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QEX 107

WITH Gateway

ARRL Experimenters' Exchange

JANUARY 1991

PACKET RADIO

AND THE GENTLE ART OF HOME-BREWING

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Purposes of *QEX*:

1) provide a medium for the exchange of ideas and information between Amateur Radio experimenters
2) document advanced technical work in the Amateur Radio field
3) support efforts to advance the state of the Amateur Radio art.

All correspondence concerning *QEX* should be addressed to the American Radio Relay League, 225 Main Street, Newington, CT 06111 USA. Envelopes containing manuscripts and correspondence for publication in *QEX* should be marked: Editor, *QEX*.

Both theoretical and practical technical articles are welcomed. Manuscripts should be typed and double spaced. Please use the standard ARRL abbreviations found in recent editions of *The ARRL Handbook*. Photos should be glossy, black-and-white positive prints of good definition and contrast, and should be the same size or larger than the size that is to appear in *QEX*.

Empirically Speaking. . .

Let Not the Light Be Hid from Their Eyes

With that King James type of title, you're probably wondering whether this is about semaphore or even laser communications. Naw. The topic is getting information out to the public and, more particularly, telecommunications professionals about the technical achievements of Amateur Radio. Hams in the industry are helpful in explaining the ongoing technical contributions of amateur and amateur-satellite services. These individuals are often *gateways*—people who serve as conduits between their groups and outside groups. Many a ham has taken a bit of Amateur Radio technology and applied it to problems on the job, and vice versa. These occurences are too many to document.

Unfortunately, this doesn't do the whole job. There are people in the telecommunications business who do not understand the contributions of radio amateurs. Some have a vague idea of past achievements, but figure that the day of hams experimenting must be long gone. In 1990, one magazine characterized the amateur-satellite program as a best-kept secret. Certainly the Amateur Radio press was bristling with news about the seven amateur satellites launched in 1990. And news releases about the constellation of ham satellites went to major magazine publishers who normally carry telecommunications and aerospace happenings. CNN carried it. Neither AMSAT or the ARRL were *trying* to keep it secret. Perhaps we should learn something from the military—they try to keep their satellite launches secret but hit every newscast for two or three days and get their systems featured in aerospace magazines. The topping on the cake is a hardbound technothriller followed by the softbound edition, then a movie. The joking comment often heard in the government or companies who work on these projects is that it was so secret that I didn't know what I was doing. Of course, if we *try* to keep things secret, we could run the risk of succeeding, which could leave us without even the satisfaction of "we told you so."

The Shuttle Amateur Radio Experiment (SAREX) has fared a bit better in the press. While those involved may have thought only about contact scheduling, the hardware, software, antenna placement and link power budgets, the STS-35 mission SAREX program was also an opportunity for school children to talk to an astronaut. Newspapers saw it as a human-interest story and some gave it page one coverage with color photos.

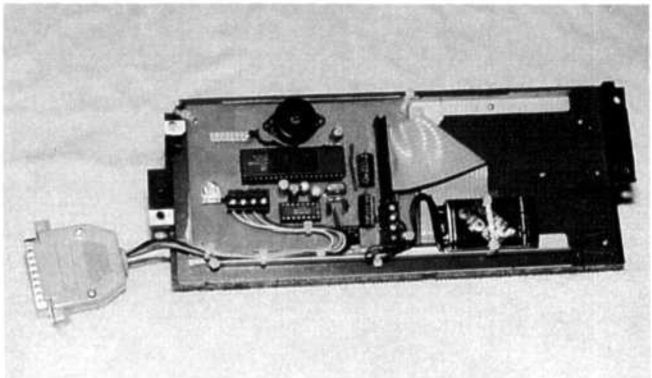
In December, 1990, AMSAT made presentations to some Federal Communications Commission and National Telecommunications and Information Administration officials. AMSAT had prepared a special booklet with color photographs and salient data on past and proposed amateur satellites. AMSAT plans to brief other key telecommunications people in Washington in January, and possibly later during 1991. These presentations are well-timed to get the amateur-satellite service's message out to the regulators while they're preparing for WARC-92.

ARRL has been continually active in getting the story of Amateur Radio's technical achievements to the US Government and the International Telecommunication Union. President Larry Price, W4RA, is a regular visitor to Washington for high-level meetings with government officials. Vice President David Sumner, K1ZZ, meets with frequently with government officials and members of the FCC's Industry Advisory Group for WARC-92 (IAC). ARRL Washington Area Coordinator Perry Williams, W1UED, makes the rounds in Washingtion for several days of every week to meet with the FCC, NTIA, FEMA, DOD and many other letters of the alphabet. Paul Rinaldo, W4RI, has been in Washington almost every week in various working groups of the International Radio Consultative Committee (CCIR) and FCC IAC, and has been in Geneva and Helsinki for CCIR Interim Working Parties preparing for WARC-92. Chuck Dorian, W3JPT, as Assistant Washington Area Coordinator, attends CCIR, CITEL (Inter-American Telecommunications Conference) and other meetings in Washington. The ARRL has been represented at, and contributed papers to, every working group meeting that could possibly have an effect on amateur or amateur-satellite service allocations at WARC-92. At the national and international levels, the ARRL and the amateur services are well known among

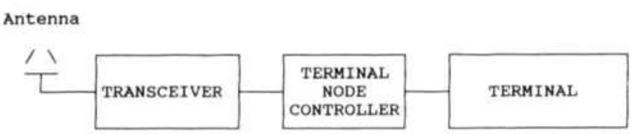
continued on page 23

Low-Power Portable Packet Terminal

By Steven Avritch, WB1EOB
21 Morningside West
Bristol, CT 06010



Packet radio is fast becoming a very popular mode of communication in the amateur community. It enables amateur operators to communicate via a digital link with virtually error-free results. Packet radio requires three basic components as shown in the figure below:



The Terminal Node Controller (TNC) is the interface between the terminal and the transceiver. The TNC formats the data and performs all error checking. The terminal is the interface to the amateur operator and usually consists of a keyboard and display screen (most packet operators utilize a personal computer and terminal emulation software for the terminal). The problem with packet radio is that the operator is usually confined to the ham shack because of the bulky 110-V ac-powered computer terminal or very expensive lap-top computer that needs to accompany any portable packet station. Portable packet radio can now be convenient and economical with the low-power packet terminal described in this article. With just a handful of components you can build a fully featured portable terminal which is compact, low power, and best of all, inexpensive.

The Low-Power Portable Packet Terminal described in this article has the following features:

- 40 × 2 line LCD display
- Full keyboard
- Selectable baud rates from 300 to 19,200 bits per second
- Selectable protocol (number of bits and parity)
- Programmable scroll rate
- Recall of last two lines displayed
- 6-V dc battery power or 8-15 V dc power
- CMOS design for low current drain and long battery life

Hardware Design

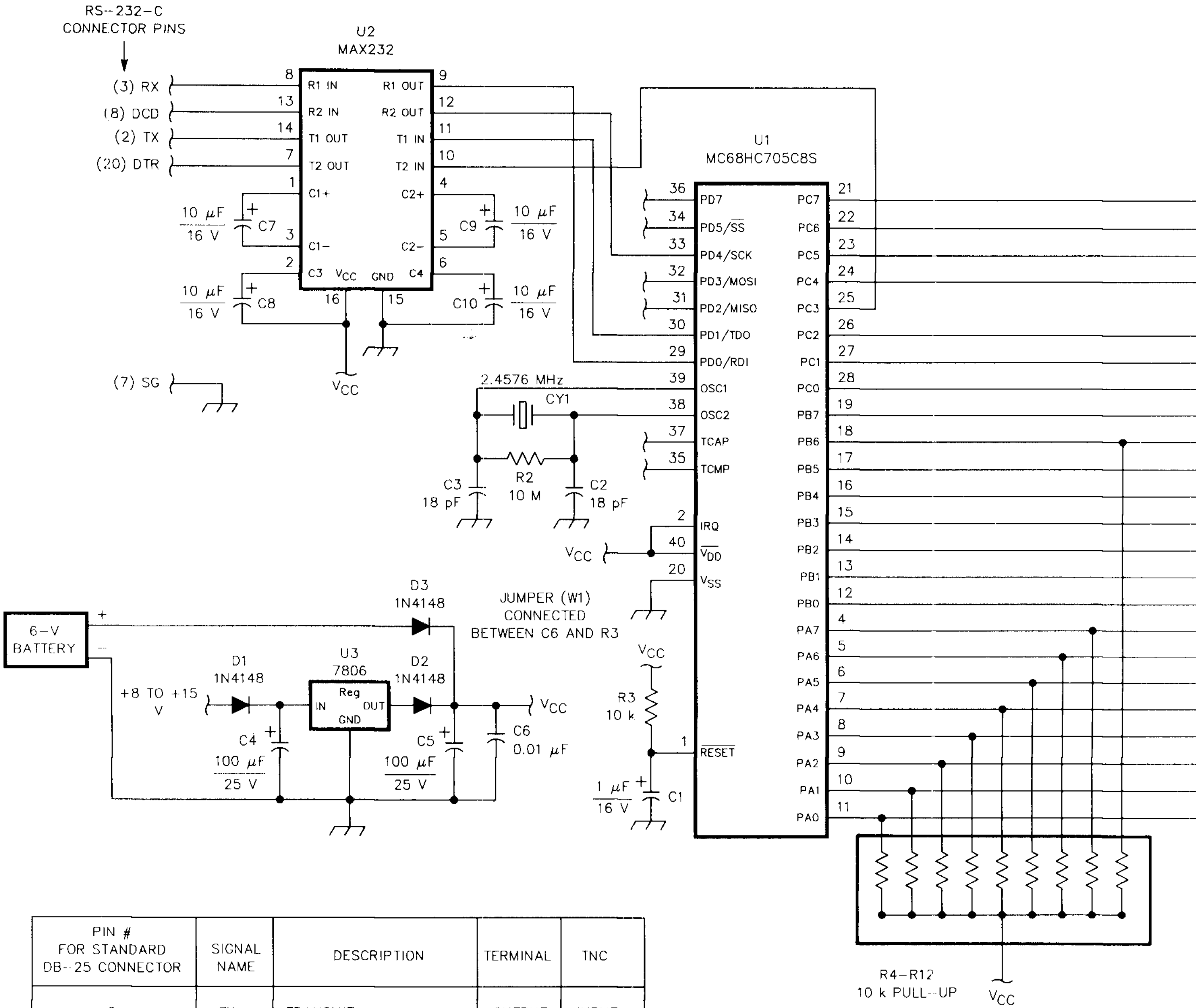
The heart of this terminal is the Motorola MC68HC705C8 single-chip microcontroller (U1). This chip is a full computer in one 40-pin DIP and features built-in PROM, RAM, I/O ports, serial ports, timers, etc. The MC68HC705C8 performs the three primary functions associated with any terminal.

1. Keyboard scan
2. Display control
3. Serial communication

The low-power packet terminal accepts a wide range of input voltages with its two power supply options. The terminal can be powered from either a 6-V dc battery (ie, 4 AA cells) or from any 8-15 V dc source (ie, 9-V battery, automobile power, etc). U3 is a 6-V regulator which converts the 8-15 V dc supply power to 6 volts. The supply voltage is further dropped through D2 to approximately 5.3 volts. The 6-V battery input feeds the circuit through diode D3. Diodes D1 and D3 isolate the two power supplies and provide reverse polarity protection.

U2 is a Maxim MAX232 RS-232 transceiver. This device converts the 0 to 5-V dc TTL signals from the microcontroller to −12 to +12-V dc required for RS-232 interfaces. Unlike most RS-232 transceivers which require +12 and −12 V power supplies, the MAX232 has built-in charge pumps to generate the required voltages from a single 5-V supply. This eliminates the need for sophisticated power supplies required with traditional RS-232 transceiver chips.

All other components are simple resistors, capacitors and a 2.4576-MHz crystal. This is a standard cry-



PIN # FOR STANDARD DB-25 CONNECTOR	SIGNAL NAME	DESCRIPTION	TERMINAL	TNC
2	TX	TRANSMIT	OUTPUT	INPUT
3	RX	RECEIVE	INPUT	OUTPUT
7	SG	SIGNAL GROUND		
8	DCD	DATA CARRIER DETECTED	INPUT	OUTPUT
20	DTR	DATA TERMINAL READY	OUTPUT	INPUT

Fig 1

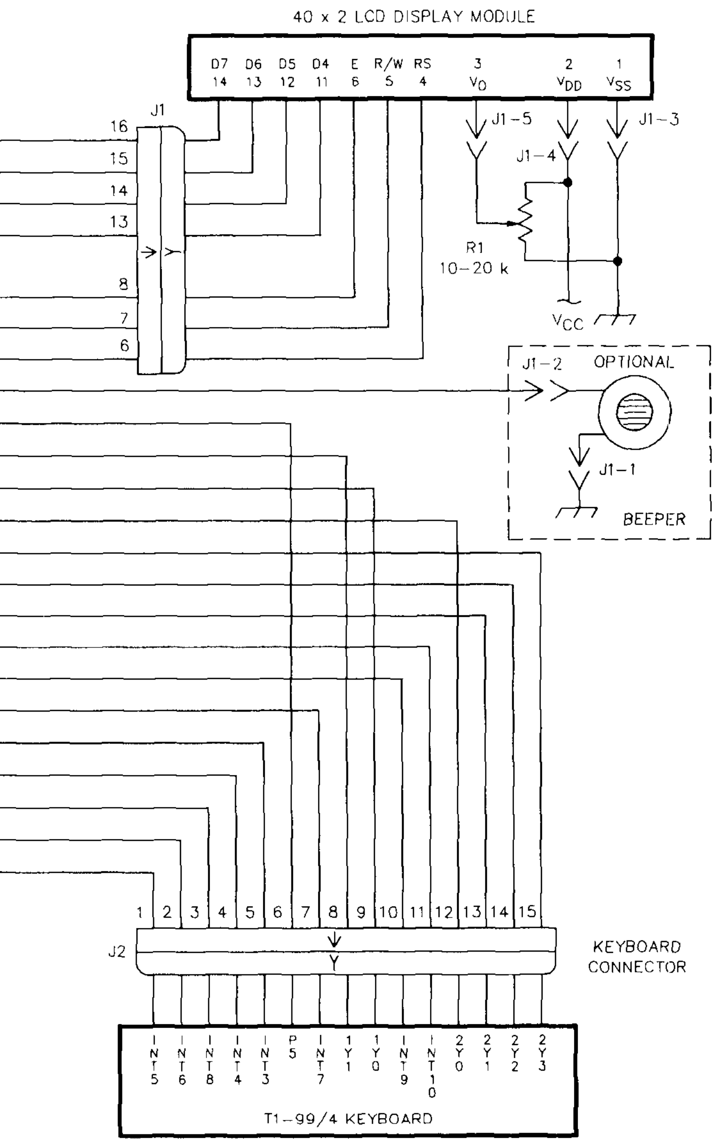
stal and is readily available. (Note: The crystal must be exactly 2.4576 MHz in order to generate the correct baud rates).

The keyboard is a TI-99/4 keyboard (from the old Texas Instruments personal computers). This keyboard is inexpensive and is available through surplus electronics suppliers.

An optional beeper may be connected to pin 19 (port B7) of the microcontroller U1. This beeper will beep whenever a <bell> character (CNTL G) is received over the RS-232 link. Many TNC's issue a <bell> character when a connection is established with another packet station. The beeper must be TTL compatible (ie, operate from 5 V and draw less than 3 mA). A Radio Shack no. 273.65 beeper or equivalent is acceptable.

Software Design

The software continuously monitors the keyboard and the RS-232 receiver for activity. Whenever a key is pressed the microcontroller first determines if it is a



FNCT 0 – DISPLAY PARAMETERS
FNCT 1 – SET BAUD RATE
FNCT 2 – SET PARITY
FNCT 3 – SET SCROLL RATE
FNCT 4 – DISPLAY TNC CONNECT STATUS
FNCT 5 – TOGGLE BETWEEN SCROLL AND 2-LINE MODE
FNCT 6 – DISPLAY LAST TWO LINES
FNCT 7 – TOGGLE BETWEEN LF ENABLE AND LF IGNORE MODES
FNCT L – TOGGLE BETWEEN LOCAL/ONLINE

FUNCTION request or a normal character. FUNCTION requests allow the user to change the terminal parameters from the keyboard. If the keystroke is a FUNCTION request, the terminal prompts the user for the appropriate parameters to be changed. If the key stroke is a normal character, the terminal converts the character to its ASCII equivalent and transmits the character over the RS-232 serial link.

Whenever a character is received over the serial link, it is displayed on the screen.

Shared Keys

SHARED keys are keys that do not have their own unique location on the keyboard but are located on the front regular keys (for example the question mark symbol is located on the front of the "I" key). SHARED keys are accessed by simultaneously pressing the FCTN key and the desired character.

Function Requests

FUNCTION requests allow the user to change a variety of terminal parameters from the keyboard. FUNCTION requests are made by simultaneously pressing the FCTN key and the number or letter of the appropriate request. The various FUNCTION requests are listed below:

<FCTN>	0	— Display current terminal parameters
"	1	— Set baud rate
"	2	— Set protocol (parity, number of bits)
"	3	— Set scroll rate delay
"	4	— Display TNC connect status
"	5	— Toggle between scroll and two-line mode
"	6	— Recall last two lines
"	7	— Toggle between LF enabled and LF disabled
"	L	— Toggle between local and online mode

Display Current Parameters

The "DISPLAY CURRENT PARAMETERS" FUNCTION request displays all the current terminal parameters without altering any of the parameters. The default terminal parameters which are set automatically at power-up are listed below:

- Baud rate—1200 bit/s
- Protocol—7,E,1 (7 data bits, even parity, 1 stop)
- Scroll rate—0 (no delay)
- Scroll mode
- LF enabled
- Online

Set Baud Rate (FCTN 1)

After pressing the "SET BAUD RATE" FUNCTION request, the terminal prompts the user to enter the number of the parameter desired. For example, to set the baud rate the user simultaneously presses the <FCTN> and "1" key. The terminal responds with the following display:

```
SET BAUD 0-19.2K, 1-9600, 2-4800, 3-2400
4-1200, 5-600, 6-300          SPACE-NO CHANGE
```

The user then presses the number of the desired baud rate (0 for 19.2 k, 1 for 9600, etc). Pressing the space bar exits the set baud mode without changing the baud rate.

Set Protocol (FCTN 2)

The protocol of the terminal defines the number of data bits and stop bits in each word as well as the parity. The 3 protocols supported by the terminal include:

- 8,N,1—8 Data bits, no parity, 1 stop bit
- 7,O,1—7 Data bits, odd parity, 1 stop bit
- 7,E,1—7 Data bits, even parity, 1 stop bit

Scroll Rate Delay (FCTN 3)

Since the display is only two lines long, the data may scroll faster than the user can read. The programmable scroll rate allows the user to slow the display by disabling the DATA SET READY (DSR) signal after each carriage return for a certain period of time. The TNC will stop sending data while the DSR signal is disabled giving the user time to read the currently displayed data. The scroll-rate delay is selectable from 0 for no delay to 9 for maximum delay (approximately 3 seconds).

Display TNC Connect Status (FCTN 4)

The Display TNC Connect status displays the status of the Data Carrier Detected (DCD) signal from the TNC. Most TNCs use the DCD signal to inform the terminal if the TNC is connected with another packet station. The terminal displays the TNC connect status with the appropriate message shown below:

```
TNC IS CONNECTED
HIT ANY KEY TO CONTINUE
```

```
TNC IS NOT CONNECTED
HIT ANY KEY TO CONTINUE
```

LF Enable/Disabled (FCTN 5)

Certain TNCs and computer terminals issue a line feed (LF) in addition to a carriage return (CR) at the end of each line. This extra line feed causes a blank line to be displayed on the screen. The user can choose to ignore this extra line feed by selecting the LF Disabled mode.

Recall Last Two Lines (FCTN 6)

This function request allows the user to recall the last two lines that scrolled off the screen. If a line scrolls off the screen before it can be read, this function can be used to recall that line. Hitting any key will return the display to the current two lines. (Note: Communication between the TNC and terminal is disabled via the DSR signal when recalling the last two lines; communication is re-enabled upon return to the current two lines.)

Two Line & Scroll Modes (FCTN 7)

<FCTN> 7 toggles between the scroll mode and 2-line mode. In the scroll mode the terminal continues to scroll the incoming data at the preprogrammed scroll rate (set by <FCTN> 3). In the 2-line mode the terminal stops the display every time both lines of the screen are filled. Pressing the space bar then allows the next two lines to be displayed.

Local/Online Mode (FCTN L)

LOCAL MODE—The terminal transmitter and receiver are disabled. Characters typed on the keyboard are displayed on the LCD display.

ONLINE MODE—The terminal transmitter and receiver are enabled. Characters typed on the keyboard are immediately transmitted over the serial link. Characters received over the serial link are displayed on the LCD display.

Interfacing to the TNC

The terminal interfaces to the TNC via a standard RS-232 DB25 connector. Only five of the 25 pins in the connector are utilized. The pin definition is listed below:

Pin #	NAME	DESCRIPTION	TERMINAL	TNC
2	TXD	TRANSMITTED DATA	OUTPUT	INPUT
3	RXD	RECEIVED DATA	INPUT	OUTPUT
7	SG	SIGNAL GROUND	(GROUND)	
8	DCD	DATA CARRIER DETECTED	INPUT	OUTPUT
20	DTR	DATA TERMINAL READY	OUTPUT	INPUT

Nearly all commercially available TNCs support the five RS-232 signals listed above. If you are utilizing a home-brew or modified TNC, it must at least support the TXD, RXD, and SG signals. If the TNC does not support the DCD signal, the terminal will not properly display the connect status of the TNC. If the TNC does not support the DTR signal, the scroll delay feature of the terminal cannot be used.

Initial Check Out

After verifying the connections between the TNC and the Terminal, simply turn on the terminal. The following initialization message will appear on the screen:

```
PORTABLE LOW POWER PACKET TERMINAL
     STEVEN AVRITCH WB1EOB (1990)
```

Adjust the contrast control potentiomenter, R1, for the desired contrast.

Now set the terminal baud rate and protocol to that of the TNC using the Function Request keys. The TNC's baud rate is normally selected using dip switches on the back of the TNC; its protocol is normally programmable from the terminal keyboard (most TNC's default protocol is 7 bits, 1 stop bit, even parity). Now turn on the TNC. The TNC's initialization message should appear on the screen. If the screen is garbled, either the baud rate or the protocol is incorrectly set (total garbage usually means incorrect baud rate; a display that has only certain letters corrupted usually means the protocol is set incorrectly). After correctly setting the baud rate and pro-

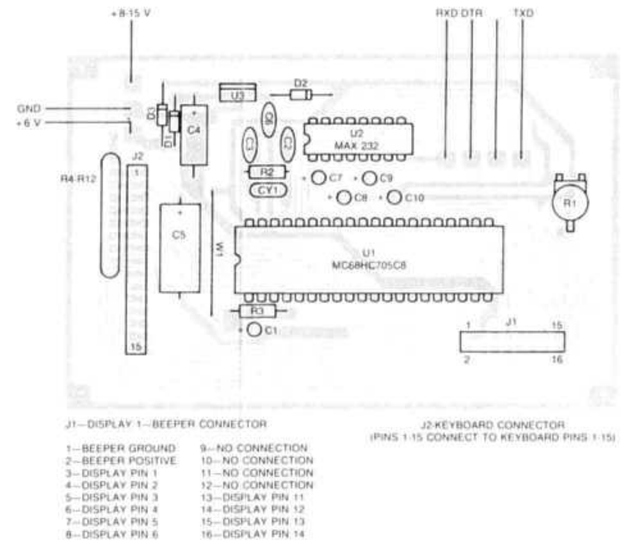


Fig 2

tocol you are ready to proceed according to the TNC's users manual.

Troubleshooting Hints

If the terminal does not come up with its own initialization message on power-up, there is a wiring hack. This wiring problem is most likely in the power or ground lines (U1, pins 20 and 40), the oscillator lines (U1, pins 38 and 39), the reset line (U1, pin 1) or the display interface lines (pins 1-6 and 11-14 of the LCD display).

If the terminal comes up with its initialization message but does not seem to communicate with the TNC, the keyboard and RS-232 driver must be checked. First check the keyboard by pressing <FCTN> 0 to display the system parameters. If the system parameters are not displayed on the screen, recheck the keyboard wiring. If the terminal does correctly display the system parameters, press <FCTN> L to put the terminal in local mode and fully test the keyboard by pressing every key and checking for the correct letter on the display.

If the keyboard checks out okay, the problem is probably in the RS-232 driver, in the cabling, or in the TNC. Remove the connector from the TNC and check for the following voltages:

Pin #2	−7 to −12 V dc
Pin #3	0-V dc
Pin #7	Check for continuity to ground
Pin #8	0-V dc
Pin #20	Toggles between +7 to +12 and −7 to −12 V dc by pressing CNTL S and CNTL Q on terminal

If any of the voltages do not agree, check the wiring of the RS-232 Driver chip (U2).

Next, reconnect the TNC, disconnect the terminal, and check for the following voltages:

Pin #2	0 V dc
Pin #3	−7 to −12 V dc

(measure pins 2 and 3 using pin 7 as ground)

If the TNC voltages do not agree then refer to the TNC manual for further assistance.

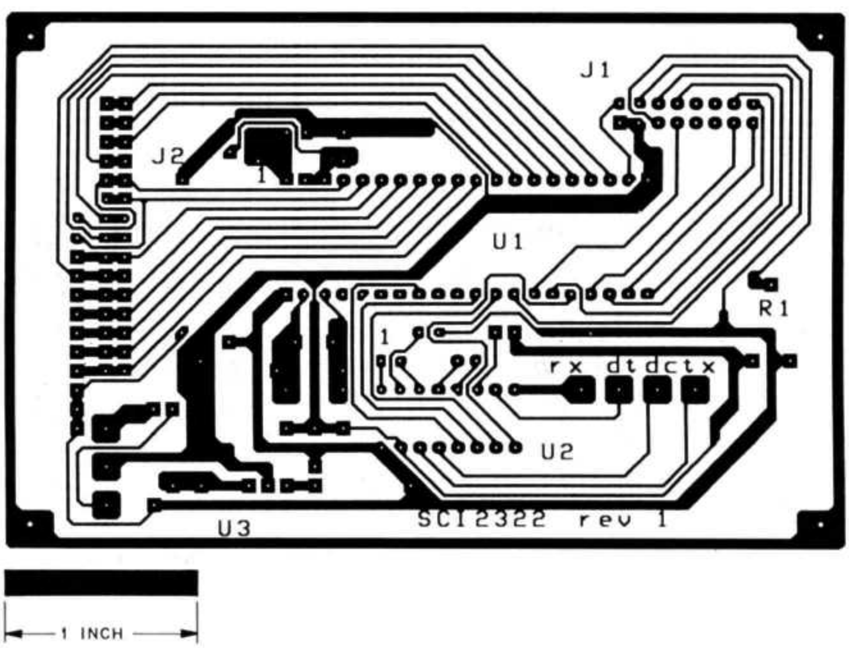


Fig 3—Etching pattern for the packet terminal shown from the foil side of the board.

PARTS LIST

PART No.	DESCRIPTION
Display	40 × 2 LCD display module (Hitachi LM018L or equivalent)
Keyboard	TI-99/4 (48-key, 15-pin connector)
U1	MC68HC705C8 CMOS Motorola microcontroller
U2	MAX232 5-V, RS-232 transceiver
U3	7806 6-V regulator (TO-220 case)
D1-D3	1N4148 diodes
C1	1-μF, 16-V electrolytic capacitor (radial)
C2,C3	18-pF ceramic disk capacitor
C4,C5	100-μF, 25-V electrolytic capacitor (axial)
C6	0.01-μF ceramic disk capacitor
C7-C10	10-μF, 16-V electrolytic capacitor (radial)
R1	10 - 20-kΩ potentiometer
R2	10-MΩ resistor
R3	10-kΩ resistor
R4-R12	10-kΩ resistor network (10-pin SIP)
CY1	2.4576-MHz crystal
DB25 connector	Male

Ordering Information

The following parts are available from:

Simple Design Implementations
PO Box 9303
Forestville, CT 06010
(203) 582-8526

1. Complete parts kit including all parts in parts list, custom PC board, IC sockets, instructions and schematic. Cost: $75 plus $5 shipping/handling.

2. Preprogrammed MC68HC705C8, instructions and schematic. Cost: $28.00 plus $2.50 shipping/handling.

3. Custom PC-board. Cost: $18 plus $2.50 shipping/handling.

(CT residents please add 8% sales tax)

The AMTOR Mailbox Standard: A Progress Report

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United Kingdom

Background

In the February 1990 issue of *QEX*, I described the outline of a protocol which I put forward as a prospective standard for the exchange of messages between unattended AMTOR stations on HF. In that article, I drew attention to some of the fundamental requirements that have to be met in devising a system for exchanging error-free commands and responses over a communications channel that is "slightly error prone" in both directions. Some interesting conclusions were reached as a result of consideration of these requirements. For example, it turns out that no use can be made of an "error message" received back from a distant station to which a command has been sent. This led to the formulation of the "command repeat rule," in which the commanding station has no option but to repeat his last command if he does not get the correct response. This led on to discussion of what constitutes a "correct response," and the introduction of the concept of a "double command" to prevent duplicate messages resulting from garbled acknowledgements. Finally, I considered some special tricks needed to "garble proof" the process of reversing the functions of "commander" and "responder."

In a follow-up article in the same issue, I described the GB7PLX HF AMTOR mailbox system that I operate, which, at that time, was the only AMTOR mailbox operating in accordance with the protocol I had described. However, one cannot operate any kind of a network with only one node!

In the remainder of this article, I will describe how progress has been made since then, and invite participation in the continuation and expansion of the project.

The New GB7PLX Mailbox

The software for the GB7PLX system was originally written for my own home-brew computer, which had become, over the 15 years since it was built, less and less compatible with the emerging range of home computers. It soon became clear that I would have to drop the home-brew machine in favor of a more modern one if I was to persuade anyone else to help with further work on the project. With this in mind, a PC/AT® was purchased, and work was started to convert the mailbox program to run on it. The software has been written partly in Turbo Pascal® and partly in assembler language. Apart from the forwarding protocol, which I have described, the system has a friendly AMTOR user-access capability which operates in the same way as most of the preexisting AMTOR mailboxes in Europe, and a packet port which interfaces with a TNC 2. This supports forwarding to the usual RLI/MBL standard, including hierarchical addressing and the standard form of message route header. Such headers on incoming packet traffic are passed transparently through the AMTOR system. Although it was never the intention to make the packet side emulate a full-specification BBS, the AMTOR-side commands are available on the packet side, and these are enough to allow local stations to upload and download their own messages directly to the AMTOR system, and to allow housekeeping to be done by a remote assistant sysop.

The AMTOR HF side has a 16-channel mulitband capability with a connection between the computer and the radio to select the required channel. Any or all of these channels can be scanned for incoming calls with an enhanced scanning system, whereby the short 700-ms channel dwell time is lengthened temporarily if the AMTOR system detects the first part of its own selcal code, long enough to catch the second part. For forwarding, the system selects a channel from an internal table, indexed by time-of-day, so that, if the called station is also known to be scanning channels in several different bands, then the best band can be chosen for the time-of-day. This table is set up on installation by the sysop, together with the call sign and selcal code of the called station. Before calling another mailbox for forwarding, the system runs a routine to check if the channel is free. Although a perfect free-channel detection procedure is an impossibility, this one has proved effective, and is combined with a short (15 second) call time to further reduce the possibility of unintentional interference.

The software has been written in a modular form, with the parts that interface with the outside world written in "installable drivers," which can be separately "plugged in." Drivers have already been written for AMT-1, AMT-2 and AMT-3 units, TNC 2 and derivative TNCs, and, on the radio side, a driver has been written to connect the second printer port to a "hard-wired" channel-selector system, with others being written as required for various serial interfaces appearing on modern radios.

The Network

As a result of making this software available, the AMTOR network now has enough nodes to prove the system thoroughly. Only one small change has been needed to the protocol as described in the February article: The "sign-on" procedure was then defined to consist of the two call signs, optionally separated by "DE", in the traditional manner. Because of the ambiguity of letters/figures at the start of a contact using the ITA2 alphabet, it has been necessary to make the "DE" compulsory. The first call sign is "thrown away" on the first call, but serves the purpose of defining the required letters/figures state, since, by a happy coincidence, all known amateur call signs contain both letters and figures! The "DE" is detected to identify the position of the second call sign (the caller). A repeated sign-on (remember that the caller could need to repeat it) is handled

(continued on page 15)

Microsat BiΦ Modulator: Interfaces with any VHF TNC

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Uplink access to the Microsats and the Japanese satellite digital mode FO-20 requires a two-meter FM signal input keyed with Manchester biphase (BiΦ). The following describes an assembly that transforms the normal VHF AFSK (audio frequency shift keyed) output from any unmodified TNC into the BiΦ format. As an example, I use it with my old PK64. The assembly is relatively simple and all parts, including the ICs, can be purchased from a single mail-order supplier (All Electronics Corp, PO Box 567, Van Nuys, CA 91408, tel 800-826-5432). Alignment/testing of the assembly can be performed using the TNC together with an oscilloscope and audio oscillator.

Manchester BiΦ Keyed

The BiΦ-keyed method was used in the first Japanese digital-mode satellite, FO-12. The resulting backlog of stations having the necessary uplink instrumentation made an important influence in selecting BiΦ keying for the Microsat uplink. BiΦ is simply a continuous carrier that is synchronous with the NRZI input data and having a frequency equal to the bauds, in this case 1200 Hz. Data modulation is a 180-degree phase shift of the carrier at every NRZI-level transition. NRZI recovery in a BiΦ-keyed signal is simply the process of detecting carrier phase shift, each shift representing a zero bit. It is like the Microsat downlink PSK (phase shift keyed) method except for the synchronous feature.

The conventional manner of developing BiΦ is to obtain both the NRZI and the clock directly from the TNC, processing this data to make the BiΦ format. However, in some equipment, like the PK64, this is not possible without digging into the TNC circuit board. The described method includes an AFSK-to-NRZI converter, and a clock recovery circuit. The only data required from the TNC is the conventional VHF 1200/2200-Hz AFSK output and the PTT (push-to-talk) switch. Admittedly, reconstructing the NRZI and clock is a potential source of error. However, the error probability is small when considering there is no source of external noise. It's comparable to going through a digipeater in a closed loop configuration.

Block Diagram Description

Referring to the block diagram, Fig 1, and the waveform diagrams, Fig 2, the following describes each waveform diagram. The bit-level sequence indicated at the top of the diagram was chosen to illustrate two typical conditions; two successive-level changes (00), and a single-level change (0).

[A] Input—The standard VHF TNC 1200/2200-Hz output

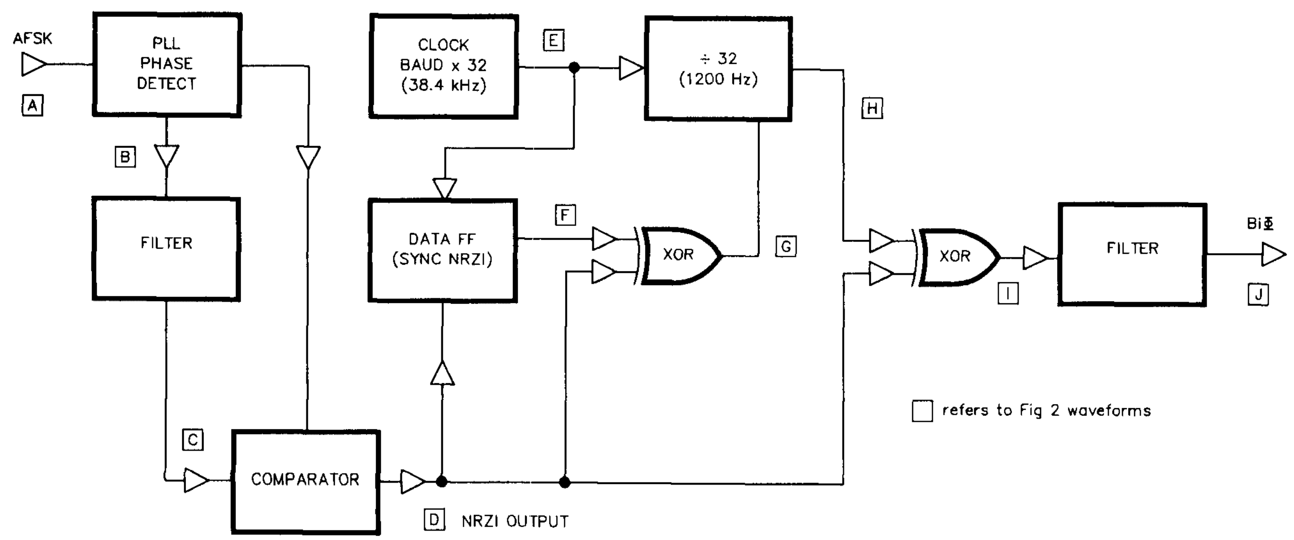

Fig 1—Block diagram—AFSK conversion to BiΦ.

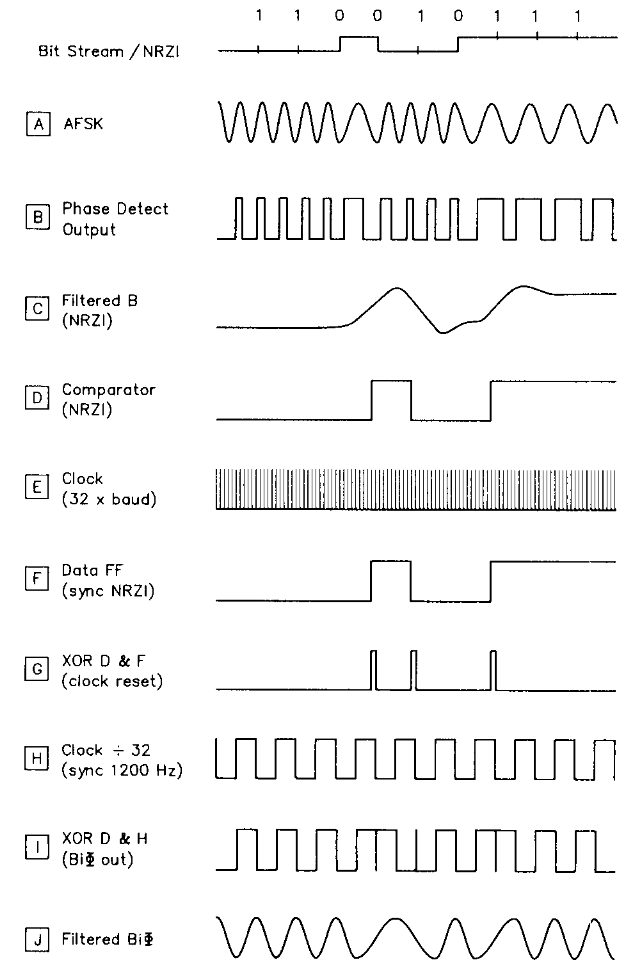

Fig 2—Waveform diagrams.

where the frequency shifts when there is a zero bit in the bit stream.

B Phase-detector output—Operating the phase-locked loop (PLL) IC in a closed loop configuration, the internal VCO will lock on and follow both the 1200- and 2200-Hz inputs. The phase-detector output is linearly proportional to the difference between the input-signal frequency and the free-running VCO frequency. It is adjusted to make the 1200- and 2200-Hz inputs produce equal outputs of opposite polarity. The output is a variable-duty cycle pulse.

C Filtering of B—Low-pass filtering extracts the NRZI component from the variable-duty cycle pulse at B.

D Comparitor output—The PLL reference is compared to the phase-detector filtered output and amplified. The result is a sharply-defined NRZI output.

E Clock—A timer-clock source makes clock pulses at 38.4 kHz (bauds × 32). The frequency is trimmed to conform with the TNC clock frequency.

F Sync flip-flop—The clock triggers a data-controlled flip-flop where the data input is the NRZI. The result is an NRZI output that is synchronized with the clock.

G Clock reset—Comparing the input NRZI with the clock-sync NRZI in an XOR gate results in a clock reset pulse at each data transition (0 bit).

H Sync 1200 Hz—Dividing the clock by 32, with a counter that is reset by G, makes a 1200-Hz square wave that is synchronized with the input NRZI. This clock reset method illustrates a deliberate and inherent characteristic of the NRZI code. One start flag results in accurate synchronous operation.

I BiΦ—Comparing the data NRZI synchronized 1200 Hz in an XOR gate makes the BiΦ. Note the narrow pulse within transition pulse period. This is caused by a slight jitter that takes place in reconstructing the NRZI from the nonsynchronous AFSK.

J Filtered BiΦ—There are two stages of filtering. The first eliminates the narrow pulse within the transition pulse period, and the second is simply a low-pass filter.

Circuit

My initial developmental breadboard was mounted on a 6 × 18-inch chassis. There were no apparent critical considerations except I did find the AFSK-to-NRZI converter some sensitive to RFI. The result was a slight unbalance of the two levels when I turned on the final RF amplifier (50 W). Simple shielding corrected the problem. To maintain alignment, it is important that the capacitors concerned with the PLL/VCO (C1) and the clock timer (C4) have temperature-stable characteristics.

Alignment/Test

1) With no AFSK input, adjust R1 so that the waveform at B is about 1700 Hz. 2) Adjust R2 to make the output waveform at J 1200-Hz. 3) Program the TNC to a special test condition making it repeat packets consisting primarily of start flags (16 per packet). The PK64 menu selection for this is: Band, VHF; Frack, 1; Fulldup, on; Retry, 0; TXdelay, 16. Test condition is initiated by the command, C A (cmd mode). 4) Connect the TNC AFSK to the input (keyed in the test mode). The comparator output at D will be a series of NRZI one-bit pulses (0.8 ms) repeated at 150 Hz during the PTT period. This pulse will shift from plus to minus with alternate packets. If it does not shift in polarity, try a different test-command input other than the letter A (selection of even or odd number of packet bits). 5) Trim the PLL/VCO adjustment R1 to make the NRZI positive and negative start-flag pulses have identical widths. 7) While viewing the output at I, trim the clock frequency adjustment R2 to make the clock synchronous with the input NRZI. Synchronous operation will become apparent as the 1200-Hz waveform will remain the same frequency regardless of whether or not a packet is in progress. A small frequency drift is of no consequence. 8) Proper alignment will show the BiΦ waveforms as they appear at I and J for the 00-bit example. Look for symmetry between the positive/negative phase shifts and six clean 1200-Hz pulses between the phase shifts.

A potential problem area is the FM transmitter inter-

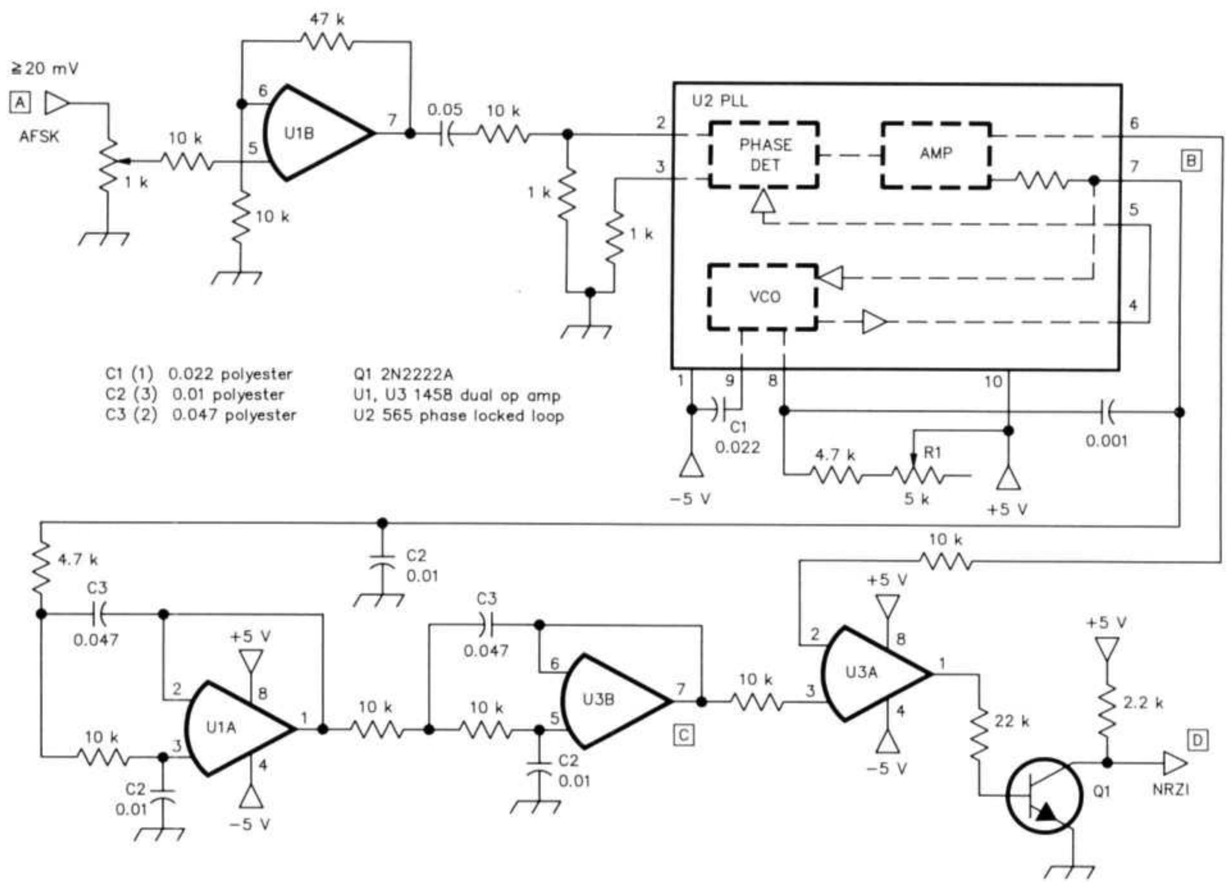

Fig 3—Schematic of the AFSK-to-NRZI assembly.

face. The question concerns the reaction of the preamplifier and the varactor modulator interface to the BiΦ input. In my case, and by monitoring the varactor input, I found the BiΦ signal severely distorted from multiple time constants in the preamplifier. Corrective action was to simply bring out the varactor interface with a separate miniature microphone cable, allowing direct connection between the varactor and BiΦ. I also tried tailored bandpass filtering between the BiΦ and microphone input jack, optimizing the filter characteristics while viewing the waveform at the varactor. Although the method was successful, the waveform appearance did not implant a lot of confidence. Apparently the bird is quite forgiving.

Using the TNC as a tester becomes marginal if there are interface waveform problems. It is desirable to evaluate operation with different bit combinations using a variable-width AFSK source. I used assemblies

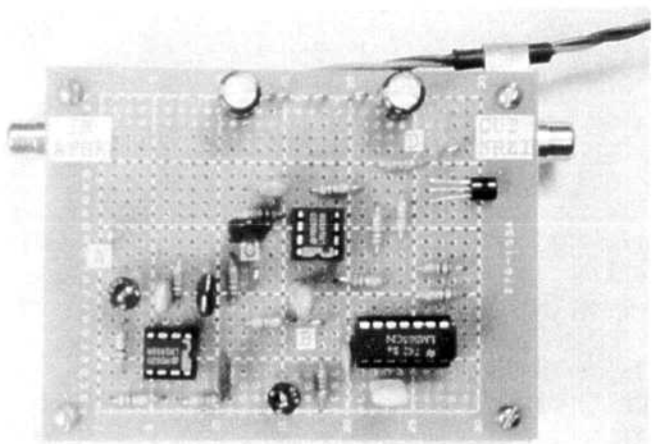

Fig 4—AFSK-to-NRZI assembly mounted on a 2¾ × 3¾-inch perf board.

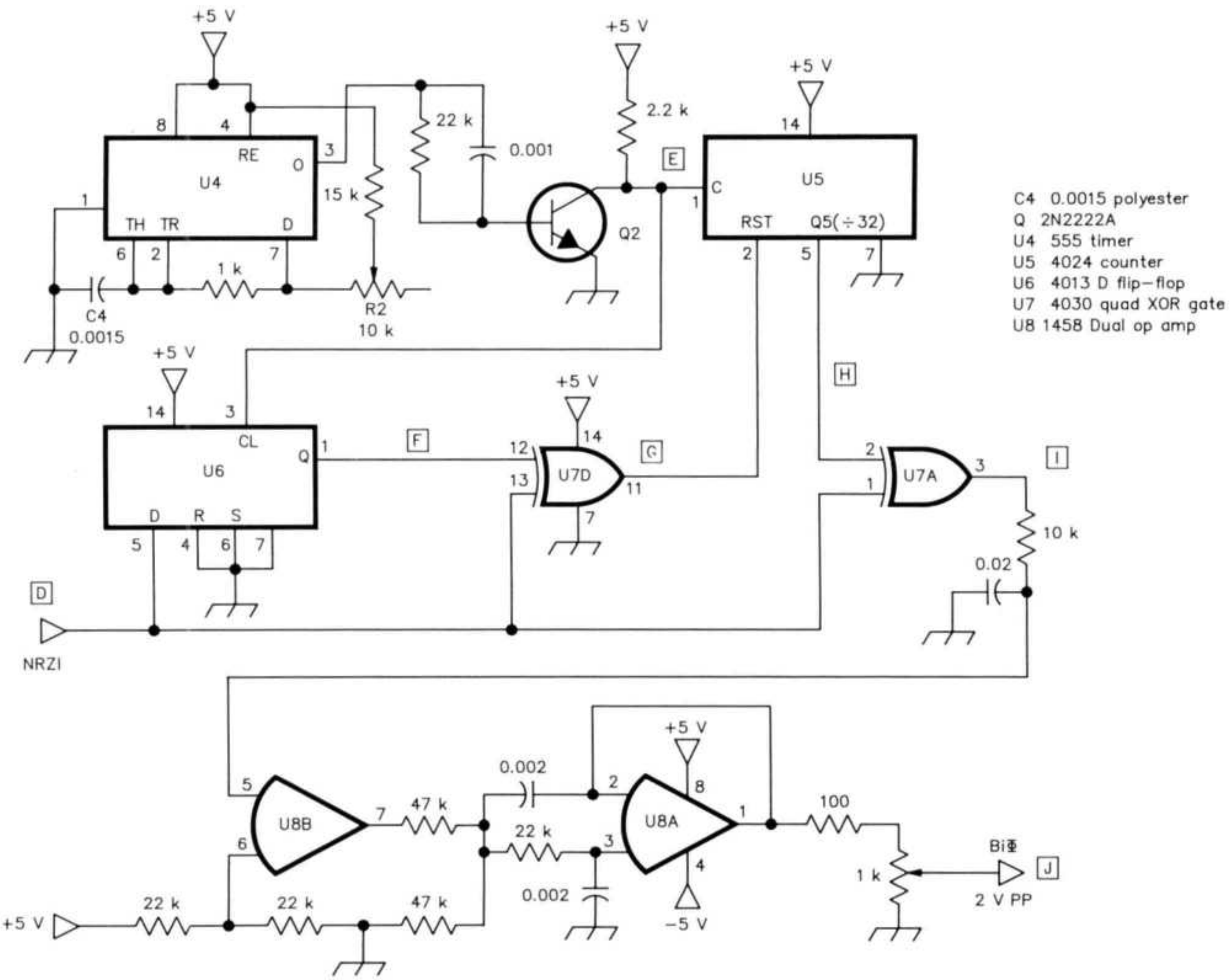

Fig 5— Schematic of the NRZI-to-BiΦ assembly.

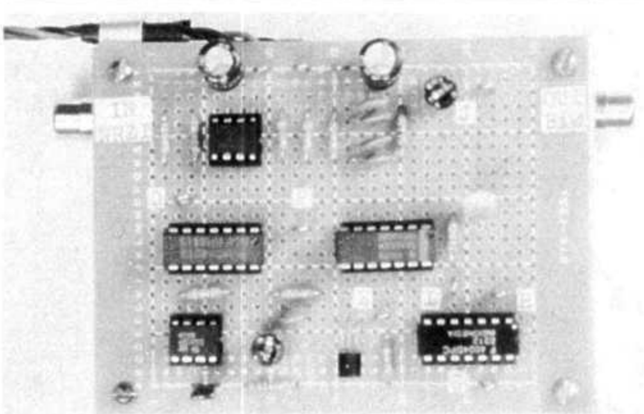

Fig 6—NRZI-to-BiΦ assembly mounted on a 2¾ × 3¾-inch perf board.

developed for the "Microsat Demodulator" described in September *QEX*. The simple variable-width pulser test device coupled to the NRZI-to-AFSK converter assembly works flawlessly. It allows, as an example, evaluation of multiple bit configurations as related to filter time constants. Another advantage is that it eliminates the annoyance of PTT breaks that are part of the TNC test method.

Summary

Although there is some similarity between this project and the "Microsat Demodulator" described in September *QEX*, there are enough differences to make it an interesting project. I know of no better way of understanding the system than to build the hardware and make it work. Besides, the uplink is a necessity if you can't resist the challenge of DX digipeating using a low-orbit satellite.

HF Frequency Synthesizer. . . Easier Than Ever

By Pierre Boillat, HB9AIS
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Translated from the January 1990 issue of *old man*

The first generation of HF equipment featuring digital frequency readout dedicated to Amateur Radio appeared on the market about 25 years ago. This technological development was much appreciated. Try to imagine, or remember, all the care that was needed when only analog displays were used, and when you wanted to make a sked on a specific frequency. It was certainly difficult to find the right frequency on your homemade receiver with a VFO and analog display.

Many improvements were made since that time. Chief among them was displaying the frequency of the VFO or the resultant mixing of the VFO, crystal and PLL. The results obtained are interesting, and therefore almost all modern HF transceivers are designed that way. Meanwhile, this is not easily achieved by the amateur. VFO design requires great care, both electrically and mechanically. The system becomes bulky and heavy. I looked for another solution—frequency synthesizers. I constructed a small transceiver for the 10-MHz band. Its frequency synthesizer was made from off-the-shelf components: 8 ICs (crystal oscillator and divider), some transistors, a Varicap diode, and about 40 other passive components. This was straightforward and worked well, but what I'm going to describe below is an even-easier method to build an HF synthesizer.

The Synthesizer. . . New Generation

A relative new LSI IC from Motorola® appeared on the market, the MC 145163, which is an HF synthesizer. This 28-pin IC may be directly connected to 4 BCD encoders for setting the desired frequency (see photo). The device contains a crystal oscillator; 2 programmable dividers, one for the reference frequency, the other for the VCO signal; a PLL LED output; and, two phase detectors.

Using this clever IC, we can build an HF frequency synthesizer with only one IC, saving 7 ICs and simplifying the wiring from my earlier design.

The Schematic

The HF synthesizer is composed of two basic parts: Parts a and b. An optional VXO is described in Part c. (See Fig 1.)

Part a—The Synthesizer

The synthesizer is based on the MC 145163, featuring a 4.096-MHz crystal oscillator whose frequency may be smoothly adjusted by means of a 5-65 pF capacitor. The crystal frequency is divided by a programmable divider, pins 5 and 6, by a factor of 4096, and thus the 1-kHz reference frequency is obtained from pin 25. The

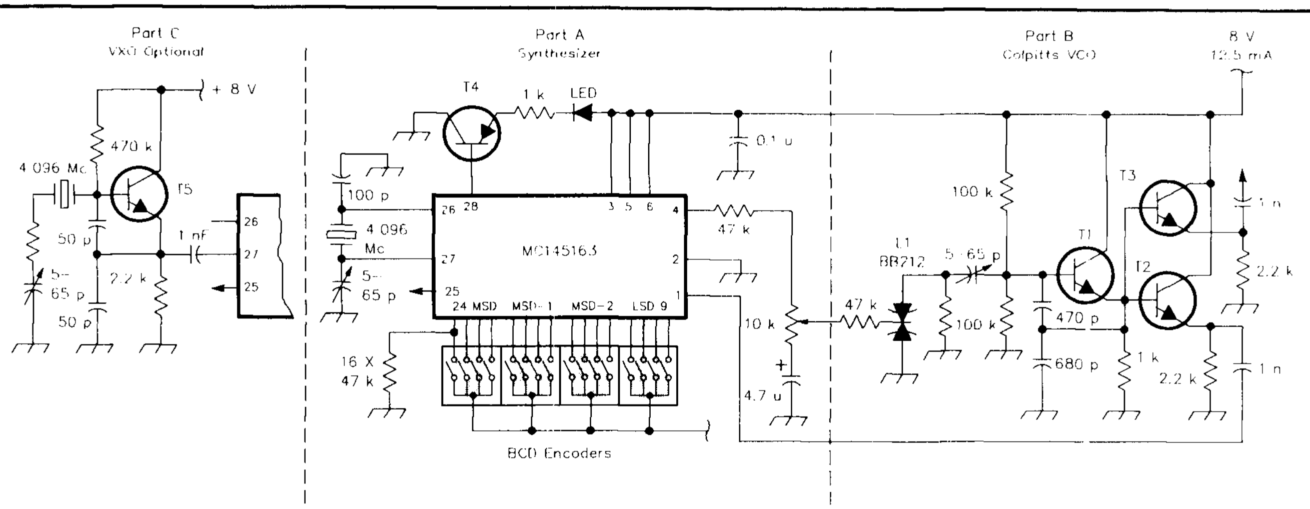

Fig 1—4.5-9.999 MHz frequency synthesizer.
T1-3, T5, 2N2222
T4, BC2907
L1, 17 t, Tore Philips No. 4322 020 97170, about 15 μH
L2, 47 t, Tore Philips No. 4322 020 97170, about 100 μH
MC 145163, Motorola
BB 212, Philips

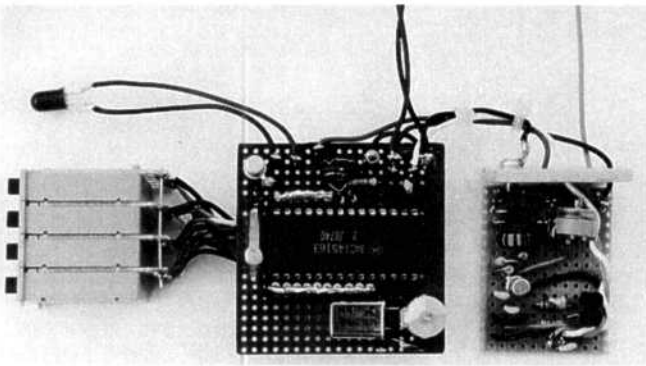

Fig 2—The frequency synthesizer (Part a) is connected to four BCD encoders, to the LED PLL indicator, and to the Colpitts VCO (Part b).

4 BCD encoders are connected to pins 9 through 24. Sixteen 47-kΩ resistors connected between these inputs and ground ensure that a logical 0 will be present on the IC's input whenever the BCD encoders' contacts are open. The VCO (Part b) signal enters the IC on pin 1. An error signal is available on pin 4. This signal is fed back to the VCO to correct its oscillating frequency. A PLL signal will be present on pin 28 and will be amplified by means of a PNP transistor to drive the LED.

Part b—The VCO

In principle, any kind of VCO can be considered. In order to achieve very-high frequency stability and minimize phase noise, the oscillator, T1, is a Colpitts type. The output of the amplifier, T2, is connected to pin 1 of the synthesizer (Part a). In turn, the error signal from the synthesizer, pin 4, is fed to a filter consisting of a 47-kΩ fixed resistor, a 10-kΩ pot, and a 4.7-μF capacitor. The error signal is taken from the rotor of the pot and sent to the VCO (Part b) Varicap diode. Note: To obtain a frequency as pure as possible, it is necessary to adjust the 10-kΩ pot so as to reach PLL sync (LED from pin 28 via T4) within 0.2 to 1 second. The frequency set on the BCD encoders is then present at the output of the second amplifier, T3, with an amplitude of 1-2 $V_{P\text{-}P}$.

Part c—Optional VXO

The synthesizer (Part a) in conjunction with the VCO (Part b), produces a frequency programmable from 4.5 to 9.999 MHz in steps of 1 kHz. For continuous coverage in this frequency range, it is possible to vary the crystal frequency by means of a VXO (Part c). The crystal frequency may be pushed or pulled by ±3 kHz around 4.096 MHz without affecting the stability. The emitter of T5 is connected through a 1-nF capacitor to pin 27 of the MC 145163. Frequencies in excess of 1 kHz can be set on the BCD encoders for continuous coverage of the frequency range. When using the VXO option, pin 26 of the MC 145163 is left open.

Conclusions

The natural application of such a frequency synthesizer is quick and easy construction of a small 7-MHz transceiver; a 3.5-MHz rig may also be made provided that the self L1 be adapted to this frequency by adding a few turns. Or it could be used with a mixer, a prescaler, or a PLL, to generate highly stable HF or VHF signals.

No more than 3 to 4 hours are needed to build this synthesizer on perf board, at a cost of about $20. The stability is the same as that of the crystal, and frequency drift vs supply voltage is much less than 100 Hz. Further, the system is much more shock resistant than any good VFO.

You will find the synthesizer easy to use on the air, and you will have a professional product with little time invested.

The AMTOR Mailbox Standard: A Progress Report

(continued from page 9)

by accepting the first call sign (my call) as a command word, which responds in the same way as a first sign-on.

The mailbox software is being made available to stations already operating licensed mailboxes, or to individuals who have applied for a license. As a result, six stations are active at the time of writing, four of which are fully multichannel scanning/forwarding. All these are run by mailbox operators with programming experience, and so the full source code has been made available to them. This has enhanced the ease of exchange of ideas for improvements and has speeded up the finding and fixing of bugs since solutions can be discussed and communicated over the network itself. The performance has been impressive. The forwarding protocol has proven to be completely garble-proof, and there has been no evidence of the duplicate-message problem prevalent on packet. As expected, many users have spent quite some time sending messages by both AMTOR and packet routes where both exist, and the AMTOR route is usually an order of magnitude faster. The nonzero error rate on message text has not caused any comment from packet users, nor has the restriction to upper-case characters. AMTOR users have found the forwarding syntax easy to drive manually, and some have even written their own software for auto-polling for their messages, since the "double-command" rule has also been applied to the process of removing messages from the system. At GB7PLX, a total of 450 different stations account for 60 log entries per day, with most of the forwarded traffic coming in and out on AMTOR rather than packet.

The Future

I hope I have shown that the "AMTOR Mailbox Standard" which I described in February has grown into a useful contribution to the development of amateur communication techniques. I hope that this article may help to promote interest in extending the network further.

Correspondence

Stripped-Down TNC

The multi-TNC thing (June 1990 *QEX*) is nice, but I feel it would be better to make up "stripped-down" TNC 2s as daughter boards and a double-sided mother board with four TNCs on the top and four TNCs on the bottom. It could be set up as a rack-mount assembly. I wouldn't even bother doing it at RS-232 levels. TTL would work, I guess. The mother board might even have ten minutes of back-up power and, at a power fail of six minutes, stop accepting incoming data, and at seven minutes feed out a "power fail" message to all ports. The way I see it, you could build up all the daughter board TNCs with no sockets, no clock, no RS-232, and come up with a box in kit form for around $300-350 for the eight TNCs and the mother board.

I do not see the need for separate cabinets, RS-232, etc, except for the fact that many TNCs are already out there. But they could be sold off to get more hams on packet. Those chips used are probably fairly expensive and at TTL/CMOS, etc, things might be far cheaper, etc.—*Joseph A. Wolos, WA1OCK, 1139 St James Avenue, Springfield, MA 01104-1375*

Telemetry Reception with the PK-232

The PK-232 can copy satellite telemetry from AO-13 and UoSAT 11. A minor hardware modification is needed to copy UO-11. Satellite-related bulletins as well as satellite status reports are sent in plain text for part of each telemetry frame daily on AO-13 and most days on UO-11.

Reception of PSK telemetry sent by FO-20 and the Microsats requires an added external PSK modem. Reasonably priced ones are available as kits from AMSAT-UK and TAPR. TAPR sells a modem disconnect board that plugs into a 40-pin IC socket inside the PK-232 and offers an easy way to interface any PSK modem to the PK-232. The external modem connector on the PK-232 does not have the clock data, so using it requires modifications to the PK-232 circuit board. Installing the modem disconnect board is easier and leaves you with the PK-232's external modem disconnect port free so you can now have two external modems. Both of mine are used, so I now need three!

The following settings will copy AO-13 SSB Baudot RTTY telemetry which is sent on 145.812 MHz on the hour +15 and +45 minutes when operating mode B, and on 435.651 MHz on the hour +00, +15, +30 and +45 minutes when in mode JL:

BA, RXR = OFF (mode B), RXR = ON (mode JL), WI = OFF, RB 50

Frequencies are plus or minus Doppler shift. An oscilloscope connected to the PK-232 will simplify keeping up with the Doppler shifted tones on AO-13 as a shift in the cross pattern is seen easier than a shift of the PK-232's leads. Tones do not change with Doppler on the UO-11 as it transmits FM AFSK.

RXR does not operate above 300 bauds because of a PK-232 hardware limitation. To copy UO-11's inverted shift, an unused inverter in the PK-232 (U15 pins 1 and 2) must be wired to a switch in series with the output to JP4 as follows:

1. Solder a jumper wire between U15's pins 1 and 6.
2. Cut the circuit board trace connecting U15's pin 6 to the inside pin of JP4. This trace is easiest to cut where it comes out from under R20 on the top (component side) of the PC board. Be sure to double check that this is the correct trace with an ohm meter. Cut with care (with a sharp x-acto® knife) so adjacent traces are not touched.
3. Mount a SPDT switch on the front panel where it will not interfere with other components (like near the upper left corner by the AEA logo).
4. Connect the center of this switch to the inner pin of JP4 or the trace that goes to it (which was cut to disconnect it from U15 pin 6).
5. Connect the switch contact which will be "RXR OFF" to U15 pin 6.
6. Connect the switch contact which will be "RXR ON" to U15 pin 2.

As you have the PK-232 apart, this is a good time to sand off all the paint where the two cabinet shells mate and screws fasten to improve RFI shielding. Star washers under the cabinet screws will also improve grounding. This reduced PK-232 RFI into my receiver. Toroids on all cables connected to your receiver may also help reduce RFI. Those square "snap-together" ones are easy to use. I needed one on my 12-volt line.

With your RXR switch in the "reverse" position, the following software settings will now copy UO-11 FM AFSK ASCII telemetry on 145.825 MHz (if not heard, try 435.025 MHz):

AS, WI = ON, AB = 1200

Be sure to return your RXR switch to "normal" when you want to return to normal operation as this switch is on line for all modes when the PK-232's internal modem is used.

If you have an HF RTTY modem you can use this with the PK-232 to improve copy of AO-13 (as well as greatly improve terrestrial HF operation of the PK-232), as the lack of individual tone filters and 200-Hz shift of the PK-232 results in less than optimum decoding. I found that with my HF modem's 170-Hz shift (which is AO-13's RTTY tone shift) and separate tone filters, I can copy AO-13 RTTY telemetry from horizon to horizon error free, while the PK-232's internal modem will return occasional errors until the signal reaches a high enough strength to overcome the PK-232's modem band-pass (not separate tone) filtering and 200-Hz shift limitations. Also on HF RTTY, I can copy weak signals with a greatly reduced error rate.

All you need do is wire in 3 double-throw switches with the center pins of JP4, JP5 and JP6 connected to the center lugs of your double-throw switches. Then wire the inside and outside pins of JP4, JP5 and JP6 to these switches so that the JP center pins are switched to the inside pins for the internal PK-232 modem or to the outside pins for your external modem. These switches can be mounted on the front panel where space permits (like the upper right corner under "model PK-232"). To ease future servicing, I recommend not soldering directly to the pins on JP4, JP5 and JP6. Check your catalogs (or local electronic supply store) for DIP connectors that are 0.100 center/0.040 square hole size and wire your switches to them. Be sure to mark each connector so you'll always reconnect them to the correct pins in the future. A look at the PK-232 schematic will clearly show you what you are doing. A triple-pole double-throw switch would be nice if you can find one. I made do by ganging a SPDT and DPDT together.

Earlier PK-232's connected the middle pins of JP4, JP5 and JP6 to the inner pins with a circuit trace on the bottom of the PC board. These three traces must be cut. Check beneath the JP pins to see if your model has these traces. Current models use three removable jumpers that will not be needed with the switches.

The above information is based on my own experimentation and several conversations with the helpful technical staff at Advanced Electronics Applications (AEA). The UoSAT-11 hardware mod was published by AMSAT-UK in their monthly *OSCAR News*, No. 73, October 1988.

For more information on PSK modems and other items of interest to satellite uses, write: AMSAT-UK, 94 Herongate Road, Wanstead Park, London E12 5EQ, England or TAPR, PO Box 12925, Tucson, AZ 85732.

A list of programs for determining satellite passes can be obtained from Project OSCAR, PO Box 1136, Los Altos, CA 94023-1136 and from AMSAT-NA, PO Box 27, Washington, DC 20044. Everyone interested in satellite activities is invited to check into the Tuesday night East Coast, Central and Pacific Coast AMSAT nets on 3840 kHz (± QRM) at 8 PM local time. Two-meter AMSAT nets are also active in some areas. Contact AMSAT or Project OSCAR for more information on these nets and for other satellite-related information. Join the space age today.—*Howard Sodja, W6SHP, 4317 Santa Rita Road, El Sobrante, CA 94803*

Conducted by: Stan Horzepa, WA1LOU
75 Kreger Drive
Wolcott, CT 06716-2702

SARBX MAKES CONNECTIONS

Starting off with a smooth launch and a "nominal trajectory," STS-35 lifted off in a spectacular night-time launch with two gigantic white pillars of fire trailing behind. Aboard the shuttle Columbia were Ron Parise, WA4SIR, and the Shuttle Amateur Radio Experiment (SAREX). On this mission, SAREX consisted of a packet-radio robot TNC 2 and a 5-watt FM transceiver. Operating only during Ron's work shift, over 1000 contacts have been logged. During his "spare" time, Ron answered questions posed by inquisitive school children. Thanks to the efforts of relay stations in Australia (VK5AGR, VK2AS and VK6IU) and in Brazil (PY2BYO), school children from over 40 schools got to hear Ron tackle some very difficult questions about space science and spaceflight.

Reports from all over the world have been pouring in about the successful connects packet-radio stations have made with WA4SIR. One factor that made communicating with WA4SIR difficult, if not impossible, has been Columbia's attitude. Because the shuttle's experiments have required attitude adjustments, the window-mounted antenna on the pilot's side, ie, on the right side above the center, has not always been pointing to Earth. When the antenna is pointed away from Earth, as it has been on several occasions, signals have completely disappeared. Despite this problem, when all the QSOs are counted, it will indicate that SAREX was a major success.

For those who have made a packet contact with WA4SIR and would like to receive a QSL card, please send your QSL card, QSO number and an SASE to ARRL Headquarters.
—from AMSAT

COURT AFFIRMS FCC'S REALLOCATION OF 220 MHZ

The text of ARRL Bulletin 50, dated December 5, 1990, follows.

"The U.S. Court of Appeals for the District of Columbia Circuit has denied the ARRL petition for review of the FCC order reallocating 220 to 222 MHz to the land mobile service. The court concluded that by law it had to give great deference to the views of the Commission and it could not say that the Commission did not arrive at a reasoned decision about the best way to advance the public convenience, interest or necessity."

What this means for packet radio is that all activity in the 220 to 222 MHz subband will have to be curtailed and some of it will move into the 222 to 225 MHz subband. In many areas of the country, the move to the upper subband has already occurred with packet radio activity congregating around the FM simplex channels above and below 223.50 MHz. When everyone is forced to vacate the lower 2 MHz, these frequencies may become as congested as those above and below 145.01 MHz.

RUDAK-2 LAUNCH

According to the latest schedule, the launch of RUDAK-2 will occur on January 7. The following describes the frequencies and modes of operation that radio amateurs can expect once RUDAK-2 begins operation.

RUDAK-2 Transponder System Specifications

1. System configuration:

   Two sets of the equipment are installed aboard the satellite:

   Linear Transponder #1 Mode B, RUDAK-2 with subsystems and Linear Transponder #2 Mode B with subsystems. The first set is considered to be the primary transponder system; the second one is backup. The backup can be brought into operation in the case of failure of the first.
2. Commands

   Equipped with real-time program command functions.
3. Beacon and Telemetry Set #1

CW Telemetry 8 channels	145.822 MHz, 0.2 watts,
Digital Telemetry 30 channels	145.952 MHz, 0.4 watts, 1100 bit/s, BPSK/FM, 2-kHz deviation
Digital Telemetry RUDAK-2	145.983 MHz, 3.0 watts, BPSK 1200 bit/s AX.25

4. Beacon and Telemetry Set #2

CW Telemetry 8 channels	145.948 MHz, 0.2 watts,
Digital Telemetry 30 channels	145.838 MHz, 0.4 watts, 1100 bit/s, BPSK/FM, 2-kHz deviation
Digital Telemetry 30 channels	145.800 MHz, 2.0 watts, 1100 bit/s BPSK/FM, 2-kHz deviation

5. Transponder #*1* Set

(1) Linear Transponder:	inversely hetrodyned translator
Uplink Passband	435.102 to 435.022 MHz
Downlink Passband	45.852 to 145.932 MHz
Transmitter Output max	10 watts
Bandwidth (3 db)	80 kHz
Uplink EIRP required about	100 watts

(2) Digital Transponder RUDAK-2:

Digipeater and store-and-forward packet communication (AX.25), telecommunications experiment with digital signal processing (DSP) with up to nearly 20 kHz, 1-Mbyte RAM disk, with four separate uplink channels.

Uplink frequencies:	RX-1	435.016 MHz 1200 bit/s FSK, NRZIC/Bi-phase-M
	RX-2	435.155 MHz (AFC) 2400 bit/s, BPSK, Bi-phase-S
	RX-3a	435.193 MHz (AFC) 4800 bit/s, RSM

RX-3b	435.193 MHz (AFC) 9600 bit/s, RSM
RX-4	435.041 MHz (digital AFC) RX for RTX-DSP

Downlink frequency: 145.983 MHz, 3 watts

The downlink can be switched to the following operating modes:

Mode 1: 1200 bit/s, BPSK, NRZI, (NRZ-S)
Mode 2: 400 bit/s, BPSK, Bi-phase-S
Mode 3: 2400 bit/s, BPSK, Bi-phase-S
Mode 4: 4800 bit/s, RSM, NRZIC (Bi-phase-M)
Mode 5: 9600 bit/s, RSM, NRZI (NRZ-S) + Scrabler
Mode 6: CW keying (only for special events)
Mode 7: FSK (F1 or F2B), eg, RTTY, SSTV, FAX, etc (for special events)
Mode 8: FM modulated by D/A signals from DSP-RISC processor (speech)

Note: RSM stands for "Rectangular Spectrum Modulation."

6. Transponder Set #2

Linear transponder:	inversely hetrodyned translator
Uplink passband	435.123 to 435.043 MHz
Downlink passband	145.866 to 145.946 MHz
Transmitter output max	10 watts max
Bandwidth (3 db)	80 kHz
Uplink EIRP required	about 100 Watts

—from AMSAT

SPACE STATION TO GET PACKET RADIO

The Soviet space station MIR is scheduled to receive a packet-radio experiment package for permanent installation this month. It will use a standard TNC employing AFSK (FM) modulation of AX.25. Besides operating in the packet-radio mode, it will also have a voice synthesizer which will transmit greetings and general information in English, Russian and German.

—from AMSAT

TAPR ANNUAL MEETING SET FOR MARCH

The annual meeting of Tucson Amateur Packet Radio (TAPR) will be held in Tucson on March 2-3, 1991, at the Best Western Inn at the Airport. There are a limited number of rooms reserved at $65 per night, single or double occupancy. For further details, contact Tucson Amateur Packet Radio, PO Box 12925, Tucson, AZ 85732-2925, telephone 602-749-9479, fax 602-749-5636.

—from Bob Nielsen, W6SWE

UNIX AND PACKET RADIO

George Church, WB2SJZ, has been experimenting with an ATT 6300 UNIX-based computer, using an enhanced version of the W2XO software that adapts UNIX for amateur use. The computer, on line in the 144.91 MHz subnet, has unique features embedded in the code. For example, the software permits the SYSOP to provide additional "sockets" that are accessible by initiating an AX.25 connection to WB2SJZ-8 (this may later be augmented to accept TELNET connections).

According to George, "I have been experimenting with a modified version of NET I recently received from N8EMR, Gary Sanders. It runs on a UNIX PC-7300 and allows use of external sockets. This version also allows new mailbox commands to be created and mapped to external sockets.

"I have defined several external sockets on my system by writing some short shell scripts (batch files). Nothing elaborate. They are no more than several lines long, but it shows the kinds of things that can be done very easily with external sockets. I have also created matching mailbox commands."

*—from **POLI NetNooze***

POLISH PACKET RADIO

The following messages from Lucjan Morcinek, SP9VU, describe the state of packet radio in Poland.

"Two friends and I founded the Polish Packet Radio Group to press the Polish Communications Ministry and the state radio inspectorate (the Polish version of the FCC) to allow us to start experimenting in packet radio. It took us three years before we received a temporary permit for three months under the condition that we submit a TNC to the inspectorate so that they could monitor us. We collected money and bought one in West Germany and then we started. . . of course, all on 20 meters and you well know how difficult packet radio is on the HF bands. Our group has grown to 36 licenses (still under temporary permit) and about five to eight are active on HF. The first 2-meter PBBS will start in Warsaw. I can't reach Warsaw. It's about 230 km away (my home PBBS is RK3KP via 20 meters).

"We are trying to get more hams into packet radio, but, as you may know, the situation is very difficult economically for most of the people. Most of the hams hardly can afford a computer and TNC. . . and a better radio. We also lack publications about digital modes."

NEW SOFTWARE AVAILABLE

The following new packet radio software has become available recently. Most of the following information comes from CompuServe's HamNet. Additional information is provided, if known. Although, all of the delineated software may be downloaded from HamNet, some of the software may be downloaded from other sources such as other online services, landline and packet radio BBSs. Other software sources are provided, if known.

AMIGAK.LZH, binary, 203776 bytes

Version 1.3 of G1YYH's port of KA9Q's TCP/IP NOS software for the Amiga computer provides borderless windows, better command defaults, etc. Downloadable from CompuServe HamNet Library 9.

AMIGAN.LZH, binary, 200704 bytes

C source code for *AMIGAK.LZH*. Downloadable from CompuServe HamNet Library 9.

AO13.ZIP, binary, 21973 bytes

A fully interrupt driven AO-13 receiver from Bob McGwier, N4HY, that is intended for a 38400 or a 20 MHz IBM-class computer. Downloadable from CompuServe HamNet Library 5.

ARES14.EXE, binary, 157088 bytes

ARES/Data Version 1.4 is a multiconnect, multiport general-purpose database accessible via packet radio with a full-featured conference bridge. The program was written by W.E. Moerner, WN6I, and Dave Palmer, N6KL, for use in a wide variety of emergency and public service

Amateur Radio situations. (For information on the application of ARES/Data to Amateur Radio public service, see *QST*, December 1990, page 75.) The data base runs on an IBM PC or compatible and requires a TNC with WA8DED firmware and/or DRSI PC*PA packet adapters (up to a mix of 4 TNCs or PC*PAs). User stations can use any type of terminal or computer and TNC. If you have an earlier version, the new features are primarily fixes of the TNC busy and the repeating transmitted packet errors. New ".HLP" files are included so users can download help for various commands. Downloadable from CompuServe HamNet Library 9. Also available on disk from DRSI and TAPR.

BCAST1.SIT, binary, 68992 bytes
Version 1b4 of a PACSAT broadcast protocol decoder for Macintosh computers from Ron Cox, W9KFB. Downloadable from CompuServe HamNet Library 5.

BPQNET.ZIP, binary, 8165 bytes
BPQCFG.TXT and AUTOEXEC.NET files for using the G8BPQ networking program with the PE1CHL version of KA9Q's NET TCP/IP software. It does not properly implement the NET/ROM capabilities of NET, but does allow NET to access all of the radios through a G8BPQ network. Downloadable from CompuServe HamNet Library 9.

BTERM.COM, binary, 63527 bytes.
Version 1.03 of a PACSAT broadcast protocol receiver for IBM-class computers written by Norberto Pennini, LU8DYF. It supports COM 1/2/3/4, 2400/4800/9600/19200 bit/s RS-232-C links. The file is self-extracting and contains the ISH file converter (see *ISH200.COM* below). Downloadable from CompuServe HamNet Library 5.

EZP.ZIP, binary, 41728 bytes
This is a very simple packet radio program for IBM-class computers. It has no advanced features, but is very good for those just beginning to explore packet radio. Downloadable from CompuServe HamNet Library 9.

FO-20.SIT, binary, 18688 bytes
Macintosh application to decode saved White Knight text files from FO-20 mode JD (RA frames) from Ron Cox, W9KFB. Output is in speadsheet compatible format for printing or graphing. TNC's date and time stamp must be on when creating the stored text file. Downloadable from CompuServe HamNet Library 5.

GOLDTD.EXE, binary, 156750 bytes
This is the "test-drive" version of *Packet-Gold*, a multiscreen, multimode, multiconnect terminal program for IBM-class computers and the AEA PK-87/88/232/232MBX controllers. It features huge scroll-back buffers, copy/paste to/from any connect/mode, painless binary file transfers, conferencing and more. (Your *Gateway* editor is now evaluating Packet-Gold and will have a full report soon.) Downloadable from CompuServe HamNet Library 9. Also available on disk from Interflex Systems Design Corp, PO Box 6418, Laguna Niguel, CA 92607.

ISH200.COM, binary, 30366 bytes
A powerful binary/text code converter widely used in Japan written by M. Ishizuka, to transfer any binary code via the PBBS network. Downloadable from CompuServe HamNet Library 9.

MSATBI.SIT, binary, 24704 bytes
Macintosh application from Ron Cox, W9KFB, that decodes saved White Knight text files of PACSAT, LUSAT, DOVE, or WEBER TLM data. White Knight's parity must be set to ignore for binary data. TNC's date and time stamp must be on when creating the stored text file. Files are output in spreadsheet format. Downloadable from CompuServe HamNet Library 5.

MSATBI.TXT, text, 12885 bytes
C source file for *MSATBIN.SIT*. Downloadable from CompuServe HamNet Library 5.

MSATWO.SIT, binary, 25472 bytes
Macintosh application from Ron Cox, W9KFB, that processes saved White Knight text files to recover WOD data. White Knight's parity must be set to ignore for binary data. TNC's date and time stamp must be on when creating the stored text file. Downloadable from CompuServe HamNet Library 5.

MSATWO.TXT, text, 15407 bytes
C source code for *MSATWOD.SIT*. Downloadable from CompuServe HamNet Library 5.

PACBRO.ZIP, binary, 49124 bytes
Version 1.0 of this program for IBM-class computers reads a KISS file and extracts the broadcast protocol files transmitted by UO-14 and AO-16. Creates a hole list on disk to use different files sequentially. Uses CRC check and also creates a PFH files on disk. Downloadable from CompuServe HamNet Library 5.

PBREL.ZIP, binary, 43392 bytes
A PACSAT broadcast protocol receiver for IBM-class computers from Jeff Ward, GØ/K8KA. Downloadable from CompuServe HamNet Library 5, from tomcat.gsfc.nasa.gov via Internet, and from the AMSAT-DRIG BBS at 214-394-7438.

PHSREL.ZIP, binary, 39936 bytes
PACSAT file header add/remove programs for IBM-class computers from Jeff Ward, GØ/K8KA. Downloadable from CompuServe HamNet Library 5, from tomcat.gsfc.nasa.gov via Internet, and from the AMSAT-DRIG BBS at 214-394-7438.

R147R.ZIP, binary, 241566 bytes
The PRMBS/ROSERVER version 1.47 full runtime package for fresh startup or updating pre-1.46 versions. Downloadable from CompuServe HamNet Library 9 for IBM-class computers.

RSWD11.ZIP, binary, 66560 bytes
This file contains the Documentation for the ROSE Switch and the necessary instructions to install it in a TNC. Downloadable from CompuServe HamNet Library 9, RATS UNIX BBS at 201-387-8898 (1200 baud, login "rats," follow menu), PacComm BBS at 813-874-3078 (1200 baud, "DX ROSE filename"), K4NGC BBS at 703-680-5970 (1200/2400 baud, file area #17), or WA6RDH BBS at 916-678-1535 (1200/2400/9600 baud).

RZSW11.ZIP, binary, 88704 bytes
This contains the files needed to make a ROSE Switch. This November 11, 1990 version supports stacking switches with a diode matrix similar to NET/ROM. It also has password protection for the SYSOPs piece of mind. It is shareware from Radio Amateur Telecommunications

Society (RATS). Downloadable from the same sources as *RSWD11.ZIP*.

XTNC10.ZIP, binary, 42892 bytes

For Windows 3.0 users who have the Crosstalk for Windows telecommunications program. This updated version of XTNC supports the July 1990 version firmware for the AEA PK-232 with a consistent Windows 3.0 interface for all text modes. Downloadable from CompuServe HamNet Library 9.

PACKET RADIO HELP LINE ESTABLISHED

Dan Burton, N2FWQ, believes that he has developed a new concept in packet radio that will help newcomers adjust more easily to the packet-radio mode of communication. With his system, a station in a local area sets up his or her personal mailbox as a packet help line, whereby stations can connect at their convenience and ask questions about packet radio, eg, how to hookup a TNC, how to send and read bulletins, etc. The station offering the service would then answer the question or provide resources, then the inquiring station can reconnect, again at his or her convenience and get the answers.

The benefits of such a service would be that stations could get help and assistance at their own convenience, stations would feel less intimidated asking questions and PBBS SYSOPs would be relieved of this burden to devote more time to PBBS upkeep. Dan has established a packet radio help line in the metropolitan New York City area that is working quite well. Please let him know your feelings and comments (@N2EYR) regarding such a service.

BHF PACKET NET MOVES TO 17 METERS

The HF Packet Net, which was on 28.490 MHz, has moved to 18.150 MHz to increase readability for all stations. Stations are invited to check in and say hello on Sundays at 12 EST. Listen for N1GMV or KP2N.

RHODE ISLAND IP ADDRESS COORDINATOR

Charlie Green, W1CG, is the IP address coordinator for the state of Rhode Island despite what you may have read here or elsewhere recently.

HELP WANTED BUILDING BACKBONE

The South Florida DX Association is planning to install a 440-MHz packet radio backbone to accommodate the projected burden that the DX spotting system will create. The Association is seeking advice from those who have already built such a backbone so that they do not have to reinvent the wheel. If you can provide any assistance, please contact Tom Mannix, WA4YLD, at PO Box 6296, Hollywood, FL 33081.

SERVICES AVAILABLE ON TCP/IP

What can you do with TCP/IP? The standard answer says you can do electronic mail with SMTP, file transfers with FTP, keyboard-to-keyboard using TELNET, query FINGER services, etc. Actually, TCP/IP is a lot of fun! But newcomers want to know how to find other stations on the network?

The answer: by using the list below! This is a living document, one which will be regularly updated. It's being published here and in *The NE TCPer*, as well. And it's available on the air, in the Services directories at both ka1mf.ampr.org and nc1n.ampr.org.

So, whether you are just starting or have been using TCP/IP for a while, we hope you find the following list helpful.

Anonymous FTP File Servers

The following stations have files available on-line for anonymous FTP. To access these servers, establish an FTP session using "anonymous" as the user name and your call sign as the password. Then, browse, copy files and enjoy!

Host Name: n1gcr.ampr.org
SYSOP: Mark Hochman, N1GCR
For information, contact: n1gcr@n1gcr.ampr.org

Mark has a dual system: TCP/IP and landline BBS (called InterVision) at his New Hampshire QTH. Like most BBSs, he carries lots (about 18 Mbytes) of IBM type programs there, some of which are ham related. Some are free and some are shareware. To get an idea of what is available, users should retrieve the file named "files.bbs" that gives a summary and size of each program available.

In particular, Mark would like to draw people's attention to his arc indows subdirectory. In this area, he has almost 3 Mbytes of Windows 3.0 software. This subdirectory also has its own "files.bbs" listing.

Host Name: k1ne.ampr.org
SYSOP: Bill Becker, K1NE
For information, contact: k1ne@k1ne.ampr.org

Bill has a number of GIF pictures and display programs. The programs are in the files subdirectory and the pictures are in the "files gif" subdirectory. K1NE is on the air 24 hours a day.

Host Name: wa1phy.ampr.org
SYSOP: Doc Willard, W1EO
For information, contact: w1eo%wa1phy@bbs.wa1phy

WA1PHY is located at MITRE in Bedford, Massachusetts. It is well-known as a PBBS (see the listing for bbs.wa1phy under "Gateways" below) and actually is a complex node with two different computers. The host wa1phy.ampr.org contains an extensive set of files available for FTP. They cover a variety of subjects of interest to TCP operators.

Note: WA1PHY's FTP area used to be located on the bbs.wa1phy node. However, the bbs.wa1phy address is now dedicated to the packet mail gateway service.

Services Available Through SMTP

Services available through SMTP? Isn't SMTP a mail protocol? Well, yes, but the following systems each offer something special. Either the operator will offer help in the form of answers to questions or is looking for some kind of input from you. So, they are included in our list of services.

Host Name: n1gcr.ampr.org
SYSOP: Mark Hochman, N1GCR
Send SMTP Mail To: netcper@n1gcr.ampr.org

Mark is the editor of *The NE TCPer*. He is always looking for interesting articles. Please send anything you feel others would be interested in hearing about to netcper@n1gcr.ampr.org. Sending via SMTP is fine. Special arrangements for FTP submission can be made especially if you're a regular contributor.

Host Name: ka1mf.ampr.org
SYSOP: Don Hughes, KA1MF
Send SMTP Mail To: ka1mf@ka1mf.ampr.org

Don is the Amateur Radio IP address coordinator for Eastern and Central Massachusetts. Any licensed ham in those areas needing an IP address should contact Don. Send him your name, call sign, host name(s) (if special or multiple) and QTH. In addition to his SMTP address, Don can be reached at KA1MF@WA1PHY in the WØRLI-type packet mail world and also handles requests passed through a third party (eg, a current TCP/IP operator forwarding a request for a newcomer). Don also responds to mail requests for help, particularly from new comers. Don is most familiar with the IBM versions of the KA9Q software.

Host Name: nc1n.ampr.org
SYSOP: Charlie Ross, NC1N
Send SMTP Mail To: nc1n@nc1n.ampr.org

Charlie is the keeper of this AMPRNET services list. If you would like to contribute an entry or revise something that already appears, please send him mail. It is periodically published in several newsletters and maintained for anonymous FTP at several locations.

He's also very active within the Boston Computer Society (BCS) Amateur Radio Group. As such, any questions about the BCS can be addressed to him. He enjoys helping beginners get started particularly with the Macintosh TCP/IP software and tries to respond to questions promptly.

Host Name: ka1syf.ampr.org
SYSOP: Frank Knight, KA1SYF
Send SMTP Mail To: ka1syf@ka1syf.ampr.org

Frank is an answer man for NET/NOS and is happy to respond to user queries. He's had a lot of experience working with and adapting the source code.

Host Name: balrog.k8lt.ampr.org
SYSOP: Gary Grebus, K8LT
Send SMTP Mail To: glg@balrog.k8lt.ampr.org

Gary is the IP address coordinator for New Hampshire. Any licensed ham in that area needing an address should contact Gary. Send him your name, call sign, host name(s) (if special or multiple) and QTH. Gary's WØRLI packet address is K8LT@WB1AES. On the Internet, he's reachable at grebus@nobozo.enet.dec.com. He handles third-party requests.

FINGER Services

FINGER services are among the simplest to use! Just establish a FINGER session as indicated in the description and the remote system will send you the information as a text display.

Host Name: n1ewb.ampr.org
SYSOP: Ned Kroeker, N1EWB
For information, contact: n1ewb@n1ewb.ampr.org

Ned maintains an on-line callbook server covering the first and second call areas. To look someone up, FINGER %call sign@n1ewb. For example, to get a listing on nc1n, FINGER %nc1n @n1ewb. Don't forget the % sign!

Host Name: ke3z.ampr.org
SYSOP: Jon Bloom, KE3Z
For information, contact: ke3z@ke3z.ampr.org

Jon maintains the Connecticut News service. FINGER news@ke3z to get an on-line listing of current noteworthy happenings.

Host Name: ka8scp.ampr.org
SYSOP: Terry Stader, KA8SCP
For information, contact: ka8scp@ka8scp.ampr.org

Terry maintains the Eastern and Central Massachusetts Update service. FINGER update@ka8scp to get a current on-line newsletter of area TCP/IP news and events.

Gateway Services

There are several different kinds of gateways available. The one thing in common is that they provide a "gateway" (an interface between two different communications systems). (TCP/IP "switches" often are gateways between different packet frequencies, but we will cover them in a separate listing.)

Host Name: bbs.wa1phy.ampr.org
SYSOP: Doc Willard, W1EO
For information, contact: w1eo%wa1phy@bbs.wa1phy

One of the most heavily used nodes on the regional AMPRNET, bbs.wa1phy provides a gateway from SMTP into the traditional packet mailbox/BBS world. Anyone can send mail through the gateway as follows.

To send mail to the packet address call@BBS (for example, nc1n@wa1phy), send SMTP mail to call%bbs-@bbs.wa1phy (for example, nc1n%wa1phy@bbs.wa1phy). The gateway will convert it to regular packet mail and send it along its way.

Doc can configure the gateway to auto-forward in the other direction as well. Certain constraints apply, however. First, WA1PHY must be established as your home PBBS. Second, you must only use your call sign as your SMTP user name (eg, nc1n@nc1n rather than charlie@nc1n). Third, to prevent backups at the gateway, your TCP/IP node must be on the air regularly. Send Doc a message if you want more information or wish to request that forwarding be established.

One final note: you can send packet bulletins (eg, to all%nebbs@bbs.wa1phy) through the gateway. It is possible to pass categories of received bulletins. For details, contact Doc, however, to see all bulletins, your best bet is still to log into a PBBS using regular AX.25 packet.

Host Name: balrog.k8lt.ampr.org
SYSOP: Gary Grebus, K8LT
For information, contact: glg@balrog.k8lt.ampr.org

Gary redistributes the Internet "tcp group" mailing list. This is the mailing list of people on the Internet involved in developing and applying the KA9Q software. The list is archived in batches available for FTP at KA1MF. Gary's willing to mail this to other hosts that are up most of the time.

Gary also has an experimental mail gateway between the local AMPRNET and Usenet. He automatically routes ham-to-Usenet mail sent to user%host@balrog.k8lt or host1!host2!user@balrog.k8lt.

To contribute additions to this list, please contact Charlie, NC1N, by sending SMTP mail to nc1n@nc1n.ampr.org.

—*by Charlie Ross, NC1N, from Boston Computer Society's* The Wireless Bitstream

GATEWAY CONTRIBUTIONS

Submissions for publication in *Gateway* are welcome. You may submit material via the US mail or electronically, via CompuServe to user ID *70645,247* or via Internet to *horzepa@gdc.portal.com*. Via telephone, your editor can be reached on evenings and weekends at 203-879-1348 and he can switch a modem on line to receive text at 300, 1200 or 2400 bit/s. (Personal messages may be sent to your *Gateway* editor via packet radio to WA1LOU @ N1DCS or IP address 44.88.0.14.)

The deadline for each installment of *Gateway* is the tenth day of the month preceding the issue date of *QEX*.

Empirically Speaking

(continued from page 2)

telecommunications engineers. There is a spirit of professionalism, cooperation and consensus-building in these groups, despite the fact that everyone is there to advance their particular causes.

The International Amateur Radio Union (IARU) has been represented at CCIR meetings in Geneva and Helsinki this past year, and has contributed papers giving a global view of the amateur and amateur-satellite services. A summary of the IARU's WARC-92 preparation activities appears on page 67 of the January, 1991 edition of *QST*.

All of what has just been described doesn't do the whole job, particularly as the world prepares for WARC-92 and perhaps future WARCs. There are many other opportunities for radio amateurs, as individuals or representing an organization, to give telecommunications professionals, regulators and the general public a better idea of the contributions of the amateur and amateur-satellite services. The Institute of Electrical and Electronics Engineers (IEEE) and other professional organizations hold numerous conferences throughout the US and the world. Radio amateurs have given some excellent papers at these conferences, but there are many additional opportunities. Properly done, radio amateurs can get the word out on the state-of-the-art technical contributions of the amateur and amateur-satellite services.—*W4RI*