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AUGUST 1979/$1.25

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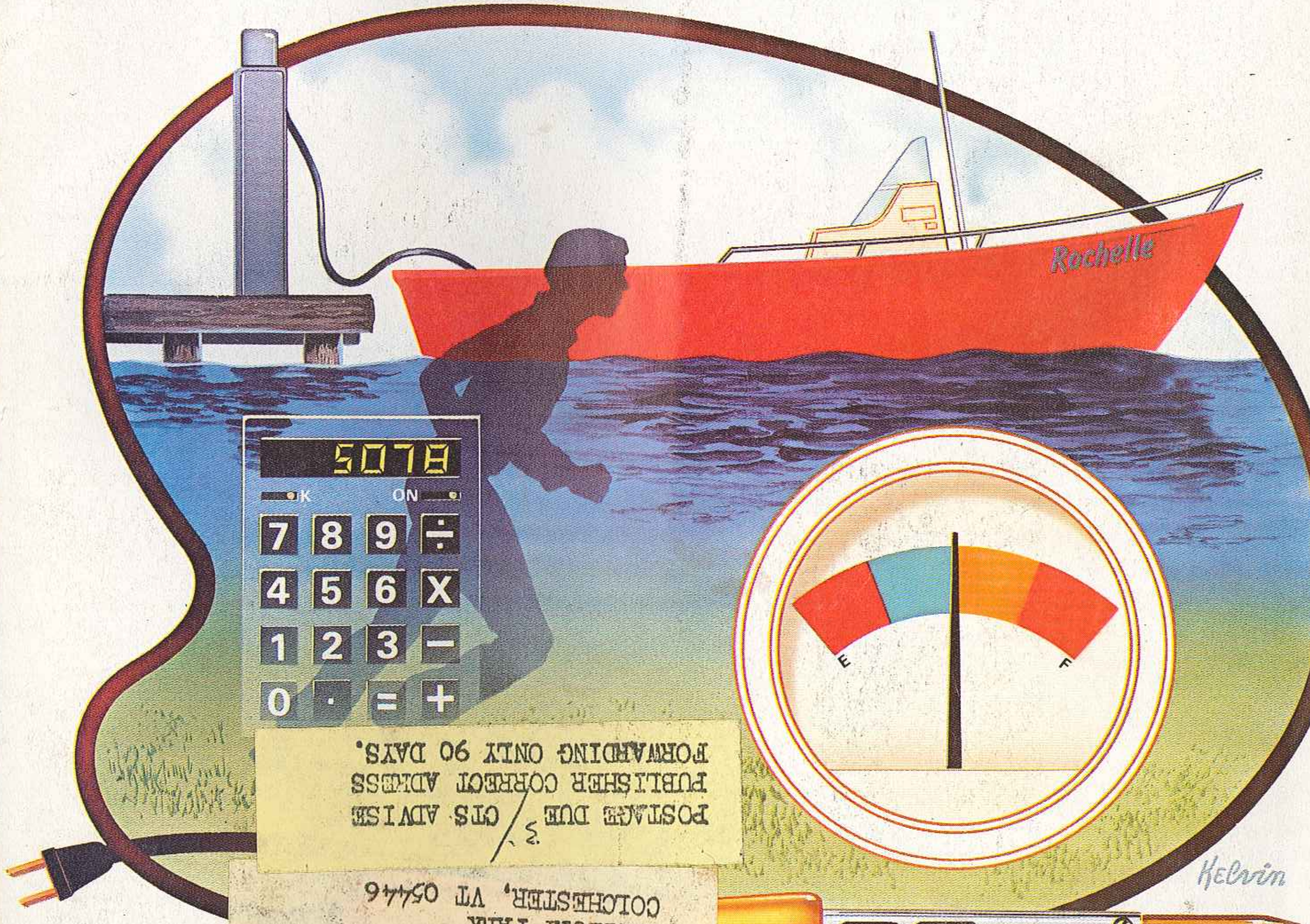

...60 Speaker System

...HE Phono Cartridge

...r II Model 4 Personal Computer

third and second longest elements will be 17" (43.2-cm) and 18" (45.4-cm) long, respectively, on each side of the log periodic array's boom.

Trim the longer corner reflector elements so that each of them is 16" long. Then lift the antenna to locate its new center of balance. Drill two new ¼" (6.35-mm) holes, properly spaced, through the boom to accommodate the U bolt that fastens the antenna to its mast. Make certain that these holes are drilled to permit the antenna to be oriented so that its elements point up and down after mast mounting. Also, make certain that the U-bolt hardware does not touch the aluminum wire that cross-connects the elements.

Mount the antenna on a 36" (0.91-m) length of 1¼" (31.8-mm) outer-diameter rigid PVC pipe. Do *not* substitute a metal pipe because it will interfere with the signal path. The metal mast should be at least λ/4 away from the longest antenna element. (Rigid PVC pipe can be obtained from any building supply house and many hardware stores.)

Mount the antenna and PVC pipe support on a rotator, following the cable-routing instructions faithfully. Connect the Balun transformer to the antenna and the coax feed line to the Balun. Then coat the connections with silicone adhesive to weatherproof them.

How It Performs. We made comparison checks between the modified TV antenna and an excellent commercially available vhf/uhf discone monitor antenna. Signals that were barely readable on vhf with the discone antenna came in substantially stronger with the modified beam antenna. More important was the fact that signals from the back of the antenna were noticeably reduced and those off to the sides were deeply attenuated with the beam, all of which contribute to a reduction in interference and an overall improvement in reception. The modified beam performed even better on uhf than it did on vhf. Signals improved from "barely-discernable" to "full-quieting."

Our experience with the modified beam makes it clear that this antenna is an excellent choice for listeners who are plagued by strong nearby transmitters and experience weak incoming signals. The modified beam even has the added advantage that it works well on the 2-meter amateur radio band; just be careful to avoid pumping more than a few watts into the Balun to avoid overheating. Happy listening. ◇

BASIC programs for Ohm's law, resonance, and inductive formulas using a Level-1 machine with 4K of RAM

SIMPLE TRS-80 PROGRAMS SOLVE ELECTRONICS CALCULATIONS

BY ROY BABYLON

THE FOLLOWING programs were designed to be run on a Level-1 TRS-80 microcomputer having 4K of memory. All the programs are self-prompting when run and are also readily adaptable to any other BASIC. (The square-root subroutine can be eliminated if your particular BASIC has a built-in square-root function.)

Ohm's Law. This program, shown in Table 1, is fairly short and has no subroutines. Line 40 selects the unknown resistance, voltage, current or power. Lines 70 through 100 are used to determine the unknown resistance; lines 110 through 130 are for current, while lines 145 through 160 are used to determine the voltage. Once the current (I) and resistance (R) have been determined, line 295 displays the wattage.

Resonance. The program shown in Table 2 can determine frequency of a tuned circuit when C and L are known, or can determine either C or L if the desired resonant frequency and one of these two elements are known. The program will also determine the Q of a series or parallel tuned circuit, bandwidth and/or the impedance. The square-root subroutine used in determining resonant frequency is called at line 220.

Inductive Formulas. Table 3 illustrates a program that will determine instantaneous voltage, inductance of a single-layer coil, inductive/resistive time constant, the values of series and/or parallel inductors, the Q of a coil, inductive reactance and impedance of an inductive/resistive circuit. The only subroutine used (square root) is called at line 720, with this subroutine residing at line 30000.

Table 1—Ohm's Law

```
15   CLS
20   P.T. (20); "OHM'S LAW FORMULAS"
30   P. "SELECT NUMBER FOR DESIRED FUNCTION"
40   IN. "RESISTANCE=R, CURRENT=C, VOLTAGE=V,
     POWER=P"; A
60   IF A=R, G.70
62   IF A=C, G.110
65   IF A=V, G.145
67   IF A=P, G.180
70   IN. "ENTER VOLTAGE IN VOLTS"; E
80   IN. "ENTER CURRENT IN AMPERES"; I
100  P."THE RESISTANCE EQUALS";E/I;" OHMS"
105  END
110  IN."ENTER VOLTAGE IN VOLTS";E
120  IN."ENTER RESISTANCE IN OHMS";R
130  P."THE CURRENT IS EQUAL TO";E/R;" AMPERES"
140  END
145  IN."ENTER CURRENT IN AMPERES";I
150  IN."ENTER RESISTANCE IN OHMS";R
160  P."THE VOLTAGE IS ";I*R;" VOLTS WITH ";R;" OHMS
       AND ";I;" AMPERES"
170  END
180  IN."ENTER MISSING VARIABLE R,I,E";B
190  IF B=R, G.210
195  IF B=I, G.240
200  IF B=E, G.270
210  IN."ENTER CURRENT (I)";I
220  IN."ENTER VOLTAGE (E)";E
230  P=I*E
235  G.295
240  IN."ENTER VOLTAGE (E)";E
250  IN."ENTER RESISTANCE (R)";R
260  P=(E*E)/R
265  G.295
270  IN."ENTER CURRENT (I)";I
280  IN."ENTER RESISTANCE (R)";R
290  P=(I*I)*R
295  P."THE POWER IS ";P;" WATTS"
300  END
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Table 2—Resonance (Tuned Circuits)

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5    CLS
10   P.T.(15);"VARIOUS FORMULAS
       ON RESONANT FREQUENCY"
20   P."ENTER NUMBER OF DESIRED FUNCTION";
30   P."RESONANT FREQUENCY   (FO)                     #1"
40   P."UNKNOWN INDUCTANCE   (L)                      #2"
50   P."UNKNOWN CAPACITOR   (C)                       #3"
60   P." Q OF SERIES OR PARALLEL CIRCUIT   (Q)        #4"
70   P."BANDWIDTH   (BW)                              #5"
80   P."IMPEDANCE, SERIES OR PARALLEL   (Z)           #6"
90   IN."UNKNOWN FACTOR IS NUMBER ";U
100  IF U=1,G.170
110  IF U=2,G.240
120  IF U=3,G.280
130  IF U=4,G.320
140  IF U=5,G.360
150  IF U=6,G.520
170  IN."ENTER VALUE OF INDUCTOR IN MILLIHENRIES";L
180  IN."ENTER VALUE OF CAPACITOR IN MICROFARADS";C
210  X=(L/IE3)*(C/1E6)
220  GOS.30030
230  P."THE RESONANT FREQUENCY IS ";.159/Y;" HERTZ"
235  END
240  IN."ENTER RESONANT FREQUENCY (FO) DESIRED";F
250  IN."ENTER CAPACITOR VALUE IN MICROFARADS";C
260  L=.0254/(F*F)*(C/1E6)
270  P."THE INDUCTOR NEEDED IS ";L*1000;" MILLIHENRIES"
275  END
280  IN."ENTER RESONANT FREQUENCY DESIRED ";F
290  IN."ENTER INDUCTOR VALUE IN MILLIHENRIES ";L
300  C=.0254/(F*F)*(L/1E3)
310  P."THE CAPACITOR NEEDED IS ";C*1E6;" MICROFARADS"
315  END
320  IN."ENTER THE REACTANCE (XC OR XL) IN OHMS";X
330  IN."ENTER THE SERIES RESISTANCE IN OHMS";R
340  P."THE Q OF THE CIRCUIT IS ";X/R;" UNITS"
350  END
360  IN."ENTER UNKNOWN, Q=Q, FO=F, BW=B";X
370  IF X=Q,G.400
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380    IF X=F,G.440
390    IF X=B,G.480
400    IN."ENTER FO IN HERTZ";F
410    IN."ENTER BW (F2-F1) IN HERTZ";B
420    P."THE Q IS EQUAL TO ";F/B;" UNITS"
430    END
440    IN."ENTER THE Q OF THE CIRCUIT";Q
450    IN."ENTER THE BW (F2-F1) IN HERTZ";B
460    P."THE RESONANT FREQUENCY (FO)
          IS ";Q*B;" HERTZ"
470    END
480    IN."ENTER RESONANT FREQUENCY (FO) IN HERTZ";F
490    IN."ENTER THE Q VALUE";Q
500    P."THE BANDWIDTH IS ";F/Q;" HERTZ"
510    END
520    IN."ENTER VALUE OF INDUCTOR IN MILLIHENRIES";L
530    IN."ENTER FREQUENCY IN HERTZ";F
535    IN."ENTER RESISTOR VALUE IN OHMS";R
540    P."AT SERIES RESONANCE, XL AND XC CANCEL
          THEREFORE Z=";R
550    P=(6.28)*(F)*(L/1E3)
560    Q=P/R
570    P."THE PARALLEL IMPEDANCE IS EQUAL
          TO ";P*Q;" OHMS"
580    END
30000  END
30010  REM *SQUARE ROOT* INPUT X, OUTPUT Y
30020  REM ALSO USES W & Z INTERNALLY
30030  IF X=O T. Y=O:RET.
30040  IF X > O T. 30060
30050  P."ROOT OF NEGATIVE NUMBER?":STOP
30060  Y=X*.5:Z=O
30070  W=(X/Y-Y)*.5
30080  IF (W=O) + (W=Z) T. RET.
30090  Y=Y+W: Z=W:G.30070
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Table 3—Inductive Formulas

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2      CLS
10     P."AFTER EACH SOLUTION, PRESS R. ENTER
          TO BEGIN."
15     P.T.(15)"VARIOUS INDUCTIVE FORMULAS"
20     P."ENTER THE NUMBER NEXT TO DESIRED
          FUNCTION"
30     P."INSTANTANEOUS VOLTAGE                       #1"
40     P."INDUCTANCE OF A SINGLE LAYER COIL           #2"
50     P."INDUCTIVE/RESISTIVE TIME CONSTANT           #3"
60     P."SERIES AND PARALLEL INDUCTORS               #4"
70     P."Q OF A COIL                                 #5"
80     P."INDUCTIVE REACTANCE (XL)                    #6"
90     P."IMPEDANCE OF INDUCTIVE/RESISTIVE CIRCUIT    #7"
100    IN."FORMULA DESIRED";F
110    IF F=1 G.160
120    IF F=2 G.220
130    IF F=3 G.280
140    IF F=4 G.320
144    IF F=5 G.570
145    IF F=6 G.640
146    IF F=7 G.690
160    IN."ENTER VALUE OF INDUCTANCE IN HENRIES";L
170    IN."ENTER CHANGE IN CURRENT (I2-I1) IN AMPS";I
180    IN."ENTER CHANGE IN TIME (T2-T1) IN SECONDS";T
190    E=L*(I/T)
200    P."THE VOLTAGE DEVELOPED IS";E;"VOLTS"
210    END
220    IN."ENTER NUMBER OF TURNS";N
230    IN."ENTER RADIUS OF COIL IN INCHES";R
240    IN."ENTER LENGTH OF COIL IN INCHES";D
250    L=(N*R)*(N*R)/(9*R)+(10*D)
260    P."THE INDUCTANCE IS";L;"MICROHENRIES"
270    END
280    IN."ENTER THE VALUE OF INDUCTANCE
          IN HENRIES";L
290    IN."ENTER THE VALUE OF RESISTANCE
          IN OHMS";R
300    T=L/R
310    P."THE TIME CONSTANT IS";T;"SECONDS"
315    END
320    IN."ENTER THE NUMBER OF INDUCTORS";B
330    IF B=2 G.360
340    IF B=3 G.420
350    IF B=4 G.490
360    IN."ENTER VALUE OF L1 IN HENRIES";A
370    IN."ENTER VALUE OF L2 IN HENRIES";B
380    C=A+B
390    P."THE TOTAL SERIES INDUCTANCE IS";C;"HENRIES"
400    D=(1/A)+(1/B)
405    P."THE TOTAL PARALLEL INDUCTANCE
          IS";1/D;"HENRIES"
410    END
420    IN."ENTER VALUE OF L1 IN HENRIES";A
430    IN."ENTER VALUE OF L2 IN HENRIES";B
440    IN."ENTER VALUE OF L3 IN HENRIES";C
450    D=(1/A)+(1/B)+(1/C)
460    P."THE TOTAL INDUCTANCE IN SERIES
          IS";A+B+C; "HENRIES"
470    P."THE TOTAL INDUCTANCE IN PARALLEL
          IS";1/D;"HENRIES"
480    END
490    IN."ENTER VALUE OF L1 IN HENRIES";A
500    IN."ENTER VALUE OF L2 IN HENRIES";B
510    IN."ENTER VALUE OF L3 IN HENRIES";C
520    IN."ENTER VALUE OF L4 IN HENRIES";D
530    E=(1/A)+(1/B)+(1/C)+(1/D)
550    P."THE TOTAL PARALLEL INDUCTANCE
          IS";1/E;"HENRIES"
540    P."THE TOTAL SERIES INDUCTANCE
          IS";A+B+C+D; "HENRIES"
555    END
570    IN."ENTER INDUCTOR VALUE IN HENRIES";L
580    IN."ENTER THE FREQUENCY IN HERTZ";H
590    IN."ENTER RESISTOR VALUE IN OHMS";R
600    X=6.28*H*L
610    Q=X/R
620    P."THE REACTANCE OF THE CIRCUIT
          IS";X;"OHMS WITH A Q OF";Q
630    END
640    IN."ENTER THE VALUE OF INDUCTOR IN
          MILLIHENRIES";L
650    IN."ENTER THE FREQUENCY IN HERTZ";H
660    X=(6.28)*(H)*(L/1000)
670    P."THE REACTANCE OF THE CIRCUIT IS";X;"OHMS"
680    END
690    IN."ENTER THE VALUE OF INDUCTIVE REACTANCE
          IN OHMS";P
700    IN."ENTER THE VALUE OF RESISTANCE
          IN OHMS";R
710    X=(P*P)+(R*R)
720    GOS. 30030
730    P."THE IMPEDANCE OF THE CIRCUIT IS";Y;"OHMS"
740    END
30000  END
30010  REM*SQUARE ROOT*INPUT X, OUTPUT Y
30020  REM ALSO USES W AND Z INTERNALLY
30030  IF X=O T. Y=O :RET.
30040  IF X > O T. 30060
30050  P."ROOT OF A NEGATIVE NUMBER?" :STOP
30060  Y=X*.5 :Z=O
30070  W=(X/Y-Y)*.5
30080  IF (W=O)+(W=Z) T. RET.
30090  Y=Y+W :Z=W : G.30070
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The Art of EQUALIZATION

An expert tells how to "sweeten" instruments and achieve that special recorded "sound"

BY ETHAN WINER

¶ A growing number of audio enthusiasts are using equalizers to shape a stereo system's frequency response, whether to "adjust" a room or for creative recording purposes.

¶ An equalizer is nothing more than a device to allow frequency response of an audio signal path to be adjusted in some way. Thus, conventional bass and treble controls qualify as charter members of the club. More often, however, the term implies equipment that is more complex and sophisticated, such as that used by a mixing engineer. Let's take a look at some of the reasons equalization (EQ) is useful and how its implementation has developed into a high art.

¶ Standard bass and treble tone controls are broadband devices that have greatest effect at the frequency extremes; that is, the highest highs and the lowest lows. While this is fine for touching up reproduction, it is of virtually no help in correcting for narrowband colorations, which are often highly disturbing. For example, a peak in the response of an audio system in the low-to-middle treble region can produce a shrill or scratchy quality that a normal treble control cannot effectively tame. Turning down the control enough to eliminate the shrillness kills too much of the highest treble, robbing music of clarity and sparkle. Similarly, using a bass control to correct tubbiness or muddy bass response also falls short of success. Turning the control down to relieve such midbass exaggeration would simply remove the deepest frequencies so important to lifelike reproduction, while perhaps still allowing some muddiness to persist. There's got to be a better way—and there is.

(continued overleaf)