

DAS-208SA Disk Array

User Guide

For Serial-ATA to Ultra320 RAID Subsystem

v. 1.01b



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The revision date for this guide is **Apr. 30, 2004**

Version **1.0**

FCC Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates and can radiate radio frequency energy and, if not installed and used according to the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which is found 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:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and device
- Connect the equipment to an outlet other than the receiver
- Consult a dealer or an experienced radio/TV technician for assistance

CE Mark Warning

This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Chapter 1 General Information

This chapter provides general information of the DAS-208SA Disk Array.

The following topics are covered in this chapter:

Introduction

Key Features & Benefits

Unpacking Your DAS-208SA Disk Array

Components of DAS-208SA Disk Array

1.1 Introduction

The DAS-208SA is a Serial ATA to Ultra320 SCSI RAID (Redundant Array of Independent Disks) Disk Array. By implementing sophisticated RAID technology and unique cache algorithm, this disk array provides the best protection for the data stored on the array.

And thanks to today's powerful disk technology, one RAID system can now provide the capacity more than 1TB in a large cabinet. This offers a wealth of significant advantages that would be attractive to almost any serious PC users. Equipped with eight half-height 3.5" disk drives in hot-swappable canisters, the DAS-208SA Disk Array provides mass data capacity and easy installation for the individual customers. In addition, this RAID system has dual host channels and high availability software that ensures 24 hours a day, seven days a week of nonstop service capability.

Throughout this manual, the **DAS-208SA Disk Array** may be referred to as **DAS-208SA**, or simply as **Disk Array**.

1.2 Key Features and Benefits

- ◆ Advanced LCD display panel
- ◆ Four easy-to-use push buttons on front panel (**(up)**, **(down)** ,, **ENTER, ESC**)
- ◆ Selectable multiple RAID levels (Level 0,1, 3,5,10, 30, 50, JBOD)
- ◆ 2 Ultra 320 SCSI channels
- ◆ 8 driver bays 3.5" disk drive
- ◆ Intel 80321 IO processor
- ◆ Up to 1GB cache memory
- ◆ 2U compact tower design for more capacity
- ◆ Cable-less design for better reliability
- ◆ Swappable design for faster and easier maintenance
- ◆ Multiple alter design for easier management

1.3 Unpacking Your DAS-208SA

Before removing your DAS-208SA from the shipping carton, you should virtually inspect the physical condition of the container. The package of DAS-208SA should appear in good condition when you first received it. If any damaged found, do not remove the components. Contact the place of purchase for further instructions.

If the shipping container appears to be in good condition, unpack it and verify that the DAS-208SA and accessories are all there and in good condition.

Your DAS-208SA package should contain the following items:

Items	Quantity
DAS-208SA unit	1
Drive Canister	8
Ultra320 SCSI Cable	1
Power Cord	2
RS-232 Cable	1
User Manual CD	1
Spare screws	40

If any item is missing or damaged, please contact the place of purchase for assistance. Retain the shipping container and packing material for reuse.



Before you begin to use your DAS-208SA, read section 1.4

Note

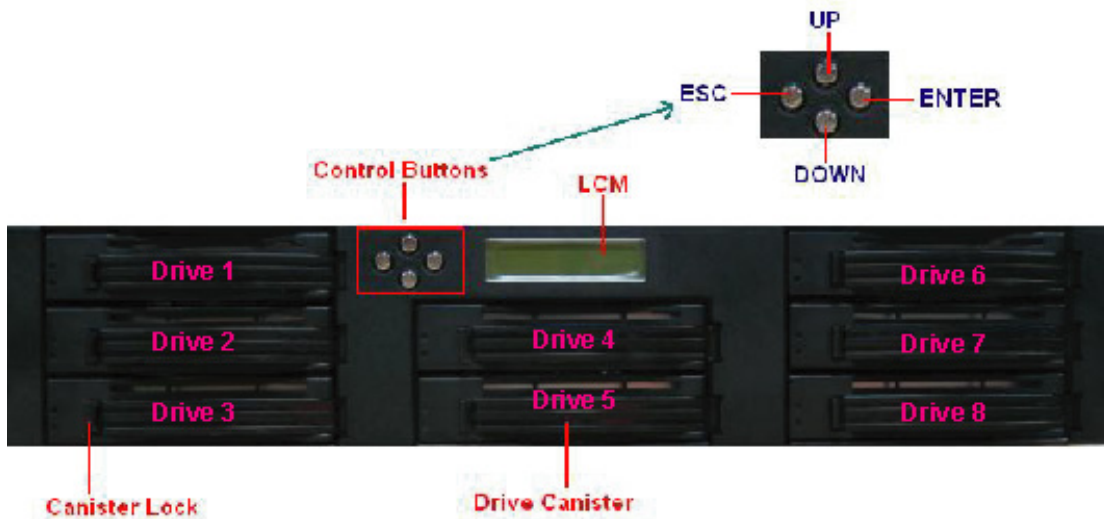
Components of the DAS-208SA to learn more about the major components or your RAID Disk Array.

1.4 Components of the DAS-208SA

This section describes the major components of the DAS-208SA, including its front panel, LED display panel and rear panel. Read this section before you start to use your RAID Disk Array Subsystem.

1.4.1 The Front Panel

Please refer to Figure 1-1 for the front panel of DAS-208SA Disk Array in the following page.



1.4.2 LCD Display Panel and Control Buttons

The control panel of the DAS-208SA consists of a LCD display panel and 4 control buttons. This is where you will check the configuration and status of the disk array. Figure 1-2 shows the general information, such as RAID status, thermograph, and fan temperature of the Disk Array. Meanwhile, control buttons allow you to use **Up** (▲) and **Down** (▼) arrow keys to go through the information on the LCM display screen. The **ENTER** button is used to enter the option you have selected and the **ESC** button can take you back to the previous menu. Please refer to Table 1-1 for detailed information of each status.

For the status of each hard disk in Disk Array, please refer to Table 1-2.

Meanwhile, for fans and power error messages, alarm and indicators shown on the LCD, please refer Table 1-3.

Table 1-1

Items	Status Description
DAS-208SA Disk Array	Indicates the model name of the product
Installed Memory 128 Mbytes	Indicates the capacity of the memory
CPU Type: 80321 4 Ultra320	Indicates the CPU model and interface
Firmware Version v. 1.0	Indicates the version of the firmware
Serial Number: xxxxxxxxxxxxxx	Indicates the serial number of the RAID controller
FAN1 RPM*	Indicates the speed of Fan 1
FAN2 RPM*	Indicates the speed of Fan 2
Temp 1	Indicates the temperature of the upper part of the backplane.
Temp 2	Indicates the temperature of the central part of the backplane.
Temp 3	Indicates the temperature of the bottom part of the backplane.
ZzZZzZZz	Indicates the random display when parity checking
z	A single “z” appearing at the right end of the LCD panel (eg. 11112222z) indicates that memory is not enough during read & write.

*** Please note that RPM under 2200 will be considered fan failure; replace the fan immediately for better performance.**

Table 1-2

Hard Disk Status	Letter shown on LCD
JBOD	J
Disk Offline	X
Disk Rebuilding	A
Disk Removed	R
Spare Disk	S
Disk Initializing	I
RAID Set 1	1
RAID Set 2	2
RAID Set 3	3
RAID Set 4	4
Too many bad sector	W

Table 1-3

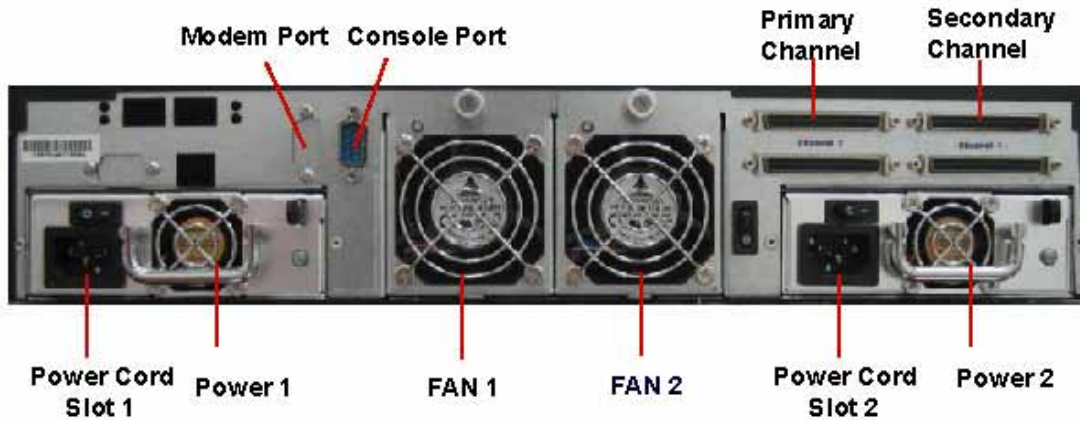
Item	Error messages shown on LCD
LCD show Fan module#1 fail	"Fan1 Failed"
LCD show Fan module#2 fail	"Fan2 Failed"
LCD show power module#1 fail	"PW1 Malfunction"
LCD show power module#2 fail	"PW2 Malfunction"

Table 1-4

Function	FAN status	
	FAN 1	FAN 2
Condition		
Temperature Sensor at <u>30</u>	5000 rpm	5000 rpm
Temperature Sensor at <u>31- 35</u>	5600 rpm	5600 rpm
Temperature Sensor at <u>36- 40</u>	6200 rpm	6200 rpm
Temperature Sensor over <u>40</u>	Full Speed(6800)	Full Speed(6800)
FAN 1 failed	x	Full Speed(6800)
FAN 2 failed	Full Speed(6800)	x
Any power module failed	Full Speed(6800)	Full Speed(6800)

1.4.3 The Rear Panel

The rear panel of DAS-208SA is shown below.



Refer to Table 1-4 for detailed description of each part on the rear panel of DAS-208SA.

Table 1-4

Part	Description
Modem port	This is where you can connect your disk array to a modem.
Console port	This is a RS-232 serial port, allowing you to connect to a terminal or a PC. You may configure this disk array, and upgrade the firmware and RAID.
Primary and Secondary Channels	DAS-208SA has two host channels—primary and secondary—to allow you to connect to SCSI devices.
Fan	There are 2 fans located at the rear of the system unit. They are designed to provide good airflow and heat dissipation.
Power	The disk array comes with 2 hot-swappable power

	supplies located at the rear of the subsystem. If two of the power supplies are in use and one fails to function, an audible alarm will warn you of the power failure.
Power Cord Slot	These are where you connect power cords to power socket.

Chapter 2 Hardware Installation

This chapter discusses the basic operational installation and the Disk Drive installation.

The following topics are covered in this chapter:

- ◆ Preparing for the Installation
- ◆ Disk Drive Installation
- ◆ Table and Shelf Installation
- ◆ Rack-Mount Installation
- ◆ Tower Conversion kit Installation

2.1 Preparing for the Installation

If you will be connecting your DAS-208SA Disk Array to the computer using a SCSI adapter, installed the adapter(s) in an available slot in the computer prior to beginning the DAS-208SA installation. See your operating system manuals for the configuration procedures for the host bus adapter.

2.1.2 Terminating Disk Drive Channels

All SCSI buses must be terminated at each end. Termination absorbs electrical signals and prevents those signals from bouncing back along the bus and causing interference.

The SCSI drive channels of the DAS-208SA have been terminated inside the chassis on the back plane. **There is no need to terminate the disk drives!**

2.1.3 Connecting the DAS-208SA

DAS-208SA can be connected to the host computer via 2 Ultra320 SCSI ports.

2.1.4 Host Bus SCSI ID Assignment

You may assign any SCSI ID to the host channel. The range of SCSI IDs on a Wide SCSI bus starts from 0 to 15. You can use the LCD panel or a terminal to set the host channel ID. (Refer to *Section 3.1 Configuration Methods* for more information.) Be sure to assign an ID that does not conflict with any other devices on the host bus as well as the host adapter.

2.1.5 Host Bus Termination

The disk array is shipped with host channel buses terminated. If the disk array is not the last device on the host bus, you must turn off termination from the LCD panel or a terminal.

2.1.6 Back Plane

The back plane of the DAS-208SA is specifically designed to furnish the stability of voltage and provide the reliability for disk array.

2.1.7 Connecting the Power Cord

Before you connect the power cords to the power supplies, make sure the power supplies have been firmly seated inside the DAS-208SA Disk Array.

2.1.8 Uninterruptible Power Supplies

To insure the integrity of the data stored on a RAID array, we strongly recommend connecting the DAS-208SA Disk Array to an external UPS.

2.2 Disk Drive Installation

Any 3.5" Serial-ATA hard disk, half-height 1" (2.54cm) SCA connector can be installed into the canister of DAS-208SA.

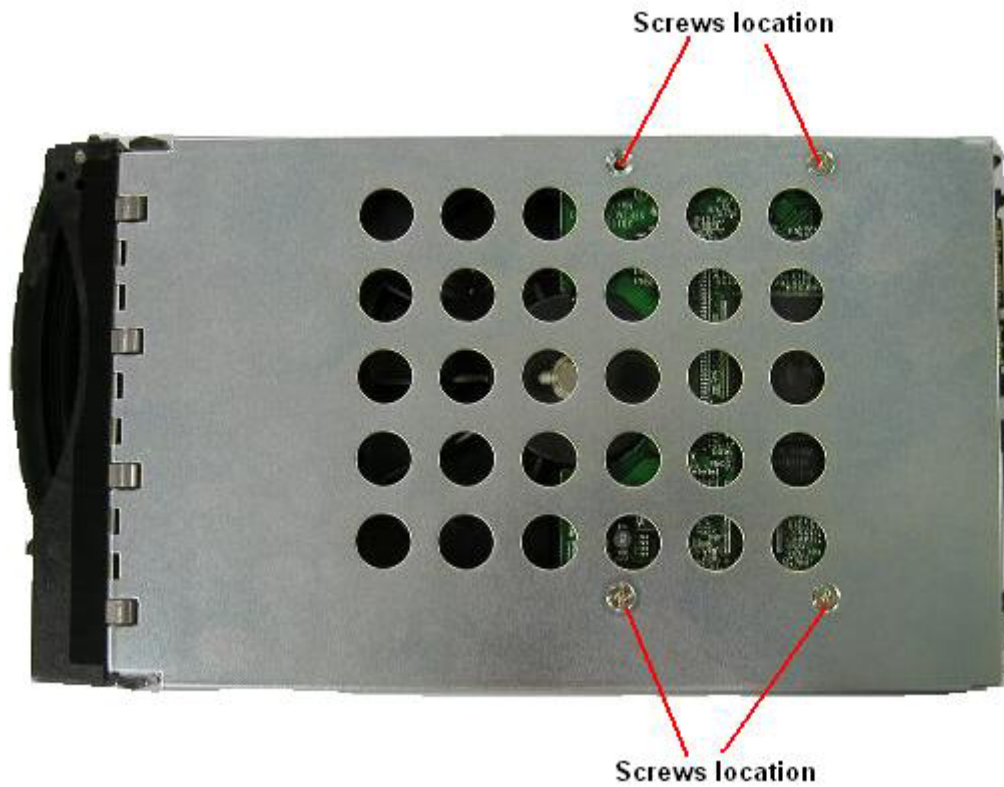
Figure 2-1 shows the disk drive and canister of DAS-208SA Disk Array.

Figure 2-1 Disk Drive and Canister



Second, use four screws to fasten the drive to the drive canister. **Please note that you fasten the drive at the right location.** (See Figure 2-2)

Figure 2-2



DAS-208SA Disk Array provides eight slots that enable you to utilize eight disk drives. Insert each slot to the drive canister of Disk Array; system will automatically check all available disks.

Chapter 3 Configuration

FASTORA DAS-208SA can be configured via its LCD panel or via a terminal.

This chapter will discuss the configuration methods and the detailed information about the operation modes.

This chapter covers the following topics:

- ◆ **Configuring Through the LCD Display Panel**
- ◆ **Configuring Through a Terminal**
- ◆ **Operation Modes**
- ◆ **Main Menu**

3.1 Configuring Through the LCD Display Panel

The LCD Panel consists of a two lines 16-character LCD display, two LED indicators, four push buttons, and a reset button, allowing users to configure and monitor the operation of the disk array. A menu of configuration options will appear on the display. By using the () **Up** arrow, () **Down** arrow, **ESC**, and **ENTER** buttons, users can traverse various menu levels and configure his desired parameters.

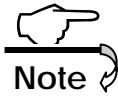
The function of the buttons is described as follows:

() **Up Arrow** To scroll upward through the menu items;

() **Down Arrow** To scroll downward through the menu items;

Enter To select a menu item, open a sub-menu, and select a value

ESC To exit a sub-menu and returns to the previous menu.



If you wish to start with the LCD display panel as quickly as possible, refer to **Chapter 4.1.1 Quick Setup via LCD Display Panel** to configure the disk array.

3.2 Configuring Through a Terminal

The LCD control panel allows the exploration of all configurable features of the disk array. However, the frame of the LCD panel only allows a few messages of output. In this case, a very limited amount of information can be displayed at a given time on the LCD display panel.

In fact, using a terminal to configure your disk array will be exactly the same as using the LCD display to do the configuration. Unlike the LCD display that can only show 2 lines of the configuration information, a terminal, connected via a modem or direct serial interface, displays all information pertinent to a particular function on a larger terminal screen. In addition, the help information, which is impractical to be shown on the LCD panel, is also available on the terminal.

3.2.1 Connecting a Terminal

Located at the rear of the disk array, a RS-232 connector, marked as **Console**, can be used to support the local terminal access. When connecting a terminal to the disk array, make sure you have attached the supplied RS-232 cable to the right Console connector. Note that you should set up the communication parameters before using this terminal. To start up:

1. Plug one end of the supplied RS-232 cable to the port marked as Console at the rear of the disk array.
2. Connect one end of the RS-232 cable to the COM port of your terminal or PC.
3. Run an equivalent program of the terminal.
4. Change the setting of the terminal to match the default settings of the

FASTORADAS-208SA, namely:

- ◆ Baud rate: 115,200
- ◆ Data bit: 8
- ◆ Stop bit: 1
- ◆ Parity: None
- ◆ Flow Control: None

You shall see a pop-up screen indicating that the connection has been setup successfully. Then, you may configure the disk array with your terminal. Refer to section *3.2.3 Control Key Definition under ANSI Terminal* to learn the control keys for terminal emulation.

Please note that if you wish to start to configure with your terminal as quickly as possible, you may refer to Section 4.1.2 Quick setup via Terminal Configuration.

3.2.2 Using PC for Terminal Emulation

If you do not have a dedicated terminal, you can still use a PC configured as a terminal, running a terminal emulation program. Microsoft Windows and Windows 95 both have built-in terminal emulation support. Please select ANSI terminal as the terminal type for the terminal emulation. You can also use other terminal emulation programs such as KERMIT or VTERM. If you cannot see anything on the screen after the session has been established, press TAB key followed by Ctrl-D key combination to refresh the screen.

Follow the same steps discussed in section 3.2.1 Connecting a Terminal to connect your PC to the disk array.

3.2.3 Control Key Definition under ANSI Terminal

Using ANSI terminal display, the following keys are supported:

A - used to scroll upward through the menu items

Z - used to scroll downward through the menu items

ENTER - used to select a menu item, open a sub-menu, and select a value

ESC - used to exit a sub-menu and return to the previous menu

TAB - used to switch between windows

The rest of the alphanumeric keys are also supported for password input and when prompted for **Yes** or **No** input.

3.3 Operation Modes

DAS-208SA Disk Array has three operation modes: Self-Diagnostic Mode, Operation Mode, and Configuration Mode. We will discuss each of the RAID disk array operation mode in the following sections.

3.3.1 Self Diagnostic Mode

To ensure flawless operation, the disk array has a built-in self-diagnostic utility. Self-diagnostics will be performed automatically upon power up of the disk array or right after you restart the unit. In this mode of operation, all components will be tested. If any problem occurred, it will report to the user.

The Self-Diagnostic mode runs three major diagnostics. The first diagnostic tests the CPU and supporting the core logic chips, internal bus, memory, SCSI controllers, and RS-232 controllers. The second diagnostic tests the presence of disks on each individual disk channel. It also checks the functionality of the disks found. The last diagnostic tests RAID functionality.

3.3.2 Operation Mode

Operation mode continuously reports the operating status of the disk array and the drives connected to it. During normal operation, the LCD display will continuously show the status of all the major components. Note that the last character on the second line of the LCD panel with a tiny square moving up and down, to indicate that the DAS-208SA Disk Array is in operation.

3.3.3 Configuration Mode

Configuration mode is used to modify the settings of disk array. Users can configure the DAS-208SA either through the LCD panel or via a terminal. Note that you are entering the configuration mode whenever you are pressing the **SEL** button during the Operation Mode. If you wish to enter to the configuration mode from a terminal, simply use the “TAB” key to take you to your desired mode.

1. You cannot enter the configuration Mode from LCD panel and Terminal at the same time.
2. You will be prompted to enter your password if the password-checking feature is enabled. Provide the correct password to continue your configuration.

Unless the disk array is running the self-diagnose mode, you may select any of the configuration modes at any time. The configuration mode of DAS-208SA is completely menu-driven for the ease of use. And the menu options allow you to fine-tune disk array to your specific configuration.

3.4 Main Menu

The main menu under Configuration mode consists of the following menus: **Quick Setup, RAID Parameters, SCSI Parameters, RS-232 Parameters, System Parameters, NVRAM, and RAID Functions.** We will navigate the main tree in this section. Figure 3-1 shows the main menu screen when configuring through a terminal.

Figure 3-1

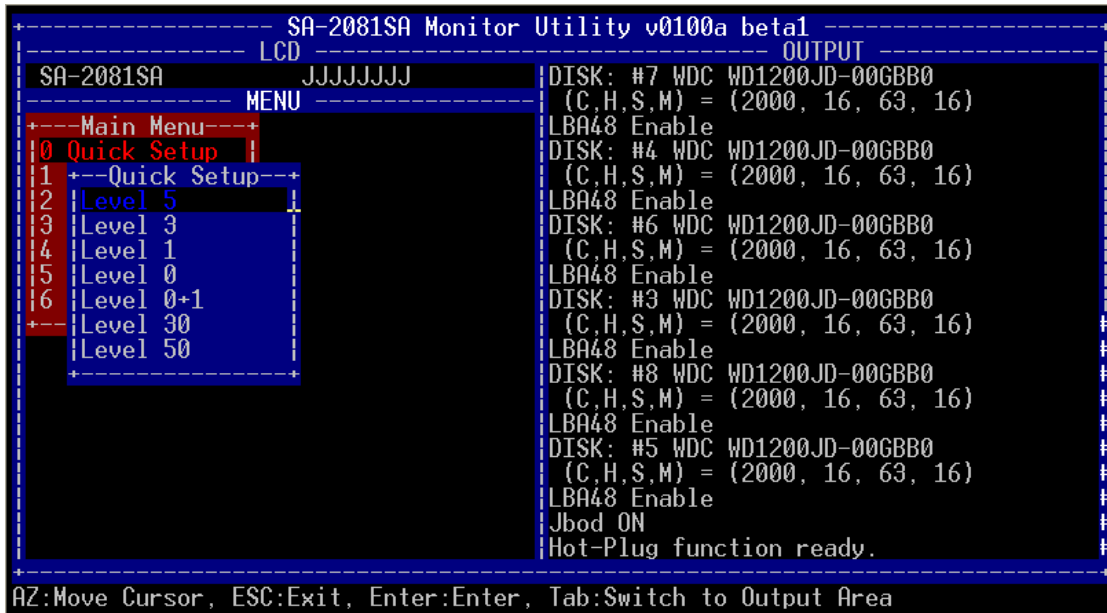
```

SA-2081SA Monitor Utility v0100a beta1
----- LCD -----
SA-2081SA      JJJJJJJJ      DISK: #7 WDC WD1200JD-00GBB0
----- MENU -----      (C,H,S,M) = (2000, 16, 63, 16)
+--- Main Menu ---+      LBA48 Enable
|0 Quick Setup|      DISK: #4 WDC WD1200JD-00GBB0
|1 RAID Params|      (C,H,S,M) = (2000, 16, 63, 16)
|2 SCSI Params|      LBA48 Enable
|3 RS232 Params|      DISK: #6 WDC WD1200JD-00GBB0
|4 System Params|      (C,H,S,M) = (2000, 16, 63, 16)
|5 NVRAM|      LBA48 Enable
|6 RAID Funcs|      DISK: #3 WDC WD1200JD-00GBB0
+-----+      (C,H,S,M) = (2000, 16, 63, 16)
|      |      LBA48 Enable
|      |      DISK: #8 WDC WD1200JD-00GBB0
|      |      (C,H,S,M) = (2000, 16, 63, 16)
|      |      LBA48 Enable
|      |      DISK: #5 WDC WD1200JD-00GBB0
|      |      (C,H,S,M) = (2000, 16, 63, 16)
|      |      LBA48 Enable
|      |      Jbod ON
|      |      Hot-Plug function ready.
+-----+
AZ:Move Cursor, ESC:Exit, Enter:Enter, Tab:Switch to Output Area
  
```

3.4.1 Quick Setup

Quick Setup allows users to quickly setup the RAID level and choose the desired drives. The DAS-208SA provides the following RAID levels: 5, 3, 1, 0, 0+1, 30 and 50.

Figure 3-2

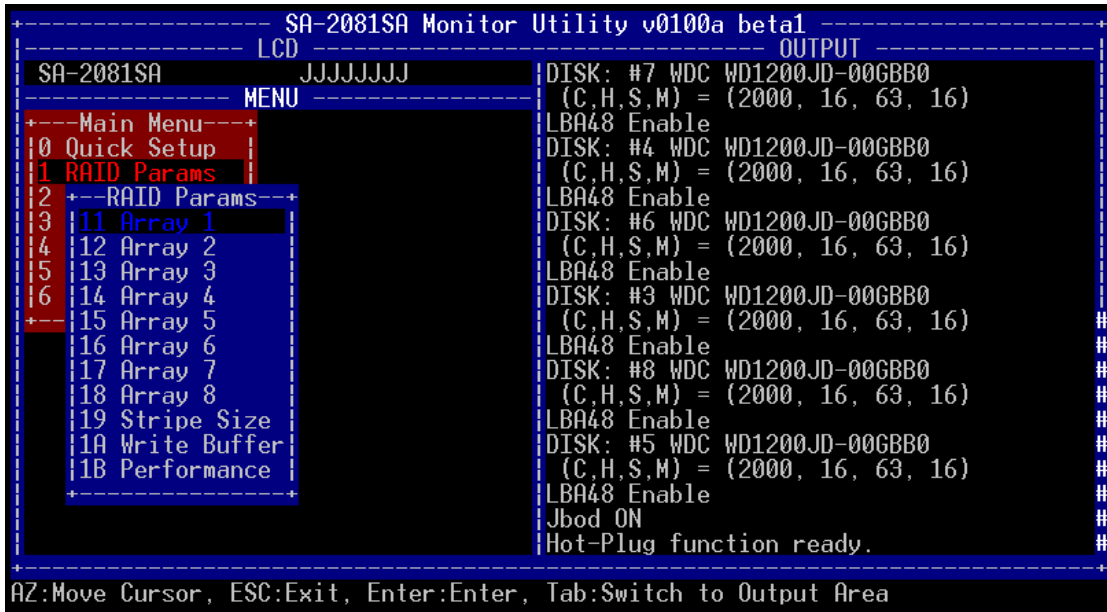


Select the raid level that fulfills your demand, and then choose **Yes** to complete.

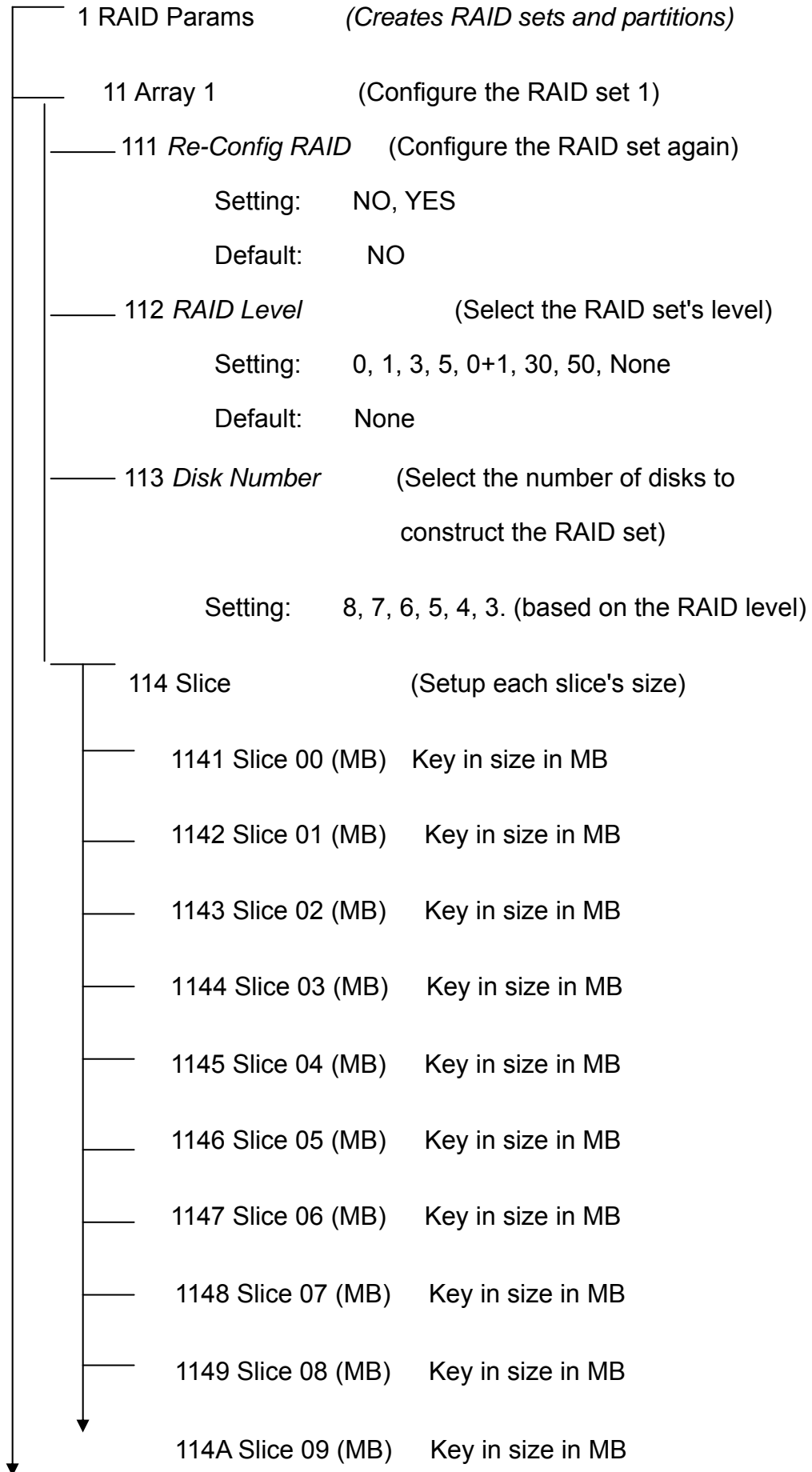
3.4.2 RAID Parameters

RAID Parameters menu allows users to configure RAID settings, such as array, partitions, slice and stripe size. See Figure 3-3 for the main screen of RAID Parameters menus.

Figure 3-3



The following is the detailed explanation for each part of RAID Parameters menu.

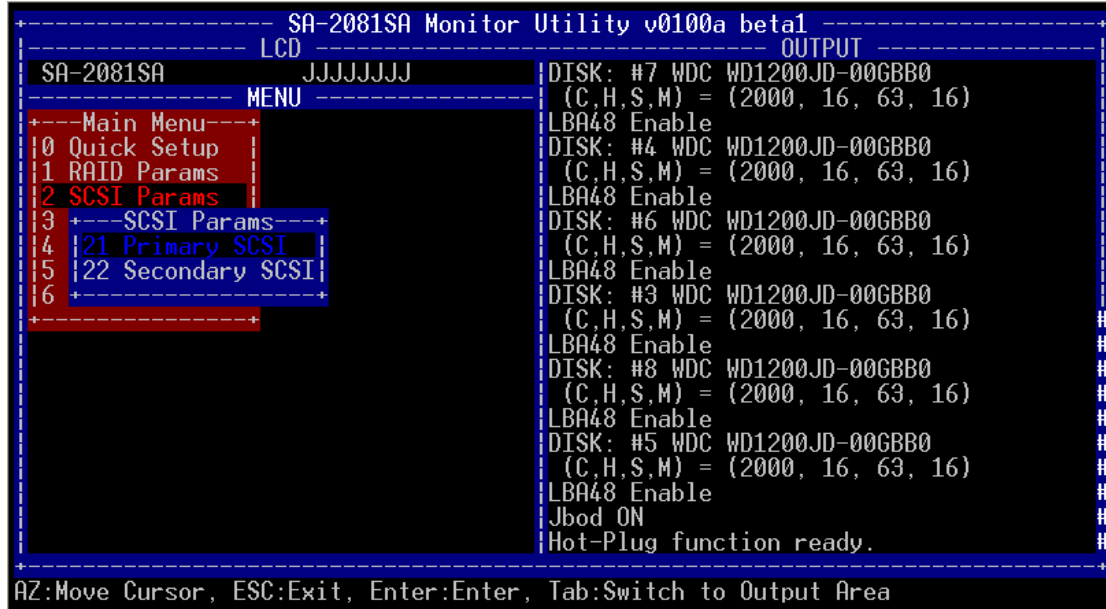


114B	Slice 10 (MB)	Key in size in MB
114C	Slice 11 (MB)	Key in size in MB
114D	Slice 12 (MB)	Key in size in MB
114E	Slice 13 (MB)	Key in size in MB
114F	Slice 14 (MB)	Key in size in MB
114G	Slice 15 (MB)	Key in size in MB
12	Array 2	(Configure the RAID set 2)
13	Array 3	(Configure the RAID set 3)
14	Array 4	(Configure the RAID set 4)
15	Array 5	(Configure the RAID set 4)
16	Array 6	(Configure the RAID set 4)
17	Array 7	(Configure the RAID set 4)
18	Array 8	(Configure the RAID set 4)
19	Stripe Size	(Setup the array's stripe size) Setting: 1024, 512, 256, 128, 64, 32, 16, or 8 sector Default: 128
1A	Write Buffer	(Enable/disable Write Buffer used) Setting: ENABLE, DISABLE Default: ENABLE
1B	Performance	(This allows you to select I/O policy) Setting: Random, Sequential Default: Sequential

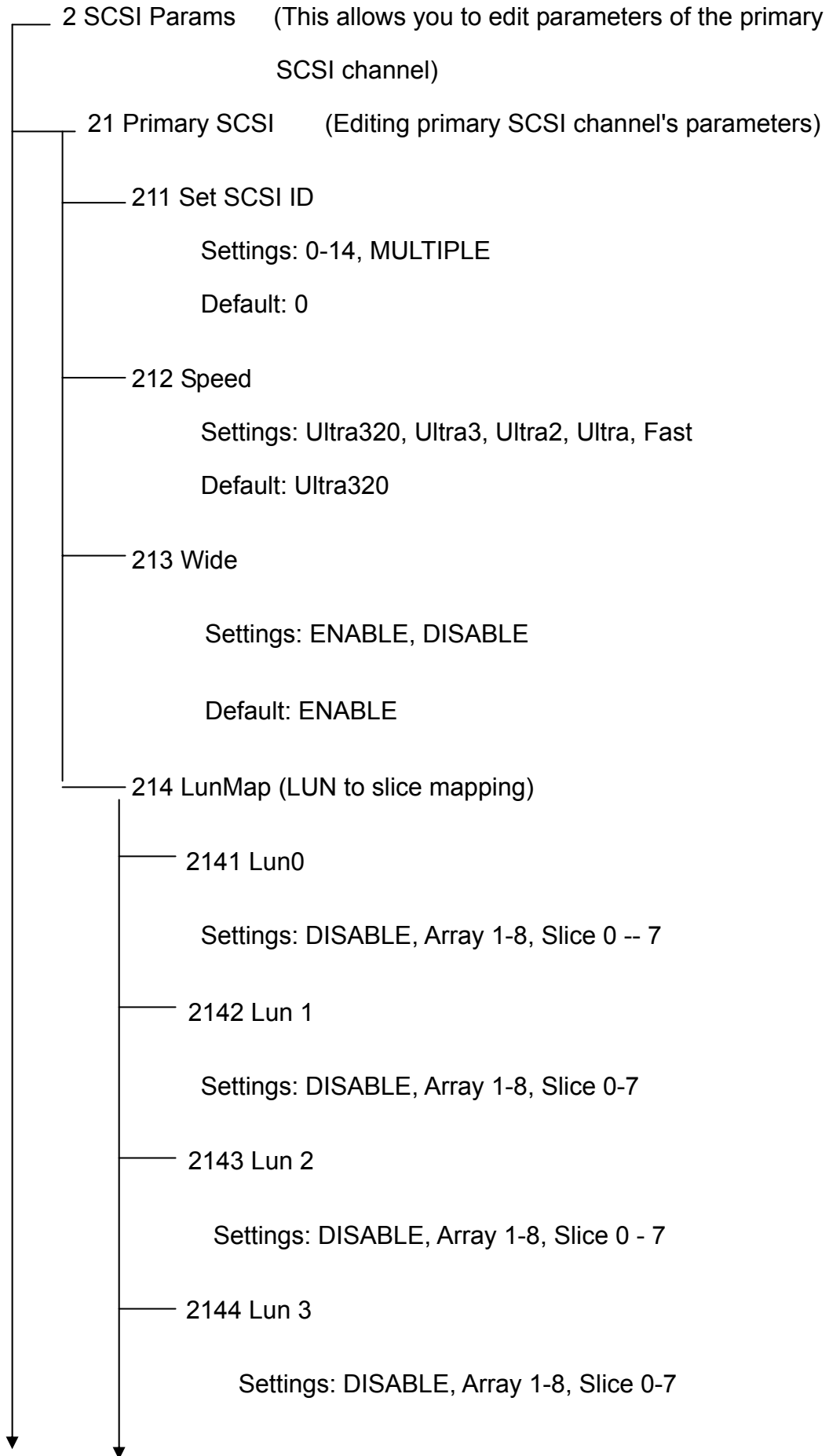
3.4.3 SCSI Parameters

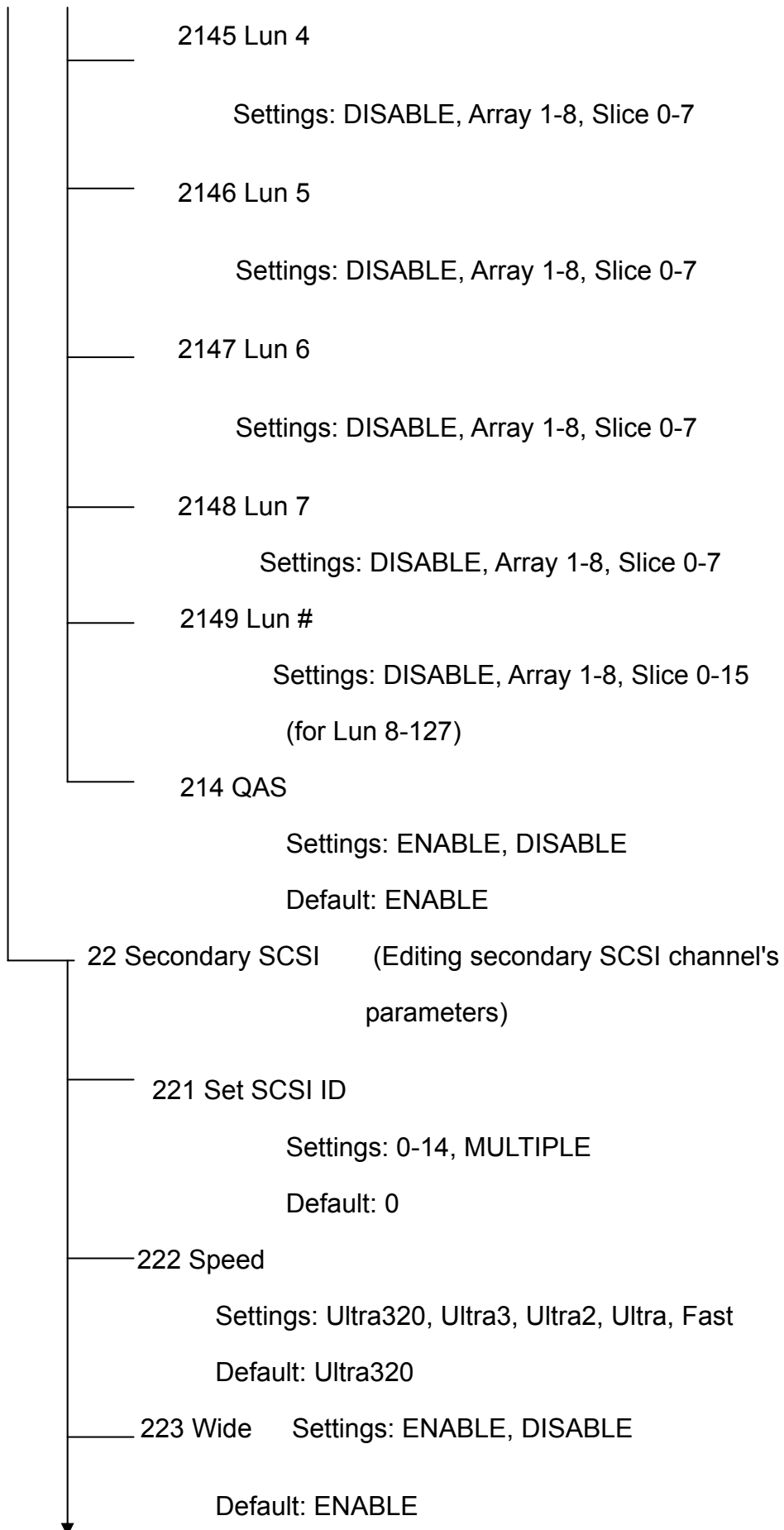
The SCSI Parameters menu is used to edit parameters of two SCSI host channels of the Disk Array. See Figure 3-4 SCSI Parameters Menu Screen.

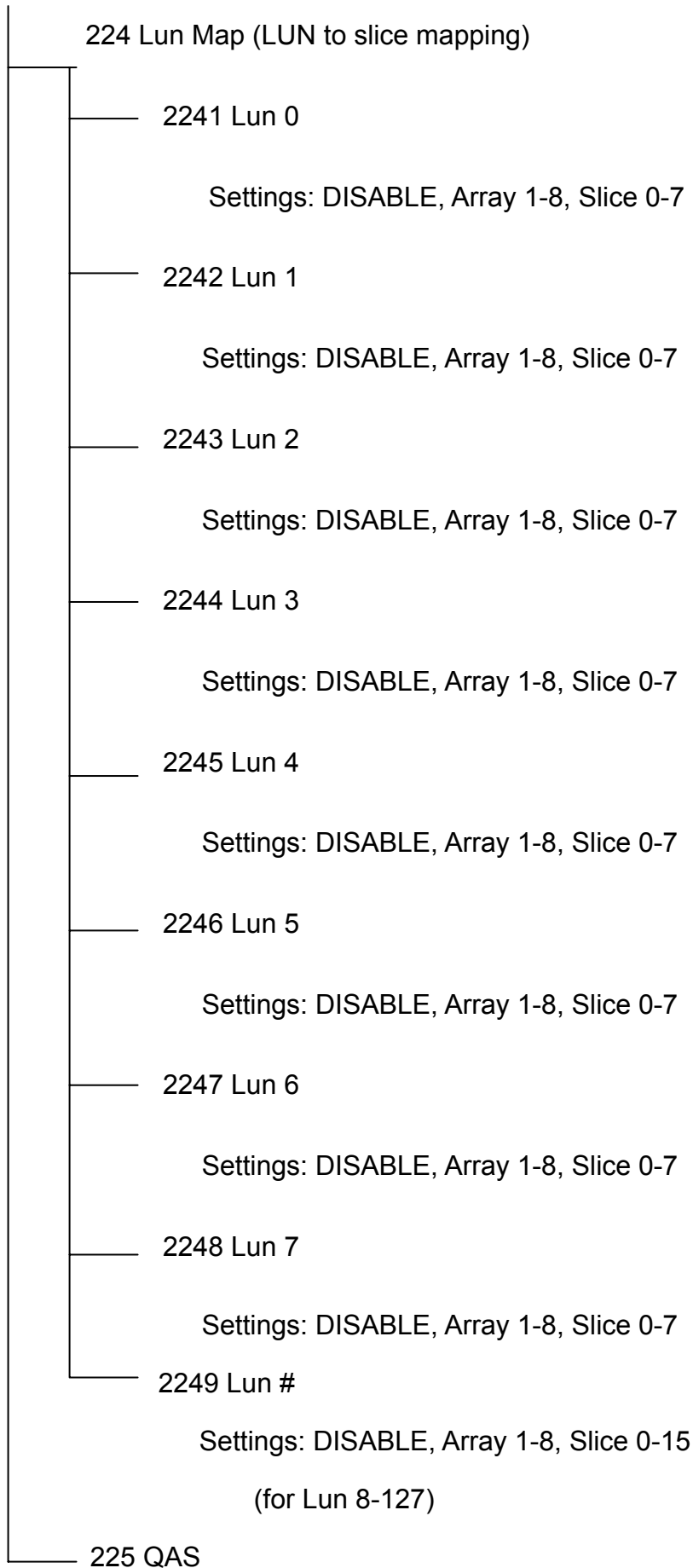
Figure 3-4



The brief explanation of the selection item of **RAID Parameters** menu is listed below:







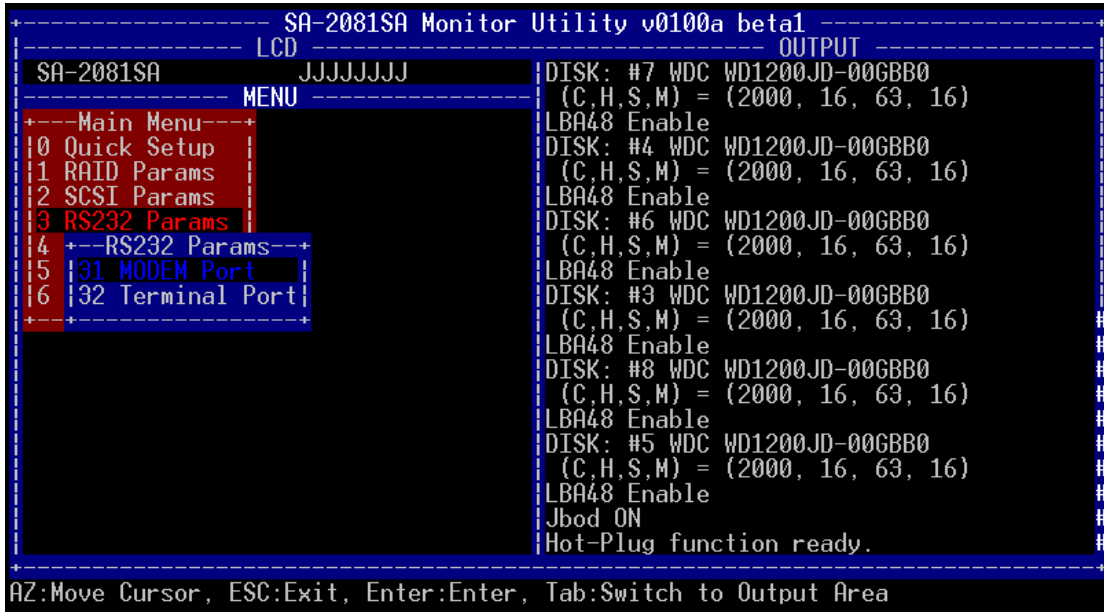
Settings: ENABLE, DISABLE

Default: ENABLE

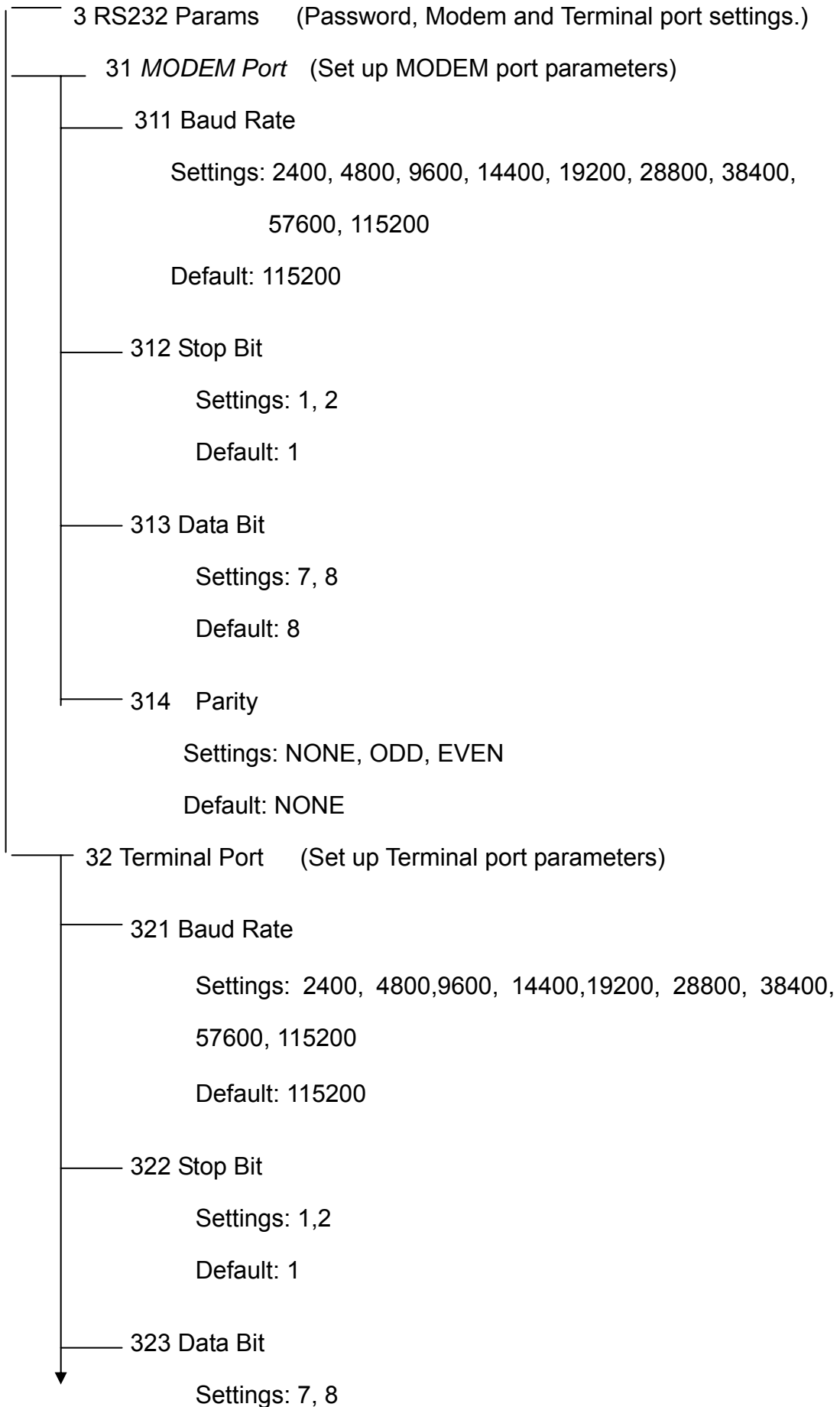
3.4.4 RS232 Parameters

The RS232 Parameters Menu is used to configure the settings of RS232 port, including password, modem and terminal port settings. See Figure 3-5 RS232 Parameters Menu Screen.

Figure 3-5



The brief explanation of the selection item of **RS232 Parameters** menu is listed below:



Default: 8

— 324 Parity

Settings: NONE, ODD, EVEN

Default: NONE

3.4.5 System Parameters

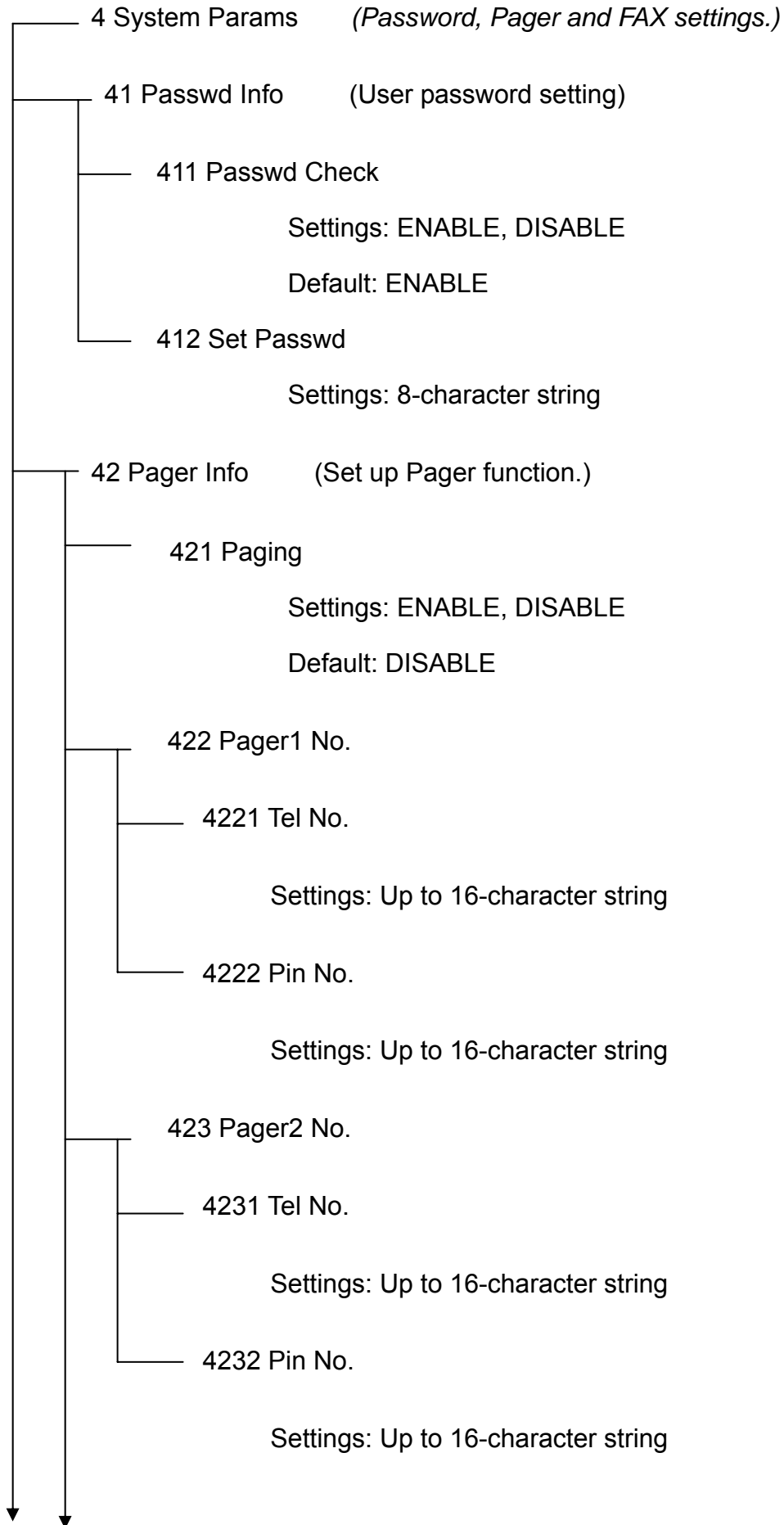
The **System Parameters** menu allows you to configure the system, including password, pager and fax settings. See Figure 3-6 System Parameters Menu Screen.

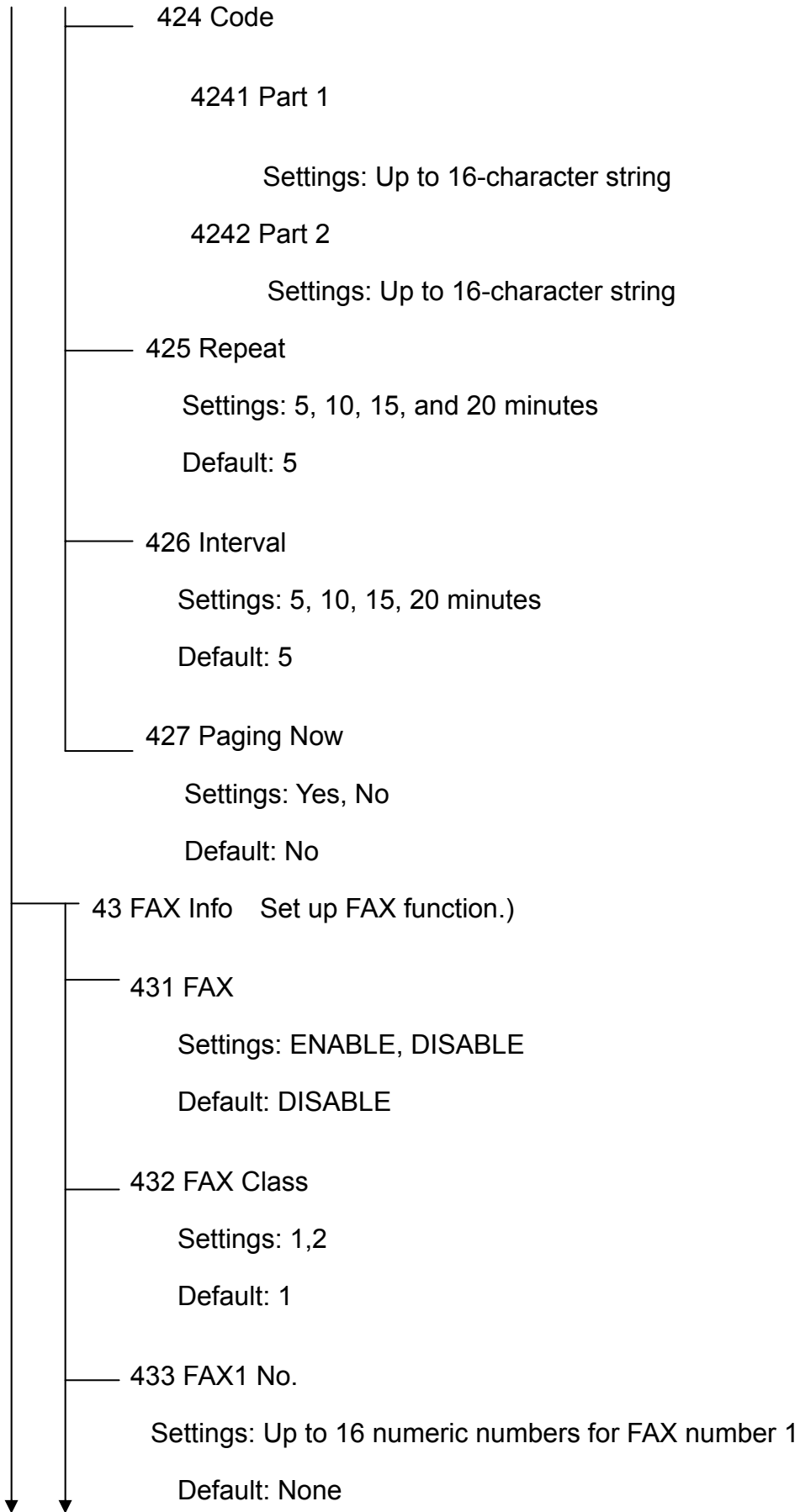
Figure 3-6

```

SA-2081SA Monitor Utility v0100a beta1
----- LCD -----
SA-2081SA JJJJJJJJ
----- MENU -----
+--- Main Menu ---+
|0 Quick Setup
|1 RAID Params
|2 SCSI Params
|3 RS232 Params
|4 System Params
|5 +---System Params---+
|6 |41 Passwd Info
|   |42 Pager Info
|   |43 FAX Info
|   |44 Company Info
|   |45 Modem Init St
+---+
DISK: #7 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #4 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #6 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #3 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #8 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #5 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
Jbod ON
Hot-Plug function ready.
-----
AZ:Move Cursor, ESC:Exit, Enter:Enter, Tab:Switch to Output Area
  
```

The expansion of the selection item of **System Parameters** menu is listed below:



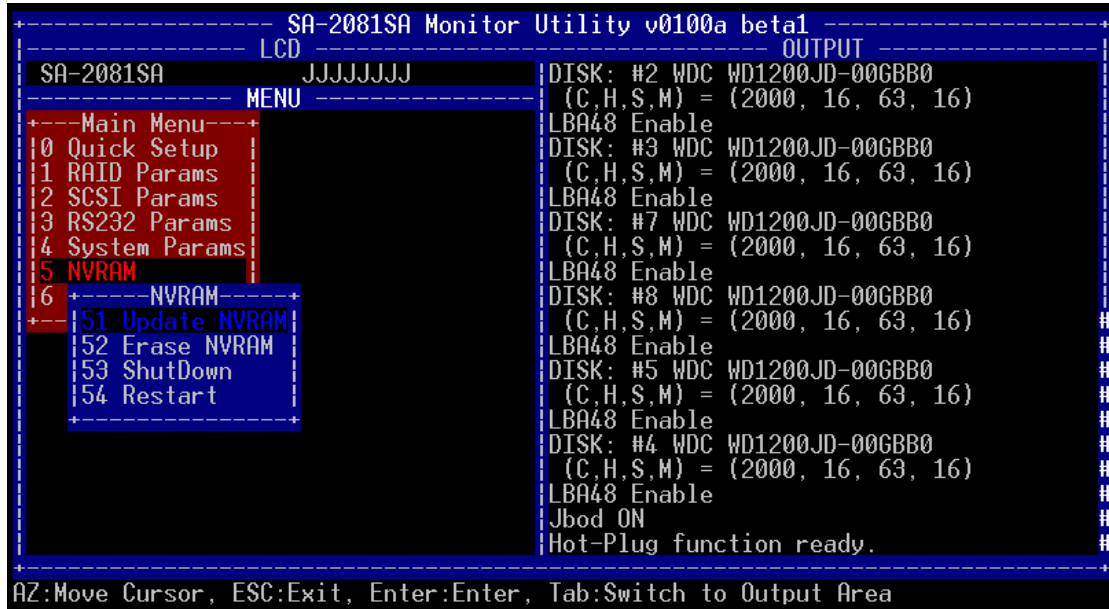


- 434 FAX2 No.
 - Settings: Up to 16 numeric numbers for FAX number 2
 - Default: None
- 435 Retry #
 - Settings: 5, 10, 15, and 20 times
 - Default: 5
- 436 FAX Now
 - Settings: Yes, No
 - Default: No
- 44 Company Info (Used to enter Log information with the FAX.)
 - 441 String 1
 - Settings: Up to 16 alphanumeric characters
 - Default: None
 - 442 String 2
 - Settings: Up to 16 alphanumeric characters
 - Default: None
- 45 Modem Init St
 - Setting: Up to 16 alphanumeric characters
 - Default: AT&DO&K4EO

3.4.6 NVRAM

The **NVRAM Menu** describes the information of the controller. See Figure 3-7 NVRAM Menu Screen.

Figure 3-7



The expansion of the selection item of NVRAM menu is listed below:

- 5 NVRAM (*Saves the information related to the controller or reboots it.*)
- 51 Update NVRAM (Update the RAID controller's configuration)
 - Settings: NO, YES
 - Default: NO
- 52 Erase NVRAM (Erase the RAID controller's configuration)
 - Settings: NO, YES
 - Default: NO
- 53 Restart (Reboot the RAID controller.)
 - Settings: NO, YES
 - Default: NO

3.4.7 RAID Functions

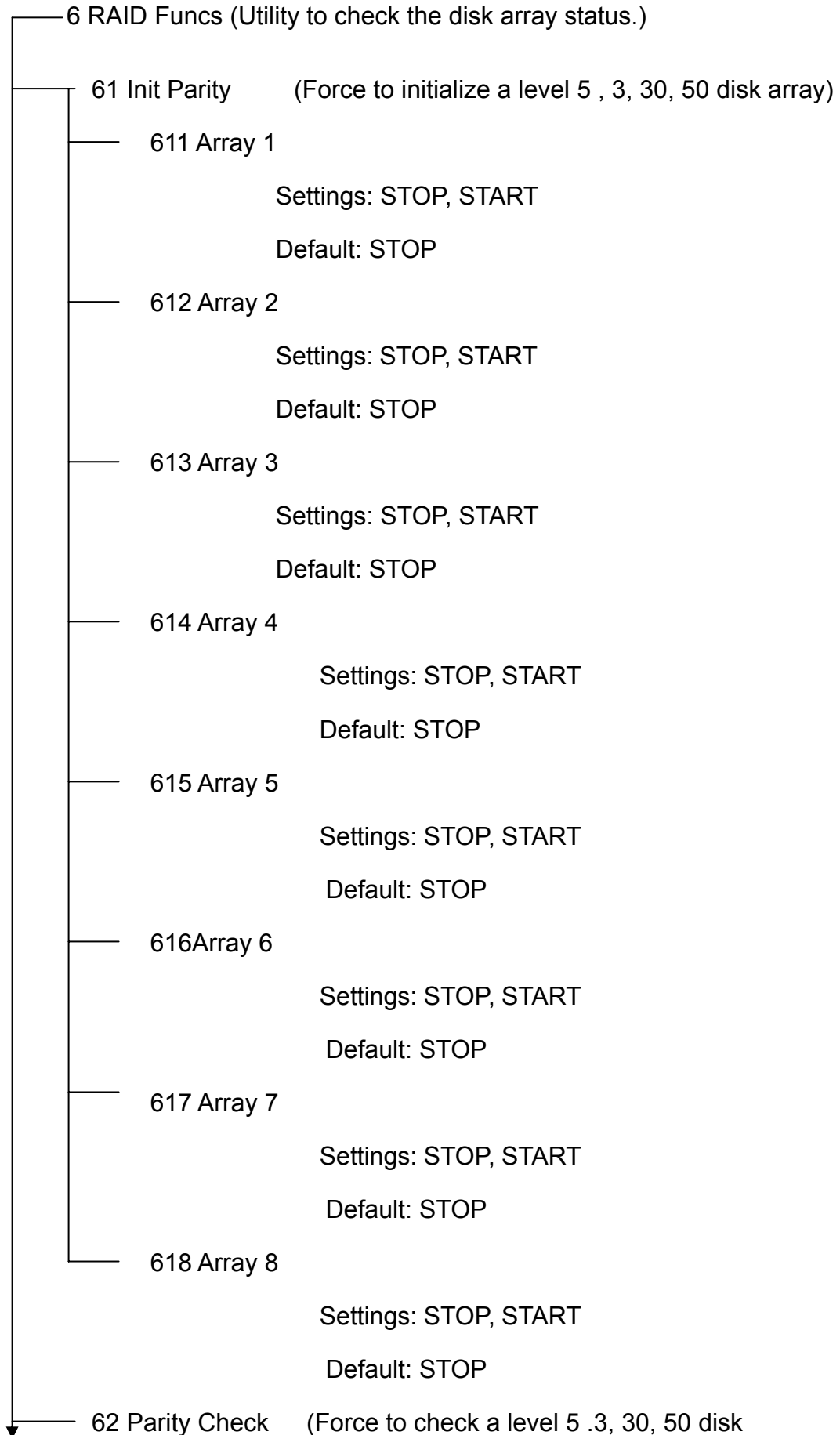
The RAID Functions menu allows you to check the system status. See Figure 3-8 RAID Functions Menu Screen.

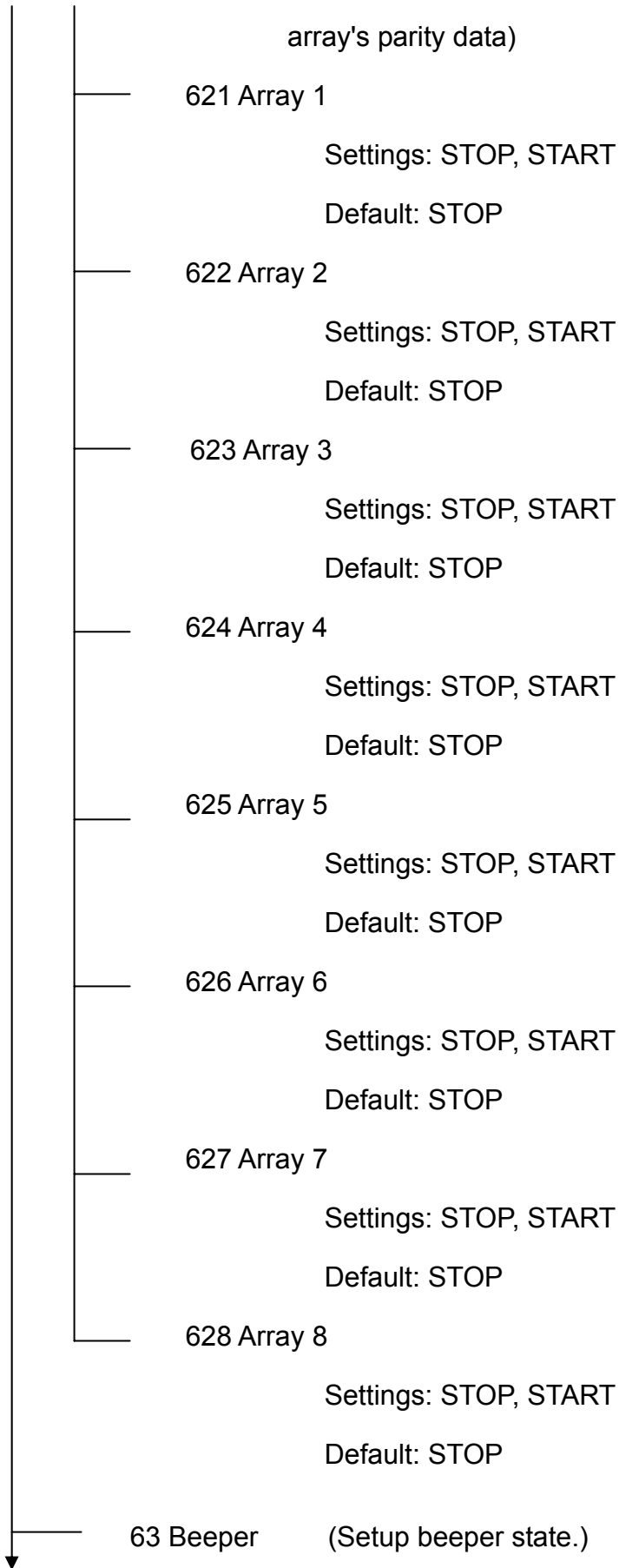
Figure 3-8

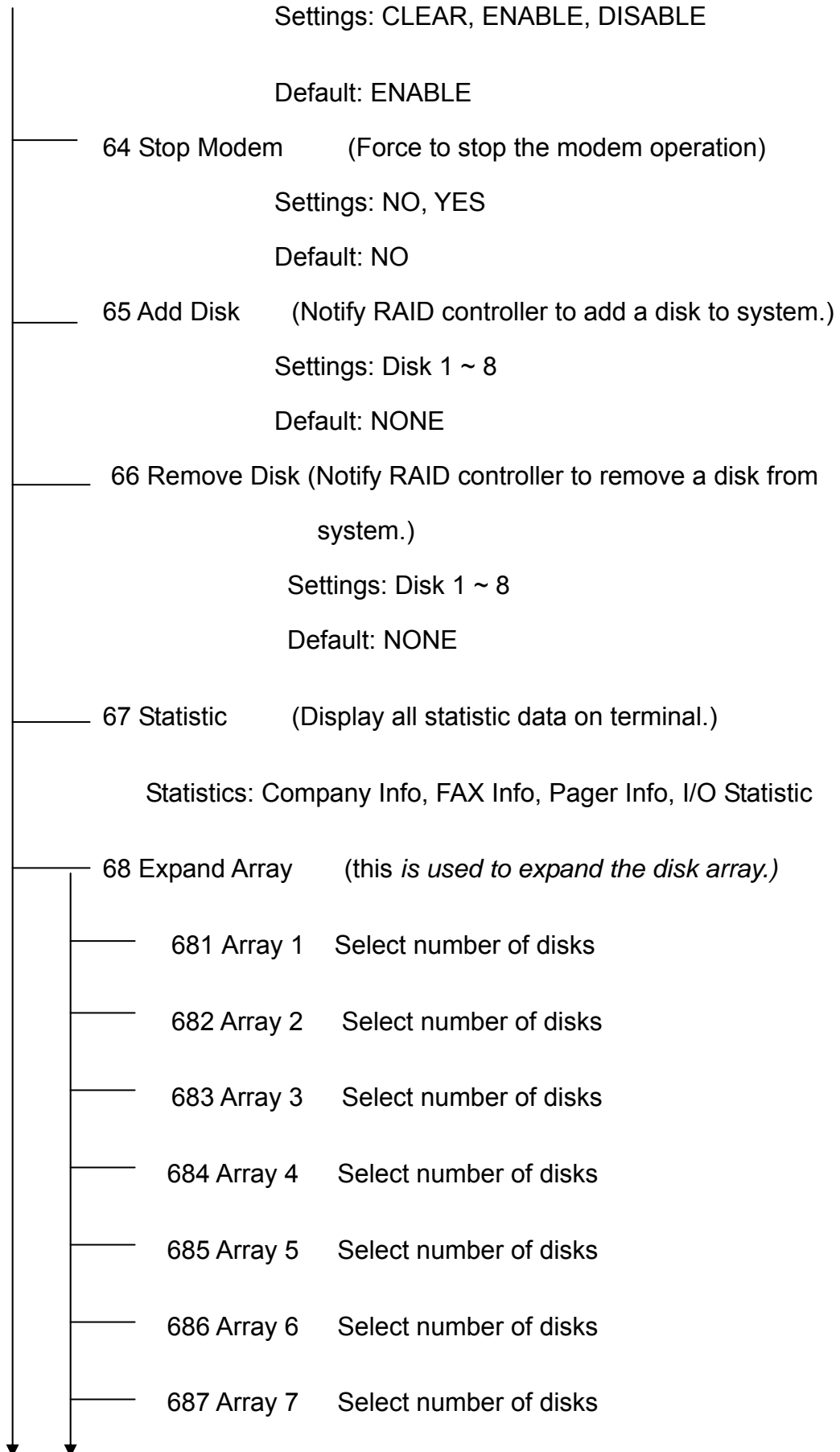
```

----- SA-2081SA Monitor Utility v0100a beta1 -----
LCD JJJJJJJJ OUTPUT
SA-2081SA
----- MENU -----
+--- Main Menu ---+
|0 Quick Setup
|1 RAID Params
|2 SCSI Params
|3 RS232 Params
|4 System Params
|5 +---RAID Funcs---+
|6 |61 Init Parity
|6 |62 Parity Check
|6 |63 Beeper
|6 |64 Stop Modem
|6 |65 Add Disk
|6 |66 Remove Disk
|6 |67 Statistic
|6 |68 Expand Array
|6 |69 Log Event
|6 |6A Update ROM
-----
DISK: #2 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #3 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #7 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #8 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #5 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #4 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
Jbod ON
Hot-Plug function ready.
-----
AZ:Move Cursor, ESC:Exit, Enter:Enter, Tab:Switch to Output Area
  
```

The expansion of the selection item of RAID Functions menu is listed below:







- └─┬─ 688 Array 8 Select number of disks
- └─ 69 Update ROM (Update the RAID controller's firmware)

Chapter 4 Quick Setup Guide

This Chapter describes the steps necessary to configure a disk array for the first time and create a disk array with different configurations. Before you configure the disk array, we recommend that you create a plan. For example, what RAID levels you will create and how many partitions you will need, etc.

This chapter covers the following topics:

- ◆ Quick Setup
- ◆ Creating RAID Sets and Setup Host Channels
- ◆ Creating RAID Sets with One or Multiple Partitions
- ◆ Setting up Host and Disk Channels
- ◆ Spare Drives designation
- ◆ Setting Up Alert Functions
- ◆ Rebuilding a Failed Disk Drive
- ◆ Deleting a RAID Set or a Partition of RAID Set

4.1 Quick Setup

The quick setup is intended as a shortcut so that experienced users can get started as quickly as possible. You will learn how to quickly set up your DAS-208SA from the LCD panel or a terminal in this section.

4.1.1 Quick Setup via LCD Panel

A default configuration, which is based on the number of the installed drives, has been set within the unit for the ease of installation for the first time user.

This will allow you to verify the integrity of the disk array immediately. The “Quick Setup” assumes that there is only one partition on the disk array. To start up, do the following steps:

- Step 1** Press **ENTER** button to select to the “Enter Password” screen as shown below in Figure 4-1. Use the **Up** and **Down** arrow button to select your desired number for your Password (The default value is 00000000). Keep pushing ENTER button for the password. You will receive a “Main Menu” option screen once you enter a correct password. (See Figure 4-2)

Figure 4-1

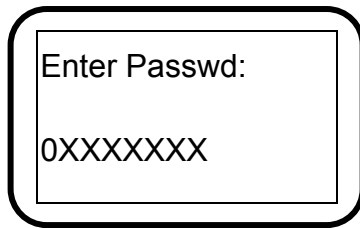
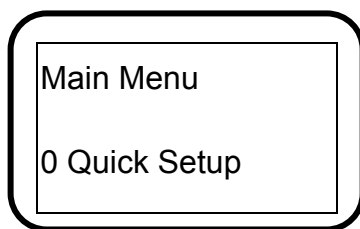


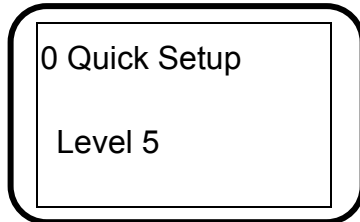
Figure 4-2



- Step 2** Press **ENTER** to confirm your selection. This will bring you to set the RAID level of the disk array. Use **UP** and **DOWN** arrow button to select the RAID level. Press SEL to confirm your selection again. Figure 4-3 shows the default value of the RAID set (RAID 5)

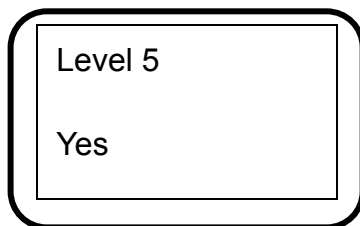
of the unit.

Figure 4-3



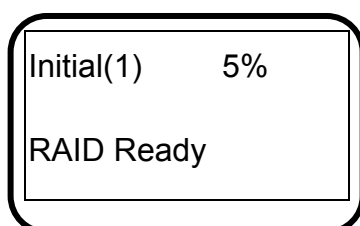
Step 3 Press **UP** and **DOWN** arrow buttons to select **Yes** or **No** for the level . Then press **Enter** to confirm your selection. (See Figure 4-4)

Figure 4-4



Step 4 The controller will start to initialize the RAID sets. After initializing the RAID set, the subsystem is ready for the host OS to perform high-level format. (Figure 4-5 shows the result of the Initialization)

Figure 4-5

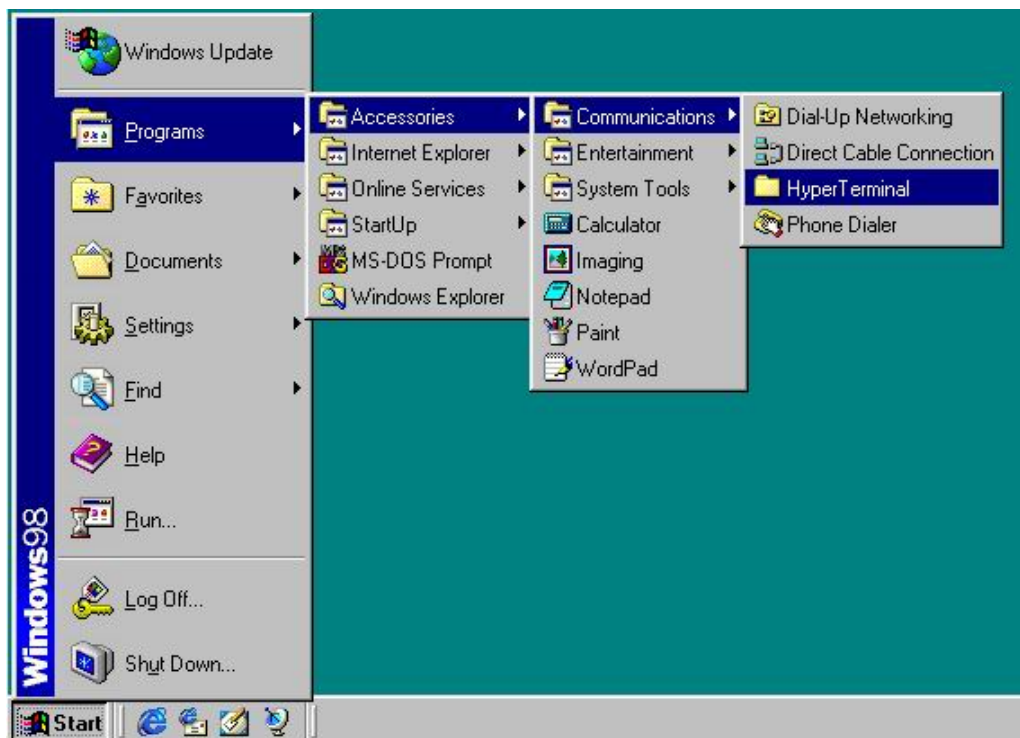


4.1.2 Quick Setup via Terminals or PCs

Do the following steps to quickly set up your DAS-208SA via a terminal or PC.

- Step 1** Connect one end of the supplied RS-232 cable to the COM port of your terminal or PC, and the other end to Console port.
- Step 2** Plug the multiport cable to the port marked as “AUX” at the rear of the disk array.
- Step 3** From the windows desktop click on **Start> Programs> Accessories> Communications> Hyper Terminal** to connect your terminal to the disk array. See Figure 4-8

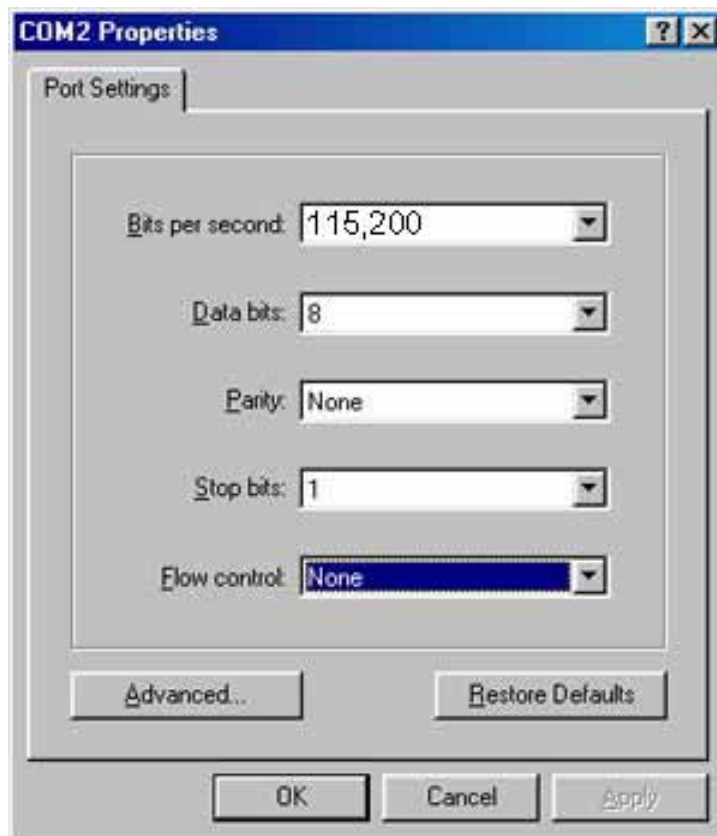
Figure 4-8



Step 4 Change the setting of the terminal to match the default settings of DAS-208SA (See Figure 4-9), namely:

- ◆ Baud rate: 115,200
- ◆ Data bit: 8
- ◆ Stop bit: 1
- ◆ Parity : None
- ◆ Flow Control: None

Figure 4-9



Step 5 Press **Control-D** to receive the following RAID Console screen.
 (Figure 4-10)

Figure 4-10

```

----- SA-2081SA Monitor Utility v0100a beta1 -----
LCD                                     OUTPUT
SA-2081SA  JJJJJJJJ  | DISK: #7 WDC WD1200JD-00GBB0
----- MENU -----  | (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| DISK: #4 WDC WD1200JD-00GBB0
| (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| DISK: #6 WDC WD1200JD-00GBB0
| (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| DISK: #3 WDC WD1200JD-00GBB0
| (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| DISK: #8 WDC WD1200JD-00GBB0
| (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| DISK: #5 WDC WD1200JD-00GBB0
| (C,H,S,M) = (2000, 16, 63, 16)
| LBA48 Enable
| Jbod ON
| Hot-Plug function ready.
-----
Move Cursor:AZSX, Tab:Switch to Menu Area
    
```

- Step 6** Press **TAB** and **Enter** key, a password screen will prompt up.
 (See Figure 4-11) Then, enter the password. (Default Password:00000000)

Figure 4-11

```

SA-2081SA Monitor Utility v0100a beta1
----- LCD -----
SA-2081SA JJJJJJJJ
----- MENU -----
+---Password:---+
| 00000000 |
+-----+
----- OUTPUT -----
DISK: #7 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #4 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #6 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #3 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #8 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #5 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
Jbod ON
Hot-Plug function ready.
Please input key: ' ' '..'}'
    
```

Step 7 Highlight **Quick Setup** and then press Enter. Use key **A** and **Z** to highlight your desired RAID level and then press **Enter** to select the option. See Figure 4-12 and 4-13

Figure 4-12

```

SA-2081SA Monitor Utility v0100a beta1
----- LCD -----
SA-2081SA      JJJJJJJJ      OUTPUT
----- MENU -----
*---Main Menu---*
|0 Quick Setup
|1 RAID Params
|2 SCSI Params
|3 RS232 Params
|4 System Params
|5 NVRAM
|6 RAID Funcs
-----

DISK: #7 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #4 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #6 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #3 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #8 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
DISK: #5 WDC WD1200JD-00GBB0
(C,H,S,M) = (2000, 16, 63, 16)
LBA48 Enable
Jbod ON
Hot-Plug function ready.

AZ:Move Cursor, ESC:Exit, Enter:Enter, Tab:Switch to Output Area
  
```

Figure 4-13

```
----- SA-2081SA Monitor Utility v0100a beta1 -----
LCD                                         OUTPUT
SA-2081SA      JJJJJJJJ                  DISK: #7 WDC WD1200JD-00GBB0
----- MENU -----                       (C,H,S,M) = (2000, 16, 63, 16)
+---Main Menu---+                         LBA48 Enable
0 Quick Setup |                             DISK: #4 WDC WD1200JD-00GBB0
1 +---Quick Setup---+                       (C,H,S,M) = (2000, 16, 63, 16)
2 | Level 5 |                               LBA48 Enable
3 | Level 3 |                               DISK: #6 WDC WD1200JD-00GBB0
4 | Level 1 |                               (C,H,S,M) = (2000, 16, 63, 16)
5 | Level 0 |                               LBA48 Enable
6 | Level 0+1 |                             DISK: #3 WDC WD1200JD-00GBB0
+---| Level 30 |----- (C,H,S,M) = (2000, 16, 63, 16) #
| Level 50 |----- LBA48 Enable #
+-----+----- DISK: #8 WDC WD1200JD-00GBB0 #
                                           (C,H,S,M) = (2000, 16, 63, 16) #
                                           LBA48 Enable #
                                           DISK: #5 WDC WD1200JD-00GBB0 #
                                           (C,H,S,M) = (2000, 16, 63, 16) #
                                           LBA48 Enable #
                                           Jbod ON #
                                           Hot-Plug function ready. #
-----+-----
AZ:Move Cursor, ESC:Exit, Enter:Enter, Tab:Switch to Output Area
```

Step 8 Highlight the number of hard disk you want to use and then press choose **Yes** to confirm your option. (See Figure 4-14) Note that you need to restart your disk array to activate the settings.

Figure 4-14



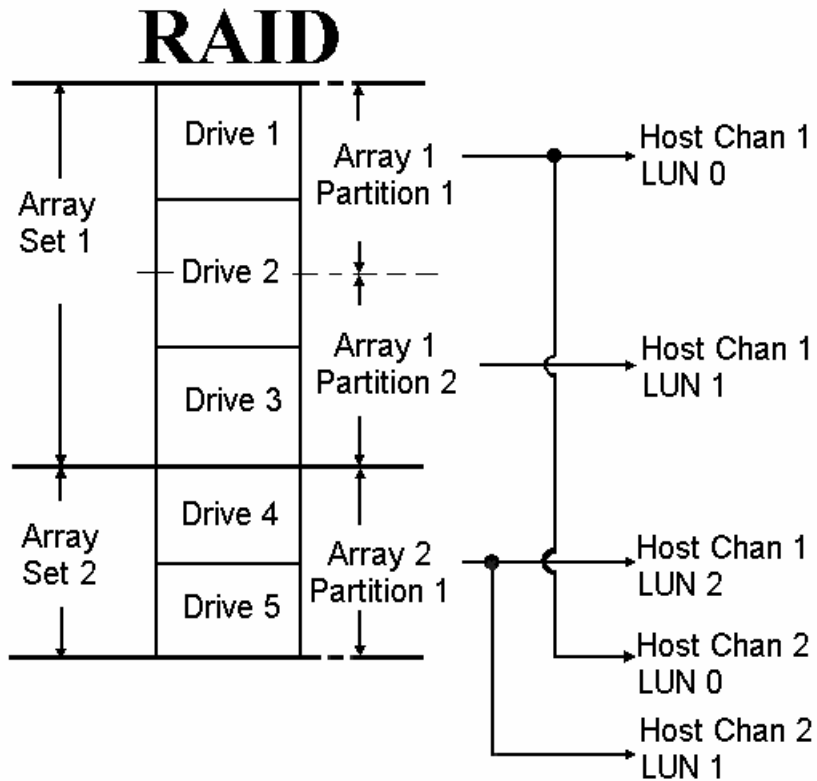
Step 9 The controller will start to initialize the RAID sets. After initializing the RAID set, the subsystem is ready for the host OS to perform high-level format.

4.2 Creating RAID Sets and Setup Host Channels

The disk array has great flexibility in creating RAID sets. Drives of different sizes and manufacturers may be combined in a RAID set (Although the smallest drive in the set will limit how much of the other drives' capacity can be used). The disk array can have as many as 4 RAID sets. Each RAID set can be assigned a different RAID level. A RAID set may be partitioned into as many as 4 partitions. Each partition could be mapped to the LUNs of host channel 1 and/or 2. Each host channel will have 8 LUNs maximum for mapping the RAID partitions. In the following section we will outline the steps needed to create RAID sets with multiple partitions and then maps them to different host channels.

For example, you want to create a disk array with two RAID sets. The first RAID set has two partitions using three drives with RAID level 5 and the second one has only one partition using two drives with RAID level 1. The partitions of the first RAID set are mapped to the LUN0 and LUN1 of the host channel 1 respectively. The partition of the second RAID set is mapped to the LUN2 of the host channel 1. In addition, the first partition of the first array and that of the second one set are mapped to the LUN0 and LUN1 of the host channel 2 respectively. The Figure 4-15 shows the configuration.

Figure 4-15

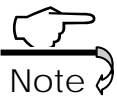


4.3 Creating RAID Sets with One or Multiple Partitions

To create RAID sets, follow these steps.

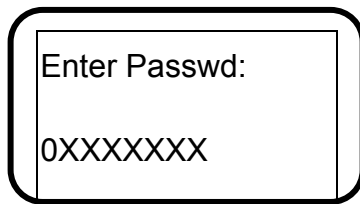
From the LCD panel, use **UP** and **DOWN** arrow button keys to select the desired character and press **ENTER** to move to the next character of the password. Follow the previous step to enter all the characters for the password. After entering the correct password, you will be presented with the 'Main Menu'.

Alternatively, from the terminal press **TAB** and **CTRL-D** to refresh to screen and press **TAB** to the left 'LCD' window for the desired selection. The right 'OUTPUT' window will display messages from the RAID. You can press **CTRL-D** at any time to refresh the screen. Key in the password and enter the 'Main Menu' as if using the LCD panel.

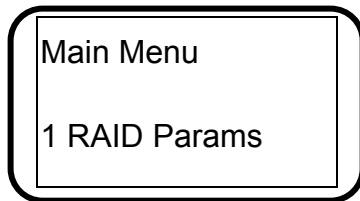


It is strongly recommended to use the terminal or terminal emulation for the RAID setup.

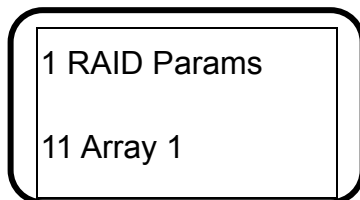
The set up message on the LCD is shown in the rectangle in the remainder of this manual. The terminal (emulation) will display detailed information on the monitor in a similar way.



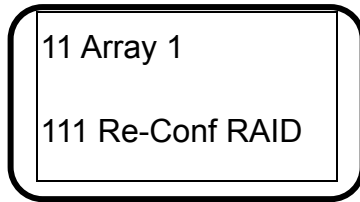
From the 'Main Menu', use **A** or **Z** key of the keyboard to move to **1 RAID Params** function.



Press **Enter** to select.

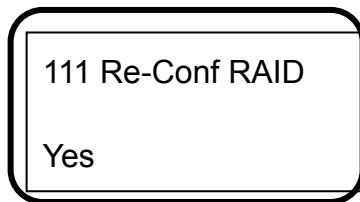


Select the **Re-conf RAID** and enter.



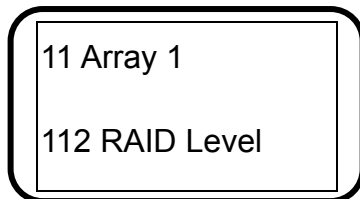
11 Array 1
111 Re-Conf RAID

Select **Yes** and press ENTER to configure RAID Set



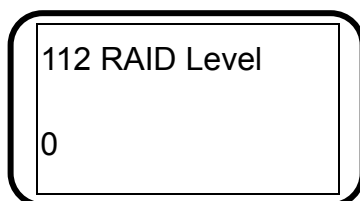
111 Re-Conf RAID
Yes

Select **112 RAID Level** to set RAID.



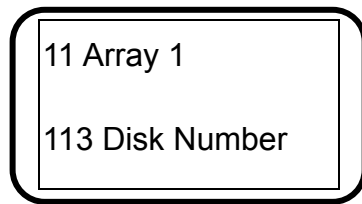
11 Array 1
112 RAID Level

Use arrow keys to select the RAID level you want. For example, you may set RAID level as 0, 1, 3, 5, 0+1, 30, 50, or none.

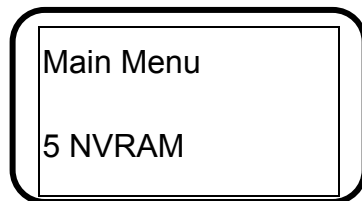


112 RAID Level
0

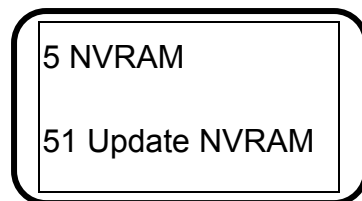
When RAID levels has been set, move to **113 Disk Number** to designate the specific drives that RAID levels are going to be used.



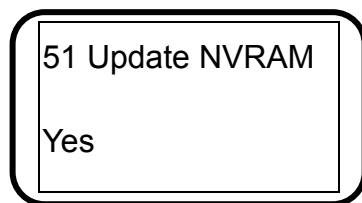
When it is done, remember to save all configurations so that RAID levels will be recorded and start to work. Go to **5 NVRAM** menu.



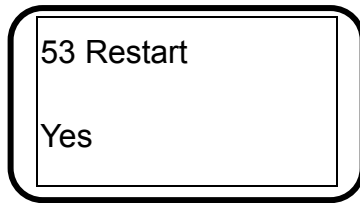
Select **51 Update NVRAM**.



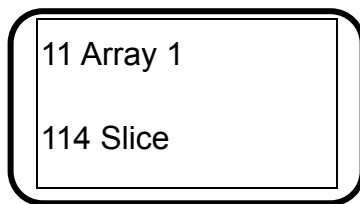
Use arrow keys, select **Yes** to save the configurations.



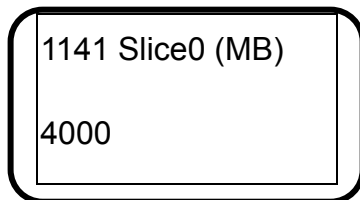
Then move to **53 Restart**, and select Yes so that system will be restarted and all configurations will be done and start to work.



Next, you may configure the partitions on the disk drives by moving to **114 Slice**.



Select 1141 Slice 0 and enter the size of the partition 1 of the RAID set 1 in MB. For example, enter 4000 and press **Enter**. You may repeat the same procedure to configure Slice1 to Slice7.

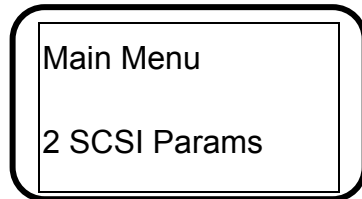


When it is done, remember to save all configurations in **51 Update NVRAM**, so that all settings will be saved. Then move to **53 Restart** to reboot the system and new configurations will start to work.

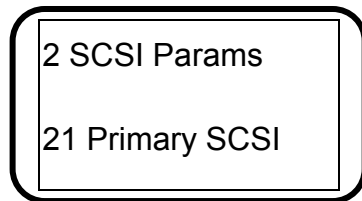
4.4 Setting Host and Disk Channels

In order to map the RAID sets to each of the host channels follow these steps.

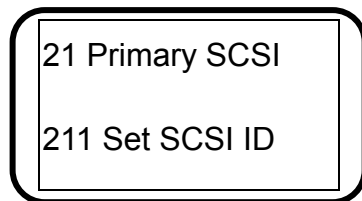
Select **2 SCSI Params** menu item from the main menu.



Press arrow key and move to **21 Primary SCSI**.



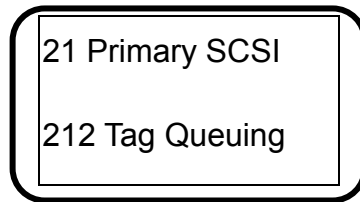
Select **211 Set SCSI ID**.



Move to **211 Set SCSI ID**, this is the RAID SCSI ID recognized by the host 1.

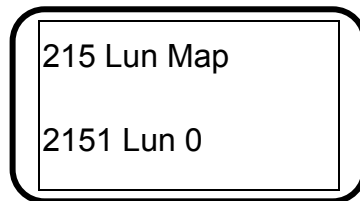
The options are from 0 to 15 and 'multiple ID'. The 'multiple ID' is for those controllers that do not support multiple LUNs.

Move to **212 Tag Queue** menu item. Queue the SCSI commands in the controller. Enabling tag queuing will improve the performance of the RAID. If your SCSI host adapter has an option of enabling the tag queuing, make sure to enable it. Press **ENTER** to Enable.

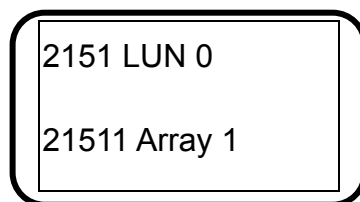


The **213 Speed** options are to be set according to the host 1 SCSI bus.

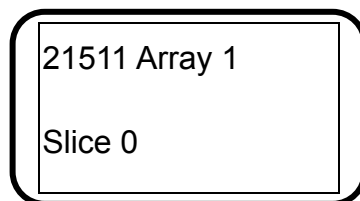
Next, move to LUN 0



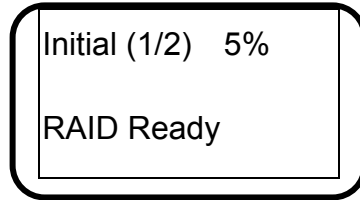
Press **Enter** to select 'LUN 0', and move to 'Array 1'.



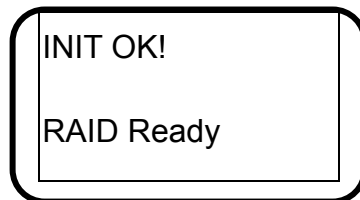
Select **Slice 0**, press **Enter** to complete.



Remember to save your configurations in **51 Update NVRAM**. Press **Enter** and the RAID will begin to initialize the disks.



Where (1/2) is the first of the two RAID sets.



Now the RAID is ready for the host OS high-level format.

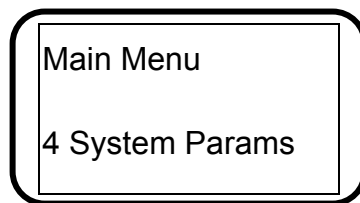
4.5 Spare Drives designation

The disk array automatically identifies the drive in the enclosure that is not included by any RAID set as a spare drive.

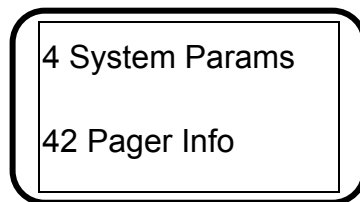
4.6 Setting up Alert Functions

There are two alert functions provided by the disk array. You could choose to send the warning messages to a fax or to a pager. The steps needed to setup the functions are shown below.

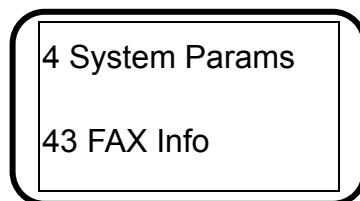
Select the **4 System Params** function from the main menu.



Select the **42 Page Info** or **43 FAX Info** you wish to complete.



Or,



From the **42 Pager Info** sub-menu, there are a few options to setup.

421 Paging: To enable or disable the paging function.

422 Pager 1 No.: Paging the first number.

423 Pager 2 No.: If the pager 1 number failed, page this number.

424 Code: Address the RAID ID for paging message.

425 Repeat #: Try to page number of times if it cannot get through.

426 Interval: The time between each page in minutes.

427 Paging Now: Test the set up of the paging function.

From the '43 FAX Info' sub-menu, there are a few options to setup.

431 FAX: To enable or disable the paging function.

432 FAX Class: Set up the Class of FAX.

433 FAX 1 No.: FAX to the first number.

434 FAX 2 No.: If the FAX 1 number failed, fax to this number.

435 Retry #: Try to FAX number of times if it cannot get through.

436 FAX Now: Test the set up of the FAX function.

The contents of the FAX are entered in **44 Company Info**.

441 String 1: Set up the RAID ID for FAX.

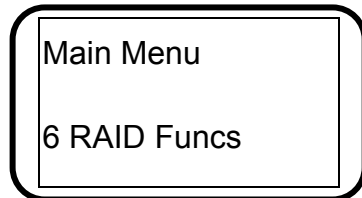
442 String 2: Set up the RAID ID for FAX

In addition, the MODEM initialization string is entered in **45 Modem Init String**.

After the setup, remember to go back to the **Main Menu** and select **51 Update NVRAM** to save all the settings just made.

4.7 Rebuilding a Failed Disk Drive

If you have a spare drive on the system, the controller will rebuild the disk array automatically. Select the **6 RAID Funcs** from main menu.



Select the 65 Add Disk option, press **Enter** and specify which slot has a newly installed disk drive. DAS-208SA Disk Array has all the slots numbered on the front panel (HD1 – HD8).

For example, the fourth slot has a new disk.

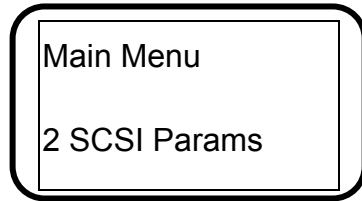


System will automatically rebuild the new disk. Wait for a while for completion.

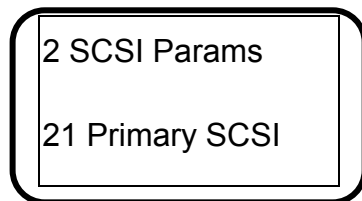
4.8 Deleting a RAID Set or a Partition of RAID Set

Warning! All the data will be lost in the deleted partition. Remember to backup your data before the deletion.

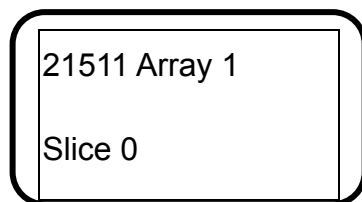
Select the **2 SCSI Params** function from main menu.



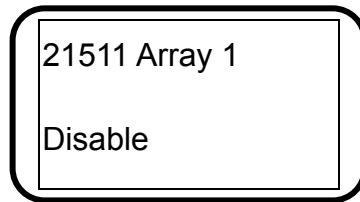
Select the **21 Primary SCSI** function.



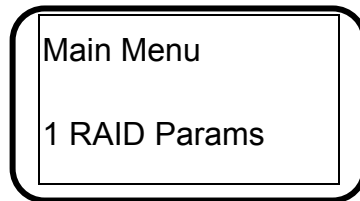
Select 215 Lun Map, then select 2151 Lun 0 => 21511 Array 1.



Press **Enter**, then use arrow key to select **Disable**. **All the data will be lost after you choose Disable. Backup all your data before proceeding!**

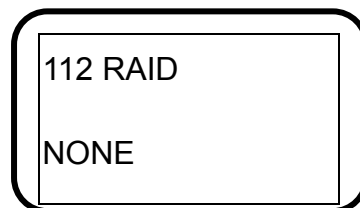


Next, move to **1RAID Params** from **Main menu**.



From the **Main Menu**, follow **11 Array 1** => **111 Re-conf RAID** (Select Yes)=>

112 RAID Level



Go to **51 Update NVRAM** to save all configurations.

Chapter 5 Upgrading Your Firmware

In this chapter, we'll discuss two different firmware upgrade procedures. The embedded firmware of the disk array can be updated through the TERMINAL port using a PC running terminal emulation program. However, you need another procedure to upgrade the firmware of 8051. Read this chapter carefully if you want to upgrade the latest firmware for your DAS-208SA Disk Array.

5.1 Disk Array Firmware Upgrade

The embedded firmware of the disk array can be updated through the TERMINAL port using a PC running terminal emulation program. The procedures are as below:

- Select the "9 Utilities" function from main menu.
 - From the "9B Update ROM" option you could change the firmware of the disk array.
 - After the "9B Update ROM" option is selected, follows the messages as below to update the firmware.
 - Before downloading the new firmware, shutdown the host computer system.
 - Are you ready to download the new firmware? (Y/N) **Y**
 - Are you sure? (Y/N) **Y**
 - Begin firmware file transfer now.
 - To abort download, restart the RAID system.
 - (After you key in the answer, select the **ASCII file transfer** to download the new firmware.)
-

- 00001A00 (the number will run indicating the file download)
- File transfer complete.
- Checksum = 0x3827: OK.
- New firmware transfer complete.
- Enter 'Go' to update the firmware. **Go** (the G must be upper case and o is lowercase)
- Enter 'Go' to reconfirm. **Go**
- Programming...
- count = 0656
- Done!
- Verifying...

After the firmware updated,DAS-208SA Disk Array will restart automatically and perform the system initialization sequence. All the RAID configuration data is still kept.

Chapter 6 Array Roaming

DAS-208SA Disk Array offers **Array Roaming** function which allows users to discharge all hard drives from the original SA-2081 SA and insert them in the new DAS-208SA Disk Array. This function is necessarily significant when hardware failure happens.

However, please note the following details to make Array Roaming work properly.

1. When hardware failure happens to the original DAS-208SA Disk Array, please switch off the power and then discharge all 8-bay hard drives.
2. **Re-insert hard drives in the new DAS-208SA Disk Array in the correct order.** For example, the first hard drive in the original disk array should be inserted in the first hard drive bay in the new disk array. If you insert the hard drives in the incorrect order, **all data and information in the hard drives will be damaged and lost.**
3. Power on the new disk array, and wait for several minutes for rebuilding, so that disk array can continue operation.

Chapter 7 Troubleshooting

DAS-208SA Disk Array employs a sophisticated combination of audio and visual signals to warn or inform you of conditions that may require user's attention. In this chapter, we will describe the diagnostic facilities that are available as well as solutions to common problems.

This chapter will cover the following topics:

- ◆ LEDs During Normal Operation
- ◆ Alarm Signals

7.1 LEDs During Normal Operation

During normal operation green POWER lights will be lit up, indicating that power is being applied to the drives and that the drives are operational. Yellow ACCESS LEDs will go off and on with each drive read or write operation. Power supplies have green LEDs that stay on all the time if the power supply is functioning properly (the LED will become red if one of the power supplies fails). Fan failed red LEDs for the four cooling fans at the rear will light if the fan fails.

7.2 Alarm Signals

Whenever there is a failed hard disk, fan, power supply or overheating condition, the audio alarm will be triggered. Red LEDs will light up indicating the part that has failed. The LCD panel will also display a warning message. To turn off the alarm signal from the controller, enter the configuration mode ('6 Raid Func' → '63 Beeper') of the controller to disable the beeper.

Appendix A : RAID Levels Tutorial

FASTORA DAS-208SA Disk Array Subsystem supports RAID levels 0, 1, 3, 5 and 0+1. This tutorial will give you a brief look of the RAID (Redundant Array of Inexpensive Disks) technology.

This appendix covers the following topics:

- ◆ A.1 RAID Fundamentals
- ◆ RAID 0
- ◆ RAID 1
- ◆ RAID 2
- ◆ RAID 3
- ◆ RAID 4
- ◆ RAID 5
- ◆ Summary Table

A.1 RAID Fundamentals

RAID (**R**edundant **A**rray of **I**nexpensive **D**isks) is a series of storage technologies described in 1987 by three researchers from University of California at Berkeley: David Patterson, Garth Gibson and Randy Katz. RAIDs were conceived to overcome the data reliability problems associated with disk storage subsystems while increasing various performance aspects.

Here we put a description of how each type of RAID operates, plus its strengths and weaknesses. An unavoidable drawback to all large groups of disk drives, although disk MTBF figures range up to 250,000 hours or five years, is a large number of “maintenance incidents”. Because of redundancy schemes, these “incidents” in a RAID do not normally result in any loss of data

or even access to the data. Stated another way, there will be failures of disks over the lifetime of a large RAID disk subsystem, but it is unlikely that there will be data lost or made unavailable.

The RAID redundancy schemes are capable of regenerating the data from a failed disk drive. After a disk has failed, it can be replaced by a spare (called a “hot spare” if it is always resident and powered up in the subsystem) and the data can then be rebuilt on the replacement disk. The overhead associated with the rebuilding process may affect storage “throughput”, which is the data access rate that can be serviced by the storage subsystem. Depending on the application of the data processing system, storage throughput is measured by **transaction rate** or **transfer rate** (or both). Transaction rate is expressed in input/output, or I/O, operations per second (**IOPS** or **IO/s**). Transfer rate is expressed in millions of bytes transferred per second (**MBPS** or **MB/s**).

Two other shortcomings of RAID are shared with disk drives in general: **seek** and **latency**. Seek is the time it takes to move the read/write (R/W) heads to the location of the data, and latency is the time it takes for the specific data to spin around under the R/W head. Average latency for a disk is $\frac{1}{2}$ a revolution. RAID can make latency worse if, as in RAID levels 2 and 3, multiple disks store the data and the disks are not rotationally synchronized. A disk feature called “spindle synchronization” can overcome this drawback, but not all disks offer the feature.

A.2 RAID 0

This is not a true RAID as defined by the Berkeley group, but rather a colloquial addition to describe the typical “disk farm” used by midrange and larger computers. A technique called “striping” or “spanning” increases the

effective data transfer rate by dividing up the data file into smaller blocks and recording them on separate disks. Susceptibility to failure is increased because any particular disk stores a portion of many data files; if a disk is lost, the files are also lost.

Logically, RAID 3 is RAID 0 with added fault tolerance.

A.3 RAID 1

This version of RAID has been around for years, known as “mirroring” or “duplexing”. The exact same data exists on pairs of disk drives, and can be read from either. This allows two simultaneous reads per mirrored pair, which can double the read transaction rate. Write operations, which must be done to both disks in the mirrored pair, offer no performance advantage, and may actually reduce write performance well below that of a single disk.

Because of its high data reliability and ease of implementation, RAID 1 has been used in storing critical data for years. Theoretically it is the most expensive fault tolerant technique, due to having twice the disks required to store the data, and does little to enhance performance.

A.4 RAID 2

Each disk in the array contributes one bit of the data transfer word; e.g., a 32-bit word requires 32 data disks. A solid-state memory Error Checking and Correction (ECC) scheme called Hamming Code provides fault tolerance. While Hamming Code requires several additional ECC disks (7 for 32 bits of data, 8 for 64 bits of data), it is capable of identifying and correcting single disk failures on the fly, so throughput is not affected by a disk failure.

Because all disks are involved in each data file access, the transfer rate is very

high while the transaction rate is that of a single disk. If spindle synchronization is not used, average latency approaches a full disk revolution. RAID 2's high transfer rate is targeted at **very** large data record sizes, which it can efficiently handle. It is seldom seen outside of the special application and supercomputer environments.

A.5 RAID 3

RAID 3 (and RAID 4 and 5 also) is based on the **odd parity principle**, which is best explained through an example. If we assume that there are four synchronized data streams of bits ("**binary digits**", which can only be zero or one), a fifth "parity" stream would be generated, so that the total number of bits at any given instant is always odd. E.g., if the data bits at an instant in time are 0101, the parity generated would be 1 (total of three bits on); for 0001, p would be 0 (1 bit on); for 0110, p = 1; for 1000, p = 0; etc. The parity bit is stored with its corresponding data bits, so that it can be used for either **error detection** or **error correction**.

In **error detection**, if the total number of bits including parity is even, an error occurred (which bit position is not known without more information). In **error correction**, in which bit line is in error is known, parity may be generated for all lines except the one in error, recreating the failed bit stream. Disks are checked for read failure at the end of each physical block recorded on the surface of the disk (called a "sector") when the error checking code (ECC) that was recorded with the data is compared to the ECC generated on reading back the data.

In RAID 3, a variable number of data disks (usually four to eight) store blocked

(grouped) data streams (like RAID 0) and a single parity disk records the generated parity for the data blocks. A data file that is to be recorded is broken up into blocks and recorded on the data disks, with its corresponding parity block(s) recorded on the data disks. Because all disks together transfer each data file, the number of data disks multiplies the data transfer rate, but the transaction rate is that of a single disk. Both read and write operations involve all array disks.

If a disk fails, the data from the good disks can recreate the failed data via generating parity. Which disk failed is known from the fact that a disk is not responding or has reported an ECC error.

A.6 RAID 4

Rather than being broken up into blocks and stored on multiple data disks, as a RAID 3 data file is, RAID 4 stores the entire data file on a single disk. The corresponding location on the parity disk contains the parity for not just the first data file, but also for the other (unrelated) data files stored on the corresponding locations on the other data disks.

Data transfer rates are the same **per data file** as single disk transfer rates, but multiple (as many as there are data disks) files may be simultaneously read. This generates a high read transaction rate and good aggregate read transfer rates. However, RAID 4 is seldom implemented because of the problems that ensue in the event of a read error or any write operation.

A RAID 4 write operation requires two disk revolutions for the following sequence:

- both the old data file (to be overwritten) and its corresponding parity file must be read;
- a new parity file is generated from the old data file, the parity file, and the new data file;
- the new data file and the new parity file are written.

A read error requires that all disks be used to recreate the failed data file, eliminating the multiple concurrent transfer potential.

A.7 RAID 5

To improve the poor write and read error performance of RAID 4, RAID 5 makes one simple (in concept) change which has major performance ramifications: distributed parity files. Instead of having all parity files located on a single disk, the parity files are allocated evenly to all disks, always with the corresponding data files on other disks.

This change allows multiple writes to take place as long as they don't "collide" at a particular disk; e.g., in an eight disk RAID 5 environment, as many as four concurrent writes could occur. Each write still involves two disk revolutions.

Read transaction performance is excellent, with as many concurrent reads possible as there are disks. The aggregate read transfer rate is also excellent, but each individual read is transferred at a single disk's rate.

A. 8 Summary Table

Given: Net storage capacity = 8GB: RAID 1 = 2 ea. 8GB disks; RAID 2 = 11 ea.

1GB disks; RAID 3, 4 and 5 = 5 ea. 2GB disks. Disk seek and latency equal.

Spindle synchronized where needed. Numbers in parenthesis indicate how many possible concurrent operations of that type are possible, if more than 1.

RAID type	Read transaction rate*	Write transaction rate*	Transfer rate per read*	Transfer rate per write*	Parity/ ECC Disk overhead	Transaction rate on failure*	Transfer rate on failure*
1	2X	=	= (2)	=	100%	=	=
2	=	=	8X	8X	27%	=	8X
3	=	=	4X	4X	20%	=	‡
4	4X	=	= (4)	=	20%	= (<2)	<=
5	5X	≈ 2X+	= (5)	= (2+)	20%	≈ 3X+	‡

* Compared to a single 8GB disk.

‡ Varies with RAID manufacturer

Appendix B: Technical Specifications

Model	DAS-208SA Disk Array
Processor	Intel 80321
RAM	128MB ECC (up to 1GB)
Disk Interface	Serial ATA
Disk Channels	8 operating parallel channels
Disk Type	Serial ATA/150MBps
Host Interface	Ultra320 LVD SCSI
Host Channels	2 channels
Drive Bays	8 bays
Environment Monitor	Power, fan, disk, and temperature failure
Power	300 Watts redundant power supplies with load sharing
RAID Level	0, 1, 10, 3, 5, 30, 50, JBOD
Multiple RAID Sets	Yes
Online Capacity Expansion	Yes
Rebuild Hot Spare Drives	Automatically and transparently
Drive Hot Swap	Yes
Drive Insertion or removal	Automatic detection and rebuilding
Firmware Upgrade	Via RS-232 port
Management Tool	LCD panel or RS-232 port
Dimensions	40.9 x 8.7 x 43.1 (cm) (LxHxW)
Weight	18kg (w/o HDD)
Input Voltage	100-240V AC

Appendix C: On-line Capacity Expansion

Examples of On-line Capacity Expansion

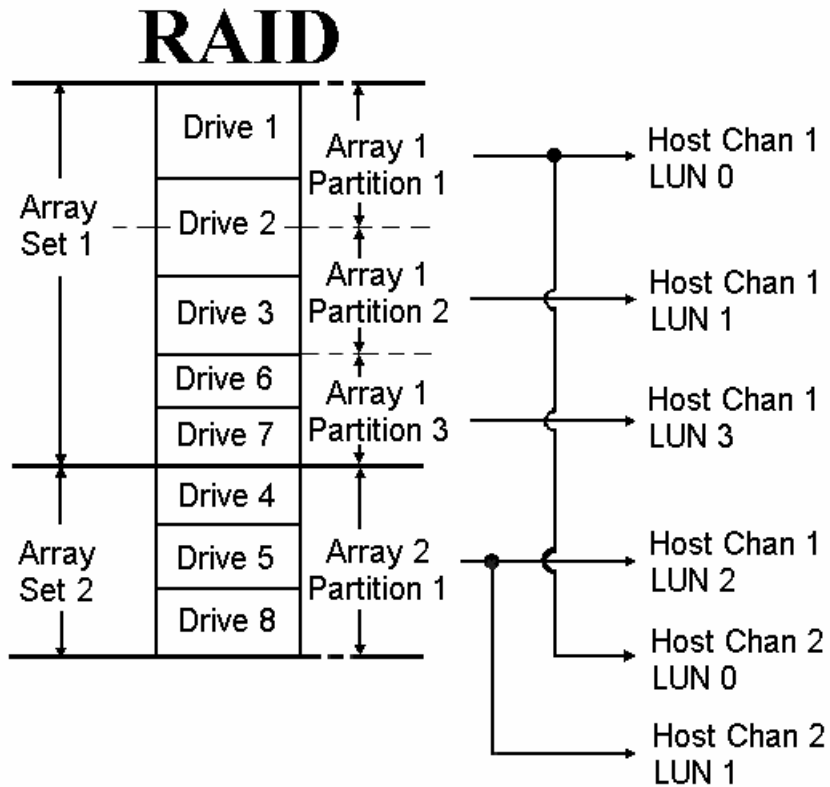
Recently, we have introduced new firmware feature – online RAID capacity expansion. It allows the user to add drives to an already created RAID set and dynamically expand capacity over these drives. In this appendix we will give some examples and show how this is done.

Backup Recommendations

Before you expand the capacity of your existing RAID set, we strongly recommend you have a current backup of data contained on the RAID. This feature has only recently been implemented and has not been fully regression tested. In order to avoid the loss of crucial data and programs you must have a current backup prior to attempting to expand the capacity of the RAID array.

Expanding an Existing RAID Set

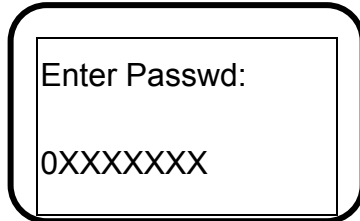
Figure C-1. On line RAID expansion



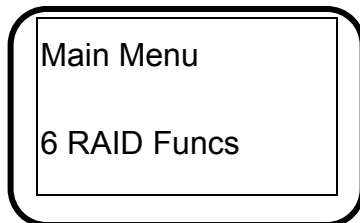
The sample will illustrate how to expand the capacity of the previously configured disk array. We will add three hard drives: DRIVE6, DRIVE7 and DRIVE8. Each drive adds 2GB to the disk array. Drives DRIVE6 and DRIVE7 will be added to array 1 partition 3 that maps to host channel 1 LUN 3. Drive DRIVE8 will be added to array 2 partition 1 that maps to host channel 2 LUN 1.

Expanding Capacity of a New Partition

We recommend using the terminal or terminal emulation for the RAID setup. However, we will use the LCD panel in our examples. The terminal (emulation) will display detailed information on a monitor in a similar way.

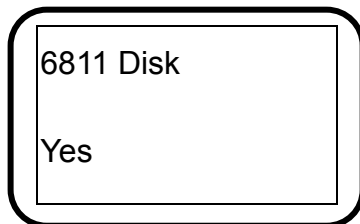


From the **Main Menu**, move to **6 RAID Funcs**.



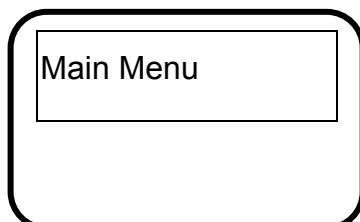
From **6 RAID Funcs**, go to **68 Expand Array => 681 Array 1 => 6811 Disk**.

Then select **Yes** to expand your disk.



The system will check your disk, indicating the process of expanding by percentage. When it is finished, you will see **DONE** in the LCD.

Next, move to **1 RAID Params**.

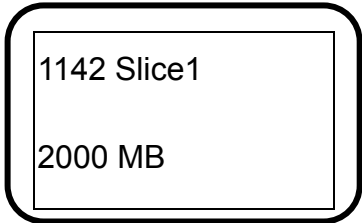




1 RAID Params

Go to **11 Array** => **114 Slice** => **1142 Slice1** as Slice0 may have been set.

Enter the size you want to allocate.



1142 Slice1

2000 MB

Remember to go to **51 Update NVRAM** to save all configurations.

Then move to **2 SCSI Params**.



Main Menu

2 SCSI Params

Go to **21 Primary** => **215 Lun Map** => **2152 Lun1** (as Lun0 may have been set) => **21521 Array 1** => **Slice2** (as Slice1 may have been set).

Press **Enter** to set the configuration.



21521 Array 1

Slice2

Go to **51 Update NVRAM** to save all configurations.

Appendix D: Upgrade Cache Memory

The disk array has default 128MB cache memory. If you decide to upgrade cache memory, it should meet the following specifications. To install the cache memory, please power off the disk array first.

Pins	200 Pins, DDR-266 SO-DIMM
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