

Testing a Mark 5A System with the Field System

Alan R. Whitney
Dan L. Smythe
MIT Haystack Observatory
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This memo describes a set of simple procedures for verifying the proper operation of a Mark 5A VLBI system as a data-acquisition system. For more complete procedures, including testing as a playback system into a correlator, see *Mark 5A System Test Procedures* at <http://web.haystack.mit.edu/mark5/operations.html>.

Equipment Requirements

The minimum equipment required to perform a full test suite, including the unit under test (UUT), includes:

1. One Mark 5A unit under test (UUT).
2. One Mark 4 decoder.
3. One Mark 4 formatter
4. One 'scratch' disk module loaded with 8 disks.
5. One Field System Computer

Note: *All Mark 5A units with I/O Panels must have all 8 jumpers installed on the I/O Panel.*

Note: *Terminator blocks should be installed on all four I/O Panel output connectors.*

Testing strategy

Testing of the Mark 5A is broken into four separate tests:

1. Initial bank testing
Tests rudimentary functionality of Banks A and B.
2. Test with internal tvg
Record a small amount of data on from internal Mark 5A test vector generator (tvgr) and perform a software check of the recorded data.
3. Test in 'bypass' ('idle') mode
With a known good data source and a Mark 4 decoder, test that all 64 UUT input tracks function properly.
4. Record and playback test data on UUT
Record data to disks and playback to decoder.

Important concepts that will ease understanding test results

The reader is urged to study the basic concepts of the Mark 5A system as explained in the *Mark 5A User's Manual*. It will help you to understand the tests in this document.

Commands used during testing

We briefly describe here the basic commands and procedures needed to do the testing. For complete details of all Mark 5A commands, refer to the *Mark 5A command set* memo.

1. Select active bank

mk5=bank_set=A or *mk5=bank_set=B* or *mk5=bank_set=inc*

The disk module in the selected bank must be ready. The key switches may also be used to select the active bank.

2. Show VSN

Ctrl-Shift-5 to start Monit5 disk space remaining display

bank_status Update Monit5 disk space remaining display

mk5=VSN? Show extended-VSN of selected module

mk5=bank_set? Show extended-VSN of both modules

3. Show disk serial numbers

disk_serial Show disk serial numbers on mounted module

4. Erase disks:

mk5=protect=off Required before any *erase* command.

mk5=reset=erase Erase *all* data on the selected module.

5. Set data mode

mk5=mode=<data mode>:<data submode>

The Mark 5A must always be set to the data mode that the user desires. Ordinarily, data recorded in a particular data mode must be played back in the same data mode, otherwise the reproduced data will be non-sense.

mk5=mode? Get current data mode

6. Record data:

'disk_record=on'

Starts recording from end of current data set. The assigned scan name comes from the most recent *scan_name* command.

'disk_record=off' Stop recording

7. Set playback rate

mk5=play_rate=clock:<MHz>

Sets the track-clock rate for playback; default is 9 MHz; range is 0 to 40 MHz (though max VLBI playback clock rate is a function of data mode). Also sets clock frequency of on-board tvgr.

8. Set playback for a particular scan

mk5=scan_set=<scan_name> (or <scan_number>)

Sets the scan pointer (and play pointer) to the beginning of the named scan.

mk5=scan_set? – returns current value

9. Play back a single scan

mk5=scan_play=

Plays back last recorded scan or scan named in preceding '*scan_set*' command. Stops at end of scan or on '*play=off*' command.

mk5=play=on

Starts playback from current play pointer position. Continues playing subsequent scans until end of recording is reached or '*play=off*' is issued.

mk5=play=off

Stops playback and updates play pointer to position at which playback stops.

10. Quick scan check

mk5=scan_check?

This is probably the most useful general check for a recorded scan. To use it, first point to the scan of interest with the command '*scan_set=<scan_name>*'. Then issue the '*scan_check?*' query, which will sample data near both the beginning and end of the scan and return such information as data mode, scan start time, scan length, and track data rate. By examining time tags at the beginning and end of the scan and counting the number of bytes in between, it also determines whether there are any missing or extra bytes in the recorded data. This command is more powerful, and therefore takes longer, than the *data_check* command.

11. Check tracks with decoder

mk5=track_set=<track A>:<track B>

Set tracks to be examined at Mark 5A output. If track is in set 2, add 100. These two tracks are selected to go to decoder channels A and B, respectively, for examination. Note that all 64 output tracks are active in all operational modes (idle, recording, playback) and may be examined at any time.

Useful shortcut: '*track_set=inc:inc*' will increment the current values of *<track A>* and *<track B>*, which is very useful when cycling through tracks for checking purposes.

mk5=track_set? - returns current value of *<track A>* and *<track B>*

12. Check tracks recorded on disks

mk5=track_check?

This is the most useful command for checking the data on individual tracks recorded from a formatter. To use it, first set the play pointer to the beginning of the scan of interest with '*scan_set=<scan_name>*' or ('*scan_set=<scan_number>*'). The track to be examined is *<track A>* as set by the '*track_set*' command and should correspond to a track actually recorded from the formatter (not a duplicated track at the Mark 5A output). The '*track_check?*' query returns detailed information about the data recorded from the target track, including data mode, time, etc.

13. Check record and playback pointers:

'disk_pos'

The Mark 5A maintains both a 'record' and 'playback' pointer (in bytes from the beginning of the data set) which indicates the present recording or playback position. Normally, it is not necessary to access these pointers since all scans are referenced by name. However, during initial testing, it is sometime useful to examine the position of the 'record' pointer while recording to see that it is incrementing properly.

14. Check remaining record time

bank_status Update Monit5 disk space remaining display

mk5=rtime?

Returns remaining record time (in seconds) in the current mode and data rate. Also returns remaining GB, mode:submode, assumed tract data rate (set by *'play_rate'* command), and total recording rate. Note that the Mark 5A has no knowledge of the recording clock rate when recording from the formatter; it simply follows the clock provided by the formatter. Therefore, in order for the *'rtime?'* query to provide an accurate estimate of the remaining recording time, you must specify the track clock rate with a *'play_rate=clock:<rate>'* command.

15. Status

mk5=status?

Returns system status as a hex number. Useful for diagnostic purposes, but you must decode the bits - see 'Mark 5A command set' memo for details'.

Operating the Mark 5A

Refer to the *Mark 5A User's Manual* for details of the operation of the Mark 5A system.

Initialization and Startup¹

1. Insert a module in Bank A and turn the keyswitch to 'on'.
2. Mark 5A Login name: *oper*
Password: *****
Contact Richard Crowley (<mailto:rcrowley@haystack.mit.edu>) or John Ball (<mailto:jball@haystack.mit.edu>) for logins and passwords.
3. Issue *'script -af <filename>'* if you wish to retain a Mark 5A log of your session. The default file name is 'typescript' in the current directory.
4. Run *'ssopen'*
This initializes the StreamStor (may take 20 seconds or so).
If successful, 'StreamStor opened successfully' will be reported.
5. If *'ssopen'* fails, try *'SSReset'* to reset the StreamStor card; then try *'ssopen'* again.

¹ See the Mark 5A User's Manual at <http://web.haystack.mit.edu/mark5/Mark5.htm> for more details on operating the Mark 5A system.

6. Run² 'Mark5A -m0 |& LLogr &' ('-m0' turns on debug display; '&' forces to background³, '|& LLogr' puts time tags on debug display⁴)
 'Mark5A' is the primary operations program for the Mark 5 system and will accept normal Mark 5 commands with VSI-specified syntax.
7. Make sure you have a `mk5ad.ctl` file with the IP address of your Mark 5 system.⁵
8. Start the Field System
 You may type any command or query from the Mark 5A command set⁶ by preceding it with "`mk5=`".

Test 1 - Initial bank testing

Test that both Banks A and B appear to initialize properly⁷:

With Bank B empty, insert a known-good 8-disk module into Bank A and turn the keyswitch to 'On'. You should observe the following:

- a. 'Locked' and 'Power' LED's should illuminate quickly; all 'activity' LED's on the module should illuminate (for all buses with installed disks).
- b. 'Activity' LED's should extinguish one-by-one from top to bottom; this should progress smoothly, with perhaps a slight hesitation between 2/3 and 4/5, and take no more than a few seconds. If this process stalls or significantly hesitates, there may be a problem.
- c. The 'Ready' LED should illuminate, signifying the module is ready to be used. A blinking 'Ready' LED indicates that the module needs to be erased.
- d. The 'Selected' LED should illuminate indicating it is the active module.
- e. Read the VSN – enter '`mk5=VSN?`' or '`bank_status`'

Turn the keyswitch to 'Off'; wait for the 'Power' light to extinguish and give disks a few seconds to spin down. Remove the module, place it in Bank B and repeat the test.

Notes:

This test verifies only some aspects of the operation of the StreamStor board and is entirely independent of the Mark 5A I/O board. The I/O board must be in place for the *Mark5A* program to be happy, but the FPDP jumper cable between the StreamStor board and the I/O board need not be present.

² The Mark5A run string given here is for version 2.4 and later; see Mark 5A Users Manual for earlier versions.

³ If you forget to type the '&', you can put 'Mark5A' into the background by typing Ctrl-Z to get a prompt, then 'bg' to put 'Mark5A' into the background.

⁴ For more information, search for "llogr" in <http://web.haystack.edu/Mark5/UpdateMark5.html>.

⁵ For more information, search `/usr2/fs/misc/fs9512up.txt` for "mk5ad".

⁶ The complete Mark 5A command set is available at <http://web.haystack.mit.edu/mark5/Mark5.htm>.

⁷ Disk bank management is described in detail in the Mark 5A User's Manual, available at <http://web.haystack.mit.edu/mark5/Mark5.htm>.

Test 2 - Test with internal test vector generator

This test uses the internal test vector generator (tvg) as a data source for a test recording.

Requirements: Standalone UUT with a scratch module ready and selected in Bank A or in Bank B. This test does not require a formatter.

Procedure

1. *mk5=protect=off* Required before any *erase* command.
(Ignore any error messages.)
2. *mk5=reset=erase* Erase the disk module
3. *mk5=play_rate=9* Set tvg rate to 9 MHz
4. *mk5=mode=tvg* Set to tvg mode
5. *scan_name=tvg288* Assign a scan name
6. *disk_record=on* Record tvg data (288 Mb/s aggregate rate) for 30 s or so
7. Observe that disk activity LED's on front of module; they should show roughly equal activity.
8. *disk_record=off* Turn recording off
9. *mk5=scan_check?* Check data. Last four returned parameters should be '*: tvg : 0 : n : m ;*' where *n* and *m* have the same value, normally 249856.
10. Repeat steps 3-9, but with '*play_rate=32*' (1024 Mb/s aggregate rate).
11. Turn keyswitch A to 'Off', move the module to Bank B, set keyswitch B to 'On' to select. Repeat steps 3-10 with the disk module in Bank B. This verifies that both banks write and read properly at clock rates up to 32 MHz.

Notes:

Testing with the internal tvg verifies operation of the StreamStor board and the Input Section of the I/O board.

Test 4 – Record and playback data on UUT

Setup:

Set up as shown in Figure 1. Set up the Mark 4 formatter according to Appendix B (64-tracks, 18 Mbps/track clock rate). A suitable setup is automated in the *setup1g* procedure in `ftp://web.haystack.edu/pub/mark5/SNAP/mark5.prc`.

Procedure:

For each ‘UUT Data mode’ listed in Table 1, perform the following procedure:

1. `mk5=play_rate=16` Set playback rate so the ‘*rtime?*’ command will work properly.
 2. `mk5=mode=<Data mode>` Set UUT data mode
 3. `mk5=rtime?` or `bank_status` Get remaining record time
 4. `scan_name=<scan name>` Assign a scan name
 5. `disk_record=on` Start recording, (wait few seconds)
 6. `mk5=rtime?` Make sure record time is diminishing as expected
 7. `disk_record=off` Turn off recording (after a few minutes)
 8. Software check of recording on disk:
 - a. `mk5=scan_check?` Check scan for proper recording (not exhaustive)
 - b. `mk5=track_set=2; track_check?` Set to lowest-number track recorded
 - c. `mk5=track_set=inc; track_check?` Increment selected tracks (check with ‘*track_set?*’ if necessary); repeat as necessary
- The *trkchk32* and *trkchk64* procedures in `mark5.prc` automate steps b & c of this test.
9. Check playback to decoder:
 - a. `mk5=track_set=2:102` Initialize track selection (check results on decoder)
 - b. `mk5=scan_play` Initiate scan playback.
 - c. `mk5=track_set=inc:inc` Repeat this as necessary to cycle through tracks; check for proper results on the decoder.

Steps b & c of this test are automated by the *auxerr32* and *auxerr64* procedures in `ftp://web.haystack.edu/pub/mark5/SNAP/mark5.prc`.

Notes:

This test does not check for proper playback through the I/O Panel Output connectors; if this is important, see the full “Mark 5A System Test Procedures” on the Mark 5 web site.

If you observe a “record pointer not incrementing” while you are trying to record, this probably means that no clock from the formatter is reaching the Mark 5A; see Notes under Test 3.

Scan Name	Data Mode	#trks	Clock Rate (MHz)	Total Recorded Data Rate (Mb/s)	Input Tracks		Output Tracks	
					Set 1	Set 2	Set 1	Set 2
st-mark4	st:mark4	32	18	576	2-33	-	2-33	2-33
mark4-8	mark4:8	8	18	128	2-17 even	-	2-16 even 3-17 odd 18-32 even 19-33 odd	2-16 even 3-17 odd 18-32 even 19-33 odd
mark4-16	mark4:16	16	18	256	2-33 even	-	2-32 even 3-33 odd	2-32 even 3-33 odd
mark4-32	mark4:32	32	18	512	2-33	-	2-33	2-33
mark4-64	mark4:64	64	18	1024	2-33	2-33	2-33	2-33

Table 1: Test data modes

Shutdown

To end *Mark5A*, type *'EndM5'*. Do not use just <Ctrl C> to try to end *Mark5A* because this sends interrupts to all threads and creates a mess.

To shutdown the OS: From the Mark 5A console, enter *'halt'* or, from a remote terminal issue *'su'* to become root, then use the normal Linux shutdown *'/sbin/shutdown -h now'*.

Other Utility and Test Programs

'sstest' – erase modules, then writes a small (~30 MB) amount of 'StreamStor test data' to the disks from main memory. Reported as 'SS' on *mk5=data_check?*, *mk5=track_check?*, and *mk5=scan_check?* queries.

'SSReset' – standalone SS reset program

'SSErase' – standalone disk-erase and disk-conditioning program; also reports number of disks.

'DirList' – standalone directory listing

Appendix A – Mark 5A cable testing and debugging

Cables and connectors are common sources of problems that are sometimes overlooked during debugging. The following tests and procedures are suggested:

1. Test each new cable by swapping it into a Known Working Unit (KWU).
2. If a cable fails, make sure that all connector contacts are clean. Clean as necessary.

3. Check procedures for 68-conductor input cables from I/O Panel to I/O Board (in an otherwise KWU Mark 5A):

With a KWU, a Mark 4 formatter, and a Mark 4 decoder

Setup: Connect as shown in Figure 1. Set formatter for 64-track operation (see Appendix B). A disk module is not needed.

On KWU -

1. *mk5=mode=st:mark4* Set data mode
2. *mk5=track_set=2:18* Select tracks; there should be no errors on decoder; verify correct data on decoder. (see Appendices C and D)
3. *mk5=track_set=inc:inc* Increment tracks; check on decoder; repeat this command until all 32 tracks are checked.

Or, you can use the *auxerr32* procedure in
<ftp://web.haystack.edu/pub/mark5/SNAP/mark5.prc>.

4. Check procedure for 20-pin decoder cables from I/O Board to I/O Panel (in an otherwise KWU Mark 5A):

Setup: Connect as shown in Figure 1. Set formatter for Mark III Mode A operation with *form=a*. A disk module is not needed.

On KWU -

1. *mk5=mode=st:mark4* Set data mode
2. *mk5=track_set=15:16* Select tracks; there should be no errors on decoder; verify track numbers on decoder (see Appendices C and D)

5. Check procedure for FPDP cable (in an otherwise KWU):

Setup: Install cable under test in otherwise KWU. Insert scratch disk module. A formatter is not required for this test.

On KWU -

1. *mk5=play_rate=8* Set playback rate 8 MHz
2. *mk5=mode=tvgr* Set mode to 'tvgr'
3. *scan_name=tvgrtest* Assign a scan name
4. *disk_record=on* Start recording; record for 30 seconds or so
5. *disk_record=off* Stop recording
6. *mk5=scan_check?* Perform data check

If *scan_check?* passes, the return will be of the form:

!scan_check? 0 : 47 : tvgrtest : tvgr : 0 : n : m ; where $n=m$;

if n and m are different, there is likely a problem with the FPDP cable

Appendix B - Mark 4 formatter setup procedure

Issue the following commands to the formatter (each is followed by a <CR>):

```
form4=/status          show formatter status
    Sample response: '0x00a8 0x0000 0x9206 41 204 32000 12 0 0 0
                    ('32000' is the sample rate in kHz)
form4=/rec 1          turns on the clock lines to the Mark 5
form4=/time          request the current formatter time
form4=/time 2002 203 17 35 00 set the time
form4=/con 206       set to mode 204 (64 trks, 2 bits/sample, 1:2 fanout)
form4=/rate 32000   enable the sample rate to 32 MHz
form4=/con 0        set the sample rate
```

A similar setup is automated in the *setup1g* procedure in
ftp://web.haystack.edu/pub/mark5/SNAP/mark5.prc.

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Appendix C – Interpreting the Mark 4 Decoder Display

The Mark 4 decoder displays information from the two tracks designated by the *'track_set=<trackA>:<trackB.'* command in the Mark 5A system. Figure 2 shows a view of the display/control portion of the Mark 4 decoder. For purposes of testing Mark 5A systems, the following is important:

The function of the Mark IV decoder is perhaps most easily understood by reference to the front-panel display in shown in Figure 2.

Display

The display is a backlit LCD with 4 lines of 20 characters each.

Display Modes

The desired display mode is selected by repeatedly pressing the 'Mode' button, which cycles through the display modes. The available display modes are as follows:

1. 'A' - displays information derived from tape-track channel A.
2. 'B' - displays information derived from tape-track channel B.
3. 'FRMTR' - displays information derived from four channels of raw-sampled data from the Mark IV formatter (not relevant for Mark 5A checkout).

In the 'A' and 'B' modes, the following information is continuously displayed for the selected channel (see Figure 2):

- 'Time' - decoded time/CRC information. The 'Freeze' button allows the user to 'freeze' the display at a random time to examine, for example, the validity of lower-order time digits. The display is 'frozen' whenever the 'Freeze' button is pushed and held; normal display resumes upon its release.
- 'Aux Data' - displays the current decoded auxiliary-data field. The display is frozen whenever the 'Freeze' button is depressed and held; normal display resumes upon its release. When the 'Freeze' button is depressed, the 'Time' and 'Aux' data displayed are from the same tape frame header. For Mark 5A testing, the most important part of this data is the track number embedded in the auxiliary data, which in Figure 2 are the two digits enclosed by a small rectangle. Set 1 (Headstack1) tracks 2-33 display as '2-33', respectively; Set 2 (Headstack2) tracks 2-33 display as '42-73', respectively.
- 'Errors' - displays four 4-digit error counts for the displayed channel. Counts are cleared when 'Clear' button is pushed; error counting resumes when released. The displayed parity-error count is the number of parity errors over sequential intervals of 400 (default) tape frames; all other error types simply accumulate; however, the parity-error count available through the external RS-232 interface simply accumulates until read. If error counts exceed the available display field, the error count divided by 1000 (and properly rounded) is displayed, followed by a 'k' (e.g. 35kP indicates ~35000 parity errors).
- 'PCAL' - extracts 10 kHz phase-cal amplitude and phase from the decoded data stream and displays results. The last field of the PCAL line alternately displays "4Ms/s" and the data sample rate ("MHz") inferred from the header data.

- Errors

Four types of errors are displayed on LED's for each of the decoder channels A and B. Upon the occurrence of each type of error, the corresponding LED will illuminate for *one full tape frame*. The detected error types are as follows:

- 'Parity' - parity error threshold (software settable, default=0) exceeded in preceding tape frame.
- 'NoSync' - detection of a missing 'sync' word (i.e. sync word not detected where expected) in the preceding tape frame.
- 'ReSync' - detection of unexpected sync word in the preceding tape frame.
- 'CRC' - detection of cyclic redundancy code error (in Mark 4 tape frame header) in preceding tape frame.

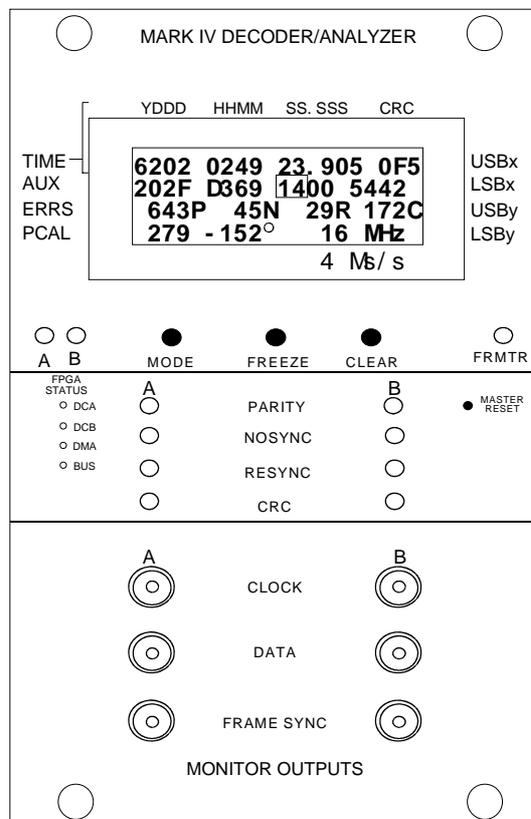


Figure 2: Mark 4 decoder front panel

Appendix D – Decoder ‘track’ numbers as function of ‘track_set’ values

For each Mark 5A data mode, Table 2 lists the track numbers that should be displayed on Channels A and B of the decoder as a function of the ‘track_set’ values.

‘track_set’ values	Expected corresponding Decoder Chan A:Chan B ‘track’ numbers				
	st:mark4	mark4:8	mark4:16	mark4:32	mark4:64
2:102	2:2	2:2	2:2	2:2	2:42
3:103	3:3	2:2	2:2	3:3	3:43
4:104	4:4	4:4	4:4	4:4	4:44
5:105	5:5	4:4	4:4	5:5	5:45
6:106	6:6	6:6	6:6	6:6	6:46
7:107	7:7	6:6	6:6	7:7	7:47
8:108	8:8	8:8	8:8	8:8	8:48
9:109	9:9	8:8	8:8	9:9	9:49
10:110	10:10	10:10	10:10	10:10	10:50
11:111	11:11	10:10	10:10	11:11	11:51
12:112	12:12	12:12	12:12	12:12	12:52
13:113	13:33	12:12	12:12	13:33	13:53
14:114	14:14	14:14	14:14	14:14	14:54
15:115	15:15	14:14	14:14	15:15	15:55
16:116	16:16	16:16	16:16	16:16	16:56
17:117	17:17	16:16	16:16	17:17	17:57
18:118	18:18	2:2	18:18	18:18	18:58
19:119	19:19	2:2	18:18	19:19	19:59
20:120	20:20	4:4	20:20	20:20	20:60
21:121	21:21	4:4	20:20	21:21	21:61
22:122	22:22	6:6	22:22	22:22	22:62
23:123	23:23	6:6	22:22	23:23	23:63
24:124	24:24	8:8	24:24	24:24	24:64
25:125	25:25	8:8	24:24	25:25	25:65
26:126	26:26	10:10	26:26	26:26	26:66
27:127	27:27	10:10	26:26	27:27	27:67
28:128	28:28	12:12	28:28	28:28	28:68
29:129	29:29	12:12	28:28	29:29	29:69
30:130	30:30	14:14	30:30	30:30	30:70
31:131	31:31	14:14	30:30	31:31	31:71
32:132	32:32	16:16	32:32	32:32	32:72
33:133	33:33	16:16	32:32	33:33	33:73

Table 2: Decoder track numbers as function of ‘track_set’ values

The stand-alone SSErase program can be used to condition a set of disks. There are two settable parameters:

- m sets the message level (range -1 to 3, default 1)
- c sets conditioning (0 for FALSE, 1 for TRUE, default is FALSE)

For example:

```
SSErase -m 0 -c 1
```

goes through the conditioning process on whatever disks it finds, up to 16 at a time in both banks. Conditioning amounts to a read-write cycle through the whole set of disks. With the message level set to 0, debug prints a status report every minute. The status report is the number of bytes per bus remaining to be read or written in the current read or write cycle.

Conditioning disks is recommended before recording, especially if they are to be recorded at 1024 Mb/s.

Typical conditioning times:

GB	minutes		average		
----	-----		Mb/s		----
120	101	1H41M	317	Western Digital	
2*120		103	1H43M	621	Western Digital
4*120		111	1H51M	1153	Western Digital
8*123.5	149		2H29M	1775	Hitachi
8*120		157	2H37M	1631	Western Digital
16*120		278	4H38M	1842	Western Digital
185	140	2H20M	353	Hitachi	
8*185		235	3H45M	1681	Hitachi
16*185		430	7H10M	1838	Hitachi
200	160	2H40M	333	Western Digital	
8*200		286	4H46M	1492	Western Digital
16*200		465	7H45M	1835	Western Digital
250	173	2H53M	385	Hitachi	
8*250		313	5H13M	1704	Hitachi
16*250		580	9H40M	1839	Hitachi
300	197	3H17M	406	Quantum Diamond Max 10	
2*300		197	3H17M	812	Master-Master
2*300		348	5H48M	460	Master-Slave
8*300		376	6H16M	1700	Estimated
16*300		696	11H36M	1840	Estimated
8*400		503	8H23M	1700	Estimated
16*400		930	15H30M	1840	Estimated

These times are approximate for the typical case; but, if any of the disk drives in the module has a problem, times can be longer.

If conditioning takes longer than a few minutes more than the time listed above, or if one or more of the disk drives shows slow statistics*, then the slow drive or drives should be replaced before the 8-pack is used at 1024 Mb/s.

After conditioning two disk packs at a time (e.g., more than eight

disks), or if you change the disks into a different configuration, then you may need to erase each disk pack separately before recording.

* slow statistics:

SSErase STATS: 3 : 577998 : 3064661 : 3535 : 8687 : 7268 : 487 : 143 : 27 ;

good statistics:

SSErase STATS: 6 : 571657 : 3090952 : 148 : 37 : 10 : 1 : 1 : 0 ;

See the "get_stats" command in the "Mark 5A Command Set Memo" <<http://web.haystack.mit.edu/mark5/command5a.pdf>> for an explanation of the meaning of these numbers. Note that SSErase does not report the <replaced-block-count>, which has no meaning when conditioning.

Dan L. Smythe - 13 April 2005 - MIT Haystack Observatory