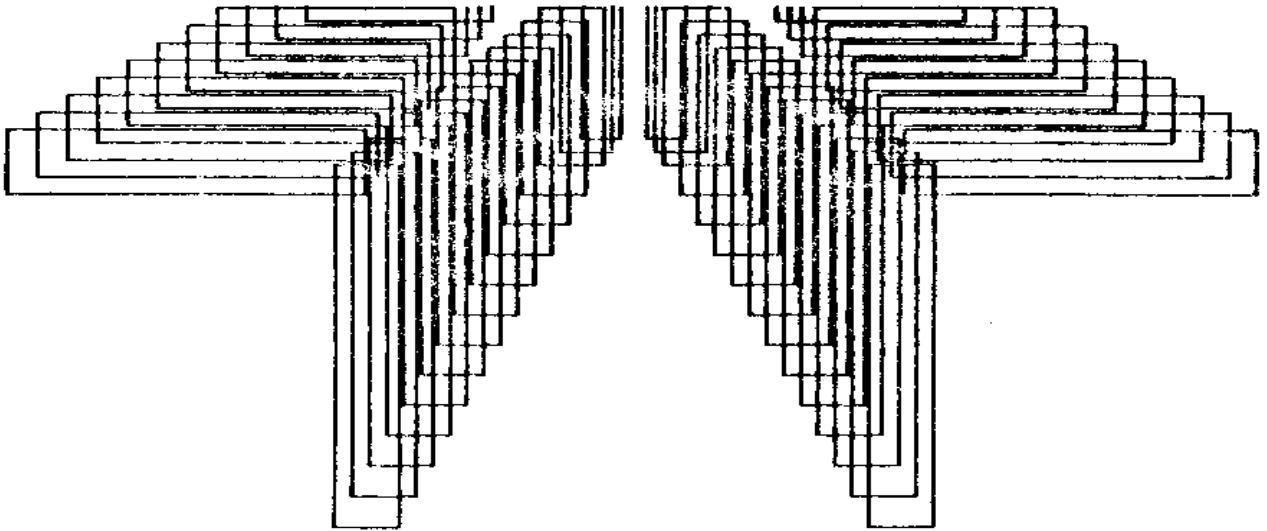


**ADVANCED
DIAGNOSTICS**



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START UP INSTRUCTIONS

>> **IMPORTANT WARNINGS** << This utility program can execute a number of different WRITE operations to your diskettes! Read through THE COMMANDS section of the manual before attempting to execute any of the Advanced Diagnostics commands or you may inadvertently DESTROY part of a good diskette!! ——— **ALWAYS** keep the write protect notch covered on the Advanced Diagnostics diskette. You should only remove it to change the DIAGCONFIG Command File and then immediately cover it back up. (see Command File in THE COMMANDS section of this manual for more information on the DIAGCONFIG file.)

Advanced Diagnostics comes with two different loaders on the disk. One for Extended Basic and one for the Editor Assembler or Mini Memory module.

NOTE: The Advanced Diagnostics disk **MUST** be in Drive 1 when loading.

EXTENDED BASIC

To load Diags with the Extended Basic module place the Advanced Diagnostics disk in drive 1 and select Extended Basic from the menu. There is a file named LOAD on the disk that will Auto Boot and Run Advanced Diagnostics.

EDITOR/ASSEMBLER

To load Diags with the Editor/Assembler module place the Advanced Diagnostics disk in drive 1 and select Editor/Assembler from the menu. Next select 3 LOAD AND RUN from the Editor/Assembler menu.

| | |
|--------------------------|-----------------------------------|
| When this prompt appears | * LOAD AND RUN * |
| | FILENAME? |
| Type in | DSK1.DIAGS and press ENTER |

Advanced Diagnostics will then load and Auto Run.

MINI MEMORY

To load Diags with the Mini Memory module place the Advanced Diagnostics disk in drive 1 and select Mini Memory from the menu. Next select 1 LOAD AND RUN from the Mini Memory menu.

| | |
|--------------------------|-----------------------------------|
| When this prompt appears | * LOAD AND RUN * |
| | FILENAME? |
| Type in | DSK1.DIAGS and press ENTER |

Advanced Diagnostics will then load and Auto Run.



QUICK REFERENCE - ADVANCED DIAGNOSTICS COMMAND LIST

| Name | Abbreviation | Syntax | Example |
|--|--------------|--|--------------------|
| BEKP | - BE | BEKP | BE |
| Sounds a Beep tone. Mainly for use in Command Files. | | | |
| CHANGE COLORS | - CC | CHANGE COLORS fore back border *char (1-16) | CC 16 5 16 8 |
| Sets the foreground (alphanumerics), background (screen), border (boxes) and * char (special character) colors. | | | |
| CHECK DISK | - CD | CHECK DISK | CD |
| Check the diskette in the Selected Drive for sectors that are mapped as bad. It then reports the disk Free, Used and Bad, and displays the sector numbers that are bad. After listing out the Bad sector numbers, on a key press, this routine will list out all of the fractured files on the selected disk | | | |
| COMMAND FILE | - CF | COMMAND FILE DSKx.filename or CF REDO | CF DSK1.DIAGCONFIG |
| This command loads and runs a DIS/VAR 80 text file from the indicated device and executes the commands in the file as if they had been typed in from the keyboard. | | | |
| CHECK MEMORY | - CM | CHECK MEMORY | CM |
| Performs complete Refresh and Bit Shift memory tests of Scratch Pad RAM, VDP RAM, Memory Expansion RAM and Mini Memory RAM. | | | |
| CONVERT NUMBER- | CM | CONVERT NUMBER no. or >no. or Bno. (0-65535) | CM >5AB |
| Converts the specified number (decimal, hexadecimal or binary) into the other two number bases and displays all three number bases on the screen. | | | |
| COPY READ | - CR | COPY READ start_sector(0-7) #_of_sectors(1-36) | CR 0 36 |
| Reads 1 to 36 sectors from the Selected Drive, starting with the specified sector, into a copy buffer for use with COPY WRITE to copy diskettes or parts of diskettes. | | | |
| COPY WRITE | - CW | COPY WRITE start_sector(0-7) #_of_sectors(1-36) | CW 0 36 |
| Writes 1 to 36 sectors from the copy buffer onto the diskette in the Selected Drive starting with the specified sector. (see COPY READ) | | | |
| DISK DIRECTORY- | DD | DISK DIRECTORY | DD |
| Reads and displays the file names on the Selected Drive. | | | |
| EDIT SECTOR | - ES | EDIT SECTOR sector#(0-7) or ES REDO | ES 719 |
| Positions the head to the specified sector and reads the data into an editing buffer. The data can then be edited in ASCII or Hex and written back out. (see WRITE SECTOR) | | | |
| FORMAT DISK | - FD | FORMAT DISK #sides(1-2) density(S-D) diskname | FD 1 S TEST |
| Formats the diskette in the Selected Drive in the format specified and places a standard header on sector zero with the specified diskname. NOTE: All data previously on the disk will be WRITTEN OVER! | | | |
| FIND FILE | - FF | FIND FILE filename | FF DIAGCONFIG |
| This command finds the file header of the specified file. The Track, Sector and Side indicators in the Status block point to the file header location. The location(s) and number of sectors of the file are displayed under the Status block along with the file size and type. | | | |
| HEAD STEP | - HS | HEAD STEP step_time | HS 10 |
| Sets the head step time at the specified time in milliseconds for all disk operations. TI = 6, 12, 20 or 30 CC = 3, 6, 10 or 15 | | | |



QUICK REFERENCE - ADVANCED DIAGNOSTICS COMMAND LIST Continued

| Name | Abbreviation | Syntax | Example |
|--|--------------|--|----------|
| MOTOR SPEED | - MS | MOTOR SPEED sample_rate Hz(50-60) | MS 10 60 |
| Displays the RPM of the Selected Drive based on the sample rate (# of index pulses) specified. High sample rate returns drives average RPM. The Hz is the AC cycles per second for Foreign (50) or U.S. (60) power. | | | |
| OUTPUT DEVICE | - OD | OUTPUT DEVICE device_name | OD PIO |
| Sets the output device for FCTN 0 screen dumps. Any valid output device may be used. ie: Disk, Thermal Printer, etc. | | | |
| OUTPUT WIDTH | - OW | OUTPUT WIDTH line_length(1-80) | OW 80 |
| Changes the line length of the DIS/VAR output file for FCTN 0 screen dumps from the default of 80 to the specified line length. | | | |
| PAUSE | - PA | PAUSE | PA |
| Halts execution, displays 'Press any key to continue' and waits for a key press. Mainly for use in Command Files to allow diskette changes or a chance to abort. | | | |
| READ TRACK | - RT | READ TRACK track#(0-79) | RT 3 |
| Steps the read/write head to the specified track and reads every sector, Gap and Address byte of the track into a page-able buffer. | | | |
| SEEK TRACK | - ST | SEEK TRACK track#(0-79) | ST 38 |
| Steps the read/write head to the specified track. Track numbers 0 through 39 are on side one and 40 through 79 are on side two. | | | |
| SELECT DRIVE | - SD | SELECT DRIVE drive#(1-5) | SD 2 |
| Selects the drive number for all commands except Command File and Output Device. | | | |
| TIME DELAY | - TD | TIME DELAY #_of_seconds | TD 3 |
| Implements a time delay between instructions. Mainly for use in Command Files to allow diskette changes and/or the drive motor to time out (stop turning). | | | |
| USE DSR | - UD | USE DSR | UD |
| Toggles the DSR ROM on and off for using the sector and format routines in the DSR ROM. This allows testing of the DSR ROM routines or the use of Diags with a true RAM Disk. | | | |
| WRITE SECTOR | - WS | WRITE SECTOR sector#(0-?) | WS 45 |
| Positions the read/write head to the specified sector and Writes the data that is in the Edit Sector buffer and verifies that the data was written out properly. NOTE: Any data previously in the sector will be WRITTEN OVER! | | | |
| WRITE TRACK | - WT | WRITE TRACK track#(0-79) density(S-D) | WT 6 S |
| Steps the head to the specified track and Writes default format data to every sector on the track in the specified density. NOTE: All data previously on the track will be DESTROYED! | | | |

NOTE

Even though the Examples listed only show the abbreviated command, you may also use the full command name. (see THE COMMANDS - General Rules)

ie: Format Disk 1 S TEST performs the same as FD 1 S TEST



QUICK REFERENCE - FCTN & CTRL KEY LIST

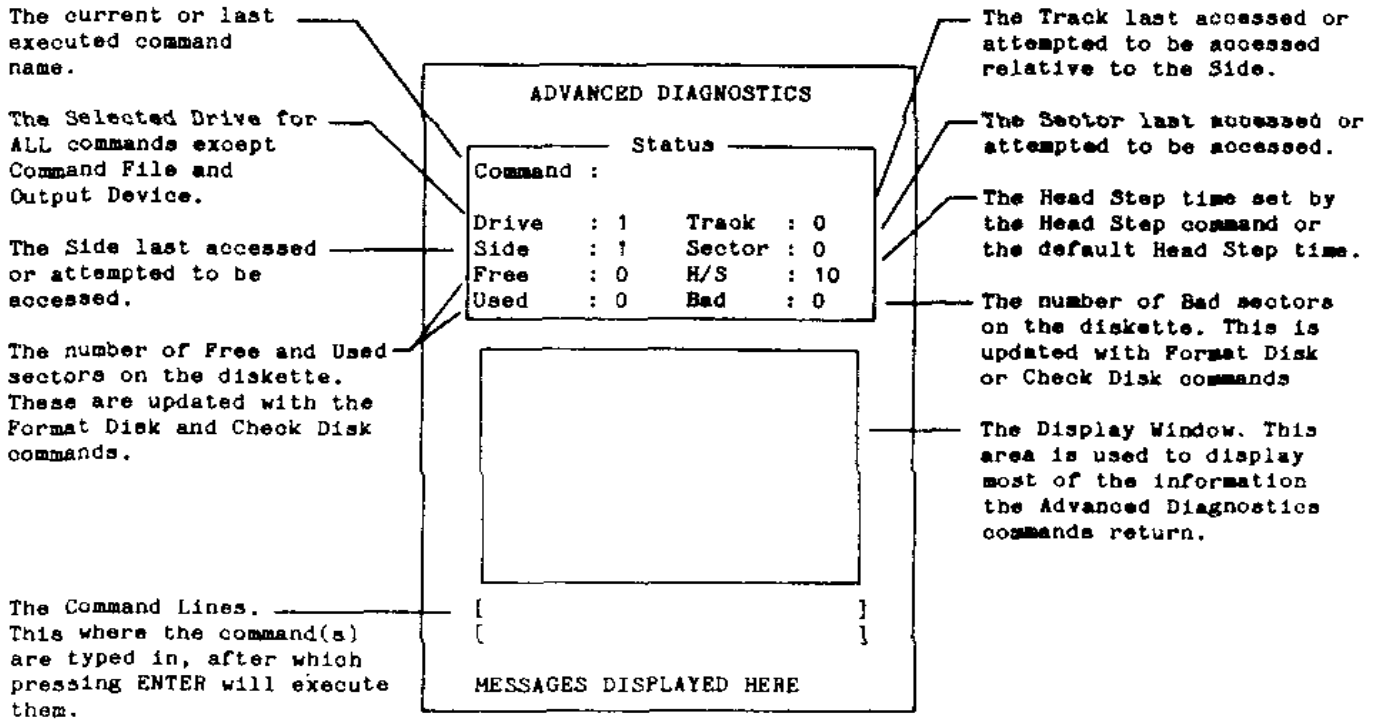
| FCTN Key | Key-code | Description |
|---------------|----------|---|
| 1 DELETE | [3] | Deletes a character from the command line or sector being edited. |
| 2 INSERT | [4] | Inserts a space character into the command line or the sector being edited. |
| 3 ERASE | [7] | Erases the entire command line or sector being edited. (see Edit Sector) |
| 4 ROLL UP | [2] | Brings the next higher numbered sector/track into the Edit/Track buffer. Note: Any changes to the sector that was previously in the edit buffer will be lost. You MUST perform a WRITE SECTOR to save your changes. |
| 5 BEGIN | [14] | Takes you from any screen to the program's title screen. From the program's title screen FCTN 5 BEGIN will take you out of the program to the computers title screen. This key also Aborts most of the Diags commands. |
| 6 ROLL DOWN | [12] | Brings the next lower numbered sector/track into the Edit/Track buffer. Note: Any changes to the sector that was previously in the edit buffer will be lost. You MUST perform a WRITE SECTOR to save your changes. |
| 7 AID | [1] | Windows in the help screen. CTRL E & CTRL X allow you to page through the help section any other key press will abort Help. |
| 8 REDO | [6] | Re-checks a memory location that is bad during the Check Memory command. |
| 9 BACK | [15] | Brings you back to the main Command Screen from Edit Sector or Read Track. |
| 0 SCRIN DUMP | [188] | Dumps the contents of the screen to the Output Device selected. (see Output Device) |
| = ASCII/HEX | [5] | Toggles the Edit buffer and Track buffer displays between ASCII characters and their hexadecimal values. |
| E UP ARROW | [11] | Moves the cursor up a line. If the cursor is on the top line of the display it will home the cursor. |
| X DOWN ARROW | [10] | Moves the cursor down a line. |
| S LEFT ARROW | [8] | Moves the cursor left one character. |
| D RIGHT ARROW | [9] | Moves the cursor right one character. |

| CTRL Key | Key-code | Description |
|--------------|----------|--|
| E UP ARROW | [133] | Page Up is used during FCTN 7 HELP and Read Track to display the next Help screen or track buffer. |
| X DOWN ARROW | [152] | Page Down is used during FCTN 7 HELP and Read Track to display the previous Help screen or track buffer. |

Special Characters For Use In A Command File

- [253] Delay. Executes 1 second delay in a Command File
- [254] Executes a Command File in Slow speed.
- [255] Executes a Command File in High speed.
- [] End Of File marker for Command Files.

QUICK REFERENCE - ADVANCED DIAGNOSTICS COMMAND SCREEN



NOTES

The commands COPY WRITE, FORMAT DISK, WRITE SECTOR and WRITE TRACK will all WRITE data to the diskette in the Selected Drive. Make sure the drive indicator in the Status Window displays the proper drive number before executing ANY of these commands!!

The Command Line will not erase itself after the command is completed, so you can execute a command over and over by just pressing Enter. The cursor does not need to be at the end of the command list to execute the entire Command Line. After a command has been executed the cursor will home itself. To clear the entire Command Line just press FCTN 3 ERASE.

The Status Window is updated at the beginning and end of every command. So with some commands, such as Check Disk or Find File, with a lot of file clusters, the Status Window will only display correct information after ALL of the "Press Any Key To Continue" functions have been completed. Most commands do not affect all of the Status indicators. In the COMMANDS section of this manual, where the screens are displayed, the indicators that have a "nu" after them are not used by the command being documented. These "nu" indicators will display the information from the last command that updated them.

The Status Window on the Edit Sector and Head Track Screens (not show here) display correct information with every Roll Up or Roll Down. If however you are using the DSH ROM routines (see USE DSR command) the Side and Track indicators will not be updated.



THE COMMANDS

General Rules

1. All commands and command parameters are delimited with a space character. Every command must end with a space character or Carriage Return (ENTER) and it must have at least 1 space inbetween each parameter. If you use the full command name there must NOT be more than one space inbetween the first and second word of the command. If you use the abbreviated form of the command then there must NOT be any spaces inbetween the first and second letters of the command.

| Correct | Incorrect |
|--------------------------|------------------------|
| Select Drive 1 | Select Drive 1 |
| Change Colors 16 13 12 4 | Change Colors16 1312 4 |
| SD 1 HS 10 | S D 1 H S10 |

2. The commands and parameters can be in upper case or lower case or both. All of the following are Correct:

select DRIVE 1 Select Drive 1 sElect drive 1 SD 1 sd 1 Sd 1

3. The numeric parameters can be input in either Decimal or Hexadecimal numbers. Hexadecimal numbers must be preceded by the > sign. Some of the commands, such as Edit Sector, do not have an upper limit, however the Status Window will only display 4 digits. This was done to allow access to future devices, like a RAM Disk.

| Correct | Incorrect |
|----------------------------|-----------------|
| Edit Sector >3F | Edit Sector 3F |
| Edit Sector 27? or ES >10F | Edit Sector 10F |

BEEP or BE

Generates a Beep tone. Mainly for use in Command Files to indicate a PAUSE or the end of the Command File however, it can also be used in the Command Lines.

Example: SD 1 HS 10 BEEP PA Format Disk 1 S TEST

This will Select Drive 1, set the Head Step time to 10 milliseconds, BEEP, wait for a key press (PA) and then Format the diskette in drive 1 as single sided single density with the disk name of TEST.

CHANGE COLORS foreground background border *char or CC foreground background border *char

Allows you to set the foreground (alphanumeric characters), the background (screen), the border (box lines) and the * character (special * character) colors to suit your monitor. The * character is used on the Edit Sector and Read Track Screens. It is used on these screens in ASCII display mode to indicate that the value in that byte location is out of the normal 32 - 127 ASCII display range.

Color Codes

| | | | |
|----------------|--------------|-----------------|---------------|
| 1 Transparent | 5 Dark Blue | 9 Medium Red | 13 Dark Green |
| 2 Black | 6 Light Blue | 10 Light Red | 14 Purple |
| 3 Medium Green | 7 Dark Red | 11 Dark Yellow | 15 Gray |
| 4 Light Green | 8 Cyan | 12 Light Yellow | 16 White |

Example: CC 16 13 12 *

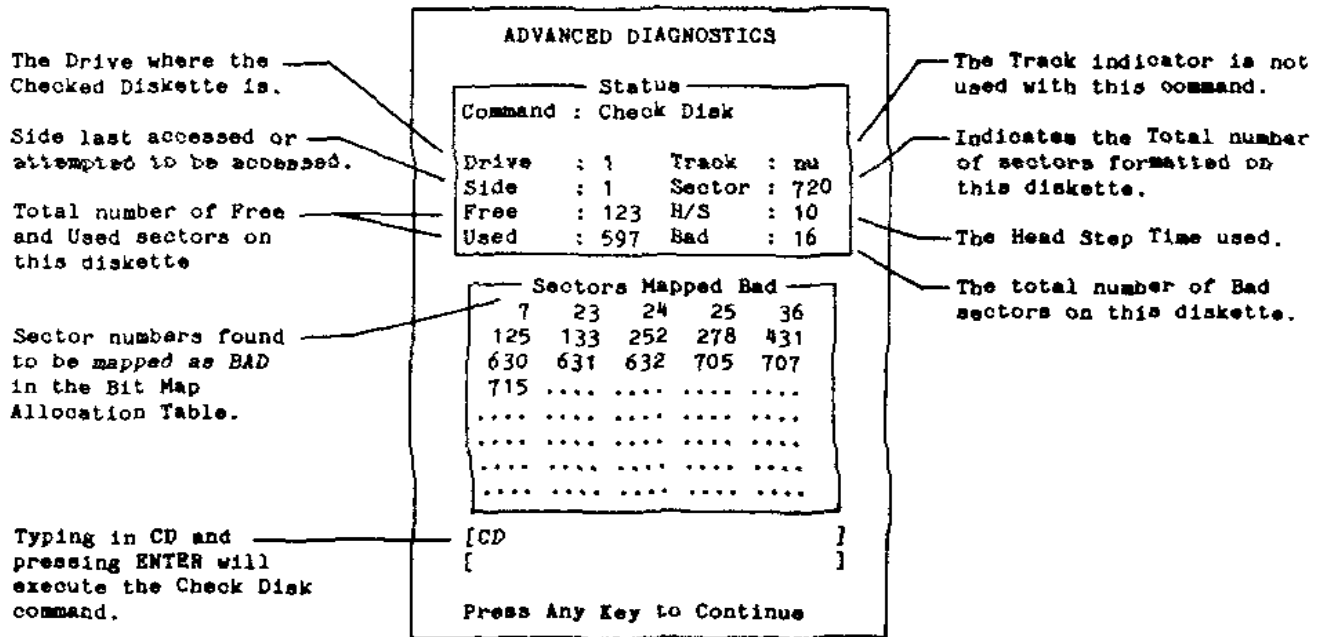
This will set the text color to White, the screen color to Dark Green, the box lines to Light Yellow and the * character to Light Green.



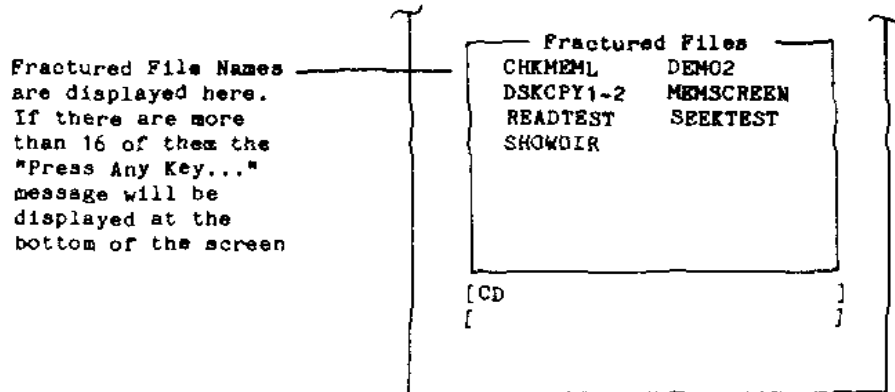
THE COMMANDS Continued

CHECK DISK or CD

The Check Disk command checks the diskette for sectors that have been mapped bad in the Bit Map Allocation Table in sector 0 and it also checks the diskette for Fractured Files. This command will also update the Free, Used and Bad indicators in the Status Window.



After it has displayed the bad sector numbers, if there are any, it displays "Press Any Key To Continue" at the bottom of the screen. After you press a key it will then display the file names of the files that are found to be Fractured. A Fractured File is a file whose data does not reside in numerically contiguous sectors. Part of the file may be in sectors 34 through 42 and the rest of the file may be in sectors 56 through 61. If a file is badly fractured (more than three noncontiguous sections) it may slow down the access time for reading and writing to the file because of all the head stepping required to get to the other sectors. To unfracture files simply use the Disk Manager's file copy function to copy the whole disk onto a new disk. Sector copiers will NOT unfracture files. (see FIND FILE for displaying the files location(s))



THE COMMANDS Continued

COMMAND FILE DSKx.filename or CF DSKx.filename or COMMAND FILE REDO or CF REDO

A Command File is a collection of Advanced Diagnostic commands, key-codes and key strokes which are created with any editor or word processor that saves its files in DIS/VAR 80 format. Two such utilities are the Editor/Assembler editor and the TI Writer word processor programs. When the Command File DSKx.filename command is executed, Advanced Diagnostics will go to the specified drive and load the specified file into memory. After it is loaded Diags will then execute the commands in the file as if they were typed in from the keyboard only much faster. This advanced feature allows the creation of some powerful Command Files that will automatically perform repetitive functions and tasks for you. Command Files may be any size up to 2048 bytes and they can contain ANY of the commands, key-codes and keystrokes known to Diags. A Command File can also load and run another Command File, as the last command in the file, so you can chain multiple Command Files together to perform large tasks.

Command File Tips & Rules

1. 2048 bytes is 2K or approx 50 lines with 40 columns of characters. This is a file size of about 9 disk sectors, 1 for the File Header and 8 sectors of data. If a Command File is larger than 2K Advanced Diagnostics will NOT execute it.
2. Each of the two Command Lines is 26 characters long. This is the 3rd tab position in the Editor Assembler and the 4th tab position in TI Writer. If you use TI Writer to create your Command Files, save your files with the Print File command and not the Save File command. The Print File command does not save the TI Writer tabs as the last record of the file. No matter which editor you use make sure the last characters in your Command File are []. This is the End of File marker for Diags.
3. To have Diags execute the FCTN & CTRL keys in your Command File just place the key-code inside the bracket characters. ie: [9] will move the cursor right one character. See the Quick Reference - FCTN & CTRL Keys page for the various key-codes. You can also use these brackets for any character value. ie: [32] prints a space character. If you forget to close an open bracket, [8[32], Diags will stop execution at that point. The following characters have a special meaning to the Command File interpreter:
 - [253] Generates a 1 second delay before executing the next item in your Command File. The delay time is the same for high speed or slow speed Command File execution.
 - [254] Tells the interpreter to execute the items that follow it in Slow speed. This speed is good for testing and debugging your Command Files. You can abort a slow speed Command File at any time by pressing any key on the keyboard.
 - [255] Tells the interpreter to execute the items that follow it in High speed. You can change the speed as often as you wish within the Command File. The only time you can abort a high speed Command File is when the PAUSE command is executed and you press FCTN 5 BEGIN.
 - [] Tells the interpreter that this is the End of the Command File so that it will not try to execute any commands left over from a previous Command File.
- NOTE:** ALL key-codes and character values must be in decimal and have only 1 value per bracket. ie: [8 32] is not allowed, change it to [8][32].
4. Some of the Advanced Diagnostics commands require one or more key presses to complete the command. Check Disk, Disk Directory, Motor Speed and Find File when there are a lot of clusters, are a few such commands. When you place these in a Command File you should include a few extra space characters after the [13] key-code to compensate for this. Otherwise Diags might use a few of the characters from the next command, which will cause an error.
5. Since the Command Files are saved in a DIS/VAR 80 format, all space characters on the end of the lines are stripped off. If you want to retain some space characters just use the [32] key-code as the last space character on the line.

MG

THE COMMANDS Continued

COMMAND FILE Continued

- Whenever a Command File is loaded, or executed with Command File REDO, the ASCII/Hex display mode automatically defaults to Hex. This way you always know what display mode you are in for Edit Sector or Read Track. The [5] key-code will toggle the display mode in your Command Files, this is the same as pressing PCTN =.
- When a Command File is loaded and starts to run, the previous command(s) are still on the Command Line. The [7] key-code in your Command Files will erase this area, so it is a good idea to place this at the beginning of your Command Files. This is the same as pressing PCTN 3 ERASE.

Command Files can easily be created to perform a variety of tasks and tests. As you become familiar with Diags and Command Files we think you'll find this to be a truly advanced and powerful feature. There are 7 Command Files on the Advanced Diagnostics disk that should help you understand the structure and simplicity of a Command File. These files perform the follow tasks and tests:

| | |
|--------------------|--|
| DIAGCONFIG | This Command File automatically loads and runs when ADVANCED DIAGNOSTICS first starts up. It currently contains the commands Change Colors and Output Device. You can modify this Command File to have Diags boot up with your own Output Device, Head Step time, Colors etc. to match your system's configuration. If DIAGCONFIG is not on the diskette in drive 1 Diags will return the "Bad Open Attribute" error message, which means it could not be found. (see Appendix A - FDC and DSR Error Messages) |
| BOXFORMAT | This file will format a box of ten floppy diskettes in the Selected Drive as single sided, single density with the disk names of DISK-01 through DISK-10. This file can easily be modified for double sided and/or double density. |
| DISKCOPY1-2 | This will format the disk in drive 2 as single sided, single density and then copy the entire single sided, single density disk in drive 1 to drive 2. |
| DISKHEADER | This file will Edit Sectors 0 and 1 in the Selected Drive and change them to a standard, freshly formatted, disk header for a single sided, single density diskette. This file was included to show you how to use the Edit Sector command in a Command File. |
| RAWTEST | This file performs a complete single sided, single density Read and Write Test on the Selected Drive. This test is not destructive since it rewrites the same data that was Read. |
| READTEST | This file performs a complete single sided, single density Read Only test on the Selected Drive. |
| SEEKTEST | This file performs a complete single sided Seek Track test on the Selected Drive with the Head Step time that was previously set. |

Example DIAGCONFIG Command File

| | |
|----------------------------|--|
| [255][7] | Sets up high speed execution and clears the Command Line. |
| CC 16 13 12 4 [13][7] | Changes the Colors and clears the Command Line. |
| OD RS232.BA=4800 [13][7] | Sets up the Output Device and clears the Command Line. |
| Beep [13][7] | Generates a Beep tone and clears the Command Line. |
| Welcome to [32] | Displays part of the message. |
| ADVANCED DIAGNOSTICS [253] | Displays the rest of the message, waits 3 seconds and then |
| [253][253][7][1] | clears the Command Line and ends the Command File. |



THE COMMANDS Continued

CHECK MEMORY or CM

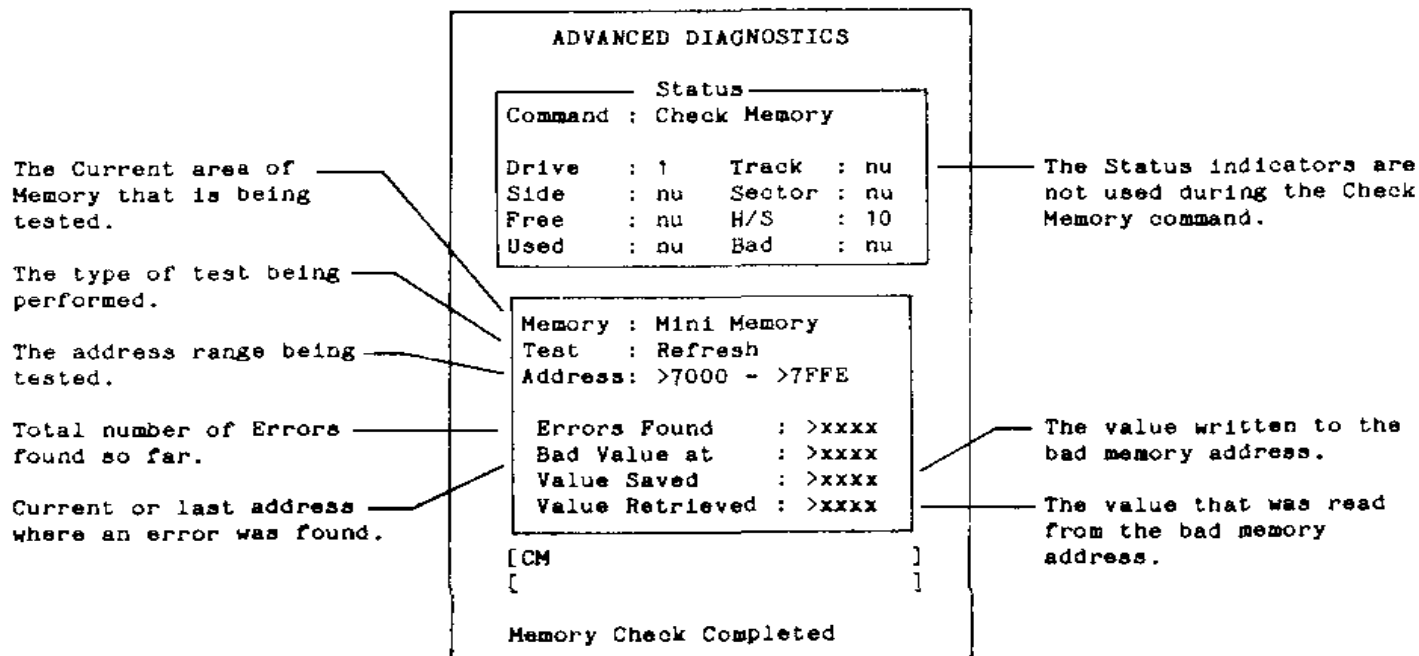
The Check Memory command performs complete Refresh and Bit Shift tests on Scratch Pad RAM, VDP RAM, Memory Expansion RAM and Mini Memory RAM, if it is present. These tests are conducted on the entire area of RAM in 4K segments. During these tests ADVANCED DIAGNOSTICS moves a number of 4K blocks of memory around to preserve the Diags environment. Because of this some of the Diags functions are turned off until the test is completed or aborted when a error is found. One such function is the FCTN 0 Screen Dump to the Output Device.

The Bit Shift test writes a bit value to every bit location in every RAM word in the test and then checks it. The Refresh test writes a value to every word location in the RAM areas. After these Refresh values have been written to the 4K segment Diags will wait approximately 3 seconds and then go back and check to make sure that the value written is still intact. Since there are 8 bits in every byte and Diags writes to every byte 9 times, once for refresh and 8 times for Bit Shift and then reads every byte 9 times, there are 18 accesses made to every byte of RAM. This means that the Check Memory test performs 4,608 accesses on Scratch Pad RAM (18 x 256). 294,912 accesses on VDP RAM (18 x 16,384). 589,824 accesses on Memory Expansion RAM (18 x 32,768) and 73,728 accesses on Mini Memory RAM for a total memory check of 963,072 memory accesses, not counting all of the 4K block moves that take place to preserve the Diags environment.

NOTE: If an area of memory is found to be bad Advanced Diagnostics will halt the test and ask if you want to continue. At this time you can press FCTN 8 REDO to retest that memory location. It is possible that this bad area of memory is pertinent to the proper operation of Check Memory and as such Diags will not perform properly after the test.

EXAMPLE: Check Memory or CM will execute the Check Memory test.
 PA Check Memory or PA CM will execute the test after a key press.

NOTE: All values displayed in the Display Window are in hexadecimal for this command.



THE COMMANDS Continued

CONVERT NUMBER no. or >no. or Bno. or CN no. or >no. or Bno.

Convert Number enables you to convert a decimal, hexadecimal or binary number from its current base into the other two number bases which will be shown in the Display Window on the Command Screen. The valid input and display range for the different bases are: 0 - 65535 for decimal, >0 - >FFFF for hexadecimal and B0 - B1111111111111111 for binary.

EXAMPLES: Convert Number 239 or CN 239 converts the decimal number 239
Convert Number >2FE or CN >2FE converts the hexadecimal number >2FE
Convert Number B0110 or CN B0110 converts the binary number 0110

COPY READ start_sector(0-?) #_of_sectors(1-36) or CR start_sector(0-?) #_of_sectors(1-36)

With this command you can copy up to 36 sectors at a time into a copy buffer from the Selected Drive, starting with the specified start_sector number. After the sectors are in the buffer the Copy Write command will write them back out. This allows you to move sectors around on the diskette or to copy part or all of one diskette to another.

36 sectors equals 4 full tracks on a single density diskette or 2 full tracks on a double density diskette. Since these sectors are read into a buffer you can easily switch diskettes in a single drive system or select another drive before issuing the Copy Write command.

EXAMPLES: Copy Read 0 36 reads sectors 0 through 35, inclusive, into the buffer.
Copy Read 36 36 reads sectors 36 through 71, inclusive, into the buffer.
CR 34 2 reads sectors 34 and 35 into the buffer.

NOTE: The buffer used for Copy Read and Copy Write is also used by the Check Disk, Check Memory, Format Disk, Disk Directory and Read Track commands. You must issue a COPY WRITE command before any of these commands or the data in the buffer will be DESTROYED! Edit Sector does not destroy the copy buffer.

COPY WRITE start_sector(0-?) #_of_sectors(1-36) or CW start_sector(0-?) #_of_sectors(1-36)

Copy Write is the complementary command to Copy Read. This command writes part or all of the copy buffer out to the Selected Drive starting at the specified start_sector for the number of sectors specified. If the copy buffer is empty or if you have issued any of the commands in the above "NOTE:" issuing this command will most likely write invalid data out to your diskette. You SHOULD issue this command immediately after the Copy Read command.

The start_sector for Copy Write does not have to be the same as Copy Read. This allows you to move sectors around to different locations. However, for disk copying purposes the start_sector and #_of_sectors must be the same on both commands for an exact copy.

EXAMPLES: SD 1 CR 0 36 SD 2 CW 0 36 Copies sectors 0 through 35 from drive 1 to sectors 0 through 35 on drive 2.
SD 1 CR 0 18 SD 2 CW 18 18 Copies sectors 0 through 17 from drive 1 to sectors 18 through 35 on drive 2.
CR 2 32 PA CW 300 33 Copies sectors 2 through 33 on the Selected Drive to sectors 300 through 332 on the same drive but the PA allows you to switch diskettes before it writes out the sectors.

MG

THE COMMANDS Continued

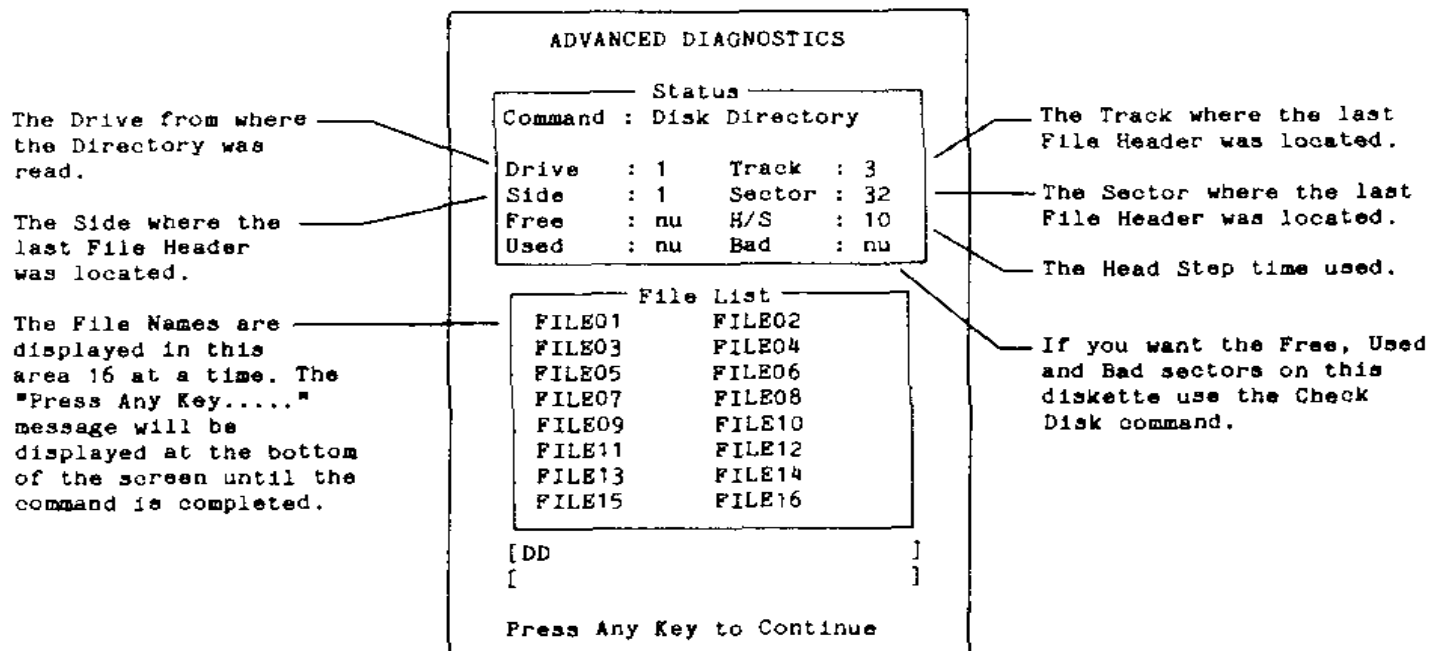
DISK DIRECTORY or DD

The Disk Directory command will list the file names on the diskette, in the Selected Drive, in the Display Window area of the Command Screen. This command will display 16 file names at a time and then wait for a key press to continue.

If you want to know the location of a file or its size, type etc. use the Find File command.

EXAMPLE: Disk Directory or DD will list the files names in the Display Window.

NOTE: Since the Disk Directory command usually requires a number of key presses to complete the command, you should included a few space characters in your Command File(s) after the DD command to compensate for this.



THE COMMANDS Continued

EDIT SECTOR sector#(0-7) or ES sector#(0-7)

The Edit Sector command allows you to edit the contents of any valid sector on the disk. After the command has read the sector into the Edit Buffer it will be displayed on the screen along with a Status Window. The Status Window has indicators for Drive, Side, Byte, Track, Sector and Display Mode. The Drive, Side, Track and Sector indicators display information about the location of this sector. The Display Mode indicator indicates the display mode, which is selected by the FCTN = ASCII/Hex toggle. The Byte indicator is updated as you move the cursor around the screen and it indicates which byte number the cursor is sitting on.

The FCTN E, S, D and X keys move the cursor around. FCTN 9 BACK takes you back to the Command Screen. FCTN 1 DELETE and FCTN 2 INSERT will Delete and Insert characters into the sector. FCTN 3 ERASE will erase the contents of the Edit Buffer. Pressing FCTN 3 ERASE in ASCII Mode fills the Edit Buffer with space characters and in Hex Mode it fills the Buffer with zeros. (see Quick Reference - FCTN & CTRL Keys for a complete listing of the other functions). In Hex Mode the active keys for inputting or changing data are 0 through 9 and UPPER CASE A through F. In ASCII Mode any of the keys on the keyboard, except the function keys in the Quick Reference section of the manual, may be used to input or change data.

EXAMPLES: **Edit Sector 34** reads sector number 34 into the Edit Buffer and displays the following screen for editing the data.

Edit Sector >22 reads sector number >22 (34) into the Edit Buffer for editing.

NOTE: After you have edited a sector you must press FCTN 9 BACK and then execute the WRITE SECTOR command to write your sector changes to the diskette.

When a Command File is first executed it will automatically set the Display Mode to Hex. That way you know, when you execute Edit Sector from a Command File, which Display Mode you are in and you can easily change it with the [5] key code. It will then stay in that Mode until you run another Command File, execute CF REDO or execute the [5] key code.

```

Drive : 1   Track : 0
Side  : 1   Sector : 0
Byte  : 0   Display: Hex

5445535420202020202001680944
534B202801010000000000000000
0000000000000000000000000000
0000000000000000000000000000
030000000000000000001020*08000
010204081020400000000000000000
000000000000000000000000000000
000000FFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFF

```



THE COMMANDS Continued

FORMAT DISK #sides(1-2) density(S-D) diskname or FD #sides(1-2) density(S-D) diskname

The Format Disk command formats the entire diskette in the SELECTED DRIVE with the number of sides, density and disk name as specified in the command. This format routine formats a diskette that is fully compatible with the Disk Manager, the various TI Languages and other Command Modules.

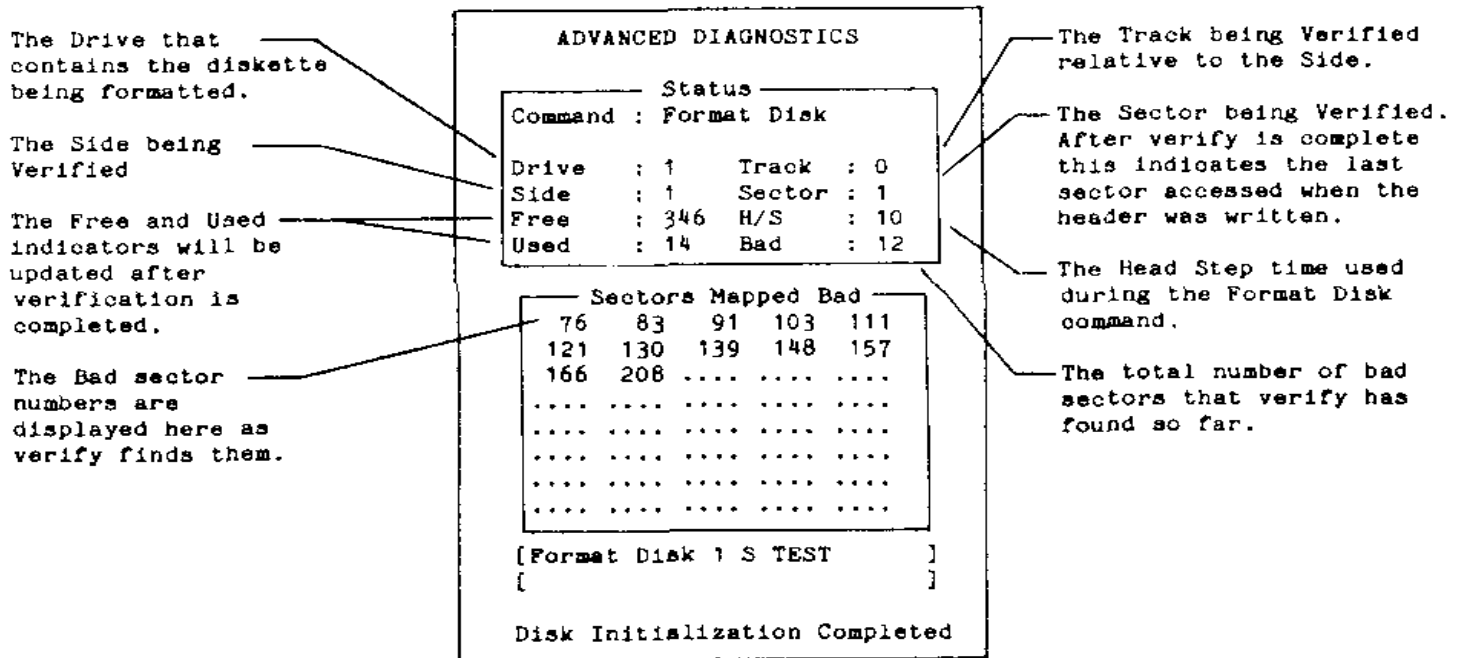
Provisions have also been implemented through USE DSR (see) to allow formatting with other Disk Controller cards or other devices that have DSR headers that incorporate a Format subprogram. If USE DSR is not turned on then Diags will use its own internal format routine otherwise it uses the format routine in the Disk Controller card.

You can format just selected tracks on a diskette by using the Write Track command and then with the Edit Sector command you can build a proper header for the disk on the sectors 0 and 1. (see Write Track and Command File - DISKHEAD)

- EXAMPLES:**
- FD 1 S TEST** Formats a single sided, single density, 360 sector diskette in the SELECTED DRIVE with the disk name of TEST.
 - FD 1 D DISK-01** Formats a single sided, double density, 720 sector diskette in the SELECTED DRIVE with the disk name of DISK-01.
 - FD 2 D XFILES** Formats a double sided, double density, 1440 sector diskette in the SELECTED DRIVE with the disk name of XFILES.

NOTE: Pressing any key during Verify will abort the verify and a standard header will NOT be written out to the disk.

Double Density disk accesses can only be done with a Double Density Disk Controller Card. The TI Disk Controller Card will NOT access Double Density.



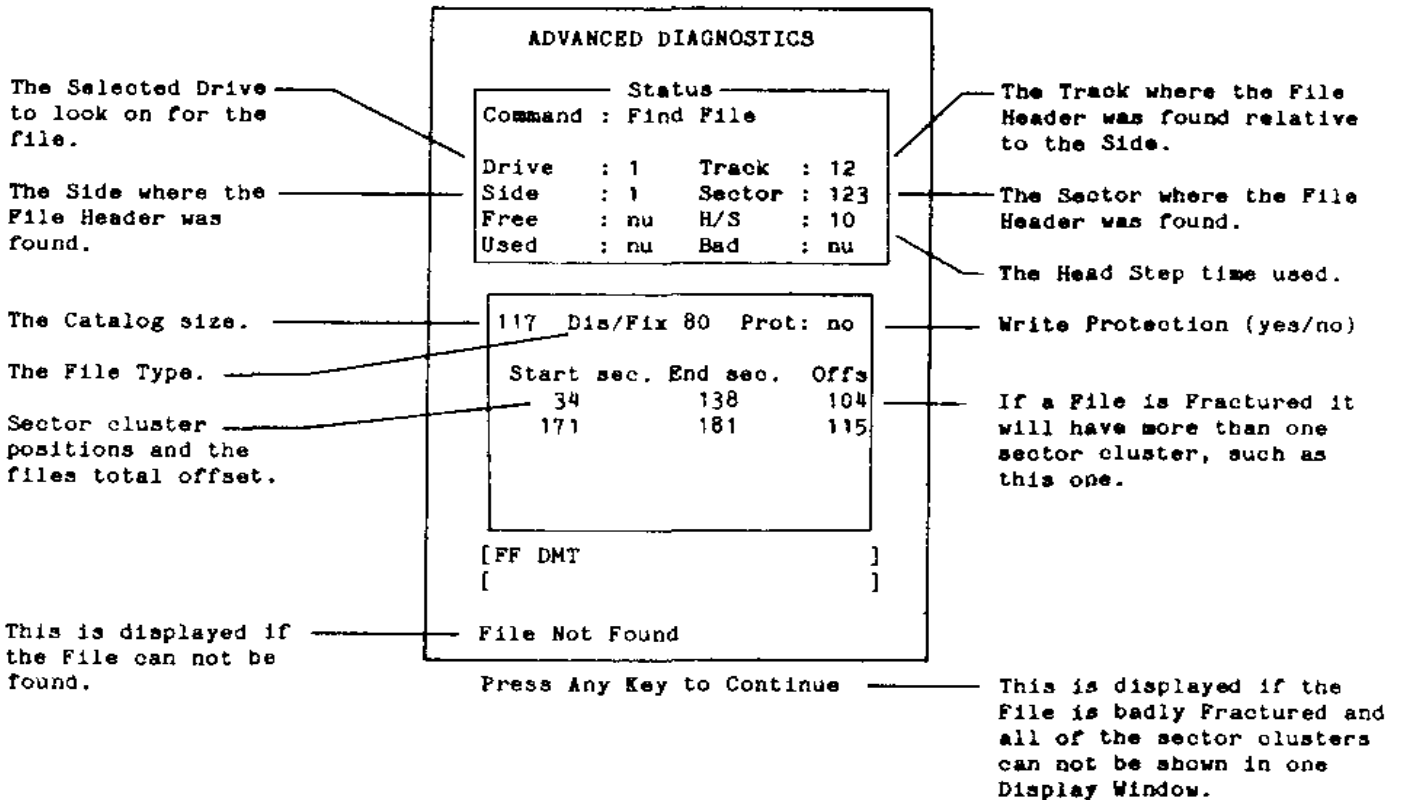
THE COMMANDS Continued

FIND FILE filename or **FF filename**

The Find File command displays the file's size, type, write protection, sector locations and total offset in the Display Window. Upon completion of the command, the Side, Track and Sector indicators point to the location of the File Header (File Descriptor Record) on the Selected Drive.

If the file does not exist on the Selected Drive this command will display the "File Not Found" error message at the bottom of the screen. If you would like a directory listing of the files on the Selected Drive use the Disk Directory command.

EXAMPLES: Find File LOAD will display the information for the file named LOAD.
 FF SEEKTEST displays the information for the file named SEEKTEST.



THE COMMANDS Continued

HEAD STEP ~~step_time~~ or HS ~~step_time~~

The Head Step command sets the head step time in milliseconds for all commands that require the head to step in or out, such as Edit Sector, Seek Track, Format Disk etc. This Head Step time is used whenever USE DSR is turned OFF (Not Using DSR). When use DSR is ON, the head step time used is determined by the Disk Controller card setting. A good test for proper Head Step time is included on the Advanced Diagnostics disk. To test different times, input the desired time and run the Command File named SEEKTEST with the command "Command File DSK1.SEEKTEST". If the time selected is too fast diags will display error messages that end with "... or Bad H/S". If this happens selected a slower Head Step time and try again with the command "Command File REDO". Once you have found a good time for your drives you might want to include it in your DIAGCONFIG file. Also see "Intro to Floppy Disk Controllers" for more information on Head Step times.

TI Head Step Times: 6, 12, 20 or 30

CorComp Head Step Times: 3, 6, 10 or 15

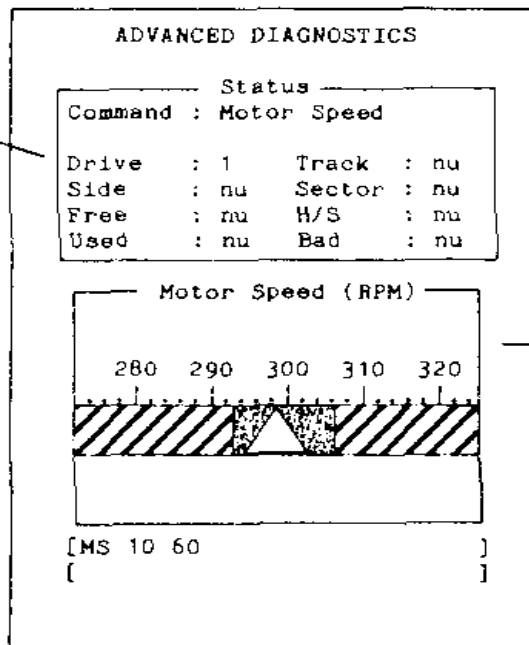
MOTOR SPEED ~~sample_rate~~ Hz(50-60) or MS ~~sample_rate~~ Hz(50-60)

The Motor Speed command will check and display the disk drive's RPM for the Selected Drive on a Bar Graph type scale. This command has two parameters, the first one, ~~sample_rate~~, allows you to select the number of index pluses for calculating the RPM. A high sample rate number will give you the average RPM for the drive. A small sample rate will update the pointer more often. There are approx 5 index pluses per second, so if you choose a large sample rate Diags will not check for a key press to abort, very often. In a Command File you should place a few [255] or [254] key-codes after the [13] to keep this test going. You should also have an extra space character after these key-codes to abort this test. The second parameter allows Diags to handle the cycles per second, Hz, for the different AC currents around the world. For the United States use 60 for this parameter, for other countries use 50 or 60 depending on your AC current.

EXAMPLES: Motor Speed 10 60 will execute the Motor Speed test for U.S. current, 60 cycles per second, at a sample rate of 10 index pluses.

Motor Speed 8 50 will execute the Motor speed test for 50 cycles per second AC current and at a sample rate of 8 index pluses.

The Drive that the Motor Speed command is testing.



The Drives RPM is pointed to by the white arrow. If the point of the arrow stays in the Green area of the Bar, your drive is OK. If it is in the Red, your drive needs its Motor Speed adjusted to perform properly. (300 is the optimum RPM)



THE COMMANDS Continued

OUTPUT DEVICE *device_name* or OD *device_name*

The Output Device command sets the device to dump the screen out to with the FCTN 0 SCREEN DUMP function. Any valid device may be used such as DSK, RS232, PIO, TP etc. (except CS1 & 2). Once the Output Device has been set all FCTN 0's will dump the contents of the screen to it. If you choose a disk file (DSK1.filename) then every FCTN 0 will dump the screen to the same file, which will write over whatever was in the file, so choose your DSK filenames carefully. The FCTN 0 SCREEN DUMP dumps the screen in a DIS/VAR format. (see Output Width)

EXAMPLES: Output Device RS232.BA=1200.DA=8 sets the output device as RS232 port 1 with a baud rate of 1200 and 8 data bits.

 Output Device DSK1.SCREEN sets the Output Device as a DIS/VAR file named SCREEN on drive 1.

OUTPUT WIDTH *line_length(1-80)* or OW *line_length(1-80)*

The Output Width command allows you to change the output line length from the default of 80. The valid range for this command is 1 through 80. If you select a narrow width, such as 16, the FCTN 0 screen dump function will only dump the left hand half of the screen. The main purpose for this command is to allow screen dumps to a narrow device like the TI Thermal Printer. You may want to include this command in your DIAGCONFIG command file if your Output Device has a narrower line length than 80.

EXAMPLE: Output Width 40 sets the line length to 40 for a DIS/VAR 40 type file when the FCTN 0 Screen Dump is activated.

PAUSE or PA

The Pause command prevents the commands that follow it from being executed until a key is pressed. When the Pause command is executed the message "Press Any Key to Continue" will appear at the bottom of the screen. This command is very useful in command files for two reasons. First it allows you stop the command file for disk swapping purposes or verification to continue. Secondly, it is the only way to halt and abort a command file that is running in high speed.

If you want to abort a multiple command line or a Command File when the Pause command is executed just press FCTN 5 BEGIN. This will take you to the title screen and abort command processing. From the title screen, when you press any key, you will return to the command screen and your command line and/or Command File will still be intact. If you want to re-execute your command line just press ENTER. If you want to rerun your Command File type in COMMAND FILE REDO or CF REDO and press ENTER.

NOTE: If you use the Pause command in a Command File you must press a key from the keyboard. The characters and key codes that follow it in the Command File do not act as a key press.

FCTN 7 HELP and FCTN 0 SCREEN DUMP are active and they will not act as a key press for continuing the execution of the commands.

EXAMPLE: PAUSE SD 1 FD 1 S DISK1 this multiple command line will wait for a key press,
 PAUSE SD 2 FD 1 S DISK2 format the diskette in drive 1 and then wait for another
 key press before formatting the diskette in drive 2.

THE COMMANDS Continued

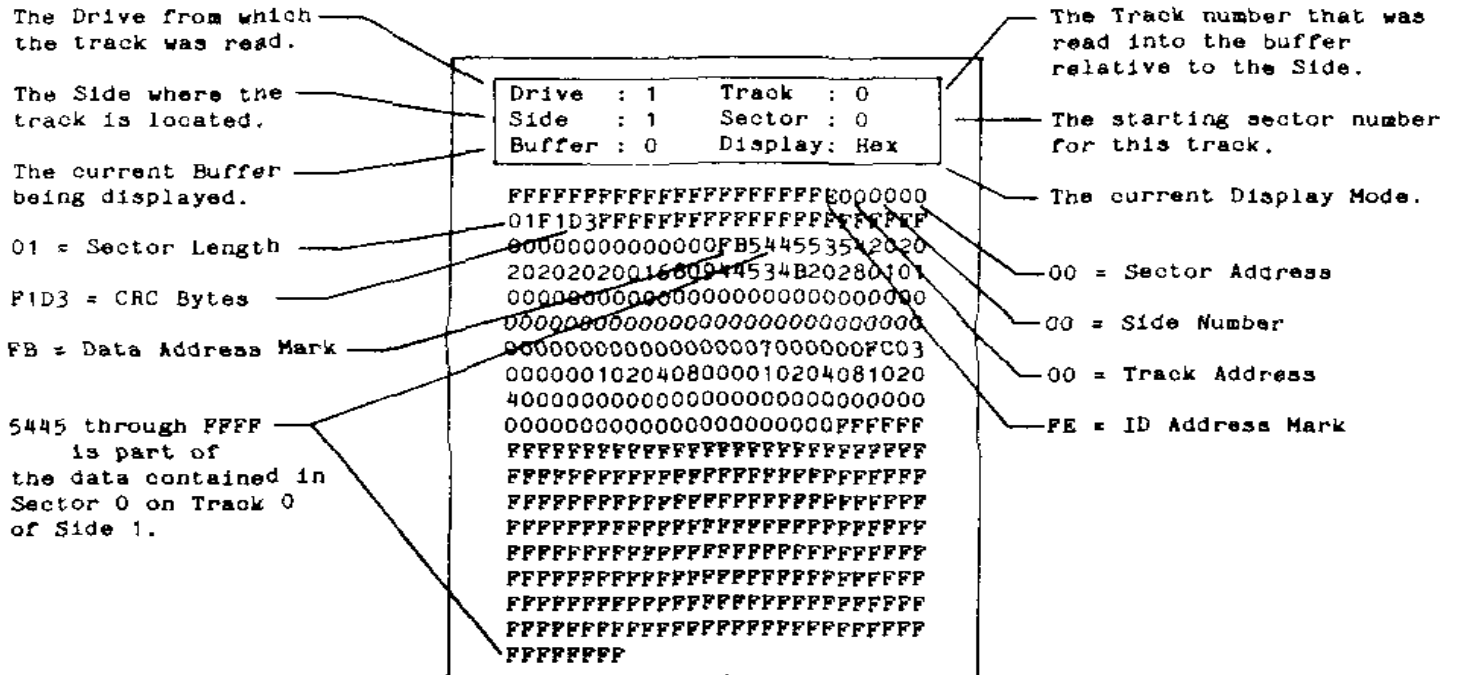
READ TRACK track#(0-79) or RT track#(0-79)

The Read Track command allows you to analyze the information that is written to the specified track when it is formatted and resides inbetween the sectors. This information includes the Gap, Sync, Address, Data and Cyclic Redundancy Check (CRC) Bytes. The items of most interest are the Address bytes which include the ID Address Mark, Track Number, Side Number, Sector Number, Sector Length and 2 CRC Bytes. The ID Address Mark byte is an >FE followed by the other bytes. This byte tells the Floppy disk Controller Chip (FDC) that the next 6 bytes contain the address information. The 2 CRC Bytes are used by the Floppy Disk Controller Chip for checking the integrity of the data it has just read in.

You may notice when Rolling Up, FCTN 4, and Rolling Down, FCTN 6 through the tracks that some of the Gap and Data information displayed on the screen is incomplete. This happens because of the state that the FDC is in during a Read Track and it can also be caused by noise or write-splice time synchronization. In this state, if the FDC detects certain byte values it interprets these as being an ID Address Mark or other special Mark and assembles or collects the bytes following it as something other than data. Do not be concerned if this occurs during a Read Track since this command is NOT used during normal operation of the TI 99/4A disk system it is only used for diagnostic purposes. Most of the information displayed on your screen, except the 256 bytes of data, is used by the FDC for synchronization, error checking and, identification and verification of the location of the Read/Write head. (see Introduction to Floppy Disk Controllers, Seek Track and Write Track for more information).

EXAMPLE: Read Track 0

steps the Read/Write head to track 0, reads the data on that track into the Diags track buffer. CTRL E and CTRL X can be used to page through the buffer to display different portions of the track data. FCTN = will toggle the display between ASCII and Hex.



NOTE: The Data Displayed here is from a single sided single density Test diskette. For information on double density format see Introduction to Floppy Disk Controllers.



THE COMMANDS Continued

SEEK TRACK track#(0-79) or ST track#(0-79)

The Seek Track command instructs the Selected Drive to step the Read/Write head to the specified track on the diskette. Tracks 0-39 access side 1 and tracks 40-79 access side 2. This command tests the stepping function of your disk drives at the selected Head Step time. Upon completion of this command the Side, Track and Sector indicators in the Status Window are updated.

The Side indicator displays the side number where the track is located. The Sector indicator displays the lowest, or starting, sector number, relative to the density, on the track. The Track indicator displays the track number relative to the side. Both sides of the diskette contain tracks that are numbered from 0 to 39 so specifying a track number greater than 39 will step the head to a track on side 2 of the diskette. If you want to step to a track on side two just add 40 to the valid track number. (see Introduction to Floppy Disk Controllers, Read Track and Write Track for more information).

EXAMPLES: **Seek Track 23** steps the head out to track 23 on side 1.
 Seek Track 63 steps the head out to track 23 on side 2.

NOTE: Also see Command File - SEEKTEST

SELECT DRIVE drive#(1-5) or SD drive#(1-5)

The Select Drive command sets the disk drive number for all commands to operate on except Command File DSKx.filename and FCTN 0 Screen Dump. The valid range for this drive selection is 1 through 5. The 5th drive is to allow for possible future expansion of your system with a RAM Disk that is known as Drive 5. (see USE DSR)

EXAMPLE: **Select Drive 2** sets the drive for the various commands to Drive 2.

NOTE: Once the drive is selected all commands that execute a Write operation, such as Format Disk, Write Sector and Write Track will write to that drive. Be VERY CAREFUL of your drive selection before executing any of these commands or you may inadvertently write over an important diskette.

TIME DELAY #_of_seconds or TD #_of_seconds

The Time Delay command allows you to halt command execution for the specified number of seconds. This command can be used to allow for diskette swaps in a single drive system or it can be used to allow the disk drive motor to time out (stop turning).

EXAMPLES: **Time Delay 4** causes a delay of 4 seconds.
 TD >A cause a delay of >A (10) seconds.

NOTE: For a time delay in a Command File, without executing the Time Delay command, you can include the [253] delay function. (see Command File for more information.)

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THE COMMANDS Continued

USE DSR or UD

The Use DSR command instructs Advanced Diagnostics to use the Sector Read/Write and Format subroutines that are built into the Disk Controller or other device's DSR ROM. This command is the only command that has a toggling action. The first time it is executed the message "Using DSR ROM" will be displayed at the bottom of the screen. The next time it is executed the message "Not Using DSR ROM" will be displayed.

This command serves two purposes. First it allows testing of the DSR ROM and a couple of its subroutines. And, secondly it allows Advanced Diagnostics to work with any future device, such as a RAM Disk, that has a standard DSR Header with the Sector I/O and/or Format subroutines in it for that device.

When Use DSR is turned ON, "Using DSR ROM", some of the Status Window indicators are not updated such as Track and Side. This is because a RAM Disk does not have Tracks or Sides only sections of memory addressed as Sectors, so these indicators would be invalid.

EXAMPLE: **Use DSR** toggles the DSR ROM ON or OFF.

WRITE SECTOR sector#(0-7) or WS sector#(0-7)

The Write Sector command is the complimentary command to Edit Sector. This command writes whatever is in the Edit Buffer to the specified sector number on the Selected Drive. Be VERY CAREFUL when you issue this command and make sure that the SELECTED DRIVE is the drive you want to write to!

EXAMPLE: **Write Sector 0** writes whatever is in the Edit Buffer onto sector 0 in the Selected Drive.

NOTE: The Edit Buffer is also used by the **Format Disk** and **Read Track** commands. You must issue a **WRITE SECTOR** command before any of these commands or the data in the buffer will be **DESTROYED!** Copy Read does not destroy the Edit Buffer.

WRITE TRACK track#(0-79) density(S-D) or WT track#(0-79) density(S-D)

The Write Track command writes standard format information to the specified track number in the specified density. Tracks 0-39 access side 1 and tracks 40-79 access side 2. This command can be used to format just part of a diskette. Since it does not write a standard header to sector 0, you will have to generate a header that maps the formatted sectors into the Allocation Bit Map.

Part of a diskette can be formatted in single density and part of it in double density, if you have a double density disk controller card. If you should do this keep in mind that all of the relative addressing that the Sector I/O commands and Disk Controller DSR subroutines perform will be out of order. This happens because the track location of a sector is computed by dividing the number of sectors per track (9 for single density and 18 for double density) by the sector number specified.

For example, lets say you format tracks 0 and 1 as single density, track 2 as double density and track 3 as single density. Sectors 0 through 17 will be on tracks 0 and 1 and sectors 27 through 35 will be on track 3, like they are suppose to be. However, because of the relative addressing that takes place in the sector I/O routines, sectors 36 through 53 will be on track 2. The relative addressing says that track 2 is double density so the first sector on that track must be 36 ($18 \times 2 = 36$). This will create havoc with the Disk Controller when sectors are searched for in numerical order. You can however Edit these sectors even though they are in the wrong location relative to the other tracks, but you can not Roll Up or Roll Down to them.

EXAMPLE: **Write Track 1 S** formats track 1 as single density.

M
G

INTRODUCTION TO FLOPPY DISK CONTROLLERS

The TI Disk Controller can control up to three 5 1/4 inch floppy disk drives. Each drive may be single or double sided. Since this controller works in single density there are 40 tracks (0-39) per side and 9 sectors (0-8) per track on the diskette. The CorComp Disk Controller can control up to 4 drives and each drive may also be single or double sided. This controller will work in either single or double density. In double density, with this controller, there are 40 tracks (0-39) per side and 18 (0-17) sectors per track on the diskette.

With both controllers each sector is 256 bytes in length and is commonly referred to as 1 Allocation Unit. An allocation unit is the smallest unit of Data that can be Read or Written from the diskette. The position of the tracks on the diskette is controlled by the Floppy Disk Controller chip and with these two controllers track 0 is nearest the outside and track 39 is nearest the center of the diskette. This is true for both sides of the diskette.

These two Disk Controllers use a technique called soft sectoring when the disk is formatted. This approach uses software and an single index pulse to control the placement of data on a diskette. On a hard sectored diskette there are as many index holes as there are sectors and this determines the placement and size of each sector. On our soft sector systems the location of sectors is determined by an ID Address field. This field contains the Track Number, Side Number, Sector Number (0-8 or 0-17), Sector Length and CRC error checking bytes. (see Single and Double Density Format on pages 24 & 25).

Following the ID Address field are some separation bytes and then the Data field. These separation bytes serve two purposes. First they allow for slight variations in disk drive motor speed and secondly they prevent the read/write head's magnetic field from disturbing the ID Address field on sector writes. The Data field is also followed by some separation bytes. These two fields, ID and Data, along with the separation bytes are written to the track for each sector. So even though a single sided, single density diskette has 90K of DATA storage it actually contains many more bytes than that.

The Floppy Disk Controller Chip (FDC) controls the disk head movement, searches for the specified track and/or sector, converts parallel information from the console to serial data for the disk drive and converts serial data from the disk drive to parallel data for the Console. Since the disk drive head only reads and writes a bit at a time it is up to the FDC to assemble these bits into bytes. On a read 8 bits are assembled by the FDC and then transferred to the Console as a byte. When data is written to the diskette, a byte is passed to the FDC which in turn writes it out to the diskette a bit at a time. So, to read or write one sector of Data 2048 bits are transferred plus some additional bits for the Sync, Address Mark and CRC bytes.

When a read or write command is issued the FDC looks for an ID Address Mark. When found, the track address and sector address values are scanned for a match. If they do not match the search continues. If a match is found, a CRC check is made. If the CRC check fails the search continues. If the CRC check is OK then the FDC looks for the Data Address Mark. When found the data is read and the information is sent to the console a byte at a time. After the data is read a CRC check is made. If it fails an error message is sent to the console. In either case the command terminates and the controller tells the console the command is complete.

When a write is requested, the FDC, after finding the specified ID Address Mark field, will wait for the ID/DATA Separator field to pass and then write the sync bytes followed by the Data Address Mark, Data and CRC bytes. On a verify, Diags will read the last sector written and compare it to the buffer it was written from. If everything is OK Diags continues with the next operation. If is not OK it will try to verify it again, if it can't verify it Diags will return the "Bad Compare on a Write Verify" error message.

If the FDC can not find the proper ID field within 5 revolutions during a read or write it returns a Record Not Found error to Diags. Diags will then attempt the read or write 5 to 10 more times before it returns with an error. If this happens Diags will return the "Record Not Found on a Read" or "Record Not Found on a Write" error message.



INTRODUCTION TO FLOPPY DISK CONTROLLERS Continued

Single density data is recorded on a diskette with a technique called Frequency Modulation (FM). This self clocking code resists phase shifts and clock variations. Each Data Mark (bit cell) contains a clock pulse, at the leading edge, and an optional data pulse. If a bit is 0 then the Data Mark does not contain a data pulse. If a bit is a 1 then the Data Mark contains a data pulse. (see FM diagram)

Double density data is recorded on a diskette with a technique called Modified Frequency Modulation (MFM). If a bit is 1 the Data Mark contains a data pulse. If a bit is 0 then the Data Mark does not contain a data pulse. If there are two Data Marks in a row that do not contain data pulses then a clock pulse is generated at the leading of the second Data Mark. (see MFM diagram)

The ID and Data Address Marks (see pages 24 and 25) are special bytes which do not follow the standard FM or MFM encoding technique. These data bytes have 2 clock pulses missing in the middle of each byte. They indicate to the controller that an ID or Data field has been detected and to byte synchronize the controller.

The single density disk format is shown on page 24. This information is written to the diskette when it is initialized. When a sector is rewritten (updated) only the section between Read/Write Sector and End Read/Write Sector is written. The format starts with an Index Gap of 12 bytes.

This is followed by the ID Syno bytes, ID Address Mark, Address and ID CRC Bytes. The start of the ID field has 6 zeros to synchronize the disk controller Data Separator to the bit level. These syno bytes are followed by an ID Address Mark (>FE) which specifies the start of the ID field. This field contains the track address, side number, sector address and length of the sector. This field is terminated with 2 Cyclic Redundancy Check bytes used to verify information correctness of the ID field. The ID field is followed by 11 gap bytes as a separator from the Data field. Due to disk drive motor speed variations this gap may vary when a sector is rewritten. Following the separator bytes is the Data field. This field is composed of 6 syno bytes, a Data Address Mark (>FB) and then 256 bytes of data. This field is also terminated by 2 bytes of CRC data followed by 36 bytes of >FF. Each data field is separated from the next ID field by these 36 bytes. This protects the following ID field after writing the previous sector. The information in this paragraph is written 9 times in each track, once per sector.

After the last sector, there is an additional gap of 240 >FF bytes. This gap may vary by +- 32 bytes due to motor speed variations when the diskette is initialized.

The double density disk format is shown on page 25. This format starts with an Index Gap of 32 >4E bytes.

This is followed by the ID Syno bytes, ID Address Mark, Address and ID CRC Bytes. The start of the ID field has 12 zeros to synchronize the disk controller Data Separator to the bit level. These syno bytes are followed by three >A1 bytes which are necessary for MFM recording. Next comes an ID Address Mark (>FE) which specifies the start of the ID field. This field contains the track address, side number, sector address and length of the sector. This field is terminated with 2 Cyclic Redundancy Check bytes used to verify information correctness of the ID field. The ID field is followed by 22 gap bytes as a separator from the Data field. Due to disk drive motor speed variations this gap may vary when a sector is rewritten. Following the separator bytes is the Data field. This field is composed of 12 syno bytes, another three >A1 bytes, a Data Address Mark (>FB) and then 256 bytes of data. This field is also terminated by 2 bytes of CRC data followed by 28 bytes of >4E. Each data field is separated from the next ID field by these 28 bytes. This protects the following ID field after writing the previous sector. The information in this paragraph is written 18 times in each track, once per sector.

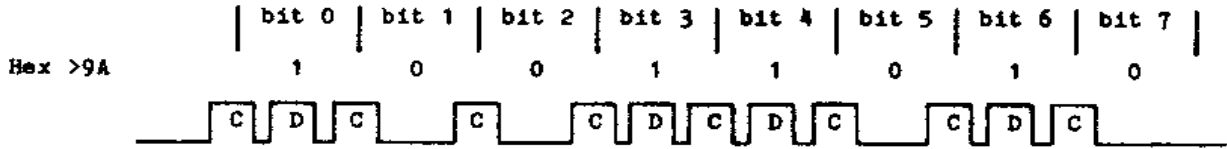
After the last sector, there is an additional gap of 190 >4E bytes. This gap may vary by +- 32 bytes due to motor speed variations when the diskette is initialized.

You can view both of these formats by using the Advanced Diagnostics Read Track command. The CTRL E and CTRL X keys will allow you the page through the different sections of the track (Buffer). FCTN = ASCII/Hex toggle will display the information in ASCII or Hexadecimal values.



INTRODUCTION TO FLOPPY DISK CONTROLLERS Continued

FH Recording

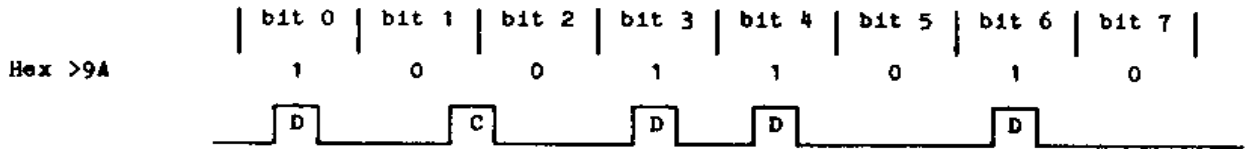


C = Clock bit D = Data bit

Rules:

1. Write data bits at center of bit cell if the bit is on "1".
2. Write clock bits at leading edge of bit cell.

MFM Recording

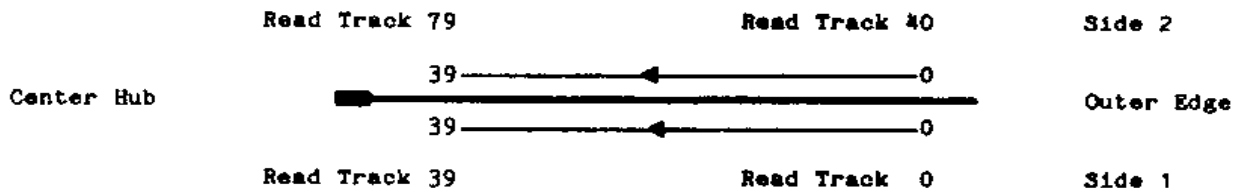


C = Clock bit D = Data bit

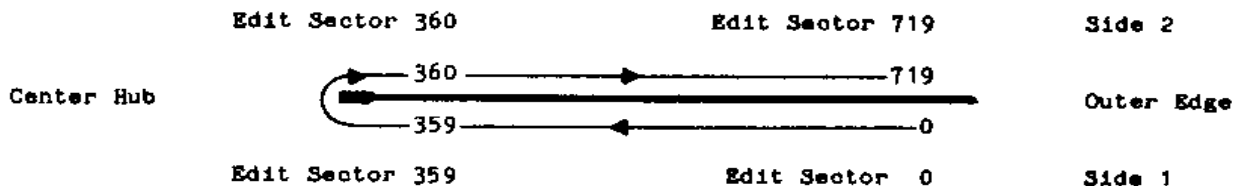
Rules:

1. Write data bits at center of bit cell if the bit is on "1".
2. Write clock bits at leading edge of bit cell IF: no data is in the previous bit cell and no data will be in the next bit cell.

Track Order on a Double Sided Disk



Sector Order on a Double Sided, Single Density Disk



INTRODUCTION TO FLOPPY DISK CONTROLLERS Continued

SINGLE DENSITY DISK FORMAT (FM)

The following information is displayed on your monitor when a Read Track command is executed on a single density diskette by Advanced Diagnostics.

| | | Start of Track | | |
|---------------------|-----------------------|-----------------|---|--|
| Name | # of bytes | Read Track Info | Description | |
| INDEX GAP | 12 | >FF | Index mark filler. | |
| — ID SYNC BYTES | 6 | >00 | Synchronizes controller for ID Mark. | |
| R ID ADDRESS MARK | 1 | >FE | Identifies this as an Address Field. | |
| e TRACK ADDRESS | 1 | Track # | >00 through >27 = tracks 0 - 39. | |
| p SIDE NUMBER | 1 | Side # | >00 = side 1 >01 = side 2. | |
| e SECTOR ADDRESS | 1 | Sector # | >00 through >08 = sectors 0 - 8. | |
| a SECTOR LENGTH | 1 | >01 | >01 = sector size of 256 bytes. | |
| t ID CRC | 2 | ID CRC Value | Used for error checking - ID Field. | |
| e ID/DATA SEPARATOR | 11 | >FF | Used to prevent Write Sector from erasing part of the ID Field. | |
| 9 | Read/Write Sector | | | |
| T DATA SYNC BYTES | 6 | >00 | Synchronizes controller for Data Mark | |
| i DATA ADDRESS MARK | 1 | >FB | Identifies this as a Data Field. | |
| m DATA | 256 | File Data | This is the File Data - (Edit Sector) | |
| e DATA CRC | 2 | Data CRC Value | Used for error checking - Data Field | |
| s | End Read/Write Sector | | | |
| — DATA/ID SEPARATOR | 36 | >FF | Used to prevent Write Sector from erasing part of the ID Field. | |
| END OF TRACK FILLER | 240 | >FF | # of bytes varies with Drive Motor speed. | |
| | | End of Track | | |

325 bytes x 9 Sectors = 2925
 2925 + INDEX GAP + END OF TRACK = 3177 bytes total per track

256 bytes x 9 Sectors = 2304 bytes of data storage per track

NOTE: Due to Write-splice time synchronization and/or noise the bytes in the INDEX GAP, ID/DATA SEPARATOR, DATA, DATA/ID SEPARATOR and END OF TRACK FILLER may vary from Read to Read. However, The ID ADDRESS MARK and the ADDRESS information will be correct. (Also see Read Track in the COMMANDS section of this manual)



INTRODUCTION TO FLOPPY DISK CONTROLLERS Continued

DOUBLE DENSITY DISK FORMAT (MFM)

The following information is displayed on your monitor when a Read Track command is executed on a double density diskette by Advanced Diagnostics.

| | | Start of Track | | | |
|---|-----------------------|-----------------|----------------|---|--|
| Name | # of bytes | Read Track Info | | Description | |
| INDEX GAP | 32 | >4E | | Index mark filler. | |
| R e p e a t e d 1 8 T i n e s | ID SYNC BYTES | 12 | >00 | Synchronizes controller for ID Mark. | |
| | ID ADDRESS MARK | 3 | >A1 | For MFM only. | |
| | TRACK ADDRESS | 1 | >FE | Identifies this as an Address Field. | |
| | SIDE NUMBER | 1 | Track # | >00 through >27 = tracks 0 - 39. | |
| | SECTOR ADDRESS | 1 | Side # | >00 = side 1 >01 = side 2. | |
| | SECTOR LENGTH | 1 | Sector # | >00 through >11 = sectors 0 - 17. | |
| | ID CRC | 2 | >01 | >01 = sector size of 256 bytes. | |
| | ID DATA SEPARATOR | 22 | ID CRC Value | Used for error checking - ID Field. | |
| | Read/Write Sector | | | Used to prevent Write Sector from erasing part of the ID Field. | |
| | DATA SYNC BYTES | 12 | >00 | Synchronizes controller for Data Mark | |
| | DATA ADDRESS MARK | 3 | >A1 | For MFM only. | |
| | DATA | 256 | >FB | Identifies this as a Data Field. | |
| | DATA CRC | 2 | File Data | This is the File Data - (Edit Sector) | |
| | End Read/Write Sector | | Data CRC Value | Used for error checking - Data Field | |
| | DATA/ID SEPARATOR | 28 | >4E | Used to prevent Write Sector from erasing part of the ID Field. | |
| | END OF TRACK FILLER | 190 | >4E | # of bytes varies with Drive Motor speed. | |
| | | | End of Track | | |

346 bytes x 18 Sectors = 6228
 6228 + INDEX GAP + END OF TRACK = 6450 bytes total per track

256 bytes x 18 Sectors = 4608 bytes of data storage per track

NOTE: Due to Write-splice time synchronization and/or noise the bytes in the INDEX GAP, ID/DATA SEPARATOR, DATA, DATA/ID SEPARATOR and END OF TRACK FILLER may vary from Read to Read. However, The ID ADDRESS MARK and the ADDRESS information will be correct. (Also see Read Track in the COMMANDS section of this manual)



INTRODUCTION TO FLOPPY DISK CONTROLLERS Continued

Head Step Times

Head Step Time is the duration of the track stepping pulses that are sent to the disk drive's head stepping motor from the floppy disk controller chip. These pulses are generally programmable in two ranges, depending on the clock rate for the chip. For a 1 MHz clock, such as the TI card, the pulses can be 6, 12, 20 or 30 milliseconds in length. For a 2 MHz clock the pulses can be 3, 6, 10 or 15 milliseconds in length.

If the pulses are too long, 15 or 30 ms, the disk drive stepping motor will chatter when it steps. This chattering can cause excessive wear on the motor and might cause it to prematurely fail. If the pulses are too short, 3 or 6 ms, the stepping motor may not step at all or may only partially step to the specified track. Usually when the step rate is too short Advanced Diagnostics will return an error message that has "...or Bad H/S" at the end of it. If this occurs use the Head Step command to select a new head step time for Diags to use.

Most disk drives will work fine at 10 ms. Some of the newer double sided half high drives will work best at 6 ms or 3 ms. The SEEKTEST Command File is a good test to see if the Head Step time selected is proper for your drives. As the Read/Write head steps in and out you should hear either a clean crisp clicking sound or very little, if any, sound for fast step times.

Set Head Step Time Guide

| PROBLEM | CAUSE | SOLUTION |
|---|---|--|
| Drive will not Seek, Read or Write. Stepping Motor chatters a lot. Head does not step. | Head Step Time is set too fast. (3 or 6 ms) | Select a slower Head Step Time (10 or 12 ms) and try the SEEKTEST again. |
| Drive may Read and Write but with a lot of bad sectors on a Format Verify. Drive sounds good. | Head Step Time is set too fast. | Select a slower Head Step Time and reformat a diskette. |
| Drive Seeks, Reads and Writes OK - no errors. When the Head Steps the drive sounds good. no chattering. | Head Step Time is set correctly. | ----- |
| Drive Seeks, Reads and Writes OK - no errors - but the Drive chatters some when the head steps. | Head Step Time is set too slow. (15 or 30 ms) | Select a faster Head Step Time (10 or 20 ms) and try the SEEKTEST again. |

Sector Interlace or Interleave

Sector Interlace or Interleave is the physical order of the sectors within a track. On every track the sectors are numbered 0 - 8 (>00 - >08) for single density and 0 - 17 (>00 - >11) for double density. The Interlace pattern determines where these sectors are on the track. They usually are not in numerical order (012345678) but are instead spaced around the track in a known pattern. Lets look at the Diags single density interlace pattern of 0 7 5 3 1 8 6 4 2. This pattern tells us that after reading sector 0, three sectors (7 5 3) will pass under the read/write head before sector 1 is in position to be read. Our timing test have shown us that in single density this interlace pattern provides the best results. While those three sectors are passing under the read/write head the Disk Controller DSR and Console are passing the bytes from sector 0. So, after the data has been passed, sector 1 is in position and we do not have to wait for the diskette to go all the way around once more before we can read sector 1.

Diags Single Density Interlace 0 7 5 3 1 8 6 4 2

Diags Double Density Interlace 0 11 4 15 8 1 12 5 16 9 2 13 6 17 10 3 14 7



APPENDIX - A**Advanced Diagnostics Floppy Disk Controller
and DSR Error Messages.**

When one of these Errors are generated by Advanced Diagnostics check the following items:
Drive door open - No diskette in drive - Selected Drive number does not exist in your system
Drive power not turned on - Not initialized or Bad floppy diskette - Ribbon and/or power
cables connected to the selected drive are bad - Head Step time set wrong for the selected
drive - Possible bad stepping motor in drive - Diskette not turning (bad motor or bad
floppy) - Diskette turning too fast or too slow, check Motor Speed - Dirty or clogged
Read/Write head - Cables, Dip Shunts, Termination Resistor packs wrong on a new drive
installation.

FDC Error Message**Indicates**

| | |
|---|--|
| No Diskette/Drive or Bad H/S | The disk drive has not set the ready line to the proper state (device not ready) or the Head Step time is too fast. |
| Seek Error or Bad H/S | The desired Track could not be found when the read/write head was stepping in or out or the Head Step time is too fast. |
| Record Not Found on a Read Record Not Found on a Write | The desired Track, Sector or Side could not be found on a Read or Write operation. |
| Lost Data on a Read Lost Data on a Write | A data byte was lost (not ready to be transferred) on a Read Sector, Write Sector, Read Address, Read Track, Write Track command. |
| Crc Error on a Read | An error was found in one or more of the ID fields or an error was found in the data on a Read Sector, Read Track or Read Address command. |
| Write Protected Disk | The write protect notch on the diskette is covered up. |

DSR Error Message**Indicates**

| | |
|-------------------------------|---|
| Bad DSR Parameter(s) | An out of range value was received for a Track number, Sector number, Density or the Selected Drive was not found. |
| Bad Device Name | An nonexistent device name was received. |
| Bad Open Attribute | One of the Open Attributes (file type, file name, protected file etc.) were wrong to match any of the files on the diskette. This error usually shows up when a wrong Command File name is input. |
| Illegal Operation | An Command File Input was requested from an invalid device for Input such as the Thermal Printer. |
| Out of Table or Buffer Space | The diskette is full or there are already 127 files on it. |
| Bad Compare on a Write Verify | The data in the Write buffer does not compare with the data that was written to the diskette. |
| Device Error | The diskette is not initialized or damaged, the power has been interrupted to the Peripherals, or the drive is bad. |
| File Access Error | The Command File requested is not a DIS/VAN 80 type file. |

APPENDIX - B

Advanced Diagnostics Command Error Messages

When one of these Errors are generated by Advanced Diagnostics you should check the proper syntax, spacing and range limits for the command.

| Diags Error Message | Indicates |
|-----------------------------|---|
| Bad command | The spelling or abbreviation for the command is wrong. |
| Parameter Not Found | One or more of the parameters for the command that the cursor stopped on is missing a space or is missing entirely. |
| Bad Parameter(s) | One or more of the parameters for the command that the cursor stopped on is incorrect or out of range. |
| Bad Drive Number | The drive number Selected is out of the 1 - 5 range. |
| Bad Step Rate | The Head Step time selected is not a valid step time for the Disk Controller Card in your system. |
| Bad Color(s) | One or more of the colors selected is not valid. |
| Bad Line Size | The Output Width is not in the 1 - 80 range. |
| Number of Sectors Too Large | The number of sectors for the Copy Read or Copy Write command is not in the 1 - 36 range. |
| File Not Found | The file requested for Find File is not on the Selected Drive. |

NOTE: Advanced Diagnostics will automatically place the cursor at the beginning of the command that caused the error.

APPENDIX - C

SECTOR 0 - THE VOLUME INFORMATION BLOCK - VIB

| Byte Nos. | Contents |
|-----------|--|
| 0 - 9 | 10 Character (max) Disk Name or Volume Name Unused characters = space character |
| 10 - 11 | Total Number of Formatted Sectors. On the TI 4A system 1 sector is often referred to as 1 Allocation Unit or AU. >0168 = SS/SD 360 sectors >02D0 = SS/DD 720 sectors >02D0 = DS/SD 720 sectors >05A0 = DS/DD 1440 sectors |
| 12 | Number of Sectors per Track >09 = 9 sectors per track >12 = 18 sectors per track |
| 13 - 15 | DSK - The letters DSK are used to signify to the disk manager that the disk has been initialized by a TI or compatible disk controller. |
| 16 | |
| 17 | Number of Tracks per Side >23 = 35 tracks per side >28 = 40 tracks per side |
| 18 | Number of Sides >01 = single sided SS >02 = double sided DS |
| 19 | Diskette Density >01 = single density SD >02 = double density DD |
| 20 - 55 | These bytes are reserved for future expansion. This is currently an unused area - all 0's |
| 56 - 255 | Allocation Bit Map - each bit represents 1 sector or AU - there are enough bits in this 200 byte area to map out 1600 256 byte sectors or 400K of storage, but currently only 360K or 1440 bits are used by a Double Density disk. 56 - 100 = are used by SS/SD - sectors 0 - 359 101 - 145 = are used by SS/DD - sectors 360 - 719 146 - 235 = are used by DS/SD - sectors 360 - 719 236 - 255 = are currently not used by any format. Note: After formatting, the unformatted sectors are marked as used, all bits on. (Byte no. - 56) * 8 = start of 8 sector group. ie: (56 - 56) * 8 = 0 sector numbers 0-7 (73 - 56) * 8 = 136 sector numbers 136-143 Sector No./8 + 56 = Byte no. remainder = Bit no. ie: 137/8 + 56 = 73.125 .125 * 8 = bit 1 34/8 + 56 = 4.25 .25 * 8 = bit 2 Each byte (8 bits) represents 8 sectors, one bit per sector. The bits are numbered from right to left and if the bit is on, 1, the sector is used. bit nos - 7 6 5 4 3 2 1 0 byte no 73 = 143 142 141 140 139 138 137 136 byte no 100 = 359 358 357 356 355 354 353 352 byte no 231 = 1407 1406 1405 1404 1403 1402 1401 1400 |



APPENDIX - D

SECTOR 0 - ALLOCATION BIT MAP TABLE

SS/SD
Sectors 0 - 359

SS/DD or DS/SD
Sectors 360 - 719

| Hex Value | >80 | >40 | >20 | >10 | >08 | >04 | >02 | >01 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Bit Number | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

| Hex Value | >80 | >40 | >20 | >10 | >08 | >04 | >02 | >01 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Bit Number | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Byte No.

| | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| 56 - | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 57 - | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 58 - | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| 59 - | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| 60 - | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 |
| 61 - | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 |
| 62 - | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 |
| 63 - | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 |
| 64 - | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 |
| 65 - | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 |
| 66 - | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 80 |
| 67 - | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 88 |
| 68 - | 103 | 102 | 101 | 100 | 99 | 98 | 97 | 96 |
| 69 - | 111 | 110 | 109 | 108 | 107 | 106 | 105 | 104 |
| 70 - | 119 | 118 | 117 | 116 | 115 | 114 | 113 | 112 |
| 71 - | 127 | 126 | 125 | 124 | 123 | 122 | 121 | 120 |
| 72 - | 135 | 134 | 133 | 132 | 131 | 130 | 129 | 128 |
| 73 - | 143 | 142 | 141 | 140 | 139 | 138 | 137 | 136 |
| 74 - | 151 | 150 | 149 | 148 | 147 | 146 | 145 | 144 |
| 75 - | 159 | 158 | 157 | 156 | 155 | 154 | 153 | 152 |
| 76 - | 167 | 166 | 165 | 164 | 163 | 162 | 161 | 160 |
| 77 - | 175 | 174 | 173 | 172 | 171 | 170 | 169 | 168 |
| 78 - | 183 | 182 | 181 | 180 | 179 | 178 | 177 | 176 |
| 79 - | 191 | 190 | 189 | 188 | 187 | 186 | 185 | 184 |
| 80 - | 199 | 198 | 197 | 196 | 195 | 194 | 193 | 192 |
| 81 - | 207 | 206 | 205 | 204 | 203 | 202 | 201 | 200 |
| 82 - | 215 | 214 | 213 | 212 | 211 | 210 | 209 | 208 |
| 83 - | 223 | 222 | 221 | 220 | 219 | 218 | 217 | 216 |
| 84 - | 231 | 230 | 229 | 228 | 227 | 226 | 225 | 224 |
| 85 - | 239 | 238 | 237 | 236 | 235 | 234 | 233 | 232 |
| 86 - | 247 | 246 | 245 | 244 | 243 | 242 | 241 | 240 |
| 87 - | 255 | 254 | 253 | 252 | 251 | 250 | 249 | 248 |
| 88 - | 263 | 262 | 261 | 260 | 269 | 268 | 267 | 266 |
| 89 - | 271 | 270 | 269 | 268 | 267 | 266 | 265 | 264 |
| 90 - | 279 | 278 | 277 | 276 | 275 | 274 | 273 | 272 |
| 91 - | 287 | 286 | 285 | 284 | 283 | 282 | 281 | 280 |
| 92 - | 295 | 294 | 293 | 292 | 291 | 290 | 289 | 288 |
| 93 - | 303 | 302 | 301 | 300 | 299 | 298 | 297 | 296 |
| 94 - | 311 | 310 | 309 | 308 | 307 | 306 | 305 | 304 |
| 95 - | 319 | 318 | 317 | 316 | 315 | 314 | 313 | 312 |
| 96 - | 327 | 326 | 325 | 324 | 323 | 322 | 321 | 320 |
| 97 - | 335 | 334 | 333 | 332 | 331 | 330 | 329 | 328 |
| 98 - | 343 | 342 | 341 | 340 | 339 | 338 | 337 | 336 |
| 99 - | 351 | 350 | 349 | 348 | 347 | 346 | 345 | 344 |
| 100 - | 359 | 358 | 357 | 356 | 355 | 354 | 353 | 352 |

Byte No.

| | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| 101 - | 367 | 366 | 365 | 364 | 363 | 362 | 361 | 360 |
| 102 - | 375 | 374 | 373 | 372 | 371 | 370 | 369 | 368 |
| 103 - | 383 | 382 | 381 | 380 | 379 | 378 | 377 | 376 |
| 104 - | 391 | 390 | 389 | 388 | 387 | 386 | 385 | 384 |
| 105 - | 399 | 398 | 397 | 396 | 395 | 394 | 393 | 392 |
| 106 - | 407 | 406 | 405 | 404 | 403 | 402 | 401 | 400 |
| 107 - | 415 | 414 | 413 | 412 | 411 | 410 | 409 | 408 |
| 108 - | 423 | 422 | 421 | 420 | 419 | 418 | 417 | 416 |
| 109 - | 431 | 430 | 429 | 428 | 427 | 426 | 425 | 424 |
| 110 - | 439 | 438 | 437 | 436 | 435 | 434 | 433 | 432 |
| 111 - | 447 | 446 | 445 | 444 | 443 | 442 | 441 | 440 |
| 112 - | 455 | 454 | 453 | 452 | 451 | 450 | 449 | 448 |
| 113 - | 463 | 462 | 461 | 460 | 459 | 458 | 457 | 456 |
| 114 - | 471 | 470 | 469 | 468 | 467 | 466 | 465 | 464 |
| 115 - | 479 | 478 | 477 | 476 | 475 | 474 | 473 | 472 |
| 116 - | 487 | 486 | 485 | 484 | 483 | 482 | 481 | 480 |
| 117 - | 495 | 494 | 493 | 492 | 491 | 490 | 489 | 488 |
| 118 - | 503 | 502 | 501 | 500 | 499 | 498 | 497 | 496 |
| 119 - | 511 | 510 | 509 | 508 | 507 | 506 | 505 | 504 |
| 120 - | 519 | 518 | 517 | 516 | 515 | 514 | 513 | 512 |
| 121 - | 527 | 526 | 525 | 524 | 523 | 522 | 521 | 520 |
| 122 - | 535 | 534 | 533 | 532 | 531 | 530 | 529 | 528 |
| 123 - | 543 | 542 | 541 | 540 | 539 | 538 | 537 | 536 |
| 124 - | 551 | 550 | 549 | 548 | 547 | 546 | 545 | 544 |
| 125 - | 559 | 558 | 557 | 556 | 555 | 554 | 553 | 552 |
| 126 - | 567 | 566 | 565 | 564 | 563 | 562 | 561 | 560 |
| 127 - | 575 | 574 | 573 | 572 | 571 | 570 | 569 | 568 |
| 128 - | 583 | 582 | 581 | 580 | 579 | 578 | 577 | 576 |
| 129 - | 591 | 590 | 589 | 588 | 587 | 586 | 585 | 584 |
| 130 - | 599 | 598 | 597 | 596 | 595 | 594 | 593 | 592 |
| 131 - | 607 | 606 | 605 | 604 | 603 | 602 | 601 | 600 |
| 132 - | 615 | 614 | 613 | 612 | 611 | 610 | 609 | 608 |
| 133 - | 623 | 622 | 621 | 620 | 619 | 618 | 617 | 616 |
| 134 - | 631 | 630 | 629 | 628 | 627 | 626 | 625 | 624 |
| 135 - | 639 | 638 | 637 | 636 | 635 | 634 | 633 | 632 |
| 136 - | 647 | 646 | 645 | 644 | 643 | 642 | 641 | 640 |
| 137 - | 655 | 654 | 653 | 652 | 651 | 650 | 649 | 648 |
| 138 - | 663 | 662 | 661 | 660 | 659 | 658 | 657 | 656 |
| 139 - | 671 | 670 | 669 | 668 | 667 | 666 | 665 | 664 |
| 140 - | 679 | 678 | 677 | 676 | 675 | 674 | 673 | 672 |
| 141 - | 687 | 686 | 685 | 684 | 683 | 682 | 681 | 680 |
| 142 - | 695 | 694 | 693 | 692 | 691 | 690 | 689 | 688 |
| 143 - | 703 | 702 | 701 | 700 | 699 | 698 | 697 | 696 |
| 144 - | 711 | 710 | 709 | 708 | 707 | 706 | 705 | 704 |
| 145 - | 719 | 718 | 717 | 716 | 715 | 714 | 713 | 712 |



DS/DD
Sectors 720 - 1440

| Hex Value | >80 | >40 | >20 | >10 | >08 | >04 | >02 | >01 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Bit Number | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

| Hex Value | >80 | >40 | >20 | >10 | >08 | >04 | >02 | >01 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Bit Number | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

| Byte No. | 727 | 726 | 725 | 724 | 723 | 722 | 721 | 720 |
|----------|------|------|------|------|------|------|------|------|
| 146 | 727 | 726 | 725 | 724 | 723 | 722 | 721 | 720 |
| 147 | 735 | 734 | 733 | 732 | 731 | 730 | 729 | 728 |
| 148 | 743 | 742 | 741 | 740 | 739 | 738 | 737 | 736 |
| 149 | 751 | 750 | 749 | 748 | 747 | 746 | 745 | 744 |
| 150 | 759 | 758 | 757 | 756 | 755 | 754 | 753 | 752 |
| 151 | 767 | 766 | 765 | 764 | 763 | 762 | 761 | 760 |
| 152 | 775 | 774 | 773 | 772 | 771 | 770 | 769 | 768 |
| 153 | 783 | 782 | 781 | 780 | 779 | 778 | 777 | 776 |
| 154 | 791 | 790 | 789 | 788 | 787 | 786 | 785 | 784 |
| 155 | 799 | 798 | 797 | 796 | 795 | 794 | 793 | 792 |
| 156 | 807 | 806 | 805 | 804 | 803 | 802 | 801 | 800 |
| 157 | 815 | 814 | 813 | 812 | 811 | 810 | 809 | 808 |
| 158 | 823 | 822 | 821 | 820 | 819 | 818 | 817 | 816 |
| 159 | 831 | 830 | 829 | 828 | 827 | 826 | 825 | 824 |
| 160 | 839 | 838 | 837 | 836 | 835 | 834 | 833 | 832 |
| 161 | 847 | 846 | 845 | 844 | 843 | 842 | 841 | 840 |
| 162 | 855 | 854 | 853 | 852 | 851 | 850 | 849 | 848 |
| 163 | 863 | 862 | 861 | 860 | 859 | 858 | 857 | 856 |
| 164 | 871 | 870 | 869 | 868 | 867 | 866 | 865 | 864 |
| 165 | 879 | 878 | 877 | 876 | 875 | 874 | 873 | 872 |
| 166 | 887 | 886 | 885 | 884 | 883 | 882 | 881 | 880 |
| 167 | 895 | 894 | 893 | 892 | 891 | 890 | 889 | 888 |
| 168 | 903 | 902 | 901 | 900 | 899 | 898 | 897 | 896 |
| 169 | 911 | 910 | 909 | 908 | 907 | 906 | 905 | 904 |
| 170 | 919 | 918 | 917 | 916 | 915 | 914 | 913 | 912 |
| 171 | 927 | 926 | 925 | 924 | 923 | 922 | 921 | 920 |
| 172 | 935 | 934 | 933 | 932 | 931 | 930 | 929 | 928 |
| 173 | 943 | 942 | 941 | 940 | 939 | 938 | 937 | 936 |
| 174 | 951 | 950 | 949 | 948 | 947 | 946 | 945 | 944 |
| 175 | 959 | 958 | 957 | 956 | 955 | 954 | 953 | 952 |
| 176 | 967 | 966 | 965 | 964 | 963 | 962 | 961 | 960 |
| 177 | 975 | 974 | 973 | 972 | 971 | 970 | 969 | 968 |
| 178 | 983 | 982 | 981 | 980 | 979 | 978 | 977 | 976 |
| 179 | 991 | 990 | 989 | 988 | 987 | 986 | 985 | 984 |
| 180 | 999 | 998 | 997 | 996 | 995 | 994 | 993 | 992 |
| 181 | 1007 | 1006 | 1005 | 1004 | 1003 | 1002 | 1001 | 1000 |
| 182 | 1015 | 1014 | 1013 | 1012 | 1011 | 1010 | 1009 | 1008 |
| 183 | 1023 | 1022 | 1021 | 1020 | 1019 | 1018 | 1017 | 1016 |
| 184 | 1031 | 1030 | 1029 | 1028 | 1027 | 1026 | 1025 | 1024 |
| 185 | 1039 | 1038 | 1037 | 1036 | 1035 | 1034 | 1033 | 1032 |
| 186 | 1047 | 1046 | 1045 | 1044 | 1043 | 1042 | 1041 | 1040 |
| 187 | 1055 | 1054 | 1053 | 1052 | 1051 | 1050 | 1049 | 1048 |
| 188 | 1063 | 1062 | 1061 | 1060 | 1059 | 1058 | 1057 | 1056 |
| 189 | 1071 | 1070 | 1069 | 1068 | 1067 | 1066 | 1065 | 1064 |
| 190 | 1079 | 1078 | 1077 | 1076 | 1075 | 1074 | 1073 | 1072 |

| Byte No. | 1087 | 1086 | 1085 | 1084 | 1083 | 1082 | 1081 | 1080 |
|----------|------|------|------|------|------|------|------|------|
| 191 | 1087 | 1086 | 1085 | 1084 | 1083 | 1082 | 1081 | 1080 |
| 192 | 1095 | 1094 | 1093 | 1092 | 1091 | 1090 | 1089 | 1088 |
| 193 | 1103 | 1102 | 1101 | 1100 | 1099 | 1098 | 1097 | 1096 |
| 194 | 1111 | 1110 | 1109 | 1108 | 1107 | 1106 | 1105 | 1104 |
| 195 | 1119 | 1118 | 1117 | 1116 | 1115 | 1114 | 1113 | 1112 |
| 196 | 1127 | 1126 | 1125 | 1124 | 1123 | 1122 | 1121 | 1120 |
| 197 | 1135 | 1134 | 1133 | 1132 | 1131 | 1130 | 1129 | 1128 |
| 198 | 1143 | 1142 | 1141 | 1140 | 1139 | 1138 | 1137 | 1136 |
| 199 | 1151 | 1150 | 1149 | 1148 | 1147 | 1146 | 1145 | 1144 |
| 200 | 1159 | 1158 | 1157 | 1156 | 1155 | 1154 | 1153 | 1152 |
| 201 | 1167 | 1166 | 1165 | 1164 | 1163 | 1162 | 1161 | 1160 |
| 202 | 1175 | 1174 | 1173 | 1172 | 1171 | 1170 | 1169 | 1168 |
| 203 | 1183 | 1182 | 1181 | 1180 | 1179 | 1178 | 1177 | 1176 |
| 204 | 1191 | 1190 | 1189 | 1188 | 1187 | 1186 | 1185 | 1184 |
| 205 | 1199 | 1198 | 1197 | 1196 | 1195 | 1194 | 1193 | 1192 |
| 206 | 1207 | 1206 | 1205 | 1204 | 1203 | 1202 | 1201 | 1200 |
| 207 | 1215 | 1214 | 1213 | 1212 | 1211 | 1210 | 1209 | 1208 |
| 208 | 1223 | 1222 | 1221 | 1220 | 1219 | 1218 | 1217 | 1216 |
| 209 | 1231 | 1230 | 1229 | 1228 | 1227 | 1226 | 1225 | 1224 |
| 210 | 1239 | 1238 | 1237 | 1236 | 1235 | 1234 | 1233 | 1232 |
| 211 | 1247 | 1246 | 1245 | 1244 | 1243 | 1242 | 1241 | 1240 |
| 212 | 1255 | 1254 | 1253 | 1252 | 1251 | 1250 | 1249 | 1248 |
| 213 | 1263 | 1262 | 1261 | 1260 | 1259 | 1258 | 1257 | 1256 |
| 214 | 1271 | 1270 | 1269 | 1268 | 1267 | 1266 | 1265 | 1264 |
| 215 | 1279 | 1278 | 1277 | 1276 | 1275 | 1274 | 1273 | 1272 |
| 216 | 1287 | 1286 | 1285 | 1284 | 1283 | 1282 | 1281 | 1280 |
| 217 | 1295 | 1294 | 1293 | 1292 | 1291 | 1290 | 1289 | 1288 |
| 218 | 1303 | 1302 | 1301 | 1300 | 1299 | 1298 | 1297 | 1296 |
| 219 | 1311 | 1310 | 1309 | 1308 | 1307 | 1306 | 1305 | 1304 |
| 220 | 1319 | 1318 | 1317 | 1316 | 1315 | 1314 | 1313 | 1312 |
| 221 | 1327 | 1326 | 1325 | 1324 | 1323 | 1322 | 1321 | 1320 |
| 222 | 1335 | 1334 | 1333 | 1332 | 1331 | 1330 | 1329 | 1328 |
| 223 | 1343 | 1342 | 1341 | 1340 | 1339 | 1338 | 1337 | 1336 |
| 224 | 1351 | 1350 | 1349 | 1348 | 1347 | 1346 | 1345 | 1344 |
| 225 | 1359 | 1358 | 1357 | 1356 | 1355 | 1354 | 1353 | 1352 |
| 226 | 1367 | 1366 | 1365 | 1364 | 1363 | 1362 | 1361 | 1360 |
| 227 | 1375 | 1374 | 1373 | 1372 | 1371 | 1370 | 1369 | 1368 |
| 228 | 1383 | 1382 | 1381 | 1380 | 1379 | 1378 | 1377 | 1376 |
| 229 | 1391 | 1390 | 1389 | 1388 | 1387 | 1386 | 1385 | 1384 |
| 230 | 1399 | 1398 | 1397 | 1396 | 1395 | 1394 | 1393 | 1392 |
| 231 | 1407 | 1406 | 1405 | 1404 | 1403 | 1402 | 1401 | 1400 |
| 232 | 1415 | 1414 | 1413 | 1412 | 1411 | 1410 | 1409 | 1408 |
| 233 | 1423 | 1422 | 1421 | 1420 | 1419 | 1418 | 1417 | 1416 |
| 234 | 1431 | 1430 | 1429 | 1428 | 1427 | 1426 | 1425 | 1424 |
| 235 | 1439 | 1438 | 1437 | 1436 | 1435 | 1434 | 1433 | 1432 |



| Byte Nos. | Contents |
|-----------|--|
| 0 - 1 | Pointer to Alphabetically 1st File Descriptor Record Sector Number |
| 2 - 3 | Pointer to Alphabetically 2nd File Descriptor Record Sector Number |
| 4 - 5 | Pointer to Alphabetically 3rd File Descriptor Record Sector Number |
| 5 - 6 | Pointer to Alphabetically 4th File Descriptor Record Sector Number |
| .. - .. | Pointer to Alphabetically ... File Descriptor Record Sector Number |

The two byte values in this table point to the sector number that contains the File Descriptor Record or File Header (File Name). These pointers are placed in this table according to the alphabetical order of the File Names. (see Sector 2 - xx description)

There is enough room in this record for 127 File Header Pointers. This is what limits the disk capacity to 127 file names. After the format routine has formatted the tracks it writes the VIB to sector 0 and then writes this sector with all 0's in it.

As files are added to the disk the pointers in this table are sorted and the sector is rewritten. When a file is deleted from the disk its pointer is removed from this table, the table is adjusted and rewritten, and the sectors that the file resided in are released from the Allocation Bit Map in sector 0. The File Header and the file's data remain intact until another file or additional data is written to the disk in the sectors that the deleted file resides in.

If you change the order of the pointers so they are out of alphabetical order some of the File Headers might not be found during the binary search for the file name (FILE NOT FOUND ERROR). If the list is out of order the File Names will also be cataloged out of alphabetical order. If you duplicate some of the pointers then the File names will also appear more than once in a catalog listing. If a disk is copied with the disk manager file by file, not sector by sector, then, since the files are copied alphabetically, the pointers will be in numerical order.

1e: >0002 >0003 >0004 >0005 >0006 >0007 >0008 >0009 >000A >000B >000C >000D
>000E >000F >0010 >0011 etc.

Also if the first 2 bytes equal >0000 but the following bytes contain pointers to the File Headers then the file names will NOT show up when the disk is cataloged BUT the files can still be located with OLD, OPEN, LOAD AND RUN, RUN PROGRAM etc.

The easiest way to Restore a deleted file is to insert the File Header's sector pointer back into this table where it alphabetically belongs and then, using the disk manager, copy the file to another disk and then copy it back onto this disk. This will also properly restore the bits in the Allocation Bit Map to remark the sectors as used.

NOTE: This only works IF YOU HAVE NOT WRITTEN ANYTHING TO THE DISK SINCE THE FILE WAS DELETED!!

IF THIS SECTOR OR SECTOR 0 ARE MAPPED BAD DURING A FORMAT OPERATION THEN THE WHOLE DISK IS CONSIDERED TO BE BAD. THESE POINTERS MUST RESIDE IN THIS SECTOR AND THE BIT MAP MUST BE IN SECTOR 0 FOR THE DSR ROUTINE.

APPENDIX - F

SECTORS 2 - xx - FILE DESCRIPTOR RECORDS - FDR

| Byte Nos. | Contents | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------|---|-----------------------------|---------------------|------------|--------------------------|---------------|----------|--------------------------|-----------|---------------|---|----------------------|---------------------------|---------------|------|-----------------------------|------------|---------------|-----------|-----------------|---------------------|---------------|-----|----------|----------|------------------------|---|-----------------|--------------|
| 0 - 9 | 10 Character (max) File Name Unused characters = space character | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 - 11 | Reserved for future expansion not used - all 0's >00 >00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | <p>File Status Flags</p> <table border="1"> <thead> <tr> <th></th> <th>Bit No.</th> <th>On = 1</th> <th>Off = 0</th> </tr> </thead> <tbody> <tr> <td>>00 = Dis/Fix</td> <td>0</td> <td>Program file</td> <td>Data file</td> </tr> <tr> <td>>01 = Program</td> <td>1</td> <td>Internal (Binary)</td> <td>Display (ASCII)</td> </tr> <tr> <td>>02 = Int/Fix</td> <td>2</td> <td>Reserved</td> <td>Reserved</td> </tr> <tr> <td>>80 = Dis/Var</td> <td>3</td> <td>Write Protected</td> <td>Not Write Protected</td> </tr> <tr> <td>>82 = Int/Var</td> <td>4-6</td> <td>Reserved</td> <td>Reserved</td> </tr> <tr> <td>If Write Prot. add >08</td> <td>7</td> <td>Variable length</td> <td>Fixed length</td> </tr> </tbody> </table> | | Bit No. | On = 1 | Off = 0 | >00 = Dis/Fix | 0 | Program file | Data file | >01 = Program | 1 | Internal (Binary) | Display (ASCII) | >02 = Int/Fix | 2 | Reserved | Reserved | >80 = Dis/Var | 3 | Write Protected | Not Write Protected | >82 = Int/Var | 4-6 | Reserved | Reserved | If Write Prot. add >08 | 7 | Variable length | Fixed length |
| | Bit No. | On = 1 | Off = 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >00 = Dis/Fix | 0 | Program file | Data file | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >01 = Program | 1 | Internal (Binary) | Display (ASCII) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >02 = Int/Fix | 2 | Reserved | Reserved | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >80 = Dis/Var | 3 | Write Protected | Not Write Protected | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >82 = Int/Var | 4-6 | Reserved | Reserved | | | | | | | | | | | | | | | | | | | | | | | | | | |
| If Write Prot. add >08 | 7 | Variable length | Fixed length | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | <p>Maximum Number of Records per Sector or AU</p> <p>This byte equals the sector size (256 bytes) divided by the record length (>100/>50 = >03 or 256/80 = 3 . Program files = >00 ie: Dis/Fix 40 = >06 Dis/Fix 60 = >04 Dis/Fix 80 = >03 etc.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 - 15 | <p>Total Number of Sectors Used</p> <p>This is the same as the directory or cataloged size minus 1. The value in this sector does not include this sector (the FDR).</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | <p>End of File Offset</p> <p>For Variable length files and Program files this byte indicates how many bytes of the last sector of the file are used. This byte also indicates what byte number the EOF marker is at. For Fixed length files this byte = >00.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | <p>Logical Record Length</p> <p>ie: Fixed or Variable 40 = >28 80 = >50 163 = >A3 254 = >FE</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 - 19 | <p>Number of Fixed Length Records or Number of Sectors Used by Variable Length Records.</p> <p>Note: The bytes are reversed so >0500 = >0005 (not used by Program files)</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 -27 | Reserved for future expansion - not used all 0's >0000 >0000 >0000 >0000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 - 255 | <p>Data Chain Pointer Blocks</p> <p>3 byte groups that point to the clusters of sectors used by a file and also indicate the highest logical offset (total number of sectors used so far).</p> <p>Note: The second byte in each cluster is split up into two nibbles and each nibble is joined to the other two bytes to form two three nibble pointers like this:</p> <pre> ss2 : ss1 of1 : ss3 of3 : of2 gets changed to: ss3 : ss2 : ss1 of3 : of2 : of1 </pre> <p>ie:</p> <table border="1"> <thead> <tr> <th></th> <th>Disk Reads</th> <th>Convert to</th> </tr> </thead> <tbody> <tr> <td>@ byte 28-30 - >2E 10 00</td> <td></td> <td>>02E 001</td> </tr> <tr> <td>@ byte 31-33 - >91 50 00</td> <td></td> <td>>091 005</td> </tr> </tbody> </table> <p>the cluster starts at sector number</p> <table border="1"> <thead> <tr> <th></th> <th>with total offset of</th> <th>so Find File will display</th> </tr> </thead> <tbody> <tr> <td>>02E (46)</td> <td>>001</td> <td>Start End Offset 46 47 1</td> </tr> <tr> <td>>091 (145)</td> <td>>005</td> <td>145 148 5</td> </tr> </tbody> </table> <p>Note: If no clusters are indicated then this file is just a header.</p> | | Disk Reads | Convert to | @ byte 28-30 - >2E 10 00 | | >02E 001 | @ byte 31-33 - >91 50 00 | | >091 005 | | with total offset of | so Find File will display | >02E (46) | >001 | Start End Offset 46 47 1 | >091 (145) | >005 | 145 148 5 | | | | | | | | | | |
| | Disk Reads | Convert to | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| @ byte 28-30 - >2E 10 00 | | >02E 001 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| @ byte 31-33 - >91 50 00 | | >091 005 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | with total offset of | so Find File will display | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >02E (46) | >001 | Start End Offset 46 47 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >091 (145) | >005 | 145 148 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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