Antenna Workshop

John Heys G3BDQ describes the AntMatch, a versatile antenna tuner/matcher for the 144MHz band.

Antenna tuning units (a.t.u.s) or antenna matchers (a.m.u.s) for the 144MHz band are seldom described in our Amateur Radio press. To find a suitable design, I had to go back to the late 1960s to find a circuit and details of such a very useful piece of equipment.

The *ARRL Antenna Handbook* published in 1971 describes 'A Transmatch for 50 and 144MHz with SWR Bridge'. This article was, no doubt, a reprint of an article that had appeared earlier in *QST Magazine.* I have omitted the 50MHz details and the s.w.r. bridge and just re-worked the 144MHz circuitry and details.

These days we buy or construct our v.h.f. antennas, adjust them for a minimum s.w.r. while the antenna is mounted at no more than two or three metres above ground. This done we then strive to get the antenna up as high as possible.

After having erected the antenna, it's often found that the s.w.r. has mysteriously deteriorated. There are the fortunate few who can make their final s.w.r. adjustments when the antennas are positioned high up in the air but most of us with only relatively flimsy masts and not towers, cannot make that final 'tweak' to the beams in its final working space.

I have a couple of 144MHz beams and a quarter-wave vertical in my roof space. But even though they're relatively accessible, carrying out antenna tweaking in the loft, while the s.w.r. meter is in a room down below, becomes an impossible task.

A five element beam adjusted for unity s.w.r. downstairs presented a disappointing 1.4:1 s.w.r. when positioned in the roof space where it shares space with a variety of copper piping, electrical wiring, an old galvanised water tank and sundry other objects.

Modern transceivers are programmed to gradually shut down their power output when the s.w.r. of the antenna in use rises above a certain level. My rig is no exception, its nominal 100W r.f. output has dropped down to just over half of that power with the antenna's new match.

The problems that I've outlined above, stimulated my search for a simple 'sure-fire' antenna matcher for 144MHz. Having this AntMatch has other advantages beyond its matching performance. It has the ability to match antennas that have

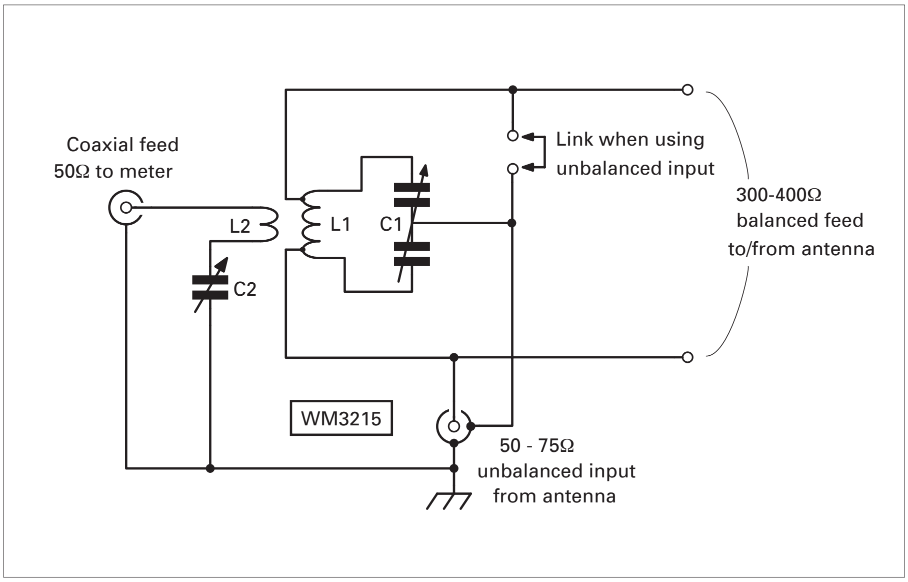

Fig. 1. The AntMatch circuit which illustrates the inherent balance of the project.

plastic or open wire antenna feeders and perfect matching when coaxial cable is used to the antenna.

Additionally, there will be a significant reduction in the radiation of unwanted harmonics with up to 30dB of attenuation. On the receiving side the additional tuned circuit at 144MHz improves selectivity and reduces any responses to out-of-band signals, such as those from pager signals. The r.f. losses through the AntMatch are insignificant, unlike the 20% r.f. losses inherent with some of the modern auto-tune h.f. matchers.

The Circuit

The AntMatch has a balanced tuned circuit with a coil L1 (see **Fig. 1**) tuned by a 'Butterfly' type variable capacitor C1. The inductor L1 is tapped down to provide connections to a balanced feed line and also to unbalanced coaxial cable feeder. In an emergency even a short single wire can be matched but the wire must present an impedance roughly between 300 and 500Ω.

When using unbalanced feed with coaxial cable one of the balanced connections (away from the coaxial feedpoint) must be earthed by using a jumper wire to an earth connection on the box. A two turn link winding (L2) is positioned over the centre of L1, its inductive reactance being tuned out with C2.

Screened Box

The unit was built into a completely screened box. I had a box to hand, a die-cast alloy one measuring 170x120x105mm deep which may seem a little large but its size made the building stages much easier. A much smaller box might influence the inductance and *Q* (goodness factor) of L1.

The illustration, **Fig. 2**, shows the overall appearance of the controls (C1 and C2), the two insulated antenna feeder terminals, the coaxial input and output connections and an earthed wing nut for the jumper wire. All the components and the wiring can be seen in the photo (**Fig. 3**), the layout is arranged to preserve balance and to keep the connections reasonably short.

The type of variable capacitors, known as 'Butterfly' types were once easily and cheaply available on the radio surplus market, though now they may be hard to find. Capacitor C1 has a maximum capacitance of 10+10pF and as I only had a larger value capacitor, this had to be adjusted to the correct value by the careful removal of some of its plates using a fine piercing saw.

Each section was then left with just two fixed and one moving plate. The capacitor, C2, is a 35pF trimmer capacitor, which fortunately has a spindle for tuning and it is another item that came from the junk box. The coil L1 is self supporting ans has four turns of bare soft-drawn 2mm diameter

(16s.w.g.) copper wire. It is 30mm in diameter and is 20mm long.

Using bare copper wire simplified the soldering of the tap connections which are each made one turn in at each end of L1. The link coupling inductance is made with 2mm diameter (16s.w.g.) enamelled wire and has just two turns. Its diameter is 40mm and has a length of 5mm.

The 'Butterfly' capacitor is earthed through its spindle. The ends of L2 are soldered to a pair of small ceramic 'stand-off' insulators that are mounted beneath the top of the box. A small nylon cable tie holds the two turns of L2 together and stops them from springing apart.

Fig. 2. The completed AntMatch with its connectors positioned on the top of the diecast box.

Setting Up

Let's now look at how the system is set up. First, tune your transceiver to mid-band and set its power output to around 4 or 5W. Connect an s.w.r. meter between the transceiver and the AntMatch coaxial input socket but instead of an antenna, connect a non-inductive resistor of between 300 and 450Ω (using a couple of 2W 680 or 820Ω resistors in parallel or five 56Ω 1W resistors in series) to the balanced feeder terminals.

It will be possible to tune the unit using C1 and C2 to obtain either a very low or ideally unity s.w.r. indication. Then connect a 50Ω non-inductive resistor, such as a pair of 100Ω 2W components in parallel, to the unbalanced coaxial socket. The jumper wire must connect to the terminal at the end of L1 away from where the coaxial cable connects. Again, an adjustment of C1 and C2 should give a unity s.w.r. reading.

Knowing that the AntMatch works as intended, your antenna or antennas can be connected and the output power increased.

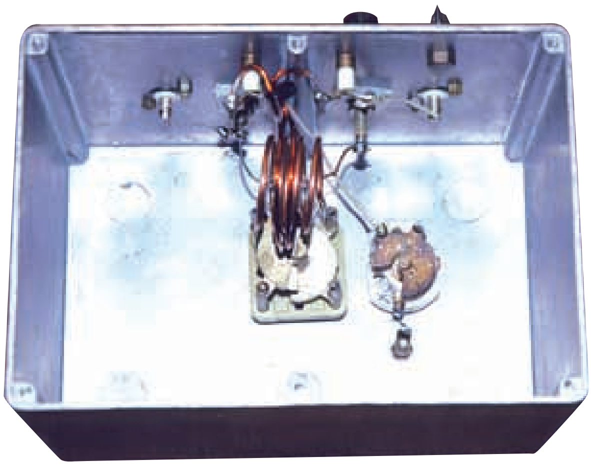

Fig. 3. Inside the box showing the layout of the components. The modified 'Butterfly capacitor' is in the centre.

As shown here, the unit handles 100W of r.f. power without flash overs. **But please note!** Never use it without an antenna or a dummy load connected.

Should your antenna already give you a 1:1 s.w.r. reading the Antmatch can still be employed, for it will reduce any harmonics that may come from the transceiver and will help to reduce any break-through of unwanted out-of-band signals.

My AntMatch is always in circuit and it lets me run my TS-2000 to its full 100W output to feed any of my three indoor 144MHz antennas. ●