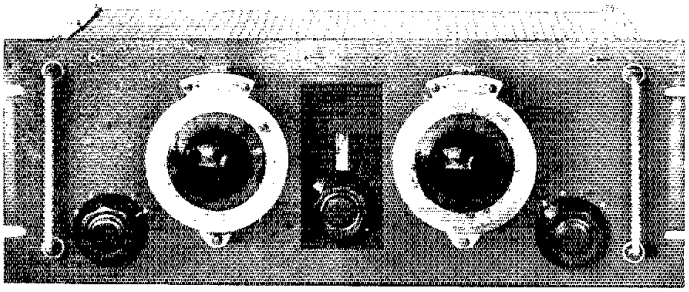
Build This L-Match



Is a narrow-bandwidth antenna cramping your style? Broaden your operating range! Dig into your junkbox and build this L-Match.

By Harry R. Hyder,* W7IV

My antenna is sufficiently broadband at 7 MHz and higher to be within the range of the output network of my transceiver. On the 3.5-MHz band it is a different story. My antenna is a trap vertical, and when the trap has been adjusted for some particular frequency, departures of more than 50 kHz on 80 meters are beyond the matching capabilities of the rig. Since I like to operate both phone and cw on the 3.5-MHz band and have plans to load the vertical on 1.8 MHz, a matching network is obviously needed.

What a ham builds is usually influenced by the parts on hand and the personal station arrangement. A five-gang receiving variable capacitor and a number of high-voltage mica capacitors were on hand, and fitted in nicely with an L network, so that is what I built.

Nothing more elaborate than an L network should ever be needed for impedance matching. PI and T networks are capable of giving greater harmonic attenuation, but TVI problems on 1.8 and 3.5 MHz are minimal, and they were to be the primary bands of operation for the L-Match. There is no reason why the L-Match can't be used on higher frequencies; it just was not built with that in mind.

There are eight possible L-network configurations; these are shown in Fig. 1. No single configuration will handle all possible mismatches, but those shown in Figs. 1A and 1B together can match any impedance.

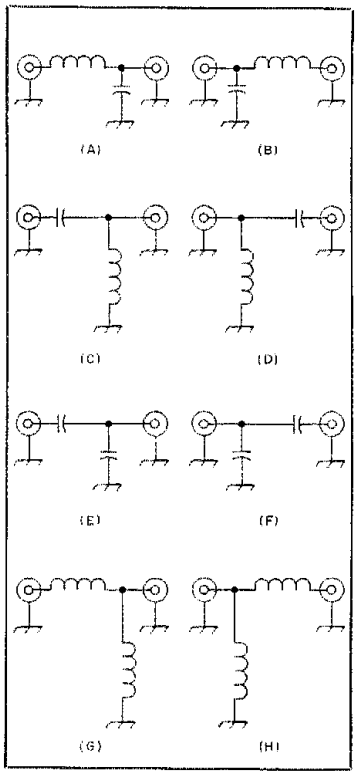


Fig. 1 — The eight possible L-network configurations.

Construction of the L-Match

The L-Match is reversible. That is, to change between the Fig. 1A and 1B configurations, the input and output are interchanged. In my station this is accomplished by an antenna switch in the station control panel, wired as shown in Fig. 2. One switch position bypasses the L-Match.

Component values depend on the degree of mismatch to be accommodated and on the operating frequency. I decided to limit its range to a VSWR of 10 at 1.8 MHz. For these conditions a capacitance of almost 6000 pF and a maximum inductance of 16 μH are needed. Obtaining the necessary inductance was no problem; a surplus roller inductor of 28 μH was on hand. The required capacitance was obtained from the five-gang, 410-pF-per section variable unit and two banks of capacitors, each with five 400-pF, 2500-V mica capacitors in parallel. This provided more than 6000 pF.

Hams may be skeptical of using mica capacitors in circuits carrying heavy rf current, but this is standard commercial practice. In fact, the surplus BC-375 tuning units from which these capacitors had been removed used them in just that way. These capacitors actually have an rf current rating of 1.0 ampere at 3.0 MHz. This is for continuous duty in an extreme environment; for ham use it can be stretched safely to 2 or 3 amperes.

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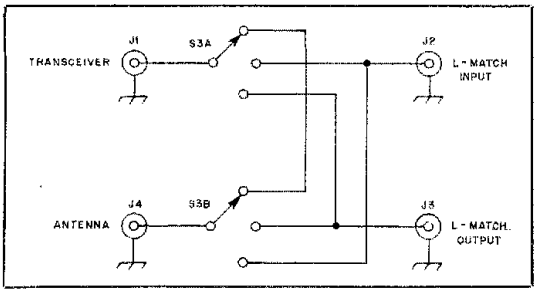

Fig. 2 — Antenna switch in the station control panel used to change the L-Match network from that of Fig. 1A to Fig. 1B. S3 is a two-section ceramic wafer switch.

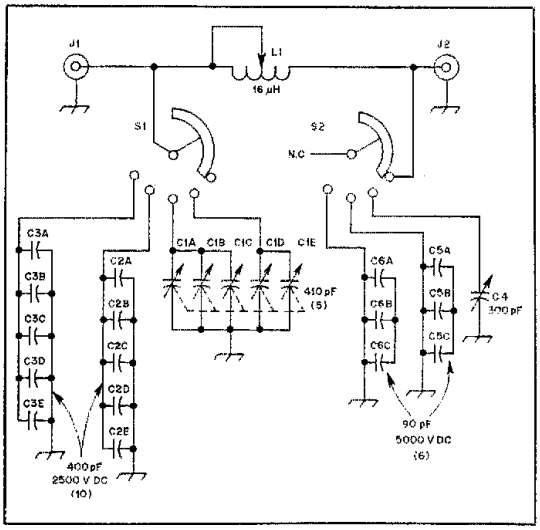

Fig. 3 — Schematic diagram of the L-Match.
L1 — 16-µH (or greater) roller inductor.
C1 — Five-section, 410-pF-per-section variable capacitor.
C2, C3 — 400-pF, 2500-V mica capacitors (CM-55 style), five capacitors each.
C4 — 300-pF variable capacitor.
C5, C6 — 90-pF, 5000-V mica capacitors (CM-65 style), three capacitors each.

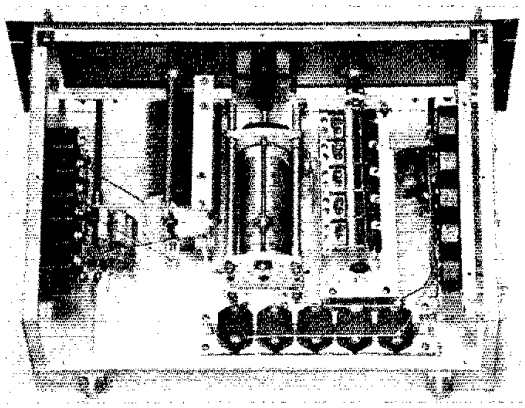

Fig. 4 — Interior view, showing construction details of the L-Match.

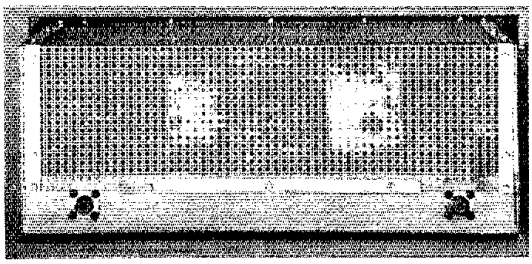

Fig. 5 — Method of attaching the cover, using 1/2-inch-wide aluminum strips.

Fig. 3 is a schematic diagram of the L-Match. One question that will be asked is why the schematic diagram and photograph show two sets of capacitors if only one is needed in an L network (see Fig. 4). This is another example of designing for a specific set of conditions at a particular ham station. When the network of Fig. 1A is used, with the capacitor on the antenna side of the network, the rf voltage will be higher than at the input, and generally less capacitance will be needed.

My rf power is normally 150 watts. With a VSWR of 10, the peak voltage across the capacitor would be about 400 volts, safe for the receiving capacitor used. I occasionally use an amplifier with an output of 600 watts. The peak voltage could then be 800, and this seemed to be asking too much of the capacitor. Since the 300-pF transmitting variable and the 5000-V mica capacitors were on hand, they were added for safety. The net capacitance is about 850 pF. This is not enough to accommodate all possible VSWR values at 1.8 MHz, but my amplifier does not work on 160 meters. The capacitance is high enough to handle the majority of cases at 3.5 MHz and higher.

For 200 or 300 watts, receiving capacitors are adequate, and the second bank of capacitors is not needed. In this circuit one or the other bank of capacitors is used — never both. Switch positions remove either bank. The capacitor switches were taken from BC-375 tuning units, and are ideal for the purpose since they progressively short-circuit contacts as they are rotated. S1 was modified by adding a braid pigtail to the rotor and by filing another notch in the detent disk.

Packaging

Most of my homemade gear is designed to be rack mounted. The L-Match uses a 7 × 19-inch panel (mm = inches × 25.4); the chassis is 2 × 12 × 17 inches, employed upside down. The side walls are aluminum, 6-1/2 × 12 inches. The cover is fastened to 1/2 × 1/2 × 1/16-inch aluminum angle stock inside the walls. The cover is aluminum "cane" material, sold in many "do-it-yourself" stores. This material is rather flimsy, so it is held down with 1/2-inch-wide aluminum strips and sheet-metal screws (see Fig. 5).

If you don't have the exact parts described in this article, build an L-Match anyway. Use the parts you have. Isn't that one of the things ham radio is all about? QST