



CVPM02, CVPM05 Power Modules | CVFM04 Cache Module

**User Guide
Version 1.1**

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Introduction

This guide documents the following Broadcom® MegaRAID® cache backup products used with MegaRAID SAS high-performance SAS+SATA RAID controllers to protect cached data:

- CacheVault™ flash module (CVFM)
 - CVFM04
- CacheVault power modules (CVPMs)
 - CVPM02
 - CVPM05

The memory modules protect the integrity of cached data on MegaRAID controllers by offloading the cached data to nonvolatile flash memory if a complete AC power failure, or a brief power outage, occurs. These products provide an alternative to using an uninterruptible power supply (UPS), or a second level of fault tolerance when used with a UPS.

This guide describes the backup products, including installation instructions and technical specifications.

Cache Backup Benefits

The cache memory available on MegaRAID controllers improves overall system performance because writing data to the controller's cache memory is much faster than writing it to a storage device. Write operations appear to complete quickly at the software application level. The MegaRAID controller writes the cached data to the storage device when system activity is low or when the cache gets full.

The risk of using write-back cache is that the cached data can be lost if the AC power fails before the data is written to the storage device. To eliminate this risk, the MegaRAID controller supports an energy backup solution to ensure no data is lost during power or system failure. The cached data is offloaded to flash, which is restored when power resumes.

CacheVault Modules

CacheVault technology consists of two primary items. The CVPM is an ultracapacitor-based energy source that powers the critical adapter components in the event of a power loss, long enough to offload cached data to the nonvolatile flash memory on the CVFM. The DRAM contents are restored to the CVFM the next time the MegaRAID controller is powered, and the cached data is written to the storage devices. The CVPM is also sometimes referred to as a supercapacitor or flash backup unit (FBU).

CacheVault flash technology virtually eliminates the hardware maintenance associated with batteries, offers lower total cost of ownership over the life of the controller, and provides more environmentally friendly cache protection, all while maintaining optimal RAID performance.

The following table describes the cache protection options for each MegaRAID adapter.

Table 1: MegaRAID CacheVault Flash Modules Matrix

MegaRAID Adapter	Adapter Controller	CacheVault Kit	CacheVault Memory Module	Module Information	CacheVault Power Module
9560-16i 9560-8i 9580-8i8e	SAS3916 or SAS3908	—	NAND flash is local on adapter.	Separate flash module not required. The CVPM or supercapacitor provides the CacheVault technology.	CVPM05 (FBU345)

MegaRAID Adapter	Adapter Controller	CacheVault Kit	CacheVault Memory Module	Module Information	CacheVault Power Module
9460-16i 9460-8i 9480-8i8e 9365-28i	SAS3516 or SAS3508	—	NAND flash is local on adapter.		CVPM05 (FBU345)
9361-24i 9361-16i 9380-8i8e	SAS3324 or SAS3316	—	NAND flash is local on adapter.		CVPM02 (FBU02)
9361-8i 9361-4i 9380-8e 9380-4i4e	SAS3108	CVM02	CVFM04	Cache protection components are sold as a kit, including the flash module daughter card and the supercapacitor.	CVPM02

The modules are described in the following list:

CVPM02 module

A supercapacitor pack installed on a remote mount board or locally mounted in the system, and connects remotely by cable to a CVFM or a MegaRAID controller.

CVPM05 module

A supercapacitor pack installed on a remote mount board or locally mounted in the system, and connects remotely by cable to a MegaRAID controller.

CVFM04 module

An ONFI flash module that attaches to a MegaRAID controller and connects by cable to a CVPM02 module installed on a remote mount board.

ATTENTION

You cannot hot plug a CVPM. Removing or inserting a CVPM with the server powered on damages the board and the supercapacitor functionality. To attach a CVPM to, or remove a CVPM from, a controller, you must fully power down the controller before you attach the module to, or remove the module from, its mating connector.

Installing the Cache Backup Products

This chapter explains how to connect the CacheVault module to back up power units.



CAUTION

Electrostatic discharge (ESD) can damage the modules and the MegaRAID controllers. Always ground yourself, and use a ground strap before you touch the MegaRAID controller or the module. Perform all installation work at an ESD-safe workstation that meets the requirements of EIA-625, *Requirements for Handling Electrostatic Discharge Sensitive Devices*. Follow the ESD-recommended practices in the latest revision of the Inter-Process Communication (IPC) IPC-A-610, Acceptability of Electronic Assemblies, standard.

If screws are required, use an ESD-safe Phillips screwdriver to install them. Be sure the screwdriver is centered in the screw to avoid damaging the screw head. If you exceed the maximum torque specification, you might damage the board, connectors, or screws, and you void the board warranty.

NOTE

To protect your data, set the MegaRAID controller Write Policy to *write-through* until the battery unit is charged. After the battery unit charges, you can change the Write Policy to *write-back* to take advantage of data caching performance improvements.

See [Handle and Dispose of CacheVault Power Modules](#) for information about how to handle and dispose of a CVPM properly.

See [CacheVault Module Specifications](#) for technical specifications.

If you choose to connect the clip directly to the chassis, see [Mount without the Remote Mount Board](#). If you choose to make a custom clip, see [Using a Custom Mounting Bracket](#) for design details.

Attaching the CVFM04 Module to the MegaRAID Controller and by Cable to a CVPM02 Module on a Remote Mount Board

This section describes how to attach the CVFM04 module directly to your MegaRAID controller, and then connect the CVFM04 module by cable to a CVPM02 module on a BBU-BRACKET-05 remote mount board (sold separately). The CVFM04 module attaches directly to the MegaRAID controller, and the CVPM02 module fits on a clip that attaches to the remote mount board. The MegaRAID controller and the remote mount board are then installed in PCIe slots on the motherboard. The CVPM02 module can mount locally in the system as long as sufficient airflow maintains a proper operating temperature range. See [CacheVault Module Specifications](#) for airflow requirements.

The CVFM04 module and the CVPM02 module are used on the following MegaRAID controllers:

- MegaRAID SAS 9361-4i
- MegaRAID SAS 9361-8i
- MegaRAID SAS 9380-4i4e
- MegaRAID SAS 9380-8e

Perform the following tasks to attach the CVFM04 module directly to your MegaRAID controller, and then by cable to the CVPM02 module on a remote mount board.

1. Remove the MegaRAID controller from the host system. See [Removing the MegaRAID Controller from the Host Computer](#).
2. Attach the CVFM04 module directly to the MegaRAID controller. See [Attach the CVFM04 Module Directly to the MegaRAID Controller](#).
3. Install the clip on the remote mount board. See [Installing the Clip on the Remote Mount Board](#).
4. Attach the CVPM02 module to the clip. See [Attach the CVPM to the Clip on the Remote Mount Board](#).

5. Connect the CVFM04 module to the remote CVPM02 module. See [Connect the CVFM04 Module to the Remote CVPM02 Module](#).
6. Install the MegaRAID controller and the remote mounting board in the host computer. See [Install the MegaRAID Controller and Remote Mount Board in the Motherboard](#).

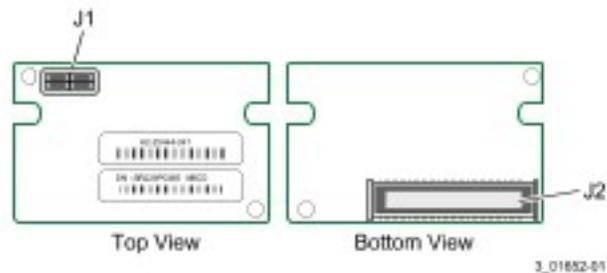
Front View and Back View of the CVFM04 Module

The following figure shows the front view and the back view of the CVFM04 module. The front view is the side that you can see when the unit is installed on a MegaRAID controller.

NOTE

Record your unit serial number in a safe location in case you need to contact Broadcom support.

Figure 1: Front View and Back View of the CVFM04 Module



- J1 – 9-pin Connector to the Remote CVPM02 Module
- J2 – 70-pin Board-to-Board Connector

Removing the MegaRAID Controller from the Host Computer

If the MegaRAID controller is already installed in a host computer, follow these steps to remove it before you install the unit:

1. Shut down the host computer, turn off the power, and unplug the power cords.
2. Remove the cover from the host computer according to the instructions in the system user's manual so you can access the MegaRAID controller.
3. Ground yourself before you touch the MegaRAID controller.
4. Unplug all cables from the MegaRAID controller, remove the screw that attaches the bracket to the server chassis, and carefully remove the MegaRAID controller from the PCIe slot.
5. Place the MegaRAID controller front-side up on a flat, clean, static-free surface, and continue with the next procedure.

Attaching the CVFM04 Module Directly to the MegaRAID Controller

Follow these steps to attach the CVFM04 module to the front of the MegaRAID controller.

1. Ground yourself, and make sure that the system is grounded.
2. Remove the CVFM04 module from the package.
3. Place the CVFM04 module front-side-up on a flat, clean, static-free surface.
4. Mount the two standoffs on the front side of the controller by screwing in two screws from the back side of the controller.

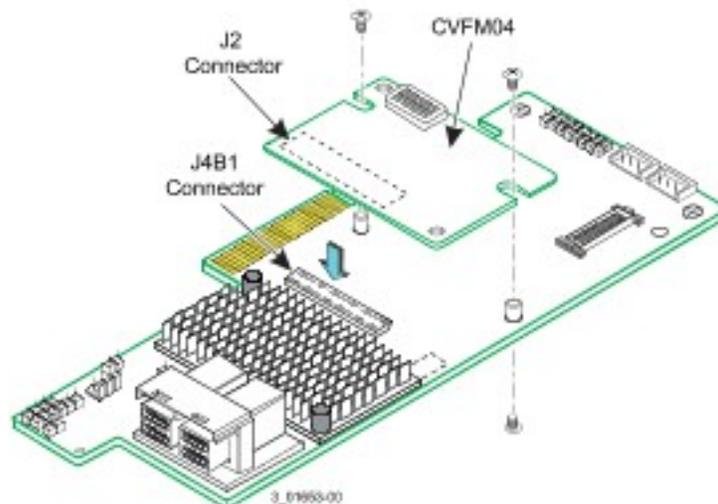
The standoffs are threaded at both ends, and the screws thread from the back side of the controller into the board-to-board standoffs.

NOTE

Center the screwdriver carefully to avoid stripping the screwhead. Do *not* overtighten the screws.

5. Hold the CVFM04 module so that the top side is facing upward, and align the J2 connector on the CVFM04 module with the connector on the MegaRAID controller, as shown in the following figure.

Figure 2: Attach the CVFM04 Module Directly to the MegaRAID SAS 9361-8i Controller



6. Carefully press the CVFM04 module onto the MegaRAID controller so that the two connectors are firmly joined.
7. Secure the CVFM04 module to the MegaRAID controller by screwing in the two screws from the top side of the controller.

The standoffs are threaded at both ends, and the screws thread from the back side of the controller into the board-to-board standoffs.

NOTE

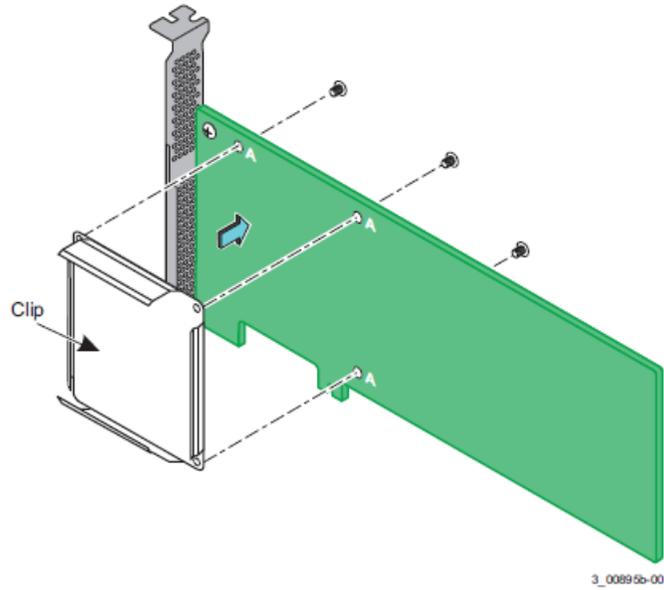
Center the screwdriver carefully to avoid stripping the screwhead. Do *not* overtighten the screws.

Installing the Clip on the Remote Mount Board

Follow these steps to install the clip directly on the BBU-BRACKET-05 remote mount board.

1. Remove the clip and the remote mount board module from the package.
2. With the remote mount board on a flat, clean, static-free surface, ground yourself, and make sure that the system is grounded.
3. Hold the clip so that the screw holes on the clip align with the screw holes on the remote mount board, as shown in the following figure.

Figure 3: Install the Clip on the Remote Mount Board



4. Secure the clip to the remote mount board in three screw holes with the screws and the nuts.
5. Thread the screws through the front of the clip and the remote mount board.

NOTE

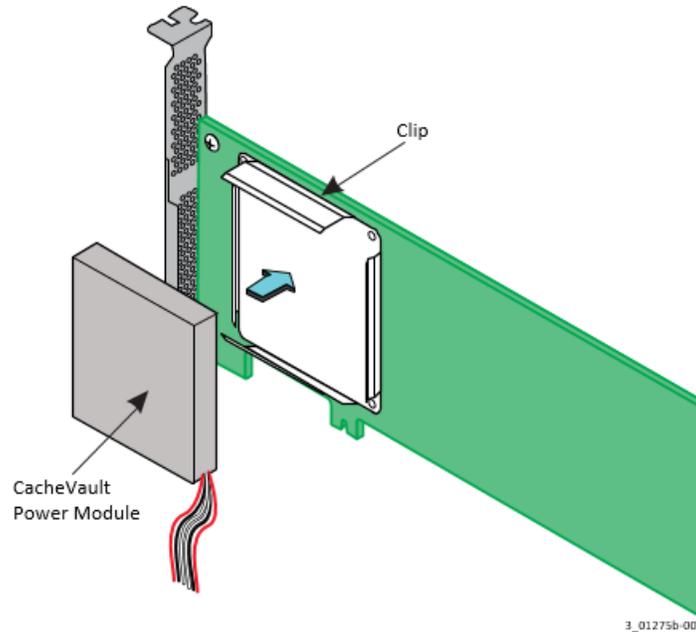
Center the screwdriver carefully to avoid stripping the screwhead. Do *not* overtighten the screws.

Attaching the CVPM to the Clip on the Remote Mount Board

Follow these steps to attach the CVPM to the clip on the remote mount board.

1. With the remote mount board on a flat, clean, static-free surface, ground yourself, and make sure that the system is grounded.
2. Remove the CVPM from the package.
3. Press the CVPM into the clip on the remote mount board until the module clicks firmly into place, as shown in the following figure.

Figure 4: Connect the CVPM to the Clip on the Remote Mount Board

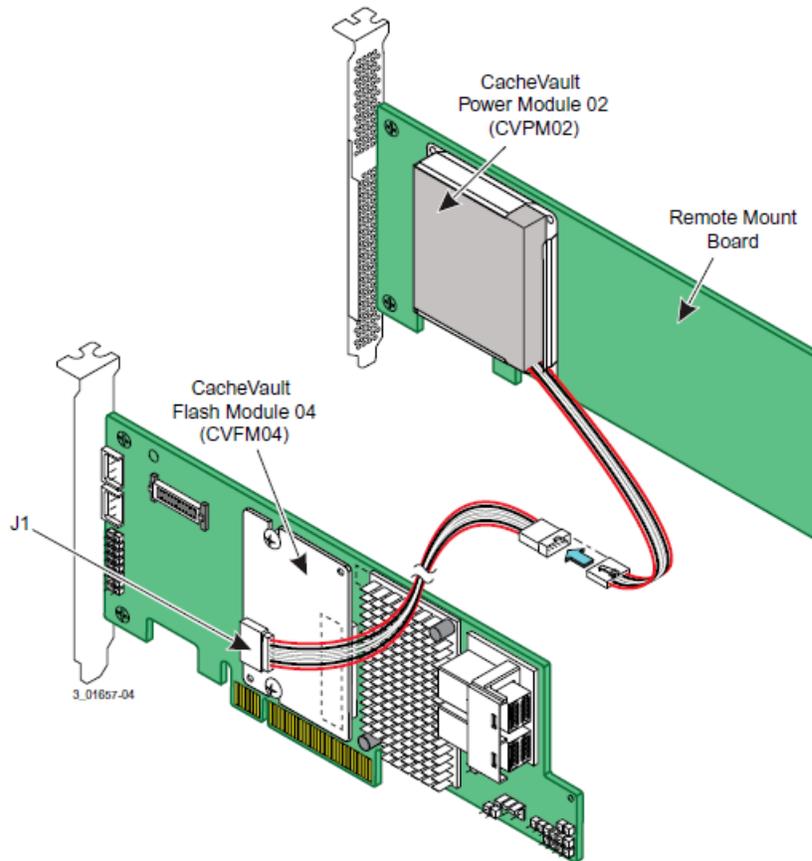


Connecting the CVFM04 Module to the Remote CVPM02 Module

Follow these steps to connect the CVFM04 module on a MegaRAID SAS 9361 controller by cable to the remote CVPM02 module. Use the same steps for other supported MegaRAID controllers.

1. Ground yourself, and make sure that the system is grounded.
2. Remove the cable included in the MegaRAID controller box.
3. Insert one 9-pin cable connector on the cable into the 9-pin J1 connector on the CVFM04 module, as shown in the following figure.

Figure 5: Connect the CVFM04 Module on a MegaRAID Controller by Cable to the Remote CVPM02 Module



4. Insert the other 9-pin cable connector into the 9-pin connector on the remote CVPM02 module. Align the cable connectors to make sure they are connected correctly.

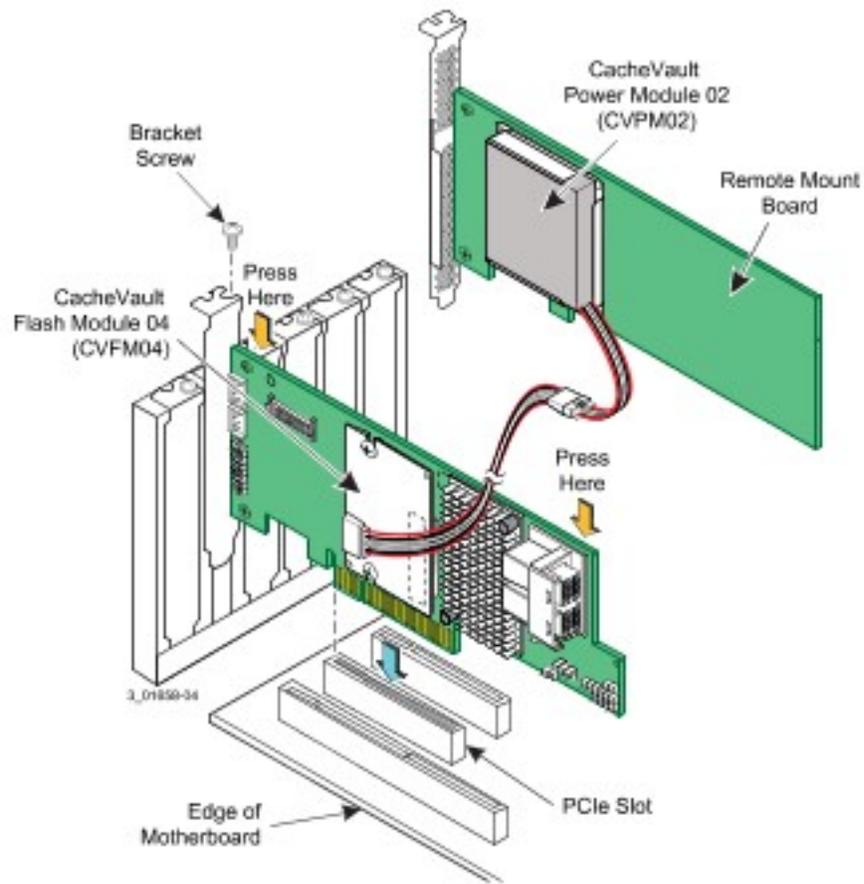
Installing the MegaRAID Controller and Remote Mount Board in the Motherboard

Follow these steps to install your MegaRAID controller and the remote mount board in the motherboard.

1. Make sure that the power to the chassis is turned off, the power cords are unplugged, and the chassis is grounded and has no AC power.
2. Install the MegaRAID controller in the computer in the PCIe slot, as shown in the following figure.

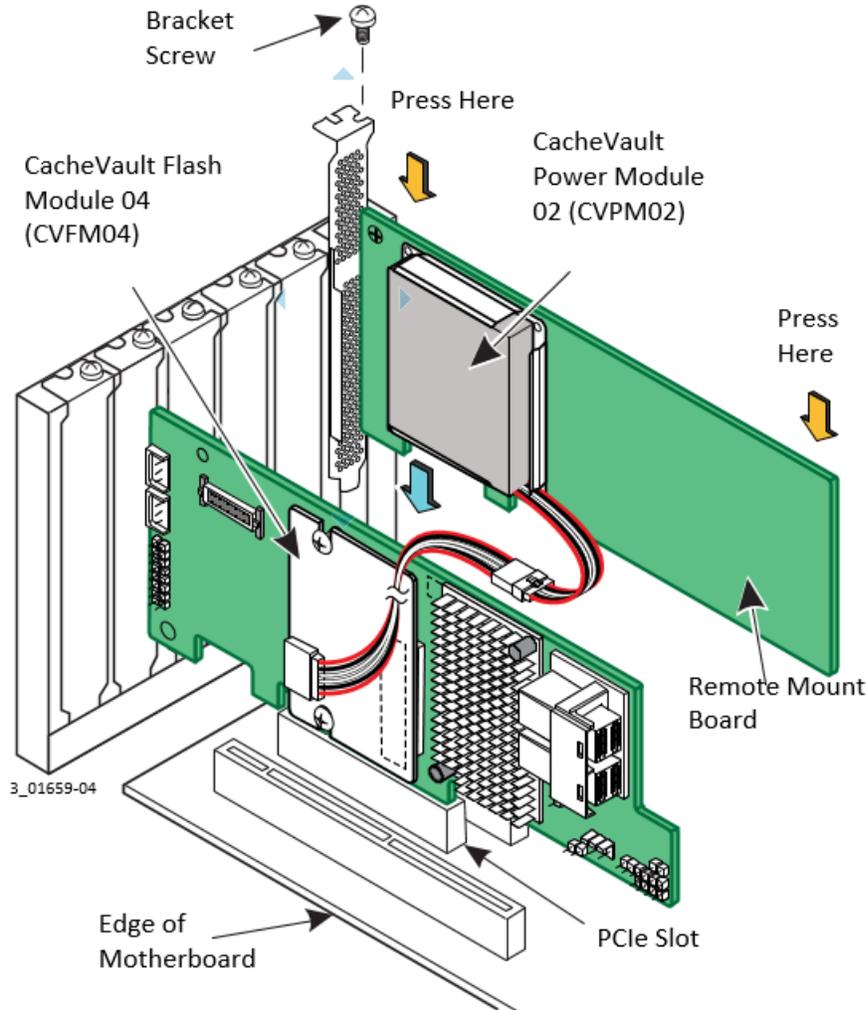
This controller is a PCIe x8 card, and it can operate in x8 or x16 slots. Some PCIe slots, however, support only PCIe graphics cards; if a controller is installed in one of these slots, the controller will not function. Refer to the guide for your motherboard for information about the PCIe slot.

Figure 6: Reinstall the MegaRAID Controller



3. Press down gently, but firmly, to seat the card correctly in the slot.
4. Secure the MegaRAID controller to the server chassis with the bracket screw.
5. Insert the remote mount board in a PCIe slot on the motherboard, as shown in the following figure.

Figure 7: Install the Remote Mount Board



6. Press down gently, but firmly, to seat the card correctly in the slot.
7. Secure the remote mount board to the server chassis with the bracket screw.
8. Replace the computer cover and reattach the power cords.
9. Turn on the power to the computer.

Refer to the *12Gb/s MegaRAID SAS Software User Guide* for information about the RAID configuration utility and the *MegaRAID SAS Device Driver Installation User Guide* for software driver installation information.

Attaching a Remote CVPM05 Module by Cable to a MegaRAID Controller

This section describes how to attach the CVPM05 module on a clip that attaches directly to the BBU-BRACKET-05 remote mount board (sold separately), and then connect the CVPM05 module by cable to your MegaRAID controller.

The MegaRAID controller and the remote mount board are then installed in PCIe slots on the motherboard. The CVPM05 module can be mounted locally in the system as long as sufficient airflow maintains proper operating temperature range. See [CacheVault Module Specifications](#) for airflow requirements.

The CVPM05 module works with the following MegaRAID controllers:

- MegaRAID 9365-28i
- MegaRAID 9460-16i
- MegaRAID 9460-8i
- MegaRAID 9480-8i8e
- MegaRAID 9560-16i
- MegaRAID 9560-8i
- MegaRAID 9580-8i8e

Perform the following tasks to attach the CVPM05 module by cable to your MegaRAID controller, and then install the MegaRAID controller and the remote mount board on the motherboard.

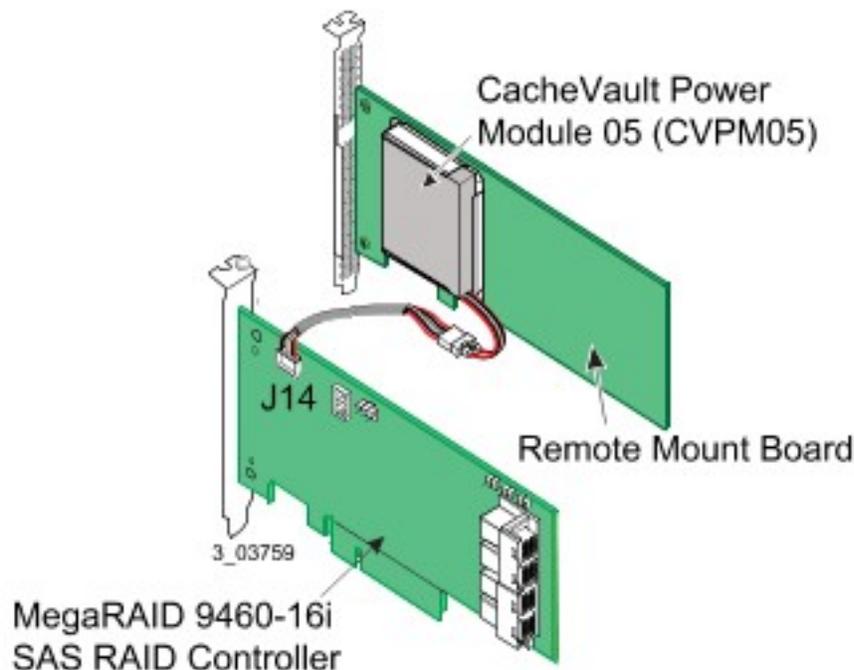
1. Remove the MegaRAID controller from the host system. See [Removing the MegaRAID Controller from the Host Computer](#).
2. Install the clip on the remote mount board. See [Installing the Clip on the Remote Mount Board](#).
3. Attach the CVPM05 module to the clip. See [Attaching the CVPM to the Clip on the Remote Mount Board](#).
4. Connect the MegaRAID controller by cable to the remote CVPM05 module. See [Connect the Remote CVPM05 Module to the MegaRAID Controller](#).
5. Install the MegaRAID controller and the remote mount board in the host computer. See [Install the MegaRAID Controller and Remote Mount Board in the Motherboard](#).

Connecting the Remote CVPM05 Module to the MegaRAID Controller

Follow these steps to connect the remote CVPM05 module by cable to the MegaRAID controller.

1. Ground yourself, and make sure that the system is grounded.
2. Remove the cable included in the MegaRAID controller box.
3. Insert one 9-pin cable connector on the cable into the 9-pin J14 connector on the MegaRAID controller, as shown in the following figure.

Figure 8: Connect the Remote CVPM05 Module by Cable to the MegaRAID 9460-16i Controller



4. Insert the other 9-pin cable connector into the 9-pin connector on the remote CVPM05 module.
Align the cable connectors to make sure they are connected correctly.

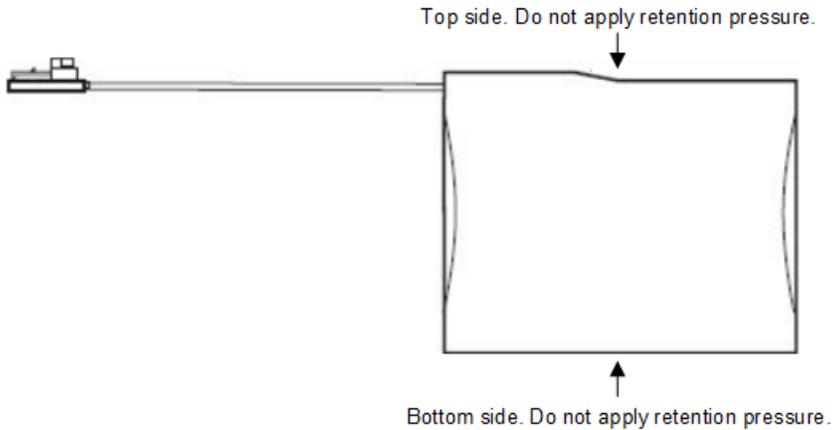
Mount without the Remote Mount Board

If you mount the Broadcom retention clip directly to the chassis, make sure that no ground path to the retention clip exists. If you must attach the retention clip to chassis ground, do not damage the supercapacitor's outer sleeve when inserting it into the clip. Damaging the supercapacitor's outer sleeve and allowing the clip to make contact with the supercapacitor's metal case can cause a failure if the retention clip is attached to chassis ground.

Using a Custom Mounting Bracket

If you design your own retention clip, the clip must not apply pressure to the top side of the supercapacitor. This pressure can damage the PCB that mounts to the top of the capacitors. Your clip design must only apply retention pressure to the sides of the supercapacitor. Do not design the clip to apply pressure to the top or bottom of the supercapacitor. The top and bottom of the supercapacitor pack keeps the supercapacitor from shifting out of the clip.

Figure 9: CVPM Top and Bottom



See [CacheVault Module Specifications](#) for the supercapacitor dimensions, or download a 2D and 3D mechanical drawing of the supercapacitor and metal clip from docSAFE (log in and select docSAFE from <https://portal.broadcom.com/group/support/docsafe>).

Monitor and Manage CacheVault Modules

This chapter explains how to monitor and manage the MegaRAID CacheVault modules used with the MegaRAID SAS controllers. You can use the following Broadcom MegaRAID utility programs to retrieve status information for CVPMs used with MegaRAID controllers:

Storage Command Line Tool (StorCLI)

The command line management software designed for the MegaRAID product line.

Human Interface Infrastructure (HII) configuration utility

A tool for configuring controllers, physical disks, and virtual disks, and for performing other configuration tasks in a pre-boot, Unified Extensible Firmware Interface (UEFI) environment.

For more information about CacheVault functions in these utilities, refer to the *MegaRAID SAS Software User Guide*, which applies to 6Gb/s MegaRAID controllers, or the *12Gb/s MegaRAID SAS Software User Guide* for 12Gb/s MegaRAID controllers.

Monitor CacheVault Module Information in StorCLI

The StorCLI utility supports the following CacheVault command, which identifies the specific controller to which a CacheVault module is connected:

```
storcli /cx/cv show all
```

The object identifier `/cx/cv` refers to the CacheVault module on controller `x`. Only one CacheVault module can connect to a controller at a time.

NOTE

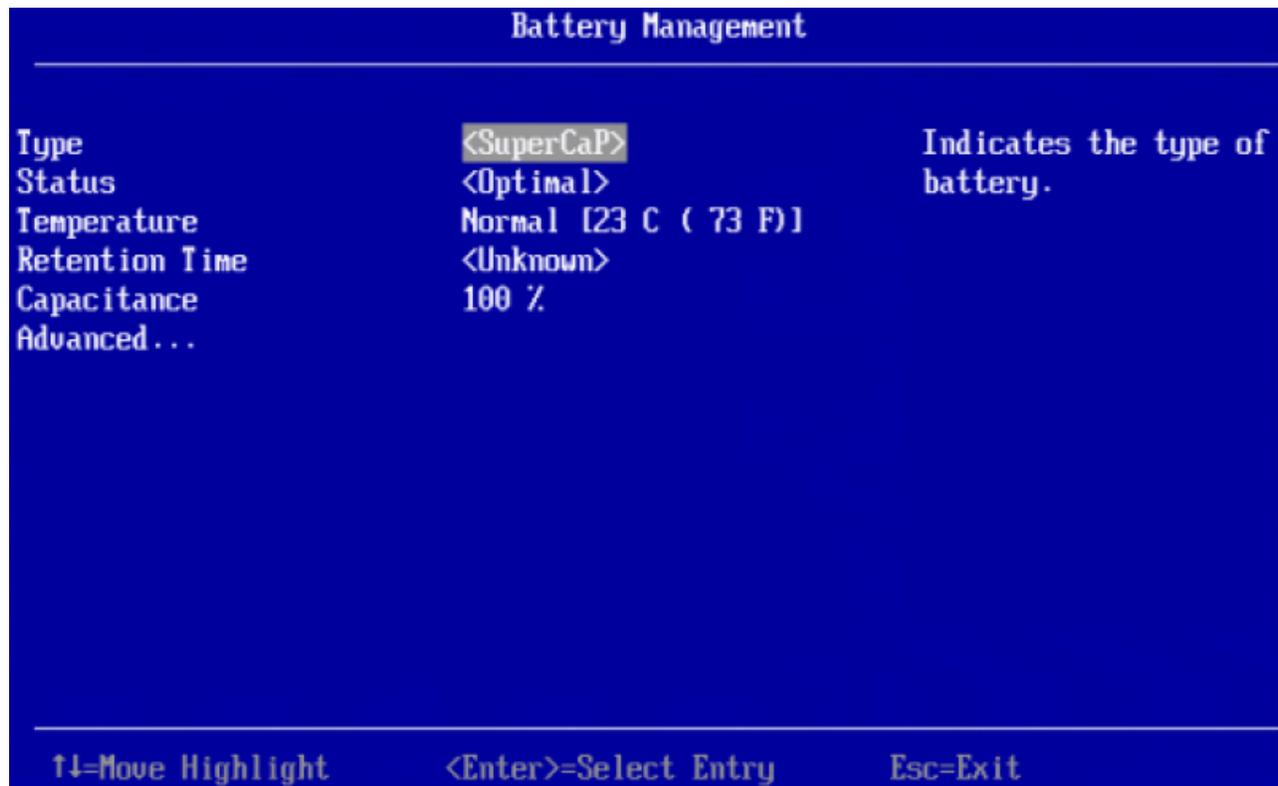
This command works only when a CacheVault module is connected to the controller; otherwise, an error message appears.

Input example: `storcli /c0/cv show all`

where, `c0` identifies controller number 0.

Monitor CacheVault Module Information with the HII Configuration Utility

You can use the HII Configuration utility to display information about the CVPM on the following **Battery Management** screen. `<SuperCaP>` in the **Type** field refers to the CVPM.

Figure 10: HII Battery Management Screen

Handle and Dispose of CacheVault Power Modules

The CVPM02 module and the CVPM05 module are power modules that contain individual supercapacitors, which are low-voltage devices, but can deliver extremely high currents especially in short-circuit situations. Handle the supercapacitors in an uncharged state.

The following statements are general safety considerations.

- Supercapacitors can vent or rupture if overcharged, reverse charged, incinerated, or heated above 150°C.
- Do not crush, mutilate, nail penetrate, or disassemble.
- High case temperature (burn hazard) can result from abuse of the supercapacitor.

In the event the packaging of an individual capacitor is compromised, either by puncturing or crushing, a very limited amount of electrolyte fluid will be released. If the product is found to be leaking (identified by a white salt crystal formation on product), remove it from the system. A leaking capacitor will eventually increase in resistance or could cause long-term corrosion of interconnects. Incidental contact with the white salt residue is not harmful, although it should not be ingested. Take normal precautions after contact, which includes washing hands.

Supercapacitors are composed of aluminum, carbon, paper, and an organic electrolyte. Supercapacitors contain no heavy metals or toxic materials hazardous to the environment. Municipalities differ in how materials are classified for disposal. A material safety data sheet (MSDS) for the electrolyte (acetonitrile) is available to aid in determining regional or local classification and disposal requirements.

CacheVault Module Specifications

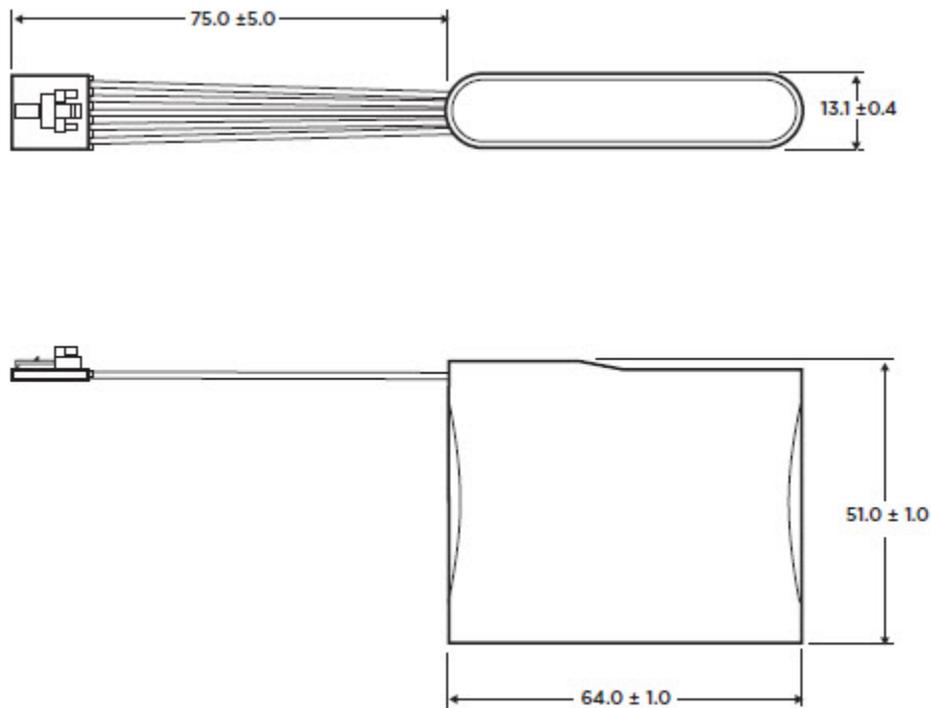
The following table lists the specifications for the CVFM and CVPMs. Design your system with an airflow that allows the CacheVault device to operate within the operating temperature range listed in the following table.

Table 2: Specifications for the CacheVault Modules

Specification	CacheVault Flash Module 04	CacheVault Power Module 02 CacheVault Power Module 05
Technology	On-board ONFI flash module	Remote supercapacitor pack
Operating temperature (ambient)	0°C to 55°C	
Storage temperature	-40°C to 70°C	
Humidity (storage and operating)	5% to 95% noncondensing	
Mechanical (form factor)	2.087 in. × 1.378 in.	See Figure 11, CVPM Dimensions .

The following figure shows the CVPM02 and CVPM05 module form factor information.

Figure 11: CVPM Dimensions



Units = mm

Figure represents CVPM02. CVPM05 uses Molex 43025-0800 connector, but dimension of 75.0 mm from capacitor to connector edge remains the same.

Revision History

Version 1.1; June 8, 2021

- Added [Mount without the Remote Mount Board](#) and [Using a Custom Mounting Bracket](#).
- Template update.

Version 1.0; February 14, 2020

Initial release of this document, built from the *Cache Backup Products for MegaRAID SAS+SATA RAID Controllers User Guide* (document number CacheVault-05-UG).

