A 900-MHz Parrot Repeater

Multi-Access Amateur Use of 33 cm (902–928 MHz)

We amateurs almost forget that we have an amateur band in the 902–928 MHz frequency spectrum. So totally loaded with non-amateur users, this band seems to be unattractive to many of us. In spite of this, KE4NZG decided to go ahead and build a repeater for this band. Making sure that it was accessible to as broad a group of amateurs as possible, Jim also included inputs on three separate bands.

By Jim Labor,* KE4NZG

Loud and clear out of the scanner tuned to 919.300 MHz came: "KE4NZG testing 900-MHz repeater...." I had just completed transmitting the identical statement on 446.900 MHz to test the UHF input/access to my recently installed homebrew 900-MHz repeater. Seconds earlier a similar test proved that the 145.170-MHz VHF input also worked. After years of the concept bouncing around in my head and components being joined together, my 900-MHz repeater was built, installed, and status *active!*

I had adhered to the saying "use 'em or lose 'em" by launching a repeater that not only operated with input on 907.300 MHz, but also permitted hams without that capability to access it through inputs at 145.770 and 446.900 MHz. Now I could actually make use of this 33-cm band and also provide the use of the 902–928-MHz spectrum to other hams in my area.

I built my repeater around a Standard GX-3000K commercial, 800-MHz land-mobile transceiver (photo A). This unit is a conventional, non-trunked, 64-channel, 25-watt radio. Modification to convert it to 900-MHz operation proved easy with very minimal degradation.

The brain for this well-designed FM two-way radio is a 16K 2716 EPROM integrated circuit. This EPROM was reprogrammed to operate on channel one only, with an input frequency of 907.300

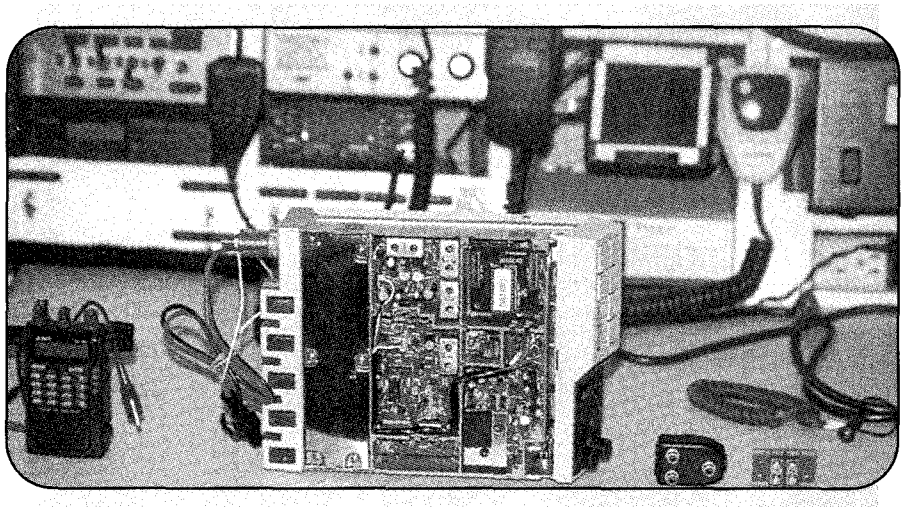

Photo A. Standard GX-3000K business-band conventional, non-trunked, 64-channel, 25-watt, 800-MHz transceiver.

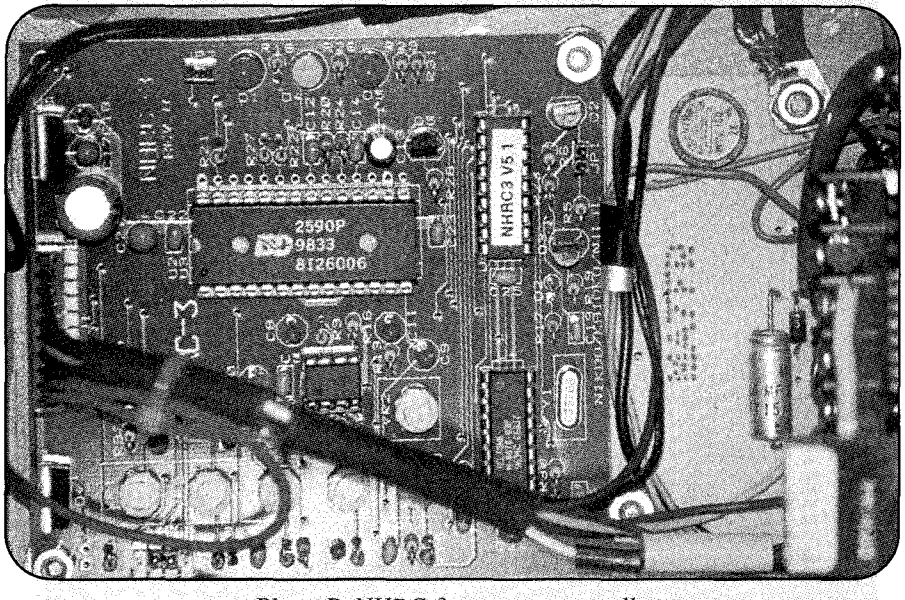

Photo B. NHRC-3 repeater controller.

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Photo C. Alinco DJ-580 dual-band HT.

MHz and an output frequency of 919.300 MHz. Nestled back in its socket, the newly reprogrammed EPROM was ready to command external circuits.

The next step was to realign the receiver section and retune the transmitter. As it turned out, realigning the receiver was accomplished with only seven points of adjustment. Likewise, only seven points of adjustment were required in the transmitter section.

With just over 13 volts of DC power to the system (under-load), RF power output at 919.300 MHz was a stable and consistent 21 watts. A salvaged Motorola Flexar DC power supply accommodated with ease the 7-amps total current requirement of the complete system.

An NHRC-3 repeater controller (photo B) was integrated into this system. It was selected for several desirable features, including a 90-second stored speech function, DTMF remote control, and multiple programming options. In addition, the "Special ID Mode" permits real-voice identification while operating in simplex mode.

The "parrot" simplex mode was selected as an inexpensive approach, since an 800/900-MHz duplexer alone could cost well over the total investment in this 900-MHz repeater project. Also, this simplex parrot operation serves well for experimenters—key your microphone, speak, unkey, then hear the results.

To provide 2-meter and 70-cm access I chose a spare Alinco DJ-580 dual-band HT (handie-talkie). The HT accommodates the 145.770-MHz and 446.900-MHz receive process. A Comet GP-3 antenna with gain of 4.5 dB on VHF and 7.2 dB on UHF serves as the receive-only antenna. The decode tone of 103.5 Hz was programmed to offset false keying of the 900-MHz transmitter by the HT-style receiver. A Comet KP-20 antenna was selected for the 900 MHz segment. This antenna features a $7^1/3$-foot vertical element rated at 7 dB gain at 915.000 MHz.

Several types of coax were tested for loss and attenuation at 919.300 MHz. These tests were made using the 21 watts from the GX-3000K. The results revealed that quad-shield 75-ohm RG-6 cable is very effective. It is also inexpensive. A good match and transfer of RF power to the KP-20 from the GX-3000K was achieved. This RG-6 quad-shield feedline is very easy to work with, while using simple but effective F-type connectors

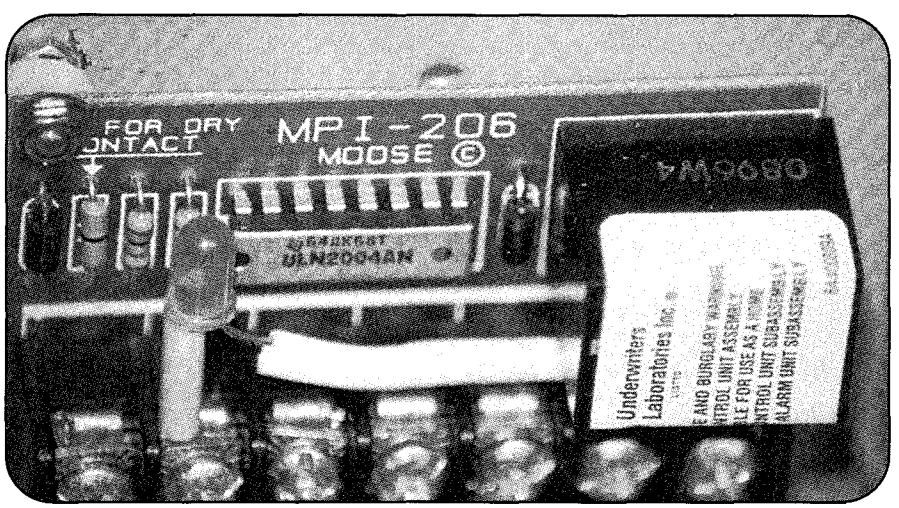

Photo D. Sentrol MPI-206 universal relay board.

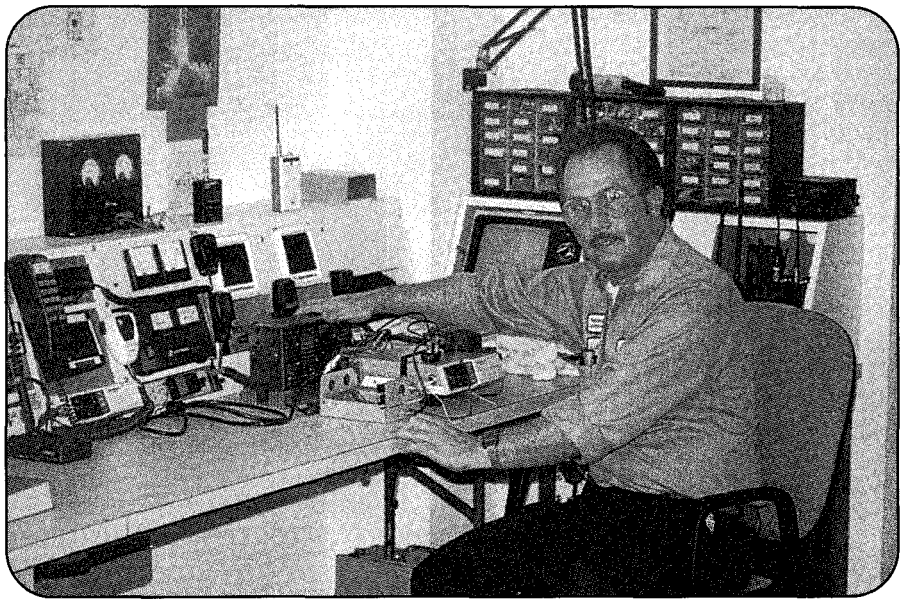

Photo E. The author checking the power supply for heating under load conditions.

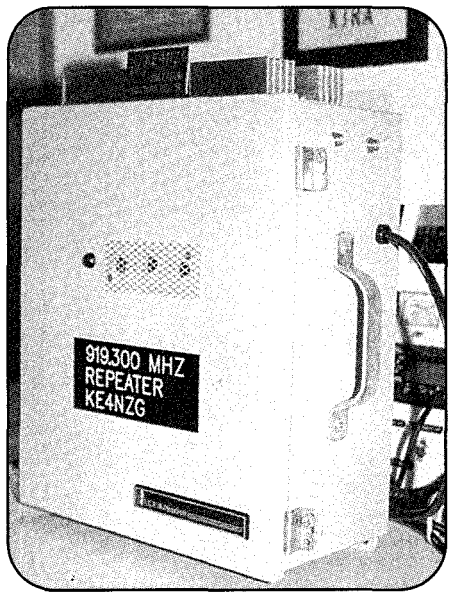

Photo G. External view of the completed 900-MHz repeater.

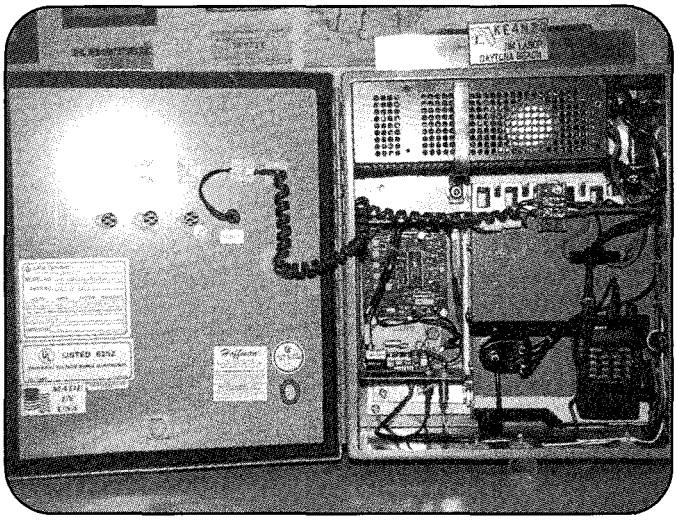

Photo F. Internal view of the completed 900-MHz repeater.

Components and Parts List

Standard GX-3000K business-band conventional, non-trunked, 64-channel, 25-watt, 800-MHz transceiver
NHRC-3 repeater controller
Alinco DJ-580 dual-band HT
Comet GP-3 dual-band, 2m-70cm base vertical antenna
Comet KP-20 900-MHz base vertical antenna
RG-6 quad-shield coax cable
Homebrew-type N- to F-connector adapter (See text for details.)
Sentrol MPI-206 universal relay board

for termination. Incidentally, CATV coax along with the F-connectors is useful for the gigahertz region.

Because N-male to F-connector adapters essentially are unavailable, I fabricated my own using a standard RG-8 style male N-connector and a chassis-mount F-connector. I attached and carefully soldered these together while maintaining 100-percent shielding with minimal insertion loss. At least 90 percent of base-station antennas available for the UHF spectrum and above terminate using female N-connectors. Therefore, my homebrew adapters provide efficient interface to F-connected RG-6 cable.

A more difficult task than homebrewing the adapters was locating a useful COS (carrier-operated squelch) line in the Alinco HT to provide the NHRC-3 controller requirement for a triggering voltage for transmit PTT (push-to-talk) action. I was only able to find a maximum derived positive-going voltage of 2.2 volts DC, so I began a quest to provide an unsquelched setting of at least 6+ volts.

Finally, to accommodate the NHRC-3's desired keying input voltage, an option using a Sentrol MPI-206 (universal relay board) was employed. The MPI-206 provides a 12-volt plus (switched) line using the low 2.2-volt triggering input. A nice aspect of the MPI-206 is that it can be triggered by either a positive- or negative-going voltage input with a source as low as an astounding 3 milliamps!

The task of locating the unsquelched DC-plus voltage required by the NHRC-3 controller in the receive section of the GX-3000K pin 13 of QR-56 was much easier. A TK 10420 integrated circuit provides a substantial +8 volts. Also, the low-noise, high-sensitivity receive function necessary at 900 MHz is available with the GX-3000K with its squelch threshold sensitivity at a very usable 0.03 microvolts. Two 25C 3358 RF amplifiers in the front end provide these features. Typical frequency cut-off approaches 1100 MHz. The GX-3000K business-band transceiver played a very important role in making this 900 MHz repeater project move forward from inception to reality.

I realize that details are lacking in this article, but my primary purpose was to report what was done. For anyone interested in duplicating my efforts, I will be happy to provide details. Please contact me at the e-mail address at the beginning of this article. If you are in the Daytona Beach area, please feel welcome to use the repeater. ■

Repeater Inputs and Output

Repeater inputs: 907.300 MHz, 446.900 MHz, and 145.770 MHz
Repeater output: 919.300 MHz