

Equipment review

The Palstar AT1KP 1200 W antenna tuner

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Looking at purchasing an antenna tuner? Here is one which could be worthy of your consideration. Rugged, easy to use, and efficient, it is in the upper echelon of antenna tuners.

As with other reviews, this one reflects the observations of one user of the AT1KP HF/6 metre tuner, made by Palstar.

Many designs of antenna tuner (ATU) have appeared over the years, some good, some not so good. For an unbalanced tuner (that is, coax in and coax out) one of the 'classic' designs was the original 'Universal Transmatch' described by Lew McCoy W1ICP, way back in the July 1970 issue of QST. This design, which was the mainstay of ARRL handbooks for many years, was overtaken by the so-called Series-Parallel Capacitance, or SPC, circuit which added an extra capacitor to obtain higher transmitter harmonic rejection by increasing circuit 'Q'. This design by Doug DeMaw W1FB also appeared in a generation of ARRL handbooks. Sadly, nothing in life is free, and while the SPC circuit did achieve its objective, the increased losses in the circuit sparked the search for something better.

Of more recent times, many published and commercial designs have been based around the 'T' circuit. And so is the Palstar AT1KP. It is probably worthwhile exploring (briefly) how the 'T' circuit operates, before we look further at the Palstar which uses a particularly ingenious variant on the classic 'T'.

First, let us look at the 'T' circuit in Figure 1. Pretty simple – just a capacitor (C1) in series with the input, then a shunt inductor (L) to ground, then another series capacitor in the output side. So how does it work?

This is where Figure 2 helps. If we split the circuit in half, with double the inductance (2L) in each half, we can see that we have a pair of 'L' networks – one at the input, the other (backwards) at the output.

The 'L' circuit has the useful property in that can transform a relatively low



Photo 1: A view of the Palstar AT1KP antenna tuning unit.

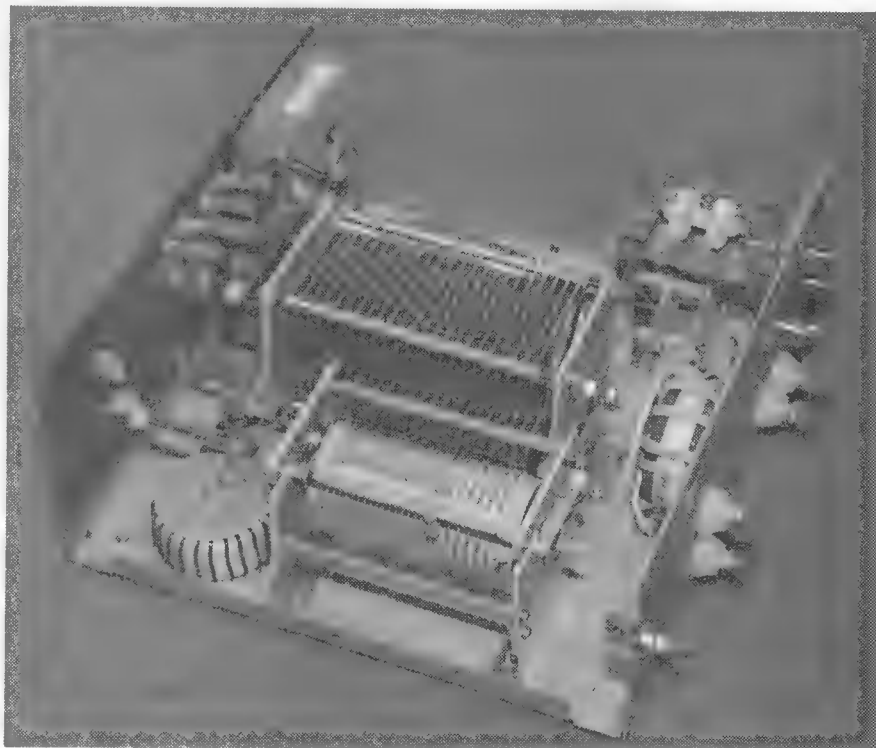


Photo 2: An overall view of the insides of the antenna tuning unit.

impedance at the input to a much higher impedance at the output. This can be shown mathematically, or at a hand-waving level can be deduced from the behaviour of a parallel tuned circuit with a small series resistance. I will leave this to you!

So, the input 'L' section has transformed the input (which we want to be 50 ohms) up to some much higher value – maybe a couple of thousand ohms. Of course, the 'L' section works in reverse too, to transform a high impedance to a lower impedance. And this is just what the output section does. In this case, the output impedance is something other than 50 ohms – it is whatever the impedance is that we wish to match at the end of the coax. While we have discussed the operation of this circuit with nominally resistive input and output impedances, in practice (with suitable choice of components) it can match a wide range of reactance as well.

But the AT1KP, while it uses a 'T' circuit, is different, and this is where the clever bit comes in. As noted above, 'T' circuits use three elements – two variable capacitors and one variable inductance. All are necessary to give a wide tuning range. Such a design takes some skill and practice (not to mention sometimes perseverance!) to 'walk' all the adjustments towards a perfect match. With 3 knobs to twiddle, this can take some time!

In the AT1KP, the two capacitors are ganged together in a differential arrangement. Most people would have come across the usual two-gang variable capacitor – with this, both sections of the capacitor have the same value, increasing or reducing at once. With a differential capacitor, when you turn the knob, as one section increases, the other reduces. But wait, there is more than just reducing the number of knobs!

Not only are there only two adjustments, the controls interact considerably less than is usual with most other circuits. This is not to say they do not interact – just that it is not such a problem as usual. Why is this? Let us look at how it is used.

To tune up an antenna, you start by setting the 'C' knob to about midrange (the manual suggests some starting settings for each band), then find resonance by varying the 'L'. With the 'C' setting midrange, the impedance at the output is the same as the input.

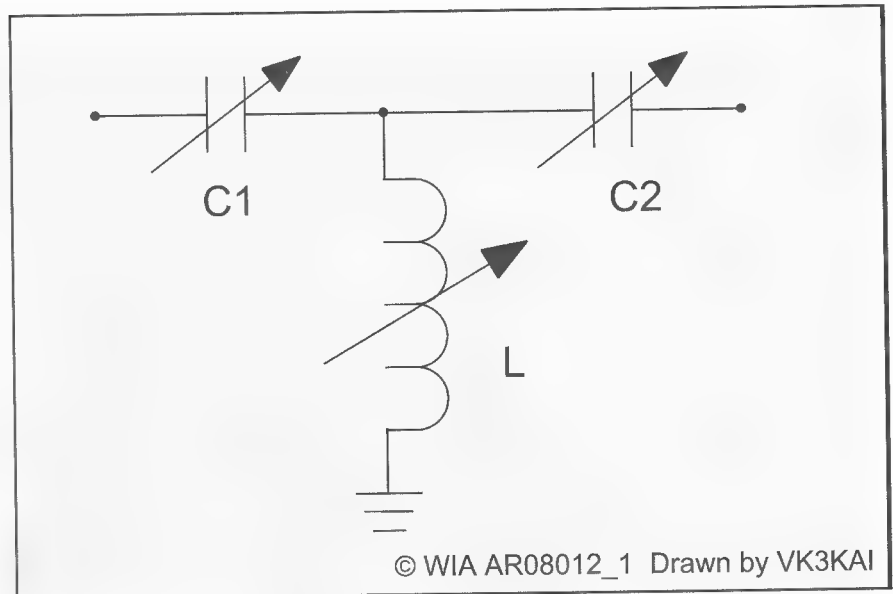


Figure 1: A simplified version of the T circuit of the antenna tuner.

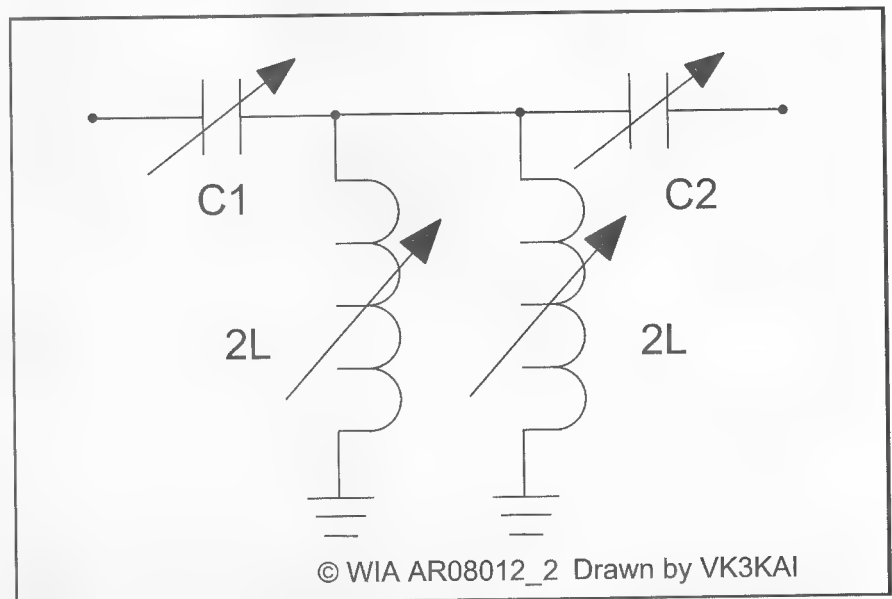


Figure 2: The T circuit can be shown to be equivalent to a pair of L networks.

Now comes another clever bit. Because the impedance transformation depends on the relative value of the two 'C's, varying the 'C' knob works to change the impedance transformation of the whole circuit. And, because the two 'C's are differentially ganged, turning the knob doesn't change the resonant frequency of the whole circuit by much, making it much easier to 'walk' the two adjustments towards the best setting.

I am used to tuning up with an old homebrew 'Ultimate Transmatch' circuit, which operates virtually the same as a 'T' with three adjustments which all interact pretty savagely. Compared to this, the

two adjustments on the AT1KP were little short of a revelation! Fast, easy, and smooth are descriptions which come to mind.

With all of this description of its operation behind us, let's look at the beast itself.

The AT1KP comes very securely packed in a large cardboard box, well surrounded by packing. The device itself is not exactly small, and will need a reasonable area (over 300 mm square) on your operating desk. It is no lightweight, either; one Palstar product comes with the proud description "built like a tank" on the box, and I have to

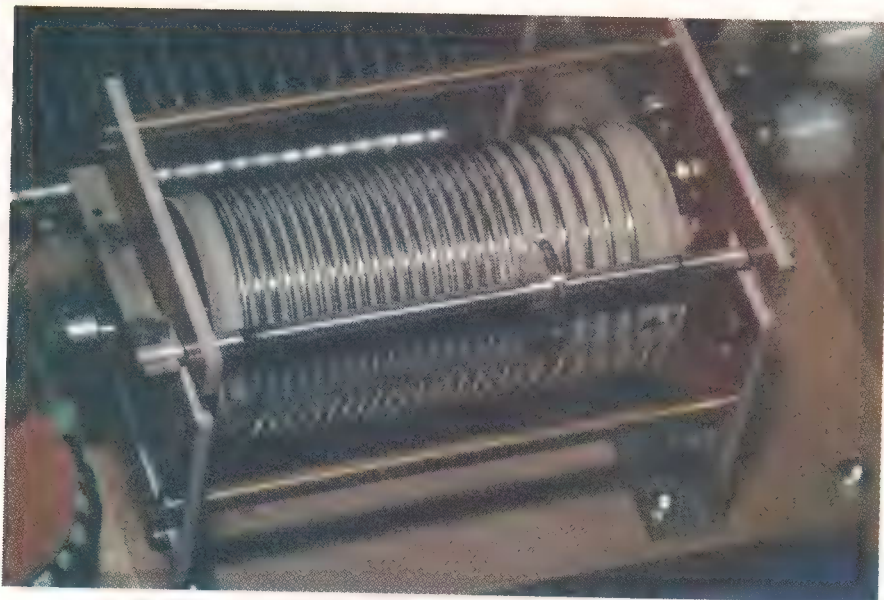


Photo 3: Close up of the roller inductor.

concur this applies to this tuner too! The chassis and case are built of heavy gauge gold aluminium, and look as though you could stand on them without doing any damage. (I do not recommend you try, though!) *(Editor's note: The Owner's manual notes that the "chassis and top cover is 11 ga. (.090) aluminum (sic) that has been chem.-film treated in gold color (sic)." The .090 dimension would be in inches, equivalent to approximately 2.3 mm.)*

The AT1KP is rated at 1200 W PEP (800 W CW), over quite a wide range of antenna impedances and over the frequency range 1.8 to 54 MHz. It is

also quite flexible, with provision for switching between two antennae, plus a third output for a dummy load or another antenna. Other positions of the function switch allow 'straight through' operation to either antenna or the balanced line outputs, which are also provided for, via a high power balun. The AT1KP does need 12 V DC for some metering functions, the meter lamp and for a relay to switch in some extra "L" for 160 metre operation. The manual notes that a suitable 12 V plug pack is supplied in the US but that does not seem to apply here (Editor's note: TTS Systems advise that they discard the 110 V AC plug pack

that is supplied with the unit from the US, thus avoiding possible damage. The unit is supplied with an appropriate DC connector. Given the quantity of units sold locally, buyers could purchase a plug pack, if required, at the same cost as TTS Systems. If TTS Systems supplied the plug pack, the local price would increase by the cost of the plug pack.)

I tried tuning some known 'difficult' loads (well outside the specified range) and the AT1KP had no problems matching them to 50 ohms – although I must admit I only checked this at 100 watts. Higher power would of course cause higher voltages and currents which increase the stress on tuner components considerably, so if you try really nasty loads at high power, you are on your own! I also checked the circuit losses by measuring the power delivered to my 'difficult' load – suffice to say, losses were quite low and were substantially less than my venerable homebrew 'Ultimate Transmatch'. So, no worries there.

Lifting the lid for a peek inside shows a neat layout with high quality components. Of particular note are the wide-spaced dual differential capacitor and the substantial silver-plated roller inductor. The balun is also very substantial (used if you wish to feed a balanced line) and the selector switch is everything you could wish at this power level. This is a well built tuner! The SWR measuring bridge is located at the input to the tuner; the meter has switchable power and SWR ranges, and the cross-needle meter (nice touch, Palstar) can be set to read average or peak power, with a useful selection of power ranges.

Correspondence with the local supplier reveals that all the variable capacitors and roller inductors used in their tuners are manufactured in house by Palstar.

Conclusion

Overall, my impression is that the Palstar AT1KP is a well built, heavy duty tuner built with good quality components. It has sufficient flexibility for most purposes and having only the two adjustments makes it easier to operate than most. With current pricing of \$630 it is a significant investment, which should give good service for many years.

Thanks to TTS Systems of Tyabb for the loan of the AT1KP for the review.

All photos by the author.



Photo 4: Close up of the differential dual gang capacitor.