Number 22 on your Feedback card

HOMING IN

Radio Direction Finding

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RDFing for QRM

Unlike 40 years ago, the FCC no longer has the budget and the mandate to scan the spectrum looking for violations in the amateur radio service. As I stated last month, it is more important than ever for us to live up to our reputation for being self-policing. Whenever possible, we must seek to solve our own cases of careless and malicious interference without FCC intervention.

When peer pressure doesn't work, we can serve as extra eyes and ears for the FCC in the Amateur Auxiliary, gathering evidence for eventual prosecution. By adding radio direction finding (RDF) capability to your HF mobile installation, you can track down interference problems in your area.

Besides jammers, you can locate QRN sources such as noisy power lines and cable TV leakage. You don't need fancy, expensive equipment. A simple loop is all it takes for accurate ground-wave RDFing.

Build the Homer

I can hear some veteran VHF T-hunters scoffing at the idea of hunting jammers with an old-fashioned loop. It's true that loops are not competitive with beams and dopplers on 2 meter FM T-hunts. But on 15 meters, dopplers and beams are out of the question for mobiles.

There are more sophisticated mobile RDF setups for the HF bands, but how many hams are willing to spend the time and dollars to implement them just to hunt an occasional jammer? The HF Homer, on the other hand, is so simple that just about any HF mobile enthusiast can build and use it. When interference comes on, it's too late to start the project, so get the parts together and start building now.

A Combat-Proven Design

I adapted the HF Homer from a design used by the US Army in the fifties. The hand-held AT-340/PRC RDF Homing Antenna covered 20 to 39 MHz and worked with field portable receivers that were predecessors of the "manpacks" of today. Surplus AT-340s are hard to find now because they

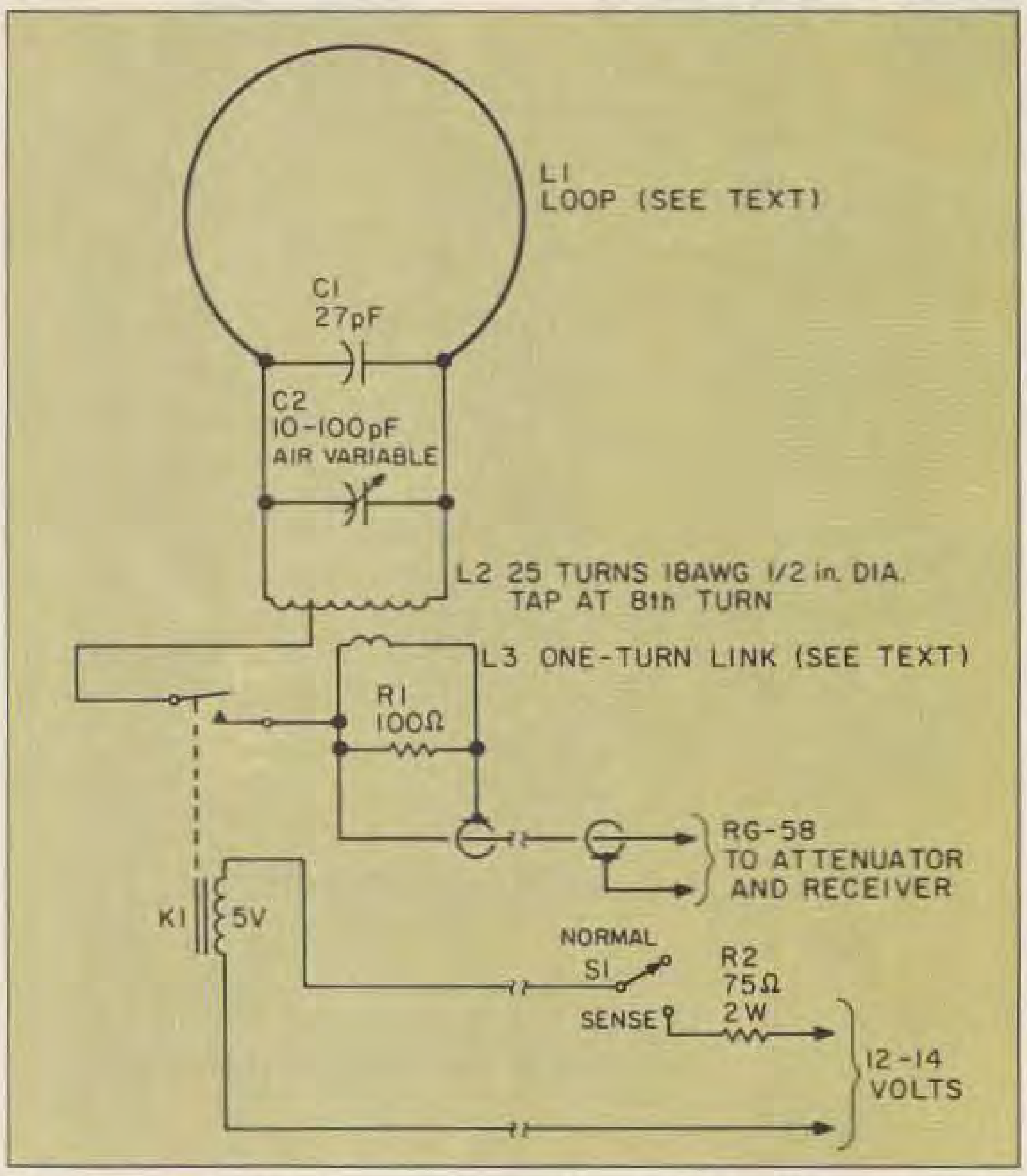

Figure 1. Schematic diagram of the HF Homer. S1 and R2 are inside the vehicle. All other parts are in the mast-mounted box.

Photo A. The HF Homer uses soft copper tubing securely bolted to a plastic box, mounted on a PVC pipe mast.

were snapped up by hams back when 10 meter foxhunts were popular.

The HF Homer gives the same performance and ease of use as the army loop, but it has a lower frequency range (18 to 30 MHz) and it's mast-mounted for mobile hunting. The loop, shown in Photo A, is 13½" in diameter, on a mast two feet above the roof of the van to minimize proximity effects. The SENSE mode was selected by a toggle switch on the AT-340 case, but in my design, it is relay-activated from inside the vehicle.

The HF Homer is a "workalike" to the VHF-FM Handy Tracker (see "Homing In" for September 1989). The principle of operation is different, but hunting procedures are quite similar. You get the sharpest bearing indications in the NORMAL mode, which has a figure-8 antenna pattern.

Two broad-response peaks and two very sharp nulls are indicated on the receiver's S-meter as you rotate the mast of the antenna 360 degrees.

Peak response occurs when the incoming signal is in the plane of the loop, and the nulls occur when the signal is "through the loop." Usually, you'll use the nulls instead of the peaks to determine the line of bearing. This gives two possible directions for the incoming signal, 180 degrees apart.

Closing S1 picks up relay K1 and puts the HF Homer in the SENSE mode, changing the antenna response pattern to favor one of the two peaks.

The purpose of the SENSE mode is to resolve the 180 degree ambiguity of the NORMAL mode's peaks and nulls. Once you have practiced a bit, you can take a bearing much faster than I can explain how to do it.

If you have experimented with HF loops in the past, you'll notice some differences between the HF Homer and typical ham designs. This is not a shielded loop. Many loops have a shield to eliminate the "antenna effect" and couple only to the magnetic component of the incoming signal. Such designs require a separate vertical sense antenna to resolve the 180 degree ambiguity.

The HF Homer takes advantage of the antenna effect to resolve the ambiguity in the SENSE mode by properly combining the electrical and magnetic field pickup. In the NORMAL mode, the antenna effect is canceled by properly configuring the L2/L3 coupling coils. This eliminates the shield and the separate whip, simplifying construction.

To the Plumbing Store

There are no exotic parts in the HF Homer. You should be able to assemble it in an evening or two. I made the loop from ¼" O.D. soft copper tubing. You'll find it in the plumbing section of your local do-it-yourself store, intended for supplying water to refrigerator ice-makers. It comes in a coil, so you won't have to form it into a circle. Cut the tubing to 39".

Use solder lugs and 10-32 hardware to mount the tubing on the 4¾" x 2½" x 1½" plastic case (Radio Shack 270-222). I soldered the tubing and lugs directly to the

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Photo B. Inside the HF Homer enclosure. Stator terminals of C1 are clipped off to make it fit in the box.

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bolts, to keep them from working loose. (Intermittents were a problem with the army's collapsible version.) Solder the bolt and lug to the tubing before fastening it on the box, so you don't melt the plastic.

The mast is ¾" Schedule 40 PVC pipe. The coax and relay control signal leads go down the inside of the pipe. Mount a ¾" slip-type PVC pipe cap to the box as shown in Photo B, using 6-32 hardware. Match-drill the pipe cap and box for the wires.

Bolt a 1" x 2" piece of unclad perfboard in the box to terminate the external leads and to mount K1 and R1. I used a subminiature relay (Radio Shack 275-240) with a 5 volt coil. That allows me to use the unit on foot with a "sniffer" that has a 6 volt battery supply.

R2 drops the voltage when I use the vehicle's electrical system. If you only intend to use the loop in the vehicle, you can substitute the RS 275-241 or another relay with a 12-volt coil, and eliminate R2.

Tuning capacitor C1, shown in the middle of the box in Photo B, must be an air variable type. Small air variables are becoming hard to find. Try your local surplus emporium or electronic swap meet.

Marlin P. Jones Company (PO Box 12685, Lake Park, FL 33403, (407) 844-8764) has a 120 pF part, stock number AV-0091, for $1.75. Measure your capacitor before mounting it, as it might be too long to fit on the side wall of the box.

Wind L2 on a ½" diameter form, with the 25 turns spaced for a coil length of 2". I used rod stock from a local plastics supplier for the form. The tap is 8 turns from the right end. L3 is a length of solid AWG 22 insulated wire formed into a single-turn link over L2. Lightly twist its leads over to K1 on the perfboard. Leave a little slack so the link can be moved along the length of L2.

You will find the exact position of L3 during alignment. In Photo B, the link is over the tenth turn from the left end, held in place with a dab of hot glue. Put yours there for starters.

You can hold the loop out a car window by hand to take bearings, but I don't recommend it. Interaction with the vehicle causes errors and it's hard to get bearings while driving. And imagine the sore muscles and wet, cold fingers you'll get on a rainy night. Make a rotating mount for the mast.

Put a 360 degree compass indicator on the mast for accurate triangulation. Set the pointer to indicate one of the two nulls.

It's hard to tell when you are looking exactly through the loop, so set the mast to indicate 90 or 270 degrees relative to vehicle heading, and visually line up the loop so the plane is exactly to the front and rear. Use bolts or glue at all PVC slip joints so nothing twists.

Besides the loop, you will need a well-shielded receiver and attenuation system, all securely mounted in the vehicle for convenience and safety.

A stable test signal for each band is a great help in alignment. A QRP milliwatt rig is fine, or perhaps you have an old VFO or signal generator. I use a TTL oscillator I built to check crystals for activity. Start the alignment on 15 meters. Be sure the vehicle is in a clear area, away from overhead wires.

First, tune the loop to resonance. With S1 in the NORMAL position (relay open) and the loop plane in the direction of the test signal, tune C2 for maximum S-meter reading. Locate the receiver so that you can see the S-meter when tuning, because you won't be able to find the exact peak by ear. Use your attenuator to knock down the signal if the S-meter reads over S9. Most S-meters are less sensitive to small changes when readings are in the upper scale.

As you rotate the loop in the NORMAL mode, there should be two deep nulls perpendicular to the plane of the loop and exactly 180 degrees apart. One of these nulls should be in the direction of your mast pointer. Repeat this check on 10, 12, and 17 meters.

If the NORMAL mode nulls are not exactly 180 degrees apart or are very shallow, the loop isn't well balanced. Experiment with the location of link L3 on coil L2 for optimum performance on the four bands.

Next, check SENSE mode operation. Close S1 and turn the mast +90 and −90 degrees from the pointer null. One or the other directions should give stronger S-meter readings on the test signal, depending on how you connected L2/L3 leads. Mark the side of the mast to indicate the strongest peak side. Check the SENSE mode on all four bands. You will probably get best front-to-back sense indications on 15 meters, because that band is closest to design center frequency, but indications will be good enough to use on all bands. ■

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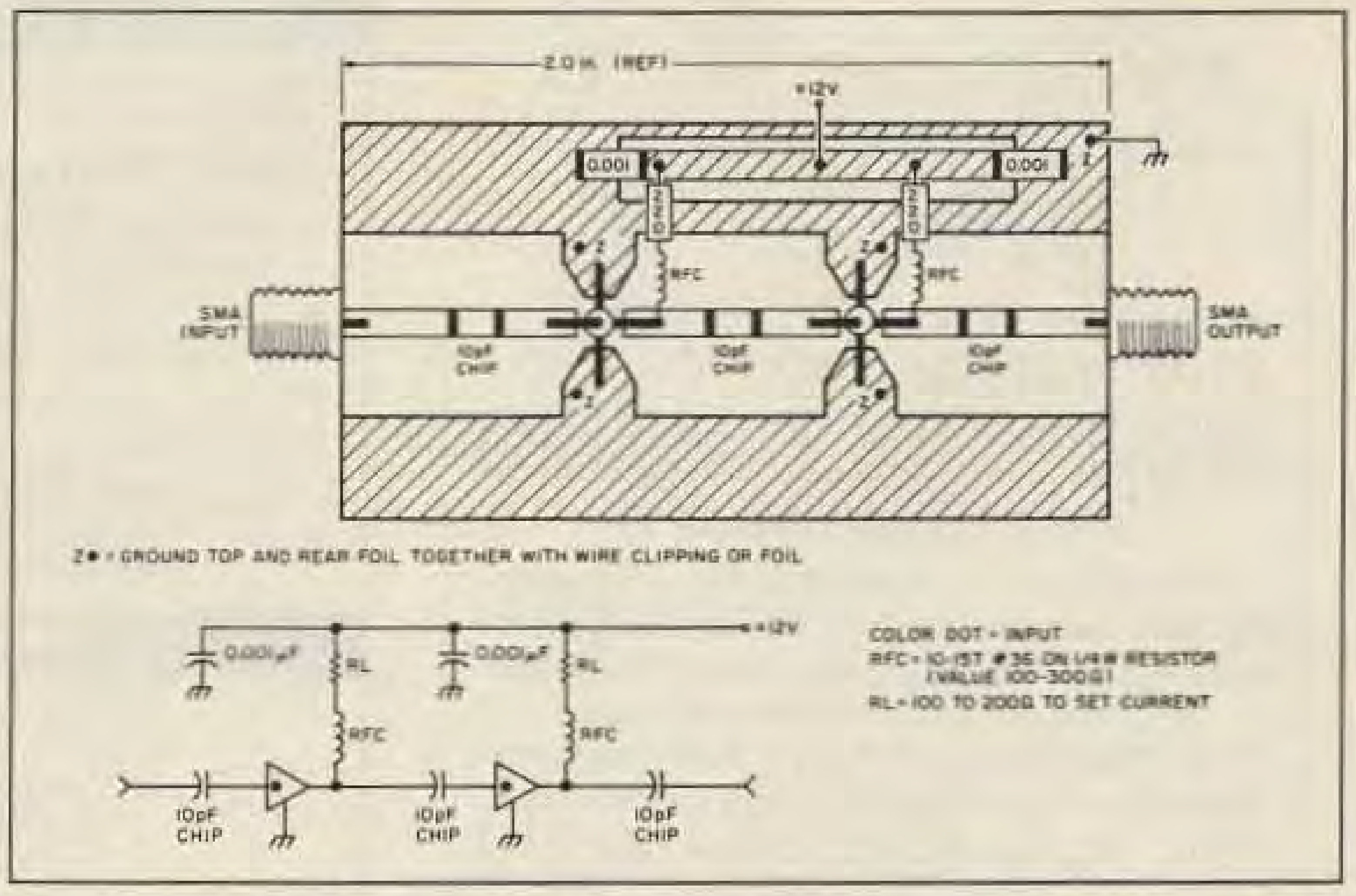

Figure 1. MMIC amplifier test circuits. You can use them as a single-stage amplifier.

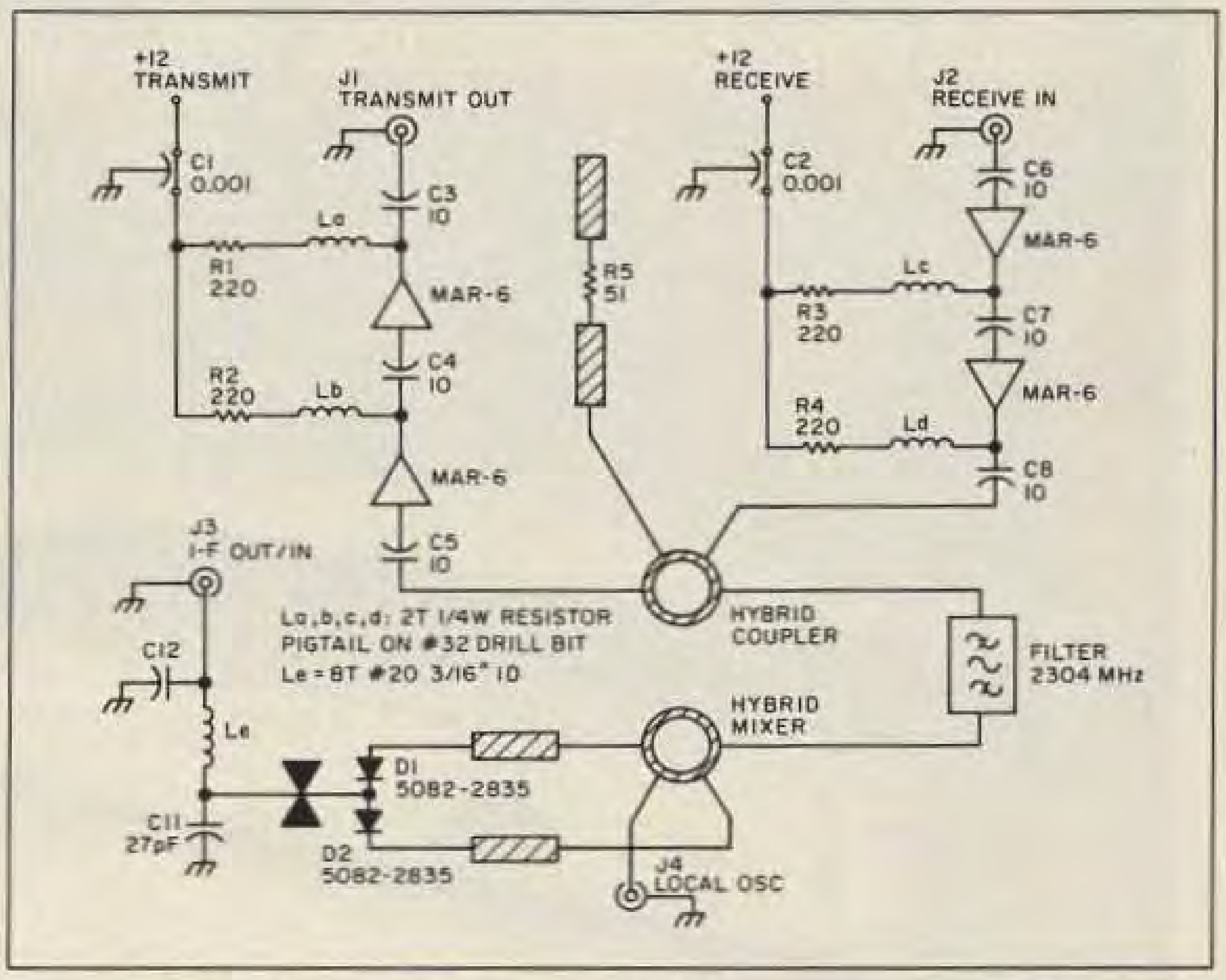

Figure 2. Design by Don Lund WAØIQN, courtesy of Feedpoint, *published by the North Texas Microwave Society, May 1989.*

higher speed packet, and looking for receivers and transmitters to build to achieve this goal. I have received similar requests for simple devices to construct that don't become "deep pocket" projects.

I can think of many projects that would fill the bill, such as my past projects in *73 Magazine* articles on wideband FM systems. These can be adapted for packet, though I haven't gotten into that myself, yet.

Several good references are available. The San Diego Microwave Group has a booklet covering our entry into wideband FM on 10 GHz. The booklet details all the projects you need to construct a station for FM, beacons, SSB operation and associated test equipment. Full schematics and some printed circuit boards are available. Cost is $15 postpaid and is available from me at the above address.

The North Texas Microwave Society's newsletter, *Feedpoint*, is packed full of up-to-date microwave projects and happenings. I always look forward to receiving it. Dues are $12 a year. For information, contact WA5TKU, Wes Atchison, Rt. 4, Box 565, Sanger TX 76266.

Another good reference book I'm very fond of is *The RSGB VHF/UHF Handbook* by G.R. Jessop G6JP. It costs about $35 and covers the full gamut of our VHF/UHF spectrum, including topics on receivers, transmitters, filters, antennas, and test equipment for frequencies from 50 MHz and up. You can buy this book at some large ham radio stores and technical bookstores. Also check *73's* bookshelf at (603) 525-4201.

As always, I'll be glad to answer any questions concerning this or any other amateur related VHF/UHF project. Please send an SASE for prompt reply. 73's, Chuck WB6IGP ■