

The Hands ATU-1 Kit

Reviewed by
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WHEN USING a low-powered transmitter or transceiver on the short-wave bands, the operator does not often have the convenience of a resonant antenna. That is, an antenna which is purpose-built to match the output of the transmitter at the required frequency. This is even more the case when a single antenna is used to operate on more than one band.

Most of us do not have the space, the means and probably not the wealth, to have antennas which will work instantly with our transceiver over the range of frequencies we wish to use. Very often radio amateurs use simple antennas, sometimes just a length of wire into which we inject our transmitted signal at one end and use it to radiate the radio frequency power against ground (or earth). The problem is impedance matching. Most amateur radio transmitters have an output impedance of 50Ω and our available antenna will probably not be resonant at the required frequency at 50Ω.

IMPEDANCE MATCHING

MAXIMUM POWER transfer from the transmitter to the



Rear of the ATU-1, showing input and output connectors, the printed circuit board with switch and the two variable capacitors, C1 and C2.

antenna cannot occur unless the impedances between the two are matched. The greater the mismatch, the greater the power loss and at low power levels it is important to transfer as much of the signal as possible to the antenna. The usual answer is to use an antenna tuner, often called an ATU (Antenna Tuning Unit). These contain tuned circuits made up of inductors and capacitors which, when connected between the transmitter and the antenna, make the antenna 'see' an impedance of 50Ω.

Antenna tuners can have another advantage in that they can help eliminated unwanted signals from the transmission.

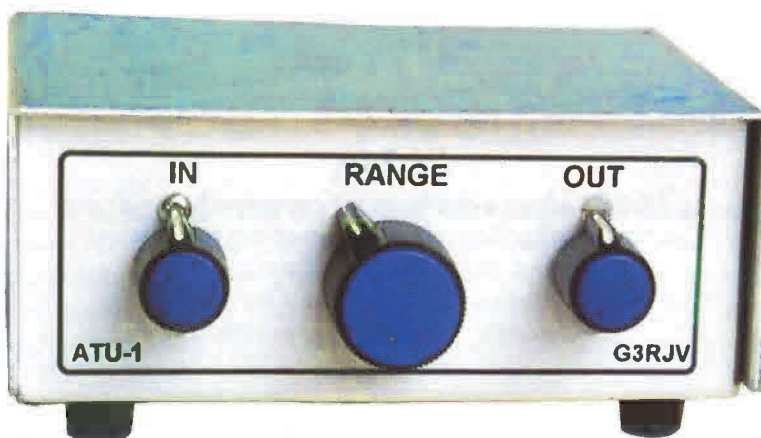
Transmitters produce the wanted frequency but to this they add harmonics of that frequency: outputs at twice the frequency, three time the frequency and so on. A transmitter should have a

low-pass filter on the output to help eliminate these unwanted signals. Many ATU circuits help to reduce these signals further.

THE ATU-1

THE ATU-1 is a simple antenna tuner offered in kit form by Hands Electronics. The circuit is shown in Fig 1. Like many amateur radio circuits, it has a history. The ATU-1 kit is based upon a circuit from Ken Ruiz, G4SGF, which appeared in *Radio Communication* in April 1992. That article, in turn, was based upon an idea from Doug DeMaw, W1FB, which originally appeared in the American *QST* magazine in September 1988. It is reproduced in a book, *QRP Classics*, published by the ARRL and available from the RSGB book sales department: a useful book full of good practical things to build.

Unlike many antenna tuners, this circuit is a resonant tuner. That is, it contains a tuned circuit at the actual operating



frequency. Many antenna tuners contain inductors and capacitors which are used to cancel inductive or capacitive elements in the antenna rather than tune the actual frequency. The resonant antenna tuner is not only simple but it also offers good harmonic reduction. The ATU-1 kit also has the advantage that commercial inductors are supplied ready for use.

HOW IT WORKS

THE SIGNAL from the transmitter is coupled by L1 into a tuned circuit formed by L2 and C1. L1 is a small winding which matches the low impedance output of the transmitter to the tuned circuit. L2 and C1 are tuned to the frequency of the transmitter - a resonant circuit at the required frequency. C2 couples the signal to the antenna and is variable to permit matching the transmitter to the antenna. A match should occur at some setting of C2 for most antennas.

The settings of C2 affect the capacitance of C1. This is usually called interaction. In simple terms, C2 adds to the capacitance of C1. Therefore C1 and C2 must be adjusted alternately when tuning-up an antenna. It would be very difficult to get practical values for L2 and C1 which cover several amateur bands. Very often antenna tuners have tapped inductors: the coils have places along their windings which can be switched. This circuit uses a simple method to vary the inductance by switching in other inductors in series or parallel.

When inductors are placed in parallel the total inductance becomes smaller, when they are placed in series the inductances add together to give a higher total (check it out in a radio theory book!) So in this circuit, L3, L4 and L5 which are switched in parallel with L2

reduce the inductance in the tuned circuit, and L6 which is switched in series with L2 increases the inductance. The higher inductances are required for the low-frequency bands and the lower inductances for the higher frequencies.

BUILDING THE KIT

THE ATU-1 is not difficult to build, the kit comes complete with all the required parts, including a case and knobs, and there are no coils to wind. Also included is a printed circuit board. The inductance switch (S1 A and B) is mounted on this board, with the inductors, so that no complex wiring between the pins of the switch is required. The kit also includes a pre-punched case and all the hardware.

The only slightly tricky process I encountered when building the kit was to saw a small metal tube in half to make an extender to the shafts of C1 and C2. But in truth it just requires careful use of a small hacksaw. For someone who builds a lot of amateur radio projects, my skill at simple metalworking is poor! The kit does require the careful insulation of C2 from the case. This is vital because C2 has radio frequency power present on both sides of the capacitor, including the metal shaft. It is even important to insulate the grub screw which holds the knob for C2 in place. I know, because in my rush to test the ATU-1, I forgot and got a 'tingle' from the shaft of C2!

HOW TO USE THE ATU-1

WHEN USING the ATU-1, remember that C1 and C2 interact and C1 must be re-adjusted whenever C2 is altered. Begin by setting C1 and the inductance to tune the

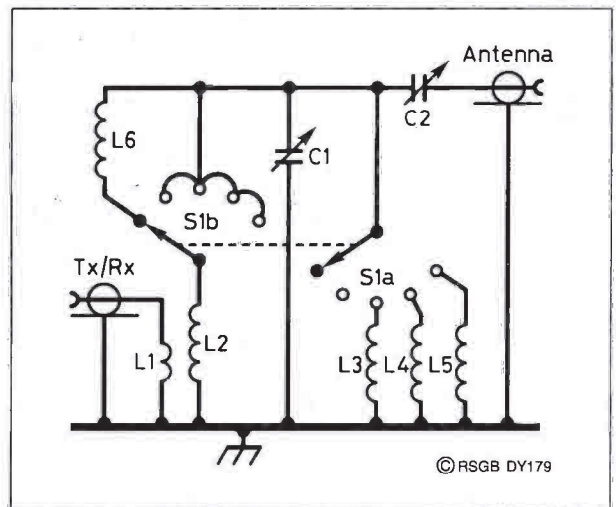


Fig 1: The circuit of the Hands ATU-1 antenna tuner.

required amateur band. The easiest way is to listen on the band with the ATU-1 in circuit and adjust the switched inductance and the setting of C1 for maximum received signal strength.

The ATU-1 can then be set for transmission using an SWR meter in line with the ATU and the antenna. Start with C2 at minimum capacitance (the moving vanes right out from the fixed vanes) and increase the capacitance of C2, re-adjusting C1 each time for minimum SWR. There may be more than one setting of C2 which produces a low SWR. Always use the maximum amount of capacitance at C2 (vanes furthest in) that can produce a low SWR in conjunction with C1.

DID IT WORK ?

I TRIED my ATU-1 with three antennas in my own shack and managed to get transmitters to match them all on several bands. It would make a useful ATU for any Novice HF station. It does require the use of an SWR (Standing Wave Ratio) meter or impedance bridge. Perhaps you already have one? They are also simple to build, and I am describing one elsewhere in this edition of *D-i-Y Radio*.

The Hands ATU-1 kit is available fully cased at £18.99 plus £2.50 P+P from Hands Electronics, Tegryn, Llanfyrnach, Dyfed SA35 0BL, tel: 01239 77427.