT- on the board.
- 6. Verify that the ground (RTN) connection from the HV winding of the flyback transformer is properly connected to GND or some other suitable RTN.



The output of the flyback transformer is High Voltage. DO NOT touch or allow yourself to come into contact with the output HV wire at any time!

- 8. Plug in the 120VAC power cord.
- 9. If everything was installed properly, your flyback transformer should be operating and producing high voltage. With the power off, you can position the HV output wire close to a GND discharge point to create a high voltage arc.
- 10. Once everything has been verified to be working correctly, you can now try adjusting the output frequency of your driver. Flyback transformers typically have a resonant frequency between 10kHz and 100kHz depending on their type, size, and configuration. To get maximum output voltage, the output frequency of the driver needs to be set to the resonant frequency of the flyback transformer. To do this, simply adjust potentiometer R7 until the longest output arc is achieved.

Congratulations! Your Universal Flyback Driver is now completed and operational.

Troubleshooting

PROBLEM: No output arc. (Blue LEDs are not working)

SOLUTION: In this case, either Q1, Q2, Q3 or U3 has probably failed. Your unit will require diagnose and repair.

PROBLEM: Output arc is very small

SOLUTION: The output frequency of the driver may not be set correctly. Try adjusting potentiometer R7 to try to match the output frequency of the driver to the resonant frequency of the flyback driver. Also, ensure that the voltage output of Q1 is set at its maximum voltage. Potentiometer R4 is used to adjust this output voltage.

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@easternvoltage.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.easternvoltage.com/terms.html>

Military Dash Number Identification (M39014/01-xxxx) – Ceramic Capacitors

Failure Rate Level (%/1,000 Hours)				Capacitance (pF)	Capacitance Tolerance ±Percent	WVDC
1.0 (M)	0.1 (P)	0.01 (R)	0.001 (S)			
CKR05 (BX)						
1201	1241	1281	1321	10	10	200
1202	1242	1282	1322	10	20	200
1203	1243	1283	1323	12	10	200
1204	1244	1284	1324	15	10	200
1205	1245	1285	1325	15	20	200
1206	1246	1286	1326	18	10	200
1207	1247	1287	1327	22	10	200
1208	1248	1288	1328	22	20	200
1209	1249	1289	1329	27	10	200
1210	1250	1290	1330	33	10	200
1211	1251	1291	1331	33	20	200
1212	1252	1292	1332	39	10	200
1213	1253	1293	1333	47	10	200
1214	1254	1294	1334	47	20	200
1215	1255	1295	1335	56	10	200
1216	1256	1296	1336	68	10	200
1217	1257	1297	1337	68	20	200
1218	1258	1298	1338	82	10	200
1219	1259	1299	1339	100	10	200
1220	1260	1300	1340	100	20	200
1221	1261	1301	1341	120	10	200
1222	1262	1302	1342	150	10	200
1223	1263	1303	1343	150	20	200
1224	1264	1304	1344	180	10	200
1225	1265	1305	1345	220	10	200
1226	1266	1306	1346	220	20	200
1227	1267	1307	1347	270	10	200
1228	1268	1308	1348	330	10	200
1229	1269	1309	1349	330	20	200
1230	1270	1310	1350	390	10	200
1231	1271	1311	1351	470	10	200
1232	1272	1312	1352	470	20	200
1233	1273	1313	1353	560	10	200
1234	1274	1314	1354	680	10	200
1235	1275	1315	1355	680	20	200
1236	1276	1316	1356	820	10	200
1237	1277	1317	1357	1,000	10	200
1238	1278	1318	1358	1,000	20	200
1239	1279	1319	1359	1,200	10	100
1240	1280	1320	1360	1,500	10	100
1441	1481	1521	1561	1,500	20	100
1442	1482	1522	1562	1,800	10	100
1443	1483	1523	1563	2,200	10	100
1444	1484	1524	1564	2,200	20	100
1445	1485	1525	1565	2,700	10	100
1446	1486	1526	1566	3,300	10	100
1447	1487	1527	1567	3,300	20	100
1448	1488	1528	1568	3,900	10	100
1449	1489	1529	1569	4,700	10	100
1450	1490	1530	1570	4,700	20	100
1451	1491	1531	1571	5,600	10	100
1452	1492	1532	1572	6,800	10	100
1453	1493	1533	1573	6,800	20	100
1454	1494	1534	1574	8,200	10	100
1455	1495	1535	1575	10,000	10	100
1456	1496	1536	1576	10,000	20	100
1457	1497	1537	1577	12,000	10	50
1458	1498	1538	1578	15,000	10	50
1459	1499	1539	1579	15,000	20	50
1480	1500	1540	1580	18,000	10	50
1461	1501	1541	1581	22,000	10	50
1462	1502	1542	1582	22,000	20	50
1463	1503	1543	1583	27,000	10	50
1464	1504	1544	1584	33,000	10	50
1465	1505	1545	1585	33,000	20	50
1466	1506	1546	1586	39,000	10	50
1467	1507	1547	1587	47,000	10	50
1468	1508	1548	1588	47,000	20	50
1469	1509	1549	1589	56,000	10	50
1470	1510	1550	1590	68,000	10	50
1471	1511	1551	1591	68,000	20	50
1472	1512	1552	1592	82,000	10	50
1473	1513	1553	1593	100,000	10	50
1474	1514	1554	1594	100,000	20	50

Military Dash Number Identification (M39014/02-xxxx) – Ceramic Capacitors

Failure Rate Level (%/1,000 Hours)				Capacitance (pF)	Capacitance Tolerance ±Percent	WVDC
1.0 (M)	0.1 (P)	0.01 (R)	0.001 (S)			
CKR06 (BX)						
1201	1241	1281	1321	1200	10	200
1202	1242	1282	1322	1500	10	200
1203	1243	1283	1323	1500	20	200
1204	1244	1284	1324	1800	10	200
1206	1246	1286	1326	2200	10	200
1207	1247	1287	1327	2200	20	200
1208	1248	1288	1328	2700	10	200
1209	1249	1289	1329	3300	10	200
1210	1250	1290	1330	3300	20	200
1211	1251	1291	1331	3900	10	200
1212	1252	1292	1332	4700	10	200
1213	1253	1293	1333	4700	20	200
1214	1254	1294	1334	5600	10	200
1215	1255	1295	1335	6800	10	200
1216	1256	1296	1336	6800	20	200
1217	1257	1297	1337	8200	10	200
1218	1258	1298	1338	10,000	10	200
1219	1259	1299	1339	10,000	20	200
1231	1271	1311	1351	12,000	10	100
1220	1260	1300	1340	15,000	10	100
1221	1261	1301	1341	18,000	10	100
1222	1262	1302	1342	22,000	10	100
1232	1272	1312	1352	27,000	10	100
1223	1263	1303	1343	33,000	10	100
1224	1264	1304	1344	39,000	10	100
1225	1265	1305	1345	47,000	10	100
1226	1266	1306	1346	56,000	10	100
1227	1267	1307	1347	68,000	10	100
1229	1269	1309	1349	82,000	10	100
1230	1270	1310	1350	100,000	10	100
1233	1273	1313	1353	120,000	10	50
1234	1274	1314	1354	150,000	10	50
1235	1275	1315	1355	180,000	10	50
1236	1276	1316	1356	220,000	10	50
1237	1277	1317	1357	270,000	10	50
1238	1278	1318	1358	330,000	10	50
1239	1279	1319	1359	390,000	10	50
1240	1280	1320	1360	470,000	10	50
1404	1408	1412	1416	560,000	10	50
1405	1409	1413	1417	680,000	10	50
1406	1410	1414	1418	820,000	10	50
1407	1411	1415	1419	1,000,000	10	50