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# Simplify Transceiver to Amplifier Interfacing with an In-Line Attenuator

*Solve a classic interface problem with this simple to make device.*

**Phil Salas, AD5X**

Many high power HF amplifiers require less than 100 W to drive them to full output. All modern transceivers have the ability to have their output power reduced as necessary to properly drive an external amplifier. Besides having to remember to turn down your transceiver's output power when you put your amplifier on-line, it can also be a hassle to readjust your transceiver's output power, especially if it has to be done via a menu setting.

## The Problem May be More Serious

Many transceivers output a full power transmit spike when first keyed at the beginning of each new transmission, even if the power has been reduced. The output power is quickly cut back to the desired output level by the radio's internal automatic level control (ALC) circuitry. Even so, the initial spike may cause some amplifiers to go into a fault condition due to the amplifier's internal overdrive protection circuitry.

I first ran into this problem while driving my Ameritron ALS-600 solid-state amplifier with my ICOM IC-706MKIIG transceiver. The ALS-600 needs about 65 W to drive it to full output power. Turning back the power of the IC-706MKIIG to 65 W is done via a menu setting. But the first dit of each new CW transmission would always result in an initial full power spike, which would badly overdrive the amplifier.

## The Solution at Hand

I solved these issues by simply putting a 2 dB attenuator pad in series with the transceiver's output. This permits me to leave the radio set for full power all the time, while the resulting power to the amplifier stays constant at about 60 to 65 W. With the transceiver set for full output power, a full power spike won't occur. The 2 dB attenuator has minimal effect on the receiver signal-to-noise ratio, and makes a negligible reduction in receiver sensitivity. Finally, the attenuator even improves the match to your transceiver when feeding a less than perfect tuned amplifier input network — as you might have if trying to use an older amplifier

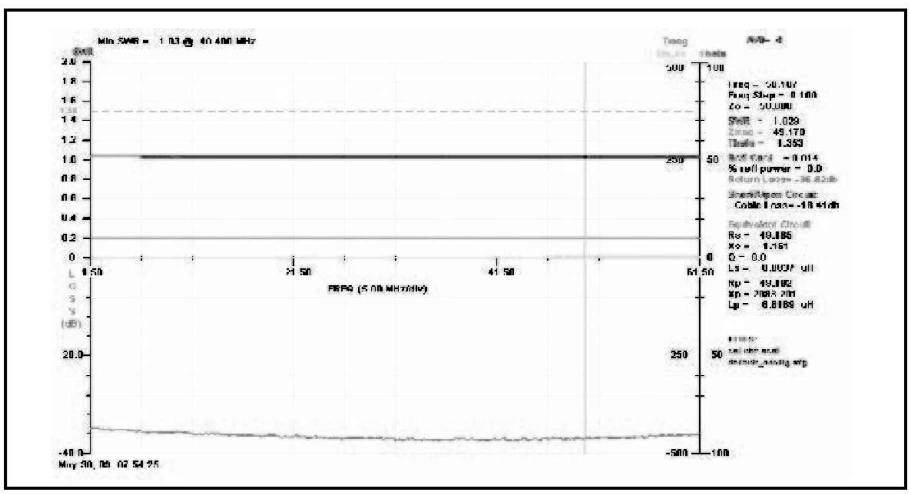
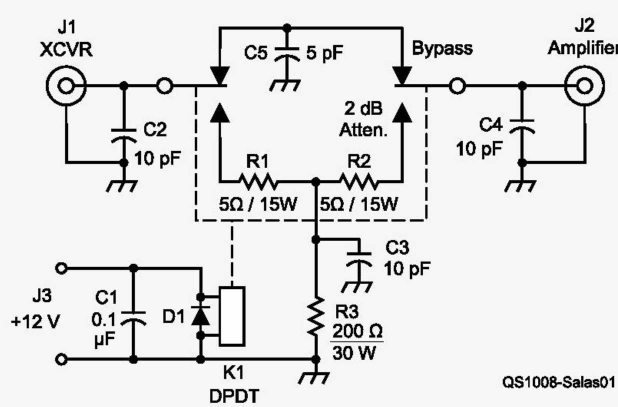


**Figure 2 — SWR and Return Loss plot — 2 dB attenuator with 5 and 10 pF tuning capacitors.**

**Figure 1 — Schematic diagram and parts list for the 2 dB power attenuator. Mouser parts are available at www.mouser.com.**

C1 — 0.1 µF, 50 V capacitor (Mouser 140-50U5-104M-RC).
C2-C4 — 10 pF, 1 kV ceramic capacitor (Mouser 75-561R10TCCQ10).
C5 — 5 pF, 1 kV ceramic capacitor (Mouser 75-561R10TCCV50).
D1 — 1N4003 diode (Mouser 625-1N4003-E3/73).
J1, J2 — SO-239, UHF type coaxial jacks (Mouser 601-25-7350).
J3 — 2.1 × 5.5 mm dc power connector (Mouser 163-4304-E).
K1 — 12 V, DPDT relay (Mouser 769-DS2E-M-DC12V).*
R1, R2 — 5 Ω, 15 W thick film resistor (Mouser 684-MP915-5).
R3 — 200 Ω, 30 W thick film resistor (Mouser 684-MP930-200).
Cast aluminum box (Mouser 563-CU-5123).
*Alternately, a DPDT slide switch, such as Mouser 629-GF11261110, can be used.



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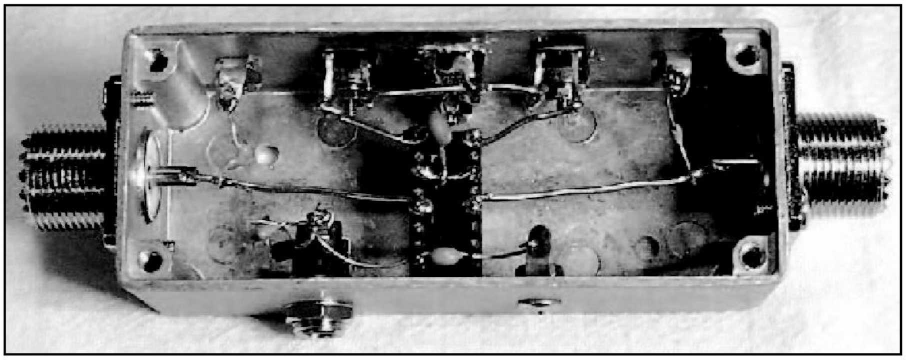

**Figure 3 — Inside view of 2 dB power attenuator mounted in cast aluminum box.**

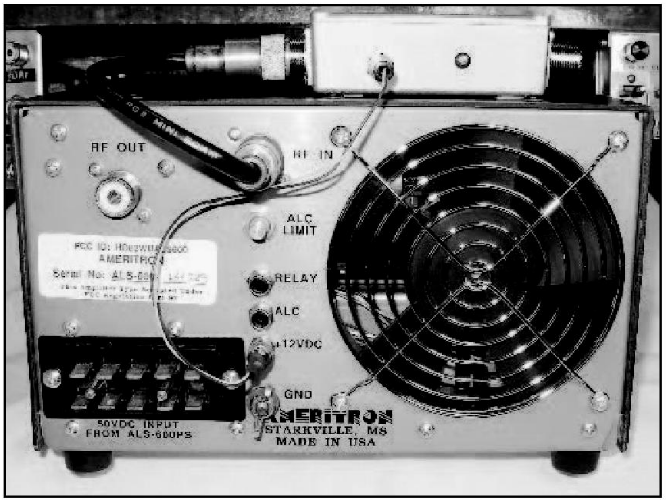


**Figure 4 — Attenuator mounted on top of the ALS-600 amplifier cabinet for additional heat disipation capacity.**

on the 30, 17 or 12 meter bands that weren't available when the amplifier was made. As an example, a 2:1 load SWR becomes a 1.5:1 SWR with the 2 dB pad placed in-line.

## Under the Covers

Figure 1 is the schematic diagram with parts list of my 2 dB attenuator. While this is not a precision attenuator, it is certainly close enough for our purposes (1.04:1 SWR if terminated in a perfect 50 Ω load, with 1.95 dB loss). The resistors are Caddock 15 and 30 W thick-film resistors, which are purely resistive well up into the VHF range. The 5 Ω resistors dissipate about 7 W each at full power so you can use 15 W rated resistors. The 200 Ω resistor dissipates about 20 W so a 30 W rated resistor is used.

An internal DPDT relay bypasses the 2 dB attenuator if operating barefoot. The relay contacts are rated to 3 A, which is more than sufficient for a 100 W transceiver. Note that the relay coil is polarity sensitive. If desired, you may wish to use a DPDT switch instead of the relay. Point-to-point wiring is used, which works pretty well for HF operation. There is, however, some stray inductance that I tuned out with the small capacitors shown on the schematic.

This tuning is not really necessary for most HF applications, as the SWR is less than 1.2:1 through 30 MHz without the capacitors. Figure 2 shows the SWR plots with the tuned 2 dB attenuator is in-line.

## Attenuator Construction

The attenuator is built into a cast aluminum box, which does a good job of dissipating the heat, especially for low duty cycle CW and SSB amateur applications (see Figure 3). However, you may want to provide additional heat sinking as this attenuator dissipates about 35 W. In my case, I mounted the attenuator directly to the cover of my ALS-600 amplifier as you can see in Figure 4. The ALS-600 cover provides all the power dissipation needed. For a standalone unit (not mounted to a large surface), a large microprocessor-type heat sink can be attached to the die-cast attenuator box.

The attenuator relay is powered from the +12 V dc RCA accessory jack on the back of the ALS-600. In this way, the attenuator automatically goes in line whenever the amplifier is turned on. It's a truly "stupid-proof" implementation for me, as there is no thinking necessary about drive power when I want to use the amplifier.

## If 2 dB isn't Enough

If your amplifier wants to see 50 W drive, the attenuator can easily be changed to a 3 dB unit that also uses readily available thick film resistors. Change R1 and R2 to 10 Ω, 30 W (Mouser 684-MP930-10) and R3 to 150 Ω, 30 W (Mouser 684-MP930-150) units. Again, this is not a perfect 3 dB attenuator pad, but it is very close (1.06:1 SWR when terminated in a perfect 50 Ω load, and 3.2 dB loss). The same compensating capacitors as in the 2 dB attenuator will improve the match here as well. Again, these are not really necessary — especially if you use the DPDT slide switch, which has less stray inductance.

If 2 or 3 dB of attenuation is not enough, within the same cast aluminum box you can cascade two attenuators as necessary to achieve 4, 5 or 6 dB of attenuation using these inexpensive and readily available thick film resistors.

## Conclusion

I've described a simple and automatic means of reducing transceiver power when you are driving an amplifier. Not only does the described attenuator eliminate having to remember to turn down your transceiver's output power when driving an amplifier, but it also eliminates an initial high power spike that is output by some transceivers when they are adjusted for less than full power output. If you are having problems with a high amplifier input SWR, such as if operating on the 30, 17 and 12 meter bands with an amplifier built before they became ham bands, this attenuator will also improve that mismatch. [Note that 30 meter operation in the US is limited to 200 W PEP output. — *Ed.*] Build this inexpensive accessory and make amplifier operation more convenient.

*Photos by the author.*

*Frequent* QST *author and ARRL Life Member Phil Salas, AD5X, has been an active ham since he was first licensed in 1964. He obtained BSEE and MSEE degrees from Virginia Tech and Southern Methodist University, respectively, and spent the next 33 years holding positions from design engineer to vice president of engineering in microwave and lightwave development. Now fully retired, Phil enjoys spending all his time with his wife Debbie, N5UPT, along with continued tinkering with ham related projects.*

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