

Dell Express Flash NVMe PCIe SSD User's Guide

Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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NVMe PCIe SSD overview

Dell NVMe PCIe SSD products include both 2.5-inch (U.2) and add-in controller (AIC) form factors.

Storage management applications enable you to manage and configure the NVMe PCIe SSD. These applications also allow you to control and monitor multiple NVMe PCIe SSDs, and provide online maintenance.

The NVMe PCIe SSD solution supports Unified Extensible Firmware Interface (UEFI) and Human Interface Infrastructure (HII) for preoperating system device management, OpenManage Server Administrator (OMSA) application for operating system device management, and Integrated Dell Remote Access Controller (iDRAC) with Lifecycle Controller for local or remote device management. The NVMe PCIe SSD solution supports UEFI, HII, and iDRAC with Lifecycle Controller management on select PowerEdge systems only. OMSA for NVMe PCIe SSD device management is available on all supported PowerEdge systems.

- NOTE:** The NVMe PCIe SSD drives support Power Loss Protection (PLP) by default.
- NOTE:** The Instant Secure Erase feature on NVMe PCIe SSD drives is compliant with National Institute for Standards and Technology 800-88R1 requirements.
- NOTE:** This documentation assumes you use OMSA, iDRAC, or HII for all management and configuration tasks. See [Related documentation](#) for links to information about the use of these tools.
- NOTE:** For the safety, regulatory, and ergonomic information that is associated with these devices, and for more information about iDRAC/LC remote management, see your platform documentation.

NVMe PCIe U.2 SSD

Install the NVMe PCIe U.2 SSD into its carrier before installing it into the server.





Hot-plug drive serviceability

PowerEdge 14th generation and later servers support hot-plug serviceability for NVMe PCIe U.2 2.5-inch SSD models only. Hot-plug serviceability allows this device to be added and removed without turning off the server, maximizing server availability and reducing downtime.

There are two types of hot-plug operations depending on whether you notify the server before you conduct the operation:

- Orderly removal—Performed after notifying the system that the operation is about to take place.
 - Surprise insertion and removal—Performed without notifying the system that the operation is about to take place.
- CAUTION:** To prevent data loss or corruption during a surprise removal of an NVMe PCIe SSD, ensure that the data on the drive is no longer in use. Also, do not perform a hot-plug operation while the system is accessing the system BIOS or HII configuration setup.
- CAUTION:** Do not remove a non-RAID boot storage device or a swap file storage device from a running server because the operating system becomes unresponsive.
- CAUTION:** When removing an NVMe PCIe SSD from your system, ensure that the data on the device is not critical to the functioning of the system.

Surprise removal is only supported when the NVMe PCIe SSD is installed in a supported Dell system running the following operating systems:

- Windows Server 2019 and later
- VMware ESXi 7.0 patch release 7.0b, build 16324942 or later, although hot-plug operations are limited to specific configurations. See [NVMe Hot-Plug on Dell PowerEdge servers running VMware vSphere or vSAN](#) white paper.
- Linux
 - Red Hat Enterprise Linux 8.2 or later
 - SUSE Linux Enterprise Server 15 SP2 or later
 - Ubuntu Server 20.4 or later

For additional Linux requirements, see the [NVMe Surprise Removal on Dell PowerEdge servers running Linux operating systems](#) white paper.

For operating systems or applications that do not support surprise removal of NVMe PCIe U.2 2.5-inch SSDs, Dell management tools such as OpenManage Server Administrator and Integrated Dell Remote Access Controller (iDRAC) provide a procedure to perform orderly removal of the device. In the **OpenManage Server Administrator**, go to the **Physical Devices on PCIe SSD subsystem** page, select **Prepare to Remove** from the **Tasks** list for the selected SSD. For more information, see

the OpenManage Server documentation (go to www.dell.com/openmanagemanuals and click **OpenManage Administrator** or *iDRAC User's Guide* available at www.dell.com/idracmanuals).

To ensure that you have correct hardware setup for your NVMe SSD device, see the device owner's manual at www.dell.com/manuals.

Slot population guidelines


Dell Technologies recommends installing hot-pluggable NVMe devices in front-facing backplanes before other backplane orientations, if possible. Hot-pluggable NVMe devices that are installed in front-facing backplanes can have greater performance than devices installed in the other backplane orientations due to lower operating temperatures at the front of the system.

Dell Technologies also recommends installing hot-pluggable NVMe devices with high capacities in front-facing backplanes before hot-pluggable NVMe devices with lower capacities in the front-facing backplanes. Since high capacity NVMe devices typically operate at high temperatures, they can use the highest cooling available at the front of the system.

For more information about the NVMe slots support, see the respective product documentation available at Dell.com/poweredgemanuals > select the platform under **PowerEdge** > select the Model number > click the **Select this Product** option > **Documentation** > search for **Installation and Service Manuals**.

NVMe PCIe SSD AIC

Install the NVMe PCIe SSD AIC form factor into the appropriate system board slot. See your server documentation for more information.

 **NOTE:** Hot-plug operations are not supported on NVMe PCIe SSD AIC.

NVMe PCIe SSD features

NVMe PCIe SSDs offer features including drive serviceability, device health, SMART, remaining rated write, device write status, and boot capabilities.

Device health

Dell Express Flash NVMe PCIe SSDs include several features such as SMART, remaining rated write endurance, and device write status, that allow you to monitor device health.


Use these features to help maintain the health of your Dell Express Flash SSD.

Self-Monitoring Analysis and Reporting Technology (SMART)

Dell management tools such as Integrated Dell Remote Access Controller and Dell OpenManage Server Administrator use SMART to provide alert content.

Remaining rated write endurance

The NVMe PCIe SSD is warranted to a maximum amount of data written to the device in total bytes written. The NVMe PCIe SSD self monitors for these limits, and software management applications notify you when you reach these limits.

 **NOTE:** If you continue to write to the device after it reaches the threshold of total bytes written, the amount of time the NVMe PCIe SSD retains data while powered off decreases below device specifications. For more information, see the technical specification sheet for your SSD.

Device write status

If the device exhausts the available spare sectors, the NVMe PCIe SSD enters `write protect` (Read-Only) mode. In Write Protect mode, you can only perform read operations to the device. The NVMe PCIe SSD self monitors for these limits, and software management applications notify you when you reach these limits.

Boot from an NVMe PCIe U.2 SSD

Dell supports installation of operating systems to, and booting from, NVMe PCIe U.2 SSDs on select PowerEdge platforms that have been configured for UEFI BIOS boot mode. To determine whether or not an NVMe PCIe U.2 SSD may be used as a boot device on your system, see the system-specific documentation at www.dell.com/manuals.

Supported operating systems

The NVMe PCIe SSD you ordered with your system is preconfigured and ready for use. This chapter explains how you can view the configuration settings of your NVMe PCIe SSD depending on the operating system you are using.

Windows

In Windows-based systems, NVMe PCIe SSD devices have a controller entity and a device entity. The controller entity is displayed under the **Storage** controller menu in the **Device Manager**.

NOTE: When configured in Dell S140 RAID volumes, separate device entries are not shown. For more information, see the Dell S140 documentation at www.dell.com/manuals.

Use the controller entity when installing or updating the NVMe PCIe SSD driver. You can configure the NVMe PCIe SSD for use in Windows from **Computer Management > Storage > Disk Management Tool**.

Linux

On Linux-based systems, you can configure NVMe PCIe SSDs from the partitioning tool by specifying or selecting the device name. The device name for NVMe PCIe SSDs is `/dev/nvmeXn1`, where X is the number corresponding to each NVMe PCIe SSD in the system. For example:

```
/dev/nvme0n1
```

```
/dev/nvme1n1
```

```
/dev/nvme2n1
```

Use OpenManage Server Administrator for managing and performing NVMe PCIe SSD-related tasks.

VMware

In VMware systems, you can use vSphere Client to configure an NVMe PCIe SSDs as a datastore or for passthrough operation. However, configuring an NVMe PCIe SSD for passthrough operation is not recommended due to the following limitations:

- Inability to take snapshots of the Virtual Machine (VM).
- VM is no longer able to use fail over features such as VMotion and Distributed Resources Scheduler (DRS).
- Loss of hot swap capability for other devices such as USB drives. To add another device, you must first shut down the VM.

Configuring an NVMe PCIe SSD for passthrough operation is not recommended except as defined by Dell-specific solutions. See the solution-specific documentation at www.dell.com/manuals.

Troubleshooting

NOTE: To get help for your NVMe PCIe SSD, see [Contacting support](#).

NVMe PCIe SSD carrier LED indicators

The LEDs on the NVMe PCIe SSD U.2 carrier indicate the state of each physical device. Each NVMe PCIe SSD carrier in your enclosure has an activity LED (green) and a status LED (bicolor, green/amber). The activity LED flashes whenever the device is accessed.

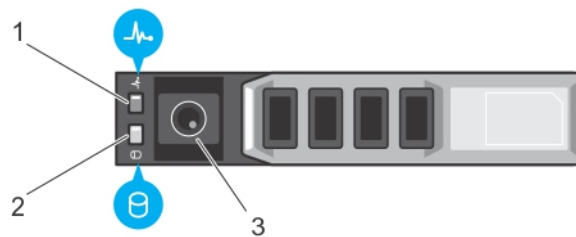


Figure 1. NVMe PCIe SSD device carrier LED indicators

1. status indicator
2. activity indicator
3. release button

While the operating system is running, the status indicator provides the current status of the device. The following table lists the device states along with the associated LED indicator codes.


Table 1. NVMe PCIe SSD U.2 states and LED indicator codes

State Name	Slot/Device State	Status LED (Green)	Status LED (Amber)
Device status off	The server or device is not powered up.	Off	Off
Device online	The device is powered up.	On	Off
Device identify (blink)	The device is identifying the slot location or is indicating the device has received a Prepare for Removal command from the host operating system.	Not applicable	Off
Device failed	The host operating system no longer has access to the device because the device is not responding or has encountered a critical error condition.	Off	On for 250 msec. Off for 250 msec.
Read only	The device will only service read operations.	Off	Not applicable
Predicted failure	The SMART feature set has predicted a degradation or fault condition.	On for 250 msec. Off for 250 msec.	Not applicable

Ungraceful system shutdown or power loss

If the host system experiences a power loss, the NVMe PCIe SSD may not have time to perform its internal shut down procedure. In such an event, the device may enter a recovery mode.

This recovery process is also known as rebuilding. During rebuilding, there is very limited access from the host operating system. After the recovery procedure is complete, the device is fully accessible from the host operating system.

 **NOTE:** Dell recommends that you use power backup solutions for all Dell systems.


General errors

The following section describes general errors related to NVMe PCIe SSD.

NVMe drive properties intermittently not available in iDRAC

Description	NVMe drive properties via sideband (iDRAC) may not be available after a PCIe SSD is hot-inserted into the system. This is most likely to occur if the PCIe SSD is formatted with a file system or has existing data.
Cause	Side band controller on the NVMe drives does not complete initialization in time for iDRAC to inventory the device.
Solution	After an AC power cycle, the system should list the inserted devices in iDRAC.

NVMe PCIe SSD is not listed in the operating system

Cause	Hardware is not correctly installed.
Solution	<p>Check the following components:</p> <ul style="list-style-type: none">• Devices: Ensure that the NVMe PCIe SSDs are installed in an NVMe PCIe SSD backplane.  NOTE: NVMe PCIe SSDs must be used with NVMe PCIe SSD backplanes. To ensure that you have the correct configuration for the NVMe PCIe SSD, see the platform-specific owner's manual at www.dell.com/manuals.• Backplane: Ensure that the cables for the NVMe PCIe SSD backplane are connected correctly.• Cables: PCIe cables are unique for the configuration. Ensure that the backplane cable connectors are connected to the backplane and the extender card or system board.• Extender card: Ensure that the PCIe extender card, if used in your server configuration, is plugged into the correct supported slot. See the system-specific owner's manual at www.dell.com/manuals.

I/O device error on write to NVMe PCIe SSD

Description	<p>Windows event log may report the following entries on the first write attempt to an NVMe PCIe SSD: Event ID 7: The device, \Device\Harddisk\DRX, has a bad block.</p> <p>When attempting to initialize the device using Computer Management > Storage > Disk Management, the following message is displayed: Virtual Disk Manager, Data Error (cyclic redundancy check).</p> <p>Linux messages log may report the following entries on a write attempt to an NVMe PCIe SSD:</p> <ul style="list-style-type: none">• Buffer I/O error on device nvmeXn1, logical block Y (where X is the number corresponding to the device and Y is the logical block)• nvmeXn1: unable to read partition table (where X is the number corresponding to the device)
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Cause	NVMe PCIe SSDs have a finite number of write cycles. When an NVMe PCIe SSD exhausts the number of writes, it goes into Write Protect (Read Only) mode.
Solution	By using system management applications, you may check the NVMe PCIe SSD state to confirm if the NVMe PCIe SSD is in Read-Only Mode . For further instructions, contact a Dell Technical Service representative.

NVMe PCIe SSD performance measurement not optimal

Description	There are several factors that may alter the performance of an NVMe PCIe SSD. It is recommended that you configure performance optimization of these devices using the basic setup options.
Cause	NVMe PCIe SSD has not been preconditioned, or the BIOS settings are not optimized.
Solution	Without preconditioning the NVMe PCIe SSD, performance measurements can be misleading as they might not reflect long-term performance of the device. Preconditioning enables flash management, which stabilizes data throughput over a period of time. For the Solid-State Storage Performance Test Specification, see snia.org .

System becomes unresponsive when NVMe PCIe U.2 2.5-inch SSD is surprise removed

Description	The system becomes unresponsive when the device is removed without first preparing the device for removal.
Cause	The operating system on the PowerEdge server is not supporting surprise removal. Surprise removal on PowerEdge servers is only supported for operating systems that are listed in the Hot plug drive serviceability section.
Solution	Perform the Prepare For Removal operation for the specific NVMe PCIe U.2 2.5-inch SSD from a Dell Management application. For operating systems or applications that do not support surprise removal of NVMe PCIe U.2 2.5-inch SSDs, Dell management tools such as OpenManage Server Administrator and iDRAC provide an option (Prepare to Remove) to perform orderly removal of the device.

System becomes unresponsive or fails when NVMe PCIe SSD is inserted

Description	The system becomes unresponsive or fails when inserting an NVMe PCIe SSD while accessing the system BIOS or HII configuration utilities.
Cause	Hot insertion is not supported in pre-operating system configuration utilities.
Solution	Insert only after allowing the operating system to fully load or when the server is powered off.

Related documentation

To...	Refer to...
Install your system into a rack	Rack documentation included with your rack solution.
Set up your system and know the system technical specifications	<i>Getting Started Guide</i> available at www.dell.com/poweredgemanuals
Install the operating system	Operating system documentation at www.dell.com/operatingsystemmanuals
Get an overview of the Dell Systems Management offerings	Dell OpenManage Systems Management Overview Guide at www.dell.com/openmanagemanuals
Configure and log in to iDRAC, set up managed and management system, know the iDRAC features and troubleshoot using iDRAC	Integrated Dell Remote Access Controller User's Guide at www.dell.com/idracmanuals
Know about the RACADM subcommands and supported RACADM interfaces	RACADM Command Line Reference Guide for iDRAC and CMC at <i>iDRAC RACADM CLI Guide</i> available at www.dell.com/idracmanuals
Launch, enable and disable Lifecycle Controller, know the features, use and troubleshoot Lifecycle Controller	Dell Lifecycle Controller User's Guide at www.dell.com/idracmanuals > Lifecycle Controller
Use Lifecycle Controller Remote Services	Dell Lifecycle Controller Remote Services Quick Start Guide at Dell.com/openmanagemanuals <i>Lifecycle Controller Remote Services Quick Start Guide</i> available at www.dell.com/idracmanuals
Set up, use, and troubleshoot OpenManage Server Administrator	Dell OpenManage Server Administrator User's Guide at www.dell.com/openmanagemanuals > OpenManage Server Administrator
Install, use and troubleshoot OpenManage Essentials	Dell OpenManage Essentials User's Guide at www.dell.com/openmanagemanuals > OpenManage Essentials
Know the system features, remove and install system components, and troubleshoot components	Owner's Manual at www.dell.com/poweredgemanuals
Know the features of the storage controller cards, deploy the cards, and manage the storage subsystem	Storage controller documentation at www.dell.com/storagecontrollermanuals
Check the event and error messages generated by the system firmware and agents that monitor system components	Dell Event and Error Messages Reference Guide at For information about the event and error messages generated by the system firmware and agents that monitor system components, go to qrl.dell.com > Look Up > Error Code , type the error code, and then click Look it up .

Your product documentation includes:

- Getting Started Guide** Provides an overview of system features, setting up your system, and technical specifications. This document is also shipped with your system.
- Owner's Manual** Provides information about system features and describes how to troubleshoot the system and install or replace system components.
- Rack Installation Instructions** Describes how to install your system into a rack. This document is shipped with your rack solution.
- Administrator's Guide** Provides information about configuring and managing the system.

Troubleshooting Guide Provides information about troubleshooting the software and the system.

OpenManage Server Administrator User's Guide Provides information about using Dell OpenManage Server Administrator to manage your system.

Getting help

Locating your system Service Tag

Your system is identified by a unique Express Service Code and Service Tag number. The Express Service Code and Service Tag are found on the front of a physical DR Series system by pulling out the information tag. The service tag can also be found on the Support page in the GUI. This information is used to route support calls to the appropriate personnel for resolution.

Contacting support

Dell Technologies provides several online and telephone based support and service options. If you do not have an active internet connection, you can find contact information about your purchase invoice, packing slip, bill, or Dell product catalog. Availability varies by country and product, and some services may not be available in your area. To contact Dell for sales, technical assistance, or customer service issues:

1. Go to Dell.com/support/home.
2. Select your country from the drop-down menu on the lower right corner of the page.
3. For customized support:
 - a. Enter your system Service Tag in the **Enter your Service Tag** field.
 - b. Click **Submit**.
The support page that lists the various support categories is displayed.
4. For general support:
 - a. Select your product category.
 - b. Select your product segment.
 - c. Select your product.
The support page that lists the various support categories is displayed.
5. For contact details of Dell Global Technical Support:
 - a. Click [Global Technical Support](#).
 - b. The **Contact Technical Support** page is displayed with details to call, chat, or e-mail the Dell Global Technical Support team.

Documentation feedback

Click the **Feedback** link in any of the Dell documentation pages, fill out the form, and click **Submit** to send your feedback.