HP Smart Array Controllers for HP ProLiant Servers
User Guide

Part Number 469988-005
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Intended audience

This document is for the person who installs, administers, and troubleshoots servers and storage systems. HP assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

Contents

Features

Memory and storage capacity conventions

Memory capacities are specified using binary prefixes:

- KiB = 2^{10} bytes
- MiB = 2^{20} bytes
- GiB = 2^{30} bytes
- TiB = 2^{40} bytes

Storage capacities are specified using SI prefixes:

- KB = 10^{3} bytes
- MB = 10^{6} bytes
- GB = 10^{9} bytes
- TB = 10^{12} bytes

Older, and other, documentation may use SI prefixes for binary values.

Actual available memory capacity and actual formatted storage capacity for devices are less than specified values.

Smart Array Advanced Pack

SAAP is a collection of additional and advanced controller features embedded in the firmware of select Smart Array controllers.

When activated with a registered license key, SAAP 1.0 provides the following features:

- RAID 6 (ADG)
- RAID 60
- Advanced Capacity Expansion
- Mirror splitting and recombining in offline mode
- Drive Erase
- Performance optimization for video on demand

To access SAAP features, you must purchase a license key from HP. To obtain a license key, see the SAAP product page on the HP website (http://www.hp.com/go/SAAP).

To install the license key and activate SAAP, use a supported array configuration tool:

- Option ROM Configuration for Arrays (ORCA)
- HP Array Configuration Utility (ACU)

For registration procedures, see the *Configuring Arrays for HP Smart Array Controllers Reference Guide* available on the controller Documentation CD or the ACU product page on the HP website (http://h18004.www1.hp.com/products/servers/proliantstorage/software-management/acumatrix/index.html).

Required hardware

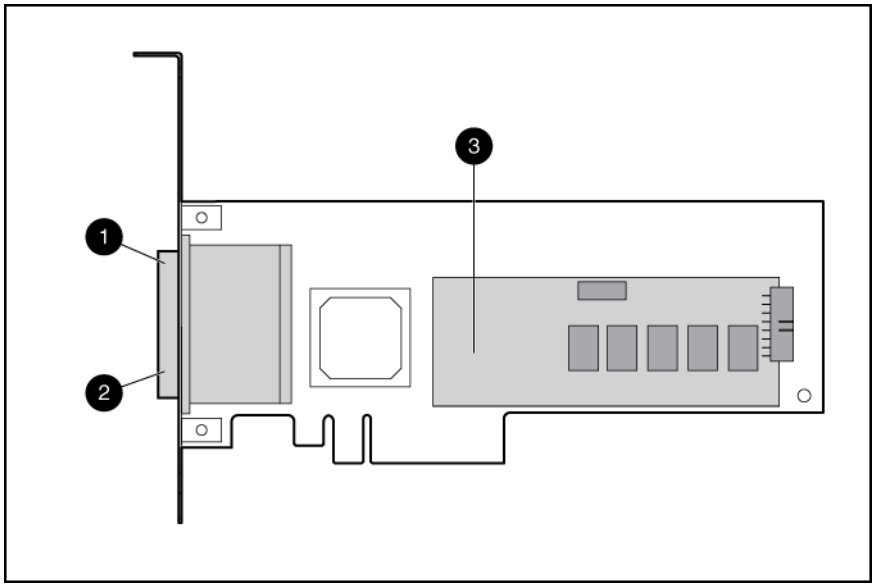
For a list of Smart Array controllers that support SAAP, see the SAAP QuickSpecs on the HP website (http://h18004.www1.hp.com/products/quickspecs/13200_na/13200_na.html).

To support some controller features, the controller may also require a hardware configuration that includes the following cache (array accelerator) options:

- A cache module that is 256 MiB or larger
- A compatible battery pack or capacitor pack

To obtain these options, contact an HP authorized reseller or see the HP website (http://www.hp.com/products/smartarray).

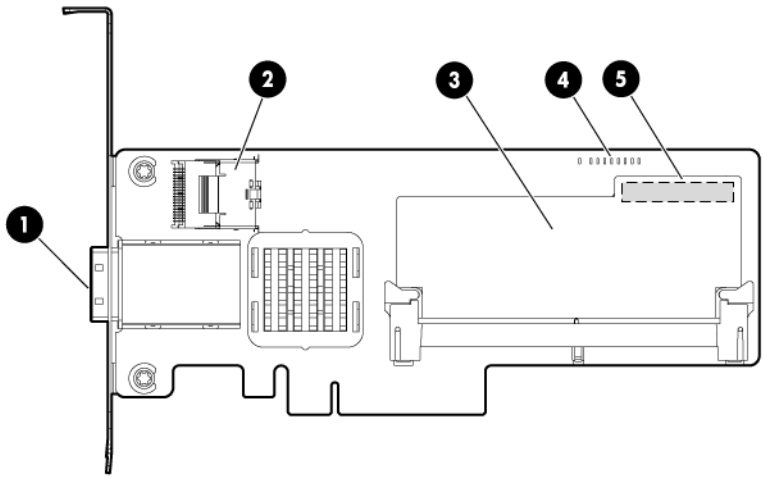
E500 model



Item	Description
1	Port 1E (Mini SAS 4x connector)
2	Port 2E (Mini SAS 4x connector)
3	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

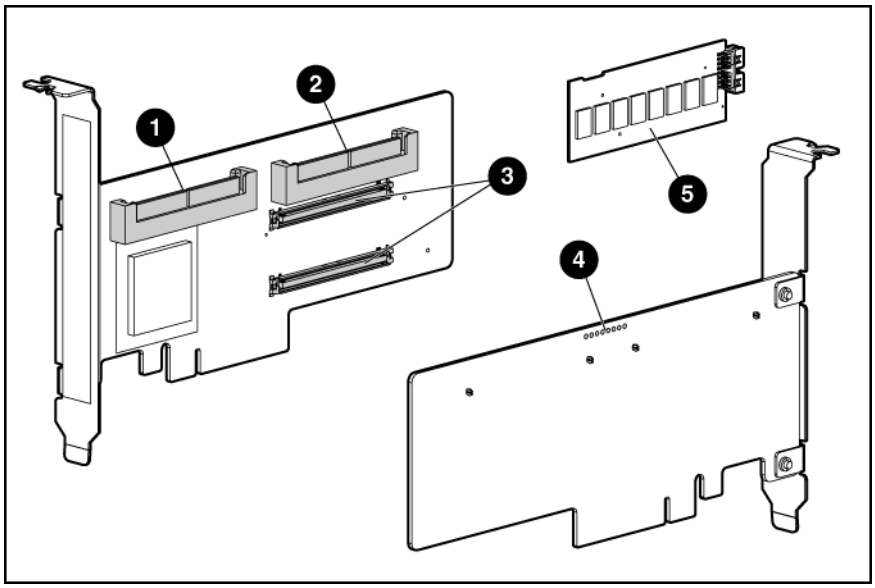
P212 model



Item	Description
1	Port 1E (Mini SAS 4x connector)
2	Port 2E (Mini SAS 4x connector)
3	Cache module (also known as array accelerator)
4	Status LEDs (runtime LEDs). For more information, see "Controller board runtime LEDs (on page 67)."
5	(On rear of cache) Connector for the cable to an optional cache battery that upgrades the cache to BBWC

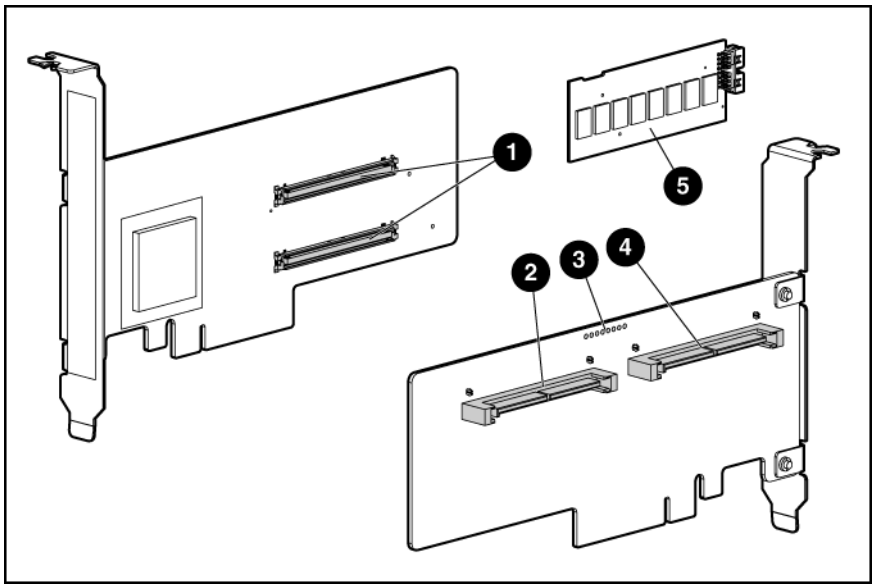
△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

P400 with SAS 4i connectors on the front of the board



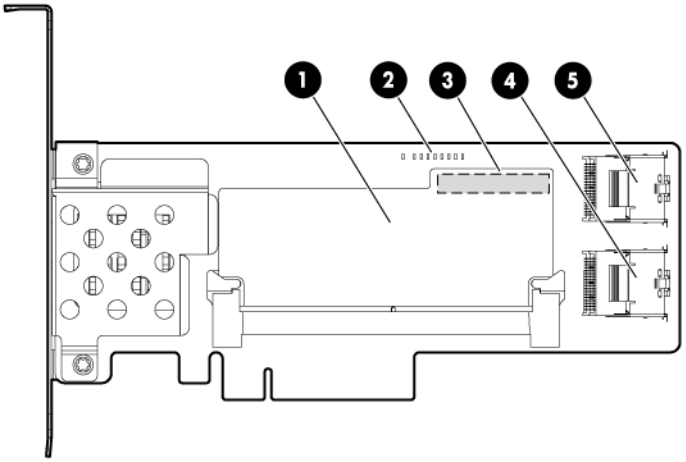
Item	Description
1	Port 2I (SAS 4i connector)
2	Port 1I (SAS 4i connector)
3	Cache module connectors
4	Runtime LEDs. See "Controller board runtime LEDs (on page 67)."
5	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

P400 with SAS 4i connectors on the back of the board



Item	Description
1	Cache module connectors
2	Port 1I (SAS 4i connector)
3	Runtime LEDs. See "Controller board runtime LEDs (on page 67)."
4	Port 2I (SAS 4i connector)
5	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

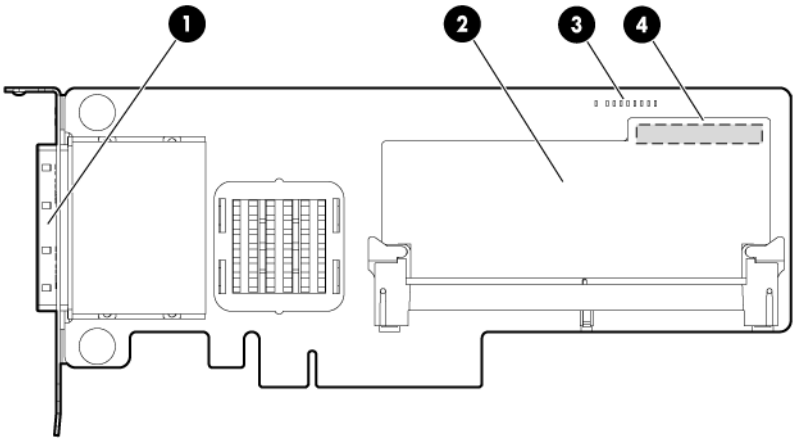
P410 model



Item	Description
1	Cache module (also known as array accelerator)
2	Runtime LEDs. See "Controller board runtime LEDs (on page 67)."
3	(On rear of cache) Connector for the cable to an optional cache battery that upgrades the cache to BBWC (Not shown) In place of the BBWC option, the controller can support a FBWC module and capacitor pack.
4	Port 1I (Mini SAS 4i connector)
5	Port 2I (Mini SAS 4i connector)

△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

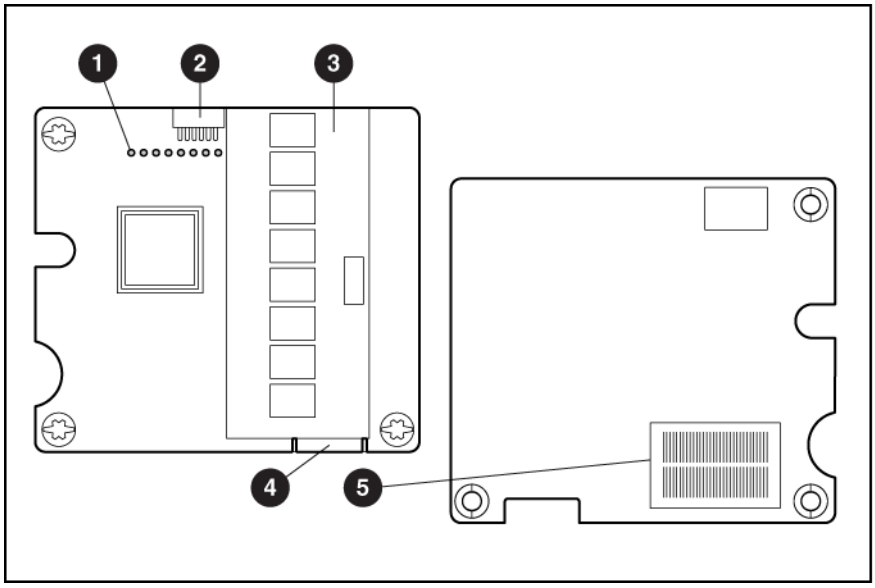
P411 model



Item	Description
1	Ports 1 and 2 (Mini SAS 4x connectors)
2	Cache module (also known as array accelerator)
3	Runtime LEDs. See "Controller board runtime LEDs (on page 67)."
4	(On rear of cache) Connector for the cable to an optional cache battery that upgrades the cache to BBWC (Not shown) In place of the BBWC option, the controller can support a FBWC module and capacitor pack.

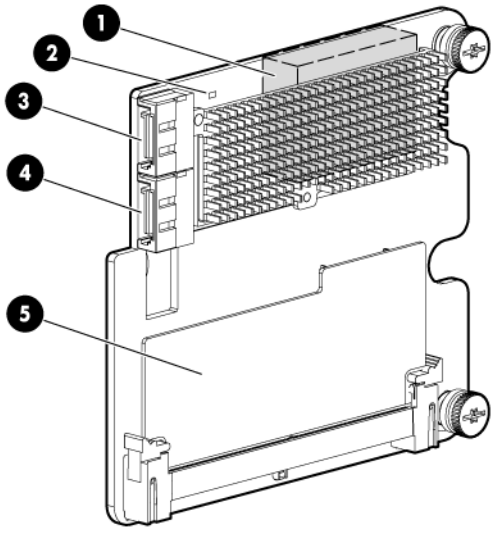
△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

P700m model



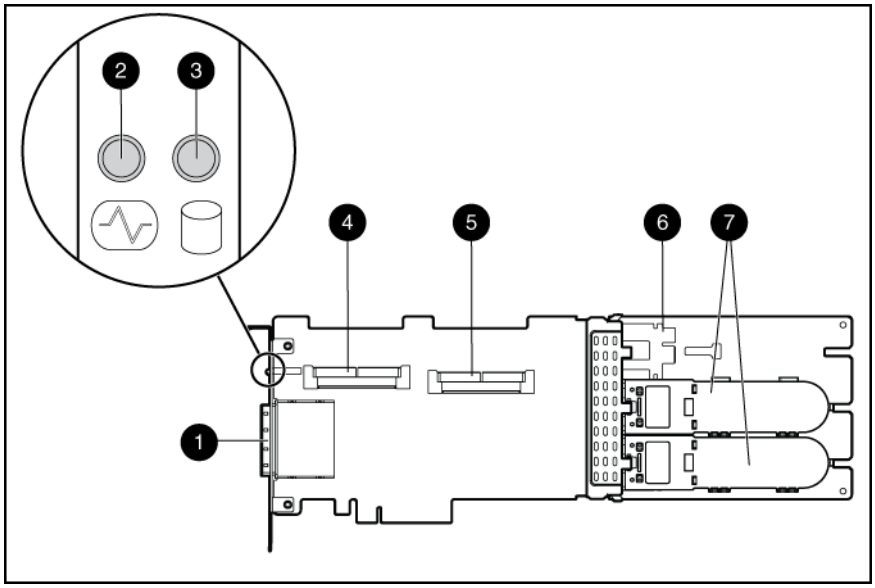
Item	Description
1	Runtime LEDs. See "Controller board runtime LEDs (on page 67)."
2	Connector (not used on HP ProLiant servers)
3	Cache module (also known as array accelerator)
4	Connector for the cable to an optional cache battery that upgrades the cache to BBWC. This connector is absent on some P700m models.
5	Mezzanine connector

P712m model



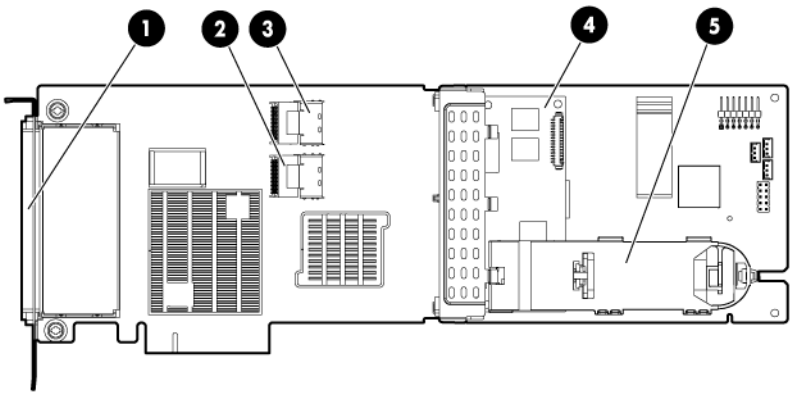
Item	Description
1	Mezzanine connector
2	Runtime LED. See "Controller board runtime LEDs (on page 67)."
3	SAS/SATA connector
4	SAS/SATA connector
5	Cache module

P800 model



Item	Description
1	Ports 1E and 2E (Mini SAS 4x connectors)
2	Heartbeat LED (flashes green when operating normally and amber if the board has failed)
3	Activity LED for external ports
4	Port 3I (Mini SAS 4i connector)
5	Port 4I (Mini SAS 4i connector)
6	Cache module (also known as array accelerator)
7	(Optional) Batteries for cache module Two batteries are normally sufficient, but you can add a third battery to provide extra security against loss of system power.

P812 model



Item	Description
1	Ports 1E, 2E, 3E, and 4E (Mini SAS 4x connectors)
2	Port 6I (Mini SAS 4i connector)
3	Port 5I (Mini SAS 4i connector)
4	Cache module (also known as array accelerator)
5	Capacitor pack for cache module

Summary of controller features and capabilities

This section describes the most commonly referenced controller features. For other features, specifications, and information about system requirements, see the HP website (http://www.hp.com/products/smartarray). To get the full benefit of all controller features, be sure that the controller is loaded with the latest firmware.

Features common to all controller models

Feature	Details
Temperature range	Operating, 10° to 55°C (50° to 131°F) Storage, -30° to 60°C (-22° to 140°F)
Relative humidity (noncondensing)	Operating, 10% to 90% Storage, 5% to 90%
Time required to recharge battery[1]	From 15 minutes to 2 hours 40 minutes, depending on the initial battery charge level
Duration of battery backup[1]	If the battery is fully charged and less than 3 years old, more than 2 days The battery pack provides a continuous charge to store the cached data in DDR memory.

Battery life expectancy[1]	3 years For more information, see "Battery pack service life (on page 15)."
Time required to recharge capacitor[2]	5 minutes or less
Duration of capacitor backup[2]	80 s The capacitor pack provides a sufficient duration to transfer the cached data from DDR memory to flash memory, where the data remains indefinitely or until a controller retrieves the data.
Capacitor life expectancy[2]	More than 3 years
Mini SAS connector life expectancy	250 connect/disconnect cycles (for external, internal, and cable Mini SAS connectors)
Supported drive types[3]	• 3.0-Gb/s SAS drives • 6.0-Gb/s SAS drives • 1.5-Gb/s SATA drives • 3.0-Gb/s SATA drives (on systems that support 6.0-Gb/s SAS drives) Not all servers support all SAS or SATA drive types. For more information, see the server QuickSpecs on the HP website (http://www.hp.com/go/bizsupport). OBDR tape drives are also supported. For more information about OBDR, see the HP website (http://www.hp.com/go/obdr).
Maximum logical drive size	8 ZB (8×10^{21} bytes)
Maximum number of logical drives	64

[1]For controllers that use battery-backed write cache
[2]For controllers that use flash-backed write cache
[3]Not all servers support all drive types. For more information, see the server QuickSpecs on the HP website (http://www.hp.com/go/bizsupport).

Battery pack service life

The batteries in BBWC battery packs are a consumable material. After 3 years of service, batteries may not provide predictable data retention times. When an HP Smart Array controller detects this condition, it automatically restricts write cache functions to protect user data. To help ensure uninterrupted performance levels, HP recommends replacing battery packs at 3-year intervals.

In NiMH batteries, the charging and discharging processes create and recombine inert gases, which can cause the button cell to swell in size by as much as 20%. Battery packs are designed to stop charging before excess swelling occurs.

However, if excess swelling does occur, a pressure mechanism within the button cell releases these non-toxic, non-corrosive gases before the cell incurs physical damage. If this pressure release occurs, the battery no longer charges properly, and the storage solution reports a failed battery.

Model-specific features

HP Smart Array E500 Controller features

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8
Dimensions, in*	6.6 x 2.8 x 0.7
Maximum number of physical drives	100 external
Maximum power required (approximate)	14 W
RAID levels	0, 1, and 1+0; with cache battery, also RAID 5
Battery kit option part number	Battery pack 383280-B21; battery cable 417836-B21
Cache module	40-bit wide, 256-MiB BBWC
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.

HP Smart Array P212 Controller features

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8
Dimensions, in*	6.6 x 2.8 x 0.7
Maximum number of physical drives	Without cache, 4 internal With cache, 4 internal and 50 external
Maximum power required (approximate)	12 W
RAID levels	Without cache, RAID 0, 1, and 1+0 With cache and battery, also RAID 5 and 50 With cache, battery, and SAAP**, also RAID 6 and 60
Battery kit option part number	462969-B21
Cache module	40-bit wide, 256-MiB BBWC
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.
**SAAP is downloadable from the HP website (http://www.hp.com/go/SAAP).

HP Smart Array P400 Controller features

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8
Dimensions, in*	6.6 x 2.8 x 0.7
Maximum number of physical drives	8 external
Maximum power required (approximate)	14 W
RAID levels	0, 1, 1+0, and 5; with cache battery, also RAID 6
Battery kit option part number	Battery pack 390936-001; battery cable 399034-001
Cache module	40-bit wide, 256-MiB BBWC
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.

HP Smart Array P410 Controller features

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8
Dimensions, in*	6.6 x 2.8 x 0.7
Maximum number of physical drives	Without cache, 8 internal With cache, 8 internal or up to 24 internal with an expander card
Maximum power required (approximate)	12 W
RAID levels	Without cache, RAID 0, 1, and 1+0 With cache and battery/capacitor, also RAID 5 and 50 With cache, battery/capacitor, and SAAP**, also RAID 6 and 60
Battery kit option part number	462969-B21
Cache module	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC 72-bit wide, 1-GiB FBWC
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.
**SAAP is downloadable from the HP website (http://www.hp.com/go/SAAP).

HP Smart Array P411 Controller features

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8
Dimensions, in*	6.6 x 2.8 x 0.7
Maximum number of physical drives	With cache, 100 external The controller does not operate without a cache module.
Maximum power required (approximate)	12 W
RAID levels	The controller does not operate without a cache module. With cache and battery/capacitor, RAID 0, 1, 1+0, 5, and 50 With cache, battery/capacitor, and SAAP**, also RAID 6 and 60
Battery kit option part number	462969-B21
Cache module	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC 72-bit wide, 1-GiB FBWC
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.
**SAAP is downloadable from the HP website (http://www.hp.com/go/SAAP).

HP Smart Array P700m Controller features

Feature	Description
Board type	Type I, 4-port, PCIe mezzanine board
Dimensions, cm	11.3 x 10.0 x 2.0
Dimensions, in	4.5 x 4.0 x 0.8
Maximum number of physical drives	108 (internal + external)
Maximum power required (approximate)	9.30 W
RAID levels	0, 1, 1+0, and 5; with cache battery, also RAID 6
Battery kit option part number	453779-001
Cache module	72-bit wide, 512-MiB BBWC (64 MiB is used by the onboard processor)
I/O connection to	Grid array mezzanine connector

Feature	Description
the system board	

HP Smart Array P712m Controller features

Feature	Description
Board type	Type I, 4-port, PCIe mezzanine board
Dimensions, cm	11.3 x 10.0 x 2.0
Dimensions, in	4.5 x 4.0 x 0.8
Maximum number of physical drives	2 internal
Maximum power required (approximate)	14 W
RAID levels	0, 1
Battery kit option part number	462969-B21
Cache module	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC
I/O connection to the system board	Grid array mezzanine connector

HP Smart Array P800 Controller features

Feature	Description
Board type	Full-size, PCIe stand-up board
Dimensions, cm*	31.1 x 11.1 x 1.2
Dimensions, in*	12.3 x 4.4 x 0.5
Maximum number of physical drives	108 (internal + external)
Maximum power required (approximate)	25 W
RAID levels	0, 1, 1+0, and 5; with cache battery, also RAID 6
Battery kit option part number	398648-001
Cache module	72-bit wide, 512-MiB BBWC (48 MiB is used by the onboard processor)
I/O connection to the system board	PCIe x8 edge connector

HP Smart Array P812 Controller features

Feature	Description
Board type	Full-size, PCIe stand-up board

Feature	Description
Dimensions, cm*	31.1 x 11.1 x 1.2
Dimensions, in*	12.3 x 4.4 x 0.5
Maximum number of physical drives	108 (internal + external)
Maximum power required (approximate)	29 W**
RAID levels	0, 1, 1+0, 5 and 50; with cache capacitor, also RAID 6 and 60
Cache module	72-bit wide, 1-GiB FBWC (112 MiB is used by the onboard processor)
I/O connection to the system board	PCIe x8 edge connector

*These dimensions exclude the board bracket.

**For use on qualified systems that support power requirements above 25 W

Overview of the installation procedure

Installing a stand-up controller in an unconfigured server

New HP ProLiant servers autoconfigure when powered up for the first time. For more information about the autoconfiguration process, see the server-specific user guide or the *HP ROM-Based Setup Utility User Guide*. These guides are available on the product Documentation CD.

IMPORTANT: Do not power up the server until the hardware configuration is satisfactory, as described in the procedure given in this section.

To install the controller in an unconfigured server:

1. Install the controller hardware ("Installing the controller hardware" on page 25). For server-specific procedures, see the server user guide.
2. If the controller supports external storage, connect external storage devices to the controller ("Connecting external storage" on page 27).
3. Install physical drives, as needed.

   The number of drives connected to the controller determines the RAID level that is autoconfigured when the server powers up. For more information, see the server-specific user guide or the *HP ROM-Based Setup Utility User Guide*.
4. Power up the external storage devices.
5. Power up the server. The autoconfiguration process runs.
6. Update the server firmware ("Updating the firmware" on page 29).
7. Update the controller firmware ("Updating the firmware" on page 29).
8. Update the drive firmware ("Updating the firmware" on page 29).
9. Install the operating system and device drivers ("Installing device drivers" on page 32). Instructions are provided with the CD that is supplied in the controller kit.
10. (Optional) Create additional logical drives ("Configuring an array" on page 30).

The server is now ready for use.

Installing a stand-up controller in a previously configured server

1. Back up data on the system.
2. Update the server firmware ("Updating the firmware" on page 29).
3. Do one of the following:

- If the new controller is the new boot device, install the device drivers ("Installing device drivers" on page 32).
- If the new controller is not the new boot device, go to the next step.

4. Power down the server.
5. Power down all peripheral devices.
6. Disconnect the power cord from the power source.
7. Disconnect the power cord from the server.
8. Disconnect all peripheral devices.
9. Install the controller hardware ("Installing the controller hardware" on page 25). For server-specific procedures, see the server user guide.
10. Connect storage devices to the controller ("Connecting storage devices" on page 26).
11. Connect peripheral devices to the server.
12. Connect the power cord to the server.
13. Connect the power cord to the power source.
14. Power up all peripheral devices.
15. Power up the server.
16. Update the controller firmware ("Updating the firmware" on page 29).
17. Update the drive firmware ("Updating the firmware" on page 29).
18. (Optional) Set this controller as the boot controller using ORCA ("Setting a controller as the boot controller" on page 31).
19. (Optional) Change the controller boot order using RBSU ("Setting the controller order" on page 31).
20. If the new controller is not the new boot device, install the device drivers ("Installing device drivers" on page 32).
21. If new versions of the Management Agents are available, update the Management Agents ("Installing Management Agents" on page 32).
22. (Optional) Create additional logical drives ("Configuring an array" on page 30).

The server is now ready for use.

Installing a mezzanine controller in an unconfigured server blade

New HP ProLiant server blades autoconfigure when powered up for the first time. For more information about the autoconfiguration process, see the server blade user guide or the *HP ROM-Based Setup Utility User Guide*. These guides are available on the product Documentation CD.

IMPORTANT: Do not power up the server until the hardware configuration is satisfactory, as described in the procedure given in this section.

To install the controller in an unconfigured server blade:

1. Remove the server blade access panel.
2. Do one of the following:

- For the HP Smart Array P712m Controller, install the cache module, if available. To boot, the controller does not require a cache module.
- For all other controllers, install the cache module. If the cache module is absent, these controllers do not boot.

3. Install the controller in the server blade. For server blade-specific procedures, see the server blade user guide.
4. Install the access panel.
5. Install an HP 3G SAS Blade Pass-Thru Module in the enclosure.
6. Connect the pass-thru module to a drive enclosure.
7. Install physical drives in the drive enclosure, as needed.

   The number of drives connected to the pass-thru module determines the RAID level that is autoconfigured when the server blade powers up. For more information, see the server-specific user guide or the *HP ROM-Based Setup Utility User Guide*.
8. Install the server blade in the enclosure.

   By default, the server blade powers up upon insertion. If necessary, power up the server blade manually. The autoconfiguration process runs.
9. Update the server firmware ("Updating the firmware" on page 29).
10. Update the controller firmware ("Updating the firmware" on page 29).
11. Update the drive firmware ("Updating the firmware" on page 29).
12. Install the operating system and device drivers ("Installing device drivers" on page 32). Instructions are provided with the CD that is supplied in the controller kit.
13. (Optional) Create additional logical drives ("Configuring an array" on page 30).

The server blade is now ready for use.

Installing a mezzanine controller in a previously configured server blade

1. Back up data on the system.
2. Update the server blade firmware ("Updating the firmware" on page 29).
3. Do one of the following:
   - If the new controller is the new boot device, install the device drivers ("Installing device drivers" on page 32).
   - If the new controller is not the new boot device, go to the next step.
4. Power down the server blade.
5. Remove the server blade from the enclosure.
6. Remove the server blade access panel.
7. Do one of the following:
   - For the HP Smart Array P712m Controller, install the cache module, if available. To boot, the controller does not require a cache module.
   - For all other controllers, install the cache module. If the cache module is absent, these controllers do not boot.

8. Install the controller in the server blade. For server blade-specific procedures, see the server blade user guide.
9. Install the access panel.
10. Install an HP 3G SAS Blade Pass-Thru Module in the enclosure.
11. Connect the pass-thru module to a drive enclosure.
12. Install the server blade in the enclosure.

    By default, the server blade powers up upon insertion. If necessary, power up the server blade manually. The autoconfiguration process runs.
13. Update the controller firmware ("Updating the firmware" on page 29).
14. Update the drive firmware ("Updating the firmware" on page 29).
15. (Optional) Set this controller as the boot controller using ORCA ("Setting a controller as the boot controller" on page 31).
16. (Optional) Change the controller boot order using RBSU ("Setting the controller order" on page 31).
17. If the new controller is not the new boot device, install the device drivers ("Installing device drivers" on page 32).
18. If new versions of the Management Agents are available, update the Management Agents ("Installing Management Agents" on page 32).

The server blade is now ready for use.

Installing the controller hardware

Installing stand-up boards

The installation procedure for stand-up boards involves the following main steps:

1. Preparing the server (on page 25).
2. Installing the controller board (on page 25).
3. Connecting storage devices (on page 26).

Preparing the server

1. Back up all data.
2. Close all applications.
3. Power down the server.

> **CAUTION:** In systems that use external data storage, be sure that the server is the first unit to be powered down and the last to be powered back up. Taking this precaution ensures that the system does not erroneously mark the drives as failed when the server is powered up.

4. Power down all peripheral devices that are attached to the server.
5. Unplug the AC power cord from the outlet and then from the server.
6. Disconnect all peripheral devices from the server.

Installing the controller board

> **WARNING:** To reduce the risk of personal injury or damage to the equipment, consult the safety information and user documentation provided with the server before attempting the installation.
>
> Many servers are capable of providing energy levels that are considered hazardous and are intended to be serviced only by qualified personnel who have been trained to deal with these hazards. Do not remove enclosures or attempt to bypass any interlocks that may be provided for the purpose of removing these hazardous conditions.

1. Remove or open the access panel.

> **WARNING:** To reduce the risk of personal injury from hot surfaces, allow the drives and the internal system components to cool before touching them.

2. Select an available x8 or larger PCIe slot.
3. Remove the slot cover. Save the retaining screw, if one is present.
4. Install the cache module on the controller.

   If the cache module is absent, the controller will not boot.

5. Slide the controller board along the slot alignment guide, if one is present, and then press the board firmly into the slot so that the contacts on the board edge are properly seated in the system board connector.
6. Secure the controller board in place with the retaining screw. If the slot alignment guide has a latch (near the rear of the board), close the latch.
7. Connect storage devices to the controller. (For details of the procedure, see "Connecting storage devices (on page 26).")
8. Close or replace the access panel, and then secure it with thumbscrews, if any are present.

CAUTION: Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.

Connecting storage devices

Depending on the controller model, you can connect SAS or SATA drives to the controller internally ("Connecting internal storage" on page 26), externally ("Connecting external storage" on page 27), or both.

For information about supported drive models for a particular controller, see the controller-specific page on the HP website (http://www.hp.com/products/smartarray).

Connecting internal storage

1. Power down the server.
2. Install drives, if necessary. For drive requirements when configuring arrays, see "Utilities available for configuring an array (on page 30)."

   The server may support different types of drives. However, to group drives in an array, they must meet the following criteria:

   - They must be either all SAS or all SATA. (This controller does not support parallel SCSI drives.)
   - They must be either all hard drives or all solid state drives.
   - For efficient use of drive space, they must have comparable capacity.

   For more information about drive installation, see the following resources:

   - Replacing, moving, or adding drives (on page 58)
   - Server documentation
   - Drive documentation
3. Use the internal wide SAS cable provided with the server to connect the controller to the drives:
   - If the drives are hot-plug capable, connect the internal connector of the controller to the SAS connector on the hot-plug drive cage.
   - If the drives are not hot-plug capable, connect the internal connector of the controller to the non-hot-plug drives.
4. Close or install the access panel, and secure it with thumbscrews, if any are present.

CAUTION: Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.

5. Power up the server.

Connecting external storage

The following procedure is valid for all controller models. However, if you connect an E500 controller to an HP MSA2000s enclosure, the following operational differences apply (compared to other combinations of controllers and storage devices):

- You use the enclosure, not the server, to set the RAID level on an array.
- You cannot set the rebuild priority.
- You cannot move arrays.
- The cache battery on the controller is no longer required.

In addition, you can connect only one MSA2000s enclosure to each E500 controller.

For further information about using an E500 with an MSA2000s, see the user guide for the MSA2000s.

1. Power down the server.
2. Connect an external SAS cable to the external port of the controller:
   a. Pull back the tab on the Mini SAS 4x connector on the cable.
   b. Insert the cable connector into the external port of the controller.
   c. Release the tab.
3. Connect the other end of the cable to the SAS input connector of the external storage enclosure:
   - If the enclosure uses a standard SAS 4x connector, insert the cable connector into the enclosure connector, and then tighten the lock screws on the cable connector.
   - If the enclosure uses a Mini SAS 4x connector, pull back the tab on the cable connector, insert the cable connector into the enclosure connector, and then release the tab.
4. Power up the enclosure.
5. Power up the server.

SAS cable part numbers

To order additional cables, use the option kit part number.

Approximate cable length	Type of cable	Option kit part number	Cable assembly number
1 m (3 ft)	Mini SAS 4x to standard SAS 4x	419570-B21	408908-002
2 m (6 ft)	Mini SAS 4x to Mini SAS 4x	407339-B21	407344-003
—	Mini SAS 4x to standard SAS 4x	419571-B21	408908-003
4 m (13 ft)	Mini SAS 4x to Mini SAS 4x	432238-B21	407344-004
—	Mini SAS 4x to standard SAS 4x	419572-B21	408908-004
6 m (20 ft)	Mini SAS 4x to Mini SAS 4x	432239-B21	407344-005
—	Mini SAS 4x to standard SAS 4x	419573-B21	408908-005

Installing mezzanine boards

The installation procedure for mezzanine boards involves the following main steps:

1. Preparing the server blade (on page 28).
2. Installing the mezzanine controller board (on page 28).
3. Connecting the mezzanine controller to storage devices (on page 28).

Preparing the server blade

1. Back up all data.
2. Close all applications.
3. Power down the server blade.

CAUTION: In systems that use external data storage, be sure that the server is the first unit to be powered down and the last to be powered back up. Taking this precaution ensures that the system does not erroneously mark the drives as failed when the server is powered up.

4. Remove the server blade from the enclosure.

Installing the mezzanine controller board

WARNING: To reduce the risk of personal injury or damage to the equipment, consult the safety information and user documentation provided with the server before attempting the installation.

Many servers are capable of providing energy levels that are considered hazardous and are intended to be serviced only by qualified personnel who have been trained to deal with these hazards. Do not remove enclosures or attempt to bypass any interlocks that may be provided for the purpose of removing these hazardous conditions.

1. Remove the access panel from the server blade.

WARNING: To reduce the risk of personal injury from hot surfaces, allow the drives and the internal system components to cool before touching them.

2. Select an available mezzanine socket on the system board.
3. Remove the socket cover, and then save it for future use.
4. Plug the controller into the socket.
5. Tighten the three spring-loaded captive screws at the corners of the controller.
6. Reinstall the access panel.

CAUTION: Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.

7. Reinstall the server blade in the enclosure.

Connecting the mezzanine controller to storage devices

1. Install an HP 3G SAS Blade Pass-Thru Module in the enclosure.
2. Connect the pass-thru module to a drive enclosure.
3. If necessary, install physical drives in the drive enclosure.
4. Power up the server blade.

Updating the firmware

Methods for updating the firmware

To update the firmware on the server, controller, or drives, use Smart Components. These components are available on the Firmware Maintenance CD. The most recent version of a particular component is available on the HP support website (http://www.hp.com/support). When prompted for product information, enter the appropriate server model name.

1. Find the most recent version of the component that you require. Components for controller firmware updates are available in offline and online formats.
2. Follow the instructions for installing the component on the server. The instructions are provided on the CD and the same Web page as the component.
3. Follow the additional instructions that describe how to use the component to flash the ROM. The instructions are provided with each component.

For more information about updating the firmware, see the *HP ProLiant Storage Firmware Maintenance User Guide* (for controller and drive firmware) or the *HP Online ROM Flash User Guide* (for server firmware).

Configuring an array

Utilities available for configuring an array

To configure an array on an HP Smart Array controller, three utilities are available:

- **Option ROM Configuration for Arrays (ORCA)**—A simple utility used mainly to configure the first logical drive in a new server before the operating system is loaded
- **HP Online Array Configuration Utility for NetWare (CPQONLIN)**—A more full-featured utility for online configuration of servers that use Novell NetWare
- **HP Array Configuration Utility (ACU)**—An advanced utility that enables you to perform many complex configuration tasks

For more information about the features of these utilities and for instructions for using the utilities, see the *Configuring Arrays on HP Smart Array Controllers Reference Guide*. This guide is available on the Documentation CD that is provided in the controller kit.

Whichever utility you use, remember the following factors when you build an array:

- All drives in an array must be of the same type (for example, either all SAS or all SATA and either all hard drives or all solid state drives).
- For the most efficient use of drive space, all drives within an array should have approximately the same capacity. Each configuration utility treats every physical drive in an array as if it has the same capacity as the smallest drive in the array. Any excess capacity of a particular drive cannot be used in the array and so is unavailable for data storage.
- The more physical drives that there are in an array, the greater the probability that the array will experience a drive failure during any given period.
- To guard against the data loss that occurs when a drive fails, configure all logical drives in an array with a suitable fault-tolerance (RAID) method.

Setting the boot controller and controller order

Setting a controller as the boot controller

Use the following procedure to set a controller as the boot controller. To adjust the boot order settings for other controllers in the system, use RBSU ("Setting the controller order" on page 31).

1. Confirm that the controller is connected to a logical drive. (If it is not, it cannot be set as the boot controller.)
2. Perform a normal system shutdown.
3. Restart the server.

   POST runs, and all controllers in the server are initialized one at a time in the current boot order sequence. If a controller is connected to one or more drives, an ORCA prompt message appears during the initialization process for that controller.

   As soon as you see the ORCA prompt for the controller that you want to set as the boot controller, continue with the next step.
4. Press the **F8** key.

   The ORCA main menu appears. If the controller is configured with a logical drive, one of the menu options is to set the controller as the boot controller.
5. Select the appropriate menu option, and follow any subsequent on-screen instructions. If prompted to save the settings, do so.
6. (Optional) To configure or reconfigure an array on this controller, you can use ORCA. For more information, see the *Configuring Arrays on HP Smart Array Controllers Reference Guide*. This guide is available on the Documentation CD that is provided in the controller kit.

   To configure an array at a later time or to use a different utility to configure the array, exit ORCA, and then restart the server for the new boot controller setting to take effect.

Setting the controller order

1. Power up the server.

   The server runs the POST sequence and briefly displays an RBSU prompt.
2. At the prompt, press the **F9** key to start RBSU.
3. Follow the on-screen instructions to set the boot order for the different controllers in the system.
4. Save the settings.
5. Exit from the utility.

For more information about using RBSU, refer to the *HP ROM-Based Setup Utility User Guide* or the server setup and installation guide. These documents are both available on the Documentation CD supplied in the server kit.

Installing device drivers and Management Agents

Installing device drivers

The drivers for the controller are located on the Support Software CD or the SmartStart CD that is provided in the controller kit. Updates are posted to the HP website (http://www.hp.com/support). When prompted for product information, enter the appropriate server model name.

Using the Support Software CD—Instructions for installing the drivers from the Support Software CD are given in the leaflet that is supplied with the CD.

Using the SmartStart CD—If you use the Assisted Installation path feature of SmartStart to install the operating system on a new server, the drivers are installed at the same time.

You can also use SmartStart to update the drivers manually on systems that are already configured. For more information, see the SmartStart documentation.

Installing Management Agents

If you use the Assisted Installation path feature of SmartStart to install the operating system on a new server, the Management Agents are automatically installed at the same time.

You can update the Management Agents by using the latest versions of the agents from the HP website (http://www.hp.com/go/hpsim). The procedure is provided with the agents.

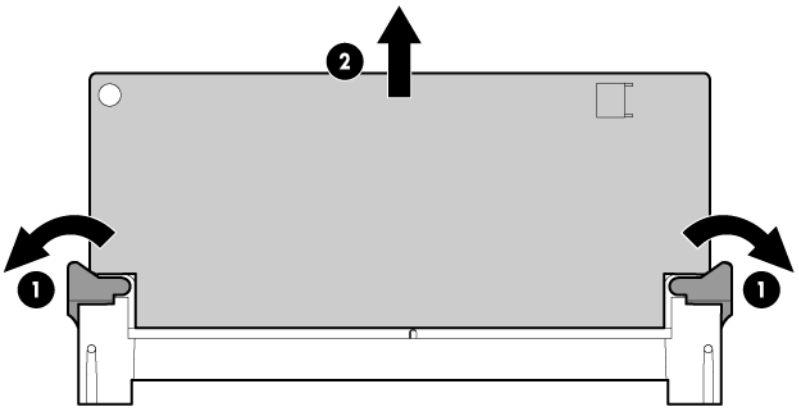
If the new agents do not function correctly, you might also need to update Systems Insight Manager. The latest version of Systems Insight Manager is available for download from the HP website (http://www.hp.com/go/hpsim).

Upgrading or replacing controller options

Replacing the FBWC module on the P410 and P411 models

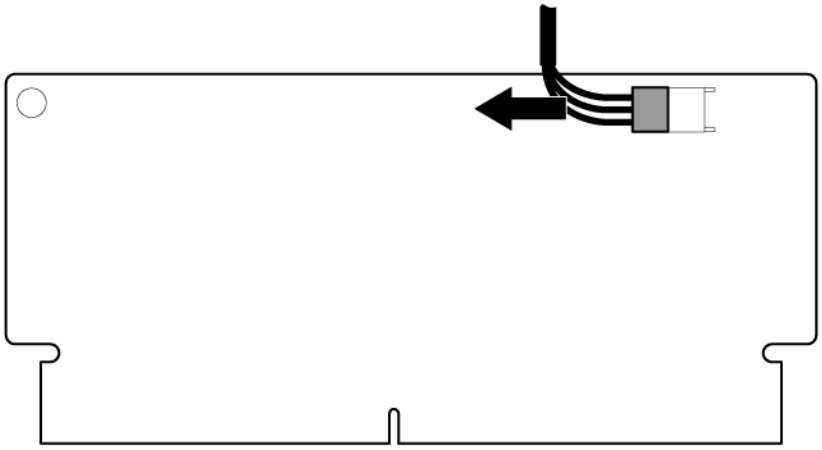
△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

1. Update the controller firmware ("Updating the firmware" on page 29).
2. Close all applications.
3. Power down the server.
4. Disconnect the power cord from the AC power source.
5. Disconnect the power cord from the server.
6. Remove or open the access panel.
7. If the existing cache module is connected to a capacitor pack, observe the FBWC module LEDs (on page 73):
   - If the amber LED is flashing, data is trapped in the cache. Restore system power, and restart this procedure from step 1.
   - If the amber LED is not illuminated, remove the controller from the server, and then continue with the next step.
8. Open the ejector latches on each side of the DIMM slot. Normally, the cache module is ejected from the DIMM slot. If the module is not ejected automatically, remove the cache module.



△ **CAUTION:** When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

9. If the cache module is connected to a capacitor pack, **carefully** disconnect the capacitor pack cable from the connector on the top of the cache module.



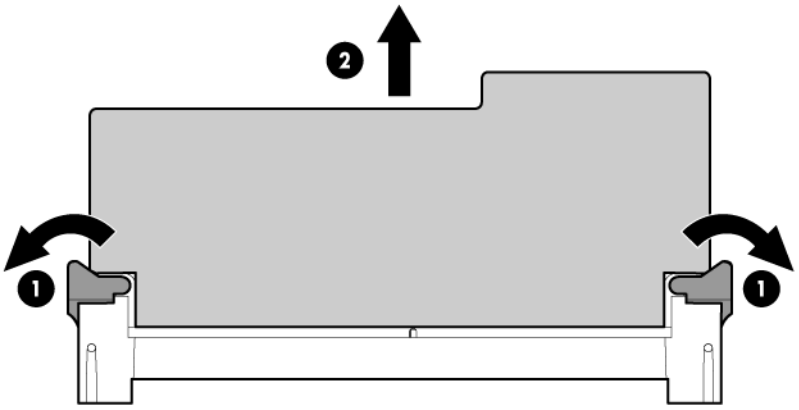
10. If the previous cache module was connected to a capacitor pack, **carefully** connect the capacitor pack cable to the new cache module.
11. Install the new cache module in the DIMM slot.
12. Close the ejector latches on the DIMM slot.
13. Install the controller.

Replacing the BBWC module on the P212, P410, P411, and P712m models

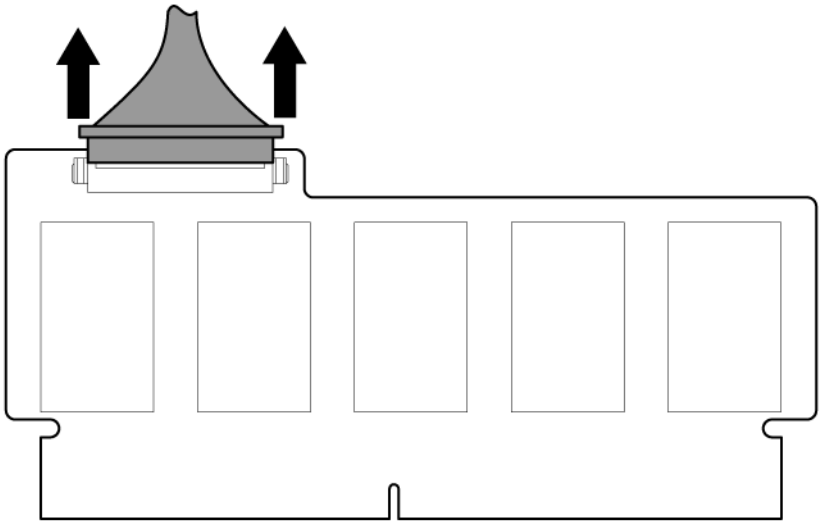
△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

1. Close all applications.
2. Power down the server.
3. Disconnect the power cord from the AC power source.
4. Disconnect the power cord from the server.
5. Remove or open the access panel.
6. If the existing cache module is connected to a battery, observe the BBWC status LED ("Battery pack LEDs" on page 74).
   - If the LED is flashing every two seconds, data is trapped in the cache. Restore system power, and then repeat the previous steps in this procedure.
   - If the LED is not lit, remove the controller from the server, and then continue with the next step.

7. Open the ejector latches on each side of the DIMM slot. Normally, the cache module is ejected from the DIMM slot. If the module is not ejected automatically, remove the cache module.



8. If the cache module is connected to a battery, disconnect the battery cable from the connector on the rear of the cache module.

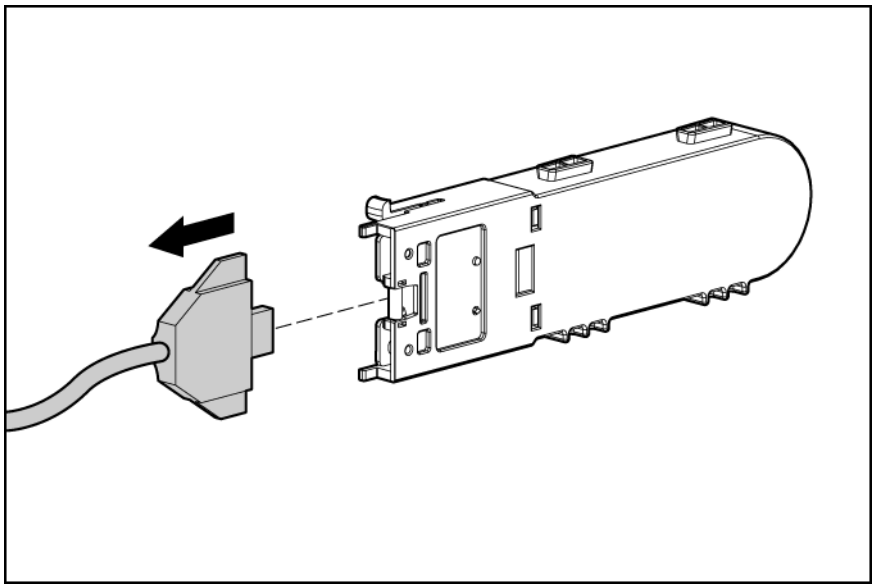


9. If the previous cache module was connected to a battery, connect the battery cable to the new cache module.
10. Install the new cache module in the DIMM slot.
11. Close the ejector latches on the DIMM slot.
12. Install the controller.

Replacing the battery on the P212, P410, and P411 models

CAUTION: Do not use this controller with batteries designed for other controller models, or the controller will malfunction and you could lose data. If you use an unsupported battery for this controller, a POST message might appear when you power up your server.

1. Close all applications.
2. Power down the server.
3. Disconnect the server from the AC power source.
4. Remove or open the access panel.
5. Observe the BBWC status LED ("Battery pack LEDs" on page 74).
   - If the LED is blinking every two seconds, data is trapped in the cache. Restore system power, and then repeat the previous steps in this procedure.
   - If the LED is not lit, continue with the next step.
6. Unplug the battery cable from the old battery.



7. Connect the battery cable to the new battery.
8. Place the new battery at the same site in the server that the old battery occupied.
9. Close the access panel.

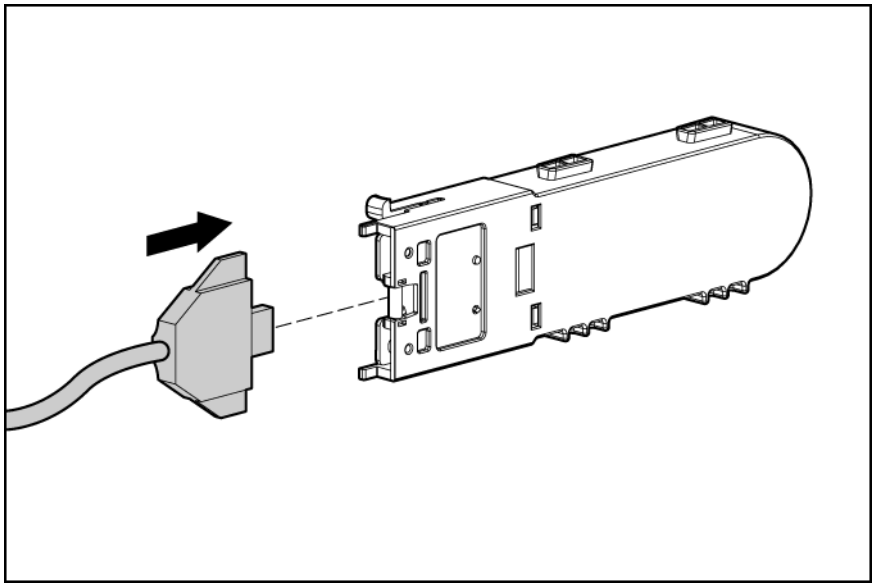
Installing an E500 or P400 cache battery

If you are replacing an existing E500 or P400 cache battery (instead of installing a battery where one did not exist), use the replacement procedure ("Replacing an E500 or P400 cache battery" on page 37) instead of this installation procedure.

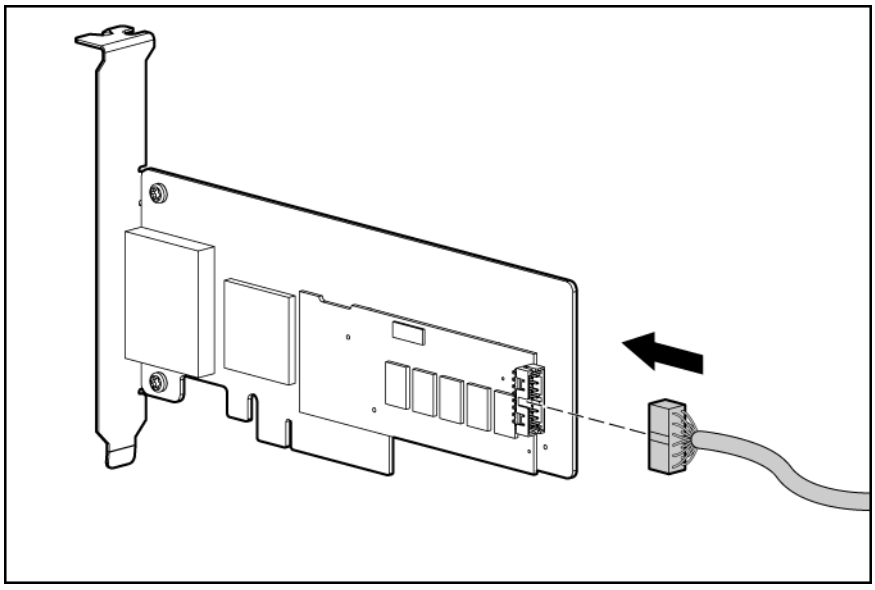
WARNING: There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice (on page 81)" before installing or removing any item that contains a battery pack.

1. Close all applications, and then power down the server.

2. Plug the battery cable (supplied in the battery pack kit) into the battery pack.



3. Install the new battery pack into the server. (The installation site depends on the server. For further information, refer to the server-specific user guide.)
4. Plug the other end of the battery cable into the connector on the cache module.



After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is temporarily disabled. This behavior is normal because the new battery pack is likely to have a low charge. You do not need to take any action because the recharge process begins automatically when the battery pack is installed. The controller operates properly while the battery pack is recharging, although the performance advantage of the array accelerator is absent. When the battery pack has been charged to a predetermined level, the array accelerator is automatically enabled.

Replacing an E500 or P400 cache battery

⚠ **WARNING:** There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice (on page 81)" before installing or removing any item that contains a battery pack.

△ **CAUTION:** Do not replace a battery pack while the server is powered up. In this situation, the loose end of the battery cable that is still connected to the cache can cause a short circuit, leading to permanent electrical damage.

1. Close all applications, and then power down the server.
2. Disconnect the server from the AC power source.
3. Remove all components that prevent access to the battery pack. For more information, see the server-specific user guide.
4. Observe the BBWC Status LED ("Battery pack LEDs" on page 74):
   - If the LED is flashing every two seconds, data is still trapped in the cache. Restore system power, and then repeat the previous steps in this procedure.
   - If the LED is not lit, proceed with the next step.
5. Disconnect the cache cable from the battery pack.
6. Remove the battery pack from the server.
7. Connect the cache cable to the new battery pack.
8. Install the new battery pack into the server.

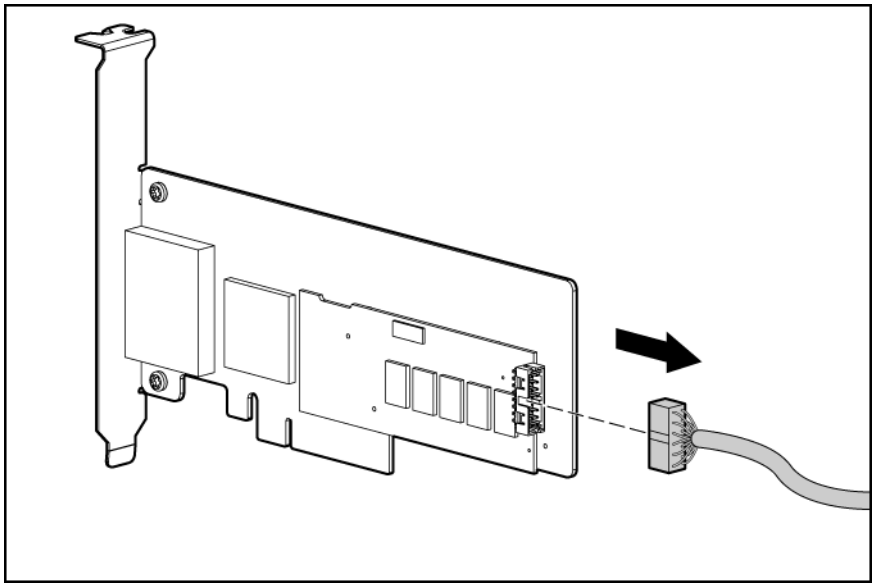
NOTE: After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is temporarily disabled. This is normal, because the new battery pack is likely to have a low charge. You do not need to take any action, because the recharge process begins automatically when the battery pack is installed. The controller will operate properly while the battery pack recharges, although the performance advantage of the array accelerator will be absent. When the battery pack has been charged to a satisfactory level, the array accelerator will automatically be enabled.

Replacing the E500 or P400 cache

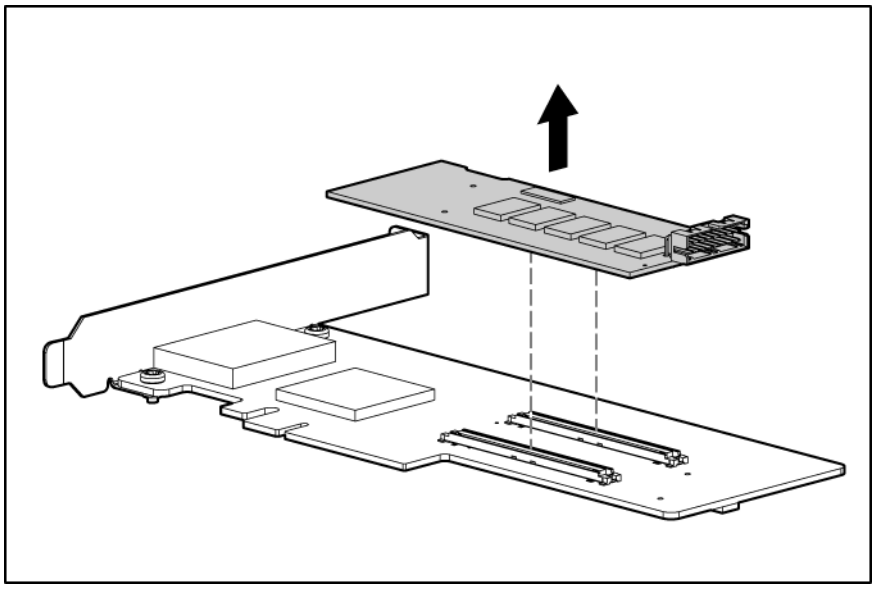
△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

1. Close all applications, and then power down the server. This procedure flushes all data from the cache.
2. Disconnect the power cord from the AC power source.
3. Disconnect the power cord from the server.
4. If the existing cache is connected to a battery, observe the BBWC Status LED ("Battery pack LEDs" on page 74).
   - If the LED is flashing every 2 seconds, data is still trapped in the cache. Restore system power, and then repeat the previous steps in this procedure.

- If the LED is not lit, disconnect the battery cable from the cache.



5. Remove the controller from the server and place it on a firm, flat, nonconductive surface.
6. Remove the existing cache from the controller by pulling at both ends of the cache module with equal force.



7. Install the new cache on the controller. Press firmly above each connector to ensure good electrical contact. (If the cache is not connected properly, the controller cannot boot.)
8. Install the controller in the server.
9. If the previous cache was connected to a battery pack, connect the battery cable to the new cache.

Replacing the P700m or P712m cache battery

△ **CAUTION:** Electrostatic discharge can damage electronic components. Be sure you are properly grounded before beginning this procedure.

The method for replacing a battery depends on whether the battery case is mounted on the inner wall of the server chassis by a hook-and-loop strip or located in a drive slot.

To replace a battery case mounted on the inner wall of the server chassis:

1. Back up all data.
2. Close all applications.
3. Power down the server.
4. Remove the server from the enclosure.
5. Remove the server access panel.
6. Remove the battery case from the chassis wall.
7. Disconnect the cable from the battery.
8. Connect the battery cable to the replacement battery.
9. Mount the battery case on the chassis wall.
10. Close the server access panel.
11. Reinstall the server in the enclosure.

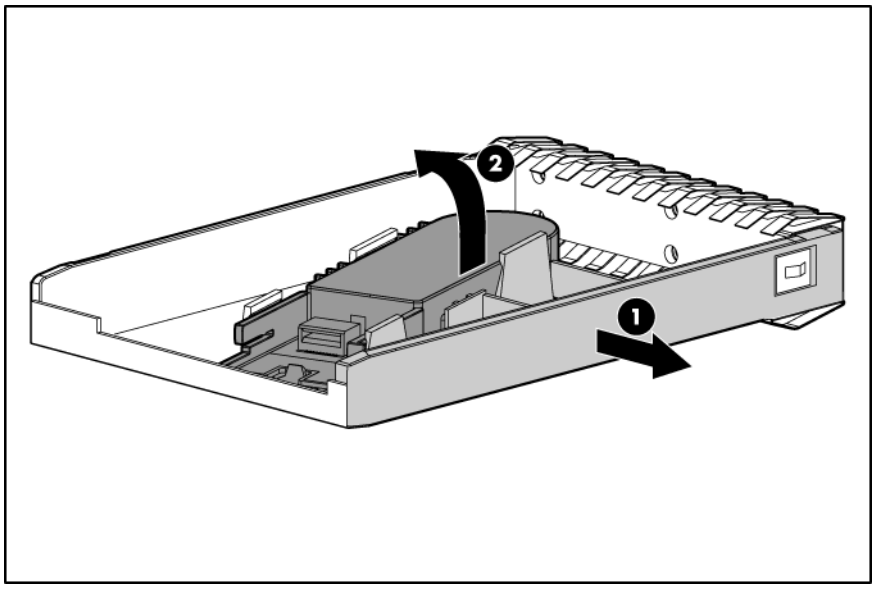
After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is disabled temporarily. This behavior is normal because the new battery pack is likely to have a low charge.

The controller operates properly while the battery pack is recharging, although the performance advantage of the array accelerator is absent. You do not need to take any action because the recharge process begins automatically when the battery pack is installed. When the battery pack has been charged to a predetermined level, the array accelerator is enabled automatically.

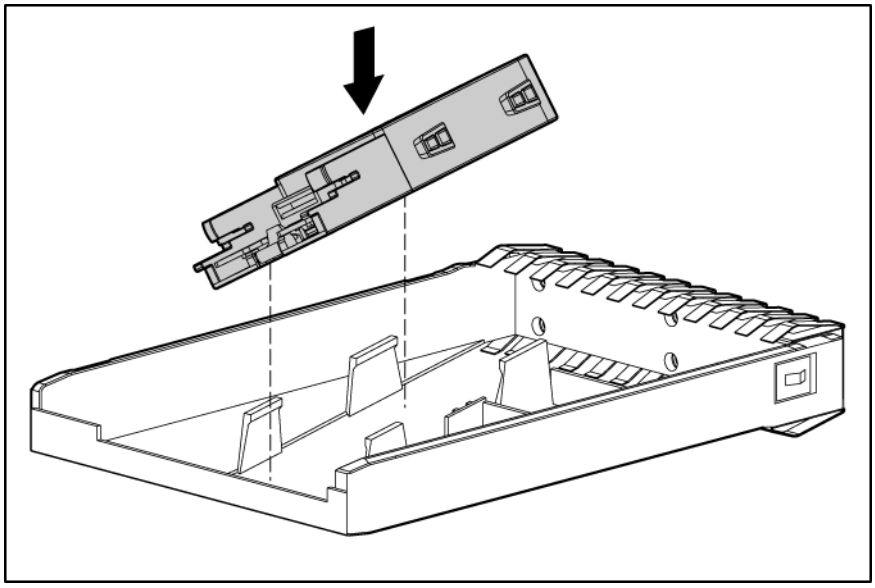
To replace a battery case located in a drive slot:

1. Back up all data.
2. Close all applications.
3. Power down the server.
4. Remove the server from the enclosure.
5. Remove the server access panel.
6. Remove the battery case from the drive slot.
7. Disconnect the battery cable.
8. Invert the battery case.

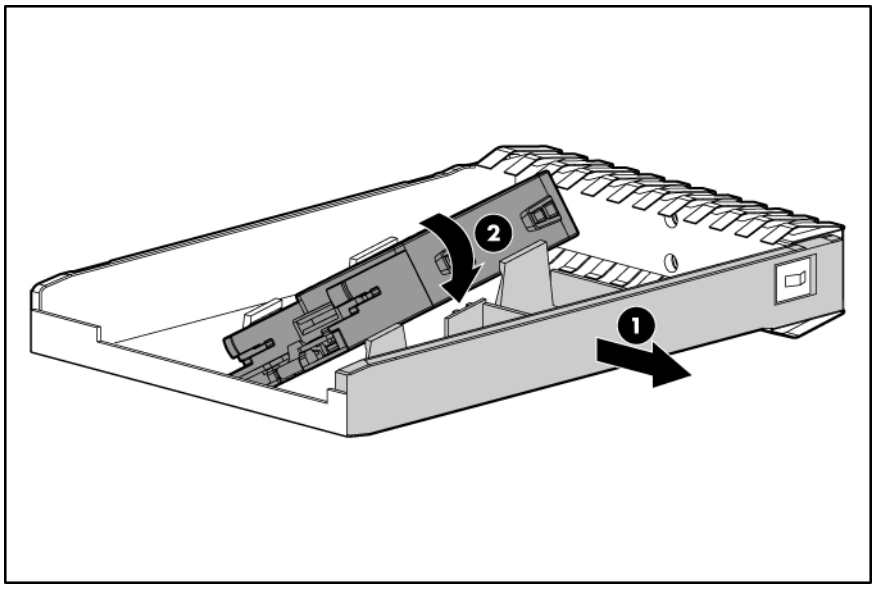
9. Pull the right hand portion of the battery case away from the battery pack, and simultaneously rotate the battery pack out of the opening.



10. Position the replacement battery pack in the opening in the battery case as shown. The upper left edge of the battery pack is under the flanges on the pillars at the left edge of the opening, and the right side of the battery pack rests on the right pillars.



11. Pull the right-hand portion of the battery case away from the battery pack, and simultaneously rotate the battery pack into the opening.



12. Connect the battery cable to the battery pack and the cache. Route the battery cable so that the cache and battery pack can be removed together. (If you need to remove the cache to transfer data, the battery pack must remain connected to it so that the data is preserved.)
13. Insert the battery case into the drive slot.
14. Close the server access panel.
15. Install the server in the enclosure.

After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is disabled temporarily. This behavior is normal because the new battery pack is likely to have a low charge.

The controller operates properly while the battery pack is recharging, although the performance advantage of the array accelerator is absent. You do not need to take any action because the recharge process begins automatically when the battery pack is installed. When the battery pack has been charged to a predetermined level, the array accelerator is enabled automatically.

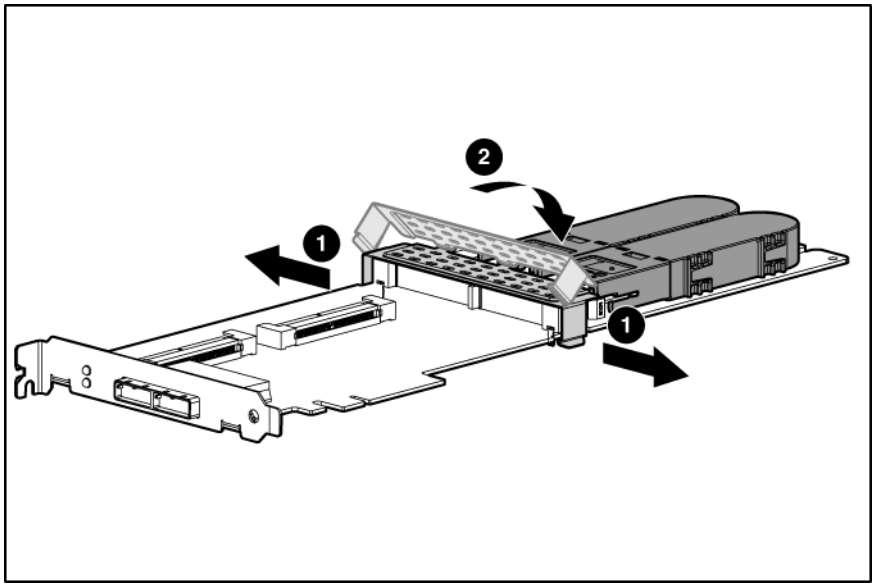
Replacing a P800 cache battery

△ **CAUTION:** Electrostatic discharge can damage electronic components. Be sure you are properly grounded before beginning this procedure.

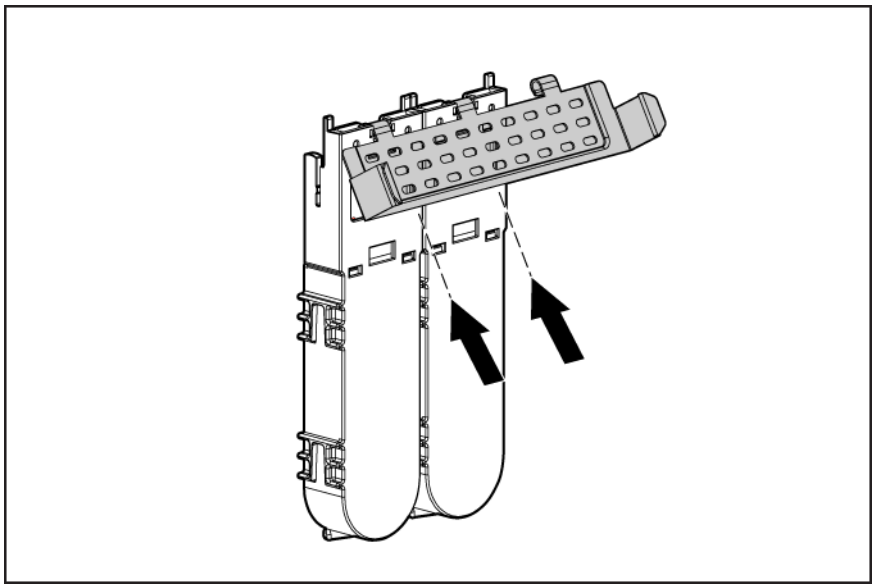
1. Close all applications, and then power down the server. This procedure flushes all data from the cache.
2. Observe the BBWC Status LED ("Battery pack LEDs" on page 74).
   - If the LED is blinking every 2 seconds, data is trapped in the cache. Restore system power, and then repeat the previous steps in this procedure.
   - If the LED is not lit, proceed with the next step.

⚠ **WARNING:** There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice (on page 81)" before installing or removing any item that contains a battery pack.

3. Remove the controller from the server.
4. Pull the flanges on the battery clip outward (1), and then swivel the clip 180 degrees so that it rests on the batteries (2).



5. Slide the batteries toward the right edge of the controller, away from the bracket.
6. While holding the battery assembly, tilt the clip until it is at about 30 degrees to the batteries, and then push the clip in line with the clip hinges until the clip detaches from the batteries.

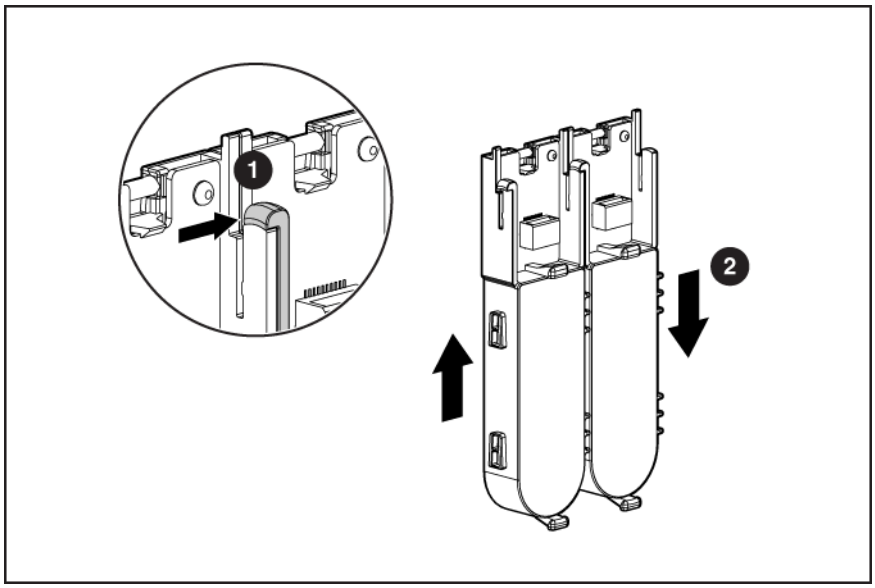


The rest of the procedure depends on whether you are replacing a battery or adding one.

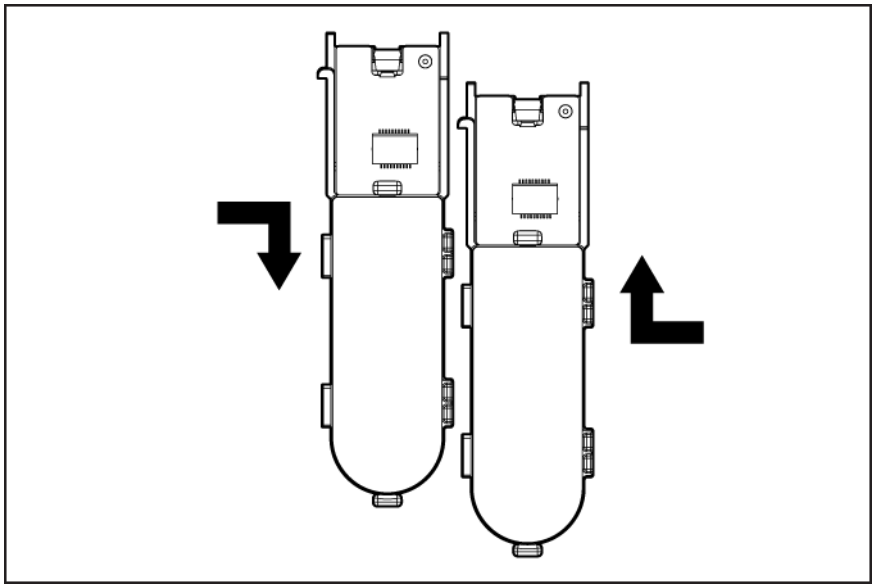
- If you are replacing a battery, continue with the next step.
- If you are only adding an optional third battery, go to step 9.

7. Separate the batteries.

a. Turn the batteries over.
b. Pull the lip on the right battery case away from the edge of the adjacent battery case (1).
c. Slide the batteries apart (2).

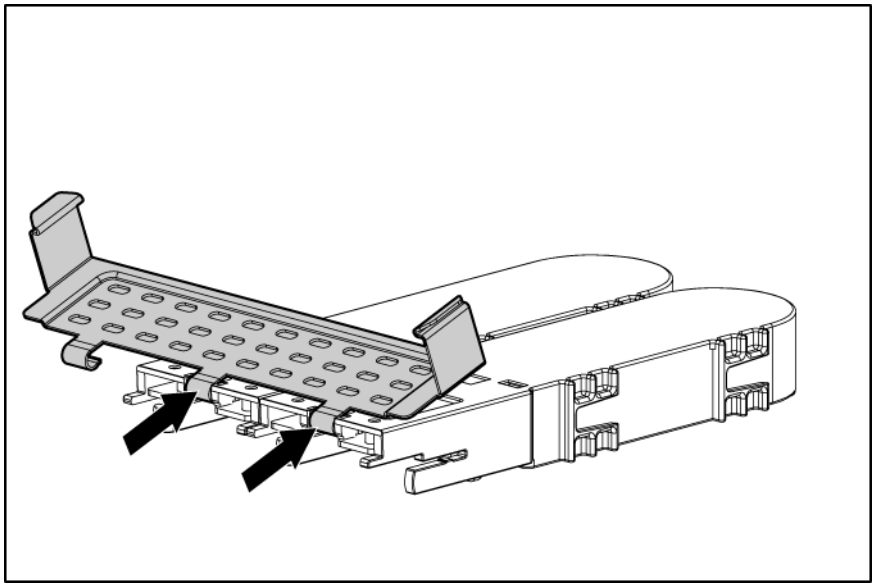


8. Dispose of the exhausted or faulty battery using environmentally approved procedures ("Battery replacement notice" on page 81).
9. Position the new battery and the remaining good battery as indicated, push them together, and then slide them until they are aligned. The batteries combine into one unit.

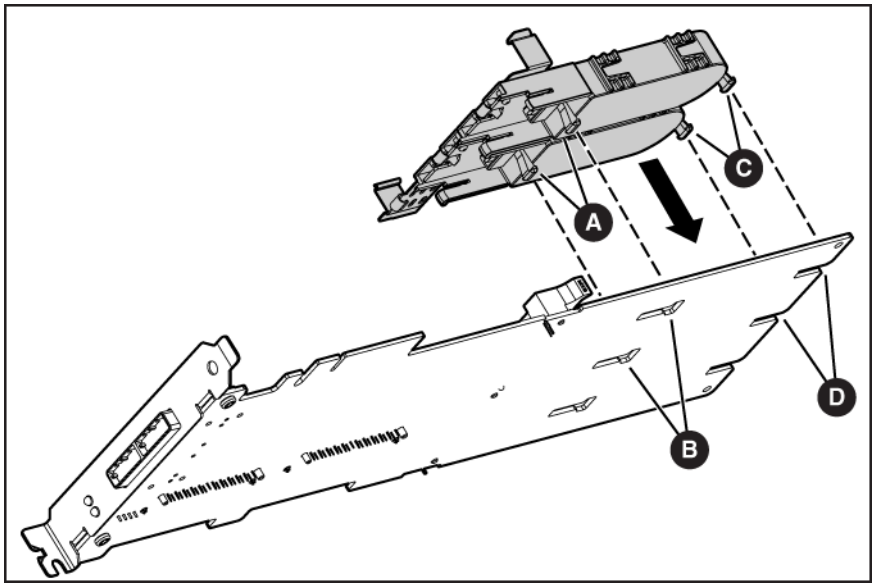


10. Install the battery clip.
    a. Position the clip so that the hinges on the clip are next to the appropriate hinge pillars on the batteries.
    b. Hold the clip at about 30 degrees to the batteries.

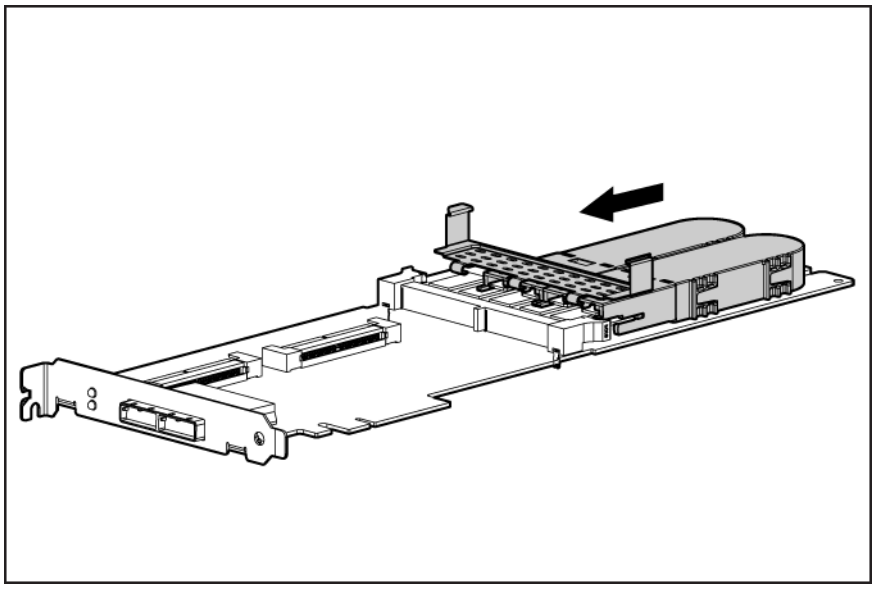
c. Push the clip at the hinges until the clip clicks into place.



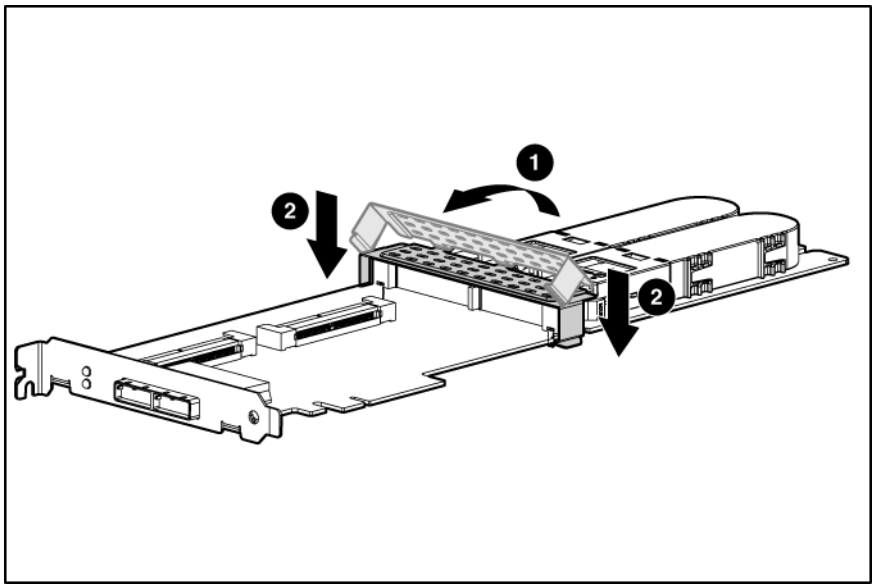
11. Reinstall the batteries.
    a. Hold the controller board near the DIMM socket and at the top and right edges to minimize bending of the board.
    b. Position the batteries so that the pegs A on the underside of each battery are in the appropriate holes B on the controller board and pegs C are in slots D.



c. Slide the batteries toward the board bracket until they are firmly seated against the connectors on the cache module.



12. Secure the battery clip to the controller board:
    a. Swivel the clip over the cache module (1).
    b. Push the clip firmly at both ends (2) until it clicks into place under the controller board.



13. Reinstall the controller in the server.

After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is temporarily disabled. This behavior is normal because the new battery pack is likely to have a low charge. You do not need to take any action, because the recharge process begins automatically when the battery pack is installed. The controller operates properly while the battery pack recharges, although the performance advantage of the array accelerator is absent. When the battery pack has been charged to a satisfactory level, the array accelerator is automatically enabled.

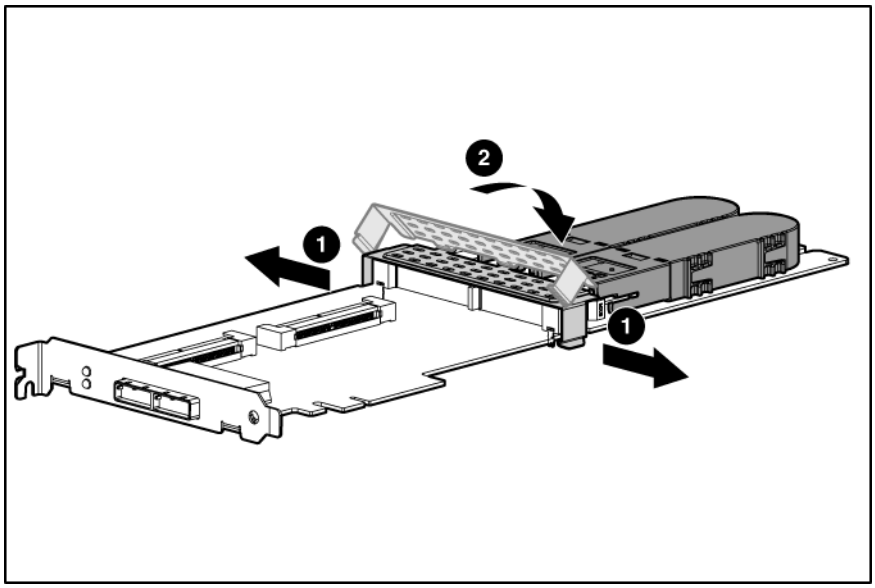
Replacing the P800 cache module or controller

CAUTION: Electrostatic discharge can damage electronic components. Be sure you are properly grounded before beginning this procedure.

1. Close all applications, and then power down the server. This procedure flushes all data from the cache.
2. Observe the BBWC Status LED ("Battery pack LEDs" on page 74).
   - If the LED is blinking every 2 seconds, data is trapped in the cache. Restore system power, and repeat the previous steps in this procedure.
   - If the LED is not lit, proceed with the next step.

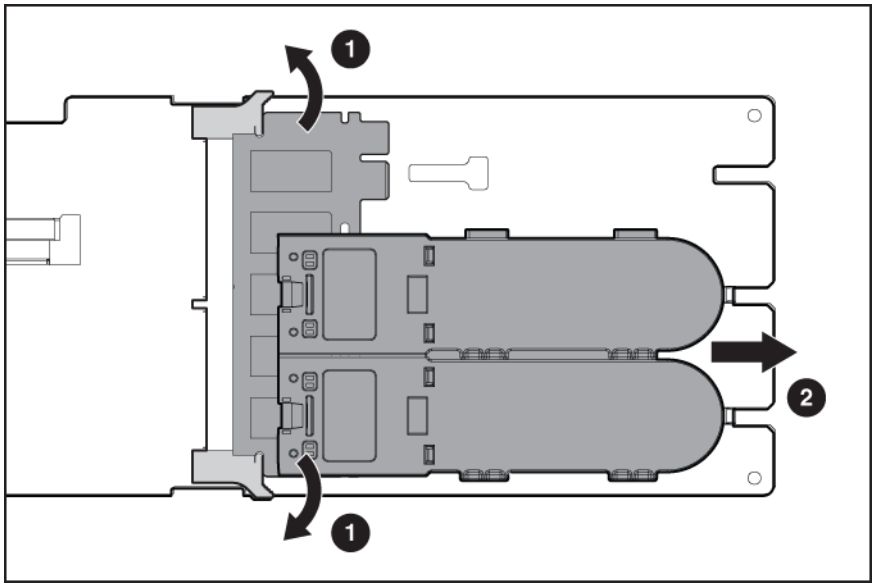
WARNING: There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice (on page 81)" before installing or removing any item that contains a battery pack.

3. Remove the controller from the server.
4. Pull the flanges on the battery clip outward (1), and then swivel the clip 180 degrees so that it rests on the batteries (2).



5. Swivel the latches on the DIMM connector outward (1).

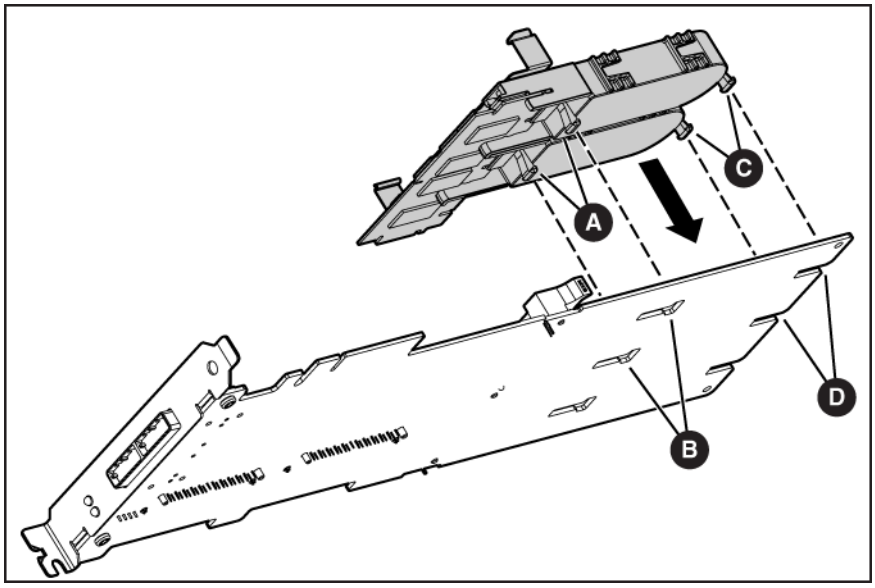
6. Slide the battery assembly and the cache module off the controller board (2).



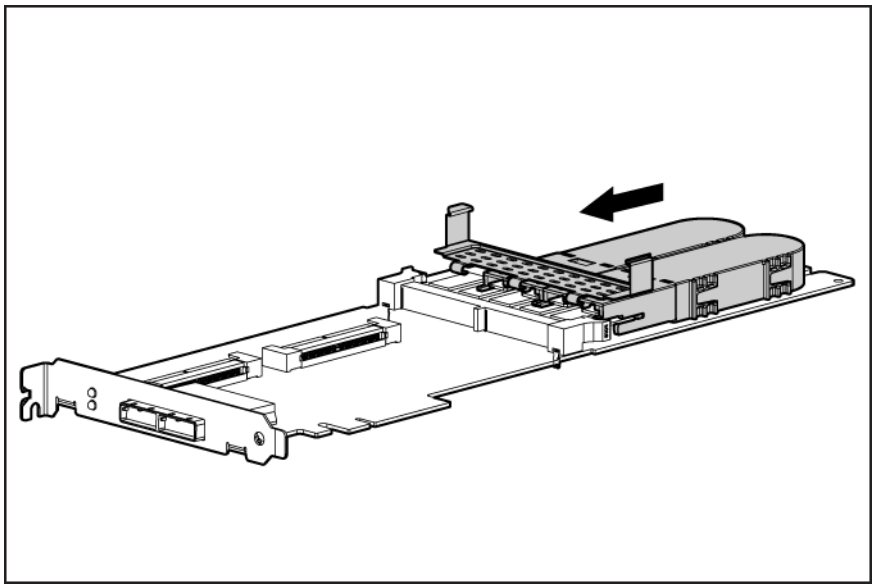
The procedure at this point depends on whether you are replacing the controller or the cache module.

- If you are replacing the controller, go directly to the next step.
- If you are replacing the cache module, pull it out of the battery assembly, install the new cache module in its place, and then go to the next step.

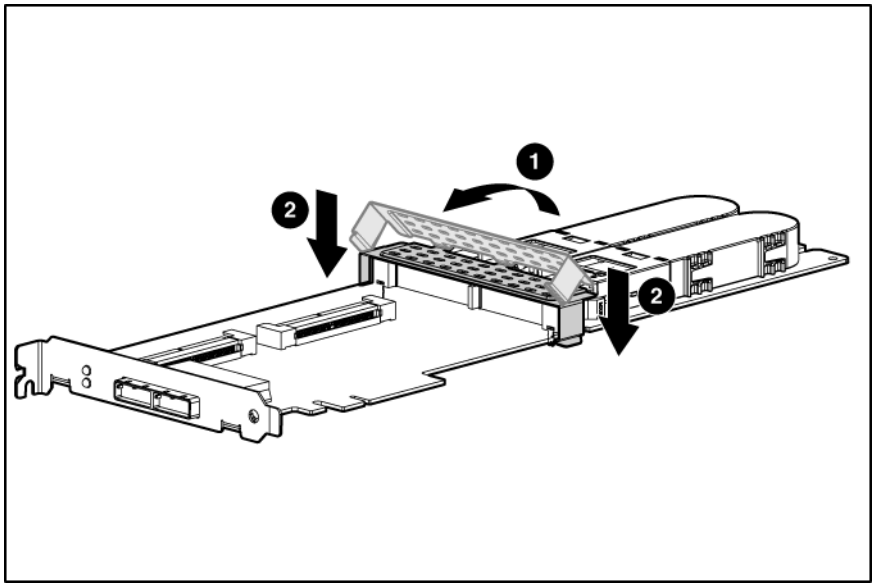
7. Install the cache module and batteries on the controller board.
   a. Hold the controller board near the DIMM connector and at the top and right edges to minimize bending of the board.
   b. Position the batteries so that the pegs A on the underside of each battery are in the appropriate holes B on the controller board, and pegs C are in slots D.



c. Slide the batteries toward the board bracket until the connectors on the cache module are firmly seated in the DIMM connector. (When the cache module is correctly seated, the gold contacts on the cache module are completely hidden within the DIMM connector.)



8. Secure the battery clip to the controller board.
   a. Swivel the clip over the cache module (1).
   b. Push the clip firmly at both ends (2) until it clicks into place under the controller board.

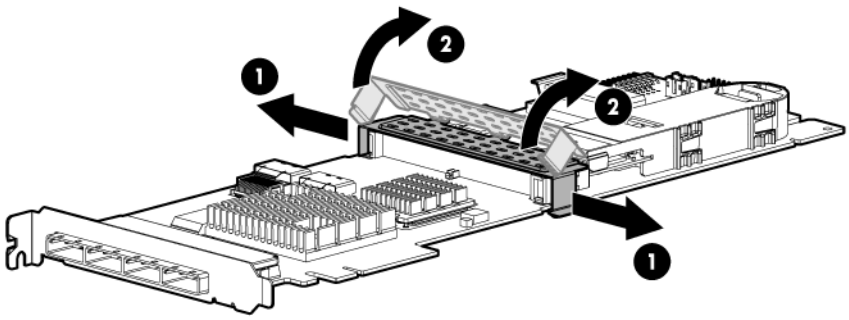


9. Reinstall the controller in the server.

Replacing a P812 capacitor pack

△ **CAUTION:** To prevent damage to electrical components, properly ground the server before beginning any installation, removal, or replacement procedure. Improper grounding can cause electrostatic discharge.

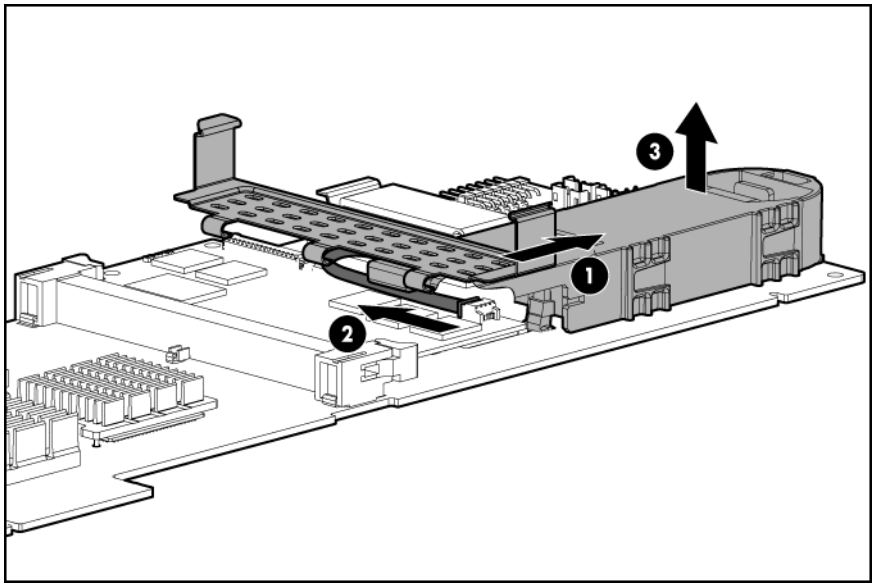
1. Close all applications, and then power down the server. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 73):
   - If the green LED is off and the amber LED is on, the controller is transferring data from DDR memory to flash memory. Wait for data transfer to complete (about 60 seconds), and then proceed with the next step.
   - If the amber LED is off, then proceed with the next step.
3. Remove the controller from the server. See the documentation that ships with the server.
4. Open the capacitor pack clip:
   a. Pull the battery clip flanges outward.
   b. Rotate the clip 180 degrees so that it rests on top of the capacitor pack.



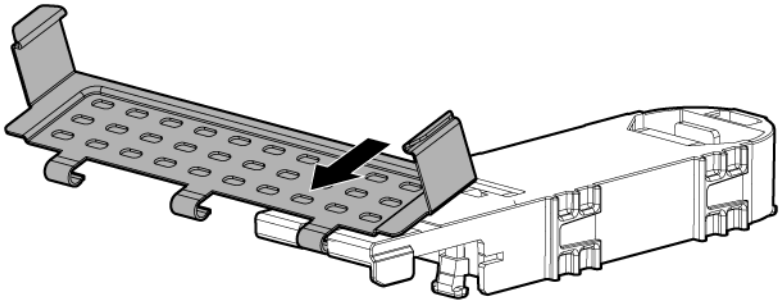
△ **CAUTION:** When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

5. Remove the capacitor pack:
   a. Slide the capacitor pack 2 cm away from the cache module.
   b. Disconnect the capacitor pack cable from the cache module.

c. Lift the capacitor pack and clip from the controller.

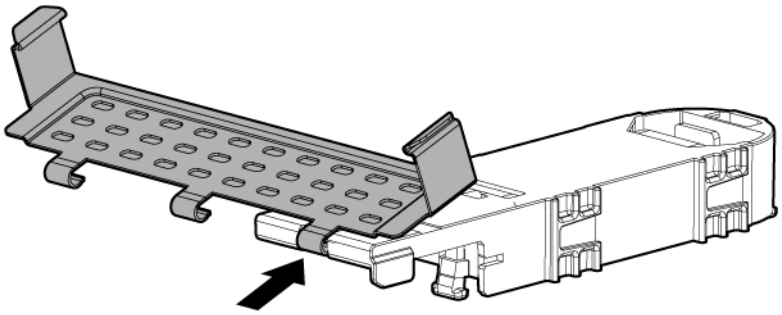


6. Remove the capacitor pack clip:
   a. While holding the capacitor pack assembly, rotate the clip until it is about 30 degrees from the capacitor pack.
   b. Push the clip in line with the clip hinges until the clip detaches from the hinge pillar.

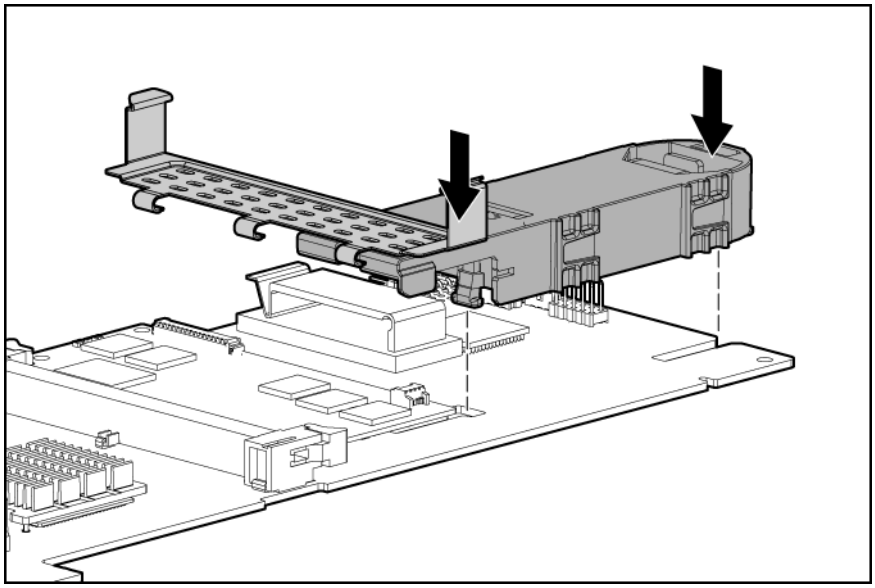


7. Install the capacitor pack clip:
   a. Position the clip so that the hinge on the right is aligned with the hinge pillar on the new capacitor pack.
   b. Hold the clip at about a 30 degree angle to the capacitor pack.

c. Push the clip onto the hinge pillar.



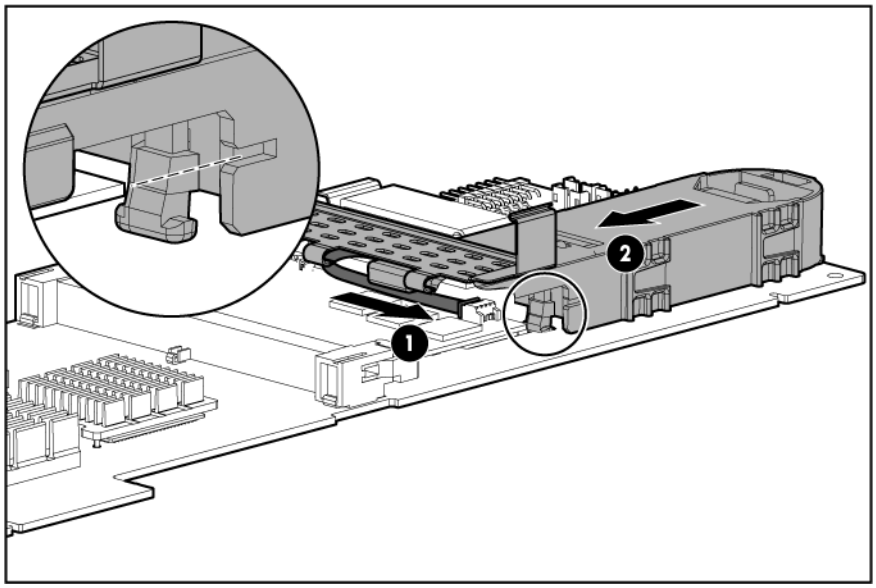
8. Align the posts on the bottom of the capacitor pack with the hole and groove on the controller.
9. Lower the capacitor pack onto the controller, leaving sufficient room to connect the capacitor pack cable.



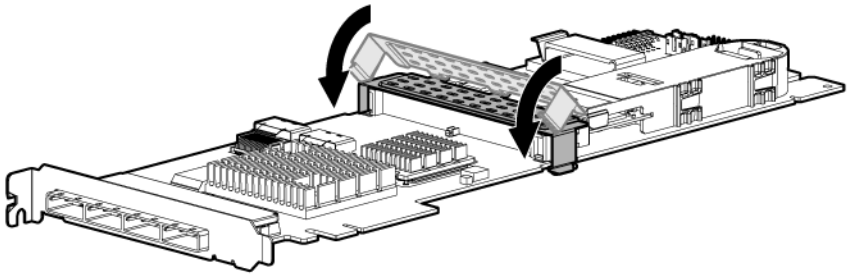
△ **CAUTION:** When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

10. Connect the capacitor pack cable to the cache module.

11. Slide the capacitor pack toward the cache module. Be sure that the edge of the cache module slides into the groove in the capacitor pack.



12. Secure the capacitor pack clip:
    a. Rotate the clip down over the cache module.



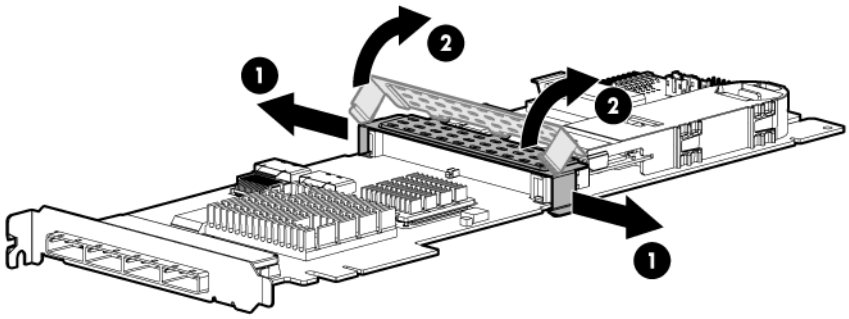
    b. Firmly press both ends of the clip until they click into place beneath the controller board.
13. Install the controller in the server.

After installing a capacitor pack, you might see a POST message during reboot indicating that the array accelerator (cache module) is disabled temporarily. This behavior is normal because the new capacitor pack is likely to have a low charge. You do not need to take any action, because the recharge process begins automatically after the capacitor pack is installed and the server is powered. The controller operates properly while the capacitor pack recharges, although the performance advantage of the array accelerator is absent. When the capacitor pack has been charged to a satisfactory level, the controller enables the array accelerator automatically.

Replacing a P812 cache module

△ **CAUTION:** To prevent damage to electrical components, properly ground the server before beginning any installation, removal, or replacement procedure. Improper grounding can cause electrostatic discharge.

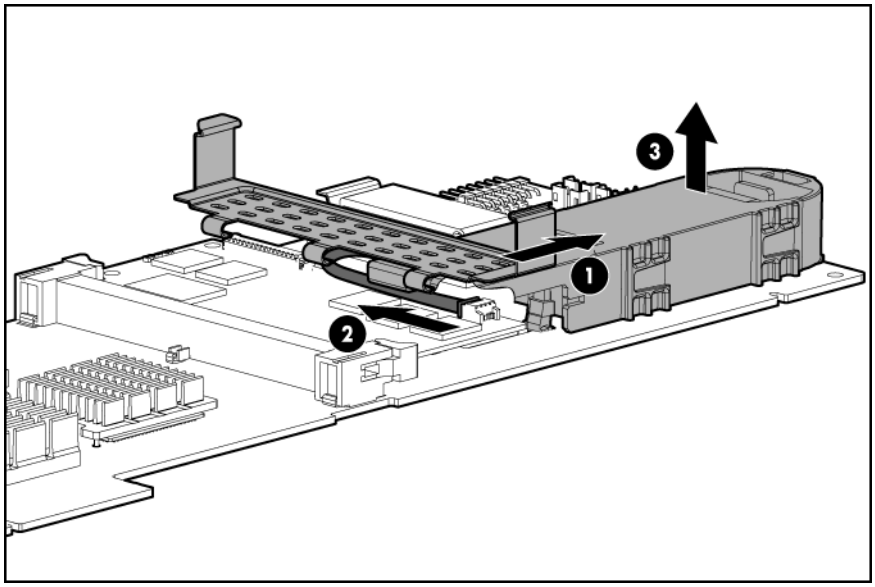
1. Close all applications, and then power down the server. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 73):
   - If the green LED is off and the amber LED is on, the controller is transferring data from DDR memory to flash memory. Wait for data transfer to complete (about 60 seconds), and then proceed with the next step.
   - If the amber LED is off, then proceed with the next step.
3. Remove the controller from the server. See the documentation that ships with the server.
4. Open the capacitor pack clip:
   a. Pull the battery clip flanges outward.
   b. Rotate the clip 180 degrees so that it rests on top of the capacitor pack.



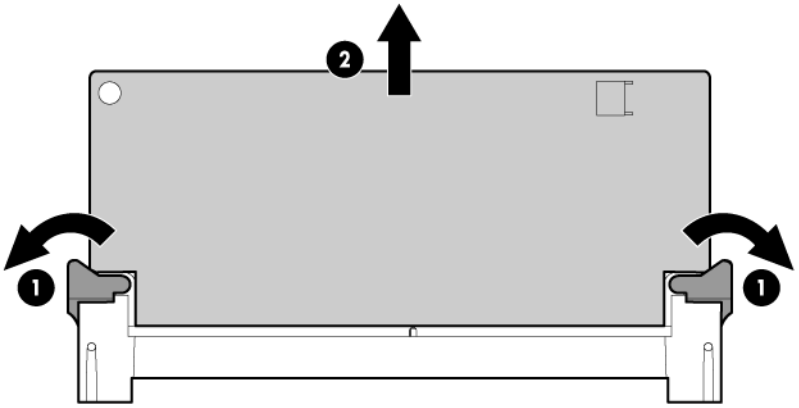
△ **CAUTION:** When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

5. Remove the capacitor pack:
   a. Slide the capacitor pack 2 cm away from the cache module.
   b. Disconnect the capacitor pack cable from the cache module.

c. Lift the capacitor pack and clip from the controller.

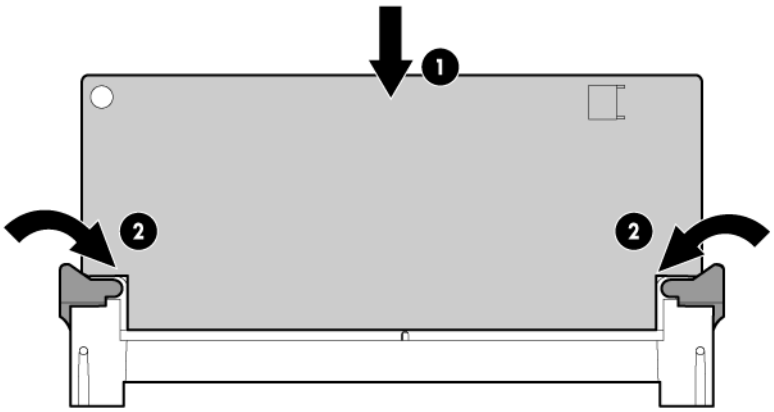


6. Remove the original cache module.

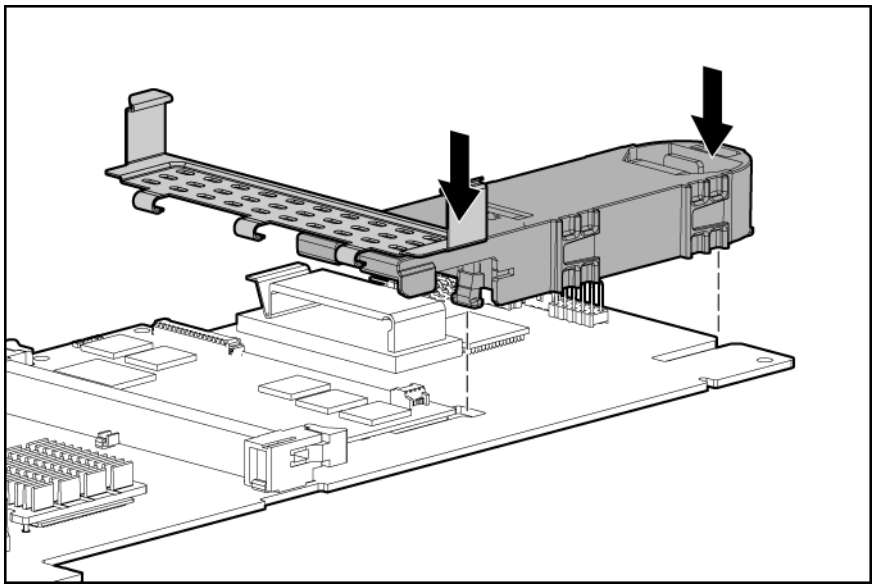


△ **CAUTION:** Do not use this controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to a different controller module, because you can lose data.

7. Install the replacement or upgrade cache module.



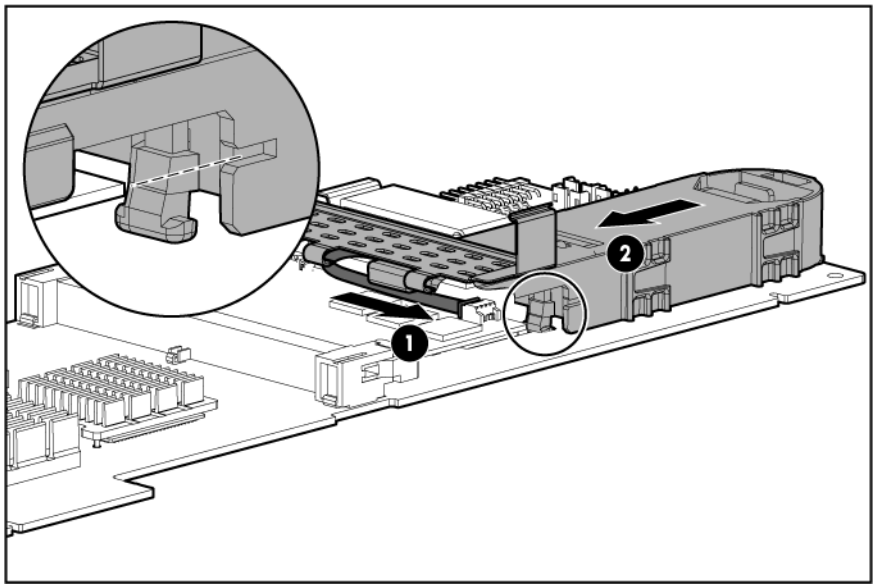
8. Align the posts on the bottom of the capacitor pack with the hole and groove on the controller.
9. Lower the capacitor pack onto the controller, leaving sufficient room to connect the capacitor pack cable.



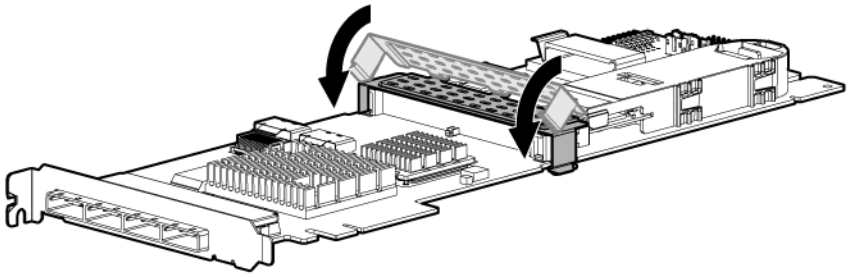
△ **CAUTION:** When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

10. Connect the capacitor pack cable to the cache module.

11. Slide the capacitor pack toward the cache module. Be sure that the edge of the cache module slides into the groove in the capacitor pack.



12. Secure the capacitor pack clip:
    a. Rotate the clip down over the cache module.



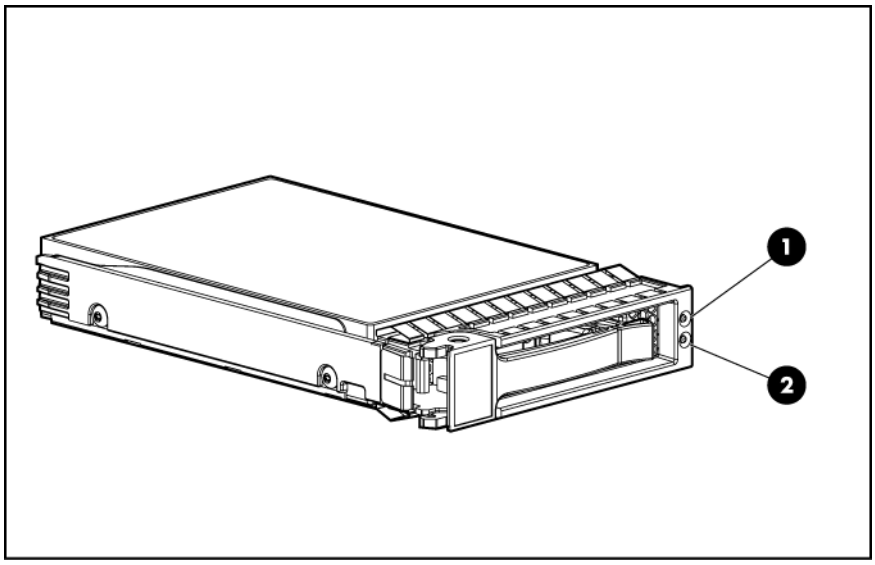
    b. Firmly press both ends of the clip until they click into place beneath the controller board.
13. Install the controller in the server.

After installing a capacitor pack, you might see a POST message during reboot indicating that the array accelerator (cache module) is disabled temporarily. This behavior is normal because the new capacitor pack is likely to have a low charge. You do not need to take any action, because the recharge process begins automatically after the capacitor pack is installed and the server is powered. The controller operates properly while the capacitor pack recharges, although the performance advantage of the array accelerator is absent. When the capacitor pack has been charged to a satisfactory level, the controller enables the array accelerator automatically.

Replacing, moving, or adding drives

Identifying the status of a drive

When a drive is configured as a part of an array and connected to a powered-up controller, the drive LEDs indicate the condition of the drive.



Item	Description
1	Fault/UID LED (amber/blue)
2	Online LED (green)

Online/activity LED (green)	Fault/UID LED (amber/blue)	Interpretation
On, off, or flashing	Alternating amber and blue	The drive has failed, or a predictive failure alert has been received for this drive; it also has been selected by a management application.
On, off, or flashing	Steadily blue	The drive is operating normally, and it has been selected by a management application.
On	Amber, flashing regularly (1 Hz)	A predictive failure alert has been received for this drive. Replace the drive as soon as possible.
On	Off	The drive is online, but it is not active currently.
Flashing regularly (1 Hz)	Amber, flashing regularly (1 Hz)	**Do not remove the drive. Removing a drive may terminate the current operation and cause data loss.** The drive is part of an array that is undergoing capacity expansion or stripe migration, but a predictive failure alert has been received for this drive. To minimize the risk of data loss, do not replace the drive until the expansion or migration is complete.

Online/activity LED (green)	Fault/UID LED (amber/blue)	Interpretation
Flashing regularly (1 Hz)	Off	**Do not remove the drive. Removing a drive may terminate the current operation and cause data loss.** The drive is rebuilding, erasing, or it is part of an array that is undergoing capacity expansion or stripe migration.
Flashing irregularly	Amber, flashing regularly (1 Hz)	The drive is active, but a predictive failure alert has been received for this drive. Replace the drive as soon as possible.
Flashing irregularly	Off	The drive is active, and it is operating normally.
Off	Steadily amber	A critical fault condition has been identified for this drive, and the controller has placed it offline. Replace the drive as soon as possible.
Off	Amber, flashing regularly (1 Hz)	A predictive failure alert has been received for this drive. Replace the drive as soon as possible.
Off	Off	The drive is offline, a spare, or not configured as part of an array.

Recognizing drive failure

If any of the following occurs, the drive has failed:

- The fault LED illuminates.
- If failed drives are inside, the amber LED on the front of a storage system illuminates. This LED also illuminates when other problems occur such as when a fan fails, a redundant power supply fails, or the system overheats.
- A POST message lists failed drives when the system is restarted, as long as the controller detects at least one functional drive.
- ACU represents failed drives with a distinctive icon.
- HP Systems Insight Manager can detect failed drives remotely across a network. For more information about HP Systems Insight Manager, see the documentation on the Management CD.
- The HP System Management Homepage (SMHP) indicates that a drive has failed.
- The Event Notification Service posts an event to the Microsoft® Windows® system event log and the IML.
- ADU lists all failed drives.

For additional information about diagnosing drive problems, see the *HP Servers Troubleshooting Guide*.

△ **CAUTION:** Sometimes, a drive that has previously been failed by the controller may seem to be operational after the system is power-cycled or (for a hot-pluggable drive) after the drive has been removed and reinserted. However, continued use of such marginal drives may eventually result in data loss. Replace the marginal drive as soon as possible.

Effects of a drive failure

When a drive fails, all logical drives that are in the same array are affected. Each logical drive in an array might be using a different fault-tolerance method, so each logical drive can be affected differently.

- RAID 0 configurations cannot tolerate drive failure. If any physical drive in the array fails, all RAID 0 logical drives in the same array also fail.
- RAID 1+0 configurations can tolerate multiple drive failures as long as no failed drives are mirrored to one another.
- RAID 5 configurations can tolerate one drive failure.
- RAID 50 configurations can tolerate one failed drive in each parity group.
- RAID 6 configurations can tolerate two failed drives at a given time.
- RAID 60 configurations can tolerate two failed drives in each parity group.

Compromised fault tolerance

CAUTION: When fault tolerance is compromised, data loss can occur. However, it may be possible to recover the data. For more information, see "Recovering from compromised fault tolerance (on page 60)."

If more drives fail than the fault-tolerance method can manage, fault tolerance is compromised, and the logical drive fails. If this failure occurs, the operating system rejects all requests and indicates unrecoverable errors.

For example, fault tolerance might occur when a drive in an array fails while another drive in the array is being rebuilt.

Compromised fault tolerance can also be caused by problems unrelated to drives. In such cases, replacing the physical drives is not required.

Recovering from compromised fault tolerance

If fault tolerance is compromised, inserting replacement drives does not improve the condition of the logical volume. Instead, if the screen displays unrecoverable error messages, perform the following procedure to recover data:

1. Power down the entire system, and then power it back up. In some cases, a marginal drive will work again for long enough to enable you to make copies of important files.

   If a 1779 POST message is displayed, press the **F2** key to re-enable the logical volumes. Remember that data loss has probably occurred and any data on the logical volume is suspect.
2. Make copies of important data, if possible.
3. Replace any failed drives.
4. After you have replaced the failed drives, fault tolerance may again be compromised. If so, cycle the power again. If the 1779 POST message is displayed:
   a. Press the **F2** key to re-enable the logical drives.
   b. Recreate the partitions.
   c. Restore all data from backup.

To minimize the risk of data loss that is caused by compromised fault tolerance, make frequent backups of all logical volumes.

Replacing drives

The most common reason for replacing a drive is that it has failed. However, another reason is to gradually increase the storage capacity of the entire system ("Upgrading drive capacity" on page 64).

If you insert a hot-pluggable drive into a drive bay while the system power is on, all disk activity in the array pauses for 1 or 2 seconds while the new drive is initializing. When the drive is ready, data recovery to the replacement drive begins automatically if the array is in a fault-tolerant configuration.

If you replace a drive belonging to a fault-tolerant configuration while the system power is off, a POST message appears when the system is next powered up. This message prompts you to press the **F1** key to start automatic data recovery. If you do not enable automatic data recovery, the logical volume remains in a ready-to-recover condition and the same POST message appears whenever the system is restarted.

Before replacing drives

- Open Systems Insight Manager, and inspect the Error Counter window for each physical drive in the same array to confirm that no other drives have any errors. For more information, see the Systems Insight Manager documentation on the Management CD.
- Be sure that the array has a current, valid backup.
- Confirm that the replacement drive is of the same type as the degraded drive (either SAS or SATA and either hard drive or solid state drive).
- Use replacement drives that have a capacity equal to or larger than the capacity of the smallest drive in the array. The controller immediately fails drives that have insufficient capacity.

In systems that use external data storage, be sure that the server is the first unit to be powered down and the last unit to be powered up. Taking this precaution ensures that the system does not, erroneously, mark the drives as failed when the server is powered up.

In some situations, you can replace more than one drive at a time without data loss. For example:

- In RAID 1+0 configurations, drives are mirrored in pairs. You can replace several drives simultaneously if they are not mirrored to other removed or failed drives.
- In RAID 50 configurations, drives are arranged in parity groups. You can replace several drives simultaneously, if the drives belong to different parity groups. It two drives belong to the same parity group, replace those drives one at a time.
- In RAID 6 configurations, you can replace any two drives simultaneously.
- In RAID 60 configurations, drives are arranged in parity groups. You can replace several drives simultaneously, if no more than two of the drives being replaced belong to the same parity group.

To remove more drives from an array than the fault tolerance method can support, follow the previous guidelines for removing several drives simultaneously, and then wait until rebuild is complete (as indicated by the drive LEDs) before removing additional drives.

However, if fault tolerance has been compromised, and you must replace more drives than the fault tolerance method can support, delay drive replacement until after you attempt to recover the data (refer to "Recovering from compromised fault tolerance" on page 60).

Automatic data recovery (rebuild)

When you replace a drive in an array, the controller uses the fault-tolerance information on the remaining drives in the array to reconstruct the missing data (the data that was originally on the replaced drive) and then write the data to the replacement drive. This process is called automatic data recovery or rebuild. If fault tolerance is compromised, the controller cannot reconstruct the data, and the data is likely lost permanently.

If another drive in the array fails while fault tolerance is unavailable during rebuild, a fatal system error can occur, and all data on the array can be lost. However, failure of another drive does not always lead to a fatal system error in the following exceptional cases:

- Failure after activation of a spare drive
- Failure of a drive that is not mirrored to any other failed drives (in a RAID 1+0 configuration)
- Failure of a second drive in a RAID 50 or RAID 60 configuration if the two failed drives are in different parity groups
- Failure of a second drive in a RAID 6 configuration

Time required for a rebuild

The time required for a rebuild varies, depending on several factors:

- The priority that the rebuild is given over normal I/O operations (you can change the priority setting by using ACU)
- The amount of I/O activity during the rebuild operation
- The average bandwidth capability (MBps) of the drives
- The availability of drive cache
- The brand, model, and age of the drives
- The amount of unused capacity on the drives
- For RAID 5, RAID 50, RAID 6, and RAID 60, the number of drives in the array

△ **CAUTION:** Because data rebuild time ranges from 200 to 520 GB/h, the system could be unprotected against drive failure for an extended period during data recovery or a drive capacity upgrade. When possible, perform rebuild operations only during periods of minimal system activity.

When automatic data recovery has finished, the replacement drive Online/Activity LED changes from flashing steadily (1 Hz) to one of the following states:

- The LED is on if the drive is inactive.
- The LED flashes irregularly if the drive is active.

△ **CAUTION:** If the Online/Activity LED on the replacement drive does not light up while the corresponding LEDs on other drives in the array are active, the rebuild process has abnormally terminated. The amber Fault LED of one or more drives might also be illuminated. Refer to "Abnormal termination of a rebuild (on page 63)" to determine what action you must take.

Abnormal termination of a rebuild

If the Online/Activity LED on the replacement drive permanently ceases to be illuminated even while other drives in the array are active, the rebuild process has abnormally terminated. The following table indicates the three possible causes of abnormal termination of a rebuild.

Observation	Cause of rebuild termination
None of the drives in the array have an illuminated amber Fault LED.	One of the drives in the array has experienced an uncorrectable read error.
The replacement drive has an illuminated amber Fault LED.	The replacement drive has failed.
One of the other drives in the array has an illuminated amber Fault LED.	The drive with the illuminated Fault LED has now failed.

Each of these situations requires a different remedial action.

Case 1: An uncorrectable read error has occurred.

1. Back up as much data as possible from the logical drive.

> **CAUTION:** Do not remove the drive that has the media error. Doing so causes the logical drive to fail.

2. Restore data from backup. Writing data to the location of the unreadable sector often eliminates the error.
3. Remove and reinsert the replacement drive. This action restarts the rebuild process.

If the rebuild process still terminates abnormally:

1. Delete and recreate the logical drive.
2. Restore data from backup.

Case 2: The replacement drive has failed.

Verify that the replacement drive is of the correct capacity and is a supported model. If these factors are not the cause of the problem, use a different drive as the replacement.

Case 3: Another drive in the array has failed.

A drive that has recently failed can sometimes be made temporarily operational again by cycling the server power.

1. Power down the server.
2. Remove the replacement physical drive (the one undergoing a rebuild), and reinstall the drive that it is replacing.
3. Power up the server.

If the newly failed drive seems to be operational again:

1. Back up any unsaved data.
2. Remove the drive that was originally to be replaced, and reinsert the replacement physical drive. The rebuild process automatically restarts.
3. When the rebuild process has finished, replace the newly failed drive.

However, if the newly failed drive has not recovered:

1. Remove the drive that was originally to be replaced, and reinsert the replacement physical drive.

2. Replace the newly failed drive.
3. Restore data from backup.

Upgrading drive capacity

You can increase the storage capacity on a system, even if there are no available drive bays, by swapping drives one at a time for higher capacity drives. This method is viable as long as a fault-tolerance method is running.

> **CAUTION:** Because data rebuild time ranges from 200 to 520 GB/h, the system could be unprotected against drive failure for an extended period during data recovery or a drive capacity upgrade. When possible, perform rebuild operations only during periods of minimal system activity.

To upgrade drive capacity:

1. Back up all data.
2. Replace any drive. The data on the new drive is re-created from redundant information on the remaining drives.

   > **CAUTION:** Do not replace any other drive until data rebuild on this drive is complete.

   When data rebuild on the new drive is complete, the Online/Activity LED changes from flashing steadily (1 Hz) to one of the following states:
   - The LED is on if the drive is inactive.
   - The LED flashes irregularly if the drive is active.
3. Repeat the previous step for the other drives in the array, one at a time.

When you have replaced all drives, you can use the extra capacity to either create new logical drives or extend existing logical drives. For more information, see the *Configuring Arrays on HP Smart Array Controllers Reference Guide* on the HP website (http://www.hp.com).

Moving drives and arrays

You can move drives to other ID positions on the same array controller. You can also move a complete array from one controller to another, even if the controllers are on different servers.

Before moving drives, you must meet the following conditions:

- If moving the drives to a different server, be sure the new server has enough empty bays to accommodate all the drives simultaneously.
- The array does not have failed or missing drives.
- No spare drive in the array is acting as a replacement for a failed drive.
- The controller is not performing capacity expansion, capacity extension, or RAID or stripe size migration.
- The controller is using the latest firmware version.
- The server is powered down.

Before you move an array to another controller, you must meet the following conditions:

△ **CAUTION:** If the number of physical or logical drives exceeds the limit for the controller model and firmware version, then the controller may recognize an unpredictable subset of the drives, possibly resulting in failed arrays and data loss.

- If the other controller is connected already to one or more arrays of configured logical drives, the total number of logical drives on the controller after the drives have been moved must not exceed the number of logical drives that the controller supports. This number depends on the controller model and on the controller firmware version.
- The total number of physical drives on the other controller after the drives have been moved must not exceed the maximum number of supported physical drives for that controller model and firmware version.
- All drives in the array must be moved at the same time.

When all the conditions have been met, move the drives:

1. Back up all data before removing any drives or changing configuration. This step is **required** if you are moving data-containing drives from a controller that does not have a cache module.
2. Power down the system.
3. Move the drives.
4. Power up the system.
5. Observe the POST messages:
   - If a 1785 POST message appears, the drive array did not configure properly. Continue with step 6.
   - If a 1724 or 1727 POST message appears, drive positions were changed successfully and the configuration was updated. Continue with step 7.
6. If the array did not configure properly, do the following:
   a. Power down the system immediately to prevent data loss.
   b. Return the drives to their original locations.
   c. Restore the data from backup, if necessary.
7. Verify the new drive configuration by running ORCA or ACU ("Configuring an array" on page 30).

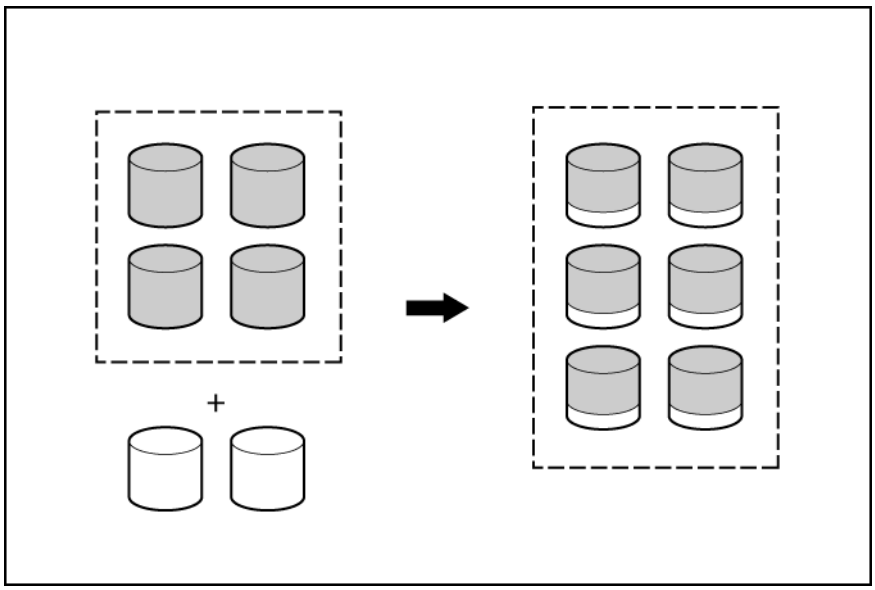
Adding drives

You can add drives to a system at any time, if you do not exceed the maximum number of drives that the controller supports. You can then either build a new array from the added drives or use the extra storage capacity to expand the capacity of an existing array.

If the drives that you intend to add to the system are already configured into logical drives, you must meet certain conditions before adding drives to the system. For more information, see "Moving drives and arrays (on page 64)." When you have successfully added the drives, reset the server so that the controller can recognize the logical drives.

To perform an array capacity expansion, use ACU. If the system uses hot-pluggable drives and ACU runs in the same environment as the normal server applications, you can expand array capacity without shutting down the operating system. For more information, see the *Configuring Arrays on HP Smart Array Controllers Reference Guide* on the HP website (http://www.hp.com).

The expansion process is illustrated in the following figure, in which the original array (containing data) is shown with a dashed border, and the newly added drives (containing no data) are shown unshaded. The array controller adds the new drives to the array and redistributes the original logical drives over the enlarged array one logical drive at a time. This process liberates some storage capacity on each physical drive in the array. Each logical drive keeps the same fault-tolerance method in the enlarged array that it had in the smaller array.



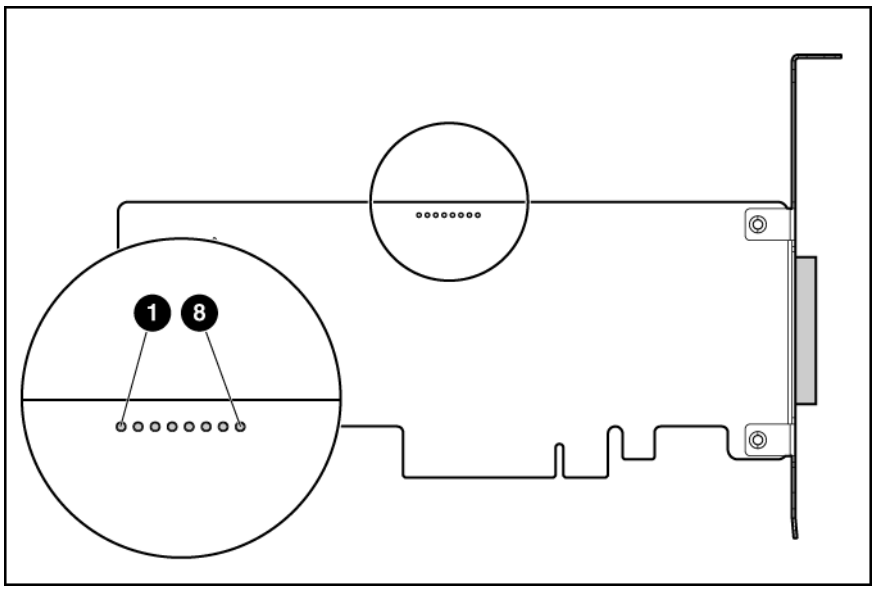
When the expansion process has finished, you can use the liberated storage capacity on the enlarged array to create new logical drives. Alternatively, you can use ACU to enlarge (extend) one of the original logical drives.

Diagnosing array problems

Controller board runtime LEDs

Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller. To determine the controller status, see the appropriate controller-specific section.

Runtime LEDs for E500 and P400 models

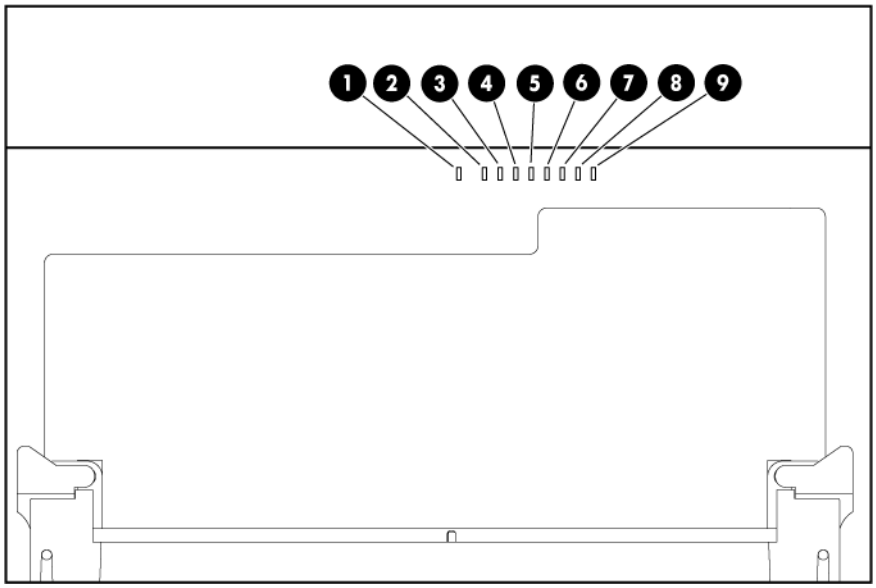


LED ID	Color	Name	Comments
1	Amber	CR14: Controller Lockup	The controller ASIC has locked up and cannot process any commands.
2	Amber	CR13: Drive Failure	To determine which drive has failed, check the Fault LED of each physical drive connected to the controller.
3	Green	CR3: Activity	Port 2E on the E500, or port 2I on the P400, is active.
4	Green	CR8: Activity	Port 1E on the E500, or port 1I on the P400, is active.
5	Green	CR5: Command Outstanding	The controller is working on a command from the host driver.
6	Green	CR6: Heartbeat	When the controller is in good health, this LED flashes every two seconds.

LED ID	Color	Name	Comments
7	Green	CR4: Gas Pedal	This LED, together with the Idle Task LED (next item), indicates the amount of controller CPU activity. For details, see the following table.
8	Green	CR7: Idle Task	This LED, together with the Gas Pedal LED (previous item), indicates the amount of controller CPU activity. For details, see the following table.

Gas Pedal LED status	Idle Task LED status	Controller CPU activity level
Off	Blinking	0–25%
Blinking	Off	25–50%
On steadily	Off	50–75%
On steadily	On steadily	75–100%

Runtime LEDs for P212, P410, and P411 models

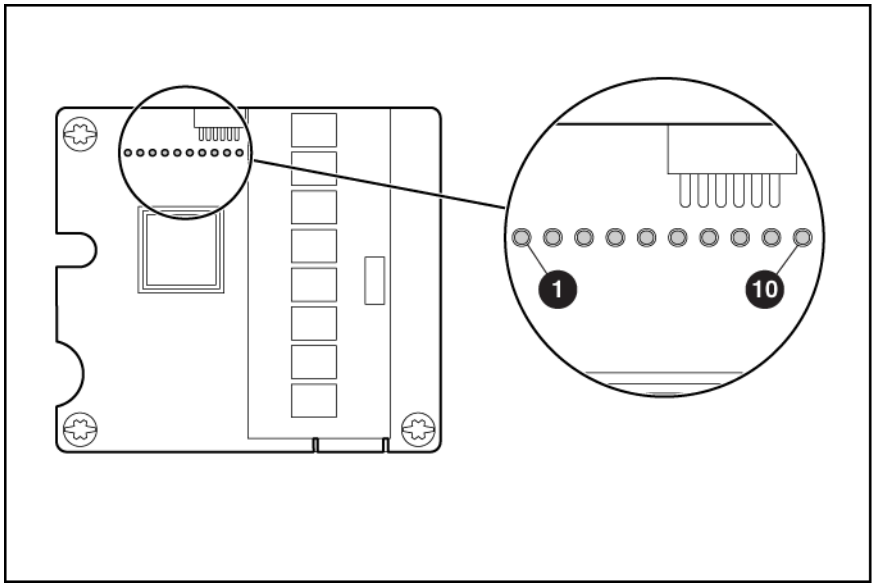


LED ID	Color	Name	Comments
1	Amber	DS9: System Error	The controller ASIC has locked up and cannot process any commands.
2	Green	DS8: Idle Task	This LED, together with the Gas Pedal LED (next item), indicates the amount of controller CPU activity. For details, see the following table.
3	Green	DS7: Gas Pedal	This LED, together with the Idle Task LED (previous item), indicates the amount of controller activity. For details, see the following table.
4	Green	DS6: Heartbeat	When the controller is in good health, this LED flashes every two seconds.
5	Green	DS5: Pending Command	The controller is working on a command from the host driver.

LED ID	Color	Name	Comments
6	Green	DS4: Port 1 Active	Port 1 is active.
7	Green	DS3: Port 2 Active	Port 2 is active.
8	Amber	DS2: Drive Failure	To determine which drive has failed, check the Fault LED of each physical drive connected to the controller.
9	Amber	DS1: Diagnostics Error	One of the server diagnostics utilities has detected a controller error.

Gas pedal LED status	Idle task LED status	Controller CPU activity level
Off	Flashing	0-25%
Flashing	Off	25-50%
On steadily	Off	50-75%
On steadily	On steadily	75-100%

Runtime LEDs for P700m model

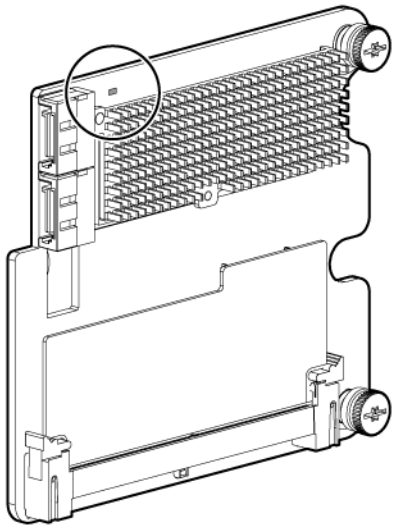


LED ID	Color	Name	Comments
1	Amber	CR10: Thermal Alert	This LED is not used.
2	Amber	CR9: System Error	The controller ASIC has locked up and cannot process any commands.
3	Amber	CR1: Diagnostics Error	One of the server diagnostics utilities has detected a controller error.
4	Amber	CR2: Drive Failure	To determine which drive has failed, check the Fault LED of each physical drive connected to the controller.
5	Green	CR3: Activity	Port 2 is active.
6	Green	CR4: Activity	Port 1 is active.

LED ID	Color	Name	Comments
7	Green	CR5: Command Outstanding	The controller is working on a command from the host driver.
8	Green	CR6: Controller Heartbeat	When the controller is in good health, this LED flashes every two seconds.
9	Green	CR7: Gas Pedal	This LED, together with the Idle Task LED (next item), indicates the amount of controller CPU activity. For details, see the following table.
10	Green	CR8: Idle Task	This LED, together with the Gas Pedal LED (previous item), indicates the amount of controller CPU activity. For details, see the following table.

Gas Pedal LED status	Idle Task LED status	Controller CPU activity level
Off	Blinking	0–25%
Blinking	Off	25–50%
On steadily	Off	50–75%
On steadily	On steadily	75–100%

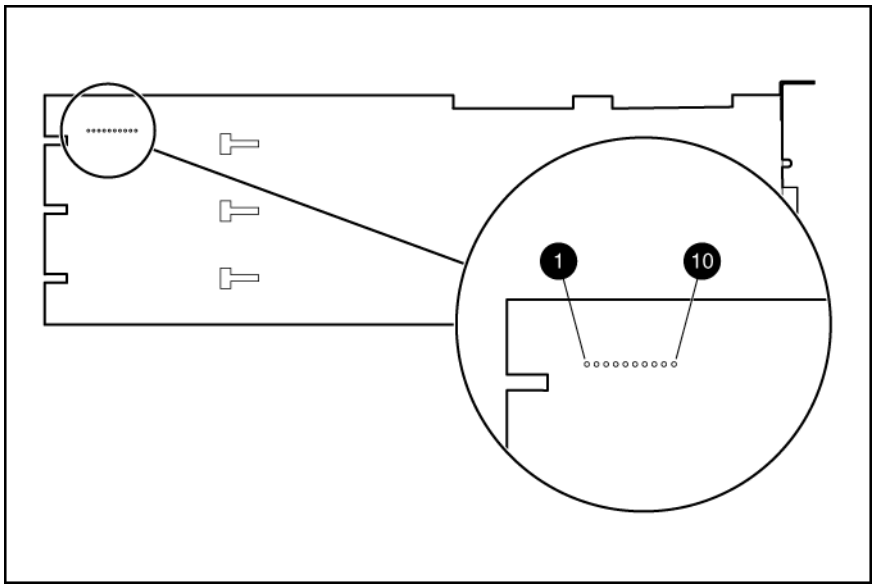
Runtime LED for P712m model



Name: Controller heartbeat LED (CR6)

Status: Flashes every 2 seconds = The controller is functioning properly.

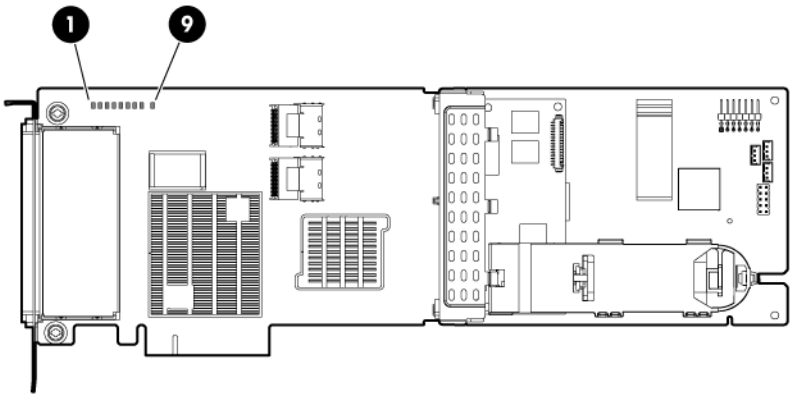
Runtime LEDs for P800 model



LED ID	Color	Name	Comments
1	Green	CR502: Expander Heartbeat	This LED flashes every two seconds during normal operation. If the LED glows steadily, the expander cannot function due to an internal problem. If the LED flashes twice per second, the expander cannot function because the NVRAM is corrupt.
2	Amber	CR510: System Error	The controller ASIC has locked up and cannot process any commands.
3	Amber	CR509: Diagnostics Error	One of the server diagnostics utilities has detected a controller error.
4	Amber	CR500: Drive Failure	To determine which drive has failed, check the Fault LED of each physical drive connected to the controller.
5	Green	CR508: Activity	Port 4I is active.
6	Green	CR507: Activity	Port 3I is active.
7	Green	CR506: Command Outstanding	The controller is working on a command from the host driver.
8	Green	CR505: Controller Heartbeat	When the controller is in good health, this LED flashes every two seconds.
9	Green	CR504: Gas Pedal	This LED, together with the Idle Task LED (next item), indicates the amount of controller CPU activity. For details, see the following table.
10	Green	CR503: Idle Task	This LED, together with the Gas Pedal LED (previous item), indicates the amount of controller CPU activity. For details, see the following table.

Gas pedal LED status	Idle task LED status	Controller CPU activity level
Off	Blinking	0–25%
Blinking	Off	25–50%
On steadily	Off	50–75%
On steadily	On steadily	75–100%

Runtime LEDs for P812 model



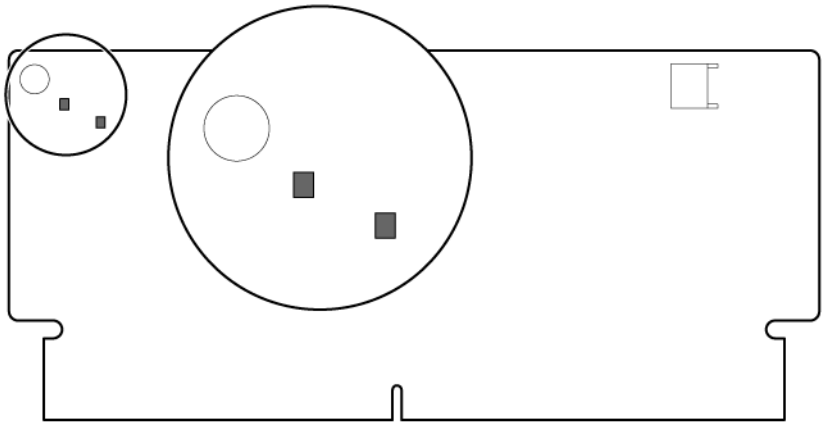
Item	Color	Name	Comments
1	Green	CR76: Idle Task	This LED, together with the Gas Pedal LED (following item), indicates the amount of controller CPU activity. For more information, see the following table.
2	Green	CR75: Gas Pedal	This LED, together with the Idle Task LED (previous item), indicates the amount of controller CPU activity. For more information, see the following table.
3	Green	CR74: Heartbeat	When the controller is in good health, this LED flashes every 2 seconds.
4	Green	CR73: Pending Command	The controller is working on a command from the host driver.
5	Green	CR72: Port 1 Activity	Port 1 is active.
6	Green	CR 71: Port 2 Activity	Port 2 is active.
7	Amber	CR78: Drive Failure	To determine which drive has failed, check the Fault LED of each physical drive connected to the controller.
8	Amber	CR77: Diagnostics Error	One of the server diagnostics utilities has detected a controller error.

Item	Color	Name	Comments
9	Green	CR82: MIPS ready	The embedded SAS expander is active.

Gas pedal LED status	Idle task LED status	Controller CPU activity level
Off	Flashing	0–25%
Flashing	Off	25–50%
On	Off	50–75%
On	On	75–100%

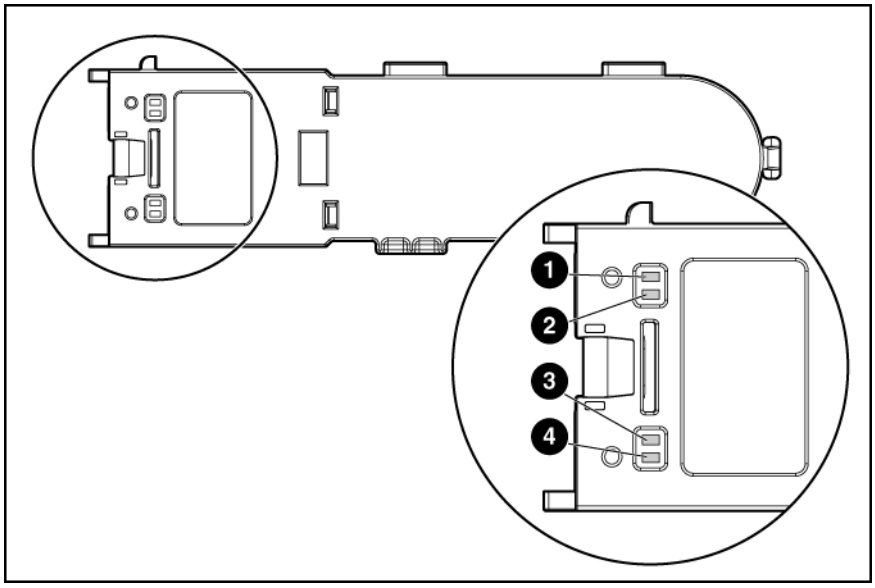
FBWC module LEDs

The FBWC module has two single-color LEDs (green and amber). The LEDs are duplicated on the reverse side of the cache module to facilitate status viewing.



Green LED	Amber LED	Interpretation
Off	On	A backup is in progress.
Flashing (1 Hz)	On	A restore is in progress.
Flashing (1 Hz)	Off	The capacitor pack is charging.
On	Off	The capacitor pack has completed charging.
Flashing (2 Hz) Alternating with amber LED	Flashing (2 Hz) Alternating with green LED	One of the following conditions exists: • The charging process has timed out. • The capacitor pack is not connected.
On	On	The flash code image failed to load.
Off	Off	The flash code is corrupt.

Battery pack LEDs



Item ID	Color	Description
1	Green	System Power LED. This LED glows steadily when the system is powered up and 12 V system power is available. This power supply is used to maintain the battery charge and provide supplementary power to the cache microcontroller.
2	Green	Auxiliary Power LED. This LED glows steadily when 3.3V auxiliary voltage is detected. The auxiliary voltage is used to preserve BBWC data and is available any time that the system power cords are connected to a power supply.
3	Amber	Battery Health LED. To interpret the illumination patterns of this LED, see the following table.
4	Green	BBWC Status LED. To interpret the illumination patterns of this LED, see the following table.

LED3 pattern	LED4 pattern	Interpretation
—	One blink every two seconds	The system is powered down, and the cache contains data that has not yet been written to the drives. Restore system power as soon as possible to prevent data loss. Data preservation time is extended any time that 3.3 V auxiliary power is available, as indicated by LED 2. In the absence of auxiliary power, battery power alone preserves the data. A fully-charged battery can normally preserve data for at least two days. The battery lifetime also depends on the cache module size. For further information, refer to the controller QuickSpecs on the HP website (http://www.hp.com).
—	Double blink, then pause	The cache microcontroller is waiting for the host controller to communicate.

LED3 pattern	LED4 pattern	Interpretation
—	One blink per second	The battery pack is below the minimum charge level and is being charged. Features that require a battery (such as write cache, capacity expansion, stripe size migration, and RAID migration) are temporarily unavailable until charging is complete. The recharge process takes between 15 minutes and two hours, depending on the initial capacity of the battery.
—	Steady glow	The battery pack is fully charged, and posted write data is stored in the cache.
—	Off	The battery pack is fully charged, and there is no posted write data in the cache.
One blink per second	One blink per second	An alternating green and amber blink pattern indicates that the cache microcontroller is executing from within its boot loader and receiving new flash code from the host controller.
Steady glow	—	There is a short circuit across the battery terminals or within the battery pack. BBWC features are disabled until the battery pack is replaced. The life expectancy of a battery pack is typically more than three years.
One blink per second	—	There is an open circuit across the battery terminals or within the battery pack. BBWC features are disabled until the battery pack is replaced. The life expectancy of a battery pack is typically more than three years.

Diagnostic tools

To troubleshoot array problems and generate feedback about arrays, use the following diagnostic tools:

- **ACU**

  For more recent products, array diagnostics is available with ACU v8.28.13.0 and later. This utility is available on the SmartStart CD in the controller kit and also on the HP website (http://www.hp.com/support). For more information about ACU, see the *Configuring Arrays on HP Smart Array Controllers Reference Guide* on the Documentation CD that ships with the controller. For more information about error messages, see the *HP ProLiant Servers Troubleshooting Guide*.

- **ADU**

  For products that support SmartStart v8.25 and earlier, this utility is available on the SmartStart CD in the controller kit and also on the HP website (http://www.hp.com/support). When prompted for product information, enter the server model name. For more information about the meanings of the various ADU error messages, see the *HP ProLiant Servers Troubleshooting Guide*.

- **Event Notification Service**

  This utility reports array events to the Microsoft® Windows® system event log and IML. You can obtain the utility from the SmartStart CD or the HP website (http://www.hp.com/support). When prompted for product information, enter the server model name.

- **HP Insight Diagnostics**

  HP Insight Diagnostics is a tool that displays information about the system hardware configuration and performs tests on the system and its components, including drives if they are connected to Smart Array controllers. This utility is available on the SmartStart CD and also on the HP website (http://www.hp.com/servers/diags).

- **POST messages**

  Smart Array controllers produce diagnostic error messages (POST messages) at reboot. Many POST messages suggest corrective actions. For more information about POST messages, see the *HP ProLiant Servers Troubleshooting Guide*.

Electrostatic discharge

Preventing electrostatic discharge

To prevent damaging the system, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

To prevent electrostatic damage:

- Avoid hand contact by transporting and storing products in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.

Grounding methods to prevent electrostatic discharge

Several methods are used for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm ±10 percent resistance in the ground cords. To provide proper ground, wear the strap snug against the skin.
- Use heel straps, toe straps, or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an authorized reseller install the part.

For more information on static electricity or assistance with product installation, contact an authorized reseller.

Regulatory compliance notices

Federal Communications Commission notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

FCC rating label

The FCC rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or ID on the label. Class A devices do not have an FCC logo or ID on the label. After you determine the class of the device, refer to the corresponding statement.

Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Class B equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

Declaration of conformity for products marked with the FCC logo, United States only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding this product, contact us by mail or telephone:

- Hewlett-Packard Company
  P. O. Box 692000, Mail Stop 530113
  Houston, Texas 77269-2000
- 1-800-HP-INVENT (1-800-474-6836). (For continuous quality improvement, calls may be recorded or monitored.)

For questions regarding this FCC declaration, contact us by mail or telephone:

- Hewlett-Packard Company
  P. O. Box 692000, Mail Stop 510101
  Houston, Texas 77269-2000
- 1-281-514-3333

To identify this product, refer to the part, series, or model number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Canadian notice (Avis Canadien)

Class A equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union regulatory notice

This product complies with the following EU Directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

Compliance with these directives implies conformity to applicable harmonized European standards (European Norms) which are listed on the EU Declaration of Conformity issued by Hewlett-Packard for this product or product family.

This compliance is indicated by the following conformity marking placed on the product:

CE

This marking is valid for non-Telecom products and EU harmonized Telecom products (e.g. Bluetooth).

CE(xxxx*)!

This marking is valid for EU non-harmonized Telecom products.

*Notified body number (used only if applicable—refer to the product label)

Hewlett-Packard GmbH, HQ-TRE, Herrenberger Strasse 140, 71034 Boeblingen, Germany

The official EU CE declaration of conformity for this device can be found on the HP website (http://www.hp.com/go/certificates).

BSMI notice

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，使用者會被要求採取某些適當的對策。

Chinese notice

Class A equipment

声明
此为 A 级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，可能需要用户对其干扰采取可行的措施。

Japanese notice

ご使用になっている装置に VCCI マークが付いていましたら、次の説明文をお読み下さい。

この装置は、クラス B 情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。取扱説明書に従って正しい取り扱いをして下さい。

VCCI-B

VCCI マークが付いていない場合には、次の点にご注意下さい。

この装置は、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は適切な対策を講ずるよう要求されることがあります。

VCCI-A

Korean notice

Class A equipment

A급 기기 (업무용 방송통신기기)	이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

Class B equipment

B급 기기 (가정용 방송통신기기)	이 기기는 가정용(B급)으로 전자파적합등록을 한 기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

Battery replacement notice

This component uses a nickel metal hydride (NiMH) battery pack.

⚠ **WARNING:** There is a risk of explosion, fire, or personal injury if a battery pack is mishandled. To reduce this risk:

- Do not attempt to recharge the batteries if they are disconnected from the controller.
- Do not expose the battery pack to water, or to temperatures higher than 60°C (140°F).
- Do not abuse, disassemble, crush, or puncture the battery pack.
- Do not short the external contacts.
- Replace the battery pack only with the designated HP spare.
- Battery disposal should comply with local regulations.

Batteries, battery packs, and accumulators should not be disposed of together with the general household waste. To forward them to recycling or proper disposal, use the public collection system or return them to HP, an authorized HP Partner, or their agents.

For more information about battery replacement or proper disposal, contact an authorized reseller or an authorized service provider.

Taiwan battery recycling notice

The Taiwan EPA requires dry battery manufacturing or importing firms in accordance with Article 15 of the Waste Disposal Act to indicate the recovery marks on the batteries used in sales, giveaway or promotion. Contact a qualified Taiwanese recycler for proper battery disposal.

Acronyms and abbreviations

ACU

Array Configuration Utility

ADU

Array Diagnostics Utility

BBWC

battery-backed write cache

CPQONLIN

NetWare Online Array Configuration Utility

FBWC

flash-backed write cache

IML

Integrated Management Log

OBDR

One Button Disaster Recovery

ORCA

Option ROM Configuration for Arrays

POST

Power-On Self Test

RBSU

ROM-Based Setup Utility

SAAP

Smart Array Advanced Pack

SMHP

HP System Management Homepage

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