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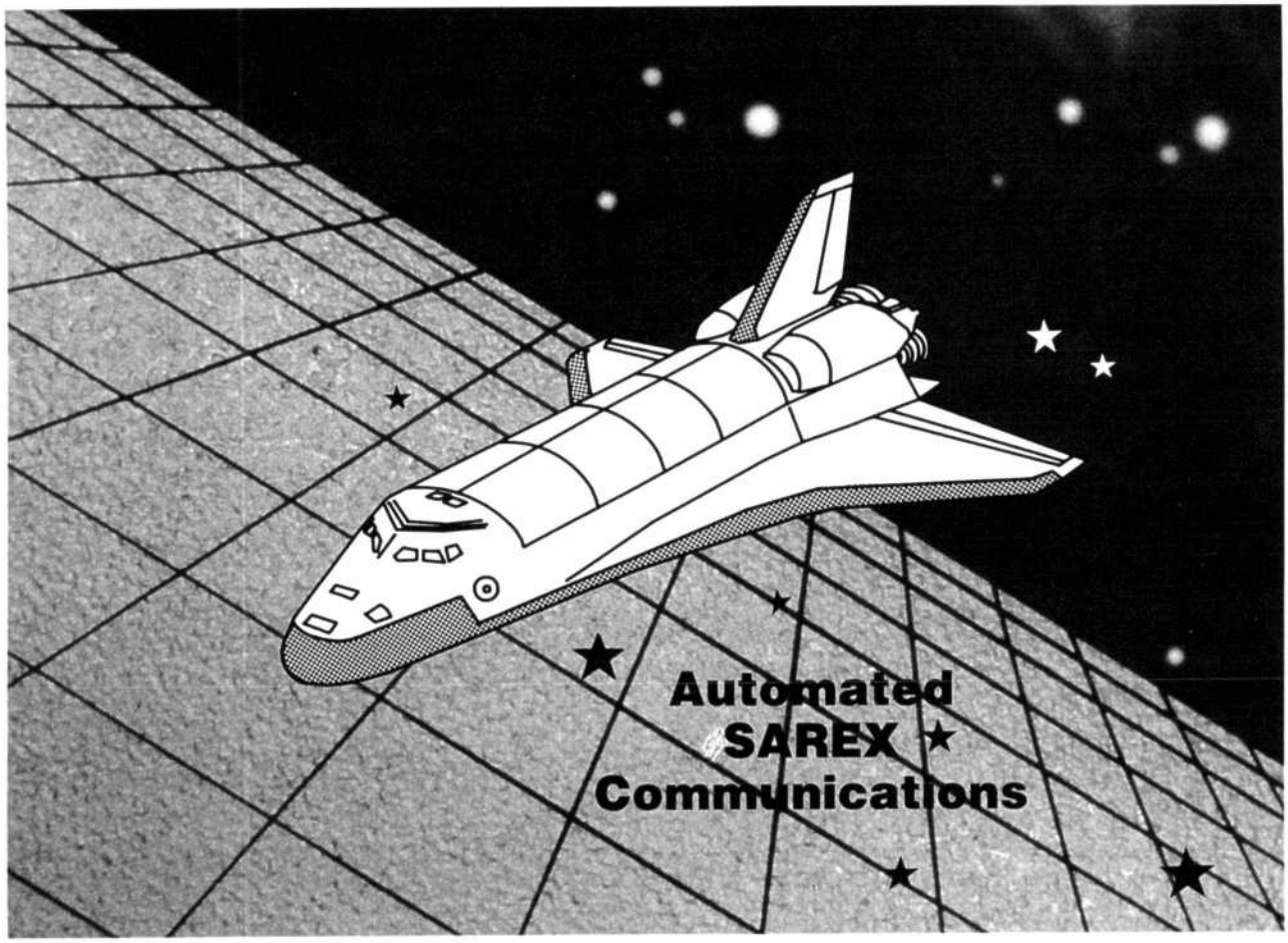
ARRL Experimenters' Exchange

APRIL 1991



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THE AMERICAN RADIO RELAY LEAGUE, INC

The American Radio Relay League, Inc, is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communications in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

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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*.

Any opinions expressed in *QEX* are those of the authors, not necessarily those of the editor or the League. While we attempt to ensure that all articles are technically valid, authors are expected to defend their own material. Products mentioned in the text are included for your information; no endorsement is implied. The information is believed to be correct, but readers are cautioned to verify availability of the product before sending money to the vendor.

Empirically Speaking . . .

Countdown to WARC-92

Those of you who have been trying to get hold of me are aware that I've been traveling most of the time—virtually all of it in connection with WARC preparation. For 1990, my calendar showed that I attended 85 WARC-prep meetings; those that Dave Sumner, Perry Williams, and Chuck Dorian covered brought the total to well over 100 meetings.

The International Radio Consultative Committee (CCIR) is responsible for producing a report that becomes the technical and operational basis for WARC-92. The Joint Interim Working Party (JIWP WARC-92) completed its work in a two-week meeting ending March 15. IARU, ARRL, JARL and WIA representatives were there to defend the parts of the report concerning Amateur Radio developed last year in lower-level Interim Working Parties. The result was that the texts relating to the amateur and amateur-satellite services were in the final report with only the most minor editing. Much of the CCIR report contains technical data on the potential for sharing between various services and radio systems, including the amateur services. For example, it says that it is difficult, but not impossible, for the amateur service to share with the HF broadcasting service because of the great difference in power levels. That information, with the CCIR's imprimatur, may provide the technical basis for WARC-92 to correct the longstanding interference between broadcasting and amateur services in the 7.1-7.3 MHz band.

The CCIR report also includes information relating to possible new allocations for digital audio broadcasting via satellite and mobile satellites, including those in low Earth orbit (LEO) looking very much like amateur Microsats. Basically, CCIR says that it's difficult for satellite broadcasting to share with anybody because broadcasters have to lay down a high enough signal on the ground for portable and vehicular receivers to pick up with wet-noodle antennas. For mobile satellites, however, CCIR goes into much sharing detail, which amounts to sometimes they can, sometimes they can't. All of this may be only academic for us if WARC-92 decides to put these services in bands not presently allocated to the amateur services.

In its Second Notice of Inquiry (NOI) on WARC-92, the FCC proposed the reallocation of 420-421 MHz exclusively to the mobile-satellite service for LEO downlinks. In its comments, the League opposed the exclusion of the amateur service from this band and use of the band as a downlink. Through our participation in many meetings of the FCC Industry Advisory Committee (IAC), we gathered IAC support for sharing the 420-421 MHz band and turning it around so that the LEO satellites would use it only for uplinks, which would cause us much less interference. Also, we were successful in getting geostationary mobile satellite proponents to drop their quest for the 1260-1300 MHz band. The Second NOI proposed that the 2390-2450 MHz band be reallocated to satellite sound broadcasting. The League and AMSAT objected to that. Meanwhile, there has been an accumulation of technical data supporting satellite sound broadcasting at a band around 1.5 GHz. However, there still remains interest in a band around 2.5 GHz for satellite sound broadcasting.

Because of many conflicting comments about proposals for the 1-3 GHz bands, the FCC decided to issue a Supplemental NOI, primarily to address these issues. The Supplemental NOI now asks public comment on reallocating 2360-2410 MHz to the broadcasting-satellite (sound) and 2410-2450 MHz to mobile-satellite (Earth-to-space), while leaving the amateur services to share these bands on a secondary basis (as we are now). Needless to say, these issues are getting priority attention—the deadlines are April 12 for comments and April 26 for reply comments.

To put the above in context, this is simply an FCC request for public comment. It is not the final position of the US government, which will be developed in coordination with other agencies. Even if the US government adopts a proposal to reallocate our 2390-2450 MHz band (either to remove the amateur services or give us new sharing partners), WARC-92 may decide otherwise. The League will continue to be involved in every phase of the WARC-92 process to ensure that amateurs will continue to have access to our present bands and that any new services added to those bands will be compatible sharing partners.—*W4RI*

Automated SAREX Communication

By Eric L. Smitt, K9ES
107 Atlantic Boulevard
Indian Harbour Beach, FL 32937

When NASA and AMSAT first placed amateur radio aboard an orbiting shuttle, I was unprepared to try and establish contact with Owen Garriott, W5LFL. I remember how clear his voice came over my 2-m HT, as he was just clearing the Yucatan Peninsula, while I stood in my kitchen in Massachusetts. I also remember how my friend, Jim Podsiadlo, AE1C, set up his OSCAR station to track the orbits, and how he was present during almost every pass calling W5LFL. It was, however, his wife, Vivian, KT1U, who walked in the station during one pass and place one call only to have Owen call her back. So even with this high-power station, Jim couldn't manage a QSO with the Shuttle.

The next amateur mission occurred with Tony England, WØORE, bringing live pictures to amateurs via slow-scan TV. These pictures were received and processed using commercial ROBOT ATV gear as well as a number of home-brew projects. However, to get the picture, you had to be in the shack when he came in view.

The current Amateur Radio EXperiment, SAREX, included a complete packet station controlled by a computer that maintained the logging function. The robot would be turned on at a specific time and try and make QSOs with amateurs over the world using basic AFSK packet protocol. Occasionally, Ron Parise, WA4SIR, would grab the mike and come over in a clear voice. However, most of the orbits we heard were packet transmissions.

I had just moved to a new QTH just 30 miles south of Cape Kennedy. As with most new comers to the Space Coast, the activity at the Cape becomes very interesting to observe. A letter to NASA last January produced a visitors pass to watch the launch of STS-35 from the NASA Causeway, just five miles across the Banana River from the Pad-39 complex. My station was set up to get back on OSCAR and, with the gear, I could communicate with WA4SIR. All that was required was to wait for the launch.

The first launch schedule was postponed due to technical problems in the Shuttle. They had hydrogen leaks around the plumbing that were considered too dangerous to allow launch. The next scheduled launch, around September, was also scrubbed due to similar problems. Then, on December 2 at 12:49 AM, the ground shook, and the night was illuminated like daylight, as STS-35 roared into orbit. My family and I, along with thousands of other observers, all cheered as the clock counted down and the solid rocket boosters came to life. STS-35 was on its way into orbit and SAREX would become operational.

I went home and got to sleep dreaming about what it would take to make the QSO. Then, the next morning, on a packet BBS, I read out the initial Keplerian element set and loaded the data into the appropriate file for *InstantTrack* to use for orbital predictions. The next orbital pass within view of my QTH would take place in the evening around 9 PM local time.

I went to the shack at the scheduled time and listened to 145.550 MHz, but did not hear any activity. I tried to connect to WA4SIR with no luck. I stayed in the shack during the 15-minute period calling out a packet "C WA4SIR" message every 10 seconds. The same thing occurred on the next pass, 75 minutes later. Then on the third pass of the evening, I heard his packets. But I didn't connect. This same scenario occurred the next five nights. All I had was pages of logs of QSOs that he was making; I couldn't seem to get through.

I then read a message from Tom Clark, W3IWI, about 2 parameters in the TNC which, if modified, might increase the probability of making a connection; DWAIT and FRACK. FRACK is the adjustment that establishes the frame acknowledgment timeout, or the time that the packet waits before trying to repeat the same frame over. DWAIT is the variable that establishes the delay that the TNC will wait after it has heard packet traffic stop before transmitting its own packet. What Tom suggested was that all the TNCs would be set to the same values, and since we were not receiving on the channel that we were transmitting, the normal collision avoidance methods were not functional, and everybody was clobbering everyone else's packet. By changing to different values, the possibility of collission was somewhat reduced.

I modified these two parameters as suggested and tried again to QSO with *Columbia*. Still, I did not get a connection. I was losing a lot of sleep trying to be in the shack for all these late-night/early morning passes. I thought that there must be a better way!

My station control is with an IBM® XT clone computer. It is the "basic" system, with a 20-Mbyte hard drive and 640-kbyte RAM. I use the *InstantTrack* software, written by Franklin Antonio, as my OSCAR tracking program[1]. It tells me where I have to point the antenna and what the relative Doppler shift is, among other things. I also use a G-5400B rotator, which gives me azimuth and elevation control to the OSCAR antenna. My antenna for 2 meters consists of a pair of Cushcraft 215-WB Yagis, mounted on a common boom, with a phasing harness and matching transformer to provide right-hand circular polarization. When the shuttle comes over, a pass will swing the antenna from west to east and the elevation from zero to some angle and back to zero in a few minutes. This means that the antenna must track quickly. To control the antenna and use communications programs to talk to the TNC is a lot of operator move-

[1]Notes appear on page 6.

ment during this 15-minute pass. There must be a way of automating this system!

I purchased an interface board from L.L. Grace Communications Products. This board is the *Kansas City Tracker/Tuner* product[2]. The product and software take data from the *InstantTrack* program and drive the G-5400 rotor in real time to track the satellite (or shuttle). The interface will operate almost any kind of rotor that uses a voltage indication of position. A couple of nights of wiring and some installation of software brought the antenna tracking to a new level of automation.

The actual installation is done when I bring up the *IT* software. I created a "batch" program under MS-DOS®. I execute this batch program and everything comes to life. The batch commands are as follows:

```
; Batch Program "TRACKIT.BAT"
;   By Eric Smitt  K9ES
;
CD C:\OSCAR                          ; get to correct directory
SET TZ=EST5EDT                       ; sets GMT calculation
DRV/LOCAL=-4/FLIP=1/PA=5/STALL=24    ; KCT Driver parameter
OSC/JPT=$18                          ; Key = "Alt-O"
ORBITNCP                             ; TSR for the Orbit Driver
ITNCP                                ; Start InstantTrack
```

The first thing observed is that the rotor begins to move to its PARK position. The computer sends, in CW, the present position of the rotor and the *InstantTrack* program comes to life. I do not have a graphic monitor on my IBM and I am also lacking a math co-processor. Therefore, I use the *ITNCP* and *ORBITNCP.DRV* programs. If I had the co-processor, I would use *IT* and *ORBITDRV* programs.

The initial screen for *IT* is the main menu. Without a graphics monitor, *IT* provides the ability to track a satellite using an alphanumeric screen. By typing 1 to the main menu, you get a list of satellites from the data base. Each satellite in range is highlighted. Type the number of the satellite from the data base and *IT* then provides tracking information. Then, by typing an R, the TSR program *ORBITNCP* is activated[3]. At this point, the actual tracking program can be halted. The TSR program continues to calculate and control the rotator, through the KCT interface.

Once the TSR is stated, I then bring up *ProCOMM*® using a timed execution file, or TEF command[4]. The structure of the actual TEF command is a follows:

TEF File.CMD hh:mm

The file.CMD file is a *ProCOMM* command file that will be explained later. The TEF command will bring up *ProCOMM* and execute the command file when the clock in the computer is set to the exact time of the "hh:mm" time in the TEF statement. I write a batch file, made of several different TEF lines, for each night's passes. The batch file can be called anything, but I use a format that identifies the batch by the date which it will execute. This file is called, for example, DEC08.BAT. This file is as follows:

```
TEF   STS-08-1.CMD   22:54
TEF   STS-08-2.CMD   00:09
TEF   STS-08-3.CMD   01:21
TEF   STS-08-4.CMD   02:37
TEF   STS-08-5.CMD   03:50
TEF   STS-08-6.CMD   05:10
TEF   STS-08-7.CMD   06:25
```

Each STS-08-X.CMD file is similar, except that the time loaded into the TNC is set for the time in the TEF line that calls the program. I have not found a way for the computer to read the time from its clock and load this into the DA statement to update the TNC. I do know that the TNC clock drifts such that in a day the errors in time can be extreme. I also know that as much as I try to play around with the clock frequency, using the CLKADJ command that I cannot get the time of the TNC to be accurate. Therefore, it is better to initialize the clock for each pass.

Each line of the TEF commands has a time associated with it. I started the *ProCOMM* run two minutes before the anticipated pass. Since the Keplerian elements are not updated every day, I think a better approach would be to start *ProCOMM* five or ten minuted before the *IT* said that AOS would occur. This will compensate for any errors that *IT* has with the actual orbit.

The actual command file, STS-08-X.CMD file is as follows:

```
;     PROCOMM COMMAND FILE FOR STS-35
;     CONNECTION VIA PACKET TO SAREX
;     ROBOT
;           BY ERIC SMITT  K9ES
;
;     OPEN LOG TO DISK, NAMED FOR THE
;     DATE OF MISSION
;
LOG OPEN "STS35.008"                 ; Long file will be called
                                     ; STS35.008 for these passes
                                     ; even though they start on
                                     ; December 7
;
;     START PRINTER PORT AND ENABLE
;     MFJ TNC PARAMETERS
;
SET BAUDRATE 9600
SET DATABITS 7
SET STOPBITS 1
SET PARITY EVEN
SET PORT COM1
;
;     SET HALF DUPLEX TO MONITOR CONNECTION
;     ATTEMPTS
;
SET DUPLEX HALF
;
;     NOW SET THE TIME OF DAY AND MONITOR
;     FUNCTION ON TNC
;
TRANSMIT "^C!"                       ; CONTROL C
TRANSMIT "da 9012072254!"            ; DATE AND TIME This is the
                                     ; time in the first TEF command
                                     ; statement
TRANSMIT "^C!"                       ; CONTROL C
TRANSMIT "MON ON!"                   ; PUT TNC MONITOR ON TO
                                     ; START LOGGING ACTIVITY
;
;     NOW WAIT TO HEAR PACKET FROM SAREX BEFORE
;     INITIATING TRANSMIT ROUTINE
LISTEN_FIRST:
      WAITFOR "WA4SIR>" 1200         ; THIS SHOULD BE HEARD
         IF WAITFOR                  ; BEFORE YOU START TO
            GOTO START_XMIT          ; TRANSMIT. THE TIMEOUT
         ELSE                        ; IS SET FOR 20 MINUTES
            GOTO LISTEN_FIRST        ;
         ENDIF
;
;     IF TIMEOUT OCCURS, THEN THERE WAS NO RECEIVED
;     PACKETS DURING PASS, AND THE PROGRAM PRINTS
;     END OF PASS MESSAGES, CLOSES THE LOG, AND QUITS
;
END_OF_PASS:
      MESSAGE "END OF PASS!"         ; PRINT TO LOG AND PAPER
      LOG CLOSE                      ; CLOSE THE LOG
      TRANSMIT "^C!"                 ; CONTROL C TO TNC
      TRANSMIT "MON OFF!"            ; TURN MONITOR OFF
      PRINTER OFF                    ; TURN PRINTER OFF
      QUIT                           ; EXIT BATCH FILE TO DOS
;
;     THE ACTUAL TRANSMIT TIME BEFORE THE TNC GETS
;     A RETRY COUNT EXCEEDED MESSAGE IS MEASURED AT
;     130 SECONDS. THIS LOOPING PROGRAM IS STARTED
;     FOR n = (TOTAL PASS TIME / 130)
;     THIS IS A SUB-ROUTINE, THAT IS CALLED WITH A
;     GOSUB COMMAND. UPON COMPLETION, THE PROGRAM
;     RETURNS TO THE CALLING ROUTINE +1
;
```

```
XMIT_TNC:
      MESSAGE "ATTEMPTING CONNECTION!"          ; LOG TO PRINTOUT
      TRANSMIT "^C!"                            ; CONTROL C TO TNC
      TRANSMIT "C WA4SIR!"                      ; CONNECT TO WA4SIR
      WAITFOR "*** CONNECTED TO WA4SIR" 130     ; WAIT FOR ACTUAL
          IF WAITFOR                            ; CONNECTION TO SHUTTLE
              GOTO CHAT                         ;
          ELSE                                  ;
              GOTO TIMEOUT                      ;
          ENDIF                                 ;
TIMEOUT:                                        ;
      WAITFOR "*** RETRY COUNT EXCEEDED" 130    ; WAIT FOR END OF
          IF WAITFOR                            ; RETRIES TO START OVER
              GOTO STOPIT                       ;
          ELSE                                  ;
              GOTO STOPIT                       ;
STOPIT:                                         ; EITHER TIMEOUT OR
      RETURN                                    ; OR RETRY STARTS OVER
;
;     CHAT ROUTINE IS USED TO ENTER QSO AND MAKE CERTAIN
;     THAT COMPLETE PROTOCOL EXISTS, UP TO PROPER DISCONNECT
;
CHAT:                                           ;
      MESSAGE "**********************!"         ; MARK THE LOG FOR
      MESSAGE "**********************!"         ; EASY SPOTTING
      WAITFOR "*** DISCONNECTED" 130            ; MAKE SURE YOU GET
         IF WAITFOR                             ; PROPER MESSAGE.
             GOTO END_OF_PASS                   ; END, YOU MADE QSO
         ELSE                                   ;
             MESSAGE "*** POSSIBLE INCOMPLETE QSO ***!"
             GOTO STOPIT                        ; TRY AGAIN !!!
         ENDIF                                  ;
;
;     ROUTINE THAT ACTUALLY STARTS THE TRANSMIT PERIODS
;
START_XMIT:                                     ; USE THE CORRECT
   GOSUB XMIT_TNC                               ; NUMBER OF CALLS
   GOSUB XMIT_TNC                               ; TO MAKE UP A PASS
   GOSUB XMIT_TNC                               ; PERIOD
   GOTO END_OF_PASS                             ;
```

For each CMD file, make certain that the time statement in the line "TRANSMIT DA 90120xhhmm!" is correct. This line initializes the TNC so that you get a record of activity with an accurate time stamp associated. The actual contact that I made, QSO 1312, was done during a 1½ hour period when somehow, the clock in SAREX was reset. I got a message from W3IWI to check my logs and verify when my QSO occurred.

With the TSR program running in background, I start the TEF program batch for DEC 8 by just typing the MS-DOS command "DEC08" and then "Enter." MS-DOS finds the batch program, DEC08.BAT, and executes the first line, which is the first TEF command. The computer is now "armed" until the time matches 22:54 on 7 December. Then, the computer comes to life, and executes the first command files for *ProCOMM*. My printer is turned on, a log file is opened, the TNC time is set and all the other functions of the TNC are set. The computer is now in a monitor mode, waiting to hear the first packet burst from WA4SIR.

I used this safeguard for the following reason. When I first automated the program, I came up and started trying a connection to WA4SIR. However, the Shuttle came active on voice and Ron was calling CQ waiting for FM QSOs. I was answering him with packet. A few minutes later, my telephone rang and someone informed me that I was transmitting packets while he was looking for voice contacts. After an embarrassing moment, I corrected the batch program and put in a test for hearing his packet, before starting my transmit run. This also minimized any potential interference to other packet services on 144.950 MHz. It also prevents transmitting until I actually hear the shuttle. Many "operator errors" occurred when people began transmitting on 145.550 MHz.

The success story was obvious when on the morning of December 8 I was reading through my logs and I came upon the following received data. This is an *exact copy* from my log.

ATTEMPTING CONNECTION

cmd:C WA4SIR

WA4SIR>BILL [12/08/90 07:49:05]
#1310-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

WA4SIR>KB4SYV [12/08/90 07:49:15]
#1309-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

WA4SIR>N4PLY [12/08/90 07:49:55]
<D>

WA4SIR>WD4SBV [12/08/90 07:50:35]
<UA>

*** CONNECTED TO WA4SIR [12/08/90 07:51:05]
#1312-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

WA4SIR>WD4SBV [12/08/90 07:51:20]
#1311-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

WA4SIR>WD4SBV [12/08/90 07:51:30]
<D>

WA4SIR>AB4PX [12/08/90 07:51:35]
<UA>

WA4SIR>K4OSM [12/08/90 07:51:45]
<UA>

#1312-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

WA4SIR>WD4SBV [12/08/90 07:51:50]
<D>

WA4SIR>WB5AAA [12/08/90 07:51:55]
<UA>

#1312-is your SAREX QSO number.
Thanks for the connect
from the Space Shuttle Columbia.

*** DISCONNECTED [12/08/90 07:51:47]

My equipment consists of the following. I ran an ICOM-271A transceiver, modified for improved overload conditions, with the Mutek Front-End board. The IC-271A fed a Mirage 160-watt amplifier, backed down to 100-watts output. I use the pair of 215-WB Yagis in RHCP mode, up 35 feet, to clear all trees. For 432, I use the IC-471A transceiver with a Cushcraft 416B OSCAR antenna. I plan to have a home-brew 4CX250K amplifier on line to give me about 300-watts output on 432. I also will have a K2RIW amplifier on line for 2 meters before the next launch.

While this list of equipment seems advanced, I think that a good 2-meter station with circular polarization Yagis that have elevation control will greatly improve chances for a Shuttle QSO. The largest activity where QRM is highest is when the Shuttle was over populated area. I was able

to work him when he had already gone from west through south and towards east. This placed the Shuttle over water and not over the highly congested areas. My elevation at the time of QSO was 9 degrees, so he was going away.

To improve the chances to make a Shuttle QSO, follow these simple guidelines. First, modify the parameters in the TNC as described so that your TNC performs slightly different from everyone else's. Then use a good antenna to increase your signal in the direction of the Shuttle. Understand that a 1/4-wave vertical radiates slightly better towards the sky than a 5/8-wave or collinear vertical. If you cannot get a directional array with elevation control as well as azimuth control, use a turnstile with a reflector. A Yagi is a better antenna and finally, a circular polarized antenna is best. I found that I needed about 100-watts output to the antennas, to make it through the QRM. The calculated ERP was about 1 kW when all the losses were taken into consideration along with the gain of the Yagis. But the biggest suggestion is to run as many of the functions automated. The antennas should be tracked to lock them to the Shuttle. The computer should put everything both to hard copy and to a log file. And the rest is a matter of luck.

References

AMSAT-NA can be contacted at the following address: AMSAT-NA, PO Box 27, Washington, DC 20044.

[1]*InstantTrack* is licensed software, written by Franklin Antonio, N6NKF, 2765 Cordoba Cove, Del Mar, CA 92014. All comments can be forwarded directly to Mr. Antonio.

[2]*Kansas City Tracker* and *ORBITNCP* are licensed by L.L. Grace Communications Products, 41 Acadia Drive, Voorhees, NJ 08043, tel (609) 751-1018. Inquiries and orders for these products may go direct to this number. The package includes several option, so please contact them before ordering any hardware. They also have ready-made harnesses to interface from their board to the G-5400 rotor control.

[3]See reference 2.

[4]*ProCOMM* is licensed by DATASTORM Technologies, PO Box 1471, Columbia, MO 65205, tel (314) 474-8461. Inquiries should be sent to the DATASTORM Corporation. The software routines that I wrote may not perform correctly in all situations, as many of the commands are hardware specific.

SAREX Update

The STS-37 *Atlantis* mission will carry the Gamma-Ray Observatory (GRO) for deployment into orbit, experimental "scooters" to be evaluated for use in *Space Station Freedom* assembly, and a Shuttle Amateur Radio Experiment (SAREX) setup. STS-37, scheduled for around April 4, is the fourth flight to carry an Amateur Radio experiment and this mission encompasses the most ambitious demonstrations so far in the space program. NASA has approved the use of Amateur Radio experiments during Shuttle flight for two reasons: to encourage public participation in the space program and to support educational opportunities offered by Amateur Radio voice and digital communications.

The setup for STS-37 will include two capabilities that are eagerly anticipated—packet and fast-scan television (FSTV). Packet radio was first demonstrated in 1990 on STS-35 with great success and it will be used again on STS-37. A first-time effort will be a television uplink to the manned spacecraft using a broadcast-standard transmission format (fast-scan television). Selected Amateur Radio operators hope to use this uplink to carry live video from crew members' families to the Shuttle.

During the astronauts' sleep periods and when no other SAREX activities are scheduled, equipment will be left on in packet robot mode. If time permits, the crew will set up SAREX to retransmit SSTV using orbiter video cameras during the GRO satellite release and during the extravehicular activity (EVA). The GRO satellite release is scheduled for mission elapsed time (MET) 2/03:00 (2 days and 3 hours after launch) for 1 hour. The EVA is scheduled for MET 2/22:00 through MET 3/05:00.

The primary mission of SAREX is voice communication with ten schools across the United States. From these contacts, hundreds of students and teachers will be directly involved in communication with astronauts during a Space Shuttle mission.

A possibility exists for contact between *Atlantis* and *Mir*, the soviet orbiting space station. Two opportunities were planned during the STS-35 mission but neither opportunity could be realized. At the time of the first opportunity *Mir* was docking with another Soviet spacecraft, and the second opportunity was not realized because *Columbia* returned to Earth a day earlier than scheduled.

Astronaut Ken Cameron, KB5AWP, the pilot for mission STS-37, has been a ham since 1984, even before he joined NASA. He is extremely enthusiastic about flying SAREX aboard the flight and has encouraged his fellow crew members to become hams. All five astronauts now have their tickets!

The other crew members are Commander Steve Nagel, N5RAW; Mission Specialist Linda Godwin, N5RAX; and Mission Specialist Jay Apt, N5QWL. —*WA1STO (Information thanks to Johnson Space Center)*

The OZ1HWO 144-148 MHz Pocket FM Receiver

By Morten Tolstrup, OZ1HWO
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Denmark

Translated from the May 1990 issue of ***OZ*** *Magazine*

If you're looking for a simple receiver project, one that's easily built in a couple of evenings, this project will surely catch your interest.

Introduction

This compact 2-meter receiver was inspired by Motorola application note AN980 and other articles and design notes describing the MC3362. The project is based on the Motorola MC3362 dual-conversion single-chip receiver, which yields several benefits—simple design, low component count, low cost and compact design.

Don't compare this receiver with a $700 receiver; consider it a simple monitor receiver that, in spite of simple design and low cost, produces good reception—good sensitivity and selectivity.

The MC3362 is a complete dual-conversion receiver from antenna input to audio output, including S-meter circuit, varicap diode for tuning the first LO, carrier detector and quadrature detector. With internal oscillators, the MC3362 is suitable for reception up to 180 MHz, with external oscillators, up to 470 MHz (the sensitivity falls with rising frequency). A block diagram of the MC3362 is shown in Fig 1.

Some important data of the MC3362 (for more details refer to Motorola data sheets):

1st IF	10.7 MHz
2nd IF	455 kHz
Supply voltage	2-7 V
Current consumption	4 mA
Sensitivity (50 MHz - 20 dB sinad)	0.7 μV
Frequency range:	
With internal oscillator	180 MHz
With external oscillator	470 MHz

A Block-by-Block Description of the MC3362

First Mixer—The antenna input is fed directly into the first mixer via pin 1. This mixer has an 18 dB gain. It is also possible to feed the first mixer balanced via pin 1/24. The mixer provides a 10.7 MHz IF output on pin 19.

First LO—The first local oscillator can use an external source, an LC tank or a crystal to determine the reception frequency. If (as in this receiver) an LC tank (pin 21/22) is preferred, a built-in varicap diode will provide proper tuning of the reception frequency. The varicap control voltage must be kept between 1.2 V and V_{cc}. If you do not use the varicap, connect pin 23 to V_{cc}.

The first LO has a frequency range up to 180 MHz (V_{cc} 6-7 V), and is internally fed to the first mixer; output is available on pin 20.

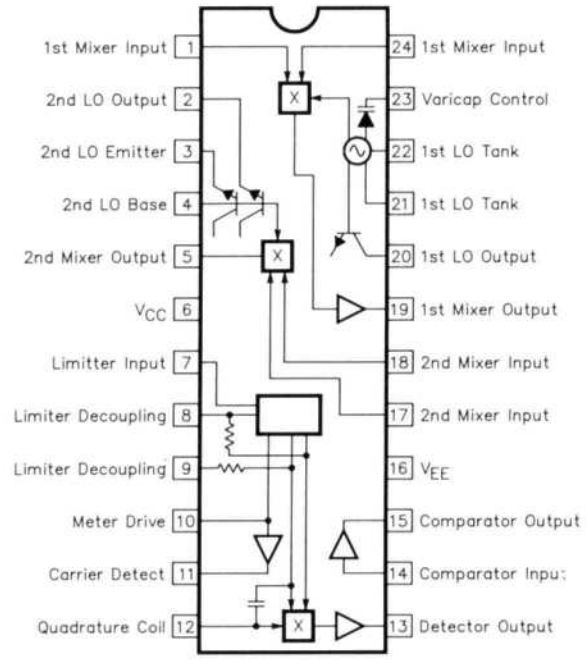


Fig 1—Block diagram of the MC3362.

First IF: 10.7 MHz—From the first mixer, the 10.7-MHz signal is via pin 19, fed to an IF filter, in this case a ceramic filter SFE10, 7MA from MuRata. The 10.7 MHz IF passes the IF filter and is fed into the second mixer input, pin 17.

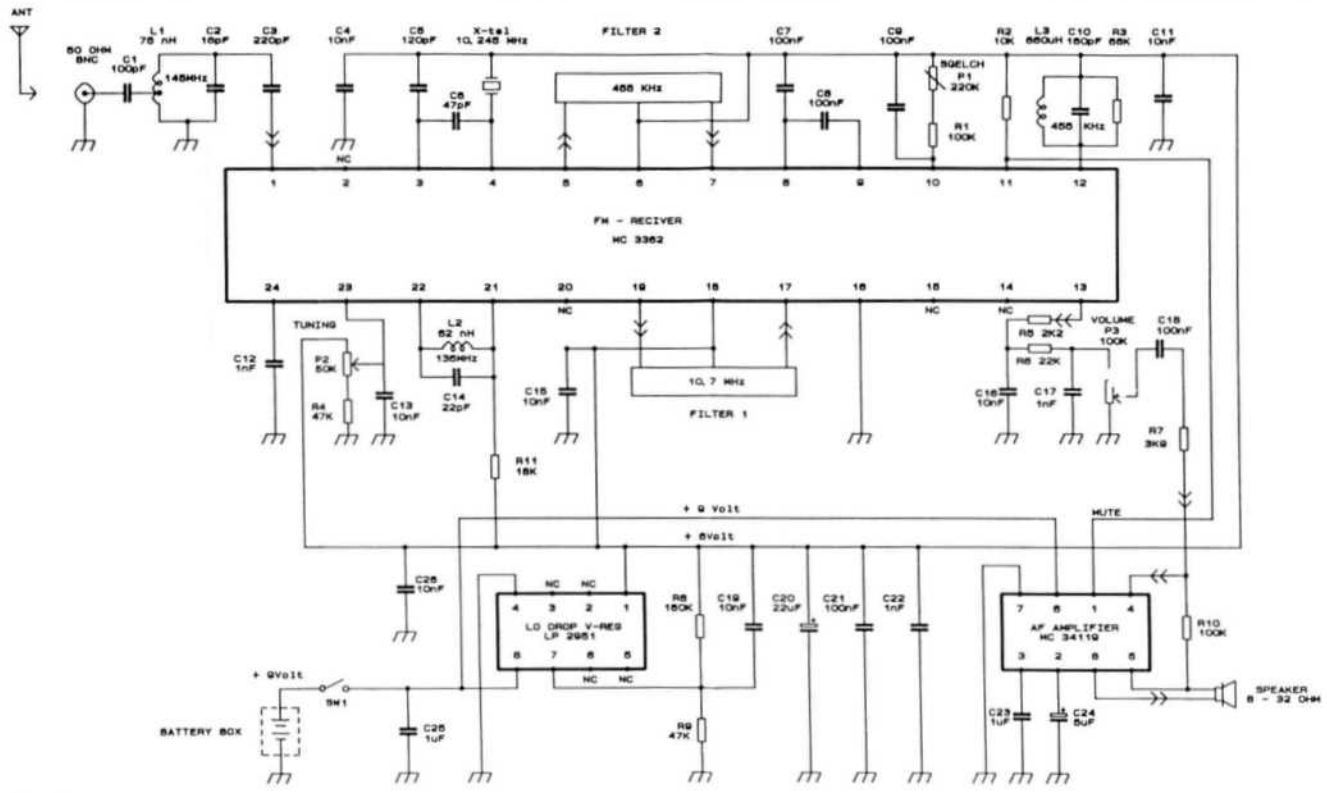


Fig 2—Receiver diagram

Second Mixer—Like the first mixer, the second mixer allows balanced input via pin 17/18. Output is a normal 455-kHz IF signal. The second mixer has approximately 21-dB gain; output is available on pin 5.

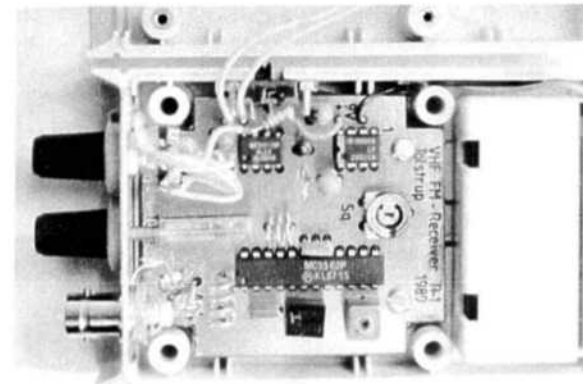
Second LO—The second oscillator is crystal controlled (pin 3/4) with 10.245 MHz as the resonance frequency (10.7 MHz – 455 kHz = 10.245 MHz). The crystal should be an IF-standard parallel-cut crystal with 32-40 pF load capacity. The oscillator is internally fed to the second mixer; output is available on pin 2.

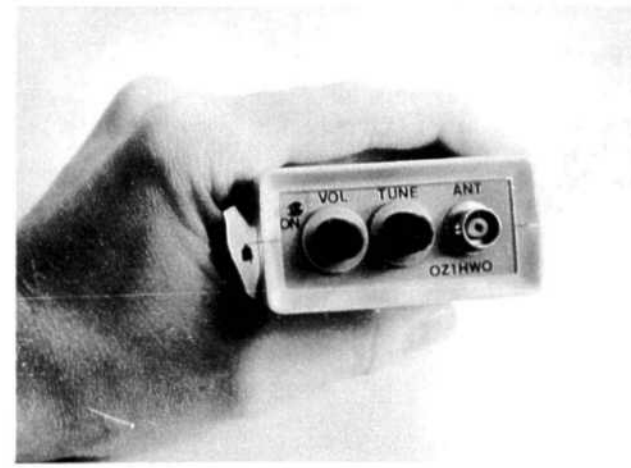
Second IF: 455 kHz—From the second mixer, the 455-kHz IF signal via pin 5 passes the 455-kHz ceramic IF filter (CFU455A) and goes back to the limiter input on pin 7.

The Limiter—The 455-kHz IF signal is fed into the limiter input, pin 7. The limiter suppresses AM noise and is effective up to approximately 1 MHz.

The Detector—The limiter output is internally fed to the quadrature detector. The quadrature detector needs a low Q tank circuit on pin 12 (455-kHz resonance). The detector provides an AF output on pin 13.

The MC3362 also has a built-in S-meter amplifier and squelch circuit (mute signal on pin 11).





Receiver Circuit Description

The general function of the MC3362 has been described, therefore only the other circuits contained in the receiver will be described, along with remarks to the components vital for the receiver.

The PCB—The pocket receiver is assembled on a glass

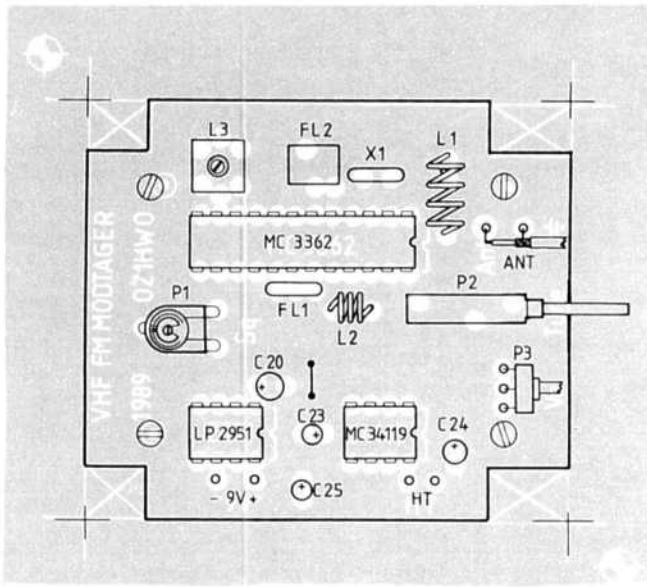


Fig 3—Component placement—top of PC board.

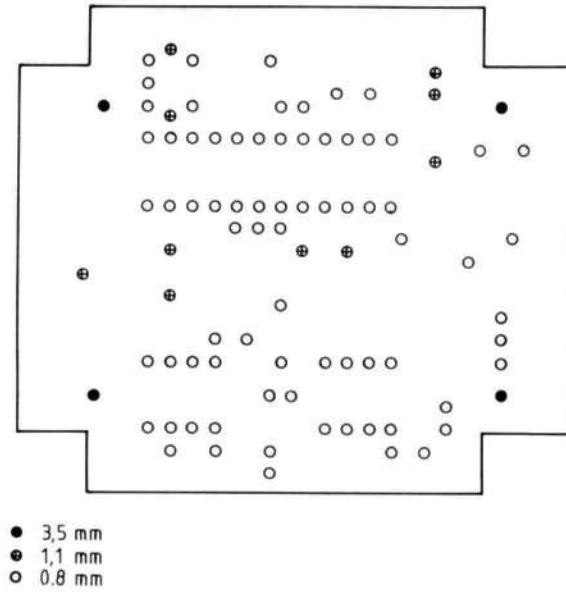


Fig 4—Diagram for drilling the PC board.

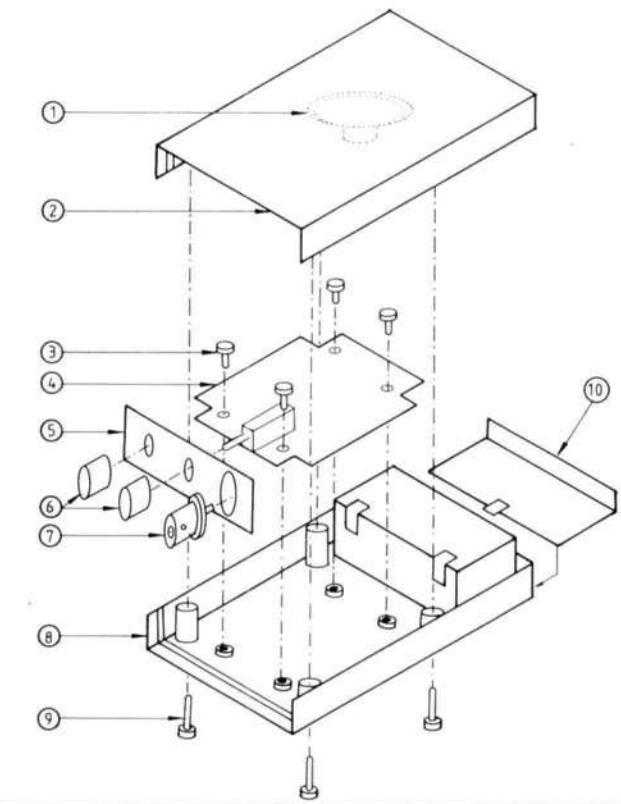


Fig 5—Assembly of the cabinet.
1—Speaker, 1½ inch, 8 ohm, 0.1 W.
2—Top plate.*
3—4 self-tapping screws.
4—PC board.
5—Front plate.
6—2 knobs, OKW no. 26 09 04 0.
7—BNC socket.
8—Bottom plate.*
9—4 self-tapping screws.*
10—Battery compartment.*
***Complete cabinet, OKW A 94 07 114, contains top, bottom, battery compartment and self-tapping screws.**

fiber PCB, 55 × 65 mm, with a ground top plane to prevent oscillations and EMC difficulties.

The size and shape of the PCB is designed to fit in a cabinet from Odenwalder.

All of the resistors and most of the capacitors are SMDs as they are more feasible for high-frequency applications. Don't be nervous using/soldering these small components, you'll soon get use to SMDs.

The Voltage Stabilizer—The V_{cc} +6 V is stabilized with a low drop requlator LP2951 from National. The LP2951 has the advantage that it only needs a voltage drop of around 0.2 V, a "normal" voltage regulator like the 78L05 needs about a 2-V drop to stabilize the output voltage. This means that if the battery voltage, as in this receiver, is 9 volts, the output voltage will be only a stable 6 volts. With a battery voltage down to 8 volts using the 78L05, using the LP2951, the V_{cc} +6 V will be stable with a battery voltage down to 6.2 volts. This means a considerably longer battery life-time with the LP2951.

AF Amplifier—The MC34119 is selected as an AF amplifier. It's a little amplifier with a low external component count. The MC34119 has enough power to drive the speaker in this receiver. The amplifier is powered directly from the battery to prevent over load of the stabilized +6 volts V_{cc}.

The Receiver—The antenna signal passes C1, and the resonance circuit L1/C2 passes C3 to the input of the first mixer on pin 1 of the MC3362.

The output from the first mixer is the antenna frequency minus the frequency from the first oscillator tank circuit on pin 21/22 (the difference equals 10.7 MHz). In the first IF signal, 10.7 MHz passes the first IF filter on pin 17/19 and is then fed into the second mixer, pin 17, and is mixed down to 455 kHz in the second mixer (10.7 MHz – 10.245 MHz = 455 kHz).

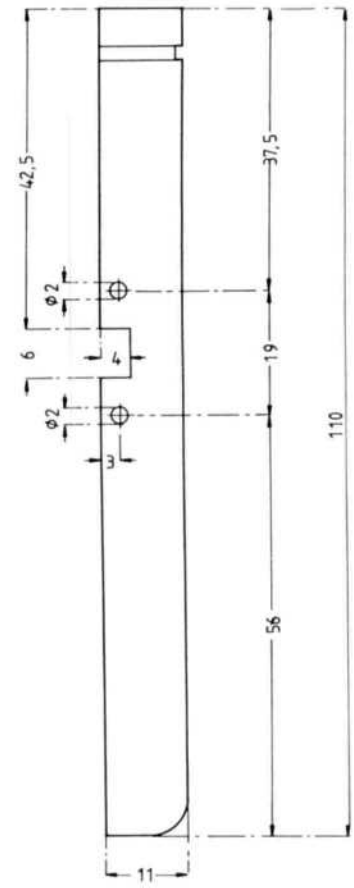


Fig 6—Diagram for drilling the bottom of the cabinet.

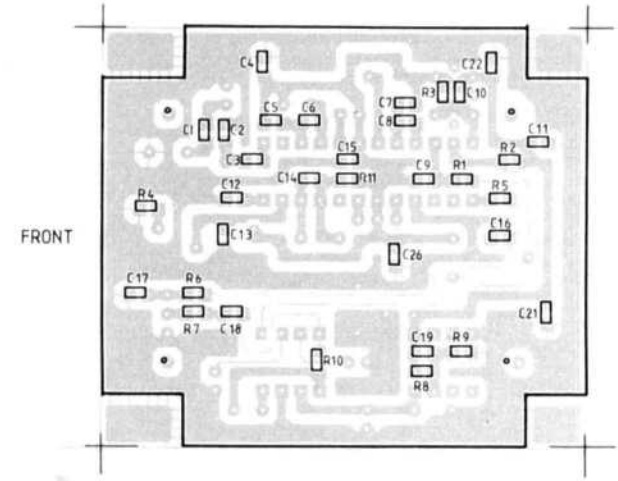


Fig 7—SMD placement—PC board bottom, solder side.

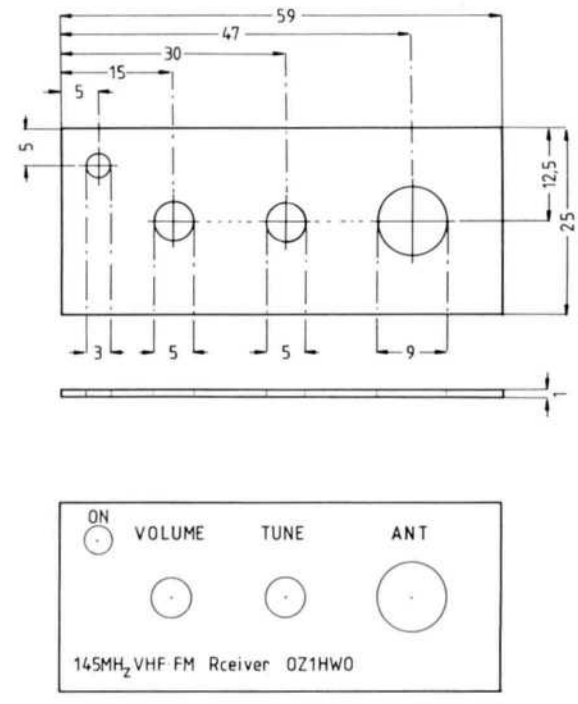


Fig 8—Cabinet top plate.

The output from the second mixer, pin 5 (455 kHz), is via the second IF filter connected to the limiter input pin 7. The limiter suppresses any AM noise on the FM (IF) signal and the output from the limiter is internally fed to the detector; AF output is available on pin 13.

The built-in carrier detector is used as a squelch providing a mute output to the AF amplifier on pin 11. The squelch level can be adjusted by P1.

Other Frequencies?—You may not wish to use this receiver on 2 meters, but perhaps on the other bands. It is quite easy to modify the receiver to other frequencies. You only have to retune the antenna circuit C1/L1 to the desired frequency and retune the first LO L2/C14 (resonance frequency = receive frequency – 10.7 MHz).

Assembly—If this is your first experience with mounting SMD, it is advisable that you follow these instructions carefully:

After etching and drilling of the PCB, first mount the SMDs carefully—remember to heat properly—but don't overdo it. Use enough solder to cover approximately half the end of the pad/SMD component (hold the SMD with tweezers). Hereafter, the other components can be mounted on the top of the PCB, with the ICs being last. Be careful to ground the tools when mounting the ICs to avoid ESD (electrostatic damage). If you use sockets for the ICs, select good quality sockets.

Adjustment—When the receiver assembly is complete, it is time to power up for the first test/adjustment. It is advisable to use a power supply with a current limiter (20 mA) for the first test to avoid major damage in case of any component misplacement.

The squelch should be adjusted down (noise in speaker). Adjust the tuning potentiometer to center position, connect a frequency generator with output frequency adjusted to center frequency (146.500 MHz). Then gently pull or

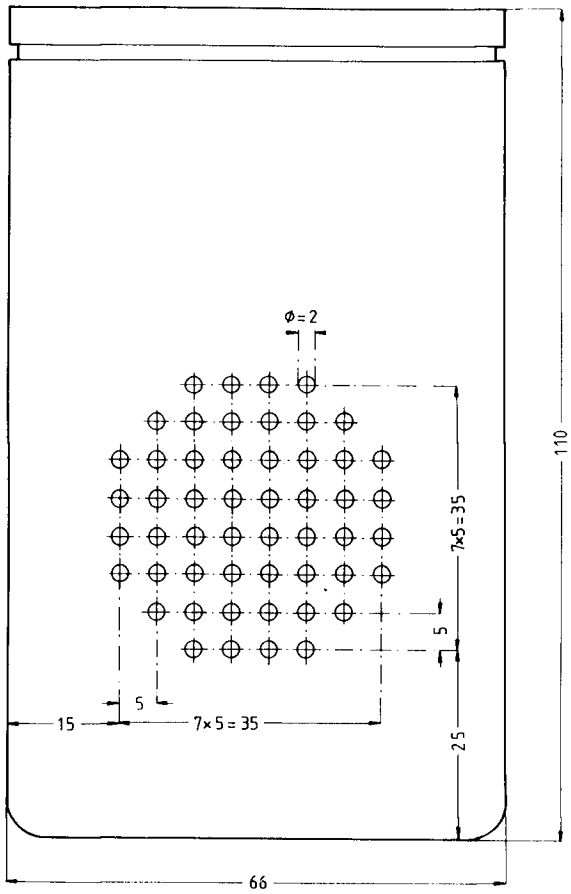


Fig 9—Diagram for drilling the top of the cabinet.

press L2 so the center frequency of the receiver matches the generator output.

Before adjusting L2, it's a good idea to adjust the generator frequency until a signal is received. To get an impression, the receiver should be tuned up (press L2) or down (pull L2) in frequency, but be careful, you don't have to adjust L2 much before the receiver frequency is moved 5 MHz.

If you don't have access to a frequency generator, use a gate dipper (I did).

Final Remarks

I hope that you will find pleasure in building this little receiver, either by yourself or as a club project.

I have measured the sensitivity on my receiver at 145 MHz to approximately 1μ-V/10-dB SINAD.

Have fun; maybe I'll see you down the log on 14-MHz CW.

Parts List—The OZ1HWO 144-148 MHz Pocket FM Receiver

SMD 1206 Capacitors-ceramic 5%:

C1—100 pF
C2—15 pF
C3—220 pF
C4,11,13,15,16,19,26—10 nF
C5—120 pF
C6—47 pF
C7,8,9,18,21—100 nF
C10—180 pF
C12,17,22—1 nF
C14—22 pF

Tantal Capacitors:

C20—22 μF/10 V
C23—1 μF/6 V
C24—4.7 μF/6 V
C25—1 μF/10 V

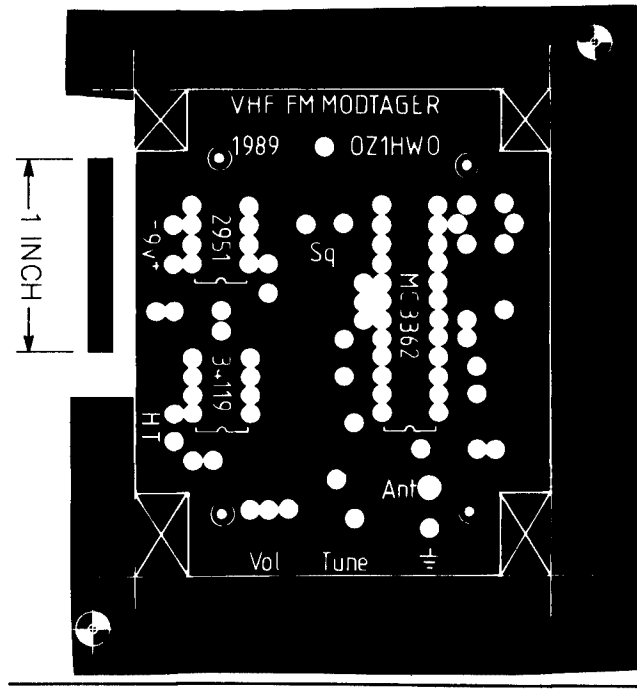


Fig 10

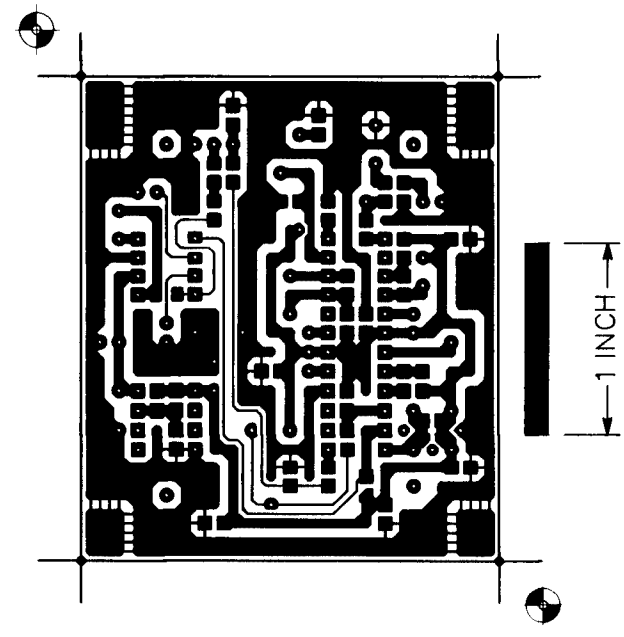


Fig 11

SMD 1206 Resistors:
- R1,10—100 kΩ
- R2—10 kΩ
- R3—68 kΩ
- R4,9—47 kΩ
- R5—2.2 kΩ
- R6—22 kΩ
- R7—3.9 kΩ
- R8—180 kΩ
- R11—18 kΩ

Potentiometers:
- P1—horizontal little trimmer, 220 kΩ
- P2—10 turns, 4 mm, 50 kΩ
- P3—Log, 4 mm, 100 kΩ
- SW1—Switch

Ceramic/Crystal Filters:
- FL1—MuRata SFE 10.7 mA
- FL2—MuRata CFU 455A
- X1—HC18U 10.245-MHz parallel out 30/40 pF

Inductors:
- L1—Air inductor, 4 windings 1.0-mm copper with silver (0 = 1.0 mm), made around a 4.5-mm drill, 10 mm long. Input to receiver, one winding from ground.
- L2—Air inductor, 3 windings 1.0-mm copper with silver (0 = 1.0 mm), made around a 4.5-mm drill, 5 mm long.
- L3—220 windings, 0.1-mm copper coated wire on Neosid 7M1S.

Integrated Circuits (DIL):
- FM receiver—MC3362P
- AF amplifier—MC34119P
- Voltage stabilizer—LP2951CN

Other Components:
- Speaker—1½-inc, 8-Ω, 0.1 W
- Cabinet—Odenwalder OKW A 94 07 114
- Bottoms, Battery, BNC chassis socket

VHF+ Technology

By Geoff Krauss, WA2GFP
1927 Audubon Drive, Dresher, PA 19025

My next-to-last column, scheduled for November '90, got lost in the mail (yeah, I *know* all the arguments for transmission via radio, but *is* it a "commercial" use? —besides, the shoemaker's children always go barefoot!), so I updated the material and present it a bit later, but better, I hope, than never...

Changing the Contest Rules, Revisited

I had heard rumors that the results of the poll conducted by the staff of the VHF/UHF Contesting column in the *National Contest Journal* (*NCJ*) have been presented to the ARRL Contest Advisory Committee (CAC), which is the group that actually makes the changes in the rules, even for our VHF/UHF contests. This has now been verified by comments published in the Nov/Dec issue of *NCJ*, as well as some comments at the beginning of the June Contest Results in December 1990 *QST*. I continue to be bothered by the fact that, although much was said about how the CAC will consider these "suggestions," the actual survey results were not given to the readership (nor, for that matter, stated as given to the CAC!). As one VHF+er who received a survey form and cared enough to have responded, I would really like to know how my outlook (and the apparently one-sided outlook of participants in forums on the subject at the Northeast [Nashua, NH] and Packrats [Warrington, PA] VHF/UHF conferences) stacks up against the totality of what was reported to the CAC. I do not want to unduly belabor this topic, but I believe every VHF+er should be at least thinking about the possible effects of the current attempt to change the rules for rover stations and multiop stations. Much, if not all, of the recent progress in 500+ MHz capability available to an average station has been because people in these two categories have done some pioneering work in order to increase contest scores. I still feel that a separate category for 3, 4 or 5-band multioperator stations in any VHF/UHF contest is an invitation to stagnation, as a group can go out and buy whatever is needed to do state-of-the-art 50/144/222/432/902 or 1296-MHz contesting. It is even possible to buy a full capability station on 2300/3456 or 10368 MHz!

Now I've said this before, so why am I repeating the same arguments again? Look at the June/September 1990 VHF Contest scores; add up the published contact totals and grid totals for W2SZ/1 on 50-1296 (forget about their hundreds of QSO points in 50+ grids on the bands above 1300 MHz) and compare them to the all band totals of any other competitor. Proof positive that a serious multiop effort does not have to bother with microwaves, rovers, or doing much with VHF+ technology, beyond buying good gear, finding the right QTH and having not too much bad luck (which, I am told, is why N6CA did not beat W2SZ—if so, I certainly hope CA does not get discouraged and tries again. We need really intense top competition to keep interest up among the so-called "super stations").

The matter, to my mind, gets even more importance because we can shortly expect an influx of "new" (codeless) Technician class operators; what they will and won't do in VHF+ contests could well shape our 50-MHz and up bands in this last decade of the second millennium. I remember my teenage years, when many of my high-school pals were into tech stuff (building VHF radios) or mech stuff (building performance cars) and it was really enjoyable because we were doing things which were generally available only to those who were willing to put in a lot of personal work. In our hobby, it's the same today only in certain somewhat restricted areas. Call me crazy, but I worry about the direction our hobby is going to take if newcomers sense that it takes big money to buy into all of the fun things that the hobby has to offer: multithousand dollar transceivers and transverters for weak signal work; a bigger antenna, amplifier or station than is really necessary for a particular use/path; expensive RF modems and computers for packet, etc, etc. We should be aware of the socioeconomics of our new colleagues—if they tend to be older, more economically secure individuals, it may be because of the large perceived cost of entry into VHF+ radio. My kids (15 and 20) have always been interested in ham radio to the extent of being able to talk to other people, but they are *not* interested in studying the technical side and so never even considered a license while the code requirement was present—it was another "technical" thing that did not interest them. Now, however, at least one of them, and several of his friends, are more inclined toward the hobby. They especially want to go off to some mountaintop to contest (I hope my son's stories of lots of food, drink and craziness are not the real reasons!) *But,* no matter how enthusiastic any one of them may be, there is no way that he or she is going to spend mucho money to get on the air. Cars, college, the opposite sex and sports all have more appeal to their available funds, even if some of these youngsters do have a significant income. Besides, they have this threshold problem: why spend lots of time to get a license, and then spend lots of money to get on the air, to talk to people at random; wouldn't it be better to buy a magazine with a list of people who want to discuss some listed topic and then call them on your cellular phone? The go-anywhere phone is seen as cheaper, especially since you almost always get the particular person you want to talk to! I say the foregoing almost facetiously, but it does represent the thinking of many of today's teens.

Maybe the era of Heathkit 6ers (remember those? 1-tube Tx and superregen Rx) is forever gone, but weaning new contesters onto FM, then SSB and then, under really rough conditions, CW, may be the way to get new blood into our hobby. Where young hams of my generation could get on the air for a cost of 10% of a used car (*that's* the kind of cost you have to speak about here) what would it cost today's beginner to get on 220 packet, 6-m SSB or 10-Gig mountaintopping? Do we want to discourage the newcomer? Wouldn't it really be better to take them along in a big contest group, where they can operate 2-m FM or 220 FM, or be the second operator in a rover team, to get started in, and hooked on, our hobby? It takes lots of multi-ops and rover capability to offer that chance. A small group

of superops in a 3-5 band, limited-class contest station is going to have the opposite, undesired effect. Hence, I'm going to continue to question this limited-band multiop idea as long as it is proposed.

High-Temperature Superconductors (HTS)

. . . will soon have an effect on our VHF + activities. If you could have looked in at a few special operations (contest, EME, etc) over the past few years you might have found the technical types trying to obtain really low receive noise figures (NF) by forced cooling of the receive low-noise amplifier (LNA). Someone apparently noticed that the NF of an LNA could be lowered by cooling the unit. First, some LNAs were packed in easily available dry ice and their real temperature was reduced to about −20° F (−29° C or 244 K), an improvement over the standard 290 K (17° C or 63° F) room temperature at which NF is calculated. Then someone was able to dunk an LNA in a bath of liquid nitrogen (LN2), which is a harder- (but not difficult) to-obtain coolant to temperatures of about −321° F (−196° C or 77 K), and the noise figure was even better. Some professional radio astronomers have even cooled their LNAs to 4.2 K (−268.9° C or −452° F) in liquid helium to get really fantastic results. Amateur VHF + ers have tried the LN2 cooling route, and it has worked...up to a point. Even when the best GaAsFET devices are used, there is a minimum residual NF that has nothing to do with the device NF; the loss of impedance matching circuit between the antenna and the device input sets a lower NF limit. Thus, a set of preamps were built with Fujitsu FSC10LF GaAsFETs and had room-temperature NFs built between 0.20 and 0.35 dB for various operating/optimizing frequencies in the 25-500 MHz range; cooling with dry ice lowered the NFs to between 0.15 and 0.22 dB, while cooling with LN2 to 77 K, gave final NFs of 0.11 to 0.17 dB! How much contribution did the input matching circuit make? At 60 MHz, the insertion loss was 0.14/0.10/0.07 dB, respectively; the real noise contribution of the device was 0.08/0.07/0.05 dB, at the respective 290/244/77 K temperatures. We see that cooling had two separate effects: the device NF dropped, due to decreased carrier collisions, and; the coupling circuit insertion loss/NF dropped, due to decreased random electron motion. Theoretically, the circuit loss/NF should drop to zero at a temperature of absolute zero (0 K). Since most VHF + ers are going to be hard pressed to work at even LN2 temperatures, is there any hope that the front-end network losses can be further decreased? Yes, if the conductivity of the network leads (wiring) can be drastically decreased.

We should all know that VHF + wiring resistance and loss normally decreases as you increase the size of the wire or use a more conductive material, as the current flows only in the "skin" (near the outer surface) of the lead; the better material only needs to be a coating. This is the basis for silverplating lines and cavities to develop low loss/high Q. But, the loss difference between a good conductor (say, copper) and a better conductor (say, silver) is at most one order of magnitude (10X). And 10X is not much; we would like to get resistance down by many orders of magnitude (say, at least 6 orders, which would be a 1,000,000X improvement). Can it ever be done?

Enter the superconductor, a material which has extremely low resistance, usually at a reduced temperature. Look at Fig 1. For a superconducting material, the relative

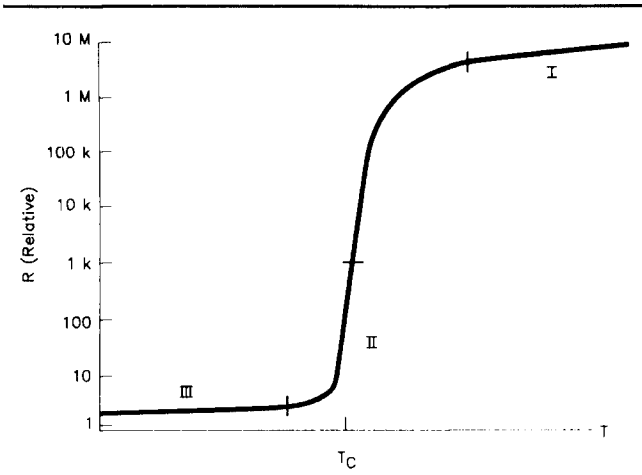


Fig 1

resistance R slowly decreases (region I) for decreasing temperatures well above the transition temperature Tc. This is the normal resistance curve. In region II, there is a sharp decrease of several orders of magnitude in resistance, as the material becomes superconductive and opposition to current flow rapidly decreases for small decreasing changes in temperature. In region III, the material has a fairly uniform, very low resistivity even if the temperature is further decreased; there is nothing to be gained by cooling into region III. Before 1986, the highest superconductor transition temperature Tc was about 23 K and was much too low for amateurs to work with. Then, two Swiss IBM researchers (Bednorz and Mueller) found that thin films of a new class of superconductive copper oxide ceramics existed. They got the Nobel Prize; we got YBaCuO (pronounced, around here, as *why-back-woe*), with a Tc of 93° K. It easily superconducts in liquid nitrogen, which is fairly easily obtained and not too expensive. In fact, the amount of power needed to provide one unit of LN2 is less than 1% of the power needed to obtain cooling with 4.2 K LHe.

Thin films of YBa2Cu3O7 apparently work fine in the VHF + regions, as long as frequencies below 1000 GHz are not exceeded (no problem in *my* shack!), although microwave resonators and filters do have to be fabricated on some pretty unordinary substrates, like lanthanum aluminum oxide (LaA1O3 is *not* what your average PC board is made out of, even for millimeter wave work). A microstrip line formed of this material has 10,000X less loss than a similar line of copper, if both are cooled to 77 K! If the cooled copper is used to make up a resonator, a Q of about 200 might be realized at 1 GHz; that's a bandwidth of 5 MHz, and the resulting filter (say, four coupled resonators) might have an insertion loss of about 3 dB. The superconductive YBaCuO resonator might have a Q of 500,000; that's a bandwidth of 2 kHz, and the same type of filter would have an insertion loss of about 0.3 dB and much sharper skirts. Not to mention that a 3.4-GHz, 4-stage U-line YBaCuO on LaA1O3 filter should fit on a quarter, while the copper filter needs cavities and is the size of your fist. Weight is also greatly different (which is why superconducting filters are being worked on for satellite applications where they can be easily cooled to the sub-10 K temperatures of space).

Since I cannot believe any one of us is going to have

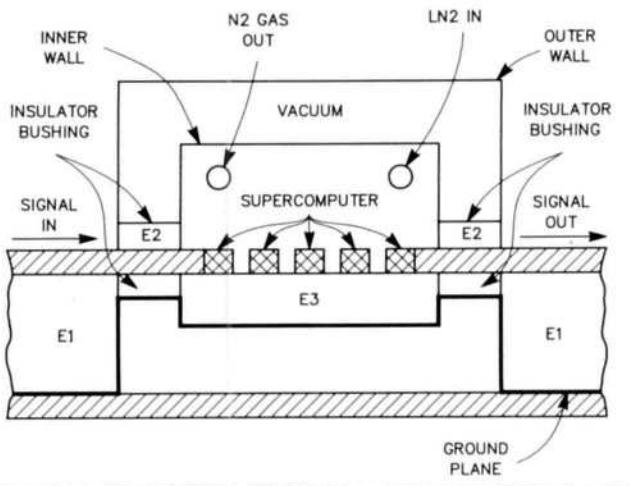


Fig 2

the facilities to make up one of these superconducting microwave filters of networks at home, I want to assume that we may eventually be able to buy a prefabricated unit on a substrate and possibly package it ourself. Fig 2 shows a cross-sectional view of how one such superconducting microstrip filter package might look. The signal comes in on a normal piece of microstrip line (say, copper on a glass-Teflon® dielectric E1); passes into a double-walled vacuum bottle, or Dewar flask, through a feedthrough bushing with an insulator of dielectric constant E2; and is operated upon by the filter, with its superconducting resonators on a substrate with a dielectric constant E3; the filtered signal goes through another insulator bushing and the output signal travels away on another length of normal microstrip line. The LN2 coolant comes into the central chamber and is converted to nitrogen (N2) gas as it cools the superconductor by absorbing heat energy from the filter elements, etc.

Problems VHF + ers will have to solve before this technique can be easily used are (1) to reduce the necessary amount of LN2 coolant—we want the minimum amount of external heat introduced into the central chamber. But that means that the Dewar flask inner wall should be thermally isolated from the outer wall—an impossibility if a continuous ground plane (shown by the heavy line) is needed, and (2) each of the lines probably has a different dielectric, with different properties, including mechanical properties (eg, different coefficients of expansion will work against dimensional stability and make maintenance of internal vacuum difficult) and electrical properties (eg, different dielectric constants will exacerbate the ground plane heat conduction problem). Nevertheless, this entire area was nonexistent five years ago, and we may be routinely using HTS components in another five years. Something for the VHF + er to look forward to!

Gateway

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

CARDINAL CARD READY TO FLY

The Cardinal card is an IBM PC/XT/AT plug-in card that contains a Z80 microprocessor, a pair of SIO/O serial chips and other components that let it emulate a TexNet Node Control Processor (NCP) board. It has been tested for about 10 months now in an XT and an AT clone computer. It is operational with Version 1.60 Texas Packet Radio Society (TPRS) code. Later, numerous software support routines will be available, such as a debugger, background ISRs for the PC, buffer managers, etc.

The purpose of the card is to make available a board that contains X.25 drivers, real-time processing, and optionally, the TexNet network protocol. The card will be capable of performing more sophisticated applications than can fit in 24-kbyte of ROM (of a stand-alone NCP) and will run in an IBM PC or compatible computer. A simple multi-user network-aware read/write mailbox program was written in a few pages of C code by utilizing the device drivers provided with the module. It is designed to free the programmer from having to know much about the real-time aspects of protocols and, instead, concentrate on the application code. All of the software has been written in 8086 assembly using the Borland Version 2.0 C compiler and the Version 1.0 assembler. Other more sophisticated executives are rumored to be in the mill written with the Borland Version 1.0 C++ compiler and assembly language.

The layout has been completed and should be at the board house as of this writing. It is estimated that it will be a four-layer printed circuit board, packed with parts. All of the hardware debug registers were included in the board layout, although they do not have to be assembled. The card contains 20-pin headers that are compatible with the existing TPRS 1200- and 9600-baud modems. The card may be configured to support a multiple node packet-radio switch. More information will be forthcoming as to the availability of the first boards. Those that are interested in getting alpha boards should contact Greg Jones, WD5IVD.

The printed-circuit board layout allows the card to be strapped to one of four addresses, allowing up to four of them to be plugged into a single PC chassis. This means that, theoretically, up to a 16-port packet-radio switch could be constructed because each card has 4 serial ports. The current Version 1.60 code supports three synchronous ports and one asynchronous port per board, but not yet four synchronous ports per board.

There are many possible applications for a card like this, such as protocol gateways, mail conversion systems, application servers and lots others (see the following story). It is our intention to allow others to write and test these new software packages. The design of the software drivers allows Level-2 and Level-3 interfaces for TexNet and also Layer-2 interfaces for AX.25, Versions 1 and 2, for those whose applications have nothing to do with TexNet.

—by Tom McDermott, N5EG, from Texas Packet Radio Society Quarterly Report

NMS LIVE!

Well, actually, a reincarnation of the network management system (NMS) is in trial. We have written software to allow multiple tasks to run on the PC and exchange data with a Cardinal card.

One of those tasks has been the simple read/write file server known as CARDNAL on the network. A new task is a reincarnation of the NMS task. These two run concurrently (ie, multitask) on one PC clone. Thus, the network manager and the file server can both pretend they own the whole computer (and the programmer can pretend so, too!)

Anyway, once every 15 minutes, the NMS polls every node in the network for its statistics. It counts the statistics and notes whether or not the node responded and, at midnight, makes three reports on the health of the network. The files are put into the user area of the read/write file server, so you, too, can read them whenever you want. The three reports are the statistics report, ie, a listing of all the network statistics for the previous 24 hours, the link performance report, which tells how well (or poorly) the radio and hardwire links are working, and the event report, which lists who did not answer the wake-up call each 15 minutes. These three reports are coded with unique file names.

SRmmddyy.RPT - Statistics report for mm/dd/yy
PRmmddyy.RPT - Link Performance for mm/dd/yy
ERmmddyy.RPT - Event log file for mm/dd/yy

They get archived once a week, which means you have to read them with the

R archive/SRmmddyy.RPT

style of command. In this era of "kinder and gentler" networks, the NMS no longer tries to reboot errant nodes. Alas, Version 1.60 of the code seems to take care of that problem pretty well, thank goodness.

The NMS operator (me) gets to see the neat multi-windowed display with real-time color-coded graphics of the node activity. One of these days, maybe we'll figure out how to send color graphics via packet radio in real time.

—by Tom McDermott, N5EG, from Texas Packet Radio Society Quarterly Report

KUWAIT APLINKED DURING IRAQI OCCUPATION

Amateur Radio played an important, perhaps crucial role, in providing information from inside Kuwait during its occupation by Iraq. A lone amateur operator in Kuwait City, using equipment he managed to keep out of the hands of the Iraqis, has, since August 3, the day following the invasion, been sending computerized message traffic to amateur operators outside Kuwait.

Messages numbering in the thousands were received by amateurs in the United States, then forwarded to the US government. Messages with potentially useful intelligence information were used to confirm reports from other sources within Kuwait, and may sometimes have been the first and perhaps only source.

"The information was legitimate and authentic, no question," a State Department official said. "It was very useful. Much of the traffic concerned the atrocities being committed in Kuwait. We also got word that the Iraqis had begun to move a large number of Kuwaitis out of Kuwait and into Iraq just a few days before the coalition began its land assault."

Amateur Radio operators on several continents were involved in the effort, as well as one aboard the USS *John F. Kennedy,* stationed offshore in the Persian Gulf. Traffic with intelligence value coming through the *Kennedy* connection was used aboard ship as well as forwarded through the radio system to North America. The *Kennedy* connection was lost when shipboard radio restrictions were imposed for security reasons a few days before the coalition bombing began (on January 16).

The group used AMTOR via the established APLink system, using several HF amateur bands; most were already well-established members of the APLink network, which was designed for efficient message handling. Amateurs in the Netherlands, Lebanon and Guatemala, as well as in the US, have been mentioned as playing crucial roles.

The identity of the Kuwaiti amateur (code-named "Abdul") has been a closely guarded secret; during the Iraqi occupation his life could have been at great risk. Even following the coalition liberation of Kuwait, "Abdul" feared for the safety of several of his relatives still missing and thought to be in the hands of the Iraqis. Even the Department of State did not know his identity or, for that matter, precisely how the information was reaching the US.

"Had the word got out, we feared the Iraqis might kill every licensed amateur in Kuwait," said Frank Moore, WA1URA, of Ft. Wayne, Indiana, one of the US amateurs involved. The fear for "Abdul's" safety led two amateurs in the chain, both of whom knew him personally, to ask personal questions only Abdul would know the answers to. His replies "told us he was not operating with a gun at his head," Moore said. Portions of this story "broke" on March 3, in *The Indianapolis Star*, although Amateur Radio was not mentioned, again to protect "Abdul."

Also playing important roles in this operation were Clark Constant, W9CD; Scott Ward, N5DST (the USS *Kennedy* radio operator); Bob Foster, WB7QWG/9; John Troost, TG9VT; and PAØ/QRS.

—*from* The ARRL Letter

DAYTON IN APRIL

The Dayton HamVention® will be held on the weekend of April 26-28 and your Gateway contributing editor will be there to attend the packet-radio forum, which will be held on Friday, April 26, from 1 to 4:45 PM. Bob Neben, K9BL, will be the moderator of the forum and, as in the past, you can expect the makers and shakers of packet radio to be there revealing their latest and greatest.

Your Gateway contributing editor will also be touring the hundreds of booths and flea market spots to report back to you what he finds new in packet radio this year. Dayton is always the site of new revelations in packet-radioware and the word I hear from the grapevine is that this year will not be a disappointment. The voices from the grapevine keep repeating a three-letter acronym that starts with a D and ends with a P. I'll try to fill in the miSSing letter for you at the Hara Arena.

And, if those pranksters at Radisson don't glue me to a bar stool like they did last year, I plan to attend the annual packet-radio get-together that typically gets together on Saturday night at McNasty's (check the TAPR and/or AMSAT booths for the low-down on this hoe-down).

ILLINOIS IP ADDRESS COORDINATOR

Despite what was published in the February installment of Gateway, the IP address coordinator for the state of Illinois is Ken Stritzel, WA9AEK (not WA8AEK or WD9DBJ).

AA4RE BBS VERSION 2.11 AVAILABLE

After a long wait, the AA4RE mailbox BB Version 2.11 is available. Its significant new features include:

- Sorting of messages to be forwarded by type, size, age, etc,
- Forwarding control based on message size, path, and time,
- Forward aging (eg, don't try second system until so many hours have passed),
- Added SYSOP action file:

Hold or reject incoming messages based on many factors,

Make a file from a message automatically,

Control over user-originated message based on class, address, etc (eg, no more SP ALL @ALLUS),

Ability to automatically kill messages that are superseded (eg, AMSAT orbital data),

- Route messages to ? and the corresponding L? command to find bad addresses,
- Multiple language support and
- Emergency Mode for ARES/RACES support. This is an implementation of the recommendations of the ARES/RACES/NTS meetings that followed the October 1989 Northern California earthquake

There are also a lot of minor improvements and fixes.

You can get this program by sending $5 US (or equivalent) to Dave Larton, N6JQJ, 766 El Cerrito Way, #D, Gilroy, CA 95020-4149, phone 408-847-3605, or John Anderson, N7IJI, 2729 Park Rd, Charlotte, NC 28209, phone 704-333-3249. Canadians can send $5 CDN to ARES Group, Att: REBBS Update, PO Box 35, St-Jean Chrysostome, Quebec G6Z 2L3. For source code, include $2 more. Indicate which format disk you need. We can handle all formats of 5¼- and 3½-inch disks. Don't include a disk or mailer, as we will supply them.

The software can also be obtained by downloading from the following BBSs:

WA6RDH BBS at 916-678-1535 (300/1200/2400/4800/9600 N81 V.32/MNP5)
WB3FFV BBS at 301-625-0817 (1200/2400, Non-MNP)
at 301-625-9482 (1200/2400/4800/9600 V.32/V.42/MNP5)
at 301-625-9663 (1200/2400/9600/19200, PEP)

The software is also loaded onto the W3IWI TOMCAT

TCP/IP server that is accessible via SLIP and Internet. BITNET users can receive the code direct from me. Drop me a line at ENGE at ALMADEN.

*—from Roy Engehausen, AA4RE@*AA4RE.#NOCAL.CA.USA.NA

NEW PACKET-RADIO SOFTWARE AVAILABLE

Other new packet-radio software has become available during the past month. The following information comes from *CompuServe's* HamNet and other sources. Although, all of the delineated software may be downloaded from HamNet, some of the software may be downloaded from other sources such as other on-line services, as well as, landline and packet-radio BBSs.

Amiganos Version 2.5, file name: V25AMI.LZH, binary, 164352 bytes

This is the G1YYH Version 2.5 of Amiganos for the Commodore Amiga computer. New features include tcp, netrom and ax25. Timertype has a linear back-off selection, mbox has a new trace feature and the BBS can be called from the net prompt. Also included is Version 4.0 of LS, netrom user documentation and G1YYH nos-start-up file.

APLink Version 5.03, file name: APFILE.EXE, binary, 286861 bytes

This is a "maintenance" update of APLink with only minor changes from Version 5.00. APLink is a Packet/AMTOR BBS/MBO program for the IBM PC written by Vic Poor, W5SMM.

HAPN-1/DRSI MSYS Package, file name: HAPNMS.COM, binary, 24355 bytes

This is a "maintenance" release of the HAPN-1 and DRSI PC-Packet optional support package for IBM PC PBBS MSYS Version 1.10 and later, that fixes the HAPNKISS bug which caused it to transmit without regard to any carrier on the channel.

PACSAT Directory Utility, file name: PGDIR.ZIP, binary, 13014 bytes

This IBM PC program allows you to look at all of your PGxxx.DIR files without using PG.EXE.

PG.EXE Version 910207, file name: PG0207.ZIP, binary, 48092 bytes

PACSAT Ground Station Software Version 910207R that fixes the monitoring bugs found in previous releases.

PG.EXE Version 910207r Documentation, file name: PGDOC.ZIP, binary, 9954 bytes

Complete documentation for PG.EXE through Version 910207r.

PHS and PFHADD, file name: PFH021.ZIP, binary, 28803 bytes

This program is a combination of IBM PC programs PFHADD and PHS. It allows you to add headers for uploading to the PACSATs and to strip those headers from downloaded files.

PRMBS/ROSERVER Version 1.50 Complete Runtime, file name: RS150R.ZIP, binary, 263410 bytes

This is the complete runtime package of PRMBS/ROSERVER Version 1.50 including MBBIOS Version 3.2, its configuration program and all the files necessary to setup and run PRMBS on an IBM PC.

PRMBS/ROSERVER Version 1.50 Update Package, file name: RS150U.ZIP, binary, 148601 bytes

This software package updates PRMBS/ROSERVER Versions 1.44 through 1.48 to Version 1.50.

DX Cluster Monitor Program, file name: DXCMON.ZIP, binary, 66439 bytes

This is a bug fix of Version 0.30 of the IBM PC program that allows you to monitor a DX cluster node and display DX spots on your monitor without connecting to the node.

ROSErver/PRMBS Version 1.50 Documentation, file name: RS150D.ZIP, binary, 91592 bytes

Documentation for ROSErver/PRMBS Version 1.50.

TAPR TNC 2 Firmware Version 1.1.7b, file name: TAP117.COM, binary, 27115 bytes

Version 1.1.7b of the TAPR TNC 2 firmware in Intel HEX format. This code contains the KISS fixes for Version 1.1.7a and allocates additional memory to KISS.

WA7MBL PBBS Version 5.14 Upgrade, file name: MBL514.ARC, binary, 112854 bytes

This is a set of files for IBM PCs that upgrades WA7MBL PBBS Version 5.12 to Version 5.14.

WØRLI MailBox Version 11.17, file name: MB1117.EXE, binary, 275456 bytes

This is WØRLI MailBox Version 11.17 for IBM PCs. It has improved wild card matches and an L-command function that lists messages for a specified location.

SIXTH ANNUAL AMSAT-UK COLLOQUIUM SCHEDULED

AMSAT-UK is sponsoring a symposium that will focus on all OSCAR satellites and digital communications. Question and answer sessions with various amateur satellite experts are planned as are tours of the UoSAT command station. As in years past, the University of Surrey will be the meeting place for this colloquium. The following is the preliminary line-up of programs planned for the week of July 25-28:

July 25: International Satellite Day
July 26-28: Satellite Sessions

For more details on the symposium, contact Ron Broadbent, G3AAJ, 94 Herongate Rd, Wanstead Park, London E12 5EQ, England, phone 081-989-6741, fax 081-989-3430. Note that the telephone code for AMSAT-UK has changed. To call AMSAT-UK from the US, replace the 081 prefix with 011-44-81. Contact your long distance carrier for their international dialing instructions.

Check with your travel agent as soon as possible as many of the airlines are offering very favorable rates to Europe.

—from AMSAT

WORLDWIDE LIST OF APLINK STATIONS

The following is the worldwide list of APLink (AMTOR/Packet Link) stations. These stations provide a link between domestic packet-radio networks and long haul stations and networks using AMTOR.

These HF AMTOR APLink stations operate 24 hours-a-day (unless noted otherwise) on the B (mark) frequencies listed below. All frequencies are in kilohertz. The Y (space) frequency is always 170 Hz below the listed B frequency.

The list is in alphabetical order by country and, within the country, by call sign. The format is call sign, SELCAL, SYSOP's location with the following lines indicating frequency and any time restrictions (in UTC). If needed, the nearest large city is noted parenthetically (like this). Postal code, if given, is listed before the country name.

Argentina
MLU1LDS LLDS Paso de los Libres (Corrientes) Argentina
14072.3 (2200-0200)

Australia
VK2AGE VAGE Goonellabah (Lismore) NSW 2480 Australia
7045.0 14075.0 14077.0 21076.0
(0200-0600 beam NA, 0600-0700 Africa, 0700-1030 Asia, 1030-1200 NA, 1200-1800 EU, 1800-1900 NA, 1900-0000 EU)

VK2EHQ VEHQ Kulnura (Sydney) NSW 2251 Australia
14070.5

VK20G VKOG Quaker's Hill (Sydney) NSW 2763 Australia
14069.0

VK6YM VKYM Beckenham (Perth) 6107 Australia 14081.0

Canada
VE3IUI VIUI Burlington (Toronto) L7PIW8 Canada
14068.5 (beam USA/CAN/AUS 0200-1400, EU 1400-0200)

VE7CTJ VCTJ Squamish BC VON3GO Canada
7072.0 14072.5

VE8DX VIDX Pond Inlet NWT Canada
7073.5 7077.0 14071.5 14072.5 14073.5 14077.0 21071.5 21075.0 21079.8 28071.5 28075.0 28080.0

Cayman Islands
ZFIGC ZFGC Bodden Town Cayman Islands
14069.5 14070.5 14071.5 14072.5
14073.5 14074.5 14075.5

Denmark
OZ2FAR OFAR Farum Denmark
14076.0

Egypt
SU1ER SUER Heliopolis (Cairo) 11341 Egypt
14075.0 (1800-0800, Fri & Sat)
21075.0 (0800-1000, Sat)

Germany
DLØYB DLYB Dassendorf (Hamburg) Germany
14080.0 (2000-1000)
21080.0 (1000-2000)

Guatemala
TG9VT TGVT Guatemala City Guatemala
14068.0 14069.0 14074.0 18102.0 21074.0

India
VU2DPG VDPG New Dehli India
14079.0 (1600-0300)
14079.0 or 21079.0 (1300-1600)
21079.0 or 28079.0 (0300-1300)

Indonesia
YBØIN YBIN Jakarta Indonesia
?? 14801.0 (1400-1700)

Ivory Coast
TU2BB TUBB Abidjan Ivory Coast
21076.0 (0700-1830)
14076.0 (1900-2300)
29076.0 (Sun)

Namibia
V51NH VVNH Windhoek Namibia
14070.0

Netherlands
PAØQRS PQRS Krimpen (Rotterdam) Netherlands
3581.0 3586.0 7034.0 7037.0
14070.0 14071.0 14072.0 21076.0
PAØRVR QRVR Papendrecht Netherlands
14071.0 (1600-0600)

Netherlands Antilles
PJ2MI PJMI Curacao Netherlands Antilles
14077.8 (1000-1200 & 2200-0100)

New Caledonia
FK8BK FKBK Noumea New Caledonia
14070.0 (0800-1300, Mon-Sat)

New Zealand
ZL1ACO ZACO Pukekohe (Auckland) 1800 New Zealand
14070.5 14072.5 14073.5 14075.0 14075.5 14076.0

Peru
OA4CK OACK Lirna Peru
14080.0

Phillipines
DU9BC DUBC Davao City Phillipines
7023.0 (0000-1000)
14072.0 (1000-2300)

United Kingdom
GB7SCA GSCA Plymouth 4411 England
7038.0 7039.0 7040.0 14070.5 14071.5
14077.0 14081.0 21078.0 21080.0 28077.0

United States of America
AH6D AAHD Aiea (Honolulu) HI 96701 USA
14068.5 14069.5 14070.5 1407l.5 14072.5
14073.5 14074.5 14075.0 14075.5 14077.0
K1UOL KUOL Bethel CT 06801 USA
7077.0 (Nights)
14071.5 (Days)

K2PEQ/4 KPEQ Fort Lauderdale FL 33301 USA
14079 (1100-2300)

K7BUC KBUC Phoenix AZ USA
7071.0 10140.0 14071.5 14073.5 14074.0 21073.5 (Days)
3627.0 7071.0 10140.0 14071.5 14073.5 14074.0 (Nights)

KB1PJ KBPJ Boston MA USA
3607.5 3625.0 7037.5 7071.0 10140.5 10142.5
14070.5 14071.5 14072.5 14073.5 18102.5 21074.0

KE5HE KEHE Hearne (College Station) TX 77859 USA
3625.0 7071.0 7072.5 10140.5 10142.5 14070.5 14071.5
14072.5 14073.5 18102.5 21072.5 21074.0 28125.0

KK4CQ KKCQ Pensacola FL 32506 USA
14074.0 14070.5 14073.5 14072.5 21076.0
21074.0 21092.5 21072.5 28125.0 28075.5

NØIA/7 NNIA Las Vegas NV USA
3625.0 7071.0 10140.5 14072.5 28125.0 (24 hours)
3627.0 7047.5 7072.5 (0200-1400)
14070.5 21072.5 21074.0 (1400-0200)

N5DST/MM NDST Aboard ship on High Seas
7075.5 or 14071.5 or 21071.5

N6EQZ/7 NEQZ Renton (Seattle) WA 98056 USA
3625.0 7071.0 7072.0 14070.5 14072.5
14073.5 14075.0 14076.0 21072.5 21074.5

V73AT VVAT Kwajalein Marshall Islands 96555 USA
14069.5 14070.5 14071.5 14073.5 14074.5 (0800-0130)
14075.5 14077.0 14079.0 14081.0 (0800-0130)

W1FYR WFYR Gilsum NH 03448 USA
3620.0 3622.0 7071.0 7075.5 10140.5 14070.5 14071.5
14072.5 14075.0 18102.5 21074.0

W7DCR WDCR La Pine OR 97739 USA
3625.0 7071.0 7072.5 10140.5 10142.4
14070.5 14072.5 18102.5 21072.5 28075.5

WAIURA/9 WURA Grabill (Fort Wayne) IN 46741 USA
3625.0 7071.0 7075.5 7076.9 10140.5
10141.5 10142.5 14068.0 14069.0 14070.5
14071.5 14073.5 14075.0 21076.0 21079.0

WA7NTF WNTF Fort Mead MD 20755 USA
14073.5

WA8DRZ/6 WDRZ Redwood City (San Francisco) CA 94062 USA
10140.5 10141.5 14068.5 14069.5 14070.5
14071.5 14072.5 14073.5 14074.5 14075.5

WB7QWG/9 WQWG Indianapolis IN 46236 USA
7072.5 7075.5 14071.5 14073.5 21071.5 28075.5

WB8APD WAPD Willoughby (Cleveland) OH 44094 USA
14071.5

Send corrections to Paul Newland, AD7I, PO Box 205, Holmdel, NJ 07733. Email addresses are: APLink: AD71 AT KB1PJ; packet radio: ad7i@KD6TH.#NNJ.NJ.USA.NA; Internet: ad7i@hocpa!att.com; TELEX: TRT 15-722-4370 (AAB: PNEWLAND); AT&T Mail: !pnewland.

—from Paul Newland, AD7I

GATEWAY CONTRIBUTIONS

Submissions for publication in *Gateway* are welcome. You may submit material via the US mail to 75 Kreger Dr, Wolcott, CT 06716, 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*.

Bits

7th Annual Eastern VHF/UHF/SHF Conference

The 17th Annual Eastern VHF/UHF/SHF Conference, sponsored by the Eastern VHF Society and the New England VHF Association, will be held May 17-19, 1991, at Rivier College, Nashua, New Hampshire.

An informal social gathering will be held on Friday night. Technical talks and rap sessions for each of the VHF/UHF bands will take place on Saturday. A buffet-style banquet, followed by noise figure measurements and informal social activities will be held Saturday evening. Antenna gain measurements (weather permitting) and an informal swap-fest are scheduled for Sunday.

Preregistration (prior to May 13) is $23.00; registration at the door is $30.00. Saturday's banquet is $20.00, payable in advance. Registration for Sunday's activities is $5.00. Send registration fees to David Knight, KA1DT, address below.

Housing will be available in dormitory rooms at the college—$30.00 single or $50.00 double (twin beds), payable by May 13. Numerous hotels and motels are nearby for those wishing to make their own arrangements. (Be sure to ask for weekend rates.)

For more information contact David Knight, KA1DT, 15 Oakdale Avenue, Nashua, NH 03062. Please include a self-addressed stamped envelope.

Software Service

Karsten Jensen, OZ1AKD, from Experimenterende Danske Radioamatorer (IARU Danish Radio Society) has a listing of approximately 625 different computer programs, most of them having to do with Amateur Radio. The programs are available for exchange to anyone interested. Karsten's present listing, which contains all information, is an ASCII file, 105000 kbytes, uncompressed. To receive a copy send 2 IRCs and a disk (3½", 720/1.44 or 5¼", 180/360/720/1.2MB) to Karsten at the address below.

OZ1AKD would like to get in touch with anyone who is running some type of software service or program exchange. His interest lies in swapping programs to make them more available to amateurs throughout the world. If you're running this type of service, or are interested in what EDR has to offer, please contact Karsten Jensen, OZ1AKD, at: Hoejmarksvaenget 56, DK-8600 Silkeborg, Denmark.

Logic Tutor

Tatum Labs, Inc, has announced the availability of Logic Tutor, a Macintosh-based interactive instructional programs for digital switching logic.

Logic Tutor is an evolving and expanding set of six interactive instructional programs. Not only for engineers, this program is for anyone learning it new, teaching it, or just looking for refresher material. Varied multiple lessons for each subject are done in a manner that you will learn the material, not just memorize a few screens. Contents include illustrations of I/O tables, circuit and timing diagrams, exercises and simulations in six topical segments on: 1) Combination logic—single gate, product of sums/sum of products and general logic circuits. 2) Logic function exercises at three difficulty levels involving Karnaugh maps and Quine-McClusky reduction procedure. 3) Tests in device simulations of multiplexers, PLAs, segmented and dot matrix displays and sequential programmed logic devices. Contains exercises on 4) flip flops and counters and 5) synchronous and asynchronous state machines. And includes 6) digital arithmetic such as base conversions, binary-hexadecimal addition, two's complement addition and more.

Cost for program and manual: $49.90. To order, or for more information, contact: Tatum Labs, Inc, 3917 Research Park Drive B-1, Ann Arbor, MI 48108. Tel: 313-663-8810.

Computer Program Designs, Simulates, and Optimizes High-Efficiency (Class E) RF Power Amplifiers

Single-ended switching-mode (Class E) RF power amplifiers offer high efficiency, high reliability and low sensitivity to component variations. However, the circuits are difficult to design when using nonideal components (finite-Q inductors and capacitors, and power transistors with series resistances and nonzero switching times). Complicated interactions among variables make it difficult to design accurately for required values of RF output power and operating bandwidth. Optimizing the design is even more difficult.

HEPAPLUS (High Efficiency Power Amplifier PLUS), a new program in Design Automation, Inc's new "High Efficiency Power Amplifier" series, makes it easy and fast to design and optimize these otherwise desirable circuits. The program combines the capabilities of its four predecessors: *predict transistor capability* for use in high-efficiency RF power amplifiers; *design* a circuit for a specified RF output power and operating bandwidth, accounting for the nonideal characteristics of all circuits components; *simulate* the circuit to yield voltage and current waveforms and spectra, dc input power, RF output power, efficiency and power dissipation in each circuit component; and *optimize* the design for efficiency and output power.

HEPAPLUS can perform a series of analyses, sweeping any of the nine major circuit parameters, and plot the computers results vs the swept parameter. Waveforms can be plotted on the monitor screen and printed on a dot-matrix or laser printer. All that's required is an IBM PC, XT, AT, PS-2 or compatible computer with 512 kbytes of RAM. A floating-point numeric coprocessor is recommended, but not required. Prices range from $1150-1950, depending on quantity, for a single-payment perpetual lease. *Demo disk* with all program functions is available for $30.00, postpaid (North America, $45 elsewhere).

For more information, or to order, contact Nathan Sokal at Design Automation, Inc, 809 Massachusetts Ave, Lexington, MA 02173-3992, tel 617-862-8998, fax 617-862-3769.