S-Unit Table & Info

Paul NA5N

One S-unit is a change of 6dB in signal strength, which corresponds to double the VOLTAGE or four times the POWER at the receiver input.

HANDY-DANDY S-METER CHART

VOLTS	POWER
S9+20dB 500uV	= - 53 dBm
S9+6dB 100uV	= - 67 dBm
S9 50uV	= - 73 dBm
S8 25uV	= - 79 dBm
S7 12.5uV	= - 85 dBm
S6 6.2uV	= - 91 dBm
S5 3.1uV	= - 97 dBm
S4 1.6uV	= -103 dBm
S3 .77uV	= -109 dBm
S2 .39uV	= -115 dBm
S1 .19uV	= -121 dBm

An S-METER is calibrated by connecting a signal generator to the antenna terminal and setting the output power to 50uV, or -73dBm, and adjusting the S-meter calibration pot for a reading of S-9. Since the S-meter is usually derived from the receiver AGC line, it “is” relatively linear from about S3-S4 and upward (since a good AGC usually "kicks in" around -100 to -105dBm). This linearity is also due to the diodes used for the AGC detector, once they are conducting in the linear region (again, around S3-S4). Statements that "S-meters are totally worthless" or "a change in 2 S-units means nothing" are thus actually quite incorrect. An S-meter “is” a fairly good RELATIVE power indicator for received signal strengths and noise levels.

SO WHAT-THE-HECK IS AN S-METER GOOD FOR?

The purpose of an S-meter is not to provide any absolute indication of power or voltage, but a RELATIVE indication between received signal strengths ... such as between two different signals, or between a signal and the "noise floor" of the band.

Example: On 40M, typically the "noise" will be S4, or about -103dBm. If your receiver has an MDS (minimum detectable signal) of -133dBm, it means you're loosing 30dB of your dynamic range to the noise! (133-103=30dB). In this case, the S-meter is more-or-less giving you an absolute power DIFFERENCE between its MDS and the noise floor, in dB.

Example: A station claims his beam antenna has 12dB gain over his dipole. So he switches

between the two and asks you for an "A-B" comparison. His signal goes from S7 to S8 ...a 6dB change. That ain't 12dB! 12dB should have shown 2 S-units of change. (I'm assuming his beam antenna “was” properly pointed at you - hi).

Likewise, YOU are comparing two antennas at your shack. You are LISTENING to a QSO in progress, switching between the two antennas. One antenna causes the S-meter to rise about 1/2 S unit. Well, that's 3dB, and that's not bad for most wire antennas. Or ... you are switching between two antennas and notice that the noise seems to be much less on one, in fact, the S-meter drops from S4 to S3. You have a problem with the antenna with the higher noise. If the noise drops 2 S-units, you have a BIG problem with that antenna! Obviously, you want to use the antenna with the lowest noise, because an S5 signal will be an S5 signal on the same receiver. The difference, is if one antenna has an S4 to S5 noise, you'll be digging that S5 signal "out of the mud." With an antenna at S3 noise level, that S5 signal now has a 2 S-unit (12dB) improvement in signal-to-noise, and will obviously be much easier to work.

An S-meter also makes it convenient to make internal tuning adjustments to your receiver, such as peaking any IF cans, filters, etc. You can tune to a carrier or QSO in the S8 range, then tune above and below and mark the frequency where the S-meter drops 1 S-unit (6dB), 2 S-units (12dB), etc. to make a rough graph of your overall selectivity/filtering of your receiver. If your receiver claims the RF amplifier, when kicked in, provides 12dB of gain, well, you should clearly see about a 2 S-unit change. Or if the 3dB filter bandwidth is 300Hz, then you should clearly see a 1 S-unit change over about twice that, huh? You can do the same with a DVM on your audio output, but an S-meter sure makes it more convenient, and quite easy to verify some of the specs and claims the rig/kit vendor is claiming or to check for a change in performance later on for troubleshooting purposes. It is ALWAYS beneficial to do some of these basic measurements when you put a new rig on-line, so you have a baseline to check performance later on if troubles begin. A simple S-meter is all you need to record some of these important specs.

WHAT ABOUT THIS QRO vs QRP THING?

You have to QUADRUPLE (X4) your signal to DOUBLE your signal strength at the receiver end. Likewise, if you drop your power by one-fourth, your received signal strength will be one-half less, or 1 S-unit. You are working a station running 100W and he is S8. If he drops his power to 1/4th, or 25W, his signal strength should drop about 1 S-unit, or to S7.

If he drops another 1/4th, to about 6W, he should drop another S unit, or to about S6. Therefore, the difference between 100W and 5W QRP is about 2 S-units. Big deal. Dropping to 1W is about another S-unit, then to 250mW another S-unit, etc. OK, now you're getting down into the S4 noise level on 40M. Now you're hoping the guy on the other end has only a S3 noise level on his end :-)

Hopefully this answers some of the questions raised about S-meters and how to use them.

72, Paul NA5N