

# Oracle 3.84 TB NVMe SSD User Guide



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Oracle 3.84 TB NVMe SSD User Guide,

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# 1

## Using This Documentation

- **Overview** – Provides late-breaking information and specifications about Oracle 3.84 TB NVMe SSD
- **Audience** – System administrators, network administrators, and service technicians
- **Required knowledge** – Advanced understanding of server systems

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- [Product Documentation Library](#)
- [Feedback](#)

## Product Documentation Library

Documentation and resources for this product and related products are available at: <https://www.oracle.com/goto/oracleflashf640/docs>

## Feedback

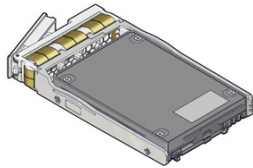
Provide feedback about this documentation at: <https://www.oracle.com/goto/docfeedback>

# 2

## Oracle 3.84 TB NVMe SSD Product Information

This section contains late-breaking information about Oracle 3.84 TB NVMe SSDs. Read this section before reading other Oracle 3.84 TB NVMe SSD documentation. Always refer to the latest version of the product information.

For specific installation instructions, late-breaking information about the installation and use of Oracle 3.84 TB NVMe SSDs with your server, supported firmware and operating systems, important operating notes, and known issues, refer to the latest platform product notes document.



Review the software and firmware supported for Oracle 3.84 TB NVMe SSDs. Review important information for configuring Oracle 3.84 TB NVMe SSDs. Check known issues. Review specifications.

For detailed instructions on how to install Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drive, refer to your server service documentation or drive enclosure documentation at <https://docs.oracle.com>.

The Drive Bracket Assembly consists of the solid state drive assembled within the bracket assembly. The Drive Bracket Assembly should not be disassembled for any reason by the user.

These topics are included in this section.

- [Supported Hardware and Software](#)
- [Implementation Considerations](#)
- [Updating Oracle 3.84 TB NVMe SSD Software and Firmware](#)
- [Issues Fixed in This Firmware Release](#)
- [Known Issues](#)
- [Oracle 3.84 TB NVMe Solid State Drive Specification](#)
- [Oracle NVMe SSD Product Accessibility](#)

## Supported Hardware and Software

The following sections describe the software and firmware supported for Oracle 3.84 TB NVMe SSDs:

- [Supported Servers and Locations](#)
- [Minimum Supported Card Firmware Version](#)
- [Required Host Firmware](#)
- [Keep Drivers and Firmware Up to Date](#)
- [Server Management Tools](#)

## Supported Servers and Locations

This section lists the servers that support Oracle 3.84 TB NVMe SSDs. For detailed information about using this 3.84TB NVMe SSD with your server, refer to the product notes for your server, available at <https://docs.oracle.com>.

The following servers are supported for the Oracle 3.84 TB NVMe SSD.

<b>x86 Servers</b>	<b>Max Number of SSDs</b>	<b>Slots Supported for Installing 3.84TB NVMe SSDs</b>
Oracle Server X9-2	4	4 drive cage: 2, 3, 4, 5. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3
Oracle Server X9-2L	4 drive cage: 4 8 drive cage: 8 12 drive cage: 12	4 drive cage: 2, 3, 4, 5. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3  8 drive cage: Dual CPU X9-2L configuration supports up to 8 NVMe SSDs without Oracle PCIe Re-timer Card card (Slots 0, 1, 2, 3, 4, 5, 6, and 7). Slots labeled NVMe0, NVMe1, NVMe2, NVMe3, NVMe4, NVMe5, NVMe6, NVMe7  12 drive cage: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3 NVMe4, NVMe5, NVMe6, NVMe7, NVMe8, NVMe9, NVMe10, NVMe11
<b>SPARC Servers</b>	<b>Max Number of SSDs</b>	<b>Slots Supported for Installing 3.84TB NVMe SSDs</b>
SPARC S7-2 Server	4	4 drive cage: 2, 3, 4, 5. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3
SPARC S7-2L Server	8 drive cage: 4 12 drive cage: 12 24 drive cage: 4	8 drive cage: 2, 3, 4, 5. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3  12 drive cage: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3 NVMe4, NVMe5, NVMe6, NVMe7, NVMe8, NVMe9, NVMe10, NVMe11  24 drive cage: 3, 4, 19, 20. Slots labeled NVMe0, NVMe1, NVMe2, NVMe3

Other servers and processors might be added to this list in the future, if they qualify. Check your server product notes for confirmation that your server has subsequently been qualified for device support.

 **Caution:**

Any unsupported configuration causes the host to power off as soon as it is powered on. A fault is generated on the service processor when an unsupported configuration is detected. The fault clears after the unsupported configuration is fixed and the host is powered on.

 **Note:**

Refer to your server product notes for up-to-date information on supported servers, operating systems, and required patchsets.

## Minimum Supported Card Firmware Version

Oracle 3.84 TB NVMe SSDs run with the minimum required firmware package listed in the following table.

Firmware	Minimum Required Card Firmware Version	Recommended Card Firmware Version
Oracle 3.84 TB NVMe SSD Package	2CV1RC30 F640 1.0.0 - FIRMWARE	2CV1RC50 Patch 35148263: Oracle 3.84GB/6.8TB NVMe PCIe 4.0 SSD - FIRMWARE PACK Patch 35148263: Oracle 3.84GB/6.8TB NVMe PCIe 3.0 SSD SW 1.0.7 - FIRMWARE PACK

 **Note:****Important**

You cannot downgrade from Firmware Version 2CV1RC50.

If you install Oracle 3.84 TB NVMe SSDs as an add-on option, you must update the firmware if the release number is lower than 2CV1RC50.

 **Note:**

For best practice, install the latest device firmware versions.

- [Summary of Changes in Firmware Releases](#)

## Summary of Changes in Firmware Releases

The following improvements or changes were included in firmware releases of Oracle 3.84 TB NVMe SSD:



- If you install Oracle 3.84 TB NVMe SSDs as an option, you must update firmware to 2CV1RC50, or a subsequent firmware release if available.

## Required Host Firmware



### Note:

Refer to [Firmware Downloads and Release History for Oracle Systems \(https://www.oracle.com/servers/technologies/firmware/release-history-jsp.html\)](https://www.oracle.com/servers/technologies/firmware/release-history-jsp.html)

Oracle 3.84 TB NVMe SSDs run with the minimum required host firmware listed in the following table.

x86 Driver	Minimum Required System Firmware Version (Patch No.)	Recommended System Firmware Version (Patch No.)
Oracle Server X9-2	Patch 29913849: Oracle Server X9-2 SW 1.2.2 - FIRMWARE PACK	Patch 35209070: Oracle Server X9-2 SW 3.4.0 - FIRMWARE PACK or later
Oracle Server X9-2L	Patch 29811557: Oracle Server X9-2L SW 1.2.2 - FIRMWARE PACK	Patch 35209056: Oracle Server X9-2L SW 3.4.0 - FIRMWARE PACK or later

SPARC Driver	Minimum Required System Firmware Version (Patch No.)	Recommended System Firmware Version (Patch No.)
SPARC S7-2 Server	Patch 33812797: FIRMWARE: SPARC S7-2 SUN SYSTEM FIRMWARE 9.10.4.A	Patch 33812797: FIRMWARE: SPARC S7-2 SUN SYSTEM FIRMWARE 9.10.4.A or later
SPARC S7-2L Server	Patch 33812797: FIRMWARE: SPARC S7-2 SUN SYSTEM FIRMWARE 9.10.4.A	Patch 30673927: FIRMWARE: SPARC S7-2L SUN SYSTEM FIRMWARE 9.10.4.A or later

## Keep Drivers and Firmware Up to Date

Refer to the server documentation to check for updates to the device firmware. For information on updating drivers and firmware for Oracle 3.84 TB NVMe SSDs, see [Accessing Software Updates and Firmware Downloads](#).

## Server Management Tools

The following management tools are available for the server:

- Oracle Integrated Lights Out Management (ILOM). Preinstalled service processor (SP) with integrated firmware. No installation required. Some initial configuration is required.

For information, refer to the product information page at: [Oracle Integrated Lights Out Manager](#). For documentation, refer to [Oracle ILOM Documentation](#).

- Oracle Hardware Management Pack, available with the Oracle Solaris OS or as a standalone product with other OS. Monitor hardware through the host operating system, either remotely using SNMP or locally using command-line interface tools.

For information, refer to the product information page at: [Oracle Hardware Management Pack](#). For documentation and OS support matrix, refer to Oracle Hardware Management Pack Documentation at: [Servers Documentation Systems Management](#)

- Oracle Enterprise Manager Ops Center, available software to manage multiple systems in a data center. For information, refer to the product information page at: [Oracle Enterprise Manager](#). For documentation, refer to Oracle Enterprise Manager Cloud Control Documentation at: [Oracle Enterprise Manager Cloud Control](#).

## Implementation Considerations

These topics provide important information for configuring Oracle 3.84 TB NVMe SSDs in supported servers:

- [Oracle Server X9-2 Configuration](#)
- [Oracle Server X9-2L Configuration](#)
- [SPARC S7-2 Server Configuration](#)
- [SPARC S7-2L Server Configuration](#)
- [SSD Volume Management](#)

### Related Topics

- [Accessing Software Updates and Firmware Downloads](#)

## Oracle Server X9-2 Configuration

Minimum required software for Oracle Server X9-2 is SW1.2.2.1.

Oracle Server X9-2 supports Oracle 3.84 TB NVMe SSD as a boot device.

Refer to the server documentation at <https://www.oracle.com/goto/x9-2/docs> .

## Oracle Server X9-2L Configuration

Oracle Server X9-2L supports Oracle 3.84 TB NVMe SSD as a boot device.

Oracle 3.84 TB NVMe SSD supported quantity in Oracle Server X9-2L depends on whether:

The Oracle 3.84 TB NVMe SSD configuration includes Oracle Server X9-2L one or two CPUs.

Oracle Server X9-2L dual CPU configuration includes the PCIe Retimer Card.

Single CPU Oracle Server X9-2L supports up to 4 Oracle 3.84 TB NVMe SSDs (Slots 0, 1, 5 and 5)

Oracle Server X9-2L Dual CPU configuration supports up to 8 Oracle 3.84 TB NVMe SSDs without PCIe Retimer Card (Slots 0, 1, 2, 3, 4, 5, 6 and 7) and up to 12 Oracle 3.84 TB NVMe SSDs with the PCIe Retimer Card (Slots 0-11)

Oracle 3.84 TB NVMe SSD population rules for Oracle Server X9-2L: If quantity is two, then installation order is: NVMe0, NVMe1.

Minimum required software for Oracle Server X9-2L is SW1.2.2.1.

Refer to the server documentation at <https://www.oracle.com/goto/x9-2l/docs>

## SPARC S7-2 Server Configuration

SPARC S7-2 servers support Oracle 3.84 TB NVMe SSD as a boot device.

An Oracle PCIe Re-timer (Switch) Card is not required in a four NVMe drive configuration. The switch function is included in the motherboard.

Refer to the server documentation at <https://www.oracle.com/goto/s7-2/docs> .

## SPARC S7-2L Server Configuration

SPARC S7-2L servers support Oracle 3.84 TB NVMe SSD as a boot device. Single CPU S7-2L supports up to 4 NVMe SSDs (Slots 0, 1, 5 and 5). Dual CPU config support up to 8 without Oracle PCIe Re-timer (Switch) Card (Slots 0,1,2, 3, 4, 5, 6 and 7) and up to 12 with the Oracle PCIe Re-timer Card (Slots 0-11).

Additional Oracle PCIe Re-timer Cards are required to support backplane configurations with more than four NVMe drives. An Oracle PCIe Re-timer Card is not required in a four NVMe drive configuration. The switch function is included in the motherboard. The SPARC S7-2L Server can support three Oracle PCIe Re-timer Cards.

Refer to the server documentation at <https://www.oracle.com/goto/s7-2l/docs> .

## SSD Volume Management

A volume manager can present multiple SSD devices as one larger volume. Use the Automatic Storage Management (ASM) volume manager or other volume manager to concatenate multiple flash memory domains. For example, a volume manager can be used to concatenate two 3.84 TB domains into a single 7.68 TB volume.

Refer to the Automatic Storage Management documentation at <https://docs.oracle.com/en/database/oracle/oracle-database/19/ostmg/index.html> .

## Updating Oracle 3.84 TB NVMe SSD Software and Firmware

This section provides information on updating Oracle 3.84 TB NVMe SSD firmware and software.

- [Accessing Software Updates and Firmware Downloads](#)

## Accessing Software Updates and Firmware Downloads

Product patches, updates and firmware are available on [My Oracle Support](#) from the Patches and Updates tab.

These topics provide important information for updating Oracle 3.84 TB NVMe SSD software in supported servers:

- [Download the Device Software Package](#)
- [Update the NVMe Storage Drive Firmware](#)

- [Verify Oracle 3.84 TB NVMe SSD Operation](#)

## Download the Device Software Package

To find the device software package, access My Oracle Support and download the latest software package for Oracle 3.84 TB NVMe SSDs.

1. Go to the My Oracle Support web site: <https://support.oracle.com>.
2. Sign in to My Oracle Support.
3. At the top of the page, click the Patches & Updates tab.  
The Patch Search pane appears at the right of the screen.
4. Within the Search tab area, click Number/Name or Bug Number (Simple).  
The Search tab area appears with search fields.
5. In the Product field, enter the patch number for Oracle 3.84 TB NVMe SSDs.  
See [Minimum Supported Card Firmware Version](#).
6. In the Release field, select a software release from the drop-down list.  
Expand the list to see all available software releases.
7. Click Search.  
The Patch Advanced Search Results screen appears, listing the patches for the software release.
8. To select a patch for a software release, click the patch number next to the software release version.  
You can use the Shift key to select more than one patch.  
A pop-up action panel appears. The panel contains several action options, including the ReadMe, Download, and Add to Plan options. For information about the Add to Plan option, click the associated button and select “Why use a plan?”.
9. To review the ReadMe file for this patch, click ReadMe.
10. To download the patch for the software release, click Download.
11. In the File Download dialog box, click the patch zip file name.  
The patch for the software release downloads. The download is an archive zip file, which you must extract to find the directory containing the image.pkg file.

## Update the NVMe Storage Drive Firmware

- Update your system to the latest software release.
- Verify that the latest supported software release of Oracle Hardware Management Pack is installed on the host.

For CLI command instructions, refer to Oracle Hardware Management Pack documentation at <https://docs.oracle.com/en/servers/management.html>.

This procedure provides instructions to update Oracle 3.84 TB NVMe SSD NAND flash controller firmware on the host for supported Oracle Solaris and Linux operating systems. Oracle 3.84 TB NVMe SSD firmware is updated as a single package using Oracle Hardware Management Pack utility command-line interface (CLI) tools.

**Note:**

For detailed instructions on system software updates, refer to the server documentation.

1. Check 3.84 TB NVMe SSD User Guide for the latest firmware requirements.  
See [Minimum Supported Card Firmware Version](#).
2. Log in to the target system.  
For detailed instructions, refer to the server installation guide. For example, to log in to the target system through SSH or through Oracle ILOM Remote System Console Plus, do one of the following:
  - If you are using an SSH client connection.
    - a. From a shell command line in a terminal window, establish an SSH connection to the server host.  
  
Type: `ssh root@hostname` , where *hostname* can be the DNS name or the IP address for the server host.
    - b. Log in to the system using an account with root access.
    - c. Proceed to Step 3.
  - If you are using a remote system console, first refer to the server Administration Guide and then perform these steps.  
  
To launch an Oracle ILOM Remote System Console Plus session, refer to Launching Remote KVMS Redirection Sessions in the server Administration Guide.
    - a. Establish a remote connection to the host console.  
Start an Oracle ILOM serial console session, type:  

```
-> start /HOST/console
```

```
Are you sure you want to start /HOST/console (y/n)? y
```
    - b. Ensure that the server is powered on and booted.
    - c. Access the operating system command-line interface.  
  
You issue Oracle Hardware Management Pack commands from the operating system command-line interface.
3. Download and store any firmware image file updates on the server that are required to support Oracle 3.84 TB NVMe SSDs.
  - a. Download firmware image files from this location:  
<https://support.oracle.com>  
See [Download the Device Software Package](#).
  - b. Copy the downloaded firmware image files obtained to the target system root directory.
4. Identify all Oracle 3.84 TB NVMe SSD controller firmware versions in the server.
  - a. Type `# fwupdate list controller`.

In the following examples, Oracle 3.84 TB NVMe SSD controllers c0 to c11 are enumerated in the output returned by the above command.

```
# fwupdate list controller
=====
CONTROLLER
=====
ID      Type      Manufacturer  Model      Product Name      FW Version
-----
c0      NVMe     Samsung      0xa824     SAMSUNG MZWLR7T6HALA-00AU3MPK94R5Q
c1      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c2      HDC      Intel        0xa182     0x4873            -
c3      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c4      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c5      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC30
c6      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC30
c7      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC50
c8      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC50
c9      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c10     NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c11     NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
```

- b. Verify that the firmware package files that are installed in Oracle 3.84 TB NVMe SSDs require updating.

To identify NVMe controllers that need updated firmware image files, view the FW Version column in the output from the `fwupdate list controller` command.

In the following example, Oracle 3.84 TB NVMe SSD controller c5 and c6 shows firmware version 2CV1RC30, while the other NVMe controllers show firmware version 2CV1RC50.

```
# fwupdate list controller
=====
CONTROLLER
=====
ID      Type      Manufacturer  Model      Product Name      FW Version
-----
c0      NVMe     Samsung      0xa824     SAMSUNG MZWLR7T6HALA-00AU3MPK94R5Q
c1      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c2      HDC      Intel        0xa182     0x4873            -
c3      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c4      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c5      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC30
c6      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC30
c7      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC50
c8      NVMe     Intel        0x0b60     INTEL SSDPFCKE064T9S      2CV1RC50
c9      NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c10     NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
c11     NVMe     Intel        0x0b60     INTEL SSDPF2KX076T9S      2CV1RC50
```

- c. View the Firmware Revision in the output from the `nvmeadm list -v` command.

To identify NVMe controllers and current firmware versions type `# nvmeadm list -v`.

In the following example, controllers SUNW-NVME-1 and SUNW-NVME-2 show firmware version 2CV1R150 in the output returned by the above command.

```
# nvmeadm list -v
SUNW-NVME-1
    PCI Vendor ID:                0x144d
    Serial Number:                 S64TNE0N800033
    Model Number:                  SAMSUNG MZWLR7T6HALA-00AU3
    Firmware Revision:             MPK94R5Q
    Number of Namespaces:         32
SUNW-NVME-2 ....
    PCI Vendor ID:                0x8086
    Serial Number:                 PHAB011200LV7P6GGN
    Model Number:                  INTEL SSDPF2KX076T9S
    Firmware Revision:             2CV1RC50
    Number of Namespaces:         128
```

5. Quiesce Oracle 3.84 TB NVMe SSD devices.

Before removing the card, manually quiesce I/O and device usage.

 **Caution:**

**System hang or data loss.** Before updating device firmware, ensure that the device is quiesced and the following events are not occurring:

- The operating system is not accessing the disk (for example, the system boot disk).
- An application is not accessing the disk (for example, a database application).

6. Update the selected Oracle 3.84 TB NVMe SSDs with the specified firmware package.

The `fwupdate` command can update firmware for all similar devices in the system utilizing an XML metadata file. This method is called Automatic Mode and is the recommended method for upgrades.

 **Note:**

Alternately, if you determine that each device must be updated with a separate `fwupdate` command, perform the `fwupdate` Automatic Single Drive method, or the `fwupdate` Manual method (if an XML metadata file is not available). For CLI command instructions, refer to Oracle Hardware Management Pack documentation at: <https://docs.oracle.com/en/servers/management.html>.

a. Verify that an XML metadata file is available for the server.

An XML metadata file must be included with the firmware update package to use Automatic Mode. Refer to the update package release notes for more information.

b. To update device firmware on Oracle 3.84 TB NVMe SSDs, type `# fwupdate update controller -x metadata.xml`

In the following example, controllers `c5` and `c6` will be upgraded to firmware version `2CV1R150`.

```
# fwupdate update controller -x metadata.xml
The following components will be upgraded as shown:
=====
ID          Priority Action      Status      Old Firmware Ver.  Proposed
Ver.        New Firmware Ver.  System Reboot
-----
c5          1          Check FW    Success        2CV1RC30
2CV1RC50          N/A
c6          1          Check FW    Success        2CV1RC30
2CV1RC50          N/A
Do you wish to process all of the above component upgrades? [y/n]?
```

If the current firmware package version on the selected controller is higher than the specified firmware package version, the command returns an error. For error codes, refer to Oracle Hardware Management Pack documentation at <https://docs.oracle.com/en/servers/management.html>.

- c. To upgrade the firmware packages and process all of the above component upgrades, type `y`.

```
Updating c5: Success
Updating c6: Success
```

```
Verifying all priority 1 updates
```

```
=====
ID          Priority Action      Status      Old Firmware Ver.  Proposed
Ver.        New Firmware Ver.  System Reboot
-----
c5          1          Check FW    Success        2CV1RC30
2CV1RC50          N/A
c6          1          Check FW    Success        2CV1RC30
2CV1RC50          N/A
```

```
System Reboot required for some applied firmware
Do you wish to automatically reboot now? [y/n]?
```

- d. Type `y` to reboot the host server to initialize the firmware update.

7. Re-access the console. See step 2.

For more instructions, refer to the server Installation Guide.

8. Verify that updated firmware packages are installed in Oracle 3.84 TB NVMe SSDs.

- a. Type the following from a terminal:

```
# fwupdate list controller
```

In the following example, Oracle 3.84 TB NVMe SSDs are displayed.

```
# fwupdate list controller
=====
CONTROLLER
=====
ID   Type   Manufacturer  Model   Product Name          FW Version
-----
c0   NVMe   Samsung       0xa824  SAMSUNG MZWLR7T6HALA-00AU3MPK94R5Q
c1   NVMe   Intel         0x0b60  INTEL SSDPF2KX076T9S  2CV1RC50
c2   HDC    Intel         0xa182  0x4873                -
c3   NVMe   Intel         0x0b60  INTEL SSDPF2KX076T9S  2CV1RC50
c4   NVMe   Intel         0x0b60  INTEL SSDPF2KX076T9S  2CV1RC50
```



```

c5    NVMe  Intel    0x0b60  INTEL  SSDPFCKE064T9S
2CV1RC50
c6    NVMe  Intel    0x0b60  INTEL  SSDPFCKE064T9S
2CV1RC50
c7    NVMe  Intel    0x0b60  INTEL  SSDPFCKE064T9S
2CV1RC50
c8    NVMe  Intel    0x0b60  INTEL  SSDPFCKE064T9S
2CV1RC50
c9    NVMe  Intel    0x0b60  INTEL  SSDPF2KX076T9S
2CV1RC50
c10   NVMe  Intel    0x0b60  INTEL  SSDPF2KX076T9S
2CV1RC50
c11   NVMe  Intel    0x0b60  INTEL  SSDPF2KX076T9S
2CV1RC50

```

- b.** Verify host recognition of all Oracle 3.84 TB NVMe SSD and 6.4 TB NVMe SSD v2s by checking PCIe ID enumeration.

In the above example, Oracle 3.84 TB NVMe SSD controllers `c0` to `c11` are enumerated in the output returned by the above command with firmware `2CV1RC50`.

- c.** Ensure that Oracle 3.84 TB NVMe SSD and 6.4 TB NVMe SSD firmware was updated in the output returned by the above command.

In the above example, Oracle 3.84 TB NVMe SSD controllers `c5` and `c6` show firmware version `2CV1RC50`.

- 9.** Verify Oracle 3.84 TB NVMe SSD operation.

See [Verify Oracle 3.84 TB NVMe SSD Operation](#).

- 10.** Repeat the firmware upgrade process until Oracle 3.84 TB NVMe SSDs have the most up to date firmware release.

See [Minimum Supported Card Firmware Version](#).

For example, upgrade firmware revision to `2CV1R150`.

#### Related Information

- [Minimum Supported Card Firmware Version](#)
- For CLI command instructions, refer to Oracle Hardware Management Pack documentation at <https://docs.oracle.com/en/servers/management.html>.

*Oracle Server CLI Tools User's Guide*

## Verify Oracle 3.84 TB NVMe SSD Operation

- Verify that Oracle Hardware Management Pack is installed on the host.  
For CLI command instructions, refer to Oracle Hardware Management Pack documentation at <https://docs.oracle.com/en/servers/management.html>.
- Ensure that you have access to the server (either directly or over the network).

This procedure provides instructions to verify Oracle 3.84 TB NVMe SSD operation on the host for supported Oracle Solaris and Oracle Linux operating systems. Verify Oracle 3.84 TB NVMe SSD operation using Oracle Hardware Management Pack utility CLI tools.

- 1.** Observe Oracle 3.84 TB NVMe SSD status indicator LEDs.

Verify that the Fault-Service Action Required Oracle 3.84 TB NVMe SSD status indicator is not lit and that the green Power status indicator is lit on Oracle 3.84 TB NVMe SSDs that you updated.

Refer to *LED Status Indicator Characteristics in Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drive Specification*.

## 2. Log in to the target system.

For detailed instructions, refer to the server installation guide. For example, to log in to the target system through SSH or through Oracle ILOM Remote System Console Plus, do one of the following:

- If you are using an SSH client connection.
  - a. From a shell command line in a terminal window, establish an SSH connection to the server host.
 

Type: `ssh root@hostname` , where *hostname* can be the DNS name or the IP address for the server host.
  - b. Log in to the system using an account with root access.
  - c. Proceed to Step 3.
- If you are using a remote system console, refer to the server administration guide and perform these steps.

### a. Establish a remote connection to the host console.

Start an Oracle ILOM serial console session, type:

```
-> start /HOST/console
```

```
Are you sure you want to start /HOST/console (y/n)? y
```

To launch an Oracle ILOM Remote System Console Plus session, refer to *Launching Remote KVMs Redirection Sessions in the server administration guide*.

### b. Ensure that the server is powered on and booted.

### c. Access the operating system command-line interface.

You issue Oracle Hardware Management Pack commands from the operating system command-line interface.

## 3. Identify all Oracle 3.84 TB NVMe SSDs and verify that the latest firmware packages are installed.

### a. Type the following command: `# fwupdate list controller`.

```
#
fwupdate list controller
=====
CONTROLLER
=====
ID      Type   Manufacturer  Model    Product Name                FW Version
-----
c0      NVMe   Samsung       0xa824   SAMSUNG MZWLR7T6HALA-00AU3MPK94R5Q
c1      NVMe   Intel         0x0b60   INTEL SSDPF2KX076T9S       2CV1RC30
c2      HDC    Intel         0xa182   0x4873                       -
c3      NVMe   Intel         0x0b60   INTEL SSDPF2KX076T9S       2CV1RC30
c4      NVMe   Intel         0x0b60   INTEL SSDPF2KX076T9S       2CV1RC30
c5      NVMe   Intel         0x0b60   INTEL SSDPFCKE064T9S       2CV1R104
```

```

c6    NVMe   Intel      0x0b60    INTEL SSDPFCKE064T9S
2CV1R104
c7    NVMe   Intel      0x0b60    INTEL SSDPFCKE064T9S
2CV1R103
c8    NVMe   Intel      0x0b60    INTEL SSDPFCKE064T9S
2CV1R103
c9    NVMe   Intel      0x0b60    INTEL SSDPF2KX076T9S
2CV1RC30
c10   NVMe   Intel      0x0b60    INTEL SSDPF2KX076T9S
2CV1RC30
c11   NVMe   Intel      0x0b60    INTEL SSDPF2KX076T9S
2CV1RC30

```

- b. Verify host recognition of all Oracle 3.84 TB NVMe SSDs by checking controller ID enumeration.

In the above example, Oracle 3.84 TB NVMe SSD controllers `c0` and `c1` are enumerated in the output returned by the above command.

- c. Ensure that all Oracle 3.84 TB NVMe SSD firmware revisions are current in the FW Version output returned by the above command.

See [Minimum Supported Card Firmware Version](#).

#### 4. Check NVMe device status.

To identify NVMe controllers and current firmware versions, type `# nvmeadm list -v`.

To identify NVMe controllers that have updated firmware, view the `Firmware Revision` row in the output from the `nvmeadm list -v` command.

In the following example, controllers `SUNW-NVME-1` and `SUNW-NVME-1` show firmware version `2CV1RC30` in the output returned by the above command.

```

#
nvmeadm list -v
SUNW-NVME-1
  PCI Vendor ID:          0x144d
  Serial Number:          S64TNE0N800033
  Model Number:           SAMSUNG MZWLR7T6HALA-00AU3
  Firmware Revision:      MPK94R5Q
  Number of Namespaces:   32
SUNW-NVME-2
  PCI Vendor ID:          0x8086
  Serial Number:          PHAB011200LV7P6GGN
  Model Number:           INTEL SSDPF2KX076T9S
  Firmware Revision:      2CV1RC30
  Number of Namespaces:   128
SUNW-NVME-3
  PCI Vendor ID:          0x8086
  Serial Number:          PHAB011200G17P6GGN
  Model Number:           INTEL SSDPF2KX076T9S
  Firmware Revision:      2CV1RC30
  Number of Namespaces:   128

```

#### 5. Check Oracle 3.84 TB NVMe SSD health and SMART information.

To check the selected Oracle 3.84 TB NVMe SSD health and SMART (Self-Monitoring, Analysis, and Reporting Technology) information, type:

```
# nvmeadm getlog -h
```

Ensure that Oracle 3.84 TB NVMe SSDs have remaining drive life (Percentage Used) in the output returned by the above command.

```
#
nvmeadm getlog -h

SUNW-NVME-1
SMART/Health Information:
  Critical Warning: 0
  Temperature: 315 Kelvin
  Available Spare: 100 percent
  Available Spare Threshold: 10 percent
  Percentage Used: 0 percent
  Data Unit Read: 0x2falc314 of 512k bytes.
  Data Unit Written: 0x23bd12c7 of 512k bytes.
  Number of Host Read Commands: 0x3f0bb9308
  Number of Host Write Commands: 0x1c2433434
  Controller Busy Time in Minutes: 0x525
  Number of Power Cycle: 0x56e
  Number of Power On Hours: 0x55f
  Number of Unsafe Shutdown: 0x307
  Number of Media Errors: 0x0
  Number of Error Info Log Entries: 0x0

SUNW-NVME-2
SMART/Health Information:
  Critical Warning: 0
  Temperature: 310 Kelvin
  Available Spare: 99 percent
  Available Spare Threshold: 10 percent
  Percentage Used: 1 percent
  Data Unit Read: 0x138a818a of 512k bytes.
  Data Unit Written: 0x2d71a25d of 512k bytes.
  Number of Host Read Commands: 0xe75e59ca
  Number of Host Write Commands: 0x7a604b45c
  Controller Busy Time in Minutes: 0xe0
  Number of Power Cycle: 0x89
  Number of Power On Hours: 0x1443
  Number of Unsafe Shutdown: 0x78
  Number of Media Errors: 0x0
  Number of Error Info Log Entries: 0x0
```

### Related Information

- [Minimum Supported Card Firmware Version](#)
- Oracle Hardware Management Pack documentation at: <https://docs.oracle.com/en/servers/management.html>

### Related Topics

- [Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drive Specification](#)

## Issues Fixed in This Firmware Release

This section lists the cumulative issues fixed in Firmware Release 2CV1RC30 or previously.

- [Fixed Issues](#)

## Fixed Issues

The following issues are fixed in Oracle 3.84 TB NVMe SSD Firmware Release 2CV1RC30.

Bug ID	Issue
Bug 26566040	<p>Determine the correct NVMe Shutdown timeout period for RTD3 (RunTime D3) power state</p> <p>Oracle 3.84 TB NVMe SSDs support NVMe specifications for RTD3 Resume Latency and RTD3 Entry Latency. RTD3R Resume latency allows 7.5 seconds of margin for devices to safely start before main power is applied to the device controller. RTD3E Entry latency allows 6 seconds of margin for active devices to safely shutdown before main power is removed from the device controller.</p> <p><b>Shutdown not complete messages may appear for OSES that do not support RTD3 Resume Latency and RTD3 Entry Latency.</b></p>

## Known Issues

This section describes important operating issues and known hardware and software issues for Oracle 3.84 TB NVMe SSDs.

Supplementary and workaround information for Oracle 3.84 TB NVMe SSDs. Specific Bug ID identification numbers are provided for service personnel.

- [Oracle ILOM Incorrectly Faults the Device with Message `fault.io.scsi.cmd.disk.dev.rqs.baddrv`](#)
- [Oracle ILOM Reports a Fault for NVMe Devices When Performing a Reboot, Firmware Update, or Hot-Plug Operation](#)
- [Oracle ILOM Reports Faults for Correctable Errors](#)
- [Secure Erase Drives Before Use](#)

### Oracle ILOM Incorrectly Faults the Device with Message

`fault.io.scsi.cmd.disk.dev.rqs.baddrv`

**Bug ID:** 28244670

**Issue:** Oracle ILOM might report a `fault.io.scsi.cmd.disk.dev.rqs.baddrv` error for NVMe devices. Oracle ILOM incorrectly faults the device with message `Fault fault.io.scsi.cmd.disk.dev.rqs.baddrv on FRU /SYS`.

**Affected Hardware and Software:** NVMe storage devices on all supported operating systems

**Workaround:** None

**Recovery:**

If a system encounters this issue, do the following steps.

1. Look for the NVMe ILOM fault code: `fault.io.scsi.cmd.disk.dev.rqs.baddrv`

The following screen shows a `fault.io.scsi.cmd.disk.dev.rqs.baddrv` error for Oracle 3.84 TB NVMe SSD.

```
ereport.io.scsi.cmd.disk.dev.rqs.baddrv@SYS/MB/PCIE5
      status_flags = 0xc3
      smart_warning = 0xff
      reason       = Drive is not functional
```

You can also use the Oracle ILOM `show faulty` command at the Oracle ILOM command-line prompt (->) to identify a drive failure.

To list all known faults in the server, log in to the Oracle ILOM service processor from the Oracle ILOM Fault Management Shell and issue the `fmadm faulty` command. For more information about how to use the Oracle ILOM Fault Management Shell and supported commands, refer to the *Oracle ILOM User's Guide for System Monitoring and Diagnostics* in the Oracle Integrated Lights Out Manager (ILOM) 5.0 Documentation Library at <https://www.oracle.com/goto/ilom/docs>.

2. Upgrade drive firmware if not current.

See Oracle 3.84 TB NVMe SSD [Supported Hardware and Software](#).

3. Do one of the following:

If `SMBus status_flags = 0xbb` displays, then clear the fault. No power cycling is required. To clear the fault code in Oracle ILOM, go to step 4.

If `SMBus status_flags = 0xc3` displays, complete a server power cycle, then clear the fault. Do the following to recover, then go to step 4.

- a. To identify the drive slot, type:

```
# lspci -vv -s 1b:00.0
  1b:00.0 Non-Volatile memory controller: [NVM Express])
    Subsystem: Oracle/SUN Device
    Physical Slot: 900
    Control: I/O- The PCIe address of /dev/nvme10n1 is 0000:e7:00.0
```

- b. Take the affected drive off-line.

Disconnect all users of the NVMe drive and back up the NVMe drive data as needed. Use the `umount` command to unmount any file systems that are mounted on the device. Remove the device from any multiple device (md) and Logical Volume Manager (LVM) volume using it.

If the device is a member of an LVM Volume group, then it might be necessary to move data off the device using the `pvmove` command, then use the `vgreduce` command to remove the physical volume, and (optionally) `pvremove` to remove the LVM metadata from the disk. If the device uses multipathing, run `multipath -l` and note all the paths to the device. Then, remove the multipathed device using the `multipath -f device` command. Run the `blockdev --flushbufs device` command to flush any outstanding I/O to all paths to the device.

- c. To prepare the NVMe drive for removal, that is, to detach the NVMe device driver and power off the NVMe drive slot, type: `# echo 0 >/sys/bus/pci/slots/900/power`
- d. To power on the drive, type: `# echo 1 >/sys/bus/pci/slots/900/power`

4. To clear the fault code in Oracle ILOM, type:

```
-> set /SYS/DBP/HDD0 clear_fault_action=true
Are you sure you want to clear /SYS/MB/PCIE5 (y/n)? y
```

```
Set 'clear_fault_action' to 'true'  
->
```

#### 5. Enable the drive.

Rescan the PCI bus to rediscover the NVMe drive.

```
# echo 1 > /sys/bus/pci/rescan.
```

If the same failure occurs again, use the same recovery process noted above. The drive has failed if the failure occurs again within minutes. If problem persists, then replace the faulty card identified in the `fmadm faulty` output.

Refer to the following document for the latest procedures for displaying event content in preparation for submitting a service request and applying any post-repair actions that may be required. *PSH Procedural Article for ILOM-Based Diagnosis* (Doc ID 1155200.1)

## Oracle ILOM Reports a Fault for NVMe Devices When Performing a Reboot, Firmware Update, or Hot-Plug Operation

**Bug ID:** 28654297

**Issue:** Oracle ILOM might report a `fault.chassis.device.fail` error for NVMe devices when performing a reboot, a firmware update, or hot-plug operation.

**Affected Hardware and Software:** NVMe storage devices on all supported operating systems

**Workaround :** Disable the `device_monitor` feature in Oracle ILOM using the following command:

```
set /SP/services/device_monitor servicestate=disabled
```

## Oracle ILOM Reports Faults for Correctable Errors

**Bug ID:** 28601316

**Issue:** The PCIe link retrains, a PCIe PHY reset event occurs on PCIe channels, and Oracle ILOM reports three different types of correctable errors. OS logs contain errors.

- Bad DLLP
- Bad TLP
- RTTO

**Workaround:** None

The TCRH (Train Cold – Run Hot) Compensation Feature is an expected behavior on Oracle Server X9 series servers.

## Secure Erase Drives Before Use

Oracle 3.84 TB NVMe SSD may report uncorrectable errors or assert after not being powered for three or more months. For best practice, secure erase Oracle 3.84 TB NVMe SSDs before use (especially if use is reading from the card as a test) and especially if the Oracle 3.84 TB NVMe SSD has been unpowered for more than three

months. If the NAND media is not refreshed for approximately three months, the drive may experience media errors.

Over time, the drive firmware policy refreshes the media in the background while it remains powered-on. If the drive has been powered on long enough for the background refresh policy to be applied to all bits, the drive is not at risk for this issue. The time required to refresh all the bits is approximately 14 days and varies by product.

If the number of bits experiencing this issue exceeds the error-correction code (ECC) capability, it may result in an uncorrectable read error. If the uncorrectable read errors occur during normal drive operation, the drive will report an increased number of SMART media errors to the host.

**Workaround:**

Secure erase the drive to return the drive to service. Secure erase frees and reuses all blocks starting with an empty Flash Translation Layer table (FTL). Any LBAs that may have held data that may have degraded are now released as free blocks to be reused.

Select one of the following methods before use of the drive for operation or test. An off-line server can be used.

Choose one of the erase options:

- Secure erase the drive, using the `nvmeadmin` utility.
- Download and use third party utilities to secure erase the drive.
- Wait two weeks for a media refresh while the drive is powered-on before using the drive.

 **Caution:**

All data will be destroyed after an erase.

**Secure Erase Drive Using `nvmeadmin` Utility**

To secure erase the drive, using the Oracle Hardware Management Pack NVMe admin utility:

1. Stop all IO to the NVMe device before attempting this action.
2. To securely erase all namespaces, type: `# nvmeadm erase -s -a controller_name`.  
For example: `# nvmeadm erase -s -a SUNW-NVME-1`
3. List all server devices.
4. Verify drive health.

Refer to *Oracle Hardware Management Pack 2.4 Server CLI Tools User's Guide*: <https://www.oracle.com/goto/ohmp/docs> . See [Server Management Tools](#).

**Secure Erase Drive Using Third-party Utilities**

To secure erase the drive before use, using the Intel Solid-State Drive Configuration Manager utility, if available:

1. Install the Intel Solid-State Drive Configuration Manager.
2. Stop all IO to the NVMe device before attempting this action.
3. Use the `-secure_erase` option to erase all the data on the drive.



```
issdcm -drive_index 1 -secure_erase
```

- The user is prompted unless the `-force` option is used:

```
WARNING: You have selected to secure erase the drive!
Proceed with the secure erase? (Y/N)
```

- If the drive contains a partition, the prompt contains a second warning message:

```
WARNING: You have selected to secure erase the drive!
WARNING: Tool has detected as partition on the drive!
Proceed with the secure erase? (Y/N)
```

- To bypass the warning prompts, use the `-force` option:

```
issdcm -drive_index 1 -secure_erase -force
```

- List all server devices.
- Verify drive health.

## Oracle 3.84 TB NVMe Solid State Drive Specification

This section provides the specification for Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drives.

- [Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drive Specification](#)

## Oracle 3.84 Tbyte, 2.5-inch, NVMe Solid State Drive Specification

General specifications are listed in the following table.

Specification	Value
Device name	<ul style="list-style-type: none"> <li>Product Identifier: SSDPF2KX038T9S</li> <li>Oracle Part Number: 8206194</li> <li>7605159: One 3.84 TB 2.5-inch NVMe PCIe 4.0 SSD mix use 2.5-inch bracket, Intel (for factory installation)</li> <li>7605160: One 3.84 TB 2.5-inch NVMe PCIe 4.0 SSD mix use 2.5-inch bracket, Intel</li> <li>Device Identification: <ul style="list-style-type: none"> <li>Designation: SE=Standard Endurance</li> <li>PCIe Device ID: 0x0B60</li> <li>Subsystem PCIe Vendor ID: 0x108e</li> <li>Subsystem ID 0x4882</li> </ul> </li> </ul>
Manufacturing name	3.84TB Intel ArbordalePlus, 3D NAND TLC SFF 2.5-inch Solid State Drive
Form factors	<ul style="list-style-type: none"> <li>2.5-inch SFF (small form factor): U.2</li> <li>SFF-8639 compatible connector</li> </ul>
PCIe interface	PCIe Gen4 Interface, x4 lanes
Flash controller	<ul style="list-style-type: none"> <li>Intel Sentinel Rock Plus Quad Core controller</li> </ul>
Features	<ul style="list-style-type: none"> <li>NVMe PCIe Gen4 Interface</li> <li>NVMe-MI (MCTP)</li> <li>VPD per NVMe-MI Ver 1.0a specification</li> <li>Opal 2.0</li> </ul>

Specification	Value
Product Compliance	<ul style="list-style-type: none"> <li>NVM Express Specification Rev. 1.3c</li> <li>PCI Express Base Specification Rev. 4.0</li> <li>Enterprise SSD Form Factor Version 1.0a</li> <li>NVMe-MI Rev 1.0a</li> </ul>
Product ecological compliance	RoHS
Certifications and declarations	cUL-us, CE, TUV-GS, CB, CE, BSMI, KCC, Morocco, VCCI, RCM, FCC, IC

**Table 2-1 Drive Usage Information**

Usage	Description
Operating temperature (Case)	0 to 70 degrees Celsius
Non-Operating temperature	-40 to 95 degrees Celsius
Maximum temperature (SMART trip)	Thermal Throttling at 70 degrees Celsius (SMART) when approaching maximum temperature. Thermal Shutdown at 80 degrees Celsius (SMART)
Error rates	Uncorrectable Bit Error Rate (UBER): 1 sector per 10 <sup>17</sup> bits read
Data retention	3 months powered off at 40 degrees Celsius at end of rated endurance
Endurance	<ul style="list-style-type: none"> <li>Drive Writes Per Day (DWPD) for 5 years: 1</li> <li>PBW (at 4KB Random Write) 7 PB</li> </ul> Refer to the JEDEC JESD218A standard for SSD device life and endurance measurement techniques.

**Table 2-2 Drive Reliability**

Attribute	Value
Component Design Life (Useful life)	5 years
MTBF	2,000,000 hours
Expected AFR (Annualized Failure Rate)	0.44% for normal 24x7 operating conditions

**Table 2-3 Drive Capacity and Performance**

Attribute	Value
Capacity, formatted	Default Formatted Capacity: 3,840,755,982,336 bytes Sector Size (LBA size): 512 bytes per sector
Capacity, unformatted	Unformatted Capacity (Total User Addressable LBA): 7501476528
Capacity, raw NAND	4096 GiB
Random 4 KB Read	780K IOPS Typical 4KB Random Read QD=1, Worker=1: 78us

**Table 2-3 (Cont.) Drive Capacity and Performance**

Attribute	Value
Random 4 KB Write	Random 4 KB Write 118K IOPS Typical 4KB Random Write QD=1, Worker=1: 15us
Sequential Read	128 KB, QD 128, Worker=1: 7,000 MB/s
Sequential Write	128 KB, QD 128, Worker=1: 3,500 MB/s
Interface data transfer rate	<ul style="list-style-type: none"> <li>• Interface Data Rate: PCIe Gen 4</li> <li>• Data Transfer Rate 16 GT/sec</li> <li>• Interface drivers/receivers SFF: 1x4 lanes</li> </ul>

**Table 2-4 Drive Electrical Specifications**

Attribute	Value
Power On to Ready (no rebuild)	RTD3R: 5 seconds <ul style="list-style-type: none"> <li>• Safe Shutdown time = 5 seconds</li> <li>• Time to Ready after safe shutdown = 5 seconds</li> <li>• Time to Ready after unsafe shutdown = 20 seconds</li> </ul>
Power On to Ready (full rebuild)	18 seconds
Supply Voltage / Tolerance	12 V +10%/-20% 3.3 Vaux +/-15%
Inrush Current	12 V, 1.5 A
Power Consumption	<ul style="list-style-type: none"> <li>• Active Read: 12.5 W</li> <li>• Active Write: 18 W</li> <li>• Idle &lt; 5 W</li> <li>• Max Burst: 21.6 W</li> </ul>
Power Requirements	Refer to vendor product specification.

**Table 2-5 Drive Physical Characteristics**

Height	Width	Depth	Weight
15.0 mm +/-0.5 mm	69.85 +/-0.25 mm	100.45 mm Max	146 +/- 5 g

**Table 2-6 NVMe Solid State Drive Characteristics**

Attribute	Value
Minimum operating system versions	Refer to the server product notes for minimum operating system versions, hardware, firmware, and software compatibility.

**Table 2-6 (Cont.) NVMe Solid State Drive Characteristics**

Attribute	Value
Life monitoring capability	<p>Provides alerts for proactive replacement of the drive before the endurance is depleted. Provides endurance remaining in NVMe SMART logs. SSD supports the standard method defined by NVMe for Solid State Drive to report NAND wear through the “Get Log” command SMART/Health Information Percentage Used field. The units are whole percentage of wear.</p> <p>Percentage Used: Contains a vendor specific estimate of the percentage of NVM subsystem life used based on the actual usage and the manufacturer’s prediction of NVM life. A value of 100 indicates that the estimated endurance of the NVM in the NVM subsystem has been consumed, but may not indicate an NVM subsystem failure. The value is allowed to exceed 100. Percentages greater than 254 are represented as 255. This value is updated once per power-on hour (when the controller is not in a sleep state).</p> <p>Refer to the JEDEC JESD218A standard for SSD device life and endurance measurement techniques.</p>
End-to-End data-path protection	T10 DIF Type 0, Type 1, Type 2, Type 3, no performance impact. T10 DIF (data integrity field) end-to-end data protection includes multiple levels of data-path protection.
Enhanced power-loss data protection	Energy storage components complete buffered writes to the persistent flash storage in case of a sudden power loss.
Power loss protection capacitor self-test	Supports testing of the power loss capacitor. Power is monitored using SMART (Self-Monitoring, Analysis, and Reporting Technology) attribute critical warning.
Out-of-Band Management (SMBUS)	Managed through the SMBUS. Provides out-of-band management by means of SMBUS interface. This requires 3.3V auxiliary voltage. SMBUS access includes NVMe-MI, the VPD page and temperature sensor.
Hot-Plug Support	Supports PCIe presence detect and link-up detect. Device advanced power loss protection provides robust data integrity. During IOs, the storage drive integrated monitoring enables the integrity of already committed data on the media and commits acknowledged writes to the media.
Management utilities	For more information about management utilities, refer to the server documentation.

**Table 2-7 LED Status Indicator Characteristics**

LED	Color	Normal operation	Status
(1) Ready to Remove	Blue	OFF – The drive has not been prepared for removal. Normal operation.	STEADY ON – The drive is in standby power state. The drive can be removed safely during a hot-plug operation. A lit Ready to Remove indicator indicates that service action is allowed on the drive.

**Table 2-7 (Cont.) LED Status Indicator Characteristics**

LED	Color	Normal operation	Status
(2) Service Action Required	Amber	OFF – Normal operation.	<p>STEADY ON – Service action is required. The system has detected a fault with the drive.</p> <p>BLINKING – Locator. Status indicator blinks on and off to locate drive.</p>
(3) Power/OK/Activity	Green	STEADY ON (does not blink) – Drive is engaged and is receiving full power. Normal operation.	<p>RANDOM BLINKING – There is drive activity. Status indicator blinks on and off to indicate activity.</p> <p>OFF – Power is off, or installed drive is not recognized by the system.</p>

## Oracle NVMe SSD Product Accessibility

Oracle strives to make its products, services, and supporting documentation usable and accessible to the disabled community. To that end, products, services, and documentation include features that make the product accessible to users of assistive technology.

For more information about Oracle's commitment to accessibility, go to <https://www.oracle.com/corporate/accessibility/>.

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## Documentation Accessibility

Documentation for Oracle hardware is provided in HTML and PDF formats. The HTML documents are accessible using standard operating system controls and assistive technology. PDF documents are also provided, but are not an accessible format. PDF documents are considered support documents because the PDF content is available in accessible HTML format.

Product documentation provides figures, other types of images, and screenshots that do not rely on color for interpretation. Within the figures, callouts indicate the referenced component information. The callouts are mapped within a table to provide text descriptions of the referenced parts of the figures. In addition, alternative text is provided for all tables and images that provides the context of the information and images.

Note that screen readers might not always correctly read the code examples in the documentation. The conventions for writing code require that closing braces should appear on an otherwise empty line. However, some screen readers might not always read a line of text that consists solely of a bracket or brace.

The documentation might contain links to web sites of other companies and organizations that Oracle does not own or control. Oracle neither evaluates nor makes any representations regarding the accessibility of these web sites.

You can access the accessible HTML documentation for Oracle 3.84 TB NVMe SSD products at <https://www.oracle.com/goto/oracleflashf640/docs> .

## Diversity and Inclusion

Oracle is fully committed to diversity and inclusion. Oracle respects and values having a diverse workforce that increases thought leadership and innovation. As part of our initiative to build a more inclusive culture that positively impacts our employees, customers and partners we are working to remove insensitive terms from our products and documentation. We are also mindful of the necessity to maintain compatibility with our customers' existing technologies and the need to ensure continuity of service as Oracle's offerings and industry standards evolve. Because of these technical constraints, our effort to remove insensitive terms is ongoing and will take time and external cooperation.