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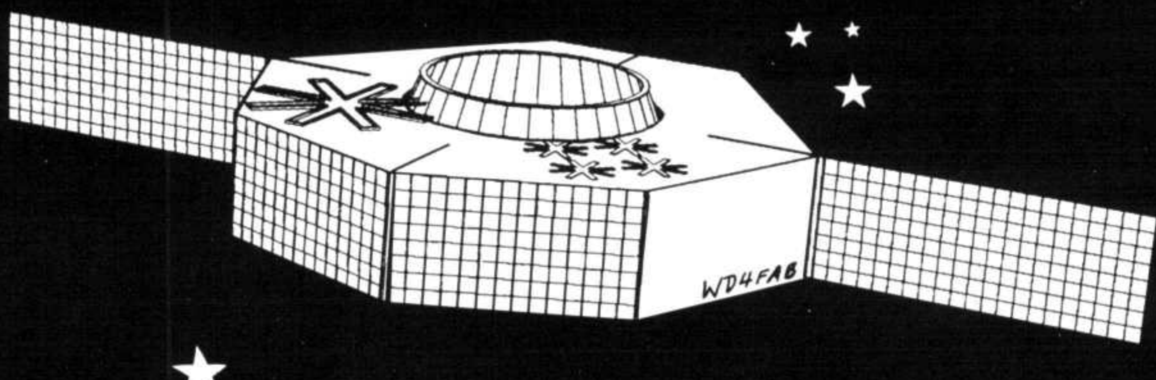
QEX 114 with Gateway

ARRL Experimenters' Exchange

AUGUST 1991



Could this be the shape of things to come? ★★★★★★★★★★★★★★★★★★★★

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TABLE OF CONTENTS

COLUMNS

On the cover:
This month's cover is a preliminary drawing of the outside envelope of the AMSAT Phase 3D satellite now on the drawing boards. *(WD4FAB drawing.)*

THE AMERICAN RADIO RELAY LEAGUE, INC

The American Radio Relay League, Inc, is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communications in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

ARRL is an incorporated association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is noncommercial, and no one who could gain financially from the shaping of its affairs is eligible for membership on its Board.

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Purposes of *QEX:*

1) provide a medium for the exchange of ideas and information between Amateur Radio experimenters
2) document advanced technical work in the Amateur Radio field
3) support efforts to advance the state of the Amateur Radio art.

All correspondence concerning *QEX* should be addressed to the American Radio Relay League, 225 Main Street, Newington, CT 06111 USA. Envelopes containing manuscripts and correspondence for publication in *QEX* should be marked: Editor, *QEX*.

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*.

Any opinions expressed in *QEX* are those of the authors, not necessarily those of the editor or the League. While we attempt to ensure that all articles are technically valid, authors are expected to defend their own material. Products mentioned in the text are included for your information; no endorsement is implied. The information is believed to be correct, but readers are cautioned to verify availability of the product before sending money to the vendor.

Empirically Speaking. . .

You Can't Win if You Don't Play

That's a motto often seen on lottery advertising. But it's equally applicable to *QEX* as an experimenters' exchange. Probably the most typical letter an editor gets is "Why don't you. . .," then it goes on to identify what someone else should do to satisfy the needs or preferences of the writer.

Of course, the simplest answer is "We can't print what we don't receive" in the case of a publication that's dependent upon reader-authored articles. While true, that's only part of the story. Editors, to be successful, have to get the word out on what kind of manuscripts they want, and *QEX* initiates contact with authors who should have something to say on topic X. Often, the author of choice on a given subject is deeply engrossed in his or her subject and given a choice between doing something or writing about it will choose the former.

A case in point is digital signal processing (DSP). There is a small number of Amateur Radio experimenters active in DSP design work, either hardware or software. Even fewer are skilled in both disciplines. ARRL has had some success in getting some good DSP overview manuscripts for *QST*. We'd like to have a series of theoretical and practical tutorials on DSP for *QEX*. If you'd like to work with us on developing such manuscripts, please phone, fax or write.

QEX serves a number of interests. Some people want to have information about the "cutting edge" of technology. Their definition of experimentation is doing something that no one has done before. More likely than not, their technology is digital. Another group does not feel "at home" with digital technology and would prefer to see RF/analog subjects get the emphasis. Amateur Radio is a bastion of RF/analog technology, as many in the industry will attest. Amateur Radio still serves as a valuable training ground for this discipline. *QEX* is interested in both analog and digital subjects. And there is room for both cutting-edge subjects and revisitations of technologies that have been around for a while.

Besides technical articles, we would also welcome articles describing new projects being undertaken by the authors as well as progress reports on those projects. Results of on-the-air testing of new systems are not often enough documented. Articles on carefully crafted propagation observations could contribute to the technical literature.

How do we get up-to-date technical manuscripts from the people working on the cutting-edge stuff? One way is to show a continuing interest. As a reader, a nice note of thanks to the author may be encouragement enough to evoke another article. If the individual is never going to write an article, then it may be possible to tape-record a talk and lift a set of overhead transparencies when the author gives a presentation. If there is no presentation, then maybe it's possible for a scribe to look over the experimenter's shoulder and document the good work. It seems that experimenters have a tendency to build something, make it work (once), then lose interest because something really neat is next in the queue.

At minimum, it would be useful for each experimenter to have a clean-up person, someone who would let the world know what had been achieved and possibly how to duplicate it. In itself, that doesn't get the idea or product into being except for the few who might want to replicate the work for their own use or to boost the technology yet another notch. Many have learned that some marketing skills are needed to drum up interest, get beta test models made, coordinate testing, and interest someone in making production models. Obviously, publication of technical design and testing information is an important part of any such effort.

Letters for the *QEX* Correspondence column are also welcome. This column is available for items that are not manuscript length and can be on any subject of interest to *QEX* readers. Bits may be used for short announcements. These columns have rather short lead times, particularly when you have something with a time element.

This is your experimenters' exchange. If you aren't familiar with how to prepare manuscripts, please ask for the ARRL Author's Kit.—*W4RI*

A Different Weave of SSB Exciter

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

This article describes an experimental 75-meter, 80-milliwatt single-sideband (SSB) exciter designed to make maximum use of modern integrated circuits (ICs). This exciter contains no crystal or mechanical band-pass filters, and no audio phase-shift network. Instead, IC low-pass filters are used to implement a variation of Weaver's method of SSB generation. I will discuss the theory first, and then specific circuit details.

Theory of Operation

D. K. Weaver's method of SSB[1] is little known in Amateur Radio, having appeared only once in *QST* in an article by Howard F. Wright, W1PNB[2]. Wright explains well how the Weaver method works, and explores the method's strengths and weaknesses by reporting the results of building a working Weaver exciter. A comparison of Wright's exciter to the exciter described here shows the tremendous improvement in analog signal processing components since 1957.

The block diagram in Fig 1 shows the similarity between Weaver and phasing methods of SSB generation. Like the phasing method, the Weaver method relies on converting the input audio into two signals, I_a and Q_a. After I_a and Q_a are generated, the remainder of the circuitry is identical for phasing and Weaver methods.

I_a and Q_a are applied to a pair of balanced mixers whose radio frequency (RF) carrier inputs, I_{rf} and Q_{rf}, are phased 90 degrees apart. The mixer outputs are added together and the result is ideally the desired SSB signal.

The Weaver and phasing methods have different methods of generating I_a and Q_a, and this results in different SSB signals being generated by the two methods. The spectra are shown in Fig 2. In the phasing method, the SSB passband is entirely on one side of the carrier frequency. In the Weaver method, the SSB passband is centered on the carrier frequency and extends to one-half of the passband width on either side of the carrier.

In the phasing method, the input audio is applied to a band-pass filter. As shown in the block diagram in Fig 3, the filter output drives an audio phase-shift network which generates I_a and Q_a such that I_a and Q_a are the same amplitude and 90 degrees apart in phase for all frequencies in the audio passband. The band-pass filter must have steep skirts for this filter alone sets the passband width for the final SSB signal.

In the Weaver method, a crude band-pass filter, two identical balanced mixers, and two identical sharp-cutoff low-pass filters are used to create I_a and Q_a. See the block diagram in Fig 4. The band-pass filter can be crude; its function is to block far-out-of-band signals from getting to the mixers. The filter output drives one input of each mixer.

[1]Notes appear on page 9.

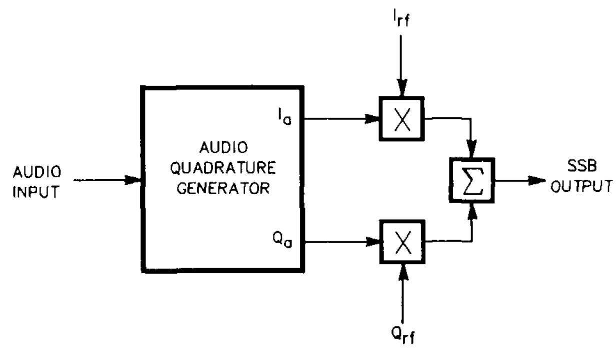


Fig 1—Block diagram of Weaver and phasing SSB generators. Blocks labeled X are multipliers or doubly balanced mixers. The block labeled Σ is a summer or power combiner. I_{rf} and Q_{rf} are radio frequency carriers. Q_{rf} is 90° out of phase from I_{rf}.

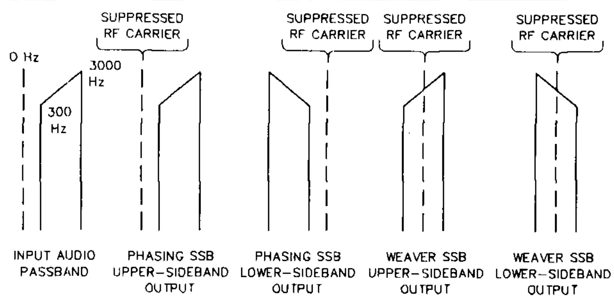


Fig 2—Frequency spectra of phasing and Weaver SSB signals. The RF carrier in the Weaver signal is in the center of the passband.

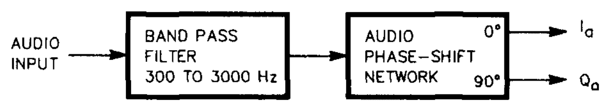


Fig 3—Block diagram of phasing-method audio quadrature generator.

The other inputs to the mixers, I_c and Q_c, are carriers 90 degrees out of phase from each other at a constant frequency of 1477 Hz, the center of the input audio passband. The mixer outputs go to the inputs of the low-pass filters, and the filter outputs are the desired signals I_a and Q_a.

The low-pass filters pass frequencies from dc to 1152 Hz, half the audio passband. The low-pass filters block frequencies of 1477 Hz and above. This is a very steep skirt:

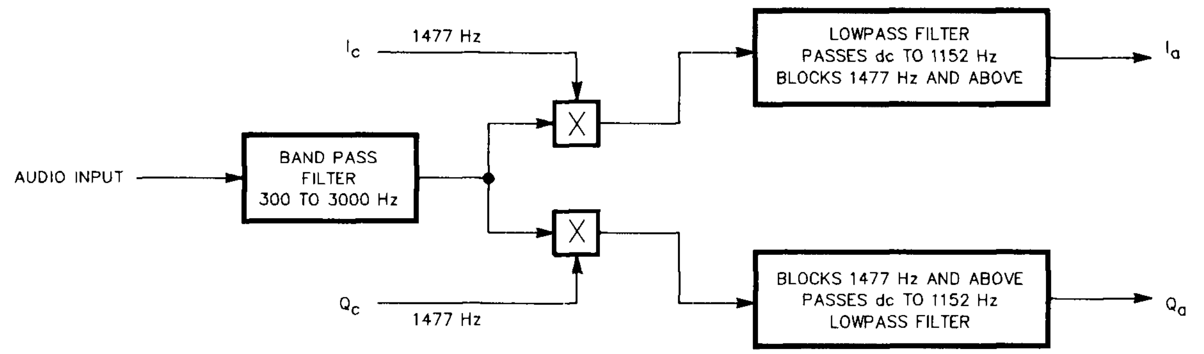


Fig 4—Block diagram of Weaver-method audio quadrature generator. I_c and Q_c are 1477-Hz carriers. Q_c is 90° out of phase from I_c.

stopband / passband = 1477 Hz / 1152 Hz = 1.28. An eighth-order elliptic filter will provide this performance and is available in IC form as the Linear Technology LTC1064-1.

The passband in I_a and Q_a is thus dc to 1152 Hz. The original audio passband is folded into the I_a, Q_a passband, so the audio passband is 1477 − 1152 = 325 Hz to 1477 + 1152 = 2629 Hz. Two frequencies in the audio passband, 1477 Hz − f and 1477 Hz + f, are converted by the mixers to the same frequency f in the I_a, Q_a passband. For one of the two, I_a leads Q_a by 90 degrees, and for the other, I_a lags Q_a by 90 degrees.

As in the phasing method, these phase relationships cause the 1477 Hz − f signal to appear on one side of the RF carrier, and the 1477 Hz + f signal to appear on the other side of the RF carrier. Thus, the exciter RF output signal is double-sideband, suppressed-carrier emission with different information in the two sidebands. This signal appears to be an SSB signal to a receiver. A conventional receiver dial will be set 1477 Hz away from the RF carrier frequency in the transmitter for proper reception.

Both the phasing method and the Weaver method will produce unwanted outputs if the phase or amplitude balance of the I_a and Q_a channels are not correct. These unwanted outputs are on the other side of the RF carrier frequency from the desired outputs.

For the phasing method, these unwanted outputs are outside the SSB passband and interfere with other stations on adjacent frequencies. For the Weaver method, these unwanted outputs are in the SSB passband and appear as audio distortion rather than as interference with other stations. This is a major advantage of the Weaver method. Good audio quality requires only 20 dB of attenuation of unwanted outputs, while the FCC requires out-of-band spurious outputs to be reduced more than 40 dB.

One unwanted output in the Weaver method is especially troublesome. Dc offsets in I_a or Q_a produce an RF carrier output in the center of the passband. Imbalances in the RF mixers have the same effect. This output can be reduced enough for a transmitter, but limits the dynamic range achievable in a receiver built with the Weaver method.

Wright had trouble with unbalances in his audio mixers, and with getting steep enough filter slopes. Modern parts solve these problems completely.

Circuit Details

The circuit diagrams for my specific 75-meter exciter are shown in Figs 5 through 10. All resistors are 1% tolerance to minimize gain-matching errors. 0.1% resistors would be better in critical areas.

Oscillator U1 provides a stable digital clock to drive the frequency dividers in the clock generator in Fig 5.

Complementary metal-oxide-silicon (CMOS) digital integrated circuits U2 through U7 form a digital frequency divider, providing the 1477-Hz carriers Ic and Qc and 115.2 kHz squarewave LPCLK. LPCLK sets the passband corner frequency in the switched-capacitor low-pass filters. This clock is 100 times the passband corner frequency desired in the filters.

I_c and Q_c are each actually two digital signals, as described below, as required by the particular audio mixers used. The I_c and Q_c generator includes an input, SB, which can be grounded to switch sidebands in the final output, by changing the phase of Q_c by 180 degrees. Fig 6 shows the timing relations of these signals. For the particular RF circuitry used here, leaving SB open (hence pulled high by the resistor) gives lower-sideband SSB output, and grounding SB gives upper-sideband SSB output.

The input band-pass filter, shown in Fig 7, is built from a single-pole high-pass filter and a three-pole low-pass filter. This filter also provides a midband gain of about 200, to amplify a 10-millivolts peak input signal to 2-volts peak, the signal level needed by the audio mixers and low-pass filters.

The audio input from a high-impedance dynamic microphone is high-pass filtered and amplified by op amp U11A. Op amps U11B and U12A form a three-pole low-pass filter using op amp U12A. Op amp U12B is used as a unity-gain inverting amplifier.

The audio balanced mixers, shown in Fig 8, are built with CMOS analog multiplexers rather than with diodes or transistors. The 1477-Hz signals, I_c and Q_c are CMOS-level digital signals controlling the multiplexers. The switches in each mixer select whether to multiply the audio signal by +1, 0, or −1, by connecting to the output of U12A, ground, or the output of U12B to the switch output.

One mixer is built from analog multiplexer U8, and the other mixer is built from analog multiplexer U9. The term "analog multiplexer" means that U8 (or U9) connects one of its analog inputs to its analog output, depending on the

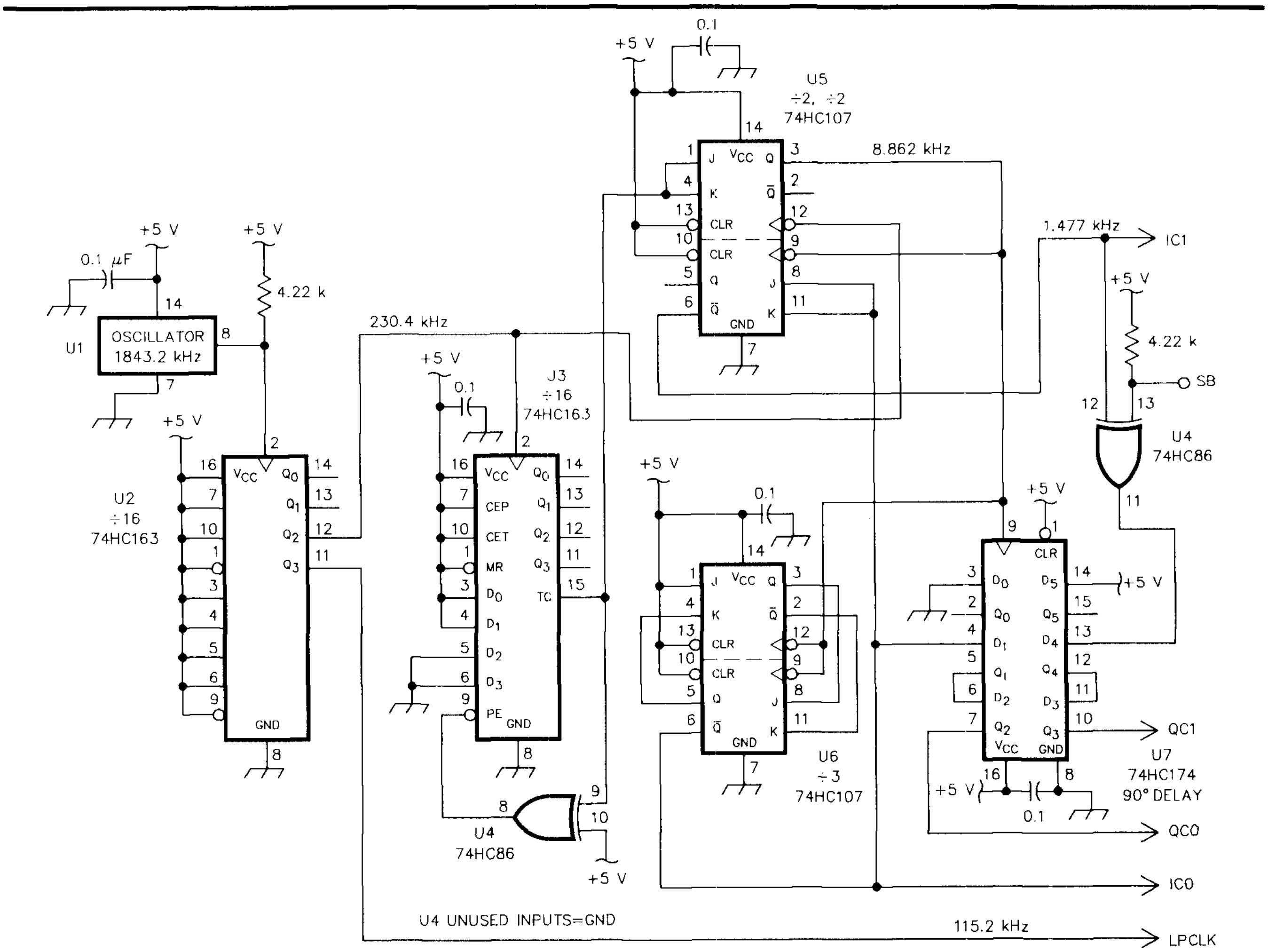


Fig 5—Clock generator.

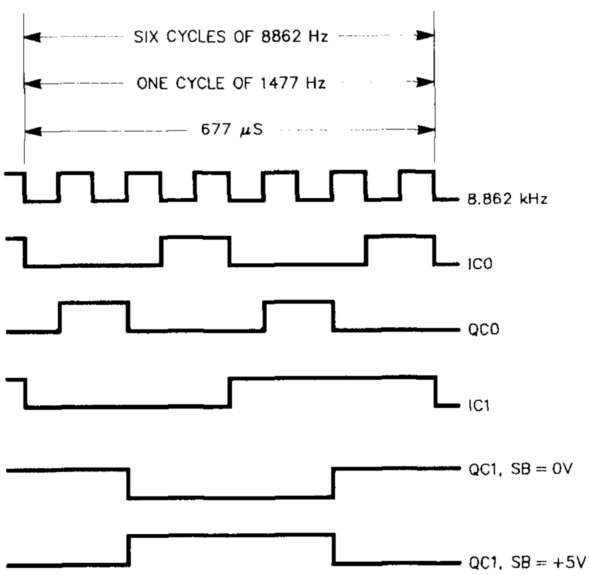


Fig 6—1477-Hz clock waveforms.

digital inputs ICO and ICO (or QCO and QC1). The multiplexer outputs are buffered by unity-gain op amps U12C and U12D.

Block-diagram signal I_c is actually two digital signals, ICO and IC1, and Q_c is actually two signals, QCO and QC1. This is done to permit the switches in each mixer to have three states, +1, 0, and −1, rather than the usual two states of +1 and −1. The state sequence used is +1, +1, 0, −1, −1, 0, for six states for each cycle of the 1477-Hz carrier. The lowest harmonic in this sequence is the fifth harmonic of 1477 Hz, which is 7385 Hz. Even harmonics are canceled out, as is the third harmonic.

The low-pass filters, U10 and U13 in Fig 8, pass frequencies below 1152 Hz. Thus, the desired input audio-frequency passband is from 1477-1152 = 325 Hz to 1477+1152 = 2629 Hz. The input band-pass filter must pass these frequencies. To block alias responses, the input band-pass filter must block frequencies above 7385-1152 = 6233 Hz.

U10 and U13 are eighth-order elliptic filters. They are switched-capacitor filters, so the clock noise must be removed from their outputs by one-pole passive low-pass filters. U10 and U13 also exhibit large dc offsets on their

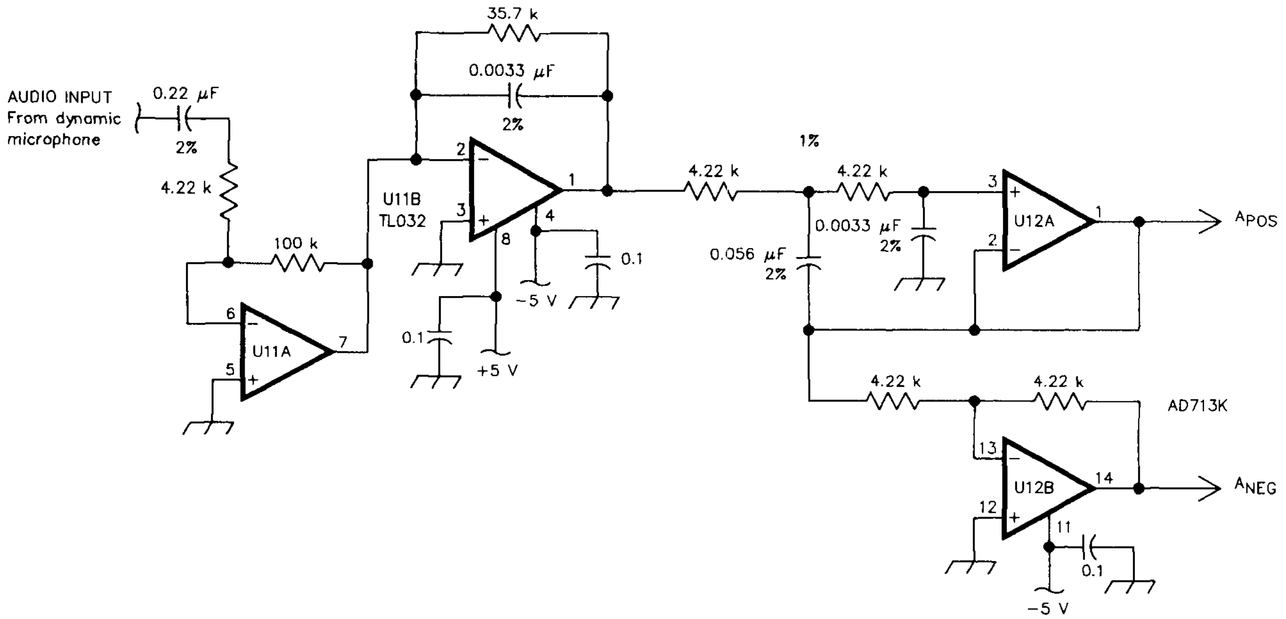


Fig 7—Input filters.

outputs, so fine and coarse offset-trim circuits are included. This gets us block-diagram signals I_a and Q_a.

Active low-pass filters built with op amps would be more complex, but would exhibit much less dc offset, reducing or eliminating the need for trimming.

Quad op amp U14 in Fig 8 converts quadrature signals I_a, Q_a to three-phase signals A_a, B_a, C_a needed by the RF mixer. I_a, Q_a are two signals of equal amplitude, with phases of 0 and 90 degrees. A_a, B_a, C_a are three signals of equal amplitude with phases of 0, 120, and 240 degrees. This circuit is called a Scott-T, after the original implementation with transformers.

The RF mixer shown in Fig 9 is unusual. Rather than two matched balanced mixers followed by a summer, a single three-phase mixer is used. This was done to reduce the VFO frequency from four times the RF carrier frequency to three times the RF carrier frequency, and to simplify the mixer.

The three-phase mixer multiplies a three-phase baseband signal, A_a, B_a, C_a, by a three-phase RF carrier, A_{rf}, B_{rf}, C_{rf}, to produce the desired SSB output. The mixer is actually an analog multiplexer, built of discrete parts because available integrated circuits were too slow.

Op amps U15B, U15C, and U15D, together with 2N3904 transistors Q1, Q2, and Q3, convert A_a, B_a, and C_a into precise currents, with added bias currents so that the currents never go to zero. The multiplexer switches these currents, rather than voltages, as current switches are generally faster than voltage switches.

The three starred resistors were added to trim the gains of the three channels to be the same when looking at the MOSFET drain current as described below. These resistors are optional; audio quality should be adequate without this trim.

Each current switch is implemented using gate one of a dual-gate MOSFET as the switching gate, switching the source current on and off. Gate two is bypassed to ground, to isolate the switch from the drain circuit.

Dual-gate MOSFETs Q4, Q5, and Q6 are 40673s. MFE211s or 3N211s could also be used, and may be more readily available. Each MOSFET has one precise current applied to its source, and one RF carrier signal applied between gate one and source. The source is bypassed to ground for the RF carrier, but not for the low-frequency precise current.

The RF clock generator, Fig 10, divides the VFO frequency by three to generate A_{rf}, B_{rf}, and C_{rf}. Only one of these three is high (+5 volts) at a time, with the other two low (0 volts). Thus, only one MOSFET switch is on at a time. Each MOSFET is on one third of the time. When on, the drain current is three times the precise current applied to the source. When off, the drain current is zero. There is also a current spike when the MOSFET turns on.

The combined drain currents can be observed by replacing the drain load circuitry shown in Fig 9, with a 383-ohm resistor to +12 volts. Observation of the drain voltage with a high-speed oscilloscope will then show the drain current waveform. At fast sweep speeds, the steps as each MOSFET turns on are visible, as are the current spikes. At slow sweep speeds, the waveform looks like the superposition of the three signals A_a, B_a, and C_a.

The drain load circuitry in Fig 9 is tuned to pass the carrier frequency component of the drain current to op amp U16, and to block low-frequency and harmonic components. U16 is the final amplifier of the exciter. U16 is operating with a loop gain of only 2 or so, so it isn't really being used as an op amp.

There are many new op amps capable of as good or better performance than the AD842 used for U16. Complementary-bipolar processes, which permit the building of ICs with fast PNP and NPN transistors on one chip, make these op amps feasible, and television and computer graphics provide large markets which make these op amps cheap.

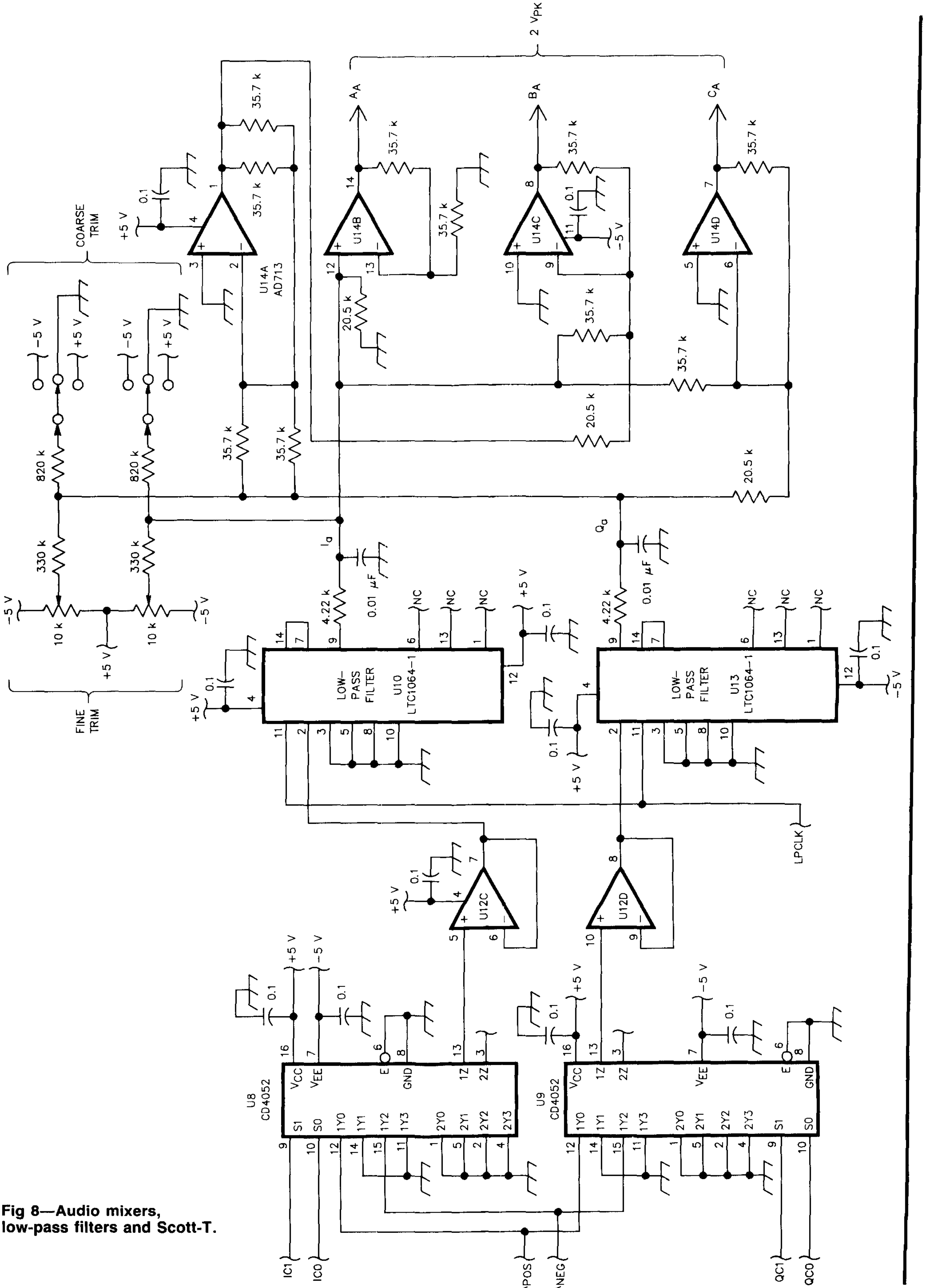


Fig 8—Audio mixers, low-pass filters and Scott-T.

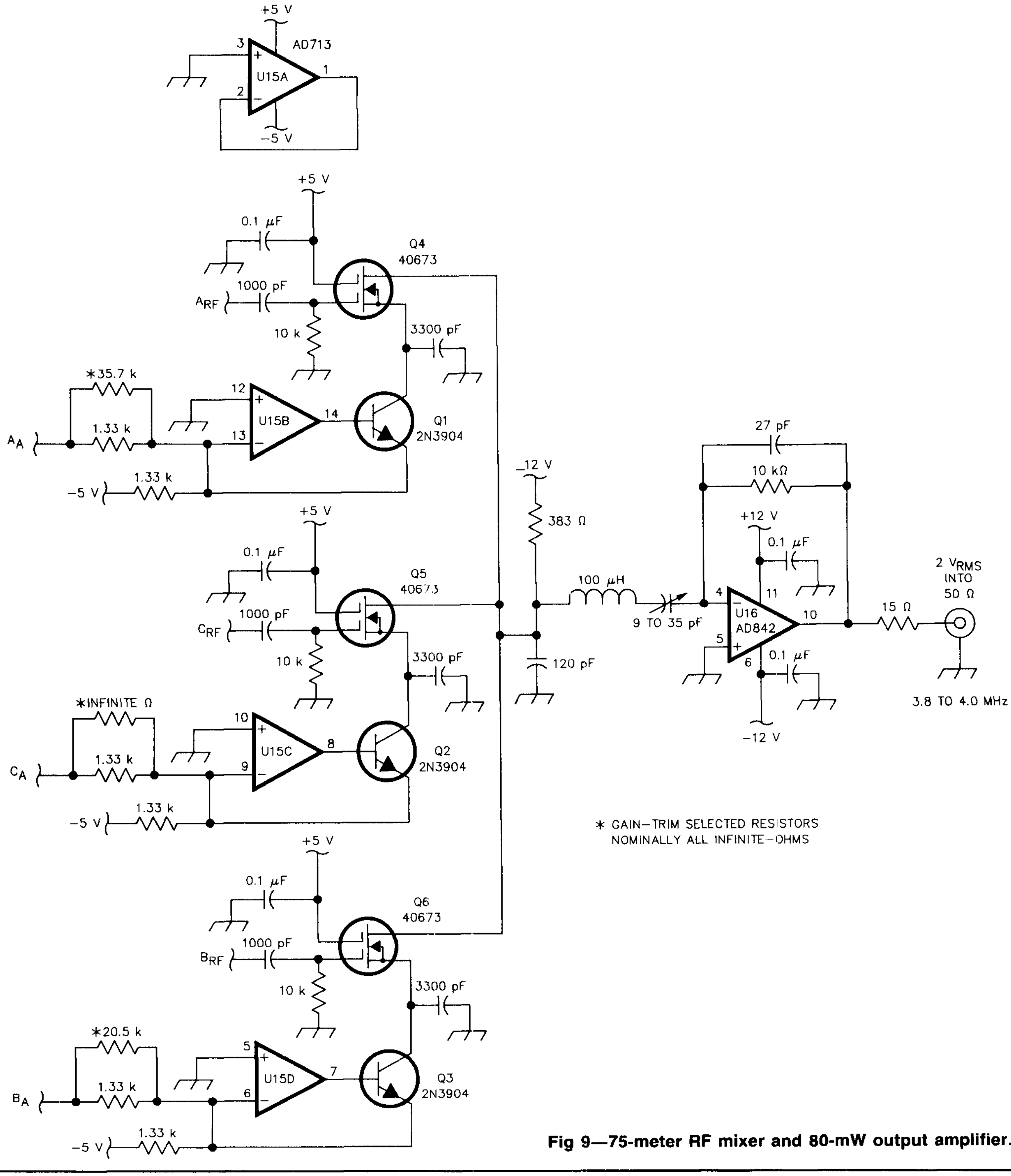


Fig 9—75-meter RF mixer and 80-mW output amplifier.

The 15-ohm resistor ensures that U16 will not oscillate if the load is reactive. This op amp is rated to supply 100-milliamps peak output current at frequencies up to 6 MHz. I was able to get 60-milliamps peak at 4 MHz without obvious distortion. This works out to 80 milliwatts into a 50-ohm load.

The VFO is a transistorized T195 VFO (3), with the capacitance in the tank circuit reduced to raise the frequency range to 12 MHz. The RF clock generator logic in Fig 10 is built from very fast CMOS logic circuits. These circuits are much faster than needed for the 12-MHz clock to reduce the analog effects of variations in digital propagation delays. The circuits are CMOS to get a 5-volt swing to gate one of the dual-gate MOSFETs.

This exciter performs well for a first experimental model. All spurious outputs are at least 40 dB down from

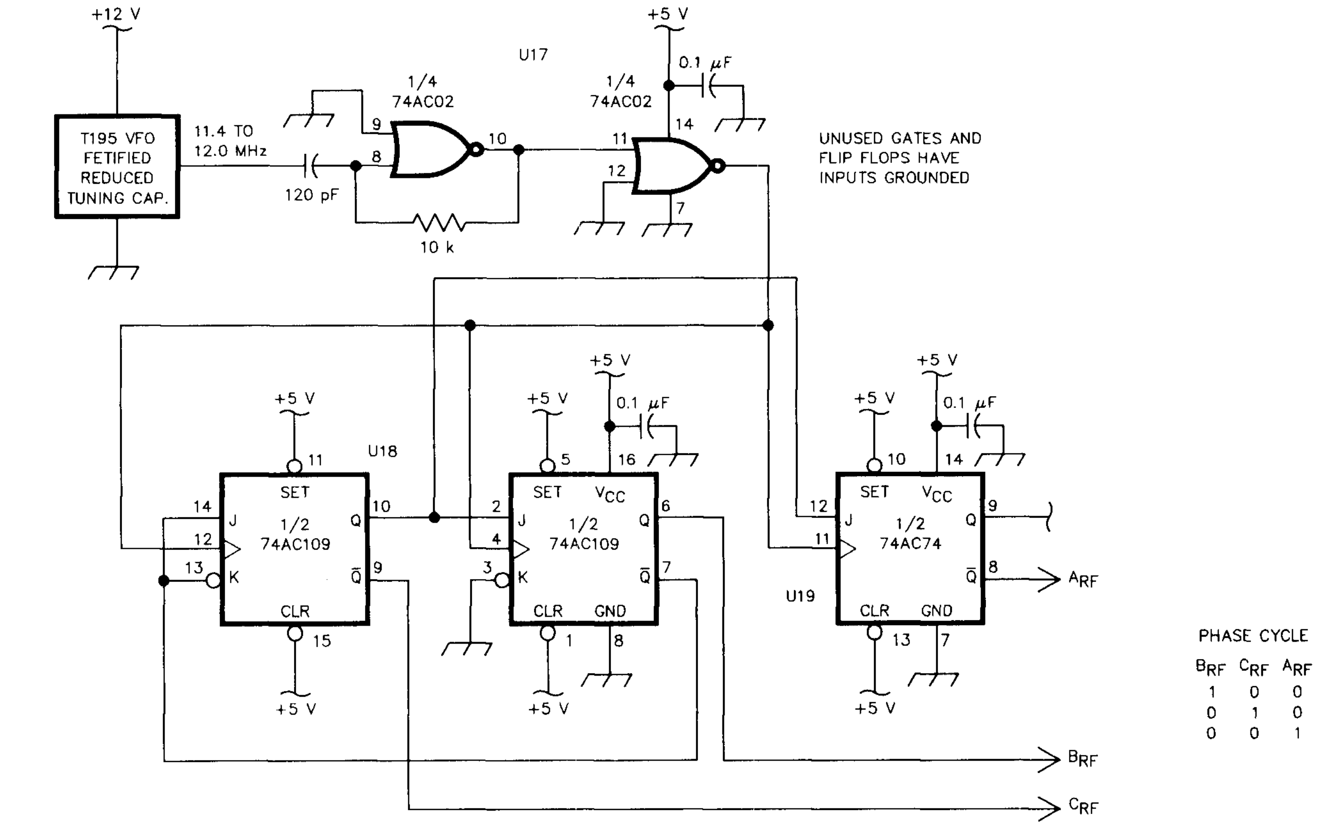


Fig 10—75-meter RF 3-phase clock generator.

full output, with the possible exception of harmonics of the RF carrier. I did not worry too much about carrier harmonics, as the following linear amplifier would require a low-pass filter anyway.

I tested audio quality by feeding audio from an all-news broadcast station into the audio input, and coupling the SSB output through an attenuator into a good communications receiver. The audio quality was excellent to my ears. The voices, even women's voices, were easily intelligible. This is impressive given the narrow audio passband used.

Gain mismatch problems were much worse to my oscilloscope than to my ears. This confirms Wright's observations[3]. Gain mismatch errors produce small amounts of unwanted sideband energy superimposed on the desired sideband energy. A design with no gain trims at all should be readily achievable.

A receiver converts the undesired sideband energy to frequency-inverted speech. Note that the unwanted sideband energy is within the desired passband, and causes no interference to adjacent channels. The ear tends to ignore the inverted speech.

Wright reported that 20-dB attenuation of the unwanted sideband produced excellent quality, and 10-dB attenuation good quality. He was even able to copy the signal with no attenuation of the unwanted sideband where the inverted speech was as strong as the normal speech.

Dc offset trims are necessary with the present switched-capacitor filters. Ac coupling the low-pass filter outputs could eliminate these trims at the expense of putting a notch in the center of the passband. The trims might still be necessary to correct for offsets in the RF mixer.

The residual RF carrier due to dc offsets was inaudible during speech passages. During intervals of silence, the receiver AGC would bring up the carrier level to easy audibility. The trimmed residual carrier was 40 dB down from full output.

The audio circuitry has to be carefully shielded to keep the RF carrier from beating with the clocks in the audio circuitry.

The Weaver method shows promise for designing easily producible SSB exciters, with little or no alignment needed. If the dynamic range problems can be solved, the Weaver method could also be used in receivers. A Weaver receiver would show very sharp filter skirts compared to many conventional receivers.

Notes

[1]D.K. Weaver, "A Third Method of Generation and Detection of Single-Sideband Signals," *Proceedings of the IRE*, December, 1956.

[2]H.F. Wright, "The Third Method of SSB, How It Works in Theory and Practice," *QST*, September, 1957, pp 11-15.

[3]P.T. Anderson, "Transistorizing Surplus VFOs," *QST*, February, 1989, pp 45-46.

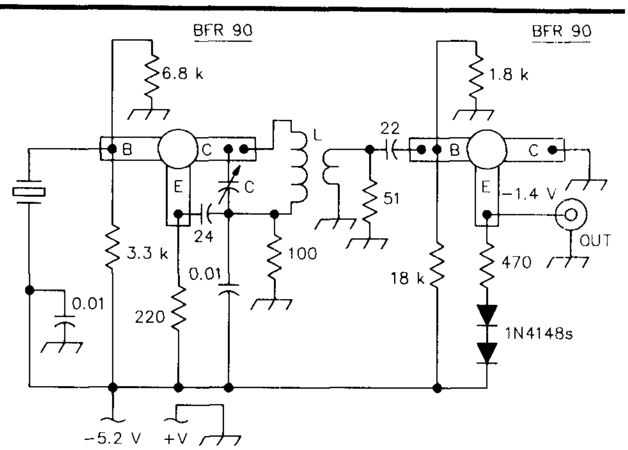
Correspondence

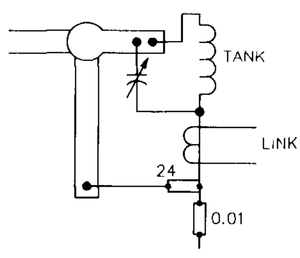
My interest in Quartz crystal controlled oscillators spans more than 50 years, but only recently have I attained acceptable crystal controlled oscillation above 200 MHz. I want to share with readers of *QEX* how this was accomplished by detailing two operating oscillator circuits, by describing simple test instrumentation for this endeavor, and concluding with an explanatory historical comment.

A VHF Crystal-Controlled Oscillator with Positive Ground

Preliminary testing of this circuit has been completed with satisfactory performance from less than 100 MHz to over 500 MHz. Fundamental or overtone-mode crystals may be used with no circuit alteration except for adjustment or modification of the LC tank to conform to frequency.

Buffered square-wave output is provided by means of a common-collector saturated amplifier. A −1.4 volt dc bias is provided on the signal line for direct drive of an emitter-coupled logic (ECL) gate. The positive supply source is connected to ground.





- The 24-pF capacitor is a disc ceramic type. It must be positioned in line with the cold end of the tank inductor. The link is placed between that capacitor and the tank. The value is not critical.
- Approximate LC dimensions:

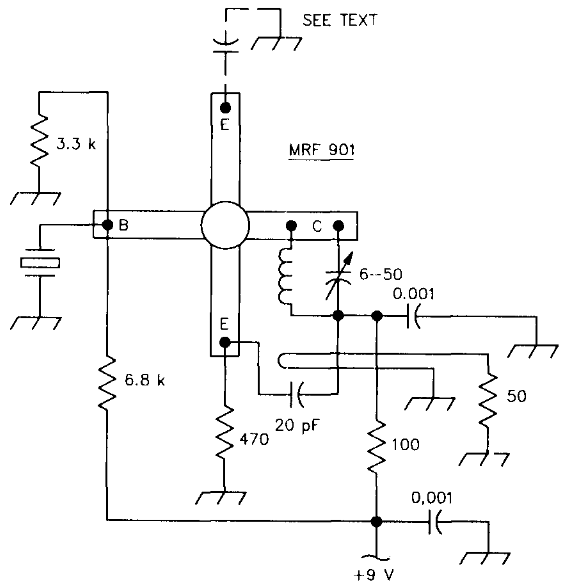
MHz	*Trimmer**	*L (#24 copper wire)*
90-280	6-50	3t, 0.187 diam × 0.185 long
280-400	4.5-30	3t, 0.187 diam × 0.185 long
400-480	2.8-10	2t, 0.100 diam × 0.187 long
480-515	2-6	2t, 0.100 diam × 0.187 long

*Sprague-Goodman, GKU series.

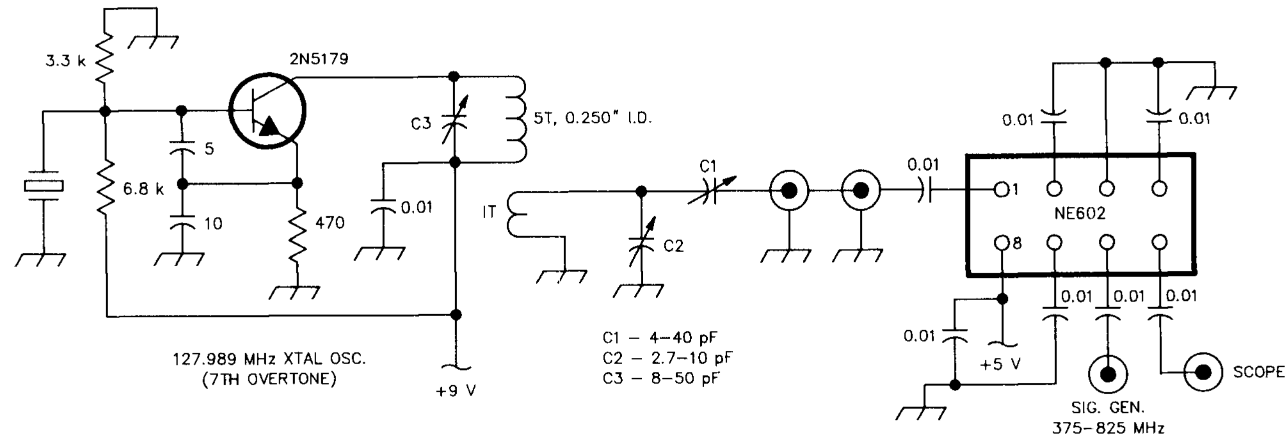
- Nominal voltage: −5.2 ±10%
- Supply current: Less than 20 mA; exact value determined by voltage and crystal activity.
- Coaxial connector and cable output desired for best wave form.

A VHF Crystal-Controlled Oscillator with Negative Ground

This is a circuit from an unpublished manuscript entitled "Practical Overtone Crystal Oscillation above 200 MHz." It is designed for use with chemically milled inverted-mesa crystal wafers with AT temperature characteristics. It has been tested at frequencies from 200 to 513 MHz and at overtone modes from the 3rd to 9th.



- The inductor consists of 2 turns of no. 26 copper wire with an inside diameter of 0.125 inch and spread to 0.250 inch.
- The 20-pF capacitor is placed physically adjacent to the cold end of the tank circuit with the single turn output link placed between that capacitor and the tank.
- The capacitor represented by the dotted line is used only when a particular crystal exhibits high activity with attendant instability. This capacitor acts as part of an RF voltage divider and reduces the feedback drive to the MRF901. Values of 40 pF, preferably less, are appropriate.



Signetics NE602 as a Test Instrument

Use the Signetics NE602 doubly balanced active mixer as a down converter to expand the useful bandwidth of an oscilloscope. The demonstration circuit shown has been employed to observe clearly the 13th harmonic of the crystal oscillator at a frequency of 1663.857 MHz. In this example, the 3rd harmonic of the signal generator operating at a fundamental frequency of ⅓ 1663.857 MHz or 554.619 MHz is positioned a few kHz above or below 1663.857 MHz to provide a convenient IF display on the oscilloscope. The 4th harmonic of the crystal oscillator is observable using a fundamental frequency from the generator. Lower frequency signal generator sources may be used to observe other bands of interest, however, as the converted frequency and the upper bandwidth limit of the oscilloscope converge, filters must be employed to obtain meaningful oscillographic displays.

- Distortion will result if either pin 1 or pin 6 is overdriven. Drive voltage from the oscillator shown will be optimum at 127.989 MHz with C1, C2 eliminated and direct coupling made to the 0.01 blocking capacitor.
- Trimmers C1 and C2 provide a "peaking" adjustment at particular harmonics. The effect of these adjustments is clearly displayed on the oscilloscope.
- The signal generator is an ancient, continuously tuned UHF TV tuner. A panel-mounted BNC receptacle brings out a small amount of its local oscillator voltage to the demonstration circuit. Coarse calibration was made with the help of a modern digitally tuned TV set.
- It is probable that almost any oscilloscope can be made to function to some extent in this system. Best results will be obtained when using an oscilloscope with triggered sweep, 5-MHz or greater bandwidth and vertical sensitivity of at least 5 mV per cm.

Some Historical Information

The crystals used for my oscillator experiments were especially processed to yield fundamental frequencies of 40 to 160 MHz. Processing capability to at least 500 MHz is possible using this technique. Most crystal suppliers are limited to the production of fundamental crystals of not more than 20 MHz, a few will take orders for units up to 25 MHz and some to 30 MHz with relaxed tolerances.

Performance specifications for either low or high fundamental devices are much the same except for package capacitance. Typically, low to high fundamental processing results in a 3 to 1 capacitance reduction. This reduction becomes increasingly important for successful overtone oscillator performance as frequencies increase above 150 MHz, no matter what order overtone is attempted.

Successful 13th overtone operation at approximately 237 MHz has been accomplished with my circuits when using a fundamental crystal of 18.28 MHz. However, for a practical purpose, such performance must be considered as a technical curiosity.

Overtone operation somewhat above 150 MHz is perfectly feasible with conventional crystals but most suppliers are reluctant to assume orders for this range and still guarantee performance.

Initial quantities of high-order fundamental crystals were obtained in February 1989 (from Innovative Frequency Control Products, Inc, PO Box 300, Plainfield, PA 17081). Two oscillator circuits were devised to exploit the unique capability of these crystals. One, for use in a negatively grounded system, the other for a positively grounded application.

To date, completely satisfactory fundamental crystal-controlled oscillation has been accomplished easily at nine different frequencies from 40 to 160 MHz. All of the original samples performed satisfactorily at their 3rd overtone. For example, the 160-MHz device proved to be an excellent oscillator at about 480 MHz.

Four of the samples did well at their 5th overtone. Three at their 7th, and a 57-MHz fundamental sample operated properly at its 9th overtone of about 513 MHz.

None of the samples were characterized for oscillator service. All were fabricated as filters.

These oscillators are relatively insensitive to power-supply voltage change as well as to environmental capacitance and temperature effects. All appear to operate with efficiencies equal to crystal oscillators operating at lower frequencies.

I am convinced serious overtone oscillator experimentation above 100 MHz should not be undertaken without, at least, minimum instrumentation to monitor progress every step of the way. The NE602 down converter/signal generator/oscilloscope combination was found invaluable for this endeavor. A sensitive active wave meter calibrated over the entire spectrum from 1.5 to over 800 MHz was employed to detect spurious responses and double check overtone frequencies.

The high frequency down converting capability of the NE602 was discovered as a most welcomed by-product during development of instrumentation for this crystal-oscillator project. It was found to be usable to at least 3 GHz. My 1988 Signetics catalog specifies 6-GHz junctions for this device, but I feel current production could be specified to be near 9 or 10 GHz, based on my crude evaluation of its performance.

Do not overdrive the NE602, otherwise severe distortion will result. Also, because of its high frequency capability, exposure to short duration spikes in the microwave region will surely zap the device.

The down-conversion circuit functions in a manner similar to the *autodyne* system found in some early radio sets. The term "direct conversion" I believe is used now.

The direct-conversion arrangement provides operating benefits not generally appreciated: (1) The bandwidth of each event is determined by the bandwidth of the local oscillator; (2) The usable gain is set by the amplitude of the signal plus the amplitude of the local oscillator plus any differential gain supplied by the NE602.

I have constructed a test fixture complete with NE602, BNC connectors and power supply as a companion to my oscilloscope. It has been used to examine the SSB waveform directly from my home-built 2-m transmitter. I am sure it could be used for similar observations at any higher frequency band to at least 2.3 GHz.—*Clint Bowman, W9GLW, Box 282, Prospect Heights, IL 60070*

VHF+ Technology

By Geoff Krauss, WA2GFP
1927 Audubon Drive
Dresher, PA 19025

Writing some three weeks after the June '91 VHF 'Test, the best information I have is that scores ran about 30% higher this contest (compared to last year) among the larger multioperator contest groups in the Northeast. I use them as my yardstick because their participation levels, year-to-year, remain fairly predictable. The same person may not be operating for the same number of hours each year, but the same number of man hours of activity do occur at stations with a larger group of operators, each ready to work at any station left open at any time. Also, it is a lot easier to get early info from the multiops; there is a lower level of score secrecy (possibly because there are many more participants coming home with the knowledge of how things went). In any event, it appears that there was a lot more 0.9-3.5 GHz stations on this year—way to go VHF + ers!

While no big change was noted in 220 operations (and no great change is expected in 220 work in the August UHF Contest), I am sure that many of you will be looking to the September VHF Contest to see how many 220 CW/SSB contesters actually made the changeover in the early part of September. *Remember: No further use of 220-222 MHz after August 27, 1991!* Since there will be only about ten days between weak-signal workers shift day and contest weekend, I wonder whether the 222ers are making plans sufficiently early to obtain the new crystal(s) for moving up frequency in the interim? Will you be ready and retuned for 222.1 work? Of course, if you have already done your moving plans and ordered new parts, you probably have also measured your 222 antenna system SWR and done all the calculations necessary to be ready to trim antenna elements to obtain best results when you shift up frequency. Luckily, the move is up; elements must be shortened. Most smaller Yagis may not need much, if any, element cutting; even larger antennas may still be okay with the small percentage change. Most transmitters, transverters and receiver converters should have more than enough tuning range to allow the small changes needed. The important thing is to carefully review what has to be done to your 220 equipment to move it on up, and to make the proper changes in a controlled manner. As an example, a transverter with a seven-stage 219.5-221.5 band-pass filter with 70-dB rejection traps at TV channel 13 (at about 214 MHz) may *not* be easily retuned to a center frequency of 222.5 by simple peaking with a single-frequency source and detection meter. A sweep generator and scope setup will probably be required, along with some knowledge of which adjustment is to be made in a certain order and for a certain result. In extreme cases, especially where the unit is very compact or the tweakers are not easily identified (which usually will not happen if you have built the beast yourself!), the equipment may have to go back to the manufacturer. Now is the time to find out what you have to do and prepare to do it—if you want to be on the air at any reasonable time (much less promptly) after the switch.

I received a letter recently from Larry Filby, K1LPS, a staunch VHF + er from the state of Vermont, and well known in the Northeast US. Larry comments on the difficulty of a single operator running up to 10 different bands in VHF/UHF contests, but he is seriously trying to cover all applicable bands from some of the rarer FN44/5 grids. (Actually, Larry, you have to cover *11* bands: three VHF bands—50, 144 and *222*; four UHF bands—430, 900, 1240 and 2300; and four microwave bands—3400, 5600, 10G and 24G—don't forget that last one!) Larry is in the middle of his 2300/3400 system and is on 10 GHz, both WBFM and narrow CW-SSB; he has gotten a group of local VHF + ers on WBFM with converted 10-GHz Doppler units and they have made many, many easy QSOs over 50-80 miles paths with about 10-mW output power. In order to generate the same kind of local interest, Larry is looking for a way to build some "quick and cheap" WBFM stuff to try out 5600 MHz (before he adds the more complex equipment for going the CW-SSB route). Any VHF + er out there have some good Gunn diode oscillator designs/data for this band? As some of you may already know, once you have a basic Gunn diode oscillator design, it can be relatively easily scaled to other frequencies by changing the size of the waveguide in which the oscillator is built, *if* the Gunn diode parameters do not change too much. Unfortunately, most Gunn diodes are optimized for a "relatively narrow" range of frequencies (say 8.5-10.6 GHz for one type) so that a change in operating frequency outside of the band for one diode type requires that a totally different diode type and supporting waveguide-structure design be used. On the other hand, the diode-in-the-guide receive mixer used on 10/24-GHz Gunnplexers® can be used in other bands in the same form, often with nothing more than some suitable scaling of the associated dimensions. Before jumping into WBFM below 10 GHz, consider some other aspects of Gunn diodes: They are not easily obtained in small quantities, especially at lower microwave frequencies, and they may require odd power supplies because the oscillation phenomenon is related to the potential gradient in the diode's semiconductor (typically GaAs). Usually, the lower in frequency one wants a Gunn diode to oscillate, the higher the required diode voltage: 24-GHz Gunns work at 6-8 V dc and 10-GHz Gunns work at 10-12 V dc; a 5.6-Gunn may well require 16-20 V dc at over 0.1 A. Not an easy voltage to obtain for portable or mobile use. Another thing not easy to obtain, as Larry also noted, is test equipment (*any* test equipment) for these kinds of frequencies; even rarer is reliable test equipment. Sometimes the easiest way to do this is via a club or a local engineer, etc. Of course, there may not be any such person in your area, in which case you have to plan very far in advance to acquire test equipment (if there is any on the market and if it is within your price range). This has always been a major stumbling block to advance work; the frequencies at which expensive TE is needed does, though, keep moving up. In 1960 it was 430 MHz, in 1990 it is 5600 MHz. (The no-tune transverters for 0.9-3.5 GHz make the difference, and only because MMICs, etc, have come into general use in the last 5 or so years.)

I mentioned waveguide filters in my February 1991 column, and the difficultly of their design. I received a letter from Dennis Sweeney, WA4LPR, who knows all about this problem and has solved much of it with a computer program he call *WGFIL*. This synthesis program apparently runs on any MS-DOS computer and will design post-coupled or iris-coupled WG band-pass filters. While Dennis did send me a floppy disk with a copy of the program, I have not yet tried it out (mostly because the floppy was a 5¼-inch disk and my MS-DOS computer only has a 3½-inch drive. I'm glad to see that someone besides me occasionally ends up with some sort of equipment compatibility problem, even if the drive mismatch is due to an advancement in the state-of-the-art.) Dennis may write a *QEX* article about his program, and hopefully, also include something about the little-discussed area of waveguide impedance in general, so I will say no more at this time. He did send along a few trial run printouts and the results appear to be almost the same as those obtained in actual filters in other *QEX* articles by Glenn Elmore, N6GN. For those who cannot wait for an article in *QEX*, Dennis discussed some aspects of *WGFIL* and the resulting filters in the *Proceedings of Microwave Update '89*, pp 124-132, available from the ARRL. Dennis can, if you must, be contacted at 1914A Shadow Lake Road, Blacksburg, VA 24060. (Don't forget the courtesy of an SASE.)

WA4LPR and N6GN tune their waveguide filters with ordinary machine screws, held in place by common hardware, such as by a matching nut soldered to the guide exterior wall and a second nut tightened against the soldered nut after the screw is adjusted. This is one variation on a variable-impedance element theme usable in all sorts of amateur equipment. Other alternatives exist. For those VHF+ers who are seeking a better tuning mechanism, consider the microwave tuning elements commercially available from Johanson Manufacturing Corp (what! you've never heard of Johanson?) probably best known as makers of piston-type trimmer capacitors, Rockaway Valley Road, Boonton, NJ 07005. While other manufacturers make similar tuning elements, the JMC "Microwave Products Application Guide," which appears to be their publication J10-M8-C7 (1987), has 8 pages of interesting information of these parts, their use and typical applications, as well as some other interesting VHF+ hardware (adjustable diode holders, tunable back shorts and variable phase line section) which may give the amateur microwave builder some ideas. Of course, if you have access to the JMC commercial catalogs, you also have a source of excellent trimmer capacitor data; the Johanson GIGA-TRIM® line of microwave trimmer capacitors are highly desirable for 500+ MHz use (but are very difficult to obtain at amateur-level prices; check local flea markets and used parts shops—these units and the few other brands available are well worth the few dollars per piece that the units cost in the used-parts market).

Speaking of VHF+ Conference Proceedings available from ARRL, I just received those of the *24th Central States VHF Society Conference* (1990). Among other items, I note that: The trend continues toward more presentations about computer-related design and propagation analysis. About the same number of different, but truly interesting VHF+ LNAs are presented each year. This probably indicates that, while very low NFs (below 0.3 dB) are more common these days below 800 or 1000 MHz, no one has found an optimum, works-every-time design. Antennas are still the one station item that more VHF+ers build, rebuild, continue experimentation on and are never satisfied with.

In closing, I direct the attention of the more technically minded to a new Motorola silicon microwave power transistor, the MRF10120. This is a 960-1215 MHz common-based device, which has a power output of 120 W with at least 8× power gain, for 36-V dc supply, when used under so-called "long pulse" conditions (about 25% duty cycle). I wonder what the 1296-MHz specs would be, and whether use in intermittent amateur conditions would still allow 120-W output? Hmmm, with a couple of power dividers and combiners, some devices and a 100-A power supply, I might yet find something to fill the large heat sink I labeled "Solid State 1296 Kilowatt Amplifier" some ten years ago. If you have the design, let me know.

Gateway

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

ARRL SEEKS ACCESS TO 216-220 MHZ FOR PACKET-RADIO LINKS

The ARRL has petitioned the Federal Communications Commission for a new spectrum allocation to help replace that at 220-222 MHz which will be lost on Aug 27.

On June 4, the League filed a Petition for Rule Making with the FCC, seeking a secondary, noninterference allocation for the Amateur Radio Service at 216-220 MHz to "provide reaccommodation for those present and future wideband data intercity links and other point-to-point fixed amateur stations which stand. . . to be displaced from the 220-222 MHz band." The idea of replacement spectrum had its genesis with Congressman Robert E. Wise, Jr, of West Virginia, Chairman of the House Government Information, Justice, and Agriçulture Subcommittee. During the subcommittee's May 11, 1989 hearings on the FCC's 220-MHz decision (see *QST*, July 1989, p 44), in calling attention to the fact that 216-220 MHz was underutilized, ARRL Executive Vice President David Sumner, K1ZZ, had testified that "radio amateurs would love to have access to [the 216-220 MHz band] in the rest of the country [where it is not used for waterways communications]. We'd make very good use of it."

Rep. Wise followed up by writing to then-FCC Chairman Dennis Patrick to suggest that the Commission consider some alternative scenarios for 216-222 MHz that would have provided some continued amateur access. The Commission declined to do so in the context of the Docket 87-14 proceeding, but agreed to give such a proposal consideration if submitted separately. In his reply to Rep. Wise, Chairman Patrick said, "We did not consider in any depth amateur use of the 216-220 MHz band in this proceeding. It was not proposed by the Commission, nor was it addressed in the comments. However, ARRL did make a general comment in this regard in its petition for reconsideration. We have, therefore, in our Memorandum Opinion and Order invited the amateur community to make a specific proposal. This would allow full public comment by all interested parties. It is possible that some limited secondary fixed use of this band may be made by the amateur service in reaccommodating the amateur fixed operations from the 220-222 MHz band. The Commission noted that while it is willing to consider this matter, potential impact on other users of this spectrum, particularly potential interference to TV broadcasting, will need to be addressed."

All other avenues for relief having been exhausted, on June 4 the League submitted the specific proposal invited by the Commission.

The 216-220 MHz band currently is occupied by the

Maritime Mobile Service and by some fixed and mobile assignments. In addition, part of the range (specifically, 218-218.5 MHz) also is under consideration for use by a new Interactive Video Data Service.

An engineering study by Atlantic Research Corp, commissioned by the League, found that the Amateur Service "could effectively operate in the 216-220 MHz band subject to appropriate frequency and distance separation constraints," even if usage of the band by commercial interests "grows substantially."

Another engineering study conducted by the staff of the ARRL Technical Department Laboratory found that interference to television channels 11 and 13 also could be avoided, particularly if amateur operation were confined above 218 MHz in areas served by channel 13 television stations.

The League's petition notes that despite the apparent constraints that would be presented by sharing arrangements with existing and planned commercial operations, "there appears a significant opportunity for additional operation in segments of the band on certain frequencies in vast areas of the country."

The League's petition notes that the spectrum soon to be lost at 220-222 MHz was generally free of the repeater operations that dominate the band above 222 MHz. For that reason it had been planned, the petition says, that 220-222 MHz would be used for "high-speed, inter-city" packet radio, a system that is regarded as vital to amateurs' continued public service work in the coming years.

The League contends that the FCC's assumption that amateurs could merely move operations from 220-222 MHz "up the band" was incorrect; that such a move is not possible "because of the differences in the technology used in the different segments." The use of 222-225 MHz for voice repeater operation is expected to grow as new Technician class licensees occupy the band, further compounding the problem of finding space for the wideband channels necessary for high speed packet operation.

Most new high-speed modems for packet radio "were designed specifically for the amateur 220 MHz band," the petition says, and notes that while in 1987, 30,000 amateur packet stations were thought to exist, the number today is thought to be more than 100,000. In many cases the inter-city packet networks envisioned for 216-220 MHz cannot be accommodated elsewhere, above or below those frequencies, because of band loading, sharing, or path length considerations.

The petition notes that the US Department of Defense, on behalf of the National Communications System (NCS), filed reply comments on behalf of amateurs in Docket 87-14 (which reallocated 220-222 MHz to land mobile interests). NCS, in planning to use amateur communications itself, already had signed a memorandum of understanding with the League.

"The deprivation of these types of communication resources, which would be vital in times of emergency or crisis, could significantly hamper the ability of the NCS to carry out its responsibilities in the area of national security," the Secretary of Defense told the FCC at the time of Docket 87-14.

The ARRL Laboratory studied the potential television interference problem. TV channel 13 occupies 210-216 MHz. While the potential for interference would at first glance seem substantial, there are mitigating factors. Namely, the amateur stations occupying the proposed allocation at 216-220 MHz would be point-to-point, using low power (the petition proposes 50 watts PEP) and highly directive antennas that could be cross-polarized to television receiving antennas. The situation is comparable to the four decades of 6 meter amateurs' coexistence with the adjacent television channel 2: Operation is more difficult in some places than in others, but on the whole the band is quite useful to the Amateur Service.

The study by Atlantic Research Corporation is a "Compatibility Assessment of the Amateur Service in the 216-220 MHz Band," that is, it estimates the potential for sharing of the segment between amateurs and the services mentioned earlier (the Maritime Mobile Service and the proposed IVDS). Here is the conclusion of this highly technical study: "Given that band usage is currently very sparse, the amateur service could effectively operate in the 216-220 MHz band subject to appropriate frequency and distance separation constraints (ie, as is the case with respect to amateur systems sharing with fixed and mobile services in the 220-225 MHz band). The constraints calculated in this study indicate that substantial spectrum resources would be available to the amateur service in the 216-220 MHz band throughout the US, even if usage of the band by other services grows substantially. . ."

The study recommends the Amateur Service develop and maintain a data base of current assignments in other services in the 216-220 MHz range and that proposed amateur stations in the range be planned according to the possible constraints resulting from sharing with other services.

The findings of both studies are incorporated into the League's petition, including "spectrum management and database administration."

"The League is willing to coordinate, through continued database management, any amateur operation initiated in the band, and assist in resolving any interference problems which may arise. The League can be contacted by any non-amateur user of the band to register [an] interference complaint, which will be addressed immediately by contacting the amateur licensee involved. This way, there will be no administrative burden to any user, or to the Commission," the petition concludes.

—from The ARRL Letter

ARRL COMPUTER NETWORKING CONFERENCE

The 10th ARRL Amateur Radio Computer Networking Conference will be held on the weekend of September 27-29 at the Radisson Airport Hotel in San Jose, CA. The Northern California Packet Association (NCPA) is hosting this year's conference and invites you to attend. Glenn Tenney, AA6ER, is the local conference chairperson.

Hams from around the world will be presenting papers on what they're working on in packet radio. The presentations and papers might cover any subject from satellites to spread spectrum, from protocols to hardware or any other topic related to how hams are, or will be networking. In addition to the usual presentation of papers all day Saturday, this year's conference will be surrounded by other interesting and informative activities. See the agenda below for what is planned on Friday and Sunday. So as not to miss any of this, send in the registration form (below) now and contact the ARRL for an author's packet.

How to Submit Papers

The deadline for receipt of camera-ready papers is August 12. If you're going to submit a paper, contact Lori Weinberg at ARRL headquarters. She is handling the arrangements for the proceedings.

How to Register for the Conference

Please use the attached conference registration form for the tutorials, main conference and the dinners. We are working with a very tight budget and would appreciate receiving your registration and check at the earliest possible date. We have already had to make quite a commitment to the hotel and catering is asking for a commitment which requires a close attendance count. Make checks payable to "Fantasia Systems Inc." and mail them to:

Glenn Tenney, AA6ER
Fantasia Systems Inc.
2111 Ensenada Way
San Mateo, CA 94403

Hotel Reservations

We've arranged an attractive room rate of $69 per night, plus tax, for single or double occupancy. You will have to make your hotel reservations early as the number of rooms blocked out for us is limited. Call the Radisson Hotel directly at 800-333-3333 to make your reservation. Tell them your reservation is for the "ARRL CNC" in order to access our block of rooms. The way hotels work, it will help us meet our budget if our block of rooms is used up.

Transportation

The conference hotel is located near the San Jose International Airport which supports both commercial and general aircraft. The Radisson Hotel offers shuttle service to and from the airport. Be sure to ask about the shuttle service when you make your hotel reservation.

In an effort to save you money, we've selected American Airlines as the official airline for the conference, which means you can receive discount air fares (eg, from within the US, 5% off the lowest published applicable fare). Contact American Airlines directly for details. Call their Meeting Services Desk at 800-433-1790 and refer to Star #S47Z14A. Since San Jose is an American Airlines hub, you should find it very convenient.

The Agenda

We are still improving and tweaking the agenda, but here it is as it stands right now:

Friday, September 27

13:00-17:00: In-Depth Tutorials

Three concurrent in-depth technical sessions will be available. These planned "tutorials" are expected to include: Digital Signal Processing; Spread Spectrum and Part 15; and Packet Satellites. The speakers selected will be those currently working on the leading edge of these technologies. These sessions will allow the subjects to be covered in depth and right down to the bits and bytes level. These sessions are priced separately and will include handouts and a mid-afternoon break.

19:00-21:30: Dinner

Instead of everyone trying to find a pizza place that can handle 50 or a couple of hundred people, we have decided to have a very special group dinner. As an option, you can sign up for the Friday evening dinner and join everyone for a luau! Yes, a real honest to goodness luau! This should be an ideal time for everyone to relax. We expect that most of you will join us, even if you aren't attending the tutorials. This will be right at the hotel, so you won't have to drive anywhere. After dinner we expect to have some informal "birds of a feather" sessions.

Saturday, September 28

08:30-17:00: Presentation of Papers

This is the traditional part of the conference. As in past years, we will be gathering up all of the papers submitted for presentation and divide them into the time available. Everyone will have a chance to present a paper. The published proceedings and lunch (at noon) are included in the conference fee.

18:30-21:00: Dinner

The conference doesn't stop at dinner. We've arranged an optional dinner at the hotel complete with a guest speaker. At this time, we do not know who will be the banquet speaker, but based on some of the names we are discussing, you will not want to miss this!

21:00-24:00: Birds of a Feather sessions

Ten or fifteen minutes per paper really is not enough, so we have planned break-out rooms for "birds of a feather" sessions. During the day we will have sign-up sheets so that discussion groups can form and really get into topics of greatest interest.

Sunday, 29 September

As usual, the ARRL Digital Committee will have their business meeting Sunday morning from 09:00 until 12:00. But that's not all. . .

We are going to have a demonstration room available from about 09:00 until 13:00 and we are hoping that you will be able to bring a rig with you to show off your latest work. We may also have some exhibitors. But wait, that's still not all...

We are going to present various newcomer tutorials from 10:00 until 13:00. These tutorials may be for the first-time packet user, while others might be for the first-time TCP/IP user. These tutorials will help folks learn more about various aspects of packet radio. The demonstration/exhibit room and newcomer tutorials will be open to all hams and prospective hams whether signed up for the rest of the conference or not.

And finally, the San Jose Technology Center is a short light-rail ride away and they have a fantastic high-tech museum called "The Garage." Although a trip to The Garage isn't an official part of the conference, we are sure a large group will be planning a visit on Sunday. We will try to help plan this outing during the conference. . . most likely a late morning trip and an early afternoon trip.

from Glenn Tenney, AA6ER

Registration Form

Name____

Address____

____

____

Call ______________ Telephone: ______________

We are printing a roster. Should we keep you out of the roster (yes means you will not be in the roster)? __________

Do you want vegetarian or special meals, if so what?

____

Will you be presenting a paper?______________

Add up the fees for each person for each event (guests are encouraged). We have to prepay most of our costs a month before the conference, so please hurry.

Friday afternoon tutorials:
$30 now, $40 after August 20th
Quantity:____________ Total $____________

Friday night Luau:
$35 now, $45 after August 20th
Quantity: ____________ Total $____________

Saturday conference (all day)
$30 now, $40 after August 20th
Quantity:____________ Total $____________

Saturday banquet (with speaker):
$30 now, $40 after August 20th
Quantity: ____________ Total $____________

Total Fee: $____________________________________

REMOTE LINKED MESSAGE/DATA DISTRIBUTION SYSTEM

Realizing the need to thwart the woes of a potential news junky, I had to just "say no" to the news and put my energies toward rehabilitation. I cast the TV remote aside and ran for sanctuary, the ham shack. As I entered, I was greeted with the warm, amber glow of three packet monitoring systems. While monitoring one HF and two VHF channels, my electronic scribes of packetdom cataloged with great accuracy the data transfers, PBBS beacons and other digital events of most recent history. Well, maybe it wasn't quite that dramatic, but the multiple monitoring systems spawned a solution to a problem posed by a club event coordinator.

The Problem

Amateur Radio and Amateur Radio-assisted civic events are often comparatively large. Events may be divided into smaller areas such as pavilions, arenas, fields, blocks or even different cities or towns, thus making logistics interesting at best. Information pertaining to event coordination, safety announcements, participant/spectator bulletins, etc, will need to be disseminated from a central or command point. Voice radio is adequate for security or general purposes, but falls short when larger volumes of data have to be moved to specific places quickly. Packet radio is a natural solution and the TAPR standard helps simplify the software task. The following ideas are offered as enhancements that can spice up an event and perhaps its efficiency.

A Solution

1. Use packet-linked remote displays/monitors each consisting of...
   A TNC with standard TAPR command set.
   A receiver (scanner is usually OK).
   A terminal device (VIC-20, they are common, easy to use, and cheap. The VIC-20 utilizes bigger characters which are easier to read, especially from the back of small crowds.)
   A color display (19-inch or larger, if possible).
2. The TNC can be set to a specific call sign or address name and decode data sent specifically to that device.
3. Several monitoring units can have the same address, thus allowing group related distribution of a data type.
4. Another approach to decoding specific data would be to set the Budlist so as to exclude impertinent data.
5. Since the VIC-20 also provides NTSC video, another suggestion may be to use an ATV transmitter for additional distribution. In this case, station identification should be included in each screen full of data.
6. With some programming creativity, use of the VIC-20 would also allow graphics and text together. Although it has not been fully tested, it is possible that stop-frame animation may be generated and sent by the command point. One VIC-20 screen equals about one packet at a Paclen of 255. Throughput is perceived to be slow.
7. To keep the system simple, use of just a receiver is suggested. In some cases, however, it may be necessary to use a transceiver and take advantage of the full error detection scheme. Doing so, however, may preclude the use of the group address unless a cluster-like dissemination program is used by the originating or command point.
8. Use of a transceiver and digipeater capability at the remote site(s) will enhance the physical range of the network. This has some intuitively obvious advantages.
9. Also as in #8, it will be possible for the command point to test the integrity of the entire monitoring system by "bouncing" a test packet to itself throughout the network. Note that it may be prudent to have at least one monitoring unit set up with a transceiver. This will allow communications to a system meeting the "unattended" criteria and avoid the "one way communications" rule problem.

It has been fun piecing this system together and trying various options. I am sure that there are other possibilities which I will leave to your discovery.

—by Marcello Soliven, KJ6OA, from Northern California Packet Association's The Downlink

IEEE PACKET-RADIO ARTICLES

The following articles concerned with packet radio have appeared in various IEEE publications recently.

"A New Approach for the Analysis of the Slotted ALOHA Local Packet Radio Networks" by Ker Zhang and Kaveh Pahlavan, *Supercomm ICC '90 Conference Record - International Conference on Communications*, vol 3.

"Accurate Evaluation of Spreading Code Protocols for Packet Radio Networks" by Jeffrey W. Gluck, *IEEE International Conference on Systems Engineering*.

"Adaptive Forwarding and Routing in Frequency-Hop Spread-Spectrum Packet Radio Networks with Partial-Band Jamming" by M. B. Pursley and H. B. Russell, *Proceedings - IEEE Military Communications Conference*, vol 1.

"Adaptive Signalling in Distributed Self-Organizing Mobile Packet Radio Networks" by Lawrence C. Pond and Victor O. K. Li, *Supercomm ICC '90 Conference Record - International Conference on Communications*, vol 3.

"Analytical Model of Busy Channel Multiple Access (BCMA) for Packet Radio Networks in a Local Environment" by Oreste Andrisano, Gioia Grandi and Carla Raffaelli, *IEEE Transactions on Vehicular Technology*, vol 39, no. 4, November 1990.

"Antenna Selection in a Multi-Sector Packet Radio Network" by C. Lau and C. Leung, *Conference Record - International Conference on Communications*, vol 3.

"Capture Models for Mobile Packet Radio Networks" by C. Lau and C. Leung, *Supercomm ICC '90 Conference Record - International Conference on Communications*, vol 3.

"Cellular Packet Radio Network" by M. C. Davie, I. Harris and J. B. Smith, *IEEE Conference Publication*, no. 325.

"Coded Tone Sense Protocol for Multihop Spread-Spectrum Packet Radio Networks" by Tak-Shing Yum and Kwok-Wah Hung, *IEEE Global Telecommunications Conference and Exhibition*, vol 2.

"Collision Resolution Algorithms in Multistation Packet Radio Networks" by Ayal Bar-David and Moshe Sidi, *IEEE Transactions on Communications*, vol 37, no. 12, December 1989.

"Comments on 'Packet Error Probabilities in Frequency-Hopped Spread-Spectrum Packet Radio Networks - Memoryless Frequency-Hopping Patterns Considered', by M. Georgiopoulos" by Chingshyang Lo, *IEEE Transactions on Communications*, vol 38, no. 6, June 1990.

"Congestion Based Routing in Packet Radio Networks" by Osmund S. deSouza, Prodip Sen and Robert R. Boorstyn, *Conference Record - International Conference on Communications*, vol 3.

"Connectivity Properties of a Packet Radio Network Model" by Thomas K. Philips, Shivendra S. Panwar and Asser N. Tantawi, *IEEE Transactions on Information Theory*, vol 35, no. 5, September 1989.

"Delay and Throughput for Three Transmission Schemes in Packet Radio Networks" by Michael B. Pursley and Stuart D. Sandberg, *IEEE Transactions on Communications*, vol 37, no. 12, December 1990.

"Design Algorithms for Multihop Packet Radio Networks with Multiple Directional Antenna Stations" by Tak-Shing Yum and Kwok-Wah Hung, *IEEE Global Telecommunications Conference and Exhibition*, vol 2.

"Distributed Assignment Algorithms for Multihop Packet Radio Networks" by Israel Cidon and Moshe Sidi, *IEEE Transactions on Computers*, vol 38, no. 10, October 1989.

"Distributed Time-Slot Assignment Protocol for Mobile Multi-Hop Broadcast Packet Radio Networks" by Lawrence C. Pond and Victor O. K. Li, *Proceedings - IEEE Military Communications Conference*, vol 1.

"Effect of Multipath Interference on the Performance of Packet Radios" by Jyn-Horng Wen and Jin-Fu Chang, *Conference Record - International Conference on Communications*, vol 3.

"Effects of Multipath Interference on the Performance of Packet Radios" by Jyn-Horng Wen and Jin-Fu Chang, *IEEE Transactions on Communications*, vol 38, no. 6, June 1990.

"Idle-Signal Casting Multiple Access with Data Slot Reservation (ICMA-DR) for Packet Radio Communications" by Atsushi Murase and Kenji Inamura, *IEEE Transactions on Vehicular Technology*, vol 38, no. 2, May 1989.

"Interconnection Algorithms in Multi-Hop Packet Radio Topologies" by P. Papantoni-Kazakos, *Eighth Annual International Phoenix Conference on Computers and Communications 1989 Conference Proceedings*.

"Interference Modeling in a Direct-Sequence Spread-Spectrum Packet Radio Network" by Elvino S. Sousa, *IEEE Transactions on Communications*, vol 38, no. 9, September 1990.

"Minislot Access Protocol for CDMA Packet Radio Networks with Positive Acknowledgment" by Jeffrey C. Dill, *Proceedings - IEEE Military Communications Conference*, vol 1.

"Near/Far Effects on Packet Radio Networks with Direct-Sequence Spread-Spectrum Signaling" by Yu-Dong Yao, Asrar U. H. Sheikh and Shi-Xin Cheng, *IEEE Pacific RIM Conference on Communications, Computers and Signal Processing*.

"Network Setup Time Analysis of Mobile Multi-Hop Packet Radio Networks under Virtual Circuit and TDMA Policies" by Lawrence C. Pond and Victor O. K. Li, *Supercomm ICC '90 Conference Record - International Conference on Communications*, vol 3.

"Optimum Transmission Ranges in a Direct-Sequence Spread-Spectrum Multihop Packet Radio Network" by Elvino S. Sousa and John A. Silvester, *IEEE Journal on Selected Areas in Communications*, vol 8, no. 5, June 1990.

"Packet Error Probabilities in Direct-Sequence Spread-Spectrum Packet Radio Networks" by Michael Georgiopoulos, *IEEE Transactions on Communications*, vol 38, no. 9, September 1990.

"Performance Analysis of a Star S-ALOHA Packet Radio Network with Different Models of the Central Station" by Wojciech Sobczak and Jozef Wozniak, *VLSI and Computer Peripherals*.

"Performance Evaluation of Frequency Hopped Receiver Oriented Spread Spectrum Packet Radio Networks" by Michael Georgiopoulos, *Conference Record -*

International Conference on Communications, vol 3.

"Performance of BCH and Convolutional Codes in Direct Sequence Spread Spectrum Packet Radio Networks" by Hugh T. Owens, Michael Georgiopoulos and Madjid Belkerdid, *Proceedings - IEEE Military Communications Conference*, vol 1.

"Placing Repeaters in Multi-Hop Packet Radio Networks" by A. K. Kakaes and R. R. Boorstyn, *IEEE Global Telecommunications Conference and Exhibition*, vol 2.

"Packet Radio Network Using Inhibit Sense Multiple Access with Capture" by Kenneth J. Zdunek, Donald R. Ucci and Joseph L. LoCicero, *IEEE Global Telecommunications Conference and Exhibition*, vol 2.

"Reliable Multicast over the Mobile Packet Radio Channel" by Yukiji Yamauchi, *IEEE Vehicular Technology Conference*.

"Rule-Based Network Design: Application to Packet Radio Networks" by Lillian Ruston and Prodip Sen, *IEEE Network*, vol 3, no. 4, July 1989.

"Throughput Optimization in Single Commodity Slotted ALOHA Multi-Hop Packet Radio Networks" by Thomas D. Papavassiliou, John A. Silvester and Jonathan L. Wang, *Proceedings - IEEE Military Communications Conference*, vol 2. *—from John Weihn, awaiting call sign*

GATEWAY CONTRIBUTIONS

Submissions for publication in Gateway are welcome. You may submit material via the US mail to 75 Kreger Dr, Wolcott, CT 06716, or electronically, via CompuServe to user ID 70645,247, or via Internet to horzepa@gdc.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*.

Bits

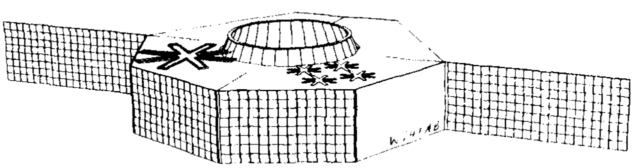
International Phase IIID Satellite Program

Word was received from ESA early July 15, 1991, that the Phase 3D spacecraft and mission has been approved for launch aboard the Ariane 502 flight, currently scheduled for October 1995.

There are many interfaces to be finalized, but the baseline spacecraft is similar to that shown at the end of the Marburg meeting in May 1991. The configuration allows for a bus ring diameter of 3.2 m and a height of 650 mm, with a mass of 500 kg. Mounted within the spacecraft will be a conical launch adaptor to support spacecraft above the Phase 3D, currently shown to be two "Cluster" spacecraft. The AR502 launch will have a total of four Cluster spacecraft aboard. The launch adaptor in the Phase 3D will have to support 2.5 metric tons at a distance of 2 m above the top.

This spacecraft concept, which is very preliminary, is shown below.

With this announcement, the P3D Design Team now has the go ahead signal to do a lot of work to make this mission successful.



Microwave Update 1991

Sponsored by the North Texas Microwave Society, Microwave Update 1991 will be held October 18-20, 1991, in Arlington, Texas.

Scheduled is a fine panel of speakers for a well rounded program. A new addition to the program is Mr. Paul Rinaldo, W4RI, Editor of *QST* and *QEX*, who will discuss what's ahead with the up coming WARC-92 conference. WARC-92 is extremely important if we are to retain our microwave frequencies.

Technical presentations will be held Friday and Saturday, noise figure measurements on Friday night, and a Texas-Style BBQ will be served Saturday night. Special family activities are also planned.

In order to better plan in advance of the conference, preregistration is requested. Early registration is $35 ($40 at the door) which includes a copy of the Conference Proceedings, a ticket to two nights worth of flea market, the ability to tweak and retweak those preamplifiers and of course, a fine technical program. The fee also helps offset the costs associated with speakers who must fly in, audio-visual equipment, coffee breaks, etc.

Registration forms and a full schedule of events can be obtained from Al Ward, WB5LUA, 2375 Forest Grove Estates Road, Allen, TX 75002.

If you're interested in presenting a paper, the deadline for receipt is ***September 1, 1991***. Short articles are also being solicited and you don't have to present a paper to submit an article for the Proceedings. Contact Al Ward, WB5LUA, for information on topics and general guidelines for submitting papers (if you just want an Author Package, contact Maty Weinberg at ARRL HQ).—*Al Ward, WB5LUA*

Corrigendum

The following are corrections and/or improvements to the February 1991 *QEX* article "Switching Power Supplies for High Voltage," by Timothy P. Hulick, PhD, W9QQ.

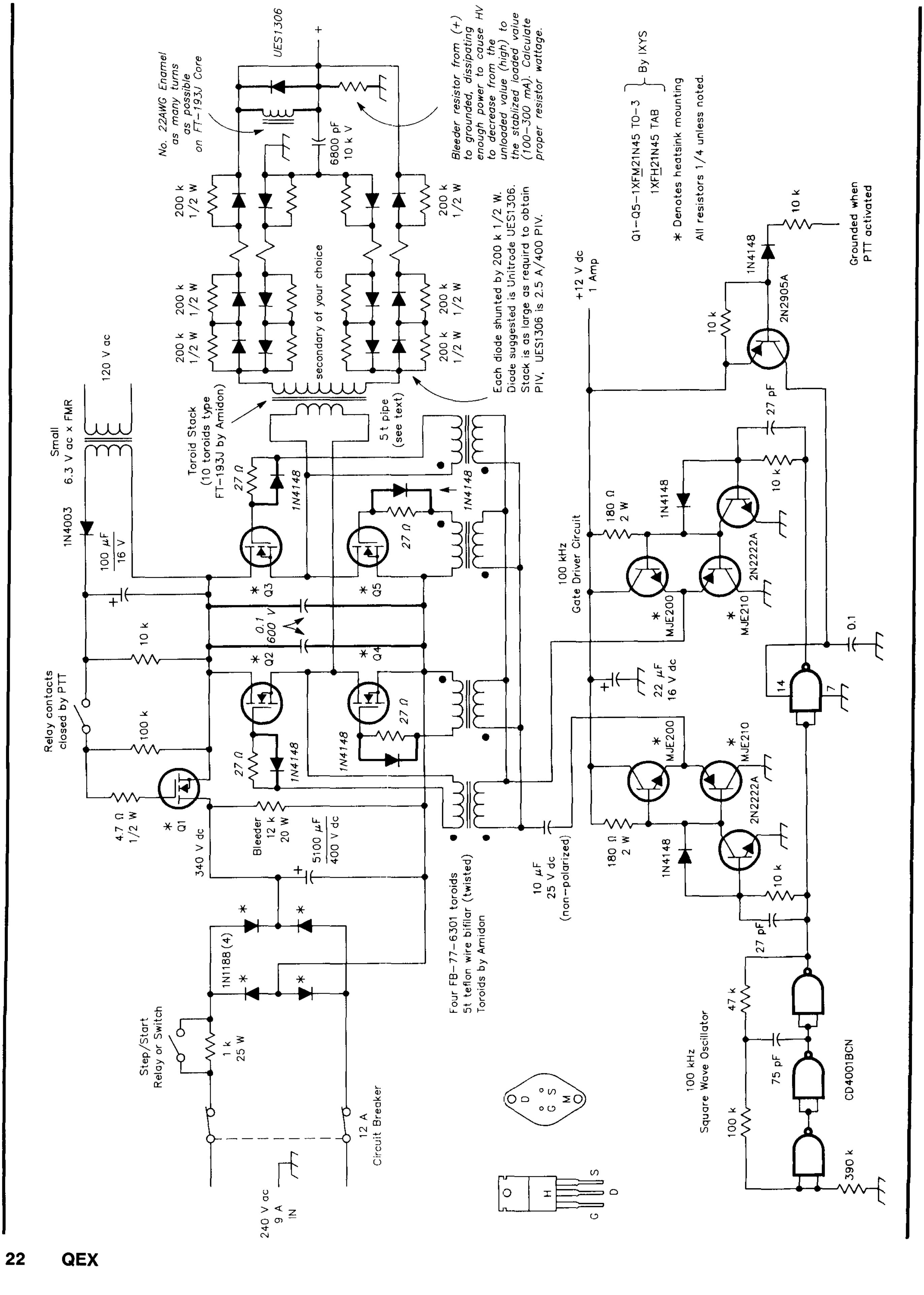
Under the "Enhancement-Mode FET" section, page 4:
1st paragraph, last sentence, just before the equation. "At ±1 V" should read "At ± 10 V."

Under the "Hints and Results" section, page 8:
1st paragraph, 5th line. IXTS' type 21N45 should be corrected to read IXYS' type 21N45.

1st paragraph, 11th line should read...would be evident by spurs spaced at ±n 100 kHz...

5th paragraph, 4th line. Delete the sentence beginning "The small-value (4.7-ohm)..." and insert "A 27-Ω, 1/4-watt resistor shunted by a switching diode in the direction shown in Fig 9 allows for 100 ns of time gap between turn off of one set of FETs and turn on of the other. This helps to prevent ON state overlap of the FETs.

Fig 9, page 8, should be corrected as follows (see next page):


No. 22AWG Enamel as many turns as possible on FT-193J Core
UES1306
+
Bleeder resistor from (+) to grounded, dissipating enough power to cause HV to decrease from the unloaded value (high) to the stabized loaded value (100–300 mA). Calculate proper resistor wattage.
6800 pF
10 k V
200 k
1/2 W
secondary of your choice
Each diode shunted by 200 k 1/2 W.
Diode suggested is Unitrode UES1306.
Stack is as large as required to obtain PIV. UES1306 is 2.5 A/400 PIV.
Q1–Q5–1XFM21N45 TO-3
1XFH21N45 TAB
By IXYS
∗ Denotes heatsink mounting
All resistors 1/4 unless noted.
120 V ac
Small
6.3 V ac x FMR
1N4003
100 µF
16 V
Toroid Stack
(10 toroids type
FT-193J by Amidon)
5t pipe
(see text)
27 Ω
1N4148
Q3
Q5
Q2
Q4
0.1
600 V
+12 V dc
1 Amp
10 k
1N4148
2N2905A
Grounded when PTT activated
27 pF
100 kHz
Gate Driver Circuit
180 Ω
2 W
MJE200
MJE210
2N2222A
0.1
14
7
22 µF
16 V dc
Relay contacts closed by PTT
100 k
4.7 Ω
1/2 W
Q1
340 V dc
Bleeder
12 k
20 W
5100 µF
400 V dc
1N1188 (4)
Four FB-77-6301 toroids
5t teflon wire bifilar (twisted)
Toroids by Amidan
10 µF
25 V dc
(non-polarized)
Step/Start
Relay or Switch
1 k
25 W
12 A
Circuit Breaker
240 V ac
9 A
IN
D
G S
M
H
G D S
100 kHz
Square Wave Oscillator
47 k
75 pF
100 k
390 k
CD4001BCN
27 pF