Xerox 820-1 Compendium—Part 5

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Talking to Fred

In our previous encounter with frequency hopping, the Xerox 820-1 board was hooked to an ICOM IC-2AT handheld transceiver to frequency hop rather slowly (10-100 hops/second).[32] This month we will lay the groundwork for high-speed frequency hopping on HF. Note that the new FCC rules do not allow this, but our AMRAD Special Temporary Authorization (STA) does.[33] Before we can hop cleanly, it is necessary to have a Fred. What is a Fred?

The Fred Williams Synthesizer

In 1984, *QST* published an article on a remarkable synthesizer that produced a clean signal from 1 Hz to 7 MHz, in 1-Hz steps.[34] The synthesizer used a TRW D/A converter and hard-to-get parts. It was designed and built by Fred Williams, an employee of the TRW LSI Products Div. AMRAD members were able to obtain the parts, an EPROM and the schematic to build one. In a subsequent article, *QST* published information on a hand-set frequency controller to allow the synthesizer to be programmed easily.[35] At the same time, a revised schematic was available; it used less expensive parts that were more obtainable. Also, A & A Engineering (2521 W LaPalma Ave, Unit K, Anaheim, CA 92801; tel 714-952-2114) produced kits for both the synthesizer and controller. AMRAD ordered one kit each and Elton (Sandy) Sanders, WB5MMB, constructed the units. AMRAD named the project and synthesizer "Fred" in honor of its designer.

Xerox 820 Talks to Fred

Sandy brought the completed units to my laboratory to demonstrate that they worked. Once convinced that both units were working properly, Sandy constructed a cable to run between the Xerox 820 parallel port and Fred. The details of that cable appear in Fig 7. Note that Fred expects serial programming. The three lines that run to Fred from the computer are responsible for changing the unit to the desired frequency.

- Frequency Load (Transfer Line, "Change Freq Now")
- Transfer Clock (Clock transitions for digit valid)
- Frequency Control Data (Desired Freq—24 bits)

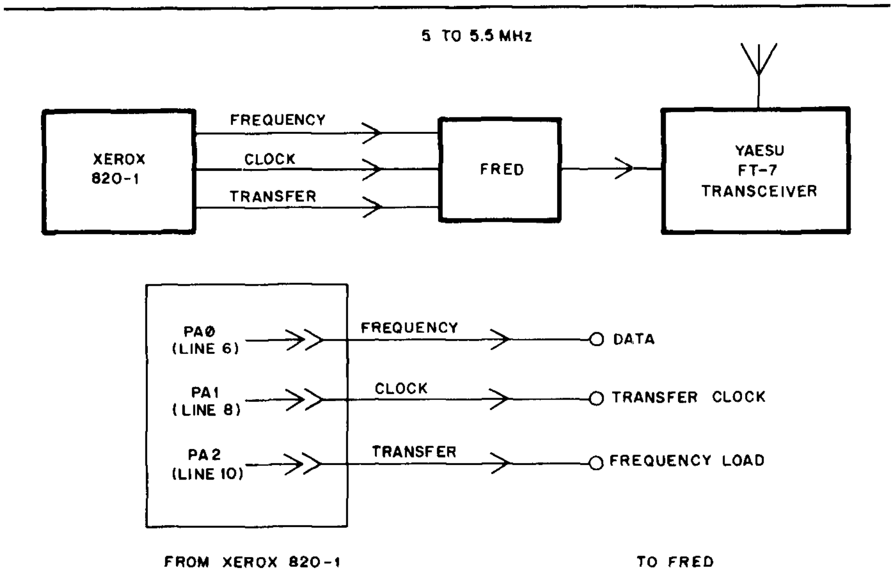

Fig 7—A Xerox-to-Fred-to-Yaesu interface allows the operator to have computer control of the FT-7 transceiver. Refer to the lower drawing: On the frequency line, send the frequency as 24-binary bits, with the most significant bit (MSB) first. Toggle the clock line for each binary digit sent. Lower the transfer line at the beginning of the transfer; raise the line toward the end.

Hal Feinstein, WB3KDU, and I programmed Fred to do several tasks. We first hooked Fred's output to a Yaesu FT-7 HF transceiver. The FT-7 wants a VFO frequency of 5.0-5.5 MHz, just perfect for Fred. The FT-7's socket that accepts the external VFO resides on the back of the rig. The socket looks like a 5-pin DIN, but it is not. The coaxial cable from Fred was soldered to the FT-7 and the power to the internal VFO was cut. Using the handset controller that Sandy built from the kit, we had frequency control of the FT-7 and could move up and down the band. We quickly unplugged the controller and plugged in the Xerox 820. The program in Table 1 controls Fred; let's start in a simple manner. Enter the 24 binary digits (1 or 0). When the 24th digit is typed in, Fred will change to the new frequency and the FT-7 will hear whatever is on frequency.

PACANSWR

The basic complaint about packet bulletin board systems (PBBS) is that users interact with other local PBBS computers on 145.01 MHz. This causes problems because the computers are channel hogs. Computers and human typists do not share the same frequency well; the computer always wins. Therefore, I offer some suggestions: (1) Marry the AMRAD frequency agile ICOM-2AT transceiver with the packet radio TNC code from Phil Karn, KA9Q, and produce the Frequency Agile Bulletin Board; (2) The PACANSWR machine.

For years, people have used telephone answering machines. Many people dislike them, but they help to screen calls. Thanks to Ward Christensen's MODEM program, many people now leave their TNCs in the capture mode (capture all traffic on disk during a 24-hour period). If your TNC is set for the monitor mode, you will receive all traffic on disk, too. If you disable the monitor mode, then traffic sent to you exclusively is received only. The problem? Callers who know you have a capture mode will leave a message, others won't.

What is needed is a packet answering machine. This device informs the caller that they have reached my station, but that I am busy and they can leave a message.

Let's take the easy way out. Disable the

[32]Notes appear on page 15.

Table 1

Frequency Set Program in BASIC

```
1Ø REM HANDSET BY XEROX 82Ø KEYBOARD FRED OUTPUT
2Ø REM ARRAY OF 24 BINARY DIGITS FOR FREQUENCY
22 DIM D(24)
25 PRINT "BEGINNING FREQUENCY SET OF FRED"
26 REM BEGIN BY INITIALIZING PARALLEL PORT
27 REM SET PORT A TO BIT MODE
28 OUT 9,2Ø7
29 REM SET PORT A TO ALL OUTPUT BITS
3Ø OUT 9,Ø
31 REM DISABLE INTERRUPTS ON PORT A
32 OUT 9,64
33 REM CLEAR ALL LINES FOR ACTION, RAISE TRANSFER
34 OUT 8,4
35 REM THE BIT FREQ SET LOOP, QUIT WITH CTRL-C
36 FOR I = 1 TO 24
37 PRINT "THE CURRENT BINARY DIGIT IS-",I
4Ø INPUT D(I)
5Ø IF D(I) = 1 THEN GOSUB 1ØØØ
6Ø IF D(I) = Ø THEN GOSUB 2ØØØ
7Ø NEXT I
75 REM THE FREQ IS NOW SET, SO DO IT
8Ø OUT 8,4
85 REM DO IT AGAIN UNTIL CTRL-C SAYS QUIT
9Ø GOTO 35
1ØØØ REM SEND A ONE
1ØØ5 REM SET A ONE, TOGGLE CLOCK, SET XFER LOW
1Ø1Ø OUT 8,1
1Ø2Ø OUT 8,3
1Ø3Ø OUT 8,Ø
1Ø35 RETURN
2ØØØ REM SEND A ZERO
2ØØ5 REM SEND A ZERO, TOGGLE CLOCK, SET XFER LOW
2Ø1Ø OUT 8,Ø
2Ø2Ø OUT 8,2
2Ø25 OUT 8,Ø
2Ø3Ø RETURN
```

monitor mode on the packet board so it will only respond to connect requests. I did this and captured one hour's worth of monitor mode and examined it. I was receiving the WB2MNF PBBS being relayed through WB2RVX0, WB4APR6 and WB4JFI5 as well as normal nightly traffic on the busy 145.01-MHz channel. The result was 16 kbytes of disk. By disabling the monitor mode, the TNC is discriminative and will ignore beacons, PBBSs and so on. It also makes the code simpler.

Let's look for *CNCT* and *DISC* in our code. On connection, the packet caller is informed that our PACANSWR program is ready to capture traffic.

The hardware is simple and does not require a schematic. Run a four-conductor wire from your computer serial port DB25 female connector to the Vancouver/Ashby DB25 female connector. This wire need only contain a hookup for pin 2 (Frame ground), pin 2 and 3 (receiver and send) and pin 7 on the Vancouver side. The Macintosh® computer uses RS-422, which has a DB9 connector instead of a DB25. Wire the chassis ground to DB9, pin 1. Signal ground goes to pin 3, transmitted data goes to TXD, pin 5 and receiver data goes to RXD, pin 9. Do not bother with handshaking. The Macintosh does not handle it correctly unless a serial driver is installed.

I coded Table 2 in Microsoft® BASIC 2.0 for the Macintosh. It is easier to understand than the C language. Notice the BASIC used is not like one you've seen before. There are no line numbers and this style of BASIC resembles FORTRAN. There are nice syntax structures included like the IF-THEN-ELSE statements. If are familiar with BASIC, this code should be easy to follow.

That's the program. I keep it simple. The Macintosh has an 8530 serial port that is handled in BASIC by setting up a

Table 2

PACANSWR in Microsoft® Basic 2.0

```
REM
REM --- PACKET ANSWER MACHINE PROGRAM
REM
PACANSWR:
     GOSUB INIT
     OPEN "Ø",#4, "CAPTURETEXT"
REM
REM N IS THE NUMBER OF ASTERISK RECEIVED AS IN
REM *CNCT* OR *DISC*
REM M IS A FLAG, 1 = CONNECTION AND Ø=NO CONNECTION
REM
     N = Ø
     M = Ø
LOOP:
     P$ = INPUT$(LOC(1),1)
     PRINT P$;
     PRINT #4, P$;
     IF P$ = "*" THEN N = N + 1
     IF N = 2 THEN GOSUB CNCTDISC
     IF LOC(1) > Ø THEN LOOP
     K$ = INKEY$
     IF K$ = "@" THEN GOTO QUIT
     IF K$ = "" THEN LOOP
     PRINT #1, K$
     GOTO LOOP
QUIT:
     CLOSE #4
     END
REM
REM INITIALIZATION SUBROUTINE
REM MONACO MOSPACED NON-PROPORTIONAL FONT
REM 9 POINT ALLOWS 8Ø CHARACTERS PER LINE
REM XOR TEXT WITH WHAT IS ON THE SCREEN
REM
INIT:
     TEXTFONT 4
     TEXTSIZE 9
     TEXTMODE 1
REM SETUP COMMUNICATIONS 853Ø PORT
    OPEN "COM1:3ØØ,N,8,1" AS 1 LEN=2ØØØ
    RETURN
REM
REM CNCTDISC SUBROUTINE
REM DETERMINE WHICH IS GOING ON
REM
CNCTDISC:
     N = Ø
     IF M = Ø THEN GOSUB CNCTMSG:RETURN
     IF M = 1 THEN GOSUB DISCMSG
     RETURN
REM
REM IF CONNECTION ESTABLISHED, INFORM CALLER
REM
CNCTMSG:
     M = 1
     PRINT#1,"YOU HAVE CONNECTED WITH K8MMO, DAVE"
     PRINT#1,"BUT HE IS UNAVAILABLE, SO PLEASE"
     PRINT#1,"LEAVE YOUR MESSAGE AT THE BEEP AND"
     PRINT#1,"HE WILL GET BACK TO YOU...THANKS"
     PRINT#1,"DAVID'S COMPUTER...SKINNY MAC"
     PRINT#1,"                 BEEP"
     RETURN
REM
REM DISCONNECTION, RESET FLAG AND ANNOUNCE TO CRT
REM
DISCMSG:
     M = Ø
     PRINT "DISCONNECTION"
     RETURN
```

Continued on page 15.

test antenna to the detector and see how much the detector meter reading changes. For example, if you insert a 6-dB pad, the meter reading should decrease by 6 dB.

Another simple detector is a receiver tuned to the test frequency. You can read the AGC voltage with a VTVM to get rough measurements, but there are too many places for nonlinearities here. I don't recommend this system for real accuracy.

A more sophisticated system, used at many antenna-gain measuring contests, is shown in Fig 2. It consists of an HP416B ratiometer as a detector and a 1-kHz modulated source. The '416, as the name implies, compares the signal coming into two separate ports and reads the difference in decibels. In this system, a *reference-port antenna* is left connected to one port at all times. All measurements are compared to the signal level from the reference antenna. This system has the desirable feature of taking out inaccuracies caused by variations (over time) in the output power from the source. The ratiometer uses a square law (diode) detector, so be sure to check for linearity when using this system.

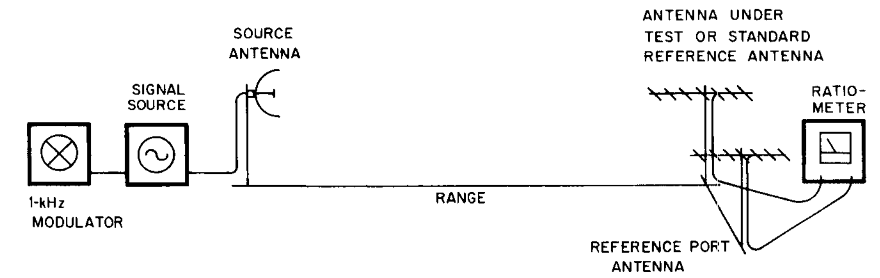

Fig 2—This improved antenna-gain measuring setup uses a ratiometer to factor out variations in source output power.

Standard Reference Antenna

The final critical part of the antenna measuring system is a standard-gain reference antenna with which all unknown antennas are to be compared. This is usually an antenna with moderate and *very* predictable gain. The EIA standard-gain antenna, a pair of dipoles over a groundplane is one such antenna. Various horn antennas with predictable performance can also be built.

If you don't have access to one of these standard antennas, an antenna of known performance (for example, the RIW-13 432-MHz antenna you measured at last year's VHF conference and which has been hanging up in the garage since) is probably as good as anything. Although your absolute numbers may be off a decibel or two, you really are only looking for system improvement. Relative readings are fine. Do not try to use a dipole as a standard reference. It will respond to signals from all over, including reflections from the test equipment. The higher the gain of the standard reference antenna, the better.

Making Measurements

Once you've gathered and assembled your test range, making the measurements is fun. Turn on the source and point the source antenna toward the detector end of the range. Walk back to the detector end and probe the field with the standard-gain antenna. Look for the maximum reading on the detector. You may have to move a bit or climb a ladder to get the peak.

Next, record the reading on your detector meter. The meter reading should be in decibels, probably referenced to a milliwatt (dBm). This is your reference level. Attach the test antenna to the same feed line in place of the standard-antenna and peak for maximum signal. If you know the gain of the standard, the gain of the antenna you're testing can be calculated. If, for example, your standard antenna reads 3.5 dB on the meter and your test antenna reads 6.5, your test antenna has 3-dB more gain than the standard. So, if the standard has 7 dB gain, your test antenna has about 10-dB gain.

If your measurement system has enough dynamic range, you can rotate the antenna 360 degrees and record the total pattern. At a minimum, you can record the sidelobe level and front-to-back ratio. If the gain is what you expected and the pattern is clean with sidelobes down 16 or 17 dB below the main lobe, put the antenna up. If not, maybe you better go back and read the instructions or try again!

I receive about one card or letter each month from the readers. I am assured that there are more who actually read the column, but it would be nice to hear from some of you. Any suggestions for future columns? I'll be glad to oblige if I can. In any case keep that card or letter coming!

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2000-character buffer. When a character comes to the computer from the Vancouver board, an interrupt occurs and the character is placed in the 2000-character buffer at the next available place. Using the LOC statement, INPUT$(LOC(1),1), one character is input to us from the 2000-character buffer. If LOC(1) is 1, this means at least one character is in the buffer. When the buffer is cleared, LOC(1) is a zero and we can check the keyboard.

This program is based on the terminal program supplied with the BASIC on the Macintosh. If you own a Macintosh, give it a try. If each packeteer had a program like this, most of the bulletin boards could be eliminated.

Disk Drives for the Xerox 820-1

Canon MDD2 double-sided, double-density drives were purchased from B.G. Micro (PO Box 280298, Dallas, TX 75228; tel 214-271-5546). The drives are 2/3 height, which means that two occupy more space than one Shugart SA450. They make fine drives for the Xerox computer. After two of these drives came into my possession, Mel Seyle, WA3KZR, discovered that the following switch settings work fine with Xerox 820s.

SW1—1 on, 2 off, 3 off, 4 off
SW2—1 on, 2 off, 3 on, 4 off, 5 off, 6 on, 7 off
SW3—1 off, 2 on, 3 on, 4 on, 5 on, 6 off

These settings allow the Xerox to shut off the drives after about 20 seconds of nonuse. The drives appear to work excellent and its low price encourages other ideas concerning packet and spread-spectrum software.

[Part 6 concludes the Xerox 820-1 Compendium; a composite video board for the 820-1 is discussed.]

Notes

[32]D. Borden, "Xerox 820-1 Compendium—Part 4," *QEX*, Sep 1986, p 10.
[33]H. Feinstein, "Spread Spectrum: Frequency Hopping, Direct Sequence and You," Jun 1986 *QST*, p 42.
[34]F. Williams, "A Digital Frequency Synthesizer," *QST*, Apr 1984, p 24.
[35]F. Williams, "A Microprocessor Controller for the Digital Frequency Synthesizer," *QST*, Feb 1985, p 14.