

# Chapter 8:

## Use of the MDFS Tape Drive

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This chapter is split into the following sections:

Section 8.1	Introduction
Section 8.2	Using the Tape Drive in Utility Mode
Section 8.3	On Line Tape Operation

### 8.1 Introduction

The Tape Drive is used to take backups (ie copies) of any winchesters connected to your MDFS system. Most tape operations are done in *Utility Mode*, although the MDFS can be set up to take a backup in the middle of the night when nobody is using the system; in this case the MDFS will automatically go into utility mode, take a backup and re-boot.

Each tape cartridge holds approximately 39Mbytes of information on it, hence is large enough to take a complete copy of a 35Mbyte winchester. Winchester larger than 35Mbyte will automatically be partitioned into 35Mbyte chunks, hence a 50Mbyte winchester will require two tapes to take a complete copy of the disc; one a copy of the 35Mbyte partition, the other a copy of the 15Mbyte partition.

Having taken a backup, there are two ways of accessing the data stored on the tape. We can copy the entire contents of the tape back onto the winchester, and this is called *restoring from tape*. This might be used after some disastrous loss of data, due to directory corruption etc, or possibly a head crash or some other mode of winchester disc failure.

Alternatively we can restore individual files from the tape. This is done by the selecting the tape as another disc using the psuedo-directory `%TAPE`, while the MDFS is *on line*. We can then use all the usual commands like `*DIR` and `*LOAD` and the BASIC program "COPIER" to load the file from tape and transfer it back to the winchester. You might use this technique after an accidental deletion of a particular file (see section 8.3).

#### 8.1.1 The Tape Drive

The Tape Drive is a bit like a cassette player in that it has a capstan to move the tape backwards and forwards and a read/write head. The main difference is that the head in this case can move up and down across the tape into a total of 24 defined positions. These create 24 *serpentine tracks*, so called because if a particular track is read/written in one direction, the adjacent track will be recorded in the opposite direction. The tape drive is also capable of moving to a particular position along one of these tracks and this gives it a *random-access* capability which is what it uses to read a particular file from a tape.

The red LED on the front panel indicates that the tape is moving or that the head is moving up or down. Do not press the eject bar while this LED is on (not normally, anyway).

#### 8.1.2 Inserting a Cartridge and Autoload

The tape cartridge (type DC2000), when correctly inserted, is held firmly by the drive. It is not possible to insert the cartridge the wrong way round apart from the 'obviously' wrong way round (i.e. sideways on). Directly after insertion the drive will start to whirr, executing its *autoload* sequence. (N.B. If nothing happens after you insert a cartridge please check the power connections to the tape drive, and inform SJ Research.) The first part of the *autoload* sequence is a *conditioning pass*, and is a standard feature of all tape drives. The drive will wind the tape to one end of the tape and then wind it all the way back to the beginning again. After this it will continue to wind the tape back and forth while it determines exactly where the edge

of tape is, sets the read gain and a number of other parameters.

The sequence is complete when the drive has stopped whirring and the red LED has gone out. This can take anything between 1 and 3 minutes, and it is only after this that the tape can be written or read. Trying to access the tape (using the tape menu) during autoloading will give an appropriate error message.

### 8.1.3 Removing the Cartridge and *Unloading*

While it is possible to remove the tape at any time by pressing the eject bar (although preferably not while the LED is on), it is best to *unload* the tape prior to ejecting it. This winds the tape to the end, exposing only a blank section of the tape, reducing the possibility of data corruption and cutting down the time for the next *autoload*. Unlike autoloading, *unloading* is not automatically initiated by the drive and you have to initiate it by:

In *utility mode*:

Either a) Use the 'U' command

Or b) Use the option after quitting the Tape Menu

Or c) Use the auto-reboot option when taking a backup (as this also automatically unloads the tape)

When *on line* use the command \*UNLOADTAPE.

*Unloading* is complete when the red LED goes out, which takes less than a minute. You may then press the eject bar and remove the cartridge.

### 8.1.4 Tape Cartridges

Like floppy discs (and hard discs), tape cartridges require *formatting* before you can read or write to them. Of the two cartridges that come with the tape drive, one will have already had some information written onto it during the test procedure, and hence will be formatted. The other will be blank and will require formatting, using either the 'B' or 'F' options. Tapes may be reformatted if you wish (but this is not usually necessary).

We can also *write-protect* the tape by moving the little black tab against the direction of the arrow. This can be used to protect against accidental mistakes on the part of the user. But bear in mind that if you do decide to write to the tape you will have to *unload* the tape, move the tab and reinsert the tape; this may take several minutes.

### 8.1.5 Tape Cartridge Life-expectancy

Tape Cartridges have a limited lifespan measured in *passes*. Winding the tape from the beginning to the end is considered to be one *pass*. Thus an Autoload sequence does two passes. The DC2000 Cartridge is specified for up to 5000 passes, and an attempt to record the number of passes is made, the information being written onto the tape itself. This number (which is read by the 'P' option) represents the number of passes over the tape during any Format or Backup operations. Since backups will probably represent by far the greater proportion of tape use this should be a good indicator of tape usage.

### 8.1.6 Managing Tape Backups

The two cartridges supplied with the system provide the bare minimum for taking backups (with only 1 cartridge, while the backup was taking place there would be no consistent copies of the disc, and if the cartridge itself failed there would be no older backup to rely on, nor any means of testing the system). With two tapes backups should be taken *in rotation*; time-stamping of the tapes means that you can easily identify which is the younger of the two. A *rotational* system can be explained as follows: suppose you have three tapes called 'A', 'B' and 'C'. If you used tape 'B' for your last backup then use 'C' for the next, then 'A' and then use 'B' again for the one after that.

The particular backup system (i.e. number of tapes, frequency and method of backup) depends on what security you want, how important your data is and what effect there would be if a disc did go down, etc. If your system has two discs then one could decide to backup one of them more frequently than the other, having one disc as a fairly *static* disc, and the other as a main *work* disc.

In deciding what security is needed, it is worthwhile to examine the possible causes of data loss; these fall into seven groups: human error, mains power failure, File Server software bugs, File Server hardware failure, Disc failure, Drive failure and possibly malicious users, if you are unlucky.

Human errors will occur the most frequently; accidental deletion (and use of wildcards without due caution), over-saving with the wrong program, over-saving with a 2-byte file (i.e. forgetting to type OLD after pressing BREAK), removing a disc without pressing the Release Disc button (applies to floppies only). They usually only affect a few files, and these can be read back individually from a backup tape.

The effects of drive failure are usually spontaneous and total. That's right, no warning and you've lost the lot. And yes it happened to us in May 1986. But luckily we had a backup tape, replaced the disc with a new one and restored the data.

The other categories can have effects anywhere from corrupting the name of a file to wiping out large chunks of the directory structure. Another big advantage of frequent backups is that it means frequent re-booting of the fileserver, during which the directory structure is checked for inconsistencies, identifying the 'dormant' bugs.

Backing up every evening is a good method to use, and if your data is valuable (e.g. you have some pupils doing exam work on the system) then IT IS ESSENTIAL. The problem with backups daily is that you don't get a lot of history, so that if someone has accidentally deleted a program or it has got corrupted a week ago, you probably do not have a copy of it on a tape. To get round this problem you can, in addition to a daily backup scheme, have a weekly backup scheme, also using a rotating sequence of tapes. This will give you a few weeks of history as well as an up-to-date copy to guard against major disasters.

## 8.2 Using the Tape Drive in Utility Mode

All tape operations must be done from the *Tape Menu*. Press 'T' from the *Main Menu* to get this. You can get out of the Tape Menu by pressing 'Q' or ESCAPE. In normal use you will probably only use the 'B' and 'P' options from the menu.

### TAPE MENU

```
B - Backup winchester to tape
C - Check winchester against tape
F - Format tape
N - Name tape
P - Print tape information
Q - Quit tape menu
R - Restore winchester from tape
U - Unload tape
V - Verify tape
```

Tape command (H for Help) ?

### 8.2.1 Using the *Backup* command

This option allows you to do more than just take backups, like formatting, re-booting the MDFS, unloading the tape, and waiting for the autoloader sequence to finish, so you'll probably use it most of the time.

#### Example Backup

Here is an example for an MDFS with a single 20Mbyte disc drive, and a formatted tape in the tape drive already autoloader. Total time for backup is about 30 minutes.

```
Tape command (H for Help) ?B

  BACKUP WINCHESTER TO TAPE

Winchester discs available :-

E: Name: BLANK-DISC size: 20800K

Choose disc to backup from (E..H)? E
Boot FS after backup (Y/N)? No

About to write to tape:
Name: A-Tape
Descriptor:

Everything OK (Y/N)? Yes
Copying...
```

At this point the MDFS is now reading data from the disc and writing it to the tape drive. The tape drive LED should be on continuously and the disc LED should flash a few times a second. This part will take about 15 minutes for a 20Mbyte disc.

Checking...

The MDFS is now reading data off both the disc and the tape drive, comparing the data bytes as they come back. Again this phase will take about 15 minutes.

Backup completed OK.

## More General use of the Backup command

After you have chosen which disc you wish to backup, the MDFS will read the tape cartridge. There are 4 possibilities:

- a) The Tape is formatted and the ID sector OK - as in the example above.
- b) There is no tape in the drive or it is autoloading. The MDFS will print

```
Wait for tape (Y/N)?
```

You would normally press 'Y' here; this will cause the MDFS to wait for the tape to finish autoloading just prior to taking the backup proper.

- c) The tape is unformatted. The MDFS will print

```
Tape is unformatted  
New tape name (max 10 chars) ? Tape4
```

- d) The tape is formatted but the ID sector is corrupt. Very unlikely. The backup operation will be aborted.

The next question that the MDFS will ask is whether you wish to reboot the FS after taking the backup. If you enable this option, the MDFS will also unload the tape afterwards. If the backup subsequently fails, then the FS will not reboot the system to alert the system manager to this fact.

## Errors during the Backup command

During the *Copying* and *Checking* phases of the backup, most errors will not cause the backup to abort. Because the MDFS is read/writing to both the winchester and the tape, errors will either be tape errors, disc errors or *data corruption* errors.

Disc errors should never cause the backup to abort except if there are too many of them (more than about 20) in which case you will get the message TOO MANY ERRORS. As far as tape errors go, error numbers 10 to 18 are not considered fatal, but any other error numbers will abort. Errors in the latter category are usually permanent, i.e. they won't go away without human intervention (such as inserting a different cartridge). Errors in the former category are dealt with after each of the *Copying* and *Checking* phases. Such bad sectors as have been encountered are *reassigned*, the data is rewritten to an *alternate* (i.e. 'spare') sector and the sector number is entered into the *bad block list*, which is also written back to the tape. Problems can occur when this list becomes full, and if this happens the tape must be reformatted which will provide a new set of 'spare' sectors.

The system maintains a *flag* (i.e. a piece of information) on the tape as to whether the the backup succeeded or not. Before the backup occurs, it writes this flag as meaning 'Backup not OK'. After it has written the whole tape, read it all back again and verified that all the bytes were correct it then goes back and rewrites the flag to mean 'Backup OK'. However not all errors encountered on the tape will cause the backup to fail; the MDFS will attempt to recover from most error conditions. If this recovery procedure is found to work correctly, then the flag will also be set to 'OK'.

## Aborting Backups

You can if you wish interrupt the backup process, by pressing the ESCAPE button. With reference to the above paragraph, this will leave the *flag* mentioned in the 'Backup not OK' state. Note that this (in this particular circumstance) will not return you to the main menu, but leaves you in the tape menu.

### Taking a Backup in the evening, example:

- a) Get the MDFS into Utility Mode
- b) Insert a tape cartridge
- c) Select the tape menu
- d) Press 'B'
- e) Select the disc
- f) Reply 'Y' to **Wait for tape?**
- g) Reply 'Y' to **Boot FS after Backup?**
- h) Reply 'Y' to **Everything OK?**
- i) Go home and let the MDFS do the rest.

## 8.2.2 Formatting tapes

As mentioned earlier, you can also use the Backup option to format tapes. During format, the entire tape is rewritten, and then read back again to determine whether there are any bad areas of the tape. These are entered into a list which is then stored on the tape. If the tape is reformatted, all areas of the tape that have subsequently found to be bad (during the backup process) will be considered bad automatically. The overall tape size is set after each format operation.

```
Tape command (H for Help)? F
```

```
FORMAT TAPE
```

```
Formatting will take about 40 minutes.
```

```
New tape name: B-tape
```

```
Are you sure you want  
to format (Y/N)? Yes
```

```
Formatting...
```

```
Format complete:
```

```
Bad blocks -
```

```
    Primary: 34
```

```
    Growing: 0
```

```
Tape Size: 38664k
```

The number of *Primary* bad blocks is the number of bad sectors found during the format operation and includes all the bad blocks found during previous format and backup operations. The larger this number, the smaller the tape size. More than about 40 bad blocks on a freshly formatted tape should be considered excessive. The number of *Growing* bad blocks is the number of bad sectors found during a backup operation.

### 8.2.3 Getting tape information

Tape command (H for Help)? **P**

PRINT TAPE INFORMATION

Name: DisCE--2

Descriptor: Rotating Backup

Bad blocks -

Primary: 34

Growing: 0

Tape Size: 38680k

Number of tape passes: 154

(Cartridge is spec'ed to a max of 5000)

Last formatted: 05:54 09nov86

List of discs backed-up:

Name	Size	Time	Date	State
pupil-DISC	20Mb	16:17	29dec86	OK

### 8.2.4 Restoring data from a tape backup

Tape command (H for Help)? **R**

RESTORE WINCHESTER FROM TAPE

List of discs backed-up:

Name	Size	Time	Date	State
Teacher	20Mb	16:17	29dec86	OK

Winchester discs available :-

E: Name: BLANK-DISC size: 20800K

Choose disc to overwrite (E..H)? **E**

Everything OK (Y/N)? **Yes**

The restore operation will take 15 minutes for a 20Mb disc.

N.B. Restoring from a tape will completely overwrite the entire disc, including the password file, printer setup (as in Editprint) and File Server software. The latter may cause the system to run an entire version of the File Server code. Please check that your version number (using \*VERS) and copy on the latest version if necessary (see section 4.4).

## 8.2.5 Other operations

### Unload tape

Try to get into the habit of using this command. Although it is not essential that you do this before removing the tape, it is wise because it leaves an unsensitive part of the tape near the window. This command will return a prompt before the drive starts to whirr - please wait until the red LED goes out before you remove the tape; it takes about 30 seconds to unload the tape.

### Check tape against disc

This command reads the disc and the tape, comparing the data read byte-for-byte. In fact the Backup command does this operation anyway, and if you reboot the fileserver after a Backup and then do a Check, you will get the error **Data fail @ 8** (but you shouldn't get any errors after that). This is because the fileserver will have written the current time to all discs in the system as soon as it has gone *on line*, making the data on the disc different to that on the tape.

### Verify tape

This operation reads each sector, making sure that it is readable, but ignores the actual data bytes read back. In version 1.03 it only verifies the area used by the last backup, and takes about 15 minutes for a 20Mbyte verify.

### Name tape

Allows you to change the name and/or descriptor of the tape. The *name* is a 10 character (max) name, with character restrictions, whilst the *descriptor* can be up to 80 characters long, with any characters, most importantly spaces, allowed.



## 8.3 On Line Tape Operation

When the tape is accessed with the MDFS on line, the tape is seen as a (rather slow) read-only disc; the data on this 'disc' is the data written onto it during the last backup. A tape cartridge can be inserted at any time, and once it has finished autoloading, you can use all the usual commands \*DIR, \*CAT, LOAD etc to move around the tape directory structure and read a particular file from it. You cannot use any commands which would write to the media, e.g. \*ACCESS, \*RENAME, \*DELETE, SAVE etc. Access to files on the tape is subject to the usual accounting rules, just like an ordinary disc. The root, \$, of the tape is the pseudo-directory %TAPE, so to catalogue the root type \*CAT %TAPE. If you select the tape as your current directory, to select an ordinary disc you will need to refer to its discname, or you can use \*DIR<return> or the character & (ampersand).

The main point to remember is that because the tape is slow it can often take a very long time to retrieve a directory or file, long enough to cause the BBC microcomputer to time-out and produce the error message No reply. The programs COPIER and MULTICOPY take advantage of the ability of ANFS to increase this time-out value to several minutes, so you will find it easier to use machines with ANFS if you have any (BBC microcomputers have NFS as standard).

The command \*DIR has particularly nasty side-effects if it generates a No reply error as any subsequent communication with the File Server will result in a Channel error. The only way out is to log-on to the File Server again. The caching on the File Server comes into its own when dealing with tapes, and subsequent access to data will be almost instantaneous (provided of course that the system is not being heavily used by other clients causing tape data to be thrown out to make room for new disc data). If you want to use \*DIR with safety, therefore, type \*INFO <dir.> to cache the data, wait for the tape to stop winding, and then do the \*DIR.

The error %TAPE not found is generated by a reference to %TAPE with no tape drive connected, no tape cartridge in the drive, or before the drive has finished autoloading. When you have finished using a cartridge you should use the command \*UNLOADTAPE, which will initiate the drive's unload sequence. When the red drive LED has gone out you may then remove the cartridge. If you remove the tape without issuing \*UNLOADTAPE. You will be able to access that part of the tape data which is already in cache, but as soon as a new sector is required from the tape the File Server will sense that the tape has gone and will report Drive error. The disadvantage is that the tape will be left with a sensitive area of the tape in a rather exposed position.

### 8.3.1 Example File Recovery

This example is applicable in the case where the full pathname of the file in question is known and a BBC microcomputer is being used (i.e. no ANFS):

You will need to repeatedly load the file from tape until it is fully cached. A function key is therefore a useful method. To recover a BASIC program, for example:

```
Type: *KEY 0 LOAD "%TAPE.FORM1.Jim.Work.Addresprog"|m
```

and for any other sort of file (less than 31K long),

```
Type: *KEY 0 *LOAD %TAPE.Fiona.Project.teletxt001 8000|m
```

and then press function-key 0. The tape will start to wind while it is searching through the pathname. After about 30 seconds, if the tape is still winding, the BBC microcomputer will give No reply. Wait until the tape stops winding (the File Server will lock your station out anyway until the tape has finished), and then press function-key 0 again. Repeat until the LOAD completes without error. It will do this eventually as gradually more and more data will be in cache, reducing the amount of time taken to transfer the file. At this point you may save the file directly (if it was a BASIC program), or type CHAIN"COPIER" and transfer the file again.

On a machine with ANFS, use COPIER directly:

**CHAIN"COPIER"<return>**

Source Filing System \*DIR %TAPE<return>

Dest. Filing System \*DIR :<discname>

File name: **form1.jim.datafiles.addresses**<return>

New name:<return> (uses the same filename)

File name:<escape>

N.B You will now have %TAPE as your current directory, so remember to select a directory on another disc before you do anything else.