

20 KV Power Supply for 300KV Marx Construction Notes

7 Mar 11

By Vaughn P. McDowell

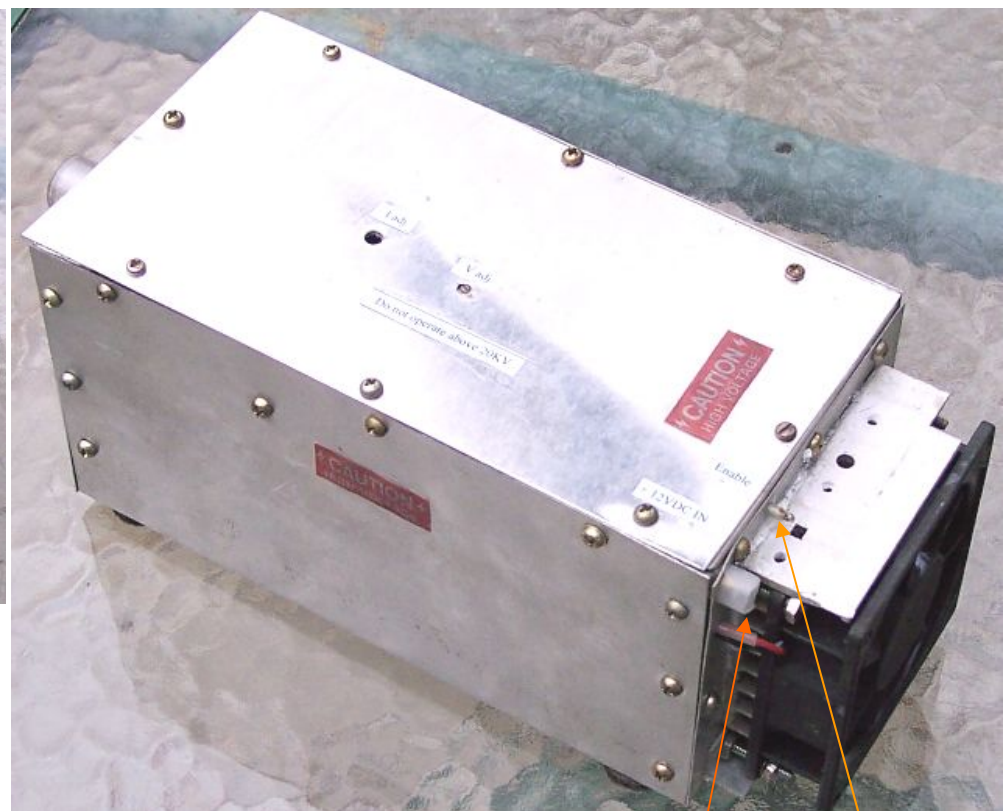
Several years ago I was using my handy general purpose ten year old variable HV power supply to power up my 300KV mini-Marx generators. To free it up for other experiments a dedicated 20KV HVPS was constructed specific to these mini-Marx..The original sketch construction operational notes got lost somewhere; the following is an attempt to reverse engineer and document its construction. The output power is about 15 - 20 watts, adequate for my purposes.

Some General Comments About This Unit

There are some power up issues that I hope to address in the near future; specifically when the unit is enabled during power up even while the HV output is not loaded; sometimes causing high inrush current. This happens in spite of having one of the two sets of TL494 inputs used for current limit sensing. If a 12 volt source supplies adequate current (ie car battery) the in rush current is momentary; after which it operates in it normal mode. If the unit is enabled after having been powered up, the unit operates smoothly drawing little input rush current. As long as proper precautions are taken the unit is quite functional; however it is obvious that there are some some design issues that need to be worked out. When operating the 300KV Marx the HVPS was powered up in the enable mode using a 12 volt car battery. In this manner the 20KV power supply operated very satisfactory.



HV OUT

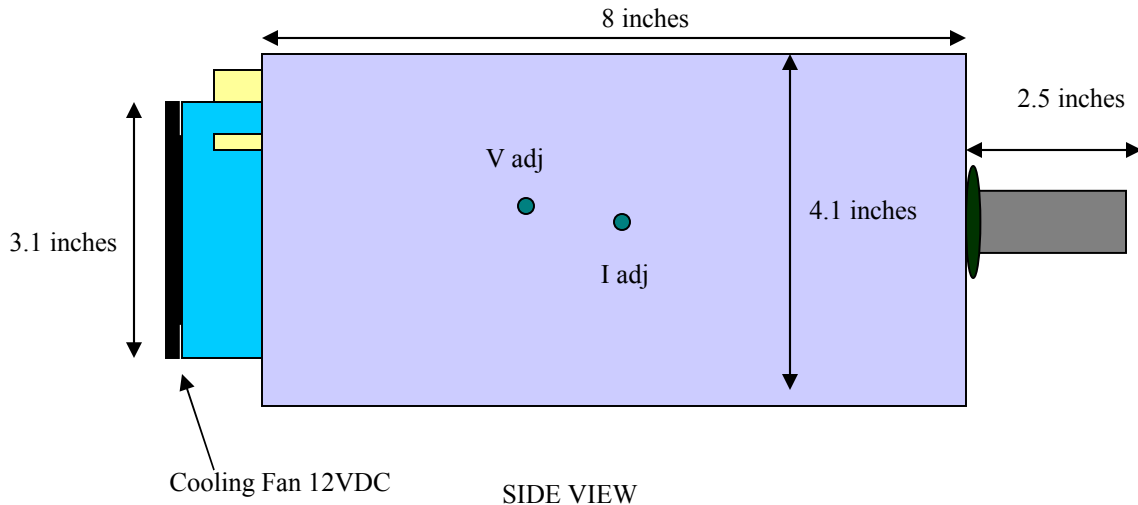


12VDC PWR

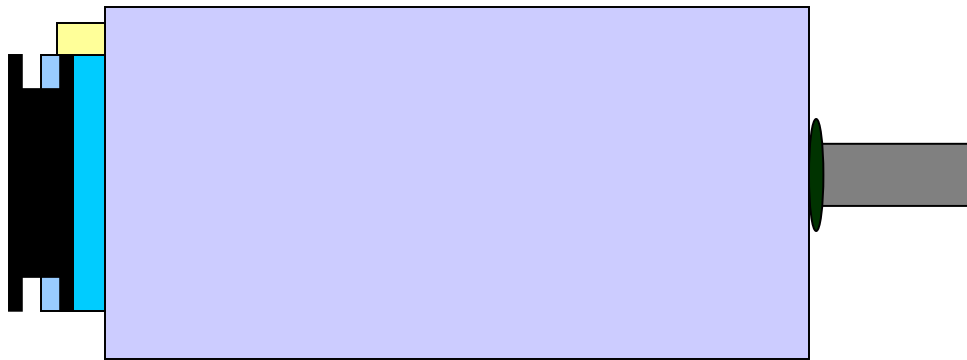
HV Enable
+12 VDC

Construction Note 20KV HVPS UNIT \ Some Physical Outside Dimensions

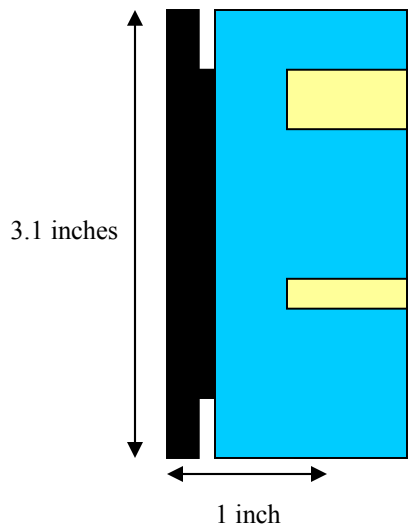
TOP VIEW



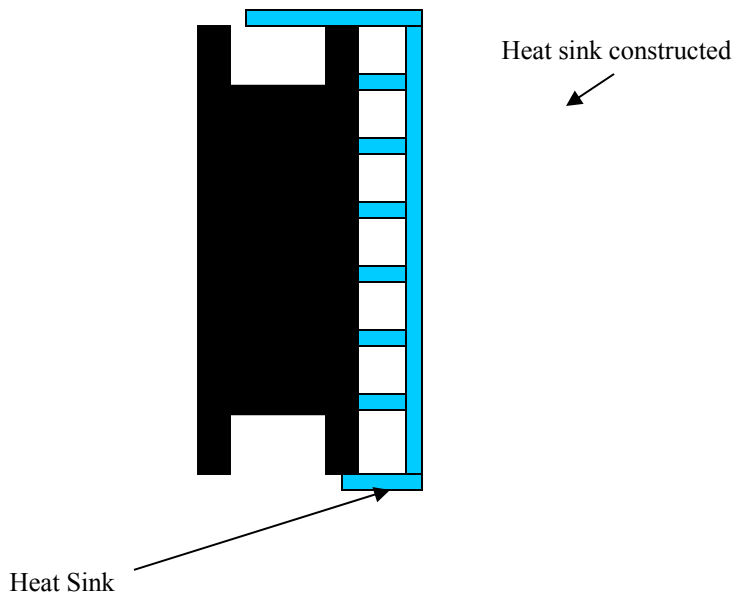
SIDE VIEW



TOP VIEW

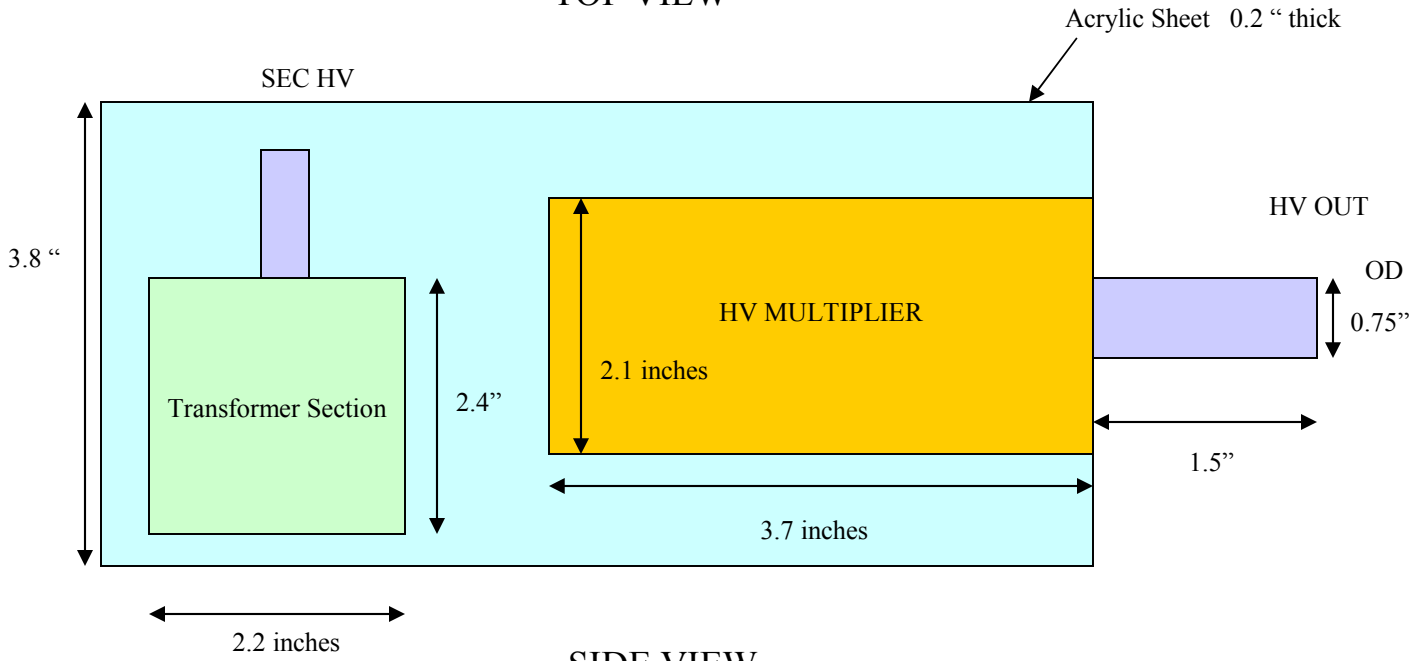


SIDE VIEW

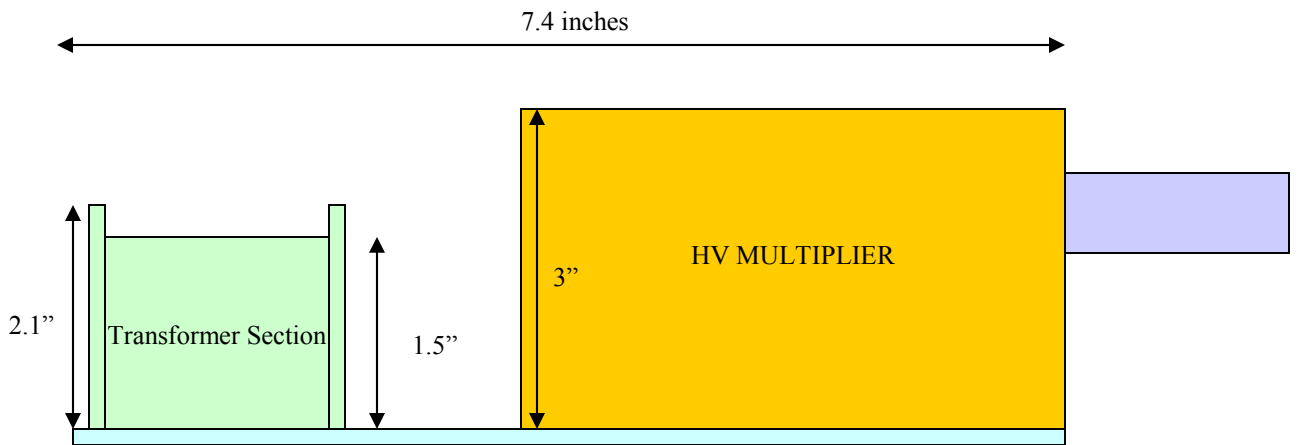


Construction Note Photos (Quick Overview) \ HV section \ Some Physical Dimensions

TOP VIEW

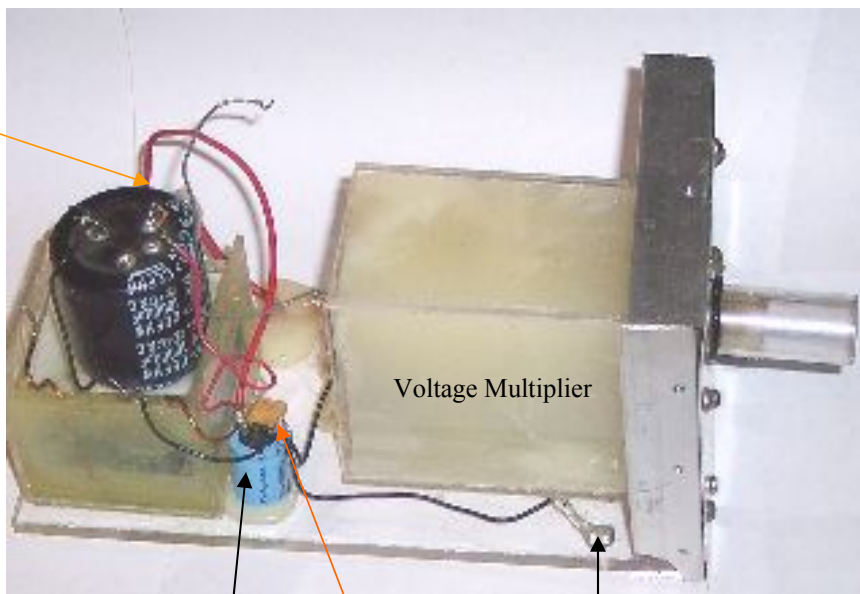


SIDE VIEW



Construction Note Photos (Quick Overview) \ HV section \ Some Physical Dimensions

12-14 VDC
INPUT PWR



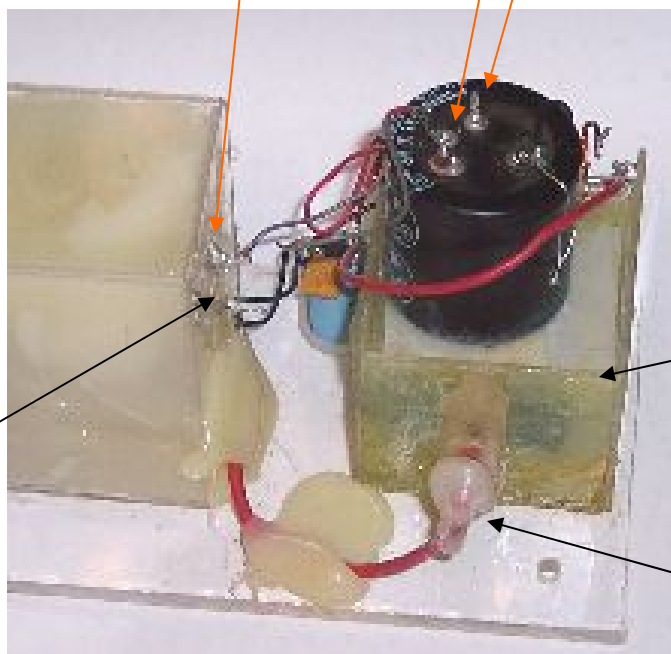
1000uF 25VDC

.1uF ceramic

GND

HV probe feed back

10,000uF 35VDC ea

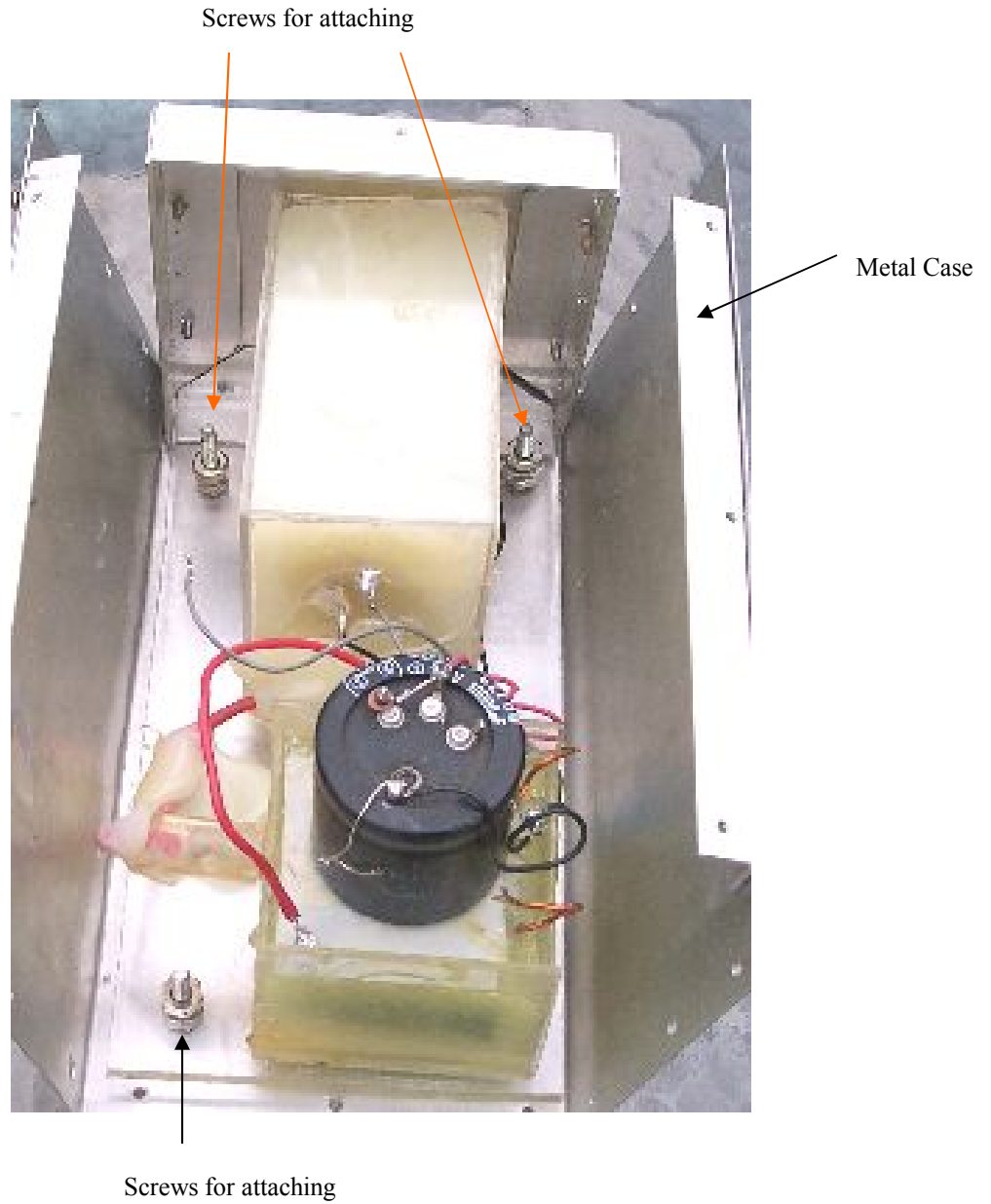


transformer

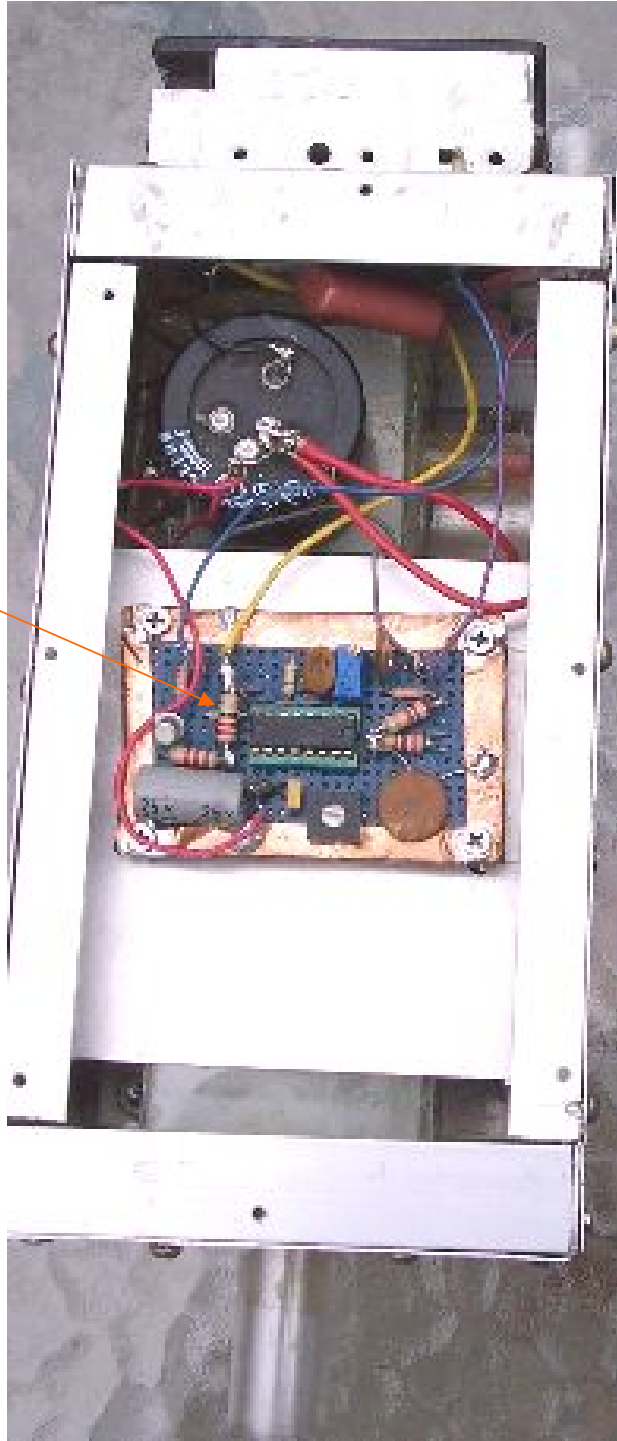
HV Multiplier GND

HV SEC

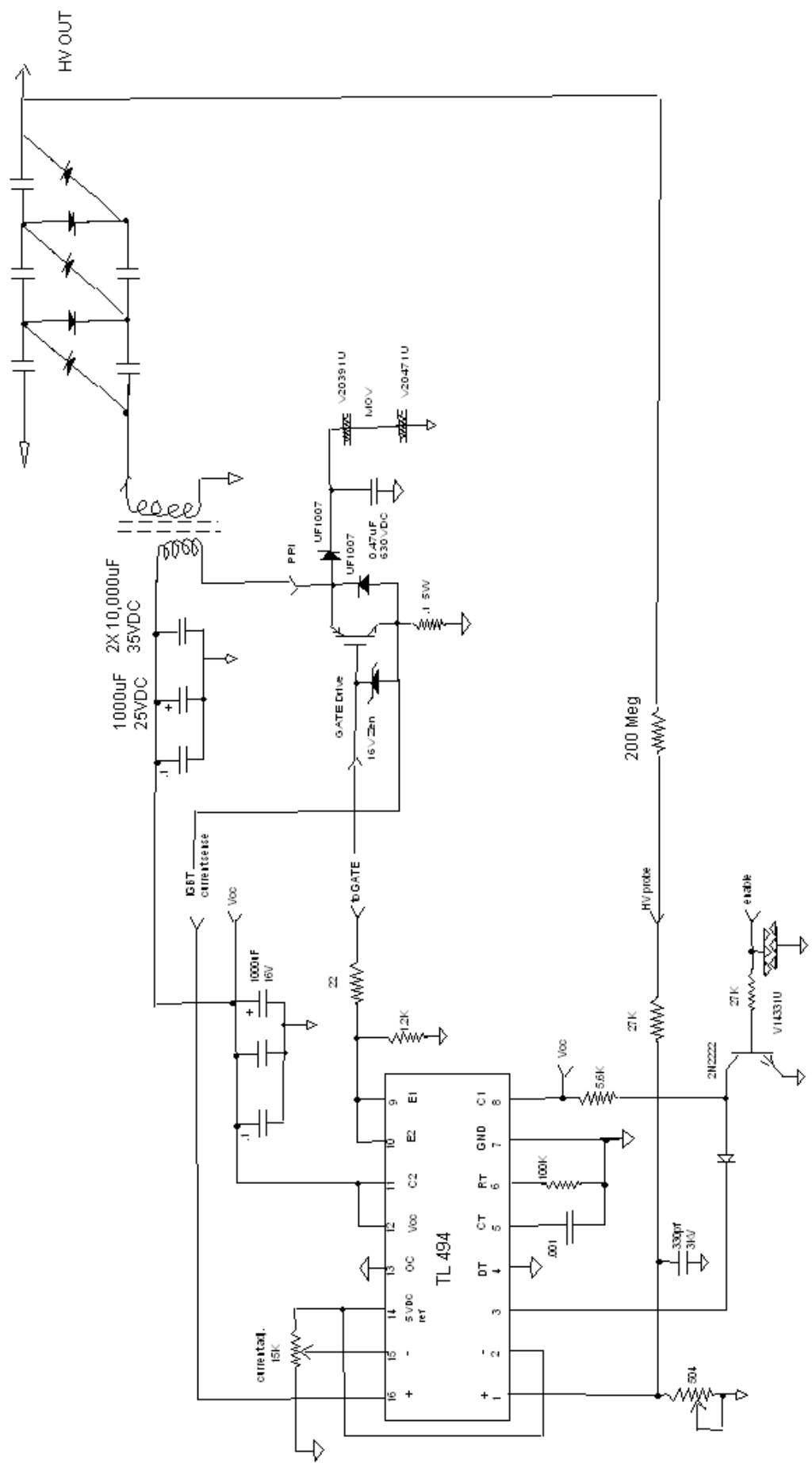
Top View



COMPLETED UNIT / Lid Removed



NEW; 22ohm resistor
IGBT gate drive current limit



Construction Note Details \ Controller Circuit

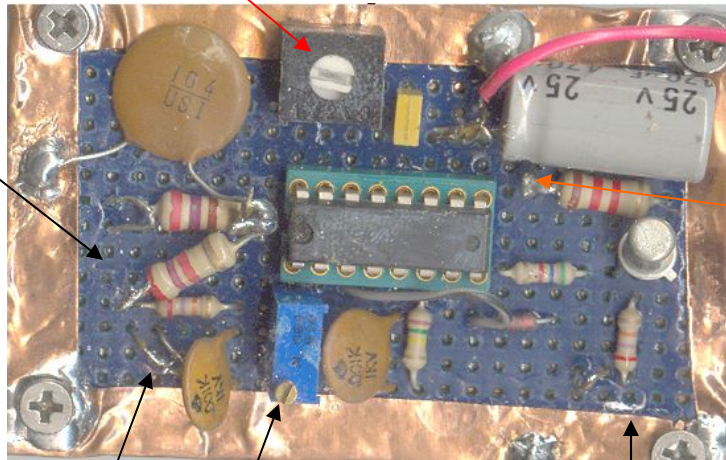
Comments:

The gate drive source and sink is enhanced by paralleling E1 & 2 and C1 & 2 (emitter and collector).. A 1.2K resistor keeps the gate voltage close to zero when the IC is removed for diagnostic purposes.

A third input control was added to pin 3 for the enable circuitry (1N4148, 2N2222, ..). The first input is for voltage adjustment, the second for limiting the current.

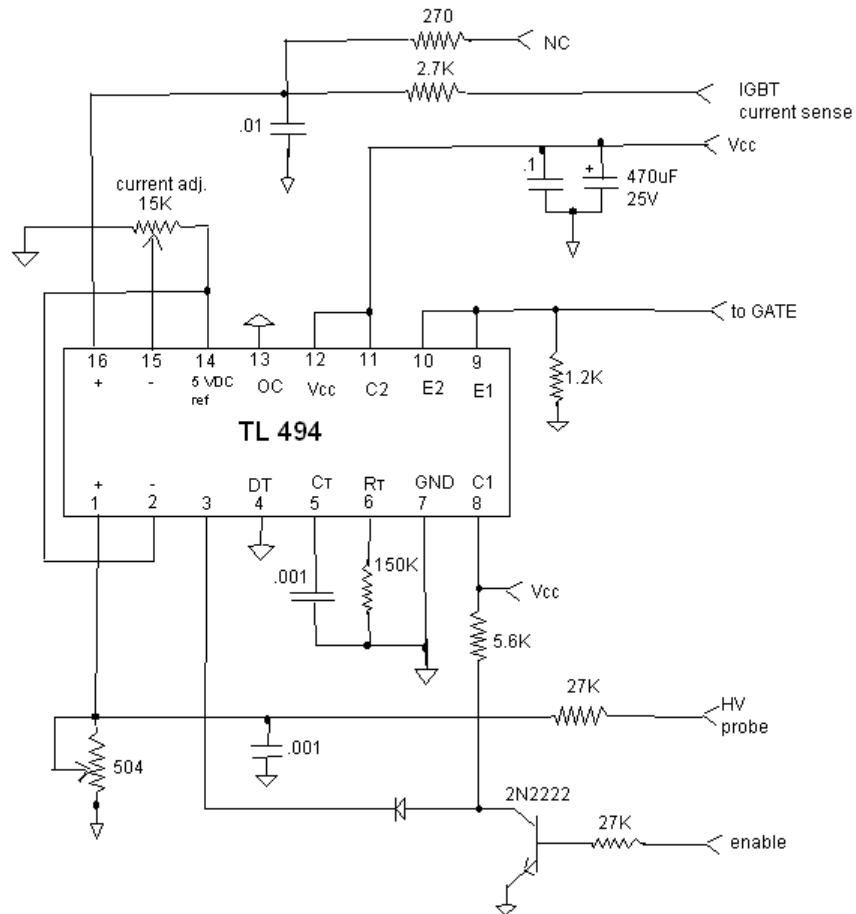
Start up current adj.

IGBT current sense



Vcc 12VDC

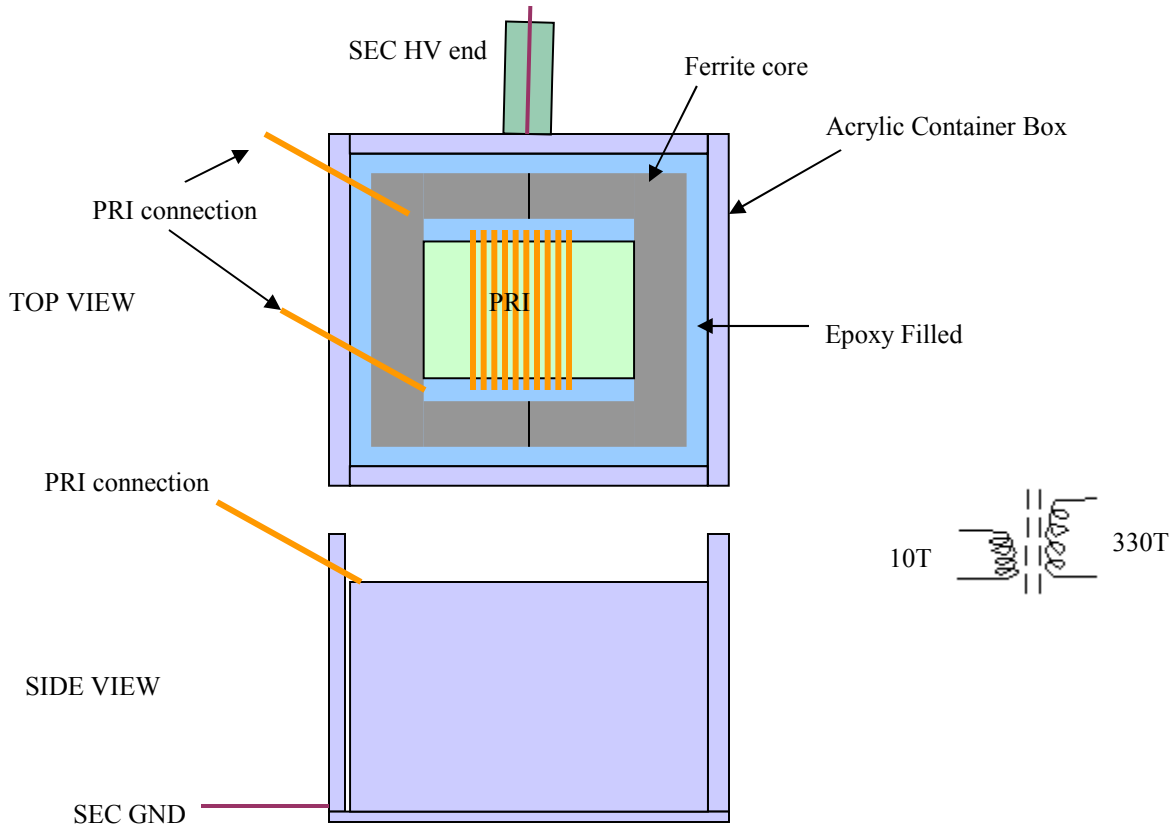
To Gate



Construction Note Details \ Transformer

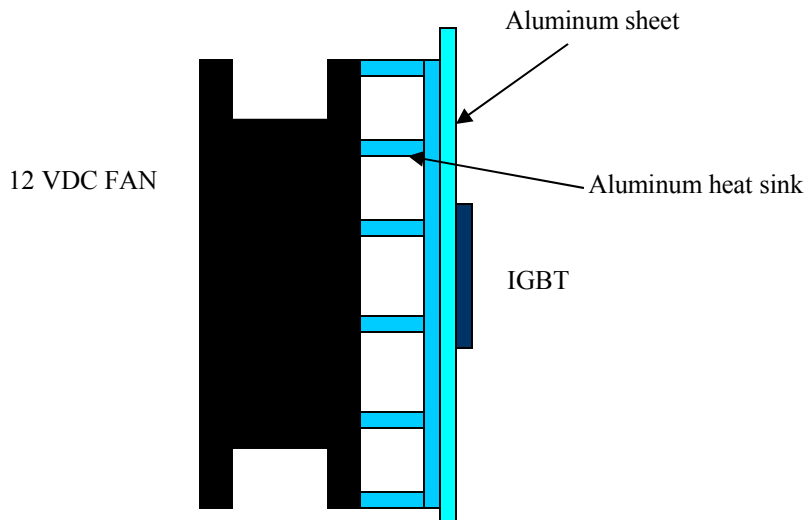
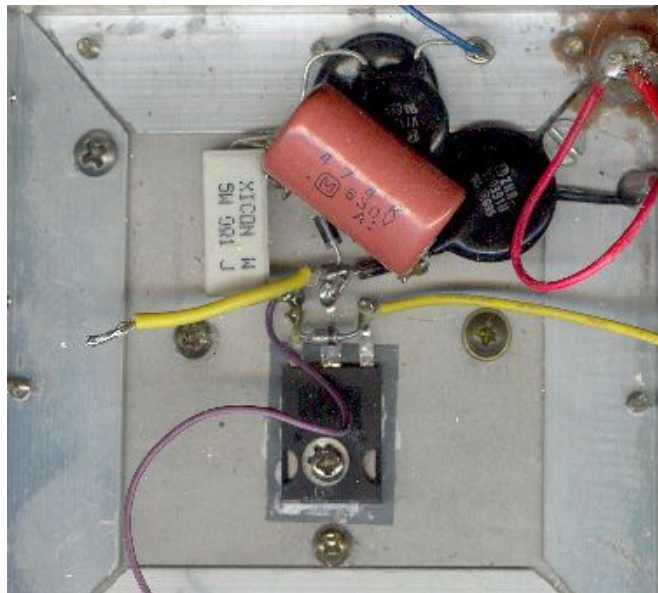
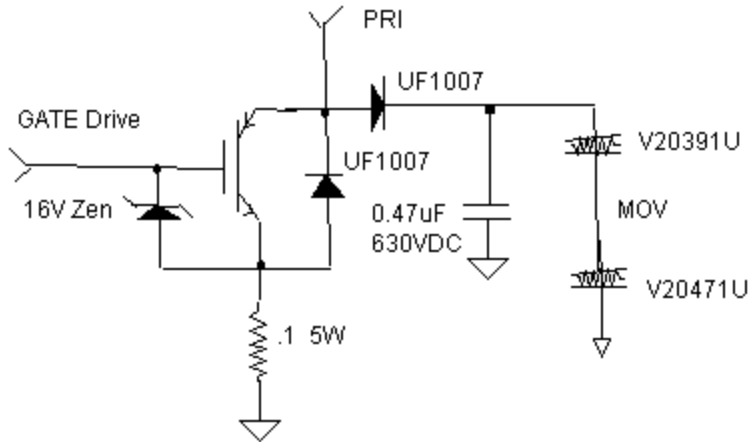
The technique for the flyback transformer construction is described at:
(http://vaughns_page.50webs.com/HV/transformer/flybk_A/flybk_a.html)

This project used, when convenient, pre-constructed components; this particular transformer assembly was constructed about two years before this project was conceived. The Fair-Rite core type is believed to be 77; the core itself is ETD part # 9577440002. The primary is 10 T of # 20 magnet wire; the secondary about 330 T # 30 magnet wire.



Construction Note Details \ IGBT Section

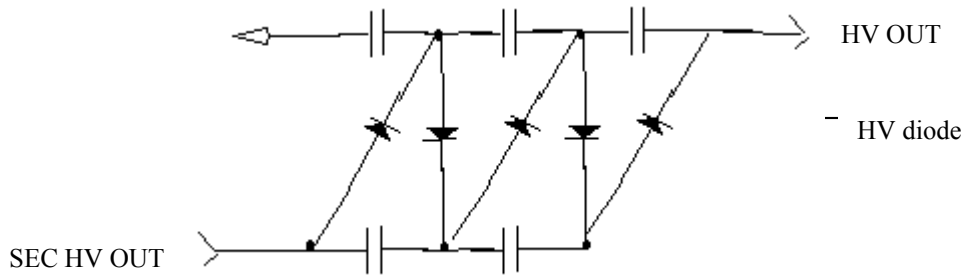
The IGBT section is a circuit I used ten years ago on a flyback transformer project; the IGBT is of the 1200 Volt type IRG4PH50U or similar; the diodes are of the ultra fast recovery UF1007. The remaining components protect the GATE (16 volt Zenor) and anode (MOVs etc.)



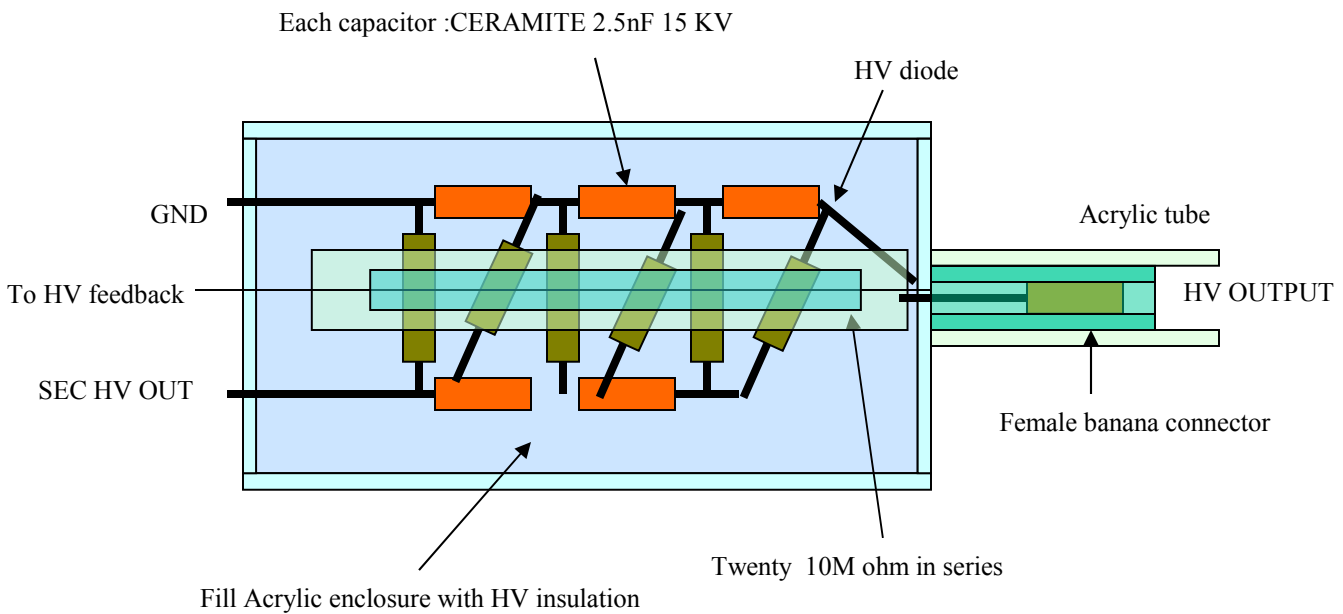
Construction Note Details \ HV Multiplier Section

Comments:

The voltage multiplier was constructed some time ago and shelved; most of the components are not visible being immersed in HV insulation (epoxy and hot glue). The circuit diagram shown below (for documentation purposes) is my best guess .



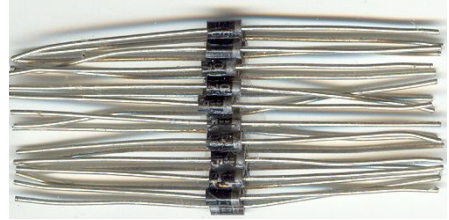
TOP VIEW



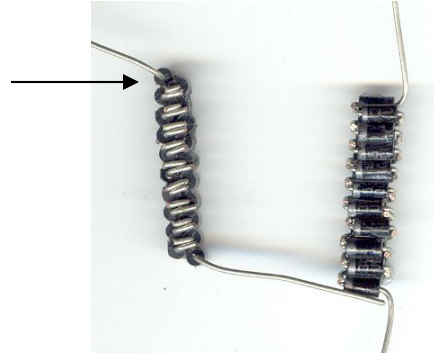
Construction Note Details \ HV Multiplier Section \ HV Diodes

HV Diode Construction

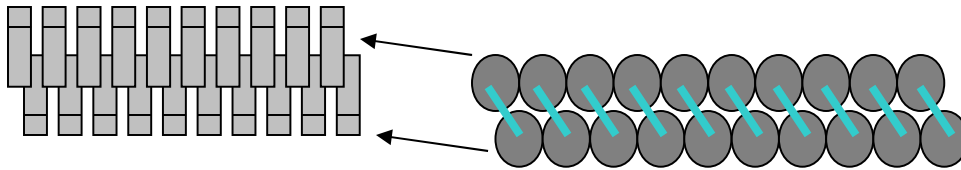
Ultra fast diode type UF1007 1KV PIV @ 1A (Digi-Key) are laid out parallel in groups of tens super glued together. After drying two of the ten glued diode sections are stacked and glued. Take careful note below of the orientation of the anode and cathode. These twenty diodes are to be connected and soldered in series. When carefully assembled I have had very good success with these.



After the two layers are glued the leads are trimmed to length except for the end sections



The folded and trimmed leads are carefully soldered together; keep solder smooth as possible to reduce HV stress



The soldered diode assembly is cleaned(alcohol) and dried; then carefully given an epoxy coating being careful to work out any air bubbles between the soldered leads