QEX 8 September 1982

The ARRL Experimenters' Exchange

Microphone and Power Connector Standards

Have you ever has a problem with the incompatibility of microphone or power connectors with different Amateur Radio equipment? You're not alone! In some cases, the connectors physically may fit, but the contact wiring is different. One can become very emotional after seeing equipment smoke because of reversed polarity as a result of plugging in the wrong power cable.

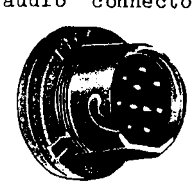
Compatibility of microphone and power connectors has particularly plagued amateurs involved in emergency communications. Some groups have gone so far as to rewire all connectors used on cables and radios in their emergency communications equipment. This allows them to use any microphone with any radio.

This subject was brought up at the July 21-22, 1982 meeting of the ARRL Board of Directors. In minute 24, the Board voted that the General Manager encourage the manufacturers of amateur radio equipment to standardize on connectors such as microphone and power supply inputs. In minute 90, the Board voted that the Emergency Communications Advisory Committee study the feasibility of selecting a common connector for use with radio equipment (microphones and power supplies), to report back to the Board at the Annual Meeting in March, 1983.

Amateurs are not the only ones with this problem. Commercial communications equipment manufacturers use a variety of connectors. Often, different radios built by the same division of a manufacturer use microphones of different impedances and use incompatible connectors, for reasons which are not clear to an outside observer.

Military services have paid close attention to the connector compatibility problem for years. During World War II, the U.S. Army Signal Corps produced vast quantities of radio equipment (some of which can still be seen at hamfests). In those days, many military microphones used a PL-68 (now PJ-068) telephone-type plug which had a ring, tip and sleeve. Earphones typically used a PL-55 (now PJ-055B) phone plug. These plugs were robust, but the jacks mounted on the equipment front panel could be a place for moisture or dirt to enter. So, they put spring-loaded rubber-gasketed lids to cover the holes when the plug was removed. That was a partial solution that got us through the forties.

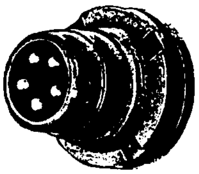
The next generation of military field gear used a 10-contact "audio" connector per MIL-C-10554.



U-79/U Panel Receptacle

The connectors in this series were U-77/U, U-78/U, U-79/U, U-126/U, U-127/U and U-161/U. Hams aren't as familiar with these connectors as the WWII variety. However, you may have noticed them on AN/PRC-6, AN/PRC-8 and other military radios of the fifties. These connectors provided more contacts, in a standardized wiring scheme to accommodate microphones, earphones, speakers, handsets, and even retransmission kits (to connect two radios together to make a repeater). The connectors were waterproof, built like a tank and heavy. Enough of that.

The army then went to the MIL-C-55116 5-contact audio connector series which is in current use.



U-183/U Panel Receptacle

The family is U-181/U, U-182/U, U-183/U, U-228/U, U-229/U and U-230/U. Like the earlier 10-contact audio connectors, butt contacts were used, with the contacts on one of the two mating connectors spring-loaded. Usually, in gear like the AN/PRC-25 or AN/PRC-77, you will see two U-183/U panel receptacles mounted on the radio for flexibility. These 5-contact connectors have standard contact assignments for ground, microphone, push-to-talk, earphone/speaker and keying. The need for special accessories requiring +12-V power from the radio brought about the addition of a sixth contact in the middle of the connector in some radios built in the late sixties and the seventies.

I mention the MIL-C-55116 audio connectors here not as a proposed solution to amateur audio connector problems but simply as an example of how the military solved a similar problem. Their choice of connector design stressed waterproofing and pressure resistance. The military audio connectors cost several times that of the connectors used on microphones for Amateur Radio equipment.

In the power supply connector arena, it's anarchy anywhere you look. The military would like to have things orderly here but must live with a bewildering list of power sources such as primary batteries, 28 Vdc and 115 V 400 Hz for aircraft, 26 Vdc for military vehicles, 12 Vdc for civilian-type vehicles, 26 Vdc for field equipment, and 90-260 V 50-60 Hz ac commercial power. Commercial and amateur power sources are about as varied. There is very little standardization of power connectors.

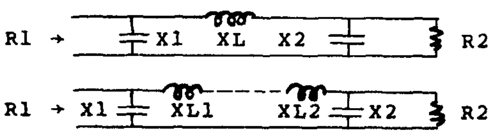
There is a ray of hope in primary circuit connectors for ac mains. You will see new electronic test equipment, computer hardware, office equipment and some Amateur Radio equipment using
(continued on page 11)

Correspondence

Pi-Network Formulas

In the QEX May 82 pi-network article by W9MKY the expression from "Radio Handbook," 21st edition, Fig. 35, page 11.30, that is used for the XL (Ed. Note: read X sub L throughout. Superscripts such as Q squared appear as Q^2) value is an approximation to the XL only. It is a good approximation for Q values of 10 or more but for low Q values such as the Q = 1.5, 50 to 120 ohm examples given the results are not acceptable. The L value of 2.9 uH stated for the 3.9 MHz example should be 2.58 uH and the error is too great.

The correct Q based pi-network formulas will be given below.



Pi-net, XL = XL1 + XL2

In terms of the pi-net element symbols shown above W9MKY's program line 35: J = B/D - H/I is equivalent to:

$$XL = \frac{R1}{Q} + \frac{R2\hat{\ }2\ X2}{R2\hat{\ }2 + X2} \quad \text{(magnitudes)}$$

The first term R1/Q is an approxmation to XL1, the second term is the magnitude of XL2. The correct and exact term for XL1 is:

$$XL1 = Q\ R1\ /\ Q\hat{\ }2 + 1$$

Since the Q based pi-network is invariably used in the low pass configuration shown in the sketch in amateur practice there is no need to be concerned about reactance signs as used in line 35 and elsewhere. There is always XL in the series element and XC in the shunt elements.

Using the circuit symbols as shown in the first pi-net sketch above the Q based pi-network formulas are:

R1 and R2 given. R1 at energy source end, R2 at load end. R1 may equal, be greater than, or be less than R2, the formulas still apply. The only requirement is that: Q^2 + 1 > R1 / R2.

Step 1: Select Q value. Q^2 + 1 > R1 / R2 a requirement.

Step 2: $X1 = R1\ /\ Q$

Step 3: $X2 = R2 \sqrt{\dfrac{R1\ /\ R2}{Q\hat{\ }2 + 1 - R1\ /\ R2}}$

Step 4: $XL = \dfrac{Q\ R1 + R1\ R2\ /\ X2}{Q\hat{\ }2 + 1}$

The expressions give exact results for any permitted Q. The Q is always equal to the Rp/Xp at the source end. The only restriction is implicit in the X2 formula, the quantity under the radical must yield a real number. That is: Q^2 + 1 > R1 / R2. For Q^2 + 1 < R1 / R2, no solution. For Q^2 + 1 = R1 / R2 implies that X2 → infinity, C2 absent, and this is then an L network. Q^2 + 1 = R1 / R2 is the L net solution equation.

It is unfortunate that both the ARRL ("The Radio Amateur's) Handbook and the "Radio Handbook," the reference books most generally available and used by amateurs, have faulty Q based pi-network design formulas. The ARRL Handbook Chapter 2 treatment of this topic beginning with the 1977 edition and continuing with the 1982 edition is downright silly and useless. The "Radio Handbook" formulas give usable results for Q > 10 as is common in tube type rf amplifiers but it seems pointless to give their approximate formulas when the exact formulas I give above are simpler and more straightforward.

The ARRL "Solid State Design" gives correct pi-net formulas on page 53. The "ARRL Electronics Data Book" has an erroneous formula for XL, Eq. 4 on page 35, incorrectly copied from Motorola Applications Note AN-267 which gives correct data and formulas for the pi-net and other networks.

The Q based pi-network formulas that I give (above) were first developed by Philip Cutler in the mid-1940's according to the late W1HR.

These formulas were first published in the amateur literature by Pappenfus, WØSYF and Kippel, WØSQO of Collins Radio Company in CQ Magazine, September 1950. The ARRL Handbook commenced publishing these formulas in the mid-1950's (about 56 or 57) and continued until 1977 when they substituted a silly and useless "treatment" in Chapter 2 that continues through the 82 edition.

The ARRL and "Radio Handbook" are not alone in getting this simple matter confused.. Ham Radio Magazine has published a differently flawed version in recent years. CQ Ham Radio (Japan), "Radio Data Reference Book," 3rd edition published incorrect pi-network material similar to the "double Q" nonsense published by Ham Radio.

In view of the incorrect material on this Q based pi-network equations topic in the amateur periodical and reference literature it is little wonder that many amateurs lack understanding in this simple circuit matter. This includes some who write the material for publication.

It appears that at least in part this lack of understanding may arise from the fact that the derivation of the formulas has never been given in the amateur literature nor is it given in the engineering circuit theory textbooks excepting that according to Motorola AN-267, Philip Cutler does give it in Electronic Circuit Analysis, Volume 1, "Passive Networks."

I have ready for typing an article in which a detailed derivation of the Q based pi-network equations is given along with a discussion of equivalent circuits, resonance, reactive and active power concepts and the energy related Q concept.

To make this palatable to a larger number of amateurs the mathematics level is restricted to no higher than C^2 = a^2 + b^2 (Pythagoras right triangle) or its electrical counterparts, Z^2 = R^2 + X^2 or Z = R^2 + X^2. There is no mention of j (or i), complex numbers, complex algebra or phasor or vector algebra. Even so the development is completely rigorous and neither the math, the engineering nor the physics professors will fault it.

In addition to the Q based pi-net equations the parallel-to-series and series-to-parallel equivalent circuit equations are derived as well as the L net equations since these are a necessary part of the derivation of the pi-net equations.

I believe that by keeping the math to the absolute *minimum* the material will motivate an understanding of this circuit topic by a larger number of amateurs including those who would write pi-network articles. - Elmer A. Wingfield, W5FD, 26 Belmont Dr, Little Rock, AR 72204

A Secondary Time Standard - Clock

By John R. True,* N4BA

The clock described here is neither a time standard such as WWV, nor is it a power-line clock which wobbles about the correct time by 5 seconds, more or less, until there is a momentary dip, or a complete loss of several seconds each time the substation drops the load. Especially those two-plus-hour outages when that 'drunken bum' mows down a power pole rounding that curve up the road, to say nothing of the ice and high-wind outages. The secondary time-standard/clock will provide correct time to within a few seconds a year, regardless of power line failures (up to about 8 hours) and is relatively inexpensive.

The heart of this clock is the encapsuled color-burst crystal and the unique IC that acts as an oscillator plus dividing the color-burst frequency by 59,659 to provide 60.0000-Hz output with an accuracy of 10 to the minus sixth or better, dependent upon the care you put into the construction of this unit.

The second special IC is the clock module, which may be modified to be controlled by the aforementioned crystal module. It has a four 0.7-in. LED digital readout in either 12- or 24-hour format. It has several additional features: minute/seconds display, sleep display, alarm display with repetitive 9-minute snooze periods which can be used as a 10-minute call sign reminder. Other features include: on/off radio or other external control capability. Both of these ICs are available at many electronic suppliers, who also supply specifications at a nominal price.

The power supply including transformer, regulators and backup battery can also be obtained from several suppliers. Judicious use of hamfests and your, or your friend's 'goodie bin' should reduce the cost of most parts.

Construction

Crystal oscillator-divider MM5369 (National Semiconductor) uses a color-burst crystal at 3.579540 MHz dividing by 59659 to produce highly accurate 60.0 Hz. This unit when encapsulated in a thermally insulated assembly will provide clock accuracy to within 1 part in 10 to the minus 6th or better. The use of a building insulation material known as PolyFoam comes in several thicknesses. I used 1-in. thick material for my oven. A built-up cube measuring 4.5 x 5 x 5.5 in. houses the crystal, MM5369, resistors and capacitors required to produce the 60-Hz output at 10 V pk-pk. In this way I was able to obtain near 10 to the minus 7th stability from a standard color-burst crystal. A half-watt 560-ohm resistor on the 10-volt supply holds the crystal module near 30 degrees C. The clock housing of 1/4-in. plywood paneling holds the heat from the transformer clock and battery to approximately 25 degrees C, which helps the stability of the insulated module.

Clock module MA1023-1 (National Semiconductor) is normally controlled by the 60-Hz power-line frequency. Fig. 1 shows several modifications that are necessary to convert this unit to the high-precision 60 Hz generated by the MM5369 module. Since the printed circuitry of this module is extremely fine and will break if not handled carefully, it is suggested that very small, flexible connecting wires be attached to this module using a small soldering iron. Since it requires only 8 mA at 8 to 10 volts for the clock circuitry, there is no need for high conductivity.

*10322 Georgetown Pike, Great Falls, VA 22066, 703-759-2073.

The power supply should be capable of delivering 9.5 V regulated, which when delivered through the uniterruptible power supply (Ref 1) will recharge the battery after power failure. When fully charged, the 8.4-V 'transistor type' nickel cadmium battery will deliver 100 mAh. Recharging will require about 140 mAh. This application uses less than a mA for several hundred hours. The power supply must also provide 8 mA to the clock and 2 mA to the MM5369 module as well as about 18 mA to the heater resistor. In addition, the LEDs require a rather 'stiff' regulated supply inasmuch as their load varies from 80 mA at 1:11 to 260 mA at 20:08. Caution: The transformer advertised with the MA1023-1 will **not** deliver the required voltage for the LEDs. A 12.6-V ct, 0.5-A transformer will get the job done properly. When regulated as shown in Fig. 3, the stability becomes excellent.

After trying an aluminum box and double-sided pc board as housing materials, I came to the conclusion that a housing that would conduct less of the external environment to the inside of the assembly would be the better choice. Having several pieces of 1/4-in. plywood paneling, this became my choice of housing material. The first unit made was 6 w x 6 d x 4 h (in.). This allowed a full inch of foam insulation around a rather expensive 'high accuracy' crystal and the MM5369 oscillator-divider module. The switches were mounted on the front panel of this unit for accessibility.

The second unit made used the larger 4.5 x 5.5 x 5-in. thermally insulated module. The switches on this unit were placed inside the housing with an access door for control. The crystal used in this model was a 'standard' color-burst crystal but gave almost identical results due largely to the 2 inches of foam insulation in all directions surrounding the oscillator-divider module. This housing was made 7 h x 7 d x 6 w (in.) to better house the larger foam-covered assembly. This size seems to be optimum, considering bulkiness, yet having the relatively tight thermally insulated critical components. If I were to make a third unit, I would try accessing all the switches through the bottom panel. This would hide this rather bristling group of components, yet provide access to them for control and calibration. Four components are located on the bottom panel: The ac line cord exits through the bottom, the RCA phono jack provides crystal monitor access, an access hole through to the crystal vernier capacitor and the 'alarm' loudspeaker (1.5-in. diameter) as well as four paste-on rubber feet. Except for the front panel components, all other parts are mounted on the inside of the bottom panel so they can be inserted into the housing for final assembly.

Calibration

The following instrumentation was used in my experiments, part or all of them may not be required to get your unit calibrated:

a. A frequency counter good up to 50 MHz.

b. A 10-MHz dual-trace scope.

c. A home-brew secondary frequency standard on 1.000,000 MHz accurate to near 1 part in 10 to the 7th.

Upon completion of the MM5369 oscillator-divider, add power and check the wave form on a scope; it should show a very square wave at 60 Hz and a good square wave on 3.579,540. Output should be 10 V pk-pk and 4 V pk-pk respectively.

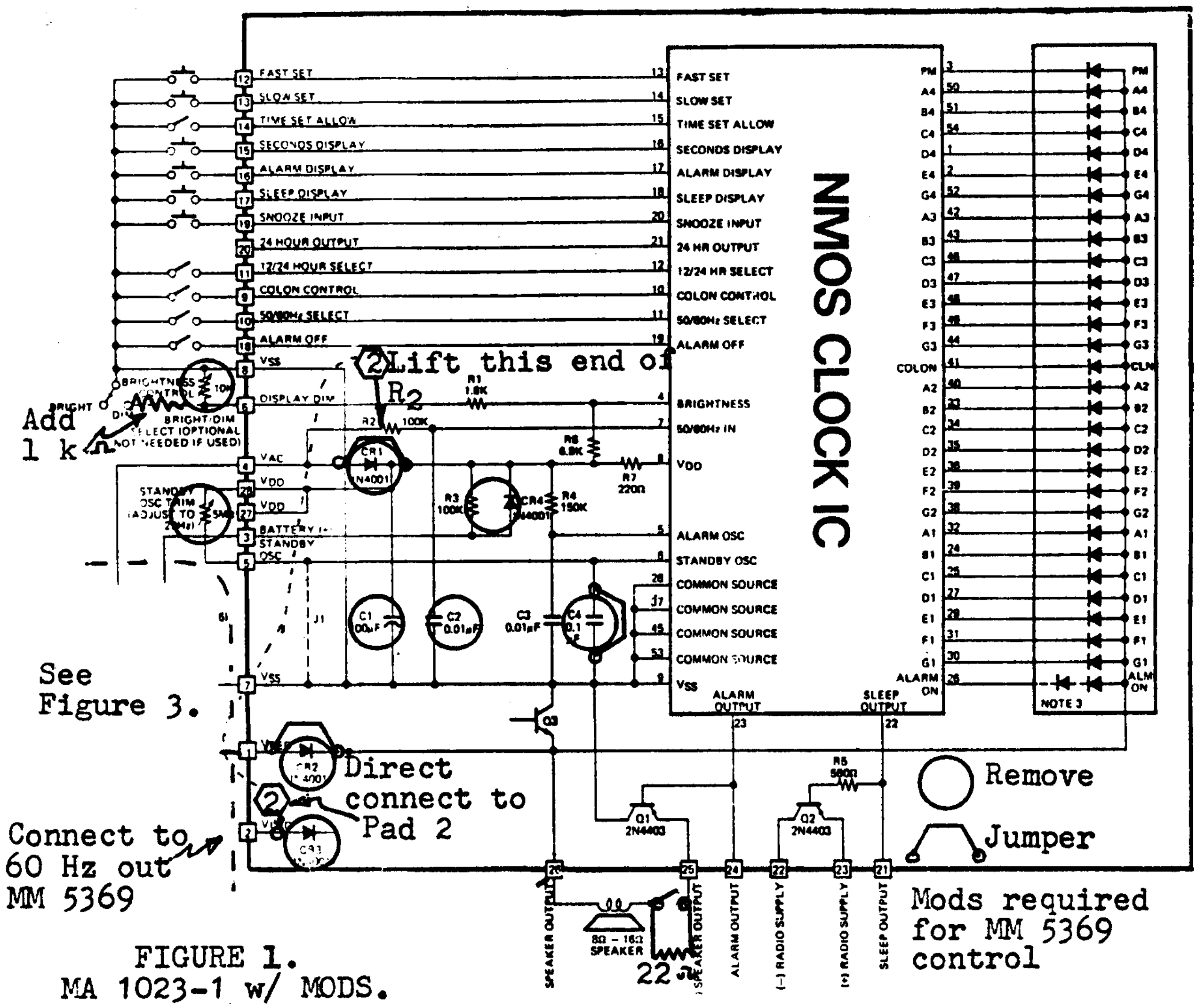


FIGURE 1.
MA 1023-1 w/ MODS.

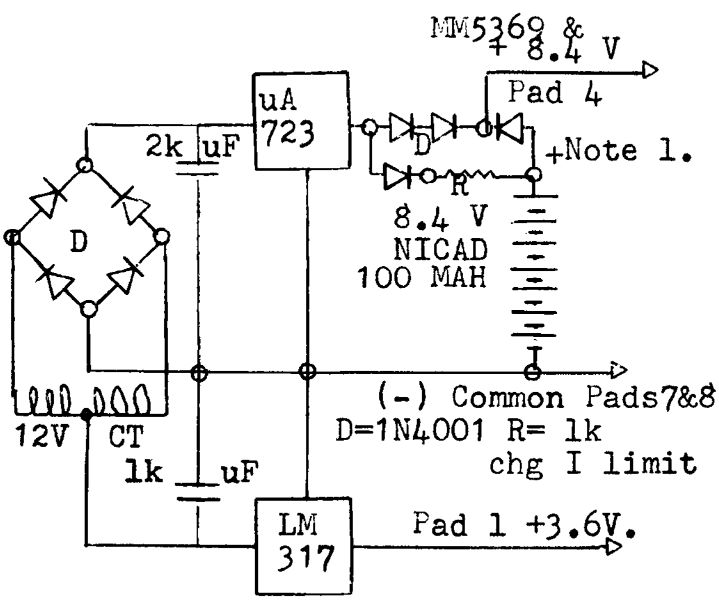
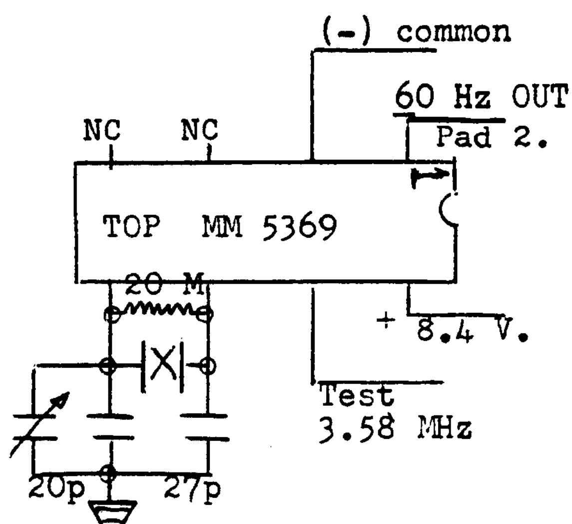


FIGURE 3. Power Supply
Note 1 See Ref 1 (modified)



CL= 12 pF. Figure 2
Oscillator-Divider

Using a counter, correct the crystal frequency. Encapsulate the oscillator-divider with adequate lead length to reach the front panel, power supply and RCA phono jack monitor. Be sure to leave an access hole to the vernier capacitor for re-zeroing the crystal frequency when in final position.

Check the frequency standard against WWV and correct as required. Let the counter warm up for at least an hour and check it against the frequency standard, recording the counter error. When reading the crystal frequency, the counter error at 1.000 MHz must be multiplied by 3.58 to obtain the clock frequency error. This error is to be recorded against clock time on. When the entire unit is completely wired, test it to see if all functions are operational. Go through all switches, etc., noting and correcting as required.

When satisfied that all construction and wiring is correct, close the housing and record clock status. Let it run for a few days, noting frequency and clock accuracy, etc., to get a feel for its drift rate while settling down. It will probably drift downward in frequency a few cycles for a week or more. Re-zero and record each time corrected against time on.

Alternate instrumentation: See QEX May 1982 correspondence from W4ANN calibrating frequency counters by use of your TV's color-burst oscillator which is accurate to above 1 part in 10 to the 6th.

Another practical method using a receiver capable of receiving WWV and 3.579,540 MHz: After checking against WWV, tune the MM5369 crystal frequency and set it to as near your calibration of 3.579,540 as you can read it. When the assembly is complete, after turn on, let it settle down and set the clock to the correct time in accordance with WWV. Carefully read the flashing colon (actually a single LED) and make the start of the flash and minute change in phase with WWV's, on the minute tone. Observe for several days and correct as required. In this way, you will be able to make your unit as good as the one that is calibrated with more-sophisticated instrumentation. It may take a little more time and patience, but the end result will be the same. Mine, after a month, is less than half a second off WWV.

For those who might require more 'hints and kinks,' I have several pages of addendum with a lot of time-saving short cuts, procedures and what goes together before which, so that you will not have to make as many mistakes as I did in assembly and calibration (post paid for U.S. $1).

Fig. 1 was taken from National Semiconductor specification (MA1023-1) sheet. Modifications required to use the MM5369 high-accuracy control timing is shown.

Fig. 2 is a reproduction of National Semiconductor specification MM5369 oscillator-divider.

Fig. 3 schematic is my solution to a highly regulated power supply, possibly a little over-designed, but it holds everything together for a high-accuracy final product.

Try it. You'll like it!

References

1 W2LWO, "Uninterruptible Power Supply," QEX 4, May 1982, modified by adding a second diode to line delivery side to reduce voltage at load to equal voltage delivered by battery when power fails.

2 W4ANN, "Calibrating Frequency Counters," QEX 4, May 1982.

(Correspondence - continued)

AD7I Modem

I saw the article in QEX #4 and have built up the XR2211 modulator on the bench for some testing. Seems to do much better than some other schemes, since the R/C networks for the function generator are independent of one another (within reason), and set up is fairly easy. I expect that we'll get on the air with asynchronous ASCII first, just to test the local climate for digital communications, and if there is sufficient interest, expand it to a full-blown packet repeater. We'll just have to see if the local repeater groups and clubs are interested in this. - Jon Titus, KA4QVK, P.O. Box 242, Blacksburg, VA 24060.

On the "COIL DESIGN" Program

Would you like to know how much wire to buy when you use the "COIL DESIGN" program printed in the July 1982 issue?

O.K., then just add the following line suggested by Ron Jones, K7RJ.

```
1665 PRINT "APPROXIMATE LENGTH OF WIRE = ";
INT(3.14159*D*N2); "INCHES"
```

- Harry L. Rosier, K4LBF, 12 Hastings Circle, Greensboro, NC 27406.

Post Card from the Northwest

You folks put out a great pub. Each issue has something that I have found useful - Number 2 regarding the video tapes available from FCC; #4 regarding the vhf front end on a chip; #5 regarding the RTTY demodulator. Nice work, and thanks. - Cliff Appel, WB6AWM/7, P.O. Box 251, Electric City, WA 99123.

AMSAT Search for Candidates

The successful launch of AMSAT's first Phase III satellite in early 1983 will bring unprecedented growth to this primarily volunteer- managed organization. This will require a full-time, professional executive director/general manager. The successful candidate will:

--Develop and implement innovative educational programs to bring an awareness and appreciation of space science and technology at the personal level to amateurs and non-amateurs around the world.

--Manage and coordinate the work of hundreds of volunteers who design, build, launch and operate the worldwide amateur space communications system.

--Oversee the day-to-day operatations of AMSAT involving membership services, publications, public information and staff management.

--Lead a comprehensive fund-raising activity both inside and outside the Amateur Radio community.

This position is located in suburban Washington, DC and will require some travel and weekend work. Compensation is in the $30,000-per- year range, with substantial performance-based incentives. An engineering/technical background is desirable. Active radio amateur interest is mandatory. The deadline is November 1, 1982. Send resumes to: Search Committee/AMSAT, P.O. Box 27, Washington, DC 20044.

Quest for IBM PC RTTY

I own an IBM PC computer and would like to use it on RTTY. I would appreciate it very much if you could tell me what hardware and/or software I need, and where I can purchase it. - Nathan Janco, 1801 Forest Boulevard, Tulsa, OK 74114.

RTTY Art Storage by Computer

By George Gadbois,* W3FEY

If you have collected very much RTTY art on paper tape you know that this form of storage is rather bulky and a bit clumsy to use. Many amateurs have adopted audio cassettes as a means of storing RTTY art. Audio cassettes are much handier than paper tape, but the record must be made and used at the original transmission speed. With the advent of computer-based RTTY terminals, it makes sense to use a computer to process the art and store the data on digital cassettes or discs. Digital storage can be much more compact than recording audio tones, and the computer provides the means to change the transmission speed or the code.

One obvious problem with handling RTTY art in a computer is the large number of characters in a typical RTTY picture. Most RTTY art is highly redundant, and you can take advantage of this fact to save memory. I have written machine-language subroutines to pack and unpack RTTY art on my RCA VIP computer. These subroutines could be used in any CDP1802-based computer. The programming scheme is simple and easily can be adapted to any microcomputer. I hope that my notes are sufficiently clear that anyone can make the conversion to another micro.

The idea of counting how many times a character is repeated and then storing the character and the number of repetitions is obvious. If one byte of memory is used to store the character and the next byte is used to store the number of repetitions, the memory requirement for storage of RTTY art is greatly reduced. ASCII code requires seven information bits leaving one spare bit to be used as a repeat flag. I store single characters with the eighth bit normally set to zero. The eighth bit is set to one for repeated characters. With this scheme the memory required is never more than that required to store each character individually, so there is no need to differentiate between picture and text storage. When the computer finds the eighth bit set, it knows that the next byte is a repeat count rather than a new character.

Most RTTY art is transmitted with Baudot code which has some excess overhead that can be eliminated by conversion to ASCII, the LTRS/FIGS characters for example. Because of keyboard differences between teletypewriters, most creators of RTTY art insert redundant bell/apostrophe characters. The data storage routine shown in Listing 1 strips out unnecessary characters and counts repetitions for storage. Redundancies such as bell/apostrophe can be reinserted at the time of transmission if needed.

The assumption is made that the standard NNNN shutdown sequence will be used to terminate storage. You will see a reference to a command word in the subroutine in Listing 1. Another subroutine scans the incoming traffic for command words and leaves an appropriate byte in memory upon recognition. Occasional creators of RTTY art will use NNNN in their creation which causes a termination of my storage program. The program easily could be modified for manual termination of the storage program. However, I want unattended operation, so I have to suffer the occasional loss of a picture.

Another alternative would be to sense the end of transmission and terminate storage after allowing a time delay for the transmitting station to change paper tape reels, etc.

I use a 26-k byte storage buffer for incoming traffic. This is sufficient for almost any RTTY art other than the famous reclining nude.

The subroutine in Listing 2 unpacks the data for transmission. In the example, the transmission code is assumed to be Baudot. LTRS/FIGS characters are automatically inserted. Unshift on space is used to be fully compatible with mechanical teletypewriters. Carriage returns are sent twice to allow time for carriages to return to the left margin. Of course, the routine is simplified for direct ASCII transmission.

W3FEY RTTY Program

My overall RTTY program uses a modified form of the RCA CHIP-8 interpreter. An article describing a simple version of the program is scheduled for publication in 73 magazine in the near future. A 4-k RAM VIP is required for the simple program which has only a 256-byte storage buffer and direct keyboard transmit. No provision is included for RTTY art, memory dumps, etc. A very simple UART interface for any 1802-based computer, such as the VIP, is shown in the January RTTY column in 73. RS-232-C interfacing can be added with a couple of op amps if needed. (Ref)

A machine-language dump of my expanded RTTY program for the VIP is available for copying and mailing costs.

Comments on Listings

A few tips on how the RCA CHIP-8 (computer hobbyist interpreter program) language works will make it easier to understand the disassembled listings which appear on the following pages. The listings are machine-language subroutines called by my modified CHIP-8 interpreter which I call RY-8.

The RY-8 (CHIP-8) call subroutine program counter is R(4) which is always on memory page 00. Thus, a zero is always in the high byte of R(4) which provides an easy way to get a zero when needed. R(5) is the RY-8 (CHIP-8) program counter. Upon entry to a machine language subroutine called by RY-8, R(2) is the stack pointer, R(3) is the program counter, R(5) points to the next RY-8 instruction to be executed, and R(6) and R(7) point to the work space page where temporary data is stored. RY-8 does not disturb R(8) and R(9) so they can be left pointing at data without concern. This is not true for CHIP-8. All machine-language subroutines end with a D4 instruction which returns control to the call subroutine. You will note that at several points I change R(5) in a machine-language subroutine. Thus, the return will not be to the point that called the subroutine - a very sneaky trick that saves a lot of overhead.

Reference

RCA, "COS/MOS Memories, Microprocessors, and Support Systems," 1979, Pub. SSD-260, pp.305- 310.

*141 Maple Lane, Lancaster, PA 17601.

Listing 1

```
REM  DATA COMPACT AND STORE SUB
REM  DATA STORED IN BUFFER POINTED
REM  TO BY R(8). ON ENTRY R(6)
REM  AND R(7) POINT AT WORKSPACE.
REM  INPUT CODE IS BAUDOT IN THIS
REM  EXAMPLE. WORKS WITH ASCII AS IS.
REM
0770  E6      SEX   R(6) IS DATA POINTER
0771  F8F0    LDI   LOAD IMI F0, INC R(P)+1
0773  A6      PLO   PUT D INTO LSB OF R(6)
0774  06      LDN   LD D FM LOC IN R(6)
0775  329A    BZ    IF D=0 SHORT BR TO 079A, ELSE INC R(P)+1
0777  AA      PLO   PUT D INTO LSB OF R(A)
0778  FB0E    XRI   EXCL OR IMI D WITH 0E, INC R(P)+1
077A  329A    BZ    IF D=0 SHORT BR TO 079A, ELSE INC R(P)+1
077C  FB01    XRI   EXCL OR IMI D WITH 01, INC R(P)+1
077E  329A    BZ    IF D=0 SHORT BR TO 079A, ELSE INC R(P)+1
0780  FB08    XRI   EXCL OR IMI D WITH 08, INC R(P)+1
0782  329A    BZ    IF D=0 SHORT BR TO 079A, ELSE INC R(P)+1
REM  LTRS, FIGS, AND BELL NOT STORED
0784  16      INC   INC R(6)
0785  16      INC   INC R(6)
0786  06      LDN   LD D FM LOC IN R(6)
0787  32E7    BZ    IF D=0 SHORT BR TO 07E7, ELSE INC R(P)+1
0789  8A      GLO   LD D WITH LSB OF R(A)
078A  F3      XOR   EXCL OR D BITS WITH LOC IN R(X)
078B  16      INC   INC R(6)
078C  3A9B    BNZ   IF D NOT 0  SHORT BR TO 079B, ELSE INC R(P)+1
078E  06      LDN   LD D FM LOC IN R(6)
078F  FC73    ADI   ADD IMI D WITH 73, INC R(P)+1
0791  F8F7    LDI   LOAD IMI F7, INC R(P)+1
0793  A7      PLO   PUT D INTO LSB OF R(7)
0794  A7      PLO   PUT D INTO LSB OF R(7)
0795  07      LDN   LD D FM LOC IN R(7)
0796  FB5C    XRI   EXCL OR IMI D WITH 5C, INC R(P)+1
0798  32EE    BZ    IF D=0 SHORT BR TO 07EE, ELSE INC R(P)+1
079A  D4      SEP   R(4) IS PROGRAM CTR
REM  RETURN FM SUB CT INCR AND 4N
REM  TESTED AT 0796.
079B  06      LDN   LD D FM LOC IN R(6)
079C  FB01    XRI   EXCL OR IMI D WITH 01, INC R(P)+1
079E  26      DEC   DEC R(6)
079F  3ACF    BNZ   IF D NOT 0  SHORT BR TO 07CF, ELSE INC R(P)+1
07A1  18      INC   INC R(8)
07A2  06      LDN   LD D FM LOC IN R(6)
07A3  58      STR   STORE D IN LOC IN R(8)
07A4  8A      GLO   LD D WITH LSB OF R(A)
07A5  56      STR   STORE D IN LOC IN R(6)
07A6  88      GLO   LD D WITH LSB OF R(8)
07A7  FFFB    SMI   SUBT IMI FB FROM D, INC R(P)+1
07A9  3B9A    BNF   IF DF=0,<,-   SHORT BR TO 079A, ELSE INC R(P)+1
07AB  98      GHI   LD D WITH MSB OF R(8)
07AC  FB7F    XRI   EXCL OR IMI D WITH 7F, INC R(P)+1
07AE  3A9A    BNZ   IF D NOT 0  SHORT BR TO 079A, ELSE INC R(P)+1
REM  ABOVE TESTS FOR END OF BUFFER
07B0  18      INC   INC R(8)
07B1  F817    LDI   LOAD IMI 17, INC R(P)+1
07B3  58      STR   STORE D IN LOC IN R(8)
07B4  F8FE    LDI   LOAD IMI FE, INC R(P)+1
07B6  AF      PLO   PUT D INTO LSB OF R(F)
07B7  F87F    LDI   LOAD IMI 7F, INC R(P)+1
07B9  BF      PHI   PUT D INTO MSB OF R(F)
07BA  98      GHI   LD D WITH MSB OF R(8)
07BB  5F      STR   STORE D IN LOC IN R(F)
07BC  1F      INC   INC R(F)
07BD  88      GLO   LD D WITH LSB OF R(8)
07BE  5F      STR   STORE D IN LOC IN R(F)
07BF  F8FD    LDI   LOAD IMI FD, INC R(P)+1
07C1  A6      PLO   PUT D INTO LSB OF R(6)
07C2  94      GHI   LD D WITH MSB OF R(4)
07C3  56      STR   STORE D IN LOC IN R(6)
07C4  16      INC   INC R(6)
07C5  F86C    LDI   LOAD IMI 6C, INC R(P)+1
07C7  56      STR   STORE D IN LOC IN R(6)
07C8  F808    LDI   LOAD IMI 08, INC R(P)+1
07CA  B5      PHI   PUT D INTO MSB OF R(5)
07CB  F844    LDI   LOAD IMI 44, INC R(P)+1
07CD  A5      PLO   PUT D INTO LSB OF R(5)
07CE  D4      SEP   R(4) IS PROGRAM CTR
REM  ABOVE CODE CHANGES THE
REM  SUB RETURN POINT. NOW CHANGED
REM  TO 'BUFFER FULL' MSG.
REM  STORAGE ROUTINE IS TERMINATED
07CF  F80D    LDI   LOAD IMI 0D, INC R(P)+1
07D1  F3      XOR   EXCL OR D BITS WITH LOC IN R(X)
07D2  32E1    BZ    IF D=0 SHORT BR TO 07E1, ELSE INC R(P)+1
07D4  46      LDA   LD D FM LOC IN R(6) AND INC R(6)
07D5  F980    ORI   OR IMI D WITH 80, INC R(P)+1
07D7  18      INC   INC R(8)
07D8  58      STR   STORE D IN LOC IN R(8)
07D9  18      INC   INC R(8)
07DA  06      LDN   LD D FM LOC IN R(6)
07DB  58      STR   STORE D IN LOC IN R(8)
07DC  F801    LDI   LOAD IMI 01, INC R(P)+1
07DE  73      STXD  STORE D IN LOC IN R(X), DEC R(X)
07DF  30A4    BR    SHORT BR TO 07A4
07E1  16      INC   INC R(6)
07E2  F801    LDI   LOAD IMI 01, INC R(P)+1
07E4  73      STXD  STORE D IN LOC IN R(X), DEC R(X)
07E5  30A1    BR    SHORT BR TO 07A1
07E7  8A      GLO   LD D WITH LSB OF R(A)
07E8  56      STR   STORE D IN LOC IN R(6)
07E9  16      INC   INC R(6)
07EA  F801    LDI   LOAD IMI 01, INC R(P)+1
07EC  56      STR   STORE D IN LOC IN R(6)
07ED  D4      SEP   R(4) IS PROGRAM CTR
07EE  56      STR   STORE D IN LOC IN R(6)
07EF  18      INC   INC R(8)
07F0  F81C    LDI   LOAD IMI 1C, INC R(P)+1
07F2  58      STR   STORE D IN LOC IN R(8)
REM  FILE SEPARATOR(ASCII 1CHEX) IN
REM  BUFFER AT END OF EACH MSG
07F3  F8FE    LDI   LOAD IMI FE, INC R(P)+1
07F5  AF      PLO   PUT D INTO LSB OF R(F)
07F6  F87F    LDI   LOAD IMI 7F, INC R(P)+1
07F8  BF      PHI   PUT D INTO MSB OF R(F)
07F9  98      GHI   LD D WITH MSB OF R(8)
07FA  5F      STR   STORE D IN LOC IN R(F)
07FB  1F      INC   INC R(F)
07FC  88      GLO   LD D WITH LSB OF R(8)
07FD  5F      STR   STORE D IN LOC IN R(F)
REM  END OF TRAFFIC ADDRESS IN
REM  MEMORY LOC 7FFE-7FFF
07FE  30A6    BR    SHORT BR TO 07A6
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Listing 2

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REM  XMT SUB--BAUDOT-EXPANDS PACKED
REM  DATA FROM BUFFER.  0F80-SHIFT FLAG
REM  0F81-CHAR RPT; 0F82-PREV CHAR
REM  0F83-BUFFER PTR; 0F84-LINE CT
REM  0F85-CR FLAG
0900  22     DEC   DEC R(2)
0901  6F     INP7  BUS TO LOC IN R(X) & D, I/O-#=7
0902  FE     SHL   SHIFT LFT (TO MSB), MSB TO DF, 0 TO LSB
0903  3309   BDF   IF DF=1,-,0,>   SHORT BR TO 0909, ELSE INC R(P)+1
REM TEST UART THRE(XMT REG EMPTY)
0905  12     INC   INC R(2)
0906  15     INC   INC R(5)
0907  15     INC   INC R(5)
0908  D4     SEP   R(4) IS PROGRAM CTR
0909  F881   LDI   LOAD IMI 81, INC R(P)+1
090B  A6     PLO   PUT D INTO LSB OF R(6)
REM R(6) NOW POINTS @0F81
090C  F804   LDI   LOAD IMI 04, INC R(P)+1
090E  BA     PHI   PUT D INTO MSB OF R(A)
090F  BF     PHI   PUT D INTO MSB OF R(F)
REM  R(A) AND R(F) NOW PT TO CONV TBLS
0910  46     LDA   LD D FM LOC IN R(6) AND INC R(6)
0911  3228   BZ    IF D=0 SHORT BR TO 0928, ELSE INC R(P)+1
0913  06     LDN   LD D FM LOC IN R(6)
0914  AA     PLO   PUT D INTO LSB OF R(A)
0915  FC80   ADI   ADD IMI D WITH 80, INC R(P)+1
0917  AF     PLO   PUT D INTO LSB OF R(F)
0918  26     DEC   DEC R(6)
0919  06     LDN   LD D FM LOC IN R(6)
091A  FCFF   ADI   ADD IMI D WITH FF, INC R(P)+1
091C  56     STR   STORE D IN LOC IN R(6)
091D  EF     SEX   R(F) IS DATA POINTER
091E  66     OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
091F  12     INC   INC R(2)
0920  F807   LDI   LOAD IMI 07, INC R(P)+1
0922  BC     PHI   PUT D INTO MSB OF R(C)
0923  F825   LDI   LOAD IMI 25, INC R(P)+1
0925  AC     PLO   PUT D INTO LSB OF R(C)
0926  DC     SEP   R(C) IS PROGRAM CTR
REM  GOTO DISP SUB AT 0725
0927  **           RESERVED
0928  16     INC   INC R(6)
0929  46     LDA   LD D FM LOC IN R(6) AND INC R(6)
092A  3ABF   BNZ   IF D NOT 0  SHORT BR TO 09BF, ELSE INC R(P)+1
092C  89     GLO   LD D WITH LSB OF R(9)
092D  52     STR   STORE D IN LOC IN R(2)
092E  AE     PLO   PUT D INTO LSB OF R(E)
092F  88     GLO   LD D WITH LSB OF R(8)
0930  F3     XOR   EXCL OR D BITS WITH LOC IN R(X)
0931  3A39   BNZ   IF D NOT 0  SHORT BR TO 0939, ELSE INC R(P)+1
0933  99     GHI   LD D WITH MSB OF R(9)
0934  52     STR   STORE D IN LOC IN R(2)
0935  98     GHI   LD D WITH MSB OF R(8)
0936  F3     XOR   EXCL OR D BITS WITH LOC IN R(X)
0937  3205   BZ    IF D=0 SHORT BR TO 0905, ELSE INC R(P)+1
0939  99     GHI   LD D WITH MSB OF R(9)
093A  52     STR   STORE D IN LOC IN R(2)
093B  89     GLO   LD D WITH LSB OF R(9)
093C  FBFF   XRI   EXCL OR IMI D WITH FF, INC R(P)+1
093E  3A48   BNZ   IF D NOT 0  SHORT BR TO 0948, ELSE INC R(P)+1
REM TEST FOR R(8)=R(9),i.e. ALL SENT
0940  99     GHI   LD D WITH MSB OF R(9)
0941  FB13   XRI   EXCL OR IMI D WITH 13, INC R(P)+1
0943  3A48   BNZ   IF D NOT 0  SHORT BR TO 0948, ELSE INC R(P)+1
0943  3A48   BNZ   IF D NOT 0  SHORT BR TO 0948, ELSE INC R(P)+1
0945  F80F   LDI   LOAD IMI 0F, INC R(P)+1
0947  B9     PHI   PUT D INTO MSB OF R(9)
0948  19     INC   INC R(9)
0949  F880   LDI   LOAD IMI 80, INC R(P)+1
094B  A7     PLO   PUT D INTO LSB OF R(7)
094C  09     LDN   LD D FM LOC IN R(9)
094D  AA     PLO   PUT D INTO LSB OF R(A)
094E  FC80   ADI   ADD IMI D WITH 80, INC R(P)+1
0950  AF     PLO   PUT D INTO LSB OF R(F)
0951  E6     SEX   R(6) IS DATA POINTER
0952  8A     GLO   LD D WITH LSB OF R(A)
0953  FD1F   SDI   SUBT IMI D FROM 1F, INC R(P)+1
0955  33FF   BDF   IF DF=1,-,0,>   SHORT BR TO 09FF, ELSE INC R(P)+1
0957  06     LDN   LD D FM LOC IN R(6)
0958  FD3C   SDI   SUBT IMI D FROM 3C, INC R(P)+1
095A  3366   BDF   IF DF=1,-,0,>   SHORT BR TO 0966, ELSE INC R(P)+1
095C  8A     GLO   LD D WITH LSB OF R(A)
095D  FB20   XRI   EXCL OR IMI D WITH 20, INC R(P)+1
095F  32A9   BZ    IF D=0 SHORT BR TO 09A9, ELSE INC R(P)+1
0961  06     LDN   LD D FM LOC IN R(6)
0962  FB48   XRI   EXCL OR IMI D WITH 48, INC R(P)+1
0964  328C   BZ    IF D=0 SHORT BR TO 098C, ELSE INC R(P)+1
0966  0F     LDN   LD D FM LOC IN R(F)
0967  FA20   ANI   AND IMI D WITH 20, INC R(P)+1
0969  3A82   BNZ   IF D NOT 0  SHORT BR TO 0982, ELSE INC R(P)+1
096B  07     LDN   LD D FM LOC IN R(7)
096C  3A74   BNZ   IF D NOT 0  SHORT BR TO 0974, ELSE INC R(P)+1
096E  06     LDN   LD D FM LOC IN R(6)
096F  FC01   ADI   ADD IMI D WITH 01, INC R(P)+1
0971  56     STR   STORE D IN LOC IN R(6)
0972  301D   BR    SHORT BR TO 091D
0974  E7     SEX   R(7) IS DATA POINTER
0975  F81F   LDI   LOAD IMI 1F, INC R(P)+1
0977  57     STR   STORE D IN LOC IN R(7)
0978  66     OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0979  27     DEC   DEC R(7)
097A  94     GHI   LD D WITH MSB OF R(4)
097B  57     STR   STORE D IN LOC IN R(7)
097C  8E     GLO   LD D WITH LSB OF R(E)
097D  A9     PLO   PUT D INTO LSB OF R(9)
097E  42     LDA   LD D FM LOC IN R(2) AND INC R(2)
097F  B9     PHI   PUT D INTO MSB OF R(9)
0980  3006   BR    SHORT BR TO 0906
0982  07     LDN   LD D FM LOC IN R(7)
0983  3A6E   BNZ   IF D NOT 0  SHORT BR TO 096E, ELSE INC R(P)+1
0985  E7     SEX   R(7) IS DATA POINTER
0986  F81B   LDI   LOAD IMI 1B, INC R(P)+1
0988  57     STR   STORE D IN LOC IN R(7)
0989  66     OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
098A  307C   BR    SHORT BR TO 097C
098C  16     INC   INC R(6)
098D  06     LDN   LD D FM LOC IN R(6)
098E  3A9F   BNZ   IF D NOT 0  SHORT BR TO 099F, ELSE INC R(P)+1
0990  8E     GLO   LD D WITH LSB OF R(E)
0991  A9     PLO   PUT D INTO LSB OF R(9)
0992  02     LDN   LD D FM LOC IN R(2)
0993  B9     PHI   PUT D INTO MSB OF R(9)
0994  F80D   LDI   LOAD IMI 0D, INC R(P)+1
0996  73     STXD  STORE D IN LOC IN R(X), DEC R(X)
0997  26     DEC   DEC R(6)
0998  26     DEC   DEC R(6)
0999  73     STXD  STORE D IN LOC IN R(X), DEC R(X)
099A  F802   LDI   LOAD IMI 02, INC R(P)+1
099C  56     STR   STORE D IN LOC IN R(6)
099D  3010   BR    SHORT BR TO 0910
099F  F802   LDI   LOAD IMI 02, INC R(P)+1
09A1  56     STR   STORE D IN LOC IN R(6)
09A2  66     OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
09A3  26     DEC   DEC R(6)
09A4  94     GHI   LD D WITH MSB OF R(4)
09A5  73     STXD  STORE D IN LOC IN R(X), DEC R(X)
09A6  56     STR   STORE D IN LOC IN R(6)
09A7  307C   BR    SHORT BR TO 097C
09A9  16     INC   INC R(6)
09AA  06     LDN   LD D FM LOC IN R(6)
09AB  3290   BZ    IF D=0 SHORT BR TO 0990, ELSE INC R(P)+1
09AD  F802   LDI   LOAD IMI 02, INC R(P)+1
09AF  56     STR   STORE D IN LOC IN R(6)
09B0  66     OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
09B1  26     DEC   DEC R(6)
09B2  94     GHI   LD D WITH MSB OF R(4)
09B3  73     STXD  STORE D IN LOC IN R(X), DEC R(X)
09B4  56     STR   STORE D IN LOC IN R(6)
09B5  3005   BR    SHORT BR TO 0905
REM  ABOVE CODE INSERTS CR/LF AS NEEDED
09B7  **           RESERVED
09B8  **           RESERVED
09B9  **           RESERVED
09BA  **           RESERVED
09BB  **           RESERVED
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09BC  ##        RESERVED
09BD  ##        RESERVED
09BE  ##        RESERVED
09BF  E6        SEX   R(6) IS DATA POINTER
09C0  F80A      LDI   LOAD IMI 0A, INC R(P)+1
09C2  BD        PHI   PUT D INTO MSB OF R(D)
09C3  F863      LDI   LOAD IMI 63, INC R(P)+1
09C5  AD        PLO   PUT D INTO LSB OF R(D)
09C6  DD        SEP   R(D) IS PROGRAM CTR
REM  VIP DISPLAY REQUIRES THAT LONG
REM  BRANCH INSTRUCTIONS BE AVOIDED.
REM  ABOVE SETS LONG BRANCH TO 0AAD
09FF  E6        SEX   R(6) IS DATA POINTER
0A00  8A        GLO   LD D WITH LSB OF R(A)
0A01  FB07      XRI   EXCL OR IMI D WITH 07, INC R(P)+1
0A03  32E9      BZ    IF D=0 SHORT BR TO 0AE9, ELSE INC R(P)+1
0A05  FB0A      XRI   EXCL OR IMI D WITH 0A, INC R(P)+1
0A07  32F3      BZ    IF D=0 SHORT BR TO 0AF3, ELSE INC R(P)+1
0A09  FB13      XRI   EXCL OR IMI D WITH 13, INC R(P)+1
0A0B  3225      BZ    IF D=0 SHORT BR TO 0A25, ELSE INC R(P)+1
0A0D  FB1A      XRI   EXCL OR IMI D WITH 1A, INC R(P)+1
0A0F  3217      BZ    IF D=0 SHORT BR TO 0A17, ELSE INC R(P)+1
REM  ABOVE LOOKS FOR CONTROL CHARS
0A11  EF        SEX   R(F) IS DATA POINTER
0A12  66        OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0A13  12        INC   INC R(2)
0A14  15        INC   INC R(5)
0A15  15        INC   INC R(5)
0A16  D4        SEP   R(4) IS PROGRAM CTR
0A17  E2        SEX   R(2) IS DATA POINTER
0A18  6F        INP7  BUS TO LOC IN R(X) & D, I/O-#=7
0A19  FA40      ANI   AND IMI D WITH 40, INC R(P)+1
0A1B  3218      BZ    IF D=0 SHORT BR TO 0A18, ELSE INC R(P)+1
0A1D  12        INC   INC R(2)
0A1E  F803      LDI   LOAD IMI 03, INC R(P)+1
0A20  B5        PHI   PUT D INTO MSB OF R(5)
0A21  F82E      LDI   LOAD IMI 2E, INC R(P)+1
0A23  A5        PLO   PUT D INTO LSB OF R(5)
0A24  D4        SEP   R(4) IS PROGRAM CTR
REM  RETURN TO RX AT END OF DATA
REM  INDICATED BY ASCII EOT
0A25  E2        SEX   R(2) IS DATA POINTER
0A26  22        DEC   DEC R(2)
0A27  89        GLO   LD D WITH LSB OF R(9)
0A28  52        STR   STORE D IN LOC IN R(2)
0A29  88        GLO   LD D WITH LSB OF R(8)
0A2A  F3        XOR   EXCL OR D BITS WITH LOC IN R(X)
0A2B  3A35      BNZ   IF D NOT 0  SHORT BR TO 0A35, ELSE INC R(P)+1
0A2D  99        GHI   LD D WITH MSB OF R(9)
0A2E  52        STR   STORE D IN LOC IN R(2)
0A2F  98        GHI   LD D WITH MSB OF R(8)
0A30  F3        XOR   EXCL OR D BITS WITH LOC IN R(X)
0A31  12        INC   INC R(2)
0A32  32E2      BZ    IF D=0 SHORT BR TO 0AE2, ELSE INC R(P)+1
0A34  22        DEC   DEC R(2)
0A35  12        INC   INC R(2)
0A36  89        GLO   LD D WITH LSB OF R(9)
0A37  FBFF      XRI   EXCL OR IMI D WITH FF, INC R(P)+1
0A39  3A43      BNZ   IF D NOT 0  SHORT BR TO 0A43, ELSE INC R(P)+1
0A3B  99        GHI   LD D WITH MSB OF R(9)
0A3C  FB13      XRI   EXCL OR IMI D WITH 13, INC R(P)+1
0A3E  3A43      BNZ   IF D NOT 0  SHORT BR TO 0A43, ELSE INC R(P)+1
0A40  F80F      LDI   LOAD IMI 0F, INC R(P)+1
0A42  B9        PHI   PUT D INTO MSB OF R(9)
0A43  19        INC   INC R(9)
0A44  09        LDN   LD D FM LOC IN R(9)
0A45  FD30      SDI   SUBT IMI D FROM 30, INC R(P)+1
0A47  3313      BDF   IF DF=1,-,0,>   SHORT BR TO 0A13, ELSE INC R(P)+1
0A49  09        LDN   LD D FM LOC IN R(9)
0A4A  FF32      SMI   SUBT IMI 32 FROM D, INC R(P)+1
0A4C  3313      BDF   IF DF=1,-,0,>   SHORT BR TO 0A13, ELSE INC R(P)+1
REM  SET NEW BUFFER PTR
0A4E  09        LDN   LD D FM LOC IN R(9)
0A4F  FF30      SMI   SUBT IMI 30 FROM D, INC R(P)+1
0A51  FE        SHL   SHIFT LFT (TO MSB), MSB TO DF, 0 TO LSB
0A52  FE        SHL   SHIFT LFT (TO MSB), MSB TO DF, 0 TO LSB
0A53  26        DEC   DEC R(6)
0A54  56        STR   STORE D IN LOC IN R(6)
0A55  A7        PLO   PUT D INTO LSB OF R(7)
0A56  F887      LDI   LOAD IMI 87, INC R(P)+1
0A58  A6        PLO   PUT D INTO LSB OF R(6)
0A59  E6        SEX   R(6) IS DATA POINTER
0A5A  89        GLO   LD D WITH LSB OF R(9)
0A5B  73        STXD  STORE D IN LOC IN R(X), DEC R(X)
0A5C  99        GHI   LD D WITH MSB OF R(9)
0A5D  73        STXD  STORE D IN LOC IN R(X), DEC R(X)
0A5E  07        LDN   LD D FM LOC IN R(7)
0A5F  B9        PHI   PUT D INTO MSB OF R(9)
0A60  17        INC   INC R(7)
0A61  07        LDN   LD D FM LOC IN R(7)
0A62  A9        PLO   PUT D INTO LSB OF R(9)
0A63  19        INC   INC R(9)
0A64  09        LDN   LD D FM LOC IN R(9)
0A65  FA80      ANI   AND IMI D WITH 80, INC R(P)+1
0A67  BE        PHI   PUT D INTO MSB OF R(E)
0A68  09        LDN   LD D FM LOC IN R(9)
0A69  FA7F      ANI   AND IMI D WITH 7F, INC R(P)+1
0A6B  AA        PLO   PUT D INTO LSB OF R(A)
0A6C  FC80      ADI   ADD IMI D WITH 80, INC R(P)+1
0A6E  AF        PLO   PUT D INTO LSB OF R(F)
0A6F  F880      LDI   LOAD IMI 80, INC R(P)+1
0A71  A7        PLO   PUT D INTO LSB OF R(7)
0A72  0F        LDN   LD D FM LOC IN R(F)
0A73  FA20      ANI   AND IMI D WITH 20, INC R(P)+1
0A75  3AD8      BNZ   IF D NOT 0  SHORT BR TO 0AD8, ELSE INC R(P)+1
0A77  07        LDN   LD D FM LOC IN R(7)
0A78  3ACD      BNZ   IF D NOT 0  SHORT BR TO 0ACD, ELSE INC R(P)+1
0A7A  F882      LDI   LOAD IMI 82, INC R(P)+1
0A7C  A6        PLO   PUT D INTO LSB OF R(6)
0A7D  8A        GLO   LD D WITH LSB OF R(A)
0A7E  FB17      XRI   EXCL OR IMI D WITH 17, INC R(P)+1
0A80  32C1      BZ    IF D=0 SHORT BR TO 0AC1, ELSE INC R(P)+1
REM  ASCII ETB(17hex) AT END OF MESSAGE
0A82  FB1A      XRI   EXCL OR IMI D WITH 1A, INC R(P)+1
0A84  32BA      BZ    IF D=0 SHORT BR TO 0ABA, ELSE INC R(P)+1
0A86  308A      BR    SHORT BR TO 0A8A
0A88  ##        RESERVED
0A89  ##        RESERVED
0A8A  8A        GLO   LD D WITH LSB OF R(A)
0A8B  73        STXD  STORE D IN LOC IN R(X), DEC R(X)
0A8C  9E        GHI   LD D WITH MSB OF R(E)
0A8D  3A99      BNZ   IF D NOT 0  SHORT BR TO 0A99, ELSE INC R(P)+1
0A8F  EF        SEX   R(F) IS DATA POINTER
0A90  66        OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0A91  12        INC   INC R(2)
0A92  F807      LDI   LOAD IMI 07, INC R(P)+1
0A94  BC        PHI   PUT D INTO MSB OF R(C)
0A95  F825      LDI   LOAD IMI 25, INC R(P)+1
0A97  AC        PLO   PUT D INTO LSB OF R(C)
0A98  DC        SEP   R(C) IS PROGRAM CTR
REM SETS BRANCH TO DISP ROUTINE
0A99  19        INC   INC R(9)
0A9A  09        LDN   LD D FM LOC IN R(9)
0A9B  FF01      SMI   SUBT IMI 01 FROM D, INC R(P)+1
0A9D  56        STR   STORE D IN LOC IN R(6)
0A9E  308F      BR    SHORT BR TO 0A8F
0AA0  06        LDN   LD D FM LOC IN R(6)
0AA1  FB07      XRI   EXCL OR IMI D WITH 07, INC R(P)+1
0AA3  328A      BZ    IF D=0 SHORT BR TO 0A8A, ELSE INC R(P)+1
0AA5  F807      LDI   LOAD IMI 07, INC R(P)+1
0AA7  73        STXD  STORE D IN LOC IN R(X), DEC R(X)
0AA8  FC80      ADI   ADD IMI D WITH 80, INC R(P)+1
0AAA  AF        PLO   PUT D INTO LSB OF R(F)
0AAB  9E        GHI   LD D WITH MSB OF R(E)
0AAC  3AB1      BNZ   IF D NOT 0  SHORT BR TO 0AB1, ELSE INC R(P)+1
0AAE  29        DEC   DEC R(9)
0AAF  3011      BR    SHORT BR TO 0A11
0AB1  19        INC   INC R(9)
0AB2  09        LDN   LD D FM LOC IN R(9)
0AB3  FF01      SMI   SUBT IMI 01 FROM D, INC R(P)+1
0AB5  56        STR   STORE D IN LOC IN R(6)
0AB6  29        DEC   DEC R(9)
0AB7  29        DEC   DEC R(9)
0AB8  3011      BR    SHORT BR TO 0A11
0ABA  8A        GLO   LD D WITH LSB OF R(A)
0ABB  73        STXD  STORE D IN LOC IN R(X), DEC R(X)
```
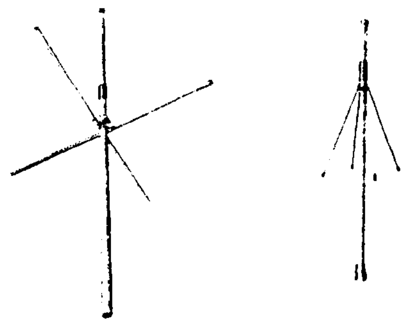

Monopole with Drooping Radials

With reference to (N3BEK's) letter in QEX July 1982 let me comment. The input impedance of a ground rod antenna is less than 50 ohms, and for commercial antennas two methods are used to raise the feedpoint impedance. In one the feed point is raised to point where a good match to 50 ohms is reached, c.f. the SRL-217 antenna (Fig. 1). In another, the ground rods are bent back toward the feed line (also illustrated in Fig. 1).



SRL-217 **SRL-238**

Fig. 1 - Sinclair Omnidirectional Antennas

Why does this raise the impedance? One can answer this question by the following reasoning. The input impedance of a coaxial vertical (see Fig. 2) is about 72 ohms. Therefore, the impedance of an antenna with drooping radials can be about 50 ohms, i.e., less than 72 ohms and more than 36 ohms. The length of the ground rods for an antenna where the ground rods are in a horizontal plane should be approximately a quarter wavelength long. The ground rods in effect choke current flow on the sheath of the coax (radiating current). The length of the monopole is about 5% shorter than a quarter wavelength (for wire antennas). Therefore the ground rods will be about 5% longer than the radiator. When the ground rods are bent back, they become a part of the radiating antenna system carrying in-phase current. Their length will have to be shortened to maintain resonance by an appropriate antenna factor. Maximum shortening and optimum shielding of currents on the sheath of the feader coax will be achieved when the radials are dressed more-or-less parallel to the feedline, and a skirt wire connects their open ends.

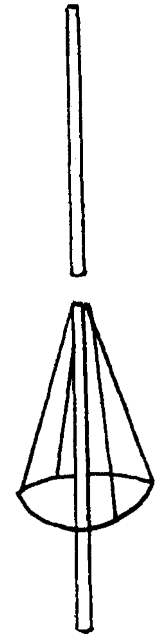


Fig. 2 - Coaxial vertical

The fact that you have obtained a good match (apparently to 50 ohms) for ground rods bent back is puzzling, but I suppose the explanation is as follows. Since you have used a feeder coax that is an integral multiple of a half wavelength, the impedance seen at the input to the coax is exactly that of the terminating impedance (which is the antenna). There will be no impedance transformation by the feeder even for unmatched conditions. Most transceivers will deliver maximum forward power at apparent low SWR even though the actual SWR (with reference to 50 ohms) is 1:1.5, provided there is no reactance which would necessitate retuning the pi-network of the transceiver. You may think you have a 50 ohm antenna, as judged by low SWR even though the actual impedance is not exactly 50 ohms.

If you read my article on the ribbon-J (see May 1982 issue of QST), you will note that for portable temporary antennas I recommend using a feeder coax that was cut to an integral multiple of a half wavelength. If the coax becomes a part of the tuned circuit, because the antenna is not matched exactly to 50 ohms, this increases the Q-factor of the system and complicates tuning.

Incidentally, with elevated feed the length of the radiator can be made longer than a quarter wavelength (e.g. a three-quarter wavelength antenna) and a gain of 2-3 dBd can be achieved (see Hatch, Struszynski and Thurgood, "The Marconi Eighth Aerial Adcock HF Direction Finder Type S-480," The Marconi Review, XXIX, 1-23, 1966). - John S. Belrose, VE2CV.

```
0ABC  F801        LDI   LOAD IMI 01, INC R(P)+1
0ABE  56          STR   STORE D IN LOC IN R(6)
0ABF  3011        BR    SHORT BR TO 0A11
0AC1  16          INC   INC R(6)
0AC2  94          GHI   LD D WITH MSB OF R(4)
0AC3  56          STR   STORE D IN LOC IN R(6)
0AC4  F886        LDI   LOAD IMI 86, INC R(P)+1
0AC6  A6          PLO   PUT D INTO LSB OF R(6)
0AC7  46          LDA   LD D FM LOC IN R(6) AND INC R(6)
0AC8  B9          PHI   PUT D INTO MSB OF R(9)
0AC9  06          LDN   LD D FM LOC IN R(6)
0ACA  A9          PLO   PUT D INTO LSB OF R(9)
0ACB  3013        BR    SHORT BR TO 0A13
REM  RESET TO MAIN XMT BUFFER
0ACD  F81F        LDI   LOAD IMI 1F, INC R(P)+1
0ACF  57          STR   STORE D IN LOC IN R(7)
0AD0  E7          SEX   R(7) IS DATA POINTER
0AD1  66          OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0AD2  27          DEC   DEC R(7)
0AD3  94          GHI   LD D WITH MSB OF R(4)
0AD4  57          STR   STORE D IN LOC IN R(7)
0AD5  29          DEC   DEC R(9)
0AD6  3013        BR    SHORT BR TO 0A13
0AD8  07          LDN   LD D FM LOC IN R(7)
0AD9  3A7A        BNZ   IF D NOT 0  SHORT BR TO 0A7A, ELSE INC R(P)+1
0ADB  F81B        LDI   LOAD IMI 1B, INC R(P)+1
0ADD  57          STR   STORE D IN LOC IN R(7)
0ADE  E7          SEX   R(7) IS DATA POINTER
0ADF  66          OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0AE0  30D5        BR    SHORT BR TO 0AD5
0AE2  8E          GLO   LD D WITH LSB OF R(E)
0AE3  A9          PLO   PUT D INTO LSB OF R(9)
0AE4  42          LDA   LD D FM LOC IN R(2) AND INC R(2)
0AE5  B9          PHI   PUT D INTO MSB OF R(9)
0AE6  15          INC   INC R(5)
0AE7  15          INC   INC R(5)
0AE8  D4          SEP   R(4) IS PROGRAM CTR
0AE9  07          LDN   LD D FM LOC IN R(7)
0AEA  3A11        BNZ   IF D NOT 0  SHORT BR TO 0A11, ELSE INC R(P)+1
0AEC  F81B        LDI   LOAD IMI 1B, INC R(P)+1
0AEE  57          STR   STORE D IN LOC IN R(7)
0AEF  E7          SEX   R(7) IS DATA POINTER
0AF0  66          OUT6  LOC IN R(X) ON BUS, INC R(X), I/O-#=6
0AF1  30E2        BR    SHORT BR TO 0AE2
0AF3  73          STXD  STORE D IN LOC IN R(X), DEC R(X)
0AF4  26          DEC   DEC R(6)
0AF5  30BA        BR    SHORT BR TO 0ABA
0AF7  ##                RESERVED
0AF8  ##                RESERVED
```

Tactile Transducer for Cw

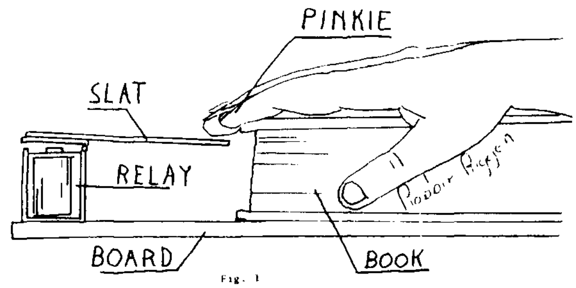


Fig. 1

By T. K. Riggen,* W1HFZ

Any idea that works should be published in the literature, patented or marketed. The device described here may be fifty years too late to be widely accepted, but it may be useful to a small segment of the ham population. If you or a friend are a confirmed cw operator and your hearing is impaired, and you don't like the thought of staring at blinking lights, read on. If you just like gadgets for their own sake, this one can be built from the junk box in an evening.

Mount a relay (with its contacts removed) on a board as shown in Fig. 1. Extend the armature with a tongue depressor or a strip of metal out past the hinge. Lay your hand on the "hand book" (hence the name!) so that the balls of your fingers are above, but not touching, the armature extension. When the relay closes the extension will rise up and touch your fingers, which have the most closely spaced tactile nerves you have. If the relay operates in response to cw you will be able to tell a "dit" from a "dah" on the first try.

*87 Donegal Circle, Centerville, MA 02532.

You will find that you can read cw at about half of your regular speed on the first try, and it won't take much practice to get to full speed. Your hand already "knows" the code. Reading by contact rather than pressure change is more effective, so adjust the relative height of the relay and your fingers accordingly. If you like to "pencil copy" or if you work with rapid break-in, position the device to be read by your non-dominant hand.

Most of the receivers on the market have at least two watts of audio output which is enough to work a good relay. A speaker transformer can be used backwards to match the speaker jack to the relay. A bridge rectifier and a small capacitor will stop the jitters by removing the audio tone from the relay coil. This will improve readability above ten or twelve words per minute. If the "clack" of the relay bothers you, deaden it with rubber tape between the armature and the pole.

I would be interested to know how you make out with this, particularly if you are hearing impaired. I would be very pleased if this helped one hearing-impaired cw operator stay on the air.

I would like to thank my 11-year-old grandson, Robbie, for the sketch in Fig. 1.

Microphone and Power Connector Standards
(continued from page 1)

a 3-wire (grounded) ac connector with rectangular pins. These connectors are as standardized in Publication 22 of the International Commission on Rules for the Approval of Electrical Equipment (CEE).

The most widely used of the CEE-22 types

The type illustrated above is UL and CSA recognized for use up to 20 amps but is limited to 6 amps, 250 volts at 65 degrees C by European standards agencies. The chassis receptacles are available in various configurations including with built-in power-line RFI filters and 115/230-V switches. One company, Panel Components Corporation of Santa Rosa, CA specializes in cable assemblies with the CEE-22 sockets on one end and a choice of U.S. and foreign ac plugs. CEE-22 sockets with RFI filters have started showing up at hamfests, making them available at low cost for home-brew projects.

QEX will welcome articles which research the Amateur Radio equipment microphone and power supply connector problem. Also I would like to invite articles which propose specific standards for consideration by the readership and those tasked by the ARRL Board of Directors to come up with recommendations. Authors should consider various aspects of the problem such as:

(a) the connectors and pin assignments in current use;

(b) connectors standard(s) for new equipment;

(c) retrofitting old equipment;

(d) provision for options and flexibility;

(e) economic (or other) impact; and,

(f) how to get manufacturers and individual amateurs to pay any attention to the standards once adopted.

If you feel that what you have to say on this subject is better put in a letter to the ARRL General Manager, please send a copy to QEX. Also, if you elect to send correspondence to the Chairman of the Emergency Communications Advisory Committee, please keep QEX readers in mind. - W4RI.

Data Communications

Conducted by
David W. Borden,* K8MMO

While my various data-communications-oriented friends around the country debate the best way to internet our various metropolitan area networks (MANs), I cast about for some programming that I could do without wasting effort on code that might be thrown away with the next network conference decision. The East Coast seems to be firming up on AX.25 (Amateur X.25 Protocol) for the metropolitan area networks. The Tucson Amateur Packet Radio group is using an implementation of IEEE 802 (another MAN standard) and promise to do an X.25 interface. So, I looked towards applications. Our local MAN lacked a computer. When a computer is available to users of a MAN, it is referred to as a host. Each user attaches his terminal to a packet assembler/disassembler (PAD), alternatively called a terminal node controller (TNC). The user establishes a virtual connection to the host computer and computes. What could he accomplish by doing this?

Applications for a Host Computer

1. Mailbox (leave a message for someone who will pick it up at some later time)

2. Games (play a game with the computer, such as Adventure, Chess, Monopoly, Space Paranoids, etc.)

3. Teleconference (hold a roundtable digital QSO while editing a document)

4. Calculate (run a program to figure antenna dimensions or propagation or active filter component values or whatever)

5. User Competition (a game between users in which the computer acts as a scorekeeper only or provides the rules and game setting acting as a referee)

6. Simulation (users activate the computer to load the MAN with packets at some given rate simulating many independent QSOs and then users change their protocol time delay parameters to maximize thruput)

7. Data Bank Access (computer provides large storage access of desirable data)

It appeared I had a reasonable idea since I could demonstrate some of the above applications using just my normal hamshack computer, an S-100 system with dual floppy disk drives. I would connect the computer to my PAD (running slightly modified Vancouver software) and let users of the local MAN test the system.

There also appeared a local opportunity to demonstrate packet radio technology to uninitiated civilians at a local community get-together. There would be normal ham radio activities (voice communications on hf) demonstrated and just dualogue (two amateurs engaged in digital communication) seemed a rather mundane demonstration. It was suggested that if my S-100 computer could be running an Adventure program, a packet station at the demostration site could play the game remotely. This seemed an interesting challenge, so I proceeded to connect my S-100 computer to my PAD.

From our San Francisco friends, host software was provided by an assembly time option. By setting a software switch True, the Vancouver PAD software allowed communication with a computer on the terminal side. Where you would normally connect a terminal, you connected a cable to a serial port on your host computer. RTS (request to send) and CTS (clear to send) handshaking signals are required (normally not required for terminal connection to the PAD). I examined the software to observe what made a host different from a terminal.

First, I removed the sign-on message normally printed on the user's terminal at reset time. My host computer did not desire to see any sign on trivia about the version of software. Next, I removed the dialogue between the user and the PAD concerning the cw i-d speed. The line (modem side) would always be 1200 baud, so only one cw i-d speed would be required. While I was changing everything, I turned the echo off. My host computer knows what it sent and needs no reminder.

Then I encountered the code provided by Hank Magnuski, KA6M, to handle the host mode. It concerned the packet terminator.

Normally, under the Doug Lockhart (VE7APU) design, packets are terminated by a line feed character being typed at the terminal. Under the modifications added by Calvin Teague, K6HWJ, a carriage return may be caused to automatically be followed by a line feed and thus none need be typed on the terminal. But, if a host computer is doing the sending requiring packetizing by the PAD, then a packet must be terminated every time the computer program running in the host expects user input (we must remember here where the user is - at the other end of this link). For example, I run the CP/M operating system. It expects input after the output of a forward arrow (>). So a forward arrow must be a packet terminator. Various CP/M utility programs expect input after a colon (:) or a question mark (?), so they must be added to the terminator list. These new terminators were added to the list by Hank and cover most situations. If the computer is expecting input from the user and none is received because the prompt from the computer did not terminate a packet which the user did not get to know he needs to supply input, we have a Catch-22 situation.

These changes were made by assembly time switch option and new PROMs were burned for my PAD the day before the demonstration. Some testing was done, but no stress testing was possible to simulate the conditions of the demonstration (does anyone ever stress test prior to the required working of a device?).

The demonstration worked, but several drawbacks were noted. When the rf link was good, the host hookup worked well. When the link degraded, the wait for an answer from the host took forever to get across. The 1200-baud link speed was too slow.

Normally, if more than 128 characters are sent from a terminal, a packet is terminated and a new one begun. For the host mode, that limit was lowered to 64. It appears a good number might be 5. More experimentation needs to be done in this area.

It should appear to the user that no hardware is between the user terminal and the host computer. Possibly the way to do this is to set a timer in the PAD so that if no character is received for two character times, a packet should be terminated.

A word should be said for the other digital users on the channel where a user-host virtual circuit exists. The San Francisco group has a lot of experience in this area. Basically, the host hookup hogs the channel, even given the time-division multiplex aspect of packeteering. The timers of the PAD (delay before transmit when channel clear) should be experimented with to allow the Dualogue users to coexist with the host users on a given channel. Increasing the speed would help.

*Route 2, Box 233B, Sterling, VA 22170,
703-450-5284 home.

Components

Conducted by Mark Forbes,* KC9C

The first item discussed this month is a component that seldom receives mention in the press but yet finds its way into most projects. This component is the venerable knob. I have seen some very nice projects turned into eyesores because old TV knobs or whatever were used. Buckeye is only one of many manufacturers, but they have an extensive line and a very nice catalog available.

Buckeye Knobs and Enclosures

The Buckeye Stamping Company has some of the nicest looking knobs and enclosures available. Buckeye's knobs are available in ten distinctive series and six different diameters. Included are round, pointer, skirted, concentric, bars and spinners. Just about any type of knob you might need is available.

Also available from Buckeye is a complete line of enclosures. All sizes are produced, including rack-mount styles. Accessories for the enclosures include printed-circuit mounting hardware, feet and front bails to elevate the front of the cabinet.

For more information, request a catalog from: Buckeye Stamping Company, 555 Marion Road, Columbus, OH 43207.

Panasonic Paper-Thin Lithium Batteries

An area that seldom receives much fanfare as advancing in the state of the art is battery technology. Lithium batteries have been around for many years but have had a few problems -- such as exploding in some instances! However, work has continued in the lithium battery area, and Panasonic has introduced an amazing battery product. These batteries are not only tiny in size but are inherently safe by design. The new batteries use lithium and polycarbon monoflouride as electrolytes instead of lithium-manganese dioxide used in older, potentially hazardous batteries.

The lithium battery has a terminal voltage of 3 volts, which means that one lithium battery can replace two carbon-zinc cells. In terms of efficiency, lithium batteries have an energy density (per volume) of 5 to 10 times that of carbon-zinc cells. Since the lithium cell contains no water, the conductivity of the battery remains good at very cold temperatures, unlike carbon-zinc or alkaline batteries.

*1000 Shenandoah Dr, Lafayette, IN 47905, 317-447-4272, 2300-0230 UTC weekdays, until 0230 weekends.

The Panasonic batteries are available in several sizes. A "half-postcard" size (70 x 94 x 1.8 mm) provides 3 volts and has a capacity of 1.5 Ah! Other sizes, such as the "business-card" size (350 mAh) and "chewing gum" (80 mAh) are available. For more information, write: Panasonic Industrial Co., Battery Sales Division, 1 Panasonic Way, Secaucus, NJ 07094.

Litton Trackball System

Did you ever wonder where those video game type trackball systems (as that on "Missile Command") could be purchased for inclusion in your latest amateur radio or computer project? Litton Industries, Encoder Division has several models available. The trackballs are supplied in a voltage range from 5 to 24 Vdc and several sizes. I don't have pricing on these, but I understand that they are not exactly cheap. If you want to know more about their trackballs, write to: Litton Industries, Encoder Division, 20745 Nordhoff St, Chatsworth, CA 91311.

ECL Voltage-Controlled Oscillators

Frequency Sources, Inc. has a series of four VCO chips available that cover many amateur frequencies. The KJ1000 series covers from 21 to 53 MHz. Other frequencies are said to be available upon request. The chips are packaged in 24-pin DIPs, operate on a single power supply, and feature low phase jitter, wide tuning range, fast tuning response and a stable +5 dBm output power. A super set of application notes is available from the manufacturer.

The following models are available for $22.80 each (single pieces): KJ1021 (21 to 30 MHz), KJ1025 (25 to 36 MHz), and KJ1030 (30 to 44 MHz).

More information is available from: Frequency Sources, Inc., Semiconductor Division, 16 Maple Rd, Chelmsford, MA 01824, 617-256-8101.

TI VLSI/LSI Telecommunications Catalog

A catalog of products relating to telecommunications is in its first printing from Texas Instruments. Included in the catalog are SLICs, tone encoders, ring detectors, CODECs (both u-Law and A-Law) and filters. To obtain a copy, ask for "VLSI/LSI Circuits for Telecommunications from Texas Instruments" at the following address: Texas Instruments, P.O. Box 225012, Dallas, TX 75265, 214-995-6531.

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The purposes of QEX are to:

1) provide a medium for the exchange of ideas and information between Amateur Radio experimenters,

2) document advanced technical work in the Amateur Radio field, and

3) support efforts to advance the state of the Amateur Radio art.

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