73 Review *by Tom Gilchrist N7KHU*

The Heath HK-21 TNC

Hand-held TNC!

When I saw the ad for the Heathkit HK-21 TNC, I knew I just had to have one. Heath calls the HK-21 a "Pocket Packet" for a very good reason. It's a compact, self-contained TNC with a built-in personal packet bulletin board system (PBBS). It was just the excuse I needed to put together a portable packet radio system.

The system I finally built fits into a molded equipment/camera case, just the right size to take on vacations, business trips, or whenever I want to operate packet away from my base station.

Hardware Features

Heathkit sells the HK-21 already assembled. It's just as well, since, after looking inside, I'm not sure my hands would be steady enough to put this one together. Photos A and B show the main board, with ICs mounted on both sides.

The system is built around a Z-80A, software compatible ASIC (Application Specific Integrated Circuit). This 100-pin pack is soldered on the back of the main board (Photo B) and contains enough smarts to keep the total chip count of the TNC to only 9 packs. The other card is only half as long as the processor card and contains the modem and 5 volt DC power supply.

One of the first reasons to consider the HK-21 is its size. It measures 2½" wide x 1" high x 4¼" long with no cables plugged in. Add another two or three inches to cover the RS-232 DB-25 male plug on the back and the radio connection cable on the front.

With the internal battery pack, the unit weighs about 5½ ounces. The TNC is smaller and lighter than almost any 2 meter hand-held (HT). I added a strip of hook-and-loop fastener to the bottom of the HK-

21 and to the back of my HT, and mounted the TNC to my HT (see Photo C).

While the compact size and weight are two of the most obvious visual features, the HK-21 has a number of internal features worth mentioning.

An Inside Look

First, the unit draws very little current. In standard 12 volt DC use, it draws a little less than 40 mA. This makes the unit just right for battery and solar applications. It works with external voltages from 10 volts DC to 13.8 volts DC.

The optional internal NiCd battery pack is rated at 120 mAh and is charged whenever external power is applied. In my system, the internal battery lasts for three to four hours of continuous use. This is more than enough time to go through two battery packs on my HT and just about the time it takes to deplete the NiCds in my Model 102.

Figure 1 shows the details of the front panel. There are two DIP switches on the panel which will turn off the power to the status LEDs and the RS-232 port. Turn off the LED switch to save battery juice. The RS-232 switch turns off the MAX-232 chip in the unit which converts the TTL serial level of the TNC processor chip to the +/− 12 volt DC RS-232 levels. Using the internal HK-21 PBBS software, you can turn off the MAX-232 when you are using the HK-21 as a dedicated digipeater or PBBS. I did a test that showed that turning off the LEDs adds up to 30 to 45 minutes to the life of the internal battery.

In my portable unit, I usually use an external

12 volt 2.5 VA Gel-Cell to power both the HT and the HK-21, so saving a few mA is no big deal. Also, I am used to watching the LED status indicators. Because the HK-21 uses differently colored LEDs for each status indicator, you can read the TNC status at a glance.

There are also two radio connections on the front panel. The first uses a small telephone handset cord plug and includes the audio IN/OUT and PTT control lines. The unit has a miniature and subminiature plug for HTs.

The terminal connection uses a DB-25 connector and can be attached to a terminal or computer using an RS-232 level. The HK-21 cannot directly interface with TTL levels. Both *Xon/Xoff* software and RTS/CTS hardware flow control are available. The flow control will
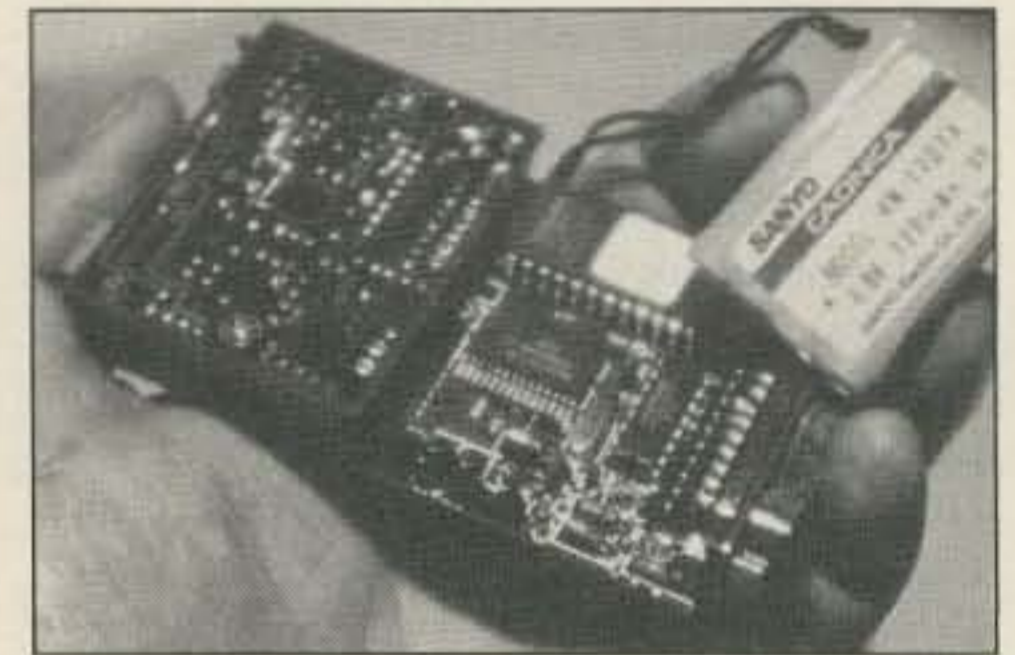

Photo A. Inside the HK-21.

help you keep from losing characters when transmitting and receiving.

Software Features

The HK-21 uses AX.25 software which you can set for the current level 2.0 protocol or the older Level 1. The unit is designed for 1200 baud VHF and UHF only; it will not work for 300 baud HF.

The manual states that the TNC uses the standard TAPR TNC-2 commands and is upload compatible. That is, if you have special terminal software designed to interface via TAPR TNC-2 standard commands, it should work.

The unit has an auto baud rate configuration for cold startup to get your terminal working with the TNC. Once you have the right baud rate, you can set the TNC to remember it on subsequent startups. The unit has a small internal memory backup lithium battery (not to be confused with the optional internal NiCd) which keeps your default command settings and PBBS data from disappearing when either the external or internal battery fails or is disconnected. The system has 32K of ROM
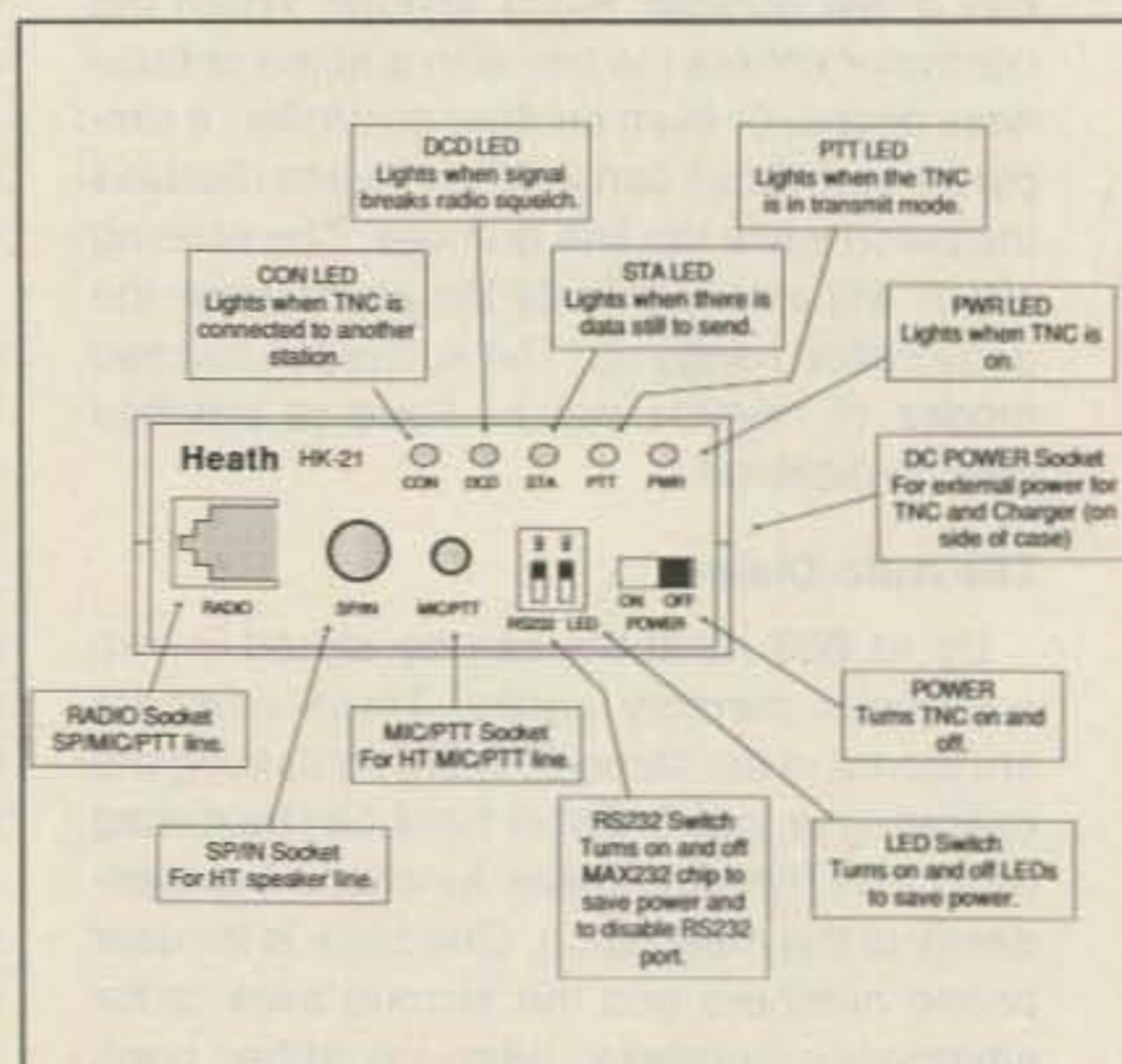

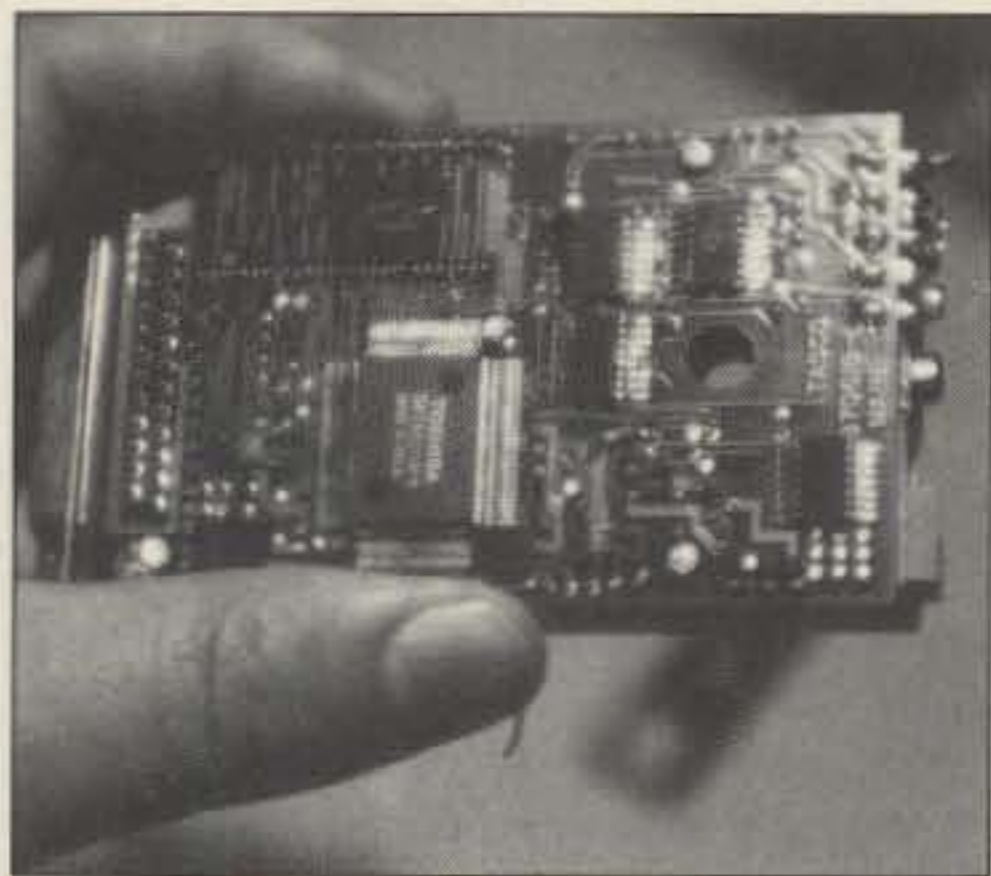*Figure 1. Details of the front panel of the HK-21.*

Photo B. The brains of the unit—the Z80A.

and 32K of RAM. The ROM contains the AX.25 and PBBS software (version 1.17 on my unit). The 32K of RAM contains, among other data, the system scratch pad memory, user command defaults, I/O buffers, PBBS data.

The PBBS

The personal Packet Bulletin Board System (PBBS) on the HK-21 is quite complete. You can post and retrieve personal and public messages. An outside computer isn't necessary; software and the storage of messages is part of the HK-21.

The system has about 15,000 bytes of storage for messages. Most of the messages I have on my system average about 225 bytes each. Based on this, the system will store about 65 messages. I don't think there is an upper limit to the length of a message, so a few long messages or computer listings could use up the memory. The unit was designed for a
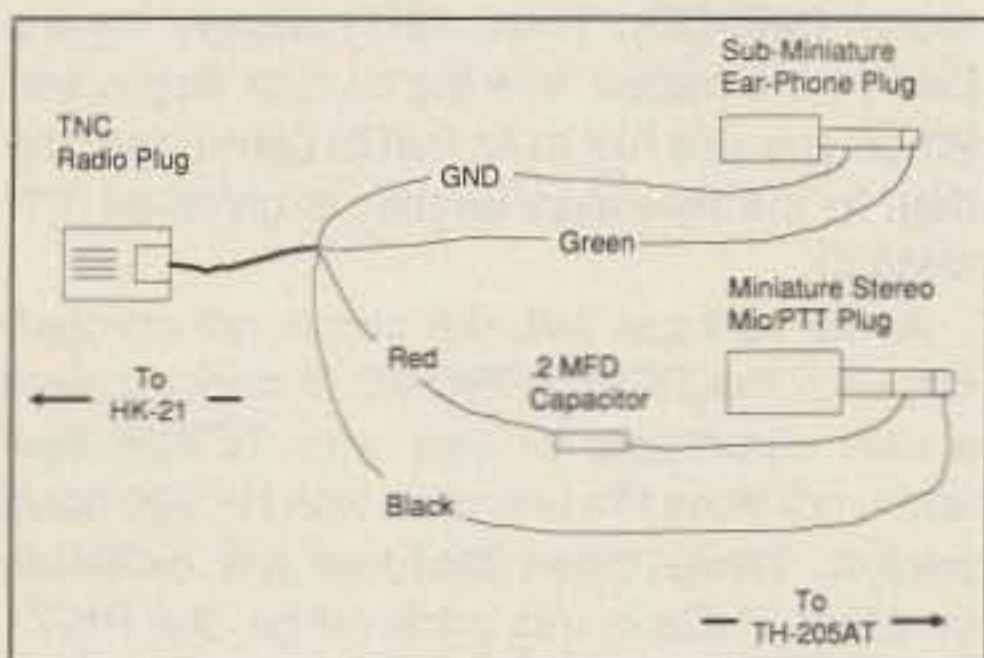

Figure 2. The TNC and HT work together by means of a telephone jack.

small personal PBBS, rather than a large, hard disk computer system.

PBBS Commands

The table lists and describes the PBBS commands. The local terminal can use all the commands except HELP and BYE. If you have loaded the DAYTIME command with the current time and date at power-up of the HK-21, each message will be time-stamped. The time and date is kept by the computer within the HK-21, so when the unit is off, the current time and date information is lost. If you don't enter the correct time before connecting and sending (WRITE) a message, the time and date stamp will not be automatically attached to the description.

The PBBS has a callsign of its own. You set

it up with the MYMCALL command. While it can have the same call as the MYCALL port, I find it is better to use a substation ID (SSID). I set my MYCALL to "N7KHU" and my PBBS MYMCALL to "N7KHU-1." This way someone else can use the PBBS while I am connected to other stations.

The PBBS can be activated and deactivated at any time on the local terminal by using the MBOD command. The PBBS does not lose any messages when it is turned off.

One of the nice features of the HK-21 is that you can store a message in the CTEXT buffer and instruct it to automatically disconnect after transmitting. A CTEXT message I sometimes use is: "I am not available, please connect to N7KHU-1 and leave me a message—73"

Before I go out, I set CMSG ON (send the CTEXT message) and CMSGD ON (disconnect after sending the CTEXT message). When a user connects to my node (C N7KHU), he gets the message in CTEXT, then he is disconnected. He then can connect to the PBBS (C N7KHU-1) and leave a message by typing W N7KHU. When I return home, I can turn on my local terminal and type MINE or MI to see if there are any messages, and use the R n (where n is the message number) to read the message. To delete a message, you use KILL n. Of course, you can connect to the PBBS via another packet radio system and list, read, and delete your messages. When you want to allow users to connect again, simply type CMSG OFF and CMSGD OFF.

Just like a large BBS system, the HK-21 PBBS keeps mail private. If you send a message to a specific call, only the sender and the receiver can read or kill the message over the air (however, the local terminal attached to the HK-21 can access and delete any message regardless of the sender and receiver callsigns). For public bulletins or messages, you can W ALL. Any station which connects to the PBBS can list and read public messages.

The HK-21 Manual

Heathkit documentation is known to be a cut above the ordinary. The HK-21 manual is one of the best TNC manuals I've seen. It is oriented to the new-to-average user of packet.

The first 30 pages tell you how to hook the TNC, radio, and computer or terminal together, and they give you tutorial sessions using all of the common commands. The bulk of the manual, 54 pages, details each of the HK-21 commands and their defaults, and describes how they work. The last few pages include a short troubleshooting table, command summary, schematic, and index.

The manual does not go into technical detail about packet radio or packet standards. To understand and use packet, you have to read some of the good books and magazine articles available on the subject.

I did find that the hook-up procedure for my Kenwood HT was not correct in the manual. I have a new TH-205A and it will not work with the directions given for Kenwood radios. This might be because the TH-205A is not like other Kenwoods. However, the general information and schematics were enough to get me

by. See sidebar about the portable packet station using the TH-205A HT and the Tandy Model 100/102 laptop.

The schematic is very easy to read. The one drawback I found with it is that it should include placement of the jumper pads. Without this information, it's very difficult to tell the relationship between the PC board layout and the schematic.

The standard 8½" x 11" size of the three-ring binder makes the manual easy to copy and put in a binder with other equipment manuals and documents. The quality typesetting, graphics, paper, and printing give the manual a professional appearance. I always feel uneasy somehow about manuals printed by dot matrix.

Connecting the Radio

There are two ways to connect a radio to the HK-21. There is a miniature and subminiature phone jack intended for HT use. The PTT (push-to-talk) line is part of the microphone circuit. The second connection uses a small,

Photo C. The HT and TNC fastened together. Note the phone jack.

4-conductor phone plug (like the size used on a phone handset). This connector allows you to have separate PTT and MIC lines. This socket is intended for non-HT installations. In my case, I got my TNC and HT to work together using the telephone jack shown in Photo C. I used a small plastic barrel from a phono plug to house the 0.2 μF capacitor and to make the connections from the supplied HK-21 cable to the MIC/PTT and speaker cables (see Figure 2). Then I wrapped the barrel with electrical tape.

The computer cable I used for the Model 102 computer only needs lines 1, 2, 3, and 7 (pin 1 to 1, 2 to 2, etc.) because the internal TERM (terminal) program on the Models 100/102 is designed to handshake only with Xon/Xoff protocol. If you need to use the hardware
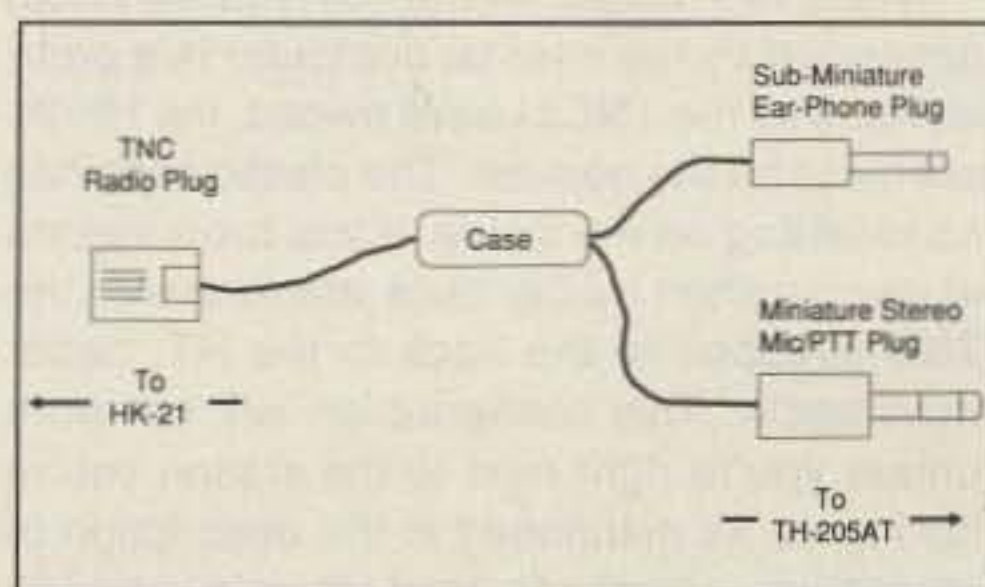

Figure 3. The TNC/HT interface physical layout.

flow control, you will need to use more lines. The HK-21 manual has instructions for most popular computers.

I use 1200 baud by setting the TERM STAT to "57E1E" on the Models 100/102 and setting ABAUD on the HK-21 to 1200. You can stop and start the display by entering CRTL S and CTRL Q in sequence.

There is one small problem with this system. The display will sometimes stop by itself. When this happens, the computer doesn't seem to want to talk to the TNC. If you type CTRL Q, the display will start again. This happens because the display on the Model 100/102 will not always keep up with 1200 baud packet. The computer automatically sends out an *Xoff* (CTRL S) when it needs to catch up. It then automatically sends an *Xon* (CTRL Q) when it is ready for more characters from the TNC. This seems to work just fine most of the time but, once in a while, either the computer doesn't send the *Xon,* or the TNC doesn't see it. The TNC just keeps waiting until you manually type CTRL Q.

The TERM software in the Model 100/102 allows you to upload and download ASCII text. You can also print out a hard copy. You can store files on a cassette tape or save them to disk with a 3½" disk drive.

Concerns and Suggestions

As nice as the HK-21 is, there are a few "gotchas" that you should be aware of. Most are minor, some have to do with my preferences, and some might already be history by the time you read this.

First, my HK-21 came with mounts for the DB-25 connector hood that had the wrong threads. I informed Heath, and they sent me the right bushings. I don't know why I bothered to put the new bushings on; I don't screw the DB-25 hood on anyway! The HK-21 is so small and light, it will follow the connector and cord anywhere it wants to go (with or without the screws tightened).

The second problem was more serious. I was not able to use the TNC in my portable system on 145.01 because of a "birdie" or spurious signal introduced by the TNC into the HT radio. I found I could solve the problem by attaching an antenna mounted far away (like on the roof of the house). However, this was not suitable for portable and mobile use.

Contact with Heathkit produced the fix of putting a 5 pF capacitor across the 4.915 MHz crystal (connected to pins 65 and 66 of the IC-8 processor). This has allowed me to work the 144.99 and 145.01 MHz frequencies in my area. The birdie now shows up on 145.00, away from any packet frequencies.

While RFI (radio frequency interference) generated by the internal computer is a problem with all the TNCs I have owned, the HK-21 seems to be the noisiest. The plastic case has no shielding on the inside. If you have visions of using a short rubber duck antenna with the TNC strapped to the back to the HT, better think again. This configuration will not work unless you're right next to the station you're talking to. As mentioned in the description of my system, a more practical set up is to use an antenna a 3–12 foot distance from the HT,

Command	Mnemonic	Terminal *	Description
DAYTIME	DA	LOCAL	Used to set current time and date.
MYMCALL	MYM	LOCAL	PBBS call sign (and SSID)
MBOD	MB	LOCAL	Turn PBBS on and off.
BYE	B	RADIO	Log off PBBS.
MINE	MI	BOTH	List messages which are to you or from you. Gives message number, subject, time, and call (10 at a time).
FILE	FI	BOTH	Same as MINE except all messages are listed.
HELP	H	RADIO	Displays HK-21 PBBS help file.
?	?	RADIO	Same as HELP.
KILL	KI	BOTH	Kills a given message (by message number). Use a "%" or "&" instead of message number to kill oldest 10 messages.
READ	R	BOTH	Read a given message (by message number)
WRITE	W	BOTH	Write a message to a given station (by call sign). If no call sign given, message is to "ALL".

* TERMINAL Codes

LOCAL: Only computer or terminal attached to HK-21 RS-232 port can use this command.
RADIO: Only remote station using packet radio can use this command.
BOTH: Command can be used from either LOCAL or RADIO terminal.

NOTE: Mnemonics only used in LOCAL mode. The first letter of each command is used while remote station is connected to RADIO. Also, LOCAL mode inactive while a station is using the PBBS on RADIO.

The PBBS commands, with descriptions.

TNC, and computer. The farther away the antenna, the better the performance.

In my unit, I had some problems with the system memory losing its mind from time to time. I would lose all my PBBS messages and I would have to re-enter all my defaults. After this happened a few times, I looked inside and discovered that the battery had a loose connection to the PC board. After a quick solder job, the problem was fixed. The lithium battery should be good for at least 5 years.

There are small inconveniences one will find with any product this complex. However,

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"The system is built around a Z-80A, software compatible chip."

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there are two hardware features I find really annoying. First, the external power plug is on the side of the unit. For mounting in my case, it would have been better positioned on the back or the front of the TNC. In defense of the designers, I can see that the DB-25 plug takes up space on the back and the front panel is full! This brings me to my other annoyance.

Why did the designers use a standard DB-25 on the back of the unit? It adds two inches to the length of the unit. A telephone plug similar to the radio input on the front would have been perfect.

The HK-21's software has been exceptionally dependable. The unit has never tripped off

into never-never land. However, some small quirks are worth mentioning. First, you can change the date from MM-DD-YY to DD-MMM-YY with the DAYUSA command. This is used in the MHEARD list and for time-stamping packets. However, the command does not change the date format in the PBBS. This is especially confusing because, when you list messages with the FILE or MINE PBBS commands, the headers only show the day and month (MM/DD). Thus, 12/11 always means Dec 11, no matter how the DAYUSA flag is set. When you use the READ PBBS command, the date in the message header is given as YY/MM/DD.

As far as I can tell, the unit is not compatible with Net-ROM EPROMS. It doesn't have a KISS command for use with TCP/IP systems, nor does the unit work with HF 300 baud packet. While these features are available on other TNCs in this price range, the HK-21 was clearly intended to surpass the size, weight, and current consumption of the competition.

Support

I have contacted Heathkit twice about my HK-21, once by letter (phone lines were busy all afternoon) and once at the ARRL Convention in Portland, Oregon. Both times they were able to answer my questions and solve my problems quickly. I have been happy with the quality of the product and the service.

As far I as know, at $219.95, the HK-21 is the most expensive UHF/VHF single radio TNC on the market today. Add another $17.95 for the HKA-21-1, an optional internal battery pack. If size, a built-in battery pack, low current consumption, and a built-in PBBS are features on the top of your list, you might well feel it is worth the price. I did. For me, the HK-21 is the perfect TNC for my portable packet station. 73