

PACKET STATUS REGISTER

June 1984
Number 11



Tucson Amateur Packet Radio Corporation

TAPR currently maintains membership files and TNC-related orders on an IBM PC. The database manager used has been a real workhorse, but had some limitations that resulted in a fair amount of labor that could be better done by the computer.

The rapid growth of the organization has taxed our volunteer staff to the limit and relief was needed.

Margaret Morrison, KV7D, is presently re-writing the TAPR database system under a more flexible database manager. This is an undertaking that requires considerable effort and expertise, but the result will be better, faster and more efficient service to our members and less workload on our assistants.

Please bear with us while the conversion takes place and the "staff" becomes familiar with the new system.

For those who own Beta boards, or have kits and don't want to pay the price for the deluxe "Gootchie" cabinet kit, we have a limited supply of alternative cases.

A steel 4" by 12" by 13" (approximately) case with wooden (looks like walnut) end plates and a plexiglas front cover overlay (that will need replacement) was located at Dayton and TAPR bought 150 of them.

They are very nice looking cases, metal on all six sides. Rubber feet. The whole nine yards.

We can ship them in pairs only, for \$25 prepaid UPS. This breaks down to about \$11 for UPS, \$14 for TAPR. Remember, this is for a PAIR of cabinets.

The intent is that they be used for TNCs. Later, we will make known another use that may clean out the warehouse.

Please take a tally in your local area and send a check to TAPR's PO box. The cases will then be on the way to you.

Need help for a Club or Hamfest presentation?

TAPR now has available a four-page, glossy, black-and-white brochure on the TNC. This brochure, along with a simple one-page "what is TAPR" and the order form, make a complete, easy-to-digest handout for introducing the newcomer to packet radio.

Please contact us at the TAPR PO Box for further details on obtaining copies for your local activities.

The TNC Cabinet kits are in "beta test." This means that a few have been shipped to selected sites for construction and evaluation of the assembly instructions. The next 100 or so will follow this testing -- so hold on! Your cabinet may be arriving soon!

Steve Mendelson, WA2DHF, filed this report with Westlink, a national audio newsletter:

Steve: "Winner of the first Technical Achievement given by the Hamvention was Lyle Johnson, WA7GXD, for his work on the packet radio terminal node controller. How did Lyle feel?"

Lyle: "I am incredibly honored and certainly very moved to be able to receive the award on behalf of the efforts that were done by so many people.

"I was out of the country an awful lot earlier this year, and I came home, got a phone call late one Sunday night, and a fellow told me I that I had won the award, and I was just completely taken by surprise and shocked."

(Editor's note: having observed the above interview from just out of earshot, I know Lyle said considerably more. However, this transcript, is all that was broadcast following the weekend at Dayton)

TAPR would like to express its appreciation to ICOM America and Larsen Electronics for the loan of 1.2 GHz equipment at the Dayton Hamvention.

The British publication Radio and Electronics World, in the March 1984 issue, contains two OSCAR related articles. The first describes the scientific payload on OSCAR-11, the other is a description of Keplerian elements and how they relate to OSCAR-10 elliptical orbits. An SASE to PO Box 575, Wharton, NJ 07885 will bring a copy.

From Byte Magazine: "Rose Bowl Scoreboard Snafu done with Portable Computer"... During January's Rose Bowl, a scoreboard prank by two CalTech students was made possible by two computers and radio modems. The students, who are now being prosecuted for trespassing, used an Epson HX-20 notebook-size portable computer with an RF modem to tap into an 8086 breadboard they'd attached between the scoreboard and its operators. The students put several messages on the scoreboard's scratch-pad area and finally changed the names of the teams to show CalTech trouncing rival MIT, instead of UCLA beating Illinois. The students later held a seminar called "Packet RF Control of Remote Digital Displays."

President's Corner

by Lyle Johnson, WA7GXD

Dayton

Spring launches the Hamfest season, and Dayton is the premier event. Dayton, 1984, was no exception -- yet this Hamvention was exceptional.

The weather was fine. 14 acres of flea-market were scrutinized by a jostling throng. Innumerable HTs were blaring. And packets were flying on 1.2 GHz...

However, this year Dayton was different than any other Hamvention. This year, Dayton recognized packet radio. We were placed on the map.

Every year since 1955, Dayton has selected an outstanding Amateur to be honored as the "Amateur of the Year." This year's selection was Dave Bell, K6AQ, the man who has made the many excellent films introducing Amateur Radio to the general public.

Since the mid '70s, a "Special Achievement Award" has been presented to an outstanding Amateur deserving recognition different in nature from the Amateur of the Year award. This year, Ethel Smith, K4LMB, founder of the YLRL, was honored.

In 1984, a third award was added. The "Technical Excellence Award" was created to recognize an individual or small group for outstanding accomplishment in a technical area of Amateur radio.

And this year, that award went to Packet Radio. To TAPR. For our TNC.

Because the award must be made to a named individual, I was honored to receive the first ever Technical Excellence award on your behalf...

A small group of people poured man-years of effort into the TNC design. A larger group of people expressed confidence in the project and undertook the Beta test: an unprecedented experiment in the annals of Amateur radio history. And an even larger group of people have taken the next step, developing applications for the new mode.

An informal survey taken at Trenton and again at Dayton indicates that there are about 1200 Amateur packet stations, worldwide, that have been active at least once. The TAPR TNC is standard equipment in about 900 of these stations.

To say that these results are gratifying is an understatement.

However, with our increasing "legitimacy" comes increased responsibility. It is no longer enough to show the apparent advantages of packet (error-free, multiple concurrent QSOs, etc.). We must now attack the question of networking with the same energy and dedication that produced the TNC.

What we now have is a so-called level-two interface. This simply means that we can "packetize" information into small chunks and send that information to another station that we specify that is within radio range. Now, this is quite an accomplishment in itself.

But it is not enough. We need a system that will allow us to send information to stations beyond our "local" area. Ultimately, the system must be able to determine how to get a packet from location A to location B without the station operator at either end knowing how to route the packet.

What we have been calling "level three" in our loosely applied Amateur parlance, or simply "linking," is in fact much more. We need to design and build linking hardware -- devices with multiple channels at various rates and perhaps even various protocols -- and provide enough memory for the software folks to come up with workable routing schemes. The effort involved will make the TNC development seem like child's play.

The system that many of us have been kicking around would consist of up to four two-port controllers. Each port would be capable of supporting a "link" -- perhaps 1200 baud AX.25 level 2, like a TNC, or maybe 56 kilobaud AX.25 level 3, or AMTOR, or... A motherboard would support these controllers and have the routing information needed to switch the various packets between the proper ports to allow multiple-hop connections between locations that are not in the local radio domain.

The initial (prototype) hardware will most likely consist of 2-80 microprocessors and support chips. The interface to the motherboard will be either via Direct Memory Access (DMA) control or multi-port RAM.

The designs are being worked out now for the initial configuration. If you have some inputs to this design, please write to the TAPR PO Box and mark the envelope "LINKING". Expertise in hardware and especially software will be needed for development and testing.

1984 - the year of Linking - the year of Packet.

★★★★★★

New Packet Radio DX Record: On May 6 at about 16:00 UTC a new Packet Radio DX record of 15,700 km was established between Paul, VK2AQG (near Sydney) and W3IWI (near Washington). This QSO took place using the AMSAT-OSCAR-10 satellite near its apogee, with elevation angles of 12 degrees in Australia and < 1 degree in Maryland. VK2AQG was running about 100 watts output and used a VADG TNC, while W3IWI had to run about 200 watts and used a TAPR TNC. Both TNC's ran the AX.25 protocol. VE2AQG had previously QSO'd VE1PAC (a.k.a. VE1SAT/VE6) and KL7GNG in North America, but this was the first QSO from VK to mainland U.S. Eavesdroppers on channel listening to the QSO included VE1SAT/VE1PAC, KL7GNG and N9AN. To our knowledge, the previous DX records were held by ZL1AOX who QSO'd WA2LQO on 10 meters (14,300 km) and W3IWI on both AO-10 and 10 meters (13,900 km).

From the mailbox: "WHAT HATH TAPR WROUGHT?" was one of the first packets transmitted in Vermont. KLAUE and N1CBT, both in the Burlington area, initially established two-way packet radio communications on May 10, 1984.

Walt Grant, N1CBT, who has an appliance operator's approach to amateur radio and a superficial acquaintance with digital communications, found the TNC kit a pleasure to build and interface with his terminal and radio. KLAUE, a systems engineer who has a shack full of home-built computers and radios, was impressed with TAPR's engineering and quality control.

Both operators report a keen interest in packet radio among other amateurs in the area now that 1200-baud signals are actually on the air.

UOSAT-2 Status

by Martin Sweeting, UOSAT Programme Manager

The UOSAT Team at the University of Surrey successfully re-established command over the UOSAT-2 (Editor's note: This spacecraft is also known as UOSAT-B and AMSAT OSCAR-11) spacecraft at 2135 gmt 6th June on orbit 1418 using the hitherto inoperative VHF command uplink.

Following a successful launch by NASA on 1st March, UOSAT-2 performed perfectly for the first 4 orbits, switched off the 145 MHz downlink under computer control as instructed and then refused to respond to ground commands. A lengthy series of tests to attempt to home in on the nature of the spacecraft's problem were undertaken over a period of 10 weeks - culminating in the successful reception and tracking of the known very low level microwatt signal which is continuously radiated from the microwave receivers on the spacecraft. This breakthrough, by an outstation of SRI International in Greenland, confirmed, for the first time after UOSAT-2 fell silent, that the spacecraft primary power systems were functioning and that the Surrey groundstation was indeed tracking the spacecraft accurately.

The next day - May 14th on orbit 1076 - the Surrey command station succeeded, with difficulty, in switching the 145 MHz transmitter back on using the UHF command uplink. The data subsequently transmitted from the spacecraft allowed the command team to proceed with cautious diagnostic routines to attempt to pinpoint the cause of the problem. After four weeks of exhaustive and painfully slow tests and analyses, the problem has been identified and isolated to a small area of circuitry - about 5 components - that directs command data received by the spacecraft from the VHF uplink to the command decoder. This crucial circuit has triple redundancy, one for each of the three command receivers, and the same fault has not yet occurred on the other circuits. In keeping with the design philosophy of 'redundancy through different technologies', there are also two routes whereby this area of circuit can be bypassed using either the primary spacecraft (1802) computer or the Digital Communications Experiment (DCE).

Once the problem had been fully understood, the DCE was programmed - using the UHF uplink - to provide a 'bypass' around the fault and, when activated on orbit 1418, restored the VHF uplink back to full capacity. The DCE was chosen to do this task firstly as it would leave the primary spacecraft computer free to concentrate on the complex navigation and attitude control & stabilisation tasks now imminent, and secondly as the DCE requires a shorter 'start-up' sequence transmitted to get it going! The final configuration will depend on operational requirements and the by-pass may be provided by either (or both) computers.

Initial results indicate that the VHF/UHF antennas, antenna feeds, hybrid and diplexers are all performing excellently supporting low error-rate full duplex operations at 145 MHz. The current unfavourable attitude of the spacecraft gives rise to a marginal UHF uplink due to antenna directivity - aggravated by low temperatures. This should improve if the spacecraft becomes earth-pointing following attitude control manoeuvres and stabilisation.

In the immediate future, UOSAT-2 operations will entail a checkout of the spacecraft functions; detailed navigation analyses and attitude manoeuvres to prepare for gravity gradient stabilisation before the various experiments can be activated on a regular basis.

(continued on page 19)

From the Editors

by Paul Barnett, N0CRN

It has been some time since we took over editing of PSR, and I decided it was time for a few explanations, apologies, and requests.

Pat Snyder, WA0TTW, and I generate very little original material, and we depend on a continuing source of contributions to put together something every 6 weeks to 2 months. OK, OK, so we haven't been very good at publishing a newsletter on a regular basis, but we now have the process down to the point that we aren't trying something new every issue. The problem is that an issue seems to come due about the same time that either Pat or I is swamped with other obligations.

Our motto is: "All the news that fits, we print," subject to the amount of effort that it takes us to massage submitted material into acceptable form. So, the preferred methods of submission are in order, as follows:

(1) A Wordstar document file, 50 columns per line, left and right justification. Pat and I use an IBM-PC or one of the clones, so we can read any 5-1/4 inch diskettes written by MS-DOS or its cousins (either 320K or 360K). We also have a way to read 8-inch CP/M disks if that is your pleasure. If you send us the diskette(s) in a mailer, we will try to get them back to you in a reasonable amount of time.

(2) We have access to a number of electronic mail services, the public one being CompuServe Information Service. If you EMAIL it to my ID: 70225,1252, and then mail us a reminder, I will log in and download it. Please, Please (a thousand times Please!) do NOT attempt to send formatted text via electronic MAIL! Right-justification adds extra hard spaces between words, and we have to spend hours deleting them out by hand. Attempting to send a Wordstar file this way also causes a lot of grief, because some systems are thoroughly confused by the control characters used by the program for formatting controls. Because of these problems, we will be discarding anything we receive that has the above problems, unless we are really hurting for material. Anything that is all UPPER case will be ignored altogether.

(3) Short letters of praise, news from your local area, etc. may be mailed to us. Please try to type or print them, and remember to use a new ribbon (no thermal paper, please!). Julia Snyder, Pat's wife, has done a very good job of converting correspondence to machine-readable form.

Anything that is sent to us via the US Mail should be addressed according to the masthead on the back page (at the University of MN). Please do NOT send any questions, membership dues, orders, or material unrelated to publication of PSR to us via any of the methods listed above. We will only have to forward it on to Tucson, and things might get lost in either the shuffle or the translation.

★★★★★

Junior, PY2BJO, in Sao Paulo reported by phone 5/5 that his TNC was done and he was hooking it up and expected to be on OSCAR-10 soon. KA6M has since reported (around 6/1) hearing PY2BJO on AO-10, but has not yet "connected".

.....
Several TNCs are in 7S thanks to ZS1FE/KE3D and ZS6AKV's efforts over the past year. We have also had reports that DL stations should be on soon.

Kit Oscillator Problem

by Lyle Johnson

TAPR has recently received reports of field failures of the 7.3728 MHz oscillator on the TNC. The symptoms are improper reset or failed operation.

Careful analysis of the problem indicated that the oscillator, U1A, U1F, X1 and associated components on the kit board, would free-run at 22 to 49 MHz.

The problem has been duplicated and confirmed here in Tucson. There is a fix, however!

It appears that the Fairchild 74LS14 ICs shipped in kits starting about January may exhibit this symptom, sometimes when cold and starting up, other times when warm. The simple cure is usually just a power off/on cycle or two. This is not a fix, however.

We tested several Fairchild, Hitachi and National parts as well as the Signetics 74LS14s that are scheduled for the next 1200 or so kits. The Fairchild parts are the most susceptible to this fault, but the others may do it as well.

The fix is as follows:

- (1) Replace R12 (1.5 k) with a 1k 5% carbon film resistor.
- (2) Replace R13 (1.5 k) with a 1k 5% carbon film resistor.
- (3) Carefully cut the trace on the top side of the PC board that goes from the lower end of R8 to U1 pin 5.
- (4) Add a 470-ohm 5% carbon film resistor from the lower end of R8 to U1 pin 5. This resistor will be R87.
- (5) Add a 4.7k 5% carbon film resistor from U5 (6809) pin 37 to U1 pin 5. This resistor will be R88.
- (6) Replace U1 with a 74LS04 IC.

An alternate fix, previously circulated, required changing R12 and R13 to 1k and adding a 20 or 22 pF capacitor at location Cy. This fix has been documented and supplied with TNC kits shipped after 6 April 1984. It appears to work in most cases, but the modification outlined above is better.

A secondary benefit may be a reduction in the rate of NOVRAM "forgetting" symptoms -- this has not been confirmed, however. Feedback in this area would be appreciated. Some oscillators before the mod had the symptom of starting at a very high frequency, then locking on to the crystal after a few hundred milliseconds, often requiring a toggle of the RESET switch to bring the TNC up.

★★★★★

The June 2, 1984 issue of SCIENCE NEWS (page 343) carries a nice two-column article entitled "UOSAT-2 Satellite Comes Back to Life", written by Jonathan Eberhardt. The contrast is drawn between the UO-11 resurrection and the the JPL effort to save the Viking Lander on Mars. Mentioned prominently in the article are Martin Sweeting and the Surrey team, Bob Leonard's group at SRI and AMSAT.

Also, on page 88 in the May 1984 of Byte Magazine, there is a column entitled "Bulletin Boards in Space". Harold Price, NK6K, worked very hard with the author to ensure its accuracy.

Binary File Transfer

by Harold Price, NK6K

In response to recent grumblings about transparent mode not being, and "Why doesn't MODEM7 work through the TNC", the following is offered, and applies only to those who wish to run binary (8 bit) data through the TNC.

As page 4-25 of the general release TNC System Manual states, to get true 8 bit transparency, you must set both AWLEN to 8 and PARITY to 4(none). After modifying these parameters, you must reset the board with the RESET command. The serial parameters are only changed after a reset, allowing multiple change commands to be entered before you get halfway betwixt and between. A casual thought, there should be no reason why you can't run 8 and 4 all the time, since most people you'll be talking to have AND 7FH in their terminal driver, and input parity is stripped on input in command and converse mode anyway.

If you are really using the MODEM series of programs thru the TNC, you must also set your PACLEN to 255, otherwise the default 128 will split MODEM packets among AX.25 frames. The possible delay between one frame and the other may cause the receiving MODEM to timeout. You may have to increase the timeout values in any case, since the packet technique means you won't get any data until the entire frame has been received. This may cause enough delay end to end to cause MODEM to get upset.

Note that this handling of PARITY is different than rel 2.x software. Someone somewhere complained that the TNC couldn't handle 8 bits and a parity bit (total of 9). Version 3.1 can, but to make binary data go between normal micros, you must have AWLEN 8 and PARITY 4.

I tested this with a program that dumped 30H - FFH thru a TNC connected to itself in transparent mode. The program checks the incoming bytes, and does indeed find a mismatch with PARITY=3 (default). I tested both BETA 3.1 (on beta board #25K) and 3.1 (on kit board #217).

Which brings up another point, when reporting bugs, please tell us what software rev you are running, and what hardware rev. If you give us the serial number, we can also correlate the incremental minor fixes or known shipping errors (like the run of boards that had 20 ohm instead of 20k pots).

Also, if you have some doubt as to what is actually going into your packets, get a third party to listen to the freq with TRACE \$2100 set. This will give you the actual data in hex that was received.

To review:

Rev 3.1 needs AWLEN 8 and PARITY 4.

Rev 3.0 had a problem with PARITY, I think you were stuck with PARITY 3 no matter what.

Rev 2.x worked different, I haven't got one anymore, and you shouldn't either. Contact TAPR for info on free software upgrades, or check with your local group.

As far as MODEM goes, what is really needed is a higher level packet protocol for file transfer. Using MODEM is a very inefficient way to go in the long run. MODEM provides CRCed data in the correct order, something the TNC is already doing for you.

★★★★★

Pete Eaton Resigns

by Lyle Johnson, WA7GXD

On May 9th, I received a telephone call from TAPR Executive Vice President, Peter Eaton, WB9FLW. The purpose of the call was singular: Pete was resigning from Office in TAPR.

Pete explained that he had devoted the last 2-1/2 years of his life to Amateur packet radio activities, but the time had come for him to end his "retirement" and divert his energies to his personal life. He requested that we respect his decision.

Reluctantly, but in conformance with Pete's desires, I accepted. Pete's will be a tough act to follow.

He was first involved with TAPR in early 1982. He represented TAPR at the Dayton Packet Forum that April, showing off one of the then-new Alpha boards.

In June, 1982, he founded SLAPR, a St. Louis-based packet group that achieved national recognition. He was SLAPR's President from its inception until last December, when he resigned to more fully devote his energies at the national and international levels.

Acting as Beta Coordinator for the St. Louis area, Pete went into every corner of the metropolitan environs and spoke of Packet to every ham he met. The St. Louis Beta site was the first on the air, with Beta boards hand-carried from Tucson, by Pete, on January 31, 1983.

In June of '82, he flew to San Diego to help work the Convention that launched TAPR as a more-than-Arizona organization.

During the summer of 1982, Pete located a transformer manufacturer in Illinois to make the custom power transformers for the Beta boards.

He also came to Arizona and video-taped the June TAPR meeting and subsequent introductory tape that followed.

During the October, 1982, AMSAT-sponsored meeting that adopted the AX.25 protocol, Pete accepted the responsibility for getting the Beta PC board laid out.

When push came to shove in November, 1982, Pete arranged to have a couple prototype Beta boards made and shipped to Tucson. He then came himself and spent nearly a month with us in Tucson, working 16-hour days, day after day, to help haunch the Beta production.

He was with us on Black Thursday, and helped TAPR survive that crisis.

After spending so much time in Tucson, Pete nevertheless flew back for the Annual Meeting. This was less than 1 week after hand-carrying the Beta Boards to St. Louis...

He was primarily responsible for the Amateur Packet Radio booth at Dayton last year, working tirelessly for the professional appearance and good first impression that so many of you commented on.

He was on-camera for the "Introduction to Packet Radio" videotape done in Des Moines last summer.

Pete helped in the preparation of the kit TNC manual, and did considerable work on the PC-board illustrations.

He arranged for the kit board layout, and was one of the kit test-board assemblers (his is kit TNC number one...).

The 3-ring TNC manual cover was Pete's doing.

After his election to Executive Vice President at the Board of Director's meeting last February, he plunged into the tasks of coordinating the cabinet project and preparing for Dayton.

Pete was a prime instigator of the efforts to have the first-ever Dayton Hamvention Award for Technical Excellence bestowed on the TAPR TNC.

The new TNC brochure was arranged by him.

In the midst of all of this activity, Pete has travelled extensively throughout the midwest, spreading the word on packet to hamfests, clubs, conventions -- anyone who would listen.

As you can see, Pete Eaton has been a selfless dynamo, directing considerable energy, time and money into packet radio. Without his efforts, packet radio as a whole, and TAPR in particular, would not be close to the stature it presently enjoys. He has earned the nickname, "Packet Pete".

We will miss the insight, devotion and energy he brought to the Office of TAPR Executive Vice President.

We offer him our full support for his future endeavors, and wish him the best of the best in all he undertakes.

★★★★★

WASHINGTON (BS) State Department officials here today announced that a pre-dawn raid has netted another shipment of a highly complex electronic component destined for the Soviet Union.

The super-sophisticated "7400 Quad Two-input NAND Gate," as it is known in elite industry jargon, could have been used in video games, officials said, adding that the shipment had an estimated "street value" of at least \$10 million.

Other top officials, speaking under the condition that they not be identified, said the parts were worth about \$1,000 apiece. "At least that's what we pay for them through the Pentagon's spare parts procurement program," commented one official.

Later reports from knowledgeable sources said that the "7400" components are manufactured in hidden factories in exotic jungle locations such as Malaysia and Puerto Rico and are blatantly sold over-the-counter in Radio Shack stores within blocks of the Soviet Embassy.

"With enough of these super-hi-tech parts, the Soviets could have constructed the world's fastest video game," said one spokesman. "Such a game would be superior to current American and Japanese models because it would also serve as an excellent space heater, and we all know how cold Moscow winters are."

Commenting on the raid, an obviously pleased President Reagan said, "It is obvious that one of America's greatest assets is its large pool of skilled youngsters ready to take the controls when the nation constructs its sophisticated space-based laser ICBM defense system. This technology would have given the Soviets the capacity to train THEIR youngsters to shoot down OUR missiles."

OSCAR-10 Linking

by Tom Clark, W3IWI

We conducted interesting gateway test on Sunday, April 1. This involved W3IWI operating the WB6UUT Packet BBS in the LA area thru Oscar-10 and NK6K's gateway. (Parenthetical comments added):

(First, I command my TNC to connect with NK6K)

```
cmd:c nk6k
*** CONNECTED to NK6K
```

(Second, I command Harold Price's link TNC)

```
cmd:my
MYCALL AO10
cmd:my w3iwi-1
```

(I change the call on Harold's TNC)

```
cmd:my
MYCALL W3IWI-1
cmd:cw n
was ON
cmd:c wb6uut v wa6ozj
```

(link involved intermediate digipeater in LA)

```
cmd:c
Link state is: CONNECT in progress
cmd:*** CONNECTED to WB6UUT
```

```
Mailbox release 2.17b -- Please Stand-by...
What is your first name: Tom
Is "Tom" correct? y
Where are you located: Clarksville, MD
Is "Clarksville, MD" correct? y
```

Hello Tom

There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable.

There is another which states that this has already happened.

-- Douglas Adams

SDPG Meeting 7 April -- Stay tuned for details!

(some other stuff edited out here)

```
Logged on at 10:14 AM 1 Apr 84
First message is #1590, next message will be #1728
```

Note: someone else is waiting to use the mailbox
Commands: Help, List users, Send, Read, Display, Browse, Call SysOp, Quit

```
Command: s
Message To: QST
Sorry, I don't know QST
```

(I should have addressed it to ALL)

Note: someone else is waiting to use the mailbox
Commands: Help, List users, Send, Read, Display, Browse, Call SysOp, Quit

```
Command: s
Message To: all
Subject (30 characters max): Hello Via Oscar-10
```

Enter text, "****end" to end

Greetings to all in the LA area. I am accessing the WB6UUT BBS thru a circuitous route --- W3IWI in Maryland ==> AMSAT-OSCAR-10 Satellite ==> NK6K gateway in Redondo Beach ==> WA0CZJ ==> finally WB6UUT. This is quite an exciting opportunity to demonstrate the global possibilities of Packet Radio. We hope to have

similar linking capabilities in the Washington DC area soon, so perhaps the LA area Packet BBS and their counterparts on the east-coast will become an integrated system soon.

Thanks for allowing us to conduct this demonstration -- 73,

Tom Clark, W3IWI

****end

Send, Abort, Type, Delete Line, Insert Line: s
Message #1728 being entered -- Thank you

(Then Lynn, WB6UUT came on-line for a brief chat)

```
(UUT) Hello Tom (CO DX??) -- This is Lynn, WB6UUT.
(IWI) hi lynn, exciting, isn't it???
(UUT) How is the WX on the east coast??
```

Indeed -- looks fine here...

```
(IWI) It's a beautiful sunny April Fools Day here,
but I haven't been outside for a while since we
were testing this link!!!
```

```
(UUT) Saw the note -- I will be sending along a
copy of the note into the Pat Snyder Review.
```

```
(IWI) FB!! This certainly shows the way of the
future. Glad that all our collective efforts are
coming to fruition! (even if it is a bit slow!!!)
```

```
(UUT) It's a pretty nice day here -- I guess it's
in the 60's or so, but a bit breezy. Gotta crawl
before you can run... It's definitely progress.
```

```
(IWI) Let me try a couple of things on ur BBS
before I quit -- I'd like to fetch a current list
of users.
```

```
(UUT) Certainly -- will let you have the mailbox
after your next packet(s) -- 73.
(IWI) tnx & 73 de W3IWI
```

Note: someone else is waiting to use the mailbox
Commands: Help, List users, Send, Read, Display, Browse, Call SysOp, Quit

Command: l

(list of current users deleted for brevity)

Note: someone else is waiting to use the mailbox

(Then I decided to see what some of the BBS mail looked like)

Commands: Help, List users, Send, Read, Display, Browse, Call SysOp, Quit

Command: b

```
To (Call sign, Net ID, or return): all
From (Call sign or return for every message):
Display Current, All, or serial number: 1700
```

```
Message #1704 To: ALL From: WB6HHV
Subject: 820 drive power control
-- Entered: 11:35 PM 29 Mar 84
```

```
Message #1728 To: ALL From: W3IWI
Subject: Hello Via Oscar-10 Satellite
-- Entered: 10:25 AM 1 Apr 84
```

Display Message (Serial number): 1704

```
Message #1704 To: ALL From: WB6HHV
Subject: 820 drive power control
-- Entered: 11:35 PM 29 Mar 84
```

It turns out that Xerox left in the automatic deselection of all drives after a timeout period with no disk activity. They also left in the logic to make sure the drive is up to speed when starting a new access. This works for both 8 inch and 5 1/4 inch drives, when using the standard ROM monitor supplied. This means that you can hook up a solid state relay to control the AC motor, and control the relay with the drive select line
(continued on page 19)

HF Linking

by Tom Clark, W3IWI

This is a report on HF packet gateway activity. This describes the use of WB4APR's gateway operating between 145.01 MHz (1200 baud) and 10.145 MHz (300 baud). Bob's hardware consists of back-to-back Vancouver TNC's inter-connected via a Vic-20 and a "switchboard" program written in BASIC. The following QSO took place from 14:30 thru about 16:00 UTC on April 8 between W3IWI in Maryland and W9TD in the Chicago area. I added notes in () parentheses. The [] brackets are added by APR's Vic-20 program to convey status info.

```
cmd:c wb4apr-5 v wb4jfi-5
```

(I used the WB4JFI digipeater between IWI & APR)

```
cmd:*** CONNECTED to WB4APR-5
AMRAD EASTNET HF GATEWAY
=>- band hf
```

(his hdnw requires that the switchboard be set up)

```
[W3IWI >=<(NONE)
=>- [HF IS SELECTED]
=>- connect w9td
[GATE OPEN 103849]
```

(WB4APR time-tags some Vic-20 responses in EST)

```
[TRYING CNCT WITH W9TD]
*CNCT**W9TD
[W3IWI >=<(W9TD)]
```

(lower case is W3IWI, upper case is W9TD)

```
hello
WHO'S THERE?
hi gary, this is tom, w3iwi
am I making it?
HELLO, TOM
SIGNALS ARE WEAK
was just talking with w0rpk on satellite.
he will be here soon, too.
OK. I SAW YOU CHECK IN HERE YESTERDAY
you must have had conok off!!
NEVER
i was seeing your beacon messages through wb4apr.
however, the local packet rptr kept crashing.
DOES RPK HAVE HIS 'GATEWAY' FOR HF UP YET?
sounds like he is close.
he was running it on 430 mhz with k0cy.
did you get the tapr oscillator modification info?
NO, I HAVN'T EVEN GOT MY PSR YET
this info came out last nite. there is a problem
that the 7 mhz xtal oscillator is flaky. part of
the problem is that fairchild 741514 in u1 is
marginal. fix #1: put in any other brand. then
fix #2: change r12 and r13 from 1.5k to 1.0k and
put a 20 or 22 pf capacitor in the space labeled
cy near xtal x1. kkkk
OK, I'M OK BECAUSE I HAVE BETA TNC AT 3.6MHZ (td)
```

(things got fouled up here, so after a few minutes, we got the link re-established)

```
comedy of errors. bob's 3 minute time zonked you,
and then something he sent (twice!!!) locked up my
tnc hard so it was like totally groddy! who knows?
by the way, did you see the report on our
satellite gateway operation?
YES, I HEARD OF IT
gee -- this wrks pretty well. bob reported he
disabled the timer.
SIGNALS ARE WEAK TO BEGIN WITH
IS HE TALKING ON VOICE CHANNEL?
occasionally he interjects a note of sarcasm
[ORX]
```

(WB4APR interjected something on the link..[] denotes sysop comments)

```
[MOVE FREQ UP A BIT]
[TO GET AROUHD A COMPUTER BIRDIE ON MARK FREQ]
[OK GARY?]
I'LL FOLLOW
[OK HERE]
HELLO?
[OK LOOKS GOOD NOW.]
```

(other chitchat between WB4APR and W9TD deleted)

```
hello again (still?)
DID TERRY EVER GET HIS SCC BOARD TO RUN PACKET?
you mean the s-100 board?
HE HAD AN ARTICLE IN AMRAD LETTER ABOUT ZILOG SCC
BOARD
i don't know the status for sure. he was close,
but that has been the story for months. i dont
see/talk to him v often. shall we try a file
transfer -- i'd like to see how good this link is.
I ONLY HAVE TERMINAL HERE
ok, let me try anyway
```

(at this point I terminated the file capture and successfully sent a 2.8 kbyte file. We then resumed the QSO for some chit-chat about Dayton, our equipment, satellite gateways, etc.)

★★★★★★

The TAPR TNC will be made available in three forms: complete kit, partial kit and minimum kit.

The complete kit contains all parts specified in the TNC parts list, including PC board and pre-programmed (EP)ROMs. In addition, the TNC System Manual with Binder and dividers is included. This is the form of the TNC kit that most people order, and is the recommended form unless you are in very special circumstances (price = \$240).

The minimum kit includes only the PC board, pre-programmed address decoder and pre-programmed (EP)ROM set containing the complete TNC software. This kit is intended for those who have access to the other needed parts to complete the TNC. The TNC uses some very specialized components, so be sure you have access to them before you order this version (price = \$82.50+\$8 S&H).

The partial kit includes the minimum kit as well as all parts in the following categories as specified in the TNC parts list (see TNC Systems Manual, Appendix F): 18 Resistors, Trimpots, Mylar or Monolithic Capacitors, and Connectors. In addition, the following parts are included: Custom Power Transformer; heat Sink, MOLEX Power connector housing and pins; 7.3728 MHz Crystal; 1N5400 Diodes; 2206 IC, 2211 IC, 2212 IC, MF-10 IC; 1933 IC and 6264 IC. This version of the kit is intended for those who have ready access to the more commonly available parts used in the TNC. As noted above, this is not the recommended version unless you are in very special circumstances (price = \$199+\$10 S&H).

Our present allocation of PC boards and EPROMs are all dedicated to satisfying orders for complete kits, which have priority. However, we have had a lot of inquiries regarding PC boards and partial kits. Since we do not have the manpower resources to cater to custom orders for one of this and three of that, we have decided to make the TNC available as described above.

From the mailbox: Packets were flying in Nebraska on March 19 between Lyman Nelson, WB0IEN, and Jerry Morris, WB0RUS. Contacts were also made with a number of stations in Iowa (N0BKB, N0AS, KC00J, WB0GG1) via a voice repeater.

Third ARRL Computer Networking Conference

by Lyle Johnson, WA7GXD

"Trenton? What in the world am I doing in Trenton?" I kept asking myself this question as I sloshed through the drizzle, occasionally glancing toward the grey skies in the faint hope of seeing a wandering patch of blue. The wind, careless of the 80 degree temperatures of home, gusted and blew. Trenton...

I had arrived Friday night on the same flight from St. Louis that carried TAPR VP Pete Eaton (yes, it was pre-arranged). We met up with Bill Reed, Dave Cheek, Harold Price and Wally Linsturth at Philadelphia International (I suspect people want to get a LONG way from there!) and, renting two cars, drove to Trenton.

The evening was filled with discussions of packet activities, including PACSAT, the GAS can controller (not really packet, but...) and ideas for linking. Outside, the wind was rising.

Saturday dawned -- well, the gloom lessened. Those of us responsible for various aspects of the PACSAT project met in a room all morning long. A break for lunch and we were at it again. Timetables. Interfaces. Budgets. Reviews of OSCAR 11. Modem designs. Goals. Dreams. Hopes.

By midafternoon, we had accomplished all that could be accomplished for PACSAT. We headed for the Trenton Computerfest, using obsolete F3 for 2m "linking." The skies darkened. Rain cascaded about us. We drove on.

Locating the campus (the Computerfest is held at Trenton State College), we parked and started walking. We walked faster and faster as the dampness and the wind sought us out. We entered the confusion, checked out the flea market (mostly wet fleas) and went to the commercial halls.

There were some really good deals to be had. There were also some bad ones... We met up with many packeteers -- Paul Rinaldo of ARRL, Terry Fox of AMRAD, Doug Lockhart of VADCG -- and some lively discussions developed.

Leaving early (ya gotta stay warm...), we headed for the Packet Dinner. More discussions. More linking ideas. More heat!

The dinner was great. There were about 35 to 40 people, all discussing various aspects of Amateur digital communications. AMTOR. Packet. (Mostly Packet.)

Afterwards, we all followed the ARRL Digital Committee to their hotel (so we could get a sneak preview of the Proceedings for the Conference and generally disrupt the meeting). The meeting was held and several important points regarding legal and other aspects of Amateur digital activities were discussed. Those of us not on the committee tried real hard to only observe, and the meeting went very well.

Sunday morning, we again headed out into the New Jersey weather, found the College, and proceeded to the Conference.

I don't have a count, and I make no claims to being an accurate estimator of crowds, but there must have been upwards of 100 people in attendance. The handouts disappeared. People were alternately listening attentively and asking questions.

Paul Rinaldo, W4R1, opened the Conference and showed a videotape of real-time color TV, in motion, sent and decoded from a 56 kbps packet stream. Eyes glistened.

A number of speakers were given the opportunity to make their presentations to the attendees.

I would fill this PSR if I attempted to explain all the presentations. Suffice it to say that this year's Proceedings fill a volume of 135 pages, compared to last year's 76!

If you are really interested in seeing what is being proposed and implemented in Amateur packet radio, get a copy from the ARRL. They are \$10.00 postpaid in the US.

There are papers on linking, networks in general, the software approach, the TAPR TNC, OSCAR 11, hf gatewaying, AMTOR, a new Vancouver protocol -- and packet radio at the horse races!

★★★★★

Phil Karn forwarded a netnews item from Don Mitchell at Bell Labs. Don's specialty is cryptography and related fields, which includes error detecting codes. Looks like we didn't make a bad choice with X.25!

These are the results of an experiment to test the quality of various error detecting codes. The table shows failures to detect errors in 131072 tests on 128-bit messages.

Protocol	Number of Bits Incorrect						
	1	2	3	5	8	13	26
X.25	0	0	0	0	5	0	3
TCP/IP	0	3699	337	94	19	6	5
PUP-I	0	2925	256	62	17	0	0
Brand X	0	7327	0	0	100	0	5
UUCP	7687	3353	913	141	40	4	3
Hash	0	0	9	2	2	0	0
Crypto	4	1	3	4	1	3	2

TCP/IP is the Department of Defense standard protocol, and is implemented in Berkeley Unix 4.2 and in some commercial packages. PUP-I is the Xerox datagram standard, which adds 32-bit integers, shifting the result over by a bit after each addition. Both are fast and easy to compute.

"Brand X" is a cute reference to AT&T's Datakit switch, which internally passes 9-bit bytes as part of each 16-byte packet. As with all parity schemes, it fails utterly when you have an even number of errors. UUCP is used almost universally between UNIX systems over dialup telephone lines, and consists of a practically indecipherable ad-hoc hash code.

"Hash" is equivalent to taking the whole message as one big "number" and reducing it modulo 65521 (one word at a time). It is mathematically related to X.25, and is almost as good. "Crypto" is cipher block chaining, which is a mode of the data encryption standard (DES). Both take forever and a day to compute.

A good error code means more than a good hashing algorithm. DES is a nearly perfect hash, but fails to detect 1-bit errors. CRC, in addition to being a good hash, detects ALL small-number-of-bits errors.

The point is that schemes which are specifically designed to do error detection, particularly those based on feedback shift register techniques (CRC), are the best. Unfortunately, for those situations where a software algorithm is necessary, it is tempting to invent your own because CRC is expensive to do in software.

CA BBS Activity

by Harold Price, NK6K

In our ever continuing effort to show up the rest of the northern hemisphere, here is the current list of active users in the LA/SD area. Of the 36 Bulletin Board users below, 23 have logged in at least once in the past seven days. The area now has 2 CPM host systems, one gets most of the general stuff from this net and AMSAT TMAIL. Also one mailbox system, and one experimental digital duplex repeater with back to back 202 modems for bit regen. We also have a oscar-10 teleport. VEISAT logged thru it to UUT yesterday and pulled 9k bytes thru in about 15 minutes.

Enough TNCs are on the air to ensure multiple digipeat paths linking Santa Barbara to San Diego and most points in between. Some users are so far out in the boonies that they need a multi-digipeat hop to talk to anyone else. N6DPU must go WA4EJR->WA6OZJ->WB6UUT. There are other examples. Even a mountain top repeater wouldn't help this guy. I throw this in just to bug the "protocol experts" and "purists". Sure, multihopping looks ugly in the header, and sure, it boggles the mind when thinking about efficiency. But it enabled us on the west coast to get 50+ boards over 15,000 square miles linked into a common knowledge and interest pool without spending \$ on a multi-port link box or waiting for a level three protocol. And that's what ham radio is all about. Using what you've got to get the job done.

We'll move to level three PDQ when one is available, but until then we'll keep moving data. I guess this was all started by something I got in the mail about one of the newer packet board producers to hit the scene. The one that says something like "Our board is pure and good, and we didn't implement any of the tack-on warts, like multihopping." I had a neat line here, but it may have been considered libelous so I took it out, I'm basically a nice guy.

Anyway, here is the user list. Not everyone in the area is a BB user, and if you don't check in for three weeks or so, Lynn throws your ID out.

Call, Name	Location	Last Access
KA6AIO, Dave	Mission Viejo	10:39 PM 12 Mar 84
WA2AMB, Bill	Hermosa Beach	1:06 AM 18 Feb 84
WD6AWP, Tim	Seal Beach	8:08 PM 13 Mar 84
K6AWT, JACK	SANTA ANA	2:37 PM 15 Mar 84
KB6BBL, JIM	COSTA MESA	9:19 PM 8 Mar 84
WA6BJY, Gray	Capistrano Beach	4:33 PM 23 Feb 84
WA5BNH, Leon	san diego	12:21 PM 3 Mar 84
WA6CFM, RICH	POINT LOMA	6:53 AM 15 Mar 84
WA6CGR, Dave	Diamond Bar	4:06 PM 28 Feb 84
N6CXB, bob	glendale	1:59 AM 15 Mar 84
WB6CYT, brian	San Diego	4:12 PM 3 Mar 84
N6DPU, Howard	Mission Viejo	9:09 PM 27 Feb 84
NN6E, Bob	Encinitas Ca.	3:23 PM 14 Mar 84
WA4EJR, JACK	LAGUNA HILLS	11:18 PM 29 Feb 84
WB5EKU, Don	Sepulveda	5:26 AM 15 Mar 84
WD6FPY, BILL	SAN DIEGO (EAST)	2:12 PM 15 Mar 84
WB6HHV, Mike	Mira Mesa	7:59 PM 14 Mar 84
KD6HR, Pete	Woodland Hills	11:28 AM 9 Mar 84
WB6HRD, Roland	Altadena	7:20 PM 6 Mar 84
W6KAG, Marion	Palos Verdes	9:41 PM 11 Mar 84
W6LLE, hoppy	point loma	6:51 PM 10 Mar 84
W6MNO, Chuck	San Diego	3:23 PM 15 Mar 84
WA6OVY, Rich	Long Beach	12:57 AM 15 Mar 84
WA6OZJ, JIM	PALOS VERDES	9:09 PM 2 Mar 84
NG6P, Roger	Glendale	5:22 PM 12 Mar 84
K6RYA, Howard	LA MESA	8:26 PM 29 Feb 84
W6SE, JOHN	ENCINITAS	12:40 PM 15 Mar 84
N6TE, Harry	La Jolla	9:05 PM 13 Mar 84
WA2TMP, Al	Santa Ana, CA	9:39 PM 13 Mar 84
WA6TUB, STEVEN	HAWTHORNE	7:10 PM 28 Feb 84
WA5VRC, ROBERT	EL TORO	1:26 PM 10 Mar 84
W36YMH, Skip	Palos Verdes	9:26 PM 13 Mar 84
WA6ZMR, JIM	SAN DIEGO	6:40 PM 29 Feb 84

★★★★★

Message Headers

by Mike Brock

I'm trying to standardize on some sort of header within whatever transmission media messages take. What you see listed above is what I'm using now. All fields must be present. If they are not used just leave data following it blank, but leave everything up to and including the colon. The details of it's structure is as follows:

MSG#: PRG-SDG-840405-01

Message number which is filled in by the station that receives the message from the user. PRG stands for Packet Radio Gateway (for the sake of something arbitrary to put in this space) SDG is three letters for San Diego, 840405 is the date in 2 digit year, month, day sequence, and 01 is the first message of the day.

TIME: 05 APR 84 20:35:00

This one is hopefully obvious. It is the time stamp filled in by the first gateway station when the message is received. Time is UTC.

TO : WB9FLW

The destination station(s) by call sign. This one will need some work since I doing the routine manually right now and I just happen to know where you are. This will no doubt change when we figure out some of the routing/linking stuff. The format for multiple calls is separation by a space or a comma. Multiple lines are acceptable as long as the colon is in column 5. There is no text before the colon on extended lines.

CC :

The stations to copy. Same format and comments as the TO field.

FROM: WB6HHV

The originating station's call.

VIA : WB6HHV-2 San Diego Gateway 05 APR 84 20:35

The path and time stamps of the path taken. Each station other than the originating and destination station will put it's mark here including the first network station to receive the message. Stations after the first one will add a new line just before the SUBJ: field. The first six characters of the added line will be ' : ' which will be followed by information similar to that shown. The times given are when the station receives the message not when it transmits it on to the next station.

SUBJ: Gateway Headers

This is the subject from the originators message. Tom suggested a maximum of 32 characters and I've seen that in other places as well but I see no reason to restrict it to less than a line.

TEXT:

This is the real heart of message. This is the text from the originators message. Tom suggested keeping the lines to 64 characters or less but again I don't see a real need for this. I suggest keeping it to 80 characters or less because that is the way I expect most messages to arrive.

This is what I'm using as an experiment. The gateway operation is a completely manual for the moment so it is a bit of work to do all of this. On the other hand, I think it will give use a chance to play with formats and see what it is that we really want. One other item that I would like to address under the subject of headers is message forwarding i.e. the destination station wants to send the message on to others that were not on the original distribution. This is really

(continued on page 19)

TNC Modem Tuning Indicator

by Lyle Johnson, WA7GXD

Many users of the TAPR TNC have expressed the desire for a simple tuning indicator that would enable them to easily tune in a packet transmission in non-FM modes. If you are among this group, read on!

Background

For normal VHF-FM packet activity, a tuning indicator is not needed. One simply tunes the receiving radio to the local packet channel, and the FM audio recovery process assures that the demodulated FSK tones are at the right frequency (pitch).

On HF and OSCAR, however, the modulation method used is typically FSK (generated by injecting audio tones into the microphone input of an SSB transmitter). Thus, accurate recovered audio pitch is not assured, and careful tuning is required. To make matters worse, the tuning accuracy required is on the order of 20 Hz, and becomes more and more critical as the data rate (baud) increases for a given shift.

The XR2211 FSK demodulator IC used in the TAPR TNC was originally designed for use on baseband (audio) links, such as a telephone line. Thus, tuning indicator outputs were not considered needed as part of the IC design.

Development

Examination of the 2211 phase-locked-loop demodulator used on the TNC reveals that the information needed for a tuning indicator is in

fact present. Please refer to your TNC schematic diagram, sheet 3. In the following discussion, the bit callout will be given first, followed by the Beta board callout in parentheses.

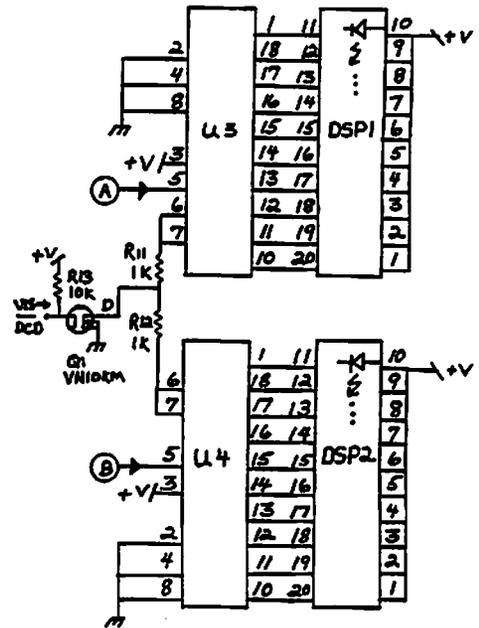
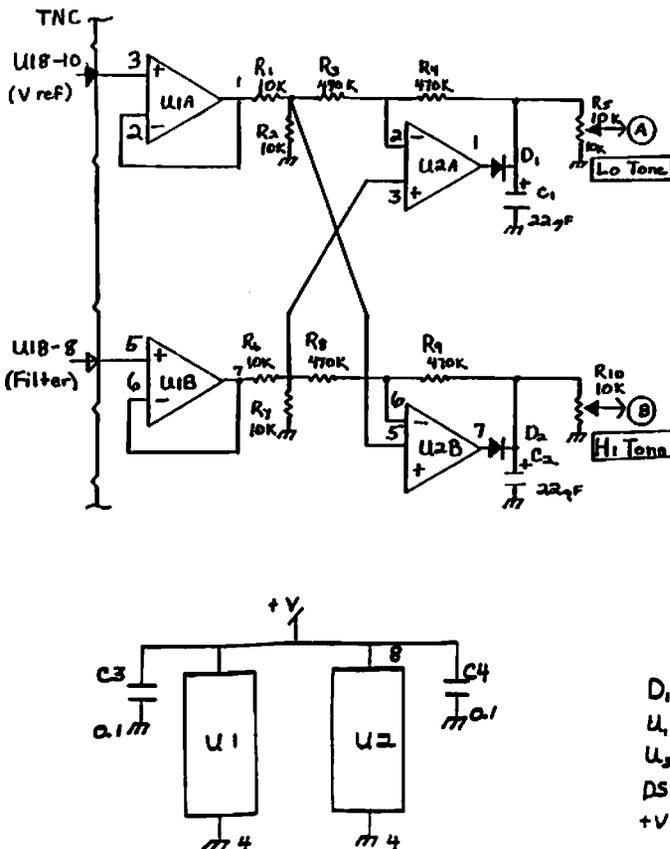
U18 (U18) is the XR2211 PLL demodulator. Note that there is a block marked "VREF" with an output at pin 10. This reference voltage is used in the 2211 to determine when an incoming signal is above or below the center (free-running) frequency of the PLL. C24 (C12) is simply a filter on this reference voltage to suppress high frequency noise.

The block marked "FSK" in U18 (U18) is simply a comparator that determines whether the voltage at the output of the loop detector filter C20/R45/C21 (C25/R13/C11) is above or below the pin 10 reference voltage. The filter voltage is developed in the loop detector and is proportional to the frequency of the incoming signal. It is used to steer the 2211's VCO to the incoming signal frequency to maintain lock.

The voltage at the output of the filter (pin 8 of the 2211) is below the reference voltage when the applied signal frequency is above the vco center frequency, and above the reference voltage when the applied signal is lower in frequency.

What is needed, then, is a voltmeter that can read the instantaneous voltage at pin 8 and have its scale calibrated in frequency.

A practical circuit is presented below.
(continued on page 11)



D₁, D₂ = 1N4148
 U₁, U₂ = LM1458
 U₃, U₄ = LM3914
 DSP1, DSP2 = MV5310C
 +V = +12V

Implementation

The signal voltages from the XR2211 are buffered by Op Amps U1A/U1B. These are configured as simple voltage followers to present a high impedance to the '2211; the loop data filter (pin 8) is especially sensitive to loading. The voltage follower outputs are then attenuated to 1/2 the actual level by R1 and R2 for U1A and by R6 and R7 for U1B.

Each buffered channel is then applied to a peak detector circuit consisting of an Op Amp section (U2A/R3/R4 and U2B/R8/R9) whose positive peak output is sampled by a detector (D1/C1 and D2/C2). Each channel's reference point (the non-inverting input) is tied to the other channel's signal.

Perhaps an example will help clarify the circuit operation: Consider the case where the applied frequency to the 2211 is below the vco center frequency. The voltage at the output of the loop data filter (pin 8) will be some value more positive than the reference voltage generated at pin 10. This means that the output of U1A will be lower than the output of U1B. U2A will seek to force its input pins to the same value (basic Op Amp operation). Since the non-inverting (+) input is more positive than the inverting (-) input, the output voltage will rise. When the output voltage is exactly twice the input voltage difference, the inputs will be matched and the output will stabilize.

U2B, on the other hand, will have its + input lower than its - input, so its output will be driven towards ground. This will back bias D2, effectively forcing U2B to the ground rail.

In the case of a signal frequency above the vco center frequency, the opposite will occur and U2A will go to ground on its output, with U2B providing a voltage at its output proportional to the difference in voltages received from the 2211.

The voltage differential between the 2211 pins 8 and 10 is proportional to the frequency difference between the vco center frequency and the applied signal.

The time constant C1/R5, or C2/R10, determines the peak "hold" time of the circuit. The values given provide good operation of the circuit, but you may wish to experiment. The idea is to have fast response time with a hold time longer than the slowest applied data rate.

The outputs of R5 and R10 are applied to identical LED bar-graph displays. The National LM3914 is used, as it has a linear response (don't use the LM3915 with its logarithmic weighting!). The ten outputs are passed to a 10-LED bar-graph display, with the LM3914 set to provide a "moving dot" as opposed to a "stretching bar".

The brightness of the display is set by R11 and R12. Q1 is tied to the otherwise unused data carrier detect output of the 2211 (pin 6), assisted by pullup R13. When no signal is being received, Q1 is off, forcing the LED displays to minimum intensity. When a signal is detected, Q1 is turned on, causing the display to operate at normal brightness.

Each display will show a moving dot, proportional to the applied frequencies. With the hold time introduced by C1 and C2, the dot will tend to hang at the location corresponding to the high or low tone frequency of the input FSK signal.

Calibration

With the demodulator configured for operation at the data rate desired (see the 300 baud and 1200 baud modem configuration articles elsewhere in this PSR), set the TNC to the CALIBRATE mode.

Verify the calibration of the 2211 center frequency to be exactly 1700 Hz (or whatever frequency you have configured it for).

Now, select the low tone (1600 Hz for 300 baud operation). Place a jumper at J3 pins 3 and 5 (Beta boards simply ensure that J8 is in place) to cause the output of the 2206 FSK modulator to loop back to the input of the 2211 demodulator.

Adjust the frequency of the 2206 to the exact value desired. Next, adjust R5 on the tuning indicator so that the two middle LEDs of DSP1 are glowing and flickering with equal intensity. It is important that both LEDs be glowing.

Select the high tone adjust the 2206 for the value desired. Then, adjust R10 on the tuning indicator so the two middle LEDs of DSP2 are glowing with equal intensity.

Remove the loopback jumper and set the TNC up for normal operation.

Operation

When operating on FM, the center LEDs on DSP1 and DSP2 should glow when receiving packets. Observe the displays carefully in this mode. You may notice that one or the other of the center LEDs glows brighter than the other, and this tendency will vary with the data that is being received. This is due to the loop filter characteristics at pin 8 of the 2211. The loop filter is properly configured to be -3db at the design data rate, so when a number of "0's" are sent in HDLC format, the peak output voltage at pin 8 of the 2211 is slightly less than at lower data rates. It is this lower voltage that causes one of the center LEDs to tend to be brighter than the other.

After gaining familiarity with the patterns to be expected with a properly tuned signal, change modes to SSB and try to tune in a 300 baud HF signal (10.147 MHz, LSB is a packet standard HF frequency) or a 1200 baud OSCAR signal (145.835 MHz downlink). The correct tuning will be greatly simplified with the use of this circuit.

With a short "training" period, it is easy to tune in a stable signal to an accuracy of 10 Hz.

Construction Hints

At present, no kit is available for this tuning indicator. However, TAPR is planning on having a PC board and parts kit available. As in all TAPR projects, do not send money or orders until the kit is officially announced in PSR.

Not counting the PC board, the cost to build the indicator should not exceed about 12 to 20 dollars.

No special precautions need to be taken regarding parts layout. You may find it most convenient to place the LED displays horizontally, with one display immediately above the other. An alternative display method, which will save a bit of money and space, is to parallel the LM3914 outputs and drive a single 10-element LED bar-graph display. In this case, the display may be easier to interpret if the the outputs are criss-crossed (pin 1 of U3 tied to pin 10 of U4, pin 10 of U3 tied to pin 11 of U4, etc.). However, the calibration of the indicator may prove more challenging in this case!

Credits

The design of the tuning indicator presented here was done by Eric Gustafson, N7CL, who is also the person most responsible for the modem sensitivity and 300 baud modifications.

★★★★★★

Modem Sensitivity Modifications

by Lyle Johnson, WA7GXD

See the end of this Note for ordering instructions for parts kits to accomplish these modifications. TAPR parts kits come with complete assembly instructions.

NOTE: DO NOT attempt ANY modifications until the TNC has been constructed, tested and successfully used on-the-air!

Improved Sensitivity

TAPR is currently conducting experiments to improve the already excellent performance of the TNC modem. While the results are still coming in, field testing by a number of packeteers has indicated that modem performance may be improved by about 2 db under weak signal conditions with the following modification. The improvements are particularly applicable to hf and OSCAR-10 operations.

NOTE: Beta part number callouts are in parentheses following kit callouts.

- (1) Change the value of C20 (C25) from 0.01 uF to 0.0047 uF. C20 is located on header U34.
- (2) Change the value of R46 (R14) from 30.1 k to 47.0 k. R46 is on header U34.
- (3) Attach a 4.7 k resistor from U18 pin 7 to +12 volts.

Kits: A good place to add this resistor is at the plate-through hole at the right of the trace just below U21/just above C18 and R39. The other lead should be carefully soldered to the trace leading to pin 1 of U18.

Beta: The 4.7k resistor just below and to the left of U18 pin 7 should be removed. Replace it with another 4.7k resistor. The right end of the resistor should be installed as before, but the left end should be re-routed to the rightmost hole of the +12 volt bus in the wire-wrap area. This is the hole just below and to the left of the 4.7k resistor.

(4) Kits: The trace from U18 pin 7 passes under R76, R77, R78 and R79 on its way to J5. Just to the right of these resistors and the plate-through hole adjacent to R78, cut the trace carefully, exposing about 1/16 inch (0.2 mm) of bare PC board. Scrape some of the coating off of this trace for a distance of about 1/8" (0.4 mm) on the side that leads away from R78.

Beta: On the top of the board, locate the trace which coming from JP3 which goes to a plate-through hole near the left end of J3. Turn the board over and follow this trace until it ends at a plate-through hole under U17 (in line with pins 14 and 27 of U17). Carefully cut the trace near the plate-through hole under U17, exposing about 1/16" (0.2 mm) of bare board. Scrape some of the coating off of this trace for a distance of about 1/8" (0.4 mm).

- (5) Attach a VN10KM transistor as follows:

Kits: Drain to the plate-through hole adjacent to R78; Source to the ground strip at the bottom of R78; Gate to the trace from U18 pin 7 (cut in [4] above).

Beta: On the solder side of the board, attach gate to the trace leading back to JP3; Source to U17 pin 28; Drain to the plate-through hole mentioned in step [4] above.

(6) Beta only: Install a 4.7k resistor on the solder side of the board. One end should attach to the U17 pin 27 and the other end should be soldered to the "top" side of the 0.1 uF capacitor between U17 and U25 (this is the side that goes to U25 pin 14).

(7) Recalibrate the demodulator center frequency to 1685 Hz by typing:

cal:3/1094

while in the calibrate mode.

300 Baud Modifications

For 300 baud use (such as on hf), a 200 Hz shift appears optimum. To incorporate these changes on your TNC, make the following changes:

- (1) Change C21 (C11) from 0.0022 uF to 0.01 uF.
- (2) Change R46 (R14) from 30.1 k to 227 k.
- (3) Set the modulator low tone to 1600 Hz (cal:1/1152).
- (4) Set the modulator high tone to 1800 Hz (cal:2/1024).
- (5) Set the demodulator center frequency to 1700 Hz (cal:3).

Note that these parts mount on header U34 on the kits; they are part of the circuit board assembly on the Beta boards.

Special Radio / Modem Combinations

While the default FM modem filter configuration works satisfactorily with the radios listed below, special filter values have been calculated and are presented for those interested.

Resistor	Icom 2A	Kenwood 7950
R51	10.0 k	10.0 k
R52	51.8 k	47.3 k
R53	57.1 k	45.4 k
R54	10.0 k	10.0 k
R55	10.0 k	10.0 k
R56	14.3 k	10.0 k
R57	10.0 k	10.6 k
R58	38.6 k	20.7 k

HF/OSCAR Flat Filter

While covered in greater detail in PSR 9 (January, 1984, pg 6), the following data is provided for completeness.

Kits: Change the resistors on header U30 as follows:

R58	23.7 k
R57	10.0 k
R56	11.4 k
R55	10.0 k

(and move the end previously attached to pin 4 to pin 7 of the header)

R52	43.7 k
R54	10.0 k
R53	38.0 k
R51	10.0 k

(continued on page 19)

Modem Modifications Tests

The following articles detail the results of individual tests of the modem sensitivity modifications described on the previous page.

by Steve Goode, K9NG

I have done additional testing of the new recommended modifications. I modified CAPRA's [Chicago Area Packet Radio Association -- TAPR's first affiliated club!] kit board by changing C20 to a 0.0047, R46 to a 47k within 0.5% and moving it to 12v, buffered the HDLC chip with a 10k pull-up to 5v and a hot carrier diode to the fsk slicer output since I did not have a FET to use for a buffer. The total board operation was tested by using a test setup similar to the one described in the QEX [August, 1983] article when I checked the packet probability of reception. The kit transmit audio was used as a transmitter and feed to the IDC box and HP 8640 generator, the generator output went to the SYNTOR receiver and its output was run to the modified kit board and my unmodified Beta board. The generator was then set at different levels and 100 packets were sent at each level. The kit board PTT was also used to pulse the 8640 on and off. The number of packets received by each board was then counted and is tabulated below (with the number being #received/#sent):

RF LEVEL	KIT BOARD	BETA BOARD
-121 dbm	2/100	2/100
-120.5	11/100	7/100
-120	26/100	19/100
-119	58/100	55/100
-118	83/100	79/100
-117	98/100	94/100

As you can see, both boards fell apart at about the same level.

I also tested the performance of the boards in a simulated Rayleigh fading field. At -107 dBm into the receiver in a Rayleigh field with an average 8 Hz Doppler the kit board received 61/100 and the Beta board received 67/100.

Unfortunately, I cannot report a significant improvement with the modifications in a FM channel.

★★★★★★

by Gary Kaatz, W9TD

The following is a commentary on the results of measurements made on my Beta TNC before and after the modem modifications.

To make the measurements repeatable, I built a pseudo-noise (PN) generator. This consisted of a 17 stage shift register with an XOR gate tapped at the 17th and 12th stages and the output fed back to the beginning. The clock to the PN generator was above 20 kHz and the noise spectrum was measured to be flat out to nearly 10 kHz. The PN was summed with the modem transmit audio, and both signals were equipped with gain adjustments to simplify setting the signal-to-noise ratio (S/N) and the absolute audio level into the modem's receive input. Measurement of the S/N ratio was done at the output of the MF-10 so that the bandwidth of the system was known. Since pin 1 of the MF-10 has a significant amount of clock feed-thru which is not filtered out in the Beta TNC [the kit TNC is filtered], I used an RC filter with a corner of 7.2 kHz at the input of the HP400D that I used for measurements. The MF-10 header for flat frequency response, published in PSR #9, was used.

The Packet Probability of Reception (PPR) was measured by sending 50 packets, and dividing the number correctly received by 50 (see Steve's paper in QEX #18 for an explanation of the terminology). This was measured for several values of S/N. The packets used were empty, just a carriage return, and therefore contained 168 bits. Bit Error Rate (BER) can be calculated from PPR by the following formula:

$$BER = 1 - (PPR)^{-168}$$

Prior to making any measurements, the modem was aligned and the bandwidth of the MF-10 filter was measured. The 3dB bandwidth was 2200 Hz and the equivalent noise bandwidth was 2162 Hz. The audio level fed to the TNC was -16 dBm (0.12Vrms). The level at the output of the MF-10 was then -15dBm (0.14Vrms).

Before presenting the results I would like to make some comments on the modifications. I found that when only the gain setting resistor between pins 11 and 12 of the 2211 was increased to 47K [R46 in the kit TNC, R14 on the Beta board] and the output at pin 7 pulled up to 12v, the TNC was deaf. The increased amount of voltage required to tune the VCO was causing slew rate limiting at 1200 baud. Lower baud rates were no problem. Therefore, I had to decrease the loop capacitor [C20 in the kit, C25 for Beta] from 0.01uF to 0.0047uF to ease the slew rate problem. I can confirm that reception of 1800 baud was then possible, but only over nearly noiseless channels, and that the ringing at the data filter (pin 8) was also reduced.

TAPR 202 Modem Performance at 1200 Baud

S/N (dB)	Before		After	
	PPR (%)	BER (X10E-3)	PPR (%)	BER (X10E-3)
16.4	100	0	100	0
11.7	74	1.79	98	0.12
9.54	32	6.76	74	1.79
6.65			36	6.06

The modem modifications are seen to produce about a 2dB improvement in a flat channel. 1800 baud operation was found to have a PPR of only 88% in a noiseless channel and 28% when the S/N was 16.4 dB. The optimum signal level for the modified modem was also sought. The dynamic range was beyond my measurement range of 33 dB. This extended from 0.69V rms down to 15.4mV rms, the range of adjustment at the summing node. It should be noted that my modem was modified for larger dynamic range as specified in PSR #9. For a S/N of 9.5 dB, the optimum level was found to be about -10 dBm (0.245Vrms).

★★★★★★

by Ted Huff, K4NTA

[The following article is excerpted from the FADCA>BEACON for April, 1984]

In the February issue of the FADCA>BEACON there was an article by KV7B and W0RPK on modifications to the TAPR Beta and Kit TNCs. I made these mods on two Beta TNCs and found good results. The mod is rather simple and I would recommend it to anyone using the TAPR gear who thinks that his board may not hear well...

I did a little test to find out just what improvement, if any, I had made. I connected a step attenuator in the antenna line of my Icom IC-22A. Of course, I unplugged the mic first. Then, before any modifications were made, I asked

(continued on page 20)

BER Performance of TAPR TNC Modem

by Steve Goode, K9NG

(The following article is reprinted from the August, 1983 issue of QEX. It is must reading for anyone interested in the noise performance of their TNC's modem. Note that the modem tested in this article is the unmodified Beta board system.)

Any packet operator who simultaneously monitors the channel with their TNC has probably heard packets that the TNC did not print. This raises the question, "What signal strength should it possess to print a packet?"

The 20 dB quieting sensitivity of a receiver is a known factor to most hams who operate on vhf and if would be helpful if some measure of performance was done on the TNC in relation to the 20 dB quieting level (20 dBQ) of the receiver.

Bit Error Rate

Data transmission systems are normally measured on the basis of their Bit Error Rate (BER). The BER is defined as the probability of not receiving the transmitted bit properly at the receiver. This is expressed in percent or in direct decimal form. For example, a system may have a BER of:

$$1 \times 10^{-3}$$

or 0.1%. The chance of receiving the transmitted bit incorrectly is one in every 1000 bits. On the positive side, the chance of receiving the bit correctly is 100% - 0.1% or 99.9%. BER is measured by comparing the transmitted data bits with the received data bits and counting the number of errors. As is true for all digital systems, the BER for packet radios is dependent on the input signal to the receiver. The correct way of measuring performance, therefore, is a graph of BER versus input to the receiver.

Test Setup

The test setup used to measure the BER of the Tucson Amateur Packet Radio (TAPR) TNC modem is shown in Fig. 1. The modem was calibrated before the tests using a frequency counter and the internal calibration routine. The Bit Error Rate Tester (BERT) shown in the figure generates a pseudo-random data stream and is connected to the TNC modem by removing JP11 [JP4 on the kit TNC] and connecting the data into the input of the modem. JP3 [J5 pins 17 and 18 jumper for the kit TNC] is removed and the modem output is connected to the BERT. BERT retimes the received data with an internal clock and the transmitted data is delayed to allow for transmission and reception delays. The transmitted and received data streams are then compared and a BER is displayed.

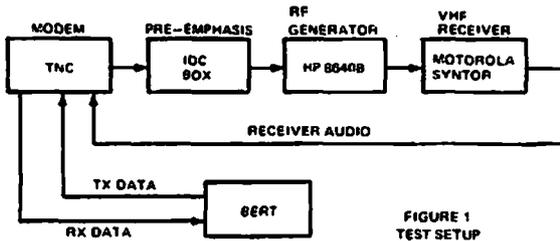
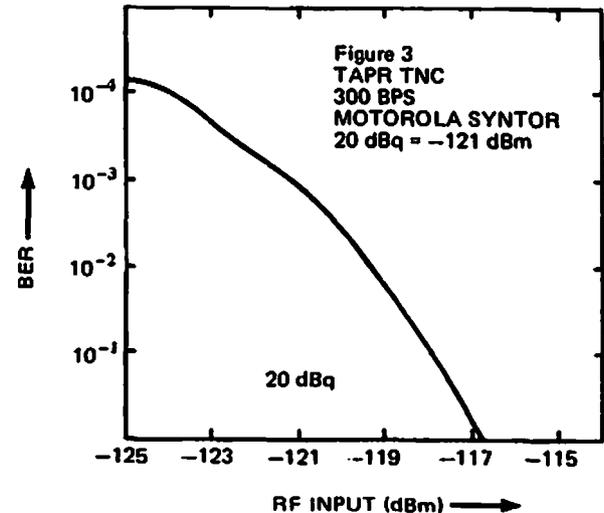
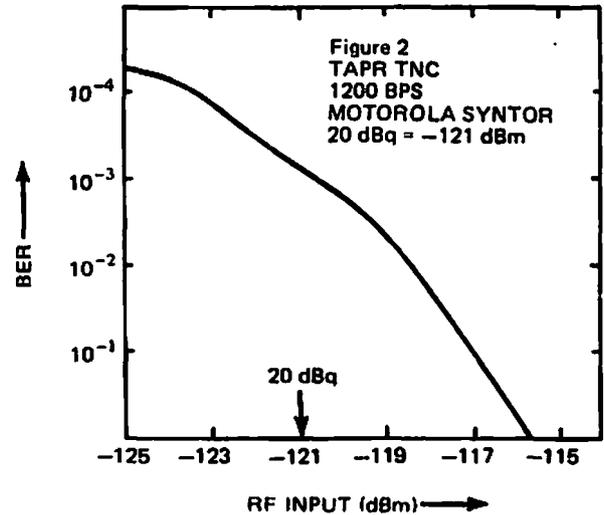


FIGURE 1
TEST SETUP

For these tests, the output of the TNC modem was connected through an IDC Box into the fm input of an HP 8640B signal generator. The IDC Box contains the pre-emphasis and clipping circuitry of a Motorola Motran transmitter. The receiver used for these tests was a Motorola VHF Syntor. It had a 20 dBQ sensitivity of -121 dBm (0.2 uV).

Data

The transmitter and receiver levels must be set before taking data. Since the TNC contains circuitry to correct pre-emphasis and de-emphasis differences, the transmitter and receiver audio should be kept out of clipping. A quick measurement of BER at one signal level showed best BER performance was obtained when both the IDC Box and the TNC were out of clipping. The Beta TNC manual says to keep the clipping LEDs off when receiving [the RCVR Audio LEDs should be glowing on the kit TNC]. BER data was then taken by varying the input signal to the receiver and measuring the BER for each level. The curve in Fig. 2 shows the BER performance of the modem at 1200 bps. The BER performance in Fig. 3 is at 300 bps.



Interpreting the Data

Now that the BER performance of the modem is known, what are the odds of receiving an unconnected packet or maintaining a packet QSO for 15 packets? As said before, the Bit Probability of Reception (BPR) is 100% minus the BER. Since each bit is independent of any other, the probability of receiving two consecutive bits correctly is:

$$BPR \times BPR \text{ or } BPR^2$$

(continued on page 15)

(BER PERFORMANCE continued from page 14)
 The probability of receiving three consecutive bits correctly is:

$$BPR \times BPR \times BPR \text{ or } BPR^3$$

and so on. Thus, the probability of receiving N consecutive bits is:

$$BPR^N$$

All flags, control bits and data bits must be obtained correctly before receiving a packet. For a maximum 128 byte length packet through a [single] digipeater, this is 1240 bits. Therefore, the Packet Probability of Reception (PPR) is:

$$PPR = (1 - BER)^N = (1 - BER)^{1240} \quad [1]$$

The probability of receiving a packet for a given signal level and packet length can now be calculated. Let's take a signal at 20 dBQ, on the 1200 bps curve. It has a BER of:

$$1.6 \times 10^{-2}$$

For a 1240 bit length packet, this gives a PPR of:

$$2 \times 10^{-9}$$

or 2 packets received in every billion sent. Not very good odds. We can convert from a given PPR to a BER by solving equation [1] for BER. The BER required for a PPR of 10% is:

$$1.8 \times 10^{-3}$$

It corresponds to about -119 dBm, and to a 23 dBQ in the Syntor. We can also calculate the level for a PPR of 98% to be:

$$1.6 \times 10^{-5}$$

or about -116 dBm. This corresponds to 25 dBQ in the Syntor. This shows that the fast quieting effect of fm takes the PPR from 10% to 98% for a change of only 3 dB in input signal strength.

"What are my odds for maintaining a packet QSO for 15 packets?" We must first know the odds of not retrying out for the current packet. To maintain a packet QSO, one packet should be received correctly in every set retry count or it will retry out. Let's call this the Remain Connected Probability (RCP). This is the probability that the packet will be correctly received at least once for the set retry count (L). Since the probability of not receiving a packet is 100% - PPR, the RCP is:

$$RCP = 1 - (1 - PPR)^L$$

Assuming the other station receives your acknowledgments, calculate the probability of maintaining a QSO for M number of packets. This is called the QSO Probability for M packets (QPM) and is obtained by raising the RCP to M:

$$QPM = RCP^M$$

If we assume a maximum retry count of 10 at -119 dBm, the QP15 (QSO probability for 15 packets) would be:

$$BER = 2.2 \times 10^{-3}$$

$$PPR = (1 - BER)^N = (1 - 2.2 \times 10^{-3})^{1240} = 0.065 = 6.5\%$$

$$RCP = 1 - (1 - PPR)^L$$

$$RCP = 1 - (1 - 0.065)^{10} = 0.49 = 49\%$$

$$QP15 = RCP^{15}$$

$$QP15 = (0.49)^{15} = 2.2 \times 10^{-5}$$

or about 2 chances in every 100,000. Again, not very good odds. At -118 dBm, the BER is:

$$5.2 \times 10^{-4}$$

for a PPR of 52.5%, an RCP of 99.94% and a QP15 of 99%. So, in a change of 1 dB, we go from an extremely small chance of not retrying out to a high probability of sending 15 packets without an error. With these formulas, we should be able to calculate the probability of staying connected for any number of packets, at any set retry count and any received signal level.

Since it is easy to send unconnected packets and the TNC can receive and transmit simultaneously, the calculations shown were checked by keying the HP 8640B pulse input with the transmitter line from the TNC. This allowed the TNC to receive its own unconnected packets in the CONVERTS MONITOR ALL mode. The generator level was set at -119 dBm. Only one data character was sent per packet so the packet length was 168 bits (8 Flag + 112 Address + 8 Control + 8 PID + 8 Data + 16 FCS + 8 Flag). This gives a PPR of:

$$PPR = (1 - 2.2 \times 10^{-3})^{168} = 0.69 = 69\%$$

One hundred packets were sent with 66 being received for a measured PPR of 66%.

Conclusions

We now know that at the 20 dB quieting level of an fm receiver, the TAPR TNC has an extremely small chance of receiving a packet. At 23 dBQ the packet probability of reception for a 128 byte packet is 10% and at the 25 dBQ level the PPR is 98%. Therefore, useful sensitivity of the TAPR TNC is about 23 dBQ. Above 25 dBQ a packet QSO has a high reliability. As a general rule of thumb, the TAPR TNC will require a stronger signal than a voice contact since 20 dBQ is normally defined as usable voice sensitivity. The TAPR board requires about 23 dBQ to print. The dBQ of a station being received is easily seen by measuring the voltage out of your receiver audio with no signal on channel. The audio level is then measured with the station not modulating, taking that ratio and expressing it in dB volts. For example, if the output from your receiver is one volt on noise and 0.05 volts with the unmodulated station:

$$dBQ = 20 \log \frac{(0.05)}{1} = 26$$

or 26 dBQ. By measuring the dBQ of the packet station you are trying to contact, you should get a good idea if you will be able to carry on a packet QSO.

This data also raises questions such as: can the TAPR TNC sensitivity be improved? Would alternate modulation techniques provide even greater improvement and would it justify changing the modem standard? Experiments will have to be made to answer these questions. I am interested in hearing from anyone who does on-the-air test or has done bench tests similar to these on the TAPR or other modems with FM receivers.

★★★★★

Modem Comparison

by Steve Goode, K9NG

[The following is a letter received from Steve Goode, K9NG, last fall when he first evaluated the performance of the kit TNC modem to the Beta TNC modem]

I took a Bit Error Rate curve of the new TNC today. Its sensitivity is equivalent to the old Beta board and follows the same BER curve when tested with the same FM system as the Beta board. I also tested the dynamic range of the new board. It has a dynamic range of 51 dB. From -20 to +31 dB from the Beta board optimum input, the new TNC has the same BER. The LEDs begin to light at about +22 dB, giving a 9 dB range where the LEDs can be on with no degradation in system sensitivity [Steve had a pre-production kit; the kits generally released have audio LEDs that come on about 10 dB sooner]. The upper limit of dynamic range is when the MF-10 goes into limit. This can be seen on a 'scope, so if you watch the input to the 2211 and it is out of clip (and the TNC is printing something) then you are within the optimum setting for the new board.

I also re-tested the effect of allowing the transmitter to go into clip. Again, the clipping action of the transmitter audio circuits degrades system sensitivity, so both the transmitter and receiver should be kept out of clip. I also tested the effect of de-emphasizing before modulation. This degraded performance with the new TNC.

I also removed the MF-10 and pre-emphasized the receiver output (this is the suggested system from GLB). This system performed about 1.5 dB worse. Removing the MF-10 with no reshaping of the transmit audio degraded system performance by about 2 dB. Therefore, the optimum system still seems to be keeping the transmitter and receiver out of clip and, contrary to GLB's statements, the MF-10 does produce about a 2 dB improvement in system performance.

★★★★★★

At Dayton, three different packet radio TNCs were in evidence.

The TAPR TNC, fully dressed in the new cabinet, was busily operating three different systems at Booth 303 (the TAPR booth).

AMSAT was monitoring the activity on 1.2 GHz (with radios graciously loaned to us from ICOM) with a TAPR TNC and video terminal.

GLB was present with their PK-1 controller, and showing a prototype of their PKR-1 digipeater (TNC with attached radio in a single case). Very interesting.

AEA introduced their PKT-1. This unit is based on the TAPR TNC design, housed in a cabinet and modified to run on +12-volts dc.

At the recent annual meeting of NZART, the New Zealand national society, Ian Ashley, ZL1AOX was presented a certificate of merit naming him as Amateur of the Year for 1983 for his work as an AO-10 telecommand station and for his pioneering work in packet radio.

From USENET (with apologies from the editors):
Question: What do you get when you mix an artificial intelligence system and an orangutan?
Answer: another Harry Keasner!

Deviation Adjustment

by Gary Field, WA1GRC

[The following article is reprinted from the March issue of the NEPRA PacketEar]

Newcomers to packet radio may not realize the importance of proper deviation adjustment; however, underdeviation will result in poor noise tolerance, and overdeviation will result in high error rate and inter-channel splatter. Proper deviation is approximately +/- 4 kHz peak deviation. This keeps the sidebands toward the middle of the passband away from the phase-distorting rolloff frequencies. Since every packet station is using different combinations of equipment, no "fixed" set of potentiometer settings will produce proper deviation. This adjustment must be performed when a station is first set up for packet; it normally will not change much with time providing none of the equipment is replaced or serviced. The best method of adjusting the deviation is to use a deviation meter; however, since most hams do not have access to one of these, an alternate, less precise but adequate method will be outlined here.

The only test equipment required is an extra FM receiver operating on the same frequency as the packet transmitter, and your ears. This receiver should have IF filters no wider than 15 kHz. Filters wider than this will result in overdeviation when you use the following technique.

(1) Connect the tone output from the TNC to the radio, connect a 50 ohm dummy load to the transmitter output and turn the radio on.

(2) Turn the tone output from the TNC all the way down.

(3) Turn on the extra receiver and set to the same frequency as the packet rig. It is generally best not to connect an antenna to this receiver.

(4) Slowly increase the audio output level from the TNC. The tone in the extra receiver should get louder and louder until no further increase in output is noticed. STOP when this point is reached.

(5) Decrease the output from the TNC until a definite decrease in volume is noted (about 3 to 4 dB). Set the output of the TNC slightly below this level.

Let me explain why this method works: When the audio level into an FM radio is increased, a corresponding increase in RF bandwidth is caused. What we have done is use a receiver with a known IF bandwidth to tell us when the RF bandwidth is equal to the IF bandwidth. This happens because when we start deviating past the edges of the IF filter, no further increase in volume will result; the signal will only get more distorted. If your signal sounds louder or softer than most of the others on the channel, you should suspect that your deviation is not optimum even if your packet station seems to work fairly well. Do not use distant noisy signals for this comparison, but most others should sound about the same.

After a while you will be able to recognize packet signals which are not properly adjusted for deviation and also tone calibration.

Tone calibration is not a problem with the TAPR TNC since a very nice software calibration function is included in the onboard PROM; however, other TNCs must be calibrated using a frequency counter. The two tones must typically be set to within 20 Hz if good performance is to be expected.

★★★★★★

TAPR Modem Measurements

by Tom Kneisel, K4GFG

[The following article is excerpted from the FADCA>BEACON for April, 1984]

In the few weeks since I've had my new TAPR kit, I've been looking at the radio side of it and wondering how to get the best performance out of the RF channel. Here are some observations that may be of interest to you.

First the receiver audio section has a bandpass response as shown in Fig. 1. Between 1200 and 2200 Hz, the slope is about 8 dB per octave, which results in an amplification of the 2200 Hz tone about 7.5 dB above the 1200 Hz tone (if they were to be input to the board at equal levels). I then measured a commercial hand-held portable radio, the Motorola MX350. It's receiver audio response is shown in Fig. 2. This de-emphasis rolls off the received audio at 2200 Hz by about 6.5 dB relative to the 1200 Hz tone.

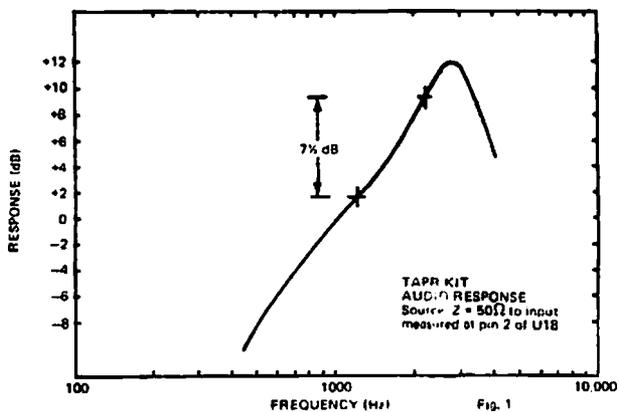


Fig. 1

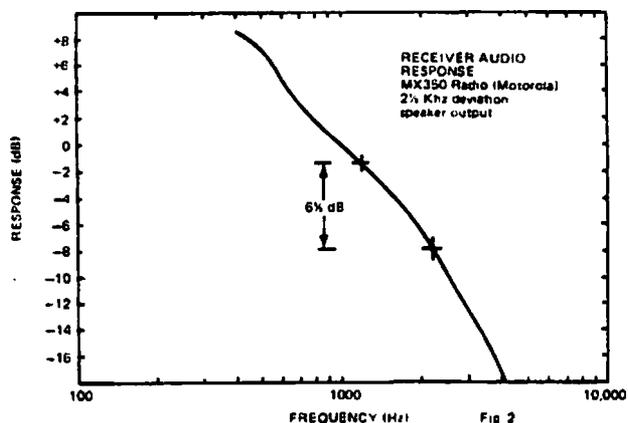


Fig. 2

We find then that the receiver plus TNC board together appear to form a fairly flat response combination, with the TNC board compensating for the receiver rolloff to within about 1 dB. Lyle Johnson of TAPR has written that the Exar 2211 demodulator chip is very sensitive to amplitude imbalance of greater than 3 dB, and that a 6 dB imbalance will render the channel inoperative. If true, this would seem to require that the tones be transmitted with nearly equal deviation by the transmitter. A good way to do this with minimal phase distortion would be to bypass the transmitter audio circuits altogether. This is not always practical, and Gary Field has suggested how to best adjust transmitter audio circuits for drive level and deviation.

I then measured my 2m transceiver and found that my Yaesu FT 221 receiver has a de-emphasis of only 2 dB between 1200 Hz and 2200 Hz! Using the speaker output did work, but not well on weak signals. I decided to bypass all the audio shaping in the Yaesu and to pick up the receiver signal off the discriminator. What I needed then was a flat response filter for my TAPR TNC! Fortunately TAPR's Dan and Margaret Morrison have detailed the changes to the TNC filter header U30 that result in a very flat response with linear phase.

To test how well this works, I took the (no-signal) noise out of my receiver's discriminator, summed in the TNC's transmit audio tones, and fed this audio to the TNC receive input. Putting the TNC in the full duplex mode and transmitting packets of a single text character, I found the results shown in Fig. 3. PPR is the packet probability of reception, as described in Steve Goode's article in QEX [and reprinted elsewhere in this issue of PSR]. The curves show that the modifications recommended in February's FADCA>BEACON [and included elsewhere in this PSR] yield about 2 dB improvement. In general, the board has good S/N performance. These tests were done with audio in noise which is presumably parabolic in spectral shape (more noise at higher frequencies).

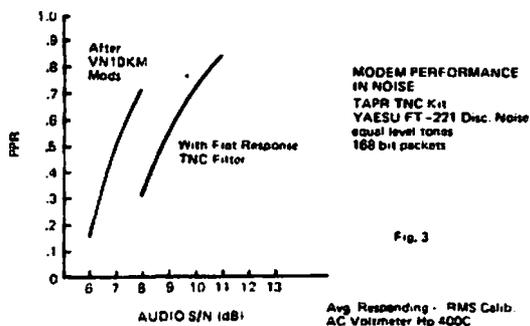


Fig. 3

★★★★★

In Ottawa, Canada, one of the earliest amateur packet radio systems anywhere has recently started the conversion from a 9600 BPS all digital FSK system on 220 MHz using a polled protocol to an AX.25 TAPR based system on 145.01 MHz.

The early Ottawa work (1978) was based on a need for very high efficiency and high data throughput system that used a very simple 2K byte protocol and much modified VHF Engineering kit radios to support digital transmission. Very limited attempts were made to popularize the polled protocol - the work was later eclipsed in popularity by the Vancouver and still later the Tucson software and hardware efforts.

On test now and shortly to be integrated into a choice local radio site is a 10 watt 2 Metre transceiver and a TAPR TNC. There are about 12 AX.25 TNC's in the area.

A major demonstration of packet linking is planned for August 1984. A 2 Metre handheld radio, TAPR TNC, and Radio Shack Model 100, all operating off a rechargeable battery, will be taken to the peak of Whiteface mountain for tests into lower New York state as well as Vermont, New Hampshire, and Massachusetts. Whiteface mountain (about 5000 ft) is located in north-eastern New York state and was a key location in the 1960 Winter Olympic games. A digital repeater on Whiteface is a possibility in the future.

Dayton Report

by Joe Buswell, K5JB

During the visit to Dayton, I got an opportunity to attend the Packet Radio presentation and meet some of the movers and shakers. Two people whom I especially admire, Lyle Johnson, WA7GXD, President of Tucson Amateur Packet Radio Corp. and Gil Boelke, W2EUP, of GLB Electronics took turns on the platform along with representatives from St. Louis (SLAPR), Dayton (Miami Valley FM Association), AMRAD, and the ARRL (Paul Rinaldo, W4RI).

After the presentation I got to meet Gil and ask him if he minded my modifying the code in the PK-1. He said heck no and to call the company later to get specific answers to my questions (which I subsequently did, and to which they responded in writing with specific answers to my questions. This is without any knowledge of my reputation as an agitator/instigator). I chose my questions carefully though because firmware is a really touchy subject. I have a real warm feeling about the GLB folks. I think their aim is to please.

The next morning I got to visit briefly with Lyle Johnson, WA7GXD, who is certainly one of the most energetic and creative persons I have encountered. I can understand how he has been such a sparkplug for the TAPR activity).

There are currently six sources of TNC's or alternate methods of getting into Packet Radio: AEA's, Ashby and Son's (K2TKN & KA2OEG), GLB's, Bob Richardson's (W4UCH), TAPR's, and VADCG's. Someone in AMRAD is working on a TNC called a PAD (Packet Assembler - Disassembler) which is apparently slanted toward S-100 Bus Computer systems. AEA (Advanced Electronic Applications) announced its TNC at the Hamvention but had no representative on the program.

AEA has a handsome design that looks like a development from the TAPR TNC, for a price of about \$500. I saw no evidence of the Ashby and Son TNC at the show but I could have missed it. Likewise, I saw no evidence of Bob Richardson's (W4UCH) Radio Shack model 1 and 3 program, but it was respectfully mentioned by Gil Boehm from GLB. It seems that since Bob and Gil are neighbors, they regularly communicate on program design questions but developed their programs independently.

Gil defended the GLB's Spartan design by stating that he Value Engineered the problem to strike an economical compromise in hardware vs. software trade-offs and decide whether to add audio shaping and filtering to the PK-1. He was challenged by a later AMRAD speaker who felt that the five bucks the filter would have cost would be a cheap 1.5 dB improvement if one were working satellites. Later when Gil answered a question about whether the TP-1 would run 300 Baud for HF operation, he answered both points when he stated that its design goal just didn't include those applications.

There still is no absolute answer to the question, "Which is better, the GLB or the TAPR?" It depends for which use the TNC is intended. For the benefit of you who have not been following this discussion, the following salient differences exist between the two.

The TAPR TNC costs approximately \$250.00 in kit form, has an optional cabinet for about \$70.00, runs Vancouver and AX.25 protocol and runs on 120 Vac.

The GLB costs approximately \$150.00 assembled, has an optional cabinet for about \$25.00, runs both protocols and runs on 12 Vdc.

The TAPR TNC uses hardware (Western Digital 1933 SDLC) to make and read packets, the GLB TNC does all in software (firmware). The hardware v.s. software is the major difference between the two and accounts for most of the cost difference. The only performance disadvantage I have found in the GLB approach is the packet reception disruption that occurs if a key is touched on the terminal during the reception process. The keyboard has interrupt priority and the Processor must service the keyboard at the expense of its packet activities. Gil (and the accompanying TP-1 literature) advises that the computer, which is most often the case used to act as a terminal, be programmed to accept the input off-line from the TNC and send it, when ready, to the TNC at a high data rate, reducing the probability of a clash with packet operation. The TAPR TNC, with its packet handling hardware, is not placing any strain on the processor to make the data input and output process appear transparent to the operator.

Mark, WD5DY1, is now using his TP-1 regularly and this disadvantage is much more apparent as he creates his epistle sized packets. I had not noticed the problem so much because I usually send rather terse packets, or type in short, five character, bursts of about a thousand words per minute, spending the rest of the time looking for the next five keys! Packets easily slip in while I am looking. Mark is not a programmer but he will eventually want to do the line editing on his computer. I toyed with the idea on the Model-100 but got bogged down in the creeping elegance of interrupt handling from the RS-232 port.

The TAPR documentation is awesome and contributes to a portion of the price difference. Since this is a kit, construction and adjustment instructions cause some of the book's volume but, in fact, the TNC is one of the most thoroughly documented pieces of hardware I have ever seen.

The GLB documentation has come a long way since I bought mine. It is now 35 typewritten pages bound looseleaf between a couple of nice, blue covers, with a command cross reference chart printed on the back for easy reference. Also, it now has a schematic! The manual is certainly adequate to support the PK-1 and its many features.

The TAPR hardware was designed for flexibility in order to enable as many conceivable modifications as possible so that it could be used for other applications. It has a socket for an external modem in case one is impatient with 1200 Baud, or just wants to try external hardware. Its audio filtering can be easily modified for HF use by installing suitable resistors on DIP headers. As already mentioned, with the GLB you roll your own if you want audio filtering or shaping. If you run out of Packet things to do with the TAPR TNC, you can get the EPROM programmer from TAPR, plug it into the socket provided on the TNC and do your own thing. These functions were simply not part of the requirements in the GLB design concept. (Like a friend of mine says, "If you wanted the Penguin to fly you should have included it in the specs!")

The TAPR TNC can be made to operate the radio side from 50 to 4800 Baud half or full duplex while the GLB PK-1 is restricted to 600 and 1200 Baud, half duplex. N5MS and I experimented with 600 Baud over a noisy path and it didn't seem to be any better than the 1200 Baud speed. So far, I have enjoyed my particular application, using it portable with the Model-100 computer as a
(continued on page 20)

(UOSAT-2 STATUS continued from page 3)

In a demonstration of the flexible design of the spacecraft, the UOSAT-2 mission has been revitalised. The result is that we are now back to where we were on orbit 3 after launch and we have to proceed with the commissioning of the spacecraft and its experiments. We do not yet know whether there are any other 'gremlins' in the spacecraft nor what the operational implications of the use of the on-board computers for the 'bypass' will be on the planned experiments.

The UOSAT Team would like to thank all those who have given support through the dark passages of the last months and particularly to Bob Leonard and his team at SRI International and to Harold Price (AMSAT/VITA) for providing the necessary software for the DCE at short notice - transferred from California by electronic mail!

(MESSAGE HEADERS continued from page 9)

quite simple, just generate a new header with new data, including subject. Let the station doing the forwarding enter some text if desired and then specify the message to be forwarded. The format would be something like this:

MSG#: PRG-STL-840406-02

"

SUBJ: This a forwarded message

TEXT:

Hello Joe, I though you might be interested in this. Jack

FORWARDED MESSAGE:

MSG#: PRG-SDG-840404-01

"

SUBJ: 820 supplies

TEXT:

"

This is sort of the way that telemail does it.

Good grief! This whole thing is getting out of hand. I was just going to suggest that you start using this type of format to get a feel for it when sending messages to Lynn. I'm making the assumption that you are a gateway station. Well I guess now that it has grown into a substantial message I'll send it to everyone and see what sort of flaming arrows it draws. I am not familiar with the CCITT MHF so this most like dosen't look anything at all like any part of it. This is based on the suggestion by Tom Clark with my own bias and thought thrown in for good measure. Again, it is my intent to try using something just to help figure out what it is we really want when this whole thing is finally automated. This message is actually a bad choice for an example since it only to the people with direct access to this medium. I suggest this header only for messages that travel outside to people who are not potential 'gateways'.

CAPRA (Chicago Area Packet Radio Association) has become the first TAPR-affiliated group.

Affiliation provides your local area with a clear, direct line of speedy communications with TAPR. In addition, TAPR can provide you with names, addresses, and etc., of enquirers, TAPR members and kit owners on a semi-regular basis. Further, your club can provide us with a one-page flyer that we can send to others who contact us from your area.

TAPR desires to see strong, local packet organizations flourish in the true spirit of Amateur radio. Affiliation may help us assist you in achieving this goal.

(OSCAR-10 LINKING continued from page 6) without having to worry about a timer circuit. The delay is a litte short, on the order of 5 to 10 seconds, but it seems to work quite well on the 8 inch drives.

Mike

Display Message (Serial number): 1728

Message #1728 To: ALL From: W3IWI
Subject: Hello Via Oscar-10 Satellite
-- Entered: 10:25 AM 1 Apr 84

(The message that I entered above was displayed)

Display Message (Serial number):

Note: someone else is waiting to use the mailbox
Commands: Help, List users, Send, Read, Display, Browse, Call SysOp, Quit

Command: q

*** DISCONNECTED

(MODEM SENSITIVITY MODS continued from page 12)

Beta: Change the resistors on header U30 as follows:

Pins 1 and 16	10.0 k
Pins 2 and 15	38.0 k
Pins 3 and 14	10.0 k
Pins 4 and 13	43.7 k
Pins 5 and 12	10.0 k

(and move the end previously attached to pin 5 to pin 2)

Pins 6 and 11	10.0 k
Pins 7 and 10	11.4 k
Pins 8 and 9	23.7 k

Parts Kits

TAPR has available parts kits for most of these modifications. Just send your name, callsign, mailing address, TNC serial number and a check or money order for the amounts listed below to the TAPR PO Box marked "ATTN: Modem Parts Kits".

Improved Sensitivity Mod Kit	\$ 5.00
HF/Oscar Flat Filter Kit	5.00
300 Baud Mod Kit (Kit TNC)	5.00
300 Baud Mod Kit (Beta)	2.00

Note: The Kit TNC 300 Baud kit contains a new header U34, plus new C20, C21, C22, R44, R45, R46 and R47 to provide a complete 300 Baud plug-in assembly.

Please do not include any correspondence not directly related to your parts order; TAPR has volunteers at various locations performing these services, so including unrelated items will only cause delay in taking action on (or perhaps loss of) the other information.

Credits

The improved sensitivity and 300 baud demodulator mods are a result of extensive investigations conducted by Eric Gustafson, N7CL. The filter resistor mods are due to the efforts of Dan Morrison, KV7B, and Margaret Morrison, KV7D.

In addition, TAPR would like to thank all who have been assisting in the testing of these modem enhancements.

From the mailbox: The first PA-PA (the Netherlands!) packet radio QSO took place on April 23, 1984 on 144.625 MHz at 1200 at 1800 GMT between PA0RYS and PA3BMG.

(MODEM MODS TESTS continued from page 13)
George, WD4BRF, to send me the default beacon every 10 seconds. I then switched in attenuation until I got about 50% copy based on an average of about 24 packets.

Then the modifications were made and more attenuation was added until I got the same 50% copy. On one board I gained 4 dB and on the other about 2 dB.

Adjustment of the XR2211 center frequency was the most difficult part of the job. On the Beta boards the 1700 Hz calibration routine does not work very well [this is a hardware problem cured on the kit TNC and included in the Beta upgrade kit]. I used the procedures outlined in the January 1984 PSR.

The Tucson Amateur Packet Radio Corporation is a nonprofit scientific research and development corporation. The Corporation is licensed in the State of Arizona for the purpose of designing and developing new systems for packet radio communication in the Amateur Radio Service, and for freely disseminating information acquired during and obtained from such research.

The officers of the Tucson Amateur Packet Radio Corporation are:

- Lyle Johnson WA7GXD ... President
- Heather Johnson .. N7DZU Secretary
- Chuck Green N0ADI Treasurer

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(DAYTON REVIEW continued from page 18)
terminal. Joe, WA5FLT, also has a TAPR TNC and can provide his opinions as soon as he gains experience. He intends to put his into remote operation. This is a special feature incorporated in the GLB that requires adding only a transceiver, watchdog timer and transmitter timeout time. The TNC receives its commands via the packet channel.

The decision on which TNC to buy is a personal one. One has to first determine the function he wishes to perform. Lyle, WA7GXD, put it most succinctly when he commented that the TAPR TNC was intended for the bearded experimenter down in the basement (He sports a handsome bush). On the other hand, Gil claims the GLB PK-1 was not intended to be all things to all people.

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21.280 MHz 1900Z Sundays 2100Z Sundays

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