

The \$100 GMRS Repeater (Updated)

By Jim Sharp

Once you have decided you want to put up a GMRS repeater you go to a local radio shop and they lend new meaning to the phrase "sticker shock". A new repeater complete runs from \$1200 to \$8000. Then, the other solution is go buy a used system somewhere and hope it is reliable and try not to pay too much for it. Here is choice number three. Build a complete, reliable, high performance, 20 watt repeater for \$550 or so, depending on options. The repeater will be composed five components; the radio itself, a 12 volt power supply, a tone board or repeater controller, a RF preamp and a duplexer. The radio is a EF Johnson PPL6060 mobile radio (very popular UHF mobile a few years ago) and you can find them used for as little as \$25. The power supply can be found used for a few dollars or purchase a new Astron RS7A for \$48 from Tessco (call 1-800-472-7373 and request a catalog). If you want CTCSS (also known as PL or Channel Guard) order a TS-64 (Tessco, or from Communications Specialists directly) for \$58. For a controller, it's your choice, a Hamtronics COR-3 or 4 or none. The duplexer is your choice but you can get out for as little as \$291 for a new Sinclair MR-356 from Tessco (or you can use two antennas or look for a good one for about \$100 at ebay). I suggest you buy a pass/reject base station duplexer, not one of those mobile, reject only types. The optional preamp is a P450VDG available from Advanced Receiver Research (they are on the web) for \$80. It makes an awesome difference if you use portables on the system. If you use two antennas, a used power supply, a Com Spec tone board and no preamp you can get going for about \$100. The choices on options is governed by your budget but the real "trick" is the 20 watt duplex radio for \$25 or so dollars.

Included is a word doc with a PC layout. The following is a description of how to modify the radio. You will need a radio (try to get a later version as it was rated at 20 watts out instead of 15), a manual (if possible), a set of crystals for

the GMRS repeater frequency you are licensed on and technician to do the modifications (or do it yourself).

1. First, crystal, checkout, and tune up the radio simplex and be sure to set audio deviation and tone deviation with the existing EFJ tone board (the controls interact). I no longer recommend the EFJ board because it is too hard to get TOS running the transmitter correctly and this day and age you need CTCSS out anyway.

2. Begin by bringing out the RX antenna port out of the radio. Build a 15 inch pigtail out of RG-142A or RG-400 with what ever type of connector you want to use. I use a crimp BNC and connect it directly to the pre-amp out port. Remove C-12 (33 pF) and remove the trace on the bottom of the PC from the C-12 eyelet to where it connects to the first helical filter (about ½ inch). Connect the center conductor of the RG-142 to the point where the first helical filter is. Solder the braid to the ground plane. Get some .010 brass shim stock and make a small cover for this connection. Also, construct a small shield for the area of Q-1 (the first RF amp). This will be a 1 inch square of shim stock with the edges turned down about 1/16 inch on 3 sides. The better these two shields fit and RF "seal" the less de-sense you will encounter later. File a small square notch in the rear case (near the existing antenna connector) to run the RX pigtail out. Then you can re-install the bottom case and the pigtail will hang out the rear of the radio. The original antenna connection becomes the transmitter port. Between the radio ports and the duplexer (or separate antennas) use RG-142A or RG-400 and quality connectors with as short as possible cable lengths.

3. With this NEW procedure, it is easier to duplex the radio. Locate and remove CR-203, CR-206, CR-402 and R-319 (if installed). DONE! This same technique can be used for a late model Fleetcom or a Transcom.

4. Install a current model Com Spec TS-64 in the radio. Connect the Red wire to pin 4 of the Channel Guard board plug. Connect the Black wire to pin 3 of the

Channel Guard board plug. Connect the Green wire to pin 5 of the Channel Guard board plug. Connect the Violet wire to pin 1 of the Channel Guard board plug. Connect the Yellow wire to pin 6 of the Channel Guard board plug. Select the required tone and bridge the appropriate solder pads on the decoder board.

5. The old TS-64 tone board allowed a simple mute circuit and a hang timer to be added. Unfortunately that board is no longer available. If you want a budget repeater with TOT and TOS and no hang Timer follow these directions (if you want a hang timer purchase a Hamtronics COR-3 or COR-4 controller and go to Step 6). Connect the White wire to the Orange wire. Connect the Grey wire to pin 2 of the Mike socket. Bridge the solder pad on JP7. Bridge JP8 and JP9 to set the Time Out Timer at 3 minutes. Install a 10 K pot from the RX audio to ground and connect the wiper to Pin 1 of the mike socket (set this pot for +/-4 KHz TX audio deviation with a +/- 4 KHz modulated 1 KHz tone into the receiver). For the more technically minded individuals out there, if you mute RX audio with both TOS and COS, you can route it to the TX audio and build a delay circuit for a hang-timer you can actually get by without a controller and still have a good sounding repeater.

6. To wire in a controller follow its instructions. RX audio is picked up at the junction of C-277 and R-253 (this is NOT squelch muted audio but it has tone removed). Discriminator audio is available on pin 5 of the tone board connector. RX COS is positive-going (active high) at pin 8 of IC-202B. TOS is available on the White wire of the TS-64 (program JP7 for polarity). TX audio (Pin 1), PTT (Pin 2) , ground (Pin 3) and hang-up (Pin 4) are all available on the mike connector. Connect a jumper from ground to pin 4 to allow the tone decoder to operate properly.

7. I have built several dozen of these repeaters and they have always performed perfectly. I have one that has been in continuous duty for 10 years with a community repeater panel on it. I have also used this design to build several full

duplex mobiles for telephone interconnected systems on commercial repeaters. I mounted one of these in a weather-proof box and tower-mounted it with two mobile antennas and ran it for a year or so (saves on cable costs). There are now three repeaters (and three spares) built like this on the island of Dominica in the Caribbean operating for the Civil Defense. If you have a problem or some confusion or call me at 830-612-2648 evenings (CST) or weekends or email me at jsharp2316@msn.com.