# ATTENUATORS AND MINIMUM-LOSS PADS

**Larry Friedman**

■"Attenuators" and "Minimum Loss Pads" is a program that quickly calculates the resistance values for H and T attenuators and the values for minimum-loss L-matching networks. Simply key in the input and output impedances and the desired amount of loss. The screen will display the actual pad configuration and the required resistance values. If you haven't the displayed resistor values on hand, you get a chance to recycle the program and make minor changes in loss or impedance until you come up with a pad using resistor values you happen to have.

To make the program truly universal, it is written in "Timeshare Basic," which means it should run on every computer without modification of any kind except perhaps for the CLS (CLEAR SCREEN) function. If your own computer uses something other than CLS for CLEAR SCREEN simply make the substitution. Otherwise, no further modification to the program should be required.

Because PRINT USING is not a universal BASIC function, resistance values are rounded off to their nearest integer value. For example, 144.3 ohms is displayed as 144; 144.6 ohms is displayed as 145 ohms. Rounding should have no practical effect on an attenuator. On the other hand, decibel loss is displayed in decimal values because that is the common and desired notation.

To make the screen and printer graphics universal, they are created from conventional ASCII symbols. Figures 1, 2 and 3 show how the three kinds of calculated pads are both printed and displayed. The negative (−) symbol in front of some of the resistor values in Figure 1 indicate that the impedance on that side of the circuit is less than on the opposite side. Note from the illustrations that two different ways are used to indicate input and output impedances. You can substitute either kind of labelling in the program since both employ universal characters.

Depending on the kind of computer used, the graphic display will either fill most of the screen or appear scrunched on the left. This is caused by writing the program so it will run on all computers regardless of the display's column width; also, screen dumps to a printer will print on every kind of printer used with personal computers, from conventional 80/100 column models to pocket printers which use narrow calculator-type tape.◀Ⓓ▶

```
LOSS =  10 DB
    261          -14
----XXXX--------XXXX----
            !
            !
            X
            X   211
            X
            !
            !
----XXXX--------XXXX----
    261          -14

 600 OHMS IN   150 OHMS OUT

DO IT AGAIN? (Y OR N)?

LOSS =  3 DB
    474
----XXXX----------------
            !
            !
            X
            X   53
            X
            !
            !
------------------------
Z= 500 -->     <-- Z= 50

DO IT AGAIN? (Y OR N)? .
```

```
    103
----XXXX----------------
            !
            !
            X
            X   1703
            X
            !
            !
------------------------
Z= 600 -->     <-- Z= 600

DO IT AGAIN? (Y OR N)? .

LOSS IS  15.7948  DB
```

**FIG. 1—THIS IS HOW the three types of pads are both printed and displayed. Please refer to the text for additional information.**

```
10 REM ATTENUATOR PADS
20 REM      BY
30 REM LARRY FRIEDMAN
40 REM CALCULATES H,T,L PADS
50 REM  IN UNIVERSAL BASIC
60 CLS
70 PRINT TAB(10) "1 = H PAD"
80 PRINT TAB(10) "2 = T PAD"
90 PRINT TAB(10) "3 = L PAD"
100 INPUT "ENTER PAD TYPE (1, 2 OR 3) ";T
110 CLS
120 IF T=3 GOTO 3000
130 IF T>3 GOTO 60
140 INPUT "INPUT LOSS IN DB "; DB
150 N=EXP((DB)*0.230259)
160 INPUT "INPUT Z IN";Z1
170 INPUT "INPUT Z OUT";Z2
180 R3=(2*SQR(N*Z1*Z2))/(N-1)
190 R1=Z1*((N+1)/(N-1))-R3
200 R2=Z2*((N+1)/(N-1))-R3
210 CLS
220 IF T=1 GOTO 1000
230 IF T=2 GOTO 2000
240 CLS
250 INPUT "DO IT AGAIN? (Y OR N)";Q$
260 IF Q$="Y" GOTO 110
270 CLS
280 END
1000 PRINT "    "INT(R1/2+0.5) TAB(16);INT(R2/2+0.5)
1010 PRINT "----xxxx--------xxxx----"
1020 PRINT TAB(12)"!":PRINT TAB(12)"!"
1030 PRINT TAB(12)"X"
1040 PRINT TAB(12)"X  " ;INT(R3+0.5)
1050 PRINT TAB(12)"X"
1060 PRINT TAB(12)"!":PRINT TAB(12)"!"
1070 PRINT "----XXXX--------XXXX----"
1080 PRINT "    "INT(R1/2+0.5) TAB(16) INT(R2/2+0.5)
1090 PRINT
1100 PRINT Z1 "OHMS IN" TAB(14) Z2 "OHMS OUT"
1110 PRINT
1120 GOTO 250
2000 PRINT "     "INT(R1+0.5)
2010 PRINT "----XXXX----------------"
2020 PRINT TAB(12)"!":PRINT TAB(12)"!"
2030 PRINT TAB(12)"X"
2040 PRINT TAB(12)"X  "INT(R3+0.5)
2050 PRINT TAB(12)"X"
2060 PRINT TAB(12)"!":PRINT TAB(12)"!"
2070 PRINT "------------------------"
2080 PRINT
2090 PRINT "Z="Z1"-->" TAB(14) "<-- Z="Z2
2100 PRINT
2110 GOTO 250
3000 INPUT "INPUT LARGER Z";Z1
3010 INPUT "INPUT SMALLER Z";Z2
3020 IF Z2>Z1 PRINT "ERROR":GOTO 3000
3030 R1=SQR(Z1*(Z1-Z2))
3040 R2=(Z1*Z2)/R1
3050 R3=R2
3060 L=20*LOG(SQR(Z1/Z2)+SQR((Z1/Z2)-1))/2.30259
3070 CLS
3080 PRINT "LOSS IS ";L" DB"
3090 GOTO 2000
```