

Input Voltage Conditioner for the FT-817

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Introduction

When it comes to a portable do-anything/go-anywhere rig, it is hard to beat the Yaesu FT-817. Since it is all-modes and all-bands below 450 MHz (except 220 MHz), it is really ideal as a take-along radio for trips, vacations, backpacking, etc. I've used my FT-817 for over three years now and have really enjoyed it. My only concern is that there is no fusing and no reverse battery protection built into the radio. Further, there have been reports that some switching power supplies put out momentary voltage spikes up to 18 volts when they are turned on. As it turns out, the finals aren't disconnected from the DC input when the radio is turned off, so a voltage spike exceeding the 15-volt maximum spec of the FT-817 could be bad even if the FT-817 is turned off! Therefore my goal was to condition the input power supply voltage to ensure it could not harm the radio in any way. Also, I've never really cared for the little 4mm x 1.7mm power connector interface on the FT-817 and I wanted to do something about that as well.

Some interesting observations lead to a plan

An interesting fact about the FT-817 is that it draws the same amount of current across most of the useful voltage range for a given output power. I.e., at 5-watts output power, the FT-817 draws 1.9 amps typically no matter whether the supply voltage is 9.6 volts or 13.8 volts! So all you're doing at the higher voltages is dissipating more power inside the radio (8-watts difference between 9.6 volts and 13.8 volts!).

Once I found this out, I started carrying around 9.6V 3AH R/C NiMH battery sticks for portable operation (I purchased two packs plus a smart charger for \$55 from www.batteryspace.com). Two of these sticks, plus my internally charged W4RT OPP (1800 mah) gives me a huge amount of operating time. Therefore, I decided that I would limit the voltage to the FT-817 to 9.6 volts when external power is applied. Additionally, I wanted to add DC input low- and high-frequency decoupling along with my goals of reverse polarity protection, 15-volt over-voltage protection, and an in-line fuse. And last but not least, I wanted to change my power supply interface from the 4mm x 1.7 mm power plug to an Anderson Powerpole connector.

The Electrical Design

Figure 1 is the schematic of the power conditioning circuit. The heart of this circuit is the STM LD1085V low drop-out adjustable voltage regulator. This regulator is packaged in a TO-220 case, and is rated at 3-amps of output current. And at the full 3-amp current limit, this device only needs a 1.2-volt drop input/output differential voltage, so you can easily run the radio from an external 12-volt power supply. The voltage drop is closer to 1-volt at the 2-amps normally drawn by the FT-817 at 5-watts output power. You can adjust the regulator output for other voltages if you wish, by adjusting the value of the

two resistors, or you can just replace the two resistors with a 1K potentiometer with the wiper connected to the ADJ pin of the regulator.

For both over-voltage and reverse-voltage protection, a 15 volt 600 watt voltage transient suppressor diode is used. This transient suppressor diode will take care of any voltage transients above 15 volts (and can sink up to 100 amps of current for 10 milliseconds). Also, when reverse voltage is applied, this transient suppressor diode looks like a forward biased diode, and will blow the fuse. The fuse is a miniature leaded fuse soldered in place. You'll also notice that I included a switch so that I could bypass the regulator when I'm using voltages less than 10.5 volts (like with my 9.6 volt NiMH R/C batteries), or if higher voltage (+13.8V) is needed for charging internal NiMH batteries from the internal FT-817 charger.

The Mechanical Design

The interesting part of this project was the mechanical design. As I discussed earlier, I wanted to get away from relying on the 4mm x 1.7mm DC plug. Also, I needed to package everything neatly. I found a nice little plastic box (Mouser to the rescue – again) that mounts nicely up against the back of the FT-817. You'll need to drill two holes as shown in Figure 2 on the bottom of the plastic box. The larger 5/16" diameter hole fits over the ground post on the FT-817. The smaller 3/16" diameter hole should be a tight fit to the threaded shaft of the 4mm x 1.7mm DC plug that you'll need to purchase. You may have to enlarge this hole slightly, but keep the fit snug. Discard the plastic thread-on collar, and then thread this plug partially into the 3/16" diameter hole. Keep the plug as straight as possible. Now insert this plug/plastic box assembly so that the plug mates with the DC jack on the FT-817. Adjust the length of the plug (by screwing it in or out of the plastic box) such that the plug fully mates with the jack when the bottom of the box is flush with the back of the FT-817. Once you've determined the correct length, epoxy both sides of the 4mm x 1.7 mm plug to the plastic box. See Figure 3 and photo "Plug&Epoxy.jpg".

The last two items to be mounted on the box are the slide switch and the Powerpole connector. The cutout dimensions shown for the Powerpole connector will ensure that this connector slides securely in place into the box. Since the box is soft plastic, the rectangular cut-outs are easily made with a hobby knife, assuming you have a little patience. Figure 4 shows the cover mounting locations for the switch and the screw hole necessary for holding the assembly to the FT-817. Figure 5 and photo "Side.jpg" shows the information on mounting the Powerpole connector on the box.

Internal Wiring and Assembly

To wire everything up, I first temporarily mounted the TO-220 voltage regulator with a screw, nut, and washers to simulate the height of the heat sink post it will eventually be mounted to. Then I was able to wire-up everything point-to-point. One of the 0.01uf capacitors was soldered directly across the 4mm x 1.7mm plug terminals. I found that this completely eliminated the need for the external ferrite required by earlier FT-817

radios when externally powered and using the attached whip antenna on 440 MHz. Refer to Figure 6 for the component locations of the major parts, primarily the 47 uf and 22 uf electrolytic capacitors. When finished, I removed all the temporary hardware from the regulator, and then mounted the regulator as shown in Figure 7 and photo “InsideWiring.jpg”. Note that I used a 3mm x 25mm screw with the head cut off to mount the regulator. This creates a 3mm x 25mm stud for mounting the regulator, plus it extends through the cover and holds the entire assembly to the FT-817 chassis. And there is enough length left to add another nut and lockwasher should you wish to still use this for a ground connection. Notice that with the regulator mounted directly to the FT-817 heatsink, power that was normally dissipated internal to the FT-817 due to higher voltages is now dissipated directly into the heatsink before it even gets into the radio! Photo “MountedBK.jpg” shows the complete assembly mounted in place on the back of the FT-817. Photo “Mounted.jpg” shows the assembly with a Powerpole plug connected to it. And photos “TopView.jpg” and “TopFront.jpg” show top views of the FT-817 with the voltage conditioner assembly mounted to the back. All labeling is done using Casio “white-on-clear” labeling tape (Casio XR-9Axs).

Operation

Operation is very simple. Just connect your Powerpole DC input to the Powerpole on the voltage conditioner. If your input voltage is below 10.5 volts, flip the switch to the “< 10.5V” position as this will bypass the 9.6-volt regulator. You will also need to use this switch position if you are using the internal FT-817 charger to charge an internal battery pack (you need +13.8 volts input to have sufficient current to charge internal batteries). For input voltages greater than 10.5 volts, put the switch in the “> 10.5V” position. In both cases, the over-voltage, reverse voltage, and fusing is on-line and protecting your FT-817. Remember that the FT-817 automatically switches to 2.5 watts output power when the input voltage is below about 11 volts. However, you can easily set the output power to 5-watts through the FT-817 menu (Function row 9) when the voltage is below 11 volts. You should also be aware the even when an external power supply is used, when the regulator is in-line, you will draw current from the internal battery until its voltage drops below the 9.6 volt regulator output. So always make sure the internal battery is charged just before going out to operate battery-portable.

Summary

I’ve described a bolt-on input voltage conditioner assembly for the FT-817. This assembly is compact, yet provides over-voltage and reverse voltage protection, fusing, and improved power dissipation at voltages over 10.5 volts. Additionally, the DC interface is now the standard Anderson Powerpole connector. Build-up one of these units for your FT-817 and sleep a little easier!

Phil Salas AD5X has been licensed over 40 years and primarily enjoys HF CW operation. He is an ARRL Life Member, and holds BSEE and MSEE degrees from Virginia Tech and Southern Methodist University, respectively. Phil is currently the Vice President of

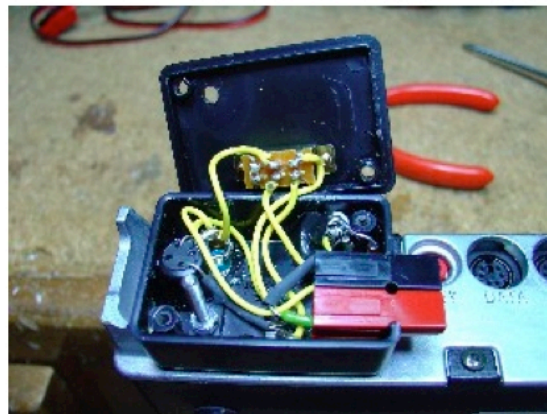
Engineering for Celion Networks in Richardson, TX. Phil may be contacted at ad5x@arrl.net.

Parts List

<u>QTY</u>	<u>Description</u>	<u>Source</u>
1	STM voltage regulator	Mouser PN 511-LD1085V
1	3-amp fuse	Mouser 576-0251003.M
1	15V/600W Volt.Prot.Device	Mouser 511-P6KE15A
1	47uf 16V elec. capacitor	Mouser 140-HTRL16V47-TB
1	22uf 16V elec. Capacitor	Mouser 140-HTRL16V22-TB
2	0.01uf 50V capacitor	Mouser 80-C315C153K5R
1	4x1.7mm DC plug	Mouser 171-3219
1	470 ohm 1/4-watt resistor	Mouser 71-CCF07-J-470
1	68 ohm 1/4-watt res.	Mouser 71-CCF07-J-68
1	1.97"x1.38"x0.67" box	Mouser 546-1551GBK
1	DPDT 3A slide switch	Mouser 629-GF1263011
1 pr	Anderson Powerpole	West Mountain Radio
1	Heat Sink Grease	RS 276-1372
1	M3x25mm screw	
2-3	3mm nuts	
2	4-40x.5" screws	
2	4-40 nuts	
2	# 4 washers	



Plug & Epoxy



Inside Wiring



Mounted on Back



Top View

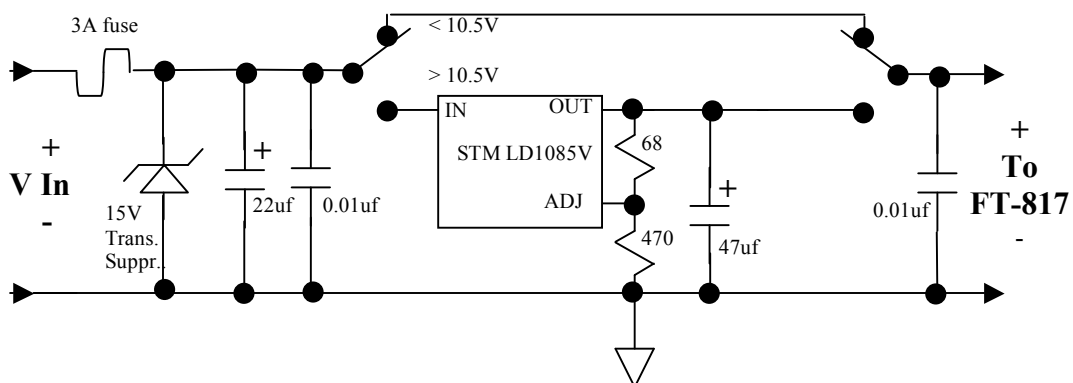
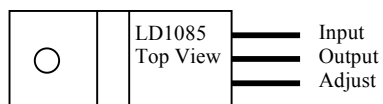


Figure 1: Schematic – FT-817 Voltage Conditioner

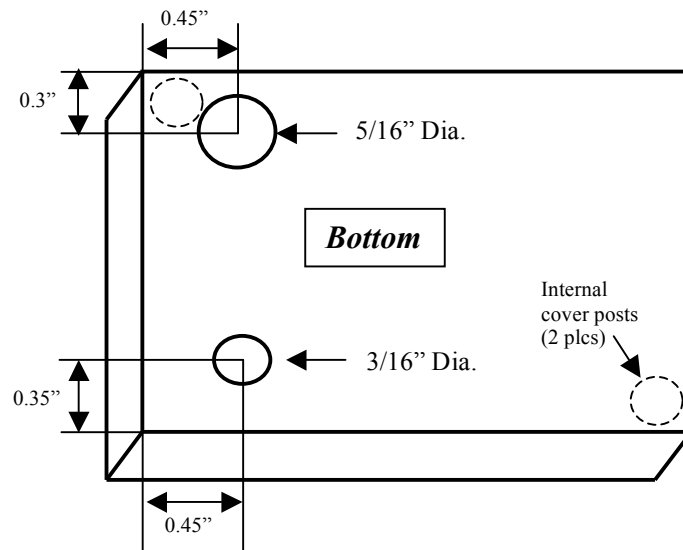


Figure 2: Plug and Post hole dimensions

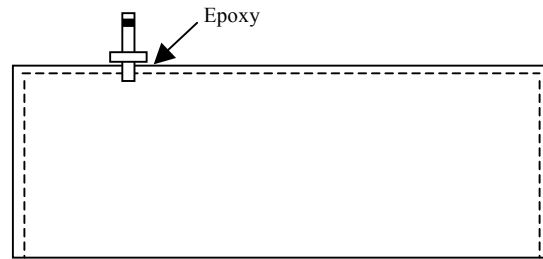


Figure 3: 4x1.7mm plug installed on box

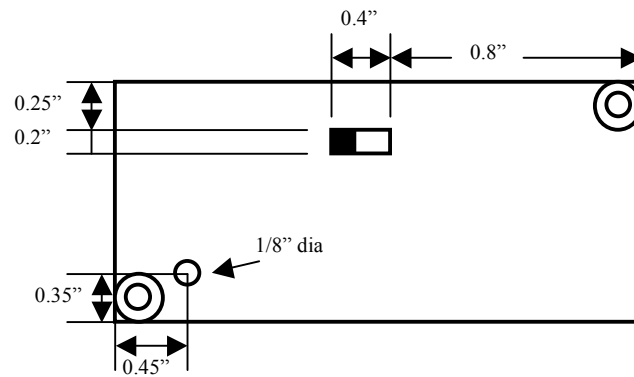


Figure 4: Cover – Switch & Mounting Hole

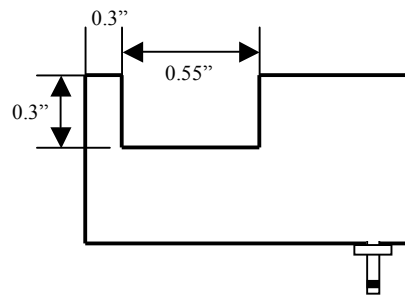


Figure 5: Side View – Powerpole cutout

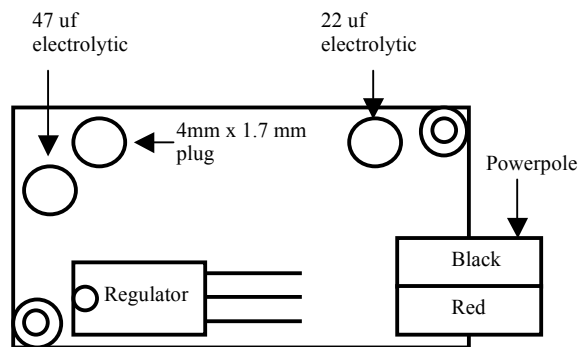


Figure 6: Internal Component Mounting
(Top View)

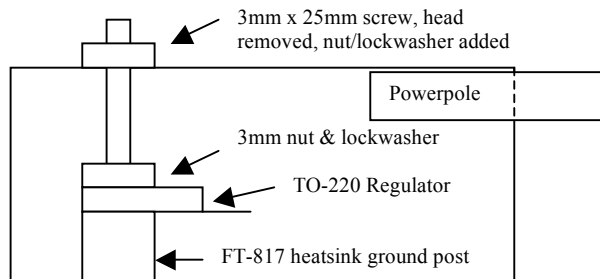


Figure 7: Regulator mounting – Side View