TABLE 1

Inhibit Input	Select Inputs C	B	A	Decimal	Closed Switch (all others open)
0	0	0	0	0	S1
0	1	0	0	1	S2
0	0	1	0	2	S3
0	0	1	1	3	S4
0	1	0	0	4	S5
0	1	0	1	5	S6
0	1	1	0	6	S7
0	1	1	1	7	S8
1	X	X	X	0 - 7	All Open

you can wire the switches to a connector that mates with the circuit you're going to test. Then, it's a simple job to connect and disconnect the circuit. This will help to prevent mistakes and it will save some—but not enough—time.

PC continuity testing

To make a PC do all the work, the mechanical switches in Fig. 2 must be replaced with electronic ones. Then the PC must control those switches, provide the test signal, and sense the outputs. In the circuit shown in Fig. 3, the mechanical switches have been replaced by a CD4051B CMOS 8-channel analog multiplexer/demultiplexer. The 4051 contains eight electronic switches, controlled by three select input pins 9, 10, and 11. Table 1 shows how the inputs select the switches that will be activated. When any one switch is closed, the other switches are open (high impedance). When the inhibit line is high, all of the switches are open, regardless of the select inputs.

The circuit in Fig. 3 is controlled by the PC I/O interface shown in Fig. 4. The PC I/O interface is described in detail in *Radio Electronics*, July 1991, page 53. The connections marked P1 go to a female DB-25 jack that mates with the PC I/O board. Jacks J1 and J2 are the input and output connectors for the device (most likely a multiconductor cable) to be tested.

The continuity tester contains six 4051s, three on the input side and three on the output side. The common inputs of the 4051s (pin 3) are connected through current-limiting resistor R1 to +5 volts DC, obtained from pin 25 of the PC I/O card. When any of the switches in IC1, IC2, or IC3 is turned on, 5 volts is passed through that switch to J1 and the associated test line. Switch selection is controlled by pins 1, 2, and 3 of P1, which are connected to the select inputs of the 4051s. This allows the PC to select any one of the eight internal switches in IC1, IC2, or IC3.

The select inputs of all three 4051s are connected together. However, only one 4051 should be active at a time if the circuit is to work properly. Therefore, the inhibit pins (pin 6) of the 4051s are also controlled by the PC. That permits the computer to activate any one of the 4051s and inhibit the other two.

The output side of the tester is essentially the same circuit, but with one difference. The 4051 common output/input pins (pin 3) are connected together and output at P1 pin 17. That pin, an input to the PC I/O board, must see either a low (ground) or high logic level. Since the 4051s will output either a high (+5 volts) or a high-impedance open, R2 is positioned between the output and ground as a pull-down resistor to ensure that a logic low can be sensed.

The goal of the circuit design was to test cables with up to 25 conductors. However, the three 4051s can test only 24 lines. Therefore, another way to check that last line had to be found. Pin 7 of P1 can send a signal through diode D1 to J1 pin 25. On the output side, J2 pin 25 goes to P1 pin 18 which can sense the output. The diode ensures that J1 pin 25 will not pull up any line to which it is shorted and give a false indication.

Building the circuit

The circuit can be built on perfboard. Begin by soldering a 5-inch length of solid No. 24 wire to each of the 25 pins of two female DB-25 connectors (J1 and J2). Then solder a 5-inch length of No. 24 solid wire to pins 1–6, 9–14, 17, 18, 23, and 25 of a second female DB-25 connector (this will be P1).

The circuit can also be built on a solderless breadboard with at least 50 rows of connection points and two vertical rows for power distribution. The circuit should be housed in a case that provides support for the panel-mount DB-25 connectors. It is

PARTS LIST

R1—100 ohms, ½-watt
R2, R3—10,000 ohms, ¼-watt
D1—1N4148 or 1N914 diode
J1, J2, P1—female DB-25
IC1–IC6—CD4051B CMOS 8-channel analog multiplexer/demultiplexer, Harris or equiv.
Breadboard (Radio Shack solderless P/N 276-174, solderable P/N 276-170, or equivalent), 30 feet of 24 gauge solid wire, enclosure

Note: The following items are available from J.J. Barbarello, 817 Tennent Road, Manalapan, NJ 07726:

- **A complete PC I/O board kit (part No. PCIO, contains PC board and all components)—$39.95**
- **Software, including complied and source code versions containing the enhancements mentioned in the article (part No. PCC-S, specify disk size)—$8.00**
- **Continutiy tester parts (part No. PCC-H, contains six 4051 ICs, R1–R3, and D1—$8.00**

Send check or money order (foreign orders please send payment in notes redeemable at a U.S. bank. Please specify part numbers. The author will answer all questions, but they must be accompanied by a self-addressed stamped return envelope.

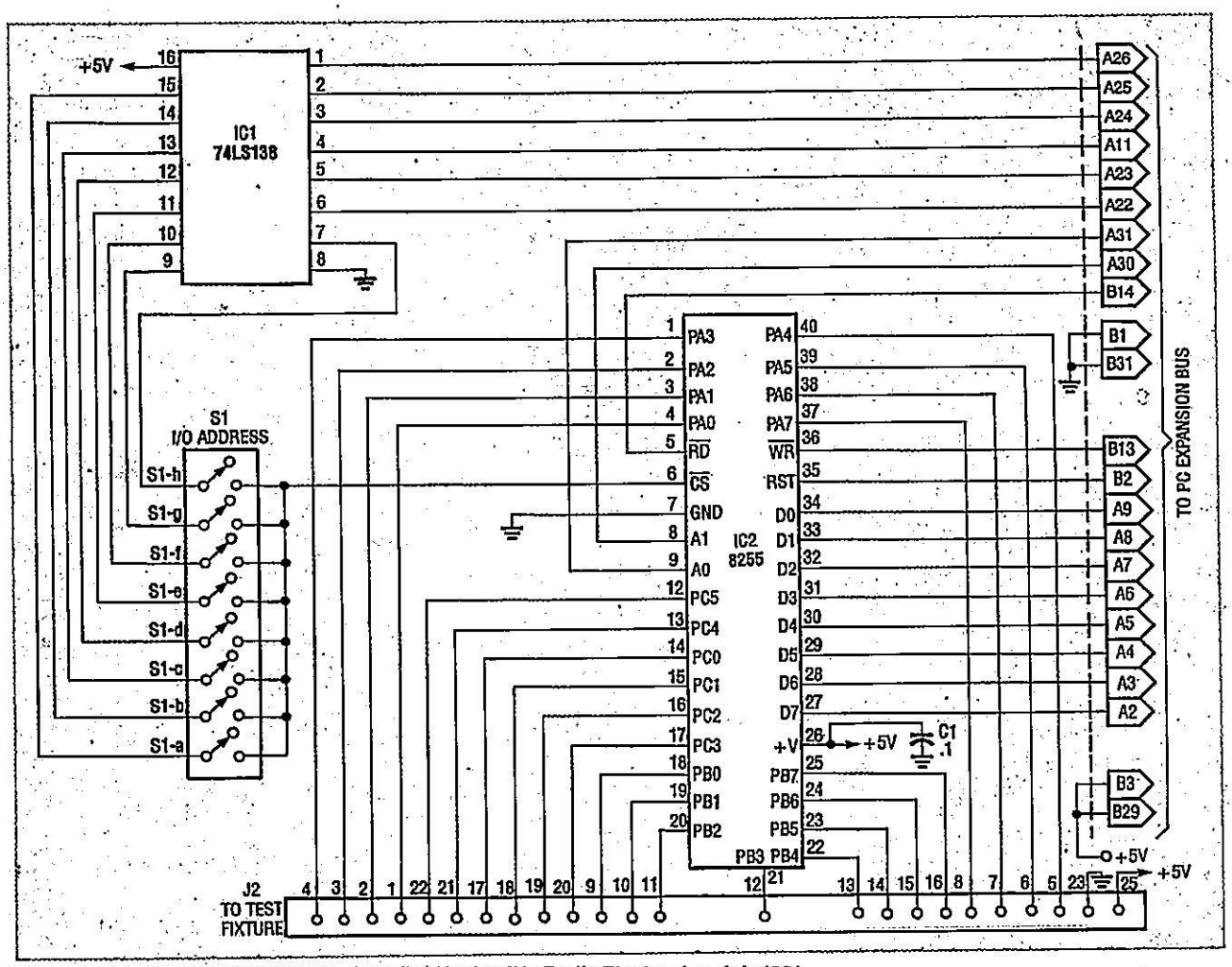

FIG. 4—THE PC I/O INTERFACE was described in detail in Radio Electronics, July 1991. This is the original circuit.

recommended that you mount the connectors to the case before wiring them.

Testing

To test the continuity tester your PC must be equipped with a PC I/O card, a male-to-male DB-25 cable, and a logic probe or voltmeter. Connect the cable from the PC I/O board to P1 and turn on the computer. Check for about +5 volts on pin 16 of each 4051, and ground on pins 7 and 8. Type in and run the output test program in Listing 1 using GWBASIC, BASICA or QUICKBASIC. Alternatively, the programs are available on the Gernsback BBS as part of a file called CONTTEST.TXT.

When running that program, enter each pin number (1 through 25) in turn. When "Press any key to continue..." appears, check that pin for a high signal. Then press a key and enter another pin number. Continue this until you've verified the operation of all 25 pins.

To check the output side, type in and run the input test program in Listing 2. Connect one end of a jumper wire to the junction point of pin 3 of IC1–IC3 and R1.

When you see the questions "Which J2 Pin (1..25)...," place the free end of the jumper into the pin number you want to test. While holding it there, enter that pin number. On the next line you'll see a "1" or a "0." A "1" indicates the high level was correctly sensed. Remove the jumper and enter the pin

LISTING 1

```
1  CLEAR : CLS : DEFINT A, E, I-K, O: DIM INH(4), I(625), O(625)
2  INH(1) = 48: INH(2) = 40: INH(3) = 24
3  DEFUSR = 64: ADD = 640
4  REM: Change ADD if necessary to match the address of your PcI/O Card.
5  OUT ADD + 3, 137: REM: Set PCIO For A=OUT, B=OUT, C=IN
6  REM: OUTPUT TEST (c) 1992 JJ Barbarello
7  INPUT "Which J1 Pin (1..25)..."; WHICH
8  IF WHICH > 0 AND WHICH < 9 THEN IC = 1
9  IF WHICH > 8 AND WHICH < 17 THEN IC = 2
10 IF WHICH > 16 AND WHICH < 25 THEN IC = 3
11 IF WHICH = 25 THEN IC = 4
12 IMASK = WHICH - (IC - 1) * 8 - 1 + INH(IC)
13 IF WHICH = 25 THEN IMASK = 64 + 56
14 OUT ADD, IMASK
15 PRINT "Press any key to continue...";
16 A$ = INPUT$(1): PRINT : PRINT
17 IF ASC(A$) = 27 THEN END
18 GOTO 6
```