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QEX 106 WITH Gateway

ARRL Experimenters' Exchange

DECEMBER 1990

FLAME ON. FLAME OFF. An introduction to flaming in *Gateway*.

EX: The ARRL
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merican Radio Relay League
25 Main Street
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Non-Profit Org.
US Postage
PAID
Hartford, CT
Permit No. 2929

QEX (ISSN: 0886-8093) is published monthly by the American Radio Relay League, Newington, CT USA.

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

Subscription rate for 12 issues:
In the US by Third Class Mail:
ARRL Member $12, nonmember $24;

US, Canada and Mexico by First Class Mail:
ARRL Member $25, nonmember $37;

Elsewhere by Airmail:
ARRL Member $48, nonmember $60.

QEX subscription orders, changes of address, and reports of missing or damaged copies may be marked: *QEX* Circulation.

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

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Empirically Speaking. . .

Fall 1990 *QEX* Reader Survey Results

First I'd like to thank those of you who took the time to return the survey; we've received just shy of 300 responses, about 5%. The results are below.

What do you like/dislike about *QEX*?

This is one of those "six-of-one, half-dozen-of-the-other" type questions. Likes *and* dislikes both include: Gateway; fairly technical information; digital modes; current topics and details; UHF/VHF; microwave; packet; computers; constructions articles; experimental in nature; satellites; VHF+ Technology; and, Components. What one *did not* like, another *did* like. At least it seems that everyone is happy with something we're doing.

A few said that *QEX* was just the right size—easy to read in a short time. Some would like to see *QEX* in *QST*. Most, however, would like to see *QEX* expanded. With your input, we can be on the lookout for more of what you want and solicit articles in your areas of interest.

Another notable "dislike" (or maybe it's a "like") is the editing/technical accuracy style. *QEX* is intended as an experimenters' exchange. Articles are accepted based on the idea that it could/should work. A limited amount of editing is done to the original manuscript. We've found that ideas and meaning are often changed with editing, so we err on the side of too little editing. Projects are not built and tested (at ARRL) before publication. The idea is to experiment. If there's a problem, the author is the contact person. Suggestions or improvements, etc, can be made via our Correspondence column—correspondence is always welcome.

What would you like to see in *QEX*?

There's a variety of topics you'd all like to see more of. They include: VHF; UHF; microwave; DSP; digital applications; spread spectrum; ATV; and, satellites. Construction is high on the list (beginner through expert levels), for both long-term and weekend projects. Practical theory and design, tutorials, and short "hints-and-kinks" type items are also being requested.

Now that word is out on what you want, let's get going. Don't leave it up to someone else; if you're working on something, have any interesting ideas, or if you've seen an article somewhere else that you think should be in *QEX*, send it in.—*LJW*

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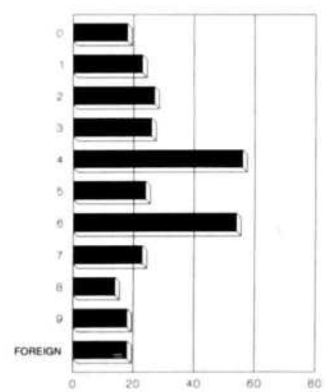

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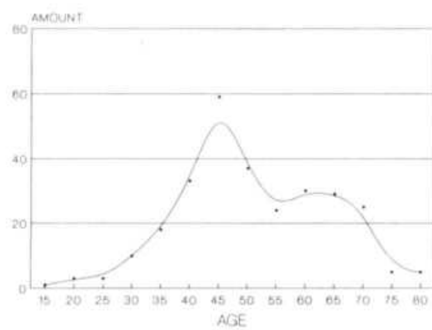

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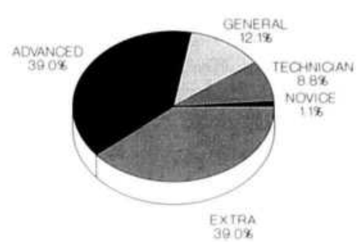

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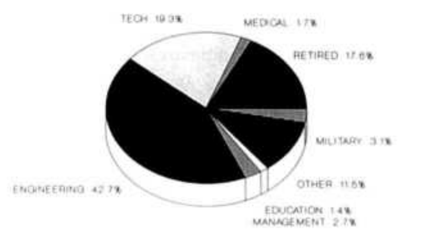

Graphs continued on page 16.

Faster Synchronizing for Mode B AMTOR

By Jerry W. Egleston, Sr., WAØSVG
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Independence, MO 64057

Introduction

Tuning onto a Mode B AMTOR transmission that is underway can be a puzzling experience. Some transmissions seem to grind on and on before any printing occurs. Sometimes just as a terminal synchronizes, the sending station sends the end of transmission sequence and the terminal switches to standby, resulting in no printing at all. This happens most often when tuning across somebody calling CQ.

CQ is frequently called by sending a message stored in a computer buffer. The operator hits a key, sits back and waits for the buffer to empty. Depending upon the terminal or TNC, the entire contents of the buffer may be sent without any idle characters. Since most terminals require idles for synchronizing, nothing is printed by stations tuning onto the signal.

Some TNCs automatically interrupt the buffer sending and place idle characters in the data stream at fixed intervals.[1] With this feature, the likelihood of every receiving station printing something is increased. Informed operators might send a series of short buffers, pausing in between to allow some idle characters to be sent. But, there is no standard. CCIR Recommendation 476-3 requires only an initial minimum of four pairs of idle characters for synchronization.[2] Thereafter, in theory at least, one could send forever without using any more idle characters. I decided to search for an alternate method of synchronizing Mode B signals, one that doesn't require idle characters.

Qwikstart is the name I have given to a procedure that rapidly synchronizes a data receiver for Mode B AMTOR reception. Qwikstart works with or without the reception of idle characters to permit printing almost immediately upon properly turning in the signal. This article will describe the method I derived.

Basic Principles

To achieve this task an alternate way of recognizing an in-sync condition is needed. Ordinarily, the data receiver hunts for the idle sequence and locks on.[3] A look at the FEC protocol gave me some clues:

1. Each valid character has exactly four one bits and three zero bits.
2. Each valid DX character has itself repeated by an RX character. Four nonrelated characters separate the DX from its RX counterpart.

[1]Notes appear on page 4.

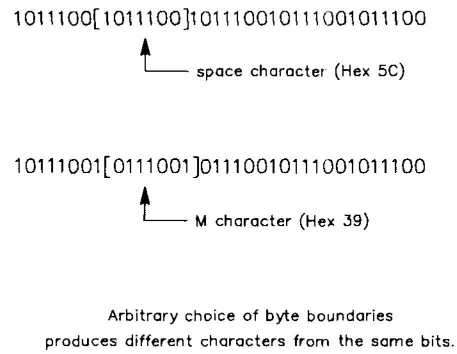


Fig 1

The solution seemed simple. One might search for these characteristics during the hunt phase of synchronizing.[4]

Working with Pseudo-Sync, my FEC terminal program for the Commodore 64™, I expanded the 7-bit shift register used in the hunt (phasing) procedure to 56 bits.[5] Stage one and six were compared for equal and valid AMTOR characters. All other stages were required to contain valid AMTOR characters. The method worked, but problems showed up occasionally.

False Start

Using signals from WOO, I soon discovered one of the fallacies in the procedure.[6] This method will not work reliably whenever several identical characters are received sequentially. For example, refer to Fig 1 where a series of bits are shown. When synchronizing, the byte boundaries are unknown. Guessing can produce seven different valid AMTOR characters. Of course, only one can be correct, but which one? The brackets show an arbitrary choice of boundary. Moving the brackets left or right, which simulates the hunting process, will demonstrate that the other choices are also valid characters. One other problem became apparent. The method can not differentiate between a DX and RX character when several identical characters occur sequentially. Clearly, a better procedure was needed.

Looking for a Better Way

I reasoned that it made better sense to hunt for a specific character, one that occurs frequently, and then to check for its RX counterpart. Somewhere I read that the most commonly used letter in the English language is "E." However, it occurred to me that the most commonly used character in printed text language is probably the space. To investigate this, I wrote a BASIC program to read several text files and compute the probability of each character's occurrence. My hunch was confirmed. The space character occurred almost twice as often as the letter "E."[7] So, I wrote the code to hunt for a space and its RX.

As previously described, all shift register stages must contain valid AMTOR characters. Also, I eliminated the usual requirement of waiting for the carriage-return line-feed sequence before printing can begin. This speeds things up considerably.

The method works very well. Some of the benefits of hunting for a space became apparent right away. The space is one of only a few characters that is likely to be repeated several times sequentially. By hunting specifically for the space, the procedure will not falsely line up on any of the six possible wrong characters caused by accepting a wrong byte boundary. Other characters that occur sequentially are ignored and produce no effect during the hunting process.[8] There remains no way to determine whether any one of several sequential spaces is a DX or RX character, however. Actually, there may be no way to determine absolutely whether any given space is an RX or DX character without idle characters for a reference.

Getting it Right

Fig 2 shows how a false sync point can result from this method. It is possible to detect a space character, search back five characters and find another space, and presume falsely that the first space is a DX. One way to reduce the probability of this happening is to compare the second and seventh stages of the shift register for a match as well as comparing the first and sixth stages. I did not include this in my procedure, but so far it has not caused any noticeable problems. Evidently, the probability of this occurrence is fairly low.

The easiest way to affirm the DX/RX relationship is with an idle character. So, I wrote the code to correct any problem with the first idle character received. In addition, if idles are received before the Qwikstart procedure synchronizes, the program will sync on the idles.

Conclusion

Implementing the code is straight forward using Pseudo-Sync because the CIA device driver is software based. However, implementing the procedure on a machine where the device driver is firmware based will be a bit trickier. These units commonly have an USART chip in which the length of the shift register for hunting is fixed, often at 8 or 16 bits. Although I have not tried it, I believe that a programmer with determination could get a similar procedure to run on these units as well.

Qwikstart is a statistical synchronizing method that works well, but not perfectly. As noted, false starts can occur during AMTOR reception, but false starts due to random noise may actually be less likely than with present methods.[9] The procedure could be implemented as an operator option. However, I think that the method will quickly prove itself and most operators will prefer it.

Operating with Qwikstart is a true pleasure. You can tune in a signal and see printing almost immediately, even when there are no idle characters available for synchronizing. This could be a decisive advantage when working contests or DX, where seconds count. It is my hope that as Mode B becomes easier to use it will attract more operators.

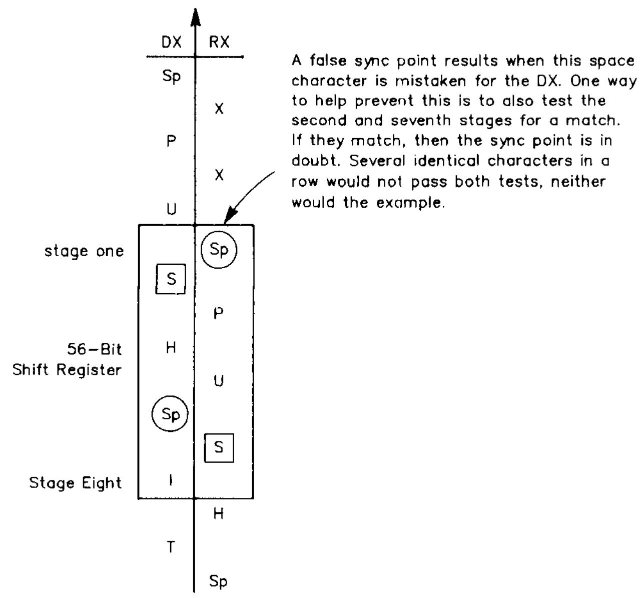


Fig 2

Notes

[1]This can be observed by watching the idle LED on the PK-232 during sending or receiving. It also can be observed as a periodic pause in printing or sending of a message.

[2]CCIR Recommendation 476-3, para 3.2.1.2.

[3]The idle sequence, Hexadecimal 66,00,66 or 00,66,00, is generally taken as the sync signal for mode B. This is specified by CCIR Recommendation 476-3, para 3.2.5.2.

[4]During the hunt phase, data bits are shifted in one at a time. After the entry of each bit, the shift register contents are tested for the occurrence of a specific sequence or character. An in-sync condition occurs when the desired character or sequence is recognized.

[5]Pseudo-Sync accepts only the sequence 66,00 as the sync signal for Mode B. The program uses a 7-bit shift register. The hunt phase terminates after receiving the 02 idle character (Hexadecimal 66) and is followed by a normal read cycle to verify the 01 idle (hex 0F). Hunting resumes if the 01 does not follow immediately. More information about Pseudo-Sync can be found in *QEX*, Nov 89 and May 90 issues.

[6]AT&T station WOO, 8051.5 kHz, transmits continuous Mode-B signals that are received reliably at my QTH. Thus, it makes an excellent signal source for testing.

[7]My data showed the probability of a space to be 0.160 and that of an "E" to be 0.088. Data from several files consisting of over 16,000 characters were processed.

[8]An interesting, but unlikely problem can result if more than five or six identical sequential characters such as the M, B, L, Q, S, J or their shift case counterparts are received while synchronizing. During the hunt phase, the shift register will align as though spaces were received. See Fig 1.

[9]Qwikstart uses an eight-stage (seven bits per stage) shift register. To synchronize, the first stage must contain either a space or a 02 idle character. The probability of noise satisfying this requirement is 0.0156, determined as follows:

$$\text{Probability} = 2/128 = \frac{\text{(number of acceptable combinations}}{\text{(number of possible combinations)}}$$

The sixth stage must contain a space if the first stage does or it must contain a 01 idle if the first stage contains a 02 idle. Because there is only one acceptable combination of bits that depends upon the contents of the first stage, the probability of noise satisfying this requirement is 0.00781, as follows:

$$\text{Probability} = 1 / 128$$

All other stages must contain valid AMTOR characters. Since there are 35 valid AMTOR characters, the probability of noise filling all six stages with good characters is 0.00042, as follows:

$$\text{Probability} = (35 / 128)^6$$

The overall probability of noise satisfying all sync requirements is 5.1×10^{-8}, as follows:

$$\text{Probability} = (2 / 128)\,(1 / 128)\,(35 / 128)^6$$

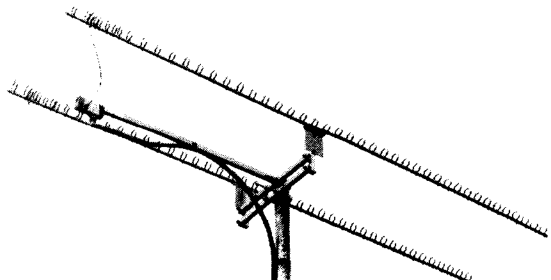
Following the same reasoning for a conventional system using three stages, the probability of noise satisfying the sync requirements is 9.54 × 10½-7/, as follows:

$$\text{Probability} = (2 / 128)\,(1 /128)^2$$

Thus, it appears that the Qwikstart method is less noise sensitive than present methods. The full implementation would also require that the second and seventh stages *not* be equal. This feature will slightly improve the immunity to false starts from noise, but its main advantage is an improved resistance to falsing during AMTOR reception.

Bits

The Seventh Annual RF Expo West, sponsored by *RF Design* magazine, will be held at the Santa Clara Convention Center, Santa Clara, California, on February 5-7, 1991. Conference proceedings are available. This conference and exposition is for engineers and engineering managers involved in the design, development and application of radio frequency equipment and communications. For more information, contact Kristin Kohn, Convention Manager, 6300 South Syracuse Way, Suite 650, Englewood, CO 80111; tel (800) 525-9254; fax (303) 770-0253.



A High-Performance Narrow-Band 534-Hz CW Filter Using Five 88-mH Inductors

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Annapolis, MD 21401

Introduction

About two years ago, a CW filter with a 750-Hz center frequency and using seven 88-mH inductors in a five-resonator design was described in *QEX*-82[1]. This design had excellent selectivity (as indicated by its 30/3-dB shape factor of 2.14) and its nominal impedance level of 200 ohms could be matched to the typical 8-ohm audio jack and headset with standard inexpensive Mouser transformers. The 750-Hz center frequency was appropriate because this was the sidetone provided by most commercial transceivers. However, there are now indications that a lower center frequency may be preferable, especially among the older ham generation.

Experiments recently completed by members of the G-QRP Club and reported in *Radio Communication* showed that the lower frequencies around 500 Hz were preferred for CW reception as compared to the often recommended 750- to 850-Hz tone[2]. A panel of ten operators, all 50 years or more and under the direction of ex-RAF radio operator, Tony Tuite, found by experiment that the most preferred CW tone was between 450 and 600 Hz. Angus Taylor, G8PG, editor of the G-QRP Communications Forum in *SPRAT* (the Journal of the G-QRP Club) commented: "So far, all our work points to CW reception frequencies in the range of 450-600 Hz as being the most acceptable, with many operators unconsciously adopting them."

In view of these experimental results, it is obvious that another high-performance CW filter design is needed, this time with a center frequency around 500 Hz. The following article discusses the design and construction of such a filter using one five-inductor stack of the 88-mH inductors and twelve capacitance values.

Design Procedure

Preferred Band-Pass Filter Parameters

Before we discuss the band-pass filter design procedure, we will review the preferred filter parameters and the reasons for choosing them. The desired filter center frequency is around 500 Hz with a 3-dB bandwidth of about twenty-five percent, or 0.25 × 500 = 125 Hz. The most convenient number of inductors to use is five because this is the number of inductors in one stack. The desired filter termination impedance is that which can be matched to 8 ohms with inexpensive commercial units available from Mouser Electronics.

The nominal 500-Hz center frequency was picked because of the reason mentioned in the introduction, but we will be satisfied with anything from 450 to 550 Hz. The selected 3-dB bandwidth will be a compromise—if it is too narrow (for example, less than 15 percent of the center frequency), it will be difficult to keep the desired CW signal in the filter passband and the filter insertion loss will be so high that an outboard amplifier will be needed. If the filter bandwidth is too broad (greater than 40 percent), the filter insertion loss will be low but the selectivity will be poor. Because the minimum practical filter bandwidth is greatly dependent on the inductor Q at the center frequency, we can determine the inductor Q at about 500 Hz and use this value to find a practical bandwidth.

One of the 88-mH inductors in a 5-inductor stack was resonated with a single 1.03-μF capacitor to produce resonance at 534 Hz (the center frequency of the CW filter design finally selected) and the 3-dB bandwidth was measured to be 14 Hz. If the losses of this L-C tuned circuit are assumed to be primarily due to the inductor, we can calculate the inductor Q using the equation QL = Fc / BW or QL = 534 / 14 = 38. If the inductor Q is 20 times or more greater than the ratio of the band-pass filter center frequency (BPF Fc) to the BPF 3-dB bandwidth (BPF BW), then the actual band-pass filter response will closely match the theoretical band-pass filter response; however, even if the inductor Q is as low as nine or ten times (BPF Fc) / (BPF BW), the actual band-pass filter response will still be close enough to the theoretical response to be satisfactory. If we assume that the filter bandwidth must be such that the inductor Q will be about nine times (BPF Fc) / (BPF BW), we can get a good approximation of the practical minimum CW band-pass filter bandwidth. Using the equation BW = 9 × Fc / QL, we calculate the minimum practical 3-dB bandwidth of the CW filter as: BW = 9 × 534 / 38 = 9 × 14.05 = 126 Hz. Of course, a filter bandwidth of less than 126 Hz can be used, but the actual filter response will be more severely rounded at the 3-dB corner frequencies than for a higher inductor Q.

[1]Notes appear on page 10.

Based on previous experience, the required filter termination impedance will probably be between 100 and 500 ohms. Mouser Electronics stocks 0.4-watt miniature transformers with PC leads for impedance transformations of 8/48, 8/120, 8/200 and 8/500 ohms, all center tapped. Consequently, the final design must have a termination impedance within ten percent of one of these high-impedance windings. With these band-pass filter parameters in mind, we now go to the next step of the design procedure, which involves choosing the most appropriate band-pass filter configuration.

Selection of Band-Pass Filter Configuration

The three possible band-pass filter configurations for the narrow-band CW filter are the Resonant Branch, the Top-Coupled Shunt Resonator and the Bottom-Coupled Series Resonator. Because the component values of the resonant-branch design become increasingly impractical for bandwidths of about thirty percent or less, we can conclude that the resonant-branch configuration is not appropriate for the narrow-band CW filter design.

For narrow band-pass designs, the coupled-resonator configuration is preferred for percentage bandwidths of less than ten percent. According to Williams[3], "...The theoretical justification for the design method is based on the assumption that the coupling elements have a constant impedance with frequency. This assumption is approximately accurate over narrow bandwidths." Although our desired percentage bandwidth is greater than ten percent, it nevertheless is small enough to provide acceptable performance.

Normally, the top-coupled resonator form would be chosen for this applicaton, and its configuration is shown in Fig 1. Because of the capacitive top coupling, the filter acts somewhat like a highpass filter at frequencies above the center frequency, and the rate of attenuation rolloff is less abrupt than for frequencies below the center frequency. Since the human ear is more sensitive to frequencies above 500 Hz than below, this response characteristic of the top-coupled resonator is not optimum for a CW band-pass filter. In comparison, the bottom-coupled series-resonator band-pass filter shown in Fig 2 has maximum attenuation on the high side of the center frequency with a more gradual attenuation rolloff below 300 Hz on the low side. However, the poorer performance of the coupling transformers below 300 Hz and the lower sensitivity of the human ear to frequencies below 300 Hz will provide some additional attenuation to compensate for the poorer low-frequency attenuation of the bottom-coupled series-resonator band-pass filter. For this reason, the bottom-coupled 5-resonator band-pass filter configuration shown in Fig 2 is selected for the narrow-band CW filter.

Filter Component Calculation

After the filter configuration is selected, we next find a design having the desired center frequency, bandwidth

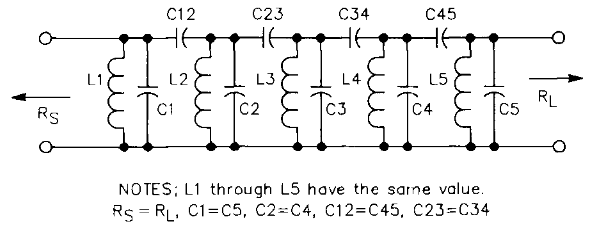


Fig 1—Schematic diagram of the top-coupled 5-resonator band-pass (5-R BPF) filter. NOTES: L1 through L5 have the same value, Rs = RL, C1 = C5, C2 = C4, C12 = C45, C23 = C34.

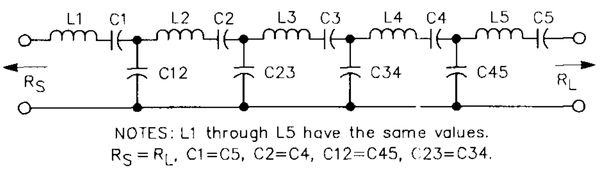


Fig 2—Schematic diagram of the bottom-coupled 5-R BPF. NOTES: L1 through L5 have the same value, Rs = RL, C1 = C5, C2 = C4, C12 = C45, C23 = C34.

and impedance level. This phase of the design procedure is most conveniently accomplished with Philip Geffe's band-pass filter design computer program, "BAND," which was reviewed in *QEX*-98[4]. Those not interested in purchasing Geffe's program may be interested in trying the narrow-band band-pass filter design program written in BASIC by William Sabin, WØIYH[5].

Several trail designs were computer-calculated with BAND to find the impedance level that results when using 88-mH inductors and the desired center frequency and bandwidth. It soon became obvious that a filter impedance level of 120 ohms (a standard Mouser transformer impedance value) could be obtained if all inductors were 88 mH and the center frequency and 3-dB bandwidth were 534 Hz and 126 Hz, respectively. The BAND computer printout for a Butterworth design for FA = 474 Hz, FB = 600 Hz, QL = 38 and QC = 250 is shown in Fig 3, where FA and FB are the lower and upper 3-dB frequencies, and QL and QC are the inductor and capacitor d's, respectively. Although the nominal inductor value is 88 mH, a value of 87.4 mH was accepted because the actual measured inductance is frequently one percent or so on the low side of the nominal value.

The total capacity of the capacitors shown in the computer-printed schematic diagram (see Fig 3) is 29.2 μF. Fortunately, this capacity can be substantially reduced by performing a Tee-to-Pi transformation on the capacitor networks within the filter schematic diagram. Fig 4 shows the capacitors of Fig 3 arranged to more clearly show the Tee configuration before the transformation. Note that C2, C3 and C4 have been split into

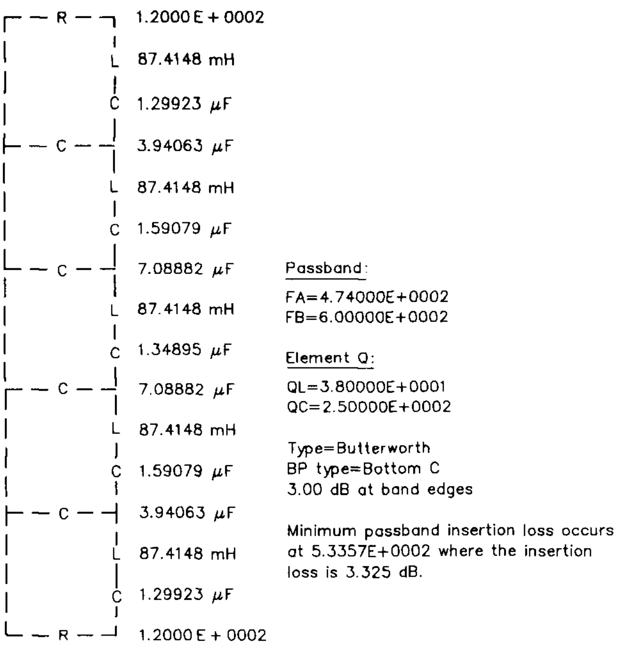


Fig 3—Computer printout of the bottom-coupled 5-R BPF design obtained by using Geffe's BAND program.

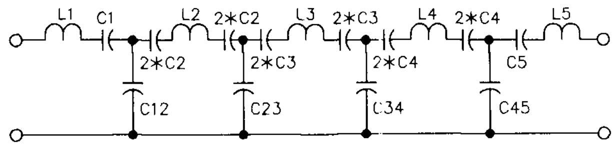


Fig 4—Schematic diagram of the bottom-coupled 5-R BPF redrawn to more clearly show the Tee-network coupling capacitors.

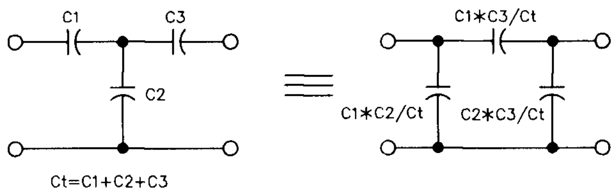


Fig 5—Schematic diagrams and equations used in the Tee-to-Pi capacitor network transformation.

two capacitors, each of which have been doubled in capacity and redrawn to complete the third leg of the Tee-capacitor network. The other capacitor values remain unchanged from the values given in Fig 3. Fig 5 shows the procedure used to transform the Tee-capacitor network into an equivalent Pi network. Fig 6 shows the final CW filter schematic diagram with the new capacitor values and with the capacitors now in the Pi configuration. The total capacitance required for the CW filter is now only 12.9 μF, which is a substantial reduction from the 29.2 μF required by the original Tee configuration shown in Fig 3.

In addition to the capacitor and inductor values, Fig 6 also lists the measured inductor Q at 534 Hz, the filter source and load impedance, the design center frequency and the design 3-dB and 30-dB bandwidths. This concludes the discussion of the filter design procedure.

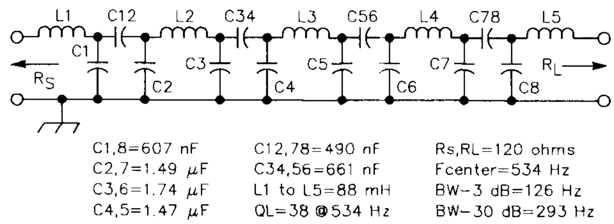


Fig 6—Final schematic diagram of the bottom-coupled 5-R BPF after completion of the Tee-to-Pi transformation to reduce total filter capacitance.

Assembly of the CW Filter

Fig 7 shows the pictorial diagram of the inductor stack wiring. The shunt capacitors are numbered left to right, 1 to 8, and the series capacitors are labeled using the numbers of the adjacent shunt capacitors. In order for the twelve capacitors to fit on the stack, the Panasonic miniaturized metallized polyester film capacitor, Type ECQ-E(F), was used. This capacitor type, available from Digi-Key[6], is unusual for its large capacity and small size. For example, the dimensions of a 100-V, 1.5-μF capacitor are 11/16 × 7/16 × 3/16 inches. When necessary, two capacitors are paralleled to get within one percent of the design value.

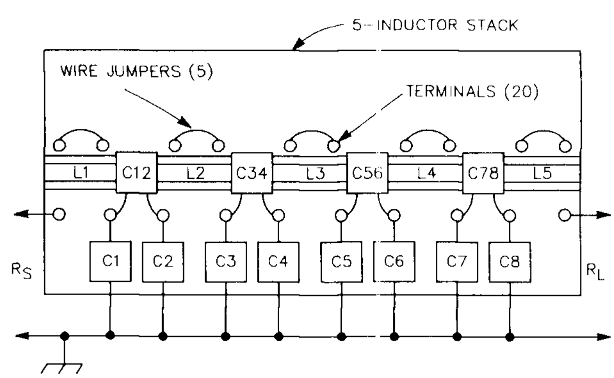


Fig 7—The pictorial diagram shows how to wire an 88-mH inductor stack to realize the narrow-band CW filter design. The inductor stack terminals provide convenient tie-points for mounting the capacitors and making the input/output connections.

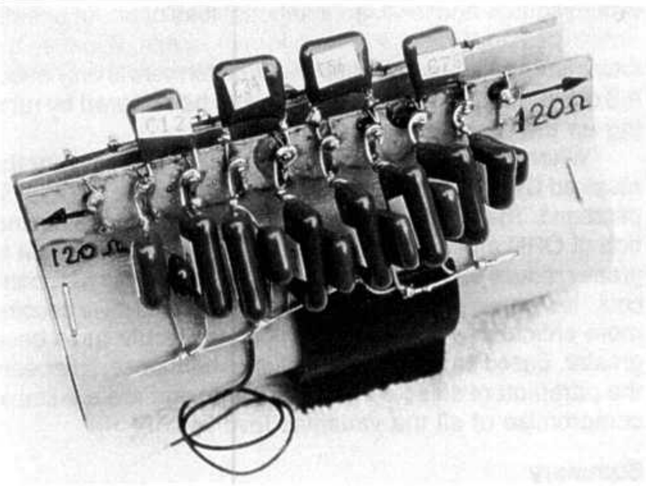


Fig 8—The photograph shows a completely wired inductor stack mounted on a plastic clip. Take particular note of the convenient size of the Panasonic miniaturized metallized polyester film capacitors used in the assembly.

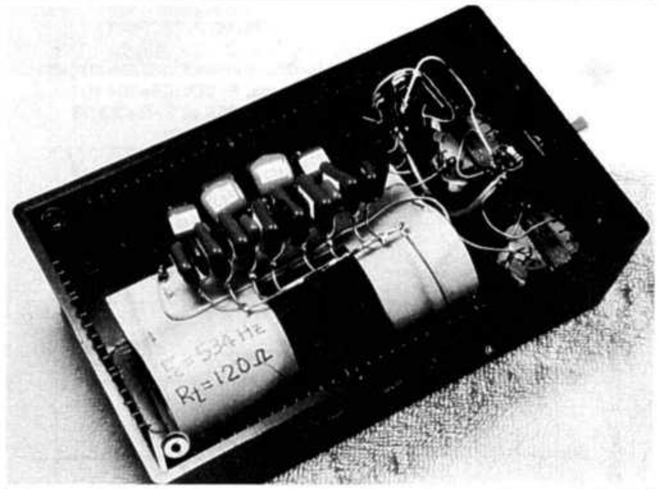


Fig 9—The photograph shows the filter assembly mounted in a plastic box and includes two 8/120-ohm matching transformers, a DPDT bypass switch and a ¼-inch phone plug and jack.

Fig 8 shows a photograph of a completely wired inductor stack. See Fig 2 in the *QEX*-82 article for the schematic diagram showing the wiring of the filter, transformers, DPDT switch and the phone jack and plug. Fig 9 shows a photo of the stack and capacitors installed in a 6.0 × 3.5 × 1.875-inch black plastic box, available for $2.75 from Jameco[7]. This box, Part No. H2851, comes complete with four screws and lid. The box is just large enough to contain the phone jack, two transformers, a DPDT miniature switch and the inductor-capacitor stack assembly. After much researching of manufacturer and distributor catalogs, I am convinced that this Jameco box is the best buy for containing the CW filter parts. Comparable boxes from other sources cost two to three times as much.

The 88-mH inductor stacks are being made available for Amateur Radio applications through the courtesy and cooperation of the Chesapeake and Potomac Telephone Company of Maryland. Send a stamped, self-addressed, business-sized envelope to the author for details on how to obtain the inductor stacks and other parts for constructing this CW filter.

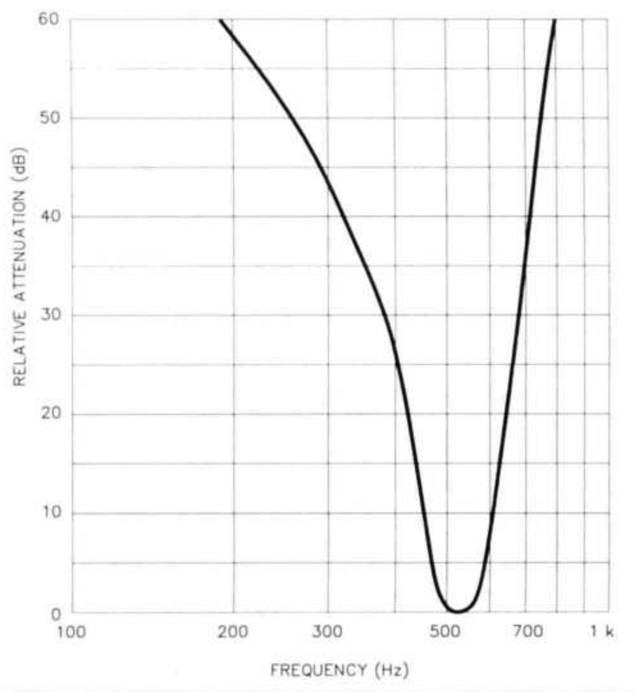


Fig 10—The measured CW filter response is plotted on semi-log graph paper with lower- and upper-frequency limits of 100 Hz and 3 kHz to clearly show the filter passband relative to the audio range of a typical communications receiver.

Measured Performance of the CW Filter

Fig 10 shows the measured relative attenuation of the CW filter plotted on semi-log graph paper. The 200-Hz and 3-kHz lower and upper limits of the graph indicate the audio-frequency limits of a typical communications receiver, and the filter response relative to these limits gives a good indication of how the filter eliminates a majority of the unwanted audio spectrum. By reducing the received audio spectrum to a minimum, operating fatigue is reduced and the ability to receive weak signals in the presence of QRN and QRM is greatly enhanced.

The asymmetrical shape of the bottom-coupled filter response is quite obvious in the semilog plot, and this is a consequence of the series inductors causing poorer low-frequency attenuation. As explained earlier, this response was considered to be preferable to that of the top-coupled configuration in which the high-frequency response would have been poorer.

The measured relative attenuation is also shown in

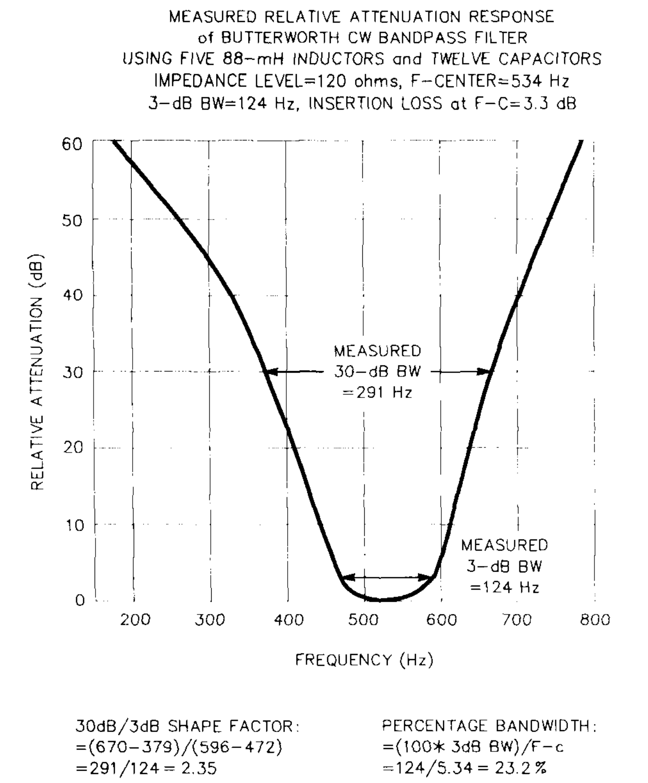


Fig 11—The measured filter response is plotted on linear graph paper to show the detailed filter response over the 200-to-800 Hz frequency range. The measured filter response is virtually identical with the calculated response provided by the BAND design program.

Fig 11, but this time the response is plotted on linear graph paper and only over the 180-Hz to 800-Hz range. The finer detail of the linear plot permits accurate graphical representations of the 3-dB and 30-dB bandwidths as compared to the semi-log plot. The relative attenuation filter response was measured with a signal generator and an ac VTVM modified to simulate a source and load impedance of 120 ohms. The filter attenuation could not be accurately measured below 300 Hz because the test signal harmonics appear in the filter passband; consequently, the untuned voltmeter gives an incorrect indication. Because of this, the filter attenuation below 300 Hz was plotted from calculated values to complete the plot. The measured insertion loss at 534 Hz was 3.3 dB, which agrees with the calculated value given in Fig 3. The measured 30/3-dB shape factor of 2.35 may be used as a bench mark for comparing the filter performance with other CW filters.

The computer-calculated and measured attenuations are virtually identical, indicating that the capacitor values and the assembly wiring are correct. When using 8/120-ohm transformers to match the filter input and output to the standard 8-ohm source and load, an additional loss of about one dB should be expected due to transformer losses. Because the total insertion loss of the filter and transformers is only about 4.3 dB, the reduced audio volume can be restored by turning up the receiver audio gain control.

When using the filter, it is possible to slightly vary the received CW tone while keeping the signal within the 124-Hz passband. The most noticeable effect of the filter is the elimination of QRN and all of the unnecessary audio spectrum to greatly reduce operating fatigue. Although the filter passband could have been made sharper, the tuning would have become more critical and the filter insertion loss would have been greater. Based on the observed filter performance, it appears the parameters selected for this CW design are a suitable compromise of all the variables involved.

Summary

The results of a recent study demonstrated that a CW filter center frequency near 500 Hz is preferred by many older hams instead of the more commonly used 750-Hz center frequency. Using the Geffe BAND computer program, the design of a CW band-pass filter was demonstrated in which a stack of five 88-mH inductors and twelve capacitor values were used to produce a filter having a standard impedance level and a 534-Hz center frequency with a 124-Hz 3-dB bandwidth. The low cost, high performance and ease of assembly makes this filter an ideal weekend project for those preferring to copy CW at a frequency near 500 Hz.

References

[1]E. Wetherhold, "CW and SSB Audio Filters Using 88-mH Inductors," *QEX*-82, December 1988.
[2]Pat Hawker, "Preferred CW-copying Tones," Technical Topics, p 32, *Radio Communication*, April 1990. (*Radio Communication* is the official journal of the Radio Society of Great Britain.)
[3]Arthur B. Williams and Fred J. Taylor, *Electronic Filter Design Handbook*, p 5-19, 2nd edition, McGraw-Hill Publishing Co, New York, 1988.
[4]E. Wetherhold, "A Review of Phil Geffe's Filterware, BAND," p 11, *QEX*-98, April 1990.
[5]William E. Sabin, WØIYH, "Designing Narrowband Bandpass Filters with a BASIC Program," *QST*, May 1983.
[6]Digi-Key Corp, PO Box 677, Thief River Falls, MN 56701-0677. Call Digi-Key at 1-800-344-4539 for their free electronic parts catalog.
[7]1990 Catalog, p 58, Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002, (415) 592-8097. $25 minimum order.

The Safari-4: A High-Integration, 4-Band QRP Transceiver—*Part 3 of 3*

By Wayne Burdick, N6KR
446 Mt Hope Street, Unit 9
North Attleboro, MA 02760

[Continued from November issue.]

Construction

I built the Safari-4 using nine circuit boards, four of which are transverters. I opted for "clean" rather than "ugly" layout techniques to make the project easier to duplicate. PC boards are certainly optional—I had the entire IF section, keyer, and 10-meter transverter breadboarded at one point—but will likely save you weeks of assembly time.

The full set of circuit boards for the Safari-4 will be made available by the author if there is enough demand to make quantity production feasible.[7] If not, I will provide the PC artwork to interested builders.

Assembly of the author's PC boards will be much easier if you use the exact components recommended (see Parts Suppliers, Table 1). Use ¼-watt resistors, and capacitors with lead spacings of 0.2 inches or less. None of the resistors, RF chokes or diodes need be mounted vertically except on the keyer board (Z4). All component leads should be trimmed as short as possible during PC board assembly to minimize board height.

Table 1

Parts Suppliers

Amidon Associates, 12033 Otsego St, N Hollywood, CA 91607; tel 818-760-4429

Curtis Electro Devices, Inc, Box 4090, Mountain View, CA 94040; tel 415-964-3846

Digi-Key, 701 Brooks Ave South, Box 677, Thief River Falls, MN 56701-0677; tel 800-344-4539

Gateway Electronics, 9222 Chesapeake, San Diego, CA 92123; tel 619-279-6802

International Crystal Manufacturing Co (ICM), Box 26330, Oklahoma City, OK 73126-0330; tel 405-236-3741 or 800-426-9825

Mouser Electronics, 11433 Woodside Ave, Santee, CA 92071; tel 800-346-6873

Radiokit, Box 973, Pelham, NH 03076; tel 603-635-2235

Subassembly Construction Notes

8.8-MHz IF board (Z5): I breadboarded an NE602 oscillator, then matched five 4.915-MHz crystals within 50 Hz. Digi-Key currently sells 10 of the crystals for only $13.50.

Transverter boards (Z6-Z9): To minimize vertical height of the transverter boards, lay the crystals flat, use low-profile PA heat sinks, and keep all components under 0.5-inch tall. If sensitivity on 15 or 10 meters seems inadequate, an 8.8-MHz tuned output circuit can be used in lieu of the broadband transformer shown (T2): solder a 50-pF trimmer directly across U1 pins 4 and 5, and use a transformer with an 8-μH primary winding (45 turns no. 30 on a T-37-2 core) and 6-turn secondary.

Keyer/Control (Z4): The trim pots used on this board should be top-adjustable if the board is to be mounted as shown in Fig 11. Vertical mounting of resistors and some other components was necessary here to conserve space. DO NOT substitute silicon diodes for the germanium diodes used for protecting the 8044 (D2 and D3).

SWR/Meter Control (Z1): This board mounts directly to the Modutec meter mounting screws (see Fig 12). If lead lengths from the board to the meter and to S1 are kept under a few inches, coax will probably be unnecessary on the SWR in/out connections.

VFO (Z2): Special attention was paid to physical stability. L1 was given two healthy coats of Q-dope, and the main tuning capacitor, C4, is rigidly mounted to a Jackson 6:1 reduction drive as shown in Fig 13. Note that the drive is mounted inside the enclosure due to space constraints. The tuning rate is about 20 kHz per knob revolution.

RIT (Z3): The RIT board should be mounted in the same enclosure as the VFO. However, the leads to R9 and S7 (on the wiring diagram—see Fig 3) need not be short or shielded.

Final Assembly

In contrast to the easy task of assembling the circuit boards, the ultracompact chassis layout that I used will likely challenge even ambidextrous electronics techs. I had to use very small controls and components, and there is literally no usable space left over in the LMB enclosure (Mouser P/N 537-CR-753). Fig 3 gives details on other chassis components.

To get a better idea of how tight the layout is, consider that the 12-volt gelled-electrolyte battery is held firmly in place on all sides: by the IF board on top, the VFO enclosure in front, the antenna and external +12-V jacks on the left, and the walls of the chassis on the right,

[1]Notes appear on page 14.

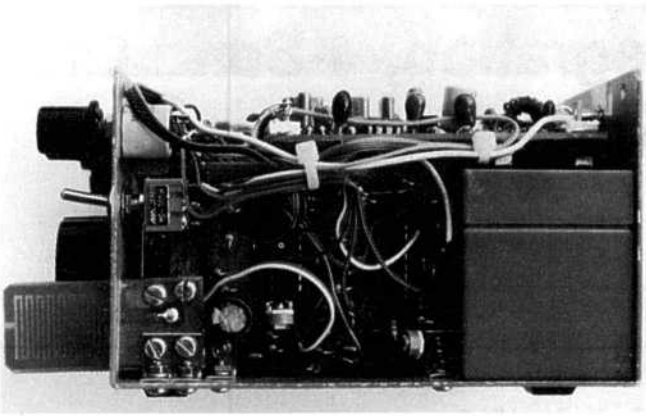


Fig 11—Right-side view. The keyer/control board and paddle are at the left. On the right is the 12-volt battery. The 8.8-MHz IF board is on top, and is attached to the back of the chassis with hinged standoffs.

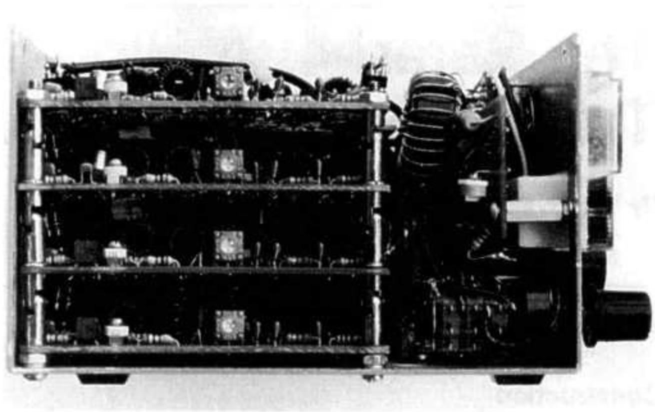


Fig 12—Left-side view. The stack of transverter boards is at the left; each is attached to the board below with two hinged standoffs, except for the 40-meter board, which uses 4-40 nuts beneath it to keep its height above the chassis at a minimum. The SWR/meter control switch, S1, is at the right, below the meter and its piggy-backed SWR board (Z1).

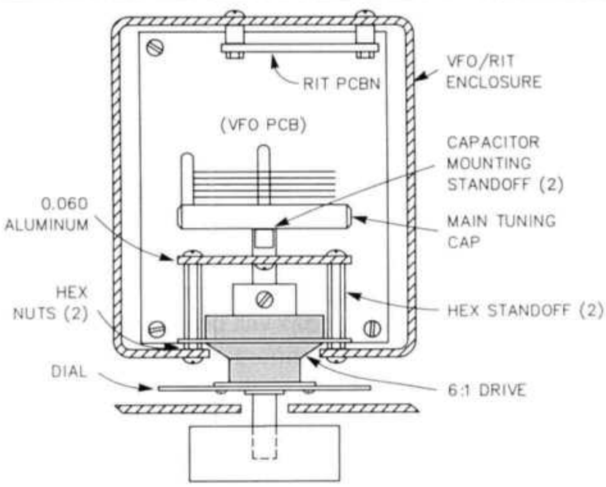


Fig 13—VFO/RIT enclosure detail, showing the mounting of the VFO and RIT boards and the 6:1 reduction drive. The enclosure is an unpainted LMB minibox, 2-3/4 by 2-1/8 by 1-5/8 inches (Mouser 537-TF-770). The reduction drive is a Jackson Brothers 4511/DAF (Radiokit).

Fig 14—This view of the transceiver shows the front panel controls and labeling. The front panel is only 3 by 7 inches, so layout is critical (see text).

back, and bottom! Detailed chassis planning is essential, particularly for the front panel.

Note that the stack of four transverters will only fit in a 3-inch high enclosure if you use 0.625-inch standoffs between them, and the smallest possible vertical standoff between the bottom board and the chassis. Also, the 10-meter board, which uses only 0.37-inch-OD toroids, must be on the top of the stack to provide good chassis-cover clearance. Keep all components on that board under 0.4 inch in height.

AF gain control R8 (Fig 3) is optional—I use phones with built-in gain controls instead. If you do include R8, make sure that the resistance between the wiper and the high end is well under 1 ohm when adjusted for maximum volume.

Short ground leads of no. 20 or larger wire should be used to connect each of the transverter boards (at J4) to the chassis, to prevent dc voltage drops that would end up as AF clicks on transmit. I also needed a 0.001-μF capacitor from the key line to ground on the 10-m and 15-m transverter boards.

The antenna tuning capacitor, C2, must be insulated from ground. I used nylon screws and washers to attach C2 to the bottom of the chassis.

I used a 1.5-inch-long machine screw (no. 10) to prop up the front edge of the cabinet; the underside of the chassis has a tapped hole for this purpose. The screw can be used to adjust the height, and may be removed for transport.

Alignment

Although not absolutely necessary, an oscilloscope and frequency counter will be helpful during alignment. This is especially true when aligning the transmit mixers and PA stages, which should be examined for clean, harmonic-free output. The following paragraphs detail the alignment procedure.

VFO: With C4 at minimum, adjust C3 until the VFO frequency is 3.955 MHz; this is actually the low end of the tuning range (eg, 22.870 − 14.000 − 4.915 = 3.955). With C4 at maximum, the VFO should now read 3.885 MHz; I had to remove a couple of plates from C4 to achieve this range. The transmit offset trimmer, C8, must be adjusted with the shift line from Z4 connected (or with a temporary 22-kΩ resistor to ground) to keep D3 from rectifying any stray RF. Apply 12 V to the shift input and adjust C8 for 750-Hz offset. When VFO adjustment is completed, install the VFO enclosure cover to keep stray RF out during subsequent alignment.

RIT: Apply 0 V to the +12-V transmit input and set the RIT adjust pot so that the RIT-ON frequency matches the RIT-OFF frequency. Then physically align the pointer on the RIT knob at 12 o'clock.

8.8-MHz IF/AF: Connect a pair of headphones to the audio output, and disable the AGC by grounding the base of Q2. Set a signal generator for 8.835 MHz and couple it loosely to the IF input. Connect the VFO, set it for about 3.920 MHz, and find the 8.835-MHz signal. Then peak C4 and C6 for maximum audio. Next, adjust BFO trimmer C15 so that an AF tone of about 750 Hz is centered in the crystal filter's passband. You'll need to readjust the VFO frequency occasionally during this procedure.

Q2's base can now be ungrounded, and the AGC level control, R4, adjusted. Start with R4 set so that Q2's emitter is at ground. Next, turn up the signal generator until the dc voltage at U1 pin 2 reads 0 V, and add a few dB more. Then adjust R4 for 0.60 volts at U1 pin 2; this is close to the optimum mixer cutoff bias. The final level of R4 must be determined during on-air testing; likewise any value of R placed in parallel with R17, the AGC time-constant setting resistor.

Keeping the signal generator at the same level, the S-meter control, R18, should now be adjusted so that M1 reads somewhat less than full scale. With the signal generator removed, M1 should return slowly to zero, as U1 pin 2 rises to about 1.25 volts.

Align the first transmit mixer by applying 12 V to the +12-TX input of Z5 and adjusting C35 for maximum TX IF output. Use an oscilloscope to verify that the output is a clean sine wave.

Keyer/Control: Tie the keyer sidetone output to its input on the IF board, and connect a pair of headphones to the AF output. Ground the OFF-AIR input, then ground the TUNE input as well (in that order) to allow sidetone adjustment. Adjust the sidetone level control on Z5 for comfortable volume. With a counter at the 8044's sidetone output (U2 pin 13), adjust the pitch control, R14, for 750 Hz.

Now unground the TUNE control, and adjust the paddle sensitivity control, R5, to just below the point where the keyer starts outputting alternating dots and dashes. In extremely dry climates your skin resistance may be too high; in this case the sensitivity can be increased by using 22 MΩ at R3 and R4.

Transverters: The conversion oscillator should be aligned first. Set frequency trimmer C8 at minimum to make sure the oscillator will start. Then peak C11 while observing the oscillator's amplitude at U2 pin 8. This will keep the scope or RF voltmeter probe from loading Q1's collector circuit. After C11 is set, C8 can be used to fine-tune the oscillator frequency, but it may reduce the output a bit. The first receive mixer, U1, may now be aligned by peaking C2 and C4 at mid-band using a low-level signal generator at the RF input frequency. The S-meter should be helpful here.

Before adjusting the transmitter strip, remove P1—this will keep the PA, Q5, out of the circuit. Set R12 for maximum drive, and monitor the gate of Q3 with a scope. Key the transmitter (at mid-band) using the TUNE control on the keyer board, and peak C15. Then move the scope probe to Q4's collector, key the rig again and peak C22. Now set R12 for minimum drive, reinstall P1, and attach a 50-Ω load (along with the scope probe) to J1. Alternatively, if the SWR bridge and tuner are already in the line, set S1 to SWR, and set L1 and C2 to zero (see Fig 3).

Key the transmitter sparingly while increasing the drive until the control is at maximum, or until the RF voltage at J1 is 20-V p-p (about 1 watt). You may need to repeak C15 and C22 along the way. You probably won't get a full watt on 10 and 15 meters.

One final note on transverter alignment. If you experience audio clicks when keying, try slightly misaligning the conversion oscillator tank (C11). If that fails, slightly detune the receiver. This is best accomplished by stagger-tuning the input to the second mixer (8.8 MHz), since it is likely to cure the problem on all four bands, but the same technique may be tried with the individual first receive mixer stages. In any case, the misalignment will reduce the sensitivity of the receiver to the RF output signal.

SWR/Meter Control: Once the transverters are aligned, set the SWR CAL control, R5, so that the transverter with the highest output reads full scale with S1 in the CAL position. The other bands may read 70 to 100 percent of full scale, but this will have little effect on tune-up accuracy. The battery-voltage CAL control, R8, can be adjusted to show either percentage of full charge or a suitable absolute scale, such as 0.6 mA = 12 volts.

Operation

Antenna Matching: The most critical thing to remember when operating the Safari-4, or any other rig without SWR protection on the PA transistor, is that you must *not* key the transmitter without a matched load connected to the PA output. This requirement is easily met in the case of the Safari-4 by making sure that the metering switch is in the SWR or CAL position *before* turning the unit on. This will guarantee a reasonable load on the PA transistor until the antenna tuner is properly adjusted. If you don't do this, you may find your PA transistor smoking in public.

Another trick that I use is to put the keyer mode switch in the OFF-AIR position before power-on. This will prevent the keyer—which always generates a dot when you initially apply power—from keying the transmitter.

Once safely powered up, the desired band should be selected, and the meter switch, S1, placed in the CAL position. Key the transmitter with the keyer mode switch, S8, in the TUNE position, and verify that M1 deflects to 70-100% of full scale.

Now switch to SWR, key the transmitter, and adjust the antenna tuner controls for best null (closest to 0 on M1). It helps to preadjust the coarse inductance (S3) and C2 while listening to the receiver noise level. You may need to try both the series and L-network positions of S2. Finally, the meter switch can be placed in the OPERATE position, in which an increase in strength of received signals should be apparent.

It is imperative that a good null be obtained. If M1 reads over 20% of its CAL deflection, you risk transmitting a garbage signal and destroying the PA transistor. Changing the antenna length or orientation slightly will often result in better matching. Or you can run two wires off in different directions from the antenna jack, resulting in a more tunable center-fed configuration. Of course, a resonant antenna with 50-Ω coaxial feed is always best; in that case, S3 will most likely be set for minimum inductance.

Miscellaneous controls: The keyer mode switch, S8, is right where you want it—just above the paddle. With the switch in the OFF-AIR position (up), the keyer speed or sidetone pitch can be tested without causing QRM or draining the battery. This is especially useful if you've adjusted the sidetone frequency and transmit offset for the same pitch (see alignment). In the TUNE position (down), the transmitter is keyed continuously. In the OPERATE position (center), the unit is ready for normal full break-in operation.

The RIT circuit is activated by placing S7 in the RIT ON position. The receive frequency can be varied by +0.7 kHz and −1.3 kHz on the prototype. The transmitted frequency is, of course, unaffected by the position of the RIT control.

M1 can be set to read battery voltage by placing S1 in the BAT position. This will show the battery voltage or the external supply voltage, whichever is higher, and the switch may be left in this position during transmit.

Performance

I have used the Safari-4 as both a portable and home station for several months. The full QSK, along with the layout of the keyer paddle and controls, make operating this rig a lot more fun than my QRO rig with its clunky peripheral equipment. And with the built-in tuner, almost any unsuspecting hunk of wire can be conscripted as an antenna.

The one-watt level is three or more S-units down from the rest of the world, but I have easily worked Europe and Asia when a good antenna was available. At home, I have only a mediocre random wire—ten feet up, forty feet long—but have still snagged plenty of DX with it. The advantages of the 1-watt level are simplicity and good battery life; I've used the rig casually for two weeks on a single charge.

Signal quality reports are uniformly excellent; I've had numerous compliments on the clean keying. This is a direct result of the excellent physical and electrical isolation of the VFO.

On the negative side, the simplistic AGC circuit is subject to overload, and the 2nd receive mixer develops objectionable cross modulation on 40 meters when the AGC saturates. But the receive IF attenuator switch (S6, Fig 3) can be used to eliminate most of the problem. AF limiting is a possible alternative to the AGC circuit used here.[8]

Conclusion

I began this project wondering whether I could, without being an RF engineer, build a compact, multiband transceiver. I found the task difficult but possible, requiring a lot of sweat, some late nights, a good collection of reference books, and a cheap 20-MHz oscilloscope. I hope the resulting design will inspire others to try high-integration packaging.

If you've got the time to build it, a rig like the Safari-4 will definitely simplify your future safaris. But beware—you can bet the natives will try to steal it!

Biography

Wayne Burdick was first licensed in 1971, and upgraded to Extra Class in 1975. He was an Electronics Technician in the Coast Guard for four years, then worked as an engineering technician and programmer while completing his bachelor's degree in Cognitive Science at the University of California at San Diego. He's now a firmware engineer and part-time acoustic guitar fanatic.

Notes

[7]Pricing for the boards has not been set; those interested should contact the author. The author may also supply certain parts for the boards, including the Signetics NE602, depending on demand.

[8]Lau, Z., "The QRP Three-Bander," Oct 1989 *QST*, pp 25-30.

Correspondence

More on US/Foreign Equivalents

☐ After reading "Foreign Component Equivalents," April 1990 *QEX* Correspondence by Fred Bonavita, W5QJM, my first reaction was a big smile. It was "The revenge of the Nerds on foreign components." Fred is complaining about European denominations on a reprint from *Radio Communication.* What he forgets is the fact that *QST*, *Ham Radio*, *73*, *CQ* and, of course, *QEX* have a very big audience in Europe and the whole world. Can you imagine the frustration of thousands of hams trying to get some European equivalent of an Amidon toroid, a Motorola MRF transistor, or an Arco-Elmenco compression mica trimmer? And I'm not even talking about schematics where the only reference is a catalog number from Radio Shack...

Please consider also the case of hams living in Eastern European countries, or in the USSR. There everything is home-brewing and components are, if not scarce, nonexistent. For them even the problem of equivalents is out of the question. And, on top of that, they cannot by any means buy the components outside...

After almost two years here (at the University of Massachusetts) I have found the home-brewer paradise. You pick up the phone, make a toll-free call and, two days later, get a huge catalog with all the gizmos you wish to have; make another call and UPS is knocking on your door to deliver. From the "old era" I still keep a bag with my treasures: integrated circuits, toroids, jumbo beads, ferrite rings, RF transistors, trimmers, Gunn and Hot-carrier diodes and all sorts of weird components you "Americans" use on your designs. With this and some equivalence charts (easily available in other parts of the world) I am quite able to copy any design or new gadget for my shack. And when I had any trouble, I used to get the mike, or send a packet message asking for help. It works wonders!

Com'on! Where is the creativity of hams? I am a QRPer and, in most of the articles about transmitters the author writes: "Try several final transistors to get maximum power." This trial and error system can be used for most of the circuits published (with the exception of integrated circuits). Give it a try!

To be constructive, I don't have any of my documentation here, but I'll be going back to Spain next September. If you need a volunteer, let me know.—*Jon Iza, W1/EA2SN, 615 Main Street, Apt 29, Amherst, MA 01002-2422*

☐ I note in your April issue, page 14, "US versus Foreign Component Equivalents," you have an appeal for a volunteer to come up with proper substitutes of components that are specified in foreign construction projects.

The BA244 diode looks like a 1N4148. There's another version of the BA244, the BA244S, which has a more closely controlled capacity specification. A suitable American replacement for this unit could be a 1N4448. The Fair-Rite 28-430002420 toroid is made by an American company, address Fair-Rite, PO Box J, 1 Commercial Row, Wallkill, NY 12589, tel 914-895-2055. (The specific number was not in their catalog, possibly the 2420 was a typo that should have read 2402. Their line of products have an initial pair of numbers which indicate the particular kind, in this case Series 28 balun and broadband cores. The second pair of numbers indicates the grade of ferrite material, in this case 43 which is quite high in frequency. You will find that these grade numbers are used by many other manufacturers. Their catalog is quite useful.)—*Earl H. Hornbostel, General Manager, Crystalsem, Inc, 216 Ortega Street, San Juan, Metro Manilla 1500, Philippines*

Comments on 13 cm +

Is the ability to tweak out the last bit of performance all that important on the microwave bands? It seems to me that someone needing the best possible system can do quite well by building multiple no-tune modules and mixing and matching for best performance. The surplus units can then be made to serve as spares. Better yet, these can be made into quite serviceable stations for lending purposes or given away to those who wish to use them. After all, what use is the ultimate transverter if there is nobody to work? —*Zack Lau, KH6CP, ARRL Lab Engineer*

Clarifying Thoughts on Phase 4

By now, we all know that AMSAT-NA has put the Phase-4 project on "hold." Some of John H. Klingelhoeffer's opinions (May 1990 *QEX* Correspondence "Phase 4—Time to Move Ahead") are for the Phase-4 satellite(s) in particular; some are of general interest to the *QEX* reader. Being a member of AMSAT-NA (and a daily user of amateur satellites) I feel some of his thoughts need to be clarified.

Amateur satellite communication is only a part of our hobby, such as packet radio, SSTV, RTTY or HF communication, to name a few. Primarily, it's the challenge and availabilities of equipment which attracts people to operate in a new mode and not the "how to become a satellite communicator in five easy lessons" publications. The more you "push" someone into something, the sooner he drops out—and having a "telephone in the sky" is not enough of a challenge to our youngsters for joining our ranks. The "good portion of your operating time is spent doing tracking duties" is also no argument for not using the present amateur satellites. If someone dislikes tracking duties (I personally feel that the knowledge and application of Kepler Laws exceeds, by far, the burden of tracking) just skip that part and let the software do the job. Comparing the "paper and pencil" tracking for the early OSCARs with today's possibilities, I really see no valid argument against tracking.

To "increase the reliability of our communications capability during emergencies" with the help of an amateur satellite must give some bad feelings to the many dedicated volunteers of the various emergency nets. Whenever there was a major disaster in the United States, amateurs handled the situation in an outstanding manner. Even the worst disruption of communication affects only a certain area and if this requires the use of a satellite, then the area of destruction must be of such a size which exceeds our imagination by far, and, hopefully, will never occur.

I'm sure the decision to stop the Phase-4 project by AMSAT-NA was not an easy one. I'm equally sure that the many gifted engineers working for AMSAT-NA would have solved the technical hurdles. But I hope *you* understand equally well that the rest of the world was neither interested, nor willing to support, a project which only serves the US ham population.

The present state-of-the-art in amateur communications, accessible in a future satellite and available to all of us, requires the pooling of all resources, otherwise the ever-increasing costs for launching such a satellite exceeds our financial capabilities for many years to come.—*Hanspeter Nafzger, Obstgartenstr 6, CH-8302 Kloten, Switzerland*

Amateur Web

The Editorial in May 1990 *QEX* seems to point in the direction of a digital amateur "web" to link the country. This is a fabulous idea and I urge the ARRL to actively pursue the concept and lead the amateur community on this endeavor. It would be real nifty to have a noncommercial communication backbone to rival the commercial communications entities.

There are some legal areas that need to be addressed to make such an investment feasible. The spectrum to be used for such a system as proposed must be available to the amateur community even in time of emergency. Currently, most of our microwave spectrum can be shut off by Presidential Order as it does not fall under the RACES frequency authorizations. This should be addressed by ARRL in order to send an "OK" signal to the amateur community.

Another area of legality that needs to be addressed to help this "web" is getting a modification of the interpretation by FCC that they will hold both a user and a trustee responsible for communications through a repeater. This issue should be addressed soon. The packet backbone is all too vulnerable to abuse. A possible way to address this might be to get the FCC interpretation altered so that primarily it is a user who will be held responsible for his actions and not so much the trustee of the repeater. The FCC should look at repeaters as a form of utility; in essence they have in the repeater docket.

While this entire concept of a vast digital "web" on microwave frequencies is a great idea, it would take close to ten years before such a complex system could be put in place. A more near-term concept of linking communications systems could occur by encouraging some modifications to our national band plans.

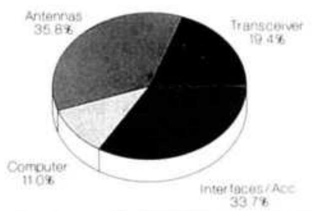
None of the band plans call for cross-band pairing of inputs and outputs. It would seem logical to pair some of the 6-m frequencies with 430-450 ones, etc. Cross-band repeaters do not require duplexers making them economically feasible short-term quick solutions.

The idea that NBFM is the only repeater mode is not in the best interest of the amateur service. Terrestrial based multiple IF linear translators are a very feasible technology that is currently an untapped alternative to NBFM. Many radios purchased today are of the multimode emission type. I urge the ARRL to encourage changes in the band plans to change a few of the repeater pairs to be for translators.—*Joseph A. Wolos, WA1OCK, 1139 St James Avenue, Springfield, MA 01104-1375*

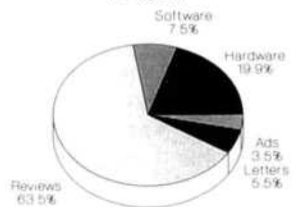
Empirically Speaking

Continued from page 2.

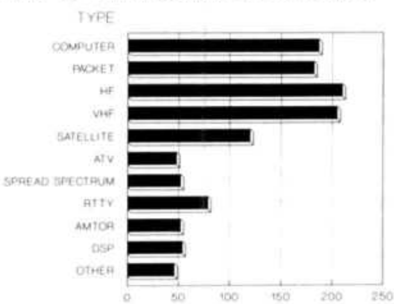
AMATEUR RADIO EQUIPMENT
BUILT OR MOST LIKELY TO BUILD



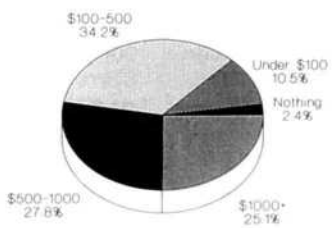
WHAT DO YOU READ THE MOST
In *QEX*



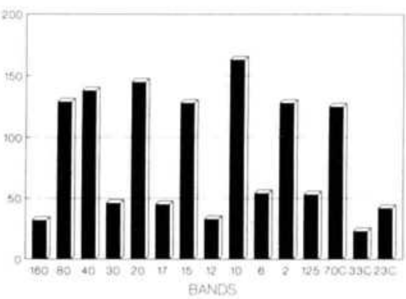
AREAS OF AMATEUR RADIO INTEREST



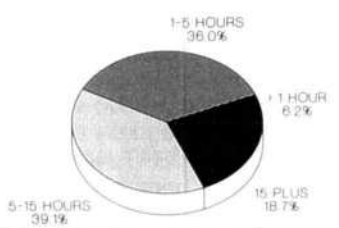
HOW MUCH DID YOU SPEND ON AMATEUR RADIO
In the past 12 months



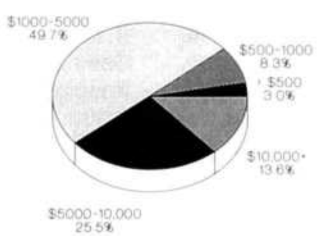
BANDS USED



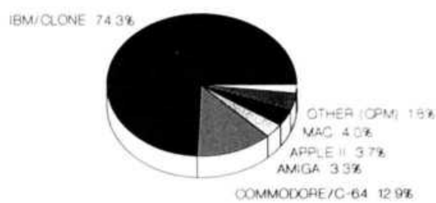
HOURS SPENT ON AMATEUR RADIO
Per week



HOW MUCH DO YOU HAVE INVESTED
In Amateur Radio Equipment



TYPE OF COMPUTERS
272 OUT OF 300 RESPONDED



—*KC1EX*

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

AO-16 PBBS UP AND RUNNING

The PACSAT PBBS was started on AO-16 tonight and appears to be running fine. I have already uploaded a list of all the people who contributed to the Microsat effort (16k) and the current AMSAT bulletin (15k). These files are now broadcasting. I also sent a small message to Jeff Ward, GØ/K8KA, co-designer of the protocols and implementor of the file server software.

Broadcast files have a little binary in front of each frame and are sent from PACSAT-11 to QST-1 with a PID of 0xbb. Some TNCs will filter out any frames that do not have a PID of 0xf0, which is the normal PID. If you can defeat this feature, you will be able to see the raw data frames. Most TNCs have a TRACE ON command that will show you the hex dump of the frame if you want to see what is going on. The best thing, of course, is to run PB.EXE.

AO-16 sounds like it is transmitting data continuously now, which it is, but due to the PID of 0xBB on the broadcast frames, you may not see all of them with a regular TNC. You will still be able to digipeat, however. Since the transmit queue is full now, your digipeated frame will take longer to come out (there will usually be three broadcast frames in front of your packet). I will probably reduce this number on the next upload.

Telemetry frames will continue to come down as always, at a 30-second repeated rate.

We will probably wait a few days to see what problems develop or what adjustments need to be made before loading the software to LO-19. I have already encountered an oversight that will cause me to unload and reload the file server program, probably later in the week.

It has been a long road to this point and a lot of work by a lot of people, but we are close to where we want to be. It should be only a few days more before the rest of you can log into the spacecraft and upload files. Anyone can write their own software to send and receive, of course; the protocol specifications are in the *ARRL 9th Computer Networking Conference* proceedings. Several people have already written a broadcast receiver; this is the easiest one to do.

A reminder: the PACSAT PBBS design is not like the PBBS on FO-20. If you connect to the PBBS call sign, you will get a binary prompt meant for a program and you will be logged off after a while. Although you will not get a good idea of what I am talking about until you see it in action, it is very nice to be able to prepare the messages off-line, then have the program automatically connect up and send your messages.

November 13 Microsat Status Report

AO-16 is currently running the basic command and telemetry system, without the Whole Orbit Data (WOD) routines. This is in preparation for a full reload later this week with an updated operating system. Fixes include various improvements in memory utilization, making more memory available to application programs.

This operating system will support the first production version of the file server software, to be loaded this weekend. That version will support the full 8-Mbyte file system.

DO-17: No Changes. Uploading new software is planned for December.

WO-18: The version 3.0 imaging software was unloaded November 13. The 3.5 version was scheduled to be loaded November 14. This version uses the arrays currents as well as the horizon sensors in the attitude determination algorithm. A variable timer has been added allowing a longer time for constraints to be met before an image capture is triggered.

LO-19: No Changes. Uploading the file server is planned for late November.

—by Harold Price, NK6K, via CompuServe's HamNet

GROUND STATION SOFTWARE FOR SATELLITE PBBS

The store-and-forward software loaded on UO-14, AO-16 and LU-19 requires ground station software in order to interpret the data which is in binary rather than ASCII format. A description of the protocol used is presented in the *ARRL 9th Computer Networking Conference* proceedings. Software will be made available as shareware on CompuServe's HamNet and from the Dallas Remote Imaging Group BBS at 241-394-7438.

The software is broken into five distinct packages. PFHADD is a program that adds a header to a file and prepares it for uploading. The header contains information on the source, destination and contents of the file. It also contains the file name, which is used when the file is later downloaded. A file must have the header appended before it can be uploaded. Basically, you create a file using you favorite editor or get a file from any other source, including .EXE or .ZIP files; run it through PFHADD; and get a .OUT file. This file is then sent via PG.

The PG program is used to upload and download files in the connected mode. It can get a directory of all files on the spacecraft. A later version will be able to select files based on the contents of their headers. PG has an upload command that will send all files with a tag of .OUT in the current directory. It will also automatically continue sending files which were partially transmitted on a previous pass. It has a download command that will download selected files, and it will automatically continue receiving files which were partially downloaded on a previous pass.

PHS is a program that removes the header from a file that has been downloaded or received as a broadcast. It will use the embedded file name to build a file on your disk (if a file with that name does not already exist).

The PB (broadcast) program is used to capture files that are being broadcast. It can capture up to 10 concurrent broadcast files. Lists of missing segments of files are kept and files can be gradually accumulated over several passes. It can also request that a file be added to the broadcast queue. A requested file is broadcast for five minutes. A special version of PB is available to Official Bulletin Stations to have messages broadcast for longer periods.

These five programs are preliminary versions and require some human intervention to direct their activities, such as selecting files to capture and download. Future versions will be totally automated. In addition, you will be able to send and receive ASCII or binary files of arbitrary length (up to 2 Mbytes for the first version) and will be able to passively receive bulletin and other broadcast files.

The programs will be fully documented. The initial offering of these programs will be for IBM PCs and IBM clones. The programs are also in the process of being ported to other platforms and AMSAT will announce when and where they are being made available.

—from AMSAT

TEXNET VERSION 1.60 IN THE WORKS

Some of you may have already seen sign-on banners from the MURPHY or RICH nodes indicating that Version 1.60 of TexNet code is in test. Hopefully, by the time you read this it will be installed in a few more locations for more exhaustive testing. The primary benefit to the average user will be more reliable links. For network managers, less time will be needed to keep things running smoothly. The changes incorporated in 1.60 are the result of over a year of observation of links that appeared to be functioning normally at the link layer, but showed no route at the network layer. Briefly, what would happen was that, due to either poor propagation or channel contention on the backbone frequency, the link layer would retry out at one side of the connection. The other side would still be in the retrying process when the conditions improved and the link layer connection would get reestablished. Unfortunately, the information required to have a network circuit is lost during that process. Therefore, several changes were incorporated in the 1.60 code to re-establish the information necessary for network packets to be carried on that broken and reconnected link layer connection.

These changes in the TexNet code in no way modifies Texas Packet Radio Society's (TPRS) recommendation of a 30-mile path maximum between node sites. The best way to have a reliable network is still to have good solid paths on the 440-MHz backbone.

Other changes in 1.60 are primarily aimed at network management. It will now be possible to look at the routing table of a remote node and make changes, if required. Statistics are now standardized on the basis of four ports. All nodes will respond as if they were equipped with four channels. Those channels that are not available on that particular node will be sent as zeros. Along with the statistics, three additional bytes are sent to indicate the node type and software revision. These will not be displayed on the user screen, but the automated network management software will be able to make use of these extra bytes. SYSOPs will be able to force the sending of the I'M HERE network announcement to bring wayward nodes back into the flock instead of having to initialize the node.

The other change is one made to allow a user to be disconnected upon any error condition. This is for the benefit of automated users such as PBBSs or PacketClusters that are unable to understand the error messages being returned. Since these users are normally making connections across the network rather than using the internal services, the switch for this function is part of the Connect command sequence. When this function is available at your node (as indicated by the sign on banner as being Version 1.60 or later), you may use the following command: C % W5ABC @ ANODE. Anything that causes the connection to fail will disconnect the originating user.

—by John Koster, W9DDD, from *The TPRS Quarterly Report*

GRAPHIC PBBS SOFTWARE PROPOSAL

From the title of this article, it would appear that there is something wrong with the current generation of PBBS software. Well, in my view, there is! All of the PBBS software presently available suffers from the same problem: they are all text-based. All are designed to run on the ubiquitous IBM PC, which means an 80-column display and, quite reasonably, all output from these PBBSs assume an 80-column display is at the receiving end. But what if the poor user has only a Spectrum or C64?

An 80-column display on these machines does not look very nice! Then again, do we really need just a text-based system or can we somehow provide the users with a viewdata type PBBS system? We can assume that the end is near for pure text-based systems. I base this assumption on the fact that WA7MBL is no longer supporting his code and WØRLI and AA4RE updates seem to be getting farther apart. Indeed, I would suggest that all text-based systems have now reached the end of their development and any other advances, from the users point of view, will be small. Perhaps there will be enhancements to existing commands, but even non-user functions, ie, those used to forward mail, etc, have reached the end of development. Even the compression of mail forwarding is done in the G1NNA system (and has been from the start). So, what are the problems, if any, of providing graphics on a PBBS system? Adopting ANSI (American National Standards Institute) standards for character output should, in theory at least, allow graphics and text to be mixed on the same screen. (This article assumes version 3 of the ANSI manuals are used.)

For those who do not know about ANSI drivers, they are basically an extended set of characters, entered first with a control sequence. This sequence is always ESC[. There are a number of interesting options available, so let us start with cursor control. The cursor control sequences are CUU, CUD, CUF and CUB. These sequences either move the cursor up, down, forward (to the right) or backwards (to the left). The actual sequences are CUU ESC[#A, CUD ESC[#B, CUF ESC[#C and CU8 ESC[#D. The # can be an optional number, in decimal. So, to move the cursor backwards (to the left) one character, the sequence will be ESC[D or to move 4 characters forward (to the right) will be ESC[4C. Note that ESC is ASCII 01BH, so the sequence to move right would appear as codes 1B 5B 04 43.

There are two sequences that move the cursor to a particular screen position, CUP and HVP. The sequences are ESC[#;#H and ESC[#;#F. The H sequence is not mentioned in version 3, but is still available. The first # is the row and the second #, the column. To move the cursor to about the middle of the 80-column screen, the sequence will be ESC[13;40F which will appear coded as 1B 5B 31 33 3B 34 30 66. There are also sequences to get the current cursor position, erase the whole screen or scroll parts of it, set modes and graphics rendition, etc.

The adoption of ANSI graphic sequences would seem an ideal way of mixing text and graphics on a PBBS. But there are problems. Not all computers can support the ANSI sequences. Worse, most PBBS software will not allow the sequences to be displayed: they eat them. Again, the 80-column standard cannot be used even with these sequences as the display will not look right on screens with less columns, as mentioned before. So what is the solution? In true amateur fashion, we take a standard and adapt it to our needs. This was done with X.25, which became AX.25, so I propose an "AANSI" set of sequences and commands that remove the problems of the 80-column display. This will also allow the free mixing of both text and graphics, moving more to the view-data type of PBBS which will, I am sure, be the PBBS of the 1990s.

—by Steve Coleman, G4YFB, from *Connect International*

FAX MODEM TESTS CONDUCTED

Between July 25 and August 6, Robert King, WB8WKA, and Jeff King, WA8OOH, tested a CCITT V.29 FAX modem chip, the Yamaha 7109, between their respective packet radio stations. Distances involved were about 7-8 miles over urban terrain. Results were quite positive with respect to the performance of the radio link.

Equipment, power levels and software used are as follows:

WA8OOH in Livonia, MI: ICOM 28A (5 watts), MFJ 1270 TNC, MSYS V1.08 on IBM AT.

WB8WKA in Farmington, MI: Kenwood 7950 with 160-watt amplifier, GLB TNC2A, NOS on IBM AT.

Additional radios were also tested. At WA8OOH, good results were also obtained with a 215 Kenwood HT at 200-300 milliwatts. A Kenwood 7730 was also tested with very poor results.

At WB8WKA, tests were also run at power levels less then 160 watts with excellent results, but due to the sharing of the radio with one of the Detroit/Windsor TCP/IP LANs, running lower power full time was not practical. In addition, an ICOM 2AT was tested at l00 mW with excellent results.

Signal strengths at both stations were full scale, even at lower power levels. The antenna used at WB8WKA consisted of an AEA Isopole at 50 feet, while at WA8OOH, a Hustler G7 at 20 feet was used. All tests where conducted on 2 meters.

As was to be expected, throughput took a dramatic step up. About one megabyte of files were moved via TCP/IP with the throughput hovering around 100 bytes/sec. While this is certainly nowhere near 9600 baud, it was a significant jump over earlier TCP/IP testing at 1200 baud. It is thought that there may be some incompatibilities between MSYS TCP/IP and NET/NOS. Tests will be run later this week between two MSYS stations to see if this figure can be improved.

In AX.25 operations, (user to PBBS) operation was, simply put, a dream. By using the XF command in MSYS, full packets were transferred. Setting X22 allowed a full screen to be transferred at a time. Throughput was about 1 page per second, which works out to be about 6000-8000 bits/s. From a user perspective (I was the user in this case), it made operating the PBBS much more enjoyable. Since many of the LANs in southeast Michigan are crowded, the additional speed did not go to waste.

If I may quote WA4DSY, "Oh where, oh where is my high speed digital?" What this means, of course, is that we were not able to fully exercise the modems due to MSYS and/or our TNCs not being able to go beyond 9600 baud. The TNCs were modified for 19,200 baud operations, but we experienced dropped characters. In any type of KISS operation, it is important for maximum throughput that your data link (asynchronous link) be at least twice as fast as your radio link. We were not able to achieve this, but our hope is that much faster throughput can be obtained.

Improvements

Audio setup is much more critical. Tones will tend to sound undermodulated. In addition to audio setup, a key-up delay circuit must be setup as well because the modems send a training sequence upon key-up. This must be held off until the radio is fully keyed-up (generally 100-200 ms). Once these parameters are set up, things seem to be fairly stable and the modems can be relied upon in day-to-day operations.

An easier method for tune-up needs to be developed. If possible, mounting inside the TNC would also help. Current Carrier Detect in the Yamaha chip is useless. We have been unable to get the state machine DCD to work on this chip, but it is needed. Current layout uses ±5 V. This needs to go; it should run on only +5 V. Also, it needs a programming header and mode select DIP switch.

The existing PC board (a carbon copy of the PRUG circuit board) needs to be improved. Quite a bit of digital noise exists on this chip and a relayout of the PC board would help greatly.

While my original idea for using this modem was networking, more and more I am beginning to feel this will be the next step for the end user. In many applications, such as the DX cluster, TCP/IP, and PBBS operation, the increase of speed on the user LAN is becoming more important. While this modem should be a fine performer on our network backbones, the ease of implementation and the fact that it can be used on existing radios unmodified should be quite appealing for the amateur that wishes to increase LAN throughput.

In the next week or two, I will relayout the circuit board to include the improvements that are needed. In addition, I desperately need schematics for TNCs. I have schematics for the TNC 1, TNC 2, PK-232 and DRSI. If you have schematics for any other TNC, please send a copy to me at 22816 Maple Avenue, Farmington, MI 48336. Also, if you would like copies of the article describing this chip, please send an SASE to the same address.

So far, 16 people have expressed interest in participating in a beta test of this modem. What this basically means is that we will all get together and make a group-buy of parts and such to reduce our costs. In addition, of course, we will share information. With a professionally done PC board and all the parts, I expect costs to be on the order of $60-70. This is assuming we can get a decent discount of the YM7109 (fax chip) as it alone goes for $55!

—by Jeff King, WB8WKA, from *Packet Status Register*

LOW-COST, PORTABLE PACSAT STATION OPERATIONAL

Researchers at the University of Surrey took their portable packet satellite station out into the field and put it on the air last week. UoSAT/Microsat software developer, Jeff Ward GØ/K8KA, used the 9600-baud semi-automated packet station to operate UO-14 from his apartment.

As Jeff describes it, other than the antennas, the station fits in a metal carrying case about the size of a small briefcase. The RF gear (built by GØ/VE3LMX in the UoSAT Lab) uses single-channel FM receiver and transmitter strips from Wood & Douglas with minor modifications. The transmitter generates 10-watt output and no Doppler compensation is used. The receiver has a daughter board with an automatic frequency control circuit. This AFC sweeps the entire

Doppler band until it detects the satellite, allowing for unattended operation. The transmit/receive equipment costs less than $200. The system also uses a PacCom 9600-baud modem, which was added to the TNC as a daughter board. The TNC and modem both fit into the standard small extruded TNC case.

The receive antenna used was a 1.5-turn helix sitting on the ground pointed more or less straight up with a turnstile for the uplink. Jeff's initial attempts with a ¼-wave ground plane on receive gave little success. So as not to alarm his landlords, he put the antennas very close to the house. They are completely blocked on the south and west, but look fairly clear to the north and west.

On the evening of November 3, during a 60-degree pass east of his location, he managed to connect to the spacecraft FTL0 PBBS server, obtained a directory, uploaded a message and download about 16 kbytes. He then switched to the broadcast protocol, requested and received an AMSAT Keplerian element file. The next morning he was able to download a reply to his message. Jeff feels that he should be able to receive 100-kbytes of data on any pass of 10-degrees maximum elevation or better.

This effort illustrates that, as many people have shown in the past, you do not need lots of money to get into this corner of the hobby.

—from AMSAT

HELLO, ROSE OF TEXAS

In the past four months, a sizable ROSE packet switching network has been installed in Texas, Louisiana and Oklahoma. Many NET/ROM nodes on 145.01 MHz have been converted to ROSE switches. The network currently includes a total of 19 user input/output switches and seven backbone switches. Cecil Estes, N5DT, in Waco, Tom Callahan, N5BCA, in Dallas, and I, in College Station, originally planned to change the NET/ROM nodes between College Station and Dallas to see how well a ROSE system would actually perform. After testing the February 3, 1990, version of the code at my house, we decided it was worth a try. Earlier versions of the ROSE code had been known to have bugs and, unfortunately, the 900203 version also had some bugs. After monitoring for a while and tracking down what caused the problems, a new version of ROSE was released (900713). We installed it and it has been working very well. We are quite pleased with the results. In particular, we can now have seemingly indefinitely long contacts without getting disconnected. None of the hardware was changed during the conversion, so that was a big factor in deciding to permanently change to the ROSE code.

The ROSE network is easy to use since one direct connect from a TNC will establish a link to another packeteer anywhere within the network. Primary and alternate routes are configured by the network managers. Information about the network is posted on each ROSE switch, so any packeteer can check his local switch for network help.

There are plans to enhance the network in several ways. The UHF backbone will be upgraded to 9600 baud. The backbone currently extends from College Station to Dallas with one branch to the east of Waco to Malakoff. Jacksonville and Carthage plan to get on the backbone. The first ROSE switch in Arkansas is scheduled to go on the air very soon. It will be located in Mena. Mississippi has just installed their first switch in McComb.

A drawback to the 900713 version of ROSE is its inability to pass TCP/IP packets. Thus, if TCP/IP is your cup of tea, ROSE will not meet your needs! Fortunately, Tom Moulton, W2VY, and the organization developing the ROSE code plan to make the changes needed to pass packets with any PID value.

—by Charles Burnett, AA5AV, from *The TPRS Quarterly Report*

AMSAT SPACE SYMPOSIUM DRAWS LARGE CROWD

The Johnson Spaceflight Center (JSC) near Houston was the site of the 1990 AMSAT Space Symposium and was deemed an unqualified success by its 225 participants. The JSC Amateur Radio Club sponsored the event at the JSC Visitor Center Auditorium. Twenty-two talks were presented during the three-day event. The subjects of the talks ranged from an update on the Microsat operation, beginners' sessions on what it takes to operate through a satellite, to a look at possible new AMSAT satellite projects. Ron Parise, WA4SIR, along with Lou McFaddin, W5DID, presented a talk on the Shuttle Amateur Radio Experiment (SAREX) program. Lou spoke on how the concept was developed and sold to NASA management. He also brought some of the prototype and flight hardware to be used on the STS-37 flight, which will have at least four hams on-board. [Late word is that there will be *five* hams on STS-37.—Ed] Ron spoke about his mission on STS-35 and how the amateur operations will be fit into his mission time line.

After Sunday morning's talks, a number of attendees toured the station of Dave Blashke, W5UN, the site of the largest 2-meter EME array. After Dave demonstrated armchair copy of SSB signals off the moon, he was presented an award for his work rescuing DO-17 (DOVE) from a condition that prevented modestly equipped command stations from issuing commands to DOVE.

—from AMSAT

STRAY BITS

RUDAK-2 Launch Imminent

According to Peter Guelzow, DB2OS, of AMSAT-DL, the launch of RS-14/RUDAK-2 was expected on or about November 29.

The DIGICOM Exchange

Chris Rendenna, KB2BBW, produces a monthly newsletter that contains technical information and operating tips for DIGICOM>64, the TNC emulation software that runs on a Commodore 64 computer. *The DIGICOM Exchange* is distributed via packet radio for free and hard copies may be obtained by sending an SASE monthly to KB2BBW at 709 Ten Eyck Avenue, Floor 2, Lyndhurst, NJ 07071. Chris also has an English translation of the DIGICOM>64 Version 3.51 documentation available for $1 per copy.

TAPR Annual Meeting Scheduled

The annual meeting of Tucson Amateur Packet Radio (TAPR) will be held on the weekend of March 2-3, 1991, in Tucson. Further details will be published when they are available.

AN INTRODUCTION TO FLAMING

Flaming, for those not familiar with this practice, consists of activities performed by electronic mail (typically on the Internet), which, if done in person, might be called mud slinging, raving, blowing one's cool, or throwing a tantrum. It requires that a modicum of fact and a maximum of opinion be loudly proclaimed in a message, which is then provided with wide distribution among the target audience, usually those having interests in common with the writer. This sort of behavior is fairly common on the net and provides much of that medium's entertainment value. In ritual performances, one receives formal notice of what's to come in messages of the form:

> In message 23456.dingbat@foobar.edu, Joe Dingbat writes:
> Quote from Joe
> ***FLAME ON*** (Whoooshhh!!!)
> [Formal warning: send the kids to bed]
> Dingbat, you're a -*%!!@ lid who couldn't tell his left foot from a DSP chip if his life depended on it!
> Rant! Rave! Babble!
> [Additional frothing at the mouth deleted by a merciful editor.]
> ***FLAME OFF** ~
> There. I feel better now.
> (Signed) Al Hacker, AHACK@turkey.com

The FLAME ON/OFF notices allows those not in the mood to be screamed at to skip such messages. Someone originating a posting (message), which is of a controversial nature and likely to trigger flames in response may also include the line:

> flames > /dev/nul

at the end of the message. This signifies, in UNIX-Speak, that you needn't bother sending him flames 'cause he ain't a-gonna read 'em, let alone answer 'em.' This does not, of course, deter those whose flames are posted simply for the amusement of the net rather than in anticipation of a response.

Another type of flame consists of digs at people, places or things without the appropriate FLAME ON warning. This is dangerous if done by persons alleging some expertise in the subject at hand, as it may lead the unsuspecting reader to assume that the criticism is to be taken seriously when in fact it's just another performance.

—by Dick Barth, W3HWN, from *AMRAD Newsletter*

PACKET IN AIPOTU

Trebor appeared for a visit, if such it can be called; this time we talked about packet radio in Aipotu. For those unfamiliar with the Parallel Universe phenomenon, a few words may help in understanding the background of this visit. I think the hole between the universes was caused by the interaction of the experimental tri-helical antenna with the vectored spread-spectrum transceiver. Regardless, from time to time Trebor gets duplicated from his home universe into ours and he says I get duplicated into his. I have no memory of being in his world. The duplicates only last about an hour, then fade away. When we talk, it is pointless to tell him anything, as he will neither remember nor take it back with him; our conversations are one-sided. He says it is the same on his side, but, of course, I do not know about that.

In Aipotu, he reports, their packet radio has a history similar to ours, but in the past three years they have deviated from the path we have taken here. They had the same problems with channel congestion and overload, but instead of diverging into various interest groups (keyboard, TCP/IP, DXSPN, PBBS), they concentrated their efforts on technological developments. I will summarize the system used there, as well as his comments about ours.

In Aipotu, the national amateur radio association (NCEC, North Columbia Etherwave Club) has been a leader in amateur technology and has coordinated the development of the continental network of packet systems. The leadership has been active in equitable redistribution of frequency allocations as technology advanced and appears to have avoided our tendency to look forward to the past. When packet first appeared, a committee was formed to plan for future growth and improved technology. The results of that planning are evident in their present system.

Trebor has expressed surprise (as he does every time) that we use 1200-baud AFSK for packet. They have been using 9600-baud FSK, duplex transceiver-TNC-terminal units, about the size of a portable computer. The integrated design and widespread use of the units means they cost about as much as one of our all-mode VHF transceivers. He estimates that they have five times as many packet users as we have. The cooperation of the local equipment manufacturers, who foresaw the packet explosion, has been an important component in the evolution of the system. Trebor is always surprised that we do not make equipment in this country and says that they would not have been able to develop their system using equipment developed for audio use. Their "PK" units can be set to connect to each other in remote locations or emergencies, but are usually used through a network of crossband duplex linear transponders (CDLT). In CDLT use, the user unit transmits in the 480-Mc (cycles, not Hertz) band and receives in the 960-Mc band. Each CDLT has one or more associated "Exchange" stations, that act like our PBBSs, but also incorporate TCP/IP, DXSPN, NET/ROM and DSP (Digital Speech) capabilities. The user's PK unit can be set for any type of use (personal mailbox at the same time as real-time keyboard contacts, while monitoring the DXSPN).

The PK connects to the Exchange on the calling frequency, which is the same everywhere. The Exchange then assigns the contact frequency and the PK shifts to that frequency. The Exchange can add more transceiver units (channel pairs) as needed by the user load. Each Exchange is a member of a Local Exchange Network and a hierarchy of InterLENs, Wide Area ENs and Trans-Continental ENs, operating on the same basic principles (but at higher bauds), makes it possible to have real-time keyboard operating anywhere in the country.

The "PK4" packet protocol that they use has been adapted to permit much longer packets and additional information. Real-time communication packets get priority handling. Delayed ACKs, automatic frequency assignment, the ability to shift to the use of a separate channel for all ACKs, the ability of the Exchange to broadcast bulletins to multiple receiving PKs or Exchanges and the NET/ROM-like ability to back up and fill missed packets increase throughput far beyond that of our system, even if we were to switch today to 9600 baud.

The duplex crossband transponders make it possible for both PKs and Exchanges to operate without duplexers because the PKs, Exchange units and transponders all transmit in one band and receive in the other.

Just as we were beginning to get into the subjects of integration of the packet satellites and packet speech, Trebor faded out. I was left with more ideas and questions than I could handle alone, so I am passing this on. I hope it is as thought-provoking for you as it has been for me.

—by Robert Knapp, WW6L, from *The NCPA Downlink*

OLD DOGS, NEW TRICKS

"Great masses of Soviet radio amateurs are completely uninformed about how (the Radiosport Federation) works. Recently, the question was raised about introducing new types of communications. Finally, permission to operate packet was given. But to whom? Only to those who have a first-category (highest class license) station.

"Does this decision make sense? I do not think so. In our club, for example, twenty people have the first category. Twelve of them do not intend to operate packet. Why? Because all of them have reached an age when they do not intend to master a new technique, since it is beyond them.

"But we have 309 people with stations of the second and third categories. As a rule, these are young people who are inquisitive and full of initiative. But it turns out that the new type of communication is prohibited to them. So, who will master packet communication? The remaining eight people? Isn't that a little low?"

—by C. Yurchenko, chairman of the UHF Section, Moscow City Sport-Technical Radio Club, quoted in *Radio* magazine, as translated by Dex Anderson, W4KM

BROADCAST PROTOCOL SPECIFICATION FIXES

There is an error in the description of the flags field in the broadcast protocol specification as published in the *ARRL 9th Computer Networking Conference proceedings*, pages 240 and 242. The corrected version follows. Note that for UoSAT/Microsat, the O[ffset] bit will always be 1 and the E bit is not currently implemented.

On the request frame, the current s/c software will add a file to the broadcast list using the 00 command, but will not process the whole list. The entire file is sent. This and the E bit will be implemented in the near future.

```
Fix to A.2.1.1:

        flags       A bit field as follows:

 7 6 5 4 3 2 1  0
/----------------\
|* * E 0 V V Of L|
\----------------/

L       1       length field is present
        0       length field is not present

Of      1       offset is a byte offset from the beginning of the file.
        0       offset is a block number (not currently used).

VV              Two bit version identifier.  This version is 0.

E       1       Last byte of frame is the last byte of the file.
        0       Not last.

0               Always 0.

*               Reserved, must be 0.

Fix to A.3.2.1

        flags       - A bit field as follows:

 7 6 5 4 3 2 1 0
/---------------\
|* * * 1 V V C C|
\---------------/

CC              Two bit field as follows:

        00      start sending file <file_id>
        01      stop sending file <file_id>
        10      Frame contains a hole list.

VV              Two bit version identifier.  This version is 0.

1               Always 1.

*               Reserved, must be 0.

        --by Harold Price, NK6K
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GATEWAY CONTRIBUTIONS

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

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