QEX 30

AUGUST 1984

$1

The ARRL Experimenters' Exchange

Project COMPANION

AMSAT, Project OSCAR, and the ARRL are exploring the feasibility of transmitting amplitude compandored single sideband (ACSB®) through the OSCAR 10 satellite. ACSB will do two things: (1) it will improve the signal-to-noise ratio as compared to SSB, and (2) automatically keep the SSB signal tuned despite any doppler.

Vernard Riportella, WA2LQQ, and I were all set to go to Rochester, NY to visit Sideband Technology Inc., the principal ACSB patent holder and manufacturer. Unfortunately, Rip had to cancel at the last minute. I muddled through anyway and met with Paul H. Jacobs, W2IOG, Vice President of Engineering, STI. We reviewed the technology behind ACSB and had a bench-to-bench demonstration of the system. I had witnessed ACSB tests at the FCC lab and knew more or less what to expect. However, I had not heard what ACSB sounded like on a conventional SSB receiver. I was expecting it to sound like "aaaargh, muffle muffle" but was pleasantly surprised to find that there seemed to be less compression than some amateurs use on SSB. The 3.1-kHz pilot tone could be heard as the signal was being tuned in; the receiver's normal SSB filter took out the pilot tone when the signal was tuned in properly.

STI was kind enough to provide us with one of their ACSB transceivers for tests. This transceiver is being modified so it can be used at W1AW for tests via OSCAR 10. We have asked STI for two more units for AMSAT and Project OSCAR.

It will be a month or so before W1AW is ready for any ACSB test transmissions. We have to obtain crystals and build/acquire an up-converter. If all works out, we'll use it for the voice bulletins on the Special Service Channel. If you hear a 3.1-kHz pilot tone one day, you'll know what's going on.

Please do not bug STI about this subject or ask them for freebies. If you would like to get involved in ACSB testing or development for the Amateur Radio Service, please contact AMSAT (Rip, WA2LQQ), Project OSCAR (John Browning, W6SP), or ARRL (Paul Rinaldo, W4RI).

Meanwhile, if you're not up to speed on ACSB, there is an overview of it in the 1984 Handbook along with a bibliography. If you are up on ACSB technology and are interested in writing an article for QST, please drop me a line.

Meteor Scatter

A propagation mechanism once thought to be useless for any serious communications, might turn out to be just the ticket for packet radio. Meteor scatter can support paths from about 600 to 1200 miles in length -- but typically for some fraction of a second. That's just long enough to get off a high-speed packet and get an ACK. Scientific Radio Systems, Inc. of Rochester, NY has fielded 4800-bit/s packet meteor scatter systems that operate in the high end of the 40-MHz band. I stopped in to see Jacob (Jack) Schanker, W2STM, SRS Chief Engineer to talk about Amateur Radio meteor-scatter experimentation. He suggested that the easiest thing to explore would be 10 meters, where meteor scatter should be good now that the F-layer activity is minimal. Amateurs wishing to experiment should start with a full kW and at least a 3-element beam. With the present 1200-baud speed limit on 10 meters, packets should be kept very short (on the order of a few words) until more experimental data is available.

We also discussed some possible tests on 6 meters and made arrangements to obtain a 1-kW amplifier for W1AW. Plans are still fluid, but we hope to do some testing between Rochester and Newington some time this fall.

Starting in mid July, Ralph Wallio, W0RPK, will be testing packet radio via meteor scatter on 50.505 MHz from Central Iowa. He is using AX.25 protocol, AFSK on FM, 300-W output and an 11.3-dBi gain antenna. He is looking for some company and would like to arrange schedules with stations up to 1200 miles away. Ralph can be reached on (515) 961-6406.

Rich Zwirko, K1HTV, is planning some meteor-scatter packet tests on 145.05 MHz to coincide with the Perseids meteor shower which peaks August 11. Rich recommends that stations use a minimum ERP of 1 kW. Transmissions are to consist of a brief message with the station's grid locator (see details in January 1983 QST, page 50). He is in Maryland and is looking for contacts with stations in the Midwest. You can reach Rich by phone between the hours of 5 and 10 P.M. by calling (301) 464-2133. - W4RI

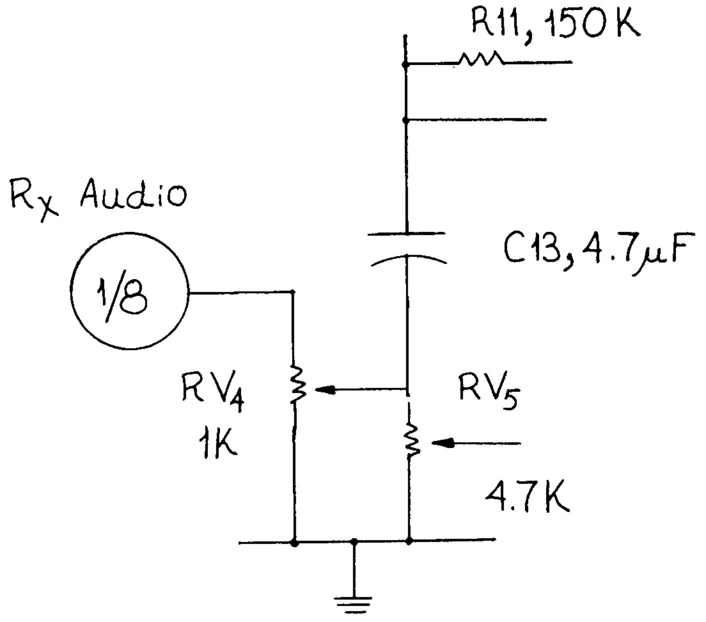
Correspondence

Feedback

Thank you for the reprints of my article, "The GB3US Mk2: A Microprocessor Repeater Logic System." I should like to point out that there is a slight omission in Fig. 3 on page 11 of May QEX (no. 27). C13 (4.7 uF) is missing, but does appear correctly in the components list and PCB layout. The correct Fig. 3 follows. -- A. J. T. Whitaker, G3RKL, Univ. of Sheffield, Dept. of Electrical Engineering, Mappin St., Sheffield, S1 3JD, ENGLAND.

Loop Antennas

I am interested in small, multi-turn loop antennas for transmitting use. If you have design information, or know where I can find it, please contact me. -- William L. Rasins, KB4KJZ, 1031 Plantation Dr., Myrtle Beach, SC 29577.



(Fig. 3 Correction)

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QEX1 683

Every so often QEX revises its list of FCC tutorials (issues no. 2 and 20). The last update appeared in the March 1984 (no. 25) issue. For those readers who were not subscribing to the newsletter at that time, I will repeat the ordering information.

The Prism Corp. has a video duplication service available for those wanting to obtain FCC Science and Technology Tutorials. Their address is 4545 42nd Street, N. W., Washington, DC 20016, tel. (202) 686-8250. Ms. Carole Watt will answer your questions on their prices and copying services.

Tutorials not listed previously in QEX are:

Title	Speak/Affiliation	Time
Fundamental Limitations of RF Frequencies from 1-300 GHz	Dr. Robert K. Crane, Thayer School of Engineering	1:30
Mobile Radio Data Transmission Research	Peter J. Mabey, Philips Research Labs	1:30
Developments in Optical Fiber Systems in the UK	John E. Midwinter, British Telecom Research Laboratories	1:20
Digital -- A Revolution in Television	Dr. Kerns H. Powers, David Sarnoff Research Center of RCA	1:30
Principles and Economics of Packet Switching	Dr. Lawrence Roberts, President, DHL Corp. Dr. Leonard Kleinrock Professor, UCLA	1:30
Improving Spectrum Utilization Through the Application of Packet Switching of Mobile Radio Systems	Dr. Barry M. Leiner, DARPA	1:20
Value-Driven Decision Theory as Applied to Spectrum Allocation	Dr. George E. Pugh, Decision-Science Applications, Inc.	1:25
Improved High Performance Television Receiver	Darrell Ash, RF Monolithics & Members of the FCC Staff	1:30

New Power Amplifier

A new 9 W, 13.8 V, 915-940 MHz Power Amplifier Module is being distributed by the California Eastern Laboratories, Inc., Santa Clara, CA. Known as the MC5240, it is designed for mobile radio applications, and offers a minimum broadband output power of 8 W with 19 dB gain. It has a better than 30% overall efficiency. Each gain stage within the module has a separate supply pin offering optimum circuit design flexibility. For maximum power output, VCC1 should be 12.5 V with VCC2/3 13.8 V. In practice, VCC1 may be supplied via a dropping resistor from VCC2/3.

For more information on the MC5240, write California Eastern Laboratories, Inc., 3005 Democracy Way, Santa Clara, CA 95050. Sales offices are located throughout the continental United States.

MC5240

PERFORMANCE SPECIFICATIONS (T_a=25°C)

MC PART NUMBER			MC5240		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**
P_{out}	Output Power at P_{in} = 0.1W, V_{CC} = 13.8V, f = 915~940 MHz	W	8	9	
$VSWR_i$	Input VSWR at f = 915~940 MHz, Z_{out} = 50Ω			2.0:1	
ηT	Overall Power Added Efficiency*	%	30	35	
	Load Mismatch at P_{out} = 8W, P_{in} = 0.25W, V_{CC} = 13.8V				3:1
I_{co}	Quiescent Current at V_{CC1} = 12.5V, $V_{CC2/3}$ = 13.8V	mA			10

$$\eta_{add} = \frac{P_{out} - P_{in}}{P_{DC}} \times 100\%$$

P_{DC} (total OC input power) = $(V_{CC1} \times I_{C1}) + (V_{CC2} \times I_{C2}) + (V_{CC3} \times I_{C3})$.

(Performance characteristics for the MC5240 are shown on page 11.)

Thoughts on Antenna Design

By Cliff Francis, Jr.,* W0MBP

This article sums up six different ways of how you could have won $500. With the ARRL antenna design contest underway, many new antenna ideas will be presented in QST as early as January 1985. Anyone with even an inkling of a thought on modifying transmission lines should have been encouraged to enter. Whether or not you participated, you might discover a useful design from my ideas that will benefit not only your station, but the Amateur Radio community as well. [The closing date for the ARRL Antenna Design Contest was April 15, 1984. -- Ed.]

Going Back to Basics

Creativity comes from reapplying the basics, or challenging them. Don't forget to seek out facts that are often overlooked when designing any antenna. Some thoughts I keep in mind when practicing this idea is that the optimum length of a dipole element is 1.28 wavelength (5/8 for verticals). How do I solve the problem of a rapidly dropping radiation resistance of two center-fed elements as they are moved toward each other on a boom by sweeping them into a 100° Vee, like some arrow-shaped TV antenna? Or, try using off-center feed to raise radiation resistance to a matchable value. Also, remember that dipoles will usually function on harmonic frequencies, but not on second harmonics. And last, the usual Windom won't radiate on 21 MHz.

How do you design an antenna with both wide frequency range and high gain? One approach is to look at wide-band antenna elements on the market today. You could add gain-producing elements later, or combine high-gain elements over a wide-frequency range. Another approach is to construct a design of your own.

A quick review of wideband antennas include: the center-fed Zepp, the Windom, the W8JK beam, fan-type dipoles, the log periodic, the discone, the bi-square, and various verticals. Two key questions are how to combine wideband elements to get gain, or singular high-gain elements to give a wideband effect.

How do we match impedances involved? Many times there is quite a bit of empirical adjustment required, so start with the basic antenna. It gives you known quantities to work with.

The innovative antenna approach requires much thought on subjects like electrically active elements, self-adjusting elements, mixed techniques such as travelling wave/yagi-dipole/log-periodic combinations, LP-quad-yagi combo's, zig-zag elements, and all-driven-element designs. These choices can present quite a challenge.

Modifying the Windom

This section offers some ideas on building multiband antennas to cover WARC frequencies and MARS activity. Do you remember the Windom 65 ft 40-, 20-, and 10-meter antenna? Make a square quad loop with it as shown in Figs. 1B. Use the formula 1005/f(MHz) to find the second harmonic. Do you recall the method of feeding it with 300-twin line? This is not advisable because the Windom is an unbalanced antenna unhappy with balanced line. However, a double Windom, two Windom loops connected with twin line, produces a balanced antenna if the connecting feed line is given a twist (Fig. 1C).

You now have a two-element quad for 40, 20, and 10 meters. Make loops for 10.5, 21, 18 and 24 MHz (four total loops), and presto -- a seven band antenna! For MARS work, the four loops can be designed to fit these nine frequencies: Loop (1) 7.2, 14.4, and 28.8 MHz; Loop (2) 9 and 18 MHz; Loop (3) 10.5 and 21 MHz; Loop (4) 12 and 24 MHz.

Since the Windom can be matched with twin line and a matchbox over a wide range, it is possible to have a nine-band antenna that reaches beyond band edges for MARS work and 10.1 MHz.

Impedance matching is empirical, based on several decisions you must make. First, feed each band/group separately, then tie all loops together on each spreader element at the smallest loop, or at mid-point between the smallest and largest loop. If you really want a wideband four-element quad, feed the two middle Windom loops at the connecting feed line midpoint as though they were a W8JK two-element bi-directional beam, with yagi director and reflector loops.

A Look at the W8JK

The old W8JK two-element bi-directional beam functions (somewhat) on 10 through 30 MHz continuously. Voltage hot spots occur, however, because the low feed-point impedance causes excessive voltage excursions at some frequencies. The theory covering this principle follows that when two center-fed dipoles are brought close together, radiation resistance drops abysmally, making matching difficult. Some designers use a folded dipole driven element to raise radiation resistance, or special matching devices -- usually useless for multi-band operation.

How can you overcome this problem? Raise the radiation resistance to a matchable quantity over

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*325 S. 3rd St., Silsbee, TX 77656

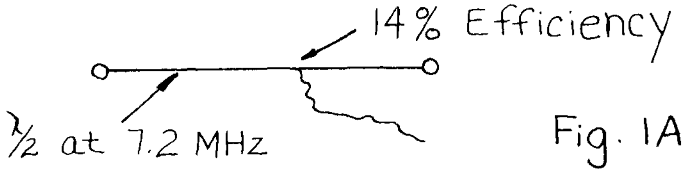


Fig. 1A

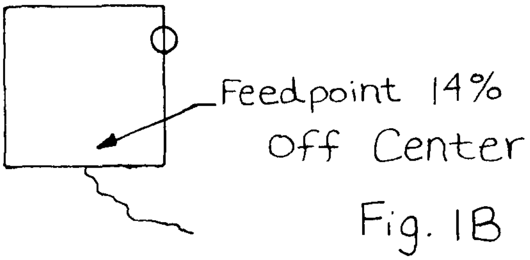


Fig. 1B

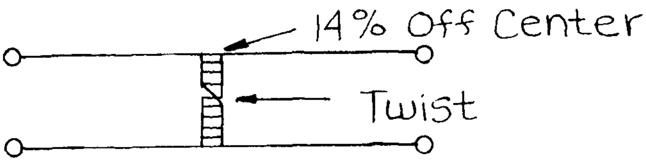


Fig. 1C

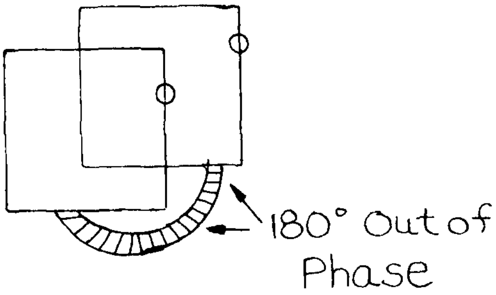


Fig. 1D

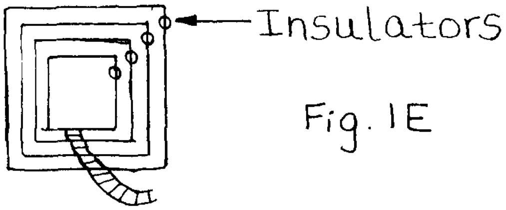


Fig. 1E

Fig. 2A

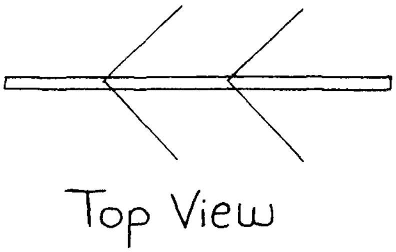
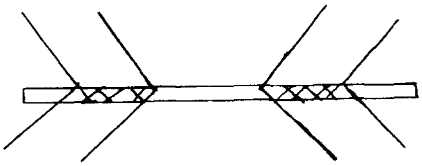


Fig. 2B



a wide frequency range. Here are some ideas: (1) Fold the dipole element tubing into a Vee of about 100° to raise radiation resistance as shown in Fig. 2A. Fig. 2B shows the design reversed. This decreases interaction between the beams. (2) Dodge voltage excursions with a bow-tie or two-wire designs for each end of the dipole. (Fig. 2C). (3) Use off-center feed. (There has not been much research on this and you might achieve a breakthrough.) (4) Try one-wavelength loops.

If all goes well, consider a four-element beam made from two W8JK beams fed (and matched) together, with an element length of 33 ft each, and approximately 8 ft spacing (Fig. 3). There you are -- 10 through 30 MHz. Now where did you put all that wire and plumbing?

The Log-Periodic Antenna

Several articles have appeared in ham magazines over the years on the log-periodic antenna. Most hams immediately dismiss the idea of building one because they are too large and complicated. But, with compromises, a workable, rotatable LP can be built with wire on a quad frame to cover 14 through 30 MHz. Here is advice on how to accomplish this feat.

Fig. 4 shows the spider quad with slanting spreaders, used as an advantage in the optimum spacing of quad loops. Imagine a four-element spider quad, with four loops on each element. Divide 14 through 30 MHz into four frequency ranges and build four LP quads on the same quad support frame (Fig. 5). Each is fed as an LP with each set of four loops designed for one frequency range: 14 to 18, 19 to 22, 23 to 26, and 27 to 30 MHz.

This design offers one boom with a continuous frequency coverage of 14 through 30 MHz. If you are clever at matching impedances and/or feeding LP's, you might decide how to feed all of them with one feedline. This would give you an additional gain of 16 loops instead of just four. If you are even sharper, you can optimize the loops for WARC bands at the expense of continuous frequency (MARS) coverage.

The Pleasure Principle

Sigmund Freud's Pleasure Principle is really a statement about the tendency of human beings and RF to escape rough spots by taking the easy way out. Let's modify an antenna for the WARC HF bands upon this principle. We'll take a Yagi triband beam to reach 18 and 24 MHz (and possibly 10 MHz).

These ideas are offered on modifying a beam: Try stub decoupling -- either the whole element or part of it to modify the frequency range (common technique on vertical antennas). Add a drop-loop to your yagi-element cut for the new frequency. Resonate your yagi element on the second or third harmonic where applicable to a new WARC band if other frequency shifts, and impedance matching problems, can be solved. Finally, add elements.

The Pleasure Principle for RF is defined as the path of least resistance (impedance), usually at resonance. RF normally chooses the correct resonant path when offered several choices. By adding new devices or elements to your triband yagi beam, you can convert it to WARC frequencies.

The Pain Principle operates along the lines of by which any length of element will radiate if you force-match its impedance, fool it, divert it or parallel it. I have even seen experimental yagi antennas with 20-meter size elements, converted with 75-meter inductances (coils) at the ends, and the most gosh-awful impedance matching devices you can imagine, used to achieve resonance from 3.9 to 30 MHz. How they worked is a mystery; how well is almost irrelevant! The pleasure is yours, however, to simply convert a triband yagi to WARC bands and thereby earn the laurels of your fellow hams. Good luck!

Another Approach to Yagi Designs

The unorthodox approach to antenna design sometimes works. Reading obscure antenna books will occasionally give you an idea about adapting and simplifying esoteric designs to fit the ham bands.

For instance, can the "Breitbandringantenna" design on p. 422 of Taschen Buch Der Hochfrequenztechnik by Meinke/Gandlach, Springer, Gerlag, 1956, be adapted to WARC bands? See your local library or bookseller.

Since forward-swept yagi elements formed into a 100° Vee might raise radiation resistance to a matchable quantity in close-spaced designs, can quad loops also be swept forward to produce the same effect avoiding the usual too-low radiation resistance? The answer is important because a swept-quad-dipole-element could then be efficiently center fed like a center-fed Zepp on a very wide range of frequencies at the close spacing of yagi design, making possible very broadband beam antennas.

Many yagi designs can be converted to all driven-element designs, and fed with parallel line through a matchbox to achieve a broader frequency response. Notice also that some commercial antennas are using all-frequency Zig-Zag designs. These are usually too large for ham use, but can the design be adapted to WARC frequencies? If so, a bamboo and wire beam could be built for 14 through 30 MHz continuous coverage.

The term "human being" cannot be defined because every accurate definition must set limits; human beings have unlimited potential. Creation is one of the great joys. Turn your imagination loose to create a new design, and go for the gold!

Fig. 2C

End View

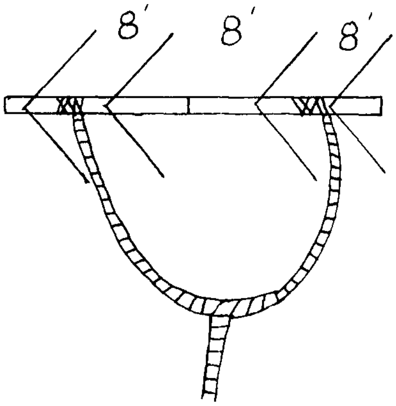


Fig. 3

Oblique Side View

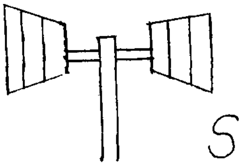


Fig. 4

Side View

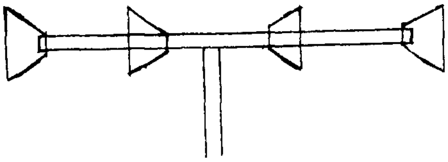
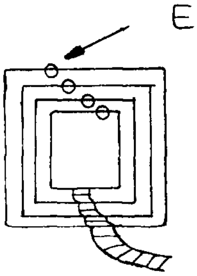


Fig. 5



Either dipole or continuous (Quad) loops (preferably)

End View

Fig. 5A

A Coax-Antenna Trap Program for the Timex/Sinclair 1000

By Andy S. Griffith,* W4ULD

The Technical Correspondence column in the March 1984 issue of QST featured an article by Frank Noble, W3MT, on coax antenna traps. It was of special interest to me since I had just completed a similar analysis for the TIMEX/SINCLAIR 1000 computer. I used a different approach than Frank because I wanted to solve for the number of turns in the trap when given coax specifications, coil form diameter, and frequency. My computer program is shown later. I will first go through the method I used for those who wish to program other computers. Analyzing my step-by-step procedure might lead the proficient programmer to a better approach.

Using N for the number of turns of coax required in a trap, a FOR/NEXT loop was programmed. The first sequence is FOR N = 1 to 100, starting with the following formula:

$$L = \frac{A^2 \times N^2}{18A + [40 \times CD \times (N + 1)]} \ \mu H \qquad \text{(Eq. 1)}$$

where,

A = Diameter of coil form plus the diameter of the coax, both in inches.

CD = Diameter of coax in inches.

This is the same formula used by Noble except N + 1 rather than N is used to calculate the length of the coil, i.e. the term b in the usual inductance formula. Unless N + 1 is used, the results come out consistently low.

The next step in the first loop is to calculate X_L from L:

$$X_L = 2 \times \pi \times f \times L \text{ Ohms} \qquad \text{(Eq. 2)}$$

where,

f = Frequency in MHz.

L = Inductance from Eq. 1 in μH.

Next, the capacitance of the coil at N turns is calculated:

$$C = \frac{C_c \times A \times \pi \times N}{12} \text{ pF per inch} \qquad \text{(Eq. 3)}$$

where,

C_c = Capacitance per foot of coax in pF.

It is important to measure the capacitance of the coax for good results.

The next step in the loop calculates X_c as follows:

$$X_c = \frac{10^6}{2 \times \pi \times f \times C} \text{ Ohms} \qquad \text{(Eq. 4)}$$

The computer inserts sequential values of N in the above formulas and calculates X_L and X_c for each N value. When the calculated X_L is equal to or greater than the value of X_c, that is the resonant circuit and the computer moves to the second loop. So far, the computer has calculated the nearest whole number of turns that will satisfy $X_L = X_c$ at f.

The second loop uses the letter M:

$$\text{FOR } M = (N - 1) \times 10 \text{ TO } (N + 1) \times 10 \qquad \text{(Eq. 5)}$$

where,

N = The turns the computer calculated in the first loop. The computer automatically transfers this value to the second loop.

In the second loop N1 is used for the number of turns:

$$N1 = \frac{M}{10} \qquad \text{(Eq. 6)}$$

The net result is that each unit step in M by the computer increases N1 by 0.1 turns starting at N - 1. N1 now sequences through Eq. 1 to 4 until X_L is again equal or greater than X_c, but this time the number of turns will be calculated to the nearest 0.1 turn.

Why use two loops? The answer is speed. If only one loop was used to calculate 20.0 turns, the computer would have to go through the calculations 200 times and take approximately one minute. With two loops only 5 to 10 seconds are required. The first loop makes 20 calculations to 20 turns and the second loop makes 10 calculations starting at 19 turns to attain 20.0 turns.

The final step is to display the answer. I set up to display X_L, X_c, L, C, and turns. The display of X_L and X_c are a check on the program since the two will be equal or X_L will be slightly

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*1904 York St., Kinston, NC 28501

greater than X_c.

Test vs. calculated results are shown in Table 1. My procedure is not the best choice for a small calculator. Noble's Eq. 4 can be substituted for mine and might work best. Make several calculations for frequency on each side of the desired frequency and plot these vs. the turns in each calculation. Then, pick off the turns at the desired frequency. I believe you should use N + 1 rather than N in the numerator of his formula for better accuracy. (Use N in the denominator.)

Picking up Eq. 4 from Frank Noble's Technical Correspondence article, we have:

$$f = 127\sqrt{\frac{9d + 20\,bn}{\varepsilon\, d^3\, n^3}}\ \text{MHz} \qquad \text{(Eq. 4)}$$

where,

ε = capacitance per inch of cable, in pF.
d = diameter (to center conductor) of coil in inches.
n = number of turns.

For RG-58/U:

b = 0.195 inch.
ε = 2.375 pF per inch.

Table 1

Test vs. Calculated Results

Coax Type	Form dia. inches	Meas. pF/ft* Coax	Coax dia. inches	Actual Number Turns	Meas.** Resonant Freq., MHz	Calculated Turns
58A/U	1.69	32.4	0.2	13.1	5.57	12.8
58A/U	1.25	36.6	0.2	7.2	14.08	7.5
59	1.69	21	0.242	5.8	18.68	5.7

* Measured with a calibrated Heathkit RCL bridge. Several feet were measured and divided by the number of feet.

** Measured with a GDO and a frequency counter.

PROGRAM FOR TIMEX/SINCLAIR 1000

```
 5 PRINT "THIS PROGRAM WILL CALCULATE THE (SPACE)
        TURNS REQUIRED FOR A COAX AN-(3 SPACES)
        TENNA TRAP.  IT ALSO GIVES L, C, (SPACE)
        XL, AND XC.  INPUTS ARE COAX (5 SPACES)
        DIA., CAP PER FOOT, COIL FORM (3 SPACES)
        DIA., AND FREQUENCY"
10 PRINT
11 PRINT "ENTER GOTO 20"
20 CLEAR
22 PRINT "ENTER COAX DIA., INS."
30 INPUT CD
40 PRINT AT 0,27; CD
50 PRINT "ENTER COAX CAP/FT., PF"
60 INPUT CC
70 PRINT AT 1,27; CC
80 PRINT AT 2,0; "ENTER COIL FORM DIA., INS."
90 INPUT D
100 PRINT AT 2,27; D
110 PRINT AT 3,0; "ENTER FREQ., MHZ"
120 INPUT F
130 PRINT AT 3,27; F
140 LET A = D + CD
150 FOR N = 1 TO 100
160 LET L = A**2*N**2/((18*A) + (40*CD*(N + 1)))
170 LET XL = 2*PI*F*L
180 LET C = A*PI*N*CC/12
190 LET XC = 10**6/(2*PI*F*C)
200 IF XL > = XC THEN GOTO 300
210 NEXT N
300 LET X = (N - 1)*10
```

(The TIMEX/SINCLAIR 1000 Program is continued on page 11 .)

VHF+ Technology

Conducted by Geoff Krauss, * WA2GFP

My apologies if you have missed this column in recent months. I was side tracked in a morass of computer-related problems: Digital interfacing of my spectrum analyzer to a C-64 computer, adaptation of a normal Polaroid camera to the analyzer, interfacing to have picture exposure also controlled by the C-64, and so on. In the midst of my activities, I remembered that a certain amount of building and/or repair work was required on equipment built for the VHF contest effort of W2SZ/1 and myself.

With respect to the three VHF/UHF contests of June, August and September in 1983, I was dismayed to see a decrease in the level of competition in the multi-op station category. It was the intense rivalry between groups such as W1FC, W2SZ/1, W3BBS, W3CCX et al. that generated most of the recent state-of-the-art advancement in U.S. Amateur Radio equipment above 1300 MHz. Although some of the techniques learned by W2SZ/1 personnel for building relatively inexpensive and reproducible equipment on 2304/3456 MHz will eventually find their way into ARRL publications, a lot of information from other sources may not. If you have information in this area, consider making it available to all VHF+ers. Myself or the QEX/QST technical staff would be glad to assist you in preparing appropriate material for publication in these journals.

New VHF Records

With the addition of several new frequencies, a few remarkable, but perhaps unrecognized, achievements have been made by the multi-op contest groups' "quest-for-sections." (It should be noted that whether you are for or against the use of grid squares, extra multipliers would be available with each new band in either case.) While I have never seen the following "records" listed in W3XO's "World Above 50 MHz" column in QST (or in W1JR's list of terrestrial propagation records in the July 1984 Ham Radio, which unfortunately ends at 24.25 GHz), I list here those "records" I have personal knowledge of. I hope at least one of my readers will break these records soon and advance the art.

48 GHz:	W2SZ/1-WA2AAU/1	0.3 miles (June VHF QSO Party - 1982)
72 GHz:	WA2GFP-WA2GFP/2	0.2 miles (June VHF QSO Party - 1984)
>300 GHz:	WA2GFP/2-K2KXS/2	0.2 miles at 632.8 nanometers (nm) (June VHF QSO Party - 1983)

The 48-GHz contact was made on equipment provided by WA1UGE. The second harmonic of a 24-GHz Gunn oscillator was separated from the fundamental signal via a circulator and 48-GHz waveguide (operating as a high-pass filter). Most of the power was used for the LO to a diode mixer, and transmitted power was in the tens-of-microwatt range; a horn antenna of about 20 dB helped. The IF frequency was only 10.7 MHz and the poor noise figure of the detectors was even further hindered by lack of image-noise rejections. K7AUO, W7TYR and WB7UNU are known to have made at least one 48-GHz QSO in the June 1983 or August 1983 contests. Perhaps one of their operators would like to describe the system and distance record.

The 72-GHz contact should probably not have been listed with the others as it was not a QSO between 2 different amateur stations, but involved 2 stations set up and controlled by this writer. It consisted of predetermined "codes" (as in EME work) that was used for information exchange between my 8-year old son and myself. It is listed to show that 72 GHz (soon to be 75 GHz) work can be done, although it takes a lot of luck and time.

My luck was given to me by a non-ham who wishes to remain anonymous. He donated a pair of pulsed-diode oscillators that failed to pass testing at a slightly different frequency, and retuned the units to the center of the present 72-GHz band where something less than a 1 mW average output (5 us pulse, 1% duty cycle) was obtainable. A dielectric-lens "horn" served as a gain antenna. The diode is used as a self-oscillating mixer, but adds an additional problem. The mixer only works during each 5 us pulse when the diode is actually oscillating! It takes no fancy math to show that if your receiver logic requires a 500-ns pulse presence for detection (as my receive IF does), and the signal propagates at about 1 ft/ns, a perfectly-synchronized pair of oscillators would have a maximum range of no more than 4500 ft!

Since synchronization was nowhere near perfect, approximately 1500 ft represents the present capability of this type of equipment. Obviously, this communication could not, at this time, meet the contest rule for "true" communications potential (i.e. over 1 km). Perhaps the contest committee should review that limit for bands above 25 GHz and below >300 GHz.

The 632.8-nm contact was done with a pair of 1+ mW Helium Neon (HeNe) lasers, gated by electromechanical shutters, and photodiode receivers. No optics were used; my calculations indicate that cooled photomultiplier-tube receivers and available optics should allow a range of at least 10 miles (line of sight, of course). The W1FC and W6OAL groups are known to have done at least one laser QSO each in the June 1982 and September 1983 contests. Again, descriptions of their systems and distances would be of great interest to all VHF+ers.

Update on the 432 and 1296-Converter Kits

Lastly, a number of readers have called and

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written about my results in testing the RadioKit 432 and 1296-converter kits (mentioned in my March 1984 column, issue no. 25). My test results agreed almost exactly with the published specs (rarity of rarities). As these converters were originally purchased to be used with 432/1296 liaison stations for additional 72 GHz work, they were never field-tested to the fullest extent. It was impossible for me to find another ham who wanted to carry a 3-band station around Whiteface Mountain on a 90+° day in June.

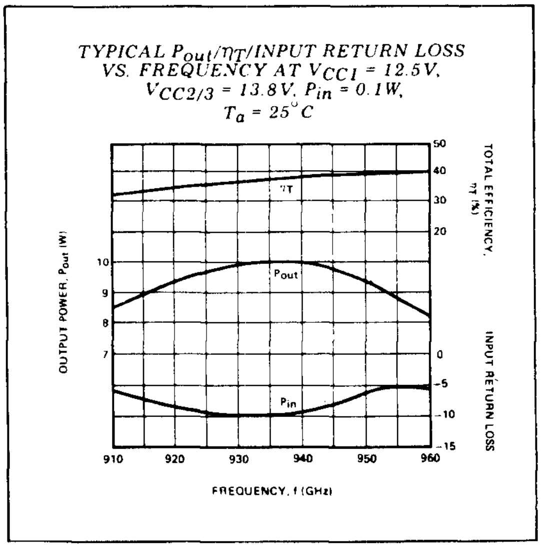
Backyard and car tests, however, show that the only problem is the stability of the on-board conversion oscillators. Even though each is crystal controlled and voltage-regulated, the temperature stability is only sufficient for relative wideband (greater than 2 kHz) modes. Narrow-band CW is not really possible with most internal oscillator converters; an out-board temperature-stabilized oscillator/buffer is almost always required. More on this topic in the next column.

(The TIMEX/SINCLAIR 1000 Program continued from page 9.)

```
310 LET Y = (N + 1)*10
320 FOR M = X TO Y
330 LET N1 = M/10
340 LET L1 = A**2*N1**2/((18*A) + (40*CD*(N + 1)))
350 LET XL1 = 2*PI*F*L1
360 LET C1 = A*PI*N1*CC/12
370 LET XC1 = 10**6/(2*PI*F*C1)
380 IF XL1 > = XC1 THEN GOTO 450
400 NEXT M
450 PRINT AT 5,0; "XL ="; AT 5,8; INT(XL1*100)/100
460 PRINT AT 6,0; "XC ="; AT 6,8; INT(XC1*100)/100
470 PRINT AT 7,0; "L ="; AT 7,8; INT(L1*100)/100
480 PRINT AT 8,0; "C ="; AT 8,8; INT(C1*100)/100
490 PRINT AT 9,0; "TURNS ="; AT 9,8; N1
500 PRINT AT 11,0; "ENTER GOTO 22 FOR RECALCULATION"
510 PRINT AT 13,0; "ENTER GOTO 80 TO RECALCULATE (3 SPACES)
    COIL DIA. AND F ONLY."
520 PRINT AT 16,0; "ENTER GOTO 110 TO RECALCULATE (2 SPACES)
    F ONLY."
```

(continued from page 3)

PERFORMANCE CHARACTERISTICS



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

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

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