QEX

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The ARRL Experimenters' Exchange

ARRL Technical Advisors

The ARRL Technical Department has on tap a number of volunteer Technical Advisors (TAs) on many areas of technical expertise. TAs have not been given much publicity, and it is possible that you have not been been aware of this program. At least, you should know that there is such a program to assist the League's Technical Editors with specialized problems. In addition, you may have needed specialized knowledge and may wish to volunteer as a TA.

To qualify for appointment, Technical Advisors:

(1) should be licensed amateurs;

(2) must be League members;

(3) must be employed by the industry in the field of expertise for which the appointment is made;

(4) should be willing to critique manuscripts and accept letters and phone calls from ARRL officials concerning technical matters; and,

(5) will be asked to critique League publications and offer advice for improving them.

Here is a list of current TAs:

John O. Battle, N4CE	Rf microwave circuit design, hf receiver design
John S. Belrose, VE2CV	Antennas
Peter M. Bradley, N1ADX	Biological effects of rf energy
Norman Bradshaw, W8EEF	Use and maintenance of electronic test equipment
John Champa, K8OCL	Industrial Health and Safety
Mark A. Corbitt, WB4FNE	Digital Communications, satellite links
David Davidson, W1GKM	Biological effects of rf energy
Robert V.C. Dickinson, W2CCE	CATV, CATV leakage problems
Dave Geiser, WA2ANU	Vhf/uhf components and applications
Helge Granberg, K7ES	Mf/hf rf power
John Grebenkemper, KA3BLO	Solar astronomy, space propagation, satellite links and receivers
Albert E. Hayes, Jr., K6BH	RFI/RFI filter design and applications
Wes Hayward, W7ZOI	Receiver design, testing
Roy C. Hejhall, K7QWR	Rf power devices and applications
Albert Helfrick, K2BLA	RTTY
Michael E. Hiehle, W6RZ	Hf/vhf/uhf antennas
Lawrence Higgins, W5QMU	Biological effects of rf energy
Edward L. Kane, W6ONT	Antennas and radiation patterns
Deane E. Kidd, W7TYR	Component specifications and sources
Oliver K. Lewis, W4EVV	Metrics
Douglas Macheel, K6HLE	Vhf broadband amplifiers and remote base stations
Hank S. Magnuski, KA6M	Packet radio
John A. Maguire, AE9I	Microwave measurements
Al Markwardt, W5PXH	Antennas, RFI
Walter Maxwell, W2DU	Antennas
John Montague, WØRUE	Computer scientist
J.P. Neil, KN6B	Telephone standards and regulations
Peter J. Nord, WB8FGE	Biological effects of rf energy
Thomas R. O'Hara, W6ORG	Fast-scan TV, ATV
Rick Olsen, N6NR	Microwave circuits
Ed Oxner, KB6QJ	VMOS Power FETs
Robert S. Parnass, AJ9S	Computers, software, RTTY
Daniel N. Petersen, WA6OIL	Pc board fabrication, circuit packaging, microwave consultant
Andrew Pfeiffer, K1KLO	Mechanical structures
Harold Richman, W4CIZ	RFI/TVI
Paul L. Rinaldo, W4RI	Computer communications, spread spectrum, technical aids to the handicapped
Jay B. Rusgrove, W1VD	Receiver design and performance
Kerry Sandstrom, K5KS	Biological effects of rf energy
Jerry Sevick, W2FMI	Antennas, broadband transformers
Richard A. Simpson, W6JTH	EME, radio propagation
Nathan Sokal, WA1HQC	Solid-state power amplifiers
Roger Stephens, K5VRX	Biological effects of rf energy
Jim Stewart, WA4MVI	Radio propagation, predictions, EME
Ken Stuart, W3VVN	Dc power systems
Jeff Walker, W4AAD	Equipment performance measurements, EMC/RFI
Richard L. Webster, K9ULW	Test procedures for communications equipment
Edward Wetherhold, W3NQN	LC filters
Glenn L. Williams, AF8C	Digital, logic, ASCII
Paul M. Wilson, W4HHK	EME
Brian Wood, WØDZ	RTTY, microprocessor control, digital design, computer software & firmware
David Zinder, W7TMD	Power supply design

If you are interested in becoming a TA (and doing the work), contact Technical Department Manager, Doug DeMaw, W1FB at ARRL Hq. - W4RI

Correspondence

On Calibrating a Frequency Counter

Here's another method of calibrating counter time-base crystals. This method was accepted by NASA, Navy and Air Force. Before retirement in 1970 I worked for one of the large aircraft (military) manufacturers. During a ten-year period from about 1952-1962 I supervised the engineering standards, calibration and repair of electronic equipment.

To calibrate time-base crystals in counters we used a visual method (not a scope). The method used a Brownings Laboratory "WWV Receiver." The receiver tuned only to WWV on all its frequencies. The receiver had a very, very active signal strength meter. It had no BFO. It employed an a-m signal from WWV. After warmup on the best WWV signal the counter crystal signal was introduced into the input of the WWV receiver. As the trimmer of the counter crystal was tuned, the two signals would beat together and the "S" meter would move rapidly until near zero beat. At exactly zero beat the phase difference between the two signals would be practically nothing, less than one cycle per second, much less when signals were strong. - Malcolm J. Taylor, W5SIW, 2602 Kansas Ave, Kenner, LA 70062.

More on Calibration

Thank you very much for your efforts in making QEX the success that it is. I look forward to receiving the announced monthly issue.

The following response to the subject: "a method of calibrating a frequency counter" is submitted:

1. Warm up unit for 24 hours.

2. Connect the input to reference oscillator output from the internal oscillator of the counter.

3. Adjust the internal oscillator so that the counter displays the internal oscillator reference frequency.

4. This method gives a result that is very close to that of the NBS.

Manufacturers recommend leaving frequency counters on "standby" at all times, to maintain stability of the reference clock crystal.

Credit for this response goes to D.B. McBrayer, Supervisor, Test Lab, SoPac Communications Co, Burlingame, CA. - Ray Greene, KA6ITF, 158 Beachview Ave, Pacifica, CA 94044.

Calibration on Color Burst Reference

The main idea is to use the cheapest source but accurate for calibrating a frequency counter. One of the cheapest source I use to calibrate my frequency counter is the output of a 3.58-MHz reference oscillator of a color TV. The exact frequency of the oscillator is 3.579545 MHz. The reference oscillator is sometimes called NTSC color standard.

First, you must look up the shematic for the TV set. Locate the output of the 3.579545-Mhz oscillator (NTSC) on the schematic and the TV set.

Let the counter in need of calibration warm up for about 15 to 30 minutes. During the frequency counter warm-up period the TV for calibration should be warming up. The warm-up period is to maintain good frequency stability.

Before connecting the counter to the output of reference oscillator (NTSC), there should be a coupling capacitor between the counter coaxial cable input and NTSC oscillator output. I attached a 0.047-uF 600-Vdc capacitor to the end of a coaxial cable not connected to the frequency counter. The other end of the capacitor should be free to connect to the NTSC oscillator.

Now, connect the frequency counter needing calibration to the 3.579545-MHz output point.

Follow the adjustment procedures for your frequency counter instruction/service manual. My output results were good (3.579545 MHz on my counter's display). - Henry R. Leggette, WB4MNW, 1555 Galveston St, Memphis, TN 38114.

Drooping Radial Impedance Information

I am soliciting technical information related to a two-meter antenna design that I have lucked into. It is a simple, inexpensive attic antenna that allows me to remain on the weather-watch net during a local thunder storm.

The antenna consists of a piece of #12 copper wire soldered into a PL-259. The wire has a hook bent into the end to allow it to be suspended from a piece of nylon cord tacked to an attic rafter. The PL-259 is screwed into an SO-239. A piece of #12 wire is fastened with a machine screw to each of the four mounting holes (enlarged) on the corners of the SO-239. These four "radials" have been bent down to be nearly parallel to the "whip;" the bottom of each about 6 in. from the coax connected to the SO-239.

Surprisingly (to me) it was possible to trim the elements to a minimum indicated reflected power of 0.36% at 145 MHz. The indicated SWR is:

144 MHz 1.16:1	145 MHz 1.13:1	146 MHz 1.23:1
147 MHz 1.38:1	148 MHz 1.60:1	

Measurements were made with an Azden PCS-3000 transceiver, a Heathkit IM-4190 bidirectional rf wattmeter, and a mini RG-8/U coax cut to nine half wavelengths by use of a grid-dip meter.

The antenna hung in the attic is clear of metal objects except for a horizontal bx cable about 29 in. above and to one side of the whip.

The final configuration was arrived at as follows. The radials were first bent down about 45 degrees, the droop that was expected to give the best match to 50 ohms. The whip and radials were trimmed to provide minimum reflected power near the center of the band -- excellent match achieved. By happenstance the resulting radial length was about 5% longer than the whip which was 17 3/8 in. from the top of the PL-259 to the top of the hook. Since the antenna is to be used at only one frequency I thought perhaps it would be more effective as a vertical dipole even at the expense of some increase in SWR. So I bent the radials to be nearly parallel to the whip. In this configuration the frequency at minimum at minimum SWR was considerably lowered. I brought the minimum SWR to 145 MHz by shortening the radials only, and found both near-zero reflected power and broad banding. The resulting radial length is 19.5 in.

I would appreciate receiving information or reference to technical literature explaining the parameters of antenna design with drooping radials or experience with the specific design that I arrived at. I would like to understand how the good impedance match came about. Everyone I discussed this with preducted a correct match only with the radials drooping about 45 degrees. - Jack Geist, N3BEK, 2205 Henderson Ave, Silver Spring, MD 20902.

(More correspondence on page 4)

On Ssb Radio Communications

By John S. Belrose*

Single-sideband (ssb) modulation has been largely ignored for mobile radio in the vhf and uhf bands, although its application for this service was proposed some 25 years ago (ref. 1) and its use has grown very rapidly in similar bands used by radio amateurs. However, this situation is likely to change. Narrow-band technology, amplitude-compandored single sidebaand (ACSB**) is indeed likely to take its place alongside fm in mobile radio communications. There are at least three companies in the USA gearing up for production, and extensive ssb studies have been conducted in the USA (ref. 2), at Philips Research Laboratories in Surrey, in the UK, and in Japan (ref. 3).

Actually, amplitude compandoring is only a part of this new technology, and not all researchers agree that amplitude compandoring is necessary. The required high-frequency stability (±20 Hz, although ±50 Hz is good enough), the rapidly fading signal, requiring agc time constants on the order of 20 ms, and the relatively poor performance in early ssb receivers in the presence of even modest levels of igition noise has, until recently, discouraged the use of ssb. Moreover, it has become apparent, from some of these studies, that the narrower bandwidth of ssb compared with fm is not as real as might be supposed, because of the limited rejection of the unwanted sideband achieved in practical transmitters, especially when modulated by speech. Rejections of 50 dB are not adequate to free the adjacent channel for use in the same location, and so the number of available channels would not increase in proportion to the nominal reduction in occupied bandwidth.

The New Technology

The basis of the new technology is actually fairly straightforward. The problems with good agc characteristics, and frequency lock for ssb reception can be overcome by transmitting a "pilot signal," and various forms of such signaling have been evaluated, including pilot carrier, tone-in-band, tone-above-band, analog Lincompex and digital Sycompex***. The first three were found to be very similar and the latter provide signal-to-noise enhancement through amplitude compression and expansion. That is an advantage that is also achievable using much simpler circuitry since ICs are available that provide a 2:1 amplitude compression and amplitude expansion, it being necessary only to set the threshold before expansion.

The "convenience circuits" developed by Bruce Lusignan (ref. 4) are the basics for this technology which is best described, although complete circuitry is not given, in his reports. A pilot tone-above-band is transmitted (about 3 kHz at a power level of -13 dB below peak power). To facilitate positive frequency lock in the presence of various tone signaling that may be employed for radio-selective-call and radio-to-telephone interconnect, this pilot tone is frequency modulated by a 40-Hz tone. Furthermore, the most recent tests have shown that two stages of 2:1 amplitude compandoring, and pre-emphasis should be included, along with automatic microphone gain, automatic linearity, and control circuitry for agc and frequency lock. Compandoring gives at least 12 dB improvement over straight ssb, 10-15 dB improvement over fm; and ssb occupies 1/5th of the fm bandwidth.

Commercial Development

The ACSB design described above was done by Bruce Lusignan. VBC Inc. is licensed to develop an LSI chip that would incorporate all the features and circuitry developed at SRI. Johnson Radio are licensed to use the ACSB pc board designs, and they are presently developing an ACSB 900-MHz groun-air-ground communications system. Sideband Technology, Inc. (ref. 5), following the available information in the SRI reports have (apparently) developed their own version of the Lusignan convenience circuitry and have manufactured prototype ACSB transceivers for the 150-174 MHz range. These transceivers are presently not for sale, but numbers of them are presently undergoing user-evaluation trials, in Indiana by Standard Oil, in Canada by CP Rail (in the Hawkesbury, Ontario area) and probably elsewhere. Subsequent trials will be conducted in Canada by Bell Canada, the Department of Transport and the Communications Research Centre. An ACSB transceiver is also being developed by Stephens Engineering Assoc. Inc., Mountlake Terrace, WA, but little is known about this transceiver at present, except that it will be a 16-channel 30-watt unit. The Stephens Eng. transceiver will also be evaluated and field-trialed by CRC later this year.

The availability of the ACSB LSI chip is unknown. But when developed, it should have wide application for mobile radio communications because it would be relatively easy to incorporate it into ssb equipment.

Ssb Technology in the Amateur Radio Service

A number of mobile radio transceivers are currently available manufactured by ICOM, Yaesu, Kenwood and others. The 2-m transceivers can be translated to 70 cm and 23 cm rather easily by employing linear-frequency transverters manufactured by Microwave Modules, Liverpool, UK. The agc circuitry has, however been optimized for base-station application, but results of tests show that performance is adequate at normal vehicle speeds (at 146 MHz), and the frequency stability, using a TCXO seems adequate for the amateur service. Communication tests carried out by CRC employing an ICOM 251AE revealed that the characteristic "popping" of fm communications at distances near the limiting range was entirely absent employing ssb. They also showed that the distance to which ssb communications extended well exceeded (for the same peak power) the range for standard fm with ±5-kHz deviation. At low signal levels, the quality of the transmission (in the writer's view) is acceptable and more comfortable to listen to than weak fm signals with loud noise bursts. The fm radio, however, provides a more natural-sounding voice due to its wider audio bandwidth.

The ACSB LSI chip when available should be adaptable for use with these types of radio amateur transceivers, permitting amateurs to experiment with ACSB. →

*Communications Research Centre, P.O. Box 11490, Station "H," Ottawa, Ontario K2H 8S2, Canada.

**ACSB is a registered trademark of Sideband Technology, Inc., Rochester, NY.

***The digital version of Lincompex, named Syncompex was invented by Sherman Chow, at the Communications Research Centre, and is presently licensed to industry (Miller Communications). Applications to date however have been for hf-ssb communications.

ACSB (continued from page 3)

References

1. Richardson, Eness and Dronsuth, "Experience with Single-Sideband Mobile Equipment," Proc. IRE, Vol. 45, pp 823-829, 1957.

2. Lusignan, "The Use of Amplitude Companded SSB in the Mobile Radio Bands: Final Report," Stanford Electronics Laboratories, Technical Report No. 29, Stanford University, July 1980.

3. "Is Land Mobile SSB an American Exclusive?," Communications, pp 94-97, January 1982.

4. Lusignan, "Convenience Circuits," Stanford Electronics Laboratory, Technical Report No. 30, Stanford University, June 1980.

5. Jacobs, "In Defence of ACSB," Mobile Times, pp 22-26, June 1981.

Names and Companies

1. VBC Inc., P.O. Box 1289, San Mateo, CA 94401 (Tom Lott, VE2AGF, 415-348-8400).

2. Sideband Technology, Inc., Townline Park, Bldg. E, 3000 Winton Road S, Rochester, NY 14623 (Paul Jacobs, VP Engineering, 716-244-5500).

3. Stephens Engineering Assoc. Inc., 7030 220th S.W., Mountlake Terrace, WA 98043 (Dave Thompson, 206-771-2182).

4. E.F. Johnson Company, Waseca, MN 56093 (Bruce Pontius, VP, Engineering, 507-835-6540).

5. A.J. Bonney Communications Inc., 24 Queen St E., Suite 300, Brampton, Ontario L6V 1A3, Canada (Tony Bonney, 416-453-4205).

6. Radio Science Laboratory, Stanford Electronics Laboratories, Department of Electrical Engineering, Stanford University, Stanford, CA 94305 (Prof. Bruce Lusignan, 416-497-3471).

Correspondence (continued from page 2)

PIDGIN

I might commend to the readers of QEX a recently described high-level language called "PIDGIN." It was first described in Dr. Dobbs Journal, No. 57, by William A. Gale, together with a complete compiler listing. Although first written for a 6502 CPU, an 8080/CPM version recently was published in DDJ, No. 65. I have been in the process of bringing up a 8080/ProcTech SOL version, and, perhaps naturally, adding my own 'enhancements' for that environment (improved modularity, run-time variable I/O, etc.). The language permits creation of very fast, highly structured, compiled machine code for a given machine. Inasmuch as PIDGIN is a high-level language, the code is easily transportable. As such, it would be a natural choice to implement packet radio terminal node controllers (TNCs) or station node controllers (SNCs), and to pass source code along the nets once a backbone is up.

The language includes the following structures:

1. Simple variables and arrays, of 2 types,

2. Data transfer statements, with automatic type conversion.

3. +, -, *, /, increment, decrement arithmetic functions.

4. Arithmetic comparisons,

5. Logical operations (AND, OR, NOT),

6. Control structures, including: IF/THEN/ELSE; n-way CASE; WHILE; subroutine CALL and code modules; machine code CALL (my extensions add PEEK, POKE, PUSH, POP, INPUT, OUTPUT), and

7. Blocked and byte-wise input/output facilities.

With the simple addition of asynchronous, multiple-interrupt handling extensions, the language would closely reproduce a subset of mainframe PL/I; with that, TNC/SNC drivers could be written in a more widely understood structured, linear programming form. As packet networks enter the mainstream of ham radio, end users, who are willing to devote the non-trivial effort of developing proficiency in modeless threaded languages will need the power and the usefulness of a common, machine-independent HLL of a traditional linear style, which may be used at both a systems and an applications level.

Back issues of DDJ, including Nos. 57 and 65, are available at a cost of $3.50 + 50 cents shipping/handling, from DDJ, P.O. Box E, Menlo Park, CA 94025. - Russell P. Herrold III, WB8SKY, 2834 Clifton Rd, Columbus, OH 43221.

Amplifier for the Century 21

I wonder if anyone has any info re: an amplifier for the Century 21 digital rig? That's something like a 10 amplification (about 250 W output for this rig).

Perhaps an ad section (buy, sell exchange, etc.) can be added to your pages. - Edward G. Bowley, W2VLH, 86-22 Dongan Ave, Elmhurst, NY 11373.

Comments on QEX Issue No. 4

Obvious efforts paying off in good works! BRAVO! (especially) ENCORE!

Ref. issue #4: Page 2: get Charles W6FPV to write in re his 1750-m transceiver! Page 1: How can we send stuff in MODEM7 format if you won't tell us his format? Re calling you by phone: too poor for that. Pages 3-6 (Data and Clock Modem, DCM-1, by Paul Newland, AD7I): Sounds like exactly what I've been looking for. Will probably build it this summer. Will keep you posted. Pages 7-8: are you interested in revisions of your program for TRS-80 Color? If so, I may supply it. - Richard (Rick) Herndon, K5FNI, 8103 Parkdale Dr, Austin, TX 78758.

Ed. Note: An article by W6FPV describing his 1750-meter transceiver will appear in one of the next issues of QEX.

MODEM7 is not a "format" in the sense of arranging text on a page but is a computer-to-computer communications program for use over the telephone. It was written by Ward Christensen, is in the public domain and is available through the CPM Users Group library for computers which can use the CP/M operating system. MODEM7 has a "file-transfer" mode which includes automatic error checking of each 128-byte transmission block. In addition, it has a "terminal" mode which will permit a computer to talk to bulletin boards and time-sharing systems and save everything said during the session on disk. I am using MODEM7 to receive the "Data Communications" column from Dave Borden, K8MMO. I have used MODEM7 to receive files from other writers, including Dick Barth, W3HWN, who has rewritten MODEM7 so that it will run on a Smoke Signal Broadcasting Company 6809 computer.

To minimize editing, I prefer authors to format their manuscripts 50 characters per line, indenting 3 spaces for paragraphs, and using standard ARRL abbreviations. Other details of the format can be discerned by looking over this issue of QEX. Even if a different format is used by the author, it is usually much easier to receive it electrically and edit it than it is to keyboard the entire article. - W4RI.

Coil Design in BASIC

By Harry L. Rosier,* K4LBF

Have you ever wondered how many turns of what size wire and on how big a coil form would yield a particular inductance or reactance?

Well, take heart, the following computer program will make all these decisions for you! It will let you choose your coil form from a 0.5- to 2-watt reistor to a form of your own choosing. And, it will let you choose the wire size and inform you if that size will fit on the form that you have selected. It will also let you space-wind a coil and give you the length-to-diameter ratio so you can pick an optimal coil configuration.

*12 Hastings Circle, Greensboro, NC 27406.

I have used it to design coils from video chokes to the final coil in my kilowatt final. It seems to be accurate to well within Amateur Radio needs.

The program was written in Microsoft BASIC on a Commodore PET computer. With very minor modifications is should be transportable to any computer using that BASIC language.

It requires a memory of only about 5700 bytes to load and run, so it should fit in most small machines.

Happy coil designing. If you find any errors, please let me know the fixes for them.

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100 CLR:PRINT"":REM CLEAR SCREEN
110 REM"THIS IS A COIL DESIGN PROGRAM BY"
120 REM"HARRY L. ROSIER - K4LBF"
130 REM"FINAL DESIGN NOVEMBER 5, 1980."
140 REM"SPECIAL THANKS TO THE RADIO"
150 REM"AMATEUR'S HANDBOOK FOR THE"
160 REM"EQUATION AND WIRE TABLES"
170 PRINTTAB(12)"COIL DESIGN":PRINT:PRINT
180 PRINT"THIS PROGRAM IS SELF EXPLANATORY BUT "
190 PRINT"WOULD YOU LIKE A BRIEF DESCRIPTION?"
200 PRINT"PLEASE ANSWER (Y OR N)":INPUT D$
210 PRINT
220 IF D$="Y" THEN GOSUB1690
230 PRINT:PRINT
240 IF D$="N" THEN GOTO 280
250 PRINT"        TO CONTINUE, PRESS ANY KEY":FORI=1TO8:PRINT:NEXTI
260 GET A$:IF A$=""GOTO260
270 FOR I = 1 TO 100: NEXT I
280 PRINTTAB(15)"NOTES":PRINT:PRINT
290 PRINT"1. DESIGN OF THE COIL MUST MEET"
300 PRINT"   THE FOLLOWING CRITERIA:"
310 PRINT
320 PRINT"      75 MICROHENRIES MAX. INDUCTANCE"
330 PRINT"      .2 MICROHENRIES MIN. INDUCTANCE"
340 PRINT"       8 GAGE MAX. WIRE SIZE"
350 PRINT"      40 GAGE MIN. WIRE SIZE"
360 PRINT"     (FOR 1/4 INCH TUBING - USE SIZE 0)"
370 PRINT
380 PRINT"2. RESISTORS CAN BE USED AS COIL FORMS,"
390 PRINT"   AND MUST BE COMPOSITION TYPE HAVING"
400 PRINT"   THE FOLLOWING DIMENSIONS"
410 PRINT
420 PRINT"      1. 1/2 WATT - .14 X .38 INCHES"
430 PRINT"     2. 1   WATT - .22 X .58 INCHES"
440 PRINT"     3. 2   WATT - .30 X .70 INCHES"
450 PRINT"     (THESE ARE STANDARD RESISTOR SIZES)"
460 PRINT"3. OR SELECT YOUR OWN DIAMETER FORM"
470 PRINT:PRINT"        TO CONTINUE PRESS ANY KEY"
480 GET A$: IF A$="" THEN480
490 FORI=1TO20:PRINT:NEXTI
500 PRINT"DO YOU WISH TO BEGIN WITH":PRINT
510 PRINT"1-INDUCTANCE IN MICROHENRIES, OR"
520 PRINT"2-INDUCTIVE REACTANCE"
530 PRINT
540 INPUT S:PRINT
550 IF S=1 THEN 660:IF S=2 THEN 570
560 IFS<1ORS>2THENPRINT"ANSWER 1 OR 2 PLEASE":GOTO540
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570 INPUT"WHAT IS THE DESIRED INDUCTIVE REACTANCE IN OHMS";XL:PRINT
580 INPUT"WHAT FREQUENCY IN MEGAHERTZ";F:PRINT
590 L=XL/(2*3.14159*F)
600 L$=STR$(L)
610 PRINT"REQUIRED INDUCTANCE=";LEFT$(L$,5)
620 PRINT"MICROHENRIES"
630 IF L<.2 OR L>75  GOTO570
640 GOTO690
650 FOR X=1TO16:PRINT"":NEXT
660 INPUT"WHAT IS THE DESIRED COIL INDUCTANCE IN   MICROHENRIES";L:PRINT
670 IF L>75  THEN PRINT"75  MICRO-H MAX. PLEASE REENTER":GOTO660
680 IF L<.2 THEN PRINT"0.2 MICROHENRIES MIN.- PLEASE REENTER":GOTO660
690 PRINT"SELECT COIL FORM"
700 PRINT"   1-1/2 W RESISTOR"
710 PRINT"   2-1   W RESISTOR"
720 PRINT"   3-2   W RESISTOR"
730 PRINT"   4- OTHER FORM"
740 PRINT
750 INPUT A
760 IF A<10RA>4 THEN750
770 IF A =1   THEN D=.140
780 IF A =2   THEN D=.220
790 IF A =3   THEN D=.300
800 IF A =4   THEN820
810 IF A =<3   THEN850
820 PRINT"WHAT IS THE DIAMETER OF THE"
830 PRINT"COIL IN INCHES?"
840 PRINT  : INPUT D
850 INPUT "WHAT GAGE ENAMELED WIRE IS TO BE USED  ";G
860 IF G=0 THEN W=.250
870 IF G=8  THEN W=.131
880 IF G=9  THEN W=.116
890 IF G=10 THEN W=.104
900 IF G=11 THEN W=.093
910 IF G=12 THEN W=.083
920 IF G=13 THEN W=.074
930 IF G=14 THEN W=.067
940 IF G=15 THEN W=.060
950 IF G=16 THEN W=.053
960 IF G=17 THEN W=.047
970 IF G=18 THEN W=.042
980 IF G=19 THEN W=.038
990 IF G=20 THEN W=.034
1000 IF G=21 THEN W=.030
1010 IF G=22 THEN W=.027
1020 IF G=23 THEN W=.024
1030 IF G=24 THEN W=.0216
1040 IF G=25 THEN W=.0193
1050 IF G=26 THEN W=.0172
1060 IF G=27 THEN W=.0154
1070 IF G=28 THEN W=.0138
1080 IF G=29 THEN W=.0122
1090 IF G=30 THEN W=.011
1100 IF G=31 THEN W=.0099
1110 IF G=32 THEN W=.00885
1120 IF G=33 THEN W=.0079
1130 IF G=34 THEN W=.0070
1140 IF G=35 THEN W=.0063
1150 IF G=36 THEN W=.0057
1160 IF G=37 THEN W=.0050
1170 IF G=38 THEN W=.0045
1180 IF G=39 THEN W=.0040
1190 IF G=40 THEN W=.0035
1200 IF G>40 THEN850
1210 N=((40*L*W)+SQR ((1600*W↑2*L↑2) +(72*D↑2*L)))/(2*D↑2)
1220 N1=((40*L*W)-SQR ((1600*W↑2*L↑2) +(72*D↑2*L)))/(2*D↑2)
1230 IF N>N1 THEN N2=N
1240 IF N<=N1 THEN N2=N1
1250 N2=(INT(N2*10))/10
1260 FOR X=1 TO 15:PRINT:NEXT
1270 PRINT"WIRE SIZE=";G;" GAGE"
1280 PRINT"COIL DIA.=";D;" INCHES"
1290 PRINT"NUMBER OF TURNS=";N2
1300 PRINT"COIL LENGTH=";(INT(N2*W*100))/100;" INCHES":PRINT
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1310 R=INT(N2*W*100/D)/100
1320 IF A =1   THEN 1480
1330 IF A =2   THEN 1500
1340 IF A =3   THEN 1520
1350 PRINT"THE LENGTH TO DIA. RATIO IS"
1360 PRINT R
1370 IF A=4 THEN GOSUB1540
1380 FOR X=1 TO 10:PRINT:NEXT
1390 PRINT "SELECT ANOTHER FORM AND/OR DIFFERENT "
1400 PRINT"SIZE WIRE?":PRINT
1410 INPUT"(Y OR N)";C$
1420 IF C$="Y" THEN690:PRINT
1430 INPUT "DESIGN ANOTHER COIL?(Y OR N)";B$
1440 IF B$="Y" THEN500
1450 PRINT:PRINT
1460 PRINT"O.K. GOOD LUCK WITH YOUR PROJECT!!"
1470 END
1480 IF N2*W>.385 THEN PRINT"COIL TOO LONG   FOR 1/2 W FORM":GOTO1390
1490 IF N2*W<=.385 GOTO1350
1500 IF N2*W>.525 THEN PRINT"COIL TOO LONG   FOR 1W FORM":GOTO1390
1510 IF N2*W<=.525 GOTO1350
1520 IF N2*W>.650 THEN PRINT"COIL TOO LONG    FOR 2W FORM":GOTO1390
1530 IF N2*W<=.650 GOTO1350
1540 PRINT"WOULD YOU LIKE TO SELECT THE LENGTH"
1550 INPUT"FOR A SPACE WOUND COIL (Y OR N)";Z$
1560 IF Z$="N" GOTO1430
1570 SL=(INT(N2*W*100))/100
1580 PRINT"THE LENGTH MUST BE GREATER THAN": SL
1590 PRINT"INCHES,  NEW LENGTH?"
1600 INPUT NL
1610 N2=INT((SQR((L*(4.5*D+10*NL)/((D/2)↑2))))* 100+.5)/100
1620 FOR X=1 TO 14:PRINT"":NEXT
1630 PRINT"WIRE SIZE=";G;" GAGE"
1640 PRINT"COIL DIA.=";D;" INCHES"
1650 PRINT"NUMBER OF TURNS=";N2
1660 PRINT"COIL LENGTH=";NL;"INCHES"
1670 RETURN
1680 END
1690 PRINTTAB(3)"THIS IS A COIL DESIGN PROGRAM BY"
1700 PRINT
1710 PRINTTAB(8)"HARRY L. ROSIER K4LBF" :PRINT:FORI=1TO2000:NEXT
1720 PRINT"THE PROGRAM IS TO BE USED TO DESIGN "
1730 PRINT"SINGLE LAYER SOLENOIDS ON STANDARD"
1740 PRINT"RESISTOR FORMS OR ON A FORM HAVING A "
1750 PRINT"DIAMETER OF YOUR CHOOSING."
1760 PRINT
1770 PRINT"THE INDUCTANCE FORMULA IS FROM THE"
1780 PRINT"RADIO AMATEUR'S HANDBOOK."
1790 PRINT
1800 PRINT"THIS FORMULA IS TRANSPOSED TO DETERMINE"
1810 PRINT"THE NUMBER OF TURNS REQUIRED, AND THE "
1820 PRINT"RESULTING QUADRATIC IS SOLVED USING THE"
1830 PRINT"CLASSICAL EQUATION."
1840 PRINT
1850 PRINT"YOU DECIDE THE SIZE OF COIL FORM, THE"
1860 PRINT"INDUCANCE, OR INDUCTIVE REACTANCE, AND"
1870 PRINT"THE THE WIRE SIZE -"
1880 PRINT
1890 PRINT"**** THE COMPUTER WILL DO THE REST! ****"
1900 PRINT:PRINT" TO CONTINUE PRESS ANY KEY":PRINT:PRINT
1910 GETZ$:IFZ$=""THEN1910
1920 PRINT"IF THE COIL SIZE/WIRE SIZE COMBINATION"
1930 PRINT"WON'T FIT ON THE RESISTOR FORM CHOSEN"
1940 PRINT"THEN THE COMPUTER WILL TELL YOU SO AND"
1950 PRINT"ASK FOR ANOTHER CHOICE."
1960 PRINT
1970 PRINT"IF YOU CHOOSE THE COIL DIAMETER, THEN"
1980 PRINT"THE LENGTH CAN BE WHATEVER IS NECESSARY.":PRINT
1990 PRINT"THE COMPUTER WILL ALSO TELL YOU THE"
2000 PRINT"LENGTH TO DIAMETER RATIO AND ASK IF YOU"
2010 PRINT"WOULD LIKE THE NUMBER OF TURNS FOR A"
2020 PRINT"SPACE WOUND COIL OF SPECIFIED LENGTH."
2030 RETURN
READY.
```

Data Communications

Conducted by
David W. Borden,* K8MMO

This month we examine the Terminal Interface Program (TIP) running on the VADCG terminal node controller (TNC) board. This program was orginally written by Doug Lockhart, VE7APU. Many people have modified it since then, as Doug had intended. The TIP is the personality module of the system. What code goes in the TIP depends on what device you put on the TNC board as the end user. You could put a printer, a CRT/TTY terminal, a facsimile machine, or a another computer (called a host), or a VOTRAX speech board or whatever device you have that can be accessed by data (binary ones and zeros). For whatever device you have, a TIP must be written. To begin easily in our packet system, Doug did a TIP to use the 8250 programmable USART to communicate with a local terminal.

The particular TIP we will study was modified by Calvin Teague, K6HWJ to allow data transparency (packets need not terminate when a line-feed character is sent on the terminal) and other modifications that allow future networking to be easier.

You can begin your study by obtaining from the Vancouver Amateur Digital Communications Group, 818 Rondeau Street, Coquitlam, BC, Canada V3J 5Z3, the September 1980 issue of The Packet. That issue has Doug's orginal TIP software published and some explanation of what is going on. The Hamilton Area packet group has expanded on this software and that group should also be contacted for back issues of their newsletter.

An important "gotcha" should be noted at once. If you are using the Cal Teague TIP (and you will be if you get software from AMRAD's Terry Fox), then you must tie the CTS line on the 8250 side of the TNC board high with a 5k-15k resistor and connect and use the RTS and CTS lines from your terminal/computer. Failure to do so means no characters will ever print on the terminal.

The TIP interfaces with the node communications program (LIP) discussed previously. The LIP, in the "look-for-work-loop" allows the TIP to run. The first code entered is the TIPINIT routine where the serial port is set up and the default keyboard mode bytes are set up (no automatic line feed on carriage return, echo on, recognize control characters, mask keyboard data to 7 bits). The interrupts from the serial interface are then unmasked, the receive buffer register is cleared out, receive data available interrupts are enabled and the the handshake lines for the terminal are set correctly. At this point, I added some code to print the signon message differently than designed by Doug. I asked at what speed you run the line (modem) and set the CWID speed correctly. Doug of course did not have this problem since the Canadians do not have the CWID problem to worry about. After setting the CWID speed, a return to the LIP is executed.

The TIP's job is to accept data from whatever device is connected to the TNC board and then build it into blocks to pass to the LIP (as pointers to the terminal buffer) and accept blocks of data from the LIP (as pointers to the line buffer) to pass to the terminal. The code currently fits in two 2708 EPROMs addressed from 0800H to 0FFFH (remembering the 256 bytes of CWID code in the top PROM from 0F00-0FFF).

The TIP normally is accessed by the LIP through the DISPATCH entry point (after initialization discussed above). The point called from is in the main DISPATCH routine in the LIP and the point called is the DISPATCH routine in the TIP where if transmit interrupts are enabled,we just return. If output flow control is in effect, we return and try again later. The LIP's transmitter holding register is checked for empty and if it is not empty, we try again later. We try to get a buffer to print on the terminal (the LIP tells TIP when one is ready). If we find one ready, we store the length away for the interrupt routine and return.

There are two major interrupt routines in the TIP, RXINT (used to process characters banged on the keyboard) and TXINT (used to send characters to the CRT screen). There is only one interrupt entry point, RST55 (restart 5.5) and we check the interrupt identification information to see which routine we want.

In the RXINT routine (receiver interrupt processing) we load the DATAMASK to see if we are dealing with 7 or 8 bits at this point (Cal made it selectable) and strip parity if desired. We check for special characters (prefix character is Data Link Escape, Control-P) and if the last character was a prefix character, we check this character to see what is desired. An "N" at this point followed by a second character will turn off something:

NE-Turn off echo
NL-Turn off automatic line feed on carriage return
NR-Turn off request for repeat bit in address
NS-Turn off special control character recog

If no "N" was typed, something is being turned on:

C- Connect to station
D- Disconnect from station
E- Turn on the echo
I- Initialize software (DO NOT USE THIS COMMAND!)
L -Send automatic line feed on carriage return
P - Send the packet right now
R - Set the request for repeat bit in address
S - Recognize all special control characters
7 - Seven data bits only please
8 - All eight data bits please
T - Stop everything and send QST message every eight minutes on the channel

Of course the incoming character might be desired to be packetized and not an order to the TNC board. If the character is good, a check is made to see if the buffer is full, if so input is ignored, else it is stored. A check is made for 128 characters and a packet sent if 128 is reached. The character is echoed to the terminal if desired and a check is made for termination of packet (line feed). Cal has added checks for Control-S (stop sending characters to the screen) and Control-Q (resume sending characters to the screen after a Control-S) and CTS false. This handshaking is essential for computers tied to the TNC board and I am currently experimenting with these lines so as to have my S-100 personal computer available to the Washington packeteers.

In the TXINT routine, we process serial I/O transmit interrupts. We first check the CTS line and then previous Control-S commands that might be active (not yet followed by Control-Q). If all is clear, we grab a character from the buffer and send it to the CRT screen. We of course bump our pointer and decrease our count (if zero, all done then we disable transmit interrupts).

When the LIP frees up some buffer space from a full condition (by sending the stuff out as packets), it enters the TIP by another door and gets to the TIPFREE routine. We then turn off our overflow and flow control and we are back in the TIP business. If buffer is full, it is difficult to put blocks into the buffer.

It should be noted that in the TIP is hardcoded your callsign and CWID bits. Doug did not intend this at first, allowing the station node to assign addresses. There is great debate at present on how to handle the address, how to repeat (or not) and how to really network. The TIP must be rewritten for these changes.

Once again I have lightly passed over the hard work of Doug and Cal. Both have a great contribution here to packeteering. There is a lot more work to be done.

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Components

Conducted by Mark Forbes,* KC9C

I would like to thank all who have written to me with suggestions or comments regarding the "Components" column. The aim of this column is to provide information that you think is valuable, not just what I happen to find interesting. So, if I am neglecting an area that you are interested in, let me know. Also, if you are requesting information, please include an s.a.s.e.

Thomson-CSF Capacitor Kit

This should be of special interest to home builders. Thomson-CSF, one of Europe's largest electronics manufacturers, is offering a kit of their multilayer film capacitors, which can be substituted for ceramic capacitors in 85% of applications so they say.

The kits, valued at more than $55.00, include 25 capacitors each of 17 different values. These values range from 0.001 to 0.47 uF, are 10% and rated at 63 volts. The caps have a 5-mm lead spacing, so care must be exercised when using with pc boards with English-unit spacing. The price for the capacitor kit is $25.00 and can be ordered from: Thomson-CSF Components Corp., 6660 Variel Ave, Canoga Park, CA 91303, 213-887-1010.

National Semiconductor MF-10 Filter

This part is probably the most significant electronic part introduced this year. This part, housed in a 16-pin DIP, offers two 2-pole filters using switched-capacitance techniques. This chip can be configured into a low-pass, high-pass, band-pass, or notch filter using only resistors. The filter's response can be modified into 4-pole, 6-pole, etc. filters by cascading the filter blocks. Maybe the best part about the MF-10 is the price -- about $3.00! An MF-6 and MF-4 are due in the near future to complement the Monolithic Filter family from National.

The switched-capacitor technique itself was pioneered to aid in DTMF decoding a few years ago. Basically, a clock is used to switch a small on-chip capacitor between two voltages. This emulates a large-value capacitor, and when coupled with another on-chip small-value capacitor, a filter is easy to construct. Now, the switched-capacitor technology is finding its way into many applications and will have a great impact on analog circuit design in the future.

Further explanation of the switched-capacitor technique will appear in the near future in an article by me in Ham Radio magazine.

For information on the MF-10 write: National Semiconductor Corp., 2900 Semiconductor Dr, Santa Clara, CA 95051.

Intersil ICM7555 and ICM7556 Timers

These two parts aren't that new but represent a significant advance over the bipolar 555 and 556 timers. These Intersil parts are direct drop-in replacements for the ever-popular NE555 and 556 timers. Because they are CMOS in construction, the power drain is drastically reduced. Additionally, the power supply spikes associated with the bipolar versions are virtually eliminated. The power requirements for the ICM7555 are 2 to 18 volts at 80 uA -- that's right, microamps!

The only major consideration when changing a circuit from the bipolar version to the CMOS version is that the timing equation changes slightly. The equation for the ICM7555 is:

$$T = 0.69\ RC$$

for the monostable (one-shot) operation and for the astable (free-running) configuration:

$$F = 1.46 / (R1 + 2\ R2)\ C.$$

Another nice thing about the ICM7555 is that your local Radio Shack carries them as their part number 276-1743, for about $1.99. Other data is available from: Intersil, Inc., 10710 N. Tantau Ave, Cupertino, CA 95014, 408-996-5000.

Intersil Voltage-to-Frequency Converters

Another product from Intersil is the VFQ family of voltage-to-frequency (V-f) converters. V-f has many applications in Amateur Radio, but I haven't seen many exploited in amateur publications. The VFQ family operates from 10 Hz to 100 kHz. Power requirements are either a single 10- to 15-volt supply or dual ± 4- to ± 7.5-volt supply. The difference between the 3 members in the family is the linearity specification. The VFQ-1 has a linearity of 0.05%, the VFQ-2 0.01 and the VFQ-3 0.25%, all measured at 10 kHz. Information on these parts is available from Intersil at the address given above.

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