ARRAID

AEM

REPLACEMENT SYSTEM
for
LEGACY DISK DRIVES

USER REFERENCE MANUAL

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REVISION HISTORY

REV	DATE	REFLECTS FIRMWARE	COMMENTS
A	April 4, 1995	VER 1.12	PRELIMINARY RELEASE
B	July 7, 1995	VER 1.16	ADDED NEW COMMANDS, FIRST RELEASE
C	Sept. 29, 1995	VER 1.16	MISC CHANGES AND ADDITIONS
D	Oct. 10, 1995	VER 1.2	MISC CHANGES AND ADDITIONS
E	Oct. 23, 1995	VER 1.2	MISC CHANGES AND ADDITIONS
F	Jan. 16, 1996	VER 1.24	ADDED MIRRORING FEATURE
G	May 20, 1996	VER 1.33	MISC CHANGES AND ADDITIONS
H	June 25, 1996	VER 1.34	MISC CHANGES AND ADDITIONS
I	July 9, 1996	VER 1.34	ADDED COMMAND INDEX TO MANUAL
J	Jan. 12, 1997	VER 2.0	ADDED MULTI-VOLUME SUPPORT FEATURES
K	June 25, 1997	VER 2.01	ADDED NEW FEATURES AND COMMANDS
L	Dec. 31, 1997	VER 2.03 - 2.05	ADDED NEW FEATURES AND COMMANDS
M	Feb. 1, 1998	VER 2.06	ADDED TO CHMOD COMMAND, ADDED XLAT_TBL 4
N	Jul. 17, 1998	VER 2.07-3.00	ADDED XLAT_TBL 5&6, ADDED HISI MPLX INTERFACE
O	Sept. 10, 1998	VER 3.01	ADDED ON-LINE BACKUP FEATURE
P	Jan.12, 1999	VER 4.00	ADDED 256K FLASH SUPPORT AND SELF LEARN CONFIG SUPPORT
Q	Jul. 22,1999	VER 4.08	MISC ADDITIONS
R	May 3,2001	VER 4..16 "C" VER 1.12	EXTENDED MULTI VOLUME and MISC ADDITIONS. INCORPORATE AEM-5 AND "C" MODELS
S	Sept 10, 2001	VER 4..16 "C" VER 1.14	ADDED AEM-6C (HP-MAC interface)
T	Dec 25, 2001	VER 4.16 "C" VER 1.16	Incorporate New Flat Front panel and XLAT-TBL 8
U	Jun 21, 2002	VER 4.20 "C" VER 1.21	Incorporate AEM-7 (HP 7900 Emulation)
V	Sep 23, 2002	VER 4.21 "C" VER 1.22	Incorporate XLAT_TBL=9

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This manual revision describes the operation and support for products with the corresponding firmware revision. Certain features and operations may not function as described for older firmware versions. Please contact your ***ARRAID*** *distributor for the latest AEM firmware.*

● PLEASE NOTICE ●

This document, specifications, and description are subject to change without notice. Please consult your ***ARRAID*** *agent for the latest Product description and specifications.*

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Product Warranty Caution

The AEM Disk Drive Module is warranted to be free from defects in materials, parts, and workmanship and will conform to the current product specification upon delivery. For the specific details of your warranty, refer to your sales contract or contact the company from which the AEM was purchased.

The warranty for the AEM shall not apply to failures of any unit when:

- The AEM is physically abused or is used in a manner that is inconsistent with the operating instructions or product specification defined by the Manufacturer.
- The AEM fails because of accident, misuse, abuse, neglect, mishandling, misapplication, alteration, faulty installation, modification, or service by anyone other than the factory service center or its approved agent.
- The AEM is repaired by anyone, including an approved agent, in a manner that is contrary to the maintenance or installation instructions supplied by the Manufacturer.
- The Manufacturer's serial number tag is removed.
- The AEM is damaged because of improper packaging on return.

> ***CAUTION***
>
> *Returning the AEM in unauthorized packaging may damage the unit and void the warranty.*
>
> *If you are returning the AEM for repair, package it in its original packaging (or in replacement packaging obtained from your vendor).*

Please ensure the warranty registration coupon attached to the AEM has been completed and returned to ARRAID, Inc. promptly after receipt of the system. This will provide information ARRAID necessary for technical support personnel to properly handle any technical support or warranty issues regarding your system.

If problems with the AEM occur, contact your maintenance organization; do not void the product warranty by allowing untrained or unauthorized personnel to attempt repairs.

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EMC
DECLARATION OF CONFORMITY

Application of Council Directive:	89/336/EEC
Manufacturer's Name:	ARRAID, Inc.
Manufacturer's Address:	21430 N. 2nd Avenue, Suite 2 Phoenix, AZ 85027 USA
European Representative's Name:	Reactive Computer Services, Ltd.
European Representative's Address:	The Granary, Hose Hill, Sulhamstead Berkshire RG7 4BB, England
Model Name:	AEM
Conformance to Directive[s]/Standard[s]:	EN 55022, class A EN 50082-1. referencing IEC 801-2:1984, class 3 IEC 801-3:1984, class 2 IEC 801-4:1988, class 2
Equipment Type/Environment:	ITE / Commercial, Light Industrial
Note:	Test Certificate H/EMC 96000129, dated 18-Mar-96. Issued by the NAMAS Accredited Hursley EMC Lab. IBM UK Ltd, Hursley Park, Winchester, England
Beginning Serial Number:	96020242
Year of manufacture:	1996

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FIGURES AND ILLUSTRATIONS

1 INTRODUCTION

This document describes the specifications, installation, and operation of the ARRAID AEM Disk Drive Emulation system and its available options and configurations.

1.1 RELATED PUBLICATIONS

- CDC Spec 64712402 - SMD specification
- CDC Spec 64709300 - CDC Engineering; Product Specification for the Flat-cable Interface Storage Module Drive Family
- CDC Spec 64710800 - CDC Engineering; Product Specification for the 75Pin Multiplexed interface Storage Module Drive Family (HISI)

1.2 REGULATORY AND SAFETY AGENCY STANDARDS

- Std. UL 478 - Electronic Data Processing Units and Systems (60 Hz units)
- Std. CSA C22.2 - Canadian Standards Association, C22.2 No. 154-1975
- FCC Rules, Part 15, Sub part J Class B, Computing Devices
- CSA Radio Act ROR/88-475;3862 01 Data Processing Equipment, Class B
- VDE 08.71/6.78, Vfg 523/1969 and Vfg 1046/1984 Class B
- EN 55022, class A EN 50082-1. referencing
  IEC 801-2:1984, class 3
  IEC 801-3:1984, class 2
  IEC 801-4:1988, class 2

1.3 OTHER TEST STANDARDS

When shipped, the AEM is packaged in a manner that complies with the testing criteria defined by the National Safe Transit Association (NSTA) Project 1.

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2 ABOUT THE AEM

The ARRAID Emulation Module for SMD, HISI, or Pertec/Diablo disk drive system replacement is a family of products that is designed to be plug compatible with existing Legacy drives. The AEM-1 SMD drive system offers users of older equipment the opportunity to upgrade their disk peripherals with the latest SCSI disk drive technology. The AEM-3 Multiplexed interface (HISI) drive system may be used to replace the HISI versions of the older drives. The AEM-5 is used to replace various Pertec/Diablo/DEC RK-05 types of drives.

2.1 FEATURES

Standard features of the AEM system are:

- **USES STANDARD SCSI DRIVES**

  No hardware or software changes required to use the latest SCSI drives on your existing SMD, SMD-E, HISI, or Pertec/Diablo controller.

- **PLUG COMPATIBLE WITH SMD, SMD-E, HISI, or PERTEC/DIABLO INTERFACED DRIVES**

  The AEM-1 replaces many popular disk drives using the industry standard SMD or SMD-E interface. Versions are available to replace drives made by Control Data Corp., Fujitsu, Century Data, Ampex, Priam, Data General, Memorex, Pertec, Wang, and many others. Dual access porting and daisy chaining are fully implemented. Merely unplug the existing drive and install the AEM-1 using the same cables.

  The AEM-3 replaces many popular disk drives using the standard 75 or 60 pin Multiplexed interface. This interface is often referred to as the HISI interface.

  The AEM-5 replaces various Pertec/Diablo or DEC drives.

- **MANY CONFIGURATIONS AVAILABLE**

  The AEM-1, AEM-3, and AEM-5 are available in many configurations. Any SMD, HISI, or Pertec/Diablo disk drive can be replaced with a comparable capacity SCSI drive. Table top, rack mounted, and custom configurations are available. For a complete list of compatible drives please contact ARRAID marketing.

- **CACHE BUFFERING FOR FAST ACCESS TO DATA**

  Up to 64M Bytes of data caching (1024 track buffers) provides significantly reduced access times to frequently accessed data. The cache is managed using a "Least Recently Used Track" scheme. "C" models are 100% cached.

- **MAINTENANCE FREE**

  The AEM Systems use the latest SCSI technology disk drives for zero maintenance operation. Drives are rated in excess of 200,000 hours MTBF and are guaranteed for up to five years of continuous operation.

- **REDUCED POWER AND COOLING**

  The AEM Systems use significantly less power and cooling than the older drives they replace (up to 95% less). Floor space requirements can be reduced up to 95% using the AEM-1 or AEM-3 in place of older SMD type drives.

- **EASE OF USE**

  The operator controls and indicators are compatible with the older disk drives making the AEM easy to use. Operators familiar with existing drives will already know how to use the AEM.

- **FIRMWARE CONFIGURABLE**

Drive Emulation parameters may be changed via a serial interface port. Parameters such as the number of cylinders, number of heads, track length, sector size, and other parameters are easily configurable by the user or maintenance personnel. Firmware upgrades may be made through the serial interface from an ordinary PC with a floppy disk or modem interface.

- **MICROPROCESSOR CONTROLLED**

The AEM uses a combination of microprocessor control and Field Programmable Logic circuits for optimum performance and flexibility at the lowest price possible for sophisticated system design.

- **OTHER FEATURES INCLUDE:**

_ User configuration tables for up to 16 different drive types,
_ Emulation for drives with up to 64 heads and 2048 cylinders,
_ Emulation for drives with up to 32768 bytes per track,
_ Multiple Emulation volumes on one SCSI drive,
_ Available in table top or rack mountable packaging configurations
_ Fixed or removable drive and removable media configurations.
_ Off line SCSI drive preparation and security erase.

2.2 OPTIONAL FEATURES

Optional features include:

_ Emulation for drives with up to 32 heads and 4096 cylinders,
_ Emulation of drives up to 65536 bytes per track,
_ Up to 64M Bytes of data caching (1024 track buffers),
_ Dual Port SMD interface,
_ High speed, Off-line disk copy,
_ Off-line Disk to QIC tape or DAT tape backup and restore,
_ On-line RAID-1 Disk mirroring.
_ Magneto-Optical disk drive backup.
_ Multiple AEMs sharing one SCSI drive,
_ Front panel Emulation volume selection,
_ Central file server support,

2.3 MODELS

AEM systems are available in table top versions, 19" RETMA rack mountable configurations, and other form factors similar to the drives being replaced.

Some configurations can be packaged as a single drive replacement or a dual drive replacement. The dual versions are completely separate systems packaged in one chassis and powered by a common power supply. Each half of a dual unit can emulate a different drive and may be connected to entirely different systems or controllers.

The basic AEM-1 is available in three models; "A" models will emulate drives with up to 32767 bytes per track, "B" models will emulate drives with up to 65535 bytes per track, and "C" models hold the complete drive emulation in solid-state memory. The AEM-3 is available only as an "A" model. The AEM-5 emulates the Pertec / Diablo interface drives and is available only in a "C" model. Table 1 lists some of the basic AEM models:

"A" MODELS	"B" MODELS	"C" MODELS	DESCRIPTION
AEM-1A/RMF	AEM-1B/RMF	AEM-1C/RMF	Single SMD emulator with non-removable drive in a 19 " rack mountable chassis
AEM-1A/RMDF	AEM-1B/RMDF	AEM-1C/RMDF	Dual SMD emulator with non-removable drives in a 19 "rack mountable chassis
AEM-1A/RMR	AEM-1B/RMR	AEM-1C/RMR	Single SMD emulator with removable drives in a 19 "rack mountable chassis
AEM-1A/RMDR	AEM-1B/RMDR	AEM-1C/RMDR	Dual SMD emulator with removable drives in a 19 "rack mountable chassis (Discontinued in 1999)
AEM-1A/RSD	AEM-1B/RSD	AEM-1C/RSD	Single SMD emulator with removable drives in a CDC FSD or RSD form Factor
EID-1A	EID-1B	EID-1C	Single SMD emulator in an eight inch form factor ie. Sabre
AEM-1A/TTR	AEM-1B/TTR	AEM-1C/TTR	Single SMD emulator with removable drives in a table top "tower" cabinet (Discontinued in 1999)
AEM-1A/TTDR	AEM-1B/TTDR	AEM-1C/TTDR	Dual SMD emulator with removable drives in a table top "tower" cabinet (Discontinued in 1999)
AEM-3A/TTR	N/A	N/A	Single HISI emulator with removable drives in a table top "tower" cabinet
AEM-3A/RMR	N/A	N/A	Single HISI emulator with removable drives in a 19 "rack mountable chassis
N/A	N/A	AEM-5C/RMR	Pertec/Diablo emulator with removable drives in a 19" rack mountable chassis
N/A	N/A	AEM-6C/RMR	Hewlett Packard MAC interface Drive emulator with removable drives in a 19" rack mountable chassis
N/A	N/A	AEM-7C/RMR	Hewlett Packard 7900 Drive emulator with removable drives in a 19" rack mountable chassis
Other models are available, please contact ***ARRAID, Inc.*** for more information.			

Table 1 AEM MODELS

Dual models are powered by a single power supply and are controlled by a single power switch. Applications requiring 100% redundancy should consider the fact that both systems must be powered on or off simultaneously.

2.4 OPTIONS

Many options are available for the AEM. For example: Dual Port SMD interface (AEM-1 only), up to 64M Bytes of data caching (1024 track buffers), off-line disk copy, off-line Disk to QIC tape or DAT tape backup and restore, on-line RAID-1 Disk mirroring, Multi-volume support, Magneto Optical SCSI drives, Various Interface Connector Options, and many others. Please contact ARRAID for a current list of options.

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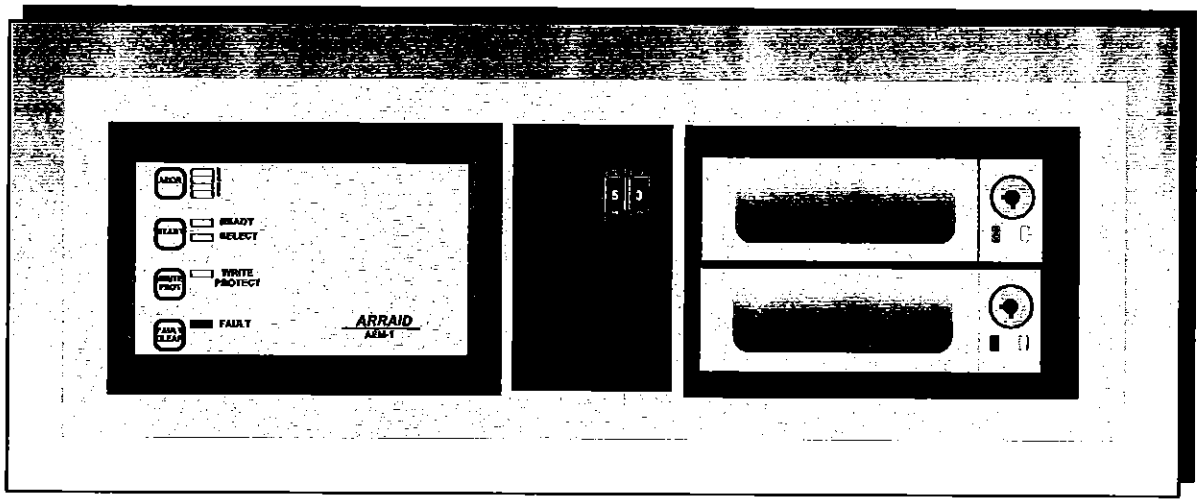

Figure 1 AEM-5C/RMR with Multi Volume and Backup Drive Options

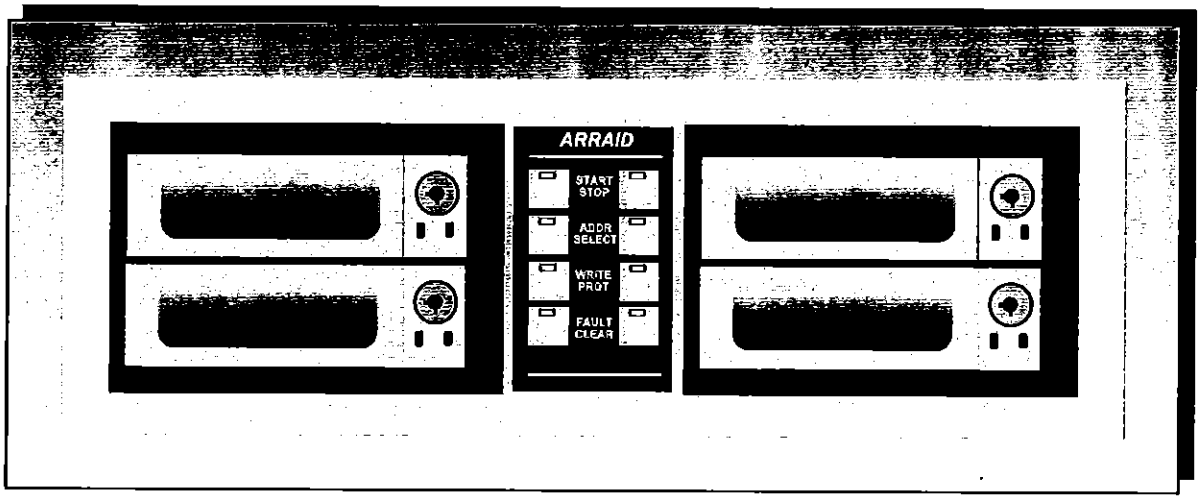

Figure 2 AEM-1A/RMDR with Mirrored Drive Options

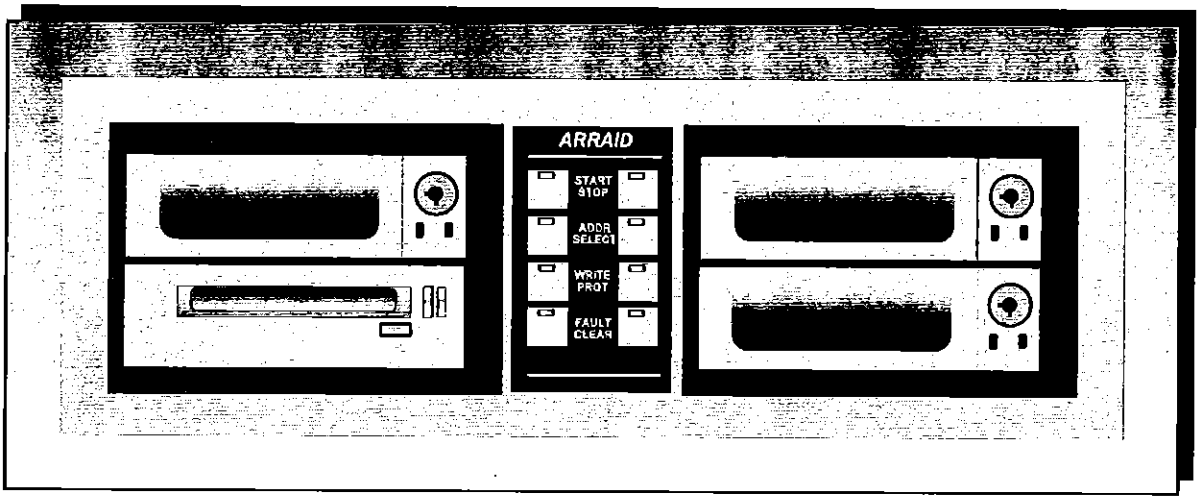

Figure 3 AEM-1A/RMDR with Backup Drive and Tape Options

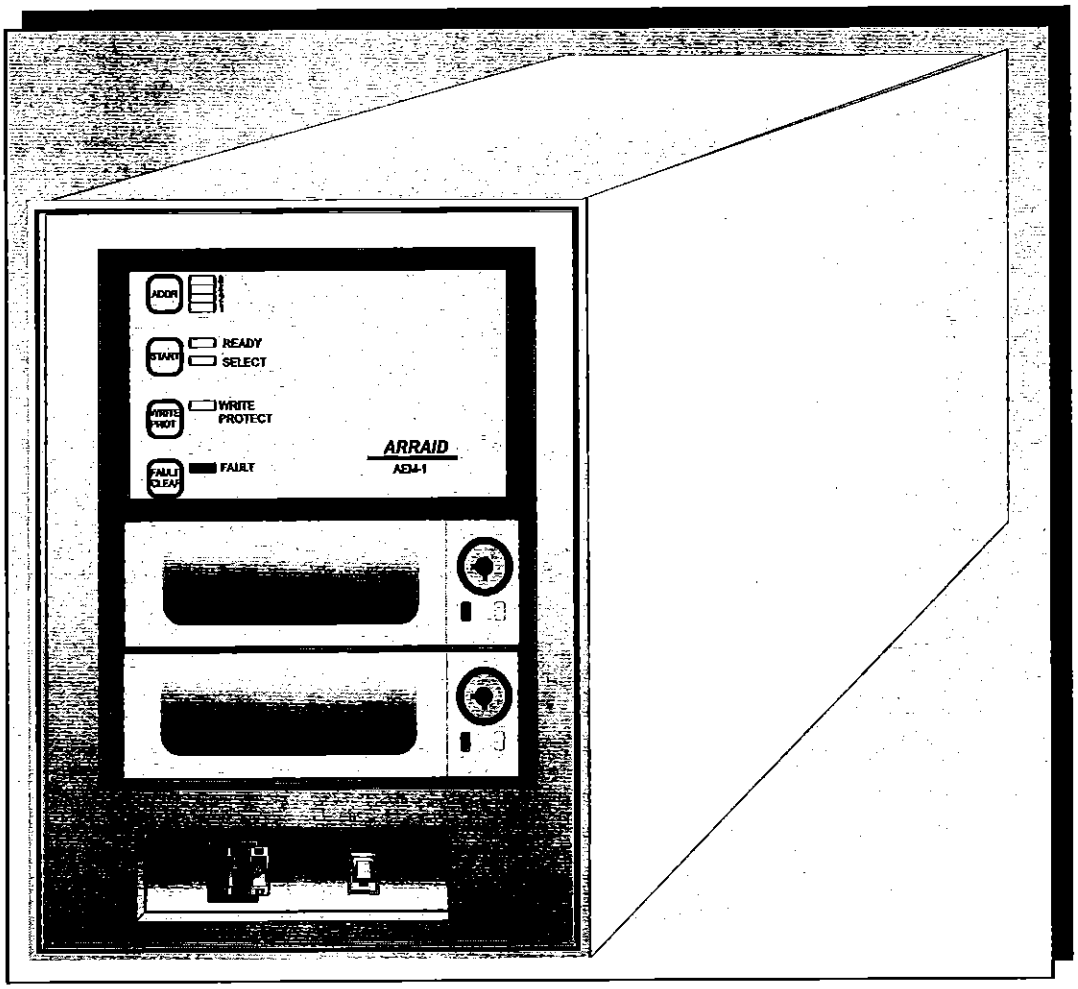

Figure 4 AEM-1B/RSD with Multi-Volume and Backup Options

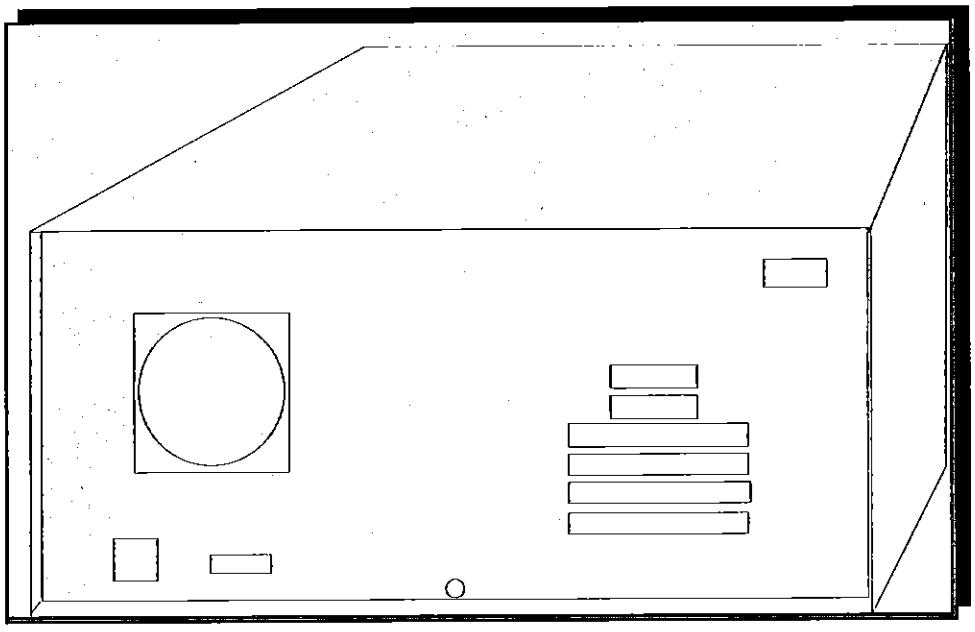

Figure 5 EID-1 Eight inch form factor (Rear View)

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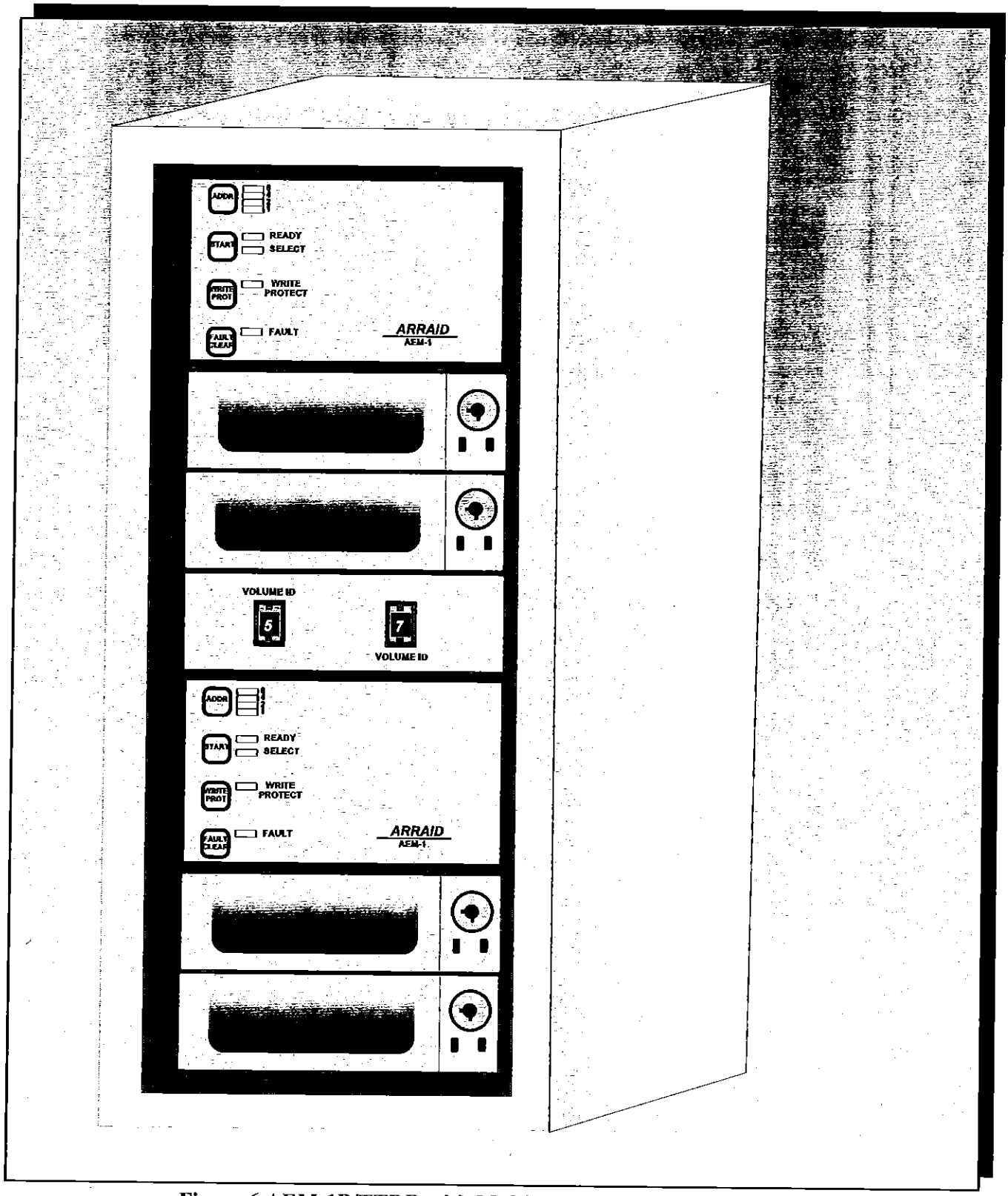


Figure 6 AEM-1B/TTDR with Multi-Volume and Backup Options

3 OVERALL OPERATION

3.1 DISK DRIVE EMULATION

The AEM system uses a technique called "Emulation" to perform disk drive operations that closely resemble the original family of disk drives. The permanent storage of data is on a SCSI drive. However, the host controller does not directly control, read from, or write to the SCSI drive. Instead, the AEM interface performs all write, read, format, and control operations to a RAM buffer memory. This RAM is addressed by a counter that runs (increments) at a chosen frequency e.g. 9.67 MHZ. As the counter increments, it sequentially addresses the RAM buffer simulating the rotation of a disk under a read/write head. When the host controller is writing, the write data is merely deposited in the currently addressed bit of the RAM. When the controller is reading, the contents of the currently addressed bit in the RAM buffer is presented to the host controller. When the counter reaches the maximum bit address for the emulated track, it resets and starts over. This resetting action simulates the index point on the emulated disk. One emulated track represents a specific head positioned over a specific cylinder of the Emulated drive. When the host controller selects a different head or cylinder, the new track is read from the SCSI drive into another buffer and the previous

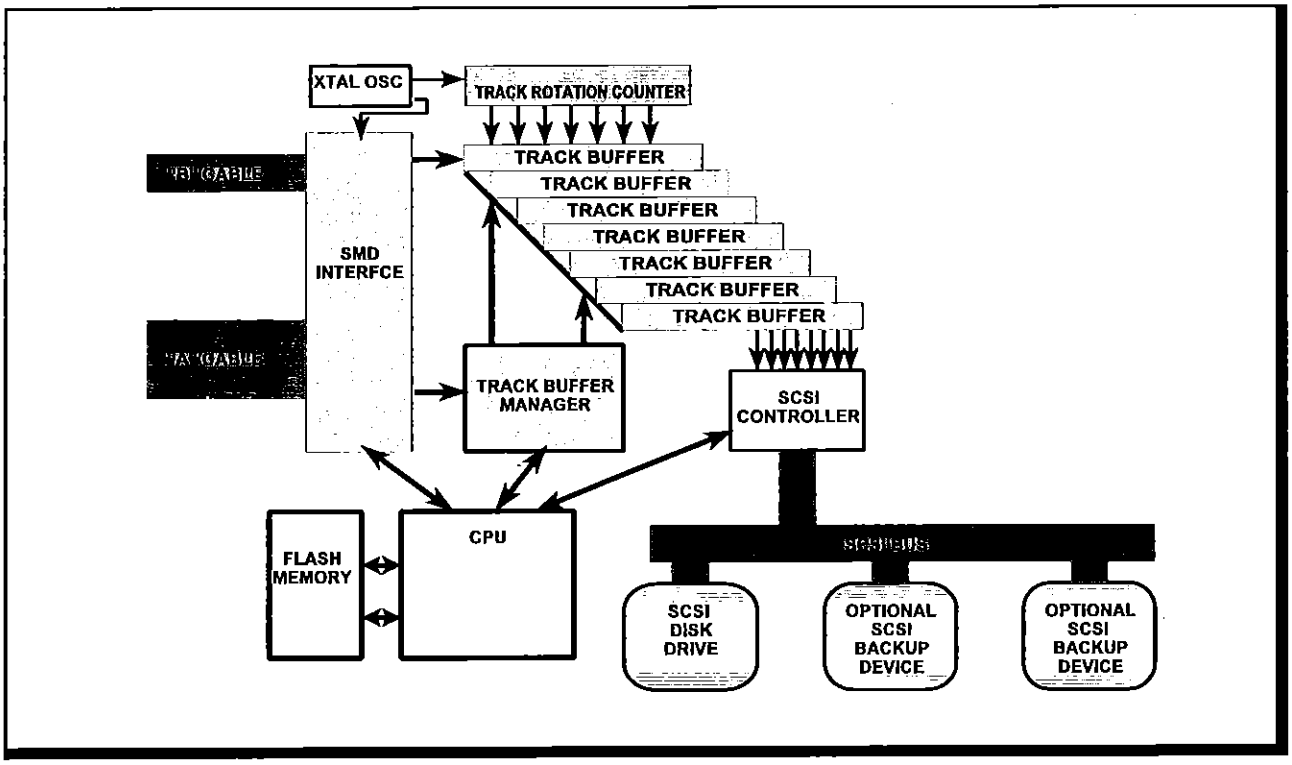


Figure 7 AEM FUNCTIONAL BLOCK DIAGRAM

RAM buffer is written as a series of SCSI 512 byte blocks to the SCSI drive. The data written to the SCSI drive contains the entire Emulated track. It includes all formatting information, address marks, data, CRC or ECC fields, and any dead or unused portions of the track. The AEM has no knowledge of the emulated track except for its length and its head and cylinder address. All formatting is performed, checked and managed by the host system's Disk Drive controller.

3.2 DATA FLOW

The AEM system reads data from the SCSI drive into the RAM cache buffer in logical blocks of 512 bytes each. The entire track is read into the RAM before any data is available to the host controller. The Host Interface side of the system transfers data to the host controller in bit serial form using the clock from the emulation track counter to synchronize the read operation.

When writing data from the host controller, the data is transferred from the host to the AEM in bit serial form using the AEM clock as the servo clock for write data synchronization. Except in "C" models, newly written data is retained in the AEM track buffer until the host controller selects a different track or until the drive is taken off-line or spun down. Data is then organized into 512 byte logical blocks and written to the SCSI drive(s). In "C" Models, the data is written to the SCSI drive immediately after it appears in the AEM's Track buffer,

> Please note that data may remain in the AEM's buffer for an extended period of time before it is written to the SCSI drive. To prevent loss of this track, the AEM must always be spun down and taken off line prior to loss of power. For critical applications, an Un-interruptible Power Supply should be used to prevent loss of power. An interface to a UPS is provided as a standard feature.

3.3 CONTROLLER RESTRAINT

Since the Host interface provides no advance warning of a read or write operation, the AEM must assume that a read or write operation can occur at any time. Therefore, when the host controller performs a seek or head selection operation, the AEM must obtain the track data from the SCSI drive and place it in the RAM buffer. Many Host controllers expect the data for a new track to be under the read/write head within a few microseconds after a head select operation. The AEM system, however, must wait until the required data for the track to be read in from the SCSI drive. This can take many milliseconds. Read-ahead is employed in both the SCSI drive and the AEM cache to help overcome this wait delay. In cases where the new track must be read in from the SCSI drive, the AEM employs a technique called "blocking" to restrain the host controller until the new track data is available. Blocking occurs anytime the host controller requires a change to a new track. If the track change is a result of a seek command, the blocking uses the conventional NOT-ON-CYLINDER signal to restrain the controller until the track is available. When the track change is a result of a new head selection, the blocking action is effected by inhibiting the sector and index pulses, the Address Mark Found signal, and optionally, the servo and read clock pulses until the track has been read into the buffer. Which blocking technique is employed depends on the application. In AEM "C" Models, the entire Emulated drive is held in Track buffers. Therefore, no "blocking" is necessary. The newly addressed track is available immediately.

3.4 TRACK CACHING

The Track Buffer RAM is segmented into multiple tracks or Track Buffers. The minimum AEM system contains 64 Track Buffers. The maximum configuration for an AEM "A" or "B" Model is 1024 Track Buffers. The AEM "C" Models can be configured with up to 1GB of Track Buffer memory. In the "C" Models, the entire emulated Drive is contained in Track Buffer Memory (100% Cache).

Obviously, there are more than 64 tracks on a typical SMD or HISI drive, so, the RAM buffer can contain only the most recently used tracks. The track buffers are managed by the AEM hardware using a Least Recently Used Track cache management scheme. Each logical Disk track can occupy one of several buffers in the RAM. Which buffer is selected depends on the track number, the number of buffers in a set of buffers, and whether the tracks currently in the buffer are "dirty" (yet unwritten to the SCSI drive). When the Host controller selects a new track, either by a seek command or a head select command, the AEM buffer manager searches the Buffer Directory to see if the new track is already present in RAM. If not, the AEM firmware will obtain the track from the SCSI drive and place it in an unused buffer. If all buffers for the selected track are full, the AEM firmware will select the Least-Recently-Used non-dirty buffer, and use it. If all buffers are dirty, the oldest dirty buffer will be written to the SCSI drive and its buffer will be used for the new track.

The caching of Disk tracks helps to improve the performance of the emulated drive. In some cases, the AEM appears to have an average access time of zero. However several factors should be considered when configurating the AEM, such as: the application (highly sequential or random access), data volatility (the track writes are deferred until SCSI bus time is available or until all track buffers are dirty), and emulated drive to SCSI drive speed relationship.

The AEM system uses additional techniques to enhance the cache performance. For example, read-ahead is employed to reduce seek times when performing sequential operations. The read-ahead mode is user programmable. For applications that write small

blocks of data, the AEM can be placed in a mode that writes only the altered portion of a track when it writes from the cache to the SCSI drive.

3.5 CONFIGURATION

The AEM is designed to handle the majority of SMD, HISI, or Diablo/Pertec applications with simple configuration changes. Changing the configuration can be accomplished by the user using a conventional RS232 terminal or PC with a terminal emulator and simple command interface through the serial port on the AEM. Additional configuration changes are accomplished through the use of jumpers on the AEM circuit boards. The operating read/write data rate is controlled by a plug-in crystal oscillator chip in the AEM.

3.6 AEM FIRMWARE

The AEM makes extensive use of Field Programmable Logic Arrays and a microprocessor for control of the hardware. The firmware files used by the AEM are stored in a non-volatile FLASH memory. When the system is powered up, the firmware loads the appropriate files as needed into the FPLAs and microprocessor RAM. Firmware may be updated to include the latest features and options. This update may be accomplished through the serial RS232 port from a MS/DOS compatible PC. Firmware version 4.xx uses 256K byte Flash storage with capacity to contain many variations of the FPLA files. This allows version 4.xx to support multiple interfaces and different revision circuit boards. "C" Models use firmware version 1.xx. This firmware has many features not found in the other AEM Models.

3.7 POWER UP/DOWN

The AEM is powered up much like the conventional Disk drive. However, the AEM can be programmed to power up in the standby mode or, for unattended operation, come to life with the drives spinning and the system on line.

The AEM should always be powered down gracefully, that is to say, the SCSI drive(s) should be spun down and the system placed in the off-line mode prior to power off. This will ensure that any unwritten data in the cache RAM will be written to the SCSI drive(s) before power is lost. For unattended operation, a UPS system is recommended. The AEM will monitor a UPS system and automatically close out any unwritten data and spin the drives down before power is lost.

4 SMD INTERFACE

4.1 PHYSICAL INTERFACE

The SMD interface is provided at the rear of the unit. The SMD port consists of an "A" cable connector IN, an "A" cable connector OUT, and a "B" cable connector. The following tables and Appendix "C" contain a complete listing of the SMD interface signals and connector pin numbers.

The "A" IN and OUT connectors are provided to facilitate daisy chaining. In the AEM, there is no difference between these two connectors. Either connector may be used as an IN or OUT.

The standard methods for SMD cabling and termination apply. Good grounding back to the host computer is critical. See the INSTALLATION section of this document for a discussion of proper grounding.

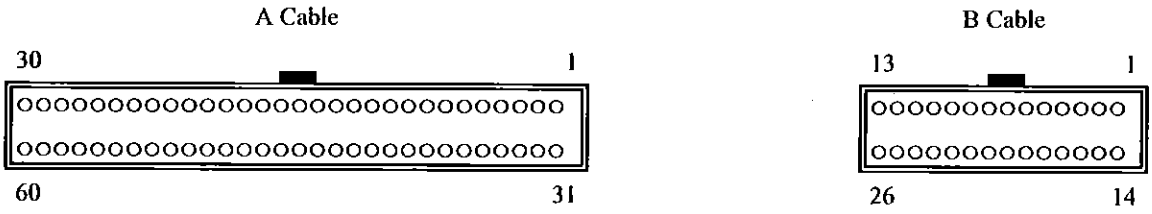
A dual port option provides an additional set of connectors for the second port. The dual port functions exactly as the original SMD drive.

> ***PLEASE NOTE***
> *The SMD interface consists of an "A" cable (the daisy chained control cable), and a "B" cable (the radial data cable). These are not to be confused with the A and B channels of a dual port system. This document refers to the two ports of a dual port system as port 1 and port 2. Each of these two ports contain both of these cables.*

Any standard SMD terminator may be used with this system provided it is mechanically compatible. Terminator ground is provided for each port. A good chassis ground connection should be provided between the Host system controller chassis and the AEM chassis.

Block connectors are not usually supported in the AEM. An I/O adapter panel may be added to the cabinet to receive block connectors and translate to flat ribbon to connect with the AEM (OPT-12). Contact *ARRAID, Inc.* for more information.

SMD Connector Pinouts as viewed from the rear of the AEM:



SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
1	31	TAG 1 (Cylinder select)	This tag line gates the data on the bus out lines to the drive Cylinder Address register. The bus bits have the significance listed below.

SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)

CABLE PIN LOW	CABLE PIN HIGH	SIGNAL NAME	DESCRIPTION
			Bus Out Bit / Cylinder value 0 — 1 1 — 2 2 — 4 3 — 8 4 — 16 5 — 32 6 — 64 7 — 128 8 — 256 9 — 512
2	32	TAG 2 (Head select)	This tag line gates the data on the bus lines to the drive Head Address register. The bus bits have the significance listed below.(SMD-E sends most significant cylinder bits during Tag-2) Bus Out Bit / Head Address Value 0 — 1 1 — 2 2 — 4 3 — 8 4 — 16 5 — 32 (cyl 1024) Additional cylinder bits for SMD-E (SMD_MODE=3) 6 — (cyl 2048) Additional cylinder bits for SMD-E (SMD_MODE=3)

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SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)

CABLE PIN LOW	CABLE PIN HIGH	SIGNAL NAME	DESCRIPTION
3	33	TAG 3 (Control)	This tag line gates the data on the bus lines to the logic circuits of the AEM for commanding various operations. The operation performed is dependent upon which of the bus lines is active. The significance of the bus bits is as follows:
		Bus Out Bit	Name — Function Performed
		0	Write Gate — Enables write circuitry. Operation not completed if a fault condition exists.
		1	Read Gate — Enables read circuitry. Leading edge should occur during an all-zeros pattern (preamble). Operation not completed if a fault condition exists.
		2	Servo Offset Plus — Emulated but not applicable to the AEM. Write operations cannot be performed in offset state.
		3	Servo Offset Minus — Emulated but not applicable to the AEM. Write operations cannot be performed in offset state.
		4	Fault Clear — Clears the fault latches provided fault condition no longer exists.
		5	Address Mark Enable — Writes an address mark when concurrent with Write Gate, or initiates an address mark search when concurrent with Read Gate.
		6	RTZ — Causes the drive to move to cylinder zero, track zero. It also resets the Head Address register and Seek Error status.
		7	Data Strobe Early — Emulated but not applicable to the AEM.
		8	Data Strobe Late — Emulated but not applicable to the AEM.
		9	Release (Dual channel option only) — Clears channel reserved and channel priority select reserve status. (Refer to Unit Selection discussion.)
4	34	BUS Bit 0	These ten lines carry data to the AEM. The meaning of the data is a function of the active tag line.
5	35	BUS Bit 1	
6	36	BUS Bit 2	
7	37	BUS Bit 3	
8	38	BUS Bit 4	
9	39	BUS Bit 5	
10	40	BUS Bit 6	
11	41	BUS Bit 7	
12	42	BUS Bit 8	
13	43	BUS Bit 9	
14	44	OPEN CABLE DETECTOR	A voltage is supplied by the controller to override the bias voltage at the AEM's receiver. If the "A" cable is disconnected or if controller power is lost, unit selection and controller commands are inhibited.

SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
15	45	FAULT	When the line is active it indicates that one or more of the following faults exist: 1. Write Fault -- A write command has been received while the AEM is write protected or not ready to accept a write command. 2. Read + Write Fault -- Read Gate and Write Gate are active simultaneously. Condition is cleared by removing Read Gate or Write Gate. 3. Not Ready -- A read or Write command has been received for a drive that is not ready. 4. Read or Write while not On Cylinder
16	46	SEEK ERROR	An attempt to seek to an invalid cylinder address. This fault can be cleared by seeking to a valid cylinder.
17	47	ON CYLINDER	This indicates that the drive's actuator is positioned on a track. Any seek movement, including servo offset, results in a loss of the signal. During an offset mode operation, this line drops momentarily, but comes back on after a delay. On Cylinder status is cleared by any seek command including a zero track seek.
18	48	INDEX	This signal is generated by the AEM once per revolution of the emulated disk. Its leading edge is the beginning of sector zero.
19	49	UNIT READY	Unit Ready indicates that the emulated drive is on cylinder, the On-Line switch is activated, and no fault condition exists.
20	50	ADDRESS MARK FOUND	When an address mark has been found during an Address mark search operation, this line is asserted.
21	51	BUSY	This signal is generated when a controller attempts to select or reserve a drive that has already been selected and/or reserved by the other controller. This signal is sen to the controller attempting the selection.
22	52	UNIT SELECT TAG	This signal gates Unit Select Bit lines into an address compare circuit. Unit is selected after a selectable delay period. The AEM will not process commands until selected. In dual-port units, selection also causes the device to be reserved for the selecting port. The reserve condition is canceled by one of the following: 1. Reception of a Release command 2. At the completion of the current operation and time out of the RTZ ticks timer, provided the Release Timer Select switch is set to RTM. 3. Reception of a priority select from the other channel. When the Unit Select Tag is accompanied by a Bus Bit 9 active, this indicates a priority select status. The drive is unconditionally selected and reserved by the channel issuing this command provided that both channels are enabled and a priority select condition does not exist on the other channel.

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SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
23	53	UNIT SELECT 1	A binary code is placed on these four lines to address and select a drive. The binary code must match the logical address of the drive defined by the position of the address switches, the Unit_add config parameter, or the optional Address plug on the front panel. Drives can be numbered 0 through 15.
24	54	UNIT SELECT 2	
26	56	UNIT SELECT 4	
27	57	UNIT SELECT 8	
25	55	SECTOR	This signal is derived from an internal crystal oscillator and is used to indicate the beginning of each sector on the track. The number of sector pulses that occur for each revolution of the emulated drive is programable.
28	58	WRITE PROTECTED	When this line is asserted, it indicates that the AEM's write circuits are disabled. The write protect mode is enabled by the WRITE PROTECT push-button switch on the operator panel. Attempting to write while the write protect mode is active results in a fault condition.
	29	POWER PICK	These signals are not used by the AEM. However, they are propagated through to the next unit on the "A" cable.
	59	POWER HOLD	
30	60	Not used or used as TAG4 (or SIGNAL GROUND)	The AEM may be shipped from the factory with no connection to these pins. However, they are propagated through to the next unit connected to the "A: cable. For extended SMD applications, (SMD_MODE=2), This pins will be used for the most significant cylinder bit. Jumpers E3 and E10 on the SMD interface board are used for this purpose. These pins may also be connected to signal ground by installing the jumpers E1, E2, E8, and E9 on the SMD interface circuit board. This is necessary in some applications when these pins are used to provide the current return path for the SMD bus terminator.

The SMD interface is supported as per the CDC SMD interface specification. The interface drivers / receivers are MC3450's and MC3453's. These are rated for operation up to 15MHz data rates. For high speed SMD-E emulations (above 15MHz), the AEM can optionally use 10192 (ECL) drivers for the data and clock signals by changing jumpers on the SMD interface board. Refer to the SMD board layout page 67 of this document for specific jumper setup. All signals are terminated per the specification. Critical signals are biased to prevent improper operation if a cable is open.

The only exception is pins 29 and 59. Pin 29 is the PICK daisy chain. It is used to sequence power on for the older drives. Pin 29 is connected to both A cable connectors but is not used by the AEM. Pin 59 is also passed through to both "A" cable connectors, but is not connected to any circuitry in the AEM. Power sequencing is not necessary due to the low power consumption of the unit.

Pins 30 and 60 on the 'A' cable may be used in several ways:

They may be connected to a receiver which makes the signal available to the interface logic and used for extended cylinder addressing (greater than 1024 cylinders) see SMD_MODE parameter.

Pins 30 and 60 may be connected to the terminator ground lug, logic ground, or both. Some SMD drives used this line for the terminator ground return in lieu of a chassis ground strap which is customary. Controllers that are designed to be used with such drives, or applications where the AEM will be in a string with such drives, might require this configuration.

Pins 30 and 60 may be left open if not specifically required. They are passed from "A" cable in to "A" cable out so other drives in the chain that might use these lines will be unaffected. The 'B' cable is fully supported. Index and Sector pulses are present on both the 'A' and 'B' cables.

SMD INTERFACE SIGNAL DESCRIPTION -- "B" CABLE (RADIAL)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
8	20	WRITE DATA	This line transmits NRZ data from the controller to the AEM for recording on the disk surface.
2	14	SERVO CLOCK	Servo Clock is a signal derived from the crystal oscillator on the AEM's Data manager board. Servo Clock is transmitted to the controller and is usually used to syncronize write data and generate Write Clock.
3	16	READ DATA	This line transmits data from the AEM. This data is transmitted in NRZ form to the controller.
5	17	READ CLOCK	Read Clock defines the beginning of a data cell during a Read operation. This clock synchronous with Servo Clock and Read data.
6	19	WRITE CLOCK	This signal from the controller defines the beginning of a data cell during a Write operation. It is usually derived from the AEM's Servo Clock.
10	23	SEEK END	This signal indicates either an on cylinder status or seek error status resulting from a seek operation that has terminated.
22	9	UNIT SELECTED	This signal indicates the drive has accepted a Unit Select request. This line must be active before the drive will respond to any commands from the controller.
12 **(24)	24 **(12)	INDEX	This signal is generated by the AEM's Data Manager board. It occurs once per revolution of the emulated disk, and its leading edge is the leading edge of the first sector.
13 **(26)	26 **(13)	SECTOR	This signal is derived from the AEM's Data Manager board and is used to indicate the beginning of each sector on the track. The number of sector pulses that occur for each revolution of the emulated drive is programable.
	7	SIGNAL GROUND	Signal ground is referenced to the "A" cable terminator ground.
	18	SIGNAL GROUND	
	1	SIGNAL GROUND	
	15	SIGNAL GROUND	
	4	SIGNAL GROUND	
	11	SIGNAL GROUND	
	21	SIGNAL GROUND	These two pins are used in some controllers as a "device type" definition code input. (See ARRAID Application note L92001)
	25	SIGNAL GROUND	

** These signals may be inverted for use with certain controllers. Please contact ARRAID tech support for more information.

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5 HISI (MLPLX) INTERFACE

5.1 PHYSICAL INTERFACE

The HISI 60 pin Multiplexed interface is provided at the rear of the unit. An optional 75 pin "Block" connector interface is available. The HISI port consists of an "A" cable connector IN, an "A" cable connector OUT, and a "B" cable connector. The following tables and Appendix "D" contain a complete listing of the HISI interface signals and connector pin numbers.

The "A" IN and OUT connectors are provided to facilitate daisy chaining. In the AEM, there is no difference between these two connectors. Either connector may be used as an IN or OUT.

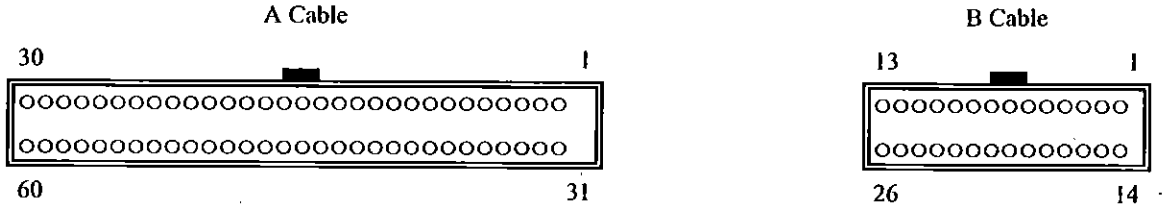
The standard methods for HISI cabling and termination apply. Good grounding back to the host computer is critical. See the INSTALLATION section of this document for a discussion of proper grounding.

The AEM-3 does not support the HISI dual port interface.

Any standard HISI terminator may be used with this system provided it is mechanically compatible. Terminator ground is provided next to the "A" cable connectors. A good chassis ground connection should be provided between the Host system controller chassis and the AEM chassis.

See the appendix for the pin to pin translation of the HISI block connectors

HISI 60 pin Connector Pinouts as viewed from the rear of the AEM:



HISI INTERFACE SIGNAL DESCRIPTION -- 60 Pin "A" CABLE (DAISY CHAINED)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
1	31	TAG 2^0	Tag Signals from the controller to the AEM. See Command/Status decode table for the meaning of these signals
2	32	TAG 2^1	
3	33	TAG 2^2	
4	34	BUS OUT Bit 0	These eight lines carry data to the AEM. The meaning of the data is a function of the active tag state. Bit 0 is MSB bit 7 is LSB. See Command/Status decode table for the meaning of these signals
5	35	BUS OUT Bit 1	
6	36	BUS OUT Bit 2	
7	37	BUS OUT Bit 3	
8	38	BUS OUT Bit 4	
9	39	BUS OUT Bit 5	
10	40	BUS OUT Bit 6	
11	41	BUS OUT Bit 7	
12	42	SPARE 2	This line is connected to a spare receiver in the AEM. It is currently not used.
13	43	SPARE 1	This line is connected to a spare receiver in the AEM. It is currently not used.
21	51	SPARE 3	This line is connected to a spare receiver in the AEM. It is currently not used.
14	44	SELECT HOLD	This line is driven by the controller to hold the AEM in a selected state.
20	50	BUS IN Bit 0	These eight lines carry data to the HISI controller. The meaning of the data is a function of the active tag state. Bit 0 is MSB bit 7 is LSB. See Command/Status decode table for the meaning of these signals
23	53	BUS IN Bit 1	
17	47	BUS IN Bit 2	
19	49	BUS IN Bit 3	
24	54	BUS IN Bit 4	
26	56	BUS IN Bit 5	
16	46	BUS IN Bit 6	
15	45	BUS IN Bit 7	
18	48	INDEX	This signal is derived from an internal crystal oscillator and is generated by the AEM once per revolution of the emulated disk. Its leading edge is the beginning of sector zero.
22	52	TAG GATE OUT	This line is driven by the controller to cause the AEM to decode the TAG line states and respond accordingly
25	55	SECTOR	This signal is derived from an internal crystal oscillator and is used to indicate the beginning of each sector on the track. The number of sector pulses that occur for each revolution of the emulated drive is programable.
27	57	TAG GATE IN	This line is used to acknowledge the receipt of TAG GATE OUT approx. 100ns later.
28	58	SPARE	This line is not connected in the AEM
	29	POWER PICK	These signals are not used by the AEM. However, they are propagated through to the next unit on the "A" cable.
	59	POWER HOLD	
30	60	SPARE OUT	This line is connected to a spare receiver in the AEM. It is currently not used.

The HISI interface is supported as per the CDC 75 pin multiplexed HISI interface specification. The interface drivers / receivers are MC3450's and MC3453's. These are rated for operation up to 15MHz data rates. All signals are terminated per the specification. Critical signals are biased to prevent improper operation if the controller is not powered on or a cable is removed or open.

The only exception is pins 29 and 59. Pin 29 is the PICK daisy chain. It is used to sequence power on for the older drives. Pin 29 is connected to both A cable connectors but is not used by the AEM. Pin 59 is also passed through to both "A" cable connectors, but is not connected to any circuitry in the AEM. Power sequencing is not necessary for the AEM due to the low power consumption of the unit.

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The 'B' cable is fully supported.

HISI INTERFACE SIGNAL DESCRIPTION -- 26 Pin"B" CABLE (RADIAL)			
CABLE PIN		SIGNAL NAME	DESCRIPTION
LOW	HIGH		
8	20	WRITE / READ DATA	This bi-directional line transmits NRZ data from the controller to the AEM for recording on the disk surface.This line also transmits data from the AEM to the controller when READ GATE is active.
2	14	SERVO CLOCK	Servo Clock is a signal derived from the crystal oscillator on the AEM's Data manager board. Servo Clock is transmitted to the controller and is usually used to syncronize write data and generate Write Clock.
3	16	INTERRUPT	This line is used to transmit an interrupt to the controller for rotational position sensing.
5	17	READ CLOCK	Read Clock defines the beginning of a data cell during a Read operation. This clock synchronous with Servo Clock and Read data.
6	19	WRITE CLOCK	This signal from the controller defines the beginning of a data cell during a Write operation. It is usually derived from the AEM's Servo Clock.
10	23	SEEK END	This signal indicates either an on cylinder status or seek error status resulting from a seek operation that has terminated.
22	9	MOD SELECTED	This signal indicates the AEM has accepted a Unit Select request. This line must be active before the drive will respond to any commands from the controller.
12	24	NOT USED	Not Connected in the AEM
13	26	NOT USED	Not Connected in the AEM
	1	SIGNAL GROUND	Signal ground is referenced to the "A" cable terminator ground.
	4	SIGNAL GROUND	
	7	SIGNAL GROUND	
	11	SIGNAL GROUND	
	15	SIGNAL GROUND	
	18	SIGNAL GROUND	
	21	SIGNAL GROUND	
	25	SIGNAL GROUND	

6 DIABLO / PERTEC INTERFACE

6.1 PHYSICAL INTERFACE

The Diablo / Pertec interface is available in several forms. Table 2 Page 21 illustrates various options for this interface.

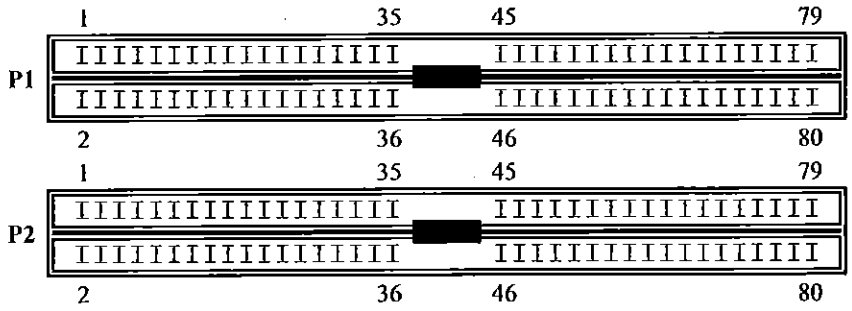
PERTEC / DIABLO Disk Emulations			
Application	**Number of Platters**	**Rear Panel Connector**	**AEM Option #**
DEC RK05 on PDP-11 using DEC RK11	1	DEC BLOCK	37A
DEC RK05 (Genrad) on PDP-8 using DEC 3 board controller	1	DEC BLOCK	37B
DEC RK05 (Genrad) on PDP-8 using Plessey Controller	1	42 Pin Winchester	38B
Sperry/Varian 620 with 4027560 Controller	2	100 Pin Card Edge	39
Honeywell 316 using XEBEC Controller	2	100 Pin Card Edge	39
CDC HAWK 9427H on Computer Automation Alpha-16 with 53263/4 controller	2	50 Pin Winchester	38A
CDC HAWK 9427H on Foxboro 1A	2	50 Pin Winchester	38A
Ferranti ARGUS	2	50 Pin Winchester	38A

Table 2 AEM-5 PERTEC/DIABLO EMULATION OPTIONS

6.1.1 DEC Interface

The DEC RK05 Emulation uses a pair of 80 Pin Edge connectors modified to provide the proper keying of the DEC cables. This interface must be "daisy chained" or a Terminator must be installed in either P1 or P2.

DEC BLOCK CONNECTOR (Rear Panel View)



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DEC Block (RK-05) INTERFACE SIGNAL DESCRIPTION P1 & P2				
DEC CABLE PIN	REAR PANEL PIN #	J1 & J2 PIN #	SIGNAL NAME	DESCRIPTION
A1	1		NC	Not Used
B1	3		NC	Not Used
C1	5	33	-CYL 8	Cylinder address bit 2^3 (From Controller)
D1	7	17	-CYL 2	Cylinder address bit 2^1 (From Controller)
E1	9	31	-CYL 64	Cylinder address bit 2^6 (From Controller)
F1	11	28	-CYL 16	Cylinder address bit 2^4 (From Controller)
H1	13	11	-CYL 128	Cylinder address bit 2^7 (From Controller)
J1	15	35	-CYL 32	Cylinder address bit 2^5 (From Controller)
K1	17	39	-CYL 1	Cylinder address bit 2^0 (From Controller)
L1	19	40	-CYL 4	Cylinder address bit 2^2 (From Controller)
M1	21	14	-RTZ	Return To Zero Seek (From Controller)
N1	23		NC	Not Used
P1	25		NC	Not Used
R1	27		NC	Not Used
S1	29		NC	Not Used
T1	31	1 & 15 & 32	GROUND	
U1	33	36	-AD MODE	Address Mode
V1	35		NC	Not Used
37	37		NC	Key Position
39	39		NC	Key Position
41	41		NC	Key Position
43	43		NC	Key Position
A2	45		NC	Not Used
B2	47		NC	Not Used
C2	49		NC	Not Used
D2	51		NC	Not Used
E2	53		NC	Not Used
F2	55		-AC LOW	Not Used
H2	57	18	-CYL STROBE	Cylinder Address Strobe (From Controller)
J2	59	20	-SCNT 8	Sector Address bit 8 (2^3)
K2	61	22	-W CHECK	Fault Line (Write Check)
L2	63	25	-SCNT 1	Sector Address bit 1 (2^0)
M2	65	27	-INDEX	Index Pulses
N2	67	30	-F READY	Unit Ready
P2	69	34	-WP OUT	Write Protected
R2	71	41	-R GATE	Read Gate From Controller)
S2	73	44	-R CLOCK	Data Clock From the Drive
T2	75			Not Used
U2	77			Not Used
V2	79			Not Used
A1	2	19 & 51 & 52	TERM PWR	Terminator Power from AEM

DEC Block (RK-05) INTERFACE SIGNAL DESCRIPTION P1 & P2				
DEC CABLE PIN	REAR PANEL PIN #	J1 & J2 PIN #	SIGNAL NAME	DESCRIPTION
B1	4	1 & 15 & 32	GROUND	Signal Ground
C1	6			Not Used
D1	8			Not Used
E1	10			Not Used
F1	12	50	-W DATA	Write Data (From Controller)
H1	14	45	-RSRW	On Cylinder from the Drive
J1	16	46	-U SEL 1	Unit Select 2^0
K1	18	47	-U SEL 2	Unit Select 2^2
L1	20	49	-U SEL 3	Unit Select 2^3
M1	22	48	-U SEL 4	Unit Select 2^4
N1	24			Not Used
P1	26	3	-SCNT 2	Sector Address bit 2 (2^1)
R1	28	4	-ADD ACK	Address Acknowledge
S1	30	5	-SEEK ERR	Seek Error
T1	32	9	-ILL ADD	Logical Address Interlock
U1	34			Not Used
V1	36			Not Used
37	38		NC	Key Position Not Used
39	40		NC	Key Position Not Used
41	42		NC	Key Position Not Used
43	44		NC	Key Position Not Used
A2	46	19 & 51 & 52	TERM PWR	Terminator Power from AEM
B2	48	1 & 15 & 32	GROUND	Signal Ground
C2	50			Not Used
D2	52			Not Used
E2	54			Not Used
F2	56		-DC LO	Not Used
H2	68			Not Used
J2	60			Not Used
K2	62	21	-SCNT 4	Sector Address bit 4 (2^2)
L2	64	23	-W GATE	Write Gate (From Controller)
M2	66	26	- HEAD	Head Select 2^0 (From Controller)
N2	68	29	-SECTOR	Sector Pulses
P2	70	12	-200T/HD 4	Density Status or Head Select 2^2 (From Controller)
R2	72	38	-WP IN	Write Protect (From Controller)
S2	74	42	-R DATA	Read Data from the Drive
T2	76			Not Used
U2	78			Not Used
V2	80			Not Used

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6.1.2 50 Pin Winchester Interface

50 Pin WINCHESTER INTERFACE SIGNAL DESCRIPTION P1			
CABLE PIN P1	J1	SIGNAL NAME	DESCRIPTION
A	44	-R CLOCK	Data Clock From the Drive
B	50	-W DATA	Write Data (From Controller)
C	42	-R DATA	Read Data from the Drive
D	43	-SPARE	not used
E	41	-R GATE	Read Gate From Controller)
F	45	-RSRW	On Cylinder from the Drive
H	38	-WP IN	Write Protect (From Controller)
J	40	-CYL 4	Cylinder address bit 2^2 (From Controller)
K	37	-E GATE	Erase Gate (From Controller)
L	46	-U SEL 1	Unit Select 2^0 (From Controller)
M	36	-AD MODE	Unit Addressing Mode(binary or discrete)
N	39	-CYL 1	Cylinder address bit 2^0 (From Controller)
P	34	-WP OUT	Write Protected
R	47	-U SEL 2	Unit Select 2^2 (From Controller)
S	1 & 15 & 32	GROUND	
T	35	-CYL 32	Cylinder address bit 2^5 (From Controller)
U	30	-F READY	Unit Ready
V	49	-U SEL 3	Unit Select 2^3 (From Controller)
W	29	-SECTOR	Sector Pulses
X	33	-CYL 8	Cylinder address bit 2^3 (From Controller)
Y	27	-INDEX	Index Pulses
Z	48	-U SEL 4	Unit Select 2^4 (From Controller)
a	26	- HEAD	Head Select 2^0 (From Controller)
b	31	-CYL 64	Cylinder address bit 2^6 (From Controller)
c	25	-SCNT 1	Sector Address bit 1 (2^0)
d	1 & 15 & 32	GROUND	Signal Ground / Sector Address bit 32 (2^5)
e	23	-W GATE	Write Gate (From Controller)
f	28	-CYL 16	Cylinder address bit 2^4 (From Controller)
h	22	-W CHECK	Fault Line (Write Check)
j	3	-SCNT 2	Sector Address bit 2 (2^1)
k	21	-SCNT 4	Sector Address bit 4 (2^2)
m	24	-CYL 256	Cylinder address bit 2^8 (From Controller)
n	20	-SCNT 8	Sector Address bit 8 (2^3)
p	4	-ADD ACK	Address Acknowledge
r	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
s	17	-CYL 2	Cylinder address bit 2 (2^1)(From Controller)
t	18	-CYL STROBE	Cylinder Address Strobe (From Controller)
u	5	-SEEK ERR	Seek Error
v	16	-SCNT 16	Sector Address bit 1 (2^0)
w	14	-RTZ	Return To Zero Seek (From Controller)
x	1 & 15 & 32	GROUND	
y	9	-ILL ADD	Logical Address Interlock
z	12	-200T/HD4	Density Status or Head Select 2^2 (From Controller)
AA	13	-DISK	Disk Select (Head Select 2^1) (From Controller)
BB	11	-CYL 128	Cylinder address bit 2^7 (From Controller)
CC	6	-ATTN 1	Interrupt

50 Pin WINCHESTER INTERFACE SIGNAL DESCRIPTION P1			
CABLE PIN P1	J1	SIGNAL NAME	DESCRIPTION
DD	10	-ATTN 2	Interrupt
EE	8	-ATTN 3	Interrupt
FF	7	-ATTN 4	Interrupt
HH	1 & 15 & 32	GROUND	J3 Ground Lug

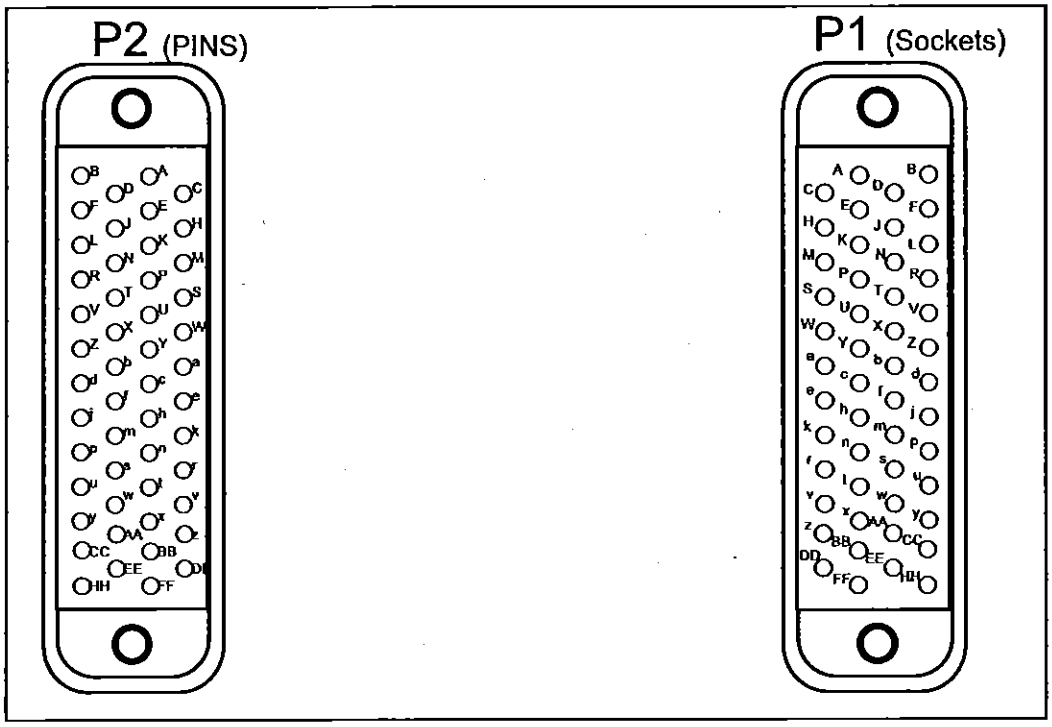

Figure 8 50 Pin Winchester Connectors

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6.1.3 42 Pin Winchester interface

42 Pin WINCHESTER INTERFACE SIGNAL DESCRIPTION P1 & P2			
CABLE PIN	J1	SIGNAL NAME	DESCRIPTION
A	44	-R'CLOCK	Data Clock From the Drive
B	50	-W DATA	Write Data (From Controller)
C	42	-R DATA	Read Data from the Drive
D	1	GROUND	Signal Ground
E	41	-R GATE	Read Gate (From Controller)
F	45	-RSRW	On Cylinder from the Drive
H	38	-WP IN	Write Protect (From Controller)
J	33	-CYL 8	Cylinder address bit 2^3 (From Controller)
K	37	-E GATE	Erase Gate (From Controller)
L	46	-U SEL 1	Unit Select 2^0 (From Controller)
M	12	-200T	High Density
N	17	-CYL 2	Cylinder address bit 2^1 (From Controller)
P	34	-WP OUT	Write Protected
R	47	-U SEL 2	Unit Select 2^2 (From Controller)
S	43	SPARE	
T	31	-CYL 64	Cylinder address bit 2^6 (From Controller)
U	30	-F READY	Unit Ready
V	49	-U SEL 3	Unit Select 2^3 (From Controller)
W	29	-SECTOR	Sector Pulses
X	28	-CYL 16	Cylinder address bit 2^4 (From Controller)
Y	27	-INDEX	Index Pulses
Z	48	-U SEL 4	Unit Select 2^4 (From Controller)
AA	26	- HEAD	Head Select 2^0 (From Controller)
BB	11	-CYL 128	Cylinder address bit 2^7 (From Controller)
CC	25	-SCNT 1	Sector Address bit 1 (2^0)
DD	15	GROUND	Signal Ground
EE	23	-W GATE	Write Gate (From Controller)
FF	35	-CYL 32	Cylinder address bit 2^5 (From Controller)
HH	22	-W CHECK	Fault Line (Write Check)
JJ	3	-SCNT 2	Sector Address bit 2 (2^1)
KK	21	-SCNT 4	Sector Address bit 4 (2^2)
LL	39	-CYL 1	Cylinder address bit 2^0 (From Controller)
MM	20	-SCNT 8	Sector Address bit 8 (2^3)
NN	4	-ADD ACK	Address Acknowledge
PP	52	TERM PWR	Terminator Power from AEM
RR	40	-CYL 4	Cylinder address bit 2^2 (From Controller)
SS	18	-CYL STROBE	Cylinder Address Strobe (From Controller)
TT	5	-SEEK ERR	Seek Error
UU	16	-SCNT 16	Sector Address bit 1 (2^0)
VV	14	-RTZ	Return To Zero Seek (From Controller)
WW	1	GROUND	Ground Lug
XX	9	-ILL ADD	Logical Address Interlock

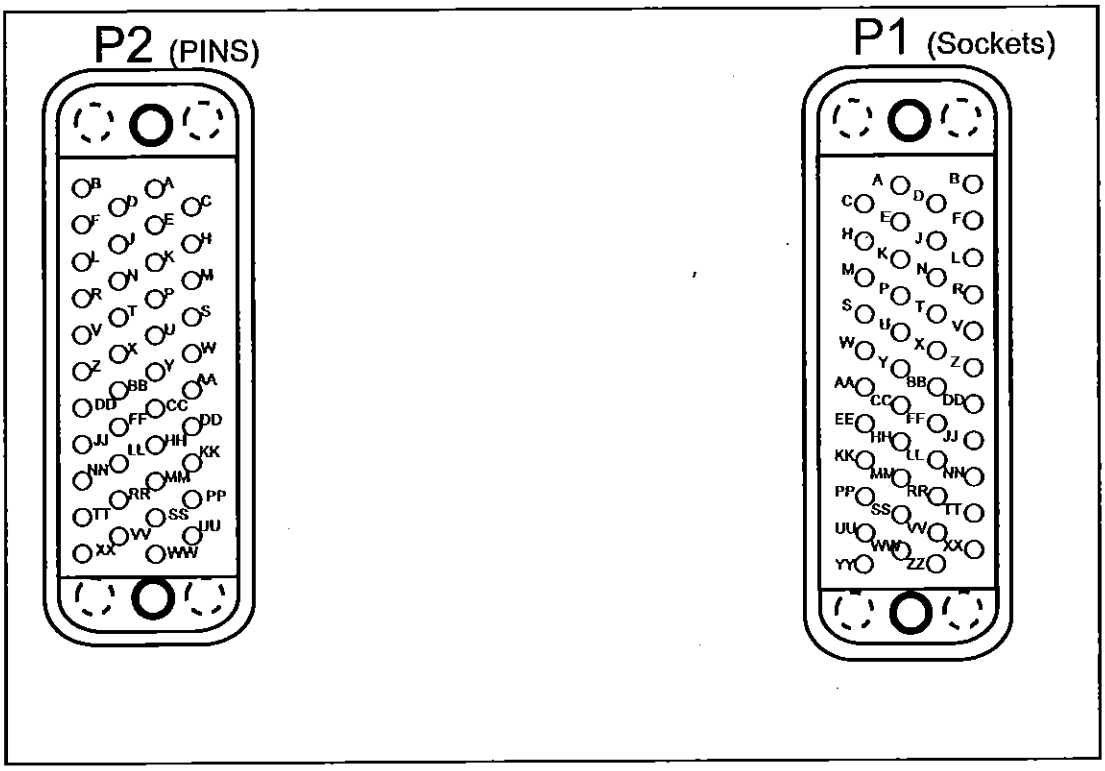

Figure 9 42 Pin Winchestor Connectors

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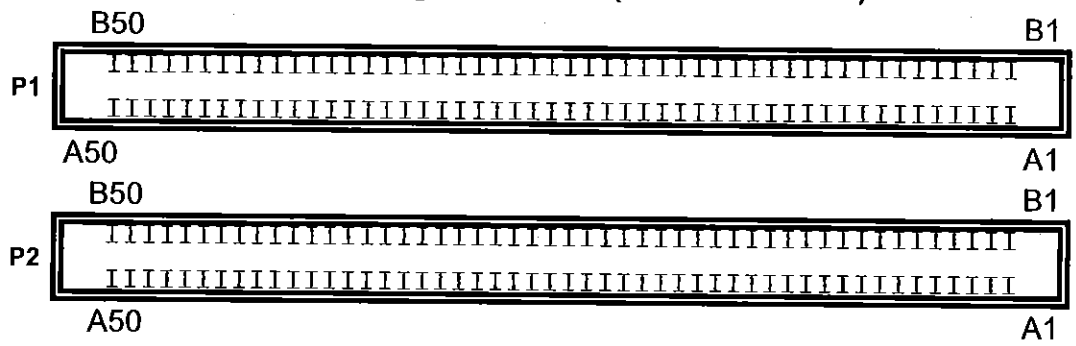
6.1.4 100 Pin Edge connector interface

100 Pin Edge connector (Rear Panel View)



100 Pin EDGE CONNECTOR INTERFACE SIGNAL DESCRIPTION P1			
CABLE PIN	J1	SIGNAL NAME	DESCRIPTION
	1	GROUND	
	15	GROUND	J3 Ground Lug
	32	GROUND	
	36	-AD MODE	
A1	34	-WP OUT	Write Protected
A3		-PSEUDO	
A4	29	-SECTOR	Sector Pulses
A6		SP6	
A7	12	-200T/HD4	Density Status or Head Select 2^2 (From Controller)
A9		SP7	
A10	43	-SCNT 64	Sector Address bit 464(2^8)
A12	16	-SCNT 16	Sector Address bit 16 (2^8)
A13	21	-SCNT 4	Sector Address bit 4 (2^2)
A15	25	-SCNT 1	Sector Address bit 1 (2^0)
A16	42	-R DATA	Read Data from the Drive
A18	4	-ADD ACK	Address Acknowledge
A19	10	-ATTN 2	Interrupt
A21	7	-ATTN 4	Interrupt
A22	37	-E GATE	Erase Gate (From Controller)
A24		SP8	
A25		-OFFSET -	
A27	26	- HEAD	Head Select 2^0 (From Controller)
A28	50	-W DATA	Write Data (From Controller)
A30		-HI DENSI	
A31	14	-RTZ	Return To Zero Seek (From Controller)
A33	24	-CYL 256	Cylinder address bit 2^8 (From Controller)
A34	31	-CYL 64	Cylinder address bit 2^6 (From Controller)
A36	28	-CYL 16	Cylinder address bit 2^4 (From Controller)
A37	40	-CYL 4	Cylinder address bit 2^2 (From Controller)
A39	39	-CYL 1	Cylinder address bit 2^0 (From Controller)
A40		SP9	
A42	47	-U SEL 2	Unit Select 2^2 (From Controller)

100 Pin EDGE CONNECTOR INTERFACE SIGNAL DESCRIPTION P1			
CABLE PIN	J1	SIGNAL NAME	DESCRIPTION
A43	48	-U SEL 4	Unit Select 2^4 (From Controller)
A45	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
A46		SP10	
A47		SP11	
A48	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
A49	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
A50	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
B1	30	-F READY	Unit Ready
B3	9	-ILL ADD	Logical Address Interlock
B4	27	-INDEX	Index Pulses
B6	22	-W CHECK	Fault Line (Write Check)
B7		-DUL PL	Pulled to ground
B9		SP1	
B10		SP2	
B12	2	-SCNT 32	Sector Address bit 16 (2^7)
B13	20	-SCNT 8	Sector Address bit 8 (2^3)
B15	3	-SCNT 2	Sector Address bit 2 (2^1)
B16	44	-R CLOCK	Data Clock From the Drive
B18	45	-RSRW	On Cylinder from the Drive
B19	6	-ATTN 1	Interrupt
B21	8	-ATTN 3	Interrupt
B22	23	-W GATE	Write Gate (From Controller)
B24	41	-R GATE	Read Gate From Controller)
B25		-OFFSET +	
B27	13	-DISK	Disk Select (Head Select 2^1) (From Controller)
B28	5	-SEEK ERR	Seek Error
B30		-STRT/STP	
B31	38	-WP IN	Write Protect (From Controller)
B33	18	-CYL STROBE	Cylinder Address Strobe (From Controller)
B34	11	-CYL 128	Cylinder address bit 2^7 (From Controller)
B36	35	-CYL 32	Cylinder address bit 2^5 (From Controller)
B37	33	-CYL 8	Cylinder address bit 2^3 (From Controller)
B39	17	-CYL 2	Cylinder address bit 2 (2^1)(From Controller)
B40		SP3	
B42	46	-U SEL 1	Unit Select 2^1 (From Controller)
B43	49	-U SEL 3	Unit Select 2^3 (From Controller)
B45	51 & 52	TERM PWR	Terminator Monitor (Terminator Power from AEM)
B46		SP4	
B47		SP5	

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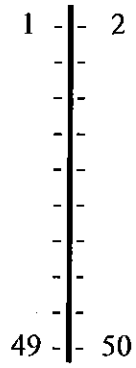
7 HP-MAC INTERFACE (AEM-6C)

PIN	NAME	PIN	NAME
1	Power Clear (for tester)	2	N/C
3	Control Bus 0	4	Control Bus 11
5	Control Bus 1	6	Control Bus 10
7	Control Bus 2	8	Control Bus 9
9	Control Bus 3	10	Control Bus 8
11	GND	12	GND
13	Tag Strobe	14	GND
15	GND	16	GND
17	N/C	18	N/C
19	GND	20	GND
21	Control Bus 4	22	N/C
23	Control Bus 5	24	Off Cylinder (for tester)
25	Control Bus 6	26	+5 Volts
27	Control Bus 7	28	N/C
29	GND	30	+5 Volts
31	GND	32	+5 Volts
33	GND	34	GND
35	+5 Volts	36	N/C
37	Tag 0	38	Control Bus 12
39	Tag 1	40	Control Bus 13
41	Tag 2	42	Control Bus 14
43	Tag 3	44	Control Bus 15
45	GND	46	GND
47	GND	48	GND
49	GND	50	GND

Figure 8 HP 79xx Interface connections

PIN	NAME
1	R/W Bus +
2	R/W Bus -
3	Key (missing pin)
4	Select

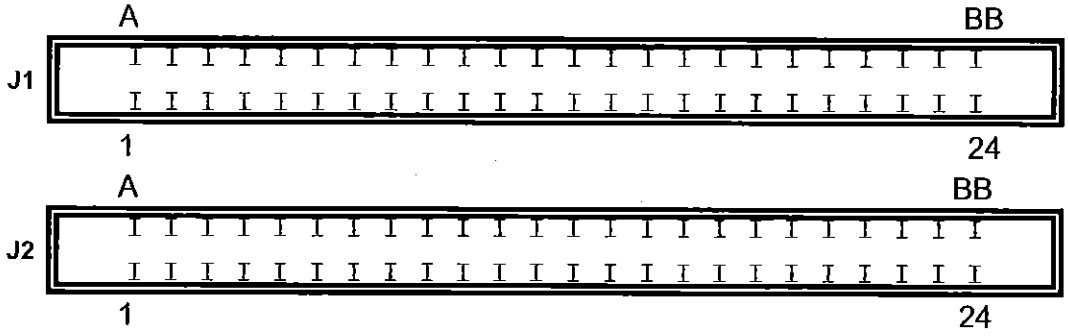
Figure 10 HP79XX MAC Data Cable



HP connector (rear) view

8 HP-7900 INTERFACE (AEM-7C)

48 Pin Edge connectors (Rear Panel View)



PIN	NAME	PIN	NAME
A	-CONTROL	1	-OUT B1
B	-OUT B0	2	-SET HD
C	-OUT B3	3	-SET CYL
D	GND	4	-OUT B7
E	GND	5	-SELECT 2
F	GND	6	-SELECT 1
H	GND	7	-OUT B4
J	GND	8	-OUT B5
K	GND	9	-OUT B6
L	GND	10	NC
M	GND	11	-SECTOR
N	GND	12	-SEC COMPARE
P	GND	13	-ACC READY
R	GND	14	-IN B4
S	GND	15	-OUT B2
T	GND	16	-IN B2
U	GND	17	-IN B3
V	GND	18	-IN B0
W	GND	19	-IN B1
X	GND	20	-DRIVE RDY
Y	GND	21	DATA 1
Z	DATA 2	22	DATA2
AA	TERM POWER	23	TERM POWER
BB	GND	24	GND

Figure 11 HP 7900 Interface Connections

9 OPERATOR PANEL

The AEM Operator panel can come in several configurations. These include: The AEM standard flat panel type operator panel, an key-switch type panel, or no panel at all. Refer to the appropriate section below for your operator panel.

If no operator panel exists, the AEM contains switches on the cpu board (lower board) that duplicate the operator functions. See section 15.5.2 page 66 for details.

Operator panels may contain momentary or alternate-action switches. Operation is the same. Press the switch once to activate. Press the switch again to release. The momentary switches will not latch in the depressed state but the function will be latched in the AEM circuitry. The specific Operator panel type will be defined in the AEM SYSTEM CONFIGURATION TABLE.

The AEM microprocessor monitors the Operator Panel. When a switch is pressed, the software will recognize it. Hold the switch until the appropriate LED acknowledges the action.

9.1 AEM FLAT PANEL TYPE OPERATOR PANEL

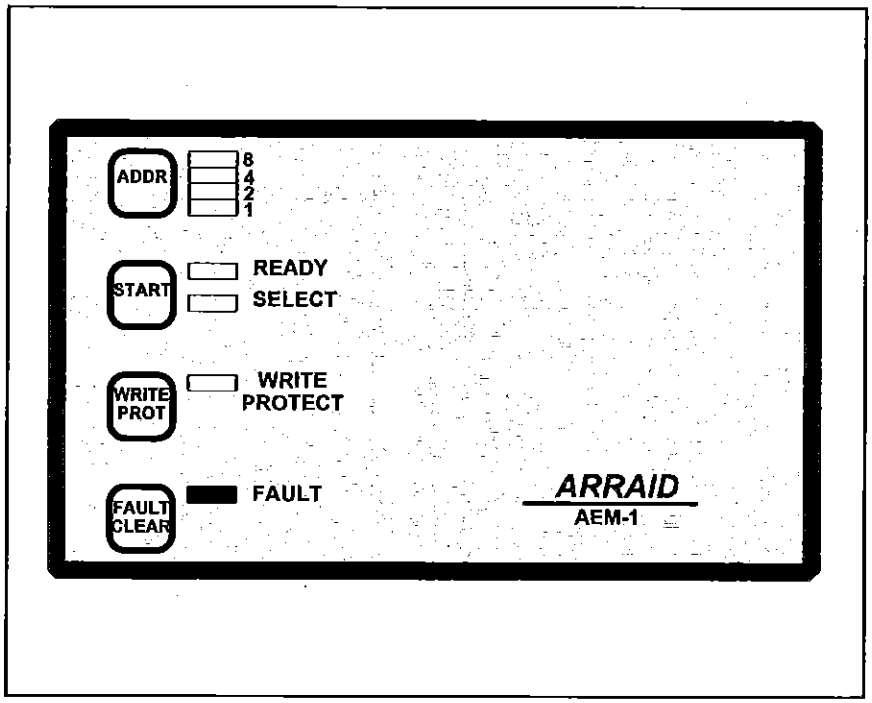


Figure 10 AEM INTEGRATED OPERATOR PANEL

The standard operator panel is integrated on the mother board of the emulation chassis. It consists of 4 switches and 8 LEDs. The switches on the flat panel type of operator panel are all momentary. The functions of the switches and LEDs are:

ADDR Press and hold the ADDR switch to change the unit's Interface address. The address will increment at 1 second intervals. The new address will take effect approximately 5 seconds after the switch is released. The 4 address LEDs represent the address in binary (0-15). All off is zero.

START The start switch is used to place the drive on and off line. In a fixed drive application, the switch will just change the READY status presented to theHost interface. In a removable drive or removable media application, the SCSI drive will be spun up or down.

READY The READY indicator next to the switch shows the current state of the Interface READY status. In a removable drive or removable media application, the READY indicator will flash when the SCSI drive is being spun up or

down. The indicator will also show drive activity by going not ready momentarily when the emulated drive is not ON-CYLINDER.

SELECT The SELECT indicator shows the drive's selected status. When On, the AEM has been selected. Some Host controllers "Poll" the connected drives. This will result in the SELECT indicator glowing at a reduced level or flickering.

WRITE PROTECT The WRITE PROT switch inhibits writing from the Host interface.
The WRITE PROT indicator shows the current write protect state. Press the switch once to assert write protect. Press the switch again to remove write protect.

FAULT The FAULT indicator shows a fault condition on the interface. Pressing the FAULT CLEAR switch will clear the fault if it is not a fatal system fault. Faults may be further explained using the LEDs at the rear of the AEMs cpu board or from the RS-232 command interface.

9.2 CENTER MOUNTED FLAT PANEL

The Center Mounted Operator Panel has two configurations, Single and Dual. The Dual panel controls two emulation systems in one Chassis .The Single panel consists of 5 switches, a Decimal LED display, and 4 LEDs. One RJ-11 terminal jack is conveniently located for connection to a Command Terminal for maintenance purposes. The switches on the flat panel type of operator panel are all momentary. The functions of the switches and LEDs are:

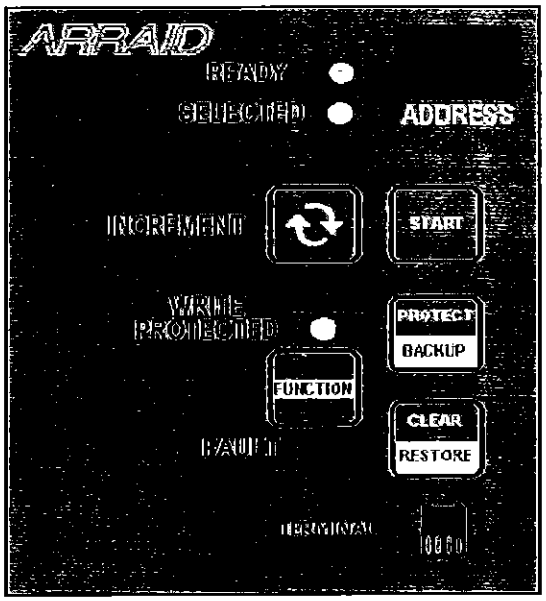


Figure 11 Center Mounted Flat Panel

INCREMENT Press and hold the INCREMENT switch to change the unit's Interface address. The address will increment at 1 second intervals. The new address will take effect approximately 5 seconds after the switch is released. The ADDRESS LED display will display the new Device address. This switch is functional only when the AEM is OFF-LINE.

START The start switch is used to place the drive on and off line. In a fixed drive application, the switch will just change the READY status presented to the Host interface. In a removable drive or removable media application, the SCSI drive will be spun up or down.

READY The READY indicator next to the switch shows the current state of the Interface READY status. READY means ON-LINE. In a removable drive or removable media application, the READY indicator will flash when the SCSI

drive is being spun up or down. The indicator will also show drive activity by going not ready momentarily when the emulated drive is not ON-CYLINDER.

SELECT The SELECT indicator shows the drive's selected status. When On, the AEM has been selected. Some Host controllers "Poll" the connected drives. This will result in the SELECT indicator glowing at a reduced level or flickering.

WRITE The PROTECT switch inhibits writing from the Host interface. Press the switch once to assert write protect. Press the switch again to remove **PROTECT** write protect. The WRITE PROTECTED indicator shows the current write protect state.

FAULT The FAULT indicator shows a fault condition on the interface. Pressing the FAULT CLEAR switch will clear the fault if it is not a fatal system fault. Faults may be further explained using the LEDs at the rear of the AEMs cpu board or from the RS-232 command interface.

FUNCTION

The FUNCTION switch alters the meaning of the PROTECT, CLEAR, and INCREMENT switches.

Press and hold the FUNCTION switch while pressing the INCREMENT switch, will increment the VOLUME (partition) number through a range of 0 to 99.

Press and hold the FUNCTION switch while pressing the PROTECT switch, will initiate an Off-Line Backup operation.
Press and hold the FUNCTION switch while pressing the CLEAR switch, will initiate an Off-Line Restore operation.

9.3 PUSH-BUTTON SWITCH OPERATOR PANELS

Push-button type operator panels are used when the AEM module sub chassis is internally mounted in a larger cabinet. This Operator panel was discontinued in 1999. The panel used in ARRAID's rack mount chassis has the following functions:

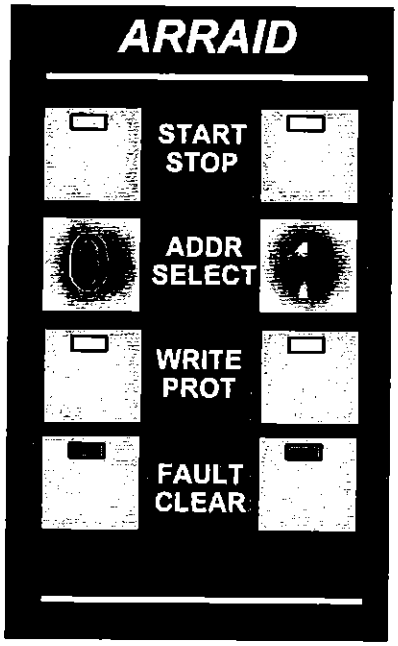


Figure 12 AEM Dual Push-button type Operator Panel

START or ON-LINE The start switch is used to place the drive on and off line. In a fixed drive application, the switch will merely change the READY status presented to the Host interface. In a removable drive or removable media application, the SCSI drive will be spun up or down.

READY The READY indicator in the START switch shows the current state of the Interface READY status. In a removable drive or removable media application, the READY indicator will flash when the SCSI drive is being spun up or down. The indicator will also show drive activity by going not ready momentarily when the emulated drive is not on cylinder.

ADDRESS PLUG The address for the unit is set by installing a numbered plug in the switch.
This plug is optional in some systems. Systems without an address plug have a SELECT indicator. Systems without an address plug may use the drive emulation configuration table to set the unit address.

SELECT The SELECT indicator shows the drive's selected status. In systems with the front panel addressing option, it is located behind, and illuminates, the ADDRESS PLUG.

WRITE PROT The WRITE PROT switch inhibits writing from the Host interface.
The WRITE PROT indicator shows the current write protect state. Press the switch once to assert write protect. Press the switch again to remove write protect.

FAULT The FAULT indicator shows a fault condition on the interface. Pressing the CLEAR switch will clear the fault if it is not a fatal system fault. Faults may be further explained using the LEDs at the rear of the AEMs cpu board or from the RS-232 command interface.

9.4 VOLUME ID SWITCH (OPTIONAL)

An optional Emulation VOLUME ID selection switch may be installed to select the current partition (volume) of a multi-volume SCSI drive. Changing this switch setting, while on-line, will spin down the SCSI drive and restart the drive with the newly selected volume of a multi-volume drive. See section 11 page 39.

9.5 INTERNAL DIP SWITCHES

In addition to the operator panel, DIP switches are provided on the rear of the CPU board (lower board). The switches may be used in place of the operator panel, or to override some of the Operator panel functions. Refer to section 15.5.2 page 66 for setup.

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10 SCSI DISK DRIVES

The AEM uses SCSI disk drives to store the emulated drive's image. Most SCSI drives may be used if they have a single ended interface. System performance is largely influenced by the SCSI drive's characteristics. Therefore, care should be taken when choosing a drive to be used in the AEM. Mere capacity is only one consideration. Factors such as drive rotational speed, sector interleave, power managment, thermal calibration, internal transfer rate, and caching capability are equally important considerations. Please contact ARRAID for information regarding your application and a specific SCSI drive. SCSI drives appear defect free to the host user. Therefore, the drive emulation will present a defect free Disk Drive image to the Host controller.

10.1 DRIVE CAPACITY

The capacity required for a particular single volume emulation may be determined as follows:

STEP 1. Determine the number of tracks to be emulated by multiplying total Emulated heads by total Emulated cylinders in the drive to be emulated.

STEP 2. Determine the emulated drive's track capacity in bytes (unformatted). Do not use the formatted capacity for this purpose.

STEP 3. If ADDRESS MARKS are to be used;

Multiply the Emulated track length by 16/15^{ths} then divide the result by 512. The 16/15^{ths} factor is the overhead for address marks. Round up to the next whole integer (the AEM uses 512 byte blocks in the SCSI drive). This is the number of blocks required to hold one SMD track with address marks.

If ADDRESS MARKS are not to be used;

Divide the Emulated track length by 512. Round up to the next whole integer (the AEM uses 512 byte blocks in the SCSI drive.) This is the number of blocks required to hold one Emulated track without address marks.

STEP 4. Multiply step 3's result by the number of tracks determined in step 1. Add 1. The result is the total number of formatted SCSI 512 byte logical blocks required for this emulation.

Additional blocks may be required by the SCSI drive for its defect management. Excess capacity will not be used by the AEM.

The following Table 3 illustrates some common sizes.

DRIVE EMULATION	#of CYLs	#of HDs	#of TRKS	TRK LEN	BLKS/ TRK**	# of SCSI BLKS	REQUIRED SCSI CAP
80 MB	823	5	4,115	20,160	42	172,830	90 MB
160 MB	823	10	8,230	20,160	42	345,660	172 MB
315 MB	823	19	15,637	20,160	42	656,754	328 MB
330 MB	1,024	16	16,384	20,160	42	688,128	344 MB
340 MB	711	24	17,064	20,160	42	716,688	358 MB
515 MB	711	24	17,064	30,240	63	1,075,032	537 MB
1230 MB	1,635	15	24,525	50,400	105	2,575,125	1,287 MB
						** including Address Mark factor	

Table 3 REQUIRED SCSI CAPACITIES

10.2 SCSI DRIVE CONFIGURATION

The SCSI drive should be configured without terminators (the SCSI bus termination is provided within the AEM unless otherwise configured from the ARRAID factory). Fixed drives should be set to SCSI ID zero. Removable drives should be connected to the remote SCSI ID jumpers inside the canister. Their SCSI ID will then be defined by the base receptacle in which they are inserted. Drives inserted in the primary receptacle will be set to SCSI ID zero and drives installed in the optional backup drive receptacle will be set to the SCSI ID as defined in the AEM's System configuration table. (see section 15.4.4.1 page 61)

PLEASE NOTE:

If the SCSI drive uses power management, or thermal re-calibration, these features must be disabled. If the drive performs periodic thermal re-calibration, it may interfere with the real time availability of the drive. This is unacceptable for many applications. If the drive has a power management feature that causes it to go into a standby mode after periods of inactivity, this may require long restarting periods that will be unacceptable to many applications.

All SCSI drives used in an AEM system should be configured for:

- spin-up at power on,
- disabled delayed spin-up
- parity enabled,
- TERMPWR supplied by the AEM,
- no spindle sync,
- no thermal recalibration,
- disabled power management.

If SCSI-2 fast drives are used, the AEM may be configured to use their higher speed capability. (refer to section 15.3.5.1 page 59)

10.3 REMOVABLE DISK DRIVES

If the AEM is equipped with a removable disk drive, the drive will be powered up and down by the ON-LINE switch. The drive should only be removed when the READY indicator is off or not flashing.
The AEM drive receptacle is equipped with a key switch which must be in the locked position before the drive will spin up. If the ON-LINE switch is pressed without the key switch locked, the FAULT indicator will flash momentarily. If the key switch is unlocked while the drive is ON-LINE, the system will go OFF LINE and the drive will be spun down. The drive should not be removed until the system is "not ready" (the READY indicator has stopped flashing). If the internal DIP switch is set to the ON-LINE position, locking the key switch will cause the AEM to go ON-LINE.

10.4 REMOVABLE MEDIA CARTRIDGE DRIVES

Insert and remove the media cartridge according to the drive manufacturer's instructions. After a cartridge is installed, the user may place the AEM "ON-LINE". When the media has been spun up, the cartridge will be locked and the AEM will go READY. The cartridge cannot be removed until the AEM is placed OFF LINE (not READY). Some removable media may be received in a Software Write Protected condition. To use this media, it must be reformatted prior to use.

10.5 FORMATTING NEW DISK DRIVES or MEDIA

Drives or cartridges that are new from the manufacturer should be formatted at 512 bytes per logical block. Drives intended for non 512 byte block applications will require reformatting. The AEM provides a means to do this using a terminal command. Some SCSI drives will not allow reformatting. They will usually require a return to the manufacturer to be reformatted. Please contact ARRAID Technical support department for assistance.

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10.6 INITIALIZING NEW DRIVES

SCSI drives new to the AEM, or drives that have been used in other applications should be initialized or "cleaned" prior to using them on the AEM. The "CLEAN" command has been provided for this purpose. The cleaning process will write zeros to all blocks on the drive used by the current emulation. This assures that all address marks have been erased and will not result in false address marks for the current emulation (see section 17.2, 17.2 page 78).

10.7 TESTING SCSI DRIVES

The AEM can be used to test a SCSI drive by using the "VCOPY" terminal command (see page 80). If VCOPY is started with the write protect switch activated, the drive will be read only. This provides a means for testing the integrity of the Emulated image without destroying information on the drive. If the Maintenence Mode is enabled while the VCOPY command is running, drive perfomance statistics will be continuously displayed on the terminal. The "STEST" command (see page 95) will provide a complete functional test of the SCSI drive. Care should be taken using the STEST command, as it will destroy all customer data and Emulated images on the drive under test.

11 MULTI-VOLUME DRIVE PARTITIONING

More than one emulated image may be stored on a SCSI drive if the drive has sufficient capacity. For example; a 2 GB disk drive may hold up to six 300 MB images. Each Emulated image partition (VOLUME) is stored consecutively so that volume 0 is the first volume on the disk, volume 1 is the second volume, volume 2 is the third etc.

An optional Multi-Volume ID switch may be located on the front panel of the AEM. The VOLUME ID switch setting defines which volume of a multi-volume drive is currently being used. Up to eight volumes may be selected using the VOLUME ID switch.(Eighty volumes are available on special order) Additional volumes are available to multi-volume terminal commands such as VCOPY. If the multi-volume switch is installed, one selected volume (from zero to seven or zero to seventy nine) may be placed ON-LINE.

Several of the terminal commands will address multi-volumes. However, without the multi-volume option installed, only volume zero can be placed ON-LINE.

12 MULTI-VOLUME FILE SERVERS

The AEM with the Multi-Volume support option is available with a large capacity storage device. Multiple AEMs may be interfaced to a common file server. Up to eighty volumes on one file server can be addressed by each AEM. File sharing (volume sharing) is not supported within the AEM. Each AEM must be addressed to a unique volume. Only one AEM should be set to address a particular volume on the common file server at one time.

NUMBER OF VOLUMES PER SCSI DRIVE or FILE SERVER

VOLUME SIZE	SCSI DRIVE or SERVER SIZE in MBYTES								
	540	1,020	1,080	1,280	2,160	4,320	9,000	24,000	36,000
80 MB HS	6	12	12	15	25	51	80	80	80
80 MB SS	6	11	12	14	24	48	80	80	80
160 MB HS	3	6	6	7	12	25	53	80	80
160 MB SS	3	5	6	7	12	24	50	80	80
315 MB HS	1	3	3	3	6	13	28	74	80
315 MB SS	1	3	3	3	6	12	26	71	80.
340 MB HS	1	2	3	3	6	12	25	68	80
340 MB SS	1	2	2	3	5	11	24	65	80
515 MB HS	1	1	2	2	4	8	17	45	68
515 MB SS		1	1	2	3	7	16	43	65
675 MB HS		1	1	1	3	6	13	34	52
675 MB SS		1	1	1	2	5	12	33	49
1250 MB HS					1	2	5	15	23
1250 MB SS					1	2	5	14	21

HS = without address marks SS = using address marks

Table 4 MULTI-VOLUME DRIVE CAPACITIES

13 SAFETY, HANDLING, AND ELECTROSTATIC DISCHARGE PROTECTION

13.1 SAFETY PRECAUTIONS

For your safety, follow all safety procedures described here and in other chapters of this manual.

- Power must be removed from the AEM system before installing or removing the covers to prevent the possibility of electrical shock. Unplug the AEM to provide an added measure of safety.
- Read, understand, and observe all label warnings.

13.2 HANDLING

Damage to the AEM circuit boards or disk drive can occur as the result of careless or rough handling, vibration, shock or ESD. Always handle the drive with care to avoid damage to the precision internal components.

Follow these guidelines to avoid damage to the AEM or disk drive:

- Always observe prescribed ESD precautions
- Keep drives in an antistatic bag until ready to install into canisters
- Always use a properly fitted wrist strap or other suitable ESD protection when handling the circuit boards or bare drive
- Hold bare drive only by its sides. Do not touch any components on the PCB.
- Always handle the drive carefully and gently.
- Do not bump, jar, or drop the drive. Be careful when using trolleys, carts, and other equipment to transport the drive.
- Ensure shipping containers are protected from shock and vibration. Avoid transporting disk drives over rough surfaces (i.e., rolling a shop cart containing drives over expansion joints, Power cords, etc.)
- Always gently place the drive flat, PCB side down, on an appropriate ESD-protected work surface to avoid being accidentally knocked over.
- Do not pack other materials with a drive in the shielded bag.
- Do not place drives in shipping container or packaging foam unless in the antistatic bag.
- Do not stack drives upon one another or other objects upon the drive
- Never force the drive or drive bracket assembly into the drive bay.
- Do not expose the drive to moisture.
- Avoid damaging the tape seal on the drive's HDA. Doing so will void the warranty.

13.3 ELECTROSTATIC DISCHARGE (ESD) PROTECTION

Various electrical components within the AEM or disk drive are sensitive to static electricity and electrostatic discharge (ESD). Even a static buildup or discharge that is too slight to feel can be sufficient to destroy or degrade a component's operation.

When installing SCSI drives into ARRAID provided canisters, please observe the following precautions to avoid ESD-related problems:

- Leave the drive in its antistatic bag until you are ready to install it in the canister.

- Use a properly installed antistatic pad on your work surface.
- Wear wrist straps properly and observe proper ESD grounding techniques.
- Do not touch any components on the PCB.
- Handle or touch the drive by its sides only.
- Place the drive on a properly grounded antistatic work surface pad when outside of its protective antistatic bag.
- Do not use the bag as a substitute for the work surface antistatic pad. The outside of the bag may not have the same antistatic properties as the inside. It could actually increase the possibility of ESD problems.
- Do not use a ohmmeter or other test equipment to check components on the PCB. There are no user-serviceable components on the drive.

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14 INSTALLATION

14.1 SHIPPING DIMENSIONS

The table top AEM systems are shipped in a box 15.5"H x 22.5"W x 25.5"D. Shipping weight is less than 40 lbs. The rack mount systems are shipped in a box 12"H x 24"W x 32"D. Shipping weight is less than 36 lbs.

14.2 INSTALLING RACK MOUNT SYSTEMS

The rack mountable version of the AEM is designed to be installed in a standard RETMA rack. The AEM may be supported by a shelf or by the mounting thumbscrews. Option 5 may be purchased to provide this support. To install the AEM in the RETMA rack, remove the AEM's front bezel. It is held on by spring clips. Some models have cable connections that must be disconnected with care prior to removal of the bezel. After installation in the rack, the bezel may be reinstalled.

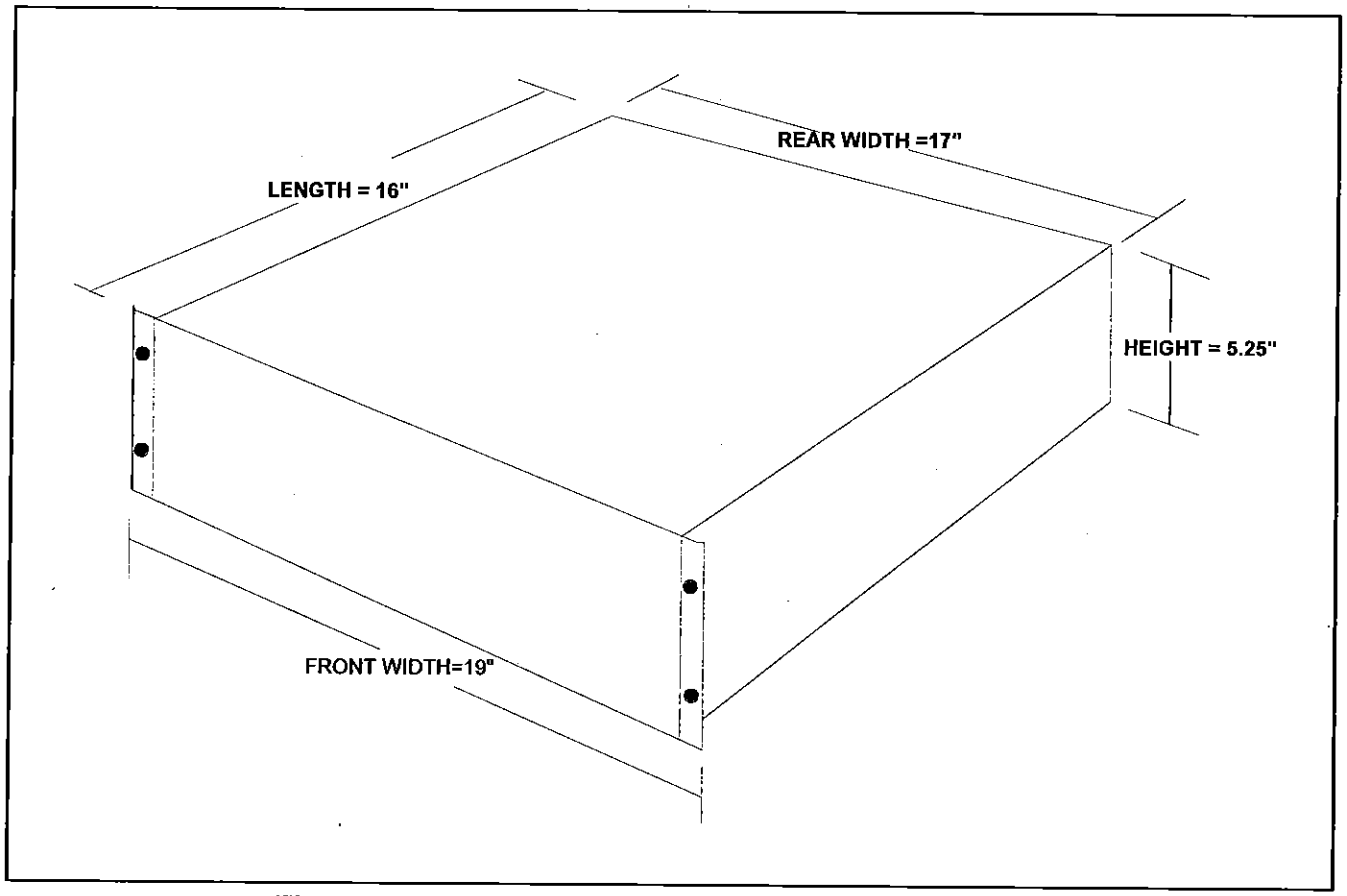

Figure 13 AEM RACK MOUNT OVERALL DIMENSIONS

14.3 CONNECTING THE HOST INTERFACE

Before installing the interface cables, check and set the power input voltage selection located next to the power supply. Install the interface cables in their respective connectors, taking care to prevent the interface cables from blocking exhaust air at the rear of the unit. The AEM may be daisy chained with other AEM modules or other Original type Drives. Each drive module must have its own "B" cable connected to the controller. The "A" cables may be daisy chained using either connector as the input or output. Refer to **Figure 14** for cabling configuration example.

> ***Please Note:***
> *Only cables designed to meet the SMD specification should be used to connect the AEM to the host controller. The B cables should be of the type that has a ground plane within the cable to control the cable's impedance. Using any other cable configuration may result in unreliable operation due to noise from signal reflections within the uncontrolled impedance cable. Some SMD controllers are sensitive to B cable length. These controllers will experience intermittent "data" or "addressing" errors if the length of the B cable is not optimized. Please consult your* ***ARRAID*** *technical representative if in doubt.*

14.4 INTERFACE CABLE TERMINATION

If the AEM is the last drive on the chain, a terminator must be connected to the unused interface connector. For SMD and HISI models, a separate ground is provided for the Terminator adjacent to the Interface "A" connectors.

Any standard Original terminator may be used with this system provided it is mechanically compatible. Terminator ground is provided for each port. A good chassis ground connection should be provided between the Host system controller chassis and the AEM chassis.

14.5 HISI TERMINATION

The Standard SMD terminator may be used in the 60 pin HISI interface connector. In a block connector environment, the Standard HISI Block version terminator should be used. A separate ground is provided for the Terminator adjacent to the Interface "A" connectors.

14.6 SYSTEM GROUND CONNECTION

The AEM should be connected to the controller's system common ground connection using a separate .25 inch braided ground strap. A ground lug is provided at the rear of the AEM for this purpose. Each AEM module should be grounded to the host controller in a daisy-chain sequence identical to the daisy chained "A" cables as shown in **Figure 14.** This will prevent common mode noise from affecting operation of the drives. If the optional Dual Port interface is used, a separate ground should be connected to each host controller.

14.7 OPTIONAL TERMINATOR GROUND

In some SMD interfaces, pins 30 and 60 of the "A" interface cable (daisy chained cable) are used as the terminator return current path. When the AEM is used in these systems, jumpers (E1, E2, E8 & E9) must beinstalled in the AEM-1's SMD interface PCB to connect the AEM-1 signal ground to pins 30 and 60 of the "A" Cable. (Jumpers E3 and E10 must also be removed.) (This feature is not present in the AEM-3 or AEM-5)

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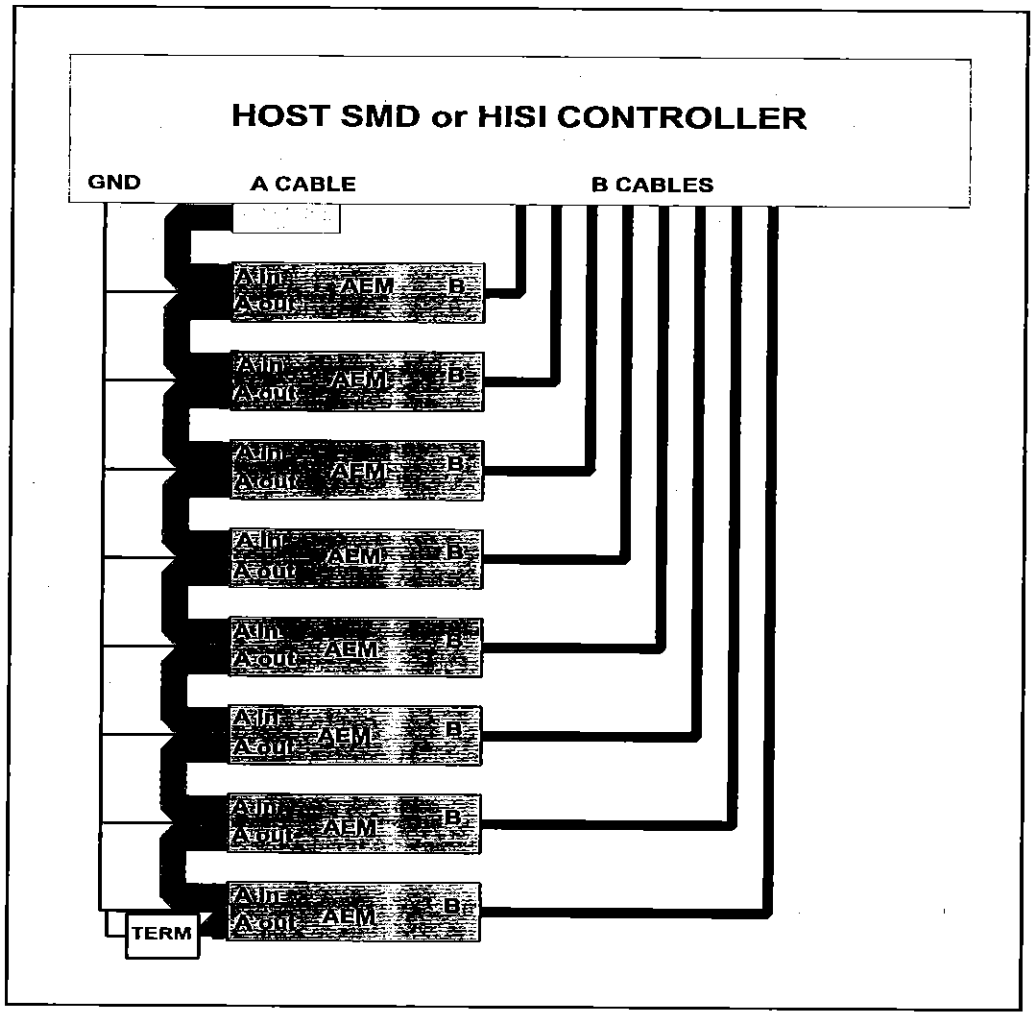

Figure 14 TYPICAL SYSTEM CABLING (SINGLE PORT)

A block cable interface can be provided by using optional cable converters (OPT-12). Contact ARRAID, Inc. for more information.

The SMD and HISI interface uses standard Motorola MC3450 and MC3453 level translators for all control and data signals. For high speed SMD-E emulations, it can optionally use the 10192 (ECL) drivers for the data signals by changing the jumpers on the SMD board.

14.8 UPS CONNECTION

The AEM may be used with a UPS system. The UPS must be connected to the AEM in order to initiate the power failure sequencing in the AEM. The AEM system may also be used to initiate shut down of the UPS when it has completed the drive spin-down.

Figure 15 illustrates a typical UPS installation. If the AEM is purchased with the optional built-in UPS power supply, it will be internally connected in this manner. The UPS interface is also available at the rear of the AEM chassis for connecting additional external UPS systems.

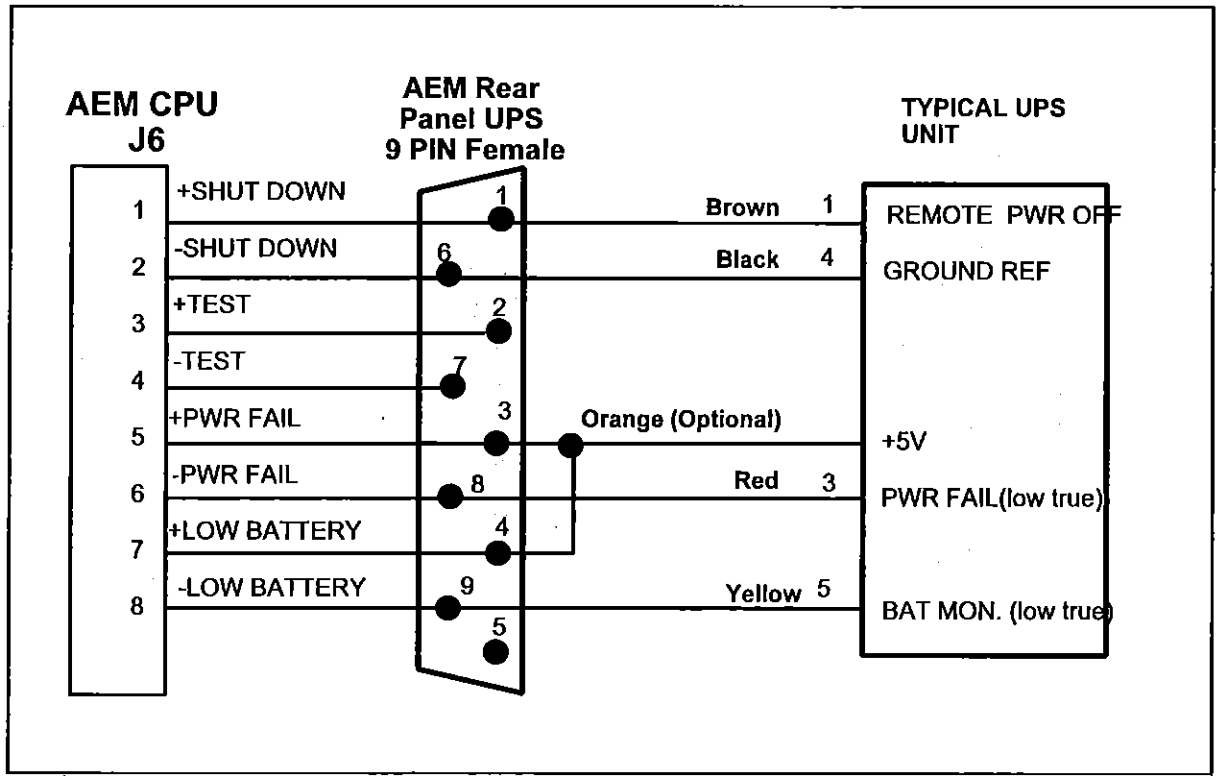

Figure 15 TYPICAL UPS CONNECTION

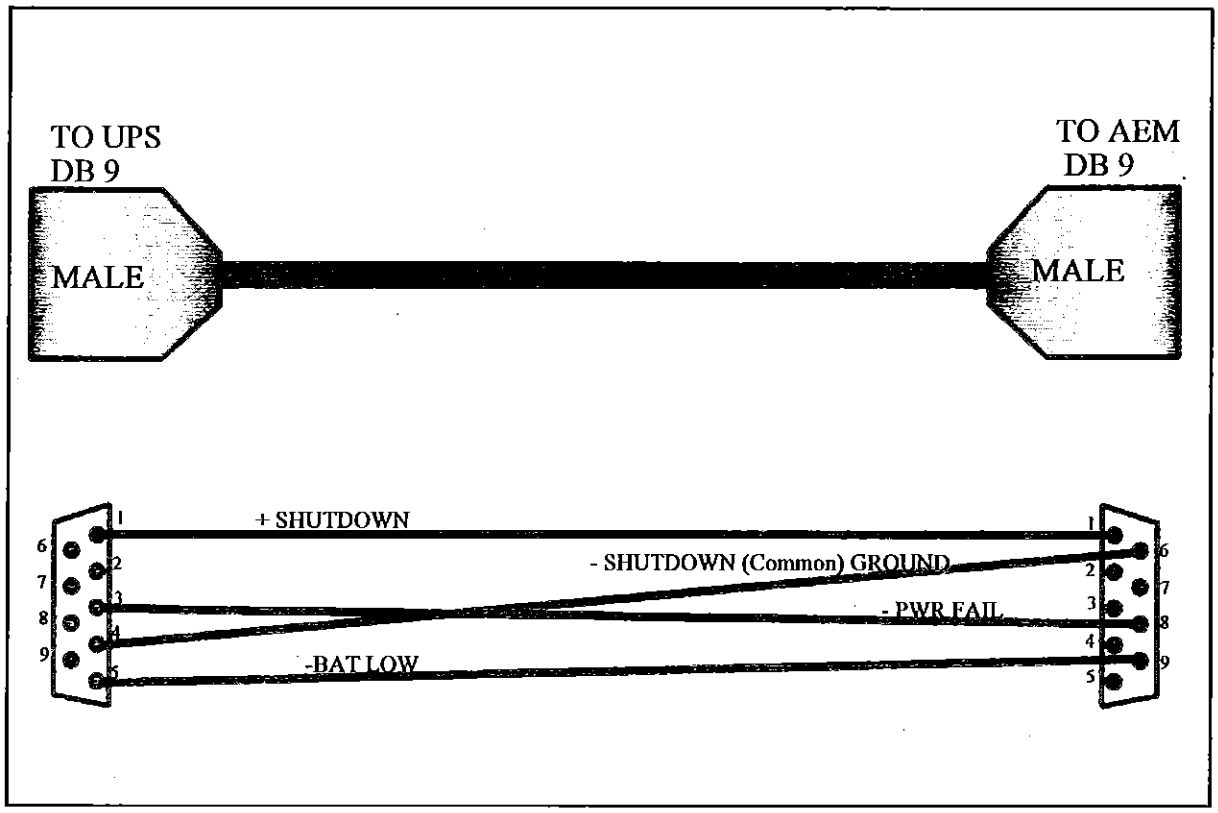

Figure 16 Typical UPS Cable

15 CONFIGURATION

15.1 CONFIGURATION OVERVIEW

This section contains general guidelines for configuration of ARRAID's AEM product family. The AEM is designed to handle the majority of Host applications with simple configuration changes. The following sections contain information for changing the hardware and software configuration of the AEM. It is assumed the reader is conversant with Legacy disk drives and with the characteristics of the drive to be emulated.

Changing the configuration requires the use of the AEM Command Interface. Please refer to the section on Command Interface Language. (see section 17 page 72)

Please note the firmware revision number listed in this document's revision log. When the AEM is powered on, it will display its revision. Please be sure the revisions match. Parameters may be defined differently when software revisions change.

15.2 AEM FIRMWARE FILE STRUCTURE

The firmware files used by the AEM are stored in a non-volatile FLASH memory. When the system is initialized, the firmware loads the appropriate modules as needed into RAM. These modules are identified by a 'Directory' also located in FLASH. Among these files are system configuration tables and emulation configuration tables. Drive emulation changes are accomplished by changing configuration parameters (Variables) in the emulation Configuration Table. The overall AEM hardware system configuration is defined and controlled by the System Configuration Table.

Changes are made only to the currently active table. To select an emulation table and make it active: Use the "Change Table" (CT) command.

Each parameter or variable in the configuration file consists of a NAME and a VALUE. The command interface provides a means to modify the value of each parameter, check the change for validity, and write the changes to FLASH. The commands for saving emulation configuration changes and system configuration changes are different. Make sure you are using the correct command.

After changes are made and written to FLASH, the system will not go ON-LINE until the system is rebooted. Cycling power will cause the system to use the new configuration.

15.3 DRIVE EMULATION CONFIGURATION

The parameters discussed in this section are those that control or affect the emulation process. These parameters, when correctly programmed, make the AEM appear to be the same device as the one being replaced.

Parameter values are always numeric. The number can have several different meanings: On/Off parameters use 0 for OFF and 1 for ON. Mode parameters use 0, 1, 2, etc. Flag parameters are numeric values where each bit of the value in binary has a specific meaning. Numeric parameters use the actual value of the parameter. The discussion below describes each parameter and its correct use.

15.3.1 PHYSICAL DRIVE CHARACTERISTICS:

These parameters define the physical architecture of the drive being emulated. In most instances, these parameters should be set to the same values as the drive being replaced. Unless otherwise noted, all parameters apply to both SMD, Multiplexed (HISI), and Pertec/Diablo Interfaces.

15.3.1.1 MAX_CYL

MAX_CYL= 1 - 1023 (if using SMD mode 0 or 1)
1 - 2047 (if using SMD mode 2)
1 - 4095 (if using SMD mode 3)

This value is set to the maximum legal cylinder value. For example; if the emulated drive's number of cylinders = 823, then MAX_CYL is 822.

15.3.1.2 MAX_HD

MAX_HD= 0 - 63 (if using SMD mode 0, 1 or 2)
0 - 31 (if using SMD mode 3)

This value is set to the maximum legal head value. For example; if the emulated drive's number of heads = 19, then MAX_HD is 18.

If a custom disk drive geometry is being defined, please note that the total number of logical tracks (# of cylinders multiplied by the total number of heads) cannot exceed 65535.

15.3.1.3 TRACK_LEN

TRACK_LEN= 30720 max (if AM_MODE=1 AEM-1,3A)
32767 max (if AM_MODE=0 "")
61440 max (if AM_MODE=1 AEM-1B or AEM-1,5C)
65535 max (if AM_MODE=0 AEM-1A or AEM-1,5C)

The track length should be set to the same value as the drive being replaced. The raw (unformatted) value of the old drive should be used, not the formatted value. Note that the maximum track length value is a function of the AEM track buffer memory configuration.

15.3.1.4 NUM_SCTRS

The number of sectors is determined by the sector length. It is not separately programmable. Only the SCTR_LEN variable may be changed. The NUM_SCTRS will be automatically calculated when the parameters are saved to Flash. If the TRACK_LEN is not equally divisible by the SCTR_LEN, a runt sector results and the number of sectors is rounded up to the next integer value.

15.3.1.5 SCTR_LEN

SCTR_LEN= 1 to 65535 half bytes

The sector length value is in 1/2 byte increments. Some drives used bytes as the divisor and some used dibits which is equal to 1.5 data bytes. This is the total sector length. Not merely the data field length.

SCTR_LEN = bytes / sector * 2 or
SCTR_LEN = dibits / sector * 3

Setting SCTR_LEN to 0 or 1 will disable all sector pulses.

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15.3.1.6 SMD_MODE

SMD_MODE= 0 - 3 MODE

The SMD mode parameter controls the type of SMD interface. The SMD MODE will also affect the drive's cylinder and head addressing range. (see section 15.3.1.1)

SMD mode 0 is for older style CDC drives: SMD, FMD. (SMD, HISI, and Diablo/Pertec interfaces)

SMD mode 1 is for newer style drive like the FSD. (SMD and HISI only) The difference between mode 0 and 1 is the handshaking of ON CYLINDER when a seek error occurs. This would only show up during a diagnostic testing of the response to illegal seeks. If one mode fails the diagnostic, try the other.

SMD mode 2 is for drives using extended cylinder addressing (SMD-O). (SMD interface only) SMD-O uses the previously undefined signal pair of pins 30, 60 on the A-Cable for cylinder bit 2^{11} to extend the number of cylinders.

SMD mode 3 is for SMD-E drives. SMD-E is the newest version of the SMD interface. Some SMD-E drives may operate in either SMD mode 2 or 3. (SMD interface only)

15.3.1.7 AM_MODE

AM_MODE = 1 (ON) supports hard and soft sector with Address Marks.

0 (OFF) is hard sector only, Address Marks must not be used in the drive's track format. Mode 0 reduces overhead and required SCSI drive capacity by 6.67%.

15.3.1.8 XLAT_TBL

XLATE_TBL = 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9 NUM

0 = Normal HEAD and CYLINDER to AEM logical track translation.

1 = Special translation for CDC 9448 CMD Fixed/Removable drive emulation.
CMD Volume 0 (SMD Head 0) and CMD Volume 1 (heads 16 - 20) translate to consecutive logical track numbers. All tracks will be written to one SCSI drive. The drive may be either fixed, removable, or a removable media cartridge type drive. The Backup and Restore commands will combine both Fixed and Removable portions of this emulation on to one backup drive.

2 = Special translation for CDC 9448 CMD Fixed/Removable drive emulation. This emulation uses two SCSI drives. One is fixed and the other is a removable type.
CMD Volume 0 (SMD Head 0) translates to first 823 logical tracks, CMD Volume 1 (heads 16-20) translates to logical track 823 and up. Tracks for CMD Volume 0 (Head 0) will be written on the removable portion of the CMD emulation at SCSI ID defined in COPY_ID, Tracks for CMD Volume 1 (heads 16-20) will be written to the SCSI drive at SCSI ID 0.

3= Special inverted translation for CDC 9448 CMD Fixed/Removable drive emulation. This emulation uses two SCSI drives. One is fixed and the other is a removable type. CMD Volume 0 (SMD Head 16) translates to first 823 logical tracks, CMD Volume 1 (head 0 - 5) translates to logical track 823 and up. Tracks for Head 16 will be written on the removable portion of the CMD emulation at SCSI ID defined in COPY_ID, Tracks for heads 0-5 will be written to the SCSI drive at SCSI ID 0.

4 = Special translation for CDC 9448 CMD Fixed/Removable drive emulation. (Same as XLAT_TBL=1). However, if this emulation is used with the AEM BACKUP option, the high order surface will not be included in the Backup. Nor will it be restored. This allows most of a CDC9448 CMD emulation image to be backed up to a small removable media drive.

5 = Special translation for CDC 9448 CMD Fixed/Removable drive emulation. CMD Volume 0 (SMD Head 0) translates to first 823 logical tracks, CMD Volume 1 (heads 16-20) translates to logical track 823 and up. All tracks will be written to one SCSI drive. The drive may be either fixed, removable, or a removable media cartridge type drive. This emulation allows for separation of the Fixed and Removal portions of the SMD image during Backup and Restore.

6 = Special inverted translation for CDC 9448 CMD Fixed/Removable drive emulation. CMD Volume 0 (SMD Head 16) translates to first 823 logical tracks, CMD Volume 1 (head 0 - 5) translates to logical track 823 and up. All tracks will be written to one SCSI drive. The drive may be either fixed, removable, or a removable media cartridge type drive. This emulation allows for separation of the Fixed and Removal portions of the SMD image during Backup and Restore.

7 = Special translation for Fixed/Removable drive emulation. Dual Platter drives where one platter is removable and one is fixed use this table to cause one platter to use the Primary SCSI drive, and the other to use a Second SCSI drive.

8 = Special translation for Fixed/Removable drive emulation. Dual Platter drives where one platter is removable and one is fixed use this table to combine the images of all tracks on one Primary SCSI drive. The Fixed drive tracks(lower order half of head numbers) will be stored in the first half of the total tracks. The High order number of heads will translate to the high order half of track numbers All tracks will be written to one SCSI drive. The drive may be either fixed, removable, or a removable media cartridge type drive. The Backup and Restore commands will ask which partition to send to the Backup Device.

9 = Same as translation table 7 except, if the Multi-Volume feature is installed, the Fixed drive emulation always uses Volume Zero. Only the Removable drive portion of the emulation responds to the Multi-Volume selection.

15.3.1.9 SEL_MODE

SEL_MODE=0, 1 or 2 MODE (AEM-1 SMD interface only)

This parameter defines the type of unit select logic employed. (AEM-3 and AEM-5 use SEL_MODE=0)

mode 0 = normal select mode. The select operation occurs immediately upon the leading edge of the unit select tag signal.

mode 1 = Delayed select. The select operation occurs after a 125 - 500ns delay from the leading edge of the unit select tag signal.

Mode 2 = Latched select mode. The selected signal is latched until a subsequent unit select tag is issued with a different address contained in the unit select address lines. This mode is often used for CDC 9448 CMD emulation.

15.3.1.10 UNIT_ID

UNIT_ID= 0 to 255 NUM

This parameter defines the ID number reported during a special TAG sequence for SMD-E and HISI drives. The value should be set to the ID of the unit being replaced. On all other types of drives this value is not used. (Do not confuse this parameter with the Interface address parameter UNIT_ADD. They are not related)

If UNIT_ID is set to 255, the AEM will power up with the trace mode on. This is useful for debugging and system integration purposes.

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15.3.1.11 RTZ_TICKS

RTZ_TICKS= 0 to 50 (x10ms) Return To Zero seek time

This controls the amount of time ON CYLINDER is held in the off state during an RTZ operation. For most emulations, a value of 20 (200ms) is standard.

NOTE: A value of 0 will cause the AEM to be OFF CYLINDER for a time proportional to the cylinder position at the time the RTZ command is issued.(10ms to 500ms)

15.3.1.12 INDX_WIDTH

INDX_WIDTH= 0 to 255 (AEM-5C only)

This variable allows the index and sector pulse widths to be adjusted. The unit of adjustment is 1/8th of the interface crystal frequency period. The sector and index pulse widths will be of equal width.

15.3.1.13 INDX_OFFSET

INDX_OFFSET= 0 to 255(AEM-5C only)

This variable allows positioning of the index pulse between the last and first sectors. In order for this option to take effect, OPTS1 - ENABLE INDX DELAY must be enabled. The unit of adjustment is 1/8th of the interface crystal frequency period.

15.3.1.14 OPTS (AEM-5C only)

OPTS= 0 to 65535 (AEM-5C only)

Two 16 bit option tables (OPTS lsb and OPTS msb) are used to define additional emulation characteristics of the AEM-5. OPTS value is the sum of all bits to be set in both lsb and msb.

Example - A 36 sector device with two platters, each containing two heads with heads 0 and 1 reversed, attentions equal to on cylinder would have a setting of OPTS=337 (256+64+16+1=337).

OPTS (least significant byte)								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG	AND Cyl Stb 2 RTZ	Enable > 32 Sectors	Enable Head 4	Enable Platter	Enable Cyl 256	Invert Head 4	Invert Platter	Invert Head 1

The above decimal values have the following meaning:

1	Invert Head 1	Reverses head 0 and 1 addressing
2	Invert Platter	Reverses the fixed and removable platter. CAUTION: This option will affect data placement on the removable media.
4	Invert Head 4	Reverses head bit 4 addressing. This option is only used on special versions emulating eight heads
8	Enable Cyl 256	Used to enable emulations having more than 256 cylinders. (See MAX_CYL)
16	Enable Platter	Used to enable 4 head emulation. (See MAX_HD)
32	Enable Head 4	Used to enable 8 head emulation. (See MAX_HD)
64	Enable > 32 Sectors	Enables another sector counter bit on emulation having more than 32 sectors.
128	AND Cyl Stb 2 RTZ	Cylinder strobe Anded with RESTORE, Enable for RK05 emulation.

OPTS (most significant byte)								
BIT	15	14	13	12	11	10	9	8
VALUE	32768	16384	8192	4096	2048	1024	512	256
FLAG	2in1		Slow Seek	Early ACK	Disable WP in	Pulse ATTN	Invert ATTN	ATTN = ONCYL

The above decimal values have the following meaning:

256	ATTN =ONCYL	Attention bit at the interface mimics ON CYLINDER status
512	Invert ATTN	Used to invert polarity of the Attention lines.
1024	Pulse ATTN	Attention condition is pulsed instead of DC level.
2048	Disable WP in	Write Protect In interface signal is disabled.
4096	Early ACK	Early Cyl Strobe Acknowledge (~ 1usec) (normal = ~ 3 usec)
8192	Slow Seek	Slow Seek requires 2 Index pulses to go on-cylinder, Normal requires 2 Sector pulse times to go On-Cylinder after a seek command.
32768	2 in 1	Respond as Two Devices, Even and Odd IDs (RK05 only).
Bit 14 (Un-assigned)		

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15.3.1.15 OPTS (AEM-6C only)

OPTS= 0 to 65535 (AEM-6C only)

Two 16 bit option tables (OPTS lsb and OPTS msb) are used to define additional emulation characteristics of the AEM-6. OPTS value is the sum of all bits to be set in both lsb and msb.

Example - To emulate the HP7905 and allow formatting the OPTS value would be 9 (8+1)

OPTS (least significant byte)								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG				Drive Type 1	Drive Type 0	Write Protect Fixed	Write Protect Removable	Format Switch

The above decimal values have the following meaning:

1	Format Switch	Provides Host with status to allow Formatting.
2	Write Protect Removable	Provides Host with status to protect the Removable Image
4	Write Protect Fixed	Provides Host with status to protect the Fixed Image
8	Drive Type 0	Provides Drive Type status to Host (See table below)
16	Drive Type 1	Provides Drive Type status to Host (See table below)
32	Un-assigned	
64	Un-assigned	
128	Un-assigned	

Drive type	Drive Type 1	Drive Type 0	Value
HP7906	0	0	0
HP7920	0	1	8
HP7905	1	0	16
HP7925	1	1	24

OPTS (most significant byte)								
BIT	15	14	13	12	11	10	9	8
VALUE	32768	16384	8192	4096	2048	1024	512	256
FLAG								

The above decimal values have the following meaning:

Bits 8-15 (Un-assigned)

15.3.1.16 OPTS (AEM-7C only)

OPTS= 0 to 65535 (AEM-7C only)

Two 16 bit option tables (OPTS lsb and OPTS msb) are used to define additional emulation characteristics of the AEM-7. OPTS value is the sum of all bits to be set in both lsb and msb.

Example - To emulate the HP7900 and allow formatting the OPTS value would be 1.

OPTS (least significant byte)								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG						Write Protect Fixed	Write Protect Removable	Format Switch

The above decimal values have the following meaning:

1	Format Switch	Provides Host with status to allow Formatting.
2	Write Protect Removable	Provides Host with status to protect the Removable Image
4	Write Protect Fixed	Provides Host with status to protect the Fixed Image
8	Un-assigned	
16	Un-assigned	
32	Un-assigned	
64	Un-assigned	
128	Un-assigned	

OPTS (most significant byte)								
BIT	15	14	13	12	11	10	9	8
VALUE	32768	16384	8192	4096	2048	1024	512	256
FLAG								

The above decimal values have the following meaning:

Bits 8-15 (Un-assigned)

15.3.2 DUAL PORT OPTION SUPPORT

The AEM-1 system may be equipped with an optional second SMD port for connection to a second computer or controller. The Dual Port option functions exactly like the original Control Data SMD drives. In addition the Dual Port feature may be made to look like a modified version of the SMD dual port feature employed by Fault Tolerant computers such as those made by TANDEM and others. (A dual port option is not available for HISI interface systems)

15.3.2.1 REL_TICKS

REL_TICKS= 0 to 50 (x10ms) Dual Port Release time (RTM mode)

Applicable to Dual Port systems only. This controls the duration of the Dual Port release timer in RTM mode. A value of 50 (500ms) is standard. Controllers that poll both ports may used a modified RTM timer. This value can be adjusted to be compatible with those controllers.

15.3.2.2 PRI_SEL_MODE

PRI_SEL_MODE= 0, 1, or 2MODE (SMD interface only)

1 - is the enable mode for standard priority select.

2 - is a special priority select mode used by fault tolerant computers. It allows control to be regained by the other port.

0 - disables priority select mode. This should be used in dual port systems when the controller does not support priority select. These controllers typically leave a critical I/O line floating which could cause an errant priority select.

15.3.3 AEM CACHE MANAGEMENT AND CONTROL

The AEM system emulates a Disk drive using a RAM buffer to emulate the current logical track (the cylinder and head currently selected). When a track is selected, the data for that track is retrieved from the SCSI drive and placed in the Track Buffer. In addition there are at least 63, and optionally, up to 1023, additional Logical tracks that may be held in the Cache buffer.

This Cache is managed by the AEM hardware using a Least Recently Used (LRU) buffer management scheme. The cache is broken up into Sets of Track Buffers. Each set is examined by the hardware, when a particular track is selected, to see if the track is already present in the cache. If so, the seek or head selection process is completed immediately thereby enhancing the AEM's performance. If the track is not present in the cache, the buffer with the least recently used track will be reassigned to the new track which will then be read in from the SCSI drive.

The cache is not a write through cache, therefore, writes will be delayed until either: time is available to perform the write operation; or all buffers are full in which case, the write is performed to release the buffer for the new track to be read.

A read-ahead feature is available to "prime" the buffer with the next sequential logical track in anticipation of a future access to the next track. Many sequential operations will benefit from this read-ahead feature and will have very low average access times. However, applications that use highly random accesses with short records may suffer using read-ahead. Therefore, it can be disabled if desired.

15.3.3.1 SET_SIZE

SET_SIZE 0, 16, 32, or 64 NUM

The set size affects the caching algorithm of the track buffers. Overall caching performance depends upon the users application, size of the cache, length of tracks, and the buffer organization. The SET_SIZE parameter determines the number of track buffers in each cache set (and therefore the number of sets available for each logical track). For example: with 64 track buffers and a set size of 16, each track can use one of four sets of track buffers. With 256 track buffers and a set size of 32, each logical track can use one of eight sets.

> ***NOTE:***
> *A SET_SIZE of 0 will cause the AEM to automatically configure its cache to the maximum number of sets consistent with the number of available track buffers.*

The subject of cache management is complex and beyond the scope of this manual. But, generally, applications that are highly random with single track or less data transfers, will benefit by a smaller set size and more sets. Applications using long data transfers and that are highly sequential will benefit by using larger set sizes. The table below shows the valid combinations. Combinations other than the ones in the following table are not permitted.

MEM_SIZE (MB)	MEM_SIMMS (Qty)	TRACK_LEN Bytes	SET_SIZE	# OF TRACK BUFFERS	#OF SETS
1	2	<32K	16	64	4
1	2	<32K	32	64	2
1	4	<32K	32	128	4
1	4	<32K	64	128	2
1	4	>32K<64K	16	64	4
1	4	>32K<64K	32	64	2
4	2	<32K	32	256	8
4	2	<32K	64	256	4
4	4	<32K	64	512	8
4	4	>32K<64K	32	256	8
4	4	>32K<64K	64	256	4
16	2	<32K	64	1024	16
16	4	>32K<64K	64	1024	16

Table 5 VALID TRACK BUFFER COMBINATIONS

15.3.3.2 BLOCK

BLOCK= 0 or 1 OFF/ON

This parameter controls the AEM's response to a head select command when the desired track is not already in a Track Buffer. If a cache miss occurs (the desired track is not found in the Track Buffer), the AEM will disable the index and sector pulses until the new track has been read into a Track Buffer. When track has been fetched and the AEM is ready to accept a READ, WRITE, or AM search command, The index pulse, sector pulses, and clocks will resume according to **Table 6** Page 56.

15.3.3.3 CLOCK

CLOCK= 0 or 1 OFF/ON

This parameter, when set to 1, causes the AEM to disable the Read clock and Servo clock during a BLOCKing operation. This is necessary for controllers that are not blockable by merely shutting off the sector and index pulses. For example, the CDC Portable Field Test Unit tester requires this in order to test the AEM system properly.

15.3.3.4 FREEZE

FREEZE= 0 or 1 OFF/ON

This parameter controls the completion of a BLOCKing operation. If FREEZE is on (set to a 1), the BLOCK will release at the same sector count in which it was begun. If it is off (set to a 0), the BLOCK is released at the next Index pulse. If BLOCK is off, FREEZE is not used. Special hardware is available for applications requiring both FREEZE and JAMB modes. This FREEZE + JAMB hardware will force an immediate change to the sector in which blocking occured when the BLOCK is released.

15.3.3.5 JAMB

JAMB= 0 or 1 OFF/ON

This parameter is used to reduce the time that BLOCK is asserted. For controllers that are resyncronized at Index time, this mode will end the BLOCKing operation by immediately forcing an Index pulse. This is possible because in the AEM the rotation of the emulated drive is controlled by a hardware counter and not dependent upon mechanical rotation of a disk. JAMB can be used in certain instances to increase the performance of the AEM. If BLOCK is off, FREEZE and JAMB are not used. Special hardware is available for applications requiring both FREEZE and JAMB modes. This FREEZE+JAMB hardware will force an immediate change to the sector in which blocking occured when the BLOCK is released.

	FREEZE & JAMB =0	FREEZE =1, JAMB =0	FREEZE =0, JAMB =1	FREEZE & JAMB = 1
BLOCK = 0 CLOCK = 0	Index and Sector pulses resume immediately when the track has been completely read into the buffer.	Index and Sector pulses resume immediately when the track has been completely read into the buffer.	Index and Sector pulses resume immediately when the track has been completely read into the buffer.	Index and Sector pulses resume immediately when the track has been completely read into the buffer.
BLOCK = 1 CLOCK = 0	Index and Sector pulses resume when the track has been completely read into the buffer and the next index pulse time occurs.	Index and Sector pulses resume when the track has been completely read into the buffer and the sector time in which the blocking began occurs.	Index and Sector pulses resume immediately when the track has been completely read into the buffer. The index is generated immediately.	Index and Sector pulses resume when the track has been completely read into the buffer
BLOCK = 0 CLOCK = 1	Index , Sector pulses, and clocks resume immediately when track has been completely read into the buffer.	Index , Sector pulses, and clocks resume immediately when track has been completely read into the buffer.	Index , Sector pulses, and clocks resume immediately when track has been completely read into the buffer.	Index , Sector pulses, and clocks resume immediately when track has been completely read into the buffer.
BLOCK = 1 CLOCK = 1	Index, Sector pulses and clocks resume when the track is completely read into the buffer and the next index pulse time occurs.	Index, Sector pulses and clocks resume when the track is completely read into the buffer and the sector time in which the blocking began occurs.	Index, Sector pulses and clocks resume when the track is completely read into the buffer. The index is generated immediately.	Index, Sector pulses and clocks resume when the track is completely read into the buffer.
NOTE:	FREEZE & JAMB = 1 requires special hardware. This mode combination will enhance performance in some applications by eliminating the wait for the sector time in which Blocking was asserted.			

Table 6 BLOCKING RELEASE CONTROL

15.3.3.6 NONC_BLOCK

NONC_BLOCK= 0 or 1 MODE

0 = OFF Index and Sector pulses are present during seek operations (NOT ON CYLINDER)
1 = ON Index and Sector pulses are "Blocked" during seek operations while NOT ON CYLINDER

Some SMD controllers require the sector and index pulsed to cease while the drive is seeking. This mode may also help restrain certain controllers when switching from a removable to a fixed portion of a emulated Fixed/removable drive such as the CDC 9448 CMD series.

15.3.3.7 RD_AHD

RD_AHD= 0, 1, or 2MODE

0 = OFF
1 = Read-ahead ON with low LRU value assigned to the read-ahead buffer.
2 = Read-ahead ON with high LRU value assigned to the read-ahead buffer.

When in mode 1 or 2, the AEM will follow each track access (seek or head select) with a read-ahead of the next sequential logical track. The next track will then already be in the track buffer if (and when) it is needed. Mode 1 or 2 may be used in most emulations. Only Mode 2 should be used in 16, 32, or 64 head emulations.

The read-ahead mode can significantly improve performance for some applications. Applications where files are allocated in large contiguous blocks, read-ahead will improve performance. However, for other applications, especially those that read or write small blocks of data in a very random fashion, read-ahead may actually reduce the performance of the system. In highly random access applications the read-ahead operation may increase the time it takes to retrieve the next desired track into the track buffer. For applications that access data in truly random fashion, the overhead of read-ahead may actually reduce performance. In these applications it is advisable to set this parameter to OFF.

15.3.3.8 WB_MODE

WB_MODE	0 or 1	OFF/ON

When OFF (0), the entire track is written back to the SCSI drive, regardless of how much of the track was altered. When ON (1), only the dirty portions (in 512 byte blocks) of a track buffer will be written to the SCSI drive, reducing write back overhead.

15.3.3.9 HOLD_ONC

HOLD_ONC= 0, or 1 MODE

This parameter is used in special circumstances to allow the AEM to delay the ON CYLINDER state during a seek. Controllers that are not "blockable" may require this parameter set to 1 to prevent read / write errors.

0 - is normal operation. Seeks that result in cache hits will be completed immediatly (30us). This may be faster than the emulated drive's normal seek would have been. Seeks that require a new track to be fetched from the SCSI drive, will complete when the entire track has been read into a track buffer. The ON CYL interface signal will be asserted to indicate the seek completion.

1 - delays ON CYL until the next sequential logical track is also in the buffer. READ-AHEAD will be enabled if using this mode.

15.3.4 POWER UP STATE CONTROL

15.3.4.1 UNIT_ADD

UNIT_ADD= 0 to 15 Initial address at power up.
16 address defined using an optional front panel address plug.

When the system powers on, this parameter is used for the initial address. For operation with a UPS, this parameter will be saved in the Flash during a power fail condition. When power resumes, the AEM will return to the mode as saved in the Flash. When the optional front panel address plug is used, this parameter must be set to 16.

15.3.4.2 ONL_SAVE

ONL_SAVE 0 or 1 OFF/ON

Used to control the power up state of the AEM system. If set to OFF (0), the AEM will power up in the OFF-LINE state. If set to ON (1), the AEM will power up and be placed in the ON-LINE state. If operating with a UPS, this parameter will be saved in the Flash during a power fail condition. When power resumes, the AEM will return to the state as saved in the Flash.

15.3.4.3 WP_SAVE

WP_SAVE= 0 or 1 OFF/ON

Used to control the power up state of the AEM system. If set to 0, the AEM will power up in the WRITE- ENABLED mode. If set to a 1, the AEM will power up and be placed in the WRITE PROTected state. For operation with a UPS, this parameter will be saved in the Flash during a power fail condition. When power resumes, the AEM will return to the state as saved in the Flash.

15.3.4.4 VOLUME_NUM (AEM-xC models only)

VOLUME_NUM= 0 to 99

Used to define the Volume to be used at power up. Remembers the Last Volume number used prior to power down.

15.3.5 SCSI DRIVE PARAMETERS

15.3.5.1 SCSI_PARAM(N)

SCSI_PARAM0	0 to 255	NUM
SCSI_PARAM1	0 to 255	NUM
SCSI_PARAM4	0 to 255	NUM
SCSI_PARAM6	0 to 255	NUM

This parameter sets the Operating characteristics for the SCSI devices at SCSI ID (N). This parameter is bit mapped. Set the parameter according to the following table:

SCSI PARAMETER								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG	FS	FC	SC	AN	S2	SY	FUA	X

FS - Fast SCSI: Used on drives supporting FAST SCSI-2 timing.
FC - Fast Clock (40MHZ): Must be set for all AEM systems manufactured after August 1994.
SC - Slow Cable: Used to further reduce data speed for cables over 6 ft. In the AEM the cable is so short that this bit should always be off (0).
AN - Active Negation: Speeds bus timing by actively negating signals. Always set for AEM use.
S2 - SCSI 2 features: These are not used at this time. Leave this bit 0.
SY - Synchronous mode: This bit causes the AEM to negotiate for synchronous data transfer.
FUA - Force unit access: This bit forces writes to write directly to the media, bypassing the SCSI cache.
X - Undefined: Leave set to 0 for future compatibility.

Example values: 0x50 (80) - drives that do not support FAST SCSI-2 timing.
0x54 (84) - synchronous transfer drives that do not support FAST SCSI-2 timing.
0xd0 (208) - FAST SCSI-2 drives , up to 7MB/s async only.
0xd4 (212) - FAST SCSI-2 drives, Full synchronous transfers to 10MB/s.

15.4 SYSTEM CONFIGURATION

The items listed in this section are in the system configuration table. The parameters in this table describe various hardware configurations and are used for all emulations. These parameters must be updated if the system hardware is reconfigured.

15.4.1 TRACK BUFFER MEMORY

The track buffer parameters describe the size of the memory SIMM, number of SIMMs installed, and the emulated track length.

15.4.1.1 MEM_SIZE

MEM_SIZE 1, 4, or 16 NUM

This numeric value must match the size of SIMM installed (in Megabytes). The SIMMs must be standard 30 pin 1Mx8(or 9), 4Mx8, or 16Mx8 SIMMs. The speed must be 70ns or faster. Note that if SIMMs larger than those specified are installed, a smaller configuration can be defined and the extra memory will be ignored.

15.4.1.2 MEM_SIMMS

MEM_SIMMS 2 or 4 NUM

The SIMMs must be installed 16 bits at a time (in pairs). If the track length is greater than 32K, 4 SIMMs must be installed. If the track length is less than 32K, the upper 2 SIMMs may be used to double the number of track buffers.

15.4.2 OPERATOR PANEL TYPE

The operator panel for the AEM can be of several types or may be omitted entirely: the AEM's integrated operator panel or one of several external operator panels. If an external panel is used, the OP_TYPE variable must be set based on the type of switches used on the panel.

15.4.2.1 OP_TYPE

OP_TYPE= 0, 1, 2, or 3 TYPE

0 = AEM integrated operator panel. Panel is part of the mother board on the AEM chassis
1 = External operator panel with momentary contact switches.
2 = External operator panel with Alternate action (mechanically latching) switches.
3 = Center mounted Flat Panel with Decimal LED Displays.

15.4.3 DRIVE REMOVABILITY

The AEM can be configured with fixed SCSI drives, removable SCSI drives, or removable media cartridge SCSI drives. The Primary drive and optional Backup drive can be different types.

15.4.3.1 REMOV (primary drive)

REMOV= 0, 1, or 2 TYPE

0 = fixed drive applications.
1 = removable drives that are controlled (powered on or off) by the AEM.
2 = removable media cartridge drives.

15.4.3.2 REMOVB (backup drive)

REMOVB= 0, 1, or 2 TYPE

0 = fixed drive applications.
1 = removable drives that are controlled (powered on or off) by the AEM.
2 = removable media cartridge drives.

15.4.3.3 AEM_SCSI_ID

AEM_SCSI_ID= 1, 2, 3, 4, 5, 6, or 7. NUM

This parameter defines the AEM's SCSI ID. Normally it should be set to 7. However, in systems configured with more than one AEM connected to a single SCSI drive or other SCSI device, each AEM must be set to a different SCSI ID. Care must be taken to prevent more than one AEM or drive on the SCSI bus from having the same SCSI ID.

15.4.4 OPTIONAL BACKUP FACILITY

The AEM can be configured with an optional off-line backup capability. Several versions of this option are available. The backup device may be another SCSI disk drive, a removable media cartridge drive, a quarter inch tape cartridge drive, a 4mm DAT type tape drive, a 8 mm helical scan tape drive, or a WORM or rewritable optical disk drive. The following parameters are used to define the backup device.

15.4.4.1 BACKUP_ID

BACKUP_ID= 1 - 6 NUM
0 = Backup option not present.

This parameter defines the SCSI ID of the backup device. Normally ARRAID configures the Backup drive at SCSI ID 4. In cases of multiple backup devices, other SCSI IDs may be used.

15.4.4.2 COPY_ID

COPY_ID= 1 - 6 NUM
0 = Copy option not present.

This parameter defines the SCSI ID of a second SCSI drive used for making copies of the primary device. Normally ARRAID configures the Copy drive at SCSI ID 4. In cases of multiple backup devices, other SCSI IDs may be used.

This parameter is also used for special Fixed/Removable drive emulations such as the CDC 9448-CMD. In these emulations, the COPY_ID defines the SCSI address of the removable part of the emulation.

15.4.4.3 MIRROR_ID

MIRROR_ID= 1 - 6 NUM
0 = Mirroring option not present.

This parameter defines the SCSI ID of a second SCSI drive used as the mirror in a RAID-1 mirrored system. Normally ARRAID configures the Mirror drive at SCSI ID 4. Usually this is the same address of the COPY and BACKUP device. In cases of multiple backup devices, other SCSI IDs may be used.

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15.4.5 UPS TYPE

If a UPS is present, the AEM will perform an orderly shutdown in the event of a power failure. The two variables described here configure how that shutdown is to proceed.

15.4.5.1 UPS_FLAGS

UPS_FLAGS= 0 -15 FLAGS

The variable describes the UPS functions available. The UPS Flags must match the capabilities of the UPS. A mismatch in the configuration may cause unexpected results. If no UPS exists, the Flags must be 0.
The value is bit mapped using the following bit meanings:

UPS FLAGS								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG	0	0	0	0	RESPOND PWR FAIL	RESPOND BAT LOW	ENABLE DIAG	ENA PWR DWN

Bit 3: (8) Shut Down on power fail - When this bit is a ONE, the AEM will respond to the POWER FAIL input.
Bit 2: (4) Shut Down on battery low - When this bit is a ONE, the AEM responds to the BATTERY LOW input.
Bit 1: (2) Enable Diagnostic - When this is a ONE, the AEM will test the UPS operation at start up. If the UPS does not support a TEST mode, this bit must be a ZERO.
Bit 0: (1) Enable Power Down - This bit causes the software to shut off the power supply once an orderly shutdown has been completed. This will preserve the battery's charge. If the UPS does not support a shutdown command, this bit must be ZERO.

Bits 3 and 2 determine when shutdown should occur. Power Fail mode begins shutdown as soon as a power fail occurs. Battery low mode allows operation to continue as long as there is power in the UPS. Battery low mode should not be used if the computer system connected to the AEM is not also on a UPS.

Note: if the system is using battery low mode, the UPS will require recharging after a complete battery drain. When the system powers on again, it will fault with an initial status of UPS failure. This indicates that the battery still needs charging. Leave the AEM powered on for a while to charge, then cycle power again to reboot.

15.4.5.2 UPS_DELAY

UPS_DELAY = 0 to 65535 (x10ms) VALUE

The UPS_DELAY variable is used to 'deglitch' the power fail signal. UPS's that use a standby configuration will switch at the first sign of AC failure. The switch might be transient. The AEM will wait for this delay value before beginning shutdown. Typical value is 500 (5 seconds).

15.4.6 COMM PORT SETTINGS

The COMM port used for this configuration process is configurable. If a terminal is unavailable at the factory default settings, reconfiguration is impossible. Request a special default setting from ARRAID.

Please be aware that when these parameters are changed, the terminal must be changed to match the new characteristics prior to rebooting or the terminal will not function properly!
The system can be forced to the default settings by pressing and holding WRITE PROTECT and FAULT CLEAR switches while powering up.

The COMM port reconfiguration can be used to switch to modem use, or to match more available types of terminals.. Once the system variables have been changed, the system must be rebooted for the new comm port parameters to take effect. The default configuration is 8 bits, no parity, 9600 baud with the ECHO and C_CL flags on.

15.4.6.1 COMM1_BAUD

COMM1_BAUD= 300 - 19200 VALUE

This parameter defines the baud rate. Valid values are 300, 600, 1200, 2400, 4800, 9600, and 19200.

15.4.6.2 COMM1_FLAGS

COMM1_FLAGS=
This parameter defines the operating mode. These bits are also bit mapped:

COMM1_FLAGS								
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1
FLAG	0	0	ECHO	C_CL	0	8 BIT XFR	PARITY ENA	EVEN PARITY

Bits 7, 6, 3 undefined, leave ZERO.
Bit 5: (32) ECHO - when on, terminal inputs are automatically echoed.
Bit 4: (16) C_CL - Convert <Carriage Return> to <CR><LF>. The command interface requires a <Line Feed> to terminate the command line. Set this bit for terminals that send only <CR>.
Bit 2: (4) 8 Bit - when a ONE, the interface uses 8 bit transfers. Off is 7 bit transfers.
Bit 1: (2) Parity Enable - when enabled, the COMM port will transmit an additional parity bit.
Bit 0: (1) Parity Even - A ONE uses even parity, a ZERO is odd parity. If parity is not enabled, this bit is ignored. MARK parity or SPACE parity is not supported.

15.5 HARDWARE CONFIGURATION

The interface type and the data transfer rate require hardware definition. These items are not affected by system or emulation variables. Refer to the following illustrations for CPU switch and jumper locations:

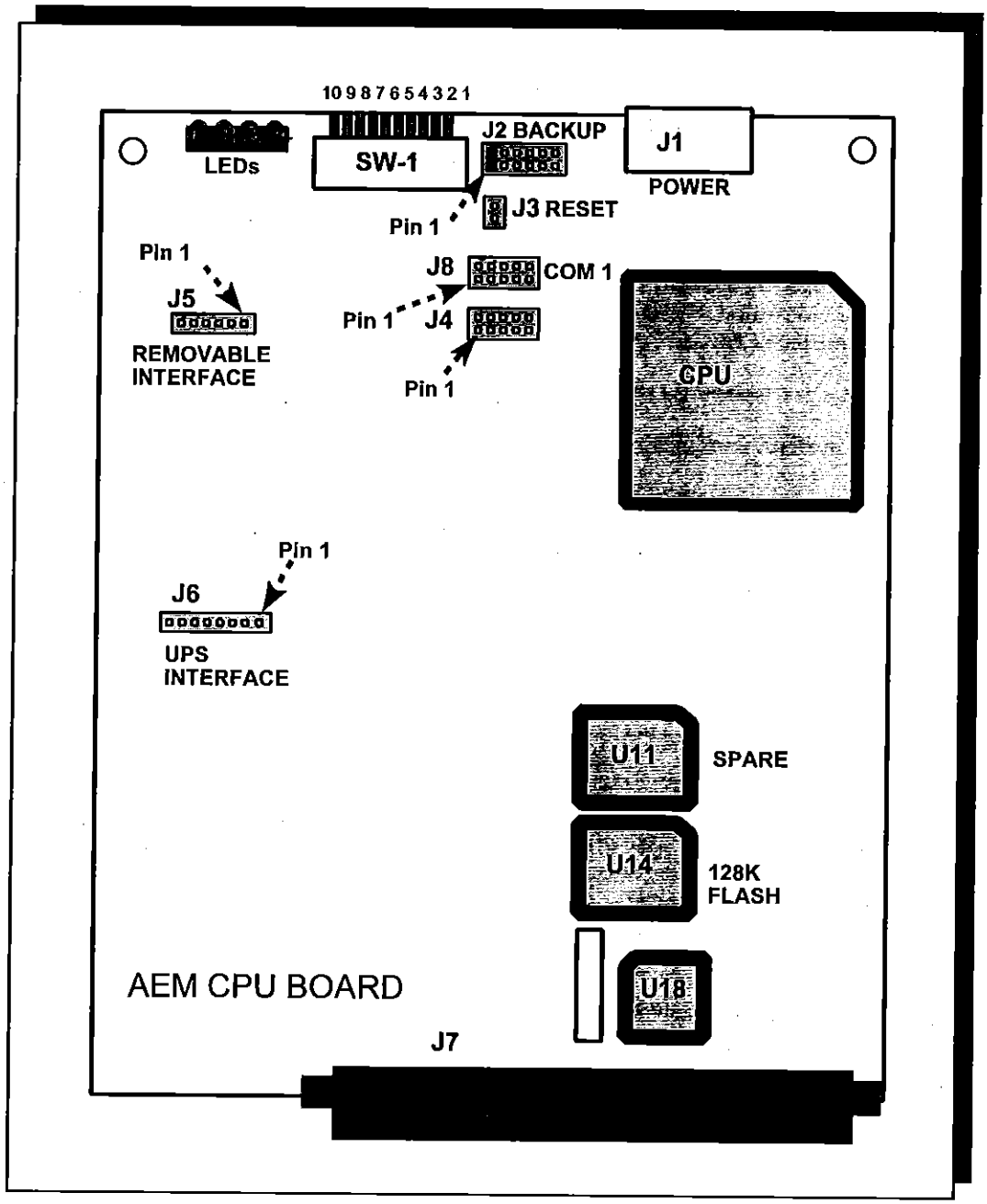

Figure 17 CPU BOARD With 128K FFLASH

15.5.1 256K FLASH CONFIGURATIONS

Firmware version 4.00 and later requires 256K FLASH chips. Earlier 128 K systems may be upgraded to 256K FLASH by using two 128K chips or replacing the 128K chip with a 256K Flash. Enhanced CPU boards (see **Figure 18**) may have 256K or 128K FLASH chips installed. If 128K FLASH chips are installed, Jumper J13-1 to J13-2 must be removed.

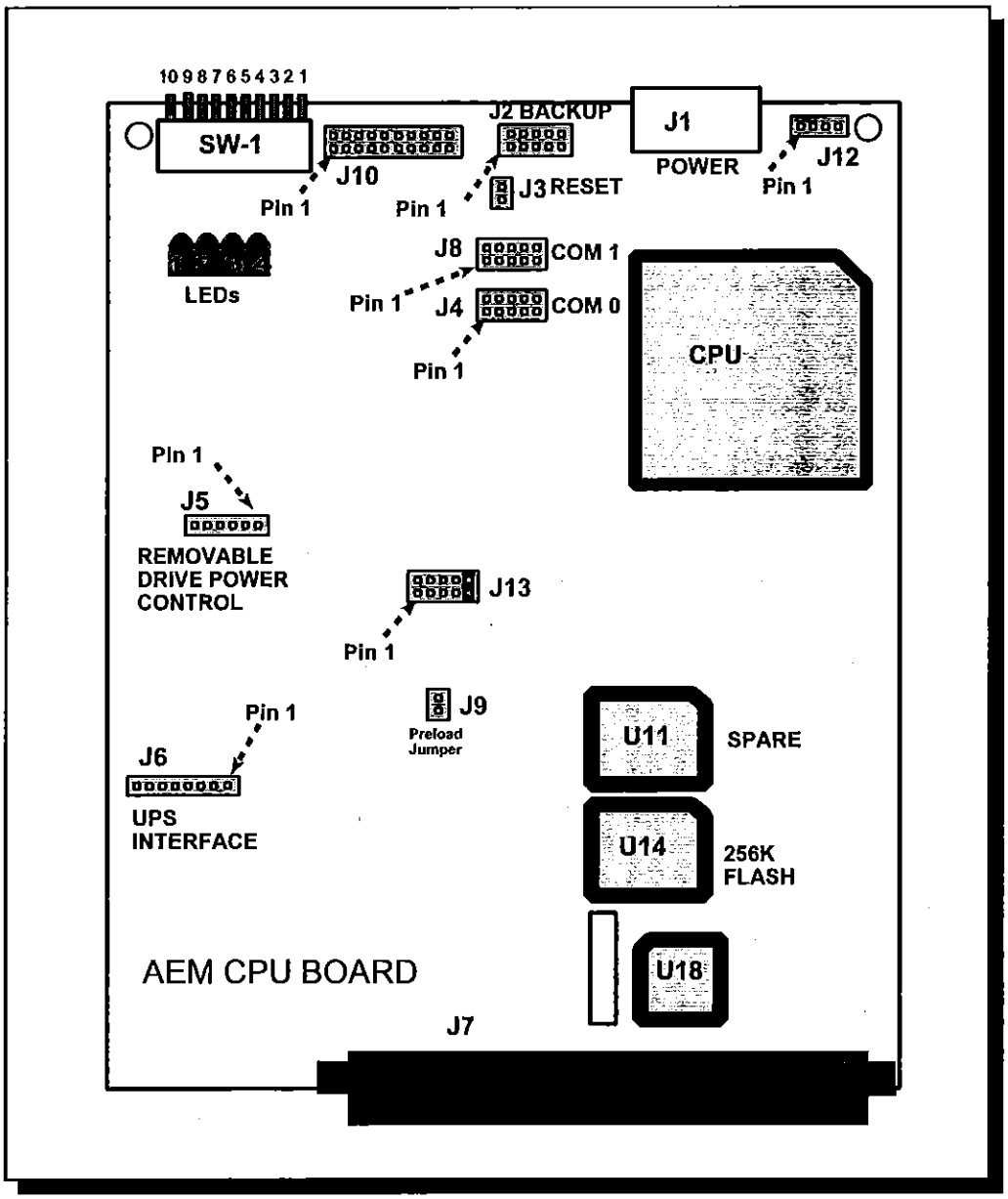

Figure 18 CPU BOARD with 256K FLASH

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15.5.2 INTERNAL DIP SWITCHES

DIP switches (SW1) are provided on the rear of the CPU board (lower board). The switches may be used in place of the operator panel, or to override some of the Operator panel functions. (see **Figure 17** page 64)

SWITCH	1	2	3	4	5	6	7	8	9	10
FUNCTION	Must Be Open				PORT 1(A) ENABLE	PORT 2(B) ENABLE	ON LINE	WRITE PROT	FAULT CLEAR	RELEASE MODE
OPEN(UP)	X	X	X	X	ENABLE	ENABLE	ON LINE	WRT PROT	CLEAR FAULT	ABR
CLOSED(DOWN)					DISABLE	DISABLE	*****	*****	*****	RTM
					AEM-1 only	*AEM-1 only*	***** FRONT PANEL ENABLED			*AEM-1 only*

Table 7 CPU BOARD DIP SWITCHES

Must Be Open — SW1-1 through SW1-4 . These switches should all be OPEN.

1/2 (A / B) ENABLE — These switches have no corresponding operator panel function. The appropriate switch(s) must be open to enable the port(s) being used. (*AEM-1 only*)

ON LINE, WRT PROT, FLT CLR — When open, these switches override their corresponding operator panel function. When closed, the operator panel is enabled.

ABR/RTM — This switch is used to select the desired reserve/release mode for dual port systems. In the ABR (Absolute Bus Release) mode, the SMD controller winning dual port arbitration will seize and reserve the drive until it issues a Release command. In the RTM (Reserve Time-out) mode, the reserve will be automatically released if no select activity occurs during the reserve time-out period.(see section 15.3.2.1 page 53). (*AEM-1 only*)

15.5.3 SMD INTERFACE TYPE

The AEM-1 SMD interface supports both TTL and ECL data drivers and receivers. Standard SMD and SMD-O drives up to 15Mb/s typically used TTL level translators. SMD-E drives from 15 to 24 Mbits/sec used ECL translators. While they are somewhat compatible on the SMD side of the interface, best results are achieved by using the correct interface levels.

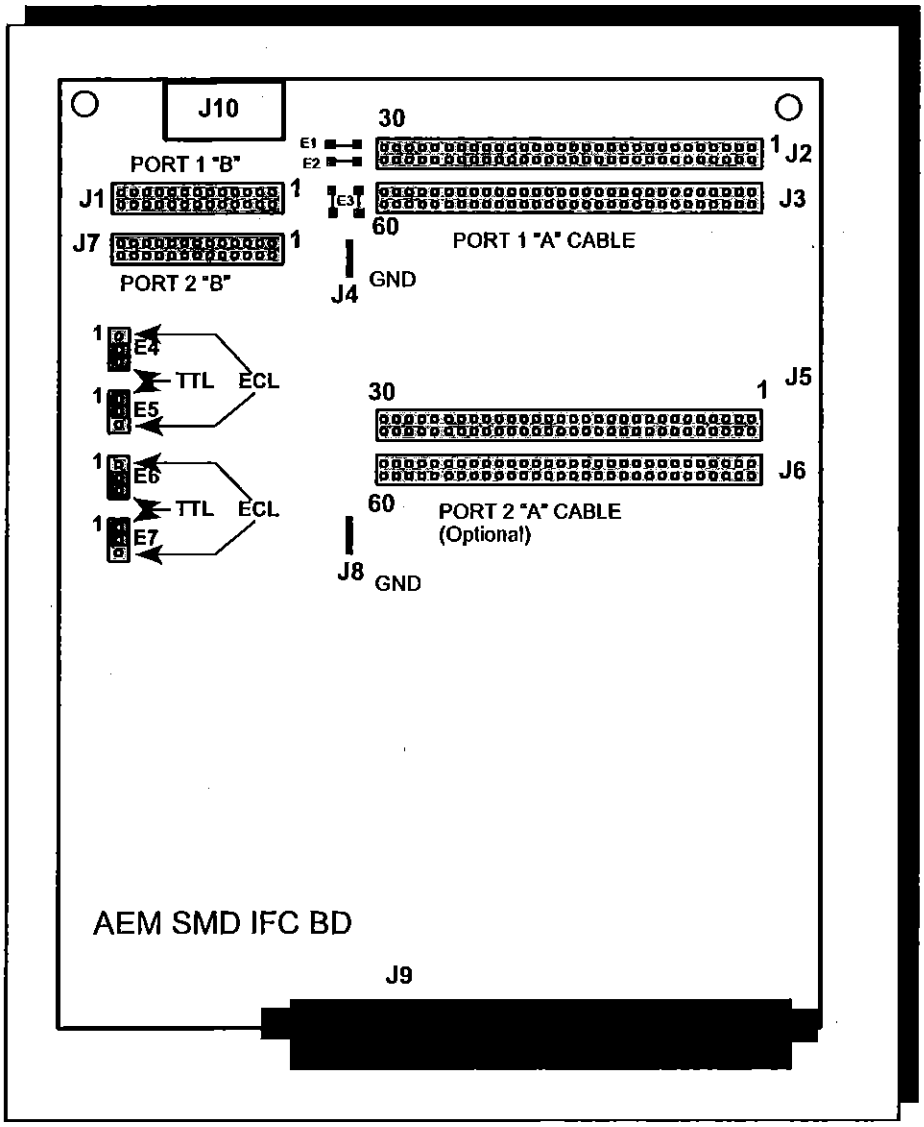


Figure 19 SMD INTERFACE BOARD LAYOUT

If jumpers E1 & E2 (E8 & E9 for the dual port option) are installed, the AEM signal ground will be connected to pins 30 and 60 of the "A" Cable. (Jumpers E3 and E10 must also be removed.) Jumpers E3 & E10 will connect pin 30 and 60 to the extended cylinder bits for SMD mode 2 operation.)

The interface drivers and receivers are selected by jumpers located on the SMD board (top board) in the AEM. The jumpers are E4 and E5 for port 1, (and E6 and E7 for port 2, Dual Port systems only). The illustration below illustrates the correct jumper positions:

USE OF PIN 30 & 60 in the SMD "A" CABLE		
PIN 30 & 60	E3, E10	E1, E2 & E8, E9
TAG 4 (EXTENDED CYLINDER MODE)	INSTALLED	REMOVED
GROUNDED	REMOVED	INSTALLED
Jumpers are solder in type		

Table 8 SMD INTERFACE BOARD JUMPERS

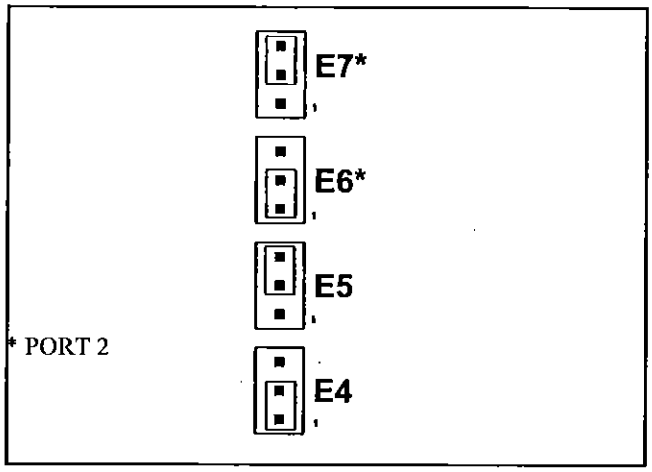


Figure 20 ECL INTERFACE SELECTION

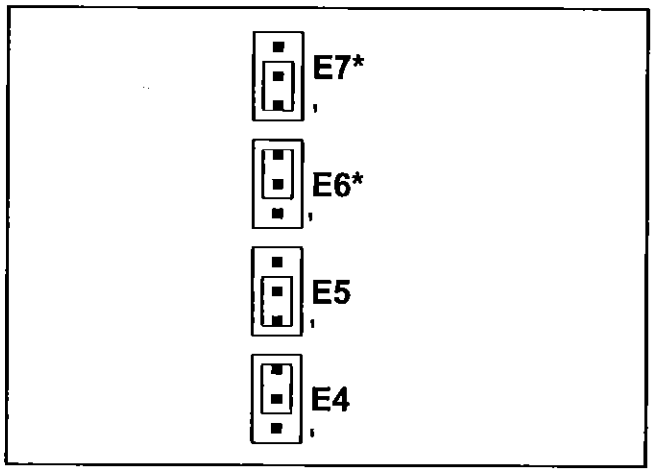


Figure 21 TTL INTERFACE SELECTION

15.5.4 HISI (MULTIPLEXED) INTERFACE TYPE

The AEM-3 supports the Honeywell Information Systems Interface also known as the 75 pin Multiplexed interface. This interface is very similar to the SMD interface. It uses either a 60 pin Flat cable or a 75 pin Block connector type of cable for the "A" cable. The differences between the SMD and the HISI interface require a different interface PCB for each interface type. The HISI interface PCB requires no jumpering or setup.

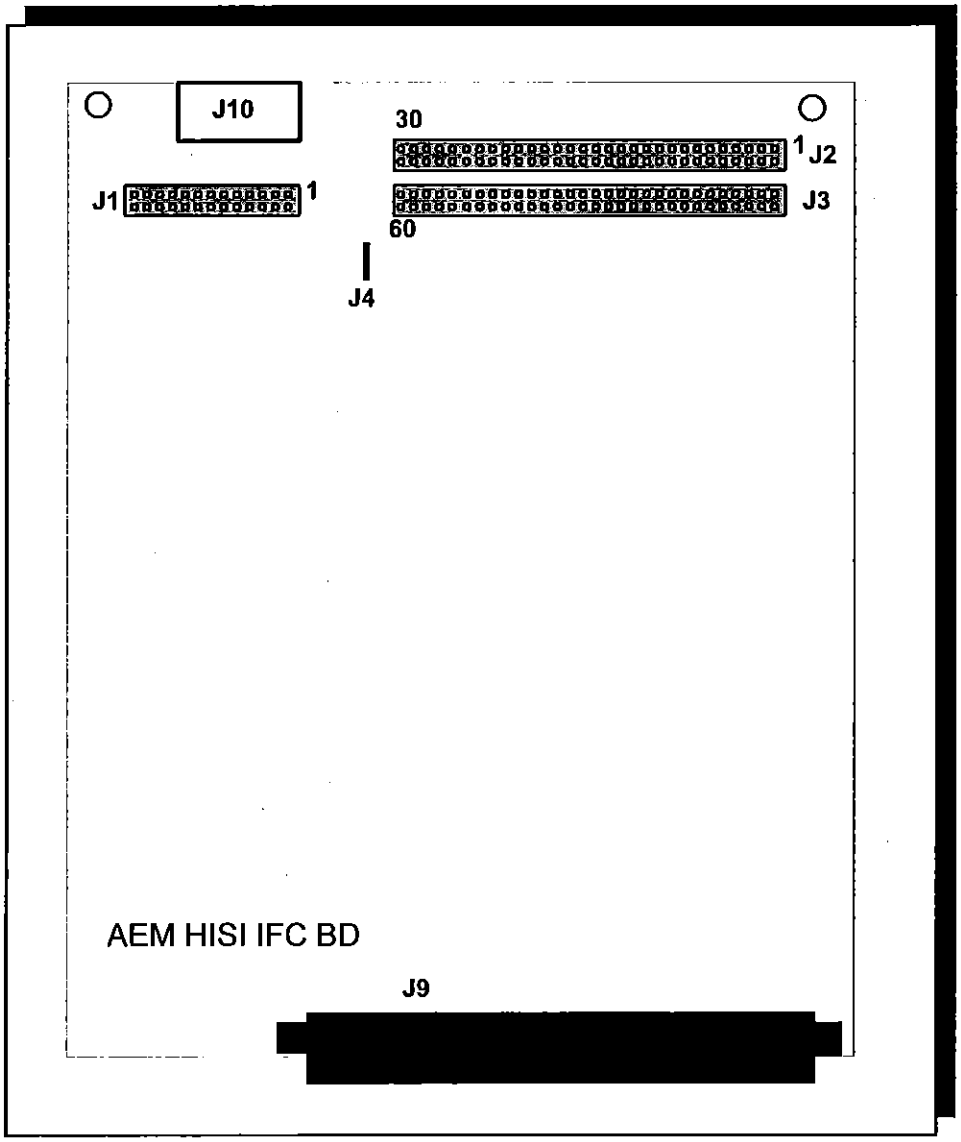


Figure 22 HISI INTERFACE BOARD LAYOUT

15.5.5 INTERFACE DATA TRANSFER RATE

The interface data rate is controlled by the crystal oscillator (U1) on the AEM Data Manager Board (middle board). The crystal is located at the rear edge of the board. The oscillator should be the same frequency as the data rate of the drive being replaced. (see Figure 23 page 70)

Common frequencies are:

9.676 Mhz, 10 Mhz, 14.515 Mhz, 15 Mhz, 19.352 Mhz, 20 Mhz, 24 Mhz, and 24.192 Mhz

Many controllers are insensitive to the data rate and can use any of the above frequencies. Some controllers require the exact data rate. Consult ARRAID for more information.

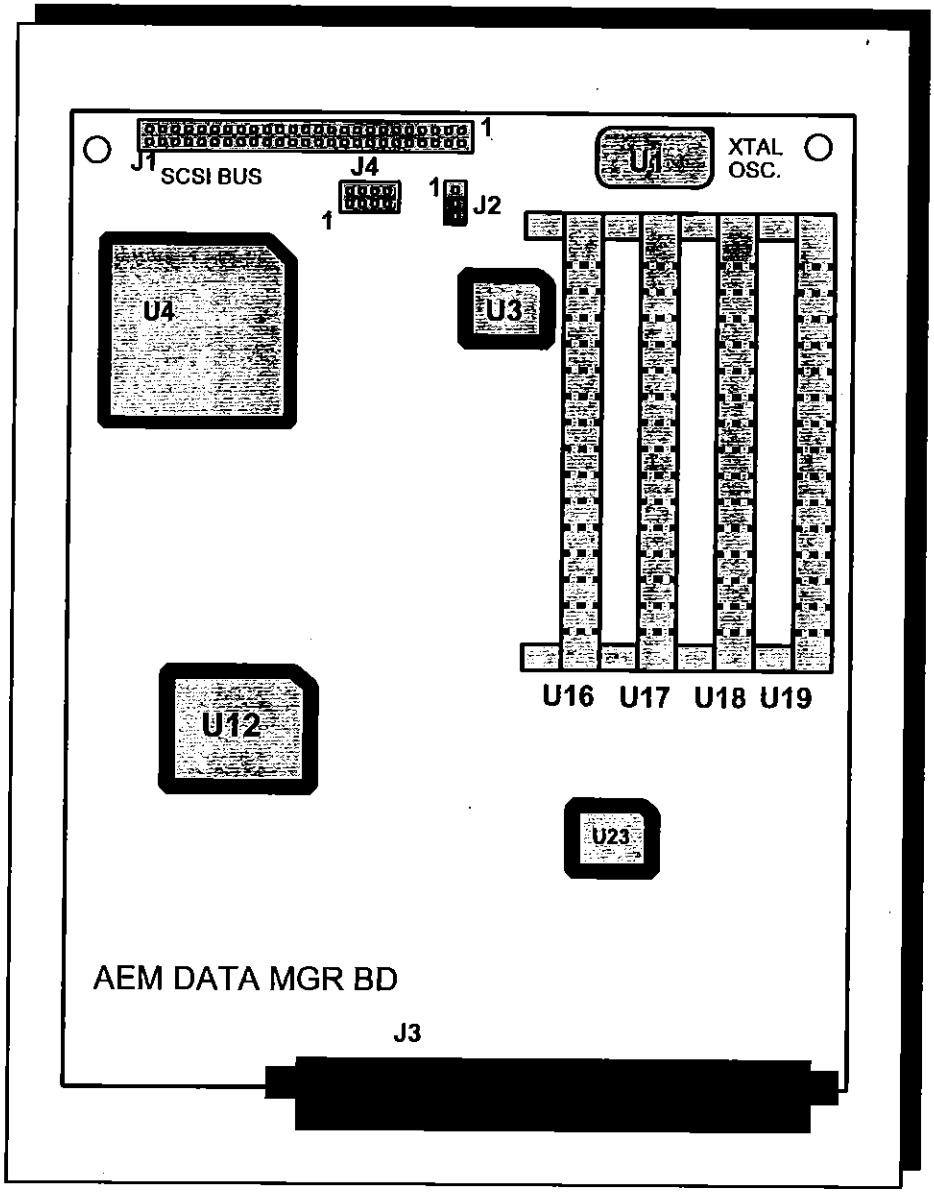


Figure 23 DATA MANAGER BOARD LAYOUT

16 AEM COMMAND AND CONFIGURATION TERMINAL

16.1 RS-232 PORT SPECIFICATIONS

To use the AEM command language, a terminal (or a PC with a terminal emulation package) is required. The terminal must be properly configured and connected to the AEM's COMM 1 TERMINAL port. This port is a 9 Pin male "D" type connector configured as DTE and is located at the rear of the AEM chassis. (Internally it is connected to J8 on the CPU board). An adapter cable (Null Modem) is needed to translate to either a 9 pin DCE or a 25 pin DCE standard. Rackmount systems will also have a RJ-11 type female receptacle on the front panel of the system. Either connection may be used, but, not both.

The AEM's TERMINAL port supports **data leads only** (bold). Signals in ( ) are shown for reference only. They are neither driven nor monitored by the AEM. Request to Send is driven true by the AEM. Clear to Send is ignored. If the terminal requires the modem lines (DSR, DTR, DCD) to be connected, an adapter must be installed in the cable between the AEM and the terminal.

The default configuration for the TERMINAL COMM port is 9600 baud, 8 bits, no parity, 1 stop bit. This configuration may be changed in the system configuration table. The default mode for the port is to ECHO all characters (no local echo is required), and to convert <CARRIAGE RETURN> to <CR><LF>. If the terminal has a <CR> to <CR><LF> conversion mode, it should be turned

SIGNAL NAME	DESCRIPTION (Direction)	AEM 9 PIN (DTE)	AEM RJ-11**	TERMINAL 9 PIN (DCE)
DCD	Data Carrier Detect	(1)		(1)
RXD	Receive Data (AEM <--- TERM)	2	GREEN	3
TXD	Transmit Data (AEM ---> TERM)	3	RED	2
DTR	Data Terminal Ready	(4)		(6)
GND	Ground	5	BLACK or YELLOW	5
DSR	Data Set Ready	(6)		(4)
RTS	Request to Send (AEM ---> TERM)	7	BLUE	8
CTS	Clear to Send (AEM <--- TERM)	8	WHITE	7
RI	Ring Indicator	(9)		(9)
** Rackmount systems only				

Table 9 TERMINAL INTERFACE PINS

off. If the terminal must send <CR><LF>, turn off the conversion in the AEM.

Other baud rates and frame sizes may be used. Please refer to section for more information.

If changes to the baud rate etc. setup parameters have rendered the AEM's terminal port inoperable, the default of 9600 baud, 8 bits, no parity, and 1 stop bit may be forced by holding the FAULT CLEAR and WRITE PROTECT switches on while powering up. The switches must be held in until the AEM has finished the power up LED test. Setup parameters may then be changed to the proper settings using the CV command.

Each AEM system is shipped with kit consisting of; a cable terminated with modular telephone plugs at each end, a 9 pin female connector, a 25 pin female connector, and a 25 pin gender changer. This cable kit will satisfy most terminal installations. However, if the user requires a different length or special cables, the TERMINAL interface cable should be wired as in Table 9 Page 71.

17 AEM TERMINAL COMMAND LANGUAGE

The command language interface to the AEM is helpful for in-the-field configuration and control. Use of this interface is not required for normal system operation.

The command interface is facilitated by connecting a simple RS-232 serial terminal to the AEM's terminal port. It may be used with a either a simple terminal or terminal emulator. This section describes the basic commands, and their application.

Note that commands and configuration variables are subject to change with future firmware enhancements. Please be certain that the revision table at the front of this manual corresponds with the revision of your AEM firmware. The AEM will display its firmware revision level on the terminal upon power up.

17.1 COMMAND SYNTAX

The format for commands is: CMD param <opt param> CR

A command line consists of a command acronym up to 5 letters (not case sensitive), 0 to 5 parameters, and terminated with a CR-LF, LINE FEED (note: See CHMOD command). The following text will highlight terminal input in **BOLD**. Parameters listed after the command are mandatory unless enclosed in < >. All command line arguments must be separated by a single **SPACE**.

All commands will respond with one of the following prompts when finished:

RDY>	The command finished normally
FAIL>	The command finished abnormally
INV>	The command was invalid
REJ>	The command was rejected

All commands requiring parameter arguments will respond with FAIL> if insufficient arguments are included with the command. Extra arguments are ignored. Numeric parameter arguments may be entered in decimal <0-9> or hexadecimal <0x0-9, a-f>. Hex values must be proceeded with '0x' such as: 0x1fce.

Some commands are designed for use only with a terminal (TERM). They will print information to the screen using XON/XOFF protocol.

Commands labeled as remote(REM) are intended for use with a PC or host computer only. They transmit or receive information blocks of information in a HEX-ASCII format. These commands will time out if they are accidentally initiated from a terminal.

Some commands are effective when the system is either ON-LINE or OFF-LINE. Commands restricted to OFF-LINE operation only will return REJ> if the AEM is in an on-line state. Some of the commands allowed during on-line operation may take significant execution time. These commands are available only in the Maintenance Mode (see MM command).Using these commands during Interface bus activity may cause problems. They are intended for diagnostic use to dump the state of the machine once activity has ceased. The command descriptions that follow will identify commands as ONL/OFFL for immediate execution, and OFFL for off-line only commands.

A complete list of commands may be obtained by entering a "?" or typing HELP at the RDY> prompt.

17.2 GENERAL COMMANDS

? or HELP **Display list of terminal commands**

Effective: T/R ONL/OFFL

Display: Complete list of all terminal commands.
If the AEM is in Maintenance Mode, additional Maintenance Mode commands will be displayed.
Commands shown in upper case are effective either ON-LINE or OFF-LINE. Commands shown in lower case are effective only when the AEM is OFF-LINE.

Response: RDY>

F **Display interface Fault status**

Effective: T/R ONL/OFFL

Display: interface Fault status explanation bits

```
----- IFC FAULT STATUS -----
SKER xxxx  HD  W*WP WRTF xxxx R+WO R*W
 0    0    0   0    0    0    0    0
```

Response: RDY>

BIT	EXPLANATION:
SKER	Seek Error - an invalid cylinder address has been issued by the host controller.
xxxx	bit is not used
HD	Head Fault - an invalid head number has been selected by the host controller.
W*WP	Write command was issued to a Write Protected drive.
WRTF	Write Fault - a Write was attempted while the AEM was not ready or in a BLOCK state.
R+WO	Read or Write issued by the Host controller while the AEM was not ON CYLINDER.
R*W	Read and Write commands were issued by the Host controller at the same time.

OFFL **Place the AEM in the OFF-LINE mode**

Effective: T/R ONL

Purpose: To take the AEM OFF-LINE. Same as pressing the START or ON-LINE operator push button switch when the AEM is ON-LINE.

Display: none

Response: RDY>

ONL **Place the AEM in the ON-LINE mode**

Effective: T/R OFFL

Purpose: To place the AEM ON-LINE. Same as pressing the START or ON-LINE operator push button switch when the AEM is OFF-LINE.

Display: none

Response: RDY>

P **Display Performance statistics**

Purpose: Display Performance statistics.

Effective: T/R ONL/OFFL

Display: Interface track accesses, cache misses, average Interface access time, maximum Interface access time, average SCSI access times, and maximum SCSI access times since last reset.
Times displayed are in milliseconds with a resolution of +/- 1 ms.

Additional information may be displayed in the Maintenance Mode:

Flse Acc-	false accesses, track number mismatches
SCSIerrs-	various scsi errors
DBR Err	- dirty bit table errors
Frcd ACC	- forced accesses(see False acc)
No Bufr	- no avail buffers
Rtunness	- read track unecessary
Unk Int	- unknown interface interrupts
Chg2Same	- Change interrupt to same track
SCSItimr	- wfi excessive time errors
NotDirty-	writing not dirty buffer
LateTag1	- Tag1 came in after access cycle started
LostVlid-	Current buffer lost its VALID bit
StolenTB	- Manager stole the TB from the write queue
SIOabort	- Read requests aborted startI/O RdAhd or writes
Ioproces-	Read requests found while Scsi I/O in process

Response: RDY>

R **Toggle Read Ahead mode**

Purpose: Toggle Read Ahead mode. This is useful for evaluating the effect read-ahead has on performance.

Effective: TERM ONL/OFFL

Display: R=0 or R=1 or R=2 (0 means OFF, 1 or 2 means ON)

Response: RDY>

S **Display Status**

Purpose: Display current track Status. Displays the current Emulation Volume, track# (cylinder position, head selection), and associated track buffer assignment.

Effective: T/R ONL/OFFL

Display: `Vol:<volume> cyl:<cyl> hd:< hd> trk:< track> tb: <track buf>`

Response: `RDY>`

SS **System Status**

Effective: T/R ONL/OFFL

Display: ON

WRT LIN	IFC PRT	SYS FLT	SCSI ERR	FAT ERR	PORT ERR	PORT 1DET	IFC 2DET	ADDR
1	0	0	0	0	0	1	0	3

Response: `RDY>`

Explanation:

ON LIN 1 = AEM on-line

WRT PRT 1 = Write Protect is on

IFC FLT 1 = Interface fault, use "F" command for details

SYS ERR N = system error --- see page 119

SCSI ERR
0 = no errors
1 = read error
2 = read error
3 = write error
4 = write error ---- see page 119

FAT ERR 1 = fatal error

PORT DET 1 = Port is connected to a powered up controller
0 = Port is not connected, Port is not enabled, or Host is not powered on

IFC ADDR 0 - 15 = Interface bus address currently in effect for this AEM

Please note: Additional information will be displayed if the Mirroring option is installed or if in the Maintenance Mode

US **Display UPS Status**

Effective: TERM ONL/OFFL

Purpose: Display the current UPS status. This command is effective only for systems connected to the UPS control interface and with UPS systems that support the diagnostic information..

Display:
```
UPS = PWR_OK   BAT_OK
UPS = PWR_OK   BAT_LOW
UPS = PWR_FAIL BAT_OK
UPS = PWR_FAIL BAT_LOW
```

Response: RDY>

W **Toggle Write Back mode**

Purpose: Toggle Write Back mode. This controls whether writes to the SCSI drive are on a dirty block, or entire track basis.

Effective: TERM ONL/OFFL

Display:
```
WB=0 or  WB=1 (0 = OFF = write the entire track, 1 = ON= write only
dirty portion)
```

Response: RDY>

Z **Zero statistics counters**

Purpose: Zero statistics counters. When Z is issued, the statistics counters are reset. They are also reset when ON-LINE is initiated.

Effective: T/R ONL/OFFL

Display: S=RESET

Response: RDY>

VER Version

Purpose: Displays the sign on message including the firmware VERsion.

Effective: T/R ONL/OFFL

Display:
```
AEM-1 SMD DRIVE EMULATION SYSTEM -
(c)1995-2000 by ARRAID Inc.  Revision 4.16
ARRAID Technical Support TEL: 623-582-4592
```

Or:
```
AEM-3 SMD DRIVE EMULATION SYSTEM -
(c)1995-2000 by ARRAID Inc.  Revision 4.16
ARRAID Technical Support TEL: 623-582-4592
```

Or:
```
AEM-5C DRIVE EMULATION SYSTEM -
(c)1995-2000 by ARRAID Inc.  Revision 1.16
ARRAID Technical Support TEL: 623-582-4592
```

Or:
```
AEM-6C DRIVE EMULATION SYSTEM -
(c)1995-2000 by ARRAID Inc.  Revision 1.16
ARRAID Technical Support TEL: 623-582-4592
```

Response: RDY>

CHMOD <param> Change Terminal Mode params

Purpose: This command will change the current values of the ECHO and C_CL flags. The changes will not be permanent. The default value for these flags and Baud rate will be restored when the system reboots.

Effective: T/R ONL/OFFL

Parameters:
+ECHO - sets echo flag
-ECHO - removes echo flag
+C_CL - activates conversion of <cr> to <cr><lf>
-C_CL - removes conversion
+B - Double Baud rate
-B - Halve Baud rate

Response:
FAIL> if any parameter arguments are incorrect
RDY> otherwise

If Baud rate is changed, the system will respond at the new Baud rate. This will result in the RDY> prompt appearing as garbage characters. You will also have to change the Baud rate of your terminal before intelligent communications can resume. The change will not be permanent. The default value for the Baud rate will be restored when the system reboots.

CLEAN <Y> <pat> Initialize a SCSI drive

Purpose: Initialize a SCSI drive. Writes zeros to every block of the current Emulation Volume (as defined by the current emulation) on the SCSI drive . This command is used to precondition a SCSI drive, removing all previously written formatting, data and address marks. It does not affect the low level SCSI formatting.

Effective: DISK TERM OFFL

Parameters: 'Y' overrides prompting the user for permission
SCSI ID - default is 0.
Pat - Word pattern (0 -65535, 0x0 - 0xFFFF) to be written to the disk. (Default = 0)

for some Fixed /Removable emulations such as those using XLAT_TBL=8, the system will ask which partition is to be cleaned (F or R)

Display: Clean process progress is displayed every 10 tracks.

Response: **FAIL>** if canister not installed, if key interlock is off, or if a SCSI error occurs during execution of the CLEAN operation.
RDY> Normal successful completion.

CVOL <N> Change VOLume

Purpose: To define a new Active Volume on the SCSI drives. .

Effective: DISK TERM OFFL

Parameters: 0 to 99

Display: Same as "S" command

Response: **INV>** if a Volume greater than 99 is attempted
RDY> Normal successful completion.

PON <ID> Power on Drive bay

Purpose: Apply Power to a removable drive module bay.

Effective: TERM ONL/OFFL

Parameters: 0 = Primary drive bay (default)
1 - 6 = Copy or Mirror drive bay

Display: none

Response: **FAIL>** if canister not installed or key interlock is off.
RDY> otherwise.

POFF <ID> **Power off Drive bay**

Purpose: Remove power from removable drive module. Ignored if drive is not a removable drive.
Effective: TERM OFFL

Parameters: 0 = Primary drive bay (default)
1 - 6 = Copy or Mirror drive bay

Display: none

Response: **RDY>**

MM **Enable Maintenance Mode**

Purpose: Enable the Maintenance Mode.
Enables the maintenance and debug commands.

Effective: TERM ONL/OFFL

Display: **MM=1**

Response: **RDY>**

MT **Monitor Track**

Purpose: Continuously display the current emulated track position information. Displayis only updated at approximately 200 ms intervals.

Effective: TERM ONL/OFFL MM

Display: `c:0813 h:17 t:15464` (cylinder head and logical track number)

Response: (continues to display until terminated with any other command)

SDODW **Security Wipe**

Purpose: SCSI DOD Wipe performs a security erase of the Primary SCSI drive. To ensure complete erasure of the drive, each SCSI block is written with all zeros (0x00) then overwritten with all ones (0xff). This is repeated 7 times for each block. The block is then overwritten with the pattern 0xF6. All logical SCSI blocks on the SCSI drive are wiped for all volumes on the drive. The current emulation is ignored.

Effective: DISK TERM OFFL

Parameters: 'Y' overrides prompting the user for permission

Display: The progress of the SDODW will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.
When completed, the total number of blocks erased is displayed.

Response: **FAIL>** if canister not installed, if key interlock is off, or if a SCSI error occurs during execution of the SDODW operation.
RDY> normal completion.

WO Toggle Write Only mode

Purpose: Toggle Write Only mode. This mode inhibits track prefetching. Normal seeks and head selects cause the newly desired track contents to be read from the SCSI drive prior to enabling the track to the interface. In the Write Only mode, a track buffer is assigned for the new track but it is not filled with corresponding track from the SCSI drive. This speeds up certain "write only" operations such as an Format process. Caution should be used when operating in this mode. Operations that require reading the Emulated track prior to writing will not function properly and may corrupt the Emulated image on the SCSI drive.

Setting the Write Only mode will force the Read Ahead mode to 2.

The Write Only mode will be automatically terminated when the last Emulated logical track has been reached.

Effective: TERM ONL/OFFL MM

Display: `WO=0 or WO=1` (0 = OFF, 1 = ON)

Response: **RDY>**

VCOPY <FROM VOL> <TO VOL> <T> Volume COPY command

Purpose: Copy the Emulated Volume image from one logical volume to another logical volume on the Primary disk drive at SCSI ID 0. The number of tracks to be copied is determined from the current drive emulation configuration table. This command may be used to make backup copies of an Emulated image on the same drive providing, of course, the drive has the capacity to hold more than one Emulated image. See Table 3 page 36

Effective: D T/R OFFL

Parameters:
FROM VOL= the source Volume # on the Primary drive.
TO VOL= the target Volume # on the Primary. The SCSI drive must have sufficient capacity to hold the complete Emulated image for both volumes.
T= If this argument is present when in the Maintenance Mode, the VCOPY command will perform as a SCSI drive test / exerciser randomly copying tracks . The VCOPY will run continuously until the key interlock is opened.

NOTE: The VCOPY command provides a means to exercise the SCSI drive using both read and write commands by copying a volume to itself.
For example:
VCOPY 0 0 will copy volume zero to itself.
VCOPY 0 0 T will copy random tracks on volume zero to itself and run continuously until the FAULT-CLEAR switch is pressed.
If the WRITE PROTect switch is on, the drive will only be read and not written. .

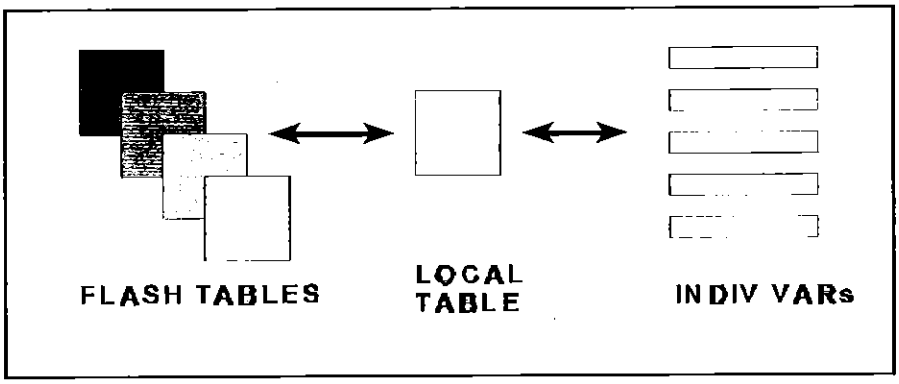
Display: Volume numbers and number of tracks to be copied. (Emulated heads and cylinders)
The progress of the Volume COPY will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.

Response:
RDY> if the command completed successfully.
REJ> if the AEM is not OFF-LINE when command is issued..
FAIL> if any SCSI operation returns a non recoverable error.

17.3 USING AEM CONFIGURATION COMMANDS

The AEM is configured using programmable configuration tables that are resident in the on board FLASH memory. The FLASH resident tables may be reconfigured by the user. This provides a facility to make configuration changes using a simple command interface. The AEM system contains one system configuration table, and 16 drive emulation configurations tables. The system configuration defines variations in system hardware such as Track buffer size, operator panel type, fixed or removable drive types, UPS control interface, etc. The drive emulation tables control the specific drive emulation parameters and various operating modes such as Read-ahead, sector control, hard or soft sectoring, etc.

The configuration process in the AEM is illustrated as follows:



The 16 Configuration tables containing specific emulation variables reside in the FLASH. The FLASH's file directory indicates the location of each table, and which one is active. Only one table may be active at a time. The AEM system uses the active table to control power up loading and initialization of the firmware. The active table is loaded from FLASH into to the processor's RAM where it is referred to as the LOCAL TABLE. The system uses the LOCAL TABLE for hardware initialization and system operation.

A list of the current valid configuration variables may be found in Appendix A. The "Configuration Display"' command will also list these variables.

Changing the AEM Emulation is a three step process:

(1) Variables in the LOCAL TABLE may be modified using the 'Change Variable' command. These changes have no immediate effect on the system. The "Check Config" command verifies the validity of certain variables. Others are checked for dependency. If the check is OK, the LOCAL TABLE may be saved in the FLASH.
Shortcut Note: the "CV" command may be ommitted. Merely typing the VAR=VALUE is sufficient.

(2) To make the changes permanent, the LOCAL TABLE must be saved to the FLASH memory by answering "Y" to the "OK to write to flash" prompt or using the "Configuration Write" command. The "Configuration Write" command copies the LOCAL TABLE into the active FLASH TABLE.

(3) The system must then be power cycled in order for the new table to take effect.

(4) After a table is modified, the system will not go ON-LINE until power cycled.

To modify data in a different table, use the 'Change Table' command. Changes may then be made to the variables in the new table. However, the system must be power cycled for that table to be in effect.

CC Check Configuration

Purpose: Check Configuration performs a rules check on the parameters in the current configuration tables. It also calculates some of the dependent variables. Both the current configuration table and the current system configuration table are checked with this command.

Effective: T/R OFFL

Parameters: none

Display: none

Response: `RDY>` if all parameters are valid
`FAIL>` if any parameter or combination of parameters is invalid

CD Configuration Display

Purpose: Configuration Display lists all the variables in the current local table and their values.

Effective: T/R ONL/OFFL

Parameters: none

Display:

Variable	Value	Variable	Value
MAX_CYL	822	PRI_SEL_MD	0
MAX_HD	4	UNIT_ADD	0
TRACK_LEN	20160	ONL_SAVE	0
NUM_SCTRS	18	WP_SAVE	0
SCTR_LEN	2241	UNIT_ID	0
SMD_MODE	0	HOLD_ONC	0
AM_MODE	0	SET_SIZE	32
BLOCK	1	XLAT_TBL	0
FREEZE	0	SEL_MODE	0
JAMB	0	SCSI_PARAM0	208
CLOCK	0	SCSI_PARAM1	208
NONC_BLOCK	0	SCSI_PARAM4	208
RD_AHD	2	SCSI_PARAM6	208
WB_MODE	1		0
RTZ_TICKS	1		0
REL_TICKS	50		0

(Note: the above order may vary from table to table)

Response: `RDY>`

CT <N> **Change Table**

Purpose: Change Config Table selects a new configuration table in FLASH. (To display the table descriptions, use the DIR command.)

Effective: T/R OFFL

Parameters: 'N' = new configuration table number (0 - 15)

Display: The table name for the newly selected table
Example: `Configuration is : CDC9766_ XDX_Controller`

Response: **RDY>** The table variables are now available for display or modification. However, power must be cycled to allow the new table to take effect.

CW <Y> **Config Write**

Purpose: Config Write performs a check of the configuration variables ("CC") and writes the current local configuration table to FLASH.

Effective: T/R OFFL

Parameters: 'Y' is optional. If specified, the write takes place immediately. If not, the user will be prompted for permission.

Display: none

Response: **RDY>** if write is OK
FAIL> if CFG table was not found (FLASH was corrupted)
or if Config data is invalid (see 'CC' command)

CS TEXT **Change title String**

Purpose: Changes the configuration table's title string in the FLASH directory. This command affects only the current table, and immediately alters the title string in the FLASH.

Effective: T/R OFFL

Parameters: TEXT is the title string. It must contain only valid ASCII text characters. It may not have any intervening spaces (Use the underbar '_' character). The text string will be truncated at 21 characters.

Display: none

Response: **RDY>**

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CV VAR=VALUE **Change Emulation or System Variable**

Purpose: Change Variable. Changes variable values in the AEM local emulation or system configuration table.

Shortcut Note: the "CV" command may be ommitted. Merely typing the VAR=VALUE is sufficient.

Effective: T/R OFFL

Parameters: 1 to 5 parameters of the format VAR=VALUE.
VAR must be a valid configuration keyword. No spaces are allowed between parameters and the equal sign.

Display: Changed Configuration Table or System Configuration Table followed by a prompt for writing the table to FLASH.

Response: **RDY>** if VAR name is good
INV> if VAR name is not found

17.3.2 SYSTEM CONFIGURATION COMMANDS

CCS Check Configuration (System)

Purpose: Check Configuration performs a rules check on the parameters in the current config tables. It also calculates some of the dependent variables. Both the current config table and the current sys config table are checked with this command.

Effective: T/R OFFL

Parameters: none

Display: none

Response: **RDY>** if all parameters are valid
FAIL> if any parameter is invalid

CDS Configuration Display (System)

Purpose: Configuration Display (System) lists all the variables in the current local table and their values.

Effective: T/R ONL/OFFL

Parameters: none

Display:

Variable	Value
MEM_SIZE	4
MEM_SIMMS	4
NUM_TB	512
OP_TYPE	0
REMOV	1
REMOVB	1
AEM_SCSI_ID	7
BACKUP_ID	4
COPY_ID	4
MIRROR_ID	0
UPS_DELAY	500
UPS_FLAGS	0
COMM1_BAUD	9600
COMM1_FLAGS	52
	0

Response: **RDY>**

CSS TEXT **Change title String (System)**

Purpose: Changes the System configuration table's title string in the directory. This command affects only the current system config table, and alters the title string in the FLASH immediately

Effective: T/R OFFL

Parameters: TEXT is the title string. It must contain only valid ASCII text characters. It may not have any intervening spaces (Use the underbar '_' character instead of a space). The text string will be truncated at 21 characters.

Display: none

Response: **RDY>**

CVS VAR=VALUE **Change Emulation or System Variable**

Purpose: Change Variable. Changes variable values in the AEM local emulation or system configuration table.

Shortcut Note: the "CVS" command may be ommitted. Merely typing the VAR=VALUE is sufficient.

Effective: T/R OFFL

Parameters: 1 to 5 parameters of the format VAR=VALUE.
VAR must be a valid configuration keyword. No spaces are allowed between parameters and the equal sign.

Display: Changed Configuration Table or System Configuration Table followed by a prompt for writing the table to FLASH.

Response: **RDY>** if system VAR name is good
INV> if system VAR name is not found

CWS <Y> **Config Write (System)**

Purpose: Config Write (System) performs a check of the system configuration variables ("CC") and writes the current local system config table to FLASH.

Effective: T/R OFFL

Parameters: 'Y' is optional. If specified, the write takes place immediately. If not, the user will be prompted for permission.

Display: none

Response: **RDY>** if write is OK
FAIL> if CFG table was not found (FLASH was corrupted)
or if System Config data is invalid (see 'CCS' command)

17.4 DIRECTORY COMMANDS

DIR **Display Config tables Directory**

Purpose: Displays the FLASH configuration table DIRectory on the terminal.

Effective: T/R ONL/OFFL

Parameters: none.

Display: lists the configuration tables by table number:

TABLE DESCRIPTION

```
SYS     AEM_A14_1_R_B_R        This is the System config table
  0      80MB 24S BLK          This is CONFIG TABLE 0
CUR1     160MB 32S BLK         This is CONFIG TABLE 1 (active)
  2      80MB 40S BLK          This is CONFIG TABLE 2
  3      160MB 40S BLK         This is CONFIG TABLE 3
  4      300MB 40S BLK         This is CONFIG TABLE 4
  5      340MB 40S BLK         This is CONFIG TABLE 5
  6      675MB 40S BLK         This is CONFIG TABLE 6
  7      80MB 23S BLK          This is CONFIG TABLE 7
  8      160MB 23S BLK         This is CONFIG TABLE 8
  9      300MB 23S BLK         This is CONFIG TABLE 9
 10      340MB 23S BLK         This is CONFIG TABLE 10
 11      675MB 23S BLK         This is CONFIG TABLE 11
 12      120MB 67S BLK         This is CONFIG TABLE 12
 13      80MB 64S BLK          This is CONFIG TABLE 13
 14      160MB 64S BLK         This is CONFIG TABLE 14
 15      FACTORY_TEST          This is CONFIG TABLE 15
```

Response: **RDY>**

DFD **Display File Directory**

Purpose: Display File Directory. Displays the FLASH file directory on the terminal.

Effective: T/R OFFL

Parameters: none.

Display: lists the directory entries by line number:

```
LINE  ID  LOC SIZE LOAD  ENT    DESCRIPTION
   00 01 e000 0800 0000 0000 Directory
   01 30 e080 0100 0000 0000 AEM_A44_1_R_M_R
   02 a0 e090 0200 0000 0000 80MB_UDC/IDC_563X        This is CONFIG TABLE 0
   03 a1 e0b0 0200 0000 0000 300MB_UDC/IDC_565X       This is CONFIG TABLE 1
   04 a2 e0d0 0200 0000 0000 82MB_IDC_533X            This is CONFIG TABLE 2
   05 a3 e0f0 0200 0000 0000 160MB_IDC_535X_MMD
   06 a4 e110 0200 0000 0000 474MB_IDC_536X_FUJI
   07 a5 e130 0200 0000 0000 675MB_IDC_566X_FMD
   08 a6 e150 0200 0000 0000 SPARE
   09 a7 e170 0200 0000 0000 SPARE
   10 a8 e190 0200 0000 0000 SPARE
   11 a9 e1b0 0200 0000 0000 SPARE
   12 aa e1d0 0200 0000 0000 SPARE
   13 ab e1f0 0200 0000 0000 SPARE
   14 ac e210 0200 0000 0000 SPARE
   15 ad e230 0200 0000 0000 SPARE
Hit <space> to continue, any other key to EXIT
 LINE  ID  LOC SIZE LOAD  ENT    DESCRIPTION
   16 ae e250 0200 0000 0000 FACTORY_VAX_TST
   17 2f e270 0200 0000 0000 FACTORY_PFTU_TST   This is CONFIG TABLE 15 (active)
   18 08 e290 073d 0000 0000 OPR____A
   19 09 e308 073d 0000 0000 MGR16__A
   20 0a e380 073d 0000 0000 MGR32__A
   21 0b e3f8 073d 0000 0000 MGR64__A
   22 11 e470 073d 0000 0000 SELND__A
   23 13 e4e8 073d 0000 0000 SELDLY_A
   24 14 e560 073d 0000 0000 SELLCH_A
   25 12 e5d8 164e 0000 0000 SMD3___A
   26 0d e758 2e64 0000 0000 ADR45__A
   27 10 ea40 2e64 0000 0000 DATH5__A
   28 40 ef00 ffff 0800 0000 AEMOS
   29 ff ff00 1000 ff00 0000 Loader
   30 00 0000 0000 0000 0000
   31 00 0000 0000 0000 0000
Hit <space> to continue, any other key to EXIT
```

Response: RDY>

17.5 USING SCSI COMMANDS

The SCSI command interface contains many more commands than are used by the system. Only SCSI Reset, SCSI Start, SCSI Stop, SCSI Test Unit Rdy, SCSI Request Sense, SCSI Rd Cap, SCSI Wr Track, and SCSI Rd Track are used by the AEM. The other commands are provided for firmware debug and diagnostic use.

The AEM uses only the Read Track and Write Track functions to transfer data directly (DMA) to the track buffer memory. The Read and Write Block commands use a non-DMA mode. Data for these commands is stored in a local buffer. The block commands are provided merely as a diagnostic tool.

The CLEAN command has been provided to initialize drives that have been used in a different application and ensure that all previous information is overwritten with all zeros.

Additional commands are available for controlling an optional SCSI Tape or Disk backup device. These commands allow the "CLONING" and/or BACKUP of the Emulated data drive to removable media for archival or backup purposes.

17.5.1 SCSI COMMANDS

The standard response for SCSI commands will be as follows, unless otherwise noted:

RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE. Additionally, SRST and SSNS get sense information. The SENSE KEY must be NO SENSE.

REJ> if the AEM is ON-LINE or not in Maintenance Mode.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

Commands that apply to both disk and tape SCSI devices are designated D/T and must have the <ID> specified or the command will default to SCSI ID 0. Commands that apply to disk only are designated DISK. Commands that apply to tape only are designated TAPE and must have the tape drive SCSI ID (BACKUP_ID) specified as they normally default to the hard drive SCSI ID.

SRST <ID> **SCSI Reset**

Purpose: SCSI Reset. This command is to reset and restore the drive and SCSI bus to a known state.

Effective: D/T T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: none

Response:

RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE. Additionally, SRST and SSNS get sense information. The SENSE KEY must be NO SENSE.

REJ> if the AEM is ON-LINE or not in Maintenance Mode.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STUR <ID> **SCSI Test Unit Ready**

Purpose: Tests for the SCSI device "ready to read / write" media condition.

Effective: D/T T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: none

Response:
RDY> if the SCSI command returned STATUS = GOOD and MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SSNS <ID> **SCSI Request Sense**

Purpose: Obtain sense information from the SCSI drive.

Effective: D/T TERM OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: Sense Data if SENSE KEY is non zero

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE. Additionally, SRST and SSNS get sense information. The SENSE KEY must be NO SENSE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SINQ <ID> **SCSI Inquiry**

Purpose: Retrieve drive information from the SCSI device

Effective: D/T TERM OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: none, data is put in the BUFFER

Example of buffer using SINQ followed by a SDB command:

```
 0  0  2  2 33  0  0 92 4d 49 43 52 4f 50 20 20    ....3..MICROP
34 32 32 31 2d 30 39 4d 5a 20 20 31 30 32 30 34    4221-09MZ  10204
48 54 30 31 34 32 32 31 2d 30 39 53 43 32 31 30    HT014221-09SC210
32 30 34 58 54 4e 30 35  0  b 2f 87  0  d 9b 54    204XTN05../..T
 0  e 75 3d  0  e d8 30  0  f 34 ea  0  f 7a ec    ..u=..╪0..4Ω..z∞
 0  f 7f 69  0 11 53 c1  0 12 ab f0  0 14 bf 88    .i..S┴..½≡..┐ê
 0 14 df 73  0 18 5e 2a  0 19 86 ec  0 19 b7 80    ..▀s..^*..∞..╖
 0 1a 62 c6  0 1b f9 c4  0 1c e1 58  0 1d f6 7c    ..b╞..·─..ßX..÷|
 0 1e 88 b9  0 22  a 28  0 22 9c e7  0 24 54 16    ..ê╣."."(."τ.$T.
 0 26 ac 27  0 29 c3 f0  0 2a 73 d5  0 2e 20 1f    .&¼'.)├≡.*s╒..  .
 0 2e 56 55  0 2f 30 b1  0 35 e7 52  0 38 1c  a    ..VU./0▒.5τR.8..
 0 38 36 ed  0 38 39 db  0 38 3c c9  0 38 3f b7    .86φ.89█.8<╔.8?╖
 0 38 42 a5  0 38 45 93  0 38 48 81  0 38 4b 6f    .8BÑ.8E.8H.8Ko
 0 38 4e 5d  0 38 51 4b  0 38 53 5f  0 38 54 39    .8N].8QK.8S_.8T9
 0 38 57 27  0 38 5a 15  0 38 5d  3  0 38 5f f1    .8W'.8Z..8]..8_±
 0 38 62 df  0 38 65 cd  0 38 68 bb  0 38 6b a9    .8b▀.8e═.8h╗.8k┌
Hit <space> to continue, any other key to EXIT
```

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE. Additionally, SRST and SSNS get sense information. The SENSE KEY must be NO SENSE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SSTRT <ID> **SCSI Start Unit**

Purpose: Start the SCSI drive's spindle motor

Effective: DISK TERM OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SSTOP <ID> **SCSI Stop Unit**

Purpose: Stop drive spinning.

Effective: DISK TERM OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SCAP <ID> **SCSI Read Capacity**

Purpose: Read the capacity of the SCSI drive.

Effective: DISK TERM OFFL MM

Parameters: ID - SCSI ID - optional, default is 0.

Display: Capacity in blocks and bytes. Example:
Drive capacity is 4004218 blocks of 512 bytes

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SDUMP <ID> **SCSI Drive Dump**

Purpose: SCSI Drive Dump. This command may be used to display the contents of a SCSI drive on the terminal.

Effective: TERM OFFL

Parameters: none

Display: Test information

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SSCAN **SCSI Bus Scan**

Purpose: Scan SCSI Bus. This command is used to display the active SCSI devices on the terminal.

Effective: TERM OFFL

Parameters: Removable drives should be powered on prior to issuing this command

Display: Test information

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE.

SFIFO **SCSI Test Fifo**

Purpose: SCSI Test FIFO. This test verifies that the CPU interface to the SCSI controller chip is working. This command is intended for factory testing only.

Effective: TERM OFFL

Parameters: none

Display: Test information

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SRBLK BLOCK <ID> **SCSI Read Block**

Purpose: Read logical block from the SCSI device(non DMA).

Effective: DISK T/R OFFL MM

Parameters: BLOCK is the block number to read. It must be within the capacity of the current drive emulation or the command will fail.
ID - SCSI ID - optional, default is 0.

Display: none. Data is transferred to the BUFFER

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SWBLK BLOCK <ID> **SCSI Write Block**

Purpose: Writes a SCSI logical block from the BUFFER (non DMA).

Effective: DISK T/R OFFL MM

Parameters: BLOCK is the block number to write. It must be within the capacity of the drive or the command will fail.
ID - SCSI ID - optional, default is 0.

Display: none. Data is transferred from the BUFFER

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SFB <DATA> **SCSI Fill Buffer**

Purpose: Fills the SCSI BUFFER with a data pattern.

Effective: TERM OFFL MM

Parameters: DATA (a single byte) is used to fill the BUFFER. If DATA is not specified, 0 is used (clear buffer).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SRTRK TB TRACK <ID> **SCSI Read Track**

Purpose: SCSI Read Track (DMA). This command uses the DMA channel to transfer data to a track buffer. The amount of data transferred is based on the size of the current Emulated track. (This command should be used only after a SCAP command has been issued.)

Effective: DISK T/R OFFL MM

Parameters: TB is the target track buffer.
TRACK is a valid logical Emulated track.
ID - SCSI ID - optional, default is 0.

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

SWTRK TB TRACK <ID> SCSI Write Track

Purpose: SCSI Write Track (DMA). This command uses the DMA channel to transfer data from a track buffer. The amount of data transferred is based on the size of the current Emulated track. (This command should be used only after a SCAP command has been issued.)

Effective: DISK T/R OFFL MM

Parameters: TB is the source track buffer.
TRACK is a valid logical Emulated track.
ID = SCSI ID - optional, default is 0.
ID = "A" (AEM "C" Models only) Writes all track buffers in the current emulation to the SCSI drive at SCSI ID 0.

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STEST <Y> SCSI Disk Self Test

Purpose: Provide an Off-Line test capability for a SCSI Disk drive. Only Volume 0 of the "primary" SCSI drive at SCSI ID 0 will be tested. The test consists of 1 pass of the "CLEAN " command followed by one pass of the "VCOPY 0 0" followed by a continuous random read write test "VCOPY 0 0 T". Testing will continue untill either an error results, the FAULT- CLEAR switch is pressed, or the drive interlock or keylock is opened

Effective: DISK T/R OFFL MM

Parameters: <Y> - advance response to Destroy data Query

Display: Progress of test and performance results

Response:
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STRBK #OFBLKS <ID> **SCSI Tape read block**

Purpose: Read the next sequential block(s) from tape.

Effective: TAPE T/R OFFL MM

Parameters: #OF BLKS - Number of 512 byte blocks to be read.
ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STRW <ID> **SCSI Tape Rewind**

Purpose: SCSI Tape rewind command

Effective: TAPE T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STMSL <ID> **SCSI Tape mode select**

Purpose: Mode select command for tape (mode select data is firmware predefined for each device type)

Effective: TAPE T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STWBK #OF BLKS <ID> **SCSI Tape write block**

Purpose: Write block(s) from SCSI BUFFER command

Effective: TAPE T/R OFFL MM

Parameters: #OF BLKS - Number of 512 byte blocks to be written.
ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STRTK TB <ID> **SCSI Tape read track**

Purpose: Reads the next logical Emulated track from the tape device.

Effective: TAPE T/R OFFL MM

Parameters: TB - Track buffer number to be used
ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STWTK TB <ID> **SCSI Tape write track**

Purpose: Writes a logical Emulated track to the tape device from track buffer TB

Effective: TAPE T/R OFFL MM

Parameters: TB - Track buffer number to be used
ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, and MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.
FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STMSN <ID> **SCSI Tape - mode sense**

Purpose: Obtain Mode Sense information from SCSI Tape device

Effective: TAPE T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is (BACKUP_ID).

Display: (See individual Tape Drive manual for explanation of Mode Sense data) Example:
Mode sense data = e, 4, 10, 8, f, 0, 0, 0, 0, 0, 2, 0, 2, 1c, 0

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

STWH <ID> **SCSI Tape write header**

Purpose: Write a header on the SCSI tape.

Effective: TAPE T/R OFFL MM

Parameters: ID - SCSI ID - optional, default is (BACKUP_ID).

Display: none

Response:
RDY> if the SCSI transaction returned STATUS = GOOD, MESSAGE = COMMAND COMPLETE.
REJ> if the AEM is ON-LINE or not in Maintenance Mode.

FAIL> if the SCSI transaction returns bad STATUS, MESSAGE, or SENSE, or if the drive returns a FATAL ERROR.

17.6 TRACK BUFFER DEBUG COMMANDS

TBD <TB> <MODE> <SCTR> <ADDR> <BITS> Track Buffer Dump

Purpose: Track Buffer Dump displays the track buffer on the terminal.

Effective: TERM ONL/OFFL MM

Parameters: TB is the target track buffer.
MODE is the display mode. H = hexidecimal, O = octal, B = binary, A = ASCII.
SCTR is the beginning sector number. Default is sector 0.
ADDR is the beginning buffer offset address. Default is 0.
BITS is the desired bit offset for each word in the buffer. Default is 0.

Parameters must be entered in sequence. ie. if the <MODE> parameter is desired, <TB> must be entered prior to <MODE>. Once a parameter is entered, subsequent TBD commands will default to the most recently entered parameter values.

Display: Dump in requested mode.

Response: **RDY>**
REJ> if the AEM is not in Maintenance Mode.

TBDIR Track Buffer Directory

Purpose: Track Buffer Directory displays the track buffer directory.

Effective: TERM ONL/OFFL MM

Parameters: none

Display: Directory Dump: TB#: TRACK# LRU V D
LRU = Least Recently Used count
V = Valid
D = Dirty

Response: **RDY>**
REJ> if the AEM is not in Maintenance Mode.

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Phoenix, AZ USA Tel: 623-582-4592

TBF TB <NUM> **Track Buffer Fill**

Purpose: Track Buffer Fill(s) the track buffer with value NUM.

Effective: TERM ONL/OFFL MM

Parameters: TB is the target track buffer.(if TB is specified as "A", all track buffers will be filled with their corresponding number. This process may take several minutes to complete.)

NUM is the value to be used for fill bytes (0-255). Default is 0.

Display: none

Response: **RDY>**
REJ> if the AEM is not in Maintenance Mode.

17.7 USING TRACE COMMANDS

The AEM TRACE function may be used to log Activity and Error information without affecting system performance. The TRACE Buffer is an array of 2048 memory locations into which information is stored. When trace is activated, various software routines may log information in the Trace Buffer for later display. This prevents system from being over burdened by displaying large amounts of information.

To use the TRACE commands, the AEM must be placed in Maintenance Mode.

The TRACE process operates using FLAGS and TIME. The flags control which information is logged:
The TRACE operates like a one-shot, triggered by the 'T' command. TRACE may be triggered as many times as desired. Information is only logged while TRACE is active. Time may be specified up to 65535 10MS ticks (about 10.9 min.).

The TRACE Buffer is a ring buffer. It is 2048 entrys deep therefore, only the last 2048 events are stored. Previous logged events are overwritten. Displaying the TRACE buffer also clears the buffer.

17.7.1 TRACE COMMANDS

TS TIME <FLAGS> **Trace Setup**

Purpose: Trace Setup. When activated, the trace will run until the time specified in TIME argument has elapsed.

Effective: TERM ONL/OFFL MM

Parameters: TIME is the time duration that TRACE information is logged. If TIME is specified as zero (0), trace will run indefinitely. Flags are:

FLAG	FUNCTION
ERR1	SCSI Command Errors
ERR2	Detailed Dump SCSI Command Errors
SEL	Select interrupt processing
IFC1	Interface interrupt activity
IFC2	Detailed Breakdown Interface interrupt activity
SCSI1	Shows SCSI routine calls
SCSI2	Shows SCSI Wait for interrupt (wfi) activity
MON	Shows track reading and writing activity
WQ1	Shows write queue activity
ALL	All of the above

Use a '+' in front of the name to activate a trace, and a '-' to deactivate a trace.

Display: none.

Response: **RDY>**

NOTE: To place the AEM in the trace mode automatically upon power up, Set the UNIT_ID configuration variable to 255. The AEM will be placed in the equivalent of "**TS 0 +ALL**" at power up.

T **Toggle Trace active**

Purpose: Trace toggles the TRACE function. The trace will run until the TIME specified in the Trace Setup command is reached (see TS).

Effective: TERM ONL/OFFL MM

Parameters: none.

Display: `Trace=1` (the trace flags will be displayed) or `Trace=0`

Response: **RDY>**

TD **Trace Display**

Purpose: Trace Display dumps the trace information to the terminal.

Effective: TERM ONL/OFFL MM

Parameters: none.

Display: Displays the most recent TRACE information, up to 2048 lines.

Response: **RDY>** after TRACE dump or if no TRACE information has been collected.

18 OFF-LINE BACK UP OPTION

The AEM can be optionally configured with an off-line backup capability. Either a tape drive or another disk may be employed as the backup device. The backup and restore is similar regardless of the type of device used. Please refer to the terminal commands BACKup, COPY, and RESTore. (see section 18.7 page 108)

18.1 DISK TO DISK BACKUP USING INTEGRATED FLAT or PUSHBUTTON OPERATOR PANELS

If a removable disk drive or removable media disk drive is used as the backup device, the following procedure may be used to copy the current volume on the primary SCSI drive(as entered in the optional multi-volume Volume ID switch) to volume zero on the backup device:

The AEM must be in the OFF LINE state.

Select the primary drive volume to be backed up. (this backup procedure allows only Volume 0 to be the target volume on the Backup device)

Press and hold the FAULT CLEAR switch.

Press the WRITE PROTECT switch while holding the FAULT clear switch.

When the FAULT and WRITE PROTECT indicators begin flashing, release both switches.

The indicators will flash for 10 seconds. During that interval press the ON-LINE switch.

When the ON-LINE switch is pressed, the READY and SELECTED indicators will turn on. The backup process has begun.

Both drives will be spun up (if not already spinning), checked for capacity to handle the number of blocks for the current emulation, and readied for reading or writing.

As each Emulated track is copied to the backup device, the READY indicator will blink. The backup elapsed time will depend on drive types and capacity of the current emulation. Only the tracks used for the current emulation (as defined by the current emulation configuration) and current volume will be copied to the backup device.

When all four indicators go out, the system has returned to normal mode.

If the backup process terminates abnormally, the FAULT indicator will remain on or flash a fault code. If power is interrupted, or the process is aborted by some other means, the procedure may be restarted.

For Fixed/Removable emulations (such as XLAT_TBL=8), only the Removable partition can be backed up using the Front Panel Backup procedure.

18.2 DISK TO DISK BACKUP USING CENTER MOUNTED FLAT OPERATOR PANELS

If a removable disk drive or removable media disk drive is used as the backup device, the following procedure may be used to copy the current volume on the primary SCSI drive(as entered in the optional multi-volume Volume ID switch) to volume zero on the backup device:

The AEM must be in the OFF LINE state.

Select the primary drive volume to be backed up. (this backup procedure allows only Volume 0 to be the target volume on the Backup device)

Press and hold the FUNCTION switch.

Press the BACKUP switch while holding the FUNCTION switch.
When the BACKUP switch is pressed, the READY and SELECTED indicators will turn on. The backup process has begun.

Both drives will be spun up (if not already spinning), checked for capacity to handle the number of blocks for the current emulation, and readied for reading or writing.

As each Emulated track is copied to the backup device, the READY indicator will blink. The backup elapsed time will depend on drive types and capacity of the current emulation. Only the tracks used for the current emulation (as defined by the current emulation configuration) and current volume will be copied to the backup device.

When all indicators go out, the system has returned to normal mode.

If the backup process terminates abnormally, the FAULT indicator will remain on or flash a fault code. If power is interrupted, or the process is aborted by some other means, the procedure may be restarted.

For Fixed/Removable emulations (such as XLAT_TBL=8), only the Removable partition can be backed up using the Front Panel Backup procedure.

18.3 DISK TO TAPE BACKUP USING INTEGRATED FLAT or PUSHBUTTON OPERATOR PANELS

If a tape drive is used as the backup device, the following procedure may be used to copy the primary SCSI drive to the backup device(refer to Figure 24 page 106):

The AEM must be in the OFF LINE state.

Select the primary drive volume to be backed up using the optional multi-volume Volume ID switch.
(this backup procedure allows only Volume 0 to be the target volume on the Backup device)

Install a tape in the backup drive with sufficient capacity for the current emulation. Wait until the tape drive finishes its initialization.

Press and hold the FAULT CLEAR switch.

While holding the FAULT clear switch, press the WRITE PROTECT switch.

When the FAULT and WRITE PROTECT indicators begin flashing, release both switches.

The indicators will flash for 20 seconds. During that interval press the ON-LINE(START) switch.

When the ON-LINE(START) switch is pressed, the READY and SELECTED indicators will turn on. The backup process has begun.

The primary disk drive will be spun up (if not already spinning), checked for capacity to handle the number of blocks for the current emulation, and prepared for reading. The tape drive will be rewound and positioned to the beginning of tape.

As each Emulated track is copied to the backup device, the READY indicator will blink. The backup elapsed time will depend on drive types and capacity of the current emulation. Only the tracks for the current emulation will be copied to the backup device.

When all four indicators go out, the system has returned to normal mode, the tape has been rewound and may now be removed.

If the backup process terminates abnormally, the FAULT indicator will remain on. If power is interrupted, or the process is aborted by some other means, the procedure may be restarted.

For Fixed/Removable emulations (such as XLAT_TBL=8), only the Removable partition can be backed up using the Front Panel Backup procedure.

18.4 DISK TO TAPE BACKUP USING CENTER MOUNTED FLAT OPERATOR PANELS

If a tape drive is used as the backup device, the following procedure may be used to copy the primary SCSI drive to the backup device(refer to **Figure 24** page 106):

The AEM must be in the OFF LINE state.

Select the primary drive volume to be backed up using the optional multi-volume Volume ID switch.
(this backup procedure allows only Volume 0 to be the target volume on the Backup device)

Install a tape in the backup drive with sufficient capacity for the current emulation. Wait until the tape drive finishes its initialization.

Press and hold the FUNCTION switch.

While holding the FUNCTION switch, press the BACKUP switch.

When the BACKUP switch is pressed, the READY and SELECTED indicators will turn on. The backup process has begun.

The primary disk drive will be spun up (if not already spinning), checked for capacity to handle the number of blocks for the current emulation, and prepared for reading. The tape drive will be rewound and positioned to the beginning of tape.

As each Emulated track is copied to the backup device, the READY indicator will blink. The backup elapsed time will depend on drive types and capacity of the current emulation. Only the tracks for the current emulation will be copied to the backup device.

When all indicators go out, the system has returned to normal mode, the tape has been rewound and may now be removed.

If the backup process terminates abnormally, the FAULT indicator will remain on. If power is interrupted, or the process is aborted by some other means, the procedure may be restarted.

For Fixed/Removable emulations (such as XLAT_TBL=8), only the Removable partition can be backed up using the Front Panel Backup procedure.

18.5 VERIFYING A BACKUP DRIVE OR TAPE

To verify a backup disk or tape image, The primary drive image may be compared to the backup image either from the front panel or using a terminal connected to the AEM's serial port connector. The SVFY command, issued from the terminal, will compare the previously saved Emulation volume image on the backup device to the Emulation volume image on the primary SCSI drive (see section 18.7 page 110). Placing the AEM in the WRITE PROTECTED mode prior to initiating the Front Panel Backup procedure, will cause the Verify process to run. If a mis-compare occurs the FAULT led will be illuminated.

18.6 RESTORING DRIVES FROM THE BACKUP

To restore an image from the backup media to the primary SCSI drive, a terminal must be connected to the AEM's serial port connector. The RESTore command, issued from the terminal, will copy the previously saved Emulation volume image from the backup device to the primary SCSI drive (see section 18.7, 18.7 page 109, 110).

For systems using a second removable SCSI drive as the backup device, the operator panel backup procedure can be used to restore volume zero on a drive. Merely insert the backup drive in the primary receptacle, and the drive to be copied onto in the backup receptacle, and perform the front panel backup procedure.

> ***---CAUTION---***
> *Care should be taken to prevent copying the wrong way when using the above procedure. The front panel backup procedure always reads from the primary drive receptacle at SCSI ID 0 and writes to the backup receptacle...*

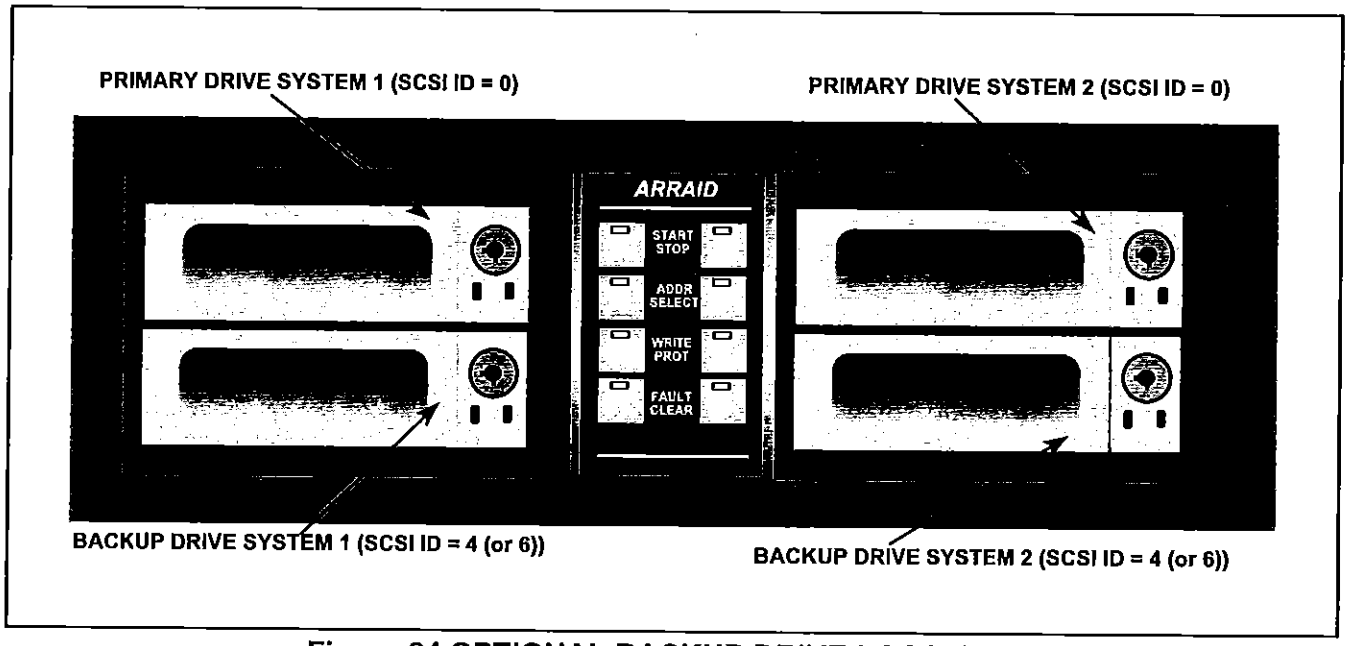

Figure 24 OPTIONAL BACKUP DRIVE LOCATIONS

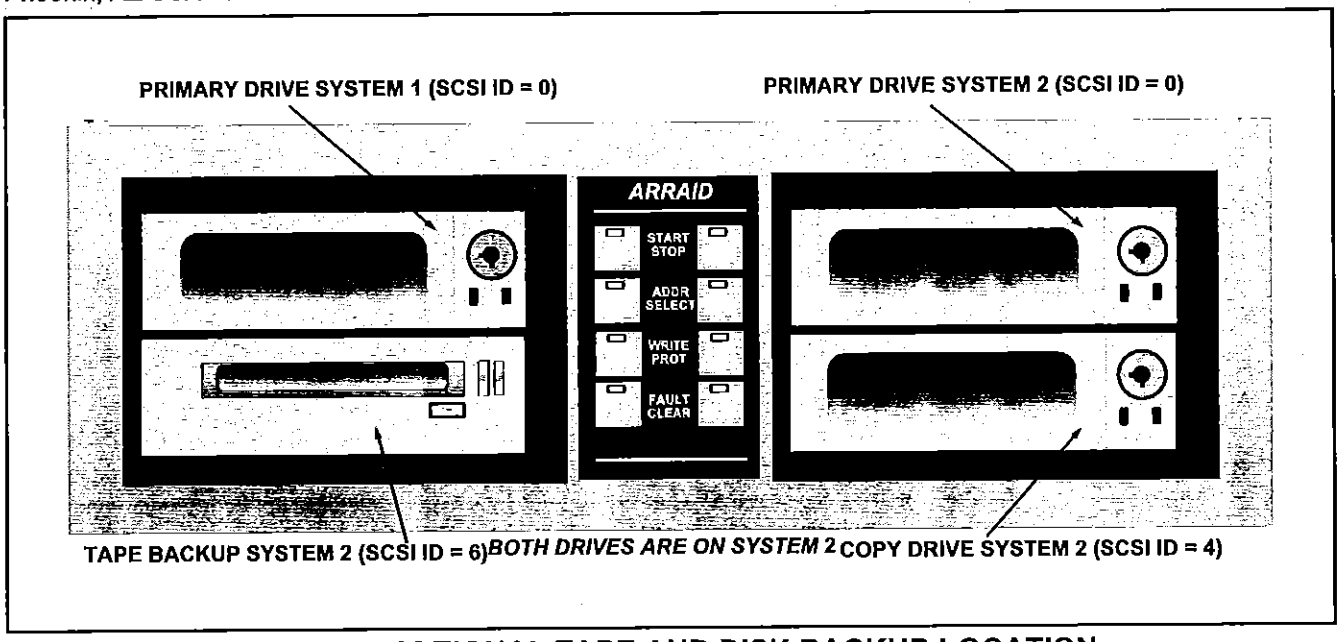

Figure 25 OPTIONAL TAPE AND DISK BACKUP LOCATION

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18.7 USING AEM OPTIONAL BACKUP/RESTORE FACILITY COMMANDS

BACK <FROM VOL> <TO VOL> Backup command

Purpose: BACKup command copies the Emulated Volume image from the Primary disk drive at SCSI ID 0 to the backup device (BACKUP_ID). The number of Emulated tracks to be copied is determined from the current drive emulation configuration table. The backup device is checked for sufficient capacity to contain the current Emulated image. If the backup device is another disk drive, the BACKup command functions exactly like the COPY command. This command may also be initiated from the AEM's front operator panel (see section 18 page 103.)

Effective: D/T T/R OFFL

Parameters: FROM VOL = the source Volume # on the Primary drive (defaults to the Volume # entered in the optional multi-volume Volume ID switch).

TO VOL = the target Volume # on the Backup drive. (defaults to Volume 0).

(NOTE: if the Backup device is a tape drive, only Volume 0 can be used as the TO parameter.)

Display: Volume number and number of tracks to be copied. (Emulated heads X cylinders)
The progress of the BACKup will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.

For Fixed/Removable emulations (such as XLAT_TBL=8), the system will ask which partition (Fixed / Removable) is to be Backed up.

Response:
RDY> if the command completed successfully.
REJ> if the AEM is not OFF-LINE when command is issued..
FAIL> if any SCSI operation returns a non recoverable error.

COPY <FROM VOL> <TO VOL> COPY command

Purpose: Copy the Emulated Volume image from the Primary disk drive at SCSI ID 0 to the Backup disk drive at SCSI ID (COPY_ID) The number of Emulated tracks to be copied is determined from the current drive emulation configuration table.

Effective: D T/R OFFL

Parameters: FROM VOL = the source Volume # on the Primary drive (defaults to the Volume # entered in the optional multi-volume Volume ID switch).

TO VOL = the target Volume # on the Backup drive. (defaults to Volume 0).

Display: Volume numbers and number of tracks to be copied. (Emulated heads and cylinders)
The progress of the COPY will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.

Response:
RDY> if the command completed successfully.
REJ> if the AEM is not OFF-LINE when command is issued..
FAIL> if any SCSI operation returns a non recoverable error.

REST <FROM VOL> <TO VOL> **Restore command**

Purpose: Restore the Emulated Volume image from the Backup device at SCSI ID (BACKUP_ID) to the Primary disk drive at SCSI ID 0. The number of Emulated tracks to be copied is determined from the current drive emulation configuration table.

Effective: D/T T/R OFFL

Parameters: FROM VOL= the source Volume # on the Backup drive (defaults to Volume 0).
(NOTE: if the Backup device is a tape drive, only Volume 0 can be used as the FROM parameter.)

TO VOL = the target Volume # on the Primary drive. (defaults to the Volume # entered in the optional multi-volume Volume ID switch).

Display: Volume number and number of tracks to be restored. (Emulated heads X cylinders)
The progress of the RESTore will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.

For Fixed/Removable emulations (such as XLAT_TBL=8), the system will ask which partition (Fixed / Removable) is to be restored.

Response: **RDY>** if the command completed successfully.
REJ> if the AEM is not OFF-LINE when command is issued..
FAIL> if any SCSI operation returns a non recoverable error.

SVFY <SUBJ VOL> <REF VOL> Scsi VeriFY command

Purpose: Compare the Emulated Volume image on the Backup device at SCSI ID (BACKUP_ID) to the Primary disk drive at SCSI ID 0. The number of Emulated tracks to be compared is determined from the current drive emulation configuration table.

Effective: D/T T/R OFFL

Parameters: SUBJ VOL= the subject Volume # on the Backup drive (defaults to Volume 0).
(NOTE: if the Backup device is a tape drive, only Volume 0 can be used as the SUBJ parameter.)

REF VOL = the referenceVolume # on the Primary drive. (defaults to the Volume # entered in the optional multi-volume Volume ID switch).

Display: Volume number and number of tracks to be compared (Emulated heads X cylinders)
The progress of the SVFY will be displayed every 10 tracks.
During the process, the front panel LEDs will blink every track and every 10 tracks.
If a miscompare occurs, the system will display the following:

```
DATA MISCOMPARE Track dddd Word dddd Was XXXX SB XXXX
```

For Fixed/Removable emulations (such as XLAT_TBL=8), the system will ask which partition (Fixed / Removable) is to be Verified.

Response:
RDY> if the command completed successfully.
REJ> if the AEM is not OFF-LINE when command is issued..
FAIL> if any SCSI operation returns a non recoverable error.

19 AEM RAID-1 DISK MIRRORING OPTION

19.1 MIRRORING OPTION

The AEM Mirroring option provides a means to record data on two disk drives at the same time. The drives become identical copies of each other. In the unlikely event of a SCSI drive failure, the other drive will continue to operate until operator intervention is available. Automatic fail-over will provide a high degree of system availability. An on-line re-synchronization of the drive's data can occur while the drive is on-line to the host controller. This option may also be used to obtain "instant" backups of the on-line data base with minimum system down time. If the multi-volume option is installed, the current Volume as controlled by the Volume ID switch, will be used for both drives. It is not possible to mirror to different volumes on the primary and mirror drives

19.2 MIRRORING TERMINOLOGY

19.2.1 PRIMARY DRIVE

The primary drive is defined as the upper (primary) drive bay. It is the drive that is written to, or read from, in a single disk system. When the mirroring mode is active, it is the drive written to first.

19.2.2 MIRROR DRIVE

The mirror drive is defined as the drive located in the lower (mirror) drive bay. When mirroring is active, the data on this drive is an identical copy or "mirror image" of the primary drive.

19.2.3 SYNC

Sync is the term used to describe the state of the data on the mirror drive. If the data on the mirror drive is identical to that on the primary drive, the drives are in sync or "SYNCED". If the data is not the same, they are out of sync.

19.2.4 RESYNC (REVIVE)

Resync is the reviving process that is used to copy the data from the primary drive to the mirror drive to bring it into sync with the primary drive. The AEM starts the resync process by copying track zero of the primary drive to track zero of the mirror drive. The track count is then incremented and the process repeats until the entire disk has been copied. The AEM is able to simultaneously perform the resync and be on-line with the host computer doing reads and writes. Resync will take longer to complete when the host computer is active (doing reads to, and writes from, the AEM) than when the host is inactive.

19.2.5 ALTERNATING READS

Alternating reads is a technique used to assure the integrity of the mirror drive. When read alternation is enabled and the host computer is reading from the AEM, the read will be performed by the drive closest to the desired track. If both drives are positioned at the same track position, the first five reads are from the primary drive, then the next five reads will be from the mirror drive. The process then repeats itself. This assures the user that valid and readable data is being written to the mirror drive as well as the primary drive.

19.3 MIRRORING STARTUP PROCESS

1. Install the primary drive canister in the PRIMARY (upper) drive bay and turn it's key switch on (clockwise). Install the mirror drive canister in the MIRROR (lower) drive bay and turn it's key switch on.

2. Press the ONLINE (START) switch. If the primary drive is not installed, or it's key switch is off, the FAULT light will flash for five seconds. The AEM applies power to the drives and waits approximately twelve seconds for them to complete their power on sequence. The AEM then sends the start command to turn the primary drive's motor on and waits for the drive to report ready. If the drive does not report ready in thirty seconds, the FAULT light will illuminate.

3. The AEM next starts the motor in the mirror drive. The AEM waits up to thirty seconds for the drive to report ready. If it does not, the FAULT light will illuminate and it will not go ready.

   Please note: If the mirror drive's key switch is off, mirroring will not be initiated and only the primary drive will be placed on-line.

4. With both drives ready, the AEM will go on-line and the WRITE PROTECT and FAULT indicators will begin flashing and remain flashing for twenty seconds. During this time, the operator may select the mirroring mode. The mode will depend on whether the drives are synced or not.

   A. If the drives are synced.

      1. If the drives are synced and the operator wishes to initiate alternating reads between the primary drive and the mirror, press the FAULT CLEAR switch while the WRITE PROTECT and FAULT indicators are flashing. The indicators will cease to flash and the AEM will start mirroring with alternating reads enabled.

      2. If the drives are synced but the operator does not wish to have alternating reads, no action is required. The indicators will cease to flash in twenty seconds and the AEM will perform mirroring without alternating reads.

   B. If the drives are not synced.

      1. If the drives are not synced, the resync process must be initiated by the operator. Depressing the ON-LINE(START) switch during the twenty second period in which the WRITE PROTECT and FAULT CLEAR indicators are flashing, will start the resync process. The ON-LINE/READY indicator will flash for every track and the SELECT/ADDR indicator will flash for every tenth track synced during the resync process. Resync will take from approximately ninety seconds to complete (80 MB emulation and the host computer is not reading or writing to or from the AEM) to approximately 30 minutes depending upon the capacity of the disk being emulated, the level of disk activity and the speed of the SCSI drive. Upon completion of resync, the indicators will cease to flash and alternate reads will begin.

5. If at some point after step 4 a resync is needed, the operator may press and hold the FAULT CLEAR switch, then press the WRITE PROTECT switch, to restart their flashing. Then repeat step 4.

6. To stop only the mirroring process, turn the key switch off (counter-clockwise) on the mirror drive bay. The system will revert to non-mirrored operation.

   Mirroring cannot be restarted by turning the key back on. To restart mirroring, the primary drive must be stopped and the mirroring startup process needs to be repeated from step two.

   Do not remove the mirror drive unless the primary drive is stopped as well. Removing the mirror drive while the primary drive is on-line may cause errors on the other drive or the SCSI bus that could cause the mirroring process to be aborted.

7. To stop both the primary drive and the mirroring drive, press on-line/ready. Do not remove either drive until the indicators on the drive bay have gone out and the start indicator has stopped flashing.

19.4 RESYNCING(REVIVING) THE MIRROR DRIVE

19.4.1 WHEN SYSTEM IS ON LINE

If at some point after the system is on-line in the mirroring mode a resync is needed, the operator may press and hold the FAULT CLEAR switch, then press the WRITE PROTECT switch, to restart their flashing. Then repeat the procedure in section 19.3 page 112 step 4. The RS command issued from the command terminal will also initiate or abort the resync process. Resync progress may be periodically displayed using the SS command from the command terminal.(see 19.6 page 114)

19.4.2 WHEN SYSTEM IS OFF LINE

The MIRROR drive may be resynced (copied from the PRIMARY) while off-line by using the BACKup or COPY commands as described in section 18.7 page 108. or by initiating the OFF-LINE-backup front panel switch sequence. Using these commands will "clone" the mirror drive from the primary drive. In systems with both mirroring and tape or optical disk backup options, only the COPY command may be used to produce an off-line copy of the PRIMARY drive since, the BACK command will copy to the tape or optical drive.

19.5 ENABLE/DISABLE ALTERNATING READS

The alternating reads mode may be stopped at any time by initiating the special front panel switch procedure (press WRITE PROTECT while holding the FAULT CLEAR switch) Merely let the 20 second WP and FLT indicators flashing expire without pressing any other switches.

To re enable the read alternation mode, initiate the special front panel switch procedure, then while the indicators are flashing, press and release the FAULT CLEAR switch. If the system is in the Mirroring mode, the reads will begin to alternate between the PRIMARY and MIRROR drives.

CAUTION; Do not initiate the read alternation mode unless you are certain that the drives are in sync. To do so when they are not, may result in corrupt files. If in doubt, initiate the automatic resync procedure instead.

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19.6 MIRRORING TERMINAL COMMANDS

SS **Display System Status**

Effective: T/R ONL/OFFL

Display: ON

```
WRT  IFC  SYS  SCSI  FAT  PORT  PORT  IFC
 LIN  PRT  FLT  ERR   ERR  ERR   1DET  2DET  ADDR
  1    0    0    0     0    0     1     0     3

MIRR   RE    OUT   PRIM  MIRR  PRIM  MIRR
MODE  SYNC  SYNC   OK    OK    FAIL  FAIL
 1      0     0    1     1     0     0
```

Response: RDY>

Explanation:

ON LIN — 1 = AEM is on-line
WRT PRT — 1 = Write Protect is on
IFC FLT — N = IFC fault, use "F" command for details
SYS ERR — N = system error, see page 119

NOTE: Fault Indicator will flash these codes if they occur:

SCSI ERR
- 0 = no errors
- 1 = mirror read error
- 2 = primary read error
- 3 = mirror write error
- 4 = primary write error
- 5 = both drives have failed to read
- 6 = SCSI capacity can not be determined
- 7 = Timeout during startup
- 8 = Drive will not start
- 9 = insufficient capacity for selected emulation
- 10 = key interlock is open, unable to start

FAT ERR — 1 = fatal error

PORT DET — 1 = Port is connected to a powered up controller
0 = Port is not connected, Port is not enabled, or Host is not powered on

MIRR MODE — 1 = mirror mode on
RE SYNC — 1 = resync in progress
0 = resync not active
OUT SYNC — 0 = primary and mirror in sync
-1 = not mirroring
NNNN = primary and mirror not in sync
PRIM OK — 1 = primary drive OK, no read/write errors
0 = primary drive has had a non-fatal read/write error
MIRR OK — 1 = mirror drive OK, no read/write errors
0 = mirror drive has had a non-fatal read or write error
PRIM FAIL — 1 = prime drive fatal error, drive marked off-line.
0 = prime drive has had no fatal errors
MIRR FAIL — 1 = mirror drive fatal error, drive marked off-line
0 = mirror drive has had no fatal errors

RS **Resync(Revive) Start/Stop**

Purpose: ReSync mirror. Toggles (Start or Stop) the ReSync (Revive) process from the terminal.

Effective: T/R ONL

Display: **RS=1** The Resync process has been started.
or
RS=0 The Resync process has been stopped.

Response: **RDY>**

20 ON-LINE BACKUP TO A REMOVABLE MEDIA DRIVE

ON-LINE Backups can be made to a removable media cartridge such as a Fujitsu MO, SyQuest, or Iomega drive as the secondary drive. This is a special Mirroring configuration which functions only with a removable media cartridge. It does not apply to removable hard drives or backup tape drives.

This feature allows a backup of the primary drive to be made without taking the AEM off line. When the AEM is On-line and in the mirroring mode, the primary drive image may be copied to the removable cartridge using the Resync command or the front panel Resync procedure. The Cartridge may then be spun down and removed.

When another backup is desired, the cartridge may be inserted and spun up without disturbing the AEM's on-line availability. While the cartridge is spun up and on line, all writes will be to both the Primary drive and the Removable cartridge. After the cartridge is revived using the Resync procedure, all writes will continue to be to both drives until the secondary cartridge is spun down. The backup image on the cartridge will be as of the moment the cartridge is spun down.

20.1 INITIATING THE ON-LINE BACKUP

If at some point after the system is on-line in the mirroring mode a backup is needed, the operator may press and hold the FAULT CLEAR switch, then press the WRITE PROTECT switch, to restart their flashing. Then repeat the procedure in section 19.3 page 112 step 4. The RS command issued from the command terminal will also initiate or abort the resync process. Resync progress may be periodically displayed using the SS command from the command terminal.(see 19.6 page 114)

20.2 PROCEDURE TO SPIN THE CARTRIDGE DOWN

To initiate the cartridge spin-down sequence, the operator may press and hold the FAULT CLEAR switch, then press the WRITE PROTECT switch, to restart their flashing. While the FC and WP indicators are flashing, press the WRITE PROTECT switch. After a delay of no more than 5 seconds, the Mirroring will be suspended and the cartridge will spin down. The cartridge may then be removed by pressing the button on the drive's bezel. If the AEM is ON-LINE and Mirroring, the BACKup terminal command will also initiate the cartridge spindown process.

NOTE: if the WRITE PROTECT indicator continues to flash at a rapid rate, the drives were not in sync and the backup image may not be valid. A new backup should be taken.

20.3 PROCEDURE TO SPIN THE CARTRIDGE UP

While the AEM is ON-LINE, a removable media cartridge may be spun up by merely inserting the cartridge and pressing the button located on the bezel of the drive. After the cartridge has spun up and is placed on-line, the FAULT and WRITE-PROTECT indicators will begin to flash. The resync procedure may be initiated by pressing the START switch. If no switches are pressed for 20 seconds the indicators will stop flashing. At this point the AEM will be mirroring all writes however, only the Primary drive will be used for reads.

21 TROUBLESHOOTING GUIDE

The most common causes of trouble or apparent system failure are poor interface cables, connections, grounding, and defective terminators. Trouble with the AEM may be caused by: an improperly configured unit, or the unlikely event of a hardware failure. Also external problems such as bad Interface connectors or cables, missing terminators, multiple drives set to the same unit ID, and many other causes can result in an apparent AEM failure. Generally, systems preconfigured for known applications should not have configuration difficulties. Please note, however, that configurations can vary depending upon controller types, even if the drive configuration being emulated is the same. Be sure the correct configuration has been selected. Refer to the section on configuration for details. Configuration help is available for customers integrating the AEM to new systems. Contact *ARRAID, Inc.* for details.

21.1 Circuit board part numbers

The following table describes the various major circuit boards and their application within the AEM:

NAME	PART NUMBER	GROUP NUMBER	DESCRIPTION	COMPATIBLE WITH:	COMMENTS
CPU BOARD	03-6102-	1	Classic CPU with 128K Flash Chips	Firmware versions up to 3.xx	installed in systems prior to 1999
		2	Extended capabilities CPU with 256K Flash chips	Firmware versions 4.00 and up	Installed in systems built in 1999
		3	Classic CPU with 2 x 128K flash chips	Special firmware Ver 4.00 and up	upgraded systems only
		4	Classic CPU with 256 K Flash chips	Firmware versions 4.00 and up	upgraded systems only
		5	Extended capabilities CPU with 128K Flash chips	Firmware versions up to 3.xx	compatible with older firmware
		6	Extended capabilities CPU with 2 x 128K Flash chips	Special firmware Ver 4.00 and up	Installed in systems built in 1999
DATA MANAGER BOARD	03-6101-	1	for 1-4 MB SIMMs Uses 4003A Xylinx chips	all Firmware Versions	has 1024 K DP ram
		2	for 16MB SIMMs Uses 4003A Xylinx chips	all Firmware Versions	has 2048 K DP ram
		3	for 1-4 MB SIMMs uses 4005E chips (FREEZE/JAMB)	all Firmware Versions	has 1024 K DP ram
		4	for 1-4 MB SIMMs uses 4004E Xyllnx chips	Firmware VER 4.xx and up	has 1024 K DP ram
SINGLE PORT INTERFACE BOARD	03-6106-	1	uses 4003A Xylinx chips	all Firmware Versions	
		2	uses 4003A Xylinx chips	all Firmware Versions	Uses special Write Data Decode Circuit
		3	uses 4003E Xyllnx chips	Firmware VER 4.xx and up	
		4	uses 4003E Xyllnx chips	Firmware VER 4.xx and up	Uses special Write Data Decode Circuit
DUAL PORT INTERFACE BOARD	03-6100-	1	uses 4003A Xylinx chips	all Firmware Versions	DUAL PORT SMD
		2	non existent		
		3	uses 4003E Xyllnx chips	Firmware VER 4.xx and up	DUAL PORT SMD
		4	non existent		
HISI INTERFACE BOARD	03-6109-	1	uses 4005E Xylinx chips	all Firmware Versions	SINGLE PORT MPLX INTERFACE

Table 10 AEM CIRCUIT BOARD CONFIGURATIONS

21.2 CPU board LEDs

To assist in diagnosing AEM system problems, the AEM has 4 LEDs located at the rear of its CPU board. These LED's are tri-color. They can be red, yellow, or green. They are used to indicate progress of a power on initialization self test, system operation, and system faults. Each of these is described below.

21.2.1 POWER ON INITIALIZATION AND SELF TEST

At power on the AEM system will initialize and check the basic hardware. All indicators will be turned on (lamp test) and remain on during the self test. The initialization process begins with the CPU board, then proceeds with the other boards. During the power on sequence the indicators at the rear of the CPU board are used to indicate progress:

INITIALIZATION STEP	PCB	4	3	2	1	
Initial power on condition	CPU	Y	R	Y	Y	Steady
Load Oper LCA	CPU	-	-	-	Y	Steady
Load MGR LCA	DATA	-	-	Y	-	Steady
Load Addr LCA	DATA	-	-	Y	Y	Steady
Load Data LCA	DATA	-	Y	-	-	Steady
Load Sel LCA	INTFC	-	Y	-	Y	Steady
Load INTFC LCA	INTFC	-	Y	Y	-	Steady
Initial Xlate Mem	DATA	-	Y	Y	Y	Steady
Initial Dual Port	DATA	Y	-	-	-	Steady
Initial Dirty Mem	DATA	Y	-	-	Y	Steady
Initial INTFC HW	INTFC	Y	-	Y	-	Steady
Initial UPS HW	CPU	Y	-	Y	Y	Steady
Initial Failure		Y	Y	Y	Y	Initial code flashing
Initial successful completion		G	G	G	G	remains on for 1 sec.

21.3 INITIALIZATION SEQUENCE

The CPU LED's will power up in a random state, go OFF when the Operator LCA is loaded, and then show the status listed above. If the LEDs do not go OFF, then the initialization sequence has failed at an early stage and the problem is confined to the CPU board.

21.4 SYSTEM OPERATION

Once initialization has completed, the LED's will remain all green for 2 seconds and then go off. The system is ready for operation. During normal operation, the LEDs will indicate the selected and reserved status of each Interface port. If an Interface fault occurs, the LEDs will change to red and indicate which Interface fault has occurred. When the fault is cleared, either by the operator or the Host Computer, the LEDs will revert to the operating state.

If a system failure occurs, the LEDs will indicate a failure code in red by flashing. The flashing distinguishes the system failure. System failures may only be cleared by the operator.

OPERATION LED	4	3	2	1	REMARKS
Initial Complete	G	G	G	G	steady for 2 sec
then ALL OFF					
Port A Selected			Y	Y	steady
Port A Reserved			Y		steady
Port B Selected	Y	Y			steady
Port B Reserved	Y				steady
Interface Controller Fault					see 21.5
Failure Code	R	R	R	R	steady
System Failure					see 21.6
Failure Code	R	R	R	R	flashing

21.5 Interface CONTROLLER FAULTS (leds on steady)

LED 4 - W*WP Write attempted while the AEM is Write Protected
LED 3 - Wrt Write Fault. The controller attempted to write but, did not supply a write clock or write data
LED 2 - R+WO The controller attempted a Read or Write command while not ON CYLINDER
LED 1 - R*W Read gate and Write gate were on at the same time.

21.6 SYSTEM FAILURES (leds flashing)

21.6.1 CODE 1 - INSUFFICIENT CAPACITY

During spin-up, the AEM calculates the required number of blocks for the drive being emulated. If the drive in the AEM does not report enough blocks available, Code 1 error is reported. Possible causes are:

The configuration selected is not the one desired.

The configuration selected is incorrectly set up.

The SCSI drive may have deallocated too many blocks as bad blocks.

21.6.2 CODE 2 - SCSI FAILURE

A SCSI error may occur if the communication process over the SCSI interface fails. The AEM has error recovery and retries built in, so this type of failure is not likely but, if it occurs, it may be serious. Possible causes are:

The SCSI drive has failed.

The SCSI drive is new. It needs low level formatting.

The SCSI drive has not been qualified by *ARRAID, Inc.* and is not completely compatible with the AEM's SCSI implementation.

Some SCSI drives may fault during the Spin-Up process. This is usually due to inconsistencies in the drive's motor spin-up time. Other SCSI drives must remain off until they come to a complete stop before they will spin up again. The AEM makes every attempt to bring these drives on-line. If a FAULT occurs during spin-up, the operator should wait at least 30 seconds prior to attempting a restart.

In systems with the Mirroring option, the AEM will attempt to keep the system on line even if a SCSI drive produces errors. When this happens, the FAULT indicator will flash in a repetitive pattern. The AEM will continue to function with the FAULT indicator flashing until reset by the Operator. (see 19.6 page 114)

21.6.3 FLASHING FAULT LED CODES:

1 = mirror drive read error
2 = primary drive read error
3 = mirror drive write error
4 = primary drive write error
5 = both drives or, only drive failed to Read
6 = unable to determine SCSI drive's capacity
7 = drive fails to come ready during time allowed
8 = drive fails to start (spinup)
9 = drive has insufficient capacity for the current emulation
10 = removable drive bay key interlock is open

21.6.4 CODE F - HARDWARE FAILURE

This failure is FATAL. The system will not operate. Possible causes are:

An unusual event has occurred on the input AC power causing the logic to be improperly configured. Try resetting the system by powering off and back on.

The files located in the FLASH memory have become corrupted. The system is inoperable. Contact *ARRAID, Inc.* for help.

21.6.5 FLASHING WRITE PROTECT LED

While the AEM is ON-LINE, a periodic test is performed on the SCSI drive(s). If a drive is not ready to receive commands, the AEM will flash the WRITE-PROTECT indicator rapidly (100ms period). Also in a system with Optional Mirroring, the OUT-OF-SYNC status is tested every 20 seconds. If the MIRROR is found to be out of sync, the WRITE-PROTECT indicator will flash rapidly. The SS command may be used to determine the cause of the flashing.

21.6.6 FLASHING SELECT LED

If an attempt is made to go ON-LINE when the AEM is not connected to a controller, the "A"cable is open, or the controller is powered off, the front panel SELECT indicator will flash rapidly (100ms period). Use the SS command to determine which PORT is not connected. A port that is not enabled will be ignored. The flashing indicator may be extinguished by pressing the FAULT CLEAR switch.

21.6.7 SYSTEM ERROR MESSAGES

If maintenance mode is enabled, and a terminal is connected one of the following messages will be displayed on the terminal:

SYS ERR 1 drive doesn't have sufficient capacity for the current emulation.
The drive emulation may be set up incorrectly, or, the wrong drive has been inserted

SYS ERR 2 any SCSI failure that prevents system operation.
The SCSI drive should be tested for defects.

SYS ERR 3 Not used.

SYS ERR 4 An attempt to write a buffer while it was still allocated to the Interface.
This should not occur during normal operation. Please contact *ARRAID* for technical assistance.

SYS ERR 5 The AEM has wrapped its write back queue.
This should not occur during normal operation. Please contact *ARRAID* for technical assistance.

SYS ERR 6 Not used.

SYS ERR 7 The Data mgr. will not recognize the freshly filled track buffer.
This should not occur during normal operation. Please contact *ARRAID* for technical assistance.

SYS ERR 8 the Data mgr. would not release the buffer in WriteTrack.
This should not occur during normal operation. Please contact *ARRAID* for technical assistance.

SYS ERR 9 - 12 Not used.

SYS ERR 13 unable to assign a buffer for ReadTrack function This is a fatal error.
This should not occur during normal operation. Please contact ***ARRAID*** for technical assistance.

SYS ERR 14 data mgr. didn't go valid after initial tracks were read.
This should not occur during normal operation. Please contact ***ARRAID*** for technical assistance.

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Phoenix, AZ USA Tel: 623-582-4592

21.7 UPDATING AEM SYSTEM FIRMWARE

The AEM firmware is stored in a non-volatile FLASH memory. The Flash chip (U-14) is located on the CPU board. To update AEM systems with firmware version 1.17 or earlier, the Flash chip must be replaced.

AEM systems with firmware version 1.18 or later may be updated through the AEM's serial terminal port from a MS-DOS compatible PC using the REFLASH software. (MS-DOS version 6.2 or later is required)

Firmware version 4.00 and later requires 256K of Flash memory. Either one 256K Flash or two 128K flash chips may be used. Most AEM systems shipped with prior firmware versions have one Flash chipU14 soldered to the CPU board. An additional 128K flash chip may be installed in the empty socket labled U11. Care must be taken to use the correct procedure for the Flash configuration installed.

21.7.1 REFLASH PROCEDURE

AEM systems with firmware version 1.18 or later may be updated through the AEM's serial terminal port from a MS-DOS compatible PC using this REFLASH facility. (MS-DOS version 6.0 or later is required)

To begin;

If you have received the reflash software as a single self extracting PKZIP file, Unzip the file by executing the file "UNZIPAEM.EXE".

The installation files will be extracted and placed in the same directory as the UNZIPAEM.EXE file.

If you have received this software on a floppy disk, it is ready for the next step.

Then;

To install the reflash software to you hard drive;
Type:

INSTALL XXXXX (XXXXX is the directory in which you want the reflash software installed).

After installation of these files, verify that the files have been placed into the proper directory and sub directory structure as follows:

```
XXXXX --- (Directory containing the reflash software)
 |
 |--AEMOPSYS  (contains the AEM operating system software)
 |--DIRECT   (contains the Configuration table files)
 |  |
 |  |--A12
 |  |  |--1RNX.BIN (system config table)
 |  |  |--SET1.ASC ( example of reflash control file)
 |  |  `--SET1.BIN ( example of AEM flash directory)
 |  |
 |  |--COMMON (contains common configuration files)
 |  `-- (Etc.)
 |--LCAS
 `--LOADER
```

Then;

Connect your MS-DOS compatible PC with a COM1 or COM2 serial port to your AEM's terminal port.

Then;

Execute the appropriate DOS Batch (.BAT) file to initiate the reflash procedure.

If no appropriate batch file exists, you may perform the reflash process using
the DOS batch file: "REFLASH.BAT"

The DOS batch file REFLASH.BAT will perform the reflashing process automatically using the following argument string.

Examples:

```
REFLASH.BAT A12 1 R N X ENC1

*  * * * * * (Please note: One space must separate arguments)
v  v v v v v
 A12 1 R N X ENC1 -- reflash configuration argument string (see note above)
 |||| | | | |  `----- configuration table set (see FILES list below)
 |||| | | | |
 |||| | | | |
 |||| | | | `-------- "F"   = with "Fixed" Secondary SCSI drive
 |||| | | |          "R"   = with "removable" Secondary SCSI drive
 |||| | | |          "C"   = with "removable media Cartridge" Secondary drive
 |||| | | |          "X"   = with no secondary SCSI drive
 |||| | | |
 |||| | | `----------"N"   = AEM with no backup options
 |||| | |            "B"   = AEM with "disk to disk Backup" Option only
 |||| | |            "BT"  = AEM with "disk to tape Backup" Option
 |||| | |            "M"   = AEM with "Mirroring" Option only
 |||| | |            "MT"  = AEM with "Mirroring and Tape Backup options
 |||| | |
 |||| | `------------ "F"   = with "Fixed" Primary SCSI drive
 |||| |              "R"   = with "removable" Primary SCSI drive
 |||| |              "C"   = with "removable media Cartridge" Primary drive
 |||| |
 |||| `-------------- "0" = AEM with "flat" operator panel
 ||||                 "1" = AEM with "momentary push button" Operator panel
 ||||                 "A" = same as "1" with changeable "ADDRESS Logic Plugs"
 ||||                 "2" = AEM with "alternate action push button" Oper Panel
 ||||
 |||`---------------- "2" = AEM contains 2 SIMMS on Data Manager Board
 |||                  "4" = AEM contains 4 SIMMS on Data Manager Board
 |||
 ||`----------------- "1" = AEM has 1 Meg SIMMS
 ||                   "4" = AEM has 4 Meg SIMMS
 ||                   "16"= AEM has 16 Meg SIMMS
 ||
 |`------------------ "A" = "A" models (track lengths less than 32768 bytes)
 |                    "B" = "B" models (track lengths greater than 32768 bytes)
```

********** REFLASH PROCEDURE **********

1) Connect your PC's COM1 or COM2 serial port to the AEM' terminal port.

2) Have the AEM powered on but not on-line.

3) If existing firmware is prior to rev 2.01, place the AEM in the maintenance mode using the MM command (refer to the AEM USER manual)

4) the PC must be in the base directory. (XXXX above)

5) To reflash your version 1.18 or later, at the DOS prompt,

execute one of the above mentioned batch command files.

NOTE: for Firmware versions prior to 2.01,
THE AEM MUST BE IN THE MAINTENANCE MODE IN ORDER TO ACCEPT THE REFLASH PROCESS

When the reflash procedure is completed, the message:

"Updating flash....." will be displayed.

The AEM's power must be cycled off, then on again, in order for the new firmware to take effect.

DO NOT ISSUE ANY OTHER AEM COMMANDS UNTIL POWER HAS BEEN CYCLED!

********** IF YOU NEED ASSISTANCE, PLEASE DO NOT HESITATE **********
TO CALL ARRAID TECHNICAL SUPPORT AT:

623-582-4592
OR E-MAIL: techsupport@arraid.com

21.7.2 CONFIGURATION FILES LIST

The following emulation table sets can be used with the reflash software.
Additional sets may be available please refer to the README.TXT file on the reflash disk.

21.7.2.1 AMP1

FOR AMPEX ESS SYSTEMS AND NEWS-STAR SYSTEMS USED ON AEM "A" MODELS

TABLE	EMULATION
0	SPARE
1	SABRE_736_AMPEX
2	FUJ_M2322_5S_AMPEX
3	FUJ_2350A_6S_AMPEX
4	FUJ_2351A_6S_AMPEX
5	CDC80MB_5S_AMPEX
6	CDC515MB_7S_AMPEX
7	CDC300MB_5S_AMPEX
8	SABRE_368_AMPEX
9	FUJ_M2322_32S_NEWS*
10	CDC_FSD340_32S
11	FUJ_M2294_64SS
12	CDC300MB_64SS
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.2 AMP2

FOR AMPEX ESS AND NEWS-STAR SYSTEMS USED ON AEM "B" MODELS

TABLE	EMULATION
0	XMD800_12S_AMPEX
1	SABRE_736_AMPEX
2	FUJ_M2322_5S_AMPEX
3	FUJ_2350A_6S_AMPEX
4	FUJ_2351A_6S_AMPEX
5	CDC80MB_5S_AMPEX
6	CDC515MB_7S_AMPEX
7	CDC300MB_5S_AMPEX
8	SABRE_368_AMPEX
9	FUJ_M2322_32S_NEWS*
10	CDC_FSD340_32S
11	FUJ_M2294_64SS
12	CDC300MB_64SS
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.3 ATEX

FOR ATEX PUBLISHING SYSTEMS

TABLE	EMULATION
0	CDC80MB_32SS
1	CDC160MB_32SS
2	CDC300MB_32SS
3	CDC340MB_32SS
4	CDC675MB_32SS
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.4 CEGE

FOR CEGELEC SYSTEMS

TABLE	EMULATION
0	PRIME_515_STRANGER
1	QUANTEL_FUJ_2294
2	QUANTEL_RSD
3	FUJ_M2294_64SS
4	FUJ_M2322_5SS
5	LARK_32SS_CEGELEC
6	CDC160MB_32SS_
7	CDC300MB_32SS
8	CDC340MB_5SS
9	CDC515MB_96SS
10	CDC80MB_64SS_FRZ
11	CDC160MB_64SS_FRZ
12	CDC300MB_64SS_FRZ
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.5 CONC

FOR CONCURRENT / PERKIN-ELMER SYSTEMS

TABLE	EMULATION
0	PE_MSM_80MB
1	PE_MSM_300MB
2	CDC_IDC_300MB
3	368SABRE_HPDI
4	CDD50_LARK_32S_IDC
5	CDD50_LARK_64S_IDC
6	CDC50_LARK_32S_IDC
7	CDC50_LARK_64S_IDC
8	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.6 DPS7

FOR HONEYWELL / BULL DPS 7000 SYSTEMS

TABLE	EMULATION
0	FSD-515_64SS_DPS7
1	FSD-515_64SS_PFTU
2	DK815-10A_64SS_DPS7
3	BARRACUDA_CLONE
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.7 ENC1

FOR ENCORE SYSTEMS (AEM "A" MODELS)

TABLE	EMULATION
0	CDC80MB_40S_UDP
1	CDC160MB_40S_UDP
2	CDC300MB_40S_UDP
3	CDC340MB_40S_UDP
4	CDC675MB_40S_UDP
5	CDC300MB_40S_IOP
6	CDC300MB_32S_UDP
7	CDC675MB_32S_UDP
8	CDC340MB_32S_UDP
9	CDC40MB_23S_9010
10	CDC80MB_23S_9010
11	CDC160MB_23S_9010
12	CDC300MB_23S_9010
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.8 ENC2

FOR ENCORE SYSTEMS (AEM "B" MODELS)

TABLE	EMULATION
0	CDC80MB_40S_UDP
1	CDC160MB_40S_UDP
2	CDC300MB_40S_UDP
3	CDC340MB_40S_UDP
4	CDC675MB_40S_UDP
5	CDC300MB_40S_IOP
6	CDC300MB_32S_UDP
7	CDC675MB_32S_UDP
8	CDC340MB_32S_UDP
9	CDC40MB_23S_9010
10	CDC80MB_23S_9010
11	CDC160MB_23S_9010
12	CDC300MB_23S_9010
13	CDC1.2GB_55S_HSDP
14	CDC858MB_54S_HSDP
15	FACTORY_TST

21.7.2.9 ENC3

FOR ENCORE SYSTEMS (AEM "A" MODELS)

TABLE	EMULATION
0	FUJI_M2372K_HSDP
1	FUJI_M2333_MPX
2	FUJI_M2351A_MPX
3	CDC500MB__MPX
4	FUJI_M2361A_MPX
5	NEC_D2362_MPX
6	CDC850MB_MPX
7	CDC858MB_MPX
8	SABRE_1.2GB_MPX
9	SABRE_368MB_MPX
10	SPARE_EMULATION
11	SPARE_EMULATION
12	SPARE_EMULATION
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.10 HAR1

FOR HARRIS H800 H1200 SYSTEMS

TABLE	EMULATION
0	80MB_UDC/IDC_563X
1	300MB_UDC/IDC_565X
2	82MB_IDC_533X
3	160MB_IDC_535X_MMD
4	474MB_IDC_536X_FUJI
5	675MB_IDC_566X_FMD
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	SPARE
14	FACTORY_VAX_TST
15	FACTORY_PFTU_TST

21.7.2.11 MTRA

FOR MITRA 225 SYSTEMS

TABLE	EMULATION
0	CDC80MB_67SS_UD80
1	CDC160MB_67SS_UD80
2	CDC300MB_67SS_UD80
3	CDC14/70_67SS_UD80
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.12 NORS

FOR NORSK DATA NORD 10 & NORD 100 SYSTEMS

TABLE	EMULATION
0	80_MB_NORD10/100
1	160_MB_NORD10/100
2	300_MB_NORD10/100
3	40_MB_NORD10/100
4	675_MB_NORD10/100
5	96_MB_NORD10/100
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

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21.7.2.13 NOVA

FOR DATA GENERAL NOVA SYSTEMS

TABLE	EMULATION
0	CDC80MB_32S
1	CDC160MB_32S
2	CDC300MB_32S
3	CDC340MB_32S
4	CDC675MB_32S
5	CDC81MB_32S
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.14 SET1

FOR MISC SYSTEMS (MOSTLY 32 or 64 SECTOR EMULATIONS)

TABLE	EMULATION
0	CDC80MB_32SS
1	CDC160MB_32SS
2	CDC300MB_32SS
3	CDC340MB_32SS
4	CDC675MB_32SS
5	CMD32MB_32SS
6	CMD64MB_32SS
7	CMD96MB_32SS
8	330MB_32SS
9	332MB_32SS
10	336MB_32SS
11	CDC80MB_64SS_FRZ
12	CDC300MB_64SS_FRZ
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.15 SET5

FOR MISC EMULATIONS PRIME, QUANTEL, CEGELEC Etc.

TABLE	EMULATION
0	PRIME_515_STRANGER
1	QUANTEL_FUJ_2294
2	QUANTEL_RSD
3	FUJ_M2294_64SS
4	FUJ_M2322_5SS
5	LARK_32SS_CEGELEC
6	CDC160MB_32SS_
7	CDC300MB_32SS
8	CDC340MB_5SS
9	CDC515MB_96SS
10	CDC80MB_64SS_FRZ
11	CDC160MB_64SS_FRZ
12	CDC300MB_64SS_FRZ
13	CDC300MB_5SS_FRZ
14	QUANTEL_FUJ_2351A
15	FACTORY_PFTU_TEST

21.7.2.16 SIEM

FOR SIEMENS COMPUTER SYSTEMS

TABLE	EMULATION
0	FUJ2350A_48SS
1	CDC_160MB_35SS
2	CDC_300MB_35SS
3	SPARE
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.17 TAND

FOR TANDEM NON-STOP and TXP SYSTEMS

TABLE	EMULATION
0	TANDEM_4104
1	TANDEM_4114
2	TANDEM_4116
3	SPARE
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.2.18 WANG

FOR WANG VS SYSTEMS

TABLE	EMULATION
0	VS_75MB_2265-V1
1	VS_288MB_2265-V2
2	VS_620MB_2265-V3
3	VS_313MB_2268-V3
4	VS_454MB_2268-V4
5	VS_90MB_2280-V3
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	FACTORY_VAX_TEST
14	FACTORY_UDP_TEST
15	FACTORY_PFTU_TEST

21.7.3 AEM-5C CONFIGURATION OPTIONS

The following table lists various application options for the Diablo / Pertec version of the AEM:

APPLICATION	OPTION #	Connector type	Xtal Freq	Config Table
PDP11 with RK11 controller	OPT-37	DEC BLOCK	11.52	DIAB-0 PDP11_RK05
GenRad PDP8 RK05 with DEC 3 board controller	OPT-37	DEC BLOCK	11.52	DIAB-3 GenRad PDP8_RK05
GenRad PDP8 RK05 with PLESSEY 3 board controller	OPT-38B	42 Pin Winchester	11.52	DIAB-1 PDP8_RK05
SPERRY/VARIAN 4027560 controller (dual drive)	OPT-39A	100 Pin Card Edge	12.49	DIAB-4 SPERRY/VARIAN_620_DP
SPERRY/VARIAN 4027560 controller (single drive)	OPT-39A	100 Pin Card Edge	12.49	DIAB-6 SPERRY/VARIAN_620_DP
Honeywell 316 with XEBEC controller (dual drive)	OPT-39B	100 Pin Card Edge	12.708	DIAB-5 Honey_316/XEBEC_DP
Honeywell 316 with XEBEC controller (single drive)	OPT-39B	100 Pin Card Edge	12.708	DIAB-7 Honey_316/XEBEC_SP
Computer Automation 52263/4 (Dual drive)	OPT-38A	50 Pin Winchester	20.00	DIAB-9 CA_52263/4_DP
Computer Automation 52263/4 (Single drive)	OPT-38A	50 Pin Winchester	20.00	DIAB-8 CA_52263/4_CNTRLR
FOX-1A/FOX-300 (Dual SCSI drive)	OPT-38A	50 Pin Winchester	20.00	DIAB-10 Fox-1A_HAWK_DP

21.8 INTEGRATION AND TROUBLESHOOTING THE AEM

To assist during the integration of the AEM with a new controller type, or for general system troubleshooting, test points have been provided on the AEM's interface circuit board (upper board). A list of these test points is found in **Table 11**, page 131.

Please do not hesitate to request the assistance of *ARRAID*'s Technical Support organization in integrating the AEM in your application. Many different systems have been fitted with the AEM. A simple telephone call can save many hours of integration time.

Application notes for most controller - drive combinations have been prepared by *ARRAID*'s Technical Support department and are available on the internet at http://www.arraid.com/support. *ARRAID*'s Technical Support Department may be reached at 623-582-4592.

TEST POINT #	SIGNAL NAME	DESCRIPTION
TP-01	WR_PROT	AEM Write Protect status
TP-02	SMD_AMF	Address Mark Found signal to SMD controller
TP-03	SMD_SECTOR	Sector Pulse to SMD controller
TP-04	READY	READY signal to controller
TP-05	SMD_ON_CYL	ON CYLINDER signal to SMD controller
TP-06	SEEK_ERR	SEEK ERROR signal to SMD controller
TP-07	SMD_INDEX	INDEX pulse to SMD controller
TP-08	FAULT	FAULT signal to SMD controller
TP-09	BIT_B7	SMD bus bit from SMD controller
TP-10	BIT_B6	"
TP-11	BIT_B8	"
TP-12	BIT_B5	"
TP-13	BIT_B3	"
TP-14	BIT_B2	"
TP-15	BIT_B4	"
TP-16	BIT_B1	"
TP-17	-TAG3	Low during TAG 3 signal (COMMAND) from SMD controller
TP-18	-TAG2	Low during TAG 2 signal (HEAD SELECT) from SMD controller
TP-19	BIT_B0	SMD bus bit from SMD controller
TP-20	-TAG1	Low during TAG 1 signal (CYL SELECT, SEEK) from SMD controller
TP-21	INDEX_IN	Index pulse from Track buffer rotator on Data Mgr board
TP-22	SECTOR_IN	Sector pulse fromsector pulse generator on Data Mgr board
TP-23	-AM_DET	Low when address mark is detected by Data Mgr during AM search
TP-24	-BLOCK	Low when requested track is not in "Current" Track Buffer
TP-25	VALID	High when "Current" track buffer has valid data and matches current track #
TP-26	-ACCESS	Low when searching for valid, matching track buffer
TP-27	-WR_GATE	Low when SMD controller is writing to current Track Buffer or writing an Address Mark
TP-28	-RD_GATE	Low when SMD controller is reading from current Track Buffer or doing an AM search
TP-29	-AM_ENA	Low when SMD controller is Writing an Address Mark or doing an AM search
TP-30	20_US	TAG1 received, window open waiting for possible TAG2
TP-31	-SK_ERR	Low when AEM logic and microprocessor has detected an invalid seek
TP-32	-SELECTED	Low when AEM has been selected
TP-33	-ON_CYL	Low when AEM is emulating an ON CYLINDER condition
TP-34	-TAG5	Low during TAG5 signal (SMD-E) from SMD controller
TP-35	-TAG4	present during TAG1 when using SMD_MODE 2 extended cylinder bit
TP-36	BIT_B9	SMD bus bit from SMD controller
TP-37	30_US	AEM internal on cylinder delay window (zero length seek)
TP-38	GROUND	AEM system logic ground

Table 11 SMD INTERFACE BOARD TEST POINTS

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TEST POINT PIN #	SIGNAL NAME	DESCRIPTION
J12-1	TAG_0	Tag bit 0
J12-2	BUSOUT0	Command and control information from Host
J12-3	BUSOUT1	" " " "
J12-4	BUSOUT2	" " " "
J12-5	BUSOUT3	" " " "
J12-6	BUSOUT4	" " " "
J12-7	BUSOUT5	" " " "
J12-8	BUSOUT6	" " " "
J12-9	BUSOUT7	" " " "
J12-10	TAG_1	Tag bit 1
J12-11	TAG_2	Tag bit 2
J12-12	-TAG_OUT	low when AEM acknowledges TAG_IN
J12-13	TAG_IN	Tag information is present from Controller
J12-14	BUSIN0	Status and other information to Host controller
J12-15	BUSIN1	" " " "
J12-16	BUSIN2	" " " "
J12-17	BUSIN3	" " " "
J12-18	BUSIN4	" " " "
J12-19	BUSIN5	" " " "
J12-20	BUSIN6	" " " "
J12-21	BUSIN7	" " " "
J12-22	RD_CLK	Cloct from AEM to synchronize Read Data
J12-23	RD_DATA	NRZ data from AEM during a read operation
J12-24	WR_CLK	Clock from Host Controller to sync Write Data
J12-25	WR_DATA	NRZ data from Controller during a write operation
J12-26	SVO_CLOCK	Clock from AEM to Controller for Write sync
J12-27	RPS_INT	
J12-28	SEL_INT	Select activity has occurred.
J12-29	IFC_INT	Seek, Head change, fault clear, or interface Fault
J12-30	SPARE	
J12-31	ALE	Address Latch Enable
J12-32	-5 VOLTS	
J12-33	+5 VOLTS	
J12-34	-RD_PG_STAT	low when AEM CPU is reading LCA Status
J12-35	GROUND	Signal ground
J12-36	GROUND	Signal ground

Table 12 HISI INTERFACE BOARD J-12 TEST POINTS

TEST POINT PIN #	SIGNAL NAME	DESCRIPTION
J13-1	MOD_SEL	
J13-2	HISI_DONE	
J13-3	-AM_ENA	low during an address mark search or write
J13-4	-AM_DET	low when an Address Mark has been detected
J13-5	-ACCESS	low = a seek or head change is in progress
J13-6	FIXED	
J13-7	SYS_CLK	20 MHZ system clock
J13-8		
J13-9	-ENA_SELD	
J13-10	NONE	
J13-11	-ENA_IFC	
J13-12	-BLOCK	low = the AEM is in the process of obtaining a track
J13-13	SECTOR	N pulses per track rotation from AEM
J13-14	INDEX	Once per track rotation pulse from the AEM
J13-15	-WR_GATE	low during a write operation. Data or Address Mark
J13-16	-RD_GATE	Low while host is reading Data from the AEM
J13-17	-RD	
J13-18	-CS_IFC	
J13-19	-ENA_XMEM	
J13-20	ON_CYL_TP	
J13-21	-SEL_HOLD	
J13-22	-XMEM_OE	
J13-23	SEEK_END	High indicates the AEM is On Cylinder
J13-24	READY	
J13-25	SEEK_ERR	High if an invalid cylinder address was issued
J13-26	-WR	
J13-27	-CSSEL	
J13-28	VALID	high indicates the current track buffer contains valid data
J13-29	NONE	
J13-30	NONE	
J13-31	NONE	
J13-32	-5 VOLTS	
J13-33	NONE	
J13-34	+5 VOLTS	
J13-35	GROUND	Signal ground
J13-36	GROUND	Signal ground

Table 13 HISI INTERFACE BOARD J-13 TEST POINTS

22 APPENDIX A - EMULATION VARIABLES

VARIABLE	VALID VALUE	NOTE	TYP
MAX_CYL	0 - 1023 0 - 2047 0 - 4095	SMD mode 0 or 1 SMD mode 2 (Extra Cyl Bit during TAG 1) SMD mode 3 (Extra Cyl Bits during TAG 2)	822
MAX_HD	0 - 63 0 - 31	SMD mode 0, 1 or 2 SMD mode 3	18
TRACK_LEN	30720 max 32767 max 61440 max 65535 max	AM_MODE =1 (soft sector) 2 SIMMs AM_MODE =0 (hard sector) 2 SIMMs AM_MODE =1 (soft sector) 4 SIMMs AM_MODE =0 (hard sector) 4 SIMMs	20160
NUM_SCTRS	0 to 255	calculated number of sectors	32 *1
SCTR_LEN	1 to 65535	1/2 bytes (1 to disable)	1260
SMD_MODE	0 - 3	0 - 1 SMD - FSD 2 . . . . . SMD-O (Extra Cyl Bit during TAG 1) 3 SMD-E (Extra Cyl Bits during TAG 2)	0
AM_MODE	0 or 1	0 = hard sector only 1 = Address marks supported	1
BLOCK	0 or 1	0 = Release BLOCK at VALID 1= Release BLOCK at Index	1
FREEZE	0 or 1	0=OFF, 1= ON (freeze and jamb can't both	0
JAMB	0 or 1	be on together)	0
CLOCK	0 or 1	clock blocking on or off	0
NONC_BLOCK	0 or 1	Not on cylinder blocking on or off	0
RTZ_TICKS	0 to 50	Return To Zero seek time (x10ms)	20
REL_TICKS	0 to 50	Release time (RTM mode)	50
PRI_SEL_MD	0, 1, or 2	0 is disabled 1 is normal 2 is TANDEM Special mode	0
UNIT_ADD	0 - 15 or 16	0 - 15 = default power up Interface address 16 = obtain address from optional front panel address logic plug	0 *2
ONL_SAVE	0 or 1	default state of ON-LINE	0 *2
WP_SAVE	0 or 1	default state of WRT PROTECT	0 *2
RD_AHD	0 or 1 or 2	0 = disabled 1 = read-ahead buffer with low LRU 2 = read-ahead buffer with high LRU	2
WB_MODE	0 or 1	0 = write back entire track 1 = write back only dirty portion of track	0
UNIT_ID	0 - 0xFF	SMD-E ID reported	0
HOLD_ONC	0, or 1	0 = normal mode 1 = hold ONC for "read-ahead" completion	0
SET_SIZE	0, 16, 32, or 64	0 = Auto configuring to maximum # of sets 16=16 buffers in each set 32=32 buffers in each set 64=64 buffers in each set	32
XLAT_TBL	0, 1, 2, 3, 4, 5. or 6	0 = normal Emulated track to logical track translation 1 6 = Special translation for CDC CMD 9448 fixed/removable drive emulation	0

VARIABLE	VALID VALUE	NOTE	TYP
SEL_MODE	0, 1, or 2	0 = normal select at leading edge of select 1 = select after 200ns delay 2 = latch select until next select tag	0
SCSI_PARAM0 SCSI_PARAM1 SCSI_PARAM4 SCSI_PARAM6	0 - 255	Bits 7 - 0 are individual flags 40MHz ASYNC 5MB/s -> 40MHz ASYNC 7MB/s -> 40MHz SYNC 7MB/s -> 40MHz SYNC 10MB/s ->	 0x10 80 0xd0 208 0x54 84 0xd4 212

Note 1: This is a calculated parameter. The "CC" command updates this value based on other parameters. To disable sector pulses, set SCTR_LEN to 1. The "CC" command will set the sector count to 0.

Note 2: These parameters are updated during UPS power fail operation. If UPS operation is disabled, these parameters may be used as power up defaults.

24 APPENDIX C - SMD INTERFACE CONNECTIONS

24.1 A CABLE (CONTROL SIGNALS)

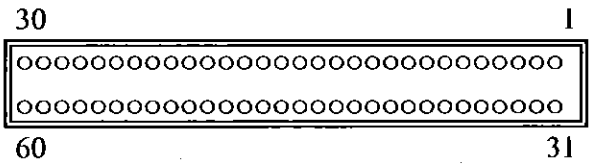
SMD INTERFACE SIGNAL DESCRIPTION -- "A" CABLE (DAISY CHAINED)					
LOW TRUE		HIGH TRUE		SOURCE	SIGNAL NAME
Block	Flat	Block	Flat		
46	1	49	31	CTRLR	TAG 1 (Set Cylinder)
48	2	51	32	CTRLR	TAG 2 (Sel Head)
52	3	55	33	CTRLR	TAG 3 (Control)
23	4	26	34	CTRLR	BUS Bit 0
24	5	27	35	CTRLR	BUS Bit 1
28	6	31	36	CTRLR	BUS Bit 2
29	7	32	37	CTRLR	BUS Bit 3
30	8	33	38	CTRLR	BUS Bit 4
34	9	37	39	CTRLR	BUS Bit 5
35	10	38	40	CTRLR	BUS Bit 6
36	11	39	41	CTRLR	BUS Bit 7
40	12	43	42	CTRLR	BUS Bit 8
41	13	44	43	CTRLR	BUS Bit 9
16	14	20	44	CTRLR	OPEN CABLE DETECTOR
11	15	14	45	DRIVE	FAULT
75	16	78	46	DRIVE	SEEK ERROR
15	17	18	47	DRIVE	ON CYLINDER
10	18	13	48	DRIVE	INDEX
17	19	21	49	DRIVE	UNIT READY
42	20	45	50	DRIVE	ADDRESS MARK FOUND
67	21	72	51	DRIVE	BUSY
22	22	25	52	CTRLR	UNIT SELECT TAG
1	23	4	53	CTRLR	UNIT SELECT 1
2	24	5	54	CTRLR	UNIT SELECT 2
3	26	7	56	CTRLR	UNIT SELECT 4
8	27	12	57	CTRLR	UNIT SELECT 8
74	25	77	55	DRIVE	SECTOR
53	28	56	58	DRIVE	WRITE PROTECTED
73	29			CTRLR	POWER PICK
		76	59	DRIVE	POWER HOLD
47	30	50	60	CTRLR	TAG 4 (or SIGNAL GROUND)
80		82			SIGNAL GROUND / (Shield Ground)

24.2 B CABLE (DATA SIGNALS)

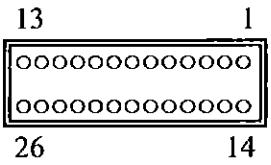
SMD INTERFACE SIGNAL DESCRIPTION -- "B" CABLE (RADIAL)					
LOW TRUE		HIGH TRUE		SOURCE	SIGNAL NAME
Round	Flat	Round	Flat		
A	8	B	20	CTRLR	WRITE DATA
M	2	N	14	DRIVE	SERVO CLOCK
U	3	V	16	DRIVE	READ DATA
W	5	X	17	DRIVE	READ CLOCK
H	6	J	19	CTRLR	WRITE CLOCK
AA	10	CC	23	DRIVE	SEEK END
DD	22	BB	9	DRIVE	UNIT SELECTED
EE	12	HH	24	DRIVE	INDEX ****
FF	13	JJ	26	DRIVE	SECTOR ****
K	1				SIGNAL GROUND
Y	4				SIGNAL GROUND
D	7				SIGNAL GROUND
L	11				SIGNAL GROUND
		T	15		SIGNAL GROUND
		E	18		SIGNAL GROUND
		C	21		SIGNAL GROUND
		F	25		SIGNAL GROUND
**** Some controllers reverse the polarity of these signals					

SMD Connector Pinouts as viewed from the rear of the AEM:

A Cable



B Cable



25 APPENDIX D - HISI INTERFACE CONNECTIONS

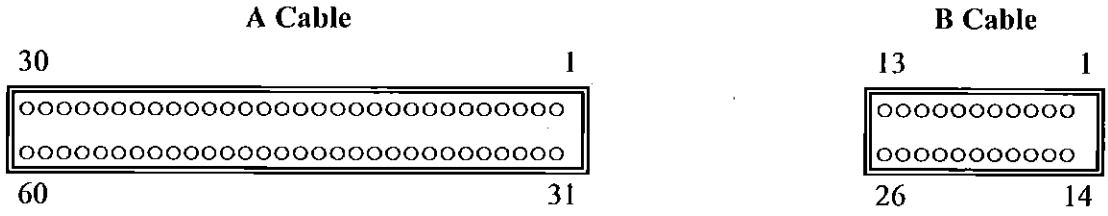
25.1 A CABLE (CONTROL SIGNALS)

HISI INTERFACE SIGNAL DESCRIPTION - "A" CABLE (DAISY CHAINED)					
CABLE PIN				SIGNAL NAME	DESCRIPTION
LOW		HIGH			
Flat	Block	Flat	Block		
1	46	31	49	TAG 2^0	Tag Signals from the controller to the AEM. See Command/Status decode table for the meaning of these signals
2	48	32	51	TAG 2^1	
3	52	33	55	TAG 2^2	
4	23	34	26	BUS OUT Bit 0	These eight lines carry data to the AEM. The meaning of the data is a function of the active tag state. Bit 0 is MSB bit 7 is LSB. See Command/Status decode table for the meaning of these signals
5	24	35	27	BUS OUT Bit 1	
6	28	36	31	BUS OUT Bit 2	
7	29	37	32	BUS OUT Bit 3	
8	30	38	33	BUS OUT Bit 4	
9	34	39	37	BUS OUT Bit 5	
10	35	40	38	BUS OUT Bit 6	
11	36	41	39	BUS OUT Bit 7	
12	40	42	43	SPARE 2	This line is connected to a spare receiver in the AEM. It is currently not used.
13	41	43	44	SPARE 1	This line is connected to a spare receiver in the AEM. It is currently not used.
21	67	51	72	SPARE 3	This line is connected to a spare receiver in the AEM. It is currently not used.
14	16	44	20	SELECT HOLD	This line is driven by the controller to hold the AEM in a selected state.
20	42	50	45	BUS IN Bit 0	These eight lines carry data to the HISI controller. The meaning of the data is a function of the active tag state. Bit 0 is MSB bit 7 is LSB. See Command/Status decode table for the meaning of these signals
23	3	53	7	BUS IN Bit 1	
17	15	47	18	BUS IN Bit 2	
19	17	49	21	BUS IN Bit 3	
24	8	54	12	BUS IN Bit 4	
26	16	56	20	BUS IN Bit 5	
16	75	46	78	BUS IN Bit 6	
15	11	45	14	BUS IN Bit 7	
18	10	48	13	INDEX	This signal is derived from an internal crystal oscillator and is generated by the AEM once per revolution of the emulated disk. Its leading edge is the beginning of sector zero.
22	1	52	4	TAG GATE OUT	This line is driven by the controller to cause the AEM to decode the TAG line states and respond accordingly
25	74	55	77	SECTOR	This signal is derived from an internal crystal oscillator and is used to indicate the beginning of each sector on the track. The number of sector pulses that occur for each revolution of the emulated drive is programable.
27	2	57	5	TAG GATE IN	This line is used to acknowledge the receipt of TAG GATE OUT approx. 100ns later.
28	53	58	56	SPARE	This line is not connected in the AEM
		29	73	POWER PICK	These signals are not used by the AEM. However, they are propagated through to the next unit on the "A" cable.
		59	76	POWER HOLD	
30		60		SPARE OUT	This line is connected to a spare receiver in the AEM. It is currently not used
21	80	21	80	TERM GROUND	Terminator Ground for Block Connector Termination.

25.2 B CABLE (DATA SIGNALS)

HISI INTERFACE SIGNAL DESCRIPTION -- 26 Pin"B" CABLE (RADIAL)					
CABLE PIN				SIGNAL NAME	DESCRIPTION
LOW		HIGH			
Flat	Block	Flat	Block		
8	A	20	B	WRITE / READ DATA	This bi-directional line transmits NRZ data from the controller to the AEM for recording on the disk surface.This line also transmits data from the AEM to the controller when READ GATE is active.
2	M	14	N	SERVO CLOCK	Servo Clock is a signal derived from the crystal oscillator on the AEM's Data manager board. Servo Clock is transmitted to the controller and is usually used to syncronize write data and generate Write Clock.
3	EE	16	HH	INTERRUPT	This line is used to transmit an interrupt to the controller for rotational position sensing.
5	W	17	X	READ CLOCK	Read Clock defines the beginning of a data cell during a Read operation. This clock synchronous with Servo Clock and Read data.
6	H	19	J	WRITE CLOCK	This signal from the controller defines the beginning of a data cell during a Write operation. It is usually derived from the AEM's Servo Clock.
10	AA	23	CC	SEEK END	This signal indicates either an on cylinder status or seek error status resulting from a seek operation that has terminated.
9	BB	22	DD	MOD SELECTED	This signal indicates the AEM has accepted a Unit Select request. This line must be active before the drive will respond to any commands from the controller.
12	FF	24	JJ	RESERVED	Not Connected in the AEM
26	LL	13	NN	SEIZED	Not Connected in the AEM
15	T	1	K	SIGNAL GROUND	Signal ground is referenced to the "A" cable terminator ground.
18	E	4	Y	SIGNAL GROUND	
21	C	7	D	SIGNAL GROUND	
25	F	11	L	SIGNAL GROUND	

HISI Flat cable connector pinouts as viewed from the rear of the AEM:



26 APPENDIX E -TERMINAL COMMANDS INDEX