Oscillators

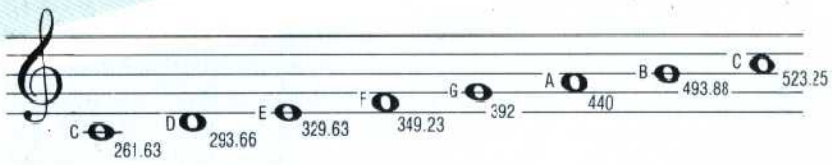
Oscillators are electronic circuits that produce repetitive signals. When these signals are amplified and fed to a speaker they make sounds of a given pitch. The number of oscillators provided by home computers varies between one and four — the more oscillators you have the more notes you can play at once.

Three characteristics describe the sound created: frequency, envelope (which includes volume) and waveform. Frequency will be introduced in this instalment and envelope generators and waveform dealt with in the second.

Frequency

This is the most important characteristic that we need to control, as it determines the pitch of the sound. Frequency is the number of times a signal repeats itself every second and is measured in hertz (Hz, cycles per second). Sounds that can be heard by the human ear have frequencies greater than 20Hz but less than about 20,000Hz. Although we cannot hear frequencies below 20Hz they can be used to modify the characteristics of an audible sound. This technique is called modulation and at present can be applied only on the Commodore 64 among home computers.

However, it is not necessary to delve deeply into frequencies. What you really need to know is how to play musical notes. The ease with which you can do this varies enormously from one machine to another. Some have BASIC commands that work out the frequencies for you so that you need only specify a pitch number or even a musical letter symbol — A, A#, B, and so on. Others make it much more difficult by providing only a table in the user manual where you look up the frequency corresponding to the required note and POKE the frequency value into a memory location. The table shows accurate conversions for the scale of middle C. It will also be useful for those wishing to program music in machine code, where BASIC is unable to help you calculate the frequencies.



Music Notes To Frequencies
You can work out the frequency of each note in the scale by multiplying the frequency of the note one semitone below it by 1.0594631. This may appear a little baffling but if the multiplication is carried out 12 times the original frequency is doubled. There are 12 semitones in an octave (the difference between two notes with the same letter) so doubling the frequency moves the sound up one octave. This table provides accurate conversions from music note symbols (for the scale of middle C) to frequencies

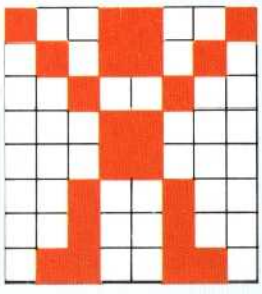
User-Defined Characters

To create unusual and attractive screen displays it is often useful to have characters available that are different from the normal alphanumeric character set. The Vic-20 and Commodore 64 have a special set of graphic characters that can be used directly from the keyboard, but even these do not cover every eventuality. On most home computers it is possible to create new characters. This is usually achieved by redefining the binary patterns of the eight locations of memory in which a character is stored. In the process the old set of binary patterns is often lost, or 'overwritten', and the 'user-defined' character takes on some of the properties of the one it has replaced in memory. Thus the new character can be used in PRINT statements by simply pressing the key of the character it has replaced. Here is an example of a user-defined character, together with its associated binary codes:

BIT PATTERN

128	64	32	16	8	4	2	1
1	0	0	1	1	0	0	1
0	1	0	1	1	0	1	0
0	0	1	0	0	1	0	0
0	0	0	1	1	0	0	0
0	0	0	1	1	0	0	0
0	0	1	0	0	1	0	0
0	0	1	0	0	1	0	0
0	1	1	0	0	1	1	0

PIXEL PATTERN



The ease with which user-defined characters can be set up varies greatly according to the computer being used. For example, with the Sinclair Spectrum's USR command, all that is required is to enter the appropriate binary patterns; whereas on the Commodore 64 the user first has to move the complete character set from ROM to RAM before POKEing in to memory the eight decimal equivalents of the bit patterns that make up the shape. However, several character-designing utility programs, available from independent suppliers, make life easier for the Commodore 64 owner.

To create larger figures it is possible to group two or more user-defined characters together. The alien figures shown (right) were constructed from four user-defined characters. The program, which runs on the Commodore 64, PRINTs the character groups on the screen in three different colours. The characters were created by using a short routine to move the normal character set from ROM to RAM and replace the graphics characters ▗ , ▐ , ▟ , and ' ' by reading in decimal numbers from DATA statements and using POKE commands to place them in the appropriate locations. Full details of how you can do this will be given in a forthcoming instalment.

Even when sprites (see page 152) are available there is often a limit to the number that can be displayed at any one time on the screen, so user-defined graphics come in useful where many similar shapes need to be displayed at the same time.

IAN McKINNELL

Extra Terrestrial
These alien creatures were created from four characters, each defined by the programmer. This method can be used on many machines that don't have sprites