

UNDERWATER SPRITES

Our series on Commodore 64 graphics is now reaching its final stages. Having examined the mechanics of designing, colouring and expanding sprites, we now turn our attention to sprite movement. The routines that control the ship, submarine and depth charges in our Subhunter game are looked at in detail here.

To position a sprite on the screen it is necessary to specify an X and a Y co-ordinate. Each sprite is defined on a 21 x 24 pixel grid, and the co-ordinates are measured from the top left-hand corner of the grid. Co-ordinates are held in registers within the VIC chip. These are assigned as follows:

Sprite Number	0		1		2		3		7	
Co-ordinate	X	Y	X	Y	X	Y	X	Y	X	Y
VIC Register	V	V+1	V+2	V+3	V+4	V+5	V+6	V+7	V+14	V+15

Each location can accept numbers in the range 0 to 255. This is more than sufficient to specify one of the 200 pixels in the vertical (Y) direction, and the extra capacity is used to allow a sprite to move in and out of view at the top or bottom of the screen. However, the 320 pixels in the horizontal (X) direction exceed the maximum of 255 allowed by an eight-bit register, so a further bit is allocated to each sprite. These extra bits are grouped together in a single register with the address V+16. The diagram below shows the

screen limits for fully visible, unexpanded sprites.

The ship's movement is controlled by program lines 230-250 and 270-290. Initial co-ordinates for the ship were set up in line 2270 of the sprite creation routine (see page 265). The ship will move in a horizontal direction only, so the Y co-ordinate will remain fixed. If this is set to 80, the ship will be correctly positioned on the ocean, which was designed using the screen setup routine. The ship's X co-ordinate, X0, is initially set to 160, giving a central starting position.

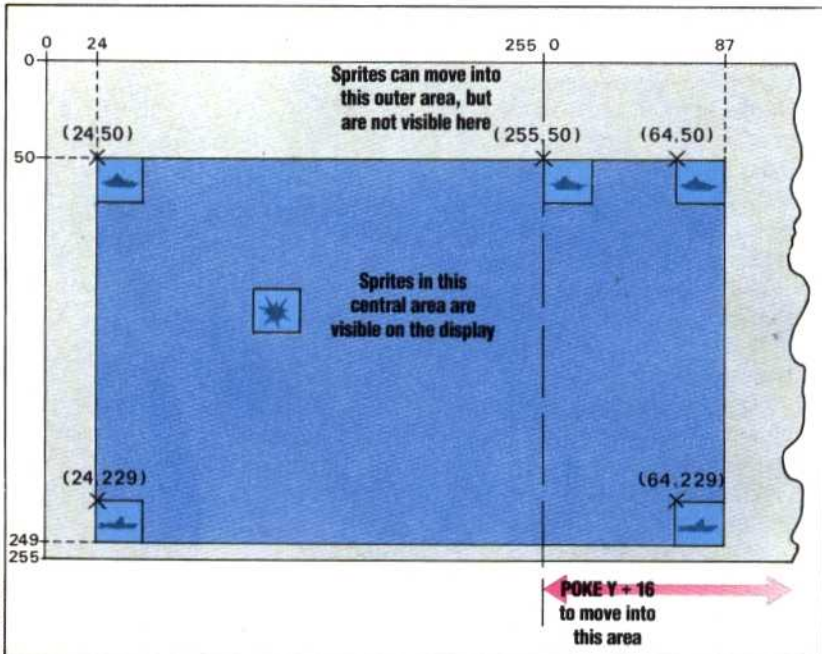
The ship is controlled from the keyboard, using the 'Z' and 'X' keys for left and right movement. Lines 230-250 of the main loop GET a character from the keyboard. If no key is pressed, program execution continues (in contrast to the INPUT command, which halts a program until the key is pressed). The value obtained by GET is then stored in A5 and used to modify the ship's X co-ordinate: if the 'Z' key is pressed, the ship is moved a short distance to the left and the X co-ordinate is decreased; if 'X' is hit it will be moved the same distance to the right and the X co-ordinate will be increased. The second part of lines 240 and 250 contains a test to see if the ship has reached the limits of its travel. The IF...THEN structure in Commodore BASIC is such that if the first condition on a program line is untrue then the rest of the line is not executed. In our program, condition testing is arranged so that computer time is not wasted in needless calculation. For example, there is no need to test for the lower limit of X0 if the 'X' key is being pressed and the value of X0 is increasing. After testing, the value of X0 is POKed into location V, the X co-ordinate register for sprite 0.

The movement of the submarine is controlled by lines 300-350 and 2500-2570, and operates within the main loop of the program as shown in the flow chart opposite. The 'Reset Sub Co-ords' subroutine starting at line 2500 uses the RND function to select the sub's depth, Y3, and speed, DX. Y3 will always be an integer number in the range 110 to 214, thus ensuring that the sub will not appear above the sea surface or below the seabed. The speed factor, DX, falls in the range 1 to 3 and sets the number of pixels by which the sub's X co-ordinate will be increased or decreased. The sub's X co-ordinate and the V+16 register bit that controls sprite 3's X co-ordinates above 255 are both set to zero.

In lines 300-350 of the main loop the value of DX selected is added to the sub's X co-ordinate and this is then tested to see if the sub has reached the edge of the screen. Lines 340 and 350 allow us to deal with the problem of having values of X3 in excess of 255. As the X co-ordinate increases to,

The Sprite Position

This diagram shows the parameters for positioning sprites on the screen of the Commodore 64. Placed in locations within the central part of this screen, a sprite will be visible on-screen. If a sprite is moved to the outer part of the display then it will not be seen. The four sprites in the corner of the central area show the limits of how far a sprite can be moved and still be entirely visible. The co-ordinates of the top left hand corners of the sprites are given



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