PRELIMINARY

Model DC-297

Disk Controller

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages

PREFACE

This manual contains information regarding installation, testing, and operation of the ZETACO Model DC-297 Disk Controller.

The technical contents of this manual have been written based on the assumptions that the reader 1) has a working knowledge of Data General computer hardware (or has access to hardware documentation) and the operating system; 2) has some familiarity with standard installation, power, grounding and peripheral cabling procedures; and 3) has access to technical information about the disk drive that will be installed with this controller.

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

SECTION 1.0 PRODUCT OVERVIEW - Describes the Model DC-297 Disk Controller's features, capabilities, specifications, power and interface requirements.

SECTION 2.0 INSTALLATION PROCEDURES - Contains procedures for unpacking and installing the controller, tailoring it for the system requirements, testing disk subsystems and initializing disk media.

SECTION 3.0 TEST PROGRAMS, TROUBLESHOOTING and CUSTOMER SERVICE - Contains information useful in fault analysis and how to get help.

SECTION 4.0 USAGE GUIDELINES - Contains information explaining the use of the DC-297 features in the system environment.

SECTION 5.0 PROGRAMMING NOTES - Contains detailed technical information for those involved in fault analysis or programming.

APPENDICES

1.0 PRODUCT OVERVIEW

1.1 GENERAL DESCRIPTION

The ZETACO DC-297 is a Disk Controller which combines the capability of being FCC Compliant or Non-FCC Compliant on a single standard interface board for use in Data General minicomputers. The controller supports most disk drives which use the industry standard SMD interface.

The DC-297 emulates Data General's 60XX, 61XX and 6214 series Disk Subsystems with no software patches required for RDOS or AOS. It must be installed in an I/O ONLY slot of Data General's Nova or Eclipse series minicomputers when the DC-297 is jumpered for FCC compliance or in any memory, Memory I/O, or I/O ONLY slot when th DC-297 is jumpered for Non-FCC compliance. Disk interface cabling is via the computer backpanel for FCC compliance or via the SMD headers mounted at the board's edge for Non-FCC compliance.

Up to four disk drives of differing sizes and transfer rates may be attached. The Disk Controller has been designed to provide optimum system throughput and reliability, and to achieve the most efficient use of the full capacities of the disk drives.

The Controller's architecture employs a dedicated microprocessor, buffers and bus acquisition control to maintain individual disk performance.

The DC-297 uses EEPROM Memory (nonvolatile, reprogrammable memory) as a replacement of switches for controller configuration. The 1/2 inch tape included with the controller contains a configurator program used to set up the controller with disk information and optional controller features.

The DC-297 Controller is warranted against defects in material and workmanship for two full years from date of factory shipment

1.2 FEATURES - ADVANTAGES

*EEPROM eliminates switches and provides total software configurability

*EEPROM Configurator Program provides total flexibility with a User Friendly format

*Software Support Package containing Configurator, Diagnostics and Utilities included on 1/2 inch tape

*Selftest microdiagnostics with error reporting via LED

*LEDS indicate Busy, Device Status and Selftest

*Internal Cabling attaches to connector panel for use in FCC approved computers

*Shielded external cabling (optional) is in compliance with FCC for RF Emission

*Capable of FCC compliance or Non-FCC compliance via jumper blocks

*Emulation of Data General 6060, 6061, 6067, 6160, 6161, 6122 and 6214 Disk Subsystems

*Simultaneous control of up to four (4) SMD Interfaced Disk Drives

*Incorporates an Elevel Bit SMD Tag Bus to accomodate full capacity of the larger drives

*Mix drives of different capacities, transfer rates, and media formats

*On-board 32 bit error checking with correcting of burst errors up to 11 bits in length

*High speed microprocessor design supports transfer rates up to 2.5 Mb per second

*Two sector ping-pong buffer

*User definable sector interleaving

*Adjustable DCH throttle control

*Supports overlap seeks

*Offset positioning for data error recovery

*Automatic 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

*One second pick delay on power up controls disk drive power sequencing

*Header CRC error auto re-try

*Supports two logical disks on one physical disk drive

*Dual volume drives supported (two physical volumes)

*Supports dual ported drives (dual processor)

*User definable header Sync Byte

*Program Load (BOOT) waits for drive ready

*Fairchild "FAST" logic used to increase performance and reduce power consumption

1.3 SPECIFICATIONS

1.3.1 FUNCTIONAL CONTROLLER CHARACTERISTICS

Drives Per Controller:	Up to 4 single volume or up to 2 dual volume
Media Format:	4 available formats selectable per port with user-defined sync byte (see Figure 2.2 for more detailed information)
Sector Organization:	Continuous or variable interleaved
Error Correction Code:	32-bit polynomial; detects and corrects burst errors up to 11 bits.
Transfer Rate:	Up to 2.5 Mbytes/sec. (20 Mhz bit rate)

Emulation:	Data General 6060, 6061, 6067, 6160, 6161, 6122 and 6214 Disk Subsystems
Indicator LEDS: (See Figure 1.1)	YELLOW: UNIT DE-SELECTED - if this LED is on, it indicates that no disk units are currently selected. Either no DOA has yet been issued, or the controller is not receiving disk status properly. GREEN: DISK CONTROLLER BUSY - if this LED is on, it indicates that the disk controller busy flag is set. RED: SELFTEST - when the LED is on, the controller is executing selftest. If selftest fails, the LED is used to display the error code by blinking on and off.

1.3.2 COMPUTER INTERFACE

The DC-297 uses the standard Data General I/O and data channel interface and supports standard or high speed data transfers.

The controller installs in Data General Nova or Eclipse model minicomputers.

CAUTION: THE DC-297 CONTROLLER MAY ONLY BE INSERTED IN AN I/O ONLY SLOT WHEN JUMPERED FOR FCC COMPLIANCE. COMPONENT DAMAGE MAY OCCUR IF A SLOT OTHER THAN I/O ONLY IS USED WHEN THE CONTROLLER IS JUMPERED FOR FCC COMPLIANCE. ZETACO'S WARRANTY IS VOID IF A NON-I/O ONLY SLOT IS USED UNDER THIS CONDITION.

The Controller's internal cabling (*) has been designed for use only in chassis with rear-mounted backpanel. In addition, because of the number of packpanel pins required for disk interfacing, only "I/O ONLY" slots will accomodate the controller when jumpered for FCC compliance. ("I/O ONLY" slots provide unrestricted use of more backplane pins required by the DC-297; some of these pins are reserved in memory-or-I/O slots.) A slot selection guide for various computers is provided in Section 2.3.1 as an aid in choosing a slot.

* Internal cabling is required only to run the DC-297 Controller as FCC Compliant. For Non-FCC compliance the internal cabling is unnecessary.

1.3.3 DISK DRIVE INTERFACE

FUNCTIONAL:	SMD Standard
ELECTRICAL:	Balanced line differential drivers and receivers.

CABLING:

EXTERNAL

60 conductor, shielded round (FCC compliant) or flat ribbon, twisted pair (Non-FCC compliant). "A" cable daisy-chain connected, computer to first drive, to next drive, etc. (See Table 1.1 for pin assignments.)

26 conductor, shielded round (FCC compliant) or flat ribbon (Non-FCC compliant). "B" cable radially connected, computer to drive(s). (See Table 1.2 for pin assignments.) 6' or 16' length cables are available for the "A" and "B" External Cables.

INTERNAL

(Required to run FCC Compliant only) Internal cabling consists of the "A" and "B" paddleboards with attachable ribbon cabling. Cabling is terminated with "D" connectors for panel mounting.

"A" backpanel cable assembly consists of a 100 pin paddleboard and a 2 ft. 60 conductor ribbon cable.

"B" backpanel cable assembly consists of a 100 pin paddleboard and four 2 ft. 26 conductor ribbon cables.

1.3.4 POWER REQUIREMENTS

+5 VDC @ 6.5 amps typical

-5 VDC @ .5 amps typical

TABLE 1.1 Disk "A" (J1) Cable Pin Assignments

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

PIN #	SIGNAL NAME
48	INDEX+
49	UNIT READY+
50	NOT USED
51	BUSY+
52	UNIT SELECT TAG+
53	UNIT SELECT 0+
54	UNIT SELECT 1+
55	SECTOR+
56	UNIT SELECT 2+ (note 3)
57	UNIT SELECT 3+ (note 3)
58	WRITE PROTECTED+
59	POWER SEQ. HOLD (note 2)
60	BIT 10+

NOTE 1: Unit select 2- and 3- are tied to +5V via 470 ohm resistor

NOTE 2: "Pick" and "Hold" are connected internally on controller

NOTE 3: Unit select 2 and 3 are tied to -5V via 470 ohm resistor

TABLE 1.2 Disk "B" (J2-J5) Cable Pin Assignments

PIN #	SIGNAL NAME
1	GROUND (connected to internal cable shield)
2	SERVO CLOCK-
3	READ DATA-
4	GROUND
5	READ CLOCK-
6	WRITE CLOCK-
7	GROUND
8	WRITE DATA-
9	UNIT SELECTED+
10	SEEK END-
11	GROUND
12	NOT USED
13	NOT USED
14	SERVO CLOCK+
15	GROUND
16	READ DATA+
17	READ CLOCK+
18	GROUND
19	WRITE CLOCK+
20	WRITE DATA+
21	GROUND
22	UNIT SELECTED-

PIN #	SIGNAL NAME
23	SEEK END+
24	NOT USED
25	GROUND
26	NOT USED

1.3.5 PHYSICAL CHARACTERISTICS

DIMENSIONS: 15" X 15" X 0.5"

SHIPPING WEIGHT: 10 pounds; includes shipping carton software tape and documentation. (External cabling not included.)

1.3.6 ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE: 0 to 55 degrees C

RELATIVE HUMIDITY: 10% to 90% (non-condensing)

Exceeds all Nova/Eclipse minicomputer temperature and humidity specifications.

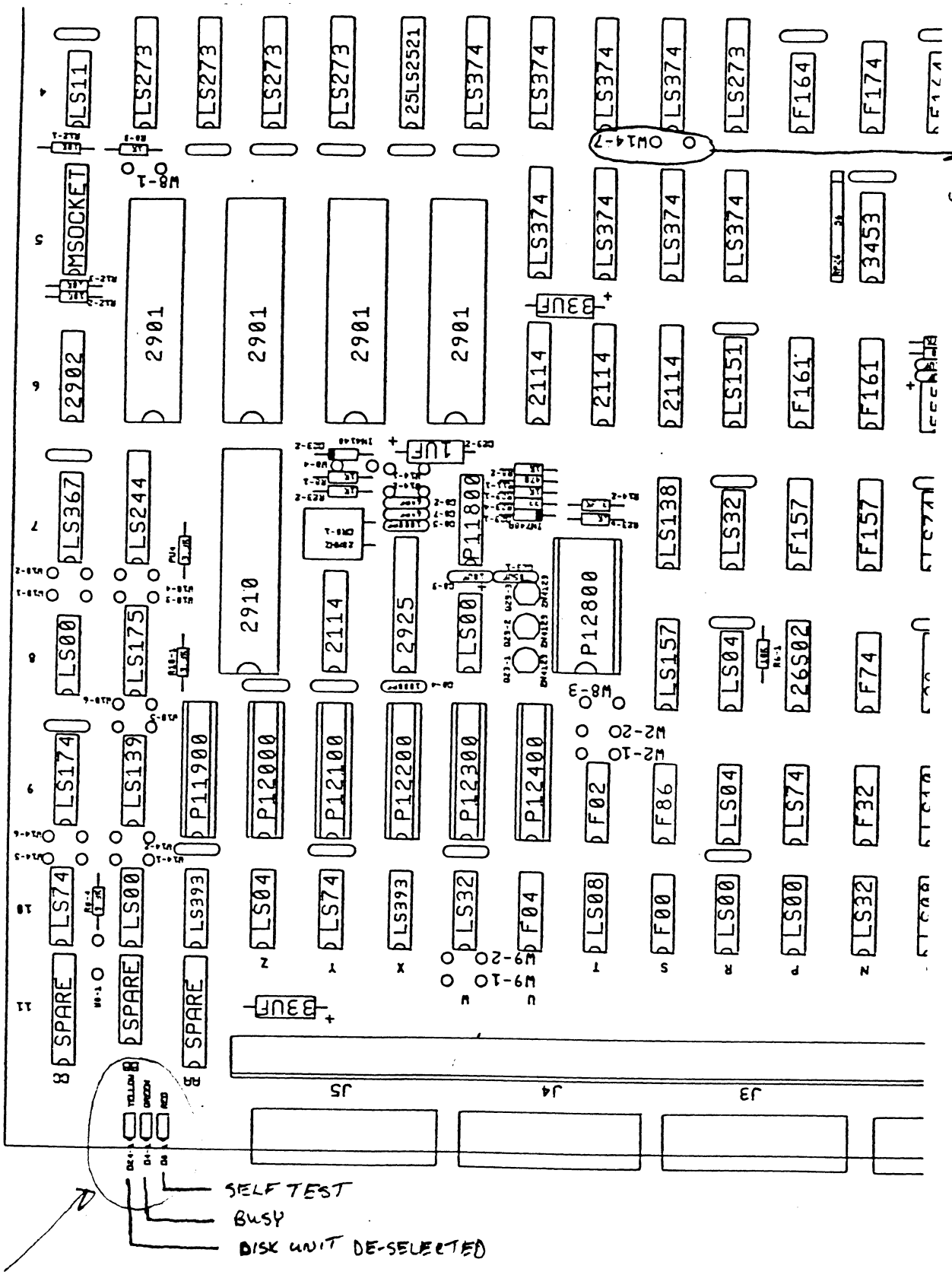
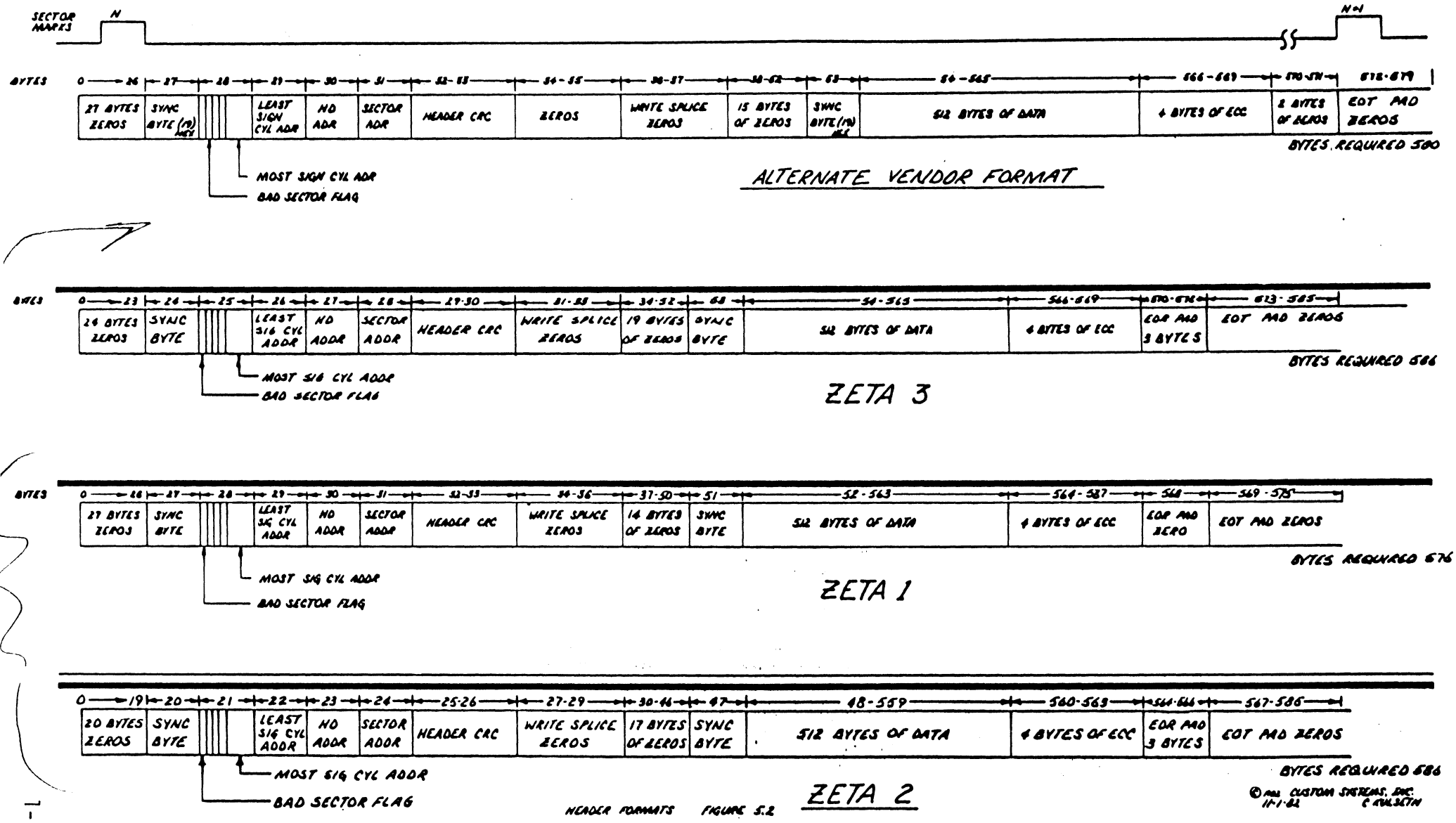


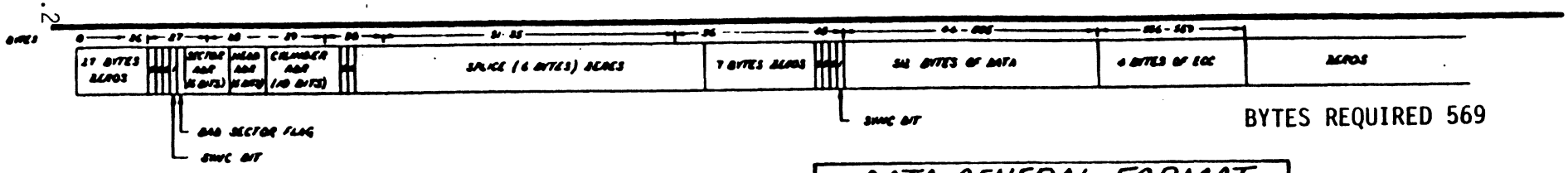
Fig. 1.1 INDICATOR LED's & ~~write~~ E² prom write protect jumper

IBM 3 Format ... Secondary Format



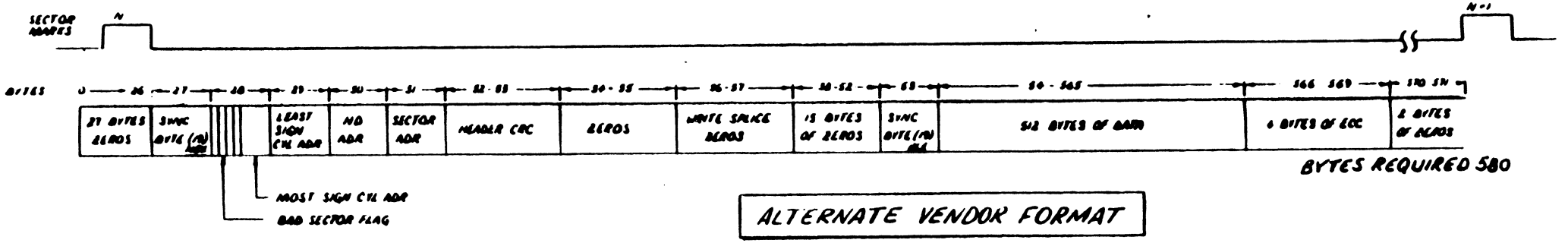
1-10.1

Fig. 1.2 DISK FORMATS



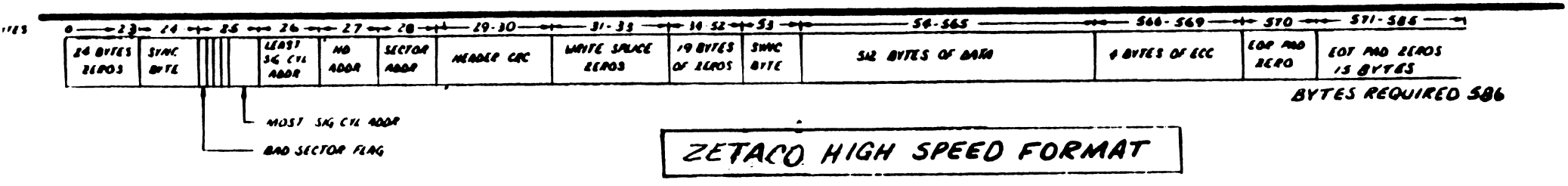
BYTES REQUIRED 569

DATA GENERAL FORMAT



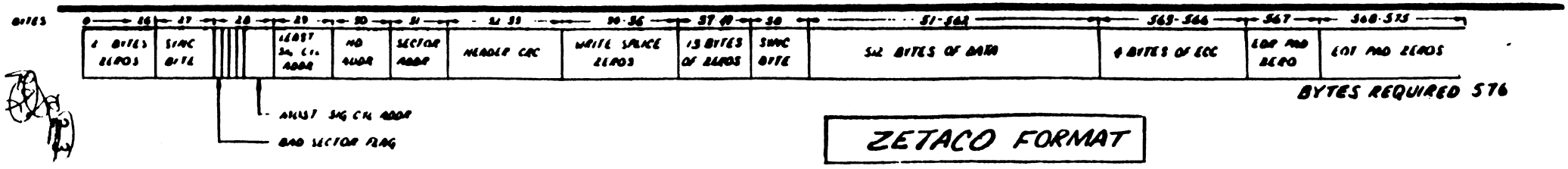
BYTES REQUIRED 580

ALTERNATE VENDOR FORMAT



BYTES REQUIRED 586

ZETACO HIGH SPEED FORMAT



BYTES REQUIRED 576

ZETACO FORMAT

DISK MEDIA FORMATS
FIGURE 2.2 1.0

2.0 INSTALLATION PROCEDURES

This section contains the procedures necessary for proper installation of the DC-297 Disk Controller. Please read carefully.

Sections 2.1 through 2.6 involve preparation and installation of the DC-297 in the computer and then to the disk drive. In addition, some information pertaining to the disk drive is also mentioned. Installation personnel should have access to hardware documentation of the computer and the disk drive. The remaining sections describe the Configurator program, diagnostics, disk media initialization and disk sysgen examples.

The Configurator Program must be used to program the controller with the necessary information for your particular installation. This program is included on the 1/2" magnetic tape shipped with the controller. Unless otherwise specified prior to shipment, the tape is 1600 BPI and is marked so on the label of the tape.

The Configurator Program need only be run at installation or when re-configuring the controller. The information will not be lost when the system is shut down, due to the use of programmable, nonvolatile memory within the controller. This memory serves as a replacement of switches and provides a fast, reliable method of controller preparation.

2.1 UNPACKING AND INSPECTION

The following items are shipped standard with each DC-297:

	ITEM	P/N
a)	DC-297 Controller Board	500405-000
b)	DC-297 Board Cover	TBA
c)	1/2" Magnetic Diagnostic Tape	400405-000
d)	Technical Manual	600405-000

In addition, the following option disk cables and accessories may be ordered with the controller:

I. ITEMS REQUIRED TO RUN THE DC-297 FCC COMPLIANT

a)	"A" Paddleboard		xxxxxx-xxx
b)	"A" Internal Cable; 2 ft. 60 conductor flat ribbon cable		xxxxxx-xxx
c)	"B" Paddleboard		xxxxxx-xxx
d)	"B" Internal Cable; 2 ft. 26 conductor flat ribbon cable		xxxxxx-xxx
e)	Disk "A" Cable (panel to drive)	6'	300013-001
		16'	300013-002
f)	Disk "B" Cable	6'	300011-001
		16'	300011-002
g)	Disk Daisy-Chain "A" Cable	6'	100915-001
		16'	100915-002

II. ITEMS REQUIRED TO RUN THE DC-297 NON-FCC COMPLIANT

Flat Ribbon Cables (Non-FCC Compliant)

a)	Disk "A" Cable	16'	100911-002
b)	Disk "B" Cable	16'	100916-002

Upon receipt of the Model DC-297 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 to obtain return authorization instructions.

2.2 CONTROLLER PREPARATION

All setup required to define the controller's functionality for various subsystem emulations, disk drive models and other features are done via the Configurator Program supplied on the M297 tape. The only selectable hardware options on the controller are described in the following sections.

2.2.1 DEVICE CODE SELECTION

The DC-297 can be set to any device code between 0 and 77 (octal), however, the primary device code is 27 (octal) and the secondary device code is 67 (octal). The primary device code 27 has been factory set and should be left accordingly unless another disk subsystem exists with the same device code.

A DIP Switch on the handle edge of the controller is used to select the device code on this controller. Refer to Figure 2.3. Its individual switches are labeled DS0 through DS5 and correspond to the device select lines on the controller. DS0 is the most significant bit of the six-bit device code representation.

For example, to select device code 27, all switches would be up except the switches labeled S4, S6, S7 and S8. Refer to Table 2.3.

2.2.2 FCC/NON-FCC JUMPER SELECTION

The FCC/Non-FCC jumpers are located near the "A" and "B" connectors, (see Figure 2.4). There are 8 sets of jumpers with 3 rows of 10 pins in each set. These sets of jumpers give the option to run the DC-297 in either of two modes - FCC compliant, or Non-FCC compliant. To set the DC-297 in the FCC compliant mode, the jumper block must be connected across the 2 rows of pins closest to the keyways, (closest to the "A" and "B" backplane connector). All 8 jumper blocks must be moved in this manner, (see Figure 2.4.1).

To set the DC-297 in the Non-FCC Mode, the jumper blocks must be connected across the 2 rows of pins closest to the SMD interface connectors, (furthest from the "A" and "B" backplane connector, see Figure 2.4.2).

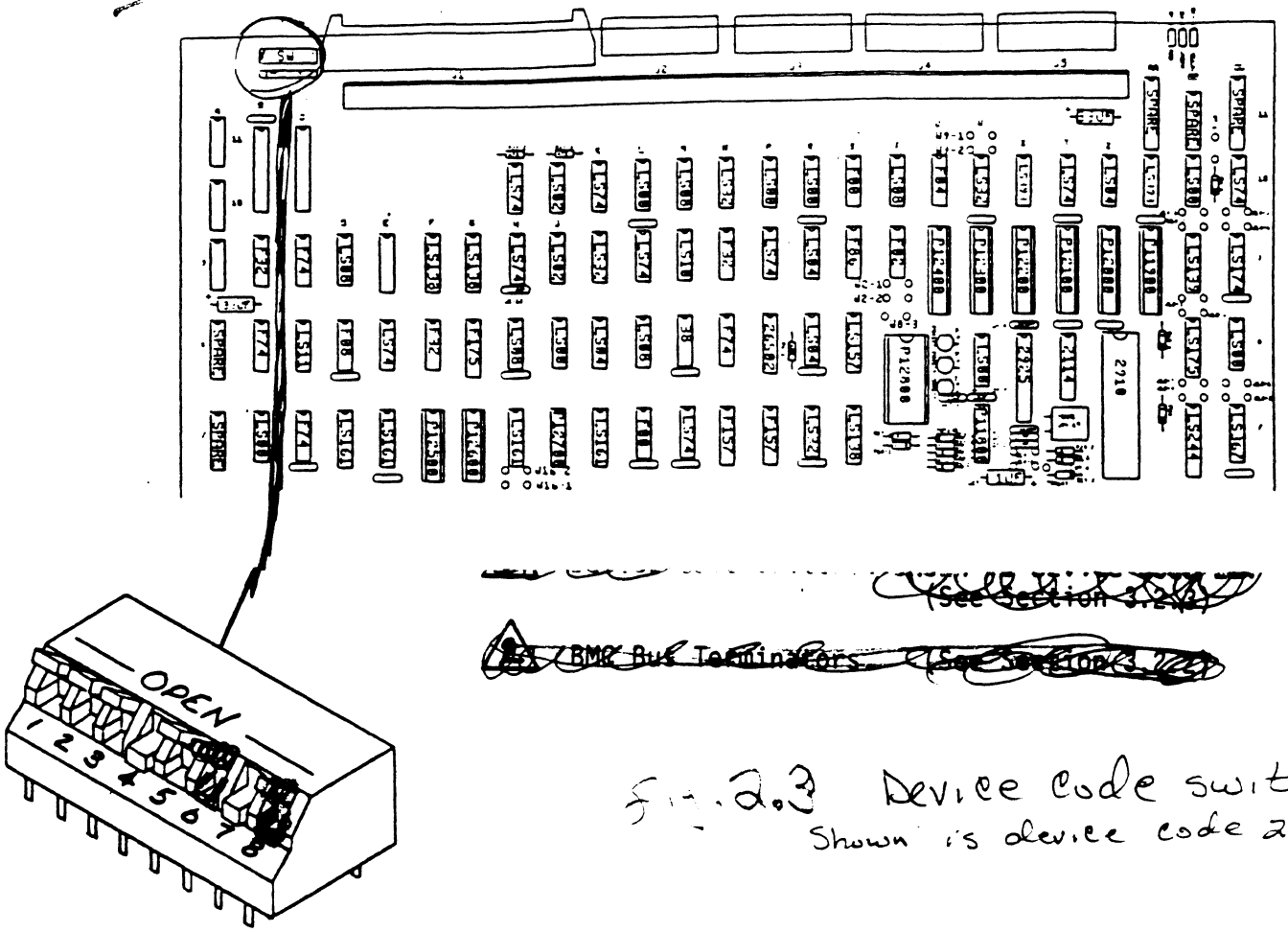


Fig. 2.3 Device code switch. Shown is device code 27

DEVICE CODE	S1 REINIT	S2 RESERVED	S3 DS0	S4 DS1	S5 DS2	S6 DS3	S7 DS4	S8 DS5
0X	UP	UP	UP	UP	UP			
1X	UP	UP	UP	UP	DOWN			
2X	UP	UP	UP	DOWN	UP			
3X	UP	UP	UP	DOWN	UP			
4X	UP	UP	DOWN	UP	UP			
5X	UP	UP	DOWN	UP	DOWN			
6X	UP	UP	DOWN	DOWN	UP			
7X	UP	UP	DOWN	DOWN	DOWN			
X0	UP	UP				UP	UP	UP
X1	UP	UP				UP	UP	DOWN
X2	UP	UP				UP	DOWN	UP
X3	UP	UP				UP	DOWN	DOWN
X4	UP	UP				DOWN	UP	UP
X5	UP	UP				DOWN	UP	DOWN
X6	UP	UP				DOWN	DOWN	UP
X7	UP	UP				DOWN	DOWN	DOWN

TABLE 2.3 BOARD LAYOUT AND DEVICE SWITCH

To determine which mode to run, one question must be answered, "Does the chassis in which the DC-297 will be installed have an I/O ONLY slot?" If the answer is no, then the DC-297 must be set up in the Non-FCC compliant mode and the SMD ribbon cables must be connected to the SMD connectors that are physically soldered to the outer edge of the DC-297 PC Board. Failure to set up the DC-297 in Non-FCC compliance for a non-I/O ONLY slot will cause extensive damage to the DC-297 as well as to the CPU and memory. Explicitly, a slot that is not I/O ONLY has additional pins allocated on the backplane to memory which are also used by the DC-297. Thus, damage will occur due to the conflict between these memory pins and the DC-297. If the answer to the earlier mentioned question is yes, then the DC-297 can be run in the I/O ONLY Slot in the FCC compliant mode.

NOTE: It is not mandatory to run a DC-297 that will be installed in an I/O ONLY Slot in the FCC mode, (i.e. nothing can be damaged by running the DC-297 in the Non-FCC compliant mode when plugged in an I/O ONLY Slot).

2.2.3 EEPROM WRITE DISABLE JUMPER

After configuration of the controller is complete it is possible to hardware disable any further alterations to the configuration EEPROM. To write disable the EEPROM, cut foil jumper WXX-X at location XXX on the controller board, (see Figure 1.1). Jumper XXX-X is factory installed.

2.3 CHASSIS PREPARATION

As mentioned in Section 2.2, the DC-297 Controller is designed to be jumper selectable between FCC compliant and Non-FCC compliant. If FCC compliance is selected install the DC-297 in an I/O ONLY Slot. The controller will not function in a Memory or Memory I/O Slot when jumpered for FCC compliance. When the DC-297 is jumpered for FCC compliance, disk interface signals are routed from the DC-297 through the computer backplane and out to the disk drive. This means that the computer must not use any of the pins that the disk signals are now using. An I/O ONLY Slot must be used to obtain the number of free pins on the backplane required to run the disk interface through the computer backplane. However, if the DC-297 is jumpered for Non-FCC compliance, any Memory, Memory I/O or I/O ONLY Slot can be used, but the disk cables must be connected to the connectors provided on the DC-297 board edge.

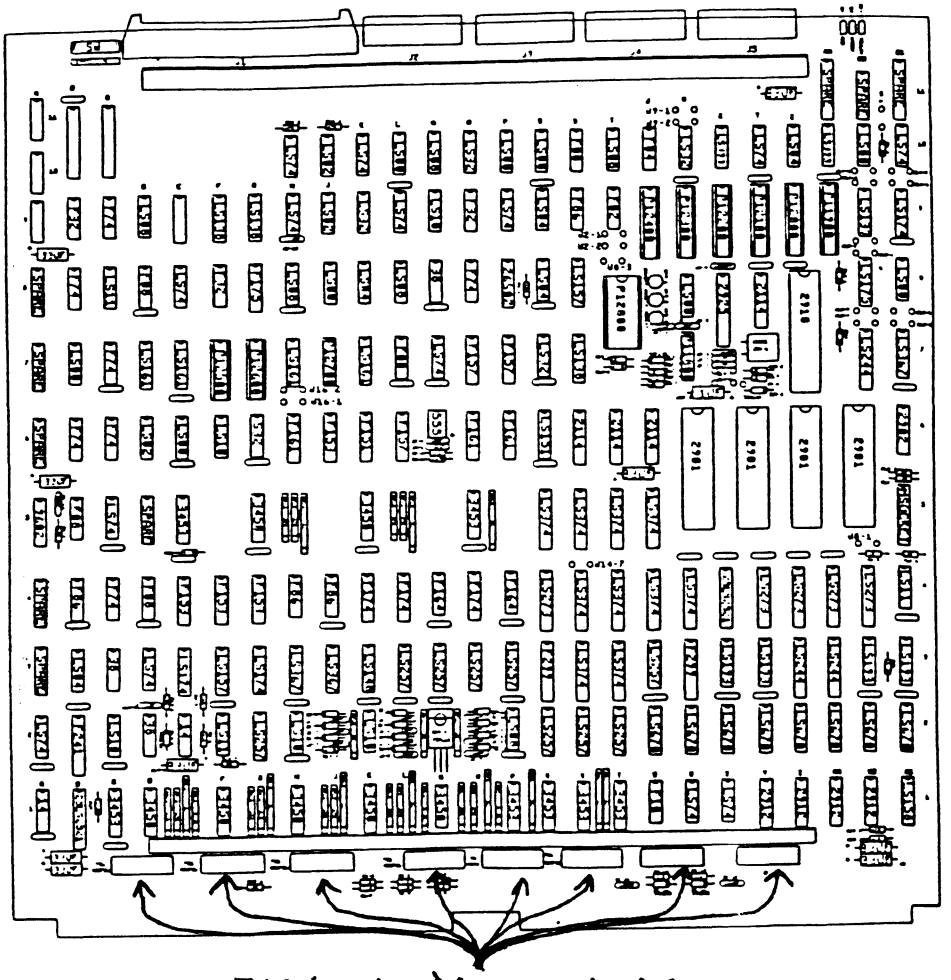


FIG. 2.4 FCC/NON-FCC JUMPER LOCATIONS ON THE DC-297 CONTROLLER.

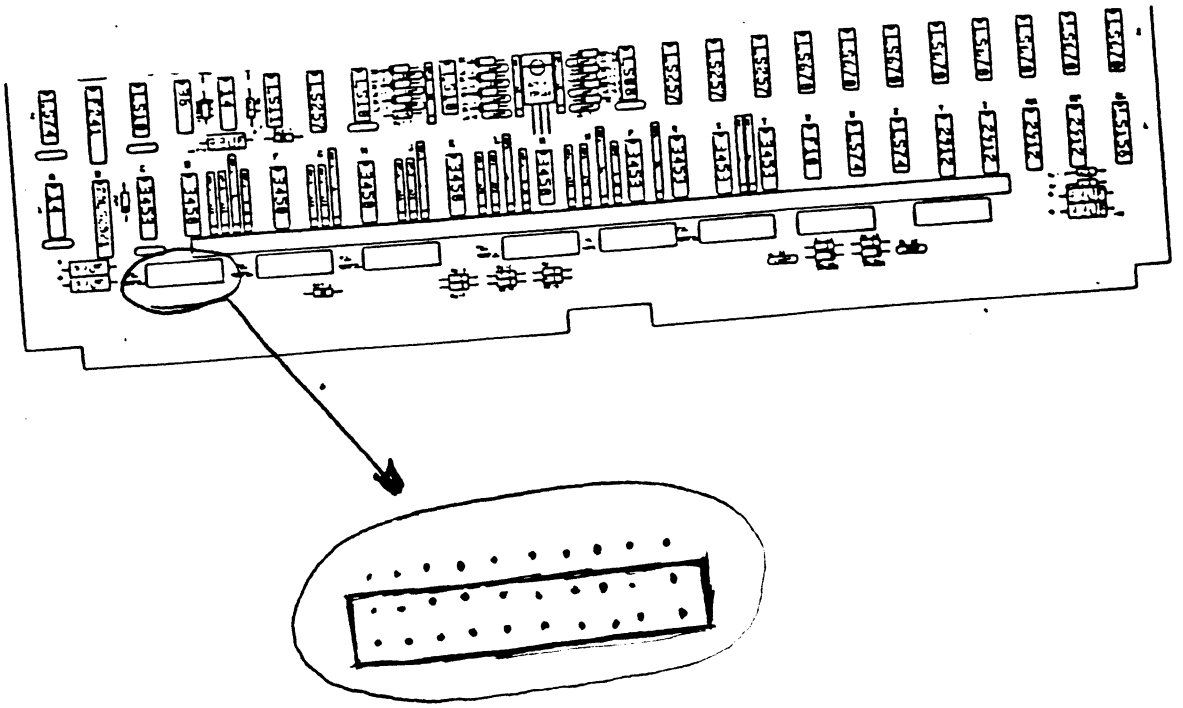


Fig. 2.4.1 The FCC/non-FCC compliance jumpers set for FCC compliant operation.

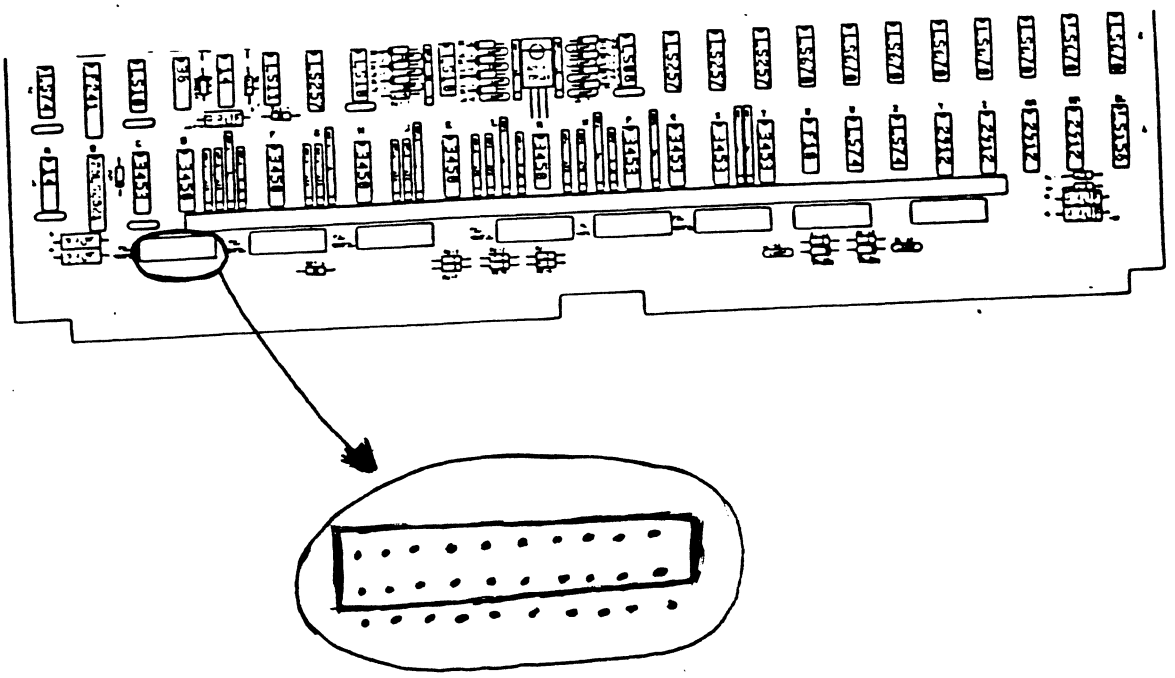


Fig. 2.4.2 The FCC/ NON-FCC compliance jumpers Set for non-FCC compliant operation.

2.3.1 SLOT SELECTION

Below is a list of most of the Data General minicomputers that the DC-297 may be used in when jumpered for FCC compliance. To the right are the slot numbers of the I/O ONLY Slots within each chassis. Do not attempt to install the controller in any other chassis unless you are certain that the chassis contains I/O ONLY Slots and which slots they are. Again, this is applicable only when the DC-297 is jumpered for FCC compliance. For Non-FCC compliance this is of no concern.

MODEL	I/O ONLY SLOTS
NOVA 4 (5 slot)	3-5
NOVA 4 (16 slot)	12-16
ECLIPSE S120 (5 slot)	3-5
ECLIPSE S120 (16 slot)	12-16
ECLIPSE S140	12-16
ECLIPSE S280	11-19
ECLIPSE S250	2-16 (optional, add-on slots)
ECLIPSE C350	2-16 (optional, add-on slots)

The controller is a high speed data channel device. If it must occupy an I/O ONLY Slot, (jumpered for FCC compliance), ensure it is close enough in the priority chain to the CPU to receive sufficient priority. The controller must also allow sufficient priority for other high speed controllers further from the CPU. Current loading rules must also be observed for groups of slots within the chassis. Refer to your computer's Configuration Rules Reference for more information.

2.3.2 PRIORITY JUMPERS

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 to obtain priority continuity between controllers. To jumper across unused slots, see Figure 2.5. Pin A94, (Data Channel Priority IN), of the lowest empty slot must be jumpered to A93, (Data Channel Priority OUT), of the highest empty slot below the DC-297 and A96, (Interrupt Priority IN), of the lower slot to A95, (Interrupt Priority OUT), of the highest slot.

If the DC-297 is to be configured at or near highest priority in an S140 computer, (Slots 12-16 I/O ONLY), jumper the priority first up to the DC-297, then back down to the additional controller boards in slots 4 and up. See Figure 2.6 for an example.

2.3.3 POWER FAIL PROTECTION

The DC-297 Controller contains a double protection power fail scheme which disables the disk drive write circuitry through the open cable detect line.

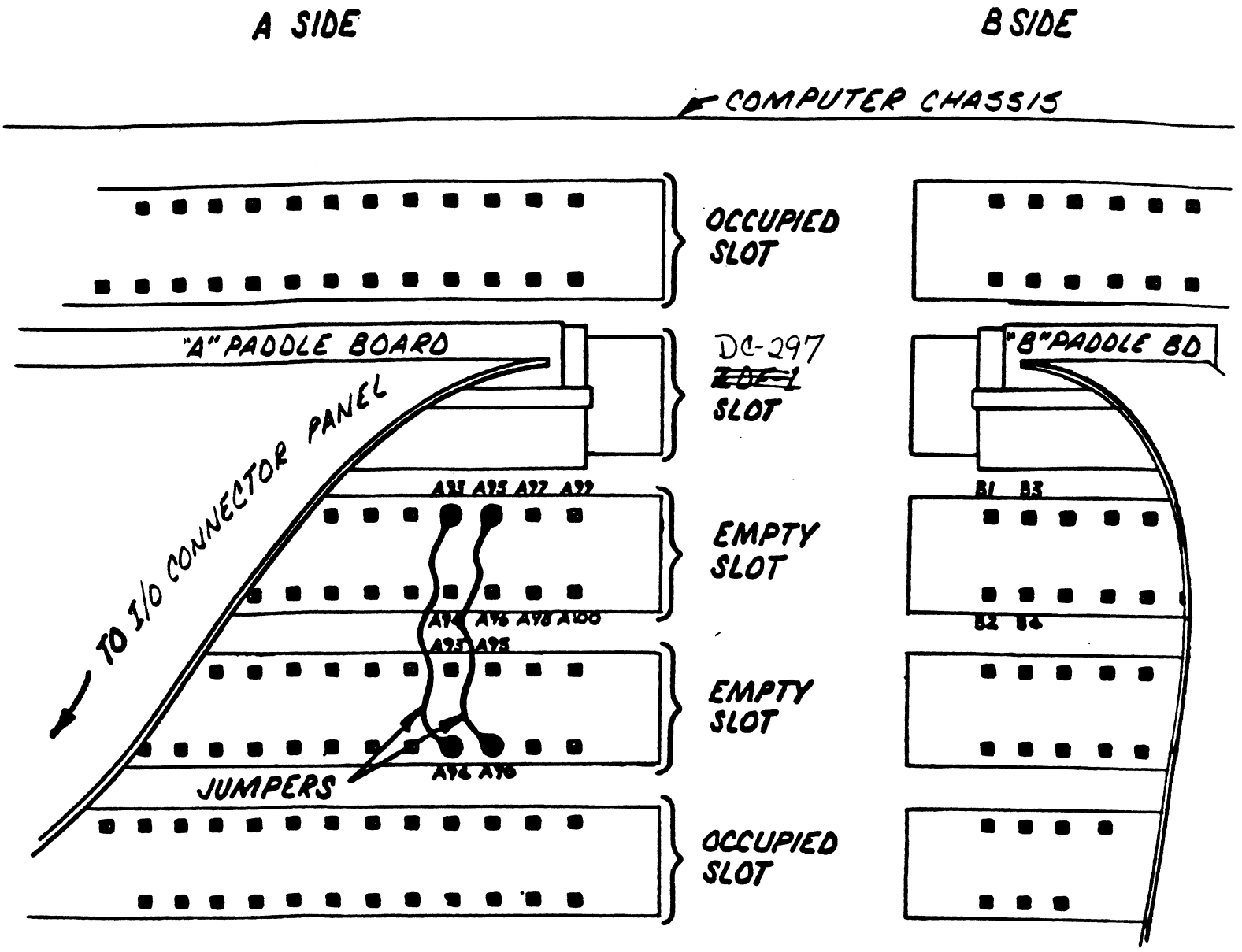
The Data General power supply outputs a signal called "POWER FAIL" which gives an early warning of power loss. This signal is located at the B21 pin of the backpanel. Some computers provide this signal on all slots, however, on others it may only be available on B21 of the top slot. If so, to use this signal, backpanel pin B21 of the controller's slot must be jumper connected to B21 of the top slot in the computer.

In addition, the controller contains power fail circuitry to further protect disk drive data integrity in the event of power loss to the slot in which the controller is installed.

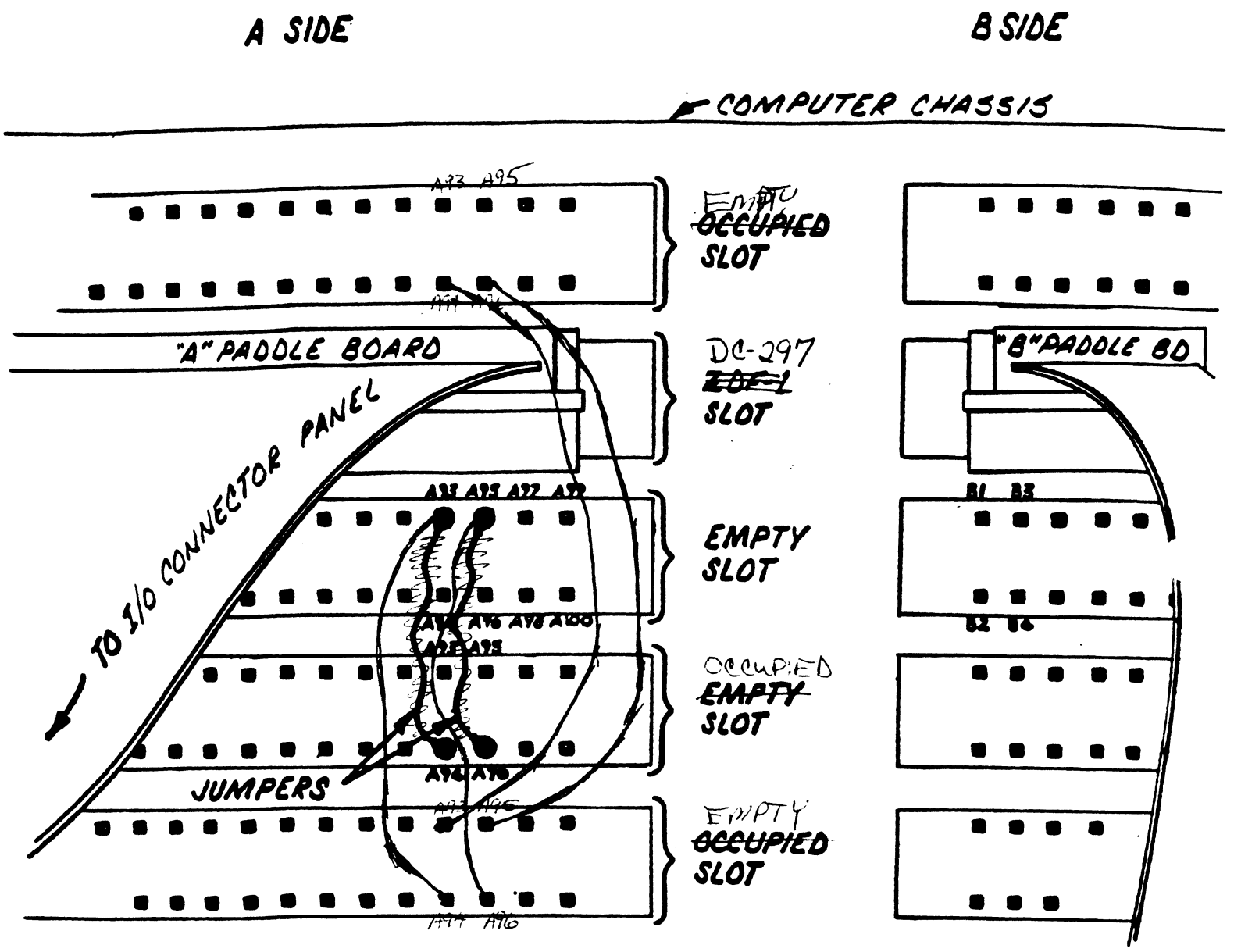
2.4 CONTROLLER BOARD INSERTION

After selecting the proper slot* in Section 2.3.1, insert the controller by fitting the board edges between the slot guides and allowing the board to follow the guides evenly. Pull out the ejectors on the two outside corners of the board and use them to provide leverage when the board meets the connector. Use equal pressure on both ejectors until the board seats firmly into the backpanel connectors.

CAUTION: THE DC-297 CONTROLLER MAY ONLY BE INSERTED IN AN I/O ONLY SLOT WHEN JUMPERED FOR FCC COMPLIANCE. COMPONENT DAMAGE WILL OCCUR IF A SLOT OTHER THAN AN I/O SLOT IS USED AND THE CONTROLLER IS JUMPERED FOR FCC COMPLIANCE. ZETACO'S WARRANTY IS VOID IF A NON-I/O ONLY SLOT IS USED UNDER THIS CONDITION.



BACKPANEL PRIORITY JUMPERS
FIGURE 2-5



BACKPANEL PRIORITY JUMPERS
FIGURE

2.5 CABLING INSTALLATION

The cabling procedure is different for FCC compliance as opposed to Non-FCC compliance. For FCC compliance, follow the instructions in Sections 2.5.1 through 2.5.4. For Non-FCC compliance skip to Section 2.5.4.

2.5.1 PADDLEBOARD INSTALLATION (Required for FCC Compliance)

Because the paddleboards carry signals from the cables to the backpanel, care must be taken in aligning the over the proper backpanel pins.

The computer backpanel, viewed from the rear, has the "A" side pins on the left. On computers with vertically mounted controller boards, the "A" side is on the bottom.

Locate the two rows of pins on the "A" side of the backpanel for the slot containing the DC-297 Controller. Ensure that no pins are bent, and position the "A" paddleboard block connector over all 100 pins with the SMD connectors facing up, (for vertical board machines, the SMD connectors should face left). Press the connector securely over the pins, making sure all pins insert and do not bend, until the guide block is flush with the backpanel.

CAUTION: COMPONENT DAMAGE MAY OCCUR IF PADDLEBOARD IS MIS-ALIGNED. MAKE SURE THE BLOCK IS NOT SHIFTED RIGHT OR LEFT BY CHECKING FOR NON-INSERTED PINS ON BOTH ENDS. DOUBLECHECK THAT THE BLOCK IS POSITIONED OVER THE CORRECT TWO ROWS OF PINS, AND NOT BETWEEN SLOTS. IT MAY BE NECESSARY TO COUNT PAIRS OF ROWS TO DETERMINE CORRECT POSITIONING.

Repeat this procedure for mounting the "B" paddleboard on the "B" side of the backpanel.

2.5.2 INTERNAL CABLING (Necessary for FCC Compliance Only)

Internal Cabling is shown in Figure 2.7. Each assembly consists of a paddleboard and corresponding ribbon cabling. The cables are terminated with shielded connectors which mount on the I/O connector panel on one end and a dual parallel connector block on the other which connects to the paddleboard.

Attached to each paddleboard is a 100 pin block connector which mounts onto the chassis backpanel pins.

The "A" backpanel internal cable contains the disk "A" (control) cable. The "B" internal cable contains the four disk "B" (data) cables. Each connector is labeled appropriately.

2.5.3 MOUNTING "D" CONNECTORS (Required for FCC Compliance)

Figure 2.8 depicts the computer I/O connector panel viewed from the back. To mount the "D" connectors to the I/O backpanel, remove the covers from the desired mounting holes on the I/O connector panel. With the mounting hardware removed from the "D" connectors, insert the connectors into the I/O panel and insert the hex bolts from the outside of the I/O panel. Secure each connector to the panel with the washers and nuts.

2.5.4 EXTERNAL DISK CABLING

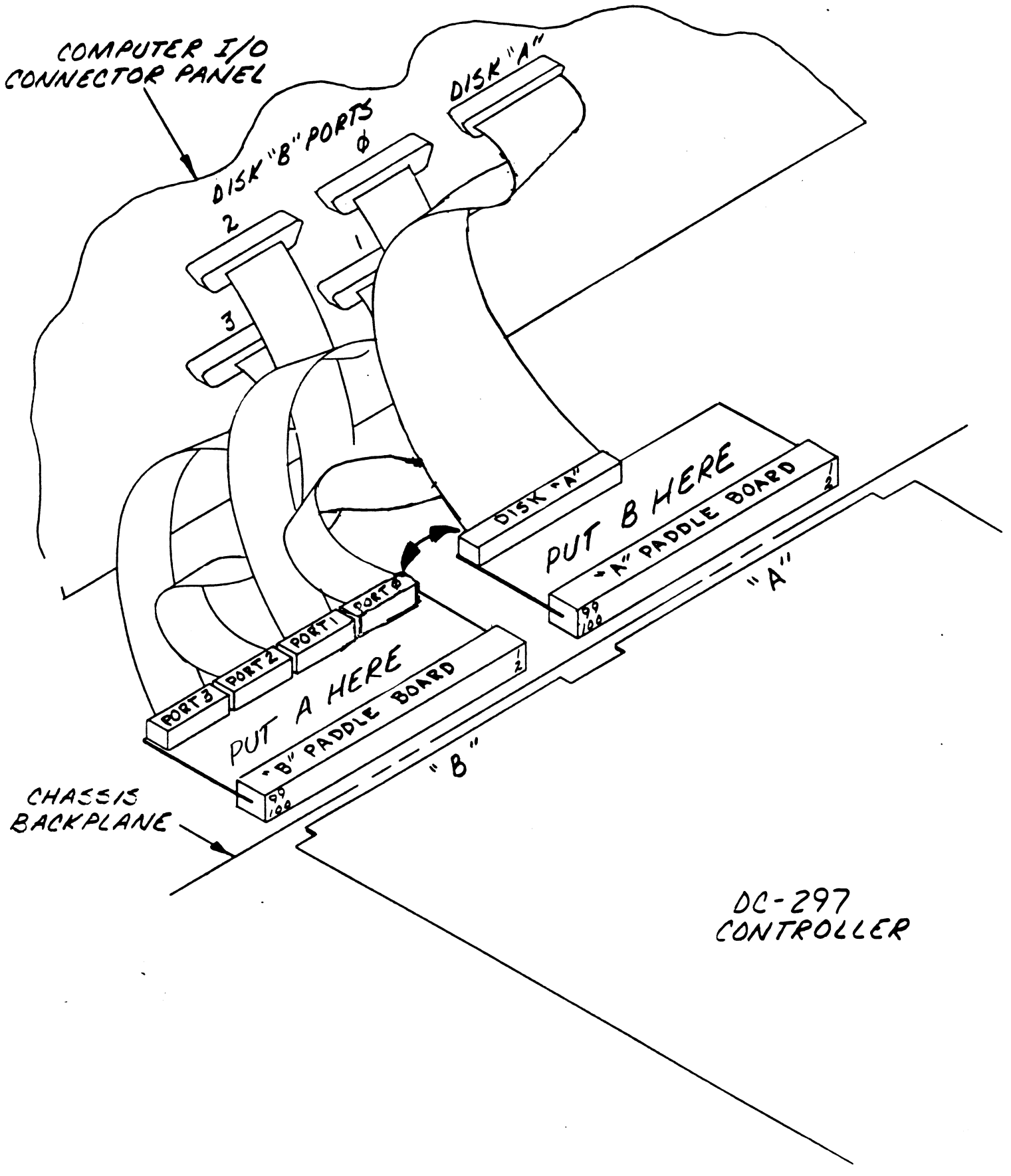
Round, Shielded Cabling (Necessary for FCC Compliance)

The Disk "A" Cable (P/N 300013-000) mounts to the I/O connector panel and is terminated with a 60 pin connector which attaches to the first disk drive. The Disk "B" Cable (P/N 300011-000) mounts to the panel and is terminated with a 26 pin connector which attaches to the disk drive. For every additional disk drive added to this controller, one daisy chain "A" cable (P/N 100915-000) is required between each disk along with another "B" cable connecting the added disk to one of the unused ports on the controller.

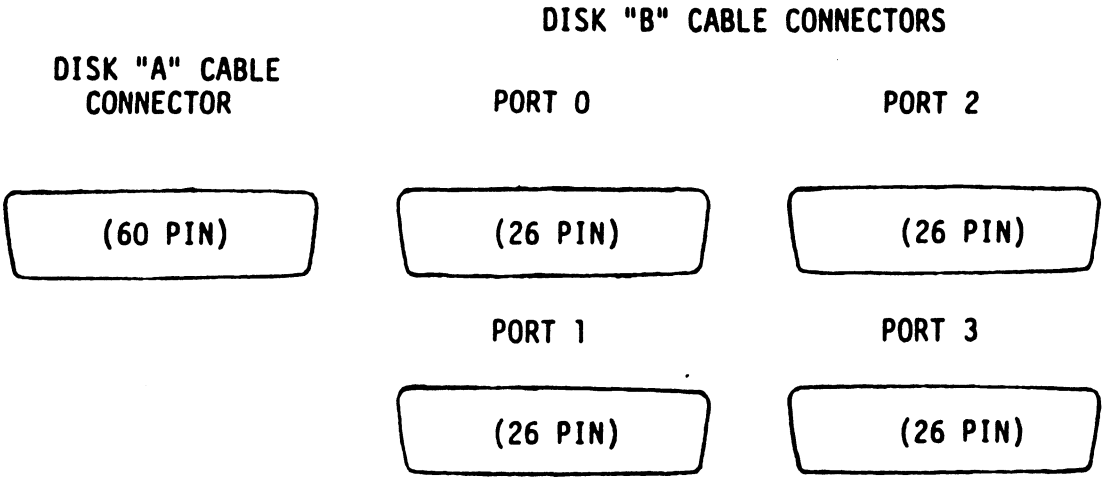
2.5.5 EXTERNAL DISK CABLING

Flat Ribbon Cabling (Used for Non-FCC Compliance)

The Disk "A" Cabling (P/N 100911-002) is 60 conductor, twisted pair with 60 pin connectors on each end. The Disk "B" Cable (P/N 100916-002) is 26 conductor with 26 pin connectors on each end. An additional "A" and "B" cable is required for each disk unit added to the DC-297 Controller. Be sure to observe the arrow on the cable and the on-board connectors line up to provide proper SMD signal connection between the controller and disk unit.



INTERNAL CABLING
FIGURE 2-7



CONNECTOR PANEL EXAMPLE LAYOUT
FIGURE

Attach the Disk "A" Cable to the appropriate on-board "A" header if external flat ribbon cable is used (Non-FCC Compliance) or to the appropriate backpanel D connector if round, shielded cabling is used (FCC Compliant). Attach the other end of the "A" cable to the appropriate 60 pin header on the first disk drive, again, observing the arrows on header and connector align. For additional drives, remove the terminator from the additional disk units and connect the "A" cables from drive to drive in a daisy chain fashion as shown in Figure 2.9. Ensure that only one terminator is installed in the entire chain positioned in the termination header of the last disk drive in the chain.

Next, connect the "B" cable(s) to the appropriate on-board header if flat ribbon cable is used (Non-FCC Compliant) or proper backpanel D connector if round, shielded cabling is used (FCC Compliant). The other ends of each "B" cable should connect to each individual disk drive. These "B" cables are not daisy chained. Each disk unit has a "B" cable connected directly to the DC-297.

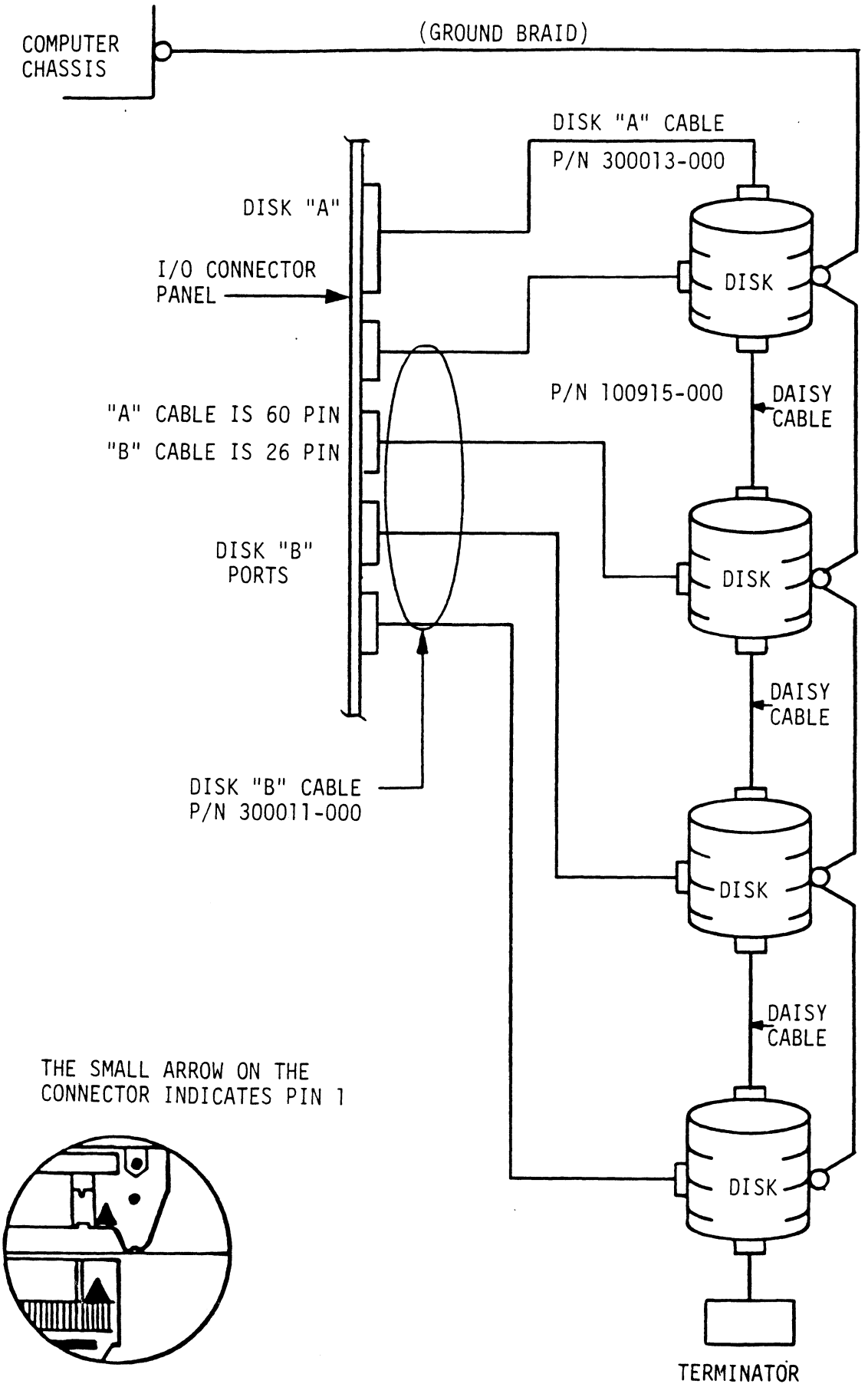
It is important to note that a drive's unit number setting does not dictate the "B" connector it must attach to. The controller allows any unit to be attached to any of the four "B" ports and assigns individual drive characteristics on a port-by-port basis. Therefore, it must be noted which port each disk drive is attached to (Port 0 - Port 3, labeled on the connectors), so that proper drive characteristics are assigned to each port when assigned to each port when the Configurator Program is run.

2.5.6 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 disk 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 DISK DRIVE 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 YOUR 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.

FIGURE 2.9 Disk Drive Cabling



2.6 DISK DRIVE PREPARATION

Each disk drive will need to be set to the correct number of sectors per track, and to the desired unit number. In addition, the disk drive's installation manual should be read to see if any other setup is required.

2.6.1 SECTORS PER TRACK SELECTION

The number of sectors per track each disk drive should be set to is shown in Table 2.4 below. Find the disk drive model that will be run on the DC-297. Adjacent to the model is the number of sectors the disk should be set to.

NOTE: If the DC-297 is configured for split sectors for any disk drive, that particular disk drive will appear to the system as two disks with half the number of sectors shown in the maximum sectors column of the table below. The table shows the maximum number of sectors for each disk model using at least 576 bytes in each sector of the disk surface. Problems are inevitable if this number is not adhered to. Use this number to calculate the number of sectors a disk drive can have if it is not shown in the table.

TABLE 2.4 Maximum Sectors Table

DISK DRIVE MODEL NUMBER	MAXIMUM NUMBER OF SECTORS SUPPORTED
A1-AMPEX 165	35
A2-AMPEX 330	35
A3-AMPEX 980	35
A4-AMPEX 80	35
A5-AMPEX 660	35
A7-AMPEX 932	35
A8-AMPEX 964	35
A9-AMPEX 996	35
AA-APS 4830-202	70
AB-APS 4835-202	70
AC-APS 4830-337	70
AD-APS 4835-337	70
AE-APS 4830-404	70
AF-APS 4835-404	70
AG-APS 4865	70

DISK DRIVE MODEL NUMBER	MAXIMUM NUMBER OF SECTORS SUPPORTED
AL-AMCODYNE 7110	32
AM-AMCODYNE 8160	35
C1-CDC 9730-80	35
C2-CDC 9730-160	35
C3-CDC 9762	35
C4-CDC 9766	35
C5-CDC 9775	35
C6-CDC 9710 (RSD)	35
C7-CDC 9715-160	35
C8-CDC 9715-340	35
C9-CDC 9715-515	51
CA-CDC LARK 9457	32
CB-CDC LARK 9455	32
CC-CDC CMD 9448-32	35
CD-CDC CMD 9448-64	35
CE-CDC CMD 9448-96	35
CF-CDC 9410-8	23
CG-CDC 9410-24	23
CH-CDC 9410-32	23
CI-CDC 9410-40	23
CJ-CDC-9412	35
D1-DATA PER. D1600	35
DA-DISC TECH 3306	35
E1-CENTURY 300	35
E2-CENTURY 302	35
E3-CENTURY 306	35
E4-CENTURY AMS 315	35
E5-CENTURY T82	35
E6-CENTURY 160	41
E7-CENTURY AMS 513	55
E8-CENTURY AMS 380	55
E9-CENTURY AMS 571	56
EA-CENTURY C2048	32
F1-FUJITSU 2280	35
F2-FUJITSU 2284	35
F3-FUJITSU 2294	35
F4-FUJITSU 2351	48
F5-FUJITSU 2311	35
F6-FUJITSU 2312	35
F7-FUJITSU 2333	70
F8-FUJITSU 2331	70
F9-FUJITSU 2361	70

DISK DRIVE MODEL NUMBER	MAXIMUM NUMBER OF SECTORS SUPPORTED
FA-FUJITSU 2298	70
K1-KENNEDY 7380	35
K2-KENNEDY 5380	35
K3-KENNEDY 53160	35
K4-KENNEDY 7340	35
M1-MEGAVAULT 83	35
M2-MEGAVAULT 116	35
MA-MEMOREX 677-30	35
MB-MEMOREX 677-70	23
MC-MEMOREX 213	35
MD-MEMOREX 214	35
N1-NEC 2220	35
N2-NEC 2230	35
N3-NEC 2246	35
N4-NEC D2351	62
P1-PRIAM 15450	35
P2-PRIAM 804	35
P3-PRIAM 3350	35
P4-PRIAM 3450	23
P5-PRIAM 7050	23
P6-PRIAM 6650	35
T1-TECSTOR 85	35
T2-TECSTOR 165	35
T3-TECSTOR 200	35
T4-TECSTOR 300	35
T5-TECSTOR 160	35
UD-USER DEFINED	128

NOTE: RDOS users below revision 7.0 are limited to 32 sectors by the operating system. If the system in which this controller will be installed will run RDOS below revision 7.0, set the disk unit for no more than 32 sectors.

2.6.2 UNIT NUMBER, MISCELLANEOUS PREPARATION

Set the drive(s) to the desired unit numbers. This is usually done via switch in the drive or by changing lens csps on the front. For two or more drives, unit numbers assigned are usually consecutive, with unit "0" being the primary unit. For dual volume drives such as CDC's CMD, Lark, etc., or drives which the controller treats as dual volume, (indicated in the Disk Drive "HELP" section of ZETACO'S Configurator Program on the M297 tape), the drive must be set to unit 0 or 2, with the next consecutive odd unit number used by the other volume of the disk drive.

On initial power-up, the controller will delay activating pick-hold (spins up drive) for one second. This feature eases the initial currnt demand on the AC power source. This feature requires that the disk drive be selected for REMOTE spin up operation.

Ensure the disk drive you are installing has the index and sector signals on the "A" cable. If these signals are on the "B" cable only, the controller will not function correctly.

2.6.3 SPECIAL CONSIDERATIONS - VARIOUS DRIVES

FUJITSU 2351 SECTOR SELECTION

The Fujitsu 2351 should be set to 48 sectors per track by setting the number of bytes per sector to 586 and not 587 as in the Fujitsu 2351 manual. This eliminates the awkward, smaller, last sector and makes all the used sectors equal as to the number of bytes in each sector. The following jumpers should be set for 586 bytes per sector on the Fujitsu 2351 sector card:

BC7	2-3	6-7	10-11	12-13
BD7	3-4	6-7	9-10	13-14
BE7	3-4	5-6	10-11	13-14
BF7	3-4	6-7	10-11	13-14

CDC 9457 (LARK 11) AND CDC 9455 (LARK)

Ensure options "Auto Seek On Head Change" and "Two Volumes (CMD)" are installed within the disk drive. The CDC Larks must be 32 sector type.

FUJITSU 2322 SECTOR SELECTION

The Fujitsu 2322 bytes per sector switches should be set to 582 instead of 566 (35 sectors) as shown in the 2322 manual. This allows all the sectors a more uniform number of bytes per sector and eliminates the unusable last sector. Set the bytes per sector switches as follows for 582 bytes per sector.

SWITCH 2							SWITCH 2						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
0	1	1	0	0	0	1	0	0	1	0	0	0	0

2.7 SYSTEM POWER-UP

Apply system power. The RED LED on the DC-297 controller should come on and then go off, indicating successful completion of controller selftesting. If this does not occur, refer to Section 3.0.

Functions of the other LEDs are described in Section 1.1. After selftest, all LEDs should be off with the exception of the yellow LED which indicates the disk unit(s) is de-selected.

2.8 DISK SUBSYSTEM TESTING AND BUILDING USING THE M297 TAPE

The following procedure is recommended to prepare each disk drive installed for system use.

2.8.1 BOOTING THE M297 TAPE

System Requirements:

- Data General Nova/Eclipse Family CPU/SPU
- Minimum 32K Words Memory
- Console Device at 10/11
- Magnetic Tape Drive: 1/2" 9-Track
- Printer at Device 17 for Hard Copy (Optional)

The M297 tape is structured so that the programs on Files 2 through 7 can be loaded and executed directly from the tape. Files 0 and 1 contain the software which enables you to boot from the tape and select the particular program you want loaded into the system. Each of the programs on Files 2 through 7 is a stand-alone program. This means that they do not need, and cannot have an operating system running when they are executed.

Programs cannot be loaded onto your disk directly from Files 0 through 7. File 8 for RDOS and File 9 for AOS contain the programs in the standard system dump format and you can load them from these files to your disk. The procedure to boot the M297 tape is described in the four following steps:

1. Mount the tape on the tape drive and put in ON-LINE. Be sure that the BPI setting matches that specified on the tape label (normally 1600 BPI).

2. Program Load - The method of program load varies depending on the processor being used.

If you system has front-panel switches, set them to 100022 when loading from the primary tape drive, or to 100062 when loading from the secondary tape drive. Then press reset and the program load switch.

For the S140 virtual console, set 11a to 100022 (or 100062 for secondary tape drive). Then enter 100022L (or 100062L).

For the S120 virtual console, enter 22H (or 62H for the secondary tape drive).

For MV class CPUs you must enter the full virtual console and respond to the prompt:

```
SCP-CLI>
with BOOT 22 (or 62 for secondary tape)
```

3. M297 menu will be displayed on your console like this:

```
FILE #    PROGRAM                              FILENAME

  2       DC-297 CONFIGURATOR                  CF297.SV
  3       DISK FORMATTER                       DISKF.SV
  4       DISK DIAGNOSTIC                      DISKD.SV
  5       DISK RELIABILITY                     DISKR.SV
  6       CSDKINIT-DISK INITIALIZER            CSDKINIT.SV
            (RDOS SYSTEMS ONLY)
  7       CSDSKED-DISK EDITOR                  CSDSKED.SV
            (RDOS SYSTEMS ONLY)
  8       ".SV & .LS" FILES AND ANY UTILITIES IN
            RDOS DUMP FORMAT.
  9       ".SV & .LS" FILES AND ANY UTILITIES IN
            AOS DUMP FORMAT
```

FILE NUMBER?

If this fails to appear on the console, use the troubleshooting section of this manual for additional information.

4. Enter the file number (2-7) you wish to execute followed by CR. The tape should then space and load the program into memory. Operation of these programs is explained below.

2.8.2 DC-297 CONFIGURATOR

The purpose of the Configurator is to set up the controller with information unique to your particular installation. The facts are then saved within the controller in non-volatile memory. Configuration need only be done at installation time, or at any later time to adjust performance, attach new disk drive, etc.

2.8.2.1 CONFIGURING THE CONTROLLER

Configure the DC-297 with the configurator program on the M297 tape sent with the controller. (A detailed explanation of the configurator program is given in Section 4.0 "Program Usage". Note the "ECC ENABLE/DISABLE" flag for each disk drive port during controller configuration. For most situations, it is recommended that on-board error correction be disabled while running disk formatter and initializer programs. Initializer programs refer to CSDKINIT AND DFMTR. This will allow the programs to flag and detect those bad blocks which are potential problems even though they might be correctable at the time of running the initializer. However, it is also possible to run the initializer programs with ECC Correction enabled in cases where there is a need for using marginal disk media.

NOTE: We strongly recommend you save a hard copy of dialogue between operator and configurator for future reference. The program has printer output control at device code 17 (LPT). If a printer is not available, the operator should record all configuration facts displayed by using the "L" command after configuration.

Boot the M297 tape and load the configurator (File 2) program.

The program will display an introduction. Please read carefully before proceeding.

2.8.2.2 CONFIGURATOR HELP

The DC-297 Configurator includes two "HELP" commands; one for OPERATIONAL questions and one which suggests WHAT you might want to do. In addition, you can get an explanation for any item by responding with an "H" to the question. Please use these functions whenever you are uncertain as to what to do.

> It is recommended that the "J" command be used for initial installation to allow setup of all parameters.
>
> When configuration is complete, enable the printer output and list the configuration. Use the "U" command to update the controller and the "Q" command to end the session.

Refer to Section 4.1 of the Usage section for additional information and configurator field descriptions.

> If the configurator does not function properly, refer to the Troubleshooting section of this manual for help.

2.8.3 RDOS USERS (AOS Users Go To Section 2.8.4)

2.8.3.1 FORMATTING

Run the Disk Formatter Program (program #3) provided on the M297 tape. Run at least three passes, preferably six.

The Disk Formatter Program is a utility designed program to format and check disk packs to be used on the Disk Systems. It is recommended that on-board error correction for each drive be disabled throughout both formatter and initializer programs. It should then be enabled by running the Configurator Program again after disk initialization. The formatter program writes header information in the header field and then writes and reads different data patterns in the data field to check the media of the disk.

This formatting process is done by first writing all the headers on the disk. When the last sector header is formatted, the program will output, "Format Done". Next, the data field is checked. Each pass of formatter program signifies the completion of writing every sector's data field on the disk with a data pattern and then reading the data back twice. The data written is compared to the data read for errors in the media. An example of running the formatter program is given below.

Boot the Disk Formatter Program from tape M297 or disk.

The followin is a sample dialogue:

```
ZETACO SMD DISK CONTROLLER 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
  (Appendix B contains information about the bits in
  the SWPAK reg.  For normal operation a (CR) is done
  here.)
START TIME? - MON,DAY,YR HR,MIN
# PASSES TO FORMAT COMPLETION? - 6
UNIT      TYPE      HDS       CYLS       SEC/TRK
  0         0         5         823          32
  2         1         5         815          24

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
```

If errors are encountered using this program, refer to the Troubleshooting section of this manual, Section 3.0.

2.8.3.2 RDOS USERS: DIAGNOSTICS

Run at least one pass of the Disk Diagnostic Program provided on the M297 tape.

This diagnostic program is provided to find failures that are related to the basic operations of the Disk Controller.

Boot the Disk Diagnostic from tape M297 or disk.

The following is a sample dialogue for 6160 emulation (AOS) with the DC-297 Controller set to device 27:

```
ZETACO SMD DISK CONTROLLER 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 DUAL DRIVE EXERCISER WITH
            SEEK OVERLAP
     500-DIAGNOSTIC (RESTART)
ENTER DEVICE CODE [27]:  Depress CR (CR uses value in
                         brackets).
ANY DUAL VOLUME UNITS?  ENTER 1  Depress CR.
ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  Depress 0,1
SET SWPAK AS PER 8.0, LISTING OR ENTER RETURN (CR) TO
  CONTINUE

     Appendix B contains information about the bits in
     the SWPAK reg.  For normal operation a (CR) is
     done here.

TESTING UNIT 0
.
.
.
.
UNIT       HDS        CYLS       SEC/TRK
  0         5          823          35
These are the units and characteristics found, do you
want to loop on reading them?  Enter 1, otherwise enter
Return (CR).
.
.
.
.
ADDRESSABLE SECTORS/TRACK WITH THIS CONTROLLER IS 64.
DRIVE UNIT #0 WILL BE IDENTIFIED AS A 6160 &73 MBYTE)
BY AOS OR AOS/VS.
```

```
DRIVE UNIT #1 WILL BE IDENTIFIED AS A 6160 (73 MBYTE)
BY AOS OR AOS/VS.
TEST(S) COMPLETE.
SEEK EXERCISER TESTS.
PASS
```

If errors are encountered using this program, refer to the Troubleshooting section of this manual, Section 3.0.

2.8.3.3 RDOS USERS: RELIABILITY

Run the Disk Reliability Program on the M297 tape for at least 15 minutes. If time permits, let this program run longer to fully exercise and test the disk system.

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. Boot the Disk Reliability program from the M297 tape.

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]:  Depress CR
STARTING ADDRESS = 505
SET SWPAK AS PER 8.0, OR HIT (CR) TO CONTINUE
     Appendix B contains inforation about the bits in
     the SWPAK reg.  For normal operation, a (CR) is
     done here.
ARE MAPS TO BE EXERCISED (YES/NO)?  Depress YES
START TIME? - MON,DAY,YR  HR,MIN    Depress NO
ANY DUAL VOLUME UNITS (YES/NO)?     Depress NO
UNIT       TYPE       HDS        CYLS       SEC/TRK
  0          0          5          823          32
  2          1          5          815          24
ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  Depress 0,1
UNIT:  0
ENTER TYPE OF DISK:  Depress 0
UNIT:  1
ENTER TYPE OF DISK:  Depress 1
TESTING UNIT 0,1      (Refer to Section 3.0 if errors occur.)
```

2.8.3.4 RDOS USERS: CSDKINIT

At this point, the disk drive and its media has been tested satisfactorily and the media (data field) must be prepared for the operating system. This is accomplished with another program from the M297 tape called CSDKINIT. Run at least one pattern of this program.

Before you load any RDOS System onto a Model DC-297 Disk, YOU MUST INITIALIZE THE DISK BY RUNNING CSDKINIT. This is a stand-alone program which performs all the functions of Data General's DKINIT. Please refer to Data General's manual on loading an RDOS System for full details on the functionality of disk initialization.

Remember that only CSDKINIT will work correctly for Model DC-297 Disks. If you are building your system from an RDOS release tape, do NOT run File 4 on the D.G. tape after running CSDKINIT. Data General's DKINIT cannot be run on a Model DC-297 Disk. CSDKINIT can, however, be used to initialize any D.G. supported disk.

STEP 1 - LOADING

Boot the CSDKINIT Program (#6) from the M297 tape.

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 EXACTLY AS SHOWN ABOVE IN "YOU RESPOND"

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 (ZETACO 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 blocks. Blocks if disk <4000 blocks.

The 99 in the #HEADS, #SEC/TRK and #CYL are simply place holders, and do not represent a real situation. The information under these headings should represent the characteristics of the disk drive the controller was configured for.

STEP 4 - COMMANDS AND SUBSEQUENT OUTPUT

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

2.8.2.5 WHAT NEXT? THE FINAL STEPS

For the final step, run the configurator again to enable ECC Correction for each disk drive port. Now that disk drive installation is completed, correction of any data error is beneficial to the system users. The disk is ready to have system data installed on it. If this disk subsystem is to be the primary disk subsystem, then the RDOS build procedure (not provided in this manual) should be continued from the section after the explanation of DKINIT. (Since CSDKINIT replaces DKINIT, this makes sense.)

NOTE: When sysgen asks, "Controller #1 6160/6161 Type?", answer NO. This allows up to four drives to be attached to the controller. Answering YES allows only two drives.

After the system has been built, you should load the programs from the M297 tape onto the system. This will allow usage of the RDOSECC program as well as store a copy of the ZETACO disk test programs in the event that the M297 tape is misplaced or head skew problems arise on the tape drive in the future. For more insight on RDOSECC program, see Section 4.0. To load these programs onto the system disk, bring up the system and execute a LOAD/V of File 8 from the M297 tape.

2.8.4 AOS USERS

2.8.4.1 FORMATTING

Run the Disk Formatter Program provided with this controller on the M297 tape. Run at least three passes, preferably six.

The Disk Formatter Program is a utility program designed to format and check disk packs to be used on the Disk Systems. It is recommended that on-board error correction for each drive be disabled throughout both formatter and initializer programs. (Initializer programs refers to DFMTR.) It should then be enabled by running the configurator again after disk initialization.

The formatter program writes header information in the header field and then writes and reads different data patterns in the data field to check the media of the disk. The formatting process is done first by writing all the headers on the disk. When the last sector header is formatted, the program will output, "Format Done". Next, the data field is checked. Each pass of formatter program signifies the completion of writing the entire data field of the disk with a data pattern and then reading the data back twice. The data written is compared to the data read for errors in the media. An example of running the formatter program is given on the following page.

Boot the Disk Formatter Program (Program #3) from the M297.

The following is a sample dialogue:

```
ZETACO SMD DISK CONTROLLER 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]:  Depress CR
SET SWPAK AS PER SECT 8.0 OR HIT (CR) TO CONTINUE
     Appendix B contains information about the bits in
     the SWPAK reg.  For normal operation a (CR) is
     done here.
START TIME? - MON,DAY,YR  HR,MIN  Depress CR
# PASSES TO FORMAT COMPLETION? - Depress 6
UNIT      TYPE      HDS       CYLS       SEC/TRK
  0          0         5         823          35
  2          1         5         815          24
ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  Depress 0,2
UNIT:  0
ENTER TYPE OF DISK:  Depress 0
UNIT:  2
ENTER TYPE OF DISK:  Depress 1
FORMATTING UNIT 0,2
```

If errors are encountered using this program, refer to Section 3.0, Troubleshooting.

2.8.4.2 AOS USERS: DIAGNOSTICS

Run at least one pass of the Disk Diagnostic Program provided on the M297 tape.

This diagnostic program is provided to find failures that are related to the basic operations of the Disk Controller.

Boot the Disk Diagnostic from tape M297 or Disk.

The following is a sample dialogue for 6160 emulation (AOS) with the DC-297 Controller set to device 27:

```
ZETACO SMD DISK CONTROLLER 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 DUAL DRIVE EXERCISER WITH
                SEEK OVERLAP
     500-DIAGNOSTIC (RESTART)
ENTER DEVICE CODE [27]:  Depress CR
ANY DUAL VOLUME UNITS?  ENTER 1  Depress CR
ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  Depress 0,1
SET SWPAK AS PER 8.0, LISTING OR ENTER RETURN (CR) TO
     CONTINUE
     Appendix B contains information about the bits in
     the SWPAK reg.  For normal operation a (CR) is
     done here.

TESTING UNIT 0
.
.
.
UNIT       HDS        CYLS       SEC/TRK
  0         5          823          35
These are the units and characteristics found, do you
want to loop on reading them?  Enter 1, otherwise enter
(CR) Return.
. .
.
.
ADDRESSABLE SECTORS/TRACK WITH THIS CONTROLLER IS 64.
DRIVE UNIT #0 WILL BE IDENTIFIED AS A 6160 (73 MBYTE)
     BY AOS OR AOS/VS.
DRIVE UNIT #1 WILL BE IDENTIFIED AS A 6160 (73 MBYTE)
     BY AOS OR AOS/VS.
TEST(S) COMPLETE.
SEEK EXERCISER TESTS.
PASS            (Refer to Section 3.0 if errors occur.)
```

2.8.4.3 AOS USERS: RELIABILITY

Run the Disk Reliability Program from the M297 tape for at least 15 minutes, but preferably one complete pass to completely exercise and test the disk subsystem.

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. Boot the Disk Reliability Program from tape M297 or Disk.

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 CONTINUE
     Appendix B contains information about the bits in
     the SWPAK reg.  For normal operation a (CR) is
     done here.
ARE MAPS TO BE EXERCISED (YES/NO)?  YES
START TIME? - MON,DAY,YR  HR,MIN
ANY DUAL VOLUME UNITS (YES/NO)?  NO
UNIT       TYPE       HDS        CYLS       SEC/TRK
  0          0          5          823          35
  2          1          5          815          24
ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  0,1
UNIT:  0
ENTER TYPE OF DISK:  0
UNIT:  1
ENTER TYPE OF DISK:  1
TESTING UNIT 0,1
```

If errors are encountered using this program, refer to Section 3.0, Troubleshooting.

2.8.4.4 DFMTR

At this point, the disk drive and its media have been tested satisfactorily and the media (data field) must be prepared for the operating system. This is accomplished with DFMTR (Data General's Disk Initializer), and is not documented in this manual. Run at least one pattern of the DFMTR Program according to the procedure outlined by the DFMTR Manual.

2.8.4.5 WHAT NEXT? THE FINAL STEPS

For the final step, run the configurator again to enable ECC Correction for each disk drive port. Now that disk drive initialization is completed, correction of any data error is beneficial to the system users. The disk is ready to have system data installed on it. If this disk subsystem is to be the primary disk subsystem, then the AOS build procedure (not provided in this manual) should be continued from the section after the explanation of DFMTR which has already been done. After the system has been built, you should load the programs from the M297 tape onto the system. This will allow usage of the AOSECC program as well as store a copy of the ZETACO disk test programs in the event that the M297 tape is misplaced or head skew problems arise on the tape drive in the future. For more insight on the AOSECC program, see Section 4.0. To load these programs onto the system disk, bring up the system and execute a LOAD/V of File 9 from the M297 tape.

3.0 TEST PROGRAMS, TROUBLESHOOTING AND CUSTOMER SERVICE

ZETACO products are supported in many ways:

-Microprocessor based self-test of over 80% of the board each time it is powered up, with LED status reporting.

-Reliability Program on 9-track tape for use during installation and troubleshooting.

-48-hour turnaround on most factory repairs or replacement.

-Customer Support Hotline manned from 8:00 a.m. to 5:00 p.m. (Central Time) to answer your questions. (612) 941-9480

-Two year warranty on all controllers in the event of a hardware failure.

NOTE: If you are referencing this section because of disk subsystem errors but the system was built long ago, use Appendix C for information on what programs to run and how to set them up so the system is not destroyed.

3.1 SELFTEST ERRORS

The DC-297 Controller runs on-board microdiagnostics each time the board is powered up. The disk microprocessor performs independent, extensive testing of all internal controller functions. The RED LED indicates selftest; the RED LED is on during disk selftest (300 ms).

If selftest passes, the red LED will go off and stay off.

If any subtest of selftest detects an error, the red LED will blink an error code, pause, then blink the error code again. The number of blinks between pauses identifies the malfunctioning circuit within the controller according to the look-up, Table 5.1, provided on the next page. Depressing the computer's reset switch while the error code is being displayed causes that section to loop on the error and the LED will be on continuously.

TABLE 5.1 Disk Selftest Error Codes

CODE	TEST	POSSIBLE FAILURE
1	EEPROM	The data in the EEPROM did not compare with expected data (55 hex). EEPROM may not have been previously burned.
2	RAM	Data read from RAM did not compare with data written. 2114, PBUS or RAM data bus may be bad.
3	SEQUENCE ERROR	A forced sequence error did not occur within a specified amount of time. Format sequencer may be bad. (No Clock)
4	SYNC DETECT	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.
5	ECC	The generated ECC pattern did not compare with the expected pattern. The shift registers, ECC logic or multiplexors may be bad.

The disk selftest error code is displayed via the red LED by the "B" SMD connector on the controller front edge. If the LED does not blink or go out, then the 2925 clock circuitry, the 2910 or the power fail circuit may be bad.

3.2 M297 UTILITY PROGRAM ERRORS

The M297 utility programs are supplied on the M297 1/2" magnetic tape. Included on the tape are the Configurator Program, Disk Maintenance Programs and System Support Programs and Utilities. This section explains what to do when problems are encountered with the disk subsystem during or after installation with these programs.

System Requirements

Data General Nova/Eclipse Family CPU/SPU
Minimum 32K Words Memory
Console Device at 10/11
Magnetic Tape Drive: 1/2" 9-Track
Printer at Device 17 for Hard Copy (Optional)

3.2.1 ERRORS BOOTING THE M297 TAPE

The M297 tape is structured so that the programs on Files 2 through 7 can be loaded and executed directly from the tape. Files 0 and 1 contain the software which enables you to boot from the tape and select the particular program you want loaded into the system. Each of the programs on Files 2 through 7 is a stand-alone program. This means that they do not need, and cannot have an operating system running when they are executed. Programs cannot be loaded onto your disk directly from Files 0 through 7. File 8 for RDOS and File 9 for AOS contain the programs in the standard system dump format and you can load them from these files to your disk. The procedure to boot the M297 tape is described in the four following steps.

1. Mount the tape on the tape drive and put it ON-LINE. Be sure that the BPI setting matches that specified on the tape label (normally 1600 BPI).

2. Program Load - The method of program load varies depending upon the processor being used.

If your system has front-panel switches, set them to 100022 when loading from the primary tape drive, or to 100062 when loading from the secondary tape drive. Then press reset and the program load switch.

For the S140 Virtual Console, set 11A to 100022 (or 100062 for secondary tape drive). Then enter 100022L (or 100062L).

For the S120 Virtual Console, enter 22H (or 62H for the secondary tape drive).

For MV class CPUs, you must enter the full Virtual Console and respond to the prompt:

```
SCP-CLI>
with BOOT 22 (or 62 for secondary tape)
```

3. M297 menu will be displayed on your console like this:

```
FILE #     PROGRAM                              FILENAME

  2        DC-297 CONFIGURATOR                  CF297.SV
  3        DISK FORMATTER                       DISKF.SV
  4        DISK DIAGNOSTIC                      DISKD.SV
  5        DISK RELIABILITY                     DISKR.SV
  6        CSDKINIT-DISK INITIALIZER            CSDKINIT.SV
               (RDOS SYSTEMS ONLY)
  7        CSDSKED-DISK EDITOR                  CSDSKED.SV
               (RDOS SYSTEMS ONLY)
  8        ".SV & .LS" FILES AND ANY UTILITIES IN
               RDOS DUMP FORMAT
  9        ".SV & .LS" FILES AND ANY UTILITIES IN
               AOS DUMP FORMAT

FILE NUMBER?
```

If the data above is not displayed, first check that the tape unit was ON-LINE. If it was not, put it ON-LINE and boot the tape again. If the tape unit was ON-LINE, depress the break key. Check the program counter for a 377. If it is 377, check the priority chain to the tape controller. Also ensure that the boot device is correct, i.e. if the M297 tape is on the primary tape subsystem, the boot procedure uses device 22. If the program counter is any number other than 377, check that the tape's density and the tape unit are the same density.

4. Enter the file number (2 through 7) you wish to execute, followed by CR. The tape should then space forward and load the program into memory.

3.2.2 DC-297 CONFIGURATOR ERRORS

The purpose of the configurator is to set up the controller with information unique to your particular installation. The facts are then saved within the controller in non-volatile memory. Configuration need only be done at installation time or at any later time to adjust performance, attach new disk drives, etc.

NOTE: We strongly recommend you save a hard copy of dialogue between operator and configurator for future reference. The program has printer output control at device code 17 (LPT). If a printer is not available, the operator should record all configuration facts displayed by using the "L" command after configuration. Using the configuration sheet sent with the controller is useful for recording this information.

If the program locks up at any point, depress the break key and examine the program counter. Examine the data at this address which can be used to determine which device is causing the program to loop.

3.2.3 DISK FORMATTER ERRORS

The Disk Formatter Program is a utility program designed to format and check disk packs to be used on the Disk Systems. It is recommended that on-board error correction for each drive be disabled throughout both formatter and initializer programs. It should then be enabled by running the configurator again after disk initialization.

3.2.3.1 FORMATTER ERROR DESCRIPTION

Errors during formatting occur after the header fields are written and "Formatting Done" has been output to the console. These errors are displayed when they are detected. The controller status will be displayed with the particular problem spelled out below the status. Each status bit is explained in the Programming Section, but since the error is also spelled out, referencing the Programming Section may not help. Most errors that can occur are Servo, Address, ECC or Ready errors.

3.2.3.2 SERVO CLOCK FAULTS

A Servo Clock Fault will terminate the format program. Note the cylinder, head and sector the error was detected on, (printed out on the console before aborting). Use the command string interpreter explained in the Appendix to seek to the cylinder noted above. Next, do a write to the head and sector (transfer one sector) noted above. If it again errors, it is not intermittent. Now try writing to other sectors around the sector that errored. If these sectors also error, there are not enough bytes per sector (576 minimum needed) and the disk unit manual should be consulted to check the number of bytes per sector. Another cause of this error could be improperly connected cables or the sector and index pulses transmitted over the "B" cable and not the "A" cable. If these errors are intermittent, again check for improper cable connections and recheck the disk type the controller is configured for using the configurator.

3.2.3.3 ECC DETECTED ERRORS

There are two types of ECC detected errors, ECC Detected Errors with data printed out, (data block flaws), and ECC Detected Errors, without data printed out. ECC Errors will not abort the program. These errors usually mean the controller detected a flaw in the disk media.

ECC Errors with error data printed out. Up to three words of the data that should be on the disk (good data) and the data that is on the disk (bad data) is printed out along with a count number. This count number is the number of words found in the sector that are bad. For example, if six words are bad in one sector, the first three bad words will be printed out with the good and bad data and the count will be six. The formatter program automatically flags these sectors bad so the operating system does not try to use this bad media.

ECC detected errors without error data words printed out mean there is a bad spot on the media where the ECC words are written. The formatter automatically flags these sectors bad. If the ECC detected errors without data printed out are excessive, (every head or more) the bytes per sector could be short which will cause this problem. Use the disk drives technical manual to check the number of bytes per sector there are on the disk unit with the present sector setting. 576 bytes or more are required to run the DC-297.

3.2.3.4 ECC UNDETECTED ERRORS

This is a data error undetected by the ECC circuitry. ECC undetected errors will terminate the formatter program. Note cylinder, head and sector the error occurred on; also note the count number. Load the configurator program and verify that the controller is configured for the right disk drive(s). If the configuration is okay, load the formatter again and bring up the command string interpreter explained in the Appendix. Use the command string to seek to the cylinder noted previously. Next, write to the head and sector (transfer one sector). This helps verify that the problem is not intermittent. Now format the noted sector and then write to it again. If the error is still there, power down the system and then power it back up. Examine the selftest LED (red) for any selftest errors. If there are none, try the DC-297 in another slot.

3.2.3.5 SURFACE OR SECTOR ADDRESS ERRORS

Surface/Sector address errors do not abort the format program. These errors usually indicate bad media in the header field. The formatter will automatically flag these sectors bad. If these errors are intermittent or excessive, check for poor disk termination, improper disk cabling or grounding, and re-check the controller configuration for the correct disk types.

3.2.3.6 LOSS OF READY

Loss of Ready errors abort the format program. They can be caused by improper cabling or termination. These errors indicate the disk unit is not ready when a command was issued. Check that the disk unit is powered up and no faults have occurred on the disk unit.

3.2.3.7 DEFAULT PARAMETERS

Default parameters can occur in the ZETACO Formatter, Reliability or Diagnostic programs. These default parameters replace the disk drive characteristics that should be printed out while running through the program questions. Default parameters exist when the controller does not see a unit selected from the disk drive. This communication problem between the controller and the disk unit can be caused by improper cabling, poor termination or grounding or a bad disk drive. The default parameters are shown below.

UNIT	TYPE	CYL	HEADS	SECTORS
0	0	411	5	32
1	1	823	5	32
2	2	823	10	32
3	3	823	19	32

3.2.3.8 ADDITIONAL INFORMATION FOR ALL PROBLEMS

For any error encountered while formatting, it is beneficial to try a different "B" port. This isolates some logic on the controller that cannot be checked by selftest.

3.2.3.9 SLOW FORMAT

The formatter program formats 300MB in about 56 minutes and time is directly proportional to the disk size. If it takes more time than this, the disk is probably skipping revolutions. To alleviate this problem, re-configure the controller to interleave the disk.

3.2.4 DISK DIAGNOSTIC

This diagnostic program is provided to find failures that are related to the basic operations of the Disk Controller.

3.2.4.1 DIAGNOSTIC ERROR DESCRIPTION

When the diagnostic detects an error, it prints out the test number that failed along with the actual problem. Use the SWPAK reg to help determine whether or not the error is intermittent. This is done by setting switch 3 which prints out an error percentage. Refer to Appendix B for detailed definitions of the bits in the SWPAK reg. Depressing the M key allow the user to observe the contents of this register.

3.2.4.2 SERVO OFFSET FORWARD

Servo Offset Forward errors can occur in the diagnostic if the disk unit does not support the offset command. They are also caused by disk drives that return a write protect to the controller during an offset. The technical manual for the disk unit should be consulted to determine whether your disk can exhibit the offset problem. If it does, this error is invalid and can be overlooked.

3.2.4.3 SERVO OFFSET REVERSE

Servo Offset Reverse errors can occur in the diagnostic if the disk unit does not support the offset command. They are also caused by disk drives that return a write protect to the controller during an offset. The technical manual for the disk unit should be consulted to determine whether your disk can exhibit the offset problem. If it does, this error is invalid and can be overlooked.

3.2.5 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. Boot the Disk Reliability program from M297 tape.

3.2.5.1 RELIABILITY ERROR DESCRIPTION

Reliability errors are displayed when they are detected. The controller status will be displayed with the particular problem spelled out below the status. Each status bit is explained in the Programming Section, but since the error is also spelled out,, referencing the Programming Section may not help. Most errors that can occur are default or ready errors.

3.2.5.2 LOSS OF READY

These errors indicate the disk unit is not ready when a command was issued. Check that the disk unit is powered up and no faults have occurred on the disk unit.

3.2.5.3 DEFAULT PARAMETERS

Default parameters exist when the controller does not see a unit selected from the disk drive. This communication problem between the controller and the disk unit is usually caused by the disk unit being powered down or faulted since this was okay in the formatter program.

3.2.5.4 ADDITIONAL INFORMATION FOR ALL PROBLEMS

For any error encountered while formatting it is beneficial to try a different "b" port. This isolates some logic on the controller that cannot be checked by selftest.

3.3 SYSTEM ERRORS

If a system error occurs, use the User's Manual provided with the system to help determine what is wrong. For example, if a panic code is given, look up the code; this information could help determine how to solve the problem. Next, try to execute a similar function and see if the same results are obtained. If a burst or a pcopy is not working, try a dump. This could add vital information about the problem.

3.4 CUSTOMER SUPPORT HOTLINE

ZETACO, Inc. provides a Customer Support Hotline (612-941-9460) to answer technical questions and to assist with installation and troubleshooting problems. The Hotline is manned by a technical team from 8:00 a.m. to 5:00 p.m. (Central Time) Monday through Friday.

3.5 WARRANTY INFORMATION

All ZETACO controllers and couplers are warranted free from manufacturing and material defects when used in a normal and proper manner for a period of two years from date of shipment. Except for the express warranties, stated above, ZETACO disclaims all warranties including all implied warranties of merchantability and fitness. The stated express warranties are in lieu of all obligations of liabilities on the part of ZETACO for damages, including but not limited to, special, indirect or consequential arising out of or in connection with the use or performance of ZETACO's products.

3.6 PRODUCT RETURN AUTHORIZATION

When controller malfunction has been confirmed using the tests outlined in Sections 3.1 through 3.4, the board can be returned to ZETACO for warranty repair or for time-and-material repair if the product has been damaged or is out of warranty. An RMA number is required before shipment and should be referenced on all packaging and correspondence.

To ensure fastest response, the information outlined in the Material Return Information form on the following page should be gathered before calling the ZETACO Hotline for the RMA number. Please include a completed copy of the Material Return Information form with the product. Each product to be returned requires a separate RMA number and Material Return Information form.

To safeguard the controller 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.

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to ZETACO for repair. This will: 1) Determine if the board is actually defective. 2) Increase the speed and accuracy of a product's repair, which is often dependent upon a complete understanding of the user's checkout test results, problem characteristics, and the user system configuration. Test results for the Disk Controller should be obtained by performing the tests below. (Use back of sheet if more space is needed.)

TEST		RESULT	
Self-test	_		_
Formatter	_		_
Diagnostics	_		_
Reliability	_		_

Other tests performed (system operation, errors, etc.):

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

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

2. Under which operating system are you running? (RDOS, AOS) Include Revision Number.

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

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

To be filled out by CUSTOMER:

Model #:_ _
Serial #:_ _
RMA #:_ _(Call ZETACO to obtain an RMA number.)

Returned by:

Your name:_ _
Firm:_ _
Address:_ _
Phone:_ _

4.0 CONTROLLER USAGE GUIDELINES

4.1 CONTROLLER FEATURES PROGRAMMED BY THE CONFIGURATOR

4.1.1 CONFIGURATOR AID (HELP)

The DC-297 Configurator includes two "HELP" commands, one for OPERATIONAL questions and one which suggests WHAT you might want to do. In addition, you can get an explanation for any item by responding with an "H" to the question. Please use these functions whenever you are uncertain as to what to do.

4.1.2 THROTTLE BURST RATE

This is defined as the number of word transfers that take place over the data channel during a single bus access by the disk controller. 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. The controller may be set to burst rates of 4, 8, 16, 32, 64, 128 and 256 words per access. A burst rate of 16 is recommended for most applications.

The DC-297 allows you to select a different burst rate for each SMD port thereby giving the ability to fine tune the bus to the particular speed or activity of each disk drive.

4.1.2 SYNC BYTE

The DC-297 supports a disk media format which contains a header sync byte and data field sync byte versus a sync bit. The sync byte provides better header address verification and data integrity. This sync byte is user definable for each SMD port. Any value between 01 hex and FF hex is acceptable, although 93 hex (223 oct) is the recommended value. When entering a sync byte use the octal (oct) number. This feature can provide a means for disk pack access security between different disk subsystems.

4.1.4 ERROR CORRECTION ENABLE/DISABLE

When this function is enabled, on-board error correction and data strobe early/late occur automatically on bad disk data. Also, 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 this function disabled, ECC corrections must be handled by the software. This feature can be selected on any port.

If any disks are going to be formatted and initialized following configuration, it is recommended that on-board ECC be disabled, then re-enabled after disk initialization.

4.1.5 MEDIA FORMAT

The DC-297 currently offers a choice of five (5) different disk media formats to maintain compatability with other disk subsystems. Each port is independently configurable for any of the formats.

The disk media formats available are:

ZETA 1 — standard 10Mhz format (recommended for drives that transfer data at rates of less than 12Mhz).

ZETA 2 — high speed format (version of standard format designed for use with drives with transfer rates of 2.5 Mbyte/second, (20Mhz).

ZETA 3 — high speed compatible format (version of standard format designed for use with drives with transfer rates of 12Mhz to 16Mhz).

SECONDARY FORMAT

ALTERNATE VENDOR FORMAT

See Figure 1.2 for detailed information.

4.1.6 INTERLEAVE FACTOR

The DC-297 supports any sector interleave from 1:1 to 6:1 and each SMD port can have a different interleave ratio. 1:1 interleave is recommended for optimum performance and should be sufficient in most cases. Disk drives with very high transfer rates may require a sector interleave of 2:1 to avoid missing the next logical sector.

Interleaving may be used, along with throttling to fine tune a system's performance. This is to avoid going a full revolution on the disk when the CPU cannot respond fast enough to access the next consecutive sector.

If data channel activity is too high to access the next consecutive sector, which is indicated by extremely slow disk performance, then an interleave factor of 2:1 or greater should be selected. To maintain optimum performance, don't select an interleave greater than is required to access the next logical sector in a multiple sector transfer.

4.1.7 DISK DRIVE TYPES

The DC-297 is capable of controlling virtually any disk drive that meets the SMD interface specification. The controller may be configured to assign drives of varying capacities, transfer rates, formats, etc. to any of the four ports.

When running under AOS, only those drives which meet the sizing characteristics of the supported emulations can be used. Under RDOS, the DC-297 can take advantage of the full capacity of most disk drives because ZETACO's Disk Initializer, CSDKINIT, allows deviation from standard RDOS disk emulations.

This section of the Configurator program allows the operator to assign drive characteristics on a port-by-port basis. Note that drive characteristics are assigned per "port", or "B" cable, and not per the drive's unit number setting. (Any unit can be connected to any of the four ports.) A warning will be issued when a potentially illegal configuration is attempted. "HELP" information is available throughout.

Notes regarding dual volume drives:

Dual volume drives must be assigned an even unit number. A dual volume drive is treated as two logical units, so a maximum of two dual volume drives or one dual volume and two single volume drives may be attached to the controller.

There are two forms of dual volume drives:

The first is an actual dual volume drive designed with two physical volumes, usually one fixed and one removable cartridge. These include the Control Data Corporation Lark and 9448 (CMD), and Amcodyne's 7110.

The other form is actually a single volume drive which is "split" by the controller into two logical units to provide the sizing characteristics necessary for emulation. For example, under AOS the Fujitsu 2351 (Eagle) is split for dual 6061 emulation and the Applied Peripheral Systems 4035 is split for dual 6161 emulation.

Both forms of dual volume drives must have each logical unit formatted separately by the initializer programs, (CSDKINIT for RDOS or DFMTR for AOS). In the case of ZETACO's formatter program, which must be run prior to the initializer program, the "split" form of dual volume drives must be formatted at the same time or errors will occur. The other form of dual volume disk drive may be formatted at the same time or separately.

4.2 DISK ECC COUNTER UTILITIES

The Model DC-297 Controller maintains a counter of ECC corrections for each disk 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 utilities must be loaded onto disk from the M297 tape (RDOSECC.SV for RDOS and AOSECC.PR for AOS). The utilities allow 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 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.

5.0 PROGRAMMING NOTES

5.1 PROGRAM INSTRUCTIONS

5.1.1 SYMBOLIC DEFINITIONS USED

DXXF AC, DSKP

DXX means either DOA, DOB, DOC, DIA, DIB or DIC

F means Function: There are three functions; C, S, P. Each affects the controller differently as described below.

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 - There are four ACs: 0, 1, 2 or 3.
DSKP	DEVICE CODE: PRIMARY - 27 Octal SECONDARY - 67 Octal (Other available)

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				

5.1.2 INTERRUPT MASKING (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.

5.1.3 I/ORESET 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.

5.1.4 I/OSKIP INSTRUCTION USAGE

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, otherwise 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.

5.2 ACCUMULATOR FORMATS FOR THE I/O INSTRUCTIONS

This section explains the meaning of each bit in the accumulator used by the I/O instruction.

5.2.1 DOA - USED TO SPECIFY A COMMAND AND A DRIVE

DOAF AC, DSKP

5.2.1.1 BINARY REPRESENTATION

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

5.2.1.2 ACCUMULATOR FORMAT

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R/W DN	CLR SEEK DONE					COMMAND		DRIVE			NOT USED				

BIT POSITION	FUNCTION OF THE BIT
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

BITS 5-8 SPECIFY A COMMAND

If bits 5-8 are set to:	COMMAND IS	FUNCTION REQUIRED TO INITIATE
0000	READ	START
0001	RECALIBRATE	PULSE
0010	SEEK	PULSE
0011	STOP DISK	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 ??? FOR DETAILED COMMAND DESCRIPTION.

BITS 9 - 10 DRIVE SELECTION: Issue the command to the drive specified by these bits

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.

BITS 11 -15 Reserved for future consideration.

5.2.2 DOB - LOAD THE STARTING MEMORY ADDRESS

Execution of this instruction will load the controller's 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.

DOBF AC, DSKP

5.2.2.1 BINARY REPRESENTATION

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					

5.2.2.2 ACCUMULATOR FORMAT

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

5.2.3 DOC - LOAD THE DRIVE ADDRESS

The DOC accumulator has two separate functions depending on the command issued by the DOA instruction. If the DOA command is a seek, then the DOC accumulator bits specify the cylinder (or track) to seek to. If the DOA command is a read, write, format or data verify, then the DOC accumulator bits specify the starting surface, the starting sector and the number of sectors to transfer (two's complement).

DOCF AC, DSKP

5.2.3.1 BINARY REPRESENTATION

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					

5.2.3.2 ACCUMULATOR FORMAT (For Seek)

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

5.2.3.3 ACCUMULATOR FORMAT (For Read, Write, Format or Data Verify)

SINGLE DOC

Single DOC describes the process of executing one DOC instruction for each DOA instruction that specifies one of the four functions mentioned. This process is used to support a disk drive running 32 sectors or less and 32 surfaces or less. The reason more than 32 sectors cannot be supported with single DOC si that only five bits of the accumulator used by the DOC are used to address a sector on the disk. (Same number of bits for the surface.) As a result, the sectors that could be addressed is sector 0 to 31 or 32 sectors. If a disk drive capable of more than 32 sectors was implemented, single DOC would not allow access to any sector above 31. This is why double DOC was developed.

DOUBLE DOC

Double DOC refers to a process where two DOC instructions are given consecutively for each DOC command specifying a read, write, format or data verify. This procedure is required to obtain the maximum efficiency from a disk drive capable of running more than 32 sectors. The first DOC's accumulator will contain extended disk address information and the second DOC's accumulator will contain the lower five bits of the surface, sector and count (this second DOC would be the only DOC for single DOC). The accumulator formats for each DOC follow.

5.2.3.3.1 THE FIRST DOC

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

5.2.3.3.2 THE SECOND DOC

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

0 - NOT USED
1 - 5 STARTING SURFACE ADDRESS
6 - 10 STARTING SECTOR ADDRESS
11 - 15 2 IS COMPLEMENT NUMBER OF SECTORS TO BE TRANSFERRED.

5.2.4 CONTROLLER STATUS

There is a large amount of status information shared between the disk controller and the computer. So much information that all the bits from the DIA, DIB and the DIC are not enough to satisfy the required amount of information. As a result, alternate mode was incorporated to change the meaning of the following DIA, DIB or DIC. There are two alternate modes called Alternate Mode 1 and Alternate Mode 2. To invoke an alternate mode, a DOA command must be issued with the desired alternate bits set. Otherwise the controller will return non-alternate mode status.

5.2.4.1 DIA - NON ALTERNATE MODE - READ DATA STATUS

DIAF, AC, DSKP

5.2.4.1.1 BINARY REPRESENTATION

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			

5.2.4.1.2 ACCUMULATOR FORMAT DIA - NON ALTERNATE MODE

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

BIT #	DEFINITION
0	Control Full
1	Read/Write 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 Address
8	ECC Error
9	Bad Sector Flag
10	Cylinder Address Error
11	Surface/Sector Address Error
12	Verify Error
13	Read/Write Timeout
14	Data Late
15	Read/Write Fault

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

DATA TRANSFER STATUS BIT DESCRIPTIONS

ACCUMULATOR BIT POSITION	DEFINITION	DESCRIPTION
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 (Recall, Seek, Stop Disk, Offset, WRT DIS, Release, Trespass or 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	SURF/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 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 a detailed description of error recovery expectations.

TABLE 6.1 Read/Write Faults (DIA)

	STATUS BIT POSITION	CONTROLLER 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 reoccurs. Make sure the controller is configured to match the drive type.
ECC ERROR	8	Sets done at 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.
SURFACE/ SECTOR ADDRESS ERROR	11	Sets done immediately.	New command. Bad sector flag should be set if surface analysis.
VERIFY ERROR	12	Sets done at end of 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.

5.2.4.2 DIB - READ DRIVE STATUS

DIB AC, DSKP

5.2.4.2.1 BINARY REPRESENTATION

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				

5.2.4.2.2 ACCUMULATOR FORMAT DIB - READ DRIVE STATUS

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

BIT #	DEFINITION
*0	Invalid Status
*1	Drive Reserved
*2	Trespassed
3	Ready
4	Busy
*5	Positioner Offset
6	Write Disabled
*7	ID
*8	Illegal Surface/Cylinder Address
*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.

DRIVE STATUS BIT DESCRIPTIONS

ACCUMULATOR BIT POSITION	DEFINITION	DESCRIPTION
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 configuration 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 a detailed description of error recovery expectations.

5.2.4.3 DIC - READ SURFACE, SECTOR AND COUNT

DICF AC, DSKP

5.2.4.3.1 BINARY REPRESENTATION

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			

5.2.4.3.2 ACCUMULATOR FORMAT DIC

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				

5.2.5 READ STATUS - ALTERNATE MODE ONE

If a DOA is issued and the alternate 1 bits are set, the following DIA, DIB, or DIC is defined by the following Sections 5.2.5.1 through 5.2.5.3.

5.2.5.1 DIA - READ CURRENT MEMORY ADDRESS (ALT MODE 1)

After the execution of this instruction the value of the accumulator specified 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.

DIAF AC, DSKP

5.2.5.1.1 ACCUMULATOR FORMAT

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

5.2.5.2 DIB - READ EXTENDED DISK ADDRESS (ALT MODE 1)

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.

DIBF AC, DSKP

5.2.5.2.1 ACCUMULATOR FORMAT

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

5.2.5.3 DIC - NOT CURRENTLY IMPLEMENTED (ALT MODE 1)

5.2.6 READ STATUS - ALTERNATE MODE TWO

If a DOA command is done with the alternate 2 mode bits set, the following DIA, DIB or DIC accumulator bits are defined Sections 5.2.6.1 through 5.2.6.3.

5.2.6.1 DIA - READ ECC REMAINDER UPPER WORD (ALT MODE 2)

DIAF AC, DSKP

5.2.6.1.1 ACCUMULATOR FORMAT

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

5.2.6.2 DIB - READ ECC REMAINDER LOWER WORD (ALT MODE 2)

DIBF AC, DSKP

5.2.6.2.1 ACCUMULATOR FORMAT

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

5.2.6.3 DIC - NOT CURRENTLY IMPLEMENTED (ALT MODE 2)

5.3 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 DOA instruction. Before any command is initiated, the selected unit must have valid status and be ready.

5.3.1 DATA TRANSFER COMMANDS

Start (Set Busy) will initiate any one of the data transfer commands. There are five data transfer commands: Read, Write, Format, Verify and Read Buffers. Up to 64 contiguous sectors may be transferred using double DOC and up to 32 contiguous sectors may be transferred using single DOC.

To read or write with this controller, the following steps are recommended.

1. Control Full and Drive Status must be tested for proper state before commencing with a Read/Write command, (no faults and ready).

2. Send the Starting Surface and Sector Address along with the two's complement of the number of sectors transferred. (See DOC Section 5.2.3.2.)

3. Send the Starting Memory Address of where the data should be stored or retrieved. (See DOB Section 6.2.1.)

4. Send the Command type and the desired drive unit number. (See DOA Section 6.2.1.)

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.

5.3.1.1 READ DATA 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 ensure 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 drive's 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 ensure 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 feature is selected, (refer to Section 3.9.1.4), 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.

5.3.1.2 WRITE DATA 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 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 onto 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 onto the disk surface preceeded 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.

5.3.1.3 VERIFY COMMAND

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.

5.3.1.4 FORMAT COMMAND

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 fomratted per command. Data that was contained within the sector will be lost (replaced by all zeros). Refer to Figure 2.2 for format details. Format is also used to set the bad sector flag.

5.3.1.5 READ BUFFERS COMMAND

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.

5.3.2 DRIVE COMMANDS

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

5.3.2.1 RECALIBRATE

This command 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.

5.3.2.2 SEEK

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.

5.3.2.3 OFFSET FORWARD

This command 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.

5.3.2.4 OFFSET REVERSE

This command 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 Forward or Reverse may be used as an attempt to recover data that cannot be corrected by the error correction algorithm.

5.3.2.5 WRITE DISABLE

Not implemented.

5.3.2.6 RELEASE DRIVE

Clears the reserved condition of the specified drive which this processor had previously reserved.

5.3.2.7 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 disk drive timout feature times out.

5.3.2.8 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.

5.3.2.9 EXAMINE RAM COMMAND

This command gives the system the capability of reading from or writing to the DC-297 Controller's memory. This command must be preceeded by a DOC containing the address of the desired RAM location. See Tables 6.3 and 6.3.1 for memory map.

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. Configuring the EEPROM

E. Features that may be considered in the future

TABLE 6.3 Disk RAM Memory Map

ADDRESS (HEX)	NAME
000 - 0FF	SECTOR BUFFER 0
100 - 1FF	SECTOR BUFFER 1
200 - 2FF	SECTOR BUFFER 2 (NOT USED)
306	CYL 0
307	CYL 1
308	CYL 2
309	CYL 3
30A	CURRENT SURFACE, SECTOR, SECTOR COUNT
30B	ZADJ. SURFACE ADDR
30D	SURF - SECT
310	BAD SECTOR FLAG
311	UNIT SELECT
312	SOFT ECC DISABLE (NOT USED)
320	UNIT 0 PORT SEEK END MAP
321	UNIT 1 PORT SEEK END MAP
322	UNIT 2 PORT SEEK END MAP
323	UNIT 3 PORT SEEK END MAP
330	*ZADJ. MAX SECTOR
331	*ZADJ. MAX SURFACE
332	*ZADJ. MAX CYLINDER
333	SYNC BYTE
334	VOLUME ADDR (CMD)
335	BANK SEL
340	*UNIT 0 CORRECTION COUNT
341	*UNIT 1 CORRECTION COUNT
342	*UNIT 2 CORRECTION COUNT
343	*UNIT 3 CORRECTION COUNT
348	SECTOR VERIFICATION ENABLE
349	SECTOR COUNT
34A	LENGTH OF LAST SECTOR (COUNT * 600 NANOSEC.)
3FF	PROM ID/REVISION LEVEL

*NOTE: Reference the detailed RAM Description in Table 6.3.2 for more information on these ram locations.

TABLE 6.3.1 EEPROM Memory Map

ADDRESS (OCTAL)	NAME
4800	START OF PORT 0 CHARACTERISTICS
4880	START OF PORT 1 CHARACTERISTICS
4900	START OF PORT 2 CHARACTERISTICS
4980	START OF PORT 3 CHARACTERISTICS

DISK PORT CHARACTERISTICS

XX00	RCHAR SWITCHES
XX01	RPARA SWITCHES
XX02	DISK DEVICE SELECT CODE
XX03	INTERLEAVE FACTOR
XX04	THROTTLE BURST RATE
XX05	NOT USED
XX06	NOT USED
XX07	TAPE DEVICE SELECT CODE
XX08	TAPE CONFIGURATION CHARACTERISTICS
XX20	MAX SECTOR
XX21	MAX CYL-UPPER
XX22	MAX CYL-LOWER
XX23	MAX HEAD
XX24	MAX HEAD-ODD UNIT
XX25	HEAD MASK
XX26	BANK PRIORITY
XX27	SYNC BYTE
XX30 - XX7F	INTERLEAVE MAP

TABLE 6.3.2 Detailed RAM Descriptions

ADDRESS (OCTAL)	NAME	DESCRIPTION
1460-1462 (330-332 hex)	SELECTED DRIVE CHARACTER-ISTICS	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 (340-343 hex)	UNIT CORRECTION COUNTS	These locations will be incremented each time the controller does a corrections 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

1777-8 PROM ID/REV

DIC ACCUMULATOR

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

5.3.3 ALTERNATE MODES

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

5.3.3.1 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.

5.3.3.2 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.

5.4 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.

5.5 FORMAT SEQUENCER

The DC-297 Disk Controller features a format sequencer which controls the disk side of the controller. The firmware which controls this sequencer is contained in PROMS, allowing disk format changes to take place in the PROMS instead of the microprocessor firmware.

The format sequencer firmware is arranged in eight banks of 64 words each and is selectable for the format bank desired. Each bank consists of READ/WRITE/FORMAT CODE. The last bank is reserved for selftest.

5.5.1 READ/WRITE FORMATS

Each disk port of the DC-297 may be independently configured to use one of four currently available sector formats. These formats are described in Section ???. See Figure 2.2 for detailed format information.

APPENDIX A

A.0 ENVOKING THE COMMAND STRING INTERPRETER

The Command String Interpreter is a diagnostic tool built into the formatter and the reliability programs on the M297 tape. To get into the Command String Interpreter, the formatter or the reliability program must be loaded into system memory. Once the formatter or reliability is in system memory, a control O should be executed and an @ should appear on the console. Now key this into the console: 503R. This will start a program from address 503 which is the command string interpreter's starting address. Questions must be answered the same as if the program was run from scratch until the point after entering the disk types. You are now in the command string and the following is an explanation of the options the command string allows.

A.1 THE COMMAND STRING FUNCTIONS

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.

As a troubleshooting aid the Service Engineer may type in his own test loop. After starting at 503, three arguments must be entered in response to three program questions, "UNIT", "DATA", and "COMMAND STRING". All numbers must be entered in octal.

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

II. DATA: RAN = RANDOM

ALO = ALL ONES
ALZ = ALL ZEROS
PAT = 155555 PATTERN
ROT = 155555 PATTERN ROTATED ON SUCCESSIVE PASSES
ALT = 52525 PATTERN
FLO = FLOATING ONE PATTERN
FLZ = FLOATING ZERO PATTERN
ADR = ALTERNATING CYLINDER AND HEAD, SECTOR WORDS
VAR = EXISTING WORDS ENTERED PREVIOUSLY AS DESCRIBED ON THE FOLLOWING PAGE

ALTERNATELY 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. DISABLE (WRITE DISABLE)
8. TRESPASS
9. STOP DISK
10. RELEASE
11. OFF (OFFSET FORWARD)
12. OFR (OFFSET REVERSE)
13. LR (BEGIN LOOP HERE)
14. VERIFY (WRITE)
15. MEMORY ADDRESS, DATA (WRITE) CONTROLLER MEMORY COMM
16. TYPE CARRIAGE RETURN TO USE THE PREVIOUS COMMAND STRING

NOTE: NEITHER SPACES OR COMMAS 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 THE COMMAND STRING START. THE ESCAPE KEY WILL BYPASS THE UNIT AND DATA PROMPTS TO THE COMMAND STRING PROMPT.

A.2 COMMAND STRING INTERPRETER EXAMPLES

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 zero to controller memory location 1500 (octal):

```
UNIT:  1
DATA:  N/A
COMMAND STRING:  MEMORY 101500, 0
NOTE:  UPPER MEMORY BIT - 1 DEFINES A WRITE
```

B.0 FORMAT SWPAK REG BIT DEFINITIONS

Once the program starts executing the state of any of the bits can be changed by hitting keys 1-9, A-F. The program will continue running after updating the options. Each key will complement the state of the bit affiliated with it, thus bit 4 can be altered by hitting key 4. Setting of any bit of location "SWREG" will set bit 0. (Default mode is defined as all bits of SWREG set to 0.)

SWREG BIT INTERPRETATION

BIT	OCTAL VALUE	BINARY VALUE	INTERPRETATION
1		0	LOOP ON ERROR
	40000	1	SKIP LOOPING ON ERROR
2		0	PRINT TO CONSOLE
	20000	1	ABORT PRINT OUT TO CONSOLE
5		0	DO NOT PRINT ON LINE PRINTER
	02000	1	PRINT ON LINE PRINTER
11(B)		0	N/A
	00020	1	ENABLE BAD SECTOR PRINTOUT

B.1 DIAGNOSTIC SWPAK REG DEFINITIONS

Once the program starts executing, the stat of any of the bits can be changed by hitting keys 1-9, A-F. The program will continue running after updating the options. Each key will complement the state of the bit affiliated with it, thus bit 4 can be altered by hitting key 4. Setting of any bit of location "SWREG" will set bit 0. (Default mode is defined as all bits of SWREG set to 0.)

SWREG BIT INTERPRETATION

BIT	OCTAL VALUE	BINARY VALUE	INTERPRETATION
1		0	LOOP ON ERROR
	40000	1	SKIP LOOPING ON ERROR
2		0	PRINT TO CONSOLE
	20000	1	ABORT PRINT TO CONSOLE
3		0	DO NOT PRINT % FAILURE
	10000	1	PRINT % FAILURE
5		0	DO NOT PRINT ON LINE PRINTER
	02000	1	PRINT ON LINE PRINTER
6		0	DO NOT HALT ON ERROR
	01000	1	HALT ON ERROR
7		0	N/A
	00400	1	EXECUTE A RE-FORMAT CHECK
8		0	N/A
	00200	1	RECALIBRATE DURING SCOPE LOOP
9		0	N/A
	00100	1	1 SECOND DELAY DURING SCOPE LOOP
10(A)		0	N/A
	00040	1	PROGRAM WILL PRINT TEST #'S AND FIRMWARE
11(B)		0	N/A
	00020	1	PROGRAM WILL EXIT TO ODT WHEN NOT IN TESTS F1-##SEE 7.5## SWITCH IS SET TO 0 UPON EXIT
12(C)		0	SKIP LONG RAM TEST
	00010	1	LONG CONTROLLER RAM TEST

B.2 RELIABILITY SWPAK REG BIT DEFINITIONS

Once the program starts executing, the state of any of the bits can be changed by hitting keys 1-9, A-F. The program will continue running after updating the options. Each key will complement the state of the bit affiliated with it, thus bit 4 can be altered by hitting key 4. Setting of any bit of location "SWREG" will set bit 0. (Default mode is defined as all bits of SWREG set to 0.)

SWREG BIT INTERPRETATIONS

BIT	OCTAL VALUE	BINARY VALUE	INTERPRETATION
1		0	LOOP ON ERROR
	40000	1	SKIP LOOPING ON ERROR
2		0	PRINT TO CONSOLE
	20000	1	ABORT PRINT OUT TO CONSOLE
4		0	PRINT PASS
	04000	1	DO NOT PRINT PASS
5		0	DO NOT PRINT ON LINE PRINTER
	02000	1	PRINT ON LINE PRINTER
6		0	DO NOT EXIT TO ODT ON ERROR
	01000	1	EXIT TO ODT ON ERROR
7		0	**** N/A
	00400	1	BREAK FOR PACK INTERCHANGE
8		0	**** N/A
	00200	1	READ ONLY MODE (SA 501,502)
9		0	N/A
	00100	1	BYPASS DATA CHECK
10(A)		0	N/A
	00040	1	VERIFY AFTER WRITE (SA 502 ONLY AND NOT RANDOM DATA)
11(B)		0	N/A
	00020	1	ENABLE BAD SECTOR PRINTOUTS
12(C)		0	N/A
	00010	1	HALT ON DRIVE ERROR PRIOR TO RECOVERY RECAL OPERATION
13(D)		0	NO TRACE
	00004	1	TRACE PRINTOUT ON ERROR

C.0 TEST PROGRAMS TO USE IF THE SYSTEM HAS BEEN BUILT BUT PROBLEMS HAVE ARISEN

This appendix explains a test that can be done on a disk that has a system or system data on it without destroying that system or data. This provides an avenue for conditions which require utility testing but time does not permit the luxury of being able to rebuild a system. To accomplish testing the disk with a utility program without destroying media has a disadvantage which is no writing will be done to the disk.

This test requires that the reliability program on the M297 tape be loaded into system memory. Answer the question, "enter device code", with the correct information. Next, depress Control O. An @ should appear on the console. There are two different tests that can be run, a Random Seek Test or a Sequencial Seek Test. To run the Random Seek Test, enter a 501R after the prompt (@). If the Sequencial Test is desired, enter a 502R after the prompt (@). Now answer the questions the program asks for as in the normal reliability testing with the exception of one question. When the question "SET SWPAK PER 8.0 OR HIT (CR) TO CONT." is asked, enter an 8 one time. This puts the program in a read only mode and writes will not be done. Enter an "M" to verify that switch 8 is now ON, because if it is not, writes will be done crashing the disk. The 501 and 502 reliability will behave in the following manner.

A. Random Reliability Test (SA 501) With Options

The operator is given options on data patterns (from the command string data), and may choose a constant cylinder, head, sector or # of sectors. Any letter response to cylinder, head, etc. gets random function for that variable. A 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.

B. Sequencial Disk Address Test (SA 502)

The operator is given option on data (from the command string data). Requested data is first written over the entire pack. Then the data is read from all sectors. This ensures that all disk pack blocks are usable and are formatted properly. The test is then repeated for all ready disks and pass is printed. The sequence is repeated indefinitely.

ZETA

Please give us your comments.

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