4.7 NOVRAM Loading, Disk Formatting, and Testing

After physically installing the UD33, several steps are required to prepare the subsystem for operation. They are:

- Loading the drive configuration into the NOVRAM
- Formatting and verifying the media
- Testing the subsystem

The UD33 disk controller firmware incorporates a self-contained set of disk preparation and diagnostic utilities, called firmware-resident diagnostics (F.R.D.). (These diagnostics are also known as onboard diagnostics.) F.R.D. provides several important disk preparation functions, including the ability to configure the controller NOVRAM, format the drive, test the disk surface and replace defective blocks, and perform reliability testing of the attached disk subsystem. These utilities allow you to communicate directly with either CRT or hardcopy devices connected to a console port.

The basic application of F.R.D. is in preparing MSCP disk drives for use in your subsystem. Before data can be stored on a drive, the disk must be formatted and any bad blocks identified. F.R.D. provides options that allow you to perform these functions. You use NOVRAM configuration options to set and review your drive parameter values.

The steps involved in disk preparation are formatting the drive and then verifying that each logical block is good. F.R.D. supports both automatic and manual block replacement operations to allow for replacing defective and pattern-sensitive blocks.

Automatic replacement, or blanket bad block replacement, is a feature of several F.R.D. options. With this feature, you can format a drive, verify, and replace any bad blocks in one step. During this format/verify operation, bad blocks are displayed in logical block number (LBN) format. If replacement is enabled, the blocks are replaced automatically.

Manual bad block replacement is a separate option. This option allows you to identify specific bad blocks to be replaced. In addition, you can identify the blocks in Bytes From Index (BFI) format or in LBN format. Using BFI format eliminates the calculation required for LBN. This is most often useful in replacing blocks identified as bad in the manufacturer's defect list when that list no longer exists on the drive.

BFI replacement must be done before any LBN replacement. Once LBN replacement occurs, the BFI values are no longer valid.

There are several ways you can use F.R.D. options to format and verify your disk. The method you choose depends on whether you:

- have formatted this disk
- want to replace blocks using BFI or LBN information
- want to preserve data on this disk

Each method is described below. The options listed are on the F.R.D. main menu. Use them in the order they are listed. (F.R.D. options are described in section 4.8.)

If this is the initial format of a disk and you want to replace only those defects that F.R.D. finds with the four worst-case data patterns, use:

- Option 2, Format and Verify (with replacement enabled)

If this is the initial format of a disk and you want to replace manufacturer's detected defects from the hardcopy list, use:

- Option 1, Format
- Option 7, Replace Block (using BFI format)
- Option 3, Verify (with replacement enabled)

If this disk is formatted and you want to preserve data and obtain a list of bad blocks, use:

- Option 4, Read Only Test (with replacement disabled)

4.7.1 F.R.D. Conventions

F.R.D. uses the following keyboard conventions:

<CR>	required to terminate operator inputs
<Ctrl C>	aborts the current operation and returns to the main menu

A delay of 10 seconds may occur between the <Ctrl C> and the next display. During some verify operations, the delay may be considerably longer because the abort is delayed until the successful completion of the current command. In this case, a screen message informs you of the delay.

In this section, operator responses to F.R.D. prompts appear in **bold** print. The symbols used in this section are listed below with their meanings:

<CR>	carriage return key
<LF>	line feed key
<Ctrl C>	Ctrl key and the letter C pressed at the same time

4.7.2 Starting F.R.D. on a VAX

F.R.D. is started by issuing a special command sequence via console ODT. The sequence to use is illustrated by the following example; specific commands are contained in the tables noted in parentheses. The example pertains to a VAX 750 with UNIBUS Adapter (UBA) #0 and a UD33 base address of 772150 (octal) or 3F468 (hex).

1. Initialize the VAX by applying power to the system and entering the console I/O mode. To initialize the UNIBUS:

   >>>D/I 37 1<CR> (Table 4-7)

2. Enable the map registers for two pages (must be longword aligned):

   >>>D/L/P F30800 80000000<CR> (Table 4-8)
   >>>D/L/P F30804 80000001<CR>

3. Deposit the UD33 "backdoor enable" code in the SA register:

   >>>D/W/P FFF46A 3003<CR> (Tables 4-9, 4-10)

   The SA register is arrived at by the following:

   UBA Base Address + UD33 Base Address + 2 = UD33 SA Register
   FC0000 + 3F468 + 2 = FFF46A

4. Wait for 100 to appear in the SA Register:

   >>>E/W/P FFF46A 100

5. Deposit UD33 F.R.D. code in the SA register:

   >>>D/W/P FFF46A 44xx<CR> (Table 4-11)

   The value of xx is 01 for the VAX 750 UBA #0.

6. Wait for 400 to appear in the SA Register:

   >>>E/W/P FFF46A<CR> 400

   A value other than 400 may indicate one of the following vendor-unique errors:

SA Register	Type of Error
100111	Timeout
100121	Driver upload failure

7. Start the F.R.D.

    S 80<CR>

Table 4-7. VAX Initialization Command Sequences

VAX Model	Initialization Command(s)
VAX 730	I<CR>
VAX 750[1]	D/I 37 1<CR>
VAX 780,[1] 8600/8650[1]	UNJAM<CR>
VAX 8200[1]	20000000+720 20000[16]<CR>

1 Console mode I/O command " I " initializes only the CPU, not the UNIBUS, for some VAX systems.

2 The format of this sequence is Node Space Address + DWUBA Control and Status Register, followed by the Data in the UPI bit. See Table 4-8.

Table 4-8. VAX and UBA Memory Map Register Addresses

VAX Model	Address	Data	Bit Definition
730	F26800 F26804	80000000 80000001	Validity bit, PFN = 0 Validity bit, PFN = 1
750	F30800 F30804 F32800 F32804	80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at UBA #0 Validity bit, DDP, PFN = 1 at UBA #0 Validity bit, DDP, PFN = 0 at UBA #1 Validity bit, DDP, PFN = 1 at UBA #1
780 and 8600/8650 on SBIA #0	20006800 20006804 20008800 20008804 2000A800 2000A804 2000C800 2000C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3.
8600/8650 on SBIA #1	22006800 22006804 22008800 22008804 2200A800 2200A804 2200C800 2200C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3

(continued on next page)

NOTE

TR levels and UBAs listed for the VAX 780/8600/8650 are standard but may vary depending on your configuration.

Table 4-8. VAX and UBA Memory Map Register Addresses (continued)

VAX Model 8200

Data to be deposited in selected Node and Map Register:

Map Addr. Offset	Data	Bit Definition
800	80000000	Validity, DDP, PFN = 0
804	80000001	Validity, DDP, PFN = 1

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20000000	22000000	24000000	26000000
1	20002000	22002000	24002000	26002000
2	20004000	22004000	24004000	26004000
3	20006000	22006000	24006000	26006000
4	20008000	22008000	24008000	26008000
5	2000A000	2200A000	2400A000	2600A000
6	2000C000	2200C000	2400C000	2600C000
7	2000E000	2200E000	2400E000	2600E000
8	20010000	22010000	24010000	26010000
9	20012000	22012000	24012000	26012000
10	20014000	22014000	24014000	26014000
11	20016000	22016000	24016000	26016000
12	20018000	22018000	24018000	26018000
13	2001A000	2201A000	2401A000	2601A000
14	2001C000	2201C000	2401C000	2601C000
15	2001E000	2201E000	2401E000	2601E000

Table 4-9. VAX and UBA I/O Base Addresses

VAX Model 730 I/O Address
UBA Base Address

FC0000

VAX Model 750 I/O Address
UBA Base Address

FC0000	UBA	#0
F80000	UBA	#1

VAX Models 780 and 8600/8650 on SBIA #0 I/O Address
UBA Address

20100000	TR	#3	UBA	#0
20140000	TR	#4	UBA	#1
20180000	TR	#5	UBA	#2
201C0000	TR	#6	UBA	#3

VAX Models 8600/8650 I/O Address on SBIA #1
UBA Base Address

22100000	TR	#3	UBA	#0
22140000	TR	#4	UBA	#1
22180000	TR	#5	UBA	#2
221C0000	TR	#6	UBA	#3

VAX Model 8200 I/O Address Window Space Assignments
(Window space offset values are 0 through 3FFFF)

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20400000	22400000	24400000	26400000
1	20440000	22440000	24440000	26440000
2	20480000	22480000	24480000	26480000
3	204C0000	224C0000	244C0000	264C0000
4	20500000	22500000	24500000	26500000
5	20540000	22540000	24540000	26540000
6	20580000	22580000	24580000	26580000
7	205C0000	225C0000	245C0000	265C0000
8	20600000	22600000	24600000	26600000
9	20640000	22640000	24640000	26640000
10	20680000	22680000	24680000	26680000
11	206C0000	226C0000	246C0000	266C0000
12	20700000	22700000	24700000	26700000
13	20740000	22740000	24740000	26740000
14	20780000	22780000	24780000	26780000
15	207C0000	227C0000	247C0000	267C0000

Table 4-10. UD33 Base Address Offsets (IP Register)

Octal	Hex
772150	3F468
772154	3F46C
760334	3E0DC
760340	3E0E0
760344	3E0E4
760350	3E0E8
760354	3E0EC
760360	3E0F0

Table 4-11. Available F.R.D. Upload Codes

(44xx) xx value	VAX and UBA Number
01	730 and 750 UBA #0
02	750 UBA #1
03	780 UBA #0 and 8600/8650 UBA #0 on SBIA #0
04	780 UBA #1 and 8600/8650 UBA #1 on SBIA #0
05	780 UBA #2 and 8600/8650 UBA #2 on SBIA #0
06	780 UBA #3 and 8600/8650 UBA #3 on SBIA #0
07	8600/8650 UBA #0 on SBIA #1
08	8600/8650 UBA #1 on SBIA #1
09	8600/8650 UBA #2 on SBIA #1
0A	8600/8650 UBA #3 on SBIA #1
10	8200 Node #0 VAXBI Bus #0
11	8200 Node #1 VAXBI Bus #0
12	8200 Node #2 VAXBI Bus #0
13	8200 Node #3 VAXBI Bus #0
14	8200 Node #4 VAXBI Bus #0
15	8200 Node #5 VAXBI Bus #0
16	8200 Node #6 VAXBI Bus #0
17	8200 Node #7 VAXBI Bus #0
18	8200 Node #8 VAXBI Bus #0
19	8200 Node #9 VAXBI Bus #0
1A	8200 Node #10 VAXBI Bus #0
1B	8200 Node #11 VAXBI Bus #0
1C	8200 Node #12 VAXBI Bus #0
1D	8200 Node #13 VAXBI Bus #0
1E	8200 Node #14 VAXBI Bus #0
1F	8200 Node #15 VAXBI Bus #0

(continued on next page)

Table 4-11. Available F.R.D. Upload Codes (continued)

(44xx) xx value	VAX and UBA Number
20	8200 Node #0 VAXBI Bus #1
21	8200 Node #1 VAXBI Bus #1
22	8200 Node #2 VAXBI Bus #1
23	8200 Node #3 VAXBI Bus #1
24	8200 Node #4 VAXBI Bus #1
25	8200 Node #5 VAXBI Bus #1
26	8200 Node #6 VAXBI Bus #1
27	8200 Node #7 VAXBI Bus #1
28	8200 Node #8 VAXBI Bus #1
29	8200 Node #9 VAXBI Bus #1
2A	8200 Node #10 VAXBI Bus #1
2B	8200 Node #11 VAXBI Bus #1
2C	8200 Node #12 VAXBI Bus #1
2D	8200 Node #13 VAXBI Bus #1
2E	8200 Node #14 VAXBI Bus #1
2F	8200 Node #15 VAXBI Bus #1
30	8200 Node #0 VAXBI Bus #2
31	8200 Node #1 VAXBI Bus #2
32	8200 Node #2 VAXBI Bus #2
33	8200 Node #3 VAXBI Bus #2
34	8200 Node #4 VAXBI Bus #2
35	8200 Node #5 VAXBI Bus #2
36	8200 Node #6 VAXBI Bus #2
37	8200 Node #7 VAXBI Bus #2
38	8200 Node #8 VAXBI Bus #2
39	8200 Node #9 VAXBI Bus #2
3A	8200 Node #10 VAXBI Bus #2
3B	8200 Node #11 VAXBI Bus #2
3C	8200 Node #12 VAXBI Bus #2
3D	8200 Node #13 VAXBI Bus #2
3E	8200 Node #14 VAXBI Bus #2
3F	8200 Node #15 VAXBI Bus #2
40	8200 Node #0 VAXBI Bus #3
41	8200 Node #1 VAXBI Bus #3
42	8200 Node #2 VAXBI Bus #3
43	8200 Node #3 VAXBI Bus #3
44	8200 Node #4 VAXBI Bus #3
45	8200 Node #5 VAXBI Bus #3
46	8200 Node #6 VAXBI Bus #3
47	8200 Node #7 VAXBI Bus #3
48	8200 Node #8 VAXBI Bus #3
49	8200 Node #9 VAXBI Bus #3
4A	8200 Node #10 VAXBI Bus #3
4B	8200 Node #11 VAXBI Bus #3
4C	8200 Node #12 VAXBI Bus #3
4D	8200 Node #13 VAXBI Bus #3
4E	8200 Node #14 VAXBI Bus #3
4F	8200 Node #15 VAXBI Bus #3

4.7.3 Starting F.R.D. on a PDP-11 System

To start F.R.D. on a PDP-11 system, first halt the processor. Then enter the following commands in response to the ODT prompt (@):

```
@ 177xxxxx/ 000000 1 <LF>
@ 177yyyyy/  4400 30003 <CR>
@/000400 42000<CR>
@ 177yyyyy/ 2000 <CR>                    !TEST FOR 2000
@ 200G
```

NOTE: XXXXX and YYYYY are offsets dependent on the address of the UD33 controller. See Table 4-12 for the available values.

Table 4-12. PDP-11 Offsets

CONTROLLER BUS ADDRESS	XXXXX	YYYYY
772150	72150	72152
772154	72154	72156
760334	60334	60336
760340	60340	60342
760344	60344	60346
760350	60350	60352
760354	60354	60356
760360	60360	60362

When the appropriate start procedure is completed, F.R.D. identifies itself by displaying the controller type and firmware revision. Then, it displays the menu options. See subsection 4.8 for more information on F.R.D. options.

4.7.4 Terminating F.R.D.

To terminate F.R.D., choose one of the following:

- Press the BREAK key, or
- Reinitialize the system, or
- Halt the CPU.

You can restart the diagnostics from a halted condition if you have not changed the memory contents. On a PDP-11 system, enter 200G at the ODT prompt. On a VAX system, enter S 80.

4.8 F.R.D. Options

F.R.D. is an interactive, menu-driven utility. This section describes the function of each option on the F.R.D. main menu. The menu appears as follows:

Program Option Menu

1 - Self-test loop
2 - Format
3 - Verify
4 - Format and verify
5 - Data reliability test
6 - Format, verify, and data reliability test
7 - Read only test
8 - List known units
9 - Replace block
10 - Display Novram
11 - Edit / Load Novram

Enter option number:

The main menu and each submenu prompt for required input. When you enter a valid selection, the next menu displays or F.R.D. performs the selected option. If you make an invalid entry, F.R.D. rejects it, displays an error message, and reprompts.

Based on the nature of the MSCP emulation being performed, some operations may produce an observable delay when performed on previously unformatted drives. This delay is approximately 30 seconds.

When an option is finished, F.R.D. displays the prompt "Hit any key to continue" and waits for you to do so before returning to the main menu.

4.8.1 Option 1 - Self-test Loop

The Self-test Loop option detects intermittent hardware failures that have already passed through the first self-test. The LED indicators on the UD33 front panel will blink when a pass has compeleted. If an error occurs, the self-test loop option stops and reports an error; the LEDs on the front panel display the error code. A description of the error codes is displayed on the host console.

4.8.2 Option 2 - Format

The Format option is used to initially format a drive. The operation writes sector headers and initializes the drive's RCT tables. It is used to format a virgin drive, a drive that has been determined to contain unusable data, or a drive with a format that is improper to use with a particular controller.

After formatting, the drive contains a valid RCT with a serial number you specified.

4.8.3 Option 3 - Verify

The Verify option Write/Read exercises all user-available blocks. F.R.D. uses four worst-case data patterns to find and replace pattern-sensitive blocks. It asks for the logical unit number (LUN) of the drive to be verified. After you enter the LUN, F.R.D. prompts for the number of write/read passes.

Verify operations are performed on 120 logical blocks at a time. Logical blocks are referenced by logical block number (LBN).

During Verify operations, F.R.D. disables all controller error recovery capabilities so that a sector is replaced for any repeatable single bit error. Each data pattern is run until error-free for a single pass, ensuring that replacement blocks are also verified.

When a block is encountered that cannot be accessed because of header or data field errors, the Logical Block Number in error displays. Because the failing pattern may not be the first pattern, it is possible that replacement blocks may not be tested with all patterns. For this reason, Emulex recommends running at least two Verify passes over all 4 data patterns.

The Verify option has many features which allow you to enable full error description. When Error Description is enabled, it reports the type of error that occurs on the bad blocks. If a drive is producing an excessive number of bad blocks, this feature helps determine the kinds of errors responsible.

The Verify option also offers a bad block replacement feature which, when enabled, replaces any bad blocks using the appropriate technique.

4.8.4 Option 4 - Format and Verify

This option formats a drive, then tests the surface to replace pattern-sensitive and defective sectors. It performs both of the operations that are available separately with options 2 (Format) and 3 (Verify). This option also offers a bad block replacement feature which, when enabled, replaces any bad blocks found during the verify operation.

4.8.5 Option 5 - Data Reliability Test

This option allows you to thoroughly test your subsystem. The reliability test uses Write, Write/Check, and Read functions to test the controller-to-drive portion of the subsystem. In addition, an independent DMA operation between the host memory and the controller tests the host/controller interface.

The test defaults to two reserved diagnostic cylinders so that user data will be protected; a test of the full pack is your option. To run the reliability test indefinitely, select 0 (zero) passes.

If the test encounters errors, F.R.D. displays text error messages. These messages are for use by Emulex technical support personnel.

4.8.6 Option 6 - Format, Verify, and Data Reliability Test

This option combines options 2 (Format), 3 (Verify), and 5 (Data Reliability Test). This option automates the initialization and testing of drives, since you can select multiple drives and activate the data reliability test without having to wait for the format and verify options to complete. The format and verify portions of this option run in the order of the drives selected. Drives with hard faults are dropped and the sequence moves to the next drive in the list. The reliability portion of this option runs simultaneously on all selected drives.

4.8.7 Option 7 - Read Only Test

This option causes all the user-available blocks on the selected drive to be Read-only, not Write/Read, during the Verify pass. When a block is encountered that cannot be accessed because of header or data field errors, the utility displays the Logical Block Number.

The Read Only Test option also offers a bad block replacement feature, which, when enabled, replaces any bad blocks. Because F.R.D. runs with ECC disabled and does not cache any read data, no corrected data is available to put in the replacement block. This means that even though the defective block is replaced and no forced error flag is set in the replacement sector, the data is nonvalid.

CAUTION

This may cause problems if the replaced blocks contain executable program files. For this reason, you should back up sensitive data before running this option with the replacement feature enabled.

This option is usually used after the drive is formatted. However, if you plan to manually replace the bad blocks identified in the manufacturer's defect list, be certain to do so before using Option 7 with replace enabled.

4.8.8 Option 8 - List Known Units

This option causes the program to list all the drives that are configured in the NOVRAM. Only those units that can be selected by the controller are listed as available.

A user size (in 512-byte blocks) and a media type I.D. are listed with all drives found by this option. The user size does not include RCT area, diagnostic cylinders, designated or hidden spare tracks or blocks, etc.

In addition, this option displays the attached drive's physical geometry. This display includes all areas of the disk. If the device size in logical blocks is calculated from this data, the number will be larger than the displayed user size. The difference is the number of LBNs used for RCT, diagnostic cylinders, spares, etc.

4.8.9 Option 9 - Replace Block

This option allows you to replace a specific bad block or group of blocks without using the blanket replacement feature found in the Verify and Read Only options. You choose to identify either logical blocks (entered in decimal MSCP Logical Block Number format) or Bytes From Index (as listed in the manufacturer's defect list), then enter the block to be replaced.

BFI replacement eliminates the calculation required to translate BFI to LBN format. F.R.D. requires the cylinder, track, and bytes from index of the defect for each BFI entry. When you initiate replacement, F.R.D. prompts for the number of bytes per track. As soon as you enter this value, F.R.D. begins replacing blocks.

LBN replacement allows you to replace blocks identified as bad during the format operation, when they are identified in LBN format by older versions of DEC operating systems which do not support host-initiated replacement.

If you are using both types of replacement, BFI replacement must be complete before LBN replacement is begun. Further, BFI replacement must be complete before the blanket bad block replacement feature of other options is enabled.

Emulex recommends that you run the Verify option after the replacement option is complete. The Verify option runs test patterns that may detect any pattern-sensitive blocks.

4.8.10 Option 10 - Display NOVRAM

This option displays the current contents of the NOVRAM.

4.8.11 Option 11 - Edit/Load NOVRAM

This option allows you to enter the drive configuration parameters into the controller. F.R.D. prompts you for the required drive parameters. (NOVRAM parameters are described in section 3.9.)

4.9 Drive Configuration Parameters

When you edit or load NOVRAM configuration parameters, you are asked to enter the values required for your configuration. This section describes each parameter and states the range of valid entries for each. The required values for each drive supported by Emulex are listed in Appendix B.

You begin loading NOVRAM parameter values by selecting Option 11 from the F.R.D. main menu. F.R.D. then displays each parameter, one at a time. The parameter displays with a range of valid entries and a default value. Enter the appropriate value (in decimal) or simply press the return key to accept the default value (the last value entered). The next parameter then displays.

4.9.1 Adaptive DMA Threshold

This parameter specifies the number of words the UD33 will transfer before it looks for another device that wants to use the Q-Bus. The valid range is from 1 through 8; the recommended value for the MicroVAX 3500/3600 is 8.

You are prompted for this parameter when you select the edit/load NOVRAM option; this prompt does not appear for each drive that you are configuring.

4.9.2 Type Code

This parameter indicates the type of disk drive. The only valid value is 1.

4.9.3 Number of Units of this Type

This parameter specifies the quantity of attached physical disk drives that use the NOVRAM parameters that follow. Valid values are 1 to 4. If you enter 1, the utility uses a separate set of parameter values for each drive. In this case, it prompts for parameter values for the other drives. If you enter 2 or more, the same parameter values are used for that number of drives.

4.9.4 Number of Sectors per Track

This parameter specifies the total number of physical sectors per track, including spares. The valid range is from 1 through 255.

4.9.5 Number of Heads

This parameter specifies the number of data heads per physical drive. The valid range is from 1 through 63.

4.9.6 Number of Cylinders

This parameter specifies the total number of physical cylinders per drive, including spares. The valid range is from 1 through 4,095.

4.9.7 Number of Spare Sectors per Track

This parameter specifies the number of spare sectors reserved per track. This number plus the number of logical sectors per track equals the total number of physical sectors per track. The valid range is 0 or 1. If 0 is specified, no spare sectors are reserved. Emulex recommends a value of 1; larger values will unnecessarily reduce the capacity of the drive.

4.9.8 Number of Alternate Cylinders

This parameter specifies the number of spare cylinders per physical drive. The valid range is from 0 through 15. At least one cylinder must be specified as an alternate. (If spare sectors are specified, the sector replacement algorithm needs one track for working space.)

If Split Code 1 is used, you must specify twice the normal number of alternate cylinders because they are divided evenly between the two logical drives. A minimum of 2 alternate cylinders must be specified if block replacement is to function with a cylinder split.

4.9.9 Configuration Bits, High Limit and Low Limit

These parameters define additional configuration characteristics of the drive, including Rotational Position Sensing which is determined by the values you select for High Limit and Low Limit.

If your subsystem includes a drive that Emulex supports, refer to Appendix B, Table B-1, for the decimal values to enter for these parameters. If your drive is not supported by Emulex, refer to the drive manufacturer's manual for drive requirements, then enter the appropriate values as discussed subsequently.

Configuration Bits:

Bit 0: This bit specifies whether or not the drive negates the On Cylinder signal during a head select operation. The valid range for this bit is 0 or 1. If this bit is 0, the On Cylinder signal remains on during a head select. If this bit is 1, the On Cylinder signal is negated during a head select.

Bit 1: This bit specifies whether or not the drive can perform early or late data strobe operations. The valid range for this bit is 0 or 1. If this bit is 0, the drive cannot perform early or late data strobe operations. If this bit is 1, the drive is capable of performing early or late data strobe operations.

Bit 2: This bit specifies whether or not the drive is capable of head offset operations. The valid range for this bit is 0 or 1. If this bit is 0, the drive cannot perform head offset operations. If this bit is 1, the drive is capable of performing head offset operations.

Rotational Position Sensing:

Rotational Position Sensing increases the performance of the disk subsystem during data transfer when two drives are active. RPS allows the controller to determine which drive is rotationally closest to any of the data transfers in the controller command buffer. By matching a data transfer with the drive rotationally closest to that command, the rotational latency is reduced, therefore increasing throughput of the subsystem.

The High and Low Limit parameters on the menu, when defined, determine where the drive will perform RPS. Recommended values are given in the Drive Configuration Parameter Value Table in Appendix B. If you need to calculate the decimal value for each drive, a minimum value of 0 and a maximum value of 15 is obtainable. These values correspond directly to the number of sectors ahead on the disk that make up the RPS window.

If RPS is enabled, the controller looks at the drive's current sector number after an initial seek has been completed for that drive, and calculates how far away the target sector is. If this value falls within the range specified in the RPS High and Low Limits, the read/write operation begins immediately on that drive. If the sector is not found in the RPS window, the next drive that is executing a seek undergoes the same process.

The recommended lower RPS limit ensures adequate time for proper controller response. Lowering this value will decrease performance by causing extra disk revolutions, since the disk is still spinning between the time the seek is issued and the time it is begun. The optimal high limit for RPS depends heavily on system factors, such as drive types and operating system usage. Though the recommended value is the optimal one for most applications, it is possible that small adjustments could increase system performance.

For example, if you have a two-drive system with a 2.4M Byte/sec drive (let us call this Drive 0) and a 1.2M Byte/sec drive (Drive 1), you would expect to see about twice as many I/O operations completed on Drive 0 as on Drive 1. By setting the Drive 0 RPS value to a low upper limit, and by setting the Drive 1 RPS value to a high upper limit, the number of completed I/O operations will even out significantly. On a heavily loaded system, this will result in more efficient overall subsystem performance.

If only one drive is used with the UD33, RPS should be disabled. You should also disable RPS if you are unfamiliar with the geometry of each of your drives. To disable RPS, simply place a zero in the RPS High and Low Limit parameters.

NOTE

Index and Sector signals must be on the B cable for RPS to function. See subsection 3.3.3.3.

4.9.10 Dual Port Options

If your firmware (Revision H and above) and system configuration support dual porting with MSCP controllers, the dynamic dual port mode, static dual port mode, and single port mode (the default) are displayed. The dual port applications are described in the following subsections.

4.9.10.1 Single Port Mode (config type 0)

This is the default setting; multiple port access is not supported under any condition. Single port mode should be selected on drives that do not support dual port or drives that do not require multiple-access paths.

4.9.10.2 Dynamic Dual Port Mode (config type 1)

This is used for systems that must share the drive between two different controllers. The drive is available to both controllers and will seize and release the port for each drive command. The only limitation is that of read/write access from two different systems. Only **one** system may have read/write abilities, the other **must** be mounted read only (nowrite), unless you provide special software to overcome these limitations.

4.9.10.3 Static Dual Port Mode (config type 3)

The static dual port option is typically used for Local Area Vax Cluster (LAVC) systems that require failover protection. This mode allows a controller to seize one port when the drive is mounted and lock out the other port (until the drive is dismounted). The drive appears offline to the controller that has not reserved the port, forcing all drive accesses through a single controller. The MSCP server then decides to use either a local access path or Ethernet for communication. Should failover occur in a LAVC system that has reserved the drive, the port is released and made available to the other controller. The VMS software is then able to select the drive and mount it.

4.9.10.3.1 Failover Requirements

If no commands are processed within 500 ms in systems that require failover, the controller releases the drive. To properly support failover, the drive must have reserve timer ENABLED.

In LAVC systems failover operations are fully software dependent, and many versions of VMS show problems with failover. Contact Digital Software Support to confirm the correct VMS version that supports this function.

4.9.10.4 Firmware Resident Diagnostics (F.R.D.) Support

The drive format, surface verification, and manual block replacements must be performed while either the controller is idle on the other port or the drive has only one port enabled. To ensure that dual porting is functioning, the Data Reliability portion of F.R.D. supports multiple Emulex controllers on the shared disk and allows multiple read/write accesses to test the drive.

4.9.10.5 Logical Drive Splits

Since the drive's port is controlled by physical addressing, Emulex cannot support logical splitting of any dual-ported drive.

4.9.11 Split Code

This parameter allows the drive(s) defined by this parameter block to be split into two logical disk units (two each, if more than one drive is defined by this block). The split codes are:

Code 0: No split.

Code 1: The cylinders are divided between the two logical drives. A starting cylinder offset value specifies the first cylinder of the second logical drive.

Code 2: The drive's data heads are divided between the two logical drives. A starting head offset value specifies the first head of the second logical drive. If you select a head split code on a drive with both fixed and removable media, the removable media may be configured as logical unit number (LUN) 0 and the fixed media as LUN 1.

Code 3: Identical to Code 2 except the logical assignments for the physical drives are reversed. Reverse head split codes also divide the drive by data heads, but assign the lower numbered heads to drive 2 and the higher numbered heads to drive 1.

Use of the split option disables seek-ordering and overlapped seek processing in the MSCP Controller, which reduces performance, particularly when both logicals of a split physical drive are active.

4.9.12 Starting Head Offset

This parameter specifies the physical drive head that is to be used as the first head of the second logical drive. This field has meaning only if a Split Code 2 or 3 is specified. The valid range is from 0 through 31. If a Split Code 0 or 1 is selected, this value must be 0.

4.9.13 Cylinder Offset

This parameter specifies the physical cylinder that is to be used as the first cylinder of the second logical drive. This field has meaning only if a Split Code 1 is specified. If a Split Code 0, 2, or 3 is selected, this parameter must be 0.

4.9.14 Removable Media

This parameter indicates whether the disk media is fixed or removable. If you are defining one physical/logical drive, this parameter uses a 1-bit field with valid values of 0 and 1, where 0 indicates fixed media and 1 indicates removable media.

If you are defining a drive with a logical split, this parameter uses a 2-bit field with a valid range from 0 through 3:

Definition	Decimal Value
LUN 0 and LUN 1 are both fixed.	0
LUN 0 is removable, LUN 1 is fixed.	1
LUN 0 is fixed, LUN 1 is removable.	2
LUN 0 and LUN 1 are both removable.	3

4.9.15 Gap 0, 1, and 2 Parameters

These parameters specify the recording format for each sector on the drive. The recording format allows gaps, as ,for example, between header and data fields. These gaps are based on a formula intended to allow the drive time for read/write transitions while maximizing data capacity.

The values Emulex recommends for qualified drives are contained in Appendix B, Disk Drive Configuration Parameters. These values are factory parameters and are to be used with Emulex qualified drives. If any of these factory parameters are altered, the UD33 may not support the disk drive.

4.9.16 Spiral Offset

This parameter specifies the number of sectors by which sector 0 of a track is offset from sector 0 of the previous track. Offsetting sector 0 from one track to the next is a technique that is used to reduce latency when performing write or read operations that cross a track boundary. When the drive is formatted, sector 0 of a track is offset a certain number of sectors from the position of sector 0 on the previous track. When this is done, spiral write and read operations are more efficient because the drive has time to seek from track to track before encountering sector 0.

The valid range is from 0 through 31.

4.10 Operation

There are no operational instructions. The UD33 is ready for MSCP initialization as soon as its drives are formatted and tested.

4.10.1 Indicators

There are three light emitting diodes (LEDs) on the UD33 PWB. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the UD33 executes a preliminary test at the following times:

- On power-up
- After a reset condition
- After a bus initialization
- After a write operation to the Initialization and Polling (IP) register (base address)

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 8031 microprocessor chip and the Disk Formatter chip. When the UD33 successfully completes the preliminary test, LED3 illuminates indicating that the UD33 is waiting for the MSCP initialization sequence.

During the MSCP initialization sequence, initiated by host software control, the UD33 executes a self-test that exercises the buffer controller chip, the Host Adapter Controller (HAC) chip and its associated circuitry, the onboard RAM, and the control memory PROM. If the UD33 passes this sequence of its self-test successfully, all the LED indicators on the edge of the UD33 are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the edge-mounted LED indicators are ON (illuminated). If the UD33 fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW2-8 ON) which causes the LED indicators to display an error code. See Self-Test Error Reporting, in Section 5, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate UNIBUS activity and SMD disk drive activity, respectively.

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FUJITSU 2333

Emulex Controller(s)	QD32/33/34/35 UD33
Unformatted Capacity	337.1 MB
Sectoring	69 SECTORS - HARD
Transfer Rate	19.6 MHZ
Approximate LBN's	548,194
Confirmed Date	YES - 1 JUL 87

NOVRAM PARAMETERS

Number of Units	1
Type Code	1
Head Offset	0
Physical Sectors per Track	68
Number of Heads	10
Number of Physical Cylinders	823
Spare Sectors per Track	1
Spare Cylinders	2
Hd Sel Negates on Cyl [QD35]	NO
Lower Limit RPS	3
Upper Limit RPS	8
Configuration Bits	6
Dual Port Option (0,1,3)	Note[1]
Split Code	0
Removable Media Flag	0
Gap 0 Parameter	259
Gap 1 Parameter	4112
Gap 2 Parameter	780
Cylinder Offset	0
Spiral Offset	1

Note[1] 0 = Single Port / 1 = Dynamic Dual Port / 3 = Static Dual Port

NOTES:

SW1...8 = OFF
SW2...4,6 = ON
SW3...2 = ON

FUJITSU 2351

Emulex Controller(s)	QD32/33/34/35 UD33
Unformatted Capacity	474.2 MB
Sectoring	48 SECTORS - HARD
Transfer Rate	14.87 MHZ
Approximate LBN's	787,156
Confirmed Date	YES - 1 JUL 86

NOVRAM PARAMETERS

Number of Units	1
Type Code	1
Head Offset	0
Physical Sectors per Track	48
Number of Heads	20
Number of Physical Cylinders	842
Spare Sectors per Track	1
Spare Cylinders	2
Hd Sel Negates on Cyl [QD35]	NO
Lower Limit RPS	3
Upper Limit RPS	7
Configuration Bits	6
Dual Port Option (0,1,3)	Note[1]
Split Code	0
Removable Media Flag	0
Gap 0 Parameter	259
Gap 1 Parameter	4112
Gap 2 Parameter	780
Cylinder Offset	0
Spiral Offset	0

Note[1] 0 = Single Port / 1 = Dynamic Dual Port / 3 = Static Dual Port

NOTES:

BC7...3-4,5-6,10-11,12-13 = IN
BD7...3-4,6-7,9-10,13-14 = IN
BE7...3-4,5-6,10-11,13-14 = IN
BF7...3-4,6-7,10-11 = IN 13,14 ✓
AE7...3-4,6-7,9-10 = IN

VNSS KK03