SPECTRA LOGIC

SPECTRA 111/121
SPECTRA 111-PLUS
SPECTRA 121-PLUS

Product Reference Manual

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WARNING
This subassembly has not been tested
to show compliance with new FCC rules
(47 CFR Part 15, subpart J).

TABLE OF CONTENTS

*RETURN INFORMATION REFERENCE SHEET

Chapter One

Introduction

1.1 GENERAL INFORMATION

The SPECTRA 121/121-PLUS is a multifunction disk and tape controller for use with Digital Equipment Corporation's (DEC) Unibus series of computers. It is constructed on a single hex board, is Unibus compatible, and interfaces with any combination of four Storage Module Drive (SMD) disks and four formatted 1/2" tape drives. Configuration changes, including drive mixing and mapping, can be made without removing the controller from the system by using extended commands to program the on board EEPROM.

The SPECTRA 121 emulates DEC's RM02, RM03, RM05, RM80, RP04, RP05, RP06, and RP07 disk subsystems, as well as DEC's TS11 tape subsystem. Complete emulation is provided for operation with DEC's RT-11, RSX-11M, RSX-11M Plus, RSX-11S, and RSTS/E operating systems. RT-11 drivers must be modified or written to provide RT-11 support. (These drivers may be obtained from Spectra Logic for a modest fee).

The SPECTRA 121-PLUS contains the same features as the SPECTRA 121 with the additional capability of being able to operate with high performance disk drives featuring data transfer rates to 2.5 MB/second, and high performance tape drives featuring data transfer rates to 1.0 MB/second. The SPECTRA 121-PLUS also has an enhanced "read ahead" buffer algorithm for faster data throughput and increased overall performance. The SPECTRA 121-PLUS also features UNIX drive sizing.

The SPECTRA 111-PLUS controller is a single function version of the SPECTRA 121-PLUS performing disk emulation only. Except for tape capability, the SPECTRA 111-PLUS has all the features of the SPECTRA 121-PLUS controller.

The SPECTRA 111/121/-PLUS provides high reliability, easy maintainability, and quality performance. Advantages not only include cost savings in the purchase price of the controller, but also the option of buying disk and tape drives from independant manufacturers. Extensive use is made of low-power Schottky and standard Schottky integrated circuits on an 8 layer PCB with power and ground planes internal. On board, self-test microdiagnostics execute upon power up, and system level diagnostics allow verification of proper operation on the subsystem. A Light Emitting Diode (LED) indication is provided to aid in fault isolation of the system. Most host diagnostics run without modification, and a patch list is provided for those which do not.

The SPECTRA 111/121/-PLUS architecture employs a single 29116 bipolar processor and dual 2911A sequencers. This design approach provides quality performance and flexability to support most SMD interface compatible disk drives and formatted 1/2" interface tape drives. When the controller is combined with 80/300 megabyte (MB) SMD drives and a formatted 1/2" tape, it runs without driver or diagnostic modifications.

1.2 FEATURES

The SPECTRA 111/121/-PLUS controller provides many important features. These features include:

* Single hex size DEC compatible PCB.
* Bipolar microprocessor/dual sequencer implementation and architecture.
* Emulation of DEC RM02, RM03, RM05, RM80, RP04, RP05, RP06, and RP07 disk drives.
* Emulation of TS11 tape subsystem.
* Supports up to four streaming or formatted start/stop tape drives.
* One model supports any four SMD disks.
* Power consumption comparable to disk-only controllers.
* Allows any logical to physical drive mapping across cylinder, head, or sector boundaries.
* Supports DEC RM80 alternate sector capabilities.
* Contains 14 sector disk buffering.
* Provides an Error Correction Code (ECC) with up to 11-bit burst error correction.
* DEC RM02/RM03/RM05 media compatible.
* Interleaved or contiguous sector transfers.
* The SPECTRA 121 supports concurrent 2.0MB/sec disk and 800KB/sec tape data transfers.
* The SPECTRA 121-PLUS supports concurrent 2.5 MB/sec disk and 1.0 MB/sec tape data transfer.
* Automatic position verification.
* Automatic self-test microdiagnostics.
* Burst interrupt mode.
* Pick/Hold power sequencing.
* Read ahead option.

1.3 SPECIFICATIONS

FUNCTIONAL CHARACTERISTICS	DISK	TAPE
Drive Attachment	4 physical, 8 logical	4
Dual Port	4 dual port drives	N/A
Interface	All SMD drives	Formatted 1/2"
Base Address Standard	776700 (octal)	772520 (octal)
Alternate 1	776300 (octal)	770520 (octal)
Alternate 2	776200 (octal)	772440 (octal)
Alternate 3	776100 (octal)	Disabled
Vector Address Standard	254 (octal)	224 (octal)
Alternate	0-376 (octal)	0-376 (octal)
Sector Addressing	Contiguous or Interleaved	N/A
DMA Addressing Range	18 bit	18 bit
DMA Burst Control	1 word to 1 sector	Selectable
DMA Interburst Delay	Selectable	Selectable
Interrupt Priority level	5	5
Buffering	14 sectors	64 byte FIFO
Capacity/Configuration	Any size/Any mix	N/A
Error Correction Code	Correction in buffer or CPU	N/A
Seek Operation Control	Explicit,Implied,Overlapped	N/A
Transfer Rate	Up to 2.0/2.5 MB/sec*.	Up to 800KB/1.0 MB/sec**

* 2.5 MB /sec transfer rate available on S111-PLUS and S121-PLUS only.

** 1.0 MB/sec transfer rate available on S121-PLUS only.

SPECIFICATIONS [continued]

PHYSICAL CHARACTERISTICS	SPECIFICATION
PCB Size	Single hex size 8.4" X 15.6"; 8 layers.
Cable Connections	Disk: One 60 pin flat cable connector and four 26 pin flat cable connectors mounted at edge of the PCB. (Maximum cable length 50 feet). Tape: Two 50 pin flat cable connectors.
Environmental	Exceeds DEC PDP-11 temperature and humidity specifications.
Power	+5 volts DC @ 8 amps. -15 volts DC @ .5 amps.
Unibus Loading	SPECTRA 121/121-PLUS presents a one unit load.

1.4 WARRANTY

Spectra Logic Corporation provides a 12 month limited warranty for the SPECTRA 111/121/-PLUS controller. Repair of PCBs returned in warranty to Spectra Logic will be effected within ten (10) working days after receipt of the failing unit. Repair of PCBs out of warranty will be performed at a nominal charge.

Chapter Two

Installation

2.1 INSTALLATION PROCEDURE

This chapter contains the information needed to install the SPECTRA 111/121/-PLUS controller in any Unibus system. Installation/maintenance personnel should be familiar with both the Unibus hardware and the specific disk and tape drives being installed. The installation procedure is as follows:

1. Inspect controller board and cables.
2. Configure controller board.
3. Configure drive.
4. Prepare CPU.
5. Install controller board.
6. Connect cables.

2.2 INSPECTION

Perform a thorough visual inspection of the SPECTRA 111/121/-PLUS PCB and cables after removal from their shipping container. Note all damage and notify the freight carrier immediately, as Spectra Logic's warranty does not cover shipping damage. Any damage claim is to be filed through the carrier with its insurance company.

Check for any broken components or bent pins, and ensure that any socketed ICs are securely in place. Inspect the interface cables for cut or broken wires, ensure that the cable is cleanly terminated with the connector, and ensure that the 26 conductor 'B' cable has the ground plane shield connected to Pin 1 of its connectors at both ends of the cable.

2.3 CONTROLLER CONFIGURATION

The SPECTRA 111/121/-PLUS configurations are determined by jumper settings, switch settings, and EEPROM parameter values. The jumper and switch settings must be set up to the configuration desired before installation into the CPU or Expansion chassis. The EEPROM parameter values must be set after installation under power. Figure 2-1 shows the location of the switches and jumper pins on the board.

2.3.1 JUMPER SETTINGS

Shorting jumpers of 0.1" pitch are used to configure some options. In most cases the "standard" setting is with the jumper installed. To select an alternate option, the jumper must be removed, or moved to a different location. The following table gives a brief description of the jumpers and their functions when they are installed in certain pin locations (as shipped from the factory).

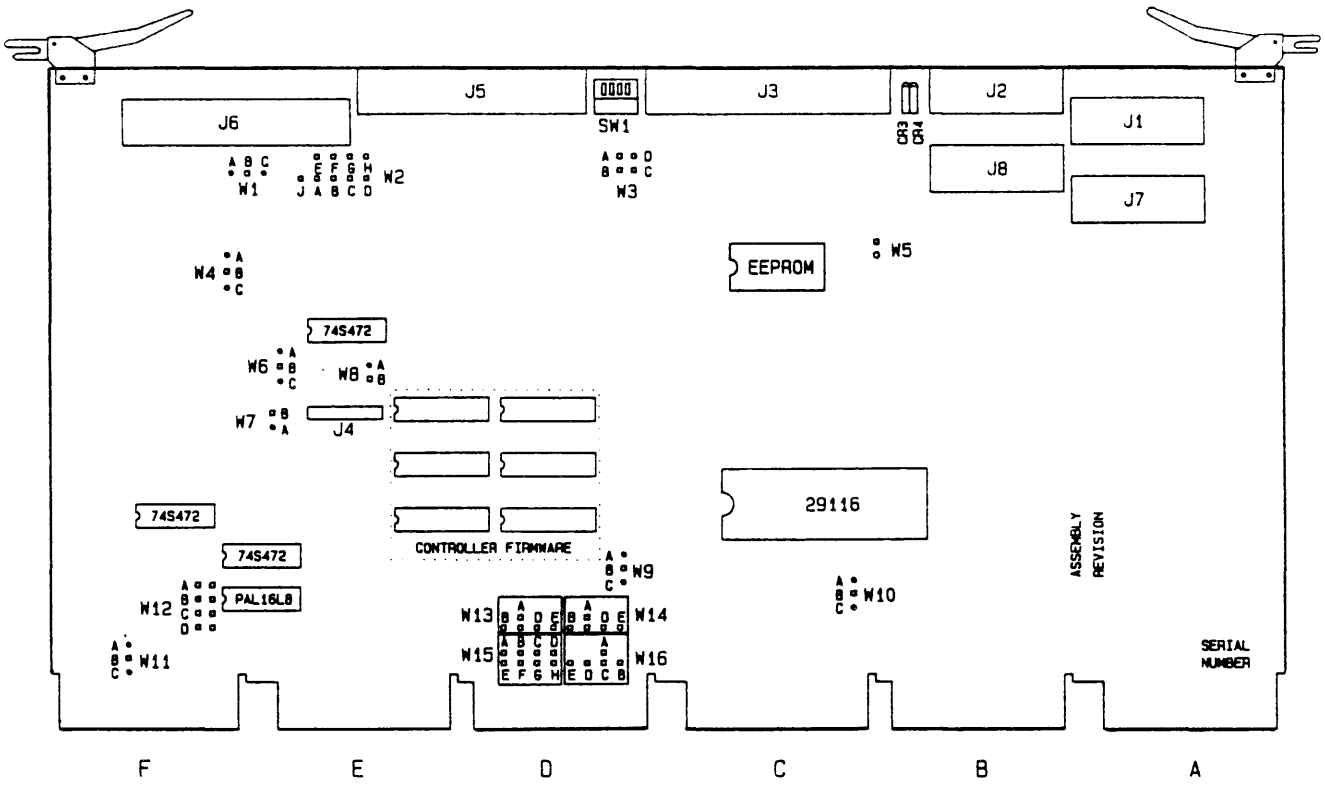

J6
J5
SW1
J3
J2
J1
J8
J7
W1
W2
W3
W4
W5
EEPROM
74S472
W6
W8
W7
J4
74S472
74S472
PAL16L8
CONTROLLER FIRMWARE
29116
W9
W10
W11
W12
W13
W14
W15
W16
ASSEMBLY REVISION
SERIAL NUMBER
F
E
D
C
B
A

FIGURE 2.1

PIN LOCATION	STANDARD SHIPPING CONFIGURATION
W1A-W1B	INRZ is monitored. (NOT USED ON S111)
W2A-W2J, W2B-W2C W2E-W2F, W2H-W2D	Mag tape address for start/stop drives using remote speed/density selection (via EEPROM option). (NOT USED ON S111)
W3A-W3B, W3C-W3D	Disk unit range 0-3 enabled.
W4A-W4B	Parity error detection enabled. (NOT USED ON S111)
W5 (Top Pin)	Assert Pick and Hold after microdiagnostics. Installed at top pin (spare jumper).
W6B-W6C	Test connector clock is SEQ0 (factory use only).
W7A-W7B	PROM size select for 8K or 4K PROMS. (S121A00, S111A00)
W9A-W9B	Microdiagnostics on power up or command.
W10A-W10B	Bus arbitration after first burst completion.
W11A-W11B	Release bus during burst upon device request.
W12A, W12B	Standard disk address of 776700.
W12C, W12D	Standard tape address of 772520.(NOT USED ON S111)
* W13A-W13C	Bus grant IN selection (BG5).
* W14A-W14C	Bus Request selection (BG5).
*W15 A-E, C-G, D-H	Bus grant PASS selection (BG5).
* W16A-W16C	Bus grant OUT selection (BG5).

* These jumpers are etched in the board.

INRZ/ISPEED Select Jumper (W1) (NOT USED ON S111)

This jumper determines which of the two mag tape interface signals (INRZ or ISPEED) the controller can monitor. If W1A is jumpered to W1B, INRZ is monitored; if W1A is jumpered to W1C, ISPEED is monitored. The status of this signal is reported in Mag Tape Extended Status 0, bit 3.

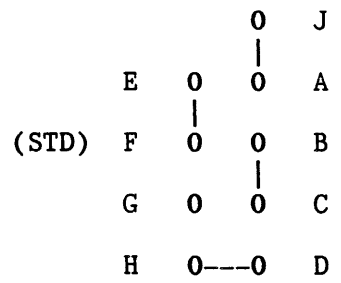
W1A-W1B	W1B-W1C		
IN	OUT	(STD)	INRZ is monitored.
OUT	IN		ISPEED is monitored.

Mag Tape Address Select Jumpers (W2) (NOT USED ON S111-PLUS)

The SPECTRA 121/121-PLUS allows several variations of jumper settings for mag tape address selection. To facilitate either remote density selection for start/stop transports or remote speed selection for streaming transports, the following jumper array is available.

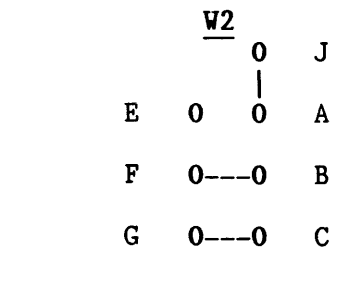
		W2			
			0	J	Ground
Control Density/Speed	E	0	0	A	Formatter address FAD(L)
Density/Speed IDEN(H)	F	0	0	B	Unit Select 0 U0(H)
Ground	G	0	0	C	Transport address 1 TAD1(H)
Unit Select 1 U1(H)	H	0	0	D	Transport address 0 TADO(H)

The following setting is recommended for start/stop drives using density/speed controlled by the EEPROM option.



Four start/stop tape drives may be daisy chained to one controller.

The following setting can be used for start/stop drives using remote density selection, or streaming tape drives using remote speed selection where the speed/density is selected by unit number.



Two start/stop tape drives or two streaming tape drives may be attached to one controller. High or low speed is selected by logical unit number.

LOGICAL UNIT #	PHYSICAL UNIT #	SPEED
0	0	LOW
1	0	HIGH
2	2	LOW
3	2	HIGH

Disk Unit Select Jumpers (W3)

The SPECTRA 111/121/-PLUS is capable of addressing a physical unit range of either 0-3 or 4-7 depending on the jumper settings. The unit range of 0-3 is standard and etched in the board. To select the unit range 4-7, cut the etched jumpers (W3A-W3B and W3D-W3C) and jumper W3A to W3D and W3B to W3C.

Unit range 4-7 enabled. Unit range 0-3 enabled.

Tape Parity Error Jumper (W4) (NOT USED ON S111-PLUS)

The controller is shipped from the factory with W4A jumpered to W4B. This setting enables the controller to check the parity of the interface signals when reading data from magnetic tape. The parity error detection is disabled by moving the jumper (from W4A to W4B) to connect W4B to W4C.

W4A-W4B	W4B-W4C		
IN	OUT	(STD)	Parity error detection enabled (odd parity).
OUT	IN		Parity error detection disabled.

Disk Drive Pick/Hold Control Jumper (W5)

W5		
IN		Pick/Hold always asserted.
OUT	(STD)	Pick/Hold asserted after passing power up microdiagnostics or on command control.

PROM Size Select Jumpers (W7, W8)

The controller is set at the factory according to the size of the PROM(s) installed. These settings should not normally be changed; however, the different settings are listed below.

W7	
IN (STD 121, S111A00)	Set for 8K or 4K PROMS.
OUT	Set for 2K PROMS.

W8	
IN	Set for 8K PROMS.
OUT (STD 111/121)	Set for 4K or 2K PROMS.

NPR Selection ACKnowledge (SACK) Control (W10)

This jumper, in conjunction with W11, is used to control bus DMA burst transactions in systems with more than one DMA device.

W10A-W10B	W10B-W10C	
IN	OUT (STD)	Allow bus arbitration requests after burst has been completed.
OUT	IN	Allow bus arbitration immediately after acquiring the bus.

NOTE: If there are devices present on the bus which do not burst and are subject to data late errors, change the jumper to W10B-W10C.

DMA Burst Control Jumper (W11)

The controller is shipped from the factory with W11A jumpered to W11B. In this position, the DMA burst is terminated either when the EEPROM burst count value is exhausted, or when the controller detects that another device on the bus is requesting either an interrupt or a DMA transfer. If the jumper is moved to connect W11B-W11C, the number of words transferred during a DMA burst is determined only by the burst count value stored in the EEPROM.

W11B-W11C	W11A-W11B	
IN	OUT	DMA burst determined by EEPROM value.
OUT	IN (STD)	DMA burst is terminated by bus request.

(NOTE: This mode requires W10B to W10C).

Disk Address Selection Jumper (W12A, W12B)

The SPECTRA 121/121-PLUS has one standard disk addressing range and three alternate disk addressing ranges. The table below shows how these four disk addressing ranges may be selected.

W12B	W12A	ADDRESS RANGE	
IN	IN	776700-776747	(STD)
IN	OUT	776300-776347	
OUT	IN	776200-776247	
OUT	OUT	776100-776147	

Tape Address Selection Jumper (W12C, W12D) (NOT USED ON S111)

The SPECTRA 111/121/-PLUS has one standard tape addressing range and two alternate tape addressing ranges. Depending on how this jumper is installed, the controller either selects a tape addressing range or disables the tape capability altogether.

W12D	W12C	ADDRESS RANGE	
IN	IN	772520-772537	(STD)
IN	OUT	770520-770537	
OUT	IN	772440-772457	
OUT	OUT	Disable tape capability.	

For example, if the address range 772520-772537 is selected, the register address allocation would be as follows.

ADDRESS	REGISTER	DRIVE
772520	TSDB	UNIT 0
772522	TSSR	UNIT 0
772524	TSDB	UNIT 1
772526	TSSR	UNIT 1
772530	TSDB	UNIT 2
772532	TSSR	UNIT 2
772534	TSDB	UNIT 3
772536	TSSR	UNIT 3

NOTE:

Mag Tape units 1, 2, 3, may be disabled by setting Bit 0 of EEPROM options "MTFLG1", "MTFLG2", "MTFLG3". This disables controller response to these unit registers, however the address space they occupied must still be reserved for the controller.

Interrupt Priority Level Jumpers (W13, W14, W15, W16)

Priority level 5 is standard (STD) and etched in the board. To select another priority level, cut the etched jumpers and hard-wire the required jumpers.

BG OUT W16	BR W14	BG W15				BG IN W13	LEVEL	
		A-E	B-F	C-G	D-H			
A-B	A-B	OUT	IN	IN	IN	A-B	4	
A-C	**A-C**	**IN**	**OUT**	**IN**	**IN**	**A-C**	5	(STD)
A-D	A-D	IN	IN	OUT	IN	A-D	6	
A-E	A-E	IN	IN	IN	OUT	A-E	7	

Miscellaneous Jumpers

The following jumpers are used by Spectra Logic manufacturing only.

Test Panel Clock (W6)

W6A-W6B	W6B-W6C	
IN	OUT	Select Clock*
OUT	IN	Select SEQ0 Clock

Microdiagnostic Control (W9)

Microdiagnostics may be controlled by the setting of this jumper or by the execution of the power up reset command. The manufacturing test configuration should be used during test panel microdiagnostic troubleshooting only.

W9A-W9B	W9B-W9C		
IN	OUT	(STD)	Microdiagnostics on power up or command control.
OUT	IN		Microdiagnostics on reset (test configuration).

2.3.2 SWITCH SETTINGS

There is only one set of switches on the SPECTRA 111/121/-PLUS. The following table summarizes the function of each switch.

	SWITCH	CLOSED (DOWN)	OPEN (UP)
*	SW1-1	Extended command function enabled.	Extended command function disabled.
	SW1-2	Buffer correction feature enabled.	Buffer correction feature disabled.
	SW1-3	Retry of ECC errors disabled.	Retry of ECC errors enabled.
*	SW1-4	EEPROM write protect enabled.	EEPROM write protect disabled.

NOTE:

If Switch SW1-1 and SW1-4 are in the open position at power up; the tape burst rate will be set to 32 words regardless of EEPROM selection.

Extended Command Enable (SW1-1)

Switching SW1-1 CLOSED allows the SPECTRA 111/121/-PLUS to perform extended commands. These are additional function codes for the disk or tape not supported by the DEC products that the SPECTRA 111/121/-PLUS is emulating. See the disk/tape command/function code table in section 3 for further details.

Switching SW1-1 OPEN prevents the SPECTRA 111/121/-PLUS from performing extended commands. Instead, an appropriate "illegal function code" response is returned.

SW1-1

CLOSED Extended command function enabled.

OPEN (STD) Extended command function disabled.

Buffer Correction Enable (SW1-2)

Switching SW1-2 CLOSED allows the SPECTRA 111/121/-PLUS to transparently correct all correctable disk ECC errors within the controller's internal buffer. When this occurs, no error is flagged to the host.

Switching SW1-2 OPEN disables the buffer correction feature. Disk ECC errors are flagged to the host with sufficient information to allow it to correct the data if the ECC error is correctable. However, if SW1-3 is OPEN (enabling the retry of ECC errors), ECC errors detected may not be flagged to the host if the error is recovered by the retry.

SW1-2	
CLOSED	Buffer correction feature enabled.
OPEN (STD)	Buffer correction feature disabled.

ECC Error Retry (SW1-3)

Switching SW1-3 OPEN allows the SPECTRA 111/121/-PLUS to automatically retry disk READ commands which detect ECC errors. Up to four retries are made in an attempt to read data without an ECC error. If an error-free read is not achieved within four retries, up to four further retries are performed. If a correctable ECC error is detected, the error is either corrected in the buffer, or flagged to the host depending on the setting of the Buffer Correction Enable switch (SW1-2). If after eight retries the error is still unable to be corrected, it is flagged as such to the host.

Switching SW1-3 CLOSED prevents the controller from retrying ECC errors.

SW1-3	
CLOSED	Retry of ECC errors disabled.
OPEN (STD)	Retry of ECC errors enabled.

EEPROM Write Protect (SW1-4)

Switching SW1-4 CLOSED hardware write protects the EEPROM, thus protecting the stored parameters from any unwanted erasure or reprogramming.

SW1-4 must be in the OPEN position and SW1-1 must be in the CLOSED position to change the stored parameter values (interrupt vectors, drive sizes, etc.).

SW1-4	
CLOSED (STD)	EEPROM write protect enabled.
OPEN	EEPROM write protect disabled.

2.4 DRIVE CONFIGURATION

Drive configuration for the SPECTRA 111/121/-PLUS controller is done through the use of an on board EEPROM. The EEPROM stores 1K byte of control parameter information which is preset from the factory. It is expected that the user will need to modify some of the control parameters (disk drive size information, for example).

The parameters may be modified three ways. The first way to modify the contents of the EEPROM is manually, either from the console or a program such as ODT (Octal Debugging Technique). To write to an EEPROM location, the address of the byte is written to RMWC, the data is written to RMDB, and the function code 43 is written to RMCS1 twice. To read an EEPROM location, the address of the byte is written to RMWC, and the function code 41 is written to RMCS1. After RDY (RMCS1 bit 7) becomes set again, the data byte may be read from RMDB.

The second way to modify the contents of the EEPROM is to use the Spectra Logic Elementary Debugger (SLED) program to automatically examine and/or modify the EEPROM contents. This procedure is described in detail in section 6.3.

The third, and most convenient way to program the EEPROM, is to use the DEC Configurator which is a user friendly program designed to run with a minimal amount of knowledge about the system. The DEC Configurator utility is described in section 6.4.

Note that the extended command enable switch (SW1-1) must be CLOSED to allow both reads and writes to the EEPROM, and the EEPROM write protect switch (SW1-4) must be OPEN to allow writes to the EEPROM.

2.5 CPU PREPARATION

The SPECTRA 111/121/-PLUS may be installed in any hex size backplane slot in the CPU or expansion chassis. Ensure that power is off before inserting or removing the board to avoid any possible damage. DC voltage should be measured on the PCB and adjusted, if necessary, to 5 volts $\pm$5%. If voltage is low and cannot be adjusted to specification, unload the supply (in twin chassis) by re-assigning PCBs to different slots.

2.6 CONTROLLER BOARD INSTALLATION

Before inserting or removing the board, ensure that the power is off to avoid any possible damage. To install the controller, hold the board by its edges and insert it into the selected backplane slot with the component side up. Gently slide the PCB towards the slot connectors, then pull the card ejectors out until the controller is firmly seated into the backplane. When removing the controller, the reverse procedure should be used.

2.7 CABLE CONNECTIONS

Disk Drive

Prior to connecting the interface cables, ensure that the drive unit number and sectors per track settings are correct. Also, the drive must be set for hard sectoring (a fixed number of sectors/track). The Spectra 111/121-PLUS does not detect soft sectoring (using address marks).

The Spectra 111/121/-PLUS uses Index and Sector in either the 'A' or the 'B' cable depending on the selection of the Rotational Position Sensing (RPS) option (contained in the EEPROM). If RPS is disabled, Index and Sector must be in the 'A' cable and gated with the Unit Selected signal. If RPS is enabled, Index and Sector must be in the 'B' cable.

To connect the interface cables to the controller board, connect the 60 conductor 'A' cable connector to the J3 header on the controller PCB. Ensure that pin 1 of the cable connector mates with pin 1 of the PCB header; pin 1 is designated by a small arrowhead and the brown/tan twisted pair.

Then, connect the 26 conductor 'B' cable connector to the J1, J2, J7, or J8 header(s) on the controller. Again, ensure that pin 1 of the cable connector mates with pin 1 of the PCB header; pin 1 is designated by a small arrowhead and cable stripe.

To connect the interface cables to the disk drive, route all cables neatly out of the CPU chassis. Connect the 60 conductor 'A' cable to the first disk drive, and if more than one drive is attached, daisy chain the 'A' cable between units. Install a terminator on the last drive in the chain. Then connect one 26 conductor 'B' cable to each drive. It is recommended that a ground braid be attached between the CPU chassis and each disk drive chassis.

Tape Drive

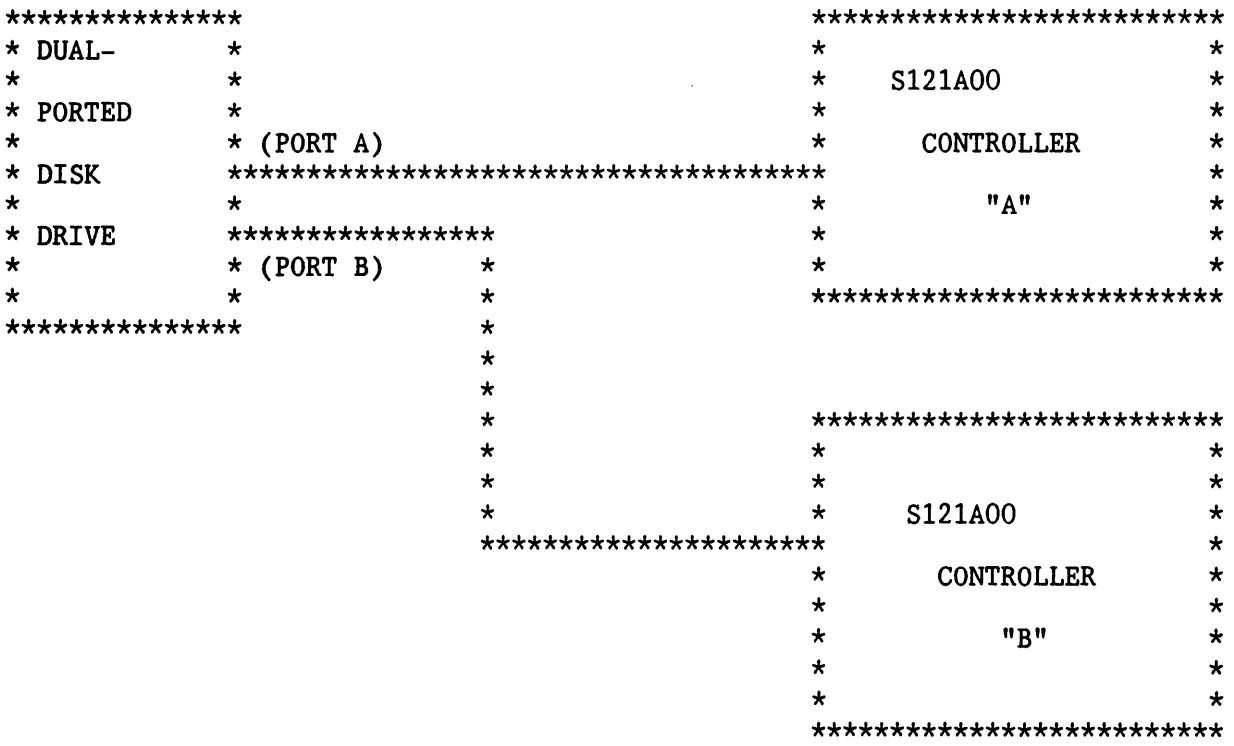
Consult the appropriate tape drive manual for the list of interface signals for each connector. Pin 2 of one connector has a signal called "FBY" or "IFBY". This connector receives the cable coming from J5 on the controller. The other connector on the tape drive connects to J6 on the controller. The 50 conductor tape cables should be connected to the J5 and J6 headers. Ensure that pin 1 of each is mated.

2.8 DUAL-PORT OPTION

The SPECTRA 111/121/-PLUS supports the dual-port option offered on many SMD disk drives. This feature is described in the following example.

Typical Dual-Port Operation

The dual port option enables two 111/121/-plus controllers to operate with a disk drive that contains the dual-port option.



TWO CONTROLLERS ACCESSING THE SAME DUAL PORTED DRIVE

For the configuration displayed;the operation is as follows:

*System issues a command to drive.
Controller attempts to seize the drive.
If the drive is busy (seized by other port) the command will be queued and no error will be generated.
When the drive becomes available, it will be seized and the transfer will be performed.

NOTE: The drive always appears to the system as available ("DVA" of RMCS1 is always set).

Also, "PGM" in RMDS is always set ("1") for Dual-Ported drive.

Controller Release Time-Out

A one second reserve timer is implemented (for each drive) by the controller. The timer is initialized by performing a write (or write low-byte) to RMCS1 (this reserves the drive). The drive remains reserved by the controller until the timer has elapsed or a release command is issued. The timer is prevented from elapsing by re-initializing periodically. Only the timer for the drive specified in RMSC2 is affected. If you are using a software which doesn't issue release commands, you must set bit 0 of XFRFLG in EEPROM to release all drives at the end of each command if you desire to disable the reserve timer.

Drive Switches

Because of the many different manufacturers of drives that contain the dual port option, the switch settings will be left up to the user to configure. However, the following possibilities exist and their function will be described.

LOCKED ON PORT A-If switches are in this setting while the drive becomes ready, the drive will be single ported with respect to Port A. All functions that are available to a non-dual-ported disk drive are available to the controller attached to Port A. The controller attached to Port B will never see the drive become ready.

LOCKED ON PORT B-If switches are in this setting while the drive becomes ready, the drive will be single ported with respect to Port B. The controller attached to Port A will never see the drive become ready.

PROGRAMMABLE-With switches in this setting while the drive becomes ready, the drive will be capable of responding to either of the controllers (Port A or Port B) connected to it.

DRIVE RELEASE TIMER ENABLE-Some drives supply a drive release timer. The function of this timer is to prevent the drive from becoming permanently seized to a port when the controller connected to that port fails.

NOTE: It is recommended that the drive release timer is enabled.

Controller/Drive Status

SEIZED ON PORT A-In this state, the controller attached to Port A has access to the drive for Read and Write operations. The controller attached to Port B is prevented from accessing the drive.

SEIZED ON PORT B-In this state, the controller attached to Port B has access to the drive for Read and Write operations. The controller attached to Port A is prevented from accessing the drive.

NEUTRAL STATE-In this state, the drive is available to either controller on a first come, first serve basis. The drive may be seized by the first controller that selects it.

Going from Seized to Unseized State

There are two ways to return to the un-seized or neutral state:

*The procedure used most often will be to issue a Release Command. The Release is issued by the controller that has seized the drive to return the drive to the neutral state. (This command must be used liberally to prevent degradation of system performance).

*If a Release Command is not issued after the last command, the drive will be released (un-seized) by the controller after one second time-out period. (This manner of releasing the drive should be avoided since it degrades system performance).

*If bit 0 of XFRFLG in EEPROM is set, then the drive will be released immediately after each command.

2.9 READ AHEAD FUNCTION DESCRIPTION

STANDARD 121

Read ahead on the standard SPECTRA 111/121 was limited to consecutive sector reads only. For example, if sector zero is read, the controller would read sector zero thru 14 into the sector buffer. Sector zero would be transferred by the host sequencer into system memory as soon as the buffer was released by the disk sequencer. In most cases the host would have moved the sector data to system memory before the disk completed the read ahead transfers thus allowing the disk to also fill the used buffer for the next sequential disk sector. This leaves us with 14 sectors (1 thru 14) in the sector buffer. If the next command requests sector 1, the disk sequencer would pass the buffer for sector 1 to the host. This sequence could be repeated until all read ahead sectors had been passed to the host. Emptied buffers would not be refilled until a non-sequential disk sector was requested.

If instead of requesting sector 1, the next command requested a sector out of sequence, the disk sequencer would read the data from the disk regardless of whether the data was in the read ahead buffer. i.e.-If sector zero was read and the next request was for sector 2 (skipping sector 1).

121-PLUS

The enhanced read ahead on the SPECTRA 121-PLUS is not limited to consecutive sectors. The disk sequencer fills up the sector buffer in a similar manner to a standard 121 except that now when another sector is requested, the disk sequencer does a search through the sector buffer first, and empties the buffers that don't match the requested sector. If the requested sector is not found, the disk sequencer reads the data from the disk. But if it finds the requested sector, it will pass the buffer for that sector to the host and goes back and fills up the emptied buffers with the next sequential sector after the last sector stored in the controller sector buffers.

In this case, if sector 1 is requested, the read ahead buffers will have sectors 1 thru 14. Then if sector 4 is requested, the disk sequencer will search through and find it in the read ahead sector buffer. After passing the buffer for sector 4 to the host, the disk sequencer goes out to the disk and puts sector 15 in sector buffer 1, sector 16 in sector buffer 2, and sector 17 in sector buffer 3. If sector 4 has been transferred to memory by this time and the disk sequencer sees the buffer has been emptied, it will go ahead and get sector 18 and put it in sector buffer 4. If the buffer is not empty, the read ahead stops.

This sequence of transferring continues until a sector has been requested that is not in any of the read ahead sector buffers. In this case, the data is read from the disk.

Chapter Three

Theory of Operation

3.1 RM REGISTER DEFINITIONS

The following table is a summary of the registers used by the software to control RM02/RM05 disk operations. Specific bit assignment and a short description of each register is contained in this section. The registers are contained in the RAM buffer of the SPECTRA 111/121/-PLUS and are written or read via the Unibus under program control. A separate set of registers for each drive is maintained in the RAM. Controller registers RMCS1, RMCS2, RMWC, RMBA, and RMDB are common, and therefore only one set of these registers is maintained.

RM REGISTER SUMMARY

REGISTER	NAME	UNIBUS ADDRESS	MODE	FUNCTION
RMCS1	CONTROL	776700	READ/WRITE	Function code, GO bit
RMWC	WORD COUNT	776702	READ/WRITE	2's complement of number of words transferred
RMBA	BUS ADDRESS	776704	READ/WRITE	Memory address where data transfer is to begin
RMDA	DESIRED SEC/TRK	776706	READ/WRITE	Sec/trk address where transfer is to begin
RMCS2	STATUS	776710	READ/WRITE	Controller status. Unit select bits.
RMDS	DRIVE STATUS	776712	READ	Non-error status plus error summary bit
RMER1	ERROR #1	776714	READ/WRITE	Contains individual error indications
RMAS	ATTENTION SUMMARY	776716	READ/WRITE	One bit per drive attention summary status
RMLA	LOOK AHEAD	776720	READ	Current sector address under heads.
RMDB	DATA BUFFER	776722	READ	Contains the word that did not compare during a write check error
RMMR1	MAINTEN-ANCE #1	776724	READ	TAG 4/5 status used for Fujitsu drives.
RMDT	DRIVE TYPE	776726	READ	Contains drive character indications
RMSN	SERIAL NUMBER	776730	READ	Reports the firmware revision level

RM REGISTER SUMMARY (continued)

REGISTER	NAME	UNIBUS ADDRESS	MODE	FUNCTION
RMOF	OFFSET	776732	READ/WRITE	Control bit for offset of drive heads
RMDC	DESIRED CYLINDER	776734	READ/WRITE	Address of cylinder for seek operations or start of data transfer
RMHR	HOLDING	776736	READ/WRITE	Not used. Always zero.
RMMR2	MAINTEN-ANCE #2	776740	READ	Tag 4/5 status used for Fujitsu drives.
RMER2	ERROR #2	776742	READ/WRITE	Drive error bits
RMEC1	ECC POSITION	776744	READ	Position of error burst
RMEC2	ECC PATTERN	776746	READ	Contains the error burst

RMCS1 (776700) BIT DEFINITIONS

The RMCS1 register is used to store the function code (command) and controller status. When the program sets the GO bit, the controller initiates the command for the specified drive.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SC	TRE	0	0	DVA	0	A17	A16	RDY	IE	F4	F3	F2	F1	F0	GO

BIT	NAME	FUNCTION
15	SC Special Condition	Set by TRE or ATTN.
14	TRE Transfer Error	Set by DLT, WCE, NEC, NEM, PGE, MXF, or a drive error during a Read/Write data transfer. If set in the command word, an RH error clear occurs.
13-12	----	Not used. Always zero.
11	DVA Drive Available	Indicates that the selected drive is available. Used for dual controller operation. This bit is always set.
10	----	Not used. Always zero.
9	A17 Bus Address	This bit is the Unibus address bit 17.
8	A16 Bus Address	This bit is the Unibus address bit 16.
7	RDY Ready	When set, indicates that the controller is ready to accept a command. Reset when the controller commences a data transfer operation.
6	IE Interrupt Enable	When set, generates interrupts if RDY or ATTN become set. When reset, interrupts are disabled.
5-1	F4-F0 Functions 0-4	Contain command code of function to be performed See command/function code table.
0	GO Go bit	Set to initiate a command. Reset when the controller completes execution of the command.

COMMAND/FUNCTION CODES

The following table corresponds to bits 5-1 of the RMCS1 register. Refer to section 3.1.1 for detailed descriptions of the commands.

F4	F3	F2	F1	F0	GO	OCTAL	MEANING
0	0	0	0	0	1	01	NO OPERATION (NOP)
0	0	0	0	1	1	03	ILLEGAL COMMAND
0	0	0	1	0	1	05	SEEK
0	0	0	1	1	1	07	RECALIBRATE
0	0	1	0	0	1	11	DRIVE CLEAR
0	0	1	0	1	1	13	RELEASE (dual port option)
0	0	1	1	0	1	15	OFFSET
0	0	1	1	1	1	17	RETURN to CENTERLINE
0	1	0	0	0	1	21	READ-IN-PRESET
0	1	0	0	1	1	23	PACK ACKNOWLEDGE
0	1	0	1	0	1	25	ILLEGAL COMMAND
0	1	0	1	1	1	27	ILLEGAL COMMAND
0	1	1	0	0	1	31	SEARCH
0	1	1	0	1	1	33	*SPIN UP DRIVES
0	1	1	1	0	1	35	*READ RAM BUFFER
0	1	1	1	1	1	37	*WRITE RAM BUFFER
1	0	0	0	0	1	41	*READ EEPROM
1	0	0	0	1	1	43	*WRITE EEPROM
1	0	0	1	0	1	45	*POWER UP RESET
1	0	0	1	1	1	47	*SPIN DOWN DRIVES
1	0	1	0	0	1	51	WRITE CHECK DATA
1	0	1	0	1	1	53	WRITE CHECK HEADER AND DATA
1	0	1	1	0	1	55	ILLEGAL COMMAND
1	0	1	1	1	1	57	ILLEGAL COMMAND
1	1	0	0	0	1	61	WRITE DATA
1	1	0	0	1	1	63	WRITE HEADER AND DATA FORMAT
1	1	0	1	0	1	65	*WRITE DATA & ECC
1	1	0	1	1	1	67	*FORMAT DRIVE OFFLINE
1	1	1	0	0	1	71	READ DATA
1	1	1	0	1	1	73	READ HEADER AND DATA
1	1	1	1	0	1	75	*READ DATA & ECC
1	1	1	1	1	1	77	*READ FUJITSU DRIVE DEFECT MAP

* Requires SW1-1 (EXTENDED COMMAND ENABLE) to be in the 'on' (closed) position.

SW1-1 should be in the 'off' (open) position during execution of standard diagnostics to flag these control codes as illegal functions.

RMWC (776702) BIT DEFINITIONS

The RMWC register is the word count register. It is loaded with the 2's complement of the number of words to be transferred. RMWC is incremented by 1 after each word is transferred. The maximum number of words to be transferred for the READ/WRITE command is 65,536.

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

BIT	NAME	FUNCTION
15-0	WC Word Count	These bits contain the 2's complement word count.

RMBA (776704) BIT DEFINITIONS

The RMBA register is the bus address register. It is loaded to specify the 16 low order bits at the starting memory address for a data transfer. Bit 0 is always a zero. The register is incremented by 2 after each word is transferred.

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

BIT	NAME	FUNCTION
15-1	BA Bus Address	These bits contain the memory address for data transfer.
0	----	Not used. Always zero.

RMDA (776706) BIT DEFINITIONS

The RMDA register is used to select the head and sector of the selected drive. The sector address is incremented automatically by the controller at the end of each sector during READ/WRITE operations until the word count is exhausted. The head address is incremented after transferring sector 31 until a maximum of 4 is reached for a RM02 emulation, or 18 for a RM05 emulation. Thereafter, the head address is reset to 0 and the cylinder address is incremented by 1.

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

BIT	NAME	FUNCTION
15-8	HA Head Address 0-255	These bits increment the head address when the last sector on the track is reached. In RM80 emulation mode, the last sector on the track may only be accessed when SSE (RMER2) is set.
7-0	SA Sector Address 0-255	These bits increment the sector address each time a sector is transferred. In RM80 emulation mode, the last sector on the track may only be accessed when SSE (RMER2) is set.

RMCS2 (776710) BIT DEFINITIONS

The RMCS2 register is used to store the unit select (drive number) and controller status. When bit 5 is set, a controller clear is initiated.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DLT	WCE	UPE	NED	NEM	PGE	MXF	0	0	IR	CLR	0	BAI	U2	U1	U0

BIT	NAME	FUNCTION
15	DLT Data Late	A Data Late cannot occur due to 14 sector data buffering. If the Unibus does not keep up with the disk, the controller will wait for a buffer and allow a disk revolution.
14	WCE Write Check Error	Set by the controller when a mismatch of disk data and memory data occurs during a WRITE CHECK DATA or WRITE CHECK HEADER and DATA command. RMDB contains bus address +1, providing that BAI is zero.
13	UPE Parity Error	Set when the controller detects a Memory Parity Error during a Read from memory.
12	NED Non Existent Drive	Set when a register READ or WRITE is attempted by the program to a drive that is not on-line (RMAS excluded). Cleared by INIT or TRE CLR.
11	NEM Non Existent Memory	Set when SLAVE SYNC does not respond to MASTER SYNC within 10 microseconds during data transfer operations.
10	PGE Program Error	Set when another data transfer command is issued by the program while a READ/WRITE command is already in progress.
9	MXF Mixed Transfer	Set if no SYNC character is found during a DATA TRANSFER command.
8	----	Not used. Always zero.

RMCS2 (776710) BIT DEFINITIONS [continued]

BIT	NAME	FUNCTION
7	OR Output Ready	Set when a word is present in RMDB and can be read by the program.
6	IR Input Ready	Always set.
5	CLR Controller Clear	When a "one" is written into this bit, the controller and all drives are initialized.
4	----	Not used. Always zero.
3	BAI Bus Address	When set, RMBA is not incremented and all data is transferred to/from the same address location
2-0	U2, U1, U0 Unit Select	These bits contain the binary address (0-7) of the logical unit selected by the controller.

RMDS (776712) BIT DEFINITIONS

The RMDS register contains drive status indicators for the drive selected.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ATA	ERR	PIP	MOL	WRL	LST	PGM	DPR	DRY	VV	0	0	0	0	0	OFM

BIT	NAME	FUNCTION
15	ATA Attention Active	Set when the attention bit for the appropriate drive is set. Also set by an error,a positioning command, a Medium On-Line bit changing state, a sector found during a SEARCH command, or when a previously addressed drive goes from unavailable to available on a dual-port drive. Reset by INIT, controller clear, writing a 1 into the Attention Summary Register,or setting the GO bit
14	ERR Error	Set if any of the error bits in RMER1 or RMER2 are set indicating a drive error.
13	PIP Positioning In Progress	Set if MOL is reset, or if a SEEK, SEARCH, RECALIBRATE, OFFSET, or RETURN TO CENTER LINE command is issued. Reset when function complete.
12	MOL Medium On-line	Set if the drive's READY signal is true and the unit is on cylinder. If the drive is off-line or powered down, MOL is cleared.
11	WRL Write Lock	Set if the drive Write Protect signal is true.
10	LST Last Sector Transferred	Set when the last addressable sector on the disk is read or written. Reset when RMDA is loaded.
9	PGM Programmable	Set if the controller is configured for the dual port drive option (EEPROM parameter).
8	DPR Drive Present	Set if the selected drive is attached to the controller and not occupied by another controller in dual-port operations.
7	DRY Drive Ready	Set when a command is completed; reset when a command is initiated.
6	VV Volume Valid	Set by a PACK ACK or READ-IN-PRESET command. Reset when the drive is spun up.
5-1	----	Not used. Always zero.
0	OFM	Set when an OFFSET command is issued.

RMER1 (776714) BIT DEFINITIONS

The RMER1 register contains error status of the selected drive. Errors are cleared by issuing a DRIVE CLEAR command.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCK	UNS	OPI	DTE	WLE	IAE	AOE	HCRC	HCE	ECH	WCF	FER	0	RMR	0	ILF

BIT	NAME	FUNCTION
15	DCK Data Check	Set if an ECC error is detected during a READ command. If the option to perform correction transparently is set, the DCK bit will be set only if ECH is set. If ECI is set, error correction is inhibited, and only DCK is set.
14	UNS Unsafe	Set if DVC (Bit 7) in RMER2 is set.
13	OPI Operation Incomplete	When set with DTE, indicates that a drive timing error occurred while attempting to read a header Otherwise, indicates that the drive did not become available for 1 second in dual port mode.
12	DTE Drive Timing Error	Set when a sync byte could not be detected while reading the header or data of a sector.
11	WLE Write Lock Error	Set if a WRITE command is issued to a drive that is write protected.
10	IAE Invalid Address Error	Set if a command is issued to an address outside the valid address range for the logical drive.
9	AOE Address Overflow	Set when RMDC overflows past the cylinder address range during a transfer.

RMER1 (776714) BIT DEFINITIONS [continued]

BIT	NAME	FUNCTION
8	HCRC Header CRC Error	Set if a CRC error is detected in the header field. It causes a READ or WRITE to terminate without transferring the sector's data. If this occurs during a READ HEADER and DATA command, the header words and sector data are transferred and HCRC is set.
7	HCE Header Compare Error	Set if the first two words of the header field read do not match the contents of RMDC and RMDA for the addressed sector. If this occurs during a READ or WRITE, sector data is not transferred to/from the disk. If this occurs during a READ HEADER and DATA, the sector data is transferred with HCE set.
6	ECH ECC Hard Error	Set if the error is not correctable. ECC also sets DCK.
5	WCF Write Clock Fail	When set,indicates that a loss of servo clock occurred while attempting a WRITE to the disk
4	FER Format Error	Set if the FMT16 bit in RMOF does not match bit 12 in the first word of the header field.
3	-----	Not used. Always zero.
2	RMR Register Mod. Refused	Set if any register WRITE is attempted to a drive that is busy.
1	-----	Not used. Always zero.
0	ILF Illegal Function	Set if the function code is illegal.

RMAS (776716) BIT DEFINITIONS

The RMAS register contains the attention summary status of all drives. A drive's attention bit may be reset by writing a "one" into the desired position to be reset. The MOV instruction should be used to perform all Read or Write operations.

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

BIT	NAME	FUNCTION
15-8	----	Not Used. Always zero.
7-0	ATA Attention Bits	Attention bits for drives 0-7.

RMLA (776720) BIT DEFINITIONS

The RMLA register contains the drive's sector counter value.

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

BIT	NAME	FUNCTION
15-14	----	Not Used. Always zero.
13-6	SC Sector Counter	Sector Counter bits 0-7.
5-0	----	Not used. Always zero.

RMDB (776722) BIT DEFINITIONS

The RMDB register contains the word that did not compare during a write check error. Also used in the extended command mode when either reading or writing the EEPROM or RAM buffer, and when using the FORMAT DRIVE command as a format pattern. See section 3.1.1 for descriptions of the extended commands.

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

BIT	NAME	FUNCTION
15-0	DB Data Buffer	Data buffer data bits 15-0.

RMMR1 (776724) BIT DEFINITIONS

The RMMR1 register reports extended drive status if the EEPROM option, TAG 4/5, is enabled on both the controller and the drive. The bit values shown below are for the Fujitsu 2351 (Eagle).

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SEC	SEC	SEC	SEC	SEC	SEC	SEC	SEC	SEC	IND	ADD	WRT	FLT	SK	ON	UNT
128	64	32	16	8	4	2	1			MRK	PRO		ERR	CYL	RDY

BIT	NAME	FUNCTION
15-0	----	If extended drive status is not enabled, the value of these bits is 000000 (octal).

RMDT (776726) BIT DEFINITIONS

The RMDT register contains the drive type of the selected drive.

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

BIT	NAME	FUNCTION
15-14	----	Not used. Always zero.
13	MOH Moving Head	This bit is hardwired to the "one" state.
12	----	Not used. Always zero.
11	DRQ Drive Request	Indicates the availability of the dual port option: 1=dual; 0= single.
10-9	----	Not used. Always zero.
8-0	DT Drive Type	These bits contain a number which allows the program to determine the type of drive being emulated. For example: 024(8)=RM03 025(8)=RM02 026(8)=RM80 027(8)=RM05 020(8)=RP04 021(8)=RP05 022(8)=RP06

RMSN (776730) BIT DEFINITIONS

The RMSN register reports the controller firmware revision level. Bits 15-8 represent the host firmware revision level, and bits 7-0 represent the disk firmware revision level (both in hexadecimal).

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

RMOF (776732) BIT DEFINITIONS

The RMOF register contains a Format mode bit, an Error Correction Inhibit bit, a Header Compare Inhibit bit, an Offset bit, and a Skip Sector Error Inhibit bit (for RM80 emulation only). The FMT16 bit should always be set. The Offset bit determines if the R/W heads are offset towards the spindle or away from the spindle.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	FMT	ECI	HCI	SSEI	0	OFF	0	0	0	0	0	0	0

BIT	NAME	FUNCTION
15-13	----	Not used. Always zero.
12	FMT 16 Format 16	Set for a 16-bit word format. The controller only uses a 16 bit mode.
11	ECI Error Correction	When set, an Error Correction is inhibited when an ECC error is detected.
10	HCI Header Compare Inhibit	When set, a header field comparison is inhibited and should always be zero during WRITE commands
9	SSEI Skip Sector Error Inhibit	When set, skip sector errors are inhibited until this bit is cleared. This bit may be cleared by writing a zero, or by detection of the end of track during data transfers. When set, this bit also allows access to the last sector on the track. Used in RM80 emulation mode only.
8	----	Not used. Always zero.
7	OFF Offset	Set to determine the direction of the R/W head offset: 0=away from spindle; 1=towards spindle. Reset by a WRITE command, a READ-IN-PRESET command, or a mid transfer seek.
6-0	----	Not used. Always zero.

RMDC (776734) BIT DEFINITIONS

The RMDC register contains the desired cylinder address that the drive is to access. It is reset when a READ-IN-PRESET command is issued. RMDC is incremented by the controller when the RMDA overflows to sector 0, head 0.

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

BIT	NAME	FUNCTION
15-11	----	Not used. Always zero.
10-0	DC Desired Cylinder	Desired cylinder address; range is 000 to 2047.

RMHR (776736) BIT DEFINITIONS

The RMHR register emulation is modified to return Drive Size information which provides compatibility with the Berkeley Unix Operating System. Writing a code into the RHMR register will return the desired parameter for the selected logical drive upon subsequent read of the RMHR register.

NOTE: This feature is not available on the S111A01 Model.

CODE	RETURNED PARAMETER
100027(8)	Number of Cylinders - 1
100030(8)	Number of Tracks - 1
100031(8)	Number of Sectors - 1

RMMR2 (776740) BIT DEFINITIONS

The RMMR2 register reports extended drive status if the EEPROM option, TAG 4/5, is enabled on both the controller and the drive. The bit values shown below are for the Fujitsu 2351 (Eagle).

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
WTL	CNL	LML	SRL	RZL	OSC	ATO	SEQ	SVE	DIW	WTR	WCR	HS	MH	CTL	IND

RMER2 (776742) BIT DEFINITIONS

The RMER2 register contains additional drive error status indicators.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BSE	SKI	0	IVC	LSC	LBC	0	0	DVC	0	SSE	0	0	0	0	0

BIT	NAME	FUNCTION
15	BSE Bad Sector	Set if bits 14 and 15 of the first header field word are 0 and HCI is 0 at the time of detection
14	SKI Seek Incomplete	Set when the selected drive returns the seek error status signal. RECALIBRATE should be issued to drive.
13	----	Not used. Always zero.
12	IVC Invalid Command	Set when any command is issued to a drive with MOL zero. If VV is zero and any command other than DRIVE CLEAR, READ-IN-PRESET, PACK ACK, or NOP is issued, IVC is set. Also set if an extended command is issued without SW1-1 on.
11	LSC Loss of System Clock	When set, indicates that the desired sector or index mark was not found during a Read or Write.
10	LBC Loss of Bit Clock	When set, indicates that a loss of read clock occurred while attempting to read from the disk.
9-8	-----	Not used. Always zero.
7	DVC Device Check	Set if the selected drive's fault status signal is true. UNS in RMER1 is also set.
6	----	Not used. Always zero.
5	SSE Skip Sector Error	Set when bit 13 of the first header word is read as a one and bit 9 (SSEI) of RMOF is not set. Bit 13 set indicates that the sector being read has been displaced because it (or a previous sector) contained a bad spot. Cleared by Drive Clear, INIT, or by writing zeroes into this register (RM80 emulation mode only).
4-0	----	Not used. Always zero.

RMEC1 (776744) BIT DEFINITIONS

The RMEC1 register contains Error Correction Code information. The position number stored is the bit count, from the first data bit in the sector to the first bit in error.

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

BIT	NAME	FUNCTION
15-13	----	Not Used. Always zero.
12-0	POS Position	ECC Position: the bit count from the first data bit of a sector to the first bit of the error pattern in RMEC2.

RMEC2 (776746) BIT DEFINITIONS

The RMEC2 register contains the ECC pattern and an 11-bit error correction pattern. Each logical "one" in this pattern indicates which bit is in error. The position of the least significant bit of the error pattern is determined by RMEC1. The 11-bit error pattern may straddle two 16-bit memory words and should be exclusive or'ed with memory locations to correct the bits in error.

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

BIT	NAME	FUNCTION
15-11	----	Not Used. Always zero.
10-0	PAT Pattern	ECC Error Pattern. The least significant bit of the error pattern is dependent upon the position count stored in RMEC1.

3.1.1 COMMAND DESCRIPTIONS

NO OPERATION

This command performs no drive functions and is provided for software compatibility.

SEEK COMMAND

This command causes the heads of the selected drive to be positioned at the cylinder indicated by the Desired Cylinder register (RMDC). If more than one logical drive is mapped on the physical drive, no explicit seek will be performed; however, the command will terminate normally. Only implied seeks required for data transfer commands will be performed on mapped drives.

RECALIBRATE COMMAND

This command causes a retraction of the drive heads and a reposition to track 0. It is normally issued after a drive error has been detected to assure proper head positioning.

DRIVE CLEAR COMMAND

This command is issued to clear errors associated with an individual drive. It causes a fault clear to be issued to the selected drive and clears the appropriate error bits in the controller drive registers.

RELEASE COMMAND

For the 111/121,this command has no function within the firmware, but it is included for software compatibility. If the drive is busy when a command is issued, the controller will wait until the drive becomes available to perform the transfer. The drive will be reserved for the duration of the data transfer and will be released upon completion of the command. For the 111/121-PLUS versions, this command will zero the drive release timer causing a release to be issued to the selected drive.

OFFSET COMMAND

This command is used on removable pack drives to recover data when an error is encountered during a Read operation. The OFFSET command is intended to compensate for minor head alignment differences between drive and head assemblies. Bit 7 of the offset register (RMOF) determines the head offset direction with respect to the spindle. The OFFSET command remains in effect until a logical cylinder boundary is crossed, or until a SEEK command or a RETURN TO CENTERLINE command is issued.

RETURN TO CENTERLINE COMMAND

This command causes the cancellation of the Offset Mode.

READ-IN-PRESET COMMAND

This command sets Volume Valid (bit 6) in the RMDS register and clears registers RMDA, RMDC, and RMOF. It is usually issued prior to a Disk Boot operation for a transfer from the boot block at sector zero, cylinder zero.

PACK ACKNOWLEDGE COMMAND

This command sets the Volume Valid bit in the RMDS register. Volume Valid must be set by the software prior to issuing any of the drive commands. The Volume Valid bit for a particular drive clears automatically when a drive transitions from offline to online.

SEARCH COMMAND

This command functions the same as a SEEK command except that upon positioning to the cylinder, the command does not terminate until the sector specified in RMDA has been located. (See the SEEK command description).

SPIN UP DRIVES COMMAND

This command causes the disk drive interface signals Pick and Hold to be asserted. This causes a drive with remote sequencing enabled to spin up. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

* **READ RAM BUFFER COMMAND** (DIAGNOSTIC USE ONLY)

This command loads data from the controller internal buffer as addressed by the RMWC register and places it in the RMDB register. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

* **WRITE RAM BUFFER COMMAND** (DIAGNOSTIC USE ONLY)

This command loads data from the RMDS register into the controller RAM buffer location addressed by the RMWC register. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION AND SW1-4 (EEPROM WRITE PROTECT ENABLE) TO BE IN THE OPEN POSITION.

*Not available on S111A01 Model.

READ EEPROM COMMAND

This command loads data from the controller internal EEPROM location as addressed by RMWC and places it in the RMDB register. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

WRITE EEPROM COMMAND

This command loads data from the RMDB register into the controller EEPROM location addressed by the RMWC register. The WRITE EEPROM command must be issued twice, consecutively, in order to perform the desired Write operation. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION AND SW1-4 (EEPROM WRITE PROTECT ENABLE) TO BE IN THE OPEN POSITION.

POWER UP RESET COMMAND

This command causes the controller to cycle through the microdiagnostics which are executed upon power up. It is normally issued after writing the EEPROM parameters to initialize the new configuration of the controller. The POWER UP RESET command may also be issued for general diagnostic purposes; however, the controller will not respond to the bus during execution of the diagnostics (approximately 10 milliseconds). If the diagnostic fails, the controller will loop on the error location. In this case, a bus timeout will occur if the controller is accessed. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

*** SPIN DOWN DRIVES COMMAND**

This command causes the disk drive interface signals Pick and Hold to be de-asserted. This causes a drive with remote sequencing enabled to spin down. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

WRITE CHECK DATA COMMAND

This command compares the data addressed by RMBA with the selected sector(s) addressed by RMDA and RMDC. The data buffer length is determined by the value in RMWC. If the data does not compare, the RMBA register points to the location that is one word past the failing location. The RMDB register contains the word that failed; registers RMDA and RMDC point to the failing sector.

WRITE CHECK HEADER AND DATA COMMAND

This command functions the same as the WRITE CHECK DATA command except that it also verifies the two sector header words.

*Not available on the S111A01 Model.

WRITE DATA COMMAND

This command transfers data addressed by the RMBA register to the sector(s) addressed by registers RMDA and RMDC. The sector size is fixed at 512 bytes. Prior to issuing the WRITE DATA command, the WRITE HEADER AND DATA or FORMAT LOGICAL DRIVE command must be issued to initialize the sector(s) to be written.

WRITE HEADER AND DATA COMMAND

This command is used in formatting the drive prior to use. It is similar to the WRITE DATA command except that the sector header is also written with data from memory. Two header words and 256 data words are transferred for each sector.

* **WRITE DATA AND ECC COMMAND** (DIAGNOSTIC COMMAND)

This is a diagnostic command used to verify the functionality of the ECC error detection and correction logic. The word length for this command is fixed at one sector plus the two ECC words. The WRITE DATA AND ECC command is similar to the WRITE DATA command except that the sector ECC field is also written with data from memory. Single and multiple bit, as well as correctable and uncorrectable errors may be simulated using the READ DATA AND ECC command to first acquire a good ECC field and then to modify the data field and write the data and ECC back to disk. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

* **FORMAT LOGICAL DRIVE COMMAND**

This command formats the specified logical drive. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION. The data pattern written in the sector data field is the contents of the Register RMDB.

READ DATA COMMAND

This command transfers data addressed by the RMBA register from the disk sector(s) addressed by the RMDA and RMDC registers. The sector size is fixed at 512 bytes. The number of words to be transferred is loaded (2's compliment) into the RMWC register.

READ HEADER AND DATA COMMAND

This command is similar to the READ DATA command except that the two sector header words are also read with the data into memory.

*Not available on the S111A01 Model.

* **READ DATA AND ECC COMMAND** (DIAGNOSTIC COMMAND)

This is a diagnostic command used to verify the functionality of the ECC error detection and correction logic. It is similar to the READ DATA

command except that the sector ECC field is also transferred into memory. The word length for this command is fixed at one sector plus the two ECC words. THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION.

* READ FUJITSU DRIVE DEFECT MAP COMMAND

This command reads the Fujitsu drive defect map and must be issued for each individual track. Track position is selected by the head address in RMDA and by the cylinder address in RMDC. The contents of RMWC is not used during execution of this command. If the defect data sync cannot be detected, a drive timing error is reported.

THIS IS AN EXTENDED DRIVE COMMAND AND REQUIRES SW1-1 (EXTENDED COMMAND ENABLE) TO BE IN THE CLOSED POSITION. Rotational Position Sensing (RPS) must also be enabled, and the drive parameters must be set for Expanded Emulation (no mapping) to recover the defect map data. Data returned by this command is shown below.

WORD 0 = Zeroes (high byte), 19 hexadecimal (low byte)
WORD 1 = Cylinder number (high order bit = 1 = defective track = more than one defect on this track)
WORD 2 = Head number (upper byte), zeroes (lower byte)
WORD 3 = First defect position (bytes from index +/- 1 byte)
WORD 4 = First defect length (length in bits +/- 1 bit)
WORD 5 = Second defect position
WORD 6 = Second defect length
WORD 7 = Third defect position
WORD 8 = Third defect length
WORD 9 = Fourth defect position
WORD 10= Fourth defect length
WORD 11= Zeroes (upper byte), F0 hexadecimal (lower byte)

*Not available on the S111A01 Model.

3.2 TS11 REGISTERS (SPECTRA 121/121-PLUS Model Only)

INTRODUCTION

Traditional tape subsystems communicate with the CPU through a set of device registers which contain command and status information. The TS11 subsystem, however, uses a different communication method. The CPU assembles a "command packet" in CPU memory space, and by writing its address to one of only two TS11 registers, it allows the TS11 subsystem to access the command information through the use of DMA transfers from CPU memory. After completion of the command, the TS11 subsystem (using DMA transfers) writes status information to a "message buffer" in CPU memory, which the CPU may read to determine the result of the previous command. The two TS11 registers may also be read by the CPU.

DEVICE REGISTERS

The TS11 has 2 Unibus word locations used as device registers. The Data Buffer register (TSDB) is located at the base address, and the Status register (TSSR) is located at the base address +2.

The TSDB is written to by the CPU with a pointer to the command packet. (If the TSDB register is read by the CPU, it will either contain the command packet address, or an address which is 2 more than the highest message buffer address depending on the timing of the read).

Although the TSDB appears to the CPU to be a 16-bit register, it allows an 18-bit command packet address to be defined. Command packet address bits 15-2 are defined by TSDB bits 15-2. Command packet address bits 1 and 0 are always zero (thus command packets may only start on modulo-4 memory addresses). Command packet address bits 17 and 16 are defined by TSDB bits 1 and 0. (These two bits are also displayed in TSSR bits 9 and 8 respectively).

The second device register is TSSR. Writing to TSSR causes a subsystem INIT command, and reading TSSR reads device status.

TSDB BIT DEFINITIONS
(WRITE)

BIT	NAME	DEFINITION
15	P15	Command Address bit 15
14	P14	Command Address bit 14
13	P13	Command Address bit 13
12	P12	Command Address bit 12
11	P11	Command Address bit 11
10	P10	Command Address bit 10
9	P9	Command Address bit 9
8	P8	Command Address bit 8
7	P7	Command Address bit 7
6	P6	Command Address bit 6
5	P5	Command Address bit 5
4	P4	Command Address bit 4
3	P3	Command Address bit 3
2	P2	Command Address bit 2
1	P17	Command Address bit 17
0	P16	Command Address bit 16

TSDB BIT DEFINITIONS
(READ)

BIT	NAME	DEFINITION
15	A15	Bus Address bit 15
14	A14	Bus Address bit 14
13	A13	Bus Address bit 13
12	A12	Bus Address bit 12
11	A11	Bus Address bit 11
10	A10	Bus Address bit 10
9	A9	Bus Address bit 9
8	A8	Bus Address bit 8
7	A7	Bus Address bit 7
6	A6	Bus Address bit 6
5	A5	Bus Address bit 5
4	A4	Bus Address bit 4
3	A3	Bus Address bit 3
2	A2	Bus Address bit 2
1	A1	Bus Address bit 1
0	A0	Bus Address bit 0

TSSR BIT DEFINITIONS

The TSSR is a 16-bit status register that can only be updated from the transport or internal controller logic. It cannot be modified from the Unibus except when SPE, UPE, RMR, NXM, and SSR bits are cleared when the TSDB is written to by the host CPU. It is a read/write register at the base address +2. It can be read at any time with or without the transport unit connected. [TC] = Termination Class Codes.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SC	UPE	SPE	RMR	NXM	NBA	A17	A16	SSR	OFL	FC1	FC0	TC2	TC1	TC0	0

BIT	NAME	FUNCTION
15	SC Special Condition	When set, indicates that the last command was not completed because an error was detected. [TC=S].
14	UPE Unibus Parity Error	Set when the controller detects a memory parity error during a Read from memory.
13	SPE Serial Parity Error	Not emulated.
12	RMR Register Mod. Refused	Set by the controller when a command pointer is loaded into TSDB and subsystem Ready (SSR) is not set. [TC=S]
11	NXM Non-Existent Memory	Set by the controller when trying to transfer to or from a memory location which does not exist. [TC=4/5].
10	NBA Need Buffer Address	When set, indicates that the transport needs a message buffer address. Cleared by a WRITE CHARACTERISTICS command if the transport gets valid data. Always set after subsystem INIT. [TC=S].
9	A17 Bus Address	Displays the value of bit 17 in TSDB. [TC=S]
8	A16 Bus Address	Displays the value of bit 16 in TSDB. [TC=S]
7	SSR Subsystem Ready	When set, indicates that the TS11 subsystem is not busy and ready to accept a command pointer. [TC=S].

TSSR BIT DEFINITIONS [continued]

BIT	NAME	FUNCTION
6	OFL Off-line	When set, indicates that the transport is off-line and unavailable for any TAPE MOTION command. [TC=S].
5-4	FC1, FC0	Not emulated.
3	TC2 Termination Class Bit 2	Acts as an offset value when an error or exception condition occurs on a command. Only valid when SC is set. [TC=S].
2	TC1	See TC2 above.
1	TC0	See TC2 above.
0	----	Not used. Always zero.

ADDITIONAL TSSR INFORMATION

TSSR register bits 12, 11 and 7 are cleared only on system power up, TS11 power up, subsystem INIT, or at the beginning of any WRITE command to the TSSR register. Bits 15 and 6 are under control of the transport. These may be set or cleared independently of any TS11 operation.

The RMR bit does not effect the error class codes because RMR may occur on an error free system. However, RMR does set Special Condition (SC). If RMR is seen in the TSSR, the CPU must have written to TSDB while the command was executing.

Any "write" function to the base address +2 is decoded as a subsystem INIT. This resets the TS11 and transport (no matter what state they are in) and causes an automatic load sequence returning the tape to BOT if the transport is on-line.

The TSSR may not reflect the current state of the hardware if ATTNs are not enabled and the message buffer is not released. (That is, the drive may be off-line while the TSSR shows on-line). To keep the TSSR up to date would violate message packet protocol.

TERMINATION CLASS CODES (TC)

The following table includes the meanings of the binary values within the termination class code field in the TSSR register. (S = Non-termination status).

TC VALUE	MESSAGE TYPE and NAME	FUNCTION
0	END Normal Termination	This message indicates that the operation was completed without incident.
1	ATTN Attention	This message indicates that the drive has undergone a status change. The change implies either going off-line or coming on-line.
2	END Tape Status Alert	This message indicates that a status condition has been encountered that may have significance to the program. These conditions may include TMK, EOT, RLS, and RLL.
3	FAIL Function Reject	This message indicates that the specified function was not initiated. Functions may include OFL, VCK, BOT, WLE, ILC, and ILA.
4	ERR Recoverable Error	This message indicates that the tape position is one record beyond what it was when the function was initiated. For recovery, log the error and issue a RETRY command.
5	ERR Recoverable Error	This message indicates that the tape position has not changed. For recovery, log the error and re-issue the original command.
6	ERR Unrecoverable Error	This message indicates that the tape position has been lost. For recovery, the tape must have labels or sequence numbers.
7	ATTN/ERR Fatal Subsystem Error	Not emulated.

XST (EXTENDED STATUS REGISTERS)

Five additional registers (the Residual Frame Count Register (RBPCR) and the Extended Status Registers 0-3) are employed to provide additional status information.

The Extended Status Registers are not read directly from the registers accessible at the Unibus interface. At the end of a command or by issuing a GET STATUS command, the message buffer information is updated. The end message buffer, which results by issuing a GET STATUS command, contains the extended status words. Therefore, a message buffer must be defined to the subsystem before the Extended Status Registers are available to the software.

RBPCR BIT DEFINITIONS

The RBPCR register contains additional status information.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
C15	C14	C13	C12	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1	C0

BIT	NAME	FUNCTION
15-0	C15-C0	This word contains the octal count of residual bytes, records, and tape marks for the READ, SPACE RECORDS, and SKIP TAPE MARK commands. The contents are meaningless for all other commands.

XSTATO BIT DEFINITIONS

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TMK	RLS	LET	RLL	WLE	NEF	ILC	ILA	MOT	ONL	IE	VCK	PED	WLK	BOT	EOT

BIT	NAME	FUNCTION
15	TMK Tape Mark	Set when a tape mark is detected during a READ SPACE or SKIP command, or by the WRITE TAPE MARK or RETRY commands. [TC=S/2]
14	RLS Record Length Short	Indicates that either the record length is shorter than the byte count on read operations, or a space records operation encounters a tape mark or BOT before the position count is exhausted, or a SKIP TAPE MARKS command is terminated by encountering BOT or a double tape mark before exhausting the position counter. [TC=2].
13	LET Logical End of Tape	Set only on a SKIP TAPE MARKS command. Set when either two contiguous tape marks are detected,or when moving off BOT and the first record is a tape mark. Will not set unless this mode of termination is enabled by the WRITE CHARACTERISTIC command [TC=2].
12	RLL Record Length Long	When set, indicates that the record read was longer than the byte count specified. [TC=2].
11	WLE Write Lock Enable	When set, a TC3 indicates a write operation was issued but the mounted tape didn't contain a write enable ring. When set, TC6 indicates the WRT lock switch was activated during a write.
10	NEF Non-Executable Function	When set, indicates that the command could not be executed due to one of the following: The command specified a reverse tape direction, but the tape was already positioned at BOT; A MOTION command was issued without the Clear Volume Check (CVC) bit being set along with the Volume Check bit; A MOTION command was issued when the transport was off-line; or, a WRITE command was issued when the tape did not contain a write enable ring/write lock status. [TC=3].

XSTATO BIT DEFINITIONS [continued]

BIT	NAME	FUNCTION
9	ILC Illegal Command	Set when a command is issued and either its command field or its command mode field contains codes not supported by the controller, or an extended command was issued without SW1-1 closed.
8	ILA Illegal Address	Set if the high order buffer address is greater than 3 for any command requiring the controller to access memory. [TC=3].
7	MOT Motion	This bit reflects the status of Formatter Busy (FBY*) on the tape interface at the time the message buffer was updated.
6	ONL On-Line	When set,indicates that the transport is on-line and operable. If the transport is off-line, it causes a TC1 on ATTN interrupt or a TC3 for a Non-Executable Function. [TC=S/1/3].
5	IE Interrupt Enable	Reflects the state of the Interrupt Enable bit supplied on the last command. [TC=S].
4	VCK Volume Check	Set when the transport changes state (from off-line to online). Always set after initialization. [TC=S/3].
3	PED Phase Encoded	Reports PE/NRZI or high/low speed from the drive determined by the W1 jumper.
2	WLK Write Locked	When set, indicates that the mounted tape reel does not have a write enable ring installed. Thus, the tape is write protected. [TC=S/3].
1	BOT Beginning of Tape	When set, indicates that the tape is positioned at the load point. It causes a TC2 if reversed into BOT, and a TC3 if at BOT when a REVERSE command occurs. [TC=S/2/3]. The SPECTRA 121 requires latched BOT from the tape drive.
0	EOT End of Tape	Set when the tape is positioned at or beyond the end of the tape reflective strip. Reset when the tape passes over the strip in reverse under program control, or subsystem initialization. (Status on a read, TC2 on a write). [TC=S/2]. The SPECTRA 121/121-PLUS requires latched BOT from tape drive.

XSTAT1 BIT DEFINITIONS

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DLT	0	COR	CRS	TIG	DBF	SCK	0	IPR	SYN	IPO	IED	POS	POL	UNC	MTE

BIT	NAME	FUNCTION
15	DLT Data Late	Set when the I/O silo is full on a READ or empty on a WRITE. Occurs when the Unibus latency exceeds the transport's data transfer rate for a significant number of transfers. [TC=4].
14	----	Not used. Always zero.
13	COR Correctable Data	Set when a correctable data error is encountered [TC=S].
12	CRS Crease Detected	Not emulated.
11	TIG Trash in Gap	Not emulated.
10	DBF Deskew Buffer	Not emulated.
9	SCK Speed Check	Not emulated.
8	----	Not used. Always zero.
7	IPR Invalid Preamble	Not emulated.
6	SYN Synchronization	Not emulated.
5	IPO Invalid Postamble	Not emulated.
4	IED Invalid End Data	Not emulated.
3	POS Postamble Short	Not emulated.
2	POL Postamble Long	Not emulated.
1	UNC Uncorrectable	Set when an uncorrectable data error is encountered [TC=S].
0	MTE Multitrack Error	Not emulated.

XSTAT2 BIT DEFINITIONS

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OPM	SIP	BPE	CAF	0	WCF	0	DTP	DT7	DT6	DT5	DT4	DT3	DT2	DT1	DT0

BIT	NAME	FUNCTION
15	OPM Operation in Progress	Set after all TAPE MOTION commands. Tape moves. [TC=S].
14	SIP Silo Parity Err.	Not emulated.
13	BPE Bus Parity Error	Not emulated.
12	CAF Capstan Accel	Not emulated.
11	----	Not used. Always zero.
10	WCF Write Card Fail	Not emulated.
9	----	Not used. Always zero.
8	DTP Dead Track Par.	Not emulated.
7	DT7 Dead Track 7	Not emulated.
6	DT6 Dead Track 6	Not emulated.
5	DT5 Dead Track 5	Not emulated.
4	DT4 Dead Track 4	Not emulated.
3	DT3 Dead Track 3	Not emulated.
2	DT2 Dead Track 2	Not emulated.
1	DT1 Dead Track 1	Not emulated.
0	DT0 Dead Track 0	Not emulated.

XSTAT3 BIT DEFINITIONS

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MEC	MEC	MEC	MEC	MEC	MEC	MEC	MEC	LMX	OPI	REV	DCK	CRF	NOI	LXS	RIB

BIT	NAME	FUNCTION
15-8	MEC Microdiagnostic Error Code	Not emulated.
7	LMX Limit Exceeded	Not emulated.
6	OPI Operation Incomplete	Set when a READ, SPACE, or SKIP operation moves 25 feet of tape without detecting any data on the tape. Also set by a WRITE command when the read head fails to see data transitions after four feet of tape. [TC=6].
5	REV Reverse	Set when the direction of a current tape operation is reverse. If at least one multifunction RETRY command is reverse, the bit is set.[TC=S].
4	CRF Capstan Response Fail	Not emulated.
3	DCK Density Check	Not emulated.
2	----	Not used. Always zero.
1	LXS Limit Exceeded Statically	Not emulated.
0	RIB Reverse into BOT	Set when a READ, SPACE, SKIP or REVERSE command already in progress encounters the BOT marker when moving tape in the reverse direction. Tape motion is halted at BOT. [TC=2].

TS11 REGISTER SUMMARY

TSDB

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0

TSSR

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SC	UPE	SPE	RMR	NXM	NBA	A17	A16	SSR	OFL	FC1	FC0	TC2	TC1	TC0	0

RBPCR

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
C15	C14	C13	C12	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1	C0

XSTAT0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TMK	RLS	LET	RLL	WLE	NEF	ILC	ILA	MOT	ONL	IE	VCK	PED	WLK	BOT	EOT

XSTAT1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DLT	0	COR	CRS	TIG	DBF	SCK	0	IPR	SYN	IPO	IED	POS	POL	UNC	MTE

XSTAT2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OPM	SIP	BPE	CAF	0	WCF	0	DTP	DT7	DT6	DT5	DT4	DT3	DT2	DT1	DT0

XSTAT3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MEC	MEC	MEC	MEC	MEC	MEC	MEC	MEC	LMX	OPI	REV	CRF	DCK	0	LXS	RIB

3.3 PACKET PROTOCOL SCHEME

The packet protocol scheme allows the drive to send a large amount of status and error information to the CPU using limited address space. It also prevents the drive from updating the error and status information asynchronously (while the CPU is reading it). The packet protocol scheme is described below.

* The drive takes up only two words of address space.
* The CPU defines a set of locations in memory called command packets.
* The command packets tell the drive what operation to perform.
* The CPU also defines a set of locations called message buffers.
* The drive puts the error and status information in the message buffers.
* The CPU must give the drive both the command packet address and the message buffer address.
* The CPU gives the command packet address to the drive on every command.
* The CPU writes the address of the command packet into the TSDB.
* The CPU gives the message buffer address to the drive when it does a WRITE CHARACTERISTICS command.

OWNERSHIP

Both the command packet and the message buffer may be owned, thus preventing the drive from updating the message buffer while the CPU is reading it. There are four different combinations that transfer the ownership; they are described as follows.

1. Transfer command packet from CPU to controller

   Transferred by writing the address of the command packet into the TSDB.

2. Transfer command packet from controller to CPU

   Transferred by setting the ACK bit in the message buffer.

3. Transfer message buffer from CPU to controller

   Transferred by setting the ACK bit in the command packet.

4. Transfer message buffer from controller to CPU

   Transferred when the drive sets the SSR bit in TSSR. Also transferred during an ATTN when the controller clears the SSR, outputs the message, then sets SSR again. Interrupts occur if IE is set.

COMMAND AND MESSAGE PACKETS

Command packets must reside on modulo-4 address boundaries within CPU memory space. This means the starting address of the packet must be divisible by 4 (that is, octal 00, 04, 10, 14 etc.).

All four words of a command packet must exist even if all four words are not used by a command. (REWIND, for example, only uses one word.)

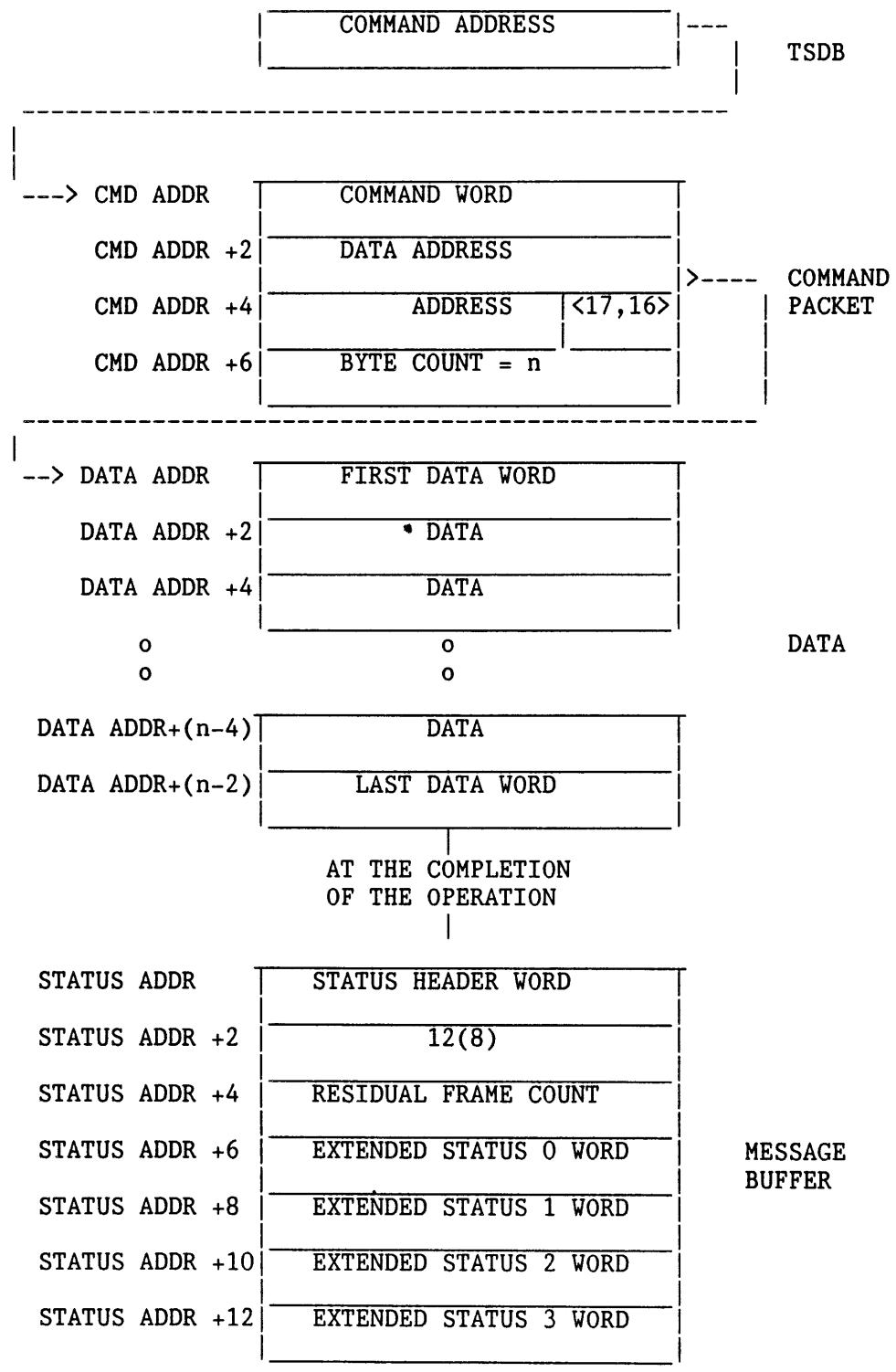
Message packets are issued by the subsystem and are deposited into the CPU's memory space. Controlled operation of the TS11 requires that it be supplied a message buffer address on a WRITE CHARACTERISTICS command. The five extended status registers are stored in this message buffer area. The END message packet, which results at the end of any command, contains these extended status words.

TYPICAL READ/WRITE OPERATION

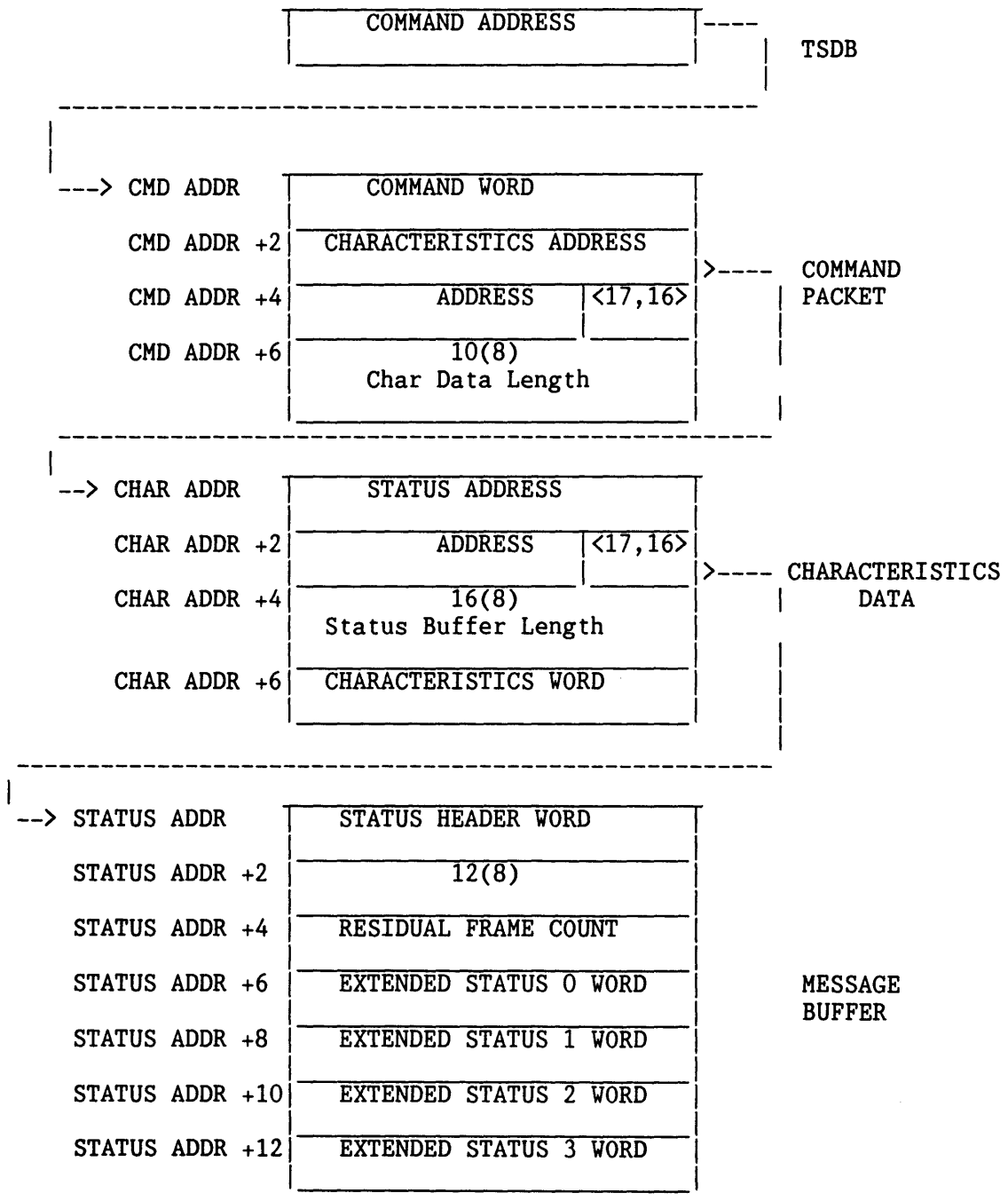
First, the CPU assembles a four word command packet in memory. This specifies the command, the address in memory where data is to be written or read, and the number of data bytes to be transferred. The starting address of this command packet is then loaded into the TSDB register (one of the two TS11 registers) to inform the controller of the new command.

The controller then reads the command packet from memory and executes the command, either reading or writing data to/from the address in memory specified in the command packet. At the completion of the command, the controller writes status information to the status register, TSSR, as well as writing a message buffer of seven words into the memory location specified by the last WRITE CHARACTERISTICS command. Usually an interrupt will then be generated to inform the CPU that the operation is complete. The Read/Write operation sequence and the Write Characteristics operation sequence are illustrated in the following diagrams.

READ/WRITE OPERATION SEQUENCE



WRITE CHARACTERISTICS OPERATION SEQUENCE



COMMAND PACKET/HEADER WORD BIT DEFINITIONS

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEVICE DEPENDENT			COMMAND MODE				PACKET FORMAT 1			COMMAND CODE				
ACK	CVC	OPP	SWB	0	M	M	M	IE	0	0	0	C	C	C	C

BIT	NAME	FUNCTION
15	ACK Acknowledge	Set when a command is issued and the CPU owns the message buffer. It informs the controller that the message buffer is now available for any pending or subsequent command packets. This passes ownership of the message buffer to the controller.
14	CVC Clear Volume Check	This bit clears Volume Check for the drive. Volume Check will be set on INIT or after the unit goes offline. Must be cleared to perform any drive command (READ/WRITE/POSITION).
13	OPP Opposite	Reverses the execution sequence of the re-read commands. Device Dependent.
12	SWB Swap Bytes	Instructs the controller to alter the sequence of storing and retrieving bytes from the CPU's memory.
11-8	CMF Command Mode Field	These bits act as an extension to the command codes and field. The allow specification of extended device commands.
7-5	PFF Packet Format Field #1	If the bit values are 000, it is a one word header; interrupt disable. If the bit values are 100, it is a one word header; interrupt enable.
4-0	CC Command Code	Refer to the Command Code table.

COMMAND CODE AND MODE FIELD DEFINITIONS

BITS 4 - 0		BITS 11 - 8	
COMMAND CODE FIELD	COMMAND NAME	COMMAND MODE FIELD	MODE NAME
00001	READ	0000	Read next (forward)
		0001	Read previous (reverse)
		0010	Read previous(space reverse,read fwd)
		0011	Read next(space forward,read reverse)
		0100	Read sense *
		0101	Read extended sense *
00100	WRITE CHARACTER	0000	Load message buffer address and set device characteristic.
00101	WRITE	0000	Write data (text).
		0010	Write data retry(space reverse,erase, write data).
		0100	Run remote diagnostics *
00110	WRITE SUBSYSTEM MEMORY	0000	Normal (diagnostic use only).
01000	POSITION	0000	Space records forward.
		0001	Space records reverse.
		0010	Skip tape marks forward.
		0011	Skip tape marks reverse.
		0100	Rewind.
01001	FORMAT	0000	Write tape mark.
		0001	Erase.
		0010	Write tape mark retry (space reverse, erase, write tape mark).
01010	CONTROL	0000	Message buffer release.
		0001	Rewind and unload.
		0010	Clean.
01011	INITIALIZE	0000	Drive initialize
		0001	Online **
		0010	High speed/density select **
		0011	Low speed/density select **
		0100	PE select *
		0101	GCR select *
		0110	Long gap select *
		0111	Short gap select *
01111	GET STATUS IMMEDIATE	0000	Get status (END message only).

*Available for CDC Keystone III drives. SW1-1 must be CLOSED.
**Available for any drive supporting this interface control function. SW1-1 must be CLOSED.

SWAP BYTES

The Swap Bytes bit in the command packet header word (bit 12) instructs the controller to alter the sequence of storing and retrieving bytes from the CPU's memory. When Swap Bytes equal 1, an industry compatible sequence (beginning with an even byte) is used. When Swap Bytes equal 0, the swapping begins with an odd byte. This swapping occurs only for data transfer operations.

The following figures indicate the memory positions for the bytes as they are read from or written on the tape. In these examples, the bytes of data in the record block on tape are numbered starting at 0. Byte 0 is always the data byte at the beginning of the block; that is, the part of the block that is closest to BOT.

When reading in reverse, the first data byte read is the last data byte of the sequence written. The READ REVERSE command stores this first byte in the last buffer position; the next byte in the next to last buffer position, etc. This results in having data put in memory in the right order when reading the buffer sequentially.

BYTE SWAP SEQUENCE Forward tape direction (READ or WRITE)

SWAP BYTES = 0
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	1	0
1002	3	2
1004	5	4
1006	7	6

SWAP BYTES = 1
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	1
1002	2	3
1004	4	5
1006	6	7

SWAP BYTES = 0
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	
1002	2	1
1004	4	3
1006	6	5
1010		7

SWAP BYTES = 1
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000		0
1002	1	2
1004	3	4
1006	5	6
1010	7	

BYTE SWAP SEQUENCE Reverse tape direction (READ)

SWAP BYTES = 0
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	1	0
1002	3	2
1004	5	4
1006	7	6

SWAP BYTES = 1
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	1
1002	2	3
1004	4	5
1006	6	7

SWAP BYTES = 0
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	
1002	2	1
1004	4	3
1006	6	5
1010		7

SWAP BYTES = 1
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000		0
1002	1	2
1004	3	4
1006	5	6
1010	7	

SWAP BYTES = 0
BUFFER ADDRESS = 1000
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	1	0
1002	3	2
1004	5	4
1006		6

SWAP BYTES = 1
BUFFER ADDRESS = 1000
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	0	1
1002	2	3
1004	4	5
1006	6	

SWAP BYTES [continued]

SWAP BYTES = 0
BUFFER ADDRESS = 1001
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	0	
1002	2	1
1004	4	3
1006	6	5

SWAP BYTES = 1
BUFFER ADDRESS = 1001
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000		0
1002	1	2
1004	3	4
1006	5	6

GET STATUS COMMAND

This command packet causes an update of the five extended status registers in the message buffer area. This command need only be used when the TS11 is left idle or when a status register update is desired without performing a READ, WRITE, or POSITION TAPE command. The TS11 hardware automatically updates the extended status registers at the end of any command. See message packet examples for data format.

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC 0 0	0 0 0 0	IE 0 0	0 1 1 1 1
NOT USED				

MODE: 0000 = GET STATUS (End message only).

READ COMMAND

The READ command packet has four modes of operation: READ FORWARD, READ REVERSE, REREAD PREVIOUS, and REREAD NEXT. A read operation is assumed to be for a record of known length; therefore, the correct record byte count must be known. If the byte count is correct, normal termination occurs. If the record is shorter than the byte count, Record Length Short (RLS) is set and a Tape Status Alert (TSA) termination occurs. If the record is larger than the byte count, Record Length Long (RLL) is set and a TSA termination occurs. If a tape mark is encountered during a read operation, data will not be transferred, Tape Mark (TMK) and Record Length Short (RLS) are set, and a TSA termination occurs.

If a Read Reverse operation runs into BOT, tape motion stops, Reverse into BOT (RIB) is set, and a TSA termination occurs. If a READ REVERSE is issued while the tape is positioned at BOT, a function reject (NEF) occurs with no tape motion.

READ COMMAND PACKET EXAMPLE

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC OPP SWB	0 0 X X	IE 0 0	0 0 0 0 1
A15	LOW ORDER BUFFER ADDRESS			A0 0
0	HIGH ORDER BUFFER ADDRESS		0	A17 A16
0	BUFFER EXTENT BYTE COUNT (16 BIT POSITIVE INTEGER)			0

MODE: 0000 = GET STATUS (End message only).
0001 = READ PREVIOUS (Reverse).
0010 = REREAD PREVIOUS (Space reverse, read forward).
0011 = REREAD NEXT (Space forward, read reverse).
0100 = READ SENSE (extended command).
0101 = READ EXTENDED SENSE (extended command).

The Opposite bit (OPP) alters the execution sequence of the REREAD command mode; that is, SPACE FORWARD, READ REVERSE becomes READ FORWARD, SPACE REVERSE, etc.

When reading in reverse, the first data byte read is the last data byte of the sequence written. The READ REVERSE command stores this first byte in the last buffer position, the next byte in the next to last buffer position, etc. This results in having data put in memory in the right order when reading the buffer sequentially.

The READ SENSE and READ EXTENDED SENSE commands are available for the CDC Keystone III drives (model 92185). If they are issued to other drives, a fault may occur. Both commands return extended status from the tape drive to memory by encoding tape control functions on the interface. The tape drive returns eight bytes of status for the READ SENSE command and twenty seven bytes of status for the READ EXTENDED SENSE command. The 'SENSE' data transfer is similar to the Tape Read operation except that no tape motion is involved. The drive need not be online to issue either of these commands. See the CDC Product Specification 49793200 for further information.

SENSE BYTES TRANSMITTED IN READ SENSE COMMAND

Eight bytes of status are returned for the READ SENSE command. The bytes are packed into status words (0-3) when transferred to memory. For example, bits 0-7 of byte 0 and bits 0-7 of byte 1 make up bits 15-0 of status word 0. The bits returned are bit reversed for each byte.

STATUS WORD 0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
REV	WRITE	EDIT	WRT FM	ERASE	HI SPD SEL	THR	LNG GAP	CMD REJ	INT REQ	DRI TYP	EQP CHK	DATA CHK	OVR RUN	UNIT CHK	UNIT EXE
[0	1	2	3	4	5	6	7]	[0	1	2	3	4	5	6	7]
BYTE 1								BYTE 0							

STATUS WORD 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FM DET	ILL CMD	DEN CON	DEV CHK	0	PAR ERR	WRT CHK	GAP CHK	RDY	ON LIN	REW	FILE PROT	POS RAMP	HI SPD	BOT	EOT
[0	1	2	3	4	5	6	7]	[0	1	2	3	4	5	6	7]
BYTE 3								BYTE 2							

STATUS WORD 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TIE 7	TIE 6	TIE 5	TIE 3	TIE 9	TIE 1	TIE 8	TIE 2	READ TIM	NOI CHK	ID CHK	UNCR DATA	POST ERR	MULT DROP	NO TRK	TIE 4
[0	1	2	3	4	5	6	7]	[0	1	2	3	4	5	6	7]
BYTE 5								BYTE 4							

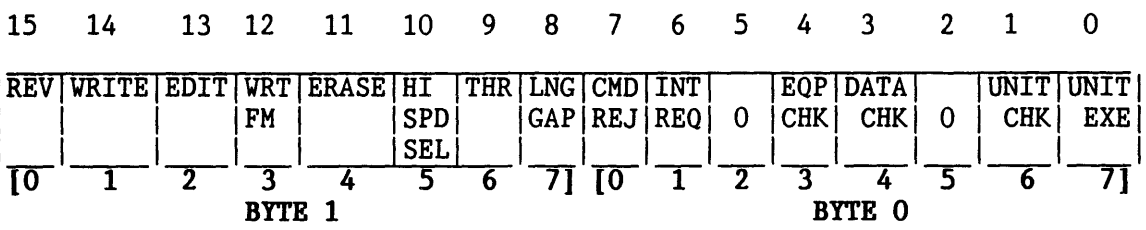
STATUS WORD 3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MARGINAL			DEVICE		INDICATION			FAULT			SYMPTOM		CODE		
[0	1	2	3	4	5	6	7]	[0	1	2	3	4	5	6	7]
BYTE 7								BYTE 6							

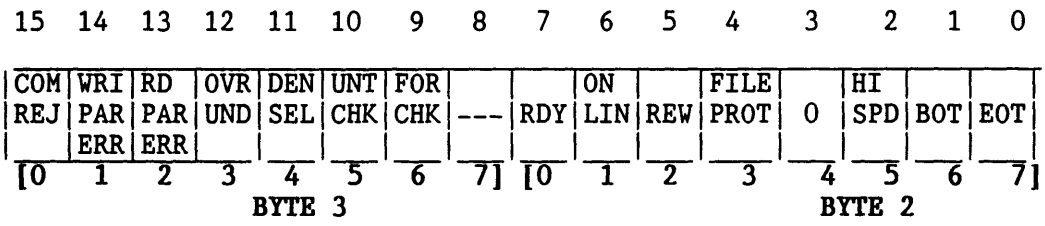
SENSE BYTES TRANSMITTED IN EXTENDED READ SENSE COMMAND

Twenty seven bytes of status are returned for the EXTENDED READ SENSE command. The bytes are packed into status words (0-13) when transferred to memory. For example, bits 0-7 of byte 0 and bits 0-7 of byte 1 make up bits 15-0 of status word 0. The bits returned are bit reversed for each byte.

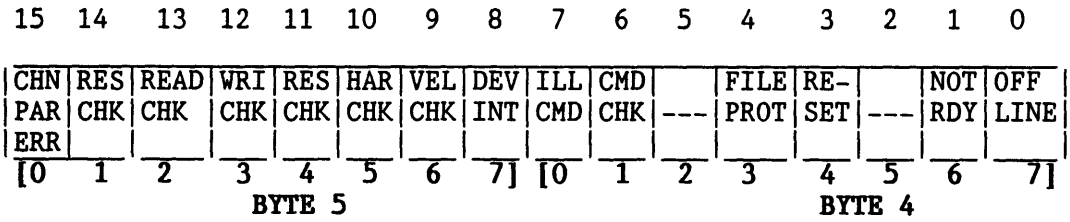
STATUS WORD 0



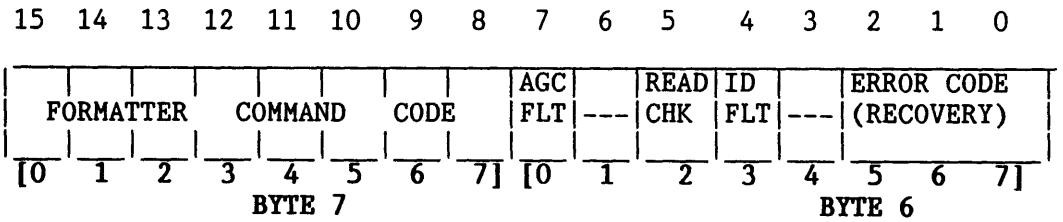
STATUS WORD 1



STATUS WORD 2

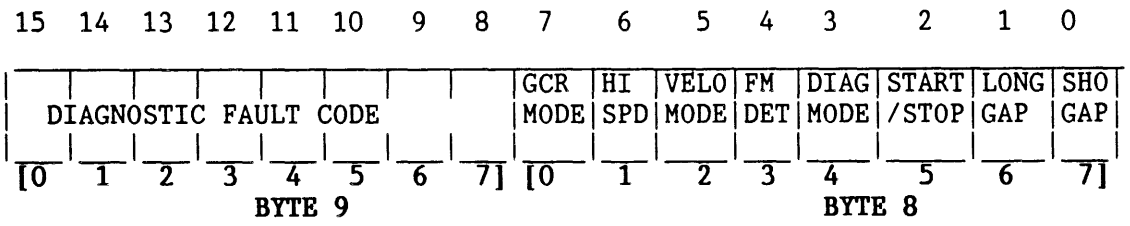


STATUS WORD 3

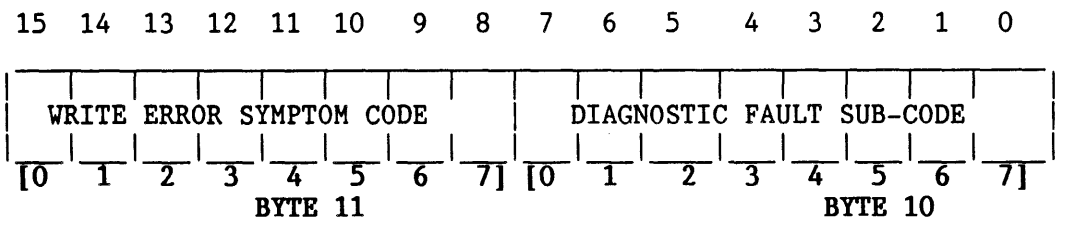


SENSE BYTES TRANSMITTED IN EXTENDED READ SENSE COMMAND [continued]

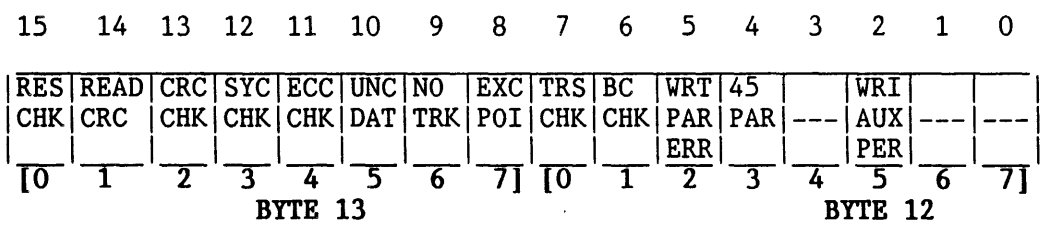
STATUS WORD 4



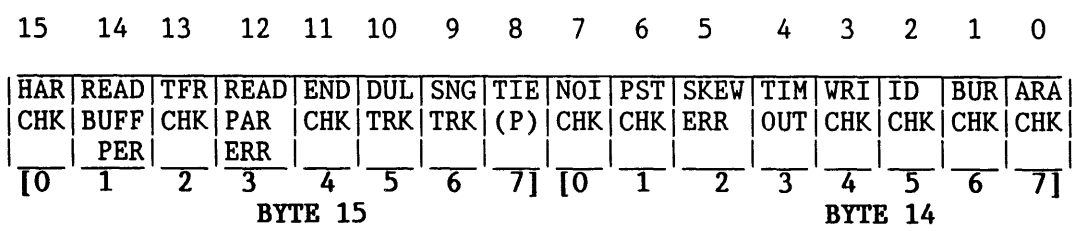
STATUS WORD 5



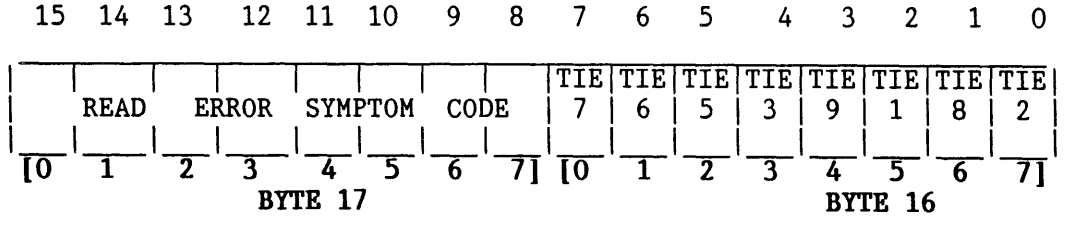
STATUS WORD 6



STATUS WORD 7

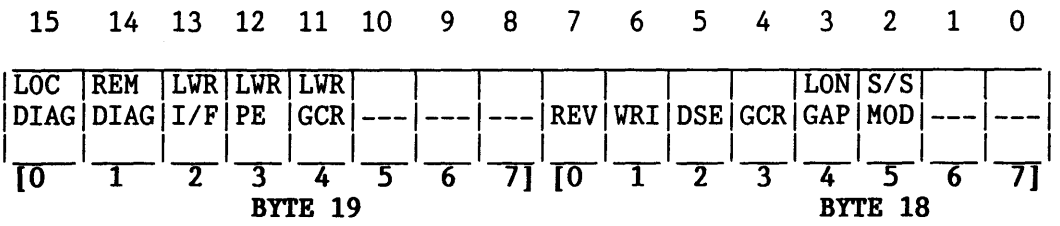


STATUS WORD 8

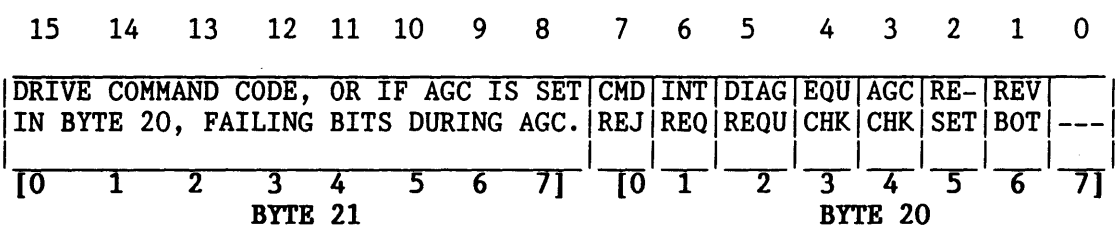


SENSE BYTES TRANSMITTED IN EXTENDED READ SENSE COMMAND [continued]

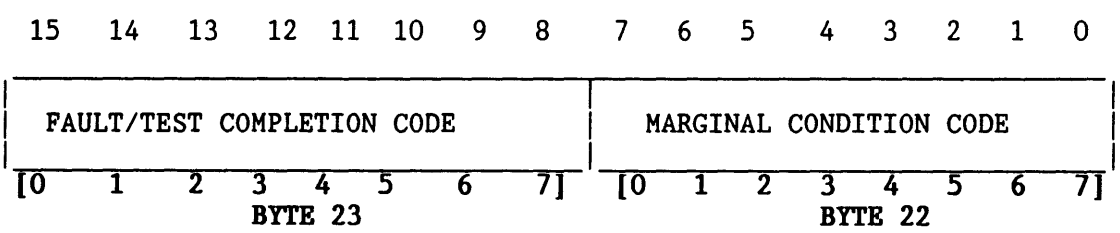
STATUS WORD 9



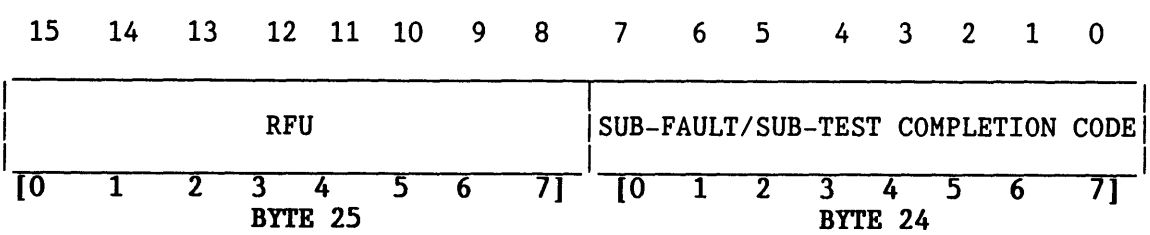
STATUS WORD 10



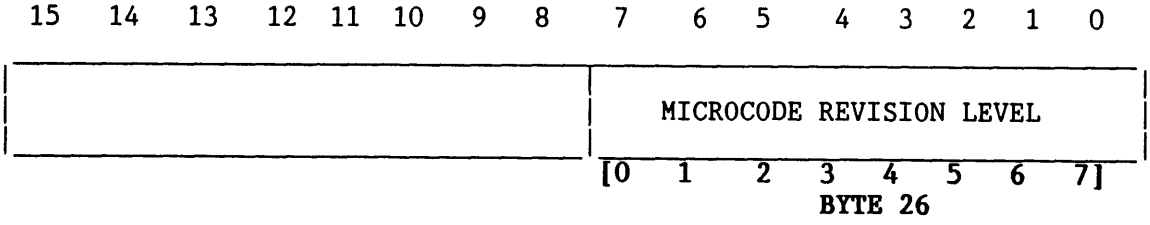
STATUS WORD 11



STATUS WORD 12



STATUS WORD 13



WRITE CHARACTERISTICS COMMAND

The WRITE CHARACTERISTICS command packet informs the TS11 subsystem of the location and size of the message buffer in CPU memory space. The message buffer must be at least seven contiguous words long and begin on a word boundary.

The WRITE CHARACTERISTICS command also transfers a characteristics mode word to the transport. If a valid buffer address is not loaded with a WRITE CHARACTERISTICS command, the Need Buffer Address (NBA) bit in the TSSR register is set.

WRITE CHARACTERISTICS COMMAND PACKET EXAMPLE

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC OPP SWB	0 0 X X	IE 0 0	0 0 0 0 1

A15	LOW ORDER CHARACTERISTICS DATA ADDRESS	A00

0	HIGH ORDER CHARACTERISTICS DATA ADDRESS -----> 0	A17 A16

0	BUFFER EXTENT BYTE COUNT ----------> 0
	16 BIT POSITIVE INTEGER

MODE: 0000 = Load message buffer address and set device characteristics.

CHARACTERISTICS DATA

A15	LOW ORDER MESSAGE BUFFER ADDRESS	A00

0	HIGH ORDER MESSAGE BUFFER ADDRESS --------> 0	A17 A16

0	LENGTH OF MESSAGE BUFFER ----------> 0 (16 BIT POSITIVE INTEGER)	(at least 14 bytes long)

0 <---------- 0	CHARACTERISTICS MODE BYTE ---------->

CHARACTERISTICS MODE BIT DEFINITIONS

BIT	NAME	FUNCTION
15-8	----	Not used. Always zero.
7	ESS Enable Skip Tape Marks Stop	When set, instructs the transport to stop during a SKIP TAPE MARKS command when a double tape mark is detected. If set to 0 (def), the SKIP TAPE MARKS command terminates only on tape mark exhausted or if it runs into BOT/EOT.
6	ENB Enable	This bit is only meaningful if ESS is set. If the drive is at BOT when a SKIP TAPE MARKS command is issued, the transport sets LET and stops after the first tape mark (if the first record seen is a tape mark). If ESS is clear, the drive counts the tape marks and continues without setting LET.
5	EAI Enable Attention Interrupts	When this bit is set, interrupts are generated. When it is cleared, attention conditions (such as on-line or off-line) do not result in interrupt to the CPU. The drive must own the message buffer,via a message buffer release, to set EAI.
4	ERI Enable Message Buffer Release Interrupts	When this bit is set, an interrupt is generated. When cleared, interrupts will not be generated when a message buffer RELEASE command is received by the transport. Upon recognition of the command, only subsystem ready (SSR) is asserted.
3-0	----	Not emulated. Always zero.

WRITE COMMAND

The standard WRITE command packet has two modes: WRITE DATA and WRITE DATA RETRY (SPACE REVERSE, ERASE, WRITE DATA). Each operation is straightforward and designed to transfer data on to tape in the forward direction only.

WRITE COMMAND PACKET EXAMPLE

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC 0 SWB	0 0 X 0	IE 0 0	0 0 1 0 1

A15	LOW ORDER BUFFER ADDRESS	A00
0	HIGH ORDER BUFFER ADDRESS	A17 A16
0	BUFFER EXTENT BYTE COUNT (16 BIT POSITIVE INTEGER)	0

MODE: 0000 = WRITE DATA
0010 = WRITE DATA RETRY (SPACE REVERSE, ERASE, WRITE DATA).
0100 = RUN REMOTE DIAGNOSTICS (extended command).

If a WRITE command is executed at or beyond the EOT marker, a Tape Status Alert (TSA) termination occurs. EOT remains set until passed in the reverse direction or until a subsystem INIT occurs.

The RUN REMOTE DIAGNOSTICS command is available for the CDC Keystone III drives (model 92185). If it is issued to other drives, a fault may occur. This command enables the host to execute diagnostic functions within the tape drive control firmware. This is done by encoding tape control functions on the interface. It will initiate diagnostic tests pertaining to formatter and drive hardware elements. A two byte data transfer to the tape drive selects the test number and option byte for the test to be performed. Refer to the Keystone field service manual (49763000) for information on test parameters.

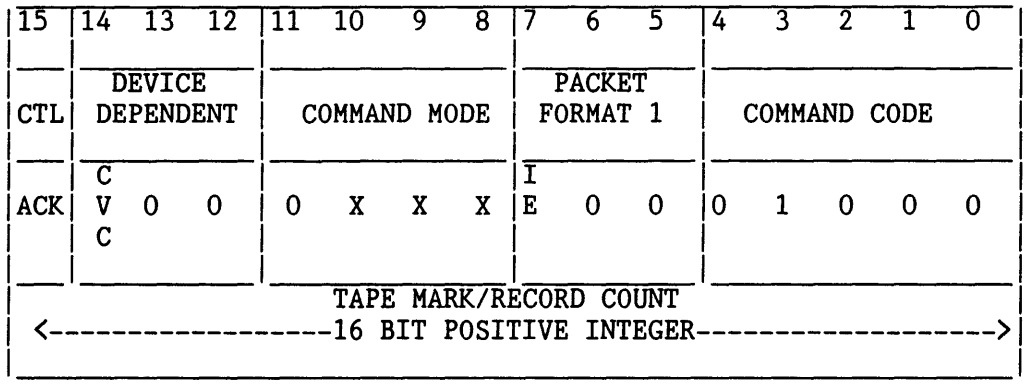
Successful issue of the RUN REMOTE DIAGNOSTICS command will transfer normal termination status to the extended status message buffer. Unsuccessful issue of the command will transfer the status packet with the appropriate error bits set. Failure information may then be obtained by issuing the READ SENSE and READ EXTENDED SENSE commands.

The GET STATUS command must be issued to poll for completion of the drive diagnostic. When FBY* is de-asserted, XSTAT3 bit 7 is cleared indicating that the diagnostic is complete.

POSITION COMMAND

The POSITION command causes tape to space records forward or reverse, skip tape marks forward or reverse, and to rewind to BOT. An exact tape mark/record count must be the second word of the packet for SKIP TAPE MARKS and SPACE RECORDS commands.

POSITION COMMAND PACKET EXAMPLE



MODE: 0000 = SPACE RECORDS FORWARD
0001 = SPACE RECORDS REVERSE
0010 = SKIP TAPE MARKS FORWARD
0011 = SKIP TAPE MARKS REVERSE
0100 = REWIND (record count ignored).

A SPACE RECORDS operation automatically terminates when a tape mark is transferred. A SPACE RECORDS REVERSE or a SKIP TAPE MARKS REVERSE command that runs into BOT sets Reverse Into BOT (RIB) and causes a Tape Status Alert (TSA) termination. Record Length Short (RLS) is set if the record count is not decremented to zero.

A SKIP TAPE MARKS command terminates when it encounters a double tape mark and the enable skip stop mode is specified (ESS bit set) in the characteristics word. Termination also occurs if a tape mark is the first record off BOT and the ESS and ENB bits are set in the characteristics word. Record Length Short (RLS) is set if the record count is not decremented to zero.

When a REWIND command is issued, an interrupt does not occur until the tape reaches BOT in the forward direction and begins to decelerate. Due to tape speed during rewind, the drive overshoots BOT in the reverse direction and moves the tape forward until BOT is located before terminating the operation. Normal termination is indicated if the operation is completed without incident.

If a SPACE REVERSE or SKIP REVERSE command is issued while the tape is positioned between BOT and the first record, RIB is set and the residual frame count will equal the specified count in the original command.

FORMAT COMMAND

The FORMAT command can write a tape mark, rewrite a tape mark, and erase tape. In all cases, executing a FORMAT command at or beyond EOT causes a Tape Status Alert (TSA) termination. The EOT bit remains set until passed in the reverse direction.

FORMAT COMMAND PACKET EXAMPLE

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC 0 0	0 0 X X	IE 0 0	0 1 0 0 1
	NOT USED			

MODE: 0000 = WRITE TAPE MARK
0001 = ERASE
0010 = WRITE TAPE MARK RETRY (space rev,erase, write tape mark).

The ERASE command causes four inces of tape to be erased. This length is controlled automatically by the transport hardware. Successive ERASE commands may be used to erase more than four inches (in four inch increments).

CONTROL COMMAND

The CONTROL command packet has three modes of operation: CLEAN, UNLOAD, and MESSAGE BUFFER RELEASE. The MESSAGE BUFFER RELEASE command, when executed with the ACK bit set, allows the transport to own the message buffer, thus enabling it to update the status in the message buffer area on an ATTN. The UNLOAD command is designed to rewind tape completely on to the supply reel. When the command is executed, termination occurs immediately and an interrupt occurs if IE is set.

CONTROL COMMAND PACKET EXAMPLE

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	DEVICE DEPENDENT	COMMAND MODE	PACKET FORMAT 1	COMMAND CODE
ACK	CVC 0 0	0 0 X X	IE 0 0	0 1 0 1 0
	NOT USED			

MODE: 0000 = MESSAGE BUFFER RELEASE
0001 = UNLOAD
0010 = CLEAN TAPE

INITIALIZE COMMAND

The INITIALIZE command is included for compatibility with packet protocol. A Drive Initialize does not require a command packet and may be done by issuing a Write to the TSSR. A DRIVE INITIALIZE command results in a message update if no errors are displayed and is equivalent to a GET STATUS command. The INITIALIZE command requires a message buffer or an "NBA" error will be generated.

INITIALIZE COMMAND PACKET EXAMPLE

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEVICE DEPENDENT			COMMAND MODE				PACKET FORMAT 1			COMMAND CODE				
ACK	CVC	0	0	0	0	X	X	IE	0	0	0	1	0	1	0
NOT USED															

MODE: 0000 = INITIALIZE
*0001 = ONLINE
*0010 = HIGH SPEED/HIGH DENSITY SELECT
*0011 = LOW SPEED/LOW DENSITY SELECT
*0100 = CDC KEYSTONE REMOTE PE MODE SELECT
*0101 = CDC KEYSTONE REMOTE GCR MODE SELECT
*0110 = CDC KEYSTONE LONG GAP SELECT
*0111 = CDC KEYSTONE SHORT GAP SELECT

* Requires SW1-1 (EXTENDED COMMAND ENABLE) to be CLOSED.

The ONLINE command causes the drive to load the tape and place the unit online.

The SPEED/DENSITY SELECT commands may be used on any drive that monitors the interface signal "IDEN" (Density Select). Some streaming tape drives use "IDEN" to select tape speed (for example, the Cipher Streamer model F880). The default settings for these commands may be controlled by the EEPROM option MTFLGS, bit 2. See section 6.2.1, EEPROM LABEL DEFINITIONS, for further information.

The REMOTE PE MODE SELECT and REMOTE GCR MODE SELECT commands may only be used with the CDC Keystone III drives. These commands cause the formatter to be placed in either the Phase Encoded (1600 bpi) mode or the Group Code Recording (6250 bpi) mode. To issue these commands, the drive must be loaded and positioned at BOT, and SW1-1 (Extended Command Enable) must be in the closed position. Jumper W3 must be installed on the tape drive interface board to enable remote density select. If MTFLGS bit 6 is set when the REMOTE GCR MODE SELECT command is issued, Read Reverse operations will be translated into a Space Reverse, Read Forward, Space Reverse sequence.

The LONG/SHORT GAP SELECT commands may only be used with the CDC Keystone III drives. These commands cause the formatter to generate long or short inter-record gaps and may be issued while the tape is positioned away from BOT.

MESSAGE PACKET HEADER WORD

15	14 13 12	11 10 9 8	7 6 5	4 3 2 1 0
CTL	RESERVED	CLASS CODE	PACKET FORMAT 1	MESSAGE CODE
ACK	0 0 0	0 0 C C	0 0 0	1 M M M M

MESSAGE PACKET FIRST HEADER WORD BIT DEFINITIONS

BIT	NAME	FUNCTION
15	ACK Acknowledge	This bit is used by the controller to inform the CPU that the command buffer is now available for any pending or subsequent command packets. On an ATTN message, this bit is not set since the drive does not own the command buffer.
14-12	RES	Reserved for future expansion.
11-8	CCF Class Code Field	This bit defines the class of failures found in the message buffer. ATTN value 0000 = on-line or off-line. FAIL value 0001 = other (ILC,ILA). FAIL value 0010 = WLE or NEF.
7-5	PF1 Packet Format Field #1	The single value supported by TS11 is: value 000 = one word header.
4-0	MC Message Code	Termination Class / Value / Definition 0,2 / 10000 / END 3 / 10001 / FAIL 4,5,6,7 / 10010 / ERROR 1,7 / 10011 / ATTENTION

MESSAGE PACKET EXAMPLE

All message packets are identical. Each message packet contains the message packet header word previously described, a word representing 12 (octal), a data length word (RBPCR), and four extended status registers.

MESSAGE PACKET EXAMPLE

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEVICE STATUS			STANDARD STATUS				PACKET FORMAT 1			MESSAGE				
ACK	0	0	0	0	0	X	X	0	0	0	M	M	M	M	M
0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
RBPCR															
XSTAT0															
XSTAT1															
XSTAT2															
XSTAT3															

MESSAGES: 10000 = END
10001 = FAIL
10010 = ERROR
10011 = ATTN

STD STATUS: 0001 = OTHER
0010 = WLE,NEF
0000 = ONLINE, OFFLINE

Chapter Four

Diagnostics

4.1 DIAGNOSTIC PROGRAMS

This chapter explains the diagnostic programs (supplied by Spectra Logic) that may be used to check out the subsystem when connecting the SPECTRA 111/121/-PLUS controller to a particular drive. The first set of diagnostics is used for standard emulation wherein the drive is set for the standard configuration. By making additional changes, this set of diagnostics may also be used for expanded emulation wherein the drive is set for a configuration other than the standard. Drive configuration tables are included at the end of the chapter to aid in the diagnostic programs.

4.2 STANDARD EMULATION

The SPECTRA 111/121/-PLUS controller is designed to run with Digital Equipment Corporation (DEC) diagnostics. In the standard emulation mode (823 cylinders, 5 heads, and 32 sectors per track for RM02/3, and 823 cylinders, 19 heads, and 32 sectors for RM05), many of the diagnostics run without modification while others require minor modifications because the Maintenance Registers are not fully emulated. The dual port logic tests and diskless diagnostics, which run exclusively in maintenance mode, are not supported (the internal functioning of the controller is verified at power up via microdiagnostics).

NAME	FUNCTION	EMULATION
ZRMAC0	RM02/3 Formatter	Unmodified
ZRMBB0	RM02/3 Performance Exerciser	Unmodified
ZRMCB2	RM02/3 Functional Test Part 1	Modified
ZRMDC0	RM02/3 Functional Test Part 2	Modified
ZRMEC0	RM02/3 Functional Test Part 3	Modified
ZRMFB0	RM02/3 Extended Drive Test	Unmodified
ZRMLB1	RM02/3/5 Formatter	Unmodified
ZRMUB1	RM02/3/5 Performance Exerciser	Modified
ZRMMB1	RM02/3/5 Functional Test Part 1	Modified
ZRMNB1	RM02/3/5 Functional Test Part 2	Modified
ZRM0B1	RM02/3/5 Functional Test Part 3	Modified
XRMAD0	RM02/3/5 DEC X11 Exerciser Module	Unmodified
XTSAA0	TS11 DEC X11 Exerciser Module	Unmodified
ZTSHC0	TS11 Data Reliability Test	Unmodified
ZRNJA0	RM80 Formatter	Unmodified
ZRNAA0	RM80 Performance Exerciser	Unmodified
ZRJBD0	RP04/05/06 Formatter	Unmodified
ZRJDE0	RP04/05/06 Performance Exerciser	Unmodified

4.3 EXPANDED EMULATION

The expanded emulation mode makes it possible to change the number of cylinders, heads, and/or sectors for a given drive. This is done by making additional parameter changes to the standard diagnostics (supplied by Spectra Logic). Only three parameters per diagnostic need be changed for a different capacity. These parameter changes (with the required values taken from the Disk Drive Configuration Tables) are as follows:

DIAGNOSTIC	ADDRESS OF NUMBER OF CYLS	ADDRESS OF NUMBER OF HDS	ADDRESS OF NUMBER OF SECS	ADDRESS OF DT REGISTER
*ZRMAC0	23464	23474	6300	27200
*ZRMBB0	32000	32010	13520	35154
*ZRMCB2	65730	65740	65734	7624
*ZRMDC0	63212	63222	23662	7646
*ZRMEC0	67216	67226	41736	7622
ZRMLB1	6250	6260	6254	
ZRMUB1	1000	1010	1004	
ZRMMB1	3010	3120	3040	
ZRMNB1	3020	3130	3050	
ZRM0B1	3020	3130	3050	

* When running this diagnostic as an RM05, change the current contents of the Drive Type (DT) Register from 20024 to 20027.

4.4 DISK DRIVE CONFIGURATION TABLES

The following tables list the major drives to which the Spectra Logic controllers interface. The values included in these tables are to be used when running diagnostics, or when patching system software. Details for patching system software are located in chapter 5. An '*' indicates that the drive is not currently supported.

AMCODYNE									
MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
7110	25MB R	644	2	32	1204	2	40	100	0,120400
	25MB F	644	2	32	1204	2	40	100	0,120400

DISK DRIVE CONFIGURATION TABLES

AMPEX

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
DM940	40MB	411	5	32	633	5	40	240	1,340
DM980	80MB	823	5	32	1467	5	40	240	2,1140
DM9160	160MB	1645	5	32	3155	5	40	240	4,2040
DM9300	300MB	815	19	32	1457	23	40	1140	7,107640
DM9300A	300MB	823	19	32	1467	23	40	1140	7,121240
C165	165MB	823	10	32	1467	12	40	500	4,2300
C330	330MB	1024	16	32	2000	20	40	1000	10,000000
*C825	825MB	1024	20	64	2000	24	100	2400	24,000000
DFR932	16MB R	823	1	32	1467	1	40	40	0,63340
	16MB F	823	1	32	1467	1	40	40	0,63340
DFR964	16MB R	823	1	32	1467	1	40	40	0,63340
	48MB F	823	3	32	1467	3	40	140	1,32240
DFR996	16MB R	823	1	32	1467	1	40	40	0,63340
	80MB F	823	5	32	1467	5	40	240	2,1140

APS

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
4835	404MB	823	24	35	1467	30	43	1510	12,106170
4865	640MB	822	19	35	1466	23	43	1231	10,53506

BASF

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
6171	8MB	614	1	24	1146	1	30	30	0,34620
6172	24MB	614	3	24	1146	3	30	110	0,126260

DISK DRIVE CONFIGURATION TABLES

BALL

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
*BD50	50MB	823	5	24	1467	5	30	170	1,100710
BD80	80MB	823	5	32	1467	5	40	240	2,1140
BD100	100MB	1024	5	32	2000	5	40	240	2,100000
BD160	160MB	1645	5	32	3155	5	40	240	4,2040

CENTURY DATA SYSTEMS

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
T82	80MB	815	5	32	1457	5	40	240	1,176540
T82RM	80MB	823	5	32	1467	5	40	240	2,1140
T302	300MB	815	19	32	1457	23	40	1140	7,107640
T302RM	300MB	823	19	32	1467	23	40	1140	7,121240
M80	80MB	569	6	40	1071	6	50	360	2,12560
M160	162MB	845	6	52	1515	6	64	470	4,2730
*AMS190	191MB	569	14	40	1071	16	50	1060	4,156260
AMS380	378MB	845	14	52	1515	16	64	1330	11,61370
AMS315	315MB	823	19	32	1467	23	40	1140	7,121240
AMS513	513MB	845	19	52	1515	23	64	1140	14,136454
AMS571	571MB	941	19	52	1655	23	64	1734	16,27654
C2075	25MB F	644	2	33	1204	2	41	102	0,123010
	50MB R	644	4	33	1204	4	41	204	1,46020

DISK DRIVE CONFIGURATION TABLES

CONTROL DATA CORPORATION

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
9760	40MB	411	5	32	633	5	40	240	1,340
9762	80MB	823	5	32	1467	5	40	240	2,1140
*9764	150MB	411	19	32	633	23	40	1140	3,150040
9766	300MB	823	19	32	1467	23	40	1140	7,121240
9448-32	16MB R	823	1	32	1467	1	40	40	0,63340
	16MB F	823	1	32	1467	1	40	40	0,63340
9448-64	16MB R	823	1	32	1467	1	40	40	0,63340
	48MB F	823	3	32	1467	3	40	140	1,32240
9448-96	16MB R	823	1	32	1467	1	40	40	0,63340
	80MB F	823	5	32	1467	5	40	240	2,1140
*9730-12	12MB	320	2	32	500	2	40	100	0,50000
*9730-24	24MB	320	4	32	500	4	40	200	0,120000
9730-80	80MB	823	5	32	1467	5	40	240	2,1140
9730-160	160MB	823	10	32	1467	12	40	500	4,2300
9775	675MB	843	40	32	1513	50	40	2400	20,73400
9455	8MB R	206	2	32	316	2	40	100	0,31600
	8MB F	206	2	32	316	2	40	100	0,31600
9457	25MB R	624	2	32	1160	2	40	100	0,116000
	25MB F	624	2	32	1160	2	40	100	0,116000
9710	80MB	823	5	32	1467	5	40	240	2,1140
9715-160	160MB	823	10	32	1467	12	40	500	4,2300
9715-340	340MB	711	24	32	1307	30	40	1400	10,52400
9715-500	500MB	711	24	50	1307	30	60	2200	14,77600
9720	362MB	1217	10	50	2301	12	62	764	11,044364
9771	825MB	1024	16	80	2000	20	120	2400	24,000000
9412	80MB	784	5	35	1420	5	43	257	2,13760

DISC TECH ONE

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
*3302	28MB	352	4	32	540	4	40	200	0,130000
*3303	42MB	352	6	32	540	6	40	300	1,4000
*3304	56MB	352	8	32	540	10	40	400	1,60000
*3305	70MB	352	10	32	540	12	40	500	1,134000
3306	84MB	352	12	32	540	14	40	600	2,10000
4160	160MB	823	10	32	1467	12	40	500	4,2300
4300	300MB	832	14	40	1500	16	50	1060	7,16000

DISK DRIVE CONFIGURATION TABLES

FUJITSU

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
2201	50MB	815	3	32	1457	3	40	140	1,30640
2211	80MB	823	5	32	1467	5	40	240	2,1140
2311	48MB	589	4	32	1115	4	40	200	1,23200
2312	84MB	589	7	32	1115	7	40	340	2,1540
2322	160MB	823	10	32	1467	12	40	500	4,2300
*2282	66MB	823	4	32	1467	4	40	200	1,115600
*2283	132MB	823	8	32	1467	10	40	400	3,33400
2284	165MB	823	10	32	1467	12	40	500	4,2300
2294	330MB	1024	16	32	2000	20	40	1000	10,000000
2298	671MB	1024	16	64	2000	20	100	2000	20,000000
2351	474MB	842	20	46	1512	24	56	1630	13,150760
**2333	337MB	823	10	65	1467	12	101	1212	1,24646
**2361	689MB	842	20	65	1512	24	101	2424	20,131710

**Fujitsu 2333 and 2361 only supported by S111/121-PLUS (A02) model.

KENNEDY

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
5300-70	70MB	700	5	32	1274	5	40	240	1,132600
5380	80MB	823	5	32	1467	5	40	240	2,1140
53160	160MB	823	10	32	1467	12	40	500	4,2300
7340	340MB	411	5	32	633	5	40	240	1,340
7380	380MB	823	5	32	1467	5	40	240	2,1140

NEC

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
D2351	555MB	760	19	59	1370	23	73	2141	14,177770
2362	778MB	850	23	65	1522	27	101	2727	23,061736

NORTHERN TELECOM

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
8210	222MB	1029	10	32	2005	12	40	500	5,3100

DISK DRIVE CONFIGURATION TABLES

PRIAM

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
3350	34MB	561	3	32	1061	3	40	140	0,151140
6650	67MB	1121	3	32	2141	3	40	140	1,122140
15450	155MB	1121	7	32	2141	7	40	340	3,152340
*3450	35MB	525	5	24	1015	5	30	170	0,173030
*7050	70MB	1049	5	24	2031	5	30	170	1,165670
803	85MB	850	5	32	1522	5	40	240	2,11500
*806	188MB	850	11	32	1522	13	40	540	4,110300
*807	330MB	1489	11	32	2721	13	40	540	7,177540
*808	495MB	1489	11	48	2721	13	60	1020	13,177420

STC

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
8775	675MB	1123	30	32	2143	36	40	1700	20,71500

TECSTOR

MODEL #	CAPACITY	CYLS	HDS	SECS	CCCC	HH	SS	HH*SS	M,LLLLLL
S160	160MB	704	12	32	1300	14	40	600	4,20000
3/83	83MB	823	5	32	1467	5	40	240	2,1140
3/166	166MB	823	10	32	1467	12	40	500	4,2300
3/200	200MB	823	12	32	1467	14	40	600	4,151200
3/315	315MB	823	19	32	1467	23	40	1140	7,121240
*3/330	330MB	823	20	32	1467	24	40	1200	10,4600

Chapter Five

System Software

5.1 RSX-11M V3.2

The SPECTRA 111/121/-PLUS controller is designed to run RSX-11M V3.2 without modifications on an 80MB disk drive with 823 cylinders, 5 heads, and 32 sectors per track. To run on a drive with different physical characteristics requires certain parameter changes which should be implemented as follows.

To generate an RSX-11M V3.2 system for other than 80MB drives, perform a normal SYSGEN, including the desired number of RM02 drives. At the end of SYSGEN Phase I, when asked "Do you wish to edit any of the Executive files?", respond affirmatively, and edit SYSTB.MAC and DRDRV.MAC as follows, choosing new values from the drive configuration tables. All values are in octal and the parameters to be changed are represented as follows:

M= Number of blocks most significant word
LLLLLL= Number of blocks least significant word
HH= Heads
SS= Sectors per track
CCCC= Cylinders

SYSTB.MAC

	ENTER	COMMENTS
>	EDI SYSTB.MAC	Edit file
*	PL .DRx:	"x" is the drive number
*	PL 1140	
*	C/1140/LLLLLL	Number of blocks, least significant word
*	N-1	
*	C/2/M	Number of blocks, most significant word
	*	REPEAT FOR EACH DRIVE SPECIFIED
*	EX	EXIT

DRDRV.MAC

ENTER	COMMENTS
> EDI DRDRV.MAC	Edit file
* PL 5*32	
* C/5/HH/	Number of heads
* PL 5.*256	Decimal (.) must be included
* C/5./HH/	Number of heads
* PL 5.*256	
* C/5./HH/	Number of heads

```
* EX                    EXIT
```

In SYSGEN Phase II, when building tasks, be sure to generate load maps for BOO.TSK, INI.TSK, and SAV.TSK because these tasks, as well as BAD.TSK, need to have parameter changes made before the new system is saved. These changes are outlined below.

BOO.TSK/LI

```
ENTER: SET /UIC = [1,54]
ENTER: RUN $ZAP
ENTER: BOO.TSK/LI
```

Make the following changes, where the base address of SPCDRV is taken from the load map.

ADDRESS	IS	CHANGE TO
SPCDRV+5166	5	HH

```
EXIT FROM ZAP
```

INI.TSK/LI

```
ENTER: RUN ZAP
ENTER: INI.TSK/LI
```

Make the following changes when the base address of INIBAD is taken from the load map.

ADDRESS	IS	CHANGE TO
INIBAD+2162	2	M
INIBAD+2164	1140	LLLLLL
INIBAD+2166	1467	CCCC
INIBAD+2170	20005	20000+HH

```
EXIT FROM ZAP
```

SAV.TSK/LI

```
ENTER: RUN $ZAP
ENTER: SAV.TSK/LI
```

Make the following changes, where the base addresses of SAVSUB and SPCDRV are taken from the load map.

ADDRESS	IS	CHANGE TO
SAVSUB+132	2	M
SAVSUB+134	1140	LLLLLL
SPCDRV+5166	5	HH

```
EXIT FROM ZAP
```

BAD.TSK/LI

```
ENTER: RUN $ZAP
ENTER: BAD.TSK/LI
```

Make the following changes.

ADDRESS	IS	CHANGE TO
2:3662	2	M
2:3664	1140	LLLLLL
2:3666	5	HH

```
EXIT FROM ZAP
```

Two stand alone programs must also have parameter changes as follows.

DSCS8.SYS/AB

```
ENTER: SET /UIC=[1,51]
ENTER: RUN $ZAP
ENTER: DSCS8.SYS/AB
```

Make the following changes.

ADDRESS	IS	CHANGE TO
21362	240	HH*SS
21600	112712	401
34560	2	M
34562	1140	LLLLLL
34616	2	M
34620	1140	LLLLLL
57236	2	M
57244	1140	LLLLLL
113370	2	M
113374	1140	LLLLLL

```
EXIT FROM ZAP
```

BADSYS.SYS/AB

```
ENTER: RUN $ZAP
ENTER: BADSYS.SYS/AB
```

Make the following changes.

ADDRESS	IS	CHANGE TO
23750	240	HH*SS
36050	2	M
36052	1140	LLLLLL
45734	2	M
45736	1140	LLLLLL
45740	5	HH
45750	240	HH*SS
53170	2	M
53176	1140	LLLLLL

```
EXIT FROM ZAP
```

5.2 RSX-11M V4.0 - V4.1

To generate an RSX-11M V4.0 or V4.1 system for other than a standard size device, perform a normal SYSGEN and specify the desired number of controllers and drives. The drives should be alternated between RM02 and RM05.

Toward the end of SYSGEN phase I, when asked "Do you wish to edit any of the Executive files?", respond affirmatively, and edit SYSTB.MAC and DRDRV.MAC as follows, choosing new values from the drive configuration tables. All values are in octal and the parameters to be changed are represented as follows:

M=	Number of blocks most significant word
LLLLLL=	Number of blocks least significant word
HH=	Heads
SS=	Sectors per track
CCCC=	Cylinders

SYSTB.MAC

	ENTER	COMMENTS
>	EDI SYSTB.MAC	
*	PL .DRx	"x" is the drive number
*	PL 1140	If "x" is an RM05, use 121240 instead of 1140
*	C/1140/LLLLLL/	Number of blocks, least significant word
*	NP-1	If "x" is an RM05, use 7 instead of 2 in next line
*	C/2/M	Number of blocks, most significant word
*		REPEAT FOR EACH DRIVE SPECIFIED
*	EX	EXIT

DRDRV.MAC

	ENTER	DRIVE TYPE
*	EDI DRDRV.MAC	RM02
*	PL PRMTBL	RM02
*	NP	RM02
*	C/<2,1140>, 5, 32, 0/<M,LLLLLL>, HH, SS, 0/	
*	NP	
*	C/<2,1140>, 5, 32, 0/<M,LLLLLL>, HH, SS, 0/	RM02
*	PL <7,121240>	
*	C/<7,121240>, 19., 32., 0/<M,LLLLLL>, HH, SS, 0/	RM05
*	NP	
*	C/<7,121240>, 19., 32., 0/<M,LLLLLL>, HH, SS, 0/	RM05
*	EX	EXIT

In SYSGEN phase II, when building tasks, be sure to generate load maps for BOO.TSK, INI.TSK, and SAV.TSK because these tasks, as well as BAD.TSK, and FMT.TSK need to have parameter changes made before the new system is saved. These changes are outlined below.

BAD.TSK/LI

```
ENTER: SET /UIC=[1,54]
ENTER: INS $ZAP
ENTER: BAD.TSK/LI
```

Make the following changes.

ADDRESS	IS	CHANGE TO	DRIVE TYPE
2:4052	2	M	RM02
2:4054	1140	LLLLLL	RM02
2:4056	5	HH	RM02
2:4060	40	SS	RM02
2:4064	40	SS	RM02
2:4066	240	SS*HH	RM02
2:4072	26	SS-12	RM02
2:4076	7	M	RM05
2:4100	121240	LLLLLL	RM05
2:4102	23	HH	RM05
2:4104	40	SS	RM05
2:4110	40	SS	RM05
2:4112	1140	SS*HH	RM05
2:4116	26	SS-12	RM05

```
EXIT FROM ZAP
```

FMT.TSK/LI

ENTER: RUN $ZAP
ENTER: FMT.TSK/LI

Make the following changes. If a drive has more than 34 sec/trk, the on-line formatter should not be used.

ADDRESS 4.0	ADDRESS 4.1	IS	CHANGE TO	DRIVE TYPE
2:51640	2:52100	2	M	RM02
2:51642	2:52102	1140	LLLLLL	RM02
2:51644	2:52104	1467	CCCC	RM02
2:51646	2:52106	5	HH	RM02
2:51650	2:52110	40	SS	RM02
2:51700	2:52140	7	M	RM05
2:51702	2:52142	121240	LLLLLL	RM05
2:51704	2:52144	1467	CCCC	RM05
2:51706	2:52146	23	HH	RM05
2:51710	2:52150	40	SS	RM05

EXIT FROM ZAP

INI.TSK/LI

ENTER: RUN $ZAP
ENTER: INI.TSK/LI

Make the following changes where the address of INIBAD is taken from the load map.

ADDRESS	IS	CHANGE TO	DRIVE TYPE
INIBAD+2214	2	M	RM02
INIBAD+2216	1140	LLLLLL	RM02
INIBAD+2220	1467	CCCC	RM02
INIBAD+2222	20005	SS high byte, HH low byte	RM02
INIBAD+2160	7	M	RM05
INIBAD+2162	121240	LLLLLL	RM05
INIBAD+2164	1467	CCCC	RM05
INIBAD+2166	20023	SS high byte, HH low byte	RM05

EXIT FROM ZAP

BOO.TSK/LI

ENTER: RUN $ZAP
ENTER: BOO.TSK/LI

Make the following changes where the base address of SAVDR is taken from the load map.

ADDRESS	IS	CHANGE TO	DRIVE TYPE
SAVDR+70	37	SS-1	RM02/RM05
SAVDR+160	5	HH	RM02
SAVDR+166	23	HH	RM05

EXIT FROM ZAP

SAV.TSK/LI

ENTER: RUN $ZAP
ENTER: SAV.TSK.LI

Make the following changes where the base address of SAVSIZ and SAVDR are taken from the load map.

ADDRESS	IS	CHANGE TO	DRIVE TYPE
SAVDR+70	37	SS-1	RM02/RM05
SAVDR+160	5	HH	RM02
SAVDR+166	23	HH	RM05
SAVSIZ+56	2	M	RM02
SAVSIZ+60	1140	LLLLLL	RM02
SAVSIZ+1260	7	M	RM05
SAVSIZ+1266	121240	LLLLLL	RM05

EXIT FROM ZAP

ALTERNATE PROCEDURE

When using a system that has already been generated, it is not necessary to perform the entire SYSGEN. The previous files require patching using ZAP in the locations outlined. In addition, the following two files require patching.

DRDRV.TSK/AB

ENTER: RUN $ZAP
ENTER: DRDRV.TSK/AB

ADDRESS	IS	CHANGE TO	DRIVE TYPE
3:42	2	Most significant word total # blks	RM02
3:44	1140	Least significant word total # blks	RM02
3:46	2440	# heads/upper byte, sectors/track/lower byte	RM02
3:52	2	Most significant word total # blks	RM02
3:54	1140	Least significant word total # blks	RM02
3:56	2440	# heads/upper byte, sectors/track/lower byte	RM02
3:102	7	Most significant word total # blks	RM05
3:104	121240	Least significant word total # blks	RM05
3:106	11440	# heads/upper byte, sectors/track/lower byte	RM05
3:112	7	Most significant word total # blks	RM05
3:114	121240	Least significant word total # blks	RM05
3:116	11440	# heads/upper byte, sectors/track/lower byte	RM05

EXIT FROM ZAP

RSX11M.TSK/AB

ENTER: RUN $ZAP
ENTER: RSX11M.TSK/AB

ADDRESS	IS	CHANGE TO
XX:NN/	M	Most significant word of total number of blocks
XX:NN+2	LLLLLL	Least significant word of total number of blocks

These locations require patching for each drive included in the system.

To determine XX and NN for each drive, find the location of .DRX in the system map. This map is in [1,34] under the name of RSX11M.MAP. To determine XX, divide the value M,LLLLLL by 1000(8) and add 3 to the quotient. To determine NN, add 12(8) to the remainder.

CONTINUE WITH THE NEXT SECTION

SAVING THE NEW SYSTEM

1. Set the current UIC to [1,54].

   ENTER: SET /UIC=[1,54]

2. When all of the above tasks are patched with the proper parameters, build a new system image.

   ENTER: PIP DRX:RSX11M.SYS/CO/NV/BL:498.=DRX:RSX11M.TSK

   DRX = the device and unit number of the drive that is the target device of the new system.

3. Install VMR with the patched tasks into the created system image. Then install BOO.TSK and boot the new system.

   ENTER: $INS VMR
   ENTER: VMR @SYSVMR
   ENTER: INS $BOO
   ENTER: BOO [1,54]RSX11M

4. When the new system boots, set the time and date. Then save the system and write a boot block pointing to this system.

   ENTER: SAV/WB

5. The new system will reboot itself after it has been saved.

STAND ALONE UTILITIES

In addition to the system files, there are stand alone utilities in [1,51] that require modification. The following changes should be made.

DSCSYS.SYS/AB

ENTER: RUN $ZAP
ENTER: [1,51] DSCSYS.SYS/AB

ADDRESS	IS	CHANGE TO	DRIVE TYPE
21564	7	Most significant word (total blks)	RM05
21566	121240	Least significant word (total blks)	RM05
21570	11440	Heads/upper byte, sectors/lower byte	RM05
21574	7	Most significant word	RM05
21576	121274	Least significant word	RM05
21600	11440	Heads, sectors per track	RM05
70740	7	Most significant word	RM05
70746	121240	Least significant word	RM05
125722	7	Most significant word	RM05
125724	121240	Least significant word	RM05
125726	20023	Heads, sectors per track	RM05

EXIT FROM ZAP

BADSYS.SYS/AB

ENTER: RUN $ZAP
ENTER: [1,51] BADSYS/AB

ADDRESS	IS	CHANGE TO	DRIVE TYPE
24310	7	Most significant word	RM05
24312	121240	Least significant word	RM05
24314	11440	Heads, sectors per track	RM05
24320	7	Most significant word	RM05
24322	121240	Least significant word	RM05
24324	11440	Heads, sectors per track	RM05
56130	7	Most significant word	RM05
56132	121240	Least significant word	RM05
56134	23	Heads	RM05
56136	40	Sectors per track	RM05
56142	40	Sectors per track	RM05
56144	1140	Sectors per cylinder	RM05
64006	7	Most significant word	RM05
64014	121240	Least significant word	RM05

EXIT FROM ZAP

5.2.1 RSX-11M-PLUS V2.1

The SPECTRA 111/121-PLUS controller is designed to run RSX-11M+, V2.1 without modifications on an 80 MB disk drive with 823 cylinders, 5 heads, and 32 sectors per track, and 823 cylinders, 19 heads, and 32 sectors per track for a 300 MB disk drive. To run on a drive with different physical characteristics requires certain parameter changes which should be implemented as follows:

> To generate an RSX-11M+, V2.1 system for other than 80MB or 300MB drive, perform a normal SYSGEN, including the desired number of RM02/RM03/RM05 drives. At the end of SYSGEN Phase I, edit DRTAB.MAC as shown on the following page, choosing new values from the drive configuration tables. All values are in octal and the parameters to be changed are the same as described previously for M,LLLLLL,HH,SS and CCCC.

BOO.TSK does not contain any disk drive parameters. The patch locations for BAD.TSK, FMT.TSK and INI.TSK are the same as RSX-11M version 4.1 shown previously in this chapter.

Enter "RUN ZAP". At this point, both the /LI and /AB options for the patch locations may be entered as shown below.

SAV.TSK/LI	SAV.TSK/AB	RM02 DATA (OCTAL)	 DESCRIPTION
SAVFN+16302	61:304	4	M
SAVFN+16344	61:346	1140	LLLLLL
SAVFN+16406	61:410	1467	CCCC
SAV.TSL/LI	SAV.TSK/AB	RM03 DATA (OCTAL)	 DESCRIPTION
SAVFN+16304	16:306	2	M
SAVFN+346	16:350	1140	LLLLLL
SAVFN+16410	16:412	1467	CCCC
SAV.TSK/LI	SAV.TSK/AB	RM05 DATA (OCTAL)	 DESCRIPTION
SAVFN+16310	16:312	7	M
SAVFN+16354	16:354	121240	LLLLLL
SAVFN+16414	16:416	1467	CCCC

Update of DRTAB.MAC at the end of SYSGEN phase I:

```
> EDI DTAB.MAC
* PL .DRO:
* NP7                    .DRO::
                         .WORD 1140 (or .WORD 121240)

* C/1140/LLLLLL/         (or C/121240/LLLLLL)

* NP-1                   .WORD 2 (or .WORD 7)

* C/2/M                  (or C/7/M)
                         .WORD M

* NP5                    .BYTE 32., 5., (or .BYTE 32., 19.)

* C/32., 5./SS., HH./    (or C/32., 19../SS., HH./)

* NP                     .WORD 823.

* C/823./CCCC./          .WORD CCCC.

     Repeat for drives   .DR1 - .DRO
```

5.3 RSTS/E

The SPECTRA 111/121/-PLUS controller is designed to run RSTS/E without modification on disk drives with standard RM02 or RM05 configurations (RSTS/E V7.2 or later). To run on a drive with different physical characteristics requires certain parameter changes which should be implemented as follows.

1. If RSTS is not running on a standard disk drive, set the controller for 823 cylinders, 5 heads, and 32 sectors per track. Then generate a RSTS system from the DEC RSTS distribution kit.

2. Create a privileged account and copy the following files to it.
   [0,1] INIT.SYS
   [0,1] SYSGEN.SIL (or other SIL)
   [1,2] HOOK.SAV
   [1,2] SAVRES.SAV

3. Make the required parameter changes using ONLPAT (ON-Line Patch) and obtain the required values from the drive configuration tables. All values are in octal and the parameters to be changed are represented as follows:
   M= Number of blocks most significant word
   LLLLLL= Number of blocks least significant word
   HH= Heads
   SS= Sectors per track
   CCCC= Cylinders

4. After the required parameter changes have been made, use HOOK.SAV and PIP.SAV to create a bootable tape with the required files as follows, (assuming that the privileged account [1,3] has been created). Exit each program using 'CONTROL C'.

```
PIP.SAV   RUN $PIP
          MT0:/ZE

HOOK.SAV  RUN $HOOK
          MT0: [0,1] INIT.SYS, SY: [1,3] INIT SYS

PIP.SAV   RUN $PIP
          MT0: [0,1] *.*/M0:16=SY: [0,1] RT11.RTS
          MT0: [0,1] =SY: [1,3] SYSGEN.SIL, HOOK.SAV,
          SAVRES.SAV.
```

5. Shut down the running system and set the controller for the desired number of cylinders, heads, and sectors.

6. Boot the tape just created, initialize the target disk, and copy the modified files to it.

7. Mount the DEC RSTS distribution kit and proceed with a standard system build and/or SYSGEN. Remember to re-install the SIL patches for each new SIL generated.

5.3.1 RSTS/E V7.0 RM02 PARAMETER CHANGES

INIT.SYS

```
ENTER: ONLPAT
ENTER: INIT.SYS
```

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
SATBUF	14364	2	MM	RM02
SATBUF	14444	1100	LLLLLL-SS	RM02
SATBUF	14524	4	CLUSTER SIZE	RM02
DBDSK	36	240	HH*SS	RM02
DBDSK	710	2400	HH*400	RM02
DSIDAT	64	151466	150000+CCCC-1	RM02
DSIDAT	66	2037	HH-1 high byte, SS-1 low byte	RM02
DSIDAT	72	151466	150000+CCCC-1	RM02
DSIDAT	74	2037	HH-1 high byte, SS-1 low byte	RM02
COPY	2252	240	HH*SS	RM02
ROOT	5560	2440	HH high byte, SS low byte	RM02

```
EXIT: CONTROL C
```

SYSGEN.SIL

```
ENTER: ONLPAT
ENTER: SYSGEN.SIL
```

MODULE	BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
RSTS	DRDSK	36	240	HH*SS	RM02
RSTS	DRDSK	710	2400	HH*400	RM02

```
EXIT: CONTROL C
```

HOOK.SAV

```
ENTER: ONLPAT
ENTER: HOOK.SAV
```

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
2564	0	240	HH*SS	RM02

```
EXIT: CONTROL C
```

SAVRES.SAV

```
ENTER: ONLPAT
ENTER: SAVRES.SAV
```

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
GGB	1172	240	HH*SS	RM02

```
EXIT: CONTROL C
```

5.3.2 RSTS/E V7.0 RM05 PARAMETER CHANGES

INIT.SYS

ENTER: ONLPAT
ENTER: INIT.SYS

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
SATBUF	15624	7	MM	RM05
SATBUF	15704	121200	LLLLLL-SS	RM05
SATBUF	15764	10	CLUSTER SIZE	RM05
DBDSK	62	1140	HH*SS	RM05
DBDSK	1312	11400	HH*400	RM05
DSIDAT	64	151466	150000+CCCC-1	RM05
DSIDAT	66	11037	HH-1 high byte, SS-1 low byte	RM05
DSIDAT	72	151466	150000+CCCC-1	RM05
DSIDAT	140	11037	HH-1 high byte, SS-1 low byte	RM05
COPY	2450	1140	HH*SS	RM05
ROOT	6212	11440	HH high byte, SS low byte	RM05

EXIT: CONTROL C

SYSGEN.SIL

ENTER: ONLPAT
ENTER: SYSGEN.SIL

MODULE	BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
RSTS	DRDSK	62	1140	HH*SS	RM05
RSTS	DRDSK	1312	11400	HH*400	RM05

EXIT: CONTROL C

HOOK.SAV

ENTER: ONLPAT
ENTER: HOOK.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
2564	0	1140	HH*SS	RM05

EXIT: CONTROL C

SAVRES.SAV

ENTER: ONLPAT
ENTER: SAVRES.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
GGB	1354	1140	HH*SS	RM05

EXIT: CONTROL C

5.3.3 RSTS/E V7.2 RM02 PARAMETER CHANGES

INIT.SYS

ENTER: ONLPAT
ENTER: INIT.SYS

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
SATBUF	15446	1454	MM (If MM=0)	RM02
SATBUF	15616	2	MM	RM02
SATBUF	15620	2	MM	RM02
SATBUF	15676	1100	LLLLLL-SS	RM02
SATBUF	15700	1100	LLLLLL-SS	RM02
SATBUF	15756	4	CLUSTER SIZE	RM02
SATBUF	15760	4	CLUSTER SIZE	RM02
DBDSK	46	240	HH*SS	RM02
DBDSK	50	40	SS	RM02
DBDSK	52	240	HH*SS	RM02
DBDSK	54	40	SS	RM02
DBDSK	1260	177440	177400+SS	RM02
DBDSK	1262	2400	HH*400	RM02
DSIDAT	112	151466	150000+CCCC-1	RM02
DSIDAT	114	2037	HH-1 high byte, SS-1 low byte	RM02
DSIDAT	120	151466	150000+CCCC-1	RM02
DSIDAT	122	2037	HH-1 high byte, SS-1 low byte	RM02
COPY	2426	240	HH*SS	RM02
COPY	2430	40	SS	RM02
COPY	2434	240	HH*SS	RM02
COPY	2436	40	SS	RM02
ROOT	6204	2440	HH high byte, SS low byte	RM02
ROOT	6206	2440	HH high byte, SS low byte	RM02

EXIT: CONTROL C

SYSGEN.SIL

ENTER: ONLPAT
ENTER: SYSGEN.SIL

MODULE	BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
DSK	DRDSK	46	240	HH*SS	RM02
DSK	DRDSK	50	40	SS	RM02
DSK	DRDSK	52	240	HH*SS	RM02
DSK	DRDSK	54	40	SS	RM02
DSK	DRDSK	1260	177440	177400+SS	RM02
DSK	DRDSK	1262	2400	HH*400	RM02
DSK	DRSEEK	46	240	HH*SS	RM02
DSK	DRSEEK	50	40	SS	RM02
DSK	DRSEEK	52	240	HH*SS	RM02
DSK	DRSEEK	54	40	SS	RM02
DSK	DRSEEK	1374	177440	177400+SS	RM02
DSK	DRSEEK	1376	2400	HH*400	RM02

EXIT: CONTROL C

HOOK.SAV

ENTER: ONLPAT
ENTER: HOOK.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
2714	0	240	HH*SS	RM02
2714	2	40	SS	RM02
2714	10	240	HH*SS	RM02
2714	12	40	SS	RM02

EXIT: CONTROL C

SAVRES.SAV

ENTER: ONLPAT
ENTER: SAVRES.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
GGB	1324	240	HH*SS	RM02
GGB	1326	40	SS	RM02
GGB	1334	240	HH*SS	RM02
GGB	1336	40	SS	RM02

EXIT: CONTROL C

5.3.4 RSTS/E V7.2 RM05 PARAMETER CHANGES

INIT.SYS

ENTER: ONLPAT
ENTER: INIT.SYS

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
SATBUF	15624	7	MM	RM05
SATBUF	15704	121200	LLLLLL-SS	RM05
SATBUF	15764	10	CLUSTER SIZE	RM05
DBDSK	62	1140	HH*SS	RM05
DBDSK	64	40	SS	RM05
DBDSK	1310	177440	177400+SS	RM05
DBDSK	1312	11400	HH*400	RM05
DSIDAT	134	151466	150000+CCCC-1	RM05
DSIDAT	136	11037	HH-1 high byte, SS-1 low byte	RM05
COPY	2450	1140	HH*SS	RM05
COPY	2452	40	SS	RM05
ROOT	6212	11440	HH high byte, SS low byte	RM05

EXIT: CONTROL C

SYSGEN.SIL

ENTER: ONLPAT
ENTER: SYSGEN.SIL

MODULE	BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
DSK	DRDSK	62	1140	HH*SS	RM05
DSK	DRDSK	64	40	SS	RM05
DSK	DRDSK	1310	177440	177400+SS	RM05
DSK	DRDSK	1312	11400	HH*400	RM05
DSK	DRSEEK	62	1140	HH*SS	RM05
DSK	DRSEEK	64	40	SS	RM05
DSK	DRSEEK	1424	177440	177400+SS	RM05
DSK	DRSEEK	1426	11400	HH*400	RM05

EXIT: CONTROL C

HOOK.SAV

ENTER: ONLPAT
ENTER: HOOK.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
2714	30	1140	HH*SS	RM05
2714	32	40	SS	RM05

EXIT: CONTROL C

SAVRES.SAV

ENTER: ONLPAT
ENTER: SAVRES.SAV

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
GGB	1354	1140	HH*SS	RM05
GGB	1356	40	SS	RM05

EXIT: CONTROL C

5.3.5 RSTS/E V8.0 PARAMETER CHANGES

INIT.SYS

ENTER: ONLPAT
ENTER: INIT.SYS

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
ONE	010550	001454	000240	RM02/3/5
ONE	010724	000002	MM	RM03
ONE	010726	000002	MM	RM02
ONE	010732	000007	MM	RM05
ONE	011004	001100	LLLLLL	RM03
ONE	011006	001100	LLLLLL	RM02
ONE	011012	121200	LLLLLL	RM05
ONE	011064	000004	CLUSTER SIZE	RM03
ONE	011066	000004	CLUSTER SIZE	RM02
ONE	011072	000010	CLUSTER SIZE	RM05
DBDSK	000046	000240	HH*SS	RM02
DBDSK	000052	000240	HH*SS	RM03
DBDSK	000062	001140	HH*SS	RM05
DBDSK	001262	002400	HHx400	RM02/3
DBDSK	001312	011400	HHx400	RM05
DSIDAT	000112	151466	150000+CCCC-1	RM03
DSIDAT	000120	151466	150000+CCCC-1	RM02
DSIDAT	000134	151466	150000+CCCC-1	RM05
DSIDAT	000114	002037	HH-1 high byte, SS-1 low byte	RM03
DSIDAT	000122	002037	HH-1 high byte, SS-1 low byte	RM02
DSIDAT	000136	011037	HH-1 high byte, SS-1 low byte	RM05
BLDBOT	000522	000240	HH*SS	RM02
BLDBOT	000526	000240	HH*SS	RM03
BLDBOT	000532	001140	HH*SS	RM05
ROOT	006150	002440	HH high byte, SS low byte	RM03
ROOT	006152	002440	HH high byte, SS low byte	RM02
ROOT	006156	011440	HH high byte, SS low byte	RM05

EXIT: CONTROL C

SYSGEN.SIL

```
ENTER: ONLPAT
ENTER: SYSGEN.SIL
```

MODULE	BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
DSK	DRDSK	000046	000240	HH*SS	RM02
DSK	DRDSK	000052	000240	HH*SS	RM03
DSK	DRDSK	000062	001140	HH*SS	RM05
DSK	DRDSK	001262	002400	HHx400	RM02/3
DSK	DRDSK	001312	011400	HHx400	RM05
DSK	DRSEEK	000046	000240	HH*SS	RM02
DSK	DRSEEK	000052	000240	HH*SS	RM03
DSK	DRSEEK	000062	001140	HH*SS	RM05
DSK	DRSEEK	001440	002400	HH*400	RM02/3
DSK	DRSEEK	001470	011400	HH*400	RM05

```
EXIT: CONTROL C
```

HOOK.SAV

```
ENTER: ONLPAT
ENTER: HOOK.SAV
```

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
BLDBOT	000522	000240	HH*SS	RM02
BLDBOT	000526	000240	HH*SS	RM03
BLDBOT	000532	001140	HH*SS	RM05

```
EXIT: CONTROL C
```

SAVRES.SAV

```
ENTER: ONLPAT
ENTER: SAVRES.SAV
```

BASE	OFFSET	IS	CHANGE TO	DRIVE TYPE
BLDBOT	000522	000240	HH*SS	RM02
BLDBOT	000526	000240	HH*SS	RM03
BLDBOT	000532	001140	HH*SS	RM05

```
EXIT: CONTROL C
```

5.4 RT-11 V4.0, V5.0

The RT-11 support tape contains the following four files which should be copied to a running system using the COPY utility.

```
DR.MAC      : SPECTRA LOGIC RM driver
DM.SLC      : SPECTRA LOGIC RK driver
SYSGEN.BAT : BATCH control file for SYSGEN.CND
SYSGEN.SLC : Modifications for SYSGEN.CND
```

The first two files, DR.MAC (RM) and DM.SLC (RK), each have a set of constants that define the logical and physical drive characteristics. Before building the system, these constants must be modified at locations DTAB and DRDEF to reflect the desired configuration. RT-11 has a limitation of 65,536 (or less) sectors per logical unit; therefore, an 80MB drive is typically divided into two logical units, and a 300MB drive divided into eight logical units, etc.

At location DTAB, the main driver has six constants for each logical unit which must be changed to reflect the desired configuration. For example, a configuration with two DFR or CMD type drives, each with 16 megabytes of removable and 80 megabytes of fixed media would be modified as follows.

LOGICAL UNIT #	PHYSICAL UNIT #	CYLINDER OFFSET	SECTORS PER LOGICAL UNIT	SECTORS PER CYLINDER	SECTORS PER TRACK
0	0	0	63000	40	40
1	1	0	177400	240	40
2	1	630	177400	240	40
3	2	0	63000	40	40
4	3	0	177400	240	40
5	3	630	177400	240	40

After the modifications at location DTAB are completed, one change is required at location DRDEF. The following string is displayed at that location:

```
RM =  .DRDEF DR, 377, FILST$!SPFUN, 177400, 176700, 254

RK =  .DRDEF DM, 376, FILST$!SPFUN, 177400, 177440, 210
```

The first constant that appears after 'FILST$!SPFUN' must be changed to the number of sectors per logical unit of the smallest unit to be supported. The smallest unit to be supported can be determined by examining the 'Sectors Per Logical Unit' column at location DTAB. For this example, the smallest unit to be supported has 63000 (octal) sectors per logical unit; therefore, that is the number to be used.

BUILDING THE SYSTEM

After loading the four files from the support tape and editing DR.MAC and DM.SLC as required, a system incorporating the RM or RK driver can be built using the following procedure. It is assumed that the BATCH handler has been generated into the currently running system. In lines two and three below, TT: (for teletype) or NL: (for null) may be used instead of LP: (for line printer).

ENTER	COMMENTS
.LOA BA:	Load BATCH handler
.LOA LP:	Load LOG handler
.ASS LP: LOG	Assign LOG device
.R BATCH	Invoke BATCH handler
*SYSGEN	Modify SYSGEN.CND
.R SYSGEN	Execute modified SYSGEN
.	
.	
.	
.@ SYSBLD	Build new system
.RENAME/SYS *.SYG * SYS	
.COPY/BOOT RT11xx.SYS DRO:	

UTILITY PROGRAMS

Two utility programs, DUP.SAV and MDUP.SAV, require modification to correctly initialize and squeeze a device that supports variable size volumes. Both patches assume the device ID to be 377 for RM or 376 for RK. See the RT-11 SYSTEM RELEASE NOTES for further details.

DUP.SAV

PROMPT	ENTER	COMMENTS
.	R SIPP	Calls up patch program
*	DUP.SAV	File to be patched
Segment?	1	
Base?	0	
Offset?	10253	

The program then echoes the segment, base, and offset that was just defined and increments the address. Enter 377 for RM, or 376 for RK when the 'New?' prompt is displayed. Then enter a 'CONTROL Y' to halt the address increment and return the '*' prompt. Enter 'CONTROL C' to exit the program.

SEGMENT	BASE	OFFSET	OLD		NEW?
000001	000000	010253	000	**ENTER:**	376 or 377
000001	000000	010254	000	**ENTER:**	^Y
*	^C		EXIT THE PROGRAM		

MDUP.SAV

PROMPT	ENTER	COMMENTS
.	R SIPP	Calls up patch program
*	MDUP.SAV	File to be patched
Base?	0	
Offset?	4450	

The program then echoes the base and offset that was just defined and increments the address. First, enter a forward slash (\) when the 'New?' prompt is displayed, then enter 377 for RM, or 376 for RK when the second 'New?' prompt is displayed. Enter a 'CONTROL Y' to halt the address increment and return the '*' prompt. Enter 'CONTROL C' to exit the program.

BASE	OFFSET	OLD		NEW?
000000	004450	000000	**ENTER:**	\
000000	004450	000	**ENTER:**	376 or 377
000000	004451	000	**ENTER:**	^Y
*	^C		EXIT THE PROGRAM	

BOOT PROCEDURE

The RM version of the RT-11 support tape can be booted only from logical unit 0. There is one constant in the boot portion of the RM driver at location BSPC: which must reflect the number of sectors per cylinder on logical unit 0.

The RK version of the RT-11 support tape is bootable by making the following changes to the bootstrap driver. The bootstrap driver is found at the end of the main driver.

```
                                          IS        CHANGE TO

READ:    MOV     #3.*22.,R3               3.*22     SS*HH
         MOV     #22.,R3                   22.        SS
 2$:     INC     R5
 3$:     ADD     #0,R4                      0       Cylinder offset
```

Next, reassemble the driver and copy the boot to the logical unit using the following command:

COPY/BOOT DX RT11xx.SYS DM:

Where xx is either 'SJ' for Single Job or 'FB' for Foreground/Background.

The RT-11 support tape for RK is now bootable.

Chapter Six

Software Utilities

6.1 SPECTRA LOGIC UTILITIES

This chapter describes the software utilities that are provided by Spectra Logic for use on the SPECTRA 111/121/-PLUS controller. The first software utility is the Spectra Logic Elementary Debugger (SLED) and is used for examining and manipulating the contents of memory and for programming the EEPROM. SLED is a powerful tool meant for use by experienced programmers. The second software utility is the DEC Configurator and is used to configure the controller and a given drive for use on computers manufacturered by Digital Equipment Corporation. The DEC configurator is a user friendly program designed to run with a minimal amount of knowledge about the system. This chapter also describes the EEPROM and its basic functions.

6.2 EEPROM PROGRAMMING

The EEPROM on the SPECTRA 111/121/-PLUS controller is used to configure a specified drive so that it is compatible with the DEC series of computers. It is a convenient replacement for both switches and drive configuration PROMs. It is user programmable on board, and each bit location effectively replaces one switch. The EEPROM may be reprogrammed to allow attachment of any SMD type drive by using the support software provided (SLED and the DEC Configurator). EEPROMs, unlike RAMs, have a maximum of 10,000 write cycles per location. Because of this limitation, the user should avoid writing any diagnostic which will significantly reduce the lifetime of this part by excessively writing any location. This section defines the EEPROM labels and the basic functions of the EEPROM.

6.2.1 EEPROM LABEL DEFINITIONS

The EEPROM labels are used to represent byte locations in the EEPROM. Each location contains values which either select options or describe drive parameters. The following table lists the labels associated with each byte location of the EEPROM. The byte addresses are given in octal.

LABEL	DEFINITION	BYTE ADDRESS	# of LOCATIONS
VRC	Vertical Redundancy Check	000000	1
OFFTIM	Off Time	000001	1
DKBRST	Disk Burst	000002	1
DRVVEC	Drive Vector	000003	1
XFRFLG	Transfer Flags	000004	1
SPARE1	Spare Location 1	000005	1
SPARE2	Spare Location 2	000006	1
SPARE3	Spare Location 3	000007	1
DKFLGL	Disk Flags Lo byte	000010	8
DKFLGH	Disk Flags Hi byte	000020	8
DKTYPL	Drive Type Lo byte	000030	8
DKTYPH	Drive Type Hi byte	000040	8
PHYUNT	Physical Unit	000050	8
HDINDX	Head Index	000060	8
CYLIXL	Cylinder Index Lo Byte	000070	8
CYLIXH	Cylinder Index Hi Byte	000100	8
PARBLK	Parameter Block Pointer	000110	8
SECMAP	Sector Map	000120	128
LSPLH	Sectors Per Logical Head	000320	128
LHPLC	Heads Per Logical Cylinder	000520	128
LCPLDL	Cylinders Per Logical Drive Lo	000720	128
LCPLDH	Cylinders Per Logical Drive Hi	001120	128
PSPPH	Sectors Per Physical Head	001320	128
PHPPC	Heads Per Physical Cylinder	001520	128
MTVEC0	Mag Tape Vector 0	001720	1
MTVEC1	Mag Tape Vector 1	001721	1
MTVEC2	Mag Tape Vector 2	001722	1
MTVEC3	Mag Tape Vector 3	001723	1
MTBRST	Mag Tape Burst	001724	1
MFGVAL	Manufacturer Value	001725	8
MODVAL	Model Value	001735	8
MTFLG0	Mag Tape Flags Unit 0	001745	1
MTFLG1	Mag Tape Flags Unit 1	001746	1
MTFLG2	Mag Tape Flags Unit 2	001747	1
MTFLG3	Mag Tape Flags Unit 3	001750	1
SPARE4	Spare Locations (reserved)	001751	23
RSVD	Reserved	002000	1024

VRC (0000)

The VRC (Vertical Redundancy Check) label represents one location. This location contains the one's complement of the exclusive-or of all locations within the EEPROM (except VRC byte). It provides a validity check of the EEPROM contents and is not used by the controller.

OFFTIM (0001)

The OFFTIM (Off Time) label represents one location. This location contains a value that determines the amount of time the controller will delay after completing a disk burst and before re-arbitrating for the next. This value should be set to zero unless devices are present on the bus which do not burst and are subject to data late errors. A value of zero causes the controller to hold the bus between bursts unless W11A-W11B are jumpered (and another device requests the bus). Setting the value to one or greater causes the controller to release the bus between disk burst transfers. The controller has an inherent delay of 3-10 microseconds before re-arbitration, and each count added to the total value delays an additional 300 nanoseconds. The bus is always released after completion of a tape burst. NOTE: Plus products release the bus upon completion of each burst. Each count added to OFFTIM value delays an additional 280 nanoseconds.

DKBRST (0002)

The DKBRST (Disk Burst) label represents one location. This location contains the maximum number of words the controller will burst during disk data transfers only. Any value may be specified from 1 to 255 decimal.

DRVVEC (0003)

The DRVVEC (Drive Vector) label represents one location. This location contains the vector that is passed to the processor during an interrupt service. Any value up to 377 octal is allowed, but must not conflict with a processor trap or with another device's vector. The standard disk vector is 254 octal.

XFRFLG (0004)

The XFRFLG (Transfer Flags) label represents one location. This location contains bits which enable transfer options.

BIT	DEFINITION
0	If this bit is set, all drives will be released upon completion of each command. (Used with dual-port). (i.e.-disable reserve timer).
1	This bit must be set for proper operation on VAX 750 with the new Unibus adapter.(Rev. L0004).

SPARE (0005,0006,0007)

These labels, SPARE1, SPARE2, SPARE3, all represent spare locations.

DKFLGL BIT DEFINITIONS (0010)

The DKFLGL (Disk Flags Lo) label represents the first location of a series of eight locations. Each byte location corresponds to 1 logical drive (e.g. location 10 contains bits for logical drive 0 and location 11 contains bits for logical drive 1). Each location contains 1 byte, or 8 bits, and each bit controls a different drive option. Each bit is defined as follows.

BIT	NAME	DEFINITION
7	Head Mapped Drive	When set, this bit indicates that the logical drive has been assigned to a physical drive on which the heads are divided into groups. Each group of heads is assigned to one logical drive enabling one physical drive to appear as multiple logical drives. A 160MB drive having 10 heads and 823 cylinders may be assigned to two logical drives, each having a capacity of 80MB with 5 heads and 823 cylinders. Some drives, such as LARK or CMD, require head mapping because they are actually two drives which have a common spindle and a common actuator. They must be treated independently.
6	Cylinder Mapped Drive	When set, this bit allows the logical drive to occupy a group of cylinders on the physical drive. A 160MB drive having 5 heads and 1645 cylinders may be partitioned so that one logical drive occupies heads 0-4 on cylinders 0-822. The second logical drive occupies heads 0-4 on cylinders 823-1645. Fixed head drives must be cylinder mapped in order to utilize the fixed head portion. The fixed head area is assigned a physical cylinder address range that does not conflict with the moving head portion. Cylinder and head mapping may be combined on one physical drive to allow unique partitioning. For example, a 240MB drive with 10 heads and 1235 cylinders should be able to accomodate three 80MB logical units. However, neither the heads nor the cylinders may be grouped to allow even distribution of the total capacity. The drive is divided so that one logical unit occupies heads 0-4 on cylinders 0-822, another logical unit occupies heads 5-9 on cylinders 0-822, and the last logical unit resides on heads 0-9 on cylinders 823-1234.

DKFLGL BIT DEFINITIONS (0010) [continued]

BIT	NAME	DEFINITION
5	Implied Seeks Only	This bit must be set for any logical drive sharing a physical drive with another logical unit. Overlapped seeks or searches are not possible because only one actuator is available to perform multiple seeks to separate cylinders at any point in time.
4	High Speed Drive	When set, this bit indicates that a special format suited for high speed data rates must be used. Set for any drive which transfers data at a rate between 1.2MB/sec. and 2.0MB/sec. **NOTE:** For drives with transfer rates greater than 2.0MB/sec, refer to PHYUNT (0050) on page 6-8 of this manual.
3	Read Ahead Enable	The controller, upon completion of a read operation, checks this bit to determine whether to continue reading sectors from the disk for the next command. If the next command is not a READ, the read ahead sectors are not used. If the next command is a READ and the read ahead sectors are requested, the sectors are transferred to memory resulting in reduced latency.
2	Sector Mapped (Interleaved)	When set with RPS, this bit instructs the controller to use the sector map table to determine which physical sector is to be read or written. If RPS is not enabled, sector mapping is not used. The logical sector address is used as an index into the sector map to retrieve the physical sector address.
1	Use RPS Counters	RPS requires that index and sector signals be in the 'B' cable. RPS allows full emulation of the SEARCH command. If RPS is not enabled, only the SEEK part of the SEARCH command is executed.
0	Dual Port Drive	Set only if the drive is to be dual ported. When set this bit instructs the controller to assume nothing about the current head position of the drive and to perform all implied seeks.

DKFLGH BIT DEFINITIONS (0020)

This label (Disk Flags Hi) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain the hi byte of additional flag bits which enable or describe drive features. The bits are defined below.

BIT	NAME	DEFINITION
7	Logical to Physical Conversion Required	When set, this bit indicates that the physical drive and the logical drive do not have the same number of heads per cylinder and/or sectors per track. For example, a Fujitsu 2312 has 32 sectors/track, 7 tracks/cylinder, and 589 cylinders. It is to be mapped as an 80MB RM03 which has 32 sectors/track, 5 tracks/cylinder, and 823 cylinders. By describing both the logical and physical drives with this bit set, the controller performs the mapping such that it is completely transparent to the system driver.
6	RM80 Emulation (skip sectoring)	When set, this bit causes the controller to enable skip sectoring. This allows mapping out 1 defective sector per track. RM80 emulation is independent of the drive type code (RMDT) for the controller; however, the system driver requires the RM80 drive type code to handle skip sectoring.
5	Seek on Head Select (Embedded Servo)	When set, indicates that the drive has the seek on head select option enabled. This option must be enabled on any drive with embedded servo information (such as LARK, AMCODYNE, and NORCOM drives).
4	Seek on Unit Select (Multiple Servo Tracks)	When set, this bit indicates that a drive has more than one servo track; therefore, a seek is required after the initial head select. These drives include CMD and DFR.

DKFLGH BIT DEFINITIONS (0020) [continued]

BIT	NAME	DEFINITION
3	Head Skewing Required	Head skewing and deskewing are required for media compatibility and media transportablility. Bits 3 and 2 must be set for removable media because it requires a large gap preceding the header to compensate for differences in head alignment when transporting media from one drive to another. They must also be set to ensure media capability when using a different make of controller to read media which has been formatted on a Spectra Logic controller. Most Winchester drives do not require a large header gap. When the bits are cleared, the gap is eliminated and sectors per track may be increased from 32 to 35 on a standard track of 20160 bytes/track. This allows a greater formatted capacity on the drive.
2	Head Deskewing Required	
Bit 3	Bit 2	
0	0	May be used for Winchesters. Must be used for Fujitsu Eagle.
0	1	Used for APS drives (special case).
1	0	Not used.
1	1	Used for removable media, Winchesters.
1	EAGLE No wait for write splice	This bit is used for eagle drives only and must always be set.
0	TAG 4/5	This bit is used for Fujitsu drives only. When set, it enables tag 4/5 status reporting to the RMMR1 and RMMR2 registers. Tag 4/5 must be enabled on the disk drive or a fault condition will occur.

DKTYPL (0030)

This label (Drive Type Lo) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain the low byte of the drive type (RMDT). See table 2-1 (drive type table).

DKTYPH (0040)

This label (Drive Type Hi) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain the hi byte of the drive type. See table 6-1 (drive type table).

TABLE 6-1
DRIVE TYPE TABLE

DRIVE NAME	DRIVE TYPE OCTAL			CYLINDERS			HEADS	SECTORS
	WORD	HIBYTE	LOBYTE	WORD	HIBYTE	LOBYTE	BYTE	BYTE
RM02	20025	040	025	1467	003	067	005	040
RM03	20024	040	024	1467	003	067	005	040
RM05	20027	040	027	1467	003	067	023	040
RM80	20026	040	026	1061	002	061	016	040 (037)
RP04	20020	040	020	633	001	233	023	026
RP05	20021	040	021	633	001	233	023	026
RP06	20022	040	022	1457	003	057	023	026
*RP07	20042	040	042	1166	002	166	40	062

* The RP07 subsystem is not fully emulated. To use the RP07 drive type code, the device driver must be modified.

PHYUNT (0050)

The Physical Unit label represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain the physical unit number where the logical drive resides. When mapping two logical units onto one physical unit, the logical and physical unit numbers are not necessarily the same. Bit 7 of PHYUNT is used for very high speed drives >2.0 MB/s.

HDINDX (0060)

The Head Index label represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain values which allow head mapping of drives. See DKFLG0 bit 7.

CYLIXL (0070)

This label (Cylinder Index Lo) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain values which allow cylinder mapping of drives. See DKFLG0 bit 6.

CYLIXH (0100)

This label (Cylinder Index Hi) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain values that allow cylinder mapping of drives. See DKFLG0 bit 6.

PARBLK (0110)

This label (Parameter Block pointer) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) contain parameter block pointers that point to one of the 128 parameter blocks. Each parameter block describes a logical drive and a physical drive. Parameter blocks consist of various parameters represented by the labels LBPLH, LHPLC, LCPLDL, LCPLDH, PBPPH, and PHPPC.

SECMAP (0120)

This label represents the first location in a series of 128 locations. These locations contain a sector look up table which allows user defined interleave up to 128 sectors. Only one table exists; therefore, there is only one interleave scheme per controller. The physical sector address is used to index into the sector table and retrieve a new physical sector address. This option is enabled via bit 2 of DKFLGL and is used only when RPS is enabled.

NOTE: Interleaved and non-interleaved drives may be configured concurrently.

LSPLH (0320)

This label (Logical Sectors Per Logical Head) represents the first location in a series of 128 locations. These locations contain parameters which define the number of sectors per head on the logical drive. When these parameters are combined with the other drive descriptor parameters, they then compose the 128 parameter blocks.

LHPLC (0520)

This label (Logical Heads Per Logical Cylinder) represents the first location in a series of 128 locations. These locations contain parameters which define the number of heads per cylinder on the logical drive. When these parameters are combined with the other drive descriptor parameters, they compose the 128 parameter blocks.

LCPLDL (0720)

This label (Logical Cylinders Per Logical Drive Lo) represents the first location in a series of 128 locations. These locations contain parameters which define the number of cylinders on the logical drive (lo byte). When these parameters are combined with the other drive descriptor parameters, they compose the 128 parameter blocks.

LCPLDH (1120)

This label (Logical Cylinders Per Logical Drive Hi) represents the first location in a series of 128 locations. These locations contain parameters which define the number of cylinders on the logical drive (hi byte). When these parameters are combined with the other drive descriptor parameters, they compose the 128 parameter blocks.

PSPPH (1320)

This label (Physical Sectors Per Physical Head) represents the first location in a series of 128 locations. These locations contain parameters which define the number of sectors per head on the physical drive. When these parameters are combined with the other drive descriptor parameters, they compose the 128 parameter blocks.

PHPPC (1520)

This label (Physical Heads Per Physical Cylinder) represents the first location in a series of 128 locations. These locations contain parameters which define the number of heads per cylinder on the physical drive. When these parameters are combined with the other drive descriptor parameters, they compose the 128 parameter blocks.

MTVEC0 (1720)

This label (Mag Tape Vector 0) represents one location. This location defines the mag tape vector for logical unit 0. (MS0).

MTVEC1 (1721)

This label (Mag Tape Vector 1) represents one location. This location defines the mag tape vector for logical unit 1. (MS1).

MTVEC2 (1722)

This label (Mag Tape Vector 2) represents one location. This location defines the mag tape vector for logical unit 2. (MS2).

MTVEC3 (1723)

This label (Mag Tape Vector 3) represents one location. This location defines the mag tape vector for logical unit 3. (MS3).

MTBRST (1724)

This label (Mag Tape Burst) represents one location. This location defines the maximum number of words the controller will transfer from tape to memory before relinquishing the bus.

MFGVAL (1725)

This label (Manufacturer Value) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) define the manufacturer of a given drive and are used in conjunction with the Dec Configurator utility.

MODVAL (1735)

This label (Model Value) represents the first location in a series of eight locations. These eight locations (one location for each logical drive) define the model of a given drive and are used in conjunction with the Dec Configurator utility.

MTFLG 0-3 (1745 - 1750)

These labels (Mag Tape Flags) represent a series of four locations. These four locations (one for each tape unit) define power up default options. The bits are defined below.

BIT	NAME	DEFINITION
7	Read Reverse Inhibit (Default)	When set, this bit transforms READ REVERSE into a Space Reverse, Read Forward, Space Reverse sequence. When reset, Read Reverse operations may be used.
6	Keystone III Flag	When set, this bit inhibits Read Reverse operations when the extended command GCR SELECT is issued. Used with the Keystone III drive only.
5	Long/Short GAP (Default)	When set, the controller selects a long gap; when reset, the controller selects a short gap. Used with the Keystone III drive only.
4-3	Reserved	These bits are reserved.
2	High/Low speed/density	When set, this bit selects high speed/density; when reset, this bit selects low speed/density.
1	Reserved	This bit is reserved.
0	Controller Present	When set, this bit will disable response to the controller's unit address for tape units 1,2 & 3 only.

SPARE4 (1751)

This label represents 23 reserved locations.

RSVD (2000)

This label (Reserved) represents 1024 reserved locations.

6.2.2 EEPROM DEFAULT VALUES

The following tables show the production default values that are pre-programmed into the EEPROM.

VRC	OFFTIM	DKBRST	DRVVEC	XFRFLG	SPARES	MTVEC0	MTVEC1	MTVEC2	MTVEC3	MTBRST
000	000	040	254	000	000	224	344	350	354	020

The table below gives the production default values for every label that represents eight byte locations; each location corresponds to one logical drive. If the value desired is already present in the default table, that label need not be accessed.

LOGICAL DRIVE	DKFLGL octal	DKFLGH octal	DKTYPL octal	DKTYPH octal	PHYUNT octal	HDINDX octal	CYLIXL octal	CYLIXH octal
0	000	014	RM03 024	RM03 040	000	000	000	000
1	000	014	RM05 027	RM05 040	001	000	000	000
2	002	214	RM03 024	RM03 040	002	000	000	000
3	242	014	RM03 024	RM03 040	003	000	000	000
4	242	014	RM03 024	RM03 040	003	005	000	000
5	172	203	RM03 024	RM03 040	004	000	000	000
6	172	203	RM03 024	RM03 040	004	000	220	000
7	172	203	RM05 027	RM05 040	004	000	040	001

EEPROM DEFAULT VALUES [continued]

The contents of the locations in the label PARBLK directly correspond to the following table. This table contains production default values for the first 11 parameter blocks.

PARBLK/ LOCATION	LSPLH octal	LHPLC octal	LCPLDH octal	LCPLDL octal	PSPPH octal	PHPPC octal	DRIVE
0	040	005	003	067	040	005	80MB CDC 9762
1	040	023	003	067	040	023	300MB CDC 9766
2	040	005	003	067	040	007	84MB FUJ 2312
3	040	005	003	067	040	005	160MB FUJ 2284
4	040	005	003	067	040	005	160MB FUJ 2284
5	040	005	003	067	056	024	474MB FUJ 2351 (EAGLE)
6	040	005	003	067	056	024	474MB FUJ 2351 (EAGLE)
7	040	023	003	067	056	024	474MB FUJ 2351 (EAGLE)

EEPROM DEFAULT VALUES [continued]

The following table shows how the Spectra 111/121/-PLUS controller is configured from the factory, or after the production default values have been written into the EEPROM.

LOGICAL UNIT	0	1	2	3	4	5	6	7
DRIVE TYPE	RM03	RM05	RM03	RM03	RM03	RM03	RM03	RM05
LOGICAL SECTORS	32	32	32	32	32	32	32	32
LOGICAL HEADS	5	19	5	5	5	5	5	19
LOGICAL CYLINDER	823	823	823	823	823	823	823	823
LOGICAL CAPACITY	80MB	300MB	80MB	80MB	80MB	80MB	80MB	300MB
PHYSICAL SECTORS	32	32	32	32		46		
PHYSICAL HEADS	5	19	7	10		20		
PHYSICAL CAPACITY	80MB	300MB	80MB	160MB		474MB		
PHYSICAL UNIT	0	1	2	3		4		
PHYSICAL CYLINDER	823	823	589	823		842		
MAKE	CDC	CDC	FUJITSU	FUJITSU		FUJITSU		
MODEL	9762	9766	2312	2284		2351 (EAGLE)		

6.3 SPECTRA LOGIC ELEMENTARY DEBUGGER

Spectra Logic Elementary Debugger (SLED) is a simple program designed to be used in hardware or software checkout. It combines several of the functions offered by DEC's ODT with special SLED functions to access device registers, read and write the EEPROM, and perform I/O operations on the SPECTRA 111/121 controller.

The Spectra Logic diagnostic tape includes the standard DEC diagnostics monitor (XXDP) as well as SLED. Procedures for running SLED under XXDP are listed below.

1. Boot the XXDP tape and follow the startup procedure until XXDP returns the "." prompt.

2. Enter "L SLED" <return> and wait for XXDP to return the "." prompt again.

3. Enter "S 2000" <return> to start execution of SLED. The program identifies itself and then displays a "SLED**" prompt.

4. Enter "R SLED" <return> to load and start execution of SLED with a single command.

FUNCTIONS

The functions and default parameters are shown as follows. The special functions are generally divided into register access and I/O operations. Data is displayed in octal format. The functions are:

,	Display all registers.
.	Open a register for display and/or modification.
$,>	Open a SLED parameter for display and/or modification.
/	Open a memory address for modification (16 bits).
\	Open a memory address for modification (8 bits).
@	Open location referenced by current location.
CR	Close currently opened register or parameter.
LF	Close currently opened register or parameter and open next.
^	Close currently opened register or parameter and open previous.
'	Execute an I/O function.
;	Execute selected function.
%	Execute extended SLED function.
-	Use negative of value given.
+	Use arithmetic function.

Display All Registers (,)

To examine all the registers of the device selected, type a comma (,). A register mnemonic, the register address, and the register contents are displayed. The bit settings in the key registers are also interpreted mnemonically.

Open a Register for Modification (.)

To open a register of the device selected, type a period (.) followed by the two letter register mnemonic followed by a slash (/). After a location is opened it may be modified and/or closed.

For example, to open register S1, type ".S1/" and SLED displays the contents of S1. To change the contents of a currently opened register, enter the desired value followed by a carriage return. While any register location is open, mnemonic bit interpretation may be displayed by typing a pound (#) sign. To close a current location without changing the value, press the carriage return key.

The following lists of mnemonics are used in conjunction with Display all Registers (,) and Open a Register for Modification (.).

RM DISK REGISTER MNEMONICS

S1	CSR #1
WC	Word Count
BA	Buffer Address
DA	Disk Address
S2	CSR #2
DS	Drive Status
E1	Error Register #1
AS	Attention Summary
LA	Look Ahead
DB	Data Buffer
M1	Maintenance Register #1
DT	Drive Type
SN	Serial Number
OF	Offset
DC	Desired Cylinder
HR	Holding Register
M2	Maintenance Register #2
E2	Error Register #2
PS	ECC Position
PT	ECC Pattern

TS TAPE REGISTER MNEMONICS

DB	Data Buffer
SR	Status Register
CH	Command Packet Header
LA	Low Order Buffer Address
HA	High Order Buffer Address
BE	Buffer Extent (byte count)
LM	Low Order Message Buffer Address
HM	High Order Message Buffer Address
LB	Length of Message Buffer (bytes)
CM	Characteristics Mode
MH	Message Buffer Header
DL	Data Length
BC	Byte Count
XO	Extended Status Register 0
X1	Extended Status Register 1
X2	Extended Status Register 2
X3	Extended Status Register 3

Open SLED Key Parameters for Modification ($), (>)

To change the contents of certain key parameters, SLED allows the examination and modification of certain memory locations. These locations may be opened and changed by typing a dollar sign ($), (>), or by pressing ESCAPE followed by the proper mnemonic. The key parameters and their defaults are as follows:

KEY	DEFAULT	DESCRIPTION
$0-$7	0	Registers 0-7
$A	0	Printer Control (0=TTY 1=LPT)
$B	40000	Buffer Address
$C	240	Constant
$D	1	CSR Address (776600)
$E	0	Extended Address Bits (Drive Type for RK)
$H	40777	High Address for Search and Fill
$L	40000	Low Address for Search and Fill
$M	177777	Mask for Search and Fill
$O	0	Cylinder Offset (0)
$P	5	Interrupt Priority
$Q	1467	Cylinders (823)
$R	177570	Switch Register Address
$S	0	Processor Status
$T	40	Sectors/Track (32)
$U	0	Unit Number (0)
$W	400	Word Count (256)
$X	240	Sectors/Cylinder (160)
>TA	35062	EEPROM Data Transfer Address
>BC	4000	EEPROM Byte Count
>PD	25062	Address of EEPROM Production Defaults (VRC=76)
>TD	31062	Address of EEPROM Test Defaults (VRC=342)

The following list defines the drive types available as well as CSR and vector addresses. Drive types 3-6 are not supported by SPECTRA 111/121/-PLUS.

$D	Drive Type	CSR	Vector address
0	RM	176700	254
1	RM	176600	244
2	RM	176300	150
3	RK	177440	210
4	RK	177400	214
5	TM	172520	224
6	TM	170520	234
7	TS	172520	224

Open Memory for Modification (/)

To access the contents of memory (16-bit words) for either examination or modification, enter the memory address followed by a "/". The contents of the location will be displayed in octal.

Open Memory for Modification (\)

To access the contents of memory (8-bit bytes) for either examination or modification, enter the memory address followed by a "\". The contents of the location will be displayed in octal.

Open Referenced Memory for Modification (@)

To access the contents of memory referenced by the currently opened location for either examination or modification, enter a "@" to close the current location and open the memory address referenced. The contents of the location will be displayed in the current mode.

Close Memory (CR)

To close the currently opened location after either examination or modification, enter a "CR". This will close the current location and return the "*" prompt.

Close Current and Open Next (LF)

To access the contents of the next location and close the currently opened location after either examination or modification, enter a "LF". This will close the current location and open the next location.

Close Current and Open Previous (^)

To access the contents of the previous location and close the currently opened location after either examination or modification, enter a "^". This will close the current location and open the previous location.

Use Negative Value (-)

To use the negative of a value, precede the value with a negative (-) sign.

Use Arithmetic Function (+)

To add the contents of the first parameter to the value of the second parameter, type "X+X" where the first X is the contents of the first parameter, and the second X is value of the second parameter.

Execute I/O Operations (')

To initiate a particular I/O operation type "#'XX" where # is the sector number and XX is the two letter mnemonic for the desired operation. For example, to read sector 14 into the data buffer starting at the address in $B, type "14'RD".

For operations not requiring a sector number, the number preceding the apostrophe may be eliminated. To perform an operation on a cylinder other than zero, preset the desired cylinder number (in octal) in $0 (cylinder offset). If an error is detected while executing a function, a question mark (?) is echoed on the console.

For tape operations, the same syntax is used to initiate I/O commands: "#'XX", where # is the byte count of the next tape record in data transfer commands, or the number of records in positioning commands. For operations not requiring a byte or record count (e.g. rewind, unload), the number preceding the apostrophe may be eliminated. All data transfers are to and from the data buffer starting at the address in $B.

The following mnemonics are used in conjunction with I/O operations.

RM DISK I/O OPERATIONS

NO	No-Op
SK	Seek
RZ	Rezero (recalibrate)
DC	Drive Clear
DR	Drive Release
OF	Offset
RC	Return to Centerline
RP	Read in Preset
PA	Pack Acknowledge
SR	Search
CD	Write-Check Data
CH	Write-Check Header and Data
WD	Write Data
WH	Write Header and Data
RD	Read Data
RH	Read Header and Data

TS TAPE I/O OPERATIONS

IN	Drive Initialize
GS	Get Drive Status
RD	Read Next Record
RR	Read Reverse
RP	Read Previous Record
RN	Re-read Next
WC	Write Characteristics
WD	Write Data
WR	Write Data Retry
SF	Space Forward
SR	Space Reverse
KF	Skip Tape Marks Forward
KR	Skip Tape Marks Reverse
RW	Rewind
WT	Write Tape Mark
ER	Erase
RT	Write Tape Mark Retry
RB	Release Message Buffer
UN	Unload
CT	Clean Tape

Execute Selected Function (;)

SLED functions are executed by preceding the function mnemonic with a semicolon (;). Some functions may require (or optionally accept) a value preceding the execute function command. The command may take the form "X;F" or ";F" where X is the value (if a value is called for) and F is the function mnemonic. The following functions may be executed.

BREAKPOINTS	;B	Clear all breakpoints.
	;NB	Clear breakpoint number N.
	X;B	Set a breakpoint at location X and give the next available number in sequence.
	X;NB	Set breakpoint at location X and give it number N.
CONSTANT	;C	Set constant to the value of zero.
	X;C	Set constant to the value of X.
SEARCH	X;W	Search for the locations containing the value X, masked by the value set in the Mask Register ($M), starting at the location set in the Low Register ($L) and ending at the location set in the High Register ($H).
	X;E	Search for the locations whose contents reference the value X, masked by the value set in the Mask Register ($M), starting at the location set in the Low Register ($L) and ending at the location set in the High Register ($H).
FILL	;F	Fill with a 16-bit word, starting at the location set in the Low Register ($L) and ending at the location set in the High Register ($H), with the value set in the Constant Register ($C).
	;I	Fill with 8-bit byte, starting at the location set in the Low Register ($L) and ending at the location set in the High Register ($H), with the value set in the Constant Register ($C).
EXECUTE	X;G	Start execution of program starting at location X.
	;P	Proceed with execution of program from current breakpoint.
	;S	Disable single instruction mode.
	;NS	Enable single instruction mode to do N number of instructions at a time.
	;+	Add the value of the first parameter to the value of the second parameter.

Execute Selected Function (;) [continued]

DUMP	;L	Dump to the console (and optionally to the line printer) the contents of the locations, starting from the location set in the Low Register ($L) to the location set in the High Register ($H). *SEE $A FOR DUMPING THE PRINTER
MEMORY MANAGER	X;M	Set the memory manager to bank X. 0= 0-200K 1 = 200-400K 2 = 400-600K 3 = 600K+
FORMAT	;Z	Format all but last track of the disk selected by the CSR Select Register ($D).
	;Q	Format the last track of the last cylinder as a disk with no bad blocks.
	-1;Z	Sets up a buffer of headers for cylinder 0, head 0 in memory for use with 'WH command.

PACK INITIALIZATION

Before using a disk pack with the controller, the pack must be formatted and the "last track" must be initialized. Obtain the necessary value from the disk drive configuration tables (section 4.4) and follow the sequence listed below.

Boot SLED program in octal. The values shown are for RM02.

*$D/0	CSR Address (0=176700, 1=776600, 2=176300)
*$T/40	Sectors per track
*$X/240	Sectors per cylinder= HH x SS
*$Q/1467	Cylinders
*;Z	Format the pack
*;Q	Initialize the last track

If a "?" response occurs after any of the entries, an error has occurred, and the parameters that were entered should be checked. If no errors occur, the pack is initialized and standard diagnostics or operating systems can be executed.

EXTENDED COMMANDS AND PARAMETERS

The following commands and parameters allow the user to read from, and write to the Electrically Erasable Programmable Read Only Memory (EEPROM) on the SPECTRA 111/121/-PLUS controller. This is accomplished by reading the entire contents of the EEPROM into the >TA memory buffer (%/RE command), and then writing the contents of the >TA memory buffer to the EEPROM (%WE command). The memory buffer is modifiable using normal SLED conventions. For detailed information on the EEPROM, refer to section 6.2.

Extended SLED Functions (%)

%RE **Read EEPROM:** This command reads the contents of the EEPROM into the >TA buffer.

%WE **Write EEPROM:** This command writes the contents of the >TA buffer back to the EEPROM after modification. (Approximate time: 40 seconds). The EEPROM Write Protect switch (SW1-1) must be in the OFF position.

%WD **Write Default:** If this parameter is preceded by a 0, it writes the Spectra Logic production defaults into the EEPROM; if the parameter is preceded by a 1, it writes the Spectra Logic test defaults into the EEPROM.

%CE **Calculate EEPROM:** This command takes the contents of the >TA buffer and calculates a value to be used for later verification. The value is stored in the VRC byte of the >TA buffer. This command should be issued before writing the contents of the current buffer (>TA) to the EEPROM.

%VE **Verify EEPROM:** This command calculates a value based the contents of the >TA buffer. This value is then compared to the value in the VRC byte in the >TA buffer. If the values are inconsistent, an error ("EEPROM CRC error") is reported.

%CW **Calculate and Write:** This command first reads in the entire contents of the EEPROM into the >TA buffer (equivalent to an %RE command). It then calculates a value based on these contents to be used for later verification. This value is then stored in both the VRC byte of the >TA buffer and the VRC byte of the EEPROM.

%WC **Write CRC:** This command takes the contents of the >TA buffer and calculates a value to be used for later verification. The value is stored in both the VRC byte of the >TA buffer and the VRC byte of the EEPROM.

%RP **Reset EEPROM:** This command causes the controller to use the user defined EEPROM parameters.

Extended SLED Functions (%) [continued]

%SL **Show Label:** SLED asks for a label name and then proceeds to show the corresponding byte location of that label.

%AL **Add Label:** SLED asks for the name and byte location of the new label.

%DL **Delete Label:** SLED asks for the name of the label that is to be deleted.

%LL **List Labels:** SLED lists the labels and their corresponding byte location. This list is shown below.

```
SLED  *
SLED  *%LL

Label : VRC     :  corresponds to address  000000
Label : OFFTIM  :  corresponds to address  000001
Label : DKBRST  :  corresponds to address  000002
Label : DRVVEC  :  corresponds to address  000003
Label : XFRFLG  :  corresponds to address  000004
Label : SPARE1  :  corresponds to address  000005
Label : SPARE2  :  corresponds to address  000006
Label : SPARE3  :  corresponds to address  000007
Label : DKFLGL  :  corresponds to address  000010
Label : DKFLGH  :  corresponds to address  000020
Label : DKTYPL  :  corresponds to address  000030
Label : DKTYPH  :  corresponds to address  000040
Label : PHYUNT  :  corresponds to address  000050
Label : HDINDX  :  corresponds to address  000060
Label : CYLIXL  :  corresponds to address  000070
Label : CYLIXH  :  corresponds to address  000100
Label : PARBLK  :  corresponds to address  000110
Label : SECMAP  :  corresponds to address  000120
Label : LSPLH   :  corresponds to address  000320
Label : LHPLC   :  corresponds to address  000520
Label : LCPLDL  :  corresponds to address  000720
Label : LCPLDH  :  corresponds to address  001120
Label : PSPPH   :  corresponds to address  001320
Label : PHPPC   :  corresponds to address  001520
Label : MTVEC0  :  corresponds to address  001720
Label : MTVEC1  :  corresponds to address  001721
Label : MTVEC2  :  corresponds to address  001722
Label : MTVEC3  :  corresponds to address  001723
Label : MTBRST  :  corresponds to address  001724
Label : MFGVAL  :  corresponds to address  001725
Label : MODVAL  :  corresponds to address  001735
Label : MTFLG0  :  corresponds to address  001745
Label : MTFLG1  :  corresponds to address  001746
Label : MTFLG2  :  corresponds to address  001747
Label : MTFLG3  :  corresponds to address  001750
Label : SPARE4  :  corresponds to address  001751
Label : RSVD    :  corresponds to address  002000
```

EEPROM PARAMETERS

SLED allows the examination and modification of certain memory locations. These locations are represented by labels and may be opened and changed by typing one of the following EEPROM parameters.

>TA **Transfer Address:** This parameter is the starting memory address of the Transfer buffer. All modifications to the EEPROM contents should be made here. The contents of the EEPROM should be read into this buffer for examination or modification and then written back to the EEPROM.

>PD **Production Default:** This parameter is the starting memory address of the Production Default buffer. This buffer contains Spectra Logic default configuration values that are set at the factory. The contents of >PD should not be modified directly; therefore, they are written to the EEPROM (using the %WD command). Then the contents of the EEPROM are read into the >TA buffer (using the %RE command) so that any needed modifications may be made there.

>TD **Test Default:** This parameter is the starting memory address of the Test Default buffer. This buffer contains configuration values used in internal testing. Its contents should not be modified.

>PA **PROM Address:** This parameter is the starting PROM location for a data transfer (Read or Write).

>BC **Byte Count:** This parameter is the number of bytes to be moved during a transfer between the >TA buffer and the EEPROM.

6.4 THE DEC CONFIGURATOR

The DEC Configurator is a utility designed to easily configure the SPECTRA 111/121/-PLUS controller and a given drive for use on computers manufactured by Digital Equipment Corporation. The drive configuration process defines the physical and logical parameters of the specific disk drives being attached to the controller. After a configuration is completed, it is stored in the Electrically Erasable Programmable Read Only Memory (EEPROM). More detailed information concerning the EEPROM is located in section 6.2.

Drive configuration is accomplished by using either DEC mapping or expanded emulation. DEC mapping provides standard emulation when the drive being used has exactly the same number of cylinders, heads, and sectors as a standard DEC drive. For example, any 80 megabyte drive with 823 cylinders, 5 heads, and 32 sectors may be run as an RM02/RM03; any 300 megabyte drive with 823 cylinders, 19 heads, and 32 sectors may be run as an RM05.

DEC mapping eliminates the need for modifications to software drivers, but it can only be used on drives with the same or greater capacity than the drive being emulated. With this method, the firmware in the controller automatically converts the logical cylinder, head, and sector numbers into physical cylinder, head, and sector numbers. Using DEC mapping, a Fujitsu 2312 could be mapped as an RM02 without making any modifications to the RM02 software driver.

DEC mapping may also be used to treat one physical drive as two or more logical drives. For example, a standard 160 megabyte drive with 823 cylinders, 10 heads, and 32 sectors may be treated as two standard RM02s, each with 823 cylinders, 5 heads, and 32 sectors.

Expanded emulation is used when the selected drive has a different number of cylinders, heads, and sectors than a standard DEC drive, and the user prefers software patches over mapping. Under expanded emulation, the software drivers must be modified to reflect the actual numbers of cylinders, heads, and sectors. For example, if using a Fujitsu 2312 drive, an RM02 software driver could be modified for 589 cylinders and 7 heads rather than the standard 823 cylinders and 5 heads. Expanded emulation must be utilized if the target drive has less capacity than the drive being emulated; however, it may also be used on target drives having a greater capacity.

6.4.1 POWER-ON CONFIGURATION

The current version of the DEC Confogurator is a program written in XXDP format. (Version BO and later). In this format it will run in the same manner as the Diagnostics. Older versions of the Configurator contained the capability to access and write single byte locations in the EEPROM. Now this function is provided in another program (also written in XXDP format). This program allows the user to configure specific controller options one byte at a time. The user may also write or modify the boot code with this program. The name of the program is MODLOC (Modify Location), and is described in Section 6.4.6.

To run the DEC Configurator, the Diagnostic tape must be mounted, at load point and the tape drive must be on-line.

Boot the Diagnostic tape by typing in the appropriate Boot Prompt. (MSO, MS1,..ETC.). Run the DEC Configurator by typing "R CFG121".

When the program comes up it will identify itself with the following message:

```
PLEASE ENTER CONSOLE TYPE:
     A....HARDCOPY TERMINAL.
     B....VT-100 COMPATIBLE TERMINAL.
     C....ANSI TERMINAL.

WHICH TYPE DO YOU HAVE (A, B, C) [DEF: A}? B
```

The Default may be selected by pressing the Carriage Return. [CR]

```
     SPECTRA LOGIC CORPORATION

     111/121 EEPROM CONFIGURATOR

VERSION 2.00 (BO):  02-MAY-85 * 14:50:18

     INITIALIZING.........INITIALIZED!

     ENTER [RETURN] TO CONTINUE
```

The program will ask for CSR Address and then display the main menu.

6.4.2 MENUS

The DEC Configurator functions with the use of menus that are essentially self-explanatory. Each menu displays the options available, along with instructions on how to make a selection. The DEC Configurator main menu is displayed initially and provides access to the other menus. Each menu is described below.

6.4.2.1 DEC CONFIGURATOR MAIN MENU

The DEC Configurator main menu is shown below followed by an explanation of each option.

```
      DEC configurator main menu

  A.) Define new EEPROM.
  B.) Modify current EEPROM.
  C.) Display current EEPROM.
  D.) Access extended options.
  X.) Exit DEC configurator main menu.
  ?.) Re-display DEC configurator main menu.
      Enter option (A-D, X or ?) :
```

Define New EEPROM

The Define New EEPROM option should be selected when the configuration desired is different from the current EEPROM contents. The current contents are the production default values (see section 6.2.2). This option allows the user to configure both the controller and the drive(s) being used. The controller configuration process begins by prompting for a disk drive interrupt vector and drive interrupt vectors for tape drives 0-3. The drive configuration process then begins by prompting for a selection of manufacturer and model number. After the drive has been selected, the program asks if the drive is dual ported, gives the current number of sectors per track with an opportunity Next, the DEC Configurator gives the formatted capacity of the selected drive followed by a list of available DEC drives. After an emulation has been selected, the program will either display a list of drives selectable for the next logical drive, or will inform the user that it is done mapping or expanding the drive. When the configuration is completed, the specific controller/drive information is displayed to show how the controller and drive(s) have been configured. The user is then prompted to save the configuration in the EEPROM.

Modify Current EEPROM

This option allows the user to modify the current contents of the EEPROM. The current contents are either the production default values (see section 6.2.2), or the configuration last defined by the user. When modifying the current EEPROM contents, the program goes through the same sequence as when defining a new EEPROM except that it begins by asking for a physical unit number and a base logical unit number. This is useful when a user wants to add drives to an existing configuration.

Display Current EEPROM

This option either displays the current contents which are the production default values , or the configuration last defined by the user. The information displayed explains how the controller makes the physical drive look to the host system, how the physical drives are mapped, and what drive types have been assigned to a particular logical drive.

Access Extended Options

This option provides several advanced functions. These functions are less often used and require some familiarity with the EEPROM. The functions allow the user to more specifically define the characteristics of the controller and the drive(s) being used.

Exit DEC Configurator Main Menu

This option allows the user to exit from this menu, and from the program itself. As the program progresses, each time an 'X' is entered it takes the program back to the previous menu level.

6.4.3 CONFIGURATION EXAMPLES

When either option 'A' (define new EEPROM), or option 'B' (modify current EEPROM) is selected from the DEC configurator main menu, two emulation methods are available during the drive configuration process. The two emulations are DEC mapping and expanded emulation. This section provides an explanation of each emulation followed by a step by step example of configuring a drive using the selected emulation.

6.4.3.1 DEC MAPPING

DEC mapping is used when one or more standard DEC (logical) drives are to be placed on a physical drive. DEC mapping does not require modifications to software drivers, but it can only be used on drives with the same or greater capacity than the drive being emulated. With this method, the firmware in the controller automatically converts the logical cylinder, head, and sector numbers into physical cylinder, head, and sector numbers. Using DEC mapping, a Fujitsu 2312 could be mapped as an RM02 without making any modifications to the RM02 software driver. DEC mapping may also be used to treat one physical drive as more than one logical drive. For example, a standard 675 megabyte drive with 843 cylinders, 40 heads, and 32 sectors may be treated as two standard RM05s, each with 823 cylinders, 19 heads, and 32 sectors.

DEC MAPPING EXAMPLE

For this example, a Fujitsu 2351 Eagle drive will be mapped as two RM03s and an RM05. The program first configures the SPECTRA 111/121/-PLUS controller by asking the following questions:

Please enter disk drive interrupt vector : (0-376)[Def : 254] :

Please enter number of tape drives in system : (0-4)[Def : 0]:

If you answer "4" to the previous question, the following will be displayed:

Please enter tape interrupt vector for drive 0 : (0-376)[Def : 224] :
Please enter tape interrupt vector for drive 1 : (0-376)[Def : 344] :
Please enter tape interrupt vector for drive 2 : (0-376)[Def : 350] :
Please enter tape interrupt vector for drive 3 : (0-376)[Def : 354] :

Select the default values for the disk drive interrupt vector and drive interrupt vectors for tape drives 0-3. Any default may be selected by pressing the carriage return.

The program then proceeds to drive configuration. The drive configuration process begins by displaying a list of the manufacturers available as follows:

Manufacturers available

A.)AMPEX-1	B.)AMPEX-2	C.)MISCELLANEOUS	D.)CENTURY DATA-1
E.)CENTURY DATA-2	F.)CONTROL DATA-1	G.)CONTROL DATA-2	H.)CONTROL DATA-3
I.)DISK TECH	J.)FUJITSU-1	K.)FUJITSU-2	L.)KENNEDY
M.)PRIAM	N.)TECSTOR		

Please enter manufacturer (A-M, ? or X) :

Select 'J' for a Fujitsu drive. The program then displays the model numbers for Fujitsu drives as shown below. (Model numbers for all supported drives are shown in table 6-2).

A.) 2282	B.) 2283	C.) 2284	D.) 2294
E.) 2311	F.) 2312	G.) 2322	H.) 2351
I.) 2298			

Please enter model (A-I, ? or X) :

DEC MAPPING [continued]

Enter 'H' for a Fujitsu 2351 Eagle and the program responds with:

Drive selected.

Is drive dual ported ? (Yes or No)[Def : No] :
Drive currently has 46 sects/track.
Is this correct for this installation ? (Yes or No)[Def : Yes] :

To determine the correct number of sectors per track for the drive being used, refer to section 6.4.4 (sector selection). The standard application on an Eagle is 46 sectors per track non-interleaved, but may be changed to 48 sectors per track interleaved if necessary. If the current number of sectors per track needs to be changed, answer 'No' to the above question and the program prompts with:

Please enter sects/track : (See manual) : (1-100)[Def : 46] :

The program proceeds with:

Do you want interleaving ? (Yes or No)[Def : No] :

NOTE: If interleaving is selected, a sector look up table (SECMAP) is created with an interleave factor of 2 to 1.

FUJITSU : 2351 mapping to DEC drives.

Current formatted space avail is 396mb
Available DEC drives are currently:

A.) RM02: 67mb B.) RM03: 67mb C.) RM05: 256mb D.) RM80: 128mb
E.) RP04: 87mb F.) RP05: 87mb G.) RP06: 174mb
H.) Expanded emulation

Please enter emulation : (A-H, X or ?) :

Select 'C' (RM05) and the program responds with:
Mapping RM05...256mb

Current formatted space avail is 140mb
Available DEC drives are currently:

A.) RM02: 67mb B.) RM03: 67mb C.) RM80: 128mb D.) RP04: 87mb
E.) RP05: 87mb

Please enter emulation : (A-E, X or ?) :

DEC MAPPING [continued]

As the capacity of the physical drive (in this case a Fujitsu 2351) is used, selection of logical drives is decreased. Therefore, the RM05, RM80, and RP06 drives have been eliminated because the capacity of these drives is larger than the remaining capacity. The user may choose between DEC mapping (which is the available DEC drives), or expanded emulation for any drive configuration, but cannot choose both in one configuration.

At this point, select 'B' (RM03) and the program displays:

Mapping RM03...67mb

Current formatted space avail is 72mb
Available DEC drives are currently:

A.) RM02: 67mb B.) RM03: 67mb

Please enter emulation : (A-B, X or ?) :

Again, select 'B' (RM03) and the program responds with:

Mapping RM03...67mb

Done mapping FUJITSU : 2351

Enter <return> to continue

Do you have another physical drive to configure ? : (Yes or No)[Def : Yes] :

If there is another physical drive to configure, the DEC Configurator displays the manufacturer's list again. If there is not another physical drive to configure, the program displays the controller/drive specific information so that the configuration may be checked before saving it in the EEPROM.

Upon saving the configuration, the program allows the user to change the Controller Status Register (CSR) address. The default address is 176700; the alternate addresses are 176300, 176200, and 176100. If the controller is at an address other than the standard, it must be changed before storing a configuration in the EEPROM so that the DEC Configurator knows the address of the controller. Also, if there is more than one controller being used, the CSR addresses must be defined.

6.4.3.2 EXPANDED EMULATION

Expanded emulation may be utilized when the drive being used has a different capacity than a standard DEC drive. The number of cylinders, heads, and sectors of the logical drive is changed in the software driver so that its drive size parameters are matched exactly to that of the physical drive size. For example, if using an Ampex DM9160 drive, an RM05 software driver could be modified for 1645 cylinders and 5 heads rather than the standard 823 cylinders and 19 heads. Expanded emulation may be utilized whether the target drive has more or less capacity than the drive being emulated; however, if the target drive has less than 67 megabytes (formatted), expanded emulation will be the only option available.

EXPANDED EMULATION EXAMPLE

For example, if using a Fujitsu 2351 Eagle drive and expanded emulation is to be used, the following sequence should be followed. The controller configuration process begins by asking the following questions:

Please enter disk drive interrupt vector : (0-376)[Def : 254] :

Please enter number of tape drives in system : (0-4)[Def : 0] :

Select the default values for the disk drive interrupt vector and no tape drive.

The drive configuration process then begins by displaying a list of the manufacturers available as shown below.

Manufacturers available

A.)AMPEX-1	B.)AMPEX-2	C.)MISCELLANEOUS	D.)CENTURY DATA-1
E.)CENTURY DATA-2	F.)CONTROL DATA-1	G.)CONTROL DATA-2	H.)CONTROL DATA-3
I.)DISK TECH	J.)FUJITSU-1	K.)FUJITSU-2	L.)KENNEDY
M.)PRIAM	N.)TECSTOR		

Please enter manufacturer (A-M, ? or X) :

EXPANDED EMULATION [continued]

Select 'J' for a Fujitsu drive. The program then displays the model numbers for Fujitsu drives as shown below. (Model numbers for all supported drives are shown in table 6-2).

A.) 2282 B.) 2283 C.) 2284 D.) 2294

E.) 2311 F.) 2312 G.) 2322 H.) 2351

I.) 2298

Please enter model (A-I, ? or X) :

Enter 'H' for a Fujitsu 2351 Eagle and the program responds with:

Drive selected.

Is drive dual ported ? (Yes or No)[Def : No] :
Drive currently has 46 sects/track.
Is this correct for this installation ? (Yes or No)[Def : Yes] :

To select the correct number of sectors per track on the drive being used, refer to section 6.4.4 (sector selection). The standard application on an Eagle is 46 sectors per track non-interleaved, but may be changed to 48 sectors per track interleaved if necessary. If the current number of sectors per track needs to be changed, answer 'No' to the above question and the program prompts with:

Please enter sects/track : (See manual) (1-100)[Def : 46] :

The program then asks:

Do you want interleaving ? (Yes or No)[Def : No] :

NOTE: If interleaving is selected, a sector look up table (SECMAP) is created with an interleave factor of 2 to 1.

The DEC configurator then displays the following:

FUJITSU : 2351 mapping to DEC drives.

Current formatted space avail is 396mb
Available DEC drives are currently:

A.) RM02: 67mb B.) RM03: 67mb C.) RM05: 256mb D.) RM80: 128mb
E.) RP04: 87mb F.) RP05: 87mb G.) RP06: 174mb
H.) Expanded emulation

Please enter emulation : (A-H, X or ?) :

EXPANDED EMULATION [continued]

Select 'H' (Expanded emulation) and the program responds with:

Available drive types are:

A.) RM02 B.) RM03 C.) RM05 D.) RM80 E.) RP04 F.) RP05
G.) RP06 H.) RP07

Please select type code for drive identification. (A-H, or ?) :

The type code selected will be reported in RMDT (the RM Drive Type register) and is the drive type to be patched in the software. Expanded emulation allows utilization of the entire capacity of the physical drive by matching its size to the logical drive type. After the drive type has been selected the program responds with:

Done expanding FUJITSU : 2351.
Enter <return> to continue
Do you have another physical drive to configure ? : (Yes or No)[Def : Yes] :

If there is another physical drive to configure, the DEC Configurator displays the manufacturer's list again. If there is not another physical drive to configure, the program displays the controller/drive specific information so that the configuration may be checked before saving it in the EEPROM.

Upon saving the configuration, the program allows the user to change the Controller Status Register (CSR) address. The default address is 176700; the alternate addresses are 176300, 176200, and 176100. If the controller is at an address other than the standard, it must be changed before storing a configuration in the EEPROM so that the DEC Configurator knows the address of the controller. Also, if there is more than one controller being used, the CSR addresses must be defined.

6.4.4 SECTOR SELECTION

Sector selection on the disk drive is dependant on the number of bytes per sector and the transfer rate of the drive. The following guideline should be used when setting the sector switches on the disk drive.

First, calculate the number of bytes per sector and round off to the next lowest integer. If the disk transfer rate is less than or equal to 1.2 MB/sec and the number of bytes per sector is less than 630 bytes, or if the disk transfer rate is greater than 1.2 MB/sec and the number of bytes per sector is less than 640 bytes, subtract 2 bytes from each sector on the drive.

For example, the Fujitsu 2351 Eagle drive has a disk transfer rate of 1.8 MB/sec and 28,160 bytes per track. At 46 sectors per track, this computes to 612.17 or 612 bytes per sector. Since 612 is less than 640 bytes per sector, and since the transfer rate is greater than 1.2 MB/sec, subtract 2 from 612 to obtain 610. Additionally, the Fujitsu manual says to subtract 1 byte from the derived value; therefore, set the jumpers on the drive to 609 bytes per sector. For drives not in the specified guideline, use the initial calculated number of bytes per sector.

NOTE: For drives with transfer rate greater than 2.0MB/sec, add in 8 bytes per sector.

TABLE 6-2
SUPPORTED MANUFACTURERS AND MODEL NUMBERS

MANUFACTURER	MODEL
AMPEX-1	DM940, DM980, DM9160, DM9300, DM9300A, C165, C330, DFR932-R, DFR932-F
AMPEX-2	DFR964-R, DFR964-F, DFR996-R, DFR996-F
MISCELLANEOUS	APS-4835, APS-4865, BASF-6171, BASF-6172, NTEL-8210, NEC-2351
CENTURY DATA-1	T82, T82RM, T302, T302RM, M80, M160, AMS190, AMS380, AMS315, AMS513
CENTURY DATA-2	AMS571, AMS2075-R, AMS2075-F
CONTROL DATA-1	9760, 9762, 9766, 9448-32-R, 9448-32-F, 9448-64-R 9448-64-F, 9448-96-R, 9448-96-F, 9730-12
CONTROL DATA-2	9730-24, 9730-80, 9730-160, 9775, 9455-R, 9455-F, 9764, 9771, 9412, 9710
CONTROL DATA-3	9457-R*, 9457-F*, 9715-160, 9715-340, 9715-500
DISK TECH	3302, 3303, 3304, 3305, 3306, 4160, 4300
FUJITSU	2282,2283,2284,2294,2311,2312,2322,2333,2351,2361,2298
KENNEDY	5300-70, 5380, 53160, 7340, 7380
PRIAM	3350, 6650, 15450, 3450, 7050, 803-21, 806, 807, 808
TECSTOR	160, 3-200, 3-315, 3-330, 3-83, 3-166

* These model numbers may also be used for the Amcodyne Arapahoe.

6.4.5 EXTENDED OPTIONS

The extended options in this section are provided for the more sophisticated user who is familiar with both the EEPROM and the SPECTRA 111/121/-PLUS controller.

The extended options may be accessed from the DEC Configurator main menu. The extended menu is displayed below followed by an explanation of each option.

```
        DEC Configurator Extended Menu

A.) Auto-Configure controller.
B.) Controller/drive configuration.
C.) Display/Print configuration.
D.) Load/Store controller configuration.
E.) Access Miscellaneous functions menu.
X.) Exit DEC Configurator Extended Menu.
?.) Re-Display DEC Configurator Extended Menu.
    Enter option (A-E, X or ?) :
```

AUTO-CONFIGURE CONTROLLER

The Auto-configure option leads the user through a series of questions which assist in configuring both the controller and the drive(s). This configuration process asks additional questions to more specifically define the controller and the drives being used. These questions are as follows:

Please enter words per tape burst.
Please enter disk drive interrupt vector.
Please enter number of tape drives in system.

The Extended Status Read option (available for the Fujitsu 2351, 2311, and 2312 drives only) requires that extended status be enabled on the disk drive or a fault error will occur.

CONTROLLER/DRIVE CONFIGURATION

This option displays a menu that allows the user to separately configure the controller and the drive(s). When the controller configuration option is selected, the program asks a series of questions which define some characteristics of the controller being used. When the drive configuration option is selected, the program asks a series of questions that define the relationship between the logical and the physical drive.

DISPLAY/PRINT CONFIGURATION

This option allows the user to either display on the screen or output to a line printer the output configuration information. If this option is selected initially, the program displays the default configuration values. The information displayed explains how the controller makes the physical drive look to the host system, how the physical drives are mapped, and what drive types have been assigned to a particular logical drive.

When the Display/Print Configuration option is selected from the DEC Configurator extended menu, the following menu is displayed:

```
     Output Configuration
A.)  Output EEPROM Configuration.
B.)  Output Drive list.
C.)  Output DEC drive list.
D.)  Output single drive specifications.
X.)  Exit Output Configuration menu.
?.)  Re-display Output Configuration menu.
     Enter option  (A-D, X or ?) :
```

Display or Print ? (D/P) ?

The output information is either displayed on the screen or optionally dumped to a line printer.

Output EEPROM Configuration

This option displays specific controller and disk configuration information. If a configuration has been defined, it should be reviewed before it is stored in the EEPROM. If a configuration has not been defined, the production default values are displayed.

Output drive list

This option displays the manufacturers, model numbers, and formatted and unformatted capacities of each drive supported by the DEC Configurator.

Output DEC drive list

This option displays specific DEC drive information including drive type and formatted and unformatted capacities.

Output single drive specifications

This option allows the user to select a manufacturer and model number and then proceeds to show the unformatted and formatted capacity of that drive.

LOAD/STORE CONTROLLER CONFIGURATION

This option allows the user to either load configuration values from the EEPROM, or to store the configuration values into the EEPROM after completing a configuration. It also provides some advanced functions which are explained below. When this option is selected from the DEC Configurator extended menu, the program displays the following menu:

```
        Configuration Storage Menu

A.) Load configuration from EEPROM.
B.) Store configuration on EEPROM.
C.) Re-Set to production default values.
D.) Compute and store VRC from EEPROM.
X.) Exit Configuration Storage menu.
?.) Re-display Configuration Storage menu.
```

Load Configuration from EEPROM

This option reads the EEPROM from the selected controller and verifies the Vertical Redundancy Check (VRC).

Store Configuration in EEPROM

This option writes the configured parameters to the EEPROM of the selected controller.

Reset to Production Default Values

This option allows the user to access and utilize the production default values. This is necessary if a configuration has been defined and stored in the EEPROM (thus overwriting the production default values). The default values need not be accessed thereafter.

Compute and Store VRC from EEPROM

This option computes and stores the Vertical Redundancy Check (VRC) from the EEPROM.

ACCESS MISCELLANEOUS FUNCTIONS MENU

When this option is selected from the DEC Configurator Extended menu, the program displays the following menu:

```
          Miscellaneous functions menu

     A.)  Re-initialize program.
     B.)  Modify CSR address.
     X.)  Exit Miscellaneous functions menu.
     ?.)  Re-display Miscellaneous functions menu.
```

Modify EEPROM Location in Buffer

This option allows the user to access a specific location in memory. This is necessary when a modification needs to be made that is not directly prompted by the program. When this option is selected, the program displays:

```
     EEPROM absolute location modification

  All values displayed in octal format. (Base 8)

Which location do you want to modify? (<x> to exit modify) : [Def  0] :
   *Enter offset : [Def : 0] :
Current contents for location 000000 are : 000
    Enter new contents : (<x> to back out to address) : [Def  000] :
```

* Offset = logical unit number.

Re-Initialize Program

This option resets the DEC Configurator program to its initial loading stage.

Modify CSR Address

This option allows the user to change the Controller Status Register (CSR) address. The standard address is 176700; the alternate addresses are 176300, 176200, and 176100. If the controller has a different address than the standard, this option may be used before storing a configuration in the EEPROM so that the DEC configurator knows the address of the controller. If there is more than one controller being used, the CSR addresses must be defined.

USER DEFINED EMULATION

User defined emulation is included for the user who may want to more specifically define the characteristics of the physical and logical drives being used. For this reason, this option should be selected if a more complex configuration is required. User mapping is accessible from the extended options menu when either the "auto-configure" or the "controller/drive" option is selected. This option requires that the user be familiar with the EEPROM (see section 6.2.1) and the SPECTRA 111/121/-PLUS controller.

The following prompts are displayed when user defined emulation is selected.

Do you want head mapping? : (Yes or No)[Def : Yes] :
Do you want cylinder mapping? : (Yes or No)[Def : Yes] :
Please enter logical Sectors/track : (0-255)[Def : X] :
Please enter logical Heads/Cylinder : (0-255)[Def : X] :
Please enter logical Cylinders/drive : (0-32767)[Def : X] :
Please enter Physical Sectors/track : (0-255)[Def : X] :
Please enter Physical Heads/Cylinder : (0-255)[Def : X] :
Please enter Head index : (0-255)[Def : 0] :
Please enter Cylinder index : (0-32767)[Def : 0] :
Do you want logical sector conversion? : (Yes or No)[Def : Yes] :
Do you want read ahead ? : (Yes or No)[Def : No] :
Please enter Disk flags : (0-177777)[Def : X] :
Do you have another logical unit ? : (Yes or No)[Def : Yes] :
Do you want to clear undefined logical units? : (Yes or No)[Def : No]

6.4.6 EEPROM 'MODIFY LOCATION' PROGRAM (MODLOC)

This program enables the user the capability to write and to configure the controller one option at a time.

Operation is as follows:

After booting the diagnostic tape type 'R MODLOC'.

The program will initialize and display the following:

```
          SPECTRA LOGIC CORPORATION

          EEPROM MODIFICATION PROGRAM

          VERSION 1.00 (A0) 02-APR-85 * 10:33:28

          ENTER [RETURN] TO CONTINUE

     DEC CONFIGURATOR MODIFY EEPROM MENU.

          A.) DISPLAY EEPROM CONFIGURATION.
          B.) DISPLAY EEPROM LABELS.
          C.) MODIFY EEPROM LOCATION IN BUFFER.
          D.) LOAD CONFIGURATION FROM EEPROM.
          E.) STORE CONFIGURATION FROM EEPROM.
          X.) EXIT DEC CONFIGURATOR MODIDY EEPROM MENU.
          ?.) RE-DISPLAY DEC CONFIGURATOR MODIFY EEPROM MENU.

               ENTER OPTION (A-E, X OR ?):___
```

Display EEPROM Configuration

This menu selection reads in and verifies the current contents of the EEPROM and displays the current configuration.

Display EEPROM Labels

This selection prints the list of EEPROM labels.

Modify Location in Buffer

This selection is used to modify a location in the EEPROM one byte at a time. The following are displayed:

EEPROM Absolute Location Modification

All values displayed in octal format. (Base 8)

<X> backs up to address or exits modify.

Which location do you want to modify?___

Load Configuration From EEPROM

Select this option to read (load) the contents of the EEPROM into the memory buffer and verify the contents using the VRC.

Store Configuration on EEPROM

This option stores the contents of the Buffer into the EEPROM.

APPENDIX A

TAPE INTERFACE PLUG CONNECTIONS

CONTROLLER CONNECTOR J5

The tape interface is compatible with the Pertec industry standard embedded formatter. This interface consists of two 50 pin connectors with pin assignments and signals defined below.

Live Pin	Ground	Signal Function	Signal Name
2	1	Formatter Busy	FBY
4	3	Last Word	LWD
6	5	Write Data 4	W4
8	7	Initiate Command	GO
10	9	Write Data 0	WO
12	11	Write Data 1	W1
14	13	Reserved	RES
16	15	Reserved	RES
18	17	Reverse	REV
20	19	Rewind	REW
22	21	Write Data Parity	WP
24	23	Write Data 7	W7
26	25	Write Data 3	W3
28	27	Write Data 6	W6
30	29	Write Data 2	W2
32	31	Write Data 5	W5
34	33	Write	WRT
*36	35	Gap Size	FLGAP
38	37	Edit	EDIT
40	39	Erase	ERASE
42	41	Write Filemark	WFM
44	43	Reserved	RES
46	45	Transport Address 0	TADO
48	47	Read Data 2	R2
50	49	Read Data 3	R3

* Used on CDC Keystone drives to select long/short inter-record gap size.

TAPE INTERFACE PLUG CONNECTIONS

CONTROLLER CONNECTOR J6

Live Pin	Ground	Signal Function	Signal Name
1	-	Read Data Parity	RP
2	-	Read Data 0	R0
3	-	Read Data 1	R1
4	-	Load Point	LDP
6	5	Read Data 4	R4
8	7	Read Data 7	R7
10	9	Read Data 6	R6
12	11	Hard Error	HER
14	13	Filemark	FMK
16	15	Identification 1	CCG
18	17	Formatter Enable	FEN
20	19	Read Data 5	R5
22	21	End Of Tape	EOT
24	23	Rewind/Unload	OFL
26	25	Reserved	RES
28	27	Ready	RDY
30	29	Rewinding	RWD
32	31	File Protect	FPT
34	33	Read Strobe	RSTR
36	35	Write Strobe	WSTR
38	37	Data Busy	DBY
40	39	Hi Speed Select Monitor	SPEED
42	41	Corrected Error	CER
44	43	On Line	ONL
46	45	Transport Address 1	TAD1
48	47	Formatter Address	FAD
50	49	High Speed Select	HISP

DISK INTERFACE PLUG CONNECTIONS

The disk interface is industry standard SMD compatible allowing attachment of up to four drives. The SPECTRA 121-PLUS provides an SMD compatible flat cable connector set with pin assignment and signals defined below.

"B" CABLE

J1, J2, J7, J8 CONNECTORS	CDC PIN #		SLC PIN #	
Signal	LO	HI	-	+
Write Data	8	20	15	14
Ground	7		13	
Write Clock	6	19	11	12
Ground	18		10	
Servo Clock	2	14	3	2
Ground	1		1	
Read Data	3	16	5	6
Ground	15		4	
Read Clock	5	17	9	8
Ground	4		7	
N/C	10	23	19	20
Unit Selected	22	9	18	17
Ground	21		16	
Reserved for Index	12	24	23	22
Ground	11		21	
Reserved for Sector	13	26	25	26
Ground	25		24	

NOTE: The 26 conductor shielded flat cable has a maximum length of 50 feet.

DISK INTERFACE PLUG CONNECTIONS

"A" CABLE

J3 CONNECTOR	CDC PIN #		SLC PIN #	
Signal	LO	HI	-	+
Unit Select Tag	22	52	43	44
Unit Select 2(0)	23	54	45	46
Unit Select 2(1)	24	54	47	48
Unit Select 2(2)	26	56	51	52
Unit Select 2(3)	27	57	53	54
Tag 1 *2	1	31	1	2
Tag 2 *2	2	32	3	4
Tag 3 *2	3	33	5	6
Bit 0 *2	4	34	7	8
Bit 1 *2	5	35	9	10
Bit 2 *2	6	36	11	12
Bit 3 *2	7	37	13	14
Bit 4 *2	8	38	15	16
Bit 5 *2	9	39	17	18
Bit 6 *2	10	40	19	20
Bit 7 *2	11	41	21	22
Bit 8 *2	12	42	23	24
Bit 9 *2	13	43	25	26

*2 Gated by Unit Selected

DISK INTERFACE PLUG CONNECTIONS

"A" CABLE

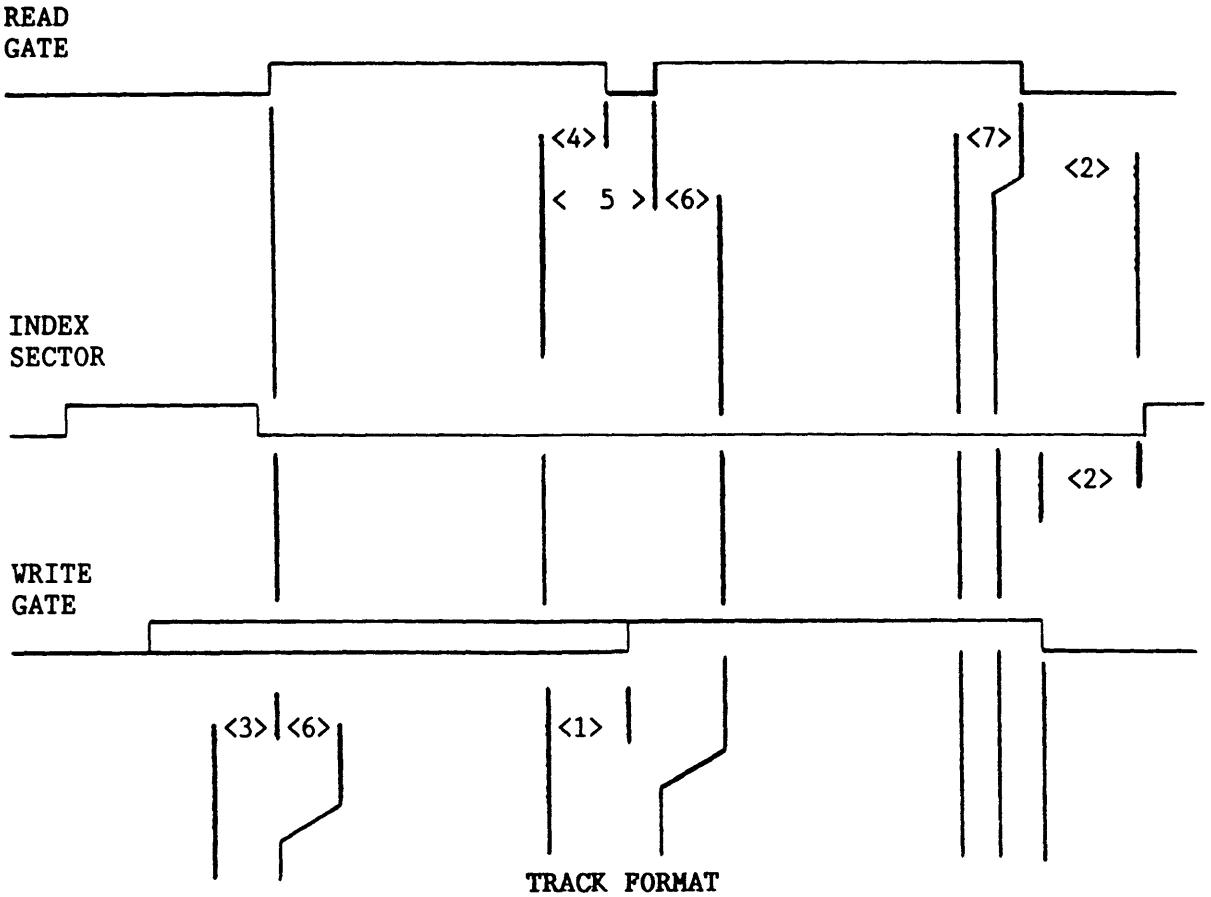
J3 CONNECTOR		CDC PIN #		SLC PIN #	
Signal		LO	HI	-	+
Open Cable Detector		14	44	27	28
Index	*2	18	48	35	36
Sector	*2	25	55	49	50
Fault	*2	15	45	29	30
Seek Error	*2	16	46	31	32
On Cylinder	*2	17	47	33	34
Unit Ready	*2	19	49	37	38
Address Mark	*2	20	50	39	40
Write Protect	*2	28	58	55	56
Power Sequence Pick			29		57
Power Sequence Hold			59		58
Busy	*2,*1	21	51	41	42
Bit 10	*2,*3	30	60	59	60

*1 Dual Port Unit only
*2 Gated by Unit Selected
*3 Bit 10 used for cylinder 1024

UNIBUS SPC BACKPLANE CONNECTIONS

COLUMN ------>	A		B		C		D		E		F	
SIDE ------>	1	2	1	2	1	2	1	2	1	2	1	2
PIN A		+5V		+5V	NPG IN	+5V		+5V		+5V		+5V
PIN B					NPG OUT	-15V						
PIN C		GND		GND	PA L	GND		GND	A12 L	GND		GND
PIN D						D15 L		BR7 L	A17 L	A15 L	BBSY L	
PIN E						D14 L		BR6 L	MSYN L	A16 L		
PIN F						D13 L		BR5 L	A02 L	C1 L		
PIN H					D11 L	D12 L		BR4 L	A01 L	A00 L		
PIN J						D10 L			SSYN L	C0 L	NPR L	
PIN K						D09 L		BG7 IN	A14 L	A13 L		
PIN L						D08 L	INIT L	BG7 OUT	A11 L			
PIN M						D07 L		BG6 IN			INTR L	
PIN N					DCLO L	D04 L		BG6 OUT		A08 L		
PIN P						D05 L		BG5 IN	A10 L	A07 L		
PIN R						D01 L		BG5 OUT	A09 L			
PIN S					PB L	D00 L		BG4 IN				
PIN T	GND		GND		GND	D03 L	GND	BG4 OUT	GND		GND	SACK L
PIN U						D02 L			A06 L	A04 L		
PIN V					ACLO L	D06 L			A05 L	A03 L		

NOTE: Side 1 is the component side of the board.



TRACK FORMAT

A	B	C	D	E	F	G	H	I	J	K
		SECTOR GAP	SYNC	HDR	CRC	HDR GAP	SYNC	DATA FIELD	ECC	ZERO
		21/27	1	4	2	19/29/37	1	512	4	2/4

NOTE

All fields except "A" and "B" are derived from Servo or Read Clock values shown are expressed in bytes.

(A) INDEX / SECTOR TO WRITE GATE

	STANDARD 121
RPS ENABLED	1575 N.S.MAX-975 N.S.MIN
INDEX/SECTOR MARKS	2475 N.S.MAX-1875 N.S.MIN

	121-PLUS
RPS ENABLE	1470 N.S.MAX-910 N.S.MIN
INDEX/SECTOR MARKS	2310 N.S.MAX-1750 N.S.MIN

(B) WRITE GATE TO START OF WORD COUNTER

300 N.S.-STANDARD 121------280 N.S.-121-PLUS

(C) SECTOR GAP

21 BYTES ZERO'S FOR "DKFLGH" BIT 3 = 0
27 BYTES ZERO'S FOR "DKFLGH" BIT 3 = 1 (HEAD SKEWING REQUIRED)

(D) SYNC BYTE 1 BYTE (19H)

(E) HEADER FIELD

(1 WORD CYLINDER ADDRESS, 1 WORD SECTOR/TRACK ADDRESS)(4 BYTES TOTAL)

CYLINDER WORD FORMAT

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MF	UF	SSE	FMT	0	CYL 1024	CYL 512	CYL 256	CYL 128	CYL 64	CYL 32	CYL 16	CYL 8	CYL 4	CYL 2	CYL 1

BITS 0 TO 10 CYL DRIVE CYLINDER ADDRESS

BIT 11 0 UNUSED

BIT 12 FMT FORMAT 16 BIT (MUST BE SET DURING FORMAT)
(18 BIT FORMAT NOT SUPPORTED)

BIT 13 SSE SKIP SECTOR ERROR FLAG
MUST BE 0 IF "DKFLGH" BIT 6 = 0 (RM80 EMULATION)
IF SET AND "DKFLGH" BIT 6 = 1; THIS SECTOR IS BAD
SKIP THIS SECTOR

BIT 14 UF USER BAD SECTOR FLAG
(0 = BAD SECTOR 1 = GOOD SECTOR)

BIT 15 MF MANUFACTURERS BAD SECTOR FLAG
(0 = BAD SECTOR 1 = GOOD SECTOR)
NOTE: BIT 13,14, AND 15 ARE NOT USED FOR RP EMULATION.

SECTOR / TRACK WORD FORMAT

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TA	TA	TA	TA	TA	TA	TA	TA	SA	SA	SA	SA	SA	SA	SA	SA
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1

BITS 0 THRU 7 SA SECTOR ADDRESS

BITS 8 THRU 15 TA TRACK ADDRESS

(F) CYCLIC REDUNDANCY CHECK WORD (CRC) (2 BYTES)

1 WORD CHECK CODE COMPUTED ON HEADER FIELD "(E)"
(CRC POLYNOMIAL X16 + X15 + X2 + X1)

(G) HEADER GAP

STANDARD 121
19 BYTES ZERO'S FOR "DKFLGL" BIT 4 = 0
29 BYTES ZERO'S FOR "DKFLGL" BIT 4 = 1 (HIGH SPEED DRIVE)*

121-PLUS
19 BYTES FOR "DKFLGL" BIT 4 = 0
29 BYTES FOR "DKFLGL" BIT 4 = 1
37 BYTES FOR "DKFLGL" BIT 4 = 1 AND "PHYUNT" BIT 7 = 1. (VERY HIGH SPEED DRIVE).**

(H) SYNC BYTE 1 BYTE (19H)

(I) DATA FIELD 256 WORDS (512 BYTES) DATA

(J) ERROR CHECK CODE (ECC)

4 BYTES CHECK CODE COMPUTED ON DATA FIELD "(I)"
AND ECC FIELD "(J)"
(ECC POLYNOMIAL X31 + X22 + X20 + X10 + X2 + X1)

(K) DATA GAP

2 BYTES ZERO'S FOR "DKFLGL" BIT 4 = 0
4 BYTES ZERO'S FOR "DKFLGL" BIT 4 = 1 (HIGH SPEED DRIVE)*

*Between 1.2 MB/s and 2.0 MB/s.

**Greater than 2.0 MB/s.

STANDARD 121
(1)HEADER CRC END TO WRITE SPLICE--1500 N.S.MIN-2 BYTES MAX

121-PLUS
1400 N.S.MIN-2 BYTES MAX

(2)INTER-SECTOR OVERHEAD----13 U.S. MIN READ
10 U.S. MIN WRITE

THIS PARAMETER SPECIFIES THE MINIMUM TIME REQUIRED AT THE END OF A SECTOR TO GUARANTEE CONSECUTIVE SECTOR TRANSFER OPERATIONS; IE: NO EXTRA REVOLUTIONS BETWEEN SECTORS.

(3) SECTOR GAP TO READ GATE ACTIVE

4 BYTES FOR "DKFLGH" BIT 2 = 0
8 BYTES FOR "DKFLGH" BIT 2 = 1 (HEAD SKEWING REQUIRED)

(4) HEADER CRC END TO READ GATE INACTIVE 600 N.S. MAX-STANDARD 121
560 N.S. MAX-121-PLUS

(5) HEADER GAP START TO READ GATE ACTIVE

4 BYTES FOR "DKFLGH" BIT 1 = 1 (EAGLE BIT DRIVE)
4 BYTES FOR "DKFLGL" BIT 4 = 0 (NOT HIGH SPEED DRIVE)
6 BYTES FOR "DKFLGH" BIT 1 = 0
AND "DKFLGL" BIT 4 = 1

(6) PHASE LOCK STABILIZATION (SWITCH TO READ CLOCK & ARM SYNC)
6 BYTES-STANDARD 121--------14 BYTES-121-PLUS

(7) ECC FIELD END TO READ GATE INACTIVE 600 N.S. MAX-STANDARD 121
560 N.S. MAX-121-PLUS

NOTE: The following values are MINIMUM bytes/sector required for Fixed Media. For Removable Media, add 6 bytes to the values given.

TRANSFER RATE	CONTIGUOUS	INTERLEAVED
1.2 MB/S	585 BYTES/SECTOR	569 BYTES/SECTOR
1.8 MB/S	607 BYTES/SECTOR	583 BYTES/SECTOR
2.5 MB/S	625 BYTES/SECTOR	593 BYTES/SECTOR

APPENDIX B

FORMATTING DISK DRIVES

This section is provided to help you format your drives. The SLED software will be used to initialize the bad sector map of the drive. You must do this due to the fact that all DEC formatters with the exception of RM80 formatter (ZRNJ), expect that the bad sector map has been initialized at the factory and will fail if this information is not present.

FORMATTING AN RM02/03

Using SLED

The SLED parameters used are as follows:

$D	This is your CSR address,	(CSR=176700	$D=0)
		(CSR=176600	$D=1)
		(CSR=176300	$D=2)

$U This is your logical drive number, (0 through 7)

$T This is the number of sectors per track in octal.
$X This is the number of sectors per cylinder in octal.
$Q This is the number of cylinders in octal.

;Z This is to format the pack.
;Q This is to initialize the last track.

It will be assumed that the CSR address is set to 176700 and that we are formatting logical unit 4.

```
.RUN SLED

*$D/00001       0         <CR>
*$U/00000       4         <CR>
*$T/40          40        <CR>
*$X/240         240       <CR>
*$Q/1467        1467      <CR>
*;Z                       <CR>
WAIT TILL YOU GET THE SLED PROMPT '*'
*;Q
```

NOTE: No changes are made to $T, $X, and $Q since SLED defaults to 40, 240, and 1467 repectively.

Using DEC Formatter ZRMA??

Upon completion of SLED, you can use DEC Formatter 'ZRMA' to format your RM02/03. To do this follow these steps.

```
.RUN ZRMA??

CZRMACO
RM02/03 FORMATTER

PROGRAM NEEDS 20K MEMORY

UNIT STATUS:

0 NOT AN RM02/RM03
1 NOT AN RM02/RM03
2 ONLINE RM02
3 ONLINE RM02
4 ONLINE RM02
5 NOT PRESENT
6 NOT PRESENT
7 NOT PRESENT

PROGRAM MODE (C OR F):                          <CR>
FORMAT AND VERIFY

OPERATE IN 32 SECTOR MODE (Y OR N)              <CR>
OPERATION WILL BE IN 32 SECTOR (16 BIT MODE)

DRIVE:                              4           <CR>

ENTER ADDRESS LIMITS:
START CYL       0/                              <CR>
START TRACK     0/                              <CR>
END CYL         822/                            <CR>
END TRACK       4/                              <CR>

SELECT DATA PATTERN (BY ENTERING 0, 1, OR 2)
     (0) ZERO'S
     (1) ONE'S
     (2) WORST CASE:                            <CR>
WORST CASE
```

Starting Format On Drive 4

Logical drive 4 is now being formatted. Upon completion, the following message will be displayed.

```
FORMAT COMPLETE, TOTAL ERRORS DETECTED: 0
(Assuming there are no bad sectors).

DRIVE:
```

NOTE: Redo all procedures if you have more than one RM02/03. Otherwise halt the processor and re-boot the system.

FORMATTING AN RM05

USING SLED

The SLED parameters used are as follows:

$D	This is your CSR address,	(CSR=176700	$D=0)
		(CSR=176600	$D=1)
		(CSR=176300	$D=2)

$U	This is your logical drive number, (0 through 7)
$T	This is the number of sectors per track in octal.
$X	This is the number of sectors per cylinders in octal.
$Q	This is the number of cylinders in octal.
;Z	This is to format the pack.
;Q	This is to initialize the last pack.

It will be assumed that the CSR address is set to 176700 and that we are formatting logical unit 4.

```
.RUN SLED

*$D/00001                    0        <CR>
*$U/00000                    4        <CR>
*$T/40                       40       <CR>
*$X/240                      1140     <CR>
*$Q/1467                     1467     <CR>
*;Z                                   <CR>
Wait Till You Get The SLED prompt '*'
*;Q                                   <CR>
```

NOTE: No changes are made to $T and $Q sinceSLED defaults to 40 and 1467 respectively.

Using DEC Formatter ZRML??

Upon completion of SLED, you can use DEC Formatter 'ZRML' to format your RM05. To do this, follow these steps.

```
.RUN ZRML??

ZRMLB1.BIC
CZRMLB0-RM05/3/2 FORMATTER

RMCS1=176700                          <CR>
RMVEC=000254                          <CR>
```

Using DEC Formatter ZRML?? (cont.)

```
UNIT STATUS:

0    LOAD DEVICE
1    ONLINE RM02
2    NOT AN RM05/3/2
3    NOT AN RM05/3/2
4    ONLINE RM05
5    NOT PRESENT
6    NOT PRESENT
7    NOT PRESENT

DO YOU WANT TO FORMAT (L) Y ?           <CR>
DO YOU WANT 16. BIT FORMAT (L) Y ?      <CR>

DRIVE:                        4         <CR>

CHANGE DRIVE PARAMETERS    (L) N ?      <CR>

FORMAT & HEADER VERIFY, OPERATE IN 16.BIT MODE.

DRIVE 4, PACK S/N: 240

STARTING TO FORMAT

STARTING QUICK HEADER VERIFY

COMPLETED
********************
```

NOTE: The test has now been completed. You'll be asked for more drives. If you have none, then halt the processor, and re-boot. If you have more RM05's, repeat the entire procedure.

FORMATTING AN RM80

Using DEC Formatter ZRNJ??

There is no need to run SLED, since ZRNJ does initialize the bad sector map. It is assumed that logical drive 4 is being formatted.

```
.RUN ZRNJ??
ZRNJA0.BIN
CZRNJA0 RM80 FORMATTER UTILITY

DRIVE:                          4           <CR>
OPTIONS:                        IN          <CR>

DATA WILL BE LOST ON DR4:
CONTINUE (L) N?                 Y           <CR>

ENTER DATE (DD-MMM-YY):         01-JAN-85 <CR>
HDA SERIAL NUMBER:              1           <CR>

BAD SECTOR FILES WILL BE OVERWRITTEN ON DR4:
CONTINUE (L) N?                 Y           <CR>

DRIVE:                          4           <CR>
OPTIONS:                        FO          <CR>

DATA WILL BE LOST ON DR4:
CONTINUE (L) N?                 Y           <CR>

UPDATE MODE (L) N?                          <CR>

START FORMATTING-FE CYLINDERS-
START VERIFICATION
DONE!
```

NOTE: The test has now completed, you'll be asked for more drives. If you have none, then halt the processor, and re-boot. If you have more RM80's repeat the entire procedure.

FORMATTING RP04/05

Using SLED

The SLED parameters used are as follows:

$D	This is your CSR address	(CSR=176700	$D=0)
		(CSR=176700	$D=1)
		(CSR=176300	$D=2)

$U This is your logical drive number, (0 through 7)
$T This is the number of sectors per track in octal.
$X This is the number of sectors per cylinder in octal.
$Q This is the number of cylinders in octal.

;Z This is to format the pack.
;Q This is to initialize the last track.

It will be assumed that the CSR address is set to 176700 and that we are formatting logical unit 4.

```
.RUN SLED

*$D/00001                    0        <CR>
*$U/00000                    4        <CR>
*$T/40                       26       <CR>
*$X/240                      642      <CR>
*$Q/1467                     633      <CR>
*;Z                                   <CR>
Wait till you get the SLED prompt '*'
*;Q
```

Using DEC formatter ZRJB??

Upon completion of SLED, you can use DEC formatter 'ZRJB' to format your RP04/RP05. To do this, follow these steps.

```
.RUN ZRJB??
ZRJBD0.BIC
ZZ-CZRJB-D
RP04/5/6 FORMATTER PROGRAM

UNIT STATUS:

0    ON LINE RP04
1    ON LINE RP04
2    ON LINE RP05
3    ON LINE RP06
4    ON LINE RP04
5    NOT PRESENT
6    NOT PRESENT
7    NOT PRESENT
```

Using DEC formatter ZRJB?? (cont.)

```
PROGRAM MODE (C OR F):                    <CR>
FORMAT & VERIFY

OPERATE IN 22 SECTOR MODE (Y OR N)?       <CR>

OPERATION WILL BE IN 22 SECTOR (16 BIT) MODE

DRIVE:                          4         <CR>

ENTER ADDRESS LIMITS                      <CR>

START CYL       0/                        <CR>
START TRK       0/                        <CR>
END CYL         410/                      <CR>
END TRK         18/                       <CR>

SELECT DATA PATTERN

(0)  ZERO'S
(1)  ONE'S
(2)  WORST CASE:                          <CR>

WORST CASE

STARTING FORMAT ON DRIVE 4
```

NOTE: The test has now started and upon completion you'll be asked for more drives. If you have none, then halt the processor, and re-boot. If you have more RP04/05's, repeat the entire procedure.

FORMATTING RP06

Using SLED

The SLED parameters used are as follows:

$D	This is your CSR address	(CSR=176700	$D=0)
		(CSR=176600	$D=1)
		(CSR=176300	$D=2)

$U This is your logical drive number (0 through 7)
$T This is the number of sectors per track in octal.
$X This is the number of sectors per cylinder in octal.
$Q This is the number of cylinders in octal.

;Z This is to format the pack.
;Q This is to initialize the last track.

It will be assumed that the CSR address is set to 176700 and that we are formatting logical unit 4.

```
.RUN SLED

*$D/00001                    0        <CR>
*$U/00000                    4        <CR>
*$T/40                       26       <CR>
*$X/240                      642      <CR>
*$Q/1467                     1457     <CR>
*;Z                                   <CR>
Wait till you get SLED prompt '*'
*;Q
```

Using DEC Formatter ZRJB??

Upon completion of SLED, you can use DEC Formatter 'ZRJB' to format your RP06. To do this follow these steps.

```
.RUN ZRJB??

ZZ-CZRJBD0
RP04/5/6 FORMATTER PROGRAM

UNIT STATUS:

0    ON LINE RP04
1    ON LINE RP04
2    ON LINE RP05
3    ON LINE RP06
4    ON LINE RP06
5    NOT PRESENT
6    NOT PRESENT
7    NOT PRESENT
```

Using DEC Formatter ZRJB?? (cont.)

```
PROGRAM MODE (C OR F):                    <CR>
FORMAT & VERIFY

OPERATE IN 22 SECTOR MODE (Y OR N)?       <CR>

OPERATION WILL BE IN 22 SECTOR (16 BIT) MODE

DRIVE:                          4         <CR>

ENTER ADDRESS LIMITS                      <CR>

START CYL       0/                        <CR>
START TRK       0/                        <CR>
END CYL         814/                      <CR>
END TRK         18/                       <CR>

SELECT DATA PATTERN

(0)  ZERO'S
(1)  ONE'S
(2)  WORST CASE:                          <CR>

WORST CASE

STARTING FORMAT ON DRIVE 4
```

NOTE: The test has now started and upon completion you'll be asked for more drives. If you have none, then halt the processor, and re-boot. If you have more RP06's, repeat the entire procedure.

HAND BOOT PROCEDURE

RM02/03/05

To hand boot your disk logical unit 0, halt the processor and change the contents of memory addresses 4000 through 4070 according to the table shown below.

MEMORY ADDRESS	CHANGE THE CONTENTS TO
4000	5005
4002	12701
4004	176700
4006	10561
4010	10
4012	12711
4014	21
4016	12761
4020	10000
4022	32
4024	16161
4026	16
4030	16
4032	12761
4034	177000
4036	2
4040	12761
4042	0
4044	4
4046	12711
4050	71
4052	105711
4054	100376
4056	5711
4060	100002
4062	5
4064	746
4066	10500
4070	5007

NOW LOAD MEMORY ADDRESS 4000 AND START.

TS11

To hand boot your tape logical unit 0, halt the processor and change the contents of memory addresses 1000 through 1020 according to the table shown below.

MEMORY ADDRESS	CHANGE THE CONTENTS TO
1000	140001
1002	0
1004	0
1006	1000
1010	140004
1012	1012
1014	0
1016	10003
1020	10702

NOW CHANGE MEMORY ADDRESSES 10000 THROUGH 10074 ACCORDING TO THE FOLLOWING TABLE.

MEMORY ADDRESS	CHANGE THE CONTENTS TO
10000	12701
10002	172520
10004	10102
10006	5721
10010	105711
10012	100376
10014	12712
10016	1010
10020	105711
10022	100376
10024	12712
10026	1000
10030	105711
10032	100376
10034	12712
10036	1000
10040	105711
10042	100376
10044	5000
10046	12704
10050	10074
10052	5007
10054	46523

NOW LOAD MEMORY ADDRESS 10000 AND START.
NOTE: Notice that this is **10000 AND NOT 1000.**

APPENDIX C

SECTOR SWITCH SETTINGS

Some drive manufacturers recommend setting the sector switches to a value that is incompatible with the S111/121 controllers. Sector switch settings are shown for the following drives:

Fujitsu 2312
2322
2351
2333
2361.

FUJITSU 2312, 2322

The Fujitsu 2312 and 2322 should be set for 32 sectors per track by setting the number of bytes per sector to 639. The drive should be set up for hard sectoring (Switch 1 Key 6-OFF). The sector count switches are set as shown below.

	SWITCH 2	SWITCH 3
KEY 1	ON	OFF
KEY 2	ON	OFF
KEY 3	ON	ON
KEY 4	ON	OFF
KEY 5	ON	OFF
KEY 6	ON	OFF
KEY 7	ON	OFF

(1 + 2 + 4 + 8 + 16 + 32 + 64 + 512 = 639 BYTES/SECTOR)

FUJITSU 2351 (EAGLE)

The Fujitsu 2351 drive should be run at 46 sectors per track. The drive should be set for 609 bytes per sector. The switch settings are shown below.

46 SECTORS/TRACK

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

(1 + 32 + 64 + 512 = 609)

The drive may also abe run at 48 Sectors/Track.

48 SECTORS/TRACK

BC7	3-4	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	

(8 + 64 + 512 = 584)

FUJITSU 2333

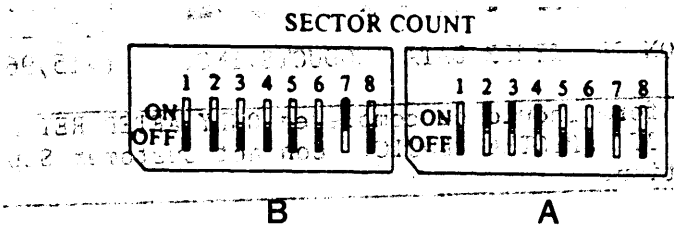
The Fujitsu 2333 should be run at 65 sectors per track. The switch settings are shown below.

	SWITCH 2	SWITCH 3
KEY 1	ON	OFF
KEY 2	OFF	ON
KEY 3	OFF	OFF
KEY 4	ON	OFF
KEY 5	ON	OFF
KEY 6	ON	OFF
KEY 7	OFF	OFF

(512 + 64 + 32 + 16 + 2 = 626 BYTES/SECTOR)

FUJITSU 2361

The Fujitsu 2361 should be run at 65 sectors per track. The switch settings are shown below.



65 SECTORS PER TRACK
(PRODUCTION MODEL; FRONT PANEL SWITCHES)

	SWITCH B	SWITCH A
KEY 1	OFF	OFF
KEY 2	OFF	ON
KEY 3	OFF	ON
KEY 4	OFF	ON
KEY 5	OFF	OFF
KEY 6	OFF	OFF
KEY 7	ON	ON
KEY 8	OFF	OFF

(2 + 16 + 32 + 64 + 512 = 626 BYTES/SECTOR)

NOTE: The production model has the sector switches on the FRONT of the drive, but there are some drives out there that have the switches on the PC board similar to the Standard Eagle. For these older (prototype) units, refer to jumper settings shown below.

65 SECTORS/TRACK

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

(2 + 16 + 32 + 64 + 512 = 626 BYTES/SECTOR)

TAG 4 AND 5:
(DISABLE)

AE7 3-4

RETURN INFORMATION REFERENCE SHEET

A DIVISION OF CIPHER DATA PRODUCTS, INC.

SPECTRA LOGIC
297 NORTH BERNARDO AVE.
P.O. BOX 7260
MOUNTAIN VIEW, CA.
94039-7260
(415)964-2211

IMPORTANT: This form should be completed ONLY AFTER RETURN SHIPMENT HAS BEEN PRE-AUTHORIZED BY SPECTRA LOGIC. Contact Customer Support Department for further information.

MODEL# _____ COMPANY NAME: _____
SERIAL# _____ CONTACT NAME: _____
PHONE#( ) _____

REASON FOR RETURN: DATE _____ CRO# _____

CREDIT
MARKETING DEMO _____
UPDATED ONLY _____ IN WARRANTY _____
REPAIR _____ OUT OF WARRANTY _____

THE REMAINDER OF THIS FORM SHOULD BE COMPLETED ONLY IF REPAIR IS NEEDED.

Did the Controller Work Previously? _____ Or was it DOA? _____

CPU TYPE _____
OPERATING SYSTEM & REV. _____
DISK DRIVE MODEL(S) _____
TAPE DRIVE MODEL(S) _____

Other comments on System Configuration (i.e.-mapping?) _____

Did the board fail during diagnostics? _____
microdiagnostics? _____
or operating system? _____

If diagnostic was run, give diagnostic name and detailed error message, and/or attach hard copy. _____

Other Comments _____