

TECHNOLOGY RESEARCH BETA 128 DISK INTERFACE -- USER MANUAL

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Dear customer

Congratulations in making a wise choice. Technology Research Ltd are confident that you will have many years of satisfied service from your interface. The wisdom of your choice is demonstrated by

the fact that there is no other Spectrum disk interface offering all these features:

- * Easy and fast access: Retrieves your data/program a lot faster than using cassette tape.
- * Wide choice of disk drives: 5.25", 3.5" or 3", 40 or 80 track, single or double sided disk drives. In short you can use most makes of disk drives on the market.
- * Capacity: Up to 4 disk drives on line. Data is stored at double density. These give a maximum capacity of over 2.5 million characters.
- * Flexibility: The Interface is independent, so you can use your disk drives with other computers.
- * Compatibility: The Interface may be used with Spectrum, Spectrum Plus and Spectrum 128 computers.
- * Auto-boot: Runs a BASIC program automatically on power-up or after a reset (Spectrum and Spectrum Plus only).
- * Auto check: Checks and adjusts the system to drive specification automatically.
- * Magic button: This special feature enables you to save tape based programs at a touch of the button.
- * System switch: Use this 3 position switch to reset the computer or switch off the Interface.
- * EPROM based TRDOS: The disk operating system (TRDOS) is contained in EPROM, and it uses only 112 bytes of RAM.
- * Syntax: Simple syntax using Spectrum keywords allows access to disk files in TRDOS from BASIC or machine code.
- * File handling: TRDOS handles number and string arrays, serial (sequential) and true random access files.

This booklet contains information that you will need to make full use of the Technology Research Beta 128 Disk Interface (hereafter referred to as the Disk Interface).

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Throughout this manual, references are made to the Spectrum computer, however, unless otherwise stated, they are equally applicable to the Spectrum Plus and Spectrum 128.

Using the Beta 128 Disk Interface with the Spectrum and the Spectrum Plus (will be referred to as SPECTRUM & PLUS) are the same. For Spectrum 128, there are a number of differences. These will be highlighted where applicable.

The Disk Interface is supplied with a Utility Disk, which contains

a number of Utility programs (see Appendix for details). The disk may be 5.25" or 3.5" depending on your requirement.

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GUARANTEE

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1 INTRODUCTION TO DISK SYSTEM

The disk system is the professional way of storing programs and data files in home and personal computer systems. There are many advantages of using the disk system other than tape based systems such as cassette tape and Microdrives. The disk system is more reliable, easy to use and much faster.

Terminology associated with floppy disks often lead to confusion. A short explanation will enable you to appreciate some of the concepts involved and thereby get the best use out of your Technology Research Disk Interface.

1.1 Disks and Drives

The Technology Research Beta Plus Disk Interface can use 5.25", 3.5" and 3" disk drives. You may have heard them referred to as floppy disk, diskette, mini-disk or micro-disk. We will refer to them simply as disk. At present, 5.25" disks are the most popular type. However, the trend is towards the smaller disk of 3.5".

Diagram 2 and 3 show the sketches of 5.25" and 3.5" disk respectively. The 5.25" diameter flexible plastic coated disk is kept in its own little cardboard or plastic jacket. Although

"flexible" the disks should not be bent. The smaller 3.5" disks are housed in stronger plastic protective cases which, for some time at least, means that their cost will be higher than the 5.25" disks.

When inserted in the drive the disks are rotated inside their protective covers at 300 RPM. To protect the disk the better quality ones have a plastic ring (the hub ring) around the edge of the central hole. It is this ring rather than the weaker disk which is clamped by the drive mechanism.

In a cassette recorder the tape unwinds past the head which is stationary. In the disk drive not only is the disk rotating past the head but the head also moves across the disk from the edge to the centre.

The index hole and a similar hole in the disk enable the drive to keep track of the disk. The actual data is written to and read from, the disk in the long slot or Data Window.

As a safeguard for valuable data the "write-protected notch" in the jacket can be covered by a small sticky label. Like the small tag on the back of a cassette tape it prevents the disk being written on or erased accidentally. The 3.5" disk covers have a device similar to the cassette.

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There are 40 and 80 track disk drives on the market. Many drives are switchable to allow the use of disks recorded as 40 or 80 track. Some drives have only one read/write head (single sided). These drives can only read and write on one side of the disk. Other drives have two read/write heads (double sided), allowing both sides of the disk to be used.

A golden rule is to ensure that backups are made before overwriting disks originally produced and intended to be read on a different specification drive. Ideally if one user of the disk is using 40 or 80 track drive then so should the other.

However, disks which are formatted and written by one type of disk drive may be read by a different type of drive. Obviously, the disk must be physically the same size. The chart below shows the compatibility between various type of disk drives.

Disk format	40T SS	40T D6	80T SS	80T DS
Drive 40T SS	C	?	X	X
40T DS	C	C	X	X
80T SS	R	?	C	?
80T DS	R	R	C	C

where T = track
 SS = single sided
 DS = double sided
 C = compatible
 R = compatible (read only)
 X = incompatible

? = incompatible but may not be detected correctly on some types of drive.

For example, a 40 track double sided drive is compatible (can read from and write to) with disks formatted on a 40 track single sided drive. But an 80 track double sided drive can only read from disks formatted on a 40 track drive.

1.2 Tracks, sectors and density

The formatting process (Section 6) enables TRDOS and the drive to electronically divide up the disk into 40 or 80 tracks (according to the disk drive) and each track into sectors. The number of sectors per track and the number of bytes per sector is dependent entirely upon the Disk Operating System (D.O.S.).

TRDOS gives you 16 sectors per track and 256 bytes per sector. This high number of small size sectors has several advantages.

Firstly if only small amounts of data are to be stored then not too much of the disk will be used. This leads to a greater number of files being saved.

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Secondly when using the Random Access files (Section 13) it provides greater program flexibility and improves speed of operation.

In order to know what is where TRDOS uses Track 0, the outermost, for its own directory purposes.

Given the above information it is possible to calculate the number of sectors and storage capacity of the formatted disk. This formatted capacity is the only meaningful figure for any system but must still be considered in conjunction with the number and size of the sectors. The following table shows the TRDOS capacity in Kilobytes with different drives:

40 track single sided =	39 * 16 =	624 sector * 256 =	156Kb
40 track double sided =	79 * 16 =	1264 sector * 256 =	316Kb
80 track single sided =	79 * 16		= 316Kb
80 track double sided =	159 * 16 =	2544 sector * 256 =	636Kb

For the mathematically minded this equates to 4Kb per track or 4 sectors to 1Kb. This last evaluation is probably the most useful. When examining the contents of a disk by CAT (Section 7) you will always be told the number of free sectors. Divide this number by 4 and you know how many Kb of spare space remains.

You will notice that we have not mentioned density. Single density and Double density refer to the recording method of packing the data on the disk. TRDOS uses double density which is why you get 16 sectors of 256 bytes per track.

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2 GETTING STARTED

2.1 Making the right connection

Now that you have the Disk Interface and one or more disk drives, please first read and understand the following procedures thoroughly before proceeding with the installation. If you have other interfaces, please also read Section 2.5 below.

- 2.1.1 The first step is to look at Diagram 1 and identify the four connections. The connection labelled A should be plugged into the back of the Spectrum unless an Interface 1 is fitted. In that case the Interface 1 goes between the Spectrum and the Disk Interface. The connection opposite A is for adding your other interfaces, e.g. joystick.
- 2.1.2 Before connecting the Disk Interface to the Spectrum, you must clean the connector on the Spectrum, by rubbing both sides gently with a cotton bud dipped in methylated spirit.
- 2.1.3 Your disk drive should already be fitted with the appropriate plug on its connecting lead and this should be inserted in the "Disk Drive Port" (labelled B in Diagram 1). Make sure the coloured side of the flat ribbon cable is towards the Spectrum.
- 2.1.4 Plug in the Disk Drive mains lead and switch on.
- 2.1.5 Switch on the TV.
- 2.1.6 SPECTRUM & PLUS : Ensure the System switch is in the centre, normal position.

Spectrum 128 : Ensure the System switch is in the off position.
- 2.1.7 Plug the power socket from your Spectrum power supply into the power supply connection (labelled C in Diagram 1).
- 2.1.8 SPECTRUM & PLUS : If more than 1 drive is fitted only drive

A will now engage and after a second you should see the following sign-on display:

```

* TR-DOS Ver 5.xx *
(C) 1986 Technology Research Ltd.
(U.K.)

```

A>

where 5.xx is the version number, and A> is the TRDOS prompt.

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It is possible that on power up, the Spectrum fails to recognise the Disk Interface. That is, the sign-on display above does not appear on the screen. If this happens, just reset the Spectrum using the System switch as described in Section 3.1.

SPECTRUM 128 : The Spectrum 128 starts up as normal. To change to TRDOS, type the following:

```
RANDOMIZEUSR 15616 <ENTER>
```

where <ENTER> is the key ENTER.

The screen will then show the sign-on display as shown above.

You are now in TRDOS. After having read the rest of the manual you will be able to use the wide variety of commands and facilities available. But first of all, you may try out an example with the Utility disk supplied. The Utility disk is write-protected (see Section 1.1), and should be kept as such.

Insert Utility disk into Drive A (and close the drive door if necessary). The CAT command (see Section 7.1 for details) may be used to display the contents of the Utility disk. Type the following after the TRDOS prompt A> and see what happens:

```
CAT <ENTER>
```

Note that CAT is a keyword and <ENTER> represents the ENTER key on the keyboard. The screen will show something like this:

```

Title: $Utili
6 file(s)
0 Del. file(s)
A:secread <C> 1:tape5.0 <C> 4
A:doctor <B> 22:tapecopy<B> 1
A:boot <B> 3:magic <B> 12

```

```
1221 Free
```

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WARNING

NEVER disconnect the Disk Interface from the Spectrum whilst the power is still switched on.

NEVER leave a disk in the drive with the door closed while the power is switched on or off.

2.2 Auto-boot

SPECTRUM 128 : The Spectrum 128 cannot use this facility.

On power up or after a Reset (assuming the System switch is in the normal position, see Section 3) you are automatically in TRDOS and drive A is always selected by the system. TRDOS will try to load a BASIC program called "boot". If there is no disk in drive A, or the drive door is open or the disk does not contain the BASIC program "boot", then the normal prompt as in Section 2.1.8 is displayed.

Having a disk in the drive with the drive door closed when the Spectrum power is turned on may corrupt the disk, particularly those drives with permanently loaded heads. It is recommended the following procedures should be used for auto-boot:

- (1) Power up the Spectrum.
- (2) Load disk with BASIC program "boot" into drive A.
- (3) Reset the computer as described in Section 3.1.

2.3 Auto check of drive specification

When TRDOS starts up, it automatically checks the specification of Drive A. This assumes that you have applied good practice and switched on the drives before or at the same time as the computer.

TRDOS adjusts to meet the step rate of the drive. This ensures that the faster step rate of modern drives is fully utilised. TRDOS also checks to match the drive specification of either 40 or 80 track, single or double sided.

These tests will be carried out even if no disk is present in the drive. If more than one drive is connected then these too will be checked when each particular drive is first addressed.

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2.4 "40" and "80" commands

Some of the older 40 track drives do not have an end stop and as a consequence the auto check may not work. That is, TRDOS thinks it is an 80 track drive. The "40" command informs the system that the currently selected drive is actually a 40 track drive, eg:

```
40 <ENTER>
```

For those 40/80 track switchable disk drives, it is possible that you switch from one position to the other after TRDOS has checked the specification. You must tell TRDOS that you have switched over by entering the "40" or the "80" command as appropriate, eg:

```
80 <ENTER>
```

2.5 Using other interfaces

The Disk Interface is designed to be compatible with all official Sinclair peripherals such as Interface 1 and Microdrives. It will also work with most other add-ons available on the market, simply by plugging them into the connector on the rear of the Disk Interface.

There are a few add-on units which use a ROM that competes for space in the memory with TRDOS. If you have such an interface connected, and unless that interface is switched off, you must first switch off the Disk Interface by pulling the System switch to the off position (Section 3.2).

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3 THE SYSTEM SWITCH

The System switch is on the left-hand side of the Disk Interface (see Diagram 1). It is a three position switch. For normal operation the switch should be at position 2. Position 1 is the reset position, and 3 is the off position.

SPECTRUM 128 : The System switch must be at the off position.

Normally when operating in TRDOS the switch should be in the centre position. You will recall that in Section 2.1.6 (for SPECTRUM & PLUS), the switch was in the centre, number 2 position on power up. This enable TRDOS to take control.

To change from TRDOS to SOS and back again (Section 5) is done without moving the switch.

* SOS stands for Standard Operating System.

3.1 Reset

SPECTRUM 128 : Do not use the System switch to reset the Spectrum 128. Use the reset button on the computer instead.

The reset facility is incorporated in the Disk Interface. Its function is to perform a complete system reset. The practical effect is as if the Spectrum had been switched off and then on again. All you need to do to effect a reset is push the switch away from you to position 1 and then return it to the centre again.

The screen will go blank for a second, at the same time TRDOS again takes over and you will see the display as in Section 2.1.8.

After a Reset the normal power on RAMTOP is restored, all variables and memory are cleared. It is therefore a very quick and easy method of ensuring that all effects and data from a previous operation are removed and the Spectrum wiped clean.

The Reset also provides a quick method of changing from one activity to another provided that none of the existing data is required.

3.2 The off position

SPECTRUM 128 : Always set the System switch at this position.

As mentioned in Section 2.5, there are a few add-on units which use a ROM that competes for space in the memory with TRDOS. If you have such an interface connected, and unless that interface is switched off, the System switch must be in the off position when power is applied.

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4 QUICK REFERENCE GUIDE

COMMAND	FUNCTION	SECTION
*"a:"	set default to drive A	5.4
*"b:"	set default to drive B	5.4
*"c:"	set default to drive C	5.4
*"d:"	set default to drive D	5.4
40	inform TRDOS that default drive is 40 track	2.4
80	inform TRDOS that default drive is 80 track	2.4
CAT	display the disk directory	7.1
CAT#	print the disk directory	7.3
CLOSE#	closing a serial/random access file	13
COPY	copying files from one drive to another	8.1
COPY s	copying files in a single drive system	8.2
COPY b	backup disk in a single drive system	8.2
ERASE	delete a file from the disk	9.2
LIST	display details of disk contents	7.2
LIST#	print details of disk contents	7.2
LOAD	load a program from the disk	10.2
INPUT#	read from serial/random access file	13
MERGE	combine Basic program from disk with one in RAM	10.3
MOVE	reorganise and pack together the files on a disk	9.3
NEW	change the existing name of a file	9.1
OPEN#	opening a stream for a serial/random access file	13
PEEK	read a sector of a file from disk to RAM	14.1
POKE	store data in RAM to a sector of a file	14.2
PRINT#	writing a serial/random access file	13

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COMMAND	FUNCTION	SECTION
RANDOMIZE USR 15616	go to TRDOS from SOS	5.2
RANDOMIZE USR 15619	call TRDOS commands from SOS	5.3

RETURN	return to SOS from TRDOS	5.1
RUN	load and run a program from the disk	10.2
SAVE	save a program to the disk	10.1
VERIFY	verify a program saved on disk	10.1

The table above is a summary of TRDOS commands. Before using these commands you are advised to read the relevant sections of the manual.

Where applicable, the commands shown are Spectrum keywords (for SPECTRUM & PLUS) obtained in the normal SOS fashion. Some of the commands require additional details and these will be dealt with in the specific sections.

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5 COMMAND SYNTAX

TRDOS is flexible and you can access the disk system:

- (a) directly from TRDOS
- (b) Direct Entry from Spectrum SOS and
- (c) from within a BASIC
- (d) from within a machine code program.

Whenever you are in TRDOS you will see the prompt of drive designation plus the arrow. This will be referred as TRDOS prompt,

eg:

```
A>
B>
```

According to the operation just finished the prompt may be followed by a further part of a TRDOS command, eg:

```
A>RUN "boot"
```

TRDOS commands may be entered directly after the TRDOS prompt. If the prompt is followed by a previous command, you must remove the old command using the DELETE [Caps shift 0] key.

5.1 Changing from TRDOS to SOS

To change to SOS the RETURN command is used. In the following example the words in [] are explanation and not part of the syntax.

```
A>                                [TRDOS prompt on screen]
A>RETURN                          [Y pressed - now on screen]
(C) Sinclair Copyright ..         [ENTER pressed - now on screen]
```

Please note that the ENTER key is pressed to complete the RETURN command. Unless otherwise stated, this will apply throughout this manual, even ENTER is not shown.

5.2 Changing from SOS to TRDOS

To change from SOS to TRDOS when the K cursor is shown requires the following entry:

```
RANDOMIZE USR 15616
```

This is obtained by using the keyword on the letter T (RANDOMIZE) to be followed by the E mode letter L (USR) and then the numbers. As in the example in Section 5.1, the ENTER key must be pressed to complete the command.

If only one drive is fitted then this will return you to drive A. However, if more than one drive is fitted then the command will return you to the drive which was last selected (see Section 5.4).

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Although no longer displayed the program is still in memory and, after executing certain TRDOS commands, such as a disk catalogue, you can return to SOS and LIST to display the program.

5.3 Calling TRDOS from SOS and BASIC programs

The syntax of the command is the same at all times, but a prefix must be used if the command is called from SOS or from a program. When the command is entered directly from SOS, it executes the command, and returns to SOS. In this case the prefix must be:

```
RANDOMIZE USR 15619: REM:
```

For example:

```
RANDOMIZE USR 15619: REM: CAT "B:"
```

The use of 15619 instead of 15616 retains control in SOS. The CATalogue action is to be taken on Drive B (see Section 5.5).

Unless the command performs an over-riding function, such as RUNning a program, it will terminate its action with the drive prompt if made from TRDOS or the Sinclair OK if made from SOS, e.g.

```
A>CAT <ENTER>           results in the prompt A> on completion
RANDOMIZEUSR 15619: REM: CAT <ENTER>       results in OK.
```

Although it is possible to execute commands from SOS, it is not recommended. Firstly, it is far less likely to lead to disaster if all actions are taken from within TRDOS. Secondly, the actual typing required is considerably less, and thirdly, the current default drive is displayed which can help to avoid the silly mistakes which lead to loss of valuable data.

When TRDOS commands are included in a BASIC program they must be prefixed with:

```
RANDOMIZEUSR 15619: REM:
```

In addition, the command must be the last item in a line. When writing a program or converting one to run from disk instead of cassette the rule you must obey is "The TRDOS command which finishes the line". For example:

Cassette program line

```
10 INK 7: PAPER 1: LOAD "" CODE: GOSUB 500:
   CLS: PRINT "Press any key"
```

Converted to disk

```
10 INK 7: PAPER 1: RANDOMIZEUSR 15619: REM: LOAD
   "TITLE" CODE
20 GOSUB 500: CLS: PRINT "Press any key"
```

Note how the empty "" cannot be used for the disk. In addition to the TRDOS command finishing line 10 we must insert the title under which the code has been saved.

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5.4 Default drive selection

The default drive is the one which will be accessed by any command which does not specify the drive to be used. On power up or after a system reset the default drive is always A.

TRDOS supports up to 4 drives, designated as A, B, C and D. To change the default drive the command format is:

```
*"drive:"
```

where drive is the designated drive A, B, C or D. For example:

```
*"B:"      to change default to drive B
*"a:"      to change default to drive A
```

NOTE: The command can use either upper or lower case to designate the drive although the screen display will always be a capital letter before the arrow.

Having changed the default from say A to B, all future commands will access drive B unless told otherwise.

If only one drive is fitted the screen designation remains A> and the flexible working of multi drives demonstrated in this manual does not apply.

5.5 Temporary drive selection

On occasion it is desirable to remain in default to one drive but want to access another drive. The syntax for this is a suffix to the command showing the required drive. The suffix is like the default change but without the star, e.g.

```
"a:"    or    "B:"    or    "c:"    or    "D:"
```

An example of the full statement from SOS would be:

```
RANDOMIZE USR 15619: REM: LOAD "b:program"
```

This ensures that "program" is loaded from drive A irrespective of which is the current default drive, including B.

From TRDOS with default drive A the command would be:

```
LOAD "b:program"
```

This would load "program" from drive A but leave default in drive A for further TRDOS operations.

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6 FORMATTING A DISK

A disk must be formatted before it can be used by the computer. This means that the sectors on each track must be checked, identified and marked electronically by TRDOS. From then on TRDOS will keep track of what it has stored where on the disk.

TRDOS contains the disk formatting routine, and no additional software needs to be loaded. Formatting can be carried out at any time, even with a program in memory.

To format a disk, insert it in the default drive and close the door. Type the keyword FORMAT [E shift, symbol shift 0] followed by the disk title in quotes, the title can be up to 8 characters long, in upper or lower case including spaces. e.g.

```
FORMAT "DISCONE"
```

Press ENTER to complete the command and sit back. The time taken by TRDOS to mark the sectors varies between single and double sided, 40 and 80 track drives. If the drives are double sided then both sides will be formatted automatically. When finished the screen will display:

```
DISCONE
624/624    or    1264/1264    or    2544/2544
```

A>

This display shows the disk title followed by the number of sectors formatted and secondly the maximum possible number of sectors for the particular disk format. If the first number is less than the second you have a faulty disk.

The maximum number of sectors varies according to the drive specification. Track 0 is always used by the system leaving 39 tracks on a SS 40 track, 79 on a DS 40 or SS 80 track and 159 on a DS 80 track. At 16 sectors per track we get 624, 1264 or 2544 as the maximum number possible (see also Section 1.2).

6.1 Format as single sided

There are occasions when you wish to format a disk as single sided. If the drive is only a single sided drive no special formatting is required, just use the standard TRDOS FORMAT command.

If the drive is double sided then the first character of the title of the disk must be "\$", e.g.

```
FORMAT "$DUMPER"
```

After you have pressed ENTER and the formatting has finished, the display will be:

```
$DUMPER
624/624   or   1264/1264   dependant upon 40 or 80 track
A>
```

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7 DISK CATALOGUE

7.1 Displaying a catalogue

There are two commands for displaying the contents on a disk. The first and most commonly used is the CAT command. The other is the LIST command.

Both the CAT and the LIST commands can be accessed whilst a program is held in memory. The CAT command displays the title, type and sector size of the files and is adequate for most purposes. The LIST command displays the catalogue with extended information, and is ideal for program analysis.

The syntax to obtain the catalogue of the disk is:

```
CAT      or
LIST
```

You may display the catalogue of a disk other than the one in the default drive, eg:

```
CAT "b:"   or
LIST "b:"
```

The command may also be called from SOS, eg:

```
RANDOMIZE USR 15616: REM: CAT "a:" or
RANDOMIZE USR 15616: REM: LIST "a:"
```

For the CAT command, the information that will be displayed on screen is:

```

Disk title
No. of files
No. of deleted files
Drive: File title: type of file: size of file [in 2 columns]
No. of free sectors
TRDOS prompt

```

For example:

```

Title: ACCOUNTS      Meaning
4 file(s)           The disk in drive A
1 Del. file(s)      4 files + 1 deleted
A: HOME <B> 12      B=BASIC program          12 sectors   (3K)
A: HOME1 <C> 6      C=machine code           6 sectors   (1.5K)
A: HOME2 <#> 13     #=serial/random access  13 sectors  (3.25K)
A: HOME3 <D> 7      D=data array             7 sectors   (1.75K)

```

```

Free 2503           2544-38=2506, deleted file occupies 3
                    sectors leaving 2503 free.
A>                 default drive is A.

```

If the number of files to be displayed is more than 30 the "scroll?" will appear. The normal Spectrum key presses will continue the display. "N" or "BREAK" will terminate the listing.

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An example of the resulting display of the LIST command is:

```

Title Poolperm      Disk Drive: B
4 file(s)           80 Track D. Sided
1 Del. File(s)      Free Sector 2480
File Name           Start Length Line
POOLCALC <B> 5       00298 01200 25
Pool1 <C> 32         32768 08000
Poolfact <#> 7       01780 01780
Poolbase <D> 8       30000 32000

```

The display is showing all the usual details of the disk, that it is in drive B, that it is 80 track double sided with 4 files and 2480 sectors (about 620K bytes) free. In addition to the CAT details of title, type and size we now have the starting address, length and , if BASIC, the start line of the programs.

7.2 Printing a catalogue

It is often desirable to know the contents of the disks without using the computer to display the catalogue every time.

The paper and pencil is an obvious method, although somewhat inconvenient and very often prone to error. TRDOS allows you to produce a hard copy of the disk catalogue, assuming you have a printer connected to your system.

The following example is based upon using Interface 1. The normal SOS procedure of opening a stream must be initiated before printing. This requires returning to SOS if currently working in TRDOS and the stream is not already open.

```

Once in SOS the usual Interface 1 syntax can be entered, eg:
FORMAT "T"; 9600 : OPEN #4; "T"

```

Once the stream is open a return to TRDOS is preferable as it provides better control and less typing (RANDOMIZE prefix). Having returned to TRDOS the CAT # and LIST # commands are exactly the same as the CAT and LIST commands above, eg:

CAT #4 will send the catalogue to the printer via stream #4.

LIST #4, "b:" will send the extended catalogue of drive B to the printer.

The Sinclair manual deals with the use of streams 0 to 15. Streams 0 to 3 are reserved for the Spectrum. The actual stream used, between 4 and 15, does not matter. Whatever stream is opened must be the one used in CAT # or LIST # commands.

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8 COPYING FILES

There are three commands for file copying:

COPY - for normal file copying
 COPY s - for single drive system file copying
 COPY b - for single drive system backup.

The basic element of the syntax is COPY. This is the Spectrum keyword on the Z key. The basic syntax is:

COPY "new_file", "old_file" type

The syntax required follows SOS practice by putting both the new and old file titles between quotes and specifying the file type using SOS keywords. The four different types of files and their file type are:

BASIC programm
 machine code programm CODE
 data array file DATA
 serial/random access file #

Note that the BASIC program has a blank file type.

All commands must have the precise form of the name including upper and lower case and spaces as well as the file type. Hence the best thing to do is to have a CAT display.

One important point to remember is that whenever 2 titles have to be quoted, e.g. for the COPY or for the NEW commands it is the new title which is quoted first. In addition, the type does not follow the new title, because it is same as the old file.

8.1 Copying to the same disk

Having put the disk containing tge file(s) to be copied into drive A (the actual drive used is unimportant) the first thing to do is a CAT of the disk. We have to tell TRDOS the title of the file to be copied and the title under which the copy should be saved. Eg:
 COPY "Vat69", "Whisky" CODE

Note that the new and the old file titles are in quotes, and the separated by a comma. Because this is a mythical machine code program related to alcoholic beverages we must add the file type CODE. Press ENTER and the command will disappear for a couple of seconds. When the TRDOS prompt reappears there will be no obvious change. By doing another CAT command we will now find the display includes the new file Vat69 <C>.

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You cannot save two files on the same disk with identical titles. Identical means exactly the same. It is possible to have the same name but with one in upper case and the other in lower case. One can be a BASIC program and the other a machine code program, eg:

```
STOCKFILE <C>      Acceptable because the file types are
STOCKFILE <B>      different

PURCHASE <B>      Acceptable because the last letter is
PURCHASE <B>      caps on one.
```

Using this principle it would have been possible to COPY our previous example without going from the general term "whisky" to a particular brand, eg:

```
COPY "WHISKY", "Whisky" CODE or
COPY "WHYSKY2" ,"WHYSKY" CODE
```

So far we have considered COPYing only to the same disk. The procedure for COPYing to another disk depends upon whether or not you have a second disk drive.

8.2 Single drive copying and backup

If only one disk drive is available the normal COPY command cannot be used. Both the "COPY s" and the "COPY b" command are for single drive system.

The first, "COPY s" is used to copy one file from one disk to another disk using the same drive. Whereas the second, "COPY b" is used to backup a disk to another disk, that is, copying all the files.

Here are some examples of the "COPY s" command:

```
COPY s "Wines"      or
COPY s "BEER"CODE
```

where both "Wines" and "BEER"CODE are existing files. Notice the difference. Previously we entered the new name in quotes immediatly after the prompt. Now we are telling TRDOS what program to copy and so the existing name goes in quotes after the "COPY s".

To make sure you haven't got the wrong disk in the drive you are

prompted to insert the disk and press Y. Having read the disk the program prompts you to replace it with the second disk and enter the new name under which the program will be copied.

The practice of making a backup copy of all programs cannot be over emphasised. With cassette based operations this is a time consuming activity. To be of value the program must be copied, the tape rewound and then verified. This can be quite a lengthy procedure!

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With TRDOS and disk it can take less than a minute to COPY and then if desired reLOAD the program to actually check that it is OK. Essentially backup of a program consists of making a COPY onto another disk kept purely for backup purposes.

The "COPY b" command operates as an extension of the "COPY s". The routine is run by entering the command "COPY b". From then on the screen prompts as to changing the disk and what keys to press are straightforward.

8.3 Twin drive copy and backup

Copying to another drive automatically means that you will be copying to another disk. Although the interchange could take place between any combination of two drives we will use drives A and B. It will be apparent from the syntax how other combinations would be entered.

Enter the keyword COPY followed by the two titles in quotes but this time include the temporary drive indicator. Being on a different disk, we can use the same title if we wish in the second disk, eg:

```
COPY "A:Whisky", "b:Whisky"
```

Although default drive is A we are copying from the disk in B to A and using the same title which is not in use on disk A. Had the disks been reversed in the two drives then we would have had:

```
COPY "B:Whisky", "A:Whisky"
```

thus copying the file from drive A to drive B.

The backup operation is much simpler using twin drive system. The disk to be copied is placed in one drive and the receiving disk (blank and formatted or partially used) is inserted in another drive. Any drives can be used. We will use drive A as the source and drive B as the recipient. The command syntax is similar to a single file copy with a "*" (the computer jargon is "wildcard") replacing a specific file title, eg:

```
COPY "B:*", "A:*"
```

Having entered the command TRDOS will do the rest. Provided that the file names are not duplicated and the receiving disk has sufficient space the operation will end with the return of the prompt A>.

If a file name is duplicated then the error message "Overwrite existing file? Y/N" appears. Enter "Y" and the overwrite will occur. Enter "N" and the COPY will continue but ignore that file. This allows you to later change and COPY one file if the name has

been duplicated on two different files.

The advantage of the "*" COPY is the speed compared with having to enter each file separately.

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9 RENAMING, ERASING FILES AND DISK HOUSEKEEPING

9.1 Renaming a file - the NEW command

The ability to change the title of any file on the disks is one of the most flexible commands at your disposal. Title changing is invaluable for program development. In addition, you can correct typing errors (they do happen) in the titles of programs.

Unlike other TRDOS commands the disk must be in the default drive and this has to be drive A. This is also one of the few disk commands for which you need to be in TRDOS rather than issuing the command from the SOS.

We are therefore going to be in TRDOS using drive A and the Spectrum keyword NEW [the A key]. First do a CAT of the disk, so that the title of the file to be changed is displayed.

Now enter the keyword NEW followed by the new title (in quotes as always) and then the existing title and the two separated by a comma, eg:

```
NEW "boot", "prog"
```

Press ENTER and the prompt will disappear for a couple of seconds. When it reappears nothing will seem to have changed. Repeat the CAT and the listing will be redisplayed showing "boot" has replaced "prog".

9.2 Erasing a file - the ERASE command

If a file on the disk becomes obsolete and no longer required, it may be erased. The command keyword is ERASE and is obtained by going into E mode and holding down the symbol shift and pressing the 7 key, eg:

```
ESARE "oldprog"  
ERASE "obsolete"DATA
```

We now ENTER the command. A CAT when the prompt reappears after a couple of seconds will confirm the file has gone and the fact recorded in the heading of the CAT as the number of file(s) deleted.

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9.3 Packing disk space - the MOVE command

When a file is erased, the sectors it used to occupy have yet to be released for other files. To retrieve the "lost" sectors by the erased files we use the MOVE command. This Spectrum keyword is obtained by going into E mode and pressing both Symbol Shift and key 6, eg:

```
MOVE or  
MOVE "b:"
```

Although the latter example is possible it is preferable to execute this with default set to the drive in which we are working. This is a command which most inevitably must be used from within TRDOS rather than from SOS. Having gone into TRDOS we have performed a CAT to examine the disk, possibly done some erasing, and are now finishing with a MOVE to reclaim the space for use.

The MOVE command itself does all the work in re-organizing the disk and its directory. When completed TRDOS prompt reappears. If CAT is now entered, the listing will show 0 file(s) deleted and the increased number of free sectors.

Like all machine code instructions the MOVE is fast but the time taken varies according to the number and size of the files stored and deleted and their whereabouts on the disk. To reduce the waiting time to a minimum it is good practice to MOVE immediately after making any deletions. This has the positive advantage that it avoids multiple readjustments and the disk always indicates precisely what is spare. It is ready to load to its maximum without having to stop and undertake housekeeping first.

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10 SAVING, VERIFYING, LOADING, RUNNING AND MERGING PROGRAMS

The syntax for all of these commands are similar. As you will see these commands have the same or similar syntax as those used for cassette based system.

All these commands operate on files. A file on the disk can be a BASIC program, a machine code program, a data array file or a serial/random access file. The loading and saving of data array file is covered in Section 12, and serial/random access files are covered in Section 13. This section covers both BASIC and machine code programs.

During all five operations of SAVE/VERIFY/LOAD/RUN/MERGE the Break key can be used to abort the command. If there is no disk in the drive the command will be aborted and the Error Message "No disk" will be displayed on screen. Similarly, if the disk does not contain the file, then the Error Message "No file(s)" will be displayed.

10.1 The SAVE and VERIFY commands

The SAVE command will save a program in the Spectrum onto the disk. A title of the program must be specified and is enclosed in quotes.

For BASIC program, a file type is not required. However a line number can be specified after the keyword LINE for auto-run. If the line number is not specified then the program will be run from the first line. Eg:

```
SAVE "homeacc"LINE 100
SAVE "graph"LINE
SAVE "A:design"
```

For a machine code program, you must specify the file type CODE, followed by the starting address and the number of bytes to be saved. Eg:

```
SAVE "Discount"CODE 47800, 955
SAVE "B:Collec"CODE 32768, 4000
```

The VERIFY command tests whether the file saved on the disk is exactly the same as that in memory. The VERIFY command may be used to verify BASIC, machine-code programs and data array files. Eg:

```
VERIFY "A:Design"
VERIFY "Discount"CODE 47800, 955
VERIFY "Money"DATA M()
```

if they are different, a Verify Error message will be displayed.

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10.2 The LOAD or RUN commands

If a BASIC program is saved to auto-run from a line number, eg:

```
SAVE "INTEREST"LINE25
```

then it will auto-run whichever command (LOAD or RUN) is used.

If the BASIC program is not saved to auto-run then LOAD will load and LIST whereas RUN will load and RUN a non-auto program.

For exaple:

```
LOAD "INTEREST"
RUN "desing"
```

As you might expect TRDOS will inform you of "Insufficient memory" if you attempt to LOAD or RUN a program which requires more memory than the Spectrum has available. This can arise if RAMTOP has been set too low.

If you enter either LOAD or RUN without the filename, TRDOS will load or run the BASIC program "boot".

As can be seen in the examples above the syntax is the same as Spectrum BASIC. For the machine code programs, they can be loaded to the same address from which they were saved, eg:

```
LOAD "A:SALECALC"CODE
```

or loaded to a different address by specifying in the loading instructions, eg:

```
LOAD "margin"CODE 51000
```

When running a machine code program the auto-run address should be the same as the strating address of the program, eg:

```
RUN "Discound"CODE 47800
```

provided the code is meant to auto-run from 47800 on loading all will be well.

The alternative is to use a two line loader, eg, SAVE the following program on disk as say "DCTLLOAD"LINE 10

```
10 RANDOMIZE USR 15619:REM:LOAD "Dsicount"CODE 47800
20 RANDOMIZE USR 47838
```

To run the program you now enter RUN "DCTLLOAD" which will load the machine code and the "run it" fom 47838.

The two line loader is necessary because the TRDOS command must be the last entry in a line.

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10.3 The MERGE command

The TRDOS merge is the same as the SOS merge. It uses the same keywords [E mode symbol shift T] and serves the same purpose to merge in the Spectrum memory a BASIC program from the disk with one already in memory.

For example:

```
MERGE "subroul"
MERGE "B:funct2"
```

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11 TRANSFERRING CASSETTE BASED PROGRAMS

If the cassette program was written by you then the copying of it to disk presents few problems. You load your program from cassette in SOS as usual. Once in Spectrum the program may be saved to a disk by the direct keyboard entry. eg:

```
RANDOMIZE USR 15619: REM: SAVE "xxx"          or  
RANDOMIZE USR 15619: REM: SAVE "xyz"CODE NNNN, BBB
```

Many other programs can be copied using the Utility Disk TAPECOPY program (see Appendix).

The syntax for these programs may require conversion to ensure that it will run under TRDOS. For other programs which are

difficult or impossible to convert and run on disk, the Magic button may be used.

11.1 Program conversion

Very often programs are a mixture of BASIC and Machine code to improve the speed. The BASIC element can vary from a simple code loader to a more complex interface between the code and the user.

For those programs which use the BASIC as an interface the conversion to use TRDOS is relatively straightforward. Other programs may require extensive "hacking" to be able to alter them to run under TRDOS. Some difficult ones may require the use of the Magic button (Section 11.3) as the only means of overcoming the problem.

You must be able to get access to all the LOAD or SAVE commands in the original BASIC program require changing, so the first step is to LIST the BASIC program.

The technique used will vary according to the individual program. In some cases the LOAD or SAVE attributes of the program are minimal and a quick scan of the LISTing is all that is required to locate the commands. Other programs can have several LOAD or SAVE options. With these the simplest way is to step through the program a line at a time looking for LOAD or SAVE instructions. Each time one is found the syntax modification is the addition of the usual prefix, i.e. RANDIMIZE USR 15619: REM:

This is inserted in front of the existing LOAD or SAVE in the program.

We must also bear in mind two other points. Firstly the TRDOS command must be the last item in a program line, and secondly the drive location must be considered. The first point will often require some slight modification to the line numbering and contents of the lines. The following example will illustrate both these points:

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EXISTING PROGRAM:

```
500 IF X=5 THEN PRINT "Name"; N$: SAVE N$ DATA C$ ():
    VERIFY N$ DATA C$ (): GOSUB 700
505 IF X=V THEN GOSUB 800: INPUT "Title"; T$: SAVE T$: SAVE
    T$ CODE 50000,575
506 ..... More of the program
```

Assuming the files are saved to the default drive.

NEW PROGRAM:

COMMENTS

```
500 IF X=5 THEN INPUT "Name"; N$: RANDOMIZE USR 15619:
    REM: SAVE N$ DATA C$ ()
502 GOSUB 700
504 IF X=V THEN GOSUB 800: INPUT "Title";T$: RANDOMIZE USR
    15619: REM: SAVE T$
505 RANDOMIZE USR 15619: REM: SAVE T$ CODE 50000,575
506 ..... program continued
```

The line adjustment will vary from program to program. Here the unused lines 502 and 504 were sufficient to allow the essential 1 line per TRDOS command. On occasion it may be necessary to adjust other lines not involved directly with the TRDOS commands to create sufficient space. At all times the program flow must be watched. It is not uncommon to find that as a result of program development another part of the program is jumping to a line number which you are now using.

As a summary, the rules for conversion are:

- (1) TRDOS command must be the last statement in a line.
- (2) Only the prefix RANDOMIZE USR 15619: REM: needs to be added to all existing LOAD and SAVE commands.
- (3) If more than one drive is used then make sure the right drive is used.
- (4) All files must have filename.
- (5) Check the program flow when adding intermediate line number.

11.2 The Magic button

The Magic button is situated at the rear of the Disk Interface (see Diagram 1). The purpose of the Magic button is to save cassette based programs and run on disk without any conversion.

There are many programs which have been written in such a manner that it is either difficult or impossible to convert and run on disk. These may be those programs with sophisticated protection or those which SAVE and LOAD data files for the main program to use. Because the substitution of TRDOS commands is not possible a different approach is required.

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For the latter the program is loaded and data file(s) created. Instead of using the programs own SAVE instructions the Magic button is used to dump the whole programs and files to disk. Subsequent reloading means loading the complete package instead of just a data file.

The minor inconvenience of having an individual tailor made version of the complete package for each type of data file is offset by the speed and flexibility of TRDOS disk working.

A formatted blank disk should be set aside purely for this purpose and when used MUST be in drive A. Assuming these are in order, the following sequences show you the detailed operations (assuming you are in TRDOS):

- (1) Return to BASIC, by typing
RETURN <ENTER>
- (2) Pull the System switch to the off position.
- (3) Clear the Spectrum by typing
PRINT USR 0 <ENTER>
- (4) Load and run program from cassette tape as normal.
- (5) After the program has been loaded and is running, press the Magic button and release it promptly.

The computer memory is then dumped to the disk. The memory is

stored as file(s) on the disk.

SPECTRUM & PLUS : only one file will be created. This file contains the image of the whole 48K of RAM. A CAT of the disk will reveal that the title is "@" and the file type is CODE.

SPECTRUM 128 : up to seven files may be saved depending on whether the pages on the upper 64k RAM are being used. An example of the disk catalogue after a Magic button dump is:

```
Title: test
7 File(s)
0 Del. File
A:@      <C>192:@7      <C> 64
A:@6     <C> 64:@4      <C> 64
A:@3     <C> 64:@1      <C> 64
A:@8     <C> 1
```

The "family" name if these files is "@".

To reload the file (for all Spectrum computers) the syntax changes from the normal LOAD or RUN. Instead the SOS keyword of GOTO [letter G] is used, eg:

```
GOTO "@"CODE
```

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The program can be renamed if copied to another disk under its own title and run by the GOTO command, eg:

```
NEW "game1", "@"CODE
COPY "B:game1", "A:@"CODE
```

When running "game1" and assuming the disk is in drive A the syntax is:

```
GOTO "game1"CODE
```

SPECTRUM 128 : it is possible to rename or copy all the files (one by one) using the NEW and the COPY commands. However, for your convenience, a Utility program, MAGIC is supplied on the Utility disk. See the Appendix for details. This Utility program may also be used to erase a "family" of files saved by the Magic button.

Before you use the Magic button to save a program, you must ensure that the disk does not contain any file with the name "@" or "@1" etc.

Some programs use a non-standart key scan routine. For these programs it will be necessary to make the first character of the disk title a "\$", eg:

```
GOTO "$game1"CODE
```

If the program is being checked before copied with a title to another disk then the file title would require the prefix "\$" if the key scan problem occurs, eg:

```
NEW "$game2", "@"CODE
```

```
GOTO "$game2"CODE
```

During the loading of these files the screen display will contain some random elements, often a number of pixel lines which look something like a visual Morse transmission. When it clears the program will run from where it was stopped.

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12 DATA ARRAY FILES

The SOS syntax for LOADING or SAVEing a non string array entitled Money is:

```
LOAD "Money"DATA M() or
SAVE "Movey"DATA M()
```

For a string array the addition of \$ is required, eg:

```
LOAD "Money"DATA M$()
```

Like most of the TRDOS commands the LOADING and SAVEing of data arrays is achieved by using SOS Basic syntax with a prefix and possibly a drive indicator. It is seldom that data arrays are likely to be handled from TRDOS.

The nature of the arrays is such that they will be saved from and loaded to a running program. The SOS syntax for use within a BASIC program would be:

```
RANDOMIZE USR 15619: REM: LOAD "Money"DATA M() or
RANDOMIZE USR 15619: REM: SAVE "Money"DATA M()
```

Note: This syntax assumes that the default drive is either fixed as drive A. If you have a twin drive system, the alternative would be to assume that the data disk is always loaded into the same drive, say B whilst the main program and default drive remain in A. In this case a temporary drive indicator would be used, eg:

```
RANDOMIZE USR 15619: REM: LOAD "B:Money"DATA M()
```

When COPYING, ERASEing, or NEWing a DATA file the command must always terminate with the designation of the file type, i.e. DATA otherwise TRDOS will assume that it is looking for a BASIC file, eg:

```
COPY "a:Money"DATA, "B:Money"DATA
```

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13 SEQUENTIAL AND RANDOM ACCESS FILES

13.1 General description

Normal data array files have been discussed in the last section. TRDOS supports two additional types of data files, Sequential and Random Access. In order to use these two types of data files, you must first open a stream. The Spectrum contains 16 streams. The SOS reserves the streams 0 to 3 for its own use and streams 4 to 15 are available to TRDOS. When a stream for a sequential or a random access data file is opened, 336 bytes of RAM are used.

Both numeric and string variables may be stored in a data file. The numeric variables are converted to strings by the computer. A string is terminated (by the system) with a carriage return (ASCII code 13).

A sequential file stores the data serially rather like a cassette tape. In order to read a string towards the end of the file it is necessary to start from very beginning if the file.

The random access file, on the other hand, stores data as a number of records. Any record in these files may be read or written by specifying the record number. Therefore, to access the last record is as quick as the first record.

The other TRDOS commands for drive selection, copying, changing titles etc all equally apply to these Sequential and Random access files. The only difference is the type of file indicator which is "#" instead of "CODE" or "DATA". Eg:

```
COPY "B:phone", "A:phone"#
NEW "newfile", "oldfile"#
ERASE "namadd"#
```

Similar to the data array files, the sequential and random access files are seldomly handled directly from TRDOS. Hence the examples that follow are assumed to be in a BASIC program.

13.2 Sequential files

A sequential file may be opened either for Write or Read but not both at the same time. To open a file for Write the syntax is:

```
OPEN stream_number, "filename",W
```

When a stream is open for Write the BASIC keyword PRINT is used to WRITE data to that stream, eg:

```
10 LET DOS = 15619
20 RANDOMIZE USR DOS: REM: OPEN #4, "TEST",W
30 PRINT #4; "This is a test line"
40 RANDOMIZE USR DOS: REM: CLOSE #4
```

Notice the use of "DOS" instead of typing in "15619" and the closure of the file.

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The string in line 30 will be saved in file "TEST" on the disk. Had the file not been closed the data would have been lost. Any closed file may be re-opened for further Write action by Reading, changing and re-saving under a new name.

To open a file for READ the syntax is:

```
OPEN stream_number, "filename",R
```

With the stream opened for READ the BASIC keyword INPUT is used to Read data from this stream, eg:

```
10 LET DOS = 15619
20 RANDOMIZE USR DOS :REM :OPEN #7, "TEST",R
30 INPUT #7; A$
```

The data file "TEST" will be loaded into A\$ from the disk.

13.3 Random access files

A random access file is a data file which contains a number of records numbered from 0 onwards. The length of the records (max 254 bytes each) is chosen and allocated when first opening the file.

The record is stored as a single string. Any string less than the allocated record length is stored, left justified and terminated by a carriage return (ASCII code 13). The remaining bytes of the record are not defined. Any string longer than the record length will be truncated to the allocated length and stored without the carriage return terminator.

When a Random Access file is first opened TRDOS will allocate 16 sectors (approximately 4K) to the file. This will be expanded automatically as the length of the file exceeds 4K.

To open a file for random access, the command syntax is:

```
OPEN stream_number, "filename"RND, record_length
```

To write a record to a file the command syntax is (RANDOMIZE prefix is not required for PRINT and INPUT):

```
PRINT stream_number; record_number, variabel_name
```

For example:

```

100 RANDOMIZE USR 15619: REM: OPEN #8, "Address"RND, 100
150 PRINT #8; 72,D$

```

Stream 8 has been opened for the file "Address" in which each record has been allocated 100 bytes. The contents of D\$ have been put in record number 72 of the file.

Unlike the sequential file, you may read and write while the file is opened, To read a record from a file the command syntax is:

```
INPUT stream_number; (record_number), variable name
```

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For example:

```

100 RANDOMIZE USR 15619: REM: OPEN #12, "TEST1"RND, 20
110 PRINT #12; 20, A$
:
:
570 INPUT #12; (15), A$
:
:
990 RANDOMIZE USR 15619: REM: CLOSE #12
999 END

```

In line 570, the record in record number 15 (remember this is the 16th record) is read and loaded into the variable A\$. When all operations with a file are completed the stream must be closed, as shown in line 990. The contents will be lost if the power is turned off before the stream is closed.

It is acceptable for a record to comprise more than one variable. It is the responsibility of the program to link together the strings of those variables for the write operation. Similarly the program must split up the string after the read operation if the data is to be split into separated variables again.

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14 DIRECT SECTOR READ/WRITE

In addition to three types of data files described in the last two sections, TRDOS also offers direct sector (one sector contains 256 bytes) read/write of a file on the disk.

14.1 The PEEK command

The PEEK command allows you to read any part of a file on the disk and transfer the data to RAM. You may only read a sector at a time and the data can be transferred to any location in RAM. The command syntax is:

```
PEEK "filename"Buffer_address, Sector_numbers
```

Eg:

```
PEEK "Record" 30023,5
```

In this example, the 5th sector of the file "Record" is read and its content is written to RAM from address 30023.

14.2 The POKE command

The POKE command allows you to write a sector of data from RAM to any location in a file on the disk. The syntax is similar to the PEEK command:

```
POKE "filename"Buffer_address, Sector_number
```

Eg:

```
POKE "B:OLD"30024, 10
```

In this example, a sector length of data starting from RAM address 30024 is written to the 10th sector of the file "OLD" in drive B. As this command changes the content of the file on the disk, it must be used with care.

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15 MACHINE CODE PROGRAMMING

The inclusion of TRDOS routines in machine code programs are relatively straightforward.

There are 3 elements required for the program:

- (1) The machine code equivalent of the BASIC TRDOS command.
- (2) The machine code routine to implement 1 above.
- (3) The machine code routine to restore the system to its original state before calling and executing the command.

The actual memory locations used will depend upon the program as a whole. For the purpose of this example the location of the routines will be at 49000 for the SAVE, at 49500 for the LOAD and at 50000 for the instructions calling them. Thus item 1 will be at either 49000 or 49500 and items 2 and 3 at 50000.

EXAMPLE:

Address	Code	Basic	Comment
49000	234	REM	Codes as in Appx A of Spectrum
49001	58	:	manual
49002	248	SAVE	
49003	34	"	
49004	69	E	
49005	120	x	
49006	97	a	
49007	109	m	File name "Example"
49008	112	p	
49009	108	l	
49010	101	e	
49011	34	"	
49012	13	ENTER	Always end with ENTER

The code for the LOAD commences at 49500 and is exactly the same as above except that address 49502 will contain 239 (LOAD) instead of 248 (SAVE).

These two routines, LOAD, and SAVE can be located anywhere, but the initiator which we are locating at 50000 requires changing at addresses 50007-50008 (Save routine address) and 50025 - 50026 (LOAD routine address) to point to the new addresses.

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To relocate, the initiator itself requires reassembly. For that reason the Z80 mnemonics only are given below.

```

CHADD EQU 23645      Location of SOS variable CHADD
      ORG XXXXX      XXXX=address of this code
      LD HL,(CHADD)  Start to save true CHADD
      LD (TEMP),HL   Temporary store of true CHADD
      LD HL,49000    Address of SAVE routine
      LD (CHADD),HL  CHADD now points to our routine
      CALL 15363     ENTER TRDOS SAVE via chadd
      JP BACK       Jump to program point from which
                   the whole routine was called

      LD HL,(CHADD)
      LD (TEMP),HL   The routine for LOAD now repeats
      LD HL,49500    the above with just the address
      LD (CHADD),HL  changed.
      CALL 15363

BACK  LD HL,(TEMP)   Start to restore CHADD
      LD (CHADD),HL  Reload original CHADD
      RET           Return from where you came
TEMP  Label allocating memory for
      temporary storage

```

The whole routine pointing to both the SAVE and LOAD routines, together with the "return to point of entry" ending routine occupies only 47 bytes.

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16 ERROR MESSAGES

16.1 On-line messages

When you enter a command in TRDOS, the command will be executed provided it is valid. If the command is not one of those recognised by TRDOS (eg LOAD, RUN, FORMAT etc) TRDOS will ignore it. If there is a syntax error or an error occurs when the command is executed, an error message will be displayed. The error message and how they are caused are explained below.

(1) No disk

There is no disk, or an unformatted disk in the drive or the drive door is open. The command is displayed after the prompt A>, you may insert a disk and/or close the drive door and press ENTER to execute the same command.

(2) No file(s)

TRDOS cannot find the file on the disk. This error will also appear if any command is used which incorrectly identifies the file, eg:

```
LOAD "TEST"CODE instead of LOAD "TEST"
ERASE "DUMMY1"DATA instead of ERASE "DUMMY2"DATA
```

(3) *ERROR*

This will appear if there is a syntax error in the command you typed, such as:

```
SAVE "CJ"
ERASE
```

The error in the SAVE command is the extra " and the filename is missing from the ERASE command.

(4) Out of memory

This message will appear when loading a program from disk and there is insufficient memory left to accommodate it, and when using the MOVE command if the necessary 4K byte work space is not available. Usually resetting of the computer will overcome the problems.

(5) File exists

A file with the same name and type that you have tried to save already exists on the disk.

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(6) Overwrite existing file ? (Y/N)

This appears when copying all the files from one disk to another. There is already a file with the same name and type on the destination disk. You may enter "Y" to overwrite the existing file or "N" to ignore that file.

- (7) Disk error
Trk xx sec yy
Retry,Abort,Ignore?

This disk has a fault at track xx,sector yy as indicated. You have three options, you can type "R" to re-try and often complete the operation successfully, "A" to abort the operation and return to TRDOS or "I" to ignore this sector and continue with the rest of the disk operations.

- (8) Write protect
Trk xx, sec yy
Retry,Abort,Ignore?

The disk is write protected. Similar to Disk error above, there are three options. However, there is no point to re-try unless you change the disk or make it non-protected.

- (9) Verify Error

This may appear when the VERIFY command is used. The message informs that the file on the disk is not the same as that in the memory.

16.2 Error codes

All the above error messages only appear when entered from TRDOS. If the command was issued from SOS or Machine Code either as a direct entry or from within a program the message will not appear on the screen. However, they are stored as Code in the Z80 Register Pair BC. The key to the code is:

- 0 ----- No errors
- 1 ----- No files
- 2 ----- File exists
- 3 ----- No space
- 4 ----- Directory full
- 5 ----- Record number overflow
- 6 ----- No disk
- 7 ----- Disk errors
- 8 ----- Syntax errors
- 10 ----- Stream already opened
- 11 ----- Not disk file
- 12 ----- Stream not open

To obtain the error code set a variable equal to the TRDOS command. The variable will take on the value of the error code on completion of the TRDOS command.

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Example 1:

```
LET A=USR 15619: REM: CAT
```

Example 2:

A simple program illustrating the use of error code 1:

```
10 CLEAR 65367
20 LET ERR = USR 15619: REM: LOAD "COPY"CODE
25 REM error code is returned in the variable ERR
30 IF ERR = 1 THE CLS: PRINT AT 10, 1;" "COPY"CODE NOT
```

```
ON DISK": STOP
40 RANDOMIZE USR 32768
50 RANDOMIZE UST 15616
```

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17 FACTS ABOUT TRDOS

17.1 TRDOS occupies 112 bytes of RAM

17.2 Without TRDOS connected user RAM commence at:-
(a) address 23755 without Interface 1 connected,
(b) address 23813 with Interface 1 connected.

With TRDOS connected user RAM commences at:-
(a) address 23867 without Interface 1 connected,
(b) address 23925 with Interface 1 connected.

To save/load/run a program which uses the bytes between 23755 and say 23925 the procedure in Section 11.3 (Magic button) must be followed.

17.3 TRDOS uses disk sectors for storage (see Section 1.2). If the

number of bytes exceeds 256 another sector is used. This continues until all the file is saved.

To save 522 bytes will occupy 3 sectors. The third sector will contain only 10 bytes. Only those 10 bytes will be loaded from disk. The empty remaining 246 bytes are not loaded to overwrite other data which may be in SOS memory.

- 17.4 In addition to the 112 bytes of RAM the TRDOS also uses a 256 bytes buffer when accessing the disk. This buffer is allocated dynamically.

When executing many commands TRDOS first shifts the BASIC program (if any) up to create the buffer. After completion of the command the BASIC programs is moved back to its original position. The operation is unseen and unnoticed.

- 17.5 The MOVE command requires 4K (minumum) of Spectrum RAM as work space. If the MOVE is being executed with a program still held in memory it will be necessary to clear the computer and then execute the MOVE. Clearing the computer can be done by returning to SOS and entering RANDOMIZE USR 0 or by using the reset position on the System swith.

- 17.6 Up to a maximum of 128 files may be stored in one disk.

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18 PIN CONNECTIONS OF THE DISK DRIVE CONNECTOR

The disk drive connector (see Diagram 1) is designed to be Shugart compatible, and the pin connections are detailed as below:

0V -- 1	2 --
0V -- 3	4 --
0V -- 5	6 -- Select drive D
0V -- 7	8 -- Index
0V -- 9	10 -- Select drive A
0V -- 11	12 -- Select drive B
0V -- 13	14 -- Select drive C
0V -- 15	16 -- Load head (motor on)
0V -- 17	18 -- Direction
0V -- 19	20 -- Step
0V -- 21	22 -- Write data
0V -- 23	24 -- Write enable
0V -- 25	26 -- Track zero
0V -- 27	28 -- Write protected
0V -- 29	30 -- Read data
0V -- 31	32 -- Side 1
0V -- 33	34 --

The pin allocation of the connector, looking into the Disk Interface from the right (see Diagram 1) is a follow:

```

    2 4                                     34
    o o o o o o o o o o o o o o o o o o
    o o o o o o o o o o o o o o o o o o
    1 3                                     33

```

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APPENDIX : UTILITY PROGRAMS

There are three Utility programs supplied with TRDOS:

```

    TAPECOPY - transferring cassette based program
    MAGIC    - renaming, copying and erasing a "family" of files
              saved by the Magic button
    DOCTOR   - disk doctor.

```

To run one of these programs, insert the Utility disk in the default drive and enter:

```
RUN "boot"
```

The BASIC program "boot" will display a menu and invite you to select one of the Utility programs. Alternatively, you may call the Utility program directly by typing one of the followings:

```

    RUN "tapecopy"
    RUN "magic" or
    RUN "doctor"

```

Once a menus has appeared on the screen, REMOVE THE UTILITY DISK.

A: TAPECOPY

The Utility program TAPECOPY is a relatively unsophisticated copier not intended to handle commercial programs with their

sophisticated security precautions. It is ideal if you transfer your programs and files on cassette.

It will copy BASIC, CODE, ARRAY and DATA files provided that the length of the file is not greater than 40,000 bytes (for SPECTRUM & PLUS).

When the program has been loaded you will see the following display:

```

      TAPE TO DISK COPIER VER 5.0
      TECHNOLOGY RESEARCH LTD

```

```

Data type:
Filename:
Code length:
Start line:
Basic length:

```

```

      PRESS [BREAK] TO STOP
      START TAPE

```

Once the display has appeared REMOVE THE UTILITY DISK. The program will save the cassette based files onto the same drive!

Having replaced the disk with the one to receive the copied files all that is required is to start the tape playing with the EAR lead from the cassette connected as usual.

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The procedure is now automatic. The display will inform you to stop the tape. At the same time the file is being copied to the disk, with the same name as that stored on the tape. When complete you will again be told to start the tape for the next file to be copied. If a file with the same name as that stored on the tape, then it will be overwritten.

The messages you may see during copying are:

START TAPE: Press the PLAY key on the cassette to start loading.

STOP TAPE: STOP the cassette recorder whilst the program is being copied to disk.

TAPE LOAD ERROR: The SOS message for loading problems, rewind and start again

NOT ENOUGH MEMORY: The program is longer than 40,000 bytes. to copy this note down the header details from the display. Now press BREAK to return to Spectrum SOS. Clear the machine with a RANDOMIZE USR 0 and load the program as normal. Use the header details to SAVE to disk in the normal way (Section 10.1).

B : MAGIC

When the Magic button is used to dump a program of the Spectrum 128 computer, a "family" of files (up to 7) are saved. It is very tedious to deal with these files one by one. This menu driven

Utility program enables you to rename, erase or copy (single drive or twin drives system) these files easily.

C : DOCTOR

This Utility program is also menu driven. The disk doctor enables you to read, inspect and modify any sector on the disk. You may set up the drive (A, B, C or D), the sector (0 to 15) and the track (0 to 159). After these have been set up, the sector may be read and stored in the buffer. The sector size is 256 bytes.

The content in the buffer may be displayed and edited. The program asks for the starting address which has a range of 0 to 255 in decimal. When the content is being displayed, you may stop it by pressing the ENTER key. If desired, the buffer can be saved back to the disk.

The "change disk" command informs the system that you have changed the disk in the drive. You may also "verify" a disk.

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GUERANTEE

This Disk Interface is guaranteed by TECHNOLOGY RESEARCH LTD for a period of twelve months from the date of purchase against material defect and bad workmanship.

The faulty Disk Interface will be repaired or replaced with a similar model during this period at the discretion of TECHNOLOGY RESEARCH LTD. The repaired or replaced model will be guaranteed for a period of one month or the balance of the unexpired guarantee period whichever is longer:

The guarantee does not cover defect caused through accidental damage, misuse, or wear and tear. The guarantee is void if any attempt has been made by persons not authorised by TECHNOLOGY RESEARCH LTD to dismantle or repair any part of the Disk Interface.

In order to claim the guarantee you must return to TECHNOLOGY RESEARCH LTD within 14 days of purchase a completed registration form with the purchase date and dealer's stamp. The Disk Interface must be returned at your own expenses to TECHNOLOGY RESEARCH LTD properly protected and insured against damages in transit together with a brief description of the nature of the fault.

The guarantee does not affect your consumer rights under the statutory law.

The guarantee is only valid in the United Kingdom.

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