

HF ANTENNA TUNER

by Harry Lythall - SM0VPO

Introduction

I keep getting E-mail asking me for an antenna tuner (ATU or ASTU) for the HF bands. First of all let me say that I do not believe in them, although I have built a few for one reason or another. But I am quite willing to share my experiences with you too.

The purpose of an ATU (Antenna Tuning Unit) is to match the antenna to the receiver or transmitter. The mis-match most frequently occurs when the system is not properly built. In order to improve the match between (say) a vertical 1/4-wave ground-plane antenna and a 50-ohm transmitter one should really make adjustments to the antenna until the system is matched (remove the errors). In practice we can add an ATU or ASTU (Antenna System Tuning Unit) and have a few more nice pretty knobs to show visitors. It works on the principle that two wrongs DO make a right (add an equal and opposite error). The ASCTU (Antenna System Correction & Tuning Unit) however is 100% passive, so it must by definition have a loss. But let us build one anyway.

Simple Matching

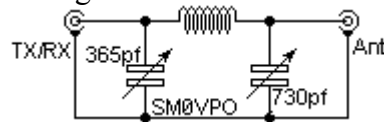
A simple 1/4-wave antenna that is too short (or too long) will behave capacitively (or inductively). Simply adding inductance (or capacitance) at the bottom of the antenna will correct the problem and make it present a resistive impedance to the transmitter. Ok, now someone is now going to send me E-mail saying:

I have a 6'2" aluminium pole, 2 Mars-bars diameter, 3-meters off the ground, fed with 0.75-furlongs of URM76. What size of coil do I need? Please state wire guage, coil diameter, turns spacing, length of wire needed and it's approximate weight to make it resonate at 1.4MHz. Please also attach a photograph of the finished coil to the reply. The answer is probably somewhere between 1 and 1000 turns, dependant upon the relative humidity (not stated!).

I used this inductor method with my [multi-band HF Balcony Antenna project](#). The main disadvantage of this technique is that there is no visible unit in the shack with loads of knobs and "sort of pushy-things". Not very impressive!

Adding Knobs

If you want to match a transmitter to a random-length of wire then the situation can become a little more extreme and requires a little more than a coil of wire. When I first began transmitting (as a pirate on 6.5MHz) I wound 20 turns of wire on a toilet roll holder and connected this between the transmitter and the antenna. A variable capacitor either end of the coil to ground enabled me to tune and load the antenna.



It must be stressed that I have had some bad experiences using those cheap plastic tuning capacitors you get out of transistor radios. They work Ok in this application, providing you do not apply more than about one watt of power. Apply any more and you will have a nice pyrotechnic display. Use air-spaced capacitors for tuning.

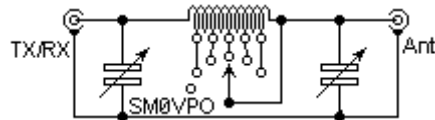
Tuning Procedure

1. Set up your transmitter to deliver about one watt continuous into a dummy load, via an SWR bridge.
2. Set the LOAD capacitor (right-hand) to mid position.
3. Adjust the TUNE (left-hand) capacitor for a dip in reflected power. Note the reading.
4. Advance the TUNE capacitor a little and repeat 3 above.
5. If the new reading is higher (worse) then reduce the TUNE and repeat 3 above.
6. If the new reading is lower (better) then advance the TUNE and repeat 3 above.
7. Repeat 5, 6 and 3 over and over again until the SWR becomes 1:1.

Mark the setting for each band/antenna. It is quite easy after a little bit of practice (*just like playing the glockenspiel with your left hand after drinking half a bottle of vodka*).

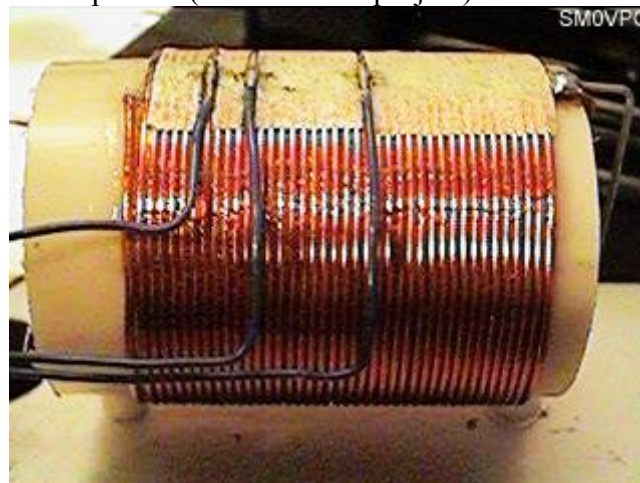
Multi-band ATU

Right, so you want to cover the whole HF band? Then you need to change the size of the coil. Wind a coil on another "bog-roll" center using about 40 turns of "thick" wire (down to about 3.5MHz). Go up to about 120 turns if you want to cover down to the top end of Medium Wave. Now make a few tapings and connect them with a rotary switch to short-out all but (for example) 3, 7, 12, 20, 50 and 120 turns of the coil. This is the circuit of what we need:



Coil Winding

The coil should be wound using insulated (enamelled) wire. If you want to make a decent permanent job of it then wind on a bit of plastic conduit tube about 3cm Dia. Do not use black tube, this often contains carbon. You can easily make connections to the turns by applying masking tape and using a scalpel blade, cut away tape from one turn. Scrape the enamel off the exposed turn and solder the connection. That sounds complicated so here is a picture (from another project) of the technique:



With this switchable coil you will be able to match a random length wire antenna over most of the HF band. The tuning procedure is exactly as given above but select the switch position that gives you the best match.

Ideal Solutions

The ideal solution is not to have an antenna that needs an ATU in the first place. But since you are reading this then you obviously need one. A transmitter with a 50-ohm output impedance will be perfectly matched to a 50-ohm feeder but it is the antenna that is at fault. Ideally the ATU should be placed not in the shack but at the base of the antenna!



Not really practical. Visitors to your shack cannot be impressed by it and it is difficult to adjust sitting at the top of a 30-meter tower. Normally the ATU is in the shack and the feeder then becomes a part of the miss-match that is being corrected. Anyway, I have now given you a start for experimenting. Unfortunately I cannot give you the box dimensions, overall project weight or even show a photo of the finished project. I have never built one of these instruments in a form that I would want to show off. I have built several, but only as a temporary measure.

That's it! I have nothing else that I want to tell you!

Have fun with this project. Regards from Harry - SM0VPO