

Elmers Corner: Of S-Units and Power

By Robert Gulley AK3Q

I think it must be part of human nature to always want more power. The car manufacturers often try to sell us on cars with lots of horsepower—as if we are going to use them the way they are shown on TV! Maybe I am just getting old, but even if I lived out on the salt flats and I could take my car “from 0-60 in 2.3 seconds” while side-sliding to avoid missiles shot at me from a James Bond-movie-type bad guy, that’s not a reason for me to buy the car. But we do like our power!

When an amateur station cannot be reached usually the first thing we think of is we need more power. “If I just had that ProPower all-mode whiz-bang amplifier I could reach that DX station.” Maybe, but maybe not.

I do a lot of listening on the air in addition to trying to work a lot of stations, and I often hear folks talking about their station with a real sense of pride, and that is a good thing! But sometimes I hear folks talking about how much power they can throw out of their station and I get the sense there is a bit of bragging going on.

When two folks are talking to one another on 40 meters and they live a few hundred miles away from one another, 1500 Watts is not usually needed to make a contact! In fact, often that much power sounds off, as though the person is overloading their audio, and quite often they are.

There are times when the full legal limit might be needed, but not nearly as often as folks like to throw it out there “because they can.” In fact, doing so violates the rules for amateur radio. We are directed by the FCC as part of our license *grant* to operate only with as much power as is sufficient to make the desired contact. Even on our repeaters we should turn our mobile power down from 50 Watts to 10 or 5 Watts if either of those power levels is sufficient to reach the repeater.

A little common sense goes a long way here, too. Minimal power does not mean your signal has to be barely just above the mud. But rather of such quality that it may be reasonably heard and understood without strain to the recipient. That may mean 10 Watts instead of 5 into the repeater, but one should also know what the bare minimum power can be used from a home or common location, just for those times when we might need to conserve power, such as when operating off of a battery or generator.

What Do I Gain by Cranking it Up?

Here's the thing: power is not a simple calculation. A change of 5 Watts to 10 Watts does not double the distance or strength of your signal. This is true whether on the HF bands or when working a repeater. Assuming a repeater hears your signal reasonably well it is going to re-transmit your signal at its assigned power level. The person on the other end cannot tell you have increased your power unless your original signal was weak coming into the repeater.

When talking about HF we often talk about S-units and signal strength. While S-units are somewhat inconsistent between radios and manufacturers, they are used as a minimal gauge of how well we are receiving a signal. In the HF world we get used to saying someone is "five-nine" (59) whether our meters read that or not, or we will give accurate readings (which is what we should do with the possible exception of some contests—but that discussion is for another day!).

Unless bands are really crowded or noise levels are extremely high, there is no real difference in the ability to copy a signal between five-seven (57) and five-nine (59). Yet I find myself sometimes thinking to myself when I get a true 57 report, "I wonder what is wrong with my signal that I only got a 57 report?" Smack! I have been temporarily infected with the power virus! At five-seven my signal was completely understandable, I received the confirmation of my call, and no doubt was able to have a good discussion with the person on the other end.

In fact, when I get someone telling me at the start of a conversation that my signal is "ten over five-nine" that really means I should *back down* my power until I am no more than five-nine, or preferably less. Do I do that? Not all the time. If I am only making short calls and then moving on to talk with someone else, then I may leave the power alone. If I am planning to "ragchew", that is, talk a while with someone, then I need to back down my power to be in good compliance with the rules.

Now, back to S-units and their real value in terms of our discussion of power. To move one S-unit, from five-seven (57) to five-eight (58), we have to quadruple our power because our signals are measured in decibels. Doubling our power means, at least in theory, an increase of 3dB signal strength. In reality, it is a little less than that, but we will not quibble over it here. So doubling my power raises my signal 3dB, while doubling it again raises my signal a theoretical 6dB. An S-unit change requires 6db signal strength change as a minimum, and actually slightly more.

So to go from five-seven to five-eight, if I started with 25 Watts I would have to increase power to 100 Watts just to move *1 S-unit*! If I want to move my five-seven signal to a five-nine (in other words, S-7 to S-9), I have to take my 25 Watts and go up to *400 Watts*. Remember each doubling of power equals $\frac{1}{2}$ S-unit change. Thus 25 to 50, 50 to 100, 100 to 200, 200 to 400 gives us a 2 S-unit change. And of course the reverse is true.

If 100 Watts gives you an S-9 signal, dropping back to 25 Watts still gives you an S-8 signal. Dropping even further, we could go down to roughly 5 Watts and still produce an S-7 signal—this is exactly why QRP operations are so popular. We do not need more than 5 Watts many times to work around the world. Again here's the math: $100 \text{ Watts} / 2 = 50 \text{ Watts}$ ($\frac{1}{2}$ S-unit); $50 \text{ Watts} / 2 = 25 \text{ Watts}$ (1 S-unit); $25 \text{ Watts} / 2 = \sim 12 \text{ Watts}$, and $\sim 12 \text{ Watts} / 2 = \sim 5 \text{ Watts}$ or 2 S-units. Five-nine becomes five-seven, which is easily copyable under most circumstances.

I say all of this just to drive home the point that power is not everything. There is nothing wrong with operating at 100 Watts and sending out a good signal, but don't assume more power is going to radically increase your reach, either. Going from 100 Watts to 800 Watts with a typical amplifier, is only an increase of 1.5 S-units, less when the amp only goes up to 600 Watts. From there, an increase from 800 Watts to 1500 Watts is only 0.5 S-unit increase; that's a lot of money and power to go up just 3dB!!

Amps are fine, just do not get caught up into thinking you have to have a legal limit amplifier to be heard! Spend more money and time getting the best antenna system you can and you will often raise **both** the transmit *and* receive capabilities of the station, boosting what you can hear. And always remember, if you can't hear 'em, you can't work 'em! An amp can help in certain situations, and they are another tool in the tool box, but they are hardly the most important one.

When you think in terms of power start thinking in terms of the decibel and S-units, and that will help you to not get too carried away by the lure of MORE POWER!! 73, Robert AK3Q