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MOVING HEAD DISC SUBSYSTEM MAINTENANCE

1. INTRODUCTION

This publication provides installation, testing, preventive maintenance, troubleshooting, adjustment, and parts information for the ADSC Moving Head Disc Subsystem, as used on Honeywell 4400 and 4500 process computer systems. This subsystem consists of a BABMC1x (AABMC11) Bulk Memory Controller on the computer's GENIE Bus, an ABMS12/14 (ADSC12) Disc Subcontroller, plus from one to four ADSC3x Disc Units, and the interconnecting cables. Each Disc Unit has a capacity of 16,855,040 24-bit words, so the maximum storage capacity of the subsystem is over 67 - million words.

Alternate model numbers are mentioned in the preceding paragraph because initial deliveries of the Bulk Memory Controller and Disc Subcontroller used wire-wrapped circuit boards, and from the latter part of 1978 on, the BMC and Subcontroller are produced as etched copper printed wire boards. The older model number above are in ( ). The newer BMC and Subcontroller function virtually identically to the older versions, but in addition to those functions, the new BMC may serve up to four 4500 CPUs as a "Ported" BMC and may also handle a Mag. Tape Subcontroller. Further, the Ported BMC may serve as a Bulk Intersystem Link (ISL), through which blocks of information are transferred between the memories of two, three, or four 4500 CPUs. For further information on possible configurations, see Technical Data & Specification ABMC/ISL-S or Section 16 of the General Description, PTH-019.

2. PRECAUTIONS

The Disc Controller (Bulk Memory Controller and Disc Subcontroller) uses no high voltages and requires no precautions other than to protect the hardware from damage. The Disc Units use 117 VAC (60 Hz) or 220 VAC (50 Hz), and the AC distribution circuits, including the circuit breakers, blowers, start triac, relays, spindle motor, and DC power supply input terminals, can present an electrical shock hazard. In addition, the Disc Units have several rotating and laterally moving mechanical components. Observe the WARNING and CAUTION notes throughout the vendor's manuals for the Disc Units.

Also, observe the Caution note under 8. Performance Tests.

3. OPTIONS

3.1 Disc Controller

The Disc Controller consists of a Bulk Memory Controller and one Disc Subcontroller. The BMC and Subcontroller consistsof four boards: (1) GENIE Bus Interface, (2) Firmware Engine, (3) Disc Subcontroller, and (4) Error Correction Unit. If the BMC is not ported, only one GENIE Bus Interface board is present. For each port implemented, one GENIE Bus Interface Board is used, and a buffer board is installed on the GENIE Bus in each CPU sharing the BMC. Ported BMCs can be installed only in an expansion cabinet, not in a Central System Unit (CPU). The board designators are indicated on Fig. 5-1 and the part numbers are in part 12 of this publication.

3.2 Disc Units

Standard software will support up to four mass storage (bulk memory) units. All of these could be Moving Head Disc Units, but it is unlikely that any practical process automation computer system would ever need more disc storage capacity than that provided by four units on one Disc Controller.

The Disc Units have 823 tracks on each of five recording surfaces and since each track contains 64 sectors of 64 words each, the disc capacity is 5 X 64 X 64 X 823 = 16,855,040 24-bit words. However, the standard RTMOS software treats only 408 full tracks and 60% of the 409th track as one logical mass storage unit with a capacity of 8,388,608 words. The second half of each unit's storage capacity may be treated by the standard software as another logical unit, thus providing 16 million words of storage capacity.

Disc Unit Model numbers are:

ADSC31 1st Unit, 60 Hz.
ADSC33 Addn'l Unit, 60 Hz.
ADSC32 1st Unit, 50 Hz.
ADSC34 Addn'l Unit, 50 Hz.

3.3 Disc Packs

Each Moving Head Disc Unit is supplied with a removable disc pack. Additional disc packs are available. The model number is ADSC41. These disc packs may be used on all model ADSC3 Disc Units and may be interchanged between units, but are not compatible with other Disc Units used on Honeywell Series 4000 process computers.

3.4 Device Address

The Disc Controller device address is selected by nine miniature switches on the controller's AAXGIG1 board. The switches are labeled AP and A7 through A0, and are set to "0" or "1", as necessary to select a binary number equal to 400_8 less than the device address, DDD, assigned to the Disc Controller by the system documentation. Bit AP is set to provide odd

parity. For example, if the device address is 401_8, the switches are set as follows:

AP	A7	A6	A5	A4	A3	A2	A1	A0	- Switch
0	0	0	0	0	0	0	0	1	- Value

If a Moving Head Disc Unit is to be used as a system bulk program load device, 401_8 must be selected as the device address for its Disc Controller, and it must be logical unit 0 on adapter 00_2 of that controller (see 3.7).

> NOTE
>
> On 4400 systems using the 4548C Disc Unit (CDS Disc), it was necessary to change the program load hardware-generated OPR instruction to an OUT instruction, manually. The Moving Head Disc Controller performs a 100_8 word program load transfer when the hardware-generated OPR S'=0 (25024001_8) is executed, so no manual change of the B-Register is needed.

3.5 Interrupt and Memory Request Priority

Six miniature switches on the controller's AXGIG1/AXIMP1* board are used to select the relative API and memory request priority of the Disc Controller of the 16 priority levels available on the master or slave bus section the controller is installed on. The switches labeled 0X, 1X, 2X, X0, X1, and X2 are set to one or zero to specify the octal number related to the priority assigned by the system documentation, as follows:

	Priority	Switch Setting
Highest	1	33_8
	2	35_8
	3	36_8
	4	37_8
	5	53_8
	6	55_8
	7	56_8
	8	57_8
	9	63_8
	10	65_8
	11	66_8
	12	67_8
	13	73_8
	14	75_8
	15	76_8
Lowest	16	77_8

* BMC and Disc Subcontroller boards are wire-wrapped (early production) or etched copper. Wire-wrapped and etched copper boards may not be be mixed in a subsystem. Throughout this publication, the board designators are given as "wire-wrapped/etched", e.g., AXGIG1/AXIMP1.

3.6 Write Protection

Two forms of write protection are available to prevent inadvertent over-writing of information on a disc pack that must be preserved: (1) whole unit write protection, which is selected with the PROTECT switch on each unit. This alternate action pushbutton enables or disables the unit's write driver. When the write driver is disabled, the PROTECT indicator is on. (2) Individual 64-word sectors may be protected by writing a protect bit in the sector header. This requires that the FORMAT switch on the Disc Subcontroller (AXMHC1/AXMHC2)* be placed in the set or format position to enable writing of the protect bit(s) in the header area and then be placed in the reset position to prohibit writing in the header area and to cause the adapter to protect the sectors in which the sector protect bit is set. Note: While test program 51191037 tests the sector write protection feature, its header writing test aid does not support writing of the sector protect bits.

3.7 Subcontroller and Disc Unit Addresses

In the standard configuration, the only Subcontroller address permitted is 00_2, although the hardware is capable of selecting from 00_2 through 11_2. This address is selected with jumpers J1, J2, J3, and J4 on the XMHC1 board. They are selected as follows:

J1	J2	J3	J4	
1	0	1	0	Binary Value
MSB		LSB		

So, to select 00, put a jumper in J2 and another in J4.

The Disc Unit may be assigned an address from 0 through 15. This address is selected by a logic plug marked with the number desired, which is inserted into the second slot from the left in the main control panel at the front of the unit. In the standard Honeywell configuration, only addresses 0 through 3 are permitted. Normally, the units arrive at the customer's site with the correct logic plug installed. If a new Disc Unit is added to a system as an expansion, check that the logic plug indicates the next available address. If not, look for the package of spare logic plugs in the base of the unit or in the expansion materials packages.

4. REFERENCES

4.1 General Description

The HS4400 General Description, PTH-004, and the 4500 General Description, PTH-019, provide a detailed functional description of all standard subsystems and devices, with no theoretical discussion, hence are a good quick reference on how things are supposed to work. A copy of the appropriate General Description

is provided in the respective Computer Maintenance Manuals in the General Information section. Section 21 of the 4400 General Description describes the Moving Head Disc Subsystem, and it is covered in Section 6 of the 4500 General Description.

4.2 Theory of Operation

Disc Subsystem theory publication ADSC-T is primarily concerned with the Disc Controller operation and its effect on the Disc Units. The Disc Unit theory is provided in the Magnetic Peripherals Inc. Hardware Reference Manual for Storage Module Drive models BJ701 and BJ7B1. MPI's publication number for this manual is 83317300. This manual and its companion Hardware Maintenance Manual are provided with each Disc Unit.

Theory of operation for the wire-wrapped version of the BMC is provided in publication no. ABMC11-T. The new Ported (etched PWA) BMC is covered in theory publication BABMC-T.

4.3 Disc Unit Hardware Maintenance Manual

Magnetic Peripherals Inc. publication no. 83311300 is the Hardware Maintenance Manual for Storage Module Drives BJ701 and BJ7B1. This manual provides installation and checkout instructions, preventive and corrective maintenance instructions, schematics, wire lists, and parts information for the Moving Head Disc Units. The Disc Unit maintenance manual and its companion theory manual (Hardware Reference Manual) are provided with each unit.

The Hardware Maintenance Manual may not be assembled to reflect any particular disc unit, but does contain information that indicates the variations that exist at different Series Code (S/C) levels. This is particularly significant in the schematics (logic drawings), where more than one version of a sheet may appear in order to reflect more than one revision level. Temporary change pages typically have the effectivity notes marked boldly on the body of the drawing, and permanent change pages have the effectivity notes typed in the title block. These notes often have "W/" (with) and "W/O" (without) followed by an ECO or FCO number, to indicate the effect of specific change orders.

Physical identification and logic symbol information for the disc unit schematics is provided in Section 4 of the Hardware Reference Manual.

4.4 System Exerciser Program/Module

The Moving Head Disc System Exerciser Module, 51191071, runs under the executive, provides an interactive check of the operation of the disc subsystem while other subsystems are running. Publication SEX-I, How to Load, Run, and Use the System Exerciser, facilitates the use of the System Exerciser and interpretation of results.

4.5 Test Program

The Moving Head Disc Subsystem Test Program is described on drawing no. 51191037. Part no. 51191037-110 is a binary loading card deck and 51191037-101 provides the test program in the form of a binary loading paper tape.

4.6 Technical Bulletins and Document Change Notices

The Disc section of the HS4400 and 4500 Computer Maintenance Manuals will, from time to time, contain technical bulletins issued by Technical Publications, Honeywell PCD/Phoenix; and by MPI, the Disc Unit manufacturer. It is a good idea to scan these bulletins before getting deeply involved in troubleshooting, because they may point out known fixes, or may explain techniques that can be used to avoid trouble.

Document change notices are issued from time to time to enable quick revisions to publications that are needed because of engineering changes or the discovery of errors.

> NOTE
>
> The Disc Units (Storage Module Drives) are manufactured by Magnetic Peripherals Inc., a firm formed by the combination of elements of Control Data Corp. (CDC) and Honeywell. The MPI documentation may still refer to the manufacturer as Control Data or CDC.

5. COMPONENT LOCATIONS

Fig. 5-1 shows the Disc Controller board complement and the principal functions of each board. These boards are installed in the order shown on Fig. 5-1.

The wire-wrapped BMC and Disc Subcontroller boards are installed in alternate slots (2 slots per board) while the etched copper boards occupy one slot each. The GENIE Interface and Firmware Engine boards are interconnected by a ribbon cable, and the Firmware Engine, Disc Subcontroller, and Error Correction Unit are interconnected by another ribbon cable. These two ribbon cables connect to connectors at the front edge of each PWA.

The Moving Head Disc Units (MPI Storage Module Drives) are freestanding units, each configured as MPI's "cabinet with top mounted drive." They must be located so as to be interconnected as shown on Fig. 5-1.

6. TEST EQUIPMENT AND MATERIALS

In addition to normal test equipment, including an oscilloscope and a multimeter, several items are needed for preventive maintenance and corrective maintenance of the Disc Unit. Preventive maintenance items include filter coating and cleaning materials and are listed early in Section 2 of MPI's Hardware Maintenance Manual. Corrective Maintenance items include extenders and tools and are listed early in Section 3 of the same manual.

Many of the corrective maintenance and adjustment procedures in MPI's Hardware Maintenance Manual require that commands be issued to the drive by MPI's Field Test Exerciser or by computer programs. The Moving Head Disc Subsystem Test Program, 51191037, can be used to exercise the drive, as needed, in virtually all cases. The head alignment procedure requires MPI's Field Test Exerciser and a special "CE" disc pack.

7. PREVENTIVE MAINTENANCE

The Disc Controller requires no scheduled preventive maintenance. Two levels of preventive maintenance scheduling for the Disc Units are specified in Section 2 of MPI's Hardware Maintenance Manual: Level 4 - Semiannual or 3000 hours, whichever occurs first; and Level 6 - Biennial or 9000 hours, whichever occurs first. The elapsed hours of power-on time are indicated on an hour meter on each unit. The specified intervals are the maximum lengths, and may need to be shorter in situations where the units are operated in dusty environments.

> NOTE
>
> Specifications on disk pack handling and cleaning, and on head inspection and cleaning are included in the Control Data Hardware Maintenance Manual, Section 3D - Repair and Replacement, pages 3-44 through 3-46.
>
> The policies and precautions in these specifications must be carefully observed to avoid damage or contamination on disc packs and heads. While these specifications provide instructions for the inspection and cleaning of packs and heads, such procedures are to be accomplished by qualified (trained) personnel only. If you have <u>any</u> doubts about your qualifications, you are <u>not</u> qualified to perform the inspection and cleaning procedures.

8. PERFORMANCE TESTS

The Moving Head Disc Subsystem is tested through the use of test program 51191037. Where the Disc Unit and Disc Controller are being installed as part of a system installation, or are being added to an existing system as an expansion, the installation and checkout steps under 8.1 should be accomplished, followed by the operational test under 8.2.

The header recording and verification procedure under 8.3 should be needed only to establish Honeywell compatible headers on a disc pack not known to have such headers already. It may also be needed on older disc packs having compatible headers where, some malfunction may have altered the header information or where the accuracy of the header information has deteriorated because of mishandling, exposure to external magnetic fields, etc.

8.1 Installation and Checkout

1. The Disc Controller is installed by inserting the PWBs in GENIE Bus slots and attaching the interconnecting cables (Fig. 5-1). The device address and interrupt/DMA priority should be selected on the AXGIG1/AXIMP1 board, as described under 3.4 and 3.5, prior to its installation.

2. Installation and preliminary checkout instructions for the Disc Units (drive) are provided in Section 1 of the vendor's Hardware Maintenance Manual. Fig. 5-1 in this Honeywell maintenance publication indicates which of the available interconnecting cabling schemes is to be employed. Necessary grounding connections are provided through the Honeywell supplied cables. The sector plug mentioned in the vendor's instructions should already be installed correctly. Each of the steps under the "Initial Checkout and Startup" heading in the vendor's manual, except step 17 (head/arm alignment) should be performed. The head/arm alignment procedure is needed only if there is some reason to believe that the alignment is not correct. (For an example, see step 6 under 8.2.) Step 18 in the vendor's procedure should be interpreted as, "perform the operational test per 8.2 in the Honeywell maintenance publication."

8.2 Operational Test

1. Unless the Disc Units have been in use and are believed to be operational, go to step 2, under 8.2, above. As a part of that step, become familiar with and verify the operation of the Disc Unit (drive) controls and indicators.

2. Check the Write Data Delay per 10.1.

3. If you are not familiar with the Moving Head Disc Subsystem Test Program, carefully read the instructions on drawing 51191037. This drawing should be found in the Test and Diagnostic binders shipped with the system documentation. *

* If an exhaustive test of the disc subsystem is not necessary or if a test of the interaction of this subsystem with other subsystems is needed, the System Exerciser (see 4.4) may be used. Honeywell's normal installation check uses the System Exerciser rather than the test program.

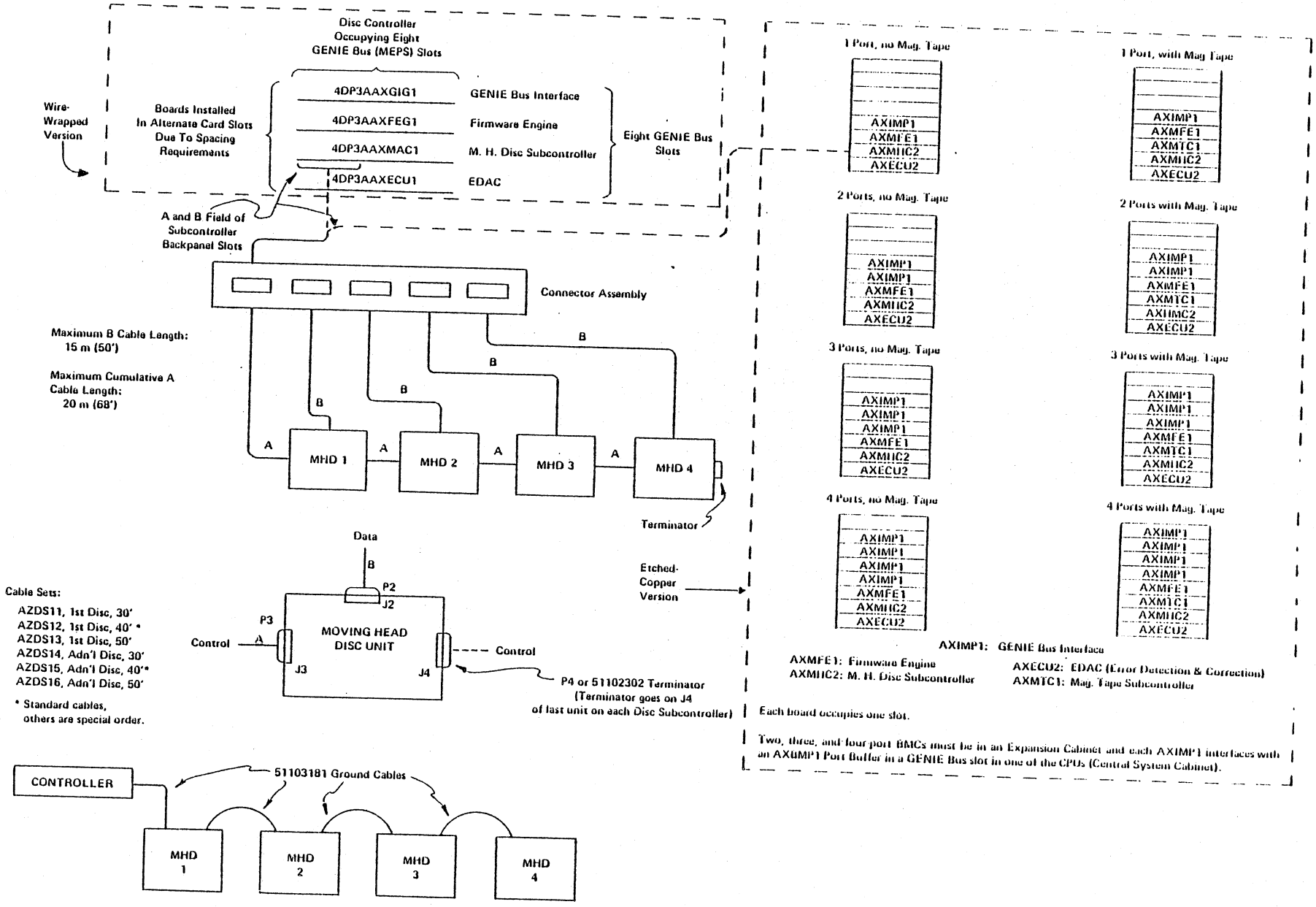


Fig. 5.1 Component Locations

4. Load and start the program per the instructions.

5. Select appropriate options pertaining to the number of units to be tested, the size of the units to be tested and the ending addresses on the units to be tested. Normally, all sectors on all 823 cylinders should be tested. If only eight million words of a Disc Unit's capacity are in use, only 410 cylinders will be accessed in normal operation. The test program's assumed values are for a test that includes the full 823 cylinders, and for this test these values may be left unchanged. If, however, there is some reason to test only the first 800 words, the following test program parameters may be changed as indicated:

	Assumed Value	Value for 8M Word Range
Disc ending cylinder/ head address	63302000_8	31442000_8
Number of cylinders per pack	$823_{10} = 1467_8$	$410_{10} = 632_8$
Number of heads per cylinder	5	5
Number of sectors per track	64	64

> CAUTION
>
> System programs and process data which are recorded on disc packs may be inadvertently destroyed while performing maintenance procedures. Before proceeding with performance tests or troubleshooting, either use a "scratch pad" disc pack whose content is unimportant, or be sure a means of reloading the disc pack is available. This may be in the form of cards or paper tapes containing the on-line programs and files. If such cards or tapes are not available, they may be prepared using the standard COS Punched Dump program under RTMOS. If Programming and Maintenance Console switch 13 is set to zero (Console Switch Register bit 13 is set to zero on 4500) while the test program is running, that program will not execute any tests which write on the disc pack, and the test, therefore, will not be exhaustive.

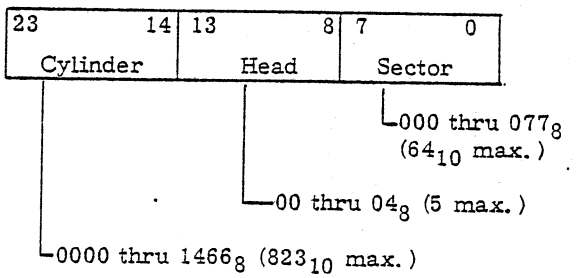
6. Allow the test program to make one pass through all of the non-test-aid tests, including manual intervention tests. If at least one error-free pass can be made, inhibit manual intervention tests (CS19 = 0) and allow the program to run through at least two passes. If possible, allow the program to run longer. Lowering CS10 (4400) or setting CS Register bit 10 (4500) will eliminate some unnecessary testing for longer runs. If errors are encountered that cannot be resolved quickly, refer to 11. Troubleshooting, in this publication.

7. If more than one Moving Head Disc Unit is in use at a site, a disc pack compatibility check should be made by exchanging packs between units and determining that acceptable operation is achieved on each unit with packs whose headers have been written on other units. Two or three passes through the test program, with manual intervention tests inhibited, should be sufficient to confirm compatibility. Should disc packs not be compatible between units, read/write head/arm alignment, as described in Section 3 of the vendor's Hardware Maintenance Manual may be required on one or more of the Disc Units involved. If head/arm adjustments are made, it may be necessary to rewrite headers per 8.3.

The desired result of this operational test is the completely error-free operation of all Disc Units. However, since no magnetic recording medium can achieve absolutely error-free operation, the Disc Controller hardware attempts to correct data errors, retrying up to three times. Both recoverable and non-recoverable errors are reported by the test program. The subsystem operation may be considered as acceptable if no errors are reported, or if only an occasional recovered or corrected error is reported. Consistent errors, especially those on a particular unit or at a particular unit address or sector, should be considered as a media defect which may require disc pack or head replacement.

8.3 Header Recording and Verification

Test 25 in the Moving Head Disc Subsystem test program, 51191037, writes headers on specified tracks and reads headers from those tracks to verify them. Program parameters must be checked and changed, if necessary, to specify the affected Disc Unit, the starting disc address, and the ending disc address. If the assumed values loaded with the program are not changed, headers will be written and verified on unit 1, starting at cylinder zero and head zero, and continuing through cylinder 822, head 4 (the 823rd cylinder and the 5th head). The starting and ending disc addresses are specified in the same form as control word 1, which is:



9. ASSEMBLY AND DISASSEMBLY

Assembly and disassembly of the Disc Controller (Bulk Memory Controller and Disc Adapter) consists only of the removal and replacement of printed wire boards, which should be accomplished only when DC power is off. Assembly disassembly information for the Disc Units (Storage Module Drives) is provided in MPI's Hardware Maintenance Manual. Disc pack removal and replacement instructions are provided in Section 2 of MPI's Hardware Reference Manual (not the maintenance manual - the reference manual).

10. ADJUSTMENTS

There is only one adjustable component in the Disc Controller (Bulk Memory Controller and Disc Subcontroller. See 10.1). The Disc Unit adjustment procedures are in Section 3 of MPI's Hardware Reference Manual. Many of these procedures require the use of MPI's Field Exerciser, which replaces the Disc Controller and exercises the Disc Unit as directed by controls on the exerciser. In most cases, it is possible to use one or more of the 51191037 test program's test aids to exercise the Disc Unit in the same manner as the exerciser does.

As a general rule, the Disc Unit adjustments should not be moved unless you have evidence that readjustment is needed. The Disc Unit adjustments are quite stable and should not require frequent readjustment, but the adjustments should be checked before other repairs or replacements are made because faulty operation can be caused by misadjustment. The adjustments should be checked after subassemblies, boards, or other parts are replaced. Occasionally, adjustments may be needed after a Disc Unit has been shipped to a new location or subjected to rough handling.

10.1 Write Delay Adjustment

During each system installation or the installation of an additional Disc Unit on a system, the relationship of the NRZ write data and the write clock from the Disc Controller should be checked. Proceed as follows:

1. Connect one vertical input of a 'scope to the TPE (NRZ write data) on the A14 board in the Disc Unit and a second vertical input to 27B at card slot A01. (9.67 MHz write clock).

2. Use the test aid in the test program (51101037) to repeatedly write a pattern with ones and zeros on any Disc Unit served by the controller.

3. The relationship of the clock to the ones and zeros in the NRZ data is shown on Fig. 10-1. The significant event is the positive transition of the write clock which should be in the center of each NRZ data bit period (each one or each zero). If these positive transitions are not within 5 ns of the center, readjust the delay per step 4.

4. The delay adjustment is a staple jumper on an IC socket at location A4 on the Disc Controller's ECU1 board. The position of the write clock is moved by moving the jumper. However, each time the jumper is pulled out of the socket, write data stops, so the test program will probably hang up and it will be necessary to restart it to check the clock centering per step 3.

11. TROUBLESHOOTING

Because the Moving Head Disc Subsystem extends from the computer's main or core memory, through the GENIE Bus, the Bulk Memory Controller, the Disc Adapter, and the Disc Units, the first problem in troubleshooting this subsystem is determining which of the functional members of the subsystem most likely contains the trouble, if indeed, it is a hardware trouble and not a software problem. Careful consideration of the trouble symptoms will normally point to the faulty functional module, and troubleshooting may then proceed through subassembly or board replacement. Isolation of a trouble to one functional module or another can be accomplished, in some situations, by examining the interfaces between modules.

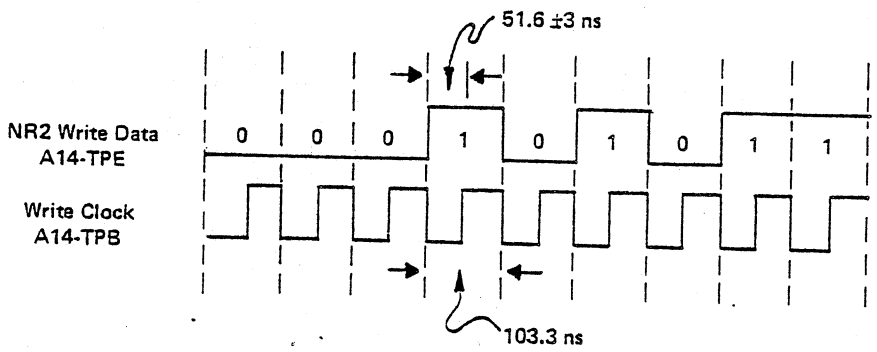


Fig. 10-1 Write Data/Write Clock

The remaining paragraphs in this Troubleshooting subsection suggest some techniques for gathering symptomatic information, for troubleshooting by unit or board replacement, trouble isolation by testing interfaces, and where necessary, troubleshooting printed wire boards.

11.1 Information Provided by Software

The standard RTMOS software reports unrecoverable Moving Head Disc errors through its Corrective Action subsystem, with considerable information as to the Bulk Memory Controller, Disc Adapter, Disc Unit, unit address, core or main memory address, and type of error. In normal on-line operations, the error printouts by the Corrective Action subsystem usually provide the first indication that troubleshooting is needed.

In some situations, it may be possible to isolate a trouble reported by the standard on-line software to a particular Disc Unit, and to exchange units, or take a suspected unit off-line temporarily, remove Disc Unit power and replace boards, and then return the unit on-line and try again. However, it is more likely that it will be necessary to take the computer system off-line to continue troubleshooting. The standard software's report of trouble can then be verified and additional information obtained by loading and running the 51191037 test program. In some instances, it may be possible to leave the system on-line while troubleshooting by examining the interfaces, but great care must be taken not to disrupt connections or to cause inadvertent misconnections.

For additional information on specific information provided by the standard software, refer to Section 3 of the RTMOS Application Manual, and to Special Discussion 13 in that manual. PTS-038 is the RTMOS Application Manual for General Software Releases 110 and 150 and PTS-051 is the RTMOS Application Manual for General Software Release 160. The edition of the manual shipped with the system will match the software release.

11.2 Information Provided by Hardware

At the completion of each operation, whether successful or not, the Disc Controller (Bulk Memory Controller and Disc Adapter) stores information on the outcome of the operation in CW1 and CW2 of the 4-word Entry Table segment related to the request for a transfer. CW1 contains information on the last cylinder, head, and sector read from or written into and CW2 contains a termination status number in bits 23 through 16. Bits 7 through 0 of CW2 contain a count indicating the number of sectors transferred. Since the termination status indications vary with the operations performed, and are already fully described in the 4400 or 4500 General Description, they are not repeated here. The General Description will be found in the first section of each Computer Maintenance Manual. Section 21 in the 4400 General Description covers the Moving Head Disc Subsystem. It is covered in Section 6 of the TDC 4500 General Description.

11.3 Exerciser Programs

The Moving Head Disc Test Program, 51191037, contains a facility for executing single or repeated transfers on user-defined disc addresses. The many operational features of this subsystem and resultant complexity make it impractical to use hand-loaded exerciser programs, and the facility in the test program is quite easy to use.

11.4 Interfaces

The Moving Head Disc Subsystem consists of three major functional areas: (1) the Central Processor, (2) the Disc Controller (Bulk Memory Controller and MH Disc Subcontroller), and (3) the Disc Unit(s). One of the first problems in troubleshooting this subsystem is deciding which of these three major areas most likely contains the trouble. Often, it is possible to make this decision by examining the interfaces between these areas with an oscilloscope or voltmeter. The interface between (1) and (2) is, of course, the GENIE Bus. It is described in the GENIE Bus Controller theory, publication no. ACPU1GC-T. The interface between (2) and (3) is described in Table 3.1 of the MPI Hardware Reference Manual.

These interfaces can be exercised by the test program or by the standard on-line software.

11.5 Troubleshooting in the Disc Controller

Troubles within the Disc Controller can usually be isolated with the least difficulty through board exchanges. This can be especially effective when a full set of replacement boards is available, either as spares, or in the presence of a second Disc Controller or a second TDC 4500 or HS4400 process computer system with its own Disc Controller. An examination of the trouble symptoms may help in determining which of the four boards is the best candidate for exchange. This may be related to the major function of each board, or may be determined by reference to the block diagrams of each board, which are provided in the early pages of each logic drawing:

- AAXGIG1, GENIE Bus Interface, logic drawing 51300751
- AAXFEG1, Firmware Engine, logic drawing 51300751
- AAXECU1, Error Correction Unit, 51300724
- AAXMHC1, Moving Head Disc Controller, 51300753

11.6 Troubleshooting in the Disc Unit

Section 3, Corrective Maintenance, in MPI's Hardware Maintenance Manual, provides basic information

needed in isolating troubles within the Disc Unit (Storage Module Drive), and it strongly infers that the first troubleshooting steps needed are checks on the various adjustments. It may be useful to check the adjustments, but in general, no adjustment should be changed unless you have a good reason to believe that readjustment is needed.

As with all TDC 4500 and HS4400 hardware subsystems, the most effective approach to troubleshooting in the Disc Unit is probably through board exchanges, especially if a full set of spare boards is available or another Disc Unit is available. Isolation of troubles to particular boards may be facilitated by reference to MPI's Hardware Reference Manual, initially to the material under the "Fault Detection" heading in Section 3 of that manual.

Conversations with MPI Field Service Representatives have yielded the following suggestions for care and feeding of the Disc Units:

- Do not open the lid to access the disc packs until the pack has stopped turning. This defeats the purpose of the absolute air filter, which is supposed to keep contaminants from the disc pack and heads.

- Do not clean the disc pack or heads routinely as was necessary on earlier disc units used on Honeywell process computer systems. Cleaning is normally not necessary and requires special training and practice. See the note under 7. Preventive Maintenance.

- The most critical areas of concern are probably the drive motor and the servo power amplifiers. The drive motor has a thermal cutout that must be allowed ample time to cool after it has tripped, before the motor can be restarted. The power amps are easily shorted out during troubleshooting. This will usually blow their fuses, which should be replaced only with fuses of the same type. Refer to fuse markings or to the parts list in the MPI Hardware Maintenance Manual.

- Areas needing careful evaluation in the event of addressing or positioning errors are the servo control signals which consist of (1) a position error signal and (2) a velocity error signal. When the heads are in the desired position, (1) and (2) are equal and opposing. There are two operating modes for the head positioning system (a) coarse (high acceleration and speed, except for travel through the last half-track) and (b) fine for the last half-track and while holding on a track.

- If the Disc Unit Fault indicator comes on the Operator Panel but no fault indicator on the Maintenance Panel is lit (see Fig. 2-1 and Table 2-1 in MPI's Hardware Reference Manual), a servo tracking fault probably occurred. This indication (as well as the others) can be cleared by the FAULT CLEAR switch on the board in card slot A05.

- If you lift the lid on the Disc Unit while the drive is running and the pack is turning, the heads will retract and the pack will stop turning. This is not recommended because contaminated air will be drawn into the pack and because the "emergency" retraction puts extra stress on components. The pack should be allowed to come to a complete stop before lifting the lid.

- If the Disc Drive blower motor fails, the heads will crash, probably damaging the heads and the disc pack. Both heads and pack must be replaced after a head crash.

Troubleshooting below the board replacement level in the Disc Unit will require a good understanding of its theory of operation, which is described in detail in MPI's Hardware Reference Manual. Schematics and logic drawings are provided in MPI's Hardware Maintenance Manual.

12. PARTS

Replaceable parts for the Disc Controller are listed on the PWB parts lists which are included with the board drawings in the PWB binders shipped with each 4500 or 4400 process computer system incorporating the Moving Head Disc.

Replaceable parts for the Disc Units are listed in MPI's Hardware Maintenance Manual.

Replaceable parts for the MHD Subsystem cables are listed on the cable drawings parts lists under the "Cables and Wiring" tab in the System Drawings binders, shipped with each computer system incorporating the Moving Head Disc. The cable model numbers appear on Fig. 5.1 in this publication.

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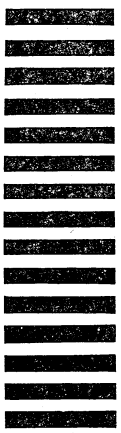

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