Concurrent Computer / Perkin-Elmer compatible

SCSI CONTROLLER

Product P/N 202776

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Revision Date: December 19, 1988

MANUAL P/N 300935 REV C
Includes:
Installation Specification
Diagnostic Support Package
Programming Specification

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1.1 Warning

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with this instruction manual, may cause interference to radio and television reception. This equipment has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient the receiving antenna.
2. Relocate the computer with respect to the receiver.
3. Move the computer away from the receiver.
4. Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.
5. Ensure that the mounting screws, attachment connector screws and ground wires are tightly secured.
6. Ensure that good quality, shielded and grounded cables are used for data communications.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the booklet *How to Identify and Resolve Radio-TV Interference Problems* prepared by the Federal Communications Commission helpful. This booklet is available from the U.S. Government Printing Office, Washington, DC 20420, Stock No. 004-000-0345-4.

1.2 Introduction

Macrolink's SCSI Disk System gives Concurrent Computer 3200 super-minicomputer users easy access to ST-506, ESDI & SCSI disk drives. Ideal for small to mid-size systems, or where space is limited. Replace older high-maintenance disks with new low cost peripherals to lower your operating costs.

The SCSI Controller replaces the fullboard SCSI Disk Controller, Part Number 202775.

Complete Disk System

We have a package solution for your disk requirements. Our SCSI disk system includes: Macrolink SCSI Controller, 5.25" disk drive, formatter module and rack mount chassis with power supply. We supply ST-506 or ESDI drives and the required formatter module, or SCSI disk drives depending on your capacity requirements. We also include an OS/32 driver, on 1600 BPI tape, and diagnostic software. Because we format and test every drive, your installation time is kept to a minimum; just mount the rack-mount chassis, slip the Macrolink SCSI controller under a SELCH and SYSGEN in our driver.

High-capacity Cartridge Tape

The new generation of high-capacity cartridge tape drives, like the Patriot 240 1/2 inch drive from Laser Magnetic Storage (CDC) and the EXB-8200 8mm from Exabyte can be installed with a disk drive or used alone. The Patriot offers 240 MBytes of storage; the EXB-8200 offers 2.3 GBytes. Both drives can be used with standard OS/32 utilities like Backup and Fastback.

Macrolink offers an optional software enhancement for Backup, called BackupPlus, for use with cache-equipped streaming tape drives that insures correct operation with multi-volume tapes.

LD1200 **Laser Disk Support**

The Macrolink SCSI Controller can be optionally equipped to support the LD1200 optical disk system. Each LD1200 drive can access 1 GByte of on-line data; each cartridge holds 2 GBytes of data. OS/32 support is offered via SVC direct-access disk calls.

Full Compatibility

We include an optimized OS/32 driver and diagnostic software. Our driver emulates standard MSM/IDC disks, so it's compatible with utilities like BACKUP and FASTCHECK, plus all other OS/32 functions. No application software changes are required to utilize the full performance and capacity of your new disks.

Up to 7 ST-506, ESDI or SCSI disks drives or tape drives of any size can be mixed in any combination. Each ST-506 or ESDI formatter module can support 2 drives; additional drives require additional formatter modules. SCSI drives connect directly to the Macrolink SCSI Controller.

Easy Upgrades

Our on-board formatting software makes it easy to add drives to your system. Just boot-load our software right from the SCSI Controller and follow the user friendly menus to format and install the drive. We eliminated option switches by storing the disk configuration on a reserved sector of each drive. Controller functions are retained in non-volatile memory.

High Performance

The Macrolink SCSI Controller takes full advantage of ST-506 and 1.25 MB/second ESDI drives. We don't require interleaving, so data transfers as fast as possible to your CPU.

INSTALLATION

2.1 Introduction

The Macrolink SCSI Controller gives Concurrent Computer/Perkin-Elmer access to low-cost disk and tape systems. The SCSI Controller connects up to 7 SCSI devices that can include SCSI/ESDI and SCSI/ST-506 controllers in any combination with up to 7 drives.

The SCSI Controller will work with virtually any ST-506 & ESDI disk drive and most SCSI disks available today without PROM changes or switch options. The configuration of each drive is stored on a reserved sector; the controller configuration is stored in non-volatile memory and read upon power-up initialization.

The SCSI Controller includes an on-board Loader Storage Unit (at address X'05') that contains a system IPL boot-loader, the disk formatter & diagnostic software. The SCSI Controller requires the supplied OS/32 DCB & driver to be installed prior to use. The SCSI Controller is not software compatible with the OS/32 & XELOS drivers for the Concurrent Computer SCSI subsystem, and will not work with the standard CCUR IPL.

2.2 Unpacking Instructions

The SCSI Controller is supplied with a 50 conductor interface cable. The board is packed in an anti-static plastic bag, and foam sponge to cushion the parts during shipment. This packing material should be retained so the board may be properly transported if it should need to be returned to the factory for repair.

Inspect the SCSI Controller immediately upon receipt. If any damage is visible from shipment, you should request the carrier's agent to inspect the damage, and file a claim with the carrier. Claims must be filed within 7 days after the shipment arrives.

Notify Macrolink of any discrepancies between the invoice and received material, or of any damage found during inspection.

2.3 Return Material Authorization

To return a product for repair, you must obtain a Return Material Authorization (RMA) number from Macrolink. This number should be written on the shipping container. When requesting an RMA number, the following information should be available:

1. Product name or part number
2. Serial Number
3. Failure description

Shipping expenses to Macrolink must be paid by the customer. Macrolink will pay for standard shipment back to the customer for products under warranty. Products returned with an inadequate failure description may be subject to an additional inspection charge.

2.4 Installing the SCSI Controller

The SCSI interface is installed into the host 3200 series CPU in the same fashion as a standard disk controller. The Operating System must be SYSGEN'd with our driver to accept the interface, and the board must be properly configured.

Install the half-board SCSI controller under the left side of a Selector Channel (SELCH) in the processor. If your system uses Sub-Channel Controllers (SCC), the SCSI controller must be installed under SCC 0 to run the on-board LSU software. The SCSI Controller may be installed under any SCC

after configuration if the on-board system IPL is not required. The standard 3200 system IPL cannot be used to boot from the SCSI Disk.

To enable the on-board Loader Storage Unit (LSU), the **LSU/RUN/FORMAT CNFG** switch should be placed in the LSU position (left). Disable the IPL switch on the 3200 consolette.

Alternatively, the system LSU can be removed, or set to an unused address, and a wire from the LSU slot pin 124 (XOFF) can be connected to the SCSI Controller slot, pin 125-1. This wire will give the 3200 consolette ENABLE/DISABLE switch control of the on-board LSU when its mode switch is set to LSU.

RACK0/TACK0 Jumper

You must remove the RACK0/TACK0 wire-wrap jumper between pins 122-1 and 222-1 on the slot selected for the SCSI Controller.

Device Address

The SCSI controller and file address are set with the diagnostic software, not switches. If the address of the module is not known, follow the directions in Chapter 3 to load and run the diagnostics. The address is displayed in the main menu.

The following rules must be observed:

1. Controller address must be even.
2. If the Controller address ends in 0 or 8, up to 7 SCSI devices may be configured.
3. If the Controller address ends in 4 or C, up to 3 SCSI devices may be configured.
4. If the Controller address ends in 2, 6, A or E, only one SCSI device may be configured.

Each SCSI device attached to the Controller must have a unique SCSI address (from 0 to 7). Each SCSI address then assigned to an unique system address. The Controller is also assigned an unique address; selecting an address that ends in '0' or '8' will result in a more straight forward installation. SCSI devices that support two drives should have an address reserved for each drive whether or not it is connected. The first drive (0) must be set for an even system address. The second drive (1) must be set for an odd system address.

Additional SCSI devices use the next consecutive addresses as follows:

☐ 1 drive: Controller address + 1 file address (2 total)

☐ 2 to 3 drives: Controller address + 3 file addresses (4 total)

☐ 4 to 7 drives: Controller address + 7 file addresses (8 total)

For example, consider a SCSI system with the controller configured for address X'F8', with an Adaptec ST506 disk controller and Exabyte tape system. First, set the SCSI address for the ST506 controller to 0 (any unique address will work). Set the address of the first ST506 drive to 0; the second drive to 1 (even if it is not installed). The system address must be even for drive 0, odd for drive 1. In this example, use X'FA' & X'FB'. Set the tape drive to SCSI address 1 with a system address X'F9'.

SCSI Bus Parity

All SCSI devices connected to the Macrolink SCSI Controller must have their SCSI bus parity disabled.

Alternate Protocol

The SCSI Controller supports Standard Protocol, Alternate Protocol and AP/Bus Switch protocol. The 6-pin jumper block at the rear of the board must be correctly strapped for one of the modes. Install the jumper in one of the following positions at the read of the module:

☐ E1 – E2 Standard Protocol

☐ E3 – E4 Alternate Protocol

☐ E5 – E6 Bus Switch mode

Interface Cabling

Each SCSI device is daisy-chain connected to the Controller. Up to 7 individual devices may be connected. Each device must have a unique SCSI bus address, and the last device connected must be terminated. The total cable length from the SCSI Controller to the last device must not exceed 20 feet.

OS/32 Installation

If you purchased a complete SCSI disk system from Macrolink it has been formatted and tested. Please proceed to Chapter 4 *OS/32 IN-STALLATION* to install the required driver and SYSGEN your system.

If you are integrating a new drive with the SCSI controller follow the instructions in Chapter 3 *DI-AGNOSTICS* to format and test the drive prior to OS/32 installation.

STANDARD PROTOCOL

ALTERNATE PROTOCOL

BUS SWITCH

7

E1   E5
E2   E6

8

A
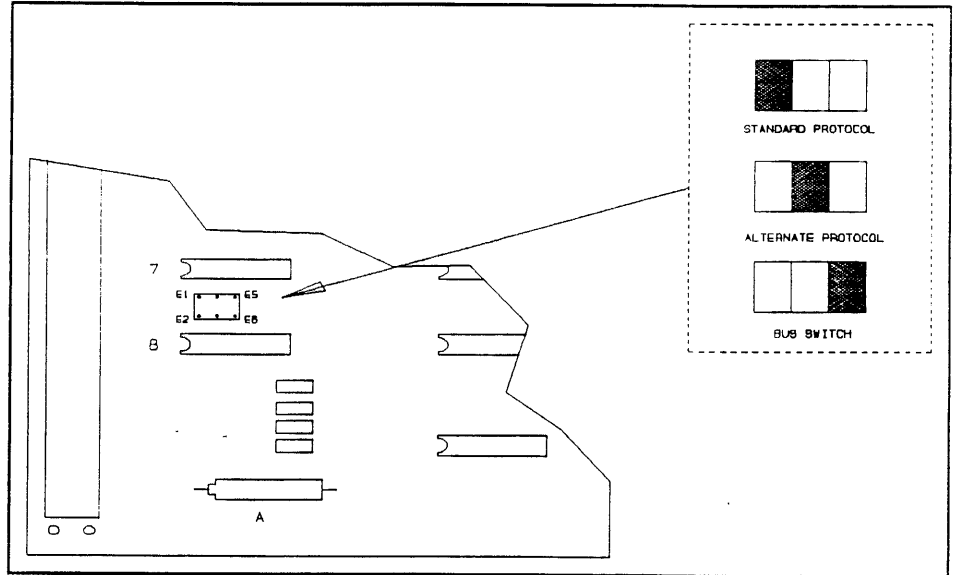
Alternate Protocol Jumpers

SCSI INTERFACE CABLING

SCSI CONTROLLER

Total interface cable length must not exceed 20 feet (6.0m). Last SCSI device must be terminated.

UP TO 7 DEVICES

SCSI DEVICE:
DISK

SCSI DEVICE:
TAPE

Term.

SCSI DEVICE:
ST-506/ESDI
ADAPTER

300935 REV C   2 - 3
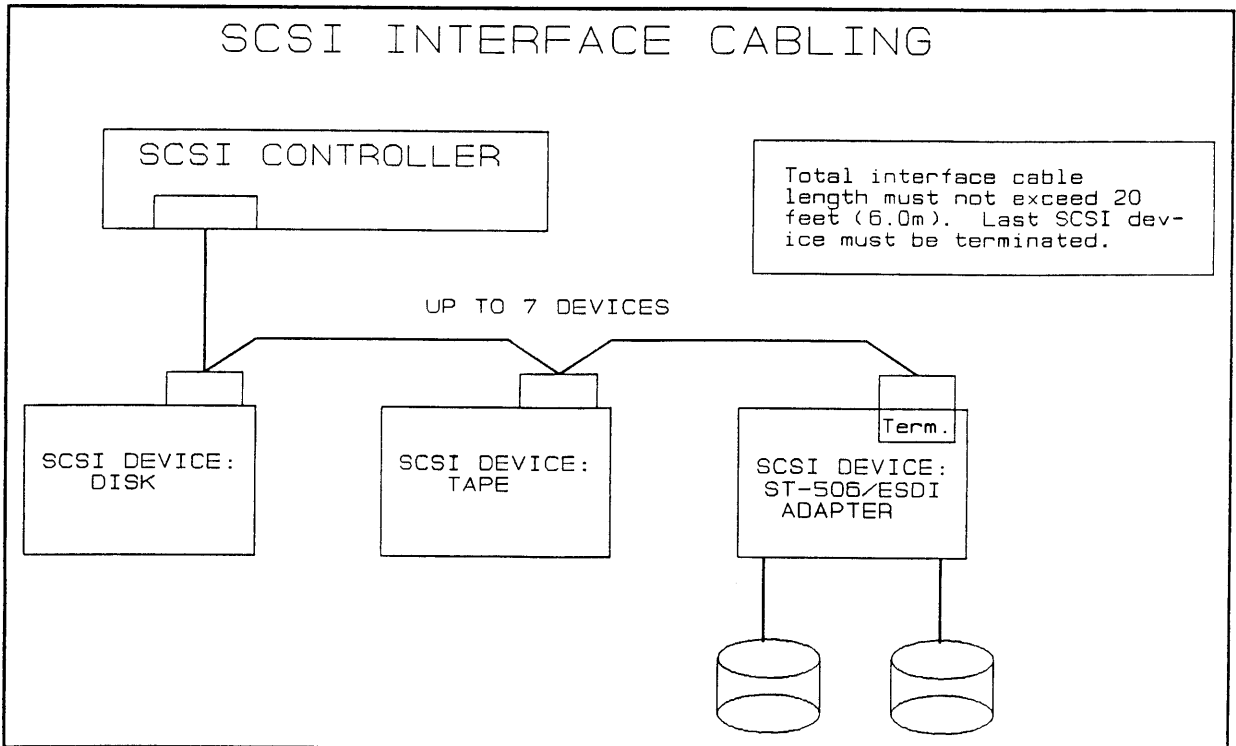
DIAGNOSTICS

3.1 Introduction

The Macrolink SCSI controller has an integrated software package that can be automatically loaded into the CPU upon system initialization. This software has formatting and diagnostic capabilities and is used to configure the SCSI controller. Additionally, a system loader is available to boot-load OS/32 from an attached disk or tape.

3.2 Minimum Hardware Requirements

The following is a list of the minimum hardware required to run this program:
- Series 3200 processor, 7/32 or 8/32.
- 1MB of memory for all functions (limited operation with less memory).
- Video Display unit (VDU) as a console at X'10'.
- VDU or line printer as a list device.

The following programs should be run prior to using the SCSI Controller diagnostic:
- Series 3200 memory test.
- Series 3200 processor test.
- Console device test.

3.3 Loading Procedure

If your system has Sub-Channel Controllers (SCC), you must install the SCSI Controller under SCC 0 in order to use the on-board software. After configuration, the SCSI Controller can be installed under any SCC.

The diagnostic software package is contained in an EPROM located on the SCSI Controller. The software is automatically loaded into the processor, except 3280s, upon system initialization with the following steps:

1. DISABLE the IPL switch on the processor's consolette.
2. Set the SCSI Controller switch to "CONFIG".
3. INITialize the processor, or execute the 3280 LSU emulator.

No other device in the system can be set to address X'05' for the on-board loader to operate correctly.

3280 Installation

The 3280 does not support the LSU load of the SCSI Controller, so an emulator program must be manually loaded. Make sure that the LSU function of the MPC installed in your system has been disabled on the board.

3280 LSU EMULATOR

LOC	OP		INST		COMMENT
30	0000		DCZ	0	LOAD ILLEGAL INSTRUCTION
32	0000		DCZ	0	LOAD ILLEGAL INSTRUCTION
34	0000		DCZ	0	LOAD ILLEGAL INSTRUCTION
36	0070		DCZ	X'70'	NEW ORG
70	C820 0005		LHI	R2,X'005'	10-BIT LSU ADDRESS
74	9B20		RDR	R2,R0	DUMMY READ
76	9D20		SSR	R2,R0	READ STATUS
78	0200		NOP		NO OP
7A	2451		LIS	R5,1	BXLE INCREMENT VALUE
7C	9920		RHR	R2,R0	XFER PSW
7E	9921		RHR	R2,R1	XFER LOCATION
80	9924		RHR	R2,R4	MEMORY START LOCATION
82	9926		RHR	R2,R6	MEMORY END LOCATION
84	DB24 0000	L1	RD	R2,0(R4)	READ A BYTE
88	C140 0084		BXLE	R4,L1	LOOP BACK TO READ
8C	2612		AIS	R1,2	BUMP START ADDRESS
8E	0301		BR	R1	XFER TO LOADED PROGRAM

Load the above program into your 3280 using the following steps:

```
* <CTRL>V <CTRL> V
*CDS> INIT
* <CTRL>V <CTRL> V
*CDS> HALT
*CDS> MOD 30,0,0,0,70
*CDS> MOD 70,C820,0005...,0301
*CDS> RUN 30
*CDS> CON
```

Use Control V, or your modified escape sequence.
Wait for the 3280 IPL menu (may take several minutes).
Use Control V, or your modified escape sequence.
Response from CDS.
Enter opcodes starting at location 30.
Enter opcodes starting at location 70.
Start at location 30.
The Macrolink menu should appear.

6/16, 8/16 & 1600 SERIES LSU EMULATOR

LOC	OP		INST		COMMENT
0050	2425		LIS	R2,5	SCSI CONTROLLER LSU ADDRESS
0052	9D20		SSR	R2,R0	READ STATUS
0054	2451		LIS	R5,1	BXLE INCREMENT VALUE
0056	9920		RHR	R2,R0	XFER PSW
0058	9921		RHR	R2,R1	XFER LOCATION
005A	9924		RHR	R2,R4	MEMORY START LOCATION
005C	9926		RHR	R2,R6	MEMORY END LOCATION
005E	DB24 0000	L1	RD	R2,0(R4)	READ A BYTE
0062	C140 007E		BXLE	R4,L1	LOOP BACK TO READ
0066	0301		BR	R1	XFER TO LOADED PROGRAM

3.4 SCSI Controller Diagnostics Menu

Your console (at address X'10') should display the SCSI Controller configuration menu after INIT, or in 3280 systems after the LSU emulator is executed. All options are preset to run from drive 0 of the SCSI Controller. The only option that you MUST verify is SELCH. SELCH is preset to X'F0'.

```
SCSI DIAGNOSTIC MAIN MENU
MACROLINK SCSI PLUS DIAGNOSTIC R00-00
COPYRIGHT 1987 MACROLINK , INC. ALL RIGHTS RESERVED.
AVAILABLE MEMORY
000000-3FFFFF
DIScon        0E8
DRIve         0
SELch         0F0
ILEVel        00
LOW           000000
HIgh          000000
MAX           FFFFFF
BYTes         008000
IMage         A5A5
BUFFil        48F0
INbuf         020000
OUTbuf        010000
PATtern       3
SCOPE         0         ITeration    001500      LOOp      0
PROCeed       1         REPeat       000001      SKIPprint 0001
CONTinous     0         Bias         000000
TEst          0
```

Configuring the SCSI Controller

After each new drive is installed, the SCSI controller must be correctly configured before the drive can be formatted, and then used by the operating system. Each SCSI device must have an unique SCSI bus address, and a unique device address. Configuration parameters are stored on the controller.

From the Main Menu, enter CONFigure:

```
*CONF
Device Address          SCSI Address    Type
E8                                      Controller Address
E9
EA                      00              SCSI DISK
EB
EC
ED
EE
EF
Autoboot Name = NONE


Enter Device Address to update, AUTOBOOT to update boot information,
CONFIGURE to store updates, or <ESC> to exit

*CONF
```

In this example, the Controller address is set to X'E8'. The Controller Device Address may be any even address. If an address with a final digit of 0 or 8 is selected, up to 7 Drives may be configured at any of the consecutive following addresses. If an address with a final digit of 4 or C is selected, up to 3 Drives may be configured at any of the consecutive following addresses. With final digits of 2, 6, A or E, one Drive may be configured at the following address. SCSI address space is automatically adjusted to 1, 3 or 7 addresses depending on the address of the Drive with the highest address. For example, if the Controller address is X 'E8' and one drive is configured at X'E9', 2 address spaces are reserved; however, if the Drive was configured at X'ED' then 8 addresses would be reserved.

The Diagnostic only lists the correct possible Drive address selections when the Controller address is selected. SCAN may then be used to check the reserved address space. At location X'EA', a SCSI disk drive has been installed with SCSI address X'00'. Each SCSI device installed must have an unique address.

To change the adapter type for an Exabyte 8200 Tape Drive, for example, enter its address, EA:

```
EA
Enter SCSI address for device address EA (0-7; CR for no device)? 0
Device type:   1 = N/A
               2 = ADAPTEC ACB-4520 ESDI
               3 = SCSI DISK
               4 = ADAPTEC ACB-4000A ST506
               5 = CDC PATRIOT TAPE
               6 = N/A
               7 = EXABYTE 8200 TAPE This list may be different for your revision software.
?7
```

Device Address	SCSI Address	Type
E8		Controller Address
E9		
EA	00	EXABYTE 8200 TAPE
EB		
EC		
ED		
EE		
EF		

Enter Device Address to update, CONFIGURE to store updates, < ESC > to exit

Similarly, to add a device enter its address, E9:

```
E9
Enter SCSI address for device address EA (0-7; CR for no device)? 1
Device type:   1 = N/A
               2 = ADAPTEC ACB-4520 ESDI
               3 = SCSI DISK
               4 = ADAPTEC ACB-4000A ST506
               5 = CDC PATRIOT TAPE
               6 = N/A
               7 = EXABYTE 8200 TAPE This list may be different for your revision software.
? 3
```

Device Address	SCSI Address	Type
E8		Controller Address
E9	01	SCSI DISK
EA	00	EXABYTE 8200 TAPE
EB		
EC		
ED		
EE		

EF:
Enter Device Address to update, CONFIGURE to store updates, <ESC> to exit

A SCSI Disk has been added at address X'E9' with SCSI ID 01. Now let's add one more for this example:

EB
Enter SCSI address for device address EA (0-7; CR for no device)? 2

Device type:	1 = N/A
	2 = ADAPTEC ACB-4520 ESDI
	3 = SCSI DISK
	4 = ADAPTEC ACB-4000A ST506
	5 = CDC PATRIOT TAPE
	6 = N/A
	7 = EXABYTE 8200 TAPE *This list may be different for your revision software.*

? 7

Device Address	SCSI Address	Type
E8		Controller Address
E9	01	SCSI DISK
EA	00	EXABYTE 8200 TAPE
EB	02	SCSI DISK
EC		
ED		
EE		
EF		

Enter Device Address to update, CONFIGURE to store updates, <ESC> to exit ? CONF

Another SCSI Disk has been added at address X'EB' with SCSI ID 02. The SCSI Disk Drives must be formatted prior to use.

AUTOBOOT Operation

The SCSI controller can be configured to automatically boot-load an Operating System upon initialization. Both SCSI disk and tape drives can be used as a boot source. Options include skip filemarks (for tape) SELCH address (default is X'F0'), and controller address (used to boot from a second controller). From the configuration menu, enter AUTOboot to select the boot configuration.

*CONF

Device Address	SCSI Address	Type
E8		Controller Address
E9	01	EXABYTE 8200 TAPE
EA	00	ADAPTEC ACB-4520 ESDI
EB		
EC		
ED		
EE		
EF		

Autoboot Name = NONE

Enter Device Address to update, AUTOBOOT to update boot information,
CONFIGURE to store updates, or <ESC> to exit
AUTO   *Enter AUTO for the AUTOBOOT configuration menu.*
Enter: NAME [op1,op2,op3,...]
Valid Names:
   NONE   SCD0   SCD1   SCD2   SCD3   SCD4   SCD5   SCD6

Valid Keyword Options (Addresses in Hex):

S = SELCH address   C = controller address
F = filemarks
Name ? SCD1   *Any SCSI file device can be used.*
FILE = SCSI10.OS   *Enter the file (and account) to be automatically loaded.*
Device Address   SCSI Address   Type
E8   Controller Address
E9   01   EXABYTE 8200 TAPE
EA   00   ADAPTEC ACB- 4000A   ST506
EB
EC
ED
EE
EF

                           Your selection will be echoed:
Autoboot Name = SCD1   FILE = SCSI10.OS /00000

Enter Device Address to update, AUTOBOOT to update boot Information,
CONFIGURE to store updates, or < ESC > to exit
CONF   *Enter CONF to save your choices, or AUTO to make corrections.*
*CONF

Autoboot can be terminated by entering ^A (control A) during the LSU memory test.

SCSI Drive Formatting

SCSI Drive Formatting supports four drives onboard: Maxtor, Seagate ST225N, Seagate ST4051, and CDC Wren. Support for other drives and additional support these drives may be obtained from Macrolink on Magnetic Tape. Commands and parameters may also be keyed in by the user and saved on tape, making it possible to use virtually any SCSI Drive with the Macrolink SCSI Controller. When attempting to use an unsupported drive, however, it is important to be aware not all SCSI Disk Drives support 256 byte sectors and Concurrent Operating Systems require that the drive is formatted with 256 byte sectors.

The normal procedure to format a SCSI Disk Drive which is currently supported is a multi-step process. First, select the Script file for the drive you wish to format. The DIR command will display the script files in your library. Use the GET command to select the file for the drive you wish to format.

The next step is to execute the SCSI Mode Select Command. This command sets the sector size and other important parameters for the drive to properly function in the Concurrent environment. Use the EXEC SELECT command to do this.

If you are formatting a Seagate drive, it is best to enter flaw map data. The Maxtor and Wren drive do a good job of finding their own flaws and this step is not generally necessary for those drives. Use the INFLAW command to enter the flaw map. INFLAW defaults to the Bytes From Index format, which is the format usually supplied by the manufacturer. If the flaw information is another format, then select the proper format for entry. See the Options Table 3.5 for detailed use of the INFLAW command.

After entering your flaw data, use the FORMAT1 command to format the drive. If you did not enter flaw data and did not use the INFLAW command then use the FORMAT command to format the drive.

Example of steps using INFLAW:

```
GET ST225N
EXEC SELECT INFLAW
#3265
#3F8E
#4021
<ESC>
FORMAT1
```

The drive will now format and SCSI status will be displayed at the end of the process. Example of steps when not entering flaw data:

```
GET MAXTOR
EXEC SELECT
EXEC FORMAT
```

The drive will now format and map its own flaws. SCSI status will be displayed at the end of the process.

If you are not using a drive which is supported by a Macrolink Script file, the following is offered as an aid to formatting your chosen drive. Keep in mind that you may be breaking new ground in doing this and you should have a good knowledge of SCSI equipment in general and your chosen drive in particular. You must read the User's Manual for your drive and understand the specific requirements for formatting your drive before attempting to proceed with the formatting process.

IMPORTANT

> *When keying in data be aware that you are accessing main memory in the host computer and careless entries can cause the operating system to fail. Be sure that you access only the data buffers used by the Macrolink SCSI Plus Diagnostic.*

Following are examples using the Option commands to format a SCSI Drive. See *Options Table 3.5* for detailed definitions of the Options.

Check the directory of supported Disk Drives

The DIR command will display the script files in your library.

```
*DIR
**MAXTOR
**ST225N
**ST4051
**WREN
```

Choosing Seagate ST225N for example

GET and LIST the Script to see the OPT commands necessary to format the ST225N.

```
*GET ST225N
*LIST                    List the Script:
0010 *SELECT
0020 BI 10000
0030 CLEAR 51
0040 MOD 0,1500,0,C00
0050 MOD 10,0,8,0,0,0,100
0060 SELWR 10,12
0070 CMD 0,6
0080 STATUS
0090 EXIT
0100 *FORMAT Without Defective Sectors
0110 BI 10000
0120 CLEAR 512
0130 MOD 0,400,0,200
0140 SELWR 10,0
0150 CMD 0,6
0160 STATUS
```

```
0170 EXIT
0180 *FORMAT1          With Defective Sectors, Use Inflaw Block Only
0190 BI 10000
0200 CLEAR 512
0210 MOD 0,410,0,200
DEPRESS <CR>
0220 MOD 10,0,0
0230 INSTALL 10
0240 MOD 0,410
0250 SELWR 10
0260 CMD 0,6
0270 STATUS
0280 EXIT
```

The *SELECT Script shows the OPT instructions necessary to send the Drive a SCSI Mode Select command. Line 20 set the bias value, pointing to the Write Buffer and Line 30 clears the buffer. Line 40 loads the buffer with the 6 byte SCSI command for Mode Select (X'15'). The X'0C' in byte 5 indicates that there are 12 bytes of data to be sent during the data phase of the command. Line 50 loads the buffer with the 12 bytes of data. The data indicates that the drive will be formatted with 256 byte sectors. Line 60 set up the SELCH to write the 12 data bytes. Line 70 sends the command to the Drive and line 80 requests status from the drive.

Just the Format Scripts may be listed

```
*LIST FORMAT
0100 *FORMAT          Without Defective Sectors
0110 BI 10000
0120 CLEAR 512
0130 MOD 0,400,0,200
0140 SELWR 10,0
0150 CMD 0,6
0160 STATUS
0170 EXIT
*LIST FORMAT1
0180 *FORMAT1         With Defective Sectors, Use Inflaw Block Only.
0190 BI 10000
0200 CLEAR 512
0210 MOD 0,410,0,200
0220 MOD 10,0,0
0230 INSTALL 10
0240 MOD 0,410
0250 SELWR 10
0260 CMD 0,6
0270 STATUS
0280 EXIT
```

The *FORMAT Script lists the OPT command used when you wish to let the Drive find and map its own flaws. This Script is may be used for the original formatting of the drive when a flaw map is not available.

*FORMAT1 is the Script used when a flaw map is available. The INFLAW option is used to enter the flaw map. This must be done before executing *FORMAT1.

To enter flaw list

The following is an example interchange in which two flaws are entered and then one is deleted.

```
*INFLAW
Enter: CYL,HD,BYTES to add, if already in map it will be deleted,
LIST to list, or <ESC> to exit
INFLAW BLOCK
Enter: LBA to add, if already in map it will be deleted,
LIST to list, or <ESC> to exit
#3265
#4021
#LIST
00003265
00004021
DEPRESS <CR>
#4021
Deleted.
#4022
#LIST
00003265
00004022
DEPRESS <CR>
#
```

Execute the Mode Select Command

Simply type EXEC SELECT and the Mode Select Script is executed. The SCSI Status, indicating a Key Code of 0 and an Error Code of 0 tells us that it executed properly. The most common error at this point would be a Key Code of 5 indicating an error in the information sent to the drive. Consult the user's manual for your drive for an explanation of Key Codes and Error Codes. Since these vary somewhat from manufacturer to manufacturer, a more detailed discussion is beyond the scope of this manual.

```
*EXEC SELECT
*BI 10000
*CLEAR 512
*MOD 0,1500,0,C00
*MOD 10,0,8,0,0,0,100
*SELWR 10,12
*CMD 0,6
*STATUS
SCSI St 70000000 0000000E 00000000 00000000 00000000 00000000 00000000 00000000
*EXIT
```

Execute the Format Command

This example executes the SCSI Format Command including the flaw list that was built using IN-FLAW.

```
*EXEC FORMAT1
*BI 10000
*CLEAR 512
*MOD 0,410,0,200
*MOD 10,0,0
*INSTALL 10
*MOD 0,410
*SELWR 10
*CMD 0,6
*STATUS
```

```
*INQUIRY
BI 10000
CLEAR 512
MOD 0,1200,0,2400
SELRD 10,36
CMD 0,6
EXA 10,18
EXIT
*SENSE
BI 10000
CLEAR 512
MOD 0,1A00,3F00,4C00
SELRD 10,76
CMD 0,6
STATUS
EXIT
*REASSIGN      Use INFLAW Block Only
BI 10000
CLEAR 512
MOD 0,700,0,0
MOD 10,0,0
INSTALL 10
SELWR 10
CMD 0,6
STATUS
EXIT
**ST225
*SELECT
BI 10000
CLEAR 512
MOD 0,1500,0,C00
MOD 10,0,8,0,0,0,100
SELWR 10,12
CMD 0,6
STATUS
EXIT
*FORMAT        Without Defective Sectors
BI 10000
CLEAR 512
MOD 0,400,0,200
SELWR 10,0
CMD 0,6
STATUS
EXIT
*FORMAT1       With Defective Setors, Use Inflaw Block Only.
BI 10000
CLEAR 512
MOD 0,410,0,200
MOD 10,0,0
INSTALL 10
MOD 0,410
```

```
SELWR 10
CMD 0,6
STATUS
EXIT
*INQUIRY
BI 10000
CLEAR 512
MOD 0,1200,0,3A00
SELRD 10,58
CMD 0,6
EXA 10,29
EXIT
*SENSE
BI 10000
CLEAR 512
MOD 0,1A00,3F00,FF00
SELRD 10,76
CMD 0,6
EXA 10,38
EXIT
*REASSIGN     Use Inflaw Block Only
BI 10000
CLEAR 512
MOD 0,700,0,0
MOD 10,0,0
INSTALL 10
SELWR 10
CMD 0,6
STATUS
EXIT
**ST405
*SELECT
BI 10000
CLEAR 512
MOD 0,1500,0,1600
MOD 10,0,8,0,0,0,100,103,D105,0,0,2
SELWR 10,22
CMD 0,6
STATUS
EXIT
*FORMAT       Without Defective Sectors
BI 10000
CLEAR 512
MOD 0,400,100,100
SELWR 10,0
CMD 0,6
STATUS
EXIT
*FORMAT1      With Defective Sectors, Use Inflaw Index Only
BI 10000
CLEAR 512
```

```
MOD 0,41C,100,100
MOD 10,0,0
INSTALL 10
SELWR 10
CMD 0,6
STATUS
EXIT
*SENSE
BI 10000
CLEAR 512
MOD 0,1A00,0,1600
SELRD 10,22
CMD 0,6
EXA 10,11
EXIT
**WREN
*SELECT
BI 10000
CLEAR 512
MOD 0,1500,0,2400
MOD 10,0,8,0,0,0,100,316,1,1,0,4,0,100,0,0,1
SELWR 10,36
CMD 0,6
STATUS
EXIT
*FORMAT
BI 10000
CLEAR 512
MOD 10,0,0
INSTALL 10
SELWR 10
CMD 0,6
STATUS
EXIT
*INQUIRY
BI 10000
CLEAR 512
MOD 0,1200,0,2400
SELRD 10,36
CMD 0,6
EXA 10,18
EXIT
*SENSE
BI 10000
CLEAR 512
MOD 0,1A00,3F00,5C00
SELRD 10,92
CMD 0,6
EXA 10,46
EXIT
*REASSIGN     Use Inflaw Block Only
```

```
BI 10000
CLEAR 512
MOD 0,700,0,0
MOD 10,0,0
INSTALL 10
SELWR 10
CMD 0,6
STATUS
EXIT
**
EOF ENCOUNTERED - 204 RECORD(S) COPIED
COPY COMPLETE - 1 FILE(S) COPIED
END
P      -END OF TASK CODE =  0   PROCESSOR = 0.648  TSK-ELAPSED = 20
```

3.5 Options Table

Examine each option in the following table and read each description. If a default value is specified and it is the desired value, no action is necessary. If a default value is not specified, or is not the desired value, then the option must be entered.

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OPTION	DESCRIPTION
@	Returns control to the system console by executing a Break-Point instruction.
ADD	The ADD command can be used as a prefix to the TEST command option to add one or more tests to the current selection. For example: "ADD TEST 1".
BIas	The BIAS option is used to specify the bias value for subsequent EXAMINE and MODIFY commands. The default value is "0".
BUFFil	The BUFFIL option specifies the background data pattern to be copied into the input data buffer prior to a read operation. The default setting is: X'48F0'.
BYTe	The BYTE option specifies the number of bytes to be transferred. X'100' = 1 sector, X'200' = 2 sectors, X'4000' = 64 sectors. When the last transfer is made, the start LBA is adjusted so that the last sector transferred ends on high LBA. When the difference between LOW and HIGH is less than the the number of sectors specified by byte then only data is transferred between LOW and HIGH.
CLEAR	The CLEAR command initializes an area at the bias address to zero. The number of bytes is specified in decimal. "CLEAR 512" clears 512 bytes beginning at the bias. An error will occur if the bias is less than X'10000'.
CMD	The CMD command is used to initiate a SCSI command. The syntax is: CMD adr,len Where **adr** the address of the SCSI command descriptor block relative to the bias. **len** the number of decimal bytes in the command descriptor block. If a SELCH transfer is not required then "SELWR 10,0" should be used. A STATUS command issued after the CMD command will wait for the execution to finish and display the SCSI status.
CONFiguration	The CONFIGURATION command is used to change the controller address and the drive assignments. The new controller address is asked for first. Enter a new address or a <CR> to default to the old address. A new drive configuration is asked for the next 7 consecutive drive addresses. Enter <CR> if no drive is to be configured or the SCSI unit number. If a SCSI unit number is entered the user will be asked for the type of drive it is. The user is asked if the data input is correct and if it is to be stored in the non-volatile RAM.
CONTinous	The CONTINOUS option controls the execution of the selected test. When it is set to the default "0" testing stops when repeat limit is reached. When continous is set to "1" or the CRT is off-line testing continues until the break key is depressed or the CRT is placed on-line.
DIRectory	The DIRectory command is used to list the library of drive types supported internally or on a tape. The syntax is:

	DIR [type[,S=ss][,C=cc]] Where **type** SCD0-SCD6,MG85, or MG62 specifies the library is on a SCSI tape, standard 800/1600, or Concurrent 6250 tape. If ommited then a directory of internal Macrolink provided entries is printed. **ss** SELCH address. Defaults to X'F0'. **cc** controller address. Defaults to current SCSI address for SCSI tape, or X'85' for others.
DIScon	The DIScon option specifies the disk controller address. The default setting is E8.
DRIve	The DRIVE option specifies the drive number to be tested. The drive number can range from 0 to 6. The default is 0.
EXAmine	The EXAmine command is used to display the contents of memory. The syntax is: EXAMINE aaaaaa[,nnnn[,d]] Where **aaaaaa**the memory address relative to the bias **nnnn** the decimal number of halfwords to be displayed **d** is the index of the output device, 1= console, 3= printer.

EXECute	The EXECute command is used to cause commands to be read from the script.
	The syntax is:
	    EXECute nnnn
	    or
	    EXECute name
	Where
	
	nnnn the script line number at which execution is to start. If not specified, execution starts at the first line.
	
	name the script label line, "*name", after which execution is to start.

EXIT	The EXIT command is used to return a script fragment to the read command from console mode.
GET	The GET command is used to read into the script the necessary commands to format a SCSI disk drive. The commands are read from an internal Macrolink provided script or from a library maintained on tape. The syntax is: GET name[,type[,S=ss][,C=cc]] Where **name** type of disk drive to be formatted. **type** SCD0-SCD6,MG85, or MG62 specifies the library is on a SCSI tape, standard 800/1600, or Concurrent 6250 tape. If ommited then the internal Macrolink provided library is used. **ss** SELCH address. Defaults to X'F0'. **cc** controler address. Defaults to current SCSI address for SCSI tape, or X'85' for others. The library is scanned until "**name" is found. The current script is deleted. Commands are copied into the script until another "**" is found.

	When reading from tape the entire library is read into an internal format starting at X'10000'.
HElp	The HELP command is provided to assist the user. Messages can be summoned to explain program options, commands, errors, and test execution. The sequence "HELP *" lists the possible option and command mnemonics. Abbreviated inputs are allowed for most mnemonics. Characters shown in parenthesis in the "HELP *" need not be entered. In general any option may be set to its default value by entering the option followed by a carriage return. Otherwise the option must be followed by a space and then the option value. To recall the function of any command or option enter: HELP MNEMONIC.
HIgh	The HIGH option specifies the ending LBA for disk read/write tests. For tape operations, HIGH specifies the number of files transferred.
ILEVel	The ILEVel option sets the the interrupt level for the SELCH, disk controller, and file address. The default is 0. The maximum ILEVEL can be is 3.
IMage	The IMAGE option specifies the data pattern transferred when the pattern option is 0 or 2. The default is: X'A5A5'.
INbuf	The INBUF option specifies the starting address of the input (read) data buffer. The default setting is: X'20000'.
INFLAW	The INFLAW command is used to enter or update the flaw map. The flaw map information can be enter in three ways, block format, bytes from index format, or physical sector format. The syntax is INFLAW [typ][,[rep][,NEW]] Where **typ** BLOCK, INDEX, or SECTOR. **rep** DECIMAL, or HEXIDECIMAL **NEW** Specifies that the current flaw map is deleted. The user is promped to input flaw information, LIST to list the flaw map, or escape to exit. To delete an entry, enter the flaw information again. A message will be printed denoting that the entry is deleted. The default is INDEX,HEXIDECIMAL.
INSTALL	The INSTALL command is used to copy the flaw map to the defect list. The syntax is: INSTALL adr Where **adr** the address of the defect list header (4 bytes). If the format command descriptor block is to 0 relative to the bias, then the last three bits of byte one are set to 0,4, or 5 depending on the inflaw type Block,Index, or Sector respectively. The flaw information is copied after the defect list header. The end of the defect list is denoted by eight bytes of X'FF'. The SELWR command uses this to determine the length.
ITeration	The ITERATION option specifies the number of times a scope function is performed. The default is: 1500.
LIst	The LIst command is used to list the current script. The syntax is:

	LIST name Where **name** the script label line "*name". Enter "HELP SCRIPT" for more information.
LOG	The LOG command is used to select the console or printer as the log device. Valid commands are: LOG CON:, LOG PR:.
LOOp	The LOOP option selects the diagnostic response to errors. The default value is "0". Possible entries are: 0 No loop on error. 1 Loop on error. Overrides proceed 1 or 2. 2 Same as 1 except there is no message output.
LOW	The LOW option specifies the starting LBA for disk read, write, and read-check tests and scope loops. For tape operations, LOW specifies the number of records per file transferred.
MAX	The MAX option specifies the last LBA on the disk. If set to X'FFFFFFFF', the last LBA value is read from the disk & displayed after any test is executed.
MODify	The MODIFY command is used to change the contents of memory. The syntax is: MODIFY aaaaaa,xxxx[,xxxx[,xxxx...]] Where **aaaaaa** the memory address relative to the bias **xxxx** is the new contents of the memory location and subsequent locations.
NEW	The NEW command causes the script to be deleted.
NEXt	The NEXT command is used to select the next subtest to be executed. The form "NEXT n", where n is the decimal test number to be executed.
OPTion	The OPTION command is used to list the program options. The "OPTION 3" command causes the options to be listed to the printer.
OUTbuf	The OUTBUF option specifies the starting address of the output (write) data buffer. The default setting is: 10000
PATtern	The PATTERN option specifies the data pattern to be output to the device. Possible values are: 0 Use the image option. 1 Use an incrementing pattern 0000,0101,0202,...,FEFE,FFFF,0000, 2 Use the image option and its complement. 3 Use the LBA address (Default).
PROCeed	The PROCEED option selects the action taken after an error. The default value is "1". Possible entries are: 0 Halt on error. Overrides loop.

	1	Proceed on error as far as possible. The proceed limit is a function of the specific error.
	2	Execute entire test no matter how many errors.
REMove		The REMOVE command can be used as a prefix to the TEST command to remove one or more tests from the current selection. For example: "RE-MOVE TEST 1".
RENUMber		The RENUMBER command causes the script line numbers to be assigned new values starting with "0010" and incrementing by "0010".
REPeat		The REPEAT option specifies the number of times the entire test sequence is to be repeated. The REPEAT option is specified in decimal and values up to 9999999 are accepted. A REPEAT value of zero is interpreted as the default "1".
RESet		The RESET command causes all program options to be reset to their default values.
RUn		The RUN command is used to start the test sequence from the first selected test.

SAVE and SAVENR		The SAVENR and SAVE commands are used to create or update a tape library of scripts respectively. The syntax is:
		    SAVENR name,type[,S=ss][,C=cc]
		    or
		    SAVE name,type[,S=ss][,C=cc]
		Where

	name	type of disk drive to be formatted.
	type	SCD0-SCD6,MG85, or MG62 specifies the library is on a SCSI tape, standard 800/1600, or Concurrent 6250.
	ss	SELCH address. Defaults to X'F0'.
	cc	controller address. Defaults to current SCSI address for SCSI tape, or X'85' for others.

		The SAVE command rewinds the tape. Reads the current library into memory starting at X'10000' skipping "**name". Rewinds the tape. Writes the library starting at X'10000'. If there is a script, writes a header "**name" then writes the script. Finally writes the trailer "**" and two file marks. The SAVENR command is the same as the SAVE command except it does not read the tape first. This allows a tape to be written if an error occurs during a SAVE or create a new tape if the contents of X'10000' is not a "**".
		The SAVENR and SAVE commands are used to create or update a tape library of scripts respectively.
		The syntax is:
		    SAVENR name,type[,S=ss][,C=cc]
		    or
		    SAVE name,type[,S=ss][,C=cc]
		Where

	name	type of disk drive to be formatted.
	type	SCD0-SCD6,MG85, or MG62 specifies the library is on a SCSI tape, standard 800/1600, or Concurrent 6250.
	ss	SELCH address. Defaults to X'F0'.

	cc controller address. Defaults to current SCSI address for SCSI tape, or X'85' for others. The SAVE command rewinds the tape. Reads the cur rent library into memory starting at X'10000' skipping "**name". Rewinds the tape. Writes the library starting at X'10000'. If there is a script, writes a header "**name" then writes the script. Finally writes the trailer "**" and two file marks. The SAVENR command is the same as the SAVE command except it does not read the tape first. This allows a tape to be written if an error occurs during a SAVE or create a new tape if the contents of X'10000' is not a "**".
SCANdev	The SCANDEV command is used to display the status of all devices on the system.
SCOPE	The SCOPE option is used for the scope loop tests. The value has the following meanings: 0 Write/read (Default) 1 Read only 2 Write only 3 Write/read/test
SELch	The SELch option is used to specify the device address of selector channel. The default setting is F0.
SELRD	The SELRD command is used to set up a transfer from the SCSI device during the CMD command. The syntax is: SELRD adr,len Where **adr** the address of the receiving buffer relative to the BIAS. **len** the length in decimal bytes.
SELWR	The SELWR command is used to set up a transfer to the SCSI device during the CMD command. The syntax is: SELWR adr[,len] Where **adr** the address of the data to be transfered relative to the BIAS. **len** the length in decimal bytes. If len=0 then no transfer takes place. If ommited then a defect list is assumed and the length is calculated.
SKIPprint	The SKIPPRINT option controls the updating of messages on the CRT. The default value of "1" causes all messages to be printed. A value of "0" causes all messages to not be printed. Any other value causes n messages to be skipped before the message is updated.
STATUS	The STATUS command causes 16 bytes of SCSI status to be read from the selected Drive and displayed on the console.
TEst	The TEST option is used to select the test or tests to be executed. To select the default tests enter TEST followed by a carriage return. To select a single test enter TEST followed by a space and the decimal test number. To select multiple tests, enter TEST followed by a space and the decimal test numbers separated by commas. To specify a range of tests, enter the

	decimal first test number, a dash, and the decimal last test number in the range. To recall the purpose of any test enter HELP TEST n where n is the decimal test number. To recall the purpose of all tests enter HELP TEST *. The default selection is: 0-4. The valid tests are: 0-13
^X	Entering control X (^X) terminates the Format or Scan and return control to the diagnostics.

The SCRIPT provides a means for the user to enter a sequence of commands and options and execute them with a single command. Commands are prefixed with a decimal line number similar to basic. Lines can be deleted by entering a line number with no command. Lines can be replaced by entering the line number and the new command. LIST causes the lines to be listed. NEW causes all lines to be deleted. RENUMBER causes all lines to be renumbered. If an error occurs execution is stopped and input is directed from the console.

3.6 Test Descriptions

TEST 00	Status check. Checks the initial status of the drive and controller.
TEST 01	Restore & read-check. Performs a test of the restore and read-check logic. LBA is set to MAXLBA. A sequence of restore, read-check 0, readcheck LBA, LBA = LBA/2 until LBA = 1 is performed. Then a restore and a read-check to MAXLBA+X'10' is done to insure a seek incomplete status is returned.
TEST 02	Oscillating read-check. The disk is partitioned into 400 parts. Read-checks are done from 0,last,0+1,last-1,0+2,...last- 399,0+399 in an oscillating motion.
TEST 03	Random read-check. 500 Random LBAs are read-checked.
TEST 04	Interrupt read-check. An interrupt readcheck of valid and illegal LBAs are made.
TEST 05	Interrupt data transfer (read only). An interrupt read is made to the low LBA.
TEST 06	Read only. A read is performed on all LBAs from low to high.
TEST 07	Write/read using pattern. A sequence of write/read/verify is performed from low to high using the data pattern selected by PATTERN.
TEST 08	Write/read image. A sequence of write/read/verify using the image data from low to high.
TEST 09	Write/read incrementing. A sequence of write/read/verify using a incrementing pattern from low to high.
TEST 10	Write/read image-complement. A sequence of write/read/verify using the image & image complement from low to high.
TEST 11	Read/write scope loop. The test provides a scope loop capability. The scope and byte options select the type of operation performed on the low LBA.
TEST 12	Readcheck scope loop. This test performs a read check on the low LBA.
TEST 13	Tape write/read. LOW=# records, HIGH=# files.
TEST 14	Tape motion commands (REW,BR,FR,WFM,FF,BF).
TEST 15	Tape write/read variable length records.
TEST 16	Tape write-long/read-short, write-short/read-long.
TEST 17	Tape Interrupt Write/Read.
TEST 18	Tape Write/Read Scope Loop. ·
TEST 19	Tape Erase, Write files, Write Directory, Read.

3.7 Error Definitions

Error 001	Machine Malfunction Interrupt.
Error 002	Supervisor Call Interrupt.
Error 003	Arithmetic Fault Interrupt.
Error 004	System Queue Service Interrupt.
Error 005	Relocation/ Protection Interrupt.
Error 006	Illegal External Interrupt.
Error 007	Interrupt Level Error.
Error 008	Illegal Instruction Interrupt.
Error 009	Data Format Fault Interrupt.
Error 010	Inbuf and Outbuf overlap.
Error 011	Inbuf or Outbuf not in valid memory.

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Error 012	False sync from controller.	
Error 013	False sync from SELCH.	
Error 014	Controller not idle after reset.	
Error 015	Controller status error during initial testing.	
Error 016	Drive status error during initial testing.	
Error 017	Invalid LOW LBA LOWMAX.	
Error 018	Invalid HIGH LBA HIGHMAX.	
Error 019	Invalid HIGH LBA LOWHIGH.	
Error 020	Selch final address error after read.	
Error 021	Selch final address error after write.	
Error 022	Selch final address error after readcheck.	
Error 023	SCSI residual length error after read.	
Error 024	Selch final address error after interrupt read.	
Error 026	Selch final address error after interrupt readcheck.	
Error 028	Selch final address error after illegal LBA readcheck.	
Error 029	Selch final address error after interrupt illegal LBA readcheck.	
Error 030	Selch status error after read.	
Error 031	Selch status error after write.	
Error 032	Selch status error after readcheck.	
Error 033	Selch busy after stop command.	
Error 034	Selch status error after interrupt read.	
Error 036	Selch status error after interrupt readcheck.	
Error 038	Selch status error after illegal LBA readcheck.	
Error 039	Selch status error after interrupt illegal LBA readcheck.	
Error 040	Background test failed during fullword store & load.	
Error 041	Background test failed during halfword store & load.	
Error 042	Background test failed during byte store & load.	
Error 043	Background test failed during floating add & subtract.	
Error 044	Background test failed during fix to float & float to fix.	
Error 045	Background test failed during floating multiply & divide.	
Error 046	Background test failed during store multiple.	
Error 047	Data compare error after read.	
Error 048	Outbuf modified after write.	
Error 049	Controller time out after reset.	
Error 050	Controller time out after read.	
Error 051	Controller time out after write.	
Error 052	Controller time out after readcheck.	
Error 053	Controller time out after restore.	
Error 054	Controller time out after interrupt read.	
Error 055	Controller time out after interrupt write.	
Error 056	Controller time out after interrupt readcheck.	
Error 057	Controller time out after interrupt restore.	
Error 058	Controller time out after illegal LBA readcheck.	
Error 059	Controller time out after interrupt illegal LBA readcheck.	
Error 060	Drive not ready time out after read.	
Error 061	Drive not ready time out after write.	
Error 062	Drive not ready time out after readcheck.	
Error 063	Drive not ready time out after restore.	
Error 064	Drive not ready time out after interrupt read.	

Error 065	Drive not ready time out after interrupt write.
Error 066	Drive not ready time out after interrupt readcheck.
Error 067	Drive not ready time out after interrupt restore.
Error 068	Drive not ready time out after illegal LBA readcheck.
Error 069	Drive not ready time out after interrupt illegal LBA readcheck.
Error 070	Selch time out after read.
Error 071	Selch time out after write.
Error 072	Selch time out after readcheck.
Error 074	Selch time out after interrupt read.
Error 075	Selch time out after interrupt write.
Error 076	Selch time out after interrupt readcheck.
Error 078	Selch time out after illegal LBA readcheck.
Error 079	Selch time out after interrupt illegal LBA readcheck.
Error 080	Controller status error after read.
Error 081	Controller status error after write.
Error 082	Controller status error after readcheck.
Error 083	Controller status error after restore.
Error 084	Controller status error after interrupt read.
Error 085	Controller status error after interrupt write.
Error 086	Controller status error after interrupt readcheck.
Error 087	Controller status error after interrupt restore.
Error 088	Controller status error after illegal LBA readcheck.
Error 089	Controller status error after interrupt illegal LBA readcheck.
Error 090	Drive status error after read.
Error 091	Drive status error after write.
Error 092	Drive status error after readcheck.
Error 093	Drive status error after restore.
Error 094	Drive status error after interrupt read error.
Error 095	Drive status error after interrupt write.
Error 096	Drive status error after interrupt readcheck.
Error 097	Drive status error after interrupt restore.
Error 098	Drive status error after illegal LBA readcheck.
Error 099	Drive status error after interrupt illegal LBA readcheck.
Error 151	Controller time out after rewind.
Error 152	Controller time out after back record.
Error 153	Controller time out after forward record.
Error 154	Controller time out after write file mark.
Error 155	Controller time out after forward file.
Error 156	Controller time out after back file.
Error 161	Drive not ready time out after rewind.
Error 162	Drive not ready time out after back record.
Error 163	Drive not ready time out after forward record.
Error 164	Drive not ready time out after write file mark.
Error 165	Drive not ready time out after forward file.
Error 166	Drive not ready time out after back file.
Error 181	Controller status error after rewind.
Error 182	Controller status error after back record.
Error 183	Controller status error after forward record.
Error 184	Controller status error after write file mark.

Error 185   Controller status error after forward file.
Error 186   Controller status error after back file.
Error 191   Drive status error after rewind.
Error 192   Drive status error after back record.
Error 193   Drive status error after forward record.
Error 194   Drive status error after write file mark.
Error 195   Drive status error after forward file.
Error 196   Drive status error after back file.

OS/32 INSTALLATION

4.1 Introduction

This section contains information on installing the supplied Macrolink disk driver into your OS/32 system. The SCSI controller is not driver compatible with existing Concurrent Computer SCSI or MSM/IDC drivers or the system LSU. This driver works with all disk types under the SCSI Controller: SCSI, ESDI, ST-506 & LD1200. In addition the driver supports the Patriot and Exabyte cartridge tape systems.

Our driver communicates to disks, via the SCSI Controller, on a logical basis, using the LBA values from the SVC. The SCSI controller converts these logical values into the physical values required by the device. To be compatible with other OS/32 constraints, physical head, sector & cylinder values must be entered to equal the logical storage content of the drive.

4.2 Distribution Tape

The Macrolink SCSI distribution tape contains programs necessary to install, SYSGEN and use the SCSI devices. The distribution tape is in BACKUP format and should be restored to the system account where tasks are loaded and SYSGENs performed. To restore, enter the following:

```
LOAD BACKUP
TASK BACKUP
START,IN = tape:,OUT = disk:,L = list:,DELE/NO,VER
```

Where
   "tape:" is the input tape device
   "disk:" is the output disk device
   "list:" is the list device.

A listing of the driver revisions can be produced by executing the CSS: SCSIREV.CSS

OS/32 Software Installation

This section contains information on installing the supplied Macrolink SCSI drivers into your OS/32 system. The SCSI Controller is not driver compatible with existing Concurrent Computer SCSI & MSM/IDC drivers or the system LSU. The disk driver works with all disk types under the SCSI Controller: SCSI, ESDI, ST506 and LD1200. The tape driver works with the Patriot 240 and EXABYTE EXB-8200.

DCB Installation

The distribution tape includes INSTLDCB.CSS to create or update the USERDLIB.MLB file. To use the installation CSS, enter the following:

```
INSTLDCB XX
```

Where XX is the revision of your OS (62, 72, 81 or 82).

When the MLU32 task is finished updating, a directory of the library will be printed. Verify that DCB63 and DCB248 appear at the end of the list.

Driver Installation

An INSTLDVR CSS is provided to create or update the USERDLIB.LIB file. To use the installation CSS enter:

INSTLDVR XX

Where XX is the revision of your OS (62, 72, 81 or 82).

When the LIBLDR is finished updating a list of programs and the library is printed, verify that IN-ITSCD, INITSCT, and INITSCO appear at the beginning of the list. These represent the Disk, Tape and Optical disk drivers. If the INSTLDVR is updating to an existing USERDLIB.LIB, the original file is saved as USERLIB.SAV.

If the file USERLIB.SAV exits from a previous INSTLDVR, the current USERDLIB.LIB is deleted and the new SCSI drivers are added to USERLIB.SAV to create USERDLIB.LIB. If other drivers are added to USERDLIB.LIB after the INSTLDVR CSS is executed, it is suggested that the file USERLIB.SAV be deleted before executing INSTLDVR again. The drivers will appear in the library more than once but only the first and most current entry is used by SYSGEN.

BKPPLUS Installation

BKPPLUS & BKPPLEXA are created to allow fully compatible use of the PATRIOT 240 and EXABYTE EXB-8200 drives with BACKUP. To give easy access, a routine is added to BACKUP to start the appropriate monitor task. BKPPLUS & BKPPLEXA are explained in section 4.4. To install the BKPPLUS software enter:

INSTLBKP

This CSS links routines with BACKUP.OBJ to create BKPPLUS.TSK and BKPPLEXA.TSK. The use of these programs requires SVC intercept support by the OS. If you do not have an INTERCEPT statement in your configuration file, add it and re-SYSGEN.

4.3 OS/32 SYSGEN Specifications

The Macrolink DCB63 is a general purpose disk driver DCB that will allow the user to define any drive configuration. If your system was previously using a disk with a device of 63, the new DCB63 will generate correct structures as before, without modifications to your SYSGEN statements. This DCB may also be used with the Macrolink MACRO 3+ disk controller and the Macrolink Solid State Disk system. You may now specify the following additional features:

CYL	total Cylinders (default 823)
HOFF	head offset drives (default 0)
SEC	logical Sector count (default 64)
TOC	slow drive Time Out Constant (default 4)
TRKS	available Tracks (default 40)
TYPE	LARK, MMD, SSD or SCD (SCSI) drives (default MMD)

Use the following form for one or more of these options:

,USER = (option = parameter)

OS/32 Revision 8.1

Example for a ST4026 under 8.1:

XD0:EA,63,SELCH = F0,CONTROLLER = E8,USER = (TYPE = SCD),USER = (SEL = 64),
USER = (TRKS = 5),USER = (CYL = 244)

OS/32 Revision 8.2

Example for a ST4026 under 8.2:

XD1:,EA,63,SELCH = F0,CONTROLLER = E8,DISK = (64,5,246,2),USER = (TYPE = SCD)

Computing the Cylinder Value

The cylinder value can be found in APPENDIX III. If your drive is not listed, the procedure is simple. Just load the SCSI diagnostic, and run Test 0. Next, enter "OPTIONS", and note the value of MAX, the

maximum available LBAs (sectors). Divide this value by 320 (5 Tracks * 64 Sectors) to round down to the next integer value to find the total cylinders: MAX/320 = Cylinders.

The driver converts the physical track & cylinder requests to a logical address, and the SCSI Controller translates the logical request to the specific configuration required by the drive. Any combination of tracks & cylinders can be used that yield the correct product. Because fractional cylinders are lost, small drives should use the 320 value. Larger drives (over 300 MBytes), can use 1216 (19 Tracks * 64 Sectors).

OS/32 Optical Disk SYSGEN specifications

The Optical disk driver, TYPE=SCO, is an updated disk driver that uses the same access to the SCSI status as first disk drivers before REV C. Refer to the section on READ SCSI status. To access this driver use TYPE=SCO instead of TYPE=SCD.

OS/32 SCSI Tape SYSGEN Specifications

The Macrolink DCB 248 is used to access the SCSI TAPE driver. This DCB allows use of OS/32 utilities by returning a device code of 64 when accessed by an SVC 7 fetch attributes call.

Use the following format for each drive SYSGEN statement: dev name, dev address, 248, selch address, controller address. Example:

XMT:,E9,248,SELCH = F0,CONTROLLER = E8

To use the BACKUP Plus software also include the INTERCEPT statement.

4.4 Backup Plus

This section describes performance limitations of the Patriot 240 and Exabyte EXB-8200. These drives are mainly used to provide a security backup of the user disk systems. FASTBACK and BACKUP are the main programs that provide this function. The tape drives are limited in two ways:

1. EOM status is only provided during a write operation on both the Patriot 240 and Exabyte EXB-8200.

2. The write filemark (WFM) operation requires a extraordinary amount of time on the Exabyte EXB-8200 because of tape repositioning.

These limitations do not affect operation under FASTBACK. FASTBACK should be used as first choice for security backup.

Optimum performance is provided because the tape drives go into streaming mode. FASTBACK also recognizes its own EOV record and does not require an EOM status when reading at the end of tape.

The standard distribution OS/32 BACKUP can be used as long as the data will fit on one tape. Because BACKUP does not recognize its own EOV record without an EOM status, multi-volume backup with cache- equipped tape drives may result in lost data at EOT. If the data spills over onto another tape BKPPLUS can be used to verify or restore the data without re-writing the data with BKPPLUS.

BKPPLUS is the OS/32 BACKUP program modified to include a routine that loads and starts a monitor program. This monitor program, SBACKUP.TSK, uses SVC intercepts to control all I/O from the backup program to the tape. Once the monitor program is started control is returned to BACKUP. BKPPLUS is loaded and started just like BACKUP. Example:

LOAD BKPPLUS
TASK BKPPLUS
START,IN = DSKO:,OUT = XMT:,L = CON:,VERIFY

During the write phase of BKPPLUS all operations are issued to the tape as if BACKUP were in use. During the read phase BKPPLUS reads ahead and buffers records. When the look ahead has determined that the EOV record is read then BKPPLUS returns the EOM status in the proper record so that BACKUP rewinds the tape and asks user to mount the next tape. This is the preferred usage of BACKUP to multi-volume tapes on the Patriot 240.

BKPPLEXA is used to create the fastest BACKUP type tape on the EXABYTE EXB-8200. Backup writes a filemark between each file on the tape. Because the Exabyte drive has to reposition on each filemark, a Backup that includes many files will take a long time. BKPPLEXA is used to overcome this limita-

tion. BKPPLEXA is loaded and started just like BKPPLUS. When BKPPLEXA is started SBACKUPE.TSK is used to monitor tape I/O from Backup. During the write phase, data is written to the tape like Backup except a write filemark (WFM) is changed into a write with a 4 byte data pattern of C'SEOF'. This allows the drive to continue writing without the time-consuming tape repositioning. When the write operation is finished and a rewind is performed to verify, a real double filemark is written so that data can be appended to the tape. If a rewind is not performed by BKPPLEXA, the user should append filemarks using the WF command before rewinding. During the read phase, BKPPLEXA does a read ahead like BKPPLUS. The difference is that all C'SEOF' records are returned as EOF status. Also, since there are no filemarks, an FF operation is changed into a read until C'SEOF'.

Both the Patriot and Exabyte drives have a maximum block transfer size of 32 KBytes. If the application program should attempt a write over this limit, an error status will be returned. For both BACKUP and Fastback, use the default block size when creating tapes.

4.5 SCSI LSU

To enable the SCSI Controller LSU, turn off the IPL (or LSU) switch on your computer and turn the toggle switch located at the front of the SCSI controller to "LSU". Press the INIT switch on the CPU, or execute the 3280 LSU Emulator in Chapter 3. The following message should appear on the system console:

```
SCSI + LSU BOOT PROGRAM
COPYRIGHT 1986 MACROLINK, INC. ALL RIGHTS RESERVED
Enter: NAME [op1,op2,op3,...]
                Valid Names:
                        SCD0 SCD1 SCD2 SCD3 SCD4 SCD5 SCD6 MG85 MG62
                Valid Keyword Options (Addresses in Hex):
                        S = selch address   C = controller address
                        D = file address    F = filemarks
Name ?          Enter the desired SCSI device name, or MG85/MG62 for standard 9-track tape.
```

The SCSI names (SCD0-SCD6) correspond to the unique SCSI address of each device (disk or tape) attached to the Macrolink SCSI Controller. Once a disk device is selected, the loader will respond with the volume name, and prompt you for the filename:

```
VOL = DSK1   FILE = Enter your filename, or <CR> for Display Files.
Display Files
```

This command operates like the DF command in OS/32. Both the "–" and "*" are supported for each field. The "–" requests all files starting with the characters preceding it displayed. The "*" requests all files with matching characters in the same position(s) to be displayed. Example:

```
-.OS/-                                  Display all of the .OS files in any account.
OS32-.OS/0000                           Display files only in account 0.
Display Files -.OS
OS3205T.OS /0000   OS3205.OS /0000   OS3230.OS /0000   OS3220T.OS /0000
                                        Strike any key to stop the display.
VOL = DSK1 FILE = OS3230.OS              Enter your selected OS filename & account information.
OS32MT08-01.OS3230  LICENSE 1-2345
MEMORY TEST IN PROGRESS
END OF MEMORY TEST
UNAVAILABLE MEMORY BLOCKS = 0
*ENTER DATE AND TIME
*                                        OS/32 is now loaded and ready
```

If the controller has been configured for AUTOBOOT mode, the boot-load can be aborted by entering ^A (control A) on the system console during the memory test.

5.1 Introduction

The MMD Support programs allows the creation and maintenance of standard Concurrent Computer Multi Media Diagnostics and user diagnostics onto the supported SCSI tape drives. Data can be transferred from the system disk, or standard 9-track tape drives onto the SCSI tape. While this utility allows you to copy CCUR MDL tapes, you are responsible for complying with your license and copyright agreements.

Two programs are provided on the SCSI distribution tape:

1. SCSI Controller MMD OS/32 Support.
2. SCSI Controller MMD Boot Loader.

5.2 OS/32 Support program

The support program is used to create or update SCSI tapes. The program assigns or allocates the following disk files for its use:

☐ LU 2 SCSIEX1.EEE

☐ LU 4 Temporary file, record length = 256 (about 2.2 MBytes required for full MMD tape).

☐ LU 5 Command input/output.

To use the program, load and start it on an MTM terminal or system console:

```
LOAD SCSIMMD
START [,cmd] CMD is an optional command input/output device. The default is the system console (CON:).
SCSI MMD SUPPORT R01-00
COPYRIGHT 1988 MACROLINK, INC.
ALL RIGHTS RESERVED
COMMAND ?
HELP
Valid commands:
ADD         DELete
List        MOVE
LList       GET
INITialize  SAVE
Pause       HELP
End
```

For more information, enter: HELP *command*, e.g. "HELP ADD". The following on-line command descriptions are available:

ADD	The ADD command is used to input programs from the MMD tape or diagnostic file. The user is asked for information pertaining to the program type, input filename, name, and selection criteria. Two types of programs are supported: Diagnostic (EEE), and Multi Media Tape (MMD). The user is asked for the name of the input file. For MMD, tape input is required. The program then asks for the 32 character directory name or MMD selection criteria.
DELETE n[,m]	The delete command is used to remove a program or a range of programs from the directory.

LIST	The LIST command lists the directory of programs on the SCSI+ tape in a condensed double column format.
MOVE n[,m]	The move command is used to rearrange the order in which the programs are listed. A program or a range of programs can be moved. The user will be asked if the programs are to be moved to the end or what program they are to be inserted before.
LLIST	This command gives a long format list each program. Each entry lists the program number, MMD sequence number MMD program number, name, start, and end.
GET	The GET command is used to read programs previously saved on tape with a SAVE command. When the GET command is executed the directory is cleared of all programs. Programs can be added, deleted, moved after the GET command.
SAVE	The SAVE command is used to write the programs read using GET and ADD commands to tape. The executive program and directory are written first to allow the LSU boot loaders to load them. Programs can be added by reading the tape with GET command. Adding with the ADD command. And saving with the SAVE command.
INITIALIZE	This command is used to set the directory and available space pointers to their initial values and copy the executive program to the scratch file on LU 4. This command must be entered before the first ADD command. The INITIALIZE command is not necessary before the GET command.
PAUSE	This command is used to pause the task. Use the continue command to continue the task.
END	This command is used to terminate the task.

To create a tape, the general command sequence is as follows:

```
INITIALIZE
ADD
:          as necessary
ADD
DELETE
MOVE
SAVE       creates tape
END
```

To update a tape the general command sequence is as follows:

```
GET        reads tape
ADD
:          as necessary
ADD
DELETE
MOVE
SAVE       writes tape
END
```

The following example shows how to add MMD diagnostics to the SCSI MMD tape.

```
COMMAND ?
INITIALIZE
COMMAND ?
```

```
ADD
TYPE (EEE,MMD) ?
MMD
FILENAME ?
MT45:
INPUT MMD SEQ. # (XXX) OR RANGE (XXX,YYY)
001,007
ADDING 001
ADDING 002
ADDING 003
ADDING 004
ADDING 006
ADDING 007
COMMAND ?
ADD
TYPE (EEE,MMD) ?
MMD
FILENAME ?
MT45:
INPUT MMD SEQ. # (XXX) OR RANGE (XXX,YYY)
100,122
ADDING 113
ADDING 114
ADDING 115
ADDING 116
ADDING 118
ADDING 119
ADDING 120
ADDING 121
ADDING 122
COMMAND ?
ADD
TYPE (EEE,MMD) ?
EEE
FILENAME ?
LNKTST32.EEE/S
NAME ?
LINK TEST 32
COMMAND ?
LI
```

NUM	NAME.....	NUM	NAME.....
1	LOW LOADER/EXECUTIVE 06-270R07	9	S32 PROC. TEST PART 3
2	3200 PROCESSOR TEST 1	10	S 32 PROC. TEST PART 4
3	3200 PROCESSOR TEST 2	11	3220 CLASS PROC DIAG (5019)
4	HIGH LOADER/EXECUTIVE	12	3240 MEMORY SYSTEM DIAGNOSTIC
5	XF PROCESSOR TEST PART 1	13	8/32 WCS TEST
6	XF PROCESSOR TEST PART 2	14	3220 WCS TEST (4456,5328)
7	S32 PROCESSOR TEST PART 1	15	3240 WCS TEST
8	S32 PROC. TEST PART 2 (3706)	16	LINK TEST 32

```
COMMAND ?
LL
```

NUM	MMD#	PROGRAM #	NAME	START	END
1	001	06-145 F01R11 11	LOW LOADER/EXECUTIVE 06-270R07	A00	7FFF
2	002	06-228 R05 05	3200 PROCESSOR TEST 1	A00	6AFF

3	003	06-229 R05 05	3200 PROCESSOR TEST 2	A00	3FFF
5	006	06-307 R00 00	XF PROCESSOR TEST PART 1	A00	6AFF
6	007	06-308 R00 00	XF PROCESSOR TEST PART 2	A00	40FF
7	113	06-154 R03 04	S32 PROCESSOR TEST PART 1	A00	3FFF
8	114	06-155 R02.1 04	S32 PROC. TEST PART 2 (3706)	A00	37FF
9	115	06-178 R01 06	S32 PROC. TEST PART 3	A00	1FFF
10	116	06-195 R00 01	S 32 PROC. TEST PART 4	A00	21FF
11	118	06-226 R00.1 01	3220 CLASS PROC DIAG (5019)	A00	A3FF
12	119	06-264 R00 00	3240 MEMORY SYSTEM DIAGNOSTIC	A00	68FF
13	120	06-192 R00 02	8/32 WCS TEST	A00	1BFF
14	121	06-232 R00.2 02	3220 WCS TEST (4456,5328)	A00	2AFF
15	122	06-234 R00 00	3240 WCS TEST	A00	30FF
16			LINK TEST 32	A00	2AFF

```
COMMAND ?
SAVE
FILENAME ?
MT45:
COMMAND ?
END
DEMO -END OF TASK CODE= 0 PROCESSOR = 5.566 TSK-ELAPSED = 42:50
```

User diagnostics should be created in the following manner:

1. Add to the source code:

```
        ORG X '60'
        B start          START OF PROGRAM
```

2. Link using the commands:

```
ESTABLISH TASK
OPTION ABS = O
INCLUDE fd
MAP
BUTLD fd .EEE
END
```

5.3 MMD Loader

The Loader is placed at the start of the tape in the format of an OS image, and loaded using the on-board LSU boot program. Once loaded, a directory is listed and the user can select from a menu of diagnostics. Multi Media diagnostics are selected by specifying "Mnnn", where nnn is the Multi Media sequence number. Other diagnostics are selected by "Pxxx" where xxx is the program number.

On-Line Help

If the user escapes from the load menu, the following commands can be entered:

```
COMMANDS: BIAS,EXAMINE,LOAD,DEVICE,SELCH,LIST,LLIST,HELP,END
COMMAND ?
```

Entering HELP will list the valid commands:

```
HELP
Valid commands:
LIst        DEVice
LLIst       SELch
LOAD        BIas
```

HELP   EXAmine
End

For more information, enter: HELP command

COMMAND ?

For a description of the LIST command, enter "HELP LIST":

LIST	The LIST command lists the directory of programs on the SCSI+ tape in a condensed double column format.
LLIST	This command gives a long format list each program on the SCSI+ tape. Each entry contains the program number, MMD sequence number, MMD program number, name, start, and end.
LOAD [n]	This command is used to load and execute a program located on the Macroloader. If a program number is not specified then the initial load menu is entered. If a program number is specified then it is loaded and started.
DEVice [adr]	The DEVICE command is used to set the address of the input tape. If no address is specified, then the current address is displayed.
SELch [adr]	The SELCH command is used to set the address of the selector channel. If no address is specified, then the current address is displayed.
BIAS addr	This command is used to set a bias for EXAMINE command.
EXAMINE addr[,count]	This command is used to examine the contents of memory. The BIAS address, if any, is added to the examine address. The count specifies the number of halfwords to be displayed.

Once the program is started, a menu of applications will appear:

```
*SCSI MMD LOADER R01-00 COPYRIGHT 1988 MACROLINK, INC. ALL RIGHTS RESERVED
DEVICE = 45 SELCH = F1
```

M001	LOW LOADER/EXECUTIVE 06-270R07	M222	32 BIT MEMORY TEST (PART 2)
M002	3200 PROCESSOR TEST 1	M223	32 BIT MEMORY TEST (PART 3)
M003	3200 PROCESSOR TEST 2	M227	S32 MULTIPORT MEM TEST (3771)
M004	HIGH LOADER/EXECUTIVE	M228	3200 STM TEST PART 1
M006	XF PROCESSOR TEST PART 1	M229	3200 STM TEST PART 2
M007	XF PROCESSOR TEST PART 2	M230	3203/3205 MEMORY DIAG 1 L
M113	S32 PROCESSOR TEST PART 1	M231	3203/3205 MEMORY DIAG 2 H
M114	S32 PROC. TEST PART 2 (3706)	M240	PE 3200 SHARED MEMORY TEST
M115	S32 PROC. TEST PART 3	M250	3200 ERROR LOGGER TEST (5672)
M116	S 32 PROC. TEST PART	M303	DIOS TEST PROGRAM
M118	3220 CLASS PROC DIAG (5019)	M305	32 BIT SELCH TEST L
M119	3240 MEMORY SYSTEM DIAGNOSTIC	M306	CHANNEL MANAGER DIAGNOSTIC
M120	8/32 WCS TEST	M307	MAC TEST (PART 1) 3389,3743
M121	3220 WCS TEST (4456,5328)	M308	MAC TEST (PART 2) X'10010'
M122	3240 WCS TEST	M309	32 BIT SYS EXEC. (5161)
M219	S32 S6A MEMORY TEST (PART 1)	M310	3220 MAC PT 1 (4314,5483,5571)
M220	S32 S6A MEMORY TEST (PART 2)	M311	3220 MAC 2 '10010' (4314,5571)
M221	32 BIT MEMORY TEST (PART 1)	M312	MAT/CACHE TEST PT1 (4655)

```
ENTER XNNN TO LOAD, <ESC> <CR> TO EXIT, <CR> FOR MORE
```

NUM	NAME.....	NUM	NAME.....
M313	MAT/CACHE TEST PT2 (4655)	M329	3200 COMMERCIAL INST. TEST
M320	3200 MAT TEST PART 1L	M330	S32 FLOATING POINT TEST
M321	3200 MAT TEST PART 2 H	P044	LINK TEST 32
M324	32 BIT LSU SUPPORT	P045	CAM TEST 32
M328	3200 FLOATING POINT TEST		

ENTER XNNN TO LOAD, <ESC> <CR> TO EXIT, <CR> FOR MORE
COMMANDS: BIAS,EXAMINE,LOAD,DEVICE,SELCH,LIST,LLIST,HELP,END
COMMAND ?

Enter the command(s) to load and execute the desired diagnostic.

6.1 Introduction

If your SCSI Controller is equipped for operation with the LMS LD1200 Laserdrive, it will be available as an option in the configuration menu. Additional SCSI magnetic disks, or tape drives may be installed with the LD1200.

While the LD1200 may be used with the supplied driver on OS/32, the optical disk is not compatible with the file management system. Because the optical disk is a write once device, the user must design a directory system that will support his application. The optical disk has no equivalent to Bit and Flaw maps, updatable PACKINFO.DIR files, or other conventional file management tools available on read/write disks. For best results with optical media, the user should address the disk like a magnetic tape drive, and append large contiguous files to the unused media.

Use the Macrolink SCSI DCB described in Chapter 4. The LD1200 will generally not work with the SCSI diagnostic package. An OS/32 system level demonstration program is provided to verify basic read/write operation.

Data Transfer Operations

The Laserdrive 1200 has a fixed 1024 byte sector size. If less than 1024 bytes are written, the last byte of data will fill the sector.

All data transfers will use bare disk access, and will be made with Supervisor Calls (SVC1).

File Management

The user must develop a file management system that is compatible with each application, and the limitations of the Laserdrive. The most straightforward method is to write concatenated contiguous data files, in the same fashion as a tape drive. However, no "skip filemark" capability exists, and serially searching over 1,000 MB of disk space will take an unacceptable time. A directory, containing the file information, starting LBA and size could be kept on another device, but this will be unsuitable for most uses.

The file system that we recommend requires reserving a directory area at the start of the disk, allowing one physical sector of directory for each file. In this 1024 byte "directory sector" the file description, starting LBA, file size, and next valid LBA are contained.

The Laserdrive has a total of 4,095,484 logical sectors. This value is divided by the average file size to give the number of directory sectors that should be reserved. For example with 250KB average file size: $4,095,484 / (262,144/256) + 1 = 3,995$ files

This value (3,995) is the starting LBA for the data. The data file must be written prior to writing the directory sector, as the ending LBA (from LBA 0) must be recorded in the directory.

Prior to writing the next file, the directory is read, and its last valid sector will contain the next blank LBA for the file write. The directory can be read one sector at a time, or a large block can be read. Upon completion of each directory read, the "LBA" and "Sense Key" of LBA 0 should be read to verify data validity.

The Laserdrive will automatically alternate a sector that cannot be written. When an SVC1 read is made to a physical sector, the user will receive the correct logical sector.

Write Operations

1. Using SVC1, write the data to the desired starting LBA.
2. Using SVC1, read with image bit set 16 bytes of extended SCSI status. This is the Sense Data transferred by the LD 1200 in response to a Request Sense Command. For a complete explanation of this data refer to the LD 1200 manual paragraph 9.1.3. *Request Sense Command*.

3. To determine the next writeable LBA, assuming you have a Sense Key (byte 2) of 0 or 1 and the Address Valid bit (byte 0) is set, add the Skip Count (bytes 8 & 9) to the LBA contained in the Information Bytes (bytes 3 through 6) and add 1. Use this LBA for your next write.

Any attempt to write to a previously written sector will produce an error (Sense Key 8).

Read Operations

1. Using SVC1, read the data from the desired starting LBA.

2. Using SVC1, read with image bit set 16 bytes of extended SCSI status. This is the Sense Data transferred by the LD 1200 in response to a Request Sense Command. For a complete explanation of this data refer to the LD 1200 manual paragraph 9.1.3.

3. To determine the next LBA to read, assuming you have a Sense Key (byte 2) of 0 or 1 and the Address Valid bit (byte 0) is set, add 1 to the LBA contained in the Information Bytes (bytes 3 through 6). Use this LBA for your next write.

Any attempt to read from a blank sector will produce an error (Sense Key 8).

7.1 Introduction

This section contains information on installing and using the Macrolink SCSI disk and tape drivers on your OS/16 R5 system. The SCSI controller is not compatible with existing OS/16 drivers or LSU programs. The SCSI drivers support all disks types — SCSI, ST-506 & ESDI — except optical disks. SCSI tape drives are also supported.

7.2 Distribution Tape

The Macrolink OS/16 SCSI distribution tape contains all programs to install, SYSGEN, and use the SCSI devices. Also included are the source files so modifications can be made if necessary. The distribution tape is in COPY format. Object files are 108 bytes per record. MAC and CAL files are 80 bytes per record. List files are 132 bytes per record. Each file is separated by one file mark. The files are supplied in the following order.

```
POSTCUP.OBJ - 23 RECORDS
SCDDVR.OBJ - 19 RECORDS
SCTDVR.OBJ - 10 RECORD(S) COPIED
SCDDVREX.OBJ - 20 RECORDS
SCTDVREX.OBJ - 11 RECORDS
POSTCUP.MAC - 264 RECORDS
POSTCUP.CAL - 769 RECORDS
SCDDVR.CAL - 782 RECORDS
SCTDVR.CAL - 438 RECORDS
POSTCUP.LST - 529 RECORDS
SCDDVR.LST - 1771 RECORDS
SCTDVR.LST - 997 RECORDS
SCDDVREX.LST - 1782 RECORDS
SCTDVREX.LST - 1003 RECORD(S) COPIED
```

Copy the files onto your SYSGEN disk as required. The files are identified as follows:

POSTCUP

Postcup is a text processor that modifies the output of cup. Postcup recognizes device code 52 as a SCSI disk or tape. Tape devices require a *MT in the comment field. Postcup changes the device busy flag pointer to point to a common busy flag for the controller. The MAC source file is provided if modifications are to be made on a OS/32 system, otherwise the CAL file is used.

SCDDVR, SCDDVREX

The disk driver is provided in non-extended and extended memory versions respectively. The disk driver replaces the standard disk driver. The 40 MB disk, device code 52, is not supported. Device code 52 is changed to support SCSI disks. The driver reads the number of sectors from the drive when it is accessed for the first time. It is not necessary to specify the size of the disk at SYSGEN time.

SCTDVR, SCTDVREX

The tape driver is provided in both non-extended and extended memory versions. The SCSI tape driver is separate from the 800/1600 BPI 9 track tape driver.

Installation

The installation of the SCSI software requires updating the SYSGEN CSS as follows:

1) Insert after the START command for CUP/16.

> LDBG POSTCUP
> TASK .BG
> START

2) Insert after the INCLUDE EXEC@1,* command for TET/16.

> EDIT SCDDVR@4.OBJ
> EDIT SCTDVR@4.OBJ

The updated SYSGEN CSS is listed below.

```
$IFNULL @1
        $COPY
        ***@0: MISSING PARAMETER (OSID)
        $N
        $CLEAR
$ENDC
TASK .BG
CLOSE ALL;OPTION NOCOMP
LDBG CUP
$IFNULL @2
        $IFNX CUPI@1
                $COPY
                ***@0: FILE CUPI@1 NONEXISTENT
                $N
                $CLEAR
        $ENDC
        ASSIGN 1,CUPI@1,SRO
$ELSE
        $IFNX @2
                $COPY
                ***@0: FILE @2 NONEXISTENT
                $N
                $CLEAR
        $ENDC
        ASSIGN 1,@2,SRO
$ENDC
ASSIGN 3,PR:
$IFX CUPO@1
        DELETE CUPO@1
$ENDC
ALLOCATE CUPO@1,IN,80
ASSIGN 2,CUPO@1
START
LDBG POSTCUP
TASK .BG
START
LDBG CAL16D
TASK .BG
ASSIGN 1,EXEC16.CAL,SRO
$IFX EXEC@1
        DELETE EXEC@1
$ENDC
ALLOCATE EXEC@1,IN
ASSIGN 2,EXEC@1
ASSIGN 7,CUPO@1,SRO
$IFNX CALS6.SCT
        ALLOCATE CALS6.SCT,IN,256
```

```
$ENDC
ASSIGN 6,CALS6.SCT
$IFNX CALS8.SCT
        ALLOCATE CALS8.SCT,IN,256
$ENDC
ASSIGN 8,CALS8.SCT
$IFNULL @3
        $IFNX CALS5.SCR
                ALLOCATE CALS5.SCR,IN,256/2
        $ENDC
        ASSIGN 5,CALS5.SCR
        $IFNX CALS9.SCR
                ALLOCATE CALS9.SCR,IN,36
        $ENDC
        ASSIGN 9,CALS9.SCR
        START,CROSS,ERLST
$ELSE
        START,NLIST
$ENDC
ASSIGN 1,FMGR16.CAL,SRO
$IFX FMGR@1
        DELETE FMGR@1
$ENDC
ALLOCATE FMGR@1,IN
ASSIGN 2,FMGR@1
$IFNULL @3
        START,CROSS,ERLST
$ELSE
        START,NLIST
$ENDC
ASSIGN 1,CMDP16.CAL,SRO
$IFX CMDP@1
        DELETE CMDP@1
$ENDC
ALLOCATE CMDP@1,IN
ASSIGN 2,CMDP@1
$IFNULL @3
        START,CROSS,ERLST
$ELSE
        START,NLIST
$ENDC
TASK BG
CLOSE 1,2,5,6,8,9
DELETE CALS6.SCT,CALS8.SCT
$IFNULL @3
        DELETE CALS5.SCR,CALS9.SCR
$ENDC
$IFX OS16@1
        DELETE OS16@1
$ENDC
ASSIGN 7,CON:
$BUILD TETIN.SGN
REMOTE
ESTABLISH OS
JOB @0
INCLUDE EXEC@1,*
EDIT SCDDVR@4.OBJ
EDIT SCTDVR@4.OBJ
EDIT DLIB16@4.OBJ
```

```
INCLUDE FMGR@1,*
INCLUDE CMDP@1,*
BUILD OS,OS16@1
MAP
AMAP
END
$ENDB
$IFNX TET.SCR
            ALLOCATE TET.SCR,IN
$ENDC
ASSIGN 4,TET.SCR
ASSIGN 5,TETIN.SGN
LDBG TET
START
TASK .BG
CLOSE ALL;DELETE TETIN.SGN,TET.SCR
$IFE 0
            $COPY
            ***@0: SYSTEM ON OS16@1
            $N
$ENDC
$EXIT
```

7.3 OS/16 SYSGEN Specifications

The Macrolink SCSI disk and tape devices are specified as follows:

DEVICE 52,dd,DEVN:,ss,cc [*MT]

Where:
dd is the drive address
ss is the selch address
cc is the controller address
*MT is the optional tape identifier

Example:

DEVICE 52,EA,DSC1:,F0,E8
DEVICE 52,EB,DSC2:,F0,E8
DEVICE 52,E9,SCT:,F0,E8 *MT

7.4 16 Bit Diagnostics

The on board diagnostics and LSU boot program are similar to the 32 bit version. The 16 bit version differs in that the HELP command only allows HELP TEST to get a summary of test routines. The diagnostic & boot program is loaded using the LSU feature of the processor. For systems that have an ALO in place of the LSU (6/16 & 8/16), the 50 sequence must be manually loaded.

When booting OS/16, locations X'7A'-X'7B' must be manually entered to enable OS/16 to determine the overlay volume.

50 SEQUENCE

ENTER:

50	D500	AL X'CF'
52	00CF	
54	4300	B X'88'
56	0088	
78	0500	LSU ADR, OUTPUT COMMAND
7A	EA34	DEVICE, DEVICE CODE

```
        7C        E8F0                CONTROLLER, SELCH
        7E        0000                NOT USED
```

Place the SCSI switch in the "CONFIG" position. Enter:

```
        DTA 50 ADR          LOC = 50
        DTA FN SEL          PSW = 0
        INI                 INITIALIZE
        RUN
```

PROGRAMMING INFORMATION

8.1 Introduction

The SCSI Controller is divided into two separate hardware functions: the Controller with one address and the Devices with up to seven consecutive following addresses. Each address must be commanded separately and each has separate status bytes.

The controller address may be configured for any address; however, configuring the controller to end on a 0 or 8 address boundary (e.g. X'F0' or X'F8'), will avoid programming confusion. Device address will be the following consecutive devices; e.g. for a controller address of X'F8' Device addresses will be X'F9', X'FA', etc. You may configure address space for one, three or seven Devices in addition to the Controller.

Devices may be configured for any SCSI address (0 through 7) and may be configured for operation at any device address within the SCSI Controller address space. Devices which may control more than one Drive should have address space reserved for as many Drives as the Device is capable of controlling whether Drives are configured or not to avoid bus contention.

For example, consider a SCSI system with the Controller configured at X'F8' which will use an Adaptec 4000 ST506 Winchester controller with one disk Drive and a CDC Patriot Tape Drive. First, set the SCSI address for the Adaptec to 0 (each SCSI device must have an unique address) and the SCSI address for the Patriot to 1. The SCSI address is jumper selectable on each Device. Next, set the Drive address jumper on the disk drive to 0 (this is not arbitrary and must match its intended device address). Using the Configuration Menu (resident in the SCSI Controller), configure the Patriot for SCSI address 1, device address X'F9' and configure the Adaptec for SCSI address 0, device addresses X'FA' and X'FB'. The disk drive will use device address X'FA' since it was set at drive address 0. This is because the least significant device address bit is used to address the drive (a drive set with drive address 1 would occupy device address X'FB'). In this example device address X'FB' is reserved for a Winchester ST506 disk drive and any attempt to configure another device at that address will result in bus contention and unpredictable results.

8.2 Controller Commands

These are commands to be sent to the Controller. Separate commands are required for the Devices. Data transfers between a Device and the Processor will require the following sequence of operations:

Data Transfer Sequence
1. Clear command to Device.
2. Write 3 bytes of LBA to the Device (Disk Drives only; Skip this step for Tape Drives).
3. Write 3 bytes of transfer size to the Device.
4. Data transfer command to Controller.
5. Start SELCH immediately.

Read Command — X'01'

The READ command caused the SCSI Controller to read data from a SCSI device and transfer it to the processor. The Data Transfer Sequence must be used for this command. Upon completion of the command the controller Idle bit will be set.

Errors are reported after retries are exhausted by the SCSI Device and normally retries by the programmer at this point will usually be futile in recovering data. Requesting Extended SCSI Status at this point may give useful information for recovering the data or determining the problem.

8.3 Write Command — X'02'

The WRITE command causes the SCSI Controller to transfer data from the Processor to a SCSI Device. The Data Transfer Sequence must be used for this command. Upon completion of the command the controller Idle bit will be set.

Errors are reported after retries are exhausted by the SCSI Device and normally retries by the programmer at this point will usually be futile in attempting to write data. Requesting Extended SCSI Status at this point may give useful information for determining the problem.

Read Check Command — X'03' (Disk Drives only)

This command does an off-line read of a single LBA. No data is passed to the Processor. Use the Data Transfer Sequence for this command except step 5 starting the SELCH must be omitted.

Execute SCSI Command — X'04' (Disk Drives only)

This command allows the user to create a SCSI Command Descriptor Block and execute it. Use the Data Transfer Sequence for this command except send the SCSI CDB instead of the LBA and transfer size. Use the Selch for the Data In or Data Out Phase if neces sary.

8.4 Device Commands

Clear Command — X'00'

This command clears the Controller's internal registers in preparation for writing LBA and transfer size data prior to issuing a data transfer command to the controller. It may also be used as a no operation command for changing interrupt bits. Upon completion, the status bits are reset.

Restore/Rewind Command — X'01'

This command restores disk drives to Cylinder 0 or rewinds tape drives to load point. The Controller is available for other device I/O during rewind.

Backspace Record — X'02' (tape drives only)

This command repositions the tape to the present LBA minus one.

Forward Space Record — X'03' (tape drives only)

This command repositions the tape to the present LBA plus one.

Write File Mark — X'04' (tape drives only)

This command writes a file mark at the present tape position. Prior to issuing this command, a Clear Command (X'00') and a zero byte must be written to the Device.

Skip File Forward — X'05' (tape drives only)

This command repositions the tape at the beginning of the file following the file containing the present LBA.

Skip File Reverse — X'06' (tape drives only)

This command repositions the tape at the beginning of the file preceding the file containing the present LBA.

Read Capacity — X'06' (disk drives only)

Execution of this command will give access to 4 bytes of data containing the last available LBA on the disk Drive. This value varies to reflect the number of alternated sectors. After waiting for Device Busy status to clear, four Data Requests to the Device will read the last LBA, most significant byte first. Requesting more data will produce unpredictable data.

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Request SCSI Status — X'07'

The first execution of this command following any other command (Controller command or Device command) will give access to the first 16 bytes of Extended SCSI status as defined in the applicable Device manual. After waiting for device busy status to clear, data requests to the Device will read the status data. If more than 16 bytes are read, the data "wraps around" and repeats; i.e. the 17th byte will be the same as the first.

The second execution of this command will give access to the next sixteen bytes of Extended SCSI status. Consult the applicable Device manual. Many Devices do give status beyond 16 bytes and the status of the ones that do is typically not very interesting. After waiting for device busy status to clear, data requests to the Device will read the status data. If more than sixteen bytes are read, the data "wraps around" and repeats; i.e. the 17th byte will be the same as the first.

Any number of data requests may be made including none and more than sixteen. There is no need to request any more data than is interesting.

Reset Command — X'08'

This is a global reset and it does not matter which Device it was sent to, the result is the same: All activity on all Devices will stop and the Controller will appear to have just powered up. Obviously, this command is to be used sparingly and is recommended only when all else fails but you are not quite ready to resort to a System Clear.

Test Device Ready — X'20'

This command is to be used after power up or after loading removable media to set the status register to a meaningful status. Status is never reported by a SCSI Device unless a command is executed. This command is therefore used to set the status when no other command is appropriate in order to make status available to the programmer.

8.5 Controller Status Byte

BIT	0	1	2	3	4	5	6	7
Controller Status	Write Protect	Header Failure	Defective Sector	Media Overflow	Busy	Examine	Idle	Data Error

Write Protect (Bit 0)

This bit is set when an attempt is made to access data that is write protected by the Device. Consult the applicable SCSI Device manual for the exact meaning of this status for the specific Device.

Header Failure (Bit 1)

This bit is set when an LBA can not be located, usually because of a data error in the header. Extended SCSI status should be requested to determine the exact nature of the error for the specific Device. This bit is not valid with tape operations.

Defective Sector (Bit 2)

This bit is set when an unrecoverable data error in the LBA is detected usually because of defective media. Extended SCSI status should be requested to determine the exact nature of the error for the specific Device. This bit is not valid with tape operations.

Media Overflow (Bit3)

An LBA was requested beyond the capacity of the Device usually during a long data transfer. Seek Incomplete status in the Device status byte will be set instead of this bit if no data has been transferred.

Busy (Bit 4)

This bit is set upon completion of any command.

Error (Bit 0)

A device error has occurred. Execute a Read SCSI Status Command and consult the device programming manual for a definition of the SCSI status.

End of File (Bit 1)

An end of file mark has been read from the tape drive.

End of Tape (Bit 2)

The logical end of tape has been reached.

Beginning of Tape (Bit 3)

The tape is positioned at the logical beginning of tape, or the load point.

Not Ready (Bit 4)

The drive is not ready to accept a command. An interrupt will be generated, if enabled, when this bit is reset.

Examine (Bit 5)

This bit is set when any of bits 0 through 3 are set. This bit is also set in conjunction with the Off-Line bit to indicate that no commands have been issued to the device (after power-up or reset) and valid status in not available. A test device ready Command (X'20') wall cause valid status to be available.

8.8 Patriot Erase & Rewind

The Patriot command structure is extended to allow erase and special rewind by writing a modified byte to the device address before the Write File Mark or rewind commands. The modifier byte is output to the device in the same sequence as the Transfer Length is output prior to a read or write.
1. Output a clear command.
2. Write 1 byte modifier (0 or 1).
3. Issue rewind or write file mark.

The modifier byte for the rewind command is:

0: Normal rewind.

1: Special rewind (no End Of Data mark written).

The modifier byte for the Write File Mark is:

0: Normal Write File Mark.

1: Short Erase.

The addition of the erase and special rewind allow a directory space to be reserved at the beginning of tape. To utilize this feature, follow the following steps:
1. Rewind
2. Erase 12 times
3. WFM 2 times
4. Rewind
5. Write a dummy block the size of the desired directory
6. Special rewind
7. Forward file
8. Write data files
9. WFM 2 times
10. Rewind
11. Write directory
12. Special Rewind

Data errors will occur if more than 12 erase commands are issued.

These functions are available on revision L or above microcode. Additionally, revision C Tape Driver is required.

OS/32 SVC1 Access

The erase and special rewind are accessed through the extended SVC1 function code. This requires a function code of X'81', device dependent function, LU and an extended function code as follows:

> 7 = Short Erase
> 10 = Special Rewind

8.9 Read SCSI Status

The Macrolink SCSI drivers provide access to the raw SCSI status from the drive or adapter. After an operation, the user can read up to 32 bytes of information. The SCSI status is accessed by one of two methods depending on the type and revision driver.

1. For all tape drivers and REV C and above disk drivers:

a. Set up a SVC1 parameter block with a READ + WAIT + IMAGE function code and a buffer of up to 32 bytes.

b. Set the SVC1 extended option to Y'80000'.

c. Link the task with the XSVC1 option.

2. For disk drivers before REV C and the Optical disc driver (TYPE=SCO):

a. Set up a SVC1 parameter block with READ + WAIT + IMAGE function code and a buffer of 32 bytes.

b. Link the task without the XSVC1 option.

Disk And Tape Driver Error Status Codes

The following is a list of error status codes for all SCSI tape drivers and REV C and above disk drivers.

A000	Service unavailable
9000	End of medium
8800	End of file
84FF	Hardware error
8283	Write protect
84xx	1. Maximum retry count reached
	2. Time out or bad status during READ SCSI STATUS xx=device status
82xx	1. Time out waiting for rewind
	2. Time out during TEST UNIT READY.

FORMATTER INSTALLATION

I.1 Introduction

This section covers the cabling and strap options for the optional disk formatter modules. If you purchased a complete SCSI disk system from Macrolink, the hardware will be correctly configured.

Cabling

ST-506 Installation

Install the 50 conductor flat cable from the connector on the SCSI Controller (P1) to the optional SCSI/ST-506 Formatter (J1). Pin 1 must be properly aligned on all connectors. The Formatter may be mounted directly to the disk drive. Connect the 34 conductor control cable from the Formatter (J2) to the drive(s). If this cable is supplied with three connectors, the middle connector should be used for the second drive. Only the drive at the end of the cable must have its termination resistor installed (see your drive manual).

Connect the first data cable from J3 on the formatter to Drive 0. Connect Formatter J4 to Drive 1, if installed.

ST-506 Formatter Configuration

The OMTI model 5100 Formatter is supplied properly configured. You can verify that the following jumpers are in place:

☐ W0: pins 0
☐ W1: 2 to 3
☐ W3: none

In addition, the 220/330 ohm resistor network must be installed in location 1D.

ST-506 Drive Configuration

The address selection for the first drive should be set to 0. The second drive is set to 1. If your drive has an "always selected" option, it must not be enabled. See your drive manual for information on these options.

ESDI Installation

Install the 50 conductor flat cable from the connector on the SCSI controller (P1) to the optional SCSI/ESDI Formatter (J4). Pin 1 must be properly aligned on all connectors.

The Formatter may be mounted directly to the disk drive. Connect the 34 conductor control cable from the Formatter (J2) to the drive(s). If this cable is supplied with three connectors, the middle connector should be used for the optional second drive. Only the drive at the end of the cable must have its termination resistor installed (see your drive manual).

Connect the data cable from J0 on the Formatter to Drive 0. Connect Formatter J1 to drive 1, if installed.

ESDI Formatter Configuration

The Adaptec model ACB-4520 Formatter is supplied properly configured. No jumpers should be in place for Drive 0 operation. A jumper should be in place from A to B for Drive 1 operation. In addition, the 220/330 ohm resistor network must be installed in location RP1.

ESDI Drive Configuration

The address selection for the first drive should be set to 0. The second drive is set to 1. If your drive has an "always selected" option, it should not be enabled. See your drive manual for information on these options.

SPECIFICATIONS

Disk interface	Any ST-506 or ESDI disk of any size. Contact Macrolink for specific SCSI disk compatibility.
Format limits	Maximum cylinders: 65,536 Maximum heads: 256 Maximum Sectors/Track: 256 Bytes/Sector: 256
CPU	Any 3200 series CPU with SELCH.
Software	OS/32 driver supplied on 1600 bpi tape. On-board formatter and diagnostic software contained in EPROM.
Data rate	1.25 MB/second transfers, byte mode.
Address	10-bit address decoding. Each SCSI Controller supports up to 7 drives with consecutive address.
Protocol	Jumper select: Standard, Alternate & Alternate Bus Switch.
Size	7 x 15 inch half-board.
Power requirements	5 volts @ 3 amps.
Product number	SCSI system includes: SCSI Controller, Half-Board Kit, 10' Direct-connect cable set, RETMA Rack-mount 5.25" chassis & slides, power supply (110-220 V, 50-60Hz), ST- 506 or ESDI disk & formatter module or SCSI disk, OS/32 driver, Installation and maintenance manual. 20MB 65ms access P/N 202720 40MB 40ms access P/N 202721 80MB 26ms access P/N 202722 182MB 16.5ms access P/N 202723 Other sizes available. Contact Macrolink for availability. OEM kit P/N 202776 includes: SCSI Controller, 10' Direct-connect cable set, OS/32 driver, Installation and maintenance manual. Select optional formatter module below. ST-506 Formatter Module P/N 202785 ESDI Formatter Module P/N 202790

MAKE	MODEL	AVG SEEK	CYL	HD	FMT MB	LBA LBA	CYL CYL
CDC	Wren IV	16.5	1365	9	268	1028FC	3309
Seagate	ST225	65	615	4	17		
Seagate	ST4026	40	615	4	17		
Seagate	ST4051	40	977	5	40	26290	488
Seagate	ST4096	28	1024	9	75.5		