SHAK NOWTZ BY "MAD" FRANK - G3ZMF

SHAK NOWTZ No 4 – ATUs

Introduction

Why use an Antenna Tuning Unit (ATU)? Let me explain with an analogy to a car's transmission system that I used several times in the 1990s at World Scout Camps at Downe, near Biggin Hill. The answer I gave was to relate the transmitter to the car's engine (it produces power), the gear box to the ATU (matches the engines power/rev rate to the axle/ wheels) and the antenna to the axle/ wheels (they convey the engine's power to the road and therefore cause the vehicle to move). Thus the ATU is simply a "radio gearbox" matching the 50 (or 75 ohm) impedance of the transmitter or receiver to the antenna and thence into the ether. You wouldn't try to drive off from a stationary position in top gear, would you?

ATUs come in various types such as series, parallel, combined series/parallel – and others. They can be used for unbalanced antennas such as long wires, verticals, or coax fed antennas where final matching is required - or balanced so as to match twin feeders of various impedances (50, 75, 150, 300, 450 or 600 ohms) to antennas such as dipoles.

Although there are many ATUs on the market, be careful what you ask them to do, because some manufacturers are inclined to save building costs and fit variable capacitors with very little air gap between the fixed and rotating vanes. The closer those vanes, the lower the voltage they will withstand before flashover occurs!

If you check the ATU maker's specified range of matching impedances, you will probably find it says "30 to 130 ohms." Any higher effective impedance will mean **higher voltages** for the same power handling. Remember Ohm's law: in particular

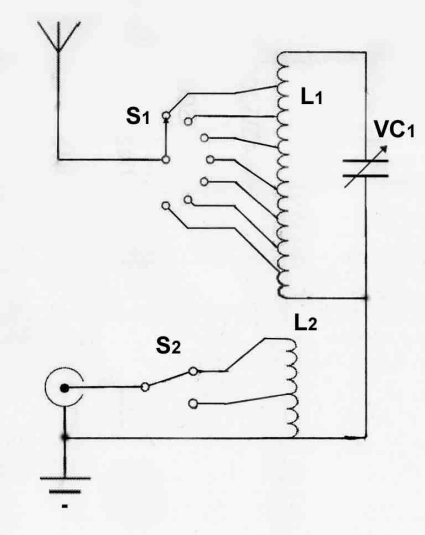
$$V = \sqrt{(W*R)}$$

For example 100 watts at 50 Ohms = 70.7 volts whereas 100 watts at 5000 ohms (eg end fed half wave antenna) = 707 volts.

Practical ATUs

The following diagrams are for reference only. You will need to check various manuals for specific frequencies and component values. Personally, I use a parallel-tuned, single-ended ATU for 160 metres and a balanced ATU in the style of the old faithful KW E-Z match or KW107 for 80 to 10 metres.

Parallel ATU



The 160m ATU at G3ZMF

S_1 selects a tap equivalent to the aerial's impedance from a few ohms to several thousand ohms on L_1. S_2 is also a multi position rotary switch on the Tx/Rx link winding (L_2) on the earthy end of L_1 to get the best match into the antenna.
As L_1/VC_1 constitute a parallel tuned circuit, VC_1 needs to be a reasonably wide spaced variable capacitor to cope with expected RF voltages at the proposed power level.

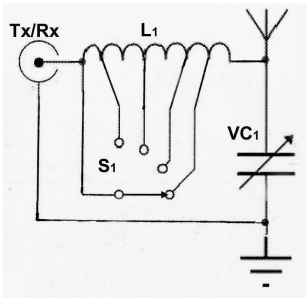
Series ATUs

This can be a single component of either L or C. By using series inductance (L) you are simply **lengthening** the antenna, while using a series capacitor effectively **shortens** the length

of the antenna.

L-Match ATU

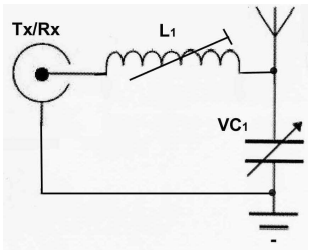
This is the simplest form of ATU, but still very effective. I have built several in compact form, in which the inductance is wound through a ferrite tube of suitable composition and power rating. (Robin of Sycom has them in stock at less than £3 each and they handle 200 watts at up to 30 MHz).



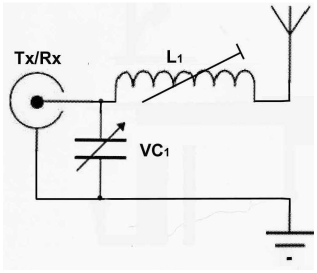
L-Match ATU

L_1 is tapped every 2 turns and progressively shorted out. I use an SO239 coaxial socket for many connections as they also take a 4mm plug in the centre hole. For other connections, I often use 4mm sockets on their own.

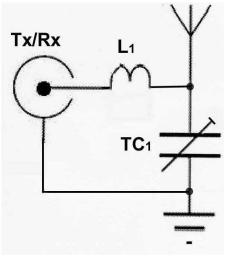
Various L-match configurations are possible depending on whether the impedance presented by the antenna at the desired frequency is higher or lower than the rig's impedance.



L-match for high impedance antennas ie > 50 ohms



L-match for low impedance antennas ie < 50 ohms



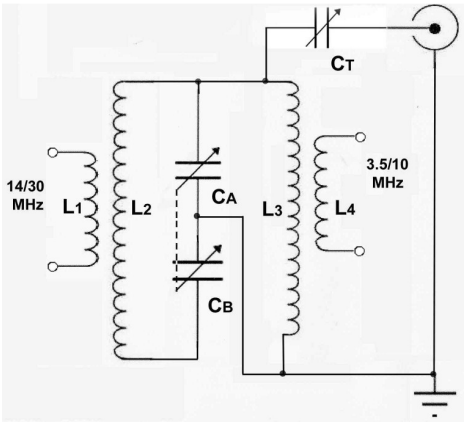
L-match configuration for yagi trimming

Here, L_1 is almost completely shorted out. The coils used in the above three circuits would often use a preset tap rather than be continuously variable

Of course, the most commonly found fully variable inductor is our old friend, the "roller coaster". But a word of warning – many of these ex-equipment units have their shafts connected to one end of the coil - or in some cases to the variable pick-up contact. In either case, the shaft and knob need to be adequately insulated from the equipment panel to prevent inadvertent contact with the user. Also, some roller coasters automatically short out turns from one end.

Balanced ATU

I use a basic Z-match ATU, where the link windings are wound over, or outside, the tuning winding. I claim **no** originality as the full details can be found in RSGB handbooks from 1968 onwards.



Z-match

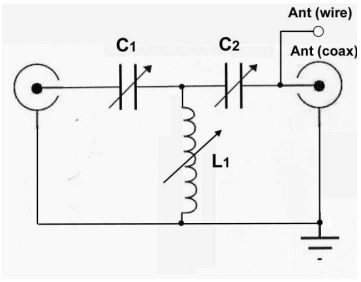
Note that on the LF bands only one side of the twin gang tuning capacitor is used. Also, C_T, the series tuning capacitor is "live in and live out" so must be fully insulated from (a) earth and (b) the tuning drive/ knob.

Ready- made Balanced ATUs

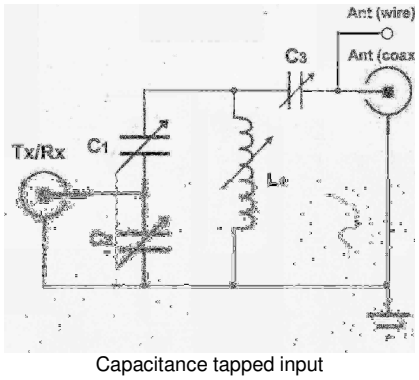
At this point, it is only fair to mention the practice of some manufacturers, who claim to have provided a "balanced" input, by fitting a small toroidal ring balun (balance–to-unbalance transformer) – **clamped to the rear panel.** In my opinion, this surely defeats the effectiveness of the toroid transformer and at the same time it has to suffer quite a mismatch between the variable components of the ATU and the antenna connection points. My opinion only – G3ZMF.

Single Ended ATUs

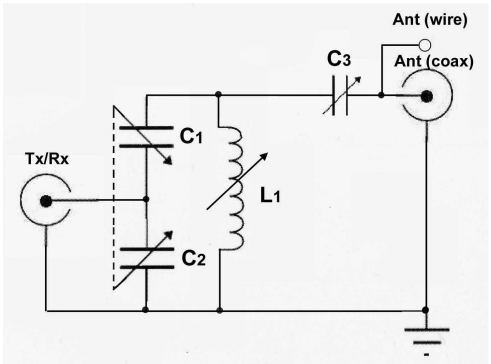
Specifically for long wires and verticals, most are in a Tee format, usually with a variable inductor to earth from the centre point of the Tee. The inputs can be via a single series capacitor (not forgetting that it must be insulated from earth and from its rotation drive) or sometimes as a tapped or even differential capacitance input. See diagrams below.



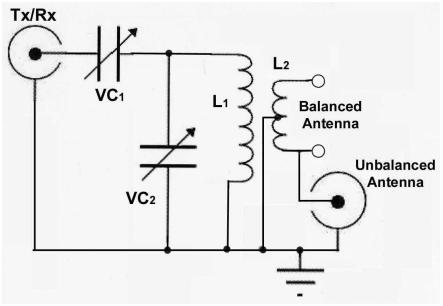
Tee configuration



Capacitance tapped input



Differential input (as C1 increases, C2 decreases, and vice versa)



50/70 MHz ATU, as used at G3ZMF

See Yer !
Mad Frank G3ZMF