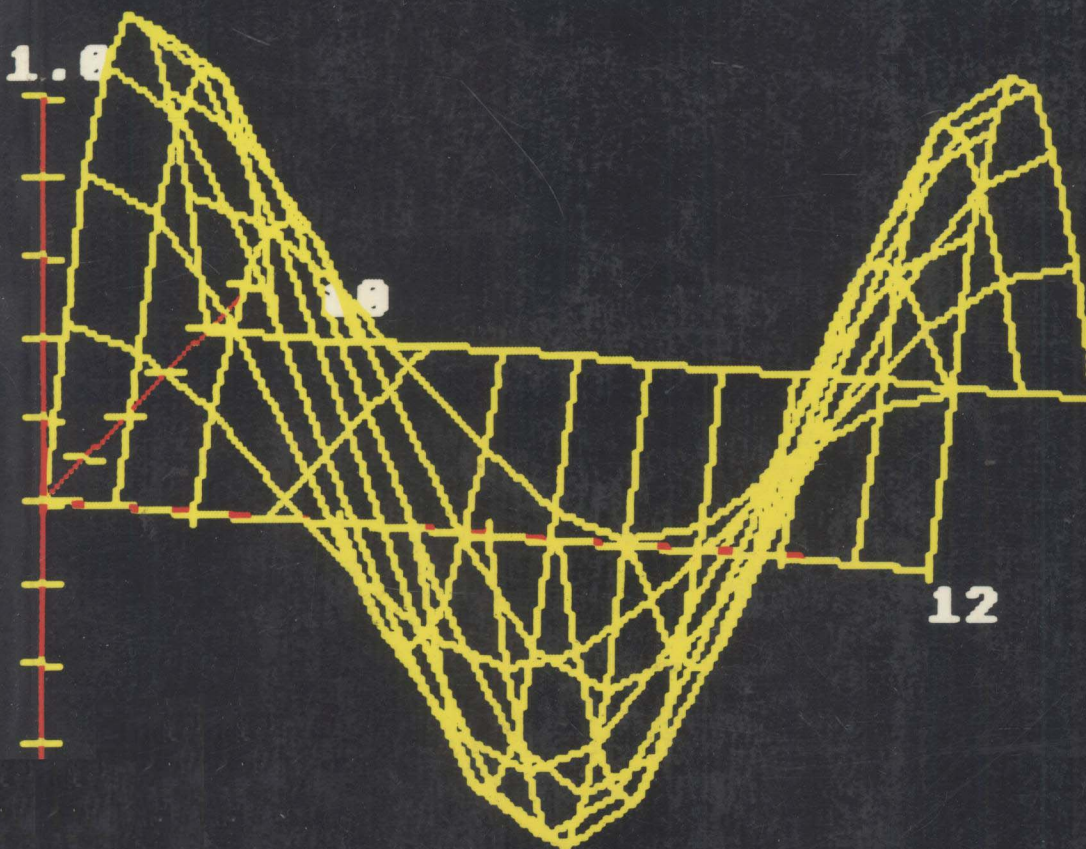


Graphs and Charts

on the BBC Microcomputer

ROBERT D. HARDING



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ACORN **SOFT**

Acknowledgement

This book and the Graphs and Charts Pack software are based on the graphics package written by the author for the project 'Computer Aided Teaching of Applied Mathematics' (CATAM) at the Department of Applied Mathematics, Cambridge University, England.

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FIRST EDITION

ISBN 0 907876 04 8

Published by:

Acornsoft Limited
4a Market Hill
Cambridge
CB2 3NJ
England

A cassette of the software described in this book is available from Acornsoft.

Summary of Loading Procedures

L3-BAR	L1-BAR (L1-2D)
L3-GRA	L1-SEC (L1-2D)
L3-CUR	L2-HIS (L1-2D)
L3-PIE	L2-PIE (L1-2D)
L3-CV3D	L2-XY (L1-2D)
L3-CO2D	L2-XYZ (L1-3D)
L3-CO3D	L2-C2 (L1-2D)
L3-SURF	L2-C3 (L1-3D)
L1-2D	L2-SURF (L1-3D)
L1-3D	L2-STER (L1-3D)
L1-CNTR (L1-2D or -3D)	L2-STSU (L1-3D)
L1-BOX (L1-2D or -3D)	

Level 3 programs (prefixed L3-) can be loaded and run in the usual way. For example, to load and run the program L3-BAR, enter

```
CHAIN "L3-BAR"
```

Press RETURN, and then press PLAY on the cassette recorder.

Programs in Levels 1 and 2 are designed to be incorporated into your own programs, and so are in EXEC format. All Level 2 programs and some Level 1 programs require either L1-2D or L1-3D, the fundamental plotting programs, to be loaded also - the appropriate program name appears in parentheses next to these program names in the listing above.

To load L2-HIS, for example, you would enter

```
*EXEC "L2-HIS"
```

and press RETURN. Press the PLAY button on the cassette recorder. The program is listed on the screen during loading. Once loaded, enter

```
*EXEC "L1-2D"
```

and press RETURN. Press PLAY on the cassette recorder and wait for this program to be loaded in also.

At this point you should refer to the appropriate chapter for details of running the program.

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1 Introduction

1.1 The Graphs and Charts Pack

This book describes a system of program modules that can be used to create a wide range of graphs and charts in a professional way for presenting data supplied by the user. The program modules will be referred to as the Graphs and Charts Pack, and have been designed to run on the BBC Microcomputer Model B. A listing of the component modules is given at the end of this book. A cassette is also available.

The Graphs and Charts Pack makes full use of the powerful and versatile graphics facilities of the BBC Microcomputer. It is nevertheless constructed in such a way that relative newcomers to computers and programming will be able to use it with ease.

You can get a general impression of what you can do with the Graphs and Charts Pack by glancing through the book to look at the examples. Notice that the programs are divided into three main sections: Level Three, Level Two, and Level One.

It is the provision of levels that makes the Graphs and Charts Pack easy to use, yet allows the BBC Microcomputer's graphics to be used to the full.

Level Two contains procedures and functions which you can use as part of your own program. They are designed so that apart from setting data, users make only one PROC call in their program in order to obtain a picture. The data can be in any units that the user pleases, there is no need to use the screen coordinates understood by the BASIC statements PLOT, MOVE or DRAW. At this level the package is therefore very easy to use.

Level One also consists of procedures and functions that you can use in your own program, but they give you much more freedom to achieve special effects. As in Level Two, users can work in any units that they please.

Using the Level One and Level Two routines it is a simple matter to build up programs for the interactive creation from the keyboard of graphs, charts, or plots of mathematical functions. The Level Three section of the book describes what such a set of programs might be, and these are included in the Graphs and Charts

Pack.

Levels One and Two are fully compatible with the screen control facilities provided by the BBC Microcomputer - the user is free to continue to use these alongside the routines.

The examples presented in the manual can be used directly on the BBC Microcomputer Model B, after loading the appropriate Level One and Level Two routines.

1.2 Loading the Programs from Cassette

Level Three programs, as explained above, are complete and ready to use, so they are provided on the cassette as BASIC programs in normal 'SAVE/LOAD' form. For example, to run the bar chart program, enter:

```
CHAIN "L3-BAR"
```

in the usual way and start the cassette recorder playing.

This simple method cannot be used for Levels Two and One, however, because LOAD and CHAIN delete any program in the computer's store before bringing in the new one. As the purpose of Levels Two and One is to form part of your program, another way must be used. This is provided by the '*EXEC' command: this causes programs on the tape to be transmitted to the computer rather as if you were typing them in yourself quickly. Each line of input starting with a line number is then accepted by the interpreter as a new line to be added to your program. As a consequence, the program code from the tape will appear on the screen as it is read in. For example:

```
>*EXEC "L1-2D"
```

You will also need to know which line numbers the Graphs and Charts Pack routines will use. They are all in the range 10000 to 20000. More precise information is given later.

1.3 Typing the Programs from Listings

To avoid any possible confusion between the lower case 'l' and the numeral '1', no lower case 'l's have been used in variable or procedure names, except in 'lo' and 'l%'.

2 Level Three Programs

2.1 Introduction

These utility programs are supplied on cassette complete and ready to run. To use them, you do not need to read any more than this section of the manual, although they should serve as a good introduction to the sort of thing you can do using the lower-level programs. To load the programs, use the CHAIN or LOAD command in the usual way.

The best way to find out how to use these programs is to run one, but the following brief summary may help.

On starting up, two or three pages of control data are displayed a page at a time. The first page is to do with which mode is to be used for the eventual display, colours to be used, etc. At the foot of each page a prompt line gives you the chance to make changes to the data on that page (type C) or you can go on (press SPACE). If you ask to make changes, the page is displayed again, pausing after each line to allow you to set new values. If the old value is acceptable, type only a RETURN, otherwise type the new value and end it with RETURN. You can go on doing this until you are satisfied, then type RETURN by itself.

The last page says that the program is ready to start drawing the graphs (or whatever is appropriate) and gives a list of keys that you will be able to use to control the program. After you next press the SPACE bar, the screen is cleared, axes are usually drawn, and the program waits for you to hit one of the control keys. To help you remember which they are, the ? key will give a list of them (without explanations) which lasts for 5 seconds. Each control key puts up a prompt on the bottom line, which you must answer with one or more data items.

For example, in the bar chart utility L3-BAR, the SPACE bar prompts for data to draw the next bar as follows:

X,Y ?

to which you could reply, for example, '5,8', to put the next bar at horizontal position 5 with height 8.

Certain control keys apply to all the utilities. C allows you to select a logical colour (see the User Guide), L allows the logical colours to be redefined in terms of physical colours, and T asks for a title and a position on the screen to put it. This position is always expected in the units used to draw the display.

When your graph is complete or you want to abandon the program, escape will clear the screen and ask you if you want to repeat or stop.

2.2 List of Level Three Utilities

L3-BAR

Draws bar charts (histograms). The user defines each bar's position individually. It is possible to change the width, colour and offset of each bar, and to put a title on the chart.

Keys:

- C: colour
- L: change logical colours
- B: bar base
- O: offset
- W: width
- T: title
- ?: list of prompt keys

L3-GRA

Draws graphs (X-Y plots). The user may specify each point individually, or define a function which will be evaluated for a specified range of the X-axis and plotted, or any combination of these. The graph may be titled, colours changed, and if a function is used this may be written on the screen at any desired point. The function must be typed in as a valid BASIC expression in X.

Keys:

- M: move to X,Y
- D: draw to X,Y
- C: colour
- L: change logical colours
- F: input function(X)
- P: range to plot, no. of points
- U: display function at X,Y
- T: title
- ?: list of prompt keys

L3-CUR

Draws graphs like L3-GRA, but for function plotting allows X and Y to be defined as separate functions of a parameter T. Note that by setting the function X(T) to be just T, the program can be made to behave just like L3-GRA. Functions must be typed as valid BASIC expressions in terms of the variable T only.

Keys:

M: move to X,Y
D: draw to X,Y
C: colour
L: change logical colours
X: input function X(T)
Y: input function Y(T)
U: display X(T) at X,Y
V: display Y(T) at X,Y
P: T-range to plot, no. of points
T: title

L3-PIE

Draws pie charts. The user specifies the size of each sector in %. The starting angle of each sector is chosen automatically, but this can be over-ridden if required. Colours may be varied, and each sector labelled with its size in %.

Keys:

S: starting angle for next sector
D: draw next sector, size in %
C: colour
L: change logical colours
T: title
W: write sector size in colour 0
of the last sector drawn.
?: display list of prompt keys

L3-CV3D

Draws perspective graphs, otherwise like L3-CUR. Three functions X(T), Y(T), and Z(T) must be set, and/or individual points may be given.

Keys:

A: change viewing angles
M: move to X,Y,Z
D: draw to X,Y,Z

C: colour
L: change logical colours
X: input function X(T)
Y: input function Y(T)
Z: input function Z(T)
P: T-range to plot, no. of points
T: title
U: print X(T) at X,Y,Z
V: print Y(T)
W: print Z(T)
?: list of prompts

L3-C02D

Draws contour maps on 'flat' axes. A function F(X,Y) needs T be set, and it must be a valid expression in BASIC involving X and Y only. The key P (for Plot) will ask for the range of contour heights that are to be drawn.

Keys:

C: colour
L: change logical colours
F: input function(X,Y)
P: plot for range of heights
T: title at X,Y
U: print fn at X,Y
?: print all recognised prompts

L3-C03D

Draws contour maps in perspective. This program behaves in most respects like L3-C02D except that perspective plots are produced. Because of the size of the program only modes 4 or 5 may be used.

Keys:

A: change view angles
M: move to X,Y,Z
D: draw to X,Y,Z
C: colour
L: change logical colours
F: input function F(X,Y)
P: plot contours
T: title
U: print F(X,Y) at X,Y,Z
?: list of prompts

L3-SURF

Draws a wireframe view of a function of two variables. This is an alternative method to L3-CO3D of investigating such functions.

Keys:

- A: change view angles
- M: move to X,Y,Z
- D: draw to X,Y,Z
- C: colour
- L: change logical colours
- F: input function F(X,Y)
- P: plot
- T: title
- U: print F(X,Y) at X,Y,Z
- ?: list of prompts

2.3 Using Level Three Utilities

The programs are large and use display mode 5 by default as this allows more memory for program than modes 1 or 2. However many of the programs can be successfully run in other modes.

Also concerning memory space, the contouring functions use an array, $\text{EW}(I,J)$ to store function values. This is dimensioned as $\text{EW}(10,10)$ by default, but the user may change this by modifying line 20 of the program to set IM%, JM% to other values.

If ESC is pressed, followed by a request to repeat the program, any functions that were previously set are preserved, but other values are not.

Note that by using the C key to draw in the background colour (0 by default) it is possible to selectively erase part of a graph or chart by drawing or plotting again over the part to be deleted.

3 Level Two Procedures

3.1 Introduction

These routines are intended for incorporation into the user's own BASIC program. They are 'minimum fuss' routines: in your part of the program you will have perhaps to dimension certain arrays and set values in them, and then call just one procedure to get graphical displays. In exchange for ease of use, you have to accept certain choices that will be made automatically by the routines. If these need to be changed, you will need to use Level One procedures.

3.2 Implementation Restrictions

All Level Two routines are accessed by PROC calls as detailed later. All global variables used by the procedures are prefixed with £, a convention which should prevent any clash of names with the user's own program. In fact the only such global variables are the graphics parameters which will be listed later, the variables £0, £1, £2, and certain arrays which the user is sometimes required to set in order to pass data. Obviously you should not use these variables in your part of the program except as specified.

Procedure and function names are also prefixed with £, with the exceptions of FNmin and FNmax. All line numbers used are in the range 10000 to 17999, but of course they may be renumbered with the RENUMBER command.

The routines assume that the full screen is available for graphics. Only the graphics cursor is moved, and only the foreground graphics colour is changed. VDU and other cursor control commands may be freely used in the user's program.

3.3 Loading the Routines

As explained in the introduction of the manual, the routines are supplied on cassette in a form that can be read using the *EXEC command. This is done so that the routines can be added to an existing program. In addition to the Level Two file that you are going to use, one of the fundamental Level One files L1-2D or L1-3D must also be loaded (using *EXEC). The detailed specifications tell you which.

3.4 Errors

If, during a run, the BASIC system were to report errors within the routines provided, this would usually be due to a failure by the routines to calculate a suitable scale factor for the data you have provided. For example, in L2-XY, suppose you set all the values £Y(I) to the same value, then the routines will give up because the range of Y-values is zero.