(seen as 69 decimal) and so on (see Appendix A of your Spectrum BASIC manual for a complete list of characters and their decimal equivalents). Large decimal numbers are dealt with in a similar way. Each decimal number is stored in the Spectrum in 5 bytes of memory. Chapter 24 of the BASIC manual explains how these bytes are used.

Before the CPU can actually start doing anything, it must be instructed what to do. The instructions for running BASIC are held in memory. The BASIC operating system program contains all of the information required by the CPU to understand BASIC. This operating program is written in machine code and starts to run when you switch the Spectrum on. The actual program is stored in the read only memory (ROM) chip IC5. Read only memory cannot be modified by the CPU and the program remains fixed in the memory chip even when the power is switched off.

The BASIC programs which you enter into the Spectrum go into random access memory (RAM). Unlike the ROM, this type of memory can be changed by the CPU. When the power is switched off, RAM forgets everything that was stored inside it. You therefore have to save your programs on a cassette before switching off. If you do not, the program will be lost forever.

Having found what to do from the program in ROM, the CPU must get inputs from the keyboard or cassette and send outputs to the video display or cassette. The uncommitted logic array (ULA) helps the CPU to interface with the outside world. The ULA gets information directly from the keyboard and cassette inputs. This information is then sent to the CPU. When the CPU wants to record a program on cassette or buzz the buzzer, it tells the ULA to do it. Output to the television is rather more complex. The ULA copies the screen output from the video memory to the video output circuit 50 times every second. This creates the illusion of a continuous display. All that the CPU has to do when it wants to output to the TV display is to put the video information into the video memory. The ULA then does the rest.

So far, transfer of information between the CPU, memory, ULA, keyboard etc. has been taken for granted. How is it actually done? All data is transferred via the data bus. The type of transfer being carried out is defined by various control signals on the control bus. For example, the CPU sends out a read signal if it wishes to read some data from the ULA or memory. This tells the ULA or memory to send some data to the CPU. If the CPU wishes to output something to be stored in memory, it sends out a write signal. This tells the memory that it must store the data from the data bus. So that the memory knows where it should store the data, the CPU also supplies an address on the 16 bit address bus. The address bus therefore allows the CPU to send or read data from up to 2^{16} = 65536 different memory locations.

The buses can only deal with the two logic states 0 or 1 on each of their lines. In practice, these logic states are represented by voltages. By convention (so that most modern computer integrated circuits are compatible with one another), logical 0 is represented by a voltage between 0 volts and 0.8 volts. Logical 1 is represented by a voltage between +2 volts and +5 volts (the maximum supply voltage for logic chips). If the voltage is between 0.8 volts and 2 volts, the signal is in the process of changing from 0—1 or 1—0. All logical data transfers occur within these voltage limits. The chips are designed so that they are not reading data at times when it may be changing.

You should now have a basic understanding of the blocks which make up the Spectrum. The following chapters explain each of these blocks in much greater detail. Each block is considered in isolation, but you should always try to remember how it is connected into the rest of the system. The full circuit diagram of the logic systems which make up the Spectrum can be found in Appendix E. You can refer to this diagram if you have any difficulty in seeing how the individual circuits interconnect.