



**Hewlett Packard
Enterprise**

HPE Smart Array Controllers for HPE ProLiant Servers User Guide

Abstract

This document includes feature, installation, and configuration information about HPE Smart Array Controllers and is for the person who installs, administers, and troubleshoots servers and storage systems. HPE assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

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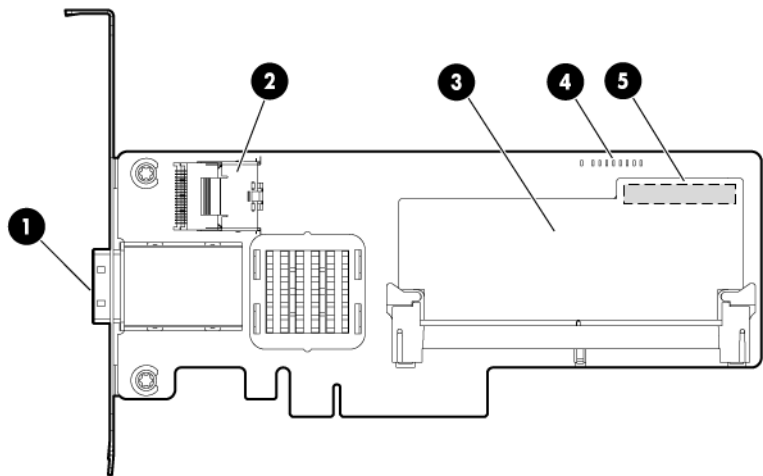
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Component identification

Controller components

For cabling configuration and troubleshooting purposes, connector names are silk-screened on the controller. For connector and other component locations, see the appropriate controller-specific section.

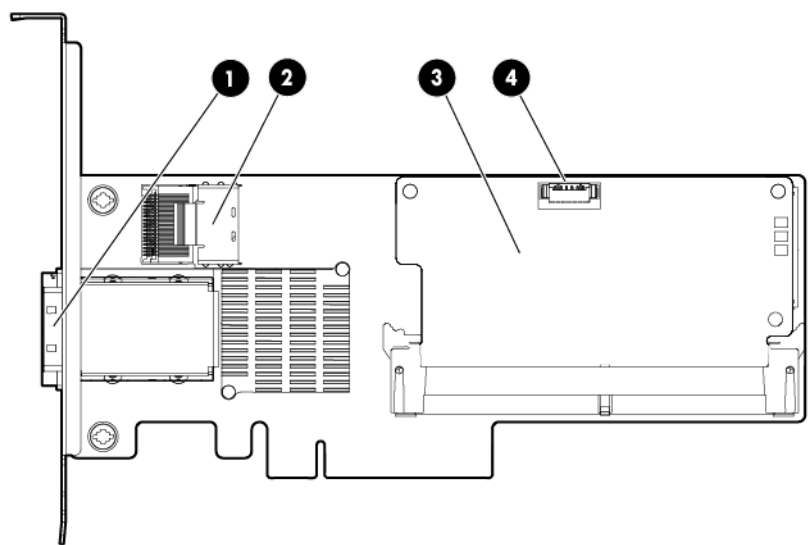
P212 components



Item	Description
1	Port 1E (Mini-SAS 4x connector)
2	Port 2I (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 16)."
5	(On rear of cache) Connector for the cable to an optional cache battery that upgrades the cache to BBWC

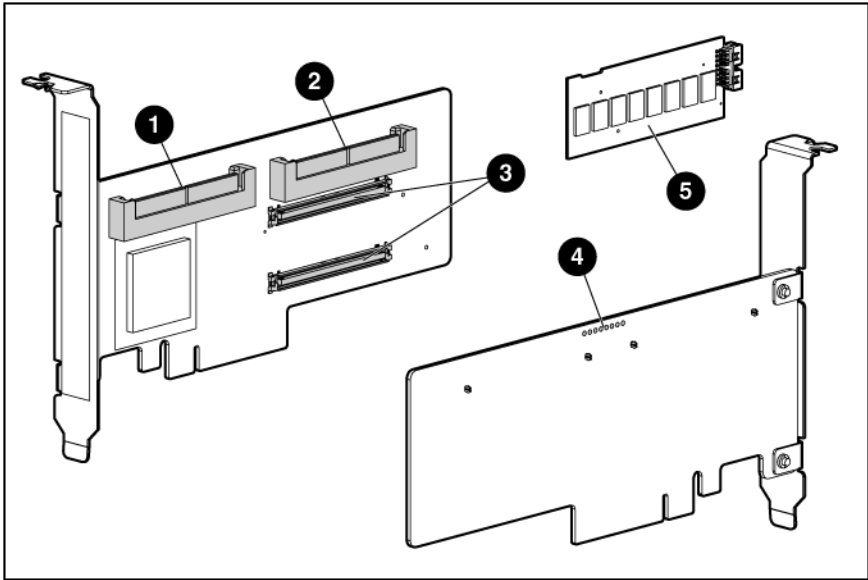
P222 components

For LED locations and status, see "P222 LEDs (on page 19)."



Item	Description
1	Port 1E (Mini-SAS 4x connector)
2	Port 2I (Mini-SAS 4x connector)
3	Cache module (also known as array accelerator)
4	Capacitor pack cable connector

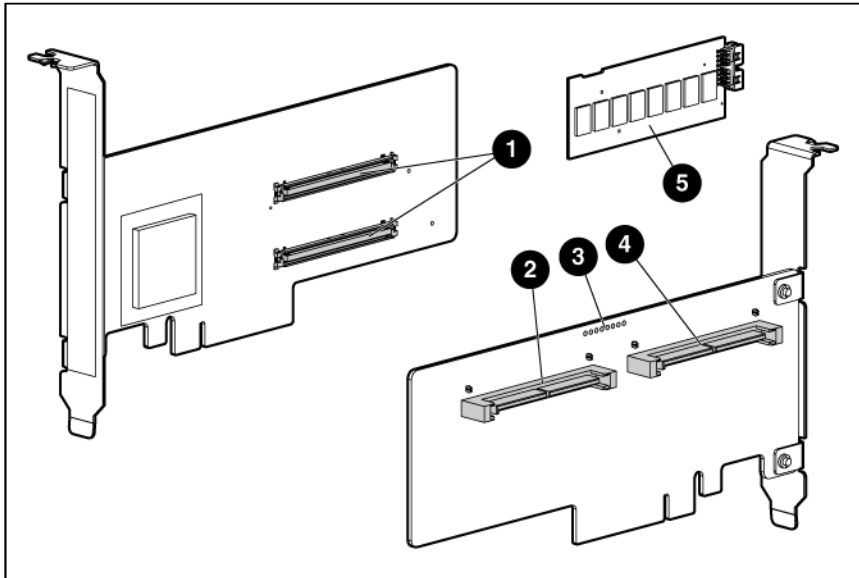
P400 components (model with front connectors)



Item	Description
1	Port 2I (SAS 4x connector)
2	Port 1I (SAS 4x connector)

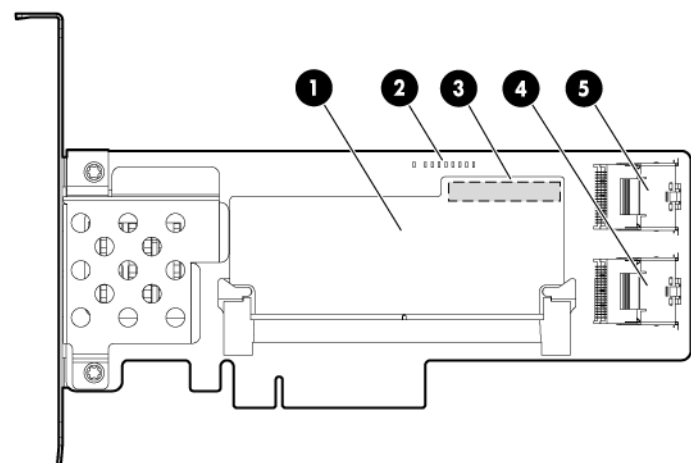
Item	Description
3	Cache module connectors
4	Runtime LEDs. See "Controller board runtime LEDs (on page 16)."
5	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

P400 components (model with back connectors)



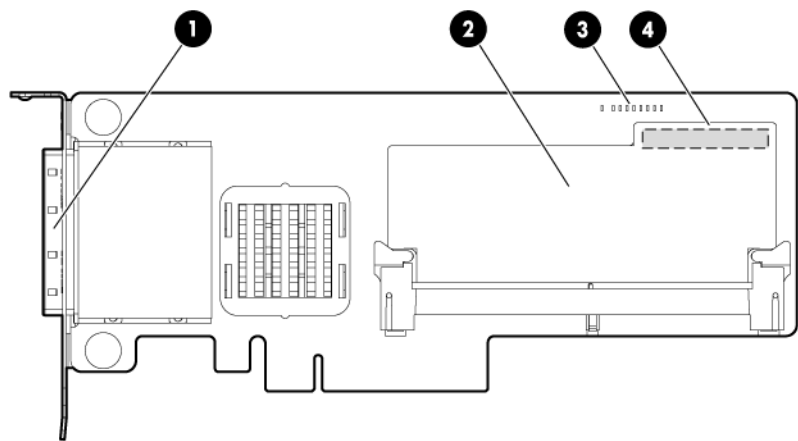
Item	Description
1	Cache module connectors
2	Port 11 (SAS 4x connector)
3	Runtime LEDs. See "Controller board runtime LEDs (on page 16)."
4	Port 21 (SAS 4x connector)
5	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

P410 components



Item	Description
1	Cache module (also known as array accelerator)
2	Runtime LEDs. See "Controller board runtime LEDs (on page 16)."
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 4x connector)
5	Port 2I (Mini-SAS 4x connector)

P411 components

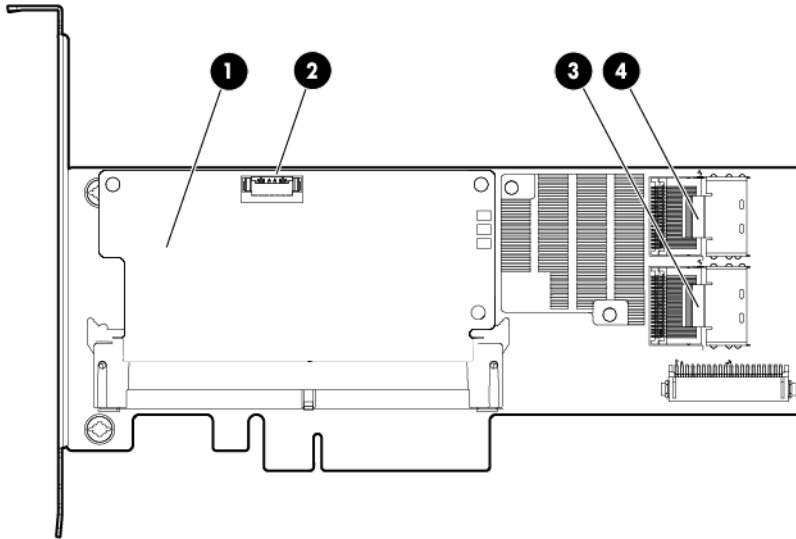


Item	Description
1	Ports 1E and 2E (Mini-SAS 4x connectors)
2	Cache module (also known as array accelerator)
3	Runtime LEDs. See "Controller board runtime LEDs (on page 16)."
4	(On rear of cache) Connector for the cable to an optional cache battery that upgrades the cache to BBWC

Item	Description
	(Not shown) In place of the BBWC option, the controller can support a FBWC module and capacitor pack.

P420 components

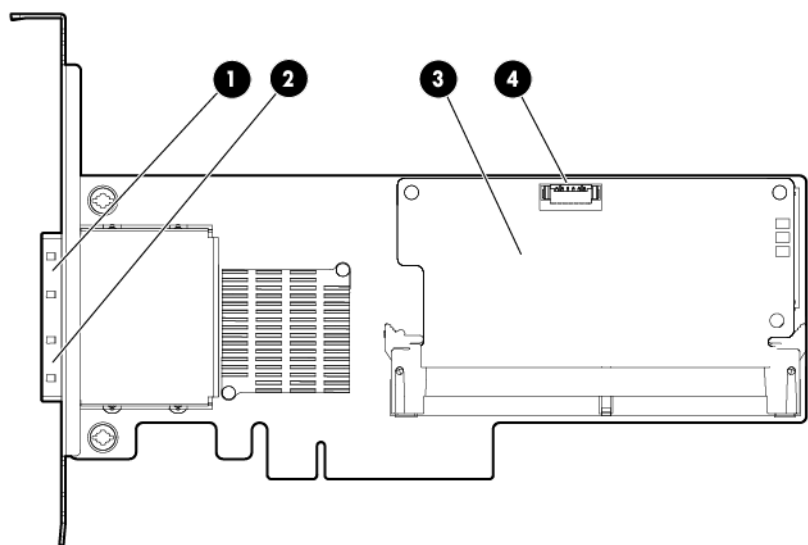
For LED locations and status, see "P420 LEDs (on page 19)."



Item	Description
1	Cache module (also known as array accelerator)
2	Capacitor pack cable connector
3	Port 2I (Mini-SAS 4x connector)
4	Port 1I (Mini-SAS 4x connector)

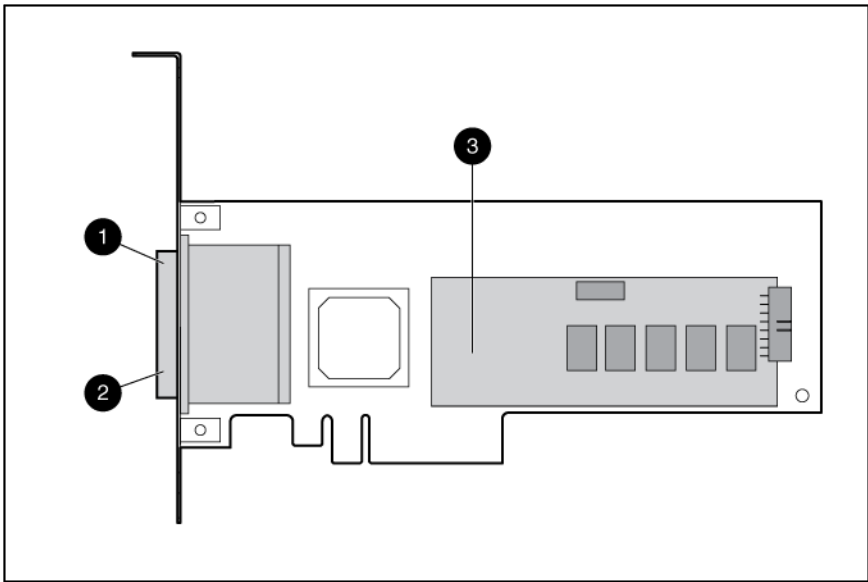
P421 components

For LED locations and status, see "P421 LEDs (on page 20)."



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	Capacitor pack cable connector

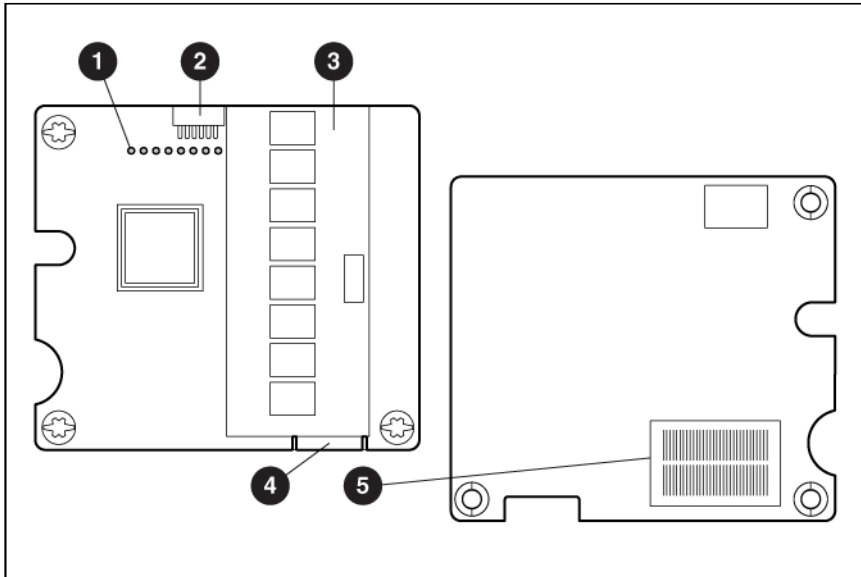
E500 components



Item	Description
1	Port 1E (Mini-SAS 4x connector)
2	Port 2E (Mini-SAS 4x connector)

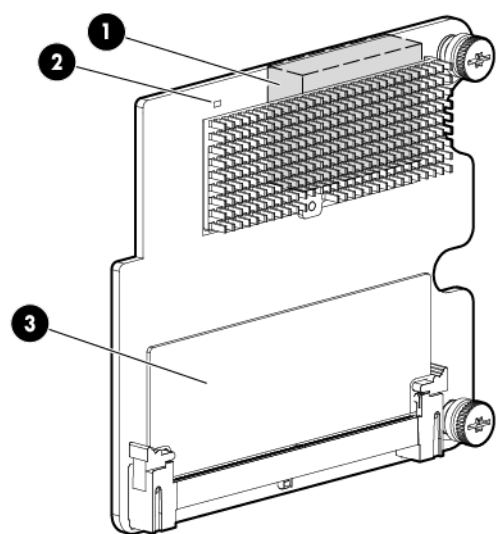
Item	Description
3	Cache module (also known as array accelerator), showing the connector for the cable to an optional battery pack that upgrades the cache to BBWC

P700m components



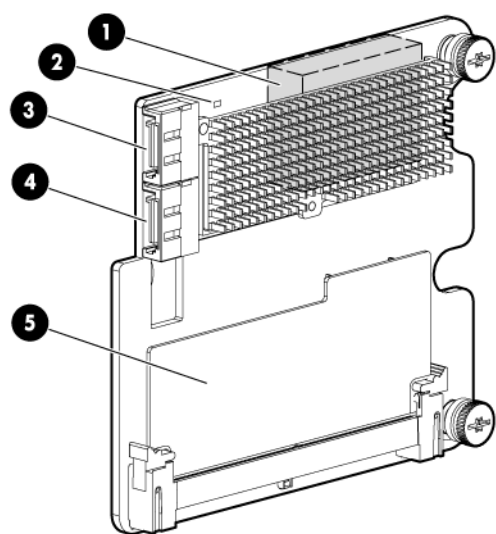
Item	Description
1	Runtime LEDs. See "Controller board runtime LEDs (on page 16)."
2	Connector (not used on HPE ProLiant servers)
3	Cache module (also known as array accelerator)
4	Connector for the cable to an optional cache battery that upgrades the cache to BBWC. This connector is absent on some P700m models.
5	Mezzanine connector

P711m components



Item	Description
1	Mezzanine connector
2	Runtime LED. See "Controller board runtime LEDs (on page 16)."
3	Cache module

P712m components

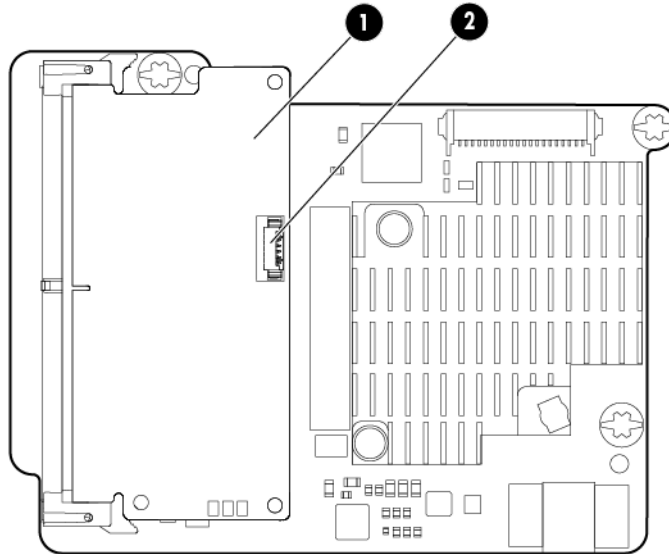


Item	Description
1	Mezzanine connector
2	Runtime LED. See "Controller board runtime LEDs (on page 16)."
3	SAS/SATA connector
4	SAS/SATA connector

Item	Description
5	Cache module (not available on all models)

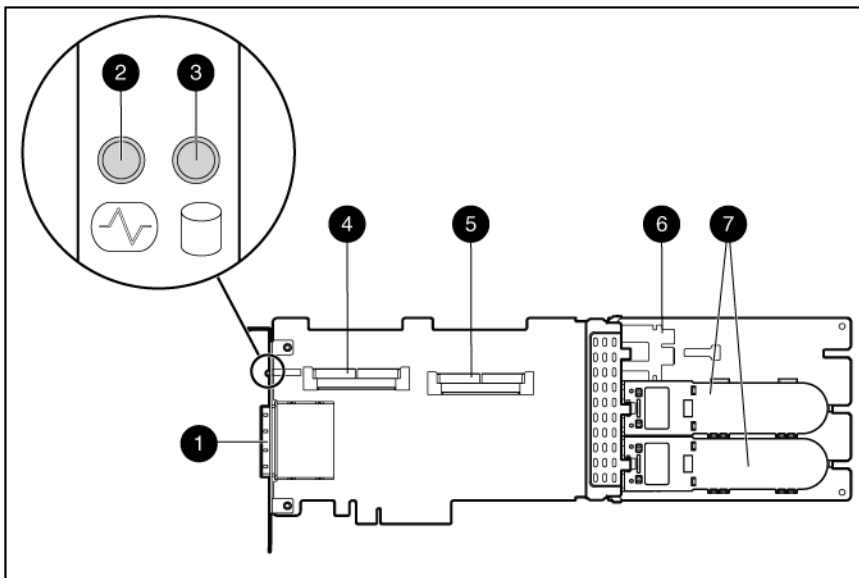
P721m components

For LED locations and status, see "P721m LEDs (on page 23)."



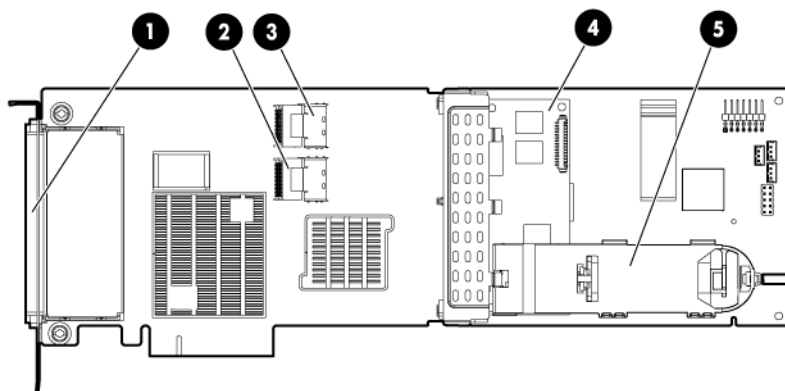
Item	Description
1	Cache module (also known as array accelerator)
2	Capacitor pack cable connector

P800 components



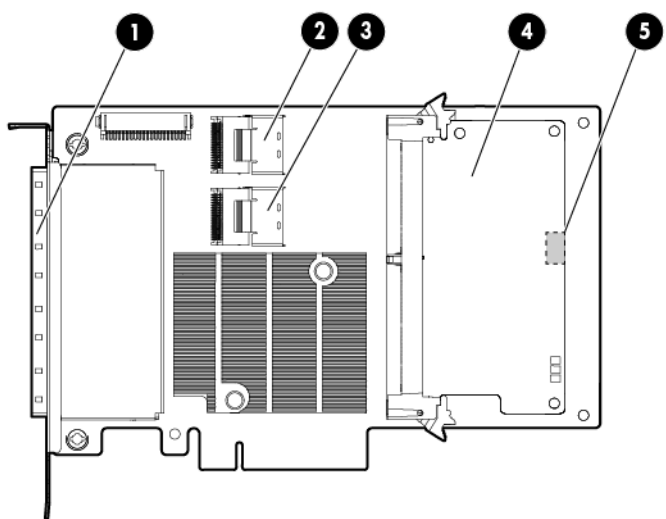
Item	Description
1	Ports 1E and 2E (Mini-SAS 4x connectors)
2	Heartbeat LED (flashes green when operating normally and amber if the board has failed)
3	Activity LED for external ports
4	Port 3I (Mini-SAS 4x connector)
5	Port 4I (Mini-SAS 4x connector)
6	Cache module (also known as array accelerator)
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 components



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

P822 components

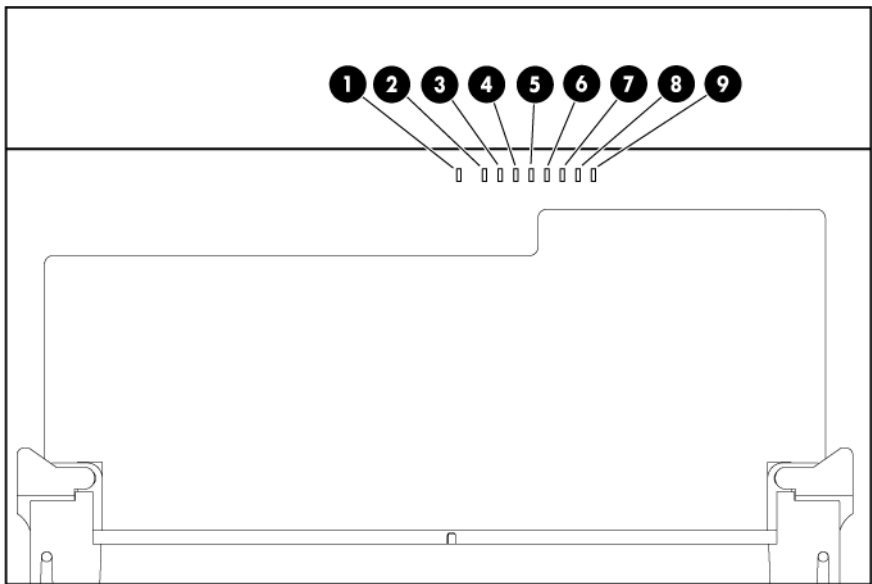


Item	Description
1	Ports 1E, 2E, 3E, and 4E (Mini-SAS 4x connectors)
2	Port 5I (Mini-SAS 4x connector)
3	Port 6I (Mini-SAS 4x connector)
4	Cache module
5	Capacitor pack connector for cache module

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.

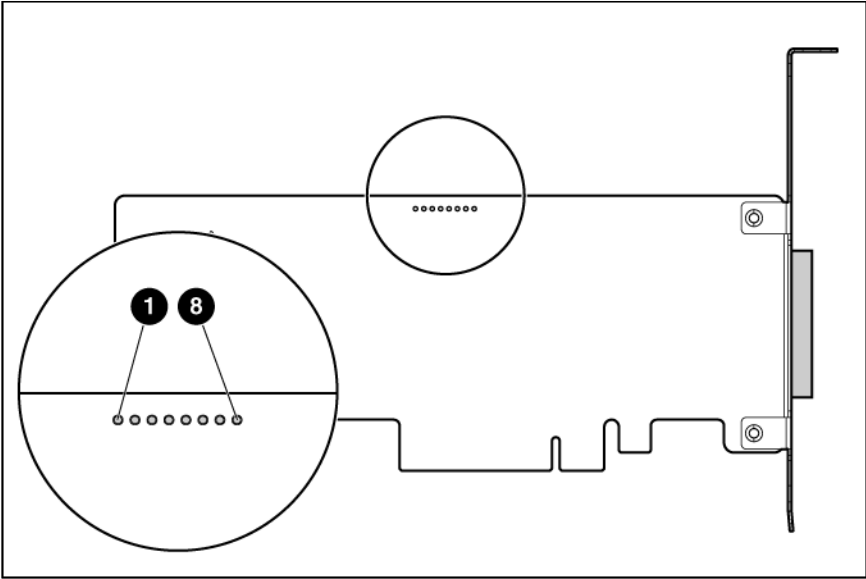
P212, P410, and P411 LEDs



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 more information, 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 more information, 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.
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%

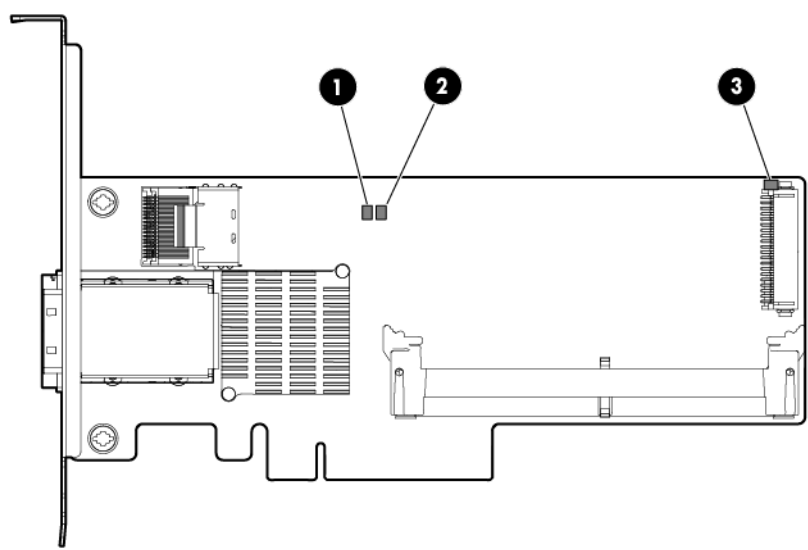
E500 and P400 LEDs



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.
7	Green	CR4: Gas Pedal	This LED, together with the Idle Task LED (next item), indicates the amount of controller CPU activity. For more information, 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 more information, see the following table.

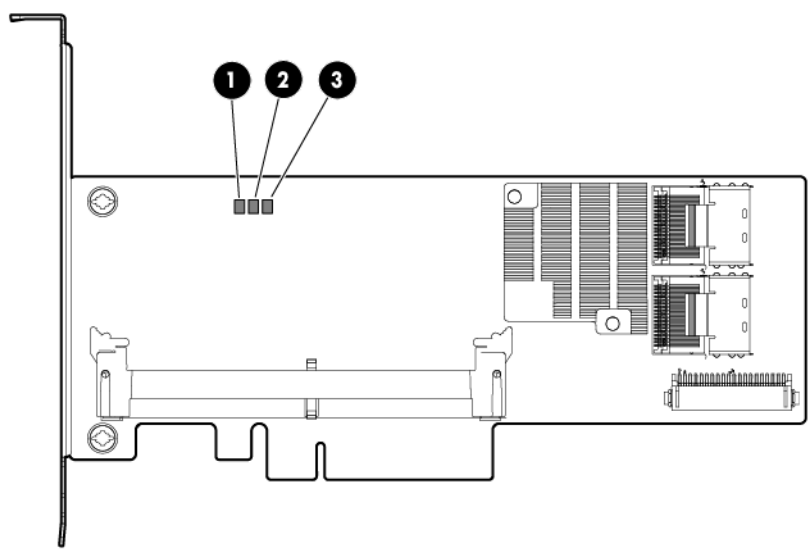
Gas Pedal LED status	Idle Task LED status	Controller CPU activity level
Off	Flashing	0–25%
Flashing	Off	25–50%
On steadily	Off	50–75%
On steadily	On steadily	75–100%

P222 LEDs



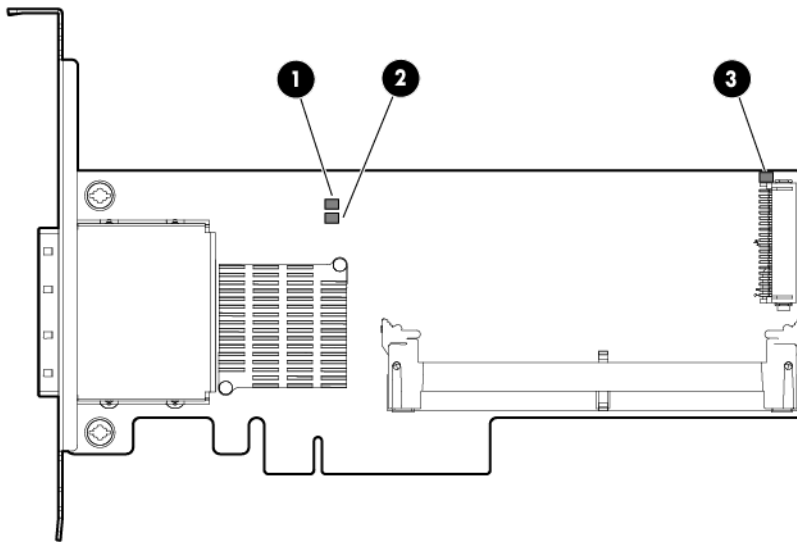
Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Red	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Amber	Debug	On = Controller is in reset. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

P420 LEDs



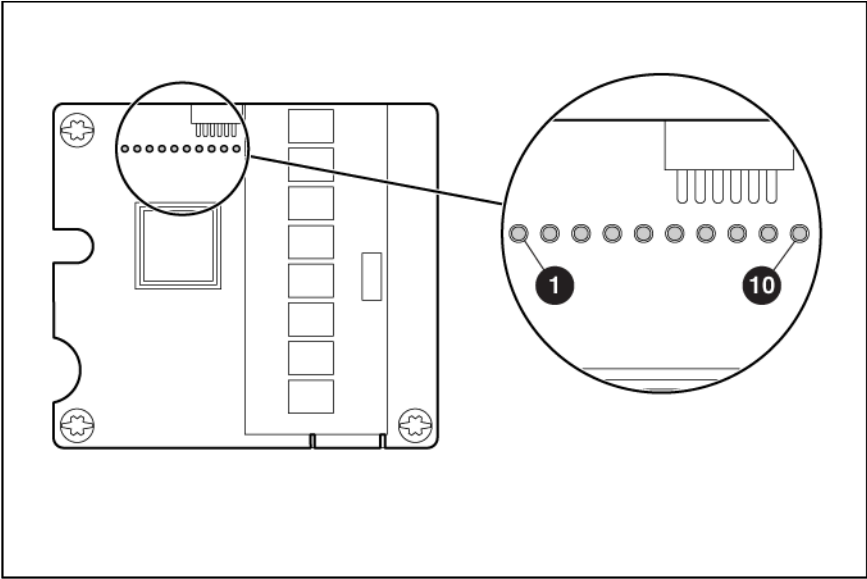
Item	Color	Name	Interpretation
1	Amber	Debug	On = Controller is in reset state. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.
2	Red	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.

P421 LEDs



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Red	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Amber	Debug	On = Controller is in reset. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

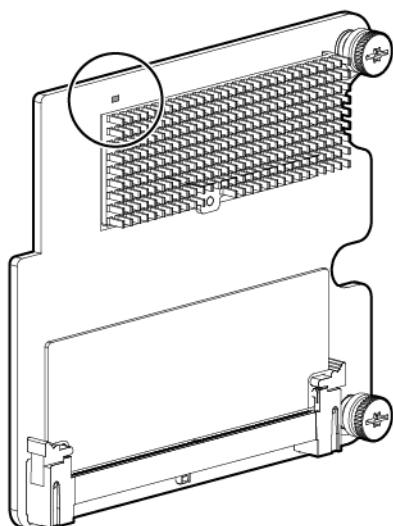
P700m LEDs



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.
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 more information, 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 more information, see the following table.

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%

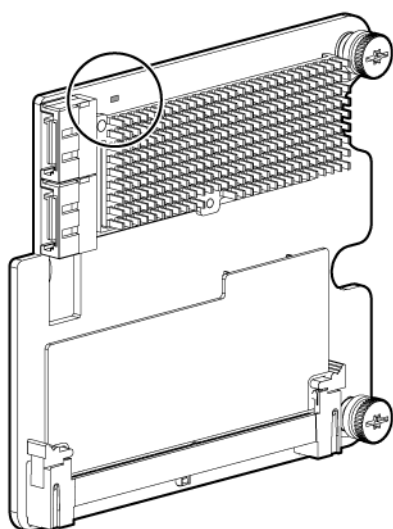
P711m LED



Name: Controller heartbeat LED (CR6)

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

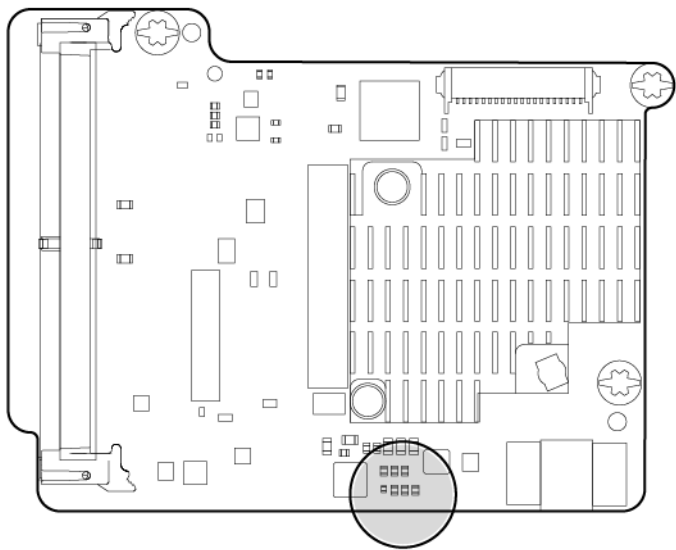
P712m LED



Name: Controller heartbeat LED (CR6)

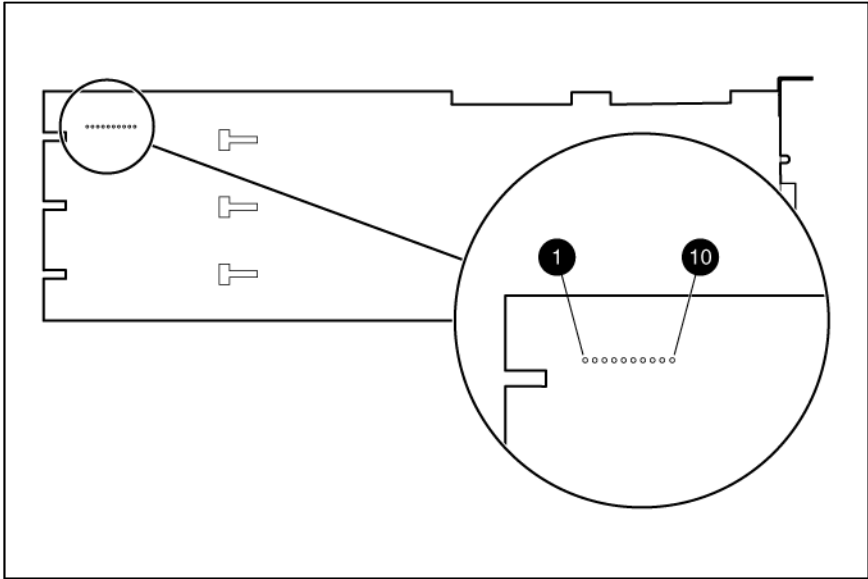
Status: Flashes every 2 seconds = The controller is functioning properly.

P721m LEDs



Color	Name	Interpretation
Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.

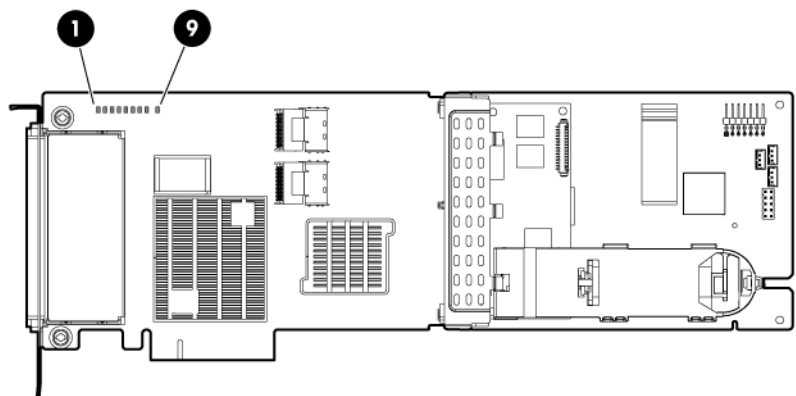
P800 LEDs



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 more information, 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 more information, see the following table.

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%

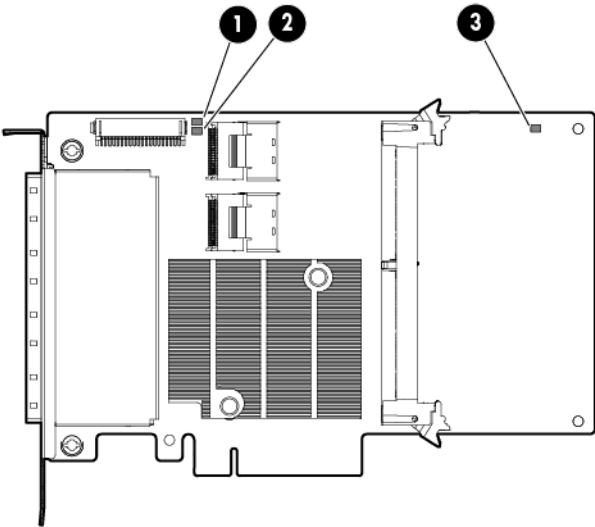
P812 LEDs



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.
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%

P822 LEDs

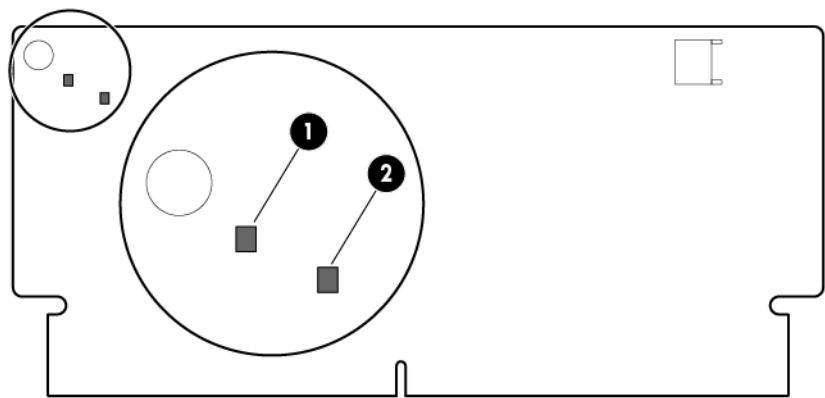


Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Red	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Amber	Debug	On = Controller is in reset. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

FBWC module LEDs

FBWC module LEDs (P410, P411, P711m, P812)

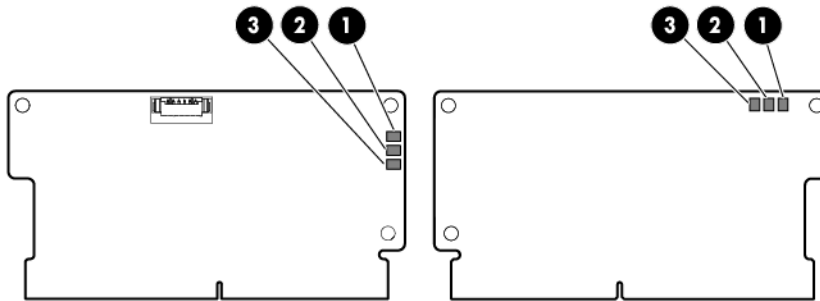
The FBWC module has two single-color LEDs (green and amber). The LEDs are duplicated on the reverse side of the cache module to facilitate status viewing.



1 Green LED	2 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.

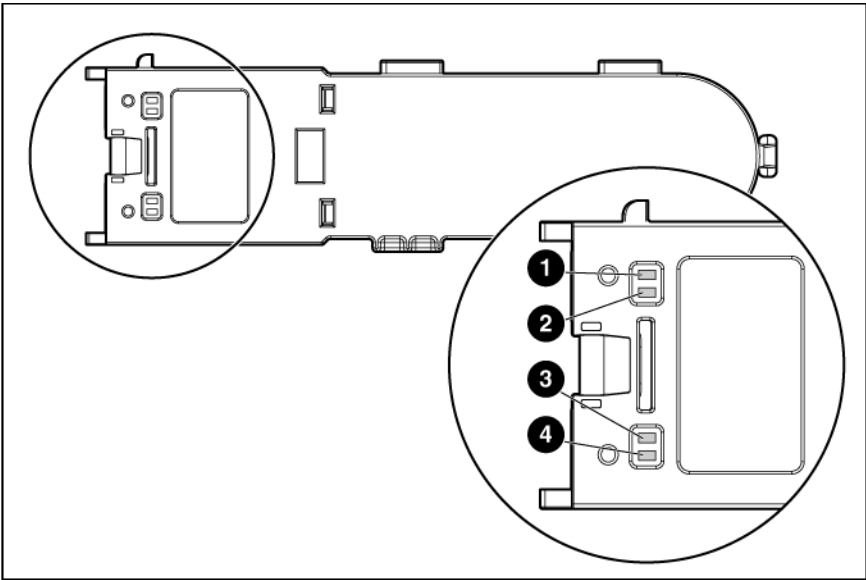
FBWC module LEDs (P222, P420, P421, P721m, P822)

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



1 - Amber	2 - Green	3 - Green	Interpretation
Off	Off	Off	The cache module is not powered.
Off	Flashing 0.5 Hz	Flashing 0.5 Hz	The cache microcontroller is executing from within its boot loader and receiving new flash code from the host controller.
Off	Flashing 1 Hz	Flashing 1 Hz	The cache module is powering up, and the capacitor pack is charging.
Off	Off	Flashing 1 Hz	The cache module is idle, and the capacitor pack is charging.
Off	Off	On	The cache module is idle, and the capacitor pack is charged.
Off	On	On	The cache module is idle, the capacitor pack is charged, and the cache contains data that has not yet been written to the drives.
Off	Flashing 1 Hz	Off	A backup is in progress.
Off	On	Off	The current backup is complete with no errors.
Flashing 1 Hz	Flashing 1 Hz	Off	The current backup failed, and data has been lost.
Flashing 1 Hz	Flashing 1 Hz	On	A power error occurred during the previous or current boot. Data may be corrupt.
Flashing 1 Hz	On	Off	An overtemperature condition exists.
Flashing 2 Hz	Flashing 2 Hz	Off	The capacitor pack is not attached.
Flashing 2 Hz	Flashing 2 Hz	On	The capacitor has been charging for 10 minutes, but has not reached sufficient charge to perform a full backup.
On	On	Off	The current backup is complete, but power fluctuations occurred during the backup.
On	On	On	The cache module microcontroller has failed.

Battery pack LEDs



Item	Color	Description
1	Green	System Power LED. This LED is on 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 is on 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
Off	Flashing (2 Hz)	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 2 days. The battery lifetime also depends on the cache module size. For more information, see the controller QuickSpecs on the Hewlett Packard Enterprise website (http://www.hpe.com/info/qs).
Off	Double flash, then pause	The cache microcontroller is waiting for the host controller to communicate.

LED3 pattern	LED4 pattern	Interpretation
Off	Flashing (1 Hz)	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 unavailable temporarily until charging is complete. The recharge process takes between 15 minutes and 2 hours, depending on the initial capacity of the battery.
Off	On	The battery pack is fully charged, and posted write data is stored in the cache.
Off	Off	The battery pack is fully charged, and no posted write data exists in the cache.
Flashing (1 Hz)	Flashing (1 Hz)	An alternating green and amber flashing pattern indicates that the cache microcontroller is executing from within its boot loader and receiving new flash code from the host controller.
On	—	A short circuit exists 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 3 years.
Flashing (1 Hz)	—	An open circuit exists 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 3 years.

Specifications

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.

RAID conventions

Hewlett Packard Enterprise uses the following naming convention for RAID levels:

- RAID 0
- RAID 1+0
- RAID 5
- RAID 50
- RAID 6
- RAID 60
- RAID 1 (ADM)
- RAID 10 (ADM)

RAID 50 and RAID 60 are also known in the industry as RAID 5+0 and RAID 6+0, respectively.

Smart Array Advanced Pack

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

To access SAAP features, activate the software 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
- Dual domain

SAAP 2.0 includes all v1.0 features and also provides the following additional features:

- RAID 1 (ADM) and RAID 10 (ADM)
- Capability for moving and deleting individual LUNs
- Split mirror backup and rollback of RAID 1, 1+0, 1 (ADM) and 10 (ADM) mirrors
- Heal Array

To access SAAP features, you must purchase a license key from Hewlett Packard Enterprise. To obtain a license key, see the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) and search for SAAP.

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

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

For registration procedures, see the *Configuring Arrays on HPE Smart Array Controllers Reference Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/CASAC_RG_en).

Required hardware

For a list of Smart Array controllers that support SAAP, see the SAAP product page on the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) and search for SAAP.

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 a Hewlett Packard Enterprise authorized reseller or see the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/smartarray>).

Supported servers and server blades

Use the following table to identify server and server blade support for HPE Smart Array controllers.

Controller	Speed	Supported product
P222	6 Gb/s	ProLiant Gen8 servers*

Controller	Speed	Supported product
P420	6 Gb/s	ProLiant Gen8 servers*
P421	6 Gb/s	ProLiant Gen8 servers
P212	6 Gb/s	ProLiant G6/G7 servers
P410	6 Gb/s	ProLiant G6/G7 servers
P411	6 Gb/s	ProLiant G6/G7 servers
P711m	6 Gb/s	ProLiant G6/G7 server blades
P712m	6 Gb/s	ProLiant G6/G7 server blades
P721m	6 Gb/s	ProLiant Gen8 server blades**
P812	6 Gb/s	ProLiant G6/G7 servers
P822	6 Gb/s	ProLiant Gen8 servers†
P400	3 Gb/s	ProLiant G4/G5 servers
P700m	3 Gb/s	ProLiant G4/G5 server blades
P800	3 Gb/s	ProLiant G4/G5 servers and select G6 servers
E500	3 Gb/s	ProLiant G4/G5 servers

* The P222 controller is not supported in the HPE ProLiant ML350p Gen8 server. The P420 is not supported in slot 3 or slot 4 of the HPE ProLiant ML350p Gen8 server.

** The P721m controller is not supported in expansion slot 1 of HPE ProLiant Gen8 server blades.

† The HPE P822 Smart Array Controller is not supported in all slots in all HPE ProLiant Gen8 servers. See the table below for slots that are not supported, or that require special configuration.

Server	Rules
DL360e Gen8	- P822 supported in slot 1 only - Requires Smart Array cable kit part number 672242-B21
DL380e Gen8	P822 is not supported in PCI slot 4.
DL380p Gen8	P822 is not supported in PCI slot 3.
DL385p Gen8	P822 is not supported in PCI slot 3.
ML350p Gen8	- P822 is not supported in slots 1, 2, 5, 6, 7, 8, or 9. - When installing P822 in slot 3, slot 4 cannot be populated.
ML350e Gen8	P822 supported in slot 2 only

For more information on installing the controller, see the server user guide.

For the latest support information, see the controller QuickSpecs on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/qs>).

Specifications common to all controller models

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

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 37)."
Time required to recharge capacitor ²	5 minutes or less
Duration of capacitor backup ²	80 seconds 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) • 6.0-Gb/s SATA drives Not all servers or storage systems support all SAS or SATA drive types. For product-specific drive support, see the product QuickSpecs on the Hewlett Packard Enterprise website (http://www.hpe.com/support/hpesc).
Maximum number of logical drives	64

¹For controllers that use battery-backed write cache

²For controllers that use flash-backed write cache

³Not all servers support all drive types. For more information, see the server QuickSpecs on the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>).

Controller specifications by model

E500, P411, and P421 specifications

Specification	E500	P411	P421
Board type	Low-profile, PCIe stand-up board	Low-profile, PCIe stand-up board	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8	16.8 x 7.0 x 1.8	16.8 x 6.9 x 1.7
Dimensions, in*	6.6 x 2.8 x 0.7	6.6 x 2.8 x 0.7	6.6 x 2.7 x 0.6
Maximum number of physical drives	100 external	100 external (controller does not operate without cache)	200 external (controller does not operate without cache)
Maximum power required (approximate)	14 W	12 W	14 W

Specification	E500	P411	P421
RAID levels**	RAID 0, 1, 1+0, and 5	RAID 0, 1, 1+0, 5, 50, 6, and 60	RAID 0, 1, 1 (ADM), 1+0, 10 (ADM), 5, 50, 6, and 60
Battery kit option part number	Battery pack 383280-B21; battery cable 417836-B21	462969-B21	—
Cache module	40-bit wide, 256-MiB BBWC	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC 72-bit wide, 1-GiB FBWC	72-bit wide, 1-GiB FBWC 72-bit wide, 2-GiB FBWC
I/O connection to the system board	PCIe x8 edge connector	PCIe 2.0 x8 edge connector	PCIe 3.0 x8 edge connector

*These dimensions exclude the board bracket.

**RAID levels 5 and 50 require an installed cache module. RAID levels 1 (ADM), 10 (ADM), 6, and 60 require an installed cache module and SAAP. To download SAAP, see the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) and search for SAAP.

P400, P410, and P420 specifications

Specification	P400	P410	P420
Board type	Low-profile, PCIe stand-up board	Low-profile, PCIe stand-up board	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8	16.8 x 7.0 x 1.8	16.8 x 6.9 x 1.7
Dimensions, in*	6.6 x 2.8 x 0.7	6.6 x 2.8 x 0.7	6.6 x 2.7 x 0.6
Maximum number of physical drives	8 external	Without cache, 8 internal With cache, 8 internal or up to 24 internal with an expander card	27 internal
Maximum power required (approximate)	14 W	12 W	14 W
RAID levels**	RAID 0, 1, 1+0, 5, and 6	RAID 0, 1, 1+0, 5, 50, 6, and 60	RAID 0, 1, 1 (ADM), 1+0, 10 (ADM), 5, 50, 6, and 60
Battery kit option part number	Battery pack 390936-001; battery cable 399034-001	462969-B21	—
Cache module	40-bit wide, 256-MiB BBWC	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC 72-bit wide, 1-GiB FBWC	72-bit wide, 1-GiB FBWC 72-bit wide, 2-GiB FBWC
I/O connection to the system board	PCIe x8 edge connector	PCIe 2.0 x8 edge connector	PCIe 3.0 x8 edge connector

*These dimensions exclude the board bracket.

**RAID levels 5 and 50 require an installed cache module. RAID levels 1 (ADM), 10 (ADM), 6, and 60 require an installed cache module and SAAP. To download SAAP, see the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) and search for SAAP.

P212 and P222 specifications

Specification	P212	P222
Board type	Low-profile, PCIe stand-up board	Low-profile, PCIe stand-up board
Dimensions, cm*	16.8 x 7.0 x 1.8	16.8 x 6.9 x 1.7
Dimensions, in*	6.6 x 2.8 x 0.7	6.6 x 2.7 x 0.6

Specification	P212	P222
Maximum number of physical drives	Without cache: 4 internal + 1 tape external With cache: 4 internal + 50 external	114 (14 internal + 100 external)
Maximum power required (approximate)	12 W	14 W
RAID levels	RAID 0, 1, 1+0, 5, 50, 6, and 60	RAID 0, 1, 1 (ADM), 1+0, 10 (ADM), 5, 50, 6, and 60
Battery kit option part number	462969-B21	—
Cache module	40-bit wide, 256-MiB BBWC	40-bit wide, 512-MiB FBWC
I/O connection to the system board	PCIe 2.0 x8 edge connector	PCIe 3.0 x8 edge connector

*These dimensions exclude the board bracket.

**RAID levels 5 and 50 require an installed cache module. RAID levels 1 (ADM), 10 (ADM), 6, and 60 require an installed cache module and SAAP. To download SAAP, see the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) and search for SAAP.

P700m, P711m, P712m, and P721m specifications

Specification	P700m	P711m	P712M	P721m
Board type	Type A, 4-port, PCIe mezzanine board	Type A, 4-port, PCIe mezzanine board	Type A, 4-port, PCIe mezzanine board	Type B, 4-port, PCIe mezzanine board
Dimensions, cm	11.3 x 10.0 x 2.0	11.3 x 10.0 x 2.0	11.3 x 10.0 x 2.0	11.3 x 10.0 x 2.0
Dimensions, in	4.5 x 4.0 x 0.8	4.5 x 4.0 x 0.8	4.5 x 4.0 x 0.8	4.5 x 4.0 x 0.8
Maximum number of physical drives	108 external	108 external	10 internal + external	227 external
Maximum power required (approximate)	9.30 W	14 W	14 W	14 W
RAID levels	RAID 0, 1, 1+0, and 5; with battery, also RAID 6	RAID 0, 1, 5, 6, 50, and 60	RAID 0 and 1	RAID 0, 1, 1 (ADM), 1+0, 10 (ADM), 5, 50, 6, and 60*
Battery kit option part number	453779-001	—	—	—
Cache module	40-bit wide, 256-MiB BBWC 72-bit wide, 512-MiB BBWC (64 MiB is used by the onboard processor)	72-bit wide, 1-GiB FBWC** (112 MiB is used by the onboard processor)	40-bit wide, 256-MiB BBWC	40-bit wide, 512-MiB FBWC 72-bit wide, 2-GiB FBWC† (controller does not operate without cache)
I/O connection to the system board	Grid array mezzanine connector	Grid array mezzanine connector	Grid array mezzanine connector	Grid array mezzanine connector

* RAID levels when using the 2-GiB FBWC. When using the 512-MiB FBWC, RAID levels are dependent on the attached arrays.

** SAAP 1.0. License key is standard.

† SAAP 2.0. License key is standard.

P800, P812, and P822 specifications

Specification	P800	P812	P822
Board type	Full-size, PCIe stand-up board	Full-size, PCIe stand-up board	Full-height, 1/2 length, PCIe stand-up board
Dimensions, cm*	31.1 x 11.1 x 1.2	31.1 x 11.1 x 1.2	16.8 x 11.1 x 1.8
Dimensions, in*	12.3 x 4.4 x 0.5	12.3 x 4.4 x 0.5	6.6 x 4.4 x 0.7
Maximum number of physical drives	108 (internal + external)	108 (internal + external)	227 [†] (internal + external)
Maximum power required (approximate)	25 W	29 W**	31 W**
RAID levels	RAID 0, 1, 1+0, and 5	RAID 0, 1, 1+0, 5, and 50	RAID 0, 1, 1 (ADM), 1+0, 10 (ADM) 5, 50, 6 and 60
Battery kit option part number	398648-001	—	—
Cache module	72-bit wide, 512-MiB BBWC	72-bit wide, 1-GiB FBWC	72-bit wide, 2-GiB FBWC
I/O connection to the system board	PCIe x8 edge connector	PCIe 2.0 x8 edge connector	PCIe 3.0 x8 edge connector

*These dimensions exclude the board bracket.

**This controller is for use on qualified systems that support power requirements above 25 W.

[†]To install SLES 11 SP2, you must reduce the number of attached hard drives to less than 200 prior to installing the operating system. After installing SLES11 SP2, download and install the latest Smart Array driver from the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>) or by using SPP, and then shut down the server. You can now reattach up to 277 hard drives and boot your server to run the SLES 11 SP2 operating system.

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. If a battery fails completely, the HPE Smart Array controller detects this condition and automatically restricts write cache functions to protect user data. To help ensure uninterrupted performance levels, Hewlett Packard Enterprise 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.

Installation and configuration

Procedures for controllers in a server

To install a stand-up controller in a server, choose one of the following procedures:

- Installing a stand-up controller in an unconfigured server (on page 38)
- Installing a stand-up controller in a previously configured server (on page 38)

Installing a stand-up controller in an unconfigured server

Unless the user chooses a different configuration option, new HPE 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 *HPE ROM-Based Setup Utility User Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/RBSU_UG_en).



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 board](#)" on page 39). For server-specific procedures, see the server user guide.
2. If the controller supports external storage, connect external storage devices to the controller.
3. Install physical drives, as needed.
The number of drives connected to the controller determines the RAID level if the server autoconfigures at powers up, unless the user chooses a different configuration option. For more information, see the server-specific user guide or the *HPE ROM-Based Setup Utility User Guide*.
4. Power up the external storage devices.
5. Power up the server. Unless the user chooses a different configuration option, the autoconfiguration process runs.
6. Verify the server firmware is the latest revision. If necessary, update the server firmware ("[Updating firmware](#)" on page 46).
7. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 46).
8. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 46).
9. Install the operating system and device drivers ("[Installing device drivers](#)" on page 46).
10. (Optional) Create additional logical drives ("[Configuration tools](#)" on page 44).

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. Close all applications.
3. Verify the server firmware is the latest revision. If necessary, update the server firmware ("[Updating firmware](#)" on page 46).
4. Do one of the following:
 - o If the new controller is the new boot device, install the device drivers ("[Installing device drivers](#)" on page 46).
 - o If the new controller is not the new boot device, go to the next step.
5. 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.

6. Power down all peripheral devices that are attached to the server.
7. Disconnect the power cord from the power source.
8. Disconnect the power cord from the server.
9. Disconnect all peripheral devices.
10. Install the controller hardware ("[Installing the controller board](#)" on page 39). For server-specific procedures, see the server user guide.
11. Connect storage devices to the controller.
12. Connect peripheral devices to the server.
13. Connect the power cord to the server.
14. Connect the power cord to the power source.
15. Power up all peripheral devices.
16. Power up the server.
17. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 46).
18. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 46).
19. (Optional) Set this controller as the boot controller using ORCA ("[Setting a controller as the boot controller](#)" on page 45).
20. (Optional) Change the controller boot order using RBSU ("[Setting the controller order](#)" on page 45).
21. If the new controller is not the new boot device, install the device drivers ("[Installing device drivers](#)" on page 46).
22. If new versions of the Management Agents are available, update the Management Agents.
23. (Optional) Create additional logical drives ("[Configuration tools](#)" on page 44).

The server is now ready for use.

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.

Some servers contain high energy, high circuits, moving parts (such as fan blades), or any combination of these hazards, that may be exposed if covers and access panels are removed while the product is powered. These products 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 guarding against 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 expansion slot.
A x8 physical size slot is required, even though the slot may run at a x4 or x1 speed.
3. Remove the slot cover. Save the retaining screw, if one is present.
4. Install the cache module, as needed.
For some controllers, if the cache module is absent, the controller does not function.
5. Slide the controller board along the slot alignment guide, if one is present, and then press the board firmly into the expansion slot so that the contacts on the board edge are seated properly in the slot.
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 internal storage devices to the controller, if necessary. For more information, see "Connecting internal storage (on page 40)."
8. Close or install 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 internal storage

1. Power down the server.
2. Install drives, if necessary. For drive requirements when configuring arrays, see "Array configuration tools (on page 46)."

The server and controller may support different types of drives. However, all drives grouped in a logical drive must meet the following criteria:

- o They must be either SAS or SATA.
- o They must be either all hard drives or all solid state drives.
- o For the most efficient use of drive space, the drives must have comparable capacity.

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

- o Drive procedures (on page 80)
- o Server documentation
- o Drive documentation

3. Use the internal SAS cable provided with the server to connect the controller to the drives:
 - o If the drives are hot-plug capable, connect the internal connector of the controller to the SAS connector on the hot-plug drive cage.
 - o 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.

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

Procedures for controllers in a server blade

To install a mezzanine controller in a server blade, choose one of the following procedures:

- Installing a mezzanine controller in an unconfigured server blade (on page 41)
- Installing a mezzanine controller in a previously configured server blade (on page 42)

Installing a mezzanine controller in an unconfigured server blade

Unless the user chooses a different configuration option, new HPE 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 *HPE ROM-Based Setup Utility User Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/RBSU_UG_en).



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 HPE Smart Array P712m Controller, install the optional cache module, if available.
 - For all other controllers, install the cache module. If the cache module is absent, these controllers do not function.
3. Install the controller in the server blade ("[Installing the mezzanine controller board](#)" on page 43). For server blade-specific procedures, see the server blade user guide.
 4. Install the access panel.
 5. Install an HPE 3Gb or 6Gb SAS Switch in the enclosure.
 6. Connect a drive enclosure to the switch.
 7. Install physical drives in the drive enclosure, as needed.
The number of drives connected to the switch determines the RAID level that is autoconfigured when the server blade powers up, unless the user chooses a different configuration option. For more information, see the server-specific user guide or the *HPE ROM-Based Setup Utility User Guide*.
 8. Create and assign drive bay or port zoning groups with HPE Virtual SAS Manager software. For more information, see the switch documentation.
 9. Install the server blade in the server blade enclosure.
By default, the server blade powers up upon insertion. If necessary, power up the server blade manually. Unless the user chooses a different configuration option, the autoconfiguration process runs.
 10. Verify the server blade firmware is the latest revision. If necessary, update the server firmware ("[Updating firmware](#)" on page 46).
 11. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 46).
 12. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 46).
 13. Install the operating system and device drivers ("[Installing device drivers](#)" on page 46).
 14. (Optional) Create additional logical drives ("[Configuration tools](#)" on page 44).

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. Close all applications.
3. Verify the server blade firmware is the latest revision. If necessary, update the server blade firmware ("[Updating firmware](#)" on page 46).
4. Do one of the following:
 - If the new controller is the new boot device, install the device drivers ("[Installing device drivers](#)" on page 46).
 - If the new controller is not the new boot device, go to the next step.
5. 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.

6. Remove the server blade from the enclosure.
7. Remove the server blade access panel.
8. Do one of the following:
 - o For the HPE Smart Array P712m Controller, install the optional cache module, if available.
 - o For all other controllers, install the cache module. If the cache module is absent, these controllers do not function.
9. Install the controller in the server blade ("[Installing the mezzanine controller board](#)" on page 43). For server blade-specific procedures, see the server blade user guide.
10. Install the access panel.
11. Install an HPE 3Gb or 6Gb SAS Switch in the enclosure.
12. Connect a drive enclosure to the switch.
13. Install physical drives in the drive enclosure, as needed.

The number of drives connected to the switch determines the RAID level that is autoconfigured when the server blade powers up, unless the user chooses a different configuration option. For more information, see the server-specific user guide or the *HPE ROM-Based Setup Utility User Guide*.
14. Create and assign drive bay or port zoning groups with HPE Virtual SAS Manager software. For more information, see the switch documentation.
15. Install the server blade in the enclosure.

By default, the server blade powers up upon insertion. If necessary, power up the server blade manually. Unless the user chooses a different configuration option, the autoconfiguration process runs.
16. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 46).
17. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 46).
18. (Optional) Set this controller as the boot controller using ORCA ("[Setting a controller as the boot controller](#)" on page 45).
19. (Optional) Change the controller boot order using RBSU ("[Setting the controller order](#)" on page 45).
20. If the new controller is not the new boot device, install the device drivers ("[Installing device drivers](#)" on page 46).
21. If new versions of the Management Agents are available, update the Management Agents.

The server blade is now ready for use.

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.

Some servers contain high energy, high circuits, moving parts (such as fan blades), or any combination of these hazards, that may be exposed if covers and access panels are removed while the product is powered. These products 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 guarding against these hazardous conditions.

1. Remove the server blade 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 mezzanine connector on the system board.
For more information, see "Supported servers and server blades (on page 32)."
3. Remove the connector cover, and then save it for future use.
4. Insert the controller into the connector.
5. Tighten the three spring-loaded captive screws at the corners of the controller.
6. Install 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. Install the server blade in the enclosure.

Configuration tools

Option ROM Configuration for Arrays

Before installing an operating system, you can use the ORCA utility to create the first logical drive, assign RAID levels, and establish online spare configurations.

The utility also provides support for the following functions:

- Reconfiguring one or more logical drives
- Viewing the current logical drive configuration
- Deleting a logical drive configuration
- Setting the controller to be the boot controller
- Selecting the boot volume

If you do not use the utility, ORCA will default to the standard configuration.

For more information regarding the default configurations that ORCA uses, see the *HPE ROM-Based Setup Utility User Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/RBSU_UG_en).

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 45).

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 HPE Smart Array Controllers Reference Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/CASAC_RG_en).

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.

ROM-Based Setup Utility

RBSU is a ROM-based configuration utility that allows you to modify server configuration settings. RBSU is machine-specific and customized for each type of server. RBSU facilitates a wide range of configuration functions, including displaying system information, selecting the operating system, and configuring system devices and options.

If RBSU is supported by the server, access the utility by pressing the **F9** key when prompted during the boot process. Refer to the *HPE ROM-Based Setup Utility User Guide* or to the server documentation.

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 server setup and installation guide or the *HPE ROM-Based Setup Utility User Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/RBSU_UG_en).

Array configuration tools

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

- **HPE Array Configuration Utility (ACU)**—An advanced utility that enables you to perform many complex configuration tasks
- **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
- **HPE Online Array Configuration Utility for NetWare (CPQONLIN)**—A customized version of ACU for online configuration of servers that use Novell NetWare

For more information about the features of these utilities and for instructions for using the utilities, see the *Configuring Arrays on HPE Smart Array Controllers Reference Guide*. This guide is available on the Hewlett Packard Enterprise website (http://www.hpe.com/support/CASAC_RG_en).

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

- All drives grouped in a logical drive 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.

System maintenance tools

Updating firmware

Server and controller firmware should be updated before using the controller for the first time, unless any installed software or components require an older version. For system software and firmware updates, download the SPP from the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/spp/download>).

To update the firmware on the server, controller, or drives, see the Hewlett Packard Enterprise support website (<http://www.hpe.com/support/hpesc>). When prompted for product information, enter the appropriate server model name.

Installing device drivers



IMPORTANT: Always perform a backup before installing or updating device drivers.

Hewlett Packard Enterprise now distributes drivers and other support software for servers and server blades through Service Pack for ProLiant, or SPP, which you can download from the Hewlett Packard

Enterprise website (<http://www.hpe.com/servers/spp/download>). Be sure to use the latest SPP version for the server or server blade.

If you installed an OS by using the Intelligent Provisioning software, its Configure and Install feature may have provided the latest driver support.

To directly locate the OS drivers for a particular server, enter the following web address into the browser:

<http://www.hpe.com/support/<servername>>

In place of <servername>, enter the server name.

For example:

<http://www.hpe.com/support/dl360g6>

Installing Management Agents

If you use the Assisted Installation path feature of the Intelligent Provisioning software 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 provided in the Intelligent Provisioning software.

Diagnostic tools

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

- **ACU**

ACU, and other system software, is available for download in the SPP from the Hewlett Packard Enterprise website (<http://www.hpe.com/info/spp>).

For more information about ACU, see the *Configuring Arrays on HPE Smart Array Controllers Reference Guide* on the Hewlett Packard Enterprise website

(http://www.hpe.com/support/CASAC_RG_en). For more information about error messages, see the appropriate troubleshooting guide for your product.

- **ADU**

ADU is available on the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>). When prompted for product information, enter the server model name. For more information about the meanings of the various ADU error messages, see the appropriate troubleshooting guide for your product.

- **Event Notification Service**

This utility reports array events to the server IML and the Microsoft® Windows® system event log. You can obtain the utility from the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>). When prompted for product information, enter the server model name.

- **HPE Insight Diagnostics**

HPE 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 Hewlett Packard Enterprise website (<http://www.hpe.com/info/insightdiagnostics>).

- **POST messages**

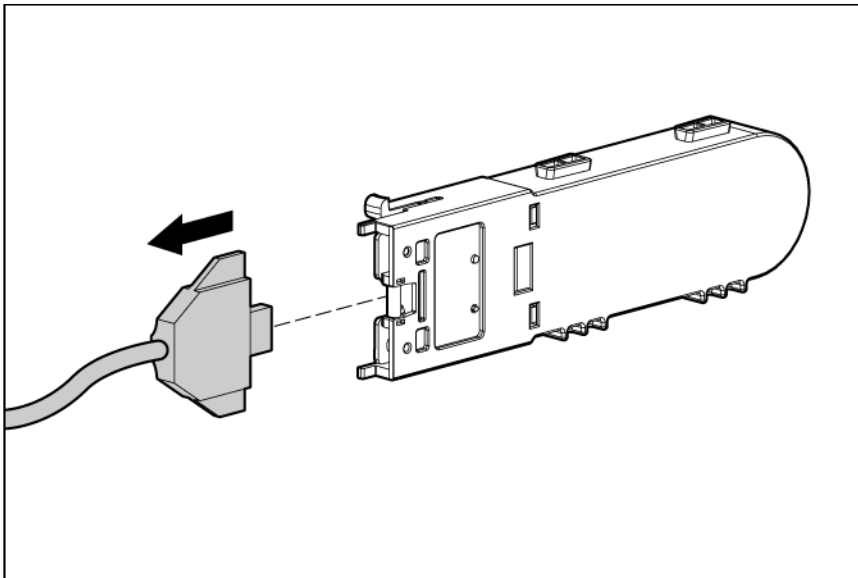
Smart Array controllers produce diagnostic error messages (POST messages) at reboot. Many POST messages suggest corrective actions. For more information about POST messages, see the appropriate troubleshooting guide for your product.

Upgrade and replacement procedures

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 29).
 - 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 illuminated, continue with the next step.
6. Disconnect the battery cable from the old battery.

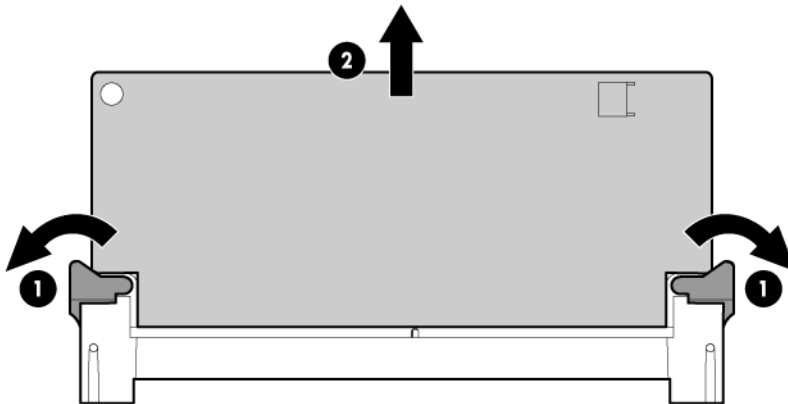


7. Connect the battery cable to the new battery.
8. Install the new battery at the same location in the server that the old battery occupied.
9. Install the access panel.

Replacing the FBWC module on the P410 and P411 models

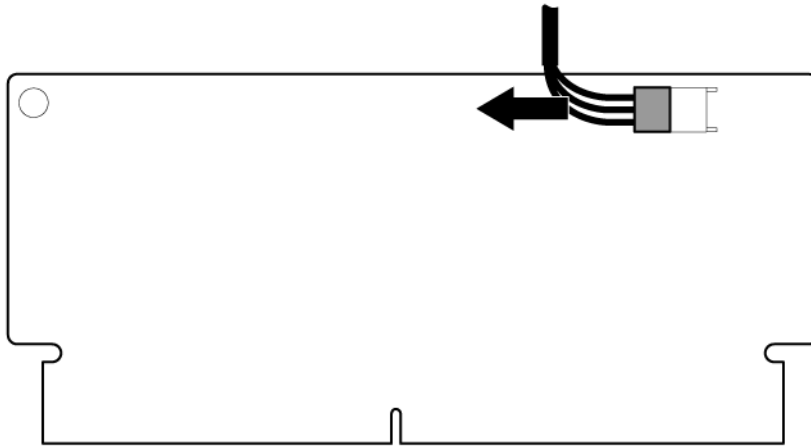
CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, because you can lose data.

1. Update the controller firmware. See "Updating firmware (on page 46)."
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 27):
 - o If the amber LED is flashing, data is trapped in the cache. Restore system power, and restart this procedure from step 1.
 - o 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.



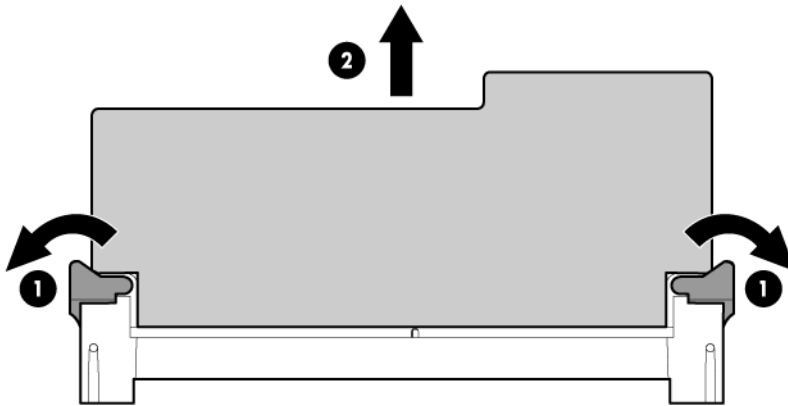
10. If the previous cache module was connected to a capacitor pack, **carefully** connect the capacitor pack cable to the new cache module.
11. Install the new cache module in the DIMM slot.
12. Close the ejector latches on the DIMM slot.
13. Install the controller.

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

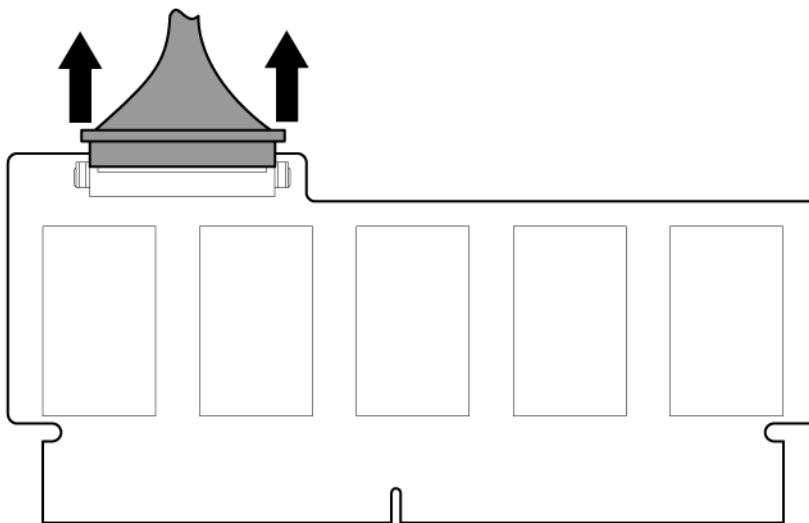
CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, 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 29).
 - 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 illuminated, 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.

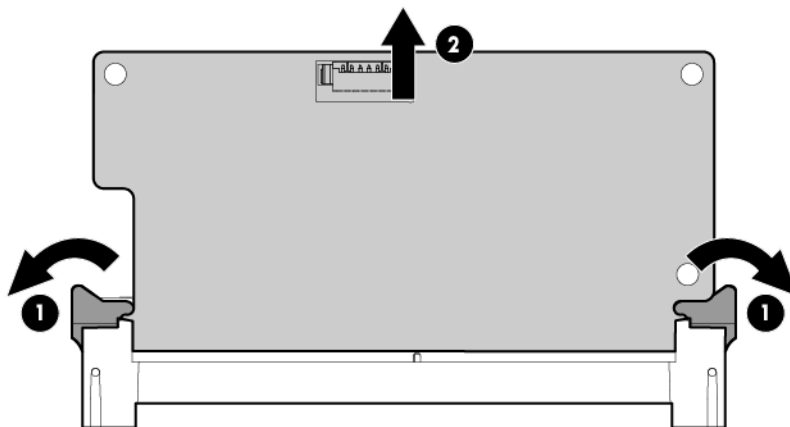


9. If the previous cache module was connected to a battery, connect the battery cable to the new cache module.
10. Install the new cache module in the DIMM slot.
11. Close the ejector latches on the DIMM slot.
12. Install the controller.

Replacing the FBWC module on the P222, P420, P421, and P822 models

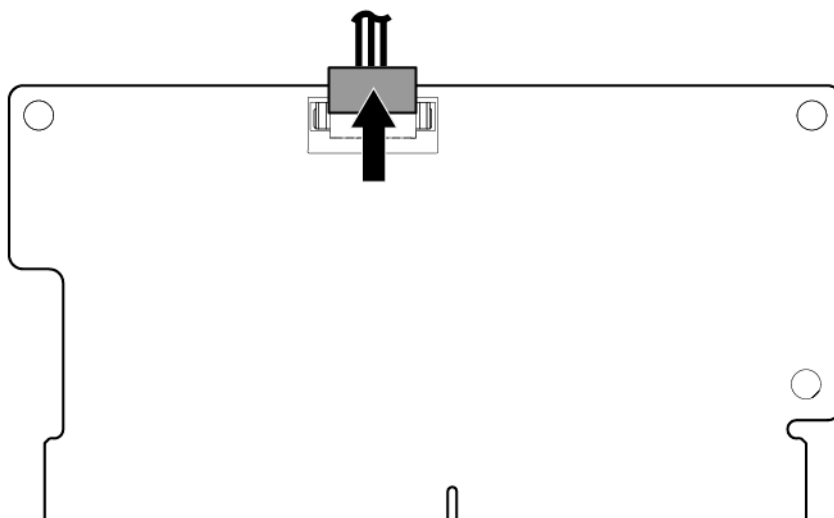
CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, because you can lose data.

1. Update the controller firmware. See "Updating firmware (on page 46)."
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 27):
 - If a backup is in progress, wait for the backup to complete.
 - If the backup is complete, or if the cache has failed, remove the controller from the server, and then continue with the next step.
8. If access to the cache module is restricted, remove the controller.
9. 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.

10. 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.



11. If the previous cache module was connected to a capacitor pack, **carefully** connect the capacitor pack cable to the new cache module.
12. Install the new cache module in the DIMM slot.
13. Close the ejector latches on the DIMM slot.
14. If you removed the controller for access purposes, install the controller.

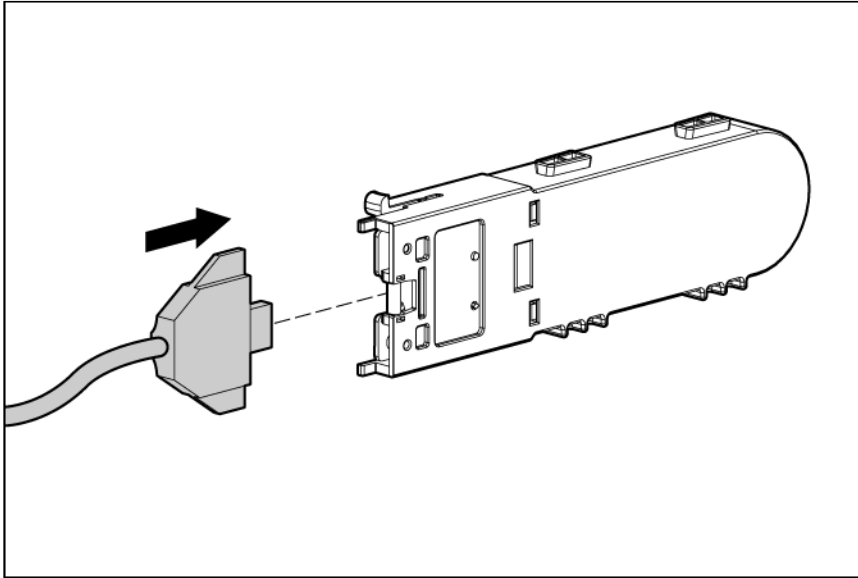
Installing an E500 or P400 cache battery

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 55) instead of this installation procedure.

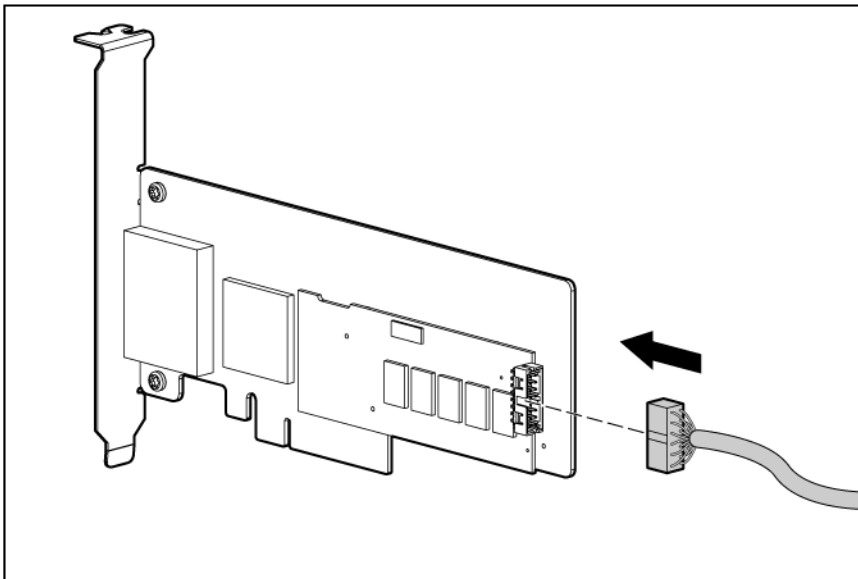
⚠ WARNING: There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "[Battery replacement notice](#)" (on page 93) before installing or removing any item that contains a battery pack.

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

2. Connect 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 more information, see the server-specific user guide.)
4. Connect 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 93) 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 29):
 - 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 illuminated, 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.
-

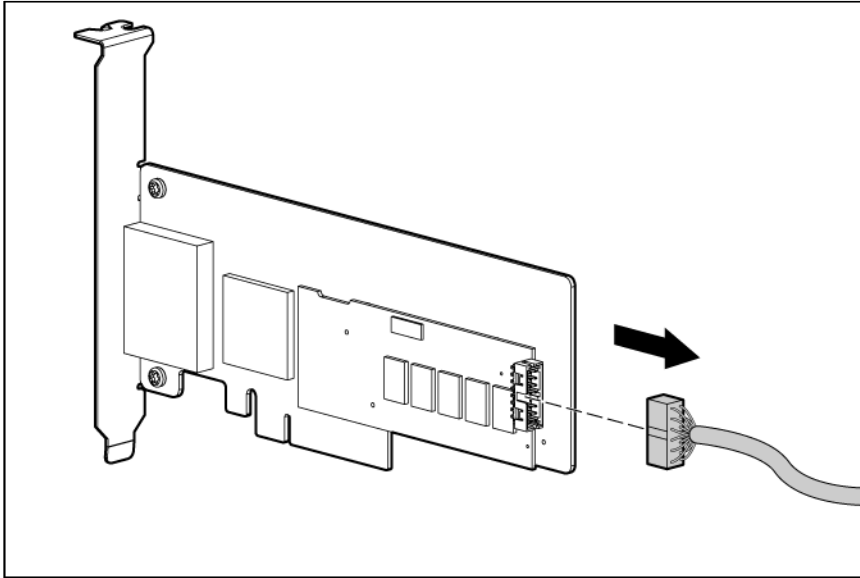
NOTE: After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is temporarily disabled. This is normal, because the new battery pack is likely to have a low charge. You do not need to take any action, because the recharge process begins 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

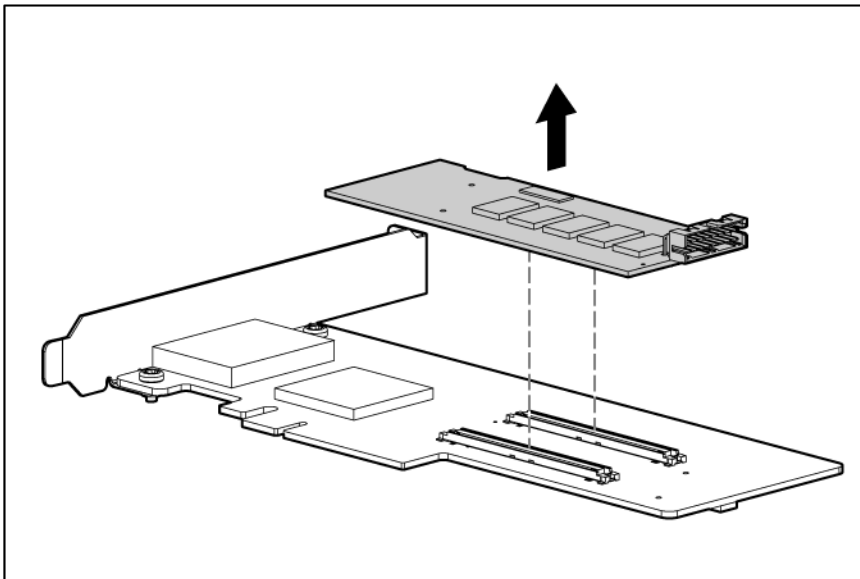
⚠ CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, 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 29).
 - 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 illuminated, 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 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. Install the server in the enclosure.

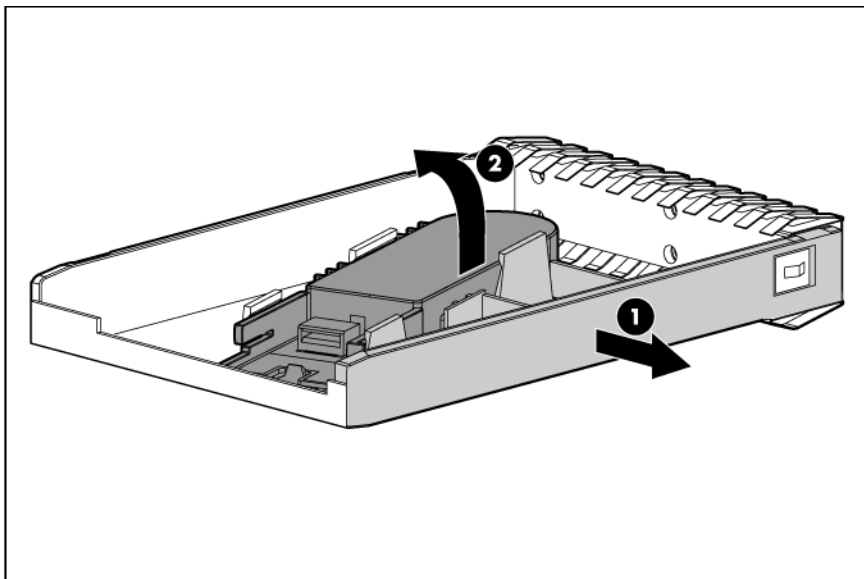
After installing a battery pack, you might see a POST message during reboot indicating that the array accelerator (cache) is disabled temporarily. This behavior is normal because the new battery pack is likely to have a low charge.

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.

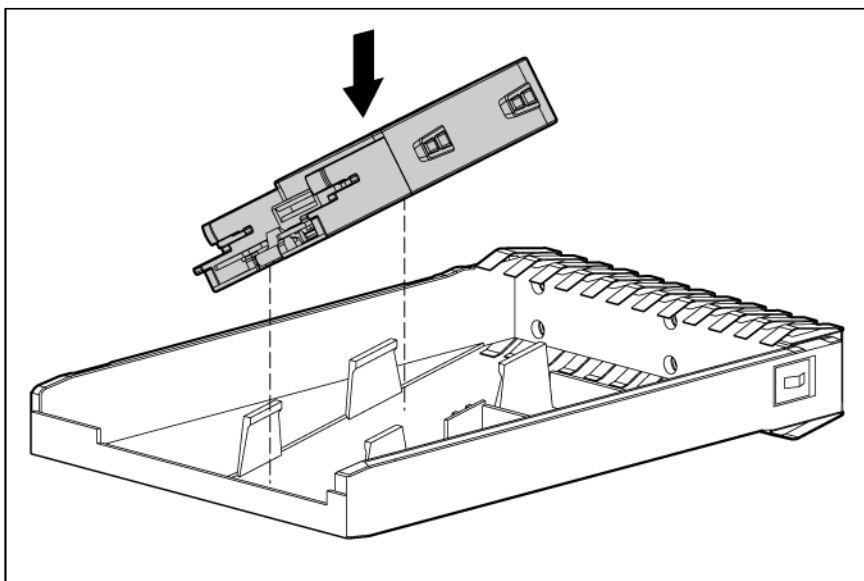
To replace a battery case located in a drive slot:

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.

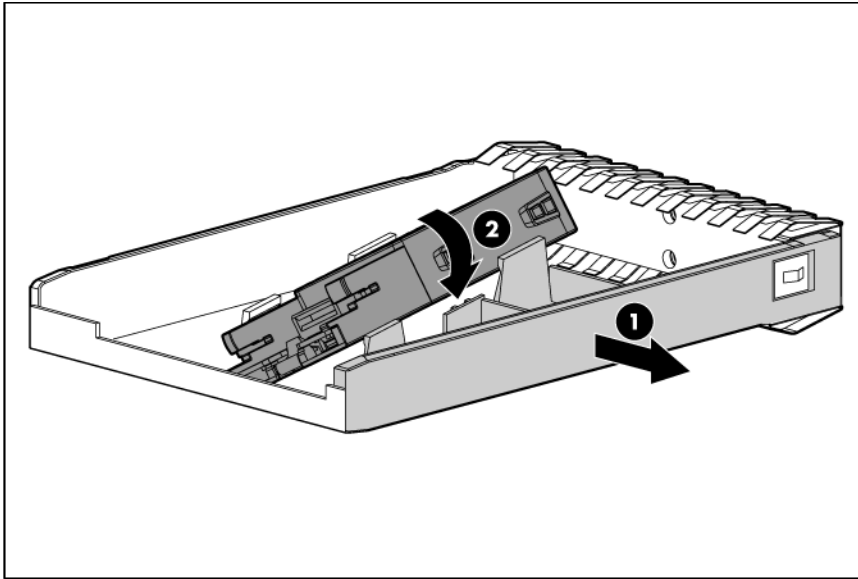
9. Pull the right hand portion of the battery case away from the battery pack, and simultaneously rotate the battery pack out of the opening.



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.

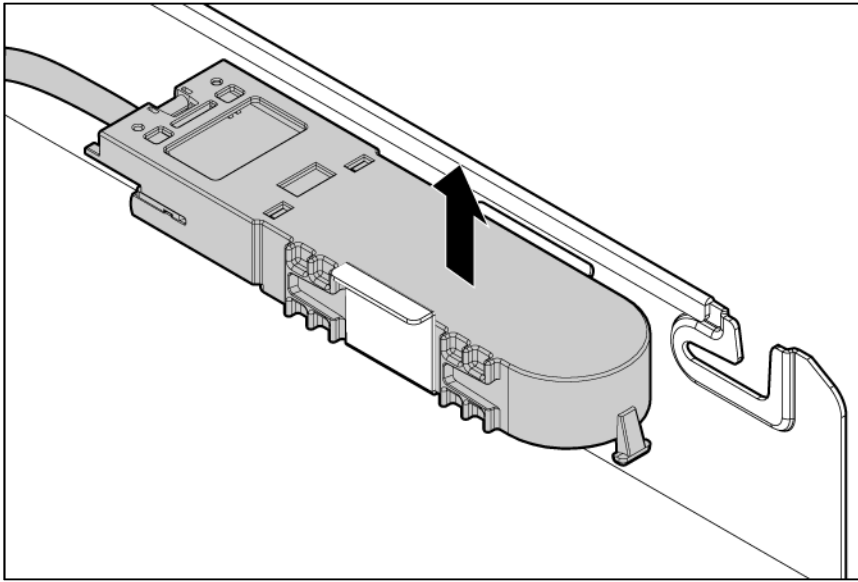
Removing a P711m capacitor pack

1. Close all applications, and then power down the server blade. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 27):
 - 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 blade.

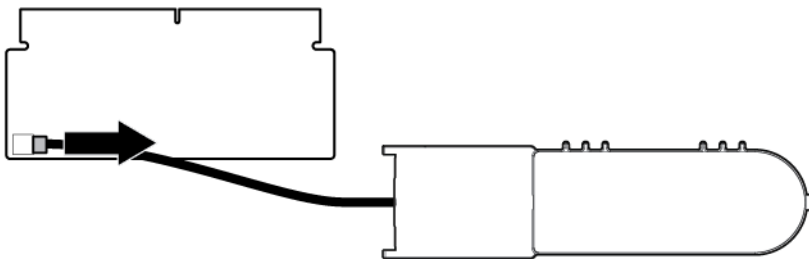


CAUTION: When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

4. Remove the capacitor pack:
 - a. Lift the capacitor pack away from the bracket.



- b. Disconnect the capacitor pack cable from the cache module.



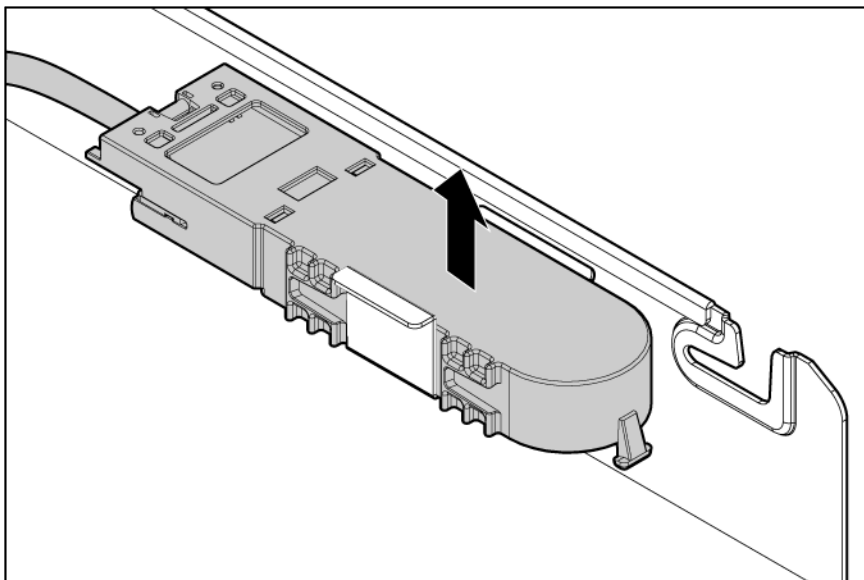
Replacing a P711m cache module

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.

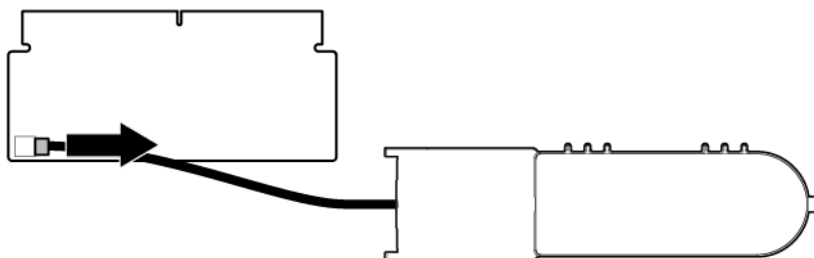
1. Close all applications, and then power down the server blade. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 27):
 - o If the green LED is off and the amber LED is on, the controller is transferring data from DDR memory to flash memory. Wait for data transfer to complete (about 60 seconds), and then proceed with the next step.
 - o 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 blade.

⚠ 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.

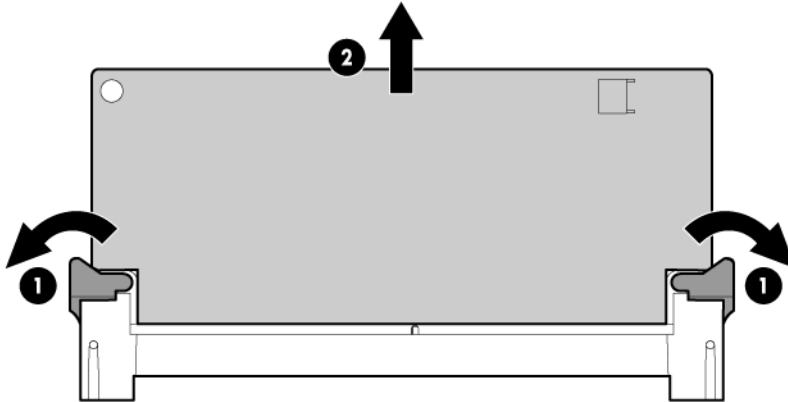
4. Remove the capacitor pack:
 - a. Lift the capacitor pack away from the bracket.



Disconnect the capacitor pack cable from the cache module.

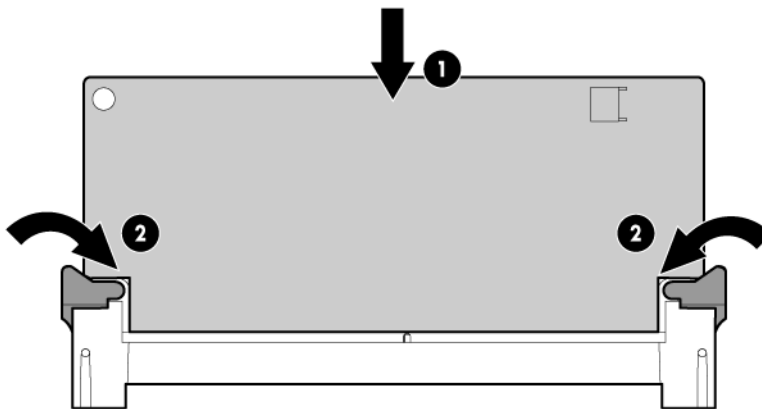


5. Remove the original cache module.

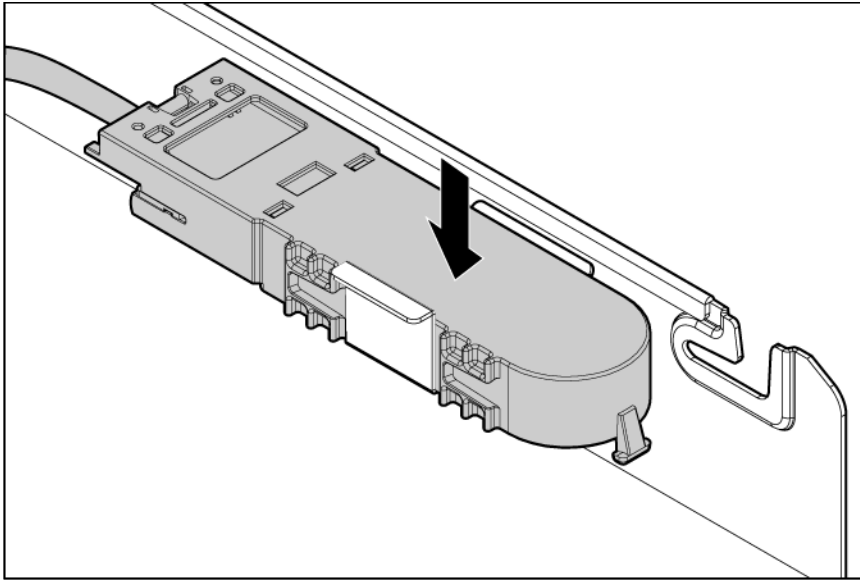


⚠ CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, because you can lose data.

6. Install the replacement or upgrade cache module.

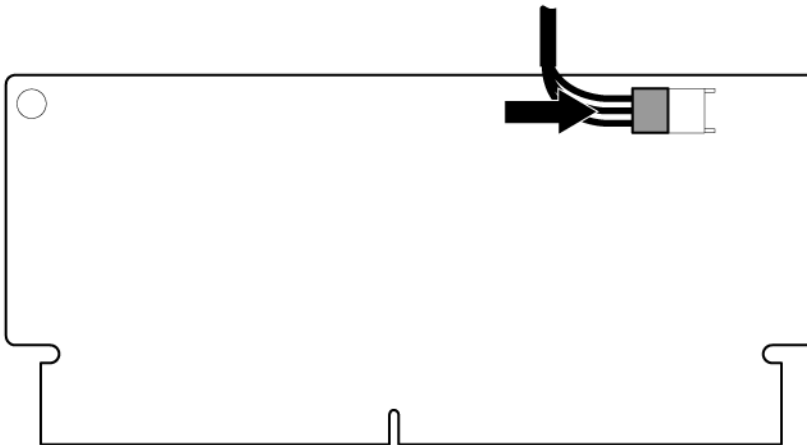


7. Install the capacitor pack onto the bracket, leaving sufficient room to connect the capacitor pack cable.



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.

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



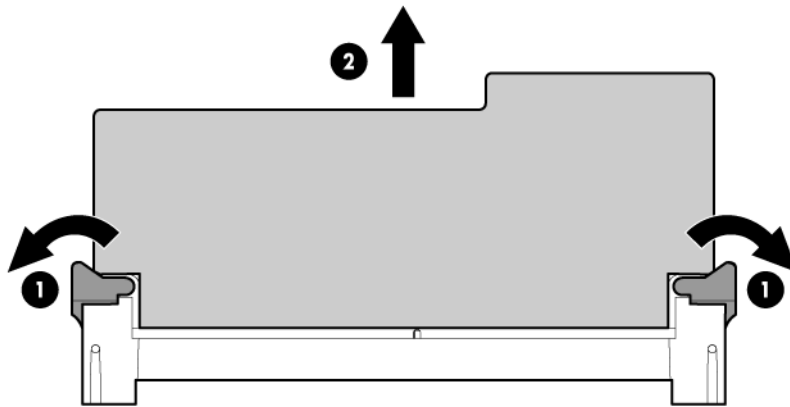
9. Install the controller in the server blade.

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 P712m cache module

CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the 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 an unsupported controller model, because you can lose data.

1. Close all applications, and then power down the server blade.
2. Remove or open the access panel.
3. 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.



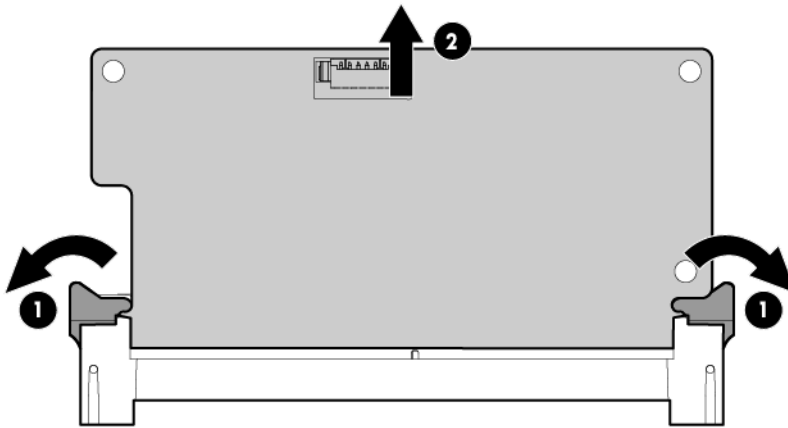
4. Install the new cache module in the DIMM slot.
5. Close the ejector latches on the DIMM slot.
6. Install the controller.

Replacing the FBWC module on the P721m

CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the 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 an unsupported controller model, because you can lose data.

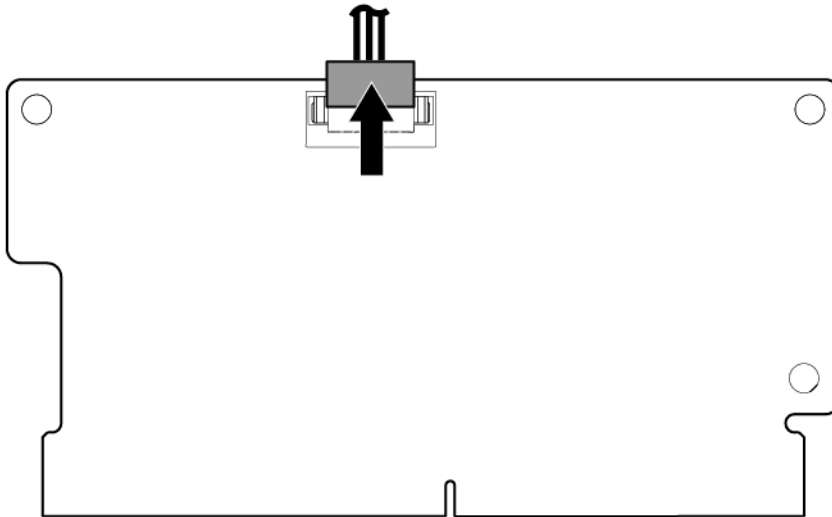
1. Update the controller firmware. See "Updating firmware (on page 46)."
2. Close all applications, and then power down the server blade.
3. Remove or open the access panel.
4. If the existing cache module is connected to a capacitor pack, observe the FBWC module LEDs (on page 27):
 - o If a backup is in progress, wait for the backup to complete.
 - o If the backup is complete, or if the cache has failed, remove the controller from the server, and then continue with the next step.
5. If access to the cache module is restricted, remove the controller.

6. 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.

7. 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.



8. If the previous cache module was connected to a capacitor pack, **carefully** connect the capacitor pack cable to the new cache module.
9. Install the new cache module in the DIMM slot.
10. Close the ejector latches on the DIMM slot.
11. If you removed the controller for access purposes, install the controller.

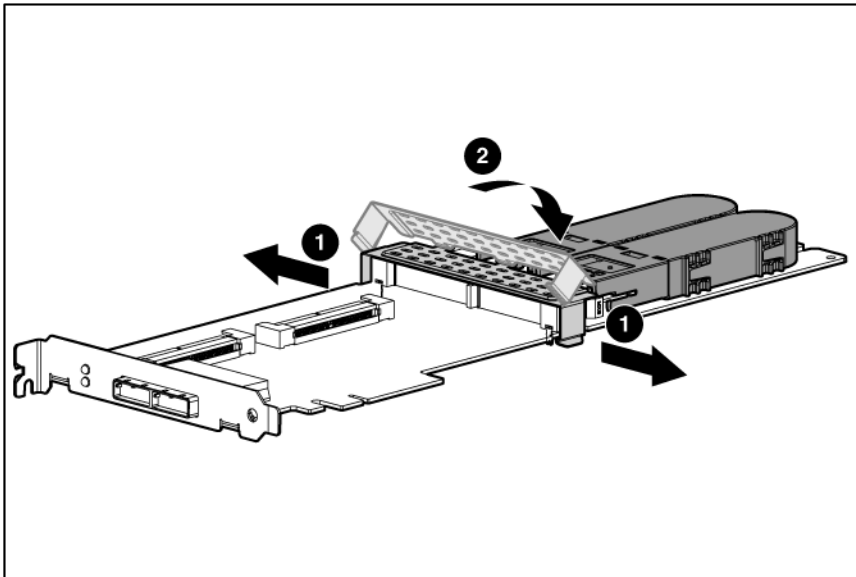
Replacing a P800 cache battery

⚠ 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 29).
 - 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 illuminated, proceed with the next step.
-

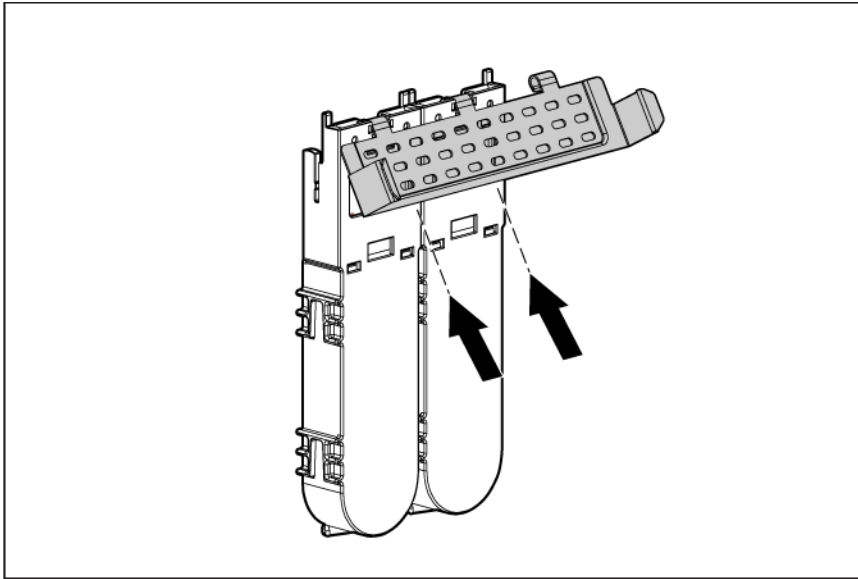
⚠ WARNING: There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice" (on page 93) before installing or removing any item that contains a battery pack.

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).



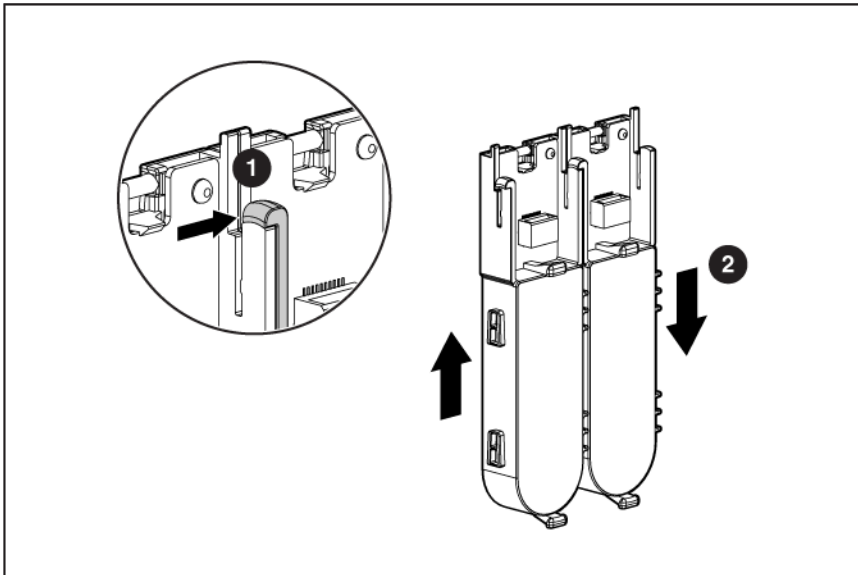
5. Slide the batteries toward the right edge of the controller, away from the bracket.

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.



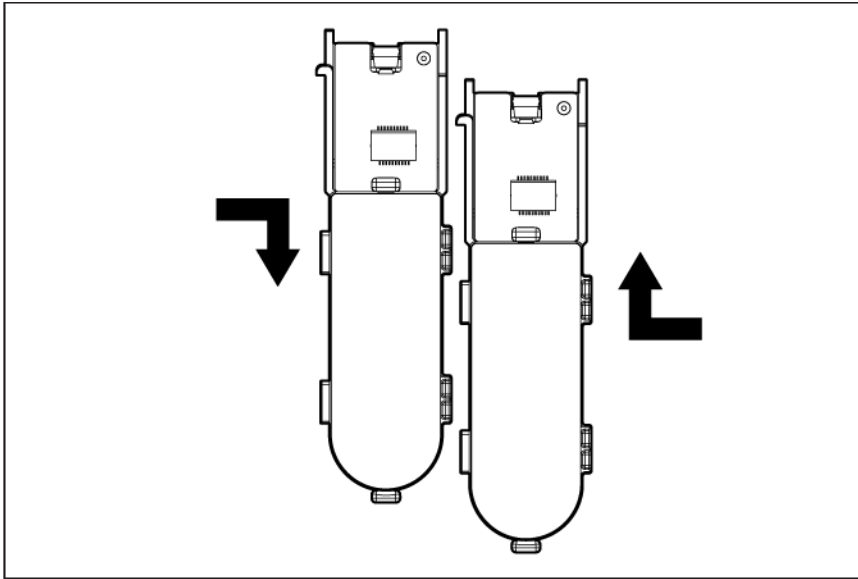
The rest of the procedure depends on whether you are replacing a battery or adding one.

- o If you are replacing a battery, continue with the next step.
 - o 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).

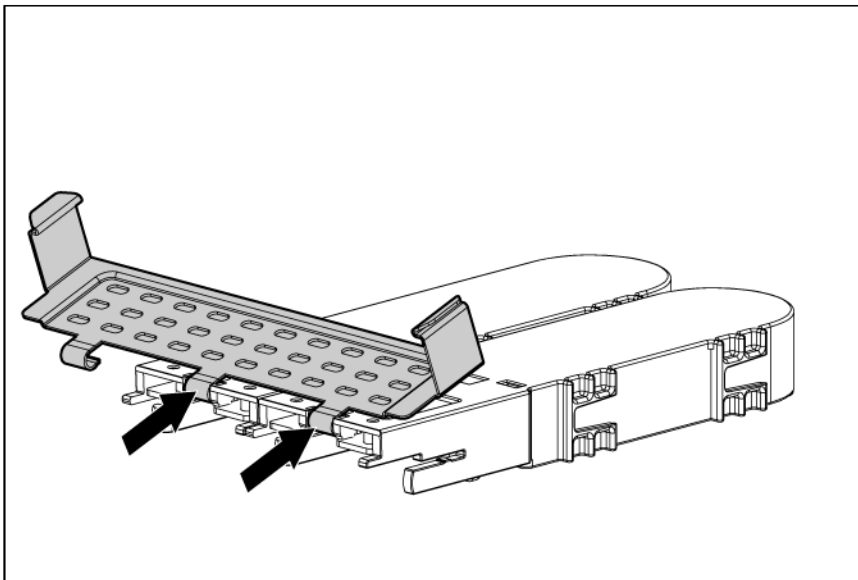


8. Dispose of the exhausted or faulty battery using environmentally approved procedures ("Battery replacement notice" (on page 93)).

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.

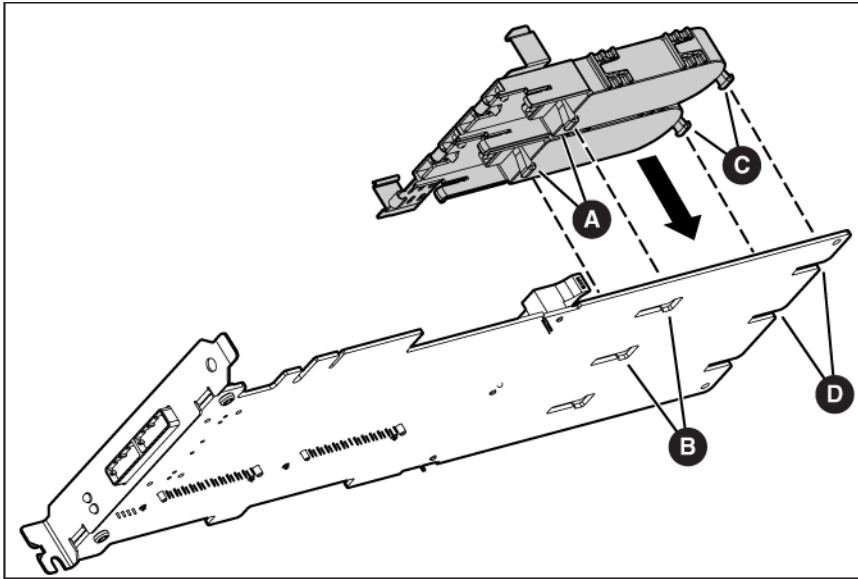


10. Install the battery clip.
- Position the clip so that the hinges on the clip are next to the appropriate hinge pillars on the batteries.
 - Hold the clip at about 30 degrees to the batteries.
 - Push the clip at the hinges until the clip clicks into place.

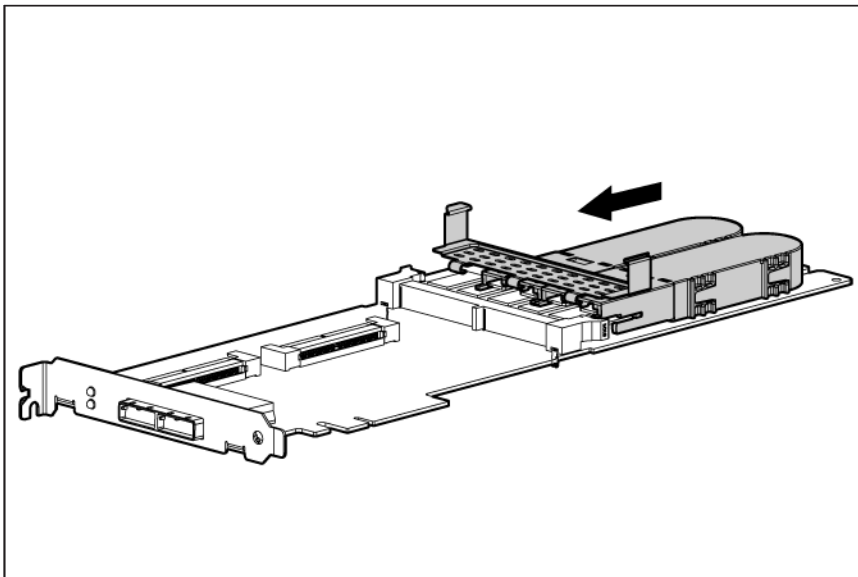


11. Reinstall the batteries.
- Hold the controller board near the DIMM socket and at the top and right edges to minimize bending of the board.

- 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.

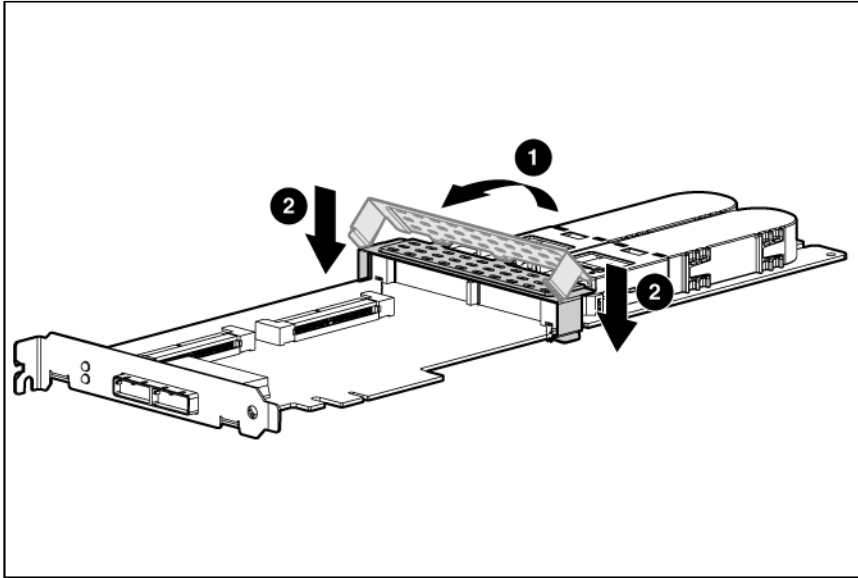


- c. Slide the batteries toward the board bracket until they are firmly seated against the connectors on the cache module.



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

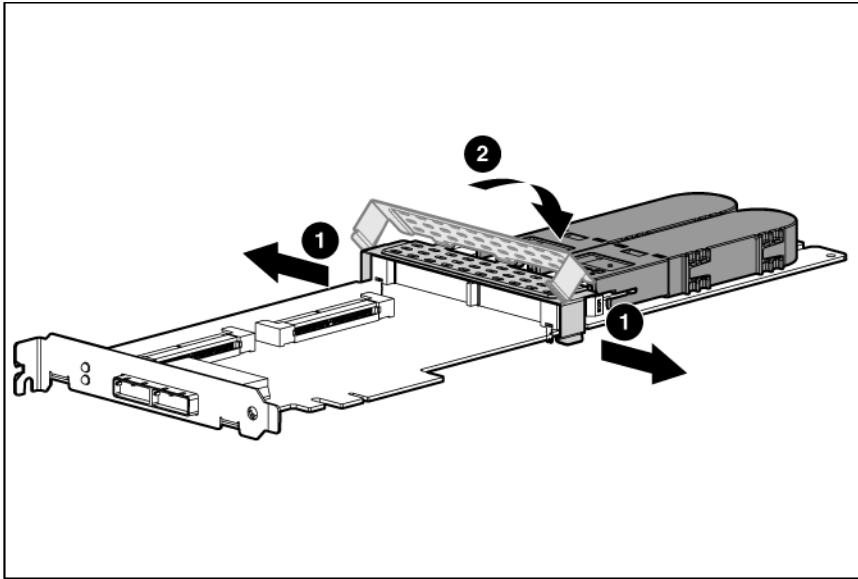
CAUTION: Electrostatic discharge can damage electronic components. Be sure you are properly grounded before beginning this procedure.

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 29).
 - o 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.
 - o If the LED is not illuminated, proceed with the next step.

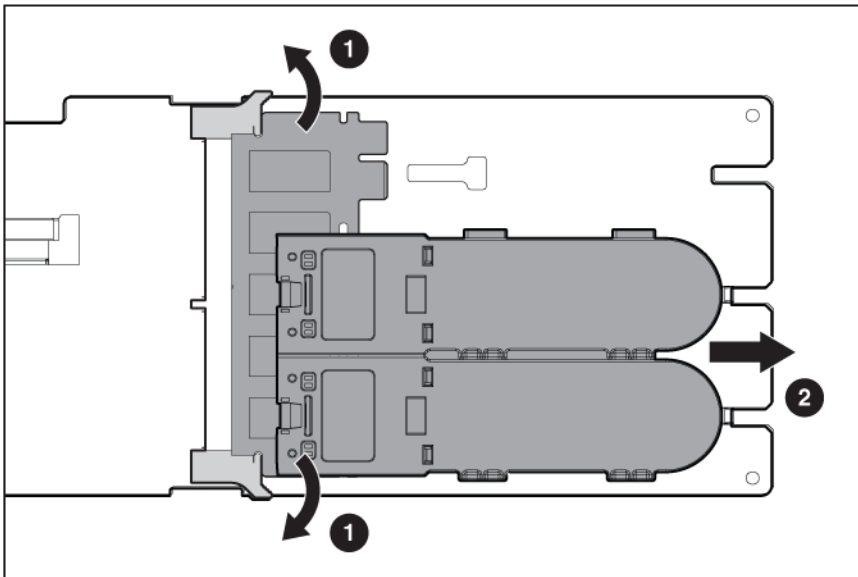
WARNING: There is a risk of explosion, fire, or personal injury if the battery pack is not properly handled. Refer to "Battery replacement notice" (on page 93) before installing or removing any item that contains a battery pack.

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).



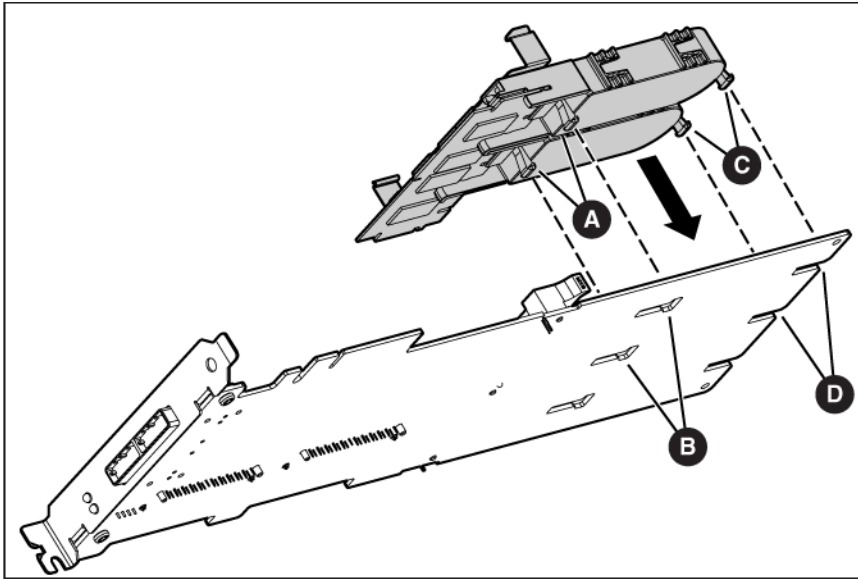
5. Swivel the latches on the DIMM connector outward (1).
6. Slide the battery assembly and the cache module off the controller board (2).



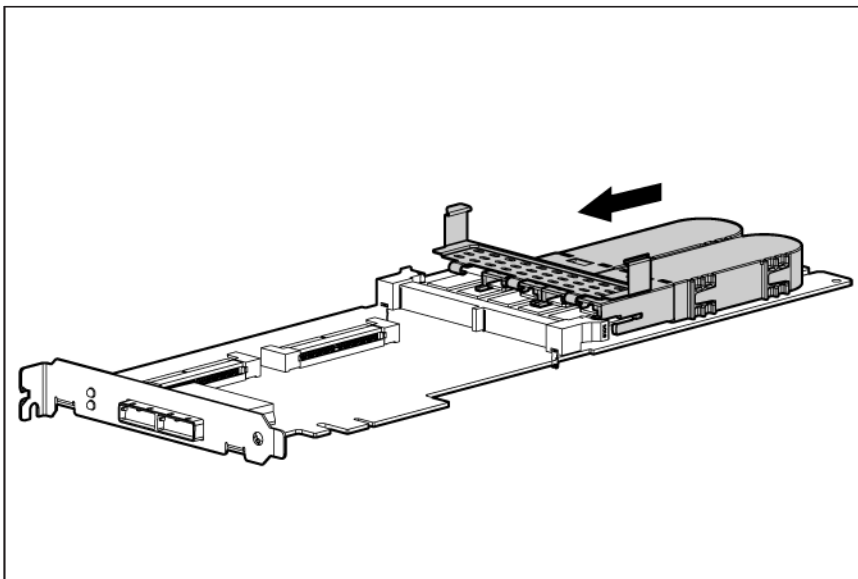
The procedure at this point depends on whether you are replacing the controller or the cache module.

- If you are replacing the controller, go directly to the next step.
 - If you are replacing the cache module, remove it from 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.)



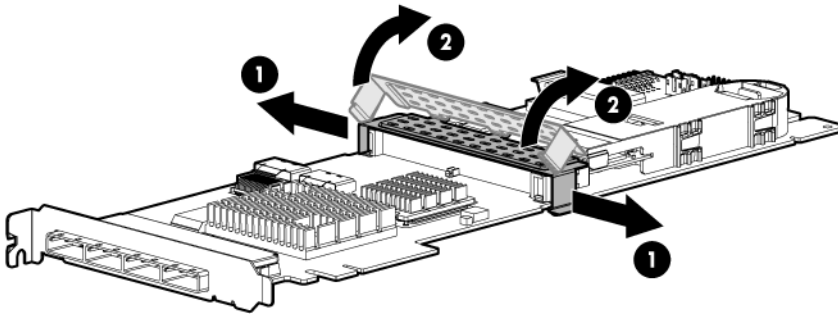
8. Secure the battery clip to the controller board.
- a. Swivel the clip over the cache module (1).

-

- # Replacing a P812 cache module

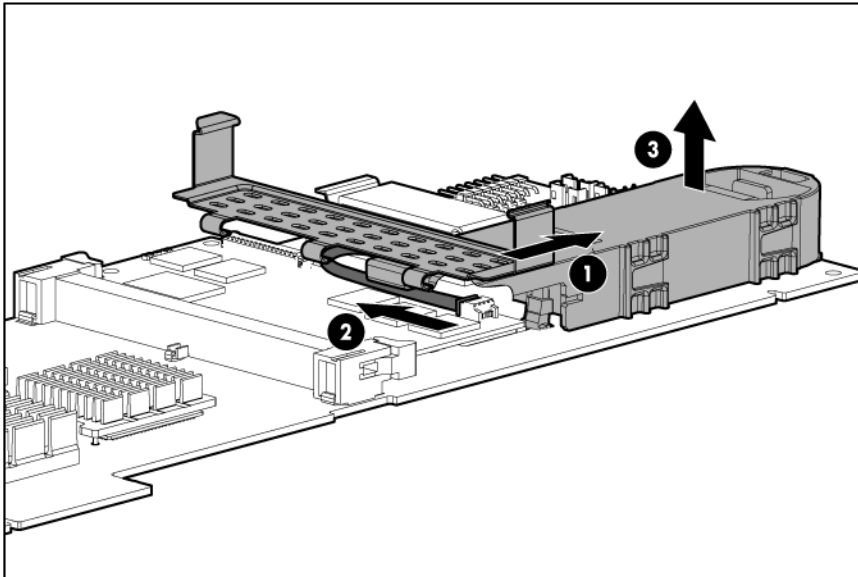
1. Close all applications, and then power down the server. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 27):
 - o If the green LED is off and the amber LED is on, the controller is transferring data from DDR memory to flash memory. Wait for data transfer to complete (about 60 seconds), and then proceed with the next step.
 - o 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.

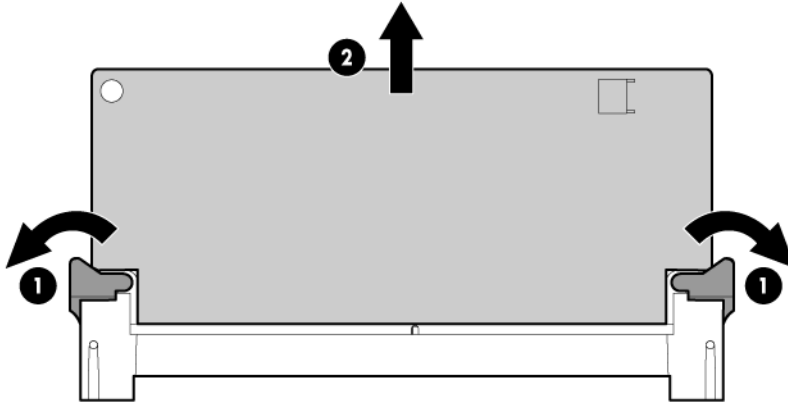


CAUTION: When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

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.

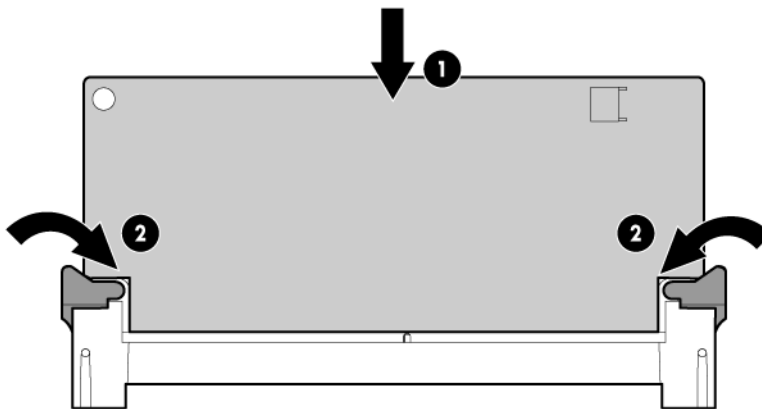


6. Remove the original cache module.



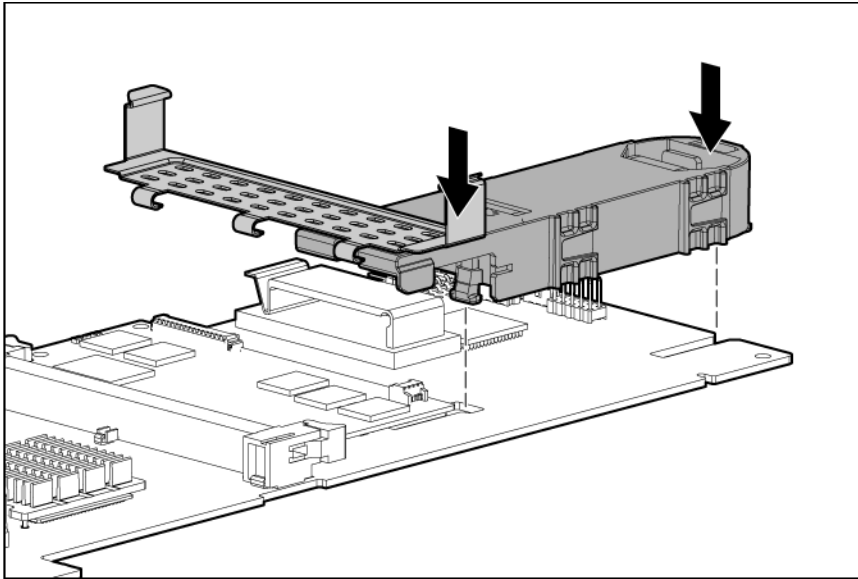
⚠ CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the controller with cache modules designed for other controller models, because the controller can malfunction and you can lose data. Also, do not transfer this cache module to an unsupported controller model, because you can lose data.

7. Install the replacement or upgrade cache module.



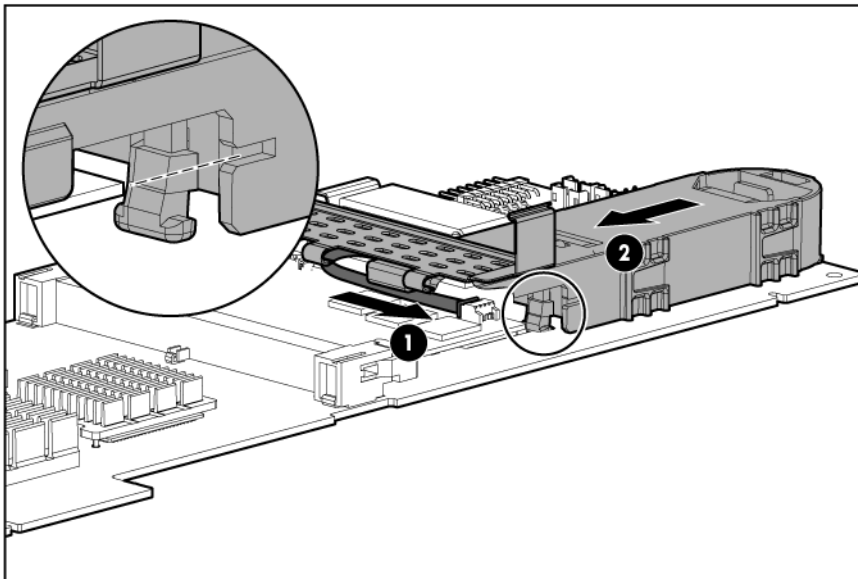
8. Align the posts on the bottom of the capacitor pack with the hole and groove on the controller.

9. Lower the capacitor pack onto the controller, leaving sufficient room to connect the capacitor pack cable.



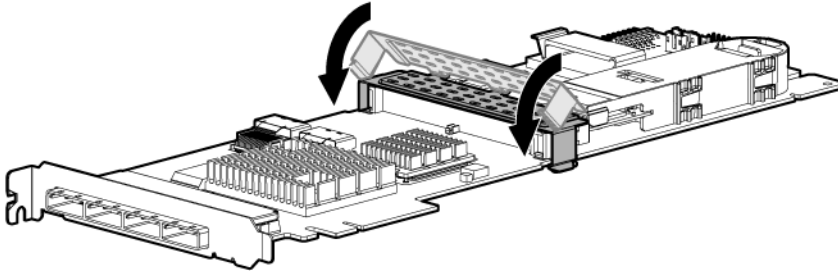
CAUTION: When connecting or disconnecting the capacitor pack cable, the connectors on the cache module and cable are susceptible to damage. Avoid excessive force and use caution to avoid damage to these connectors.

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.

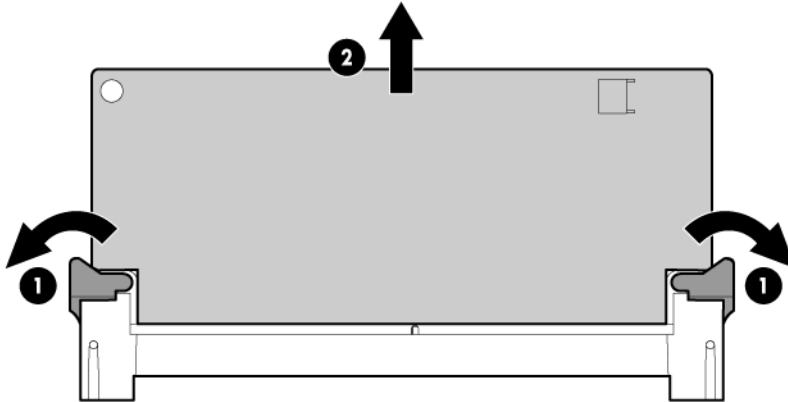
After installing a capacitor pack, you might see a POST message during reboot indicating that the array accelerator (cache module) is disabled temporarily. This behavior is normal because the new capacitor pack is likely to have a low charge. You do not need to take any action, because the recharge process 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 a P822 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.

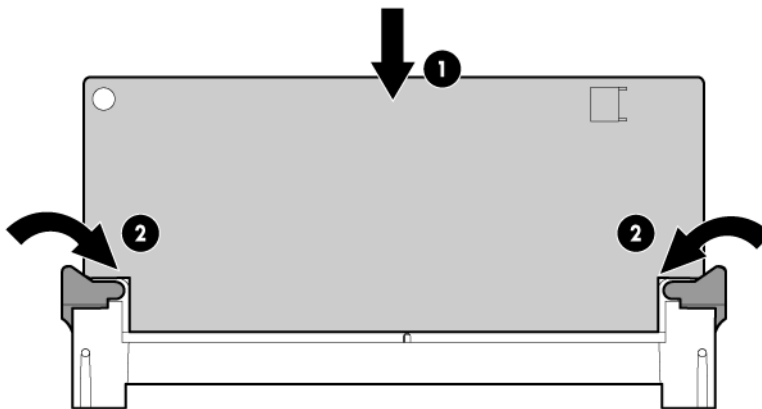
1. Close all applications, and then power down the server. This method flushes all data from the cache module.
2. Observe the FBWC module LEDs (on page 27):
 - o If the green LED is off and the amber LED is on, the controller is transferring data from DDR memory to flash memory. Wait for data transfer to complete (about 60 seconds), and then proceed with the next step.
 - o 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. Remove the original cache module.



△ CAUTION: The cache module connector does not use the industry-standard DDR3 mini-DIMM pinout. Do not use the 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 an unsupported controller model, because you can lose data.

5. Install the replacement or upgrade cache module.



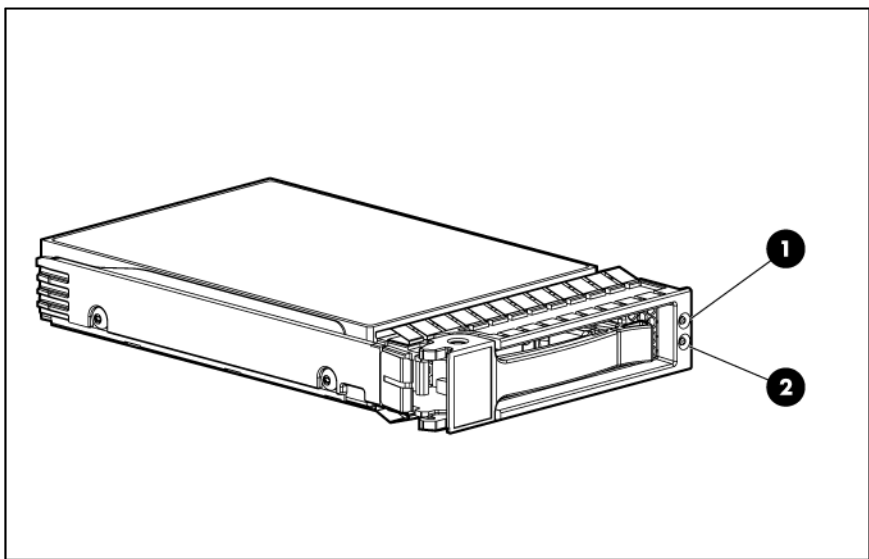
6. Install the controller in the server.

Drive procedures

Identifying the status of a legacy drive

Legacy drives are supported on ProLiant G7, and earlier, servers and server blades. Identify a legacy drive by its carrier, shown in the following illustration.

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)

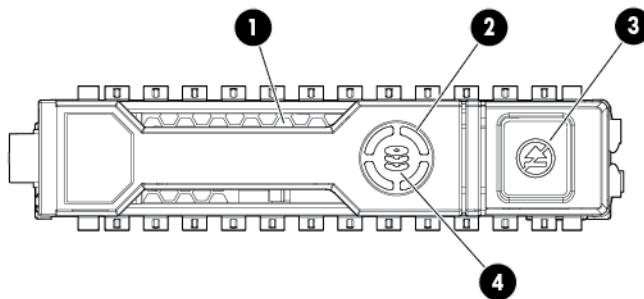
Online/activity LED (green)	Fault/UID LED (amber/blue)	Interpretation
On, off, or flashing	Alternating amber and blue	The drive has failed, or a predictive failure alert has been received for this drive; it also has been selected by a management application.
On, off, or flashing	Steadily blue	The drive 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.

Online/activity LED (green)	Fault/UID LED (amber/blue)	Interpretation
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.
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.

Identifying the status of an HPE SmartDrive

HPE SmartDrives are the latest Hewlett Packard Enterprise drive technology, and they are supported beginning with ProLiant Gen8 servers and server blades. The HPE SmartDrive is not supported on earlier generation servers and server blades. Identify an HPE SmartDrive by its carrier, shown in the following illustration.

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	LED	Status	Definition
1	Locate	Solid blue	The drive is being identified by a host application.
		Flashing blue	The drive carrier firmware is being updated or requires an update.
2	Activity ring	Rotating green	Drive activity
		Off	No drive activity

Item	LED	Status	Definition
3	Do not remove	Solid white	Do not remove the drive. Removing the drive causes one or more of the logical drives to fail.
		Off	Removing the drive does not cause a logical drive to fail.
4	Drive status	Solid green	The drive is a member of one or more logical drives.
		Flashing green	The drive is rebuilding or performing a RAID migration, stripe size migration, capacity expansion, or logical drive extension, or is erasing.
		Flashing amber/green	The drive is a member of one or more logical drives and predicts the drive will fail.
		Flashing amber	The drive is not configured and predicts the drive will fail.
		Solid amber	The drive has failed.
		Off	The drive is not configured by a RAID controller.

The blue Locate LED is behind the release lever and is visible when illuminated.

Recognizing drive failure

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

- The fault LED illuminates.
- When failed drives are located inside the server or storage system and the drive LEDs are not visible, the amber LED on the front of the server or 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.
- HPE Systems Insight Manager can detect failed drives remotely across a network. For more information about HPE Systems Insight Manager, see the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>).
- The HPE System Management Homepage (SMH) indicates that a drive has failed.
- The Event Notification Service posts an event to the server IML and the Microsoft® Windows® system event log.
- ADU lists all failed drives.

For additional information about diagnosing drive problems, see the *HPE 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 if 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.
- RAID 1 (ADM) and RAID 10 (ADM) configurations can tolerate multiple drive failures if no more than two drives, mirrored to one another, fail.

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 83)."

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.

Recreate the partitions.

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 87).

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 Hewlett Packard Enterprise website (<http://www.hpe.com/info/sim>).
- 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. If 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 83).

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
- The stripe size of the logical volume



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 LED behavior changes:

- For legacy drives, the Online/Activity LED changes from flashing steadily (1 Hz) to one of the following states:
 - On—The drive is inactive.
 - Flashing irregularly—The drive is active.

If the Online/Activity LED on the replacement drive does not illuminate while the corresponding LEDs on other drives in the array are active, the rebuild process has terminated abnormally. The amber Fault LED of one or more drives might also be illuminated.

- For HPE SmartDrives, the Drive status LED changes from flashing green to solid green.

If the Drive Status LED on the replacement drive changes to flashing or solid amber, the rebuild process has terminated abnormally.

If an abnormal termination of a rebuild occurs, identify the cause and appropriate corrective steps in "Abnormal termination of a rebuild (on page 86)."

Abnormal termination of a rebuild

If the activity LED on the replacement drive permanently ceases to be illuminated even while other drives in the array are active, the rebuild process has terminated abnormally. 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 LED.	One of the drives in the array has experienced an uncorrectable read error.
The replacement drive has an illuminated amber LED.	The replacement drive has failed.
One of the other drives in the array has an illuminated amber LED.	The drive with the illuminated amber 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, LED behavior changes:

- For legacy drives, the Online/Activity LED changes from flashing steadily (1 Hz) to one of the following states:
 - On—The drive is inactive.
 - Flashing irregularly—The drive is active.
 - For HPE SmartDrives, the Drive status LED changes from flashing green to solid green.
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 HPE Smart Array Controllers Reference Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/CASAC_RG_en).

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:
 - o If a 1785 POST message appears, the drive array did not configure properly. Continue with step 6.
 - o 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.

Return the drives to their original locations.

Restore the data from backup, if necessary.

7. Verify the new drive configuration by running ORCA or ACU ("[Configuration tools](#)" on page 44).

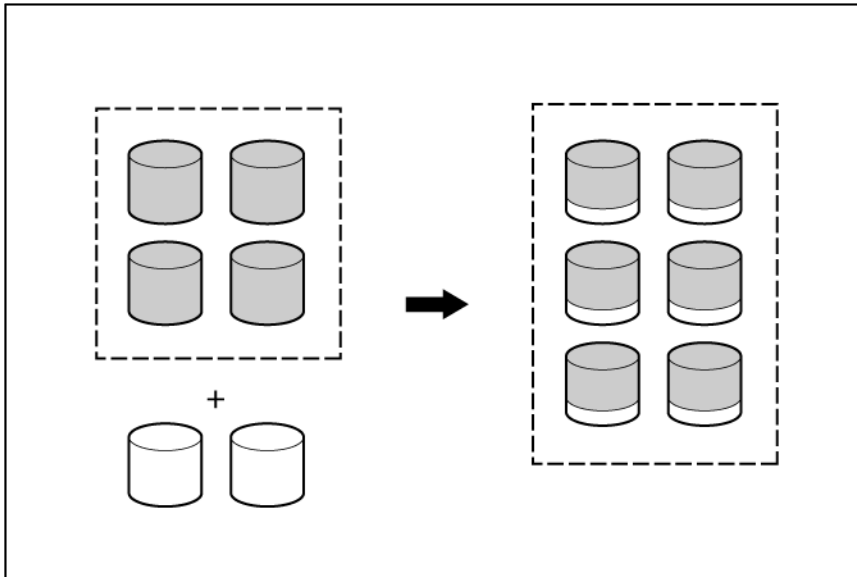
Adding drives

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 87)." 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 HPE Smart Array Controllers Reference Guide* on the Hewlett Packard Enterprise website (http://www.hpe.com/support/CASAC_RG_en).

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.

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.

Support and other resources

Accessing Hewlett Packard Enterprise support

- For live assistance, go to the Contact Hewlett Packard Enterprise Worldwide website:
<http://www.hpe.com/assistance>
- To access documentation and support services, go to the Hewlett Packard Enterprise Support Center website:
<http://www.hpe.com/support/hpesc>

Information to collect:

- Technical support registration number (if applicable)
- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages
- Product-specific reports and logs
- Add-on products or components
- Third-party products or components

Accessing updates

Some software products provide a mechanism for accessing software updates through the product interface. Review your product documentation to identify the recommended software update method.

To download product updates:

- Hewlett Packard Enterprise Support Center
www.hpe.com/support/hpesc
- Hewlett Packard Enterprise Support Center: Software downloads
www.hpe.com/support/downloads
- Software Depot
www.hpe.com/support/softwaredepot
- To subscribe to eNewsletters and alerts:
www.hpe.com/support/e-updates
- To view and update your entitlements, and to link your contracts and warranties with your profile, go to the Hewlett Packard Enterprise Support Center More Information on Access to Support Materials page:
www.hpe.com/support/AccessToSupportMaterials



IMPORTANT: Access to some updates might require product entitlement when accessed through the Hewlett Packard Enterprise Support Center. You must have an HPE Passport set up with relevant entitlements.

Customer self repair

Hewlett Packard Enterprise customer self repair (CSR) programs allow you to repair your product. If a CSR part needs to be replaced, it will be shipped directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your Hewlett Packard Enterprise authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider or go to the CSR website:

<http://www.hpe.com/support/selfrepair>

Remote support

Remote support is available with supported devices as part of your warranty or contractual support agreement. It provides intelligent event diagnosis, and automatic, secure submission of hardware event notifications to Hewlett Packard Enterprise, which will initiate a fast and accurate resolution based on your product's service level. Hewlett Packard Enterprise strongly recommends that you register your device for remote support.

If your product includes additional remote support details, use search to locate that information.

Remote support and Proactive Care information

HPE Get Connected

www.hpe.com/services/getconnected

HPE Proactive Care services

www.hpe.com/services/proactivecare

HPE Proactive Care service: Supported products list

www.hpe.com/services/proactivecaresupportedproducts

HPE Proactive Care advanced service: Supported products list

www.hpe.com/services/proactivecareadvancedsupportedproducts

Proactive Care customer information

Proactive Care central

www.hpe.com/services/proactivecarecentral

Proactive Care service activation

www.hpe.com/services/proactivecarecentralgetstarted

Warranty information

To view the warranty for your product or to view the Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products reference document, go to the Enterprise Safety and Compliance website:

www.hpe.com/support/Safety-Compliance-EnterpriseProducts

Additional warranty information

HPE ProLiant and x86 Servers and Options
www.hpe.com/support/ProLiantServers-Warranties

HPE Enterprise Servers
www.hpe.com/support/EnterpriseServers-Warranties

HPE Storage Products
www.hpe.com/support/Storage-Warranties

HPE Networking Products
www.hpe.com/support/Networking-Warranties

Regulatory information

To view the regulatory information for your product, view the Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products, available at the Hewlett Packard Enterprise Support Center:

www.hpe.com/support/Safety-Compliance-EnterpriseProducts

Additional Regulatory Information

Hewlett Packard Enterprise is committed to providing our customers with information about the chemical substances in our products as needed to comply with legal requirements such as REACH (Regulation EC No 1907/2006 of the European Parliament and the Council). A chemical information report for this product can be found at:

www.hpe.com/info/reach

For Hewlett Packard Enterprise product environmental and safety information and compliance data, including RoHS and REACH, see:

www.hpe.com/info/ecodata

For Hewlett Packard Enterprise environmental information, including company programs, product recycling, and energy efficiency, see:

www.hpe.com/info/environment

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 Hewlett Packard Enterprise 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 Hewlett Packard Enterprise, an authorized Hewlett Packard Enterprise Partner, or their agents.

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

Acronyms and abbreviations

ACU

Array Configuration Utility

ADM

Advanced Data Mirroring

ADU

Array Diagnostics Utility

BBWC

battery-backed write cache

CPQONLIN

NetWare Online Array Configuration Utility

FBWC

flash-backed write cache

IML

Integrated Management Log

ORCA

Option ROM Configuration for Arrays

POST

Power-On Self Test

RBSU

ROM-Based Setup Utility

SAAP

Smart Array Advanced Pack

SMH

System Management Homepage

SPP

HPE Service Pack for ProLiant

Documentation feedback

Hewlett Packard Enterprise is committed to providing documentation that meets your needs. To help us improve the documentation, send any errors, suggestions, or comments to Documentation Feedback (<mailto:docsfeedback@hpe.com>). Include the document title and part number, version number, or the URL when submitting your feedback.

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