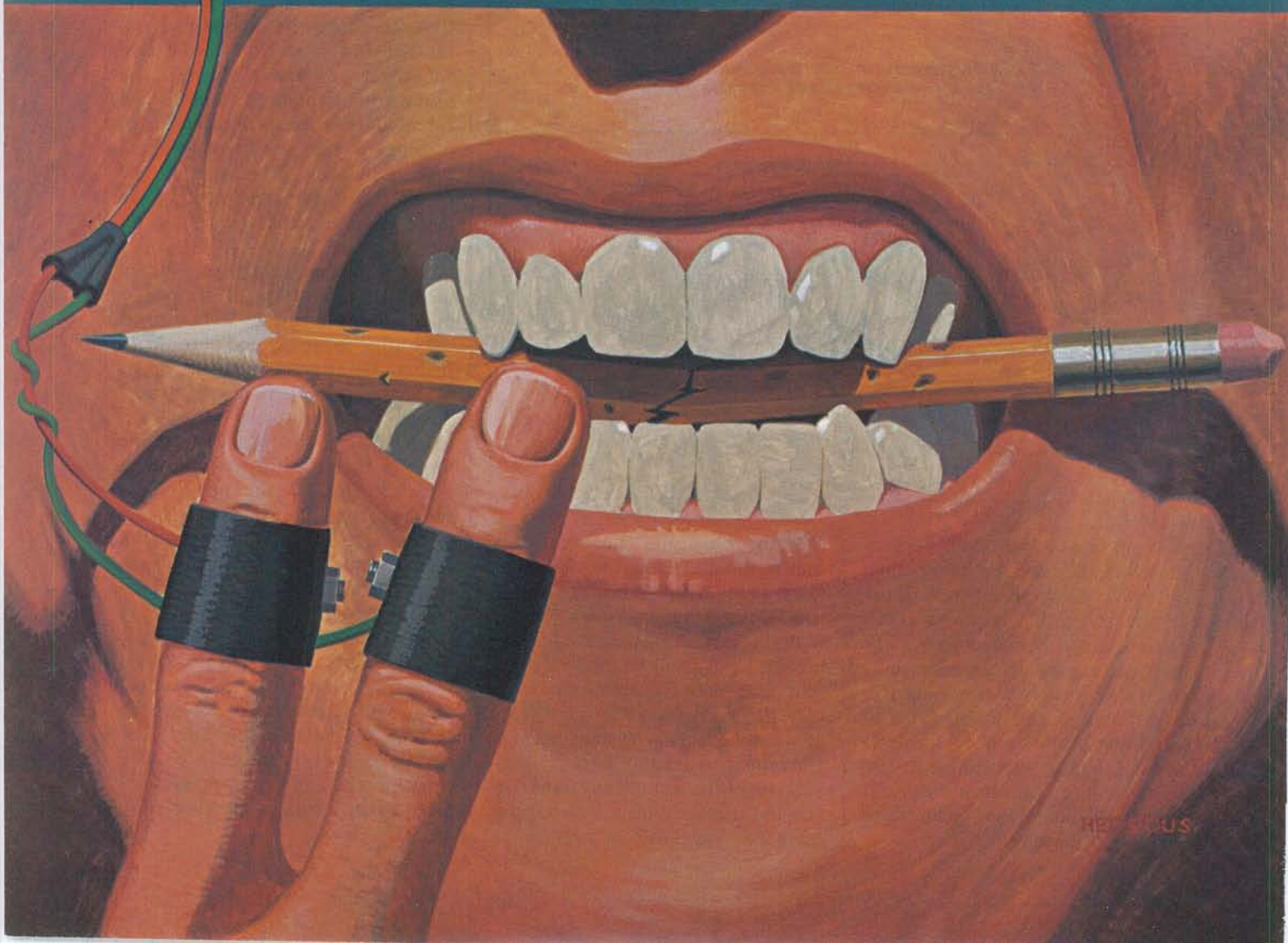


MOOD INDEX

C
A
L
M

T
E
N
S
E



What's Your TENSENESS LEVEL?

Connecting an interactive "Biobox" to a TRS-80 Color Computer enables you to monitor how tense you are and experiment with biofeedback techniques

By Jim Barbarello

RELAX!

If your emotions have been riding the express track all day and can't stop to heed the command above, maybe you need a Biobox in your life. The Biobox is a low-cost (\$15) electronic device that detects body changes due to stress and tension. The electronic information from the Biobox is applied to a TRS-80 Color Computer and fed back to you in the form of variations in sound and color on the TV display. Through the biofeedback procedure, it is possible, with practice, to consciously control your emotional state. (*Note: Biofeedback is a subjective procedure and may not give the same results in all cases.*)

About the Circuit. One condition of the body that can be measured easily is skin resistance. When you are tense or stressful, the electrical resistance between your index and middle fingers decreases. As you relax, this resistance increases. The Biobox senses this resistance change and converts it into a voltage.

As shown in Fig. 1, the two "bioprobes" are attached to the middle and index fingers. The resultant skin resistance is represented by R_{BIO} . The two resistances, R_{BIO} and R_I , form a voltage divider. As the skin resistance decreases, the voltage at the base of transistor $Q1$ increases. This voltage is multiplied (amplified) by a factor of about -20 and applied to the computer's joystick input.

About the Program. So far, the hardware we've discussed detects

changes in skin resistance and sends a binary number between 0 and 63 to the Color Computer. What we need now is a program that uses this information to provide audible and visible feedback. That program is shown on page 79. It does not use any Extended BASIC functions so it can be run on any version of the Color Computer.

The program begins with the DATA statement of line 10. The eight numbers represent the eight different screen colors (3—blue, 6—cyan, 1—green, 5—buff, 2—yellow, 7—magenta, 8—orange, and 4—red). Using these colors, we can create a "Mood Index." If we consider buff as the middle (neutral) point, the "cooler" colors of green, cyan, and blue (also black) will indicate successive stages of calm. The "hotter" yellow, magenta, orange, and red indicate escalating tension.

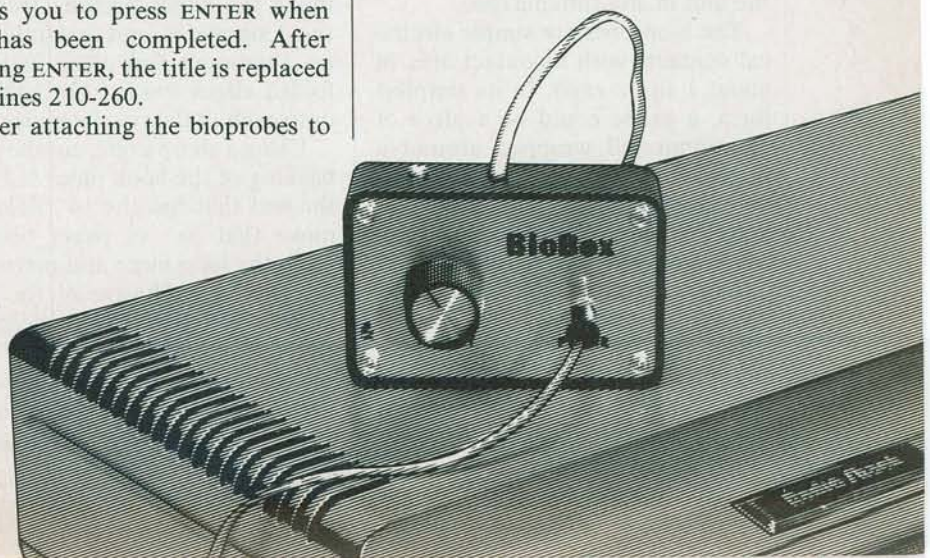
When the program is run, the screen presents a title and the Mood Index. The Index is used as a gauge with an arrow as the indicator. Next, a message to attach the Biobox to the right joystick input is displayed (lines 170-180) below the title. The message in line 190 instructs you to press ENTER when this has been completed. After pressing ENTER, the title is replaced with lines 210-260.

After attaching the bioprobes to

your index and middle fingers, you can begin to vary the ADJUST control on the biobox. As you do, you will note that the arrow pointer moves along the scale (see lines 270-300). When you press ENTER, execution jumps to line 310. The actual biofeedback monitoring occurs in lines 310-360.

The number corresponding to the voltage generated by the Biobox is stored in the variable M. This number is then used to determine the pitch of the audible feedback beep (line 330), the color the screen presents as a visual feedback (lines 340-350), and the repetition rate of the beep (line 360). Thus, as tension decreases, the screen's colors become "cooler," and the beeping is at a lower pitch and repetition rate. At the "ultimate" state of calmness (see line 320), sound and visual presentation cease (CLS0 produces a totally black screen).

Construction. The Biobox is relatively simple to construct. Start by assembling the circuit of Fig. 1 on a small piece of perf board or printed-



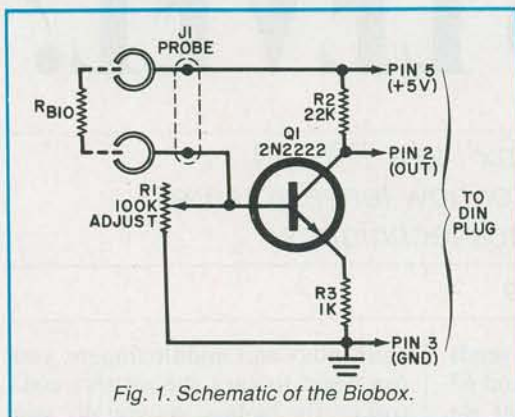


Fig. 1. Schematic of the Biobox.

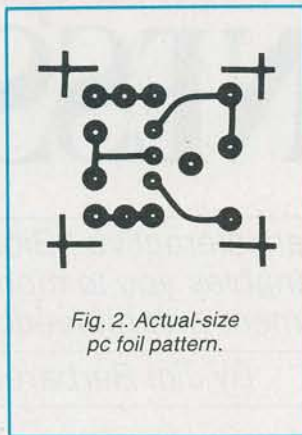


Fig. 2. Actual-size pc foil pattern.

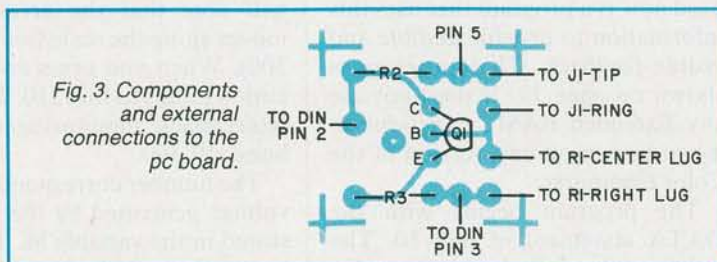


Fig. 3. Components and external connections to the pc board.

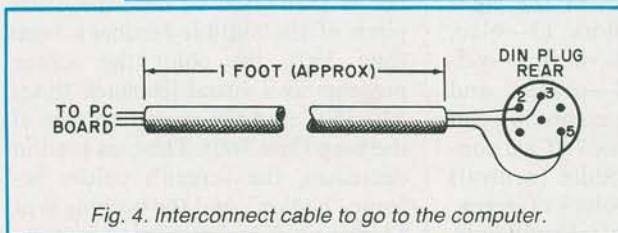


Fig. 4. Interconnect cable to go to the computer.

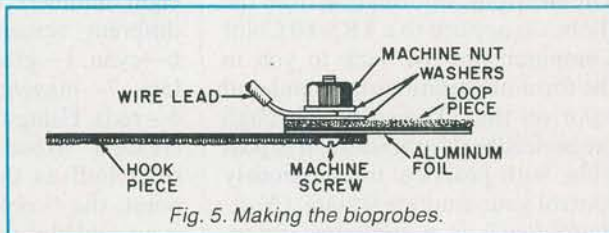


Fig. 5. Making the bioprobes.

PARTS LIST

- R1—100-kilohm linear potentiometer
- R2—22-kilohm, ¼-W, 5% resistor
- R3—1-kilohm, ¼-W, 5% resistor
- J1—3/32" subminiature phono jack
- P1—6-pin male (stereo) audio DIN connector
- P2—3/32" subminiature phono plug
- Q1—2N2222 or 2N2222A npn silicon, general-purpose transistor

Misc.—Control knob, pc board or perf board, 1' 3-conductor wire, 4' stranded and twisted wire, 1 case (Radio Shack #270-230 or similar), self-sticking hook-and-loop fasteners (Radio Shack #64-2345 or similar) two #4-40 × ¼" machine screws, two #4-40 machine nuts, 4 flat washers, 1' #22 stranded wire, solder, etc.

Note: The following is available from J. J. Barbarello, RD #1, Box 241H, Tennent Rd., Englishtown, NJ 07726: complete kit (Item CBF) containing all listed materials and Biofeed program on cassette tape for \$15. New Jersey residents, add 5% sales tax.

small piece of perf board or printed-circuit board (using the foil pattern of Fig. 2). Mount R1, R2, and Q1, and connect four 3" lengths of wires to R1 and J1 as indicated in Fig. 3. Now prepare the Color Computer interconnect cable as shown in Fig. 4. Finally, connect the cable to the pc board as shown in Fig. 3. Mount the unit in any suitable case.

The bioprobes are simple electrical contacts with a contact area of about 1 sq in. each. In its simplest form, a probe could be a piece of aluminum foil wrapped around a finger with a jumper wire connecting it to the circuit. Our bioprobes, however, are a bit more sophisticated. Besides the foil, hook-and-loop fastener material (commonly called "Velcro") is used.

Cut two 3" × ¾" hook pieces and two 1¼" × ¾" loop pieces. On each of the four pieces, punch a ⅛"-diameter hole located ¼" from

one end and centered along the width (i.e. ¾" from either side).

Cut a 2" × 3" piece of aluminum foil. Fold it in half to form a 1" × 3" piece. Fold it in half again to form a 1" × 1½" piece. Then fold the four sides over ⅛" for a final size of ¾" × 1¼". Create another piece the same way. Now remove the paper backing from the two loop pieces, and carefully place an aluminum foil piece (with the folded edges toward the adhesive) onto each of the two loop pieces.

Using a sharp knife, cut the paper backing of the hook piece ½" from the end that has the ⅛" hole. Remove that ½" of paper backing. Take the loop piece and place it on the exposed adhesive of the hook piece so that both ⅛" holes are aligned and the aluminum foil is sandwiched in the middle. Using a sharp knife, slit the aluminum foil in the ⅛" hole so the screw passes

through but makes electrical contact. Repeat this procedure with the remaining hook-and-loop piece.

To complete the bioprobes, you will need two #4-40 × ¼" machine screws, two #4-40 nuts, four small washers, a four-foot length of stranded, twisted wire and a subminiature phono jack. Place a screw through the ⅛" hole of one of the hook/loop pieces so the screw head is against the hook piece. Place a washer over the end of the screw (on the loop side). Strip ½" of insulation from one wire and wrap the wire around the end of the screw. Place another washer over the screw and secure with a nut (Fig. 5). Repeat this procedure with the other hook/loop piece. Finally, attach the subminiature phono plug to the other end of the wire. Remove the remaining paper backing and press your fingers against the adhesive. Repeat this until the adhesive is no

(Continued on page 84)

BIOFEEDBACK PROGRAM

```
1 REM** BIOFEEDBACK PROGRAM
2 REM** NAME: BIOFEED
3 REM** #4, 21 AUGUST 1982
4 REM**
5 DATA 3,6,1,5,2,7,8,4
20 CLS:FOR I=1024 TO 1055:POKE I,32:NEXT
30 FOR I=1056 TO 1212:STEP 32:POKE I,32:POKE I+31,32:NEXT
40 FOR I=1216 TO 1248:POKE I,32:NEXT:POKE 1279,32
50 PRINT@33,"*****"
60 PRINT@65,"****B I O F E E D B A C K ****";
70 PRINT@97,"*****"
80 PRINT@227,"C 1982 BY J.J. BARBARELLO";
90 FOR I=1280 TO 1535:POKE I,32:NEXT
100 A$="MOOD":FOR I=1 TO 4:POKE 1324+(I-1)*2,ASC(MID$(A$,I,1))-64:NEXT
110 A$="INDEX":FOR I=1 TO 5:POKE 1387+(I-1)*2,ASC(MID$(A$,I,1))-64:NEXT
120 POKE 1475,128
130 FOR I=0 TO 21:STEP 3:READ CL:POKE 1478+I,127+16*CL:POKE 1476+I,45:POKE 1477+I,45:NEXT
140 RESTORE:POKE 1347,3:POKE 1379,1:POKE 1411,12:POKE 1443,13:POKE 1507,30
150 POKE 1339,20:POKE 1371,5:POKE 1403,14:POKE 1435,19:POKE 1467,5
160 FOR I=1 TO 1000:NEXT:GOSUB 370
170 PRINT@133," 'BIOBOX' CONNECTS TO ";
180 PRINT@163," THE RIGHT JOYSTICK INPUT.";
190 PRINT@227," PRESS < ENTER > WHEN READY.";
200 A$=INKEY$:IF A$="" THEN 200 ELSE IF ASC(A$) < 13 THEN 200
210 GOSUB 370:PRINT@33," PLACE THE BIOPROBES ON YOUR";
220 PRINT@65," INDEX AND MIDDLE FINGERS. ";
230 PRINT@97," USING THE < ADJUST > CONTROL.";
240 PRINT@129," SET THE ARROW TO THE POSITION";
250 PRINT@161," THAT BEST MATCHES YOUR MOOD.";
260 PRINT@225," PRESS < ENTER > WHEN ADJUSTED.";
270 I=JOYSTK(0):M=JOYSTK(1):SO=SC:SC=8-INT((M+1)/8)
280 A$=INKEY$:IF A$="" THEN 290 ELSE IF ASC(A$)=13 THEN GOSUB 370:GOTO 310
290 IF SO < > SC THEN POKE 1507+SC*3,30:POKE 1507+SO*3,32
300 FOR I=1 TO 100:NEXT:GOTO 270
310 I=JOYSTK(0):M=JOYSTK(1)+1
320 IF M > 56 THEN CLS:GOTO 360
330 SOUND 197.1-M*M/16,1
340 SC=8-INT((M+1)/8)
350 FOR I=1 TO SC:READ CL:NEXT:CLS CL:RESTORE
360 FOR I=1 TO 15*M:NEXT:GOTO 310
370 FOR I=100 TO 200:STEP 20:SOUND I,1:NEXT:RETURN
```



...TENSENESS LEVEL (from p. 78)

longer sticky. This completes construction of the bioprobes.

Experimenting With Biofeedback. Locate a quiet area where you won't be disturbed. Relax yourself (loosen clothing, remove shoes, etc.). Sit in a position that is com-

fortable and provides arm/elbow support. Your hands should be clean and dry, and the room temperature should be around 70°F.

Load and run the Biofeed program. The first instructions will advise you to connect the Biobox to the right joystick connector. Do so, and then press ENTER to continue. Next, you will be advised to place one bioprobe on your index finger,

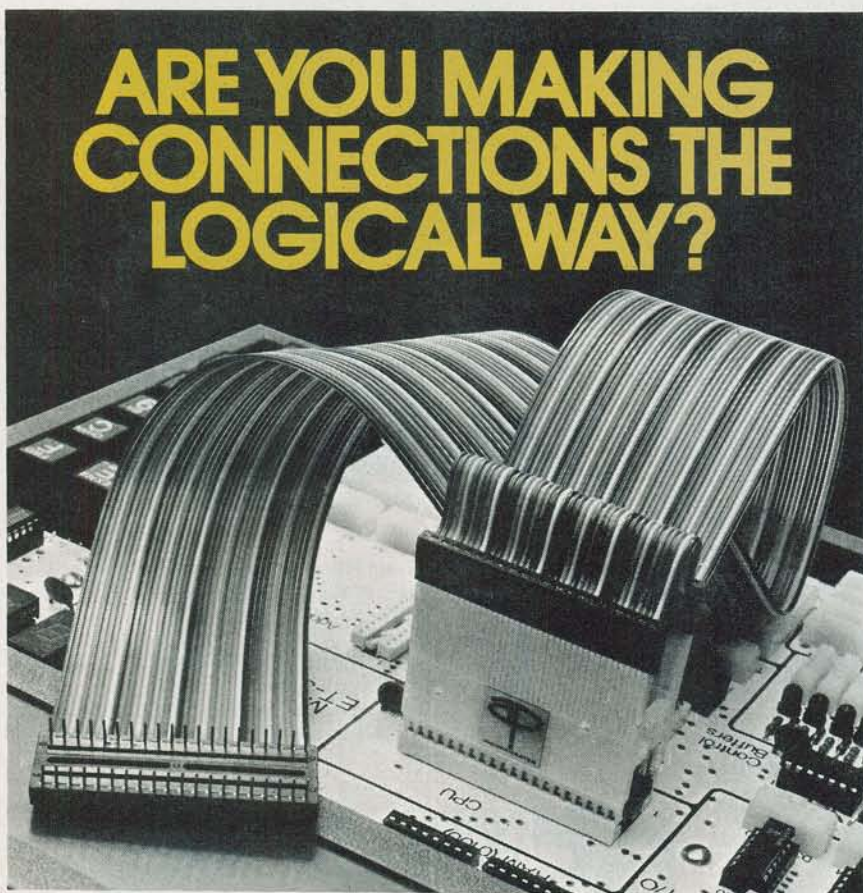
and the other on your middle finger. Turn the Biobox's ADJUST control to the point where the MOOD INDEX arrow begins moving. Keep that hand with the bioprobes stationary, and move the ADJUST control so the arrow points to the INDEX position that best matches your mood. For instance, if you are moderately calm, place the arrow to midrange (the white box). When adjustment is done, press the ENTER key.

The screen will clear in a color that reflects your level of tension/calmness. A beeping will be heard, the pitch and speed of which are also an indication of your mood. Try to relax by breathing deeply, relaxing your body, etc. Note which of your efforts get best results. You may notice that the feedback indicates momentary jumps in mood. This is common, but can be minimized by keeping your hand completely motionless.

As an experiment, take a deep breath and hold it for a few seconds. You should see a calming trend. Conversely, pinch your arm, bite your lip, or otherwise cause mild pain. You should notice an increase of tension. You will find that it is easier to increase tension than it is to calm yourself. This is a normal body reaction. The body tends to tense up faster and calm down much more slowly. In fact, trying too hard to calm down will actually cause you to tense up. Learning to relax requires practice—don't become discouraged!

Some people find that visualizing a pleasant scene (such as a beach or forest) helps in reducing tension. Conversely, thinking of an unpleasant experience can raise tension. So one method of learning to control your mood is to first visualize an unpleasant experience until the feedback indicates heightened tension, and then visualize a pleasant scene in an attempt to reduce the tension.

It is interesting to note that many people who respond to a question with a deliberate lie will exhibit increased tension. Does that suggest another use for the Biobox? If you're interested in the more serious aspects of biofeedback, your physician or a person knowledgeable in the field can direct you to further sources of information. ◊



The smartest, fastest, easiest, most reliable way to connect instrumentation to DIP IC's is with A P PRODUCTS Logical Connection.

A Logical Connection combines the performance proven IC Test Clip with a complete, tested, ready-to-use cable assembly. On one end, a pair of single row socket connectors attach to the pins of a connector compatible model Test Clip. On the other end, choose from among the four industry standard connector types, or order open-ended to terminate with your own connector. In sizes to accommodate DIPs from 14 pin to 64 pin.

The Logical Connection is available from our stocking distributors. Or ask an A P rep how we can make a custom Logical Connection for you.

Call TOLL FREE, 800-321-9668 for the name of the distributor near you. (In Ohio, call collect: (216) 354-2101)



A P PRODUCTS INCORPORATED
9450 Pineneedle Drive
P.O. Box 603
Mentor, Ohio 44060
(216) 354-2101
TWX: 810-425-2250

In Europe, contact A P PRODUCTS GmbH, Bäumlesweg 21 • D-7031 Weil 1 • W. Germany
CIRCLE NO. 5 ON FREE INFORMATION CARD