CARTRIDGE DISC MEMORY DIAGNOSTIC 7900/7901/13210

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CARTRIDGE DISC MEMORY

This diagnostic test program confirms proper output, input and control functions for the Cartridge Disc Memory, providing rapid checkout of the controller and exhaustive testing of the drive. The test operator runs the program under the default mode or defines his own tests with teleprinter and switch register options. Up to four drives can be checked serially. Interaction between drives is also tested. This diagnostic does not check more than one controller.

HARDWARE CONFIGURATION

This diagnostic program requires an HP 2100 series computer with DMA and at least 8192 words of core. The Cartridge Disc Memory has two parts: the HP 7900A or 7901A Disc Drive and the HP 13210A Disc Drive Interface Kit. A teleprinter is required; the teleprinter interface must be in a lower priority (higher numbered) I/O channel than the disc drive interface if the interrupt chain is to be checked.

OPERATING PROCEDURES

a. Load the SIO driver for the teleprinter.

b. Configure the SIO driver for the teleprinter.

c. Load this program using the Basic Binary Loader.

d. Load start address to 000002_8.

e. See Table CDM-1 for proper switch settings.

f. Push RUN.

g. The program will halt with 107077 in the T-register.

h. Load address 100_8.

i. Select desired options from Table CDM-2 by setting the appropriate bits of the switch register. If any pack being used is not formatted, use the operator design section described in Appendix A, item 9.

j. Press RUN.

k. The diagnostic will type its preamble and then run a short test on each of the three I/O channels being used.

l. If bit 2 of the switch register is set to one, the program will print the cylinder table (the 10 cylinders used if bit 6 of the switch register is set) and the pattern table (the 10 patterns used by S2). Both tables may then be changed. New table entries are placed at the top of the table, and the last entry is lost. The tables are reprinted if they are changed. At this point, the heads are selected. Heads 0 and 1 refer to the removable pack. Heads 2 and 3 refer to the fixed pack (non-existent on a 7901). The program will then loop until bit 2 is reset to zero.

m. If bit 8 of the switch register is set to one, the program requests the unit numbers of the available units to be input from the teleprinter. The program will then loop until bit 8 is reset to zero.

n. If bit 3 of the switch register is set to one, control is given to the operator design program (see Appendix A).

o. The program will execute S1 through S6. If multiple units are present, each unit will be tested serially before the multiple unit tests are run. Each drive is therefore initialized by S4. The program then verifies that overlap of seek commands functions properly.

p. The cycle count is incremented and then reported on the teleprinter. Step 1 is entered next.

PROGRAM ORGANIZATION

The diagnostic requires a configured SIO driver for the teleprinter. Table CDM-1 shows the select codes necessary for configuring the diagnostic. Table CDM-2 shows switch register settings to be used following configuration.

The program reports disc errors on the teleprinter. Disc error reports include current operation, error, and current disc address.

Unexpected interrupts form a special class of errors; no message is typed. The trap locations contain 1060XXB, where XX is equal to the trap location. Analysis of these errors is beyond the scope of this diagnostic. No recovery mechanism is provided.

Figure CDM-1 is a flow chart of the diagnostic subroutines and the respective execution sequence. Each diagnostic subprogram is briefly described.

SUBROUTINE	DESCRIPTION
INIT	This routine configures each I/O instruction. The I/O channel select codes are obtained from the switch register. The contents of the switch register are saved and used during the program.
START (AGAIN)	This routine has two entry locations. The second entry name, AGAIN, allows the test to be restarted without printing the preamble (HØ) if S7 is aborted. The program verifies that the loader is disabled, initializes trap cells and variables then tests the ability to set and clear flags and control bits, and tests interrupt operation of the teletype interface board and the two disc interface boards. Status is requested from units Ø, 1, 2 and 3 to clear any attention bits which may be set. A seek operation to clear any seek errors is performed on any drive that is ready.
SØ (WRAD)	This routine writes addresses on the disc and checks operations that relate to pack addressing. The tests occur in the following sequence: a. Set OVERRIDE switch. b. Place write lockout bit on cylinder zero, read cylinder zero (checking for flagged cylinder indication) and cyclic check cylinder zero (checking for flagged cylinder indication). c. Place defective cylinder bit on cylinder one. d. Clear OVERRIDE switch. e. Read cylinder one (checking for address error, flagged cylinder and any error indications). f. Write cylinder zero (checking for flagged cylinder and any error indications). g. Write address on cylinder zero (checking for flagged cylinder and any error indications). h. Set OVERRIDE switch. i. Initialize entire pack. j. Clear OVERRIDE switch. k. UNLOCK drive. l. Check for not-ready and any error indications. Issue a seek to check that the controller sets the command flag immediately if the disc drive is not ready. m. Ready drive.

SUBROUTINE	DESCRIPTION
SØ (WRAD)	n. Test attention bits when heads load.
	o. Perform a seek operation and test for first seek bit in status.
	p. Test POPIO line with preset switch.
	q. Set DATA PROTECT switch.
	r. Attempt to write data on the disc and then verify that no data transfer took place. Check status.
	s. Clear DATA PROTECT switch.
	Many interface lines are only tested in SØ. Among these are control bit 8, status bit 3, status bit 6, status bit 14 and POPIO.
S1	This section tests most controller functions using short reads and writes. The tests occur in the following sequence:
	a. Check status.
	b. Seek to cylinder zero.
	c. Write addresses (SØ) if requested.
	d. Seek and check status for busy indication.
	e. Seek to cylinder 203 and check status for seek-check and any error indications.
	f. Seek while a seek is in progress, then check status for seek-check and any error indications.
	g. Seek to cylinder zero and write one sector at sector zero.
	h. Change RAR to sector seven and write two sectors.
	i. Change RAR to sector zero, read one sector and check against data that was written.
	j. Change RAR to sector seven, read two sectors and check against data that was written.
	k. Change RAR to sector seven; refine one sector, change RAR to sector seven, read one sector and check against data that was written.
	l. Change RAR to sector 21 and write four sectors causing the track to be changed.
	m. Change RAR to sector 0 and attempt to cyclic check one sector too many, causing an end-of-cylinder status if the cyclic check counter counts correctly.
	n. Change RAR to sector 21, read four sectors and check against data that was written.
	o. Change RAR to sector seven and lower track.

SUBROUTINE	DESCRIPTION
S1 (Continued)	p. Force overrun following write of two words.
	q. Change RAR to sector 21 (lower track) and write four sectors. The end of cylinder indication and any error indication are expected.
	r. Verify command bit 14. Cyclic check becomes read if bit fails.
	s. Change RAR to sector seven (lower track) and read thirty words. Check zero fill and verify that the word causing overrun was not written on the disc.
	t. Change RAR to sector 21 (lower track) and read four sectors. The end of cylinder indication and any error indication are expected. Check the three sectors read against data that was written.
	u. Change RAR to cylinder ten and read one sector. Address error and any error indication are expected.
	v. Seek to cylinder 202 and then seek to first entry in cylinder table. At head one, sector nine read one sector and verify contents. The read command is issued before the seek is complete.
S2	This section writes and reads back patterns checking for bad packs or marginal heads. The tests occur in the following sequence:
	a. Select cylinder according to switch register bit six.
	b. Perform seek operation.
	c. Skip to step m if switch register bit five is set.
	d. Perform steps e through l ten times (once for each pattern).
	e. Fill write buffer with one pattern from the pattern table.
	f. Perform step g twice (once for each head).
	g. Write on first, last and second thirds of the track.
	h. Perform steps i through l twice (once for each head).
	i. If the computer is an HP 2116, skip to step k.
	j. Read first, last, third and second fourths at the track. Skip to step l.
	k. Read first, last and second thirds of the track.

SUBROUTINE	DESCRIPTION
S2 (Continued)	l. The data is checked against that written following each read. m. Select next cylinder according to switch register bit six. Skip to step b until all cylinders to be tested have been tested.
S3	This section writes and reads back random data from random locations to check seek and data transfer operations. The tests occur in the following sequence: a. Perform steps b through e 1024 times (or 64 times if switch register bit 5 is set). b. Generate random cylinder, head, sector and word count. Prevent end of cylinder error by reducing the word count if necessary. c. Generate a buffer of random data and store a word of zero in the first unused word. d. Perform seek and write operations. e. Reset the RAR, read back the data just written and check for errors.
S4	This section fills the pack full of checksummed data for S5. Each sector is checksummed separately. The entire sector sums to zero. The first two wrods sum to the cylinder number. The next two words sum to the head/sector number. Each track is written following the same scheme used to read back patterns in S2 (steps i through k). This routine then performs cyclic checks of 1, 2, 4, 8, 16 and Ø sectors at the first entry in the cylinder table. The nonzero sector counts will result in an "end-of-cylinder" status indication should any bit of the sector counter fail to set. The zero sector count will fail to result in an "end-of-cylinder" status indication should any bit of the sector counter fail to clear.
S5	This section reads one sector after a random seek and verifies checksum, cylinder, head and sector numbers. The operation is repeated 8192 times (or 256 times if switch register bit 5 is set).
S6	This section runs multiple unit test if at least two units are present. The seeks overlap. The read check is the same that S5 performs. The multiple unit test is not run until each unit under test has run through S4. Pack switching (between fixed pack and removable pack) occurs at the completion of this section. This section is time-dependent and cannot be single cycled.

SUBROUTINE	DESCRIPTION
S7 (OPDSN)	This section is entered by setting switch 3 to 1. Special test routines are written and inserted. After running, or aborting, control is returned to AGAIN. (See Appendix A.)

TIMING

If bit 5 of the switch register is set, each cycle takes less than two minutes to complete. If bit 5 of the switch register is not set, each cycle takes about 26 minutes to complete.

STATUS CHECKS

Bit 15 of the status word is masked off for all status operations. Status checks are performed by matching the status word bit by bit with the expected status.

CORE USAGE

The maximum buffer size for DB or RD in S7 is 1024 words.

The configuration portion of the diagnostic is located in the write buffer. Location 2 is lost once the I/O boards have been tested in START.

Overflow will not occur until at least 150 instructions are input. (Erased labels count as instructions.) This minimum is increased to 200 instructions if the teleprinter driver is loaded outside of 8K.

Signals Not Tested

The following interface lines are not tested by the diagnostic: PON, status bit 1, status bit 9, status bit 11, status bit 12 and status bit 15. Also, W9 of the data interface board causes no direct errors if missing. PON is not tested due to hardware which fails to detect lack of power initially.

Initial Interrupt

Whenever the heads load on any unit, an interrupt occurs (the command channel flag sets). This interrupt is not expected by the diagnostic. The diagnostic should be restarted whenever a new unit is introduced to the system.

ERROR ANALYSIS

All messages to the operator typed on the teleprinter are prefixed by a letter and a number. If the letter is an H, the message is an operating instruction or comment. If the letter is an E, the message is an error condition. The number prefix is the condition code.

Looping is provided throughout the program. Except for operations that depend upon prior operations, the program will loop on the last operation; necessary tests are included in the loop. The desirability of a previous seek operation prevents the program from looping on reads and writes. This problem may be averted by designing loops in S7. Table CDM-4 contains Status Word Bit definitions.

Error Halts

Location 111B contains the starting address of the current test or tests.

Table CDM-3 contains the program messages.

TABLE CDM-1
SWITCH REGISTER CHARACTERISTICS DURING CONFIGURATION

Bits	Function
0 - 5	Select code for the I/O channel containing the teleprinter (must be higher than the disc drive I/O channel select code if the interrupt chain is to be checked).
6 - 11	Select code for the I/O channel containing the disc interface 1 printed-circuit assembly (13210-60004) for the disc drive. (Disc interface 2 assembly is the next higher select code.)
12	If the computer is a 2100 or 2116, set bit 12 to zero. If the computer is a 2114 or 2115, set bit 12 to one.
	Note Timing messages will not be accurate on an HP 2100 Computer since the diagnostic timing is based on the cycle time of the HP 2114/2115/2116 Computers.
13	Spare.
14	If DMA channel 6 is to be used, set OFF. If DMA channel 7 exists and is to be used, set ON.
15	Spare.

TABLE CDM-2
SWITCH REGISTER CHARACTERISTICS FOLLOWING CONFIGURATION

Bits	Function
0 - 1	Spares (Used only by CE in S7).
2	If set to one, alter cylinder table and/or pattern table and/or select heads.
3	If set to one, execute operator design program (OPDSN).
4	If set to one, execute write address test SØ before S1.
5	If set to one, shorten test in S2, S3, S5 and S6.
6	If set to one, restrict cylinder selection.
7	If set to one, repeat last section.
8	If set to one, multiple drives are to be tested.
9	If set to one, halt after each section of the program.
10	If set to one, all non-error messages for the teleprinter will be suppressed.
11	If set to one, all messages for the teleprinter will be suppressed.
12	If set to one, and bit 10 and bit 11 are set to zero, timing messages will be printed in S2 and S5. Note Timing messages will not be accurate on an HP 2100 Computer.
13	If set to one, loop on last operation.
14	If set to zero, program will halt after each error.
15	If set to one, program will come to an orderly halt.

NOTES:

1. When all switches are set to zero, disc drive 0 is tested in the long mode (26 minutes per pass). The program will halt on each error and will exercise the entire removable disc pack.

2. To test the fixed disc or both discs, set switch 2 at step i of the operating instructions. If heads 0 and 1 are selected, the removable pack is tested. If heads 2 and 3 are selected, the fixed pack is tested (non-existent on 7901). Both discs may be tested alternately by selecting the third option. This selection is reset to heads 0 and 1 in subroutine S7.

3. To test other drives or multiple drives, switch 8 may be set at step i of the operating instructions. One drive will be tested each pass. The multiple drive test (S6) is performed after each drive has been tested.

4. To test the controller without testing the entire disc pack, set switches 5 and 6 at step i of the operating instructions. Each pass takes only a few minutes, but the controller is exercised as before.

5. Any time switch 5 is set, S2, S5 and S6 are shortened. S3 is also shortened if switch 5 is set when S3 starts.

6. When switch 6 is set, H53 is never printed. Switch 6 does not affect S1.

7. Switch 13 allows the program to loop. It should be used when errors are occurring except in S5 and S6.

8. To restrict cylinder selection to a different set of values than are initially in the cylinder table (0, 1, 2, 4, 8, 16, 32, 64, 128, 202) set switch 2 at step i of the operating instructions. These are the only cylinders used when switch 6 is set (and switch 3 is not set). The cylinder table is a push-through stack.

9. To use other patterns than the ten initially in the pattern table (octal: 000000, 177777, 125252, 052525, 007417, 170360, 162745, 163346, 155555, 022222) set switch 2 at step i of the operating instructions. The pattern table is used to write and read back ten patterns in each word of the pack in S2. The pattern table is a push-through stack.

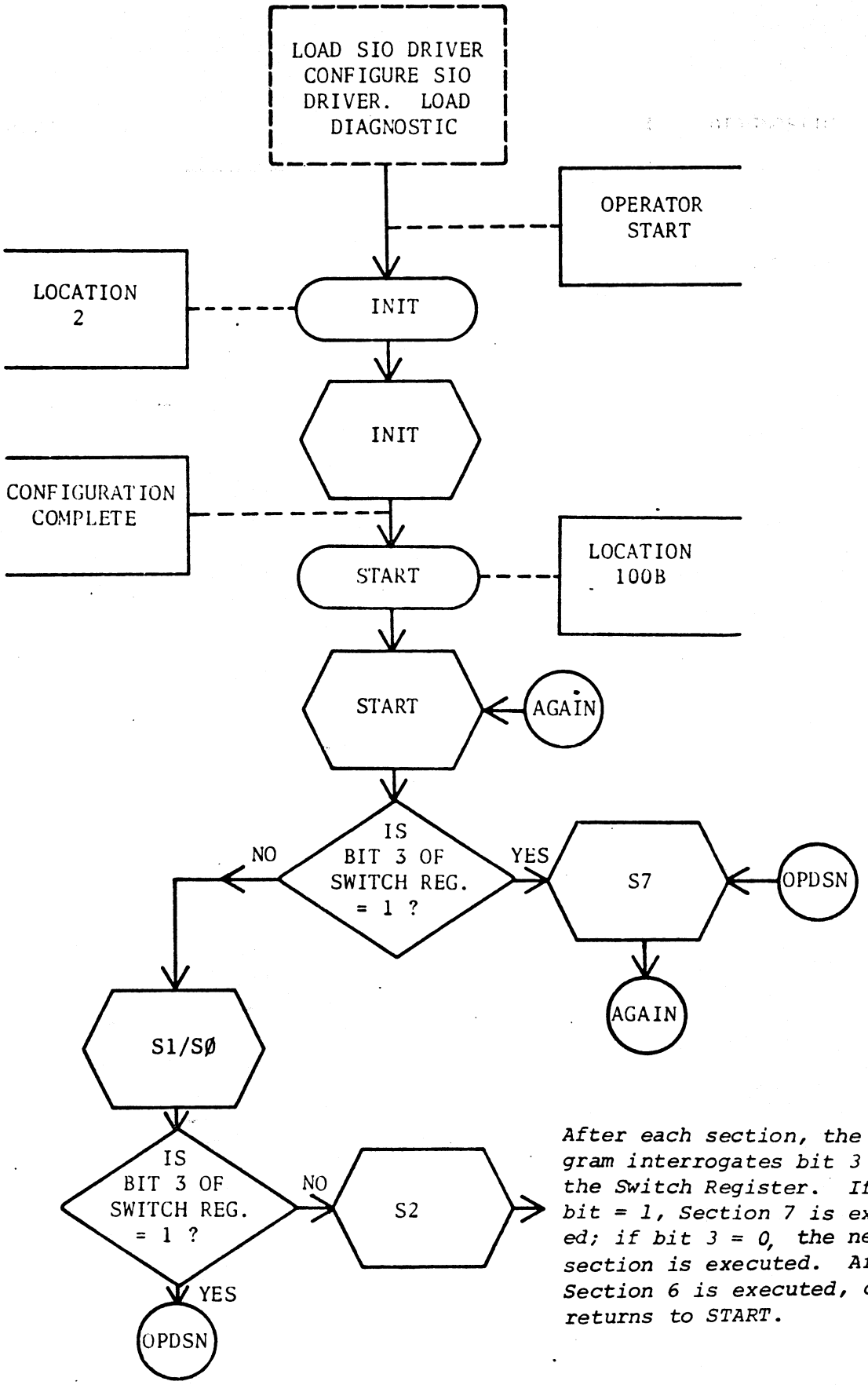
10. There are two options at the end of each section: First if switch 9 is set to one, the program will halt; if switch 7 is set to one, the section is repeated.

11. To run the tests without error reporting, set switches 11 and 14 to one.

12. Switch 4 causes S0 to be executed. These tests are not performed anywhere else in the program since they require user assistance. Switch 12 permits timing messages to be printed in S2 and S5.

13. If the user is running the operator designed section (S7) and executing a program he has created, he may regain control by resetting switch 3 (return to SØ) or by quickly resetting switch 3, then setting it again (return to operator design program). This method is valid whenever the program is running (neither halted nor reporting an error on the teleprinter).

14. Switches 0 and 1 are used by the customer engineer to help align the heads and assure drive compatibility.



After each section, the program interrogates bit 3 of the Switch Register. If this bit = 1, Section 7 is executed; if bit 3 = 0, the next section is executed. After Section 6 is executed, control returns to START.

Figure CDM-1. Program Flowchart

TABLE CDM-3

DIAGNOSTIC MESSAGES

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
1060XX	------	(none)	Trap cell interrupt. P = memory address when interrupted, XX = trap cell location.
10201X	------	(none)	Halt between sections (X = section number).
102004	------	(none)	Orderly halt.
102077	------	(none)	Halt at end of program.
107077	------	(none)	Halt at end of configuration.
----------	H0	CARTRIDGE DISC MEMORY DIAGNOSTIC	Preamble.
102001	E1	DISABLE LOADER	Precaution.
102001	E2	CLF OR SFS FAILED-CHANNEL XX	Test the ability to clear flag and test the SFS instruction on channel XX. Will not print with bad teleprinter.
102001	E3	SFC FAILED WITH FLAG CLEAR-CHANNEL XX	SFC instruction did not skip with flag clear.
102001	E4	STF OR SFC FAILED-CHANNEL XX	Test the ability to set the flag and test the SFC instruction on channel XX.
102001	E5	SFS FAILED WITH FLAG SET-CHANNEL XX	Test the SFS instruction with the flag set. Will not print with bad teleprinter.
102001	E6	NO INTERRUPT ON CHANNEL XX	Test the interrupt capability.
102001	E7	WRONG RETURN ADDRESS - CHANNEL XX	Address stored during interrupt is incorrect.
102001	E10	NO COMMAND FLAG	A flag expected on the command channel to indicate operation complete did not occur.
102001	E11	LATE DATA FLAG	A device flag was expected on the data channel and did not occur until after 90 microseconds.

TABLE CDM-3. (cont.)

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
102001	E12	NO DATA FLAG (GETTING STATUS)	This message is typed by the status routine when the device flag on the data channel was not set to indicate that the status was returned.
102001	E13	XXXX WORDS TRANSFERRED YYYY EXPECTED	When the operation complete device flag occurred on the command channel, the DMA transfer was not complete. If no words were written on a write, this message reports that one word was written.
102001	E14	NO COMMAND FLAG (USING DMA)	A transfer using DMA was in progress, and a command channel flag indicating operation complete did not occur.
----------	H15	ADDRESS RECORD IN SX	Current operation is address record.
----------	H16	OVERFLOW	Work space, between end of read buffer and end of 8K of core or beginning of teletype driver which ever is less, is full.
----------	H17	DUPLICATE LABEL	Last label input has previously been defined.
----------	H20	UNDEFINED INSTRUCTION	Last instruction input is not valid.
102001	E21	MISSING OR DUPLICATE ATTENTION BIT	The attention bits have not been set in one of the correct sequences. The unit number in H51 is the last unit selected.
----------	H22	CYCLIC CHECK IN SX	Current operation is cyclic check.
----------	H23	READ CHECK IN SX	Current operation is software verification of data read previously.
----------	H24	CYLINDER TABLE XXX, XXX, XXX, XXX, XXX, XXX, XXX, XXX, XXX, XXX	Contents of cylinder table.

TABLE CDM-3. (cont.)

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
----------	H25	WISH TO ALTER TABLE?	Operator types: Y or N
----------	H26	ENTER CYLINDERS SEPARATED BY COMMAS	Operator types, all on one line.
----------	H27	PATTERN TABLE XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX	Contents of pattern table. (XXXXXX = pattern in octal).
----------	H30	ENTER PATTERNS SEPARATED BY COMMAS	Operator types, all on one line.
----------	H31	INPUT ERROR	Bad input from teleprinter.
102002	H32	RESET SWITCH 2	Operator resets switch register bit 2.
102002	H33	RESET SWITCH 8	Operator resets switch register bit 8.
----------	H34	ENTER UNIT NUMBERS (0 - 3) SEPARATED BY COMMAS	Operator types, all on one line.
----------	H35	INITIAL STATUS	Current operation is first status command.
----------	H36	WRITE ADDRESS IN SX	Current operation is write address.
----------	H37	READ AFTER WRITE ADDRESS IN S0	Current operation is read. Previous operation was write address.
----------	H40	READ UNIT XX	Operator should place the indicated unit on-line. (XX = unit number.)
----------	H41	READ DEFECTIVE TRACK IN S0	Current operation is check for defective cylinder indication.
----------	H42	WRITE PROTECTED TRACK IN S0	Current operation is check for protected cylinder indication.
----------	H43	UNIT XX NOT READY. CHECK IN SØ	Current operation is check unit XX for unlocked indication.
----------	H44	SEEK IN SX	Current operation is seek.
----------	H45	WRITE IN SX	Current operation is write.

TABLE CDM-3. (cont.)

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
[illegible]	H46	READ IN SX	Current operation is read.
102001	E47	DATA WORD XXXX IS YYYYYY SHOULD BE ZZZZZZ	The data returned on a read operation did not match the expected data. This message is typed only for the first erroneous word in the buffer (except for CB in S7).
----------	H50	OVERRUN IN S1	Current operation is a forced overrun following a write of two words.
----------	H51	CYL XXXX HEAD XX SECTOR XX WORD COUNT XXXX UNIT XX	This message appears with most error printouts. It reports the current contents of software variables.
102001	E52	BUFFER CHECKSUM XXXXXX CYL XXXXXX (YYYY) HD/S XXXXXX (H=YY S=YY)	The checksum should be zero and the address in parenthesis (decimal) should match the one typed out in the next H51. (XXXXXX=values in octal.) Either the wrong sector was read or a data error occurred. See Note.

NOTE: *Each sector is checksummed separately. The entire sector sums to zero. This six-digit octal sum is reported as the buffer checksum.*

The first two words sum to the cylinder number. This six-digit octal sum is reported as the cyl. In addition, the four-digit decimal equivalent is shown in parenthesis. This equivalent is meaningless if the sum is an invalid cylinder number.

Words two and three sum to the head/sector number. The head is in the left half of the word and the sector is in the right half. This six-digit octal sum is reported as the HD/S. The decimal equivalent for each is shown in parenthesis. These values may also be meaningless for an invalid head or an invalid sector.

----------	H53	AVERAGE MINIMUM SEEK TIME XX.X	Time is in milliseconds. Seek covers one cylinder (length = 1).
----------	H54	AVERAGE RANDOM SEEK TIME XXXX.X, LENGTH XX.XX	Time is in milliseconds and length is in cylinders.
----------	H55	ENTER INSTRUCTIONS	Request for input in S7. (See Appendix A.)

TABLE CDM-3. (cont.)

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
----------	H56	UNDEFINED LABEL XX	Operator must define label or erase reference.
----------	H57	OVERRUN CHECK IN S1	Current operation is a read to check zero fill on the previous operation (which forced overrun).
----------	H60	REFINE IN SX	Current operation is refine record.
----------	H61	READ AFTER REFINE IN S1	Current operation is a read of a previously refined sector.
----------	H62	TYPE A FOR HEADS 0, 1; B for 2, 3; C for ALTERNATELY 0, 1 THEN 2, 3	Select heads. (A = disc pack, B = fixed disc, C = both.)
102001	E63	NO DATA FLAG	A device flag was expected on the data channel and did not occur.
102001	E64	STATUS IS XXXXXX SHOULD BE XXXXXX	The status operation did not return the expected status. Values are in octal.
----------	H65	PASS XXXX	Number of cycles completed. (One cycle is one pass through S1 to S5.)
102002	H66	SET OVERRIDE SWITCH PUSH RUN	Operator request in S0.
102002	H67	CLEAR OVERRIDE SWITCH PUSH RUN	Operator request in S0.
102002	H70	UNLOCK UNIT XX, PUSH RUN	Operator should place the indicated unit off-line.
102002	H71	PRESS PRESET THEN PRESS RUN	To test POPIO line.
102002	E72	UNIT X NOT READY	Not ready bit in status word indicates drive is not ready for one of the following reasons: a. Drive not on line. b. Drive not up to speed and heads not yet loaded. c. Drive fault.

TABLE CDM-3. (cont.)

T-REGISTER	CONDITION CODE A-REGISTER	MESSAGE	TEST DESCRIPTION or OPERATOR ACTION
----------	H73	DATA PROTECT IN S0	Current operation is a check of the DATA PROTECT switch for the appropriate disc.
102077	H74	UNLOAD, PROTECT X/D, LOAD, PUSH RUN	Operator request in S0. The disc drive must be ready before RUN is pushed.
102077	H75	CLEAR X/D PROTECT, LOAD, PUSH RUN	Operator request in S0. The disc drive must be ready before RUN is pushed.

TABLE CDM-4
STATUS WORD BIT DEFINITIONS

BIT — STATUS INDICATION

0 Any Error - The bit will be set whenever any of the following status word bits are on:

- Bit 1: Data Error
- Bit 2: Drive Busy
- Bit 3: Flagged Cylinder (when write operation attempted and override switch not on)
- Bit 4: Address Error
- Bit 5: End of Cylinder
- Bit 6: Not Ready
- Bit 8: Seek Check
- Bit 10: Write Protected (when write operation attempted)
- Bit 11: Drive Unsafe
- Bit 13: Overrun
- Bit 14: First Seek

1 Data Error - Access ready went low during data transfer or data error was detected by the error detection circuitry.

2 Drive Busy - Drive is in a seek mode or is not ready.

3 Flagged Cylinder - Cylinder being processed is write protected or defective or the initialize data command has been issued with the override switch off.

TABLE CDM-4. (cont.)

BIT	STATUS INDICATION
4	Address Error - The address read from the track does not compare with the contents of the RAR. Set for defective cylinder indication.
5	End of Cylinder - The CPU has attempted to extend a data command across a cylinder boundary.
6	Not Ready - Heads are not loaded on the selected drive.
8	Seek Check - Drive has detected illegal cylinder or sector transfer or a cylinder transfer was attempted while drive was already accessing or an attempt has been made to access head 2 or 3 on a 7901.
10	Write Protected - Write protect switch in the selected drive is on.
11	Drive Unsafe - Drive has detected unsafe condition in the Read/Write or servo system.
13	Overrun - A late data response has been detected.
14	First Seek - Drive has gone from not ready to ready.

APPENDIX A

OPERATOR DESIGN PROCEDURE

1. Program will type "H55 ENTER INSTRUCTIONS" (Table CDM-3).

2. Enter instructions in their execution sequence. Select instructions from the list in this Appendix. Commas separate fields. A field is defaulted if it is excluded from the instruction or skipped by the instruction.

   Example: "SR" seeks cylinder 0, head 0 and sector 0.
   "SR,,1" seeks cylinder 0, head 1 and sector 0.
   "SR,202,3,11" seeks cylinder 202, head 3 and sector 11.

   Complete the line with a CARRIAGE RETURN and a LINEFEED.

3. If any error has occurred, the message "H31 INPUT ERROR" will be typed. The erroneous entry has been rejected and should be typed again.

4. RUBOUT may be used to erase the present entry before the LINEFEED has been sent. EE (Erase Entry) erases the last line in the input string. The instruction may be repeated to erase multiple lines.

5. The AR,CD,DS,ID,IS,RD,RR,RS,SR and WD instructions include a software status check unless they are followed by a SC instruction. The expected status is zero. The SC instruction allows use of a different expected status.

6. Field limits are as follows:

   a. $0 \leq$ Cylinder ≤ 202

   b. $0 \leq$ Head ≤ 3 (or $0 \leq$ Head ≤ 1 for 7901)

   c. $0 \leq$ Sector ≤ 23

   d. $1 \leq$ Read or Compare Buffer Size ≤ 1024

   e. $1 \leq$ Write Buffer or Check Data Count ≤ 6144

   f. $0 \leq$ Unit Number ≤ 3

   Except for type d, no limit checks are made on numerical fields. If the limits are exceeded, fields may merge and produce unusual results (especially cylinder, head and sector). All numerical fields are decimal unless specified as octal in the instruction list.

7. Any time bit 3 of the switch register is reset, control is given back to START when the next instruction is reached.

8. An EN or LP instruction will be rejected if undefined labels exist.

9. To initialize a pack on drive X, use the following input:

```
SD,X
IS
ID
LP
```

10. Labels are exactly two characters. All printing characters are legal. Spaces are skipped.

11. No facility is provided to restart programs.

12. Following an H16 overflow message, the program may be shortened by using the EE instruction or completely erased using the EP instruction.

13. Sample Program

SD,Ø	Select drive 0.
DB,,127236	Form a 128-word write buffer using the octal pattern 127236.
SR,97,1,4	Perform a seek operation to cylinder 97, head 1 and sector 4.
WD	Transfer 128 words of the write buffer into one sector at the above address.
LB,NN	Label
SR,97,1,4	Perform a seek operation to cylinder 97, head 1 and sector 4.
RD	Transfer 128 words from the above disc address into the read buffer.
CB,,1Ø	Compare the read and write buffer. The first ten words which do not compare are reported.
GO,NN	Return to label.
EN	End

NOTE: Brackets in the following instruction list indicate fields that may be omitted. The example above does not show brackets; it shows instructions as they would appear in a program.