



## SWR (Standing Wave Ratio) and How to adjust the HFp for best SWR

SWR is a measure of how well the antenna is absorbing the power generated by the transmitter. The best SWR is 1:1 (referred to as "one-to-one"). A 1:1 SWR means that all of the power of the transmitter is being absorbed by the antenna - just as you would like it to be. If the SWR in your system is higher than 1:1, it means that some of the power sent to the antenna is not being used by the antenna, and is being reflected back to the transmitter.

Most modern transmitters will operate with full power into a load with an SWR of 2:1 or less. If the SWR is higher than 2:1, the transmitter will cut back on its output power to protect itself from excessive amounts of reflected power.

Here is a chart showing the antenna power and reflected power for a transmitter power level of 10 Watts. The chart is copied from an Excel spreadsheet, which is available for download from the Ventenna website. In the active spreadsheet, you may enter any power level in the blue cell, and see the results for different Standing Wave Ratios.

### SWR Chart

Transmitter Pwr -  Watts

SWR	% LOSS	Ant Pwr	Refl Pwr
1.0:1	0.00	10.00	0.00
1.1:1	0.20	9.98	0.02
1.2:1	0.80	9.92	0.08
1.3:1	1.70	9.83	0.17
1.4:1	2.80	9.72	0.28
1.5:1	4.00	9.60	0.40
1.6:1	5.30	9.47	0.53
1.7:1	6.70	9.33	0.67
1.8:1	8.20	9.18	0.82
2.0:1	11.10	8.89	1.11
2.2:1	14.10	8.59	1.41
2.4:1	17.00	8.30	1.70
2.6:1	19.80	8.02	1.98
3.0:1	25.00	7.50	2.50
4.0:1	36.00	6.40	3.60
5.0:1	44.00	5.60	4.40
6.0:1	51.00	4.90	5.10
7.0:1	56.30	4.37	5.63
8.0:1	60.50	3.95	6.05
9.0:1	64.00	3.60	6.40
10.0:1	66.90	3.31	6.69

Enter the transmitter power output into the "Transmitter Pwr" blue cell.

The "Ant Pwr" column shows the amount of power available to the antenna, in Watts. This is the power the antenna will radiate into space.

The "Refl Pwr" column shows the amount of power reflected back to the transmitter, in Watts.

This chart does not take into account the amount of power which may be lost in the coaxial cable. Power lost in the cable is not transmitted into space, or reflected back to the transmitter, but simply turns into heat distributed along the length of the cable.

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You can see that, at 2:1 SWR, a little over 11% of the transmitter's power is not absorbed by the antenna, and is reflected back to the transmitter. At 1.5:1, the returned power is 4%, and at 1.2:1, it's 0.8% - practically insignificant. In most situations, setting up the HFp according to the Laminated Card will result in an SWR well below 2:1 - usually in the range of 1.2:1. With 0.8% reflected power, that's a very effective antenna

It is usually pretty difficult to get the SWR much below 1.5:1 with most portable antennas - they just don't have the range of adjustments available. But, with the HFp, if you really want to make it perfect, it is possible - it'll just take a bit of time to get the adjustments exactly right.

### **How to do it**

If you want to make the effort, first set up the HFp according to the Laminated Card. Refine the whip length (and, perhaps, re-configure the elements) for the lowest possible SWR - this should be below 1.5:1.

Then shorten the radial lengths by a small amount - maybe about six inches. Change all three radials the same amount. See if the SWR goes up or down. If the SWR is going down, do another change, in the same direction. If the SWR goes up, lengthen the radials by about a foot, and check again. Note that it will take a very sensitive SWR meter to see the small SWR changes that will result from the radial length change.

These adjustments to the radials will also slightly change the resonant frequency of the antenna, so you may have to re-adjust the test frequency to re-acquire the lowest SWR point, or, alternatively, make a slight adjustment to the whip to bring the antenna's resonant frequency back to your test frequency. Changing the test frequency is easier.

Keep going with the radial length adjustments until it appears that you have reached the lowest possible SWR - typically indicated by an increase in the SWR with a new length change in the same direction. (Remember to check the frequency!) At this point, use a tape measure to be sure that all the radials are the same length. If they are not, adjust them to be the same, then re-check the SWR to see that you are still at the lowest point. Make a couple more small length adjustments if you need to.

Then, carefully change the radial lengths by rolling the spools  $\frac{1}{2}$  turn. Again, change all radials by the same amount. With a very sensitive SWR meter, and with careful adjustments, you should be able to get the HFp's SWR down so low it is not measurable.

Note that, at this point, the HFp is a very sensitive resonant circuit, and any slight intrusion into its near field will affect it quite strongly, as will be seen in the SWR readings as you move about near the antenna.