

SWR “Tamers” for HF Transceivers Phil Salas – AD5X

Manual and automatic antenna tuners can present a high SWR to your transceiver during tuning. Most HF transceivers have a low power “tune” mode and output fold-back to provide output circuitry protection under high SWR conditions. Popular QRP radios also turn down power in the presence of high SWR. But unlike higher power radios, the low turned-down output of QRP transceivers is often insufficient for proper operation of auto-tuners or auto-screwdriver tuners. As an example, my IC-703 puts out full power into a 2:1 SWR. But at a 3:1 SWR the output power is about 2-watts, and just about 1-watt at a 5:1 SWR. This makes the IC-703 incompatible with at least one auto-screwdriver tuner. So let’s look at a few different circuits that provide output SWR protection for HF transceivers, and also help keep QRP output levels high enough for automatic tuners.

My first SWR Tamer was simply a 3dB pad that could be switched in-line during tuning. The worst case SWR with this unit is about a 3:1 SWR. Figure 1 is the schematic, and Photos A and B show internal and external views of the switchable attenuator. The resistors are Caddock 15-watt thick-film resistors good well up into the VHF range, and the aluminum box is a Mouser 537 -M00-P.

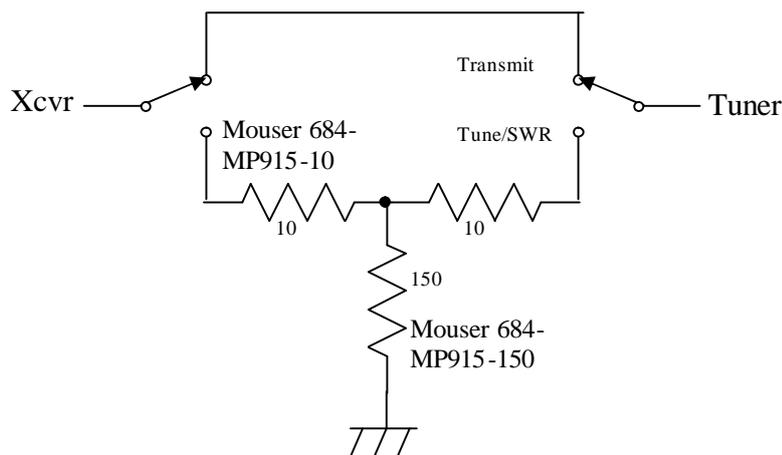


Figure 1: In-Line 3dB Attenuator

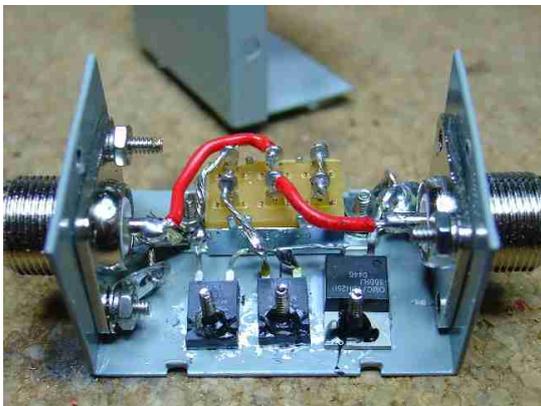


Photo A: Inside view of the 3dB attenuator

Photo B: 3dB attenuator outside view

A simpler circuit is the simple L-network shown in Figure 2. This circuit reduces the power resistors to only two, and limits your worst-case SWR to 2:1. However, under matched conditions you lose 6dB of transmit power.

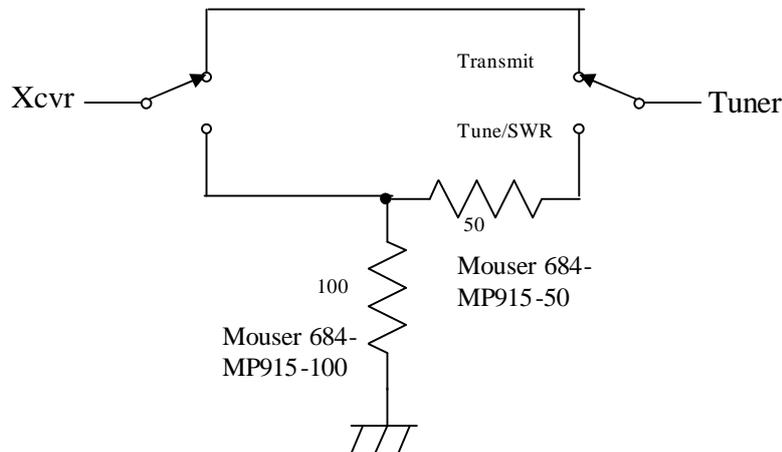


Figure 2: In-Line 6dB Attenuator

But finally it occurred to me that just placing a 100 ohm resistor across the RF line while tuning cycle could keep the SWR at 2:1 or less with the least attenuation. The exception to this is if you are trying to match a very low impedance. However, short antennas have high capacitive reactance, and screwdriver antennas either have high capacitive reactance or high inductive reactance when off resonance. I've also found that when using a manual tuner, your impedance won't be too low if you set both the matching and tuning capacitors to maximum and then peak the receive signal with the tuner inductor prior to tuning with transmit power applied.

Figure 3 is the schematic of this very simple circuit. The aluminum box, a Mouser 537-M00-P, is painted. So scrape off paint around the SO-239 mounting screws for good RF grounding, and around the base of the 100 ohm power resistor for good heat transfer (use Radio Shack 276-1372 heat-sink grease under the power resistor). You will need one solder lug to attach one end of the 100 ohm resistor to ground. The 100 ohm power resistor is mounted with a #2 screw, lockwasher and nut. The switch and SO-239 connectors are mounted with #4 hardware.

The wiring diagram is shown in Figure 4. Point-to-point wiring is used, and is just fine for HF through 6-meter operation. Photos C and D show my final wired unit. For all labeling, I used a Casio labeler with "black on clear" tape. I also added stick-on rubber feet on the bottom of the unit.

Using the unit is trivial. When tuning with either an auto or manual tuner, just flip the switch to the 2:1 position so that the 100 ohm resistor is in shunt with the load. When tuning is complete, flip the switch back to "NORM".

Conclusion

I've described a series of simple circuits that will limit the SWR to your transceiver during antenna tuning event, and also keep the transmit power level high enough so that even QRP transceivers can work with most auto-tuners. Give one of these circuits a try.

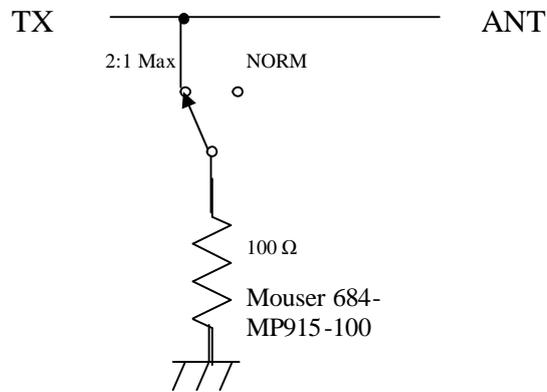


Figure 3 – Simplest SWR Tamer Schematic

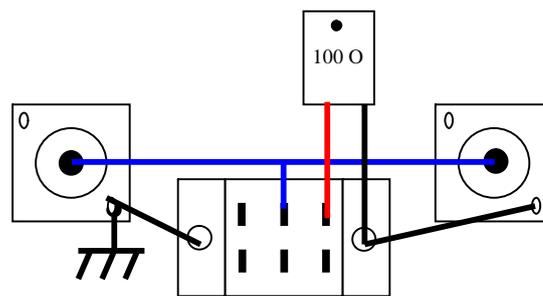


Figure 4 – Physical Wiring Diagram

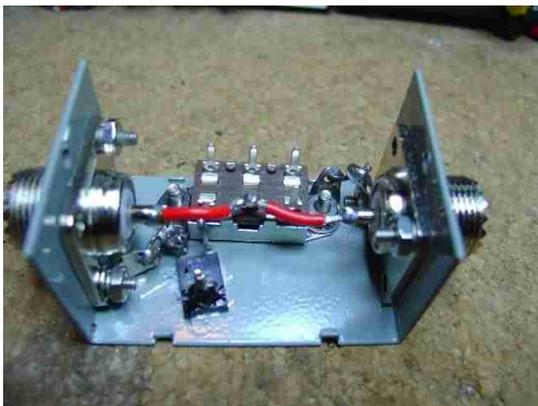


Photo C: Internal Wiring



Photo D: Outside View