DiskShelf14, DiskShelf14mk2 FC, and DiskShelf14mk4 FC
Hardware and Service Guide

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Safety Information (Sicherheitshinweise)

Safety rules

All products are Class 1 laser devices, except the NVRAM5 cluster media converter, which is Class 1M. You must follow these safety rules when working with this equipment:

DANGER

Failure to follow these directions could result in bodily harm or death.

- When using an NVRAM5 cluster media converter, the storage system must be installed in a restricted access location.
- **Switzerland only—for FAS900, GF900, R200, and C6200 systems:** This equipment relies on fuses/circuit breakers in the building installation for overcurrent protection. Each power supply must receive power from a separately dedicated outlet with a 10A fuse/circuit breaker.
- When installing disk shelves and a storage system into a movable cabinet or rack, install from the bottom up for best stability.
- DC-based systems must be installed in a restricted access location and the two input power terminals for the DC power supply must be connected to separate isolated branch circuits.
- To reduce the risk of personal injury or equipment damage, allow internal components time to cool before touching them and ensure that the equipment is properly supported or braced when installing options.
- This equipment is designed for connection to a grounded outlet. The grounding type plug is an important safety feature. To avoid the risk of electrical shock or damage to the equipment, do not disable this feature.
- This equipment has one or more replaceable batteries. There is danger of explosion if the battery is incorrectly replaced. Replace the battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

For units with multiple power cords

If your storage system or disk shelf has multiple power cords and you need to turn the unit off, heed the following warning:

DANGER

This unit has more than one power supply cord. To reduce the risk of electrical shock, disconnect all power supply cords before servicing.

Sicherheitsvorgaben

Alle Produkte sind Lasergeräte der Klasse 1, mit Ausnahme des NVRAM5 Cluster-Medienkonverters, der in Klasse 1M fällt. Beim Einsatz dieser Geräte sind die Sicherheitsvorschriften zu beachten:

Vorsicht

Nichtbeachtung dieser Vorschriften kann zu Verletzungen oder Tod führen.

- Bei der Verwendung eines NVRAM5 Cluster-Medienkonverters muss das Speichersystem an einem Standort mit beschränktem Zugriff installiert werden.
- **Nur für die Schweiz - Systeme FAS900, GF900, R200 und C6200:** Diese Geräte erfordern den Festeinbau von Sicherungen zum Überstromschutz. Jeder Netzanschluss muss mit Strom aus getrennten, speziell für diesen Zweck vorgesehenen Steckdosen versorgt werden, die jeweils mit einer 10A-Sicherung geschützt sind.
- Werden die Plattenregale und das Speichersystem in einen beweglichen Schrank oder Turm eingebaut, ist wegen der höheren Stabilität der Einbau von unten nach oben vorzunehmen.
- Gleichstrom-Systeme müssen an Betriebsstaette mit beschraenktem Zutritt installiert sein und die beiden Eingangsstromklemmen für das Gleichstrom-Netzteil müssen an separate und isolierte Abzweigleitungen angeschlossen sein.
- Zum Schutz vor Körperverletzung oder Sachschäden am Gerät lassen Sie die inneren Bauteile stets vor dem Berühren abkühlen. Sorgen Sie dafür, dass das Gerät richtig abgestützt ist oder fest aufrecht steht, bevor Sie neues Zubehör einbauen.
- Dieses Gerät ist für die Einspeisung aus einer geerdeten Netzverbindung ausgelegt. Der Netzstecker mit Erdungsvorrichtung ist ein wichtiger Sicherheitsschutz. Zum Schutz vor elektrischem Schlag oder Sachschäden am Gerät die Erdung nicht abschalten.
- Das Gerät ist mit einer oder mehreren auswechselbaren Batterien ausgestattet. Bei unsachgemäßem Auswechseln der Batterie besteht Explosionsgefahr. Batterien nur mit dem vom Hersteller empfohlenen Typ oder entsprechenden Typen ersetzen. Gebrauchte Batterien sind gemäß den Anweisungen des Herstellers zu entsorgen.

Für Geräte mit mehrfachen Netzanschlussleitungen

Wenn Ihr Speichersystem oder Plattenregal über mehrere Stromkabel verfügt und Sie die Einheit ausschalten müssen, folgenden Warnhinweis beachten:

ACHTUNG

Gerät besitzt zwei Netzanschlussleitungen. Vor Wartung alle Anschlüsse vom Netz trennen.

Preface

About this guide

This guide describes how to set up, install, connect, and manage the NetApp® Fibre Channel DiskShelf14 (DS14), DiskShelf14mk2 FC (DS14mk2 FC) and DiskShelf14mk4 FC (DS14mk4 FC).

Audience

This guide is for qualified system administrators and service personnel who are familiar with NetApp™ filers and/or NetCache® appliances.

Terminology

This guide uses the following terms:

- *Disk shelf* refers to any Fibre Channel disk shelf model.
- *HA configuration* refers to a disk shelf configuration that has an ESH (Embedded Switching Hub), ESH2 or ESH4 module instead of an LRC (Loop Resiliency Circuit) module.
- *LRC* refers to the device with the enclosure services processor that communicates the environmental data of the disk shelf to the filer and that keeps the FC-AL loop intact during the addition and removal of disks within a disk shelf.
- *ESH* refers to the device with the enclosure services processor that communicates the environmental data of the disk shelf to the filer and that provides high availability should a disk fail.
- *ESH2* refers to a second-generation, dual-loop speed ESH module.
- *ESH4* refers to the third-generation, multiloop speed ESH module.
- *Module* refers to the LRC, ESH, ESH2, and ESH4 modules.
- *Device carrier* refers to the container that encases a fan/power supply unit or a disk.
- *Disk* applies to any Fibre Channel disk encased in its device carrier.
- *Loop* refers to one or more daisy-chained disk shelves connected to a storage system.
- *Terminate* refers to the process of closing a loop on an LRC or ESH module by activating a terminate switch on the last disk shelf in the loop. The terminate switch replaces the Output terminators and the auto-terminate mechanism in previous versions of Fibre Channel disk shelves.
- *Storage system* refers to those NetApp systems that support the disk shelves.
- *Multiloop appliance* refers to a storage system with more than one FC-AL adapter connected to disk shelves.

Command conventions

You can enter filer commands on the system console or from any client that can obtain access to the filer using a Telnet session. In examples that illustrate commands executed on a UNIX workstation, the command syntax and output might differ, depending on your version of UNIX.

Formatting conventions

The following table lists different character formats used in this guide to set off special information.

Formatting convention	Type of information
Italic type	◆ Words or characters that require special attention. ◆ Placeholders for information you must supply. For example, if the guide requires you to enter the `fctest` *adaptername* command, you enter the characters "fctest" followed by the actual name of the adapter. ◆ Book titles in cross-references.
`Monospaced` font	◆ Command and daemon names. ◆ Information displayed on the system console or other computer monitors. ◆ The contents of files.
`Bold monospaced` font	Words or characters you type. What you type is always shown in lowercase letters, unless your program is case-sensitive and uppercase letters are necessary for it to work properly.

Keyboard conventions

This guide uses capitalization and some abbreviations to refer to the keys on the keyboard. The keys on your keyboard might not be labeled exactly as they are in this guide.

What is in this guide...	What it means...
hyphen (-)	Used to separate individual keys. For example, Ctrl-D means holding down the Ctrl key while pressing the D key.

What is in this guide...	What it means...
Enter	Used to refer to the key that generates a carriage return, although the key is named Return on some keyboards.
type	Used to mean pressing one or more keys on the keyboard.
enter	Used to mean pressing one or more keys and then pressing the Enter key.

Special messages

This guide contains special messages that are described as follows:

Note
A note contains important information that helps you install or operate the system efficiently.

Attention
An attention notice contains instructions that you must follow to avoid damage to the equipment, a system crash, or loss of data.

Danger
A danger notice contains instructions that you must follow to avoid personal injury.

Installation Roadmap for the diskshelf 1

About this chapter

This chapter provides a roadmap for installing the DS14, DS14mk2 FC, and DS14mk4 FC disk shelf.

Topics in this chapter

This chapter discusses the following topics:

Differences between the various disk shelf models

Differences between the disk shelves

The following table lists the differences between the various disk shelf models.

Note

See the System Configuration Guide at http://now.netapp.com for information about the storage system supporting the disk shelf configuration. Not all disk shelves or shelf modules are supported by all storage systems or operating systems.

Features	DS14	DS14mk2 FC	DS14mk4 FC
Shelf chassis	**Front:** Drive bays are not keyed. **Back:** Power supply bays are not keyed.	**Front:** Drive bays are keyed to prevent the use of unsupported drives. **Back:** Power supply bays are keyed to prevent the use of older power supplies that are incompatible. Existence of a 1-Gb/2-Gb loop-speed switch. ◆ The 1-Gb loop speed setting must be used if the disk shelf is connected to the FAS270. ◆ The 2-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 2-Gb operation. Examples of these components are this disk shelf model, SFPs, or HBAs.	**Front:** Drive bays are keyed to prevent the use of unsupported drives. **Back:** Power supply bays are keyed to prevent the use of older power supplies that are incompatible. Existence of a 1-Gb/2-Gb/ 4-Gb loop-speed switch. ◆ The 1-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 1-Gb operation. Examples of these components are the FAS270 or the DS14.. ◆ The 2-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 2-Gb operation. Examples of these components are the DS14mk2FC, SFPs, HBAs, or drives.

Features	DS14	DS14mk2 FC	DS14mk4 FC
			◆ For the 4-Gb loop speed setting to be used, all components on any part of the loop must be of 4-Gb capable. Examples of these components are this disk shelf model, SFPs, HBAs, or drives.
Drives in drive carriers	Drive carriers are unkeyed and cannot be used with DS14mk2 FC or DS14mk4 FC.	Drive carriers are keyed and can be used with all shelf models.	Drive carriers are keyed and can be used with all shelf models.
Power supplies	Power supplies are unkeyed and cannot be used with DS14mk2 FC or DS14mk4 FC.	Power supplies are keyed and can be used with all shelf models.	Power supplies are keyed and can be used with all shelf models..
ESH4	Does not support the use of ESH4.	◆ ESH4 functions at 1-Gb or 2-Gb loop speed, depending on the system configuration. ◆ Does not have a terminate switch.	◆ ESH4 functions at 1-Gb, 2-Gb, or 4-Gb loop speed, depending on the system configuration. ◆ Does not have a terminate switch.
ESH2	◆ ESH2 functions at 1-Gb loop speed. ◆ Does not have a terminate switch.	◆ ESH2 functions at 1-Gb or 2-Gb loop speed, depending on the system configuration. ◆ Does not have a terminate switch.	Does not support the use of ESH2.
ESH	ESH functions at 1-Gb loop speed.	ESH functions at 1-Gb or 2-Gb loop speed, depending on the system configuration.	Does not support the use of ESH.
LRC	LRC functions at 1-Gb loop speed.	LRC functions at 1-Gb loop speed and requires the loop-speed switch to be set at 1-Gb.	Does not support the use of LRCs

Before you begin your installation

About disk shelf installation

Before you install one or more disk shelves in a rack, you need to understand the following information:

- Disk shelf numbering
- Loop IDs
- Supported disk drives
- Drive bay requirements

Disk shelf numbering

Each disk shelf in a loop must have a unique ID. A valid shelf ID is from 1 through 7, with disk shelf 1 connected to the storage system. If you install a second or third loop of disk shelves, the disk shelf IDs in each loop must start at 1. The ID of a single disk shelf must be 1.

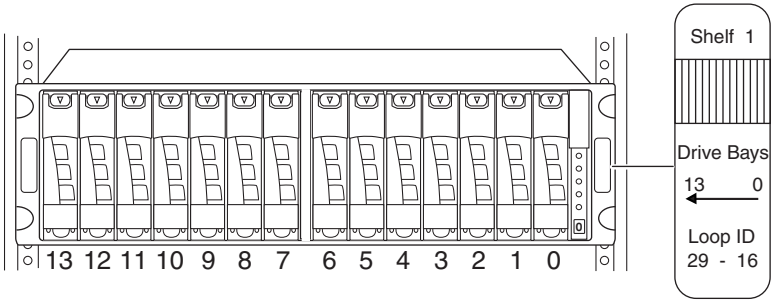
Note

When connecting a DS14 or DS14mk2 FC with LRCs to a preexisting mixed-shelf loop of FC7, FC8 and/or FC9, the DS14 or DS14mk2 FC disk shelf ID must be higher than any of the disk shelves already in the loop.

Attention

Disk shelves with LRC modules must not be present in a loop with ESH, ESH2, or ESH4 modules.

Each disk shelf is shipped with its assigned ID set on its back panel. You must ensure that the disk shelf has the correct ID number on the label. The ID label is on the right side of the disk shelf, as shown in the following illustration.



NetApp sets the disk shelf IDs at the factory on configured systems, using an ID switch on the back panel. If you order additional disk shelves, you must set the disk shelf ID.

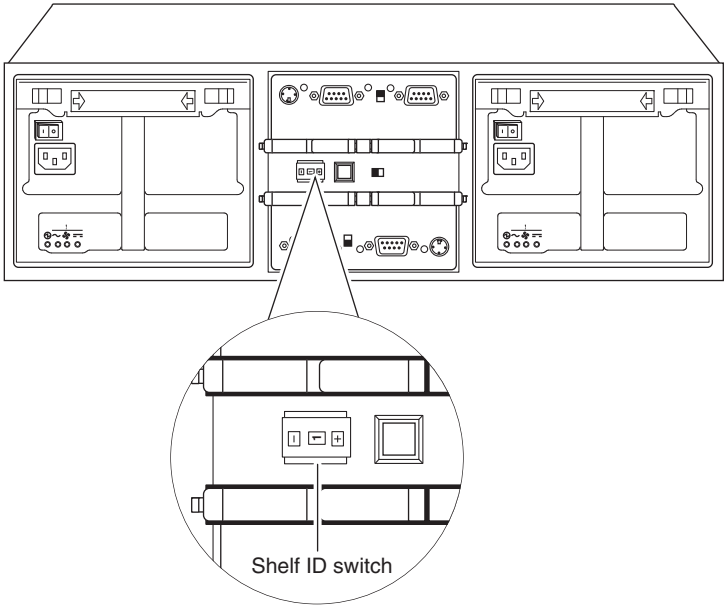
Attention

If you change a disk shelf ID, you must power-cycle the disk shelf for the new ID to take effect. The disk shelf ID display on the front of the disk shelf blinks until you power-cycle the disk shelf.

Note

If you enter a shelf ID that is not from 1 through 7, the drive addresses default to those of a shelf with the ID switch set to 7 even though the Shelf ID indicator in the front operation panel displays a dash (-).

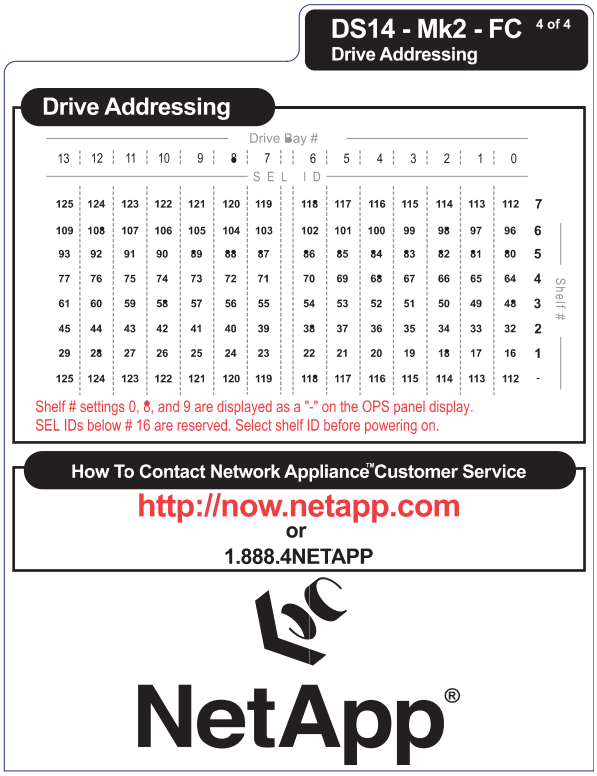
The example in the following illustration shows a DS14mk2 FC with the disk shelf ID set to 1.



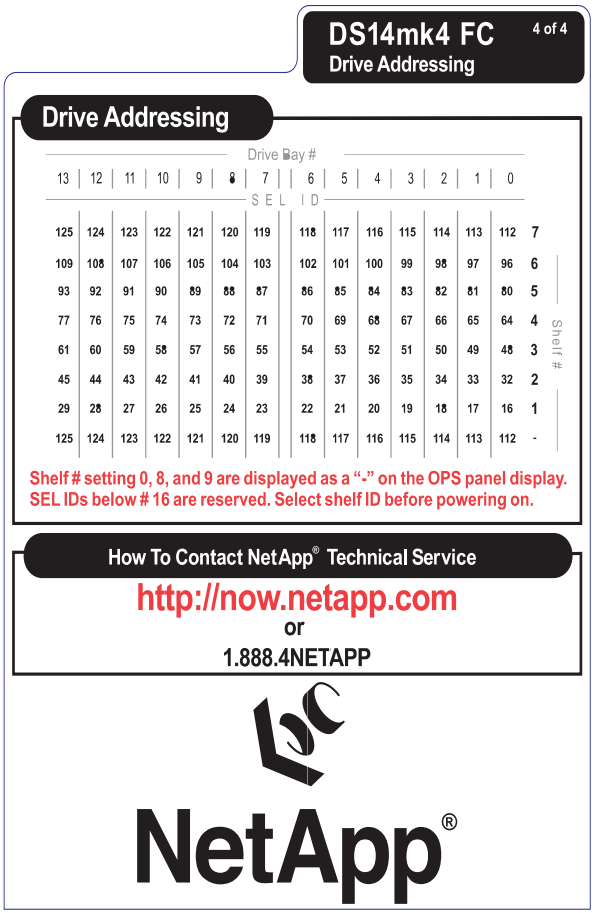
Loop IDs

In addition to identifying the disk shelf ID and the direction of the drive bays, the ID label on the right side of the disk shelf includes the loop ID. The loop ID identifies the disks in the disk shelf. The last sheets of the quick reference cards that come with your disk shelf shows the seven disk shelf IDs and their corresponding loop IDs.

For DS14 and DS14mk2 FC:



For DS14mk4 FC:



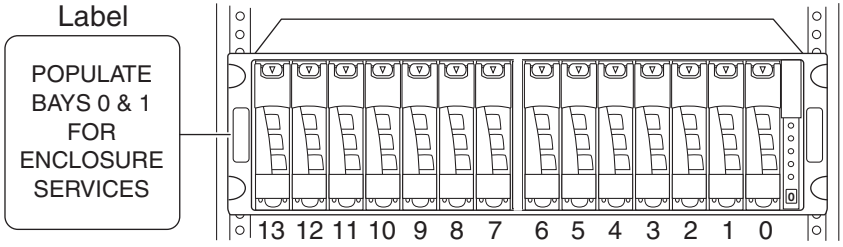
Supported disk drives

The DS14, DS14mk2 FC, and DS14mk4 FC support block checksum disk drives. See the *System Configuration Guide* at http://now.netapp.com for more information on supported drives and platforms.

Drive bay requirements

For enclosure services monitoring to work, drive bays 0 and 1 must contain a disk.

This requirement is posted on the label on the left flange of the disk shelf. The 14 drive bays in the disk shelf are numbered 0 through 13 from right to left, as shown in the following illustration.



The storage system uses the enclosure services monitoring method to monitor environmental conditions of the disk shelf. Enclosure services conditions are communicated to the storage system through the LRC/ESH module.

The following table describes the three stages of enclosure services monitoring.

Stage	Device	What it does...
1	Storage system	Uses a subset of SCSI-3 commands to monitor the disk shelf for data related to disk presence, temperature, power supply units, and fan status.
2	Storage system	Sends the commands through its Fibre Channel interface to drive bays 0 and 1 on the disk shelf.
3	Drive bays 0 and 1	Communicate the request to the LRC/ESH module and send the data to the storage system.
	LRC, ESH, or ESH2, ESH4 module	Collects the requested data and sends it to drive bays 0 and 1.

The installation process

The installation process

The following table provides a guide to the disk shelf installation process.

Stage	Procedure	Is the procedure required?	For instructions, go to...
1	Install the storage system in a freestanding rack.	Only if the disk shelf installation is part of a new system installation.	*Installation and Setup Instructions* for your storage system.
2	Install the disk shelves in the rack.	Yes, if the disk shelf is an addition to your existing system or if your new system was not shipped in a system cabinet.	*Installation and Setup Instructions* for your storage system.
3	Connect the disk shelf to the storage system.	Only in the following scenarios: ◆ If the disk shelf installation is part of a new system installation.	*Installation and Setup Instructions* for your storage system.
		◆ If the disk shelf is the first in an additional loop to your existing system.	"Hot-adding a disk shelf to an existing adapter in your system" on page 84
4	Connect the disk shelves.	Only in the following scenarios: ◆ If the new system installation has multiple disk shelves.	*Installation and Setup Instructions* for your storage system.
		◆ If the disk shelf is an addition to your existing system.	Appendix A, "Hot-adding a DS14/DS14mk2 FC/DS14mk4 FC," on page 76

Stage	Procedure	Is the procedure required?	For instructions, go to...
5	Ground the Fibre Channel disk shelves and storage system.	Yes.	*Installation and Setup Instructions* for your storage system, “Installing a disk shelf in a rack” on page 43, or Appendix A, “Adding a Disk Shelf to an Existing System,” on page 71.
6	Connect the disk shelves to a power source.	Yes.	*Installation and Setup Instructions* for your storage system, “Installing a disk shelf in a rack” on page 43, or Appendix A, “Adding a Disk Shelf to an Existing System,” on page 71.
		If the system was shipped in a system cabinet, you must connect the system cabinet to a power source.	See the *System Cabinet Guide*.
7	Configure the system.	Yes, if the disk shelf installation is part of a new system installation.	See the *Data ONTAP Software Setup Guide*.

Monitoring the Disk Shelf 2

About this chapter

This chapter describes how to monitor the disk shelf from the error messages displayed on the console that is connected to the storage system and identifies the location of the various LEDs on the disk shelf.

Note

The quick reference cards in the slide-out tray at the base of the disk shelf describe the functions of each LED on the disk shelf and the suggested course of action.

Topics in this chapter

This chapter discusses the following topics:

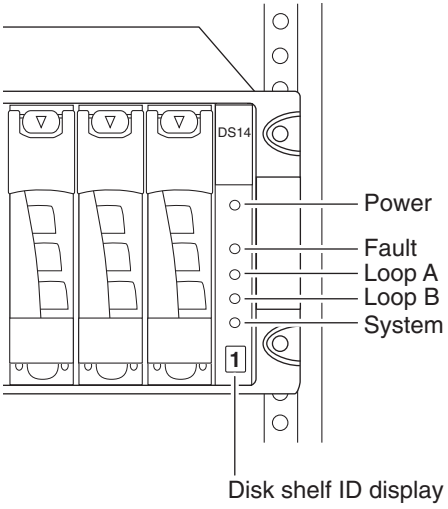
Monitoring the front operation panel

About monitoring the front operation panel

The front operation panel has five LEDs and a disk shelf ID display. The LEDs indicate whether your disk shelf is functioning normally or there are problems with the hardware. You can also identify any hardware failure associated with the front operation panel of the disk shelf from the error messages displayed on your storage system console.

Location of LEDs

The following illustration shows the location of the disk shelf ID display and the front panel LEDs.



Note

The Fault and System LEDs are amber. The other three LEDs are green. See "LED status on the front operation panel" on page 13 for an illustrated explanation of how the LEDs function.

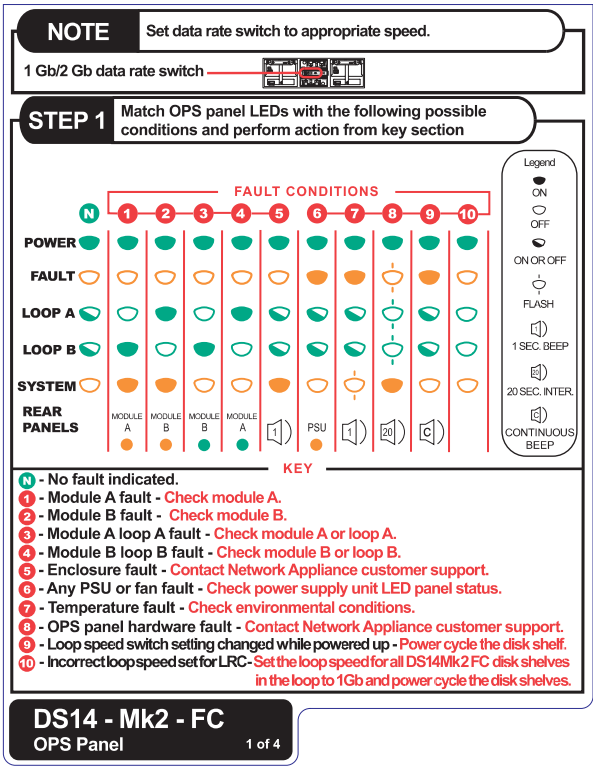
Monitoring the disk shelf ID

When you use the thumbwheel switch on the back of the disk shelf to change the disk shelf ID, the disk shelf ID display on the front panel blinks until you power-cycle the disk shelf to make the change take effect.

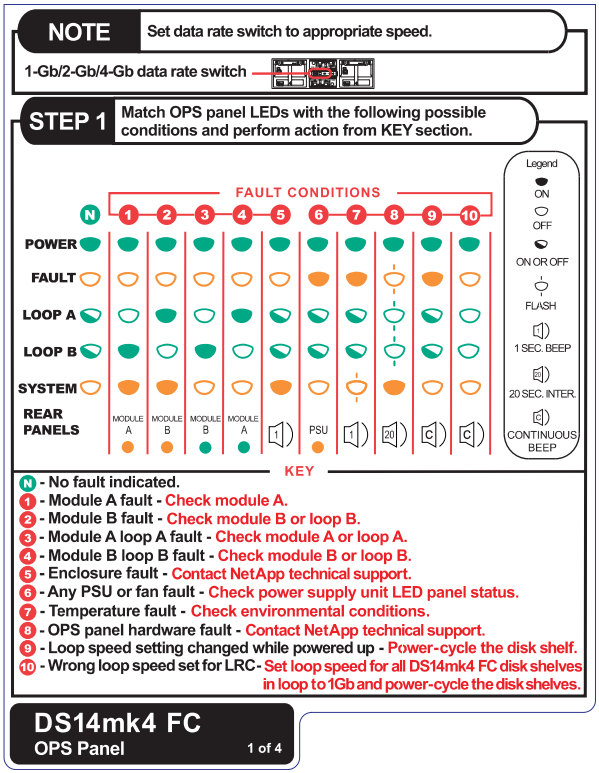
LED status on the front operation panel

The following illustrations are of the first sheets of the quick reference cards that come with your disk shelf. They shows the normal and fault conditions that the LEDs indicate and recommends a corrective action.

For DS14 and DS14mk2 FC:



For DS14mk4 FC:



Front operation panel console error messages

The following error messages appear on your storage system console if an SES element on the front operation panel fails. For information about replacing a disk shelf, see “Replacing a disk shelf” on page 34.

Error message	Action required
`Temperature sensor Element 1: failed`	The temperature sensor on the front operation panel failed. Contact technical support to replace the disk shelf.
`Alarm Element 1: failed`	The alarm on the front operation panel failed. Contact technical support to replace the disk shelf.
`Display Element 1: failed`	The alarm on the front operation panel failed. Contact technical support to replace the disk shelf.

Monitoring the LRC, ESH, ESH2, or ESH4 modules

About monitoring the modules

All the modules have LEDs that indicate whether it is functioning normally or if there are any problems with the hardware. The following table identifies the type of LED that is available for each type of module.

Note

The Fault LED is amber. The input and output LEDs are green. See "LED status on the modules" on page 17 for an illustrated explanation of the LED functions. On ESH4, the appropriate loop speed LED lights up to indicate the speed of operation.

LED indicating...	LRC	ESH	ESH2	ESH4
Input	X	X	X	X
Output	X	X	X	X
Fault	X	X	X	X
1-Gb operation	-	-	-	X
2-Gb operation	-	X	X	X
4-Gb operation	-	-	-	X
ELP (future functionality)	-	-	-	X

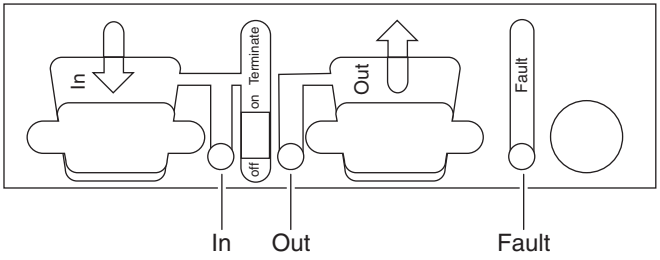
You can also identify any hardware failure associated with the module from the error messages displayed on your storage system console.

This section also describes the different types of messages that appear on the storage system console in response to a command monitoring the ESH/ESH2/ESH4.

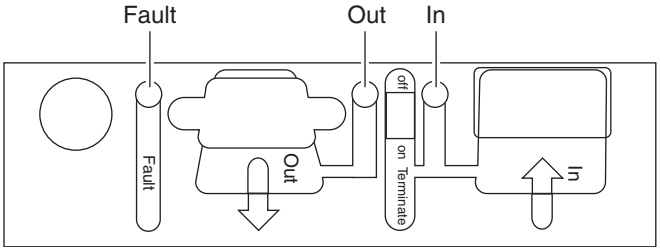
Location of the module LEDs

The modules are in the middle of the back of the disk shelf. Because module A is inverted, the location of the module A LEDs is the inverse of what is shown in some of the illustrations.

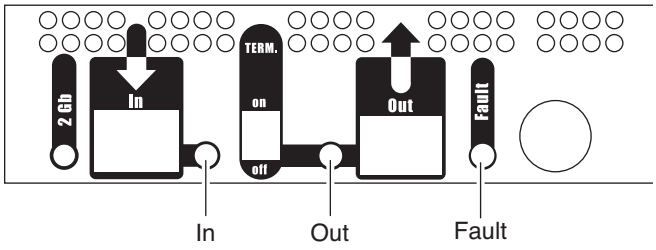
The following illustration shows the location of the LEDs for an LRC with copper interfaces.



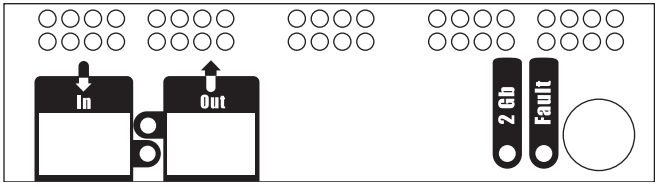
The following illustration shows the location of the LEDs for an LRC with an optical input interface and copper output interface.



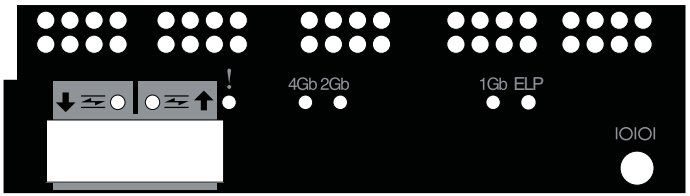
The following illustration shows the location of the LEDs for an ESH.



The following illustration shows the location of the LEDs for an ESH2.



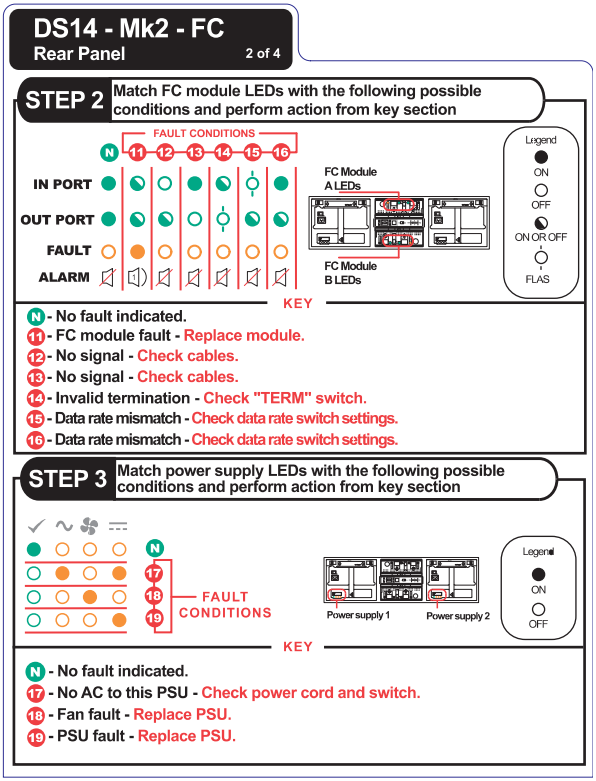
The following illustration shows the location of the LEDs for an ESH4. The LED for ELP is for future functionality.



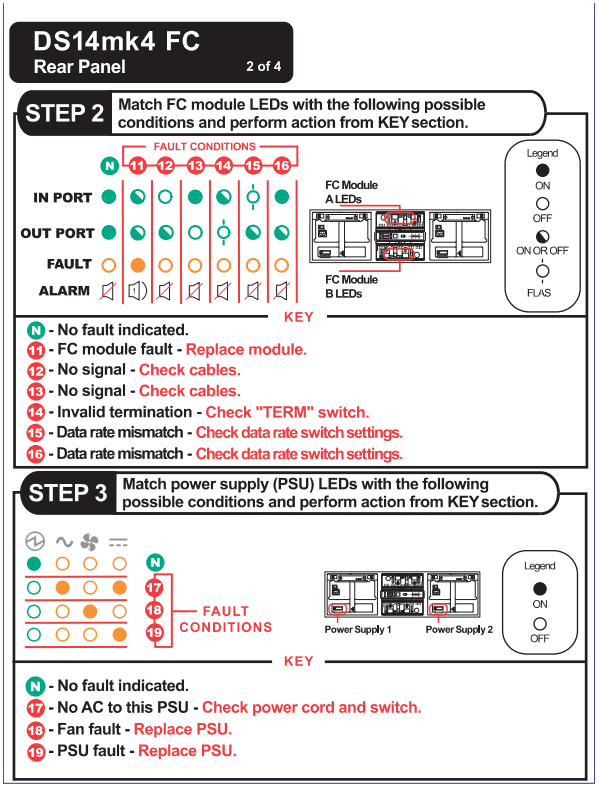
LED status on the modules

The following illustrations are of the second sheets of the quick reference cards that come with your disk shelf. The rest of the second sheet of the quick reference card identifies the LED status conditions for the power supply and the integrated fan module.

For DS14 and DS14mk2 FC:



For DS14mk4 FC:



Console error messages for the modules

The following error messages appear on your storage system console if an SES element on the module fails. For information about replacing the module, see “Replacing an LRC/ESH/ESH2/ESH4 module” on page 54.

Error message	Action required
`Temperature sensor Element 2: failed`	The temperature sensor on LRC module A on the top back of the disk shelf failed. Contact technical support to replace the module.
`Temperature sensor Element 3: failed`	The temperature sensor on LRC module B on the bottom back of the disk shelf failed. Contact technical support to replace the module.

Error message	Action required
`SES electronics Element 1: component is from a different product family`	Module A was replaced and the shelf has the following unsupported configurations: ◆ ESH and LRC ◆ ESH2 and LRC ◆ ESH and ESH2 ◆ ESH and ESH4 ◆ ESH2 and ESH4 This error message occurs during the process of hot-upgrading.
`SES electronics Element 2: component is from a different product family`	Module B was replaced and the shelf has the following unsupported configurations: ◆ ESH and LRC ◆ ESH2 and LRC ◆ ESH and ESH2 ◆ ESH and ESH4 ◆ ESH2 and ESH4 This error message occurs during the process of hot-upgrading.
`SES electronics Element 1: failed`	Module A on the top back of the disk shelf failed. Contact technical support to replace the module.
`SES electronics Element 2: failed`	Module B on the bottom back of the disk shelf failed. Contact technical support to replace the module.
`Temperature sensor Element 2: not installed or failed`	Communication was possible with the temperature sensor on ESH/ESH2/ESH4 module A at one point, but it is not possible now. Even if traffic is flowing through the Fibre Channel loop, contact technical support to replace the ESH/ESH2/ESH4.

Error message	Action required
`Temperature sensor Element 3: not installed or failed`	Communication was possible with the temperature sensor on ESH/ESH2/ESH4 module B at one point, but it is not possible now. Even if traffic is flowing through the Fibre Channel loop, contact technical support to replace the ESH/ESH2/ESH4.
`SES electronics Element 1: not installed or failed`	Communication was possible with ESH/ESH2/ESH4 module A at one point, but it is not possible now. Even if traffic is flowing through the Fibre Channel loop, contact technical support to replace the ESH/ESH2/ESH4.
`Vendor-specific Element 1: not installed or failed`	
`SES electronics Element 2: not installed or failed`	Communication was possible with ESH/ESH2/ESH4 module B at one point, but it is not possible now. Even if traffic is flowing through the Fibre Channel loop, contact technical support to replace the ESH/ESH2/ESH4.
`Vendor-specific Element 2: not installed or failed`	

Monitoring the ESH/ESH2/ESH4

Command to use: Use the following commands to enable you to monitor the ESH/ESH2/ESH4.

If the disk shelf connects to a...	Use the commands...
Storage system with Data ONTAP 7.x or earlier installed	◆ `storage show hub` ◆ `environ shelf`

If the disk shelf connects to a...	Use the commands...
Storage system with Data ONTAP 10.x installed	◆ `storage show hub` ◆ `environ shelf` But you must do the following before you can use the above commands: **1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`**

Sample output: The following is an example of the output from the `storage show hub` command. The exact messages that appear on your system console depend on your system configuration.

Note

For the ESH2/ESH4, the following output shows the *Term switch* status as N/A or not applicable because the ESH2/ESH4 does not have a terminate switch.

```
Hub name: 9.shelf2
Channel: 9
Loop: B
Shelf id: 2
Shelf UID: 50:05:0c:c0:02:00:24:02
Term switch: ON
Shelf state: ONLINE
ESH state:   OK

Disk    Disk   Port      Loop    Invalid   Invalid   Clock   Inser    Stall   Uti    LIP
ID      Bay    State     up      CRC       Word      Delta   t        Count   l %    Count
                         Count   Count     Count             Count
```

```
[IN]          OK         8        0        0        0        20       0        0        0
[OUT]         TERM       8        0        0        -8       6        0        0        0
[32]    0     OK         10       0        0        0        6        0        0        0
[33]    1     OK         8        0        0        -8       9        0        0        0
[34]    2     OK         10       0        0        -8       6        0        0        0
[35]    3     OK         10       0        0        0        8        0        0        0
[36]    4     OK         10       0        0        0        9        0        0        0
[37]    5     OK         10       0        0        -16      7        0        0        0
[38]    6     OK         10       0        0        0        6        0        0        0
[39]    7     OK         10       0        0        16       16       0        0        0
[40]    8     BYP/TBI    10       0        0        0        8        0        0        0
[41]    9     OK         8        0        0        -8       6        0        0        0
[42]    10    OK         8        0        0        0        6        0        0        0
[43]    11    EMPTY      8        0        0        0        15       0        0        0
[44]    12    OK         8        0        0        8        4        0        0        0
[45]    13    OK         10       0        0        16       8        0        0        0
```

Description of hub status information

You might receive some of the following status reports in response to the `storage show hub` command.

Shelf state: The following table lists and describes the shelf status responses.

Shelf state	Description
ONLINE	Shelf is fully configured and operational.
INIT REQD	Shelf needs to configure one or both ESH/ESH2/ESH4 modules.
OFFLINE	Contact was lost with shelf (SES drive access is down).
MISSING	Shelf was removed from the system entirely (all paths).
FAILED	Failure occurred on the shelf.

ESH/ESH2/ESH4 state: The following table lists and describes the ESH/ESH2/ESH4 status responses.

Shelf state	Description
OK	ESH/ESH2/ESH4 is fully operational.
MISSING	ESH/ESH2/ESH4 is missing from the specified slot.

Shelf state	Description
XPORT ERROR	Communication with the ESH/ESH2/ESH4 is not possible.

Terminate (Term) switch state: The following table lists and describes the terminate switch status.

Note
The information in the following table is not applicable to the ESH2 because it does not have a terminate switch.

Shelf state	Description
OK	Terminate switch is in the Off position. This DS14/DS14mk2 FC is connected to another DS14/DS14mk2 FC in the loop.
TERM	Terminate switch is in the On position. This DS14/DS14mk2 FC is the last shelf in the loop.
TERM-ERR	Forced terminate event. The terminate switch is in the On position even though this DS14/DS14mk2 FC is connected to another DS14/DS14mk2 FC in the loop. The ESH output port LED flashes to indicate this configuration error.
AUTO-TERM	Terminate switch is in the Off position. The output port is no longer connected to another DS14/DS14mk2 FC in the loop, but it once was. The ESH output port LED flashes to indicate this configuration error.

ESH/ESH2/ESH4 port state: The following table lists and describes the ESH/ESH2/ESH4 status responses.

Shelf state	Description
OK	Port is functioning normally.
EMPTY	No drive is present in bay.
BYP/TBI	Port failed loop test before insert and was not allowed into loop.
BYP/XMIT	Port bypassed due to transmitter default.

Shelf state	Description
BYP/LIPF8	Port bypassed due to drive generating LIP F8s.
BYP/DTO	Port bypassed due to data timeout errors.
BYP/RLOS	Port bypassed due to receiver loss of signal.
BYP/CLOS	Port bypassed due to comma loss of signal.
BYP/RPRT	Port bypassed due to redundant port connection.
BYP/STALL	Port bypassed due to excessive stall errors.
BYP/WRD	Port bypassed due to excessive word errors.
BYP/CRC	Port bypassed due to excessive CRC errors.
BYP/CLK	Port bypassed due to excessive clock delta.
BYP/MIR	Port bypassed due to cluster mirror bit being set (check partner).
BYP/LIPF7	Port bypassed due to drive transmitting LIP F7s.
BYP/GEN	Port bypassed due to a “generic” error.
BYP/MAN	Port was manually bypassed (Manufacturing test only).
BYP/LIP	Port bypassed due to drive generating excessive LIP requests.
BYP/OSC	Port bypassed due to excessive port state changes.
BYP/INIT	Port bypassed as part of ESH Power-On Self-Test.
///:0xXX	ESH Admin unable to decode port state XX.

Hub statistic: The following table lists and describes the hub statistic responses.

Hub statistic	Description	Common values	Failure?
Loop up Count	Number of times this port saw the loop come up or transition to up.	Depends on the number of insertions and removals of disks and LIPs that occur in the loop.	No

Hub statistic	Description	Common values	Failure?
Invalid CRC Count	Number of times this port saw a CRC error.	Is zero under normal operation. Removal and addition of disks, and a reset of the adapter, might generate some CRC errors. CRC errors on a port pinpoint the failure location. Excessive CRC errors for a continuous time period cause the ESH/ESH2/ESH4 firmware to bypass this port.	Yes, if drive was bypassed.
Invalid Word Count	Number of times this port saw invalid FC-AL words transmitted.	Is zero under normal operation. Removal and addition of disks, and a reset of the adapter, might generate some word errors. Word errors on a port pinpoint the failure location. Excessive word errors for a continuous time period causes the ESH/ESH2/ESH4 firmware to bypass this port.	Yes, if drive was bypassed.
Clock Delta	The clock delta between this port in respect to the ESH/ESH2/ESH4 clock and seven other ports.	It is normal for the FC-AL sync clocks to drift with respect to each other. This is a signed drift value. A value exceeding 6,400 PPM causes the ESH/ESH2/ESH4 firmware to bypass this port.	Yes, if drive was bypassed.
Insert Count	Number of times this port was inserted into the loop.	Depends on the number of insertions and removals of disks and LIPs that occur in the loop.	No

Hub statistic	Description	Common values	Failure?
Stall Count	Number of times this port exceeded the open/close (OPN/CLS) maximum threshold.	Is zero under normal operation. Removal and addition of disks, and a reset of the adapter, might generate some stall errors. Excessive stall errors for a continuous time period cause the ESH/ESH2/ESH4 firmware to bypass this port.	Yes, if drive was bypassed.
Utilization %	Relative use of this port versus other ports in the ESH/ESH2/ESH4.	This value does not reflect the real-time use of what the ports are currently achieving and is only obtained when extended status is available from the ESH/ESH2. It indicates the relative use from the last time extended status was available.	No
LIP Count	Number of loop initializations on any ESH2 or ESH4 port only.	Is zero under normal operation on the drive ports.	No

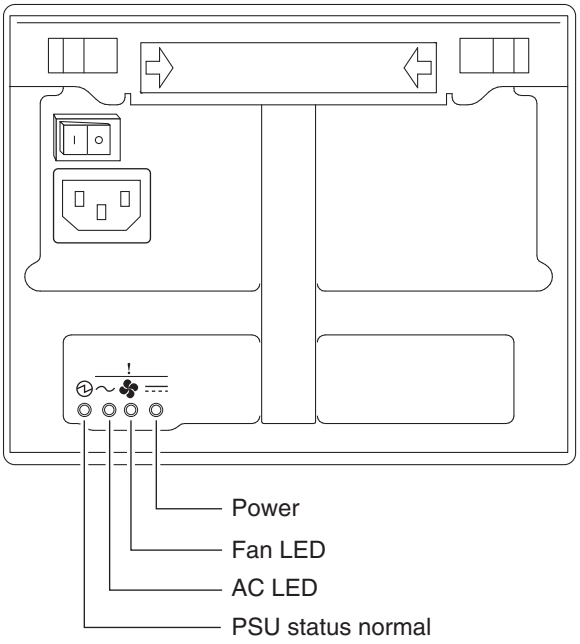
Monitoring the power supply

LEDs on the power supply

The power supply has four LEDs. The LEDs indicate whether the power supply or the integrated fan module is functioning normally or there are problems with the hardware. You can also identify any hardware failure associated with the power supplies from the error messages displayed on your storage system console.

Location of LEDs

Each power supply, which contains two LEDs, is encased in a device carrier and housed at the rear of the disk shelf. The following illustration shows the location of the power supply LEDs.



Note

The PSU status LED is green. The other three LEDs are amber. See "LED status on the modules" on page 17 for an illustrated explanation of how the LEDs function.

Power supply console error messages

The following error messages appear on your storage system console if an SES element on the power supply fails. For information about replacing the power supply, see “Replacing a power supply in a disk shelf” on page 50.

Error message	Action required
`Power supply Element 1: failed`	The power supply unit on the left at the back of the disk shelf failed. Contact technical support to replace the power supply.
`Power supply Element 2: failed`	The power supply unit on the right at the back of the disk shelf failed. Contact technical support to replace the power supply.
`Cooling element Element 1: failed`	The integrated fan module in the power supply unit on the left at the back of the disk shelf failed. Contact technical support to replace the power supply.
`Cooling element Element 2: failed`	The integrated fan module in the power supply unit on the right at the back of the disk shelf failed. Contact technical support to replace the power supply.

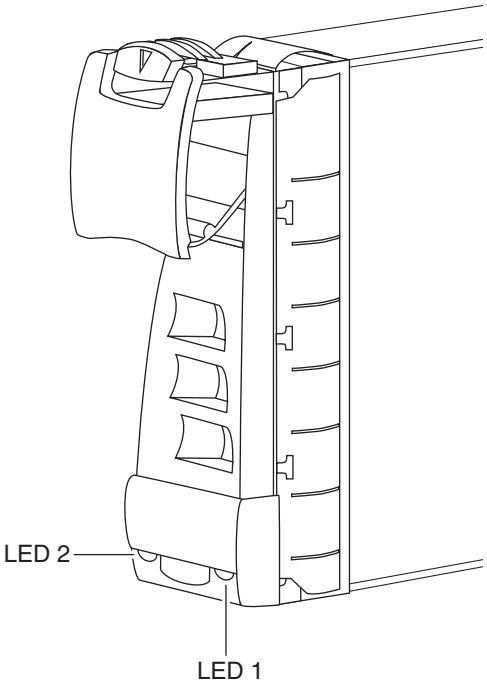
Monitoring the Fibre Channel disk

About monitoring the Fibre Channel disk

The Fibre Channel disk has two LEDs. The LEDs indicate whether the disk is functioning normally or there are problems with the hardware.

Location of LEDs

The following illustration shows the Fibre Channel disk, which has two LED indicators on the front.



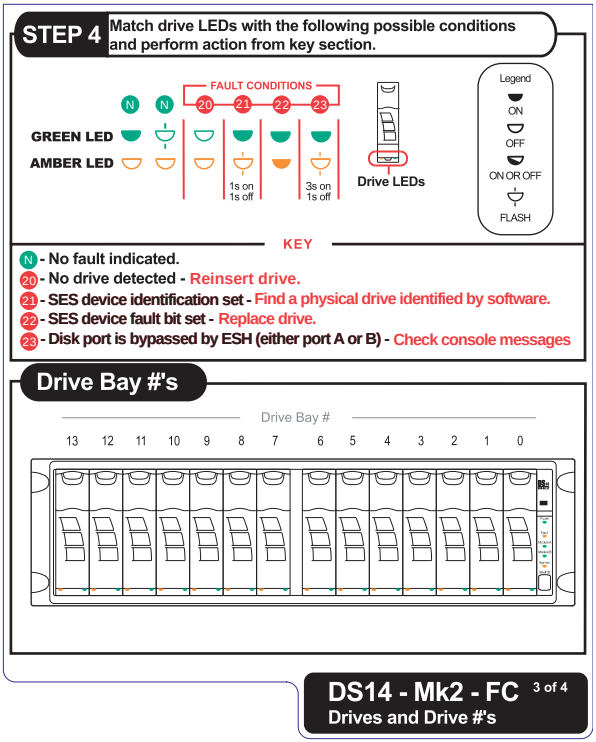
LED status on the Fibre Channel disks

The following illustrations are of the third sheets of the quick reference cards that come with your disk shelf.

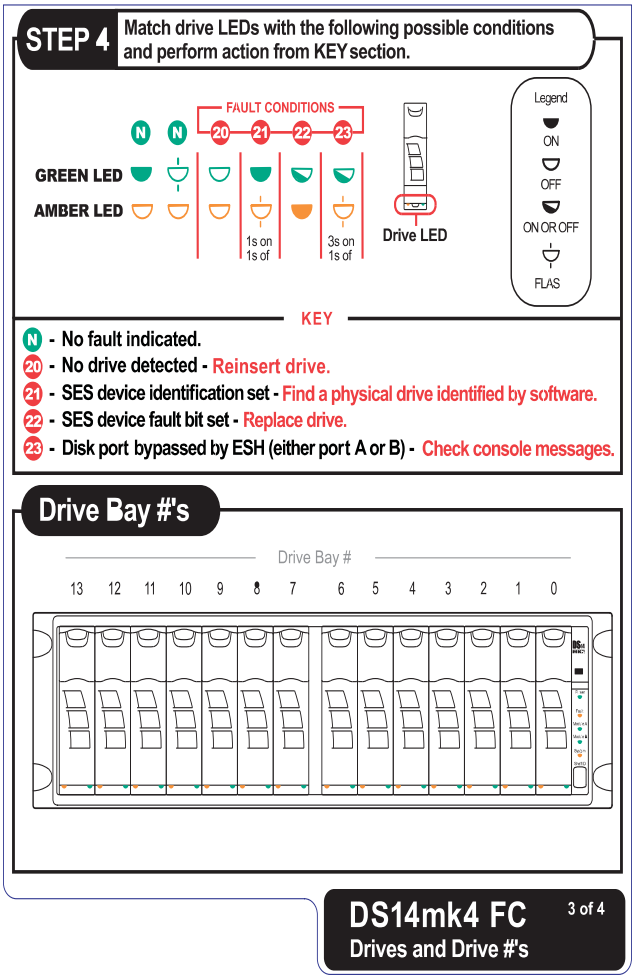
Note

As of Data ONTAP 6.4.2 and later, drives that are idle perform a media scan in the background resulting in the LEDs pulsing every half second.

For DS14 and DS14mk2 FC: The following illustration is a correction of the third sheet of the quick reference cards that come with your disk shelf.



For DS14mk4 FC:



Replacing Disk Shelf Devices 3

About this chapter

This chapter describes how to replace disk shelves in a rack, disks in a disk shelf, and other devices.

Topics in this chapter

This chapter discusses the following topics:

Replacing a disk shelf

About this section

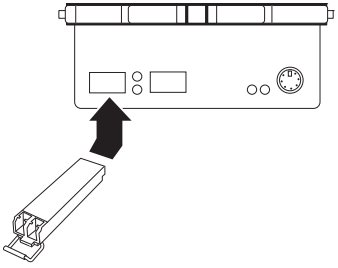
This section discusses how to disconnect a disk shelf from a storage system, how to remove a disk shelf from a loop, and how to install a disk shelf. It does not discuss how to hot-add a disk shelf to a storage system. For information about hot-adding a disk-shelf, see Appendix A, "Hot-adding a DS14/DS14mk2 FC/DS14mk4 FC," on page 76.

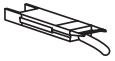
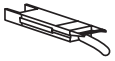
Attention

Hot removal of disk shelves is not supported. Shutdown of filer/FAS appliance is required to remove shelves from system.

Disk shelf cabling requirements

The following table lists the cabling requirements for the disk shelves.

Cable type and connector	Where used	Additional requirements
LC-to-LC: 	To connect storage system optical adapters to the ESH, ESH2, or ESH4 module	Requires optical SFP connector in the input port of the following modules: ◆ ESH ◆ ESH2 ◆ ESH4 ◆ FAS270/FAS270c, if applicable 

Cable type and connector	Where used	Additional requirements
SFP-to-SFP 	To connect disk shelves with ESH2 and ESH4 modules	None
SFP-to-...  ...HSSDC2 	To connect disk shelves with ESH2 and ESH4 modules... ...to disk shelves with ESH modules	None
HSSDC2-to-HSSDC2 	To connect disk shelves with ESH modules	None
SC-to-...  ...LC 	To connect storage system with optical adapters... ...to disk shelves with LRC modules	None
HSSDC-to-...  ...DB9 	To connect storage system with copper adapters... ...to disk shelves with LRC modules	None
DB9-to-DB9 	To connect disk shelves with LRC modules only	None

For detailed information

For detailed information about removing a disk shelf from a rack, see the following topics:

- "Removing a disk shelf from a single disk shelf configuration" on page 37
- "Removing a disk shelf from a loop" on page 40
- "Installing a disk shelf in a rack" on page 43

Removing a disk shelf from a single disk shelf configuration

Removing a disk shelf

To remove a disk shelf from a single disk shelf configuration, complete the following steps.

Step	Action	
1	Ground yourself to the system chassis using the grounding leash.	
2	**If the disk shelf connects to a...**	**Then...**
	NetCache appliance	**1.** From the Appliance Manager home page, select Maintenance tab > System Control > Halt/Reboot. **2.** Select Halt NetCache.
	Storage system with Data ONTAP 7.x or earlier installed	Shut down the storage system by entering the following command at the console `halt` **Attention** Always use the `halt` command to perform a clean shutdown.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td></td><td>Storage system with Data ONTAP 10.x installed</td><td>1. Log into the storage system and enter the following command at the console to go to the shell command mode:
<tt>ngsh</tt>
2. Enter the following command at the console to go to the command line interface:
<tt>dbladecli</tt>
3. Shut down the storage system by entering the following command at the console:
<tt>halt</tt>
Attention
Always use the <tt>halt</tt> command to perform a clean shutdown.</td></tr>
<tr><td>3</td><td colspan="2">Verify that the LCD display at the front of your NetApp appliance displays the following message:

<tt>Halted</tt></td></tr>
<tr><td rowspan="3">4</td><td>If the disk shelf has...</td><td>Then...</td></tr>
<tr><td>AC power supplies</td><td>Turn off the power switch on the disk shelf.</td></tr>
<tr><td>DC power supplies</td><td>Turn off and unplug the cables from the power source.</td></tr>
<tr><td>5</td><td colspan="2">Disconnect the two disk shelf power cords from the disk shelf.</td></tr>
<tr><td>6</td><td colspan="2">Disconnect the Fibre Channel cable connecting the disk shelf and storage system.</td></tr>
</table>

Step	Action
7	Disconnect the grounding strap connecting the disk shelf and storage system.
8	Use a Phillips screwdriver to remove the screws securing the disk shelf to the telco tray, the mid-mount bracket, or the four-post rack.
9	With the help of another person, remove the disk shelf from the rack. **DANGER** The disk shelf is very heavy when fully loaded and requires at least two people to remove.

Removing a disk shelf from a loop

Removing a daisy-chained disk shelf

To remove a disk shelf from a loop of disk shelves, complete the following steps.

Step	Action	
1	Ground yourself to the system chassis using the grounding leash.	
2	**If the disk shelf connects to a...**	**Then...**
	NetCache appliance	**1.** From the Appliance Manager home page, select Maintenance tab > System Control > Halt/Reboot. **2.** Select Halt NetCache.
	Storage system with Data ONTAP 7.x or earlier installed	Shut down the storage system by entering the following command at the console `halt` **Attention** Always use the `halt` command to perform a clean shutdown.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td></td><td>Storage system with Data ONTAP 10.x installed</td><td>1. Log into the storage system and enter the following command at the console to go to the shell command mode:
<tt>ngsh</tt>
2. Enter the following command at the console to go to the command line interface:
<tt>dbladecli</tt>
3. Shut down the storage system by entering the following command at the console
<tt>halt</tt>
Attention
Always use the <tt>halt</tt> command to perform a clean shutdown.</td></tr>
<tr><td>3</td><td colspan="2">Verify that the LCD display at the front of your NetApp appliance displays the following message:

<tt>Halted</tt></td></tr>
<tr><td rowspan="3">4</td><td>If the disk shelf has...</td><td>Then...</td></tr>
<tr><td>AC power supplies</td><td>Turn off the power switch on the disk shelf.</td></tr>
<tr><td>DC power supplies</td><td>Turn off and unplug the cables from the power source.</td></tr>
<tr><td>5</td><td colspan="2">Disconnect the two disk shelf power cords from the disk shelf that you are going to remove.</td></tr>
<tr><td>6</td><td colspan="2">Disconnect the Fibre Channel cables connecting the disk shelf to the other disk shelves or the storage system.</td></tr>
</table>

Step	Action	
7	Disconnect the grounding strap connecting the disk shelf to the other disk shelves or the storage system.	
8	Use a Phillips screwdriver to remove the screws from the flanges of the disk shelf retention bracket.	
9	With the help of another person, remove the disk shelf from the rack. **DANGER** Because the disk shelf is very heavy when fully loaded, it is advised that at least two people remove the disk shelf.	
10	**If you are...**	**Then...**
	Not installing a replacement disk shelf for the disk shelf you removed and it is the first in the loop or in the middle of the loop	Reestablish the loop by connecting the disconnected disk shelves or by connecting the unconnected disk shelf to the storage system.
	Not installing a replacement disk shelf for the disk shelf you removed and it is at the end of the loop	Set the terminate switch for the LRC/ESH on Channel A (down) and Channel B (up) to the On position. **Note** ESH2 and ESH4 are self-terminating and do not have a terminate switch.
	Installing replacement disk shelf	See “Installing a disk shelf in a rack” on page 43.

Installing a disk shelf in a rack

Installing a disk shelf

To install the disk shelf in a rack, complete the following steps.

DANGER

You must install each disk shelf with either the two-post telco tray kit or the four-post rail kit that came in your shipment package. If you choose to mid-mount the disk shelf, use the mid-mount brackets with the two-post telco tray kit. Do not ear-mount the disk shelf into a telco-type rack; the disk shelf will collapse from the rack under its own weight.

Step	Action
1	Verify that your storage system meets the minimum software requirements to support the disk shelf. See the *System Configuration Guide* at http://now.netapp.com for more information.
2	Verify that you received the envelope with the disk shelf ID labels.
3	Ground yourself to the system chassis using the grounding leash.
4	Use the rail kit installation flyer in the rail kit box to install the appropriate rail kits on the rack.
5	Install and secure the disk shelf onto the support brackets and rack.
6	Change the disk shelf ID with the following procedure: **1.** Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7. **2.** Power-cycle the disk shelf for the new ID to take effect. The disk shelf ID display on the front of the disk shelf blinks until you power-cycle the disk shelf. **3.** Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.
7	If you are adding multiple disk shelves on the same loop, repeat Step 5 and Step 6 to install the remaining disk shelves.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td rowspan="3">8</td><td>If the disk shelf...</td><td>Then...</td></tr>
<tr><td>Is a DS14</td><td>Then go to Step 9.</td></tr>
<tr><td>Is a DS14mk2 FC or a DS14mk4 FC</td><td>Set the loop speed:
The 1-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 1-Gb operation. Examples of these components are LRCs, the FAS270 or the DS14.
The 2-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 2-Gb operation. Examples of these components are the DS14mk2FC, SFPs, HBAs, or drives.
For the 4-Gb loop speed setting to be used, all components on any part of the loop must be of 4-Gb capable. Examples of these components are this disk shelf model, SFPs, HBAs, or drives.
Attention
An incorrectly set loop speed causes the storage system to panic.</td></tr>
<tr><td>9</td><td colspan="2">Connect the grounding strap connecting the disk shelf to the other disk shelves or your storage system.</td></tr>
<tr><td>10</td><td colspan="2">Use the appropriate cable to connect both modules of the disk shelf to the other disk shelves or to your storage system. See “Disk shelf cabling requirements” on page 34 for additional requirements.</td></tr>
</table>

Step	Action
11	Connect the two disk shelf power cords to each disk shelf that you are adding.
12	Turn on the power first to the disk shelves and then to the storage system.
13	Reboot the storage system.

Replacing a disk in a disk shelf

Reasons to replace a disk

You can replace a disk in a disk shelf for any reason. However, the most common reason is disk failure. If a disk fails, the storage system logs a warning message to the system console indicating which disk on which loop failed.

In addition, a disk shelf with an ESH/ESH2/ESH4 module identifies any one of the following situations as disk failure:

- A disk is bypassed.
- The filer system boots with the presence of bypassed disks.
- The filer system detects an eminent threshold bypass.

The following autosupport warning message is then sent:

```
DISK FAIL!! - Bypassed by ESH
```

Preparing to replace a disk

Before you replace a disk in a disk shelf, you must first check the disk shelf to ensure that after you remove the disk you still have enough disks installed to meet the enclosure services requirements. For information about these requirements, see “Drive bay requirements” on page 7.

About replacing a disk in a disk shelf

Replacing a disk in a disk shelf consists of the following procedures:

- “Removing a disk” on page 47
- “Installing a disk” on page 49

Note

If you are replacing several disks in a disk shelf or if you are installing several disks into a half-empty disk shelf, replace or install the disks one at a time to allow your storage system to recognize the existence of each new disk.

Removing a disk

To remove a disk, complete the following steps.

Step	Action	
1	**If the disk shelf connects to a...**	**Then...**
	NetCache appliance	**1.** In the Appliance Manager, select Maintenance tab > Disk > Management. **2.** From the Disk Type column of the Disk Status table, identify the disk that you want to remove. **3.** Click Fail. **4.** Click Swap Drive. For more information about disk management, see the *NetCache Appliance Administration Guide*.
	Storage system with Data ONTAP 7.x or earlier installed	If you are removing disk that is a member of a volume, enter: **`disk fail disk_name`** Or: If you are removing disk that is a spare disk, enter: **`disk remove disk_name`** Either command causes the amber fault LED on the disk to illuminate. For more information about LEDs, see "Monitoring the Fibre Channel disk" on page 29. For more information about disk commands, see the Data ONTAP *System Administrator's Guide*.

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** If you are removing disk that is a member of a volume, enter: **`disk fail disk_name`** Or: If you are removing disk that is a spare disk, enter: **`disk remove disk_name`** Either command causes the amber fault LED on the disk to illuminate. For more information about LEDs, see “Monitoring the Fibre Channel disk” on page 29.
2	Put on the antistatic wrist strap and grounding leash.	
3	To remove the disk, press down on its release mechanism with one hand while grasping the top flange of the disk shelf with the other hand.	

Step	Action
4	Gently slide the disk until it disengages. Wait 30 seconds for the disk to stop spinning; then continue removing the disk from the chassis. **DANGER** When removing a disk, always use two hands to support its weight.
5	If you are removing another disk, repeat Step 1 through Step 4

Installing a disk

To install a disk in a disk shelf, complete the following steps.

Step	Action
1	Put on the antistatic wrist strap and grounding leash.
2	Orient the device carrier so that the release mechanism is at the top.
3	Insert the device carrier into the guide slot in the disk shelf and firmly push it in until it engages the backplane and you see the release mechanism click into place. **Note** If the device carrier does not fully seat in the drive bay, you may be trying to install a DS14 device carrier into a DS14mk2 FC or DS14mk4 FC disk shelf. **Attention** Do not slam the device carrier into place.
4	If you are installing another disk, repeat Step 1 through Step 3
5	Make sure that disks are installed in drive bays 0 and 1 for Enclosure Services to work.

Replacing a power supply in a disk shelf

About this section

Replacing a power supply in a disk shelf consists of the following procedures:

- "Removing a power supply" on page 50
- "Installing a power supply" on page 52

Rules for replacing power supplies

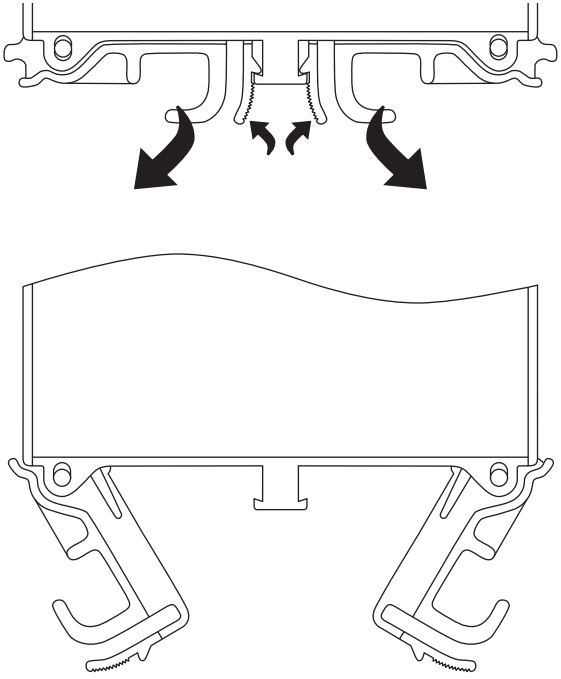
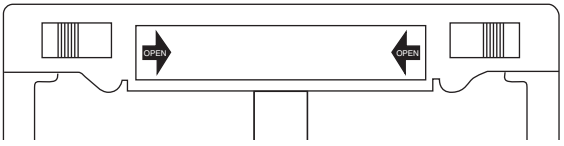
When replacing the power supply on your disk shelf, observe the following rules:

- You do not need to turn off the power when you replace one power supply.
- If you are replacing both power supplies in the same disk shelf, replace them one at a time to avoid powering down the disk shelf.

Removing a power supply

To remove a power supply, complete the following steps.

Step	Action	
1	Put on the antistatic wrist strap and grounding leash.	
2	**If you have a disk shelf with...**	**Then...**
	An AC power supply	**1.** Turn off the switch on the power supply that you are replacing. **2.** Lift up the clip lock and unplug the power cord from the storage system power supply.
	A DC power supply	**1.** Turn off and unplug the cable to the power supply you are replacing from the power source. **2.** Using a #2 Phillips screwdriver, remove and save the screws securing the connections to the power supply in the following order: ❖ For positive ground installations: first negative (–), then positive (+), then ground (⏚) ❖ For negative ground installations: first positive (+), then negative (–), then ground (⏚)

Step	Action	
3	**If the CAM mechanism on the power supply is...**	**Then...**
	In the middle of the rear of the unit	Using the thumb and index finger of both hands, press the CAM mechanism levers in the middle of the power supply to release it.
	The following figure shows how to release the CAM mechanism. 	
	At the top of the rear of the unit	Using your thumb and index finger, press the CAM mechanism levers toward each other to release the power supply handle.
	The following figure shows how to press the levers on the CAM mechanism and release the power supply handle. 	

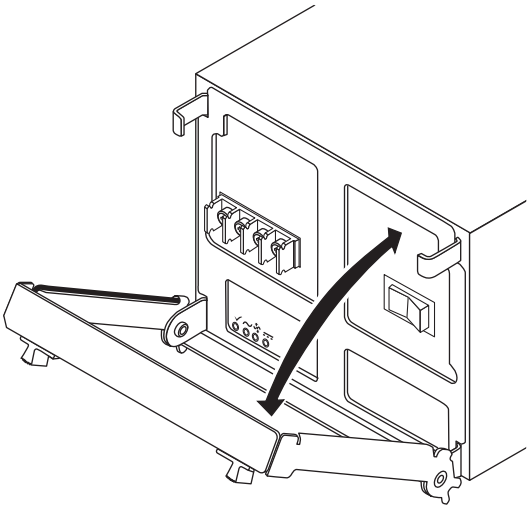
Step	Action
4	Use the handle to pull the power supply out of the disk shelf. **DANGER** When removing a power supply, always use two hands to support its weight.

Installing a power supply

To install a power supply in a disk shelf, complete the following steps.

Attention
Do not use excessive force when sliding the power supply into the disk shelf. You can damage the connector.

Step	Action	
1	Put on the antistatic wrist strap and grounding leash.	
2	**If the power supply CAM mechanism is...**	**Then slide the power supply in the power supply bay...**
	In the middle of the rear of the unit	And push the CAM mechanism levers into place.
	At the top of the rear of the unit	**1.** Until you hear the power supply connect with the connector inside the disk shelf chassis. **2.** Raise the handle and push it into place. **3.** Using your thumb and index finger, press the CAM mechanism levers toward each other to engage the power supply into place.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td></td><td colspan="2">The following figure shows how to raise the handle into place.
  </td></tr>
<tr><td rowspan="3">3</td><td>If the disk shelf has...</td><td>Then...</td></tr>
<tr><td>An AC power supply</td><td>1. Plug the power cord into the power receptacle and fasten it with the clamp.
2. Plug the other end of the power cord into a grounded AC power source.</td></tr>
<tr><td>A DC power supply</td><td>1. Connect the positive, negative, and ground wires to the power supply.
2. Plug the other end of each power cord into a power source.</td></tr>
<tr><td>4</td><td colspan="2">Turn on the power switch.</td></tr>
</table>

Replacing an LRC/ESH/ESH2/ESH4 module

About a module

The LRC/ESH/ESH2/ESH4 module in a DS14, DS14mk2 FC, DS14mk4 FC includes a SCSI-3 Enclosure Services Processor. It maintains the integrity of the loop when disks are swapped and provides signal retiming for enhanced loop stability. There are two modules in the middle of the rear of the disk shelf, one for Channel A and one for Channel B.

Note

The Input and Output ports on module A on the disk shelves are inverted from module B.

Connectors in a module: The modules have the following connectors.

Module connector	Function
Input	Provides the interface between the disk shelf and the storage system.
Output	Provides the interface between two disk shelves to create a loop of daisy-chained disk shelves.

For detailed information

This section provides information about the following topics:

- "Removing a module" on page 55
- "Installing a module" on page 57
- "Hot-swapping a module" on page 58
- "Hot-upgrading or hot-downgrading a disk shelf" on page 64

Removing a module

Assumption about this procedure

This procedure is based on the assumption that the disk shelf is in a configuration which fulfils one or all of the following requirements:

- It has a single path connection
- It is not in a cluster
- It does not use synchronous mirroring

Removing a module

To remove a module that is connected to the Fibre Channel loop, complete the following steps.

Step	Action	
1	Put on the antistatic wrist strap and grounding leash.	
2	**If the disk shelf connects to a...**	**Then...**
	NetCache appliance	**1.** From the Appliance Manager home page, select Maintenance tab > System Control > Halt/Reboot. **2.** Select Halt NetCache.
	Storage system with Data ONTAP 7.x or earlier installed	Shut down the storage system by entering the following command at the console `halt` **Attention** Always use the `halt` command to perform a clean shutdown.

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Shut down the storage system by entering the following command at the console **`halt`** **Attention** Always use the `halt` command to perform a clean shutdown.
3	Verify that the LCD display at the front of your NetApp appliance displays the following message: `Halted`	
4	Disconnect the module from the Fibre Channel cabling.	
5	Using the thumb and index finger of both hands, press the levers on the CAM mechanism on the module to release it.	
6	Pull the module out of the disk shelf.	
7	Go to “Installing a module” on page 57.	

Installing a module

Installing an module

To install a module into the disk shelf, complete the following steps.

Attention

Observe the "Disk shelf cabling requirements" on page 34 and do not mix LRC/ESH/ESH2/ESH4 modules within a shelf.

Step	Action
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.
2	Put on the antistatic wrist strap and grounding leash.
3	Push apart the levers on the CAM mechanism and slide the module into the slot at the rear of the disk shelf, then push the levers of the CAM mechanism into place. **Attention** Do not use excessive force when sliding the module into the disk shelf; you might damage the connector.
4	Reconnect the Fibre Channel cabling.
5	Turn on the power to the disk shelves.
6	Reboot the storage system.

Hot-swapping a module

Assumptions about this procedure

The assumptions about this procedure are that you are replacing either one or both modules of a single disk shelf, that the modules on the disk shelf have multipath connections to the storage system, and that you are hot-swapping one of the following:

- an LRC with another LRC
- an ESH with:
  - another ESH
  - an ESH2
  - an ESH4
- an ESH2 with:
  - another ESH2
  - an ESH4
- an ESH4 with another ESH4

Note

A hot-swap of an ESH or ESH2 with an ESH4 requires that you perform a minimum upgrade to Data ONTAP 6.4.4 or later and replace both modules in the disk shelf. A hot-swap of an ESH with an ESH4 is not supported with NetCache appliances.

Depending on the module or modules you are hot-swapping and their position in the loop, you may need to order additional cables appropriate to the modules. See "Disk shelf cabling requirements" on page 34 for additional requirements.

If you are hot-upgrading or hot-downgrading these devices, see "Hot-upgrading or hot-downgrading a disk shelf" on page 64.

Attention

If you attempt to hot-swap the module on a disk shelf that does not have multipath connections, you lose all access to the drives on this disk shelf as well as those below it.

Hot-swapping a module

To hot-swap a module, complete the following steps.

Note

To hot-swap a module on a disk shelf in a cluster, see the cluster guide for your filer or the *Active/Active Configuration Guide*.

Step	Action	
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.	
2	Ground yourself to the system chassis using the grounding leash.	
3	**If the disk shelf connects to a...**	**Then...**
	Storage system with Data ONTAP 7.x or earlier installed	From the storage system console, enter the following command to disable the loop in which the failed module is a connection: **`storage disable adapter adaptername`** The *Data ONTAP System Administrator's Guide* (7.0.1 or later) provides more information about these commands.

Step	Action	

	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode:
		`ngsh`
		2. Enter the following command at the console to go to the command line interface:
		`dbladecli`
		3. Enter the following command to disable the loop in which the failed module is a connection:
		`storage disable adapter adaptername`

4	**If you are hot-swapping...**	**Then...**
	An LRC or ESH with like modules	Note the position of the terminate switch on the LRC/ESH you are removing and set the terminate switch on the replacement LRC/ESH to the same setting before inserting it into the disk shelf.
	An ESH with an ESH2 or ESH4 for a disk shelf that is: ◆ Either the first shelf in the loop or a shelf in the middle of the loop where all other disk shelves have ESHs	**1.** Place the terminate switch on all but the last disk shelf in the loop to the Off position. For ESH A it is in the up position and for ESH B it is in the down position.

Step	Action	
		2. Place the terminate switch on the last disk shelf in the loop to the On position. For ESH A it is in the down position and for ESH B it is in the up position. **Note** ESH2 and ESH4 are self-terminating and do not have a terminate switch.
	◆ Last shelf in the loop where all other disk shelves have ESHs	On all the disk shelves in the loop, place the terminate switch to the Off position. For ESH A it is in the down position and for ESH B it is in the up position.
	An ESH2 or an ESH4 with like modules	Go to Step 5.
5	**If you are hot-swapping...**	**Then...**
	An LRC/ESH/ESH2/ESH4 with like modules	Disconnect the module that you are removing from the Fibre Channel cabling.
	An ESH with an ESH2 or ESH4	Disconnect the ESH from the Fibre Channel cabling and remove the cabling.
6	Using the thumb and index finger of both hands, press the levers on the CAM mechanism on the module to release it and pull it out of the disk shelf.	

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>7</td><td colspan="2">Slide the module into the slot at the rear of the disk shelf and push the levers of the CAM into place.

Attention
Do not use excessive force when sliding the module into the disk shelf; you might damage the connector.</td></tr>
<tr><td>8</td><td colspan="2">Use the appropriate cable to reconnect both modules of the disk shelf to the other disk shelves or to your storage system. See “Disk shelf cabling requirements” on page 34 for additional requirements.</td></tr>
<tr><td rowspan="3">9</td><td>If the disk shelf connects to a...</td><td>Then...</td></tr>
<tr><td>Storage system with Data ONTAP 7.x or earlier installed</td><td>From the storage system console, enter the following command to enable the loop in which the replacement module is a connection:
<tt>storage enable adapter adaptername</tt></td></tr>
<tr><td>Storage system with Data ONTAP 10.x installed</td><td>1. Log into the storage system and enter the following command at the console to go to the shell command mode:
<tt>ngsh</tt>
2. Enter the following command at the console to go to the command line interface:
<tt>dbladecli</tt>
3. Enter the following command to enable the loop in which the replacement module is a connection:
<tt>storage enable adapter adaptername</tt></td></tr>
</table>

Step	Action
10	Repeat Step 3 through Step 9 for Loop B.

Hot-upgrading or hot-downgrading a disk shelf

When you can hot-upgrade or hot-downgrade

You can hot-upgrade or hot-downgrade an applicable disk shelf, if your system incorporates redundancy through multipathing.

Attention

You must hot-upgrade or hot-downgrade all disk shelves in the loop.

Requirements for hot-upgrading or hot-downgrading

To hot-upgrade or hot-downgrade a disk shelf, the following requirements must be met.

Disk shelf loop speed	Hot-upgrade	Hot-downgrade
DS14 (only available at 1-Gb loop speed)	LRC to ESH/ESH2 hot-upgrade only is supported. **Attention** An ESH4 upgrade is not supported.	◆ ESH/ESH2 to LRC hot-downgrade is supported. ◆ Downgrades from ESH4 are not applicable.
DS14mk2 FC set at 1-Gb loop speed	◆ LRC to ESH/ESH2 hot-upgrade is supported. ◆ ESH to ESH2 and ESH4 hot-upgrade is supported.	◆ ESH/ESH2 to LRC hot-downgrade is supported. ◆ ESH4 and ESH2 to ESH hot-downgrade is supported.
DS14mk2 FC set at 2-Gb loop speed	◆ Upgrades from LRC are not applicable. ◆ ESH to ESH2 and ESH4 hot-upgrade is supported. See "Hot-swapping a module" on page 59.	◆ Downgrades to LRC are not applicable. ◆ ESH4 and ESH2 to ESH hot-downgrade is supported.
DS14mk4 FC	Upgrades from LRC, ESH, and ESH2 are not applicable.	Downgrades to LRC, ESH, and ESH2 are not applicable.

Hot-upgrading or hot-downgrading a disk shelf

To hot-upgrade or hot-downgrade a disk shelf, complete the following steps.

Note

To hot-upgrade or hot-downgrade a disk shelf in a cluster, see the cluster guide for your storage system.

Step	Action	
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.	
2	Put on the antistatic wrist strap and grounding leash.	
3	**If the disk shelf connects to a...**	**Then...**
	Storage system with Data ONTAP 7.x or earlier installed	From the storage system console, enter the following command to disable Loop A: **`storage disable adapter adaptername`** The *Data ONTAP System Administrator's Guide* (7.0.1 or later) provides more information about these commands.

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Enter the following command to disable Loop A: **`storage disable adapter`** ***`adaptername`***
4	**If you are...**	**Then...**
	Hot-upgrading the disk shelf	Note the position of the terminate switch on the LRC you are removing and set the terminate switch on the ESH to the same setting before inserting it into the disk shelf. **Note** ESH2 and ESH4 are self-terminating and do not have a terminate switch.

Step	Action	
	Hot-downgrading the disk shelf	
	◆ From an ESH to an LRC	Note the position of the terminate switch on the ESH you are removing and set the terminate switch on the LRC to the same setting before inserting it into the disk shelf.
	◆ From an ESH2 to an ESH/LRC	**1.** Place the terminate switch on all but the last disk shelf in the loop to the Off position. For module A it is in the up position and for module B it is in the down position. **2.** Place the terminate switch on the last disk shelf in the loop to the On position. For module A it is in the down position and for module B it is in the up position.
5	Disconnect the module from the Fibre Channel cabling and remove the cabling.	
6	Using the thumb and index finger of both hands, press the levers on the CAM mechanism on the module to release it and pull it out of the disk shelf.	
7	Wait for the following console message: `Module x is not installed`	

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>8</td><td colspan="2">Slide the module into the slot at the rear of the disk shelf and push the levers of the CAM mechanism into place.

Attention
Do not use excessive force when sliding the module into the disk shelf; you might damage the connector.</td></tr>
<tr><td>9</td><td colspan="2">Use the appropriate cable to reconnect to connect the disk shelves to each other or to your storage system. See “Disk shelf cabling requirements” on page 34 for additional requirements.</td></tr>
<tr><td>10</td><td colspan="2">Repeat Step 3 through Step 9 for the remaining modules in the loop.</td></tr>
<tr><td rowspan="2">11</td><td>If the disk shelf connects to a...</td><td>Then...</td></tr>
<tr><td>Storage system with Data ONTAP 7.x or earlier installed</td><td>From the storage system console, enter the following command to verify that the modules in Loop A report good status:
<code>environ shelf</code>
As long as only the modules in loop A are upgraded, you also receive the following error message:

<code>Element 1: component is from a different product family. This is an unsupported configuration.</code></td></tr>
</table>

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Enter the following command to verify that the modules in Loop A report good status: **`environ shelf`** As long as only the modules in loop A are upgraded, you also receive the following error message: `Element 1: component is from a different product family. This is an unsupported configuration.`
12	**If the disk shelf connects to a...**	**Then...**
	Storage system with Data ONTAP 7.x or earlier installed	From the console of the filer, enter the following command to enable Loop A: **`storage enable adapter`** ***`adaptername`***

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Enter the following command to enable Loop A: **`storage enable adapter adaptername`**
13	Repeat Step 3 through Step 12 for Loop B.	

Adding a Disk Shelf to an Existing System A

About this appendix

This appendix discusses how to install a DS14/DS14mk2 FC/DS14mk4 FC into an existing system.

Topics in this appendix

This appendix discusses the following topics:

Adding a disk shelf in an existing mixed-shelf loop

Assumptions about the existing mixed-shelf loop

This section is based on the assumption that the last disk shelf in the existing mixed shelf loop connected to your storage system is not a DS14 or DS14mk2 FC disk shelf.

Note

If the last disk shelf in your storage system system is a DS14 or DS14mk2 FC you can add the disk shelf to the loop without shutting down the system. Go to "Hot-adding a DS14/DS14mk2 FC/DS14mk4 FC" on page 76.

Attention

Do not attempt to add a DS14, DS14mk2 FC, or DS14mk4 FC that has ESH, ESH2, or ESH4 modules to a mixed shelf loop that has LRCs.

Adding the disk shelf

To add a DS14/DS14mk2 FC disk shelf into an existing mixed-shelf loop on a storage system, complete the following steps.

Danger

You must install each disk shelf with either the two-post telco tray kit or the four-post rail kit that came in your shipment package. If you choose to mid-mount the disk shelf, use the mid-mount brackets with the two-post telco tray kit. Do not ear-mount the disk shelf into a telco-type rack; the disk shelf will collapse from the rack under its own weight.

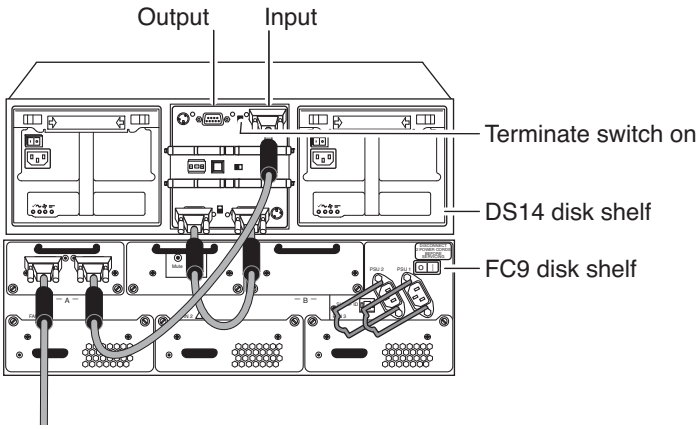
Step	Action
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.
2	Verify that you received the envelope with the disk shelf ID labels.
3	Ground yourself to the system chassis using the grounding leash.

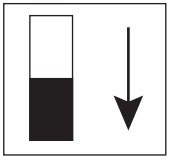
<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td rowspan="3">4</td><td>If the disk shelf connects to a...</td><td>Then...</td></tr>
<tr><td>Filer/FAS appliance</td><td>Shut down the filer/FAS appliance by entering the following command at the console
<code>halt</code>
Attention
Always use the <code>halt</code> command to perform a clean shutdown.</td></tr>
<tr><td>NetCache appliance</td><td>1. From the Appliance Manager home page, select Maintenance tab > System Control > Halt/Reboot.
2. Select Halt NetCache.</td></tr>
<tr><td>5</td><td colspan="2">Verify that the LCD display at the front of your NetApp appliance displays the following message:

<code>Halted</code></td></tr>
<tr><td rowspan="3">6</td><td>If the last disk shelf in the loop is...</td><td>Then...</td></tr>
<tr><td>An FC7 or FC8 disk shelf</td><td>1. Remove the terminator from the Output/Terminator connector.
2. Go to Step 7.</td></tr>
<tr><td>An FC9 disk shelf</td><td>Go to Step 7.</td></tr>
<tr><td>7</td><td colspan="2">Use the rail kit installation flyer in the rail kit box to install the appropriate rail kits on the rack.</td></tr>
<tr><td>8</td><td colspan="2">Install and secure the disk shelf onto the support brackets and rack.</td></tr>
<tr><td>9</td><td colspan="2">If you are adding multiple disk shelves on the same loop, repeat Step 8 and Step 13 to install the remaining disk shelves in ascending numerical order, according to the IDs on their labels.</td></tr>
</table>

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>10</td><td colspan="2">Use the appropriate cable to connect both modules of the disk shelf to the other disk shelves or to your storage system. See “Disk shelf cabling requirements” on page 34 for additional requirements.

The following illustration shows a DS14 disk shelf installed above an FC9 disk shelf.

 
</td></tr>
<tr><td rowspan="2">11</td><td>If the DS14/DS14mk2 FC...</td><td>Then...</td></tr>
<tr><td>Is the only disk shelf being added to the loop</td><td>Turn the terminate switches on LRCs A and B to the On position.

 
LRC A active terminate position

Note
Because LRC B on the disk shelf is inverted, the On terminate position on LRC B is up instead of down.</td></tr>
</table>

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>12</td><td>Is the first of additional DS14/DS14mk2 FC disk shelves being added to the loop</td><td>Verify that the terminate switch on all but the last disk shelf is in the Off position for LRC A (up) and LRC B (down). The terminate switch on the last disk shelf should be in the On position for LRC A (down) and LRC B (up).</td></tr>
<tr><td>13</td><td colspan="2">Change the disk shelf ID with the following procedure:
1. Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7.
2. Power-cycle the disk shelf for the new ID to take effect. The disk shelf ID display on the front of the disk shelf blinks until you power-cycle the disk shelf.
3. Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.</td></tr>
<tr><td>14</td><td colspan="2">Connect the grounding strap connecting the disk shelf to the other disk shelves or your storage system.</td></tr>
<tr><td rowspan="3">15</td><td>If your disk shelf is a...</td><td>Then</td></tr>
<tr><td>DS14</td><td>Go to Step 16.</td></tr>
<tr><td>DS14mk2 FC with an LRC module</td><td>Set the loop speed switch to 1 Gb.
Attention
An incorrectly set loop speed results in an open loop condition.</td></tr>
<tr><td>16</td><td colspan="2">Connect the two disk shelf power cords of each disk shelf that you are adding to a power source</td></tr>
<tr><td>17</td><td colspan="2">Turn on the power first to the disk shelves and then to the storage system.</td></tr>
<tr><td>18</td><td colspan="2">Reboot the storage system.</td></tr>
</table>

Hot-adding a DS14/DS14mk2 FC/DS14mk4 FC

About this section

This section provides information about how to hot-add a DS14/DS14mk2 FC/DS14mk4 FC to an existing system. It also tabulates the error messages that appear on your storage system console if the attempt at hot-adding was unsuccessful.

Note

Only hot-add disk shelves that your storage system supports.

NetApp recommends that you hot-add one disk shelf at a time.

Attention

Failure to follow this recommendation may cause the loop to crash.

Requirements for hot-adding

To hot-add a DS14/DS14mk2 FC/DS14mk4 FC, the following requirements must be met.

If the disk shelf being hot-added...	Then...
Has LRC modules	The disk shelves in the existing loop must have a DS14/DS14mk2 FC disk shelf with LRCs as the last shelf.
Has ESH/ESH2/ ESH4 modules	The disk shelves in the existing loop must have only DS14/DS14mk2 FC/DS14mk4 FC disk shelves with ESH/ESH2/ESH4 modules in the loop.

Error messages

The following error messages appear on your storage system console if your attempt at hot-adding the DS14/DS14mk2 FC is unsuccessful.

Error message	Explanation
`Speed mismatch termination`	The ESH modules on the disk shelf detected a speed mismatch between the preceding disk shelf and this disk shelf and is reporting them as automatic terminate errors.

Error message	Explanation
`Open loop panic`	One of three reasons cause this error message to appear: ◆ The terminate switch on LRC/ESH A and LRC/ESH B on the new disk shelf are not in the On position. ◆ The shelf-to-shelf cable between the now second-to-last disk shelf and the newly added disk shelf is defective or is not securely fastened. ◆ The speed of the newly added DS14mk2 FC/ DS14mk4 FC disk shelf is incorrectly set.
`Soft address panic`	One of two reasons cause this error message to appear: ◆ There is an invalid disk shelf ID. ◆ The power was turned on before the disk shelf ID was changed and the disk shelf was not power-cycled after the disk shelf ID was changed.

For detailed information

For detailed information about hot-adding a disk shelf, see the following topics:

- "Hot-adding a disk shelf to an existing loop" on page 78
- "Hot-adding a disk shelf to an existing adapter in your system" on page 84

Hot-adding a disk shelf to an existing loop

Requirements for this procedure

You must follow this procedure exactly when hot-adding to a mixed shelf loop.

Attention

Failure to follow the procedure exactly causes the last FC9 in the loop to automatically terminate the loop. The storage system loses contact with the existing last DS14/DS14mk2 FC in the loop and crashes.

Hot-adding a disk shelf to an existing loop

To hot-add a disk shelf to an existing loop, complete the following steps.

Attention

To hot-add disk shelves to an Active/active configuration, see the *Active/Active Configuration Guide*.

Step	Action
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.
2	Verify that you received the envelope with the disk shelf ID labels.
3	Ground yourself to the system chassis using the grounding leash.
4	Use the rail kit installation flyer in the rail kit box to install the appropriate rail kits on the rack.
5	Install and secure the disk shelf onto the support brackets and rack.
6	If you are adding multiple disk shelves on the same loop, repeat Step 4 and Step 5 to install the remaining disk shelves in ascending numerical order, according to the IDs on their labels.
7	Connect the grounding strap connecting the disk shelf to the other disk shelves or your storage system.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td rowspan="3">8</td><td>If the disk shelf...</td><td>Then...</td></tr>
<tr><td>Is a DS14</td><td>Then go to Step 9.</td></tr>
<tr><td>Is a DS14mk2 FC or a DS14mk4 FC</td><td>Set the loop speed:
The 1-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 1-Gb operation. Examples of these components are LRCs, the FAS270 or the DS14.
The 2-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 2-Gb operation. Examples of these components are the DS14mk2FC, SFPs, HBAs, or drives.
For the 4-Gb loop speed setting to be used, all components on any part of the loop must be of 4-Gb capable. Examples of these components are this disk shelf model, SFPs, HBAs, or drives.
Attention
An incorrectly set loop speed causes the storage system to panic.</td></tr>
<tr><td>9</td><td colspan="2">Connect the two disk shelf power cords of each disk shelf that you are adding to a power source.
Attention
Do not turn on the power to the disk shelf yet.</td></tr>
</table>

Step	Action	
10	**If the disk shelf connects to a...**	**Then change the disk shelf ID with the following procedure...**
	Storage system with Data ONTAP 7.x or earlier installed	**1.** Verify that the disk shelf ID is not being used in the loop by entering the following command at the console `fcstat device_map` ***`adaptername`*** **Attention** An invalid disk shelf ID causes the storage system to panic. **2.** Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7. **3.** Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Verify that the disk shelf ID is not being used in the loop by entering the following command at the console **`fcstat device_map`** ***`adaptername`*** **Attention** An invalid disk shelf ID causes the storage system to panic. **4.** Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7. **5.** Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td rowspan="3">11</td><td>If the disk shelf you added has...</td><td>Then...</td></tr>
<tr><td>LRC or ESH modules</td><td>Turn on the power to the disk shelf.

Attention
You must power up the new disk shelf before you connect it to the last disk shelf in the loop because there must be approximately a 120-second time difference between Step 11 (powering on the disk shelf) and Step 17 (turning off the terminate switch) of this procedure.</td></tr>
<tr><td>ESH2/ESH4 modules</td><td>Turn on the power to the disk shelf and you must wait 30 seconds for the shelf electronics to finish initializing.</td></tr>
<tr><td>12</td><td colspan="2">Connect one end of the provided cable to the module A Output on the last disk shelf in the existing loop.</td></tr>
<tr><td>13</td><td colspan="2">Connect the other end of the cable to the module A Input on the new disk shelf.</td></tr>
<tr><td>14</td><td colspan="2">Connect one end of the provided cable to the module B Output on the last disk shelf in the existing loop.</td></tr>
<tr><td>15</td><td colspan="2">Connect the other end of the cable to the module B Input on the new disk shelf.</td></tr>
<tr><td>16</td><td colspan="2">Verify that all the cables are securely fastened.

Attention
Poorly secured cables cause the storage system to panic over an open loop.</td></tr>
</table>

Step	Action	
17	**If the disk shelf you added has...**	**Then...**
	LRC or ESH modules	**1.** Turn the terminate switch of the newly added disk shelf to the On position for LRC/ESH A (down) and LRC/ESH B (up). **Attention** Failure to place the terminate switches in the On position causes the storage system to panic over an open loop. **2.** Turn the terminate switch of the now second-to-last disk shelf to the Off position for LRC/ESH A (up) and LRC/ESH B (down). **Result:** In 60 seconds, the storage system recognizes the hot-added disk shelf.
18	ESH4 or ESH2 modules	**Result:** In 60 seconds, the storage system recognizes the hot-added disk shelf.

Hot-adding a disk shelf to an existing adapter in your system

Requirements for this procedure

The following requirements must be met for this procedure:

- Your system must have Data ONTAP 7.2 or later.
- There must be an available but unused adapter on your storage system to do this procedure.
  - If you have an available dual-port and an available quad-port adapter, the dual-port adapter should be used first.
  - If you only have an available quad-port adapter and you are hot-adding a single loop of disk shelves, then Ports A and B are defined as a port pair and Ports C and D are defined as a port pair. For the purposes of incorporating redundancy, Module A connects to Port A or Port B and Module B connects to Port C or Port D.

Hot-adding a disk shelf to an existing adapter

To hot-add a disk shelf to an existing loop, complete the following steps.

Attention

To hot-add disk shelves to an Active/active configuration, see the *Active/Active Configuration Guide*.

Step	Action
1	Verify that your NetApp appliance meets the minimum software requirements to support the disk shelf and module combination. See the System Configuration Guide at http://now.netapp.com for more information.
2	Verify that you received the envelope with the disk shelf ID labels.
3	Ground yourself to the system chassis using the grounding leash.
4	Use the rail kit installation flyer in the rail kit box to install the appropriate rail kits on the rack.
5	Install and secure the disk shelf onto the support brackets and rack.
6	If you are adding multiple disk shelves on the same loop, repeat Step 4 and Step 5 to install the remaining disk shelves in ascending numerical order, according to the IDs on their labels.

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>7</td><td colspan="2">Connect the grounding strap connecting the disk shelf to the other disk shelves or your storage system.</td></tr>
<tr><td>8</td><td>If the disk shelf...</td><td>Then...</td></tr>
<tr><td></td><td>Is a DS14</td><td>Then go to Step 9.</td></tr>
<tr><td></td><td>Is a DS14mk2 FC or a DS14mk4 FC</td><td>Set the loop speed:
The 1-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 1-Gb operation. Examples of these components are LRCs, the FAS270 or the DS14.
The 2-Gb loop speed setting must be used if there is any component on any part of the loop that is only capable of 2-Gb operation. Examples of these components are the DS14mk2FC, SFPs, HBAs, or drives.
For the 4-Gb loop speed setting to be used, all components on any part of the loop must be of 4-Gb capable. Examples of these components are this disk shelf model, SFPs, HBAs, or drives.
Attention
An incorrectly set loop speed causes the storage system to panic.</td></tr>
<tr><td>9</td><td colspan="2">Connect the two disk shelf power cords of each disk shelf that you are adding to a power source.

Attention
Do not turn on the power to the disk shelf yet.</td></tr>
</table>

Step	Action	
10	**If the disk shelf connects to a...**	**Then change the disk shelf ID with the following procedure...**
	Storage system with Data ONTAP 7.x or earlier installed	**1.** Verify that the disk shelf ID is not being used in the loop by entering the following command at the console `fcstat device_map` ***`adaptername`*** **Attention** An invalid disk shelf ID causes the storage system to panic. **2.** Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7. **3.** Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.

Step	Action	
	Storage system with Data ONTAP 10.x installed	**1.** Log into the storage system and enter the following command at the console to go to the shell command mode: **`ngsh`** **2.** Enter the following command at the console to go to the command line interface: **`dbladecli`** **3.** Verify that the disk shelf ID is not being used in the loop by entering the following command at the console **`fcstat device_map`** ***`adaptername`*** **Attention** An invalid disk shelf ID causes the storage system to panic. **4.** Press the thumbwheel switch on the rear of the disk shelf and use the + button to raise the number and the - button to lower the number to a valid ID from 1 through 7. **5.** Select the correct label from the envelope identified in Step 2 and attach it to the right flange of the new disk shelf.

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<tr><td>LRC or ESH modules</td><td>Turn on the power to the disk shelf.
Attention
You must power up the new disk shelf before you connect it to the last disk shelf in the loop because there must be approximately a 120-second time difference between Step 11 (powering on the disk shelf) and Step 17 (turning off the terminate switch) of this procedure.</td></tr>
<tr><td>12</td><td colspan="2">Connect one end of the provided cable to the adapter in your storage system.</td></tr>
<tr><td>13</td><td colspan="2">Connect the other end of the cable to the module A Input on the new disk shelf.</td></tr>
<tr><td>14</td><td colspan="2">Connect one end of the provided cable to the adapter in your storage system.</td></tr>
<tr><td>15</td><td colspan="2">Connect the other end of the cable to the module B Input on the new disk shelf.</td></tr>
<tr><td>16</td><td colspan="2">Verify that all the cables are securely fastened.
Attention
Poorly secured cables cause the storage system to panic over an open loop.</td></tr>
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<tr><td rowspan="3">17</td><td>If the disk shelf you added has...</td><td>Then...</td></tr>
<tr><td>LRC or ESH modules</td><td>1. Turn the terminate switch of the newly added disk shelf to the On position for LRC/ESH A (down) and LRC/ESH B (up).

Attention
Failure to place the terminate switches in the On position causes the storage system to panic over an open loop.

2. Turn the terminate switch of the now second-to-last disk shelf to the Off position for LRC/ESH A (up) and LRC/ESH B (down).

Result: In 60 seconds, the storage system recognizes the hot-added disk shelf.</td></tr>
<tr><td>ESH4 or ESH2 modules</td><td>Result: In 60 seconds, the storage system recognizes the hot-added disk shelf.</td></tr>
</table>

Recommended Power Line Sizes

B

About this appendix

This appendix describes how to determine the power line lengths running from the storage system to the power source.

Topics in this appendix

This appendix discusses the following information:

Recommended AC power line sizes

About AC power feeds

Longer AC power feeds need to be properly designed to preserve voltage levels to the equipment. The wiring from the breaker panel to the power strip, which supplies power to the storage system and disk shelves, can often exceed 50 feet.

Note

Total AC wire length = breaker to wall or ceiling outlet + extension cable or ceiling drop.

The following table lists the recommended conductor size for 2% voltage drop for a particular distance in feet (taken from the Radio Engineer's Handbook).

110V, single-phase	**20A circuit**	**30A circuit**	**40A circuit**	**50A circuit**
25 feet	12 AWG	10 AWG	8 AWG	8 AWG
50 feet	8 AWG	6 AWG	6 AWG	4 AWG
75 feet	6 AWG	4 AWG	4 AWG	2 AWG

220V, single-phase	**20A circuit**	**30A circuit**	**40A circuit**	**50A circuit**
25 feet	14 AWG	12 AWG	12 AWG	10 AWG
50 feet	12 AWG	10 AWG	8 AWG	8 AWG
75 feet	10 AWG	8 AWG	6 AWG	6 AWG

The following table list the approximate equivalent wire gauge (American Wire Gauge (AWG) to Harmonized Cordage).

AWG	8	10	12
Harmonized, mm-mm mm-mm = millimeter squared	4.0	2.5	1.5

Calculating the length of DC wires

Use these variable definitions

To calculate the maximum combined length of the positive and negative wires between the DC source and DC power supplies, use the following variable definitions:

- V_{SOURCE} — Voltage across the internal source resistance
- V_{OC} — Voltage across an open circuit of the input source
- V_{LOAD} — Voltage across a load, R_{TEST}, connected to the input source
- R_{TEST} — Test resistor of known value, that is, 10Ω at 300W
- R_{CABLE} — DC resistance of the cable at a given length
- R_{SOURCE} — DC resistance of the source
- R_{TOTAL} — Combined DC resistance of the cable and DC source:

  $R_{TOTAL} = R_{SOURCE} + R_{CABLE}$
- $V = IR$ — Ohm's Law
- $V_{OC} = V_{SOURCE} + V_{LOAD}$ — Kirchoff's Voltage Law

How to calculate the length

The following two examples show how to calculate the maximum combined length of the positive and negative wires that connect the DC power supply to the DC source.

Example 1: This example uses the following given values.

Given

V_{DROP}	= 2V	Maximum voltage drop through input source and cable
V_{MIN}	= 40V	Minimum input voltage
I_{MAX}	= 8.6V	Maximum input current at 40V
V_{OC}	= 48V	Measured
V_{LOAD}	= 47.5V	Measured
R_{TEST}	= 10Ω	(300W)

Solution

$$V_{DROP} = I_{MAX}R_{TOTAL}$$

$$2 = 8.6\ R_{TOTAL}$$

$$R_{TOTAL} = 2/8.6$$

$$R_{TOTAL} = .233\Omega$$

$$V_{LOAD} = I\ R_{TEST}$$

$$I = V_{LOAD}/R_{TEST}$$

$$V_{OC} = V_{SOURCE} + V_{LOAD}$$

$$V_{OC} = IR_S + V_{LOAD}$$

$$R_S = \frac{V_{OC} - V_{LOAD}}{I}$$

$$R_S = \frac{(V_{OC} - V_{LOAD})}{V_{LOAD}/R_{TEST}}$$

$$R_S = \frac{V_{OC} - V_{LOAD}}{V_{LOAD}} \times R_{TEST}$$

$$= \frac{48V - 47.5V}{47.5V} \times 10\Omega$$

$$= 0.105\Omega$$

$$R_{TOTAL} = R_{CABLE} + R_{SOURCE}$$

$$R_{CABLE} = R_{TOTAL} - R_{SOURCE}$$

$$R_{CABLE} = 0.233\Omega - 0.105\Omega$$

$$= 0.128\Omega$$

For example, if you have a 12 gauge wire, solid strand, at room temperature, use the following calculation.

$$\text{Total cable length} = \frac{R_{CABLE}}{\text{DC resis.}^{1}}$$

$$\text{Total cable length} = \frac{.128\Omega}{.0017\Omega/\text{ft}} = 75 \text{ ft}$$

AWG	Strand	DC resistance(1) [Ω/ft.]		Total cable length(2) [ft]	
		25° C	75° C	25° C	75° C
12	Solid	.0017	.0020	75	64
12	7/20	.0015	.0018	85	71
12	19/25	.0017	.0020	75	64
12	65/30	.0018	.0022	71	58
12	165/34	.0016	.0019	80	67

1. Data from Alpha Wire, wire manufacturer
2. Combined positive and negative run

Example 2: This example uses the following given values.

Given

V_{DROP} = 2V Maximum voltage drop through input source and cable

V_{MIN} = 40V Minimum input voltage

I_{MAX} = 8.6V Maximum input current at 40V

$R_{SOURCE} \cong 0$

Solution

$$V_{DROP} = I_{MAX}R_{TOTAL}$$

$$R_{TOTAL} = \frac{V_{DROP}}{I_{MAX}}$$

$$R_{TOTAL} = 2/8.6$$

$$R_{TOTAL} = 0.233\Omega$$

$$R_{TOTAL} = R_{SOURCE} + R_{CABLE}$$

$$R_{CABLE} = R_{TOTAL} - R_{SOURCE}$$

$$R_{CABLE} = 0.233 - 0$$

$$R_{CABLE} = 0.233$$

For example, if you have a solid strand 12 gauge wire at room temperature, use the following calculation.

$$\text{Total cable length} = \frac{R_{CABLE}}{\text{DC resis.}^1}$$

$$\text{Total cable length} = \frac{.233\Omega}{.0017\Omega/\text{ft}} = 136 \text{ ft}$$

AWG	Strand	DC resistance[1] [Ω/ft.]		Total cable length[2] [ft]	
		25° C	75° C	25° C	75° C
12	Solid	.0017	.0020	136	116
12	7/20	.0015	.0018	155	129
12	19/25	.0017	.0020	136	116
12	65/30	.0018	.0022	129	105
12	165/34	.0016	.0019	145	122

1. Data from Alpha Wire, wire manufacturer.
2. Combined positive and negative run

About using other wire sizes

If you need a longer run for your combined positive and negative DC wires, choose a wire with a lower resistance and calculate the total cable length. For example, a solid #10 AWG has a lower DC resistance than a solid #12 AWG.

Feature Update Record

C

Feature update history

The following table lists and describes the history of changes made to this manual. When a change is implemented, it applies to the release in which it was implemented and all subsequent releases, unless otherwise specified.

Feature updates	Feature first implemented in	Feature release date
◆ Initial release of this manual	Data ONTAP 6.0.2	March 2001
◆ Update to include support for NetCache appliances ◆ Hot-adding of disk shelves to NetCache appliances is not supported	NetCache 5.1	April 2001
◆ Updates to multiloop cabling section	Data ONTAP 6.1.1	July 2001
◆ Update to include hot-adding of disk shelves to NetCache appliances	NetCache 5.2	August 2001
◆ Update to include FAS900 series	Data ONTAP 6.3	August 2002
◆ Update to include DS14mk2FC ◆ Update to include ESH	Data ONTAP 6.4.1 Data ONTAP 6.2	May 2003
◆ Update to specify ESH support for C6200 ◆ Address BURT on hot-adding disk shelves	NetCache 5.5 Data ONTAP 6.5	December 2003
◆ Update to include ESH2 ◆ Connecting an ESH2 to a NetCache appliance is not supported.	Data ONTAP 6.4.4 and 6.5.1	May 2004
◆ Fix for BURT 140959 ◆ Support for DC power supplies on DS14mk2FC disk shelves. ◆ Support for 300-GB drives	N.A. Data ONTAP 6.5.4 and 7.0.1	March 2005
◆ Address BURT on hot-swapping, hot-adding drives one at a time ◆ Address BURT on hot-adding disk shelves one at a time ◆ Hot-adding to an existing adapter	Data ONTAP 7.2	March 2006

Feature updates	Feature first implemented in	Feature release date
◆ Update to include DS14mk4 FC ◆ Update to include ESH4	Data ONTAP 6.4.4 and later for selected platforms. See the System Configuration Guide at http://now.netapp.com for information.	February 2007
◆ Update to specify loop speed usage requirements	Data ONTAP 6.4.4 and later for selected platforms. See the System Configuration Guide at http://now.netapp.com for information.	May 2007
◆ Update to include support for FlexCache appliances ◆ Update to include support for V30xx, V31xx, and V60xx systems ◆ Update to include Data ONTAP 10.0.x commands for procedures	Data ONTAP 7.2.5.1 and later. Data ONTAP 7.3 and later for selected platforms. Data ONTAP 10.0.x and later for selected platforms.	November 2008

Communications Regulations D

About this appendix This appendix lists the regulatory notices you need to be aware of when installing and operating your NetApp equipment.

Regulatory notices

FCC notices (U.S. only)

NetApp devices are designed for a CFR 47 (Code Federal Regulations) Part 15 Class A environment.

The FCC and NetApp guarantee the user's rights to operate this equipment only if the user complies with the following rules and regulations:

- Install and operate this equipment in accordance with the specifications and instructions in this guide.
- Modify this equipment only in the ways specified by NetApp.
- Use shielded cables with metallic RFI/EMI connector hoods to maintain compliance with applicable emissions standards.
- If the system has nine or more Fibre Channel disk shelves, install the system in two or three NetApp System Cabinets to maintain performance within Part 15 of CFR 47 regulations.

Compliance with Part 15 of CFR 47

This equipment has been tested and found compliant with Part 15 of the CFR 47 rules for Class A digital devices. These rules are designed to provide reasonable protection from interference to electronics equipment operated in a commercial environment.

Operation of this device is subject to the following two conditions:

- This device cannot cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Compliance with ICES-003

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A conforme à la norme NMB-003 du Canada.

Compliance with EN regulations

Marking by the symbol CE indicates compliance of this NetApp device to the EMC Directive and the Low Voltage Directive of the European Union. Such marking is indicative that this NetApp device meets the technical standards listed in "Declaration of Conformity," later in this appendix.

Attention

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.

Bureau of Standards, Metrology, and Inspections notice (BSMI, Taiwan only)

警告使用者:

這是甲類的資訊產品, 在居住的環境中使用時, 可能會造成射頻干擾, 在這種情況下, 使用者會被要求采取某些適當的對策.

Translation of the BSMI notice:

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.

Voluntary Control Council for Interference by Information Technology Equipment (VCCI, Japan)

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Translation of the VCCI-A notice:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. If such trouble occurs, the user may be required to take corrective actions.

Declaration of Conformity

Declaration of Conformity

NetApp, Inc.
495 East Java Drive
Sunnyvale, CA 94089, U.S.A,

declare under our sole responsibility that the products

Type of equipment	Description	Model number	Year of manufacture
Disk drive storage shelf	Fibre Channel disk shelf	DS14	2001
		DS14mk2 FC	2003

to which this declaration relates conform to the following standards:

EN 60950:2002, Information Technology Equipment (Safety)

EN 55022:1998, Emissions Requirements for Information Technology Equipment

EN 50024:1998, Immunity Requirements for Information Technology Equipment

EN 60825-1, Safety of Laser/LED Equipment

EN 61000-3-2:2002 Limits for Harmonic Current Emissions

EN 61000-3-3:1995/A1:2001 Limitation of Voltage Fluctuations and Flicker in Low-Voltage Supply Systems

following the provisions of the directives listed below:

73/23/EEC, Low Voltage Directive (Product Safety)

89/336/EEC, Electromagnetic Compatibility Directive

Part number: 210-02616

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