CUSTOM SYSTEMS, INC.

296 STORAGE MODULE

DISK CONTROLLER

REVISION HISTORY		
ECO#	DATE	DESCRIPTION

NTB16698

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUB-TABLE OF CONTENTS

1.0 INTRODUCTION

The Custom Systems, Inc. 296 Storage Module Disk Controller provides a full emulation integration of Data General Nova/Eclipse Minicomputers, SMD Interface Disk Drives and RDOS/AOS/MP/AOS Operating Systems. It is fully compatible with Data General and Data General emulating minicomputers and complies with FCC regulations.

Advantages:

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

1.1 FEATURES

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

.Offset Positioning for Data Error Recovery

.Data Strobe Early/Late for Data Error Recovery

.Two Methods of Power Fail Detection

.Logging of the number of Data Corrections that have occurred on a per unit basis

.Disk Drive Power Sequencing

.Delayed Power on Pick

.Mix different Drive Formats

.Extended Unit Select Address

.Header CRC Auto Re-try

SUB-TABLE OF CONTENTS

2.0 SPECIFICATIONS

2.1 INTERFACE

2.1.1 DRIVE

Electrical: Standard SMD Interface

Driver/Receiver: Differential

Cabling: EXTERNAL

One 60 Pin Shielded Round Cable ("A" Cable) for the first Disk Drive (Daisy Chained).

One 26 Pin Shielded Round Cable ("B" Cable) for the first Disk Drive (Radial).

INTERNAL

One 60 Pin Ribbon Cable with D Connector on one end that mounts in the backpanel. The other end plugs into a Paddle Board. See Figure 3.1.1.

One to four 26 Pin Ribbon Cables with D Connector on one end that mounts in the backpanel. The other end plugs into a Paddle Board. See Figure 3.1.1.

Multiple Drives: Up to four Drives (Dual Volume counts as two) per controller. The 60 Pin "A" Cable, Daisy Chains from Drive to Drive, with the last Drive in the chain receiving an "A" Cable terminator. The 26 Pin "B" Cable connects radially to each Drive. (No Terminators required). Reference Figure 3.8.

Performance:

2.1.2 COMPUTER

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

2.2 POWER

+5 VDC @ 6.6 Amps

-5 VDC @ 0.7 Amps

2.3 PHYSICAL

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

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

Cables: 60 Pin Ribbon "A" Cable - 15 feet

26 Pin Ribbon "B" Cable - 15 feet

2.4 ENVIRONMENTAL

Operating Temperature: 0 to 55 degrees C

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

Exceeds all Nova/Eclipse temperature and humidity specifications.

SUB-TABLE OF CONTENTS

3.0 INSTALLATION

It is suggested that the Disk Drive Manufacturer's Manual be referenced for correct switch settings of the Disk Drive. Please read the following 296 Installation Section carefully.

3.1 UNPACKING AND INSPECTION

All parts comprising of the Model 296 are shipped in one container consisting of:

a) Controller
b) Backpanel to Disk Drive Cabling (Optional)
c) Backpanel Paddle Boards
d) Backpanel to Disk Drive Cables (Optional)
e) Diagnostic Software
f) Technical Manual

On receipt of the Model 296 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.

Custom Systems' warranty does not cover shipping damage.

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

NOTE: The 1/2" magnetic tape contains; Disk Formats (CSI, CSI High Speed and Alternate), CSI Diagnostics, CSI Reliability and CSDKINIT - Disk Initializer. Refer to Section 4.0.

3.2 CONFIGURING THE 296 CONTROLLER

The configuration of the 296 is eased by having all options switch selectable. This section discusses each option switch and the meaning of each Switch's On and Off position. At the completion of Section 3.2 the configuration of the 296 will be completed. Refer to Figure 3.1 for the location of all referenced Switches and Port Connector Assignments. Insure the Disk Drive you are installing has the Index and Sectoring signals on the A Cable. If these signals are on the B Cable only, the controller board will not install correctly.

CAUTION: The 296 with its FCC cabling scheme will only work in the "I/O Only" Slots of the Nova 4, S120, S140, S280 and S250/C350 with optional "I/O Only" backplane.

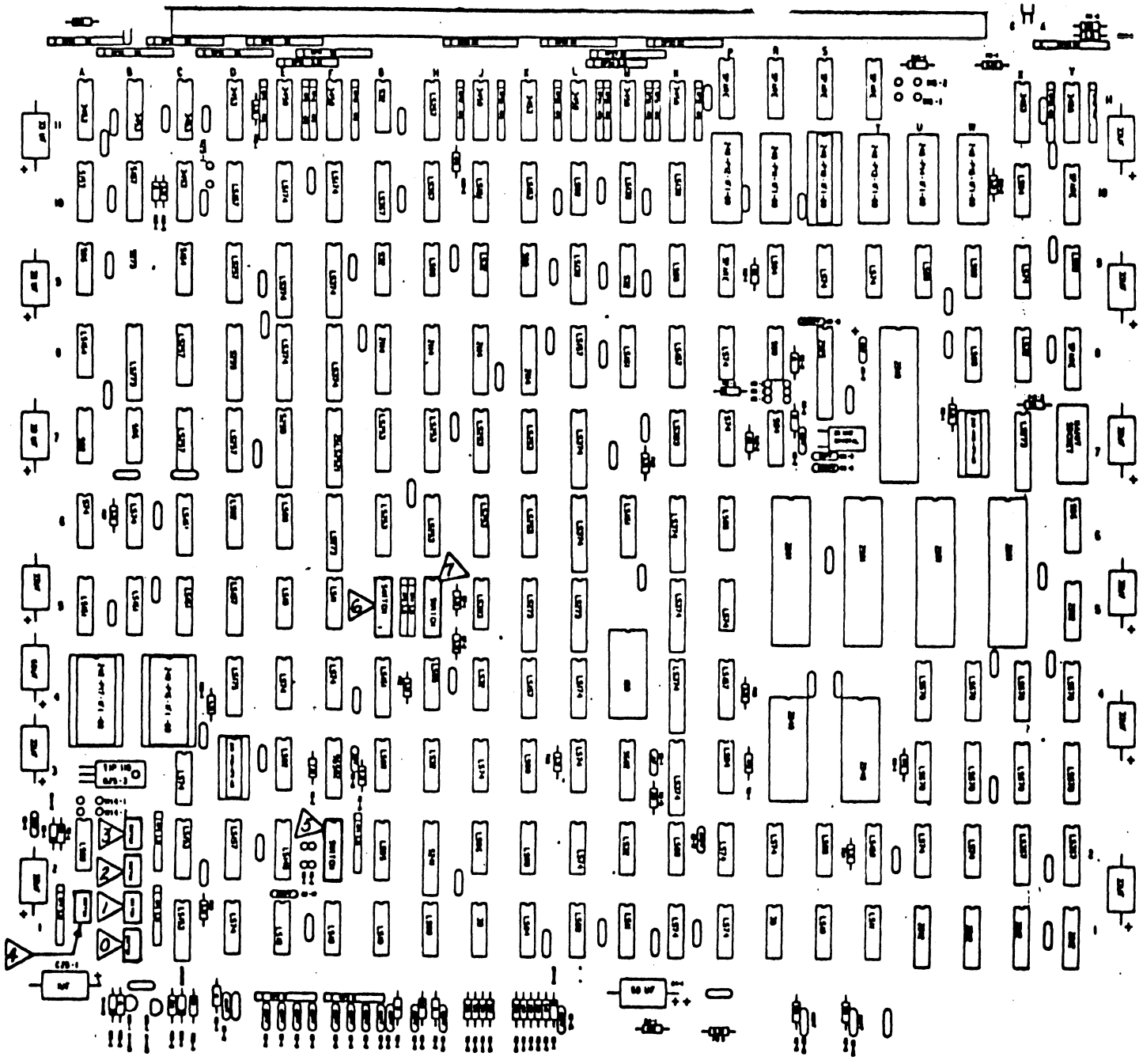
Insure you adhere to the following list to validate your warranty:

CPU TYPE(S)	"I/O ONLY" SLOTS
Nova 4, S120 (5 slot)	3-5
Nova 4, S120, S140 (16 slot)	12-16
S280 (20 slot)	11-19
S250/C350	*2-16

*Requires optional "I/O Only" backpanel.

3.2.1 SWITCH LOCATION F2 (REFERENCE FIGURE 3.2)

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

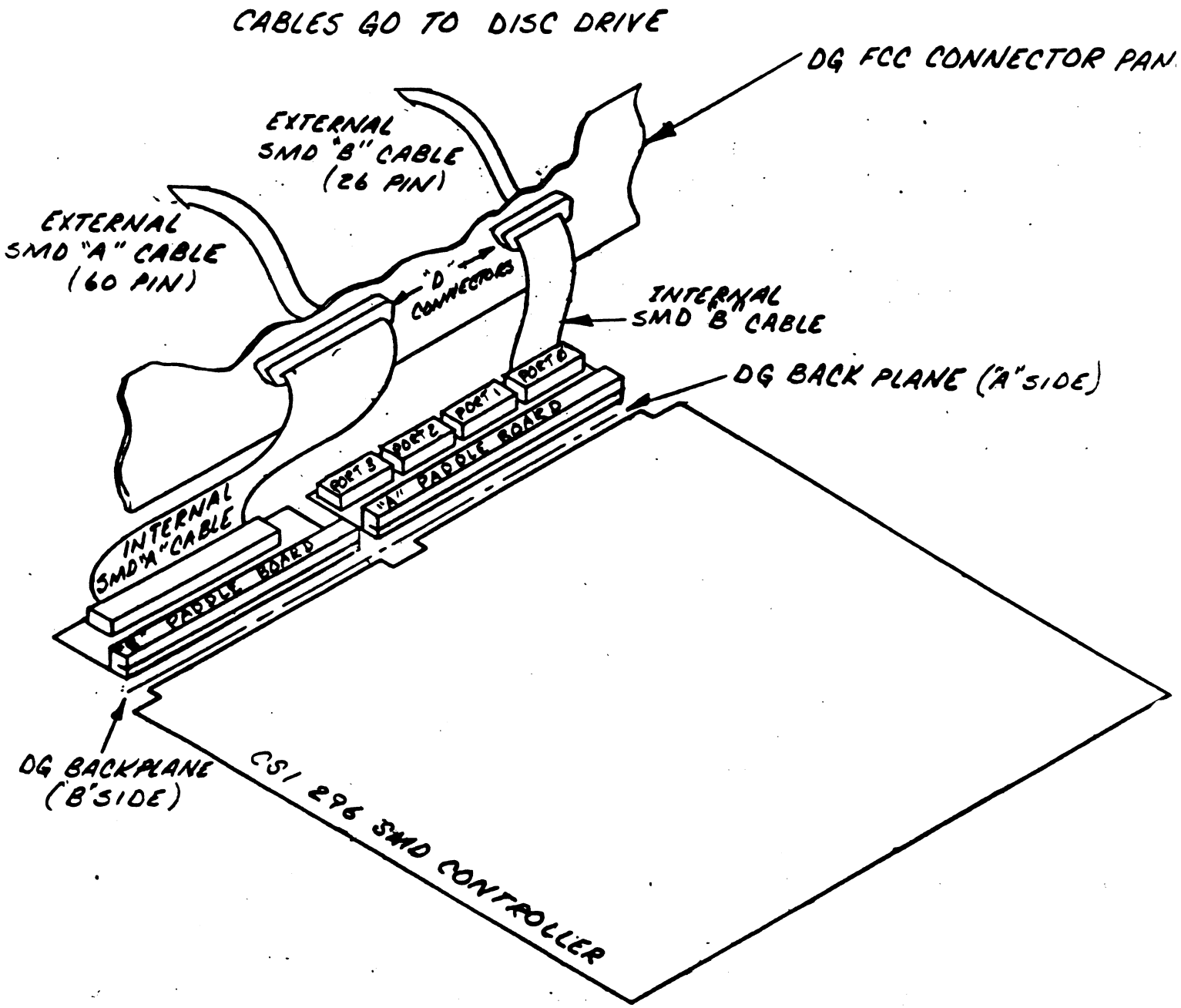


BOARD LAYOUT

Figure 3.1

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

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

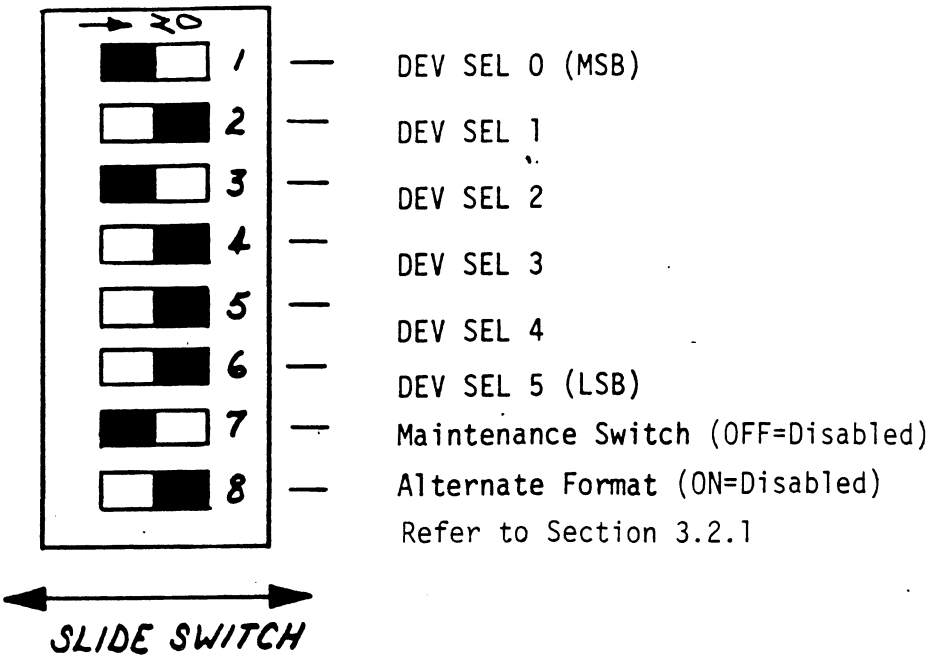


BOARD DIAGRAM

FIGURE 3.1.1

Switch Position 7 is used to control looping on the controller's Selftest Feature. With the switch in the On position the Selftest feature will operate continuously. With the switch in the Off position the Selftest will occur once on Power Up. This switch must be in the OFF position.

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



Location F2

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

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

DEVICE CODE SELECT SWITCH

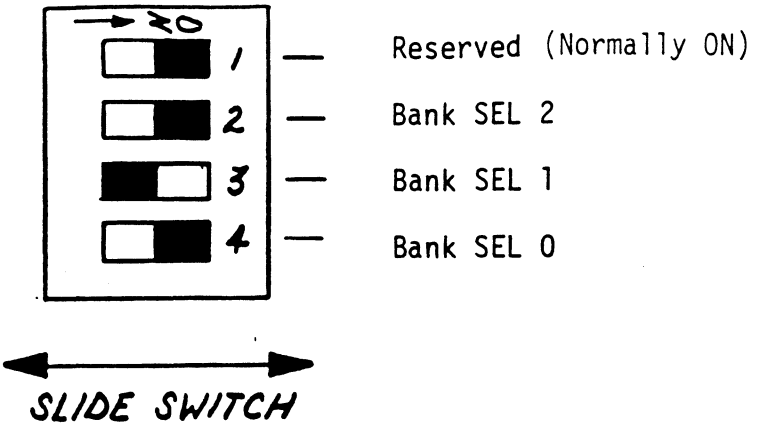
Figure 3.2

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

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

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

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



Location A1

Figure shows bank two selected.

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

BANK SELECT SWITCH

Figure 3.3

3.2.3 PORT CONFIGURATION SWITCH SELECTION

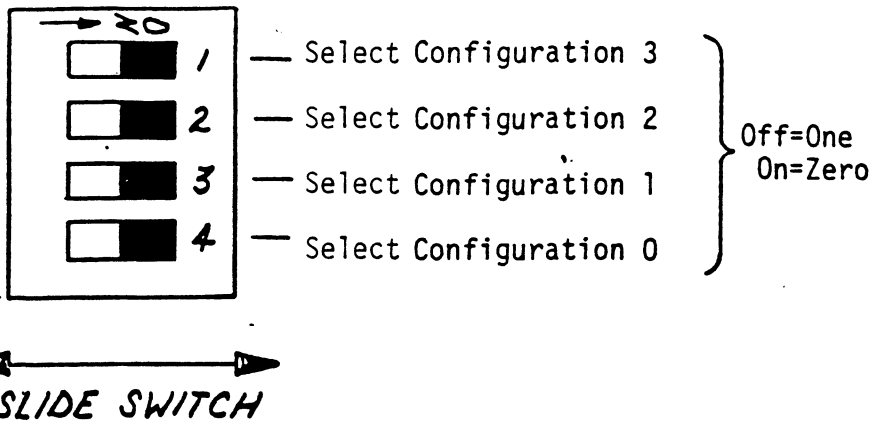
Switch Locations	B1A - Port 0 (Reference Figure 3.4)
(Select Configuration)	B1B - Port 1
	B2A - Port 2
	B2B - Port 3

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

For example, it is desired to have CSI format on all Ports and the following Disk Drives connected to -

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

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



Location B1A - Port 0
Location B1B - Port 1
Location B2A - Port 2
Location B2B - Port 3

Select Configuration 0 shown.

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

PORT CONFIGURATION SWITCHES
Figure 3.4

BANK & PORT CONFIGURATION
TABLE 3:1 60XX EMULATION
SINGLE DOC MODE

SELECT CONFIGURATION (PORT) ↓ / BANK SELECT →	1	2	3	4	5	6	7
	CSI PORT 0-3 DG PORT 2,3	CSI PORT 0-3 DG PORT 2,3	CSI PORT 0-3 DG PORT 2,3	CSI E PORT 0-3 (HIGH SPEED) CSI PORT 2,3	CSI PORT 0-3 DG PORT 2,3	DG PORT 0-3 CSI PORT 2,3	ALT 1 PORT 0-3 CSI PORT 2,3
0					AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVALT 83 · TECSTOR 85 [67MB / 32S]	AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVALT 83 · TECSTOR 85 [67MB / 32S]	AMPEX DM 980, 80 · CENTURY DATA T82 · CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 · MEGAVALT 83 · TECSTOR 85 [67MB / 32S]
1					CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 TECSTOR 300 [256 MB / 32S]	CENTURY DATA 300, T306, 315 CDC 9766 MEMOREX 677-30 · TECSTOR 300 [256 MB / 32S]	CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 TECSTOR 300 [256MB / 32S]
2		· CDC 9455-16 (REMOVABLE=0, FIXED=1) ★ [6.7/6.7 MB / 32S]			AMPEX 165 · CDC 9715, 9730-160 FUJITSU 2284 · KENNEDY 53160 TECSTOR 165 [134 MB / 32S]	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 [134 MB / 32S]	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 [134 MB / 32S]
3		CDC 9455-16 (REMOVABLE=0, FIXED=1) ★ [6.7/6.7 MB / 32S]			CDC 9448-96 (REMOVABLE: UNIT 0 or 2 FIXED=UNIT 1 or 3) ★ [13/67 MB / 32S]	CDC 9448-96 (REMOVABLE: UNIT 0 or 2 FIXED: UNIT 1 or 3) ★ [13/67 MB / 32S]	CDC 9448-96 (REMOVABLE = UNIT 0 or 2 FIXED = UNIT 1 or 3) ★ [13/67 MB / 32S]
4		· PRIAM 3450 [30 MB / 23S]			CDC 9448-96 (REMOVABLE = UNIT 1 or 3 FIXED: UNIT 0 or 2) ★ [13/67 MB / 32S]	CDC 9448-96 (REMOVABLE = UNIT 1 or 3 FIXED = UNIT 0 or 2) ★ [13/67 MB / 32S]	CDC 9448-96 (REMOVABLE = UNIT 1 or 3 FIXED = UNIT 0 or 2) ★ [illegible]
5	AMCODYNE 7110 · CDC 9457 (REMOVABLE=0, FIXED=1) ★ [20/20 MB / 32S]				6061 EMULATION [190 MB 24S]		6061 EMULATION [190 MB 24S]
6	AMCODYNE 7110 · CDC 9457 (REMOVABLE=0, FIXED=1) ★ [20/20 MB / 32S]	· MEMOREX 677-70 [182 MB / 23S]		FUJITSU 2351 (AOS) DUAL 6061 ★ [380 MB / 24/24S]	6067 EMULATION [50 MB 24S]		6067 EMULATION [50 MB 24S]
7				FUJITSU 2351 (RDOS) DUAL ★ [414 MB / 24/24S]			
8	· CDC 9410-32 [28MB / 23S]						
9							
10		CENTURY DATA C2048 (REMOVABLE=0, FIXED=1) ★ [14/28 MB / 32S]				RESERVED	
11		CENTURY DATA C2048 (REMOVABLE=1, FIXED=0) ★ [14/28 MB / 32S]	CENTURY DATA AMS 519 (AOS) DUAL 6061 ★ [380 MB / 24/24S]			6067 EMULATION [50 MB 24S]	
12		CDC 9410-8 [7MB / 23S]		APS 4830-404 (RDOS) 4835-404 DUAL ★ [324 MB / 32/32S]			
13		CDC 9410-24 [21 MB / 23S]	PRIAM 7050 [61 MB / 23S]				
14			PRIAM 3450 [30 MB / 23S]				
15			CDC - 9412 [63 MB / 32S]				

ASSOCIATED BLOCKS INDICATE FORMATTED CAPACITY IN MEGABYTES (MB) & NUMBER OF SYSTEM SECTORS (S)

★ CMD OR DUAL VOLUMN (REFER TO SECTION 3·2·5)

BANK & PORT CONFIGURATION
TABLE 3.2 6IXX EMULATION
DOUBLE DOC MODE

BANK SELECT →

SELECT CONFIGURATION PORT) ↓	1 CSI PORT 0-3 DG PORT 2,3	2 CSI PORT 0-3 DG PORT 2,3	3 CSI PORT 0-3 DG PORT 2,3	4 CSI PORT 0-3 (HIGH SPEED) CSI PORT 2,3	5 CSI PORT 0-3 DG PORT 2,3	6 DG PORT 0-3 CSI PORT 2,3	7 ALT 1 PORT 0-3 CSI PORT 2,3
0	AMPEX DM 980,80 · CENTURY DATA 782 CDC 9710, 9730-80, 9762 FUJITSU 2280 · KENNEDY 5380, 7380 MEGAVALT 83 TECSTOR 85 73MB / 355	AMPEX DFR 932 CDC 9448-32 (REMOVABLE=0, FIXED=1) * 14/14 MB / 355	NEC 2230 KENNEDY 7340 37MB / 355	FUJITSU 2351 (RDOS) (YOU MUST INTERLEAVE HERE) 405 MB / 475			
1	CENTURY DATA 300, T306, 315 · CDC 9766 · MEMOREX 677-30 · TECSTOR 300 280 MB / 355	AMPEX DFR 932 (REMOVABLE=1, FIXED=0) * 14/14 MB / 355	AMPEX DFR-64 CDC 9448-64 (REMOVABLE=0, FIXED=1) * 14/14 MB / 355	FUJITSU 2312 MEMOREX 214 73 MB / 355			
2	AMPEX 165 · CDC 9715, 9730-160 · FUJITSU 2284 · KENNEDY 53160 · TECSTOR 165 147MB / 355		AMPEX DFR-64 CDC 9448-64 (REMOVABLE=1, FIXED=1) * 14/14 MB / 355	FUJITSU 2294 294 MB / 355			
3	AMPEX DFR 96 · CDC 9448-96 (REMOVABLE=0, FIXED=1) * 14/73 MB / 355		RESERVED	FUJITSU 2280 73 MB / 355			
4	AMPEX DFR 96 · CDC 9448-96 (REMOVABLE=0, FIXED=1) * 14/73 MB / 355		AMPEX DM 160 147 MB / 355	FUJITSU 2284 147 MB / 355			
5		TECSTOR 200 176 MB / 355	CDC 9715-340 306 MB / 355	FUJITSU 2311 MEMOREX 213 42 MB / 355		6160 EMULATION 73 MB / 355	
6			NEC 74 MB / 355			CENTURY DATA 300, T305, 315 CDC 9766 · MEMOREX 677-30 · TECSTOR 300 280 MB / 355	
7	· AMPEX 330 · FUJITSU 2294 294 MB / 355	MEGAVALT 16 14.7 MB / 355	RESERVED			6161 EMULATION 147 MB / 355	
8		AMPEX 50 MEGAVALT 48 44 MB / 355	NEC D2220 22 MB / 355	FUJITSU 2351 SLIP 370 MB / 435		CDC 9448-96 (REMOVABLE = UNIT 0 or 2 FIXED = UNIT 1 or 3) * 14/73 MB / 355	
9	· FUJITSU 2312 MEMOREX 214 73MB / 355	MEGAVALT 116 103 MB / 355	PRIAM 3350 30 MB / 355	6122 EMULATION 277MB / 358		CDC 9448-96 (REMOVABLE = UNIT 1 or 3 FIXED = UNIT 0 or 2 * 14/73 MB / 35	
10	FUJITSU 2311 MEMOREX 213 42 MB / 355		CENTURY DATA AMS 513 (RDOS) 452 MB / 555	DUAL 6122 EMULATION APS 4665 (AOS) * 554 MB / 35/35 S			
11	PRIAM 6650/67 55 MB / 355			APS 4830-404, 4835-404, 4830-337, 4835 337 (AOS) DUAL 6164 294 MB / 35/35 S			
12	· PRIAM 15450 DATA PERIPHERAL 01600 139 MB / 355		DUAL 6161 EMULATION * 294 MB / 35/355			RESERVED	
13	PRIAM 804 140 MB / 355			APS 4830-404, 4835-404 (RDOS) * 354 MB / 35/35 S		6122 EMULATION 277 MB / 355	
14	AMPEX 660 587 MB / 355	AMPEX DM 980,80 · CENTURY DATA 782 · CDC 9710, 9730-80, 9762 · FUJITSU 2280 · KENNEDY 5380, 7380 MEGAVALT 83 TECSTOR 85 73 MB / 355		APS 4865 (RDOS) DUAL * 560 MB / 35/35 S			
15	CENTURY DATA AMS 380 333 MB / 555	MEGAVALT 212 189 MB / 355					

ASSOCIATED BLOCKS INDICATE FORMATTED CAPACITY IN MEGABYTES (MB) & NUMBER OF SYSTEM SECTORS (S)

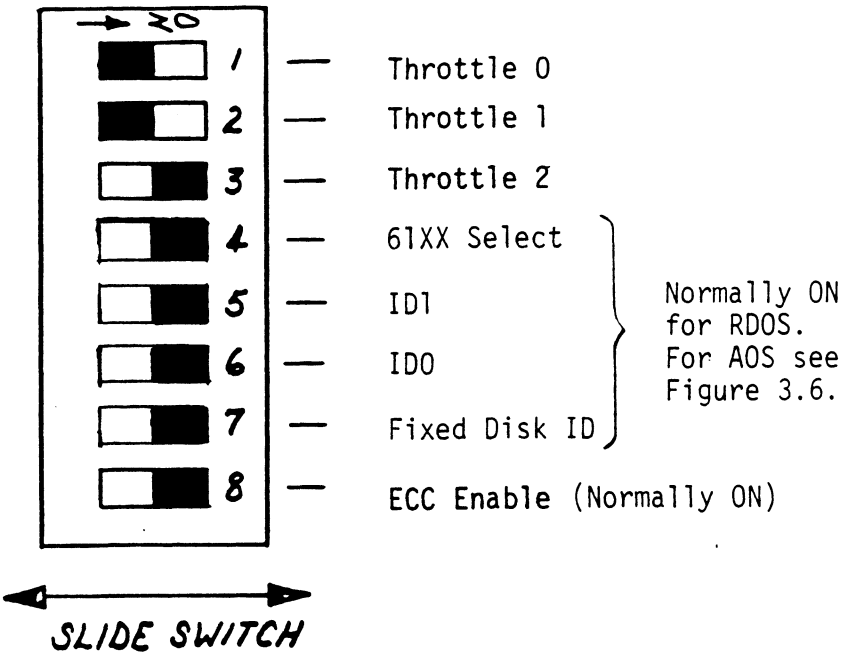
3.2.4 SWITCH LOCATION G5 (REFERENCE FIGURE 3.5)

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

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

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

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



Location G5

Throttle Setting of 16,
RDOS ON, ECC Enabled

THROTTLE SETTINGS

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

DATA CHANNEL THROTTLE SWITCH
Figure 3.5

3.2.5 SWITCH LOCATION H5 (REFERENCE FIGURE 3.7)

Switch Position 1 and 2 should be ON in all cases (AOS and RDOS). Switch 3 enables looping on any subsection of Selftest that is failing. In the OFF position you receive a short Selftest. Switch 3 is normally OFF.

Switch 4 and 5 are used to inform the Microprocessor that the Dual Unit is attached (Dual Unit indicates two volumes, fixed and removable). Examples of two Unit Drives are the Lark I (9455-16), Lark II (9457), Amcodyne 7110 and CDC CMD (9448 Series).

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

The term Dual is used in Tables 3.1/3.2. Dual indicates two emulations or Dual Volumes which are treated as two units if the drive characteristics permit. For example, Bank 4, Select Configuration 6 is for Dual 6061 (AOS) operation for the Fujitsu 2351 Eagle. The Dual Volume Switch 4 should be ON. Insure you have set switches in accordance to Figure 3.6. In Bank 4, Select Configuration 7, which operates Dual Volumes for the Fujitsu 2351 Eagle (RDOS). It also requires Switch 4 (H5) to be ON. In each case (Dual Unit and Dual Volume) you must format the two units.

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

Switch Pos.	LOCATION G5				LOCATION H5	
	7 OFF = FIXED DISK	6 ID 0 OFF=73MB ON=147MB	5 ID 1 OFF=73MB ON=147MB	4 ON = 6214 ON = 616X OFF = 6122	2 ID0 ON=6161 OFF=6214	1 ON=6161 OFF=2614
6160	OFF	OFF	OFF	ON	ON	ON
6161	OFF	ON	ON	ON	ON	ON
6122	ON	ON	ON	OFF	ON	ON
6060 6061 6067	ON	ON	ON	ON	ON	ON
RDOS	ON	ON	ON	ON	ON	ON

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

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

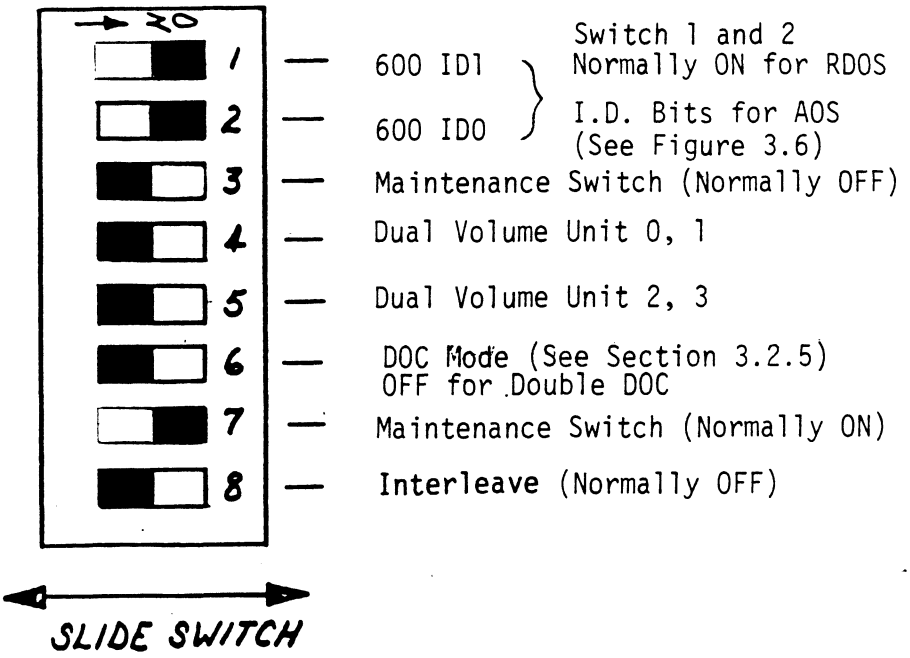
6122 - 35 Sectors
19 Heads
815 Cylinders
277 Mega Bytes Formatted

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

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

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

FIGURE 3.6
AOS SWITCH SETTINGS



Location H5

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

INTERLEAVE, CMD, SECTOR VERIFY SWITCHES

Figure 3.7

For Dual Volumes the System Sector Block, in the lower right hand corner of each Bank and Select Configuration, shows two sector numbers. These two sector numbers should be added together to determine the Disk Drive Sector Setting. For example, (Table 3.2) Bank 4, Select Configuration 11 the APS 4830/4835's Sector Switch Setting would be 70. Refer to Section 3.8.1 and 3.8.2 for special Disk Drive considerations.

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

Switch 6 is for the Single DOC or Double DOC Mode. Single DOC applies to 32 sectors or less (when in a single volume). RDOS Revision 6.7 or less is used for Single DOC. Double DOC applies to 33 to 64 sectors. Double DOC Mode requires RDOS Revision 7.0 or greater. The 296 is factory set for Double DOC unless otherwise specified. See Tables 3.1/3.2 to identify your Drive and its DOC Mode setting. Remember when using RDOS 6.7 or less you must choose Single DOC. If this switch is ON then you are in the Single DOC Mode. If this switch is OFF then you are in the Double DOC Mode (see *NOTE).

AOS

Single DOC is 6060, 6061, 6067
Double DOC is 6160, 6161, 6122

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

Switch 7 controls the run time of Selftest. When the switch is On, the short verison of the RAM test is run. When the switch is Off the long version of the RAM test is run. Normally Switch 7 is ON.

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

(X + 1)/3 = 0 Remainder

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

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

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

3.3 BOARD INSERTION

The 296 SMD is to be installed only after inspection, switch settings are verified and you determine if "I/O Only" slots are available. Component damage will occur if a slot other than an "I/O Only" slot is used (refer to Section 3.2). Custom Systems' warranty is void if a non-I/O slot is used. Carefully guide the controller board into the desired slot by allowing the edges of the board to follow the guides evenly. Use the lock tabs on the two outside corners to provide leverage when the board meets the connector. Use equal pressure on both lock tabs until the board seats firmly into the backplane connectors.

3.3.1 PADDLE BOARD INSTALLATION

Two Paddle Boards connect onto the Minicomputer backplane pins (observe which slot the 296 occupies in order to determine which set of backplane pins for connection) - one Paddle Board connects to the "A" backplane and one on the "B" backplane. Make sure the CPU backplane pins are straight first, then reference Figure 3.1.1 for proper installation. The Paddle Board, (labeled B) with the 60 pin header, goes on the "B" backplane. The Paddle Board, (labeled A) with the 4-26 pin headers, goes to the "A" backplane.

3.4 PRIORITY SELECTION

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

3.5 POWER FAIL PROTECTION

The 296 Disk Controller contains a double protection power fail scheme. The Data General CPU outputs a signal called "Power Fail" which gives an early warning of power loss. This is used on the 296 to disable the drives write circuitry through the open cable detect line.

To enable this power fail protection connect A47 of the 296 backplane slot to Pin A5 of a Nova 3 CPU backplane slot or A9 on a Nova 4 power supply slot.

In addition, the 296 contains power fail circuitry to further protect drive data integrity in the event the slot where the board is installed loses power.

3.6 CABLING

INTERNAL DISK CABLING

As shown in Figure 3.1.1 the 60 pin (female end) conductor cable (referred to as Internal SMD "A" cable) plugs into the "B" Paddle Board. The other end of this cable (D connector) mounts into the backpanel.

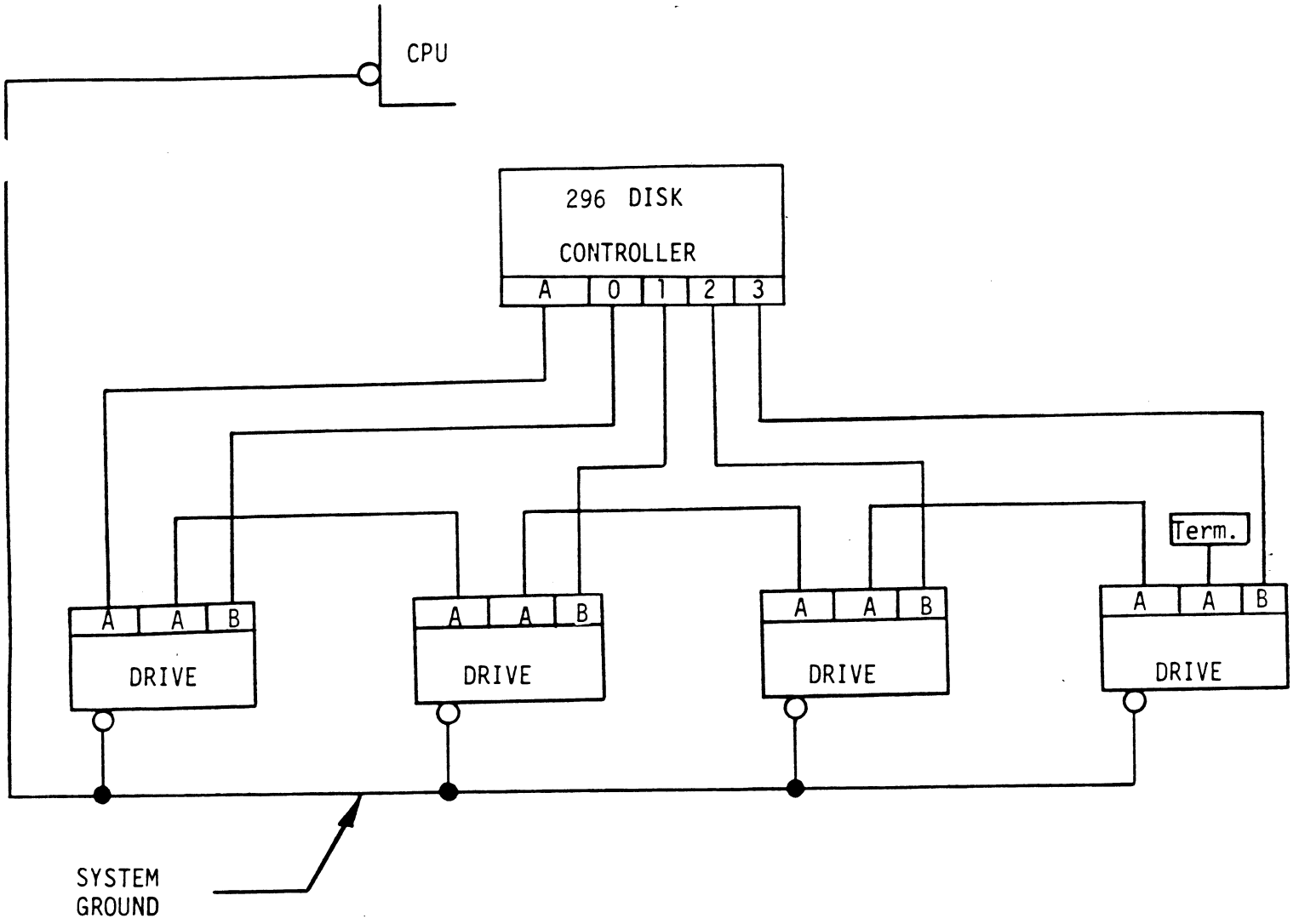
The 26 pin (female end) conductor cable (referred to as Internal SMD "B" cable) plugs into the "A" Paddle Board. The other end of this cable (D connector) mounts into the backpanel. (Observe the port assignments on the Paddle Board in order to keep track on the backpanel which port is 0-3.) If more than one Drive is to be connected, we recommend labeling the associated port(s).

EXTERNAL DISK CABLING

As shown in Figure 3.8, the 60 pin "A" cable connects between the appropriate backpanel D connector and the first Drive then continues from Drive to Drive in a daisy chain fashion. The last Drive in the chain must have a terminator installed in place of the daisy chain cable. BE SURE TO OBSERVE THE ARROWS ON THE HEADERS AND PLUGS FOR PROPER ORIENTATION. Each Drive must have a 26 pin "B" cable connected between the Drive and the backpanel D connector in a radial fashion.

Insure that the Port Configuration Switches match the corresponding Drive type plugged into that port.

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



DAISY-CHAINING DRIVES

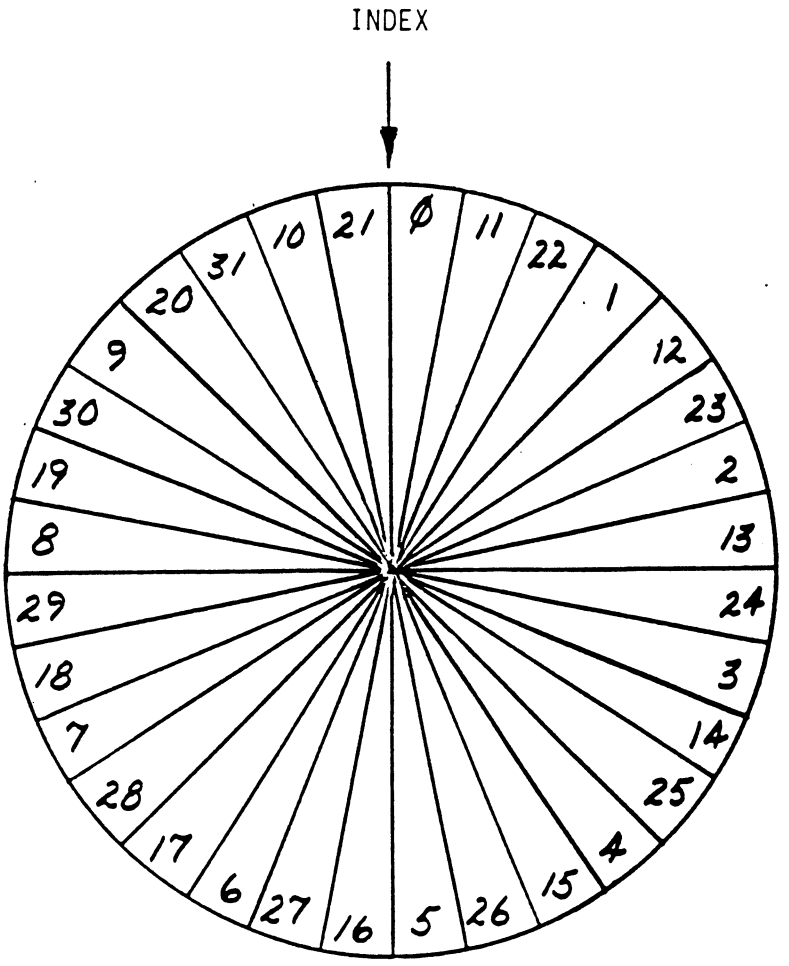
Figure 3.8

3.6.1 SYSTEM GROUNDING

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

3.7 DRIVE PICK-HOLD

On initial power up, the controller will delay activating pick-hold (spins up drive) for one second. This feature eases the initial current demand on the AC power source.



EXAMPLE FOR 32 SECTOR DISK

Figure 3.9

3.8 POWERING UP

Turn System power ON. The 296 will perform an initial "Selftest" by briefly lighting a red LED. A good test is indicated by the LED turning OFF. For more details refer to Section 5.0. Once a good test is indicated, format your Disk. We recommend using the CSI format due to its added features of; more error checks on header, conforms to necessary drive characteristics and does not require patching. For CSI Disk Formatter refer to Section 4.0, 4.2 and Appendix A. For the next installation step (RDOS) we recommend running Disk Reliability in order to exercise and test the disk system. Refer to Section 4.3 and Appendix A. If you are using AOS we recommend you run Diagnostics in addition to Reliablity. Under AOS run Diagnostics first and Reliablity second. Refer to Diagnostics Section 4.1. The final step involves the use of CSDKINIT for RDOS or DFMTR for AOS. Before you load any RDOS or AOS onto a Model 296 disk you must initialize the disk by running CSDKINIT (RDOS) or DFMTR (AOS). For CSDKINIT refer to Section 4.4. For DFMTR refer to Data General's Manual.

3.8.1 SPECIAL CONSIDERATIONS FOR FUJITSU 2351 SECTOR SELECTION

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

For Bank 4, Select Configuration 6, 7 and 8 you should also have one sector added when configuring the sector setting within the Fujitsu Eagle. Adding one sector is only true for the Fujitsu 2351 Eagle. When setting up the sector switch settings within a Disk Drive use the system sector indicated in the small Block in the lower right hand corner of each Bank and Select Configuration (Port) shown on Tables 3.1/3.2. When Dual emulations or Dual volumes are used add the two system sectors together. For example, (Table 3.1) Bank 4, Select Configuration 16 the Fujitsu Eagle sector switch setting would be 49.

3.8.2 SPECIAL CONSIDERATIONS FOR CDC 9457 (LARK II)

Insure options W-4 and W-8 are installed within the Disk Drive. W-4 identifies Auto Seek on-head change. W-8 identifies two volumes (CDC terms it CMD). The Sector Switch setting within the CDC Lark II is 32 sectors (32S) as shown in the System Sector Block of Table 3.1.

3.9 SYSGEN

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

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

NOTE: On line 3 answer NO when using RDOS. When you answer NO you allow up to four Disk Drives (6160 or 6161) to be connected to the 296. If you answer YES you allow only two Disk Drives (6160 or 6161) to be connected.

SUB-TABLE OF CONTENTS

4.0 DIAGNOSTICS AND SOFTWARE

There are three levels of diagnostics; On-board Selftest, System Diagnostics and System Reliability Programs. Included in the 296 package is a Master M248 tape containing these diagnostics and other CSI supplied software.

To load a program from the tape you should:

Mount M248 tape on drive.

Set console switches to 100022 or 100062.

Press RESET and then LOAD switches.

(See Appendix A for specific Program Load Procedures)

The M248 tape menu will be displayed:

FILE #	PROGRAM
2	Disk Diagnostic
3	Disk Formatter
4	Disk Reliability
5	CSDKINIT - Disk Initializer
6	CSDSKED - Stand-alone Disk Editor
7	Previous "SV" and "TX" Files in Dump Format
8	ECC Programs in Dump Format: RDOSECC.SV - for RDOS AOSECC.PR - for AOS

File # (CR):

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

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

LOAD/R/V MT0:N (for RDOS)

X RDOS LOAD/V @MTA0:N +.SV +.PR +.TX/C (for AOS)

4.1 DISK DIAGNOSTIC

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

Load the program from the tape provided. (See M248 tape loading in Section 4.0).

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

```
C.S.I...DISK DIAGNOSTIC REV. XX
STARTING ADDRESSES:

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

ENTER DEVICE CODE (27):

ANY DUAL VOLUME UNITS?  ENTER 1

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

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

TESTING UNIT 0

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

  0       5       823        35       C.S.I.

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

4.2 DISK FORMATTER

The Disk Formatter Program is a utility designed program to format and check Disk Packs to be used on the Disk Systems.

The following is a sample dialogue:

```
C.S.I...DISK FORMATTER REV. XX

STARTING ADDRESSES:

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

ENTER DEVICE CODE (27):

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

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

# PASSES TO FORMAT COMPLETION? - 6

CONTROLLER ECC CORRECTION IS ENABLED

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

UNIT     TYPE     HDS     CYLS     SEC/TRK     FORMAT

 0        0        5      823        32         D.G.
 2        1        5      815        24         D.G.

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

UNIT:  0

ENTER TYPE OF DISK:  0

UNIT:  2

ENTER TYPE OF DISK:  1

FORMATTING UNIT 0,2
```

See Formatter Text at end of Manual for further details.

4.3 DISK RELIABILITY

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

The following is a sample dialogue:

```
C.S.I...DISK RELIABILITY REV. XX

STARTING ADDRESSES:

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

ENTER DEVICE CODE (27):

STARTING ADDRESS = 505

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

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

NOVA 3 TOTAL OF 1K'S = 64

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

ANY DUAL VOLUME UNITS (YES/NO)?  NO

CONTROLLER ECC CORRECTION IS ENABLED

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

UNIT     TYPE     HDS     CYLS     SEC/TRK     FORMAT

 0        0        5      823        32         D.G.
 2        1        5      815        24         D.G.

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

UNIT:  0

ENTER TYPE OF DISK:  0

UNIT:  2

ENTER TYPE OF DISK:  1
TESTING UNIT 0,2
See Reliability Text at the end of Manual for further details.
```

4.4 CSDKINIT - RDOS DISK INITIALIZER

Initializing a Model 296 Disk -

Before you load any RDOS system onto a Model 296 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 manual on loading an RDOS system for full details on the functionality of disk initialization.

Remember that only CSDKINIT will work correctly for Model 296 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 296 disk. CSDKINIT can, however, be used to initialize any DG supported disk.

STEP 1 - LOADING

A) If loading from a M248 tape:

Perform the steps described for loading M248 tape in Section 4.0.

YOU RESPOND:

5

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

Mount the disk pack which contains CSDKINT.

Set console switches to correct device code.

Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

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

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK INITIALIZER - REV. NN.NN/with C.S.I. Disk Support-REV. 1
DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

NOTE: Enter the X's as shown above.

A) If the disk type is not valid-

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) if the disk type is valid -

PROGRAM DISPLAYS:

6XXX (CSI Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

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

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

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

STEP 4 - ECC CORRECTION

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

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

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS HARDWARE DISABLED.

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED.

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

YOU RESPOND:

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

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLE.

DO YOU WANT TO ENABLE? (YES/NO)

YOU RESPOND:

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

STEP 5 - 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.

4.5 CSDSKED - RDOS STAND-ALONE DISK EDITOR

CSDSKED provides the same functions for the 296 disk as Data General's DSKED does for standard DG disks. It can also be used for any DG supported disk. Please refer to the Data General Stand-alone Disk Editor Manual for a complete description of the commands.

We will describe the steps necessary to run CSDSKED.

STEP 1 - LOADING

A) If loading from a M248 Tape:

Perform the steps described for loading M248 tape in Section 4.0.

YOU RESPOND:

5

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

Mount the disk pack which contains CSDSKED.

Set console switches to correct device code.

Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

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

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK EDIT - REV NN.NN WITH C.S.I. DISK SUPPORT - REV. 1

DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

NOTE: Enter the X's as shown above.

A) If the disk type is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) If the disk type is valid -

PROGRAM DISPLAYS:

6XXX (CSI Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

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

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

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

STEP 4 - ECC CORRECTION

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

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER EC CORRECTION IS HARDWARE DISABLED

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED

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

YOU RESPOND:

YES To disable ECC correction while running CSDSKED

NO To leave ECC correction enabled while running CSDSKED

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLED

DO YOU WANT TO ENABLED? (YES/NO)

YOU RESPOND:

YES To enable ECC correction while running CSDSKED

NO To leave ECC correction disabled while running CSDSKED

STEP 5 - COMMANDS AND SUBSEQUENT OUTPUT

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

4.6 ECC - ECC ERROR CORRECTIONS COUNTER FUNCTIONS

The Model 296 controller maintains a counter of ECC corrections for each drive connected to the board(s). These are the corrections performed by the firmware and are therefore invisible to the system except through these counters. The counters are automatically cleared by the reset switch on the front panel or if the controller is powered down.

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

STEP 1 - EXECUTING THE PROGRAM UNDER CLI

A) RDOS Version

ENTER: RDOSECC

B) AOS Version

ENTER: X AOSECC

STEP 2 - MAIN MENU

CUSTOM SYSTEMS - ECC FUNCTIONS

1 - DISPLAY CONTROLLER ECC CORRECTIONS

2 - RESET CONTROLLER ECC CORRECTIONS

3 - STOP

NOTE - SELECT ONLY THOSE DRIVES WITH CSI CONTROLLER BOARDS.

RESULTS ARE UNPREDICTABLE ON OTHER BOARDS!

ENTER SELECTION

YOU RESPOND:

1) To display the ECC corrections counter(s)

2) To modify the ECC corrections counter(s)

3) To terminate the program and return to the CLI

STEP 3 - ENTERING THE UNIT

If you selected 1 or 2,

PROGRAM DISPLAYS:

ENTER UNIT:

YOU RESPOND:

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

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

STEP 4 - MODIFYING THE COUNTER

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

ENTER NEW VALUE:

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

SUB-TABLE OF CONTENTS

5.0 TROUBLESHOOTING

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

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

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

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

Reference Table 5.1 for Selftest Error Codes.

CODE	TEST	POSSIBLE FAILURE
1	REGISTER TEST	The data in register F did not compare with register Q. 2901 or 2902 may be bad.
2	RAM TEST	Data read from RAM did not compare with data written. 2114, PBUS or RAM data bus may be bad.
3	2940 ADDRESS GENERATOR TEST	Data read from 2940's did not compare with data written. 2940 may be bad.
4	CONDITION FF, BIT TEST AND 32 BIT SHIFT TEST	The state of the condition flip flops were not correct. Command Full, Busy, Done, Control Full, Overflow (2901), DCHDN (2940) may be bad. The bit testing logic may have failed. The bit shifting mechanism may have failed. (2901)
5	SEQUENCE ERROR TEST	A forced sequence error did not occur within a specified amount of time. Format sequencer may be bad. (No Clock)
6	SYNC DETECT TEST	A sync detect was not made in a specified amount of time or the terminate FF may not have set. The sync register or compare logic may be bad or the terminate FF may be bad.
7	ECC TEST	The generated ECC pattern did not compare with the expected pattern. The shift registers, ECC logic, or multiplexers may be bad.

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

SELFTEST ERROR CODES

TABLE 5.1

CUSTOMER SERVICE

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

PRODUCT RETURN

Pre-return Checkout.

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

Returned Material Authorization.

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

Returned Material Information.

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

Packaging.

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

(include with returning material)

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to Custom Systems, Inc. for repair. This will: 1) Determine if in fact the board is defective (many boards returned for repair are not defective, causing the user unnecessary system down-time, paper work, and handling while proper testing would indicate the board is working properly). 2) Increase the speed and accuracy of a product's repair which is often dependent upon a complete understanding of the user checkout test results, problem characteristics, and the user system configuration. Checkout results for the 296 SMD Controller should be obtained by performing the following tests. (Include error program counter numbers and accumulator contents if applicable).

FUNCTION	TEST	RESULT
SMD	Selftest	
	Diagnostics	
	Reliability	

Other test performed:

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

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

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

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

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

To be filled out by CUSTOMER:

Model #:
Serial #:
RMA #:

Returned by:

(company name)

SUB-TABLE OF CONTENTS

6.0 PROGRAM CONTROL

6.1 INSTRUCTION FORMAT

Symbolic form for I/O instructions:

DXXF AC, DSKP

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

F = Function:

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

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

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

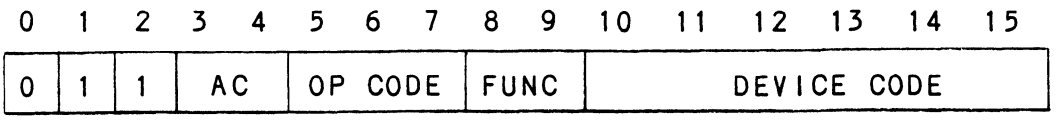
AC = Accumulator: 0, 1, 2 or 3.

DSKP = Device Code: Primary - 27 Octal

Secondary - 67 Octal

(Other available by switches)

BINARY REPRESENTATION OF AN I/O INSTRUCTION



INTERRUPT MASK BIT 7

MSKO AC

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

IORESET INSTRUCTION

IORST

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

IOSKIP INSTRUCTION

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

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

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

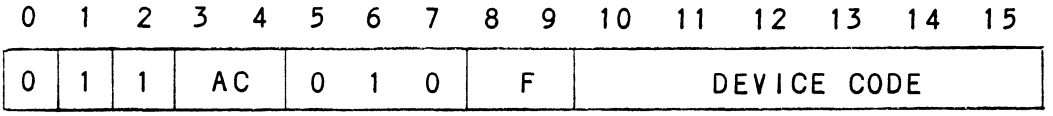
SKPDZ DSKP - SKIP IF DONE FLIP-FLOP IS CLEAR.

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

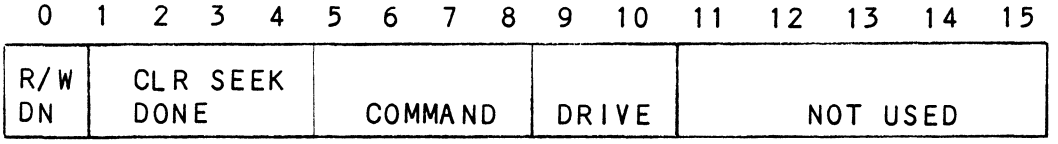
6.2 ACCUMULATOR FORMATS

6.2.1 DOA - SPECIFY COMMAND AND DRIVE

DOAF AC, DSKP



Accumulator



BIT POSITION

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

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

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

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

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

5 - 8 Specify Command

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

NOTE: See Section 6.3 for detailed command description

9 - 10 Drive Selection

00 - Drive Unit 0

01 - Drive Unit 1

10 - Drive Unit 2

11 - Drive Unit 3

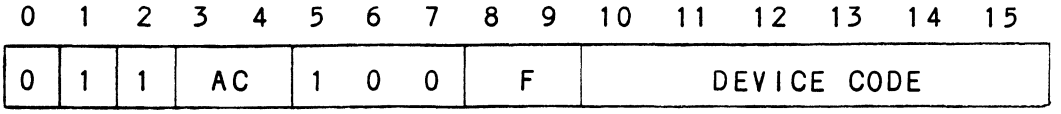
DOA will reserve a previously unreserved drive

Bit Position 9 is not used if 616X

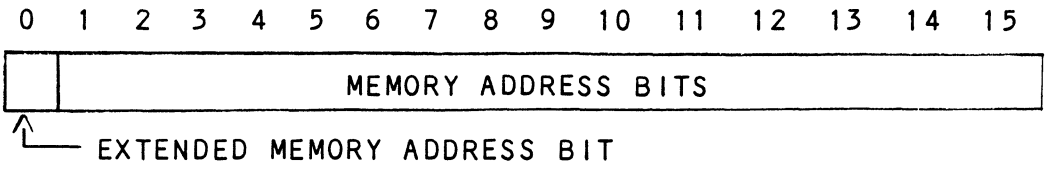
11-15 Reserved for future consideration

6.2.2 DOB - LOAD STARTING MEMORY ADDRESS

DOBF AC, DSKP



Accumulator

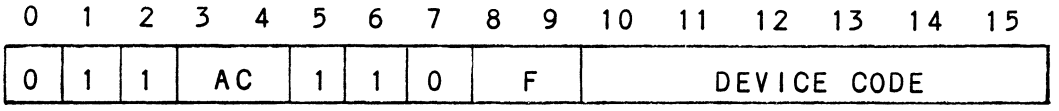


Execution of this instruction will load the controllers address counter with the contents of the specified accumulator and will be used as the starting memory address for a command that requires a data channel transfer operation.

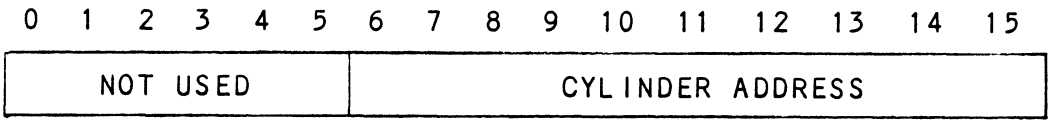
6.2.3 DOC - LOAD DRIVE ADDRESS

6.2.3.1 DOC - SPECIFY CYLINDER

DOCF AC, DSKP



Accumulator (if previous DOA specified a Seek)



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

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

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

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

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

0 - Not Used

1 - 5 Starting Surface Address

6 - 10 Starting Sector Address

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

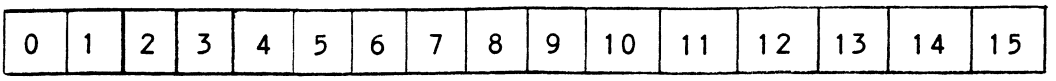
6.2.4 READ STATUS - NON ALTERNATE MODE

6.2.4.1 DIA - READ DATA TRANSFER STATUS

DIAF, AC, DSKP

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

Accumulator



0 - Control Full

1 - R/W Done

2 - Unit 0 Atten Done

3 - Unit 1 Atten Done

*4 - Unit 2 Atten Done

*5 - Unit 3 Atten Done

6 - Bus Error

7 - Illegal Sector Adr

8 - ECC Error

9 - Bad Sector Flag

10 - Cyl Addr Error

11 - Surf/Sect Addr Error

12 - Verify Error

13 - R/W Timeout

14 - Data Late

15 - Read/Write Fault

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

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

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

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

Refer to Table 6.1 for detailed description.

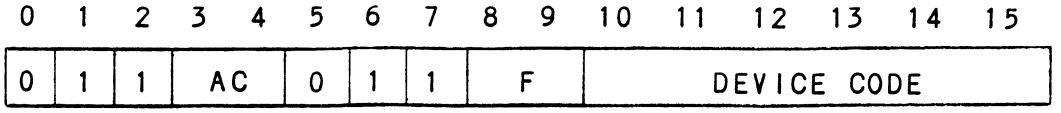
	STATUS BIT POSITION	CONTROLLLER ACTION	ERROR RECOVERY
BUS ERROR	6	Sets done immediately	New command re-try Read/Write Transfer. May correct the problem.
ILLEGAL SECTOR ADDRESS	7	Sets done immediately	New command if error re-occurs. Check the drive characteristic switches to make sure it agrees with drive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

READ/WRITE FAULTS (DIA)

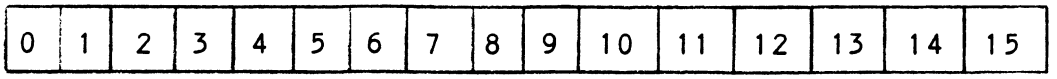
TABLE 6.1

6.2.4.2 DIB - READ DRIVE STATUS

DIB AC, DSKP



Accumulator



*0 - Invalid Status

*1 - Drive Reserved

*2 - Trespassed

3 - Ready

4 - Busy

*5 - Positioner Offset

6 - Write Disabled

*7 - ID

*8 - III Sur/Cyl Addr

*9 - Illegal Command

*10 - DC Voltage Fault

*11 - Pack Unsafe

12 - Positioner Fault

*13 - Servo Clock Fault

*14 - Write Fault

15 - Drive Fault

*These Bits are undefined if 616X

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

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

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

Refer to Table 6.2 for more detailed description.

6.2.4.3 DIC - READ SURFACE, SECTOR AND COUNT

DICF AC, DSKP

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

Accumulator

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

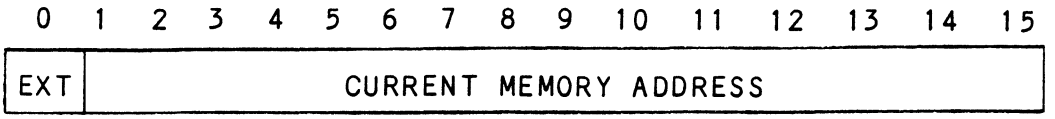
6.2.5 READ STATUS - ALTERNATE MODE ONE

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

6.2.5.1 DIA - READ CURRENT MEMORY ADDRESS

DIAF AC, DSKP

Accumulator

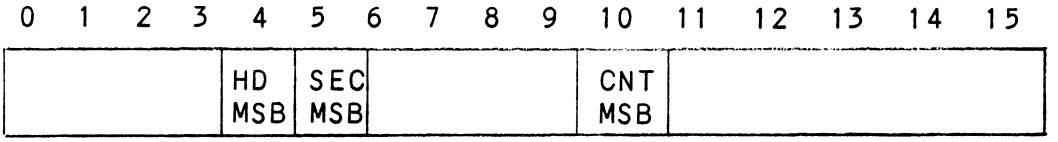


After the execution of this instruction the value of the accumulator will contain the memory address to where the next data word transfer will take place. The memory address counter is incremented by one after each data channel transfer.

6.2.5.2 DIB - READ EXTENDED MEMORY ADDRESS

DIBF AC, DSKP

Accumulator



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

6.2.5.3 DIC - NOT CURRENTLY IMPLEMENTED

6.2.6 READ STATUS - ALTERNATE MODE TWO

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

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

DRIVE FAULT TABLE (DIB)

TABLE 6.2

6.2.6.1 DIA - READ ECC REMAINDER UPPER

DIAF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
31	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

6.2.6.2 DIB - READ ECC REMAINDER LOWER

DIBF AC, DSKP

Accumulator

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

6.2.6.3 DIC - NOT CURRENTLY IMPLEMENTED

6.3 DETAILED COMMAND DESCRIPTIONS

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

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

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

6.3.1 DATA TRANSFER COMMANDS

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

Read/Write Initialization Steps:

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

Read/Write Termination Possibilities (Done Set):

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

6.3.1.1 READ COMMAND

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

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

6.3.1.2 WRITE COMMAND

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

6.3.1.3 VERIFY

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

6.3.1.4 FORMAT

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

6.3.1.5 READ BUFFERS

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

6.3.2 DRIVE COMMANDS

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

6.3.2.1 RECALIBRATE

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

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

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

6.3.2.2 SEEK

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

See the SMD specification for the Seek Timing.

6.3.2.3 OFFSET FORWARD

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

6.3.2.4 OFFSET REVERSE

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

6.3.2.5 WRITE DISABLE

Not implemented.

6.3.2.6 RELEASE DRIVE

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

6.3.2.7 TRESPASS

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

6.3.2.8 STOP DISK

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

6.3.2.9 EXAMINE RAM COMMAND

This command gives the system the capability of reading from or writing to the 296 controllers memory. This command must be proceeded by a DOC containing the address of the desired RAM location.

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

This feature is used for obtaining the following information:

a. Drive characteristics for the formatter and reliability programs.

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

c. Maintenance testing.

d. Features that may be considered in the future.

DETAILED DESCRIPTIONS OF USER RAM LOCATIONS

OCTAL ADDRESS	NAME	DESCRIPTION
1422	DISABLE CORRECTION	The least significant bit is used to indicate if controller self corrections are permitted. This bit will be initialized on a power on or an IORESET switch. If the ECC switch (G5 SW Position 8) is on it will be initialized to a zero, if it is off it will be initialized to a one. If one is written into this bit, correction will be software disabled. Correction cannot be software enabled if the ECC Enable switch is off.

1460-1462	SELECTED DRIVE CHARACTERISTICS	These locations will be updated whenever a new drive is selected. 1460 - Maximum sector address 1461 - Maximum surface address 1462 - Maximum cylinder address Allow invalid status to go away before a reference is made. Avoid writing to these locations..
1500-1503	UNIT CORRECTION COUNTS	These locations will be incremented each time the controller does a correction either by the ECC algorithm or an Early/Late re-try. The maximum count per unit is 65535 (the count will stay at maximum if there are any more corrections to that unit). The counts are initialized to zero on either a power on or an IORESET switch. A separate count is maintained for each unit. 1500 - Unit 0 1501 - Unit 1 1502 - Unit 2 1503 - Unit 3

EXAMINE RAM COMMAND

1776-8 EPROM REVISION LEVEL

DIC ACCUMULATOR

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

EXAMPLE: Revision Level 6 EPROMS

Location 1776-8 = 000006-8

1777-8 PROM ID/REV

DIC ACCUMULATOR

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

EXAMPLE: Identification 80 (Hex) Revision Level 6

Location 1777-8 = 100006

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

EXAM RAM EXAMPLE

READ Contents of Loc 1500 Octal (Unit 0 corrections)

Accumulator Set up:

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

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

WRITE To Location 1500 Octal (Clear Unit 0 Corrections)

Accumulator set up:

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

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

6.3.3 ALTERNATE MODES

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

6.3.3.1 ALTERNATE MODE ONE

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

6.3.3.2 ALTERNATE MODE TWO

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

6.4 ERROR CORRECTION CODE (ECC)

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

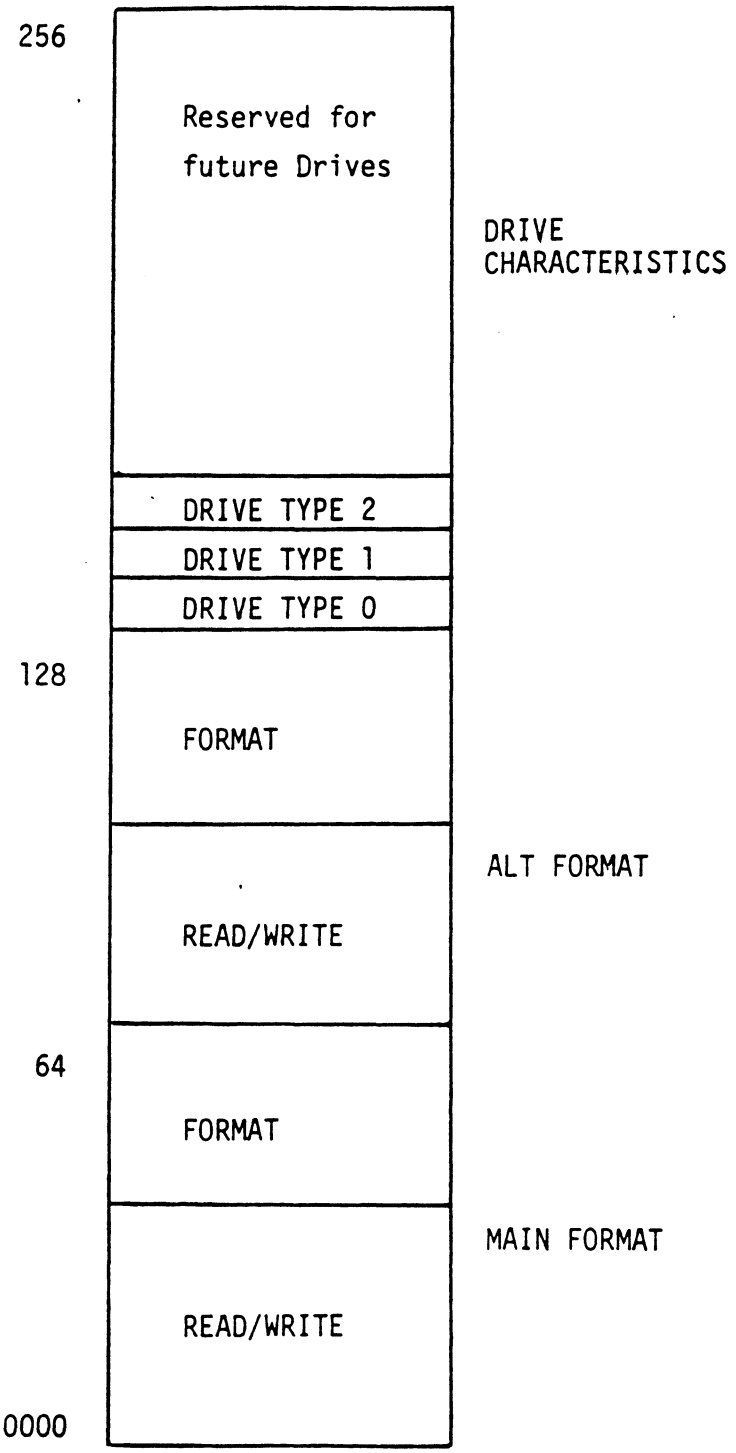
*Generator Polynomial
X-32 + X-23 + X-21 + X-11 + X-2 + 1

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

*Factored Version

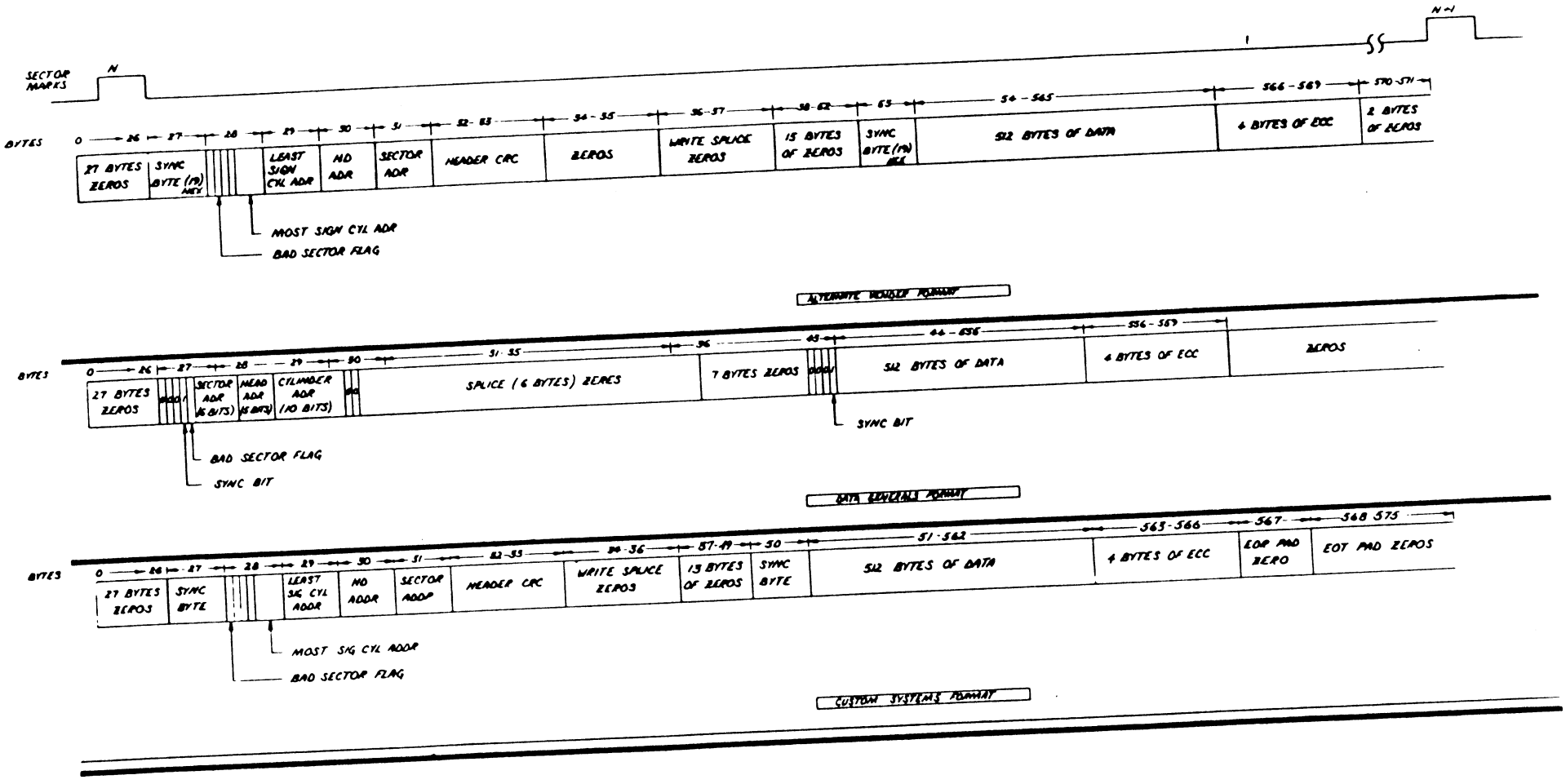
$(X^{-1} + X^{-2} + 1)(X^{-21} + 1)$

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



FORMAT SEQUENCER EPROM MAP

Figure 6.1



HEADER FORMATS

Figure 6.2

6.5 FORMAT SEQUENCER

The 296 Disk Controller features a format sequencer which controls the disk side of the controller. The firmware which controls this sequencer is contained in 2716 EPROMS allowing disk format changes to take place in the EPROMS instead of the microprocessor firmware.

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

6.5.1 READ/WRITE FORMATS

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

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

6.5.2 DRIVE CHARACTERISTICS

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

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

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

APPENDIX A

DIAGNOSTIC SUPPORT PACKAGE
GENERAL INFORMATION

Booting Diagnostics from Magnetic Tape.

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

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

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

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

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

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

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

LOADING DIAGNOSTICS FROM TAPE TO YOUR SYSTEM DISK

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

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

Step 2 For an RDOS System enter the commands:

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

For an AOS System enter the commands:

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

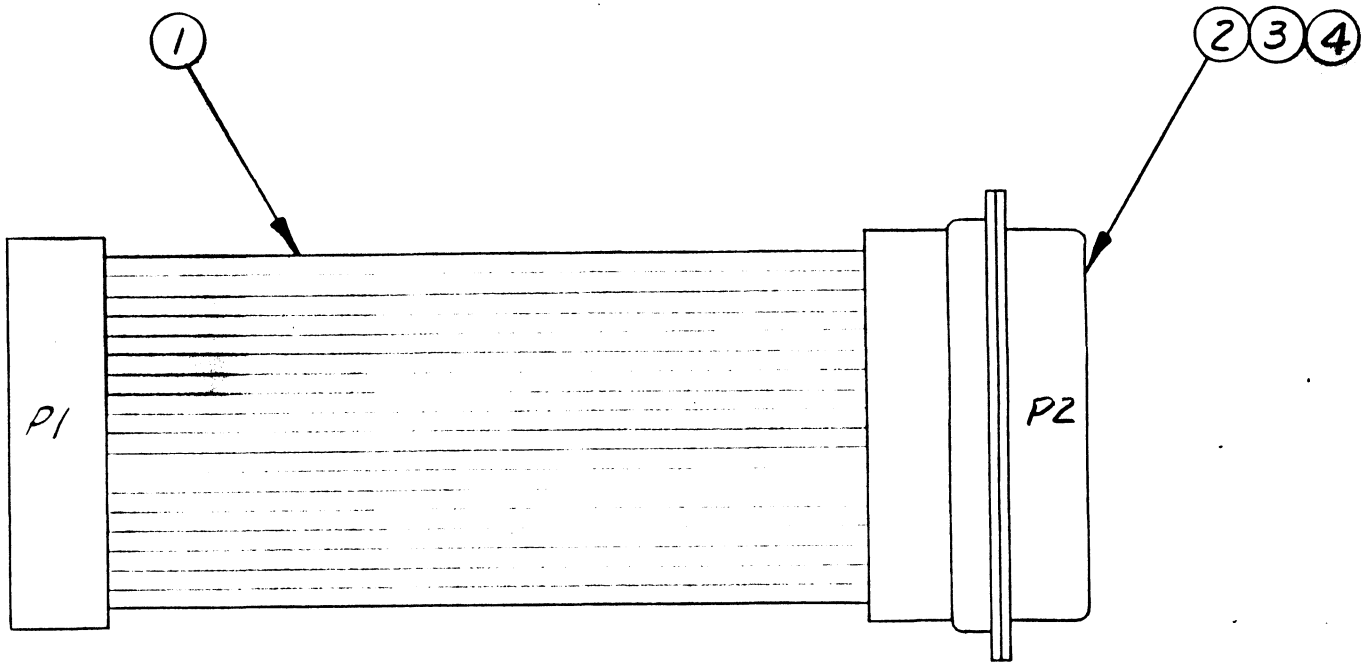
The files can now be booted from disk (enter file name in response to filename? or pathname?).

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR	FCC "A" CABLE PADDLE BOARD	REF. DWG.		286-B03-2R0-00	ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	286-A01-2R0	"A" Cable Paddle Board	CSI	
2	1	3372-1002	60 Pin Right Angle Connector	3M	
3	5	ES20-1/16	20 Pin Card Edge Connector	Circuit Assy.	
4	2	470 ohm	Resistor 1/4 Watt 5%	Airco Speer	R26-1, R26-2
5	2	3518	Polarizing Key	3M	

REV



REVISION HISTORY		
ECO	DATE	DESCRIPTION

DRAWN BY	DATE	REVISIONS	DATE
C KULSETH	9-28-83		
CHECKED BY			
APPROVED BY			
SCALE:			

TITLE	DRAWING NUMBER
INTERNAL "A" CABLE ASS'Y	286-C05-2R0-00

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR	INTERNAL "A" CABLE ASSEMBLY	REF. DWG.		286-C05-2R0-00	ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	286-C04-2R0	Internal "A" Cable	Ragon	
2	1	204508-3	78 Pin "D" Connector	Amp	
3	60	66717-5	Female Pins	Amp	
4	1	D20418-2	Hex Set	Cannon	

REV

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
TWP	28	BRN	P1-1	MASS	P2-1	3	
		TAN			P2-2		
		RED			P2-3		
		TAN			P2-4		
		ORG			P2-5		
		TAN			P2-6		
		YEL			P2-7		
		TAN			P2-8		
		GRN			P2-9		
		TAN			P2-10		
		BLU			P2-11		
		TAN			P2-12		
		VIO			P2-13		
		TAN			P2-14		
		GRY			P2-15		
		TAN			P2-16		
		WHT			P2-17		
		TAN			P2-18		
		BLK			P2-19		
		TAN			P2-20		
		BRN			P2-21		
		TAN			P2-22		
		RED			P2-23		
		TAN			P2-24		
		ORG			P2-25		
		TAN			P2-26		
		YEL			P2-27		
		TAN			P2-28		
		GRN			P2-29		
TWP	28	TAN	P1-45	MASS	P2-30	3	

CUSTOM SYSTEMS

TITLE
INTERNAL "A" CABLE ASSEMBLY

DOCUMENT NO. 286-C05-2R0-00

SHEET 3 **OF** 4 | **REV.**

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
TWP	28	BLU	P1-16	MASS	P2-31	3	
		TAN			P2-32		
		VIO			P2-33		
		TAN			P2-34		
		GRY			P2-35		
		TAN			P2-36		
		WHT			P2-37		
		TAN			P2-38		
		BLK			P2-39		
		TAN			P2-40		
		BRN			P2-41		
		TAN			P2-42		
		RED			P2-43		
		TAN			P2-44		
		ORG			P2-45		
		TAN			P2-46		
		YEL			P2-47		
		TAN			P2-48		
		GRN			P2-49		
		TAN			P2-50		
		BLU			P2-51		
		TAN			P2-52		
		VIO			P2-53		
		TAN			P2-54		
		GRY			P2-55		
		TAN			P2-56		
		WHT			P2-57		
		TAN			P2-58		
		BLK			P2-59		
TWP	28	TAN	P1-60	MASS	P2-60	3	

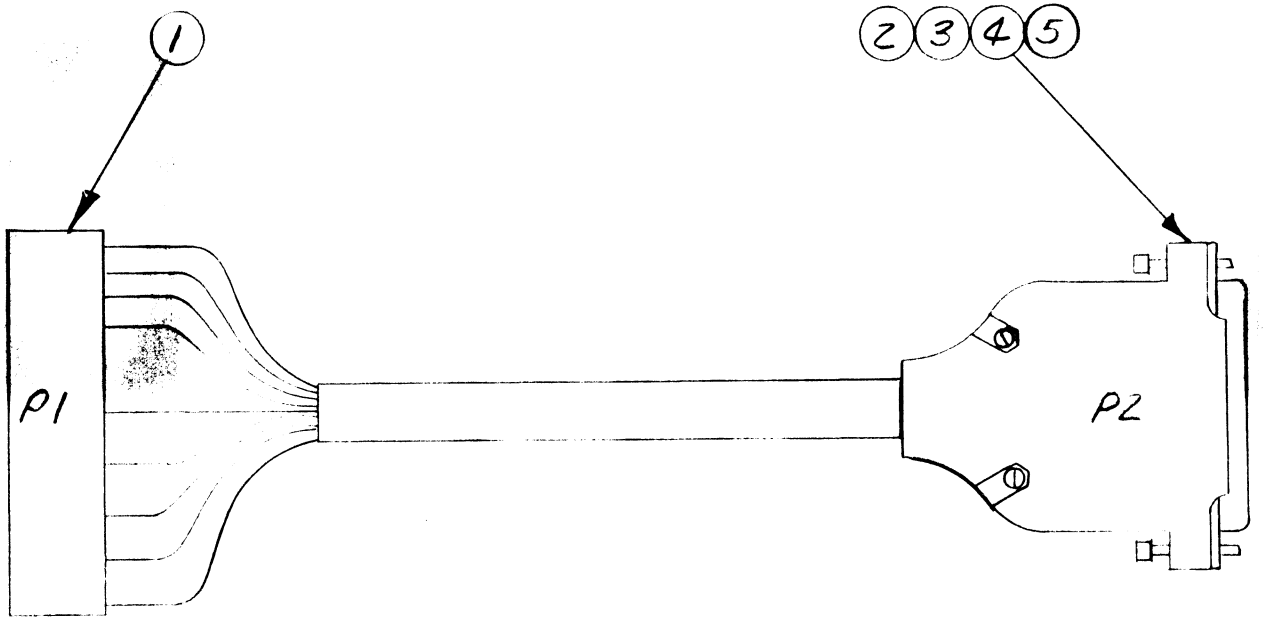
CUSTOM SYSTEMS

TITLE

INTERNAL "A" CABLE ASSEMBLY

DOCUMENT NO. 286-C05-2R0-00

SHEET 4 **OF** 4 | **REV.**



REVISION HISTORY		
ECO	DATA	DESCRIPTION

	DATE	REVISIONS	DATE
[redacted]	28-88		

TITLE: EXTERNAL "A" CABLE ASSY

DRAWING NUMBER: 86-007-2R0-00

SHEET 1 OF 4

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR	EXTERNAL "A" CABLE ASSEMBLY	REF. DWG.		286-C07-2R0-00	ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	286-C06-2R0	External "A" Cable	Ragon	
2	1	204509-3	78 Pin "D" Connector	Amp	
3	60	66718-5	Male Pin	Amp	
4	1	1-747098-1	Connector Shield	Amp	
5	1	205980-1	Screw Set	Amp	

REV

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
TWP		BRN	P1	MASS	P2-1	3	
		BLK			P2-2		
		RED			P2-3		
		BLK			P2-4		
		ORG			P2-5		
		BLK			P2-6		
		YEL			P2-7		
		BLK			P2-8		
		GRN			P2-9		
		BLK			P2-10		
		BLU			P2-11		
		BLK			P2-12		
		VIO			P2-13		
		BLK			P2-14		
		GRY			P2-15		
		BLK			P2-16		
		WHT			P2-17		
		BLK			P2-18		
		RED			P2-19		
		BRN			P2-20		
		ORG			P2-21		
		BRN			P2-22		
		YEL			P2-23		
		BRN			P2-24		
		GRN			P2-25		
		BRN			P2-26		
		BLU			P2-27		
		BRN			P2-28		
		VIO			P2-29		
TWP		BRN	P1	MASS	P2-30	3	

CUSTOM SYSTEMS

TITLE
EXTERNAL "A" CABLE ASSEMBLY

DOCUMENT NO. 286-C07-2R0-00

SHEET 3 **OF** 4 | **REV.**

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
TWP		GRY	P1	MASS	P2-31	3	
		BRN			P2-32		
		WHT			P2-33		
		BRN			P2-34		
		ORG			P2-35		
		RED			P2-36		
		YEL			P2-37		
		RED			P2-38		
		GRN			P2-39		
		RED			P2-40		
		BLU			P2-41		
		RED			P2-42		
		VIO			P2-43		
		RED			P2-44		
		GRY			P2-45		
		RED			P2-46		
		WHT			P2-47		
		RED			P2-48		
		YEL			P2-49		
		ORG			P2-50		
		GRN			P2-51		
		ORG			P2-52		
		BLU			P2-53		
		ORG			P2-54		
		VIO			P2-55		
		ORG			P2-56		
		GRY			P2-57		
		ORG			P2-58		
		WHT			P2-59		
TWP		ORG	P1	MASS	P2-60	3	

CUSTOM SYSTEMS

TITLE

EXTERNAL "A" CABLE ASSEMBLY

DOCUMENT NO. 286-C07-2R0-00

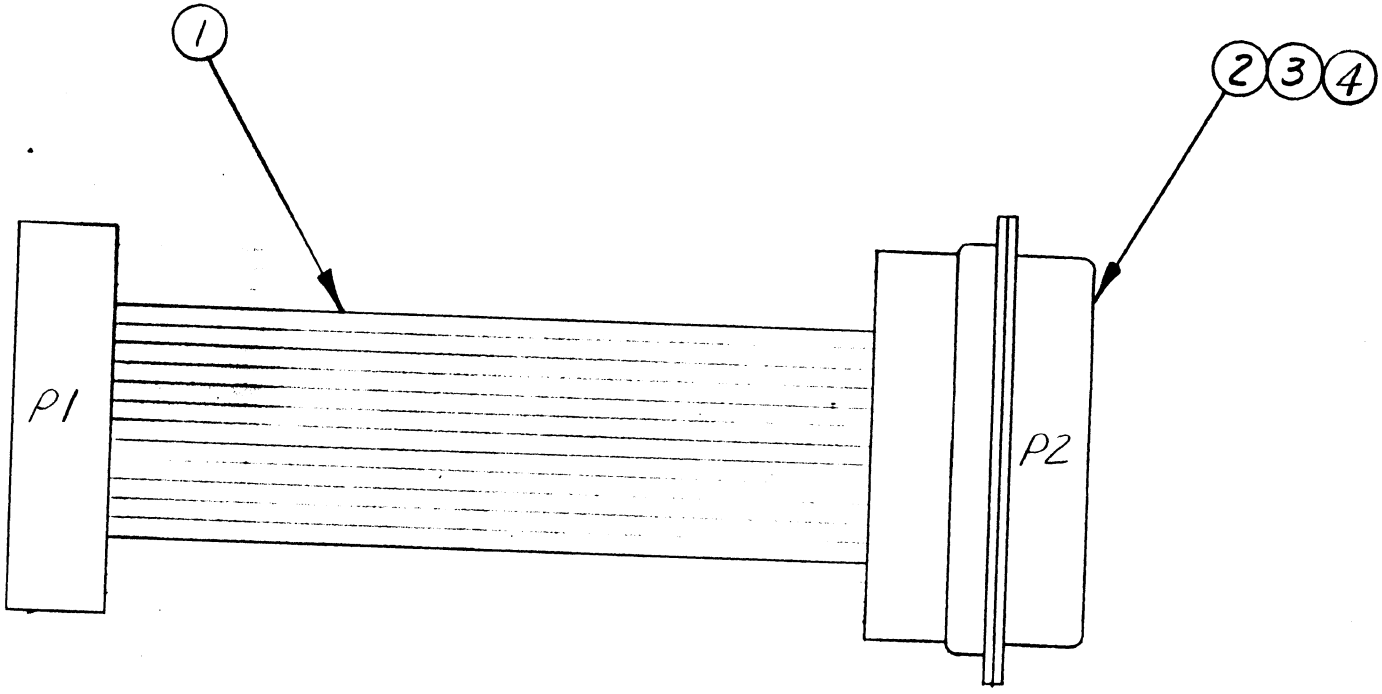
SHEET 4 **OF** 4 **REV.**

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR	FCC "B" CABLE PADDLE BOARD	REF. DWG.		287-B03-2S0-00	ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	287-A01-2S0	"B" Cable Paddle Board	CSI	
2	4	3493-1002	26 Pin Right Angle Connector	3M	
3	5	ES20-1/16	20 Pin Card Edge Connector	Circuit Assy.	

REV



REVISION HISTORY		
ECO	DATE	DESCRIPTION

DRAWN BY: C. KULSETH	DATE: 9-28-83	REVISIONS	DATE
CHECKED BY:			
APPROVED BY:			
SCALE: ~			

TITLE: INTERNAL "B" CABLE ASS'Y

DRAWING NUMBER: 287-C05-250-00

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR INTERNAL "B" CABLE ASSEMBLY

REF. DWG. | 287-C05-2S0-00 | ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	287-C04-2S0	Internal "B" Cable	Ragon	
2	1	205211-2	50 Pin "D" Connector	Amp	
3	26	66505-8	Female Pins	Amp	
4	1	D20418-2	Hex Set	Cannon	

REV

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
	28		P1-1	MASS	P2-1	3	
	↑		P1-2	↑	P2-2	↑	
			P1-3		P2-3		
			P1-4		P2-4		
			P1-5		P2-5		
			P1-6		P2-6		
			P1-7		P2-7		
			P1-8		P2-8		
			P1-9		P2-9		[redacted]
			P1-10		P2-10		
			P1-11		P2-11		
			P1-12		P2-12		
			P1-13		P2-13		
			P1-14		P2-14		
			P1-15		P2-15		
			P1-16		P2-16		
			P1-17		P2-17		
			P1-18		P2-18		
			P1-19		P2-19		
			P1-20		P2-20		
			P1-21		P2-21		
			P1-22		P2-22		
			P1-23		P2-23		
			P1-24		P2-24		
	↓		P1-25	↓	P2-25	↓	
	28		P1-26	MASS	P2-26	3	

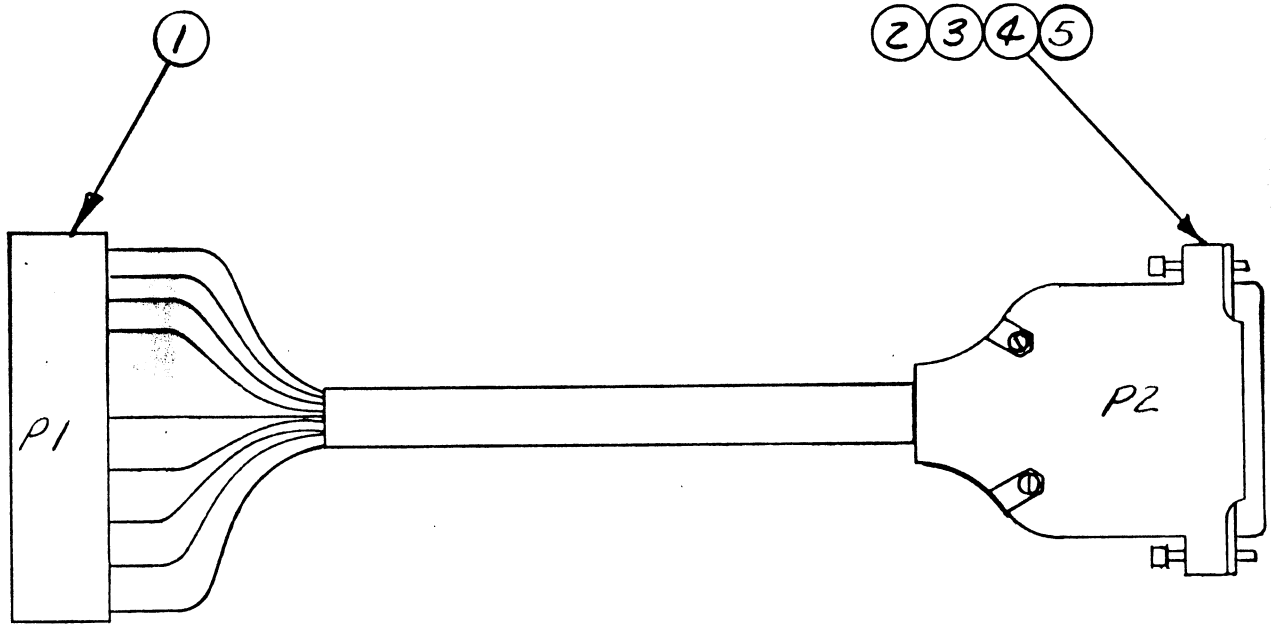
CUSTOM SYSTEMS

TITLE

INTERNAL "B" CABLE ASSEMBLY

DOCUMENT NO. 287-C05-2S0-00

SHEET 3 **OF** 3 **REV.**



REVISION HISTORY		
ECO	DATA	DESCRIPTION

DRAWN BY	DATE	REVISIONS	DATE
APILSETH	2-28-83		
CHECKED BY			
APPROVED BY			
SCALE			

TITLE	DRAWING NUMBER
EXTERNAL "B" CABLE ASS'Y	287-C07-250-00

PARTS LIST
CUSTOM SYSTEMS, INC.

FOR	EXTERNAL "B" CABLE ASSEMBLY	REF. DWG.		287-C07-2S0-00	ASSY. LOGIC

ITEM	QTY	PART TYPE	DESCRIPTION	MFG.	REF.
1	1	287-C06-2S0	External "B" Cable	Ragon	
2	1	205212-3	50 Pin "D" Connector	Amp	
3	26	66507-2	~~Male Pins~~	Amp	
4	1	1-747098-1	Connector Shield	Amp	
5	1	205980-1	Screw Set	Amp	

REV

WIRE LIST

NOTES	WIRE GAUGE	COLOR	ORIGIN	TERM. METHOD	DESTINATION	TERM. METHOD	REMARKS
TWP		BRN	P1-1	MASS	P2-1	3	
		BLK			P2-2		
		RED			P2-3		
		BLK			P2-4		
		ORG			P2-5		
		BLK			P2-6		
		YEL			P2-7		
		BLK			P2-8		
		GRN			P2-9		[redacted]
		BLK			P2-10		
		BLU			P2-11		
		BLK			P2-12		
		VIO			P2-13		
		BLK			P2-14		
		GRY			P2-15		
		BLK			P2-16		
		WHT			P2-17		
		BLK			P2-18		
		RED			P2-19		
		BRN			P2-20		
		ORG			P2-21		
		BRN			P2-22		
		YEL			P2-23		
		BRN			P2-24		
		GRN			P2-25		
TWP		BRN	P1-26	MASS	P2-26	3	

CUSTOM SYSTEMS

TITLE
EXTERNAL "B" CABLE ASSEMBLY

DOCUMENT NO. 287-C07-2S0-00