



# HOT WIRED

**A microcomputer's user port is the gateway through which we can monitor and control aspects of the world beyond the confines of the machine. In this introduction to a new Workshop series, we will look at how to access your user port so that you will be able to monitor physical phenomena such as heat, light and force, and control external devices — including a simple robot.**

Many popular home micros have user ports that allow entry to the computer's memory map by way of a series of electrical connections. The basis of all digital systems is that the binary system of ones and zeros can be easily represented by two voltage levels. Normally, a zero is represented by 0 volts and a one by +5 volts.

Each memory location is made up of a group of eight individual cells, each cell having a voltage level of 0 or 5 volts. The pattern of these voltage levels thus determines the number that is stored in that memory location. If any cell has a voltage

level of +5 volts then we say that the cell is *set high* and if the cell has a level of 0 volts then the cell is said to be *set low*. The external connections of the user port are electrically linked to one or more locations in the micro's memory, and by reading values from, or writing values to, these locations we can monitor or control electrical systems outside the computer.

There are two types of user port connections. Some ports have separate groups of pins (eight for input and eight for output) linked to two locations in memory. Others use the same eight pins for both input and output. In this part of the series, we will look at the second type of configuration, as used by the BBC and Commodore 64 micros.

## DATA DIRECTION REGISTERS

In addition to having a location linked to the eight pins of the user port, micros with bi-directional ports make use of a second memory location, known as the *data direction register* (DDR). This register determines whether each of the eight lines is to send or receive data. A one in the DDR sets a

## Plugging In

We begin our project by making leads for the BBC Micro and Commodore 64. These will be used to connect the machines to the outside world via a common format of eight data lines with an earth line on either side. You will need:

### BBC Micro

- 20-way IDC plug
- 20-way IDC ribbon cable (about 1 metre)
- Soldering iron and solder

### Commodore 64

- 24-way 0.15" edge connector
- 10-way ribbon cable (about 1 metre)
- Soldering iron and solder

The machine manuals' port pin-out diagrams show the location of the 10 lines (two earth, eight data) that we need. The BBC Micro's IDC (insulation displacing connector) plug has a locating lug on one side, and splits into two unequal pieces: hold the plug vertically with the lug away from you and its clamp section uppermost, and thread about an inch of ribbon cable through it with the red stripe to your right. Close the plug onto the cable with steady pressure (perhaps from a vice or clamp). Separate and trim 10 lines at the other end as shown, then strip and tin the ends of the remaining lines (see page 44).

For the Commodore 64, mark one side of the plug clearly as the top (and always have this side

uppermost on connection to the machine). Strip and tin both ends of the 10 lines, and solder the cable to the bottom pins of the edge connector in accordance with the pin-out.

Use the test programs and a multimeter (see page 87) to check your leads

