Compact Voltage Protector/Fuse Assembly for 100-watt transceivers
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Introduction

Do you worry about protecting your mobile transceiver from voltage transients on the mobile DC line? And in your home station, how about the possibility that your station power supply might lose regulation and put excessive voltage on your transceiver? Some power supplies have over-voltage crowbar protection to protect against this possibility, but many don't. And since many radios have un-switched DC on their final amplifier transistors and internal power lines for electronic on/off switching, any voltage in excess of the maximum spec'd voltage (typically 16-18 volts) can be damaging even when the radio is off.

Now for very little outlay in cost and effort, you can do a good job of protecting your transceiver from unforeseen powering failures and transients, and unintentional powering accidents that can be very destructive. Further, as many transceivers use 1-1/4" cartridge in-line fuses in the DC power cord, you can incorporate the fusing and voltage protection in a small enclosure that takes up no more room than the existing fuses. Finally, this voltage protector unit connects to your transceiver and power supply or batteries with Anderson Powerpole™ connectors (I have standardized on these for all my DC applications). Obviously, you can connectorize this unit with whatever connectors you've standardized on.

The Voltage Protectors

I built two versions of the voltage protector – one using standard 1-1/4" fuses and the second using automotive blade fuses.

The 1-1/4" fuse version parts list is shown in Table 1, and the schematic is shown in Figure 1. For both transient and overvoltage protection I used a 1.5KE15A 15-volt transient suppressor diode (Mouser 625-1.5KE15A). This is basically a very high current 15-volt zener diode which can handle a peak current of over 70 amps! All the circuitry is contained in a 2.36"x1.38"x0.79" plastic box. I mounted a Powerpole connector pair directly on this box (epoxied in place) which interfaces to the transceiver's pendant DC cable (see Figure 2). The rectangular cut-out for the Powerpole pair is easily made with a nibbling tool. A Powerpole terminated 12-gauge DC-input pendant cable connects to the power supply or battery. I used heat-shrink-covered braid for the interface to the epoxied-in Powerpole connector pair. To really make assembly easy, you may wish to use pendant cables for both the DC input and output. Note that it is important to properly orient the fuse assembly with respect to the 1.5KE15A so as to ensure that the diode properly provides both over-voltage and reverse voltage protection. Photo A shows the cartridge fuseholder, the plastic box and the installed (but not yet epoxied-in) PowerPole connectors. Photo B shows the fuseholder with the 1.5KE15A diode installed.

Referring to Figure 3, wire up everything and then epoxy the dual fuseholder to the box. I had to trim one corner of the fuseholder so it would clear the cover mounting post of the

box. Snap the two fuses into place and you're ready to go. I labeled this voltage protector box with Casio white-on-clear labeling tape.

Table 1: Parts List for 1-1/4" x ¼" glass fuses

QTY	Description	Source
2	25-amp 1/4x1.25" fuse	Mouser 504-AGC-25
1	1/4x1.25" Dual Fuseholder	Mouser 534-3537
1	2.36"x1.38"x0.79" box	Mouser 546-1551HBK
1	15V/1.5KW Volt.Prot.Device	Mouser 511-1.5KE15A
2 pr	Anderson Powerpole	*Connex PP-30-KIT

* www.connex-electronics.com

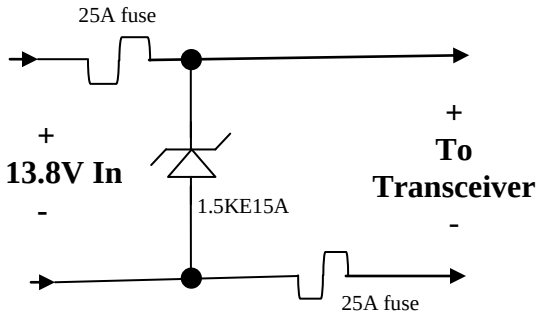

Figure 1 – 25-amp Voltage Protector

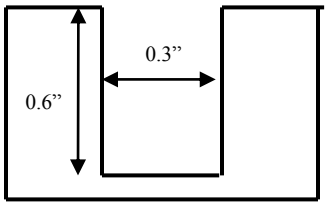

Figure 2: Side View – PowerPole cutout

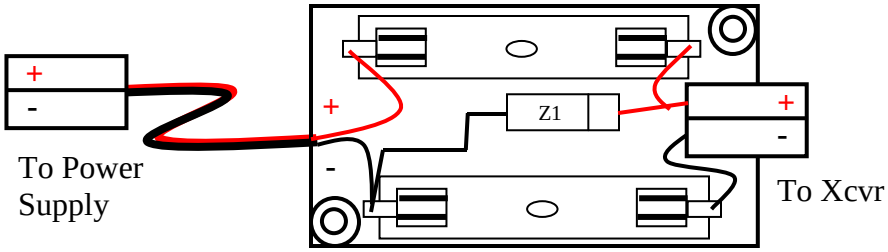

Figure 3: Internal Component Mounting

Photo A: Cartridge fuseholder & box

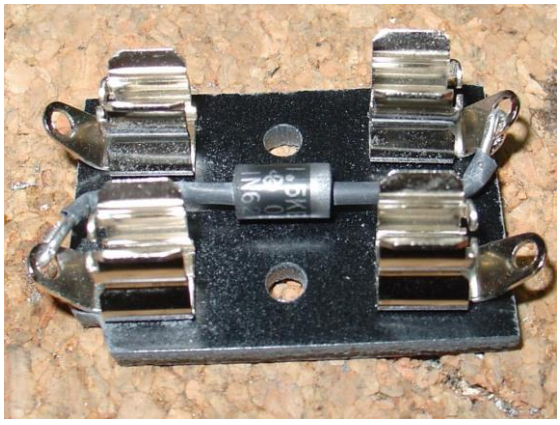

Photo B: Fuseholder with 1.5KE15A

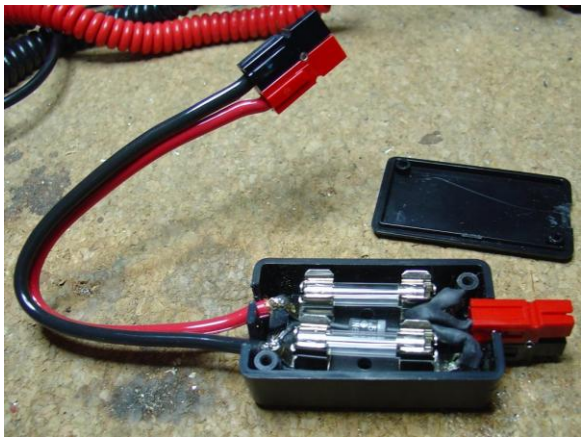

Photo C: Internal view of fuse assembly

Photo D: Final cartridge fuse assembly

Transient/Over-Voltage Testing

To check the ability of the 1.5KE15A to clamp transients, I diode-or'd a 50-volt current-limited power supply with a 13.8VDC power supply as shown in Figure 4. I keyed the relay with an external signal generator/transistor switch and observed the voltage across the 1.5KE15A. The oscilloscope waveform is shown in Photo E. As you can see, the 1.5KE15A does an excellent job of clamping the voltage to 16V maximum.

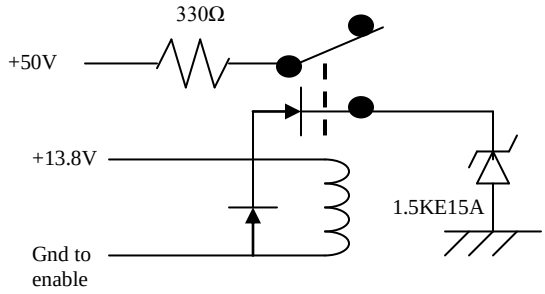

Figure 4: Test Circuit

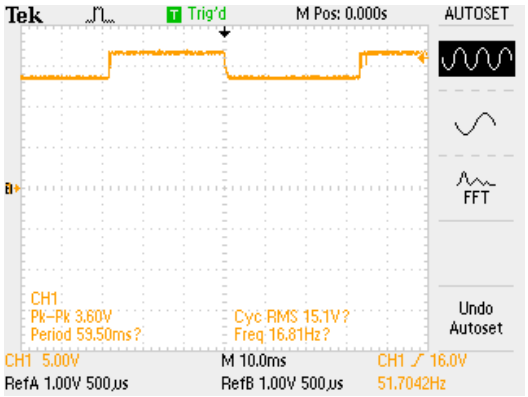

Photo E: Clamping waveform test

To check the over-voltage condition that could result from loss of power supply regulation, I put two 12V gel-cell batteries in series and connected the +24V output to the fuse assembly. The fuse blew immediately. I did this several times, and I did have one occurrence where the 1.5KE15A diode failed. It failed shorted, so the protection was still provided. Possibly I caused the failure by repeatedly testing the over-voltage protection with the same 1.5KE15A diode.

Finally I ran some reverse voltage protection tests. I did this twice - with no radio connected of course! The fuse blew immediately and there was no apparent damage to the transient suppressor diode.

Automotive Fuse Version

Because of the popularity of automotive blade fuses, I built a second voltage protector that uses these popular fuses. And because I used a larger box for the automotive fuse holders, I added crowbar protection as seen in the schematic in Figure 5. In this circuit, the 1.5KE15A still clamps and absorbs fast over-voltage transients as well as provides reverse-voltage protection. However, longer sustained over-voltage conditions, such as a power supply that loses regulation, will trip the triac which will blow the fuse. The 1uf capacitor makes the circuit insensitive to very short duration transients and noise on the incoming DC line. With this circuit the 1.5KE15A diode won't fail with any over-voltage condition.

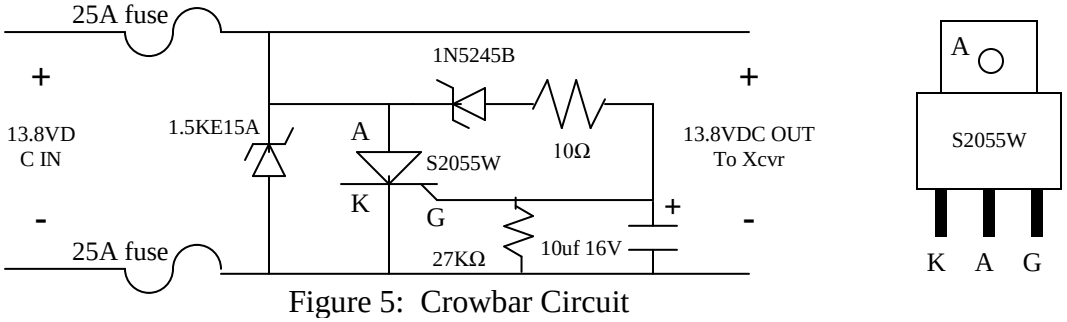

Figure 5: Crowbar Circuit

Table 2 shows the parts list for this version. The automotive fuseholders slide together to make a dual-fuse assembly which even has a position for a spare fuse. I cut out a 1" x 1.4" opening in the plastic cover of the box with a nibbling tool, and then epoxied the fuse holders into place. PowerPole mounting brackets hold the transceiver-side connector in-place, although you can use pendant cables for both the DC input and output. All parts were built on a small piece of perf-board as you can see in Photo F. Photo G shows the final assembled voltage protector (note the spare fuse). I used a Sharpie™ silver permanent marker pen to label this voltage protector unit.

Table 2: Parts List for automotive fuses

QTY	Description	Source
2	25-amp automotive fuse	Mouser 576-0257025.PXPV
2	1/4x1.25" Fuseholder	Mouser 534-3560
1	1.12"x2.13"x3.27" box	Mouser 563-CU-1941
1	15V/1.5KW Volt. Prot. Device	Mouser 511-1.5KE15A
1	S2055W triac	Mouser 576-S2055W
1	15V zener diode	Mouser 78-1N5245B
1	10 ohm ¼-watt resistor	Mouser 660-CFS1/4CT52R100J
1	27K ohm ¼-watt resistor	Mouser 660-CFs1/4CT52R273J
1	10uf 16VDC electrolytic capacitor	Mouser 647-UVP1C100MDD
2 pr	Anderson Powerpole	*Connex PP-30-KIT
1 pr	PowerPole mounting brackets	*Connex 146-2G1

* www.connex-electronics.com

I connected a high voltage variable power supply to the unit to test the crowbar circuitry. I found that the SCR would trip at 15.6 volts.

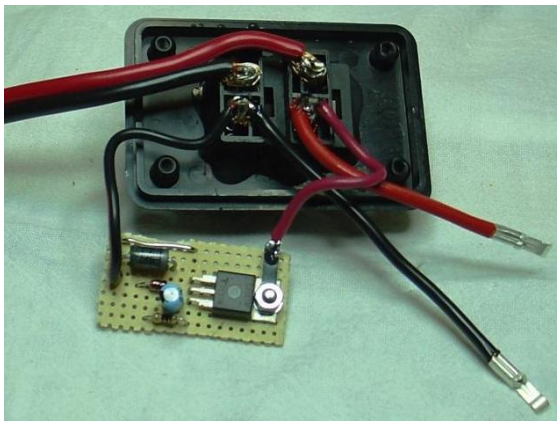

Photo F: Crowbar circuitry

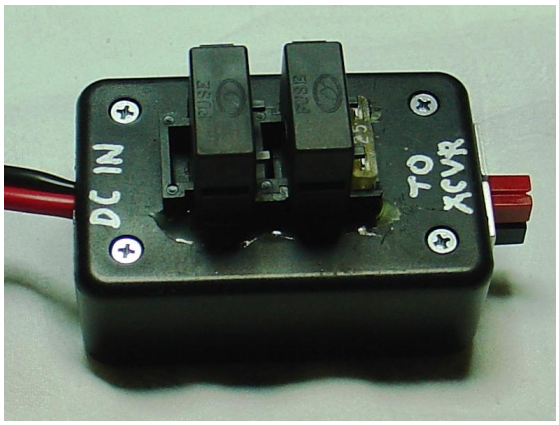

Photo G: Completed assembly

Summary

I've described two in-line voltage protectors for 20-amp 100-watt transceivers. These assemblies are compact, yet provide over-voltage and reverse voltage protection and fusing. Build-up one of these units for your transceiver and ensure you're your radio is protected from inadvertent power supply transients, power supply over-voltage failures or connection mistakes.