StorageWorks Enclosures: Configuring Modular Solutions

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Overview

On April 25, 2000 Compaq announced the MA8000/EMA12000 family of external RAID Arrays. The MA/EMA modular storage systems can be ordered three ways.

- Predefined models are available that provide a set number of controller shelves and drive shelves in a Modular Storage Cabinet.
  - MA8000: One controller shelf and 3 dual bus drive shelves in a 22U Modular Storage Cabinet
  - EMA12000 D14: Three controller shelves and 9 dual bus drive shelves in a 42U Modular Storage Cabinet
  - EMA12000 S14: One controller shelf and 6 single bus drive shelves in a 36U Modular Storage Cabinet
  - EMA12000 Blue: One controller shelf and 3 dual bus drive shelves in a 41U Modular Storage Cabinet

Note that the predefined models require the following options: Controllers, Controller firmware and drives.

- Configure-to-Order allows you to specify the number of controller shelves and drive shelves desired in a Modular Storage Cabinet. Configure-to-Order requires the use of Part Number 118102-888. This part number serves as a flag to the factory to assemble all the parts on the order.
- Assembly on site allows you to order the components separately and install them in any RETMA rack or cabinet

The purpose of this guide is to assist in the creation of Configure-To-Order and component level solutions.

Intended Audience

This document is focused toward pre-sales configurations. Users of this document should be familiar with the RA8000/ESA12000 family of products.

Scope

Although this document should help the reader configure and size the new Modular solutions, it does not include guidelines for the actual SAN itself. We hope to have this information added in the next revision of this document. Please

read the appropriate SAN and Operating System Applications notes for more SAN details

Step 1: Capacity Requirements

Knowing the total disk drive count is the foundation of any storage configuration. Without this quantity, you are unable to determine the amount of controllers, device shelves and cabinets that need to be purchased.

Several steps should be followed before total disk drive count can be determined:

Step 1A:

Determine what is the total usable disk space required for this configuration.

Usable space is defined as the actual disk space available to the operating system for data storage. The Modular solutions support the following disk drives:

Disk Drive Options	Part Number
18.2GB Ultra2 SCSI 10K RPM 1”	128418-B22
18.2 GB Ultra3 SCSI 10K RPM 1”	142673-B22
9.1GB Ultra2 SCSI 10K RPM 1”	328939-B22
9.1 GB Ultra3 SCSI 10K RPM 1”	142671-B22

Formula 1A:

Divide the total usable space required by the disk drive size to determine the total number of usable disk drives.

Example

250gb of usable storage / 18.2 GB disk drives = 13.74 drives or 14 drives

Note

Always round up to the next whole drive.

Step 1B:

Determine the level of availability, cost, performance (i.e. RAID) required.

If RAID 1, 0+1 or 3/5 storagesets are to be included in the configuration, then additional disks are required for RAID overhead. RAID 0 or JBOD (Just a Bunch of Disks) storagesets do not require additional disks. RAID overhead differs between RAID levels as shown below where N is usable space with overhead drives, if any, needed for each RAID level.

Formula 1B:

RAID Level	Drives
JBOD	N
RAID 0	N
RAID 1	N * 2
RAID 0+1	N * 2
RAID 3/5	N + 1

Using the above table, design storagesets using all usable drives from **Step 1A** to determine overhead, if any.

Example

*Using the 14 usable drives from **Step 1A** to create two 5-drive usable RAID 3/5 Storagesets and one 4-drive usable RAID 1 storageset, it will take 20 total drives.*

Storageset	Total Drives
1st 5-drive RAID 3/5 storageset	5+1 = 6 drives
2nd 5-drive RAID 3/5 storageset	5+1 = 6 drives
1st 4-drive RAID 1 storageset	4*2 = 8 drives
	20 Total Drives

Step 1C:

Determine if the configuration will use Hot Spare disks.

If RAID 1, 0+1 or 3/5 storagesets are included in the configuration, then Hot Spare disk drives are highly recommended. Although hot spares are not necessary for RAID availability, they do offer additional protection against drive failures. If a RAID member fails then the Hot Spare can automatically take the place of the failed RAID drive. The controller will then use the remaining RAIDset members to rebuild the failed member's data to the new drive.

Warning

Hot Spares cannot span between multiple HSG80 controller pairs. Each controller pair must have its own pool of hot spares.

Formula 1C:

With hot spares, there is no standard formula to compute the drives necessary. It is based on the risk/comfort level of the storage manager to allow RAID storagesets to withstand the possibility of multiple drive failures.

Other factors:

- The cost of additional overhead drives that may or may not be used.
- The use disk enclosure slots for holding the hot spares.
- The site's service contract. If a site is 24*7 with 4 hour response it might not be as critical as opposed to a site that has a 8*5 next-day response contract.

In any case, the question to ask the storage manager is: "How comfortable are you having a RAID set lose a drive at 11pm on a Friday night?"

Normally, two drives per controller pair is a reasonable number of hot spares to include in your configuration.

Example

Two drives will be added for hot spares.

Step 1D:

Determine if there is any need for future storage expansion.

If storage expansion is required, it is easier to account for the disk space now than later. Not taking into account storage expansion today could mean not only purchasing additional disk drives but might also include additional controllers, shelves and racks tomorrow.

You do not need to add expansion drives to the final purchase order but by accounting for them in the overall configuration, you guarantee disk enclosure slots available to be used later.

Use the formulas from Step 1A, 1B and 1C to include storage expansion in your overall configuration.

Step 1 Summary

Following the steps suggested by Step 1 you should come very close to providing an accurate count of all drives needed in the configuration.

Example

Total disk drive capacity:

22 drives = 14 Usable + 6 RAID overhead +2 Hot Spares

Step 2: HSG80 Controllers

The HSG80 controller firmware (ACS 8.5) can address up to 12 drives per UltraSCSI bus. In single bus mode this means that 12 of the 14 drives are used. In dual bus mode, the firmware can see 7 drives on each bus allowing use of all 14 drives

Single Bus Mode vs. Dual Bus Mode

The table below describes the advantages and disadvantages between each mode.

	Advantages	Disadvantages
Single Bus Mode	• Greater disk capacity per controller channel • Shelf failure only effects one channel	• More drives per channel can degrade performance • Doubles rack space consumed vs. dual bus shelves
Dual Bus Mode	• Less drives per channel may increase performance • Half the rack space consumed vs. single bus shelves allows greater disk and controller capacity per cabinet	• Less disk capacity per controller channel • Shelf failure effects two channels possibly causing RAIDset failure

The maximum number of drives behind an HSG80 (single or cooperating pair) using six Single Bus Shelves is 72.

The maximum number of drives behind an HSG80 (single or cooperating pair) using three Dual Bus Shelves is 42.

The Model 2200 controller shelf supports a single controller or a dual controller configuration for high availability.

Model	Part #	Model Description
2200	135820-B21	4U, RETMA Rack Mount Kit, (2) power cords IEC C13-C14, (2) 180W power supplies, EMU, (3) fans

Select each mandatory option with quantities specified.

Part #	Quantity	Description
176622-B21	1 or 2 per M2200	HSG80 RAID Array Controller w/ 256MB Cache
135823-B21	1 per controller	Single external cache battery
128697-B21	1 per controller (1)	ACS V8.5F Controller FC-AL/FC-SW Software
160091-B21	1 per controller (1)	ACS V8.5S Controller FC-SW Software with Snapshot
128698-B21	1 per controller (1)	ACS V8.5P Controller FC-SW Software with Data Replication Manager
380551-001	1 per O/S	Windows NT / Windows 2000 OS Platform Kit
380554-001	1 per O/S	Sun Solaris OS Platform Kit

380556-001	1 per O/S	SGI IRIX OS Platform Kit
380557-001	1 per O/S	HP-UX OS Platform Kit
380553-001	1 per O/S	Tru64 UNIX OS Platform Kit
380555-001	1 per O/S	OpenVMS OS Platform Kit
380559-001	1 per O/S	NetWare OS Platform Kit

Note (1)

* One variant of ACS is required: either ACS 8.5F or ACS 8.5S or ACS 8.5P. In a dual controller configuration the same version and variant of ACS is required in each controller.

Select each option with quantities specified as needed.

Part #	Quantity	Description
380674-B21	1 per controller	256MB additional cache for HSG80
176623-B21	1 per Cache Module (2)	HSG80 Cache bulkhead upgrade

Note (2)

* The cache bulkhead upgrade is only required for existing HSG80 controllers that are migrating from a BA370 enclosure into the Model 2200. New HSG80 controllers ordered under 176622-B21 ship with the appropriate cache bulkhead.

Formula 2:

Divide the total disk drive capacity from Step 1 by 72 (Single Bus) or 42 (Dual Bus) to determine the controller (single or cooperating pair) count.

Example

Step 1 example total capacity: 22 / 72 = .31 or 1 (single or cooperating pair) controller

or *22 / 42 = .52 or 1 (single or cooperating pair) controller*

Note

Always round up to the next (single or cooperating pair) controller

Step 3: Disk Drive Enclosures

The HSG80 controller firmware can address up to 12 drives per UltraSCSI bus. In single bus mode, this means that 12 of the 14 drives in single bus models are used. In dual bus mode, the firmware can see seven drives on each bus allowing use of all 14 drives.. The maximum number of drives behind an HSG80 (single or cooperating pair) is 72.

Note

Regardless of Bus Mode, it is recommended to make use of all 6 UltraSCSI channels from the controller shelf. Storageset performance and availability may be compromised if failure to do so. The formulas in this configuration guide adhere to this recommendation.

- **If you are using Single Bus Mode, go to Step 3A**
- **If you are using Dual Bus Mode, go to Step 3B**

Step 3A: Single Bus Mode Device Enclosures

The Model 4214R has slots for 14 drives and supports 12 drives in single bus mode behind an HSG80 controller running ACS 8.5. 42xx drive shelves do not support daisy chaining between shelves.

Part #	Quantity	Description
103381-001	6 per M2200 Enclosure	Disk Enclosure Model 4214R 3U, 14 bay device shelf, RETMA mounting kit, Single Bus, single power supply; single IEC-320-C13 PLUG X NEMA L5-15

Select each option with quantities specified as needed.

Part #	Quantity	Description
119826-B21	1 per device enclosure	4214R Redundant power supply, single IEC-320-C13 PLUG X NEMA
119829-B21	1 per device enclosure	4214R Dual Bus I/O Module - Changes the 4214R from single bus to dual bus mode.

Note

4214Rs manufactured before 28 February 2000 may require the exchange of the EMU and single bus modules to operate properly with the HSG80. Check the EMU and I/O modules: if you see a “FB” sticker, the modules are appropriate for the HSG80. If there is no sticker, contact your local service representative for the parts exchange under your service warranty.

Formula 3A:

Total (single or cooperating pair) controllers from Step 2 * 6 = Number of shelves

Example

*Step 2 controller total 1 * 6 = 6 Single Bus Mode Device Enclosures*

Step 3B: Dual Bus Mode Device Enclosures

The Model 4254 has slots for 14 drives, supporting seven drives per bus. 42xx drive shelves do not support daisy chaining between shelves.

Part #	Quantity	Description
138151-001	3 per M2200 Enclosure	Disk Enclosure Model 4254 3U, 14 bay device shelf, RETMA mounting kit, Dual Bus, dual power supply, (2) IEC-C13 IEC-C14, (2) IEC-320-C13 PLUG X NEMA L5-15

Formula 3B:

Total (single or cooperating pair) controllers from Step 2 * 3 = Number of shelves

Example

*Step 2 controller total 1 * 3 = 3 Dual Bus Mode Device Enclosures*

Step 4: SCSI Cables

When assembling from the component level in any rack other than the Modular Storage Cabinet, SCSI Cables must be ordered separately for connections from the Model 2200 RAID controller enclosure to the device enclosures. Both the Model 2200 RAID controller enclosure and the device enclosures have VHDCI connectors.

Part #	Description
168256-B21	1M VHDCI to VHDCI SCSI Cable
168257-B21	2M VHDCI to VHDCI SCSI Cable
189505-B21	3M VHDCI to VHDCI SCSI Cable
400983-005	5M VHDCI to VHDCI SCSI Cable
400985-010	10M VHDCI to VHDCI SCSI Cable

Note

Always try to order the shortest cables possible to avoid excessive cable storage within the rack.

Formula 4:

The total number of cables ordered must equal the total number of device enclosure I/O Module ports.

Example

Using Step 3A, 6 Single Bus device enclosures = 6 SCSI Cables
Using Step 3B, 3 Dual Bus device enclosures = 6 SCSI Cables

Step 5: Power Cords

The Model 2200 ships with two power cords (IEC320-C13 to IEC320-C14) that connect directly into a Power Distribution Unit (PDU). The Model 4214 and 4254 ship with one power cord (IEC320-C13 to NEMA 5-15) per power supply. This power cord connects to a wall outlet or power strip.

The 4254 also ships with (2) IEC-C13 IEC-C14 cables that plug into a Power Distribution Unit (PDU).

Depending on the configuration packaging, additional power cords may be required.

Power Cord: IEC320-C13 to NEMA 5-15 connector plug. (Storage controller/device enclosure to wall receptacle)

Part #	Description
103541-001	USA / Japan
103541-021	Central Europe
103541-511	Switzerland
103541-461	Italy
103541-BT1	Israel
103541-011	Australia / New Zealand
103541-031	UK / Ireland
103541-481	Denmark
103541-AR1	India / South Africa

Power Cord: IEC320-C13 to IEC320-C14 (Storage controller/device enclosure to PDU)

Part #	Description
BN35S-02	2.5M IEC cable, black
BN30B-02	2.5M IEC cable, gray

Step 6: Cabinet Requirements

The modular solution has been qualified in RETMA cabinets. The predefined and Configure-To-Order solutions are assembled in the Modular Storage Cabinets. Use of the CTO part number (118102-888) assumes use of the Modular Storage Cabinets. These cabinets include Power Distribution Units and power cables.

The following describes the configuration rules for Configure-To-Order for the Modular Storage Cabinet or component assembly for the Series 9000 Cabinets. The Series 9000 cabinets are available in three heights: 42U, 36U & 22U. The Top Gun Blue RETMA cabinet is available in a 41U height.

The Model 2200 controller enclosure as a height of 4U and the 42xx Device Enclosures have a height of 3U.

The formula below provides a starting point for determining the number of cabinets required.

Formula 6:

(DS * 3) + (CS * 4) / CU = Number of cabinets to order

DS = Device Enclosure total from **Step 3A** and/or **Step 3B**
3 = Number of U's per Device Enclosure
CS = Controller Enclosure total from **Step 2**
4 = Number of U's per Controller Enclosure
CU = Single Cabinet U's available
- Series 9000 U's available: 22U, 36U, 42U
- RETMA Top Gun Blue U's available: 41U
- Modular Storage Cabinets: 22U, 36U, 41U, 42U

Note
If there is a remainder left after the division then you must either roundup to the next whole number or you must recalculate using a larger cabinet.

- **If using the RETMA Top Gun Blue cabinet go to Step 6A**
- **If using a Opal Series 9000 rack, go to Step 6B**
- **If using a Modular Storage Cabinet, go to Step 6C**

Step 6A: RETMA Top Gun Blue Cabinet Configuration for component assembly

Order the appropriate number of cabinets based on Formula 6.

Part #	Description
125359-B21/B22	RETMA Top Gun Blue Cab. Blue 60Hz/50Hz, 1 PDU

Select RETMA Top Gun Blue cabinet options, as needed.

Part #	Description
380582-001	PDU 230V 60Hz
380583-B21	PDU 230V 50Hz
380585-B21	41U filler Panel Kit

Step 6B: Opal 9000 Series Cabinet Configuration for component assembly

Order the appropriate number of cabinets based on Formula 6.

Part #	Description	
120663-B21	Model 9142 -42U Cab (opal) No PDU	- Flat Pallet
120663-B22	Model 9142 -42U Cab (opal) No PDU	- Shock Pallet
120663-B23	Model 9142 -42U Cab (opal) No PDU	- Crated
120664-B21	Model 9136 -36U Cab (opal) No PDU	- Flat Pallet
120664-B22	Model 9136 -36U Cab (opal) No PDU	- Shock Pallet
120664-B23	Model 9136 -36U Cab (opal) No PDU	- Crated
120665-B21	Model 9122 -22U Cab (opal) No PDU	- Flat Pallet
120665-B22	Model 9122 -22U Cab (opal) No PDU	- Shock Pallet
120665-B23	Model 9122 -22U Cab (opal) No PDU	- Crated

Flat Pallet	Order when cabinet is to arrive at site empty; Ship via ground only.
Shock Pallet	Order when cabinet is to arrive at site with equipment installed; Ship via ground only. See Step 7 for M2200 shipping details
Crated	Order when cabinet is to ship via air - must be empty – may ship via ground as well.

Select each Opal 9000 Series cabinet option, as needed.

Part #	Description
295363-002	High Voltage PDU (US): Uses 12 IEC Outlets, Supports 240 Volt @ 16 Amp
120669-B21	Baying/Coupling Kit (supports 24” and 600 mm floor tile spacing)
120670-B21	Rack 9142 Side panels for 9142 (42U) bare racks
120671-B21	Rack 9136 Side panels for 9136 (36U) bare racks
120672-B21	Ballast Option Kit
120673-B21	Stabilizer Option Kit
120675-B21	Rack Rail Adapter Kit (25” depth)
120677-B21	Fan (110VAC) Roof Mount
120678-B21	Fan (220VAC) Roof Mount
120679-B21	Bustle Rack Door Extension Kit
120682-B21	Grounding Rack Option Kit

▲ **Notes**

The 9142 and 9136 ships with a front and rear door only. The 9122 ships with a front door, rear door and 2 side panels

The High Voltage PDU for the Series 9000 cabinet supports up to 16 Amps at 240 Volts. To calculate amp requirements: the drive shelf is rated at 1.7 Amp and the controller shelf is rated at 1.2 Amp.

Step 6C: Modular Storage Cabinets for component assembly or Configure-to-Order

Part #	Description
180311-B21	42U Modular Storage Cabinet (opal) 60Hz
180312-B22	42U Modular Storage Cabinet (opal) 50Hz
180313-B21	36U Modular Storage Cabinet (opal) 60Hz
180314-B22	36U Modular Storage Cabinet (opal) 50Hz
180315-B21	22U Modular Storage Cabinet (opal) 60Hz
180316-B22	22U Modular Storage Cabinet (opal) 50Hz
180317-B21	41U Modular Storage Cabinet (blue) 60Hz
180318-B22	41U Modular Storage Cabinet (blue) 50Hz

Step 7: Assembly on Site

Individual components purchased to be installed in racks other than the Modular Storage Cabinet require assembly on site. (Predefined and Configure-To-Order solutions ship assembled in the Modular Storage Cabinets.) All components ship with their installation guides. Please read the installation guides carefully before

installation to ensure that all safety considerations are met.

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Model 2200 documentation includes:

- Model 2200-Series UltraSCSI Controller Enclosure User Guide
- Controller Enclosure, RETMA Rack-Mounting Kit
- Replacing an External Cache Battery (ECB)
- ECB Battery Service Label Placement

Model 42xx documentation includes:

- Compaq StorageWorks Model 4200 Family LVD Disk Enclosures User Guide

HSG80 documentation:

- HSG80 Array Controller StorageWorks Solution Software Kit Overview
- HSG80 Array controller ACS 8.5 Configuration Guide
- HSG80 Array Controller ACS 8.5 CLI Reference Manual
- HSG80 Array Controller ACS 8.5 Maintenance and Service Guide

Platform kit documentation:

- Command Console User Guide
- Platform specific Installation Reference Guide
- Release Notes