SOTA, WA3TFS 20W QRP Amplifier and Power Delivery (PD) for Portable Operations

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This month's article will be a mixture of topics related to portable operations. First of all, Barbara (KJ5KLY) and I went back to Mineral Wells and were able to activate Johnson Peak (SOTA Summit W5T/NT-039). Again, it wasn't easy! In addition to the QMX 5W QRP radio, we brought along a 20W amplifier designed by WA3TFS – more on that later. The idea was to use 20W SSB for the activation. We called CQ on 40M many times and had no call backs. We only managed to hear a few letters of a friend's call sign from Conroe. The amplifier seemed to be acting differently than it had at home on the power supply. I suspected that the 6A-hr LiFePO4v battery could not provide enough current (~5A maximum needed). Based on later observations, however, I think it was common mode currents on the coax braid.

We decided to switch to 20M FT-8 and not use the amplifier. After setting up the radio and PC, we were decoding many stations. Calling CQ SOTA resulted in many call backs and I made 7 QSOs in 14 minutes – more than the four contacts needed to get SOTA points. Barbara took over and quickly made 7 QSOs also. While operating FT-8, the PC lost connection with the USB port of the radio many times. This is usually due to RF being picked up by the USB cable. We were using a rather long (36"), unshielded cable with no ferrites.

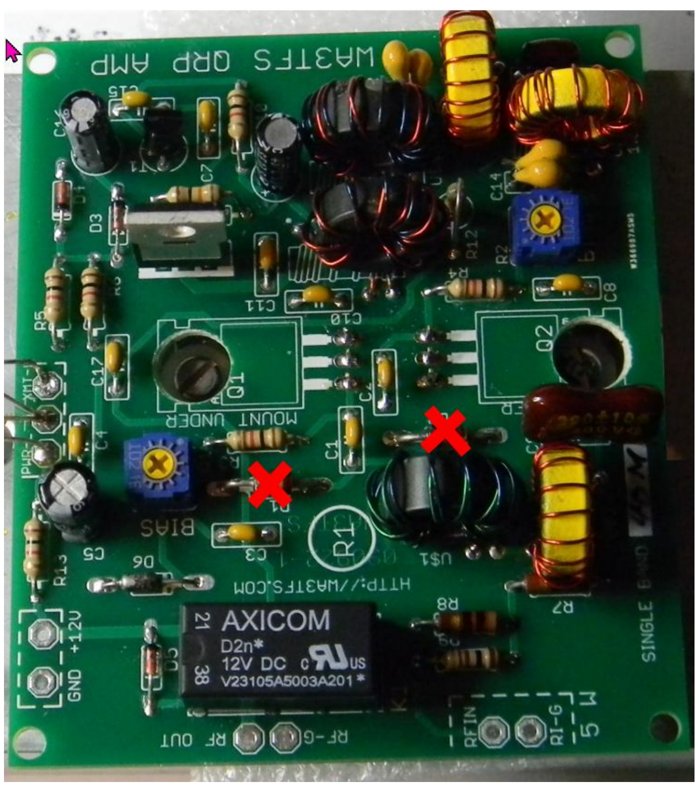
Upon returning home, I ordered a USB cable from Digirig. This cable is only 15" long and shielded with ferrites at each end. I also confirmed that the radio and amplifier worked as expected at home (on battery power) where they were much more distant from the antenna. I also added a large rectangular snap-on ferrite to our QRP bag. Multiple turns of the RG316 coax will easily fit around this ferrite and provide good RF choking. I will get another chance to test these improvements at a SOTA later this month. I will be helping as ground crew for the Doucette repeater link work. After that I plan to head to SOTA Summit W5T/NT-031, Newton County HP (High Point).

Also, once home, I re-organized my QRP gear into two bags that fit perfectly within my backpack. One bag contains the QMX, antenna, throw weight / rope, microphone, earbuds, CW key (VK3IL Paddle), 25' of RG316, 3' for RG316, PD power bank with fused cables, 9V DC-DC converter, spare fuses, Digirig USB cable, TRS audio cables for key / mic / PTT and ferrite block. In short, everything needed for 5W SSB, CW and digital (with PC). The second bag includes the WA3TFS amplifier, 6A-hr LiFePO4 battery fused cable for 20W operation. I also put a few coax adapters and simple tools in this bag (see photo below).

Above I mentioned the [WA3TFS 20W amplifier](). This is available as a bare PCB or as a kit with most (all through-hole) components. I purchased the kit. The builder has to provide an enclosure as well as a power switch and connectors to mount in the enclosure. By changing the three toroids and four capacitors of the input impedance matching components and the output LPF (low pass filter), different ham bands can be amplified. Toroid and capacitor values for 160/80/75M, 60/40M, 30/20/17M and 15/12/10M versions are provided. I opted for the 20M version. The amplifier is designed to input 5W from a QRP radio and amplify that to ~20W. I get nearly 20W output on 30M and 20M with about 12W output on 17M as the output LPF begins to attenuate. Finally, this is a linear amplifier, so all modes can be used with it, although it is not very efficient with respect to power usage.

At the input, one branch of RF input is voltage-divided to half-voltage and rectified. The rectified RF is used to turn on the base of a transistor which in turn activates a relay that provides power to the final amplifier. This is not a good method of keying the amplifier for many QRP rigs. The QMX in particular uses four BS170 transistors for the final amplifier. These transistors are very susceptible to failure due to over-voltage or over-current operation. During the amplifier keying, momentary high SWR can occur causing BS170 failure. Also, for SSB or CW operation, RF is turned on and off resulting in excessive and annoying relay chatter and "hot-switching".

Fortunately, the QMX provides a PTT output and a PTT delay. A slight modification to the amplifier build injects the PTT (+5V) into the voltage divider and then transistor / relay to turn on the amplifier just before RF is sent out of the QMX. This works perfectly to operate the amplifier and protect the QMX finals. The [QRP Labs groups.io](#) forum was instrumental in helping me and another ham with the WA3TFS amplifier implement these changes. While I had issues with the amplifier in the field, I have made many SSB contacts from home with the QMX and WA3TFS amplifier throughout the US, Canada and even Belgium. A photo of my finished amplifier and the populated PCB are shown below. The final transistors (Q1 and Q2) are mounted under the board and bolted to the enclosure to provide heat-sinking.



When I added the amplifier to my QRP kit, I decided to use a PD power bank that I already had to power the QMX. This would relieve the 6A-hr LiFePO4 battery of about 1A of current draw by the QMX during transmit and extend its ability to power the amp. These power banks are quite amazing. A 6.5″ x 3″ x 7/8″ power bank weighing just under 1 lb. contains over 26.8 A-hrs of power! During about 3-hours of use at our recent SOTA activation, I used only 6% of the available power, so it could last for up to 48-hrs.

The device (or cable) attached to the output port (USB-C) controls the output voltage at nominally 5V, 9V, 12V, 15V or 20V. Not all power banks include all of these voltages, but many do. If there is no control from the cable or attached device, then the output defaults to 5V (typical USB-A voltage). You can make custom power cables for your devices with inexpensive and very small PCB boards. These typically have solder pads that you bridge together to select the output voltage. A photograph of one that I have used is shown below. These boards are very small at less than 1″ x ½″. Barely visible is a 0-ohm resistor soldered at the 12V position. By removing this and shorting the pads at another voltage pads, that output voltage can be selected.

One possible issue with PD devices is switching power supply noise from the DC-DC converter. This would usually be observed at discrete frequencies of the switcher and harmonics. I have not personally seen this to be an issue.