Model DC-292

Cartridge Disk Controller

Technical Manual

Document Number: 600-417-00
Revision: C
Date: 4/30/86
Serial No.:

PREFACE

This manual contains information regarding installation, testing, and operation of the Model DC-292 Cartridge Disk Controller.

The technical contents of this manual have been written based on the assumptions that the reader 1) has a working knowledge of ROLM® minicomputers and associated operating systems with which this controller is to be installed; 2) is familiar with standard installation, power, grounding, and peripheral and host CPU cabling procedures; and 3) has access to technical information for the host CPU and disk drive to be installed with this controller.

The information in this manual is organized into five major sections:

SECTION 1.0	PRODUCT OVERVIEW - Describes the Model DC-292 Disk Controller features, capabilities, specifications, power, and interface requirements.
SECTION 2.0	INSTALLATION PROCEDURES - Describes and illustrates the procedures required to install the controller.
SECTION 3.0	TROUBLE-SHOOTING - Contains information useful in analyzing and resolving subsystem problems.
SECTION 4.0	USAGE GUIDELINES - Contains useful information for obtaining best utilization and suggestions for system initialization.
SECTION 5.0	PROGRAMMING NOTES - Contains technical information for those involved in fault analysis or programming.
APPENDIX A	SCHEMATIC DIAGRAMS
APPENDIX B	PROGRAM TEXT - Detailed instructions written by programming personnel for use with the diagnostic tape.

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1.0

PRODUCT OVERVIEW

1.1

GENERAL DESCRIPTION

The DC-292 Disk Controller provides 20 Mbyte Cartridge Drive Subsystem control of disk drives that use the standard Storage Module Drive (SMD) interface. The DC-292 EXP expansion option provides 42 Mbytes of disk storage. The Controller is packaged on a printed circuit board whose dimensions are 9 by 16 inches and is designed for installation in the drive subsystem enclosure. The host computer interface is compatible with ROLM CPU I/O bus specifications.

1.2

FEATURES

* Microprocessor-based architecture

* Capable of SMD transfer rates in excess of 1.3 million bytes per second

* Automatic error detection and correction of burst errors up to 11 bits in length

* 16-bit Cyclic Redundancy Check for sector ID verification

* Automatic retries and strobe early/late during error recovery

* Full byte synchronization of both sector ID and data fields

* Two-sector buffering

* Contiguous or interleaved sector addressing

* DMA throttling of host data transfers

* Automatic disabling of error correction during formatting to allow bad sector mapping

* Slip Formatter utilizes spare sectors to relocate sectors determined to be bad during surface analysis (non-expanded only)

* Internal diagnostics and LED error reporting

1.3

SPECIFICATIONS

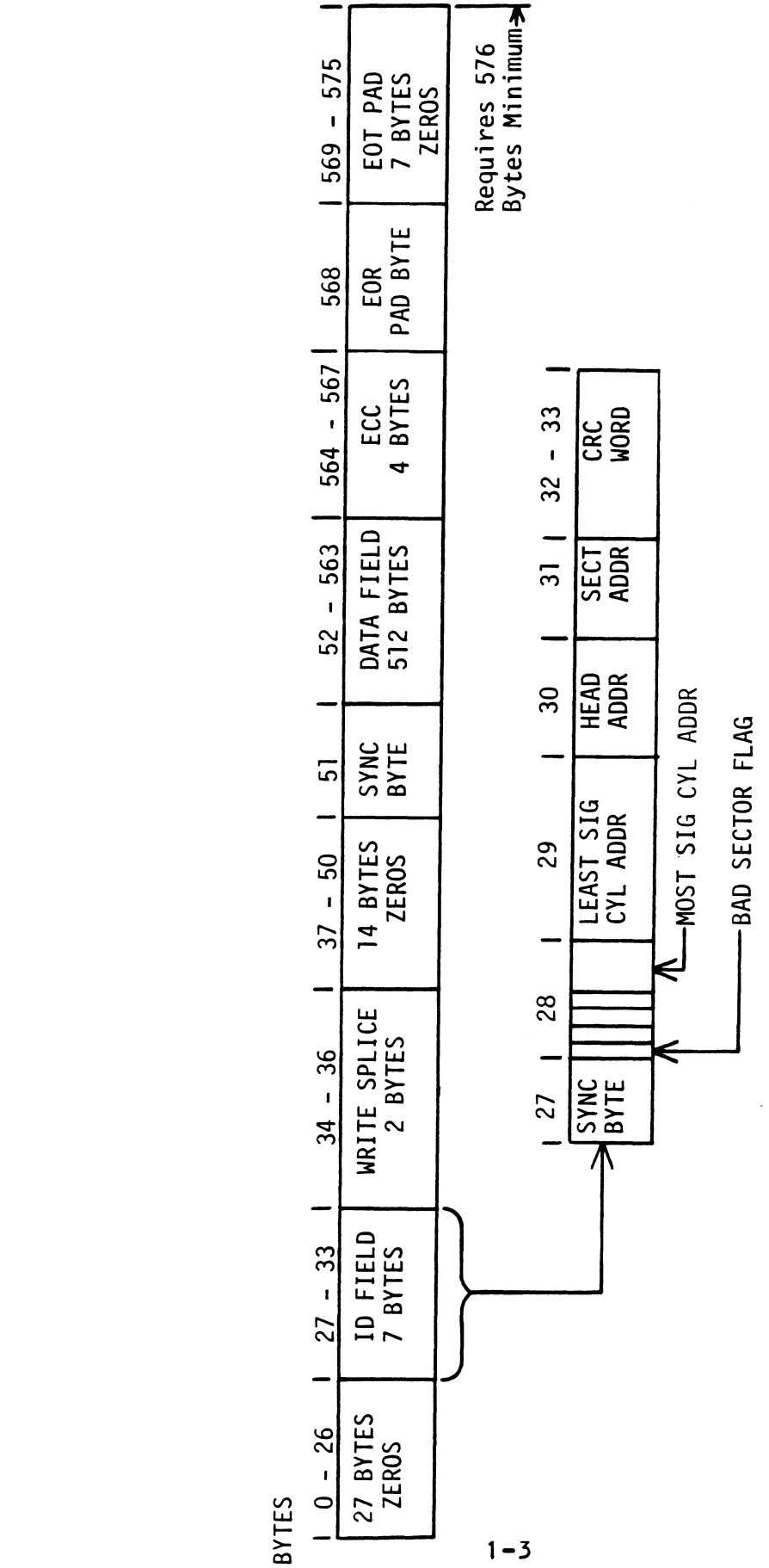
1.3.1

FUNCTIONAL

Emulation:	ROLM 3390 or Data General 6070 Cartridge Drive Subsystem or optional expanded emulation.
Device Code:	33 (primary), 73 (secondary)
Priority Mask Bit:	7
Data Channel Burst Rate:	16 words per access
Data Channel Break Period:	1 RQENB cycle between accesses
Drives per Controller:	1
Surfaces per Drive Unit:	4 (0-1 removable, 2-3 fixed)
Tracks per Surface:	408 non-expanded, 644 expanded
Sectors per Track:	24 non-expanded, 32 expanded
Words per Sector:	256
Formatted Capacity:	20, 054, 016 bytes non-expanded; 42, 205, 184 expanded
Sector Format:	576 bytes minimum required per sector. Sync bytes precede both ID and data fields. Uses 16-bit CRC for ID verification and 32-bit ECC following data. See Figure 1.1.
Sector Addressing:	Contiguous or interleaved
ID Field CRC Polynomial:	X16 + X15 + X2 + 1
Error Correction Polynomial:	Write - X32 + X23 + X21 + X11 + X2 + 1 Read (factored) - (X11 + X2 + 1)(X21 + 1)
Indicators:	Selftest LED (Red) - On during execution of internal diagnostics upon power-up. If a failure occurs during testing, LED is used to flash a code indicating the nature of the failure.

FIGURE 1.1

SECTOR FORMAT



1.3.2

COMPUTER INTERFACE

The Controller computer interface is compatible functionally and electrically with the standard ROLM I/O bus. Each signal (with the exception of Interrupt and Data Channel Priority OUT) is terminated on the Controller with a 330/390-ohm pullup/pulldown resistor pair, as required for bus expansion outside the CPU chassis. Each input itself is equal to or less than 1 unit load. Terminators add the equivalent of 9 loads to a signal, making the total approximately 10 loads per signal.

Termination resistors used on the Controller consist of SIP packages and are mounted on sockets for removal. Terminators on the Controller must be removed if a terminated repeater board is also installed in the drive subsystem enclosure. Refer to Section 2.1.1.

The 50-pin P1 and 26-pin P2 connectors on the Controller provide the interface to the I/O bus cabling. Tables 1.1 and 1.2 list the pin assignments of the connectors. Table 1.6 lists mating connectors required.

1.3.3

DISK INTERFACE

The Controller uses an SMD compatible interface capable of transfer rates in excess of 1.3 Mbytes per second. Disk drive cables attach to the 60-pin J1 and 26-pin J2 connectors on the Controller. Balanced line differential drivers and receivers (MC3450/MC3453) are used for control and data transfer. Tables 1.3 and 1.4 list disk interface pin assignments. Table 1.6 lists mating connectors required.

TABLE 1.1

CONNECTOR P1, CPU I/O-DATA PIN ASSIGNMENTS

SIGNAL NAME	HEADER P1 PIN #	RIBBON CABLE COND #	CPU "D" CONN (D1) PIN #
GRND	P1-1	1	D1-1
BDATOA	P1-27	4	D1-2
BDATIB	P1-4	7	D1-3
BINTA	P1-30	10	D1-4
BDATIA	P1-7	13	D1-5
BDATOC	P1-33	16	D1-6
/BSELB	P1-10	19	D1-7
/BSELD	P1-36	22	D1-8
GRND	P1-13	25	D1-9
/BDATA 13	P1-39	28	D1-10
/BDATA 1	P1-16	31	D1-11
/BDATA 8	P1-42	34	D1-12
/BDS4	P1-19	37	D1-13
/BDS3	P1-45	40	D1-14
/BDS2	P1-22	43	D1-15
/BDS5	P1-48	46	D1-16
GRND	P1-25	49	D1-17
BCLR	P1-2	3	D1-18
BSTRT	P1-28	6	D1-19
/BINTR	P1-5	9	D1-20
BDATIC	P1-31	12	D1-21
BDATOB	P1-8	15	D1-22
/BMSKO	P1-34	18	D1-23
/BPOWER FAIL OR /BOVRO	P1-11	21	D1-24
/BRQENB	P1-37	24	D1-25
/BDATA 9	P1-14	27	D1-26
/BDATA 15	P1-40	30	D1-27
/BDATA 3	P1-17	33	D1-28
/BDATA 7	P1-43	36	D1-29
/BDATA 12	P1-20	39	D1-30
/BDS1	P1-46	42	D1-31
/BDS0	P1-23	45	D1-32
/BDATA 10	P1-49	48	D1-33
GRND	P1-26	2	D1-34
/BDCHPOUT	P1-3	5	D1-35
/BINTPOUT	P1-29	8	D1-36
BIORST	P1-6	11	D1-37
BIOPLS	P1-32	14	D1-38
/BDCHPIN	P1-9	17	D1-39
NO CONN	P1-35	20	D1-40
NO CONN	P1-12	23	D1-41
GRND	P1-38	26	D1-42
/BDATA 2	P1-15	29	D1-43
/BDATA 6	P1-41	32	D1-44
/BDATA 14	P1-18	35	D1-45
/BDATA 5	P1-44	38	D1-46
/BDATA 11	P1-21	41	D1-47
/BDATA 4	P1-47	44	D1-48
/BDATA 0	P1-24	47	D1-49
GRND	P1-50	50	D1-50

TABLE 1.2

CONNECTOR P2, CPU DCH CONTROL PIN ASSIGNMENTS

SIGNAL NAME	HEADER P2 PIN #	RIBBON CABLE COND #	CPU "D" CONN (D2) PIN #
GRND	P2-1	1	D2-1
BOVFLO2	P2-2	3	D2-2
GRND	P2-3	5	D2-3
/BDCHA	P2-4	7	D2-4
BDCHI	P2-5	9	D2-5
GRND	P2-6	11	D2-6
BDCHO	P2-7	13	D2-7
/BDCHR	P2-8	15	D2-8
GRND	P2-9	17	D2-9
/BDCHMO	P2-10	19	D2-10
NO CONN	P2-11	21	D2-11
GRND	P2-12	23	D2-12
/BINTR2	P2-13	25	D2-13
/BINTPOUT2	P2-14	2	D2-14
NO CONN	P2-15	4	D2-15
GRND	P2-16	6	D2-16
/BDCHPOUT2	P2-17	8	D2-17
/BDCHR2	P2-18	10	D2-18
GRND	P2-19	12	D2-19
NO CONN	P2-20	14	D2-20
GRND	P2-21	16	D2-21
NO CONN	P2-22	18	D2-22
GRND	P2-23	20	D2-23
GRND	P2-24	22	D2-24
/BINTPIN	P2-25	24	D2-25

TABLE 1.3

CONNECTOR J1, DISK CONTROL PIN ASSIGNMENTS

SIGNAL PIN "+"	SIGNAL PIN "-"	SIGNAL NAME
31	1	TAG 1
32	2	TAG 2
33	3	TAG 3
34	4	BIT 0
35	5	BIT 1
36	6	BIT 2
37	7	BIT 3
38	8	BIT 4
39	9	BIT 5
40	10	BIT 6
41	11	BIT 7
42	12	BIT 8
43	13	BIT 9
44	14	OPEN CABLE DETECTOR
45	15	FAULT
46	16	SEEK ERROR
47	17	ON CYLINDER
48	18	INDEX
49	19	UNIT READY
50	20	(NOT USED)
51	21	BUSY
52	22	UNIT SELECT TAG
53	23	UNIT SELECT 0
54	24	UNIT SELECT 1
55	25	SECTOR
56	26	UNIT SELECT 2 (NOTE 1)
57	27	UNIT SELECT 3 (NOTE 1)
58	28	WRITE PROTECTED
	29	POWER SEQ. PICK (NOTE 2)
	59	POWER SEQ. HOLD (NOTE 2)
60	30	BIT 10 (NOTE 1)

NOTES: 1. UNIT SELECT 2 and 3, and BIT 10 are tied inactive via pullup/pulldown 470-ohm resistors.

2. POWER SEQUENCE PICK/HOLD are tied active (ground)

TABLE 1.4

CONNECTOR J2, DISK DATA PIN ASSIGNMENTS

SIGNAL PIN "+"	"-"	SIGNAL NAME
	1	GROUND
14	2	SERVO CLOCK
	15	GROUND
16	3	READ DATA
	4	GROUND
17	5	READ CLOCK
	18	GROUND
19	6	WRITE CLOCK
	7	GROUND
20	8	WRITE DATA
	21	GROUND
9	22	UNIT SELECTED
23	10	SEEK END
	11	GROUND
24	12	(NOT USED)
	25	GROUND
26	13	(NOT USED)

1.3.4

MECHANICAL SPECIFICATIONS

Table 1.5 lists the physical specifications of the Controller, and Figure 1.2 illustrates the board dimensions.

TABLE 1.5

CONTROLLER SPECIFICATIONS

ITEM	MEASUREMENT
Width	9.00 Inches
Length	16.00 Inches
Height	1.20 Inches
Weight	2.10 Pounds

JUMPER SWITCH SPECIFICATIONS:

Operating force:	600 grams DOWN, 200 grams UP
Vibration:	No change in position or discontinuity greater than 1 microsecond, 50G saw tooth

CONTROLLER BOARD DIMENSIONS

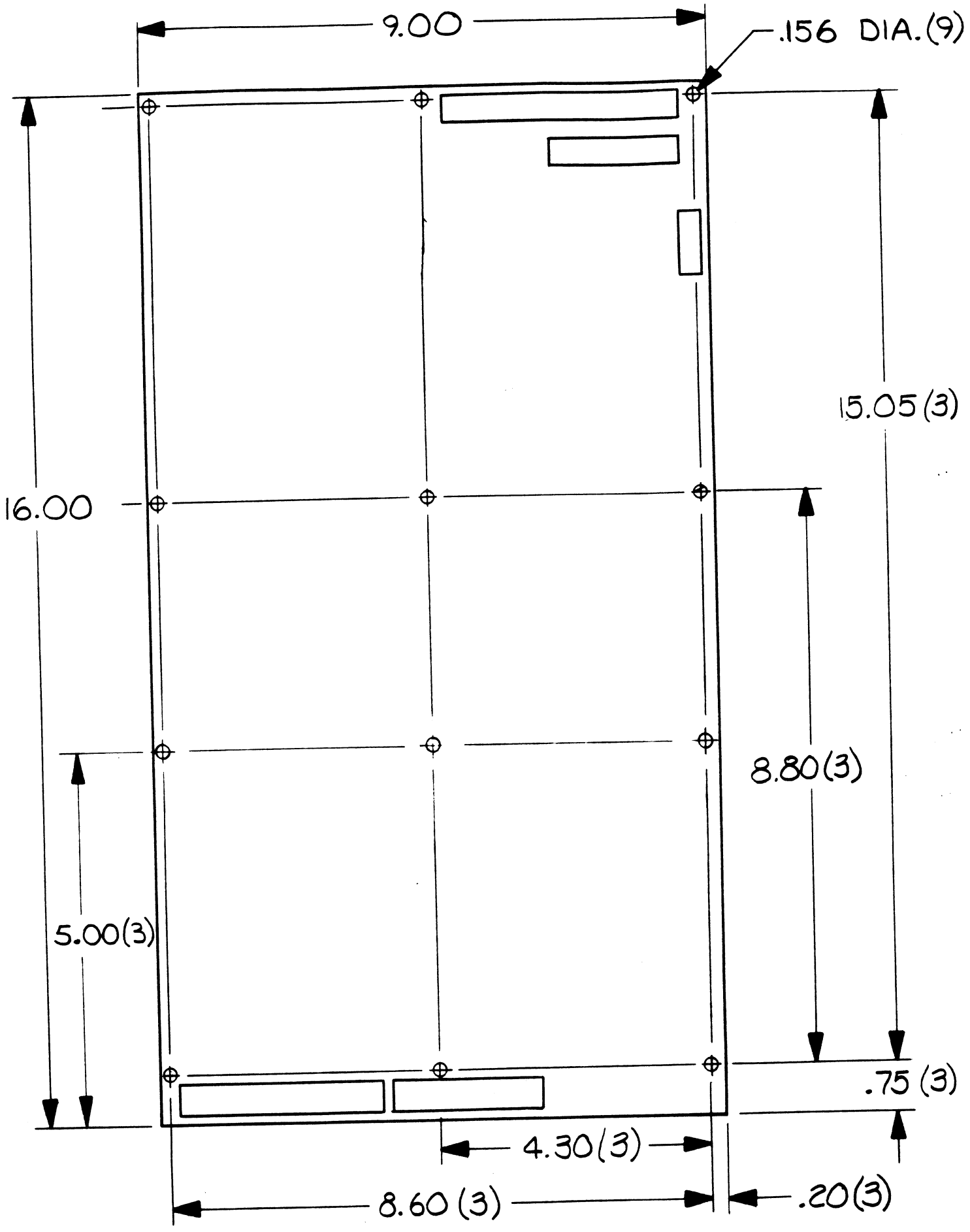


Table 1.6 lists connectors which may be used on cables that attach to the Controller.

TABLE 1.6

CONTROLLER MATING CONNECTORS

DESIGNATION	FUNCTION	SOURCE - P/N (OR EQUIVALENT)
P1	CPU I/O-Data	3M 3425-6050
P2	CPU DCH Control	3M 3399-6026
J1	Disk Control	3M 3334-6060
J2	Disk Data	3M 3399-6026
P3	Power Supply	AMP 1-480702

1.3.5

ELECTRICAL

Table 1.7 lists the electrical requirements of the Controller. All measurements are made on the Controller printed circuit board at the power connector P3.

TABLE 1.7

CONTROLLER ELECTRICAL REQUIREMENTS

VOLTAGE	RANGE	CURRENT
+5.0 Vdc	+4.75 TO +5.25 Vdc	5.5 Amp. Typ.
-5.0 Vdc	-5.25 TO -4.75 Vdc	0.4 Amp. Typ.

TABLE 1.8

CONNECTOR P3, POWER SUPPLY PIN ASSIGNMENTS

PIN NUMBER	VOLTAGE
1	-5 VDC
2	GROUND
3	+5 VDC
4	GROUND

2.0

INSTALLATION

This section contains the information for setting up and installing the Controller before placing it in operation. These preparatory steps require the proper placement of jumpers, insertion or removal of I/O bus terminators, mounting the Controller in its operating environment, and properly connecting the cables. After installation of the Controller is completed as described in Sections 2.1 through 2.3, refer to the remaining sections for testing the drive subsystem. Following testing, Section 4, " Usage Guidelines", may be referenced to for information on disk initialization.

2.1

BOARD SETUP

Setting up the controller for operation requires checking the factory installed jumpers and terminators and modifying them as necessary to fit your requirements. Figure 2.1 shows the jumpers and terminators and their locations, and Table 2.1 shows the functions of these jumpers on the Controller board, excluding the device code selection jumpers. A device code selection table is shown in Table 2.2.

TABLE 2.1

SWITCH, JUMPER AND TERMINATOR FUNCTIONS

DESIGNATION	FUNCTION	CONNECTION RESULT IN/DOWN	OUT/UP
W18-1 (SWITCH)	INTERLEAVE SELECT	2:1 I/L	NO I/L
W18-3 (SWITCH)	ERROR CORRECTION SELECT	ENABLE	DISABLE
W18-4 (JUMPER)	SEEK-ON-HEAD-CHANGE SELECT	DISABLE	ENABLE
W24-1 (JUMPER)	POWER FAIL INPUT FROM CPU	CONNECT	DISCONNECT
RN19 THRU RN26	CPU BUS TERMINATION RESISTOR NETWORKS	TERMI-NATED	NOT TERMINATED

FACTORY TEST JUMPERS:

DESIGNATION	FUNCTION	CONNECTION RESULT IN/DOWN OUT/UP
W5-2 (JUMPER)	LOOP ON SELFTEST	MUST BE OUT
W8-1 (JUMPER)	/2925 CLK SEL 3	MUST BE OUT
W8-2 (JUMPER)	2925 CLK SEL 2	MUST BE IN
W8-3 (JUMPER)	2925 CLK SEL 1	MUST BE OUT

TABLE 2.2

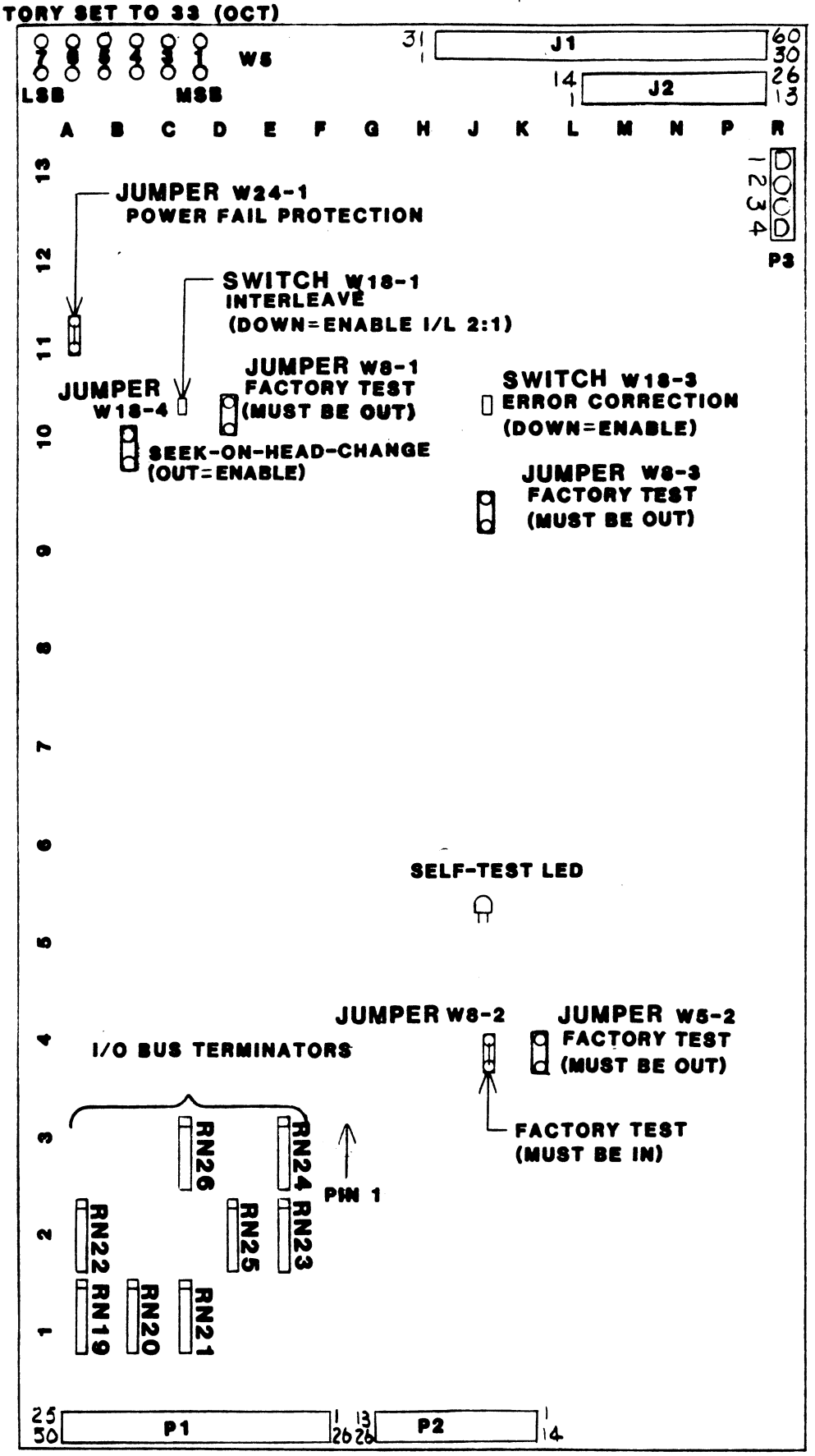
DEVICE CODE JUMPER TABLE

DEVICE CODE	W5-1 BDS0	W5-3 BDS1	W5-4 BDS2	W5-5 BDS3	W5-6 BDS4	W5-7 BDS5
0X	OUT	OUT	OUT			
1X	OUT	OUT	IN			
2X	OUT	IN	OUT			
3X	OUT	IN	IN			
4X	IN	OUT	OUT			
5X	IN	OUT	IN			
6X	IN	IN	OUT			
7X	IN	IN	IN			
X0				OUT	OUT	OUT
X1				OUT	OUT	IN
X2				OUT	IN	OUT
X3				OUT	IN	IN
X4				IN	OUT	OUT
X5				IN	OUT	IN
X6				IN	IN	OUT
X7				IN	IN	IN

DEVICE CODE JUMPERS
IN=ON
OUT=OFF
FACTORY SET TO 33 (OCT)

FIGURE 2.1

BOARD LAYOUT



P1=CPU I/O-DATA P2=CPU DCH CONTROL

The following sections provide further information on individual board setup options. Some of the jumpers used are actually miniature switches mounted on .1" centers. The switches contain high-tension locking contacts that open and close by pulling up and pushing down on the switch center.

2.1.1

CPU I/O BUS TERMINATORS

Each I/O bus signal, with the exception of Interrupt and Data Channel Priority OUT, is terminated on the Controller with a 330/390-ohm pullup/pulldown resistor pair to minimize the effects of signal reflections and cable crosstalk. Terminators add the equivalent of 9 standard TTL loads to a signal. The Controller interface, when left unterminated, presents no more than 1 load to the I/O bus. Standard processors are limited to driving the equivalent of 19 standard TTL loads. Consult your Interface Designers Reference Manual for further information on loading rules.

The Controller's terminating resistors are in the form of "single in-line packages", or SIPs, and are mounted on sockets for removal. When an I/O bus repeater is installed in the drive subsystem enclosure, the Controller termination resistors must be removed, as the repeater has bus terminators installed.

TO REMOVE I/O BUS TERMINATORS

Refer to Figure 2.1 and locate the 8 socketed resistor SIP packs RN19-RN26 near the CPU interface connectors P1 and P2. Carefully remove the resistors from their sockets. To replace the termination resistors, carefully insert the resistors into the sockets with pin 1 of the resistor pack facing towards the CENTER of the board. Pin 1 is indicated by either a "1" or a dot marking on the package.

2.1.2

DEVICE CODE SELECTION

The DC-292 GEM can be configured for any device code between 0 and 77 (octal); however, the primary is 33 and the secondary is 73. Primary device code 33 has been factory set and should be left accordingly unless another disk subsystem exists with that device code. Refer to Figure 2.2.

The jumpers next to locations A13 and B13 are used to select device code. The individual jumpers are labeled DS0 through DS5 and correspond to the Device Select lines on the Controller. DS0 is the most significant bit of the six-bit device code representation.

For example, to select device code 33, jumpers W5-3, W5-4, W5-6 and W5-7 would be installed. For jumper location, reference Figure 2.1.

2.1.3

ERROR CORRECTION ON/OFF

The Controller's automatic error correction function may be enabled or disabled by means of the switch labeled W18-3 located near the center of the board between IC locations J10 and K10.

To ENABLE error correction, push switch W18-3 DOWN.

To DISABLE error correction, pull switch W18-3 UP.

NOTE: Error correction is automatically disabled when the Controller receives a FORMAT command to allow the program to detect and map out sectors with marginal media flaws. To re-enable error correction, the CONTROLLER power supply (not the CPU) must be powered down and back up again.

2.1.4

INTERLEAVE SELECTION

The Controller may be setup to format sectors contiguously or with an interleave of 2:1. The decision whether to interleave or not depends largely on the speed of the CPU data channel. CPU activity and overall system activity are also factors in deciding whether consecutive sectors can be transferred to or from the CPU before controller buffers are eventually overrun.

If the disk is formatted with no interleaving, the need to interleave is indicated by extremely slow system performance.

Interleaving is enabled or disabled by means of the switch labeled W18-1 located on the Controller board between IC locations C10 and D10. Controllers are normally factory set with interleave ENABLED.

To format with interleave ENABLED, push switch W18-1 DOWN.

To format with interleave DISABLED, pull switch W18-1 UP.

2.1.5

SEEK-ON-HEAD-CHANGE

The dual-volume disk drive requires that all head selection commands issued by the Controller be followed by a valid SEEK command to initiate the head change. The drive has an option within it (Jumper Z6) which, when enabled will cause the drive to automatically initiate a zero-distance seek as the result of a head selection command from the Controller. With this function disabled within the drive, (Jumper Z6-S installed), the Controller must perform a SEEK after each head change.

Jumper W18-4 on the Controller determines whether or not the Controller performs a SEEK after each head change. As the automatic SEEK-ON-HEAD-CHANGE may be disabled within the drive, the Controller must then perform the SEEK, thus Jumper W18-4, located on the Controller between IC locations B10 and C10 is factory set with this option ENABLED (Jumper W18-4 not installed).

2.1.6

POWER FAIL INPUT FROM CPU

The Controller contains on-board power failure protection to protect the disk drive media in the event of loss of power to the Controller. In addition, the "Power Fail" signal from the CPU is brought in from connector D1, pin 24 for further protection. If either of these sources detect a critical drop in power supply voltage, the Open Cable Detect signal to the disk drive is dropped to 0 volts, inhibiting the drives write circuitry.

Jumper W24-1, located on the Controller between IC locations A11 and B11 is used to connect/disconnect the Controller power-fail circuit to CPU connector D1, pin 24. The jumper is not factory installed as supplied. If the CPU provides the "Power Fail" signal at connector D1, pin 24, jumper W24-1 must be installed if the additional means of protection is desired.

2.2

CONTROLLER INSTALLATION

The Controller board has 9 mounting holes for attaching stand-offs used to install the board in the disk drive enclosure. Refer to Figure 1.2 for board and mounting hole dimensions.

2.3

CONNECTING CABLES

The Controller requires attachment of five cables which connect to the CPU I/O bus interface, the disk drive and the power supply. Refer to the board layout, Figure 2.1, for connector locations.

CAUTION: Always have power removed from the Controller power supply when attaching or removing cables to prevent controller damage.

The power connector and cable are both keyed to prevent wrong connection. The disk and CPU connectors on the Controller are stamped with an arrow indicating pin 1 location, as are the cable connectors. In addition, the Controller disk and CPU connectors are also keyed to prevent wrong connection.

2.4

POWER UP

Upon application of power, the Controller performs internal diagnostics (selftest). During testing, the red LED located in the center of the board should be illuminated. Testing takes less than 1 second. Upon successful completion of the tests, the LED will turn off. If an error is detected, the LED is used to display one of the error codes found in Table 3.1. For further information, refer to Section 3.0.

2.5

DISK SUBSYSTEM TESTING

Following installation, testing should be performed on the subsystem to ensure that all components are working properly prior to system operation. The following steps are recommended to test all newly installed subsystems. If any errors should occur during these tests (with the exception of "Checkword" or "Address" errors caused by disk media flaws detected on a Read command), refer to Section 3.0, "Trouble-Shooting", for assistance in fault isolation.

Diagnostic support programs are provided on 1/2 inch magnetic tape (P/N 400-417-00) recorded at either 800 or 1600 BPI. Included on the tape are Formatter, Diagnostic and Reliability programs which can be loaded into program memory for execution. Refer to Section 3.3 for further details on using the tape and programs.

RECOMMENDED TEST PROCEDURE

1. a) Insert a scratch cartridge in the drive, preferably pre-formatted.
   b) If either the fixed or removable volume of the drive contains system data that you wish to protect, enable the appropriate write-protect for that volume at this time. (Front panel switch for the fixed volume, cartridge tab removal for removable volume.)

2. Mount the tape on the tape drive and perform a program load (BOOT). The tape loader program will then display on the system console a menu of the files on the tape followed by the prompt "File Number?".

3. Two Format Programs are available to format the disk drive media to the Controller's format. They are:

   DISKF — Disk Formatter - This is a standard formatter program that formats either non-interleaved or interleaved, whichever the Controller is set up for via Jumper W18-1. During surface analysis, the program identifies sectors that contain media flaws and re-formats those sectors with their bad sector flags set.

   DISKS — Slip Formatter - This program is designed to utilize spare sectors at the end of tracks to skip over sectors determined to contain media flaws. The bad sectors are then seen only by the Controller, eliminating the need for the system to manage bad sectors. This program may only be used if the Controller is set up to format non-interleaved, and the non-expanded emulation is being used.

Refer to Sections 3.3.4 and 3.3.5 for further information on the programs. If the volume to be tested is not formatted to the Controller's own format, enter the file number of the desired format program followed by return. If the drive is already formatted you may wish to proceed to testing. However, re-formatting is recommended prior to system use. When the program asks for surfaces to be formatted, respond accordingly:

0,1 for formatting the cartridge volume only
2,3 for the fixed volume only
0,3 to format the entire drive

If Disk Formatter is used, run one (1) pass minimum for testing purposes and six (6) passes minimum for surface analysis prior to initialization.

NOTE: Execution of a Format command to the Controller DISABLES the Controller's on-board error correction function. This is to allow detection and mapping of bad sectors by the program. Error correction is enabled again ONLY by powering the CONTROLLER power supply down and then up again. It is recommended that error correction be left disabled throughout testing and initialization.

4. Load and run the Reliability program. One (1) pass of "RUN-ALL" is recommended. Note the frequency of the seeks that the drive is performing; noticably slow performance may indicate the need to re-format with sector interleave enabled.

5. If errors are encountered during Reliability, load and run the Diagnostic program. The Diagnostic program may provide more detailed information on the nature of the problem.

6. After testing is completed, all disk volumes tested should be re-formatted prior to system initialization.

3.0

TROUBLE-SHOOTING

When a problem occurs either as a result of equipment failure or installation error, execution of stand-alone diagnostic programs as well as visual inspection may aid in locating and resolving the problem. This section provides suggestions for visually checking the Controller and drive for proper setup, and information on using the diagnostic support programs. If the support tape or programs are not available, most other 6070-compatible disk reliability or system reliability programs should run without patches.

3.1

INTERNAL DIAGNOSTICS

The Controller Internal Diagnostics (Self-Test) are executed each time power is applied, testing a majority of the Controller circuitry. During the Self-test, the red LED located near the center of the board will become illuminated. Testing takes less than 1 second, after which the LED should go out. Upon detection of an error, the Controller aborts testing and uses the LED to display the error code by flashing a number of times to indicate the test that failed. This error code is repeated six times, after which time the LED will become a constant ON and the Controller will loop on the error to aid in scoping by repair personnel. Table 3.1 lists the error codes.

TABLE 3.1

SELF-TEST ERROR CODES

CODE	TEST	POSSIBLE FAILURE
1	REGISTER TEST	The data in register F did not compare with register Q. 2901 or 2902 IC's may be bad.
2	RAM TEST	Data read from RAM did not compare with data written. 2114s, PBUS or RAM data bus may be bad.
3	CONDITION FF, BIT TEST & 32 BIT SHIFT TEST	State of the condition FFs were not correct. CONTROL FULL Busy, Done, OVFL (2901), bit test logic, or bit shift logic may be bad.
4	FORMAT SEQUENCE ERROR TEST	A forced sequencer error did not occur within a specified amount of time. Format sequencer logic may be bad.
5	SYNC DETECT TEST	Sync detect was not made in specified amount of time or term FF did not set. Check sync compare register logic and term FF.
6	ECC TEST	The generated ECC pattern did not match expected pattern. Check shift registers, ECC logic and multiplexors.

If the LED does not blink or remains on, then the 2925 clock circuitry, the 2910 or the power tail circuit may be bad. Another possible reason for the LED to be on continuously is if the +5 vdc has dropped below +4.75 vdc.

3.2

SUBSYSTEM CHECKLIST

3.2.1

CONTROLLER CHECKS

1. With power applied, ensure the Self-test LED is out. If the LED is on, remove and re-apply power to the Controller. If the LED does not go out, the problem may be one of the following:

   a) Insufficient +5V DC; must measure between 4.75V DC and 5.25V DC at controller.
   b) Power Fail input from pin 24 of D1 (CPU I/O and Data Cable) has dropped to 0v AND jumper W24-1 is IN. If the CPU does not provide a Power-Fail signal at pin 24 of D1, Jumper W24-1 must be REMOVED.
   c) Controller has internal malfunction.

2. Ensure the terminator resistor packs are installed on the Controller. (Section 2.1.1.)

3. Ensure the Device Code Jumper W5-1 is correct; OUT for Primary (33 octal).

4. Ensure the Interleave jumper switch W18-1 is set properly. Extremely slow performance may be due to interleave disabled (switch UP) during disk formatting.

5. Ensure the Seek-On-Head-Change option is properly established. (Jumper W18-4; OUT to enable or IN to disable.) If the jumper is IN to disable this option, ensure the option is enabled within the drive. The no-fault controller setting is enabled (Jumper OUT).

6. Verify that voltages at the controller (NOT the power supply) are in accordance with the specifications found in Section 1.3.5.

7. Check all cabling for broken wires, fraying and proper pin 1 orientation.

3.2.2

DISK DRIVE CHECKS

1. Ensure the drive cables are connected properly with pin 1 of the cables connected to pin 1 on the drive connectors. Also check for broken or frayed wires.

2. Verify that the drive is set for unit 0.

3.3

SOFTWARE SUPPORT PACKAGE

Disk Formatter, Reliability and Diagnostic programs are available on 1/2 inch magnetic tape (P/N 400-417-00). Tapes are available in either 800 or 1600 BPI density. The following sections contain information for loading and using these programs. All programs are "stand-alone", meaning that they do not require, nor can they be used concurrently with the operating system running. Section 3.3.1 provides instructions on copying disk-bootable versions of the programs from the tape to disk.

3.3.1

TRANSFERRING PROGRAMS TO DISK

The last two files on the tape are RDOS and AOS "DUMP" versions of the executable programs contained on the tape. Under the operating system, use the standard CLI commands for loading from tape:

FOR RDOS:

```
DIR %MDIR%
INIT MT0
LOAD/A/R/V MT0:5
RELEASE MT0
```

FOR AOS OR AOS/VS:

```
SUPERUSER ON
DIR :
LOAD/V/R @MTn:6 (n = tape unit #)
REWIND @MTn
SUPERUSER OFF
```

3.3.2

SYSTEM REQUIREMENTS

Minimum system requirements for loading and executing the programs are:

1) CPU with minimum 16K words memory
2) Console device at device codes 10/11 octal
3) 1/2", 800 or 1600 BPI tape subsystem

3.3.3

LOADING THE PROGRAMS

FROM TAPE:

Mount the tape and place the tape drive on-line. If your drive is dual-density, be sure it is set to match that shown on the tape label. Boot the tape:

- For CPUs with front panel switches, set the switches to 1000xx octal, where xx = tape device code (usually 22), then press RESET followed by PROGRAM LOAD.

- For CPUs with virtual consoles, refer to your computer documentation for booting methods.

Once loaded, the tape menu will appear on the console as shown:

FILE #	PROGRAM	FILENAME
2	DISK DIAGNOSTIC	DISKD
3	DISK FORMATTER	DISKF
4	DISK RELIABILITY	DISKR
5	SLIP/FORMATTER	DISKS
6	".SV" & "DISKD.LS" FILES IN RDOS DUMP FORMAT	
7	".SV" & "DISKD.LS" FILES IN AOS DUMP FORMAT	

FILE NUMBER?

Enter the file number of the program you wish to execute followed by return. The program will load and text will appear on the console. Refer to the following sections for program operation.

FROM DISK:

Boot the disk drive. For RDOS, enter the filename (see menu in previous section) in response to "FILENAME?". For AOS, enter the full pathname with ".SV" following the filename, in response to "PATHNAME?"

3.3.4

DISK FORMATTER - DISKF

The Disk Formatter Program both formats the disk and checks the disk media for data integrity. This program must be used if the Controller is set up with interleave enabled. Slip Formatter (File 5) requires that the Controller be set up with interleave disabled. The program first requests the disk controller device code, then displays the available starting addresses:

```
200 - CHANGE DEVICE CODE & STARTING MENU
500 - FORMAT/CHECK PROGRAM
501 - CHECK PROGRAM ONLY
503 - COMMAND STRING INTERPRETER
510 - ERROR LOG RECOVERY

STARTING ADDRESS?
```

The standard program is the FORMAT/CHECK (SA=500). This program will format the entire disk once, writing each entire sector including gaps, sync bytes, ID field, data field (all zeros) and ECC character.

NOTE: On-board error correction is automatically DISABLED by the controller, overriding switch W18-3, upon receiving a Format command. This is to allow the program to detect all media flaws during the "Check" portion of the program and flag those sectors "bad". Error correction will remain disabled until the Controller is powered down and back up again. Error correction should be kept disabled until after the disk initializer program is run.

After entering the starting address, the program asks the operator to set the program "Switch Register". Enter a return or refer to Appendix B for further information. The program then asks the console baud rate and starting time.

When the program asks "# passes to format completion?", this refers to the number of patterns it will write and read on the disk volume to test for media flaws. If the format is for disk testing only one (1) pass should be sufficient. If the disk is to be initialized, a minimum of six (6) passes are recommended for a thorough surface analysis.

The program then asks for "UNIT #, MIN SURF #, MAX SURF #". Enter "0" for unit, followed by ",0,1" to format the removable cartridge, or ",2,3" to format the fixed volume, or ",0,3" to format the entire disk drive. It is recommended that if only one volume is to be formatted, the Write-Protect (switch or cartridge tab) of the other be enabled as a precaution.

The program will then begin to format the disk. The only acceptable errors during format should be "Checkword" or "Address" errors, indicating that the program has detected a media flaw during surface analysis and will later re-format that sector with the bad sector flag set. If any other errors are detected refer to Section 5.0 to examine controller status (DIA). For more information, refer to the Format Program text in Appendix B.

3.3.5

SLIP FORMATTER - DISKS

The Slip Formatter Program formats the disk and checks the disk media for data integrity in a manner similar to the Disk Formatter Program (File 3). However, instead of only setting bad sector flags in those sectors determined to contain media flaws, it instructs the Controller to "skip" over the bad sector and resume formatting the track at the next good sector. By utilizing the spare sectors at the end of a track to skip over sectors that contain media defects, the entire disk in effect will appear flawless to the system, thus reducing the system overhead of managing bad sectors.

However, due to the nature of this method of relocating logical sector addresses it is required that sector interleave be disabled (Switch W18-1 UP). Also, since Sector Slip requires spare sectors at the end of a track, the non-expanded emulation must be used if SLIP Formatter is to be run. If your system requires sectors to be interleaved to maintain optimum performance, or the DC292-EXP option is being utilized, then the standard Disk Formatter Program must be used. Running Sector Slip does not require any different jumper set-up from the regular format program. Simply run the Slip Formatter Program.

After selecting and loading the program, the following menu appears on the console:

```
A - CHANGE DEVICE CODE
B - DO ALL (C, D, F)
C - FORMAT ENTIRE DISK
D - ANALYZE/SLIP ONLY
E - ENTER BAD SECTORS
F - DISPLAY HISTORY OF SLIPPED SECTORS
G - ENABLE/DISABLE LOGGING TO PRINTER
H - EXIT

CHOICE:
```

The standard selection is DO ALL (B). When the program requests minimum and maximum surfaces, respond accordingly:

```
0,1 - removable cartridge
2,3 - fixed volume
```

After disk initialization, power the Controller down and back up again and ensure Switch W18-3 is DOWN to re-enable error correction.

The program formats the selected surfaces (heads) once, then performs a surface analysis consisting of eight (8) data patterns written and then read over the surfaces formatted, testing for Address and Checkword errors. At the start of each cylinder, the message "ANALYZING CYLINDER nnn" is displayed on the console.

When an error is encountered, the program completes the READ of the track, then re-formats the track, instructing the Controller to "slip" those sectors found to be bad onto the next good sector of the track. Analysis of the disk then continues. Following analysis, the program displays the cylinder, surface and physical sector address of all sectors found to contain media flaws and relocated.

There is a logging function available that should be used when you have a printer. This will provide you with a hard copy to refer to. If you do not have a printer available, write down the disk addresses of all sectors slipped.

If you need to add additional bad sectors, use the ENTER BAD SECTORS (E) Command. All bad sectors on the specified track must be entered since the entire track is re-formatted. PHYSICAL, not logical sectors must be entered. In other words, you must determine the actual sector address if the track has been previously slipped. To convert a logical sector number to a physical sector number, remember that any sectors slipped from a track do NOT contribute to the logical count.

EXAMPLE 1:							
	Logical	0	1	Bad	2	3	4
	Physical	0	1	2	3	4	5

Using the Slip Formatter Program, physical sector 2 has been determined to be bad and the track re-formatted. If at some time in the future another sector becomes bad you must specify physical addresses of the newly established sector and re-specify the original bad sector.

EXAMPLE 2:							
	Logical	0	1	Bad	Bad	2	3
	Physical	0	1	2	3	4	5

3.3.6

DISK RELIABILITY - DISKR

The Disk Reliability Program is a standard maintenance program designed to exercise and test the disk subsystem. The program first requests the disk controller device code, then displays the available starting addresses:

```
200 - DEVICE CODE CHANGE AND REDISPLAY MENU
500 - RELIABILITY TEST (ALL CYLINDERS)
501 - RELIABILITY TEST (OPTIONS)
502 - INCREMENTAL DISK ADDRESS TEST
503 - COMMAND STRING INTERPRETER
504 - QUICKIE FORMATTER
505 - RUN ALL (501, 502, 507)
506 - SEEK EXERCISER (CONVERGING, DIVERGING PATTERN)
507 - SEEK EXERCISER (RANDOM PATTERN)
510 - ERROR COUNT/LOG RECOVERY
513 - MEMORY DUMP ROUTINE
```

The standard recommended program is the "RUN ALL" program (SA=505). Refer to the program text for the Reliability program located in Appendix B for descriptions of the other programs. Enter the desired starting address followed by a return.

The program then asks for "Switch Register" options, console baud rate, and starting time.

The program then asks for "UNIT #, MIN SURF #, MAX SURF #" Enter "0" for unit, followed by ",0,1" to test the removable cartridge, or ",2,3" to test the fixed volume, or ",0,3" to test the entire disk drive. The program will then begin execution by displaying "TESTING UNIT 0" on the console. If RUN ALL (SA=505) is being run, the program will display occasional "PASS" statements for the various tests. One (1) completion is indicated by "PASS - RUN ALL". If any errors occur, refer to Section 5.0 to examine controller status (DIA). For more information, refer to the Reliability program text found in Appendix B.

3.3.7

DISK DIAGNOSTIC - DISKD

The Disk Diagnostic program is intended to help isolate subsystem faults that are related to basic disk operation. The program first requests the disk controller device code, then displays the available starting addresses:

```
200 - DIAGNOSTIC (INITIALIZE)
202 - RANDOM SEEK EXERCISER
500 - DIAGNOSTIC (RESTART)

STARTING ADDRESS?
```

Enter 500 followed by a return to execute the standard Diagnostic Program. Its function is to test as much of the Controller's hardware as possible for malfunctions in a pass/fail method of operation. The program then asks for the console baud rate, drive unit # to be tested, and "Switch Register" options. The program then begins testing by displaying "TESTING UNIT: 0". Each pass is indicated by displaying "PASS #".

If an error is detected, the program displays information pertaining to the error, including the program count, DIA status, etc., and then begins to loop on the error for scoping by repair personnel. To abort the loop and cause the program to go on to the next test, enter a "1" on the console.

For further information, refer to the Diagnostic Program text found in Appendix B. Refer to Section 5.0 to examine controller status (DIA).

A hard copy listing of the Diagnostic Program may be produced by printing the "DISKD.LS" file contained in File 6 (RDOS) or File 7 (AOS) of the tape.

4.0

USAGE GUIDELINES

4.1

DISK INITIALIZATION

After formatting or re-formatting, the next step in preparing a disk volume for system use is to run the Disk Initialization Program found on your system build tape. Refer to Sections 3.3.4 and 3.3.5 for instructions on Disk Formatting. The sequence of events leading up to and including disk initialization are typically as follows:

STEP 1 - CONTROLLER SETUP AND TESTING

While testing the Controller as discussed in Section 2.5, it should have been noted whether or not sector interleaving is required. As discussed earlier, the need to interleave sectors is indicated by noticably slow performance.

STEP 2 - FORMATTING THE DISK VOLUME

After testing, and sector interleave selection has been determined, the disk volume(s) should be re-formatted. (It may be desirable to run the Reliability test again after formatting, however the Diagnostic test should NOT be run as it will destroy any previously written bad sector flags.)

If Disk Formatter (DISKF) is used to format, six (6) passes minimum are recommended for surface analysis, thereby detecting media flaws and setting bad sector flags. If Slip Formatter (DISKS) is used, the program automatically runs eight (8) passes to identify bad sectors. During formatting, the Controller automatically DISABLES error correction, overriding the error correction switch on the board. By doing this, the Formatter Program is allowed to detect and flag marginal media flaws as bad.

ERROR CORRECTION IS ENABLED AGAIN IF SWITCH W18-3 IS DOWN AND THE CONTROLLER IS POWERED DOWN AND BACK UP AGAIN.

Leave the Controller powered up at this time however until disk initialization is complete.

STEP 3 - INITIALIZATION

The Disk Initialization Program may vary from one operating system to another. It is found on the system build tape, or may be executed from disk. Refer to your system documentation for detailed instructions.

Cartridge drive subsystems usually require individual initialization of fixed and removable volumes. The program will request the unit name of the disk to be initialized; commonly used names are "DP0" for the REMOVABLE volume, and "DP0F" for the FIXED.

When six (6) or more passes of Disk Formatter are run, only one (1) or two (2) passes of the initializer should be required to detect and flag all bad sectors in the bad sector table built by the initialization program. If the Slip Formatter Program was used, a thorough surface analysis has already been made and one (1) pass of the initializer should be sufficient. After the initialization program is complete, the Controller should be powered down and then back up again to re-enable the on-board error correction.

5.0

PROGRAMMING NOTES

This section discusses, in detail, the assembly level programming characteristics of the disk Controller. Contained here are the Controller instruction breakdown and descriptions of the various operations. This information is of most use to technical personnel involved in system maintenance, development or programming.

5.1

PROGRAM CONTROL

5.1.1

DEVICE COMMAND/FLAGS

There are six Device Command/Flags that control or indicate conditions within the Controller; these are:

F = S — START PULSE - Sets BUSY active, clears DONE and INT REQUEST, and starts operation specified by command register if it was a Read, Write or Format command.

F = C — CLEAR PULSE - Clears BUSY, DONE and INT REQUEST flags, and terminates execution of command in progress. Also clears Data In A status bit 0, Seek Done bits 1-4, and bits 5,7,11,12,13 and 14.

F = P — I/O PULSE - Clears DONE and starts operation specified by command register if it was a Seek or Recalibrate command.

IORST — IORESET instruction or switch - Performs same functions as CLEAR. Also clears Interrupt Mask flag and initializes Controller.

BUSY — FLAG - Active indicates execution of a Read, Write or Format command is in progress.

DONE — FLAG - Active indicates termination of a Read, Write or Format command. (Same as DIA bit 0).

INSTRUCTION FORMAT

Symbolic form for I/O instructions:

DXXF AC,(mnemonic)

DXX = DOA, DOB, DOC, DIA, DIB, DIC

F = Function: Start, Clear or I/O Pulse

AC = Accumulator: 0,1,2 or 3

Mnemonic (typical) = DP0 (primary removable cartridge)
DP0F (primary fixed volume)
DP4 (secondary removable cartridge)
DP4F (secondary fixed volume)

Device Code (octal): 33 (primary)
73 (secondary)

Interrupt Mask Bit: 7

Binary Representation of I/O instruction:

0 1 2	3 4 5 6	7 8 9	10 11 12 13 14 15
0 1 1	AC	OPCODE	F or T	DEVICE CODE

"F" Field:

Function	Bit 8	Bit 9
Start	0	1
Clear	1	0
I/O Pulse	1	1

"T" Field (w/opcode = 111):

Test	Bit 8	Bit 9
SKPBN - Skip If BUSY Is Set	0	0
SKPBZ - Skip If BUSY Is Not Set	0	1
SKPDN - Skip If DONE Is Set	1	0
SKPDZ - Skip If DONE Is Not Set	1	1

5.2

ACCUMULATOR FORMATS

5.2.1

DOA - SPECIFY COMMAND AND CYLINDER

DOAF AC,DPx

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC					0	1	0	FUNC				
DEVICE CODE															

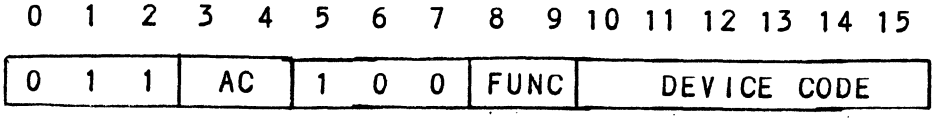
ACCUMULATOR:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	CSK		NU	CYL UPPER	CMND		CYLINDER								

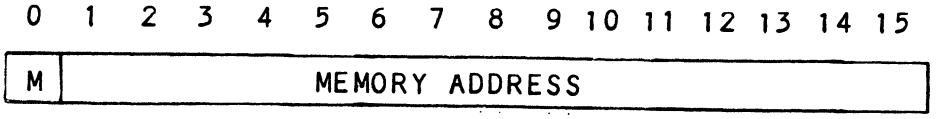
BIT	DEFINITION
0	When = 1, clears DONE, clears the following DIA status: Unsafe (bit 8), End Of Cylinder (bit 11), Address Error (bit 12), Checkword Error (bit 13).
1	When = 1, clears the SEEK DONE flag.
2-3	Not Used - reserved for Clear SEEK DONE to drives 1-2.
4	Upper Cylinder address bit.
5-6	Command: Bit 5 Bit 6 Read 0 0 *Write 0 1 Seek 1 0 Recalibrate 1 1 *If a Write command is specified, and the Controller is in format mode (bit 2 of DOC = 1), then the next Start pulse initiates a Format command.
7-15	Cylinder address for the next Seek, Read, Write or Format command.

DOB - LOAD STARTING MEMORY ADDRESS

DOBF AC,DPx



ACCUMULATOR:



BIT	DEFINITION
0	Data Channel Map Specifier (0 = Map A) (1 = Map B)
1-15	Starting memory address.

DOC - LOAD DRIVE, SURFACE, SECTOR ADDRESS AND COUNT

DOCF AC,DPx

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		1	1	0	FUNC				DEVICE CODE			

ACCUMULATOR:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DRIVE		F	D	SURF				SECTOR					COUNT		

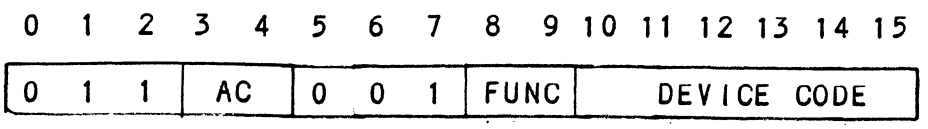
BIT	DEFINITION
0-1	Selects disk drive 0-3 (Must be = to 00).
2	A one selects Format mode. Command register (DOA) must also specify a Write command.
3	Diagnostic mode. When this bit is set, bits 2 and 6 define the test to be executed by the Controller when initiated by a Start pulse.

TEST	BIT 2	BIT 6
Read Sector Buffers	0	0
Unsafe Status Test	0	1
Checkword Error Test	1	0
Data Late Error Test	1	1

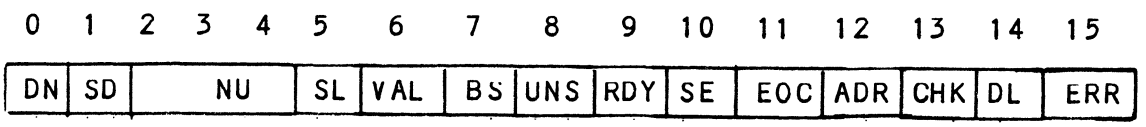
4-6	Starting Surface Address. Bit 4 must be = 0. When read with a DIC, bit 4 = 1 indicates the Read or Write command attempted to continue beyond the last surface.
7-11	Starting Sector Address.
12-15	Sector Count. Two's compliment of the number of sectors to be read or written.

DIA - READ CONTROLLER AND DRIVE STATUS

DIAF AC,DPx



ACCUMULATOR:



BIT	DEFINITION
0	R/W Done - A one indicates that the DONE flag is set following a data transfer command. Same as DONE flag.
1	Seek Done - A one (1) indicates the disk drive has completed a Seek or Recalibrate command.
2-4	Not Used - Will always be zero.
5	Slip Error - An attempt was made to execute the Slip Formatter Program with interleave 2:1 enabled (switch 18-1 down).
6	Valid - Always = 1. Indicates the Controller has control of the drive subsystem.
7	Bad Sector - The previous Read or Write command attempted to access a sector whose Bad Sector Flag was set to a 1.
8	Unsafe - A one indicates one of the following conditions exist: - An attempt was made to write or format the selected disk volume while it was write-protected. - The drive's FAULT signal is active; try to clear the condition with a Recalibrate command or power the drive down and back up again.
9	Unit Ready - Indicates that the drive is both READY and ON CYLINDER.
10	Seek Error - The SEEK ERROR signal from the drive is active, or an attempt was made to seek beyond the last usable cylinder. Try to clear with a Recalibrate command.

11 End of Cylinder Error - A one (1) indicates the previous Read, Write or Format command attempted to continue beyond the last surface of the cylinder.

12 Address Error - A one (1) indicates the Controller was unable to locate or verify the ID field of the sector to be transferred.

13 Checkword Error - A sector of data read from the disk did not correlate with the appended polynomial. This bit will set on any ECC error if Error Correction is disabled. If Error Correction is enabled, it will only set if the error was uncorrectable.

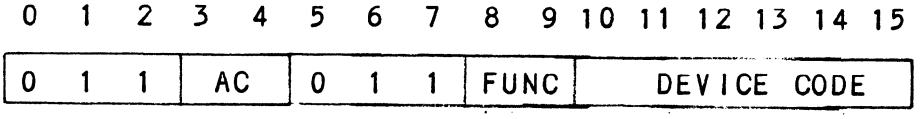
14 Data Late - A one (1) indicates the Controller was unable to complete a data channel transfer within a specified amount of time.

15 Error - A one (1) indicates that one or more of the above bits are set: 7,8,10,11,12,13,14, or a fault condition exists within the disk drive.

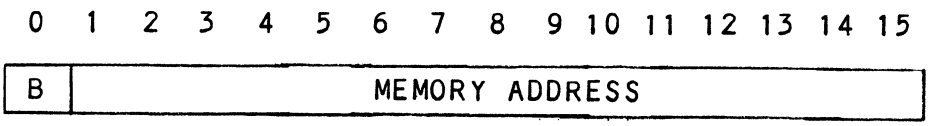
5.2.5

DIB - READ CURRENT MEMORY ADDRESS

DIBF AC,DPx



ACCUMULATOR:

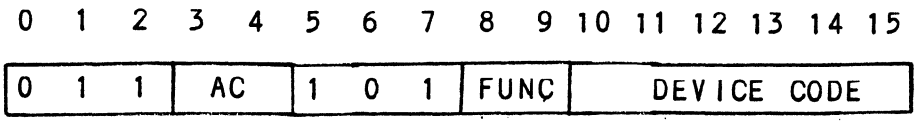


BIT	DEFINITION
0	Data Channel Map Specifier (0 = Map A) (1 = Map B)
1-15	Current Memory Address.

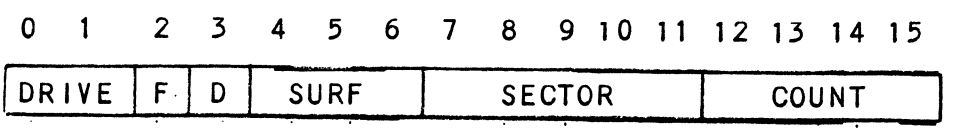
5.2.6

DIC - READ DRIVE, SURFACE, SECTOR ADDRESS AND COUNT

DICF AC,DPx



ACCUMULATOR:



BIT	DEFINITION
0-1	Disk drive selected 0-3. Controller accepts commands to drive 0 only.
2	A one (1) indicates Format Mode selected.
3	A one (1) indicates Diagnostic Mode selected.
4-6	Ending surface address. Bit 4 = 1 indicates the Read or Write command attempted to continue beyond the last surface.
7-11	Ending sector address.
12-15	Ending sector count (two's compliment).

5.3

DETAILED COMMAND DESCRIPTIONS

5.3.1

RECALIBRATE

This command moves the drive heads to cylinder 0, selects head 0, and issues a fault clear to the drive. Recalibrate moves the heads more slowly than a seek to track 0, so it should not be used for data acquisition. The command is initiated by an I/O Pulse to the Controller.

5.3.2

SEEK

Seek moves the drive heads to the cylinder specified by a DOA instruction. Seek commands must precede Read, Write or Format commands if the specified cylinder is not the one presently selected by the drive. The command is initiated by an I/O Pulse to the Controller.

5.3.3

READ DATA COMMAND

A Read command is initiated by a Start Pulse to the Controller. When the BUSY flag sets, the Controller waits for ON CYLINDER from the disk drive. Upon completion of a previous Seek, the Controller does NOT set the drive Seek Done flag (DIA). The Controller then selects the specified head, and searches for the sector ID field specified by the previous DOC. Each sector ID field is read and compared with the desired cylinder, surface and sector address. The Controller also checks for a Bad Sector flag set, and tests the ID field CRC checkword to verify that the ID read was not in error. If the Controller is not able to locate the correct sector by checking ID fields within a specified number of tries, or the desired sector's Bad Sector flag is set, the operation terminates and DONE is set.

Once the desired sector is located, the Controller searches for the data field sync character and then begins reading the serial data from the disk. The Controller's deserializer forms the data into 16-bit words for transfer to the buffer. When all 256 words are read, the 32-bit ECC character is read and compared with the character just calculated by the ECC circuitry within the Controller.

In the event of an ECC error, the Controller attempts to correct the data before transferring it to memory if the Controller's on-board error correction is enabled. If error corrrection is disabled, the controller transfers the data to memory, sets the Checkword Error Bit, then terminates the Read command and sets DONE.

If the Controller determines that the error is correctable, it then makes the correction by using the obtained "syndrome" to find the location and the bits in error within the sector. The Read command then continues. If the error is found to be uncorrectable, the Controller will automatically attempt to recover and correct the data by re-trying the read using Data Strobe Early and Data Strobe Late control. If the Controller is still unable to recover the data, the Checkword error bit is set, the Read command terminates and DONE is set.

For multiple sector transfers, the Controller transfers from one buffer to memory while also reading the next sector into the other buffer from disk. Up to 16 consecutive sectors may be read using a single command.

5.3.4

WRITE DATA COMMAND

A Write command is initiated by issuing a Start pulse to the Controller. The Controller then sets its BUSY flag, and waits for ON CYLINDER from the drive in the same manner as the Read. The Controller then transfers 256 words of data, starting at the memory address specified by the previous DOB, from memory to its first buffer. The Controller then searches for the desired sector by comparing ID fields in the same manner as the Read command.

Once the correct sector is verified, the controller enables Write Gate to the drive and writes a gap, the sync byte and the 256-word data field to the disk. The Controller then appends the calculated 32-bit ECC polynomial to the end of the sector. For multiple sector transfers, the Controller begins reading the next sector of data from memory into the second buffer while also writing the previous sector from the first buffer to disk. Up to 16 consecutive sectors may be written using a single command.

5.3.5

FORMAT COMMAND

A Format command must consist of a Write command with the Format bit (bit 2) of the DOC set to a one. The command must be preceded by a valid seek to the desired cylinder. The Controller then selects the desired surface, locates the sector specified by the DOC, and writes the entire sector onto the disk. Up to 16 consecutive sectors may be formatted with a single command.

```
;*****************************************************************
;
; NAME: DISKD.TX
;
;
; DESCRIPTION:    292 CARTRIDGE DISK DIAGNOSTIC
;
;
; REVISION HISTORY:
;
;       REV.                DATE
;
;       01                  11/25/85
;       02                  08/29/86
;
;
;*****************************************************************
```

```
; 1. PROGRAM NAME: DISKD.SR, 292 CARTRIDGE DISK
;  DIAGNOSTIC (GEMINI)

; 2. REVISION HISTORY:
;
;       01      11/25/85
;       02      08/29/86        ;EXPANDED EMULATION
;

; 3. MACHINE REQUIREMENTS:
;  1. NOVA OR ECLIPSE FAMILY CENTRAL PROCESSOR OR EQUIVALENT
;  2. MINIMUM OF 8K READ/WRITE MEMORY
;  3. 1 DC-292 CARTRIDGE DISK SYSTEM (DGC 6070 EMULATION)
;  4. TELETYPE OR CRT AND CONTROLLER

; 4. TEST REQUIREMENTS: N/A

; 5. SUMMARY:
;  THIS PROGRAM IS A HARDWARE DIAGNOSTIC FOR THE
;  DC-292 DISK CONTROLLER. THE DEVICE CODE MAY BE
;  33 OR 73 WITH THE DEFAULT BEING 33.

; 6. RESTRICTIONS:
;  DIAGNOSTIC MAY BE RUN ON ONLY ONE CPU AT A TIME AND
;  MUST BE THE ONLY PROGRAM BEING RUN WITHIN THE DISK
;  SYSTEM.

; 7. PROGRAM DESCRIPTION/THEORY OF OPERATION:

; 7.1 A SERIES TESTS CHECK:

;  - BUSY, DONE, I/O BUS SELECT LOGIC
;  - DIB, DOB, DIC, DOC, DATA PATHS AND
;    LOADING OF THE CA AND DISK ADDRESS
;    REGISTERS
;  - CLEAR OF CA AND DISK ADDRESS REGISTERS
;  - DISK SELECT LOGIC

; 7.2 B SERIES TESTS CHECK:

;  - START, BUSY, CLEAR LOGIC
;  - RECALIBRATE, ATTN, INTERRUPT LOGIC
;  - INTERRUPT DISABLE, INTA LOGIC
;  - THAT SEEKS TO CYL'S 0,252,525,408. CAN
;    AT LEAST BE EXECUTED AND SET DRIVE BUSY.
;  - READY/SELECT LOGIC
```

```
;  7.3 C SERIES TESTS CHECK:

;  - THAT THE CA REGISTER INCREMENTS PROPERLY
;    VIA DCH REQUESTS
;  - THAT A WRITE CAN BE EXECUTED
;  - SELD, CLEAR LOGIC
;  - THAT SEEK/WRITE OPERATIONS CAN BE EXECUTED
;  - WRITES TO DIFFERENT HDS,SECTORS
;  - MULTI-SECTOR WRITES (4,8,16)
;  - THE INCREMENT HEAD LOGIC
;  - ILLEGAL SECTOR, SURFACE, CYLINDER CONDITIONS

;  7.4 E SERIES TESTS CHECK:

;  - THAT A READ MAY BE EXECUTED
;  - THAT THE DCH BUFFER DATA AND ADDRESS IS
;    CORRECT AND THAT CHECKWORD LOGIC WORKS
;    CORRECTLY BOTH VIA DIAGNOSTIC CONTROL AND
;    NORMALLY.
;  - 8 SECTOR WRITE/READ OPERATIONS (9 DIFFERENT
;    DATA PATTERNS) AT CYL'S 0,200.,400.  WITH FULL
;    CORE COMPARE
;  - WRITE CYL# 10 HEAD 0,SECTOR 0 OF ALL CYLINDERS
;  - WRITE HEAD # TO SECTOR 0 OF ALL HEADS ON CYL 0
;  - WRITE SECTOR # TO ALL SECTORS OF HEAD 0,CYL 0
;  - EACH OF THE ABOVE OPERATIONS IS FOLLOWED
;    BY A CORRESPONDING READ/CHECK OPERATION TO
;    VERIFY DISK ADDRESSING LOGIC.
;
;  7.5 F SERIES TESTS CHECK:
;
;  - ADDRESS CHECK AND BAD SECTOR LOGIC BY ALTERRING
;    THE FORMAT ON CYL 0,HEAD 0,SECTOR 0 1 BIT AT A
;    TIME AND MONITORING THE RESULTS AFTER A WRITE.
;    THE FORMAT IS SET TO NORMAL AFTER COMPLETION OF
;    THESE TESTS.
;    ## SEE SWREG 7 OPTION ##

;  7.6 S SERIES SEEK EXERCISERS

;       THE DIAGNOSTIC INCLUDES IS A RANDOM SEEK TEST
;    THAT PERFORMS SEEKS TO RAN CYLS FOLLOWED BY SINGLE
;    SECTOR WRITES AND READS TO HD 0, SEC 0.
;
```

```
;8.1 SWITCH SETTINGS
;
;  LOCATION "SWREG" IS USED TO SELECT THE PROGRAM
;  OPTIONS (NOT SYSTEM CONFIGURATION). WHILE RUNNING
;  UNDER DTOS, THIS LOCATION WILL BE LOADED BY THE
;  MONITOR.
;  HOWEVER UNDER STAND ALONE AND PROGRAM LOAD MODES
;  THIS LOCATION WILL BE SET ACCORDING TO THE ANSWERS
;  SUPPLIED BY THE OPERATOR.  IN ANY CASE THE OPTIONS
;  CAN BE CHANGED OR VERIFIED BY USING ONE OF THE
;  COMMANDS GIVE IN SEC. 8.3
;
;
;8.2 SWITCH OPTIONS
;  DIFFERENT BITS AND THEIR INTERPRETATION AT LOCATION
;  "SWREG" IS AS FOLLOWS:
;
;  BIT     OCTAL BINARY INTERPRETATION
;    VALUE VALUE
;
;  .1         0 LOOP ON ERROR
;    40000    1 SKIP LOOPING ON ERROR
;
;  2          0 PRINT TO CONSOLE
;    20000    1 ABORT PRINT OUT TO CONSOLE
;
;  3          0 DO NOT PRINT % FAILURE
;    10000    1 PRINT % FAILURE
;
;  5          0 DO NOT PRINT ON THE LINE PRINTER
;    02000    1 PRINT ON THE LINE PRINTER
;
;  6          0 DO NOT HALT ON ERROR
;    01000    1 HALT ON ERROR
;
;  7          0 N/A
;    00400    1 FORMAT HD 0,CYL 0 ON PROGRAM START
;               (SEE SECT. 12.2)
;
;  12(C)      0 N/A
;    00010    1 PROGRAM WILL HALT WHEN
;               NOT IN TESTS F1-F5 (SEE SECT. 12.2)
;
;  13(D)      0 RECALIBRATE DURING SCOPE LOOP
;     0004    1 SUPRESS RECAL DURING SCOPE LOOP
;
;  14(E)      0 N/A
;     0002    1 1 SECOND DELAY DURING SCOPE LOOP
```

```
;8.3 SWITCH COMMANDS
;  ONCE THE PROGRAM STARTS EXECUTING THE STATE OF ANY OF
;  THE BITS CAN BE CHANGED BY HITTING KEYS 1-9, A-F.
;  THE PROGRAM WILL CONTINUE RUNNING AFTER UPDATING THE
;  OPTIONS EACH KEY WILL COMPLEMENT THE STATE OF THE BIT
;  AFFILIATED WITH IT, THUS BIT 4 CAN BE ALTERED BY HIT-
;  TING KEY 4. SETTING OF ANY BIT OF LOCATION "SWREG" WILL
;  SET BIT 0.  (DEFAULT MODE IS DEFINED AS ALL BITS OF SWREG
;  SET TO 0)
;
;8.4 OTHER COMMANDS  (° = CONTROL KEY)
;
;  "CR"    A "RETURN" CAN BE TYPED TO CONTINUE THE PROGRAM
;    AFTER ITS LOCKED IN A SWITCH MODIFICATION MODE
;
;  °D      THIS COMMAND GIVEN AT ANY TIME WILL RESET "SWREG"
;    TO DEFAULT MODE AND RESTART THE PROGRAM.
;
;  °R      THIS COMMAND GIVEN AT ANY TIME WILL RESTART THE
;    PROGRAM.  SWITCHES ARE LEFT WITH THE VALUES THEY HAD
;    BEFORE THE COMMAND WAS ISSUED.
;
;  °O      THIS COMMAND GIVEN AT ANY TIME WILL CAUSE THE
;    PROGRAM CONTROL TO GO TO ODT (NOTE: THIS IS AN OP-
;    TIONAL COMMAND AND IS AVAILABLE ONLY IF ODTPK IS
;    PRESENT)
;
;  M       THIS COMMAND GIVEN AT ANY TIME WILL PRINT THE
;   CURRENT OPERATING MODES.
;
;  0       THIS COMMAND GIVEN AT ANY TIME WILL LOCK THE
;   PROGRAM INTO SWITCH MODIFICATION MODE WHERE MORE THAN
;   1 BIT CAN BE CHANGED.
;

;       NOTE: INITIALLY, THE PROGRAM PROMPTS THE
;       OPERATOR TO ENTER THE DESIRED SWITCH SET-
;       TINGS.  A "CR" MUST BE GIVEN TO EXIT THIS
;       PROMPT. IF SWREG INFORMATION IS TYPED IN,
;       A 'CR' MUST ALSO BE TYPED TO EXIT FROM THE
;       SWITCH MODIFICATION MODE.
```

```
;   1. LOAD USING THE BINARY LOADER


;   2. STARTING ADDRESSES
;     2- TO IDENTIFY DISK TYPE (RE-INITIALIZE)
;        PROGRAM THEN PROCEEDS AT ADR 500.

;     4- SET DISK CONTROL ADDRESS TO OTHER THAN 33

;     6- RANDOM SEEK EXERCISER.
;     A SINGLE DRIVE EXERCISER

;     70 - ODT - DIRECT ENTRY ONLY

;     200- START DIAGNOSTIC

;   3. THE PROGRAM PRINTS "PASS #" FOLLOWING EACH
;      COMPLETE PASS THROUGH THE TESTS.  RANDOM
;      SEEK EXERCISER PERFORMS 1000 SEEKS PER
;      "PASS" MESSAGE.

;   4. IN THE ABSENCE OF A REAL TIME CLOCK A TTY BAUD
;      RATE (REFERRING TO THE BAUD RATE OF CONSOLE
;            TERMINAL) IS REQUESTED FOR TIMING PUR-
;            POSES.
```

```
; 10. PROGRAM OUTPUT/ERROR DESCRIPTION:
;
;  WHEN AN ERROR IS DETECTED THE PROGRAM will PRINT
;  the present mode (seek,etc.), unit #, data pattern
;  used, starting disk address, and most probable
;  failing module. also printed is the error pc and
;  AC'S 0,1, AND 2 AT THE POINT of error. the program
;  then goes into a scope loop between the
;  ENTRIES TO .SETUP AND .LOOP ALLOWING THE OPERATOR
;  TO SET SWREG.  IN GENERAL THE ERROR PC WILL POINT
;  TO A CALL .EHALT.  THE SIGNIFICANCE OF THE AC'S IS
;  EXPLAINED IN THE PROGRAM LISTING, HOWEVER IN GENERAL
;  AC0 CONTAINS THE COMPARISON DATA AND AC1 THE RECEIVED
;  DATA.  SWREG DETERMINES THE LOOP EXIT, PRINTOUTS, ETC.
;  (SEE 8.0).

;  DATA ERRORS WILL RESULT IN THE 1ST 3 GOOD/BAD PAIRS
;  AND THEIR ADDRESSES BEING PRINTED ALONG WITH THE
;  failing sector # and error count. If a checkword error
;  IS DETECTED, THE call chkerr will acknowledge the fact
;  AND RETURN TO the main test for the data compare.
;  PRINTOUTS REsult on the first error pass only.

;  TESTS THAT PERFORM A RECALIBRATE HAVE A 2 SEC. DELAY
;  BUILT INTO THE SCOPE LOOP.  SET SWREG 9 = 1 TO INTRO-
;  DUCE AN ADDITIONAL 1 SECOND DELAY DURING THE SCOPE
;  LOOP.

;  IN GENERAL EACH SUCCESSIVE TEST ASSUMES ALL PREVIOUS
;  TESTS WORK.  BYPASSING ERRORS CAN RESULT IN CONFUSING
;  SITUATIONS IN THE SETUP OF MORE COMPLEX TESTS.

;*********************************************************
;* SEEK EXERCISER ERROR DESCRIPTIONS ON NEXT TWO PAGES *
;*********************************************************
```

```
;********SEEK EXERCISER ERROR REPORTING**********************
;
; ERRORS ARE REPORTED AS THEY OCCUR UNDER THE FOLLOWING
; CATEGORIES:
;
;       1. NO INTERRUPT - AC'S N/A
;
;       2. SEEK PENDING TIMEOUT - AC0 = UNIT# AC1 = CYL#
;          THE PROGRAM TIMES SEEK PENDINGS BY SEARCHING
;          EACH UNIT TABLE FOR SEEK PENDING STATUS AFTER
;          EVERY INTERRUPT AND INCREMENTING A LOOP ITER-
;          ATION COUNTER IN EACH UNIT TABLE WHICH IN-
;          DICATES A SEEK PENDING STATUS.  IF AFTER AN AR-
;          BITRARY COUNT OF 12 IS EQUALLED, AND THE SEEK IS
;          STILL PENDING, A TIMEOUT ERROR IS ASSUMED.
;
;       3. STATUS ERRORS "DIA" - PRINTOUT OF EACH UNIT
;                                TABLES PERTINENT DATA
;                                AC0 = DIC  AC1 = DIA
;          A DATA COMPARE IS PERFORMED FOLLOWING CHECK-
;          WORD ERRORS AND THE FIRST 3 MISCOMPARES ARE
;          PRINTED.
;
;       4. UNEXPECTED R/W DONE - AC0 = DIC  AC1 = DIA
;
;       5. UNEXPECTED SEEK DONE - AC0 = DIC  AC1 = DIA
;
;       6. ENDING MEMORY ADDRESS ERROR - AC0 = START ADR
;                                        AC1 = END ADR
;
;*************************************************************
```

```
;**********SEEK EXERCISER ERROR ANALYSIS********************
;
; ALL SEEKS ARE PERFORMED TO RAN. CYL #S STORED IN
; THE UNIT TABLE FOR EACH CONFIGURED DRIVE.  ALL
; WRITE AND READ ARE PERFORMED ON HD 1, RAN. SECT#.,
; 1 SECTOR.  LIKEWISE, THE RANDOM SECT.# IS ALSO
; STORED IN THE CORRESPONDING DRIVES' UNIT TABLE.
; "FROM" AND "TO" SEEK PATHS ARE TRACKED IN THE UNIT
; TABLES AS WELL AS PERTINENT DRIVE STATISTICS AND
; STATUS.  THEREFORE, IT IS IMPERATIVE THAT ANY AT-
; TEMPT TO ANALYZE ERRORS IN THIS TEST MUST BE PRE-
; CEDED BY AN UNDERSTANDING OF THE OPERATION OF THIS
; TEST WITH FREQUENT REFERENCE TO THE UNIT TABLES
; FOR CONFIGURED DRIVES.  TO THIS END A DETAILED
; FUNCTIONAL FLOWBLOCK OF THE TEST IS INCLUDED AND
; IS SOMEWHAT ANALOGOUS TO THE TRADITIONAL "FLOW-
; CHART".  IF IT BECOMES NECESSARY TO ACCESS THE
; UNIT TABLES FOR THOSE ERRORS THAT DO NOT PRINT
; TABLE CONTENTS, THE OPERATOR MAY USE THE OCTAL DE-
; BUGGER TO DO SO.
; RANDOM WRITE DATA IS GENERATED ONE TIME ONLY DURING
; INITIALIZATION, CREATING A WRITE BUFFER WHOSE SIZE
; IS EQUAL TO THE NUMBER OF SECTORS TO BE TRANSFERRED
; +1 (N+1), AND IS THEREFORE 2 SECTORS IN LENGTH FOR
; SINGLE SECTOR TRANSFERS.  DURING PROGRAM EXECUTION
; THE TEST THEN GENERATES A RANDOM NUMBER FROM 1 TO
; 256 WHICH IT ADDS TO THE BASE ADDRESS OF THE WRITE
; BUFFER TO SELECT 1 OF 256 DIFFERENT SINGLE SECTOR
; RANDOM WRITE DATA BUFFERS.  THE RESULTING STARTING
; ADDRESS IS STORED IN THE UNIT TABLE FOR THE APPLIC-
; ABLE DRIVE.  THIS FEATURE ACHIEVES RANDOM DATA PAT-
; TERN SELECTION WITHOUT THE NECESSITY OF GENERATING
; AND REGENERATING THE WRITE BUFFERS EACH TIME A WRITE
; IS EXECUTED.
; THE FOLLOWING PAGE CONTAINS THE TABLE FORMATS FOR THE
; TABLES LOCATED AT THE END OF TEST.
;
;***********************************************************
```

```
; 11. DEBUG HELP:

; 11A.0 SUBROUTINES AND CALLS:

;** CHECK DATA SUBROUTINE
; CALL   CHECK
; ADDRESS OF DATA BUFFER 1
; ADDRESS OF DATA BUFFER 2
; # OF WORDS
; ERROR RETURN
; NORMAL RETURN

;** GENERATE N SECTORS OF DATA
; CALL   GENDAT
; ADDRESS OF DATA GEN ROUTINE
; DATA BUFFER ADDRESS
; # OF SECTORS
; RETURN

;** TEST FOR CHECKWORD ERROR
; CALL   CHKERR


;** I/O START ROUTINES **

;CALL    RECAL            START RECALIBRATE

;CALL    READ             START READ
; N      DOC WORD
; ADDR   BUFFER ADDRESS
; RETURN

;CALL    WRITE            START WRITE
; N      DOC WORD
; ADDR   BUFFER ADDRESS
; RETURN

;CALL    FORMAT           FORMAT(1 TRANSFER)
; N      DOC WORD
; ADDR   BUFFER ADDRESS
; RETURN
```

```
;** STATUS CHECK ROUTINES **

;CALL    SDIA            NORMAL STATUS AFTER SEEK
; ERROR RETURN
; NORMAL RETURN

;CALL    CDIA            NORMAL DIA AFTER R/W
; ERROR RETURN
; NORMAL RETURN

;CALL    CDIC            CHECK DISK ADDRESS REG
; N      DIC CHECK WORD
; ERROR RETURN
; NORMAL RETURN

;CALL    EDIA            FORCED DIA STATUS
; N      CHECK WORD
; ERROR RETURN
; NORMAL RETURN

;CALL    CDIB            CHECK ENDING READ/WRITE MAP
; N      CHECKWORD (LOWER LIMIT)
; ERROR RETURN
; NORMAL RETURN

;CALL    STALL           DELAY 20-30 US

;CALL    ADDSET
; ADDRESS LOOP RETURN ON ERROR
```

```
0?D1D     T1B
**        X=1
```

```
;   1. IF THE DISK PACK HAS BAD SECTOR FLAGS SET ON CYLINDER
;   0, OR ON THE FIRST 8 SECTORS OF HEAD 0 OF ANY CYLINDER,
;   OR HD1 ANY CYL & SECTOR, THEN
;   ERROR PRINTOUTS WILL RESULT WHEN THE FLAGS ARE ENCOUNTERED.
;   TO AVOID BAD SECTOR FLAG INDUCED ERROR PRINTOUTS, USE A
;   SCRATCH PACK FORMATTED BY "QUICK FORMATTER"(SA 504)
;   DGC DISK RELIABILITY, AS THE "QUICK FORMATTER" DOES NOT
;   SET BAD SECTOR FLAGS AUTOMATICALLY.

;   2. TESTS F1-F5 ALTER THE FORMAT ON
;   CYL 0,HD 0,SEC 0 FOR PURPOSES OF CHECKING THE ADDRESS
;   CHECK AND BAD SECTOR LOGIC.  SWREG12 SHOULD BE SET TO
;   1 IN ORDER TO STOP PROGRAM WHEN RUNNING THESE TESTS.
;   IF SWREG12 =1 WHEN IN TESTS F1-F5, PROGRAM WILL CONTINUE
;   UNTIL AFTER THESE TESTS ARE COMPLETED AND THEN HALT.

;   3. In SOME SCOPE LOOPS it may be desirable to suppress the
;   loop recalibrate. SET SWREG 8 =1 TO do so.

;   4. DISK PACKS
;   ONLY USE DISK PACKS FORMATTED BY THE 292 DISK PACK FORMATTER
;   PROGRAM.  THE DIAGNOSTIC PROGRAM WILL WRITE OVER MOST OF THE
;   DISK SURFACE.
```

```
;  13. RUNTIME:
;
;       TYPICAL RUNTIME FOR 1 PASS ON A SINGLE DRIVE IS
;       APPROXIMATELY 8. MINUTES.

.EJECT
```

```
;*****************************************************************
;
; NAME: DISKF.TX
;
;
; DESCRIPTION: 292 CARTRIDGE DISK FORMATTER PROGRAM
;
;
; REVISION HISTORY:
;
;       REV.            DATE
;
;       01              11/25/85
;       02              08/29/86
;
;*****************************************************************
```

```
;       CARTRIDGE DISK FORMATTER PROGRAM

;2.0    REVISION HISTORY:
;
;       01      11/25/85
;       02      08/29/86        ;EXPANDED EMULATION
;

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE FAMILY CENTRAL PROCESSOR OR EQUIVALENT
;       16K READ/WRITE MEMORY
;       TELETYPE OR CRT AND CONTROL
;       1 DC-292 CARTRIDGE DISK SYSTEM (DGC 6070 EMULATION)

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       THE CARTRIDGE DISK FORMATTER PROGRAM IS A
;       UTILITY PROGRAM DESIGNED TO FORMAT AND CHECK DISK
;       PACKS TO BE USED ON THE ABOVE DISK SYSTEMS.
;       THE PROGRAM IS !NOT! A MAINTENANCE PROGRAM
;       AND ASSUMES THE HARDWARE TO BE IN WORKING ORDER.
;       THE PROGRAM WILL, ON DETECTING A NON-DATA
;       RELATED ERROR, PRINT THE ERROR INFORMATION AND TAKE
;       THE UNIT OFFLINE.  IF THE CONFIGURED UNIT
;       ENCOUNTERED NON-DATA ERRORS, THE PROGRAM WILL
;       PAUSE PENDING OPERATOR INTERVENTION.

;       THE CONTROL CAN BE DEVICE 33 OR 73 OCTAL
;       THE DEFAULT IS 33.

;6.0    RESTRICTIONS:
```

```
;       A.      FORMATTER PROGRAM (STARTING ADDRESS <SA> 500)
;       THE DISK IS FIRST FORMATTED AFTER WHICH A FORMAT DONE
;       MESSAGE IS PRINTED.  THEN A 155555 PATTERN IS WRITTEN
;       TO THE ENTIRE PACK AND READ BACK 2 TIMES, AND PASS
;       IS PRINTED.  THE DATA PATTERN IS THEN ROTATED 1 BIT
;       AND THE WRITE/READ/READ PROCESS IS REPEATED.
;*************************************************************
;       IT IS RECOMMENDED THAT AT LEAST 4 PASSES (WRI/REA/REA)
;       BE ALLOWED TO INSURE PACK QUALITY.  IF TIME PERMITS,
;       LONGER RUNS WILL FURTHER INSURE QUALITY.
;
;*************************************************************
;       ANY HARD DATA OR ADDRESS ERRORS WILL RESULT IN THE
;       BAD SECTOR FLAG BEING SET IN THAT SECTOR.  ANY "SOFT
;       DATA" OR "ADDRESS ERROR" ADDRESS ENCOUNTERED TWICE
;       CAUSE THAT BAD SECTOR FLAG TO BE SET.  ANY OTHER
;       ERROR WILL CAUSE THE PROGRAM TO PRINT THE FAILURE TO
;       THE TTY AND TAKE THE CORRESPONDING UNIT OFFLINE.
;       THEN TESTING WILL RESUME ON THE REMAINING UNITS.IF
;       NO UNITS REMAIN  TO BE TESTED THE PROGRAM WILL PAUSE.
;       THIS PROGRAM IS NOT INTENDED TO BE A RELIABILITY FOR THE
;       DISK SYSTEM AND IN GENERAL ASSUMES THE CONTROL AND DRIVE
;       TO BE IN WORKING ORDER.

;       A HARD ADDRESS ERROR IS DEFINED AS SUCH AFTER TWO
;       ATTEMPTS HAVE BEEN MADE BOTH RESULTING IN AN ADDRESS
;       ERROR.  A HARD DATA ERROR IS DEFINED AS SUCH AFTER
;       2 OR MORE OF 10 READ TRY'S HAVE BEEN UNSUCCESSFUL.

;       B.      CHECK PROGRAM ONLY (SA 501)
;       SAME AS SA 500 EXCEPT THAT INITIAL PACK FORMAT
;       OPERATION IS BYPASSED.

;       B.1.    STATISTICS
;       TYPE L FOR 1ST 100. DISK ADDRESSES OF BAD SECTORS,
;       DATA AND ADDRESS ERRORS.
```

```
;       AS A TROUBLE SHOOTING AID THE SERVICE ENGINEER
;       MAY TYPE IN HIS OWN TEST LOOP.  AFTER STARTING
;       AT 503, THREE ARGUMENTS MUST BE ENTERED IN
;       RESPONSE TO THREE PROGRAM QUESTIONS; "UNIT",
;       "DATA", AND "COMMAND STRING".  ALL NUMBERS MUST
;       BE ENTERED IN OCTAL.

;       I.      UNIT:   TYPE UNIT # OR CARRIAGE TO USE
;                       THE PREVIOUS ENTRY

;       II.     DATA:   RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=110110
;                       FLO=FLOATING ONE PATTERN
;                       FLZ=FLOATING ZERO PATTERN
;                       ADR=ALTERNATING CYLINDER AND
;                       HEAD, SECTOR WORDS
;                       VAR=EXISTING WORDS ENTERED
;                       PREVIOUSLY AS DESCRIBED BELOW
;                       ALTERNATIVELY ENTER A STRING OF UP
;                       UP TO 7 OCTAL 16 BIT WORDS TO BE
;                       USED AS DATA.  THE WORDS ENTERED
;                       ARE USED REPEATEDLY TO MAKE UP A
;                       SECTOR BLOCK.  TYPE CARRIAGE TO
;                       USE THE PREVIOUS ENTRY.

;       III.    COMMAND STRING:

;       OPTIONS 1.      READ HEAD,SECTOR,#SECTORS
;               2.      WRITE SAME
;               3.      SEEK CYLINDER
;               4.      RECALIBRATE
;               5.      LOOP (GO TO BEGINNING OR LR)
;               6.      DELAY N (N=DELAY IN MS)
;               7.      LR (BEGIN LOOP HERE)
;               8.      FORMAT CYL,HD,SECTOR
;               9.      BAD (BAD SECTOR) CYL,HD,SECTOR
;               10.     TYPE CARRIAGE RETURN TO USE THE
;                       PREVIOUS COMMAND STRING,UNIT,OR
;                       DATA.

;               11.     TYPE ESCAPE TO BYPASS UNIT & DATA
;                       PROMPT TO COMMAND STRING PROMPT,
;                       USING PREVIOUSLY ENTERED UNIT #
;                       & DATA.
;
;               12.     TYPE ANY KEY TO INTERRUPT EXECUTION
;                       OF CURRENT COMMAND AND RETURN TO
;                       UNIT#.

;               13.     TYPE A "^O" TO ENTER ODT. TO RETURN TO SA MENU
;                       TYPE "200R".
```

```
;                NOTE THAT EITHER SPACES OR A COMMA MAY
;                BE USED AS AN ARGUMENT DELIMITER.  EACH
;                RESPONSE IS TERMINATED BY TYPING CARRIAGE
;                RETURN.  IF MORE ROOM IS NEEDED ON A LINE,
;                TYPE LINE FEED TO SPACE TO THE NEXT LINE.
;                A "LF" DOES NOT ELIMINATE THE NEED FOR A
;                DELIMITER.

;                SHOULD THE COMMAND STRING ENTRIES EXCEED
;                THE INPUT BUFFER CAPACITY, THE PROGRAM
;                RESPONDS WITH THE MESSAGE "INPUT OVERFLOW"
;                AND THE OPERATOR MUST THEN DEPRESS ONE OR
;                MORE "RUBOUTS" FOLLOWED BY A "CR" TO
;                POSITION THE POINTER TO THE LAST VALID
;                COMMAND IN THE STRING FOR EXCUTION.
;                THE WORD "SAME" USED WITH READ, OR WRITE,
;                WILL CAUSE THE PREVIOUS DISK ADDRESS
;                PARAMETERS TO BE USED.

;        AN "R" TYPED WHILE A STRING IS BEING EXECUTED WILL
;        CAUSE THE PROGRAM TO RETURN TO COMMAND STRING START.
;        THE ESCAPE KEY WILL BYPASS UNIT AND DATA PROMPTS TO
;        THE COMMAND STRING PROMPT.

;        THE FOLLOWING EXAMPLE WOULD CAUSE UNIT 1 TO SEEK
;        CYLINDER 50, THEN REPEATEDLY WRITE SECTORS 2 AND 3
;        OF HEAD 1, THEN READ IT BACK AND CHECK.  DATA IS
;        SPECIFIED AS ALTERNATE WORDS OF ZEROS THEN ONES.

;        UNIT:  1
;        DATA:  0,177777
;        COMMAND STRING:  SEEK 50 LR WRITE 1,2,2 READ SAME LOOP

;        D.      ERROR LOG RECOVERY (SA 510)
;        ERROR LOGS MAY BE RECOVERED AT THIS STARTING ADDRESS.
;        OPERATOR MUST NOT RESTART PROGRAM AT ANY OTHER ADDRESS
;        PRIOR TO RECOVERING LOGS AS THE LOGS ARE INITIALIZED ON
;        RESTART.
```

```
;
;       LOCATION "SWREG" IS USED TO SELECT THE PROGRAM OPTIONS
;       (NOT SYSTEM CONFIGURATION).  WHILE RUNNING UNDER DTOS,
;       THIS LOCATION WILL BE LOADED BY THE MONITOR.  HOWEVER,
;       UNDER STAND ALONE AND PROGRAM LOAD MODES THIS LOCATION
;       WILL BE SET ACCORDING TO THE ANSWERS SUPPLIED BY THE
;       OPERATOR.  IN ANY CASE THE OPTIONS CAN BE CHANGED OR
;       VERIFIED BY USING ONE OF THE COMMANDS GIVEN IN SEC. 8.3.
;
;8.2    SWITCH OPTIONS
;       DIFFERENT BITS AND THEIR INTERPRETATION AT LOCATION
;       "SWREG" IS AS FOLLOWS:
;
;       BIT     OCTAL   BINARY  INTERPRETATION
;               VALUE   VALUE
;
;       1               0       LOOP ON ERROR
;               40000   1       SKIP LOOPING ON ERROR
;
;       2               0       PRINT TO CONSOLE
;               20000   1       ABORT PRINT OUT TO CONSOLE
;
;       5               0       DO NOT PRINT ON THE LINE PRINTER
;               02000   1       PRINT ON THE LINE PRINTER
;
;       11(B)           0       N/A
;               00020   1       ENABLE BAD SECTOR PRINTOUT
;
;8.3    SWITCH COMMANDS
;       ONCE THE PROGRAM STARTS EXECUTING THE STATE OF ANY OF
;       THE BITS CAN BE CHANGED BY HITTING KEYS 1-9, A-F.  THE
;       PROGRAM WILL CONTINUE RUNNING AFTER UPDATING THE OPTIONS
;       EACH KEY WILL COMPLEMENT THE STATE OF THE BIT AFFILIATED
;       WITH IT, THUS BIT 4 CAN BE ALTERED BY HITTING KEY 4.
;       SETTING OF ANY BIT OF LOCATION "SWREG" WILL SET BIT 0.
;       (DEFAULT MODE IS DEFINED AS ALL BITS OF SWREG SET TO 0)
;
;       NOTE: INITIALLY, THE PROGRAM PROMPTS THE
;       OPERATOR TO ENTER THE DESIRED SWITCH SET-
;       TINGS.  A "CR" MUST BE GIVEN TO EXIT THIS
;       PROMPT. IF SWREG INFORMATION IS TYPED IN,
;       A 'CR' MUST ALSO BE TYPED TO EXIT FROM THE
;       SWITCH MODIFICATION MODE.
```

```
;
;       "CR"    A "RETURN" CAN BE TYPED TO CONTINUE THE PROGRAM
;               AFTER ITS LOCKED IN A SWITCH MODIFICATION MODE.
;
;       ^D      THIS COMMAND GIVEN AT ANY TIME WILL RESET "SWREG"
;               TO DEFAULT MODE AND RESTART THE PROGRAM.
;
;       ^R      THIS COMMAND GIVEN AT ANY TIME WILL RESTART THE
;               PROGRAM.  SWITCHES ARE LEFT WITH THE VALUES THEY
;               HAD BEFORE THE COMMAND WAS ISSUED.
;
;       ^O      THIS COMMAND GIVEN AT ANY TIME WILL CAUSE THE
;               PROGRAM CONTROL TO GO TO ODT (NOTE:  THIS IS AN
;               OPTIONAL COMMAND AND IS AVAILABLE ONLY IF ODTPK
;               IS PRESENT)
;
;       M       THIS COMMAND GIVEN AT ANY TIME WILL PRINT THE
;               CURRENT OPERATING MODES.
;
;       0       THIS COMMAND GIVEN AT ANY TIME WILL LOCK THE
;               PROGRAM INTO SWITCH MODIFICATION MODE WHERE
;               MORE THAN 1 BIT CAN BE CHANGED.
```

```
;       A.  VERIFY DRIVE (DRIVES) ARE READY ON-LINE
;       B.  LOAD PROGRAM USING BINARY LOADER
;       C.  RESET, LOAD ONE OF THE STARTING ADDRESSES
;           SHOWN BELOW INTO THE DATA SWITCHES AND HIT
;           START.

;       STARTING ADDRESS (SA)
;       200     CHANGE DEVICE CODE AND REDISPLAY MENU
;       500     FORMATTER/CHECK PROGRAM
;       501     CHECK PROGRAM ONLY
;       503     COMMAND STRING INTERPRETER
;       510     ERROR LOG RECOVERY (SEE 7.D)

;       INITIALLY, THE OPERATOR IS REQUESTED TO ENTER A TTY
;       BAUD RATE( NO RTC PRESENT) FOR TIMING, DATE -DAY,
;       MONTH, YEAR, HOUR, & MINUTE (A [CR]
;       RESPONSE WILL IGNORE THIS ROUTINE), & (UNIT#,MIN
;       SURFACE, MAX SURFACE) FOR EACH UNIT TO BE TESTED.
;       EX. 0,0,3 1,0,3 ETC..(SURFACE RANGE IS 0 TO 3).
;       SUBSEQUENT PROGRAM RESTARTS MAY USE PREVIOUSLY ENTERED
;       PARAMETERS FOR UNIT#'S & RANGE BY TYPING A "CR" IN
;       RESPONSE TO MESSAGE PROMPT.
;

;       OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:
;
;       L       = FIRST 100. BAD SECTORS, DATA, OR ADDRESSES

;10.0   PROGRAM OUTPUT/ERROR DESCRIPTION:

;       1.  ERRORS- ERROR STATUS IS PRINTED WHENEVER
;       ENCOUNTERED.  WHEN DATA ERRORS ARE FOUND ONLY
;       THREE ARE PRINTED PER ENCOUNTER.  (SEE PARA-
;       GRAPH 10.3)

;       2.  IF ERRORS ARE ENCOUNTERED MORE THAN ONCE,
;       A COUNT WILL BE RECORDED AND A BAD SECTOR FLAG
;       SET.  ALL ADDRESS INFO. WILL BE PRINTED IN OCTAL.

;       3.  ERROR REPORTING AND RECOVERY

;       ALL ERRORS ARE IDENTIFIED, AND THE PROGRAM IS
;       ROUTED VIA BASE TO A CALL TO CKSW.  WITH THE
;       EXCEPTION OF ADDRESS AND DATA ERRORS THE PROGRAM
;       WILL THEN LOOP FOR OPERATOR INTERVENTION, ON THE
;       BASIS OF SWPAK (SEE 8.)

;       RECALIBRATE- ANY UNUSUAL STATUS IS REPORTED IM-
;       MEDIATELY AND AN ERROR RETURN EXECUTED.

;       SEEK- POSITIONER FAULT STATUS RESULTS IN
;       STATUS PRINTOUT AND ERROR RETURN.
;       WRITE- FOLLOWING "DONE" ON A WRITE, ERRORS ARE
;       CHECKED IN THE SEQUENCE SHOWN BELOW.  ERROR
;       RECOVERY PROCEDURE IS OUTLINED FOR EACH CASE.
;       IF THE ERROR IS NOT PRESENT THE NEXT CHECK IS MADE.
```

```
;       4.  READ/WRITE TIMEOUTS, ILLEGAL SECTOR, OR
;       CHECKWORD (DATA OK) PRINT THE ILLEGAL STATUS AND DO
;       AN ERROR RETURN.

;       5.  ADDRESS ERROR- REPEAT THE WRITE, IF TEST PASSES
;       THE SECOND TIME, DO A NORMAL RETURN; OTHERWISE
;       FLAG AS HARD, SET THE BAD SECTOR FLAG FOR THAT SECTOR
;       AND DO AN ERROR RETURN.

;       IF A HARD CYLINDER ADDRESS ERROR OCCURS, A READ
;       ON AN ADJACENT HEAD WILL BE ATTEMPTED TO DETERMINE
;       WHETHER THE FAULT SHOULD BE CLASSED AS A SEEK ERROR
;       OR AN ADDRESS ERROR.  THE FIRST 30. HARD ADDRESS
;       ERRORS WILL HAVE THEIR ADDRESS LOGGED.

;       6.  ENDING MEMORY ADDRESS- PRINT THE ERROR MESSAGE,
;       CHECK FOR A DISK ADDRESS AND DO AN ERROR RETURN.

;       7.  ENDING DISK ADDRESS- PRINT THE ERROR MESSAGE AND
;       DO AN ERROR RETURN.

;       READ- ALL READ ERRORS WITH THE EXCEPTION OF DATA RELATE
;       ERRORS ARE HANDLED THE SAME AS DESCRIBED FOR THE WRITE
;       OPERATIONS

;       DATA ERRORS- DATA IS REREAD 9 TIMES,
;       IF DATA IS BAD ON 2 OR MORE OF 10 PASSES, A HARD ERROR
;       COUNT IS INCREMENTED, THE BAD SECTOR FLAG IS SET IN THAT
;       SECTOR, AND AN ERROR RETURN IS TAKEN.  IF DATA IS GOOD
;       ON ALL RETRIES, THE ERROR IS CONSIDERED SOFT AND A
;       NORMAL RETURN IS TAKEN.

;       THE 1ST 100. DATA ERRORS (HARD OR SOFT) ARE LOGGED.
```

```
**          X=0
**          0?DTD     11
**          X=1
```

```
;       1.  THE PROGRAM IS !NOT! A MAINTENANCE PROGRAM
;       AND ASSUMES THE HARDWARE TO BE IN WORKING ORDER.

;       2.  IT IS RECOMMENDED THAT AT LEAST 4 PASSES
;       (WRI/REA/REA) BE ALLOWED TO INSURE PACK QUALITY.
;       IF TIME PERMITS, LONGER RUNS WILL FURTHER INSURE
;       QUALITY.
;

;13.1   PROGRAM RUNTIME:

;       PROGRAM RUNTIMES ARE SUBSTANTIALLY REDUCED WITH
;       MEMORIES OF 16K OR LARGER.
;
;       TYPICAL RUNTIME (4 PASSES) IS APPROXIMATELY 16 MINS
;       FOR A SINGLE DRIVE , TWO SURFACES ON NOVA 800 AND LATER SERIES
;       CPU'S.
;
;



;       FOUR PASSES AFTER FORMAT ARE RECOMMENDED FOR
;       SURFACE VERIFICATION.

;       READ, WRITE AND SEEK OPERATIONS ARE TIMED BY
;       SPECIAL ROUTINES.  WHEN THE PROGRAM IS FIRST
;       STARTED, THE TIMING ROUTINE WILL TEST FOR THE
;       PRESENCE OF A REAL TIME CLOCK (RTC) TO DERIVE
;       TIMING FROM IT.  IF NO RTC IS PRESENT, THE
;       PROGRAM WILL TYPE "TTO BAUD RATE".  THIS
;       MESSAGE REFERS TO THE BAUD RATE OF THE CONSOLE
;       TERMINAL (DEVICE 10 & 11).  TYPE IN THE BAUD
;       RATE.  IF A TYPING ERROR OCCURS IN THE NUMBER
;       STRING (BEFORE THE CARRIAGE RETURN), SIMPLY
;       TYPE A NON-NUMERIC CHARACTER AND THE REQUEST
;       FOR THE BAUD RATE WILL BE REPEATED.  IF THE
;       CARRIAGE HAS BEEN GIVEN AFTER A TYPING ERROR,
;       RELOAD THE PROGRAM.

.EJECT
```

```
;*****************************************************************
;
; NAME: DISKR.TX
;
;
; DESCRIPTION: 292 CARTRIDGE DISK RELIABILITY PROGRAM
;
;
; REVISION HISTORY:
;
;       REV.            DATE
;
;        01             11/25/85
;        02             08/29/86
;
;*****************************************************************
```

```
;       CARTRIDGE DISK RELIABILITY PROGRAM

;2.0    REVISION HISTORY:
;       01      11/25/85
;       02      08/29/86        ;EXPANDED EMULATION

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE FAMILY CENTRAL PROCESSOR OR EQUIVALENT
;       16K READ/WRITE MEMORY
;       TELETYPE OR CRT AND CONTROL
;       DC-292 CARTRIDGE DISK SYSTEM (DGC 6070 EMULATION)
;       WITH 1 DISK DRIVE ONLY

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       THE CARTRIDGE DISK RELIABILITY PROGRAM
;       IS A MAINTENANCE PROGRAM DESIGNED TO
;       EXERCISE AND TEST THE DC-292 CARTRIDGE DISK
;       CONTROLLER AND 1 DISK DRIVE.

;       THE CONTROL CAN BE DEVICE CODE 33 OR 73
;       OCTAL.  THE DEFAULT IS 33 -SEE 9.0 FOR OTHER
;       SETTINGS.

;6.0    RESTRICTIONS:
```

```
;       A. RELIABILITY TEST (SA 500)

;       A RANDOM NUMBER GENERATOR IS USED TO SELECT A
;       DISK DRIVE, CYLINDER, HEAD, BEGINNING SECTOR,
;       AND NUMBER OF CONSECUTIVE SECTORS.  RANDOM
;       DATA IS THEN GENERATED, WRITTEN, AND READ.
;       THE SEQUENCE IS REPEATED INDEFINITELY.

;       B. RELIABILITY TEST (SA 501) WITH OPTIONS
;          ------------------------------------

;       SAME AS A, EXCEPT THAT OPERATOR IS GIVEN
;       THE OPTION OF SELECTING "ODD" OR "EVEN" CYL-
;       INDERS FOR RUNNING DUAL PROCESSORS BY TYPING
;       "O" FOR ODD OR "E" FOR EVEN. TYPING 'CR'
;       OPTIONS ALONE GETS SINGLE PROCESSOR
;       ON DATA PATTERNS (SEE 7D 11) FOR
;       CHOOSING A CONSTANT CYLINDER, HEAD, SECTOR
;       OR # OF SECTORS.  ANY LETTER RESPONSE TO
;       CYL, HEAD ETC. GETS RANDOM FUNCTION FOR THAT
;       VARIABLE.  A CARRIAGE RETURN ONLY GETS THE
;       RANDOM FUNCTION FOR ALL VARIABLES.  ALL
;       INPUTS ARE RANGE CHECKED AND REJECTED IF OUT
;       OF RANGE.

;       C. INCREMENTAL DISK ADDRESS TEST (SA 502)

;       OPERATOR IS GIVEN OPTION ON DATA (SEE 7D 11)
;       AND SURFACE RANGE.
;       REQUESTED DATA IS FIRST WRITTEN OVER THE
;       ENTIRE PACK.  THEN THE DATA IS READ FROM
;       ALL SECTORS.  THIS INSURES THAT ALL DISK PACK
;       BLOCKS ARE USEABLE AND ARE FORMATTED PROPERLY.
;       THE TEST IS THEN REPEATED FOR ALL READY DISCS,
;       AND PASS IS PRINTED.  THE SEQUENCE IS REPEATED
;       INDEFINITELY.
;       NOTE:  SHOULD A WRITE ERROR OCCUR ON THE
;       WRITE PASS (IE. ADDRESS OR BAD SECTOR ERROR)
;       WHICH TERMINATES THE WRITE TRANSFER, A
;       READ ERROR WILL ALSO OCCUR AT THE FAILING
;       ADDRESS ON THE READ PASS. IN SUCH INSTANCES,
;       DISCOUNT THE READ ERROR.

;       #NOTE
;       SWREG7=1, PROGRAM HALTS AFTER WRITE WITH READ
;       VERIFICATION ALLOWING OPERATOR TO CHANGE PACKS.
;       SWREG8=1, PUTS PROGRAM INTO READ ONLY MODE
;       ## SA'S 501,502 ONLY.  IF SA 501-DATA MUST
;       !NOT! BE RANDOM (SEE 7D 11)

;       ALL NUMBERS ENTERED ABOVE MUST BE IN OCTAL.
;       ANY NON-OCTAL INPUT IS TREATED AS A LETTER.
;       ANY LETTER INPUT FOR CYL, HEAD, SECTOR, OR
;       # OF SECTORS GET RANDOM FUNCTION IN THE
;       RELIABILITY TEST WITH OPTIONS.
```

```
;       D. COMMAND STRING INTERPRETER (SA 503)

;       AS A TROUBLE SHOOTING AID THE SERVICE
;       ENGINEER MAY TYPE IN HIS OWN TEST LOOP.
;       AFTER STARTING AT 503, THREE ARGUMENTS
;       MUST BE ENTERED IN RESPONSE TO THREE
;       PROGRAM QUESTIONS; "UNIT", "DATA", AND
;       "COMMAND STRING". ALL NUMBERS MUST BE
;       ENTERED IN OCTAL.
;       STATISTICS LOGS ARE VALID ONLY FOR THE
;       COMMAND STRING BEING EXECUTED.

;       I.      UNIT:   TYPE UNIT & OR CARRIAGE RETURN
;                       TO USE PREVIOUS ENTRY.

;       II.     DATA:   ROT=ROTATED 110110 PATTERN - THIS
;                       DATA OPTION APPLIES TO (SA 502)
;                       INCREMENTAL DISK ADDRESS TEST ONLY
;                       AND RESULTS IN A TOTAL OF 4 PASSES
;                       ACROSS THE PACK ROTATING THE PATTERN
;                       AFTER EACH PASS BEFORE PRINTING THE
;                       MESSAGE-"***PASS***".  THIS IS TO
;                       INSURE THAT A PEAK PHASE SHIFT IS
;                       EVOKED ACROSS EACH BIT CELL OF THE
;                       PACK.
;                       THIS TEST PATTERN IS RECOMMENDED WHEN
;                       RUNNING ERROR RATES.

;                       RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=110110 PATTERN
;                       ALT=52525 PATTERN
;                       FLO=FLOATING ONE PATTERN
;                       FLZ=FLOATING ZERO PATTERN
;                       ADR=ALTERNATING CYLINDER AND
;                           HEAD, SECTOR WORDS
;                       VAR=EXISTING WORDS ENTERED PREVIOUSLY
;                           AS DESCRIBED BELOW:

;                       ALTERNATIVELY ENTER A STRING OF UP TO 7
;                       OCTAL 16 BIT WORDS TO BE USED AS
;                       DATA.  THE WORDS ENTERED ARE USED
;                       REPEATEDLY TO MAKE UP A SECTOR BLOCK.
;                       TYPE "CR" TO USE THE PREVIOUS ENTRY.
```

```
;       OPTIONS 1.      READ HEAD,SECTOR,#SECTORS
;               2.      WRITE SAME
;               3.      SEEK CYLINDER
;               4.      RECALIBRATE
;               5.      LOOP (GO TO BEGINNING OR LR)
;               6.      DELAY N (N= DELAY IN MS)
;               7.      LR (BEGIN LOOP HERE)
;               8.      FORMAT (CYL,HD,SECTOR)
;               9.      BAD (INSTALL BAD SECTOR FLAG) CYL,HD,SEC
;               NOTE: ITEMS 8 & 9 INCLUDE THE NECESSARY SEEK

;               10.     TYPE CARRIAGE RETURN TO USE THE
;                       PREVIOUS UNIT, DATA, OR COMMAND
;                       STRING.
;               11.     TYPE ESCAPE TO BYPASS UNIT & DATA
;                       PROMPT TO COMMAND STRING PROMPT,
;                       USING PREVIOUSLY ENTERED UNIT# &
;                       DATA.
;               12.     TYPE "R" TO INTERRUPT EXECUTION
;                       OF CURRENT COMMAND AND RETURN TO
;                       UNIT# PROMPT.
;               13.     TYPE "^O" TO ENTER ODT
;                       TYPE "200R" IF YOU WISH TO RESTART PROGRAM
;               14.     TYPE "W" FOR STATISTICS LOG
;               15.     TYPE "L" FOR ERROR LOGS

;               NOTE:  OPTIONS 14 & 15 ARE VALID ONLY FOR
;               THE COMMAND STRING BEING EXECUTED; LOGS
;               ARE CLEARED PRIOR TO EACH COMMAND STRING
;               ENTRY.

;               THE FOLLOWING EXAMPLE WOULD CAUSE UNIT
;               1 TO SEEK CYLINDER 50, THEN REPEATEDLY
;               WRITE SECTORS 2 AND 3 OF HEAD 1, THEN
;               READ IT BACK AND CHECK.  DATA SPECIFIED AS
;               ALTERNATE WORDS OF ZEROS THEN ONES :

;               UNIT:  1
;               DATA:  0,177777
;               COMMAND STRING:  SEEK 50 LR WRITE 1,2,2 READ SAME LOOP

;               NOTE:  EITHER SPACES OR A COMMA MAY BE
;               USED AS AN ARGUMENT DELIMITER.  EACH RE-
;               SPONSE IS TERMINATED BY TYPING CARRIAGE
;               RETURN.  IF MORE ROOM IS NEEDED ON A LINE,
;               TYPE LINE FEED TO SPACE TO THE NEXT LINE. A "LF"
;               DOES NOT ELIMINATE THE NEED FOR A DELIMITER.
;               THE WORD "SAME" USED WITH READ, OR WRITE,
;               WILL CAUSE THE PREVIOUS DISK ADDRESS
;               PARAMETERS TO BE USED.

;               SHOULD COMMAND STRING ENTRIES EXCEED INPUT
;               BUFFER CAPACITY, THE PROGRAM RESPONDS WITH
;               THE MESSAGE "INPUT OVERFLOW".THE OPERATOR MUST
;               DEPRESS ONE OR MORE "RUBOUTS" FOLLOWED BY
;               A "CR" TO POSITION THE BUFFER POINTER TO
;               THE LAST VALID COMMAND IN THE STRING AND
;               BEGIN EXECUTION.
```

```
;               AN "R" TYPED WHILE A STRING IS BEING
;               EXECUTED WILL CAUSE THE PROGRAM TO RETURN
;               TO THE UNIT# PROMPT.  THE ESCAPE KEY WILL
;               BYPASS THE UNIT AND DATA PROMPTS TO THE
;               COMMAND STRING PROMPT, USING PREVIOUSLY
;               ENTERED UNIT# AND DATA.
;               AFTER COMPLETION OR TERMINATION OF A COM-
;               MAND STRING, TYPING A CARRIAGE RETURN WILL
;               CAUSE THE PROGRAM TO ADVANCE TO THE NEXT
;               PROMPT USING THE UNIT, DATA, OR COMMAND
;               STRING PREVIOUSLY ENTERED.

;               TO CHANGE THE CURRENT VALUE OF "SWREG" AND/OR
;               ENTER THE OCTAL DEBUGGER WHILE IN "COMMAND
;               STRING INTERPRETER", THE PROGRAM MUST BE
;               EXECUTING A COMMAND.  IF NO COMMAND HAS BEEN
;               ENTERED, PROCEED TO COMMAND STRING PROMPT AND
;               TYPE IN THE LOOP COMMAND.

;       IV.     INPUT VALIDATION:

;               A. UNIT:  THE PROGRAM WILL ACCEPT ONLY THOSE
;                         UNIT#'S PREVIOUSLY CONFIGURED BY
;                         THE OPERATOR DURING STARTUP.  AFTER
;                         A "LOSS OF READY" ON A PARTICULAR
;                         UNIT THAT UNIT'S # WILL BE REJECTED
;                         UNTIL THE UNIT HAS BEEN RE-INSTATED.
;                         SEE SECTION 12 NOTE #1.

;               B. DATA:  THE PROGRAM WILL ACCEPT ONLY THOSE
;                         PATTERNS DESCRIBED IN SECTION 5 D. II.
;                         SPELLING ERRORS OR NON-RECOGNIZED
;                         PATTERNS WILL BE REJECTED.

;               C. COMMANDS: THE PROGRAM REJECTS ANY UN-
;                         RECOGNIZED COMMANDS AND WILL ALLOW
;                         ANY INPUT WITHIN THE BIT FIELD
;                         BOUNDARIES OF THE APPLICABLE PARA-
;                         METER WITH THE EXCEPTION OF THE
;                         # OF SECTORS TO BE TRANSFERED.
;                         THE ALLOWABLE RANGE OF # OF SECTS
;                         IS DETERMINED BY THE AVAILABLE BUFFER
;                         SIZE AND CANNOT BE ZERO.
```

```
;       E. QUICK FORMATTER (SA 504)
;       THE PROGRAM DOES A QUICK FORMAT (NO PACK VALIDATION)
;       AND BREAKS TO ALLOW OPERATOR TO RESTART PROGRAM.
;       TO RESTART PROGRAM THE OPERATOR MUST ENTER THE
;       DESIRED STARTING ADDRESS FOLLOWED BY AN "R".
;       FOR EXAMPLE: 502R
;        ANY ERROR ENCOUNTERED IS CONSIDERED
;       CATASTROPHIC AND THE UNIT IS PLACED "OFFLINE".
;       THE PROGRAM THEN FORMATS ANY REMAINING UNITS.  IT
;       SHOULD BE NOTED THAT SA 502 ROT SHOULD BE RUN
;       FOLLOWING QUICK FORMATTER AND BAD SECTOR FLAGS
;       SET MANUALLY (SA 503) TO INSURE PACK RELIABILITY.

;       F. RUNALL (SA 505)
;         EXECUTES IN "TOP DOWN" FASHION THE FOLLOWING PROGRAMS:
;              (SA501)RANDOM RELIABILITY
;                     PAT,RAN,FLZ,FLO
;              (SA502) INCREMENTAL DISC ADDRESS
;                     ROT1-4,RAN,CAD,ALT,ALZ,ALO
;              (SA507) RANDOM SEEK EXERCISER

;       THE OPERATOR IS GIVEN THE OPTION TO RUN "RUNALL"
;       ON TWO DEVICE CODES WITH THE NUMBER OF PASSES PER
;       DEVICE CODE SPECIFIED. A "CR" DEFAULTS TO THE
;       CURRENT DEVICE CODE. IF THE SECOND DEVICE CODE AND
;       A PASS COUNT ARE ENTERED, THE PROGRAM RUNS "RUNALL"
;       (N) PASSES AND PRINTS OUT THE ERROR & STATISTICS
;       LOG FOR EACH DEVICE ALTERNATELY.

;       G. SEEK EXERCISER (SA 506)
;       PROGRAM PROVIDES A SEEK SCAN SEQUENCE
;       CONVERGING FROM THE EXTREME OUTERMOST TRACKS INTO THE
;       AJDACENT TRACK IN THE CENTER, THEN DIVERGING AGAIN TO
;       THE EXTREMES.

;       1. ALL SEEKS IN F/G ARE FOLLOWED BY A 1 SECTOR READ AT
;       RANDOM SECTOR WITH NO DATA CHECK.  ALL SEEKS ARE TIMED
;       WITH MAX,MIN, AND AVE. TIMES BEING LOGGED IN MS. SEEK
;       PATHS FOR MAX,MIN VALUES ARE ALSO LOGGED.  INCREMENTAL
;       DISK ADDRESS TEST (SA 502) SHOULD BE RUN PRIOR TO
;       RUNNING EITHER SEEK EXERCISER TO AVOID POSSIBLE CHECK-
;       WORD ERRORS DURING READS.
```

```
;       H. RANDOM SEEK EXERCISER (SA 507)
;       PROGRAM PROVIDES A RANDOM SEEK SEQUENCE

;       I. ERROR COUNT/LOG RECOVERY (SA 510)
;       IN THE EVENT A PROGRAM WAS STOPPED DURING A RUN, THE
;       ERROR LOGS MAY BE RECOVERED AT THIS STARTING ADDRESS.
;       ***MUST BE DONE BEFORE ANY PROGRAM RESTART AS PROGRAM
;       INITIALIZATION ZEROES ALL LOGS.

;       J. RELIABILITY TEST(SA 511), SAME AS SA 501

;       K. RELIABILITY TEST(SA 512), SAME AS SA 501

;       L. MEMORY DUMP ROUTINE (SA 513)
;       SEE SECTION 11.2.0 FOR DESCRIPTION
```

```
;
;       LOCATION "SWREG" IS USED TO SELECT THE PROGRAM
;       OPTIONS (NOT SYSTEM CONFIGURATION).  WHILE
;       RUNNING UNDER DTOS, THIS LOCATION WILL BE
;       LOADED BY THE MONITOR.
;       HOWEVER UNDER STAND ALONE AND PROGRAM LOAD MODES
;       THIS LOCATION WILL BE SET ACCORDING TO THE
;       ANSWERS SUPPLIED BY THE OPERATOR.  IN ANY CASE
;       THE OPTIONS CAN BE CHANGED OR VERIFIED BY USING
;       ONE OF THE COMMANDS GIVEN IN SEC. 8.3.
;
;
;8.2    SWITCH OPTIONS
;       DIFFERENT BITS AND THEIR INTERPRETATION AT
;       LOCATION "SWREG" IS AS FOLLOWS:
;
;       BIT     OCTAL   BINARY  INTERPRETATION
;               VALUE   VALUE
;
;        1                0      LOOP ON ERROR
;               40000     1      SKIP LOOPING ON ERROR
;
;        2                0      PRINT TO CONSOLE
;               20000     1      ABORT PRINT OUT TO CONSOLE
;
;        5                0      DO NOT PRINT ON THE LINE PRINTER
;               02000     1      PRINT ON THE LINE PRINTER
;
;        6                0      DO NOT HALT ON ERROR
;               01000     1      HALT ON ERROR
;
;        7                0      **** N/A
;               00400     1      BREAK FOR PACK INTERCHANGE
;
;        8                0      **** N/A
;               00200     1      FOR READ ONLY MODE (SA 501,502)
;
;        9                0      N/A
;               00100     1      BYPASS DATA CHECK
;
;       10(A)             0      N/A
;               00010     1      ENABLE BAD SECTOR PRINTOUTS
;
;       11(B)             0      N/A
;               00020     1      ENABLE SEEK TIMING STATISTICS
;                                AT END OF PASS (SA 506 ONLY)

;       12(C)             0      N/A
;               00040     1      ENABLE EXPANDED ERROR PRINTOUTS
;                                (SEE SECT. 10.4 "ERRORS")

;       NOTE: "SWREG" BIT 2 IS CLEARED BY PROGRAM  AUTO-
;             MATICALLY AT STARTUP.
```

```
;       ONCE THE PROGRAM STARTS EXECUTING THE STATE OF ANY
;       OF THE BITS CAN BE CHANGED BY HITTING KEYS 1-9, A-F.
;       THE PROGRAM WILL CONTINUE RUNNING AFTER UPDATING
;       THE OPTIONS EACH KEY WILL COMPLEMENT THE STATE OF THE
;       BIT AFFILIATED WITH IT, THUS BIT 4 CAN BE ALTERED BY
;       HITTING KEY 4.  SETTING OF ANY BIT OF LOCATION "SWREG"
;       WILL SET BIT 0. (DEFAULT MODE IS DEFINED AS ALL BITS
;       OF SWREG SET TO 0)
;
;8.4    OTHER COMMANDS  (° = CONTROL KEY)
;
;       "CR"    A "RETURN" CAN BE TYPED TO CONTINUE THE PROGRAM
;               AFTER ITS LOCKED IN A SWITCH MODIFICATION MODE
;
;       °D      THIS COMMAND GIVEN AT ANY TIME WILL RESET
;               "SWREG" TO DEFAULT MODE AND RESTART THE PRO-
;               GRAM.
;
;       °R      THIS COMMAND GIVEN AT ANY TIME WILL RESTART
;               THE PROGRAM.  SWITCHES ARE LEFT WITH THE
;               VALUES THEY HAD BEFORE THE COMMAND WAS
;               ISSUED AND THE OPENING MENU IS REDISPLAYED.
;
;       °O      THIS COMMAND GIVEN AT ANY TIME WILL CAUSE
;               THE PROGRAM CONTROL TO GO TO ODT (NOTE:
;               THIS IS AN OPTIONAL COMMAND AND IS AVAIL-
;               ABLE ONLY IF ODTPK IS PRESENT)
;
;       M       THIS COMMAND GIVEN AT ANY TIME WILL PRINT
;               THE CURRENT OPERATING MODES.
;
;       0       THIS COMMAND GIVEN AT ANY TIME WILL LOCK
;               THE PROGRAM INTO SWITCH MODIFICATION MODE
;               WHERE MORE THAN 1 BIT CAN BE CHANGED.

;               NOTE: INITIALLY, THE PROGRAM PROMPTS THE
;               OPERATOR TO ENTER THE DESIRED SWITCH SET-
;               TINGS.  A "CR" MUST BE GIVEN TO EXIT THIS
;               PROMPT. IF SWREG INFORMATION IS TYPED IN,
;               A 'CR' MUST ALSO BE TYPED TO EXIT FROM THE
;               SWITCH MODIFICATION MODE.
```

```
;       A. VERIFY DRIVE (DRIVES) ARE READY ON-LINE
;       B. LOAD PROGRAM USING BINARY LOADER
;       C. ENTER  ONE OF THE STARTING ADDRESSES

;       STARTING ADDRESS
;       200     CHANGE DEVICE CODE AND REDISPLAY MENU
;       500     RELIABILITY TEST, ALL CYLINDERS
;       501     RELIABILITY TEST, (OPTIONS)
;       502     INCREMENTAL DISK ADDRESS TEST
;       503     COMMAND STRING INTERPRETER
;       504     QUICKIE FORMATTER
;       505     RUN ALL
;       506     SEEK EXERCISER (CONVERGING,DIVERGING PATTERN)
;       507     SEEK EXERCISER (RANDOM PATTERN)
;       510     ERROR COUNT/LOG RECOVERY
;       511     SAME AS 501
;       512     SAME AS 501
;       513     MEMORY DUMP ROUTINE

;       INITIALLY, THE OPERATOR IS REQUESTED TO ENTER A TTY
;       BAUD RATE( NO RTC PRESENT) FOR TIMING, DATE -DAY,
;       MONTH, YEAR, HOUR, & MINUTE (A [CR]
;       RESPONSE WILL IGNORE THIS ROUTINE), & (UNIT#,MIN
;       SURFACE, MAX SURFACE) FOR EACH UNIT TO BE TESTED.
;       EX. 0,0,3 1,0,3 ETC..(SURFACE RANGE IS 0 TO 3).
;       SUBSEQUENT PROGRAM RESTARTS MAY USE PREVIOUSLY ENTERED
;       PARAMETERS FOR UNIT#'S & RANGE BY TYPING A "CR" IN
;       RESPONSE TO MESSAGE PROMPT.


;       OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:

;       L       = FIRST 100. BAD SECTORS, DATA, OR ADDRESSES
;       S       = SEEK TIMING STATISTICS (506,507 ONLY)
;       W       = SECTORS W/R PLUS ERROR COUNTS
;       **NOTE** ANY CHARACTER TYPED WILL END PRINTOUTS AT
;       THE NEXT CHANGE OF DATA TYPE.
```

```
;       1 OF 3 DIFFERENT MEMORY/INTERRUPT MODES MAY BE IN
;       USE IN THIS PROGRAM AND ARE DESCRIBED AS FOLLOWS:

;       1-BACKGROUND ONLY, WAIT ON INTERRUPT
;       MAX # OF SECTORS = ALL OF AVAILABLE CORE (IE NOT TAKEN
;       BY PROGRAM) OR 16 SECTORS MAX. USED FOR SA'S 503,
;       506,507

;       2-BACKGROUND/FOREGROUND MODES, 2 BUFFERS USED FOR
;       BOTH READ AND WRITE PURPOSES. MAX # OF SECTORS =
;       1/2 OF AVAILABLE CORE OR 16 SECTORS MAX.  USED FOR
;       INCREMENTAL ADDRESS TEST, OR RANDOM RELIABILITY
;       WITH CONSTANT DATA PATTERNS.

;       3-BACKGROUND/FOREGROUND MODES, 3 BUFFERS

;10.0   PROGRAM OUTPUT/ERROR DESCRIPTION:

;       ALL ERRORS ARE IDENTIFIED, COUNTED, AND THE
;       PROGRAM IS ROUTED VIA BASE TO A CALL TO
;       CKSW.  ON THE BASIS OF SWITCH SETTINGS (SEE
;       8.2) THE PROGRAM WILL GO INTO A SCOPE LOOP,
;       OR PROCEED, DEPENDING ON THE SWREG SETTINGS.

;       IN ALL TESTS EXCEPT (SA 503) COMMAND STRING
;       INTERPRETER, A "LOSS OF READY" WILL RESULT
;       IN THE FOLLOWING:

;       UPON LOSS OF READY AND A SINGLE DRIVE, THE
;       PROGRAM WILL PRINT THE APPROPRIATE ERROR
;       MESSAGE AND WILL HALT.  IF MULTIPLE DRIVES
;       EXIST, THE PROGRAM WILL CONTINUE WITH THE
;       REMAINING DRIVES.  IF THE DOWN DRIVE IS
;       PLACED BACK ONLINE, THE PROGRAM WILL RESUME
;       TESTING OF THAT DRIVE.  SEE 12.1

;       A "LOSS OF READY" IN (SA 503) COMMAND STRING
;       INTERPRETER CAUSES THE APPROPRIATE ERROR
;       MESSAGE TO BE PRINTED BUT DOE'S NOT REMOVE
;       THE FAILING DRIVE FROM TESTING.(ALLOWS LOOP-
;       ING ON "LOSS OF READY" FAILURES)

;       RECALIBRATE - ANY UNUSUAL STATUS IS REPORTED
;       IMMEDIATELY AND AN ERROR RETURN IS EXECUTED.

;10.1   SEEK - POSITIONER FAULT STATUS INCREMENTS SEEK
;       ERROR COUNTER.  ANY ERROR STATUS RESULTS IN
;       STATUS PRINTOUT AND ERROR RETURN.  A RECALI-
;       BRATE WILL BE PERFORMED BY THE ERROR HANDLER.
;       PROGRAM WILL LOG THE FIRST 20. CYLINDERS TO/
;       FROM ON FINDING SEEK ERRORS.
```

```
;       CHECKED IN THE SEQUENCE SHOWN BELOW.  ERROR
;       RECOVERY PROCEDURE IS OUTLINED FOR EACH CASE.
;       IF THE ERROR IS NOT PRESENT THE NEXT CHECK IS
;       MADE.

;       1. INTERRUPT TIMEOUTS,
;       ANY DRIVE FAULTS - INCREMENT THE
;       APPROPRIATE ERROR COUNT, PRINT THE ILLEGAL
;       STATUS AND DO AN ERROR RETURN.

;       2. BAD SECTOR - LOG THE DISK ADDRESS (FIRST 100.)
;       AND DO A NORMAL RETURN.  NO PRINTOUT WILL RESULT
;       UNLESS SWREG 10=1.  A "SOFT ERROR WILL BE RECORDED
;       IF THE SECTOR UNDER SCRUTINY PASSES AT LEAST 1
;       OF 4 RETRYS.  A SOFT ERROR IS DENOTED IN THE LOG
;       BY A COUNT GREATER THAN ZERO AND = TO THE NUMBER OF
;       OCCURENCES OF THAT ERROR. SOFT ERRORS WILL BE
;       PRINTED OUT REGARDLESS OF THE STATE OF SWREG 10.

;       3. ADDRESS ERROR - REPEAT THE WRITE, IF
;       TEST PASSES THE SECOND TIME, INCREMENT THE
;       SOFT ADDRESS ERROR COUNT AND DO A NORMAL
;       RETURN; OTHERWISE INCREMENT THE HARD AD-
;       DRESS ERROR COUNT AND DO AN ERROR RETURN

;       IF AN ADDRESS ERROR OCCURS ON THE FIRST
;       SECTOR TRANSFERED, A READ ON AN ADJACENT
;       HEAD WILL BE ATTEMPTED TO DETERMINE
;       WHETHER THE FAULT SHOULD BE CLASSED AS A
;       SEEK ERROR OR AN ADDRESS ERROR.  THE FIRST
;       20. ADDRESS ERRORS WILL HAVE THEIR ADDRESSES
;       LOGGED.

;       4. ENDING MEMORY ADDRESS - INCREMENT THE
;       MEMORY ADDRESS ERROR COUNT, PRINT THE ERROR
;       MESSAGE, CHECK FOR A DISK ADDRESS ERROR AND
;       DO AN ERROR RETURN

;       5. ENDING DISK ADDRESS - INCREMENT THE DISK
;       ADDRESS ERROR COUNT, PRINT THE ERROR MESSAGE,
;       AND DO AN ERROR RETURN
```

```
;       RELATED ERRORS ARE HANDLED THE SAME AS DESCRIBED
;       FOR THE WRITE OPERATIONS

;       DATA ERRORS - DATA IS REREAD 3X (4X IF CHECKWORD ERROR
;       UNDETECTED). IF PROGRAM IS IN WRITE/READ MODE AND DATA
;       IS BAD ALL 4 PASSES, A HARD ERROR COUNT IS INCREMENTED
;       AND AN ERROR RETURN IS TAKEN.  IF DATA IS GOOD ON ANY
;       FOUR PASSES, A SOFT ERROR COUNT IS INCREMENTED AND A
;       NORMAL RETURN IS TAKEN.

;       THE DISC ADDRESSES OF ALL DATA PROBLEMS
;       WILL BE PRINTED AND THE FIRST
;       100. WILL BE LOGGED.  THE FIRST THREE GOOD/BAD
;       WORD PAIRS AND RESPECTIVE ADDRESSES WILL BE PRINTED.
;
;       IF SWREG9=1 (BYPASS DATA CHECK) HARD OR SOFT DATA
;       ERRORS WILL BE DETERMINED BY CHECKWORD STATUS.


; 10.3A CHECKWORD FAILED - TWO CONDITIONS MAY FALL INTO
;       THIS CATEGORY.

;       1. A CHECKWORD ERROR WAS DETECTED BUT WITH NO AC-
;       COMPANYING DATA ERROR.
;       THIS TYPE OF ERROR SHOULD REPRESENT ONLY A VERY SMALL
;       PERCENTAGE OF THE DATA ERRORS (<1%- LARGE SAMPLE). IF
;       A SIGNIFICANTLY HIGHER PERCENTAGE OF THIS ERROR RESULTS,
;       THEN AN CHECKWORD PROBLEM WOULD BE INDICATED.

;       2. A DATA ERROR OCCURED WITHOUT A CORRESPONDING
;       CHECKWORD ERROR.

;       BOTH OF THESE CHECKWORD FAILURES WILL BE COUNTED
;       ONCE PER ERROR PATH UNDER THE CORRESPONDING
;       DRIVE STATISTICS SUMMARY HEADINGS.
```

```
;       ENCOUNTERED AS FOLLOWS:

;       'MODE'  UNIT:   'N'
;       CYL -   'N'     HEAD  'N'  SECT  'N'   #SECT  'N'

;       STRT HD-  'N'   STRT SECT-  'N'  ATT. # OF SECT-  'N'
;       ("SWREG" BIT 12= 1)-EXPANDED ERROR PRINTOUT

;       DIA STATUS = 'N'        'DESCRIPTIVE MESSAGE'

;       WHERE CYL,HEAD,SECT REFER TO THE FINAL DISK ADDRESS
;       AT THE POINT OF ERROR, AND #SECT REFERS TO THE NUMBER
;       OF SECTORS ALREADY DONE IN THE MULTI SECTOR TRANSFER,
;       AND WHERE STRT HD, STRT SECT, & ATT. # OF SECT, REFERS
;       TO THE STARTING PARAMETERS FOR THE FAILING TRANSFER.

;       WHEN DATA ERRORS ARE FOUND, ONLY THREE ARE PRINTED PER
;       ENCOUNTER. (SEE PARAGRAPH 10.3) WHEN LOOPING IS INVOLVED
;       (RETRIES OR FOR SCOPING) STATUS IS PRINTED ON THE
;       1ST PASS ONLY.  IF "SWREG" BIT 12=1 THEN
;       THE STARTING ADDRESSES FOR THE WRITE/READ BUFFERS ARE
;       PRINTED AFTER THE DATA ERROR PRINTOUT FOR USE IN
;       UTILIZING THE MEMORY DUMP UTILITY (SA 513) SHOULD
;       THE USER DESIRE TO EXAMINE MORE THAN THE FIRST THREE
;       DATA ERRORS.

;10.5   STATISTICS - TYPE A "W"
;       DURING RANDOM TESTING TO GET A REPORT OF THE
;       NUMBER OF SECTORS WRITTEN (AND/OR) READ, PLUS
;       ERROR COUNTS IN DECIMAL.

;       TYPE "L" FOR FIRST 100. DISK ADDRESSES OF BAD SECTORS AND
;       DATA ERRORS, AND FIRST 20. OF ADDRESS ERRORS AND SEEK
;       ERRORS (SEEK PATH).  IF ERROR ADDRESSES ARE ENCOUNTERED
;       MORE THAN ONCE (1ST PASS), A COUNT OF UP TO 32. WILL
;       BE RECORDED IN THE LOG.  ALSO A COUNT OF UP TO 15.
;       HARD ERRORS WILL BE RECORDED.  THIS COUNT WILL BE
;       A SUBSET OF THE FIRST COUNT.

;       NOTE: ADDRESS INFORMATION WILL BE IN OCTAL WHILE THE
;       COUNTS WILL BE DECIMAL.

;       TYPE "S" FOR SEEK TIMING STATISTICS IF RUNNING EITHER
;       SEEK EXERCISER.

;       **** NOTE ****
;       THE PROGRAM WILL ACCOUNT FOR UP TO A MAX.
;       OF 2**31 SECTORS WRITTEN OR READ. SPECIAL
;       TEST RUNS EXCEEDING THIS FACILITY WILL REQUIRE
;       AN OPERATOR'S TEST LOG TO AUGMENT SOFTWARE
;       ACCOUNTING.  2**31 SECTORS = APPROX. 5.5*
;       10**11 WORDS.
;       TYPING ANY KEY DURING "L" OR "W" STATISTICS
;       WILL TERMINATE THE TYPEOUT.
```

```
**      X=0
        0?DTD    11.1
**      X=1
```

```
;11.2.0 MEMORY DUMP UTILITY (SA513)

;
;
;11.2.0.1       THIS UTILITY AFFORDS THE USER THE CAPABILITY
;       OF DISPLAYING; IN OCTAL FORMAT; THE CONTENTS
;       OF CONTIGUOUS MEMORY LOCATIONS OF VARIABLE BLOCK
;       LENGTHS.

;11.2.0.2       BLOCKS OF CONTIGUOUS MEMORY THAT ARE IDENTICAL
;       AND GREATER THAN 64 ENTRIES IN LENGTH ARE OUT-
;       PUT IN AN ABBREVIATED FORMAT. (SEE PAR. °1.3.2).
;       THIS FEATURE WILL CONSERVE HARD COPY AND EXECUTION
;       TIME.

;11.2.0.3       THE USER MAY ALSO SPECIFY A SEARCH WORD. THE
;       TOTAL NUMBER OF ENTRIES FOUND; MATCHING THIS
;       WORD; WILL BE DISPLAYED AT THE END OF THE PRINTOUT

;11.2.0.4       THIS PROGRAM MAY BE MANUALLY STARTED AT LOCATION
;       " (SA513) " SYMBOLIC (I.E. THE FIRST ADDRESS OF
;       THE UTILITY).



;11.2.1 DIALOGUE

;11.2.1.1       PROGRAM DIALOGUE TERMINATED BY A "?" REQUIRES A
;       USER RESPONSE BEFORE PROGRAM EXECUTION CAN CON-
;       TINUE. IN THE FOLLOWING DIALOGUE USER RESPONSE IS
;       INDICATED BY "  ":
;
;       WD? "AAAAAA"
;       FST ADR? "BBBBBB"
;       LST ADR? "CCCCCC"
;
;       WHERE:
;       "AAAAAA" IS ANY OCTAL NUMBER IN THE RANGE OF 000000
;       THRU 177777.
;
;       "BBBBBB" IS ANY OCTAL NUMBER IN THE RANGE OF 000000
;       THRU 077776; AND EQUAL TO, OR LESS THAN "CCCCCC".
;
;       "CCCCCC" IS ANY OCTAL NUMBER IN THE RANGE OF 000001
;       THRU 077777; AND EQUAL TO, OR GREATER THAN "AAAAAA".
;
;11.2.1.2       A RESPONSE OF "0", "CR", "LF", "TAB", OR "SPACE"
;       TO ANY REQUEST WILL BE INTERPRETED AS A "0" RE-
;       SPONSE.
```

```
;11.2.2 ERRORS

;11.2.2.1       AN ILLEGAL RESPONSE TO A REQUEST, (I.E. A NON-
;       OCTAL CHARACTER), WILL RESULT IN A REPEAT OF THAT
;       REQUEST.

;11.2.2.2       A RANGE ERROR RESPONSE, (I.E. FIRST ADDRESS
;       GREATER THAN LAST ADDRESS), WILL RESULT IN THE RE-
;       START OF THE PROGRAM IF ENTERED MANUALLY; OR A
;       RETURN TO PC +3 IF ENTERED DYNAMICALLY.




;11.2.3 TYPICAL PROGRAM RESPONSE

;ADR:>  0      1      2      3      4      5      6      7
;0      NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN
;10     NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN
;SAME
;100    NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN
;110    NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN  NN-NN
;WD'S FOUND= MM-MM
;
;11.2.3.1       WHERE:
;       THE "NN-NN" ENTRIES ABOVE CORRESPOND TO THE CON-
;       TENTS OF THE ASSOCIATED ADDRESSES.
;
;       THE "MM-MM" ENTRY ABOVE REPRESENTS THE TOTAL NUMBER OF
;       WORDS (OCTAL) FOUND MATCHING THE SEARCH WORD.

;11.2.3.2       IN THE EXAMPLE ABOVE IT IS ASSUMMED THAT THE
;       CONTENTS OF LOCATIONS 10 THRU 107 INCLUSIVE ARE IDENTICAL.
;       THEREFORE THE ABBREVIATED OUTPUT. (I.E. LOCATIONS 20
;       THRU 107 INCLUSIVE ARE REPLACED BY THE TEXT MESSAGE
;       "SAME").
;
;       NOTE:
;       FOR MANUAL MODE OF OPERATION SWITCH "2" IN LOCATION
;       "SWREG" MUST BE "0" OR THE PROGRAM WILL HANG IN A
;       LOOP.
```

```
;       12.1  "LOSS OF READY" - SEVERAL CONSIDERATIONS
;       ARE GIVEN TO LOSS OF READY STATUS DURING
;       PROGRAM EXECUTION AS FOLLOWS:

;       (1.A) DURING INITIAL RECAL OF CONFIGURED DRIVE-
;       A LOSS OF READY RESULTS IN AN ERROR MESSAGE.

;       (1.B) ANY LOSS OF READY DURING PROGRAM EXECUTION-
;       RESULTS IN THE APPLICABLE DRIVE BEING PLACED
;       IN AN OFFLINE STATUS.  AN ERROR MESSAGE IS
;       PRINTED AND REQUESTS A NEW STARTING ADDRESS.
;       PROGRAM MUST THEN BE STARTED AS PER SECTION 3
;       (OPERATING PROCEDURES).

;       12.2  THE PROGRAM WILL ACCOUNT FOR UP TO A MAX. OF
;       2**31 SECTORS WRITTEN OR READ. SPECIAL TEST RUNS
;       EXCEEDING THIS FACILITY WILL REQUIRE AN OPERATOR'S
;       TEST LOG TO AUGMENT SOFTWARE ACCOUNTING. 2**31
;       SECTORS = APPROX. 5.5* 10**11 WORDS.
```

```
;       12.3  SWREG7=1, PROGRAM HALTS AFTER WRITE WITH READ
;       VERIFICATION ALLOWING OPERATOR TO CHANGE PACKS.
;       SWREG8=1, PUTS PROGRAM INTO READ ONLY MODE
;       ## SA'S 501,502 ONLY.  IF SA 501-DATA MUST !NOT!
;       BE RANDOM.  START AT THE ABOVE SELECTED ADDRESS.

;       12.4  ALL NUMBERS ENTERED IN 7.0 MUST BE IN OCTAL
;       ANY NON-OCTAL INPUT IS TREATED AS A LETTER.
;       ANY LETTER INPUT FOR CYL,HEAD,SECTOR, OR # OF
;       SECTORS GETS RANDOM FUNCTION IN THE RELIABILITY
;       TEST WITH OPTIONS.

;13.1   PROGRAM RUNTIME
;       THE EFFICIENCY OF THIS PROGRAM IS CORE DEPENDENT.
;       MAXIMUM THROUGHPUT UTILIZING
;       THE FULL CAPABILITY OF THE CONTROLLER IS ACHEIVED
;       WITH MEMORIES OF 16K OR LARGER.  ON SYSTEMS USED
;       FOR RUNNING ERROR RATES IT IS RECOMMENDED THAT 16K
;       OR LARGER MEMORIES BE USED.  IN ORDER TO ACTIVATE
;       THE DOUBLE BUFFERING FEATURE - SEE 9.D (OPERATING
;       MODES)

;       PROGRAM RUNTIMES ARE SUBSTANTIALLY REDUCED WITH
;       MEMORIES OF 16K OR LARGER.  PROGRAM CAN USE UP
;       TO 16K USING 2 BUFFERS AND UP TO 24K USING 4
;       BUFFERS IN THE RANDOM RELIABILITY TESTS. ## SEE 9.D

;       A TYPICAL RUNTIME IS  60 MIN FOR 1 PASS OF SA 505
;       (RUNALL) ON 1 DRIVE WITH 16K OF MEMORY.

;       READ, WRITE AND SEEK OPERATIONS ARE TIMED BY
;       SPECIAL ROUTINES.  WHEN THE PROGRAM IS FIRST
;       STARTED, THE TIMING ROUTINE WILL TEST FOR THE
;       PRESENCE OF A REAL TIME CLOCK (RTC) TO DERIVE
;       TIMING FROM IT.  IF NO RTC IS PRESENT, THE
;       PROGRAM WILL TYPE "TTO BAUD RATE". THIS MESSAGE
;       REFERS TO THE BAUD RATE OF THE CONSOLE TERMINAL
;       (DEVICE 10 & 11).  TYPE IN THE BAUD RATE.  IF A
;       TYPING ERROR OCCURS IN THE NUMBER STRING (BEFORE
;       THE CARRIAGE RETURN), SIMPLY TYPE A NON-NUMERIC
;       CHARACTER AND THE REQUEST FOR THE BAUD RATE WILL
;       BE REPEATED.  IF THE CARRIAGE RETURN HAS BEEN
;       GIVEN AFTER A TYPING ERROR, RELOAD THE PROGRAM.


        .EJECT
```