QEX November 45 1985 $1

The ARRL Experimenters' Exchange

RUDAK Lives

Acronym lovers, here's one more for you, this time German: RUDAK--Regenerating Transponder for Digital Amateur Radio Communications.

Two critical milestones in the development of the digital transponder for the AMSAT Phase 3C satellite have been reached.

On August 17, the RUDAK development team was successful in putting the prototype of the RUDAK processor into complete operation. It was wire-wrapped by K. Brenndoerfer, DF8CA.

An initial operating system (ROS-Rom), developed by S. Eckardt, DL2MDL, and G. Metz, DG2CV, permitted simple function tests of the RAMs and of both interfaces to the transponder and the on-board computer.

Using AMSAT command station DK1YQ, a command dialog was also successfully established, similar to the one already in longterm use with OSCAR 10.

The second great event was celebrated on the 6th and 7th of September. Using IPS (Interpreter of Processing Structures), Dr. Karl Meinzer, DJ4ZC, developed the main operating system for RUDAK (version IPS-CR) which used a core structured the same as in OSCAR 10, now in successful operation for over two years.

The complete schematic of the processor hardware is defined and now can be implemented. The software is now to the point at which everything else could be loaded in orbit if necessary. "Everything else" consists of applications programs for the AX.25sm pend. protocol and digipeater functions.

The engineering model of the L-band transponder, built by W. Haas, DJ5KQ, contains the RUDAK receiver and beacon.

Future efforts of the RUDAK team will be concentrated on producing a version for electrical and environmental tests, as well as two flight versions.

Concurrently, necessary equipment for the ground stations will be developed, so as to be able to carry out the required system tests at the end of the year. Ground station equipment consists of the RUDAK interface, the 2-meter/24-centimeter up-converter, and BPSK modulator. Schematics suitable for home brewing will be published well enough in advance so that everyone interested in RUDAK operation can be ready prior to the launch.

More information on the entire RUDAK experiment will be released in the near future. -- Hanspeter Kuhlen, DK1YQ

Call for Technical Articles

This is your Experimenters' Exchange, so if you have technical ideas to pass along to other experimenters, please send them to Editor, **QEX** at ARRL Hq. We also welcome letters for publication in the **QEX** Correspondence column. Technical inquiries published in **QEX** bring answers.

Opening in ARRL Laboratory

Are you interested in a lab engineer position at ARRL Hq? It would suit us just fine if you are intimately familiar with digital communications, RF/analog design, engineering staff studies, computer-aided printed-circuit design, tests and measurements, and feel that two weeks of brightly colored leaves in October justifies living in New England for the other fifty weeks of the year. A BSEE (BS in allied fields) or equivalent experience, a current Amateur Radio license, and writing ability are required.

If interested, please contact Technical Department Manager Chuck Hutchinson, K8CH. -- W4RI

Correspondence

Composition Resistor Gains Wide Recognition

* Albert Weller's article on, "Composition Resistors--Trimmed and Otherwise," in the July issue (no. 41), is quite interesting. In his experiments he rediscovered several problems with carbon composition (CC) resistors. Those wanting further information should reference Allen-Bradley's specifications (technical publication EC5021-2.1, February 1984).

CC resistors have poor humidity characteristics. As can be referenced on the data sheet in Fig. 1, the typical resistance tolerance is 0/+15%. This is a temporary change and can be removed by baking the resistors in a low-humidity environment. Thus, Mr. Weller's measurements of +8/+14% are within tolerance. I seriously doubt that his junk box CC resistors are much better!

Mr. Weller's test results for long-term humidity exposure are consistent with the CC specification of 0/+5% or so. I fully agree with his conclusions. The CC resistor should not be used in a precision application. The resistance is very susceptible to changes in humidity.

For precision applications at high frequencies, I recommend using metal film (MF) resistors which have a standard 1% tolerance. These are available from several of the surplus houses that advertise in **QST**. The chief concern with MF resistors is the inductance caused by the spiral cut to get the resistance on value. My experience with them is that this is a minor problem through at least the 2-meter band. I have built a number of attenuators that have at least 30 dB return loss through 2 meters. — Steve Lund, WA8LLY, 1055 Jennings Ave., Santa Rosa, CA 95401.

* With regard to the article, "Composition Resistors—Trimmed and Otherwise," it reminds me of when I was at the U.S. Air Force Academy during the mid-1960s. It was necessary for a group of us to sort a large quantity of resistors. The reason now escapes me, however, measuring each on a four-dial (Shalcross) resistance bridge was out of the question. We were not authorized a digital multimeter so we ordered a General Radio (now "Gen Rad") resistance limit bridge. This instrument was an accurate wheatstone bridge set up to display resistance tolerances. You simply dialed in the resistance value, plugged in the unknown resistor, and the meter would indicate the percentage and direction that the unknown resistor was deviating from the preset value.

With this instrument, we checked literally thousands of resistors, most of which were brown devils. The results? Resistors marked at 5% (gold band), were usually 10%. That is, their value fell between 5 and 10%, usually high in value. The same was true for the 10% values which were also usually high in values. We did not have enough 20% resistors to create any long-lived memory of their behavior. I feel the pattern would be the same.

Since the advent of the film resistor such as those available at Radio Shack™, I periodically measure these with a Fluke 3 1/2 digit, 0.1% digital multimeter. I find their values to be well within their prescribed tolerance.

During the mid-1970s, I began building RF step attenuators, using selected carbon composition resistors and the available film types. My findings were that the carbon type resistors were more unstable with soldering temperature, especially the 1/4 watt and smaller units. My biggest problem was frequency compensating the end product. Usually, if I didn't overheat any resistors, the attenuator came out within 1 dB per 10 dB step at audio (1000 Hz). If it came within 2 dB at 100 MHz, I was more than happy. My usage only required the signal to be attenuated; how much was relative, the more the better.

Mr. Weller mentioned to use only 1% resistors for RF work, yet he did not define the resistor's construction. Though I am from the old school, I know better, but I will bet that I can hand a 1% resistor that shouldn't be used above 10 to 20 kHz to a youngster and he would not know that it was wire wound. Or, that some are so called noninductive. The same applies to some of the earlier

Moisture Resistance [6.9] Temporary resistance change. See comment on Page 5.	Maximum		+15 / −0 %	+12 / −0 %	+14 / −0 %	+8 / −0 %	+7 / −0 %
	Typical		+9%	+6%	+7%	+5%	+4%
Humidity Characteristic (steady state) [6.10] 240 hours at +40° C and 95% relative humidity. Temporary resistance change. **Nominal Resistance** (ohms)	10	Maximum	+8 / −0 %	+5 / −0 %	+4 / −0 %	+3 / −0 %	+3 / −0 %
		Typical	+4%	+3%	+2%	+2%	+1%
	1000	Maximum	+9 / −0 %	+6 / −0 %	+6 / −0 %	+4 / −0 %	+4 / −0 %
		Typical	+5%	+4%	+4%	+2%	+2%
	100K	Maximum	+11 / −0 %	+9 / −0 %	+8 / −0 %	+5 / −0 %	+5 / −0 %
		Typical	+8%	+6%	+6%	+3%	+2.5%
	10 Meg. and 100 Meg.	Maximum	+13 / −0 %	+10 / −0 %	+9 / −0 %	+5 / −0 %	+5 / −0 %
		Typical	+9%	+8%	+7%	+3%	+2.5%

Fig. 1 — Performance characteristics courtesy of Allen-Bradley technical publication EC5021-2.1, February 1984.

versions of precision film resistors of the 1960-1970 era. These were made by depositing a resistance material on a ceramic type form. A spiral groove was then cut from one end to the other. The net effects were a single layer coil which made a fairly good resonant circuit at 2 to 200 MHz.

The next time you notch carbon resistors, may I suggest using a 1/8-inch or 3/16-inchrat-tail file. The reason is that the rounded groove will be considerably more free of physical stress. Of course, sealing with epoxy always helps. My last attempt at using a notched resistor was a complete failure as a result of component breakage. I had filed it too thin and had not used epoxy. The range of resistance values I measured ranged from 10 ohms to one megohm, and from a few to 10 megohms.

I hope this information has been of some value. What Mr. Weller has discovered about Ohmmite™ resistors has been going on for a long time. In the old days, most equipment could operate on 20% values. Today, technology has changed drastically, but Ohmmite is still building 10% and 5% resistors. Those companies who have set up to build film resistors (mostly off-shore firms), are building a much superior product all around. -- LeRoy E. Smith, WBØLTV, 238 South 5th St., Hot Springs, SD 57747.

Mr. Weller's Reply

Thank you for your letter. Your suggestion for using a rounded notch seems good, although I have not had trouble with breakage—only stability! As I indicated in my article, and inspite of the experience you relate, I am surprised by the degree of out-of-spec resistors I purchased. It remains true that the average composition resistor in my junk box is usually within the marked tolerance (just).

I have been impressed by the resistors sold by Radio Shack™ (which I assume to be metal film). While marked 5%, most that I have checked are within 2% of the marked value.

I never trimmed a metal film resistor by notching. I don't have any idea how they would respond and it is something I'd like to try.

My junk box contains a few of the spiral cut resistors. I obtained them in a "grabbag" years ago. They are of German origin and tend to be quite close to the marked value.

With reference to digital ohmmeters, I have been disappointed in their "real life" performance. Lead and contact resistances destroy their accuracy on the low ranges. I sometimes mount the resistor in a double banana plug and plug it directly into the DMM--which is a considerable improvement. However, I have built a four-lead ohmmeter attachment that, in connection with a Fluke 77, seems to do about as well as my wheatstone bridge. An LM317 is hooked up as a 100-mA current source and supplies current to the device through its own leads. The Fluke measures the voltage across the device using its leads as "potential" leads. The resistance is thus 10 times the voltage indicated by the Fluke and is not affected by reasonable contact resistances. It is quite possible to see the change in resistance as the potential tap is moved along the connecting lead of a 10-ohm resistor.

I might add that my bridge reads 0.0105 ohm when the unknown terminals are shorted by a heavy copper strap! -- Alber E. Weller, WD8KBW, 1325 Cambridge Blvd., Columbus, OH 43212.

New Subroutine for the IBM MINIMUF Program

I recently ran the IBM MINIMUF program (Nov. 1983, no. 21), on my IBM compatible AT&T 6300 computer. I found it interesting and informative. As the program already contains latitude and longitude information for the two station locations, I decided to add a couple of subroutines that would calculate and display the great circle compass bearing of the receiver with respect to the transmitter, and the great circle distance between them.

I have listed my subroutines and the minor changes I made in the original program to call them. Note that I chose to multiply all of the line numbers in the original program by a factor of ten. To restore the original line numbers, it is only necessary to drop the last zero. The 1/2^50 term in lines 3Ø2Ø and 3Ø7Ø eliminates division by zero that otherwise occurs in some special cases. I added lines 33ØØ through 336Ø to facilitate exit from the program. Fig. 2 shows a printout of a general case to show the appearance of these added data. -- George E. Stannard, KE1D, 3 Whitney Dr., Paxton, MA 01612.

```
135Ø IF LP=1 THEN 136Ø ELSE 14ØØ

14ØØ FL1=Ø:GOSUB 3ØØØ: REM ***CALC. OF BEARING AND
     DISTANCE***
141Ø GOSUB 32ØØ: REM ***PRINT BEARING AND DISTANCE
     ***
142Ø BEEP:BEEP:BEEP:BEEP:IF LP=1 THEN LPRINT CHR$(
     12)
143Ø GOTO 33ØØ: REM ***CHOICE OF CONTINUING PROGRA
     M***
146Ø REM ***MINIMUF 3.5 CALCULATION LOOP***

3ØØØ IF W1=W2 GOTO 31ØØ: REM ***SPECIAL GEOGRAPHIC
     CASES***
3Ø1Ø JJ=1/TAN((W1-W2)/2)
3Ø2Ø KK=(L2-L1)/2:LL=(L2+L1+1/2^5Ø)/2
3Ø3Ø PP=ATN(JJ*COS(KK)/SIN(LL)):QQ=ATN(JJ*SIN(KK)
     /COS(LL)):IF (L1+L2) < Ø THEN PP=PP=PI
3Ø4Ø XX=CINT((PP-QQ)/RO)
3Ø5Ø IF XX < Ø THEN 3Ø9Ø
3Ø6Ø W$="EAST OF TRUE NORTH."
3Ø7Ø DIS=CINT((138/RO)*ABS(ATN(TAN(KK)*SIN(PP)/SIN
     (QQ+1/2^50))))
3Ø8Ø RETURN
3Ø9Ø W$="WEST OF TRUE NORTH.":XX=-XX:GOTO 3Ø7Ø
31ØØ IF L1=L2 THEN FL1=1:GOTO 3Ø8Ø
311Ø IF L1>L2 THEN FL1=2 ELSE FL1=3
312Ø DIS=CINT ((ABS(L1-L2))*138/(2*RO)):GOTO 3Ø8Ø

32ØØ IF FL1=1 THEN PRINT"TRANSMITTER AND RECEIVER
```

```
     AT SAME LOCATION."
321Ø IF FL1=1 AND LP=1 THEN LPRINT"TRANSMITTER AND
     RECEIVER AT SAME LOCATION."
322Ø IF FL1=2 THEN PRINT"BEARING: DUE SOUTH";TAB(
     4Ø) "DISTANCE: ";DIS;" MILES."
323Ø IF FL1=2 AND LP=1 THEN LPRINT"BEARING: DUE
     SOUTH";TAB(4Ø) "DISTANCE: ";DIS;" MILES."
324Ø IF FL1=3 THEN PRINT"BEARING: DUE NORTH";TAB
     (4Ø) "DISTANCE: ";DIS;" MILES."
325Ø IF FL1=3 AND LP=1 THEN LPRINT"BEARING: DUE
     NORTH";TAB(4Ø) "DISTANCE: ";DIS;" MILES."
326Ø IF FL1=Ø THEN PRINT"BEARING: ";XX;" DEGREES
     ";W$:PRINT:DISTANCE: ";DIS;" MILES."
327Ø IF FL1=Ø AND LP=1 THEN LPRINT"BEARING: ";XX;"
     DEGREES ";W$:LPRINT"DISTANCE: ";DIS;" MILES."
328Ø RETURN

33ØØ PRINT:PRINT"YOUR CHOICE: (N)EXT CASE, QUIT TO
     (B)ASIC OR (D)OS?  HIT N, B, OR D."
331Ø NK$=INKEY$
332Ø IF NK$="" GOTO 331Ø
333Ø IF NK$="N" OR NK$="n" THEN CLS:GOTO 31Ø
334Ø IF NK$="B" OR NK$="b" THEN CLS:END
335Ø IF NK$="D" OR NK$="d" THEN CLS:SYSTEM
336Ø PRINT:PRINT"TRY AGAIN.":PRINT:GOTO 33ØØ
```

What's Happening With the ACSSB Boards?

I would like to know what frequency most of the ACSSB people are using. Are they rockbound, or do they use some sort of VFO? I saw WD4FAB's VCXO article in **QEX**, but I don't know if the frequencies he chose to use are compatible with what others around the country are using. Did he choose those frequencies purely for convenience in satellite operation?

Also, I am curious as to how many others have been able to get the ACSSB board running! I live in eastern Washington, a location that is surrounded by 1500-foot rock walls. If you have any information that you would like to share with me about the ACSSB project, drop me a line. — Cliff Appel, WB6AWM/7, P. O. Box 251, Electric City, WA 99123.

EMP and the Amateur

Re the correspondence on Amateur Radio and electromagnetic pulse (EMP) by N3NL in **QEX** issue no. 43, and the **QST** article in August of 1981 by AG3U, both these gentlemen present an interesting field of development by the radio amateur. Since the effects of an electromagnetic pulse attack would be felt by all users of electronic equipment, the commercial and military establishments must have already solved the ways to eliminate or minimize this problem. With all of the solid-state communication and control equipment in use, it would be interesting and enlightening if some ham/engineer in these fields would come forth in the pages of **QEX** with information and designs for the EMP protection of transceivers and computers. Before we take off at once in all directions, it would be nice to start from proven designs. With this in mind, we are going to have to stop looking at the yearly model changes of equipment built to "sales department specs." It costs a lot more to build or modify to commercial/military specs. Equipment improvements in this direction will go a long way to prevent spurious radiation into and out of these transmitters, receivers, computers, and so on, in this urban electronically-saturated spectrum. This is a present plus consideration and one can always hope that we do not have to give the equipment the final EMP test. — Wayne W. Cooper, AG4R, 9302 NW 2nd Place, Miami Shores, FL 33150.

```
DATE: 20 AUG

KE1D LOCATION                                      to Paris LOCATION
 LATITUDE: 42.3   LONGITUDE: 71.9                   LATITUDE: 49   LONGITUDE:-2

SUNSPOT NUMBER = 45.39

MUF(MHz)   UTC   0    5    10   15   20   25   30   35   40   45   50   55
========   ===   |====|====|====|====|====|====|====|====|====|====|====|=
    15.7     0   |               *
    14.4     1   |             *
    13.4     2   |            *
    12.5     3   |            *
    11.8     4   |           *
    11.6     5   |           *
    11.8     6   |           *
    13.5     7   |             *
    18.2     8   |                 *
    21.0     9   |                    *
    22.9    10   |                      *
    24.4    11   |                       *
    25.4    12   |                        *
    26.2    13   |                         *
    26.8    14   |                          *
    27.0    15   |                          *
    26.8    16   |                          *
    26.4    17   |                         *
    25.8    18   |                         *
    25.0    19   |                        *
    23.9    20   |                       *
    22.4    21   |                     *
    20.2    22   |                   *
    17.1    23   |                *
                 |====|====|====|====|====|====|====|====|====|====|====|=
                 0    5    10   15   20   25   30   35   40   45   50   55
BEARING:  55  degrees east of true north.
DISTANCE:  3452  miles.
```

Fig. 2 — A display of what your MINIMUF data will look like after lines 33ØØ through 336Ø are added.

Diversity Receiver Systems

By William Conwell, K2PO
16th Floor, Willamette Center,
121 SW Salmon St., Portland, OR 97204

A simplified space diversity receiver system was recently the subject of U.S. Patent Nos. 4,495,653 to Hamada, and 4,499,606 to Rambo.

Space diversity receiving systems typically use two or more spaced apart antennas to minimize QSB on a received signal. The receiving apparatus automatically switches between these antennas as necessary to provide the strongest signal to the receiver output. Diversity systems are widely used in military and commercial radio systems where reliability or signal quality is critical, such as in military HF radioteletype and in the HF program links of major shortwave broadcasters from their studios to their worldwide transmitter stations.

Space diversity systems have typically included two RF/IF chains, connected together by a comparison-switching circuit after the IF stages. The receiver chain with the strongest IF signal is fed to a single audio chain. Applications of such systems have been limited by the cost and complexity of the duplicated stages.

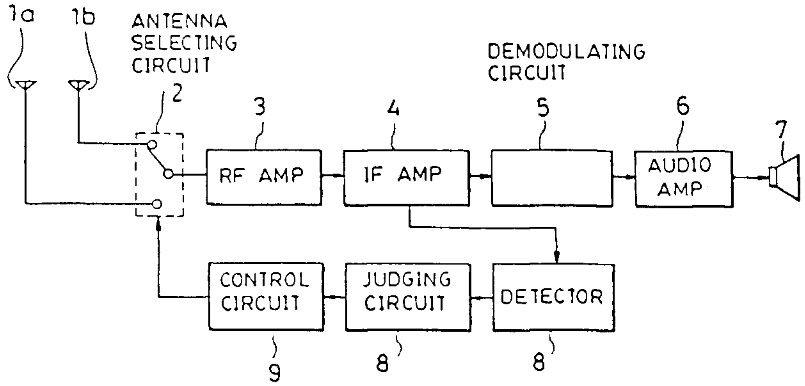
In the two patented diversity systems only a single RF/IF chain is used. The switching is accomplished between the front end stage and the two antennas. Instead of continuously comparing the levels of two actual received signals, as is done in prior systems, these inventions compare the IF signal strength produced by the presently-connected antenna with its time-averaged value. If the signal dips significantly below this average value, the front end immediately switches to the other antenna. It is statistically very unlikely that a propagation-induced fade will affect the two spaced apart antennas simultaneously, so the other antenna will likely be receiving a stronger signal and the fade will be avoided.

These inventions appear to have many applications in Amateur Radio. In addition to their historic use at HF to reduce ionospheric fading, they could also be used at VHF to reduce mobile flutter caused by multipath cancellation. (Suitable T/R switching, of course, would have to be provided for use with transceivers.) The systems' simple design and ease of attachment to existing receivers suggests that licensed versions of these products may soon appear as receiver accessories in the amateur marketplace.

Copies of these patents are available from the Commissioner of Patents, United States Patent & Trademark Office, Washington, DC 20231 for $1 each.

CAVEAT: "Whoever without authority makes, uses, or sells any patented invention, within the United States during the term of the patented invention therefor, infringes the patent." 35 U.S.C. 271.

Information on these patented inventions is printed herein in accord with **QEX**'s stated purposes of (1) providing a medium for exchange of ideas and information; (2) documenting advance technical work in the Amateur Radio field; and (3) supporting efforts to advance the state of Amateur Radio art. These particular inventions may not be practiced without a license from the owners until 17 years from their date of issue. Nonetheless, it is believed the publicity of such advances in the state of the art will broaden the perspective of amateur experimenters and promote future technical advances within the amateur community.



RTTY and CW With the Portable 100

By Louis C. Graue, K8TT
624 Campbell Hill Rd.,
Bowling Green, OH 43402

The TRS-80[R] Model 100 portable computer is the size of a notebook, yet a full-fledged computer. It has built-in software and hardware that make it ideal for use in the ham shack. Programs entered for CW, RTTY, filter and antenna design, beam headings, and even the station log can all be stored in memory. They remain there when the machine is turned off and can be recalled for use at the press of a key. The names of the stored programs appear on the LCD screen when the computer is turned on.

The Portable 100 uses a UART to send and receive serial data through the RS-232-C port. I thought that this would make it easy to write a short BASIC program to translate between Baudot and ASCII. To figure out how to program the UART from BASIC was difficult for me so I bought two books. The first was about the inner workings of the machine. I studied them for a couple of weeks. I also discovered that the serial communications line is interrupt driven. That is, whenever characters are ready to be received, the UART actuates an interrupt to a special routine to put the character in a buffer. To obtain input from the communications line, you check the buffer, not the UART directly. The keyboard is also interrupt driven, so you check its buffer and not the keyboard directly for entries.

After much study and experimenting, I finally figured out where these buffers were located and how to access them. The program is short and works well.

Features

The program presented here has the following features: It is written entirely in BASIC so it can be easily modified to fit your method of operating.

Shifting between send and receive is automatic. Keys pressed are transmitted if the Terminal Unit is in the transmit mode and anything being received automatically prints on the screen.

When you press the LABEL key, a display of what the F1 through F8 function keys do is printed on the screen above each key. The F1 key enables a string of RYs to be sent. F2 sends the ID, F4 sends a station equipment list, F5 sends CQ, F6 toggles between 60 and 100 words per minute, and F8 returns you to the MENU. The other keys are free for you to define.

Operation is possible at either 60 or 100 words per minute (WPM). The speed can be changed by pressing F6.

Anything you type between "[" and "]" becomes a leading part of the ID message. For example, if you were to answer a station for the first time, you would type '[WB8TLF] DE K8TT'. The square brackets are not transmitted, but tell the program to save the string between them to be used as the front part of the ID message. Thus, you only have to enter the other station's call at the start of each QSO.

The Portable 100 has a real time clock. This makes it possible to send DATE$ and TIME$ as part of the ID.

The Program

Remarks added to a line are intended to explain its purpose and you may omit them. Anything preceded by an apostrophe can be left out when you enter the program on your computer.

The initialization section defines the receive and transmit translation tables necessary for conversions between ASCII and Baudot. A quotation mark cannot be handled by the read data method so a special assignment for A$(49) had to be included. I prefer not to have received carriage returns and line feeds printed on the screen, but offer this option in line 15Ø. If you want them, remove the leading apostrophe in that line. The UART is programmed for a speed of 45.45 bauds (60 WPM), a word length of 5 bits, no parity, and 1.5 stop bits. The cursor is turned on. Finally, the initialization section enables the function key interrupt, defines the function key interrupt subroutines, and the labels for these keys.

The computer uses an internal interrupt routine to place data coming in the RS-232-C port into a 64-byte circular buffer which starts at address 65350. The number of bytes in the buffer is stored at address 65414. A pointer to the character to be read is kept at address 65415. The receive routine in our program reads this buffer. We keep track of the FIGURES-LETTERS shift with the variable R. It is zero for letters and 32 for figures. Adding R to the value of the Baudot character received locates the proper place in the Baudot to ASCII conversion table. After conversion, the character is printed on the screen.

The transmitting routine uses INKEY$ to get keyboard input. Only upper case letters and figures with ASCII values between 32 and 90, line feed, and carriage return are allowed to be transmitted and printed on the screen. A ROM routine at address 28210 is called to make the transmission of the character which has been converted to Baudot.

The send message routine displays and transmits any string set equal to M$. It also handles prepared messages.

Lines 53Ø and 545 contain the ID message and it should be changed to reflect your own version. Lines 555 to 59Ø contain the BRAG message. This should also be replaced to fit your situation. Lines 6ØØ to 62Ø contain the CQ message. Your call, name, and address will have to be substituted in place of mine.

The routine on lines 63Ø to 655 change the speed from 60 to 100 WPM, or vice versa, when the F6 key is pressed. Finally, the last line is called by pressing F8. It returns the LABEL line to the default condition, exits the program, and returns to the menu.

Interface

You will need a computer interface terminal that is RS-232-C compatible. The Heathkit HD-3030 or the Kantronics Universal Terminal Unit are two such units. I have a Flesher TU-170 which is only TTL compatible. This means that the I/O signals vary between about 0 and +5 volts. To be RS-232-C compatible, the I/O signals should vary between about -5 and +5 volts. I used a 1488 line driver and the 1489 line receiver chips obtained at the local Radio Shack[TM] store to modify the TU-170 for RS-232-C compatibility. See Fig. 1. These two chips are designed to interface the TTL and RS-232-C.

Use a DB25 male plug and two shielded wires such as RG-174 to make the connections between the Portable 100 and the TU. Pin 2 is used for transmitting and pin 3 for receiving on the RS-232-C connector. The shields are connected to pin 1. No other connections are necessary to run the program. It is easy to unplug so that you can take the Portable 100 out of the ham shack for other uses.

Modifications

The amount of typing can be reduced considerably by placing things sent frequently in the message section and then defining a function key to send it. If you have a printer hooked to the Portable 100, you can include an LPRINT line to send the text received to a printer. Also, you could add a PRINT# line to have text sent to a cassette or save the input to a text file in memory. The examples presented in the program will make it possible for you to easily figure out any modifications that you would like to make.

Operation of the Program

The best way to explain the use of the program is to take you through a typical operating sequence. First be sure that you have the CAPS LOCK key pressed or nothing will print. Only upper case letters are recognized by the program. RUN the program and tune the rig to a RTTY frequency. Set the terminal unit to transmit and push function key F4, which calls CQ. When that finishes, switch the TU to the receive mode and listen for a reply.

Suppose a reply comes from WB8TLF (Roy) in Toledo. Switch the TU back to transmit and press F1. This sends a string of RYs which makes it possible for Roy to adjust his receiver for best reception of your signal. Now type '[WB8TLF (ROY) IN TOLEDO] DE K8TT THANKS FOR THE CALL ----'. The square brackets will not print, but will save the string enclosed in the ID for later use. To send your BRAG message, press F5. To end this round, press F2 which sends the ID. Type 'K' and then switch the TU to receive.

Now that you figured out how it works, sit back, and put your feet up. With the Portable 100 on your lap, let your fingers do the talking. If you have any problems with the program and you think I may be of assistance, let me know.

References

[1] Morgan, C. L., **Hidden Powers of the TRS-80[R] Model 100**, The Waite Group, 1984.
[2] **TRS-80[R] Model 100 Technical Reference Manual,** Tandy Corporation, 1984.

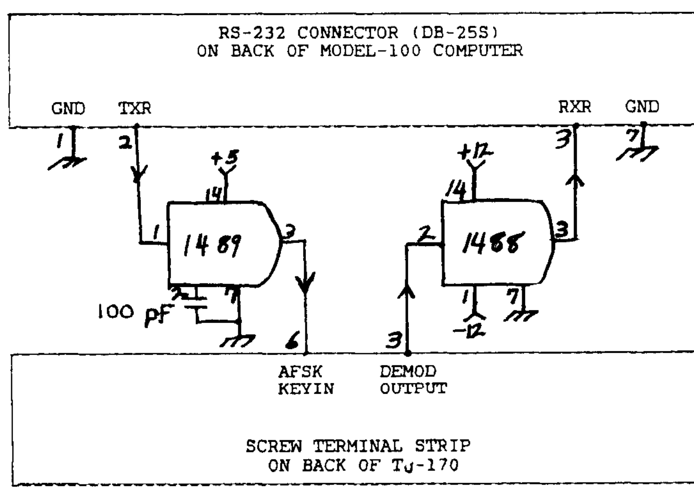
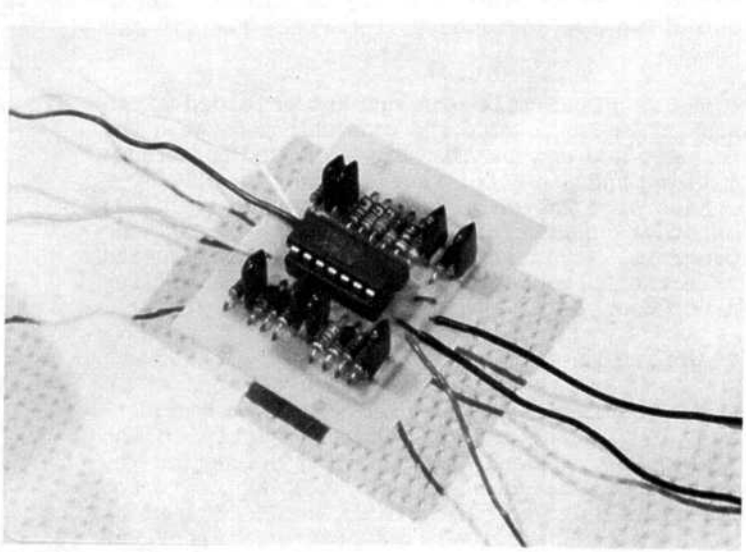


Fig. 1 — The Flesher Corporation TU-170 Terminal Unit. Connect the TU-170 to your transceiver as specified in the manual. The connections between the Model-100 RS-232-C port and the TU-170 screw terminal strip are shown.

```
100 'BASIC M100 RTTY - BY K8TT  1/28/85
105 '**********************************
110 '
115 'INITILIZATION
120 '""""""""""""""""""""""""""""""""""
125 CLEAR 1000
130 DEFINT A-Z:DIM A$(63),B(60)
135 SP=1 'SPEED 1 = 60,-1 = 100 WPM
140 FOR I=0 TO 62:READ A$(I):NEXT I
145 A$(49) = CHR$(34) 'QUOTE SYMBOL
150 'A$(2)=CHR$(10):A$(8)=CHR$(13)
155 FOR I=1 TO 57:READ B(I):NEXT I
160 OUT 189,77:OUT 188,51 '45.45 BAUD
165 OUT 184,195           'START TIMER
170 OUT 186,37            'OUT RS232
175 OUT 216,5'WORD LEN,PARITY,STOP BIT
180 CALL 28473 'INIT SERIAL BUF PARAMS
185 POKE 65346,0
190 POKE 65347,255 'SERIAL LINE ACTIVE
195 PRINT CHR$(27)+CHR$(80);'CURSOR ON
200 KEY ON 'ENABLE FCN KEY INTERRUPT
205 ON KEY GOSUB 515,530,,555,600,630,,665
210 KEY1,"RYRY":KEY2,"ID":KEY3,"     "
215 KEY4,"BRAG":KEY5,"CQ":KEY6,"60WM"
220 '
225 'RECEIVING ROUTINE
230 '""""""""""""""""""""""""""""""""""
235 R=0
240 N=PEEK(65414) '# BYTES IN BUFFER
245 IF N=0 THEN 300
250 POKE 65414,N-1 'DECREMENT # BYTES
255 A=PEEK(65350+PEEK(65415))'GET CHA
260 POKE 65415,(PEEK(65415)+1) MOD 64
265 IF A=27 THEN R=32:GOTO 240
270 IF A=31 THEN R=0 :GOTO 240
275 IF A=4 THEN R=0
280 A=A+R:PRINTA$(A);:GOTO 240
285 '
290 'TRANSMITTING ROUTINE
295 '""""""""""""""""""""""""""""""""""
300 X$=INKEY$
305 IFX$="" THEN 240 ELSE X=ASC(X$)
310 '[ ] USED TO ENCLOSE ID TO SAVE
315 IF X=91 THEN S=1:C$="":GOTO 300
320 IF X=93 THEN S=0:GOTO 300
325 GOSUB 330:GOTO 300
330 IF 31<X AND X<91 THEN PRINT X$;
335 IF31<XANDX<91ANDS=1THENC$=C$+X$
340 IFX=13THENPRINTCHR$(13)
345 IFX=13THENY=13:X=8:GOSUB 395
350 IFY=13THENX=2:GOSUB 395:Y=0:RETURN
355 IFX=32THENX=4:GOSUB 395:T=0:RETURN
360 IF X>90 THEN RETURN
365 IF X>64 THEN 385
370 IF X<32 THEN RETURN
375 IFT=0THENT=1:X=27:GOSUB395:X=ASC(X$)
380 X=X-6:X=B(X):GOSUB395:RETURN
385 IFT=1THENT=0:X=31:GOSUB395:X=ASC(X$)
390 X=X-64:X=B(X):GOSUB395:RETURN
395 CALL 28210,X:RETURN
400 '
405 'SEND MESSAGE ROUTINE
410 '""""""""""""""""""""""""""""""""""
415 Q=LEN(M$)
420 FOR L = 1 TO Q
425 X$=MID$(M$,L,1):X=ASC(X$)
430 GOSUB 330:NEXT L:RETURN
435 '
440 DATA  ,E," ",A," ",S,I,U," ",D
445 DATA R,J,N,F,C,K,T,Z,L,W,H,Y,P
450 DATA Q,O,B,G, ,M,X,V, , ,3," "
455 DATA -," "," ",8,7," ",$,4,"'"
460 DATA ",",!,":",(,5, ,),2,#,6,0
465 DATA 1,9,?,&, ,.,/,";"
470 DATA 3,25,14,9,1,13,26,20,6,11
475 DATA 15,18,28,12,24,22,23,10,5
480 DATA 16,7,30,19,29,21,17
485 DATA 13,17,20,9,0,26,11,15,18,0
490 DATA 0,12,3,28,29,22,23,19,1,10
495 DATA 16,21,7,6,24,14,30,0,0,0,25
500 '
505 'CANNED MESSAGES
510 '""""""""""""""""""""""""""""""""""
515 M$="":FORI=1TO20:M$=M$+"RY":NEXT
520 GOSUB 415:RETURN
525 '
530 D$=" DE K8TT (LOU) IN BOWLING GREEN, OHIO "
535 F$="EST = "+DATE$+" - "+TIME$
540 M$=CHR$(13)+C$+D$+CHR$(13)+F$+CHR$(13)
545 GOSUB 415:RETURN
550 '
555 A1$=CHR$(13)
560 B1$="RIG: HEATH - SB104A - SB230"
565 C1$="ANT: TH6DXX AT 40 FT. - INV V ON 40 M."
570 D1$="RTY: TRS-80 MDL 100 - HOMEBREW PROG."
575 E1$="JOB: MATH PROF AT BGSU."
580 F1$="HOB: COMPUTER - ELECTRONICS - GARDENING"
585 M$=A1$+B1$+A1$+C1$+A1$:GOSUB 415
590 M$=D1$+A1$+E1$+A1$+F1$+A1$:GOSUB 415:RETURN
595 '
600 E$=CHR$(13)
605 Q$="":FORI=1TO13:Q$=Q$+"CQ ":NEXT
610 K$=" DE K8TT K8TT K8TT K8TT K-K-K"
615 M$=E$+Q$+K$+E$
620 GOSUB 415:RETURN
625 '
630 SP=-SP
635 IF SP<0 GOTO 650
640 OUT 189,77:OUT 188,51:KEY 6,"60WM"
645 OUT 184,195:RETURN
650 OUT 189,72:OUT 188,22:KEY 6,"100"
655 OUT 184,195:RETURN
660 '
665 CALL 23164,0,23366:CALL 27795:MENU
```



Type CW on the Model 100

The program presented here has the following features:

* The transmitter is keyed through the RS-232-C interface Data Terminal Ready (DTR) signal on pin 20 using a simple interface.

* The function keys are used to reduce the amount of typing. The LABEL key calls and lists the key functions above each key.

* F6 is used to toggle between speeds of 10, 15, and 20 WPM. Speeds can be changed while sending.

* Input and output speeds are independent so that you can type well ahead of what is being transmitted. Two cursors appear on the screen. One indicates which character is being transmitted, while the other is for keyboard input.

* The ESC key can be used to clear the screen, the buffer, or to stop output at any time.

* The other station's call need be entered only once. The entire ID with the other operator's call and yours is sent merely by pressing F1.

* Your QTH is sent by pressing F2, and station equipment is described by using F3. F5 sends CQ, thus most of those things hams send on every QSO are sent via a few key strokes. They appear on the screen in proper sequence, and the output cursor informs you of what letter is being sent.

* The BKSP key is used to edit anything on the screen that has not yet been transmitted.

* The program is short and written entirely in BASIC so it can be easily modified. It is saved in memory and is available to operate immediately after the computer is turned on.

Operation

Type in the program as listed, making the following changes. Change line 274Ø to hold your call sign and not mine. Change line 3ØØØ to display your QTH and name. Change line 338Ø so it has a description of your station.

After entering the program, be sure to type 'SAVE"CW"'. This saves it in memory. The MENU displays CW.BA when the computer is turned on.

To explain the use of the program, I will run through a sample session. First I turn on the computer, place the cursor on top of CW.BA and press ENTER. The screen clears and the cursor appears in the upper left corner. I call CQ by pressing function key no. 5.

Suppose WB8TLF answers. Since I like to start with a clear screen I press the ESC key. Then I type '['. This character will not appear on the screen, but will save whatever I type afterwards up to the first character space. I type "[WB8TLF" and press the space bar. WB8TLF will be sent out to the transmitter and the output cursor moves across it as it is sent. Now press F1. "WB8TLF DE K8TT" will appear on the screen to be transmitted. Next press F2. This prints, in sequence, "TNX FOR CALL - YOU ARE 599 ? 599 IN BOWLING GREEN, OHIO ? BOWLING GREEN, OHIO - NAME IS LOU ? LOU - HW COPY?". By depressing F1 again, "WB8TLF DE K8TT" prints again. Next type "KN". This turns the contact over to the other operator. Notice that little typing was necessary for the entire first round of the QSO.

During my next round, I start by pressing F1 to send the ID sequence. While this is being sent, I can type ahead and even pause to think of what I'd like to say.

You can also keep a text file called LOG.DO in memory. After the contact, log the information there. A 'FIND' key is available for text files. Press it and type a string you wish to find. In a matter of seconds you can locate any past contact. Dump this file to a printer for a hard copy record.

Since programs and text files all reside in memory, you can quickly and easily move from one project to another. Typing F8 takes you back to the MENU where you can select the LOG.DO file and log the station contacted while the operator is sending to you. Or, you could research the call to see if you have QSOd before! Then by selecting CW.BA, you will be ready to transmit well before it is your turn to respond.

Interface to the Transmitter

Pin 20 of the RS-232-C connector is the DTR signal. Normally it is at -5 volts. It can be changed to +5 volts by the BASIC statement "OUT 178,0", and back to -5 volts by the statement "OUT 178,64". You will notice that these statements are used in the program for output. The program assumes that the statement "OUT 178,0", which produces +5 volts, will turn on the transmitter. For many solid-state transmitters, it is only necessary to ground the key line. Fig. 2 shows the interface circuit I use to connect my model 100 to the Heathkit SB104 key line. It consists of a 2N2222 type transistor, a 1N914 diode, and two resistors. The +5 volts allows the transistor to conduct and thus ground the key line. This information should make it possible for you to construct the proper interface for your transmitter.

```
1000 'CW KEYBOARD FOR THE PORTABLE 100
1020 'BY K8TT (4/8/85)
1040 '
1080 CLEAR 2000
1100 SP=0
1120 DIM C$(47)
1140 FOR I=1 TO 47:READ C$(I):NEXT I
1160 CLS
1180 PRINT CHR$(154);
1200 OUT 178,64
1220 F=0:E=0
1240 BF$=""
1244 KEY ON
1246 ONKEYGOSUB3340,3000,3380,,2740,2540,,3330
1250 KEY1,"ID":KEY2,"QTH":KEY3,"RIG"
1252 KEY4,"MESS":KEY5,"CQ"
1254 KEY7," ":KEY8,"QUIT"
1256 IFSP=0THENKEY6,"20WM"ELSEIFSP=20THENKEY6,"15WM"ELSEKEY6,"10WM"
1300 GOSUB 1400
1320 GOSUB 1760
1340 GOTO 1300
1400 K$=INKEY$:IF LEN(K$)=0 THEN GOSUB 3120:RETURN
1402 IF ASC(K$)=8 THEN GOSUB 2860:RETURN
1404 IF ASC(K$)=27THENGOTO1160
1406 IFK$="["THENID$="":C%=1:RETURN
1420 K%=ASC(K$):IFK%<>32 AND(K%<44ORK%>90)THEN3120:RETURN
1640 PRINT@E,K$;
1644 IF E<>278 THEN PRINT CHR$(154);ELSEPRINT@0,CHR$(154);
1646 E=E+1:IF E=279 THEN E=0
1660 IFC%=1THENID$=ID$+K$:IFK$=" "THENC%=0
1680 BF$=BF$+K$
1700 RETURN
1760 IF BF$="" THEN RETURN
1780 O$=LEFT$(BF$,1)
1800 PRINT@F,CHR$(255);
1820 IF O$=" " THEN GOSUB 2380:GOTO 1900
1840 CW$=C$(ASC(O$)-43)
1860 FOR J%=1TOLEN(CW$):IFMID$(CW$,J%,1)="-"THENGOSUB 2140ELSEGOSUB 2000
1880 NEXT:GOSUB 2280
1900 PRINT@F,O$;:F=F+1:IF F=279 THEN F=0
1920 BF$=RIGHT$(BF$,LEN(BF$)-1)
1940 RETURN
2000 OUT 178,0
2020 GOSUB 2460
2040 OUT 178,64
2060 GOSUB 2460
2080 RETURN
2140 OUT 178,0
2160 FOR D%=1 TO 3:GOSUB 2460:NEXT
2180 OUT 178,64
2200 GOSUB 2460
2220 RETURN
2280 OUT 178,64
2300 GOSUB 2460
2320 RETURN
2380 OUT 178,64
2400 FOR D%=1 TO 3:GOSUB 2460:NEXT:RETURN
2460 GOSUB 1400:FOR I%=1 TO SP:NEXT
2480 RETURN
2540 IFSP=0THENSP=20:KEY6,"15WM":RETURN
2560 IFSP=20THENSP=100:KEY6,"10WM":RETURN
2570 IFSP=100THENSP=0:KEY6,"20WM":RETURN
2640 SP=SP-10
2660 IF SP<0 THEN SP=0
2680 RETURN
2740 CQ$="CQ CQ CQ CQ CQ CQ CQ CQ DE K8TT K8TT K8TT K "
2760 BF$=BF$+CQ$
2780 PRINT@E,CQ$;CHR$(154);:E=E+44:IF E>319 THEN E=E-40:F=F-40
2800 RETURN
2860 IF BF$="" THEN RETURN
2880 PRINT@E,CHR$(32);CHR$(8);CHR$(8);CHR$(32);CHR$(8);CHR$(154);
2900 BF$=LEFT$(BF$,LEN(BF$)-1)
```

```
2920 E=E-1
2940 RETURN
3000 Q$="TNX FOR CALL - YOU ARE 599 ? 599 IN BOWLING GREEN, OHIO ? BOWLING
GREEN, OHIO - NAME IS LOU ? LOU - HW COPY? "
3020 BF$=BF$+Q$
3040 PRINT@E,Q$;CHR$(154);:E=E+109:IF E>319 THEN E=E-40:F=F-40
3060 RETURN
3120 FORI=1 TO 15:NEXT:RETURN
3280 DATA --..--,-....-,.-.-.-,-..-.,-----,.----,..---,...--,....-,.....
3290 DATA -....,--...,---..,----.,---...,-.-.-.,.........,-...-,.........,..-
-..,.........
3300 DATA .-,-...,-.-.,-..,.,..-.,--.,....,..,.---,-.-,.-..,--,-.,---,.--.
3320 DATA --.-,.-.,...,-,..-,...-,.--,-..-,-.--,--..
3330 CALL23164,0,23366:CALL27795:MENU
3340 S$=ID$+" DE K8TT "
3344 BF$=BF$+S$
3348 PRINT@E,S$;CHR$(154);:E=E+LEN(S$):IFE>319THENE=E-40:F=F-40
3352 RETURN
3380 R$=" RIG IS HEATH SB104A - 50 WATTS OUT TO BEAM ON 20 AND VEE ON 40 M
- TRS-80 MODEL 100 IS SENDING THE CW. "
3384 BF$=BF$+R$
3388 PRINT@E,R$;CHR$(154);:E=E+LEN(R$):IF E>319 THEN E=E-40:F=F-40
3392 RETURN
```

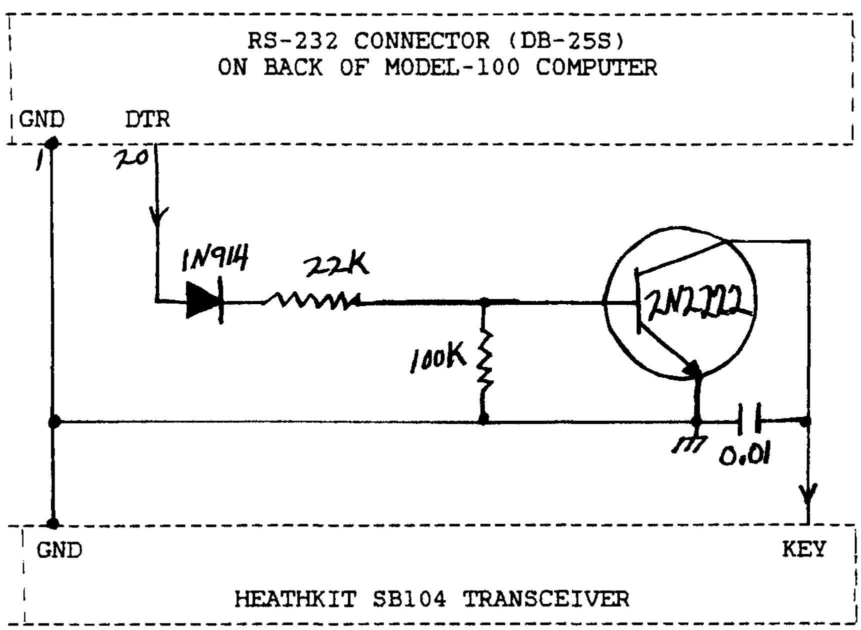


Fig. 2 — Interfacing the Model 100 with a Heathkit SB104 transceiver for sending CW. The transmitter is turned on by +5 volts at pin 20 (DTR) of the RS-232-C port of the computer.

QEX: The ARRL Experimenter's Exchange is published by the

American Radio Relay League
225 Main Street
Newington, CT 06111 USA
telephone 203-666-1541

Larry E. Price, W4RA
President

David Sumner, K1ZZ
Executive Vice President

Paul L. Rinaldo, W4RI
Editor

Maureen Thompson, KA1DYZ
Assistant Editor

Geoffrey H. Krauss, WA2GFP (VHF+ Technology)
Associate Editor

Lisa Fuini
QEX Circulation

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.

Subscriptions are available to ARRL members and non-members at the rates shown on the QEX Subscription Order Card inside this issue.

All correspondence concerning QEX should be addressed to the American Radio Relay League, 225 Main Street, Newington, CT USA 06111. Envelopes containing manuscripts and correspondence for publication in QEX should be marked: Editor, QEX. QEX subscription orders, changes of address, and reports of missing or damaged copies may be marked: QEX Circulation. Members are asked to include their membership control number or a label from their QST wrapper when applying.

Both theoretical and practical technical articles are welcomed. Manuscripts should be typed and double spaced. Please use the standard ARRL abbreviations found in the January 1984 edition of QST. Authors should supply their own artwork using black ink on white paper. When essential to the article, photographs may be included. 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 it will be when printed in QEX.

Any opinions expressed in QEX are those of the authors, not necessarily those of the editor or the League. While we attempt to ensure that all articles are technically valid, authors are expected to defend their own material. Products mentioned in QEX are included for your information, not advertising, nor is any endorsement implied. The information is believed to be correct, but readers are cautioned to verify availability of the product before sending money to the vendor. Material may be excerpted from QEX without prior permission provided that the original contributor is credited, and QEX is identified as the source.

QEX: The ARRL
Experimenters' Exchange
American Radio Relay League
225 Main Street
Newington, CT USA 06111

Nonprofit Organization
U.S. Postage
PAID
Hartford, Conn.
Permit No. 2929