

# SAS Expansion Cabling Guide

---

A Dell Technical White Paper

Dell™ PowerVault™ MD3200, MD3200i, MD3600i  
and MD3600f Series Storage Arrays



THIS WHITE PAPER IS FOR INFORMATIONAL PURPOSES ONLY, AND MAY CONTAIN TYPOGRAPHICAL ERRORS AND TECHNICAL INACCURACIES. THE CONTENT IS PROVIDED AS IS, WITHOUT EXPRESS OR IMPLIED WARRANTIES OF ANY KIND.

© 2012 Dell Inc. All rights reserved. Reproduction of this material in any manner whatsoever without the express written permission of Dell Inc. is strictly forbidden. For more information, contact Dell.

*Dell*, the *DELL* logo, and the *DELL* badge, *PowerConnect*, and *PowerVault* are trademarks of Dell Inc. Other trademarks and trade names may be used in this document to refer to either the entities claiming the marks and names or their products. Dell Inc. disclaims any proprietary interest in trademarks and trade names other than its own.

June 2012

## Contents

SAS Expansion on the Dell™ PowerVault™ MD-Series Storage Arrays .....	4
Supported Expansion Configurations .....	7
Simple Cascading Expansion Cabling vs. Fault-tolerant Asymmetric Cabling .....	7
Simple Cascading Expansion Cabling .....	7
Fault-tolerant Asymmetric Cabling .....	7
Detecting Incorrect Cabling .....	8
Allocating Physical Disks .....	8
SAS Expansion Cabling Diagrams .....	9

## Tables

Table 1. PowerVault MD-Series Storage Array Model Configurations .....	4
Table 2. PowerVault MD-Series Expansion Model Configurations .....	4
Table 3. Dividing Physical Disks across Expansion Enclosures .....	8

## Figures

Figure 1. MD3200/MD3220 RAID Storage Array (back view) .....	5
Figure 2. MD3200i/MD3220i RAID Storage Array (back view) .....	5
Figure 3. MD3600i/MD3620i RAID Storage Array (back view) .....	5
Figure 4. MD3600f/MD3620f RAID Storage Array (back view) .....	5
Figure 5. MD1200/MD1220 SAS-based Expansion Enclosure (back view) .....	5
Figure 6. SAS Expansion Port and RAID Controller Position (all arrays) .....	6
Figure 7. MD1200/1200 Expansion Enclosure Management Modules .....	6
Figure 8. Simple Cascading Expansion Cabling (Maximum Physical Disk Support) .....	10
Figure 9. Simple Cascading Expansion Cabling (Single Array, Single Expansion Enclosure) .....	11
Figure 10. Fault-tolerant Asymmetric Expansion Cabling (Maximum Physical Disk Support) .....	12
Figure 11. Fault-tolerant Asymmetric Cabling (Minimum Configuration) .....	13
Figure 12. SAS Cable Labels .....	13

# SAS Expansion on the Dell™ PowerVault™ MD-Series Storage Arrays

All Dell PowerVault MD-series RAID storage arrays support SAS expansion using the PowerVault MD1200 and MD1220 expansion enclosures.

Table 1 shows data protocol and physical disk configurations for each MD-series RAID storage array, by model.

**Table 1.** PowerVault MD-Series Storage Array Model Configurations

Model	Data Protocol	Physical Disk Configuration
PowerVault MD3200	SAS	Twelve (12) horizontal 3.5-inch disks
PowerVault MD3220	SAS	Twenty-four (24) vertical 2.5-inch disks
PowerVault MD3200i	1Gb iSCSI	Twelve (12) horizontal 3.5-inch disks
PowerVault MD3220i	1Gb iSCSI	Twenty-four (24) vertical 2.5-inch disks
PowerVault MD3600i	10Gb iSCSI	Twelve (12) horizontal 3.5-inch disks
PowerVault MD3620i	10Gb iSCSI	Twenty-four (24) vertical 2.5-inch disks
PowerVault MD3600f	Fibre channel	Twelve (12) horizontal 3.5-inch disks
PowerVault MD3620f	Fibre channel	Twenty-four (24) vertical 2.5-inch disks

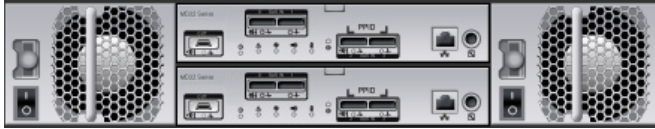
Table 2 shows data protocol and physical disk configurations for each SAS-based expansion enclosure.

**Table 2.** PowerVault MD-Series Expansion Model Configurations

Model	Data Protocol	Physical Disk Configuration
PowerVault MD1200	SAS (expansion only)	Twelve (12) horizontal 3.5-inch disks
PowerVault MD1220	SAS (expansion only)	Twenty-four (24) vertical 2.5-inch disks

Figures 1 through 4 show the RAID controller module port layout for each of the MD-series RAID storage array models.

**Figure 1.** MD3200/MD3220 RAID Storage Array (back view)



**Figure 2.** MD3200i/MD3220i RAID Storage Array (back view)



**Figure 3.** MD3600i/MD3620i RAID Storage Array (back view)



**Figure 4.** MD3600f/MD3620f RAID Storage Array (back view)



Figures 5 show the SAS port layout on the MD1200/1220 expansion enclosures.

**Figure 5.** MD1200/MD1220 SAS-based Expansion Enclosure (back view)



Figure 6 shows the SAS Out expansion port and RAID controller 0/1 position on an MD RAID storage array. Regardless of the model, the location of the expansion port and RAID controller module designation is the same.

**Figure 6.** SAS Expansion Port and RAID Controller Position (all arrays)

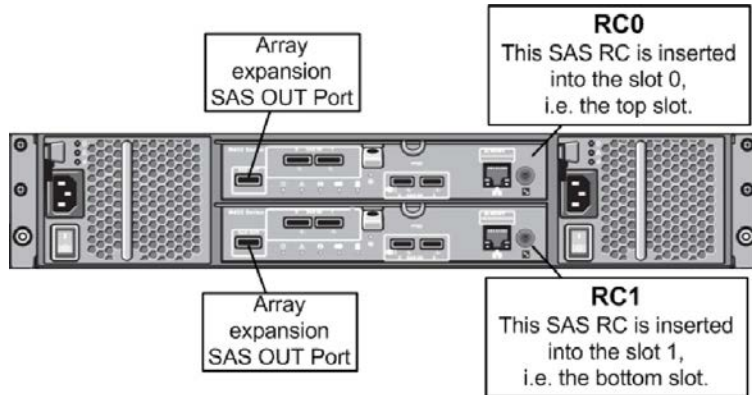
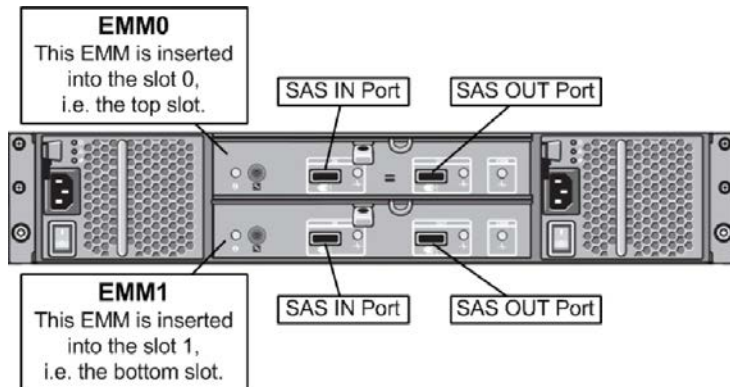


Figure 7 shows the SAS expansion port layout on the MD1200/1220 enclosure management modules.

**Figure 7.** MD1200/1220 Expansion Enclosure Management Modules



---

**NOTE:** This guide assumes that your storage array is in dual RAID controller (duplex) configuration. Dell recommends dual RAID controller configuration for all storage arrays.

---

# Supported Expansion Configurations

In its base configuration, all MD-series storage arrays support expansion up to 120 physical disks using PowerVault MD1200 or PowerVault MD1220 expansion enclosures. Expansion support up to 192 disks is available as a Premium Feature and requires activation. To more information on Premium Features, contact your Dell technical support representative.

## Simple Cascading Expansion Cabling vs. Fault-tolerant Asymmetric Cabling

How you cable your expansion enclosures determines whether you have data redundancy in the event of enclosure loss. Two different cabling schemes are supported: (1) simple cascading (non-redundant) and (2) fault-tolerant (redundant) asymmetric.

For more information on both cabling options, see the following sections of this document. For sample cabling diagrams, see Table 3.

### *Simple Cascading Expansion Cabling*

A simple cascading (or daisy-chained) cabling scheme may be appropriate when enclosure loss protection is not required. An advantage to using this simplified cabling is ease of initial setup and reduced cable complexity.

### *Fault-tolerant Asymmetric Cabling*

Although more complex to set up initially, a fault-tolerant asymmetric cabling configuration is the optimal method for connecting expansion enclosures to your storage array.

This cabling scheme guards against enclosure loss and guarantees accessibility to data on a virtual disk in a disk group in the event of total loss of a single expansion enclosure. Total loss of an expansion enclosure might occur in one of the following scenarios:

- loss of power to the expansion enclosure
- failure of both EMM modules

---

**NOTE:** If a single physical disk has already failed in a disk group, losing access to an expansion enclosure *and* experiencing a second physical disk failure in the same disk group at the same time would result in data loss. Otherwise, enclosure loss protection can be achieved in a disk group where all physical disks that comprise the disk group are located in different expansion enclosures, depending on RAID level.

---

### Detecting Incorrect Cabling

MD Storage Manager detects incorrect SAS expansion cabling and logs an event in the major event log (MEL). Additionally, a Recovery Guru automatically launches and provides guidance on how to correct the problem. However, a cabling error will only be reported *if it results in a non-functioning configuration*. If a cabling configuration is non-optimal but still allows basic array function, no event is logged and a Recovery Guru will not be launched.

### Allocating Physical Disks

Table 3 shows sample configurations for both 12 and 24 physical disk configurations. **You are not limited by the configurations shown in this table.** You can divide your physical disks across expansion enclosures in any combination up to your supported physical disk limit (120 base or 192 with Premium Feature activation).

**Table 3.** Dividing Physical Disks across Expansion Enclosures

Total Expansion Enclosures	Supported Physical Disks	Number of Enclosures (12 physical disks per enclosure)	Number of Enclosures (24 physical disks per enclosure)
12	192	8	4
8	96	8	0
7	96	6	1
7	84	7	0
6	96	4	2
6	84	5	1
6	72	6	0
5	96	2	3
5	84	3	2
5	72	4	1
5	60	5	0
4	96	0	4
4	84	1	3
4	72	2	2
4	60	3	1
4	48	4	0
3	72	0	3
3	60	1	2
3	48	2	1



3	36	3	0
2	48	0	2
2	36	1	1
2	24	2	0
1	24	0	1
1	12	1	0

## SAS Expansion Cabling Diagrams

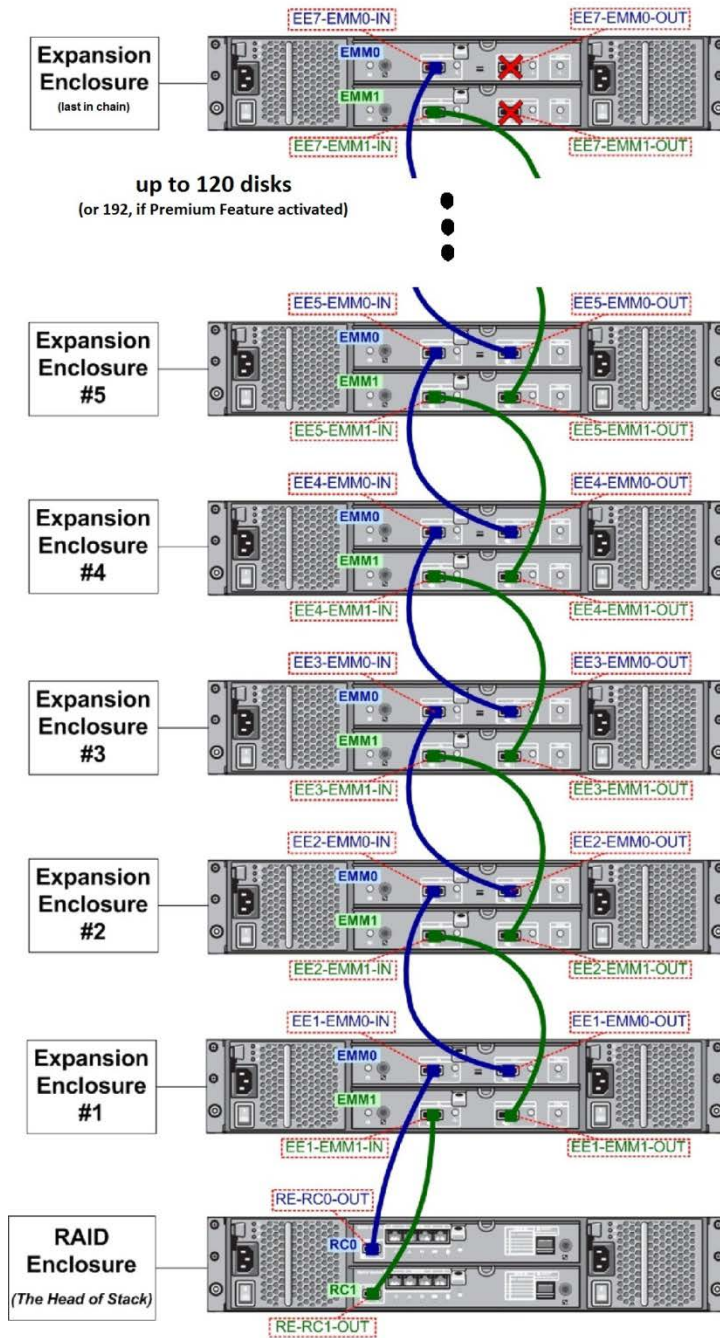
This section contains cabling diagrams illustrating the MD-series expansion configurations.

---

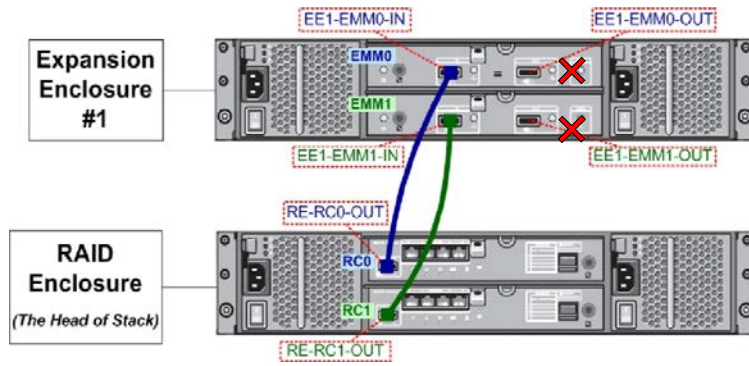
**NOTE:** Not every supported expansion cabling configuration is shown in these examples – the simple cascading or fault tolerant asymmetric cabling schemes can be applied to any combination of expansion enclosures up to your physical disk limit (up to 120 for base support or up to 192 if activated via Premium Feature). No maximum number of expansion enclosures is enforced.

---

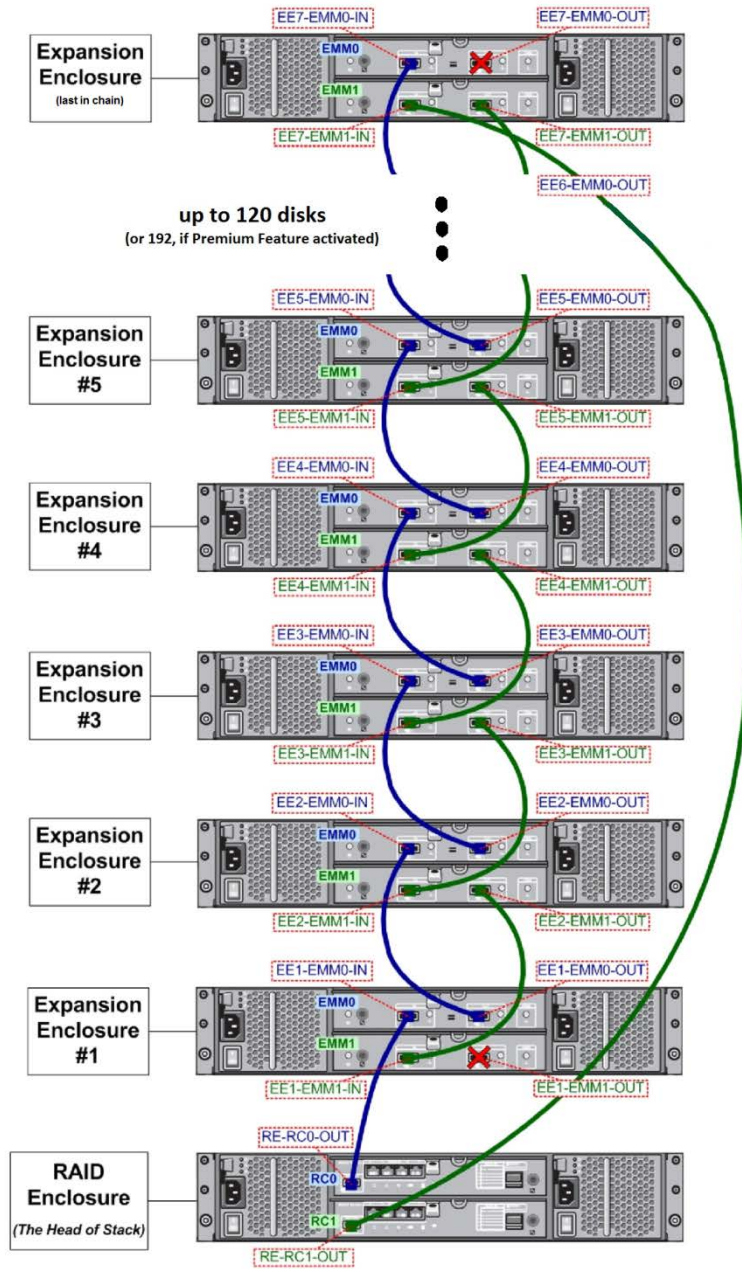
Figure 8. Simple Cascading Expansion Cabling (Maximum Physical Disk Support)



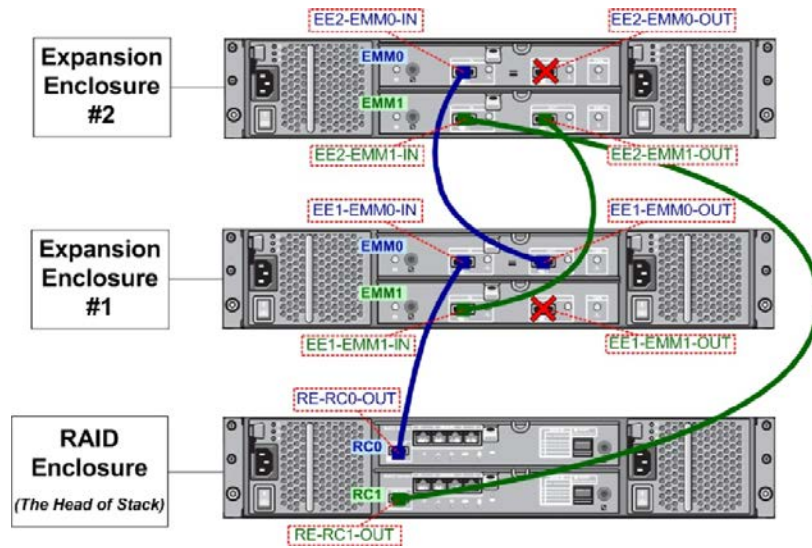
**Figure 9.** Simple Cascading Expansion Cabling (Single Array, Single Expansion Enclosure)



**Figure 10. Fault-tolerant Asymmetric Expansion Cabling (Maximum Physical Disk Support)**



**Figure 11. Fault-tolerant Asymmetric Cabling (Minimum Configuration)**



**Figure 12. SAS Cable Labels**

The following labels are supplied for you to print, cut out and attach to both ends of your SAS cables. If your storage array has to be moved, these labels may simplify recabling.

RE-RC0-OUT	RE-RC1-OUT		
EE1-EMM0-IN	EE1-EMM0-OUT	EE1-EMM1-IN	EE1-EMM1-OUT
EE1-EMM0-IN	EE1-EMM0-OUT	EE1-EMM1-IN	EE1-EMM1-OUT
EE2-EMM0-IN	EE2-EMM0-OUT	EE2-EMM1-IN	EE2-EMM1-OUT
EE2-EMM0-IN	EE2-EMM0-OUT	EE2-EMM1-IN	EE2-EMM1-OUT
EE3-EMM0-IN	EE3-EMM0-OUT	EE3-EMM1-IN	EE3-EMM1-OUT
EE3-EMM0-IN	EE3-EMM0-OUT	EE3-EMM1-IN	EE3-EMM1-OUT
EE4-EMM0-IN	EE4-EMM0-OUT	EE4-EMM1-IN	EE5-EMM1-OUT

EE4-EMMO-IN	EE4-EMMO-OUT	EE4-EMM1-IN	EE5-EMM1-OUT
EE5-EMMO-IN	EE5-EMMO-OUT	EE5-EMM1-IN	EE5-EMM1-OUT
EE5-EMMO-IN	EE5-EMMO-OUT	EE5-EMM1-IN	EE5-EMM1-OUT
EE6-EMMO-IN	EE6-EMMO-OUT	EE6-EMM1-IN	EE6-EMM1-OUT
EE6-EMMO-IN	EE6-EMMO-OUT	EE6-EMM1-IN	EE6-EMM1-OUT
EE7-EMMO-IN	EE7-EMMO-OUT	EE7-EMM1-IN	EE7-EMM1-OUT
EE7-EMMO-IN	EE7-EMMO-OUT	EE7-EMM1-IN	EE7-EMM1-OUT