In the past when we've discussed Transmatches, some VHF experimenters have felt left out. This month W1ICP discusses Transmatches for 2 meters and shows us how to build one.

How To Build A Transmatch For 2 Meters

BY LEW McCOY*, W1ICP

I've had many requests to do an article about constructing a Transmatch that can be used on 2 meters. I find that many amateurs wish to experiment with rhombics or V-beams or just oddball antennas on 2 meters. To do so, because the feed impedances of such antennas can vary widely, it is necessary to use some type of adjustable impedance transformer. Such a device will take the unknown impedance of the antenna and convert it to 50 ohms—a value required by modern transceivers. This device is usually an adjustable Transmatch.

The only reason I have held back in describing such a circuit is that it is almost impossible these days to buy small variable capacitors. Or if such capacitors are available, they are very expensive. Whenever I mentioned that fact to would-be constructors, however, the reply was always "Let us worry about that."

That may sound like a simple answer, but I still wasn't satisfied. I made it a point last year to see what was available at fleamarkets, and to my surprise there were plenty of small variable capacitors to be had. While not required, another item that proves very helpful is an old-fashioned grid dip meter.

For the scores of newcomers to amateur radio, a grid dip meter requires some explanation. In those good old days when amateurs built their own equipment (receivers and transmitters), most of the work consisted of making circuits that would either be fixed tuned or tunable to a desired frequency. This was usually accomplished by using a coil of a certain inductance, and that coil was resonated to various desired frequencies via a variable capacitor.

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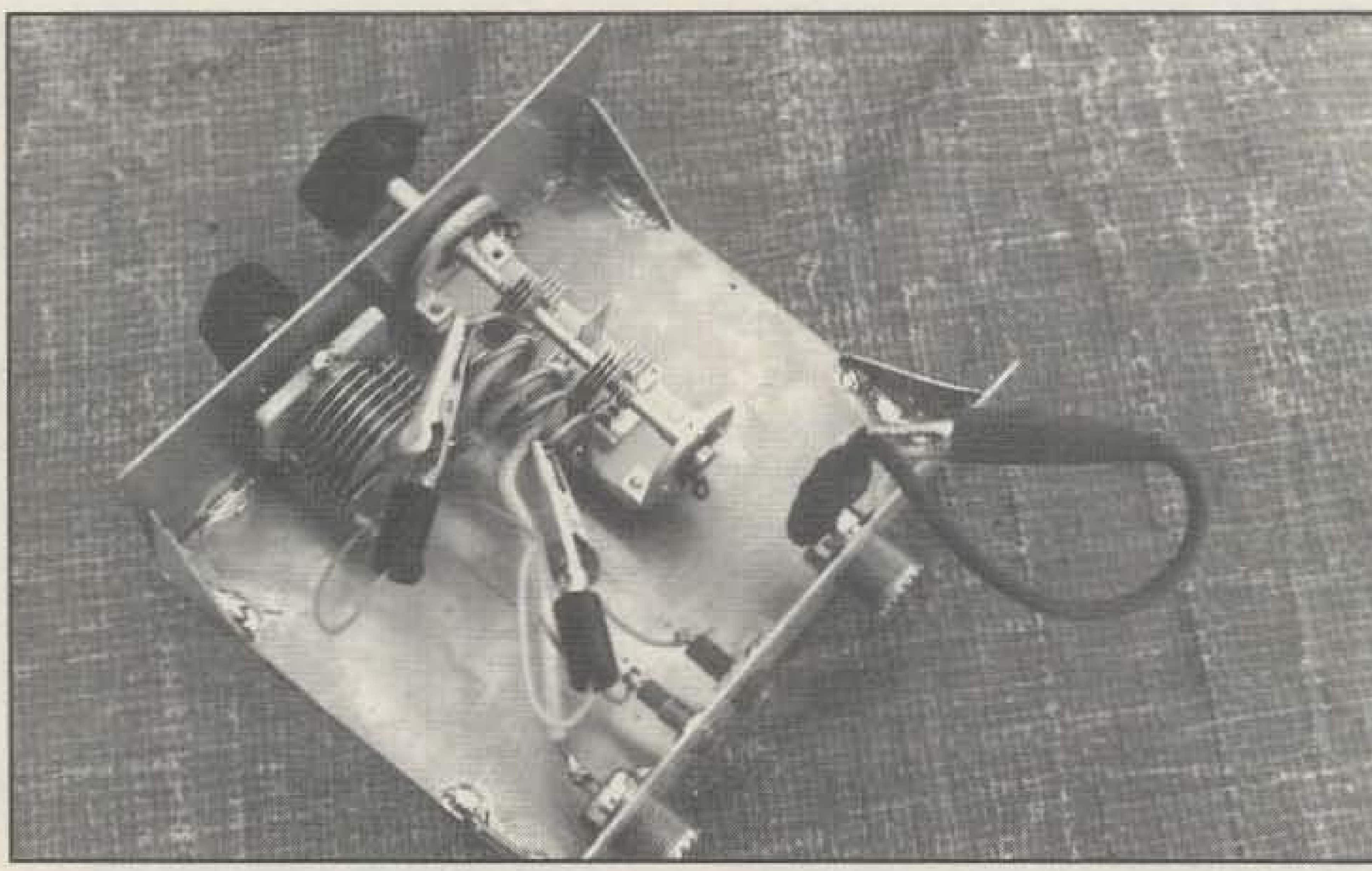

Here is the Transmatch described in the text.

To try to make this clearer to the neophyte, I have shown two circuits at fig. 1(A) and (B). In the case of (A), the coil (LA) is "fixed" tuned by use of a fixed value capacitor. At B we use the same coil and a variable capacitor so that we can cover a "tunable" range of frequencies. One of the more vexing problems with such circuits is knowing, after making one, what the frequency happened to be.

Just a spot of history is appropriate here. The first grid dip meter was described in the early 1930s in *QST*. I believe that this first model is still in the ARRL museum. The circuit was simple enough. It consisted of a tunable tube-type oscillator that would be coupled to another circuit. A change in the grid current would occur when the two coupled circuits were resonant to each other. When metering the grid current in the tube, the meter pointer would "dip," indicating a resonance spot. A frequency meter was used to calibrate the grid dip meter. We therefore ended up with a known frequency checking device that could be used to check an unknown circuit.

The *QST* device was so large, however, that it was impractical to use. A brilliant amateur named Bill Scherer, W2AEF, one of my predecessor's here at *CQ* (he is now a Silent Key), then came up with a small grid dip meter. It was so small it could be held in one hand and brought very close to the circuit to be checked. For years the Millen company manufactured the Scherer grid dip meter, calling it the Millen Grid Dip Meter.

One of my problems—if it can be called a problem—is I feel strongly that history should be preserved. I was

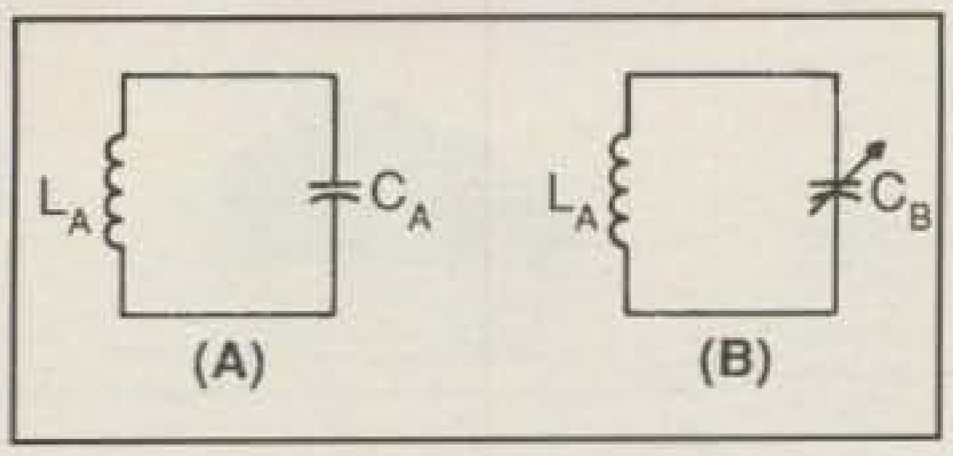

Fig. 1– At (A) is the fixed-tuned circuit using a fixed value of capacitance and resistance. At (B) the capacitor is variable, permitting tuning of the circuit to various frequencies.

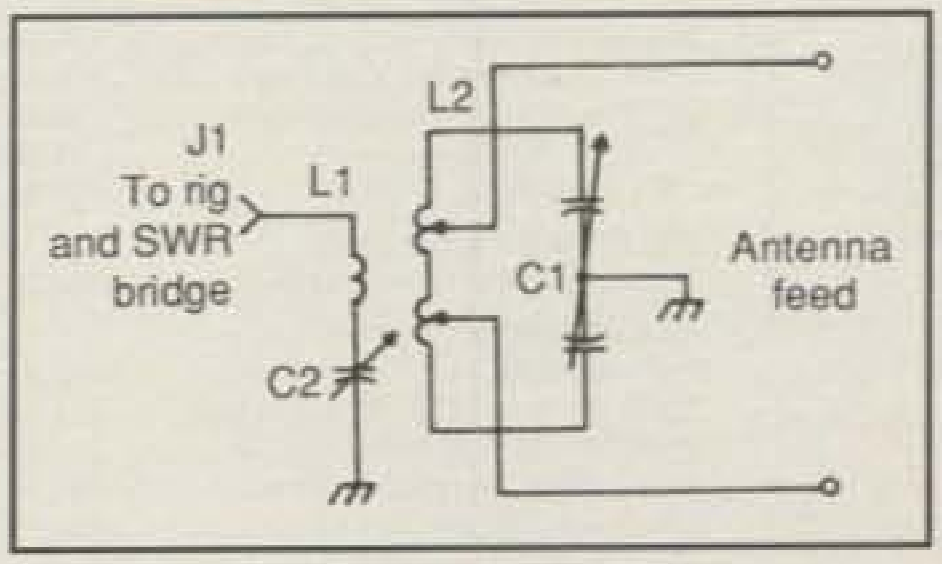

Fig. 2– This is the circuit diagram of the Transmatch. L1 and C2 comprise the input variable link circuit, and C1 and L2 are the primary circuit.

involved in many of these events, so forgive me if you feel I tend to ramble on. I do feel amateurs are interested in their history, however.

When it comes to constructing this project, where can you get a grid dip meter? Probably your best bet is to ask some of the old timers at your radio club, or any old timer for that matter. By old timer I mean anyone who has been in the hobby twenty years or so. You can still buy grid dip meters and they are useful for solving many amateur problems. They can be coupled to antennas to determine resonance, or to feed lines to see if the lines are resonant. How about checking tower guys to see if they are resonant and upsetting radiation patterns? A grid dipper will do the job. If you find one at a fleamarket, check to see that all the plug-in coils are present and also check to make sure it works. How much are they worth these days? Anything under $100 should be a buy.

Meanwhile, back to the 2 meter Transmatch. The circuit I used was cooked up by Ed Tilton, W1HDQ, and was described in many of the early ARRL *Antenna Handbooks*. I didn't have a chassis or box handy when I slapped together this unit. However, I do have a lot of copper-clad circuit board available, so I cut up some pieces and made a chassis/box. As you can see from the photo, it is nothing fancy. It took me about two hours to cut up the circuit board, solder the pieces together, drill the holes, and mount the components. Let me break away again here and discuss antennas and matching.

Today most of the amateurs on 2 meters use a coax-fed vertical, while others use beams. All of the current 2 meter rigs are designed to work into a 50 ohm load. Otherwise, either the rig won't put out rated power, or it won't load at all. This is done to protect the solid-state circuitry. This Transmatch was not really designed for these 2 meter verticals or beam types of antennas simply because these antennas are already matched and do not need a tuner. However, in the event one has a problem, I have provided for coaxial feed matching.

Essentially, the Transmatch is for antennas fed with open-wire line or TV twin lead, but it will work with coax feed. Let's face it: coax in long runs, say 150 feet or more, can be quite lossy at 2 meters so some amateurs may wish to use a low-loss line, such as open wire. Also, one doesn't need a lot of room to put up a 2 meter rhombic or V-beam to obtain a directional 10 dB gain signal. Such antennas can be fed with the insulated-type open-wire line with great success. I am thinking now of amateurs who may be marginal into a given repeater, and the subsequent answer is a high-gain directional antenna (that doesn't cost much!).

This Transmatch also can be used with random end-fed wires, or for example, a multiband, center-fed, low-band

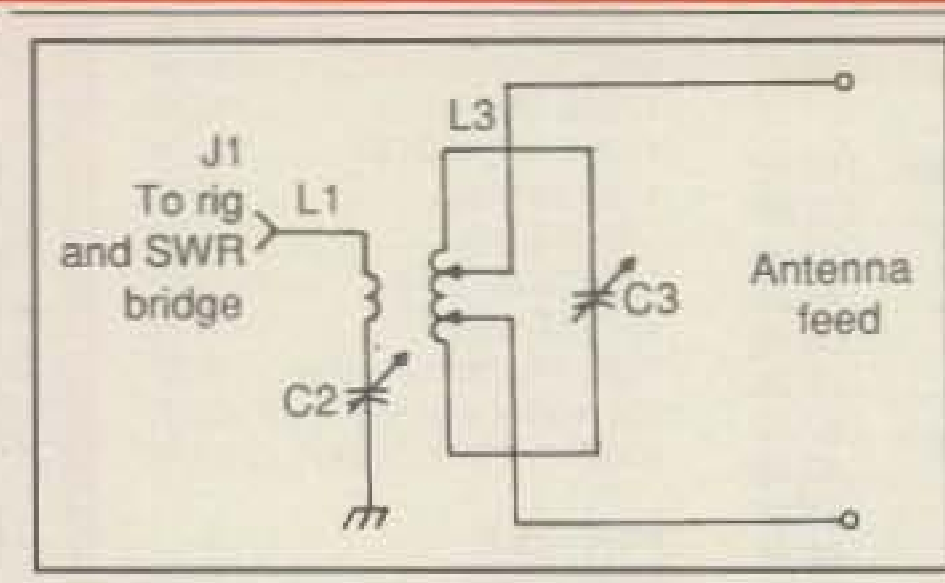

Fig. 3– Single-section variable version of fig. 2. (See text for details.)

dipole such as an 80 meter dipole. One of the antennas I use for tests is an 80 meter extended Zepp fed with open-wire line. Using this antenna on 2 meters I was surprised to find I could trigger several repeaters that my vertical would not access. I tried all kinds of "2 meter antennas." I ran a wire out to my tower, connected the single end to the Transmatch, and found I had a reasonably good antenna system. I also tried my 20 through 10 meter multiband beam, which also worked on 2.

All this experimenting was a lot of fun and provided interesting results. The Transmatch doesn't cost much, depending on what you pay for the variable capacitors and the coax fittings. The two variables I found at a fleamarket cost $3.00 for both.

Fig. 2 is the circuit I used, and fig. 3 is another configuration that will work and does not require a dual variable such as I used in the shown unit. Dual variables may be harder to find.

Study fig. 2. The output of the transceiver or transmitter is connected to J1 where the signal is routed through L1 and C2. For newer amateurs, this is an old-fashioned method of coupling which provides considerable matching flexibility. L1 is a link that is link-coupled to L2. L2 is tuned via C1. The unknown feeder/antenna load is tapped onto L2 via two clip leads. An SWR indicator is connected in the line from the rig to the Transmatch. The SWR indicator is set in the reflected reading mode. While feeding power to the Transmatch from the rig, both C1 and C2 are adjusted for a null, or zero, reading. If a zero reading in the reflected mode is not obtainable, then the clip lead taps are either moved in or out of the coil until a zero reading in the reflected position is achieved. The entire procedure is really quite simple.

In the event of single-wire feed or end-feeding a wire, the procedure is simple. Connect the single-wire terminal feed via the clip lead to the coil, starting at the outside of the coil or hot, ungrounded end of the coil. (In the fig. 2 configuration the grounded end is at the center, or rotor, of the stator.) Try matching and if you are not successful, gradually move the tap towards the grounded end, trying to match at each point. I did not find an antenna-system load I could not match perfectly, but that is not to say that such a condition doesn't exist. I would simply add 19 inches of wire to the feed end at the Transmatch, which would change the load, and in all probability would put it within matching range.

Construction Details

As I stated earlier, I made the "box" that holds the Transmatch from copper-coated circuit-board material. Any metal chassis or box can be used. My only recommendation is that you keep the two variables as close together as possible to avoid long lead lengths. My homemade box is 5 1/2 inches wide and 5 inches deep. The front and back panels are 2 1/4 inches high. (None of these dimensions are critical.)

If possible, in your search for variables try to find a small dual variable. The one shown is a Hammarlund 35 pF per section unit. To be used on 2 meters, however, you need to remove plates. Using needle-nose pliers, carefully bend the outside plates out and back a few times and they will come loose. Do this until you leave only four rotor and four stator plates on each capacitor section.

If you happen to get a slightly larger variable from a fleamarket, then you may have to remove more plates. Your goal in the plate removal is to get a capacitor that covers 144 to 148 MHz with the coil described below. None of this is as difficult as it sounds, particularly if you can beg or borrow a grid dip meter. More on this in a moment. C2 and C3 should also have a minimum value of 35 pF. You may have to remove plates on these as well.

Coils L1 and L2 were made from ordinary No. 14 copper insulated house wire. I had some Romex No. 14 handy, so I stripped the insulation off a length to make L2. L2 consists of four turns of this wire (wound on a 1/2 inch diameter dowel and then slid off the dowel). The turns were then spread to cover a total of 1 1/2 inches. This coil was then mounted to the stator connections of the dual variable, one lead going to one stator and the other coil lead going to the other stator. I must emphasize that none of this is critical if you have a grid meter.

Once the coil is soldered to the capacitor, take the grid dip meter and couple the grid dip coil close to L2, and then tune the grid dipper to 144 MHz. Tune C1 and L2 through their range and watch for a dip in the reading, indicating the circuit has hit the 2 meter band. You can determine the range of this tunable circuit by setting C1 to maximum (plates fully meshed) and then tuning the grid dip meter, looking for a dip. Likewise, open the plates fully (minimum capacitance) and again use the dipper to find the other end of the range.

Next you need to make the link. It is made from a piece of insulated No. 14 solid wire. The link is also 1/2 inch in diameter, and the turns are inserted at the center of L2 (this isn't critical). One end of the link goes to the stator section of C2, and the other end is connected to the coax input fitting.

If you make the version shown in fig. 3, then the only change would be to make the L3 three turns instead of four. Spread the turns as described above, and use a grid dip meter to check to make sure the circuit is hitting 2 meters. The link is coupled to the bottom, or ground end, of L3.

Some newcomers may be confused by circuit-diagram symbols—particularly ground connections. Fig. 2 shows the rotors of both capacitors being grounded. This ground indicates the chassis, and in reality the rotors are grounded to the circuit-board case via their mounting points through the front panel.

You may find that in actually matching an antenna system the tuning of either capacitor may be too sharp, indicating too much capacitance in either variable. You can remove more plates. I cannot tell you how much simply because there are so many different types of variables to be found. Use the grid dip method. (And please don't write asking me, as I don't have time to answer and probably would not be able to help anyway.)

Sometimes, but not always, when using certain types of wire antennas one may encounter high-impedance loads, which could lead to RF getting into the rig via the Transmatch. A simple cure is to add a quarter wavelength of feeders (19 inches) in series with the feed line at the Transmatch. Or if it is a single-wire feed, then add 19 inches of wire as I mentioned earlier. This changes the load of the system to a low or different impedance, and in all likelihood gets rid of the problem. Another thing to do is to use a complete enclosure for the Transmatch box.

The important thing here is that with this Transmatch you can try any antenna on 2 meters, and I do mean any antenna. Anyone for a high-gain rhombic? A rhombic for 2 meters would only have to be 12 feet on a side to produce one heck of a lot of gain, to trigger that remote repeater, and I am talking 12 to 14 dB of good, honest gain. Like I said, however, don't write. Use the antenna books. I'm getting too darn old, and time is become more and more important to me. I will, though, add this: For repeater work and wire high-gain antennas, think vertical polarization. Good luck! ■