PLOTMATE

Model: A4
USER MANUAL

LINEAR GRAPHICS

PLOTMATE USER GUIDE

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PLOTMATE

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Introduction

This version of PLOTMATE is designed to operate with the BBC MICRO MODEL B.

Before you start using PLOTMATE check that you have received the following items in addition to this Manual.

Plotmate
Guarantee/Registration Card
Starter Pen Pack
Two flexible magnetic strips
System Disk 40/80 Track or Cassette
Interface Lead User Port

The System Disk is located in the envelope at the front of the manual.

If you are missing any of these items then inform your supplier quoting the number that appears on your delivery note.

Inspect all the items and ensure none of them has been damaged during carriage. If damage has occurred inform your supplier immediately again quoting the delivery number.

Please fill in the Guarantee/Registration Card and send it off promptly. If your unit was supplied direct from LGL this does not apply.

SECTION 1
GENERAL DESCRIPTION

SECTION 1
GENERAL DESCRIPTION

A plotter is unlike a printer in the way that it produces an image on paper. A plotter uses a pen to draw all types of graphical information on paper while a printer generally uses a print-head acting on an ink ribbon to produce a series of characters. Thus a printer is more suited to the production of text while a plotter is ideal for line drawing.

PLOTMATE uses a pen which is directed in its movements by the BBC MICRO. The computer under program control instructs the plotter to draw a series of line elements or vectors to create a variety of more complex shapes.

For users who are not familiar with the concept, a short description follows.

A vector has two characteristics, its length and its direction. Once these are defined then the resultant line is uniquely defined. An alternative description is to define the start and end points of the vector as shown in the example.

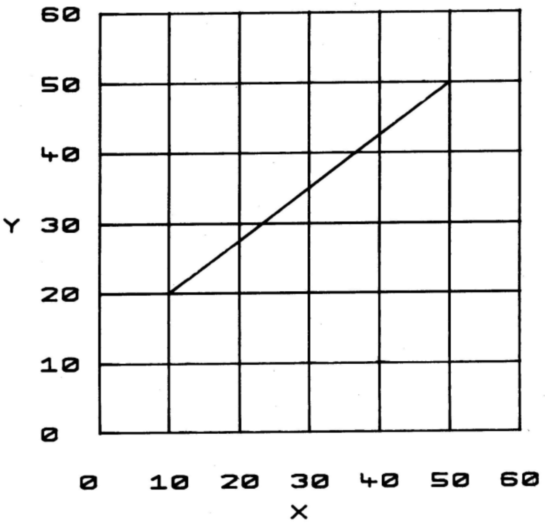

Fig. 1-1 Example of a vector

The start point is at X = 10 and Y = 20 while the end point is at X = 50 and Y = 50.

PLOTMATE can draw any vector once it has been given the start and end points, as both length and direction are fixed by these points.

In order to make this process as easy as possible, PLOTMATE responds to all the graphics commands that are used in BBC BASIC.

In order to draw the vector shown you would use MOVE 10,20(X = 10, Y = 20), followed by DRAW 40,50(X = 40, Y = 50).

By using graphics commands PLOTMATE can be directly controlled by the BASIC program. Depending on the program you have installed in your BBC MICRO, PLOTMATE can create 3D graphs, all kinds of diagrams and charts, in fact, whatever you want can be produced on PLOTMATE.

The System Disk supplied with your unit contains the control program which when loaded into your BBC MICRO decodes all the BBC graphics commands directed by the operating system to the screen.

The control program can either be loaded into program memory or into the memory normally occupied by the screen graphics. The former option does have the advantage that plotting can occur simultaneously on the screen and on PLOTMATE.

It is recommended that all users read through Sections 2, 3 and 4 carefully and follow the instructions given.

Section 5 sets out a series of examples which are well worth working through particularly if you are not an experienced programmer.

Section 6 explains all the BBC commands relevant to plotting. They are laid out in alphabetical order, with example programs.

Section 7 explains in more detail the control philosophy of PLOTMATE, while Section 8 details some useful hints on programming, while Section 9 covers troubleshooting.

SECTION 2

SYSTEM DISK PROTECTION

SECTION 2
SYSTEM DISK PROTECTION

Before proceeding any further BACK UP your System Disk. First check your System Disk is protected with a write protect tag and follow these instructions:

For a Single Disk System

1) From the keyboard enter
   ***Enable [Return]**
   ***Backup 0 0 [Return]**

Screen prompt
        INSERT SOURCE DISK AND HIT A KEY
in this case place your System Disk carefully in the slot and press a key.

Screen prompt
        INSERT DESTINATION DISK AND HIT A KEY
in which case REMOVE your System Disk and replace with a blank formatted disk then press a key.

Repeat this procedure until no more prompts appear on the screen.

For a Twin Disk System

Place your System Disk in drive 0 and your formatted blank disc in drive 1 then enter from the keyboard

***Enable [Return]**
***Backup 0 1 [Return]**
Remove disks when prompt returns on the screen.

Warning: Do not place the magnetic strips provided on top of or near your disks.

SECTION 3
GETTING STARTED

SECTION 3 GETTING STARTED

1. Connect the PLOTMATE interface lead to the USER PORT of your BBC MICRO, using the grooved cable connector.

   Push the remaining 20 way displacement plug into the socket located in the rear panel of PLOTMATE [see Fig.1]. The polarizing ridge on the plug should face upwards so that it engages with the slot in the socket.

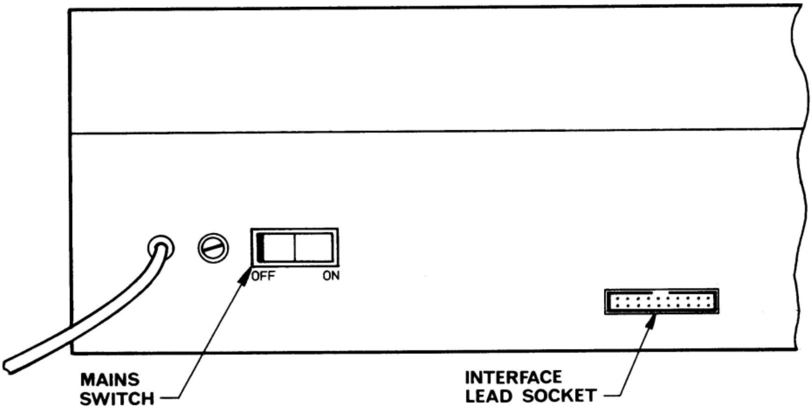

Fig.3-1. Rear view of Plotmate.

2. Plug in the mains lead.
3. Switch Mains on using rocker switch located in the rear panel of PLOTMATE [see Fig.1].
4. Insert system disk into Drive 0.
5. Simultaneously press the Shift and Break Keys on your BBC MICRO, making sure you release the Break Key first. This is called

"Auto-booting the disk". A menu appears on the screen as shown below:

```
                    PLOTMATE

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             (USER PORT VERSION 1.0)

   f0  PLOTMATE ON
   f1  PLOTMATE OFF
   f2  CURSOR KEY CONTROL
   f3  PEN HOME
   f4  PEN UP
   f5  PEN DOWN
   f6  PEN PARK
```

The pen will move to co-ordinate position 0,0.

6. Place paper in position as shown in Fig.2. Locate the top left corner of

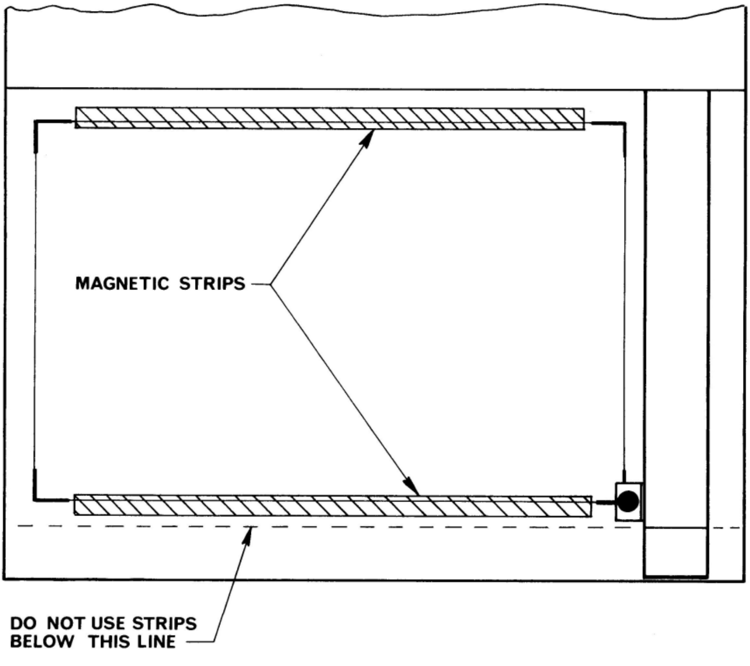


Fig.3-2. Paper location.

the paper into the corresponding corner of the A4 boundary marks. Ensure the paper is perfectly flat, with no ripples. Place magnetic strips in the position shown, making sure that the lower strip is clear of the region bounded by the dotted lines shown in Fig.2.

7. Select a PEN from the starter pack and remove cap. Support PENHOLDER and insert PEN.The locating pips on the PEN align with the two slots in the PENHOLDER. Twist PEN to fix it firmly in position [see Fig. 3].

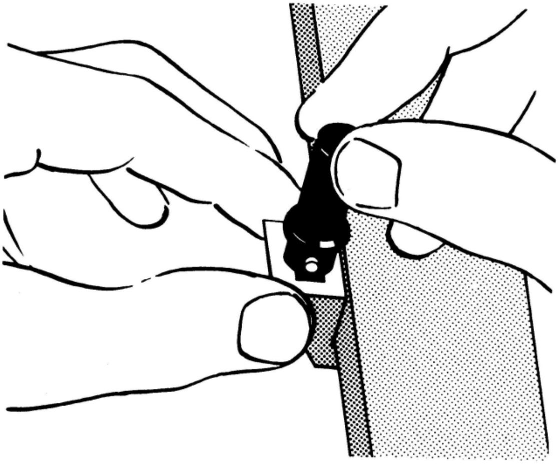


Fig.3-3. Pen location.

8. You are now ready to produce your first drawing on PLOTMATE.
9. From the keyboard enter **CHAIN "HELLO"** [RETURN].
10. A menu will appear on the screen as shown below:

```
                PLOTMATE
             LINEAR GRAPHICS
         DEMONSTRATION PROGRAMS

   INTRODUCTION
   CHARACTER SET
   ENTER DATA & PLOT
   VIBRATING STRING DISPLACEMENTS
```

RAINFALL CHART
FUNCTION KEYS REMINDER
MAP OF BRITAIN
EXIT

Press RETURN to select the first item on the menu which is an introduction to some of the powerful features of PLOTMATE.

Use the cursor Up and Down arrow keys to select other demonstration programs.

SECTION 4
USE OF FUNCTION KEYS

SECTION 4
USE OF FUNCTION KEYS

With the system disk in drive 0 simultaneously press shift and break keys to Auto-boot the disk. The PLOTMATE driver will be loaded into your BBC MICRO causing the pen to reset to the origin (0,0).

A menu will appear on the screen giving details of the function keys.

PLOTMATE

(C) LINEAR GRAPHICS LTD.
(USER PORT VERSION 1.0)

FUNCTION KEY	ACTION
f0	PLOTMATE ON
f1	PLOTMATE OFF
f2	CURSOR KEY CONTROL
f3	PEN HOME
f4	PEN UP
f5	PEN DOWN
f6	PEN PARK

Step by step demonstration of the use of the function keys.

Press f0 — Plotmate ON ready to be directed by any BBC graphics commands.

In order to view the graphics on screen.

Type **MODE 4** [Return].
The colour will disappear from the display, this is normal. Command indications in the menu are now offset to show PLOTMATE's status.

Type **HIMEM=&3400** [Return].

Type **DRAW 1000, 1000** [Return].

A line will be drawn both on the screen and on PLOTMATE.

Type **Move 0,0** [Return].

The pen will lift up and move to the origin.

Press f6 Pen will move to its parking position.

Press f2 Cursor key control
Move pen by using cursor keys on the BBC MICRO.
Press Space Bar to quit cursor key control.

Press f3 Pen will move to the origin at co-ordinate point 0,0. The origin is normally at the bottom left of the plotting area.

Type **DRAW 500,1000** [Return].
A line will be drawn, both on the screen and PLOTMATE

Press f4 Pen will lift up.

Press f5 Pen will go down for a short period of time.

Press f1 To disable PLOTMATE.

Type **DRAW 0,0** [Return].

A line will be drawn, only on the screen, back to the origin.

SECTION 5
EXAMPLE PROGRAMS

SECTION 5
EXAMPLE PROGRAMS

Your system disk and its backups will have no room for other file names. Backup (see Getting Started) your system disk using a blank formatted disk. Remove your system disk and type in *WIPE $.* [Return]
and delete all these files except !BOOT. This disk can now be used as your work disk with space of 9 file names.

Example 1. DRAWING CIRCLES AND ARCS

i) Press shift and break keys simultaneously to Auto-boot the disk.

ii) Type in the following program:

```
10 MODE 4
20 HIMEM=&3400
30 FOR T=0 to 2*PI STEP PI/30
40 X=500+SIN(T)*400
50 Y=500+COS(T)*400
60 IF T=0 THEN MOVE X,Y ELSE DRAW X,Y
70 NEXT
80 MOVE 0,0
90 END
```

iii) Now save this on disk, then type **RUN** [Return].

You should see a circle being drawn on the screen. If not then check your programming with the above code and make any necessary corrections, then try again.

Enable PLOTMATE by pressing f0 and then type **RUN** [Return].

This time both the screen and PLOTMATE will output the circle. The pen will return to the origin after plotting because of line 80.

Example 2 ADDING LABELS

i) Disable PLOTMATE (f1 key).

ii) Modify the test program in lesson 1 by adding the lines 90 to 130 below to read:

```
10 MODE 4
20 HIMEM=&3400
30 FOR T=0 TO 2*PI STEP PI/30
40 X=500+SIN(T)*400
50 Y=500+COS(T)*400
60 IF T=0 THEN MOVE X,Y ELSE DRAW X,Y
70 NEXT
80 MOVE 0,0
90 MOVE 100,950
100 VDU 5:REM JOIN TEXT CURSOR TO GRAPHICS CURSOR
110 PRINT "This is a circle"
120 VDU 4:REM SEPARATE TEXT CURSOR FROM GRAPHICS CURSOR
130 END
```

iii) Save the program on disk and then RUN. As before a circle will be drawn on the screen with the message "This is a circle" written at the top. The command VDU5 allows text to be written at the graphics cursor. VDU4 ends this capability. See the section on VDU commands in your BBC MICRO USER GUIDE for more details of this feature.

Enable PLOTMATE with f0.

Then type **RUN** [Return].

Example 3 USING OTHER GRAPHICS FUNCTIONS

i) Type in the following program:

```
10 REM This is a test
20 REM to evaluate the
30 REM listing function
40 END
```

ii) Enable PLOTMATE with f0

iii) Type **MOVE 0,700** [Return].

iv) Type in **LIST** do not press Return yet.

v) Press CTRL +E (VDU5 command). Now press Return. The listing will appear on PLOTMATE.

vi) Press CTRL+D (VDU4 command) to separate the text cursor from the graphics cursor and to prevent further printing.
NOTE: In many cases it is not necessary to disable PLOTMATE every time you want to alter code or load or save it. It is important however to stop text appearing at the graphics cursor with either CTRL+D or VDU4 command. Otherwise every instruction that appears on the screen will also appear on PLOTMATE.

vii) To alter the way in which text appears on PLOTMATE try typing this in:

```
VDU23,255,9,9,3,1,0,0,0,0
```

Then go back to step iv). Notice that the height, aspect and slant of each character has been altered by this command. For more details of this feature refer to the section on VDU 23,255 commands in section 6 of this manual.

Example 4 EXTENDED CHARACTER SET

i) Disable PLOTMATE

ii) Enter the following code:

```
  5 MODE 4
  6 HIMEM=&3400
 10 MOVE 50,50:REM THIS IS THE START POINT
 20 VDU23,255,6,8,2,2,0,0,0,0:REM CHARACTER
    ASPECT, ORIENTATION AND PLOTTING SPEED
    CHANGED
 30 VDU5:REM JOIN TEXT CURSOR TO GRAPHICS
    CURSOR
 40 FOR I= 32 TO 254
 50 IF I MOD16=15 PRINT
 60 PRINT CHR$(I);
 70 NEXT
 80 MOVE 0,0
 90 VDU4:REM SEPARATE TEXT CURSOR FROM
    GRAPHICS CURSOR
100 VDU23,255,0,0,0,0,0,2,0,0:REM Reset PLOTMATE
110 END
```

iii) Save the program.

iv) Enable PLOTMATE using f0

v) Type **RUN** [Return] and watch the output on PLOTMATE.

vi) The output on the screen does not follow the output on PLOTMATE. This is because all the characters have been rotated through 90 degrees and other symbols are available that are not part of the BBC MICRO standard set.

Example 5 INTERACTIVE USE OF PLOTMATE

i) At times it can be very convenient to operate PLOTMATE completely under program control, especially when it is used in an interactive mode. In the example shown below this facility allows inspection of the screen before plotting.

New commands:
***RUN L PLTMATE**

***RUN L ENABLE**
***RUN L DISABLE**

(Loads the control program from disk
into memory).
(Enable PLOTMATE).
(Disable PLOTMATE).

Now type this in:

```
 10 MODE 4
 20 HIMEM=&3400
 30 PROCMESH(50,50,1050,1000,20)
 40 INPUT "HARD COPY [Y/N]",A$
 50 IF A$="N" OR A$="n" THEN END
 60 REM LOAD IN PLOTMATE DRIVER
 70 *RUN L PLTMATE
 80 CLS
 90 PROCMESH(50,50,1050,1000,20)
100 *RUN L PENPARK
110 *RUN L DISABLE
120 END
130 DEF PROCMESH(X0,Y0,X1,Y1,N)
140 DY=(Y1-Y0)/N
150 FOR I=0 TO N
160 MOVE X0,Y0+I*DY
170 DRAW X1,Y0+I*DY
```

```
180 NEXT
190 DX=(X1-X0)/N
200 FOR I=0 TO N
210 MOVE X0+I*DX,Y0
220 DRAW X0+I*DX,Y1
230 NEXT
240 ENDPROC
```

ii) Save the program then type **RUN** [Return]. The output will appear first on the screen then on PLOTMATE.

iii) Try inserting these lines:

```
71 INPUT"New scaling factor [Y/N]",A$
72 IF A$="n" OR A$="N" GOTO 80
73 INPUT"Input new size 10-100(64=normal)",S%
74 IF S%¾10 S=10
75 IF S%÷100 S%=100
76 VDU23,255,0,0,0,0,0,0,0,S%
```

Before running this modified program the previous driver must be cleared from memory. This is achieved by pressing the Break key and then typing **OLD** [Return].

You will find that the plotout size will vary depending on what value you select for S%. For more details read about 23,255... in Section 6 of this manual.

SECTION 6
GRAPHICS COMMANDS
[ALPHABETICAL ORDER]

SECTION 6 GRAPHICS COMMANDS [ALPHABETICAL ORDER]

DRAW

This statement draws lines on PLOTMATE. The DRAW statement is followed by two numbers which are the X and Y co-ordinates of the end of the line. The line starting point can either be the end of the last line that was drawn or else a new point if the MOVE statement has been used before the statement DRAW.

The PLOTMATE is addressed as

X - AXIS 0 - 2854
Y - AXIS 0 - 1948

Each step measures 0.1016mm (1/250 in.) on PLOTMATE when the scaling parameter is set to 64. [See VDU 23,255,...]

The origin (position 0,0) is normally at the bottom left of the plotting area.

Example 1.

Auto-boot to load the PLOTMATE driver from the system disk.

Enter program as follows:

```
10 MODE 4
20 HIMEM=&3400
30 VDU 23,255,0,0,0,0,0,0,0,64:REM SET SCALING
   PARAMETER TO 64
40 MOVE 0,0: REM MOVE PEN TO ORIGIN
50 DRAW 1000,0
60 DRAW 1000,1000
70 DRAW 0,1000
80 DRAW 0,0
90 END
```

Press function key f0 to Enable PLOTMATE. Type **RUN** [Return].

This program directs PLOTMATE to draw a box starting at the origin. The sides of the box measure 101.6mm, which is 1000 steps of 0.1016mm length.

Section 6

Example 2.

Press function key f1 to disable PLOTMATE.
Type in **NEW** [Return] to clear the other basic program.
Enter the program as follows:

```
 10 MODE 4
 20 HIMEM = & 3400
 30 CLS
 40 VDU 23,255,0,0,0,0,0,0,64
 50 MOVE 0,0:REM MOVE PEN TO ORIGIN
 60 DRAW 1000,0
 70 DRAW 1000,1000
 80 DRAW 0,1000
 90 DRAW 0,0
100 MOVE 0,0: REM LIFT PEN UP
110 END
```

Enable PLOTMATE by pressing function key f0.

Type **RUN** [Return].

A box will appear on the monitor screen and on PLOTMATE with the pen finishing raised at the origin due to line 90.

Example 3.

Press function key f1 to disable PLOTMATE.
Type in the following program.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU 23,255,0,0,0,0,0,0,0,64
 40 MOVE 0,0:REM MOVE PEN TO ORIGIN
 50 DRAW 2854,0
 60 DRAW 2854,1948
 70 DRAW 0,1948
 80 DRAW 0,0
 90 MOVE 0,0: REM LIFT PEN UP
100 END
```

Enable PLOTMATE by pressing function key f0.

Type **RUN** [Return].

PLOTMATE will draw the rectangle that marks the boundary of the plotting area.

This time only two sides of the rectangle can be seen on the screen as the parameters that have been used in this example exceed the screen maximum parameters of X=1279 and Y=1023 (see VDU 23,255).

GCOL

This statement, when enabled, halts PLOTMATE operation and gives the user a prompt on the screen.

```
           CHANGE PEN
      PEN N (LOGICAL COLOUR)
    Press space bar to continue
```

The user must choose which of the six pen colours available should match the logical colour.

BBC Basic Logical Colours.	Pen Colours.
0 Black	Black
1 Red	Red
2 Green	Green
3 Yellow	Brown
4 Blue	Blue
5 Magenta	Violet
6 Cyan	

The first parameter following GCOL has no effect on the operation of PLOTMATE, the second decides which logical colour prompt is given to the user. Initially, GCOL does not interrupt PLOTMATE operation. It has to be enabled by setting SF=4 in the VDU 23,255...command in order to halt operation for pen changing.

Example 1.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU 23,255,0,0,0,0,0,4,0,0:REM ENABLE GCOL
 40 FOR X=1 TO 6
 50 GCOL 0,X
 60 MOVE X*100,600
 70 DRAW X*100,100
 80 NEXT X
 90 VDU 23,255,0,0,0,0,0,5,0,0:REM DISENABLE GCOL
100 MOVE 0,0
110 END
```

MOVE

This statement moves the pen on PLOTMATE to an absolute position without drawing a line. If the absolute position is beyond the plotting area the pen will stop on the boundary until a following instruction directs it back within the plotting area.

Example 1.

A MOVE command following a DRAW command without changing the parameters, has the effect of lifting the pen up.

```
10 MODE 4
20 HIMEM=&3400
30 MOVE 0,0
40 DRAW 100,100
50 MOVE 100,100
60 END
```

Example 2.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU 23,255,0,0,0,0,0,0,0,64:REM:SET SCALING
    PARAMETER
 40 MOVE 0,0:REM PEN TO ORIGIN
 50 REM
 60 MOVE 4000,0
 70 MOVE 4000,500
 80 MOVE 4000,0
 90 DRAW 0,0
100 MOVE 0,0
110 END
```

Line 90 brings the pen back into range.

Example 3.

Delete line 80 and run again.
Notice that the re-entry point is automatically calculated and a slanted line is drawn back to the origin.

Example 4.

```
10 MOVE 16383,0
20 MOVE 0,0
```

The parameter argument allowed in a Move Command is 16383. In this example there is a considerable time delay before the pen moves back to the origin, approximately 15 seconds, due to the calculations involved.

PLOT

PLOT K,X,Y is a multi-function graphics instruction which gives point, line or triangle drawing.

PLOT K,X,Y plots to the point X,Y in a manner determined by the value of K. The exact result on PLOTMATE may be different from the result on the screen. The effect of K for plotting on the screen and on PLOTMATE is as follows:

K	SCREEN	PLOTMATE
0	move relative to last point	move relative to last point
1	draw line relative in the current graphics foreground colour	draw line relative in the colour prompted by the last GCOL instruction.
2	draw line relative in the logical inverse colour	as 1 above
3	draw line relative in current graphics background colour	as 1 above
4	move to absolute position	move to absolute position
5	draw line absolute in the current graphics foreground colour	draw line absolute in the colour prompted by the last GCOL instruction
6	draw line absolute in logical inverse colour	as 5 above
7	draw line absolute in current background colour	as 5 above
8-15	as 0 to 7 but with last point in the line omitted in 'inverting action'-eg GCOL 4	as 0 to 7 above

continued

16-23	as 0 to 7 but with a dotted line	as 0 to 7 but with a dotted line pattern that is dependent on
24-31	as 0 to 7 with dotted line and without last point	the shading parameter VDU 23,255,0,0,0,0,0,0,SH,0
32-63	GRAPHICS EXTENSION ROM	does nothing
64-71	as 0 to 7 but a single point is plotted	as 0 to 7 but a single point is plotted
72-79	reserved	does nothing
80-87	as 0 to 7 but plot and fill a triangle between the co-ordinates given and the last two points visited	same, in addition, the fill pattern used is dependent on the SH parameter [see VDU 23,255,0,0,0,0,0,0,SH,0]
88-255	reserved for future expansion	does nothing

PRINT

Variables and anything enclosed in inverted commas will be drawn on PLOTMATE, if the text output has been previously enabled by the use of VDU5.

The style and position of the resultant characters are dependent on the parameter settings in force at the time. [See VDU 23,255].

Example 1

```
 10 MODE 4
 20 HIMEM=&3400
 30 MOVE 0,1000:REM MOVE PEN TOWARDS TOP OF THE
    PAGE READY FOR PRINTING
 40 VDU5
 50 PRINT 1,2
 60 PRINT 10,200
 70 PRINT;10;200
 80 PRINT
 90 A=42
100 PRINT "ANSWER";A
110 PRINT "ANSWER" A
120 PRINT "ANSWER", A
```

```
130 PRINT 1/2
140 PRINT 1/3
150 PRINT 3.3'2.25
160 VDU 4
170 MOVE 0,0
180 END
```

Example 2.

Delete line 30. PLOTMATE will not draw out characters because they are now out of range below the X axis.

The VDU screen however shows the characters appearing at the top due to its wrap-around function.

An extended character set is available to operators using the command **PRINT CHR$(n)** where n = 32-255.

The following program was used to produce the character set in Appendix 2 and is also available on the System Disk.

```
10 ON ERROR GOTO 965
20 REM
30 REM CHAR
40 REM
50 REM (C) Linear Graphics Ltd
60 REM
70 *RUN H. PLTMATE
410 MODE4
420 HT=6:WD=6:SIZE=6
430 DX=WD*SIZE*2
440 DY=HT*SIZE*2
450 VDU23,255,HT,WD,1,1,0,0,0,64
520 XO=200:YO=1800
540 MOVEXO,YO+12*WD
550 PROCHAR(" THE PLOTMATE CHARACTER SET")
555 MOVEXO+200,YO-100+12*WD:PROCHAR(" Lower
    nybble")
557 MOVEXO-190,YO-300+12*WD
561 DATA U,p,p,e,r," ",n,y,b,b,l,e
562 RESTORE 561
563 FOR 1=1 TO 12
564 READ A$
565 A$=A$+CHR$(13)
566 PROCHAR(A$)
567 NEXT
```

```
570 YO=YO-200:XS=XO-DX:YS=YO
580 YF=YS-14*DY
590 FORI=0 TO 7
600 XS=XS+DX
610 MOVEXS,YS
620 DRAWXS,YF
630 XS=XS+DX
640 MOVEXS,YF
650 DRAWXS,YS
660 NEXT
670 MOVEXS+DX,YF
680 DRAWXS +DX,YS
690 XS=XO:YS=YO+DY
700 XF=XS+16*DX
710 FORI=0 TO 7
720 YS=YS-DY
730 MOVEXS,YS
740 DRAWXF,YS
750 YS=YS-DY
760 IF I=7 GOTO790
770 MOVEXF,YS
780 DRAWXS,YS
790 NEXT
800 XO=XO+DX/4
810 MOVEXO,YO+12*WD
820 PROCHAR("0 1 2 3 4 5 6 7 8 9 A B C D E F")
830 X=XO-DX:Y=YO-DY
840 MOVEX,Y+12*WD
845 RESTORE 850
850 DATA 2,3,4,5,6,7,8,9,A,B,C,D,E,F
860 FORI=2 TO 15
870 READ A$:A$=A$+CHR$(13)
880 PROCHAR(A$)
890 NEXT
899 XO=XO-DX
900 MOVEXO+DX/2,YO-DY+12*WD
910 FORI=32 TO 255
920 J=(I-16) MOD 16
930 IF J=0 AND I<>32 PROCHAR(CHR$(13))
940 A$=" "+CHR$(I)
950 PROCHAR(A$)
960 NEXT
965 VDU4
970 *RUN H.PENPARK
```

```
975 *RUN H.DISABLE
980 CHAIN"HELLO"
990 END
1270 DEF PROCDRAW(X,Y)
1290 DRAW X,Y
1310 ENDPROC
1320 DEF PROCMOVE(X,Y)
1340 MOVE X,Y
1360 ENDPROC
1400 DEF PROCHAR (A$)
1410 VDU5
1420 PRINTA$;
1430 VDU4
1440 ENDPROC
```

VDU CODE SUMMARY

	SCREEN	PLOTMATE
0	Meaning as per table	*
1	P378 BBC MICRO USER GUIDE	*
2		*
3		*
4		no text output at graphics cursor position.
5		write text at graphics cursor position.
6		*
7		*
8		backspace if text output enabled with VDU5.
9		*
10		*
11		*
12		*
13		line feed and carriage return if text output enabled with VDU5.
14		*
15		*

16	*
17	*
18	equivalent to GCOL action.
19	*
20	*
21	*
22	when PLOTMATE enabled, MODE selection restricted.
23	no effect except when followed by 255.
24	block fill [see further details]
25	PLOT K,X,Y.
26	*
27	*
28	*
29	define graphics origin.
30	*
31	*
127	*
	* indicates VDU code recognised but no action taken.

The same effect may be achieved by pressing CTRL and the relevant key set out in the table below

VDU	CTRL	
4	D	TEXT OFF
5	E	TEXT ON

VDU CODES OPERATION

VDU 4

This code stops text output appearing on PLOTMATE.

The effect on the screen is to cause text to be written at the text cursor position. There is no equivalent of the text cursor on PLOTMATE.

VDU 5

This code allows text to be written at the position of the graphics cursor both on the screen and on PLOTMATE. On PLOTMATE the position of the graphics cursor is the same as the pen position.

If an attempt is made to print characters with the pen position near the boundary PLOTMATE may be instructed to go out of range depending on the values of the parameters affecting character size and orientation.

VDU 8

This code is equivalent to BACKSPACE on PLOTMATE and moves the graphics cursor one space to the left, if text has been enabled by a VDU5. Unlike the screen, however, if the graphics cursor is at the start of a line, it does not move to the end of the previous line, instead it backspaces further along the current line.

VDU 13

This code simulates a line feed and carriage return on PLOTMATE if text has been enabled by a VDU5. The orientation, height and width of the text are automatically taken into account.

The pen moves to a left hand margin, the position of which is set by the last move command.

VDU 18

This code is equivalent to GCOL in BASIC.

VDU 22

When PLOTMATE is DISABLED this code is used to change MODE, without changing HIMEM. When PLOTMATE is enabled only MODES 4 and 7 are available.

[See section 7 for further explanation]

VDU 23,255, ... PLOTMATE PARAMETERS

This code is normally used to re-program characters for display on the screen. On PLOTMATE however, VDU 23 has no effect except where followed by 255.

VDU 23,255 followed by eight bytes is used to specify parameters unique to PLOTMATE.

The command is shown in more detail using the initial letters to specify the parameters.

VDU 23,255,CH,CW,CS,CO,PS,SF,SH,SC

BYTE			VALUE
1	CH	Character height	1-255
2	CW	Character width	1-255
3	CS	Character slant	1-4

4	CO	Character orientation	1-4
5	PS	Pen speed	1-10
6	SF	Special function	1-9
7	SH	shading and broken line pattern	1-255
8	SC	Scale	1-255

Initially the parameters are automatically set to the following default values shown in the table below:

BYTE			VALUE
1	CH	Character height	3
2	CW	Character width	5
3	CS	Character slant	1
4	CO	Character orientation	1
5	PS	Pen speed	10
6	SF	Special function	7
7	SH	Shading and broken line pattern	1
8	SC	Scale	120

The parameters may be changed under program control by changing the value in the appropriate byte. A zero placed in a byte maintains the current parameter value.

CHARACTER HEIGHT

VDU 23,255,CH,-,-,-,-,-,-,-

This parameter controls the height of the characters. CH can be set between 1-255. The initial default value is 3.

The characters are fitted within a lattice of height 12 elements and of width 6 elements.

The vertical height of each element is altered by CH, the character height parameter, and also by SC the global scaling parameter.

The height of the lattice equals (12×CH×SC×0.1016)/64 mm.

The height of the lattice, with the default parameter values set is equal to (12×3×120×0.1016)/64 mm,
which equals 6.858mm.

Capital letters measure 6 elements high giving rise to a default character height of 3.43mm.

Example 1.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU23,255,0,0,0,0,0,2,0,0:REM RESET PARAMETERS
 40 MOVE 0,1000
 50 VDU5 : REM ENABLE CHARACTER PRINTING
 60 PRINT “CHARACTER HEIGHT = 3.43mm”
 70 VDU4 : REM DISABLE CHARACTER PRINTING
 80 END
```

Example 2.

```
 10 MODE 7
 20 HIMEM=&3400
 30 VDU23,255,0,0,0,0,0,2,0,0:REM RESET PARAMETERS
 40 INPUT “CHARACTER HEIGHT”;CH
 50 INPUT “SCALING PARAMETER”;SC
 60 CLS
 70 PRINT “CHARACTER HEIGHT =”;CH
 80 PRINT “SCALING PARAMETER =”;SC
 90 INPUT “Do you want to change parameters (Y / N)”,A$
100 If A$=“Y” or A$=“y” GO TO 10
110 VDU 23,255,CH,0,0,0,0,0,0,SC:REM
    SET CHARACTER HEIGHT AND SCALING PARAMETERS
115 VDU 5
120 MOVE 10,1000
130 PRINT “CHARACTER HEIGHT = ”, 6*CH*SC*.1016/64
    “mm”
135 VDU 4
140 END
```

CHARACTER WIDTH

VDU 23,255,-,CW,-,-,-,-,-,-

This parameter controls the width of the characters. The width of the character is altered by CW the character width parameter and by the scaling parameter.

CW can be set between 1-255. The initial default value is 5.

The width of the character lattice is given by the expression (6×CW×SC×0.1016)/64 mm.

Character width with the default parameters = 5.715mm.

Example 1.

```
10 MODE 7
20 HIMEM=&3400
30 VDU23,255,0,0,0,0,0,2,0,0
40 INPUT "Character height",CH
50 INPUT "Character width", CW
60 INPUT "Scaling parameter",SC
70 VDU 23,255,CH,CW,0,0,0,0,0,SC
80 VDU5
90 MOVE 0,1000
100 PRINT "A"
110 VDU4
120 END
```

CHARACTER SLANT

VDU 23,255,-,-,CS,-,-,-,-,-

This parameter controls the slant of the character. The default value of the parameter is 1 which gives upright text. A value between 1 and 4 may be selected.

1 Upright
2 Slant angle 14 degrees
3 Slant angle 25.5 degrees
4 Slant angle 45 degrees

Example 1.

```
10 MODE 4
20 HIMEM=&3400
30 VDU23,255,0,0,0,0,0,2,0
40 VDU5
50 MOVE1000,1000
60 FOR C=1 TO 4
70 VDU23,255,0,0,C,0,0,0,0,0,
80 PRINT "A"
90 NEXT C
100 VDU4
110 END
```

CHARACTER ORIENTATION

VDU 23,255,-,-,-,CO,-,-,-,-

This parameter controls the text orientation. Initially the value is set at

1. In this case the text will be printed in the positive X direction, left to right. A value of 2 will cause text to appear in the positive Y direction. Values 3 and 4 will print text upside down in the negative X and Y directions respectively.

Example 1.

```
10 MODE 4
20 HIMEM=&3400
30 VDU23,255,0,0,0,0,0,2,0,0
40 VDU5
50 MOVE500,500
60 FOR C=1 TO 4
70 VDU23,255,0,0,0,C,0,0,0,0
80 PRINT "PLOTMATE"
90 NEXT C
100 VDU4
110 END
```

PEN SPEED

VDU 23,255,-,-,-,-,PS,-,-,-

This parameter controls the speed at which the pen plots. The value 1 to 10 corresponds to a speed range of 1 to 11.25 cm/sec axially, with equal increments in between. The initial default valve is 10.

The pen always moves at the fastest speed when raised and when performing filling operations.

SPECIAL FUNCTIONS

VDU 23,255,-,-,-,-,-,SF,-,-

This parameter operates a number of special functions that can be called from a program. The initial default value is 7.

SF=0..... No change to special functions selected.
1..... Re-origin plotter at present PLOTMATE pen position. Equivalent to VDU 29,X;Y; where X,Y equal present pen position.
2.....Reset PLOTMATE parameters to default values.
3.....Re-origin and reset PLOTMATE parameters to default values.
4.....Enable use of GCOL (VDU 18) function.
5.....Disable use of GCOL function.
6.....Subsequent plotting will be drawn upside down.

7.....Subsequent plotting will be drawn correct way up.
8.....Enable use of Block fill with VDU24,XMIN;YMIN;
XMAX:YMAX:
9.....Disable block fill.
÷9.....No effect.

SF=6 Further Explanation.
Re-initialise PLOTMATE and configure for upside down plotting. Pen undergoes its re-start sequence then moves to the top right hand corner of the plotting area. Cursor keys now operate in reverse and all plotting on PLOTMATE will appear relative to the top right hand corner being the origin. PLOTMATE parameters are reset as for SF=3. Upside down plotting may be ended by either setting SF=7 or re-initialising PLOTMATE by booting up the system disk or by ***RUN H.PLOTMATE** or ***RUN L.PLOTMATE.**

SF=7 Further explanation.
Re-initialise PLOTMATE and configure for correct way up plotting.
PLOTMATE parameters are reset as for SF=3

SHADING PARAMETER

VDU 23,255,-,-,-,-,-,-,SH,-

The Shading Parameter alters the type of shading pattern that is used in triangle and block filling procedures and also alters the type of broken line pattern in dotted line procedures.

Its value ranges from 0-255.
SH equals L plus M where L is a value 0-15 that determines the shading pattern and M is a value 0 to 240 in multiples of 16 that determines the broken line pattern. The table below shows the effect of different values of L and M.

L	SHADING
0	No change
1	Default shading (solid fill)
2,3	Half fill
4 to 15	Less dense shading

M	LINE PATTERN
16×0 16×1 to 16×15	Default dotted line pattern Other dotted line patterns.

SCALING

VDU 23,255,-,-,-,-,-,-,-,SC

SC has a value from 1 - 255. The default value of SC is 120.

A value of 64 sets the scale such that a plotting increment on the screen corresponds to a PLOTMATE unit (0.1016mm or 1/250 in.).

More generally a BBC plotting increment or screen co-ordinate corresponds to (SC×0.1016)/64mm on PLOTMATE.

A change of scale also effects the max. X Y co-ordinates on PLOTMATE

X MAX = (64 × 2854)/SC

Y MAX = (64 × 1948)/SC

Therefore if SC = 128 the entire plot is doubled so that

X MAX = 1427
Y MAX = 974

and 1 BBC plotting increment corresponds to 2 basic PLOTMATE units of 0.1016mm (1/250in.) which equals 0.2032mm (1/125in.).

Example 1.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU 23,255,0,0,0,0,0,0,0,64:REM SCALE 64
 40 MOVE0,0:REM MOVE TO ORIGIN
 50 DRAW 2854,0
 60 DRAW 2854, 1948
 70 DRAW 0,1948
 80 DRAW 0,0
 90 VDU 23,255,0,0,0,0,0,0,0,128:REM SCALE 128
100 DRAW 1427,0
110 DRAW 1427,974
120 DRAW 0,974
130 MOVE 0,0
140 END
```

Example 2.

If the default value of SC is used (SC = 120).

X MAX =(64 × 2854)/120 = 1522

Y MAX =(64 × 1948)/120 = 1039

Maximum parameters of X=1522 and Y=1039 may be used to address the whole of the plotting area on PLOTMATE.

Referring to the BBC MICRO USERS GUIDE, page 56 the screen X co-ordinate range of 0-1279 and Y co-ordinate range of 0-1023 addresses most of the available plotting area on the PLOTMATE when SC=120. Margins of 16 BBC plotting units at the top of the plotting area and 243 BBC plotting units on the right are therefore created.

```
 10 MODE 4
 20 HIMEM=&3400
 30 VDU 23,255,0,0,0,0,0,0,0,120
 40 MOVE 0,1023:REM MAX Y ARGUMENT SCREEN
 50 DRAW 1279,1023
 60 DRAW 1279,0
 70 MOVE 0,1039
 80 DRAW 1522,1039
 90 DRAW 1522,0
100 MOVE 0,0
110 END
```

VDU 24

This command gives a block fill facility on PLOTMATE. The co-ordinates of the block are given by the four parameters following VDU24.

The syntax is as follows: VDU24,XMIN;YMIN;XMAX;YMAX;

Example 1.

```
10 MODE 4
20 HIMEM=&3400
30 VDU 23,255,0,0,0,0,0,8,0,0
40 VDU 24,500;500;600;600;
50 GCOL 0,129:REM CHANGE GRAPHICS BACKGROUND
   COLOUR
60 CLG
70 VDU 23,255,0,0,0,0,0,9,0,0:REM DISABLE BLOCK FILL
80 END
```

Example 2.

Change line 40 to **VDU24,650;650;750;750;**
Change line 30 to **VDU23,255,0,0,0,0,0,8,13,0**

A second box will be drawn but without a solid fill pattern.

Do not forget the trailing semi-colons particularly after the last parameter.

VDU 29

This code is used to move the graphics origin on the screen and on PLOTMATE. The statement VDU 29 is followed by two numbers giving the X and Y co-ordinates of the new origin.

VDU 29,640;512; moves the origin to the centre of the screen.

The corresponding position of the origin on PLOTMATE will not necessarily be at the centre of the plotting area but will be at a position determined by the setting of the scaling parameter.

[See DRAW and VDU 23,255,-----SC for further explanation]

Example 1.

```
   10 MODE 4
   HIMEM=&3400
   30 PROCSHAPE(16,100,250,0,0)
   40 PROCSHAPE(16,100,250,500,500)
    VDU29,0;0;
   60 END
   70 DEF PROCSHAPE(N,S,R,X,Y)
   80 VDU29,X;Y;
  90 FOR I=0 to N
  100 ANGLE=2* PI* I/N
  110 MOVE S* COS(ANGLE),S* SIN(ANGLE)
  120 DRAW R* COS(ANGLE),R* SIN(ANGLE)
  130 NEXT
  140 MOVE 0,0
  150 ENDPROC
```

SECTION 7
ADVANCED PROGRAMMING

Section 7

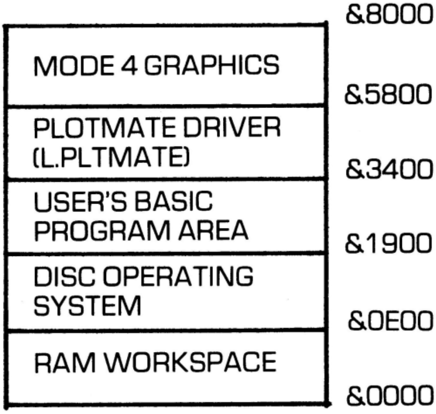
SECTION 7
ADVANCED PROGRAMMING

1) Memory Usage

There are two versions of the PLOTMATE driver code on your system disk. The version in the directory L.* is designed to be located in memory just below the MODE 4 Graphics area so that

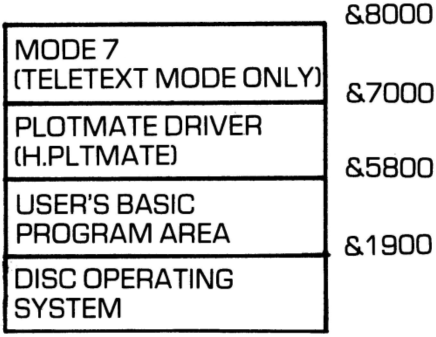
BBC MICRO MODEL B MEMORY (HEX)

BBC MICRO ROM



The version in the directory H.* is designed to be located in the MODE 4 Graphics memory space, as shown below:

BBC MICRO ROM


&8000
MODE 7 (TELETEXT MODE ONLY)
&7000
PLOTMATE DRIVER (H.PLTMATE)
&5800
USER'S BASIC PROGRAM AREA
&1900
DISC OPERATING SYSTEM

This means that the H (Higher memory) version does not allow simultaneous screen and PLOTMATE graphics plotting. The L (Lower memory) version has the penalty that 9K of the user's BASIC program area is being used by the driver. However, in this case, simultaneous plotting on the screen and PLOTMATE is possible.

Please note that zero page locations &70 to &75 are also used bythe driver code.

2) HIMEM

Before loading the H version, MODE 7 must be selected. Once this version is loaded, program calls using MODE 0,1,2,4, and 5 present no problem as HIMEM is automatically set lower than the PLOTMATE driver so there is no memory conflict. If MODE 7 is called with the H version, HIMEM will be set to &7C00 which is above that of the PLOTMATE driver. No difficulties will occur unless the dynamic variable storage area strays above &5800 or a large number of arguments are used in procedure calls. To avoid this situation it is advisable to redefine

```
   HIMEN = &5800
```

each time MODE 7 is called. Alternatively use VDU 22,7 which changes MODE but not HIMEM.

When using the L version, it is always advisable to redefine

```
   HIMEM = &3400
```

after a MODE call to ensure that the driver will not be corrupted.

3) Disk boot up

The system disk boot program !BOOT is executed when the user presses SHIFT-BREAK. This program is the single line instruction

```
   *EXEC "L.BOOT1"
```

This leads to installing the L. version of PLOTMATE. To change this to the H. version type this in with your system disk in drive 0.

```
   *ACCESS! BOOT
   *BUILD "!BOOT" [Return]
   *EXEC "H.BOOT1" [Return]
[ESCAPE]
```

Your system disk now will boot up with the H version of PLOTMATE.

4) Second Processor

When using the second processor, the H and L version of the PLOTMATE driver are always installed into the I/O processor, leaving the entire second processor free for the user's programming requirements.

There are two minor changes to make to the system programs so that the function keys may operate properly with the second processor connected.

Change the !BOOT file to read

```
   *EXEC"L.BOOT2" or
   *EXEC"H.BOOT2"
```

depending on which version is required.

This alternative is entirely functional without a second processor connected, however, system disk access is required everytime a function key is pressed.

5) Using PLOTMATE without disk booting

The commands

```
   *EXEC"L.BOOT1"
   *EXEC"L.BOOT2"
   *EXEC"H.BOOT1"
   *EXEC"H.BOOT2"
```

have exactly the same effect as booting the system disk.

6) Using PLOTMATE within a program.

In the case where the user wants to plot on the screen, decide whether a hard copy is required, the ability to load the driver in and replot is a useful facility.

To bring PLOTMATE into memory, type this in

```
   10 MODE 7
   20 HIMEM=&5800
30 *RUN H.PLTMATE
OR
   10 MODE 4 (or MODE 7)
   20 HIMEM=&3400
   30 *RUN L.PLTMATE
```

In each case the PLOTMATE pen will go through its usual reinitialisation sequence. Other commands of use to the programmer

*RUN H.ENABLE (Enable PLOTMATE)
*RUN H.DISABLE (Disable PLOTMATE)
*RUN H.CURSOR (Allow cursor keys to control pen position)
*RUN H.PENHOME (Pen will move raised to the home position)
*RUN H.PENUP (Pen will be raised if not already)
*RUN H. PENDOWN (Pen will be lowered momentarily)
*RUN H.PENPARK (Pen will move raised to the park position)

Note: There are L. versions available on the system disk of these commands.

Example 1.

```
 10 MODE 4
 20 PROCPROGRAM
 30 PRINT TAB(0,0);"Hard copy? (Y/N)";
 40 A$=GET$
 50 IF A$="N" END
 60 MODE 7
 70 HIMEM=&5800
 80 *RUN H.PLTMATE
 90 PROCPROGRAM
100 *RUN H.PENPARK
110 *RUN H.DISABLE
120 END
130 DEF PROCPROGRAM
140 MOVE 100,100
150 DRAW 500,100
160 DRAW 500,500
170 DRAW 100,500
180 DRAW 100,100
190 MOVE 100,100
200 ENDPROC
```

Example 2.

Change line 60 and 70 above to read

```
60 MODE 4
70 HIMEM=&3400
```

and change the H in lines 80, 100 and 110 to L for the lower version.

Example 3.

```
 10 MODE 4
 20 HIMEM=&3400
 30 *RUN L.PLTMATE
 40 *RUN L.DISABLE
 50 CLS
 60 PROCPROGRAM
 70 PRINT TAB(0,0);“Hard Copy? (Y/N)”;
 80 A$=GET$
 90 IF A$=“N” END
100 *RUN L.ENABLE
110 CLS
120 PROCPROGRAM
130 *RUN L.PENPARK
140 *RUN L.DISABLE
150 END
160 DEF PROCPROGRAM
170 MOVE 100,100
180 DRAW 500,100
190 DRAW 500,500
200 DRAW 100,500
210 DRAW 100,100
220 MOVE 100,100
230 END PROC
```

In this example the driver is “resident” throughout and is enabled and disabled as required.

7) Using PLOTMATE within a program and without screen prompts. (Not compatible with a second processor).

It is possible to access the driver routines directly and not rely on *RUN commands.
For instance

```
A% = 3 : X% = 1 : CALL &6020
```

has the same effect as

```
*RUN H.ENABLE
```

If X% = 0 there is no screen display. To call routines without the screen display

```
A%=11 : X%=0 : CALL &6020    (reinitialise PLOTMATE)
A%=  3 : X%=0 : CALL &6020   (Enable PLOTMATE)
A%=  4 : X%=0 : CALL &6020   (Disable PLOTMATE)
A%=  2 : X%=0 : CALL &6020   (Allow cursor keys to
                              control pen position)
A%=16 : X%=0 : CALL &6020    (Pen home)
A%=  6 : X%=0 : CALL &6020   (Pen up)
A%=  7 : X%=0 : CALL &6020   (Pen down)
A%=17 : X%=0 : CALL &6020    (Pen park)
```

All other values of A% are reserved and using them could lead to unpredictable results. Setting X%=1 in each case would bring back the screen display. The L - version is exactly the same except that the address &6020 is replaced by &3C20.

Before using any of these calls in a program, the PLOTMATE control program must be loaded into memory, otherwise an error message will be generated.

8) Calling PLOTMATE driver routines within machine code programs

The assembly language version of the instructions in the previous section are:

H - Version

```
LDA #11: LDX #0: JSR&6020   (Reinitialise PLOTMATE)
LDA #3:LDX #0: JSR&6020     (Enable PLOTMATE)
LDA #4: LDX #0: JSR&6020    (Disable PLOTMATE)
LDA #2: LDX #0: JSR&6020    (Allow cursor keys to control
                             pen position)
LDA #16: LDX #0: JSR&6020   (Pen home)
LDA #6: LDX #0: JSR&6020    (Pen up)
LDA #7: LDX #0: JSR&6020    (Pen down)
LDA #17: LDX #0: JSR&6020   (Pen park)
```

Substituting LDX # for LDX #0 will result in the screen display being shown. The L-version is exactly the same except that the address &6020 is replaced by &3C20.

Note: If a second processor is used, these addresses are in the second processor and **NOT** the I/O processor where the PLOTMATE driver always resides. It is still possible using the OSWORD routine to communicate across the TUBE in this case. Refer to the second processor user manual for more details.

SECTION 8
PROGRAMMING HINTS

SECTION 8
PROGRAMMING HINTS

1) Lack of memory

A frequent problem encountered with large programs is that they overflow into the PLOTMATE driver area. If HIMEM is correctly set by the user to

HIMEM = &3400

when using the L version of the PLOTMATE driver, the BBC operating system will inform the user that there is NO ROOM available when the BASIC Program and its stack of dynamic variables exceed that allocated by HIMEM. If HIMEM is not set to this value, portions of the PLOTMATE driver code could be overwritten during operation leading to unpredictable results.

In the case where large programs are required to run, as in the case of many commercial packages, it is recommended that the H version of the PLOTMATE driver code be used with

HIMEM = &5800

Before loading and running your graphics program

***EXEC "H.BOOT1"** [Return]

This will load in the H version of the PLOTMATE driver code and set MODE 7 and HIMEM = &5800. Popular modes for graphics are MODE 4 and MODE 5. If these are called within programs, HIMEM is automatically set to &5800.

When PLOTMATE is enabled, programs that call MODE will result in either MODE 4 or MODE 7 being called. Users with second processors need not be concerned with memory conflicts between their BASIC program which resides in the second processor memory and the PLOTMATE driver code which resides in the I/O processor, consequently HIMEM may be reset to the value determined by BASIC or HIBASIC.

2) Direct screen addressing

PLOTMATE gets its data by rerouting commands in the OSWRCH channel then sending them on afterwards into the BBC MICRO operating system. If a programmer bypasses OSWRCH by POKING data onto the VDU screen directly, PLOTMATE will not pick up the data.

PLOTMATE

SECTION 9
TROUBLESHOOTING

Section 9

SECTION 9
TROUBLESHOOTING

Symptoms	Probable cause and action required
PLOTMATE pen will not move after the system disk is booted up.	Mains not switched on. Connection lead not fully pressed home into sockets. Power fuse blown. Replace fuse (500ma). If it blows again, transformer power supply is faulty. Refer unit to service centre. If an additional board has been purchased for the BBC MICRO which utilises pins on the B side of the 6522 user port (eg SIDEWAYS RAM) PLOTMATE will not operate through this port. A printer port version is available from LGL to get round this problem.
PLOTMATE pen vibrates when system disk is booted up.	Connection lead either faulty or not fully socketed. Faulty circuit board or motor. Refer to service centre.
Pen does not reset correctly after system boot up.	Connection lead either faulty or not fully socketed.

continued

	Faulty circuit board or micro switch. Refer to service centre.
Plotout appears to have uncalled for shifts in x and y values.	Check x and y bearing rods for obstructions. Toothed belt or motor fault. Refer to service centre.
Pen is raised and lowered during operation but fails to draw on the paper.	Pen empty. Pen actuator misaligned. Refer to service centre.
Part of a plotout gets drawn but the program then hangs up.	The BASIC program has overflowed into the PLOTMATE driver area of memory. HIMEM has been incorrectly set. Programming error. A common cause being an incorrect number of parameters in a PLOT or VDU command. (Press BREAK and correct programming error). VDU screen in scrolling mode (caused by CTRL N) press SHIFT to continue.

continued

	Both H and L drivers have been loaded into memory leading to a conflict.
Draws random unpredictable lines and characters.	Programming error. Usually due to incorrect number of parameters or using commas instead of semi-colons as in VDU 29 and VDU 24 commands.
Plotout is complete but wrong size or offset.	Size and origin positions are retained by PLOTMATE until the driver is rebooted or the parameters are changed. It is advisable to re-initialise parameters at the start of each program if the driver is not to be reloaded.

APPENDIX 1

GRAPHICS COMMANDS TABLE

DRAW X,Y	Draw Absolute
GCOL N,M	Change Pen
MOVE X,Y	Move Absolute
PLOT K,X,Y	Point, Line or Triangle Drawing
PRINT	Print Function
VDU 4	No Text Output
VDU 5	Write Text
VDU 8	Backspace
VDU13	Line Feed and Carriage Return
VDU18	GCOL
VDU23,255	PLOTMATE special Parameters
VDU24	Block Fill
VDU25	Plot K,X,Y
VDU29 X;Y;	Define Graphics Origin

PLOTMATE

APPENDIX 2

! " # $ % & ' ( ) * + , - . /

0 1 2 3 4 5 6 7 8 9 : ; < = > ?

@ A B C D E F G H I J K L M N O

P Q R S T U V W X Y Z [\ ] ^ _

£ a b c d e f g h i j k l m n o

p q r s t u v w x y z { | } ~

α β γ δ ε ζ η ϑ ι κ λ μ ν ξ

ο π ρ σ τ υ φ χ ψ ω Γ Δ Ε Θ Λ Ξ

Π Σ ϒ Φ Ψ Ω θ ς ϕ ϰ ∂ ℓ Ø ø ¢ ℝ

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SCALING PARAMETER EFFECT

SC	Xmax	Ymax	Step(mm)	Step(in.)
8.	22832.	15584.	0.0127	0.0005
16.	11416.	7792.	0.0254	0.0010
24.	7611.	5195.	0.0381	0.0015
32.	5708.	3896.	0.0508	0.0020
40.	4566.	3117.	0.0635	0.0025
48.	3805.	2597.	0.0762	0.0030
56.	3262.	2226.	0.0889	0.0035
64.	2854.	1948.	0.1016	0.0040
72.	2537.	1732.	0.1143	0.0045
80.	2283.	1558.	0.1270	0.0050
88.	2076.	1417.	0.1397	0.0055
96.	1903.	1299.	0.1524	0.0060
104.	1756.	1199.	0.1651	0.0065
112.	1631.	1113.	0.1778	0.0070
120.	1522.	1039.	0.1905	0.0075
128.	1427.	974.	0.2032	0.0080
136.	1343.	917.	0.2159	0.0085
144.	1268.	866.	0.2286	0.0090
152.	1202.	820.	0.2413	0.0095
160.	1142.	779.	0.2540	0.0100
168.	1087.	742.	0.2667	0.0105
176.	1038.	708.	0.2794	0.0110
184.	993.	678.	0.2921	0.0115
192.	951.	649.	0.3048	0.0120
200.	913.	623.	0.3175	0.0125
208.	878.	599.	0.3302	0.0130
216.	846.	577.	0.3429	0.0135
224.	815.	557.	0.3556	0.0140
232.	787.	537.	0.3683	0.0145
240.	761.	519.	0.3810	0.0150
248.	737.	503.	0.3937	0.0155