

14th International EME Conference
Dallas-Ft.Worth, Texas

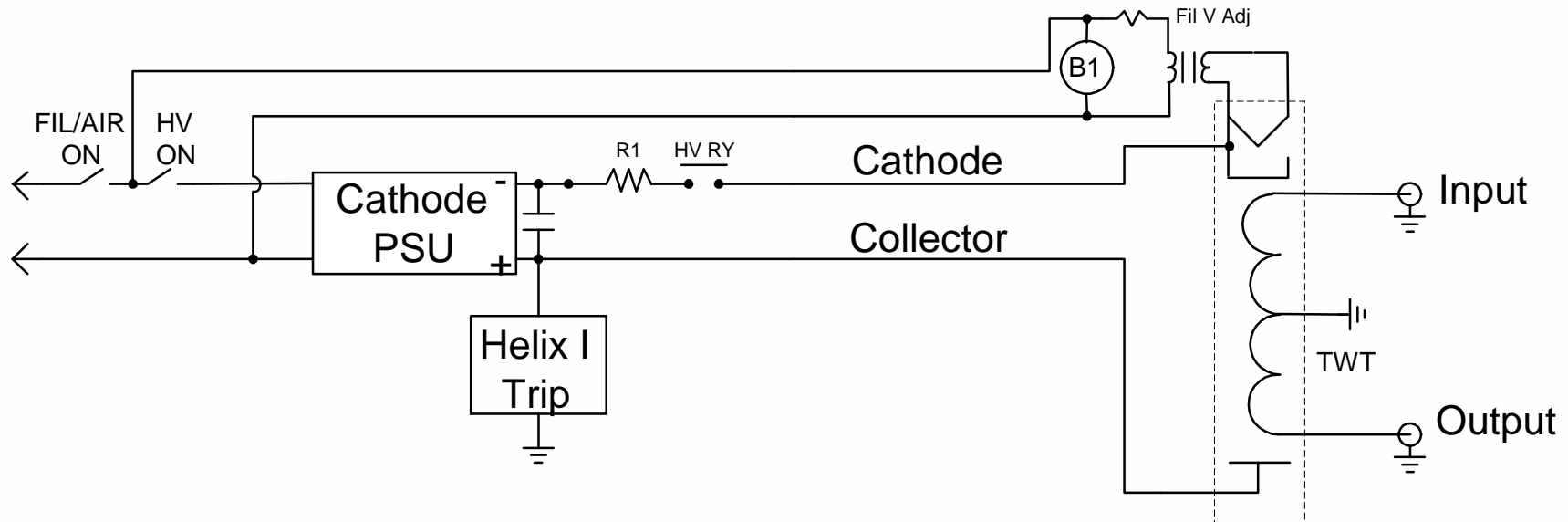
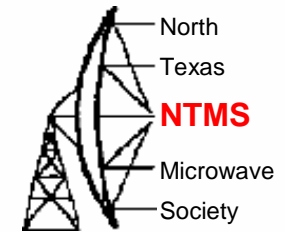
Homebrew TWT Power Supplies

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Non-Suppressed Collector TWT



Most of the cathode current must flow to the collector

Must minimize current that flows to the helix

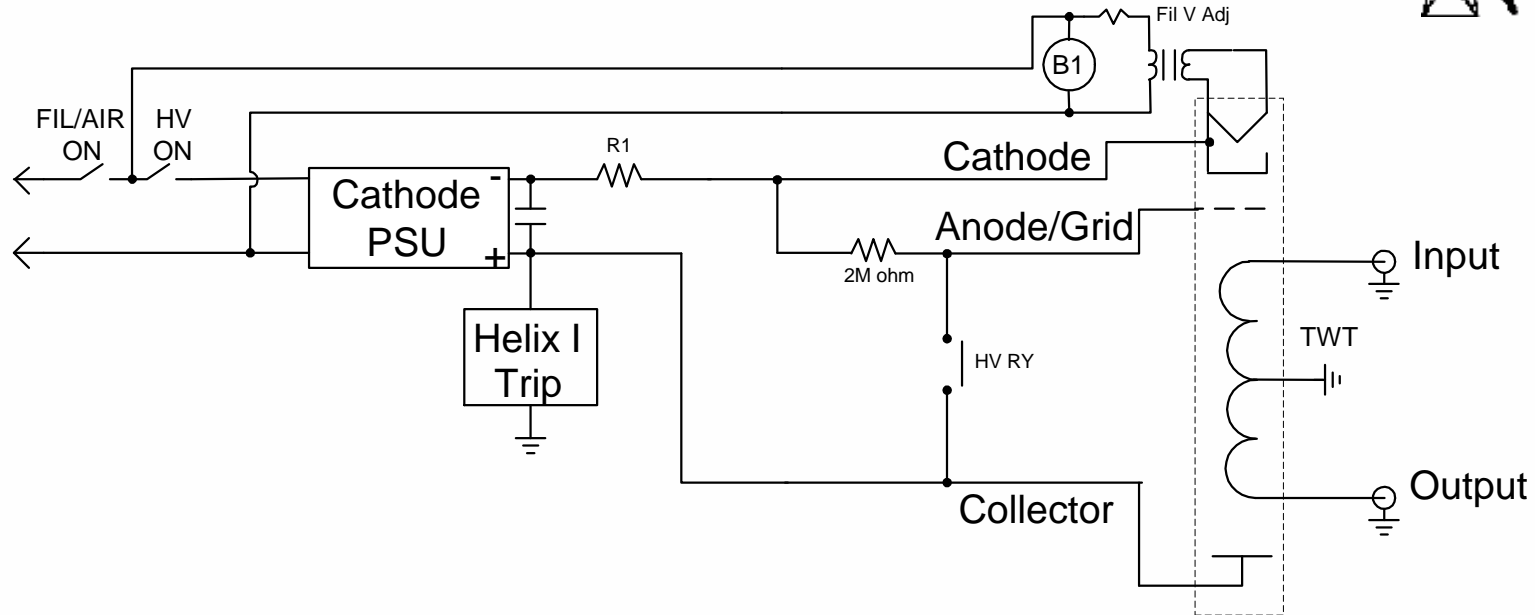
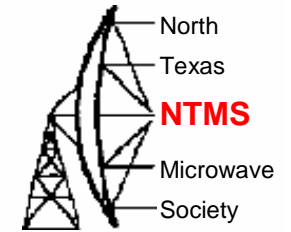
Proper focusing of the beam minimizes helix current and maximizes power output.

Filament power supply at cathode potential w.r.t. ground.

Must use HV relay in secondary to start tube in less than 100msec – can not wait for cathode power supply to charge any capacitance otherwise tube will be out of focus and current will intersect helix – could destroy tube if helix trip-out circuit not used.

R1 used to limit cathode current in case of internal arcing.

Using the Anode to control TWT



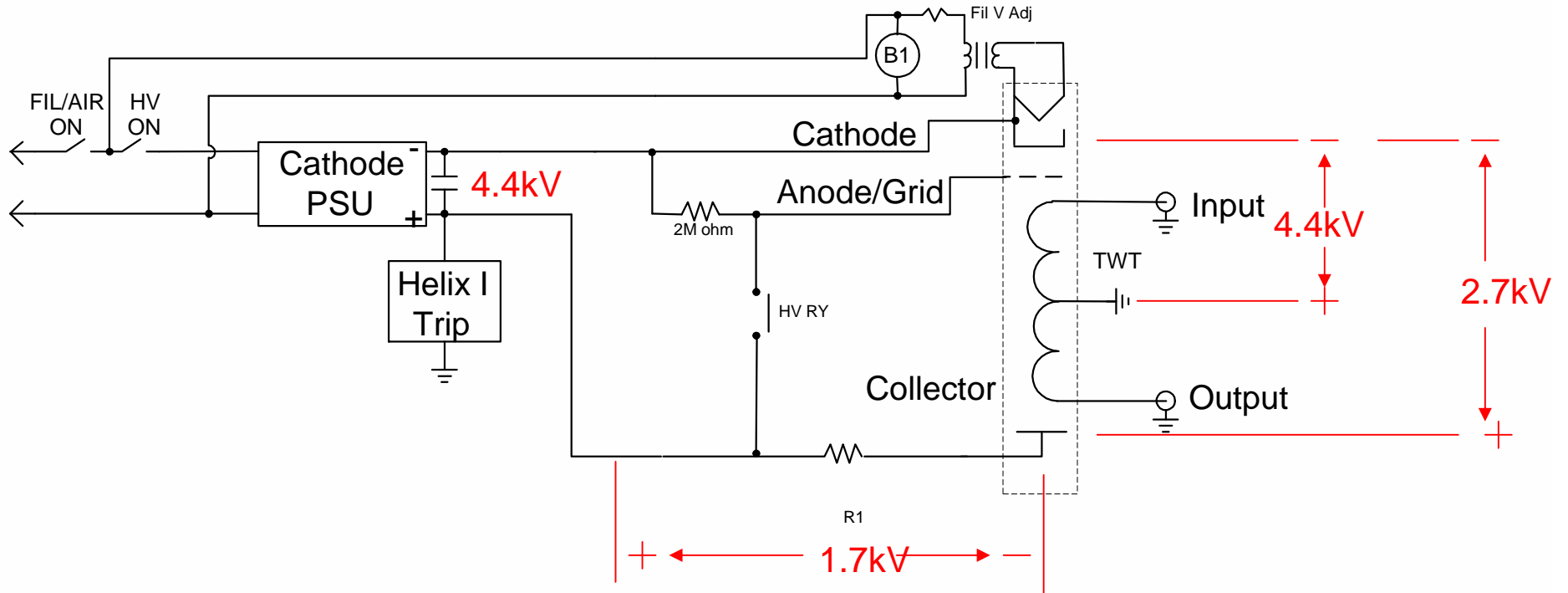
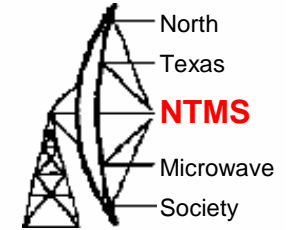
Some TWTs have a grid or an anode to either modulate the cathode current or to be used as a means to turn TWT on and off quickly.

When the anode is at cathode potential, the TWT is turned off.

When the anode is at helix or ground potential, the TWT is turned on.

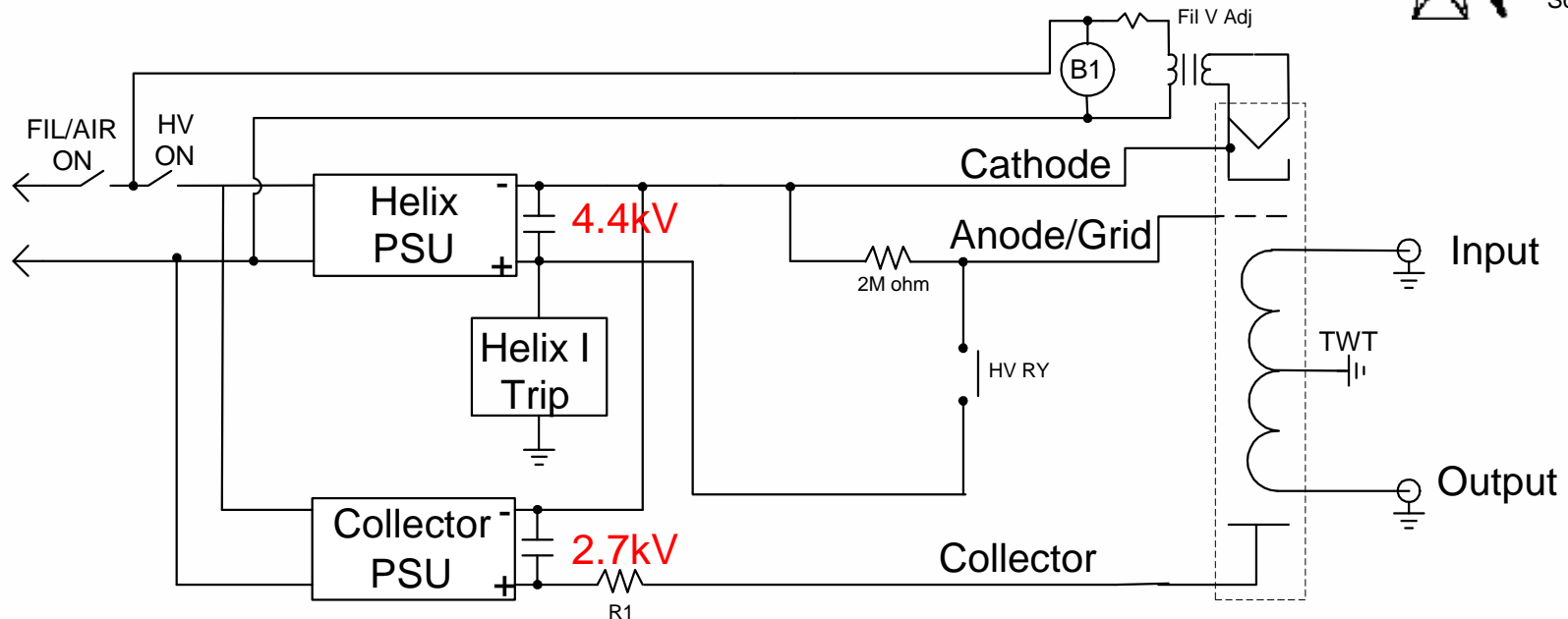
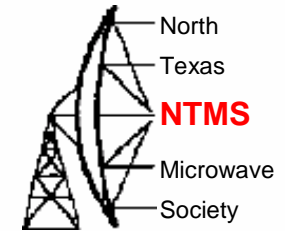
2M ohm resistor keeps anode at cathode potential until HV relay switches anode to helix potential.

Suppressed Collector Tube - Operating the Collector below Helix Potential



Typically Collector can be operated at about 60% of Helix Potential
Simplest but not best approach is to dissipate the extra power in R1
40% of the power is then dissipated in series dropping resistor R1

Using dual supplies for Helix and Collector



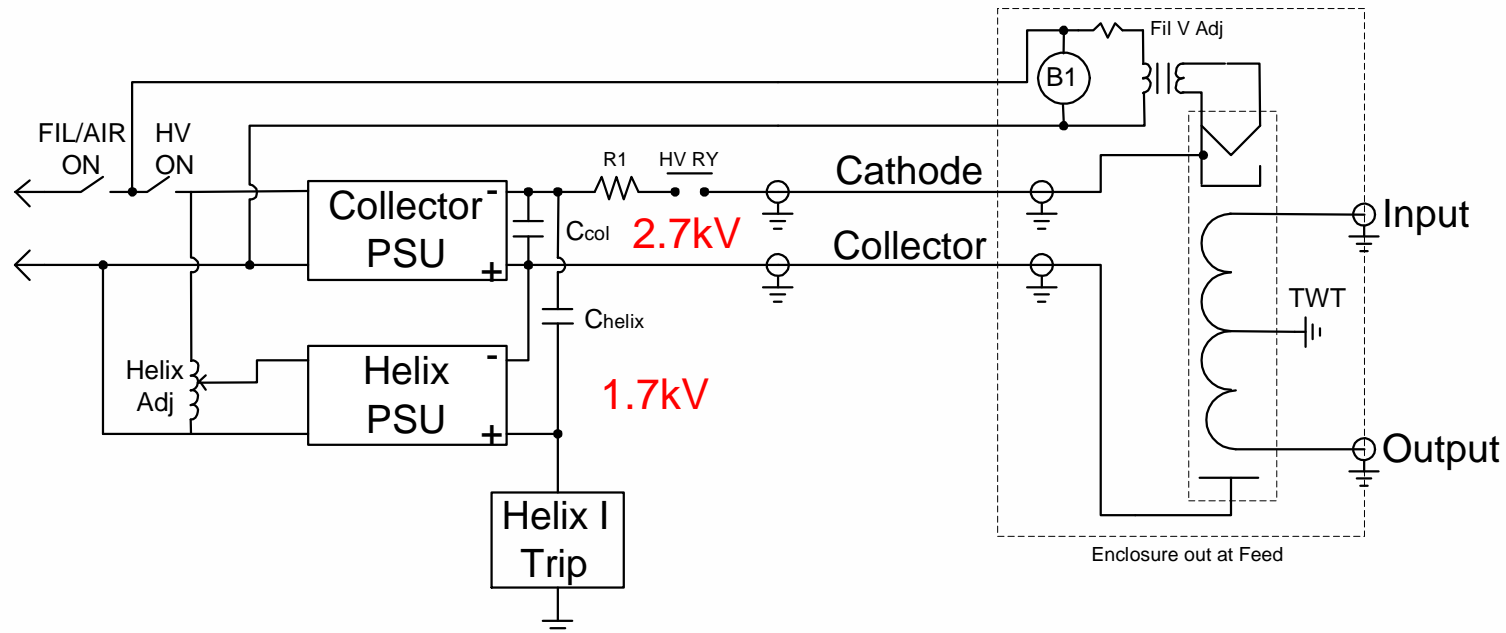
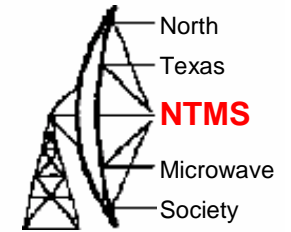
Using separate supplies minimizes high cathode to collector potential when no current is flowing – could damage TWT

Helix power supply supplies only a few mA of current for the helix

Collector power supply supplies high current for the collector.

R1 still nice to have to minimize the “big bang” effect of internal TWT arcing – only need maybe 500 ohms for a voltage drop of 150V at 300mA of collector current

The K5GW Approach - Using Power Supplies in Series

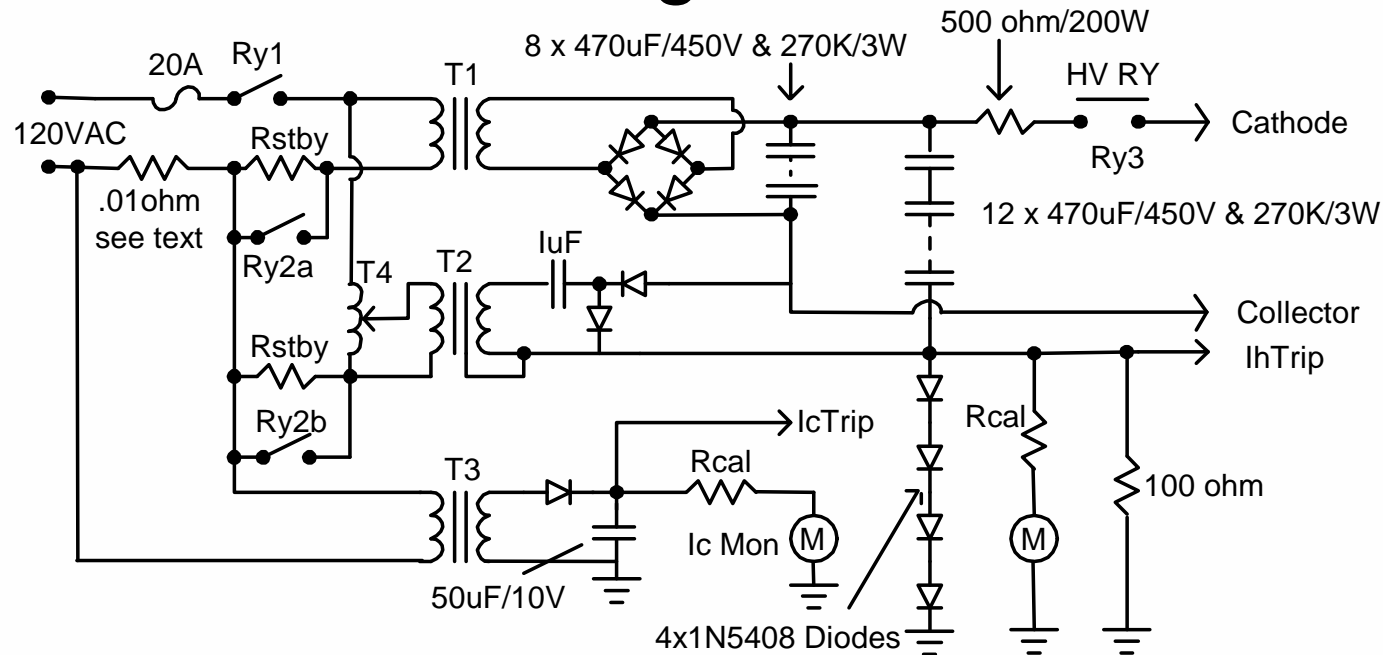
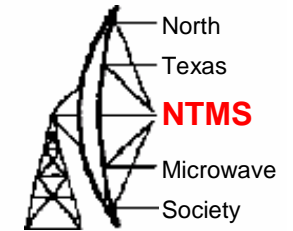


A lot of high power tubes either do not have an anode or it is internal connected to the helix/ground – requiring the use of a HV relay in the cathode to turn the TWT on.

Collector supplies 2.7kV

Helix supply is “piggy backed” or in series with the collector supply upping the collector by another 1.7kV and then having its return to the helix through the trip circuit to ground.

Schematic Diagram TWT HV PS



T1 is a 2500vrms transformer from an AL1200HF amplifier to supply collector current.

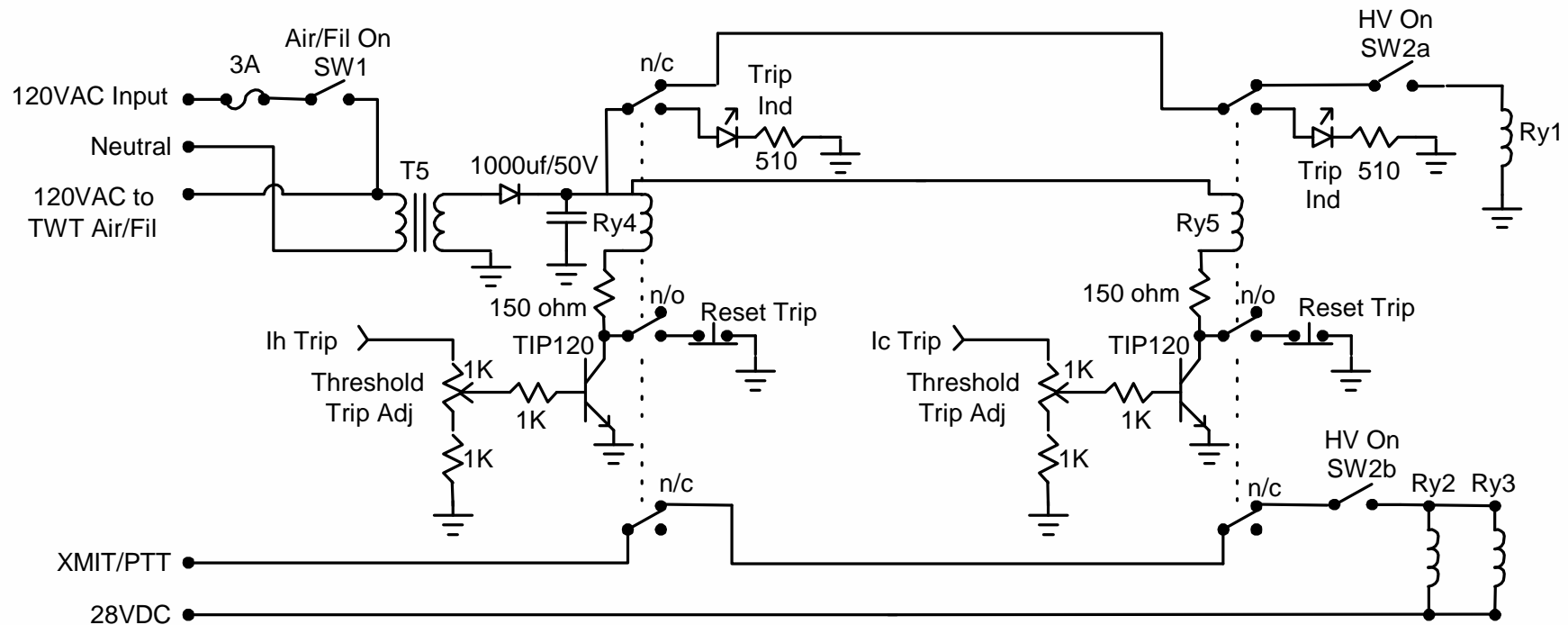
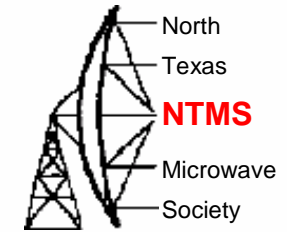
T2 is a used microwave oven transformer used to boost the collector voltage high enough for the helix – A variac at T4 is used in the primary to set the helix voltage.

Rstby in series with T1 and T2 are used to lower the voltages during standby.

T3 samples current drawn from ac lines which is proportional to collector current – Rcal used to calibrate collector current meter.

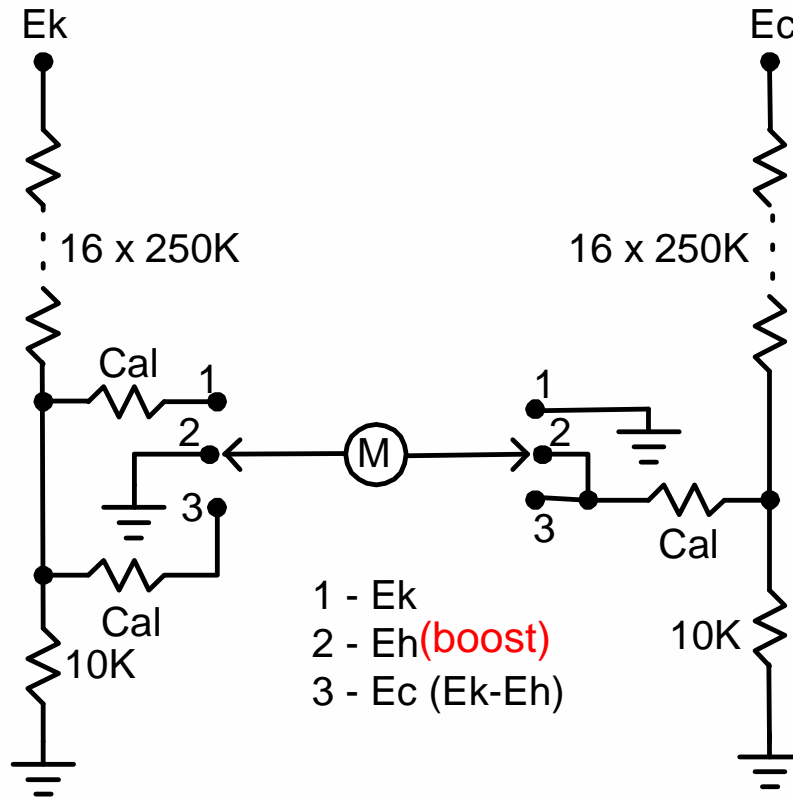
100Ω resistor used to sample helix current – 1N5408 diodes protect meter circuit in event of internal TWT arc over.

AC & TR Control & Trip Circuits



Helix and Collector current trip circuits provide TWT protection and indication of fault. Must be manually reset with push button switches to regain TWT operation.

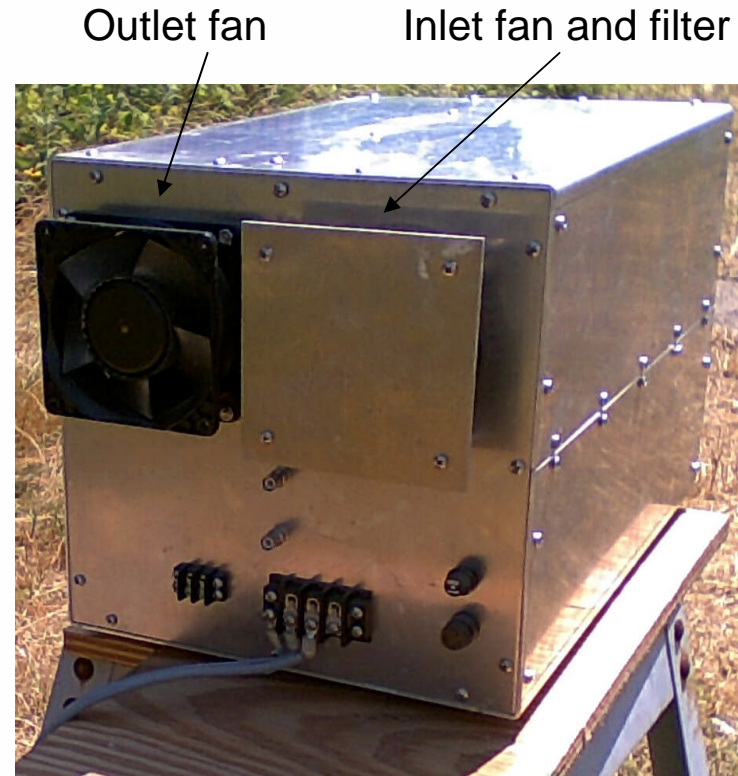
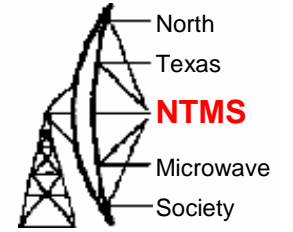
HV Monitor



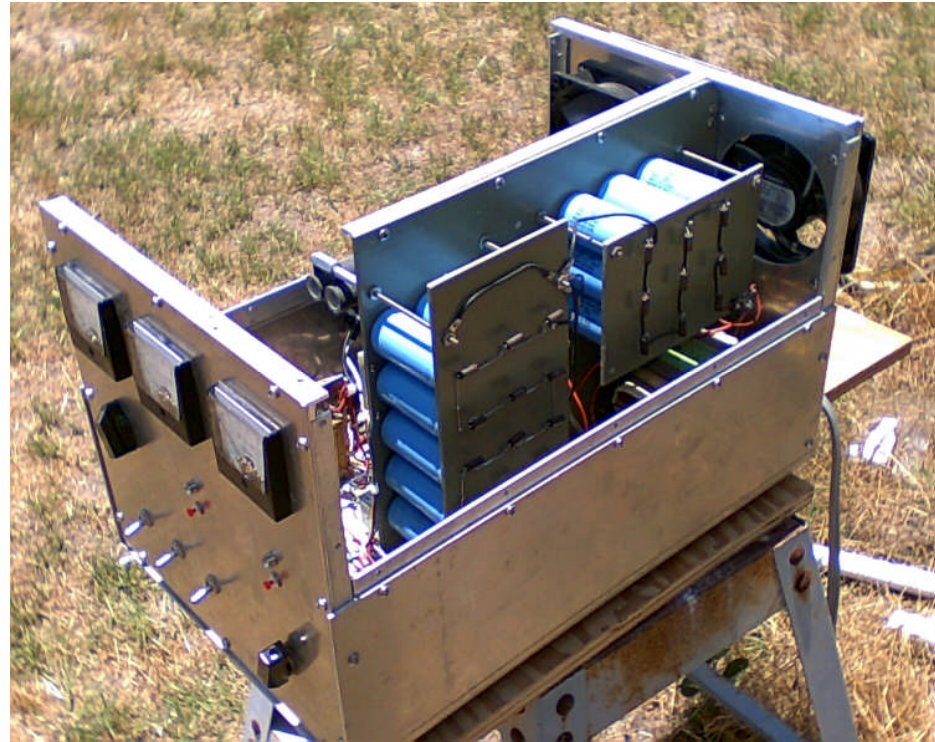
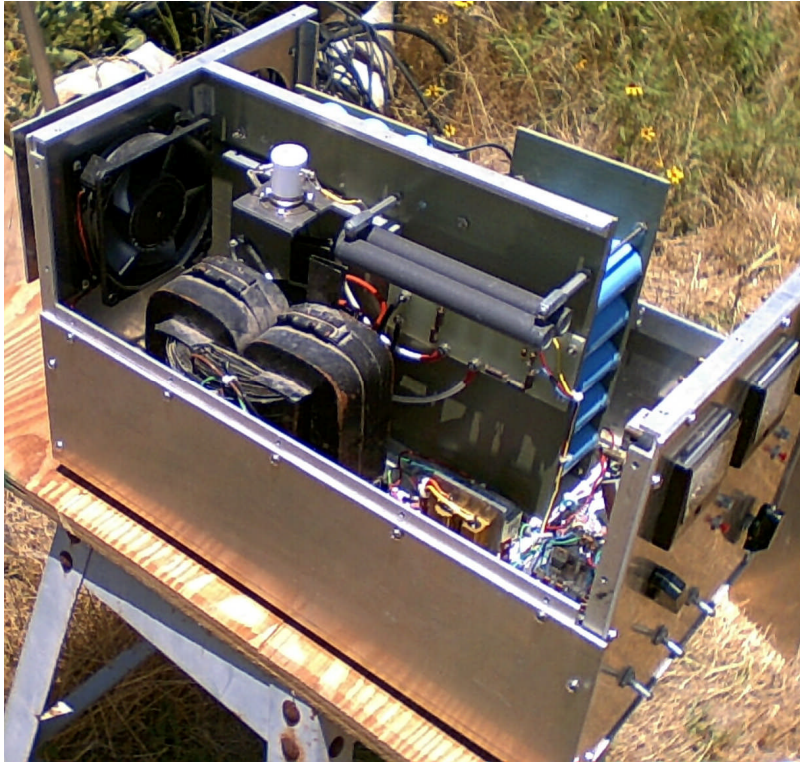
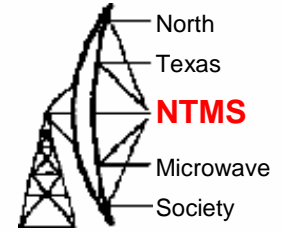
Clarification from the paper in the proceedings – Position number 1 does measure the Ek which is the cathode to helix voltage, position number 2 measures Eh which is actually the helix boost voltage, and position number 3 measures the difference Ec which is the collector voltage.

Approximately 1000:1 resistive voltage dividers are used to safely sample the voltages at the cathode and collector w.r.t ground.

Completed TWT Power Supply

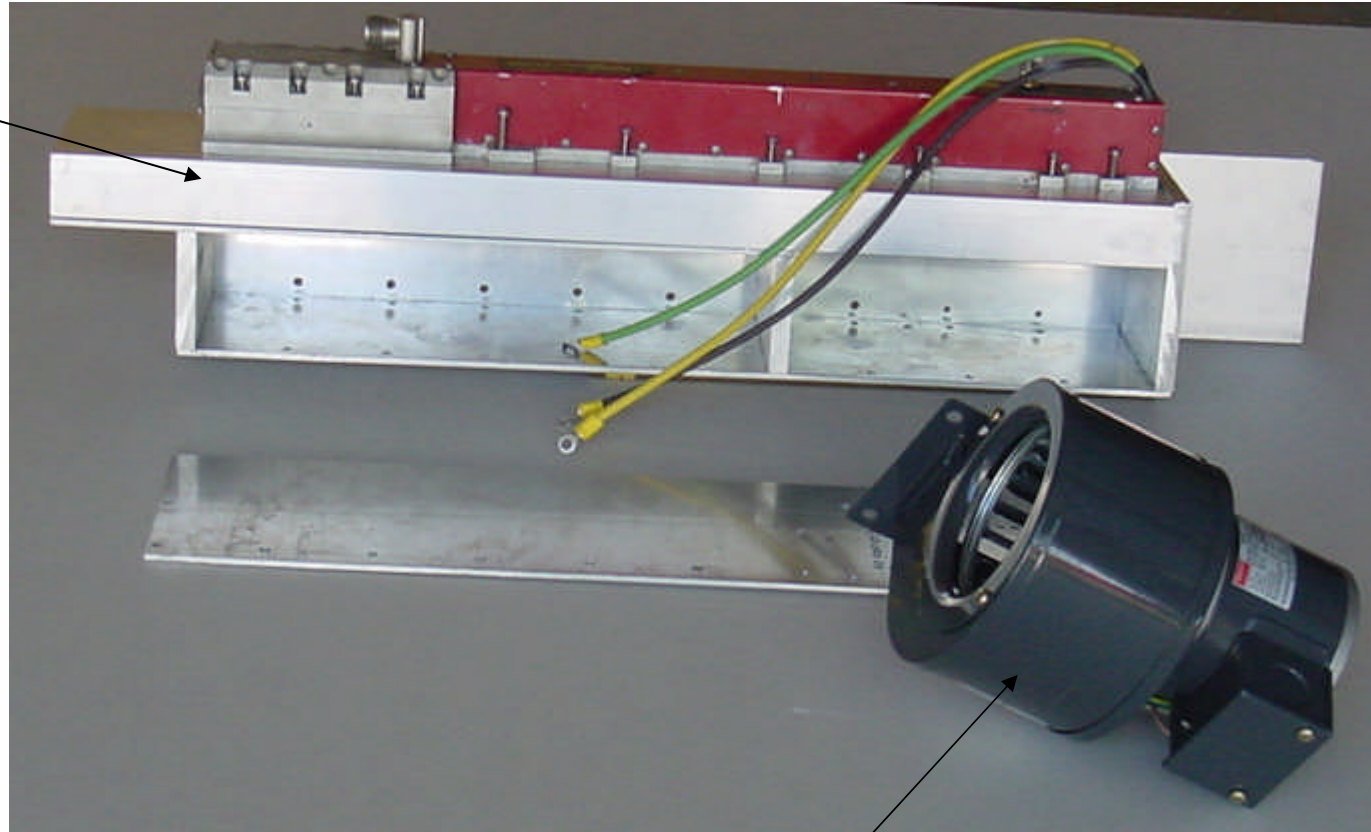


Internal Views of the Completed TWT Power Supply



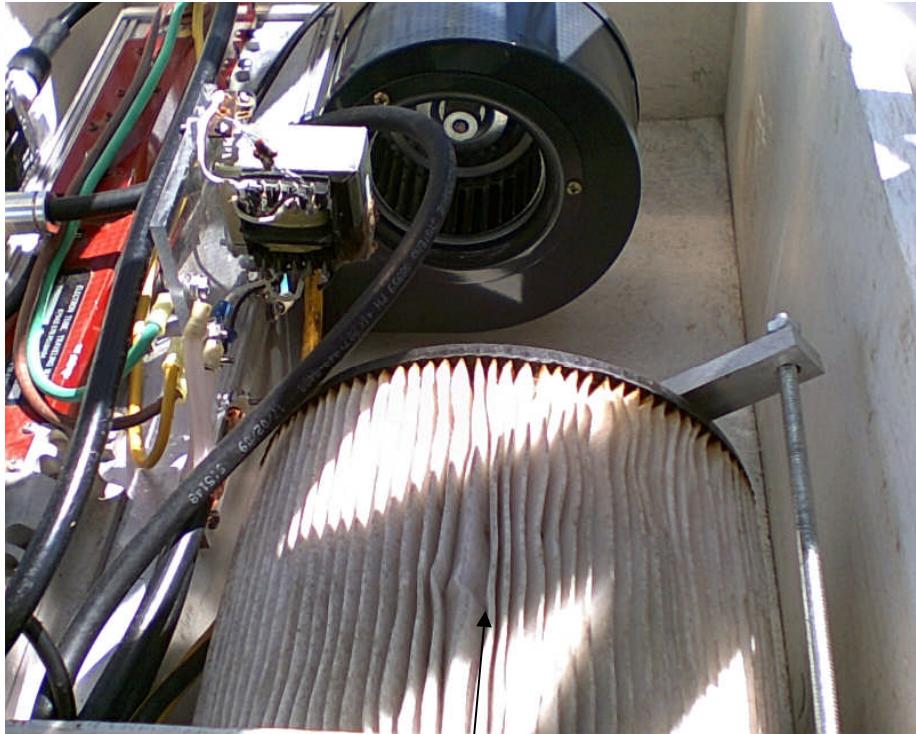
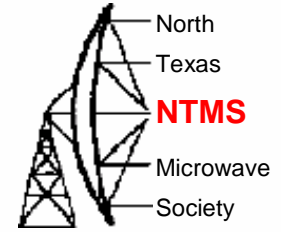
TWT Cooling Assembly

Heat Sink



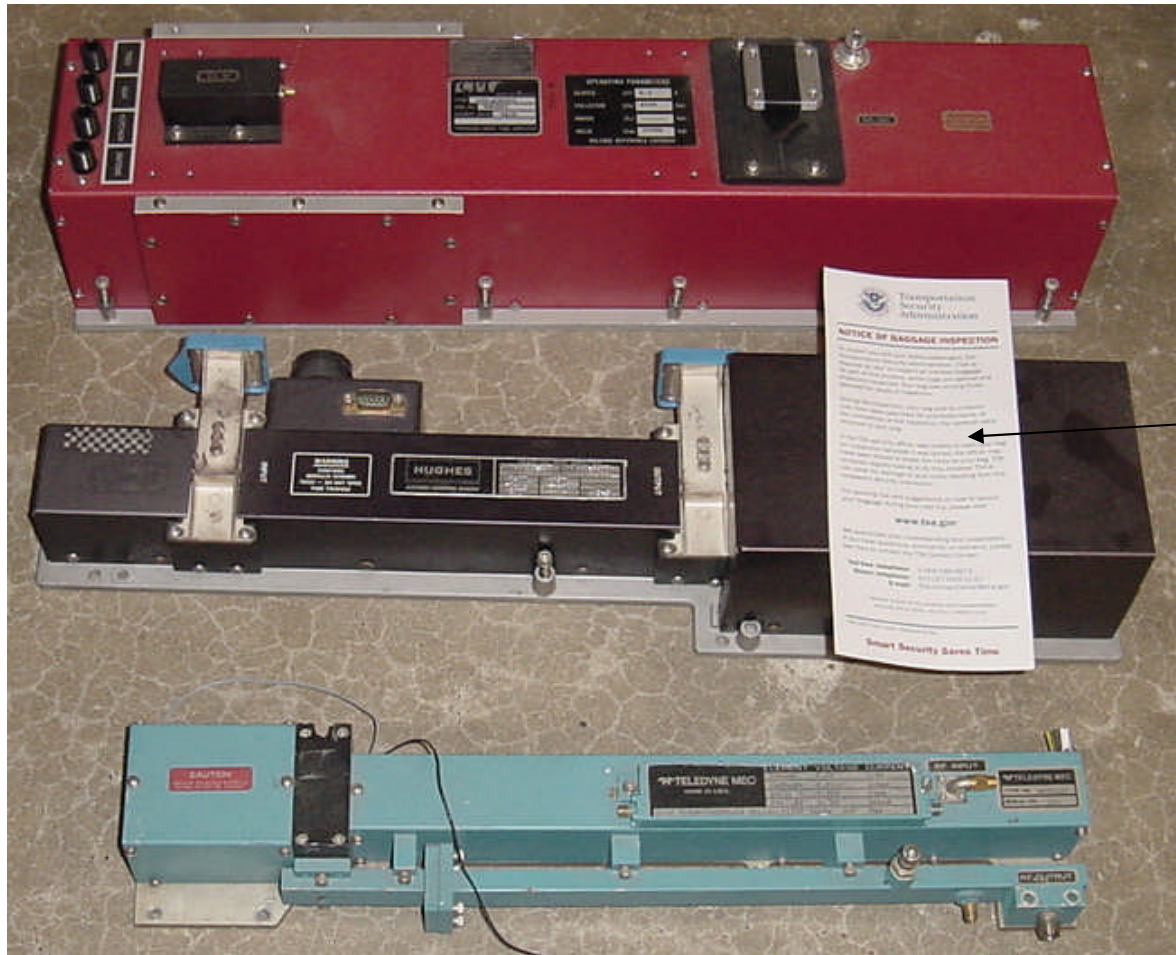
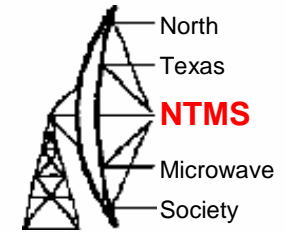
Blower – Dayton 1TDR6 rated for 110 CFM

Internal Views of the Completed TWT Assembly



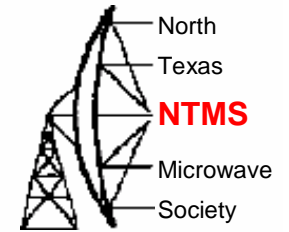
Air filter from a shop vacuum

Various High Power TWTs



Occasional gift from TSA when carrying one of these in your checked luggage

Summary



- The techniques described here have been used successfully with high power 200 watt plus tubes at K5GW and the echoes are very nice!
- Any Questions?