

# Cambridge Co-Processor



USER GUIDE



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# Cambridge Co-Processor

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Important

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# About this User Guide

This User Guide describes how to get started with the Cambridge Co-Processor and the accompanying software.

It does not contain a detailed description of the Panos Operating System or the bundled languages, nor is it a tutorial to programming.

The Guide is in three parts:

Part I describes the components of the package and how to fit the Co-Processor;

Part II gives instructions on how to install the operating system Panos and use simple commands;

Part III introduces the use of the 32000 languages and shows how to install them.

Solutions to common difficulties and problems encountered with the Co-Processor, or during the installation of Panos or the languages are outlined in Appendix B.

## Conventions adopted in this guide

(BREAK) (RETURN) (ESCAPE) and (SHIFT) signify the corresponding keyboard keys rather than the actual words. It is assumed that command lines are terminated by (RETURN).

In examples where commands have to be typed in response to a prompt (e.g. the Panos prompt ->), both the command and the prompt are shown, e.g.

```
-> cat -help
```

Where you see the prefix '32000', this refers to software distributed with the Panos system, as distinct from other systems; for instance, '32000 BASIC' refers to BBC BASIC as supplied with the Cambridge Co-Processor, rather than BBC Microcomputer (6502) BASIC.

## Conventions for naming DFS floppy disc drives

This manual assumes the use of BBC Microcomputer dual drives. Others e.g. from other manufacturers will be similar. Double sided DFS formatted floppy discs have two sides (like an LP). The top side (the one with the

label) is referred to as the upper side, the bottom side as the lower side. The dual disc drives have two slots, the top drive and the bottom drive. They also have drive numbers, corresponding to the top and bottom drives. This is represented in the following table:

Drive 0 refers to the upper side of the top drive Drive 2  
refers to the lower side of the top drive Drive 1 refers to  
the upper side of the bottom drive Drive 3 refers to the  
lower side of the bottom drive

See also the diagram in section 3.3.2.

# Part I The Hardware and Firmware



# 1 Installing the Hardware

## Introduction

The Cambridge Co-Processor uses the National Semiconductor 32000 chip set including the NS32016 Central Processor (CPU). Because the C9-Processor is a 32-bit computer, it can perform calculations much more quickly than earlier eight-bit designs, and it can address much more memory; it has an architecture designed for efficient compilation and execution of high-level languages such as Pascal. In summary, the Co-Processor offers the following capabilities:

- 32-bit internal architecture, 16-bit external data bus,
- 512K bytes of RAM, expandable to 1M byte,
- NS32081 floating point unit,
- 16K bytes of ROM containing Pandora kernel firmware,
- Disc-based software providing:
  - Panos operating system
  - including procedure library and command interpreter,
  - Editors for program and text preparation,
  - Linker for combining several compiled modules, Pascal
  - educational/systems programming language, Fortran 77
  - scientific programming language,
  - C systems programming language,
  - LISP artificial intelligence programming language,
  - BBC BASIC programming language,
  - Acorn macro assembler.

Full documentation accompanies all of the hardware and software. The manuals supplied with the system (apart from this guide) are:

- Panos Guide to Operations
- Panos Programmer's Reference Manual
- Acorn 32000 Assembler Reference Manual
- BBC BASIC Reference Manual
- C Reference Manual
- FORTTRAN 77 Reference Manual
- ISO Pascal Reference Manual
- Cambridge LISP Reference Manual

When a Co-Processor is fitted, the BBC Microcomputer becomes the input/output ( I/O) processor, performing relatively simple tasks such as displaying characters on the screen and taking characters from the keyboard. The Co-Processor ( sometimes referred to as the second processor) takes over the job of running application programs. This is enhanced by the specially written operating system, Panos, which provides an efficient programming environment for developing and executing software.

### 1.1 ROMs you will need to use the Co-Processor

If you have a Model B + BBC Microcomputer, then skip this section and move to sub-section 1.1.1.

Before the Co-Processor itself is attached to the BBC Microcomputer, the DNFS ROM should be fitted, as this contains the necessary software to support the Co-Processor. The DNFS ROM provides the BBC Microcomputer with the ability to communicate with a Co-Processor. It also contains the disc filing system (DFS) and the network filing system (NFS).

If your machine has a DFS ROM and/or an NFS ROM, it/they should be replaced by the DNFS ROM supplied. Failure to do this may result in incorrect operation. Appendix A describes how the old ROMs are removed and the new ones are fitted. If you do not feel confident enough to do this, please contact your supplier. Note that fitting ROMs yourself may affect your guarantee.

If you are currently using the advanced disc filing system (ADFS), typically with a Winchester disc, you will have to replace it with a special version suitable for use with the Co-Processor in addition to fitting the DNFS. The special ADFS ( sometimes referred to as ADFS/32) is supplied with the Co-Processor.

The BBC operating system OS 1.2 (or a higher version number) is also required to use a Co-Processor. A **ROM** containing this operating system is available on request from your supplier.

#### 1.1.1 ROMs needed for the B+

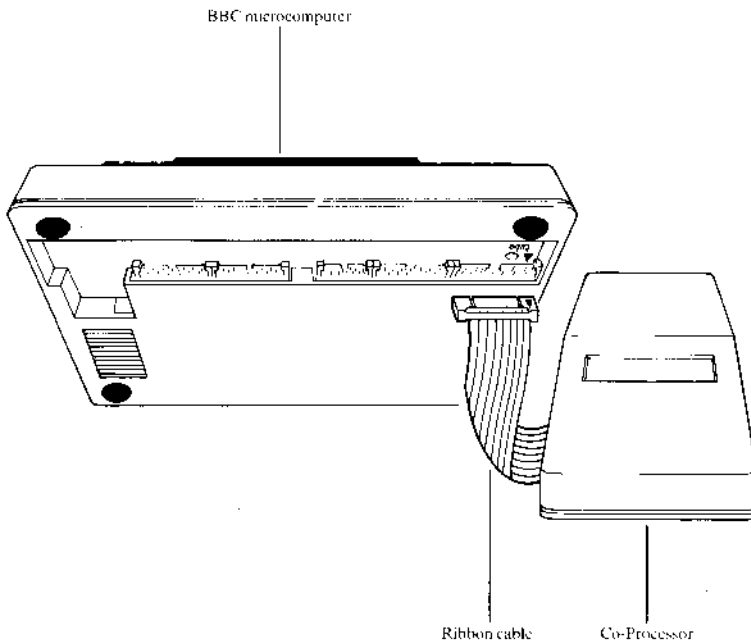
The B + model is already supplied with most of the ROMs necessary to operate Panos. However, you will need to fit the ADFS ROM if you are using Panos with a Winchester disc. This will have been supplied with the Winchester. To do this, either follow the instructions in Appendix A, or ask your dealer to fit one. Fitting ROMs yourself may affect your guarantee.

## 1.2 Connecting the Co-Processor

The Co-Processor is joined to the BBC Microcomputer by the short ribbon cable. This cable has a plug on the end which fits into the socket labelled Tube<sup>®</sup> on the underside of the BBC Microcomputer. Because of the short length of the cable, which is necessary due to the high speeds at which The Tube interface operates, the Co-Processor box may only be situated on the immediate right of the main unit.

Before fitting the Co-Processor, ensure that both it and the BBC Microcomputer are disconnected from the mains.

To plug the cable in, place the Co-Processor to the right of the BBC Microcomputer. Lift the front of the BBC Microcomputer to reveal the Tube<sup>®</sup> socket on the right. Open the plastic grips on each side of the socket and then take hold of the cable with your right hand. Push the plug at the end of the ribbon cable into the socket. Note that the plug should be orientated so that pin 1, indicated by a small triangle, is uppermost and level with the triangle near the socket, as shown in figure 1.



*Figure 1 Connecting the Co-Processor*





## 2 Starting up

Plug the Co-Processor in and switch it on. The power switch is on the rear panel, on the right-hand side looking from the front. Plug the BBC Microcomputer in and switch it on. The usual start-up message is replaced by:

```
Pandora 32016 version 1.00  
  
Memory size 512 kilobytes  
  
Acorn DFS  
  
BASIC
```

The version numbers may differ from those given above, as may the memory size, and names of the filing system and language which are printed on the fourth and fifth lines. For example, if the BBC Microcomputer has the NFS and VIEW as its two rightmost ROMS, lines three and four would say:

```
Econet Station xxx  
  
VIEW
```

### 2.1 Pandora

Pandora is a ROM based program which occupies part of the Co-Processor's 16K bytes of ROM. It performs several tasks, including communicating with the I/O processor (the BBC Microcomputer). Pandora prints a \* prompt, and passes input from the user to the BBC Microcomputer's command line interpreter. Users therefore have access to the usual \* commands such as filing system commands, \*F X, \*TV commands and so on.

Pandora also accepts and executes (CTRL) commands (i.e. VDU codes) such as the mode-change (CTRL) V command. The following programs run directly under Pandora.

```
BBC BASIC (Bas32)  
Assembler output (on request)  
Panos operating system.
```

## Chapter 2

For those such as Operating System developers requiring fuller details the Pandora kernel is documented in the *Panos Technical Reference Manual*.

## **Part II Panos**

### **Introduction**

Panos is the name given to the Co-Processor's operating system. Panos provides many facilities for writing, loading, and running programs. It also provides flexible ways of creating command files, so that a range of activities can be carried out automatically e.g. compiling, linking, and running large batches of programs.

Convenient access to the hardware for both programmers and end-users has been catered for, and it has been specially designed to integrate with the BBC Microcomputer hardware and software systems.

The minimum hardware necessary to run Panos is dual 80 track double sided single density floppy disc drives, giving a total of 800 Kbytes. It also needs to be loaded from a storage device. Depending upon your configuration, this will be a floppy disc, a Winchester disc, or an Econet file server.

Panos is supplied on double sided single density 80 track floppy discs. Before it can be used on your configuration, it must be installed, even if you intend to run it from floppy discs. Panos will not run fully on the discs as supplied; these are intended as a distribution mechanism only.



### 3 Installing Panos

To install Panos onto any filing system, follow the steps below:

1. Complete all the steps in section 3.1 This involves making copies of the distribution discs.
2. Carry out the instructions given in section 3.2. These show you how to start up Panos.
3. Now build a Panos system on your chosen disc filing system. Follow the instructions given in section 3.3 for the DFS (floppy), 3.4 for the ADFS (Winchester), and 3.5 for the NFS (Econet).

Refer to figure 2 for an overall plan.

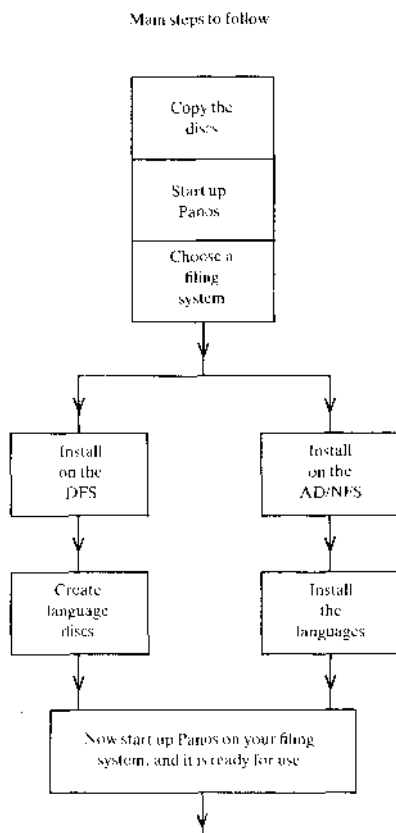


Figure 2 Plan for installing Panos

Before proceeding, you should be familiar with at least the introductory chapters of the relevant filing system User Guide. The *Panos Guide to Operations* also contains useful extra information about Panos, in particular the Panos view of the directory structure, which extends that of the underlying filing system. You may find useful the table entitled *File Types and File Name Extensions* in chapter 2. However, this guide is sufficient to get started.

### 3.1 Copying the original discs

It is very important that soon after receiving the software, you should make copies of all of the distribution discs on DFS format floppy discs. This ensures that should anything disastrous happen to your working discs, you will have the originals to fall back on.

The copying procedure involves three main steps:

1. Formatting seven discs,
2. Labelling the seven discs identically to the distribution discs,
3. Backing up the original distribution discs.

If you have problems at this stage, see Appendix **B**.

#### 3.1.1 Formatting the discs

The method for formatting DFS discs is explained in the appropriate *Disc Filing System User Guide*. If you have any other manufacturer's floppy disc, format these as usual.

#### 3.1.2 Backing up the discs

The next stage in the backing up process is to copy the distribution discs onto the newly formatted discs. As there are two sides to each disc, two \*BACKUP commands are required for each disc.

To back up a single disc, carry out these steps:

1. Ensure that the distribution disc is write-protected.
2. Insert the distribution disc in the top drive.
3. Insert the identically labelled copy disc in the bottom drive. Type:

```
*ENABLE
```

```
*BACKUP 0 1
```

When the prompt re-appears, type:

```
*ENABLE
*BACKUP 2 3
```

Note that the \* prompt is printed by Pandora, the rest typed in by the user. Repeat this backing-up procedure for each one of the seven distribution discs.

After all seven discs have been copied, put the masters away safely so that in the event of an emergency you can retrieve the distribution software.

From now on, except in the case of BASIC, Panos and not Pandora will be used.

## 3.2 Starting up Panos

Having switched on your BBC Microcomputer and Co-Processor, follow these instructions:

Press and release BREAK

you should now see the Pandora \* prompt

Insert the start up disc (disc 1) into the top drive

Type `disc`

Type `Panos`

after a short interval, you should see the Panos `->` prompt

Now set the date as shown in section 3.2.1

If the prompt does not appear, repeat the start-up procedure, making sure that the disc is the right way up (labelled side uppermost), and that you have the correct ROMs as described in Part I of this guide.

### 3.2.1 Setting the date

Setting the date and time must be carried out each time you start-up Panos after switching on the Co-Processor, or after a 'hard' break (i.e. (CTRL)-(BREAK)). To set the date and time type:

```
-> Set date
```

followed by the date and time. Several formats are permissible; these are documented in full along with the instructions for the 'set' utility in the *Panos Guide to Operations*. Example dates are:

```
-> Set date Wednesday 25th Dec 1985 3am
```

or

```
-> set date 15-oct-85 16:10
```

If you ever wish to know the time or date, simply type

```
-> show date
```

### 3.2.2 Leaving Panos

Type

```
-> .quit
```

Note the ' . '

This message is given:

```
Leaving Panos
```

and the Pandora \* prompt appears.

You may find that pressing (BREAK) can also cause exit from Panos. However, this is not recommended practice since data can be lost from files which are open. BREAKing is a powerful way of stopping activity immediately; if terminating a running program is desired within Panos, press (ESCAPE). This will cause return to the Panos prompt at occasions when, for example, any program (for instance, a utility) is running and you wish it to stop.

### 3.2.3 Welcome Demonstration

A demonstration suite has been provided with the system on a separate disc called the 'Welcome Disc'. This disc contains a few simple programs and demonstrations consisting of a menu offering you choices of languages and programs to try out. These programs have been chosen for their simplicity and size; they are not examples of model programs, designed to work as quickly and efficiently as possible. The Welcome Disc also contains several useful programs and routines such as a FORTRAN 77 graphics library.

Before continuing with the installation procedure you may like to try out a few commands and run through the demonstration procedure. Although Panos has not yet been installed, there are some things which you can do, just for the fun of it.



To run the 'Welcome' demonstration, keeping the Panos start-up disc in the top drive, place the welcome disc in the bottom drive, and type

```
-> Welcome
```

and the session will commence.

Panos is not case-sensitive, i.e. any Panos command can be typed in either upper or lower case, or a mixture of these.

Press (RETURN) after making one of the menu choices. To break out of continuously looping demonstrations such as 'Clock' and 'Slides', press (ESCAPE) See figure 3 for a picture of the 'Welcome' menu.



Figure 3 The Welcome Menu

If you like, try using one or two utilities, for example, to catalogue the welcome disc: type

```
-> cat :1
```

You will notice that files are given three-letter extensions. If you wish to know more about these, consult the *Panos Guide to Operations*. These extensions are an important feature of Panos, and correspond to the contents of the files.

### For AD/NFS Users

After installing Panos onto the ADFS or NFS, you can copy the welcome programs onto your filing system automatically. Having started up Panos on the ADFS or NFS, place the welcome disc in the top disc drive, and type

```
-> dfs:install
```

and the 'install' command file will copy all the relevant programs across into a directory called 'PanosDemos' especially created for the welcome programs. Type **We l** come, and the session will commence.

### 3.3 Installing Panos onto the DFS

By now, you should have a set of the distribution discs (which you received with the Co-Processor), and a set of backups. However, you need to create a third set, which will then be your working discs. These comprise three or more discs containing a selection of various system and language programs. The working set is created by copying certain parts of the second set, keeping this second set as backups. This may sound like an unnecessarily complicated procedure, using up a large number of floppy discs; however, it is strongly recommended, as the working set are liable to get corrupted, and therefore you should always have a set of backups from which you can make another set of working discs if necessary. The original set of discs should be kept in a safe place as the master copies, and only used to create another set of backups if the backup set have become damaged.

To install Panos for use with the DFS, follow these steps:

Step 1: Place your copy of disc 1 in the top drive.

Step 2: Place a BLANK formatted disc in the bottom drive.

Step 3: Start up Panos.

Step 4: Set the date.

Step 5: Type -> InstDFS

A message will be given, telling you to place a blank formatted disc in the bottom drive, and to press (RETURN). The installation program will then automatically copy the necessary material onto the new disc. When the disc has been copied, another message is given to check that the installation has worked.

Step 6: Take out disc 1 and replace it with disc 2.

Step 7: Take out the copied disc from the bottom drive and replace it with another BLANK formatted disc. Then press (RETURN).

The contents of disc 2 will now be copied onto the blank disc.

### 3.3.1 Alternative start-up

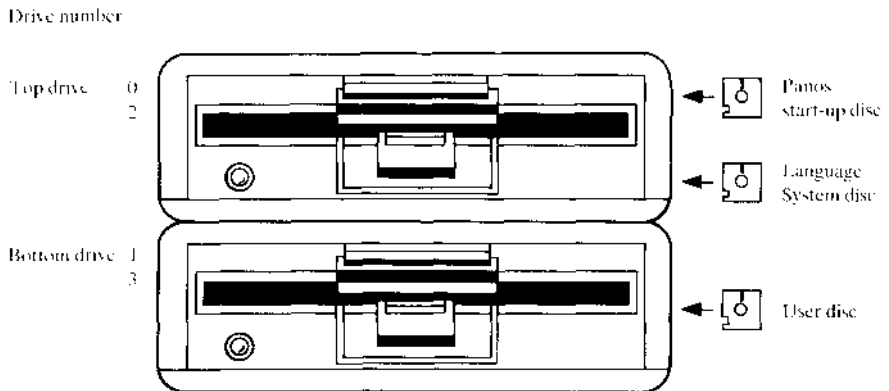
You may wish to start up Panos using a less long-winded method. This method can only be used on the DFS.

Simply place your start-up disc in the top drive, and, having switched on the Co-Processor, press (BREAK) once whilst holding down (SHIFT) and D .

### 3.3.2 Building your working DFS system

The typical configuration for a complete Panos program development system for the DFS comprises three floppy discs as shown below (although other configurations are possible to suit individual requirements).

1. A start-up disc, used once a day to initialise Panos.
2. A system disc, containing the editor and linker on the upper side, a language compiler on the lower side, and possibly some additional utilities of your choice.
3. A user language disc, which houses user's programs on the upper side, and the compiler library on the lower side.



*Figure 4 A Working DFS System*

### The Start-up Disc

The start-up disc (disc 1) is used to start up Panos. After entering Panos and setting the date, replace this disc with the system disc.

### The System Disc

You should make one system disc for each language, i.e. a disc with the editor and linker on the upper side, the language compiler on the lower side, and commonly used utilities for that language on both sides. Unfortunately, not all of the utilities will fit onto the system disc along with the editor, linker, and language compiler. At present, you may not know which utilities will be most often used. It therefore makes more sense if you copy the compiler first; you can then find out as you use the language which utilities are most useful, and copy them as they are needed. You may also like to read the *Panos Guide to Operations* where the utilities are described. Copying the compiler and libraries is covered in the relevant chapters about each language found in Part III of this guide.

#### 3.3.3 Copying the utilities

Some of the utilities reside on the upper side, and some on the lower side of the start-up disc. The steps given below show how to copy utilities from upper side to upper side. Simply change the drive numbers to copy utilities from or onto different sides.

1. Place your working copy of disc 1 in the top drive.
2. Place your working system (or user) disc in the bottom drive.
3. Type:

```
-> Copy :0.<utility-name>-rif -to :1
```

where utility name is the name of the utility you are interested in.

After copying one or two utilities, you may receive a warning that the disc side is full. Change the destination from 1 to 3, and any utilities will now be copied onto the lower side of the system disc, onto which you should have already copied a compiler. More utilities can also be copied onto the user disc, if required. It is left up to the user to decide which are the most useful utilities. In order to use the remaining utilities, it is necessary to exchange your working system disc for the start-up disc.

## Example sets of working discs

Listed below are examples of finished working discs, complete with compilers, libraries, and utilities (but no user programs), to give an idea of what your working system on the DFS should contain. See also figure 4.

The start-up disc is the same for each system, regardless of which languages are being used or if the system is used to run applications only. Note that not all of the files that appeared on the distribution discs are present on these working discs. This is simply because those relating to the ADFS and NFS (such as !ConfIA) are not necessary. See the Release Notices for the exact contents of the distribution discs.

### EXAMPLE START-UP DISC

Drive 0	
\$.!Boot	*EXEC file to call-up Panos on <u>(SHIFT) - (BREAK)</u>
\$.!Config	Default configuration file
\$.!Panos	Start-up !Panos file
\$.!Perror	Panos error message file
\$.Bas32	BASIC interpreter/editor (*Bas32) \$.
PanData	Panos RAM image
\$.Panos	Panos loader
Config-rif	Configuration utility
Copy-rif	File copy utility
Date-rif	Date set/display utility
Drive 2	
Access-rif	File permissions utility
Asm32-rif	Acorn 32000 assembler
Catalog-rif	File cataloguing utility
Create-rif	File/directory creation utility
Delete-rif	File/directory deletion utility
Echo-rif	Argument echoing utility
Rename-rif	File renaming utility
Show-rif	Utility to display Panos variables
Star-rif	Utility to issue BBC * commands

### EXAMPLE SYSTEM DISC FOR PASCAL

Drive 0	
Edit-rif	Panos text editor
Link-rif	Panos linker
Panos-lib	Panos library
ed6502-bbc	Editor's host-code

## Chapter 3

edhelp-dat	Editor's help text
Drive 2	
Copy-rif	Copy utility
LLbe-rif	Pascal compiler back end
Pascal-rif	Pascal compiler command file
rename-rif	Rename utility

### EXAMPLE USER DISC FOR PASCAL

Drive 1  
This side contains user programs

Drive 3	
Prim-dat	Pascal data file
Pas-lib	Pascal library
Pasfe-rif	Pascal compiler front end
access-rif	Access utility
cat-rif	Catalogue utility
delete-rif	Delete utility

### EXAMPLE SYSTEM DISC FOR FORTRAN

Drive 0	
edit-rif	Panos text editor
Link-rif	Panos linker
Panos-lib	Panos library
ed6502-bbc	Editor's host-code
edhelp-dat	Editor's help text

Drive 2	
f77-cmd	FORTRAN 77 compiler command file
Copy-rif	Copy utility
f77fe-rif	FORTRAN 77 compiler front end
f77cg-rif	FORTRAN 77 compiler code generator

### EXAMPLE USER DISC FOR FORTRAN

Drive 1  
This side contains user programs

Drive 3	
F77-lib	FORTRAN 77 library
cat-rif	Catalogue utility
Delete-rif	Delete utility

### 3.4 Installing Panos onto the ADFS

Having started up Panos from your copy of the distribution disc, follow these steps:

Step 1: Keeping the start-up disc (disc 1) in the top drive, type

```
-> Install ADFS
```

Step 2: When the contents have been copied, replace the start-up disc with the system disc, then press (RETURN)

The necessary ADFS directories will now be created, and the relevant files copied across.

### 3.5 Installing Panos onto the NFS

Having started up Panos from your copy of the distribution disc, follow the steps below. To log on to the Econet from within Panos, use the 'logon' utility; for example, to log on as 'syst':

```
-> logon syst password
```

Step 1: Log on to the Econet from within Panos using the 'logon' utility as System Manager at the root level.

Step 2: Keep the start-up disc (disc 1) in the top drive, and type

```
-> Install NFS
```

Step 3: When the contents have been copied, replace the start-up disc with the system disc and press (RETURN)

The necessary NFS directories will now be created, and the relevant files copied across.

### 3.6 About the AD/NFS directories

Each directory is created during the installation procedure to contain a particular type of file. It is advisable to conform to this structure, since Panos, as it is supplied with the Cambridge Co-Processor recognises certain directory names and searches for files within these. Advanced users are free to configure Panos as they wish, but Acorn software and documentation

assumes this structure is present. This is an outline of the main directories' functions; more details about Panos file extensions and directories can be found in the *Panos Guide to Operations*. See figure 5.

### Library

This contains programs which are executable under Pandora by simply typing their name, e.g. bas32, Panos.

### **PanosLib**

PanosLib contains files (usually system programs) which should be accessible to Panos from wherever in the filing system the user happens to be. For instance, if the user is in directory \$.pascal.allprogs, then s/he should still be able to use the editor, the various compiler libraries, and all of the other utilities and command files. Therefore, in the system as supplied, these programs are placed in the one directory, PanosLib, which Panos searches in first of all for commands

### **User**

The name 'user' is generic, i.e. it stands for a class of directory which can be given any legal name by the user. This type of directory could be the working directory where the user will be after entering Panos, and will typically spend most time. It contains all of the language files which the user creates. Here, the user can place local versions of the two files which set up various start-up parameters, !Config and !Panos. 'User' is divided into sub-directories according to the languages or applications being used, e.g. for the C language, the user could have a directory called, for example, `CProgs', containing further sub-directories. More details about languages and their directories are given in Part III of this guide.

### **PanosDemos and PanosTests**

The PanosDemos directory is created during the installation procedure to contain the 'Welcome' programs when the welcome disc is installed. PanosTests is similarly created for the 'Hello World' programs. These programs function as short demonstrations for each language.



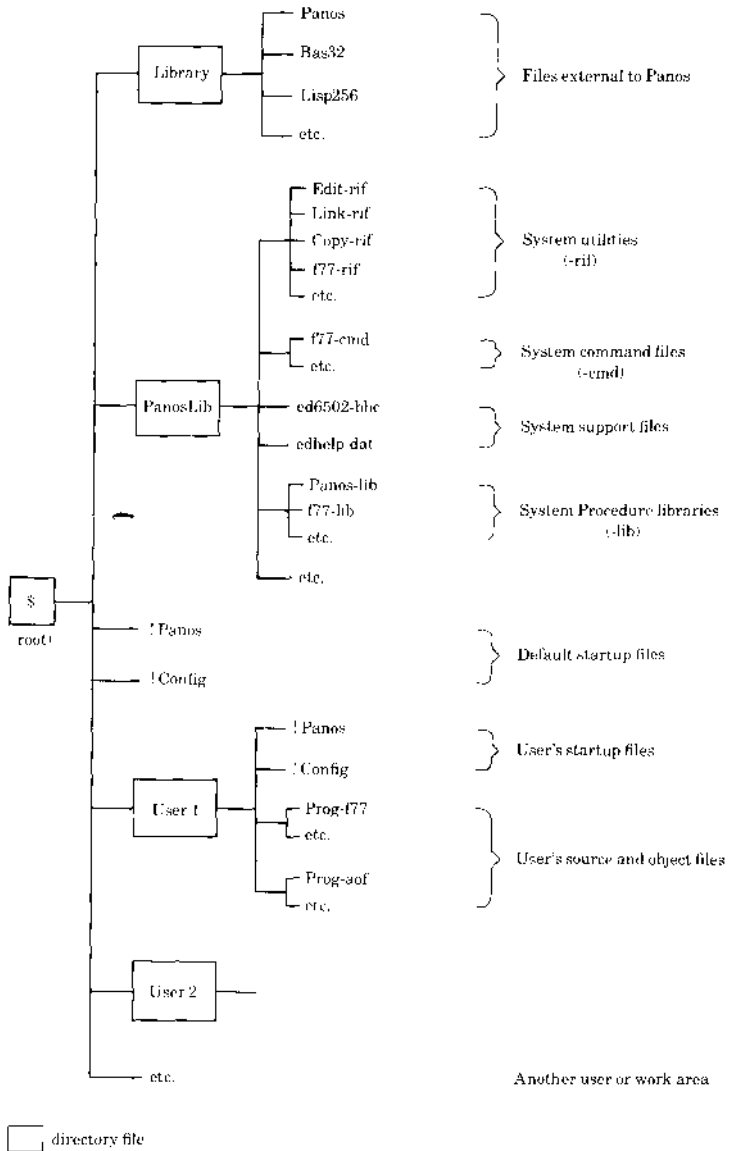


Figure 5 ADFS or NFS Directory Structure for Panos

### 3.7 Configuring Panos and Local Environments

One of the features of Panos is the ability to create separate local environments. Each language or application has a different set of compilers and libraries, and a suitable configuration for use with each filing system.

When Panos is entered, system parameters (for example, file extensions) are set according to the contents of the two files !Panos and !Config. First of all, Panos looks in the current directory for these files.

On the AD/NFS, separate 'User' directories, which each have their own associated !Config and !Panos files, can be created. Therefore, when Panos is started up from a user directory, initialisation data is taken from the local versions of !Panos and !Config. On the DFS, system discs and user language discs are different for each application. Similarly, separate start-up discs which contain different versions of !Panos and !Config can be created if necessary.

!Panos is altered by simply editing the file itself, and a utility called `Configure' allows alterations to be made to !Config. These are further explained in the *Panos Guide to Operations*. The versions of !Panos and !Config files supplied with the system are general-purpose and it is unlikely that they will need changing straight away. An exception to this is the possible need to change the system to accommodate a type of printer. As supplied, the system is configured for a parallel printer.

## **Part III Bundled Languages**

### **Introduction**

All of the `bundled' languages (i.e. those supplied with the hardware), except the interpreted language BBC BASIC, are used under Panos. Note that the languages must be installed even for use with the DFS, despite the fact that you have received it on this medium.

### **Installing the languages which run under Panos**

There are two main processes involved in setting up a Panos language for use on a particular filing system.

1. Copying the relevant files from the copies you have made of the distribution discs to the correct locations on a particular filing system;
2. Creating a suitable Panos environment for that language.

It is assumed that, at this stage, you have already made a copy of all of the distribution discs, and have installed Panos onto a filing system as described in Part II.

The first stage is carried out automatically by installation utilities which reside on the language discs.

Stage 2 is open to the user's interpretation. Creating an ideal environment will differ for each application, and so it is left up to the individual user to modify the start-up files where necessary. See section 3.7.



## 4 32000 BBC BASIC

The 32000 version of BBC BASIC is very similar to BASIC I although there are obvious improvements in speed and available memory space, and the provision of an editor. Full details of the new and changed features of 32000 BASIC can be found in the *BBC BASIC Reference Manual* supplied with this system. Note that this manual is not a tutorial; refer to a *BBC Microcomputer System User Guide* or equivalent for this purpose.

### 4.1 Installing BBC BASIC

The BASIC interpreter is called Bas32 on the start-up disc (disc 1). After installing Bas32 onto one of the filing systems as described below, read section 4.2. The BASIC editor comes as part of the interpreter program, and does not have to be installed separately.

#### 4.1.1 Installing BBC BASIC onto the DFS

BASIC is already 'installed' on the DFS, in that it resides on the upper side of the distribution disc 1. However, it is advisable to make a separate copy to use as your working copy. Refer to your *Disc Filing System User Guide* for details about copying files. Note that, if the Panos 'copy' utility is used, the '-exact' option must be given.

If you have followed all instructions up to this point, you should now have three copies of Bas32; one on the distribution disc 1, another on the backup of the original, and a third copy, the one which you have just made.

#### 4.1.2 Installing BASIC onto the ADFS or NFS

If you have installed Panos, then BBC BASIC should already have been copied into the directory '\$.Library' during the installation procedure.

### 4.2 Using BBC BASIC

Once loaded, BASIC is called from the Pandora \* prompt by typing Bas32, and will announce itself with a message of the form:

BBC BASIC IV for 32000 (c) Acorn 1985

This is followed by the usual BBC BASIC prompt:

>

If the prompt does not appear, it could be that you are not calling BASIC from the correct filing system (e.g. you have installed BASIC on the NFS, and may not have logged on to the Econet).

To leave BASIC and return to the Pandora prompt, type QUIT.

Loading and running programs is carried out in the same way as with previous versions.

The LOAD command may be used to LOAD programs which have been SAVED under earlier (6502) implementations of BBC BASIC. Similarly, programs entered using the 32000 BBC BASIC may be saved and then loaded into other implementations of the language (with the obvious restriction that 32000 BBC BASIC can hold much larger programs than 6502 BASIC). If you have any BBC BASIC programs, try running one. Enter the following, remembering to include the quotes.

```
>LOAD "file name"  
>RUN
```

or alternatively use the command

```
>CHAIN "file name"
```

which performs the action of both LOAD and RUN.

As an example of using 32000 BBC BASIC, try the program found on disc 1 of the distribution discs called 'bWorld'. During installation onto the AD/NFS, this is copied into the directory '\$.PanosTests'. Bworld is a simple confidence test which prints out the message 'Hello Basic World':

```
*bas32  
BBC Basic IV for 32000 (c) Acorn 1985  
>  
>LOAD "bWorld"  
>  
>LIST  
  10REM 32000 BBC BASIC - basic confidence test  
  20PRINT "Hello Basic world"  
  30END  
>  
>RUN  
Hello Basic world
```

# 5 32000 ISO Pascal

## Introduction

The 32000 ISO Pascal compiler runs under the Panos operating system. It comprises three files altogether, and one library. This chapter deals mainly with how to install ISO Pascal. Installation utilities are provided to transfer the relevant files to a specified filing system. This includes installing Pascal onto the DFS, despite the fact that you have received it on this medium. A small example program is given, together with a step-by-step account of how a program is compiled, linked, and executed in ISO Pascal. Details about compatibility with other versions of Pascal (in particular with Acornsoft ISO Pascal), using the compiler, and implementation extensions and restrictions, are given in the *ISO Pascal Reference Manual*.

## 5.1 Installing 32000 ISO Pascal

### 5.1.1 Installing ISO Pascal onto the DFS

Before reading any further, you should have read section 3.3 of Part II of this guide, which describes how your working Panos system should be configured. Follow these instructions having entered Panos on the DFS:

- Place your working copy of the system disc in the bottom drive (N.B. a separate system disc for each language).
- Place disc 4 in the top drive.
- Type: -> InstDFS
- When files are no longer being copied, you will see a message telling you to remove the system disc from the bottom drive and replace it with your user disc (probably a blank disc at this stage).
- Having swapped the discs, press (RETURN)

The relevant files will now all have been copied. Now you may copy utilities from the start-up disc (disc 1) onto the working system disc or user disc as described in section 3.3.2. When using Pascal, your working system disc should be placed in the top drive, and the user disc in the bottom drive.

### 5.1.2 Installing ISO Pascal onto the ADFS or NFS

To install Pascal, Panos must have been installed as described in Part II. Follow the steps outlined below. These are for a user having entered Panos from the DFS. If you have entered Panos from another filing system, then substitute 'Install' with 'dfs :Install ' .  
If you are installing onto the Econet, you should have logged on as System Manager at the '\$' level (see section 3.5)

- Place your copy of disc 4 in the top drive.
- Type:
  - > Install ADFS
  - or
  - > Install NFS

depending upon which filing system you are interested in. The relevant files should now be transferred. Use the 'create' utility to make the Pascal 'User' directory. For instance:

```
-> Create $.PasProgs -dir
-> Set dir $.PasProgs
```

Within this directory, various sub-directories will be created as required by the system. The system start-up files, !Config and !Panos set various parameters, e. g. file extensions, names of files to be linked automatically etc. When Panos is entered, it looks in the current directory for initialisation data in !Panos and !Config. Separate start-up files can be created in the language directory which will configure the system specifically for that language. It is not necessary to change these at all from the original versions, but it may be time and effort-saving to do so. The file !Panos can easily be altered simply by editing. The utility `Configure' is used to build a new !Config file. See the *Panos Guide to Operations* for more details about the utilities and start-up files.

## 5.2 Using 32000 ISO Pascal

There are four stages involved in creating and running a Pascal program: writing the source file using an editor, compiling the source program, linking the result of compilation with other files, and running the linked code.



The original source program is firstly transformed into an object file by the compiler, and then into an image file by the linker. The different files have the same name but a different extension. The compiler and linker make certain assumptions about file extensions and types, which means that they automatically look for and give the correct extension for the type of file. The compiler looks for source programs with the extension '-Pas', and therefore, you should give the programs which you create using the editor the extension '-Pas'. It then creates code in what is known as Acorn Object Format, automatically giving a compiled program the extension '-aof'. The linker also gives the Relocatable Image Format file the extension '-rif'.

### 5.2.1 An example session

The program used as a demonstration can be found on your language disc, and is called 'pWorld-pas'. During installation onto the AD/NFS, it has been copied into the directory '\$.PanosTests'. It is a simple confidence test which prints the message "Hello Pascal World". The program is listed (copied to vdu), compiled, linked, and then executed.

```
-> copy pWorld-pas -to vdu:
PROGRAM World (Output);
{ Acorn 32000 ISO Pascal - basic confidence test }
BEGIN
  WriteLn ('Hello Pascal world')
END.
Pworld-pas copied to vdu:Pworld-pas (122 bytes)
->
-> Pascal pWorld
7 lines compiled
->
-> Link pWorld Pas
->
->pWorld
Hello Pascal world
```

The command Pascal compiles the program 'pWorld-pas' (note that the extension does not need to be given), and the command Link links the file pWorld-aof with the Panos and Pascal libraries. See the *Panos Guide to Operations* for further details about linker commands and how they can be automated. Running the program is achieved by simply typing its name.



# 6 32000 FORTRAN 77

## Introduction

The 32000 FORTRAN 77 compiler runs under the Panos operating system. It comprises three files altogether and one library. This chapter deals mainly with installing FORTRAN 77. A small example session is given, together with an example of compiling, linking, and running a FORTRAN 77 program. Details about this implementation of the language itself, how to use the compiler, etc. are given in the *FORTRAN 77 Reference Manual*.

## 6.1 Installing 32000 FORTRAN 77

Installation utilities are provided on the FORTRAN disc (disc 3), which will copy the relevant files onto your filing system. Note that if you are going to use FORTRAN 77 on the DFS, it must still be installed, even though you have received it on this medium.

### 6.1.1 Installing FORTRAN 77 onto the DFS

Before reading any further, you should have read section 3.3 of Part II of this guide, which describes how your working Panos system should be configured. Follow these instructions having entered Panos:

- Place your working copy of the system disc in the bottom drive (N.B. a separate system disc for each language).
- Place disc 3 in the top drive.
- Type: -> InstDFS
- When the files have been copied, you will see a message telling you to remove the system disc from the bottom drive and replace it with your user disc (probably a blank disc at this stage)
- Having swapped the discs, press (RETURN)

The relevant files will now have been transferred. Now you are ready to copy some of the utilities as described in section 3.3. When using FORTRAN 77, your working system disc should be placed in the top drive, and the user disc in the bottom drive.

### 6.1.2 Installing FORTRAN 77 onto the ADFS or NFS

Panos must have been installed as described in Part II. Follow the instructions outlined below. These are for users having entered Panos from the DFS. If you have entered Panos from any other filing system, substitute 'Install' with 'dfs:Install'.

If you are copying files onto the Econet, you must have logged on as System Manager at the '\$' level (see section 3.5).

- Place your copy of disc 3 in the top drive.

- Type: -> Install ADFS

or -> Install NFS

depending upon which filing system you are interested in. The relevant files should now be transferred. Use the 'create' utility to make a user directory for FORTRAN 77 programming. For example:

```
-> Create $.Fortprogs -dir
-> Set dir $.FortProgs
```

Within this directory, various sub-directories will be created as required by the system.

The system start-up files, !Config and !Panos set various parameters, e.g. file extensions, names of files to be linked automatically etc. When Panos is started up, it looks in the current directory for initialisation data in !Panos and !Config. Separate start-up files can be created in the language directory which will configure the system specifically for that language. It is not necessary to change these at all from the original versions, but it may be time and effort-saving to do so. The file !Panos can easily be altered simply by editing. The utility 'Configure' is used to build a new !Config file. See the *Panos Guide to Operations* for more details about the utilities.

## 6.2 Using 32000 FORTRAN 77

There are four stages involved in creating and running a Fortran program: writing the source file using the editor, compiling the source program, linking the result of compilation with other files, and running the linked code.

The original source program file is firstly transformed into an object file by the compiler, and secondly into an image file by the linker. The different

files have the same name but different extensions. The compiler and linker make certain assumptions about file extensions, which means that they automatically give the correct extension for their type. The compiler looks for source programs with the extension ``-F77'`, and therefore, you should give the programs which you create using the editor the extension ``-F77'`. The compiler creates code in what is known as Acorn Object Format. The FORTRAN 77 compiler automatically gives a compiled program the extension `'-aof'`, and the linker gives Relocatable Image Format file the extension ``-rif'`.

### 6.2.1 An example session

The program used as a demonstration can be found on your language disc, and is called ``fWorld-F77'`. During installation onto the AD/NFS, it has been copied into the directory `'$.PanosTests'`. It is a simple confidence test which prints the message "Hello Fortran World". The program is listed (copied to vdu), compiled, linked, and then executed.

```
-> copy (World-f77 -to vdu:
      PROGRAM World
C      Acorn 32000 Fortran 77 - basic confidence test
      PRINT *, 'Hello Fortran world'
      END
fworld-f77 copied to vdu:fworld-f77 (120 bytes)
->
-> F77 fWorld
Program WORLD Compiled

Total workspace used 5054
Main program (WORLD): code 64; data 28
Total code size: 64; data size: 28
->
-> link fWorld F77
->
-> fworld
Hello Fortran world
STOP
->
```

The command `F77` compiles the program ``fWorld-f77'` (note that the extension does not need to be given), and the command `Link` links the file `fWorld-aof` with the Fortran and Panos libraries. See the *Panos Guide to Operations* for further details about linker commands and how they can be automated. Running the program is achieved by simply typing its name.



# 7 32000 C

## Introduction

The C compiler runs under the Panos operating system. It comprises three files altogether and one library. This chapter deals mainly with installing C. Details about this implementation of the language itself, how to use the compiler, etc. are given in the *C Reference Manual* supplied with the system.

## 7.1 Installing 32000 C

It is important that you do not use the actual distribution discs to create your working C discs. Use the copies which you should already have made, as described in Part II. You need to install C even if you are going to use it in conjunction with the DFS, despite the fact that you have received it on this medium. Installation utilities are provided on the C disc which will copy the relevant files onto your filing system.

### 7.1.1 Installing C onto the DFS

Before reading any further, you should have read section 3.3 of Part II of this guide, which describes how your working Panos system should be configured. Follow these instructions having entered Panos:

- Place your working copy of the system disc in the bottom drive (N.B. a separate system disc for each language).
- Place disc 5 in the top drive.
- Type: `-> InstDFS`
- When files are no longer being copied, you will see a message telling you to remove the system disc from the bottom drive and replace it with your user disc (probably a blank disc at this stage).
- Having swapped the discs, press **(RETURN)**

The relevant files will now all have been copied. Now you are ready to copy some of the utilities as described in section 3.3. When using 32000 C, your working system disc should be placed in the top drive, and the user disc in the bottom drive.

### 7.1.2 Installing 32000 C onto the ADFS or NFS

Panos must have been installed as described in Part II. Follow the instructions below.

If you are copying files onto the Econet, you must have logged on as System Manager at the '\$' level (see section 3.5).

- Start-up Panos on whichever filing system you are installing 32000 C

- Place your copy of disc 5 in the top drive.

- Type: -> dfs:Install ADFS

or -> dfs:Install NFS

The relevant files will now be transferred.

Use the 'create' utility to make a C 'User' directory. For example:

```
-> Create $.CProgs -dir
```

```
-> Set dir $.CProgs
```

The system start-up files, !Config and !Panos set various parameters, e.g. file extensions, names of files to be linked automatically etc. When Panos is entered, it looks firstly in the current directory for initialisation data in !Panos and !Config. Separate start-up files can be created in the language directory which will configure the system specifically for that language. It is not necessary to change these at all from the original versions, but it may be time and effort-saving to do so. The file !Panos can easily be altered simply by editing. The utility 'Configure' is used to build a new !Config file. See the *Panos Guide to Operations* for more details about the utilities.

### 7.2 Using 32000 C

There are four stages involved in creating and running a 32000 C program: writing the source file using the editor, compiling the source program, linking the result of compilation with other files, and running the linked code.

The original source program file is firstly transformed into an object file by the compiler, and secondly into an image file by the linker. The different files have the same name but different extensions. The compiler and linker make certain assumptions about file extensions, which means that they automatically give the correct extension for their type. The compiler looks



for source programs with the extension '-c', and therefore, you should give the programs which you create using the editor the extension '-c'.

The compiler creates code in what is known as Acorn Object Format. The 32000 C compiler automatically gives a compiled program the extension '-aof', and the linker gives Relocatable Image Format file the extension

### 7.2.1 An example session

The program used as a demonstration can be found on your language disc, and is called 'cWorld-c'. During installation onto the AD/NFS, it has been copied into the directory '\$.PanosTests'. It is a simple confidence test which prints the message "Hello C World". The program is listed (copied to vdu), compiled, linked, and then executed.

```
> Copy cWorld-c -to vdu:
/* 32000 C - basic confidence test */
main()
{
printf("Hello C world\n");
}
cworld-c copied to vdu:cWorld-c (78 bytes)
->
-> cc cWorld
->
Product:CC_NS16032, Version:cc version 1.4
->
-> Link cWorld c,Pas
-> cWorld
Hello C world
```

The command `c c` compiles the program 'cWorld-c' (note that the extension does not need to be given), and the command `Link` links the file `cWorld-aof` with the C, Pascal and Panos libraries. C programs need to be linked with three libraries altogether. Be careful to include the comma in the list of files to be linked. See the *Panios Guide to Operations* for details about linker commands and how they can be automated. Running the program is achieved by simply typing its name.



## 8 Cambridge LISP

For a full language description, see the *Cambridge LISP Reference Manual* supplied with the system.

### 8.1 Installing LISP

It is important that you do not use the actual distribution discs to create your working LISP system. Use the copies which you should already have made, as described in Part II.

#### 8.1.1 Installing LISP for use with the DFS

A working LISP system on the DFS consists of one disc only, apart from the start-up disc.. You have already made a copy of the original distribution disc 6. This should not be used as the working disc, as these can easily get corrupted; another copy should be made of this disc. Follow these steps having entered Panos on the DFS. Simply place your copy of the LISP distribution disc in the top drive, with a fresh DFS formatted disc in the bottom drive, and type:

```
-> Copy :0... -to :1...  
-> Copy :2... -to :3...
```

#### 8.1.2 Installing LISP for use with the ADFS or NFS

To install LISP on the ADFS or NFS, follow the steps below having entered Panos.

To install onto the NFS, you should have logged onto the Econet as System Manager at the '\$' level (see section 3.5).

- Having already entered Panos on the DFS, place your LISP disc in the top drive.

- Type

```
> dfs:Install ADFS
```

or

```
> dfs:Install NFS
```

The relevant directories will now be created, and all the necessary files copied across onto the chosen filing system.

## 8.2 Using LISP

Having entered Panos, type:

```
-> VLISP
```

This command loads LISP in the 'standard' fashion i.e. the image files are looked for in directory '\$.PanosLib.LISPImage' and identification is given after LISP has loaded.

### 8.2.1 Customising

After loading, no message is given unless the '-identify' start-up option has been used. The store image is loaded from the directory image. As more complex use is made of LISP, the various store preservation functions can be used to produce customised versions. See the *Cambridge LISP Reference Manual* for more details. For example, if the REDUCE system is available, typing:

```
-> LISP -image Reduce
```

will run REDUCE (if the image files for the reduce system reside in a directory called 'reduce').

The process of customisation takes the form:

```
-> LISP -image OldImage -dump NewImage
```

This preserves modules in the directory NewImage using the store image in OldImage as a base.

### 8.2.2 An example session

The following example shows the dialogue during a short session with Cambridge LISP. This short program can be found on your language disc, and is called 'IWorld'. During installation onto the AD/NFS, it has been copied into the directory '\$.PanosTests'. It simply prints the message 'Hello LISP World'. Firstly, LISP is entered and the program is loaded, then listed, and finally executed.

-> VLISP

Acorn Cambridge LISP entered in about 440 Kbytes

Store image was made at 11:38:27 on 10 May 85

LISP version - 1.00 23 Apr 85 image size 125244 bytes

Started at 10:43:11 on 15 Jul 85 after 0.01+8.85 secs - 49.  
2% store used

(rdf 'lworld)

lworld

\*\*\* End of file detected

\*\*\* End of RDF

nil

lworld

(lambda nil (printc "Hello LISP world"))

(lworld)

Hello LISP world

"Hello LISP world"



## 9 Acorn 32000 Assembler

A full language description of the assembler can be found in the *Acorn 32000 Assembler Reference Manual* supplied with the system.

### 9.1 Installing the 32000 Assembler

#### 9.1.1 Installing onto the DFS

The assembler program resides on the start-up disc (disc 1), and is called 'Asm32-rif'. To install the program onto the DFS, copy it onto a fresh DFS formatted disc, and it is ready for use.

Follow these instructions:

- Start up Panos.
- Place the new disc in the top drive.
- Type:  
-> Copy :2.Asm32-rif -to :1

If you have followed all instructions up to this point, you should now have three copies of the assembler; one on the distribution disc 1, another on the copy of the original, and a third copy, the one which you have just made.

#### 9.1.2 Installing onto the ADFS or NFS

The assembler program should already have been copied during the installation procedures described in Part II, and therefore is already installed.

### 9.2 Using the Assembler

The command to assemble a program is simply

```
-> Asm32
```

followed by the program name. See the *Acorn 32000 Assembler Reference Manual* for full details of the command. Programs should be given the file

extension '-asm'. The assembler then automatically gives the object file the extension '-aof'

### 9.2.1 An Example session

Below is a simple demonstration using a program that can be found on your distribution disc 1 called 'a.World-asm'. During installation onto the AD/NFS, it has been copied into the directory '\$.PanosTests'. The program is listed (copied to vdu), assembled, linked, and then run.

```
-> copy aworld-asm -
to vdu:
    MODULE World
; 32000 Assembler - basic confidence test
    IMPORTC XBlockWrite = 'IO' . 'XBlockWrite'
    ENTRY
    ADDR    msg, TOS
    ADDR    @msg_len, TOS
    CXP     XBlockWrite
    MOVQD   0,RO
    RXP     8
    NLSYM   10          ; ASCII standard: newline = 10
msg    DCS    'Hello Assembler world*N'
msg_len EQU   $-msg
    END
aworld-asm copied to vdu:aworld-asm (286 bytes)
->
-> asm32 aworld
Relocatable code: 34
bytes. 3 passes
required.
->
-> link aworld
->
-> aworld
Hello Assembler world
```



# Appendix A Fitting a ROM

## WARNING:

When fitting a ROM, the BBC Microcomputer and any attachments should be switched off.

If you have a BBC MODEL B + Microcomputer, then follow steps 1, 4, and 5. The ROMs are not located beneath the keyboard, but to the far left, at the rear of the computer.

1. To reach the board which houses the ROMs, undo the four screws which hold the casing together. Two are at the rear of the computer, and the other two are underneath near the front.
2. Once the top is removed, undo the bolts holding down the keyboard assembly. These are located on either side of the keyboard. Some machines have two bolts, others may have three.
3. Carefully lift the keyboard assembly until it is just clear of its locating lugs, rotate it in a clockwise direction until the five ROM sockets on the main circuit board are fully exposed, then rest it on the lower casing.
4. Remove the old ROM by gently prizing up each end of the ROM little by little with a small screwdriver or similar implement, avoiding bending the pins.
5. Fit the new ROM by facing the half-moon cut-out at one end of the ROM away from the keyboard. Holding the ends of the ROM between finger and thumb, line up all the pins with its socket. Do not force it as this may break the pins. If the pins seem too wide for the socket, then try placing one edge of the ROM against a flat surface, and very gently bending the ROM in order to draw the line of pins in closer to the ROM itself.



## Appendix B Trouble-shooting

This appendix deals with trouble. It is divided up into three sections which correspond roughly to the major parts of the User Guide. The best way of using this section is to attempt to define the problem area in terms of hardware, Panos, or the languages, and then see if any headings within the section deal more directly with your problem. If you are completely stuck and have tried the suggestions below, contact your supplier. Note that hardware failings often manifest themselves as software bugs, and a difficulty in installing one of the languages may have arisen out of failure to install Panos correctly.

### B.1 Hardware difficulties

If you suspect faults in the Cambridge Co-Processor itself (the BBC Microcomputer appears to work without the Co-Processor), then inform your supplier. The visible signs of hardware problems include:

1. The Co-Processor does not start. The start-up heading does not appear as shown at the beginning of chapter 2.
2. The Co-Processor keeps switching itself off.
3. Floating point calculations are incorrect. This could easily be due to software bugs and needs very careful checking.
4. A floppy disc fails to copy.
5. The Co-Processor overheats.

### B.2 Problems Installing Panos

If you have followed the instructions in this guide, then Panos should have been installed correctly. If nothing at all seems to work (the Panos prompt does not appear), then try deleting every Panos file and directory, and starting again using your copies of the distribution discs. If Panos does start up, but does not seem to locate programs etc., then check the value of the global variable `cli$path`. This is further described in the *Panos Guide to Operations*. If you are still having trouble installing Panos, then contact your supplier.

### **B.3 Problems with the languages**

If the 'Install' utility does not seem to function, and error messages result from attempting to use the 'Copy' utility, then it could be that you have started up Panos using a !Panos file which contains unsuitable global variables for installing the language on your filing system. Use a version of !Panos which is the same as that on the distribution disc.

Any other problems with the languages, such as bugs in the compilers themselves, should be written on the Fault Report Forms which you received with the system.

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