RESEARCH MACHINES

LINK 480Z

DISC SYSTEM

USERS GUIDE

REVISION 1

PN 11900 Revision 1

Link 480Z Disc System Users Guide
PN 11900 Revision 1

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Electrical Safety

The mains powered equipment manufactured by Research Machines and referred to in this handbook comes in the category "Class 1 Apparatus" under British Standard 415. For your safety and to comply with the requirements of that standard, the following notice is given.

Warning: This apparatus must be earthed.

Important: The wires in the mains lead(s) of this apparatus are coloured in accordance with the following code:

Green-and-yellow: Earth

Blue: Neutral

Brown: Live

As the colours in the mains lead(s) of this apparatus may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- The wire which is coloured green-and-yellow must be connected to the terminal in the plug which is marked by the letter E or by the safety earth symbol or coloured green or green-and-yellow.
- The wire which is coloured blue must be connected to the terminal which is marked with the letter N or coloured black.
- The wire which is coloured brown must be connected to the terminal which is marked with the letter L or coloured red.

Should the mains plug fitted to this equipment not be suitable for the socket outlets you have available, it must be cut off and a suitable type fitted. If in doubt, consult a qualified electrician.

- If the plug has been removed from the mains lead of this product, it must be disposed of immediately. Use of the plug after removal will cause a shock hazard and must be prevented.

- When changing the plug fuse, the fuse cover must be refitted — if the cover is lost, the plug must not be used until a replacement fuse cover has been obtained. Fuse covers are obtainable from Research Machines, quoting Part Number 13589.

The colour of the fuse cover must match the colour of the inserts near the base of the plug, and only replacement fuses approved to BS1362 and ASTA may be fitted.

Preface

This Guide has been written as an introduction to the Research Machines 480Z Disc System. It is intended to enable the new user to install the system, and to use it effectively. The Guide describes both the equipment and the operating system, and how to use them to run programs. General principles and precautions are included where appropriate.

The Guide has been designed to be read from cover to cover, although complete beginners should not go beyond chapter 4 until they are confident in setting up the system properly and in getting it running.

Chapter 1 is a general introduction to microcomputers and the associated terminology, while chapter 2 shows you how to install your new 480Z disc system. In chapter 3, there is a description of the main features and facilities of the system. Chapter 4 explains how to start up your system, how to run the Welcome Disc, and how to load CP/M from the Master System Disc.

In chapters 5 and 6 you will find a description of the activities that the system can perform on discs and on disc files. Other features of the 480Z are described in chapter 7.

Chapter 8 discusses the use of a silicon disc and Chapter 9 discusses the use of the 480Z as a network station with local disc storage.

Other 480Z Manuals

If you are interested in using the 480Z as a cassette system with BASIC in ROM and ROMPACK facilities, you should consult the following two manuals available from Research Machines:

Link 480Z Cassette System Users Guide, PN 11684

and

BASIC in ROM Reference Manual, PN 11682

Further information about the CP/M operating system used on the 480Z disc system is to be found in another manual delivered with the disc sytem, the "CP/M Operating System Users Guide, PN 11901". This describes the commands and utilities contained in the version of CP/M supplied by Research Machines for use on a 480Z disc system.

A full description of Research Machines BASIC for disc systems is provided by the "Extended BASIC Versions 5 and 6 for Disc and Network Systems, Reference Manual", supplied with your disc system.

If you want detailed information about the hardware, firmware, or operating system of the 480Z, or if you want to program in machine-language or assembly-language, there are other manuals which may be ordered from Research Machines. They are:

- LINK 480Z Information File, PN 10939

  This manual contains detailed information about the LINK 480Z hardware, especially the physical characteristics of the input/output ports, the high resolution graphics option, and the printed circuit boards.

- Firmware Reference Manual, PN 10971

  This publication describes the Front Panel and EMT

firmware facilities contained in the COS and ROS monitors

- CP/M and CP/NET Programmers Guide, PN 12084

  This publication describes the programmable interfaces available in CP/M and CP/NET for users wishing to use the BIOS and BDOS facilities.

- Machine Language Programming Guide for 380Z and 480Z, PN 11068

  This publication describes machine language programming for the Z80 microprocessor using the Front Panel facility.

- ZASM Assembler for Disc and Network Systems, PN 11066

  This publication describes the facilities of the Research Machines ZASM Assembler which translates assembly-language into machine code.

Conventions Used in This Manual

The following conventions are used throughout this manual:

- All lines of text printed in `OCR-B` represent messages displayed on the screen, as in:

  ```
  Press any key to continue
  ```

- In keyboard entries, all specified characters are to be keyed in separately, except when contained between "<" and ">".

- Entries contained between "<" and ">" refer to either a single key, as in <RETURN>, or two keys pressed simultaneously, as in <CTRL/C>.

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Chapter 4: Getting Started

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Chapter 7: Other 480Z Facilities

Chapter 8: Silicon Disc Operation

Chapter 1
Microcomputers

A Glimpse For Beginners

Most of you who read this manual will already have a good grasp of what microcomputers are and what they are capable of. Many of you will have a far greater knowledge than we could pass on in several complete manuals of this size, never mind a short introductory chapter. If that is so, you can safely go to chapter 2. If you are new to the world of microcomputers, this chapter is the way in.

Computers have come a very long way in a very short time. Only twenty five years ago, a computer able to do what your 480Z can do would have filled an entire office, and it would have taken a team of people to run it. Now, the computer is small enough to sit on a desk — a remarkable reduction in size that accounts for the family name of Microcomputers — and only one person is needed to make use of the huge potential it offers — YOU, the user.

A microcomputer (often called just a micro) is simply an electronic machine which processes information very rapidly. It cannot think for itself; it does exactly what it is told to do. However, it is designed to behave in certain ways.

Inside the microcomputer there are millions of electronic switches working very rapidly. The switches are controlled by the microcomputer itself — no operator could possibly work fast enough — following sets of instructions built in by the designers.

Switches working switches working switches working . . . very rapidly.

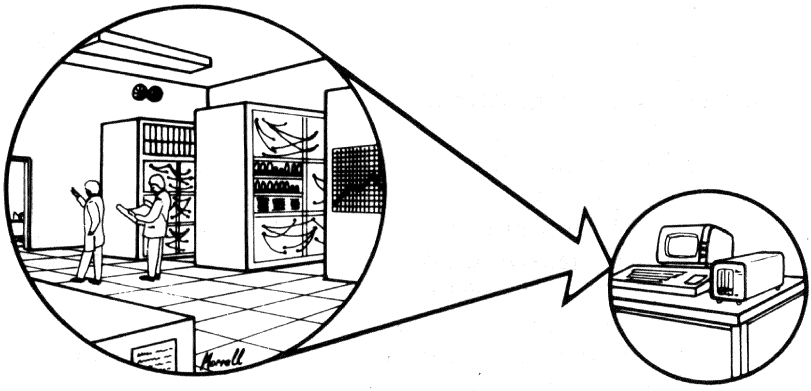


Figure 1.1 A Remarkable Reduction in Size

The user is very slow in comparison, working switches on a keyboard, for instance, and feeding instructions one by one to the microcomputer. But the job can be speeded up considerably by writing all the instructions together, one after another, until the whole task is described. This is called a program.

The program can be stored in a series of magnetic signals on cassette tape or floppy disc. This can be fed into the computer, which reads all the instructions and carries them out at its own speed, that is very, very quickly.

If this makes microcomputers sound complicated, they are. On the other hand, they are arranged in such a way that you can use them very easily without knowing very much about how they work.

Using a microcomputer is rather like driving a car. Many people learn to drive very well and go on to use a car for most of their lives without bothering about how the engine, gearbox, transmission, or brakes work. However, as any car enthusiast will tell you, the more you know about what goes on inside it, the more fun you can get from your car, the more efficiently you can run it, and the less likely you are to need help when things go wrong.

Even if you have only just started to learn about computing, you are only a short step away from being able to give your 480Z the instruction:

```
PRINT "IT'S EASY"
```

and it will print on your display screen — IT'S EASY — And it is!

Let's look at the bits and pieces that you will find in a typical microcomputer system. Roughly speaking there are two main groups:

- The hardware
  the electronic components themselves

- The software
  the programs that tell the computer how it is to do what it does.

Hardware

The hardware in a microcomputer system is likely to include some or all of the following:

- A keyboard
- A visual display unit
- A processor
- An internal memory
- An external storage device
- A printer

Some of these devices may be contained in the same case. Indeed, some microcomputers group all of the above, except the printer, into one case. In your 480Z system, the processor, the internal memory, and the keyboard are all built into one unit, while the disc drive(s) and the visual display unit are in separate units. These components are shown in figure 1.2.

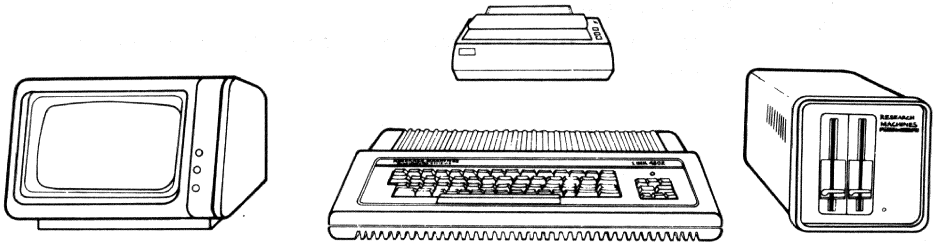


Figure 1.2 The Major Components of a Typical Microcomputer

The *keyboard* is used to put information into the computer. On the 480Z, there are alphabetic and numeric keys, similar to a typewriter, and function keys with special uses that will be explained later. A 480Z keyboard is shown in figure 1.3. Whenever you press a key with either an alphabetic or a numeric character on it, you will usually see the corresponding character displayed on your visual display unit.

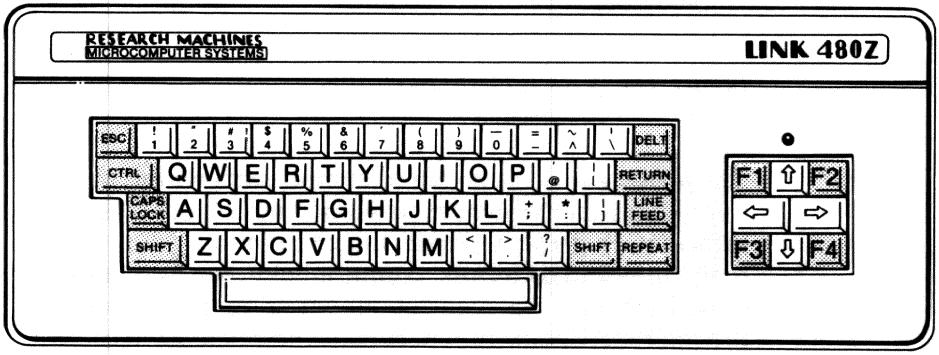


Figure 1.3 Keyboard

The *visual display unit*, often called simply a display or monitor, or abbreviated to VDU or CRT (Cathode Ray Tube), is used by the microcomputer system to display information about the task being performed at the time. The display can consist of any combination of alphabetic, numeric, or graphic characters from the character set held in the internal memory.

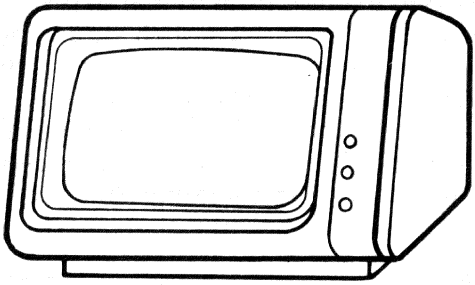


Figure 1.4 Visual Display Unit

The *processor* is the group of components within the microcomputer which, as its name implies, processes the information presented to it. Included in this group are many integrated circuits, commonly known as "chips", and at least one microprocessor, shown in figure 1.5. It is the microprocessor that performs the calculations and logical operations on the information in the computer, following the instructions in the program.

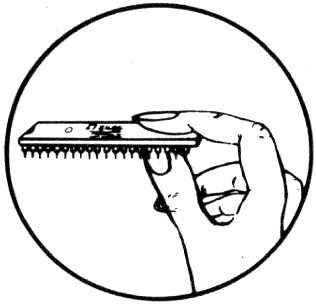


Figure 1.5 The Microprocessor

The *internal storage* has two parts; the random access memory (or RAM) and the read only memory (or ROM).The random access memory holds both the program being run and the information being processed by that program. However, this memory is 'volatile', that is, when the system is switched off, the contents will be lost.

The read only memory is separate from the random access memory and it is non-volatile, which means that its contents are not lost when the system is switched off. In the 480Z, the ROM contains instructions for controlling the system, and these instructions are sometimes known as *firmware.*

The *external storage device* is usually in the form of magnetic tape or magnetic disc. Your 480Z, for instance, uses double density magnetic discs handled by a separate disc drive unit as shown in figure 1.6. This form of storage is non-volatile; it remains unchanged from the time it is "written" to the time when it is overwritten or deleted. The system may "read" the information any number of times without it being changed. Discs and disc storage are discussed more fully in chapters 3 and 5.

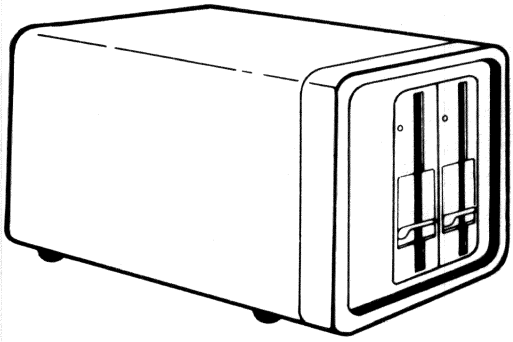


Figure 1.6 480Z Dual-Drive Disc Unit

The *printer*, shown in figure 1.7, is used to print out a copy of the processed information resulting from the work carried out on the computer. The copy is printed on paper, usually in continuous form, and is called a print-out or listing.

A printer may not be part of your 480Z microcomputer system, although you will benefit by having access to one. Chapter 7 gives details of how to connect up and use a printer with your system.

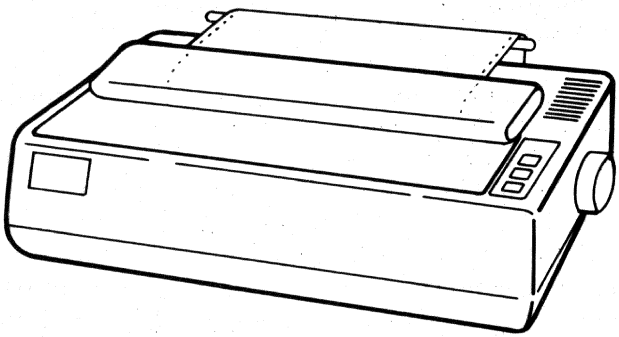


Figure 1.7 Printer

A print-out is the most permanent record of the information processed by a computer. However, because programs and data can be easily changed in the computer without obvious signs of change, make sure that your print-out is up to date and does actually represent the information intended.

Software

The term *software* means the programs of instructions that enable the computer to carry out some task. It could be a small task, such as adding one and one, or it may be a large task, such as sorting the names that are to go

into a telephone directory in alphabetical order.It may be simple, such as changing one 'bit' (binary digit) in the microprocessor, or complicated, such as controlling a guided missile.If it is a set of instructions that the computer can follow to perform some particular function, then it is software.

Software could be written in everyday English but computers do not understand English; so software is written in one of the many languages that they do understand.Some of the languages look like English and are quite easy to understand; they are called high level languages.Others may look like a lot of nonsense to those unfamiliar with them but are quite easy for the computer to understand; these are called low level languages.

There are many good publications on the subject of designing and writing programs on sale at any bookseller.

Software may also be represented by a series of diagrams, commonly referred to as "logic diagrams" or "flow charts". These diagrams are essential for writing and understanding what a program does, what it produces, what it needs to know in order to run, and how it achieves its aims. Very often, a program is designed as one or more flow charts before any instructions are written. It is very difficult to write efficient and error-free programs without first describing them with a logic diagram or flow chart.

There are two types of software:

- System software
- Applications software

System software is the set of programs supplied with a computer by the manufacturer to take care of the job of managing the system itself.

The most important part of this software is used to control all the facilities of the computer. Most of the operations that you want the system to carry out time after time are included. These instructions are called "routines" because the same set of instructions can be used by many different programs to do many different jobs.

It is an extremely laborious process to write individual programs for the system and takes a considerable amount of experience and skill. System software removes the tedious repetitive tasks, and it makes the system quick and easy to program and to use.

Applications software refers to the programs used to perform your particular needs. These programs cover a wide range of uses such as budgeting, timetabling, designing, accounting, and word processing.

A considerable amount of software is already available for your 480Z disc system and the needs of a typical user are well catered for. You may write your own programs for specific applications, but it can save a lot of time and effort, especially in the early stages, if you can make use of any suitable existing applications software that has already been tested.

Software Documentation is the description of any particular piece of software. Like any other piece of equipment that you may want to use, software should be

accompanied by a manual of some sort to tell you what it is, what it does, how to use it, how to maintain it, and so on.To get the best out of your software always read carefully through the manual or instructions supplied with it.

CP/M

This manual gives an introduction to some of the facilities of CP/M, the software that you will use regularly on a 480Z Disc System. CP/M, short for Control Program for Microcomputers, is a disc operating system, developed by Digital Research, that has been adapted for use on the 480Z.For a complete description of the Research Machines version of CP/M you will need to refer to the "CP/M 2.2D Operating System Users Guide" PN11901

There are other manuals to cover the software products supplied with your system but you should leave them alone for the time being. This manual contains all that you need to set up your system and to get it running, so read through the remaining chapters first.

The next chapter takes you straight into installing the 480Z equipment and switching on. This is intended to familiarize you with handling the equipment without having to know what each switch, socket, light, or button is used for. Later chapters tell you more about that.

Chapter 2
Installing Your New 480Z Disc System

Your newly delivered 480Z microcomputer disc system may be supplied in a variety of ways. All the main components may have been supplied together by Research Machines, or you may have extended an existing 480Z cassette system to include disc storage. If you are adding a new 480Z Disc Unit to an existing 480Z cassette system (or Network Station), you can skip the early sections of this chapter and go straight to "Connecting the 480Z Disc Unit".

The beginning of this chapter concentrates on the user who has just taken delivery of a complete new system. Other situations are discussed where appropriate, and existing users may skip the various parts of the chapter that do not apply to them.

The Delivered Components

By the time you reach this point in the manual you will probably have unpacked all the components delivered with it. Check that you have received everything that you ordered. If any item is missing, please contact Research Machines stating your order number and what is missing. The omission will be put right.

Keep all the boxes and packing materials as well as the transport card in each disc drive. If a fault occurs in any component, you can then return it to Research Machines in its own purpose-built packaging. We recommend that the original packaging should also be used when transporting the equipment from place to place.

To operate your 480Z disc system, you must have the following components:

- A 480Z microcomputer complete with a mains lead fitted with a 13-amp plug.
- A disc drive unit containing either one or two disc drives, fitted with a mains lead and a 13-amp plug.
- An interface cable to connect the disc unit to the microcomputer.
- A visual display unit (video monitor or UHF television) complete with a mains lead fitted with a 13-amp plug.
- An appropriate VDU to microcomputer signal cable fitted with connectors.
- A multi-way extension lead or adapter for your mains supply. Ideally, there should be one socket for each item.
- The appropriate documents and discs.

Note: All mains lead plugs must be fitted with 2-amp fuses, as supplied by Research Machines Ltd.

You may also have various other items, such as a printer or a cassette recorder, but the items listed above are essential.

Setting Up

To get the best out of your 480Z disc system, it should be set up in a situation where both you and the equipment can operate satisfactorily. Make sure that you can comfortably reach all the controls from where you are sitting. Position the monitor display where you can see

the screen easily, but leave enough room for the manuals and paper that you need.

A suitable location will be:

- Close to a mains supply outlet, to avoid trailing wires.
- Reasonably free from dust and dirt which can damage both your discs and the drives.
- Roomy enough to allow an unobstructed air passage from the fan, and so help to avoid overheating.
- Out of direct sunlight; the heat and ultra-violet light can be damaging to the materials used in the system, can change the state of some of the components, and can cause you eyestrain.
- Quiet and undisturbed so that you can concentrate on what you are doing

A typical layout is shown in figure 2.1, below. Set up your 480Z system in a similar way.

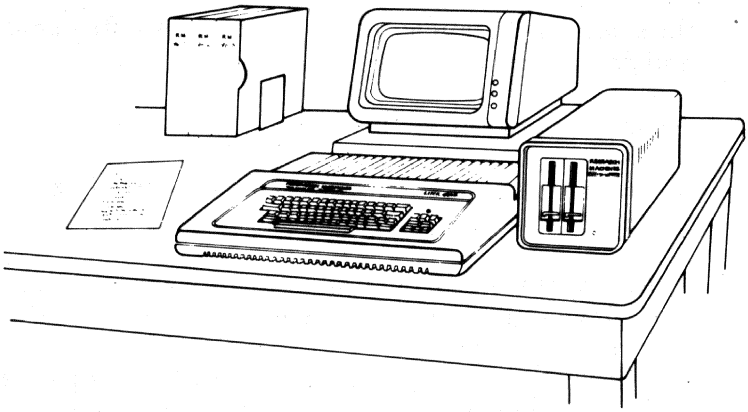


Figure 2.1 A Typical 480Z Disc System Layout

Any strong bench or table can be used to hold your system, and various special purpose racks are commercially available. Keep the keyboard and display monitor in front of you, within reach, and at a comfortable height. If you cannot arrange this, you may end up with very tired arms and a stiff neck before you have operated your 480Z for very long. You will have to keep all the units reasonably close together so that the signal cables will reach.

Handling and Transport

Your 480Z system is built to withstand frequent handling, but the equipment should be treated gently. Protect it from shocks, knocks, and vibration, and take particular care not to drop any of the devices.

If you are transporting the equipment any distance, repack it in its original packing. Disc drives should be protected by replacing the transport cards.

Connecting Up

The various sockets on the rear panel of the 480Z are shown in detail in chapter 7, and also in figure 2.2. Each socket is labelled with an indication of what device(s) it can be connected to. It is a good idea to learn which connections go where without having to look at this Users Guide each time you connect one of these devices (such as a monitor, T.V., or printer) to it.

If you have an earlier, metal-case 480Z, the rear panel connections are almost the same as in the figure shown.

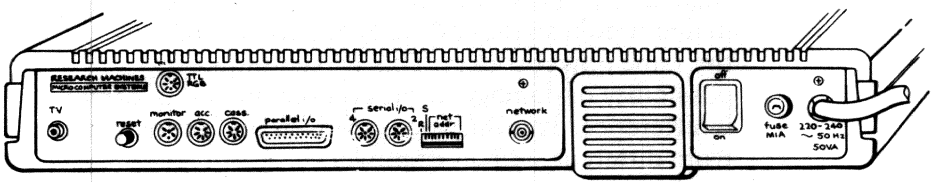


Figure 2.2 480Z Rear Panel

The connections needed to make your system run are shown in figure 2.3. The layout of the cables has been simplified for clarity and you may find that your system does not look as neat as this at the back. However, you will find it easier to connect and disconnect the units if you keep your cables tidy.

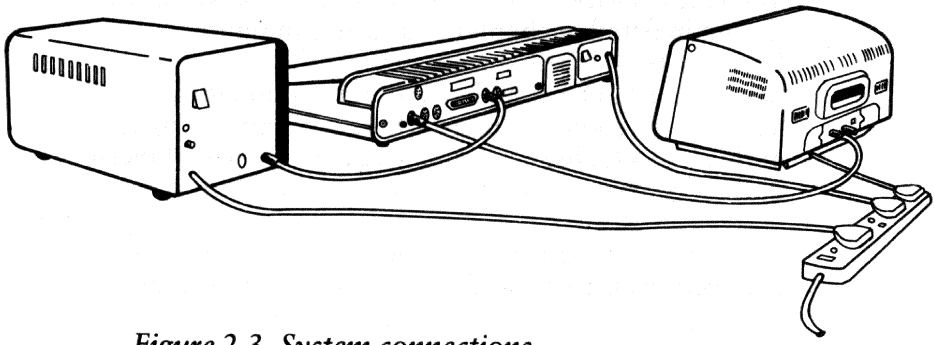


Figure 2.3 System connections

It is important to use either a multi-way extension lead, such as that shown in figure 2.4, or an adapter on the mains supply so that all components can be connected to the same power socket. This will eliminate the possibility of damage to the equipment and of earthline interference. This might cause program failure resulting from different sources of power.

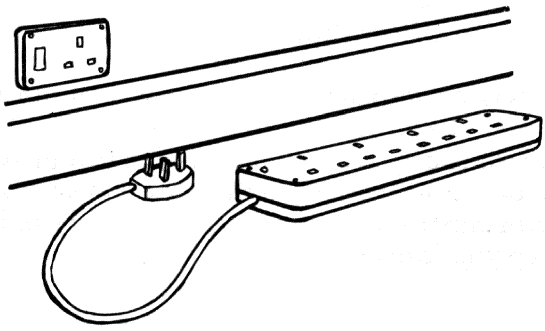


Figure 2.4 Multi-way Extension

For safety, leave the mains extension lead or adapter unplugged until you have made all the other connections

Connecting the 480Z Disc Unit

Connect up your 480Z and disc unit as follows:

- Plug the three mains leads, from your 480Z, from your disc unit, and from your VDU, into the extension lead or adapter, as shown in figure 2.5, but leave the extension or adapter unplugged.

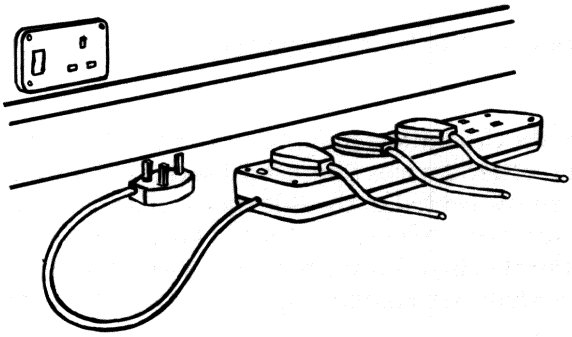
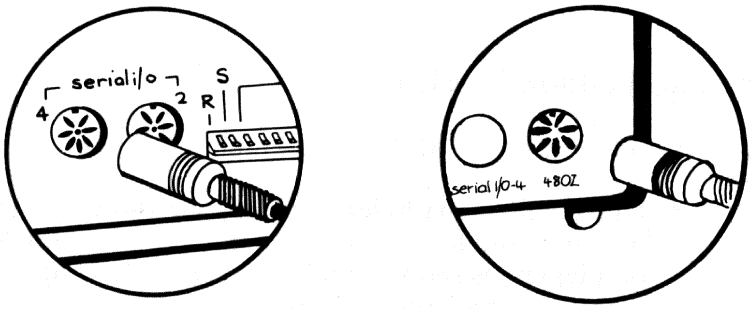


Figure 2.5 Mains Leads Connections

- Connect one end of the disc unit interface cable to the Serial I/O 4 socket on the rear panel of the 480Z as shown in figure 2.6(a), and the other to the socket marked "480Z" on the rear of the disc unit, as shown in figure 2.6(b).



(a) *(b)*

Figure 2.6 Disc Unit Interface Cable Connections

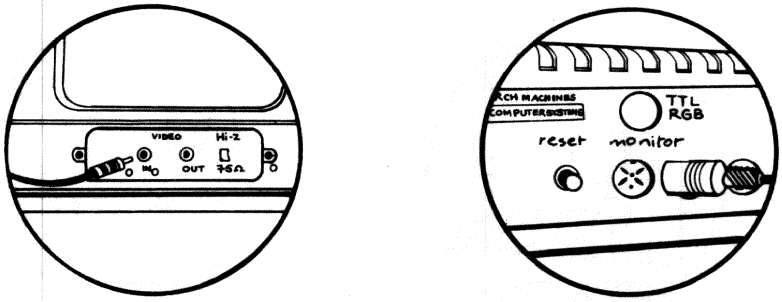
When the disc unit is plugged into the 480Z serial I/O 4 socket, other devices that need a serial I/O 4 socket must be connected to the one on the rear panel of the disc unit, shown in figure 2.6(b). This is most likely to occur when you want to connect a serial printer to your system (see chapter 7).

Connecting the Visual Display Unit

Connect the visual display unit as follows:

For a black and white monitor —

- Push the phono plug (single-pin) on the signal cable into the VIDEO IN socket on the rear panel of the monitor, as shown in figure 2.7(a), and connect the 6-pin DIN plug on the signal cable into the socket marked MONITOR on the rear panel of your 480Z, as shown in figure 2.7(b). If there is a Hi-Z switch on your monitor (usually on the rear panel), set it to the position labelled 75-ohm, as shown in figure 2.7(a).



(a) *(b)*

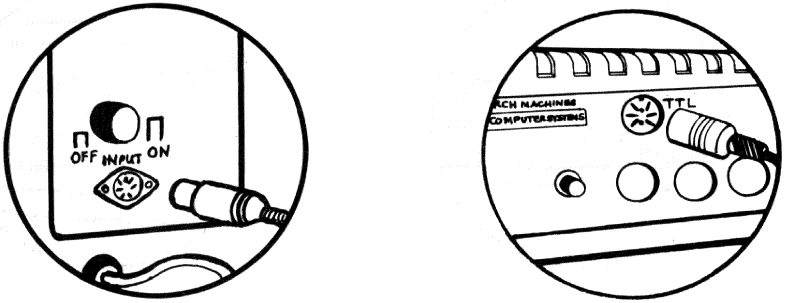
Figure 2.7 Black & White Monitor Cable Connections

For a black and white T.V. —

- Connect the aerial plug on the T.V. signal cable to the aerial socket on your T.V. and the phono plug on the other end of the cable to the socket marked TV on the rear panel of the 480Z.

For a colour monitor —

- Connect the 6-pin DIN plug on the signal cable to the input socket on the monitor, as shown in Figure 2.8(a), and connect the 8-pin DIN plug to the TTL/RGB socket on the rear panel of the 480Z, as shown in figure 2.8(b).



(a) *(b)*

Figure 2.8 Colour Monitor Signal Cable Connections

Your 480Z disc system is now ready to be plugged in and switched on.

However, if you are not familiar with discs and disc storage, the next chapter has been written to give a basic understanding of how they work and how to use them. Before starting up your 480Z, it is worth reading it through. It should remove some of the mysteries, although you will find that it is no more than an introduction to the the extensive capability of your 480Z disc system.

Chapter 3
Your 480Z Disc System

This chapter gives details of the main control switches on the rear panel of the 480Z, the control switches on your disc unit and the control switches on a black and white monitor.

Then, there is a description of the 480Z keyboard, its character keys, and control keys.

Finally, there is a section on discs, and how to load and unload your disc unit.

The 480Z Disc System

The 480Z Disc System consists of:

- A LINK 480Z microcomputer equipped with
  - — at least 64K bytes of main memory
  - — Version 1.2 or later of the ROS monitor

  and optionally
  - — High Resolution Graphics
  - — Analogue to digital converter.
- An MD1, MD2, MQ1 or MQ2 disc unit
- A visual display unit or RGB colour monitor.

Your system may also include:

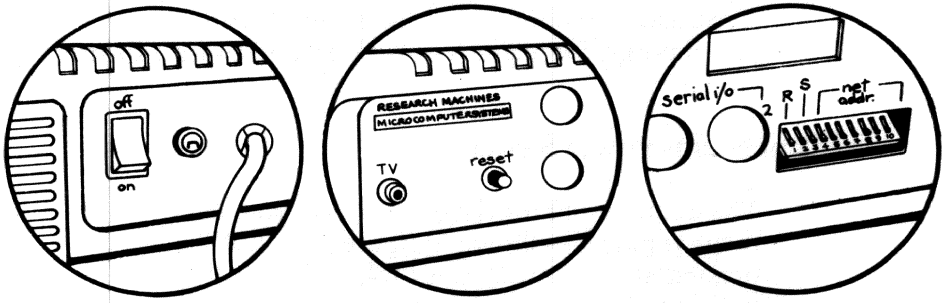
- A printer
- A cassette unit
- ROM Packs
- Other input/output devices and accessories such as a sound box or floor turtle
- A silicon disc
- A network interface

Controls and Indicators

The 480Z microcomputer has very few external controls. For most of the time it is controlled by its keyboard or by programs read from discs.

480Z Mains Power Switch

The mains power switch for the 480Z is on the back of the computer, as shown in figure 3.1(a). It is a white rocker switch which is ON when pressed at the bottom. When the power is on, a red indicator lamp on the keyboard lights up.



(a) *(b)* *(c)*

Figure 3.1 Rear Panel Controls

Reset Button

Another important control on the rear panel is the RESET button — see figure 3.1(b). When pressed, the RESET button stops the current program being executed, clears the screen, reinitializes the firmware, but retains the program and its data in the user program area of the main memory.This is particularly useful because it avoids the alternative action of switching off the system, which will erase any program in the memory.

NEVER switch on or off either the system or the disc unit while there is a disc in a drive, as the information it holds may be corrupted or completely lost.

The RESET button can be disabled. This facility is available to protect the program you are using from being halted accidentally by somebody pressing the RESET button. This is especially important if the program does not have a restart point address. One of the miniature switches on the rear panel will do this for you. These are shown in figure 3.1(c). If the switch at the left hand end — marked R — is pushed up, the RESET button will not operate.

Operate the miniature switch with the tip of a screwdriver or some other rigid item. If you use a pencil point, the lead may break off and cause a short circuit.

Disc Unit Mains Power Switch

The main switch for the disc unit is a rocker switch on the rear panel — shown in figure 3.2(b). When it is pressed at the bottom, it is ON, and a small red indicator lamp on the front panel lights up, as shown in figure 3.2(a). A lamp on each drive indicates, when lit, that data is being transferred to or from the disc in that drive.

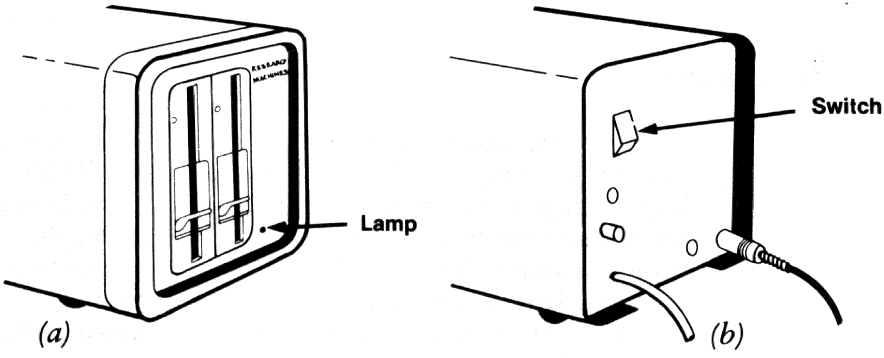


Figure 3.2 Disc Unit Front and Rear

Black and White Monitor

Various different makes and models of black and white monitor may be used in a 480Z disc system.In addition to the usual controls — ON/OFF, Contrast, Brightness — most monitors will have a switch on the rear panel marked Hi-Z/75 ohm, as shown in figure 2.7(a); this should be set to 75 ohm (down) when only one monitor is being used. However, if a series of monitors is being used, then all except the last one in the series should be set to Hi-Z, and the last monitor should be set to 75 ohm.

The 480Z Keyboard

You will normally control your 480Z system through the keyboard; the system provides a visual response on the display. It is important that you should learn how to communicate effectively with the system through these two devices.

The main keys on the keyboard of your 480Z, shown in figure 3.4, are very similar to those on a normal typewriter keyboard. In fact, the alphabetic and numeric keys are identical, but the symbol keys have various differences, and there are several additional keys (control keys) which have special purposes. The use of character keys and control keys is described in more detail below.

There is also a small keypad, at the right of the keyboard, consisting of a separate block of eight keys . These keys, which are marked, F1, F2, F3, F4, and four arrowed keys, can each be programmed to send a sequence of characters to the computer; consequently, they are very useful in replacing keying sequences that are repeated frequently when you are entering information through the keyboard. For this reason they are called the function keys. The method of programming the function keys is through an "escape sequence" ; this is described in appendix B.

Keypad overlays are provided with some of the standard software such as BASIC — shown in figure 3.3 — TXED, or WordStar. An overlay is a thin, plastic, sheet that surrounds the small keypad, indicating what function each key performs when you are running the particular program to which the overlay refers.

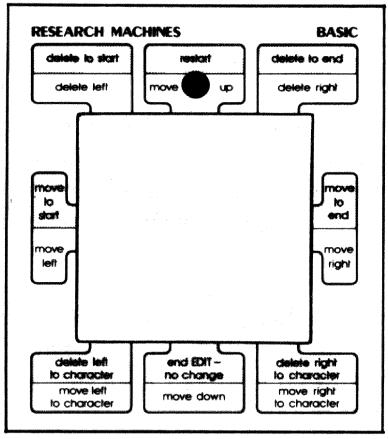


Figure 3.3 A BASIC Keypad Overlay

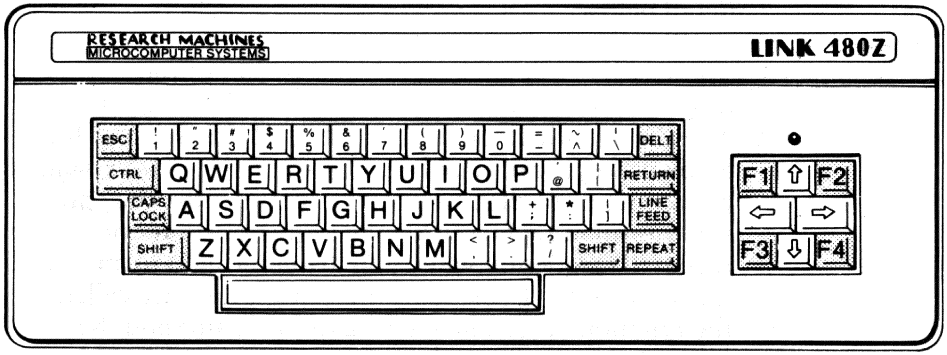


Figure 3.4 The Link 480Z Keyboard

Character Keys

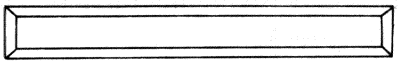
When you press a single character key, the keyboard transmits the character inscribed on the key to the 480Z processor. Alphabetic keys provide the lower-case version of the character inscribed on the key; non-alphabetic keys provide the lower of the two characters inscribed on the key.

To obtain capital (upper-case) letters and the remaining characters, see the description of the SHIFT and CAPS LOCK keys below. Usually the character is displayed on the screen immediately the key is pressed, although this depends on the program being run.

The cursor is a special character displayed on the screen to indicate where the next input character will appear, and it can be moved around the screen using certain control keys (DELT, LINE FEED, and SPACE). In CP/M, the cursor is a bright rectangle the size of the largest character in the character set.

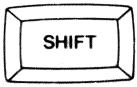
Control Keys

The function of each control key is described below: the descriptions are given in order, working up the keyboard from the bottom:

SPACE BAR 

Pressing the Space Bar sends a "space" character to the processor and normally moves the cursor one character position to the right. Notice that a space is recognised as a definite character by the 480Z, and is stored as such. It is not the same as on a typewriter where a space is the absence of a character.

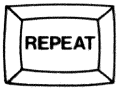
If the cursor is already at the extreme right-hand edge of the screen, then, when and the space bar is pressed, the cursor will move to the extreme left-hand end of the next line down.

SHIFT 

The SHIFT key is used in conjunction with a character key. When it is pressed down at the same time as one of the alphabetic keys is pressed, it causes the upper-case (capital) of the letter inscribed on the key to be input to the computer. When used with a non-alphabetic key, it

causes the upper of the two characters inscribed on the key to be input to the computer.

There are two shift keys which perform identical functions.

REPEAT 

The REPEAT key is used to repeat the action of any key on the main keypad. Press a key, then press REPEAT to repeat its action. Hold the REPEAT key down until the desired number of repetitions has occurred. It can be used with any character or control key.

CAPS LOCK 

(CAPS is short for CAPITALS)

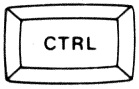
The CAPS LOCK key is similar to the SHIFT LOCK key on a typewriter, except that it applies only to the alphabetic character keys, switching them between the upper-case and lower-case modes.

Press the CAPS LOCK key to put the keyboard in upper-case mode and all subsequent alphabetic keys pressed will provide upper-case characters. Press it again to put the keyboard in lower-case mode and all subsequent alphabetic keys pressed will provide lower-case characters.

The non-alphabetic keys are unaffected by the use of the CAPS LOCK key. Their mode of operation is changed by the SHIFT key.

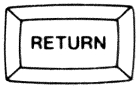
LINE FEED 

Pressing this key generates a character and moves the cursor down the screen to the line below. However this action may be altered by the program being run, so you should check the manual supplied with the program.

CTRL 

(CTRL is short for CONTROL)

The CTRL key is used in conjunction with an alphabetic key to perform functions specific to the program being run. The CTRL key must be pressed down when the associated character key is pressed. Its use will normally be referred to in the instructions for using the program. Control commands that use the CTRL key are explained as they arise later in the manual.

RETURN 

The RETURN key is normally used to inform the processor that you have finished entering either a command or a line of text. Its precise action depends on the program being run, so have a look at the instructions.

ESC 

(ESC is short for ESCAPE)

This key generates a character and is used to perform functions specific to the program being run. Again you should check its use in the program instructions.

DELT 

(DELT is short for DELETE)

Pressing the DELT key sends a "delete" character to the processor; this usually moves the cursor one character position to the left and deletes any character that was in that position. If the cursor is at the left-hand edge of the screen when DELT is pressed, it does not move.

Discs

Most of the information that your 480Z disc system will handle will be stored on floppy discs. In many publications you may find floppy discs called discettes, discs, and sometimes floppies. However, for both brevity and consistency, rather than for correctness, we call them simply *discs*, a term also used loosely to include the square black jacket containing the floppy disc itself.

Disc Characteristics

Discs are circles of thin flexible plastic sheet coated with a magnetic oxide, and they are designed to rotate at speed inside the jackets which both support and protect them. They come in several sizes, and there are many different manufacturers. Your 480Z uses 5.25-inch discs, but before buying any discs for use on your 480Z, see the section on purchasing discs in chapter 5. Figure 3.5 shows a 5.25-inch disc.

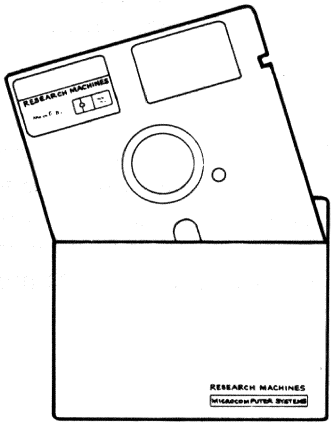


Figure 3.5 Disc and Envelope

The black jacket has several cut-outs. The large hole in the centre of the disc allows the drive to grip the disc and to spin it. The oval cut-out allows access for the read and write heads to transfer information to and from the disc. The square notch in one edge can be covered to give protection of the information on the disc by preventing it from being overwritten. The other cut-outs are for timing and disc location purposes.

All the information that your computer uses can be stored on discs; once it is written onto a disc, it remains there until it is erased or overwritten by new information.

Handling Discs

The information stored on discs is valuable to the user; yet discs can easily be damaged and the information lost. Therefore, it is worthwhile taking some simple precautions when handling discs.
Discs should be protected from:

- Magnetic fields
  Keep discs away from magnets and electrical equipment, particularly T.V.s and monitors.

- Dust, smoke, grease and dirt of any kind
  Keep discs in their envelopes and in a box when not in the drives.

  Avoid touching the surface of the disc through the cut-outs in the jacket.

  Keep cigarettes, food and drink well away from your discs.

- Distortion
  Keep discs flat at all times and avoid bending them. Store discs vertically.

Avoid indenting the disc surface. Either write on labels before sticking them to the jacket, or make alterations to labels only with a felt-tip pen.

Prevent anyone from trying to open the black jacket containing the disc, or from trying to remove the disc from it.

- Heat
  Keep discs out of the sun and away from other heat sources such as fires, radiators or lights.

Remember

If you allow your discs to be damaged in any way, you may lose the information on them and perhaps damage any disc drive in which you try to use them.

Loading Discs — MDn and MQn Drive Units

Once you have loaded discs correctly a few times (and even done it wrongly once or twice), the actions will become so automatic that you will not really think about them any more. However, initially they are not entirely straightforward.

The standard MD1, MD2, MQ1 or MQ2 480Z disc unit has either one or two disc drives, and each drive will take only one disc at a time. A disc can be loaded into either drive in eight different ways, but only one of them is correct. If you do it wrongly, a "DISC ERROR" message will show on the display.The correct way to do it is as follows:

- Switch on the 480Z and the disc unit.

- Remove the disc from its envelope (but not from the black jacket).

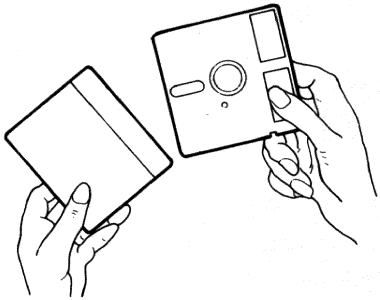


Figure 3.6 Remove the Disc

- Press the latch upwards and check that the drive is empty.

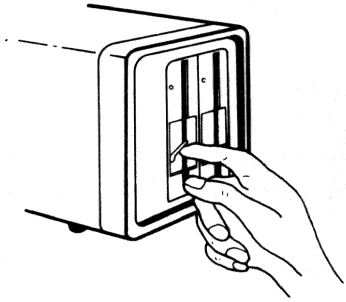


Figure 3.7 Open the Drive

- Insert the disc with the maker's label towards the latch, and the long oval cutout in the black envelope leading, as shown in figure 3.8.

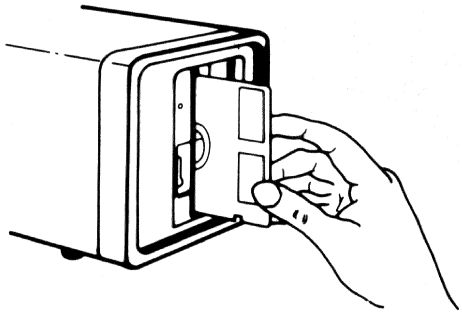


Figure 3.8 Insert the Disc

- Push the disc right into the drive until it clicks into place, as shown in figure 3.9.

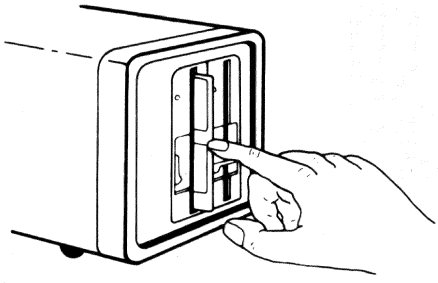


Figure 3.9 Push the Disc Right Home

- Lock the disc into the drive by closing the latch.

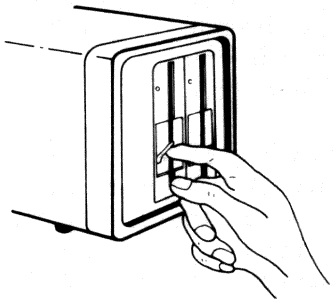


Figure 3.10 Close the Latch

Unloading Discs

Always unload the disc drives *before* switching off either the system or the disc unit.

- Open the latch as indicated above.
- Remove the disc.
- Close the latch.

Notes: We stress the importance of not switching on or off either the 480Z or the disc unit while there is a disc in the drive. It will not necessarily corrupt the information held on the disc, but it could do so; it is a good practice not to take that risk.

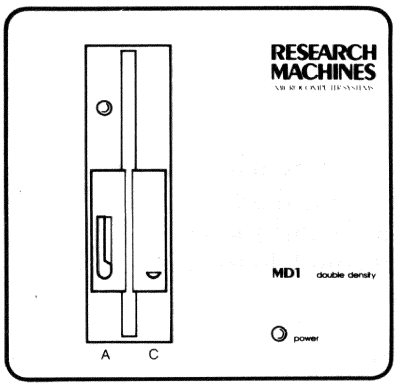
Special Primary School (DTI) Disc Drives

This manual contains descriptions of disc drives that have a lever-operated mechanism to hold the disc in place. Some LINK 480Z MD–1 systems, however, have a flap across the slot instead.

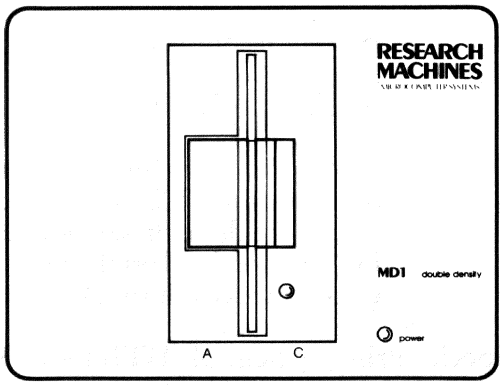
There is no difference whatsoever between the two drive units in the way that information is stored on and retrieved from the discs, and discs may be freely interchanged between the different types of drive unit. There are, however, minor differences in appearance and use which this note will describe.

The lever disc drive shown in the Users Guide has a rather narrow front panel, a locking lever near the bottom of the disc slot to secure the disc in place, and an indicator lamp showing when a read or write operation is in progress near the top left of its front panel.

In contrast, the flap disc drive has a somewhat wider front panel (in fact the whole unit has a wider case and front panel), the lamp showing that the drive is operating is fitted near the bottom right corner of the front panel of the drive, and to hold the disc in place in its slot there is a small flap or door about half way up the disc slot.



A lever type of disc drive



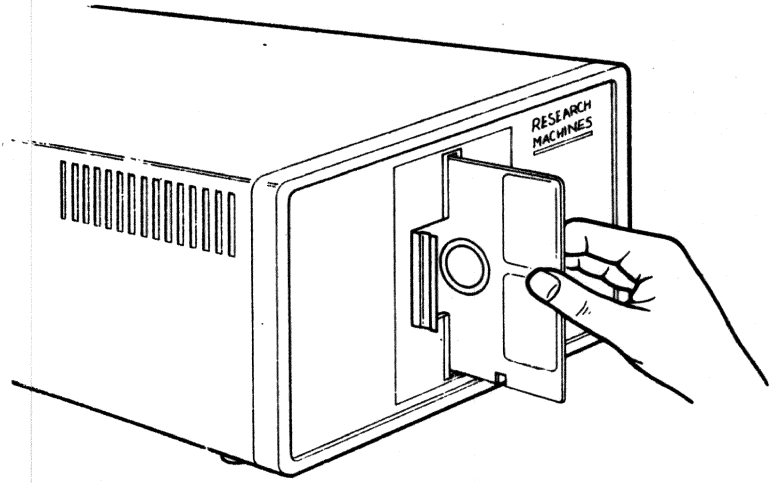
A flap type of disc drive

To open the slot of a flap type of drive, for insertion or removal of a disc, gently press the flap to the left of the disc slot.

To close the flap, pull the slightly protruding edge across the disc slot from left to right until it latches into place.

A disc can only be read from or written to if the flap is closed.

The orientation of the disc is the same in both types of drive unit. As usual, there are eight ways of inserting the disc and only one of them is correct! A disc envelope has slots through which the read/write heads in the drive unit can make contact with the disc surface, and in one edge a rectangular notch that can be covered to give the disc "write protection". A disc must always be inserted read/write slot first, with the notch at the bottom.



Inserting a Disc

Chapter 4
Getting Started

In this chapter you will read how to start up your 480Z disc system and get it running.

If you are a new user, you should have learned by now which features are essential to microcomputer systems, how to install your 480Z, what the external controls do, and which physical aspects of working with discs are important. These topics are covered in the first three chapters.

If you have had some experience of microcomputer disc systems, pick out the features from chapters 2 and 3 which relate solely to the 480Z system, and make sure that they match what you already know. A few minutes spent now could avoid a lot of frustration when the system is up and running, but refuses to behave in the way that you expect it to.

You are now prepared to switch on your 480Z disc system.

Switching On

Before turning on the mains supply, check that your system has been correctly connected up, and that the power switch on each piece of equipment is set to off. Now:

- Plug the extension lead or adapter into the mains socket and switch on at the socket.
- Switch on the video display unit, noting that some displays take a few seconds to warm up.

The power indicator lamp (if present) will light but the screen will remain blank.

- Switch on your 480Z (using the switch on the rear panel).

The red indicator lamp above the right-hand keypad will light up, you will hear the fan start, and the 480Z sign-on message should appear on the display, similar to this:

```
RML 80 Character LINK 480Z                V 1.2B
Z-Net Firmware Vers 1.1                Address: 00
```

- Adjust the brightness and contrast controls on your visual display unit to make the display as clear as possible.

You may find this easiest if your display is full of information and a quick way to fill the screen is to display the "Front Panel".

The Front Panel is not explained in this manual as it is intended for use by experienced programmers. Here you can use it merely to provide a display to allow you to adjust the screen controls. First press <CTRL> and <F> simultaneously; this displays the Front Panel. Adjust your display controls according to your needs and then press:

<K>

to leave the Front Panel and return to the start-up message. (Refer to the Firmware Reference Manual if you want more information about the Front Panel.)

- There is also the disc unit to be switched on, but first check that there are no discs or transport cards in the drives. If there are, remove them. Switch on using the switch on the rear panel.

You will hear the fan and the drive motor(s) start up, and the red indicator lamp on the front will light up.

All other items in your 480Z system should now be switched on and made ready for use. If any item has failed to come on, check that it is connected to the mains power supply and if so, check the fuses in the mains plug, the mains adapter socket, and in the equipment itself. In the unlikely event of the equipment still failing to respond correctly, then call the Technical Support Department at Research Machines.

We expect that you will find your system is perfectly operational, and you will be looking forward to seeing something on the screen. At the moment all you have is the 480Z sign-on message, similar to this:

```
RML 80 Character LINK 480Z                V 1.2B
Z-NET Firmware Vers 1.1          Address: 00

To start BASIC in ROM type the command
Please give a command or type H for help
```

You can press a few keys now, to get used to the controls. If you press the <H> key on your keyboard, a list of commands will be displayed on the screen. The left-hand column refers to the key that you press, and the right-hand column gives the corresponding command that will be executed.

Do not worry if you cannot understand these ROS commands. You will need to use some of them when you are more familiar with the system. They are introduced in appendix G.

You have already used one of these commands, <CTRL/F>, to display the Front Panel. Now try pressing <W>, and notice that the screen display changes from 40 characters

per screen width to 80 characters per screen width. You can retrieve the original screen width by pressing <W> again.

Take a little time and get used to the keyboard and screen display. If you want to be adventurous, try pressing other keys in the list; remember that you can always get back to the sign-on message by pressing the RESET button on the rear panel of the 480Z.

Having gained in confidence, you are now ready to insert a disc in your disc unit.

Distribution Discs Supplied By Research Machines

The package containing both the 480Z disc drive and this manual also contains two 5.25-inch discs. One of these discs is called the "Master System Disc" and contains a master copy of the programs and files that make up the CP/M operating system and Research Machines Extended BASIC. (See appendix E for a list of these programs and files).

The other disc is called the "Welcome Disc". It contains an introduction to the 480Z disc system, and demonstration programs. This disc can be loaded as soon as you are ready to see your disc system working correctly.

The Welcome Disc

Take the Welcome Disc and, following the guidelines already given on handling and loading discs, insert it into the left-hand (or only) drive of your disc unit.

Press <B> on your keyboard, then watch the screen. A welcome message will be followed by a list, or menu, of demonstration BASIC programs and other options. Try these programs — simply follow the screen instructions.

When you want to finish with the Welcome program, follow the escape instructions to get back to the main menu, then select the exit to CP/M option, at which point you may remove your disc. For instance, if you find that you cannot escape, when you have selected a demonstration program from which there is no exit before the end, press the RESET button on the rear panel of the 480Z. This will *not* damage the disc.

Loading The Disc Operating System (CP/M)

The Master System Disc contains CP/M, the disc operating system. The operating system is read into the computer from the system disc by the "bootstrap", which is the jargon name for a small program, right at the beginning of CP/M, that is designed to be loaded first and bring the rest of CP/M in after it.

And how is the bootstrap itself loaded? By the bootstrap loader, which consists of a few instructions held in the 480Z's firmware and programmed to read the first few bits of information on any disc in the drive. The bootstrap loader is started when the key <B> (for Boot) is pressed.

As the bootstrap will always be found right at the start of any disc on which the operating system has been stored, it is the first program to be loaded. As soon as it is loaded, it is executed, then it loads the rest of the operating system. The operating system is held in main memory throughout this session, until the 480Z is switched off. The whole process is analogous to lifting oneself up by the bootstraps.

The Master System Disc

After you have removed the Welcome Disc, follow these instructions:

- Press the RESET button
- Insert the "Master System Disc" into the left-hand (or only) drive of your disc unit.
- Press <B>.

This is the ROS command that reads the disc operating system from the disc in the left hand (or only) drive.

If CP/M is present on the disc and can be loaded successfully, the following message will be displayed:

```
Research Machines
56K CP/M vers 2.2 F 1/30B
For 480Z Disc Systems
Quad and Double Density

Silicon Disc on drive M:

A>
```

Your system is now under the control of the CP/M operating system, and it is waiting for you to enter a command so that it can do something for you, such as load and execute a program. The first thing you must do is make a copy of this disc.

The disc operating system will eventually be held on all your system discs once you have built up your disc library; but, to start with, the system is present only on the two discs supplied with a new disc drive unit.

Important: You must do two things with the Master system disc:

- First, make a master copy of it
- Lock the original Master System Disc away in a safe place.

You can then use the master copy to create all the working system discs you will need; we explain how to do this later.

You can read (in chapter 5) how to create back-up copies of the master copy disc, and then how to create working system discs for your own use.

For the time-being, you will want to know what you can do now that you have loaded CP/M. You will learn about the file-handling facilities of CP/M in chapters 5 and 6. But, to show you one of the operating system commands, enter:

DIR <RETURN>

and CP/M will display a directory of files on your disc.

Messages

Your system will often give you messages on the screen. These stored messages are displayed for various reasons, and from various sources: ROS, CP/M, interpreters of program languages, or any program you may be running.

For example, you have already seen the start-up (sign-on) message, that comes from ROS when you switched on the 480Z. This type of message gives the title of a program that you have called up, or that has automatically been called up.

The message:

```
To copy A to B
Insert disc(s), then press.. <RETURN>
(or press <Q> to quit)
```

is an instructional message which is displayed by the CP/M FASTCOPY utility. This type of message indicates that the program requires input from the keyboard before execution can continue.

Error messages form a third type, and are displayed when something has gone wrong. This may be due to inserting the disc in the wrong manner, entering invalid data, or other errors.

Messages do not always explain fully what has gone wrong, because this may demand excessive machine resources, so you may have to consult a manual to find out what the message means. For explanations of ROS or CP/M messages, consult the "CP/M Users Guide". The manual "Extended BASIC Versions 5 & 6 for Disc and Network Systems" gives details of messages that can occur when using Basic programs.

When Changing Discs

Whenever you change a disc (normally only between running two programs) you must ensure that you press the keys CTRL/C after the new disc has been inserted into a drive. This action ensures that the system recognizes the presence of a new disc and permits it to be accessed for both reading data from it and, especially, writing data onto it. If you forget to press CTRL/C, you may get the message "Disc read-only" when you next run a program that tries to write data onto it (or tries to delete or rename data already on it).

Switching Off

You can switch off at almost any time but never when there is a disc in a drive, whether or not you are running a program. If any program that you are running does not have an automatic exit to CP/M, you should exit using the command specified either in the instructions for the program or, sometimes, in its start-up message. We repeat, do not switch off either the 480Z or the disc drive when you have a disc in a drive. You may lose information if you do.

Before leaving your system, switch off each device separately, then isolate the whole system from the mains supply.

Chapter 5
Operations on Discs

This chapter introduces you to the CP/M operating system and some of its commands. In order to use CP/M, you will have to understand the convention used in naming the disc drive(s) of your disc unit. The section titled "Disc Drives" explains this convention.

Details of how to change, format, and copy discs are given, and there are sections on disc security and purchasing discs.

An Overview of CP/M

CP/M stands for Control Program for Microcomputers; it is the operating system used for the 480Z and many other popular microcomputers. It consists of a number of routines designed to carry out many of the frequently used operations performed by disc systems.

CP/M routines are loaded from the system disc whenever they are required. You should be aware that there are other routines which are *not* loaded from disc. These resident operating system (ROS) routines are held internally in the computer firmware. ROS manages the internal operations of the machine, and it is activated automatically when the computer is switched on.

CP/M acts as the interface betweeen you and the programs you execute on the 480Z disc system. In general terms it has three functions:

- Firstly, it enables you to communicate with the 480Z by providing commands which allow you either to manage the resources of the system or to write, alter, or run the programs of your choice.

- Secondly, it acts like a filing clerk, maintaining a large filing system, giving the user appropriate information about the files, and storing, retrieving, or reorganizing the disc files as instructed by you.

- Thirdly, it controls and organizes the input and output functions of the computer so that the peripherals, typically the keyboard and the display, respond to you in a meaningful and consistent way.

CP/M Commands

There are two types of CP/M command: one type is the built-in or resident command which is contained in the part of CP/M loaded into the 480Z by the bootstrap routine; the other is the transient command, which remains on disc until required, when it is loaded into memory by CP/M in the same way as any other program.

The built-in commands available to you are:

DIR
To display a directory of the disc in the current drive

ERA
To erase a file from a disc

REN
To rename a file

TYPE
To output the contents of a text file to the screen

SAVE
To save the contents of memory as a file on disc

d:
To change the current drive (where d may be A,B,C, or D).

XXX
To load and start executing a new program (where XXX is the name of the program).

Some transient commands on the system disc are:

PIP
To copy files

FASTCOPY
To copy discs

*SYSGEN
To copy the operating system between discs

FORMAT
To format a disc

*VERIFY
To verify that the sectors on a disc can be read

STAT
To display system information

CONFIG
To set system features

COPYFILE
To copy a file from one disc to another disc using a single drive system

*TURNKEY
To modify a system disc so that a program starts automatically after loading CP/M

FILEX
To transfer files between cassette and disc

Some of these utilities and commands are introduced later in this manual so that you can get started with the 480Z disc system; for a fuller description of these and the ones marked with an asterisk, see the CP/M Users Guide.

Command Lines

CP/M commands are entered in a CP/M command line; that is a line of text starting with name of the command and containing any argument list which is necessary to define the file(s) or disc(s) involved.

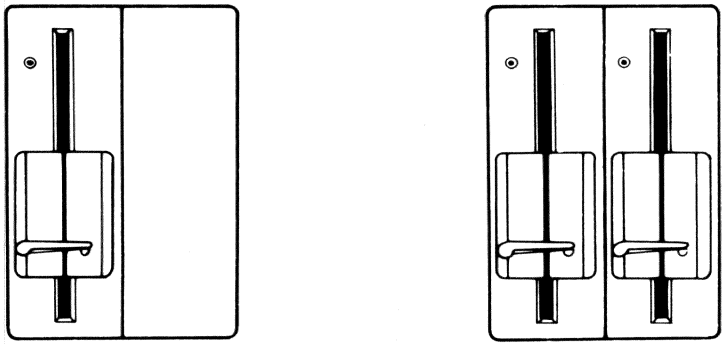
The description given in this manual for each of the CP/M commands includes a least one version of an allowable command line. The CP/M Users Guide gives other versions.

But first of all, you must be able to refer to the discs containing your files. The next section tells you how.

Disc Drives

Naming Convention

Your 480Z disc unit may contain either one or two disc drives. Each drive holds one disc at a time.



(a) Single-Drive *(b) Dual-Drive*

Figure 5.1 480Z Disc Drives

Logical Drives on Single-Drive Systems

In a single-drive system, CP/M is able to access information on either of the two surfaces of the single disc, and, in order to identify which disc surface it is to access, it refers to each surface by a name, termed the "logical drive", or occasionally, the "logical disc".

The logical drive names that are used are:

A or B — for the left hand surface of the disc (label side)

C or D — for the other side of the disc.

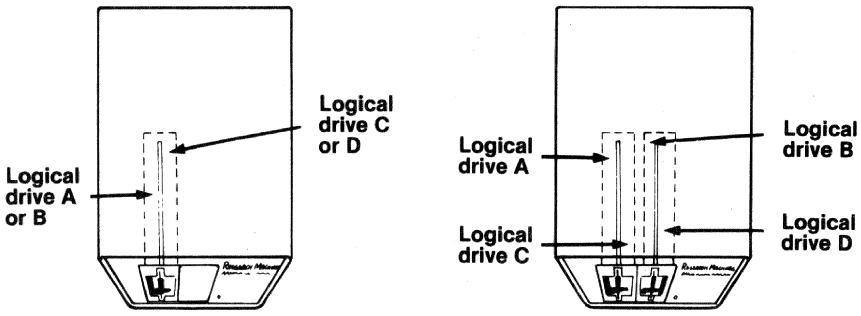
These names are always used as pairs: a disc is referred to either as A and C or as B and D. See figure 5.2(a).

The 480Z firmware keeps a check on the currently-used logical drive names. If a program requests a file that uses a logical drive name that is not being used currently, the firmware displays a message asking you to remove the current disc and insert the disc containing the requested file. At this point the firmware automatically changes the pair of logical drive names from A/C to B/D or from B/D to A/C, as is appropriate.

This facility permits software and programs written for use on dual-drive systems (using both drives) to run on single-drive systems.

It also permits file-copying and software for disc-copying (see PIP, FASTCOPY, and COPYFILE later in this manual) to run on a single-drive system.

However, you are warned to be extremely CAREFUL when changing discs when requested by the 480Z. Further warnings are given in the discussions of single-drive systems later in this manual. A mistake in inserting the wrong disc, or in not removing a disc when requested could cause the information on the disc to be lost.



(a) Single-Drive *(b) Dual-Drive*

Figure 5.2 480Z Logical Disc Drives

Logical Drives on Dual-Drive Systems

In a dual-drive system, CP/M can access information held on any of the four surfaces of the two discs. In order to identify which disc surface it is to access, it refers to each surface by a name, the "logical drive" or occasionally, the "logical disc". The system refers to the two surfaces of a disc in the left-hand drive as Logical Drive A, for its left-hand surface, and Logical Drive C, for its right surface. Similarly, the left-hand surface of the disc in the right-hand drive is referred to as Logical Drive B, and its right-hand surface as Logical Drive D. These are shown in figure 5.2 (b).

You will find references to the logical drives A, B, C, and D throughout our documentation and in screen messages from software.Most of the CP/M commands use logical drive names, and it is important to use them correctly, especially if the process involves overwriting or deletion of files.

All the above information depends on you putting the system disc in the left-hand drive and loading CP/M by using the ROS command, <B>. This is important and it should be treated as the normal starting procedure.

However, on dual-drive systems the 480Z has a useful additional facility that allows you to load CP/M from a system disc in the right-hand drive. Instead of loading CP/M with the ROS command, <B>, you can use the command, <X>. This has the effect of exchanging the logical drive-name allocation so that the right-hand drive now contains logical drives A and C, and the left-hand drive contains logical drives B and D. The logical drive-name allocation will remain interchanged like this until CP/M is next loaded using the <B> command. Understandably, this could be very confusing unless you are absolutely sure of what you are doing. Leave the exchange facility alone until you are completely familiar with the use of logical disc drive names.

Current Drive

The current drive, also known as the logged-in drive, is the drive to which the computer will refer when the next command is given. It may be any one of the four logical drive names, A, B, C, or D. When your 480Z is being controlled at CP/M level, the current drive name is displayed immediately before the CP/M prompt, usually at the left-hand edge of the screen. If the current drive is logical drive C the display will show:

```
C>
```

Changing the Current Drive

You can change the current drive quite simply by entering:

d:<RETURN>

where "d" is the logical drive name that you want as the current drive (A, B, C, or D).

For example, if the current drive is C, and you now want to change it to drive A, enter:

A:<RETURN>

and the prompt immediately becomes:

```
A>
```

indicating that the current drive is now A. On single-drive systems, this must be done before removing the disc currently in the drive.

Changing Discs

If your system is under the control of CP/M (that is, you are not running a program), then, when changing discs, you must always:

- Remove the disc in the drive
- Insert another disc, or re-insert the removed disc
- Press <CTRL/C>.

Formatting Discs

Before you can make a copy of a disc onto a new disc, that new disc must be prepared, or formatted, by a utility program supplied on the CP/M disc.

New discs have no information on them at all. In terms of magnetic storage they are blank.

Every new disc for use on the 480Z disc system must be formatted and the program to do this is called FORMAT. It performs two essential functions:

- It sets up the disc with "tracks" and "sectors" that are eventually to contain information. Normally, the discs will be formatted in double-density format. (You can choose single-density formatting if the disc is eventually to be used on an RML 380Z disc system that only permits the single-density format.)
- It sets up a header on each sector to allow access to the information stored there. The header includes an indicator to denote a blank sector, and the FORMAT program sets all of these to "blank". This is important if you reformat a used disc; all sectors will be set to "blank" and the files will be lost.

To run the FORMAT program, enter the command line:

FORMAT <RETURN>

Then put the disc you want to format in drive B and answer the questions relating to the type of format required. The final <RETURN> that you enter will set the utility running, and a track counter will be displayed on the screen.

When the formatting stops, and the FORMAT program returns to the beginning, you can either initialize another disc or leave the utility and return to CP/M command mode by entering:

<Q>

The newly-formatted disc is now ready for you to copy files from another disc.

A full description of FORMAT is given in the CP/M Users Guide.

Copying CP/M and Discs

The version of CP/M supplied in the 480Z disc system includes utility programs for preparing working versions of the operating system disc and for copying the entire contents of one disc to another.

Copying the Operating System

It makes very good sense to have several complete copies of the CP/M distribution disc (but note the licensing conditions). Use the FASTCOPY utility, described below, for this purpose.

Copying Discs (FASTCOPY)

There are many occasions when you want to make an identical copy of a disc. The disc may not necessarily be full of information, but the copy needs to include every file that is there. The utility provided to do this is FASTCOPY.

FASTCOPY copies the entire contents of a disc surface onto another disc surface, and it will format the destination disc, if required; it will repeat the operation for the other side of a double-sided disc, if required. It will operate in single, double, or quad density mode, but it will not make a copy in one density of a disc in another density.

You can run FASTCOPY, if it is on the disc in the current drive, by entering:FASTCOPY<RETURN>

The following title message will be displayed:

```
FASTCOPY                                    version 2.30

FASTCOPY is a fast disc to disc image copier. It
enables you to copy either one or both surfaces of a
disc, but will not copy from one density to another.
It automatically formats unformatted discs.

If you wish you may now remove the system disc.

WARNING
All files on the destination disc will be over written
The source disc is the location of the Master copy.

In response to any prompt you may press
<ESC> to reselect the options, or
<Q> to quit and return to CP/M.

Press <RETURN> to continue:-
```

At this point, you can remove the current disc and replace it with the disc that you are copying from (source disc), or the disc that you are copying to (destination disc). FASTCOPY copies from any logical drive to any other logical drive. See below for instructions on using FASTCOPY with a single-drive system.

When you press <RETURN>, the following questions are displayed on the screen:

```
Source disc.....(A,B,C,D) ?
Destination disc.....(B,C,D) ?
Copy both sides.....(Y/N) ?
```

Assuming that you want to copy the disc in logical drive A onto the disc in logical drive B, and that you only want to copy surface A, your responses to these questions would be <A>, <B> and <N>.

Make sure that you copy in the right direction; a mistake will leave you with two copies of the blank (or redundant) disc, and nothing whatsoever of the disc you intended to copy. So FASTCOPY now displays the following message:

```
To copy A to B,
Insert disc(s), then press..<RETURN>
(or press <Q> to quit)
```

Check your discs, and remove and reposition them if necessary. When you are sure that the discs are in the correct drives, press <RETURN>.

If your discs have different densities, FASTCOPY will now ask if you want to reformat the destination. If you do not, then FASTCOPY will refuse to copy. If you do, FASTCOPY will reformat the destination side.

A displayed message informs you that copying is taking place. On completion, FASTCOPY displays:

```
Disc copy completed
```

A full description of FASTCOPY is given in the CP/M Users Guide.

FASTCOPY on single-drive systems

The procedure for using FASTCOPY on a single-drive system is the same as above, up to the point where the message:

```
To copy A to B,
Insert disc(s), then press <RETURN>
(or press <Q> to quit)
```

is displayed. You must then proceed as follows:

1. When you press <RETURN>, the following message appears at the bottom of the screen:

   ```
   Insert disc A/C and press <space>
   ```

2. Insert disc A/C.

3. A message appears in the middle of the screen:

   ```
   Checking discs, please wait....
   ```

4. The insert message appears again at the bottom of the screen, asking for insertion of disc B/D. The checking message remains on the screen. Insert disc B/D.

5. If your discs have a different density, FASTCOPY will ask if you want to reformat the destination, as above.

6. You will be asked to insert disc A/C, when track reading takes place, then to insert disc B/D, when

track writing takes place. This process is repeated until the disc surface has been copied.

Caution

Beware of mixing your discs during this copying process.

Directory

When you want to display the list of contents of a disc, use the DIR (DIRectory) command. If the disc is in the current drive, enter:

DIR<RETURN>

However, if you want to see the contents of the directory belonging to another disc, for instance the one in drive B, enter:

DIR B:<RETURN>

The DIR command can also be used to find particular files, but this is covered in the next chapter.

Disc Security

Software is valuable and can be lost very easily. A disc error, a system fault, or just one wrong command from you can wipe out a program that may have cost many pounds to buy or many hours of work to build up. Either way, you will want to protect it.

But disc errors do sometimes occur. Systems have been known to break down. And no matter how careful you are, you will occasionally make mistakes.

To keep software secure, your task is not to try to avoid such events, but to be aware that they are likely to happen; therefore, make copies regularly and

systematically of all software of any value. But note any special licence conditions for the software.

Back-up Discs

Now that you have been informed how to copy discs using FASTCOPY, you can make back-up copies of all your important discs. Sooner or later you are going to come up against a file, or even a complete disc, that has either been accidentally erased or become unreadable. If you have a recently updated version of the same disc in your disc library, it may relieve some, if not all, of the disruption caused by the loss.

Distribution Discs

If you have a new 480Z disc system or a new version of CP/M, you will be supplied with one or more distribution discs containing CP/M, system utilities, and software programs, depending on what you ordered. You should treat these discs as irreplaceable, and you should not use them under normal cicumstances.

When you are confident in carrying out the FASTCOPY procedure, introduced in this chapter, you should be able to make copies of all your distribution discs. Do this, then store the distribution discs in a secure place. They may be needed if your copies are damaged or fail in any way, or if you have a system failure.

Master Copies of System Disc

You can make several copies of your distribution disc(s), subject to licensing conditions, but keep one carefully labelled as your master and subsequently copy all future system discs from this copy. If you regularly use only a particular combination of utilities, make a master copy with CP/M and only the utilities you need. Then you can make copies of this particular master for use as your normal system working discs whenever you need them.

Work Discs

The more work you do on your 480Z, the more work discs you will need. You will find it is a good idea to keep a number of discs prepared for use as work discs.

As explained previously, blank discs cannot be used directly; first you have to format them. Then they can be used as data (work) discs, and files may be written on to them or copied from other discs (see PIP, or COPYFILE if you have a single-drive disc system).

However, some (and possibly all) of your work discs could also have the operating system on them as well as all those utilities that are needed for day to day use. You will need to learn how to use the SYSGEN utility to create new copies of the operating system on your work discs. This action will not cause any loss of space on the disc.

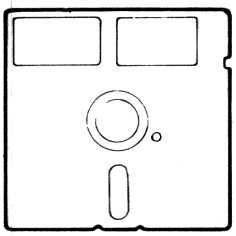
This is because the operating system is recorded on special system tracks that are reserved for this use and cannot be used for storing data. This utility is described in the manual: "CP/M Users Guide".

Your work discs are valuable, so we suggest that you acquire the habit of making back-up copies using FASTCOPY. When you are working on a particular disc, make regular copies of it. Then, if you should lose a file or a disc for any reason, you should be able to regenerate the difference between the back-up and the original work disc without too much difficulty.

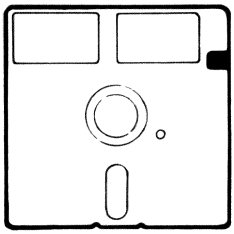
For each disc in your library, write a label listing every file stored on the disc and stick it onto the jacket.

Write Protection

Once you have stored software or data on a disc, you can prevent accidental over-writing by "write protecting" the disc.



(a) Write enabled



(b) Write protected

Figure 5.3 Write Protection of discs

Discs are provided in the write enabled, or unprotected state, figure 5.3(a), with the write enable notch uncovered. To write protect your disc, stick one of the metallic adhesive tabs (that are included in every box of discs) over the write enable notch, as in figure 5.3(b) so that both sides of the notch are covered.

In this protected state it is not possible to change anything on the disc, or write anything on to it. However you can read from the disc. You can copy it, inspect the directory, or inspect the file attributes (using the STAT command).

Purchasing Discs

It is essential that you only purchase discs from one of the manufacturers currently recommended by Research Machines Ltd. If you use a disc of inferior quality, you run the risk of oxide coating being transferred from the disc to the read/write heads in the disc drive. If this happens, the heads will be seriously damaged, and they will have to be returned to our factory for repair.

When purchasing discs, please note:

- The 480Z Disc System uses either single-sided or double-sided, 5.25 inch, soft-sectored discs.

- The Research Machines Ltd. warranty for the 480Z Disc System does not cover damage to disc drives caused by the use of discs from a non-recommended manufacturer.

- The list of recommended manufacturers, as at August 1983 is:

  Research Machines
  Maxell
  IBM
  Dysan.

- Make sure that you purchase 40-track discs for single or double density use, not 35-track discs. The use of 35-track discs is likely to result in damage to your disc drives. Use only discs certified at 96 tracks per inch (96 TPI) for quad density use.

Chapter 6
Operations on Files

On the Research Machines 480Z, both the programs and the data that you use are stored in files on a disc. Disc files were introduced in chapter 1. This chapter discusses what you can do with disc files and introduces the CP/M commands that are available to help you to control them. It should enable you to:

- Store programs you have written or obtained from elsewhere
- Store data you have gathered or generated
- Change file names and contents to suit your needs
- Find the information you need when you need it
- Create back-up security copies of all your important files.

Before reading this chapter, ensure that you are familiar with the procedures for switching your system on and off, and for loading the CP/M operating system (see chapter 4)

Filing Systems

Disc filing systems follow the same principles as a manual filing system. There is no magic about it. All you need is a filing clerk.

Your Filing Clerk

Imagine that you are the boss, and that you make use of a manual filing system which is looked after by a very efficient, but not too bright, filing clerk. Your clerk follows the instructions, given by you and the other bosses, without question.

You have several filing cabinets to hold your files each having two drawers. To start with the drawers are empty, although there is a folder at the front of the top drawer marked Instructions for Filing Clerk; it is empty.

The top drawer is used most of the time because it is the most convenient to get into, but really the second drawer is just as handy. Each drawer has a rack designed to carry expanding folders.These folders will carry any number of sheets of paper up to a drawer-full, and on the front of each folder is a tab to carry the name of the file that is put in the folder.

All the filing cabinets in the filing system look identical. They are all the same size and shape. However, in some cabinets the bottom drawer is a dummy — it cannot be opened — and some of the older cabinets can only hold half the number of papers contained in the new ones. Your filing clerk can cope with these differences, and will tell you when you ask for filing space that is not there.

To be usable, the filing cabinets must have this fixed structure laid out inside them, even when empty, and your filing clerk depends on this because all the instructions that go in the front folder of the top drawer take it for granted.

Remember that your filing clerk is not very bright and every task must have detailed instructions. These instructions are all placed together in the folder marked "Instructions for Filing Clerk". If these instructions

do not relate to the lay-out of the filing system, your filing clerk will probably not be able to carry out the required task and, worse still, if the instructions are not there at all, your clerk will be unable to do anything.

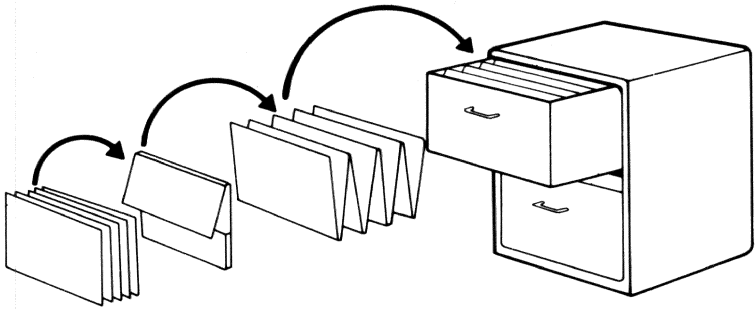


Figure 6.1 Manual Filing System

Filing Clerk in Action

Suppose you ask your filing clerk to put some papers into a file in one of the filing cabinets and call the file INFO.

First, your clerk would have to look up the instructions at the front of the top drawer to find out how to do it, since every time the instruction folder is closed, your clerk forgets how to carry out any of the tasks. Then, your clerk would take a folder, write INFO on the tab, put the folder into the rack, and put the papers into it, keeping them carefully in order.

There may be many folders in the same cabinet but they all have different names. If you want to know what folders are in a cabinet, you ask your clerk who simply lists all the names on the tabs. Your clerk can also

tell you how much space is left in the drawer, since each page was counted when it went in, and the drawers hold only a fixed number of pages.

When you ask for the INFO file, your filing clerk can find it.

Your clerk can show you the contents of the folder, change any bits of it that you want to be changed, make a copy of the file and put it in another drawer or cabinet, change its name (to DATA, say) by rewriting the tab, throw some or all of the papers away, put a lot of new papers in, or just for fun, throw the tab away so that no one could find the file again.

Your clerk can do a tremendous amount. But you must remember that your filing clerk must be able to find the instructions at the front of the top drawer to be able to do what you asked for.

You are the Boss ...

Let us get our feet back on the ground. In reality, you are a computer user — the boss. The filing clerk is the computer in front of you and you give the commands through the keyboard.

You can think of each drawer of the filing cabinet as one side of a disc. Both sides of the disc must be organized in a similar way to the drawers. Each file in the drawers has an equivalent file on the disc.

But whereas the filing clerk finds a file by looking at the tabs, the disc has a list of file references, called a directory, which tells the computer where a particular file is located on the disc.

The rest of this chapter discusses the tasks you may ask your computer to carry out in its role as a filing clerk. It introduces you to the instructions you will use in

your role as a boss, and also tells you some of the things that your computer will be unable to do.

Remember that your filing clerk is not very bright, but that the instructions in the top drawer are excellent. All you need to do now is to ensure that any task that you give your filing clerk is possible, that there is a complete set of instructions for it in the top drawer, and that you give the right commands to your clerk.

All the tasks described here are covered in greater detail in the CP/M Users Guide.

Files On Disc

When programs and data are permanently stored on disc they are called *files*. Each new file must have a new *file reference* different from all the other files on that disc. If you attempt to create a file with a file reference that already exists, the system will stop and tell you so. You must change one of the file references if you are to continue.

The file reference in the disc filing system is exactly like the tab in the manual system; it enables you to find the file you want and it differentiates it from other files.

You can have two or more files with the same file reference if they are held on different discs. This enables you to keep back-up copies. When you do this make sure that files with the same file reference always have the same contents.

The rules concerning file references for 480Z disc files are described later.

File References

The *file reference* consists of *three* parts represented as:

d:filename.typ

where:

d:
: is the name of the logical drive on which the file is held, and it is optional. Use it when the file that you want is on a disc in a drive other than the current drive. If you use the logical drive name, the colon, which is used in CP/M to indicate an input/output device, is essential.

filename
: is the primary filename and is the only mandatory part of the file reference. It can have up to eight characters but no spaces.

.typ
: is the filetype. It is used to group specific types of files, so that single commands may be made to operate on all files in the group and consists of three alphanumeric characters. The filetype is optional, but if you use it, the dot (full-stop) is mandatory. For example, all BASIC files have a .BAS filetype.

Suppose that you have just created a file (written in BASIC) that you wish to call RESULTS, and you want to store it on the disc in logical drive B. Its file reference will be:

B:RESULTS.BAS

In many CP/M utilities, there are various ways of referring to groups of files. You can group all the

files on one disc surface. All files of a particular filetype, filename, or of particular initial letters in their filename or filetype can be grouped together. This enables you to perform the same operation on several files at the same time. The various ways of doing this are described in the CP/M Users Guide.

Renaming Files (REN Command)

There are many reasons why you may want to change the name of a file, and CP/M can do this for you using the REN command. You can change the nameof one file only using REN, but it may operate on both the filename and the filetype of that file. Any attempt to rename a file that is being used at the time will probably result in loss of information.

The command to rename a file is of the form:

```
REN new-filename.typ=old-filename.typ
```

where "new-filename.typ" is the new filename and filetype you want to apply to a file that is currently referred to as "old-filename.typ". For example, the command line:

```
REN FRED.FIL=DAVE.FIL <RETURN>
```

looks for the file DAVE.FIL on the disc in current drive and renames it FRED.FIL.

If the file you want is on a disc that is not current, the full file reference must be given. Hence the command:

```
REN B:JIMSPROG.BAS=B:MYPROG.BAS <RETURN>
```

looks for the BASIC file MYPROG on the disc in drive B and changes the filename to JIMSPROG.

Files with their access attribute set to read-only (R/O) cannot be renamed (see below).

File Attributes

In CP/M 2.2, each file is given attributes that affect whether the file can be modified or not, and whether its name will or will not appear in the disc directory. These attributes are called the access attributes and the disclosure attributes.

The access attribute has two possible settings:

- R/W (read/write) to allow a file to be created, read, extended, modified, or deleted
- R/O (read only) to allow a file to be read only, and to protect it from modification or deletion.

The disclosure attribute has two possible settings:

- DIR (directory) to let the name of a file appear in the display of the disc directory produced by the DIR command
- SYS (system) to prevent the name of a file appearing in the display of the disc directory.

You can alter file attributes by using the STAT command, which is described later in this chapter.

Disc Directory

The directory is a special area on each disc; it contains information about each file, including:

- Its name
- Its physical location on the disc

- Its size
- Its file attributes

Both the DIR and STAT commands can be used to display information contained in the disc directory.

Inspecting the Contents of a Disc (DIR Command)

The DIR command is used when you want to see which of your files are on the disc loaded in the current drive or in another drive. DIR does not display files with the SYS attribute.

You can use DIR to find out what files are held on any one disc surface in the four logical drives. Use it to check the disc contents after storing, copying, or deleting files.

The command line to list the directory of a disc surface, is of the form:

DIR d:

where d is the logical drive (A,B,C, or D) accessing that surface. If you want the directory of the disc surface in the current drive, then the d: may be omitted.

There are various other ways of using DIR to check for the presence of a single file or a particular group of files. These are described in detail in the CP/M Users Guide.

Erasing a File (ERA Command)

Because the amount of space available for files on any disc is limited, we suggest that you regularly delete (erase) any files that you no longer need. Do this by using the ERA command.

You can use the ERA command to:

- Delete a single file
- Delete a group of your files
- Delete all of your files.

Here we will describe only the method of deleting a single file. (To delete groups or all of the files on a disc is risky unless you have had some experience. The method involves grouped file references which are not described in this guide; see the CP/M Users Guide.)

Before deleting any file ensure that you recognize each part of a file-reference and that you know:

- Which disc the file is on
- Which side of that disc the file is on
- Which logical drive that side is in
- What the filename is
- What the filetype is.

For example, you might want to delete the file PROG5.BAS from a particular disc. With the disc in logical drive B, use the DIR command to establish which side of the disc the file is on. Assuming that it is on the side in logical disc drive B, then to delete the file, enter the command:

```
ERA B:PROG5.BAS <RETURN>
```

The 480Z searches for a file named PROG5.BAS on the disc in logical drive B.If it finds this file, it deletes it, freeing the space that it occupied for use by other files.

Inspecting a File (TYPE Command)

The contents of any file that is held on a disc as a sequence of characters can be quickly and conveniently examined by using the TYPE command.

To inspect a file, enter:

```
TYPE file-reference <RETURN>
```

For example, enter the command:

```
TYPE BNEWS.PRN <RETURN>
```

to search the current disc for a file named BNEWS.PRN, and, if it is found, to display its contents.

If you attempt to use the TYPE command to display the contents of a non-text file such as an object program (.COM file), the display may include graphics characters not present in the file. Also, the system may stop with both the display and the keyboard locked. If this happens, enter <CTRL/D>.

Displaying the Status of a Disc or File (STAT Command)

The STAT command displays:

- The amount of space available for storage on a disc in a logical drive
- The status of an individual file or of a group of files.

The STAT command is also used to modify the access and disclosure attributes of a file.

For example, to display the space available on the disc in the current logical drive and on any previously

accessed discs present on other logical drives, enter:

STAT <RETURN>

The display for each disc consists of:

```
d: Acc, Space : nnk
```

where Acc is the disc access attribute nn is the space remaining on the disc.

For example, the display produced by this form of the command STAT might be:

```
A : R/W, Space : 480k
```

Full descriptions of all the other functions performed by STAT can be found in the CP/M Users Guide.

Copying files (PIP Command)

You will sometimes need to copy files which already exist on a disc. Use the PIP command to do this. In fact, PIP is a very versatile utility, and once you have become used to working with it, you will find that it is one of your most commonly used utilities.

You can use PIP on a single-drive system to copy files from one disc to another, but the COPYFILE utility (see below) is quicker; it performs the task with substantially fewer disc changes.

The PIP command allows you to:

- Copy a file from one disc to another, even on a single-drive disc system
- Copy a group of files from one disc to another, even on a single-drive disc system
- Make a second copy of a file on the same disc

- Copy two or more files to create a single file
- Copy a file to or from an external device, such as:

  — Keyboard to disc
  — Disc to display
  — Disc to printer
  — Disc to external device
  — External device to disc.

For example, the most common use of PIP is to copy a file from one disc to another. For this operation PIP has the form:

PIP d:=c:filename.typ <RETURN>

where:

d:
: indicates the destination disc drive

=
: separates the destination disc drive from the source file reference

c:
: indicates the source disc drive but, if omitted, the current logical disc drive is assumed

filename
: is the name of the file

typ
: is the filetype

For example, enter the command:

```
PIP C:=FRED.FIL<RETURN>
```

to copy the file FRED.FIL from the current drive to drive C.

For single-drive systems, the instructions for removing the source disc and inserting the destination disc are as

described in the FASTCOPY utility (chapter 5). Full descriptions of all the uses of PIP are given in the CP/M Users Guide.

Note that, if the disc directory contains a file reference with the filetype .$$$ after copying a file or files, then that file has been incompletely copied due to an input/output error during copying, and the copy operation should be run again. You can delete the incomplete $$$ file using the ERA command.

Copying Files on a single-drive system (COPYFILE Command)

The COPYFILE utility has been designed to allow users of single-drive 480Z systems to copy files efficiently. It does not work on other systems.

COPYFILE copies files, one at a time, from any disc surface to the same or to any other disc surface. Any number of files can be copied successively without leaving COPYFILE.

Warning
To avoid corrupting your source disc, follow the disc changing messages exactly. For extra protection, cover the write enable notch on the source disc.

Make sure that you have a disc containing the COPYFILE utility in the drive. Then enter:

```
COPYFILE <RETURN>
```

The first COPYFILE message will be displayed on the screen, then it will be followed by:

```
COPYFILE                              version 2.3A

In response to any prompt you may press
<ESC> to re-select the options, or
<Q> to quit and return to CP/M.

When asked to specify source and
destination files, give the file
reference as: d:filename.filetype
followed by <RETURN>.

Where:-
drive d may be A,B,C,D or blank,
filename may be 0 to 8 characters
filetype may be 0 to 3 characters

Source file?
```

You must now specify a source file; it must contain a file name, or a file type, with at least one character.

Enter the source file reference, followed by <RETURN>. For example:

```
A:MYPROG.BAS <RETURN>
```

COPYFILE will now display:

```
Destination file?
```

When you enter the destination file reference, it must consist of at least a logical drive name. For example:

```
B:MYPROG.BAS <RETURN>
```

copies the MYPROG file from the source disc, A, to the destination disc, B.

After the displayed message:

```
To copy from file
A:MYPROG.BAS to file B:MYPROG.BAS
insert disc then press <RETURN>.
(or press <Q> to quit)
```

insert the *source* disc and press <RETURN>.

Instructions for removing this disc and inserting the destination disc (as in the FASTCOPY utility) will follow. COPYFILE will inform you when copying is completed.

Full descriptions of all functions performed by the COPYFILE utility can be found in the CP/M Users Guide.

Transferring Files between Cassette and Disc

If you have upgraded a 480Z cassette-based system to a disc-based one, you will probably have a lot of BASIC programs and other files stored on cassette.

You can transfer these files on to disc using the FILEX utility; this also allows you to transfer files form disc to cassette.

Appendix F gives details of the FILEX utility.

Running Other Programs

When your 480Z is at CP/M command level (that is, when the current drive name is displayed with the CP/M prompt), there are other programs that you can run as well as the transient CP/M commands described above. Any program that you do run (execute) must have been prepared for the specific requirements of CP/M, and must carry the filetype .COM. However, simply giving the filetype .COM to a file will not necessarily enable it to run at CP/M

command level; if you load such a file, the system will fail.

Try displaying the directory on one of your distribution discs, using the DIR command, and see what files with the filetype .COM are available to you.

As a new user you are very unlikely to be creating programs that will run at CP/M command level (.COM files). The programs that you do run at this level will be supplied by Research Machines or by some other software supplier. They provide many of the specific applications for your system; high level languages or word processing packages, for instance.

To load such a program, first load the CP/M operating system and, if it is on a different disc, insert the disc on which the program is stored. Then enter the name of the .COM file which contains the program.

For example, to load the BASIC interpreter with the name "BASICS", enter:

```
BASICS <RETURN>
```

Note that there is no need to include the filetype (.COM) because CP/M treats every command either as a built-in command or as a file having the filetype .COM.

Your system will respond with the sign-on message:

```
RML Extended BASIC version...
```

with an appropriate version number.

Now, having loaded a file of this type, you can use it to write and run programs. In this case, your programs will be in BASIC.

Notice that the programs that you run using the BASIC interpreter or any other .COM file, are not themselves .COM files. They will have the filetype .BAS, or some similar filetype according to the .COM file you have loaded.

If the program you run is not your own program, have a look at the appropriate instructions for information on how to use it.

If you aim to confine your activities to programming in high level languages, or to using applications programs which involve no programming, your system is designed to operate at that level, and there is plenty of software available to do the tricky bits for you. On the other hand, if you aim to use the full capability of your 480Z disc system, you will want to produce your own software, but this is beyond the scope of this manual. In either case, you will probably be wondering how programs are prepared for use on your system.

The rest of this chapter aims to give you a very brief look at the way programs are prepared. The terminology may well be a little baffling to the inexperienced user but do not let it trouble you.

Program Preparation

In no way does this manual set out to teach you how to do prepare programs but it can indicate what lies ahead.

Interpreters for your high level language programs

You will probably start with a high level language, perhaps LOGO or BASIC, and you will both write and run your program(s), using an interpreter for the language you have chosen. Interpreters, which are supplied as .COM files, translate your high level language programs into an internal form that can be executed immediately.

However, as you become more experienced in programming, you will find that you can save time and space by producing programs that have been prepared as .COM files yourself.

Machine Language (.COM) Programs on CP/M Systems

The requirements for these programs are as follows:

- They must be in executable Z80 object code
- They must be confined to addresses within the CP/M transient program area
- They must access CP/M BIOS and BDOS through standard interfaces
- They should avoid direct addressing of hardware/software/CP/M facilities to ensure transportability to other Z80 systems and or versions of CP/M.

Machine-language programs run on CP/M systems can be created by using either:

- ZASM, the Research Machines assembler for the Z80 machine language, or
- A high level language program compiler, used in conjunction with a linker.

A compiler or an assembler translates source code, the programming language as written by the programmer, into object code which can be understood by the computer in question — in this case, your 480Z. However, some instructions, vital to the system in question, cannot always be supplied by a compiler or assembler; these are provided by a linker.

The linker produces "load modules" — files containing the machine-language program. The main program will be in a .COM file and, for very large programs, it will be supplemented with overlay (.OVL) files. The linker inserts overlay mechanisms into such programs to ensure that they form a complete program.

A linker is required for programs written in languages such as Fortran 80, CIS-COBOL, (TCL) PASCAL, and CBASIC, as well as for assembler programs that are incorporated (or linked) into other programs.

For those of you who want to explore the world of computing in depth, you can find further explanation of the programming facilities outlined above in the "CP/M and CP/NET Programmers Guide". Research Machines software supplied with your system in .COM files is described in other manuals. The subdivisions of CP/M mentioned above (transient program area, BDOS, and BIOS) are described in greater detail in the "CP/M Users Guide".

Be bold and experiment. If you have made copies of your Master system disc, you will not lose any vital information and, if you have set up the equipment properly and avoid physical damage, you will not harm your system.

Make a copy of the Welcome Disc, or get an experienced user to do it for you. Then try copying some of the files. Erase files, rename files, try using BASIC, try using ARROW, try any of the processes described in the manuals. These programs are not at all precious if you use a copy. The more you try, the sooner you will become familiar with all that the 480Z disc system has to offer.

Chapter 7
Other 480Z Facilities

This chapter gives details of:

- The 480Z rear panel
- Connecting and using a printer
- Sound production on the 480Z

There is also a summary of 480Z facilities that are not covered in this manual (with reference to the manuals which do cover them), and the software available for your system is discussed.

480Z Rear Panel

Figure 7.1 is a diagram of the 480Z rear panel giving details of its layout. The components are numbered and identified below the diagram. For information about the pin-connections for the sockets on the rear panel, refer to appendix H.

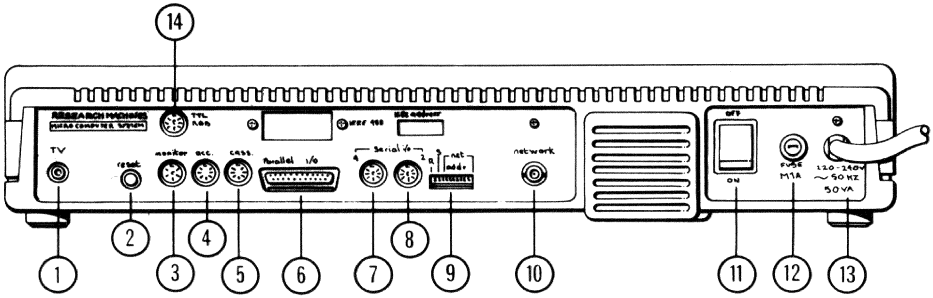


Figure 7.1 480Z Rear Panel

1. Modulator UHF (TV) socket
2. RESET Button
3. Video (Monitor) socket
4. Accessories socket
5. Cassette recorder socket
6. Parallel I/O (input/output) socket
7. Serial I/O 4 socket
8. Serial I/O 2 socket
9. Network Address, Speaker, and RESET Disable Switches
10. Network Interface Coaxial socket
11. Mains ON/OFF Switch
12. Fuse
13. Mains Cable
14. TTL/RGB Display socket

Connecting And Using A Printer

A printer must be able to accept data from the computer, in the form of 1s and 0s, then convert it into the normal characters that we can read. To complicate matters, we want the printer to work at high speed.

So, printers are complex pieces of equipment. You must read the maker's instructions before you try to use your printer, and follow any special instructions on connecting up, on-line switches, and other details.

For communication with the computer, your printer contains an interface that can be either serial or parallel. A serial printer receives signals sent one after another on the same wire; a parallel printer receives eight signals sent down eight wires simultaneously. Some printers can have both types of interface.

There is no difference in performance between a serial printer and a parallel printer, but serial printers can be used with long transmission distances.

There is a difference in how the printers are connected to the computer:

- If you have a serial printer, it must be connected to the serial I/O 4 socket on the rear panel of the 480Z. If you are using a disc unit, it will already be connected to the 480Z serial I/O 4 socket. So, your printer must be connected to the serial I/O 4 socket on the rear of the disc unit.

- If you have a parallel printer, it must be connected to the parallel I/O socket on the rear panel of the 480Z.

Once the printer is connected to the computer, you must let the computer know what type of printer is attached to it. There are several ways in which you can do this:

- Using a ROS command

- From the Front Panel

- From within a BASIC program

- Using the CP/M CONFIG command.

When you first switch on the computer, you can use one of the ROS commands, <O>, to select the printer option. ROS will ask whether you are selecting a cassette or a lineprinter. Enter <l> to choose the latter, and the following message will be displayed:

```
Printer type (0, 2, 3, 4):
```

If your printer has a parallel interface, enter <3>; if it has a serial interface, enter <4>. For a parallel interface printer, there is no data transmission rate selection, but the serial option causes the following message to be displayed:

```
Baud code (0–6):
```

Enter a number according to the following list:

Code	*Baud rate*
0	110
1	300
2	600
3	1200
4	2400
5	4800
6	9600

The printer manual should indicate what baud rate is to be used. This is a measure of how fast the printer operates.

Remember that you are still at ROS command level. You should now load CP/M or BASIC.

If you are using the Front Panel facility, you can enter <O> to set up the printer option in the same manner as with the ROS command.

You can set up a printer from within a BASIC program using the PRINTER command. To select a serial printer, use:

```
PRINTER 4, n
```

where n is the baud code number, as in the above table. To select a parallel printer, use:

```
PRINTER 3
```

It is also possible to select the printer option when you are working within CP/M. If you enter:

```
CONFIG <RETURN>
```

the set of instructions for using the CONFIG utility will be displayed. These are very easy to follow, so respond to them according to your printer type.

Sound Production On The 480Z

When you switch on your 480Z, and before you load CP/M, the resident operating system (ROS) is automatically activated. You can now produce a beep from the internal loudspeaker of the 480Z by pressing <CTRL/G>.

You can change the pitch and length of the beep using ASCII control characters (see appendix C of the LINK 480Z Cassette System Users Guide). The simplest way to do this is to press <R> to load BASIC in ROM, then use the PUT command to enter a sequence of control characters:

```
PUT 27,64,F,D,65,7
```

where

F

is the frequency value. The desired frequency can be calculated from the following formula:

Frequency = 1000/54+32*F kHz

The table below gives F values for notes in the chromatic scale between the note C two octaves below middle C, and the note C one octave above middle C.

D

is the duration value. A value of 50 approximates to a length of one second.

The following program lets you experiment with sound. Enter frequency and duration values when prompted, and the sound will be emitted. Stop with <CTRL/Z>:

```
10 INPUT "Frequency value:",F
20 INPUT "Duration value:",D
30 PUT 27,64,F,D,65,7
40 GOTO 10
```

The next program actually plays a tune. Can you recognize it?

```
 10 DATA 59,40,59,40,59,40,59,30,53,10
 20 DATA 80,30,80,10,80,30,80,5,80,80
 30 DATA -1,-1
 40 DATA 80,30,80,10,80,30,80,5,80,80
 50 DATA -1,-1
 60 DATA 90,30,90,10,90,30,90,10,90,80
 70 DATA -1,-1
 80 DATA -2,-2
 90 FOR LOOP=1 TO 2
100 RESTORE
110 READ F,D
120 IF F=-2 AND D=-2 THEN 170
130 IF F=-1 AND D=-1 THEN FOR M=1 TO 300: NEXT: GOTO
140 D=D*1.2
150 PUT 27,64,F,D,65,7
160 GOTO 110
170 NEXT
```

Note	Frequency (Hz)	Frequency value
Low C	65.4	243
C#	69.3	229
D	73.4	216
D#	77.8	204
E	82.4	192
F	87.3	181
F#	92.5	171
G	98.0	161
G#	103.8	152
A	110.0	144
A#	116.5	135
B	123.5	128
C	130.8	120
C#	138.6	114
D	146.8	107
D#	155.6	101
E	164.8	95
F	174.6	90
F#	185.0	85
G	196.0	80
G#	207.7	75
A	220.0	71
A#	233.1	67
B	246.9	63
Middle C	261.6	59
C#	277.2	56
D	293.7	53
D#	311.1	50
E	329.6	47
F	349.2	44
F#	370.0	42
G	392.0	39
G#	415.3	37
A	440.0	35
A#	466.2	33
B	493.9	31
High C	523.3	29

Table 7.1 Relationship between frequency value and note

Other 480Z Facilities

Your 480Z has the built-in facility of *BASIC in ROM*. This Research Machines Extended BASIC, Version 5 interpreter is stored in read-only memory. With it you can write and run BASIC programs; the external storage system is cassette. BASIC in ROM should not be confused with disc BASIC, which is supplied on your Master System Disc. Only one of these BASIC interpreters can be used at a time.

The BASIC in ROM interpreter supports the use of ROM Packs. These are devices that plug directly into the parallel input/output socket on the rear panel of the 480Z. The ROM Pack contains a read-only memory (ROM), the contents of which can be read into the 480Z main memory at very high speed. ROM Packs are ideal for frequently used programs.

Both BASIC in ROM and ROM Packs are covered in detail in the manual: "LINK 480Z BASIC in ROM Reference Manual, PN 11684", which is available from Research Machines.

Disc-based operation of BASIC uses the new Research Machines Extended BASIC, Version 6 which has several improvements. The main ones are:

- Random access files
- Simultaneous use of many files
- Formatted output
- Procedures
- Multi-line functions
- Enhanced string facilities.

For details see the manual: "Extended BASIC Versions 5 & 6 for Disc and Network Systems".

Your 480Z can be connected to a Research Machines CHAIN Network and used as a network station. In this situation, you cannot use your disc drive because the storage is provided by a central, shared disc system. For details of the CHAIN Network, contact Research Machines Ltd.

Other Software

With your new disc-based system, a whole new area of software has now become available. LOGO, Fortran IV, (TCL) PASCAL, and CIS-COBOL are four of the languages available. There is the WordStar word-processing package, and many educational software packages. Details are given in the Research Machines Software Catalogues.

Most Research Machines 380Z disc system software can be used on your 480Z disc system.

Chapter 8
Silicon Disc Operation

This chapter explains how to get started with a silicon disc, and covers starting up the 480Z, loading and copying files into the silicon disc.

Before reading this chapter make sure that you have installed any silicon disc upgrades and tested them using RAMTEST (described later in this chapter).

Silicon Disc Support

A "silicon disc" is, in fact, a set of random access memory (RAM) integrated circuits fitted inside the 480Z which can be used like a floppy disc to store and retrieve information rapidly.

A silicon disc is physically contained inside the 480Z and cannot be accessed by other 480Zs in a shared-disc system or a network. Also, the speed of operation in file handling is increased because of the faster access to the silicon disc compared with floppy discs. This is particularly beneficial in a shared-disc or network system when you use a silicon disc as you are not competing for the use of shared-disc or network disc resources with other users.

The silicon disc is available as logical drive M as soon as the CP/M operating system has been loaded provided that the 480Z is fitted with 256K of random access memory. The first 64K bytes of the 480Z's memory is always used for program execution while the remaining 192K bytes of memory will be used as the silicon disc. The system itself requires 18K bytes of the silicon disc.

This gives a usable disc size of 174K.

An important characteristic of a silicon disc is that its contents are lost when the power is turned off. So please remember, *always* copy any files you want to keep from the silicon disc to a "real" disc *before* turning off your 480Z.

However, any files copied onto a silicon disc remain on it *even when you press the 480Z RESET button.*

If your 480Z is not already equipped with a silicon disc, this feature can be supplied by Research Machines as an easily-fitted upgrade kit. This upgrade kit contains full details on fitting a silicon disc.

A test program "RAMTEST" is supplied in this version of CP/M for checking that the silicon disc functions correctly.

Installing The Software

All of the utilities for operating silicon discs are held on the CP/M distribution disc.

These utilities are described in detail below.

Copying Files To Your Silicon Disc

You can choose to use either the PIP or the LOADSD command to copy files into your silicon disc. LOADSD copies a predefined set of files held in a separate "list" file into the silicon disc. PIP is the general CP/M command for copying files. If you do not have a predefined list of files then you should use the PIP command to copy a file into the silicon disc.

Again, to remind you, you should always remember to copy any files you have created or updated back onto a floppy disc *before* switching off your 480Z, otherwise you will lose them.

The PIP Command

For further details of the PIP command, see chapter 5 of the CP/M 2.2D Users Guide.

Remember that the silicon disc is configured as a local disc with the logical drive name M. The PIP command would therefore take the general form:

PIP M:=d:filename.typ

(d: is the logical drive holding the disc with the file to be copied, for example, A:)

LOADSD and LIST.BAS Utilities

The LOADSD utility is used in those situations where you want to load a specific set of files each time you use your silicon disc. For instance, you may wish to copy WordStar system files together with some text files for word processing. Instead of using separate PIP commands, LOADSD will do all this in a single operation.

However, before you can copy the files, a separate "list" file containing their names must be created. The program LIST.BAS is provided for this purpose although you can use TXED or WordStar if you wish.

LIST.BAS is a BASIC program which you can use to create "list" files.

A list file is simply a file, held on disc, that contains the names of other files. When you call the list file in a command (such as LOADSD), the system copies all the files named in the list file into the silicon disc.

Having started up your 480Z, load the BASIC interpreter, for example BASICSG2. Enter:

```
A>BASICSG2 LIST <RETURN>
```

Now follow the screen messages to create the list file. Note that the default filetype "LST" is assumed by LOADSD.

Enter the filename of the file (for example, MYLIST.LST) followed by <RETURN>. Then enter, separately, the names of each file you want to copy. You must press <RETURN> after each entry and finish by pressing <RETURN> on its own. The file is now saved on your system disc.

Note:

1. You can also use TXED or WordStar to create a list file.

2. The filenames in the file can be placed on separate lines or separated by one or more space characters.

3. In WordStar, you should create the file in 'non-document' mode.

Once you have created a list file, you can use the LOADSD command:

LOADSD filename <RETURN>

where filename is the name of the list file.

Formatting Silicon Discs

When CP/M with the silicon disc support code is loaded, it checks whether a silicon disc is present and formatted. If present, the system tests whether:

- The 480Z has just been switched on. If so, the silicon disc is prepared (formatted) for use.

- The 480Z has been reset and the silicon disc is still correctly formatted. If so, files may already exist on the silicon disc and it is not formatted.

Testing The Silicon Disc (RAMTEST)

The RAMTEST utility should be run when you upgrade the 480Z with a silicon disc. This should indicate any faulty integrated circuits or incorrect links. The fitting instructions supplied with the Silicon Disc Upgrade Kit show how the links are arranged. *If you have set the links incorrectly there is a danger that the silicon disc will be damaged when you switch on your station.*

When running RAMTEST:

- Ensure that you have RAMTEST on your system disc and start up the 480Z. Enter RAMTEST <RETURN>.

- Note that the program will corrupt any data already on the silicon disc. If you wish to keep files that asre on the silicon disc, you should copy them before running RAMTEST. You are reminded of this at the start and given the opportunity to cancel the test and save any wanted files on a floppy disc.

The testing starts with a screen display indicating that the system is running a "Short Test" which is only a few seconds in duration. While it is running, the station will "beep" a couple of times to let you know it is working.

Above the "Short Test" message is a display of the size of RAM in your station (for example, 256K) and on the righthand side of the screen you should see a RAM "map" consisting of four columns of numbers (0 to 7 in each

case). Each column represents a row of integrated circuits: the lower two columns are the rows on the main board and the upper two columns are the rows on the option board. The integrated circuits in each row are numbered 0 to 7, beginning at the top of a row and working downwards (as you would see the integrated circuits if you removed the 480Z lid). Next to each number, in brackets, is the capacity of the integrated circuit in that position; for example, all 64K integrated circuits are displayed as "64K". If an integrated circuit is missing from any position it is displayed as '.' in brackets. Similarly, if the capacity of the integrated circuit is not known, the position is marked '?'. This indicates a fault in that row of memory.

Note that RAMTEST itself needs 64K of memory in which to work. This is the lefthand bank on the main board — bank 0.

Consequently this part of the memory is not tested. If there is less than 64K of memory in this bank you will get the message:

```
Not enough memory
```

Short Test

The short test takes only a few seconds to run. It works by writing a pattern of bits to each integrated circuit in turn and reading the pattern back. If it reads what it wrote then it knows that the integrated circuit is correct, otherwise the integrated circuit is displayed on the screen as being faulty and the number of the integrated circuit starts flashing; a "Faulty RAM" message is also shown. A rarer occurrence is a "RAM present" fault where the system has found a block of memory where it didn't expect to find one!

If all is well the message "RAM OK" is displayed and the long test begins automatically.

Long Test

The screen now displays "Long Test" and the program begins a more exhaustive test of the new RAM. This test takes about half an hour to complete for 192K silicon disc. Again, bit patterns are written and read back and any faults are indicated in the same way as above. You can exit from the test at any time by pressing <Q>.

When the test is completed and all is well the message "RAM OK" is displayed again and the system returns to the A> prompt.

Again, you can exit from the test at any time by pressing <Q> to return to the A> prompt.

Use Of Silicon Disc On A Shared-Disc System

A silicon disc on a 480Z used in a shared-disc system is not accessible by any other 480Z in the system. You always have read and write access to your silicon disc. You need not set it to read/write or read-only status. You have therefore, no need to use the SDS utility in order to obtain write access to the silicon disc on your station.

Chapter 9
480Z Local Disc Operation On a Network

Your 480Z can be used as a standalone disc system and can also access a Research Machines Chain network in order to run network software, to access files on the network server's disc storage, and to print files held on the "local disc" using the network's printer and print spooling facilities. This facility is also useful for copying files to or from the 480Z disc drives and the network server's disc drives.

Local Disc Support

If your 480Z disc system can be connected to a Research Machines Chain network, you can now use this version of CP/M to log on to this network. This release includes a set of files that allow you, having started up the 480Z, to request it to log on to the network. Once logged on, you have the option of using the 480Z's disc drives on your network as "local" disc drives. In other words, you can access both the network and your local disc drives and transfer files between them.

A 480Z must be equipped with a network transceiver before it can be connected to a network. 480Zs used in a shared-disc system will already have this device. An upgrade kit for most 480Zs (except the very early models) is available from Research Machines.

If your 480Z is equipped with silicon disc, it also can be accessed as a local disc while logged on to a network in local disc mode.

The idea, of course, is that you can operate your 480Z either as a standalone system or a network station and be able to transfer files to and from the network quickly and easily.

When you are working in local disc mode, other users cannot access your local disc files but you can use most of the features of the network. Also, some very large programs may not be able to execute as the use of this mode reduces the amount of memory availabale for program use from 50.5K to 45.5K.

A utility program, called SETNET, permits you to change the logical drive and printer assignments to be used by your 480Z when connected to a network.

Copyright Agreements

If you already have proprietary program products, such as WordStar or Multiplan for use on a standalone disc system and you wish to copy them for use on other network stations, you should first check the copyright agreements on that software before attempting to make additional copies or to use them on systems other than the system for which it was originally purchased.

Software Supplied

The CP/M 2.2F (or later) distribution disc you have been supplied with includes the following files:

`NET.COM`	— to log onto the network
`CCP.SPR`	— console command processor
`NDOS.SPR`	— network disc operating system
`SNIOS.SPR`	— 480Z/network interface
`SETNET.COM`	— device reconfiguration utility

Accessing The Network

To access the network when you want to use local discs, put the new CP/M 2.2D system disc in drive A and type B. When the A> prompt appears, you enter the command NET in order to log your 480Z disc system onto the network. The NET command has the forms:

NET <RETURN>
or
NET nn <RETURN>

where "nn" is the network address of the server. If you omit the nn, the network server's address is assumed to be hexadecimal 7F.

Network Servers are supplied with the network address set to hexadecimal 7F. If your server is set to a different address, enter its hexadecimal value. After you have entered the NET command, your screen should display the following information:

```
CP/NET 1.2 Loader

CP/NET 1.2 loading complete.
```

This information, terminating with the A> prompt, indicates that you have successfully logged onto the network. If the A> prompt does not appear and after about 2.5 minutes the message:

```
Failed to log in/off server id:nn
```

appears, the attempt to link up with a network server has not been successful. Check the network server address you used. If you didn't give an address in the NET command, it is probable that the network server's address is *not* 7F. You will have to find out what its address is.

When the A> prompt reappears you should be able to access the network disc drives in addition to the 480Z's own local disc drives. This means that you can use your 480Z to run programs and access files held on any disc drive on the 480Z or network server. However, you cannot access any disc drives attached to other 480Zs connected to the network, including any silicon discs that may be in use on these 480Zs.

Device Assignments

The logical device assignments when you log onto the network are:

480Z drive
A remains drive A (local)
B remains drive B (local)
C remains drive C (local)
D remains drive D (local)
M remains drive M (local)

and the network drives are renamed as follows:

Server drive
A becomes E (remote)
B becomes F (remote)
C becomes G (remote)
D becomes H (remote)
E becomes I (remote)
F becomes J (remote)
G becomes K (remote)
H becomes L (remote)

Remember that these drive assignments apply only to the 480Z accessing the network using local disc software.

So, to set your 480Z's default drive to the network system disc (drive E) for example, you should enter:

E: <RETURN>

The SETNET utility, described later in this chapter, permits you to change device assignments from local to remote and vice-versa. It also permits you to reassign a logical drive to a different physical drive.

Printing On The Network Printer

While using your 480Z with local discs on the network it is *not* possible to spool files using the SPOOL command. To print a file you should use the PIP command as follows:

PIP LST:=filename.typ <RETURN>

(Note also that you can still use the <CTRL/P> command to obtain a listing of the screen output on the network printer.)

Using User Numbers

You can use user numbers in conjunction with local discs. Be careful, however, as files stored on local discs are also subject to the same user number rules as files stored on the network server discs. If the version of CP/M you are using supports the use of a silicon disc, files stored on the silicon disc are also subject to the rules for user numbers. This is unlike the use of a silicon disc in network mode in which user numbers are ignored.

System Disc Maintenance

If the CP/M 2.2D system disc you have created for use as the working system disc will *never* be used as a standalone system disc, we suggest that you use the TURNKEY utility to execute the NET command automatically whenever you press B to load the CP/M 2.2D operating system.

TPA Size

When the local disc is in operation, the TPA (amount of main memory available in the 480Z for programs) is reduced by 5K to 45.5K. This will prevent larger software packages that need more memory than this from running. In such circumstances, the software packages must be run in standalone mode rather than local disc mode.

SETNET Utility

The SETNET utility supplied on the CP/M 2.2F distribution disc allows you to inspect and modify the device table either temporarily, for the duration of the session or until you next change it, or permanently, starting from the next time you log the 480Z onto the network.

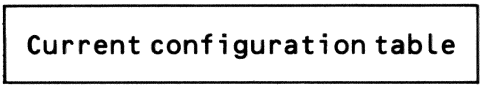
The use of SETNET from the CP/M system disc is limited to the use of your particular 480Z disc system as a network station and does not affect the network or any other 480Z station.

(Release 2.2 of the network, and any later network release, also includes the SETNET utility. If you do not yet have Release 2.2, you can install this utility on the network server disc and use it to inspect and modify the network's device tables as well).
SETNET is used as follows. Enter:

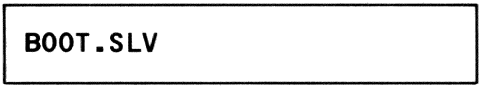
SETNET <RETURN>

The resulting screen message includes five boxes as shown:

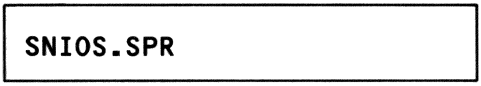
Current configuration table



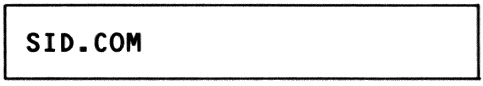
Server's internal configuration table



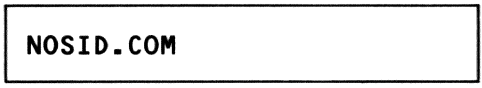
Local disc configuration table



Configuration table used with SID command



Configuration table used with NOSID command



Each box can be selected as an option and the corresponding device configuration table modified.

The first box should have a wide border. This indicates that it is selected for use. Press the <SPACE> bar a few times and see how each box is selected in turn. When the correct box is selected you press <RETURN> to look at the table.

Let's now consider each table in turn:

Current Configuration Table

This table is copied into the 480Z station whenever you use the NET command and the station is loaded with the network software. This table is copied from the file SNIOS.SPR on the CP/M system disc. It remains in the station until the RESET button is pressed or the 480Z is turned off. It is, therefore, *temporary*. Any changes you make to this table will only effect the 480Z at which the changes are made until the next time the 480Z is reset.

To display and modify this table, make sure the box is selected and press <RETURN>.

The table lists all the available disc drives, and the printer, and tells you if each is either remote (a network drive or printer) or local (attached to the station).

To change a drive setting from remote to local or from local to remote, move the cursor, using the arrow (up and down) keys, to the line you want to change. Press <SPACE> to change "local" to "remote" (or vice versa). If the cursor is on the line for drive A which says:

```
drive A: is remote A: on server [7F]
```

Press <SPACE> and this should now say:

```
drive A: is local
```

Press <SPACE> again. This should change A: back to a remote drive. Try it.

The number in the square bracket [7F] is the server address.

To change a remote device assignment to another logical drive name, press the right-arrow key. The cursor will move to the device letter and the message "Type A to P — remote drive letter" will appear above the list. Type in the new device name letter.

To change the server ID for a given device assignment (either a disc drive or printer), press the right-arrow key once or twice until the cursor is positioned over the hexadecimal address field. Type in the new hexadecimal address.

You may press <CTRL/Q> to get further help instructions.

When you are satisfied that the settings are correct, press <CTRL/D>. After the message:

```
Update table—are you sure? (y/n):
```

press Y and the table is updated. Remember that these settings will only apply for this table until the station is switched off or reset. The original table will be downloaded when the station is re-booted.

Server's Configuration Table (BOOT.SLV)

This feature should only be used by the network manager and cannot be used from SETNET on the CP/M disc, but only when SETNET is installed on the network server disc. BOOT.SLV is the server's internal configuration table. Any changes made to this affect *all* stations and are *permanent* until you next change the BOOT.SLV table.

The procedure is exactly the same as that given above for the current configuration table except that you must be in user 0. Note that the [00] in the table is automatically replaced each time the software is loaded into a station.

Warning:

- If you are in the process of altering this table from a 480Z logged onto the network as a network station rather than a 480Z being used in terminal mode, other stations may not be able start up if they have not already done so. It is advisable to change this table only when *no* other users are active and afterwards to reset the server before attempting to log any 480Z stations onto the network.

- If you accidentally alter drive A to be local and update the BOOT.SLV table, you won't be able to use the network! If this happens you should restart the network in maintenance mode (refer to the Network Users Guide), erase the BOOT.SLV file and replace it with a copy of BOOT.SLV from the original distribution floppy disc.

Local Disc Configuration Table (SNIOS.SPR)

480Z stations with local discs have the device configuration table SNIOS.SPR on the local system disc. Select the SNIOS.SPR option in order to modify this device configuration table permanently. (Refer to section 3 for details of local disc support.)

Silicon Disc Configuration Table (SID.COM)

This feature is available only in network release 2.2 or later.

Non-Silicon Disc Configuration Table (NOSID.COM)

This feature is available only in network release 2.2 or later.

Appendix A
Hexadecimal Notation

Hexadecimal notation is widely used in computer-generated output (e.g. assembler listings and the Front Panel display to represent addresses and the contents of memory locations. While the decimal number system uses a base of 10 and the symbols 0–9, the hexadecimal (hex) system uses a base of 16 and the symbols 0–9,A,B,C,D,E,F. The relationship between decimal and hexadecimal is as follows:

DEC	HEX
One	1
Two	2
Three	3
Four	4
Five	5
Six	6
Seven	7
Eight	8
Nine	9
Ten	A
Eleven	B
Twelve	C
Thirteen	D
Fourteen	E
Fifteen	F
Sixteen	10
Seventeen	11
Eighteen	12
etc	

Four-bit Binary Nimbers

There are sixteen different 4-bit binary numbers each of which can be used to represent a different hex digit:

0000	0	1000	8
0001	1	1001	9
0010	2	1010	A
0011	3	1011	B
0100	4	1100	C
0101	5	1101	D
0110	6	1110	E
0111	7	1111	F

Conversely, a single hex digit is a simple way of defining a 4-bit number.

Eight-bit Binary Numbers

To cope with eight bits, the convention is to divide the eight bits into two groups of four and to write a pair of hex digits, the first corresponding to the left-hand four bits (most significant), and the second to be right-hand four bits (least significant). So a single-byte, eight-bit number, containing 10101111 can be written in hex as AF (1010=A, 1111=F).

Sixteen-bit Binary Numbers

In the same way that an eight-bit number can be represented by two hex digits, a sixteen-bit number can be represented by four hex digits.

Negative numbers within the 480Z are often held in 'twos complement' notation. In this notation a number is negated by complementing each bit and adding one. The advantage of this representation is that two such quantities can be added without special treatment for negative numbers.

	A	E
Write number in binary:	1010	1110
Invert (complement) each bit:	0101	0001
Add 1:	0101	0010
Convert back to hex and insert sign	—52	
Convert to decimal	—82	

So, in two's complement notation, the hexadecimal number AE is equivalent to the decimal number –82.

Alternatively, the same values could have been reached using hexadecimal arithmetic:

Subtract hex value AE from 100 hex:	100—AE	52
Insert sign	—52 hex	
Convert to decimal		—82

Appendix B
Escape Sequences

An escape sequence is a character string sent to the screen and recognized as special because of certain characters appearing on the screen, other actions take place.

Escape sequences may be generated within a BASIC program by using PUT statements, and an example of their use would be to switch a screen capable of operating in either 40— or 80-character mode into the mode required for the current program.

Characteristic Features

An escape sequence is distinguishable from any other string of characters by the following characteristics:

- The first character of an escape sequence is the ESCAPE character (ASCII 27)
- The second character of an escape sequence is known as the Sequence Introducer (SI), which must be one of the characters from the list below, and its value determines the number of subsequent characters which are assumed to be part of the escape sequence
- The subsequent characters needed for each SI are also shown below, and may include a Switch (SW) and/or a Control Parameter (CP)
- A Switch may take the value '0' (to switch a feature off) or '1' (to switch it on)

- A Control Parameter may take any value given in the lists below.

Errors in Escape Sequences

Once an ESCAPE character has been sent to the screen to denote the beginning of an escape sequence and if the SI is not recognized then the escape sequence is immediately terminated and any further characters in the sequence are dislayed on the screen in the usual way.

Illegal characters after a legal SI will invalidate the sequence but will not affect the number of characters diverted from the screen.

Any escape sequence in which an error is detected is not executed.

Escape Sequences

1. Send a special character to the screen:

   ```
   SI = '!' (ASCII 33)
   ```

   The sequence after the SI is a single byte to be output directly to the screen, with the characters in the range ASCII 0–31 or ASCII 127 not being interpreted as special characters.

   Example:

   ```
   PUT 27,"!",10
   ```
   or,
   ```
   PUT 27,33,10
   ```

   will send a character with the ASCII value 10 directly to the screen.

2. Control the use of the 40-character line and 80-character line display:

   `SI = '=' (ASCII 61)`

   The sequence after the SI is a switch (SW) followed by a CP.

   `CP = 'F'`
   Switch off or on the CTRL/F action.
   (See Appendix G, "ROS Facilities")

   `CP = 'G'`
   Switch off or on the CTRL/A action
   (CTRL/A is used to control screen output. See the BASIC Reference Manual)

   `CP = 'J'`
   Switch off or on the 80-character mode

   Note:
   If you are in 'graphics' mode when the J parameter is used, the screen will return to 'text' mode.

   `CP = 'L'`
   Switch off or on the alternate character set. For example

   ```
   PUT27,"=1J"
   ```

   will ensure that the 480Z is operating in 80-character mode.

3. Restore the function keypad keys to their original uses:

   `SI = '>' (ASCII 62)`

   The sequence after the SI is a CP only.

   `CP = 'D'`
   Restore all of the function and arrow keys to their original values (i.e. undo the effects of SI = '%' which is described in 6, below.)

4. Define or redefine the display scrolling window:

   `SI = '?' (ASCII 63)`

   The sequence after the SI is 4 bytes followed by a CP.

   `CP = 'A'`
   The 4 bytes define a scrolling window, in the order X(lower), X(upper), Y(lower), Y(upper), and the values must be such that:

   0 <= XL <=XU <= 39 (40-character width screen),
   or
   0 <= XL <= XU <= 79 (80-character width screen),
   and
   0 <= YL <= YU <= 23.

   `CP = 'B'`
   The 4 bytes define a rectangular area to be cleared, with order and value limits as above.

   For example
   `PUT27,"?",0,39,20,23,"A"`

   will define a scrolling window to be the full width of a 40-character screen, using only the bottom 4

lines of the screen.

5. Beeper sound:

   SI = '@' (ASCII 64)

   The sequence after the SI is 2 bytes followed by a CP.

   CP = 'A'
   The 2 bytes define the frequency and duration respectively of the beeper (which is sounded by CTRL/G).

   Example

   ```
   PUT27,"@",150,75,"A"
   ```

6. Define new uses of the function keypad keys:

   SI = '%' (ASCII 37)

   The sequence after the SI is a CP, followed by a byte (of value n), then n further bytes. The sequence is used to redefine the character string that is generated when a function or arrow key is pressed. The new character string will be the last n bytes of the escape sequence.

   CP = 'A' Redefine the up arrow key
   CP = 'B' Redefine the right arrow key
   CP = 'C' Redefine the down arow key
   CP = 'D' Redefine the left arrow key
   CP = 'E' Redefine the F1 function key
   CP = 'F' Redefine the F2 function key
   CP = 'G' Redefine the F3 function key
   CP = 'H' Redefine the F4 function key
   CP = 'I' Redefine the SHIFT up arrow key
   CP = 'J' Redefine the SHIFT right arrow key
   CP = 'K' Redefine the SHIFT down arrow key
   CP = 'L' Redefine the SHIFT left arrow key
   CP = 'M' Redefine the SHIFT F1 function key

CP = 'N' Redefine the SHIFT F2 function key
CP = 'O' Redefine the SHIFT F3 function key
CP = 'P' Redefine the SHIFT F4 function key

The character string can be of any length from 0 to 127 bytes, but the total number of characters for all keys is also limited to 127.

If the string is too long the escape sequence will have no effect.

Example

```
PUT27,"%G",4,"RUN",13
```

will redefine the F3 function key so that it generates the string:

```
RUN <RETURN>
```

Appendix C
480Z Display Character Sets

Your LINK 480Z computer displays on its screen characters that are defined in an integrated circuit known as a character generator. All 480Z computers running under version 1.xx of the ROS operating system are fitted with a character generator of type CG05 (or earlier), but a later character generator, the CG06, is fitted to all machines incorporating ROS operating system version 2.2x or later. Your ROS operating system version number is displayed at the top right corner of the screen when you switch on or press the reset button.

Character generator CG06 contains exactly twice as many character definitions as the older CG05, and half of those in a CG06 are identical to those stored in a CG05. In a CG06, the character set matching that in a CG05 is known as the Normal set, the remainder forming the Alternate set.

If you use either a CG05 or the Normal character set from a CG06, the characters displayed on your screen are those described in tables C.1 and C.2. They may be summarized as follows:

Character codes	*Display*
0— 31	special characters, displayed bright.
32–127	alphanumeric and punctuation characters, displayed bright.
128–159	low resolution graphics (Teletext) characters, displayed dim.
192–255	low resolution graphics (Teletext) characters, displayed bright.

The Alternate character set in a CG06, however, has the Graphics characters replaced by a "Reverse Dim" version of the Normal characters set, so may be summarized as:

Character codes	*Display*
0— 31	special characters, displayed bright.
32–127	alphanumeric and punctuation characters, displayed bright.
128–159	special characters, displayed reverse dim.
192–255	alphanumeric and punctuation characters, displayed reverse dim.

"Special" characters are normally interpreted as control characters, but may be displayed if required by means of an "escape sequence".

When you are using the Alternate character set, therefore, a "normal" ASCII code (in the range 0–127) will cause a character to be displayed brightly on a dark background, while setting the top bit "on" (by adding 128 to the value of the ASCII code) will cause the same character to be displayed, but this time darkly on a light background.

A 480Z may be switched under program control to use either the Normal set or the Alternate set of characters, such control being achieved by the transmission of a suitable "escape sequence" of characters to the screen.

The escape sequence:

```
ESC = 1 L
```

will cause the Alternate set to be used.

```
ESC = 0 L
```

will cause the Normal set to be used.

You could generate the above escape sequences, for example, by executing the BASIC statements:

```
10 PUT 27,"=1L"
20 PUT 27,"=0L"
```

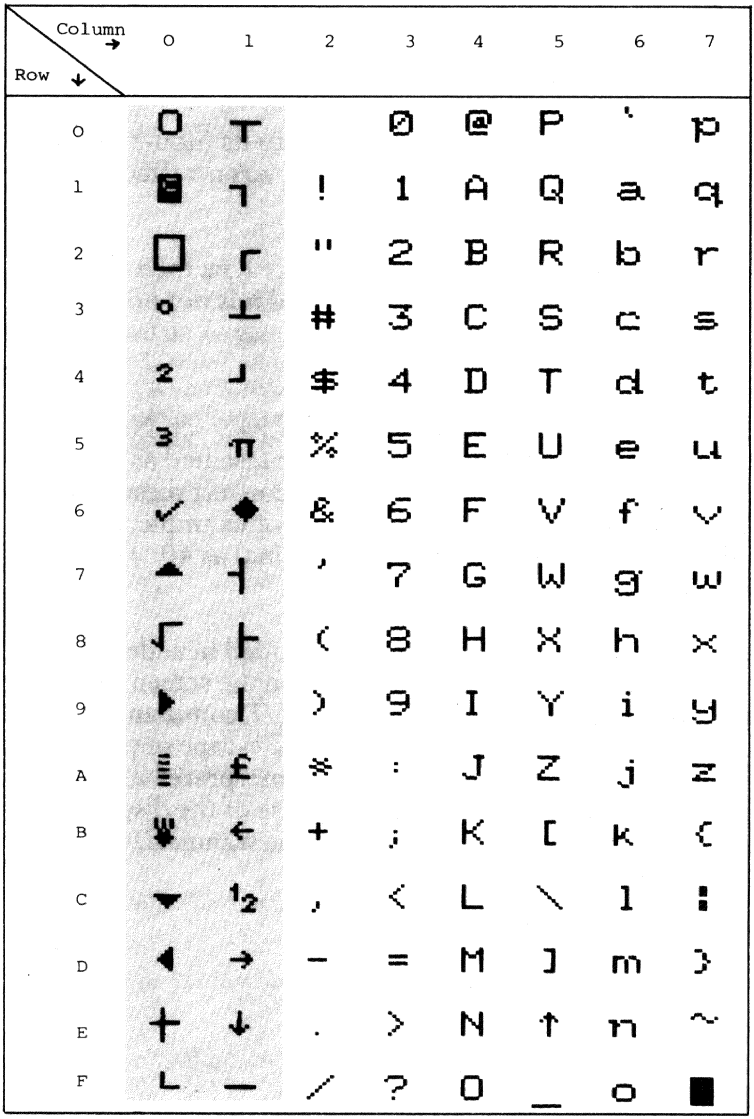
Switching a CG05 character generator to its (non-existent) "alternate" character set is allowed but has no effect on the characters displayed.

If your 480Z operating system version is 1.xx then the character generator will be a CG05, and it is not possible to replace it with a CG06.

Table C.1 illustrates the 480Z text character set. Note that the codes for each character are represented as *hexadecimal* numbers and you should convert these values to find the equivalent decimal values. For example, the symbol "@" is represented in hexadecimal as 40. The equivalent decimal value is 64.

Also note that the shaded characters, coded hexadecimal 03 to 1F (decimal 3 to 31), are displayed on the screen by a BASIC program either by using the PLOT command or by using the PUT command with a suitable escape sequence (see appendix B). Otherwise, they are interpreted as control characters for controlling the use of the display screen. Their use as control characters is summarized below in table C.3.

Table C.1 480Z Text Display Characters



Dot Plotting Codes

As an exception to this rule, the three shaded characters 00 to 02 are displayed as shown in table C.1 only by means of an escape sequence. When these codes are given in a PLOT ocmmand, a single dot is plotted, with a width of one X coordinate unit and a height of one Y coordinate unit at exactly the screen coordinates specified and with either zero intensity (Code 0), medium intensity (Code 1), or full intensity (Code 2).

The complete range of text characters is coded from hexadecimal 00 to 7F (decimal 0 to 127).

Low Resolution Graphics Characters

Table C.2 contains a complete list of the low resolution graphics characters with their appropriate decimal codes.

Note:

- Graphics characters are in the range hexadecimal 80 to FF (decimal 128 to 255) and are the standard teletext graphics characters.
- Characters in the range hexadecimal 80 to BF (decimal 128 to 191) are displayed in grey, or low intensity.
- Characters in the range hexadecimal C0 to FF (decimal 192 to 255) are the same as the grey characters but are displayed in white, or high intensity.
- These low resolution graphics characters can be printed on a Microline printer but printers such as the Epson RX and MX series cannot print them.

Table C.2 480Z Low Resolution Graphics Characters

Grey	White		Grey	White
128	192		160	224
129	193		161	225
130	194		162	226
131	195		163	227
132	196		164	228
133	197		165	229
134	198		166	230
135	199		167	231
136	200		168	232
137	201		169	233
138	202		170	234
139	203		171	235
140	204		172	236
141	205		173	237
142	206		174	238
143	207		175	239
144	208		176	240
145	209		177	241
146	210		178	242
147	211		179	243
148	212		180	244
149	213		181	245
150	214		182	246
151	215		183	247
152	216		184	248
153	217		185	249
154	218		186	250
155	219		187	251
156	220		188	252
157	221		189	253
158	222		190	254
159	223		191	255

Table C.3 480Z Display Control Codes

ASCII CODE		If sent to the screen by a PUT command, the code is normally intercepted and interpreted as a control code with the meaning:-
DEC	HEX	
0	00	—
1	01	—
2	02	—
3	03	—
4	04	Resume output
5	05	—
6	06	—
7	07	Beep
8	08	Cursor left
9	09	Tab
10	0A	Cursor down
11	0B	Cursor up
12	0C	Clear screen, cursor to bottom left
13	0D	Carriage return and line feed
14	0E	Carriage return
15	0F	Suppress output
16	10	—
17	11	Clear auto-paging
18	12	—
19	13	Set auto-paging
20	14	—
21	15	Flashing cursor
22	16	—
23	17	Steady cursor
24	18	Cursor right
25	19	Clear to end of line
26	1A	—
27	1B	Begin an escape sequence
28	1C	—
29	1D	Cursor to top left
30	1E	Clear to end of screen
31	1F	Clear screen, cursor to top left

Display Control Codes

The 480Z display is controlled by programs using a set of control codes. These control codes are in the range hexadecimal 00 to 1F (decimal 0 to 31) and their functions are defined in table C.3. They are used from within a BASIC program, using the PUT command. These control codes can be overridden and the special 480Z display characters with the same range of codes (see table C.1) can be displayed by a BASIC program using either the PUT command with an esape sequence or the PLOT command, as mentioned above.

One of the "escape sequences" described in appendix B allows any of the ASCII codes in table C.3 to be displayed as a special character on the screen by means of a PUT command. Instead of being interpreted as one of these display control codes. This results in the same character being displayed as those shown in table C.1 for PLOT.

For example, the BASIC statement:

```
10 PUT "Circumference = 2",27,33,21,"r"
```

will display:

```
Circumference = 2  r
```

on the screen, while the statement:

```
10 PUT "Circumference = 2",21,"r"
```

will display:

```
Circumference = 2r
```

on the screen and set the cursor to its flashing mode.

Appendix D
Glossary of Terms

Applications software
Programs designed to carry out a particular task or set of tasks specific to a particular user.

Argument
A term used to describe a part of a command which can vary and which affects the action of the command.

ASCII
American Standard Code for Information Interchange: the form in which characters are encoded within the 480Z.

Assembler
A program, usually provided by the computer manufacturer, to translate an assembly language program into machine code. An assembler is an item of systems software, and as such is specific to a particular model of computer.

Assembly Language
A low-level programming language which is translated into machine code by an assembler. A computer's assembly language is closely related to its machine code (each instruction is translated into one machine code instruction). Its advantage over machine code is that it is easier to use. Its main advantages over high-level languages are that its programs can occupy much less memory, run much faster, and control more closely the activities of the computer. However, assembly programs take longer to write and require of the programmer a more intimate knowledge of the computer and programming techniques.

BASIC

Beginners' All-purpose Symbolic Instruction Code — a high-level programming language commonly available on microcomputers. Its advantages are that it is easier to learn its vocabulary and grammar than with most other languages.

Baud rate

The rate, expressed in bits per second, at which data is transmitted through a serial interface.

Bit

Binary Digit — one of the digits used in binary notation (i.e. either 0 or 1).

Break

To halt execution of a program with a keystroke or an instruction in the program.

Buffer

A part of computer memory set aside for temporary storage of data. It may readily be filled or emptied without distrubing of the contents of the rest of the memory.

Bug

An error in a program.

Byte

A set of 8 bits, often corresponding to a single character (i.e. one byte can be used to represent one character). Microcomputer memory sizes are usually defined in terms of bytes.

Cassette-based (Configuration or microcomputer)

A microcomputer configuration that uses cassette recorders and tapes to save and load programs or data.

Central processing unit (CPU)

The "nerve centre" of the computer, consisting of the Arithmetic Unit, Control Unit and Memory. (Also called

the Central Processor). In a Microcomputer, the CPU is often on one single printed circuit board.

Character set

A character could be any one of the letters of the alphabet (upper or lower case), a numeric digit, or another associated symbol (e.g. * or ?). A character set is the set of characters that a device is capable of handling. In the context of this manual the characters set is the ASCII set. There are small differences between the character set used by the LINK 480Z and between various printers but the alphanumerics are the same.

Command

Two computers are compatible if programs can be transferred between them and used without alteration.

Compatibility

A sequence of characters entered from the keyboard and executed by a program. Each command consists of the name of the command followed by a list of arguments.

Compiler

A program which translates a high-level language program into a computer's machine code before the program is executed. (Each high level language instruction generally generates several machine code instructions.)

Configuration

A term used to describe the central processor and the devices linked to it.

Control Character

A character typed while the CTRL key is depressed. The name originates from devices such as the teletypewriter which uses these characters to perform control functions such as turning on and off the paper tape reader. These characters are used to perform control operations (e.g. turning a printer on and off) or to issue commands.

Data

Information in a form acceptable for input to, storage in processing by, and output from a computer.

Default

The value of an argument or part of an argument that is assumed by the system when no argument value is supplied by the user.

Documentation

1) A complete description of a program usually including helpful notes, flowcharts, program listing, test data and sample output.

2) A complete description of a computer and its system software, usually in the form of manuals.

Editor (Text Editor)

A program which allows the user to edit a file. In some microcomputers, editing facilities are built into the operating system and automatically available through simple commands. Editing facilities are very valuable, since they obviate the need to retype complete files when only minor modifications are required. The standard LINK 480Z Text Editor is a program called TXED.

Enhance

To improve or "upgrade" a computer configuration by the addition of an extra facility or item of equipment.

Error Message

Response on screen to a faulty command, or an error detected by the operating system.

Execute

To obey a program by carrying out its commands. (Synonymous with "run".)

File

Used in many computer applications to mean a collection or grouping of related information. A file on a magnetic disk or tape consists of a number of 'records' which have a common characteristic.

Front Panel

A feature which enables the contents of the LINK 480Z's memory to be examined and modified and programs executed one instruction at a time.

Graphics

The ability of a computer to display diagrams and produce images as opposed to merely displaying or printing text.

Graphics Board

A circuit board inside the microcomputer that enables graphics to be used.

Hardware

The items of equipment making up a computer configuration.

High-level language

A language such as BASIC which is easily written and understood. It needs an interpreter or compiler to make it machine readable. See chapter 1 "Introduction to Microcomputers".

High-resolution graphics

Graphics capable of displaying reasonably fine lines (i.e. 250 horizontal picture points or more).

Interface

The necessary hardware and/or software to form a working connection between two systems or parts of a system (for example the central processor and a printer).

Interpreter

A program which executes another program (written in a high-level language) one instruction at a time.

Kilobyte (K)

Consists of 1024 Bytes — used to indicate the size of the memory of a microcomputer eg. 8K of memory is 8192 memory locations (bytes). Where used in conjunction with systems software (e.g. 8K BASIC interpreter) this indicates how much memory will be occupied by that system software if used.

Low-level language

A language written in machine readable or mnemonic form. See chapter 1, "Introduction to Microcomputers".

Machine-code

The code used by the computer to represent the instructions which it will recognize and obey.

Monitor

A monitor television screen used to display output from a microcomputer. Same as Visual Display Unit (VDU). Should not be confused with Monitor Program.

Monitor Program

Term often used when referring to an operating system program (such as ROS in the 480Z) which monitors or controls the activities of the system.

Parallel I/O

The transfer of bits of data simultaneously. Each bit is transmitted along a separate channel or wire. See SERIAL I/O.

Patch

A group of instructions inserted to provide an extra facility or to correct an error in a program.

Ports

Memory addresses in which the data from external devices are placed on arrival and from which data are output.

Printer

A machine which produces printed output (print-out) from the computer.

Program

A complete set of programming language statements to perform a specified task.

Programming language

A code (with a limited vocabulary of key words and well-defined Syntax rules) that allows the user to communicate with a computer and instruct it to perform tasks.

Prompt

Indication on the screen that the computer is ready for you to type a command.

Random Access Memory (RAM)

Memory of a computer which is capable of holding the user's program and data. The content of this kind of memory is lost when the computer is switched off.

Read Only Memory (ROM)

A memory whos context is fixed (i.e. not lost when the machine is switched off). The monitor program is held in ROM so that it is available as soon as the computer is switched on. The contents of ROM cannot be altered by program instructions.

Register

These are special memory locations reserved for specific functions, and are used to hold data that affects the overall operation of the system. A computer normally contains several registers.

Restart Address

The memory address to which execution can be transferred to restart a program without losing the data on which the program is operating.

Save

The transfer of a program from immediate memory to a backing store medium (e.g. cassette).

Serial I/O

The transfer of bits of data in sequence rather than simultaneously. Bits are transmitted along the same channel or wire one after another. See PARALLEL I/O.

Scroll

To produce a display of lines of characters on a screen which move upwards with new lines coming from below.

Software

A term used to refer to programs in general.

Text Editor

A piece of software used to edit text stored in a computer. The text sometimes represents a computer program or it may be an article or a letter.

Upgrade

Normally used to mean an addition or enhancement to a computer system to improve its capacity, performance, or funtional characteristics.

User Memory

The immediate memory available to the user that is the random access memory in the microcomputer which is not used by the operating system or other essential items of systems software.

Visual Display Unit (VDU)

A device, with a cathode ray tube (as in a television) on which information is displayed. See Monitor

Appendix E
Contents of the Distribution Discs

Master System Disc

The CP/M Version 2.2F Master System disc supplied with your system contains the following files:

Side 1

File reference

BASIC.COM
Extended Basic, Version 6.3* with level 2 HRG

CCP.SPSystem file used for network access

**COPYFILE.COM
To copy single files on a single-drive 480Z

**CONFIG.COM
To set three system features; screen width, printer, and read after write check.

*DDT.COM
To debug a program

**FASTCOPY.COM
To copy entire contents of disc surface(s)

FILEX.COM
To transfer text files between disc and cassette

**FORMAT.COM
To format new discs

LIST.BAS
Basic program for creating LOADSD (LST) files

*LOAD.COM
To load a file in INTEL HEX machine code and produce a command file

LOADSD.COM
Copy files named in LST (LIST.BAS) file into the silicon disc

**MOVCPM.COM
To create a version of CP/M to match a given memory size

NDOS.SPSystem file used for network access

NET.COM
Program to initiate network access

**PIP.COM
To copy disc files

RAMTEST.COM
Program to test silicon disc memory circuits

RELEASE.PRN
On-screen text file explaining the versions of Basic contained on this disc

SETNET.COM
A utility program for displaying and changing the logical names used for each of the physical discs and the printer accessible to the 480Z when logged onto a network by means of the NET command

SNIOS.SPSystem file used for network access

**STAT.COM
To display the status of files and modify file attributes

**SYSGEN.COM
To copy CP/M onto a disc

*SUBMIT.COM
To submit a file of commands for batch processing

**TURNKEY.COM
To start a program automatically after loading the system

**VERIFY.COM
To test that a disc is readable

*XSUB.COM
To allow parameter passing from a command file to programs involved with it. Used with SUBMIT.COM

Side 2

File reference

BASIC6
Extended Basic, Version 6 without HRG

BASIC6G
Extended Basic, Version 6 with level 1 HRG

BASIC6G2
Extended Basic, Version 6 with level 2 HRG

BASIC5
Extended Basic, Version 5 without HRG

BASIC5G
Extended Basic, Version 5 with level 1 HRG

BASIC5G2
Extended Basic, Version 5 with level 2 HRG

CAT.BAS
Basic demonstration program

CODE.BAS
Basic demonstration program

MEMBER.BAS
Basic demonstration program

MEMBER.RAN
Basic demonstration program

Details about the programs marked with an asterisk (*) are not included in this manual. Descriptions of these programs can be found in either the CP/M + CP/NET Programmers Guide, by Research Machines, or the CP/M Operating System Manual, by Digital Research. Programs marked with two asterisks are described in the Research Machines Manual: CP/M Operating System (Version 2.2D) Users Guide, PN 11901.

Welcome Disc

When you insert the welcome disc into a drive of your disc unit and press <B>, the BASIC programs on this disc will start running automatically:

- A welcome message will appear on the screen
- A list (Main Menu) of demonstration programs, and the other options, will appear.

The actual contents of the Main Menu will depend on whether or not your 480Z has a high resolution graphics facility.

The Welcome disc also contains all the CP/M files contained on the Master System Disc.

Appendix F
File Transfer Between Cassette and Disc (FILEX)

The FILEX program allows you to transfer cassette files to disc, and disc files to cassette. The files must be written in ASCII format. Note that:

- You can transfer BASIC programs produced with Extended BASIC, Version 5 or later, provided that the programs were saved with the SAVE command.
- You can transfer files produced with the Research Machines TXED word processing program.
- You cannot transfer BASIC programs saved with the FSAVE command because the files are in internal format.
- You cannot transfer machine-language programs.

After you have attached a disc drive and a cassette recorder to your 480Z, proceed as follows:

1. Insert a system disc in the disc drive, and load CP/M. Then enter:

   FILEX <RETURN>

2. After an introductory message, FILEX will display:

   ```
   Read or write to cassette (R/W):
   ```

   If you want to transfer a file from cassette to disc, enter:

<R> <RETURN>
If you want to transfer a file from disc to cassette, enter:

<W> <RETURN>

Make sure that you have the correct disc and cassette ready for the transfer operation.

3. FILEX asks for a cassette file name, then a disc file name. The cassette file name consists of a filename (compulsory) and a file type (optional). The disc file name consists of a filename (compulsory), a file type (optional), and a logical disc drive name (optional).

4. The message:

```
Switches (press RETURN for normal)
```

is displayed. Press <RETURN> to commence file transfer.

5. FILEX displays messages which tell you when to press the controls of your cassette recorder.

If you have any problems when using FILEX, enter:

HELP <RETURN>

and information about the FILEX program will be displayed.

Appendix G
ROS Facilities

ROS has a number of useful features that can be controlled by means of commands entered at the ROS command level.

When the 480Z is switched on, or reset, the ROS start-up message is obtained as described in chapter 2.

The last part of the message requests:

```
Please give a command or type H for help
```

Press H to obtain the ROS 'command menu' which lists the commands that are available. The menu looks like this:

ROS Commands

N	Boot network
B	Boot disc system
R	Run BASIC in ROM
W	Switch the character display between 40 and 80 characters
L	Load a system program from cassette
D	Dump a system program to cassette
O	Select the cassette speed and printer options
C	Continue with the current system program
J	Jump to an address in memory
T	Enter terminal mode
CTRL/F	Enter Front Panel
CTRL/T	Enter printer test mode

ROS requires you to enter one of these commands after the prompt. Some of these are described in greater detail in later parts of this chapter and, if so, are indicated by * in the list:

Command	*Action*
N	Only used if the 480Z is to act as a 'station' on a Research Machines network.
B	Only used if the 480Z has floppy disc external storage.
R	Activates BASIC in ROM
W*	Changes the number of characters per line on the screen from 40 to 80, or from 80 to 40 depending on the current mode.
L*	Loads a machine-code program from a tape cassette.
D*	Writes a machine-code program from a tape cassette.
O*	The 'options' instruction allows you to select a printer or to set the cassette speed when using non-standard cassettes.
C	Returns you to executing a system program (such as BASIC in ROM) after an interrupt.
J*	Jumps to a specified memory location and executes its contents.
T	Enables the 480Z to act as a simple terminal when connected to another computer.
CTRL/F*	Displays the Front Panel on the VDU screen. See 480Z Front Panel' below.
CTRL/T*	Tests the printer connected to the 480Z. See 'Testing a Printer' below.

We shall now look at some of these ROS options in more detail. They are not, however, described in the order given in the list above.

Loading Machine-Code Programs from Cassette (ROS Command L)

To load a machine-language program from a cassette:

- Enter ROS command: L

ROS replies with:

NAME>

- Enter: program-name <RETURN> and press the PLAY key on the recorder.

ROS searches the cassette for the program and when it finds it replies by displaying the name again and the number of the block being loaded.

As soon as the program is loaded, it will start executing automatically.

Remember to press the STOP button on the recorder.

Storing Machine-Code Programs on Cassette (ROS Command D)

Programs written in machine code, like systems programs, are recorded onto cassette tape using the following procedure:

- At the prompt, enter: D

ROS responds with:

NAME>

- Enter the name of the program you want to store (do not put it in quotes) and press <RETURN>

ROS responds with:

First>

- Enter the number 100 (the value in hexadecimal of the first byte in memory of the program) followed by <RETURN>

ROS responds with:

Last>

- Enter the value of the last byte, (in hexadecimal) in memory of the program that is to be stored. This can be obtained from the relevant documentation for the program concerned.

Press <RETURN>

ROS responds with:

Start>

- Enter: 100

Place a blank tape on the recorder and make sure it is wound past the leader tape. Press the RECORD button.

- Press <RETURN>

ROS replies with the numbers of the cassette tape block it is storing. When finished the ROS monitor prompt, "' is displayed.

Selecting a Printer for the 480Z (ROS Command O)

There are four options to choose when using a printer on the 480Z. These options are numbered 0, 2, 3 and 4:

0 is the VDU screen
2 is the serial I/O 2 interface
3 is the parallel I/O interface
4 is the serial I/O 4 interface.

ROS will ask which printer you require, as described later.

This section assumes that you are using one of the printers supplied by Research Machines. It does not describe how to connect the printer to the 480Z, as this is covered in the manuals supplied with the printer, but assumes that it is correctly connected, switched on, and 'on line'.

The printer you use will be either a serial printer or a parallel printer. A serial printer receives signals from the computer sent one after another along the same wire; a parallel printer receives eight signals, sent down eight separate wires simultaneously. The connections for both types are as follows.

If you are using a serial printer, such as a MICROLINE 80, it must be plugged into the socket on the rear of the 480Z marked 'serial I/O 2' or 'serial I/O 4'.

The options for these are numbers 2 and 4 respectively.

If you are using a parallel printer, such as an ANADEX, it must be plugged into the socket marked 'parallel I/O'.

The option for this is 3.

Setting the printer option can be done from ROS command level before starting your work or from the Front Panel (which is described later) if you are already running a program. At the "' prompt the steps to follow are:

- Enter ROS command: O

ROS responds with:

Cassette or lineprinter (C/L):

- Enter: L

The display now asks:

Printer type (0,2,3,4):

The type is as described at the start of this section.

- Enter a number as requested.

If you select type 3 the ROS prompt reappears.

If you select type 2 or 4 ROS replies with:

Baud code (0–6):

- Enter a baud code chosen from the following list. The printer manual should indicate what baud rate you must select:

code	*Baud rate*
0	110
1	300
2	600
3	1200
4	2400
5	4800
6	9600

You now return to the ROS command prompt.

Warning: The printer setting you have selected may be overridden when CP/M is loaded into the 480Z. This depends on how the CP/M system has been configured. See the CONFIG utility in the manual CP/M Users Guide.

Testing a Printer (ROS Command CTRL/T)

To test if the printer is working correctly, use the ROS CTRL/T command:

- At the ROS prompt enter: CTRL/T

  ROS enters a small test routine that allows anything you enter at the keyboard to be printed both on the screen and on the printer.

- Enter some characters and press <RETURN>

  If you get no response from the printer, check that it is correctly connected and switched on, and that it is online and is loaded with paper. If everything is correct, reset the 480Z and try from the ROS command again.

  Refer to the printer manual should it still refuse to work.

To exit from the test routine you should press the RESET button.

Using a Printer with a 'READY' Line

Some serial interface printers can receive data faster than they can actually print it. For instance, a Qume Sprint 5 printer can receive data at 1200 baud, the

equivalent of 120 characters per second. However, the Qume can only print at an average of 45 characters per second, so some way of stopping the computer from sending data is required. The most appropriate way is a signal sent to the computer. This signal comes from the printer when it wants the computer to stop transmission until it is ready to receive more data (therefore it is referred to as a READY line).

The Research Machines interfaces, types SIO–2 and SIO–4, can both handle a READY line. The connection details are given in appendix H.

Changing Cassette Speed Option (ROS Command O)

When the 480Z system is turned on or reset, the cassette recorder interface is ready to accept data in a high speed format at a transfer rate of 1200 bits per second. Most Research Machines software issue and demonstration tapes are now sent out in high speed format so you do not usually have to change the speed option.

However, at some time you may wish to read programs from a tape which was recorded in low speed format (as TXED and early software issue tapes were). To do this:

- Enter the ROS Command O
- Enter C in answer to the prompt.

ROS replies with:

Tape speed (SS/FF)

- Enter the required speed. The first letter gives the reading speed and the second letter gives the writing speed.

For example, SF requests SLOW reading and FAST writing.

Note that your options are:

`SS` : Slow read and slow write
`SF` : Slow read and fast write
`FS` : Fast read and slow write
`FF` : Fast read and fast write (the 480Z is set to this when switched on)

The cassette speed option remains as chosen until you enter another O command or the 480Z is reset.

The 480Z Front Panel (ROS Command CTRL/F)

A special feature of the 480Z firmware is the Front Panel display.

Before reading this section, press CTRL/F at the keyboard and watch the VDU screen. The Front Panel display starts something like this:

(the actual numbers may be different)

```
>  PC   E87F   F7   FD   EF   04   F7   FD   F1   C9
   SP   FEFC   7F   E8   00   00   46   06   FB   03
   IY   DDAF   04   04   04   00   04   04   04   04   Page 1
   IX   FFFF   FF   FE   FE   66   EE   F7   00   00
   HL   03F8   FF   FF   FF   FF   FF   FF   FF   FF
```

The Front Panel display shows the contents of the internal registers (memory locations) at the time that CTRL/F was entered. You need not be concerned with the contents at this stage.

This manual does not discuss the use of the Front Panel in detail, as it is used mainly for correcting machine-code programs, but introduces some useful commands that are

available when the 480Z is in its Front Panel mode.

As examples of the use of the Front Panel we shall look at how to select a printer for output, and switching the screen width while you are using BASIC in ROM.

Selecting A Printer Using The Front Panel

It is possible to set up a printer for output while running a BASIC in ROM program, without losing the contents of the memory locations.

The procedure is as follows:

- Press CTRL/F.

BASIC in ROM replies with the question:

```
F--are you sure (Y/N):
```

- Enter: Y

The Front Panel is displayed, and at the bottom of the screen the message is:

```
Ready:
!
```

- Enter: O

The display now asks:

```
Cassette or lineprinter (C/L):
```

The procedure is now the same as that given earlier in the section 'Selecting a Printer for the 480Z'. However, instead of returning to the ROS prompt you return to the Front Panel prompt '!'.

- Enter K

You now return to the point where you stopped execution of your BASIC program.

Switching the Screen Width

Another use of the Front Panel is to switch the width of the screen between its two possible working modes of 40 and 80 characters per line.

When you first switch on the 480Z, or press the RESET button, the screen width is 40 characters per line. If you want to change the width then you enter the ROS command W after the ROS prompt.

However, if you are using BASIC in ROM then you must enter the Front Panel using CTRL/F as described above. Then proceed as follows:

- At the '!' prompt enter W

ROS responds with:

```
80 character
```

- Enter: K

  You now return to the BASIC 'Ready:' prompt with the screen display in the new line width.

  The procedure is exactly the same for changing back from an 80-character line width to 40-character line width.

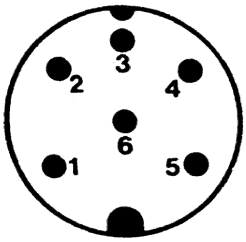
Appendix H
Connection Information

(A) Monitor Socket

6-pin din socket

(1) Video signal
(2) Ground
(3) Frame sync
(4) Line sync
(5) Audio out
(6) Wireframe video

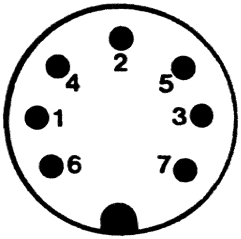
Wire frame
Video monitors only



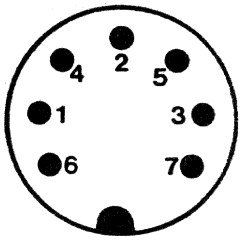
(B) Accessories Socket

7-pin din socket

(1) Analogue output
(2) Joystick 1
(3) +5V
(4) Ground
(5) Button 1
(6) Button 2
(7) Joystick 2



(C) Cassette Socket 7-pin din socket



(1) Signal from computer to cassette recorder
(2) N.C.
(3) +5V
(4) Ground
(5) N.C.
(6) Signal from cassette recorder to computer

(D) Parallel I/O Socket 25-way D type

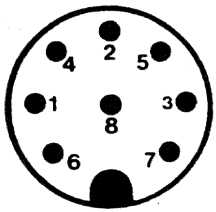
(1) Data bit 0 in
(2) Data bit 2 in
(3) Data bit 4 in
(4) Data bit 6 in
(5) Data bit 0 out
(6) Data bit 2 out
(7) Data bit 4 out
(8) Data bit 6 out
(9) +5V
(10) Input strobe
(11) Handshake output 1
(12) Handshake output 2
(13) Handshake output 3
(14) Data bit 1 in
(15) Data bit 3 in
(16) Data bit 5 in
(17) Data bit 7 in
(18) Data bit 1 out
(19) Data bit 3 out
(20) Data bit 5 out
(21) Data bit 7 out
(22) Ground
(23) Ground
(24) Input ready
(25) Handshake input 1

(E) Serial I/O 4 Socket

8-pin din socket

(1) Request to send
(2) Data terminal ready
(3) Transmitted data
(4) Ground
(5) Clear to send
(6) N.C.
(7) Data carrier detect
(8) Received data

Printer busy line

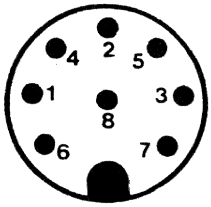


(F) Serial I/O 2 Socket

8-pin din socket

(1) N.C.
(2) N.C.
(3) Transmitted data
(4) Ground
(5) Clear to send
(6) N.C.
(7) N.C.
(8) Received data

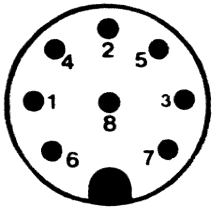
Printer busy line



(G) TTL RGB Socket

(1) Audio
(2) Mixed sync —
(3) Red
(4) Ground
(5) Blue
(6) Green
(7) Line sync —
(8) Frame sync —

8-pin din socket



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