

Antenna Tuners That Work:

Probably the most important piece of equipment that you can have in your shack these days is an antenna tuner. Why, you ask? Because in order to provide a 50-ohm load to a modern transceiver that they all ask for, you need to match the antenna impedance to look like 50 ohms to the antenna connection on your radio. Back in the old days, most tube radios had a PI network, and we didn't really have to worry as much about matching whatever the antenna impedance was to the tube output. Usually, it could be done simply by tuning the plate circuit to resonance and then loading the antenna with whatever was presented at the terminals. You could put a RF ammeter in line and tune for maximum smoke.

Today, however, with modern rigs that have a terminal impedance of 50 ohms, if you mismatch the transceiver or transmitter will roll the output power down so that you don't burn out the finals, to some degree.

So how do you get maximum power out to the antenna, you ask? Use an antenna tuner with an integrated SWR meter in line between the transceiver and the tuner. Recognize that antenna tuners are usually only necessary for wire antennas such as those you will use for 160 to 40 metres. All the other bands usually use resonant antennas because they are smaller. Many radios have internal antenna tuners in them, but when you can't get them to match the antenna then use a manual or automatic antenna tuner. Manual antenna tuners come in a few configurations. One is the "T" Match, another is the Differential "T" Match, and another is a Balanced Tuner for balanced lines using either 450 ohm window line or open wire ladder line. We are only going to talk about the "T" Match and the Differential "T" Match tuners here when discussing manual tuners. I personally like manual tuners over automatic.

Don't get me wrong, Automatic Tuners work well, but there are things you should do to make them work properly with your modern rigs. An autotuner generally uses dozens of relays to switch in various values of capacitors and inductors in both a capacitive input "L" Network or an inductive input "L" Network. (Can anyone say clickity clack as the relays do their thing?) Once it has found the match it will store it in memory. When you change frequency, it will begin the search again and after a few seconds it will find the match. Unfortunately, it sometimes does that when you are trying to talk to someone. When that happens, it will cause interference on the operating frequency you have changed to. That can be really annoying, and many people have brought their perfectly working tuners to me to fix thinking there is something wrong with them. No, it is working exactly as it is supposed to work in the automatic mode. It sees a mismatch and it try's to match it more closely by going

through its tuning routine till it reaches a match. The way to solve this problem is to have a rig that connects directly with a control cable to the antenna tuner. Simply press the AT button on the rig and the tuner will tune and lock the settings into the tuner's memory. This means that when you buy a tuner, you should also buy the cable that goes between the two devices so that the rig talks to the tuner directly. This will save a lot of frustration and drop the "Lid" moniker from after your name for QRM'ing others on the frequency. I use an LDG-AT-600 ProII on my Icom IC-7610 and it works perfectly every time. Just remember that when you change frequency to push the AT button so the antenna tuner will match the line. It usually happens in a second instead of 30 seconds like it does when it does it on its own by going through every possible combination of capacitor and inductor both capacitive input and inductive input. That takes time and causes QRM and annoyed hams.

Ok so just go out and buy one, right? But wait! Those suckers are expensive! Yes, they are, and for good reason. The parts for a good antenna tuner are expensive and specialized. First of all, you need a bunch of parts like capacitors and inductors and if you want, throw a SWR meter into the mix too. Package them appropriately in a nice RF tight box with connections for a couple of different antennas and an input as well as a connection for a balanced output and a long wire and some even put a dummy load in there too. That means that something has to be switched to be able to bypass or use either antenna which means there is a RF switch capable of handling the RF current and voltages that are present in the box too.

Who sells antenna tuners? They are usually available from Ameritron, Palstar and MFJ. The cheapest ones are made by MFJ, and you get what you pay for. If you are never going to use more than 100W then one of them will work well. The most popular being the MFJ-969 6 metres to 160 metre tuner or so they say. One thing to



remember is that an antenna tuner only has so much range and if you are trying to load an antenna that is cut for 40M on 160M, it likely is not going to work. Use a different antenna perhaps.

If you want to step up to a much better built unit I suggest the Palstar AT2K. This will handle up to 2000W and they are built like a brick &(^\$- house with quality components throughout. Many hams have this tuner and swear by it.



One model comes as a “T” match tuner with two capacitors and a roller inductor. They work very well but are a bit fiddly to work with and take some time to tune correctly. You will notice there are two capacitors and an inductor to play with on this tuner. The one good thing is that they have a wider range for which they will work out the combinations needed to match the antenna but there are limitations. They are hard to tune.

I opt for Differential tuners myself. So, what is a differential tuner, you ask? Essentially the differential tuner is one which has the input and output capacitors tied together so that they are 180 degrees opposite of each other. That simply means that when the one capacitor is fully meshed the other is fully unmeshed. So, as you adjust the capacitor it will vary the capacitance up on one and down in the other. The nicest part of a differential tuner is that there is only one place where you will get a perfect match and you will get one every time and it will be exactly where it is supposed to be for maximum efficiency. Whereas when you use a “T” match you will have two capacitors, one for the input and one for the output that you must vary with

the coil until you match the line. Often with that type of antenna tuner you can end up with several places where it looks like it's matched and all you are doing is heating up the inductor in the box.



Above is the Palstar AT2KD Differential Antenna Tuner. I will handle 2000W just like the other one, but with the added advantage that it will always give you what you want in terms of a match in seconds. You know that when you tune this you are matched and there is no second guessing. Are they expensive? Yup, but worth the peace of mind that you are not going to cause damage to your expensive radio by being mistuned.

I have built several of these antenna tuners and they all work perfectly. Here's one I built many years ago. As you can see it has only two adjustments and the way to tune it is to put the capacitor at 50 and then tune the inductance for the lowest SWR. When it is set at 50 on the scale it means that the capacitors have exactly the same capacitance. If you move the dial to the left the input capacitor changes to have more capacitance and the output capacitor is less capacitance and vice versa. Then adjust the



capacitance to bring it down. It has a roller inductor in it too so it's easy to adjust and fast to tune with a 1:1 match every time on the lower bands. I got the parts at a flea market and bent up the chassis out of scrap aluminum. I have built several of these and they all work well.



You need a dual gang high voltage capacitor with a minimum of 250pf capacitance and the ability to make it differential by putting the plates on the rotor fully meshed on one and not meshed on the other. You need either a roller inductor or a coil with taps on it and a RF capable multi pole switch to choose various options you have selected on the switch and some other parts as necessary. You can also build the SWR meter as I have done and install it in a sealed box on the input side of the input capacitor. Here is a picture of the capacitor and inductor in one of my tuners. The inductor was one that had come apart in an old MFJ tuner and I rebuilt it to use

it on this tuner. You will notice the plates on the rotor of the capacitor are exactly 180 degrees opposite of each other.

So, another very interesting and relatively easy project to build if you are so inclined. If you are interested in finding more about antenna tuners and what to use here is an article written by DJ0IP a few years ago that help explain them even further. <https://www.dj0ip.de/antenna-matchboxes/asymmetrical-matchboxes/> Why not make it a project for the new year that will provide you with decades of utility and it's something you built on your own.

Good luck,

73

Tom VE6ARG