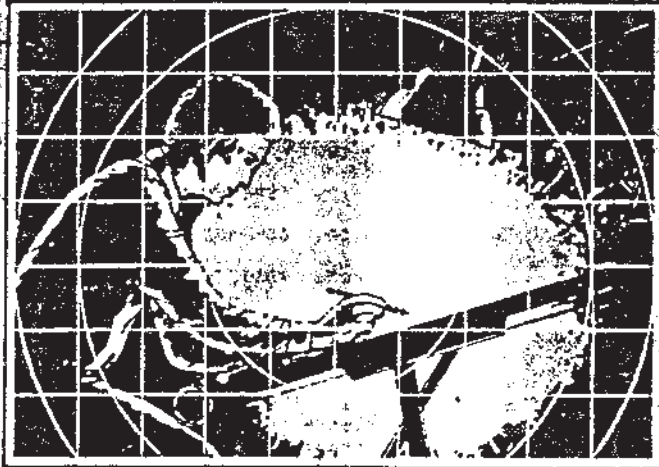
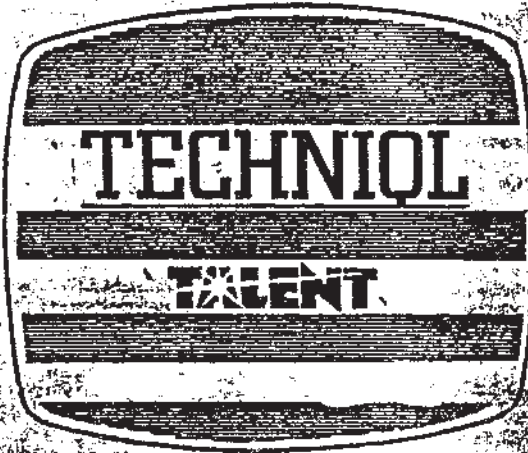


NEW FROM TALENT



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1. INTRODUCTION

A graphics program and a CAD (Computer Aided Design) package both make use of a computer's drawing capabilities. They have, however, few features in common. You would not expect a technical draughtsman working with ruler and set square, to produce an impressionist landscape. Nor would you expect an artist, painting with oils on canvas, to create a design for a printed circuit board. The exercise is theoretically possible - if both were motivated enough - but each would be using the wrong tools for the task in hand.

A graphics or paint program is designed to assist the creative artist, as much as possible by taking over the mechanical aspects of drawing and colouring. Pictures are drawn on a canvas which corresponds to the TV or monitor screen - it cannot be any larger. Standard shapes and textures can be created and the computer will store, plant, rotate and

copy them into the desired position. Colours can be added, replaced or removed. In short, the paint program allows the artist's imagination free rein and almost any kind of picture is possible.

A CAD package, on the other hand, has a more specialised purpose. The user generally has a formal concept of the design he wants to produce. This could be a flow chart, an electrical design, a mechanical drawing or a product design - anything in fact which can be represented two-dimensionally. What is important is the accuracy of detail. A single screen is too limited for the majority of applications and the CAD package therefore allows the user to specify any size of design and to scroll over it using the TV or monitor screen as a window. He can zoom in and out at will to inspect fine detail or to get an overview of the entire design.

A library of 'cells' can be created; these are shapes or symbols which may occur frequently and which the computer can manipulate to the user's specifications. Drawings can be created in layers - as if on sheets of acetate - and these can be viewed superimposed or in isolation. The whole or parts of the completed design can be printed out.

The designers of TECHNIQL have over eight years experience in using and designing CAD packages on large mainframe systems and minicomputer systems. In creating this package for the Sinclair QL, we have tried to eliminate unnecessary complexity; all the required CAD functions are present but there are only a limited number of commands to learn. Many commands can be 'nested' inside other commands, giving enormous flexibility. In this way, you have access to a sophisticated and powerful design package but you can learn how to use it fast and easily.

If you are unfamiliar with CAD techniques, we advise you to read the first part of this manual carefully. It consists of a tutorial introduction to TECHNIQL with a demonstration design to inspect and examples for you to try out. The second part is a reference manual. It states but does not explain. It is intended as a memory jog for someone who is already familiar with the system.

Jon R. Malone
Craig Renfrew

Glasgow, April 1986

2. FUNDAMENTALS

TECHNIQL is a CAD package for drawing charts, plans or diagrams on the Sinclair QL. In this context, all designs are referred to as pictures.

The picture can be many times the size of the viewport or drawing screen.

Each picture consists of one or more objects. An object is a basic drawing building block, such as a line or a box.

Objects are positioned at cursor-coordinates.

Cursor-coordinates are limited to the range -32768 to +32767 and are written as (x,y). The x coordinate counts the number of units from the left and the y coordinate counts the number of units from the top.

As the screen on a QL is only 256 x 256 units, it is difficult to draw a large picture on the small screen with any degree of accuracy.

To help you to design large screens, the viewport can be made smaller than the picture and the detail magnified.

By positioning the viewport around a small part of your picture you can zoom in and see a magnified image.

During this time the rest of your picture is temporarily hidden. It has not been lost or destroyed. Later on you can zoom out and view the complete design.

Objects in a picture can be designed in advance and called up when needed. The objects are referred to as cells. Cells are sequences of basic commands.

2.1 Starting up

This section assumes that you have read enough of the QL manual to know how to set your machine up and to load a program from a microdrive cartridge.

To run TECHNIGL you will need:

- A Sinclair QL
- A television or monitor (preferably colour)
- A blank microdrive cartridge

Later, you may also need:

- A second microdrive cartridge - to save your design.
- A joystick can be used. Plug it into socket CTL1 on the back of your QL.

Before running TECHNIGL you must make at least one backup copy of the master program cartridge marked TECHNIGL.

To make a backup copy:

- * Switch on your QL
- * Hit F1 or F2
- * Load the cartridge marked TECHNIGL into drive one.
- * Place a blank microdrive into drive two. You don't need to use a blank cartridge as long as the write protect tag is intact and you don't mind losing any information already recorded on it.
- * Type the command

Irqn mdvi_backup [ENTER]

This will copy TECHNIGL from drive one to drive two. Expect this process to take about eight minutes. You now have a copy of the CAD program on your own microdrive. Should the process fail for any reason, you will be given an informative message so that you can try again.

You can make as many copies of TECHNIGL as you like. As a security measure, we have made it impossible to run TECHNIGL from a backup copy unless the original cartridge is present in mdv2.

If you have a disk system, it is possible to transfer the program to disk by modifying both the boot program and the main TECHNIGL program. All references to mdvi must be changed into fipi or the name of your disk drive. Either do this manually or run TECHNIGL through the 'convert' program which was supplied with your disk system. The original cartridge must still be present in mdv2 when you are loading from disk.

You must not alter the original cartridge in any way - we have removed the write tab to prevent this happening by accident.

Once you have made a backup, the normal procedure for starting the program is this:

- * Switch on your QL
- * Load your backup cartridge in drive one
- * Load the original cartridge in drive two
- * Press F1 or F2 on your machine

Once the program has loaded and you have been presented with the credit screen, both cartridges can be removed and replaced in their holders.

If you wish to save the designs you are preparing you should place a fresh cartridge in one of the drives.

2.2 Commands

When you load the screen you are presented with a title page. On hitting a key you will see the screen divided into four windows.

The viewport or main drawing window is on the left of the screen with a circular white cursor in the centre. When you load TECHNIGL, you can choose whether or not to display a pre-defined 'grid' of points in the drawing window. If you don't want the grid display, press the key 'n' when you leave the title page. Any other key will bring up the grid.

The upper window on the right is the status window and gives you several items of data, such as the x and y coordinates. Don't worry if

you don't understand everything in the status window - all will be explained in the appropriate sections.

The status window includes:

- X:0 cursor position
- Y:0
- DX:0 'ruler' position from last command
- DY:0
- Kb: ??? largest block of store available
- SNAP FILL * shown when fill or snap or outline are on, blank otherwise
- L: 0 : 0 current layer and list of layers displayed
- WS: 256 width of screen in units
- INK current ink/fill colour/pattern
- cell .. 00 name of cell being edited

The central right hand window is the information window. From time to time, information about the various objects in the cell is displayed.

The lower right hand window is the help window. Instructions and prompts will appear whenever the machine is waiting for you to complete a course of action - such as drawing a circle or a box.

The system responds to a number of commands which can be selected in one of two ways:

* by choosing an item on a menu

* by typing in one, two or three characters at the keyboard

The first method has been designed to make it easy for you to learn to use TECHNIGL. As you become more familiar with the system you may prefer to bypass the menus and type in the commands yourself.

2.3 Menus

Press the F1 function key on the left of the keyboard. A menu is superimposed over the drawing screen. Now press the F2 function key. The first menu vanishes and another takes its place. There are five menus altogether, each one summoned by a different function key. They are listed below.

F1 Menu

swap snap
swap outline
cell dup
cell erase
layer list
free space
swap noise

F4 Menu

save design
load design
format
delete
directory
dump screen
printer dump

F2 Menu

swap grid
wipe
find cursor
swap mode
re edit
cursor colour

F5 Menu

circle
box
edit cell
text
polygon
curve
ellipse
plant cell
rubber band

F3 Menu

pan
cursor mark
cursor jump
zoom in
zoom out
ink colour
swap fill

To enter a menu, press the down arrow key once. The first item at the top of the list is highlighted. Continue down the menu and up again, using the up arrow key, noticing how each item is highlighted in turn. When the option you want is highlighted, press the Accept key (the space bar). The menu clears and you are returned to the drawing screen with the cursor where you left it. Any picture being composed on the screen is not affected by calling up the menu.

If you make a mistake and call up the wrong menu, you can always press the right function key to get the one you want. !ESC! will take you back to the main drawing screen.

When you select certain options on a menu, you may get a sub-menu or a colour chart. For example, if you choose ink colour, the screen fills up with a multi-coloured grid and you must move a box over your chosen ink to select it.

Once you have initiated a command - either by selecting it from a menu or by typing it on the keyboard - you cannot reposition the cursor.

Make sure that it is in the right place before you start. If it is in the wrong place, press !ESC! and start the operation again.

It is possible to call up menus and select certain commands while in the middle of carrying out other commands. For example, you can zoom in on a line or circle operation to position details accurately.

Not all commands will work sandwiched in this way. If you try to select an invalid command, the machine will groan at you and refuse to obey it.

2.4 The Accept and Abort Keys

The space bar (the Accept key) is pressed to select an option on one of the menus. It is also used to freeze a graphics operation. For example, you may want to draw a circle. You have selected the circle option and are using the cursor keys to expand and contract your shape until it is the size you want. As soon as you are satisfied, press space and the circle is drawn permanently on the screen.

As a general rule you can always get out of trouble by pressing !ESC! (the abort key) one or more times. It sometimes happens that you select an option which you do not really want. Sometimes the machine appears to be stuck because it is waiting for you to complete a command and sometimes it will 'groan' at you because you have made a mistake. !ESC! allows you to start afresh, returning you to the main drawing screen.

3. BASIC DRAWING TOOLS

3.1 The Cursor

When you load the system, you can choose whether or not to display a pre-set grid. If you want a empty screen, type 'n' when you clear the title page. Any other key gives the grid.

The cursor is your pencil. It shows you exactly where the points, lines and areas you draw are to be placed.

It can be moved about the screen by using the arrow keys on either side of the space bar. Try them now.

You will notice that the cursor appears to 'jump' around the screen in regular steps. This is because the grid has been set up (it doesn't have to be visible) and the cursor is 'snapping' to points on this grid. The word SNAP is shown in the status window to inform you that snap is enabled. You can turn off snap by selecting SNAP OFF, the first item on the F1 menu, and pressing space. Now move the cursor around and notice the difference. To turn on snap, select the SNAP command again and hit space.

Snap has been enabled at the start so that you can move the cursor around the screen more quickly. Section 7 explains the grid and snap commands in detail. Meanwhile you can choose whether to have snap on or off.

You can move the cursor a number of units at a time by holding down the iSHIFT or the iCTRL key while you use the arrow keys. iSHIFT and an arrow key move the cursor a large distance (32 pixels) while iCTRL and an arrow key move the cursor a smaller distance (8 pixels). With snap is on, iSHIFT and the arrow keys move the cursor 8 steps, iCTRL and the arrow keys, 3 steps.

You can use the arrow keys to move the cursor diagonally. To hold down a pair of keys (say up arrow and left arrow) the cursor will move in the appropriate diagonal direction.

This circular cursor we have just described is sometimes called the 'pixel cursor' to distinguish it from the other types of cursor yet to be described.

In the course of moving the cursor about, you may send it off screen and find you can't get it back again. Press F2, move the arrow to the third option on the menu, find cursor, is highlighted and then press the space bar. The cursor is positioned in the centre of the screen.

If you want to clear the screen completely, press F2, select the wipe command and press the space bar. Everything on the screen is erased and the cursor redrawn in the centre.

4. SIMPLE DRAWING

All the commands which draw lines or shapes on the screen are found in the menu associated with the F3 key.

Commands can also be typed directly on to the keyboard using an easily remembered two or three letter code. Section 14 gives a summary of all the letter codes used in TECHNIQL. The summary can also be found on a card which accompanies this package.

In this manual the commands are shown in upper case for the sake of uniformity, but you can type them using lower case if you wish. Letter codes are not shown on the menus.

All the line drawing commands operate with the maximum numbers of colours supported by your QL. Section 5 explains colour selection in detail. Unless you make a change to the ink colour, all lines drawn in Mode 8 are yellow and in Mode 4, white.

All shapes (except curves) and lines in TECHNIQL are drawn using the rubber-banded technique. Shapes or lines are pulled into position with the arrow or cursor keys and then 'frozen' using the space bar.

To get familiar with the various line and shape commands, we suggest that you try them all out one after the other. The prompt window gives you continuous on screen help so that you always know what to do next. After you have discovered the effect of each command, clear the screen completely with the wipe command iWIP! - this returns the cursor to the centre of the screen. Alternatively, you can bring back the cursor to the centre of the screen with the find cursor command iFC!. This will not affect any drawing which is present on the screen.

At the end of this section, you can combine certain commands to draw a simple picture.

Before you start to draw anything on the screen, you should remember

that the drawing area is usually much larger than the screen immediately in front of you. Think of this screen as a viewport, a window which you can move over the drawing like a glass bottomed boat over a coral reef.

At first, you may find yourself getting lost. Remember that the status window is there to help you and get into the habit of referring to the x and y coordinates all the time to find out exactly where you are. It is possible to draw with the cursor off the screen, and you may occasionally lose track of it. If this happens, use find cursor to return it to the centre.

4.1 rubber band iRB!

The rubber band command is used to draw straight lines between points. As you move the cursor, a 'rubber band' follows you, indicating the course of your proposed line.

To draw a line, first take the cursor to one of the end points of the line, then select rubber band on the F3 menu and press space. Now as you move the cursor you will see a line following you from the anchored end. When you have positioned the line just where you want it, hit the space bar. The line then changes into the current ink colour, which will be yellow if you haven't taken any action to change it. (See Section 5).

The RB command can be cancelled with the iESC! key.

4.2 circle iCI!

You can plot a circle by selecting the circle option. First put the cursor in the centre of the circle you want to draw, select circle on the F3 menu and press space. Then move the cursor to any point on the circumference. As you move the cursor, you will see a 'rubber' circle follow you, just like the band in the previous command.

iSHIFT! and iCTRL! can be used with the cursor keys to size the circle up or down quickly. If the circle is bigger than the screen, you will not be able to see it unless you:

- zoom out
 - pan the screen in one of four directions
- (these commands are explained in Section 6)

For the time being, restrict your designs to the size of the screen in front of you.

When you have got the position right, hit the space bar and the circle is drawn permanently in the selected colour. The cursor will return to the centre of the circle. This can be useful when drawing concentric circles.

You can always abort the circle drawing command by hitting the `!ESC` key. The trial rubber circle will vanish.

4.3 ellipse `!EL`

The ellipse command is for drawing an ellipse and is similar to that used for making a circle.

To plot the ellipse, you must take three steps:

First, put the cursor in the centre and select ellipse.

Next, move the cursor by a distance which specifies one of the radii of the ellipse and hit the space bar. The cursor then automatically returns to the centre.

Third, move the cursor anywhere you want. The ellipse you are defining grows and follows it. When the ellipse is correct, hit space and it is drawn permanently.

You can cancel the command with the `!ESC` key.

4.4 box `!BO`

Move the cursor to one of the diagonals of the box you want to draw and then select box from the `F3` menu. Move the cursor to the other diagonal and hit the space bar when the box is the right size. `!ESC` cancels the command.

The `BO` command is not only used to draw rectangular shapes but it can also be used to mark areas or define a grid size - more of this later.

4.5 curve `!CU`

TECHNIGL utilises Bezier curves to draw curved lines. However, the `GDOS` arc-drawing routine is not used as it contains a fatal 'bug' and could corrupt the entire program. This alternative method enables you to draw complex curves easily - however, it is a two-stage process and may at first seem less straightforward than the other drawing commands.

To draw a curve, you must call two commands: the first, cursor mark, is used to define four points. The second command, curve, tells the machine to draw a curved line between the first and last points you have just defined - the two intervening points influence the shape of the curve and are called 'attractors' since they cause the line to be pulled towards them.

To draw a Bezier curve, you must identify four points with the cursor mark command which you will find on the `F3` drop down menu. This command 'remembers' up to eight set cursor positions and is dealt with more fully in Section 9.4. The last four (four, five, six and seven) have been allocated to the curve command. Four represents the first point, five, the second, six, the third and seven, the final point.

Move the cursor to the start of the curve. Then select cursor mark. You are presented with a window which lists eight numbers, zero to seven. Move the cursor down the list until four is highlighted and press space. Now move the cursor to your second point and call cursor mark again, this time highlighting five. Repeat the process for six and seven. You now have four points defined and stored in the computer. Next you tell the machine to draw a curve between point four and seven by selecting curve on the `F3` menu and hitting space.

To accept the curve, press any key. If the curve is not what you want, press `!ESC`. You can change one or more of the marked cursor points by calling cursor mark again and then redrawing the curved line with curve.

On the keyboard, you can type `CM4` to mark the start point and `CM7` to mark the end point of your curve. `CM5` and `CM6` are the intervening 'attractor' points. Typing `CU` then draws a curve between `CM4` and `CM7`. `!ESC` cancels the command, any other key accepts it.

You can mark your points in any order you choose, as long as you remember that four and seven are always the start and end points. Practise drawing Bezier curves - you will soon become familiar with the way they work.

4.6 polygon `!PO`

Although a polygon is, strictly speaking, a closed many-sided shape, in TECHNIGL it is a sequence of connected lines which do not have to meet. Move the cursor to the start of the line and select polygon. As you move the cursor, a rubber line follows you from the start point. To 'set' the line, press the space bar. You can now move the line in a new direction. The start point is the end of the line you have just frozen.

To end polygon, hit the space bar twice.

If you want to erase part of your polygon, press `!ESC`. Each time you do this, the previous polygon line is erased.

Occasionally you will find points left on the screen after erasing polygon lines. These points are a feature of `GDOS`. They are not permanent and disappear when the screen is redrawn.

As a simple exercise, use a combination of the line drawing commands to draw a beetle.

5. COLOUR

5.1 Ink colour `!IC`

The status window displays a square of the current ink colour - which will be yellow if you have just loaded TECHNIGL. All the lines you draw are in yellow. To select another colour, highlight the ink colour

ICC option on the F3 menu and press space. A grid of colours and patterns appears on the screen with a heavy box outlining the first colour, black, on the top left-hand side. Move this box along the top line with the right arrow and press space when it outlines the colour you want. Press on until you choose a different colour, everything you draw will be in this new ink colour. The status window illustrates the new colour. Lines drawn before the change was made will be black.

5.2 Filling shapes ISF

Any closed shape - a circle, ellipse, box or polygon - can be filled with a solid colour or pattern. Some versions of the operating system may place restrictions on the form of shapes which can be filled. See the SUPERBASIC command FILL (in the keyword section of your manual) to identify any restrictions.

Shapes will not be filled until the swap fill ISF6 command is enabled. Like all the 'swap' commands in TECHNICAL, this is a toggle command. Select it once to switch it on; select it again to turn it off. When it is enabled, the word FILL is printed in the status window.

Any shape drawn from now on will be filled with the current ink colour, unless you opt otherwise by selecting a new colour or pattern with the colour.

Note that closed shapes already drawn will not be filled with the colour you have just chosen; they will remain as you originally drew them.

The SDOS FILL routine works by drawing a line between two points on the same horizontal, and it may sometimes appear that the machine has automatically 'finished off' a polygon shape for you which means that you don't always need to draw the last line. However, this shortcut may lead to problems when you rotate the shape during plot call (Section 6.4). To avoid this, always close all polygons which you wish to be filled.

5.3 swap outline ISO

Filled areas in a design can take longer to display on a plot than outlines. While working on a design you may want to display or print out draft versions, leaving out the filled-in areas until the design is complete. You can select this sketch mode by choosing swap outline ISO2. A 2 will appear in the status window in the SWAP FILL line to remind you that you have it switched on. swap outline is another toggle switch and it will display or print out features in outline form only. Select it again to disable outline mode.

Occasionally the machine selects swap outline temporarily to speed up operations.

6. PAN AND ZOOM

Frequently pictures you want to draw span one or more screens. The zoom and pan commands enable you to handle large pictures easily.

6.1 pan (PA)

The command pan causes the current cursor position to become the centre of the viewport. To see how it works, clear the screen with wipe and then draw a box which is larger than the viewport and accept it. The cursor is now at the further diagonal of the box and cannot be seen. Now use the command pan. The cursor and the rest of the box appear on the screen.

The pan command can be used at any time, either on its own or while another command is in progress.

6.2 zoom out (ZO)

Because the higher you fly the more you can see of the ground below, an alternative way of seeing all of the box that you have just drawn is to use the command zoom out (ZO). This has the effect of shrinking the current view to half its size. Repeat this command several times and see how small the box can become.

Zooming out blurs detail and because of this it may sometimes be difficult to position the cursor accurately. A way to get round this is to place it approximately where you think it should go and then use the zoom in command.

6.3 zoom in (ZI)

This command can magnify any part of a picture. You must outline the area you are interested in with a temporary box cursor. A box cursor is created in exactly the same way as the rubber box in Section 4.4. First, position the cursor at one of the diagonals of the box. Next, select zoom in and move the cursor until the box cursor is the correct size. As soon as you hit space, the area you have identified is enlarged to fill the entire viewport. The cursor is positioned in the middle of the screen.

The smaller the box you define, the greater the magnification.

If you zoom in until the screen is only one unit in width, the zoom out command will not function. Instead you must select zoom in yet again and draw a box much bigger than the screen. This will pull you out of the situation!

Pan and the zoom commands can be used in any order and at any time to position the viewport exactly where you want it.

7. THE DEMONSTRATION PICTURE

Included on the master cartridge is a demonstration picture which will give you practice in panning and zooming in and out. The picture is a map of Arran, an island in the Firth of Clyde, Scotland. The town of Brodick is shown in detail.

First type

←1

This switches on layer 1. Layers are explained in detail in Section 11.1. Next type ZO five times - or select zoom out on the menu five times. The width of the screen indicated on the status window should be about 1944 units.

Now load the demo file. Place the backup cartridge in drive 1 and select load design (LD) on the F4 menu. You are presented with a window:

Load design

Name: edvl

Type in demo (four keystrokes) and press ENTER. The demo file now loads and an outline of the whole of Arran is shown on the screen.

The area which contains detail for you to examine is surrounded by a box. Take the cursor to one of the corners of this box and then select zoom in. Outline your chosen area with a box cursor and press space. A street plan of Brodick will be displayed.

8. CELLS

One of TECHNICAL's most powerful features is the ability to create cells - frequently occurring shapes which the user can store, edit, manipulate and merge to create new designs. A cell can hold a transistor design, or a single letter of the alphabet or a door symbol for a floor plan. The contents of a cell can be as simple or as complex as you want.

In the demo picture you have just inspected, the outline map of Arran is a single cell and the street map of Brodick, another cell, consists of a collection of objects, boxes, circles, lines etc. drawn one after the other.

A cell is stored as a sequence of objects together with their coordinates. This makes for efficient use of memory and simple editing and planting of one cell inside another.

8.1 edit cell (EC)

The cell called up first when TECHNICAL is loaded is cell 00 and all the operations you have carried out so far have been confined to this cell. If you want to work on a different cell, use the edit cell (EC) command.

The drawing screen is replaced by the cell directory which consists of three columns of 75 cell names printed in red, ranging from cell 00 to cell 74. The first name, cell 00, is shown in white. You can move the cursor up and down to select the cell you want. When the name is highlighted in white, you can hit space to accept it. You are immediately returned to the main screen, with the cursor at coordinates 0,0. The name of the cell being edited is shown in the status window.

The machine distinguishes each cell by an internal number. You can easily change the cell names to make them more meaningful to you. Just type in the new name - part, wheel, door, resistor, etc. The name can be up to eight characters long and will be shown in green as you type it. You must not start a cell name with a space but may include a space within the cell name. Press ENTER when the name is complete.

You can give the same name to more than one cell, if you want. You may want to arrange your work so that the first column of cells refers to old versions, the second to current versions and the third to new versions.

Always save your work to microdrive or disk at frequent intervals. Then if something should go wrong - such as a power cut - you have a reasonably up to date version to fall back on. Some people save everything twice on two different microdrives, others keep a 'grandfather, father, son' rotation of three microdrives and save every fifteen minutes. Whatever system you use, stick to it meticulously. Saving and loading are dealt with in Section 10.1 and 10.2.

8.2 cell dup (CD)

This command is used to copy a cell. It is useful if you want to create variations on a basic design. For example, you could have a standard table shape on which you may want to place a lamp or a TV set or a book. Rather than draw the table anew each time, you copy the basic table shape into three new cells and then add any extra embellishments as you wish.

To find out how this command works, draw a simple basic shape and then call up the cell dup (CD) command - short for 'cell duplicate'. This brings up the cell directory.

You want to move your basic shape from cell 00 to cell 01, the next one in the column. The source cell, 00, is already highlighted so hit space to select it. Move the cursor down to the next name on the list, 01, and hit space to select that as the destination cell. The contents of cell 00 are now copied into cell 01. Note that any old design in cell 01 has been erased by this operation.

ESC will abort this command at any stage.

8.3 re edit (RE)

Cell construction consists of adding one object after another until the design is complete.

With re edit (RE), you are returned to the first step in the construction of the current cell. You can then step through it one object at a time. At each step, you can delete an object or select an object in order to put it somewhere else.

Try the following experiment:

Clear the screen with wipe, select swap fill and then draw a circle, a box and a triangle - using the polygon command.

Now you decide that your circle is in the wrong place. Select re edit. The window clears and the first object, the circle, is displayed. You now have four options: delete, select, move to next step or abort.

Press the F5 function key. This brings up the edit sub menu:

select
delete object

18

You can highlight and choose either of these options by using the cursor keys and space. Alternatively you can type `DD` or `DD`.

In both menu and keyboard mode, the space bar moves you to the next step, provided you haven't highlighted a new option. `ESC` redisplaya the entire cell and aborts the editing sequence.

In the example you have just drawn, you want to reposition your circle. Select it by highlighting select on the sub menu and hitting space.

Now the box is displayed. You don't want to change this, so skip it by hitting space. The final object, the triangle, is displayed. This too is skipped by hitting space. The cell is complete.

Now you can reposition the circle. Take the cursor to a 'reference point'. There is no need to be on or even near your circle. Hit space to mark it. Now move the cursor to your destination point. When you hit space again, your circle will be moved by the difference between the two points.

You can select more than one object to be moved during the re edit command. All the objects selected are then moved in the same direction by a similar amount. If you have two objects which you want to move in different directions, you must call up re edit twice.

You will note that the central information window flashes up a description of the current object as each one is called up.

For example:

```
BOX
X: 80
Y: 0
```

```
CIRCLE
X: 0
Y: 0
```

```
POLYGON
X: 64
Y: 0
```

9.4 plant cell (PC)

This command plants one cell inside another. For example you may have a standard symbol which occurs repeatedly throughout your design. A door symbol in a floor plan or a microdrive cartridge symbol. plant cell allows you to have as many doors or microdrives as you want in the same design without having to draw each one separately.

Cells can be changed or edited after they have been planted and this change will be carried through to the final design. For example you have drawn a circle with a cross in it. This is cell circle. You plant circle in another cell called symbols. Later you decide to change circle and replace the cross with a square. symbols will now show the circle cell as a circle containing a square, even though it was originally planted as a circle with a cross.

TECHNICAL supports any combination of three transformations on planted cells:

```
normal
mirror in x
mirror in y
rotate anti-clockwise by 90
```

Combinations of transformations can be built up. For example you can rotate by 90, mirror in y, then mirror in x.

You can specify a sequence of up to 8 transformations for each cell being planted.

In addition, you can 'scale' a cell - that is, increase or reduce its size as it is being planted. This scale does not affect the original cell, only the planted copy.

Sequence of operations

1. Select plant cell or type PC.
2. The cell directory is displayed. Use the cursor keys and space to select a cell to be planted.
3. The chosen cell is now displayed. At this point select the transformations you require. The F5 function key brings up a sub menu

```
mirror in x
mirror in y
rotate
```

Select one of these options with the cursor keys and space, or type MX MY or RD. The screen is redrawn after each request, showing the new orientation of the object. You can enter up to eight transformations. `ESC` cancels the sequence and allows you to enter a new set. When transformations are complete, hit space.

Note that any of the 'nestable' commands such as pan and zoom, can be used at this point.

4. The screen is redrawn with the planted cell superimposed on your original cell.

Use the cursor to position the planted cell correctly. At the same time you can scale the cell up or down. Press F5 to bring up another sub menu and then select expand or shrink with the cursor keys and space. The alternative keyboard commands for scaling are EX or SH.

The planted cell is redrawn repeatedly, getting larger or smaller each time. This can be halted by pressing any key and the cell repositioned if necessary with the cursor keys. Note that you cannot scale cells down or up by more than 256 times.

`ESC` will only abort the plant cell command at the beginning or end of the sequence.

Planting cells can be a slow operation if the cell you are planting is

large with a lot of detail. Section 11.1 explains how to speed up this operation by means of a judicious use of layers.

8.5 cell erase (CE)

This command erases the contents of a cell. The cell directory is displayed and the cell identified with the cursor keys and space. Note that you cannot erase your current cell.

8.6 Cell depth

A cell can be planted inside a cell which can then be placed inside another and so on. Alternatively, cell a can be placed inside cell b which can be placed inside cell c which can be placed inside cell d. This mind-boggling activity is called 'recursion' and, if unchecked, could cause the machine to hang or stop working.

TECHNIGL has a built-in depth limit of nine, which should be enough for most practical purposes. It should be pointed out, however, that pictures drawn to the maximum depth level could take a long time to display. If you have zoomed out a long way, the deepest cells may be shown on the screen as mere points but they still have to be calculated in full.

8.7 General points

As a general rule, it is wise to draw all cells to the same scale. Although you can size cells up and down, it saves time and effort if they are approximately the right size to start with. A rough sketch of the diagram or picture you want should first be sketched out on paper. You can then see how many units you are likely to need and design your cells accordingly.

It is easy to get lost when you are working close to a large design. Here you can use layers to your advantage. (These are explained in more detail in Section 11.1). The technique is to draw an approximate picture on layer 7 and use this as a guide while you are filling in the detail. You can disable level 7 when your picture is complete.

You may wish to transfer part of a cell into a new cell so that you can use this part again. You can do this by first copying the cell with cell dup (CD) and then editing out the unwanted portions with re edit (RE). Finally, you can edit out the duplicated part from your original cell and plant the new cell in its place - this saves memory.

9. CURSOR POSITIONS

Certain facilities in TECHNIGL allow the user to position the cursor quickly and accurately.

9.1 swap grid (SG)

A grid is a display of evenly spaced dots which is used to help create accurate designs - the grid was used to reproduce the map in the demonstration picture.

Select swap grid and define your grid size with the dot cursor (DC) - does not have to be square. You can have up to 20 divisions (400 points) on your screen. If you zoom out a long way, the grid will not be shown.

If you change the grid size, the screen is not automatically redrawn. If you need to see the new grid layout immediately, select the pan command. This is a deliberate design decision - since frequent redrawings of the screen can be both time-consuming and tedious.

Swap grid is also a toggle switch; it turns the grid on and off.

9.2 swap snap (SS)

When snap is on, the cursor is forced to move in units of grid size. The grid does not have to be visible. iSHIFT and the arrow keys move the cursor 8 steps and iCTRL with the arrow keys move it 3 steps. The cursor does not have to be aligned to the grid. For example, switch snap off, move the cursor a few units to the left, then re-enable snap.

9.3 The ruler

At any point in the design of a cell you can obtain relative measurements by using . (full stop) with the cursor. It is equivalent to a measuring tape. Type ., move the cursor and the status window will give you the exact x and y distances between the . and the cursor.

This feature is enormously helpful for measuring objects or identifying areas of a design to be printed or magnified. If you need to print out a picture 390 units square, you can take the cursor to one diagonal, type . and then move the cursor until DX (and DY) are exactly 390 units.

9.4 cursor mark and jump (CM and CJ)

When designing a picture which is larger than the viewport, you are likely to want to return to previous objects. TECHNIGL allows you to mark certain cursor positions and jump back to them when necessary. cursor mark is also associated with the curve command (Section 4.3), although the points used by this command (four, five, six and seven) may also be used independently.

The cursor must first be placed in the correct position. When cursor mark is selected, a sub menu is presented which lists eight numbers, zero to seven.

The cursor keys and space are used to select one of the numbers. This number is now associated with the cursor's current coordinates.

To return to this remembered cursor position, the user selects cursor jump and chooses the appropriate number from the menu. When space is hit, the screen is redrawn with the cursor position centered in the viewport.

The alternative keyboard commands are CM and CJ followed by a single digit in the range 0 to 7. For example, CM2 marks cursor position 2 and CJ2 returns the cursor to this marked position.

You can redefine the positions as many times as you like; the only restriction is that there cannot be more than eight at any one time.

9.5 find cursor (FC)

This command returns the cursor to the centre of the drawing screen.

10. FILE OPERATIONS

TECHNIGL allows you to save your designs to any device, such as a microdrive cartridge or floppy disk so that you can bring it back later.

Normally you will save on to a microdrive cartridge. The system takes this as the default device.

The F4 menu gives you a set of file handling commands:

save design, load design, format, delete, and directory

All these commands bring down windows which ask you for further information, such as the name of a file.

10.1 save design (SD)

To save your current work, choose the save design option on the F4 menu. The window then appears:

```
Save design
Name: mdv1_
```

Make sure that a formatted microdrive is in drive one and then enter the name of your file at the keyboard. You can give it any name you like.

```
Save design
Name: mdv1_kitchenplan
```

When the file name is typed in correctly, (using the standard Sinclair editing sequence of CTRL-/backspace if necessary), hit ENTER and your file will be saved on to microdrive one. When the operation is complete, a message appears asking you to hit any key.

You can of course specify any device name such as mdv2, floppy, or neto 3, by deleting mdv1_ and typing a new device name. Note that it is possible to save and load files to/from the RS232 link, or over the network by using an appropriate file name.

10.2 load design (LD)

Choose load design on the F4 menu. The window appears:

```
Load design
Name: mdv1_
```

Change the name of the device if necessary, enter the name of the file you want to load and then press ENTER. The file to be loaded must of course be present.

10.3 formatting a microdrive (FO)

TECHNIGL allows you to format a microdrive while you are running the system. This is useful if you forget to have a blank one handy. Choose the format option on the menu.

```
FORMAT DRIVE#
Hit 'X' to confirm!
```

This window asks you to hit a certain key to confirm this choice, since formatting a drive is an irreversible action. The message appears:

```
OK
Name: mdv1_
```

Change the name of the device if necessary and then hit ENTER. When the formatting is complete you will be told how many good sectors there are on the device. We recommend that new cartridges should be formatted at least five or six times before they are used to store your files.

The result of the format is shown in the window and gives the total number of good blocks on the device.

10.4 Deleting a file (DE)

To delete a file, select the delete option.

```
DELETE FILE #
Name: mdv1_
```

In response to the prompt, type in the file name and press ENTER.

10.5 Displaying a directory (DI)

This option allows you to inspect the directory of a device. Select the directory option.

```
List directory
Name: mdv1_
```

Change mdv1_ if necessary on the file menu. Then hit ENTER. The contents of the directory are displayed. If the list of files takes up more than one screenful, you will see the word 'MORE'. Hit any key to see the next page.

10.6 General notes on file commands

Saving and formatting can be slow - it may take several minutes to complete. Please be patient. Restoring your file is much faster.

If you change mdv1_ to mdv2_ (or to the name of another device) on one of the windows you will find that your choice is remembered by the system and reappears next time you choose this option.

We recommend that you keep at least two backups of important files on different cartridges.

The windows are different from the menus in TECHNIGL in that ESC cannot be used to escape from them. If you have made the wrong choice, you must hit CTRL/Space to get back to the main drawing screen.

11. MISCELLANEOUS COMMANDS

11.1 layer list (LL)

As objects are drawn they are placed on a layer. TECHNIGL supports 8 layers - 0-7. Layers are like sheets of acetate film which can be placed one on top of another. You can choose how many layers you want to see displayed or printed and you can assign objects to any layer you wish. You can use any colour or combination of colours in any layer.

For example, you could be designing a map of an island. Layer 0 could consist of the basic outline, layer 1 might contain the road network, layer 2, the houses of towns and villages, layer 3, the railway network and so on. If you just want to see the basic outline and the road network, you display only layer 0 and layer 1 and disable all other layers.

The demonstration map of Arras was drawn on layer 0 and the plan of Brodick was placed on layer 1. If you display the map without enabling layer 1, you will just get the outline of the island.

The layer on which objects are placed when you first start up the system is layer 0. This is indicated in the status window. To place objects on a different layer, type a digit in the range 0-7. Any object you draw subsequently is placed on this layer until you make another change.

To tell the system which layers are to be displayed or printed, select layer list. A sub menu is displayed.

```

zero*
one
two
three
four
five
six
seven
done

```

zero has an asterisk against it which means that layer zero only is enabled. Other layers can be enabled by selecting them with the cursor keys and space. These are toggle selections which means that they are enabled and disabled alternately. When you have finished adding or removing layers, select done to quit.

The status window now indicates which layers are enabled.

```
L : 2 | 0123
```

shows that you are working on layer 2 and layers 0, 1, 2, and 3 are currently enabled.

The alternative keyboard command LL puts all layers into the list; LL takes them all out. You can indicate which layers are to be included

or taken out of the list by typing + and a digit or - and a digit. For example:

```
LL+
-4
```

would enable all the layers except layer 4.

When working on a large design, you may find it helpful to make a crude design on layer 7, say, and use this as a guide for more detailed work. Layer on layer 7 can be disabled.

If you want to plant a large and detailed cell, you may find the procedure unacceptably slow. Experienced CAD designers employ the following trick. Instead of planting the complete cell, with all layers enabled, they reserve one layer on which they draw a box approximately the size of the all the features in the cell. This is called the Alignment box. All the other layers in the layer list are then switched off. The cell is planted and can be moved, reduced or expanded quickly without having to wait for all the detail to be drawn.

It is possible to put objects on a layer which is not enabled. These will appear temporarily until the next screen redraw.

You cannot plant a cell onto a specific layer. Whatever layers that cell has used will still be used when it is planted.

11.2 free space (FS)

At any point while you are working with TECHNIGL you can determine how much memory is available. When you select this command, the status window tells you the size (in Kbytes) of the largest contiguous block of memory.

```
KB : 14
```

means that you have 14 Kbytes of memory which you can use.

You should take care not to run out of space. If the system indicates that you have only a few Kbytes remaining, you should not continue. Save your current work and start again.

Expansion memory will obviously add to the amount of available space, but make sure that you don't create designs which require more space than is available on your storage device. The storage capacity of a microdrive cartridge is about 100K; a disk holds about from about 350K to 720K.

11.3 text (TE)

You can label your pictures with the text command. Your text must always be placed in a separate cell and then planted, sized up or down and positioned as required.

Because it must be possible to manipulate text, the standard Sinclair character set has not been used. Instead a special character set has been designed which includes capital letters, digits and certain symbols.

Call the text command. Move the cursor to the start of the line, select text and then type the message. The line is terminated with `ENTER`. Text cannot be edited. If you make a mistake, abort the whole operation with `ESC` and start again.

You can create your own character set if you wish by defining each letter in a separate cell and planting them in your picture.

Do not attempt to put text in screens which are less than 40 units wide. There will not be enough points on the screen to display the characters correctly.

NOTE: If you do not want to include text in your design, you can save memory by not loading the letters file when booting `TECHNIGL`. There are two ways to do this:

1. Copy `adv1` letters to a separate microdrive and delete the original from your backup. Do not change your master cartridge.
2. Load the program and then remove the backup cartridge from drive one while the security check is performed on the master. In drive two, the text command can be called but will have no effect.

`TALENT` plan shortly to produce a text font generator program for use with `TECHNIGL`. This will provide several character sets and allow users to design their own. See Section 15 for details of projected add-ons to `TECHNIGL`.

11.4 swap mode `ISM`

`TECHNIGL` allows the user to select either Mode 0 (multi colour mode) or Mode 4 (hi-res mode). Because of the system's ability to zoom in or out, the difference between the two modes is not significant.

The command, swap mode, is a toggle command. The colours and patterns available for use by either mode are limited to those which your machine will support. Change modes, call up ink colour and look at the display.

11.5 cursor colour `ICC`

This command changes the ink colour of the cursor and also the colour of the grid if this is switched on. The screen displays the palette of colours and patterns available. The first eight correspond to the solid colours. Move the outline box to the colour you want and hit space.

11.6 swap noise `ISN`

The swap noise command allows you to control the noise response generated by the system. By default the system generates a beep to confirm a correct command and a groan to signify an error. You can change the response to any of:

- 1) both noises
- 2) groans only
- 3) no noise

Each time you select this command the system moves to the next state with 1 coming after 3.

11.7 Features of `QDOS`

`TECHNIGL` uses many of the line and shape drawing routines embedded in the QL's operating system for speed and efficiency. Certain 'features' or anomalies have been inherited and should be noted. These may not be present in all version of `QDOS`. These features are not bugs in `TECHNIGL`, they can be demonstrated from `SUPERBASIC` and should therefore be attributed directly to `QDOS`.

1. If the cursor is moved to the extreme limit of the picture (at about 32767 or -32768) while zooming out a long way, objects drawn could appear incorrectly.
2. Short lines are not always drawn to the correct length. They may be one pixel too small.
3. The filling of curves may not always be completed correctly.
4. Sometimes dots may be left on the screen when `ESC` is used (e.g. when erasing polygon lines). These are not permanent and disappear when the screen is redrawn.
5. Very large ellipses may not always be drawn. Zooming in close to an ellipse may also cause it not to appear.

12. PRINTER OUTPUT

The printer dump program in `TECHNIGL` allows you to send part or all of your picture to any Epson or Epson compatible printer, including the Sinclair badged printer. Printing is fast - approximately 2 minutes per page. The design is reversed out so that the black background becomes white.

Because the printer dump program is embedded in `TECHNIGL` and is written in machine code, it is not possible to amend it to work with other makes of printer. However, an additional module is being produced which will enable the user to incorporate `TECHNIGL` designs in a `SUPERBASIC` framework. This can then be modified to drive plotters and non-standard printers. See Section 15 for details.

Printer output is always square. The length of the x axis is both the width and height of the design. Designs which are wider than a single page are printed in vertical strips which can be joined together later. The maximum width of output supported by `TECHNIGL` is 9 widths. If a greater width is required, the design can be halved.

To print out a picture, first zoom out until all of the picture you want is visible. Next position the cursor at one of the diagonals, select printer dump and draw a box cursor around the area you want to be printed. The box is an inclusive border! those parts of the design immediately under the box are included in the printout.

The dump screen window appears.

Dump screen

Name: adv1

You must change the base of the output device to the base of your printer. (Delete dev: using [CTRL] and backspace) type dev: (or whatever your device is called) and then press [ENTER]. You are then asked for the width of plot. Enter a digit between 1 and 9 and press [ENTER]. Finally indicate whether the printing is to be supervised or unsupervised, using y or n and terminate this too with [ENTER]. [CTRL]/space aborts this window.

The design to be printed is redrawn on the screen, either in full width if you have specified a single width output, or in part if you have asked for multi-width.

In unsupervised mode the entire design is printed out with no pause between screens. In supervised mode, you can check each screen before it is sent to the printer. You can skip a screen by typing n or print it (by hitting space). In both supervised and unsupervised mode [ESC] halts printing.

If the following commands are supported by your printer, it is most likely that TECHNIGL will drive it correctly.

1. ESC K low order count hl order count
2. ESC A 3

13. REFERENCE SECTION

This section contains a brief description of the various commands and facilities in TECHNIGL. The description will be useful if you already know about TECHNIGL but wish to remind yourself of any details.

Loading
The program should be loaded from backup, with the backup on a floppy disk drive one and the original on drive two. F1 or F2 is pressed to boot the system.

The Status Window
The screen is updated at the end of every operation.

X1: 0	cursor position
Y1: 0	
DX: 0	'ruler' distance from last command
DY: 0	to current cursor
Kb1: ???	size of largest block of available memory
SNAP FILL #	SNAP: present if cursor snap is set
	FILL: present if colour fill is set
	!! present if outline is set
L: 0 : 0	current layer and list of layers displayed
WS: 256	width of screen in units
INK	current ink/fill colour/pattern
cell: 00	name of cell being edited

[ESC] key
The [ESC] key, pressed one or more times, cancels or terminates any command.

The Accept key

The Accept key (the space bar) is used to select menu items and to 'freeze' a graphics operation.

Cursor movement

The arrow keys on either side of the space bar move the cursor in one of the eight directions.

If [SHIFT] is held down at the same time as an arrow key the cursor movement is in steps of 32 units. If [CTRL] is held down at the same time as an arrow key then the cursor movement is in steps of 8 units.

When snap is enabled (swap snap), the cursor is forced to move in units of grid size.

Commands

Commands in TECHNIGL can either be selected from a menu or can be typed directly on to the keyboard using a combination of one, two or three letters. A menu is called up by pressing the appropriate function key. The arrow or cursor keys are used to highlight the correct option and the space bar confirms it.

Certain commands in the F1, F2 and F3 menus, such as zoom and pan, can be selected while other commands are in progress. If you call an

invalid command, the machine will groan at you.

All swap commands are toggle commands; select them once to switch them on, select them again to turn them off.

Commands are listed as they appear on the function key menus.

F1 MENU

swap snap i35 When snap is on, the cursor is forced to move in units of grid size. The cursor keys move the cursor in single steps. The cursor keys with [SHIFT] move the cursor 8 steps and with [CTRL], 3 steps.

swap snap can be selected even when the grid is off.

swap outline i90! This option prints or displays in outline those objects which have been filled with colour or pattern.

cell dup iCD! This brings up the cell directory. The cursor keys are used to highlight the name of the cell to be copied and space selects it. The cell to be overwritten is then selected in the same way. The contents of the old cell are lost. [ESC] aborts this option at any stage.

cell erase iCE! This command erases the contents of a cell. The cell directory is displayed and the cell selected with the cursor keys and space.

layer list iLL! As objects are drawn they are placed on a layer. There are 8 layers - 0-7. To assist presentation, some layers can be turned off. Thus a cell can be designed with objects on eight layers and a decision taken to display only 4 of these. Subsequently the remaining 4 layers can be overlaid. The status window indicates which

The layer enabled for display when the system is first loaded is level 0. The layer to which objects are first assigned is also initially 0. To put new layers into the display, the digit corresponding to the layer required (0-7) is typed on the keyboard.

Selecting the layer list command brings up a sub menu which lists the layers, ending with done. Layers can be added to the display or taken from the display by using the cursor keys and space and finishing with done.

The keyboard command, LL, puts all layers into the list. LL takes them all out. The separate commands + and - followed by digits add and subtract layers from the list. + and a digit adds a layer to the list, - and a digit takes it out.

free space (FS): This command gives the largest block of available memory which can be used by the system. Its size (in Kbytes) is displayed in the status window. The user should make sure that there is enough space for the work in hand. Any expansion memory will obviously increase the amount of space available.

swap noise (SN): This command allows the user to control the noise response generated by the system. Selecting this command moves the system round three possible noise response patterns:

1. Blips and groans
2. Groans only
3. Silence

F2 MENU

swap grid (SG): Switching on the grid causes a display of evenly spaced dots. The box cursor is used to indicate the grid size - it does not need to be square.

A grid is only shown when there are less than 20 divisions (400 points) on the screen horizontally and vertically. The grid will not be displayed if the user zooms out a long way after selecting swap grid.

wipe (WIP): This command clears the current cell and positions the cursor at the centre of the screen at coordinates 0,0.

find cursor (FC): This places the cursor in the centre of the screen.

swap mode (SM): Changes Mode 4 (hi-res) to Mode 8 (low-res) or vice versa.

re edit (RE): This command redisplay the current cell and object at a time. As each object is shown, the user can choose to delete it, select it for subsequent repositioning, skip it or abort the editing sequence.

The delete/select sub-menu is summoned by the F3 function key and the options highlighted and selected with the cursor keys and space. The alternative keyboard commands are:

- DO - to delete the object
- SE - to select the object

In both menu and keyboard modes,

- space - moves to the next step if no option is highlighted
- [ESC] - redisplay the entire cell and aborts the editing sequence

When all the objects in the cell have been displayed, the user can move the selected object or objects to a new position. The cursor is first moved to a reference point and this is 'marked' by hitting space. The cursor is then moved to the destination point. When space is hit, all objects which have been selected during this re edit operation are moved in the same direction by a similar amount.

cursor colour (CC): This command changes the ink colour of the cursor. The screen clears and a palette of colours and patterns is displayed. The first eight correspond to the solid colours. The cursor keys move the outline box to the required ink and the space bar confirms the choice.

F3 MENU

pan (IPA): The screen is panned to centre the screen round the current cursor position.

cursor mark (CM): This uses a sub menu (zero - seven) up to eight cursor positions can be remembered and identified by a number. The typed command, CM, must be followed by a single digit in the range 0 - 7.

cursor jump (CJ): This command is linked to cursor mark. The sub-menu (zero - seven) is presented. Select one of the remembered cursor positions and this will become the centre of the screen. The typed command, CJ, must be followed by a single digit in the range 0 - 7.

zoom out (ZO): The current cursor position becomes the centre of the screen and the current view of the picture is reduced by half its size.

zoom in (ZI): The area to be magnified is defined with the box cursor. When the space bar is pressed, the area expands to fill the screen.

ink colour (IC) - This command is similar to CC but selects the current ink colour.

swap fill (SF): This command fills closed objects with the current ink colour.

F4 Menu

save design (SD): saves the current work to file

load design (LD): loads a design

format (FD): formats a device

delete (DE): deletes a file

directory (DI): lists the directory of a device

printer dump (PD): This command sends a design or part of a design to the printer. The user zooms out so that the complete area is visible in the viewport and positions the cursor at one of the diagonals. On selecting printer dump, a box must be drawn around the area to be

printed and this operation terminated with space. The printed output is always square; the length of the x axis is both the width and the height of the diagram.

The dump screen window appears. The user must enter the name of the output device (usually serial), the width of plot using digits 1-9, and indicate whether the printout is to be supervised or unsupervised. Each option is terminated by **ENTER**. **CTRL**/space aborts the window.

The actual design to be printed is redrawn on the screen.

In unsupervised mode, the complete design is printed out with no pause between screens. Multi-width output is printed in vertical strips. In supervised mode, the user can check each screen before it is sent to the printer, and skip the screen (n) or print it (space) as wanted.

In both supervised and unsupervised mode, **ESC** aborts printing entirely.

F5 MENU

The cursor must be positioned correctly before calling up any of the

line or shape drawing commands. All these commands except curve use 'rubber-banding' techniques; the line or shape can be positioned or sized by the cursor keys and 'frozen' with the space bar when correct.

circle **IC**! The initial cursor position marks the centre of the circle. The cursor is then moved to a point on the circumference. The space bar accepts the shape and **ESC** cancels the command.

box **IB**! The initial cursor position marks one of the diagonals of the box. The cursor is then moved to the opposite diagonal. The space bar accepts the shape and **ESC** cancels the command.

edit cell **EC**! This command is used to call up and display any of the cells in the cell directory. A cell name is highlighted with the cursor keys and selected with space.

The name of a cell can be changed by first selecting it, and then retyping it, terminating this with **ENTER**!. During retyping, the letters change temporarily from white to green.

text **IT**! This command allows the user to type in a line of text, digits and certain symbols, ending it with **ENTER**!. Text should always be placed in a separate cell. Text cannot be edited; if an error is made, the whole message must be aborted with **ESC**! and the command repeated.

polygon **IP**! This command draws a sequence of joined lines which can form an open or closed shape, with the initial cursor position marking the start of the sequence. As each line is completed it is accepted by hitting the space bar. Polygon drawing is terminated by hitting space twice. Each time **ESC** is pressed the previous polygon line is erased.

curve **ICU**! Bezier curves must take four coordinates which are marked and stored in advance with the cursor mark **ICM**! command: four **ICM4**! marks the start of the curve, seven **ICM7**! the end point and five **ICM5**! and six **ICM6**!, the two 'attractors' which influence the shape of the curve. When curve **ICU**! is selected, a line is drawn between position four and position seven.

ESC! aborts the command; any other key accepts it. The curve can be altered by repositioning one or more coordinates and selecting curve again.

ellipse **IEL**! The initial cursor position marks one of the axes of the ellipse. The cursor is then moved to the other axis and the space bar is pressed. Finally the cursor is moved until the ellipse is drawn to the required shape and size. The space bar accepts the shape. **ESC** cancels the command.

plant cell **IPC**! The cell to be planted is selected from the cell directory. It is then displayed.

The cell can now be transformed in 3 ways: it can be mirrored in x, mirrored in y and rotated anti-clockwise by 90°. A sequence of up to 8 transformations can be specified. As each transformation is requested, the screen is redrawn.

The transformation sub menu is summoned by the **F5** function key and the options selected with the cursor keys and space. The alternative keyboard commands are **MX**, **MY** and **RO** to specify mirrorx, mirror y or rotate. The space bar terminates the transformation sequence.

The planted cell is now superimposed on the original cell. The cursor is used to move it to its correct position. At the same time it can be scaled up or down by pressing **F5** and selecting expand and shrink on the sub menu with space. The alternative keyboard commands for scaling are **EX** and **SH**.

The cell is then redrawn continuously, getting larger or smaller each time. Scaling is terminated by pressing any key.

ESC can only abort the plant cell command at the beginning or end of the sequence.

rubber band **IRB**! The initial cursor position marks the start of the line. The cursor is then moved to the end of the line and space is pressed. To abandon rubber-banding hit the **ESC** key.

digits 0-7 (no menu) These allocate subsequent objects to layer levels 0-7. Preceding the digits with a '+' or a '-' includes these layers in the display or removes them from the display list.

14. COMMAND SUMMARY

TECHNOL can be used with either menu-driven commands or by typing commands directly on to the keyboard. This summary gives you a quick summary of all the keyboard commands for use when you are familiar with the system.

BD box
CC cursor colour
CD cell duplicate
CE cell erase
CI circle
CJ cursor jump (with digits 0-7)
CM cursor mark (with digits 0-7)
CU curve
DE delete file

DO delete object (during re edit)
 EC edit cell
 EL ellipse
 EX expand (during plant cell)
 FC find cursor
 FO format
 FS free space
 IC ink colour
 LD load design
 LL layer list (with * on)
 PA pan
 PC plant cell
 PD printer dump
 PO polygon
 RB rubber band
 SD save design
 SE select (during re edit)
 SF swap fill
 SG swap grid
 SH shrink (during plant cell)
 SM swap mode
 SN swap noise
 SO swap outline
 SS swap snap
 TE text
 WI wipe
 ZI zoom in
 ZO zoom out
 0-7 layer/cursor position numbers (with digits 0-7)
 + add layer to list (with digits 0-7)
 - subtract layer from list (with digits 0-7)

15. ADDITIONAL MODULES

TECHNIGL is a basic CAD package and we have deliberately tried to keep its facilities and command structure as simple as possible to suit the majority of users. Certain users may, however, need extra facilities and we plan to provide these in the form of additional modules at a reasonable price.

1. Font (character) generator.
2. Library maintenance program. This merges parts of two existing designs. It also selects cells from one design and incorporates them into another.
3. SUPERBASIC framework. This enables existing designs to be loaded independently of TECHNIGL. The SUPERBASIC program can be modified easily to drive plotters and non-standard printers.
4. Decompiler/Compiler written in SUPERBASIC. The decompiler converts designs into human readable text so that it can be edited manually. The compiler converts text instructions into TECHNIGL internal format, enabling the user to generate cells from other programs and incorporate them into TECHNIGL.
5. GRAPH PLOTTER service: as these machines are expensive, TALENT propose an A3 plotter service to plot your designs on our equipment. Send for details.
6. TALENT is investigating nice/low cost plotters.