Antenna & Ground Help

Selecting Wire Length

There are always questions about the length of wire to use with an SGC Smartuner™. We're going to talk on a purely practical level about wire length for your next antenna. The short answer to selecting a wire length is "Any wire length will do!". That's almost right and will almost always get you near a practical antenna whether you're choosing a random length wire, a vertical, or a dipole.

There are some minimums that you need to observe. Based on testing done at SGC during the design of each coupler, our specifcations include recommended minimums for operation down to 3.5 MHz*:

SG-230	**8 feet**
SG-235	**50 feet**
SG-237	**8 feet**
SG-239	**40 feet**
SG-211	**8 feet**

*Note: See individual product pages for minimum antenna length for operation down to 1.8 MHz.

Why the difference? It's a simple matter of frequency range. At the antenna feed point, the Smartuner tunes out the inductive or capacitive reactance and then matches the resistance to the feed line. Each Smartuner is adapted to particular requirements and its components determine the length of antenna it can match. Any Smartuner can tune a nearly resonant, balanced antenna.

Can you get by with just the minimum? Sometimes. In a mobile installation, we rarely have a choice. Anything larger than an 8 foot whip is hard to mount on a car. However, at 3.5 Mhz, an 8 foot whip is a very inefficient radiator. We accept it on a car because it's all we can do, but we can do better when we're portable or setting up a base station.

How about making the antenna as long as we can? That's OK up to a point, but you can overdo it and put up more wire than you need to get your signal on the air. If you put up a random wire that gets longer than about 2 wavelengths at the frequency you're using, it's considered a longwire antenna, and your radiation pattern will be directed along the wire. As your antenna gets longer and longer, it has implications for where you can send your signal. You need to know that when you set it up. Smartuners can handle these kinds of antennas, but most operators simply don't have the room.

So what **IS** a good, practical antenna length for base station or portable use? Here, the Smartuner gives you options you would not otherwise have. A practical antenna length can be determined by your space or load restrictions, not necessarily by your frequency of operation. For example, if you have a tree 100 feet away from the house, you can string a random length wire to it, you can put a dipole between it and the house with 50 foot legs, or you can string any convenient antenna type that will throw your signal where you want it. The Smartuner will make it work as long as it is within the Smartuner's frequency capture range. There's a catch though, for any given antenna you may get drastically different performance.

Each type of antenna is characterized by its feed point impedance. This is what the Smartuner is matching to when it matches the antenna to the feed line. It transforms this impedance to match to the feed line's characteristic impedance. Smartuners have a broader range of matches possible than nearly any other tuner on the market, but they aren't infinite in range. When you are working across a broad frequency band such as 1.8 to 60 Mhz there may be places where the Smartuner will not be able to find a match because it doesn't have an infinite number of tuning combinations. If one of these places occurs in a band you want to operate on, you may need to change the length of your antenna.

Normally, changing the length of your antenna by 3-6 feet will resolve a matching problem. Such problems can occur in one particular band, or several. How do you know that the problem is antenna length? When you can match perfectly on at least one band, the most likely problem is that the antenna length needs to be changed.

So, how do we turn all this into practical operation? Consider the following guidelines when putting together your antenna system:

1. Avoid lengths close to the minimum required for the frequencies you want to use to give yourself some room for differences in antenna placement.
2. Be sure that you have an adequate RF ground when using vertical or random length antennas. An RF counterpoise at least 5% longer than the antenna wire is needed, but you might find even a longer wire is necessary in some environments. A well-installed RF ground system is even better.
3. Be wary of so-called 'Good Grounds', particularly if they are part of an existing metal structure since they may not be properly connected or they may create or channel white noise into your system.
4. When using a dipole antenna, favor lengths that make the whole antenna as near as possible to ½ wavelength at the frequencies you want to operate.
5. Determine your antenna length primarily from what will be needed to support the lowest frequency of operation and adjust from there to make sure higher frequency bands will be tunable.
6. Recognize that your actual environment will change any thumbrule you use. When you install a real antenna in a real location, surrounding structures that conduct electricity will become part of your antenna system if they're close enough to it. A clue is often a change in your ability to tune at low frequencies where the antenna will reach out and interact with more metallic structures.
7. Take into account that your antenna system will change over time, but the Smartuner will hide the change by keeping you in tune. Changes are particularly rapid in the first few weeks after installation and may cause performance to suffer even though the Smartuner continues to provide a good match.

No thumb rule will handle **all** antenna situations. Your best approach is to start from what you can do within the limitations imposed by your site, and then be willing to adjust and test until you've got an antenna that delivers the performance you want. The Smartuner gives you the flexibility to do that.

SGC's book "HF User's Guide", has an overview of the issues related to HF installation and operation and includes a section on antennas. You can download a free copy in PDF format from our **publications page**.

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