



SCIENTIFIC MICRO SYSTEMS

777 East Middlefield Road
Mountain View, CA 94043
(415) 964-5700

FW INSTALLATION AND TEST MANUAL

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Document No.: 3000500
Revision: F
Date: June 28, 1982

Applicable Product Numbers:
Installation and Test Program
Diskette 1001941 Rev. J and up

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I. INTRODUCTION

This manual describes the use, requirements and operation of the FW Installation and Test Program. The Installation and Test Program is a stand-alone program which provides the user with several utility (e.g. disk copy) and test functions.

The Installation and Test Program is delivered on a diskette. The diskette contains a file in RT-11 format which can be loaded (booted) using the boot program contained in the FW controller, plus all the source files which comprise the Installation and Test Program.

II. SYSTEM REQUIREMENTS AND NOTES

The Installation and Test Program will run on any DEC LSI-11 or PDP-11 series computer which has a minimum of 28K words of memory. The program assumes the default I/O registers and interrupt vector values for the FW controller and the console terminal as shown below:

177170 - 177172g	FW Controller I/O Register Addresses
264g	FW Controller Interrupt Vector Address
177560 - 177566g	Console Terminal I/O Register Addresses
60 - 66g	Console Terminal Interrupt Vector Addresses

The user may select different I/O addresses and vectors by editing file FWCON.MAC and re-assembling and re-linking the system. Instructions are included in the FWCON.MAC text as to file order and syntax. Also FWCON.MAC contains conditional statements which allow smaller versions of the program to be generated.

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The delivered diskette contains the following files in RT-11 directory format:

FWCON.MAC	assembly conditions and addresses
FWIT1.MAC	operating system
FWIT2.MAC	
FWIT3.MAC	
FORMAT.MAC	format module
TEST1.MAC	test modules
TEST2.MAC	
COPY1.MAC	copy modules
COPY2.MAC	
GETID.MAC	read device ID module
SCAN1.MAC	media scan and init data pattern module
SCAN2.MAC	
DEFEC1.MAC	flaw management modules
DEFEC2.MAC	
DEFEC3.MAC	
DEFEC4.MAC	
BOOT.MAC	bootstrap block
FWIT.MAP	load map
FWIT.SAV	executable memory image

An unexpected trap to 4g will cause the program to print "UNEXPECTED BUS ERROR". A trap to 10g will result in an error message of "ILLEGAL INSTRUCTION ENCOUNTERED".

The following instructions are not used by this program: MIPS, MFPS, RIT, SOB, XOR, or any others not executable on a simple LSI-11 (without floating point or memory management).

If there is a Winchester in the system, the drive must be allowed time to reach operational speed (varies from 15 to 90 seconds).

Lower case ASCII codes are converted to upper case by the keyboard monitor.

Control C will not be recognized unless "done" is set in the FW command and status register. This is done to keep from issuing an "init" to the controller when a write or format is in progress (Control C sends an initialize to the controller and re-starts the program).

III. PROGRAM LOADING (BOOTSTRAPPING)

The FW Installation and Test program can be loaded using the boot program present on the FW controller. This program is described in detail in the product OEM Manual. The program typically starts at address 173000g for the LSI-11 CPU, or 171000g for the PDP-11 CPU.

To boot the FW Installation and Test program using console ODT, the following is done:

- 1) place the diskette in drive 0 (or drive 1);
- 2) type 173000G
- 3) wait for the DRV? prompt (less than 30 seconds);
- 4) enter, in upper case, alphanumeric F0 (or F1).

The program will then be loaded. Please refer to the OEM manual for details if the program does not load correctly.

IV. PROGRAM OPERATION

The purpose of this program is to allow the user a means to exercise the capabilities of the FW controller, and to provide utilities which allow common functions to be performed easily. In addition, both controller and drive testing capabilities are provided.

The Installation and Test program can be run as a stand alone system or as an RT-11 program. If the program is run from RT-11 (i.e. RUN FW1:FWIT.SAV), it is possible to return to the monitor by typing a control C. On the other hand, if the program is run from the bootstrap provided on the diskette, a control C will cause the version number to be printed and the menu displayed (see the FW OEM Manual for bootstrap instructions).

When the program is started it will display the command menu as follows:

<u>MENU</u>	<u>COMMAND</u>	<u>COMMENT</u>
COPY.....	C.....	COPY CONTENTS
DEFECT.....	D.....	FLAW MANAGEMENT
FORMAT.....	F.....	INIT BLANK FLOPPY
FORMAT.....	O.....	INIT BLANK WINI
BACKUP.....	B.....	SAVE CONTENTS
LOAD.....	L.....	RESTORE CONTENTS
WRITE.....	W.....	WRITE A BLOCK
READ.....	R.....	READ A BLOCK
GETID.....	G.....	DISPLAY DEVICE ID
TEST.....	T.....	TEST SYSTEM
INIT.....	I.....	INIT DATA PATTERN
SCAN.....	S.....	READ FOR FLAWS
QA.....	Q.....	QA TEST MODE
ERROR.....	E.....	QA TEST ERRORS

When the program is ready to accept a command, the user will be prompted.

SELECT COMMAND:

A command is selected by typing the command letter followed by a carriage return. A carriage return by itself will display the menu. After a command letter is entered, no further entries will be necessary until the next prompt is issued. Typing any illegal character will result in the command prompt being reissued. A carriage return terminates an entry. Back space is recognized for editing (also RUBOUT). Control C aborts most operations.

Upon entry of a valid command letter, the current parameters for that command are displayed. An example of a parameter is a sector number. If the parameters as displayed are what the user wants, then he responds affirmatively to the CONTINUE AS SPECIFIED prompt. However, if the user wishes to change some parameters, he responds negatively. The system will then prompt for each of the parameters associated with that command. If the user wishes to change some, but not all, of the parameters, a carriage return after the prompt will leave the parameter unchanged. A detailed explanation of each command is included in this manual. Warnings and reminders are issued, where pertinent, to simplify the use of the program. If no errors occur, the command prompt is reissued, else the error is detailed for the user before the prompt is reissued. Retries are enabled except during testing. This program executes in the FW extended mode. Many command prompts list the range of user inputs in parentheses. Appendix A lists the error codes.

Upon the selection of a Winchester for the first time, for any function, the user may be prompted for details concerning the exact Winchester in use. After the user has answered the prompt once, it is not reissued unless the program is re-initialized. A list of drives supported is printed and the user is asked for an entry. A zero or lone carriage return entry tells the system no Winchester is available.

V. FUNCTIONS

The following paragraphs explain how to use each of the functions provided by the FW Installation and Test program. The general operation of all commands is similar. A no response to the CONTINUE AS SPECIFIED (Y OR N)? prompt allows you to change the parameter values. A yes response allows the command to continue. A carriage return by itself will leave a parameter unchanged.

The FW Installation and Test program is, to a large degree, self explanatory. Therefore, in the following paragraphs, no attempt has been made to list all of the possible prompts and messages. Only those prompts which require explanation have been detailed.

A. COPY

The program displays the current parameters.

```
FROM DEVICE=X, CYLINDER=X, HEAD=X, SECTOR=X, RECORDS=X
RETRY=ENABLED
```

```
TO DEVICE=X, CYLINDER=X, HEAD=X, SECTOR=X
```

The device is F0, F1, W0, or W1. The cylinder, head and sector specify the first disk address associated with the COPY command. "Records" indicates the number of sectors to copy from one device to the other.

Since floppy cylinder 0 is a special format on IBM diskettes, reference to this cylinder is treated in a special manner.

For a copy from one IBM diskette to another, cylinder 0 is reproduced exactly. In the case of RX02, cylinder 0 is skipped and the copy begins at cylinder 1.

After the parameters are displayed, the user is prompted to continue.

```
CONTINUE AS SPECIFIED (Y OR N)?
```

If an "N" is entered, the user is prompted to specify new parameters. Parameters are prompted for as follows:

```
FROM DEVICE (F0, F1, W0, W1)?
```

A carriage return will leave the current device unchanged. Any illegal entry will cause the device prompt to be reissued. The command is not aborted.

```
FROM CYLINDER (0-MAX)?
```

Enter a decimal number of the starting cylinder. Max is the highest track address (76 for full size floppy). If a carriage return alone is entered, the parameter is not changed. Normally the starting cylinder =0. Other starting cylinders are provided for limited backup of a Winchester to a floppy.

FROM HEAD (0-MAX)?

Enter a decimal number of the starting head. Max is the highest head address (0 for SA800, 1 for SA850). Entry of a carriage return alone leaves the current parameter unchanged. Usually the starting head = 0 unless a special copy function is to be performed.

FROM SECTOR (1-MAX)?

Enter a decimal number of the starting sector. Max is the highest sector address on a given track. A carriage return alone leaves the parameter unchanged. Usually the starting sector = 1 unless a special copy function is to be performed.

NUMBER OF SECTORS TO TRANSFER (0-65535)?

Enter a decimal number terminated by a carriage return. If a zero is entered, the maximum number of sectors is transferred. If a number greater than the max possible is entered, the system transfers the max number possible and stops (no error is flagged).

TO DEVICE (F0, F1, W0, W1)?

Enter F0, F1, W0 or W1. A carriage return alone leaves the parameter unchanged. An illegal entry causes the device prompt to be reissued.

TO CYLINDER (0-MAX)?

Enter a decimal string terminated by a carriage return. Usually cylinder = 0 except when a special copy function is to be performed. A carriage return alone leaves the old parameter unchanged.

TO HEAD (0-MAX)?

Enter a decimal string terminated by a carriage return. Normally head = 0. A carriage return alone leaves the parameter unaltered.

TO SECTOR (1-MAX)?

Enter a decimal string terminated by a carriage return. Sector usually is set to one. A carriage return alone will leave the old parameter unchanged.

The program builds new parameter tables and displays the updated parameters. The user is again prompted to continue.

If a flawed sector is encountered on the Winchester, it is skipped over (doesn't abort command).

When the system is initialized (at boot time) the parameter tables are defaulted to copy the entire contents of floppy 0 to floppy 1, since this is the most common use of the copy command. Under normal use, these parameters will not be altered. Only one parameter change is needed to copy the entire contents of a floppy to the Winchester or to fill a floppy from the Winchester.

A typical command sequence would be to type a "C" for copy in order to execute the copy routine. The parameters are displayed and the operator types "YES" to execute the command. Only formatted diskettes can be copied to or copied from. A Read ID function is executed prior to the copy in order to get density and sector length information. This cuts down on the number of user prompts. If the "to" and "from" devices have different sector lengths this program copies byte for byte, regardless. No data is lost unless a total storage difference exists. Sectors with deleted data address marks are skipped. The copy is automatically verified.

**** WARNING ****

When the 'from' device has a smaller sector length than the 'to' device, the copy command will not operate correctly unless the number of sectors transferred divided by the ratio [to sector length/from sector length] is a whole number.

For example, assume the 'to' sector length is 512 and the 'from' sector length is 128. The to/from ratio is thus $512/128 = 4$. Thus, any multiple of four sectors can be transferred without encountering the zero fill problem.

B. FORMAT

The format command allows the user to format both floppy and Winchester drives. Formatting of Winchester disks causes all data to be set to 0.

Formatting Floppies

Whenever a floppy is the device selected, the user may modify the following parameters:

Sector Length	The sector length is the number of bytes in each sector. The sector length will effect floppy capacity and the number of sectors per track. Sector lengths can be 128, 256, 512 or 1024 bytes.
Density	The density can be IBM/RX01 single density (FM encoding), IBM double density (MFM encoding), or RX02 double density (MFM modified encoding).
Cylinder and Head Offset	Offsets are used to compensate for delays in switching heads and stepping to the next cylinder, and thus improve performance. The offset is specified in numbers of sectors. An offset of 1 results in no compensation. The offset specified here is a physical offset (i.e. the disk will be formatted differently depending on the offsets selected).
	SMS recommends offsets of 1 for both the head and cylinder offsets since logical offsets have been traditionally used on the floppy. See the product OEM Manual for details on head and step offsets.

The following offsets and interleaves are recommended:

<u>Drive</u>	<u>Sector Length</u>	<u>Interleave</u>	<u>Head Offset</u>	<u>Cylinder Offset</u>
SA1000	1	1	2	8
	1R	1	2	7
	* 2	1	2	4
	2R	1	2	4
SA4000	1	Not a recommended sector length.		
	1R	2	3	16
	* 2	2	2	9
	2R	1	2	9
MRX101	1	2	2	11
	1R	1	2	11
	* 2	2	2	6
	2R	1	2	6
Q2000	1	1	2	1
	1R	1	2	1
	* 2	1	2	1
	2R	1	2	1

* SMS recommended format

For drives not listed please refer to the appropriate FW OEM manual. Installation and Test automatically defaults to the SMS recommended format.

Flaw Mapping

Whenever a Winchester is formatted, the user has the option of using flaw mapping. After all the parameters have been chosen, and the user has accepted them by responding with a yes (Y) to the "CONTINUE AS SPECIFIED?" prompt, the question "WINCHESTER FLAW MANAGEMENT (Y OR N)?" will be asked. If no flaw management is desired, a no response will begin the formatting operation and no flaw map information will be requested. If the response is yes, the formatting operation will be done, and upon completion, flaw map information will be asked for. See the Defect command for details.

C. GET ID

The user is prompted to select a device. An invalid entry will cause the parameter prompt to be reissued.

```
SELECT DEVICE (F0, F1, W0, W1)?
```

When the device is selected a read ID is performed and data displayed for the user.

```
CYLINDER=X, HEAD=X, SECTOR=X
BYTES/SECTOR=X
DENSITY=X
SINGLE(DOUBLE) SIDED DISKETTE
```

numbers given in decimal

The cylinder, head, and sector is where the ID was found.

D. READ AND WRITE

The read and write command allows the user to read/write the disk, starting at a specified physical disk address.

The read and write commands work in conjunction with one another so that you can read data, modify it and then write it back to the same disk address.

The user can select the cylinder, head and sector. Retries can be enabled or disabled, and, in the case of floppies, the soft (or logical) offset can be specified. A word count of 1 to 4096 can be specified.

Read Command

After the command has been entered and the parameters selected, the data is read and displayed on the terminal. Immediately following the data, a buffer address is displayed which points to the beginning of the buffer in memory. Using console ODT, the user can then make any desired modifications.

Write Command

After the command has been entered and the parameters selected, the data is requested, one word at a time, with the following prompts:

```
WORD COUNT=X
ENTER AN OCTAL WORD:
```

The word count starts at 0 and increments each time a word is entered. Enter an octal string terminated by a carriage return. A carriage return alone terminates the entry mode and writes the data to the disk. Illegal octal words decrement the word count and reprompt the user for a legal entry. Leading zeroes are ignored. If more than six digits are entered, only the last six are processed. As many sectors as are necessary to cover the word count (max=4096) are written.

If a lone CR is entered when the word count=0, the data last read, using the read command, is written back to the disk. In this case the same number of words as was last read are written.

E. BACKUP AND LOAD

The backup command is used to write the entire content of a Winchester to a set of floppies. The Load command is used to restore the data written on the floppies by the Backup command. The Backup command 'labels' the diskettes so that the diskettes can be loaded in any sequence.

The Backup and Load commands can backup or load a double sided diskette (1.25 MBytes) in approximately 40 seconds. An 8.9 MByte SA1004 Winchester can be thus fully backed up in less than 6 minutes.

When doing a backup, the floppy and Winchester must have the same number of bytes per sector. If they are not the same, the program will abort the operation and print the message SECTOR LENGTH MISMATCH.

When this occurs, use the GETID command to determine the sector length of the Winchester and then format the floppy to the correct sector length.

**** WARNING ****

The backup command on FW Installation and Test Version 1 and 2 is not compatible with Version 3 (V3). In Version 3 the backup time was decreased, resulting in an incompatibility. Thus, a backup done with V1 or V2 cannot be loaded with V3. In general, reload with the same version used to backup.

F. SCAN

The user is prompted to select the device.

SELECT DEVICE (F0, F1, W0, W1)?

An illegal response causes the prompt to be reissued.

The program reads all sectors of the device and displays the physical addresses of those which are unreadable. When a flawed sector (i.e. data CRC error) is found, one retry is attempted. If the retry was successful, the disk address and error number is printed. If the retry was not successful, then error correction is tried (if available). If the correction was successful then the disk address, error number and the word CORRECTABLE is printed. If the correction was not successful (or correction is not available), then the disk address, error number and the words NOT CORRECTABLE are printed.

In the case of the Winchester, only flaws not in the flaw map are displayed. A message is printed if no flaws are detected. Addresses are given in decimal.

SECTOR=X, HEAD=X, CYLINDER=X, ERROR=X
.
.
.

See Appendix A for meaning of the error number.

The user may wish to repeatedly scan a disk. The number of passes requested is prompted for. A 0 entry causes the scan function to loop endlessly. A lone carriage return defaults to one pass.

G. DEFECT

Overview

The Defect command is used to enter, update or display the Winchester flaw map information. The FW controller provides a complete flaw mapping facility (see the product OEM Manual). In order to use this facility, a map of the flawed sectors must be written onto the Winchester. This map is called the flaw map and it always begins at cylinder 0, head 0, sector 1, or cylinder 0, head 1, sector 1 on the Winchester.

Because the format (i.e. bytes/sector, gap sizes, etc.) is determined by the user, the drive manufacturers cannot specify in which sector a flaw occurs. Therefore, most drive manufacturers supply flaw data in the following manner:

Cylinder, head, byte from index (offset), flaw length in bits

The Defect command accepts this information (raw data) and computes which sectors are, in fact, flawed. It then writes the information to the drive as described in the Winchester Flaw Management section of the appropriate OEM Manual. The data it writes is called the processed flaw data. It also will store the raw (manufacturer's) flaw data on the disk, however the controller itself does not use the data.

On the FW controller there is a strap (or switch) which tells the controller to use or not use the flaw map. If the switch is set to NOT do flaw mapping, the controller will simply read and write all sectors on the disk.

If flaw mapping is selected, then whenever power is turned on or an initialize is done, the controller will read the flaw map from the disk into its internal memory. The controller then uses the processed flaw map information to skip any flawed sectors on the disk if logical addressing is being used.

If flaw mapping is enabled and no valid flaw map exists on the disk, the controller will report the error FLAW MAP NOT VALID.

Subcommands

The Defect command has six subcommands. These are described as follows:

- | | |
|-------|--|
| INIT | The INIT command creates a flaw map with no entries, other than the flaw map itself, and writes it on the selected Winchester. The INIT command, in conjunction with the UPDATE command, can be used to manually enter a flaw map. |
| ENTER | The ENTER command is used to enter flaw information as received from the drive manufacturer (i.e. the raw flaw data). The data is converted to actual sector numbers and then the flaw map is written to the disk. |
| MAP | The MAP command reads the flaw map from the selected Winchester and displays its content. |

- UPDATE** The UPDATE command is used to add flaws to an existing flaw map by specifying the cylinder, head and sector number of the flaw (i.e. not the raw flaw data).
- RETRIEVE** The RETRIEVE command is used to display the raw flaw data (the flaw information as received from the drive manufacturer). Note that the RETRIEVE command converts the flaw length from a bits to bytes (8 bits) value.
- AUTO** The AUTO command will scan a Winchester for flaws a selectable number of times. When the scans are completed, a flaw map is created and any flawed sectors are entered in the map. The AUTO command should be used only after the raw data has been entered since simply reading a disk may not detect weak spots on the disk (e.g. 25 or 50 reads may be required before an error is reported).

Setting Up the Flaw Map the First Time

The most convenient way to enter a flaw map the first time is to format the Winchester, using the format command, and specify Winchester flaw management. When this is done, the format program will use the Defect command routines to prompt for the required flaw mapping information.

<u>Primary Map</u>			<u>Secondary Map</u>		
<u>Cyl</u>	<u>Head</u>	<u>Sec</u>	<u>Cyl</u>	<u>Head</u>	<u>Sec</u>
0	0	2	0	1	2
0	0	3	0	1	3
0	0	4	0	1	4
0	0	5	0	1	5

After the map parameters have been specified, the program will prompt for flaws as follows:

```
FLAW=0
CYL,HD,OFFSET,LEN(BITS):
```

The user then responds by entering the flaw data as received from the manufacturer. For example:

```
CYL,HD,OFFSET,LEN(BITS): 134,0,13342,6
```

would specify cylinder 134, head 0 has a flaw 6 bits in length, starting 13342 bytes from the index mark. Entering flaw data is terminated by a lone carriage return (CR) to the prompt. A flaw count (FLAW=count) is maintained for user convenience. After all flaws have been entered, a CONTINUE AS SPECIFIED prompt will be issued. A no response will allow the user to change the map parameters. A yes response will result in the following message being printed if the flaw map indicator is not enabled or it is unknown:

```
ENABLE FLAW MAP INDICATOR ON FORMATTER
CONTINUE AS SPECIFIED (Y OR N)?
```

At this point, the user must insure that flaw mapping is enabled by checking the strap or switch on the formatter board, and then enter a yes response (the only valid response). The DEFECT program will then write the flaw map to the disk and issue an initialize to the controller to cause it to read the flaw map into its internal memory. The format operation will then be completed and the flaw data printed.

An alternative method of entering a flaw map on a disk which does not currently have a flaw map is to use the INIT command followed by the ENTER command. In this way the disk does not have to be formatted.

Updating a Flaw Map

If a flaw already exists on a disk and you simply want to add additional flawed sectors to it, the most convenient way to accomplish this is with the UPDATE command. The UPDATE command will prompt for cylinder, head and sector. The entry process is terminated by a lone carriage return response to the cylinder prompt. Also, if the user wishes to flaw an entire track (not cylinder), enter a -1 in response to the sector prompt.

Another method of updating a flaw map is to use the AUTO command. The AUTO command adds any sectors it finds to be bad to the flaw map.

** WARNING **

When the flaw map is updated files on the disk may be corrupted since the flawed sectors may have been part of an existing file.

Converting the Raw Manufacturer's Data to a Disk Address

The Defect program converts the raw flaw data to a disk address using information about the disk format, and using offset and interleave information from responses to prompts. It uses several different algorithms, depending on the disk drive, to do the conversion. In addition, it automatically compensates for any offsets and interleaves being used.

In order to insure absolute data integrity, the algorithms used may cause an entire track to be flawed even though the flaw is relatively small. This occurs when the flaw falls in an area of the sector which is critical. Also, if a flaw falls in an area of the sector which is not used, then no sector may be flawed.

For further information about the algorithms used, contact SMS.

Example:

Assume you have received a Shugart SA4004 drive and have optioned the drive according to the OEM Manual for 512 bytes/ sector with recovery. In addition, the following flaw map was attached to the drive.

SA4000 Media #1-SN A05465

TRK & HD	BYTE CT	ERR (BITS)
094 03	14016	46
105 02	14003	15

The following can be done to format the drive and enter the flaw map:

- 1) Boot the Installation and Test Program;
- 2) Select the format command and enter the following parameters:


```

W0  Select Winchester drive 0
2R  512 bytes/sector with recovery (assumes synthesizer is set to 560);
    to 560);
  2  Head offset
  9  Cylinder offset
  2  Interleave
  N  Allow scan to occur
      
```
- 3) Respond with yes to the Winchester flaw management question;
- 4) The drive will now be formatted (this takes a minutes or so);
- 5) Respond with yes to the use default map parameters question;
- 6) Enter the flaws as shown in the flaw map. Note: Byte CT is the offset. On the terminal this would be (user enters data underlined):


```

FLAW=0
CYL,HD,OFFSET,LEN (BITS):  94,3,14016,46<CR>

FLAW=1
CYL,HD,OFFSET,LEN (BITS):  105,2,14003,15<CR>

FLAW=2
CYL,HD,OFFSET,LEN (BITS):  <CR>

CONTINUE AS SPECIFIED (Y OR N)?  Y

ENABLE FLAW INDICATOR ON FORMATTER
      
```
- 7) At this point, the user must enable flaw mapping by installing a strap (or switch) on the formatter (FWD0104 formatter: install strap W14; FWD0101 formatter: open switch 5; FWD0106 formatter: install strap W4).

Now respond with yes to the CONTINUE AS SPECIFIED prompt;
- 8) The flaw map will be output to the terminal and the format operation will be completed.

H. TEST

The Test command is used to exercise and test the controller and/or drives. The Test command has five subtests which may be selected by the user. Once a Test is started, it typically will run endlessly, or until a fatal error is encountered or a control C is typed at the keyboard. Most tests can be run on any combination of drives. Drives to be tested are selected by responding to the prompt:

SELECT TEST DRIVE (F0, F1, W0, W1)?

A lone carriage return will select all drives, otherwise enter any combination of drives, separated by commas.

The subtests available are described below:

FW This test provides access to the controller's maintenance and drive test commands. The FW subtest has 5 subtests itself which are used primarily for the maintenance of floppy drives such as head alignment (see floppy maintenance manual). In addition, the controller's drive test can be run.

SEEK The seek test causes overlapped seeks to be executed on all selected drives continuously. At the end of each seek, verification is done to insure the seek was successful. If a seek error occurs, the drive heads are registered (i.e. a seek to track 0 using the track 0 indicator is done). If the registration is successful, the test will continue; otherwise it will be terminated for that drive only. Whenever a seek error occurs, a message is printed.

RANDOM The random test is a write/read test of all selected drives. The data written can be a specified pattern or random data. The test consists of seeking to a random disk address, writing a block of data, reading the block of data, and comparing the data. If the data is not the same, or an error is detected, a message is printed to notify the user. The test will continue as long as the error is not fatal (e.g. drive not ready). The random test allows the test options to be changed. See Change Test Options.

ORDER The order test is identical to the random test except the disk addresses written and read are sequential instead of random.

ERRORS A summary of errors is given. Errors are counted and passes are counted. If more than 65,535 errors or passes occur, a message is printed and the counter reset. This occurs even when printouts are disabled. If the pass counter overflows and is reset, the error count is not reset (and vice versa). One pass consists of a write, read and compare or one seek and its verification.

CHANGE TEST OPTIONS The Order test and Random test allow various test parameters to be changed and options to be selected. These options and parameters are described below.

Word Count: The user may specify the number of words to be written and read in each pass. Allowable values are 1 to 4096 words.

Use Deleted Data AM's: This applies to floppies only. When deleted data AM's are selected, all floppy writes will use deleted data AM's.

Use Logical Addressing: The FW controller allows disk addresses to be specified as either a physical address (i.e. sector, head, cylinder), or a logical address (a number from 1 to maximum number of sectors). The default is physical addressing. Answer yes to select logical addressing.

Enable Retry: Normally no retries are done when an error is detected. Answer yes to enable retries.

Use Soft Offsetting: Soft or logical offsetting is done on the floppies only. A yes response here will cause the controller to use a 1/4 track logical offset on all floppy accesses. Default is no offsetting.

Inhibit Error Message Printing: Error message printing can be disabled by responding with a Yes here. Default is messages are printed.

Inhibit Compare Failure Printouts: When a data compare failure occurs (i.e. the data read is not the same as the data written), the differences can be printed by responding with a yes here. This is effective only if the word count is set to the sector size. Default is to not print compare failures.

Enable Floppy ECC: The FWD0101 controller can correct single bit errors. Answer yes to enable correction. Default is no ECC on floppy.

Enable Winchester ECC: The FWD0101 controller supports Winchester Error Correction. Answer yes to enable correction to occur. Default is no correction is done.

Halt On Error: To stop testing whenever an error occurs, answer yes here. If an LSI-11 is the host, CPU ODT will be entered. The test can be continued by typing P.

Select Data Pattern: A carriage return results in random data being written, otherwise the last word (16 bits) entered is written instead of random data.

I. INIT

The INIT command is used to write the entire disk or diskette to a known data pattern. The drive and data pattern to be written can be selected. A lone carriage return to the data pattern prompt will cause the bit stream 011011011011... to be written on all sectors; otherwise the last 16 bits (one word) entered will be written.

J. QA (QUALITY ASSURANCE) TEST

The QA command provides the user with a stand alone drive evaluation test for Winchester disk drives. The test consists of five existing functions pointed out in prior sections of this manual (FORMAT, INIT, SCAN, RANDOM TEST, AND SEEK TEST). They are programmatically linked together and executed as listed above. Once the test is started, the user is immediately prompted as follows:

ENTER NUMBER OF PASSES FOR SCAN (1-65535)

Enter a decimal number terminated by a carriage return. If a zero is entered or a number greater than the maximum, the prompt will be reissued. A lone carriage return will default to a 15-pass scan.

ENTER NUMBER OF MINUTES FOR RANDOM TEST (0-65535)

Note: Insure Line Time Clock is enabled because the RANDOM and SEEK tests are timed tests and require LTC interrupts.

Enter a decimal number terminated by a carriage return. If a number greater than the maximum is entered, the prompt will be reissued. The decimal number entered represents the amount of time in minutes the RANDOM test will execute.

For example: 120 represents 120 minutes or two hours. If a zero is entered, the RANDOM test will be omitted from the overall QA test. A lone carriage return will default the execution of the RANDOM test to thirty minutes.

ENTER NUMBER OF MINUTES FOR SEEK TEST (0-65535)

Enter a decimal number terminated by a carriage return. If a number greater than the maximum is entered, the prompt will be reissued. The decimal number entered represents the amount of time in minutes the SEEK test will execute. If a zero is entered, the SEEK test will be omitted from the overall QA test. A lone carriage return will default the execution of the SEEK test to five minutes.

LOOP MODE (Y OR N)?

LOOP mode provides a continuous loop of testing. Refer to Figure 1 for outline of test loop. If a "Y" is entered, the following prompt is displayed:

ENTER LOOP COUNT (1-65535)

Enter a decimal number terminated by a carriage return. If a zero or a number greater than the maximum is entered, the prompt will be reissued. The decimal number entered represents the number of times the loop mode is executed. A lone carriage return will default to inhibit the loop mode. An "N" response or a valid decimal number entered for loop count will display the following:

<u>WINCHESTER TYPE</u>	<u>CODE</u>
SA4004	1
SA4008	2
MEMOREX 101	3
RESERVED	4
SA1002	5
SA1004	6
Q2010	7
Q2020	8
Q2030	9
Q2040	10

SELECT WINCHESTER TYPE (1-10):

Enter Winchester type code according to drive type under test. If a zero or a number greater than the maximum is entered, the prompt will be reissued. This prompt is not issued when the Winchester type is already known.

FORMATTING PROCESS INITIATED

DEVICE=W0, SECTOR LENGTH=XXX, DENSITY=WINCHESTER, HEAD OFFSET=X,
CYLINDER OFFSET=X, INTERLEAVE=X, SCAN ENABLED

WINCHESTER FLAW MANAGEMENT (Y OR N)?

Enter "Y" terminated by a carriage return to specify Winchester flaw management. If a flaw map already exists, the following will be displayed:

ENABLE FLAW MAP INDICATOR ON FORMATTER

CONTINUE AS SPECIFIED (Y OR N)?

Insure flaw indicator is enabled on Formatter. Then enter "Y" terminated by a carriage return. Immediately all flaw map parameters and flaw data will be displayed followed by

DATA PATTERN INITIATED

From this point on testing becomes automatic in the sequence shown in Figure 1.

If no flaw map exists, the following prompt will be displayed:

WARNING NO FLAW MAP EXISTS

FORMAT WILL CONTINUE AFTER THE FOLLOWING PROMPTS HAVE BEEN ANSWERED (SEE DEFECT COMMAND):

Once the latter is done, a one-pass scan is performed to complete the formatting process. From this point on, testing becomes automatic in sequence shown in Figure 1.

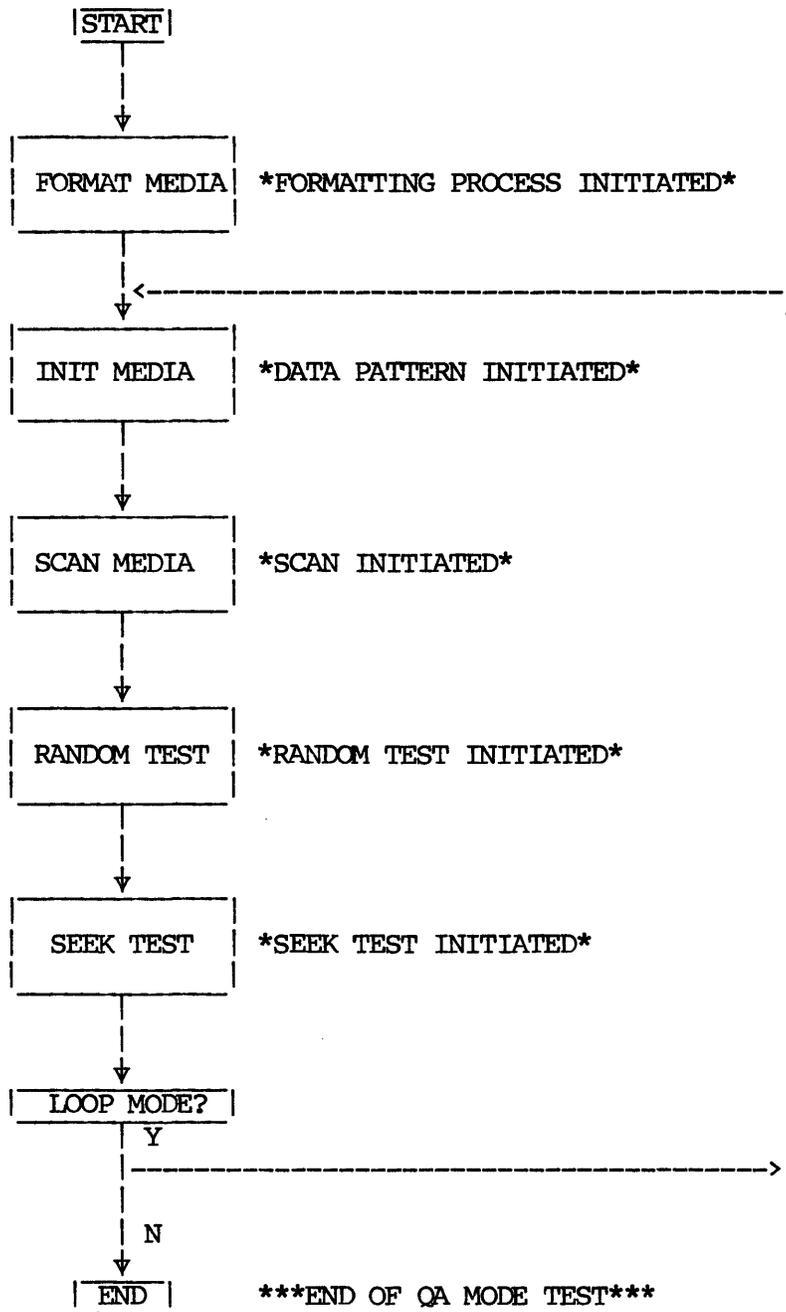


Figure 1. QA Loop Mode

K. ERROR (ERROR SUMMARY FOR QA TEST)

The error command is used in conjunction with the QA command. All errors that may have occurred through the duration of the QA test are saved in an error table according to error code and count. If any errors occurred during the test, the total count of all errors will be displayed at the end of the test as shown below:

```
***END OF QA MODE TEST***  
TOTAL ERRORS COUNTED=X
```

DONE

SELECT COMMAND:

To gain access of the error table, simply type an "E" terminated by a carriage return after SELECT COMMAND and a summary of all errors will be displayed along with the count of how many times the error occurred. See example below:

```
ERROR CODE=18, COUNT=5  
ERROR CODE=17, COUNT=1  
TOTAL ERRORS COUNTED=6
```

Refer to Appendix A for definition of error codes.

APPENDIX A. ERROR MESSAGES

ERROR
CODES

- 0 No error
- 1 (1) Illegal head address error.
The host passed the controller a head address outside the range of the drive being accessed. Head numbers start at 1.
- 2 (2) Illegal sector address error.
The host passed the controller a sector number outside the range of allowable values. Sector addressing starts at sector 1 with the largest sector number depending on drive type and format.
- 3 (3) Illegal cylinder address error.
The host passed the controller a cylinder number outside the range of allowable values of the drive being accessed. Cylinder numbers start at 0.
- 4 (4) Illegal logical address error.
Logical addresses range from 1 to the number of unflawed sectors on the disk. This error occurs when the host passes the controller an address outside of this range.
- 5 (5) Registration timeout error.
This error will occur when a Winchester does not report seek complete or the track 0 indication is not seen by the controller.
- On the Shugart SA4000 Series, this error can occur if strap C on the SA4000 control board is not installed.
- 6 (6) Reserved for internal controller uses.
(Illegal word count in compatible mode).
- 7 (7) Illegal drive type error.
If an attempt is made to access a Winchester and the formatter board drive type switches are set to a NOT USED position, this error will occur.
- 8 (10) Format error (sector length wrong).
This error will occur when sector length of the diskette does not agree with that passed to the controller by the host.
- 9 (11) Head select error.
If after one revolution the controller cannot find the desired sector, it will read an ID to determine if the head is correct. If it is not this error will be reported.
- 10 (12) Write protected error.
Host attempted to write or format a write protected diskette.
- 11 (13) Deleted data error.
Deleted data (control) AM read and the DL in the unit designator word was 0. If the DL bit is 1 the sector is skipped if it has a deleted data AM and no error is reported. This error applies to floppies only.

- 12 (14) Key word error.
Wrong key word passed by host on the Set Mode command.
- 13 (15) DMA error.
The controller detected a non-existent memory or parity error when attempting to access host memory.
- 14 (16) Disk overrun error.
The host attempted to read beyond the end of the disk.
- 15 (17) Head positioning or seek error.
After positioning the carriage over the desired cylinder if an error occurs, the controller reads an ID to determine if the cylinder is correct. If it is not, this error is reported.
- NOTE: If retries are not enabled, then, following a seek error, the host should issue an initialization to re-register the heads.
- 16 (20) No address marks on track error (floppy only).
The controller could not find any valid address marks on the track. An unformatted diskette will typically cause this error.
- 17 (21) Sector ID not found error.
The controller could not find the sector the host has requested. This would indicate media or drive problem.
- 18 (22) Data CRC or non-correctable ECC error.
After reading a sector, the CRC computed did not agree with that previously written. CRC errors often indicate media problems.
- 19 (23) Missing data address mark error.
The controller has found the desired sector but the data address mark is invalid or missing. This error will occur on any disk reads to a Winchester after a Write ID command since the write ID command will not write a valid data AM. This error may indicate drive or media problems.
- 20 (24) Data late or DMA latency error.
Host memory transfers were not occurring quickly enough to keep up with the required transfer rate of the disk. Another DMA device would typically have to be "hogging" the bus for this error to occur.
- 21 (25) Data transfer timeout error.
The controller will timeout any host memory access request after 20 msec.
- 22 (26) Diskette densities don't match error.
The density of the diskette being accessed does not agree with the value given to the controller by the host.
- 23 (27) Media not readable error (floppy only).
The controller is unable to maintain phase lock with the diskette data. This error implies media or drive problems.

- 24 (30) Drive not ready error.
The drive being accessed is not ready. If a diskette is not inserted or inserted backwards, the drive will not be ready.
- 25 (31) Drive in use error.
If a drive is busy seeking (as a result of a seek command) and another command is issued to that drive this error will be reported.
- 26 (32) Illegal format for RX02 error.
There must be 26 sectors/track when the IL bits of the unit designator are set to RX02 offset and interleave.
- 27 (33) Flaw map not valid error.
If flaw mapping is selected and a valid flaw map has not been placed on the drive, this error will be reported on any read/write access.

If an error is detected, such as CRC, when the controller attempts to read the flaw map, the CRC error will be reported. Access errors will always override CRC or ECC errors.
- 28 (34) Illegal command error.
The host has passed the controller an illegal command.
- 29 (35) Spare.
- 30 (36) Winchester ID CRC error.
A CRC error was detected when reading the ID field.
- 31 (37) Winchester write fault error.
Write Fault from the Winchester drive cannot be cleared. This usually indicates a drive or cabling problem.
- 32 (40) Spare.
- 33 (41) Flawed sector access error.
Attempt to access a flawed sector. This error will be reported when a flawed sector is accessed using physical addressing. Flawed sectors are skipped if logical addressing is used.
- 34 (42) Missing Winchester data synchronization mark or DMA access fails.
This error would typically indicate a drive is faulty. However, this error could occur if a DMA access was initiated by the controller and the DMA access was not allowed to complete.
- 35-47 (43-57) Spare

NOTE: Errors 48-63 are controller hardware and/or firmware failures. The error message will have little meaning to the general user.

APPENDIX B. BOOT PROGRAM

The bootstrap proms on the interface board read the boot block off the installation and test diskette. Control is then transferred to the boot block code (see BOOT.MAC for details of boot block execution).

The boot block is called by the boot proms on the interface board, with R0 = DT UN (see unit designator description in FW OEM Manual). This allows the diskette to be booted from either F0 or F1. Since FWIT.SAV requires extended mode function to operate, a set mode command is initiated.

The directory is searched for FWIT.SAV. If the file is found, it is read into memory. The boot block program halts if it cannot find FWIT.SAV or if an error occurs while reading FWIT.SAV into memory.

If no errors are detected, control is transferred to the beginning of FWIT.SAV. At this point the diskette may be removed.

Error Halts:

272g
302g FWIT.SAV not in directory

474g Read error (check data bus register, FWDBR, for error code)



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