
Mike Mills G3TEV's Antenna Workshop
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Balanced Feeding!

The guest author for *Antenna Workshop* – Mike Mills G3TEV – creates an adaptable balanced antenna matching unit from bits he found in his 'goodies' box!

Three controls on the front panel, the two output capacitors flanking the input matching and tuning capacitor in the centre.

Welcome to my turn writing for *Antenna Workshop* (*AW*)! Call it what you will, either an antenna tuning unit (a.t.u.) or antenna matching unit (a.m.u.). – but if you're using any form of balanced feeder you'll have need of one to be able to present the right unbalanced load to your transmitter.

I have used open wire feeders ever since I obtained my transmitting licence in 1964 and have made many versions of the a.t.u. that I now use. The early ones used home-wound plug in coils and were very successful, but as I had obtained (many years ago) several large plug in coils that were used in the US Military BC610 transmitter – I decided to remake my a.t.u. to use these coils,

The coils are all air-cored and are up to 100mm (3.9in) in diameter which makes for a very efficient a.t.u., as losses are small in large air-cored coils. The coils all have link windings which are series tuned, these being used to provide the 50Ω input to the a.t.u.

The series tuning capacitors labelled C1 and 2 in the circuits shown in this article, are wide-spaced as I run the full power of 400W. If you're a QRP operator, running only low power, then narrower-spaced capacitors will be adequate.

The Main Capacitors

The two main capacitors, C1 and 2 are 125pF and were recovered from an old surplus RAF T1154 transmitter that I scrapped many years ago. Although you could use almost any capacitor of about this value or larger – it must have a low minimum capacity to enable it to tune the higher frequencies.

The input matching and link winding tuning capacitor (C3 in the circuits) is a twin-gang 500+500pF type used in old style mains radios. Both halves are in parallel to give a value of 1000pF. Balanced a.t.u.s need to be adaptable to give either series or parallel tuning according to which antenna and frequency is being used, these set ups are shown in diagrams **Figs. 1** and **2** and **3**.

Changing Modes

Changing from one mode to another can be easily and cheaply carried out by using a system of plugs and sockets. The diagram in Fig. 3 is a method that is very flexible and can be used to good effect if difficulties are experienced in finding a match with either of the other methods. Looking at Fig. 3, you'll see that that the two capacitors can be regarded as a type of radio frequency (r.f.) potentiometer across the coil so that point **B** can be moved up and down.

As the capacitors are in series resonance can be maintained with a great variety of settings and hence a great variety of output impedances. The set-up in Fig. 3 can also be used to feed single wire fed or long wire antennas.

If the single wire feed is attached to point **A** and point B is directly earthed tuning the two capacitors will have the effect of moving the earth tap up and down the coil and a match can be found.

It's highly unlikely that anyone could make an exact duplicate of my tuner, as some of the parts are almost impossible to obtain – especially the coils. However, the coils do appear occasionally on Internet auction sites so keep looking! As my a.t.u. was never intended for public display it does look rather messily constructed, this due to it having been modified on several occasions in the past!

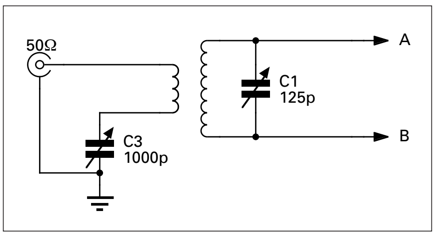


Fig. 1: Using a single capacitor in a parallel tuned output to the balanced feeders.

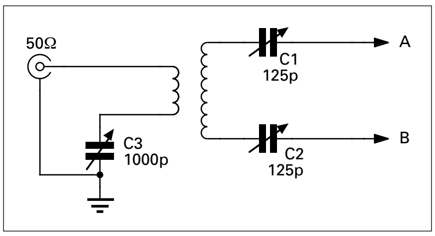


Fig. 2: In this form, the two capacitors give a series tuning output to the feeders. It also allows a degree of variation in balancing too, as each 'side' can have differing values.

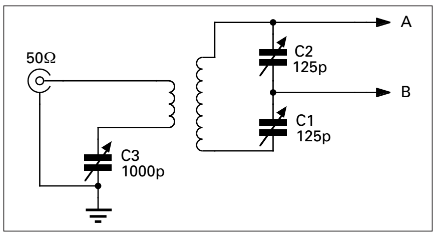


Fig. 3: A combination of both series and parallel tuning gives more versatility in impedance matching.

The Main Chassis

The main chassis of the tuner is made of 3mm aluminium sheet, the capacitors (C1 and 2) that are used to tune the main coil are insulated from the chassis on plastic blocks as both sides are 'live' and above ground potential.

The front panel is made from 4mm aluminium sheet. If a non metallic base is used the capacitors will not need isolating from the base. The link tuning capacitor (C3) is mounted on the chassis because the frame is at earth potential.

Slow motion calibrated drives are used for the link winding tuning, and I keep a record of the settings for each band enables. This allows me to make quick band changes. Most standing wave ratio (s.w.r.) bridges only indicate an impedance match and can be used to set up the a.t.u., but to take full advantage of this type of a.t.u. a bridge that indicates both impedance and reactance should be used.

Old Design

The bridge I use is a very old design that appeared way back in the 1950s. It is called *The Antenna Match* and was described in the *RSGB Bulletin* (now *Radcom*) issues of May and June 1955. It was described by the late **Frank Hicks-Arnold G6MB** and was a modification of a design for an automatic a.t.u. developed by Virgil True of the US Naval Research Laboratories.

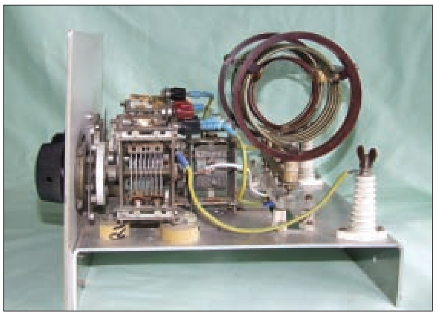
It's normal to measure the current in each leg of the feeder and try to obtain equal currents in each leg to maintain balance. This was originally done by the use of r.f. thermocouple ammeters which (unfortunately) these days are very difficult to obtain.

For low power a form of indication can be obtained using a torch bulb in each leg and obtaining equal brilliance in each bulb. For my part a.t.u. I have 'made do' by trying to keep both capacitors at equal dial readings and this has seemed to work well.

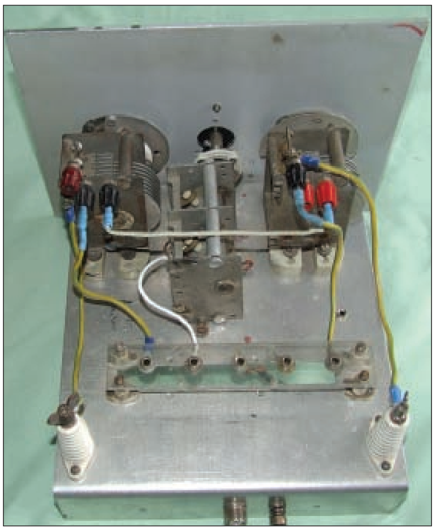
At the time of writing this article I am however, trying to make up a unit with toroidal transformers in each leg of the feeder to measure the current. This technique was described in a recent issue of the **GQRP Club's** journal *Sprat*.

Using The G3TEV ATU

To use the a.t.u. you should – first of all – tune your transmitter into a dummy load and zero your s.w.r. measuring device. Tuning the a.t.u. is carried out using the capacitors and obtaining as low an s.w.r. as possible, in fact you should in most cases be able to get a 1:1 s.w.r. – although anything below 2:1 is acceptable.



A side view of the assembled unit, with a coil suitable for the higher h.f. bands.



Rear view of a.t.u. showing plug & socket system and the linking wires on C1 and C2.

You'll also find an interaction between the main capacitors and the link tuning when adjusting until a balance is found. The interaction is most marked when you have a means of indicating reactance which – by careful adjustment – can be tuned out.

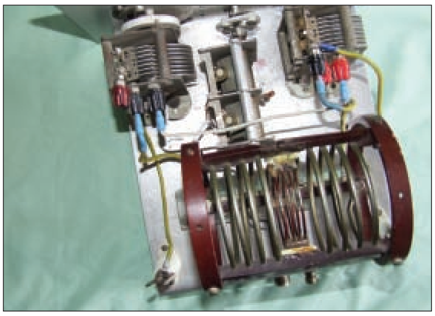
If you have an antenna analyser this can be connected to the a.t.u. The settings for all bands can then quickly be found and the settings noted for quick adjustment of the a.t.u. when used on the air.

Main Antenna

My main antenna is basically a 22m (72ft)) long inverted-V made from 2mm copper wire, and it is about 8.5m (28ft) high at the centre fed with open wire feeders, with a spacing of 110mm (4.3in). Incidentally, the feeder spacing is because those I use, are plastic mouldings made to clip into frames to carry printed circuit boards (p.c.b.s).

At the end of each leg, where it meets the garden fence at about 1.5m (4.9ft) above ground, a home made coaxial trap for 7MHz is inserted. There's then another 11m (36ft) of wire running at rather strange angles to give a full half wave on 3.5MHz.

The traps are necessary to keep the antenna current on 7MHz up in the



A view looking down on the business side of things.

The coils are all of a common 100mm diameter, but with differing numbers of turns.

centre of the antenna. I did try it without the traps but the performance on 7MHz was extremely poor. A good earth system is essential and should be connected to the a.t.u. if a metal chassis is used.

My earth system consists of three copper pipes driven into the ground as far as I can get them, this is not very far as at about 100mm (3.9in) below soil level is solid Cotswold limestone. To improve things, I have three 11m (36ft) long counterpoises made of heavy insulated wire running out in a fan shape under the lawn and connected back to the earth spikes.

The Counterpoise wires are then connected to a 16mm (0.6in) copper pipe that runs along behind my operating table and all equipment is connected to this pipe. For safety reasons the pipe is connected back to the mains earth through a 20 turn toroidal choke which maintains electrical safety – but isolates the earthing system as far as r.f. is concerned.

The antenna has now been in position for over forty years, and since 1992 I have had a daily contact with **Brian Otter 9J2BO** in Lusaka, Zambia and we have up to the end of February 2012 had in excess of 5500 contacts. I always operate in the Commonwealth Contest and regularly work stations in Australia and New Zealand on both 3.5 and 7MHz, so you can see that even my strange antenna set-up works.

So try a doublet antenna! They do work well either as a 'flat top' or as in my case an inverted V. ●