

AMSTRAD CPC 464/664, 6128

MODEL



UNIVERSE

THE THREE DIMENSIONAL DRAWING SYSTEM



MODEL UNIVERSE

A 3D DESIGN SYSTEM

Amstrad CPC 6128/664/464

by S.P. WOODMAN

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This manual was written on the PROTEXT word processor and checked using PROSPELL.

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INTRODUCTION

Model Universe has been designed to provide an excellent introduction to three dimensional modelling and to let everyone experience the fascination of seeing their ideas come to life in the form of real-time 3D animation!

Real-time three dimensional interactive graphics is among the most demanding of tasks for a computer, yet it is also one of the more visually fascinating.

For instance, during a flight simulation if the pilot banks his plane he will immediately see parts of scenery on screen that were previously hidden from view. Unlike a flight simulator most of the three dimensional graphic sequences produced for films like Walt Disney's Tron and the Channel 4 and BBC TV logos were not produced in real-time. In other words, although they were created on very fast and powerful computers, each frame of the sequence probably took hours to create and had to be planned well in advance. Graphics produced in this way yield some impressive results, but in the end all that is left is a film which is the same every time it is run.

Obviously for a computer to produce real-time interactive animation, objects or scenery within a program have to be considerably simplified. This is a rule which even applies to the world's fastest and most expensive simulators. Therefore, when the problem is tackled on an average home computer, the complexity of animation is reduced to comparatively simple shapes and designs. However, with the ever increasing power and ever decreasing cost of the microchip, in a few years time the average home computer will be vastly more powerful than any computer seen to date.

Model Universe was written expressly for the CPC series of computers and designed around the hardware. Also many of the built in operating system routines such as screen handling have been totally re-written and are many times faster, providing stunning 3D animation you are unlikely to see elsewhere.

LOADING INSTRUCTIONS

Tape version: Rewind the tape if necessary and press CTRL & ENTER simultaneously then press PLAY on the Datalogger followed by any key on the keyboard. After a few minutes the program will have loaded.

Disc version: Insert the disc and type RUN "DISC then press RETURN (or ENTER).

NOTE: Protection

- (i) The tape version will not run on a disc system.
- (ii) The disc version is supplied in protected form, and so may not be copied. The disc is guaranteed against loss of data, and will be replaced for the cost of a blank disc if necessary. If an attempt is made to copy the Model Universe disc, the message 'Disc read fail' will be displayed. This is normal and is not an indication of fault.

CONVENTIONS WITHIN THE PROGRAM

If you are using the disc version then as soon as the program has loaded you have the option to either run the program or run a demonstration. This option is not available on the tape version. The demonstration program loads each of the previously designed objects from the disc and moves it through a series of rotations and translations in real time. See the appendix for a description of the programs and files provided.

On both versions you will be asked whether you wish to use a joystick, the keyboard or a mouse. The program will wait until one of J, K or M is pressed. If either the joystick or mouse is selected, the use of the keyboard will be replaced in many parts of the program, however it is not possible to completely eliminate use of the keyboard on a program of this complexity. This selection can be changed by pressing ESC when at the main menu.

The program makes extensive use of windows and menus. Whenever you select a special mode or a new window appears on the screen the ESC key can always be used to return control to the last menu. In fact, during any data entry ESC will cancel from the present routine and take you back to where you were before.

Options are selected from menus using either the cursor keys, joystick or mouse to move the selection bar up and down. You make your selection by pressing either the ENTER key, the FIRE button on the joystick, or the first button on the mouse.

Disc users can select their own default colours for either the demonstration or the main program by setting the values of inks 2 and 3 (background & foreground) in the program DISC. The option to choose between the demonstration and the main program can also be removed if it is not required. Note that the main program can always be run with RUN "MODEL" and the demo with RUN "DEMO".

MAIN MENU

The main menu allows you to select the program's major functions such as saving and loading files and designing and displaying objects. The first two options are the most important. The DESIGN MENU option allows a 3D object to be created or, if an object has just been loaded, it allows that object to be changed or modified. The DISPLAY MENU deals with the manipulation of the object in 3 dimensions.

Unless a previously designed object is to be loaded, the first thing you will want to do is to create an object. To do this select the first option, Design menu.

DESIGN MENU

Any object created using this program, uter modelling program, will consist of a combination of two basic components – lines and vertices. The vertices are the corners of an object – or the points of intersection between two or more edges, and the lines are the edges connecting these points. For example, a cube has 8 vertices and 12 lines. Objects of up to 255 lines and 255 vertices can be created by this program. If you try to use more than this the program will inform you that an error has occurred, leaving your object intact.

The first option on the design menu allows lines and vertices to be created manually by defining their positions with a cursor. However, to make the design process easier and to facilitate quick creation of objects, many other options have been automated.

DESIGN MODE

When this option is selected the design menu is removed and an arrow cursor appears at the centre of the screen. The design screen is divided by an imaginary x axis – which runs horizontally through the centre, and an imaginary y axis – which runs perpendicular to this, also through the centre. As we will be designing three dimensional objects, a third axis – called z, is also needed. This runs into the screen perpendicular to both x and y.

The point of intersection of these three axes is called the origin and has coordinates $x=0$, $y=0$ and $z=0$. The positive half of the z axis points out of the screen. This is what is technically known as a right hand cartesian coordinate system.

The window at the bottom of the screen is the command window which constantly displays information such as the position of the cursor and the number of lines and vertices so far used in the current design.

The cursor can be moved around using the cursor keys, joystick or mouse. It can also be moved in and out of the screen by pressing one of:

SHIFT in conjunction with the up and down cursor keys

The FIRE button while moving the joystick up and down

The first mouse button while moving the mouse up and down

If the keyboard or joystick option is chosen, the cursor changes speed after moving a certain distance in any direction. This gives you full control over the cursor during either quick movements or slow, intricate design work. When in fast mode the cursor moves 4 pixels at a time and in slow it moves 1. If a mouse is being used the middle button can be used to select between fast and slow. The character next to the design mode indicator shows the current speed of the cursor.

If you wish, the cursor can be moved off the screen and the command window will still report its position. It can however only be moved a maximum of plus or minus 250 units in any direction.

Lines are created using key 7 on the numeric keypad. The first line is drawn from the origin to the current cursor position. This point then becomes the new beginning for the next line – unless a new start point is created using key 8 on the numeric keypad. Key 9 deletes the last line created along with any corresponding vertices. The last button on a mouse can also be used to draw lines.

When displaying an object the more lines and vertices there are, the more work the computer must do. As you can imagine an object using 255 lines will rotate rather more slowly than one using 3. It is therefore important not to use any more lines or vertices than is absolutely necessary. For this reason the editor does some checking for you. For instance, if you create a square with the last line connected to the starting point it realises that the two vertices in that line already exist as part of the first three and so will not create any more. Remember though, always place the cursor at exactly the same position as the other end point. Users of colour monitors might find this rather awkward, due to their lower resolution and sometimes blurred colours, but can position the cursor with absolute accuracy using the cursor coordinate display. As previously mentioned, pressing ESC returns you to the design menu.

VIEWPOINT

If you were designing a house you would probably want to put windows on all four walls. But you might only be able to see two of these walls edge on and therefore would not see clearly what you were doing. The viewpoint option has been included to overcome this difficulty. It can be used to turn objects through 90 degrees to show any face.

When selected you are asked in which axis you want to rotate the object. Entering a number between 1 and 4 will do the following:

- | | |
|---|---|
| 1 | Changes to a view from right side of object |
| 2 | Changes to a view from left side of object |
| 3 | Changes to a view from underneath object |
| 4 | Changes to a view from above object |

It must be remembered that once the object's orientation is changed, the coordinates of all of the vertices will also have changed. Sometimes you will find it useful to sketch out a design on paper before creating it using the program, as this will help to determine what the new coordinates will be when such changes are made.

It is also important to realise that what looks right in two dimensions does not necessarily look right in three. For instance, you could be drawing a window on the front wall of a house only to realise that you forgot to move the cursor out along the z axis, the result being that you have a window in the middle of the living room!

POSITION

Once an object has been designed you may find that it is not quite positioned centrally, or it might have been designed in the middle of the screen for convenience and you wish to move it to a position off the screen.

The position option is used to move objects away from their original positions. When selected you will need to specify how far and in what axis to move the object, such as: $x-50$. Where the movement is in a positive direction the + sign can be omitted. The maximum movement allowed in any direction is 250 units. If a single shift or the result of successive shifts in a particular direction would result in this number being exceeded a "shift exceeds 250" error will occur.

ENLARGE

Objects can be expanded or reduced using the enlarge option. When selected you are asked to specify whether an increase or decrease in size is required and for a corresponding scale factor. The statement takes the form $+/-n$, where a positive sign is an increase in size, a negative sign is a decrease and n is the scale factor multiplied by 10. So, entering +25 would enlarge each line by 2.5 times its original length and entering -70 would reduce each line by 7 times.

No matter how many enlargements are performed $+/-10$ will always return the object to the size at which it was originally designed. As with the POSITION function, the + sign can be omitted on positive enlargements.

Complex objects can be reduced by so much that the resolution of the computer cannot show their full detail. In fact such objects can only be seen in display mode when they are brought up very close to the viewpoint. A slight problem arises here because, to keep the object in proportion when reduced, some vertices will result in fractional coordinates. In other words, although a vertex might look as if it has coordinates 10, 15, 20 it may actually have coordinates 10.4, 15.1, 20.25. This means that drawing a line to these coordinates will not use the existing vertex but will create a new one.

CIRCLE

Object designs can incorporate circles, but even circles have to be described to the program using lines and vertices. To describe a circle first select design mode and position the cursor where you want the centre of the circle to be. Then select the circle option and enter the plane in which you want the circle to be drawn. The xy plane lies flat on the screen, the zx plane goes into the screen and parallel to the x axis (so that only the edge is seen) and the zy plane goes into the screen parallel to the y axis (in a similar way to the zx plane).

Next the radius of the circle has to be specified. This can be anything between 1 and 250 units. And finally the number of sectors has to be entered. In other words, the number of lines and vertices making up the circle. The number of sectors can be anything between 3, which produces an equilateral triangle, to 30, which produces an accurate circle.

Once created, a circle is just a series of lines and vertices and is subject to all of the other design options just as if it had been created manually, line by line. Therefore, lines within a circle can also be deleted one at a time in design mode.

If the creation of a circle would result in more than 255 lines or vertices in an object, it will not be drawn and an error will be reported.

EXTEND

The extend function offers a quick and easy way to produce a three dimensional object by drawing only one face. To create a cube using extend simply draw a square. This can then be extended any distance into or out of the z axis. The way it does this is to create a second exact copy of the design and to join up all the corresponding vertices.

You also have the option of not joining up the vertices allowing you to use the extend option to create two identical objects in the same scene.

Objects can only be extended in the z axis, and only by plus or minus 250 units at the most. As with the circle option, if an extend operation would result in more than 255 lines or vertices, an error will be reported.

EXT FLAG

The extend option on its own extends all of the current design, but there will be times when you only want a part of it extended. This is where the extend flag comes in. When selected, you are asked to indicate how you want the flag set. The first option, RESET causes the extend option to extend the whole object. The second option, UPDATE causes it to effect only those lines and vertices created from now on, and the last option, SAME allows you to leave the ext flag unchanged if you change your mind.

CANCELLING FUNCTIONS

Whenever a design function is selected the status of the current design is saved in memory, so if any function (even EXT FLAG) had an unexpected or undesirable effect, the design can be set back to its original state before the change was made. To do this select design mode and press CTRL-C. If you use a function incorrectly or need to change part of your design you must press CTRL-C BEFORE you leave the design screen otherwise it won't work.

DISPLAY MENU

The display menu is the second main part of the program and deals with the manipulation of objects in three dimensions. The screen is divided up in a similar way to that of design mode. The most noticeable difference being that the object on the screen now has perspective, or if you only created a two dimensional shape you might find that it is a slightly different size.

There are two main types of 3D transformations, these are rotation and translation. The first option on the menu – display mode – allows objects to be rotated and translated interactively using either the joystick, keyboard or mouse. The other options deal with changing the rotation and translation parameters and image outputs.

DISPLAY MODE

The origin in display mode is the point about which all rotations are performed. In display mode the cursor coordinates are replaced by the origin's coordinates. The viewpoint or the point from which you are observing from has the coordinates 0, 0, 0. The origin has coordinates 0, 0, -336, in other words it is 336 units into the screen. This origin in relation to the object itself is the same point which had coordinates 0, 0, 0 in design mode.

Rotation

If the keyboard option is chosen, keys 4 and 6 on the numeric keypad (joystick left and right) rotate the object about the y axis of the origin. The speed of rotation depends on how complex a shape is – the number of lines and vertices used. Keys 8 and 2 (joystick up and down) rotate the object about the x axis of the origin, and keys 7 and 9 (FIRE + joystick left & right) rotate the object about the z axis of the origin. The rotation keys are summarised below.

If you are using a mouse, the object rotates in the direction the mouse is being moved. So, moving the mouse left rotates the object left about the y axis, and moving up rotates upwards around the x axis. Pressing any of the mouse's buttons while moving left and right causes the object to rotate in the z axis instead of the y. You will find that the mouse is very sensitive in display mode so when large objects are being manipulated, and animation is therefore slower, it may be easier to use the joystick or keyboard.

Summary of rotation controls

KEYBOARD (NUMERIC KEYPAD):

rotate in z (anticlock- wise)	rotate in x	rotate in z (clock- wise)
[7]	[8]	[9]
rotate-[4] in y	[*]	[6]-rotate in y
[*]	[2]	[*]
	rotate in x	

JOYSTICK:

[FIRE] when held down changes
from y to z

	rotate in x	
	UP	
rotate-LEFT in y/z	+	RIGHT-rotate in y/z
	DOWN	
	rotate in x	

Translation

Objects can also be translated using the cursor keys. To move the object in and out of the screen use the SHIFT key in conjunction with the up and down cursor keys.

ORIGIN

Notice that the "S" character which indicated a slow cursor in design mode is still next to the mode indicator. In display mode this indicates the type of origin being used - Static. There are three types of origin. These are Static, Dynamic and Viewpoint.

Static origin

A static origin is one that does not change position. To best understand this try the following:

Move an object out of the screen (towards the viewpoint) using SHIFT and the down cursor key. The object gets bigger. Notice that if you move it out too far it will pass the viewpoint and disappear behind you. Move it towards you only slightly. Now rotate the object in the x or y axis (using keys 4 & 5 or joystick and mouse left & right), the direction is not important. Now instead of rotating in one place on the screen it will actually move towards one side of the screen or maybe even completely disappear off it. This is because it is rotating about a fixed point (0,0,-336), and you have just moved it away from this point.

Dynamic origin

Here's another example with which to explain the dynamic origin:

Reset the object using RESET and then move it out of the screen as before, but this time press D before rotating it. You will notice that the origin indicator has changed to D and the origin coordinates have changed. This is because the dynamic origin

moves around with the shape. If you translate an object with the cursor keys while using a dynamic origin, the origin coordinates will change correspondingly. So if you now rotate the object you will find that it rotates about its own axis. If it still moves from side to side it is because you did not design it in the middle of the screen. Remember, a dynamic origin is in the same place relative to the object as the origin in design mode. Pressing S returns to a static origin.

Viewpoint origin

Pressing V changes to viewpoint origin and the origin coordinates change to zero. This is because the origin is now at the viewpoint. If you try to rotate an object in front of you, you will find that it just moves off one side of the screen (and in the wrong direction) and eventually re-appears on the other side.

This is because all rotations and translations now affect you as opposed to the object. So if you translate left, you move left and the world outside moves right. Most of the time viewpoint origin won't be of any use but, if you create an object large enough, you can use this option to roam through it! – something you won't be able to do with a static or dynamic origin. If you do this you will probably need to change the display parameters too. See PARAMETERS below.

Although the speed of animation is almost the same using the three origins you may find that animation is slightly faster with a viewpoint origin and slightly slower with a dynamic origin.

PARAMETERS

When rotating an object, each consecutive frame of animation differs due to the object having rotated through a small angle. This angle is 6 degrees. Likewise, when it is translated, the object moves by 7 units between each frame. These values are called the display parameters. The parameters option allows them to be changed. When selected you are asked to choose an angle by entering a number between 1 and 9. The table below shows which numbers correspond to which angles.

1	=	1 degree
2	=	3 degrees
3	=	6 degrees
4	=	10 degrees
5	=	15 degrees
6	=	22 degrees
7	=	30 degrees
8	=	45 degrees
9	=	90 degrees

You are then asked to enter the new value for the translation factor. This can be any number between 1 and 50. If you wish to change just one of the two parameters you can use ENTER to skip over the one you don't want changed. If you press ESC to escape from the option after you have chosen an angle, but before entering a new translation factor, then both the angle and translation parameters will remain unchanged.

OUTPUT

After manipulating an object, you may find you want to save a permanent picture from a certain viewpoint. The output option allows the current screen image to be saved in a number of ways as follows:

TAPE and DISC

The first option on the output menu allows the entire screen to be saved either to tape or disc. The three information lines at the bottom of the screen are removed and the image is re-drawn to fill these lines. Also a small window appears in the middle of the screen prompting you to enter a filename.

When you have entered a valid filename the screen is saved and control is returned to the display menu. To load the screen again from BASIC type:

```
LOAD "filename",&C000
```

This can now be used as a loading screen for a game you might have written yourself or it can be loaded into a conventional graphics program where you can edit or add to it. Whatever you do with it you will probably find that the colours have changed. This is because the inks in the pens will be different in the new environment you are using.

The actual object image is drawn in pen 3 and the background is drawn in pen 2. Changing the inks in these pens changes the colours the image is displayed in. It is also important to remember that the object should be loaded in Mode 1, otherwise the image will look rather odd.

EPSON PRINTER

The Epson output option will print the screen on an Epson compatible printer with an option to add a title to each picture. The picture name will be printed at the bottom of the screen, and output to the printer with the rest of the screen. This allows a library of pictures to be built up each one having an individual name. If you don't want to give your picture a name just press RETURN (or ENTER) at the prompt.

BASIC

The basic output facility is one the most powerful features of the program and allows Model Universe to be customised so the screen image can be used in any way you want. If you have a plotter you can write a simple BASIC routine to allow the device to accept output from the program. The current BASIC routine outputs the image to a four colour printer plotter such as the TANDY CGP-115 or the MCP 40. If you have one of these plotters you will not have to write any programs yourself, just select the Basic option. When Model Universe is in memory, included with it is a small BASIC program. It was this program that created the 'Model Universe is loading' screen and controlled the loading of the main program. A listing of this program follows.

1 REM Model Universe Loader Program © Armor Ltd., 1986

10 MODE 1

20 INK 0,0:INK 1,14

50 OPENOUT"mu"

60 MEMORY 1879

70 LOAD "ldatafile.bin",10750

80 CLOSEOUT

90 FOR n=10750 TO 12646 STEP 8

100 x1=PEEK(n+0)+PEEK(n+1)*256

110 y1=PEEK(n+2)+PEEK(n+3)*256

120 x2=PEEK(n+4)+PEEK(n+5)*256

130 y2=PEEK(n+6)+PEEK(n+7)*256

140 MOVE x1,y1-20:DRAW x2,y2-20,1

150 NEXT

160 LOCATE 30,20:PRINT "...IS"

170 LOCATE 29,22:PRINT "LOADING"

180 LOAD"!mu1.bin"

190 LOAD"!mu2.bin"

200 CALL 3130

210 REM ***** DATA ABOUT TO GO OUT

220 REM

230 PRINT#8,CHR\$(18)

240 PRINT#8,"M0,-270"

250 PRINT#8,"I"

260 PRINT#8,"M2,36"

270 PRINT#8,"D2,297,477,297,477,36,2,36"

280 REM

290 REM *****

300 CALL &8FE2

310 IF PEEK(&80FD)=0 THEN 430

320 x1=PEEK(&80F2)*256+PEEK(&80F1)

330 y1=PEEK(&80F4)*256+PEEK(&80F3)

340 x2=PEEK(&80F6)*256+PEEK(&80F5)

350 y2=PEEK(&80F8)*256+PEEK(&80F7)

360 REM ***** DATA GOING OUT

370 REM

380 PRINT#8,"M"x1*0.75","y1*0.75

390 PRINT#8,"D"x2*0.75","y2*0.75

400 REM

410 REM *****

420 CALL &88CC 430 GOTO 310

440 REM ***** DATA FINISHED

450 REM

460 PRINT#8,"H"

470 PRINT#8,"A"

480 REM

490 REM *****

500 CALL &8FF2

510 GOTO 200

'Data is about to go out, so put the printer into graphics mode and draw a rectangular box on the paper to indicate the boundaries of the screen.

Data for the next line is in variables x1,y1,x2 & y2, so tell the plotter to move to x1,y1, and draw to x2,y2.

'Data has now finished, so put the printer back in text mode and feed the paper up.

When the basic output option is chosen the coordinates of every visible line on the screen are passed to basic in variables. You can then write a simple extension to the loader to do whatever you want with this coordinate information. The current extension outputs the coordinates to a four colour printer plotter. But you might want to output the coordinates to a file on tape or disc which can then be used by another program. The current extension serves as a good example to see how to create your own routine.

Lines 10 to 200 load Model Universe and must not be changed.

Lines 210 to 290 are executed when the basic option is chosen but before the data has actually been passed to Basic. Any initialisation of devices should be put in here. In the example the printer is put into graphics mode and a box is drawn on the paper.

Lines 360 to 410 are executed once for every visible line on the screen. The variables x1 and y1 contain the coordinates for the start of the line and variables x2 and y2 contain the coordinates for the end. The coordinate origin is the point in the far bottom left of the screen. In the example, the data is passed to the printer using the 'PRINT #8' command.

Lines 440 to 490 are executed when all the data has been output. In the example the printer is put back in text mode and the paper is moved up so the picture can be seen. Control is then returned to the main program.

Image files can also be output to tape and disc but disc users cannot output files in ASCII form because there is simply not enough room for a 2K buffer in memory. Files must be output in binary form instead. Binary files are also much more compact than ASCII files, so if you have are using a cassette system and want to save image files, use a binary form anyway.

There is an alternative loader program called "MODEL2".

If you run this version you will find that you can save your images in a far more compact form than by doing a complete screen dump (TA/DI output option). A short BASIC 'reader' program, such as the one listed below, can then be used to re-display the image. This program is also supplied after 'MODEL2' and on disc with the filename "READER".

```

10 MODE 2
20 MEMORY 40576
30 LOAD"image.bin",40577
40 a=40577
50 x1=PEEK(a+0)+PEEK(a+1)*256
60 y1=PEEK(a+2)+PEEK(a+3)*256
70 x2=PEEK(a+4)+PEEK(a+5)*256
80 y2=PEEK(a+6)+PEEK(a+7)*256
90 IF x1=65535 THEN END
100 a=a+8
110 MOVE x1,y1:DRAW x2,y2
120 GOTO 50

```

The end of file is indicated
by an x1 value of 65535.

SAVING DESIGNS

The current design can be saved to tape or disc using the SAVE option on the main menu. When saving to disc a file type is not added to the filename, allowing you to specify your own (.3D is a good one to use).

The complete status of the current object is saved, including the current enlargement factor – the colours currently being used are not saved.

LOADING DESIGNS

Previously saved designs can be loaded, and work continued on them as normal. The program checks whether the file you are trying to load was created by the program. If not an error will occur but the current file in memory will not be lost.

On side 1 of the tape version after the main program, and on side 1 of the disc version there are a number of example objects that can be loaded and experimented with. On the disc version they all have the file type .3D to distinguish them from the program files.

CATALOGUING

The catalogue option reports the contents of the disc or tape. When cataloguing a disc, all files are shown and the amount of free memory available reported. Pressing any key returns to the main menu.

When cataloguing a tape, files are listed as they are encountered on the tape. Pressing ESC halts the operation. Pressing any key then returns you to the main menu. All files created by Model Universe have a "+" as their identification character.

CHANGING COLOURS

The next three options on the main menu allow the colours in which the object is displayed to be changed. These changes remain in both design and display mode.

The foreground, background and border colours are selected in much the same way as selecting from a menu. The cursor keys, joystick or mouse are used to select from a list of 27 colours, the selection is then indicated by pressing either the ENTER key, the joystick FIRE button, or the first button on the mouse. If at any time during a colour selection the ESC key is pressed, the colour remains unchanged.

DESTROYING OBJECTS

The final option on the main menu destroys the object file currently in memory. Most of the time it is not necessary to use this option because, if you load a new file it automatically replaces the one in memory so there is no need to destroy it first. You should only use this option if you make a complete mess of your design and want to start again from scratch.

Before the object is deleted you are asked if you are sure you want to delete it, thus preventing accidental erasure of your object.

APPENDIX

These are the files and programs which you will find on your tape or disc. The files shown for the tape version are in the exact order in which they have been saved.

ON THE DISC

DISC	Menu & ink settings
MODEL	Main program loader with plotter extension
DATAFILE	Loading screen data file
★ MU1	Model Universe code part 1
★ MU2	Model Universe code part 2
MODEL2	Main program loader with binary output extension
READER	Basic program to display binary file data
DEMO	Loader for the demonstration version
DE1	Demonstration code part 1
DE2	Demonstration code part 2
BLOB.3D	Example objects...
DSQU.3D	
HEXS.3D	
HOUS.3D	
JETT.3D	
JOYS.3D	
PYRA.3D	
TIEF.3D	
TRIA.3D	
TXMU.3D	

★ Protected files. These files do not appear on the disc directory but are automatically loaded when the program is run.

ON THE TAPE

LOADER	Initial loader with ink settings
MODEL	Main program loader with plotter extension
DATAFILE	Loading screen datafile
CMU1	Model Universe code part 1
CMU2	Model Universe code part 2
MODEL2	Main program loader with binary output extension
READER	Basic program to display binary file data
BLOB.3D	Example objects...
DSQU.3D	
HEXS.3D	
HOUS.3D	
JETT.3D	
JOYS.3D	
PYRA.3D	
TIEF.3D	
TRIA.3D	
TXMU.3D	

GATECRASHER

Don't forget that on side two of your tape or disc you will find the free arcade/strategy game GATECRASHER!

LOADING INSTRUCTIONS

Tape version: Rewind the tape if necessary and press CTRL & ENTER simultaneously then press PLAY on the Datacorder followed by any key on the keyboard. After a few minutes the program will have loaded.

Disc version: Insert the disc and type RUN"DISC then press RETURN (or ENTER).

Full instructions on how to play GATECRASHER are included in the program.

