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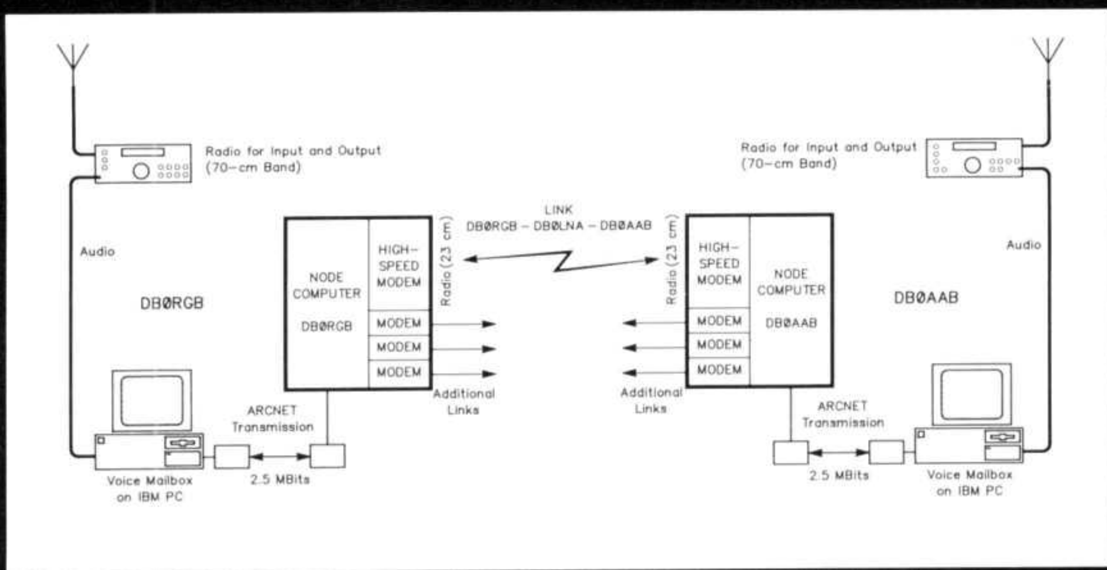
ARRL Experimenters' Exchange

DECEMBER 1991



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Offices

225 Main St, Newington, CT 06111 USA
Telephone: 203-666-1541
Telex: 650215-5052 MCI
FAX: 203-665-7531 (24 hour direct line)
Electronic Mail: MCI MAIL ID:215-5052
(user name ARRL)
Telemail address: ARRL
Internet:arrl@mcimail.com

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TABLE OF CONTENTS

COLUMNS

DECEMBER 1991 QEX ADVERTISING INDEX

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

Empirically Speaking. . .

I Know You're Out There—I Can Hear You ACKing

What would you think of an AM broadcast station that repeated each word it sent so that all of the listeners received their own "copy" of the broadcast? It sounds pretty silly, but that's the way current point-to-multipoint (broadcast) amateur packet applications work. To use Pavillion Software's PacketCluster system, for example, a user establishes a standard AX.25 connection to the cluster node. This requires that the cluster node transmit an individually addressed copy of each "broadcast" packet to *each* of the stations connected to the node. Normally, each connected station can hear the node very well, with the result that the user stations hear N copies of each chunk of data, where N is the number of stations connected to the node. A lot more data is being sent than is really needed.

The problem is exacerbated by the hidden transmitter syndrome. When the node finishes transmitting its N copies of a data packet, all N stations want to respond with an acknowledgement. On a channel where every station could hear one another, properly configured TNCs would keep the number of collisions between these ACKs to some reasonable minimum. But often the user stations *can't* hear one another, leading to a high collision rate. Not hearing an ACK from a given station causes the node to retransmit to that station—or stations—whose ACK is missing. It's retransmitting the same data yet again! Connect a dozen stations to a node, which isn't uncommon, and the result is a massive amount of channel bandwidth consumed unnecessarily. ("Bandwidth" in this case meaning the product of total occupied bandwidth and time.)

Why "unnecessarily?" Because there is no need for a full AX.25 connection between the node and the user. Consider: AX.25 is a balanced protocol. It assumes that either station may be as likely to want to transmit data. But in a point-to-multipoint application, only *one* station is transmitting data while the others are sending only ACKs. This kind of unbalanced application begs for a protocol that gives the broadcasting station control of the channel. Even in the PacketCluster case, where the user stations occasionally transmit data back to the node, a protocol that eliminated collisions in the node-to-user direction while allowing some collisions to occur in the user-to-node direction would significantly ease the situation. (Of course, most TNCs support some form of "monitor" mode for listening on the channel. But this is a chancy proposition: miss a packet and you've missed it forever.)

This is in no way to denigrate PacketCluster. It uses AX.25 connections because that's what current TNCs support. To give maximum utility to the users, the node has to conform to the users' capabilities. But PacketCluster has been so successful that in some areas it occupies the majority of the available packet frequencies—wastefully, in a purely technical sense, because if the users' TNCs supported a good point-to-multipoint protocol the PacketCluster could provide its service using less bandwidth.

A good point-to-multipoint protocol is desperately needed for this kind of VHF application, but it's also needed at HF. Right now most point-to-multipoint information is relayed between HF packet bulletin boards for distribution worldwide. Again, each transmission of data is heard—or could be heard—by hundreds of stations. But they ignore the data because the packet isn't addressed to them.

To date, the only broadcast protocol implementation in widespread amateur use is that used by the amateur packet satellites. That protocol is optimized for the unique environment of a low-earth-orbiting satellite that is available for short periods of time. But it's instructive to note that the protocol was implemented without requiring changes to TNC firmware. The KISS TNC-to-computer protocol gives the connected computer the freedom to escape the AX.25 straightjacket. Why can't this be done for terrestrial point-to-multipoint protocols? It can be. It should be. Why not get to work on it? And let the ARRL Digital Committee know how you are doing by writing to them here at Headquarters.—*Jon Bloom, KE3Z*

An Optical, Through-the-Air, Digital Communication Modem *Part 2 of 2*

By Lawrence E. Foltzer
4250 Deer Meadow Lane
Occidental, CA 95465

Part 1 of this article, which included an Electronics Hardware Description, appeared in the November 1991 issue of QEX.

Optical Components

The Lens Systems

Two different lens systems were investigated with the electronics described in Part 1. One of the systems used lenses purchased from Edmund Scientific Co, of Barrington, New Jersey. These lenses had a 153-mm (6-inch) focal length, and a diameter of 50 mm (2-inch). The part number for the Edmund lenses is B/F96090 (B/F?, one catalog uses a B prefix, the other uses an F prefix), and they sell for about $5.35 each.

I used only 30 mm (36%) of the 50-mm lens' aperture, since the largest chassis hole punch I had at the time of construction was 30 mm. The 30-mm aperture reduces the received optical power by about 4.4 dB over that which could be collected with a 50-mm diameter aperture. As a result, the transmission distance would be reduced to approximately 60% of that of a full (50-mm) aperture receiver.

The Edmund lenses were mounted on the outside of a 7-inch long LMB, Los Angeles, California, utility box, P/N 974, using hot-glue adhesive. On the other end of the box, in line with the center of the main lens, I mounted a 1-inch focal length, 0.65-inch diameter eye lens, again outside the box, over a 1/2-inch diameter hole. This arrangement forms a 6-power telescope for aligning the transmitter and receiver. As Fig 10 illustrates, the focal planes of both the objective and eye lenses coincide, and it is at this point where the transmitter LED and receiver detector are positioned. In this way, one boresights the transmitter to the receiver, and vice versa, by obscuring each other with the active optical element seen in the focal plane through the eye lens.

The second set of optics I investigated was of my own design and fabrication. They are the clear solid cylindrical lenses shown in Fig 11. The idea behind the lens was to reduce the beam divergence from an infrared LED to about a degree or so. Infrared LEDs (IRLEDs) with small integral lenses typically project beams with an 8- to 12-degree half angle. That kind of beam divergence is okay if you are trying to control a TV from across the room, but is not directive enough for long-range applications. What I wanted was as IRLED that could cast a 1- or 2-degree beam, something that would effectively concetrate the optical energy, but not so much as to complicate link alignment. I started with a 1-degree (17.5 milliradian) beam width design goal, and a more general goal of small physical size. Since I planned to make these lenses from epoxy, I was concerned that a strong exothermic reaction might occur when curing the

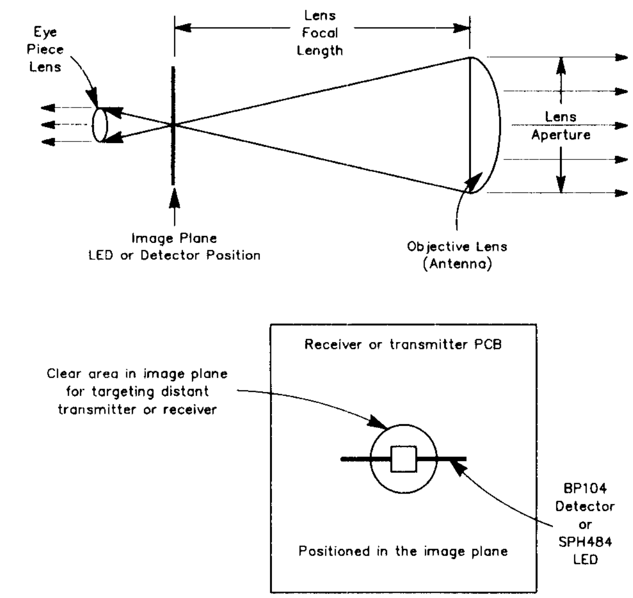


Fig 10

relatively large batches needed to make the lens. An exothermic reaction is regenerative, so if it starts, there is virtually nothing you can do to prevent it from destroying itself. I surveyed suitable IRLEDs for the project and found that a good number of them have an active area of about 0.4 mm (0.016 in.). Using a basic trigonometric relationship, $S = R\Theta$, one arrives at the conclusion that a 1-inch focal length is required to obtain a 1-degree beam. To keep the size down, and the potential of an exothermic reaction to a minimum, I decided to make the lenses 1/2 inch in diameter.

I then researched epoxies and found STYCAST 1269, a water clear, low viscosity, long pot life, high temperature curing, styrene based epoxy made by Emersom & Cummings. Armed with the epoxy's optical refractive index, I wrote a program that generated the coordinates of the lens surface I needed, and turned and polished a master in aluminum on a lathe. I used the master to make silicone rubber molds, and cast the lenses with the STYCAST 1269 epoxy. I turned a shallow groove around the perimeter of the master 1 inch from the front of the lens surface to mark the focal plane of the lens. When the lenses were fully cured

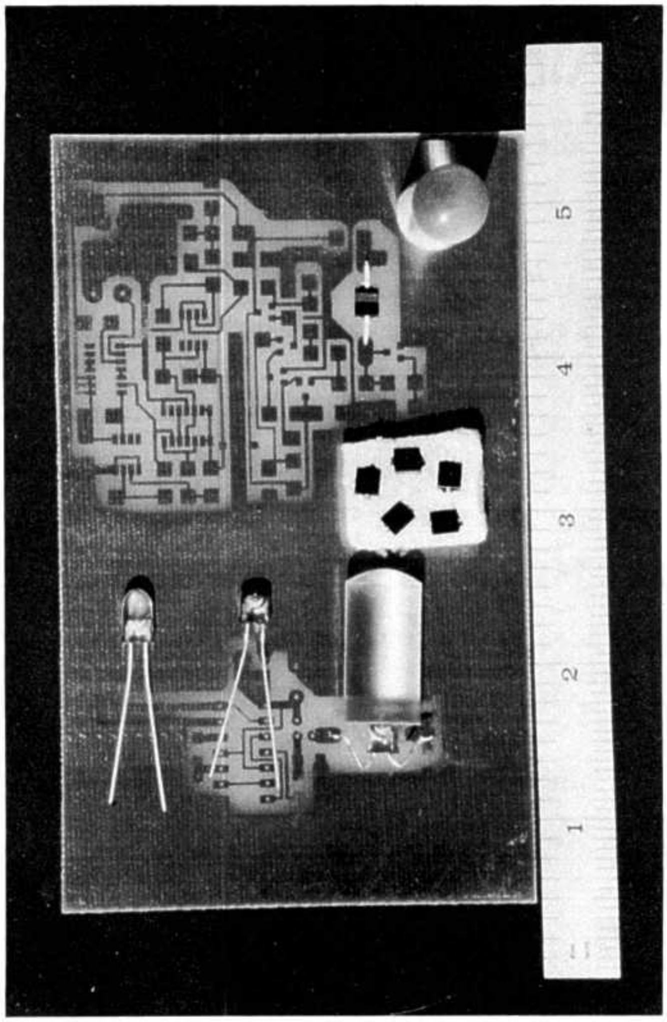


Fig 11—Transceiver PCB shown with detectors (right) and emitter (left) and short-range molded lenses.

(about 12 hours at 80-90° centigrade), I pulled them from the reusable silicone molds, and cut them off with a jewelers saw slightly longer than the focal length marked by the groove. I then clamped them in a small machinists vice to hold them perpendicular to a flat grinding surface that was covered with 600-grit wet-or-dry (use wet) sandpaper to grind them to the proper length. The end of the lenses was then polished clear by rubbing it against an old piece of belt leather, suitably charged with a paste made from toothpaste and cerium oxide, the pink abrasive stuff in Glass Wax.

Aligning an LED to the optical axis of the lens was a tricky process, best performed while the LED is operating. But these LEDs are IRLEDs, so you can't see their output, directly. Like most of you, I can't afford night vision goggles, but I found that cheap, black and white TV surveillance cameras can see partially into the IR region of the optical spectrum. So I drew a target on the wall about 10 feet from the lens that was on the optical axis of the lens in its fixture, and trained the camera on it. Using 5-minute epoxy, I positioned the LED on the back end of the lens, holding it so it cast a spot on the target, until the epoxy cured. I initially used garden variety visible red LEDs to develop the technique of positioning and gluing the LEDs to the lenses so that I could work without the aid of the IR camera in

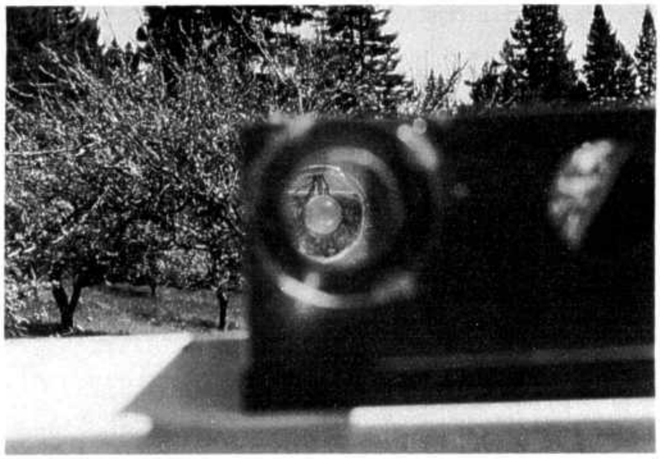


Fig 12—Looking backwards through the transmitter you can see the LED in the plane of the image formed by the eye lens.

relative daylight. I ground the ends of these LEDs down so that the chip was near the surface and polished them flat. At a distance of 30 feet they projected a well defined 6-inch diameter spot on the wall that can easily be seen in subdued lighting.

The Photodetector

I used the Siemens BP104 PIN photodiode for both of the links described in this article. The BP104 comes in a two-leaded DIP-style package, as seen on the right side of Fig 11, positioned over it mounting pads of the PCB, and mounted on the PCB facing into the page in Fig 9. Five (5) other BP104s are shown stuck in a piece of styrofoam in the center of Fig 11.

The BP104 is encapsulated in a black plastic material that serves as an effective filter that blocks out visible light, while passing the near infrared radiation (880 nm) produced by the LEDs used in the transmitter. The size of the active area of this detector is 2.2 mm by 2.2 mm, and when reverse biased at 5 volts for use in the photoconductive mode, exhibits a capacitance of approximately 15 pF. The wavelength corrected responsivity of this detector at 880 nm is about 0.56 amperes/watt. The BP104 photodiode was placed in the focal plane of the optics for both systems. Exact placement, both axially and transversely is not essential, due to the relatively large size of the active area of this detector. The large detector area also facilitates the optical alignment between the transmitter and receiver. The BP104 sells for about $1.25 each in small (<100) quantities.

The Light Emitting Diodes (LEDs)

Two LEDs of the same basic type, the SFH485P and the SFH484, manufactured by Siemens Optoelectronics, were used in the links described in this article. The SFH485P LED was used in the transmitter with the 1/2-inch diameter, 1-inch focal length optics, and comes in a flat-faced T-1-3/4 package. The flat face of the SFH485P facilitates bonding of the LED to the molded plastic lens used in the short range system. The SFH485P is shown in the center left portion of Fig 11. An SFH485P that is bonded to the plastic lens is shown in the lower left part of Fig 11 positioned over its PCB mounting pads.

The SFH484 LED was used in the transmitter with the 1. 2-inch diameter aperture. The SFH484 comes in a T-1-3/4 package with the integral lens that produced an 8-degree half-angle beam, all of which is captured by the transmitters primary 1.2-inch optics. The SFH484 is shown in the upper left hand portion of Fig 11.

The radiant intensity and power of these 880-nm emitters are among the highest available, for parts that have sub-microsecond rise and fall times (Tr/Tf = 0.6/0.5 microseconds) and of equivalent cost. The SFH484 sells for about $0.60 each, while the SFH485P sells for about $0.70 each in small (< 100) quantities.

Range Experiments

The LED-based links described in this article are designed specifically for low-cost intermediate-range application, and with relatively large optical beam widths (1 or 2 degrees), so that optical alignment is reduced to a relatively crude pointing exercise. The distribution of the power in the far field beam pattern is not uniform, in fact, the far field beam pattern is an image of the LED chip and surrounding structure. The flux density of the beam is generally higher in the center of the pattern, which is the portion of the beam that is usually measured to determine the radiant intensity of the LED. If you use the peak radiant intensity to determine a systems potential range, you are likely to become frustrated trying to demonstrate the capability. To avoid this problem, I derate the range of these relatively short distance systems to 70% of the predicted maximum range, based on conservative measurements of the LED's radiant intensity and the detector's responsivity. The 70% range figure translates to a −3 dB (1/2 power points) intensity of the beam, and determines the degree of accuracy required to align the link.

Short-Range Configuration

At the beginning of this experiment I conducted a series of measurements on the SFH485P LED and molded lens assembly. I measured the beam profile and determined that it had a 12-milliradian (0.67 degree), −3 dB beam half-width, which was close to the 8-milliradian (0.5 degree) original design goal. I also measured the Radiant Intensity (RI) of the source assembly using an unaided BP104 detector at a separation distance of 27.5 inches, which corresponds to a 10-micro-steradian receiver sampling cone. For a 200-milliampre drive current, I measured a RI of about 1.2 watts/steradian, about 120 times the RI stated on the manufacturer's data sheet for an unaided (no external optics) device. Using the measured RI, receiver sensitivity and receiver aperture size (0.5 inch), I calculated a maximum range of about 128 feet using the relationship below:

$$\text{Range(max)} - \sqrt{\frac{\text{RI} \times \text{Ar}}{\text{Pr(min)}}}$$

where

RI is the radiant intensity of the source expressed in the units of watts/steradian,

Ar is the effective area of the receiver aperture, and

Pr(min) is the minimum received power needed to operate the receiver reliably.

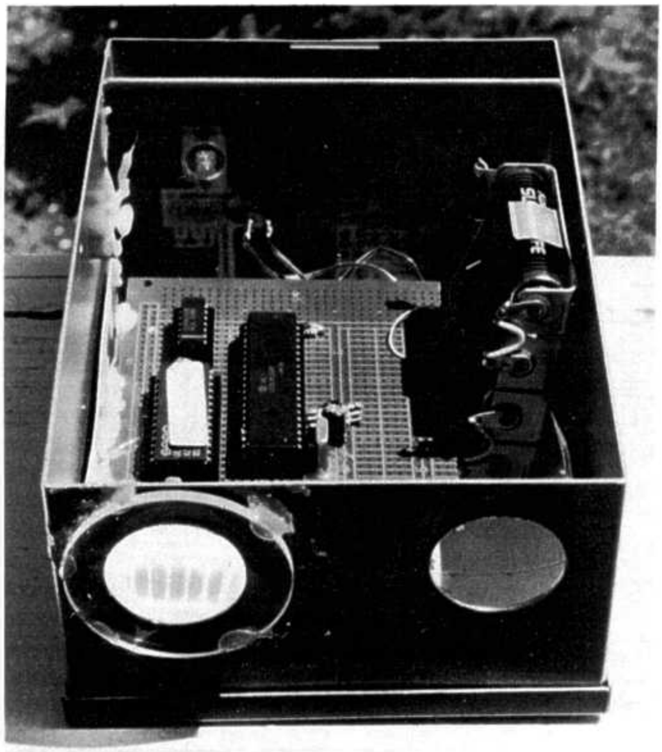


Fig 13—Transmitter assembly.

Derating the predicted range using the 70% factor results in a range of about 90 feet. I decided to stretch the range a bit and setup my experiment from 100 feet instead. The link operated successfully, with only minor alignment difficulty since no boresighting aids were used. I then used my oscilloscope and the receiver to probe the profile of the beam. I found that the receiver continued to operate as long as it was within a region that was between 2.0 and 2.5 feet in diameter. The hot-spot of the beam produced a 70-millivolt signal from the receiver front-end, which is about 3.5 dB above the minimum required to operate the link satisfactorily. From this level of performance, one could expect to achieve a maximum range of 150 feet or so, but with considerable time spent in aligning the system. An increase in LED drive current could be used to stretch the range of a practical system in excess of 200 feet, as long as the LED duty cycle is kept low.

Long-Range Configuration

Before starting this experiment, I made some measurements of the radiant intensity of the beam emitted from the transmitter using the 1.2-inch diameter, 6-inch focal length lenses with both the SFH-484 and SFH485P LEDs. I discovered, to my surprise, that the radiant intensity of the beam was stronger when I used the SFH-484 LED, rather than imaging the die of the SFH485P directly with the lens. For the 200-milliampere drive level, I measured radiant intensities between 5.2 and 11 watts/steradian. Based on these measurements, the 100-nanowatt receiver sensitivity, and the 1.2-inch receiver aperture, I could expect a maximum range between 650 and 950 feet.

I performed the range experiment in my backyard and neighboring field. I picked the longest line of sight path available at the site, which turned out to be almost exactly

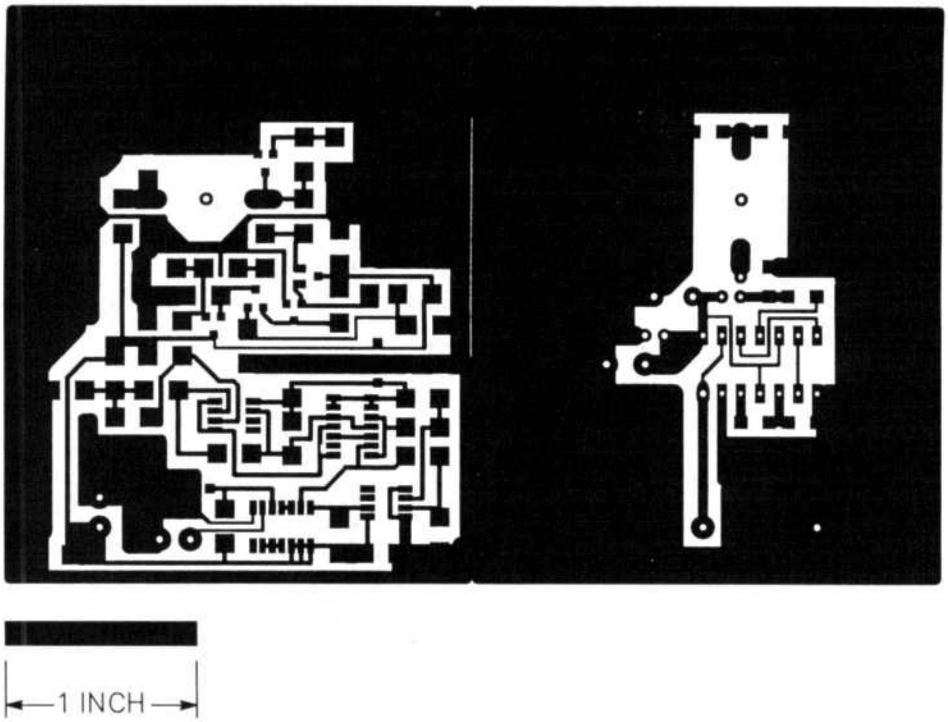


Fig 14—Transceiver PCB artwork showing surface-mount pads and traces. An updated version of this circuit with both TTL/CMDS and RS-232 compatible interfaces is available from the author.

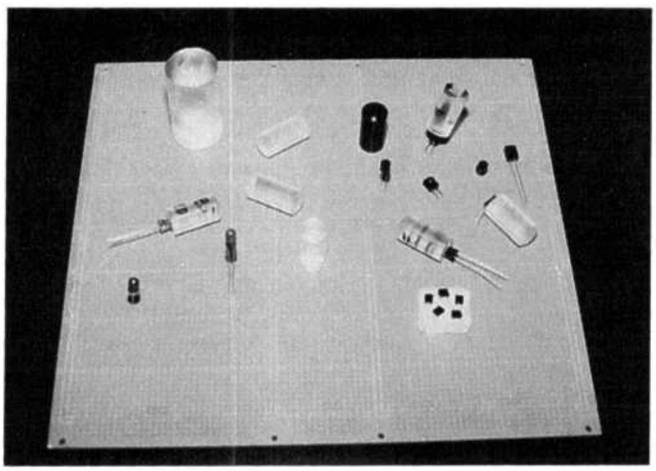


Fig 15—Short-range lens shown with a variety of LEDs and detectors that were characterized for this application. The dark lens shown is IR transparent and was made from an epoxy that turns dark red to indicate when the curing process is complete.

500 feet, which is a range that is consistent with the beam power profile derating factor discussed previously. At this range, since the focal length of the transmitter lens is 6 inches, the spot size would be about 1000 times the diameter of the source, or about 16.5 feet. If I could get the link to reliably operate at that range without having to resort to extraordinary alignment methods, I would be satisified.

The transmitter was positioned at one end of the range pointing toward the distant target, while me and a friend headed off. We stopped along the way and verified link operation at the intermediate distances of 200 and 300 feet, where we were able to position ourselves in the line-of-sight path between the transmitter and the target. We then moved across the valley and to the top of the hill at the 500-foot point where we were again "in the beam" and pointed the hand-held receiver at the transmitter. With a minimum of experience in using the built-in coaxial telescope to sight the receiver on the distant transmitter, we were able to repeatedly acquire the transmitter with no difficulty. After months of work, all that remained was the writing of this report.

Once again, we can estimate (conservatively) the power in the beam. The ratio of the beam size to the receiver aperture at 500-feet distance is 16.5 feet × (12 inches/foot) / 1.2 inches = 167, and 100 nW × 167^2 = 2.7 milliwatts. If we assume, both academically and justifiably, that the actual beam power at 500 feet is perhaps 2.33 times the baseline receiver sensitivity, then the total beam power is more like 6.5 milliwatts. In either case, the total beam power is less than the 40 mW to 50 mW output power one would anticipate from the manufacturers data sheet for the SFH484. However, the aperture of the transmitter optics is marginal in terms of its ability to capture all of the LED's radiation. In fact, the lens would have to be almost twice the diameter of that used here to capture the main beam and the side-lobe radiation from the part. All of this assumes, of course, that the LED is perfectly aligned to the optical axis of the transmitter lens.

Conclusion

In this article I have demonstrated that one can build some pretty impressive and economical optical data links that could find wide utility in Amateur Radio activities. Such links could serve as effective local communications links between stations at Field Days without compromising the RF spectrum, and in remote control or monitoring applications.

Some of the more critical parts required to build these link PCBs can be purchased from the author at the following cost plus $5.00 S&H.

HD6303R CPU	@ $10.00 ea
27C256 OTP EPROM	@ $4.00 ea—specify w or w/o TX/RX code
SFH484 LED	@ $2.00 ea
SFH485P LED	@ $2.00 ea
BP104 PIN Diode	@ $2.50 ea
Author's molded lens	@ $5.00 ea—with alignment instructions
4.9152-MHz CPU crystal	@ $3.00 ea for 0.3, 1.2, 9.6, and 76.8 KBaud

One can readily construct an RS-232 interface to the transceiver circuits using one of the commercially available 5-volt only RS-232 transceiver chips, such as the MAX232EPE from MAXIM, or the Motorola MC145406P. If you would be interested in purchasing a PCB of the transceiver described in this article with an RS-232 interface, send me an SASE. If sufficient interest exists, I will make the appropriate modifications and investigate the per unit cost and notify interested parties by mail.

Voice Mailbox at the UHF/VHF Conference in Weinheim

Translation by Don Moe, DJØHC/KE6MN

Reprinted from the November 1991 issue of cq-DL.

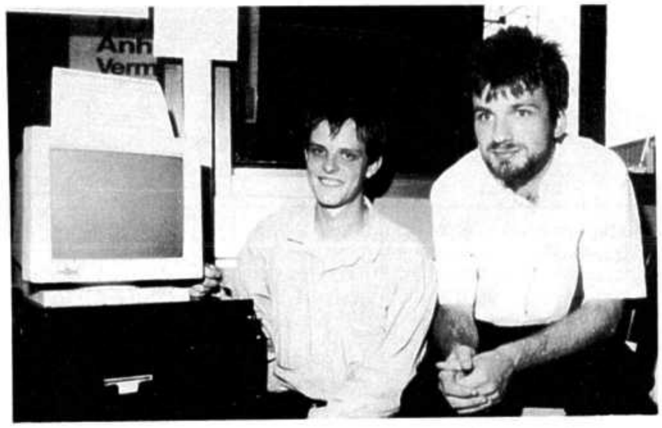
Visitors at the 36th UHF/VHF conference in Weinheim were astounded by what they heard on Saturday: A voice mailbox in operation on the simplex frequency 433.776 MHz. A more complete presentation of the technology was made at Interradio '91 in Hannover. Johannes Kneip, DG3RBU, and Florian Radlherr, DL8MBT, the "fathers" of the voice mailbox operated in Weinheim kindly provided the editor with the following system description.

The voice mailbox was developed in early 1991 by DL8MBT (software) and DG3RBU (hardware). It represents the first link in an experiment involving digital voice transmission in Amateur Radio. The voice mailbox was designed around a plug-in card for an IBM PC. A special delta modulation technique called CVSD was chosen since it is particularly well suited to voice digitization. Presently the data rate is 32 kbit/s, but this can be varied over a wide range. The maximum length of a single voice message is limited to approximately 2 to 3 minutes.

The mailbox is operated using DTMF tone sequences. Upon logging in for the first time, the user enters 999 to be assigned a three-digit user number, which he will use during subsequent sessions. He is then asked to speak his call sign.

The voice mailbox supports the following commands:

- 999 new user log-in. Assignment of the user number.
- 1xx personal user number at log-in
- 01 list of all possible commands
- 02 announces 10 numbers and calls of the users. At each entry of 02 the next group is announced.
- 021 renewed voice entry of the user's call, only when the call has not been secured by the command "023"
- 022 listen to own call
- 023 secure own call sign against unauthorized alteration. This can be reset only by the SYSOP.
- 03 announcement of the current time
- 04 list of personal messages
- 041-049 read-out of personal messages. (041=first, 042=second, etc) The user number is announced at the end of the message.
- 051-059 erase personal messages
- 06 information and current bulletins
- 07xxx entry of a message where "xxx" is replaced by the number of the recipient. Enter the number without break and after releasing the PTT. Wait for the request to speak. Release the PTT only after speaking the complete message.
- 09 exit from the voice mailbox
- * cancel the DTMF command sequence already entered
- & followed by speaking: After releasing PTT the words spoken are immediately replayed.



At the Weinheim UHF/VHF conference, only a small sign referred to the voice mailbox by Johannes, DG3RBU (left in photo) and Flori, DL8MBT (right) at the ADACOM stand. Nevertheless there was extensive interest.

Hardware of the Voice Mailbox

The voice mailbox providing the voice input and output is based on a normal IBM AT computer for which a special plug-in card was developed using an A/D-D/A converter to transform the voice signals. A special chip was chosen that is capable of digitizing analog signals in a very specific manner, namely according to the CVSD technique (Continuous Various Slope Decoding), a special type of delta modulation. In this digitizing method, instead of storing values corresponding to a particular voltage level of the analog signal, the slope of the signal at the sampling interval is noted and stored, whereby a "1" indicates a rising signal and a "0" a falling signal. The degree of inclination being encoded or decoded adapts to the history of the signal. If the previous bit was a "1", for example, and the following bit likewise a "1" (still increasing), a higher slope of the signal tangent in the modulation is therefore assumed. Demodulation functions correspondingly.

This type of encoding/decoding is particularly suited for transmission of voice signals since even relatively low data rates (eg, 16 kbit/s) yield really good signal quality following transmission. The plug-in card, on which this technique is implemented, will now be described more thoroughly.

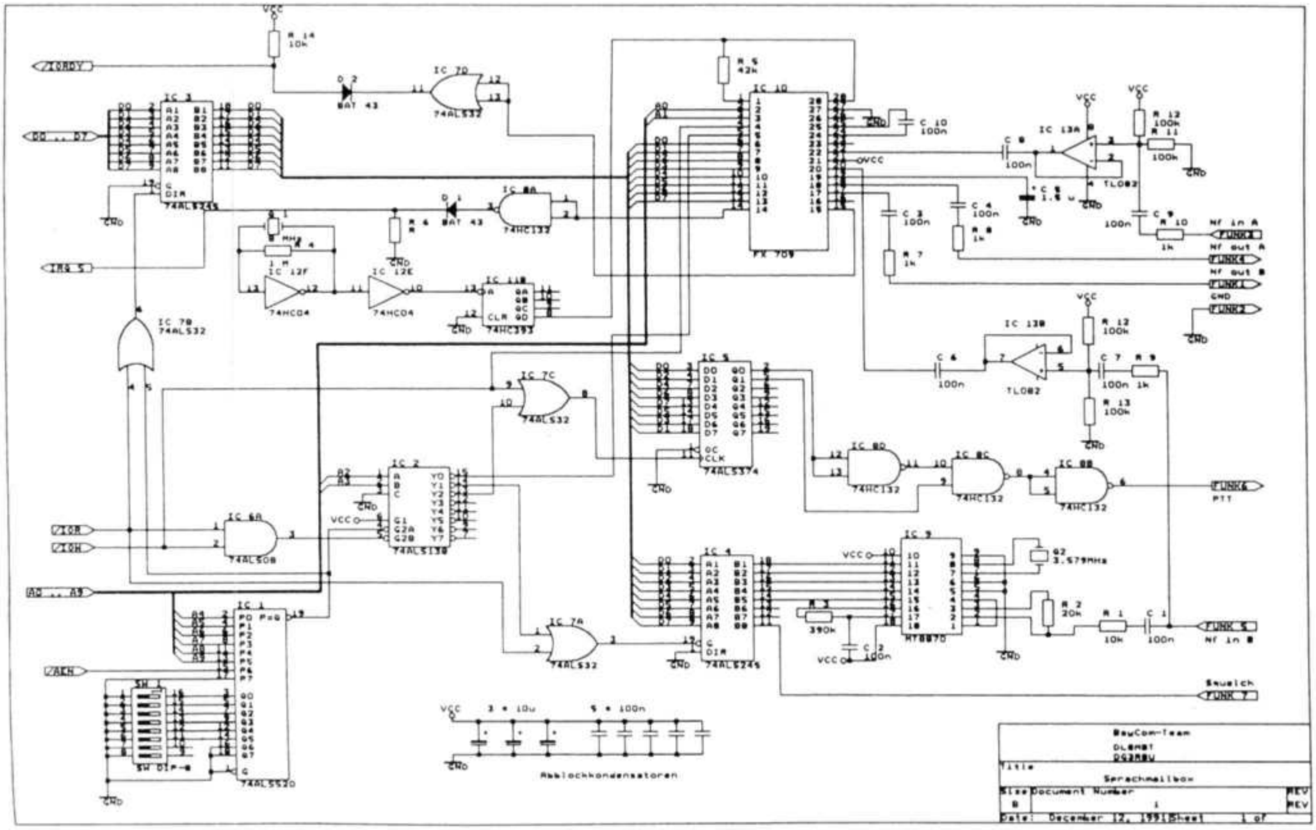


Fig 1—Schematic of voice input/output module with FX 709

In the schematic diagram, the first section is the address decoding logic (IC 1 and 2) required by the PC. The heart of the circuit is the CVSD encoder/decoder, FX-709 (IC 10), which performs the complete conversion of the data into and from the CVSD format. In this IC, the audio signal first passes through a band-pass filter before it enters the serially operated 1-bit encoder. Following the conversion into 8-bit parallel format, the data pass through IC 3 to the bus of the PC. Data in the other direction are serially decoded similarly and sent through a software configurable filter. Registers to recognize pauses and the modulation intensity supplement the device. The operational clock for the device is derived from crystal Q1 via divider IC 11, thus allowing experiments to be performed with externally selectable clock rates.

Since commands to the mailbox are performed using DTMF tones, the card was rounded off with a DTMF decoder, MT8870 (IC 9), and its associated tone and strobe register (IC 4). The PTT control is performed by register IC 5, whereby IC 8b-d form an EXNOR gate in order to prevent unintentional keying of the PTT before the register has been initialized.

The device FX709 contains two independent audio output channels which are connected to the output of the card via coupling capacitors. The impedance of the associated inputs was raised using an op-amp stage (IC 13).

Matching to the radio equipment was accomplished with passive filters in order to obtain an optimal frequency response. A very useful feature of the FX709 is its loop-back operating mode that allows coupling the digitized input signals directly back to the decoder. Thus the transmission characteristics of the component in conjunction with the radio equipment could be easily determined.

Also a member of the group interested in voice mailboxes: Eugen Weiler, DC9EL, repeater coordinator for the UHF section of the DARC. He proposed assigning the still unused duplex channels R94 to R96 (output 439.250 to 439.300 MHz) to such applications, among others.

The radio equipment must supply a DCD signal (active high) to indicate that the squelch has opened. Care should be taken that the DCD signal is free of spikes in the case of noisy signals since these would cause the message storage to be prematurely terminated.

Software

The currently available software, written in C, provides a simple, remotely controllable user interface. The output is based on a function to send previously digitized files stored on the mass storage device of the system. These individual text modules are sent sequentially to form a stream of speech, supplemented by the calls and messages of the

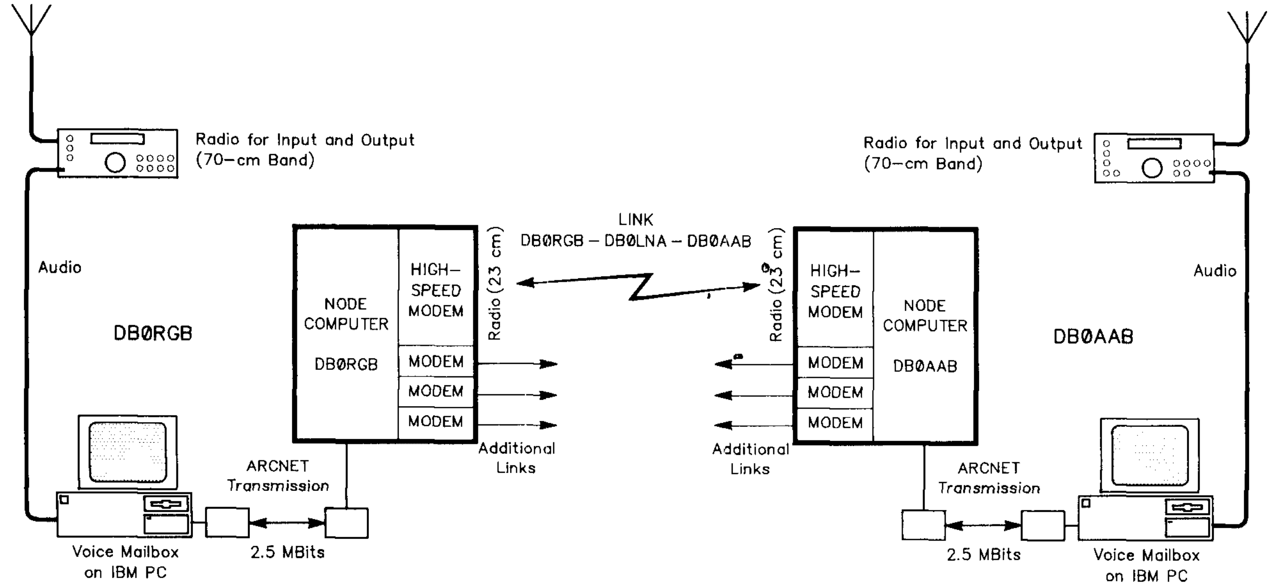


Fig 2—Block diagram of the digital voice transmission between DBØAAB and DBØRGB

users, thus leading the user through the usage of the system. Every user enters a three-digit user number as a DTMF tone sequence at log-in.

After logging in, the user is greeted by the system and informed how many messages are stored for him. A user who does not yet have a user number gets one assigned by entering the sequence "999" and speaking his call sign when asked.

To send a message, the command "07xxx" is entered where "xxx" represents the number of the recipient. Following the request to speak, the user speaks his message, which is then stored after the PTT is released.

The maximum possible length of the text is dependent upon the data rate in use. At our rate of 32 kbit/s, whereby the difference between the stored and original signals is virtually undetectable, the maximum file length is approximately 2-1/2 minutes. The reason for this is that the complete set of data must be held in working memory since the FX709 does not have an internal intermediate buffer, thus requiring prompt servicing in real time. During interruptions caused by disk accesses, this could no longer be guaranteed.

All commands mentioned thus far are possible either by radio or from the local keyboard. The voice mailbox provides the SYSOP with a friendly interface. In addition to a bar display of the modulation level, the software supports various data rates and filter characteristics. Editing the user boxes (eg, deleting files and boxes, entering calls associated with the box, etc) can likewise be performed at the keyboard. Additionally it is possible to transmit specific files, add voice modules and spell prescribed sequences.

Mailbox "On-The-Air"

In order to make the operation as free of interference as possible, various measures can be taken: The mode can be switched between "talkative," with extensive help for incorrect commands, and "curt," with only operational texts and brief reactions to incorrect entries, as well as completely silent. This is commanded either by a multiple digit DTMF sequence by radio or from the keyboard.

For practical operation in conjunction with an FM repeater, a chat squelch was incorporated. This means that the frequency must be free for a least 20 seconds, when there was a carrier for longer than 20 seconds, or less during active periods, before the box can be activated with the DTMF tones. This guarantees that normal QSOs on the mailbox frequency have priority over mailbox traffic.

During initial practical tests, we determined that a simplex frequency is not well suited for this operation. Quite frequently the hidden station problem arises, commonly known in packet radio operation, resulting in collisions between widely separated users of the mailbox who do not hear each other.

Although not possible in our tests due to the requirement for a PR link, an installation on a repeater with a duplex channel thus seems to be much more appropriate. Proper measures can then be taken to prevent the station from being used as a substitute repeater.

In the field of the digital operating modes, the transmission of text and similar data still dominates the Amateur Radio scene in DL. With the development of more powerful node computers and faster data links, additional digital transmission techniques such as for digitized voice or pictures are becoming increasingly feasible.

While developing such a system suitable for transmitting digitized voice, the following items should receive special consideration:

- encoding the analog signals in an efficient and memory conserving manner
- use of data reduction techniques
- development of an adequately powerful computer designed for high volume data in order to route the data over existing radio link in the packet radio network

• construction of this link using powerful modems and other transmission devices up to and including real-time voice transmission

Since these points are naturally quite expensive to implement, the intention is to accomplish the process over the long-term in several stages. The final goal is to achieve real-time digitized voice transmission between two distant analog locations.

After development of the first module in a digital voice transmission system consisting of voice input/output and storage capability, a definite step has been taken towards automatic routing of digital voice signals. However such transmission involves very high hardware and software costs, not only on the digital and software side, but especially in regards to the design of corresponding radio equipment for the GHz range along with appropriate modems.

Corresponding to the assumptions listed in the previous section, DG3RBU and DL8MBT are planning the following experiment:

At the sites of the digipeaters DBØRGB (Regensburg) and DBØAAB (Munich), analog voice input and output stations are being installed to provide interfaces for the users of the digital voice transmission link. Each consists of an IBM AT with a specially developed digitizing board and mass storage. The digitized data pass over a high-speed data path, based on ARCNET with RS485 transmission, to the packet radio network node. There these data are bundled into packets according to the AX.25 standard and routed as normal PR link traffic to the receiving location. Since the design of the stations at both ends is identical, the incoming data arriving over the radio link pass to the user via a voice-server in the same manner. The highlights of this design and thus the stages in construction are therefore as follows:

1. development of a voice input/output unit as a plug-in card for the PC
2. design of software with a phonetic user interface for storage and output
3. test of these units in stand-alone operation
4. development of the hardware and software for data transmission to the node computer (ARCNET cards and device drivers)
5. development of a plug-in card for the BayCom node computers which are already in operation and are capable of processing and forwarding the ensuing enormous data quantities at high speed over a radio link
6. development, implementation and test of radio equipment capable of transmitting in the 23-cm band at data rates significantly higher than 9600 bauds
7. test operation of voice transmission in non-real-time, with intermediate storage of the files
8. in the final step, the real-time transmission of data between the two test nodes

Prior to the UHF conference in Weinheim, steps 1 to 3 were well advanced, the development of the ARCNET transmission was under way, and an application for test operation has been placed with the authorities. A time frame for accomplishing steps 5-8 has been estimated at approximately 2 to 3 years, since steps 6 and 8 in particular will demand tremendous efforts. Achieving these goals is anything but guaranteed.—*Thomas Kamp, DF5JL*

(Sources: BayCom-Team: QRG 433.775 MHz Simplex Voice Mailbox at the UHF Conference in Weinheim; user command list.

Johannes Kneip, Florian Radlherr: Experiments in digital voice transmission - The voice mailbox of DL8MBT and DG3RBU.)

Correspondence

"Switching Power Supplies" Addition

As a practicing power supply engineer, I noticed an error in the "Switching Power Supplies for High Voltage" Corrigendum which appeared in the August 1991 issue. The cathodes of the lowest branch of the bridge rectifier array should not be connected directly to the output cap "+" terminal. If the connection is made as shown, the filter choke and "catch" diode would be shorted out, *but* due to the very high duty ratio of the ac the circuit would probably seem to run all right as a capacitive-only filter. (*See November 1991* QEX *Corrigendum for drawing correction. Ed.*)

Another item. It is usually not necessary to put a catch diode across the choke since the choke will pull current through both sides of the bridge during "dead time." Eliminating the catch diode would also allow choke current to continue to the output during dead time instead of being uselessly constrained to a loop. See Fig 1.—*J. Arthur Smith, WB9RWY, 203 11th Street South, Hudson, WI 54016*

Parts for the "SSB Exciter"

I was asked where I got parts for my SSB exciter ("A Different Weave of SSB Exciter," August 1991 *QEX*). Here is my response.

About the parts-procurement problem: To find a particular part, call the manufacturer and ask who their distributors are. Then call each distributor, and ask how to place a small order. Test the distributor with a small order. Some industrial distributors welcome small orders, others don't. This is a lot of work, I know, but it is the way to find sources for parts you haven't used before.

Most of my parts come from Digi-Key (they started as a manufacturer of an electronic keyer based on then-new digital integrated circuits). They offer fast delivery and cater to small orders. They send lots of catalogs. They carry only what is in their catalog; there is a lot in the catalog, including some radio-oriented items—Toko coils, helical filters, and ceramic filters. They have Cree blue LEDs (at $9.75 each); Sprague-Goodman trimmer capacitors; 2% film capacitors and 1% resistors. If you buy 100 pieces every time you need a different 1% resistor value, eventually you develop a library of values on you shelf. They have National integrated circuits and data books.

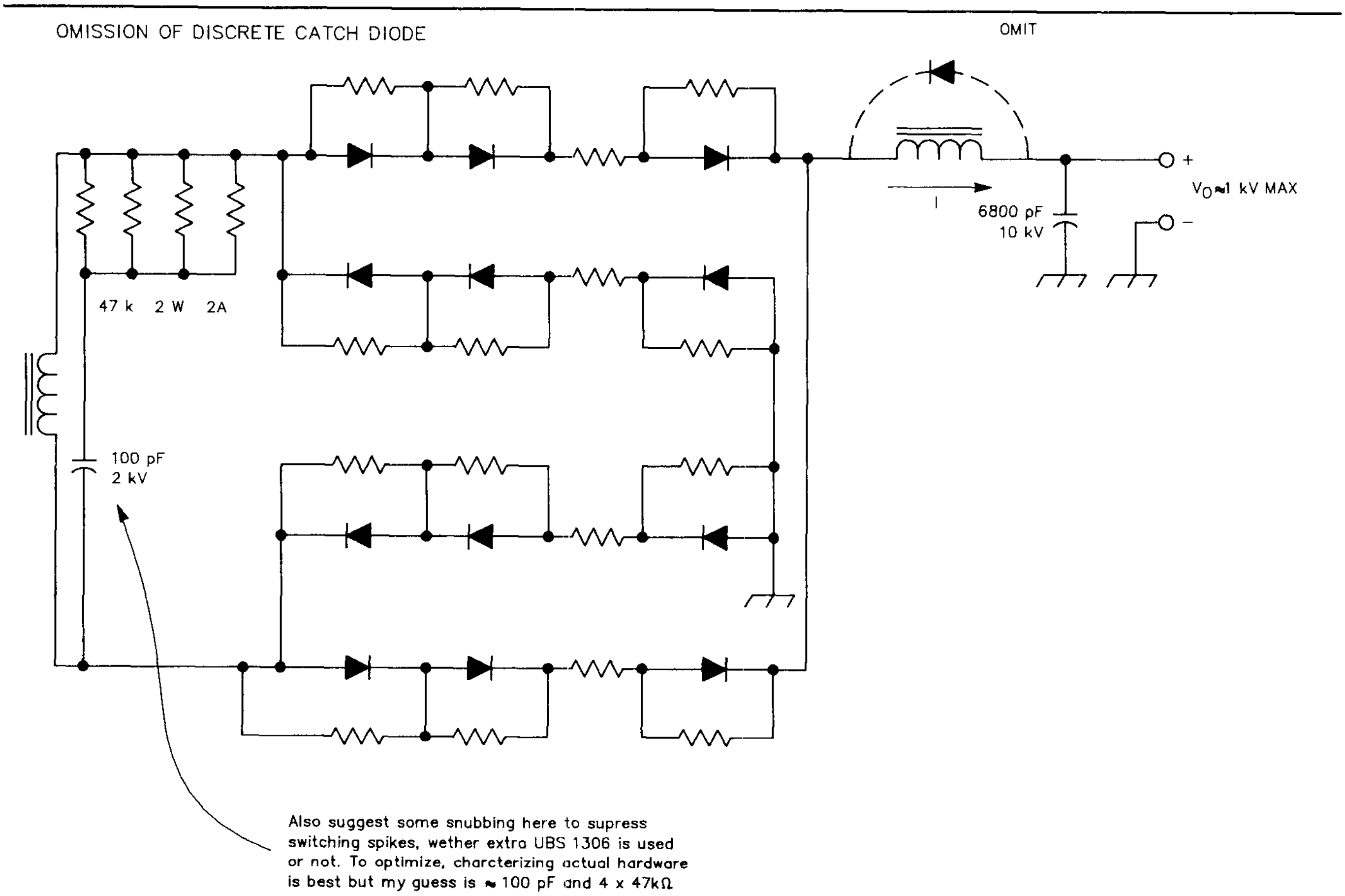


Fig 1—Omission of the discrete catch diode. See arrow—also suggest some snubbing here to suppress switching spikes whether extra UES 1306 is used or not. To optimize, characterizing actual hardware is best but my guess is ≈100 pF and 4 × 47 kΩ.

Digi-Key Corporation
701 Brooks Avenue South
PO Box 677
Thief River Falls, MN 56701-0677
tel 800 344-4539; 800 DIGI-KEY

Another good source, particularly for recent integrated circuits, is Arrow Electronics, Inc, Catalog Division. This is an offshoot of an industrial distributor, geared to the small order. They put out a catalog occasionally and encourage you to phone for latest prices and availability before placing a mail order. This is a good idea as prices vary rapidly and new parts are not yet in the catalog. They carry everything on the industrial Arrow line card, not just what is in the catalog. If you buy five items from them in one order, you are likely to receive five packages from five different parts of the country.

Arrow Electronics, Inc
Catalog Division
1860 Smithtown Avenue
Ronkonkoma, NY 11779
tel 800 932-7769; 800 93-ARROW

For the Linear Technology parts, try Gerber Electronics. They are a smaller distributor. I have not used them recently, but had good service in the past. They have Signetics and Harris semiconductors. RCA semiconductors are now part of Harris.

Gerber Electronics
128 Carnegie Row
Norwood, MA 02062
tel 617 769-6000; 800 225-1800 outside MA

Analog Devices has just switched from direct sales to distributors, so I can't help there. The AD 711 (single) and AD713 (quad) op amps are FET-input op amps. The National LF347 should work, though with higher offset voltages.

The Motorola MFE211 is a higher-transconductance replacement for the Harris (was RCA) 40673. The price on the 40673 has started the upward climb which is the prelude to obsolescence. The Motorola 2N6660 is a 1-watt (5 watts with heat sink) TO-5 power MOSFET which is inexpensive and very fast, and should be a good 1-watt class-C RF power amplifier.

For Motorola semiconductors, try Newark Electronics. I have not tried them recently. They are very large, and have many offices. Their central office can tell you the nearest office:

Newark Electronics Administrative Offices
4801 North Ravenswood Avenue
Chicago, IL 60640-4496
tel 312 784-5100

The T195 VFOs come from Fair Radio. They offer good service on surplus equipment and parts:

Fair Radio Sales Co
PO Box 1105
1016 East Eureka Street
Lima, Ohio 45802
tel 419 223-2196

To get connected to the industrial electronics world, subscribe to *EDN* or *Electronic Design* magazine. Both are free, only to those employed in the industry. What is little-known (read the fine print on the bottom of the contents page of an issue) is that they will accept paid subscriptions from anyone. They are expensive, but well worth it if you have no contact with industrial electronics. You only need to get one, and I would recommend *EDN* over *Electronic Design.*

EDN Magazine Subscriptions
Attention: Ellen Porter
Cahners Publishing Company
44 Cook Street
Denver, CO 80206-5800
tel 303 388-4511
$119.95 per year (48 issues per year)

Electronic Design
Penton Publishing Inc
1100 Superior Avenue
Cleveland, OH 44114-2543
tel 216 696-7000
$85.00 per year (24 issues)

Another magazine worth subscribing to is *RF Design,* whose editor is Gary Breed, K9AY. This is a professional magazine aimed at RF rather than microwaves. The editorial articles are often relevant to amateur equipment. If you like *QEX*, you'll like *RF Design*. This is an exciting time to read *RF Design*, as linear integrated circuits, including op amps, are becoming fast enough for RF use. For example, in the July 1991 issue, Charles Wenzel describes a circulator for frequencies up to 100 MHz using fifteen resistors and three op amps. In the September 1991 issue, John C. Roberts describes how to get an AGCed AM output from an FM IF-strip integrated circuit, while still getting the usual FM output. He ac-couples the RSSI output (which is the logarithm of the amplitude of the input RF), to an antilog circuit built with a couple of op amps.

RF Design
Subscription Office
PO Box 1077
Skokie, IL 60076-9931
tel 708 647-1200
$38.00 per year (13 issues)

—Peter Traneus Anderson, KC1HR, 990 Pine Street, Burlington, VT 05401

Antenna Rotor System

As a long time DXer and designer of electronic equipment over the last 52 years, from time to time I come up with ideas which I have never pursued mainly because there is little or no profit in making them for the limited market in the Philippines. One such idea is to make an improved antenna rotator system which would be especially useful to the avid DXer or contester.

To snare a DX station, the time it takes to rotate a beam antenna is important. The permissible rotational speed of a beam is limited by the necessary high starting torque and the resulting mechanical strains on the beam elements, the boom and its mounting structure. Another consideration is the ability of the tower to absorb the resulting reaction on its structure. Because of this limitation, any good-sized beam may take about one minute or more to make a full revolution, and this can be frustrating to the operator.

Another case where faster changing of beam heading is useful is when conditions are marginal and you are in a three-way QSO with different angular headings.

The solution to this problem of speeding up rotation is that the beam can be turned under constant torque conditions which would mean that it accelerates at a constant rate. To achieve this, two things are necessary. One, the beam motor drive, either ac or dc, would have to have a suitable speed control. Two, the speed controlling mechanism should be controlled by a small, simple dedicated computer. This computer is tied into the rotator positioning indicator so that the keyboard entry (which could be a simple numerical one like a calculator) will know the current beam heading and the wanted heading is entered. The angular difference goes into the computer and the computer, knowing the maximum speed possible with the rotating system drive, will now calculate the number of degrees rotation for bringing up the system to the maximum possible speed. It will then reduce motor drive to coast along until a second point is reached to decelerate for the correct number of degrees to come to a stop. This would then permit a far faster rotation, without exceeding permissible torque limits. In case the required angular change in the beam heading is less than that needed to reach maximum speed at the center of angular rotation, the system will go directly from acceleration to deceleration.

To make this system even more useful, the rotator control should be fairly large and lighted from the rear. The position indicator could be manually rotatable with the knob at the center. The periphery of the indicator would be labeled in degrees. The back-lighted translucent panel would have an azumithal map of the world, with country call signs entered.

I am sure that many amateurs would have the means to develop this control system. The entry of angular information into the computer can be achieved by using a circular disc behind the azumithal map, controlled by the same shaft, marked with alternative black bars, like a bar code, passing through the window of an interrupter type optocoupler, many varieties of which are made by Motorola and Harris. For the speed control, perhaps one possibility is the Harris CA3228 which is made for maintaining speed in automobiles automatically, but I am not sure of this possibility.

The bar code type of interrupter window is used on some dial mechanisms of transceivers. About 42 years ago, I built an arrangement similar to the above but without the variable speed control. I made this for a large local newspaper which wanted to have effective communication with its mobile reporters on VHF and I used the idea of a rear lighted azumithal map and a control knob with a synchro-transmitter; at the antenna end, a synchro-receiver coupled to the rotator driver motor. Starting and ending torque reduction was accomplished by using a type 80 rectifier tube to give a small amount of time delay for start off and shut down with the brake's solenoid arranged, to engage only when the rotator motor was not energized and rotation had ceased. This arrangement reduced the starting and ending torque problems. The rectifier tubes delivered current for the actuating relay coils. The rotator was a prop pitch motor.—*Earl H. Hornbostel, 216 Ortega Street, San Juan, Metro Manila 1500, Philippines*

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

SARA: A FRENCH AMATEUR RADIO TELESCOPE

On July 17, the attention of AMSAT and the rest of the world's Amateur Radio satellite communicators focused on UoSAT-F. UoSAT-F became UoSAT- 5 when it separated from the launcher and another OSCAR carrying a packet-radio amateur communication payload was in orbit. The University of Surrey calls the spacecraft UO-5, AMSAT and radio amateurs call it OSCAR 22 or UO-22. UO-5/UO-22 is a scientific satellite similar to UO-4, launched in 1990.

Hardly anyone noticed that the same Ariane launch vehicle carried the SARA spacecraft. ESIEESPACE, a French aerospace club at the Ecole Superieure d'Ingenieurs en Electrtechnique et Electronique (ESIEE), built SARA. SARA is the culmination of six years of development work that included building payloads for balloon and sub-orbital rocket launches.

SARA is not an Amateur Radio communications satellite. Although not as complex, it is an educational and experimental satellite similar to the spacecraft (UO-1, UO-2, UO-3, UO-4 and UO-5) built at the University of Surrey in England. It holds (and identifies using) the call sign FXØSAT. SARA stands for "Satellite for Amateur Radio Astronomy."

Radio astronomy began in 1932 when Karl Jansky discovered that radio waves were coming from a source in the sky. SARA is not Amateur Radio's first connection with radio astronomy. In 1937, Grote Reber, W9GFZ, designed and built the world's first radio telescope, a 31-foot dish antenna, in his Wheaton, Illinois backyard. Using this antenna, he discovered the first discrete radio sources in the sky and mapped the distribution of radio emissions in the Milky Way. Grote Reber was the only person doing research in radio astronomy before World War II and single-handedly brought radio astronomy to the attention of professional astronomers. Like Grote Reber, SARA is also a pioneer, albeit with a two-fold mission.

Primary Mission: A Radio Astronomy Experiment

SARA's primary mission is a radio astronomy experiment to listen for HF radio signals from Jupiter's radio-electronic activities in the decametric wavelengths. Jupiter emits radio noise in the HF frequency bands. This Jovian DX cannot be investigated by a terrestrial station because, for much of the time, either Earth or its atmosphere blocks the signals. In the past, a few other satellites have measured the Jovian emissions, but not long enough to achieve meaningful results.

Jupiter's radio emissions in the decametric band are powerful enough to wipe out all other natural extra-terrestrial signal sources under normal conditions. In the vicinity of Earth, the flux received from Jupiter ranges from 10 E-20 to 10 E-19 $W \cdot m^{-2} \cdot Hz^{-1}$, which is much stronger than the galactic background noise. During the sun's calm period, the flux received from the sun is about 10 E-24 $W \cdot m^{-2} \cdot Hz^{-1}$. During periods of high solar activity it increases to 10 E-17 $W \cdot m^{-2} \cdot Hz^{1}$. The solar eruptions can be distinguished from the Jovian signals by their signal strength, length of time and correlation with signals received on other wavelengths. Jupiter's radio activity in the decametric band is partially above 15 MHz. The ionosphere sometimes becomes transparent and makes it possible to do some measurements, which can then be extrapolated to the 2 to 15 MHz band.

The Jovian decametric emission is irregular. It occurs mostly during storms that last from one minute to an hour. Depending on the type of storm, radio-electronic energy peaks concentrate at 1 to 50 ms or 1 to 10 seconds in about 50-kHz wide frequency bands sweeping across the spectrum. These storms relate closely to the rotations of Jupiter and its satellite Io. Solar eruptions may influence them also.

Voyager 1 conducted reception tests in the vicinity of Jupiter. It only detected the strongest peaks of the Jovian emissions because of the decametric band electromagnetic interference from its own instruments. To date, there have been no measurements in the 2 to 15 MHz band during a period of high solar activity.

Three pairs of perpendicularly placed antennas receive the radio-electronic waves. This allows computation of the field intensity regardless of its direction and polarization. Because the received electromagnetic field is strong, three pairs of antennas are only 5 meters long. One pair serves to downlink telemetry data to Earth in the 2-meter band. The antennas are 100-mm wide steel tape. They were rolled up before the launch and unroll themselves when in orbit.

The Jovian emissions between 2 and 15 MHz are measured on eight 100-kHz wide channels. The on-board equipment averages their amplitude over a time interval of 150 seconds. The average amplitude produces the envelope of the storms but hides the peaks, which represent the internal structure of the storms. A single receiver switches between the channels and between the three pairs of antennas. Thus, the receiver gets three polarizations of the eight channels in succession. This cycle occurs several times during the 150-second interval to prevent separating the measurements on the different channels in time.

The receiver has a 40-dB dynamic range to detect Jovian and certain solar peaks without saturating it. This is enough sensitivity to detect the known background galactic noise level that serves as a reference standard when Jupiter and the sun are silent.

Secondary Mission: A Reliability Experiment

Consider the reliability of the electronic components in a spacecraft. SARA uses consumer components instead of military or space qualified parts because of cost and availability. Why do professional satellites use the most expensive components while SARA did otherwise? The launch causes 10-g vibrations. Once the payload is in orbit, outer space is a favorable environment for electronic equipment. As a result, SARA consists of tested and burnt-in components.

Commercial mass produced components are as reliable as conventional space qualified parts. For instance, a TV set that works for 10 years without needing repairs has to have very reliable components. While SARA does not use hardened components, it does not use risky components either, such as chemical capacitors. PA transistors are oversized and cooled. PROMs are debugged after programming, as advised by the manufacturer. SARA's equipment is simple and conservatively designed and that is why, statistically, a long operational life can be anticipated for the satellite.

Downlink

The satellite circles Earth in 100 minutes on its low, sun-synchronous, quasi-polar orbit at an altitude of about 770 km downlinking its data continuously. One telemetry transfer frame cycle takes 2 minutes and 48 seconds. An uplink command capability can shut the beacon down if it causes QRM.

The satellite's downlink transmitter power is about 1 watt at 145.955 MHz. The carrier wave is modulated in amplitude with a ± 3400 Hz spectrum. The modulation uses 300-bit/s AFSK coding at 1200 and 2200 Hz. The antenna polarization is linear.

On-Board Electronics

A sequencer controls the electronics because data acquisition and transmission occur at different rates and times. All logic state machines required for the experiment are on one printed circuit card. The remaining cards are analog or combinational logic. This simplifies the equipment's design and testing.

The sequencing card manages measurements. It specifies the frequency and the pair of antennas used by the receiver, digitizes and stores data, interprets received commands and prepares telemetry. Data stored during a 24 hour period is time-stamped and downlinked in telemetry cycles lasting a few minutes.

A microcontroller performs these functions. The microcontroller program must operate for years despite errors that could occur because of interference or ionizing particles. Therefore, it is reset regularly.

Power System

The power system powers the electronics equipment. It also starts the satellite up after the launch when it detects the separation from the launcher. After a time delay, the energy system frees the antennas and starts supplying power to the equipment. The equipment needs about 3 watts and uses an unregulated voltage bus locally regulated to 5 volts.

During certain times of the year, Earth eclipses the satellite for up to a third of each orbit. Thus, a storage battery is the permanent power supply. The sun charges the battery via photovoltaic cells. The battery is overload protected.

Because the satellite does not have an attitude control system, sunlight can hit it from any direction. Solar cells are on each side of the spacecraft, which is a cube. Its size was calculated so that each side can supply power for the whole experiment. High quality cells cover 60% of the 470-mm cube.

A push-button that directly controls the power supply detects separation during the launch. A security circuit also controls the power supply.

Mechanical Integration

All satellite modules sit on a 400-mm by 400-mm integration plate. The solar cells are on two half-shells made of aluminum sheets that comprise the case. The integration plate is accessible by removing the sheets. Each module is a box. Cables connect the boxes. The whole mechanical structure is aluminum. Soldered junctions carry strains. When assembled, the spacecraft is a cube measuring about 470 mm on a side.

Thermal Control

The electronic equipment and batteries need moderate temperatures. These temperatures are achieved using passive controls. The internal temperature depends on external conditions (the sun and Earth) and on the satellite's characteristics.

The target temperature is an average of 20° C, which is achieved by appropriate coatings of the external surfaces of the satellite. Solar cells do not cover about 40% of the surface. That 40% is coated thermally. The shape of the box provides a quasi-constant section in all directions. As a result, temperature is independent from the orientation of the satellite relative to the sun. The equipment dissipates 3 watts, which does not affect the thermal balance of the structure.

Heat can pass easily from the lighted to the dark sides so that temperatures remain close to the average. The small size of the satellite simplifies the problem. By using 2-mm thick aluminum shells, the thermal gap is only 30 degrees. The satellite does not have to spin to maintain thermal control.

Educational Opportunities

SARA provides a unique educational opportunity in orbital dynamics. The radio signals SARA monitors are generated as a beam of radio energy by the interaction of Jupiter and one of its moons, Io. The signals are synchronized to sidereal time and appear about four minutes earlier each day because it takes about two hours for the beam to swing across Earth.

SARA's ideal orbit is one in which Earth never gets between the spacecraft and Jupiter. SARA, however, was stuck with the orbit the Ariane rocket gave it, that is, an orbit optimized for the primary payload, Earth Resources Satellite (ERA-I). When Earth is between SARA and Jupiter, there are breaks in reception of Jovian signals for up to 40 minutes per orbit.

Plot the current positions of Jupiter and Earth in the Solar System. Look at the angles between Jupiter and the orbital plane of SARA around Earth. Does Earth eclipse SARA? If so, how long before the geometry is such that SARA will get uninterrupted viewing of Jupiter? If SARA has uninterrupted viewing, how long will this condition last? If SARA receives signals when it is eclipsed by Earth, what are they and where are they coming from?

Answering these questions can provide material for a semester or more of study. Why not bring space into the classroom? Set up a receiving station to acquire and capture the telemetry. Send in a reception report for a QSL. Write to NASA for some pictures of Jupiter.

Receiving Signals from SARA

To receive signals from SARA, you need a 2-meter FM radio. SARA downlinks are on 145.955 MHz. Its signal is weaker than UO-2 and DO-17. SARA's telemetry uses wide-shift 300-baud ASCII. The tones comply with the old *Byte* audio cassette data storage format. The modulation sense (1s and 0s) is compatible with UO-1 and are inverted with respect to UO-2. SARA's data can be demodulated with a stock AEA PK-232, a UoSAT modem or even a *Byte* audio tape interface. SARA transmits binary telemetry in a cycle of 2 minutes and 48 seconds. The sequence starts with an ASCII identification followed by many lines of binary data, as follows.

93162 NOISY LE GRAND CEDEX FRANCE
SATELLITE AMATEUR DE RADIOASTRONOMIE
ECOUTE DE L'ACTIVITE DECAMETRIQUE DE JUPITER
FXØSAT FXØSAT FXØSAT
CYCLE nxhw

All telemetry relates to the radio astronomy experiment. There is no housekeeping data. The information for decoding and processing the telemetry will be published soon. Then you will have an opportunity to analyze and correlate the downlink data and, perhaps, discover something new. SARA, albeit a simple satellite, may provide amateurs with a tool to make new discoveries in radio astronomy. AMSAT element bulletins contain sets for SARA.

SARA reception reports are welcome and will be QSL'd as soon as possible. Send reports via the QSL bureau to ON1KHP, who is the SARA's QSL Manager. Or you can send them directly to BELAMSAT (AMSAT-Belgium), c/o Patrick Hamptaux, Thier Des Critchions 2, B-4600-Chenee, Belgium.

For more information about SARA, send a packet-radio message to G3ZCZ@N4QQ.MD.USA. If you enclose the verbose headers of one or more of the bulletins (use the V or RH PBBS commands) including the BID, this will allow us to track the progression of the bulletins through the packet-radio network. A verbose listing of headers looks something like this:

[7225] PY
Date: 09 Oct 91 02:20:20 Z
From: G3ZCZ@N4QQ
To: SARA @ AMSAT
Subject: SARA-OSCAR 23

R:911009/0220z 7225@N4QQ.MD.USA [Silver Spring, Md]
Z:20901 R
R:911009/0214z @:WA7NTF.MD.USA.NOAM [TELINK/FT MEADE]
N:ARMY #:29876 Z
etc

—by Patrick Hamptaux, ON1KHP, and Joe Kasser, W3/G3ZCZ

TENTH ANNIVERSARY FOCUS OF TAPR ANNUAL MEETING PLANS

Tucson Amateur Packet Radio will celebrate its 10th anniversary at its 1992 annual meeting on March 7-8, 1992, in Tucson, Arizona. The meeting will be at the Best Western Inn at the Airport adjacent to Tucson International Airport. Special room rates of $55, single or double occupancy, with complimentary breakfast and cocktail hour are available by contacting the hotel at 1-800-772-3847 (602-746-0271 in Arizona). If you are interested in making a presentation or wish further information about the meeting, please contact TAPR by phone at 602-749-9479, by fax at 602-749-5636 or by mail at PO Box 12925, Tucson AZ 85732-2925.

—from Bob Nielsen, W6SWE

REGION 3 ADOPTS PACKET-RADIO GUIDELINES

Guidelines for packet-radio operation were adopted by Region 3 of the International Amateur Radio Union (IARU) at their conference held October 8-12 in Bandung, Indonesia. The guidelines are contained in two documents entitled "Guidelines for Packet Radio Operators" and "Guidelines for Packet Radio Bulletin Board Operators." They are intended to help promote the principle of self-regulation of the Amateur Radio Service in the Asia-Pacific area.

These documents, adopted unanimously by the conference in recognition of the international nature of packet radio and the need to avoid inappropriate traffic, are based on submissions from Australia, Japan, New Zealand, the United Kingdom, Italy, and IARU Region 1. They were prepared by a working group led by Kevin Olds, VK1OK, of the Wireless Institute of Australia.

Guidelines for Packet-Radio Operators

1. Amateur radio takes pride in being self-regulated. Packet radio operators should continue this tradition.

2. Packet radio operators, like all Amateur Radio operators, should observe published Band Plans.

3. A Packet radio operator should not send the following traffic either direct or via mail boxes:

a. All advertising for selling, buying or trading goods, including amateur equipment (except if permitted by local regulations);

b. All statements of propaganda on political or religious subjects;

c. All inappropriate language, as for instance, the use of swear words, obscenities, defamatory or libelous language, etc.;

d. All material which may infringe copyright;

e. All material which infringes privacy, whether personal or corporate.

4. A packet radio operator utilizing a BBS should avoid transmitting unnecessary or redundant messages and documents in order to enhance network efficiency.

5. A packet radio operator utilizing a BBS should ensure that the call sign of the originating station, including the name of the person responsible in the case of a club station, is clearly shown on every message so that the sender can be identified.

6. A packet radio operator should avoid messages that are too long for efficient relay through the network.

7. A packet radio operator utilizing a BBS should ensure that all messages transmitted are addressed to the appropriate group of recipients and not addressed to inappropriate areas in order to enhance network efficiency.

Guidelines for PBBS Operators

1. The operator of a Packet Radio Bulletin Board is obliged to provide a reliable service, within a defined area for a defined purpose.

2. A Packet Radio Bulletin Board operator is morally responsible for all messages forwarded by his system. He should make his best efforts to ensure that the traffic forwarded is appropriate to the Amateur Radio Service and in accordance with the "Guidelines for Packet Radio Operators."

3. HF mailboxes should only be used where there is a genuine need that cannot be provided by VHF or other means.

4. A Packet Radio Bulletin Board operator may take action to exclude a user who persistently contravenes the "Guidelines for Packet Radio Operators." Excluding a user should only be done as a last resort after the user has been warned and where exclusion does not contravene local regulations.

—from The ARRL Letter

For comparison, guidelines for packet radio in Japan and the United Kingdom follow.

JARL Guidelines for Packet Radio and RBBS

Packet radio and RBBSs (including TCP/IP, mailbox, etc) communication methods, superior in recording as well as spreading of information, are utilized by many Amateur Radio operators.

JARL (Japan Amateur Radio League) has announced the following guidelines to be met by packet-radio users and RBBS system operators.

Guidelines for Packet Radio

1. Packet radio operators must observe the frequency segments stipulated in the "Amateur Band Plan" formulated by JARL.

2. Packet radio operators must take the responsibility to see that the contents of information dispatched by their stations do not conflict with "Amateur Radio Operation Standard" (see below). Nor should such information deviate from the definition of Amateur Service stipulated in the Radio Law of Japan, in consideration of the possibility of such information spreading widely (even if intended for a specific station, it may well be transmitted to others through store-and-forward system).

3. Packet radio operators must not only be interested in technical matters, but likewise utilize packet radio for its technical development.

4. Those who utilize RBBSs must avoid transmitting (writing) redundant messages (documents) in order to enhance transmission efficiency. The call sign of the dispatching station (including the name of the person responsible in the case of a club station) must be clearly shown on every document so that the dispatcher can be identified.

Guidelines for RBBS

1. Those who have set up an RBBS must take good care of its system and documents so that the recording and forwarding functions of the RBBS work properly.

2. Those who keep an RBBS must at all times bear in mind that any message deviating from the "Amateur Radio Operation Standard" or Amateur Service should not be accepted. They must endeavor to avoid transmitting such messages to other stations when same are received (or written).

JARL Amateur Radio Operation Standard

1. Not to disgrace the reputation of any individual or organization by openly disclosing facts against ones wishes.
2. Not to impair the human rights of other people by the use of slandering or insulting words.
3. Not to infringe on the privacy of other people.
4. Not to express assertions or opinions in connection with politics, religions, elections, or any other issue in dispute.
5. Not to disturb social order or obstruct good customs.
6. Not to use indecent or obscene expressions which may offend and/or harm other people.

—from The JARL News

RSGB Packet-Radio Network Guidelines

These guidelines have been in the making for about 18 months. They were first drafted by the then RSGB (The Radio Society of Great Britain) Packet Working Group as a way of trying to interpret the existing license conditions in relation to the excellent benefits the packet-radio network offers. An early version was published in the Society's packet-radio newsletter *Connect International* and on the packet-radio network itself.

This work was overtaken by events as the Radiocommunications Agency of the DTI became concerned about the content of a number of messages circulating on the network. This concern resulted in a letter to the RSGB President from the Head of UK Licensing, published in the July 1990 *Radcom.*

The RSGB's guidelines were offered to the Radiocommunications Agency (RA), via the RSGB Licensing Advisory Committee, for comments. A meeting was arranged at Waterloo Bridge House to discuss packet-radio matters including the guidelines. The RA expressed the view that the contents "were fine" but that they would benefit from changes in context and format.

The RSGB then rewrote the guidelines in accordance with the RA's suggestions and presented them again. Since that time a number of further changes have been suggested by the RA and incorporated until finally we have arrived at the present version.

The RA is happy that "they are now much more in tune with what is required" and, therefore, they are being published in their current form. We anticipate that they will be somewhat dynamic and will change to reflect any changes in terms and conditions in the amateur licence. It is worth noting that they are only *guidelines*, operators will as always, with very good reason, interpret them in their own way. At the end of the day, it is really down to using a bit of common sense and abiding both by the letter and spirit of the licence and Amateur Radio code.

Guidelines for the Use of the Packet-Radio Network

The packet-radio network in the UK and throughout the world is an immensely useful tool for the dissemination of information, the seeking of help and advice and the publication of Amateur Radio related news. It is not uncommon to find messages giving information on AMSAT, Raynet or other similar activities. The GB2RS news is also available on the network, as is local club news in the area of a particular mailbox. This use of the network is what was in many operators' minds when they spent large amounts of time and money in developing it. Unfortunately, the very success of the network has resulted in messages appearing which are of doubtful legality under the terms of the UK licence. The RSGB Data Communications Committee, in consultation with the RA, has devised the following guidelines with which all operators are urged to comply. These guidelines have been split into four sections in order to reflect:

A. The need for messages to be within the terms of the license conditions and the implications if they are not.

B. Messages which could result in legal action being taken by other amateurs or outside bodies.

C. Actions to be taken when amateurs identify cases of abuse.

D. Other appropriate items.

SECTION A

1. All messages should reflect the purposes of the amateur license, in particular "self training in the use of communications by wireless telegraphy."

2. Any messages which clearly infringe license conditions could result in prosecution or revocation or variation of a license. The Secretary of State has the power to vary or revoke licenses if an amateur's actions call into question whether he is a fit and proper person to hold an amateur license. An example of this could be unreasonable behavior by using the packet-radio network to carry on a dispute or to deliberately antagonize other amateurs.

3. The Radiocommunications Agency has advised that the Amateur Radio license prohibits any form of advertising, whether money is involved or not.

4. Messages broadcast to "ALL" are considered acceptable but should only be used when of real value in order to avoid overloading the network.

5. Do not send anything which could be interpreted as being for the purpose of business or propaganda. This includes messages of, or on behalf of any social, political, religious or commercial organization. However, our licence specifically allows news of activities of non-profit making organizations formed for the furtherance of Amateur Radio.

SECTION B

1. Do not send any message which is libellous, defamatory, racist or abusive.

2. Do not infringe any copyright or contravene the Data Protection Act.

3. Do not publish any information which infringes personal or corporate privacy, for example, ex-directory telephone numbers or addresses withheld from the callbook.

SECTION C

1. Any cases of abuse noted should be referred in the first instance to AROS (The RSGB's Amateur Radio Observation Service), which is coordinated by Geoff Griffiths, G3STG, who will take the appropriate action.

2. It is worth noting that any transmissions which are considered grossly offensive, indecent, obscene or menacing should be dealt with by the police. This action should also

be coordinated by AROS initially.

3. Mailbox SYSOPs have been reminded by the RA that they have an obligation to review messages daily and that they should not hesitate to delete those that they deem unacceptable. It is worth remembering that their license is also at risk as well as your own.

SECTION D

1. Do not send "open letters" to individuals.

2. Do not write in the heat of the moment. Word process you bulletin first, then reread it. You may feel differently after a few minutes.

3. Obey the Golden Rule: if you would not say it on voice do not send it on packet radio.

—from Radio Communication

RADIO RECOMMENDATION

A while back, I was looking for a radio to put into service on a busy 1200-baud node that was also at a 2-meter voice repeater site. Many general recommendations were made including duplexers, but no concrete ideas were formulated. I finally settled on the Motorola Radius mobile. It is a programmable 25-watt mobile transceiver. It has proven to be one of the best decisions we have made. It has a 100% RF duty cycle rating and milspec vibration rating. The receiver is excellent and the unit hears much more than its 25 watts is able to reach. The 70-dB adjacent channel rejection at 30-kHz channel spacing has allowed the unit to run on the same tower with the GE MasterPro voice repeater with no service degradation noticed in either device. The two channels are programmed by the dealer. This unit was programmed for me, for 145.01 and 145.09 MHz. The programming requires no disassembly and can be done in about 15 minutes.

We are feeding and taking audio through the mic connector and we have the TX delay set at 30 to accommodate the slowest of our mechanical switched users. We only had a short time to play with it before it went into regular service, but I am sure it will run at much shorter TX delays. I have requested the service manual and information on the data options, but they have not come from the dealer yet. We obtained this radio brand new for less than $350. We think its a deal and the closest thing to "plug and play" you will get with commercial gear in the amateur service.

—from Mike Head, N2HTE, via CompuServe's HamNet

RECOVERY OF AO-21 RUDAK CONTINUES

The following bulletin was issued by the AO-21 Command Station Team.

The RUDAK Beacon again switched off without any command station interaction and we also lost command access to RUDAK again for some unknown reason. This happened sometime during the night of October 5-6, while AMSAT OSCAR-21 was not in range for the command stations of Russia or Germany. The latest orbit over Europe around midnight and all previous orbits proved that the RUDAK hardware seems to work properly without any sign of degradation. We would be grateful for any signal report after October 5. Please note that the AREMIR downlink is only a few kilohertz below the RUDAK downlink on 145.983 MHz. In the next weeks, we hope to repeat the power-down procedure again. Meanwhile, AMSAT-U and AMSAT-DL will continue efforts to recover AO-21/RUDAK.

—from AMSAT

"WHO HEARS ME?" COMMAND PROPOSAL

I would like to propose a new command to the roving packet-radio users.

Several of my friends have their packet-radio systems set up for travel with connection between their hand-held and the now popular laptop computers. This is a great use for those who travel and want to keep in touch with back home or want to search out new friends in a remote area. In retrospect, the same requirement also exists for the newly established packet-radio station or the old one that wants to know who is new in the area.

Look at the operation of your packet-radio station with respect to the equipment that you operate. If we take the example of the mobile packet-radio user with a hand-held, we may be operating at 5 watts (or less) from our hotel room into a J-Pole antenna. Let's say that there are several base PBBS stations around us ranging from 5 to 30 miles away with nice towers, big antenna, and a 100-watt signal.

Our hand-held is an ideal unit. For its size, it has great power and has a really excellent receiver...equal to those base stations. When we transmit, our signal strength is great to the station 5 miles away and maybe to the one 10 miles, but the ones 15 or more miles away may have a difficult time coping our signal. All the time we are copying all of those other stations because they have >10 dB more power even though they are not copying us. Why are we wasting our time listening to those stations when they can not hear us?

I would like to concentrate on those stations which can copy me! I would like to issue a command from my TNC that says "Who Hears Me" (WHM) and those stations which copy would reply as "Copying - CALL SIGN." Now I can attempt to establish a connection directly with those stations, not wasting my time with all of the stations listed under "MHEARD." Also, if new to an area, how long must I wait to compile the MHEARD list?

Naturally, a few simple rules need to be established. First, the operator must use common sense and not overburden the airwaves with this command, which I expect would be the biggest complaint. Second, the stations receiving the command should have an automatic random delay between the receipt and response to minimize collisions between responding stations. I am sure additional rules must be reviewed to ensure that the command is used to its optimum performance.

I believe that such a command would be an enhancement to the users and hope that others will appreciate this idea.

—from Dennis Rice, KA3JVA

DC AREA 900-MHZ PACKET-RADIO BACKBONE

The following are a couple of packet-radio messages from the MDCBBS (Maryland-DC Section) packet-radio network regarding ongoing plans to build a 900-MHz backbone for packet radio in the Washington, DC area, to be expanded to Richmond and Philadelphia. Equipment will be surplus cellular phone equipment modified to work in the 902-928 band with 9600 or 19.2k TNCs or radio modems running AX.25. Emphasis seems to be initially on practical, existing, off-the-shelf equipment and technologies to get something going, then once the idea proves viable from a reliability and propagation standpoint, migrating to more sophisticated techniques including higher baud rates and possibly TCP/IP. Again, the DC-area packet-radio SYSOPs seem to be (commendably) concentrating on positive action rather than blue-sky talk.

If you wish to become involved in such a project, or desire more information, contact one of the original packet-radio posters below (I don't have any information beyond what I have already included in this message).

Some of you may have followed the discussions over the past month—several of us in MD, VA and PA are trying to build a real, high-speed packet-radio backbone. I have suggested that the corridor from Richmond to Philly should be the first target.

We came into a windfall recently when we obtained over a hundred 900-MHz radios that were surplus from cellular telephone base stations in the Richmond area. The radios are all set up to be able to run 19.2-kbit/s digital data on point-to-point links.

The radios will require only minor modifications to work on the 902-928 MHz amateur band, but having suitable radios is but one necessary item. Here are some tasks that we need volunteers to assist on.

Several small circuit boards to provide circuitry not in the cellular radios are needed. We need people with design experience to prototype and develop the widgets, someone to lay out the circuit boards, someone who has the ability to make circuit boards (probably double-sided, in quantities of 25 to 100 copies), and someone to undertake the task of building them up.

The radios are useless without antennas. Most of them will be used on point-to-point links where some directivity and antenna gain is desired. Antennas might be ordinary Yagis, loop Yagis, cylindrical parabolics, etc. We need someone with a modest machine shop capability to take on the antenna building project. A shop equipped with a drill press, sheet metal shear, band saw and possibly a lathe would be ideal.

We will be looking for suitable sites. We must remember that the real cellular systems have base stations operating just below the amateur band and many of the new paging systems have strong signals just above the band. My guess is that we will be better off with good (but not super) locations which don't have a lot of QRM. They probably should be 25-35 miles apart so that the point-to-point links have good, solid signals with no QSB. We will need people who know the area to look for suitable locations (perhaps at amateurs' homes) and to verify that the sites are QRM-free.

Some of these sites can just be dumb relay sites. But many will need to have high-speed multi-point digital switches so that the network can "feed" the users. The nature of the "data pump" we use to make these switches is not clear, but the TNC 2s used in most of the NET/ROM switches will be inadequate. We need to have a group of people who can either design the proper switch hardware and software or who will choose the commercial hardware that will be used.

Building a proper packet-radio network that will meet our needs for the next several years won't be easy or cheap. We will need the support of all the area packet-radio users to make it happen. Volunteers, please step forward. Comments are solicited.

73, Tom, W3IWI

The logical location for 900-MHz nodes is at the present node sites: PHL, SALEM (NJ), ELK, NAVY (or KENTI), DCA, PMILLS, KGEO, RICNDS. The 900-MHz nodes would replace the current 440/222/50/222 backbone. These sites are 30 to 35 miles apart and would have "crushing" signals at the 40-watt power level with gain antennas.

The technology that is immediately available is TNC 2 with 9600-baud modems and AX.25. Some node sites have already upgraded to 19,200 baud on their matrices and it should be standard. One should not discount the parallel processing power of the Z80s in a node complex with TNCs communicating on the matrix with a handshaking protocol.

As better technology becomes available, we can upgrade the network. We should not make immediate plans based on technology that isn't available now and complex software yet to be written.

It would be logical to have two 900-MHz nodes at the sites with one antenna pointed north and the other south. The 900-MHz nodes would interconnect with the other slower speed nodes at each site on a 19,200-baud matrix.

There should be access to the network at the network speed (9600 bauds) and, as AC4DS points out, the 900-MHz network should be open to all packet flow. As he suggests, we could not expect amateur clubs and their members or, indeed, the general packet-radio community to donate money and time to a network benefiting only PBBSs and closed to 1200-baud users on the present network.

The equipment requirements in the DCASC area of responsibility would be eight radio transmitter/receivers, eight TNC/9600-baud modems, eight antennas and feed lines and expansion of the matrices at the four node sites. This equates to $700 to $800 per site not including the radios purchased by DCASC and now being modified.

PHL and SALEM to the north and KGEO and RICNDS to the south would be the responsibility of the neighboring jurisdictions.

This is what we could have in place by next spring. More elaborate schemes would take longer.

I can have K3AF-9:DCA900 with beam antenna and a 9600-baud TNC, ready to accept radio equipment for network testing within four weeks if this is the way we agree to do it.

73, Dick, K3AKK@N4QQ

Relayed to the Internet by Paul Schleck, KD3FU

—from USENET

GATEWAY CONTRIBUTIONS

Submissions for publication in Gateway are welcome. You may submit material via the US mail to 75 Kreger Dr, Wolcott, CT 06716, or electronically, via CompuServe to user ID 70645,247, or via Internet to horzepa@gdc.com. Via telephone, your editor can be reached on evenings and weekends at 203-879-1348 and he can switch a modem on line to receive text at 300, 1200 or 2400 bit/s. (Personal messages may be sent to your Gateway editor via packet radio to WA1LOU@N1DCS or IP address 44.88.0.14.)

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

Bits

High Schools and Amateur Radio Team Up to Support VLF Shuttle Research

In March 1992, a space shuttle launch is planned with the first mission in a series of ten flights called ATLAS-1 (Atmospheric laboratory for Applications and Science). One of the payloads called SEPAC (Space Experiments with Particle Accelerators) is intended to investigage the ionosphere and magnetosphere. SEPAC will use an 8-kilowatt electron beam modulated as a VLF transmitter by audio tones between 50 Hz and 7 kHz. Attempts will be made to receive and tape-record this signal on Earth at various locations. Through spectrum analysis and other means, the SEPAC team hopes to increase our knowledge of the Earth's magnetic field and the ionosphere.

Since there are a limited number of ground stations, high-school classes and the amateur experimental community are being encouraged to participate in listening and recording efforts. The "footprint" of the VLF signals will be difficult to define without a large number of ground receiving stations. A low-cost ($35-40) kit receiver has already been designed and tested by amateurs. The kit, complete with full documentation and project details, will be available soon.

The student effort has been dubbed INSPIRE (INteractive space Physics Ionosphere Radio Experiments) and the goal is to cover the US with a network of monitoring stations. This will be the first time in history that such an extensive data taking capability has been available to space physics researchers. Some ten thousand high schools will be invited to participate. INSPIRE will provide students and amateurs alike the unique and exciting opportunity to be exposed to space science operations. Participants will also benefit from the experience of assembling a simple but effective broadband VLF receiver, and the hands-on experience of scientific data collection and field station coordination.

How, exactly does Amateur Radio fit in? First, some of the more experienced VLF listeners and receiver designers also happen to be hams. Amateur Radio is already being used for premission daily communications regarding high school involvement. During the actual shuttle mission, Amateur Radio will play a vital part in relaying schedule changes for SEPAC transmissions. Most importantly, local ham clubs (or individual amateurs) around the country can act as an important resource to the high schools, particularly in offering practical help on kit building and setting up field listening operations. Amateurs themselves (whether high school students or not) are also invited to participate as earth stations during the mission.

For more information on the high school connection with project INSPIRE, send an SASE (two stamps) to Bill Pine, Science Department, Chaffey High School, 1245 North Euclid Avenue, Ontario, CA 91762. Interested Amateur Radio clubs (or individuals) should contact Jim Ericson, KG6EK, 226 Charles Street, Sunnyvale, CA 94086-6063 (also include a two-stamp SASE).