By Joseph J. Carr, K4IPV

Ham-Radio Potpourri

Every few months or so, I try to tie up a few loose ends or answer some of my mail, making for a "potpourri" column. Well it's that time again, so this month, we will take a look at a couple topics, including hum in direct conversion receivers and I'll provide a printed-circuit board pattern for the popular MAR-1 MMIC chip, which can be used for receiver, monitor, and scanner preamplifiers suitable for the VLF through UHF region.

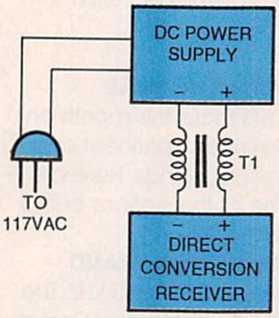

Fig. 1. One cure for AC power line hum and ripple (caused by leakage current) is to use a well regulated and filtered 9- to 18-volt DC power supply with a balancing choke (T1 in this illustration) between the power supply and the DCR.

DIRECT CONVERSION RECEIVERS

The first topic this month involves direct conversion receivers (DCR's). These simple receivers are popular with amateur builders because they are very easy to build and, if done correctly, the DCR will perform rather well. Amateur radio operators who do "QRP" (very low power) operating often use the DCR as the basis for a QRP transceiver.

The DCR uses a local oscillator on a frequency near the desired radio frequency (RF). If CW is being received, the offset is the frequency of the tone you prefer. For example, if you are receiving 3,600 kHz, and prefer an 800-Hz CW beatnote, then you would set the local oscillator to either 3,600.8 or 3,599.2 kHz. For SSB, set the local oscillator to a frequency that is ±2.7 kHz from the desired RF. Most DCR's are probably battery operated. They draw modest current, so batteries won't be depleted as rapidly as they would with more complex receivers.

When the DCR is operated from AC power lines, a hum problem often pops up. Figure 1 shows a cure for that problem (which is derived from *The ARRL Handbook for Radio Amateurs*—a book that ought to be in every ham's personal library). In that arrangement, the DC power supply converts the 117-volt AC line voltage into 9 to 18 volts of filtered DC to operate the DCR. In many cases, the use of such power supplies cause a massive amount of hum due to leakage currents and ripple.

The ripple problem can be taken care of by using a well filtered and regulated (voltage regulation reduces ripple much more than filtering alone) DC power supply. The leakage-current problem can be taken care of by connecting a balancing choke (T1 is our illustration) between the power supply and the DCR. In Fig. 1, the balancing transformer is wound on a powdered-iron toroid core. For small receivers, drawing less than 100 mA, use a T-50-6 choke wound with 12 bifilar turns of #24 enameled wire. A "bifilar" turn is one in which both wires are kept close together. One way to accomplish that type of winding is to twist the wires together (5 to 10 twists per inch), and then wind them onto the toroidal core.

Winding 12 bifilar turns onto a half-inch (T-50-xx) core crowds things a bit, so if you are uncomfortable doing it, then try a T-68-6 or T-80-6 core. The latter cores can also be used for higher powered DCR's when #22 or #24 wire is needed to accommodate larger current drains. All of those cores can be purchased from Ocean State Electronics (P.O. Box 1458, 6 Industrial Drive, Westerly, RI, 02891; Tel. 401-596-3080; fax 401-596-3590 or 800-866-6626, for orders only). And if you're interested in amateur-radio and electronic construction, ask for the Ocean State catalog. Ocean State carries lots of parts—*e.g.,* toroid cores and variable capacitors—that are hard to obtain elsewhere. They also offer a couple kits of ferrite and powdered-iron toroid cores for people who do a lot of RF experimenting.

MAR-1 RECEIVER/ SCANNER PREAMPLIFIER

Building a wideband preamplifier that works for a wide variety of receivers has always been a real torturous chore—at least that was the case until recently. In this column, and in other **Popular Electronics**

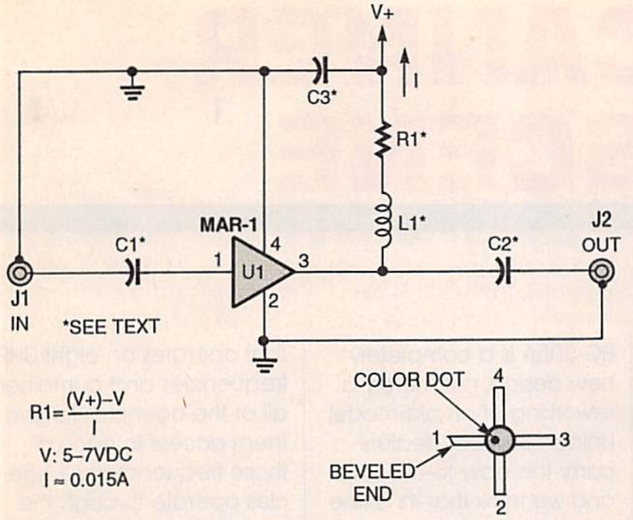

Fig. 2. The low-cost Mini-Circuits MAR-x series of chips offer the RF builder a real advantage, with their inherent 50-ohm input and output impedances (needed for RF systems). Shown here is an MAR-1-based receiver/scanner preamplifier

articles, I covered the Mini-Circuits MAR-x series of wideband chips. Those low-cost devices offer the RF builder a real advantage, with their inherent 50-ohm input and output impedances (needed for RF systems).

We previously covered the preamplifier circuit shown in Fig. 2 (see "Receiver Preamplifiers That You Can Build," June 1993, and *Ham Radio*, October 1993), but this month we'll provide a slightly different printed-circuit pattern than the one shown last time, and go into more details regarding the circuit and its construction, and use.

The circuit in Fig. 2, built around the MAR-1 device (a member of the MAR-x family), offers >13 dB gain from near-DC to 1000 MHz, so it will work throughout the HF-shortwave, VHF, and UHF bands. Using the MAR-1 is simplicity itself, for there are only four terminals: input (pin 1), output (pin 3) and two grounds (pins 2 and 4). Figure 2 also shows a combination pinout/package outline (which resembles a small-signal UHF/microwave transistor) for the MAR-1. Note that pin 1 is identified

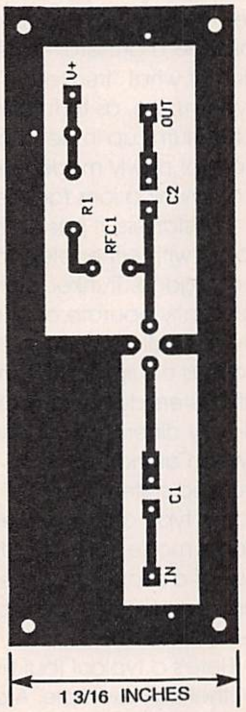

Fig. 3. Here is a printed-circuit template for the Fig. 2 circuit.

in two ways: its lead is beveled (the other leads are rounded on the ends) and there is a brown dot at pin 1.

The V+ DC power is applied to the output terminal (pin 2) through a current limiting resistor (R1) and an optional RF choke (L1). The value of R1 is set by Ohms law, and by setting the applied voltage (V+) to a value between 5 and 7 volts (higher voltages will harm the device). The value of R1 is given by:

$$R1 = V+ - V/0.015$$

That equation assumes a current (I) of 15 mA (0.015 A), which is proper for the MAR-1 (other MAR-x devices may use different optimum currents). If V+ is +9 volts DC, and the voltage applied to U1 is +6 volts DC, then R1 would have to be 200 ohms.

The input and output capacitors, C1 and C2, should be 1000-pF (0.001-µF) units for frequencies under 50 MHz (some say under 100 MHz) and 100 pF for frequencies above that. When VHF/UHF operation is desired, C1 and C2 should be *chip capacitors*, otherwise, ceramic-disc capacitors are satisfactory. Capacitor C3, which is used for power-supply decoupling, should be a ceramic-disc unit; 0.01 µF for HF and low VHF, and 0.001 µF for frequencies above 50 MHz.

MAKING YOUR OWN

Figure 3 shows a printed-circuit template for the Fig. 2 circuit, while Fig. 4 is the parts-placement diagram for the template in Fig. 3. The sites for C1 and C2 are designed to accommodate several different capacitor types. The spacing between the ends of the printed-circuit traces is set to accommodate chip capacitors. Chip capacitors would be soldered directly to the foil side of the board. On one side of each capacitor site, there are two holes to accommodate, ceramic-disc or other high-frequency capacitors.

The MAR-1 device can be mounted in either of two ways. First, you can mount the MAR-1 directly to the foil side of the board; note placement of pin 1. That approach (which is the one shown in the parts-placement diagram) is recommended for upper-UHF

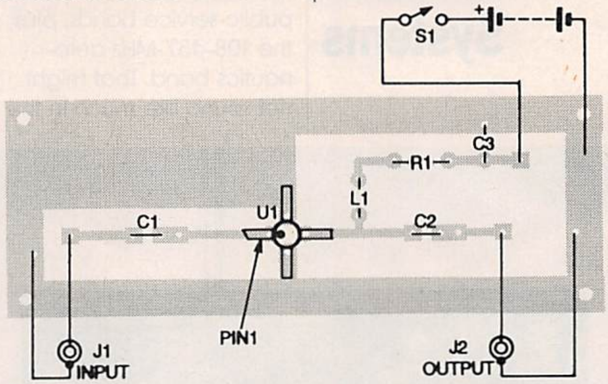

Fig. 4. This is a parts-placement diagram for the Fig. 3 printed-circuit template. (See text for assembly options).

scanner operation, or in the VHF ham bands above 220 MHz. Second, you can bend the leads 90 degrees, and insert them through the holes provided from the component (non-foil) side of the board. The second method of mounting the device works well into the VHF/UHF region.

For a limited time, I can offer the printed-circuit board for $7.00 postpaid, and the MAR-1, plus two each of either 100 pF or 1000 pF (you select) chip capacitors for $6.00. If you want both offers, then the entire set (printed-circuit board, MAR-1, and two capacitors of your choice) is $10.00. Order from me at P.O. Box 1099, Falls Church, VA 22041. ■