COMPONENT PARTS

Electronic equipment, of every kind, is made up of electrical components. Some of these components are quite dazzling in their complexity. The microprocessors and video control chips at the heart of every microcomputer are so complicated that the tremendous range of their actions and their minute size seem alien to the human world.

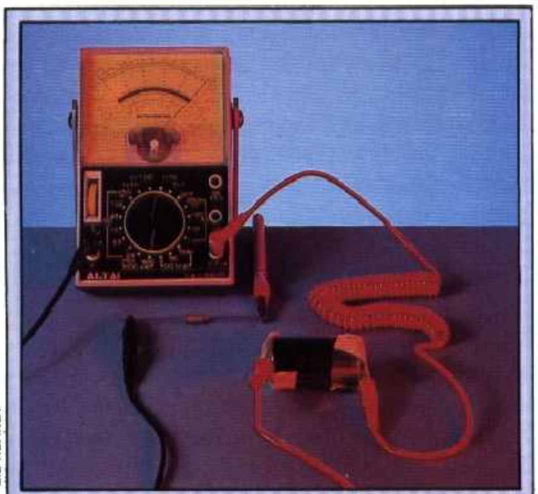
Even the most complicated of integrated circuits need support from, and are even largely made up of, much simpler electrical components. These simple building block components can be classified into two types: active and passive.

The passive components are the simplest. These merely hamper the electrical signal that flows through them. Different signals are hampered in different ways. That is what makes these components useful. Examples of such components are resistors and capacitors.

Active components are altogether more clever. They can actually add to the signal that flows through them. A transistor is a good example; when fed with a small signal it gives out a larger (amplified) signal.

Passive components are made up of simple materials. Apart from the packaging materials (the various resins and plastics) that you actually see when you buy, say, a resistor, the component is made of copper and steel and carbon. These are all conductors. The active components, though, are all made up largely of silicon or germanium. These two elements have special properties that make them behave not as conductors, like steel and copper, nor as the insulating resins and plastics, but in some way in between. Under some conditions they conduct electricity and under other conditions they do not. That is why these materials are known as semiconductors.

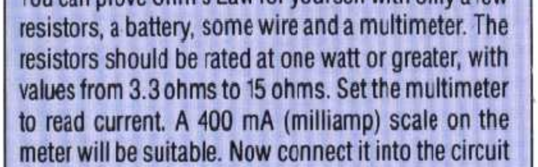
The active components, because they are based on semiconductors, work in many interesting ways. You cannot say that applying a particular voltage across a semiconductor will result in an electric current of a certain value flowing through it, nor indeed any current at all. All conductors, though, follow one very simple law. Ohm's Law (see page 114) describes the way in which any simple conductor will react to the electrical signal that flows through it. The transistor is the most important of these components to computing, as it is the basis by which computers can store and process information. In the next instalment we'll use transistors to build some of the simple logic gates that we've discussed in the Computer Science course.



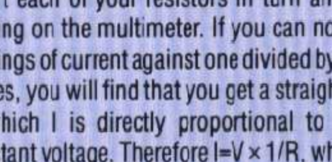
LIZ HEANEY

Proving Ohm's Law

You can prove Ohm's Law for yourself with only a few resistors, a battery, some wire and a multimeter. The resistors should be rated at one watt or greater, with values from 3.3 ohms to 15 ohms. Set the multimeter to read current. A 400 mA (milliamp) scale on the meter will be suitable. Now connect it into the circuit with the other components, as shown above. Insert each of your resistors in turn and check the reading on the multimeter. If you can now plot your readings of current against one divided by the resistor values, you will find that you get a straight line graph in which I is directly proportional to 1/R with a constant voltage. Therefore I=V × 1/R, which is V=I R — the formula for Ohm's Law



Diodes



Diodes are the electrical equivalent of a one-way valve. A diode has a very low resistance to electric current in one direction (usually a few ohms) and a very high resistance (several million ohms) to current in the other. This disobedience to Ohm's Law is because the diode is not an ordinary conductor but is a semiconductor made out of materials such as silicon and germanium. You can actually see the semiconductor in some glass packaged diodes. Every diode has a stripe at the end to which current can flow

Spectrum

```
20 DIM b$(3,7)
25 DIM c$(4,7)
30 INPUT "input colour of bands"
40 INPUT "band number 1",b$(1)
50 IF b$(1)="gold" OR b$(1)="silver" T
   HEN GO TO 30
60 INPUT "band number 2",b$(2)
70 INPUT "band number 3",b$(3)
80 PRINT
90 FOR i=1 TO 3
100  RESTORE 180
110 FOR j=0 TO 9
120 READ c$(1),c$(2),c$(3),c$(4)
130 IF c$(1)=b$(i) THEN  GO SUB 1000
140 NEXT j
150 NEXT i
160 PRINT "  ohms"
170 STOP
180 DATA "black","0","0",".0","brown","
    1","1","0","red","2","2","00","
    orange"," 3","3","000"
190 DATA "yellow","4","4","0000","green
    ","5","5","00000","blue","6","6","
    000000"
200 DATA "violet","7","7","0000000","gr
    ey","8","8",".0","white","9","9",".0"
1000 FOR k=1 TO 7
1020 IF c$((i+1),k)<>" " THEN  PRINT c$(
(i+1),k);
1025 NEXT k
1030 RETURN
```

BBC

```
10 REM resistor colour codes
20 DIM B$(3),C$(3)
30 PRINT "Input colour of bands:"
40 INPUT "BAND NUMBER 1",B$(1)
50 IF B$(1)="GOLD" OR B$(1)="
   SILVER" THEN GOTO 30
60 INPUT "BAND NUMBER 2",B$(2)
70 INPUT "BAND NUMBER 3",B$(3)
80 PRINT
90 FOR I=1 TO 3
100   RESTORE
110   FOR J=0 TO 9
120     READ C$(0),C$(1),C$(2),C$(3)
130     IF C$(0)=B$(I) THEN PRINT C$(I);
140     NEXT J
150   NEXT I
160 PRINT "  ohms"
170 END
180 DATA BLACK,0,0,, BROWN,1,1,0,
    RED,2,2,00, ORANGE,3,3,000
190 DATA YELLOW,4,4,0000, GREEN,5,5,
    00000, BLUE,6,6,000000
200 DATA VIOLET,7,7,0000000, GREY,8,8,,
    WHITE,9,9,,
```

For the Commodore 64 replace lines 40, 60 and 70 with:

```
40 INPUT "BAND NUMBER 1
   ";B$(1)
60 INPUT "BAND NUMBER 2
   ";B$(1)
70 INPUT "BAND NUMBER 3
   ";B$(3)
```