Model DC-295C

SMD Disk Controller

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages
0200	12/23/83	Typo's and Re-Organization	
0241	12/21/83	Obsolete 295A, Replaced with 295C	
0328	6/28/84	New ZETACO Cover	
0336	7/2/84	Per ECO	
0386	9/24/84	Per ECO	
0418	12/10/84	Per ECO	
0553	2/7/86	Add disk characteristics	
0579	2/28/86	Replace disk characteristics	
0523	3/4/86	New Cover	
0631	6/24/86	Change Table 3.1	3-11
0930	6/16/87	Change Table 3.1	3-11

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1.0 INTRODUCTION

The ZETACO, Inc. DC-295C Storage Module Disk Controller provides a full emulation integration of Data General Nova/Eclipse Minicomputers, SMD Interface Disk Drives and RDOS/AOS/MP/AOS Operating Systems. It is fully compatible with Data General and Data General emulating minicomputers.

Advantages:

- .Cost Savings to 60%
- .Faster Systems throughput
- .Increased Reliablity
- .Increased Capacity
- .Hardware or Software Correctable ECC
- .Full Two Year Warranty

1.1 FEATURES

- .Emulation of Data General 6060, 6061, 6067, 6122, 6160, 6161 Disk Subsystem
- .Simultaneous Control of up to (4) SMD Interfaced Disk Drives
- .Incorporates an Eleven Bit SMD Tag Bus to accommodate full capacity of the larger Drives
- .Mix Drives of differing capacities and transfer rates
- .On-Board 32 bit error checking and correcting of burst errors up to 11 bits in length
- .High speed Microprocessor design supports maximum transfer rates
- .On-Board Self-test with error reporting and LED display
- .Capable of Three Sector Buffering
- .Sector Interleaving
- .Switch Selectable DMA Throttle Control
- .Support Overlap Seeks

- .Offset Positioning for Data Error Recovery
- .Data Strobe Early/Late for Data Error Recovery
- .Two Methods of Power Fail Detection
- .Logging of the number of Data Corrections that have occurred on a per unit basis
- .Disk Drive Power Sequencing
- .Delayed Power on Pick
- .Mix different Drive Formats
- .Extended Unit Select Address
- .Header CRC Auto Re-try

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2.0 SPECIFICATIONS

2.1 INTERFACE

2.1.1 DRIVE

Electrical: Standard SMD Interface

Driver/Receiver: Differential

Cabling: One 60-Pin Cable ("A" cable) for the first disk drive (daisy-chained).

One 26-Pin Cable ("B" cable) for the first disk drive (radial).

NOTE: Both cables connect to connectors on the board edge.

Multiple Drives: Up to four drives (CMD counts as two) per Controller. The 60-pin "A" cable, daisy-chains from drive to drive, with the last drive in the chain receiving an "A" cable terminator. The 26-pin "B" cable connects radially to each drive. (No terminators required). Reference Figure 3.8.

Performance:

2.1.2 COMPUTER

The Controller is compatible with any Model DG Nova or Eclipse computer interface. Data transfer occurs over the standard or high-speed data channel.

2.2 POWER

+5 VDC @ 6.6 Amps

-5 VDC @ 0.7 Amps

2.3 PHYSICAL

Dimensions: 15 inches by 15 inches by 1/2 inch

Shipping Weight: 10 Pounds (3.7 kg.) includes cables, diagnostics and documentation.

Cables: 60-Pin "A" cable

26-Pin "B" cable

2.4 ENVIRONMENTAL

Operating Temperature: 0 to 55 degrees C

Relative Humidity: 10% to 90% (non-condensing)

Exceeds all Nova/Eclipse temperature and humidity specifications.

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3.0 INSTALLATION

It is suggested that the Disk Drive Manufacturer's Manual be referenced for correct switch settings of the Disk Drive. Please read the following 295C Installation Section carefully.

3.1 UNPACKING AND INSPECTION

All parts comprising of the Model 295C are shipped in one container consisting of:

a) Controller

b) Controller to Disk Drive Cabling (Optional)

c) Diagnostic Software

d) Technical Manual

Upon receipt of the Model 295C from the carrier, inspect the shipping carton immediately for any evidence of damage or mishandling in transit.

If the shipping carton is water stained or damaged, contact the carrier and shipper immediately, specify the nature and extent of the damage and request that the carrier's agent be present when the carton is opened.

ZETACO's warranty does not cover shipping damage.

For repair or replacement of any ZETACO product damaged in shipment, call ZETACO, Inc. to obtain return authorization instructions.

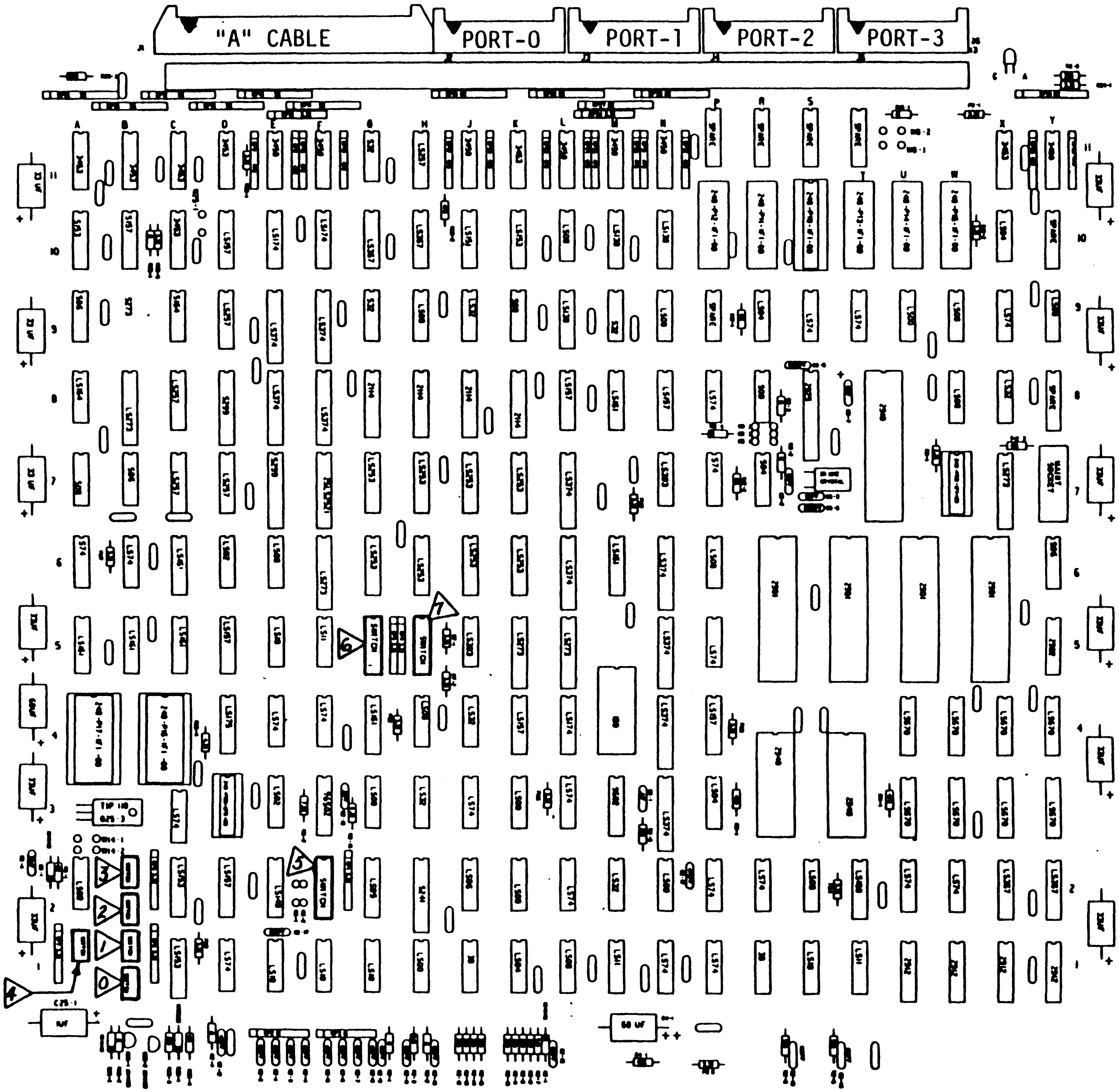
3.2 CONFIGURING THE DC-295C CONTROLLER

The configuration of the DC-295C is eased by having all options switch selectable. This section discusses each option switch and the meaning of each switch's ON and OFF position. At the completion of Section 3.2 the configuration of the DC-295C will be completed. Refer to Figure 3.1 for the location of all referenced switches and Port Connector Assignments. Insure the disk drive you are installing has the Index and Sectoring signals on the A cable. If these signals are on the B cable only, the Controller board will not install correctly.

3.2.1 SWITCH LOCATION F2 (REFERENCE FIGURE 3.2)

Switch Positions 1 thru 6 control the Device Code selection of the controller. Any of the 77 (octal) possible Device Codes are selectable with the standard Device Codes being 27 (octal) Primary and 67 (octal) Secondary. Establish the desired Device Code.

Switch Position 7 is used to control looping on the Controller's Self-test Feature. With the switch in the On position the Self-test feature will operate continuously. With the switch in the OFF position the Self-test will occur once upon power-up. This switch must be in the OFF position.

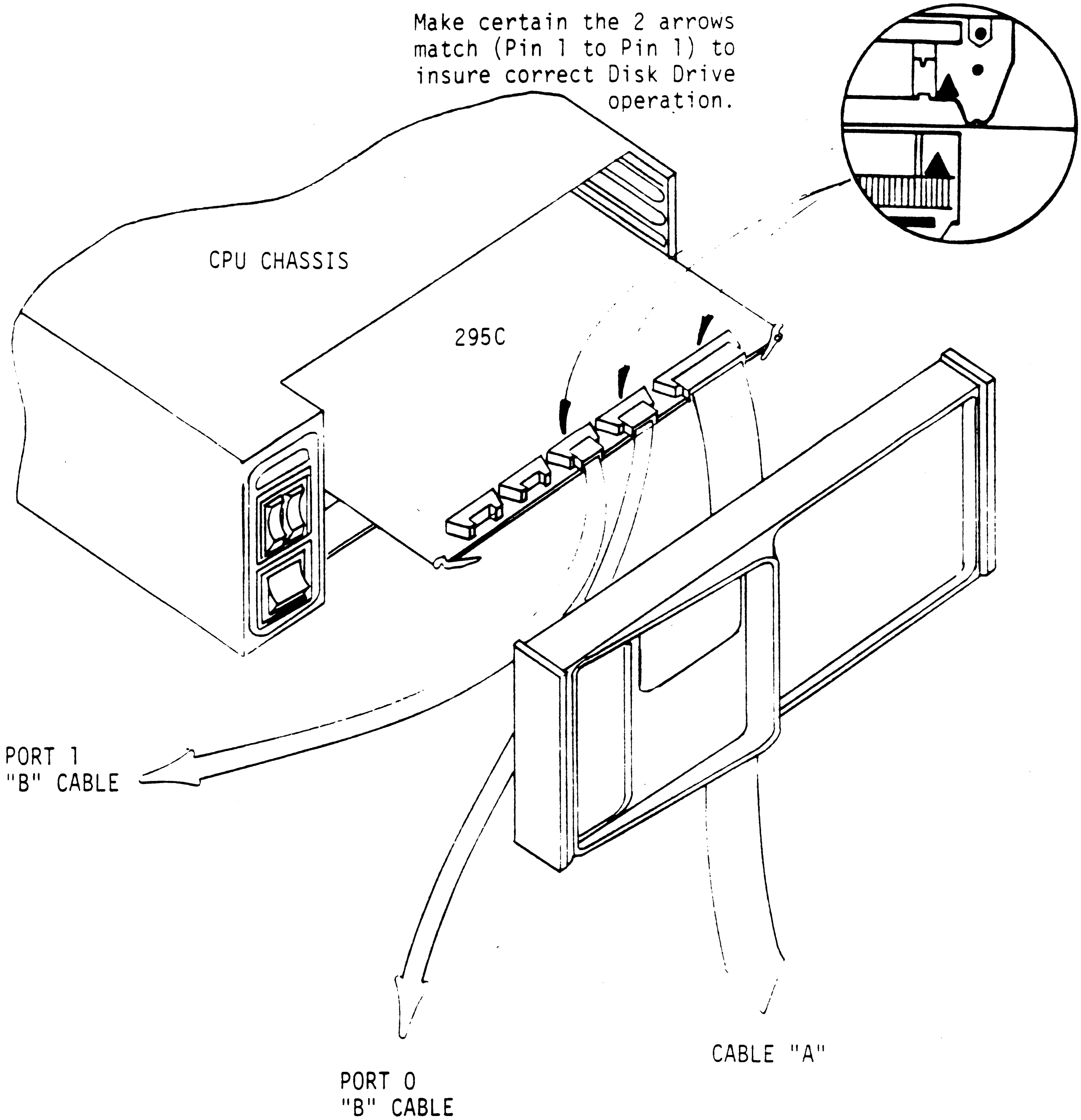


0. Port-0 Config. Switch
1. Port-1 Config. Switch
2. Port-2 Config. Switch
3. Port 3 Config. Switch
4. Bank Select Switch
5. Device Code Switch
6. Throttle & ECC Enable Switch
7. Interleave and CMD Switch

8. "▲" Indicates Pin 1
9. All Unmarked Capacitors are .05 uf

BOARD LAYOUT

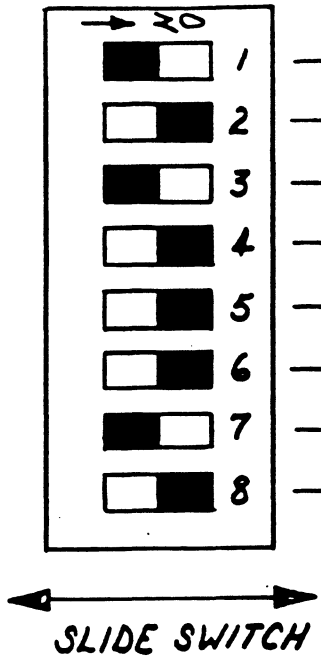
Figure 3.1



BOARD DIAGRAM

FIGURE 3.1.1

Switch Position 8 controls the Mixed Drive Format feature. When Switch 8 is ON (Alternate Format Disabled) all four Ports will use the same disk format (reference Figure 3.2). Normally Switch 8 is ON. With Switch 8 ON, when set to Bank 1-5, (reference Tables 3.1 and 3.2) you receive ZETA format on all 4 Ports (0-3). A Port indicates a connection point (B cable) for the disk drive. With Switch 8 ON, when set to Bank 6, you receive DG format on all 4 Ports (0-3). With Switch 8 ON, when set to Bank 7, you receive Alternate 1 format for all 4 Ports (0-3). In each case all 4 Ports (0-3) are the same format. If a disk format is required on Ports 0 and 1 and a different disk format is required on Ports 2 and 3, set Switch 8 to the OFF position. When Switch 8 is OFF you enable the Alternate format. Refer to Tables 3.1 and 3.2 for Alternate Format Bank Selection. For a detailed description of the Disk formats reference Section 3.8 and 6.5. Remember Switch 8 is normally ON.



DEV SEL 0 (MSB)

DEV SEL 1

DEV SEL 2

DEV SEL 3

DEV SEL 4

DEV SEL 5 (LSB)

Maintenance Switch (OFF=Disabled)

Alternate Format (ON=Disabled)

Refer to Section 3.2.1

Location F2

Figure shows Device Code 27_8,
Maintenance Switch Off,
Alternate Format Disabled.

Device Code	S1	S2	S3	S4	S5	S6
0X	OFF	OFF	OFF			
1X	OFF	OFF	ON			
2X	OFF	ON	OFF			
3X	OFF	ON	ON			
4X	ON	OFF	OFF			
5X	ON	OFF	ON			
6X	ON	ON	OFF			
7X	ON	ON	ON			
X0				OFF	OFF	OFF
X1				OFF	OFF	ON
X2				OFF	ON	OFF
X3				OFF	ON	ON
X4				ON	OFF	OFF
X5				ON	OFF	ON
X6				ON	ON	OFF
X7				ON	ON	ON

DEVICE CODE SELECT SWITCH

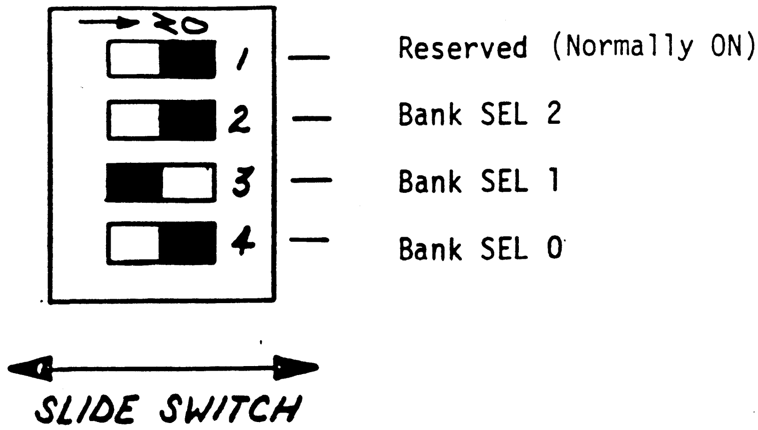
Figure 3.2

3.2.2 SWITCH LOCATION A1 - BANK SELECT (REFERENCE FIGURE 3.3)

Switch Position 1 is reserved and must be in the ON position. Switch Position 2 thru 4 select one of the seven possible Bank Selects (reference Tables 3.1 and 3.2). Two Tables reference to Bank and Port Configuration. Table 3.1 is the Single DOC Mode (see Section 6.2.3 for DOC explanation) for 6060, 6061 and 6067 emulations of 32 sectors or less. When you have RDOS 6.7 or less you must choose Table 3.1. When Dual Volumes of 32 sectors or less are needed use the Single DOC Mode. Table 3.2 is the Double DOC Mode for 6160, 6161 and 6122 emulations of more than 32 sectors. Dual 35 sectoring requires Double DOC. In Tables 3.1 and 3.2 the Bank Select numbers are on the horizontal (X) axis and the Select Configuration numbers are on the vertical (Y) axis. First decide which format will be used (ZETA, DG or ALT 1). The ZETA format has an extra Sync Bit for error checks.

NOTE: Refer to Section 3.2.1 for the correct position of Switch 8 at Location F2. This switch affects the format.

Under each Bank Select is a list of disk drives. Locate which drives will be used, insuring they all come from within the same bank. When this process is done the Bank Select can be made. Remember, only one bank can be chosen.



Location A1

Figure shows bank two selected.

SW2	SW3	SW4	BANK SELECTED
ON	ON	ON	0
ON	ON	OFF	1
ON	OFF	ON	2
ON	OFF	OFF	3
OFF	ON	ON	4
OFF	ON	OFF	5
OFF	OFF	ON	6
OFF	OFF	OFF	7

BANK SELECT SWITCH

Figure 3.3

3.2.3 PORT CONFIGURATION SWITCH SELECTION

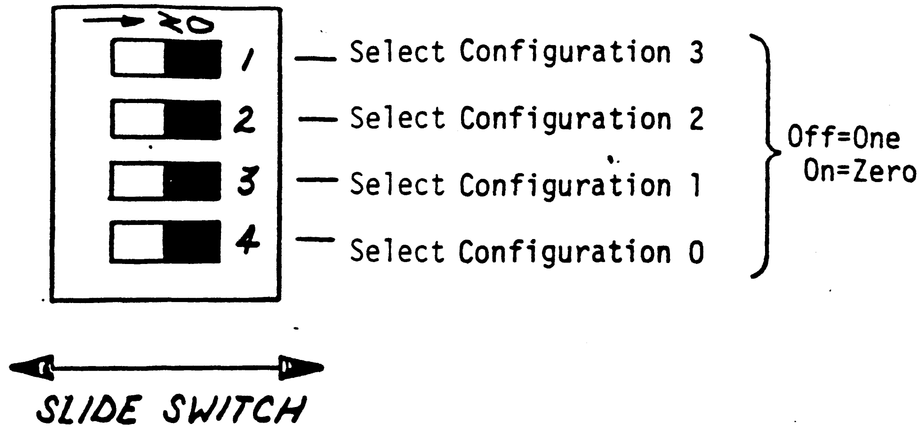
Switch Locations	B1A - Port 0 (Reference Figure 3.4)
(Select Configuration)	B1B - Port 1
	B2A - Port 2
	B2B - Port 3

Referencing back to Section 3.2.2, a Disk Format was chosen as well as what disk drives would be attached. Decide which disk type will be attached to a respective Port. Set each Switch Bay in Figure 3.4 to the Select Configuration number that corresponds to the drive type that will be attached to that particular port. Refer to Tables 3.1 and 3.2 first and Figure 3.4 second.

For example, it is desired to have ZETA format on all Ports and the following disk drives connected to -

BANK 1 {
Port 0 = CDC 9762 (Select Configuration 0)
Port 1 = CDC 9766 (Select Configuration 1)
Port 2 = Ampex Capricorn 330 (Select Configuration 7)

Tables 3.1 and 3.2 indicates that these drives are all under Bank Select 1. Therefore, set the Bank Select Switch (location A1) to Bank 1 (see Figure 3.3). Set Port 0 Switch (location B1A) to Select Configuration 0, Port 1 to Select Configuration 1 and Port 2 to Select Configuration 7 (see Figure 3.4).



Location B1A - Port 0

Location B1B - Port 1

Location B2A - Port 2

Location B2B - Port 3

Select Configuration 0 shown.

SW1	SW2	SW3	SW4	Select Configuration
ON	ON	ON	ON	0
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	12
OFF	OFF	ON	OFF	13
OFF	OFF	OFF	ON	14
OFF	OFF	OFF	OFF	15

PORT CONFIGURATION SWITCHES
Figure 3.4

TABLE 3.1 Bank and Port Configuration - 60XX Emulation Single DOC Mode

SELECT CONFIGURATION (PORT) / BANK SELECT	1	2	3	4
	ZETA PORT 0-3 DG PORT 2,3	ZETA PORT 0-3 DG PORT 2,3	ZETA PORT 0-3 DG PORT 2,3	ZETAE PORT 0-3 (HIGH SPEED) ZETA PORT 2,3
0				
1				
2		·CDC 9455-16 (REMOVABLE=0, FIXED=1) * 6.7/6.7 MB / 32S		
3		·CDC 9455-16 (REMOVABLE=1, FIXED=0) * 6.7/6.7 MB / 32S		
4		·PRIAM 3450 30 MB / 23S		
5	AMCODYNE 7110 · CDC 9457 (REMOVABLE=0, FIXED=1) * 20/20 MB / 32S			
6	AMCODYNE 7110 CDC 9457 (REMOVABLE=1, FIXED=0) * 20/20 MB / 32S	·MEMOREX 677-70 182 MB / 23S		FUJITSU 2351 (AOS) DUAL 6061 ** 380 MB / 24/24S
7				FUJITSU 2351 (RDOS) DUAL ** 414 MB / 24/24S
8	·CDC 7410-32 28 MB / 23S	CDC 9410-32 28 MB / 23		
9		CDC 9410-40 35 MB / 23		
10		CENTURY DATA C2048 (REMOVABLE=0, FIXED=1) * 14/28 MB / 32S		
11		CENTURY DATA C2048 (REMOVABLE=1, FIXED=0) * 14/28 MB / 32S	CENTURY DATA AMS 513 (AOS) DUAL 6061 ** 380 MB / 24/24S	
12		CDC 9410-8 7 MB / 23S		APS 4830-404 (RDOS) 4835-404 DUAL ** 324 MB / 32/32S
13		CDC 9410-24 21 MB / 23S	PRIAM 7050 61 MB / 23S	
14			PRIAM 3450 30 MB / 23S	
15			CDC-9412 63 MB / 32S	

Associated Blocks indicate formatted capacity in Megabytes (MB), and number of system sectors (S).

* CMD (refer to Section 3.2.5)
** Configurable in Single or Double units (see Section 3.2.5 for explanation).

TABLE 3.1 Bank and Port Configuration - 60XX Emulation (Continued)
Single DOC Mode

SELECT CONFIGURATION (PORT)

BANK SELECT — 5	6	7
ZETA PORT 0-3 DG PORT 2, 3	DG PORT 0-3 ZETA PORT 2,3	ALT 1 PORT 0-3 ZETA PORT 2,3
AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVAULT 83 · TECSTOR 85 67MB / 32S	AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVAULT 83 · TECSTOR 85 67MB / 32S	AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVAULT 83 · TECSTOR 85 67MB / 32S
CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 · TECSTOR 300 256MB / 32S	CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 · TECSTOR 300 256MB / 32S	CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 · TECSTOR 300 256MB / 32S
AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 TECSTOR 165 134MB / 32S	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 134MB / 32S	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 134MB / 32S
CDC 9448-96 (REMOVABLE: UNIT 0 OR 2 FIXED = UNIT 1 OR 3) * 13/67MB / 32S	CDC 9448-96 (REMOVABLE: UNIT 0 OR 2 FIXED: UNIT 1 OR 3) * 13/67MB / 32S	CDC 9448-96 (REMOVABLE = UNIT 0 OR 2 FIXED = UNIT 1 OR 3) * 13/67MB / 32S
CDC 9448-96 (REMOVABLE = UNIT 1 OR 3 FIXED = UNIT 0 OR 2) * 13/67MB / 32S	CDC 9448-96 (REMOVABLE = UNIT 1 OR 3. FIXED = UNIT 0 OR 2) * 13/67MB / 32S	CDC 9448-96 (REMOVABLE = UNIT 1 OR 3 FIXED = UNIT 0 OR 2) * 13/67 MB / 32S
6061 EMULATION 190 MB 24S		6061 EMULATION 190 MB 24S
6067 EMULATION 50 MB 24S		6067 EMULATION 50 MB 24S
CENTURY DATA T32 67MB/32S		
TECSTOR 200 162 MB / 32S		AMPEX 330 268 MB / 32S
	6061 EMULATION 190 MB/24S	
	6067 EMULATION 50 MB 24S	

Associated blocks indicate formatted capacity in Megabytes (MB) and number of system sectors (S).

* CMD (refer to Section 3.2.5).

** Configurable in Single or Double units (see Section 3.2.5 for explanation).

DC-295C and DC-296C

TABLE 3.2 Bank and Port Configuration - 61XX Emulation Double DOC Mode

SELECT CONFIGURATION (PORT) / BANK SELECT	1	2	3	4
	ZETA PORT 0-3 DG PORT 2,3	ZETA PORT 0-3 DG PORT 2,3	ZETA PORT 0-3 DG PORT 2,3	ZETA PORT 0-3 (HIGH SPEED) ZETA PORT 2,3
0	AMPEX DM 780,80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 · FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVALT 83 · TECSTOR 85 73MB / 35S	AMPEX DFR 932 · CDC 9448-32 (REMOVABLE=0, FIXED=1) * 14/14MB / 35S	NEC 2230 KENNEDY 7340 37MB / 35S	FUJITSU 2351 (RDOS) (YOU MUST INTERLEAVE HERE) 405 MB / 47S
1	CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 · TECSTOR 300 280MB / 35S	AMPEX DFR 932 (REMOVABLE=1, FIXED=0) * 14/14MB / 35S	AMPEX DFR-64 · CDC 9448-64 (REMOVABLE=0, FIXED=1) * 14/44 MB / 35S	FUJITSU 2312 MEMOREX 214 73 MB / 35S
2	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 147MB / 35S		AMPEX DFR-64 · CDC 9448-64 (REMOVABLE=1, FIXED=1) * 14/44MB / 35S	FUJITSU 2294 294MB / 35S
3	AMPEX DFR96 · CDC 9448-96 (REMOVABLE=0, FIXED=1) * 14/73MB / 35S		CDC 9775 RDOS VIRTUAL 675MB	FUJITSU 2280 73MB / 35S
4	AMPEX DFR96 · CDC 9448-96 (REMOVABLE=1, FIXED=0) * 14/73MB / 35S		AMPEX DM 160 147MB / 35S	FUJITSU 2284 147MB / 35S
5		TECSTOR 200 176 MB / 35S	CDC 9715-340 306 MB / 35S	FUJITSU 2311 MEMOREX 213 42 MB / 35S
6			NEC 74 MB / 35S	
7	AMPEX 330 · FUJITSU 2294 294MB / 35S	MEGAVALT 16 14.7MB / 35S	6122 EMULATION	
8			NEC D2220 22 MB / 35S	FUJITSU 2351 SLIP 370 MB / 43S
9	FUJITSU 2312 MEMOREX 214 73MB / 35S		PRIAM 3350 30 MB / 35S	6122 EMULATION 277MB / 35S
10	FUJITSU 2311 MEMOREX 213 42 MB / 35S		CENTURY DATA AMS 513 (RDOS) 452 MB / 55S	DUAL 6122 EMULATION APS 4865 (AOS) ** 554 MB / 35/35S
11	PRIAM 6650/67 55MB / 35S			** APS 4830-404, 4835-404, 4830-337, 4835-337 (AOS) DUAL 6161 294MB / 35/35 S
12	PRIAM 15450 DATA PERIPHERAL D1600 139 MB / 35S		DUAL 6161 EMULATION ** 294MB / 35/35S	
13	PRIAM 804 140MB / 35S			APS 4830-404, 4835-404 (RDOS) ** 354 MB / 35/35S
14	AMPEX 660 587 MB / 35S	AMPEX DM 780,80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 · FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVALT 83 · TECSTOR 85 73MB / 35S		APS 4865 (RDOS) ** DUAL 560 MB / 35/35S
15	CENTURY DATA AMS 380 333 MB / 55S	MEGAVALT 212 189MB / 35S		

Associated blocks indicate formatted capacity in Megabytes (MB) and number of system sectors (S).

* CMD (refer to Section 3.2.5).

** Configurable in single or double units (see Section 3.2.5 for further explanation).

TABLE 3.2 Bank and Port Configuration - 61XX Emulation
Double DOC Mode

BANK SELECT —	5	6	7
SELECT CONFIGURATION (PORT)	ZETA PORT 0-3 DG PORT 2,3	DG PORT 0-3 ZETA PORT 2,3	ALT 1 PORT 0-3 ZETA PORT 2,3
		6160 EMULATION 73 MB / 35S	
		CENTURY DATA 300, T305, 315 ·CDC 9766 ·MEMOREX 677-30 ·TECSTOR 300 280 MB / 35S	
		6161 EMULATION 147 MB / 35S	
	CENTURY DATA T82 73MB/35S	CDC 9448-96 (REMOVABLE = UNIT 0 or 2 FIXED = UNIT 1 or 3) * 14/73 MB / 35S	
		CDC 9448-96 (REMOVABLE = UNIT 1 or 3 FIXED = UNIT 0 or 2 * 14/73 MB / 35S	
		RESERVED	
		6122 EMULATION 277MB / 35S	

Associated blocks indicate formatted capacity in Megabytes (MB) and number of system sectors (S).

* CMD (refer to Section 3.2.5).

** Configurable in Single or Double units (see Section 3.2.5 for further explanation).

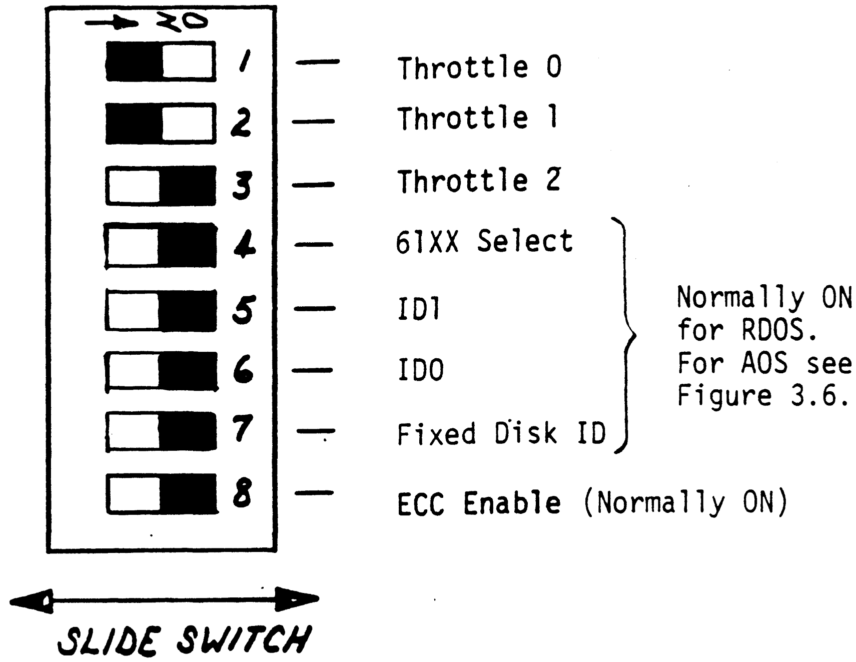
3.2.4 SWITCH LOCATION G5 (REFERENCE FIGURE 3.5)

Switch Positions 1, 2 and 3 control the DMA Throttle Setting (i.e. the number of words that will be transferred per a Data Channel Access). Throttle adjustment is dependent on the type of system configuration the Controller is installed into. Too low of a throttle setting could result in slow disk performance and too high of a setting could cause a data late on another data channel device. Set the desired throttle setting (normally set to 16).

Switch Positions 4, 5, 6 and 7 are used for identification bits to inform the system of subsystem type under AOS. (See Figure 3.6).

NOTE: These switches do not apply to RDOS. For RDOS Switch Positions 4, 5, 6 and 7 should be ON. (See Figure 3.6).

Switch Position 8 is the ECC Enable Switch. When the ECC switch is ON, on-board error correction and Data Strobe Early/Late is enabled. A running count of ECC corrections and successful Data Strobe Early or Late Data Recoveries are logged in scratch pad memory (separate count for each unit). With the switch OFF, ECC corrections must be handled by the software. The hardware switch overrides the software enabled/disabled command. (To use the software commands, the switch must be in the ON position.) When changing the switch from an OFF to an ON position, IORESET Switch or Power OFF/ON must be depressed. Switch 8 is normally ON.



Location G5

Throttle Setting of 16,
RDOS ON, ECC Enabled

THROTTLE SETTINGS

SW1	SW2	SW3	NUMBER OF WORDS
ON	ON	ON	2
OFF	ON	ON	4
ON	OFF	ON	8
OFF	OFF	ON	16
ON	ON	OFF	32
OFF	ON	OFF	64
ON	OFF	OFF	128
OFF	OFF	OFF	256

DATA CHANNEL THROTTLE SWITCH
Figure 3.5

3.2.5 SWITCH LOCATION H5 (REFERENCE FIGURE 3.7)

Switch Position 1 and 2 should be ON in all cases (AOS and RDOS). Switch 3 enables looping on any subsection of selftest that is failing. In the OFF position you receive a short Self-test. Switch 3 is normally OFF. With Switch 3 ON, you receive Sector Slip (requires special software to be written).

Switch 4 and 5 are used to inform the Microprocessor that the Dual Unit* is attached (Dual Unit* indicates two volumes, fixed and removable). Examples of two Unit Drives are the Lark I (9455-16), Lark II (9457), Amcodyne 7110 and CDC CMD (9448 Series). Dual units* (fixed/removable) are marked on Tables 3.1 and 3.2 with one asterisk (*).

If a Dual Unit is to be connected, the Drive(s) unit number plug must be an even number. A Dual Unit is treated as two logical units, so a maximum of two Dual Units, or one Dual Unit and two other Drives can be connected. The Sector Switch Setting within the Disk Drive is shown in the System Sector Block in the lower right hand corner of Tables 3.1 and 3.2. See Section 3.8.2 for special considerations for the CDC 9457 Lark II.

The terms "Dual"** and "Virtual" are used in Tables 3.1 and 3.2. "Dual"** is identified with two asterisks (**) on Tables 3.1 and 3.2. These terms refer to the way a disk drive sectors are accessed to make more efficent use of particular disk drives under AOS and RDOS. A dual select configuration port splits a disk drive's physical number of sectors in half and either doubles the units seen by the system or doubles the number of cylinders seen by the system. As an illustration, let C = number of physical cylinders, S = number of physical sectors, H = number of physical heads, and U = number of physical units of the characteristics of a disk drive. If the CMD switch (H5 SW.4 or 5) is on then the system will see number of cylinders = C, number of sectors = (1/2)S, number of heads = H, and number of units = 2U. If the CMD switch is OFF then the system will see number of cylinders = 2C, number of sectors = (1/2)S, number of heads = H, and number of units = U.

A dual configuration is exemplified by the Fujitsu 2351 (Reference to Table 3.1 Bank Select 4, Configuration Select 7). The 2351's physical characteristics are 842 cylinders, 48 sectors, 20 heads. Under the dual configuration the 2351 could be seen in two ways by the system. First, if the CMD switch (H5#4 or #5) is ON, the system will see two identical units under RDOS each with 842 cylinders, 20 heads, and 24 sectors. Second, if the CMD switch is OFF, the system will see one unit with 1684 cylinders, 20 heads, and 24 sectors under RDOS. (Use Bank Select 4 Configuration Select 6 for AOS. You may use 2 logical units only for AOS.)

	HDS	CYL	SEC	
Actual Drive Characteristics	20	842	48	"DUAL"
CMD, OFF 1 logical unit	20	1684	24	Sample of Fujitsu 2351 (RDOS)
CMD, ON 2 logical units	20	842	24	
	20	842	24	
Actual Drive Characteristics	40	843	35	"VIRTUAL"
CMD, OFF 1 logical unit	20	1686	35	Configuration CDC 9775 (RDOS only)
CMD, ON 2 logical units	20	843	35	
	20	843	35	

A virtual select configuration port splits a disk drive's physical number of heads in half and either doubles the number of units or doubles the number of cylinders seen by the system depending again on the CMD switch (H5#4 or #5). Referring to Table 3.2, Bank select 3, configuration select 3- presently the CDC 9775 has "virtual" capabilities under RDOS. The 9775 has physical characteristics of 843 cylinders, 40 heads, and 35 sectors. If the CMD switch (H5#4 or #5) is on, then the system will see two identical units each having 843 cylinders, 20 heads, and 35 sectors under RDOS. If the CMD switch (H5#4 or #5) is off, then the system will see one unit having 1686 cylinders, 20 heads, and 35 sectors under RDOS.

NOTE: When the CMD switch is ON you must format 2 units.

ID SWITCH SETTINGS FOR 61XX AND 60XX EMULATIONS UNDER AOS
NOTE: For RDOS all Switches should be ON.
(SWITCH IS LOCATED AT BOARD COORDINATES G5 AND H5)

	LOCATION G5				LOCATION H5	
Switch Pos.	7 OFF = FIXED DISK	6 ID 0 OFF=73MB ON=147MB	5 ID 1 OFF=73MB ON=147MB	4 ON = 6214 ON = 616X OFF = 6122	2 IDO ON=6161 OFF=6214	1 ON=6161 OFF=2614
6160	OFF	OFF	OFF	ON	ON	ON
6161	OFF	ON	ON	ON	ON	ON
6122	ON	ON	ON	OFF	ON	ON
6060 6061 6067	ON	ON	ON	ON	ON	ON
RDOS	ON	ON	ON	ON	ON	ON

6160 - 35 Sectors
5 Heads
823 Cylinders
73 Mega Bytes Formatted

6161 - 35 Sectors
10 Heads
823 Cylinders
147 Mega Bytes Formatted

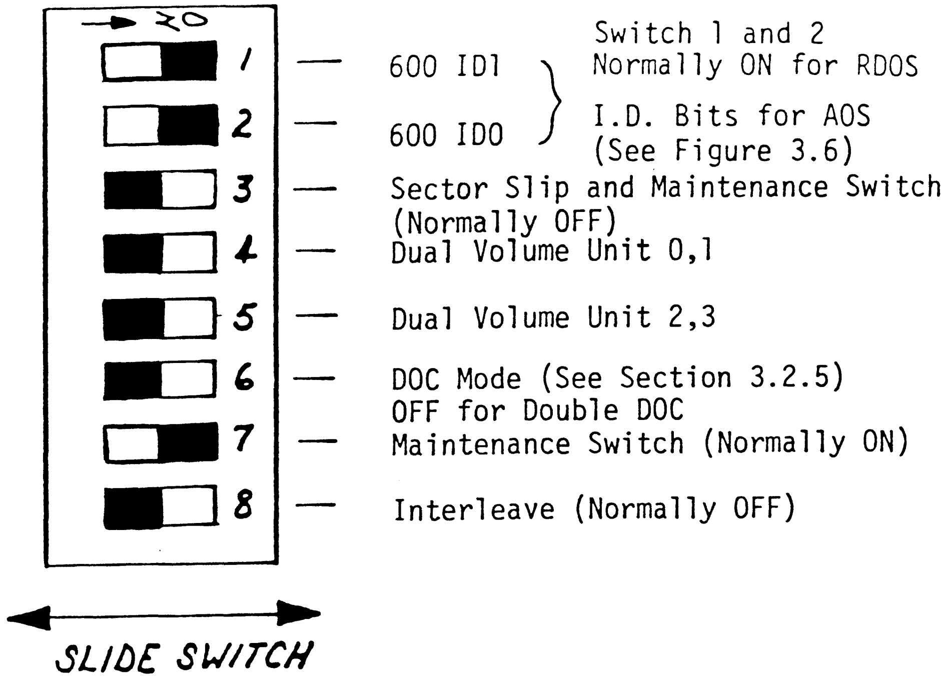
6122 - 35 Sectors
19 Heads
815 Cylinders
277 Mega Bytes Formatted

6060 - 24 Sectors
19 Heads
411 Cylinders
96 Mega Bytes Formatted

6061 - 24 Sectors
19 Heads
815 Cylinders
190 Mega Bytes Formatted

6067 - 24 Sectors
5 Heads
815 Cylinders
50 Mega Bytes Formatted

FIGURE 3.6
AOS SWITCH SETTINGS



Location H5

I.D. Bits, Maintenance Switch OFF, No CMD's, Double DOC Enabled, Maintenance Switch ON, Interleave OFF

INTERLEAVE, CMD, SECTOR VERIFY SWITCHES

Figure 3.7

If a Dual Volume Drive has logic plug 0 installed then Switch 4 must be ON and Switch 5 OFF. If a Dual Volume Drive has logic plug 2 installed then Switch 4 must be OFF and Switch 5 ON. If there are not any Dual Volume Drives, then both Switch 4 and 5 must be OFF.

Switch 6 is for the Single DOC or Double DOC Mode. Single DOC applies to 32 sectors or less (when in a single volume). RDOS Revision 6.7 or less is used for Single DOC. Double DOC applies to 33 to 64 sectors. Double DOC Mode requires RDOS Revision 7.0 or greater. The 295C is factory set for Double DOC unless otherwise specified. See Tables 3.1 and 3.2 to identify your Drive and its DOC Mode setting. Remember when using RDOS 6.7 or less you must choose Single DOC. If this switch is ON then you are in the Single DOC Mode. If this switch is OFF then you are in the Double DOC Mode (see *NOTE).

AOS

Single DOC is 6060, 6061, 6067

Double DOC is 6160, 6161, 6122

*NOTE: Single DOC Mode requires W6-1 and W6-2 be removed. Double DOC requires W6-2 be in and W6-1 should still be removed. W6-1 and W6-2 are located by F2 on the Controller board.

Switch 7 controls the run time of Self-test. When the switch is ON, the short verison of the RAM test is run. When the switch is OFF the long version of the RAM test is run. Normally Switch 7 is ON.

Switch 8 enables the sector interleaving feature. When Switch 8 is ON it enables sector interleaving by a factor of 3. See Figure 3.9 for 32 sector example. This interleave factor eliminates the need for surface spiral and is restricted to operation with the number of sectors that meets the following equation:

$$(X + 1)/3 = 0 \text{ Remainder}$$

Where X = The desired number of sectors on the drive.

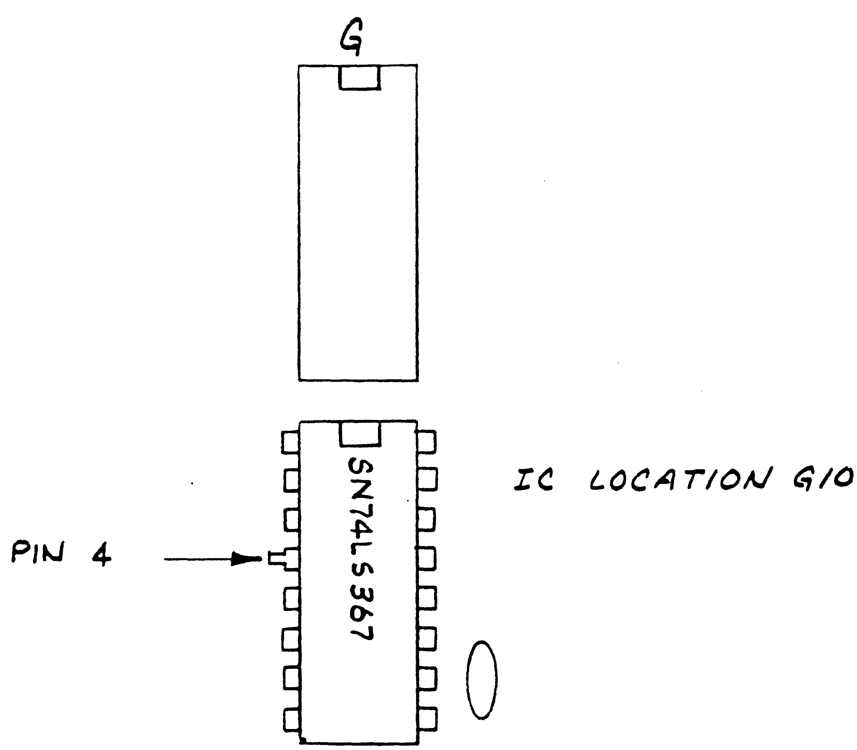
Interleaving may be desired to fine tune a systems performance. This is to avoid going a full revolution on the disk when the CPU cannot respond fast enough to catch the next sector. Only the drive at Bank 4, Select Configuration 0 utilizes the interleave. Insure Switch 8 is ON when using Bank 4, Select Configuration 0.

When Switch 8 is in the OFF position the sector interleaving feature is disabled. Normally Switch 8 is OFF.

3.2.6 RELEASE DRIVE COMMAND ENABLE/DISABLE

The "Release Drive" command is used in dual processor applications to direct the controller to clear the reserved condition of the specified drive. The standard configuration of the controller is to ignore this command to maintain fast response to unit selection for high speed processors. If the controller is to be used with a dual-port drive in dual processor applications, the Release function must be enabled as follows:

To enable Release Drive command:
Locate the IC (74LS367) at coordinates G10 on the PC board. Locate pin 4 of the IC (Figure 3.7.1). Using a cutter plier, snip pin 4 of the G10 near the bottom of the pin and bend it up, disconnecting it from the PC board.



RELEASE DRIVE COMMAND ENABLE

Figure 3.7.1

3.3 BOARD INSERTION

The DC-295C SMD is to be installed only after inspection and switch settings are verified. Carefully guide the Controller board into the desired slot by allowing the edges of the board to follow the guides evenly. Use the lock tabs on the two outside corners to provide leverage when the board meets the connector. Use equal pressure on both lock tabs until the board seats firmly into the backplane connectors.

3.4 PRIORITY SELECTION

The Controller must receive two priority signals from the Data General minicomputer backplane, Data Channel Priority In (Pin A94) and Interrupt Priority In (Pin A96). If there are vacant slots between the Controller and the processor, priority jumper wires must be installed in the vacant slot(s) to obtain priority continuity between controllers. To jumper across unused slots, connect A93 (Data Channel Priority Out) to A94 (Data Channel Priority In) and A95 (Interrupt Out) to A96 (Interrupt Priority In). Reference your Data General Manual for additional information if needed.

3.5 POWER FAIL PROTECTION

The DC-295C Disk Controller contains a double protection power fail scheme. The Data General CPU outputs a signal called "Power Fail" which gives an early warning of power loss. This is used on the DC-295C to disable the drives write circuitry through the open cable detect line.

To enable this power fail protection connect A47 of the DC-295C backplane slot to Pin A5 of a Nova 3 CPU backplane slot or A9 on a Nova 4 power supply slot.

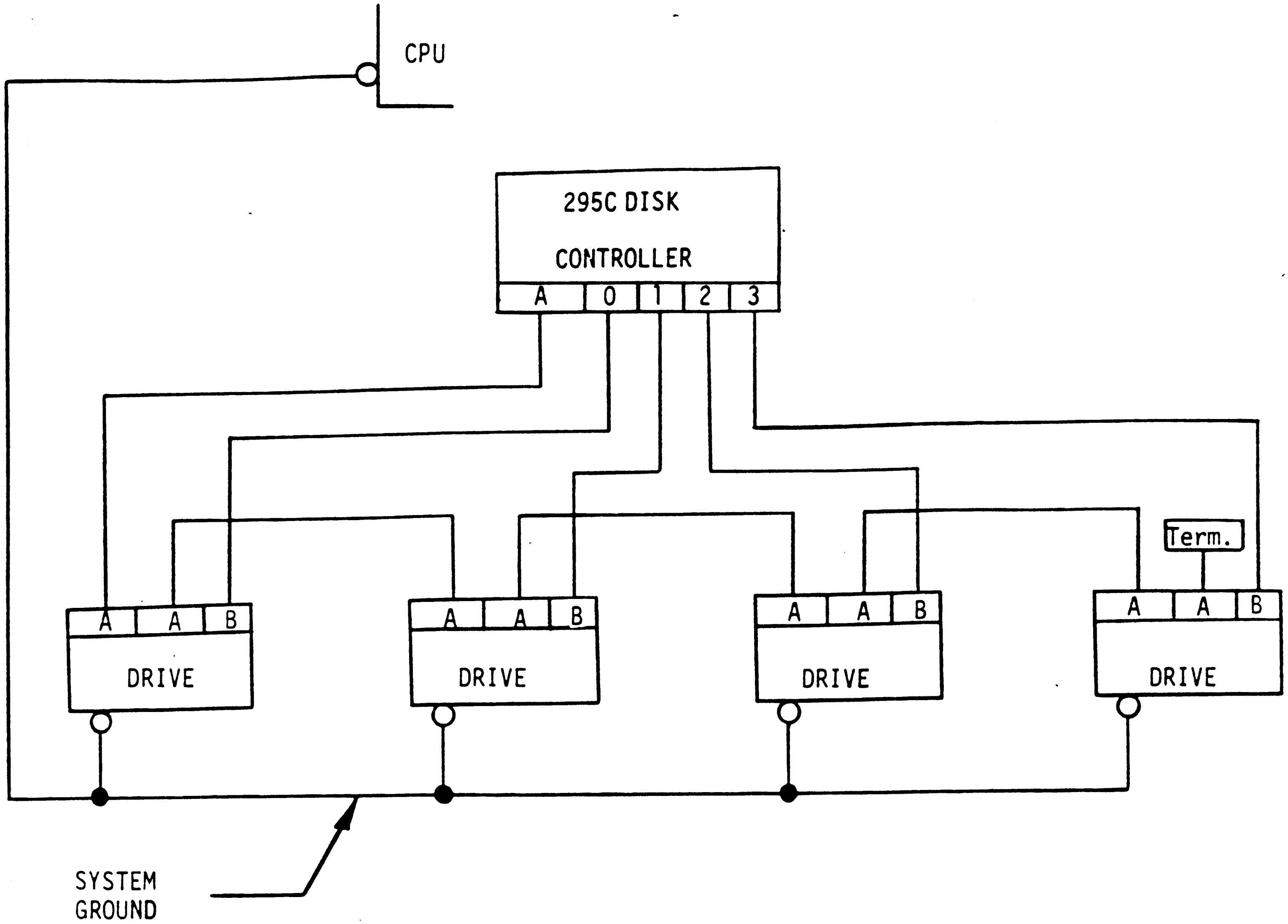
In addition, the DC-295C contains power fail circuitry to further protect drive data integrity in the event the slot where the board is installed loses power.

3.6 CABLING

Reference Figure 3.8 for proper cable connection and Figure 3.1 for Header Orientation.

BE SURE TO OBSERVE THE ARROWS ON THE HEADERS AND PLUGS FOR PROPER ORIENTATION (see Figure 3.1.1). As shown in Figure 3.8, the 60-Pin "A" cable connects between J1 and the first drive and continues from drive to drive in a daisy-chain fashion. The last drive in the chain must have a terminator installed in place of the daisy-chain cable.

Each drive must have a 26-Pin "B" cable connected between the drive and the Controller (J2-J5) in a radial fashion.



DAISY-CHAINING DRIVES

Figure 3.8

Insure that the port configuration switches match the corresponding drive type plugged into its port.

Refer to the Drive Manufacturer's Manual for proper subsystem grounding if required.

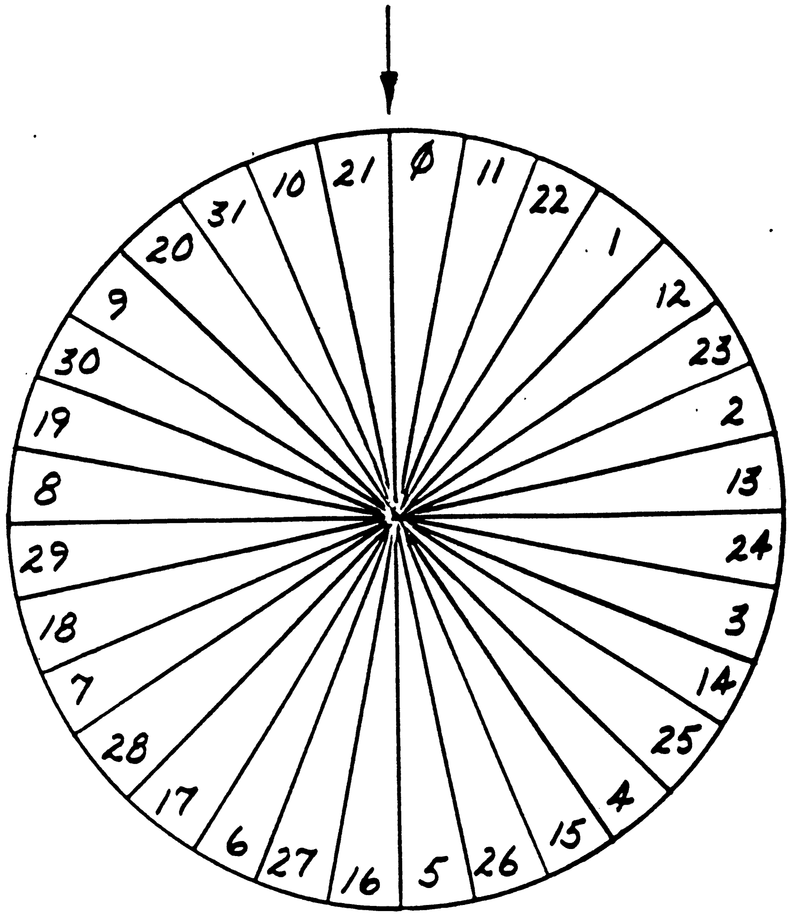
3.6.1 SYSTEM GROUNDING

Because the power system safety ground does not necessarily satisfy all system grounding requirements, additional connections are required to earth ground, referred to as system ground. The controller and its attached drive(s) must be connected to a single-point ground system. Ground connections are made via ground braids that pass from drive to drive, drive to computer chassis and computer chassis to earth ground. WARNING - To ensure proper ground return to earth, each component in the system must be connected using a daisy chain ground system. Both the AC and DC grounds within each drive must be joined (consult drive manual). The drives must then be joined by a daisy-chain grounding braid and connected to the grounding post at the rear of the computer cabinet.

3.7 DRIVE PICK/HOLD

On initial power-up, the Controller will delay activating Pick/Hold (spins up drive) for one second. This feature eases the initial current demand on the AC power source.

INDEX



EXAMPLE FOR 32 SECTOR DISK

Figure 3.9

3.8 POWERING UP

Turn system power ON. The DC-295C will perform an initial "Self-test" by briefly lighting a red LED. A good test is indicated by the LED turning OFF. For more details refer to Section 5.0. Once a good test is indicated, format your disk. We recommend using the ZETA format due to its added features of; more error checks on header, conforms to necessary drive characteristics and does not require patching. For ZETA Disk Formatter refer to Section 4.0, 4.2 and Appendix A. For the next installation step (RDOS) we recommend running Disk Reliability in order to exercise and test the disk system. Refer to Section 4.3 and Appendix A. If you are using AOS we recommend you run Diagnostics in addition to Reliablity. Under AOS run Diagnostics first and Reliablity second. Refer to Diagnostics Section 4.1. The final step involves the use of ZDKINIT for RDOS or DFMTR for AOS. Before you load any RDOS or AOS onto a Model DC-295C disk you must initialize the disk by running ZDKINIT (RDOS) or DFMTR (AOS). For ZDKINIT refer to Section 4.4. For DFMTR refer to Data General's Manual.

3.8.1 SPECIAL CONSIDERATIONS FOR FUJITSU 2351 SECTOR SELECTION

When setting up the sector switch settings within the Fujitsu 2351 Eagle add one sector to the system sector block in Table 3.1 and 3.2. For Example, Bank 4, Select Configuration 0 (see Table 3.2) indicates 47 sectors. The sector switch setting within the Fujitsu Eagle should be set to 48. With the Fujitsu Eagle set at 48 your characteristics with the ZETA format will indicate 20 heads, 842 cylinders and 47 sectors.

For Bank 4, Select Configuration 6, 7 and 8 you should also have one sector added when configuring the sector setting within the Fujitsu Eagle. Adding one sector is only true for the Fujitsu 2351 Eagle. When setting up the sector switch settings within a disk drive use the sector indicated in the small block in the lower right hand corner of each Bank and Select Configuration (Port) shown on Tables 3.1 and 3.2. When dual emulations or dual volumes are used add the two sectors together. For example, (Table 3.2) Bank 4, Select Configuration 11 the APS sector switch setting would be 70.

3.8.2 SPECIAL CONSIDERATIONS FOR CDC 9457 (LARK II)

Insure options W-4 and W-8 are installed.

3.9 SYSGEN

Listed below is an example of part of the RDOS System Generator.

1. Number of 6060/6061/6067/6122/6160/6161 Disk Controllers (0-2)
2. Device Primary ("0") or Secondary ("1")
3. Controller #1 6160/6161 Type? ("0"=NO, "1"=YES)
4. Number of Devices for Controller #1 (1-4)
5. Number of other types of Moving Head Disk Controllers (0-2)
6. Device Primary ("0") or Secondary ("1")

NOTE: On line 3 answer NO when using RDOS. When you answer NO you allow up to four Disk Drives (6160 or 6161) to be connected to the 295C. If you answer YES you allow only two Disk Drives (6160 or 6161) to be connected.

SUB-TABLE OF CONTENTS

4.0 DIAGNOSTICS AND SOFTWARE

There are three levels of diagnostics; On-board Self-test, System Diagnostics and System Reliability Programs. Included in the DC-295C package is a Master 400-284-00 tape containing these diagnostics and other ZETACO supplied software.

To load a program from the tape you should:

Mount 400-284-00 tape on drive.

Set console switches to 100022 or 100062.

Press RESET and then LOAD switches.

(See Appendix A for specific Program Load Procedures)

The 400-284-00 tape menu will be displayed:

```
FILE #      PROGRAM

  2         Disk Diagnostic

  3         Disk Formatter

  4         Disk Reliability

  5         ZDKINIT - Disk Initializer

  6         ZDSKED - Stand-Alone Disk Editor

  7         Previous "SV" and "TX" Files in Dump Format

  8         ECC Programs in Dump Format:
            RDOSECC.SV - for RDOS
            AOSECC.PR  - for AOS

File # (CR):
```

You should enter the file number of the program you wish to execute for files 2, 3, 4, 5 or 6.

To load files from file 7 or 8, use the standard CLI commands:

```
LOAD/R/V MTO:N  (for RDOS)

X RDOS LOAD/V @MTAO:N +.SV +.PR +.TX/C  (for AOS)
```

4.1 DISK DIAGNOSTIC

This diagnostic program is provided to find failures that are related to the basic operations of the Disk Controller. The ID Bits (AOS) shown in the sample below will aid in checking the switch settings. Switch settings for AOS are described in the Installation Section, Figure 3.6.

Load the program from the tape provided. (See 400-284-00 tape loading in Section 4.0).

The following is a sample dialogue for 6160 (AOS):

```
ZETACO...DISK DIAGNOSTIC REV. XX

STARTING ADDRESSES:

    200-DIAGNOSTIC (INITIALIZE)
    201-DIRECT ODT ENTRY
    202-RANDOM SEEK EXERCISERS
        SEEK EXER 1 IS A SINGLE DRIVE EXERCISER
        SEEK EXER 2 IS A TWO DRIVE EXERCISER WITH SEEK OVERLAP
    500-DIAGNOSTIC (RESTART)

ENTER DEVICE CODE (27):

ANY DUAL VOLUME UNITS? ENTER 1

ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0,2

SET SWPAK AS PER 8.0, OR HIT (CR) TO CONT.

TESTING UNIT 0

MAX # OF SECTORS/TRACK WITH THIS CONTROLLER IS 64.
--6122 I.D. BIT--
DIB BIT 7 = 0
--6160, 6161 & 6214 I.D. BITS--
ALT1 DIB BIT 1 = 1
ALT1 DIB BIT 2 = 1
ALT1 DIB BIT 3 = 1
ALT1 DIB BIT 6 = 0
ALT1 DIB BIT 7 = 0
UNIT     HDS     CYLS     SEC/TRK     FORMAT

  0       5       823       35         ZETA
```

These are the units and characteristics found, do you want to loop on reading them? Enter 1. See Diagnostic Text at the end of the Manual for further details.

4.2 DISK FORMATTER

The Disk Formatter Program is a utility designed program to format and check disk packs to be used on the disk systems.

The following is a sample dialogue:

```
ZETACO...DISK FORMATTER REV. XX

STARTING ADDRESSES:

    500-FORMATTER/CHECK PROGRAM
    501-CHECK PROGRAM ONLY
    502-ERROR LOG RECOVERY
    503-COMMAND STRING INTERPRETER

ENTER DEVICE CODE (27):

SET SWPAK AS PER SECT 8.0 OR HIT (CR) TO CONTINUE

START TIME? - MON,DAY,YR  HR,MIN

# PASSES TO FORMAT COMPLETION? - 6

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE (YES/NO)?  YES

UNIT     TYPE     HDS     CYLS     SEC/TRK     FORMAT

 0        0        5       823       32          DG
 2        1        5       815       24          DG

ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  0,2

UNIT:  0

ENTER TYPE OF DISK:  0

UNIT:  2

ENTER TYPE OF DISK:  1

FORMATTING UNIT 0,2
```

See Formatter Text at end of Manual for further details.

4.3 DISK RELIABILITY

The Disk Reliability program is a maintenance program designed to exercise and test the disk system. The program will test from one to four drives.

The following is a sample dialogue:

```
ZETACO...DISK RELIABILITY REV. XX

STARTING ADDRESSES:

    500-RELIABILITY TEST
    501-RELIABILITY TEST WITH OPTIONS
    502-DISK ADDRESS TEST
    503-COMMAND STRING INTERPRETER
    504-FORMAT ONLY
    505-RUN ALL TESTS
    506-SEEK EXERCISER
    507-RANDOM SEEK EXERCISER
    510-ERROR COUNT/LOG RECOVERY

ENTER DEVICE CODE (27):

STARTING ADDRESS = 505

SET SWPAK AS PER 8.0, OR HIT (CR) TO CONT.

ARE MAPS TO BE EXERCISED (YES/NO)?  YES

NOVA 3 TOTAL OF 1K'S = 64

START TIME? - MON,DAY,YR  HR,MIN

ANY DUAL VOLUME UNITS (YES/NO)?  NO

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE (YES/NO)?  NO

UNIT      TYPE      HDS      CYLS      SEC/TRK      FORMAT

 0         0         5       823         32           DG
 2         1         5       815         24           DG

ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  0,2

UNIT:  0

ENTER TYPE OF DISK:  0

UNIT:  2

ENTER TYPE OF DISK:  1
TESTING UNIT 0,2
```

See Reliability Text at the end of Manual for further details.

4.4 ZDKINIT - RDOS DISK INITIALIZER

Initializing a Model DC-295C Disk

Before you load any RDOS system onto a Model DC-295C Disk, you must initialize the Disk by running ZDKINIT. This is a Stand-Alone program which performs all the functions of Data General's DKINIT. Please refer to Data General manual on loading an RDOS system for full details on the functionality of disk initialization.

Remember that only ZDKINIT will work correctly for Model DC-295C Disks. If you are building your system from an RDOS release tape, do NOT run file 4 on the DG tape after running ZDKINIT. Data General's DKINIT cannot be run on a Model DC-295C Disk. ZDKINIT can, however, be used to initialize any DG supported disk.

STEP 1 - LOADING

A) If loading from a 400-284-00 tape:

Perform the steps described for loading 400-284-00 tape in Section 4.0.

YOU RESPOND:

5

B) If loading from disk: (ZDKINIT.SV must have been previously loaded onto the disk.

Mount the disk pack which contains ZDKINIT.

Set console switches to correct device code.

Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

ZDKINIT or (DIR:ZDKINIT, if the program file is located in directory, DIR, other than the master).

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK INITIALIZER - REV. NN.NN/with ZETACO Disk Support-REV. 1
DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

NOTE: Enter the X's as shown above.

A) If the disk type is not valid-

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) If the disk type is valid -

PROGRAM DISPLAYS:

6XXX (ZETA Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

DZx, where x indicates drive number: 0, 1, ..., 7

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

# HEADS	# SEC/TRK	# CYLINDERS	MGB/BLK
99	99	999	Megabytes if disk >4000 blks. Blocks if disk <4000 blks.

STEP 4 - ECC CORRECTION

ZDKINIT will allow you to disable/enable ECC correction on the Controller, if it is currently enabled/disabled via software. If ECC correction is disabled in the hardware, this cannot be changed.

For most situations it is recommended that you software disable ECC correction while running ZDKINIT. This will allow the initializer to flag those bad blocks which are potential problems even though they might be correctable at the time of running ZDKINIT. However, it is also possible to run with ECC correction enabled in cases where there is a need for using marginal media.

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS HARDWARE DISABLED.

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED.

DO YOU WANT TO SOFTWARE DISABLE? (YES/NO)

YOU RESPOND:

YES	To disable ECC correction while running ZDKINIT
NO	To leave ECC correction enabled while running ZDKINIT

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLE.

DO YOU WANT TO ENABLE? (YES/NO)

YOU RESPOND:

YES	To enable ECC correction while running ZDKINIT
NO	To leave ECC correction disabled while running ZDKINIT

STEP 5 - COMMANDS AND SUBSEQUENT OUTPUT

The commands which can be selected are identical to those of DKINIT.

From this point on ZDKINIT will perform exactly as DKINIT.

4.5 ZDSKED - RDOS STAND-ALONE DISK EDITOR

ZDSKED provides the same functions for the DC-295C Disk as Data General's DSKED does for standard DG disks. It can also be used for any DG supported disk. Please refer to the Data General Stand-Alone Disk Editor Manual for a complete description of the commands.

We will describe the steps necessary to run ZDSKED.

STEP 1 - LOADING

A) If loading from a 400-284-00 Tape:

Perform the steps described for loading 400-284-00 tape in Section 4.0.

YOU RESPOND:

5

B) If loading from disk: (ZDSKED.SV must have been previously loaded onto the disk).

Mount the disk pack which contains ZDSKED.

Set console switches to correct device code.

Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

ZDSKED or (DIR:ZDSKED, if the program file is located in directory, DIR, other than the master).

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK EDIT - REV NN.NN WITH ZETACO DISK SUPPORT - REV. 1

DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

NOTE: Enter the X's as shown above.

A) If the disk type is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) If the disk type is valid -

PROGRAM DISPLAYS:

6XXX (ZETA Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

DZx, where x indicates drive number: 0, 1, ..., 7

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

# HEADS	# SEC/TRK	# CYLINDERS	MGB/BLK
99	99	999	Megabytes if disk >4000 blks. Blocks if disk <4000 blks.

STEP 4 - ECC CORRECTION

ZDSKED will allow you to disable/enable ECC correction on the Controller, if it is currently enabled/disabled via software. If ECC correction is disabled in the hardware, this cannot be changed.

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER EC CORRECTION IS HARDWARE DISABLED

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE? (YES/NO)

YOU RESPOND:

YES To disable ECC correction while running ZDSKED

NO To leave ECC correction enabled while running ZDSKED

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLED

DO YOU WANT TO ENABLED? (YES/NO)

YOU RESPOND:

YES To enable ECC correction while running ZDSKED

NO To leave ECC correction disabled while running ZDSKED

STEP 5 - COMMANDS AND SUBSEQUENT OUTPUT

The commands which can be selected are identical to those of DSKED. From this point on ZDSKED will perform exactly as DSKED.

4.6 ECC - ECC ERROR CORRECTIONS COUNTER FUNCTIONS

The Model DC-295C Controller maintains a counter of ECC corrections for each drive connected to the board(s). These are the corrections performed by the firmware and are therefore invisible to the system except through these counters. The counters are automatically cleared by the reset switch on the front panel or if the controller is powered down.

The ZETACO supplied ECC program (RDOSECC.SV for RDOS and AOSECC.PR for AOS) allows you to monitor the media by displaying or modifying the counters. Some installations may decide to reset the counters to zero on some regular basis: daily, weekly, monthly, etc.

STEP 1 - EXECUTING THE PROGRAM UNDER CLI

A) RDOS Version

ENTER: RDOSECC

B) AOS Version

ENTER: X AOSECC

STEP 2 - MAIN MENU

ZETACO - ECC FUNCTIONS

1 - DISPLAY CONTROLLER ECC CORRECTIONS

2 - RESET CONTROLLER ECC CORRECTIONS

3 - STOP

NOTE - SELECT ONLY THOSE DRIVES WITH ZETACO CONTROLLER BOARDS.

RESULTS ARE UNPREDICTABLE ON OTHER BOARDS!

ENTER SELECTION

YOU RESPOND:

1) To display the ECC corrections counter(s)

2) To modify the ECC corrections counter(s)

3) To terminate the program and return to the CLI

STEP 3 - ENTERING THE UNIT

If you selected 1 or 2,

PROGRAM DISPLAYS:

ENTER UNIT:

YOU RESPOND:

```
DZn   (n = 0, 1, ..., 7)                   for RDOS
DPFN  (n = 0, 1, 2, 3, 10, 11, 12, 13)     for AOS
Carriage return or new line to return to Main Menu.
```

The program will display the (decimal) value of the corrections counter for the drive selected. This step will be repeated until the response to ENTER UNIT is carriage return or new line.

STEP 4 - MODIFYING THE COUNTER

If your response to the Main Menu was 2 - there will be another message after Step 3:

ENTER NEW VALUE:

You respond with the (decimal) value to which you want the counter set. The number must be between 0 and 65,535. This step will be repeated until you enter a carriage return or new line which will return you to Step 3.

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5.0 TROUBLE-SHOOTING

Self-test checks out all the internal functions of the Controller board once for every time power is applied to the board. If short RAM test is enabled the test takes approximately 300 MS. If long RAM test is selected (See Section 3.4.2 for switch setting) the test takes one minute.

If Self-test passed, the red LED will go out. If a failure was detected, the LED will blink a repetitious code indicating the subtest and corresponding circuit that failed.

Looping on error can be achieved by setting SW1 at H5 (See Section 3.4.2) and depressing the I/O reset switch which causes the microprocessor to loop on that particular subtest.

Looping on Self-test can be achieved by setting SW7 on F2 (See Section 3.2.1) which causes the microprocessor to continuously loop on the entire Self-test unless an error occurs. The LED will pulsate on each pass.

Reference Table 5.1 for 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 may be bad.
2	RAM TEST	Data read from RAM did not compare with data written. 2114, PBUS or RAM data bus may be bad.
3	2940 ADDRESS GENERATOR TEST	Data read from 2940's did not compare with data written. 2940 may be bad.
4	CONDITION FF, BIT TEST AND 32 BIT SHIFT TEST	The state of the condition flip flops were not correct. Command Full, Busy, Done, Control Full, Overflow (2901), DCHDN (2940) may be bad. The bit testing logic may have failed. The bit shifting mechanism may have failed. (2901)
5	SEQUENCE ERROR TEST	A forced sequence error did not occur within a specified amount of time. Format sequencer may be bad. (No Clock)
6	SYNC DETECT TEST	A sync detect was not made in a specified amount of time or the terminate FF may not have set. The sync register or compare logic may be bad or the terminate FF may be bad.
7	ECC TEST	The generated ECC pattern did not compare with the expected pattern. The shift registers, ECC logic, or multiplexers may be bad.

If the Self-test LED does not blink or go out, then the 2925 clock circuitry or the 2910 might be bad.

SELF-TEST ERROR CODES

TABLE 5.1

CUSTOMER SERVICE

Our warranty attests the quality of materials and workmanship in our products. If malfunction does occur, our service personnel will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions and technical advise is required, please phone ZETACO, Inc. giving the serial number, board name, model number and problem description. You will be placed in contact with the appropriate technical assistance.

PRODUCT RETURN

Pre-return Checkout.

If controller malfunction is suspected, the use of test software is needed to determine if the controller is the problem and what in particular is wrong with the controller. The tests applicable to this board are listed on the next page of the manual. Please run the test sequence BEFORE considering product return.

Returned Material Authorization.

Before returning a product to ZETACO, Inc. for repair, please ask for a "Returned Material Authorization" number. Each product returned requires a separate RMA number. Use of this number is correspondence and on a tag attached to the product will ensure proper handling and avoid unnecessary delays.

Returned Material Information.

Information concerning the problem description, system configuration, diagnostic program name, revision level and results, i.e., error program counter number should be included with the returning material. A form is provided for this information on the next page of the manual.

Packaging.

To safeguard your materials during shipment, please use packaging that is adequate to protect it from damage. Mark the box "Delicate Instrument" and indicate the RMA number(s) on the shipping label.

(Include with returning material)

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to ZETACO, Inc. for repair. This will: 1) Determine if in fact the board is defective (many boards returned for repair are not defective, causing the user unnecessary system down-time, paper work, and handling while proper testing would indicate the board is working properly). 2) Increase the speed and accuracy of a product's repair which is often dependent upon a complete understanding of the user checkout test results, problem characteristics, and the user system configuration. Checkout results for the DC-295C SMD Controller should be obtained by performing the following tests. (Include error program counter numbers and accumulator contents if applicable).

FUNCTION	TEST	RESULT
SMD	Self-test	____________________
	Diagnostics	____________________
	Reliability	____________________

Other test performed:

Please allow our service department to do the best job possible by answering the following questions thoroughly and returning this sheet with the malfunctioning board.

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain).

2. What operating system are you running under? (AOS RDOS, DDOS, DTOS).

3. Describe the system configuration (i.e. peripherals, I/O controllers, model of computer, etc.)

4. Has the controller been returned before? Same problem?

To be filled out by CUSTOMER:

Model #: ____________________
Serial #: ____________________
RMA #: ____________________

Returned by: ______________________________
(company name)

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6.0 PROGRAM CONTROL

6.1 INSTRUCTION FORMAT

Symbolic form for I/O instructions:

DXXF AC, DSKP

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

F = Function:

C (Clear) - Resets Busy and Done flags to zero, aborts all data transfer commands, and clears data transfer status (DIA) fault bits 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15. Also clears RD/WRT and drive attention flags and interrupt request.

S (Start) - Sets busy flag, clears done and initiates one of the following commands selected by a DOA: Read, Write, Format, Read Buffers or Verify. Also clears interrupt request and data transfer status (DIA) fault bits 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15.

P (Pulse) - Sets control full flag and initiates one of the following commands selected by a DOA: Recal, Seek, Stop, Offset, Write Disable, Release, Trespass and Exam Controller RAM.

AC = Accumulator: 0, 1, 2 or 3.

DSKP = Device Code: Primary - 27 Octal

Secondary - 67 Octal

(Other available by switches)

BINARY REPRESENTATION OF AN I/O INSTRUCTION

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

INTERRUPT MASK BIT 7

MSKO AC

Execution of the Mask Instruction with Bit 7 equal to a one in the selected accumulator will set the interrupt mask within the controller board. This will inhibit any further interrupt requests by the controller until the interrupt mask is cleared, either by an IORST instruction or execution of the mask instruction with accumulator Bit 7 equal to a zero.

IORESET INSTRUCTION

IORST

Execution of an IORST instruction serves as a master reset to the controller board. Upon completion of an IORST the controller will attempt to select unit zero and default the command register to a read operation.

IOSKIP INSTRUCTION

Used to poll the state of the controller board (command is done or busy). If the skip condition is met the next instruction is skipped, else the next instruction is executed.

SKPBZ DSKP - SKIP IF BUSY FLIP-FLOP IS CLEAR.

SKPBN DSKP - SKIP IF BUSY FLIP-FLOP IS SET.

SKPDZ DSKP - SKIP IF DONE FLIP-FLOP IS CLEAR.

SKPDN DSKP - SKIP IF DONE FLIP-FLOP IS SET.

6.2 ACCUMULATOR FORMATS

6.2.1 DOA - SPECIFY COMMAND AND DRIVE

DOAF AC, DSKP

0	1	2	3-4	5	6	7	8-9	10-15
0	1	1	AC	0	1	0	F	DEVICE CODE

Accumulator

0	1-4	5-8	9-10	11-15
R/W DN	CLR SEEK DONE	COMMAND	DRIVE	NOT USED

BIT POSITION

0 - Clear Read/Write Done if it is a one

1 - Clear Seek Done Attention Flag for Drive Unit 0 if it is a ONE

2 - Clear Seek Done Attention Flag for Drive Unit 1 if it is a ONE

3 - Clear Seek Done Attention Flag for Drive Unit 2 if it is a ONE

4 - Clear Seek Done Attention Flag for Drive Unit 3 if it is a ONE

5 - 8 Specify Command

		FUNCTION REQUIRED TO INITIATE
0000	READ	START
0001	RECALIBRATE	PULSE
0010	SEEK	PULSE
0011	STOP DISC	PULSE
0100	OFFSET FORWARD	PULSE
0101	OFFSET REVERSE	PULSE
0110	WRITE DISABLE	PULSE
0111	RELEASE DRIVE	PULSE
1000	TRESPASS	PULSE
1001	SET ALT MODE 1	NONE
1010	SET ALT MODE 2	NONE
1011	EXAMINE RAM	PULSE
1100	DATA VERIFY	START
1101	READ BUFFERS	START
1110	WRITE	START
1111	FORMAT	START

NOTE: See Section 6.3 for detailed command description

9 - 10 Drive Selection

00 - Drive Unit 0

01 - Drive Unit 1

10 - Drive Unit 2

11 - Drive Unit 3

DOA will reserve a previously unreserved drive

Bit Position 9 is not used if 616X

11-15 Reserved for future consideration

6.2.2 DOB - LOAD STARTING MEMORY ADDRESS

DOBF AC, DSKP

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

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	MEMORY ADDRESS BITS														

EXTENDED MEMORY ADDRESS BIT

Execution of this instruction will load the controllers address counter with the contents of the specified accumulator and will be used as the starting memory address for a command that requires a data channel transfer operation.

6.2.3 DOC - LOAD DRIVE ADDRESS

6.2.3.1 DOC - SPECIFY CYLINDER

DOCF AC, DSKP

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

Accumulator (if previous DOA specified a Seek)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NOT USED						CYLINDER ADDRESS									

6.2.3.2 DOC - FIRST DOC SPECIFIES EXTENDED SURFACE, SECTOR AND COUNT (DOUBLE DOC MODE ONLY)

Accumulator (If previous DOA specified a Read, Write, Format or Data Verify)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				HD MSB	SEC MSB					CNT MSB					

6.2.3.3 DOC - SECOND DOC SPECIFIES LOWER FIVE BITS OF SURFACE, SECTOR AND COUNT (FIRST AND ONLY DOC IF SINGLE DOC MODE)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	SURFACE ADDR					SECTOR ADDR					COUNT				

0 - Not Used

1 - 5 Starting Surface Address

6 - 10 Starting Sector Address

11-15 Two's complement of number of sectors to be transferred

6.2.4 READ STATUS - NON ALTERNATE MODE

6.2.4.1 DIA - READ DATA TRANSFER STATUS

DIAF, AC, DSKP

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

Accumulator

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

0 - Control Full

1 - R/W Done

2 - Unit 0 Atten Done

3 - Unit 1 Atten Done

*4 - Unit 2 Atten Done

*5 - Unit 3 Atten Done

6 - Bus Error

7 - Illegal Sector Adr

8 - ECC Error

9 - Bad Sector Flag

10 - Cyl Addr Error

11 - Surf/Sect Addr Error

12 - Verify Error

13 - R/W Timeout

14 - Data Late

15 - Read/Write Fault

*Bit Positions 4 and 5 are not defined if 616X Emulation

0	CONTROL FULL	Will be a one when the controller receives a pulse function. Will be a zero once the controller completes the function to the drive that was specified by the command (Recal, Seek, Stop Disk, Offset, WRT DIS, Release, Trespass and Exam Ram).
1	R/W DONE	A one indicates that the done flag was set following a data transfer command.
2-5	UNIT ATTEN DONE (UNITS 0-3)	A one indicates that the respective drive completed a successful seek or recalibrate operation. If the drive was unsuccessful in its attempt to seek, a positioner fault status will be indicated. A recalibrate operation will clear the fault.
6	BUS ERROR	An incorrect number of memory transfers resulted on the data channel when set to a one.
7	ILLEGAL SECTOR ADDR	The starting sector address (DOC) exceeded the capacity of the drive if set to a one. Done sets immediately.

8	ECC ERROR	A sector of data read from the disk did not correlate with the appended polynomial. This means that the data read does not agree with the data that was originally written.
9	BAD SECTOR FLAG	The controller detected the bad sector flag set to a one within the sectors address header. (Done will set immediately). This implies that the format program originally determined that the surface within this sector could not support errorless data.
10	CYLINDER ADDRESS ERROR	The Cylinder Address contained within the Sectors Header did not match the requested cylinder given by the previous seek command. Bit 11 will set, instead, if there is no match due to a media flaw. The Read/Write Operation will be terminated immediately.

11	SURFACE/ SECTOR ADDRESS ERROR	This status bit may be set by one of the following cases: 1) The Surface or the Sector Address contained within the Sectors Header did not match the current contents of the controller's Surface/Sector Register (initiated by a DOC). 2) The CRC polynomial did not ed. correlate with the Header Address. 3) The Data Sync on a Read Command could not be detected. The Read/Write operation will be terminated immediately.
12	VERIFY ERROR	Data in memory did not agree with the data on the disk. (See Verify Command).
13	READ/WRITE TIMEOUT	A Read or Write type of operation did not complete within one second.
14	DATA LATE	Not implemented.
15	READ/WRITE FAULT FLAG	A one indicates that at least one bit is set in bit positions 6 through 14 or a drive fault occurred during a Read/Write transfer operation.

Refer to Table 6.1 for detailed description.

	STATUS BIT POSITION	CONTROLLLER ACTION	ERROR RECOVERY
BUS ERROR	6	Sets done immediately	New command re-try Read/Write Transfer. May correct the problem.
ILLEGAL SECTOR ADDRESS	7	Sets done immediately	New command if error re-occurs. Check the drive characteristic switches to make sure it agrees with drive type.
ECC ERROR	8	Sets done at the end of sector transfer	New command. Re-tries with servo offset may correct the data. If this error is detected on a surface analysis, the bad sector flag should be set.
BAD SECTOR FLAG	9	Sets done immediately	New command. This sector should be ignored.
CYLINDER ADDRESS ERROR	10	Sets done immediately	New command. The system should diagnose this as a positioner fault.
SURF/ SECTOR ADDRESS ERROR	11	Sets done immediately	New command. Bad sector flag should be set if surface analysis.
VERIFY ERROR	12	Sets done at the end of the sector transfer	New command. Check ECC error also to determine if the error occurred due to a flaw in the media.
READ/ WRITE TIMEOUT	13	Sets done immediately	New command.

READ/WRITE FAULTS (DIA)

TABLE 6.1

6.2.4.2 DIB - READ DRIVE STATUS

DIB AC, DSKP

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

Accumulator

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

*0 - Invalid Status

*1 - Drive Reserved

*2 - Trespassed

3 - Ready

4 - Busy

*5 - Positioner Offset

6 - Write Disabled

*7 - ID

*8 - Ill Sur/Cyl Addr

*9 - Illegal Command

*10 - DC Voltage Fault

*11 - Pack Unsafe

12 - Positioner Fault

*13 - Servo Clock Fault

*14 - Write Fault

15 - Drive Fault

*These Bits are undefined if 616X

0	INVALID STATUS	A one indicates that Status Bits 1 through 15 should be ignored because the drive is not selected or it is in the process of being selected.
1	DRIVE RESERVED	In a dual port configuration the selected drive is currently in use by another processor.
2	TRESPASSED	Not implemented.
3	READY	Drive unit specified by a previous DOA command is selected, spindle is up to speed and positioner is on cylinder.
4	BUSY	The positioner within the currently selected drive is not on cylinder.
5	POSITIONER OFFSET	The selected Read/Write head was moved from on cylinder dead center as was specified by an offset forward or reverse command.
6	WRITE DISABLED	Status from the drive indicates that a write type of command cannot be executed.
7	ID	This Bit is a one if 6122 is selected, a zero for all other emulations.
8	ILLEGAL SURFACE OR CYLINDER ADDRESS	The requested surface or cylinder address exceeds the capacity of the drive. Read/Write operation will terminate immediately.

9	ILLEGAL COMMAND	The controller was requested to perform a write type of command while servo is offset or write disabled is active.
10	DC VOLTAGE FAULT	Not implemented.
11	PACK UNSAFE	Conditions exists within the drive which may impair the safety of the media. This bit will be a one if a fault status is received directly from the drive interface.
12	POSITIONER FAULT	This indicates that the drive was unable to complete a seek within 500 ms, or that the positioner has moved to a position outside the recording field. The system should send a recal command to recover from this error.
13	SERVO CLOCK FAULT	A clock synchronization failure occurred between the serial data being read and the reference clock coming from the disk drive. In most cases this means that the header or data sync was not encountered within a specified amount of time.

		This flag would set if the format on the disk did not agree with what the controller expected. Check the switch settings to make sure the proper format was selected
14	WRITE FAULT	An abnormal condition was detected by the drive during a write type of operation.
15	DRIVE FAULT	One or more bits are set in positions 8 through 14 or the drive detected an abnormal condition.

Refer to Table 6.2 for more detailed description.

6.2.4.3 DIC - READ SURFACE, SECTOR AND COUNT

DICF AC, DSKP

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

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NU	CURRENT SURFACE ADDR					CURRENT SECTOR ADDR					TWO'S COMPLEMENT OF NUMBER OF SECTORS REMAINING				

6.2.5 READ STATUS - ALTERNATE MODE ONE

See detailed description of Alternate Mode One Command. Previous DOA specified ALT Mode One for Sections 6.2.5.1 through 6.2.5.3.

6.2.5.1 DIA - READ CURRENT MEMORY ADDRESS

DIAF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EXT	CURRENT MEMORY ADDRESS														

After the execution of this instruction the value of the accumulator will contain the memory address to where the next data word transfer will take place. The memory address counter is incremented by one after each data channel transfer.

6.2.5.2 DIB - READ EXTENDED MEMORY ADDRESS

DIBF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				HD MSB	SEC MSB					CNT MSB					

The AC will contain the current most Significant Bits for the Surface (Bit 4), Sector Address (Bit 5) and Two's Complement Count (Bit 10). These Bits will allow the System to reference up to 64 heads or sectors.

6.2.5.3 DIC - NOT CURRENTLY IMPLEMENTED

6.2.6 READ STATUS - ALTERNATE MODE TWO

See detailed description of Alternate Mode Two Command. Previous DOA specified ALT Mode Two for Sections 6.2.6.1 through 6.2.6.3.

	STATUS BIT POSITION	CONTROLLER ACTION	ERROR RECOVERY	DRIVE ACTION
ILLEGAL SURFACE	8	Command is rejected and Done is set immediately,	New Command	None
ILLEGAL CYLINDER	8	Seek Command is rejected,	New Seek or Recal Command	None
ILLEGAL COMMAND	9	Command is rejected and Done is set immediately.	New Command	None
PACK UNSAFE	11	Command is terminated.	A Recal Command, if the controller caused the Fault (i.e. exceeding the Surface or Cylinder Address or Write Command while Write is disabled).	Fault status is issued to controller. Refer to Drive Manufacturer's Specifications for Faults that cannot be cleared by Fault Clear (Recal) from the controller.
POSITIONER FAULT	12	If it is detected at the start of a Read or Write Command, Pack Unsafe will also Set and the Command will terminate immediately.	Recal Command	Fault Status is issued to the controller along with Seek Error.
SERVO CLOCK	13	Read/Write Command is terminated immediately.	Reformat the surface or select the proper format on the controller. The format on the surface did not agree with the format selected on the controller.	None

DRIVE FAULT TABLE (DIB)

TABLE 6.2

6.2.6.1 DIA - READ ECC REMAINDER UPPER

DIAF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
31 X	30 X	29 X	28 X	27 X	26 X	25 X	24 X	23 X	22 X	21 X	20 X	19 X	18 X	17 X	16 X

6.2.6.2 DIB - READ ECC REMAINDER LOWER

DIBF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15 X	14 X	13 X	12 X	11 X	10 X	9 X	8 X	7 X	6 X	5 X	4 X	3 X	2 X	1 X	0 X

6.2.6.3 DIC - NOT CURRENTLY IMPLEMENTED

6.3 DETAILED COMMAND DESCRIPTIONS

The command set (16 in all) provided by the controller is basically broken up into three groups:

1. Data Transfer Command
2. Drive Commands
3. Alternate Mode Commands

The Command is stored in the controller via a DOA instruction. Before any Command is initiated, the selected Unit must have valid status and be ready.

6.3.1 DATA TRANSFER COMMANDS

Start (Set Busy) will initiate any one of the following commands: Read, Write, Format, Verify or Read Buffers up to 64 contiguous sectors may be transferred.

Read/Write Initialization Steps:

1. Control full and Drive status must be tested for proper state before commencing with a Read/Write Command.
2. Send the Starting Surface and Sector Address along with the two's complement of the number of sectors transferred. (See DOC)
3. Send the Starting Memory Address of where the data should be stored or retrieved. (See DOB)
4. Send the Command type and the desired Drive Unit Number. (See DOA)
5. Issue a Start Pulse.

Read/Write Termination Possibilities (Done Set):

1. All the sectors implied by the two's complement sector count were transferred.
2. A Drive or Read/Write Error was encountered. DIC command should be issued to determine which sector the error occurred at.
3. Busy was cleared by an IORESET instruction or a clear pulse was issued to the controller during the Read/Write transfer. Done will not set in this case.

6.3.1.1 READ COMMAND

When busy sets, the controller will wait for on cylinder if the previous seek command has not been completed yet. It will then search for the starting sector address specified by the previous DOC instruction. The header is read and compared with the starting sector address, starting surface address and stored cylinder address to insure that the proper sector has been physically located. Before the data can be accepted the header must match the specified address, the header CRC must be good and no bad sector flags encountered. If the header is in error or the bad sector flag is a one, the appropriate status bit and done flag is set immediately. When the drives RD/WRT head reaches the data field the serial data is sent to the SMD interface formed into parallel words by the controller and transferred to the buffer. When all 256 words are contained within the buffer, the ECC Code appended in the data is checked to insure proper data by reading the results of the remainder. A data error occurred if the remainder is not equal to zero. In the case of an error the controller will transfer the data into memory and then set ECC Error Flag and Done. If the ECC Enable switch was closed (refer to switch settings), the controller will attempt to correct the data within its own buffer prior to transferring it to memory.

If it determines that it is not correctable, the controller will re-try on its own with a Data Strobe Early and if unsuccessful, again with a Data Strobe Late. If the data is still not correctable, then it will set ECC Error Flag and Done. If more sectors are to be transferred, the controller will begin searching for the next sector while the data from the previous sector is transferred to memory.

6.3.1.2 WRITE COMMAND

When busy sets, the controller will wait for the positioner to be on cylinder if the selected drive is still in the process of seeking. Upon the completion of the previous seek operation, the controller will transfer 256 words of data from memory to a sector buffer. The starting address of memory was specified by the previous DOB instruction. The controller searches for the desired sector and performs a head verification (same as the read command) before data is written on to the surface of the disk. Once the correct sector is found, the controller will select the sector buffer previously written by the data channel control. The contents of this buffer is then written on to the disk surface proceeded by a gap and data sync. The controller incorporates two sector buffers. Therefore, the data channel logic can write into one buffer while data is transferred to the disk from the other.

6.3.1.3 VERIFY

When busy sets, the controller initially starts out as if it were a read command (i.e. wait for on cylinder, verify header etc). Once a full sector is transferred from the disk to a controller buffer a comparison is made against system memory. This is accomplished by reading a word from memory starting from the previous DOB and comparing each word of sector. If a word does not compare, data transfer status (DIA) Bit 12 and Done will set.

6.3.1.4 FORMAT

The objective of the format command is to write the header information (surface, sector and cylinder address) on a sector. Up to 64 contiguous sectors may be formatted per command. Data that was contained within the sector will be lost (replaced by all zeros). Refer to Figure 6.2 for format details. Format is also used to set the bad sector flag.

6.3.1.5 READ BUFFERS

Reads the contents of the currently used buffer and transfers all 256 words to memory specified by the starting address. Primarily used for diagnostic purposes.

6.3.2 DRIVE COMMANDS

IOPULSE (sets control full) initiates any one of the following commands: Recalibrate, Seek, Stop, Offset, Write Disable, Release, Examine Ram and Trespass.

6.3.2.1 RECALIBRATE

Moves the heads to cylinder 0, selects Head 0, and issues a fault clear to the drive.

An IORESET switch will automatically cause a recalibrate command to be issued to Unit 0.

This command moves the heads more slowly than a seek to 0, so it should not be used for data acquisition.

6.3.2.2 SEEK

Moves the heads to the cylinder specified by the DOC. The controller stores the cylinder address for that particular unit, initiates the seek operation and clears control full. While that unit is busy seeking the controller can accept another seek command for a different unit (overlapped seeks) or commence with a Read/Write Command for the unit busy seeking.

See the SMD specification for the Seek Timing.

6.3.2.3 OFFSET FORWARD

Offsets the heads forward off the track center-line. This operation is cleared by the next command. (The drive does not allow write operations when the positioner is offset).

6.3.2.4 OFFSET REVERSE

Offsets the heads reverse off the track center-line. This operation is cleared by the next command. (The drive does not allow write operations when the positioner is offset.) Offset forwared or reverse may be used as an attempt to recover data that cannot be corrected by the error correction algorithm.

6.3.2.5 WRITE DISABLE

Not implemented.

6.3.2.6 RELEASE DRIVE

When enabled, this command clears the reserved condition of the specified drive which the processor had previously reserved. When disabled, the controller ignores this command, thereby allowing the controller to be used with very high speed processors requiring fast response to unit selection.

If dual processor operation is required, this command must be enabled per the instructions in Section 3.2.6.

6.3.2.7 TRESPASS

The controller issues a priority select to the specified drive. The drive will immediately be reserved until a release command is issued or the drive timout feature times out.

6.3.2.8 STOP DISK

All drives connected that are selected for remote operation will unload the heads and spin down via the pick-hold line. A console reset, IORESET instruction, or another command will spin the disk back up.

6.3.2.9 EXAMINE RAM COMMAND

This command gives the system the capability of reading from or writing to the 295C controllers memory. This command must be proceeded by a DOC containing the address of the desired RAM location.

In order to write to RAM, Bit 0 (MSB) must be a one in the DOC address, and the data to be written is sent via the DOB. If a read RAM is implied (DOC Bit 0 = 0), the contents of the DIC will contain the RAM data after control full clears.

This feature is used for obtaining the following information:

a. Drive characteristics for the formatter and reliability programs.

b. Number of ECC corrections by the controller (each unit has a separate count).

c. Maintenance testing.

d. Features that may be considered in the future.

DETAILED DESCRIPTIONS OF USER RAM LOCATIONS

OCTAL ADDRESS	NAME	DESCRIPTION
1422	DISABLE CORRECTION	The least significant bit is used to indicate if controller self corrections are permitted. This bit will be initialized on a power on or an IORESET switch. If the ECC switch (G5 SW Position 8) is on it will be initialized to a zero, if it is off it will be initialized to a one. If one is written into this bit, correction will be software disabled. Correction cannot be software enabled if the ECC Enable switch is off.
1460-1462	SELECTED DRIVE CHARACTERISTICS	These locations will be updated whenever a new drive is selected. 1460 - Maximum sector address 1461 - Maximum surface address 1462 - Maximum cylinder address Allow invalid status to go away before a reference is made. Avoid writing to these locations.
1500-1503	UNIT CORRECTION COUNTS	These locations will be incremented each time the controller does a correction either by the ECC algorithm or an Early/Late re-try. The maximum count per unit is 65535 (the count will stay at maximum if there are any more corrections to that unit). The counts are initialized to zero on either a power on or an IORESET switch. A separate count is maintained for each unit. 1500 - Unit 0 1501 - Unit 1 1502 - Unit 2 1503 - Unit 3

EXAMINE RAM COMMAND

1776-8 EPROM REVISION LEVEL

DIC ACCUMULATOR

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0	0	0	0	REVISION LEVEL							

EXAMPLE: Revision Level 6 EPROMS

Location 1776-8 = 000006-8

1777-8 PROM ID/REV

DIC ACCUMULATOR

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	RES	IDENTIFICATION						REVISION LEVEL							

EXAMPLE: Identification 80 (Hex) Revision Level 6

Location 1777-8 = 100006

NOTE: Avoid referencing any locations that are not defined here.

EXAM RAM EXAMPLE

READ Contents of Loc 1500 Octal (Unit 0 corrections)

Accumulator Set up:

A0 = 002600 (NOP Command Unit 0)
A1 = 001500 (RAM Address for DOC)

```
DOC 1, DSKP              ; Send RAM Address
DOAP 0, DSKP             ; Send NOP Command and IOPULSE
DIA 0, DSKP              ; Wait for Control Full
MOVZL# 0,0,SZC           ; To be zero
JMP .-2
DIC 2, DSKP              ; Put contents of RAM Location
                           1500 into Accumulator 2
```

WRITE To Location 1500 Octal (Clear Unit 0 Corrections)

Accumulator set up:

```
A0 = 002600 (NOP Command Unit 0)
A1 = 101500 (RAM Address for DOC)
A2 = 000000 (RAM Data)

DOC 1, DSKP           ; Send RAM Address
DOB 2, DSKP           ; Send RAM Data
DOAP 0, DSKP          ; Send NOP Command and IOPULSE
```

6.3.3 ALTERNATE MODES

A command that will change the context of the data received from a DIA, DIB or DIC. A command other than Alternate Mode or an IORESET will clear Alternate Mode.

6.3.3.1 ALTERNATE MODE ONE

It changes the context of DIA to read the current memory address. The ending address after a Read/Write transfer will point to the last address plus one.

6.3.3.2 ALTERNATE MODE TWO

It changes the context of the DIA and DIB command. This is used to extract the syndrome (ECC remainder not equal to zero after a read command) from the controller in order to determine whether the data error within the sector read is correctable or not.

6.4 ERROR CORRECTION CODE (ECC)

When a write command is specified the ECC hardware divides the data field within the sector by a fixed *generator polynomial and appends the resulting checkword to the data field.

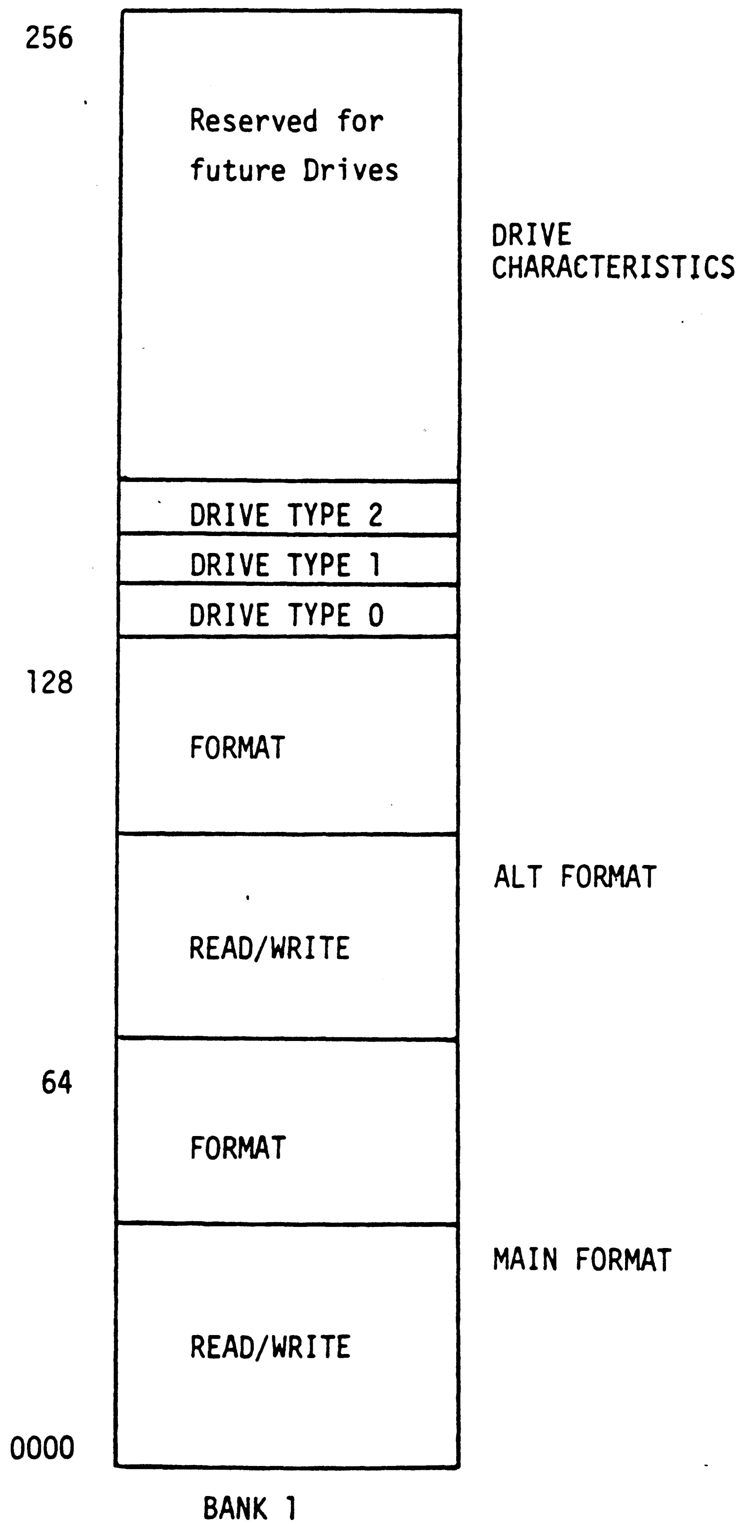
*Generator Polynomial
X-32 + X-23 + X-21 + X-11 + X-2 + 1

When a read command is specified the ECC hardware divides the data field and the appended checkword within the sector by a *factored version of the same generator polynomial. If a data error occurs, the resulting remainder is non-zero, and the data transfer status (DIA) bit position 8 is set (bit 8 will not set if the controller was enabled to correct and the error is correctable). Be aware that there exists a small class of errors which are undetectable due to the cyclic properties of the generator polynomial.

*Factored Version

(X-1 + X-2 + 1) (X-21 + 1)

The ECC feature detects all error bursts contained within 21 or less contiguous bits in a sector and allows correction of all error bursts up to 11 contiguous bits.



FORMAT SEQUENCER EPROM MAP

Figure 6.1

6.5 FORMAT SEQUENCER

The DC-295C Disk Controller features a format sequencer which controls the disk side of the Controller. The firmware which controls this sequencer is contained in 2716 EPROMS allowing disk format changes to take place in the EPROMS instead of the microprocessor firmware.

The format sequencer firmware is arranged in eight banks of 256 words each and is switch selectable for the format bank desired. Each bank consists of half READ/WRITE/ FORMAT CODE and the other half drive characteristics. See Figure 6.1.

6.5.1 READ/WRITE FORMATS

The Read/Write/Format section of a given bank contains the format choices (Main or Alternate).

The Alternate Format is selected only on Ports 2 and 3. Therefore, two header format types could operate simultaneously on this Controller restricted only by the port locations. See Figure 6.2 for Header Formats supported and Tables 3.1/3.2.

6.5.2 DRIVE CHARACTERISTICS

The drive characteristics section consists of 16 separate blocks of drive characteristics configurable for each port.

The following is information necessary to format size and communicate precisely with a given disk drive.

1) Maximum Surface, Sector and Cylinder Address
2) Two Volume (CMD, Lark, etc.) and Dual Volume
3) Sync Byte

APPENDIX A

DIAGNOSTIC SUPPORT PACKAGE
GENERAL INFORMATION

Booting Diagnostics from Magnetic Tape.

Step 1 Mount the tape on the Tape Drive and put the Drive On-line. Be sure that your BPI setting matches the tape you received.

Step 2 Program Load - The method of program load varies for different processors. Some of the possibilities are described here.

If your system does not have a program load option, consult your processor manual.

If your system has front panel switches, set them to 100022 for the Primary Tape Drive, or 100062 for the Secondary Drive. Then press program load switch.

For the S140 virtual console, set 11A to 100022 for the Primary Tape Drive, or 100062 for the Secondary Drive. Then enter 100022L (or 100062L).

For the S120 virtual console, enter 22H for the Primary Tape Drive or 62H for the Secondary Drive.

For the Point 4 virtual console, enter P22 for the Primary Tape Drive or P62 for the Secondary Drive.

LOADING DIAGNOSTICS FROM TAPE TO YOUR SYSTEM DISK

The last file on the DSP Tape (reference menu for number) is a DUMP Format copy of the previous files. This allows a User to load (use RDOS load command) the files onto a disk.

Step 1 While the System is running, mount the tape and put the Drive On-line. Be sure that you have correct BPI setting.

Step 2 For an RDOS System enter the commands:

```
INIT MT0
LOAD/R/V MT0:X
RELEASE MT0
```

For an AOS System enter the commands:

```
SUPERUSER ON
DIR :
X RDOS LOAD/V @MTA0:X
REWIND @MTA0
SUPERUSER OFF
```

The files can now be booted from disk (enter file name in response to filename? or pathname?).

Zetaco

Please give us your comments.

Please use this form to send us your comments regarding this technical manual. Your input is greatly appreciated! Problems will be promptly addressed and action taken as necessary. If you wish a written reply, please furnish your name and mailing address. Thank you.

Date____________________

Name___________________________ Title__________________________

Firm____

Address____

City/State/Zip____

TECHNICAL MANUAL TITLE__________________________________

DOCUMENT NUMBER______________________ REVISION__________

ERRORS IN MANUAL:

SUGGESTIONS FOR IMPROVING EITHER THE MANUAL OR THE PRODUCT:

```
;
;
;*************************************************************
;------------------------------------------------------------
;
; DESCRIPTION: ZETACO DISK CONTROLLER DIAGNOSTIC
;
;
; Product of ZETACO, 1986
;*************************************************************
       ;TITL   DISKD
       .DUSR   X=1
       .NOMAC  X
; 1.0 PROGRAM NAME:     DISKD.SR

; 2.0 REVISION HISTORY:
;
;      REV.       DATE
;       00       02/17/83          ;
;       01       09/07/83          ;ANOTHER RDY UNIT WARNING,1 HD
;                                  ;ERR C22, AOS BOOTSTRAP(400'S),
;                                  ;NO OFFSET TESTS FOR CMD'S
;       02       03/28/84          ;295C,296 AND BMX TESTS
;                                  ;DEVICE CODE CHANGE ROUTINE
;       03       06/12/84          ;ZDF1 CHANGES, A5 TESTS 17-76
;
;       04       08/21/85          ;DISABLE VIRTUAL, WEL-RECAL,
;                                  ;DISK SIM PARMS
;       05       11/20/86          ;297, 6214, HELP, DMA PTR, IORST

; 3.0 MACHINE REQUIREMENTS:
;      NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR
;      MINIMUM of 16K READ/WRITE MEMORY
;      ZETACO DISK CONTROLLER (ZEBRA TYPE)
;      0-3 DISK DRIVES
;      TELETYPE or CRT and CONTROL

; 4.0 TEST REQUIREMENTS:          N/A

; 5.0 SUMMARY:
;      The ZETACO DISK CONTROLLER DIAGNOSTIC PROGRAM
;      is a HARDWARE DIAGNOSTIC for the ZETACO DISK
;      CONTROLLERS and DRIVES. The Device Code may be 20-76
;      OCTAL with the Default being 27.


; 6.0 RESTRICTIONS:
;      This Program has no Restrictions as to Single or
;      Dual Processor Hardware Configuration. However, the
;      Diagnostic may be run on ONLY ONE CPU at a time and
;      must be the only Program being run within the Disk
;      System.
```

```
; 7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:

;        7.1 "A" TESTS CHECK:

;        - BUSY, DONE, I/O BUS SELECT LOGIC
;        - DISK SELECT LOGIC, CONTROLLER RAM

;        7.2 "B" TESTS CHECK:

;        - START, BUSY, CLEAR LOGIC
;        - RECALIBRATE, ATTN, INTERRUPT LOGIC
;        - INTERRUPT DISABLE, INTA LOGIC
;        - That SEEKS to CYL'S 0,1/2 CYL MAX,and CYL MAX
;          can at least be EXECUTED and SET DRIVE BUSY.
;        - READY/SELECT LOGIC

;        7.3 "C" TESTS CHECK:

;        - That the CA REGISTER INCREMENTS properly
;          VIA DCH  or BMC 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
;        - The INCREMENT HEAD LOGIC
;        - ILLEGAL SECTOR, SURFACE, CYLINDER Conditions

;        7.4  "E" TESTS CHECK:

;        - That a READ may be EXECUTED
;        - 8 SECTOR WRITE/READ OPERATIONS (9 Different
;          Data Patterns) at CYL'S 0,1/2 CYL MAX and CYL MAX
;          with Full Core Compare
;        - Data VERIFY Function (Normal and with Forced Errors)
;        - OFFSET MODES
;        - ILLEGAL COMMAND TRAPS
;        - WRITE CYL# to 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" TESTS CHECK:

;          The Format Logic on CYL 0,HEAD 0,SECTOR 0,
;          A SET BAD SECTOR FLAG given and TESTED.
;          The FORMAT is set to Normal after Completion
;          of these Tests.

;        7.6 "S" TESTS ARE SEEK EXERCISERS

;        - Performs RANDOM SEEKING. Each SEEK is Followed
;          by a Read to Head 0,Sector 0

;        - Performs RANDOM OVERLAPPED SEEKING to TWO DRIVES.
;          Each SEEK is Followed by a Read to Head 0,Sector 0.
;          U1 is the the Primary Unit under Test and U2
;          is the next Drive found in a 1,2,3,0 ETC. Search.
;          If only 1 Drive, Test is Bypassed. Test is only run
;          after a Pass is Achieved on All Drives.
```

```
; 8.0  OPERATING MODES/SWITCH SETTINGS:

;8.1     SWITCH SETTINGS
;
;        Location "SWREG" is used to select the program options. This
;        Location will be set according to the answers supplied by
;        the Operator. 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         40000    0       LOOP on ERROR
;                 000000    1       SKIP LOOPING on ERROR
;
;        2         20000    0       PRINT to CONSOLE
;                 000000    1       ABORT PRINT OUT to CONSOLE
;
;        3         10000    0       DO NOT PRINT % FAILURE
;                 000000    1       PRINT % FAILURE
;
;        5         02000    0       DO NOT PRINT on the LINE PRINTER
;                 000000    1       PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;        6         01000    0       DO NOT HALT on ERROR
;                 000000    1       HALT on ERROR
;
;        7         00400    0       N/A
;                 000000    1       DISABLE FORMATTING HD 0, CYL 0, SEC 0
;
;        8         00200    0       N/A
;                 000000    1       RECALIBRATE during SCOPE LOOP
;
;        9         00100    0       N/A
;                 000000    1       1 SECOND DELAY during SCOPE LOOP
;
;        10(A)     00040    0       N/A
;                 000000    1       PRINT TEST #'S and FIRMWARE REVISIONS
;
;        11(B)     00020    0       N/A
;                 000000    1       PROGRAM will EXIT to ODT when not in
;                                   TESTS F1-F3 SWT is Set to 0 upon EXIT
;        12(C)     00010    0       SKIP LONG RAM TEST
;                 000000    1       LONG CONTROLLER RAM TEST
;
;        16(G)     00000    0       DO NOT PRINT on the DMA LINE PRINTER
;                 100000    1       PRINT on the DMA LINE PRINTER(DC 17)
;
;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-Z. The
;        Program will Continue Running after Updating the Options.
;        Each Key will Complement the state of the Bit affiliat-
;        ed 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 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.
;
;       M       This Command given at any time will print the
;               Current Operating Modes.
;
;       O       This Command given at any time will lock the
;               Program into Switch Modification Mode where
;               more than 1 Bit can be changed.
;


; 9.0 OPERATING PROCEEDURE/OPERATOR INPUT:

;       9.1 Load the Program

;       9.2 STARTING ADDRESSES
;               200-To IDENTIFY DISK TYPE (INITIALIZE)
;                   PROGRAM then PROCEEDS to 500.
;               201-ODT DIRECT ENTRY ONLY
;               202-RANDOM SEEK EXERCISERS. (1 PASS of DIAG FIRST)
;                SEEK EXER 1 is a SINGLE DRIVE EXERCISER
;                SEEK EXER 2 is TWO DRIVE EXERCISER with SEEK OVERLAP
;               500-DIAGNOSTIC (RESTART)

;       9.3 The Program Prints"PASS" following each
;          Complete Pass through the Tests. Random
;          Seek Exerciser performs 1000 Seeks
;          per "PASS" Message.

;       9.4 Device Code of Controller is Requested (27 is Default)

;       9.5 Unit Numbers to be Tested are Requested to which the
;           Operator Enters the Unit Numbers to be Tested, Separating
;           the Individual #'s by a <,> or <Space>.

;       9.6 Operator is Requested to Enter 1, if Unit Characteristics
;           Displayed are INCORRECT, and Wants to LOOP on Reading them.
```

```
; 10. PROGRAM OUTPUT/ERROR DESCRIPTION:
;       When an ERROR is Detected the Program Prints the ERROR
;       PC, 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  SWPAK. In General the
;       ERROR PC will point to a Call ERROR.

;       The Printout will be of one of the following Formats:

;       A. STANDALONE CONTROLLER TEST FAILURES-

;       B. STATUS ERRORS

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       AC1(STATUS) SHOULD =AC0
;       DESCRIPTIONS of FAILING STATUS BITS

;       C. MEMORY/DISK ADDRESS ERROR

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       ENDING MEMORY/DISK ADDRESS ERROR
;       AC1(MA/DA) SHOULD =AC0

;       C. INTERRUPT TIMEOUT

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       INTERRUPT TIMEOUT

;       Additional Test Significance can be found in the Program
;       Listing, although it is hoped that a need for the Listing
;       will be Minimal. SWPACK(SWREG) will provide all Control
;       over Test Loop Options and Printouts.


;       Data Errors will result in the 1st 3 Good/Bad pairs and
;       their Addresses being Printed along with the Total Count.
;       If an ECC Error is Detected, the Call EHECC will
;       Acknowledge the Fact and Return to the Main Test for
;       the Data Compare. Printouts result on the 1st Error Pass
;       only. As the Check Routine Checks the entire Read Buffer,
;       any Error accompanied by an ECC Error,terminating the
;       Read, may cause all Data in succeeding Sectors to appear Bad.

;       Tests that perform a Recalibrate have a 2 SEC. Delay built
;       into the Scope Loop.  Set SWPAK 9 = 1 to introduce 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.
```

```
; 11. DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;       This Diagnostic is equipped with a built in ODT which can be
;       accessed by hitting CONTROL O at any time during the execution
;       of the Program (after Setting the Parameters). On entering ODT
;       the Address of the Location having the next instruction to be
;       executed will be typed-out.
;
;       The following Conventions are used by the ODT:
;       ?       Pressing any illegal key causes the ODT to respond
;               with a "?".
;       @       ODT is ready and at your service.
;
;       An ODT Command has the following Format:
;               [ARGUMENT][COMMAND]
;       An Argument may be one of the following:
;       "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;               separated by Plus (+) or Minus (-) signs. Leading
;               Zeros need not be typed.
;       "ADR"   An Address is the same as an Expression except
;               that Bit 0 is neglected.
;       A Command is a single teletype character
;
;       The Locations that can be EXAMINED and MODIFIED by the user
;       are called CELLS. These CELLS are of two Types: Internal CPU
;       Cells and Memory Locations. The Command to OPEN one of the
;       Internal Registers is of the form "nA" where n is any OCTAL
;       Expression between 0 and 7.
;
;       0-3     For ACCUMULATORS 0-3
;       4       For PC of the next Instruction to be Executed in the
;               event of a "P" Command.
;       5       CPU and TTO Status
;               BIT     INTERPRETATION
;               15      Status of TTO DONE FLAG
;               14      Status of INTERRUPTS (ION FLAG)
;               13      Status of CARRY BIT
;       6       Address of the Location having the BREAK POINT (if any)
;       7       Instruction at the BREAK POINT Location
;
;       Other Commands to OPEN Cells are:
;
;       "ADR"/  Open the Cell and Print its contents
;       ./      Open the Cell currently pointed to by the Pointer and
;               Print its contents.
;       .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;               contents.
;       .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;               Print its contents.
;       "CR"    The Return Key is used to Close the Open Cell with or
;               without Modification.
;       "LF"    Line Feed is used to Close the Open Cell with or without
;               Modification and to Open the succeeding Cell.
;       CTRL    Close the Open Cell with or without Modification and
;               Open the preceeding Cell.
;       /       Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents.
;       +"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents + "ADDR".
;       -"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents - "ADR".
```

```
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
;       NOTE:   In Programs which RELOCATE THEMSELVES the
;               user should place Break Points ONLY in the
;               ORIGINAL PROGRAM AREA. If a Break Point is
;               placed outside this area the results will
;               be unpredictable.
```

```
;
; 12. SPECIAL NOTES/SPECIAL FEATURES:

;        12.1 If the Disk Pack has BAD SECTOR FLAGS Set on Cylinder
;        0, or on the First 8 Sectors of Head 0 of any Cylinder,
;        Error Printouts will result when the Flags are Encountered.

;        12.2  Tests F1-F3 alter the Format on CYL 0,HD 0,SEC 0 for
;        purpases of Checking the FORMAT Logic and BAD SECTOR Logic.
;        SWPAK7 should be Set to 1 in order to stop Program from
;        executing the Format.

;        12.3  Some Scope Loops will require a Recalibrate to
;        Initialize the Disk Drive following a failure. Set
;        SWPAK 8 = 1 to Introduce the Recalibrate to the Unit
;        under Test.

;        12.4  DISK PACKS
;        Only use Disk Packs Formatted by the DISKF Pack Formatter
;        Program. The Diagnostic Program will Write over most of
;        the Disk Surface.

; 13. RUN TIME:
;        The Run Time for a PASS is approximately: 3 MIN.
```

```
;
;
;*************************************************************
;
;
; DESCRIPTION: ZETACO DISK CONTROLLER RELIABILITY PROGRAM
;
;
; Product of ZETACO, 1986
;*************************************************************
        .TITL   DISKR
        .DUSR   X=1
        .NOMAC  X
;1.0    PROGRAM NAME:   DISKR.SR

;2.0    REVISION HISTORY:
;
;       REV.      DATE
;        00     02/09/83                ;
;        01     09/07/83                ;S120 # SKP TOGETHER, STACK AND
;                                       ;AOS BOOTSTRAP AT 400, NO VERIFY
;                                       ;W/RANDOM DATA TEST 502 SWT 10
;        02     03/28/84                ;ADD RELEASE COMMAND TO RC
;                                       ;FOR DUAL PORT, DAISY CHAIN
;                                       ;DISK SECTOR PULSE COUNTER
;                                       ;DEVICE CODE CHANGE ROUTINE
;                                       ;502 PAT 24 SECTOR
;        03     05/30/84                ;ZDF1,
;
;        04     08/21/85                ;DISABLE VIRTUAL, UP TO 2048.
;                                       ;CYLS, 40 HDS
;
;        05     11/20/86                ;MULTI DC 500 & 505, DMA PTR
;                                       ;MAJOR

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR
;       16K READ/WRITE MEMORY
;       ZETACO DISK CONTROLLER (ZEBRA TYPE)
;       0-3 DISK DRIVES
;       TELETYPE or CRT and CONTROL

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       The ZETACO DISK CONTROLLER RELIABILITY PROGRAM is a
;       MAINTENANCE PROGRAM designed to EXERCISE and TEST the
;       ZETACO SMD DISK SUB-SYSTEMS and 1-4 DISK DRIVES. The
;       DISK DRIVES may be shared between TWO Computers.

;       The Device Code may be 20-76 OCTAL with the Default
;       being 27.
```

```
;       1. The DISK DRIVES may be shared between TWO Computers in
;       which case the following Programs may be running in each
;       Computer:

;       STARTING ADRESSES'S (SA) 500,501 RANDOM RELIABILITY
;       SA 503 COMMAND STRING (If a RELEASE Command is included
;       in the Command String)

;       If no Drives are to be Shared, there are no other
;       Restrictions as to the running of these Programs on a
;       Dual Processor System.

;       2. Any Combination of Drives may be Tested by this Program
;       at a single time.


;7.0    PROGRAM DESCRIPTION/THEORY OF OPERATION:

;       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 indefinately. If running Multiple
;       Units, Over Lapped SEEKS are employed, if the next Random
;       Unit is different from the current Unit under I/O Execution.

;       B. RELIABILITY TEST (SA 501) with OPTIONS

;       Same as A, Except that Operator is given Options on Data
;       Patterns and may choose a Constant Cylinder,Head,Sector
;       or # or 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.

;       The Operator is also asked to respond to JITTER OPTION
;       (YES/NO). If YES, a Random Delay(0-40,50MS) is inserted
;       into the Background Loop to create a more asynchronous
;       Disk I/O Loop.

;       C. INCREMENTAL DISK ADDRESS TEST (SA 502)

;       Operator is given Option on Data; Requested Data is first
;       Written (SEE SWPAK10) over the entire Pack. Then the Data
;       is Read from all Sectors . This insures that all Disk
;       Blocks are useable and are Formatted properly. The Test
;       is then repeated for all Ready Disks, and PASS is Printed.
;       The sequence is repeated indefinitely.

;       #NOTE
;       SWPAK8=1, puts Program into Read ONLY Mode ## SA'S 501,502 ONLY.
;       If SA 501-Data must !NOT! be Random.

;       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 gets 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
;       their 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 return
;                       to use the previous entry

;       II.     DATA:   RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=155555 PATTERN
;                       ROT=155555 PATTERN Rotated on
;                       Successive Passes.
;                       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 carriage
;                       return 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.      TRESPASS
;               8.      RELEASE
;               9.      OFF (OFFSET FORWARD)
;               10.     OFR (OFFSET REVERSE)
;               11.     LR  (begin LOOP here)
;               12.     VERIFY (WRITE)
;               13.     FORMAT CYL,HD,SECTOR
;               14.     MEMORY ADDR,DATA(WRITE) (CONTROLLER MEMORY COMMAND)
;               15.     Type Carriage Return to use the
;                       previous COMMAND STRING.

;               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. 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
```

```
;	WRITE SECTORS 2 and 3 of HEAD 5, 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 5,2,2 READ SAME LOOP

;	The following example would WRITE 0 to
;	CONTROLLER MEMORY location 1500 (OCTAL)

;	UNIT:   1
;	DATA:   N/A
;	COMMAND STRING: MEMORY 101500,0
;	NOTE: Upper memory bit = 1 defines a WRITE
;
;	E. QUICKIE FORMATTER (SA 504)
;	Formats Pack and HALTS. There is NO Verify, NO Flags are
;	Set, and NO Error Checking.

;	F. RUNALL (SA 505)
;	Program alternates between the Programs described in 7.B
;	(4 Data Patterns -PAT,RAN,FLZ,FLO) and 7.C(6 Data Patterns
;	-PAT,RAN,RAN-2,ZEROES,ONES,ALT) and 7.H, and in that order.

;	G. SEEK EXERCISER (SA 506)
;	Program provides a SEEK scan sequence converging from the
;	extreme Outermost Tracks into the adjacent track in the
;	center, then diverging again to the extremes.

;	H. RANDOM SEEK EXERCISER (SA 507)
;	Program provides a Random SEEK sequence

;	###G,H all SEEKS in G/H are followed by a 1 Sector Read but
;	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.

;	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.
;


;
;
;8.0  OPERATING MODES/SWITCH SETTINGS:

;8.1	SWITCH SETTINGS
;
;	Location "SWREG" is used to select the program options.
;	This Location will be set according to the answers
;	supplied by the Operator. 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       40000  0       LOOP on ERROR
;              000000  1       SKIP LOOPING on ERROR
;
;       2       20000  0       PRINT to CONSOLE
;              000000  1       ABORT PRINT OUT to CONSOLE
;
;       4       04000  0       PRINT PASS
;              000000  1       DO NOT PRINT PASS
;
;       5       02000  0       DO NOT PRINT on the LINE PRINTER
;              000000  1       PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;       6       01000  0       DO NOT EXIT to ODT on ERROR
;              000000  1       EXIT to ODT on ERROR
;
;       7       00400  0       NOT USED
;              000000  1

;       8       00200  0       N/A
;              000000  1       For READ ONLY MODE (SA 501,502)
;
;       9       00100  0       N/A
;              000000  1       BYPASS DATA CHECK
;
;       10(A)   00040  0       N/A
;              000000  1       DO VERIFY After WRITE (SA 502 ONLY and
;                              NOT RANDOM DATA)
;
;       11(B)   00020  0       N/A
;              000000  1       ENABLE BAD SECTOR PRINTOUTS

;       12(C)   00010  0       N/A
;              000000  1       HALT on DRIVE ERROR prior to
;                              Recovery RECALIBRATE Operation
;
;       13(D)   00004  0       NO TRACE
;              000000  1       TRACE PRINTOUT on ERROR
;
;       16(G)   00000  0       Do NOT PRINT on the DMA LINE PRINTER
;              100000  1       PRINT on the DMA LINE PRINTER(DC17)
;


;
;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-Z. The
;       Program will Continue Running after Updating the Options.
;       Each Key will Complement the state of the Bit affiliat-
;       ed 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 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.
;
;         M        This Command given at any time will print the
;                  Current Operating Modes.
;
;         O        This Command given at any time will lock the
;                  Program into Switch Modification Mode where
;                  more than 1 Bit can be changed.
;
;9.0      OPERATING PROCEEDURE/OPERATOR INPUT:

;         A. Verify drive (s) are ready on-line
;         B. Load Program
;         C. To RUN other than TEST 505, Enter CONTROL "O"
;            at 9.2, Enter STARTING ADDRESS followed by an "R"

;         STARTING ADDRESS
;         200      Read Unit Characteristics and then RUN ALL TEST (505)
;         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      MULTIPLE DEVICE CODE ENTRY

;9.1      Operator is requested to enter DEVICE CODE of CONTROLLER
;         (DEFAULT 27).
;9.2      STARTING ADDRESS is Displayed and Operator is requested to
;         SET SWPAK followed by a Carriage Return (SEE 8.3).
;9.3      Operator is requested to enter YES/NO to Exercise Maps, if
;         present and supported.
;9.4      MONTH, DAY, YEAR (I.E. 77...), HOUR, & MINUTE (If [CR] is
;         given this routine is bypassed).
;9.5      Operator is requested to enter YES/NO if any DUAL VOLUME
;         DRIVES (CMD'S).
;9.6      Operator is requested to enter YES/NO to CONTROLLER CORRECTION,
;         if it is enabled.
;9.7      Unit Numbers, Types, and their Characteristics are then
;         Displayed, (The Operator should Verify these values) Operator
;         is then requested to enter UNIT NUMBERS to be tested (0-3).
;9.8      Operator is then requested to enter TYPE of disk ( to create a
;         User Defined enter 10)
;         A.       If TYPE entered is 10, enter 0, 1, 2, or 3 to
;                  RE-DEFINE a disk TYPE
;         B.       # of HEADS for NEW TYPE (in DECIMAL)
;         C.       # of CYLINDERS for NEW TYPE (in DECIMAL)
;         D.       # of SECTORS for NEW TYPE (in DECIMAL, CANNOT be
;                  DOWNSIZED)
;         E.       RETURN to 9.7

;         ## A [CR] only response to Unit Numbers, will leave Unit
;         information in previous state.

;         ## A [CR] only response to YES/NO will DEFAULT to NO.
;

;         OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:

;         L        = FIRST 100. BAD SECTORS, DATA, or ADDRESSES
```

```
;       W        = SECTORS W/R, ERROR COUNTS, and on BOARD ECC and
;                  OFFSET CORRECTS
;       **NOTE** Any Character typed will end Printouts at the next
;       change of Data Type.


;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 SWPAK Settings.

;       Upon loss of Ready and a Single Drive, the Program will
;       print the appropriate Error Message and will not proceed
;       until Ready is returned. If Multiple Drives exist, The
;       Program will continue with the remaining Drives. If the
;       down Drive is placed back On-line, the Program will resume
;       Testing of that Drive. The above also applies to the loss
;       of Write enable if the Program is in a Write Mode.

;       RECALIBRATE - Any unusual Status is reported immediately
;       and an Error Return executed.

;10.1   SEEK - Positioner Fault Status increments Seek Error
;       Counter.  Any Error Status  results in Status Printout and
;       Error Return. A Recalibrate will be performed by the Error
;       Handler. Program will Log the first 20. Cylinders TO/FROM
;       on finding Seek Errors.

;10.2   WRITE - Following "DONE" on a Write, Errors are checked in
;       the sequence shown below. Error recovery proceedure is
;       outlined for each case. If the Error is not present the
;       next Check is made.

;       Drive Status (DIB) is Checked 1st for both Read and Write
;       before any DIA Checks are made.
;
;       1. READ/WRITE TIMEOUTS, DATA LATE, ILLEGAL SECTOR, PARITY,
;       DATA VERIFY, or any DRIVE FAULTS- Increment the appropriate
;       Error Count, Print the Illegal Status and do an Error Return.
;       Any Drive Fault will cause a Recalibrate to be performed by
;       the Error Handler.

;       2. 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 Address Error
;       count 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 20. Address Errors will have their Addresses Logged.
;
;       3. BAD SECTOR- Log the Disk Address (1st 100.) and do a Normal
;       Return. No Printout will result unless SW11=1, although the
;       I/O Operation was prematurely terminated. A "SOFT" Error will
;       be Recorded if the Sector under Test Passes at Least 1 of 4
;       Retrys. The Log denotes SOFT Errors by a count greater than 0,
;       representing the Error Count tallied. ***SEE 10.3A.

;       4. ENDING MEMORY ADDRESS - Increment the Memory Address Error
;       Count, Print the Error Message, Check for a Disk Address Error
```

```
;       5. ENDING DISK ADDRESS - Increment the Disk Address Error
;       Count, Print the Error Message, and do an Error Return.

;10.3   READ - All Read Errors with the exception of Data related
;       Errors are handled the same as described for the Write
;       Operations.

;       DATA ERRORS - Data is REREAD 3 X (4X if ECC UNDETECTED) If
;       Program is in Write/Read Mode and Data ia Bad all 4 tries,
;       A Hard Error Count is incremented and an Error Return is
;       taken. If Data is Good on any of Four tries, a Soft Error
;       Count is incremented and a Normal Return is taken.

;       If the Program is in a Read ONLY Mode (IE. Read Mode for any
;       502 Program or when 505 is running a 502 Program), the Data
;       will be REREAD an additional 4 times in both Offset Forward
;       and Offset Reverse Modes before the Problem is classed as a
;       Hard Error.

;       Thus Total retries for a Hard ECC Detected Error in a Read
;       ONLY Mode is 12 (13 for ECC UNDETECTED), and 4 if in a
;       Write/Read Mode (5 if ECC UNDETECTED). ***SEE 10.3A

;       Any Successful REREADS while in an Offset Mode will be
;       Printed and Logged. The Disk 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 SWPAK9=1 (Bypass Data Check) Hard or Soft Data  Errors
;       will be determined by ECC Status.

;10.3A  ECC (ERROR CORRECTION CODE) ANALYSIS

;       All Read Passes including retries will have the ECC results
;       Logged as per the following 4 Categories:

;       1. ECC CORRECTED -The ECC detected and successfully
;       corrected the DATA ERROR.

;       2. NON-CORRECTABLE ECC -The ECC detected and CORRECTLY
;       diagnosed the Error Pattern as UNCORRECTABLE.

;       3. ECC UNDETECTED -The ECC Failed to detect a Data Error.
;       This may be a Malfunction of the ECC Logic, but it is
;       more likely one of the following problems:

;       A Failure of the Drive to Write a Sector.
;       *NOTE- A Check should be made in the Bad Sector Log to see
;       whether a Write Operation may have encountered a Soft or
;       Faulty Bad Sector indication, which would have terminated
;       the Write.

;       A Failure in the Controller Data paths.

;       4. ECC FAILED -Two Conditions may fall into this Category.

;       4A. An ECC Error was detected but with no Accompanying
;       Data Error. A Check is made to see whether the ECC Words
;       point to an Error within the two Appended Write ECC Words.
;       If such an Error is determined to be the case, the Error
;       will be Logged as Correctable and no ECC Failed message
;       will result. This type of Error should represent only a
```

Sample). If a Significantly Higher Percentage of this
Error results, Then an ECC Problem would be Indicated.

If the ECC does not point to the two Appended Write ECC
Words, then an ECC Failed message (1st Pass only) will
result and the Actual ECC Words Read from the Controller
will be printed.

4B. An ECC Error was detected, but the ECC either Failed
to Correct a Correctable Error, or tried to Correct an
Uncorrectable Error. These Conditions (Possibly caused
by Problems other than ECC) will result in a printout
(1st Pass only) of the Simulated Write and Simulated
Read ECC Words plus the Actual Read ECC Words as Read
from the Controller.

The Simulated Write ECC Words are the result of a
Program Simulation of the ECC Logic on what the Program
believes to be the Write Data (A Write Error will cause
this Assumption to be False), and represents what the
Program believes should have been written as the Actual
two Write ECC Words on the Disk.

The Simulated Read ECC Words are the result of another
Program Simulation of the ECC Logic on the Read Data
in Memory, and represent what the Program believes
should be Read from the Controller as the two ECC
Words. The Actual Read ECC Words are those two Words
as Read from the Disk Controller.

;10.4 ERRORS- Error Status is printed whenever encountered
; as follows:

```
;       'MODE'  UNIT:    'N'
;       CYL-  'N'        HEAD  'N'        SECT  'N'    #SECT  'N'
;       DIA/DIB 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 Multiple Sector Transfer.

; When Data Errors are found, only THREE are printed per
; encounter plus the Total Number of Errors.(See PARA 5)
; If the Data Error is ECC UNDETECTED and the System is
; Mapped, the Map, Physical 1K Address, and the DCH
; Logical Addresses are also printed.

; When Looping is Involved (Retried or for Scoping)
; Status is printed on the 1st Pass only.

;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. Also Listed is a Count for Controller
; Corrects/Unit (on Board ECC Correction and Offset Corrects)

; 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 the
; first Count.

```
;       The Address Information will be in OCTAL while the Counts
;       will be DECIMAL.

;       Type S for Seek Timing Statistics if running either Seek
;       Exerciser.
```

```
;11.0   DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;        This Reliability is equipped with a built in ODT which can be
;        accessed by hitting CONTROL O at any time during the execution
;        of the Program (after Setting the Parameters). On entering ODT
;        the Address of the Location having the next instruction to be
;        executed will be typed-out.
;
;        The following Conventions are used by the ODT:
;        ?       Pressing any illegal key causes the ODT to respond
;                with a "?".
;        @       ODT is ready and at your service.
;
;        An ODT Command has the following Format:
;                [ARGUMENT][COMMAND]
;        An Argument may be one of the following:
;        "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;                separated by Plus (+) or Minus (-) signs. Leading
;                Zeros need not be typed.
;        "ADR"   An Address is the same as an Expression except
;                that Bit 0 is neglected.
;        A Command is a single teletype character
;
;        The Locations that can be EXAMINED and MODIFIED by the user
;        are called CELLS. These CELLS are of two Types: Internal CPU
;        Cells and Memory Locations. The Command to OPEN one of the
;        Internal Registers is of the form "nA" where n is any OCTAL
;        Expression between 0 and 7.
;
;        0-3     For ACCUMULATORS 0-3
;        4       For PC of the next Instruction to be Executed in the
;                event of a "P" Command.
;        5       CPU and TTO Status
;                BIT     INTERPRETATION
;                15      Status of TTO DONE FLAG
;                14      Status of INTERRUPTS (ION FLAG)
;                13      Status of CARRY BIT
;        6       Address of the Location having the BREAK POINT (If any)
;        7       Instruction at the BREAK POINT Location
;
;        Other Commands to OPEN Cells are:
;
;        "ADR"/  Open the Cell and Print its contents
;        ./      Open the Cell currently pointed to by the Pointer and
;                Print its contents.
;        .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;                contents.
;        .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;                Print its contents.
;        "CR"    The Return Key is used to Close the Open Cell with or
;                without Modification.
;        "LF"    Line Feed is used to Close the Open Cell with or without
;                Modification and to Open the succeeding Cell.
;        CTRL    Close the Open Cell with or without Modification and
;                Open the preceeding Cell.
;        /       Close the Open Cell without Modification, and Open the
;                Cell pointed to by its contents.
;        +"ADR"/ Close the Open Cell without Modification, and Open the
;                Cell pointed to by its contents + "ADDR".
;        -"ADR"/ Close the Open Cell without Modification, and Open the
;                Cell pointed to by its contents - "ADR".
```

```
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
;       NOTE:   In Programs which RELOCATE THEMSELVES the
;               user should place Break Points ONLY in the
;               ORIGINAL PROGRAM AREA. If a Break Point is
;               placed outside this area the results will
;               be unpredictable.
;
```

```
;MAPPED ODT COMMANDS
;
;        In addition to the previously listed ODT Commands, there
;        is available a Command Set that allow Map Translations for
;        Debugging purposes.
;
;        Map Command Format

;        The Letter "M" is used to specify a Map Command and is
;        used in conjuction with the Set of Characters that form
;        the Map Command Group. A Map Command is thus formed by
;        using the Letter "M" and following it with the desired
;        Command Letter (Such as "MT", "MA", ETC.)
;
;        Map Command Errors
;
;        If a Map Command is entered and the Error Message "No Map"
;        appears, then either:
;        A) A Map was not found
;        B) The Program does not support Mapped ODT.

;        Map Commands
;
;        Note: All Map Commands must be preceeded by an "M" to
;        indicate that they are Map Commands.

;        "A"     Enable User "A" Map Translations
;        "B"     Enable User "B" Map Translations
;        "M"     Enable Map Translations with the last "User"
;        "U"     Disable Mapping
;        "L"     Map Supervisor Last Block
;        "E"     Print Single Map Entry
;        "T"     Print Map Entry Table
```

```
;12.0    SPECIAL NOTES/SPECIAL FEATURES:
;
;       1. A CR only response to Unit Numbers, ETC will leave
;       information in Previous State.
;
;       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. 2* 10**9 Words.
;
;       4. SWPAK7=1, Program halts after write with Read Verification
;       allowing operator to change packs. SWPAK8=1, Puts Program into
;       Read only mode ## SA'S 501,502 Only. If SA 501-Data must !NOT!
;       be Variable. Start at the above selected Address.

;       5. 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.
;
;       6. At times the ECC may attempt to Correct a Non-Correctable
;       Data Error and the Simulated ECC and Actual ECC will Match
;       even though an ECC Failure will have been Printed. This is
;       Due to a Failure of the ECC Polynomial itself to Distinguish
;       between two different Error Patterns. One Correctable and one
;       Uncorrectable. This is !NOT! a Hardware Failure.

;13.0    PROGRAM RUNTIME:
;
;       Program Runtimes are substantially reduced with Memories of
;       16K or Larger. Program can use up to 24K using 2 Buffers
;       and up to 32K using 4 Buffers in the Random Reliability
;       Tests.

;       Runtime is defined as Time from Start to a "PASS" Message.
;       Typical runtime for a Read only or Write only Pass of SA
;       502 (Incremental Disk Address Test) is Approx. 3 and 1/2
;       Minutes with a Nova 800 (or Faster CPU) with at least 24K
;       of Memory, and 96 Megabyte.
;
;
```

```
****************************************************************
----------------------------------------------------------------

 DESCRIPTION: ZETACO DISK CONTROLLER FORMATTER PROGRAM


 Product of ZETACO, 1986
****************************************************************
--------.TITL   DISKF-------------------------------------------
        .DUSR   X=1
        .NOMAC  X
1.0     PROGRAM NAME:   DISKF.SR

;2.0    REVISION HISTORY:
;
;       REV.       DATE
;        00     02/09/83        ;
;
;        01     08/23/83        ;ADUB FOR ALT1 (STTD), AOS BSTRAP
;                               ;(400'S)
;        02     03/28/84        ;DISK PULSE COUNTER, ERROR LOGS,
;                               ;200. ERRORS, MSB FOR BAD SECTOR
;                               ;LOG, DEVICE CODE CHANGE ROUTINE
;        03     05/30/84        ;ECC ON WRITE, ZDF1
;
;        04     08/21/85        ;DISABLE VIRTUAL, UP TO 2048. CYLS
;
;        05     11/20/86        ;297, 40 HDS, DMA PTR, WELLEX,
;                               ;IORST

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR
;       16K READ/WRITE MEMORY
;       ZETACO DISK CONTROLLER (ZEBRA TYPE)
;       0-3 DISK DRIVES
;       TELETYPE or CRT and CONTROL

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       The ZETACO DISK CONTROLLER FORMATTER PROGRAM
;       is designed to FORMAT and CHECK DISK PACKS and
;       MEDIA to be used in DISK SYSTEMS. The PROGRAM is
;       !NOT! A MAINTENANCE PROGRAM and ASSUMES the HARDWARE
;       to be in WORKING ORDER. The PROGRAM will HALT on
;       any NON-DATA related ERRORS. It is also recommended
;       that ON-BOARD ECC be SOFTWARE or CONFIGURED DISABLED
;       when FORMATTING. The Device Code may be 20-76 OCTAL
;       with the Default being 27.

;6.0    RESTRICTIONS:
;       This Program has no Restrictions as to Single or
;       Dual Processor Hardware Configuration. However, the
;       Formatter may be run on ONLY ONE CPU at a time and
;       must be the only Program being run within the Disk
;       System.
```

```
;7.0    PROGRAM DESCRIPTION/THEORY OF OPERATION:

;       A. FORMATTER PROGRAM (STARTING ADDRESS <SA> 500)
;       The disk is first formatted after which a "FORMAT DONE"
;       message is printed. Then a 055555 pattern is written to
;       the entire pack and read back 2 times, A random seek
;       test is performed, and "PASS" is printed. The data pattern
;       is then rotated 1 bit and the WRITE/READ/READ/SEEK process
;       is repeated. At the completion of the number of passes
;       entered by the operator, A log is available to be printed
;       and the drives are released.
;*******************************************************
;       It is Recommended that at LEAST 3 PASSES (W/R/R/S);with
;       On-Board ECC DISABLED, be allowed to insure Pack Quality.
;       If time permits, longer runs will further insure
;       Reliability.
;**********************************************************
;       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 the BAD
;       SECTOR FLAG to be set. Any other error will cause the
;       program to print the failure and halt.

;       A HARD ADDRESS ERROR is defined as such after 2 ATTEMPTS
;       have been made BOTH resulting in an ADDRESS ERROR. A HARD
;       DATA ERROR is defined as such after 2 or MORE of 10
;       WRITE/READ RETRY'S have been unsuccessful.

;       B. CHECK PROGRAM ONLY (SA 501)
;       Same as SA 500 except that initial pack format operation is
;       bypassed.

;       C. STATISTICS
;       Type L for 1ST 200. disk addresses of BAD SECTORS, DATA and
;       ADDRESS ERRORS, plus a statistic table of overall errors.
;       **NOTE** Any character typed while executing this log will
;       end it at the next change of data type.

;       D. LOG RECOVERY (SA 502)
;       Use to recover log of program after it has stopped to get a
;       LOG PRINTOUT.

;       E. COMMAND STRING INTERPRETER (SA 503)
;       As a trouble shooting aid the service engineer may type in
;       their 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 return
;                       to use the previous entry

;       II.     DATA:   RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=110110 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
```

```
;                       The words entered are used repeatedly
;                       to make up a sector block. Type carriage
;                       return 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.      TRESPASS
;               8.      RELEASE
;               9.      OFF (OFFSET FORWARD)
;               10.     OFR (OFFSET REVERSE)
;               11.     LR  (begin LOOP here)
;               12.     VERIFY (WRITE)
;               13.     FORMAT CYL,HD,SECTOR
;               14.     BAD (BAD SECTOR) CYL,HD,SECTOR
;               15.     MEMORY ADDR,DATA(WRITE) (CONTROLLER MEMORY COMMAND)
;               16.     Type Carriage Return to use the
;                       previous COMMAND STRING.

;               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. 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 5, 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 5,2,2 READ SAME LOOP

;       The following example would WRITE 0 to
;       CONTROLLER MEMORY location 1500 (OCTAL)

;       UNIT:   1
;       DATA:   N/A
;       COMMAND STRING: MEMORY 101500,0
;       NOTE: Upper memory bit = 1 defines a WRITE
```

```
;8.0   OPERATING MODES/SWITCH SETTINGS:

;8.1     SWITCH SETTINGS
;
;        Location "SWREG" is used to select the program options.
;        This Location will be set according to the answers
;        supplied by the Operator. 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         40000    0       LOOP on ERROR
;                 000000    1       SKIP LOOPING on ERROR
;
;        2         20000    0       PRINT to CONSOLE
;                 000000    1       ABORT PRINT OUT to CONSOLE
;
;        5         02000    0       DO NOT PRINT on the LINE PRINTER
;                 000000    1       PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;        11(B)     00020    0       N/A
;                 000000    1       ENABLE BAD SECTOR PRINTOUT
;
;        16(G)     00000    0       DO NOT PRINT on DMA LINE PRINTER
;                 100000    1       PRINT on DMA LINE PRINTER(DC17)
;
;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-Z. The
;        Program will Continue Running after Updating the Options.
;        Each Key will Complement the state of the Bit affiliat-
;        ed 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 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.
;
;        M        This Command given at any time will print the
;                 Current Operating Modes.
;
;        O        This Command given at any time will lock the
;                 Program into Switch Modification Mode where
;                 more than 1 Bit can be changed.
;
```

```
;9.0     OPERATING PROCEEDURE/OPERATOR INPUT:

;        A. Verify drive (s) are ready on-line
;        B. Load Program
;        C. To RUN other than TEST 500, Enter CONTROL "O"
;           at 9.2, Enter STARTING ADDRESS followed by an "R"

;        STARTING ADDRESS (SA)
;        200     Read Unit Characteristics and then Run FORMATTER (500)
;        500     FORMATTER/CHECK PROGRAM
;        501     CHECK PROGRAM ONLY
;        502     ERROR LOG RECOVERY
;        503     COMMAND STRING INTERPRETER

;9.1     Operator is requested to enter DEVICE CODE of CONTROLLER
;        (DEFAULT 27)
;9.2     Operator is requested to SET SWPAK followed by a Carriage
;        Return (SEE 8.3)
;9.3     MONTH, DAY, YEAR (I.E. 77...), HOUR, & MIN (If [CR] is
;        given this routine is bypassed)
;9.4     Enter # of Passes for Test Completion (If [CR] is given
;        this routine is bypassed)
;9.5     Operator is requested to enter YES/NO to CONTROLLER CORRECTION,
;        if it is enabled
;9.6     Unit Numbers, Types, and their Characteristics are then
;        Displayed, (The Operator should Verify these values) Operator
;        is then requested to enter UNIT NUMBERS to be tested(0-3)
;9.7     Operator is then requested to enter TYPE of disk ( to create a
;        User Defined enter 10)
;        A.      If TYPE entered is 10, enter 0, 1, 2, or 3 to
;                RE-DEFINE a disk TYPE
;        B.      # of HEADS for NEW TYPE (in DECIMAL)
;        C.      # of CYLINDERS for NEW TYPE (in DECIMAL)
;        D.      # of SECTORS for NEW TYPE (in DECIMAL, CANNOT be
;                DOWNSIZED)
;        E.      Return to 9.7

;        OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:
;
;        L       = First 200. 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 paragraph 10.3)

;       2. If Errors are encountered more than once, a count
;       will be recorded and a BAD SECTOR FLAG SET. All address
;       information 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 immediately
;       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.

;       DRIVE STATUS (DIB) is checked 1st for both Read and Write
;       before any DIA checks are made.

;       4. READ/WRITE TIMEOUTS, DATA LATE, ILLEGAL SECTOR,
;       ECC(DATA OK), or any DRIVE FAULT- 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
;       Addresses 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 related
;       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 tries, 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 200. Data Errors (HARD or SOFT) are Logged.
```

```
;11.0   DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;       This Formatter is equipped with a built in ODT which can be
;       accessed by hitting CONTROL O at any time during the execution
;       of the Program (after Setting the Parameters). On entering ODT
;       the Address of the Location having the next instruction to be
;       executed will be typed-out.
;
;       The following Conventions are used by the ODT:
;       ?       Pressing any illegal key causes the ODT to respond
;               with a "?".
;       @       ODT is ready and at your service.
;
;       An ODT Command has the following Format:
;               [ARGUMENT][COMMAND]
;       An Argument may be one of the following:
;       "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;               separated by Plus (+) or Minus (-) signs. Leading
;               Zeros need not be typed.
;       "ADR"   An Address is the same as an Expression except
;               that Bit 0 is neglected.
;       A Command is a single teletype character
;
;       The Locations that can be EXAMINED and MODIFIED by the user
;       are called CELLS. These CELLS are of two Types: Internal CPU
;       Cells and Memory Locations. The Command to OPEN one of the
;       Internal Registers is of the form "nA" where n is any OCTAL
;       Expression between 0 and 7.
;
;       0-3     For ACCUMULATORS 0-3
;       4       For PC of the next Instruction to be Executed in the
;               event of a "P" Command.
;       5       CPU and TTO Status
;               BIT     INTERPRETATION
;               15      Status of TTO DONE FLAG
;               14      Status of INTERRUPTS (ION FLAG)
;               13      Status of CARRY BIT
;       6       Address of the Location having the BREAK POINT (If any)
;       7       Instruction at the BREAK POINT Location
;
;       Other Commands to OPEN Cells are:
;
;       "ADR"/  Open the Cell and Print its contents
;       ./      Open the Cell currently pointed to by the Pointer and
;               Print its contents.
;       .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;               contents.
;       .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;               Print its contents.
;       "CR"    The Return Key is used to Close the Open Cell with or
;               without Modification.
;       "LF"    Line Feed is used to Close the Open Cell with or without
;               Modification and to Open the succeeding Cell.
;       CTRL    Close the Open Cell with or without Modification and
;               Open the preceeding Cell.
;       /       Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents.
;       +"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents + "ADDR".
;       -"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents - "ADR".
```

```
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
;       NOTE:   In Programs which RELOCATE THEMSELVES the
;               user should place Break Points ONLY in the
;               ORIGINAL PROGRAM AREA. If a Break Point is
;               placed outside this area the results will
;               be unpredictable.
;
;
;12.0   SPECIAL NOTES/SPECIAL FEATURES:

;       1. The Program is !NOT! a Maintenance Program and assumes
;       the HARDWARE to be in working order. The Program will
;       HALT on any NON-DATA related Errors.

;       2. It is recommended that at Least 3 Passes (W/R/R/S) be
;       allowed (see below) 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 24K or larger. Runtimes are also dependant on CPU
;       Type, Drive Size and Drive Type.

        .EOT
```