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Clear Channel Communications AR-3300 Ranger 10-M All-Mode Transceiver

Pac-Comm TNC-200 Terminal Node Controller

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Clear Channel Communications AR-3300 Ranger 10-M All-Mode Transceiver

Novice Enhancement! I've had my Novice license for two years, but I was never interested in operating. The knowledge gained through studying for my license helps me better understand the publications I work on every day in the ARRL Production Department. CW operation never really excited me, and except for my first and last contacts in the 1985 Novice Roundup, I haven't been on the air. The chance to operate 10-meter SSB was different. This was something I was interested in! My husband, Bruce, KB1MW, a die-hard CW operator, has no equipment for 10-meter SSB. How could I get on the air for the Novice band warming on Friday night, March 20 (0001 UTC March 21)? When I was offered the opportunity to review the Clear Channel AR-3300, I jumped at the chance!

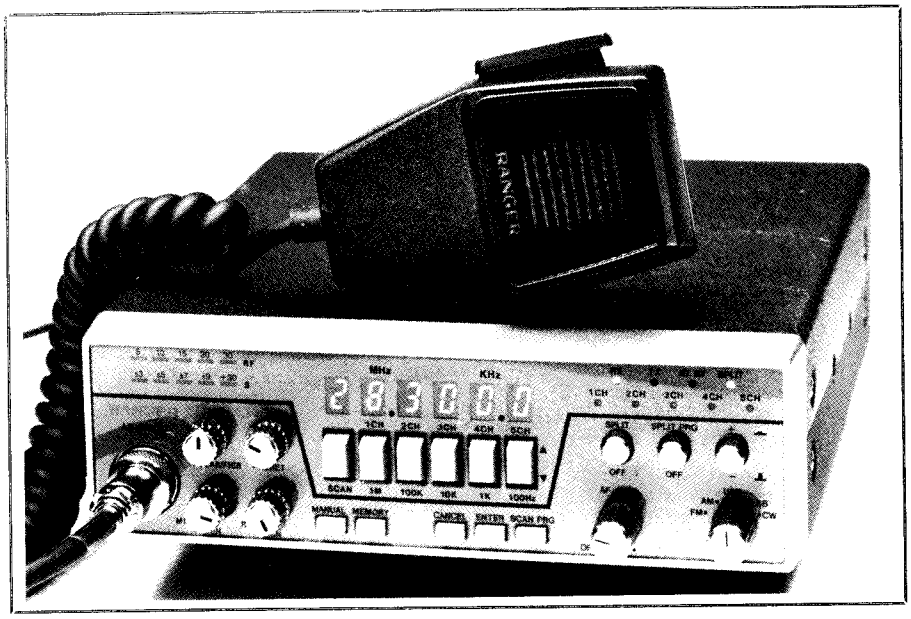
What Does This Radio Do, Anyway?

The Ranger AR-3300 is an "all-mode" 10-meter single-band amateur transceiver. It covers 28.0000 to 29.9999 MHz and operates in the FM, double-sideband AM, upper or lower SSB and CW modes. Rated power output is 25 W on SSB, 30 W on CW and 8 W on AM and FM. A 100-W-output version is also available. The Ranger has five memories for frequently used operating frequencies, and it can scan through the memories or scan between two preset frequency limits. The rig appears to be designed primarily for mobile use, as a mobile-mounting bracket is included and the rig operates on 13.8 V dc at approximately 7 A, maximum.

Knobs and Dials

The front panel of the AR-3300 is a bit intimidating to a Novice like me. There is *no* tuning knob—the operating frequency is entered and changed by several front-panel rocker switches located under the LED frequency display. The rocker switches have more than one function. Pressing a switch up causes the frequency to go up one increment at the selected digit; pressing down causes the frequency to be decremented. Each time you press a switch, the radio produces a short beep to let you know something has happened. Five of the rocker switches are also used to enter the memory frequencies; just press up to enter a frequency in the chosen channel. The SCAN switch initiates the scanning function. The AR-3300 is preset to scan in 100-Hz increments—the increment can be changed by pressing the appropriate frequency switch upwards while scanning. Pressing SCAN up causes the radio to scan from the lowest frequency to the highest; pressing the switch down causes the scan to move downward. Upon reaching the band limit, the scan automatically reverses.

There are four control knobs to the left of the frequency-entry switches: MICrophone GAIN, RF GAIN, SQuelch with an integral RESET switch and CLARIFIER. The CLARIFIER can vary the receive frequency ±500 Hz. The SQuelch can be used in all modes, and it is



Clear Channel Communications Ranger AR-3300 10-m All-Mode Transceiver, Serial No. 86021304

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 28.0000-29.9999 MHz.	As specified.
Modes of operation: AM, CW, FM, USB, LSB.	As specified.
Frequency display: Six-digit LED.	As specified.
Frequency resolution: 100 Hz.	As specified.
Frequency accuracy: 10 ppm.	As specified.
Transmitter	*Transmitter Dynamic Testing*
Power output: SSB, 25 W; CW, 30 W; AM/FM, 8 W.	28.0 MHz: CW 30.7 W, USB 27.0 W, FM/AM 8.8 W. 29.7 MHz: CW 17 W, USB 14.6 W, FM/AM 5.4 W.
Spurious signal and harmonic suppression: Greater than −50.	−55 dB. See Fig 1.
Third-order intermodulation distortion: Not specified.	−26 dB. See Fig 2.
Keying waveform: Not specified.	See Fig 3.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity: For 10 dB signal + noise + distortion/signal + distortion, SSB, CW 0.3 μV; FM 0.3 μV.	Minimum discernible signal, (noise floor, dBm): −135.
Receiver dynamic range: 100 dB (see text).	Blocking dynamic range (dB): 86. Two-tone, 3rd-order intermodulation distortion dynamic range (dB): 45. Third-order input intercept (dBm): −67.5.
	Receiver quieting (μV for 12 dB signal + noise + distortion / signal + distortion): 0.42.
Receiver audio output at 10% total harmonic distortion: Greater than 2.0 W.	2.9 W.
Color: Black wrinkle finish.	
Size (height, width, depth): 2½ × 8 × 10 in.	
Weight: 4 lb.	

used to start and stop the automatic scanning feature. The RESET switch on the SQUELCH knob is the on/off control for the radio's memory backup power. This control must be turned on to retain the memory information. If the control is turned off, everything saved in memory is erased.

To the right of the frequency controls are three push-on/push-off buttons that control the SPLIT feature. The SPLIT provides an offset between the receive frequency and the transmit frequency. With a 100-kHz split set, for example, the receive frequency might be 29.580 MHz, but when the push-to-talk (PTT) is pressed, the transmitter would automatically switch to either 29.480 or 29.680 MHz, depending on the position of the ± switch. The function of the SPLIT ON/OFF control is obvious, and the SPLIT LED in the top row of indicators shows when the SPLIT feature is activated. The first time the SPLIT PROGram switch is pressed after a RESET, the frequency display shows all zeros. The frequency offset is then selected using the frequency-select switches. The ± control selects either positive or negative offset from the *receive* frequency. The SPLIT feature is most often used on 10-m FM repeaters, but with some quick button pressing, it could be used for DX work.

The AF GAIN with its integral on/OFF switch and the mode switch are located under the split control push buttons. Five momentary-contact push buttons in the lower-center of the front panel control the memory and scan functions. MANUAL is used before starting or restarting several procedures. You must press MANUAL before directly entering a frequency, before entering a new upper or lower frequency range limit, and before beginning the procedure for storing frequencies in memory or setting frequencies for split operation. MEMORY scans the frequencies saved in memory. If SQUELCH is turned down (ccw), it scans to the next channel each time the button is pressed. If SQUELCH is turned up (cw), all memory channels are scanned automatically when MEMORY is pressed once. CANCEL clears the frequency that has been assigned to an indicated channel. ENTER directs the transceiver to accept the displayed frequency as the one you want to use. It is used to change the frequency range or save a frequency in memory.

The status LEDs in the top-right of the front panel provide the following information:

RX indicates transceiver is on and is in receive.

TX lights when transmitting.

SPLIT lights during split operation.

ST BY is not currently implemented. It will be used when accessories are available.

Channel LEDs (CH1-CH5) indicate frequency memory information. The LED flashes once when you save a frequency into memory, lights briefly as the channel's frequency is scanned, and lights when that frequency is being used. Two five-segment LED bar graphs display received signal strength (S3, S5, S7, S9 and +30) and transmitter output power (5, 10, 15, 20 and 25).

The dc power connector, SO-239 antenna connector, and jacks for a CW key and external speaker are located on the rear panel, together with a heat sink for the final amplifier transistors. No power supply is provided in the rig.

Thanks for the Memories

The AR-3300 provides five memory channels. Storing information in the memories is fairly easy. First press MANUAL, then select the frequency to be stored, and press ENTER once. The radio beeps and the display flashes once to acknowledge your action. You then select the memory channel number using the frequency select switches. Press ENTER again. Another beep, the display flashes twice and the selected memory LED flashes once. You can program up to five memories. Once the memories are programmed, you can scan them either automatically, or manually. To automatically scan memories, press MANUAL and press MEMORY once. Turn the SQUELCH clockwise until the audio noise is quieted, and the radio begins to scan through the memories. Memories that are not programmed are not scanned. To manually scan memories, press MANUAL and turn SQUELCH counterclockwise until squelch is broken, but not off. Press MEMORY. Each time you press MEMORY, the radio moves to the next channel in numerical order.

The scan function can also be used to scan the entire band or between two frequency limits. To program this operation, you press MANUAL and then SCAN PROGram. You may now select the scan increment you want (default is 100 Hz) by pressing the appropriate frequency select switch. Then press ENTER and the display flashes once. Now enter the lower frequency limit for the scan, and press ENTER again; the display flashes once again. Now enter the upper frequency limit and press ENTER again. The display flashes twice to indicate the program is complete. Turning SQUELCH clockwise and pressing the SCAN button starts the scan. When the squelch is broken by a station on a memory channel, the radio will pause at that frequency as long as the channel is active, then resume scanning.

There is no memory backup battery in the rig. Memory and scanning information can be retained, however, if the rig is turned off, but the power supply is still energized. The RESET switch on the SQUELCH must remain turned on—once it is turned OFF, all memory information is erased. This means that memory could be retained almost indefinitely in a mobile installation. Memory retention current is only 4.6 mA, so there is slight

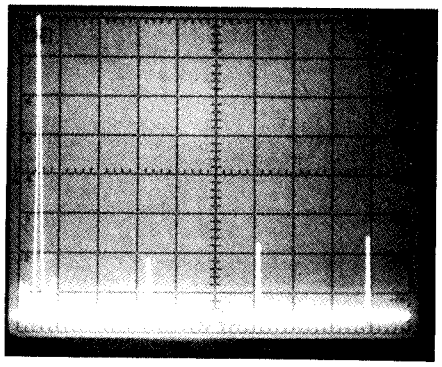


Fig 1—Worst-case spectral display of the AR-3300 operating on the 10-m band. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 27 W at a frequency of 28 MHz. All spurious emissions are at least 55 dB below peak fundamental output. The two taller pips on each side of the fundamental are mixing products, but are below the maximum level allowable under FCC regulations. The AR-3300 complies with current FCC specifications for spectral purity.

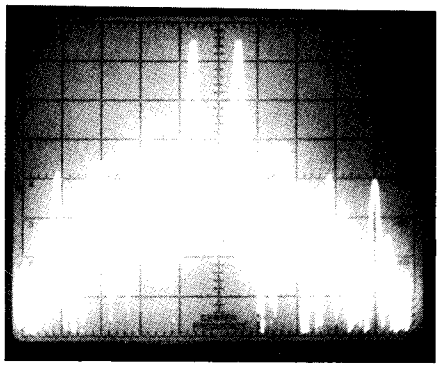
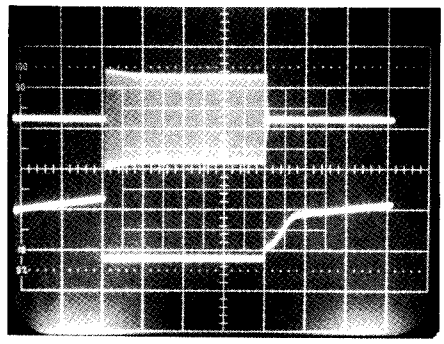
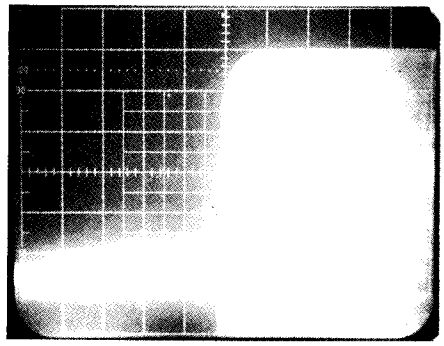


Fig 2—Spectral display of the AR-3300 output during transmitter two-tone intermodulation distortion (IMD) testing. The transmitter is being operated at rated output power on the 10-m band. Third-order products are 26 dB below PEP, and fifth-order products are 36 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz.



(A)



(B)

Fig 3—Keying waveform for the AR-3300. At A, the transmitter is operating at a power output of 25 W on 28.0 MHz. Each horizontal division is 5 ms. The bottom trace is the input key closure; the top trace is the RF output. At B, the waveform is shown in detail; each horizontal division is 10 μs. Because of the extremely short rise time of approximately 2.5 μs, this signal will cause key clicks and sound choppy. The optional semi-break-in keying accessory provides a much better keying characteristic.

danger of the radio discharging your battery overnight.

The Big Day Arrives

All of these features are nice, but what's the radio really like *on the air*? As the Novice Enhancement weekend drew closer, I became less and less sure of myself. What would I say on the air? Who would I talk to? When Friday, March 20, 7 PM EST arrived (0001 UTC March 21), we tuned the radio up and down the 200-kHz Novice phone subband, looking for just the right QSO. Ah...there's WB1AVA, Virginia Greene, calling CQ...a nice loud signal. I gave her a quick, nervous call and I was off! This wasn't so hard! She sounded good, said I sounded good, and we talked for a few minutes about nothing in particular. When she told me she had to go grade some school papers, I was glad for the break and the chance to regain my composure. I worked a few other stations that evening, then sat down to start writing this review.

Other Modes

The AR-3300 can also be used on FM and CW. Because Novices have no 10-m FM privileges, and I have little CW skill, I let my husband try the rig out on 10-meter FM. He was able to work easily through a local FM repeater about 10 miles away, even though we were using an inverted V antenna cut for the low end of the 10-meter band. Some other hams he talked to told him that the audio sounded a bit "muffled," but this may have been the result of the hand microphone supplied with the radio. He was also told that the radio sounded like it might be overdeviating. The deviation was about 5 kHz when checked in the ARRL Lab.

The rig *works* on CW, but it has a few interesting quirks. The CW key jack is a shorting type. Normally (with no plug in the jack) the CW key line is shorted to ground. When the key is inserted, the radio will not work in SSB unless the key is closed. The radio cannot be keyed in CW unless the PTT switch on the microphone is pressed. This leads to a very interesting two-handed CW operating position, and QSK is not an option with this arrangement. The other interesting thing is that CW operation is hardly mentioned in the operating manual. The CW position on the mode switch is mentioned, and the power output in the CW mode is specified, but there is no explanation of the PTT/CW key interaction. Bruce thought the microphone had inexplicably gone dead—with the CW key plugged in, you can key the rig with the microphone PTT, but the microphone audio is not connected unless the CW key is down! This seems like a rather poor design arrangement—possibly CW operation was added as an afterthought so that the rig would be "all mode." As I said, it does work after a fashion on CW. There are no CW filters, however, so the received bandwidth is a rather wide 4.2 kHz.

Problems

In addition to the CW keying problems, we noted a drop in power output at the upper end of the band. There was also a mechanical stability problem. Bumping the radio causes the frequency to vary noticeably, whether in receive or transmit. We contacted the manufacturer and requested information about these problems. The Clear Channel engineer advised us that the problems with instability had been noted on a few units, and that they were working on them. He also acknowledged the cumbersome CW method, but explained that their feeling is that most operators would not work CW very much, but would probably use the rig in a mobile phone application. When we pointed out that this radio might appeal to a large number of Novices, either as a supplement to their HF CW stations, or as an "one and only" rig for some, the engineer promised to address both subjects.

The next day he phoned us and advised that an auxiliary circuit board had been designed, incorporating semi-break-in CW keying. The accessory unit will soon be available at a low cost (around $10) for anyone who desires better CW performance. For those owners who choose not to purchase the auxiliary board for CW, a modification will be made to correct the extremely short rise and fall time of the keyed waveform. In addition, they redesigned the VCO and now use a potting compound rather than the beeswax we noted in the original unit, and added vibration and shock damping to the circuit board/cabinet interface. This improves the instability problem by reducing any movement of components on the board.

Clear Channel sent us a modified unit by air. During testing of this modified unit, it provided 30 W across the band. The mechanical stability problem had vanished—a slight warble under direct beating with a screwdriver was the worst we could find. The keying interface improved the keying characteristics, and we pointed out some additional improvements that Clear Channel has agreed to make. In addition, they will provide update information to present owners, and will automatically update any unit returned to their facility, even if it is out of warranty. They state that the updates will be performed in 48 hours, or less.

Clear Channel claims a receiver dynamic range of 100 dB. We were unable to verify this figure. We discussed this with Clear Channel, and they admitted that they may have been a bit optimistic in their specification. The receiver is extremely sensitive (MDS of −135 dBm), and the blocking dynamic range we measured in the ARRL Lab (86 dB) indicates that the receiver is certainly adequate for the intended use. Clear Channel has indicated that they will revise their dynamic range specification to a more realistic value.

The operating manual is a bit light for an all-mode rig. The manual covers SSB operation fairly well, but there is only brief mention of the other operating modes. A schematic is included with the manual.

The Bottom Line

As a Novice, this is a fun radio for me. It is physically small and less intimidating than some of the other rigs I have seen. Once I got used to the frequency-entry switches, they were not too difficult to use, although I think I would prefer a tuning knob. The switches may be more appropriate for mobile use, and the frequency memories would certainly be useful in a mobile installation, as are the scanning features. This rig might be just the thing for a Novice looking for a single-band mobile rig, or a rig to use on 10-m FM after upgrading to Technician. There are used five-band transceivers on the market for about the same price as this rig new, however.

The Clear Channel warranty is an attractive plus for this rig—one year on parts and labor, and Clear Channel maintains a computerized owner data base for free update information about the rig. Any rig returned for updates will be modified and returned within a 48-hour period, even if the warranty has expired.

The Clear Channel Ranger AR-3300 is available from selected dealers; for information, contact Clear Channel Communications, PO Box 445, Issaquah, WA 98027, tel 206-392-0419. Suggested price: AR-3300, 30 W, $499.95; 100-W model, $630.—*Leslie K. Bartoloth, KA1MJP*

PAC-COMM TNC-200 TERMINAL NODE CONTROLLER

Like many others, I am curious about packet radio. In addition, I am tired of referring questions about packet to others in the Technical Department at ARRL HQ. I thought that my curiosity could be satisfied, and my knowledge broadened, if I would obtain a Terminal Node Controller (TNC) and experiment with this popular new operating mode.

There are many different TNCs available. One of the more popular is the TNC 2 that was developed by Tucson Amateur Packet Radio Corp (TAPR). TAPR designed the TNC 2 and produced a small quantity of kits, but then returned to research and development. Under license from TAPR, several commercial suppliers offer their versions of the TNC 2. Pac-Comm is a major supplier of TNC 2 kits, and seemed a good source for my kit. Similar TNC 2 kits and assembled units are available from Heath (HD-4040, Product Review, *QST*, Nov 1985), and MFJ Enterprises (MFJ-1270, Product Review, *QST*, Sep 1986). Additional information about packet radio and equipment has been published recently in *QST*.[1-3]

The Kit

When my kit arrived, an inventory revealed one group of resistors with incorrect values, and a package of capacitors and some semiconductors missing. A telephone call to Pac-Comm resulted in prompt, courteous service and quick shipment of the missing parts. The kit consists of good quality parts, and includes a rather thick loose-leaf instruction book with a small errata sheet. The solder-masked epoxy circuit board has plated through-holes and silk-screened part locations. In addition to the parts necessary for constructing the TNC, the kit includes a coaxial power plug and a 5-pin DIN plug for the radio connection. The builder supplies the RS-232-C plug and dc power (10-15 V, 250 mA for the NMOS version; 135 mA for the CMOS). The instruction book is clear and concise. If you have successfully built a Heathkit, you should have no problem in assembling the TNC-200.

The Pac-Comm version of the TNC 2 is painted an attractive light blue with dark blue front and rear panels with white stripes and lettering. Front-panel LEDs indicate PWR on, CONnection to another station, DCD on, PTT (transmitter keyed) and STAtus (indicates that a packet has been sent but not acknowledged by the receiving station). The rear panel has connectors for the RS-232-C interface (DB-25S), radio (5-pin DIN), dc power (coaxial jack) and a push-button power switch.

[1]H. Price, "What's All This Racket About Packet?" *QST*, Jul 1985, pp 14-17.
[2]H. Price, "A Closer Look at Packet Radio," *QST*, Aug 1985, pp 17-20.
[3]S. Horzepa, "The Shopper's Guide to Packet-Radio TNCs," *QST*, Mar 1986, pp 17-21.

The TNC-200 uses a Zilog Z80® microprocessor and a Z80 SIO to perform the serial-interface and packet assembly/disassembly tasks. Modem functions are handled by an MF10 switched-capacitor filter, an XR-2206 modulator and an XR-2211 demodulator. There are 32 kbytes of ROM and 16 kbytes of battery-backed RAM, with the option of increasing RAM to 32 kbytes.

Construction

I assembled my kit at home. Except for one problem (which resulted from my poor choice of work area), the assembly was quick and easy. Some of the resistor color codes were difficult to see under normal levels of incandescent lighting. As a result, I installed about a dozen resistors in the wrong locations. If I had been in a well-lit work area, or confirmed resistor values with a multimeter, I could have prevented the problem.

Testing

Although I assembled the kit at home, it was more convenient to do the initial testing in the ARRL Lab. I had ordered a serial interface board for my Apple® computer, but it hadn't arrived yet.

The Pac-Comm test procedures are straightforward and thorough. There was a problem with the negative supply in my kit, however. The troubleshooting instructions led me to the problem, and a check with an oscilloscope revealed a faulty LM556 IC, a common and inexpensive part. I replaced it with a locally procured part rather than call Pac-Comm. The TNC-200 worked fine once the faulty chip was replaced. While waiting for my serial interface board, I connected the TNC-200 to a Xerox® 820 computer in the lab for further tests and alignment. The TNC operated perfectly once the communications program parameters were set as specified in the TNC-200 instructions.

The TNC has onboard software for counting the modem tone frequencies, but the instructions suggest using a frequency counter if one is available. When I connected the lab's frequency counter, however, its reading differed greatly from the software indication. Jon Bloom, KE3Z, the ARRL Laboratory Supervisor, warned me to expect false count problems because I wasn't in the lab's 100-dB isolation RF-screened room. (The counts could be off because of RFI from W1AW, across the parking lot.) I opted to trust the software and test it "under fire." There have been no subsequent problems and the TNC has performed flawlessly in all my work on the air, so the software frequency counter must have been correct!

Computer Interface

When my serial interface card arrived, I installed it in an Apple//e at ARRL HQ, and connected it to the TNC. We use a terminal program named ASCII Express™. At first I could copy only about half of the TNC sign-on message. I installed a break-out box in the RS-232-C line, and saw that the Data Carrier Detect (DCD, pin 8 of the DB-25 connector) line went to a false condition when the sign-on message stopped.[4] My terminal program would not connect to the TNC unless that line was held true. Jumper 1 in the the TNC-200 sets DCD true permanently, but I wanted to conveniently change the DCD connection without opening the TNC cabinet. My solution is an eight-circuit DIP switch epoxied into the DB-25 connector hood at one end of the cable. The frame and signal grounds are always connected, but I can switch each of the eight data lines at will. When I open the DCD line, the sign-on message can proceed.

The Reference Manual and Operation

The Pac-Comm instruction book actually includes two manuals. Assembly instructions appear in the back portion of the book (35 pages), while the front portion contains the 63-page TNC-200 Reference Manual.

To the casual observer, it must look as though the packet-radio operator simply keys copy into a terminal, and reads the return message. The success of packet-radio operation, however, depends on several control parameters being programmed into the TNC before operating. Therefore, the most significant factor in successful packet-radio operation is the operator's understanding of the TNC commands and their effects.

Chapters 1, 4 and 6 of the Reference Manual, together with a command reference sheet, contain the information necessary to interface the TNC and begin simple packet operation. Chapter 6 explains the TNC command set in depth (it takes 21 pages!), and explains the messages from the TNC to the operator. The separate command reference sheet gives only the operator commands, brief descriptions, mnemonics and default settings.

Chapter 5 covers binary file transfers, multiple connections and HF packet information. Binary file transfers may contain characters that would normally be interpreted as TNC commands. Special techniques allow such files to be transferred without affecting TNC operation.

The current implementation of the AX.25 protocol permits only two-way communication, but it allows a station to make several two-way connections simultaneously. For example, my station, KU7G, can be connected to Jon, KE3Z, and I can add another connection to George, NA1F. I can "speak" to either Jon or George at my whim, but neither can copy any part of my conversation with the other (unless they are monitoring *all* transmissions on the frequency). The TNC accomplishes this by allowing the operator to select one of 10 possible "streams." The 10 streams are designated A through J. A user-defined command (the default is "|") allows the operator to switch streams. This is best explained by the following example. When I turn on my TNC-200, it is on stream A, as indicated by the first two characters of the sign-on message, "|A." I connect to KE3Z and the CON LED lights. At this point, I can enter the command mode by entering CONTROL C, then type the stream-switch command, "|", and an identifier for the new stream (A-J). Let's use stream B. Once I type "|B", I'm on stream B (CON goes out because stream B is not connected). I can then connect to NA1F (CON lights again for stream B). The exchange looks like this:

cmd: C KE3Z	
***Connected to KE3Z	(CON lights)
(CONTROL C)	
cmd: |B	(CON goes off)
|B cmd: C NA1F	
***Connected to NA1F	(CON lights)

To enable multiconnect operation, the USERS command must be set to a number between 2 and 10.

The TNC-200 may be modified and adjusted for OSCAR or HF use, but the process is lengthy. It is best to use an external modem if you wish to switch often between HF and VHF packet operation. An external modem may be connected through the TNC circuit board (the connector is not supplied, although the circuit board has holes drilled for one).

The balance of the reference manual includes information about hardware, troubleshooting, packet protocol and a short bibliography. Hardware is described at the block level, with additional sections about RS-232-C handshaking, jumper functions and pinout descriptions of the various connectors. The troubleshooting section is short, and it assumes that the builder has a basic knowledge of digital-circuit troubleshooting techniques. There are no troubleshooting charts or voltage tables.

Conclusion

I am happy with my TNC-200 from Pac-Comm. It is a straightforward reproduction of the TAPR TNC 2, and performs as well as the original. It is available in several forms—as partial kits, complete kits and assembled units.

The TNC-200 is available from Pac-Comm Packet Radio Systems, Inc, 3652 West Cypress St, Tampa, FL 33607, tel 813-874-2980. List prices: CMOS kit with cabinet, $169.95; NMOS kit with cabinet, $154.95; Pac-Pro terminal software for the IBM® PC and compatibles, $29.95; terminal software for the Apple Macintosh, $49.95.

—Bob Schetgen, KU7G

[4]A break-out box is a device that allows measurement of the status of each communication line in a typical RS-232-C connection (9 or 24 lines plus frame ground). Construction details for a break-out box appear in Chapter 29 of *The ARRL Handbook.*