Wheeling and Dealing with Preamps

For a switch, from the remote hills of West Virginia comes a great antenna idea.

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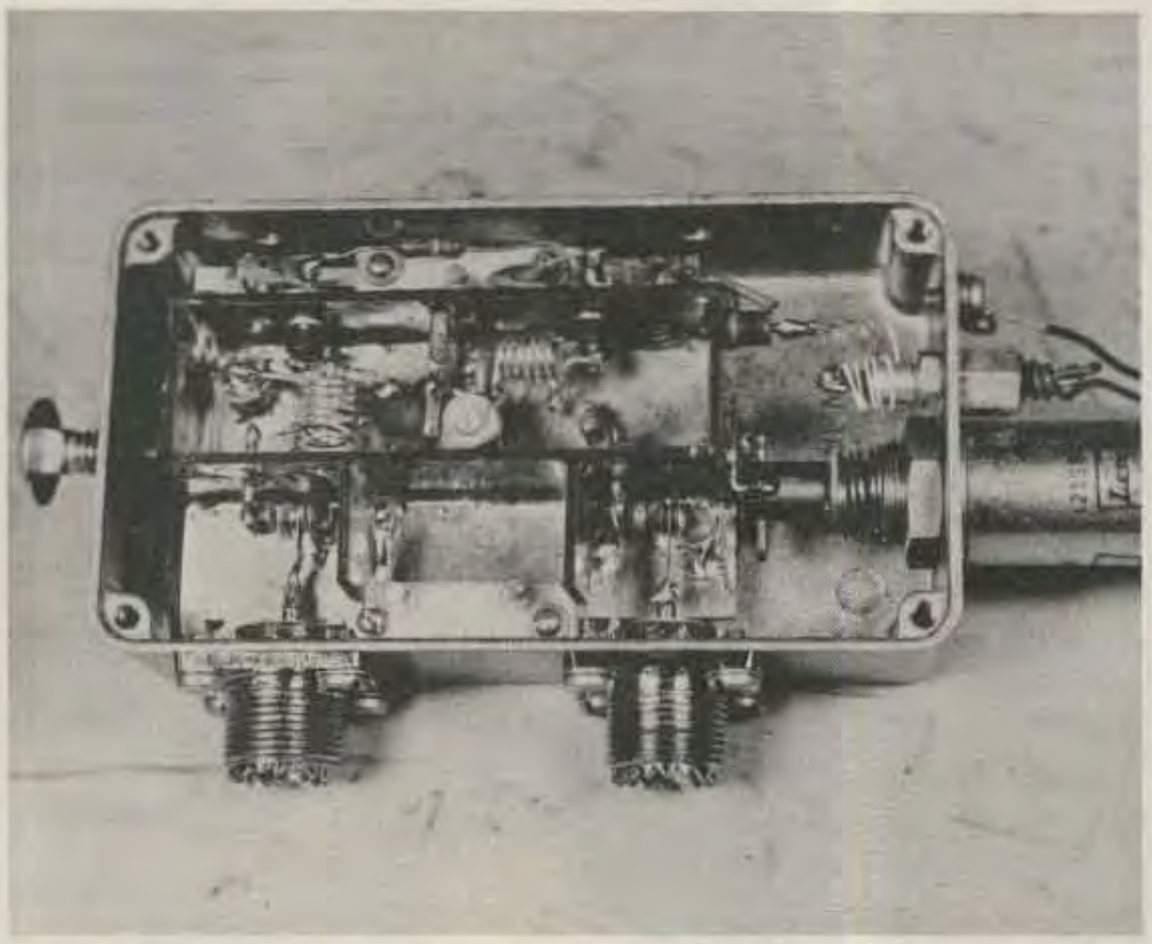


An overall view of the completed preamp.

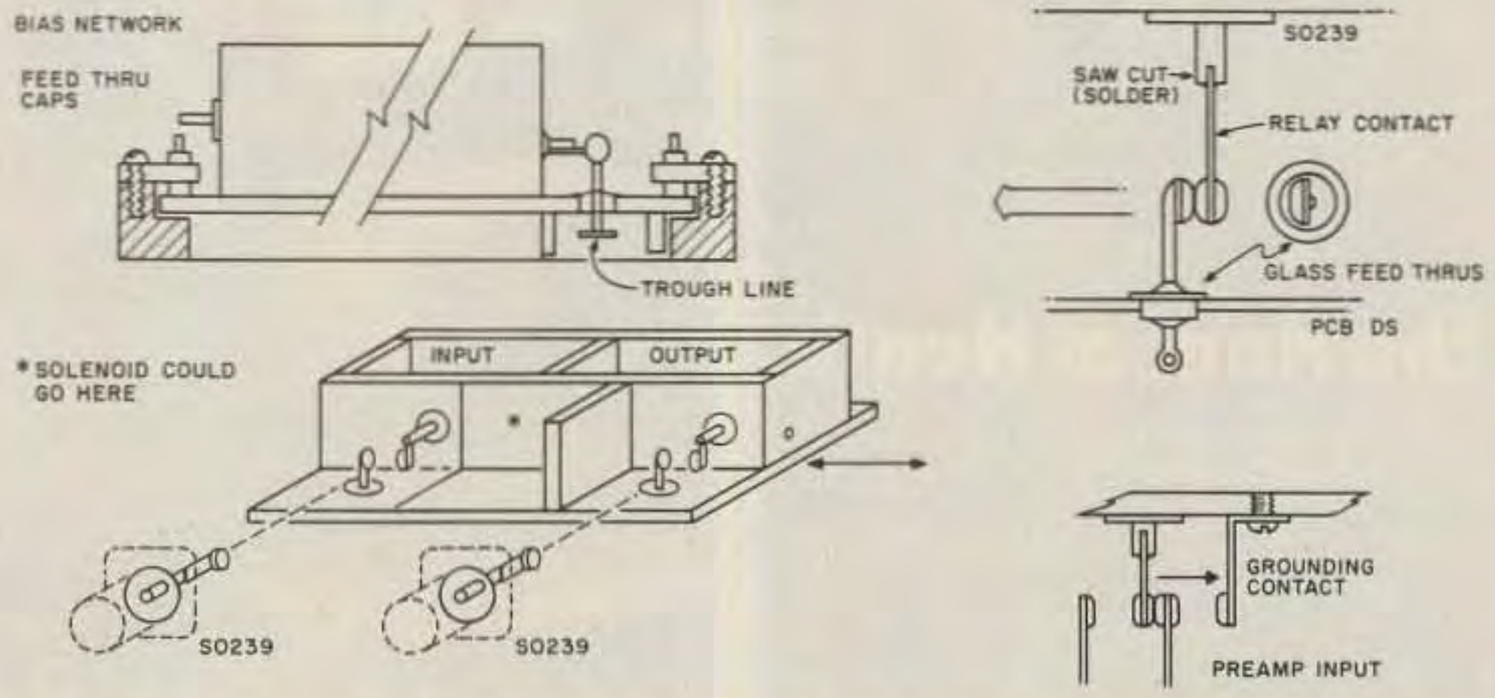


Fig. 1. The approximate method of fabricating the double-sided printed circuit board base and shielding of the preamp. The shields are covered with copper foil "lids" that are soldered to the edges of the shield enclosures. The drawing also shows the mechanical details of the switching contacts.

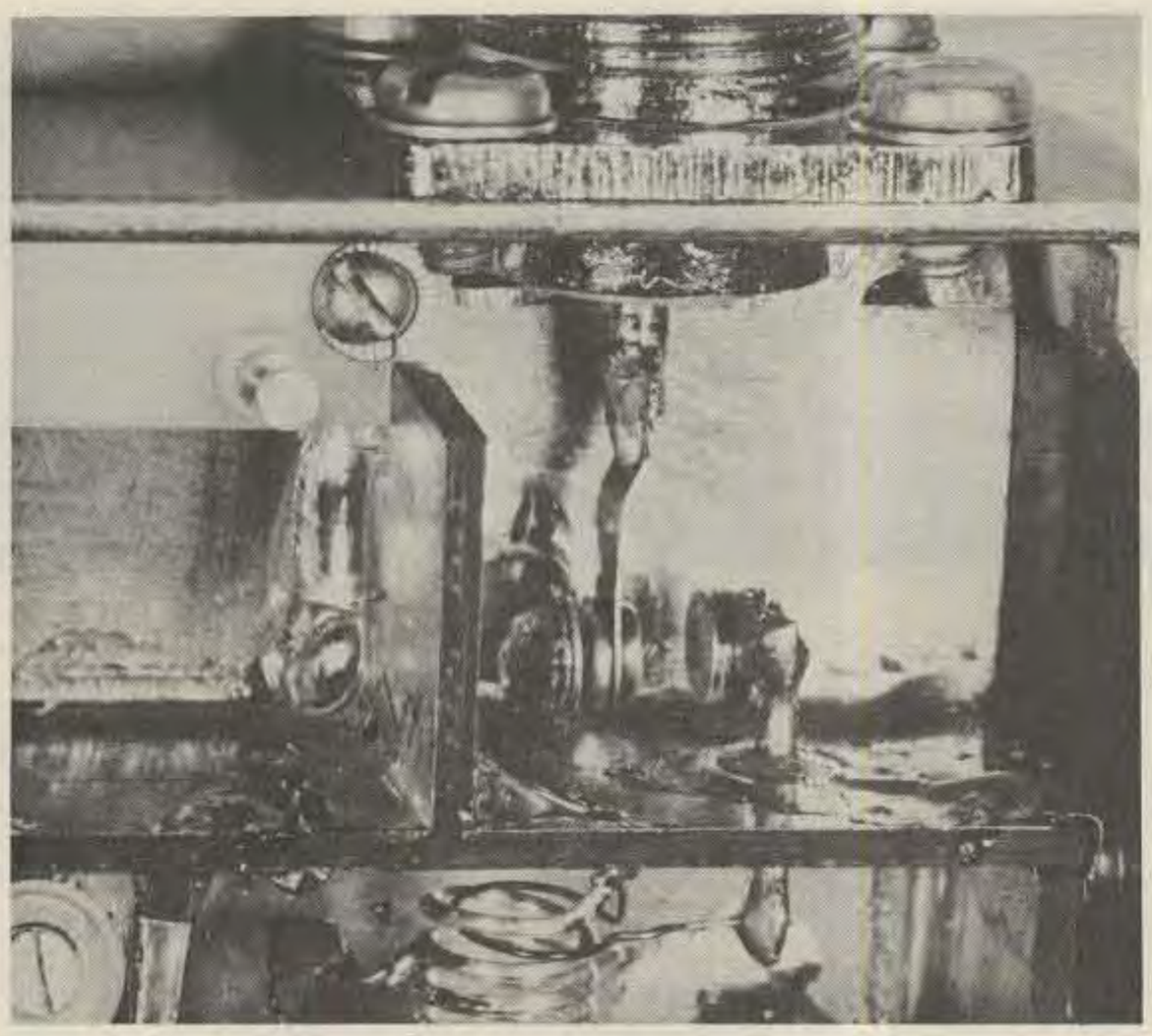
After many years of 2-meter FM operation, I found myself increasingly interested in SSB operation on the lower portion of the band. After spending an evening in the shack with Don WB8ZTV and hearing for myself the potential of SSB and CW operation, I was soon the proud owner of a brand new all-mode rig.

The old 11-element vertically-polarized beam soon went to its storage place (holding up tomato plants) and a homemade 6-element horizontal took its place on the tower. Local FM operation was unaffected by this change, and contacts out to 75–125 miles were possible with the 10-Watt output of the all-mode rig.

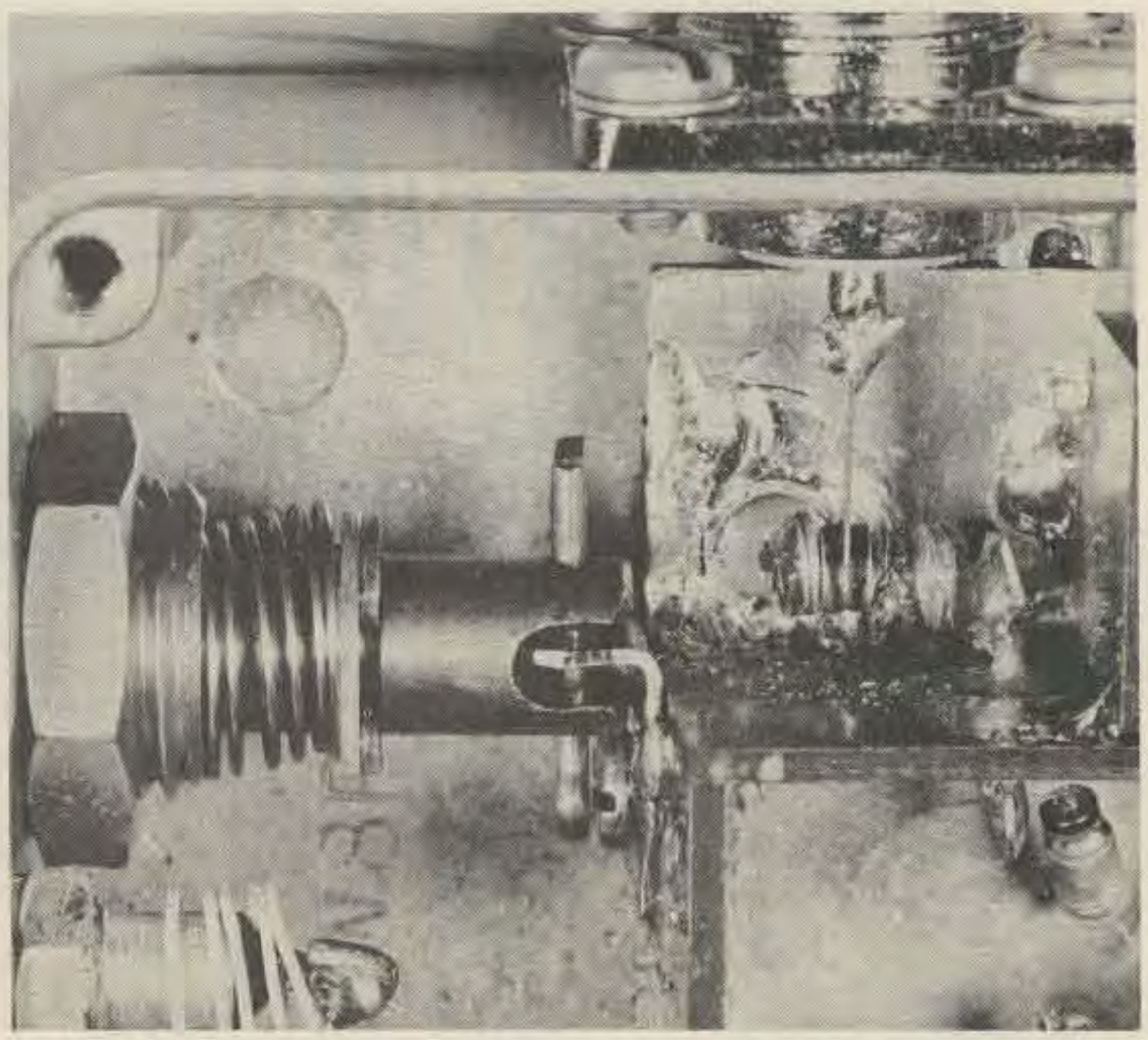
A 4CX250 amplifier that provided around 300 Watts output in linear or Class C had been around for a while and this enabled occasional contacts in the range of 150–200 miles. Before anyone scoffs at the limits, let me remind them that this area of West Virginia is quite hilly and that I live well below the tops of the surrounding aforementioned geographic features; hence, I felt reasonably pleased with the performance of my equipment.

My only problem was listening to Don run his weekly SWOT net and realizing that I didn't hear half of the stations that he was routinely conversing with week after week. Now, don't get me wrong, I fully realized that he had a superior location, stacked 88-element super whizbangs, and an antenna-mounted GaAsFET preamp, so I decided that my first project would be to try putting together a respectable preamp to mount at the antenna.

After researching several articles on preamp construction, it became apparent that one of the major problems and least discussed chores associated with remote devices such as this was switching the preamp in and out of the transmission line during use.



A detailed view of the input contacts of the preamp. The glass feedthroughs are visible, and the method of attaching the relay contacts to the feedthroughs can be seen.



Some details of the output end of the preamp. The relay contacts and the mounting of the solenoid are seen. The copper foil covers of the preamp shields are not in place.

Being a peculiar type of person that hates to cut and strip coax for BNC connectors, I felt that there had to be another means of switching a device like a preamp without the need for multitudes of ¼-wave cables and 2 BNC-type relays. What could be simpler than making the whole PC board (containing the preamp circuits) switch back and forth with a solenoid?

After several attempts, the mechanical layout shown in Fig. 1 was produced. The rf circuit does not represent the state-of-the-art in VHF rf amplifiers, but it does serve to illustrate the concept. With the addition of a few more contact strips, it would be possible to either ground the input and output of the preamp during transmission or switch them to ground through 50-Ohm resistors. The latter method seems to be the manner of choice when using GaAsFETs.

The preamp is switched out of the transmission line until the solenoid is energized. Power for the preamp is now supplied separately through an extra pair of wires in the antenna rotor cable. A 24-volt-dc supply is used, and an LM317 adjustable voltage regulator is now inside the preamp box. Remember to include the bypass capacitors on the regulator input and output. The solenoid is also shunted with a 1N4004 diode to protect against the voltage spike produced when the magnetic field collapses on turn-off.

Isolation of the preamp circuit during transmission is at least as good as some of the VHF BNC relays and could be increased by physically increasing the spacing between contacts. The design routes the rf path during transmission to the underside of the double-sided PC board where it forms an air-insulated trough-line between the PC board and the diecast box. Granted, there would be other ways to improve the impedance bump that this arrangement produces, but it is no worse than the average swr indicator.

I plan to eventually dedicate an MGF-1400 GaAsFET to the MRF-901's role, but it did provide a wealth of experience in rf amplifier design at a low cost. The original circuit (Fig. 2) proved to be extremely unstable, even with several changes of transistors, and the circuit of Fig. 3 eventually evolved. It was much easier to tame while still providing usable gain. The instability is a function of the device and only means that the MRF-901 is really a poor choice for a 2-meter rf preamp. Anyone who would like to check out that statement is referred to an article by B. H. Krauss WA2GFP, in the December, 1981, issue of *QEX*.

Construction

The circuit is mounted inside a diecast metal box approximately 4.5" × 2.5" × 1" (Hammond 1590B). Input and output connectors shown are SO-239, but BNC- or N-types are easily substituted. A fine saw is used to cut a slit in the center pin of the connector in order to mount the fixed contactor (salvaged from a 5-Amp DPDT relay). The saw blades are available from X-acto® and can be found in any hobby or hardware store.

The feedthrough connectors are an item I picked up in a flea market and are

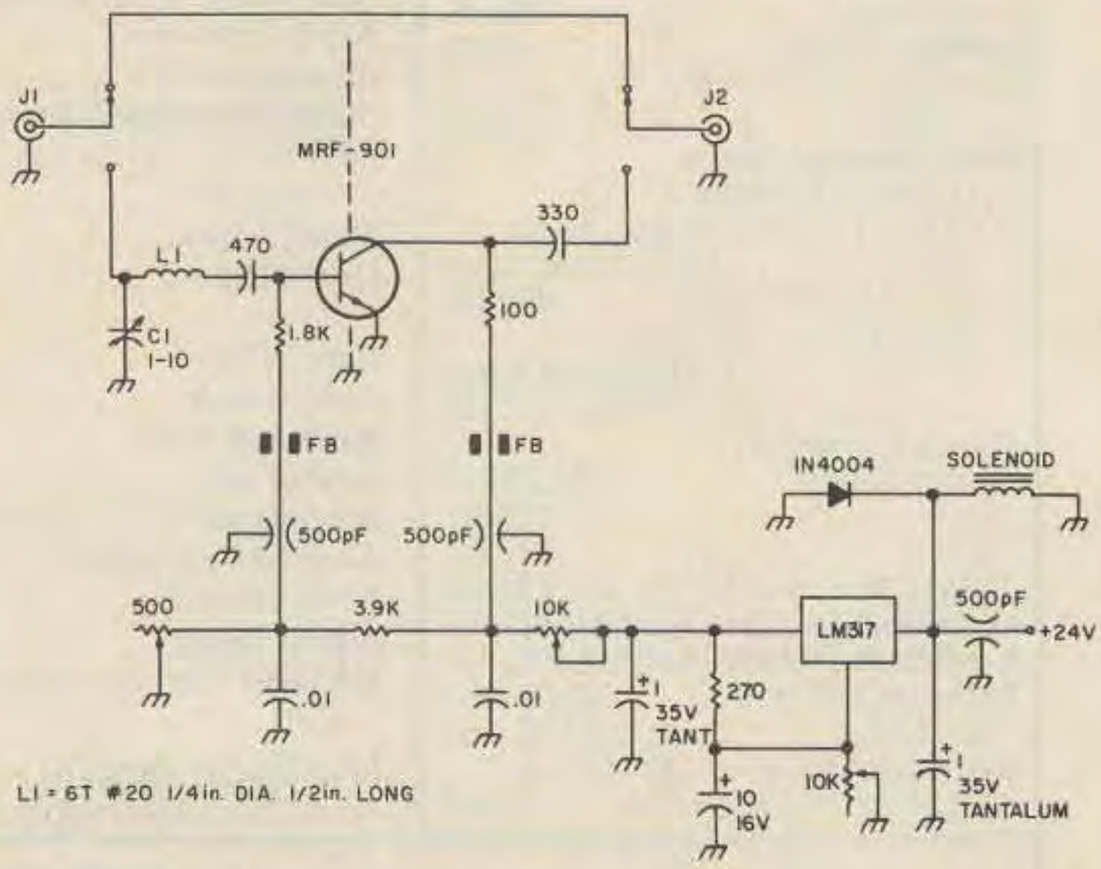


Fig. 2. The original circuit diagram. The MRF-901 proved to be very unstable in this configuration.

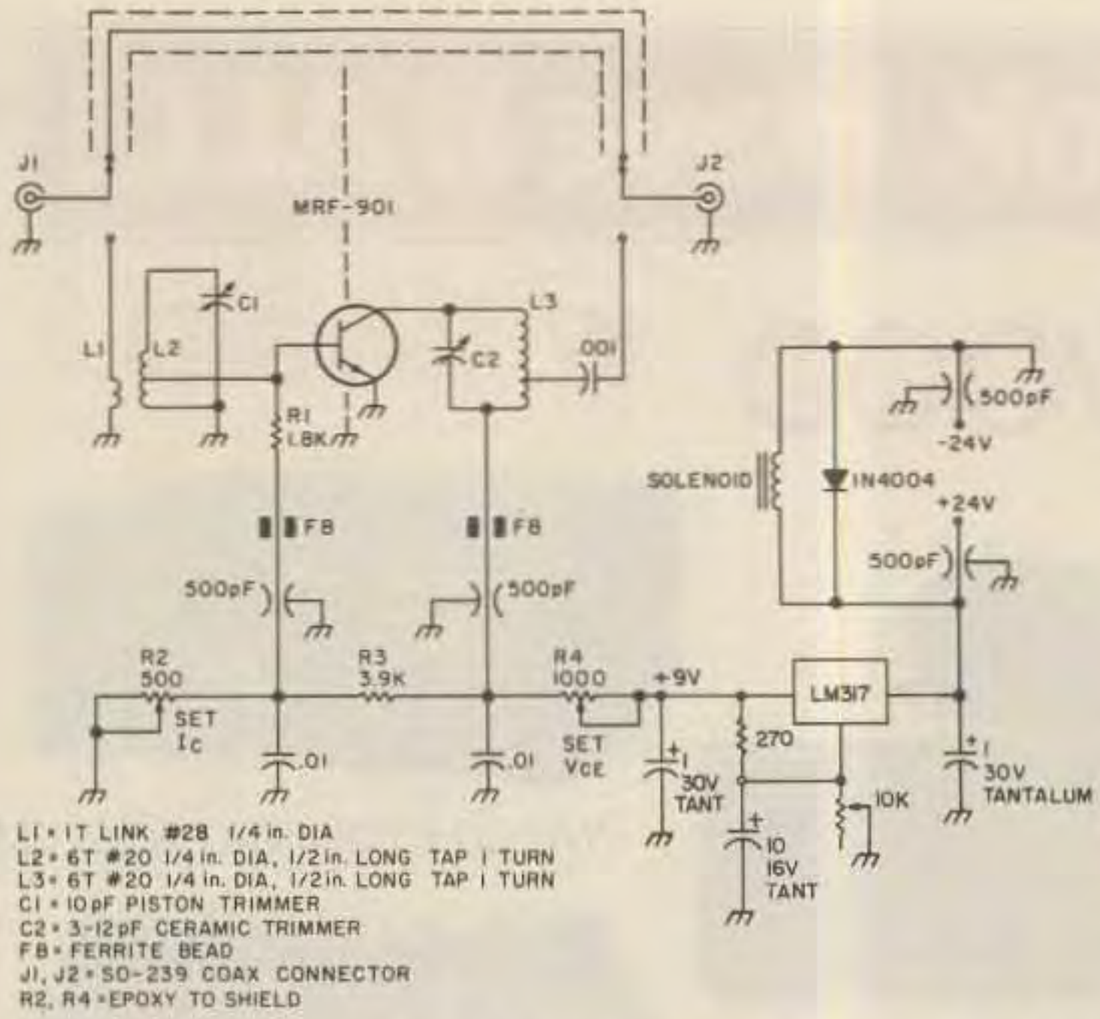


Fig. 3. The final circuit that was used in this version. It is reasonably stable once the initial tune-up is completed. It is much more narrow-banded than the original.

glass insulated. They represent the only parts that might have to be specially fabricated and might be substituted by using brass rod epoxied in the center of brass grommets. These are available anyplace that sells sewing supplies. The silver contacts for the relay end should be soldered to the rod before trying to fill in the epoxy resin. I made loads of these for feed-through use years ago, and they can be made by sticking the rod into a wax block (paraffin canner's wax), centering the grommet, and filling in the center of the grommet with epoxy on a small screwdriver blade.

The PC board is mounted on a pair of brass rails that act as guides during the mechanical shifting. A springy piece of finger stock maintains a good ground contact on the underside of the PC board during operation. Teflon® blocks are attached to the side rails and are used to hold the PC board. Any method that will permit good electrical contact with freedom of motion should suffice.

The solenoid used is a Ledex #12180133-REV A. It just surfaced in the junk box; however, it is possible to modify any screw-mounted solenoid to perform the task of pushing the PC board into its preamp position. There is sufficient spring tension to return the PC board to the neutral, or transmit, position when power is removed from the solenoid. Radio Shack is currently selling a 12-volt solenoid that should be usable.

A final construction tip is to drill and tap a hole on the end of the diecast box that will allow you to run a ¼-20 screw into the shielding to manually switch the preamp to receive position during tune-up.

I would not recommend trying to use the Hammond box out in the weather. It is not waterproof, and the solenoid, having a steel armature, will probably rust and freeze up if used where it can get wet. The whole assembly should be packaged inside a weatherproof enclosure of metal or plastic if it is mounted at the antenna. ■